2015 Ski-Doo Skandic 600 ACE / 900 ACE / WT / SWT Series

This manual may cover later years than listed above.

This manual uses a base manual and a supplemental manual.
Always refer to the supplemental manual in blue FIRST, then refer to the base manual for anything not contained within it.

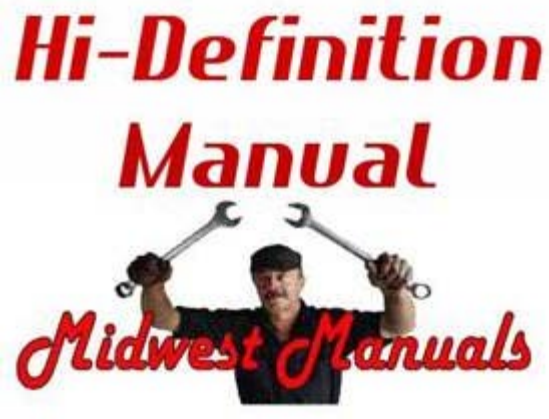
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Skandic SWT 900 ACE

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SAFETY NOTICE

This manual has been prepared as a guide to correctly service and repair 2015 Ski-Doo® snowmobiles described in the list in the *INTRODUCTION*.

This *SHOP MANUAL SUPPLEMENT* must be used in conjunction with the appropriate SHOP MANUAL. Refer to the proper manual when a particular system is not covered in this supplement.

PLATEFORM	PART NUMBER
REV-XU™	219 100 522 (2011)
	219 100 603 (2012)
	219 100 597 (2012)

This edition was primarily published to be used by technicians who are already familiar with service procedures relating to Bombardier Recreational Products Inc. (BRP) products. Mechanical technicians should attend continuous training courses given by B.R.P.T.I.

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

The content depicts parts and procedures applicable to the particular product at time of writing. *SERVICE AND WARRANTY BULLETINS* may be published to update the content of this manual. Make sure to read and understand them. Dealer modifications that were carried out after manufacturing of the product, whether or not authorized by BRP, are not included.

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

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

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

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

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

⚠ WARNING

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

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

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

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

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

Always observe common shop safety practice.

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

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

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

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

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

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

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

BRP disclaims liability for all damages and/or injuries resulting from the improper use of the contents. We strongly recommend that any services be carried out and/or verified by a highly skilled professional mechanic.

INTRODUCTION

This shop manual covers the following BRP made 2015 Ski-Doo snowmobiles.

MODEL	MODEL
Skandic™ WT 600 ACE™ iTC™	FHFA, FHFB
Skandic WT 900 ACE	FRFA
Skandic SWT 900 ACE	LDFA
Expedition™ LE 900 ACE	SRFA, SRFB
Expedition SE 900 ACE	SRFE

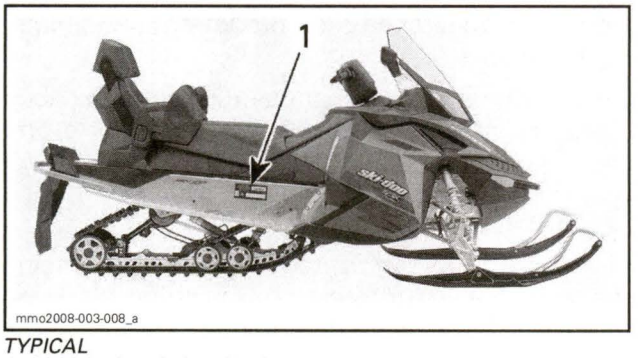
The information and component/system descriptions contained in this manual are correct at time of writing. BRP however, maintains a policy of continuous improvement of its products without imposing upon itself any obligation to install them on products previously manufactured.

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

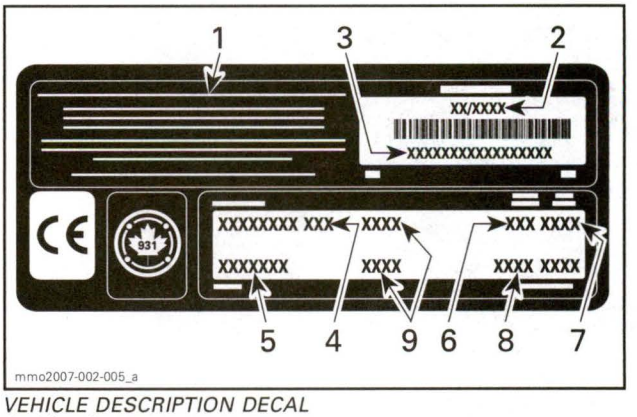
BRP reserves the right at any time to discontinue or change specifications, designs, features, models or equipment without incurring obligation.

VEHICLE INFORMATION

VEHICLE IDENTIFICATION NUMBER (VIN)

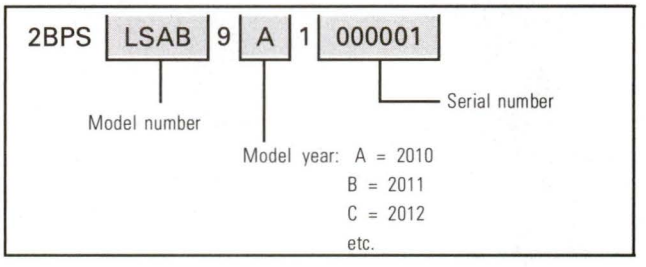


TYPICAL
1. Vehicle description decal

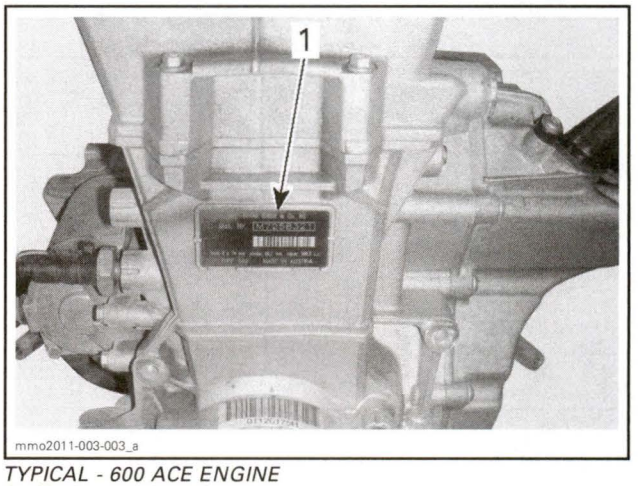


VEHICLE DESCRIPTION DECAL
1. Manufacturer name
2. Manufacturing date
3. Vehicle identification number (VIN)
4. Model name
5. Option package
6. Engine type
7. Model year
8. Color codes
9. Vehicle weight/engine power (European models)

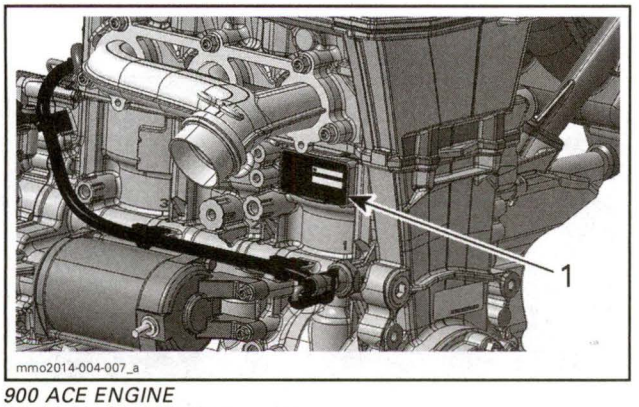
Identification Number Description



ENGINE SERIAL NUMBER



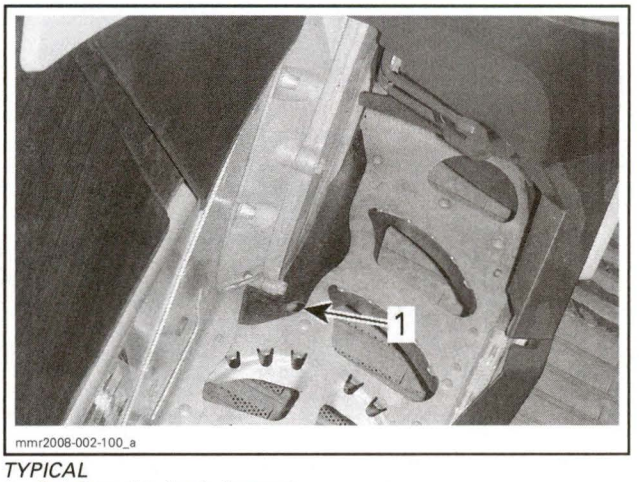
TYPICAL - 600 ACE ENGINE
1. Engine serial number



900 ACE ENGINE
1. Engine identification number

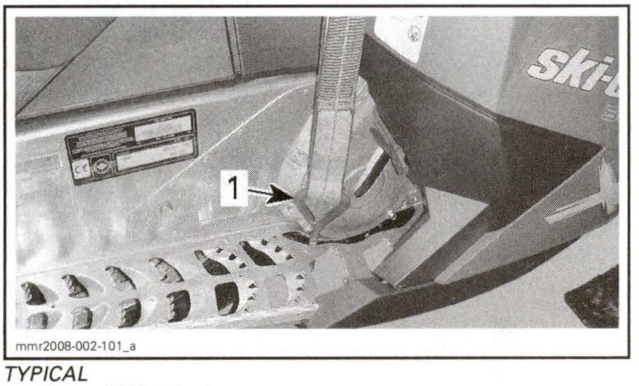
SNOWMOBILE LIFTING

To lift the snowmobile securely, it is important to use the reinforced footrest holes.



TYPICAL
1. Reinforced holes in footrest

Install lifting tool hooks in holes as shown.



TYPICAL
1. Hook of lifting tool

⚠ WARNING

Do not use footrest openings or steering column to lift the snowmobile. These parts are not designed to support the snowmobile weight. Frame or steering system could be seriously damaged and serious injury or death could happen.

ENGINE EMISSIONS INFORMATION

Manufacturer's Responsibility

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

Dealer Responsibility

When performing service on snowmobiles that carry an emissions control information label, adjustments must be kept within published factory specifications.

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

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

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

Owner Responsibility

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

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

EPA Emission Regulations

Some Ski-Doo snowmobiles manufactured by BRP are certified to the EPA as conforming to the requirements of the regulations for the control

of air pollution from new snowmobiles engines. This certification is contingent on certain adjustments being set to factory standards. For this reason, the factory procedure for servicing the product must be strictly followed and, whenever practicable, returned to the original intent of the design.

The responsibilities listed above are general and in no way a complete listing of the rules and regulations pertaining to the EPA requirements on exhaust emissions for snowmobiles products. For more detailed information on this subject, you may contact the following locations:

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

Regular US Postal Mail:
1200 Pennsylvania Ave. NW
Mail Code 6403J
Washington D.C. 20460

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

E-Mail: otaqpublicweb@epa.gov

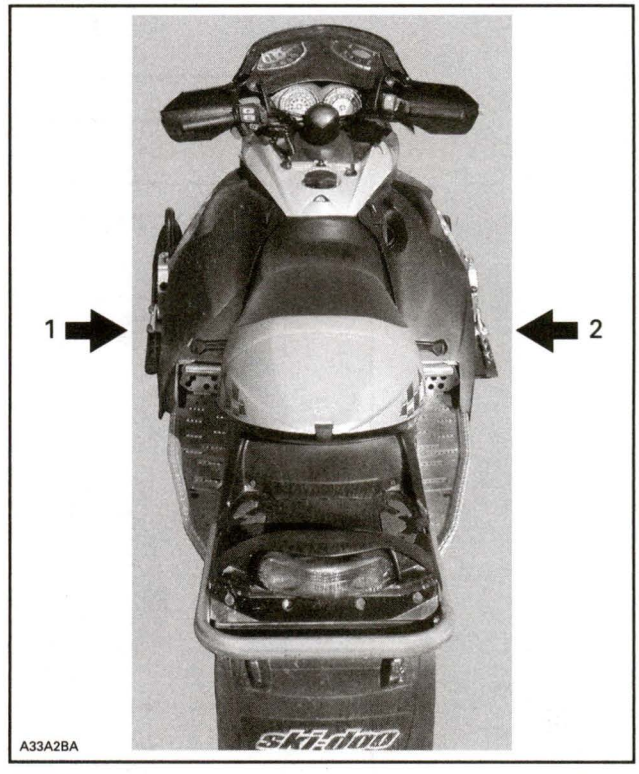
MANUAL INFORMATION

MANUAL PROCEDURES

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

A number of procedures throughout the book require the use of special tools. Before starting any procedure, be sure that you have on hand all required tools, or their approved equivalents.

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



TYPICAL
1. Left
2. Right

This manual uses technical terms which may be different from the ones of the *PARTS CATALOGS*.

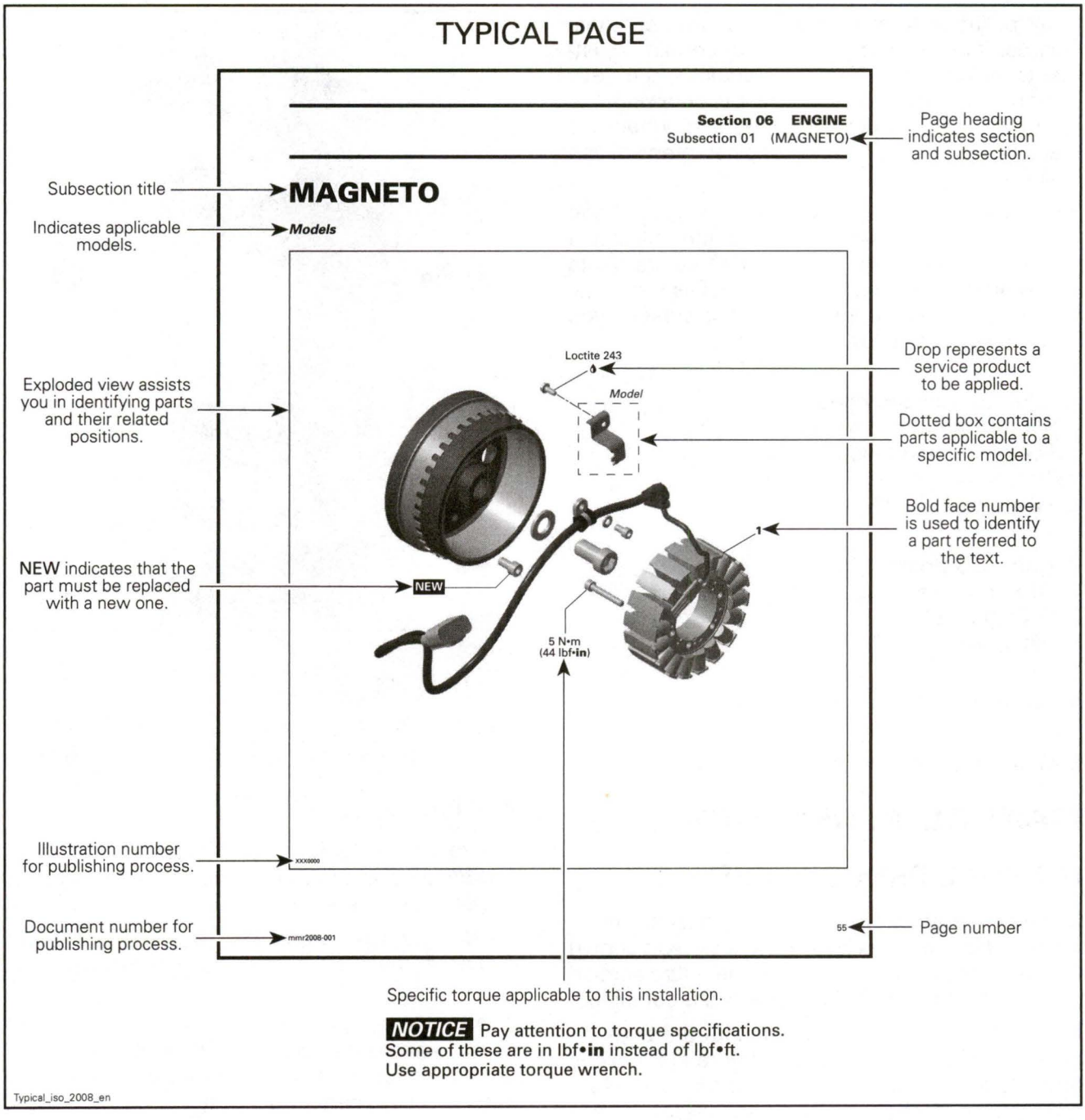
MANUAL LAYOUT

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

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

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

TYPICAL PAGE



TYPICAL PAGE

Tittle in bold indicates category of information to be carried out.

GENERAL

NOTE: The following procedures can be done without removing the engine.

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

Reference to a specific section or subsection.

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

⚠ WARNING

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

PROCEDURES

Indicates component procedures apply to.

MAGNETO FLYWHEEL

Magneto Flywheel Cleaning

Clean all metal components in a non-ferrous metal cleaner.

CAUTION: Clean magneto flywheel using only a clean cloth.

Indicates specific procedure to be carried out.

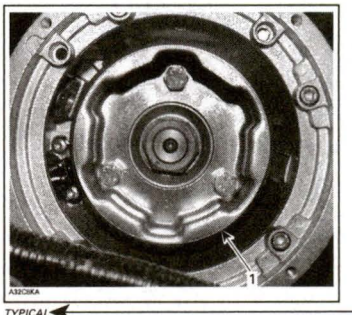
Magneto Flywheel Removal

Remove muffler, refer to the *EXHAUST SYSTEM* section.

Remove acoustic panel.

Remove rewind starter.

Remove starting pulley **no. 2**.

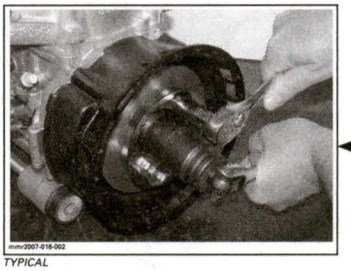


TYPICAL
1. Starting pulley

"TYPICAL" indicates a general view which may not represent exact details.

Call-outs pertaining to above illustration.

NOTE: To remove starting pulley bolts, hold magneto flywheel with a socket as shown.



TYPICAL

Illustration always follows text to which it applies.

Models

Remove the connecting flange retaining the rewind starter to the engine housing.

Italic bold face typesetting indicates a procedure applicable to a specific model(s).

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

mmr2008-001 57

typical_txt_2008_en

TIGHTENING TORQUE

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

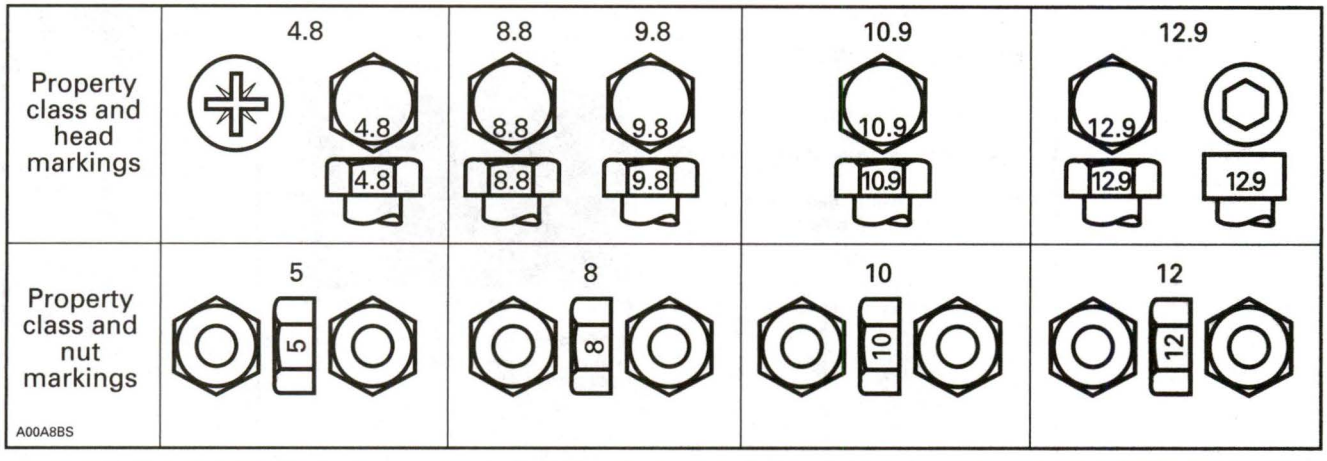
In order to avoid a poor assembly, tighten screws, bolts, or nuts in accordance with the following procedure:

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

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

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

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



FASTENER SIZE	FASTENER GRADE/TORQUE			
	5.8 Grade	8.8 Grade	10.9 Grade	12.9 Grade
M4	1.5 – 2 N•m (13 – 18 lbf•**in**)	2.5 – 3 N•m (22 – 27 lbf•**in**)	3.5 – 4 N•m (31 – 35 lbf•ft)	4 – 5 N•m (35 – 44 lbf•ft)
M5	3 – 3.5 N•m (27 – 31 lbf•ft)	4.5 – 5.5 N•m (40 – 47 lbf•ft)	7 – 8.5 N•m (62 – 75 lbf•ft)	8 – 10 N•m (71 – 89 lbf•ft)
M6	6.5 – 8.5 N•m (58 – 75 lbf•ft)	8 – 12 N•m (71 – 106 lbf•ft)	10.5 – 15 N•m (93 – 133 lbf•**in**)	16 N•m (142 lbf•**in**)
M8	15 N•m (133 lbf•**in**)	25 N•m (18 lbf•ft)	32 N•m (24 lbf•ft)	40 N•m (30 lbf•ft)
M10	29 N•m (21 lbf•ft)	48 N•m (35 lbf•ft)	61 N•m (45 lbf•ft)	73 N•m (54 lbf•ft)
M12	52 N•m (38 lbf•ft)	85 N•m (63 lbf•ft)	105 N•m (77 lbf•ft)	128 N•m (94 lbf•ft)
M14	85 N•m (63 lbf•ft)	135 N•m (100 lbf•ft)	170 N•m (125 lbf•ft)	200 N•m (148 lbf•ft)

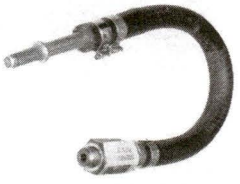
SERVICE TOOLS INDEX

12 V BATTERY SUPPLY CABLE
(P/N 529 035 997)



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ADAPTER HOSE
(P/N 529 035 652)



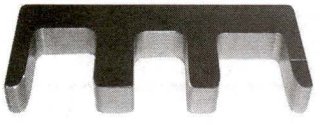
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ALIGNMENT BAR
(P/N 529 036 157)



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CAMSHAFT LOCKING TOOL
(P/N 529 036 206)



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CRANKSHAFT LOCKING TOOL
(P/N 529 036 205)



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CRANKSHAFT LOCKING TOOL
(P/N 529 036 272)



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CRANKSHAFT PROTECTOR (PTO)
(P/N 420 876 552)



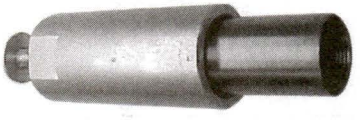
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CRANKSHAFT PROTECTOR
(P/N 529 036 213)



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DRIVEN PULLEY SPRING
COMPRESSOR
(P/N 529 036 182)



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ECM ADAPTER TOOL
(P/N 529 036 166)



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



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ENGINE LIFTING TOOL
(P/N 529 036 217)



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FLUKE 115 MULTIMETER
(P/N 529 035 868)



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FLYWHEEL PULLER
(P/N 420 976 235)



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SERVICE TOOLS INDEX

FUEL HOSE DISCONNECT TOOL
(P/N 529 036 037)



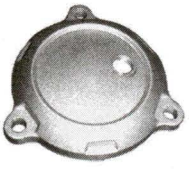
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HANDLE
(P/N 420 877 650)



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OIL PRESSURE TEST CAP
(P/N 529 036 158)



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OIL SEAL PUSHER
(P/N 529 036 210)



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OIL SEAL/BEARING PUSHER
(P/N 529 036 284)



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PISTON CIRCLP INSTALLER
(P/N 529 036 207)



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PISTON RING COMPRESSOR
(P/N 529 036 208)



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POWER INTERFACE
(P/N 515 177 223)



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PRELOAD TESTER
(P/N 529 036 164)



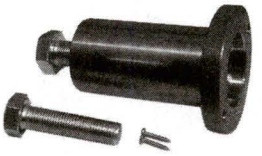
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PRESSURE GAUGE
(P/N 529 035 709)



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PTO OIL SEAL INSTALLER
(P/N 529 036 216)



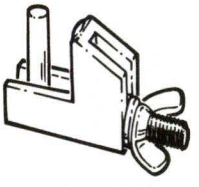
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ROTARY SEAL INSTALLER
(P/N 529 036 211)



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SMALL HOSE PINCHER
(P/N 295 000 076)



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SPRING INSTALLER/REMOVER
(P/N 529 035 983)



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TENSIOMETER
(P/N 414 348 200)



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TEST CAP
(P/N 529 035 991)



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



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VALVE SPRING COMPRESSOR CUP
(P/N 529 036 209)



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VALVE SPRING COMPRESSOR
(P/N 529 035 724)



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BREAK-IN INSPECTION

Procedures are detailed in *PERIODIC MAINTENANCE PROCEDURES* subsection.

BREAK-IN INSPECTION
Inspect engine seals and gaskets for leaks
Change engine oil and filter
Inspect exhaust system and check for leaks
Check coolant level
Inspect fuel lines and connections
Inspect drive belt
Visually inspect drive pulley
Tighten drive pulley retaining screw to specified torque
Inspect driven pulley
Check driven pulley preload
Adjust and align track
Change gearbox oil
Check brake fluid level
Inspect brake hose, pads and disk
Inspect steering mechanism
Inspect skis and runners
Inspect front suspension
Inspect rear suspension and slider shoes

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PERIODIC MAINTENANCE SCHEDULE

Procedures are detailed in *PERIODIC MAINTENANCE PROCEDURES* subsection.

NOTE: The maintenance schedule does not exempt the pre-ride inspection.

EVERY 3 000 KM (2,000 MI) OR 1 YEAR (WHICHEVER COMES FIRST)
Inspect exhaust system and check for leaks
Visually inspect and clean drive pulley
Tighten drive pulley retaining screw to specified torque
Clean driven pulley
Check driven pulley preload
Adjust and align track
Inspect brake hose, pads and disk
Inspect steering mechanism
Inspect front suspension
Inspect rear suspension and stopper strap
Lubricate rear suspension. Lubricate whenever the vehicle is used in wet conditions (rain, puddles)

EVERY 6 000 KM (4,000 MI) OR AT PRE-SEASON (WHICHEVER COMES FIRST)
Change engine oil and filter
Inspect throttle body connecting socket

EVERY 6 000 KM (4,000 MI) OR 2 YEARS (WHICHEVER COMES FIRST)
Replace fuel pump outlet filter
Replace brake fluid

EVERY 10 000 KM (6,000 MI) OR 3 YEARS (WHICHEVER COMES FIRST)
Replace spark plugs

EVERY 5 YEARS
Replace engine coolant

PERIODIC MAINTENANCE PROCEDURES

SERVICE TOOLS

Description	Part Number	Page
TENSIOMETER	414 348 200	21

SERVICE PRODUCTS

Description	Part Number	Page
BRAKE FLUID GTLMA DOT4	293 600 131	18
BRP PREMIXED COOLANT	219 700 362	9
PULLEY FLANGE CLEANER	413 711 809	17, 20
SUSPENSION GREASE	293 550 033	23–24
XPS 4-STROKE SYNTHETIC OIL (ALL CLIMATE)	293 600 112	12
XPS FUEL STABILIZER	413 408 601	15
XPS SYNTHETIC CHAINCASE OIL	413 803 300	20
XPS SYNTHETIC GREASE	293 550 010	19

GENERAL

This subsection provides general maintenance instructions. Where detailed instructions for disassembly or reassembly is required, refer to the applicable subsection.

PROCEDURES

ENGINE

Cooling System Inspection

Inspect cooling system pressure cap, hoses and clamps for leaks.

Test pressure cap for proper operation.

Recommended Engine Coolant

RECOMMENDED SERVICE PRODUCT	ACCEPTABLE
BRP premixed coolantBRP PREMIXED COOLANT (P/N 219 700 362)	A blend of 50% distilled water with 50% antifreeze (especially formulated for aluminum engines

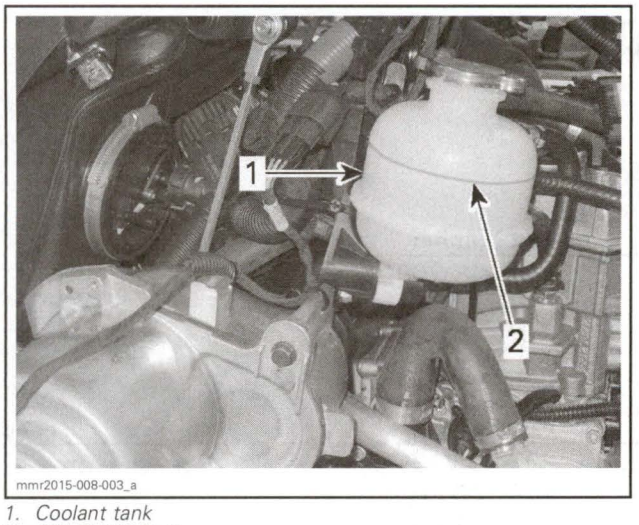
To prevent antifreeze deterioration, always use the same brand. Never mix different brands unless cooling system is completely flushed and refilled.

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

Engine Coolant Level Verification

Check coolant level at room temperature with the cap removed. Liquid should be at cold level line (engine cold) of coolant tank.

NOTE: When checking level at low temperature it may be slightly lower then the mark.



1. Coolant tank
2. COLD LEVEL line

Engine Coolant Strength Verification

Remove pressure cap.

Use an antifreeze tester to test coolant strength.

MINIMUM RECOMMENDED COOLANT STRENGTH
-30°C (-22°F)

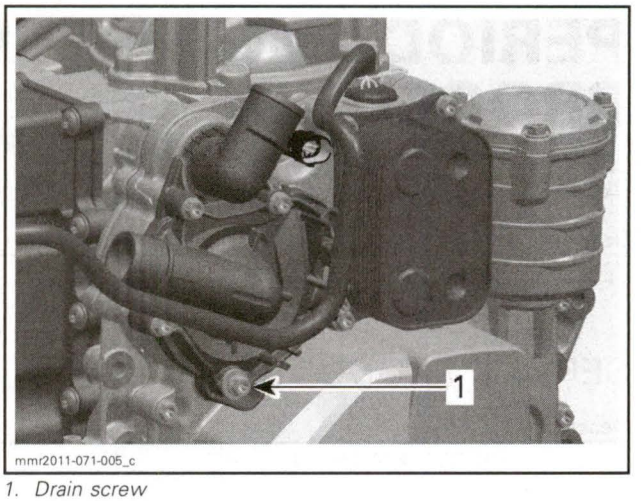
Engine Coolant Replacement

Cooling System Draining

⚠ WARNING

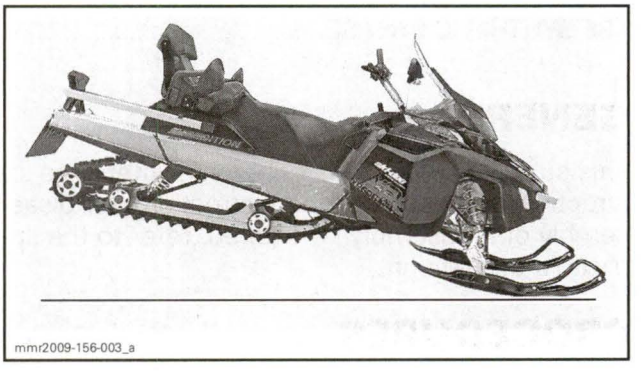
Never drain or refill the cooling system when engine is hot.

1. Remove body parts as required to access to the water pump (RH side).
2. Place a large drain pan under the vehicle bottom pan.
3. Remove drain screw at water pump to drain coolant.



1. Drain screw

4. Remove coolant reservoir cap.
5. When coolant level is low enough, lift the rear of vehicle to drain the heat exchangers.

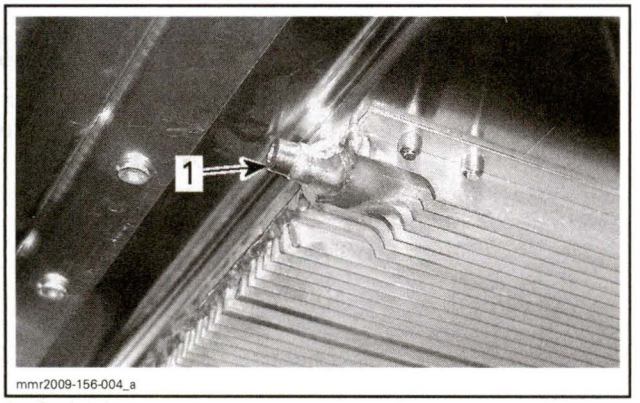


6. Install **NEW** sealing washer on drain screw.
7. Tighten drain screw to specification.

TIGHTENING TORQUE	
Drain screw	9 N•m ± 1 N•m (80 lbf•**in** ± 9 lbf•**in**)

Cooling System Refilling and Bleeding

1. Apply parking brake.
2. From underneath the back end of the chassis, remove the heat exchanger drain plug.

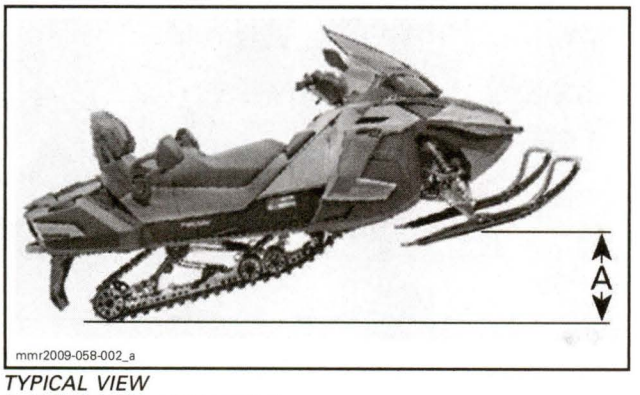


1. Drain plug

3. Fill coolant reservoir until coolant comes out of heat exchanger.
4. Install drain plug and tighten it to specification.

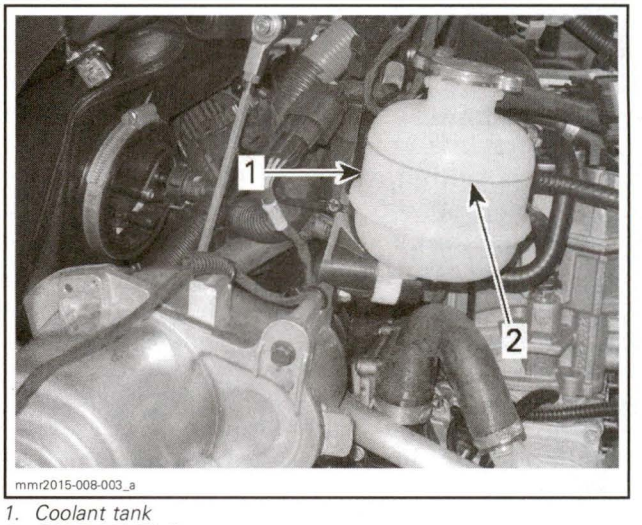
TIGHTENING TORQUE	
Drain plug	10 N•m (89 lbf•**in**)

5. Lift front of vehicle by 25 cm ± 5 cm (10 in ± 2 in) and support safely.



TYPICAL VIEW
A. 25 cm ± 5 cm (10 in ± 2 in)

6. Fill coolant tank up to COLD LEVEL line.



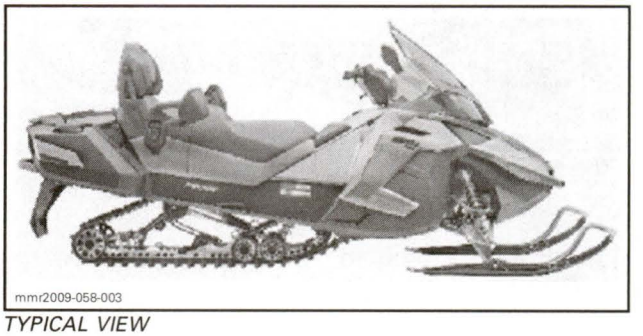
1. Coolant tank
2. COLD LEVEL line

7. Start engine.
8. Add coolant up to COLD LEVEL line while engine is idling until rear heat exchangers are warm to the touch (about 4 to 5 minutes).

NOTE: Always monitor coolant level while filling coolant tank to avoid an empty coolant reservoir, and thus allow air to enter the system.

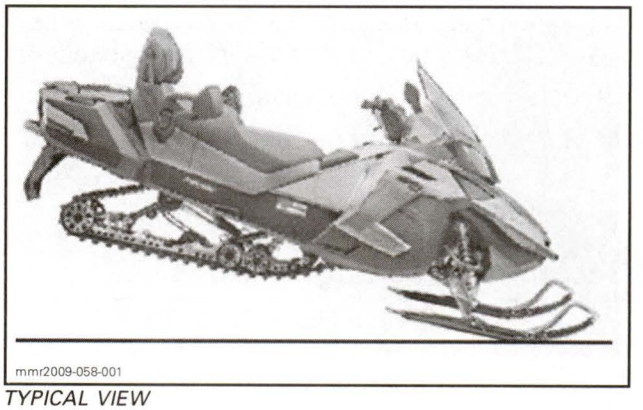
9. Install pressure cap.

Lower vehicle back on the ground.



TYPICAL VIEW

10. Lift rear of vehicle and support it safely.

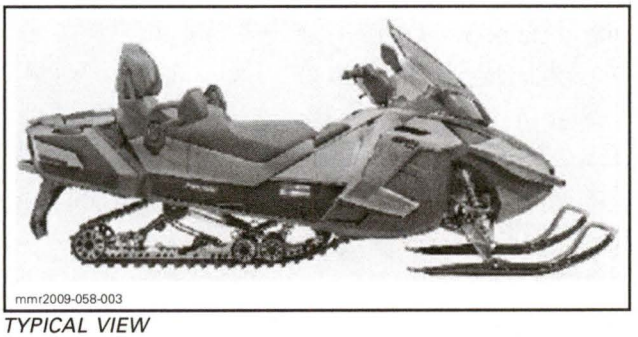


TYPICAL VIEW

⚠ WARNING

Before revving engine, ensure that the track is free of particles which could be thrown out while track is rotating. Keep hands, tools, feet and clothing clear of track. Always lift the snowmobile on a wide-base stand with a rear deflector panel. Ensure no one is standing in close proximity to the snowmobile, especially at the rear of the track. Centrifugal force could cause debris, damaged or loose studs, pieces of torn track, or an entire track to be violently thrown backwards out of the frame with tremendous force, possibly resulting in the loss of a leg or other serious injury.

11. Remove parking brake.
12. Activate throttle lever 3 - 4 times to bring engine speed to 7000 RPM.
13. Apply the brake.
14. Lower vehicle back on ground.



TYPICAL VIEW

15. Stop engine.
16. Add coolant up to 15 mm (1/2 in) above the COLD LEVEL line.
17. When engine has completely cooled down, recheck coolant level in coolant tank and refill up to line if needed.
18. Perform *ENGINE COOLANT STRENGTH VERIFICATION*. See procedure in this subsection.
19. Adjust mixture if necessary.
20. Reinstall removed parts.
21. Run vehicle a few minutes then recheck coolant level.

Recommended Engine Oil

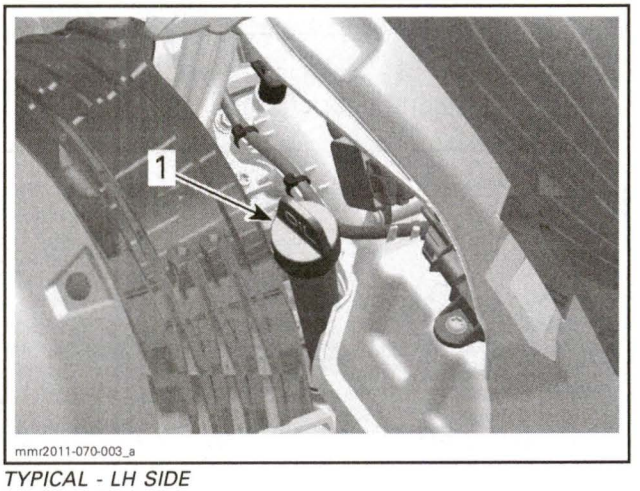
RECOMMENDED ENGINE OIL
XPS 4-STROKE SYNTHETIC OIL (ALL CLIMATE) (P/N 293 600 112)

NOTICE **The engine of this snowmobile has been developed and validated using the BRP XPS™ Synthetic 4-stroke oil. BRP strongly recommends the use of its XPS Synthetic 4-stroke oil at all times. Damages caused by oil which is not suitable for the engine will not be covered by the BRP limited warranty.**

If the recommended oil is not available, use SAE 0W-40 synthetic-based oil that meets or exceeds the requirements for API service classification SM.

Engine Oil Level Verification

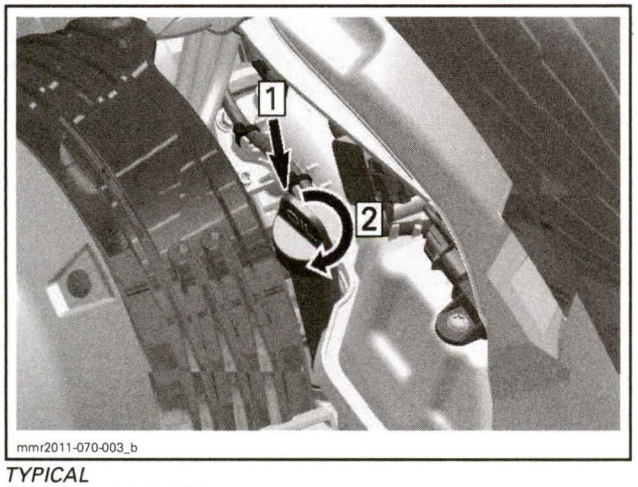
NOTICE **Operating the engine with an improper oil level may cause severe engine damage. Follow this procedure to obtain a precise reading of the engine oil level.**



TYPICAL - LH SIDE
1. Oil tank dipstick

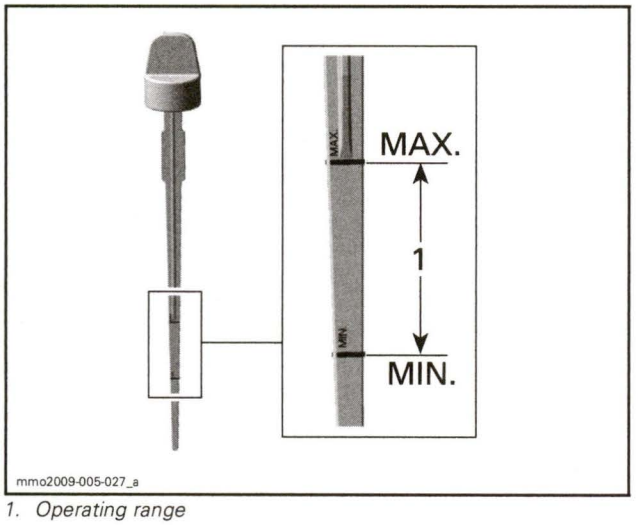
With the engine at normal operating temperature (90°C (194°F) at oil tank surface), place vehicle on a level surface and proceed as follows to check oil level:

1. Start engine and let it idle for at least 20 seconds.
2. Stop engine.
3. Open the LH side panel.
4. If applicable, remove the drive belt guard. Refer to *DRIVE BELT* subsection.
5. Unscrew and remove dipstick and wipe clean.
6. Insert dipstick in the filler tube and again tighten it.



TYPICAL
Step 1: Insert dipstick
Step 2: Tighten dipstick.

7. Remove dipstick again and check oil level. It should be near or equal to the upper mark.



1. Operating range

8. To add oil, place a funnel into the filler tube to avoid spillage.
   8.1 Add a small amount of oil and recheck oil level.
   8.2 Repeat the operation until oil level reaches the dipstick's upper mark. Do not overfill.

NOTE: The oil quantity between MIN. and MAX. mark is approximately 500 ml (16.9 U.S. oz).

9. Reinstall dipstick and properly tighten it.
10. Wipe off any oil spillage.
11. Install drive belt guard.
12. Close the LH side panel.

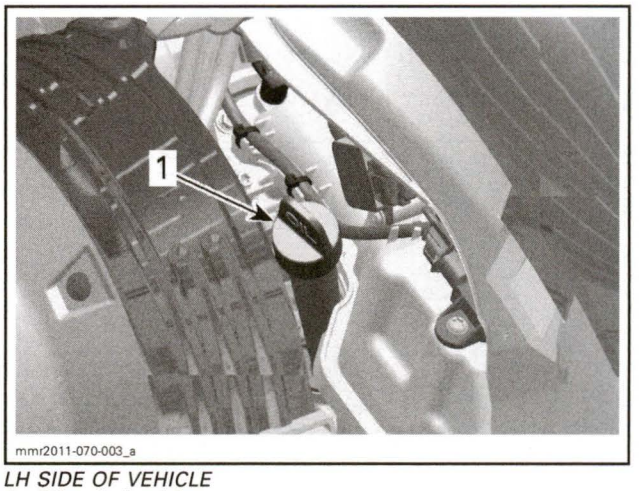
Engine Oil Replacement

⚠ WARNING

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

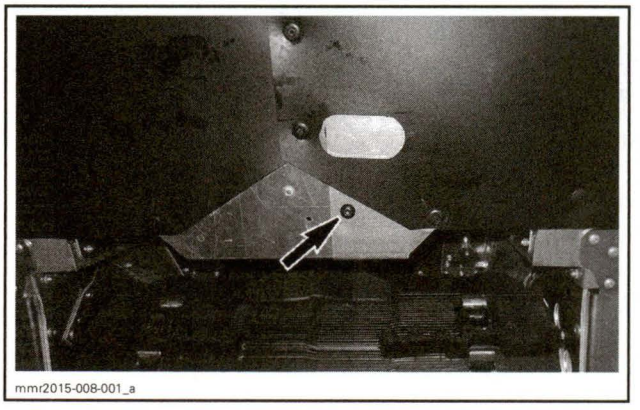
NOTICE **Engine oil and oil filter must be replaced at the same time.**

1. Bring engine to its normal operating temperature (90°C (194°F) at oil tank surface).
2. Place vehicle on a level surface.
3. Remove the LH side panel.
4. Remove dipstick.

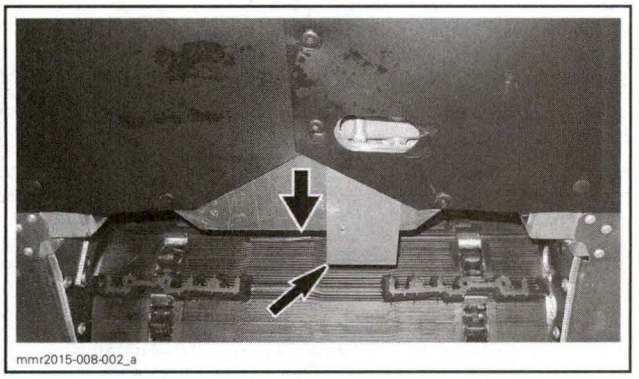


LH SIDE OF VEHICLE
1. Oil tank dipstick

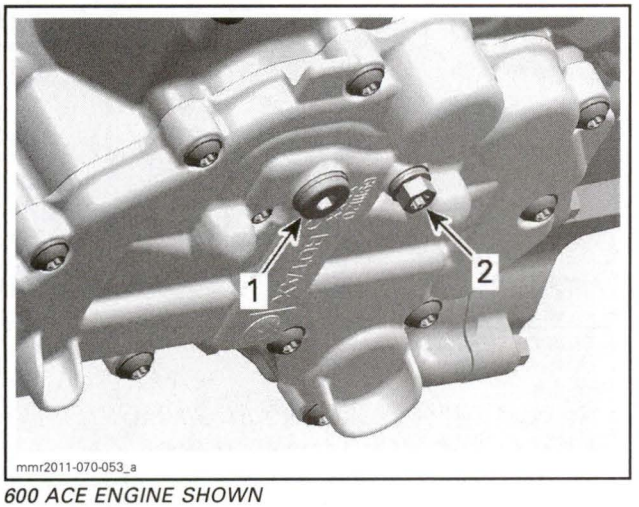
5. Remove oil filter. Refer to *ENGINE OIL FILTER REPLACEMENT* in this subsection.
6. From underneath the vehicle, access the drain plug:
   6.1 Remove the access cover retaining screw.



   6.2 Slide the access cover back to clear the bottom pan opening.


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7. Clean drain plug area.
8. Place a drain pan under the bottom pan opening.
9. Remove engine drain plugs in the following order.
   9.1 Main drain plug.
   9.2 Secondary drain plug.

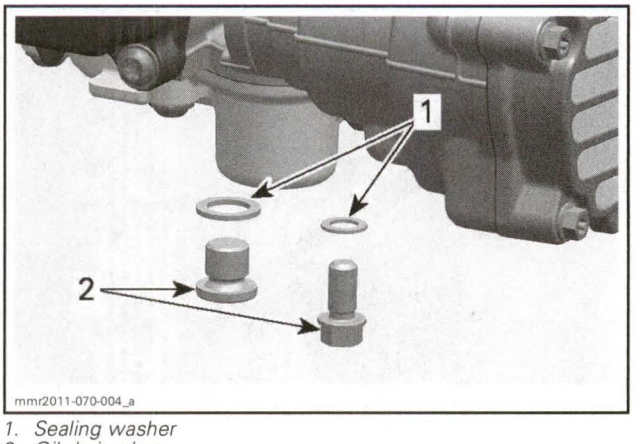


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600 ACE ENGINE SHOWN
UNDERNEATH THE ENGINE
1. *Main drain plug*
2. *Secondary drain plug*

10. Allow oil to drain completely.
11. Install **NEW** sealing washers on oil drain plugs.

NOTICE **Never use a sealing washer a second time. Always replace with a new one.**



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1. *Sealing washer*
2. *Oil drain plug*

12. Install drain plugs and tighten to the specified torque.

TIGHTENING TORQUE	
Drain plugs	15 N•m ± 2 N•m (133 lbf•**in** ± 18 lbf•**in**)

13. Replace *OIL FILTER*, see procedure in this subsection.
14. Refill oil tank at the proper level with the recommended oil.

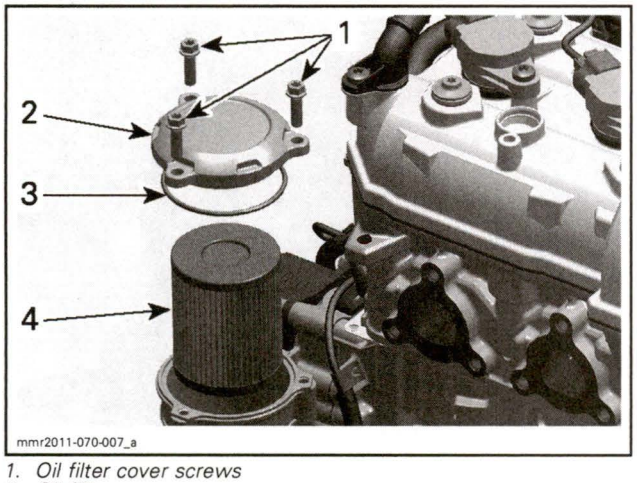
APPROXIMATE ENGINE OIL CAPACITY (WITH FILTER)	
600 ACE	2.1 L (2.2 qt (U.S. liq.))
900 ACE	3.3 L (3.5 qt (U.S. liq.))

15. Reinstall dipstick in oil tank and properly tighten it.
16. Start engine and let it idle for a few minutes.
17. Ensure there are no leaks.
18. Stop engine and check oil level as explained in this subsection. Refill if necessary.
19. Dispose oil and filter as per your local environmental regulations.

Engine Oil Filter Replacement

Oil Filter Removal

1. Remove the RH side panels.
2. Clean oil filter area.
3. Remove:
   - Oil filter cover screws
   - Oil filter cover with O-ring
   - Oil filter.

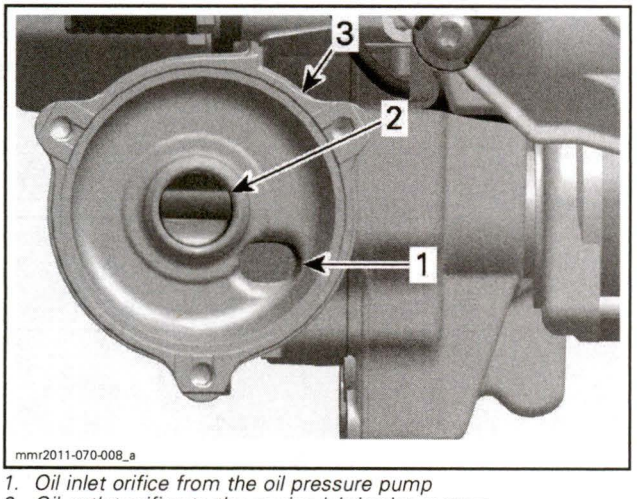


1. Oil filter cover screws
2. Oil filter cover
3. O-ring
4. Oil filter

4. Dispose filter as per your local environmental regulations.

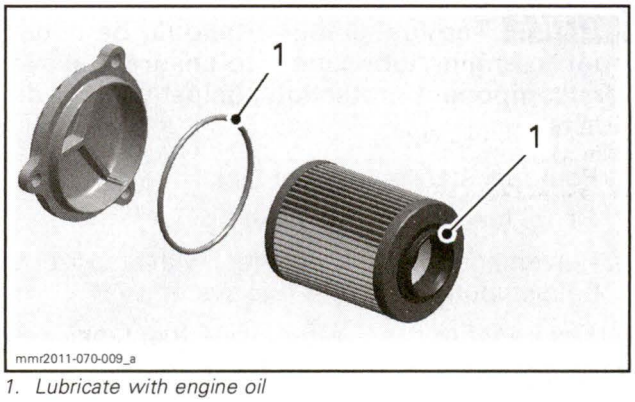
Oil Filter Installation

1. Check the oil filter inlet and outlet orifices inside oil filter receptacle (integrated part of magneto cover) for dirt and contaminations.



1. Oil inlet orifice from the oil pressure pump
2. Oil outlet orifice to the engine lubrication system
3. Oil filter receptacle

2. Install a **NEW** O-ring on oil filter cover.
3. Lubricate filter seal and cover O-ring with engine oil.



1. Lubricate with engine oil

4. Install the oil filter cover.
5. Tighten oil filter cover screws to the specified torque.

TIGHTENING TORQUE	
Oil Filter Cover	9 N•m ± 1 N•m (80 lbf•**in** ± 9 lbf•**in**)

Engine Seals and Gaskets Inspection

Visually inspect the seal and gasket areas for leaks.

Exhaust System Inspection

Check the following components for leaks, cracks, or other damage:
- Muffler
- Exhaust pipes
- Manifold.

AIR INTAKE SYSTEM

Throttle Body Connecting Socket

Visually inspect throttle body connecting socket for cracks or other damages.

Replace if necessary. Refer to *INTAKE MANIFOLD* in the *AIR INTAKE SYSTEM* subsection.

FUEL SYSTEM

Fuel System Protection

With the new fuel additives used today, it is critical to add a fuel stabilizer to the fuel during storage to prevent fuel deterioration, gum formation and fuel system gumming. Follow manufacturers instructions for proper use.

RECOMMENDED PRODUCT
XPS FUEL STABILIZER (P/N 413 408 601)

NOTICE **The fuel stabilizer should be added prior to engine lubrication, to ensure fuel system component protection against varnish deposits.**

1. Pour fuel stabilizer in fuel tank.
2. Fill up fuel tank completely.
3. Run engine sufficiently for fuel with stabilizer to be distributed to entire fuel system.
4. Ensure there is no water inside fuel tank.

NOTICE **Do not drain fuel system.**

Fuel Line and Connection Inspection

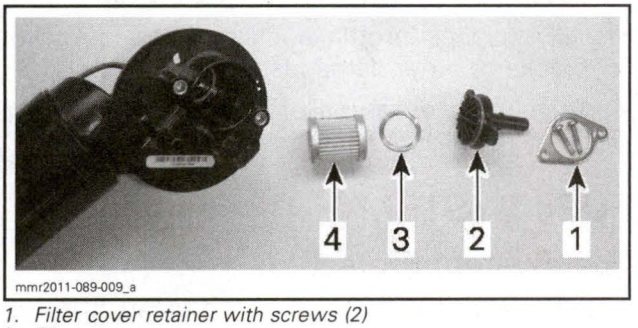
Visually inspect all fuel lines and connections for cracks or leaks.

Fuel Pump Outlet Filter Replacement

NOTE: The fuel pump outlet filter is housed within the mounting flange of the fuel pump module. It can be replaced without removing the fuel pump module from the fuel tank.

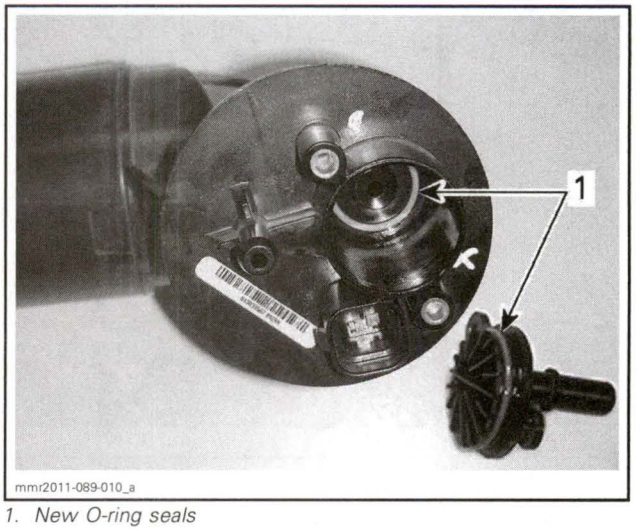
1. Disconnect fuel pump electrical connector to deactivate fuel pump.
2. Start and run engine until it stalls.
3. Place several shop rags under the fuel pump pressure hose fitting to prevent fuel from leaking onto the connectors of the voltage regulator/rectifier unit.
4. Remove following parts from fuel pump module.

NOTE: Do not remove fuel pump module from fuel tank.



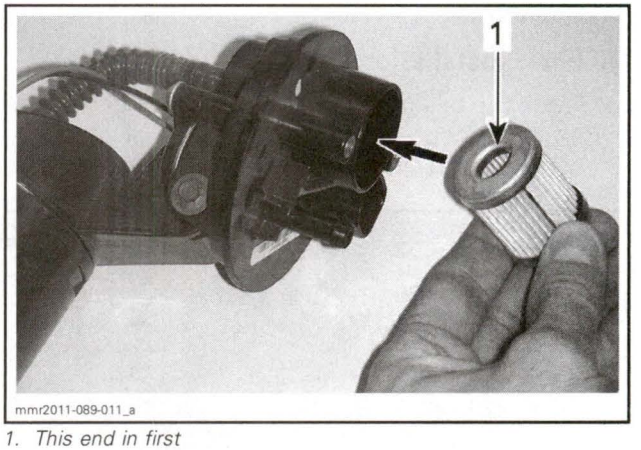
1. *Filter cover retainer with screws (2)*
2. *Filter cover*
3. *Wave spring*
4. *Filter element.*

5. Install **NEW** O-ring seals on filter cover and in filter housing.



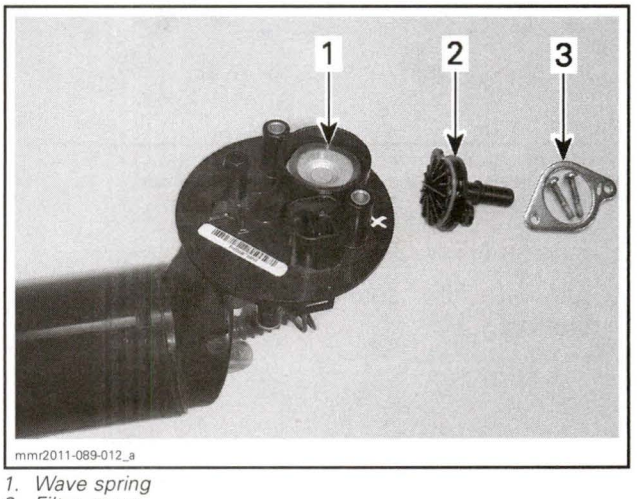
1. *New O-ring seals*

6. Insert filter element as per following illustration.



1. *This end in first*

7. Install remaining filter parts.



1. *Wave spring*
2. *Filter cover*
3. *Cover retainer with screws (2)*

TIGHTENING TORQUE	
Filter cover screw	3 N•m (27 lbf•**in**)

8. Reconnect fuel pump module (pressure hose and electrical connector), refer to *FUEL PUMP INSTALLATION (600 ACE)* in the *FUEL TANK AND FUEL PUMP* subsection.
9. Carry out a *FUEL SYSTEM PRESSURIZATION AND LEAK TEST* as detailed in the *FUEL TANK AND FUEL PUMP* subsection.
10. Install remaining parts in the reverse order of removal, refer to *FUEL TANK INSTALLATION* in this subsection.

Throttle Body Inspection and Cleaning

Clean throttle plates and throttle body bores using PULLEY FLANGE CLEANER (P/N 413 711 809).

ELECTRICAL SYSTEM

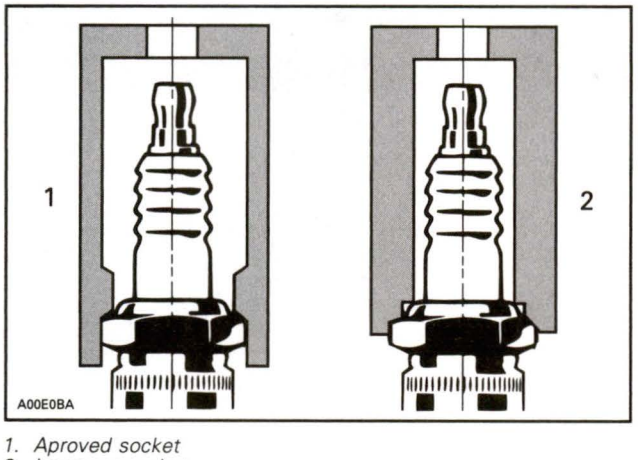
Battery Charging

To charge battery, refer to *CHARGING SYSTEM* subsection.

Spark Plug Inspection and Replacement

Spark Plug Removal

1. Remove ignition coil from spark plug. Refer to *IGNITION SYSTEM* subsection.
2. Using an approved spark plug socket, release the torque applied to the spark plug and unscrew a few turns.



1. Aproved socket
2. Improper socket

3. Clean the spark plug and cylinder head with pressurize air.
4. Remove spark plug.

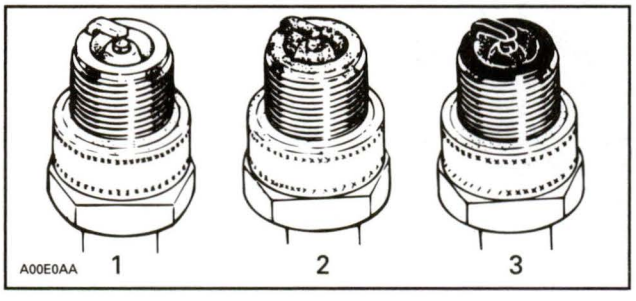
Troubleshooting a Fouled Spark Plug

Fouling of the spark plug is indicated by irregular running or misfiring of the engine, decreased engine speed due to misfiring, reduced performance, and increased fuel consumption.

Other possible causes are: a incorrect or bad fuel, defective ignition system, incorrect spark plug gap, loss of compression, or lubricating oil entering the combustion chamber.

The plug face of a fouled spark plug has either a wet or dry black carbon deposit. Such coatings form a conductive connection between the center electrode and the ground electrode.

Spark Plug Analysis



TYPICAL
1. Overheated (light gray, white)
2. Normal (light brown, brown)
3. Fouled (black, wet or dry, dark deposits, gray, melted coating)

The plug face reveals the condition of the engine, operating condition, method of driving and fuel mixture. For this reason it is advisable to inspect the spark plug at prescribed intervals, examining the plug face (i.e. the part of the plug projecting into the combustion chamber).

Spark Plug Installation

Prior to installation, ensure the contact surfaces of the cylinder head and spark plug are free of grime.

1. Using a wire feeler gauge, check electrode gap as specified in the following chart.

NOTICE Do not adjust gap on this type of spark plug. The adjustment could weaken negative electrodes which may lead to electrode breakage and severe engine damage.

SPARK PLUG	GAP mm (in)	TIGHNTENING TORQUE
NGK MR7BI-8	0.7 mm to 0.8 mm (.028 in to .031 in) **NOT** adjustable	13 N•m (115 lbf•**in**)

2. Hand screw spark plug into cylinder head. Then, tighten the spark plug clockwise to specified torque with an approved spark plug socket.
3. Install ignition coil. Refer to *IGNITION SYSTEM* subsection.
4. Complete the installation in the reverse order of the removal.

ELECTRICAL SYSTEM (LIGHTS)

Headlights Beam Aiming Adjustment

Refer to *LIGHTS, GAUGE AND ACCESSORIES* subsection.

DRIVE SYSTEM AND BRAKE

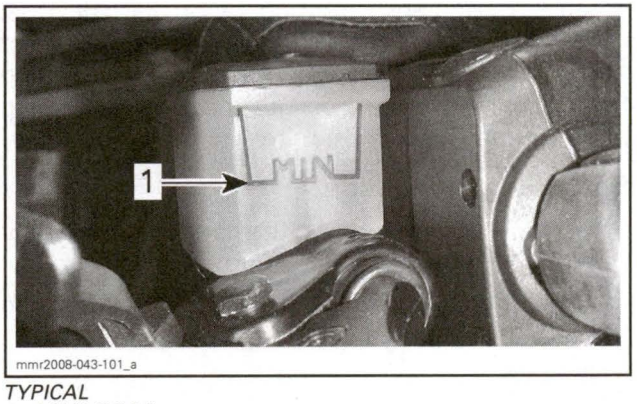
Recommended Brake Fluid

Always use brake fluid meeting the specification DOT 4 such as BRAKE FLUID GTLMA DOT4 (P/N 293 600 131).

Brake Fluid Level Verification

With the vehicle on a level surface, position steering in straight-ahead position to ensure reservoir is level.

Brake fluid must always be above the MIN. line when brake lever is squeezed.



TYPICAL
1. MINIMUM line

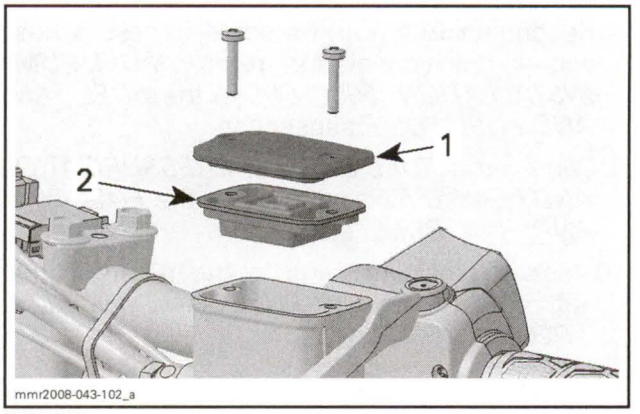
Add fluid as required. Do not overfill.

NOTE: A low level may indicate leaks or worn brake pads.

Brake Fluid Replacement

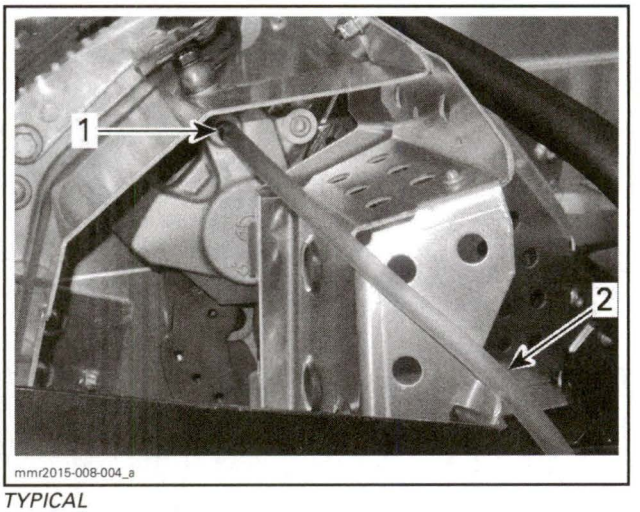
To drain brake fluid, proceed as follows:

1. Place vehicle on a level surface.
2. Remove reservoir cover with its diaphragm.



TYPICAL
1. Reservoir cover
2. Diaphragm

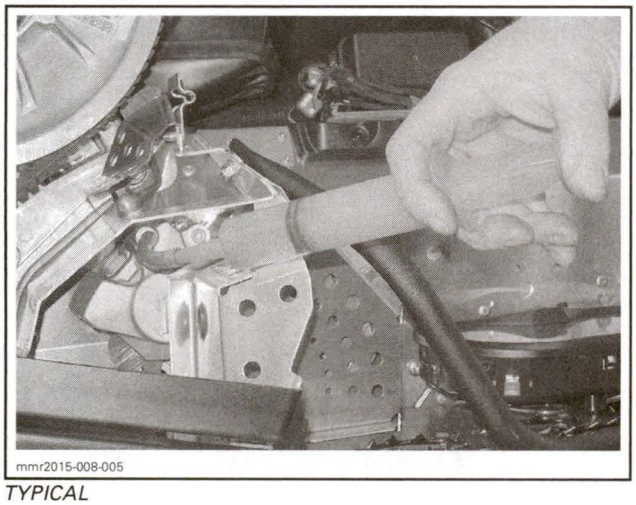
3. Connect a clear hose to caliper bleeder.
4. Place the other end of hose in a container.
5. Loosen bleeder and pump brake lever until no more fluid flows out of bleeder.



TYPICAL
1. Bleeder
2. Clear hose to used brake fluid catch container

To fill brake system when it is empty, proceed as follows:

1. Ensure reservoir cover is removed.
2. Using a large syringe and a suitable tube, inject brake fluid slowly into the caliper.



TYPICAL

3. Continue to inject brake fluid until master cylinder reservoir is half full.
4. Close bleeder.
5. Fill up reservoir and install cover.
6. Squeeze brake lever.
   6.1 If brake lever is firm, bleeding of the brake system is not required. Torque bleeder as specified.

TIGHTENING TORQUE	
Brake caliper bleeder	9 N•m (80 lbf•**in**)

   6.2 If brake lever is spongy, refer to *BRAKE SYSTEM BLEEDING* in this subsection.

Brake System Bleeding

1. Install a clear hose on bleeder.
2. Place the other end in a container partially filled with clean brake fluid.
3. Pump up brake system pressure using the brake lever until lever resistance is felt.
4. Squeeze and hold brake lever and open bleeder. When the lever touches the handlebar, do not release it and close the bleeder.
5. Release brake lever slowly.
6. Repeat the procedure until no more air bubbles appear in hose.

NOTE: Check fluid level often to prevent air from being pumped into the circuit.

7. Install cover on reservoir.
8. Squeeze brake lever.

NOTE: If brake lever feels firm; bleeding procedure is complete. Torque bleeder as specified. If brake lever is still spongy; go to step 9

TIGHTENING TORQUE	
Brake caliper bleeder	9 N•m (80 lbf•**in**)

9. Push back brake pads with caliper still installed and squeeze brake lever.
10. Repeat step 2 to step 5.
11. Torque bleeder as specified.
12. Adjust brake fluid reservoir level.
13. Install diaphragm and cover on reservoir.

Brake Hose, Pads and Disc Inspection

Break-In Inspection

Visually inspect the brake hose for leaks or any damage.

Visually inspect pads and disc for abnormal wear or any damage.

Scheduled Maintenance and Preseason

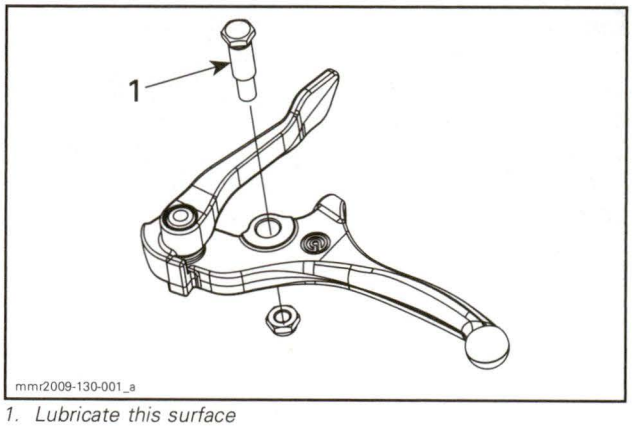
Visually inspect the brake hose for leaks or any damage.

Refer to *BRAKE* subsection and carry out:
- *BRAKE PAD INSPECTION*
- *BRAKE DISC INSPECTION.*

Brake Lever Pivot Lubrication

1. Remove brake lever pivot screw.
2. Lubricate brake lever pivot screw using recommended product.

SERVICE PRODUCT	
Brake lever pivot	XPS SYNTHETIC GREASE (P/N 293 550 010)



1. Lubricate this surface

3. Install brake lever pivot screw.
4. Torque nut on brake lever pivot screw as specified.

TIGHTENING TORQUE	
Pivot screw brake lever	6 N•m (53 lbf•**in**)

Drive Belt Inspection

Refer to *DRIVE BELT* subsection.

Drive Pulley Inspection and Cleaning

Refer to *DRIVE PULLEY* subsection.

Drive Pulley Retaining Screw Tightening

Refer to *DRIVE PULLEY* subsection.

Driven Pulley Inspection and Cleaning

Inspect pulley sheaves for dirt, marks or scratches.

Test sliding sheave operation.

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

NOTE: When removing dust on the cam, avoid altering the teflon coating. Use a dry cloth only.

Driven Pulley Spring Preload

Refer to *DRIVEN PULLEY AND COUNTERSHAFT* subsection.

DRIVE SYSTEM (GEARBOX)

Recommended Gearbox Oil

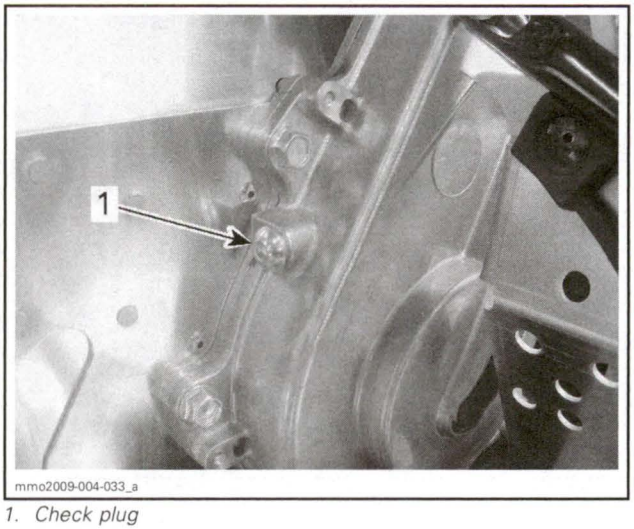
RECOMMENDED GEARBOX OIL
XPS SYNTHETIC CHAINCASE OIL (P/N 413 803 300)

NOTICE **The gearbox of this snowmobile has been developed and validated using the XPS™ Synthetic chaincase oil. BRP strongly recommends the use of its XPS Synthetic chaincase oil at all times. Damages caused by oil which is not suitable for the gearbox will not be covered by the BRP limited warranty.**

Gearbox Oil Level Verification

With the vehicle on a level surface, check the oil level by removing the check plug on the left side of gearbox.

Oil level must reach the threaded hole's lower edge.



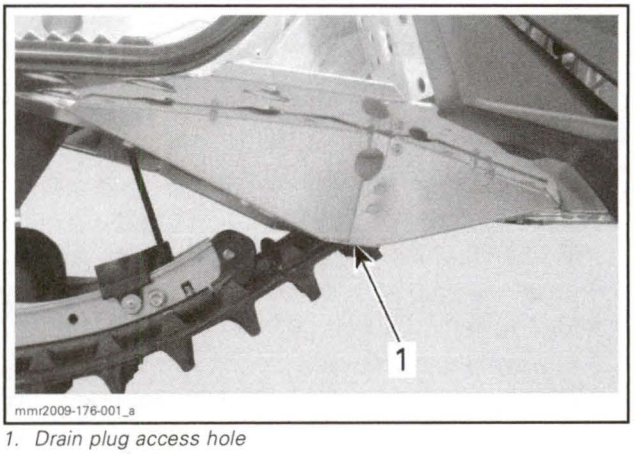
1. Check plug

1. Reinstall check plug and torque to 10 N•m ± 1 N•m (89 lbf•**in** ± 9 lbf•**in**).

Gearbox Oil Replacement

Gearbox Oil Draining

1. Place the vehicle on a level surface.
2. Place a drain pan under gearbox drain plug area.
3. Remove filler cap.
4. Remove the drain plug located at the bottom of gearbox.



1. Drain plug access hole

5. Wait a while to allow all oil to drain out of gearbox.
6. Install drain plug and torque to specification.

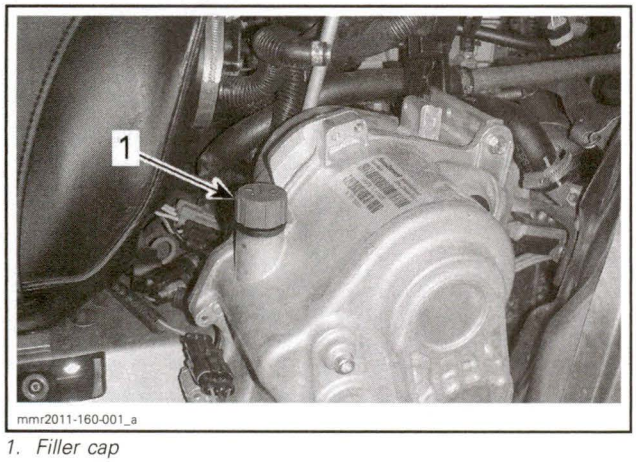
TIGHTENING TORQUE	
Gearbox drain plug	8 N•m (71 lbf•**in**)

Gearbox Oil Filling

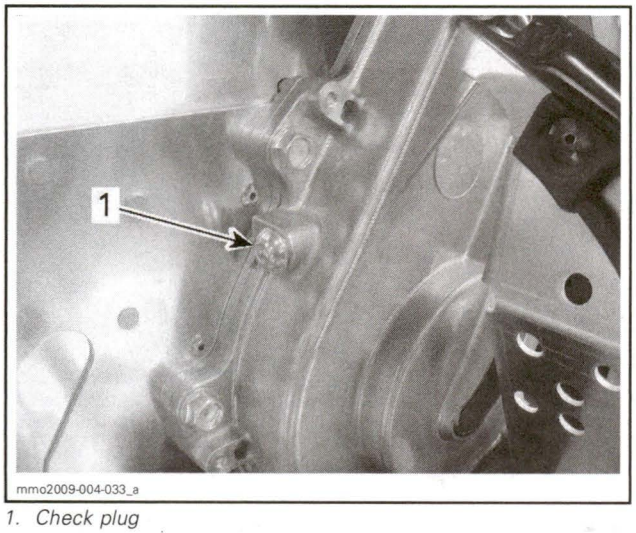
NOTE: Vehicle must be on a level surface.

1. Remove the filler cap.

2. Remove oil level check plug.



1. Filler cap



1. Check plug

3. Pour recommended oil into gearbox through the filler hole.

NOTE: Oil level is correct when it just begins to come out of the check plug orifice.

4. Reinstall check plug and torque to specification.

TIGHTENING TORQUE	
Oil level check plug	10 N•m (89 lbf•**in**)

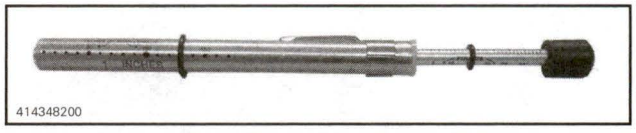
DRIVE SYSTEM (TRACK)

Track Adjustment and Alignment

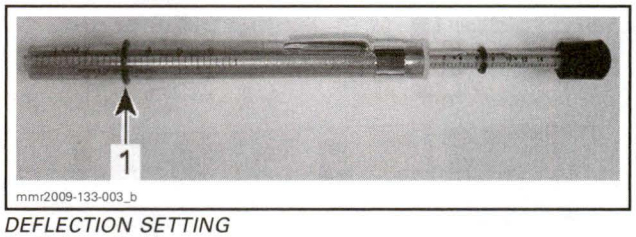
Track tension and alignment are interrelated. Do not adjust one without checking the other. Track tension procedure must be carried out prior to track alignment.

Track Tension Verification

1. Lift rear of vehicle and support it off the ground.
2. Allow rear suspension to fully extend.
3. Preset the TENSIOMETER (P/N 414 348 200) as specified in the following table.

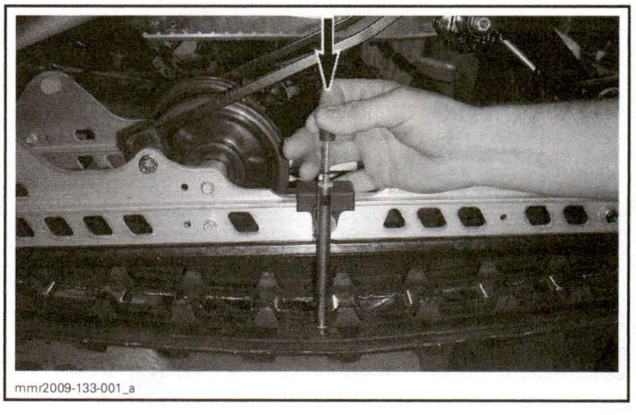


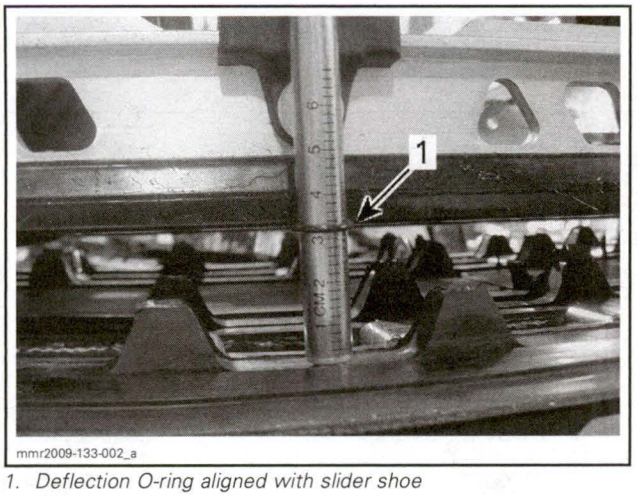
TRACK TENSIOMETER PRESETTING	
DEFLECTION O-RING (BOTTOM)	LOAD O-RING (TOP)
4.5 cm (1.772 in)	0 kgf (0 lbf)



DEFLECTION SETTING
1. Bottom O-ring

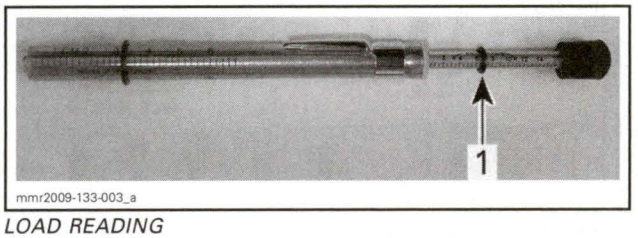
4. Position the tensiometer on track, halfway between front and rear idler wheels.
5. Push the tensiometer downwards until bottom O-ring (deflection) be aligned with the bottom of slider shoe.





1. Deflection O-ring aligned with slider shoe

6. Read load recorded by the upper O-ring on the tensiometer.



LOAD READING
1. Upper O-ring

Load reading must be as per the following table.

TRACK ADJUSTMENT SPECIFICATION	
TRACK DEFLECTION SETTING	4.5 cm (1-9/16 in)
TRACK LOAD READING	6.0 kgf to 8.5 kgf (13 lbf to 19 lbf)

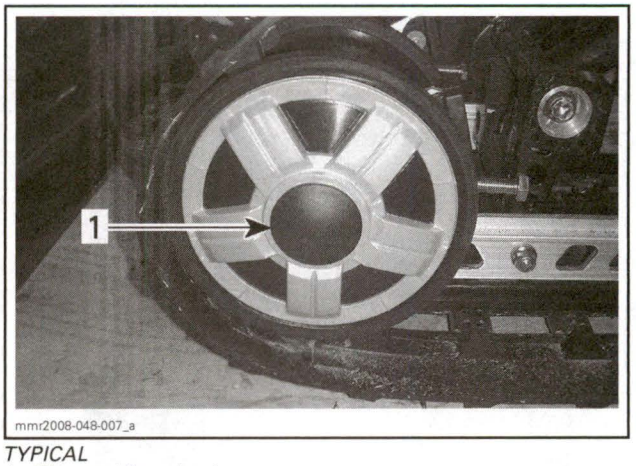
7. If load reading is not in accordance with the specification, adjust track tension. Refer to *TRACK TENSION ADJUSTMENT*.

NOTICE **Too much tension will result in power loss and excessive stresses on suspension components.**

Track Tension Adjustment

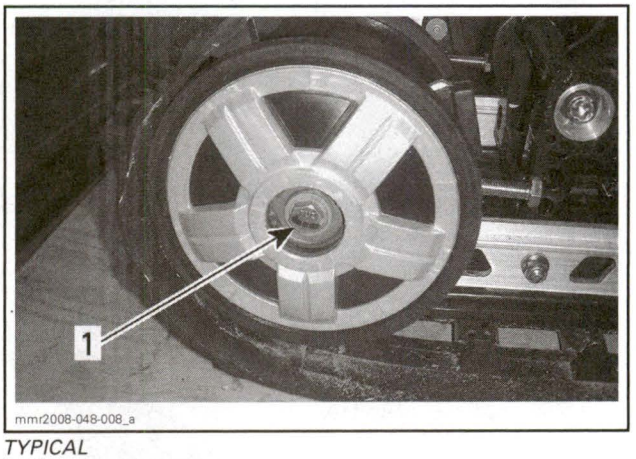
NOTE: After track tension adjustment, ride the snowmobile in snow for 15 to 20 minutes and recheck track tension.

1. Lift rear of vehicle and support it off the ground.
2. Remove rear idler wheel caps.



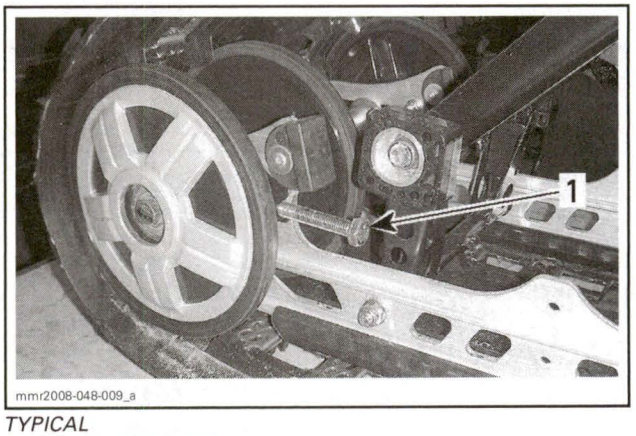
TYPICAL
1. RH rear idler wheel cap

3. Loosen rear axle screws (one each side).



TYPICAL
1. RH rear axle screw

4. Tighten or loosen both adjustment screws to increase or decrease track tension.



TYPICAL
1. RH adjustment screw

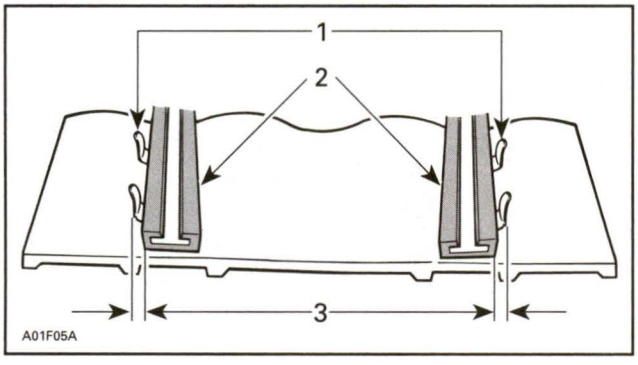
5. Verify track tension, refer to *TRACK TENSION VERIFICATION* in this subsection.

Track Alignment

⚠ WARNING

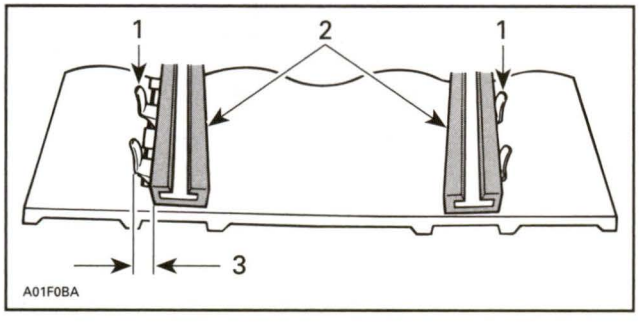
Before checking track alignment, ensure that the track is free of all particles which could be thrown out while track is rotating. Keep hands, tools, feet and clothing clear of track. Ensure no one is standing in close proximity to the vehicle. Never rotate at high speed.

1. Start engine and accelerate slightly until the track barely turns. This must be done in a short period of time (1 to 2 minutes).
2. Ensure the track is well centered; equal distance on both sides between edges of track guides and slider shoes.



1. Guides
2. Slider shoes
3. Equal distance

3. To correct track alignment:
   - 3.1 Stop engine.
   - 3.2 Loosen rear wheel screws.
   - 3.3 Tighten adjustment screw on side where the slider shoe is the farthest from the track inset guides.



1. Track guides
2. Slider shoes
3. Tighten on this side

4. Restart engine.
5. Rotate track slowly and recheck alignment.
6. If satisfactory alignment is achieved:
   - 6.1 Tighten idler wheel retaining screws.

TIGHTENING TORQUE	
Idler wheel screw	48 N•m (35 lbf•ft)

   - 6.2 Reinstall wheel caps.

CHASSIS (SUSPENSION)

Front Suspension Inspection

Visually inspect front suspension for tightness of components:
- Arms
- Stabilizer bar
- Shock absorbers
- Ball joints.

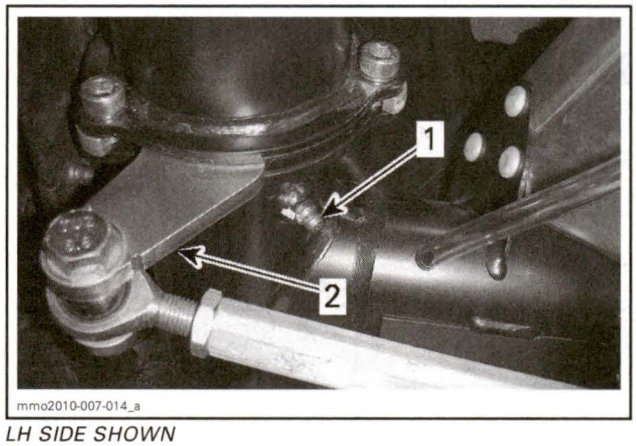
Front Suspension Lubrication (Skandic Models)

Lubricate front suspension at grease fittings using recommended product.

SERVICE PRODUCT	
Front suspension	SUSPENSION GREASE (P/N 293 550 033)

Generally, 4 to 5 grease gun strokes is sufficient.

NOTE: If too much grease is injected, the overflow will come out at steering levers and ski legs. Wipe off any excess of grease to avoid contact with other parts.



LH SIDE SHOWN
1. Grease fitting
2. Steering arm

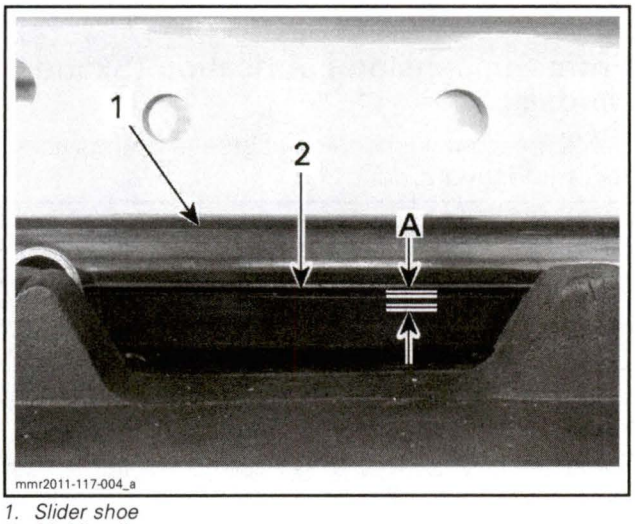
Rear Suspension, Stopper Straps and Slider Shoes Inspection

Rear Suspension Mechanism and Stopper Straps Inspection

1. Inspect rear suspension components for wear, deterioration or damage, replace defective parts if necessary.
2. Inspect stopper straps for wear or cracks.
3. Check bolt and nut securing straps for tightness. If loose, inspect strap holes for deformation. Replace strap if necessary.

Slider Shoe Inspection

Slider shoes are worn out and must be replaced when there is just 1 mm to 2 mm (.04 in to .08 in) of remaining material exceeding the molding line.



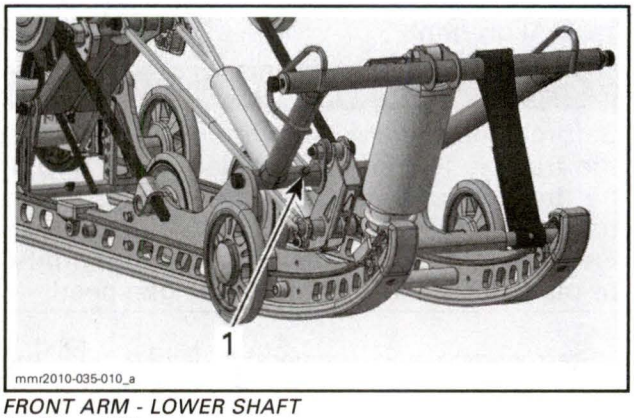
1. Slider shoe
2. Molding line
A. Minimum thickness: 1 mm to 2 mm (.04 in to .08 in)

NOTICE **Slider shoes must always be replaced in pairs.**

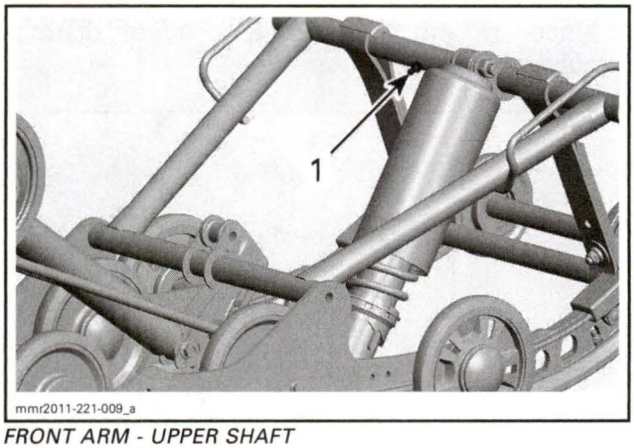
Rear Suspension Lubrication

Lubricate the following suspension pivots at grease fittings using recommended product.

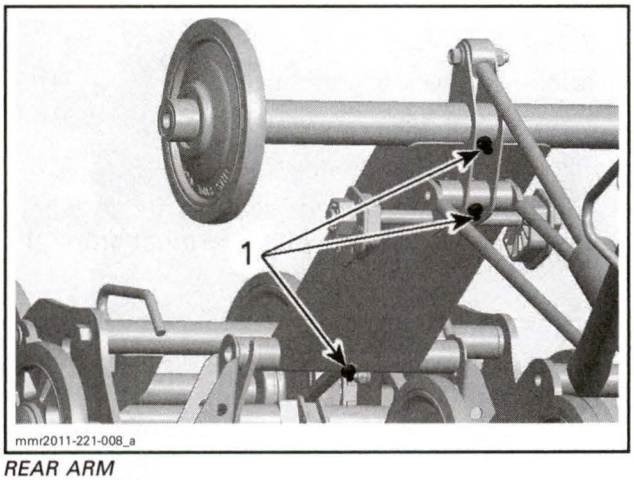
SERVICE PRODUCT	
Rear suspension	SUSPENSION GREASE (P/N 293 550 033)



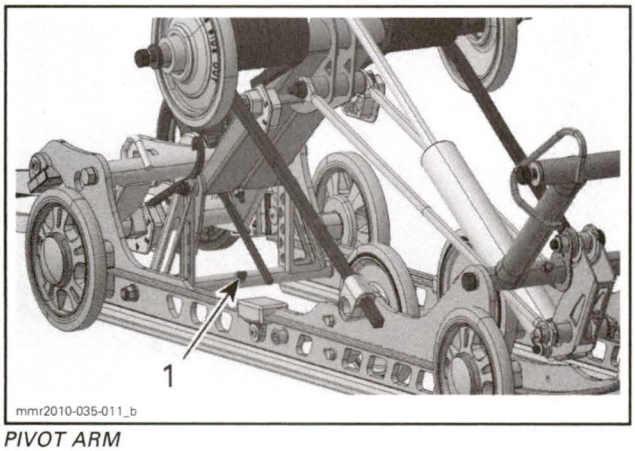
FRONT ARM - LOWER SHAFT
1. Grease fitting



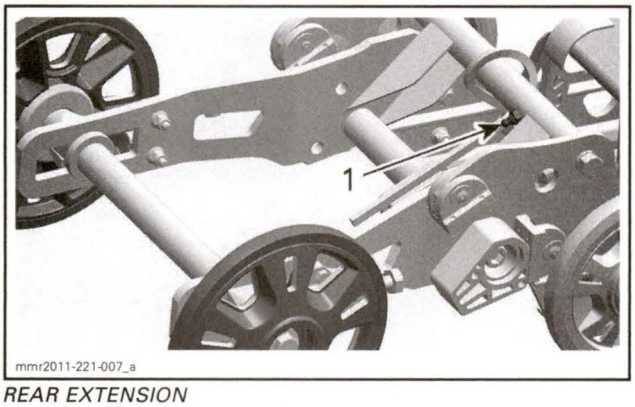
FRONT ARM - UPPER SHAFT
1. Grease fitting



REAR ARM
1. Grease fitting



PIVOT ARM
1. Grease fitting



REAR EXTENSION
1. Grease fitting

CHASSIS (STEERING)

Ski and Runner Inspection

Lift the front of vehicle and check ski runners for wear or damage (missing or broken carbide). Replace if necessary.

Inspect ski for excessive wear or other damage. Replace if necessary.

Steering Mechanism Inspection

Visually inspect steering mechanism for tightness of components (steering arms, tie rods, ski bolts, ski legs, etc.).

STORAGE PROCEDURES

During summer, or when a snowmobile is not in use for more than three months, proper storage is required.

Procedures are detailed in *PERIODIC MAINTENANCE PROCEDURES* subsection.

STORAGE
Clean the vehicle
Protect fuel system by adding fuel stabilizer to fuel following the product manufacturer recommendations. Run the engine after adding the product to the fuel
Lubricate brake lever pivot
Inspect and lubricate rear suspension
Charge battery monthly to keep it fully charge during storage
Block muffler with rags
Lubricate front suspension
Lift rear of vehicle until track is clear of the ground. Do not release track tension

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

PRESEASON PREPARATION

Proper vehicle preparation is required after the summer months or when a vehicle has not been used for more than three months.

Procedures are detailed in *PERIODIC MAINTENANCE PROCEDURES* subsection.

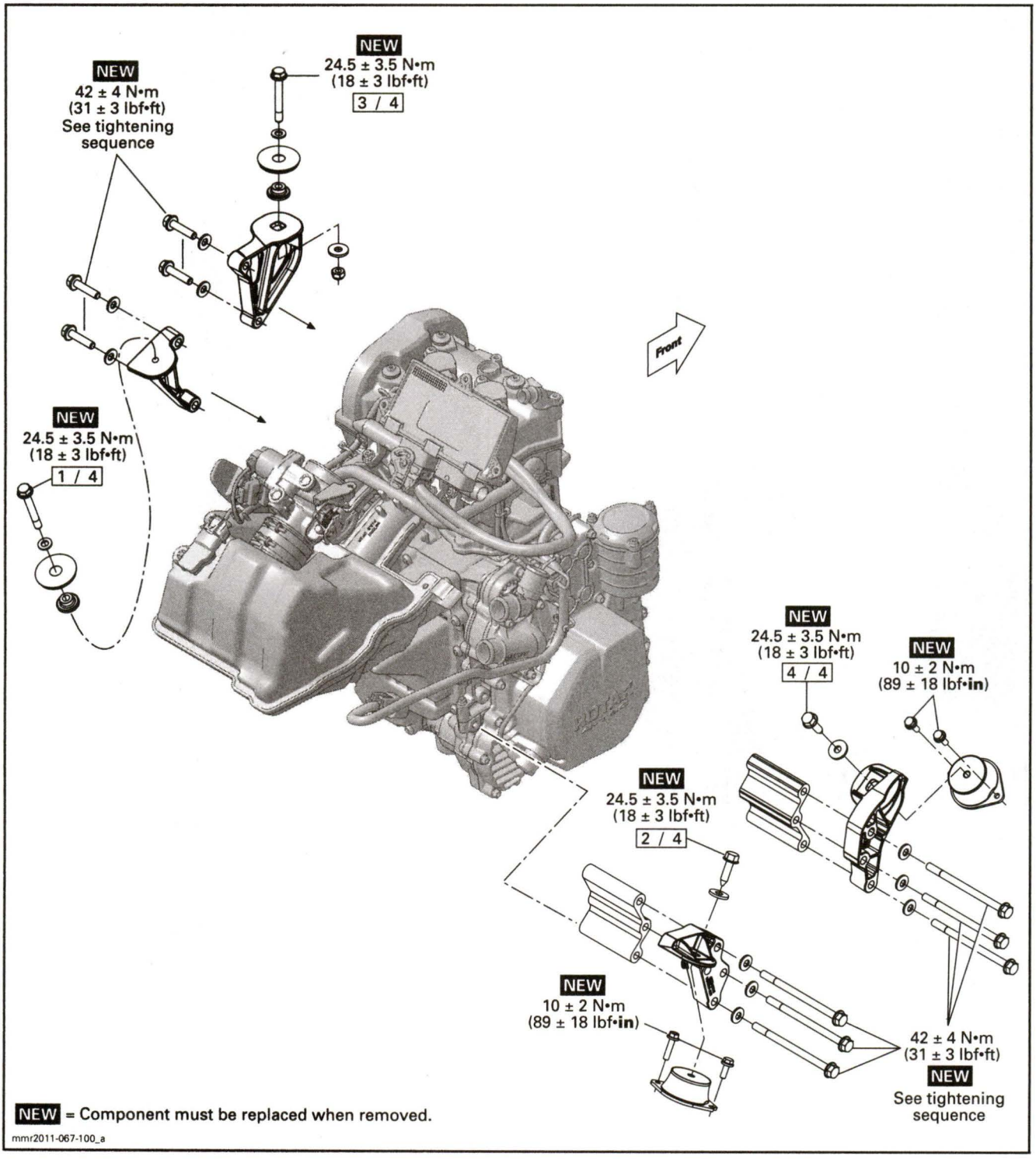
PRESEASON PREPARATION
Visually inspect engine seals and gaskets and check for leaks
Change engine oil and filter
Check exhaust system condition and check for leaks
Check coolant density
Inspect fuel lines and connections
Clean and inspect throttle body
Inspect drive belt (adjust at every drive belt replacement)
Clean and visually inspect drive pulley
Clean and inspect driven pulley
Inspect, adjust and align track
Change gearbox oil
Check brake fluid level
Inspect brake hose, pads and disc
Inspect steering mechanism
Inspect skis and runners
Inspect front suspension
Inspect rear suspension stopper strap
Charge battery
Adjust headlight beam aiming

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ENGINE REMOVAL AND INSTALLATION

SERVICE TOOLS

Description	Part Number	Page
ENGINE LIFTING TOOL	529 036 217	35



PROCEDURES

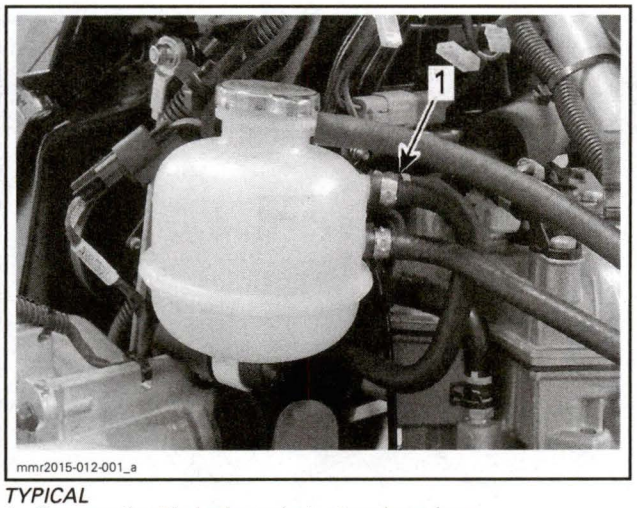
ENGINE

Engine Removal

1. Place vehicle on a workstation equipped with an engine-lifting hoist.
2. Refer to *BODY* subsection and remove:
   - LH and RH upper side panels
   - LH and RH lower side panels
   - Hood
   - LH and RH upper bottom pans.
3. Remove air intake silencer and headlights/gauge support module as a unit. Refer to *AIR INTAKE SYSTEM* subsection.
4. Move fuel tank rearward without removing it. Refer to *FUEL TANK AND FUEL PUMP* subsection.
5. Disconnect negative (–) cable from battery, refer to *CHARGING SYSTEM* subsection.

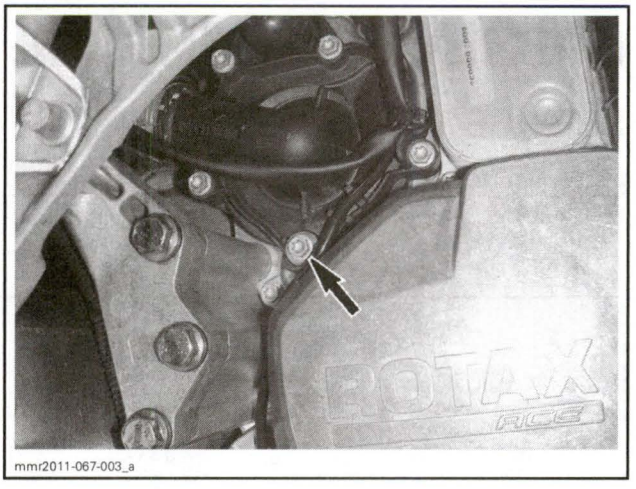
MAG Side Operations

1. Remove throttle body coolant return hose from coolant reservoir. Discard Oetiker clamp.

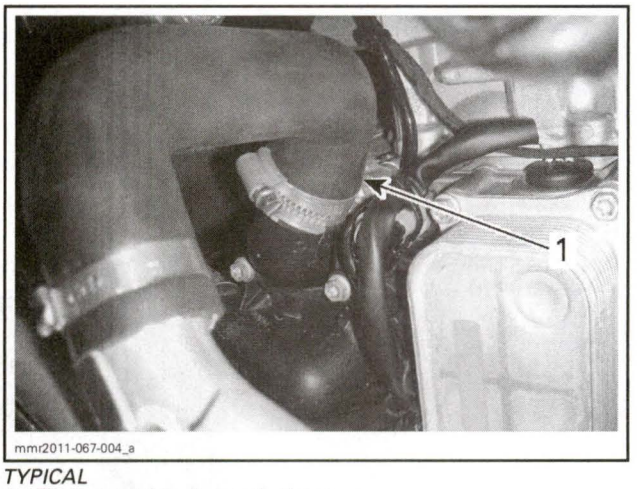


TYPICAL
1. Remove throttle body coolant return hose here

2. Refer to *EXHAUST SYSTEM* subsection and remove:
   - Muffler
   - Exhaust pipes
   - Exhaust flanges.
3. Drain engine coolant by removing lower screw from water pump.

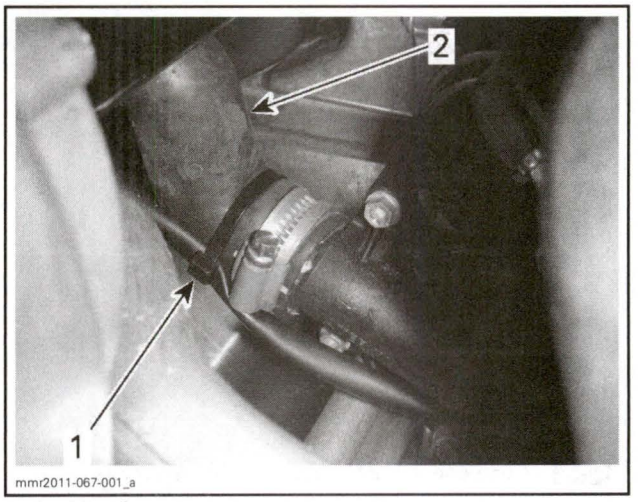


4. Disconnect outlet hose from thermostat housing.



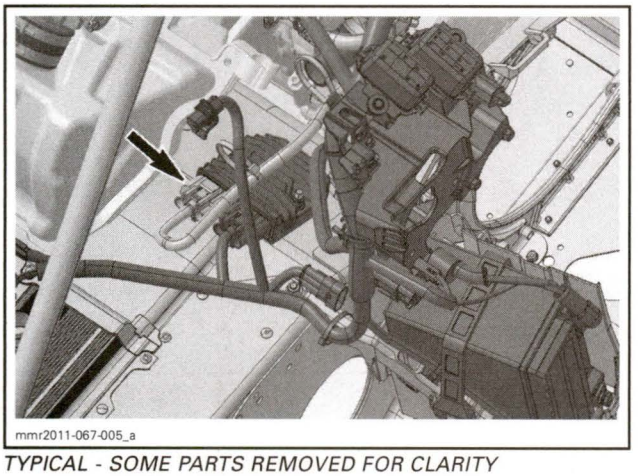
TYPICAL
1. Thermostat housing outlet hose.

5. Remove locking tie on water pump inlet hose.
6. Disconnect coolant inlet hose from water pump.



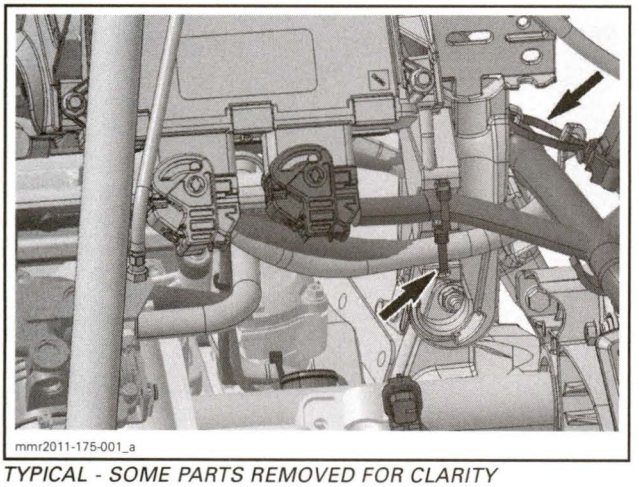
1. Locking tie
2. Water pump inlet hose

7. Remove locking tie securing magneto connector wires.
8. Disconnect magneto connector from voltage regulator.


mmr2011-067-005_a

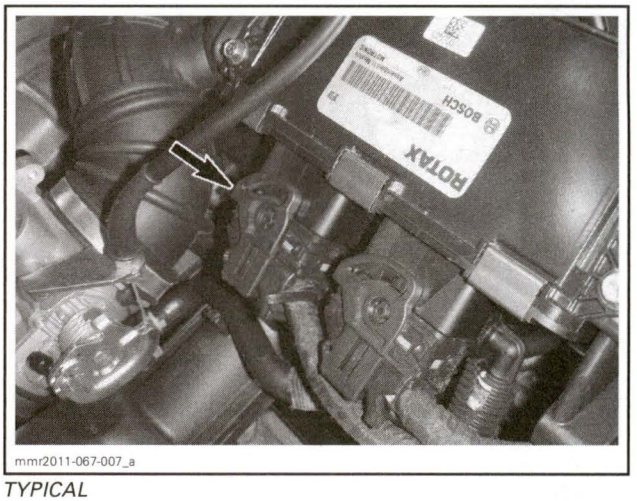
TYPICAL - SOME PARTS REMOVED FOR CLARITY

9. Remove locking ties securing harness of ECM connector A to ECM support.


mmr2011-175-001_a

TYPICAL - SOME PARTS REMOVED FOR CLARITY

10. Disconnect ECM connector A from ECM.



mmr2011-067-007_a

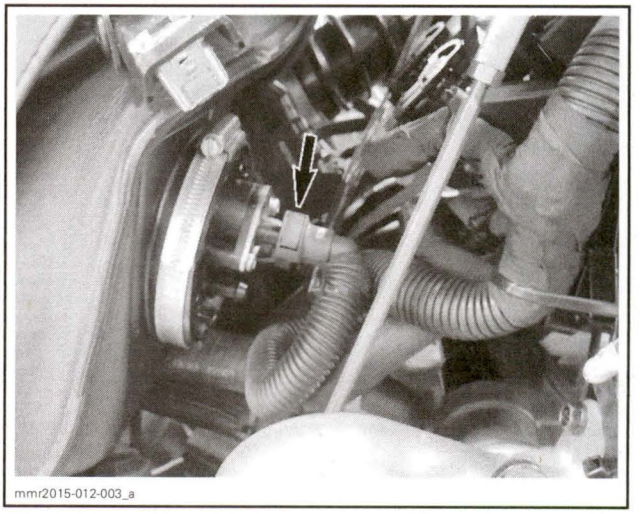
TYPICAL

11. Disconnect engine harness connector located in front of ECM support.


mmr2011-067-008_a

12. Carefully disconnect fuel hose from fuel pump.

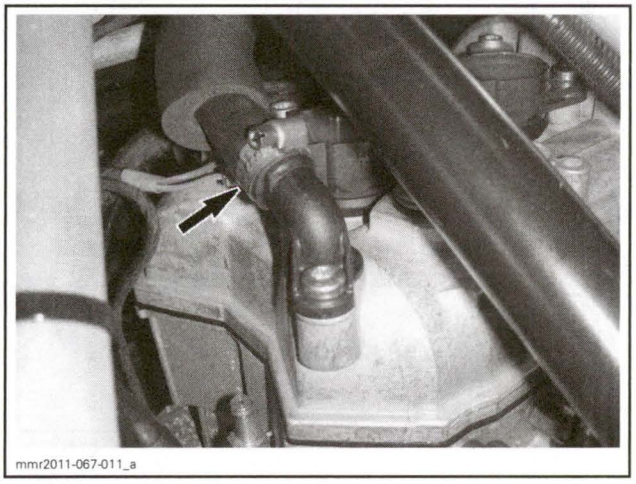
NOTE: Wrap an absorbent shop rag around fuel hose end to catch any fuel leakage.


mmr2015-012-003_a

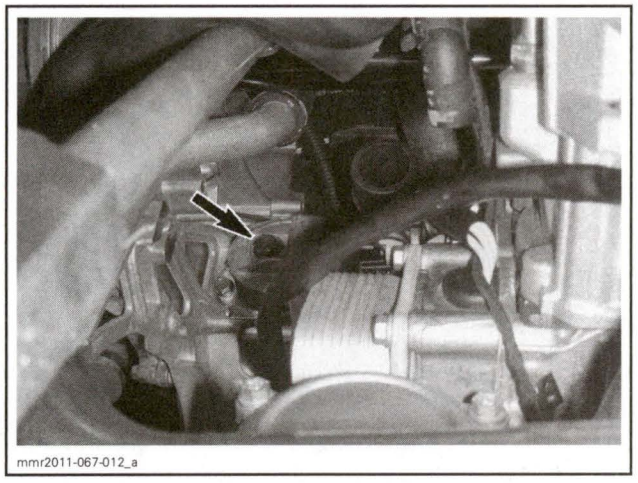
⚠ WARNING

Wipe up any fuel leakage.

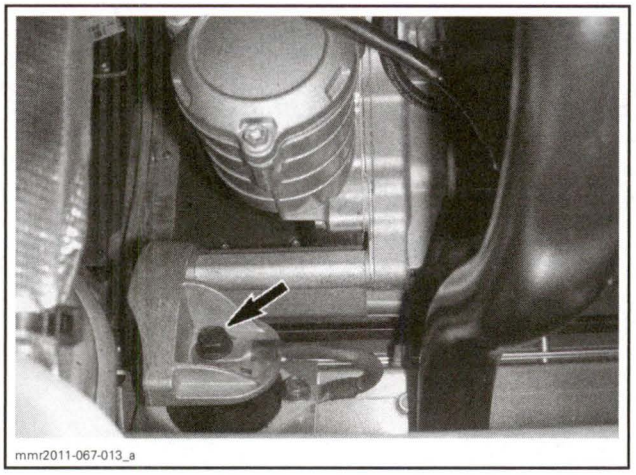
13. Disconnect breather hose from valve cover.


mmr2011-067-011_a

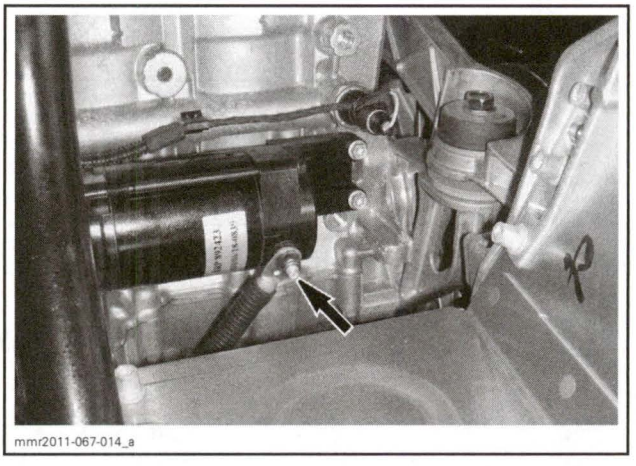
14. Remove screw securing rear rubber mount to engine support.


mmr2011-067-012_a

15. Remove screw securing front rubber mount to engine support.

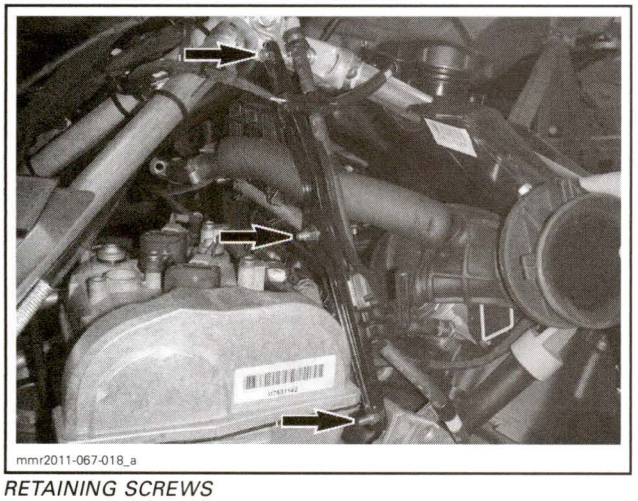

mmr2011-067-013_a

16. Disconnect positive (+) cable from starter.


mmr2011-067-014_a

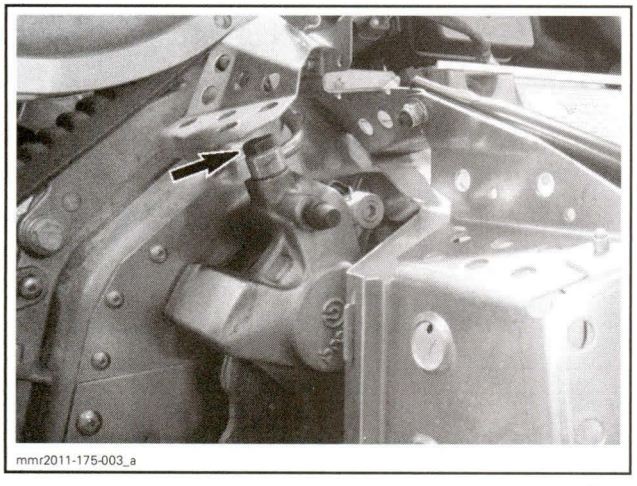
PTO Side Operations

1. Remove drive pulley. Refer to *DRIVE PULLEY (e-Drive)* subsection.
2. Refer to *DRIVEN PULLEY AND COUNTER-SHAFT* subsection and remove:
   - Driven pulley
   - Countershaft.
3. Remove LH side frame member.



RETAINING SCREWS

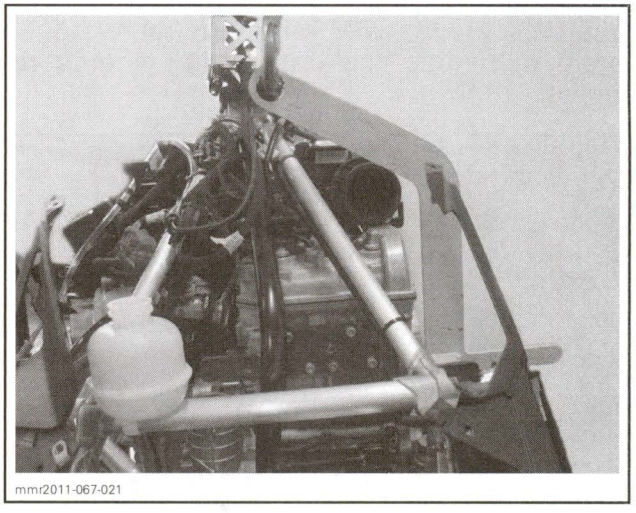
4. Remove brake hose from brake caliper and discard sealing washers.



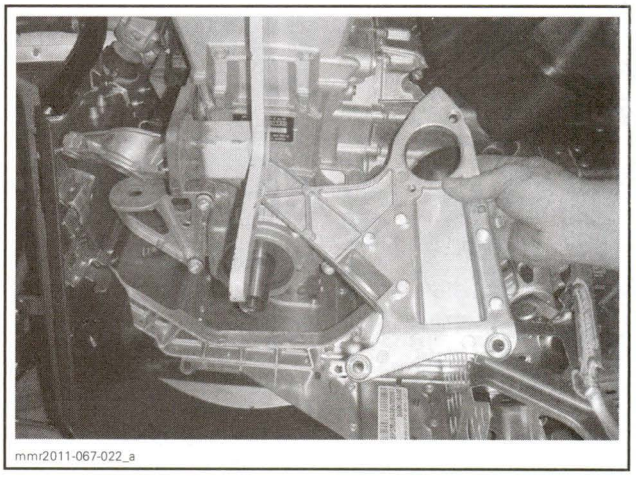
5. Install engine lifting tool in place of exhaust flanges.

REQUIRED TOOL	
ENGINE LIFTING TOOL (P/N 529 036 217)	

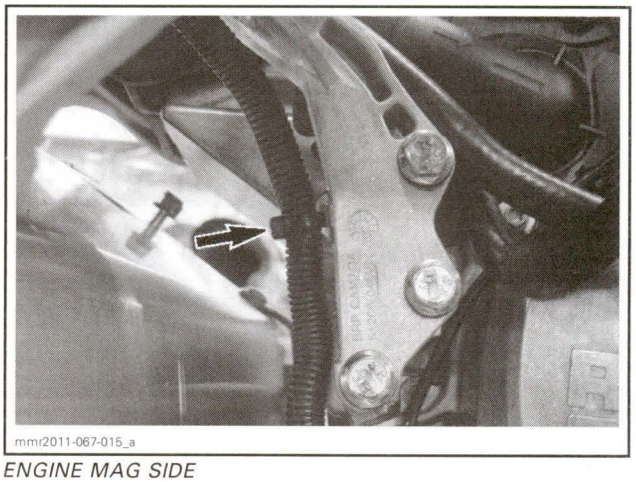
6. Secure lifting tool using exhaust flange screws.
7. **Slightly** lift engine using engine-lifting hoist.



8. Remove countershaft bearing support. Refer to *DRIVEN PULLEY AND COUNTERSHAFT.*



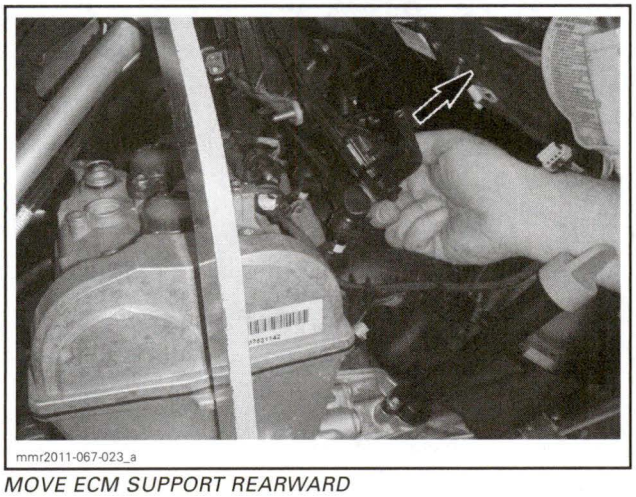
9. Remove starter cable locking tie located on rear MAG side engine support.



ENGINE MAG SIDE

10. Move engine out of vehicle.

NOTICE Move ECM support rearward to avoid damaging fuel rail during engine removal.


mmr2011-067-023_a

MOVE ECM SUPPORT REARWARD

Engine Installation

Reverse the removal procedure, however pay attention to the following.

Ensure engine supports and engine rubber mounts are in good condition before engine installation.

Install **NEW** self-locking screws where required, refer to exploded view at the beginning of this subsection.

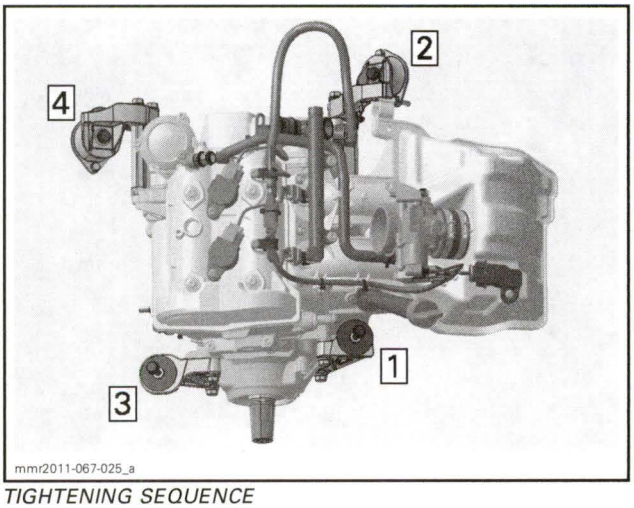
Install Banjo fitting on brake caliper using **NEW** sealing washers. Refer to *BRAKE* subsection for tightening torque.

Refill and bleed brake system. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

Properly tighten countershaft bearing support. Refer to *DRIVEN PULLEY AND COUNTERSHAFT* subsection for tightening sequence.

Tighten engine mounting screws to specification as per the following sequence.

TIGHTENING TORQUE	
Engine mounting screws (M8)	24.5 N•m ± 3.5 N•m (18 lbf•ft ± 3 lbf•ft)



mmr2011-067-025_a

TIGHTENING SEQUENCE

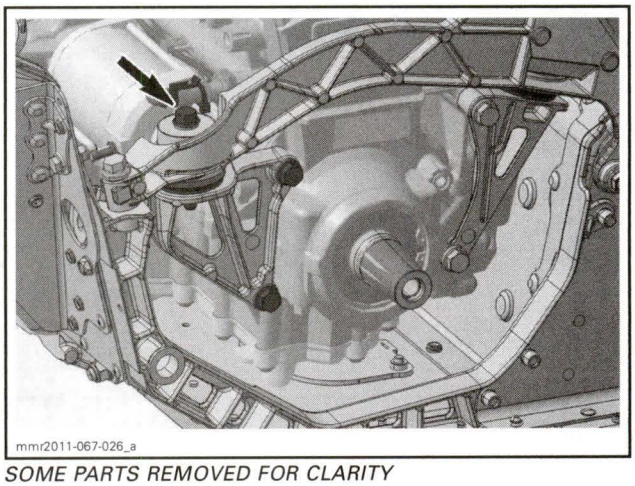
ENGINE SUPPORTS

Engine Support Inspection

Check if engine supports are cracked, bent or damaged. Replace if necessary.

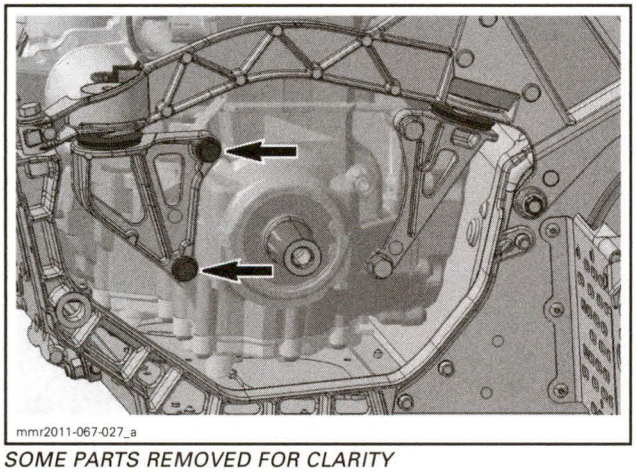
Front Engine Support Replacement (PTO Side)

1. Remove body parts and components as required to access engine support.
2. Remove and discard screw securing rubber mount to engine support.


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SOME PARTS REMOVED FOR CLARITY

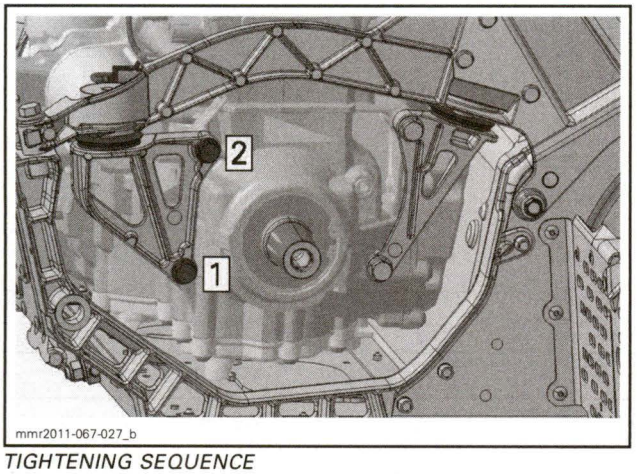
3. Remove and discard screws securing engine support to engine.



SOME PARTS REMOVED FOR CLARITY

4. Replace engine support.
5. Install **NEW** screws to secure engine support to engine.
6. Tighten engine support screws to specification as per the following sequence.

TIGHTENING TORQUE	
Engine support screws	42 N•m ± 4 N•m (31 lbf•ft ± 3 lbf•ft)

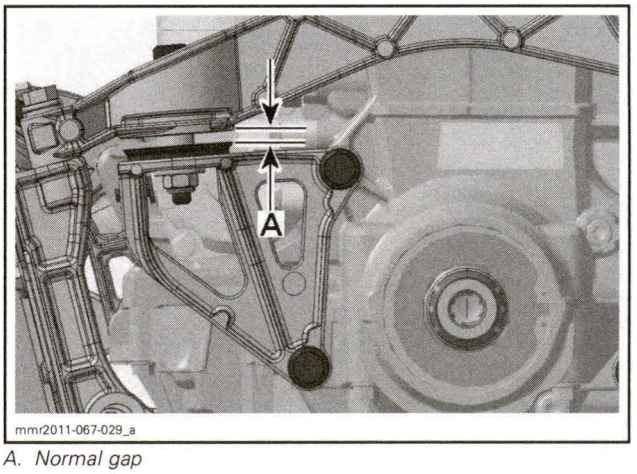


TIGHTENING SEQUENCE

7. Install **NEW** screw to secure engine rubber mount to engine support.
8. Tighten rubber mount screw to specification.

TIGHTENING TORQUE	
Rubber mount screws (M8)	24.5 N•m ± 3.5 N•m (18 lbf•ft ± 3 lbf•ft)

NOTE: It is normal that a gap (5 mm (3/16 in)) is visible between engine stopper and countershaft bearing support. This gap will allow engine to move and reduce vibration.



A. Normal gap

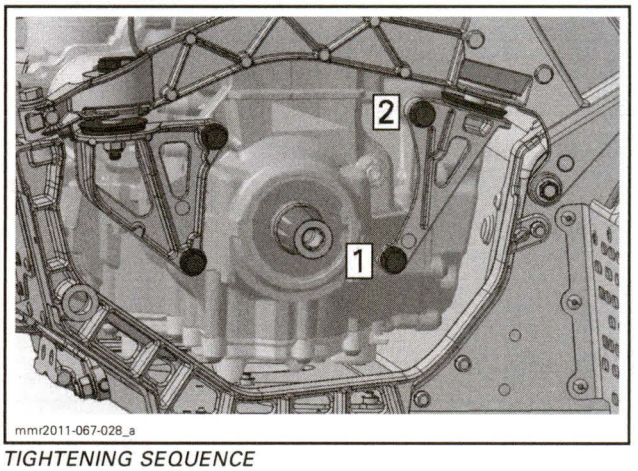
9. Install body parts and components in the reverse order of the removal procedure.

Rear Engine Support Replacement (PTO Side)

To replace rear engine support, refer to *FRONT ENGINE SUPPORT REPLACEMENT (PTO SIDE)* in this subsection. However pay attention to the following.

Tighten engine support screws to specification as per the following sequence.

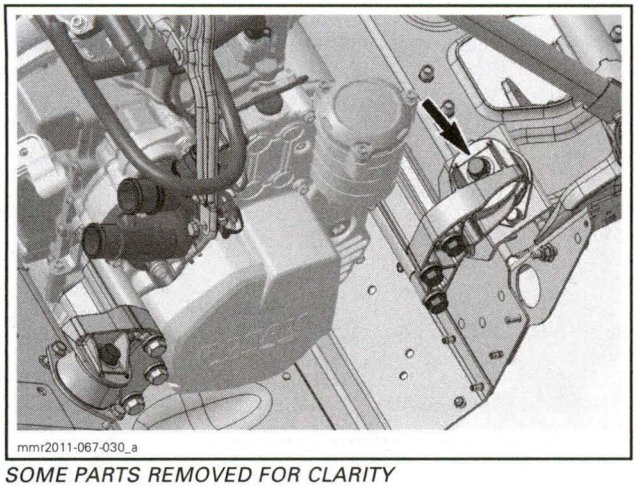
TIGHTENING TORQUE	
Engine support screws	42 N•m ± 4 N•m (31 lbf•ft ± 3 lbf•ft)



TIGHTENING SEQUENCE

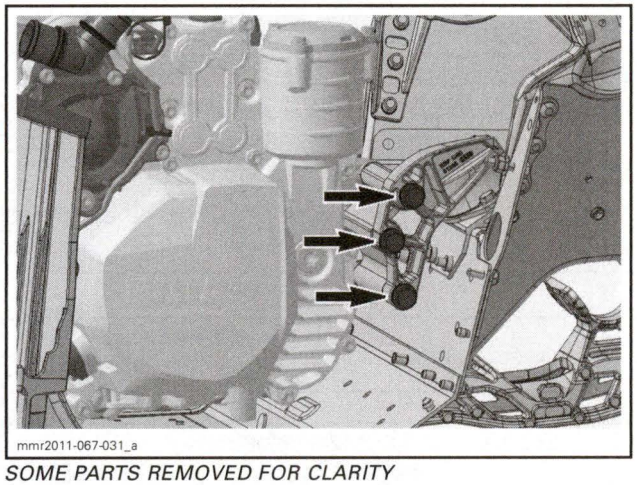
Front Engine Support Replacement (MAG Side)

1. Remove body parts and components as required to access engine support.
2. Remove and discard screw securing engine support to rubber mount.



SOME PARTS REMOVED FOR CLARITY

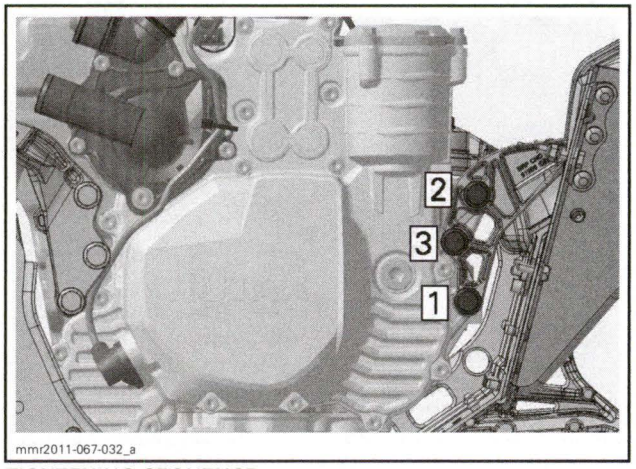
3. Remove and discard screws securing engine support to engine.



SOME PARTS REMOVED FOR CLARITY

4. Replace engine support.
5. Install **NEW** screws to secure engine support to engine.
6. Tighten engine support screws to specification as per the following sequence.

TIGHTENING TORQUE	
Engine support screws	42 N•m ± 4 N•m (31 lbf•ft ± 3 lbf•ft)



TIGHTENING SEQUENCE

7. Install **NEW** screw to secure engine support to rubber mount.
8. Tighten engine mounting screw to specification.

TIGHTENING TORQUE	
Engine mounting screws (M8)	24.5 N•m ± 3.5 N•m (18 lbf•ft ± 3 lbf•ft)

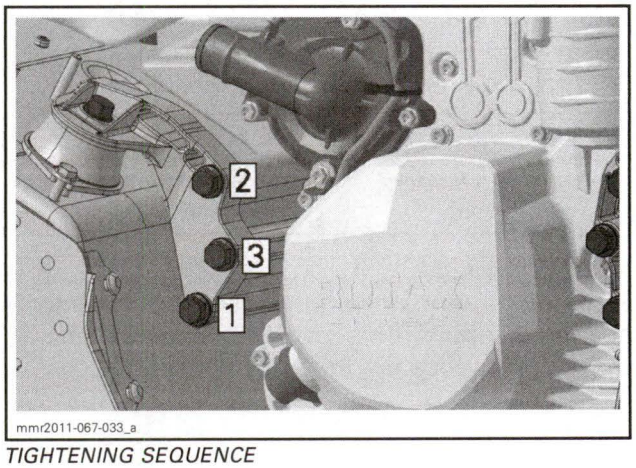
9. Install body parts and components in the reverse order of the removal procedure.

Rear Engine Support Replacement (MAG Side)

To replace rear engine support, refer to *FRONT ENGINE SUPPORT REPLACEMENT (MAG SIDE)* in this subsection. However pay attention to the following.

Tighten engine support screws to specification as per the following sequence.

TIGHTENING TORQUE	
Engine support screws	42 N•m ± 4 N•m (31 lbf•ft ± 3 lbf•ft)



TIGHTENING SEQUENCE

ENGINE RUBBER MOUNTS

Engine Rubber Mount Inspection

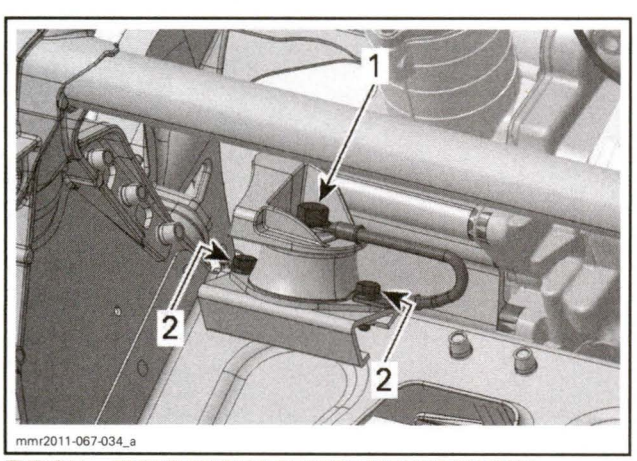
Check rubber mounts. Replace them if brittle, cracked or damaged.

Front and Rear Engine Rubber Mount Replacement (PTO Side)

1. Remove countershaft bearing support. Refer to *DRIVEN PULLEY AND COUNTER SHAFT* subsection.
2. Replace engine rubber mount.
3. Install countershaft bearing support. Refer to *DRIVEN PULLEY AND COUNTERSHAFT* subsection.

Front and Rear Engine Rubber Mount Replacement (MAG Side)

1. Remove body parts and components as required to access engine rubber mount.
2. Remove and discard screw securing engine support to rubber mount.
3. Remove and discard screws securing rubber mount to frame.



TYPICAL - FRONT ENGINE RUBBER MOUNT SHOWN
1. Screw securing engine support to rubber mount (M8)
2. Screws securing rubber mount to frame (M6)

4. Replace engine rubber mount.
5. Install **NEW** screws to secure engine and rubber mount.
6. Tighten rubber mount screws to specification.

TIGHTENING TORQUE	
Rubber mount screws (M6)	10 N•m ± 2 N•m (89 lbf•**in** ± 18 lbf•**in**)

TIGHTENING TORQUE	
Engine mounting screw (M8)	24.5 N•m ± 3.5 N•m (18 lbf•ft ± 3 lbf•ft)

7. Install body parts and components as the reverse of removal procedure.

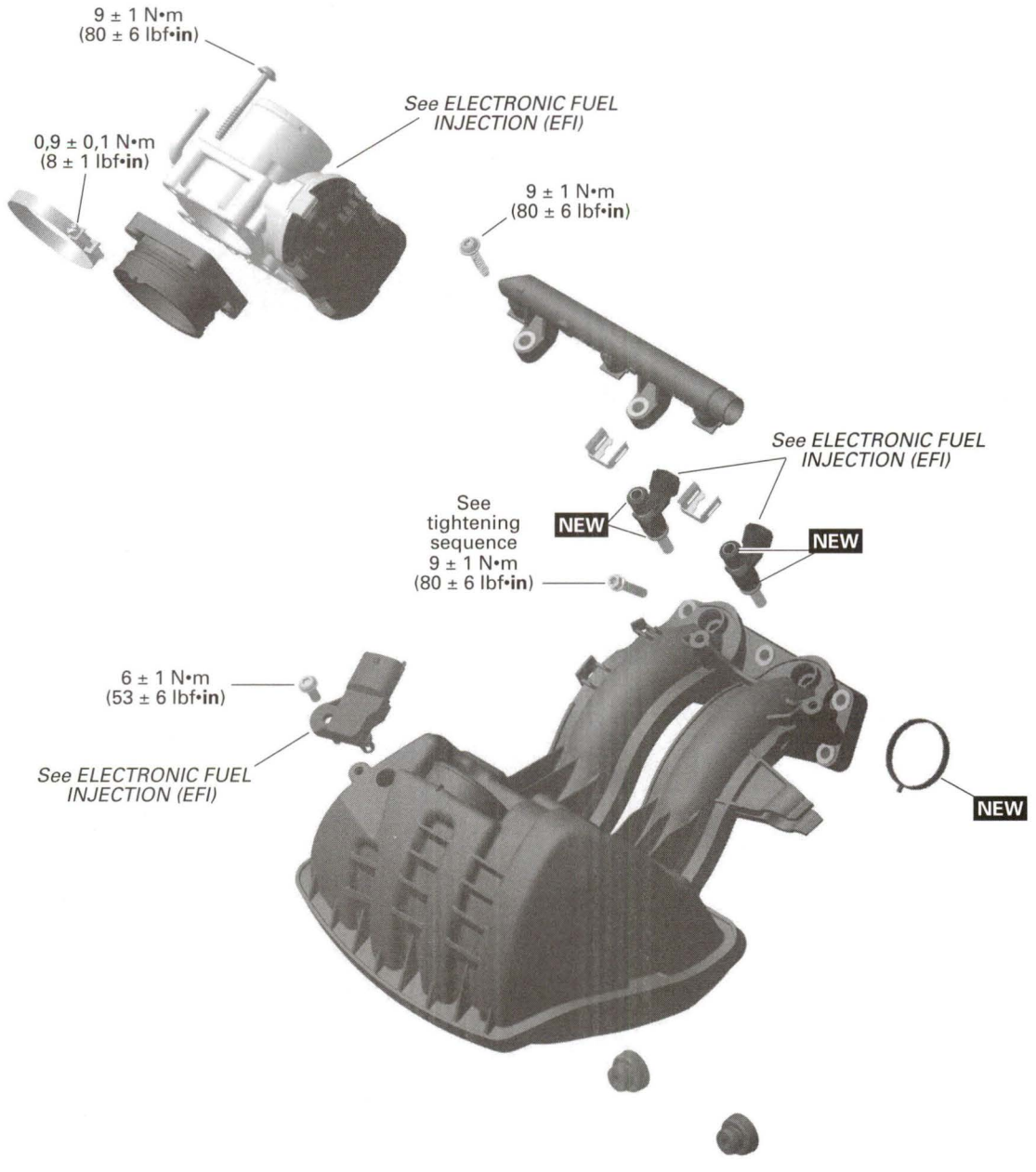
AIR INTAKE SYSTEM

SERVICE TOOLS

Description	Part Number	Page
SMALL HOSE PINCHER	295 000 076	47

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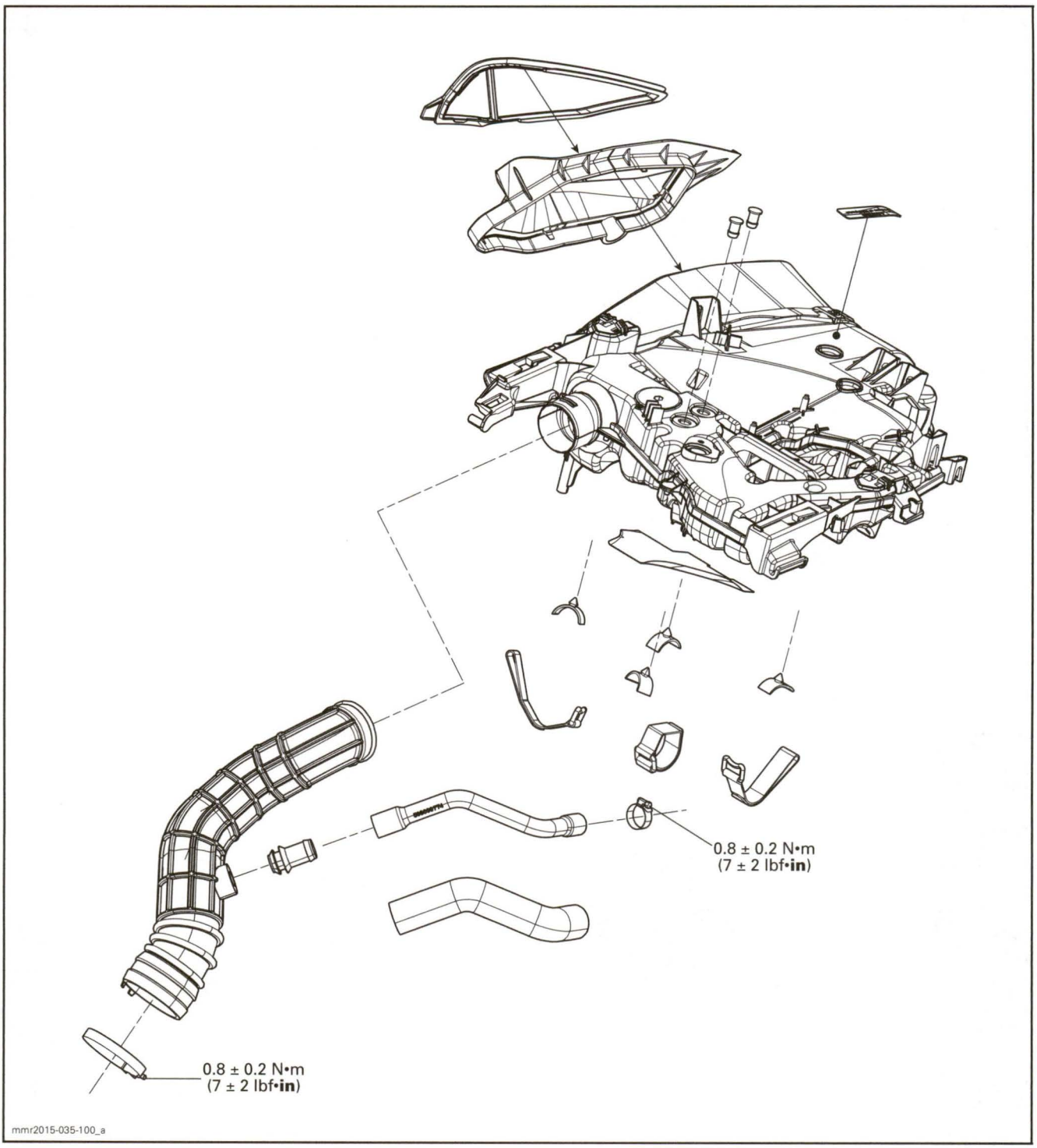
INTAKE MANIFOLD



NEW = Component must be replaced when removed.

mmr2015-035-001_a

AIR INTAKE SILENCER

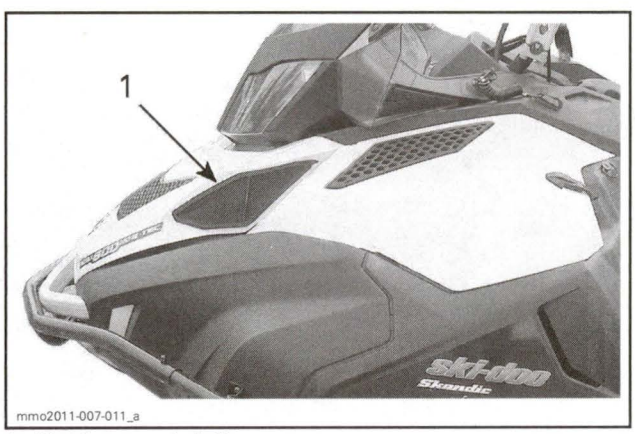


PROCEDURES

AIR INLET FILTERS

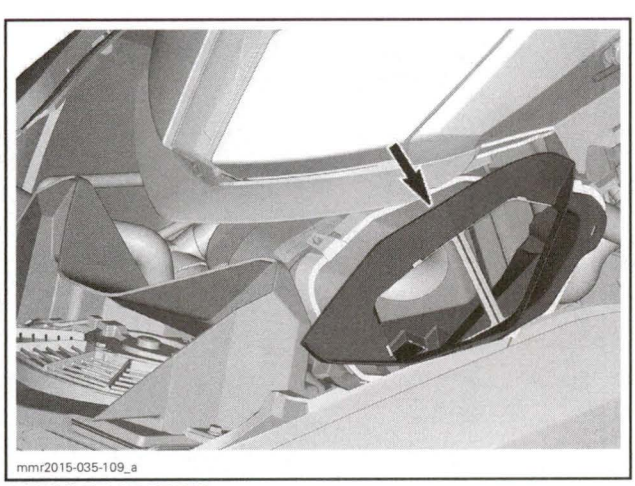
Air Filter Removal

1. Refer to *BODY* subsection and remove the following:
   - LH and RH upper side panels
   - Hood.
2. To remove hood mounted filter, simply pull it out.



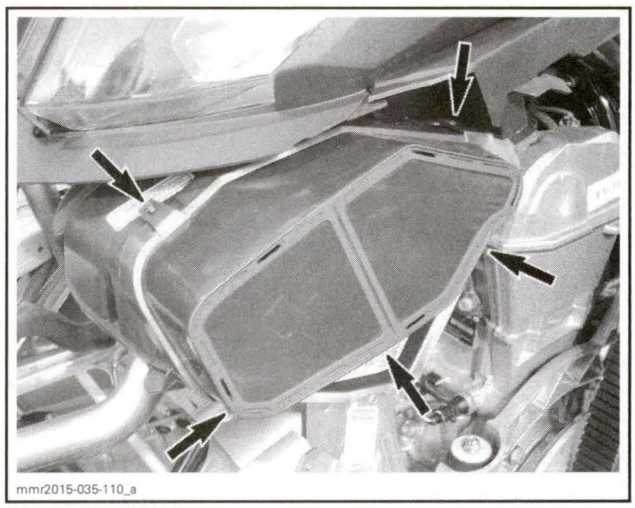
1. Hood mounted air filter

3. To remove filter from air intake silencer:
   3.1 Remove hood adapter from air inlet of air intake silencer.



AIR INLET ADAPTER

   3.2 Release retaining tabs and pull filter off air inlet.



AIR INLET FILTER

Air Filter Cleaning

Gently clean with fresh water and mild soap.

Replace air filter as required.

NOTE: If the filter is very dirty, clean the interior of the air intake silencer at the same time.

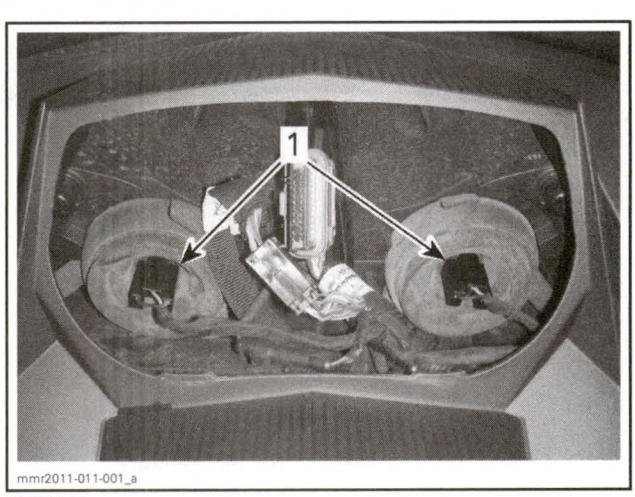
Air Filter Installation

Reverse the removal procedures. Make sure filters are properly secured.

AIR INTAKE SILENCER

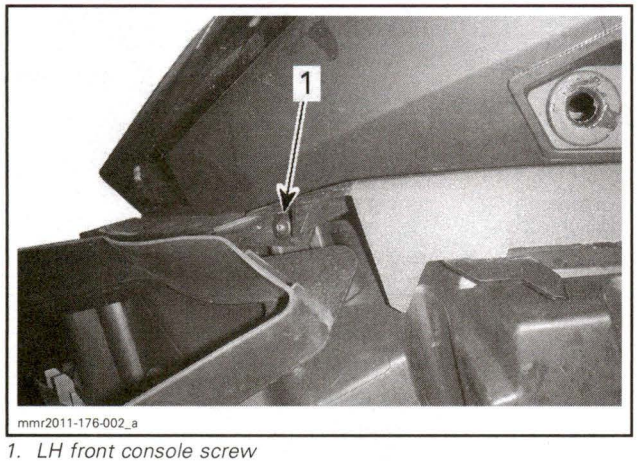
Air Intake Silencer Removal as a Unit with Headlight/Gauge Module

1. Remove multifunction gauge. Refer to *LIGHTS, GAUGE AND ACCESSORIES* subsection.
2. Disconnect headlight connectors.



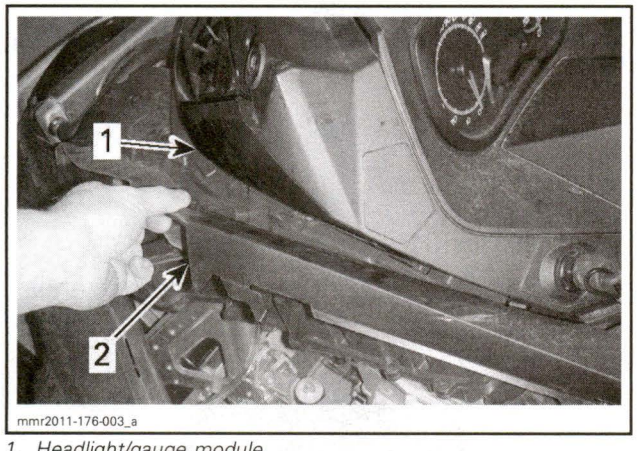
TYPICAL
1. Headlight connectors

3. Refer to *BODY* subsection and remove:
   - LH and RH upper side panels
   - Hood.
4. Remove front console screws on each side.



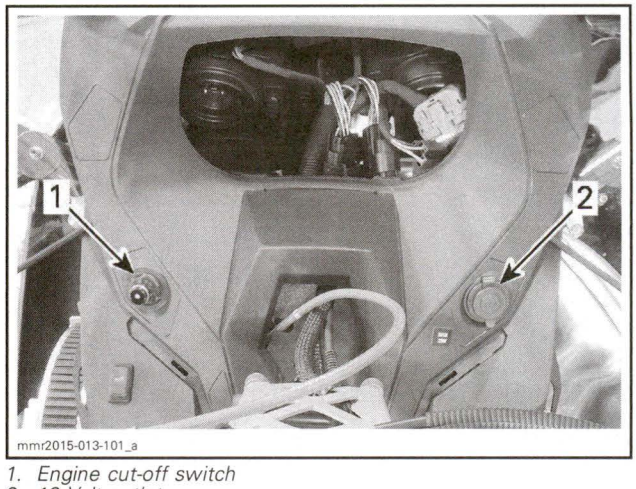
1. LH front console screw

5. Detach front of console from headlight/gauge module.



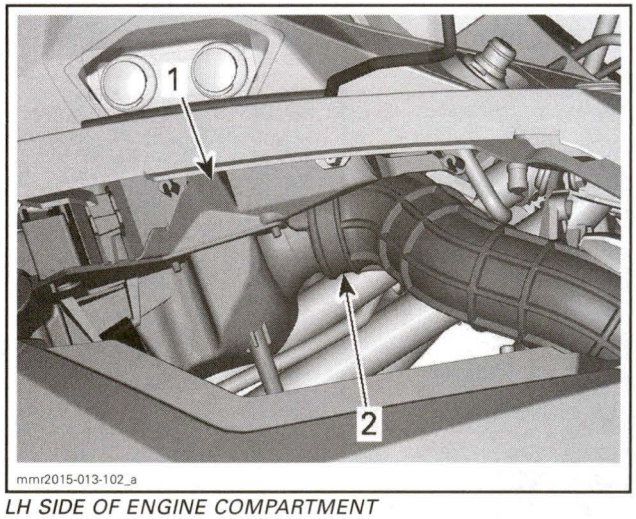
1. Headlight/gauge module
2. Console

6. Disconnect 12-volt outlet and engine cut-off switch.



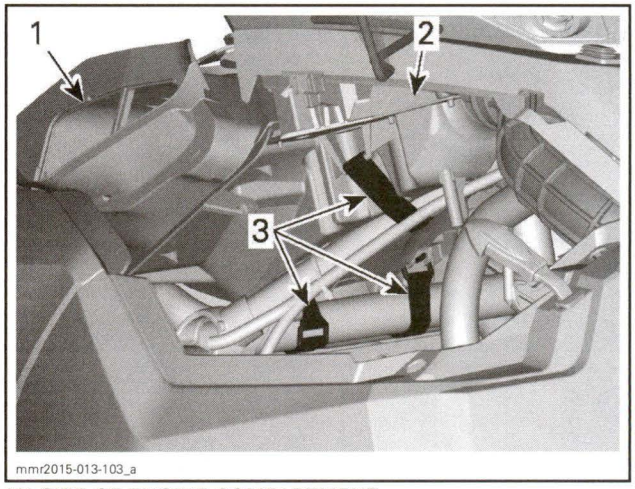
1. Engine cut-off switch
2. 12 Volt outlet

7. Disconnect intake hose from air intake silencer.



LH SIDE OF ENGINE COMPARTMENT
1. Air intake silencer
2. Intake hose

8. Detach the hook-and-loop fasteners (3).



LH SIDE OF ENGINE COMPARTMENT
1. Air inlet
2. Air intake silencer
3. Hook-and-loop fasteners

9. Remove air intake silencer and headlight/gauge module from vehicle.

Air Intake Silencer Removal

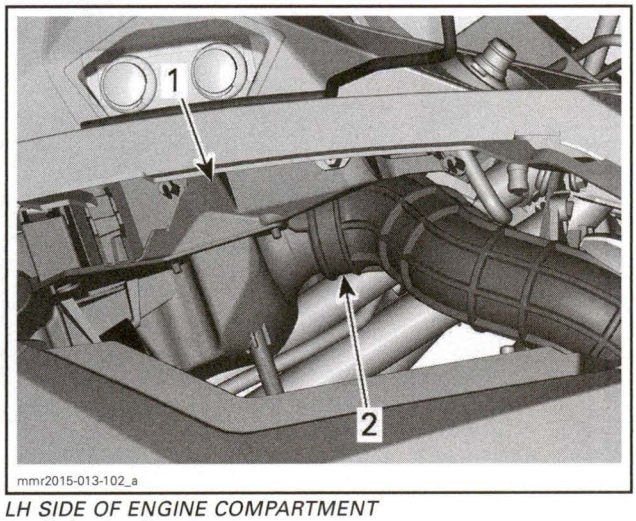
1. Proceed with *AIR INTAKE SILENCER REMOVAL AS A UNIT WITH HEADLIGHT/GAUGE MODULE.*
2. Separate air intake silencer from headlight/gauge module. Refer to *BODY* subsection.

Air Intake Silencer Installation

Reverse the removal procedure. However, pay attention to the following.

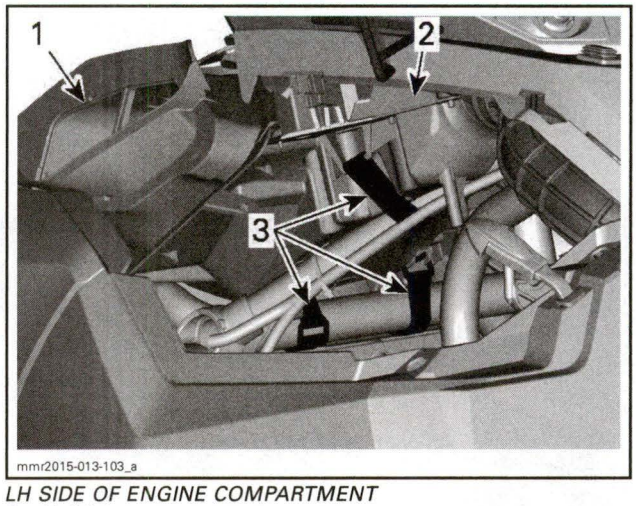
Ensure all parts are reinstalled as specified in their applicable subsection.

Ensure intake hose is completely inserted on air intake silencer.



LH SIDE OF ENGINE COMPARTMENT
1. *Air intake silencer*
2. *Intake hose flange*

Ensure hook-and-loop fasteners are properly installed.



LH SIDE OF ENGINE COMPARTMENT
1. *Air inlet*
2. *Air intake silencer*
3. *Hook-and-loop fasteners*

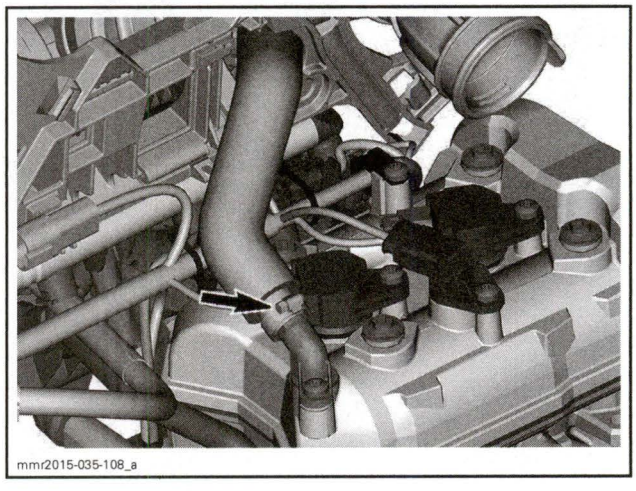
INTAKE MANIFOLD

Intake Manifold Access

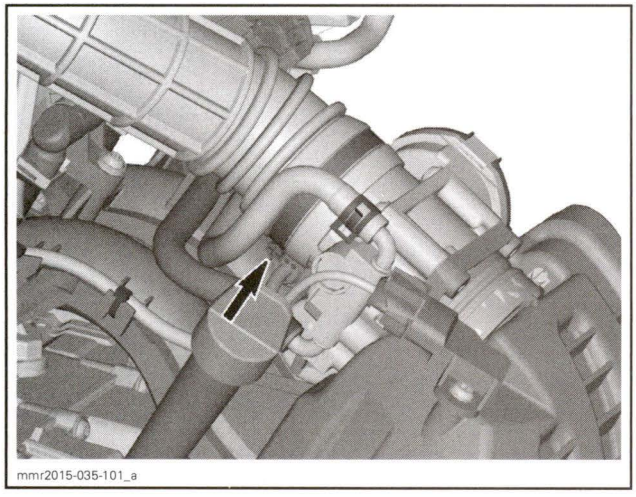
Refer to appropriate subsections and remove:
- Side panels (both sides)
- Air intake silencer and headlight/gauge support module
- Pulley guard
- Fuel tank
- Driven pulley and countershaft.

Intake Manifold Removal

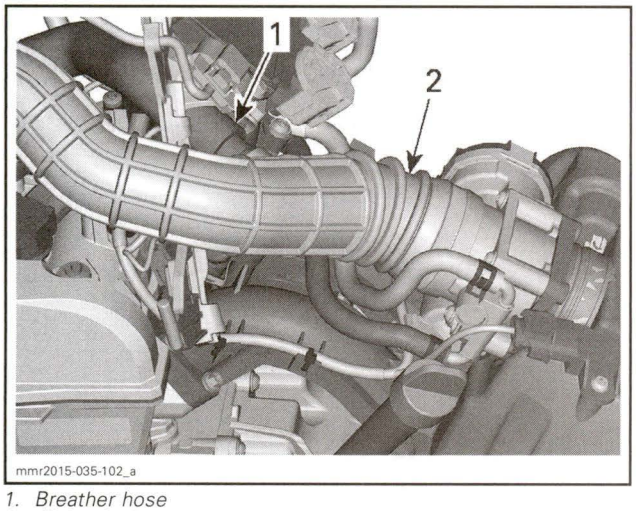
1. Loosen clamp securing breather hose to engine and disconnect hose.



2. Loosen clamp securing air intake hose to throttle body.

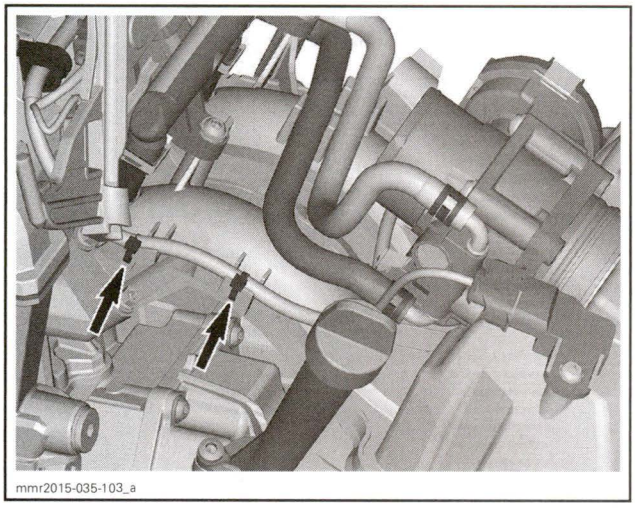


3. Remove air intake and breather hoses.

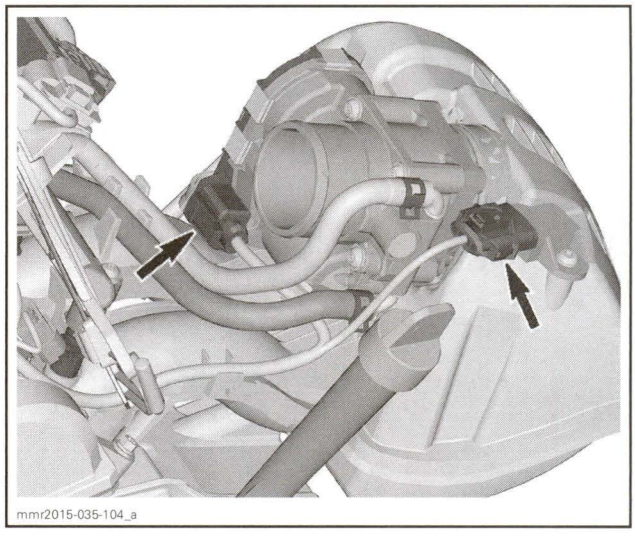


1. Breather hose
2. Air intake hose

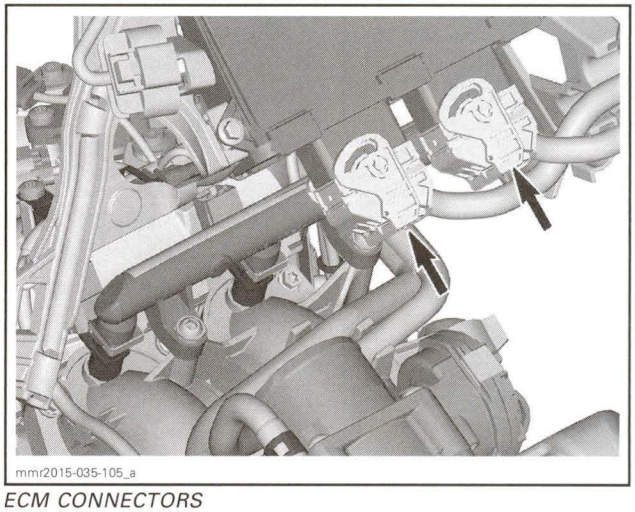
4. Cut locking ties securing MAPTS (manifold absolute pressure and temperature sensor) and ETC (electric throttle control) harness to intake manifold.



5. Disconnect MAPTS and ETC connectors.



6. Disconnect both ECM connectors

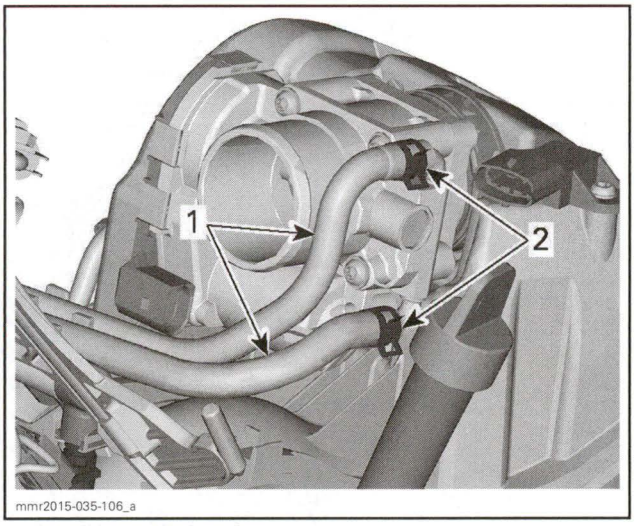


ECM CONNECTORS

7. Install a hose pincher on each coolant hose connected to throttle body.

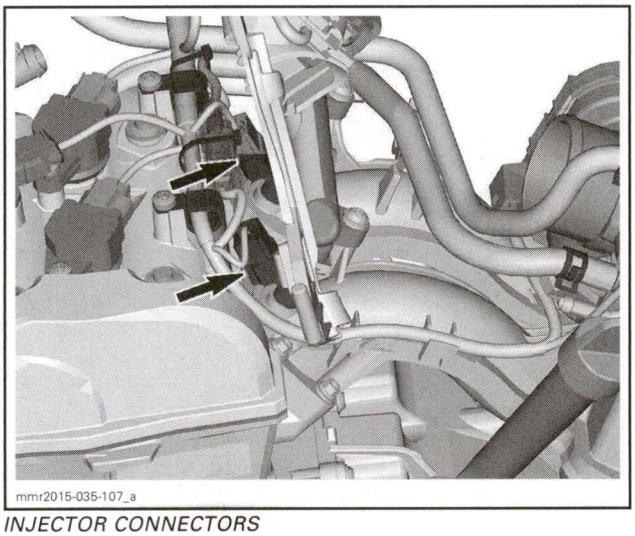
REQUIRED TOOL	
SMALL HOSE PINCHER (P/N 295 000 076)	

8. Disconnect coolant hoses from throttle body.



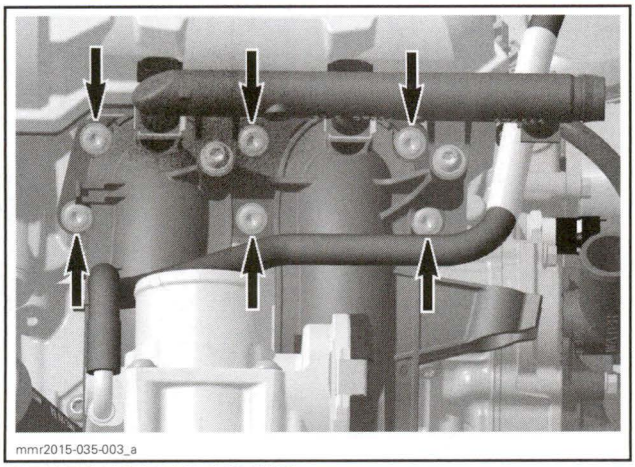
1. Install hose pinchers here
2. Disconnect hoses here

9. Disconnect fuel injector connectors.



INJECTOR CONNECTORS

10. Remove screws securing intake manifold to cylinder head.



INTAKE MANIFOLD SCREWS

11. Remove intake manifold from engine.
12. Remove and discard intake manifold gaskets.
13. If required, remove the following parts from intake manifold:
    - Throttle body with connecting socket. Refer to *ELECTRONIC FUEL INJECTION (EFI)* subsection
    - MAPTS. Refer to *ELECTRONIC FUEL INJECTION (EFI)* subsection
    - Fuel rail with injectors. Refer to *ELECTRONIC FUEL INJECTION (EFI)* subsection.

Intake Manifold Inspection

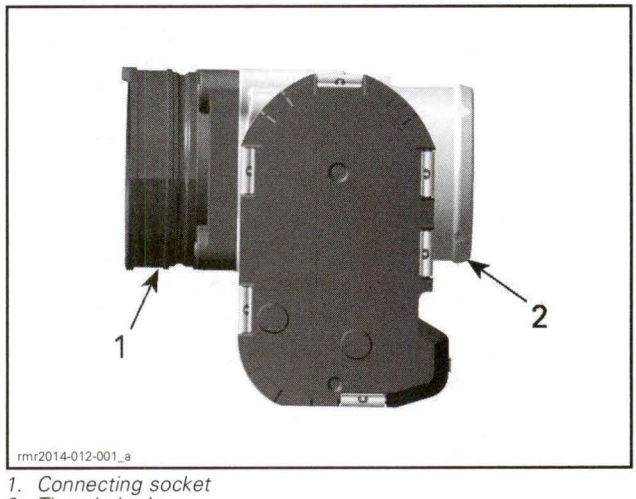
Check intake manifold for cracks, warping at flanges or any other visible damages. Replace if required.

Drain intake manifold if any liquids accumulated.

Flush intake manifold with solvent and let it dry out.

Connecting Socket Inspection

Check connecting socket for cracks, warping at flanges or any other visible damages. If required, remove it from throttle body and replace it.



1. Connecting socket
2. Throttle body

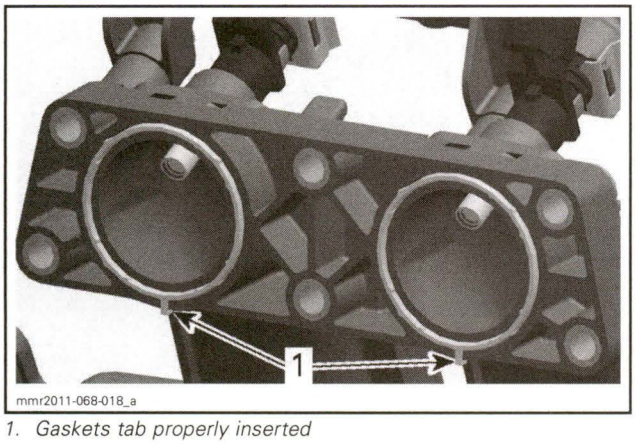
Intake Manifold Installation

Reverse the removal procedure. However, pay attention to the following.

If removed, refer to *ELECTRONIC FUEL INJECTION (EFI)* subsection to install:

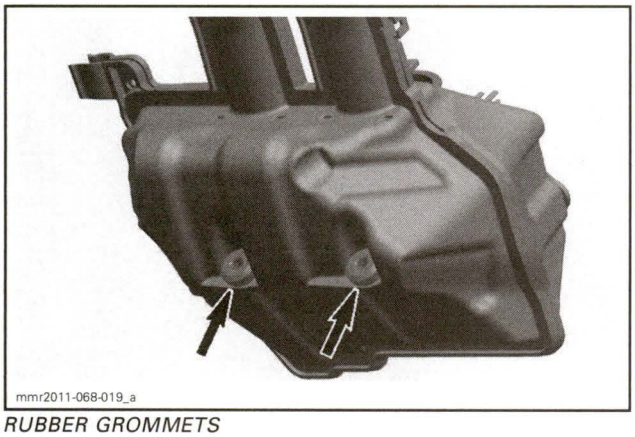
- MAPTS
- Fuel rail with injectors.

Install **NEW** gaskets with tab properly inserted in notch.



1. Gaskets tab properly inserted

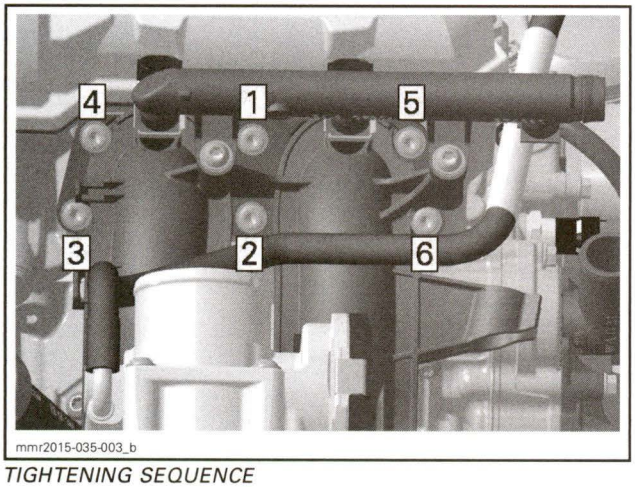
Ensure rubber grommets are properly inserted.



RUBBER GROMMETS

Tighten intake manifold screws to specification as per the following sequence.

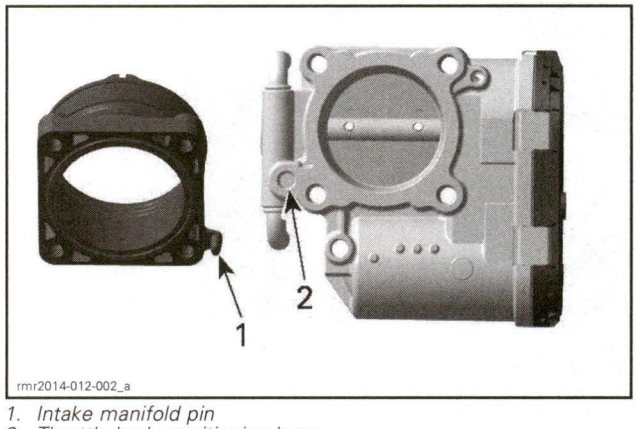
INTAKE MANIFOLD SCREWS	
Tightening torque	9 N•m ± 1 N•m (80 lbf•**in** ± 9 lbf•**in**)



TIGHTENING SEQUENCE

If removed, install throttle body on connecting socket.

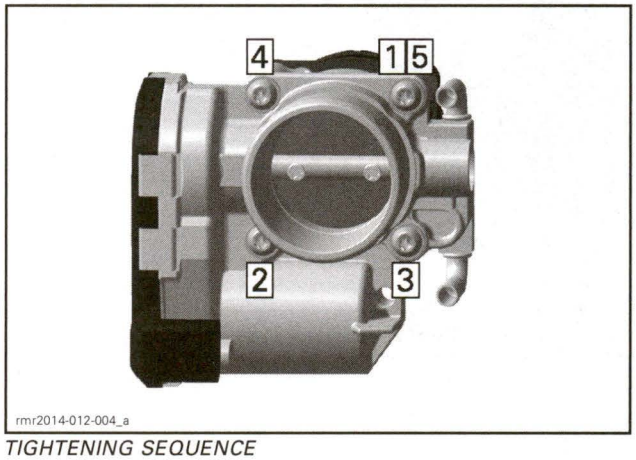
Make sure to index intake manifold pin with throttle body positioning bore.



1. Intake manifold pin
2. Throttle body positioning bore

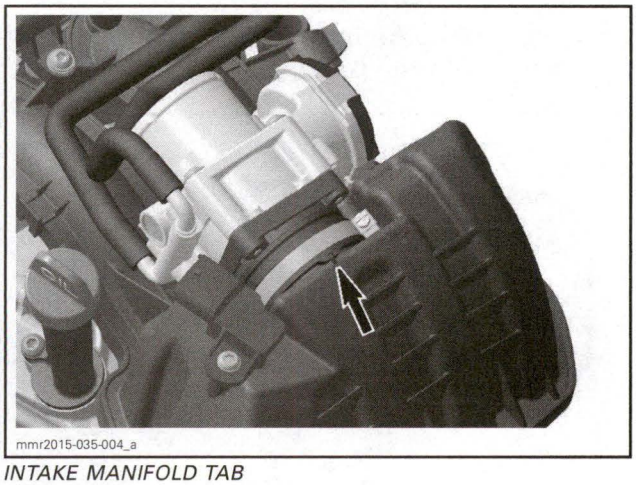
Tighten throttle body screws to specification as per the following sequence.

THROTTLE BODY SCREWS	
Tightening torque	9 N•m ± 1 N•m (80 lbf•**in** ± 9 lbf•**in**)



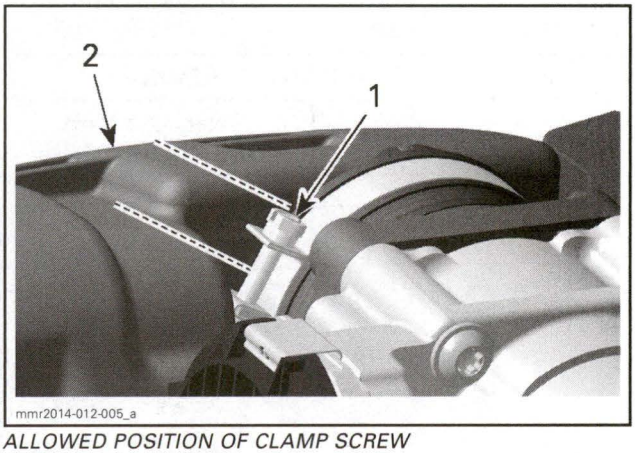
TIGHTENING SEQUENCE

Make sure to index connecting socket notch with the intake manifold tab.



INTAKE MANIFOLD TAB

Install connecting socket clamp in proper position and tighten to specification.



ALLOWED POSITION OF CLAMP SCREW
1. *Screw of clamp*
2. *Intake manifold*

CONNECTING SOCKET CLAMP	
Tightening torque	0.9 N•m ± 0.1 N•m (8 lbf•**in** ± 1 lbf•**in**)

LUBRICATION SYSTEM

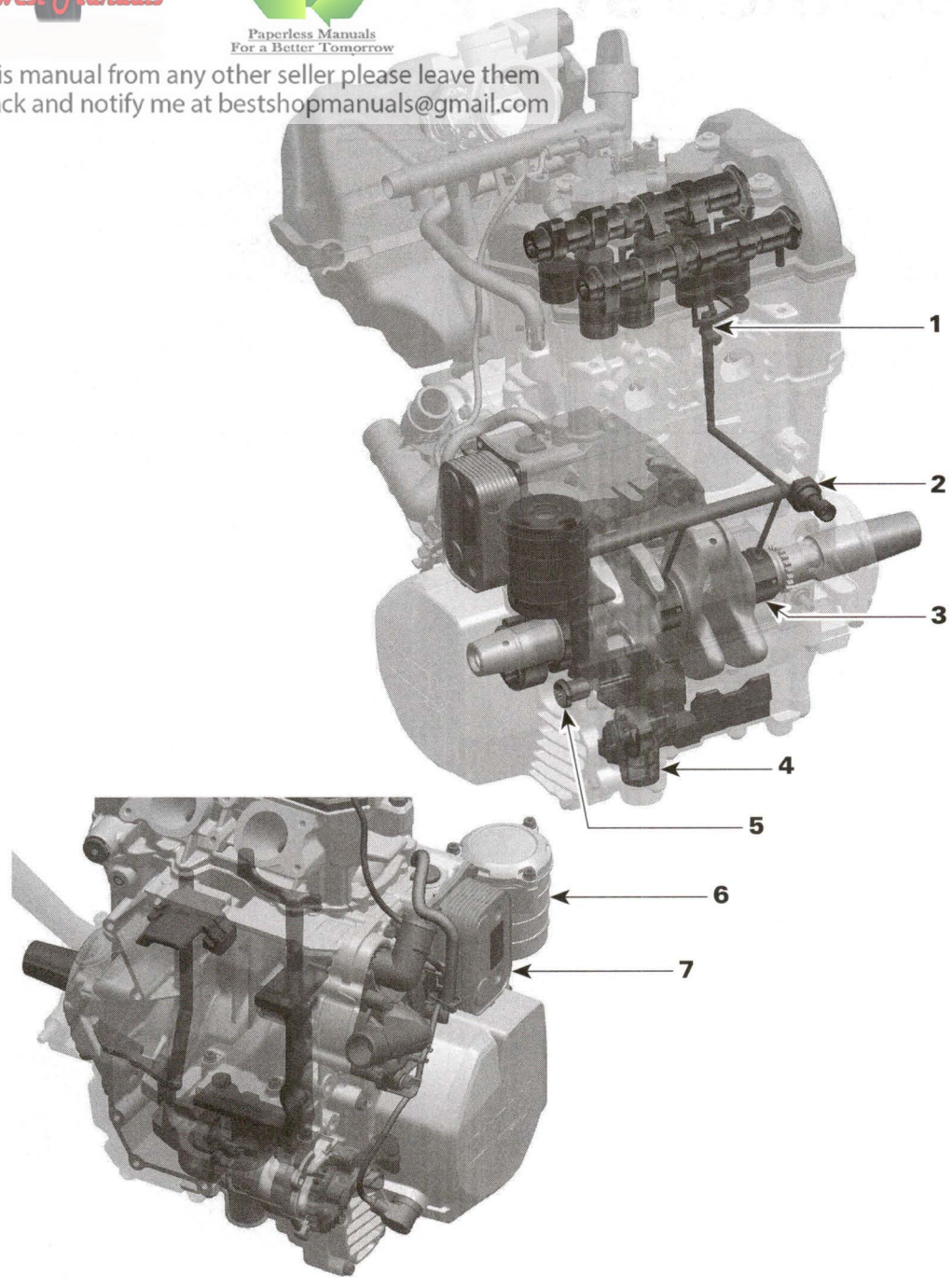
SERVICE TOOLS

Description	Part Number	Page
ADAPTER HOSE	529 035 652	54
ECM ADAPTER TOOL	529 036 166	56
FLUKE 115 MULTIMETER	529 035 868	56
OIL PRESSURE TEST CAP	529 036 158	54
PRESSURE GAUGE	529 035 709	54

SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 243 (BLUE)	293 800 060	57

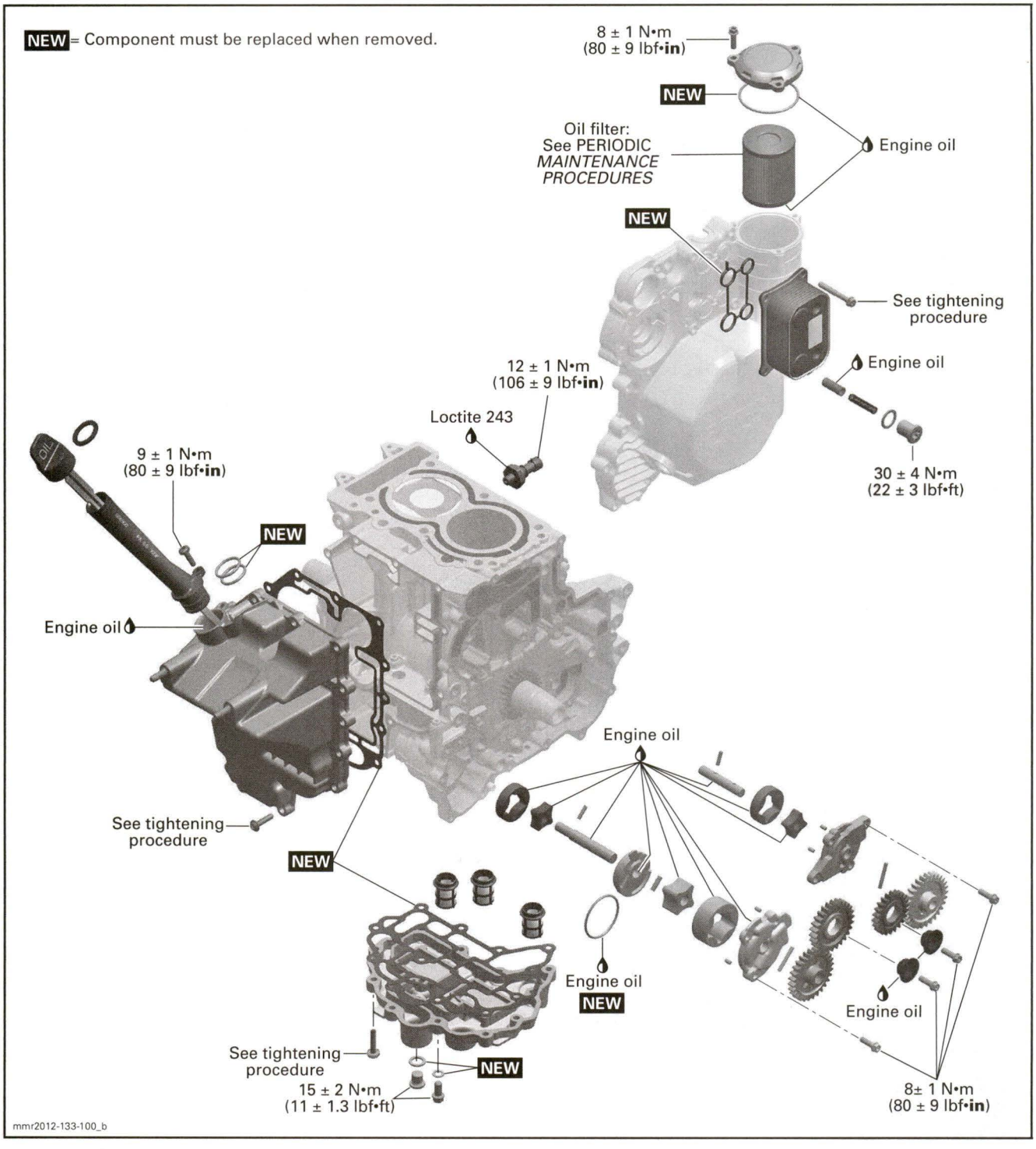
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mmr2011-070-002_a

TYPICAL
ENGINE LUBRICATION CIRCUIT

1. Oil channel to camshaft bearing
2. Oil pressure switch
3. Crankshaft main bearing
4. Oil strainer
5. Oil pressure regulator
6. Oil filter
7. Oil cooler


NEW = Component must be replaced when removed.
8 ± 1 N•m
(80 ± 9 lbf•in)
NEW
Oil filter:
See PERIODIC
MAINTENANCE
PROCEDURES
Engine oil
NEW
See tightening
procedure
Engine oil
12 ± 1 N•m
(106 ± 9 lbf•in)
Loctite 243
30 ± 4 N•m
(22 ± 3 lbf•ft)
9 ± 1 N•m
(80 ± 9 lbf•in)
NEW
Engine oil
Engine oil
See tightening
procedure
NEW
Engine oil
NEW
Engine oil
See tightening
procedure
NEW
15 ± 2 N•m
(11 ± 1.3 lbf•ft)
8± 1 N•m
(80 ± 9 lbf•in)
mmr2012-133-100_b

GENERAL

SYSTEM DESCRIPTION

This engine uses dry sump lubrication. The oil from the cylinder block, timing chain chamber and magneto cover is pumped by two suction pumps.

Both suction pumps are integrated into one module.

The 20 mm (.79 in) large oil suction pump returns the crankshaft and magneto chamber oil to the reservoir.

The 11 mm (.43 in) small oil suction pump returns the timing chain chamber oil to the oil reservoir.

An oil filter and three oil strainers are used to filter dirt and debris from the oil circuit.

The oil strainers are located between oil sump cover and crankcase lower underneath the oil pressure pump.

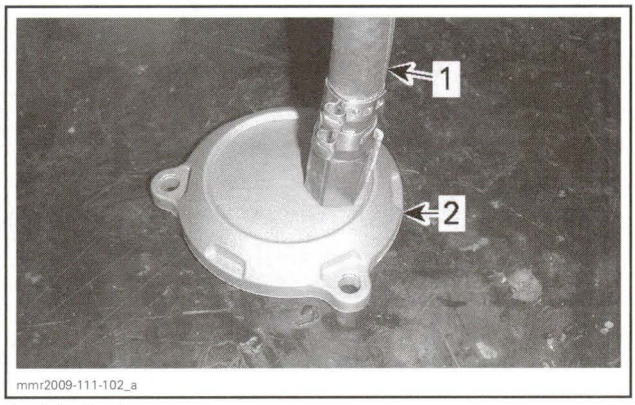
The oil pressure is provided by a pump and regulated by a spring loaded pressure regulator.

INSPECTION

ENGINE OIL PRESSURE TEST

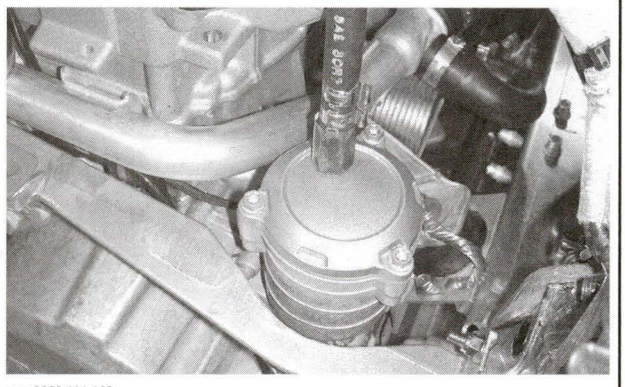
1. Remove the RH side panel.
2. Completely tighten adapter hose on oil pressure test cap.

REQUIRED TOOLS	
ADAPTER HOSE (P/N 529 035 652)	
OIL PRESSURE TEST CAP (P/N 529 036 158)	



1. Adapter hose
2. Oil pressure test cap

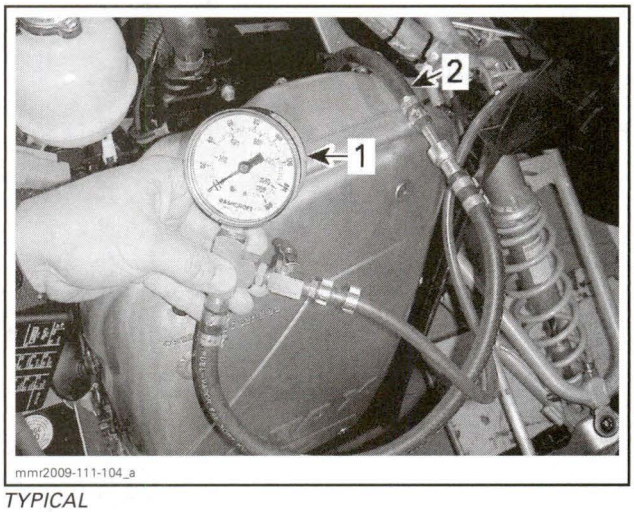
3. Install oil pressure test cap on oil filter reservoir. Position adapter hose near engine.



TYPICAL

4. Connect pressure gauge to adapter hose.

REQUIRED TOOL	
PRESSURE GAUGE (P/N 529 035 709)	



TYPICAL
1. Pressure gauge
2. Adapter hose

5. Start engine and check oil pressure.

ENGINE OIL PRESSURE @ 80°C (176°F)	
ENGINE SPEED	MINIMUM PRESSURE
Idle	60 kPa (8.7 PSI)
4000 RPM	400 kPa (58 PSI)

If the engine oil pressure is out of specification, refer to *TROUBLESHOOTING* in this subsection.

6. Remove engine oil pressure test tools.
7. Reinstall all removed parts. Refer to applicable subsection.

TROUBLESHOOTING

Always check for fault codes. If a fault code is detected, service the fault code first.

LOW OR NO ENGINE OIL PRESSURE

1. **Oil level is too low.**
   - *Refill engine oil.*
   - *Check for high oil consumption. See below.*
   - *Check for oil leaks (oil leaking out of leak indicator hole, gaskets, oil seal or O-rings). Repair or replace.*
2. **Defective or clogged oil filter.**
   - *Replace engine oil and filter.*
3. **Use of a bad grade oil.**
   - *Replace engine oil with BRP recommended oil.*
4. **Oil pressure regulator valve sticks open, or spring load is insufficient.**
   - *Clean oil regulator piston and its bore. Replace if necessary.*
   - *Measure spring free length. Replace if out of specification.*
5. **Oil pump(s) worn or damaged.**
   - *Check if oil pump drive gears are damaged. Replace if necessary.*
   - *Check oil pump rotors and its bore for wear limits. Replace if out of specification.*
6. **Engine oil strainer is clogged.**
   - *Remove and clean engine oil strainer.*
7. **Heavy wear on plain bearings.**
   - *Check radial clearance of plain bearings. Replace if out of specification.*

HIGH OIL CONSUMPTION

1. **Oil in breathing system.**
   - *Check if breather V-ring is brittle, hard or damaged. Replace V-ring.*
   - *Check if oil separator cover is damaged or missing.*
2. **Valve stem seals worn or damaged.**
   - *Replace valve stem seals.*
3. **Piston rings worn out (blue colored exhaust smoke).**
   - *Replace piston rings.*

OIL CONTAMINATION (WHITE APPEARANCE)

1. **Oil seal and rotary seal on water pump shaft leaking.**
   - *Replace oil seal, rotary seal and water pump shaft. Change engine oil.*
2. **Cylinder head gasket leaking.**
   - *Replace cylinder head gasket. Change engine oil.*
3. **Cylinder head screws not properly tightened.**
   - *Retighten screws with recommended torque. Change engine oil.*
4. **Oil cooler gasket leaking.**
   - *Replace gasket. Change engine oil.*

PROCEDURES

OPS (OIL PRESSURE SWITCH)

OPS Activation

The oil pressure switch activates if engine oil pressure is lower than the following specified pressure range.

OIL PRESSURE SWITCH ACTIVATION RANGE
20 kPa and 40 kPa (2.9 PSI and 5.8 PSI)

OPS Access

1. Remove LH side panels.
2. Remove drive belt guard. Refer to *DRIVE BELT* subsection.

OPS Inspection

First, ensure oil pressure is adequate. Refer to *ENGINE OIL PRESSURE TEST* in this subsection.

If the oil pressure is good, check the resistance of the oil pressure switch.

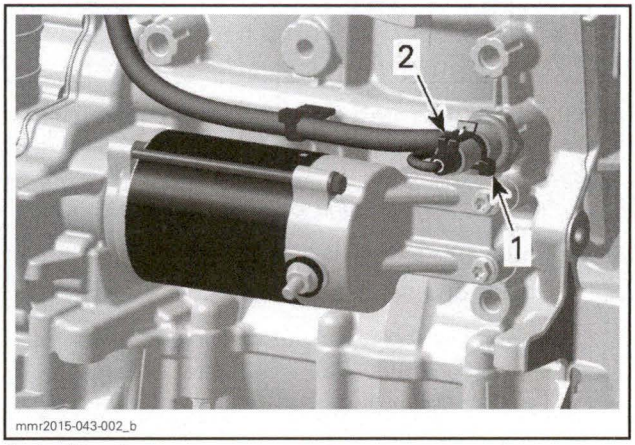
OPS Resistance Test

The engine must be warm to check the oil pressure switch properly.

⚠ WARNING

Be careful when working near hot parts. To avoid potential burns, never touch exhaust system components immediately after the engine has been running as these components are very hot. Always wear long sleeves and gloves.

1. Cut locking tie and disconnect the OPS connector.



1. Locking tie
2. OPS connector

2. Check the oil pressure switch resistance.

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

3. Read result and compare to table.

RESISTANCE (Ω)		
ENGINE NOT RUNNING		
OPS pin	Engine ground	Close to 0 Ω (normally closed switch)

If resistance is out of specification, replace the oil pressure switch.

If the resistance is correct, continue procedure. It will be necessary to use jumper wires.

4. Install drive belt guard.

5. Start engine.

6. Read result and compare to table.

RESISTANCE (Ω)		
ENGINE RUNNING		
OPS pin	Engine ground	Infinitely high (OL)

If resistance is out of specification, replace the oil pressure switch.

If the resistance is correct, check the oil pressure switch circuit continuity.

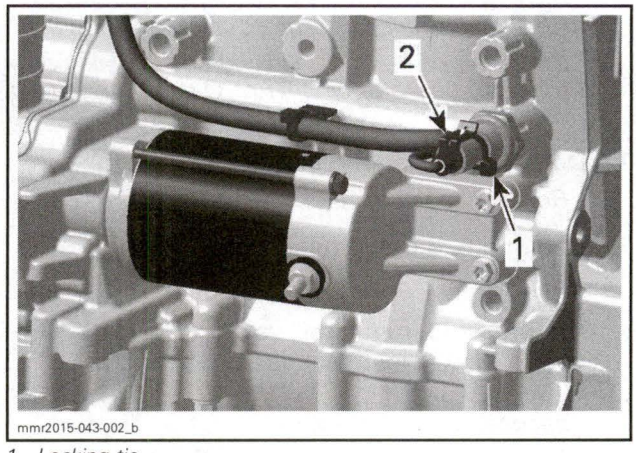
OPS Circuit Continuity Test

1. Disconnect ECM connector A. Refer to *ECM CONNECTOR ACCESS* in *ELECTRONIC FUEL INJECTION (600 ACE)* subsection.

2. Install connector A on the ECM adapter tool.

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

3. Cut locking tie and disconnect the OPS connector.



1. Locking tie
2. OPS connector

4. Check continuity as follows.

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

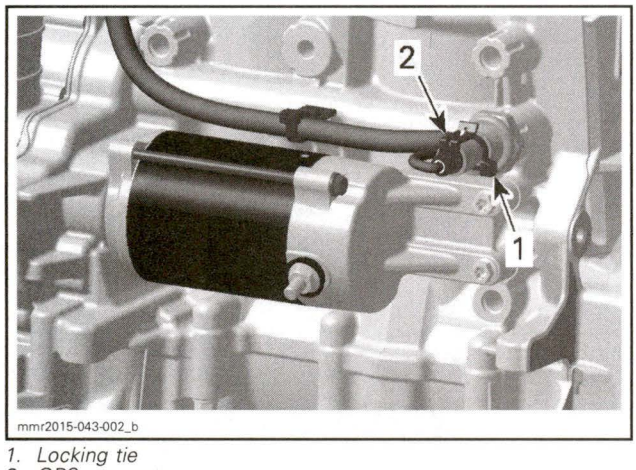
CIRCUIT CONTINUITY		
OPS connector	ECM A pin E3	Close to 0 Ω

If the continuity is good and all other tests are performed, try a **NEW** ECM.

If the continuity is bad, repair or replace defective wire or connectors.

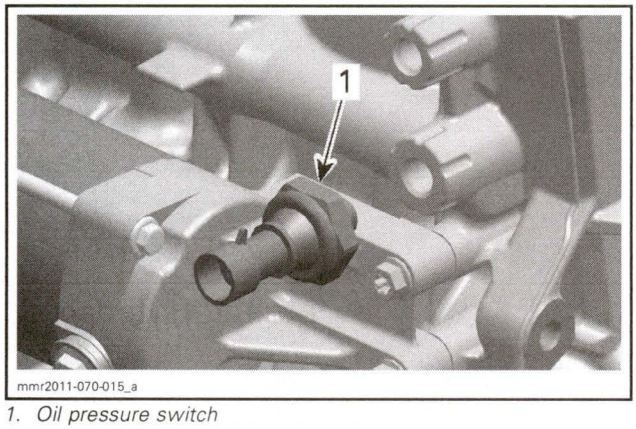
OPS Removal

1. Cut locking tie and unplug the OPS switch connector.



1. Locking tie
2. OPS connector

2. Unscrew and remove the OPS.



1. Oil pressure switch

OPS Installation

Install oil pressure switch as per the following information.

OIL PRESSURE SWITCH	
Service product	LOCTITE 243 (BLUE) (P/N 293 800 060)
Tightening torque	12 N•m ± 1 N•m (106 lbf•**in** ± 9 lbf•**in**)

Install all other removed parts.

NOTICE **When installing the locking tie on the OPS connector, take care that the wires do not make a sharp bend.**

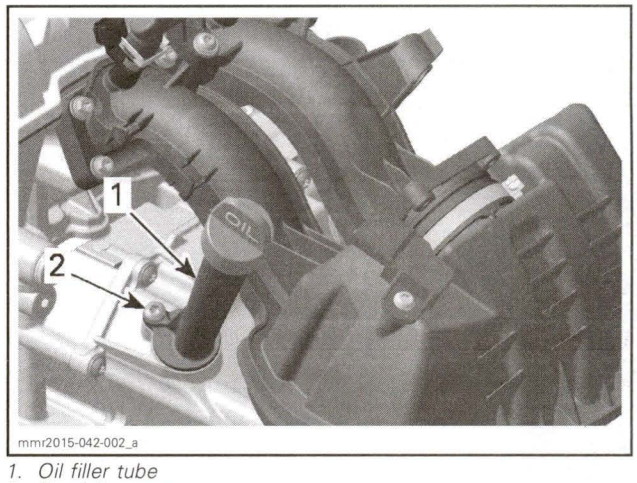
OIL FILLER TUBE

Oil Filler Tube Access

Remove drive belt guard, refer to *DRIVE BELT* subsection.

Oil Filler Tube Removal

1. Remove oil filler tube retaining screw.

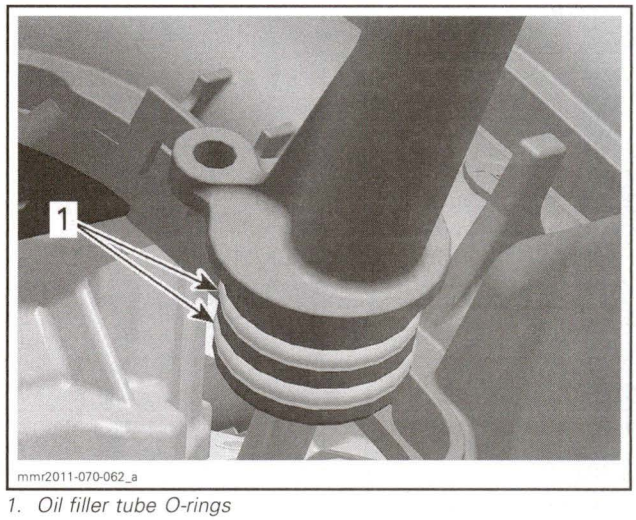


1. Oil filler tube
2. Retaining screw

2. Pull filler tube out of oil tank cover.

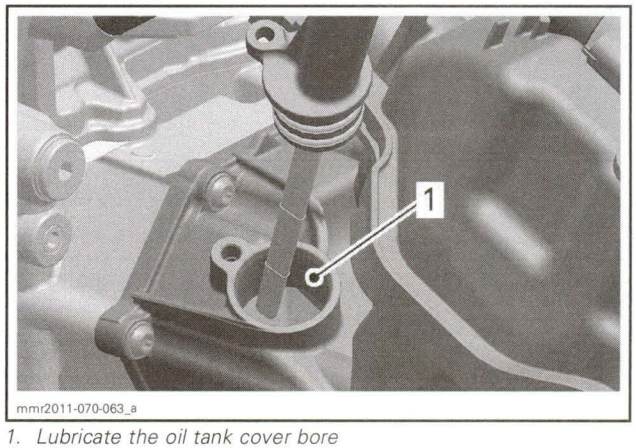
Oil Filler Tube Installation

1. Install **NEW** O-rings on oil filler tube.



1. Oil filler tube O-rings

2. Lubricate oil tank cover bore with engine oil.



1. Lubricate the oil tank cover bore

3. Install oil filler tube.

4. Tighten retaining screw to specified torque.

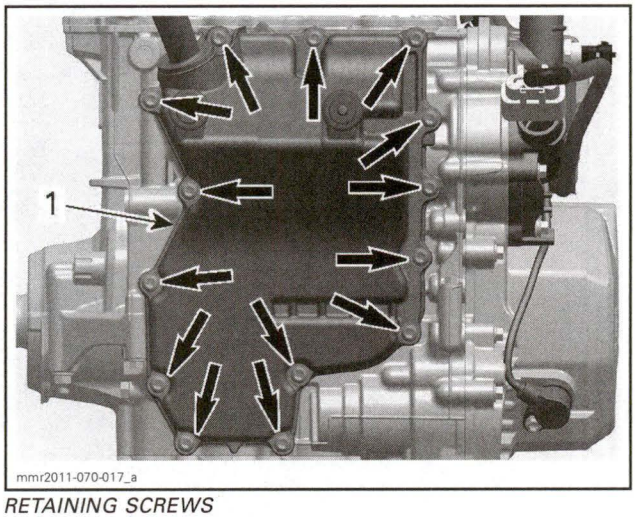
OIL FILLER TUBE SCREW	
Tightening torque	9 N•m ± 1 N•m (80 lbf•**in** ± 9 lbf•**in**)

5. Install all other removed parts.

OIL TANK

Oil Tank Cover Removal

1. Drain engine oil. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.
2. Remove engine from vehicle. Refer to *ENGINE REMOVAL AND INSTALLATION* subsection.
3. Remove intake manifold. Refer to *AIR INTAKE SYSTEM* subsection.
4. Place a drain pan underneath oil tank.
5. Unscrew oil tank cover retaining screws.



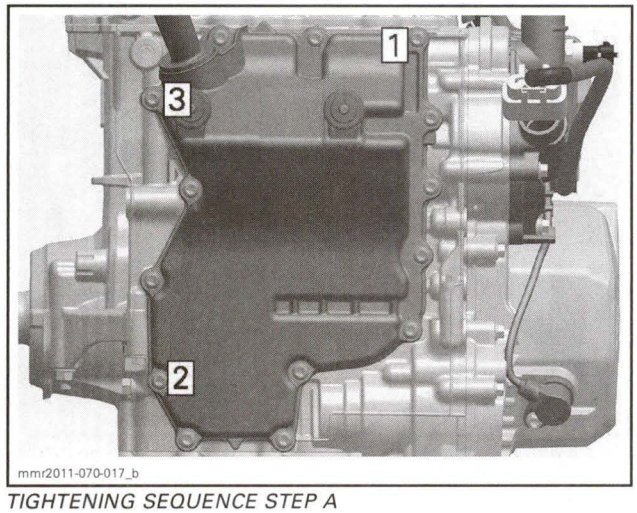
RETAINING SCREWS
1. Oil tank

6. Remove oil tank from the engine.

Oil Tank Cover Installation

1. Install **NEW** gasket.
2. Install oil tank on engine, then tighten screws in two steps as follows:
   2.1 Tighten screws to the following specified torque using the specified sequence.

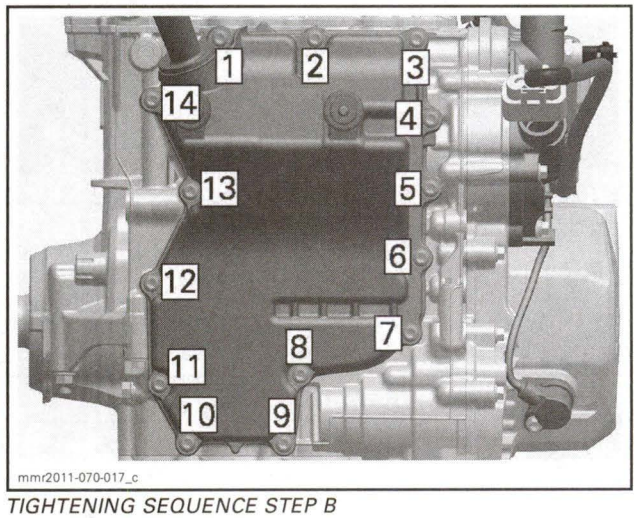
OIL TANK SCREWS TIGHTENING SEQUENCE	
STEP A	5 N•m ± 0.6 N•m (44 lbf•**in** ± 5 lbf•**in**)



TIGHTENING SEQUENCE STEP A

   2.2 Tighten screws to the following specified torque using the specified sequence.

OIL TANK SCREWS TIGHTENING SEQUENCE	
STEP B	9 N•m ± 1 N•m (80 lbf•**in** ± 9 lbf•**in**)



TIGHTENING SEQUENCE STEP B

3. Wipe up any oil spillage.
4. Install intake manifold. Refer to *AIR INTAKE SYSTEM* subsection.
5. Install engine in vehicle. Refer to *ENGINE REMOVAL AND INSTALLATION* subsection.
6. Fill up oil tank and check oil level. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

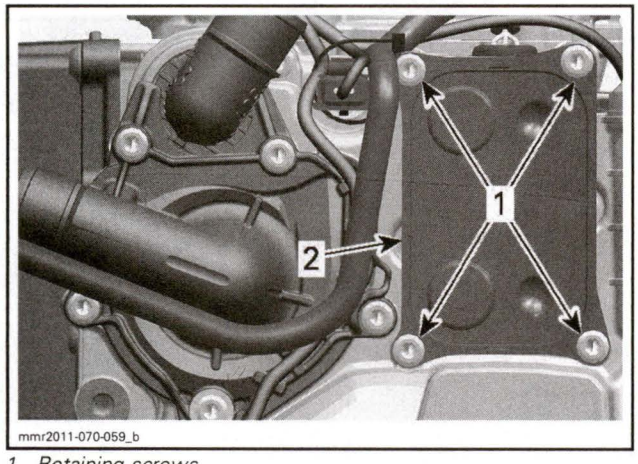
OIL COOLER

Oil Cooler Access

Remove muffler, refer to *EXHAUST SYSTEM* subsection.

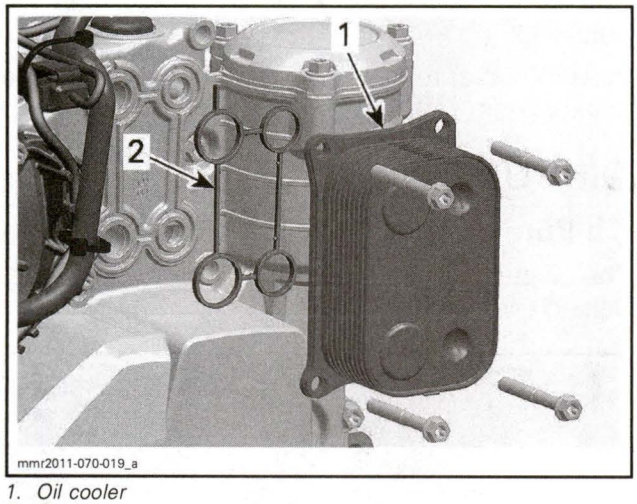
Oil Cooler Removal

1. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection to:
   - Drain engine oil
   - Drain cooling system.
2. Remove oil cooler retaining screws.



1. Retaining screws
2. Oil cooler

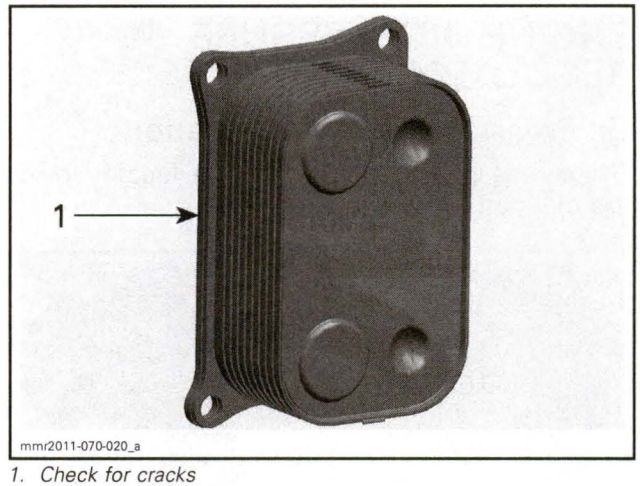
3. Place rags or towels under oil cooler to catch remaining oil and coolant.
4. Remove oil cooler and its gasket.



1. Oil cooler
2. Gasket

Oil Cooler Inspection

Check oil cooler for cracks and other damage.



1. Check for cracks

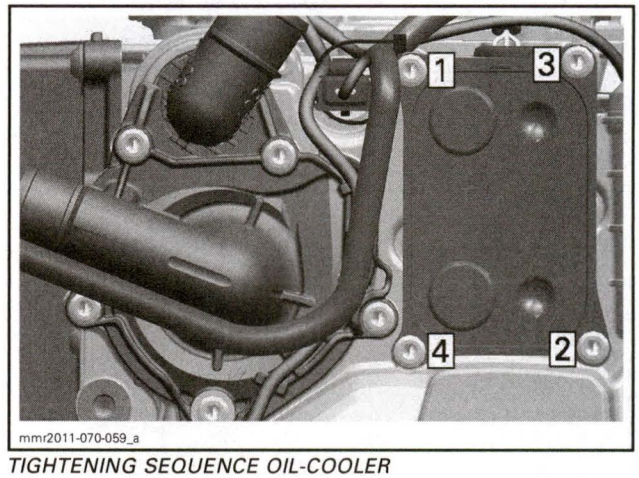
Replace parts as necessary.

Oil Cooler Installation

Reverse the removal procedure. However, pay attention to the following.

Tighten oil cooler screws in two steps to the specified torques using the illustrated sequence.

OIL COOLER SCREWS TIGHTENING PROCEDURE	
STEP A	5 N•m ± 0.6 N•m (44 lbf•**in** ± 5 lbf•**in**)
STEP B	9 N•m ± 1 N•m (80 lbf•**in** ± 9 lbf•**in**)



TIGHTENING SEQUENCE OIL-COOLER

Wipe up any oil and coolant spillage.

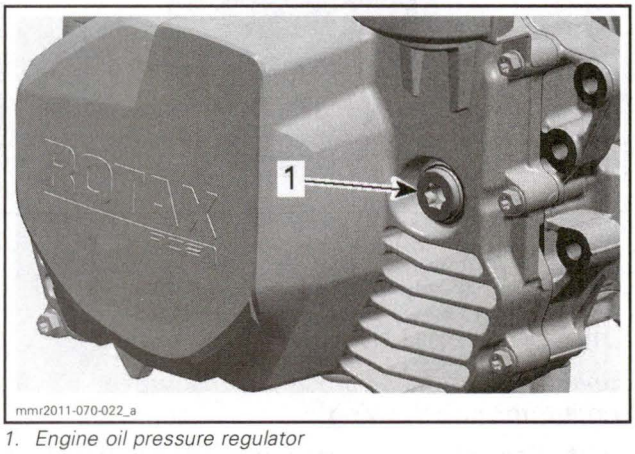
Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection to:

- Fill up oil tank and check oil level
- Refill and bleed cooling system.

ENGINE OIL PRESSURE REGULATOR

Oil Pressure Regulator Location

The engine oil pressure regulator is located inside the magneto cover.



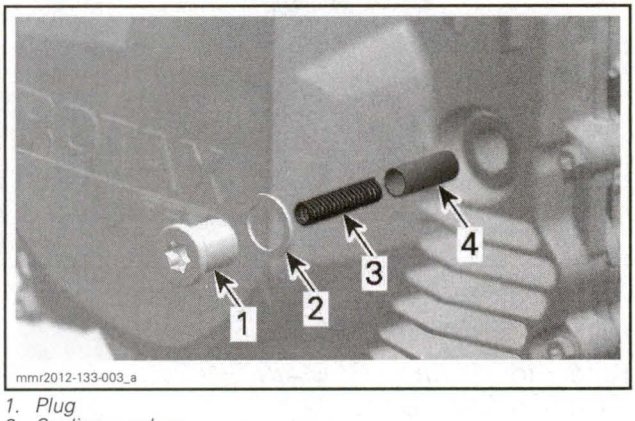
1. Engine oil pressure regulator

Oil Pressure Regulator Access

Remove muffler, refer to *EXHAUST SYSTEM* subsection.

Oil Pressure Regulator Removal

1. Drain engine oil. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.
2. Remove regulator plug and sealing washer. Discard sealing washer.
3. Pull oil pressure regulator parts out of the magneto cover.



1. Plug
2. Sealing washer
3. Regulator spring
4. Regulator piston

Oil Pressure Regulator Inspection

Clean bore and thread in the magneto cover of any contamination.

Inspect oil pressure regulator piston and bore in cylinder block for scoring or other damages.

Check if piston moves easily in its bore.

Check compression spring for free length.

SPRING FREE LENGTH	
NEW NOMINAL	46 mm (1.811 in)
SERVICE LIMIT	45 mm (1.772 in)

Visually check compression spring for squareness.

Replace worn or damaged components.

Oil Pressure Regulator Installation

Reverse the removal procedure. However, pay attention to the following.

Install a **NEW** sealing washer on plug.

Tighten regulator plug to the specified torque.

OIL PRESSURE REGULATOR PLUG	
Tightening torque	17 N•m ± 2 N•m (150 lbf•**in** ± 18 lbf•**in**)

Wipe up any oil spillage.

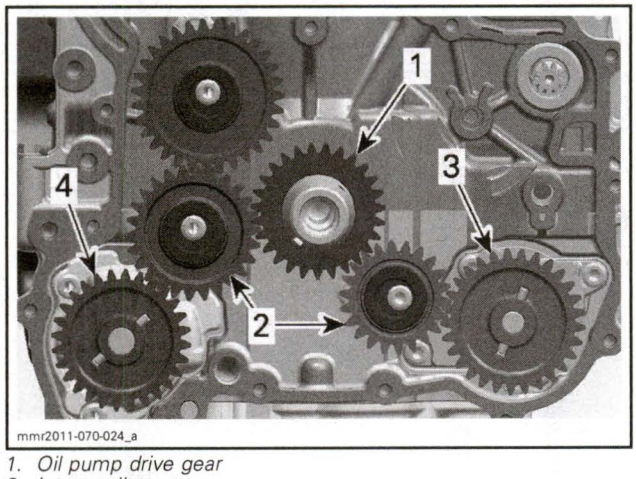
Fill up oil tank and check oil level. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

Install all other removed parts. Refer to applicable subsections.

OIL PUMP DRIVE GEARS

Oil Pump Drive Gear Location

The oil pump gears are located on the MAG side, behind the magneto cover.



1. Oil pump drive gear
2. Intermediate gears
3. Oil pressure pump gear
4. Oil suction pump gear

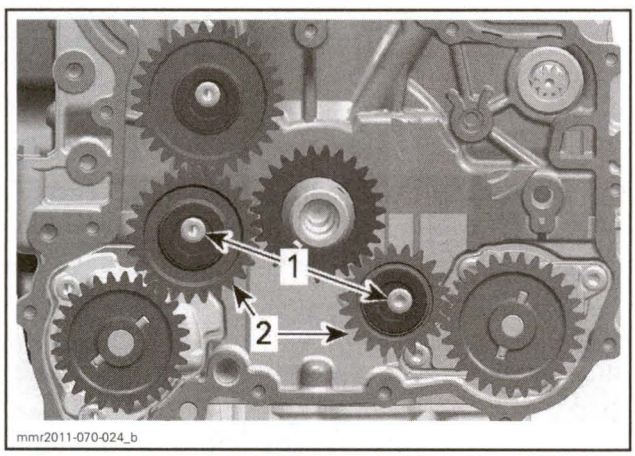
Oil Pump Drive Gear Access

Refer to *MAGNETO AND STARTER* subsection to remove:

- Magneto cover
- Rotor
- Sprag clutch gear.

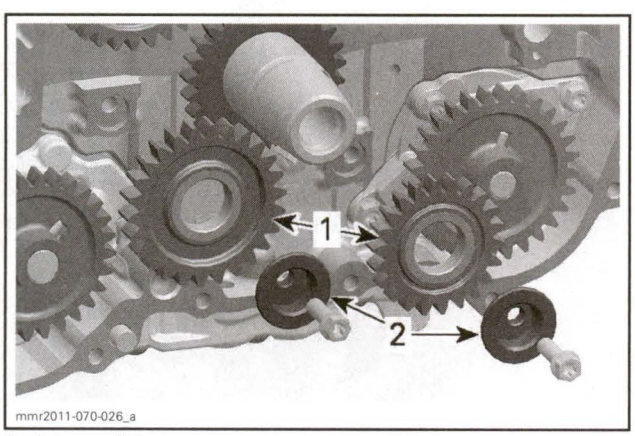
Oil Pump Drive Gear Removal

1. Unscrew oil pump intermediate gear screws.



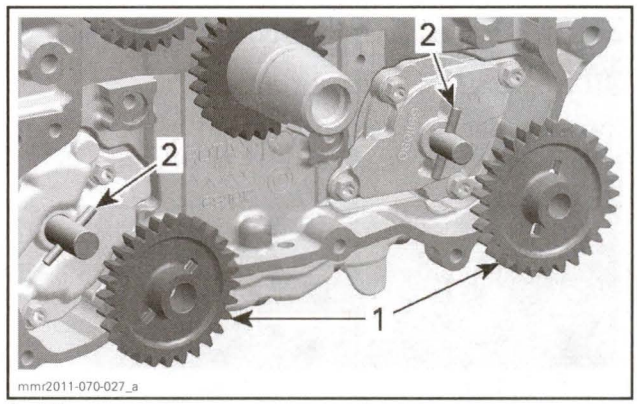
1. Retaining screws
2. Intermediate gears

2. Remove bearing sleeves and oil pump intermediate gears.



1. Intermediate gears
2. Bearing Sleeves

3. Remove oil pump gears and needle pins.



1. Oil pump gears
2. Needle pins

Oil Pump Drive Gear Inspection

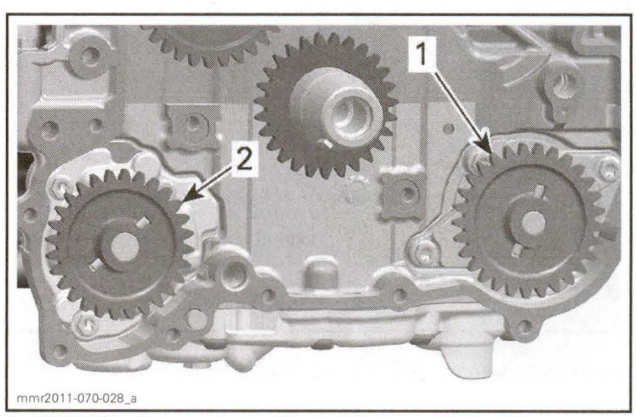
Inspect gears for wear, cracks or other damage.

Replace if damaged.

Oil Pump Drive Gear Installation

Reverse the removal procedure, however, pay attention to the following.

1. Be sure to not intermix oil pump gears, see next illustration.
   - 1.1 Install the BROWN oil pump gear (29 teeth) on oil pressure pump.
   - 1.2 Install the BLACK oil pump gear (28 teeth) on oil suction pump.



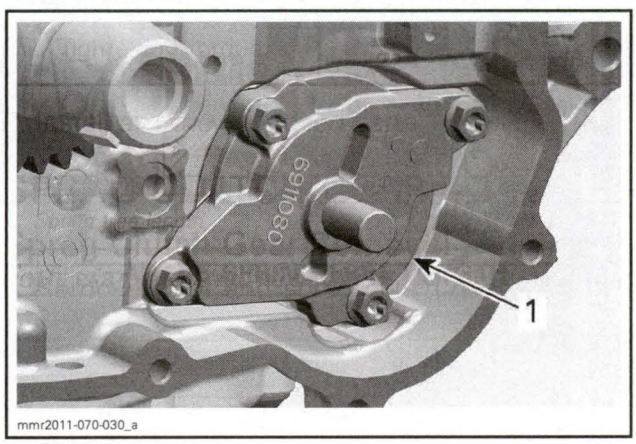
1. BROWN oil pump gear - 29 teeth
2. BLACK oil pump gear - 28 teeth

2. Lubricate intermediate gears bearing sleeves with engine oil, then install gears.
3. Install all other removed parts.
4. Fill up oil tank and check oil level. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

OIL PRESSURE PUMP

Oil Pressure Pump Location

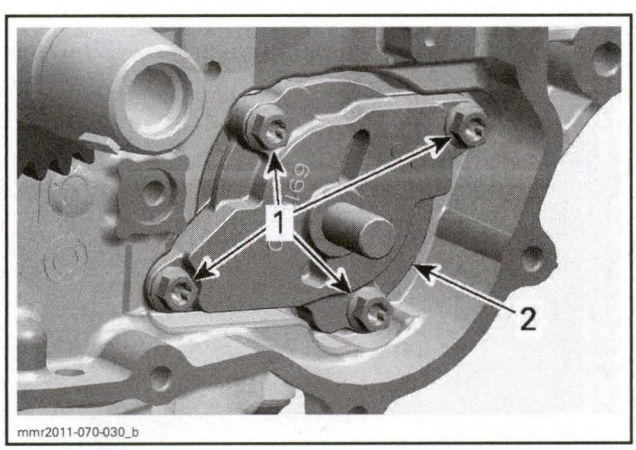
The oil pressure pump is located in the cylinder block, behind the magneto cover.



1. Oil pressure pump

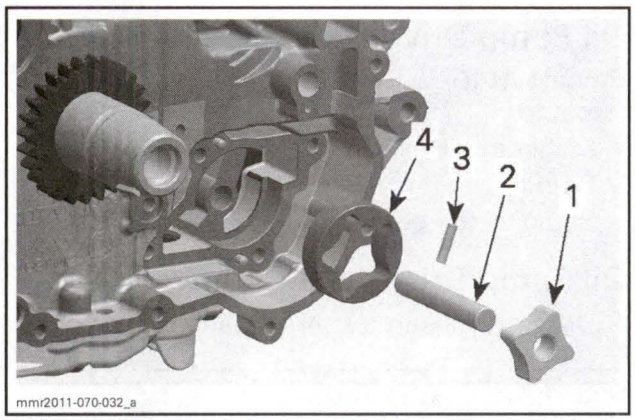
Oil Pressure Pump Removal

1. Remove *OIL PUMP DRIVE GEARS*, see procedure in this subsection.
2. Remove oil pump cover.



1. Retaining screws
2. Oil pump cover

3. Remove following parts.



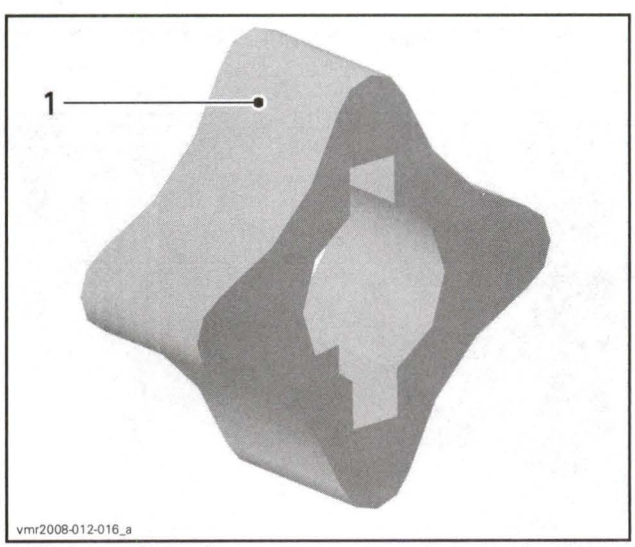
1. Inner rotor
2. Oil pump shaft
3. Needle pin
4. Outer rotor

Oil Pressure Pump Inspection

Inspect oil pump and oil pump cover bore for marks, scratches or other damage. Replace any damaged parts.

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

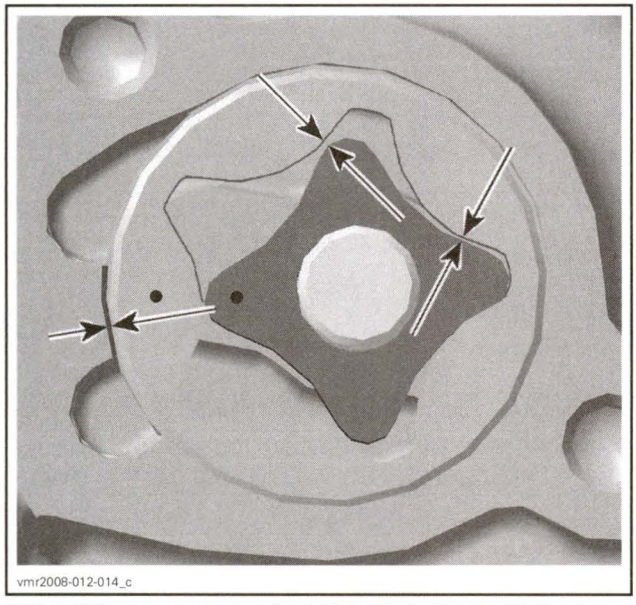
Check inner rotor for corrosion, worn pin slots or other damages. If so, replace inner and outer rotor at the same time.



1. Pitting on the teeth

Radial Clearance

Using a feeler gauge, measure the clearance of outer rotor and inner rotor as indicated by the arrows.

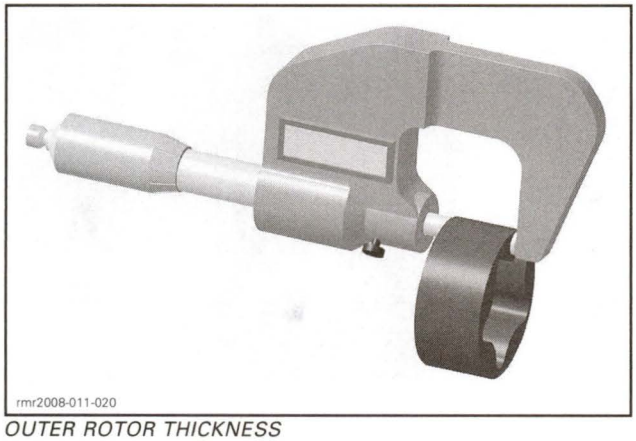

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OIL PUMP RADIAL CLEARANCE	
SERVICE LIMIT	0.25 mm (.0098 in)

NOTE: If clearance of inner and outer rotors exceeds the tolerance, replace oil pump.

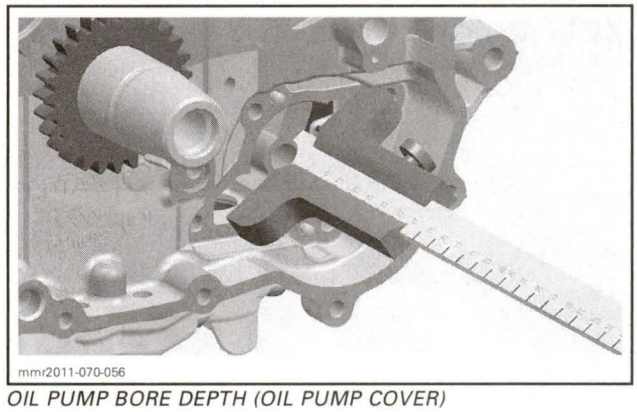
Axial Clearance

Measure outer rotor thickness with a micrometer.


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OUTER ROTOR THICKNESS

Using a depth gauge, measure the depth of oil pump bore in the lower crankcase.


mmr2011-070-056

OIL PUMP BORE DEPTH (OIL PUMP COVER)

Substract bore depth from rotor thickness to obtain axial clearance.

OIL PUMP AXIAL CLEARANCE	
SERVICE LIMIT	0.15 mm (.0059 in)

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

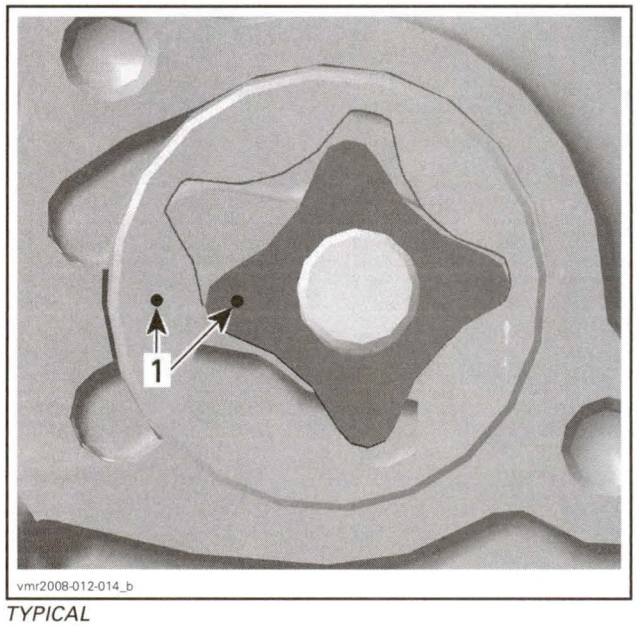
Oil Pressure Pump Installation

Reverse the removal procedure, however, pay attention to the following.

1. Lubricate outer rotor with engine oil.

NOTICE **Install rotors with the marks outwards.**

2. Install outer rotor in crankcase oil pump bore.

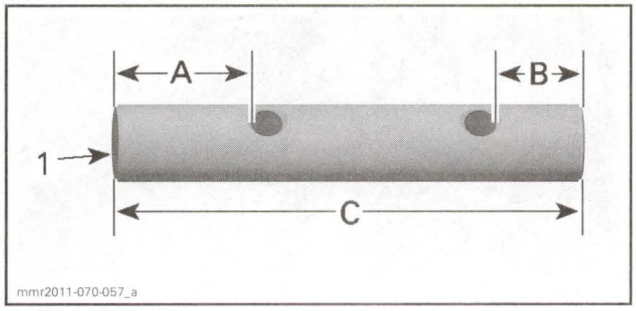


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TYPICAL
1. Marks on inner and outer rotor

3. Install needle pin in oil pump shaft.

NOTICE The oil pump shaft is not symmetrical, the longer side must be installed inward.



1. Towards engine
A. 16.96 mm (.67 in)
B. 11.43 mm (.45 in)
C. 60.5 mm (2.38 in)

4. Place inner rotor on the oil pump shaft. Lubricate oil pump shaft and inner rotor with engine oil.
5. Install oil pump shaft assembly in the crankcase.

After installation of the remaining parts, check for smooth operation of the oil pump assembly and axial play of the oil pump shaft.

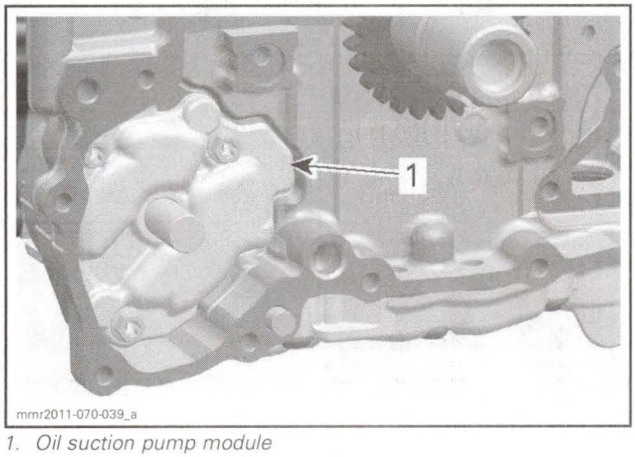
6. Fill up oil tank and check oil level. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

Start engine and make sure oil pressure is within specifications (refer to *ENGINE OIL PRESSURE TEST* in this subsection).

OIL SUCTION PUMP MODULE

Oil Suction Pump Module Location

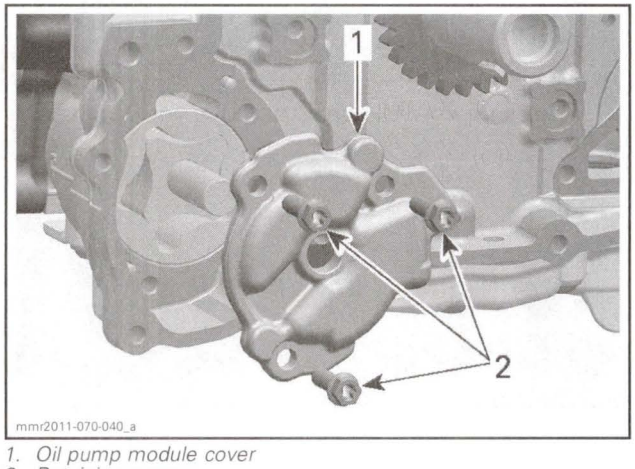
The oil suction pump module is located in the cylinder block, behind the magneto cover.



1. Oil suction pump module

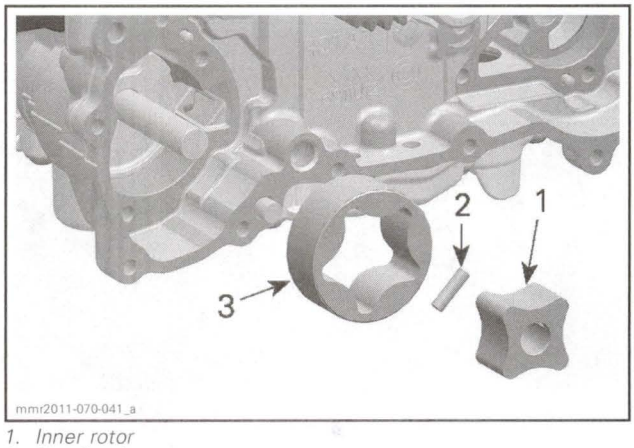
Oil Suction Pump Module Disassembly

1. Remove *OIL PUMP DRIVE GEARS*, see procedure in this subsection.
2. Remove oil pump module cover.



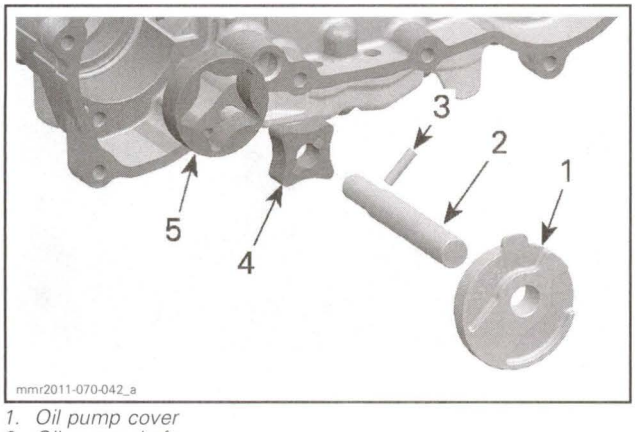
1. Oil pump module cover
2. Retaining screws

3. Disassemble the large oil suction pump as shown.



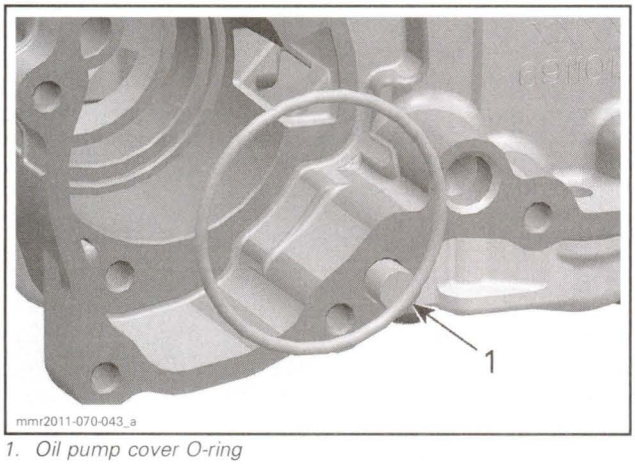
1. Inner rotor
2. Needle pin
3. Outer rotor

4. Disassemble the small oil suction pump as shown.



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

5. Remove and discard the oil pump cover O-ring.



1. *Oil pump cover O-ring*

Oil Suction Pumps Inspection

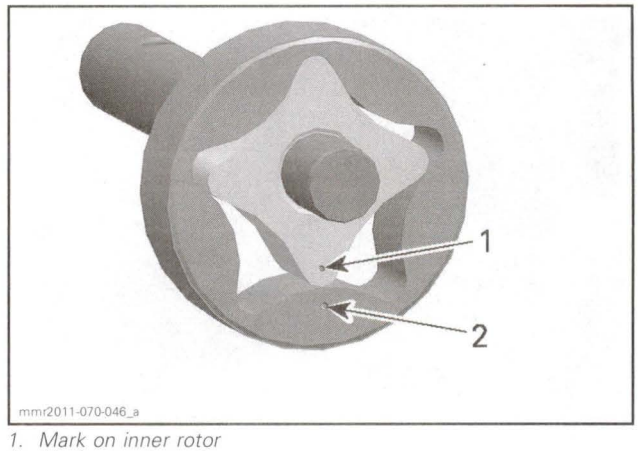
The inspection of both oil suction pumps is the same as for the oil pressure pump. Refer to *OIL PRESSURE PUMP* in this subsection.

Oil Suction Pump Module Assembly

Reverse the removal procedure, however, pay attention to the following.

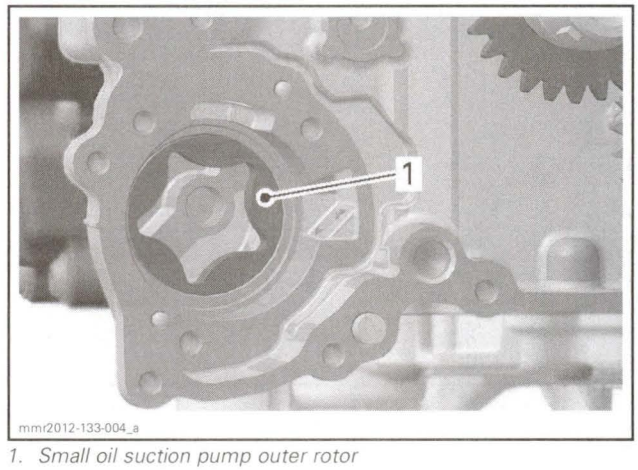
1. Lubricate small oil suction pump outer rotor with engine oil.

NOTICE When installing the oil pump rotors, make sure both marks are pointing toward the inside of the crankcase.



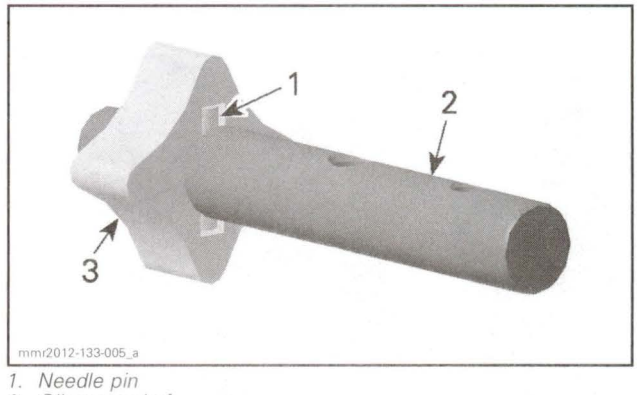
1. *Mark on inner rotor*
2. *Mark on outer rotor*

2. Install small oil suction pump outer rotor into crankcase oil pump bore.



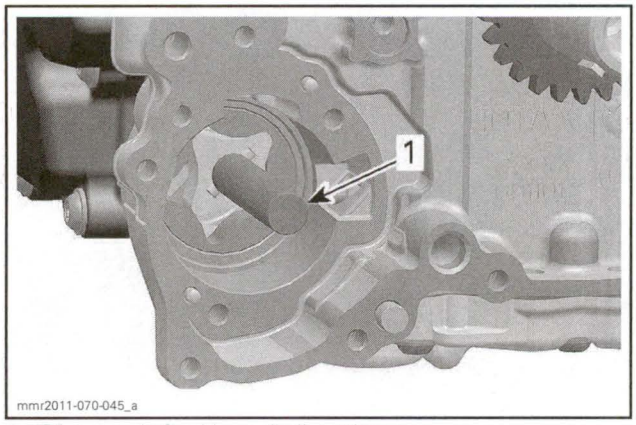
1. *Small oil suction pump outer rotor*

3. Install the needle pin in the bore of the oil pump shaft and place the small inner rotor on the shaft.



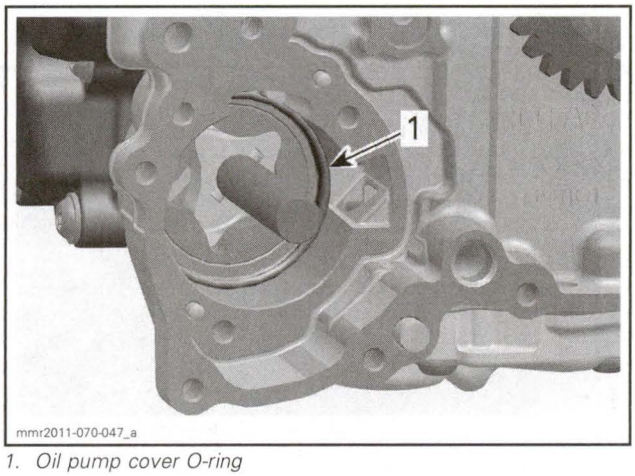
1. *Needle pin*
2. *Oil pump shaft*
3. *Small suction pump inner rotor*

4. Lubricate oil pump shaft and inner rotor with engine oil.
5. Install oil pump shaft assembly into the crankcase.



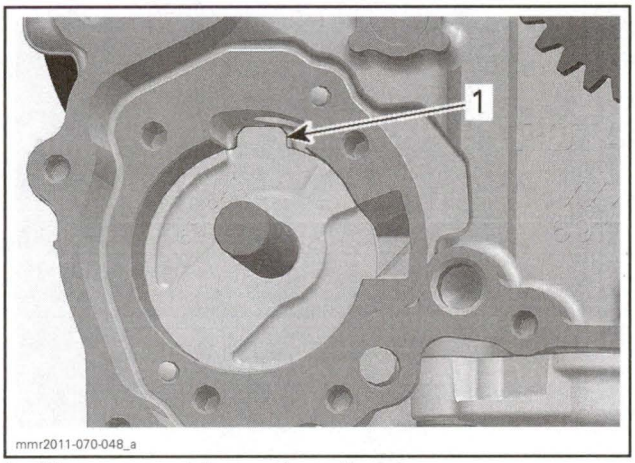
1. Oil pump shaft with small oil suction pump

6. Install a **NEW** oil pump cover O-ring.



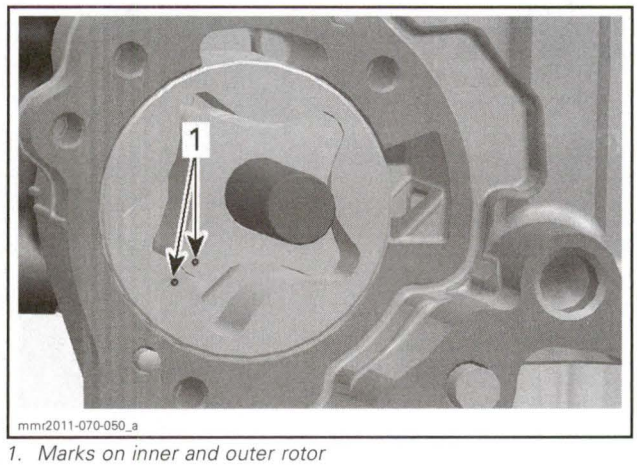
1. Oil pump cover O-ring

7. Lubricate both sides of the oil pump cover with engine oil.
8. Align tab of the oil pump cover with the upper recess in the crankcase. Push cover in until a click is heard, indicating the cover is properly installed.



1. Oil pump cover tab properly positioned

9. Install large oil suction pump needle pin.
10. Install large oil suction pump inner rotor and outer rotor with the marks outwards.



1. Marks on inner and outer rotor

11. Lubricate large oil suction pump parts with engine oil.
12. Install other removed parts.

After installation is complete, check for smooth operation of the oil pump assembly and axial play of the oil pump shaft.

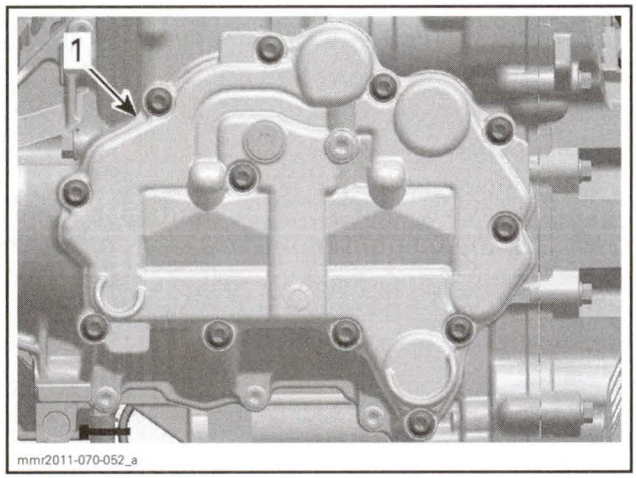
13. Fill up oil tank and check oil level. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

Start engine and make sure oil pressure is within specifications (refer to *ENGINE OIL PRESSURE TEST* in this subsection).

OIL SUMP COVER

Oil Sump Cover Location

The oil sump cover is located on the engine bottom.



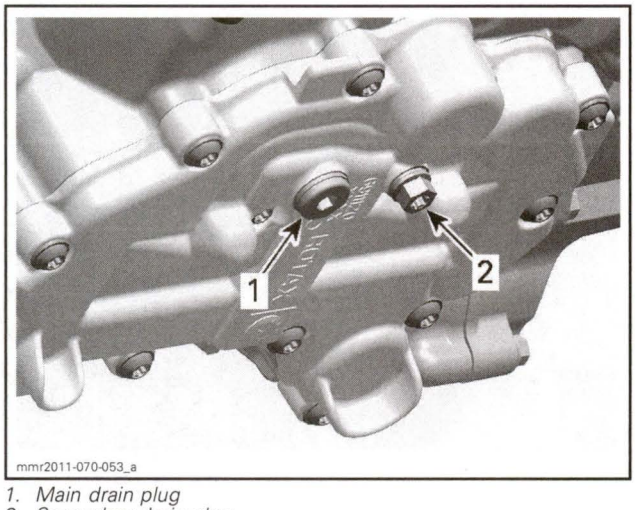
BOTTOM OF ENGINE
1. Oil sump cover

Oil Sump Cover Access

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

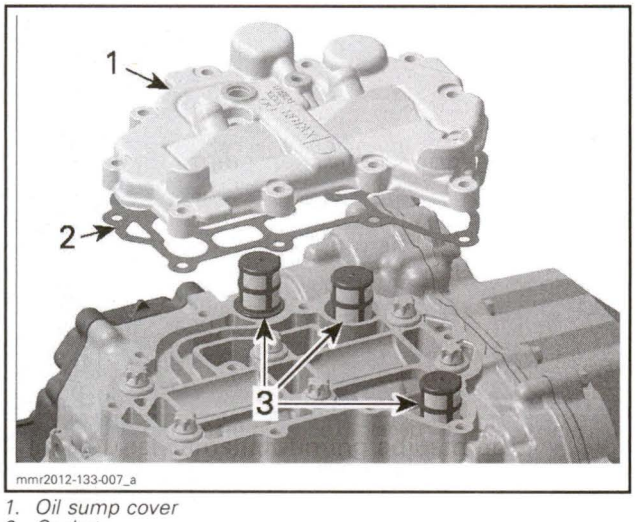
Oil Sump Cover Removal

1. Drain engine oil, refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.



1. Main drain plug
2. Secondary drain plug

2. Unscrew oil sump cover retaining screws.
3. Remove oil sump cover. Discard gasket.
4. Remove and clean engine oil strainers.

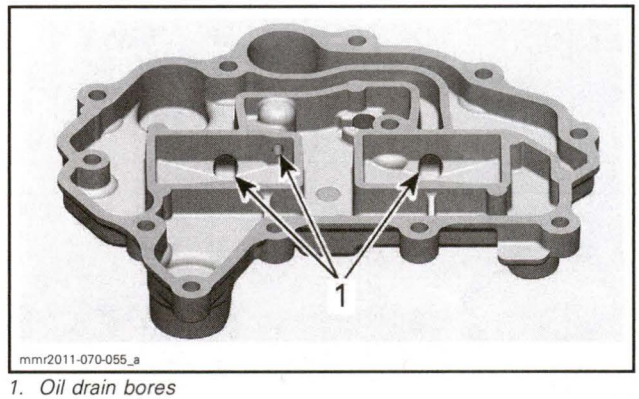


1. Oil sump cover
2. Gasket
3. Engine oil strainers

Oil Sump Cover Inspection

Clean oil sump cover and engine oil strainers with a part cleaner, then use an air gun to dry it.

Blow out the oil orifices and check if they are not clogged.



1. Oil drain bores

Check oil sump cover for cracks or other damage.

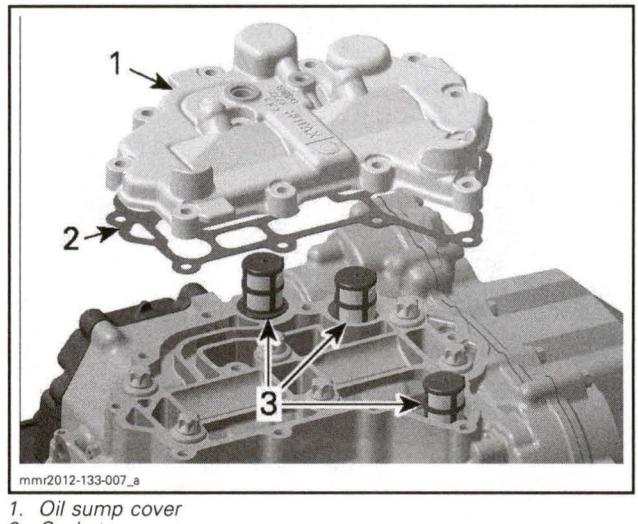
Check oil sump cover for flatness with straight edge.

Replace oil sump cover if necessary.

Check engine oil strainers for damage and change if necessary.

Oil Sump Cover Installation

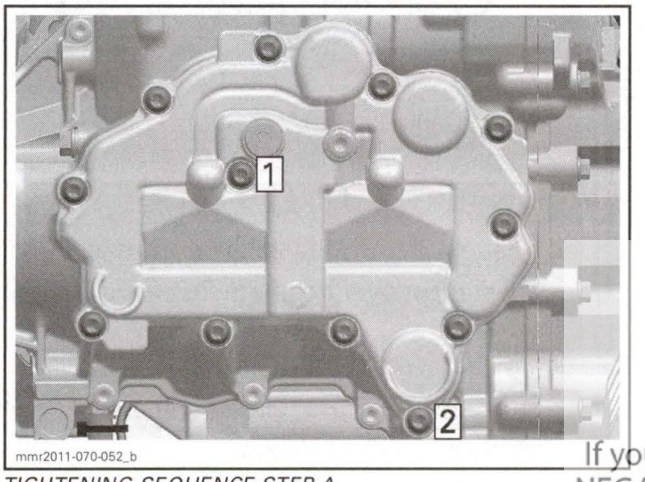
1. Install a **NEW** oil sump cover gasket.
2. Install the strainers as shown.



1. Oil sump cover
2. Gasket
3. Engine oil strainers

3. Install oil sump cover on engine, then tighten screws in two steps as follows:
   3.1 Tighten screws to the following specified torque using the specified sequence.

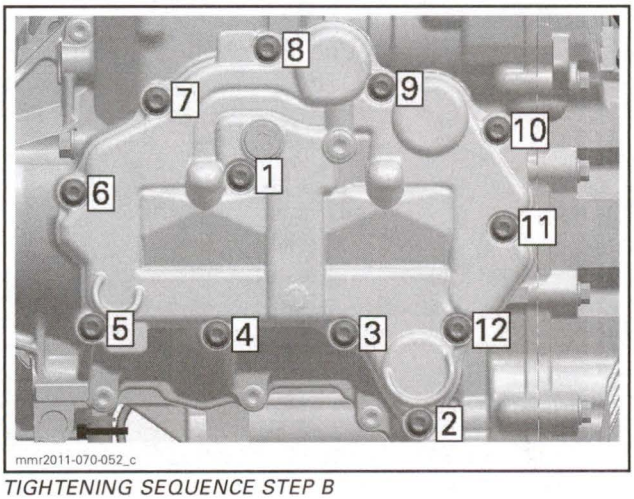
OIL SUMP COVER SCREWS TIGHTENING PROCEDURE	
STEP A	5 N•m ± 0.6 N•m (44 lbf•**in** ± 5 lbf•**in**)



TIGHTENING SEQUENCE STEP A

3.2 Tighten screws to the following specified torque using the specified sequence.

OIL SUMP COVER SCREWS TIGHTENING PROCEDURE	
STEP B	9 N•m to 1 N•m (80 lbf•**in** to 9 lbf•**in**)



TIGHTENING SEQUENCE STEP B

4. Reinstall oil drain plugs using **NEW** sealing washers.

OIL DRAIN PLUGS	
Tightening torque	15 N•m ± 2 N•m (133 lbf•**in** ± 18 lbf•**in**)

5. Install engine in vehicle. Refer to *ENGINE REMOVAL AND INSTALLATION* subsection.

6. Fill up oil tank and check oil level. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

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COOLING SYSTEM

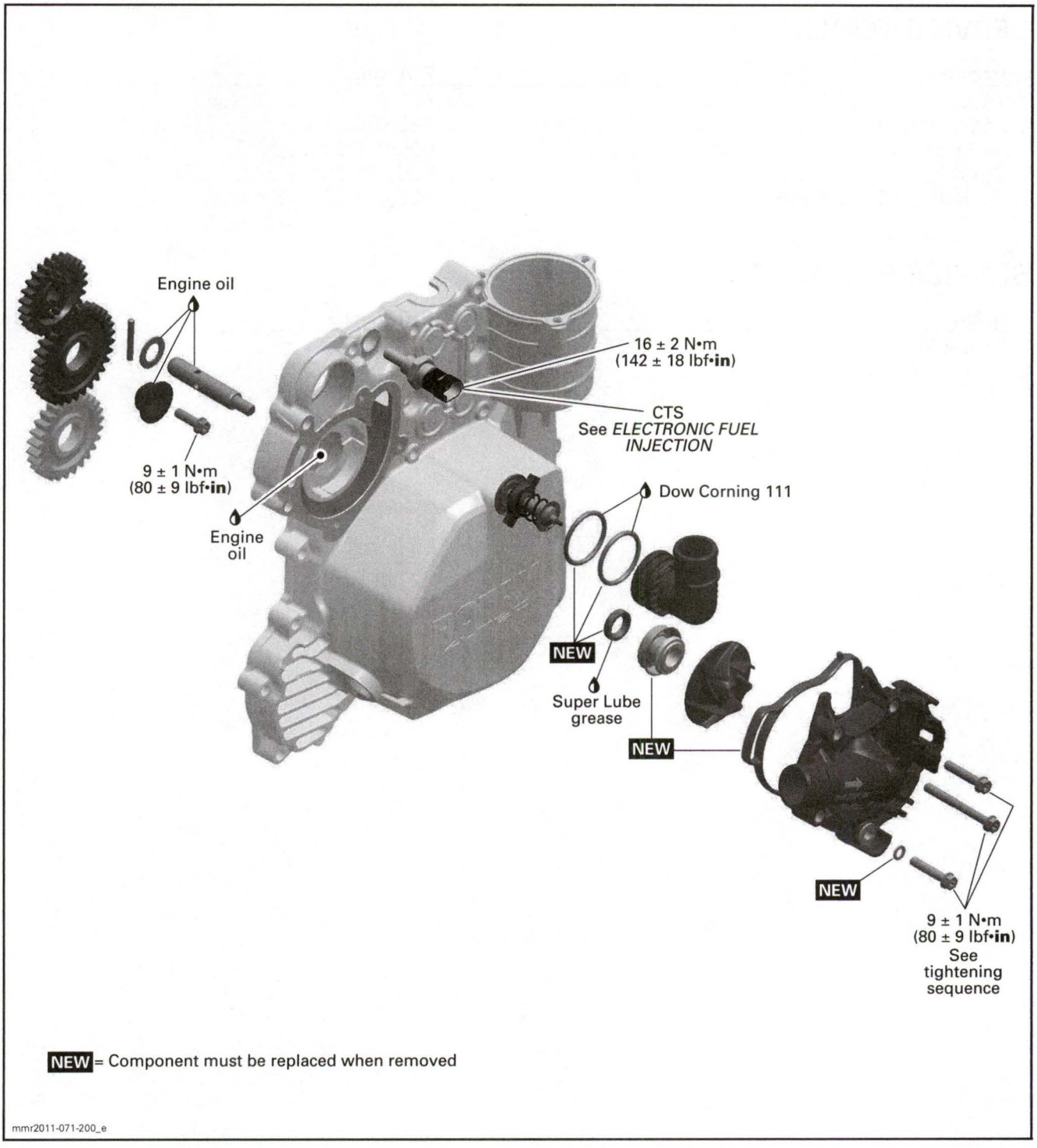
SERVICE TOOLS

Description	Part Number	Page
HANDLE	420 877 650	77
OIL SEAL PUSHER	529 036 210	77
ROTARY SEAL INSTALLER	529 036 211	77–78
TEST CAP	529 035 991	72
VACUUM/PRESSURE PUMP	529 021 800	72

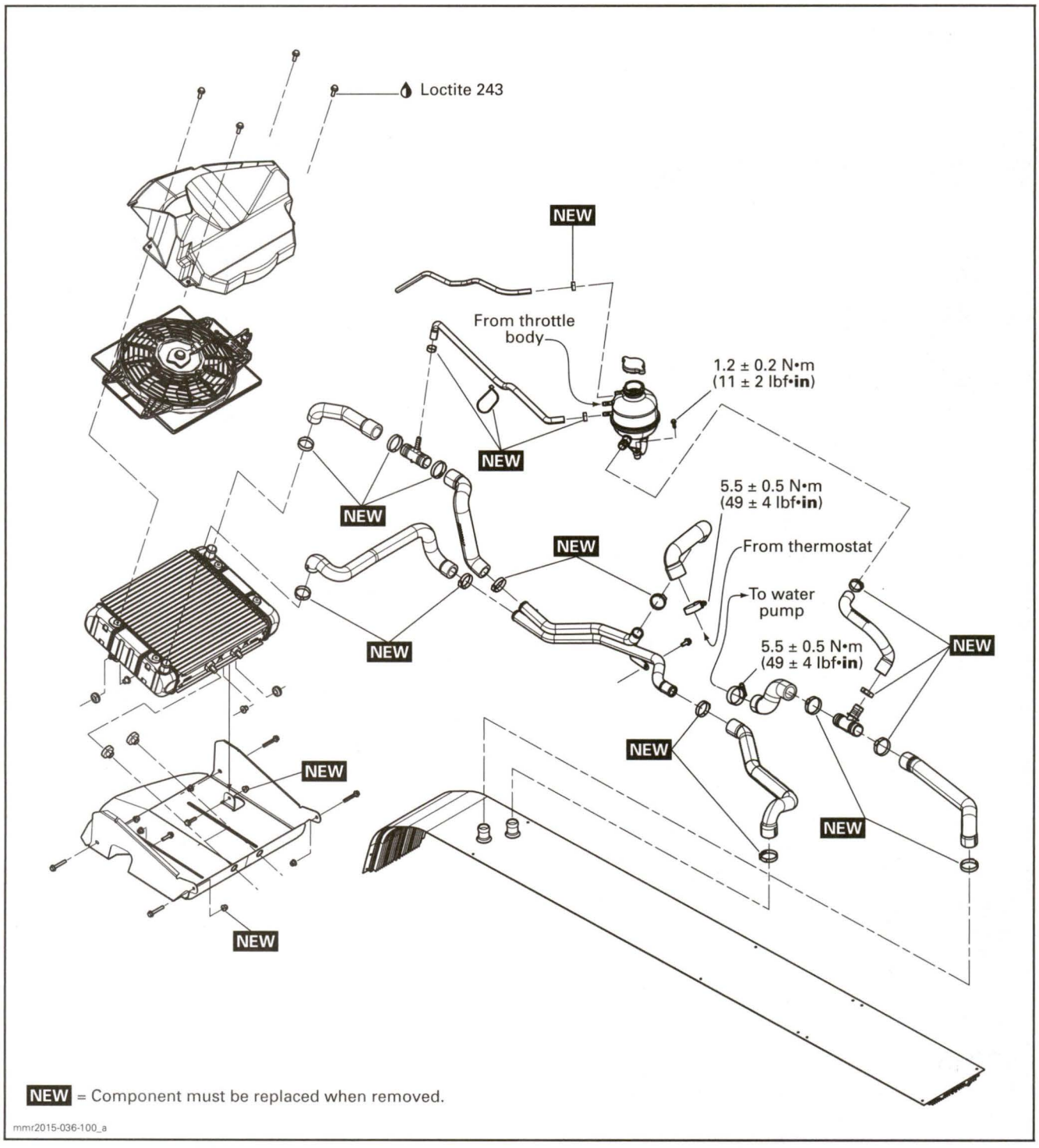
SERVICE PRODUCTS

Description	Part Number	Page
DOW CORNING 111	413 707 000	74
SUPER LUBE GREASE	293 550 030	77

ENGINE COMPONENTS



VEHICLE COMPONENTS



GENERAL

For a better understanding, some illustrations were taken with engine out of vehicle.

NOTE: It is a good practice to check for fault codes using B.U.D.S. software as a first troubleshooting step. Refer to the *DIAGNOSTIC AND FAULT CODES* subsection.

⚠ WARNING

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

INSPECTION

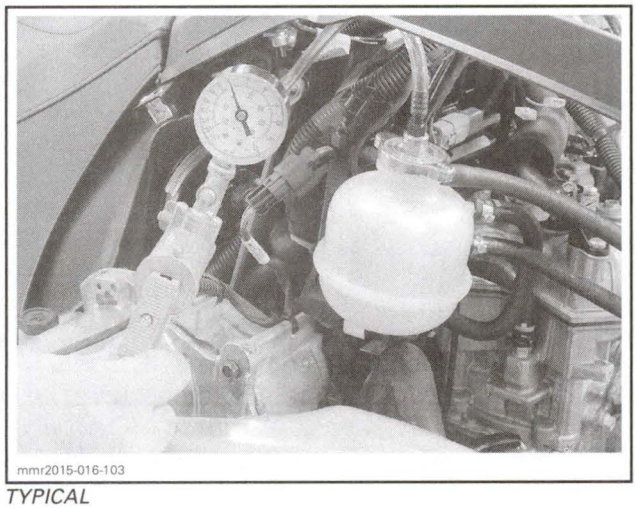
COOLING SYSTEM LEAK TEST

NOTE: This test confirms if there is a leak in the cooling system, including the engine.

Pressurize cooling system through coolant reservoir.

REQUIRED TOOLS	
TEST CAP (P/N 529 035 991)	
VACUUM/PRESSURE PUMP (P/N 529 021 800)	

COOLING SYSTEM LEAK TEST
100 kPa (15 PSI)

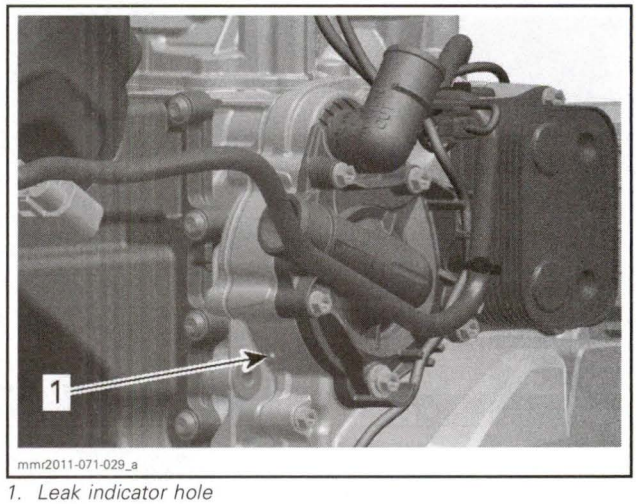


TYPICAL

If pressure drops, check all hoses and engine for coolant leaks. Spray a soap/water solution and look for air bubbles.

Check the leak indicator hole for an oil or coolant leak.

NOTE: In general leaking coolant indicates a damaged rotary seal. Leaking oil indicates a damaged oil seal. If either seal is leaking, both seals must be replaced at the same time. Refer to *WATER PUMP* in this subsection.



1. Leak indicator hole

TROUBLESHOOTING

The following is provided to help in diagnosing the probable source of troubles. It is a guideline and should not be assumed to show all causes for all problems.

Always check for fault codes. If a fault code is detected, service the fault code first.

ENGINE OVERHEATING

1. **Low coolant level.**
   - *Refill and check for leaks (coolant leaking out of leak indicator hole, hoses or clamps missing or defective, or cylinder head gaskets leaks). Repair or replace.*
2. **Dirty heat exchanger.**
   - *Clean heat exchanger fins. Replace heat exchanger as required.*
3. **Air in cooling system.**
   - *Refill and bleed cooling system.*
4. **Defective thermostat (does not open when engine is warm up).**
   - *Replace thermostat.*
5. **Defective water pump.**
   - *Inspect and replace defective components.*
6. **Coolant temperature sensor defective.**
   - *Check and replace.*

7. **Wrong coolant concentration.**
   - *Check and adjust coolant concentration according to BRP's recommendations or replace coolant.*
8. **Defective coolant reservoir cap.**
   - *Replace cap.*
9. **Defective cooling fan.**
   - *Check cooling fan motor operation.*
   - *Check fuse and relay of cooling fan motor.*
   - *Check wiring harness of cooling fan motor.*
10. **Snow guard is too high.**
    - *Check and adjust rear suspension.*

PROCEDURES

COOLANT RESERVOIR CAP

Coolant Reservoir Cap Test

Using a pressure cap tester, check the efficiency of coolant reservoir cap. If the cap does not meet specification, replace the cap.

CAP OPENING PRESSURE
110 kPa (16 PSI)

COOLANT RESERVOIR

Coolant Reservoir Removal

1. Install hose pinchers on coolant hoses attached to reservoir.
2. Siphon coolant from reservoir.
3. Disconnect coolant hoses from reservoir.
4. Remove coolant reservoir from vehicle.

Coolant Reservoir Installation

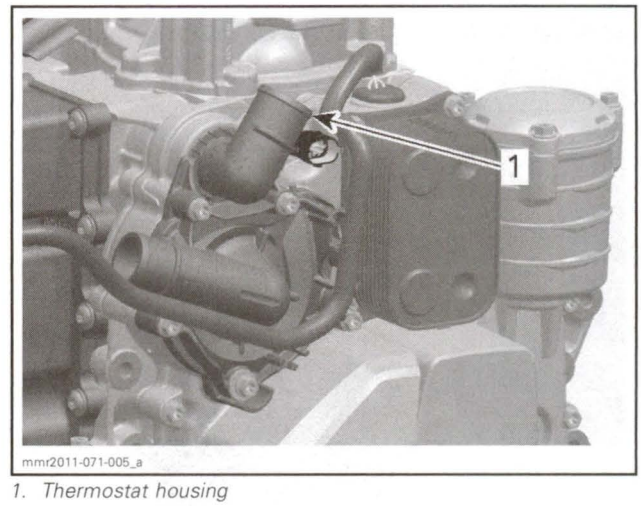
Reverse the removal procedure. However, pay attention to the following.

Refill and bleed cooling system as described in *PERIODIC MAINTENANCE PROCEDURES* subsection.

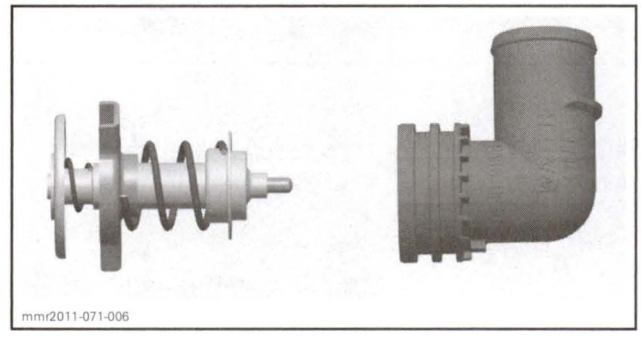
THERMOSTAT

Thermostat Location

The thermostat is located on engine MAG side.



1. Thermostat housing

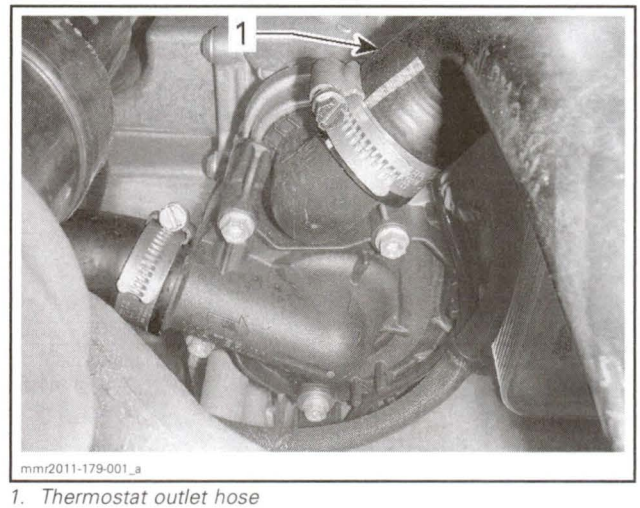


Thermostat Access

Remove upper RH side panel.

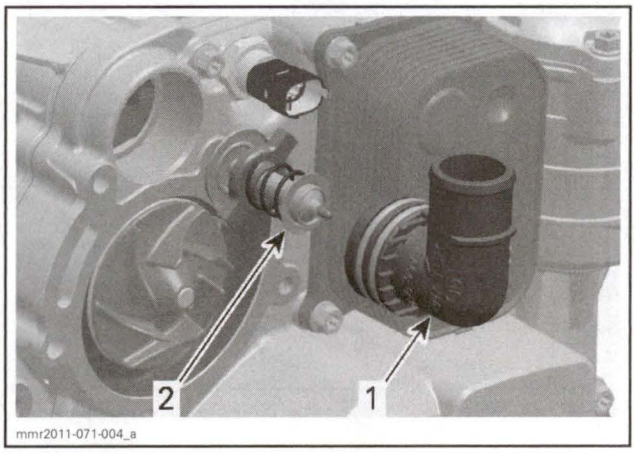
Thermostat Removal

1. Drain engine coolant. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.
2. Disconnect outlet hose from thermostat housing.



1. Thermostat outlet hose

3. Proceed with *WATER PUMP HOUSING REMOVAL*. See procedure in this subsection.
4. Remove thermostat housing then thermostat.



1. Thermostat housing
2. Thermostat

NOTE: Use shop rags to catch any spilled engine coolant.

Thermostat Test

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

THERMOSTAT TEMPERATURE	
Starts to open	75°C (167°F)
Fully open	95°C (203°F)

Replace thermostat if out of specification.

Thermostat Installation

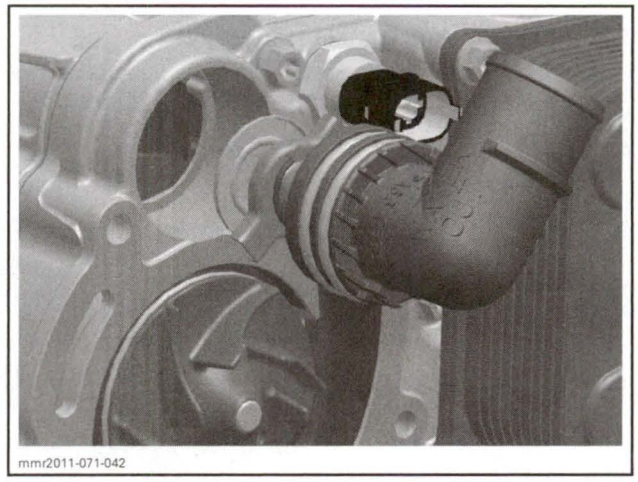
Reverse the removal procedure, however pay attention to the following.

Install **NEW** O-rings on thermostat housing.

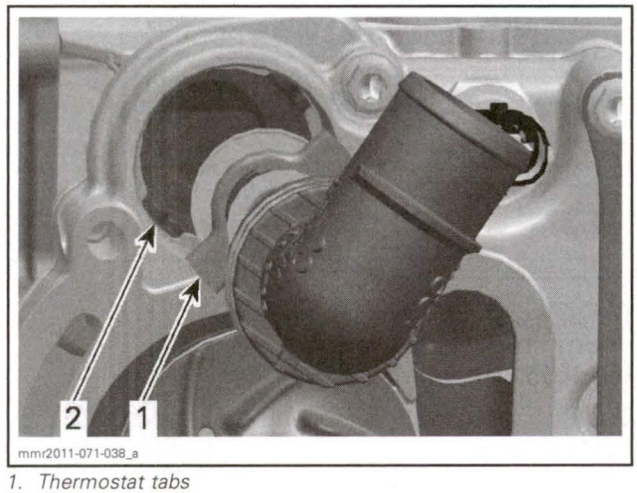
Lubricate O-rings.

THERMOSTAT HOUSING O-RING	
Service product	DOW CORNING 111 (P/N 413 707 000)

Insert thermostat in thermostat housing.



Align both tabs of thermostat with the recess in the magneto cover.



1. Thermostat tabs
2. Magneto cover recess

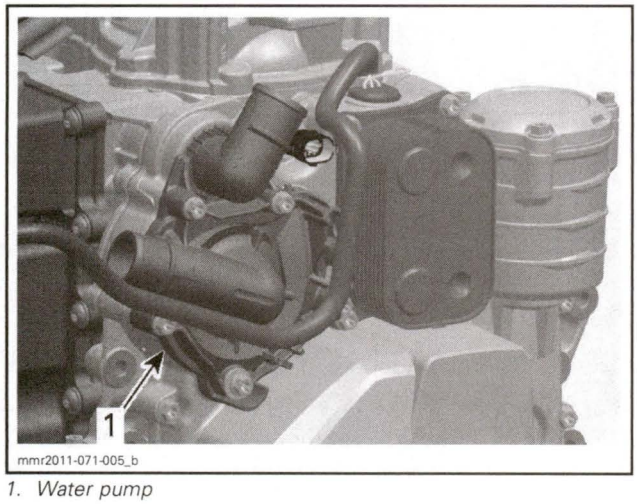
Install water pump housing, refer to *WATER PUMP HOUSING INSTALLATION* in this subsection.

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

WATER PUMP

Water Pump Location

The water pump is located on engine MAG side.



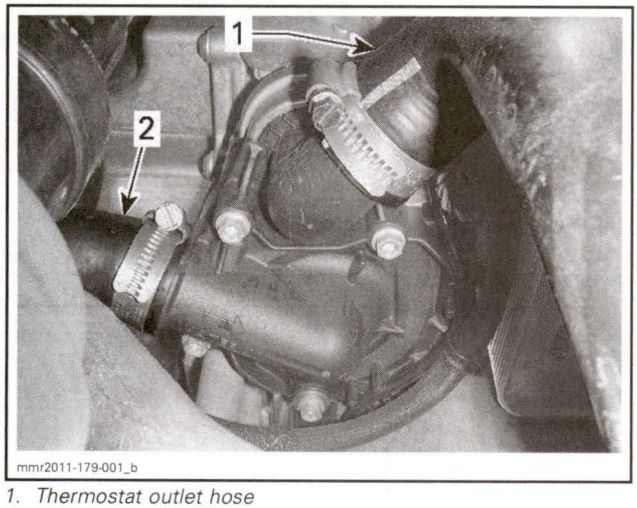
1. Water pump

Water Pump Access

Remove RH side panels.

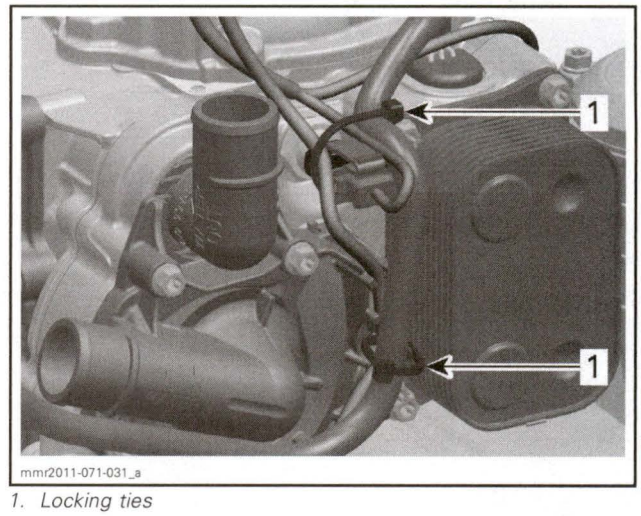
Water Pump Housing Removal

1. Drain engine coolant. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.
2. Disconnect outlet hose from thermostat housing.
3. Disconnect inlet hose from water pump.



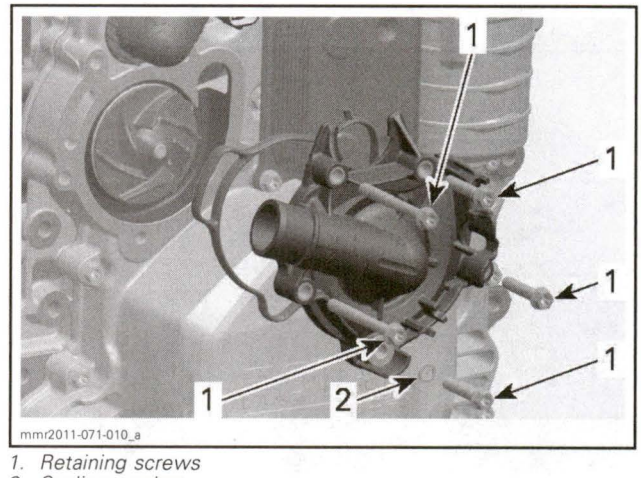
1. Thermostat outlet hose
2. Water pump inlet hose

4. Remove both locking ties securing magneto wires.



1. Locking ties

5. Remove retaining screws of water pump housing.
6. Discard sealing washer.
7. Remove water pump housing from magneto cover.

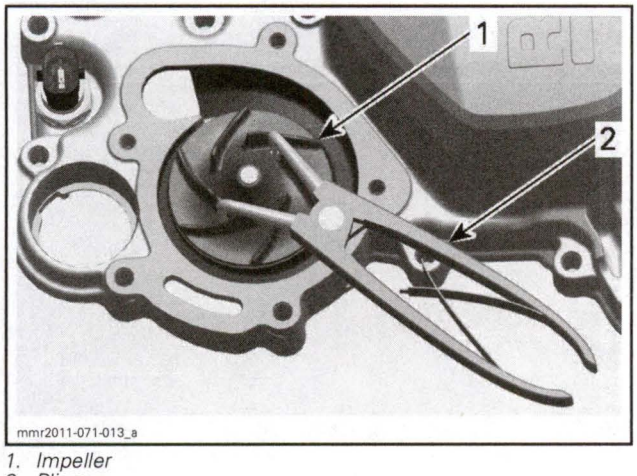


1. Retaining screws
2. Sealing washer

NOTE: Use shop rags to catch any spilled engine coolant.

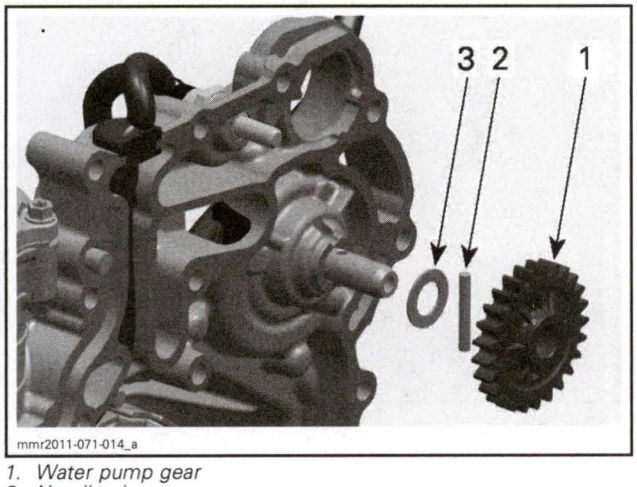
Water Pump Disassembly

1. Unscrew impeller counterclockwise using appropriate pliers.



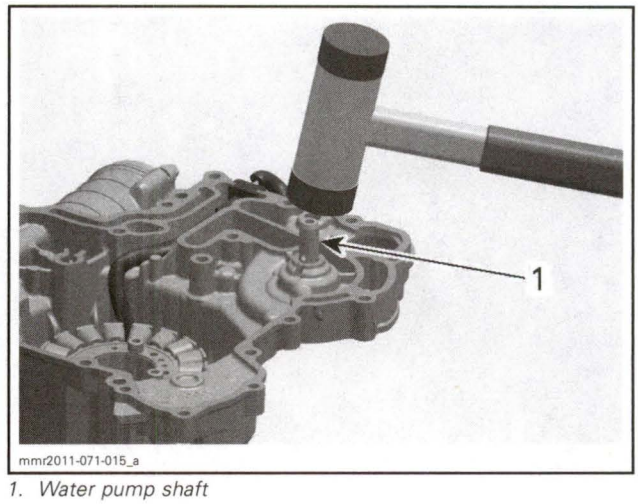
1. Impeller
2. Pliers

2. Remove magneto cover. Refer to *MAGNETO AND STARTER* subsection.
3. Remove the following components from magneto cover:
   - Water pump gear
   - Needle pin
   - Thrust washer.



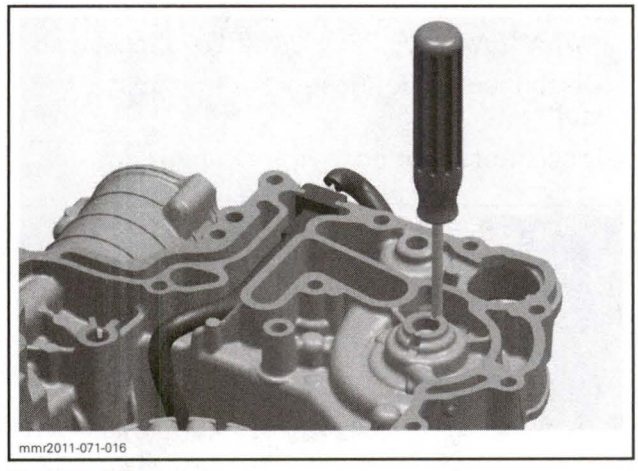
1. Water pump gear
2. Needle pin
3. Thrust washer

4. Remove water pump shaft using a plastic mallet.



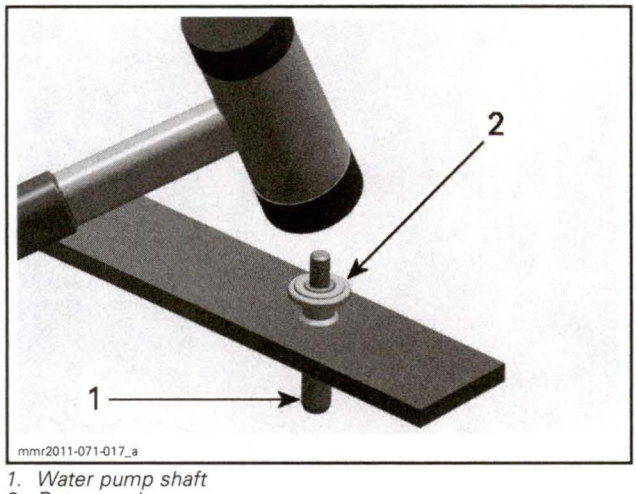
1. Water pump shaft

5. Remove the following components from magneto cover:
   - Oil seal
   - Remaining parts of rotary seal.



NOTICE **Be careful not to damage the surface of the rotary seal bore in the magneto cover.**

6. Separate rotary seal from water pump shaft.



1. *Water pump shaft*
2. *Rotary seal*

Water Pump Inspection

Check area of water pump housing for cracks or other visible damage.

Check water pump gear for wear or broken teeth.

Check if housing gasket is brittle, hard or damaged.

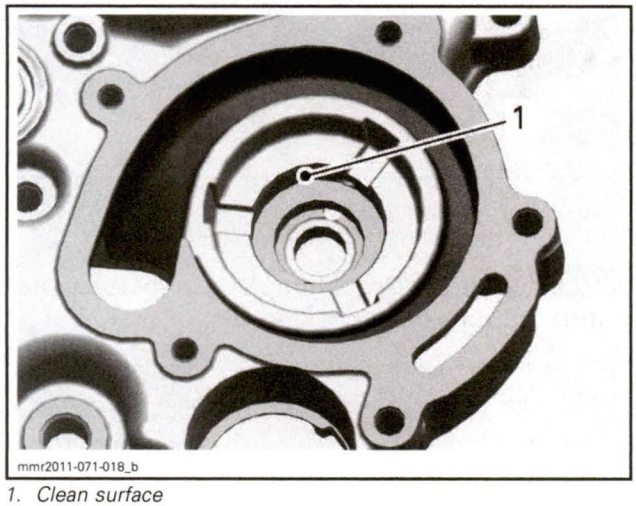
Check water pump shaft for visible damage.

Replace parts if necessary.

Water Pump Assembly

NOTE: Always replace oil seal and rotary seal at the same time.

1. Clean rotary seal surface from old sealant.



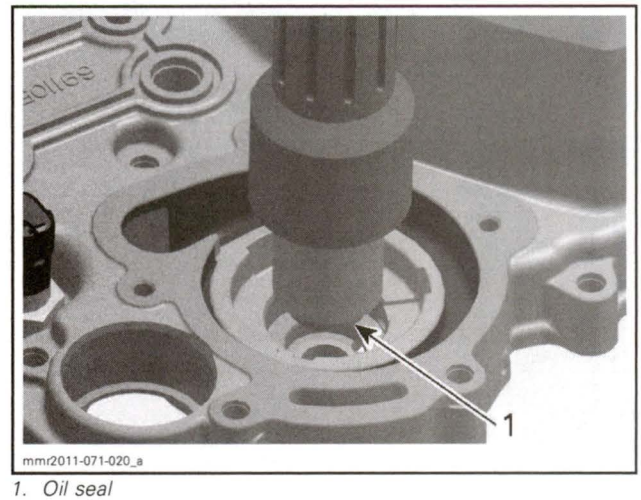
1. *Clean surface*

2. Apply engine oil on the press fit area of oil seal.

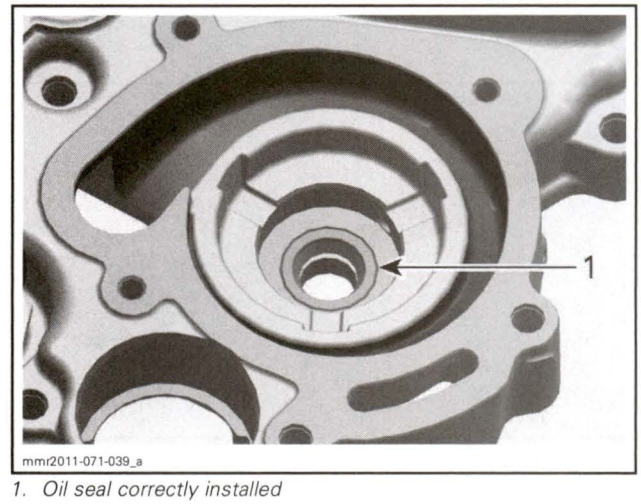
NOTICE Never use engine oil on the press fit area of the rotary seal.

3. Install **NEW** oil seal in magneto cover.

REQUIRED TOOLS	
OIL SEAL PUSHER (P/N 529 036 210)	
HANDLE (P/N 420 877 650)	



1. *Oil seal*



1. *Oil seal correctly installed*

4. Lubricate sealing lip of the oil seal.

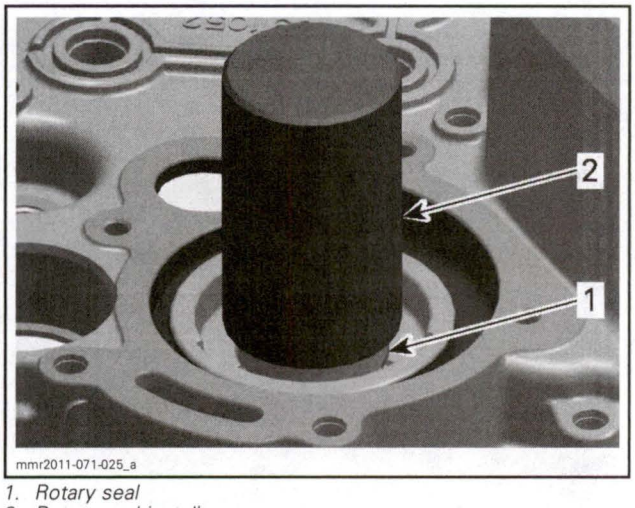
OIL SEAL	
Service product	SUPER LUBE GREASE (P/N 293 550 030)

5. Install **NEW** rotary seal on magneto cover using a press.

NOTE: Prior to installing, ensure that press fit sealing of rotary seal is not damaged.

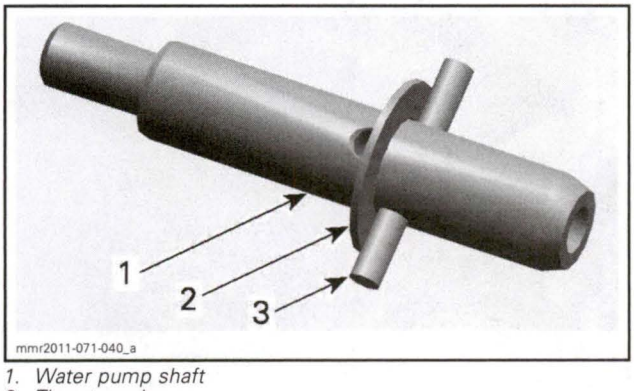
REQUIRED TOOL	
Press	
ROTARY SEAL INSTALLER (P/N 529 036 211)	

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



1. *Rotary seal*
2. *Rotary seal installer*

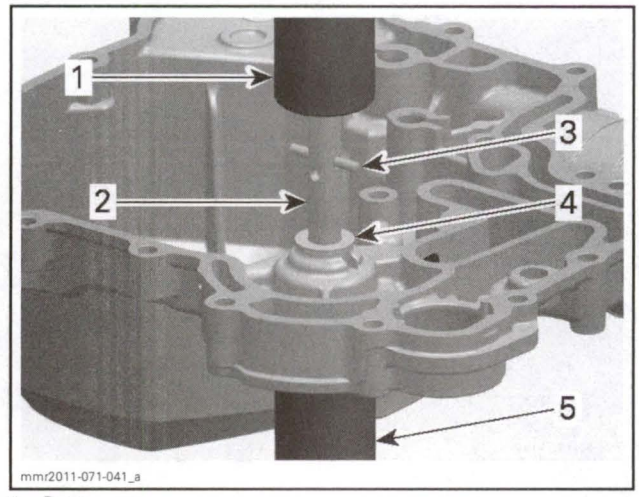
6. Assemble the following components onto water pump shaft.
   - Needle pin
   - Thrust washer.



1. *Water pump shaft*
2. *Thrust washer*
3. *Needle pin*

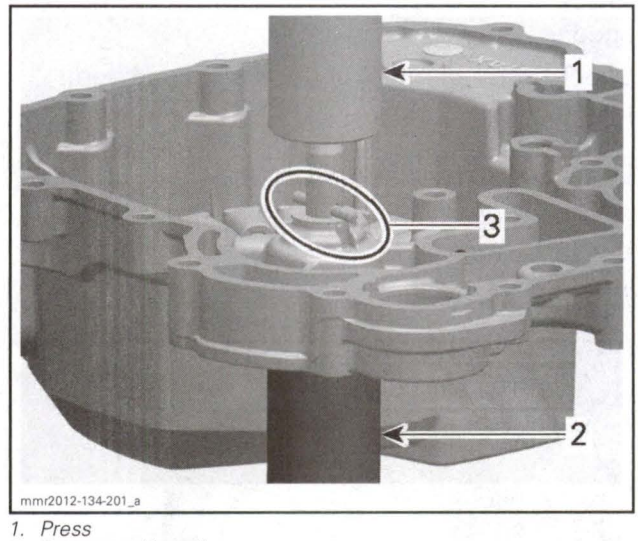
7. Slide water pump shaft into rotary seal using a press.

NOTE: To avoid damaging the rotary seal and to achieve the proper preload support the rotary seal with the ROTARY SEAL INSTALLER (P/N 529 036 211).



1. *Press*
2. *Water pump shaft*
3. *Needle pin*
4. *Thrust washer*
5. *Rotary seal installer*

8. Carefully press water pump shaft until needle pin touches thrust washer.



1. *Press*
2. *Rotary seal installer*
3. *Needle pin touches thrust washer*

NOTICE Never use a hammer to install water pump shaft into rotary seal.

NOTE: After installation, water pump shaft must rotate freely.

9. Screw impeller clockwise using appropriate pliers.

NOTICE Be careful not to damage the impeller vanes during its installation.

10. Install magneto cover. Refer to *MAGNETO AND STARTER* subsection.

Water Pump Housing Installation

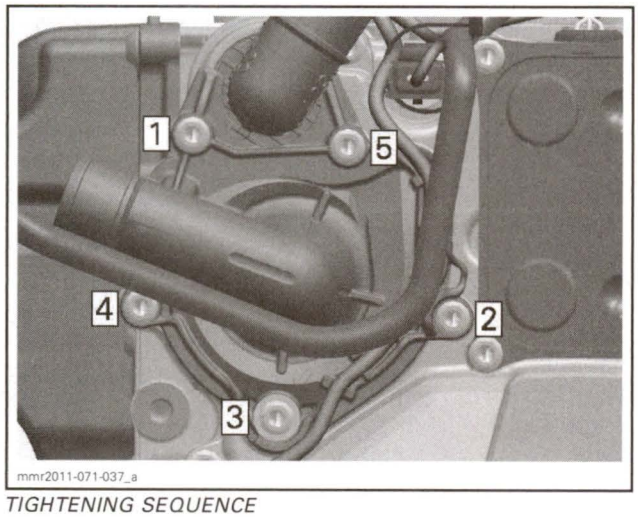
Reverse the removal procedure. However, pay attention to the following.

NOTICE When installing the water pump housing, ensure the NEW gasket is precisely positioned in the pump housing groove to prevent leakage.

Install a NEW sealing washer on drain screw.

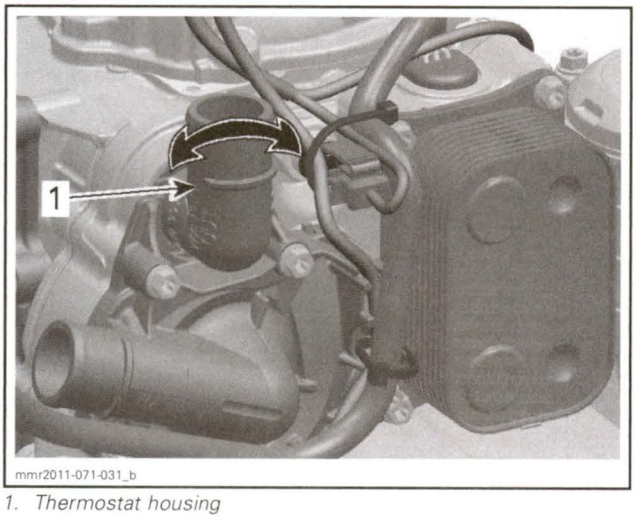
Tighten water pump housing retaining screws as per following procedure.

WATER PUMP HOUSING SCREWS	
Tightening torque	9 N•m ± 1 N•m (80 lbf•**in** ± 9 lbf•**in**)



TIGHTENING SEQUENCE

Turn thermostat housing to proper position.



1. Thermostat housing

Tighten hose clamps to specification.

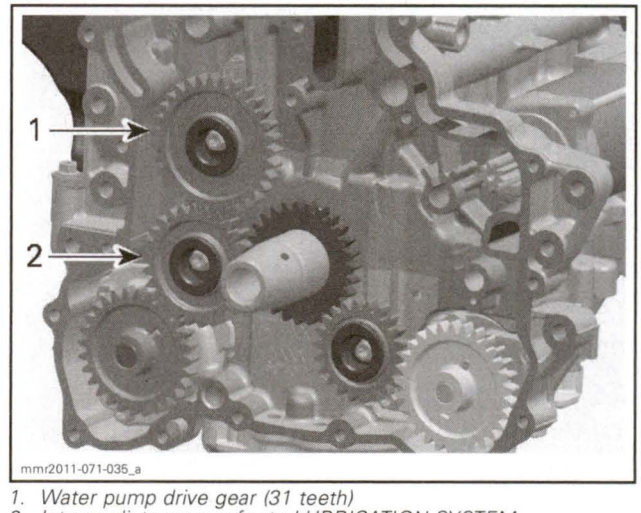
COOLANT HOSE CLAMPS	
Tightening torque	5.5 N•m ± 0.5 N•m (49 lbf•**in** ± 4 lbf•**in**)

Install remaining parts. Refer to their applicable subsection.

WATER PUMP DRIVE GEAR

Water Pump Drive Gear Location

The water pump drive gear is located behind the magneto cover.



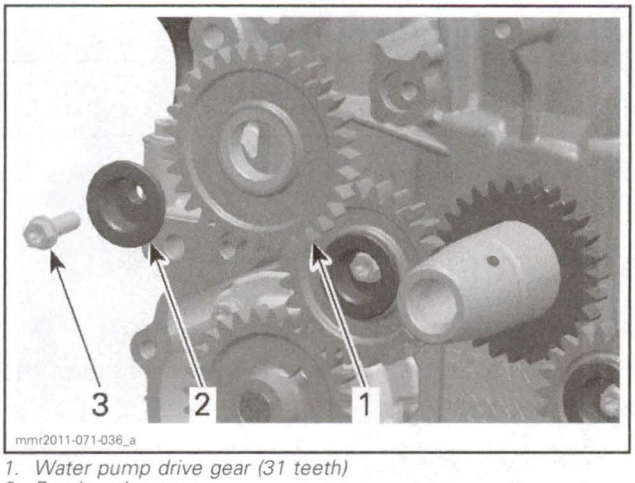
1. Water pump drive gear (31 teeth)
2. Intermediate gear, refer to LUBRICATION SYSTEM

Water Pump Drive Gear Access

Remove magneto cover. Refer to *MAGNETO AND STARTER* subsection.

Water Pump Drive Gear Removal

1. Remove screw securing water pump drive gear.
2. Remove bearing sleeve.
3. Slide off intermediate gear.



1. Water pump drive gear (31 teeth)
2. Bearing sleeve
3. M6 x 20 screw

Water Pump Drive Gear Inspection

Inspect gear for wear or other damage.

Replace gear if necessary.

Water Pump Drive Gear Installation

Reverse the removal procedure. However, pay attention to the following.

Apply engine oil on bearing sleeve.

Tighten water pump drive gear retaining screw to specification.

WATER PUMP DRIVE GEAR RETAINING SCREW	
Tightening torque	9 N•m ± 1 N•m (80 lbf•**in** ± 9 lbf•**in**)

HEAT EXCHANGER

Heat Exchanger Cleaning and Inspection

Remove all debris between heat exchanger fins.

Check if heat exchanger fins are damaged. Replace if necessary.

NOTE: A heat exchanger with many broken fins does not work properly.

Heat Exchanger Removal

1. Drain cooling system, refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.
2. Remove engine, refer to *ENGINE REMOVAL AND INSTALLATION* subsection.
3. Remove fuel tank. Refer to *FUEL TANK AND FUEL PUMP* subsection.
4. Remove rear suspension. Refer to the *REAR SUSPENSION (SC-5U)* subsection.
5. Disconnect coolant hoses from heat exchanger.
6. Drill or grind all rivets retaining the heat exchanger to the tunnel. Refer to *FRAME* subsection for drilling procedure.

NOTE: When pushing the rivets out, support the frame around the rivet with a socket on the opposite side to prevent the frame from warping.

7. Remove heat exchanger from the vehicle.

Heat Exchanger Installation

Reverse the removal procedure.

Refill cooling system as described in *PERIODIC MAINTENANCE PROCEDURES* subsection.

FRONT AIR COOLED RADIATOR

Radiator Access

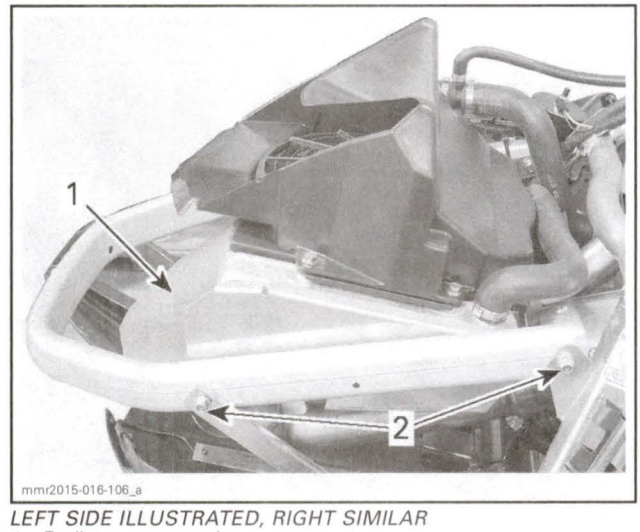
Refer to *BODY* subsection and remove the following:

- Upper and lower side panels (both sides)
- Hood
- Upper bottom pan panels (both sides)
- Front grill.

Radiator Removal for Access

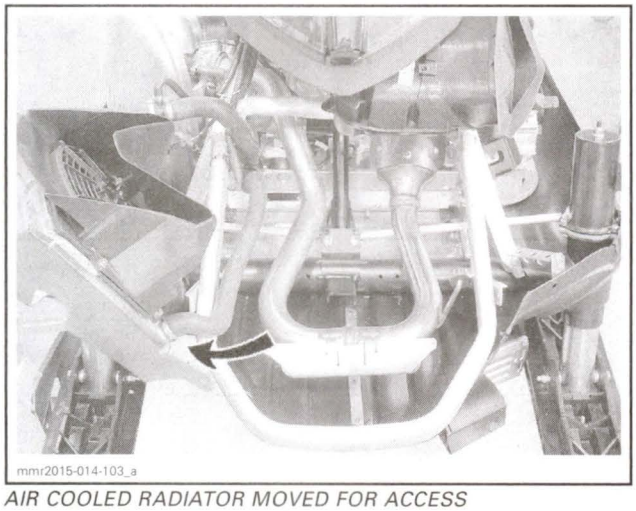
NOTE: It is not necessary to disconnect or disassemble radiator when removed for access.

1. Remove body parts listed in *RADIATOR ACCESS*.
2. Remove the fasteners that secure the radiator support plate to the front bumper.



LEFT SIDE ILLUSTRATED, RIGHT SIMILAR
1. Radiator support plate
2. Screws and nuts to remove (both sides)

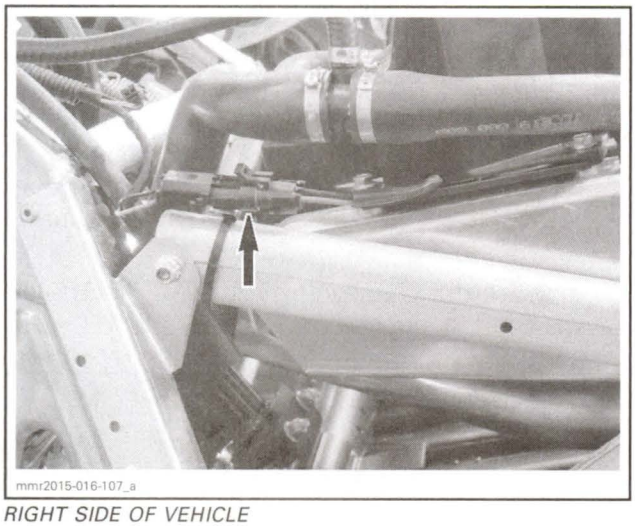
3. Move radiator to RH side of vehicle.



AIR COOLED RADIATOR MOVED FOR ACCESS

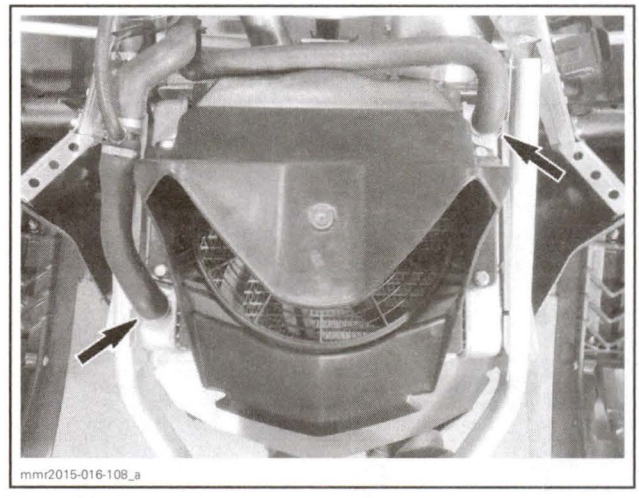
Radiator Removal for Replacement

1. Remove body parts listed in *RADIATOR ACCESS*.
2. Drain cooling system, Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.
3. Disconnect radiator cooling fan connector.

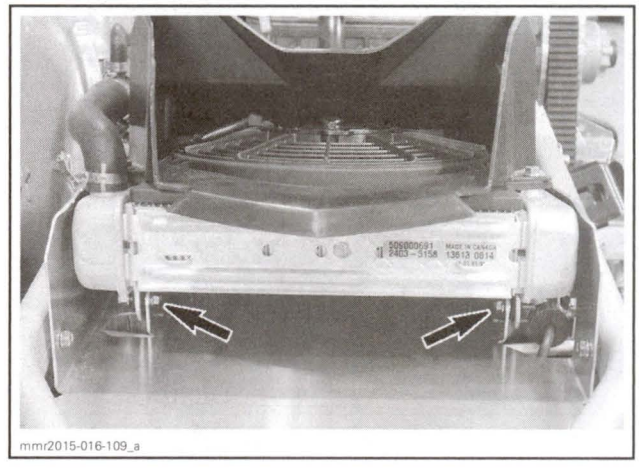


RIGHT SIDE OF VEHICLE

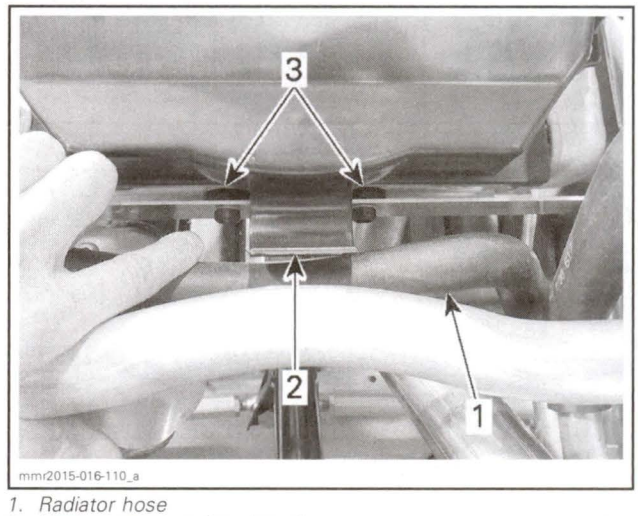
4. Disconnect coolant hoses from radiator. Discard Oetiker clamps.



5. Remove screws retaining the the radiator to the radiator support.



6. At the back of the fan shroud, remove the radiator hose from its support.



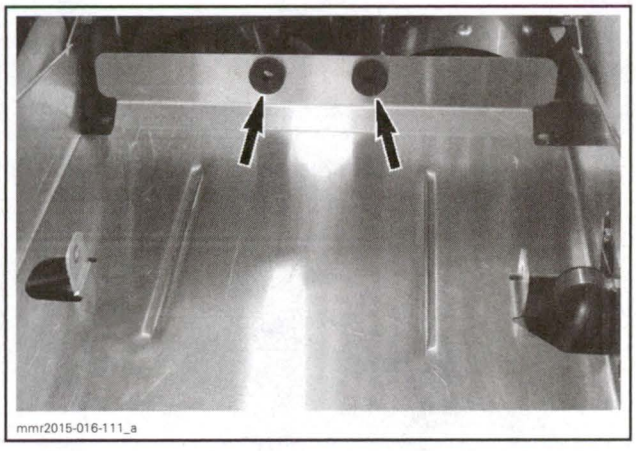
1. *Radiator hose*
2. *Hose support on fan shroud*
3. *Grommets in radiator support*

7. Pull radiator forward off its support grommets and remove radiator from vehicle.
8. Remove fan from radiator. See procedure in this subsection.

Radiator Installation

Reverse the removal procedure. However, pay attention to the following.

Ensure grommets are installed in radiator support.


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Install **NEW** Oetiker clamps to secure coolant hoses.

Fill and bleed cooling system as described in *PERIODIC MAINTENANCE PROCEDURES* subsection.

RADIATOR COOLING FAN

Cooling Fan Operating Conditions

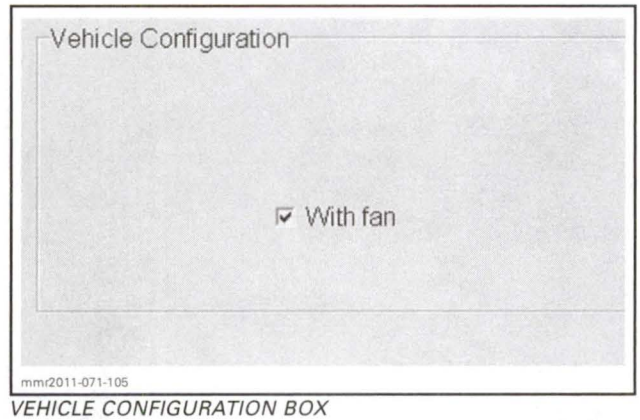
RADIATOR COOLING FAN		
ENGINE TEMPERATURE	COOLING FAN RELAY	COOLING FAN OPERATION
> 100°C (212°F)	Close	Starts
< 95°C (203°F)	Open	Stops

Cooling Fan Relay Location

The cooling fan relay is located in the fuse box. Refer to *POWER DISTRIBUTION* subsection.

Cooling Fan Configuration in B.U.D.S.

1. Connect vehicle to B.U.D.S., refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. In B.U.D.S., select the following:
   - **Read Data** button
   - **Setting** tab
   - **ECM** page.
3. Ensure that **With fan** box is properly checked.



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VEHICLE CONFIGURATION BOX

Cooling Fan Testing Sequence

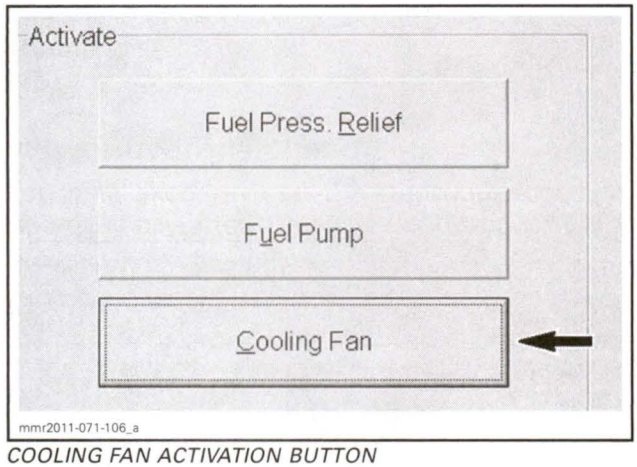
If B.U.D.S is properly configured and cooling fan does not work, follow this testing sequence to diagnose problem.

1. Check for a fault code in B.U.D.S.. Refer to *DIAGNOSTICS AND FAULT CODES* subsection.
2. Check cooling fan fuse. Refer to *POWER DISTRIBUTION* subsection.
3. Carry out the *COOLING FAN TEST USING B.U.D.S.* in this subsection.
4. Retest fan using B.U.D.S. while touching fan relay (R4).
   - If a "click" is felt, see *COOLING FAN MOTOR OPERATION TEST* in this subsection.
   - If a NO "click" is felt, test cooling fan relay. Refer to *POWER DISTRIBUTION* subsection.
5. Carry out the *COOLING FAN INPUT VOLTAGE TEST* in this subsection.
6. Carry out the *COOLING FAN RELAY INPUT VOLTAGE TEST* further in this subsection.
7. Carry out the *COOLING FAN RELAY CONTROL CIRCUIT TEST* further in this subsection.
8. Test for continuity of the following. Refer to wiring diagram.
   - Fan ground circuit
   - Relay control circuit.

Cooling Fan Test Using B.U.D.S.

1. Connect vehicle to B.U.D.S., refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. Depress vehicle start button once to activate the ECM.
3. In B.U.D.S., select the following:
   - **Read Data** button
   - **Activation** tab
   - **ECM** page.

4. Press **Cooling Fan** button to activate cooling fan motor.



COOLING FAN ACTIVATION BUTTON

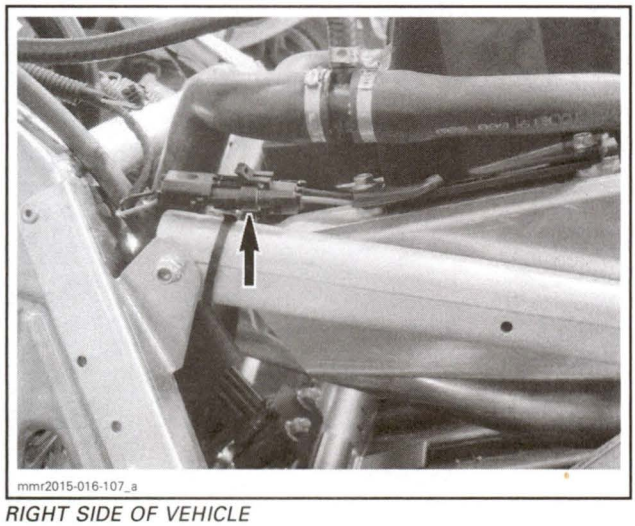
If cooling fan functions properly, test the coolant temperature sensor.

If cooling fan motor does not work, refer back to *COOLING FAN TESTING SEQUENCE* in this subsection.

NOTE: The engine must be started and the engine temperature must attain > 100°C (212°F) before the coolant temperature sensor signal tells the ECM to turn on the cooling fan. Refer to *COOLING FAN OPERATING CONDITIONS* in this subsection.

Cooling Fan Motor Operation Test

1. Disconnect radiator cooling fan connector.



RIGHT SIDE OF VEHICLE

2. Check cooling fan connector and terminal condition.
3. Connect a 12 volt battery directly to the fan motor connector.

If motor does not work, replace it.

If motor works, check:

- Fan ground circuit wiring continuity
- Carry out the *COOLING FAN INPUT VOLTAGE TEST* in this subsection.

Cooling Fan Input Voltage Test

Test conditions:

- Engine running with coolant temperature above 100°C (212°F)
- **OR** cooling fan activated using B.U.D.S. Refer to *COOLING FAN TEST USING B.U.D.S.*

Check input voltage at cooling fan connector (harness side).

COOLING FAN INPUT VOLTAGE TEST	
TEST PROBES	VOLTAGE
GRAY/GREEN	Battery voltage (± 12 Vdc)
BLACK	

Cooling Fan Relay Input Voltage Test

RELAY INPUT VOLTAGE TEST (CONTACTS)	
TEST PROBES	VOLTAGE
Fuse box pin 10C	Battery voltage (± 12 Vdc)
Battery negative (-) post	

RELAY INPUT VOLTAGE TEST (WINDING)	
TEST PROBES	VOLTAGE
Fuse box pin 10D	Battery voltage (± 12 Vdc)
Battery negative (-) post	

Cooling Fan Relay Control Circuit Test

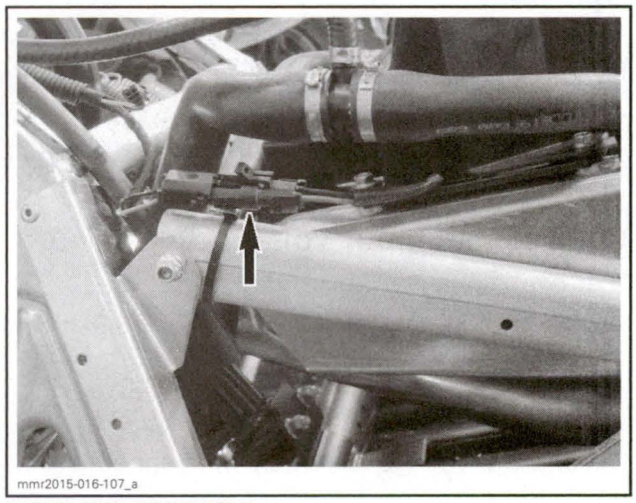
Test conditions:

- Engine running with coolant temperature above 100°C (212°F)
- **OR** cooling fan activated using B.U.D.S. Refer to *COOLING FAN TEST USING B.U.D.S.*

COOLING FAN RELAY CONTROL CIRCUIT TEST	
TEST PROBES	VOLTAGE
Fuse box pin 12C	Approximately battery voltage (± 12 Vdc)
Battery positive (+) post	

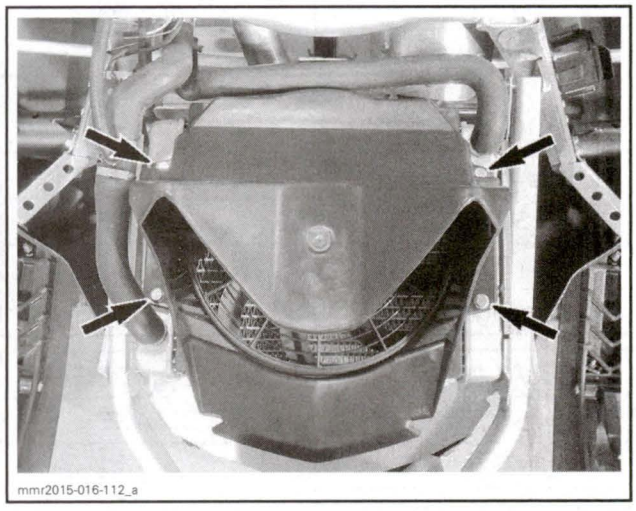
Cooling Fan Removal

1. Disconnect radiator cooling fan connector.



RIGHT SIDE OF VEHICLE

2. Remove the 4 screws that secure the fan shroud and fan to the radiator.



Cooling Fan Installation

Reverse the removal procedure.

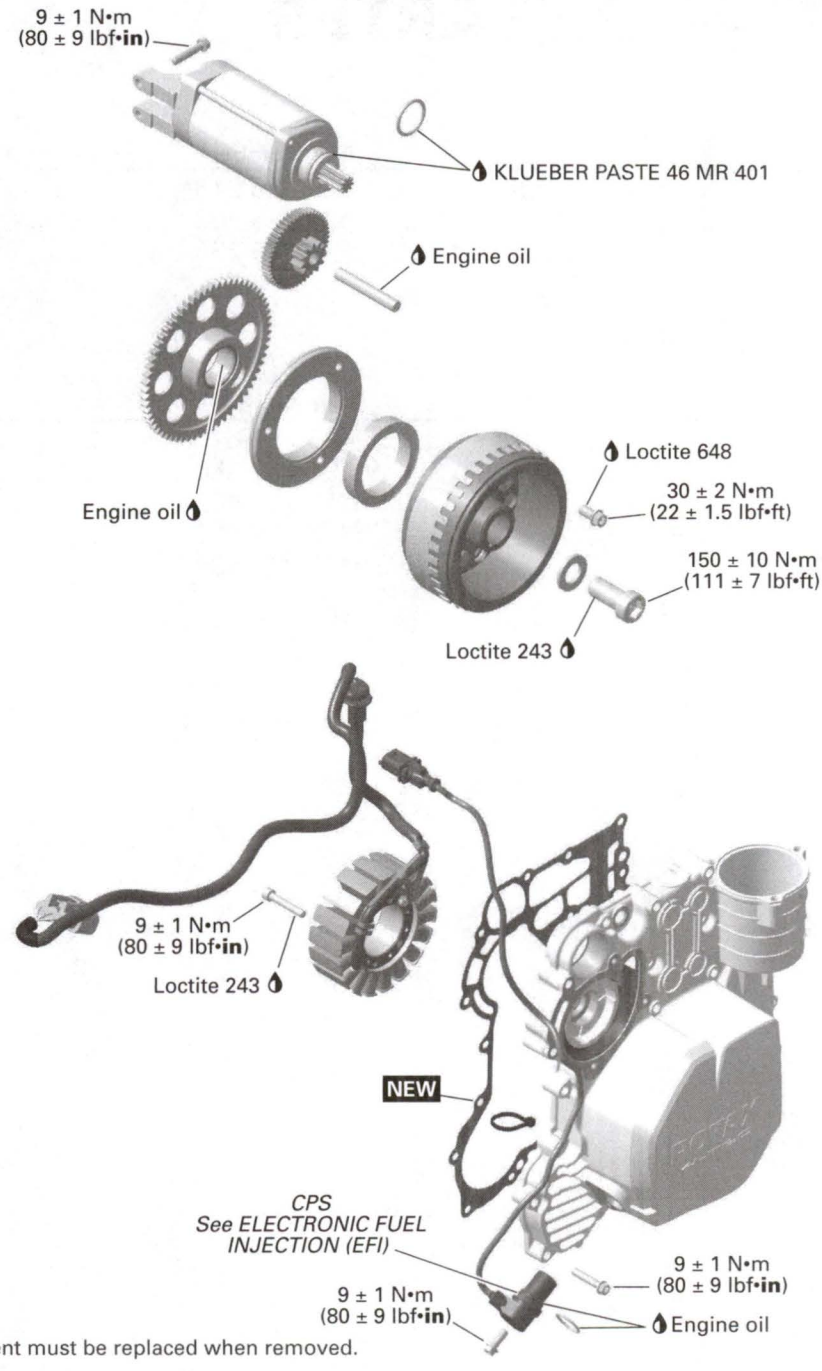
MAGNETO AND STARTER

SERVICE TOOLS

Description	Part Number	Page
CRANKSHAFT PROTECTOR	529 036 213	91
FLUKE 115 MULTIMETER	529 035 868	89
FLYWHEEL PULLER	420 976 235	91

SERVICE PRODUCTS

Description	Part Number	Page
KLÜEBER PASTE 46 MR 401	420 297 616	96
LOCTITE 243 (BLUE)	293 800 060	90, 92
LOCTITE 648 (GREEN)	413 711 400	93
LOCTITE CHISEL (GASKET REMOVER)	413 708 500	87
PULLEY FLANGE CLEANER	413 711 809	91, 93



NEW = Component must be replaced when removed.

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TROUBLESHOOTING

Always check for fault codes. If a fault code is detected, service the fault code first. Refer to *DIAGNOSTIC AND FAULT CODES* subsection.

ENGINE DOES NOT CRANK

1. **Battery voltage too low.**
   - *Check battery condition.*
2. **Starter is turning but engine does not crank.**
   - *Check sprag clutch for wear or other damages.*
3. **Starter is defective.**
   - *Check starter condition. Perform STARTER OPERATION TEST and STARTER VOLTAGE DROP TEST.*
4. **Engine is only cranking 1 - 2 seconds before it stops.**
   - *Check battery condition.*

PROCEDURES

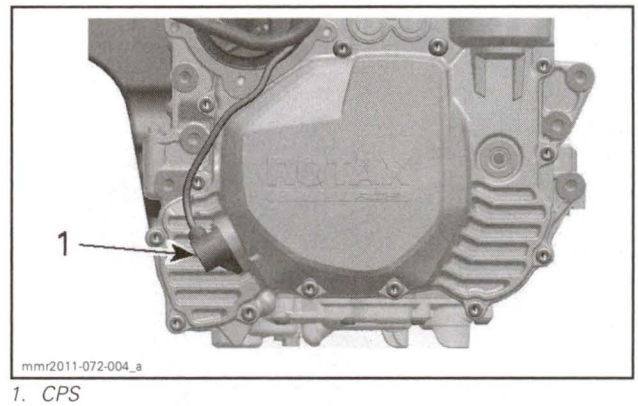
MAGNETO COVER

Magneto Cover Access

1. Refer to applicable subsection and remove:
   - Air intake silencer and headlight/gauge module as an assembly
   - Muffler
   - Exhaust pipes.
2. Detach coolant tank from the frame.
3. Detach radiator coolant pipes from frame.

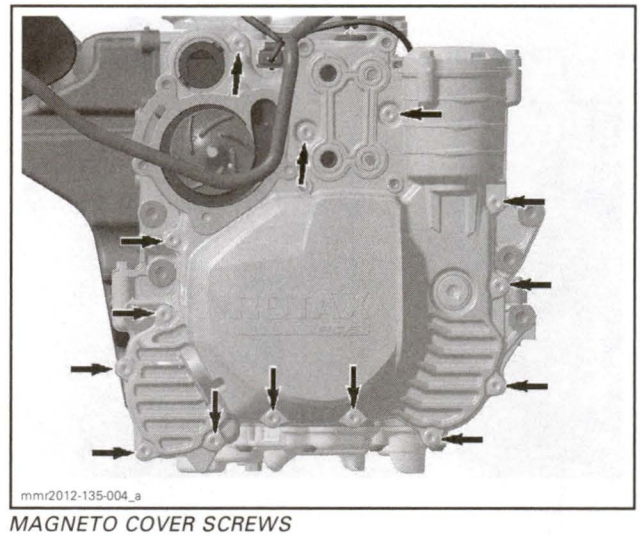
Magneto Cover Removal

1. Cut the locking tie securing the stator wiring and disconnect stator connector.
2. Disconnect the CTS connector.
3. Refer to *PERIODIC MAINTENANCE PROCEDURES* and drain:
   - Engine oil
   - Engine coolant.
4. Refer to *COOLING SYSTEM* and remove:
   - Water pump housing
   - Thermostat housing.
5. Refer to *LUBRICATION SYSTEM* subsection and remove:
   - Oil pressure regulator
   - Oil cooler.
6. Remove the CPS.



1. CPS

7. Remove magneto cover retaining screws.



MAGNETO COVER SCREWS

8. Pull magneto cover off.

Magneto Cover Inspection

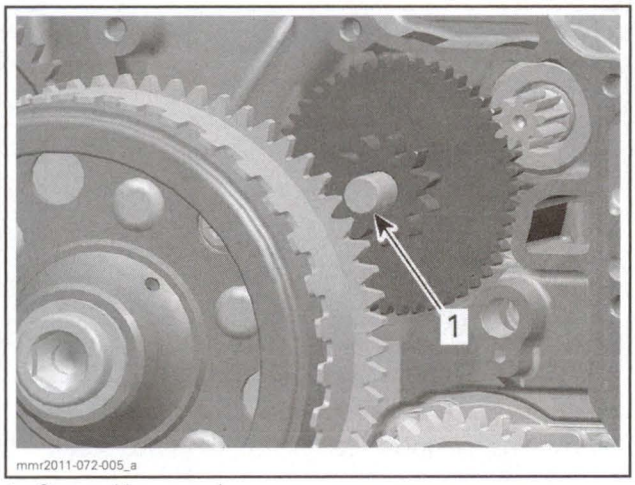
Check magneto cover for cracks or other damage. Replace if necessary.

Magneto Cover Installation

1. Clean magneto cover.

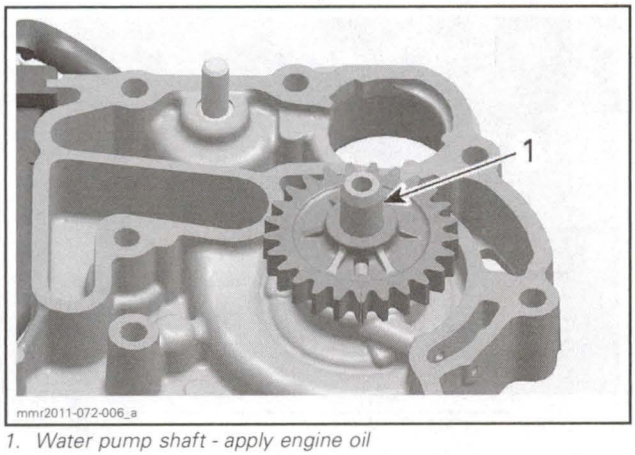
MAGNETO COVER CLEANING	
Service product	LOCTITE CHISEL (GASKET REMOVER) (P/N 413 708 500)

2. Install a **NEW** magneto cover gasket.
3. Ensure starter drive gear pin is in place.
4. Apply engine oil on starter drive gear pin.



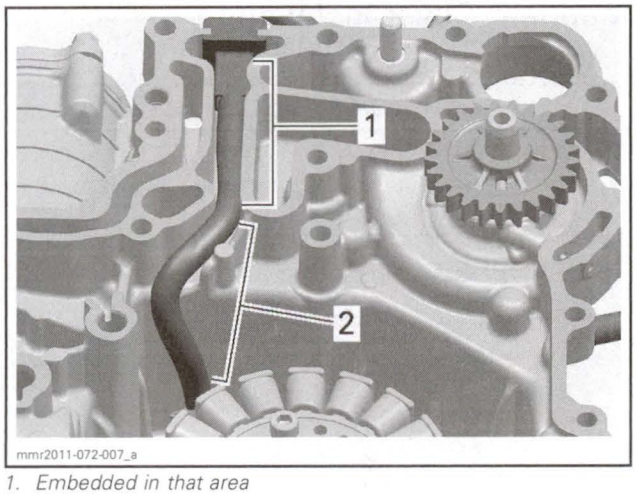
1. Starter drive gear pin

5. Apply engine oil on water pump shaft.



1. Water pump shaft - apply engine oil

NOTICE Make sure the stator cable harness is embedded in the cover channel provided. The part of the harness that is out of the channel must be tight, otherwise it might chafe or jam.



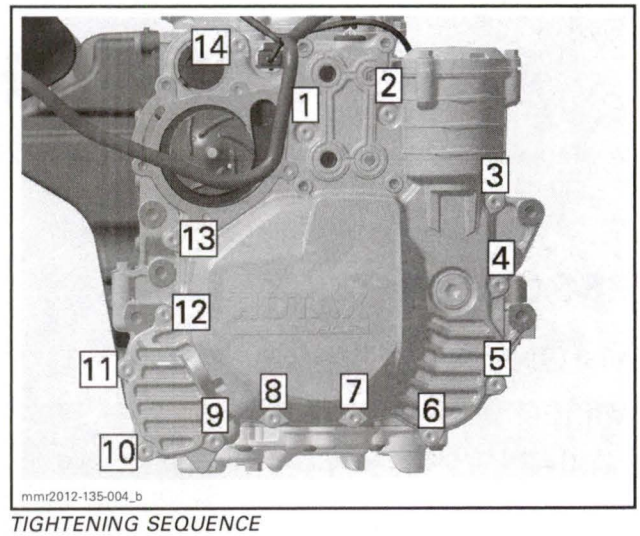
1. Embedded in that area
2. Tight in this area

6. Carefully install magneto cover.

⚠ CAUTION Magnetic force between magneto flywheel and stator is very high. Avoid finger contusions.

7. Tighten to specification magneto cover screws according to the following sequence.

MAGNETO COVER SCREWS	
Tightening torque	9 N•m ± 1 N•m (80 lbf•**in** ± 9 lbf•**in**)



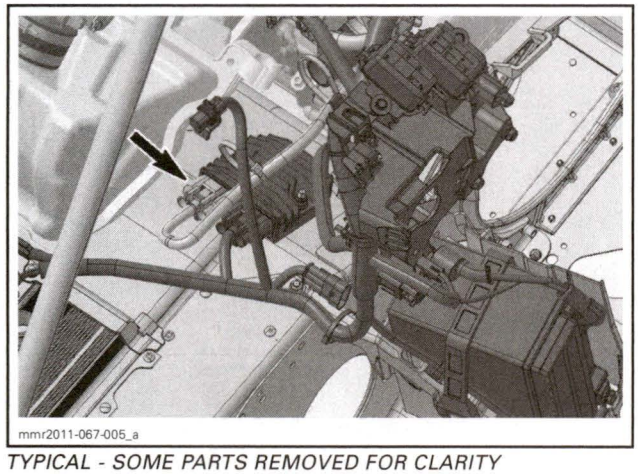
TIGHTENING SEQUENCE

8. Install all other removed parts, refer to applicable subsections.

STATOR

Stator Connector Access

1. Move fuel tank backward. Refer to *MOVING FUEL TANK REARWARD FOR SERVICING* in *FUEL TANK AND FUEL PUMP* subsection.
2. Disconnect magneto connector from voltage regulator.



TYPICAL - SOME PARTS REMOVED FOR CLARITY

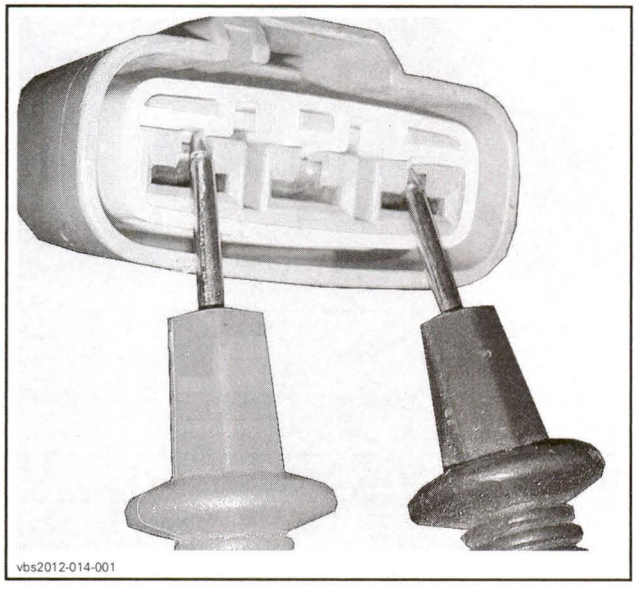
Stator Continuity Test

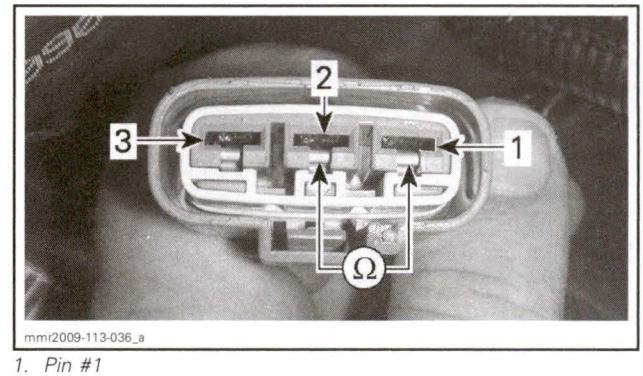
1. Disconnect the magneto connector from voltage regulator, refer to *STATOR CONNECTOR ACCESS* in this subsection.
2. Set multimeter to Ω.

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

3. Probe between each pair of YELLOW wires by touching (NOT inserting) terminals lock tabs as shown.

NOTICE **Never insert a multimeter probe into a terminal as it would ruin the terminal.**





1. *Pin #1*
2. *Pin #2*
3. *Pin #3*

4. Read resistance as per following table.

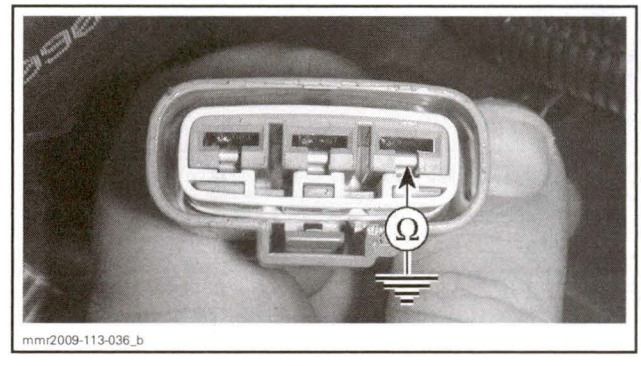
STATOR CONTINUITY TEST	
YELLOW WIRES (EACH PAIR)	RESISTANCE @ 20°C (68°F)
Pins 1 and 2	0.1 - 1 Ω
Pins 1 and 3	
Pins 2 and 3	

If any resistance reading is not as specified, the stator or the wiring (including connector) is open and needs to be repaired or replaced.

If resistance is good, perform the stator insulation test.

Stator Insulation Test

1. Connect multimeter between any YELLOW wire and chassis ground.



2. Read resistance.

STATOR INSULATION TEST	
PROBE POSITIONS	RESISTANCE @ 20°C (68°F)
Any YELLOW wire and chassis ground	Infinity (OL)

If any resistance reading is not as specified, the stator or the wiring is shorted to ground and needs to be repaired or replaced.

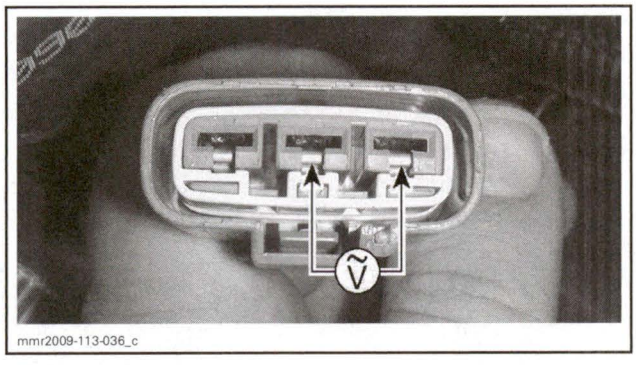
If the insulation test is good, perform the output voltage test.

Stator Output Voltage Test

1. Disconnect stator at voltage regulator.

NOTE: To ease access, move fuel tank back carefully, but do not disconnect. Refer to *FUEL TANK AND FUEL PUMP*.

2. Start engine and let it reach its operating temperature.
3. Set multimeter to Vac scale.
4. With engine idling, connect multimeter between each pair of YELLOW wires.



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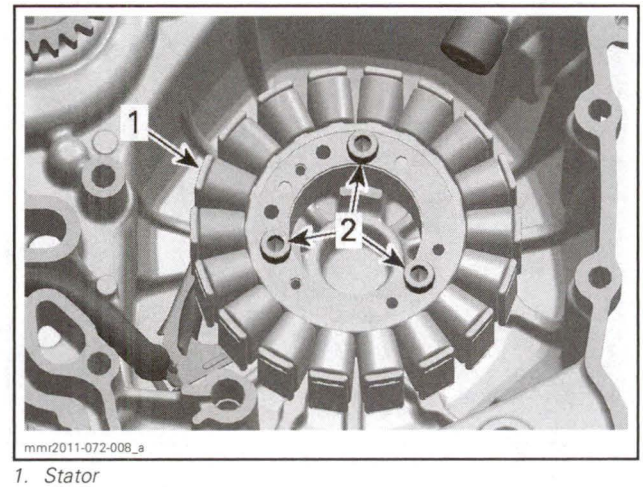
5. Read voltage.

STATOR OUTPUT VOLTAGE TEST		
TEST ENGINE SPEED	TERMINAL	VOLTAGE
Idle speed	1 and 2	± 25 Vac
	1 and 3	
	2 and 3	

If any voltage reading is significantly lower than specification, replace the stator.

Stator Removal

1. Remove the *MAGNETO COVER*, see procedure in this subsection.
2. Remove stator retaining screws.



mmr2011-072-008_a

1. Stator
2. Stator retaining screws

3. Remove stator.

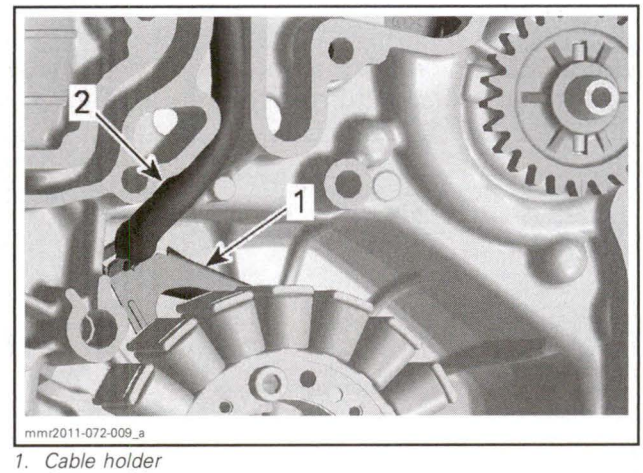
Stator Inspection

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

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

Stator Installation

1. Ensure stator cable is underneath cable holder during installation of stator.



mmr2011-072-009_a

1. Cable holder
2. Stator cable

2. Install stator retaining screws and tighten to specified torque.

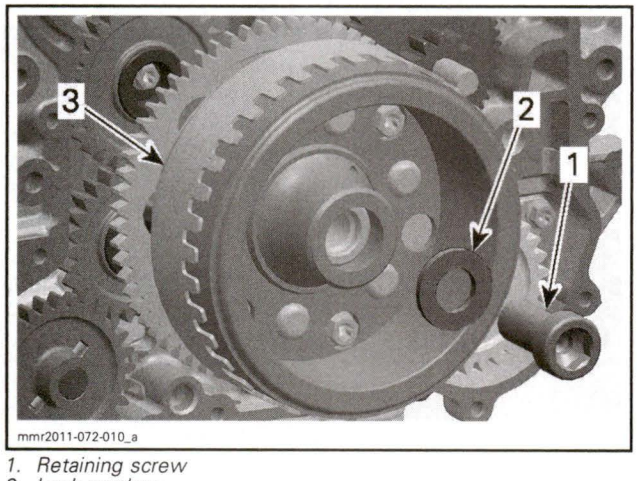
STATOR RETAINING SCREWS	
Service product	LOCTITE 243 (BLUE) (P/N 293 800 060)
Tightening torque	9 N•m ± 1 N•m (80 lbf•**in** ± 9 lbf•**in**)

3. Reinstall *MAGNETO COVER*, see procedure in this subsection.

ROTOR

Rotor Removal

1. Remove *MAGNETO COVER*, see procedure in this subsection.
2. Lock crankshaft. Refer to *BOTTOM END* subsection.
3. Remove rotor retaining screw and lock washer.

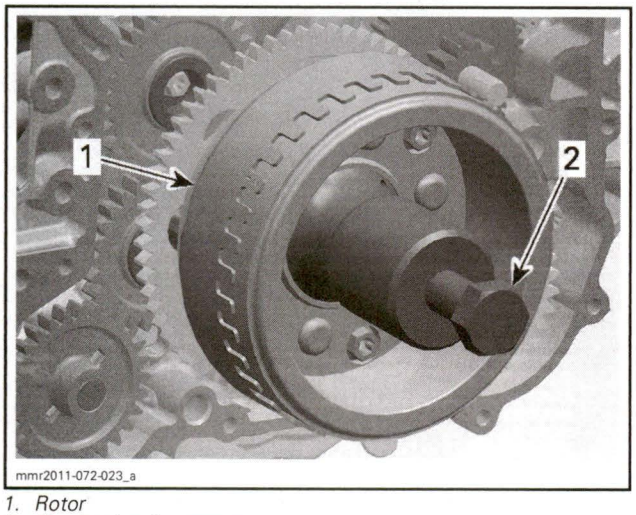


1. Retaining screw
2. Lock washer
3. Rotor

4. Remove rotor.

REQUIRED TOOLS	
CRANKSHAFT PROTECTOR (P/N 529 036 213)	
FLYWHEEL PULLER (P/N 420 976 235)	

NOTE: Apply some grease on the crankshaft protector surface to ease puller operation.



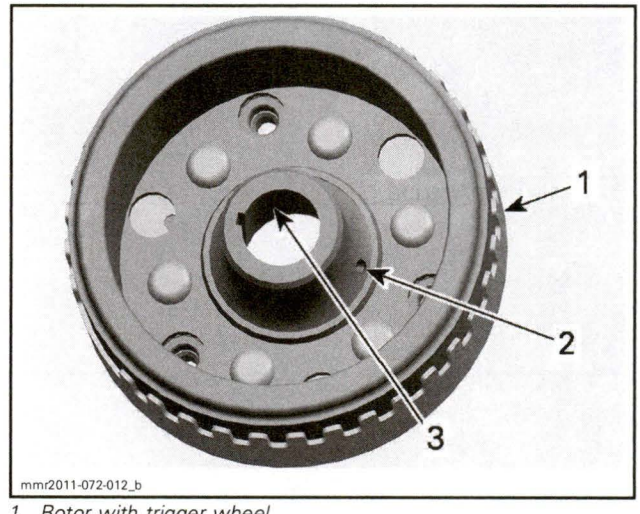
1. Rotor
2. Flywheel puller screw

Rotor Inspection

Check the inner side of the rotor for scratches or other damage.

Check keyway for wear or damages.

Check if trigger wheel teeth are bent or otherwise damaged.



1. Rotor with trigger wheel
2. Oil passage in magneto hub
3. Rotor taper

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

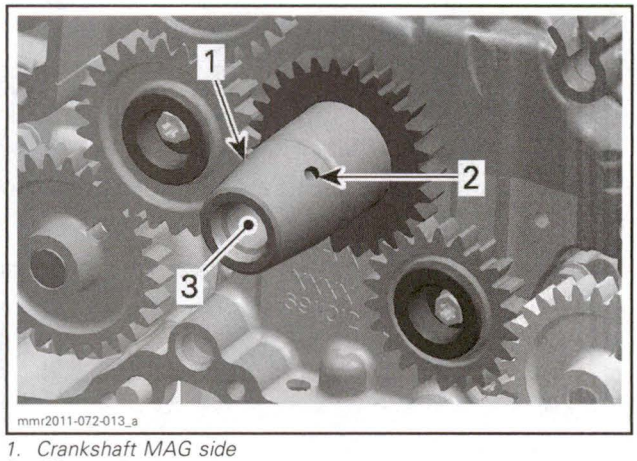
Replace parts as necessary.

Rotor Installation

Reverse the removal procedure. However, pay attention to the following.

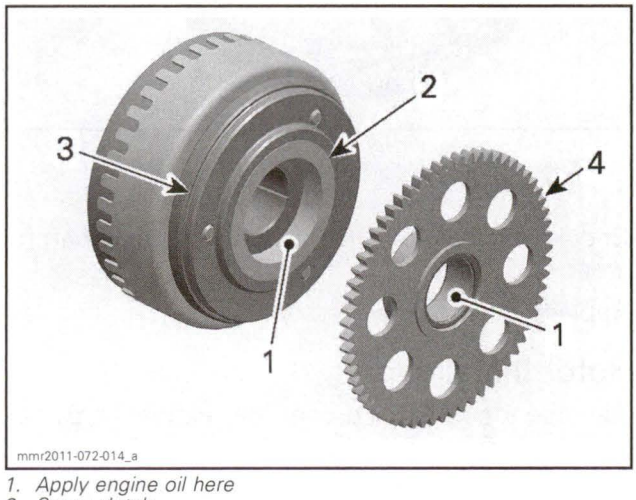
1. Blow compressed air through oil passage in magneto hub. Check if it is clogged.
2. Using PULLEY FLANGE CLEANER (P/N 413 711 809), clean:
   - The oil passage
   - The crankshaft threads
   - The crankshaft taper
   - The rotor taper.

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



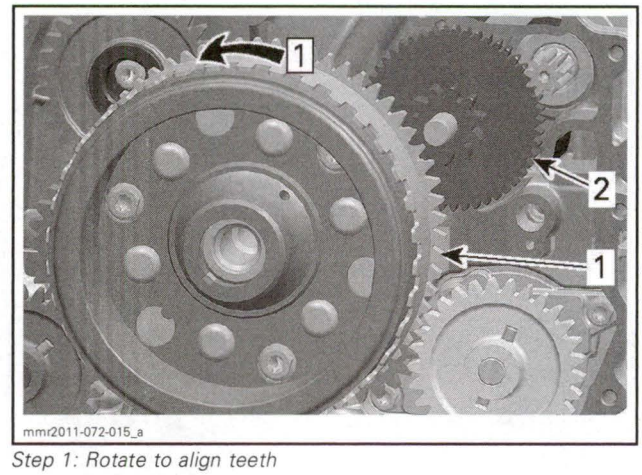
1. Crankshaft MAG side
2. Oil passage
3. Thread

3. Apply oil on sprag clutch and needle bearing.
4. Install sprag clutch gear onto the rotor.



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

5. Slide rotor along with the sprag clutch gear onto the crankshaft. The woodruff key and keyway must be aligned.
6. Rotate sprag clutch gear counterclockwise to align with starter double gear.



Step 1: Rotate to align teeth

1. Sprag clutch gear
2. Starter double gear

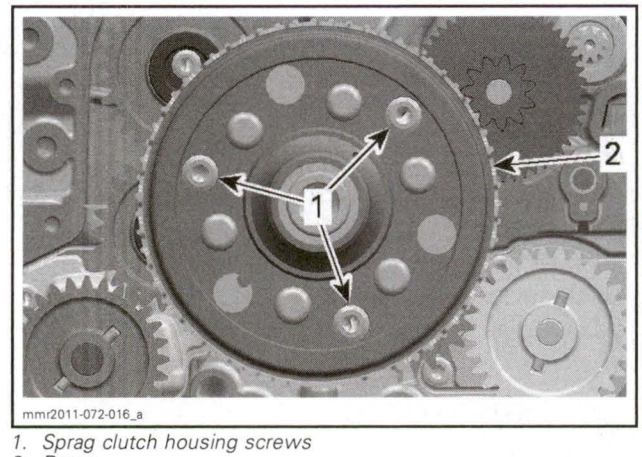
7. Install washer and retaining screw.
8. Tighten to specified torque.

ROTOR RETAINING SCREW	
Service product	LOCTITE 243 (BLUE) (P/N 293 800 060)
Tightening torque	150 N•m ± 10 N•m (111 lbf•ft ± 7 lbf•ft)

SPRAG CLUTCH

Sprag Clutch Removal

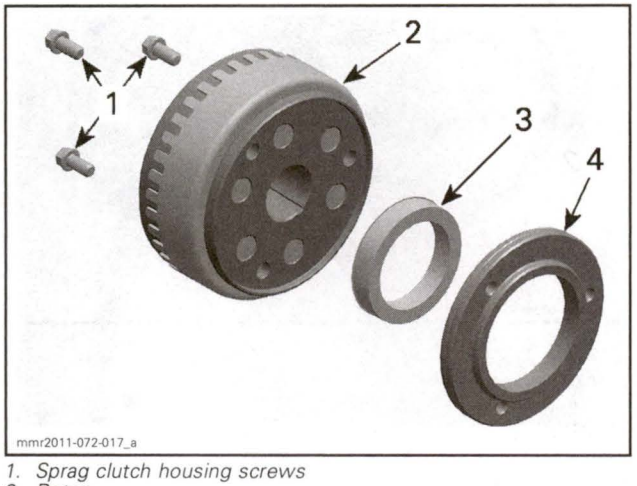
1. Remove the *MAGNETO COVER*, see procedure in this subsection.
2. Lock crankshaft. Refer to *CYLINDER BLOCK* subsection.
3. Loosen and remove sprag clutch housing screws.



1. Sprag clutch housing screws
2. Rotor

4. Remove *ROTOR*, see procedure in this subsection.
5. Remove sprag clutch housing.

6. Remove sprag clutch from sprag clutch housing.



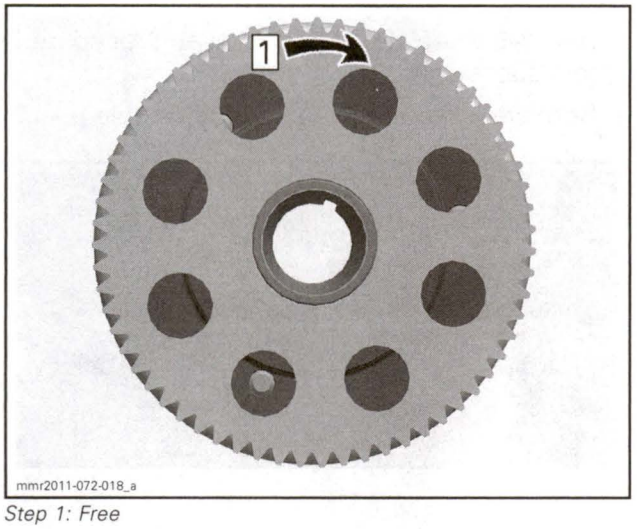
1. *Sprag clutch housing screws*
2. *Rotor*
3. *Sprag clutch*
4. *Sprag clutch housing*

Sprag Clutch Inspection

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

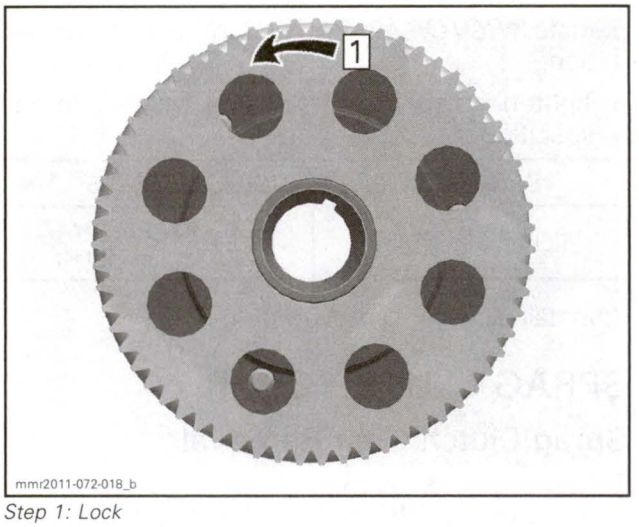
Check the collar of the sprag clutch gear, refer to *SPRAG CLUTCH GEAR* in this subsection.

Rotate sprag clutch gear clockwise. Gear must rotate freely.



Step 1: Free

Rotate sprag clutch gear counterclockwise. Gear must lock.



Step 1: Lock

Sprag Clutch Installation

1. Clean sprag clutch housing with a parts cleaner.

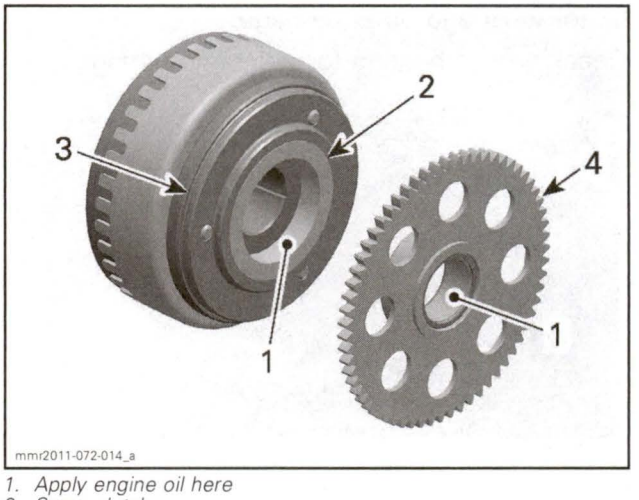
NOTICE **Threads of sprag clutch housing must be free of any lubricants.**

SPRAG CLUTCH HOUSING	
Service product	PULLEY FLANGE CLEANER (P/N 413 711 809)

2. Apply thread locker on threads of sprag clutch housing screws.

SPRAG CLUTCH HOUSING SCREWS	
Service product	LOCTITE 648 (GREEN) (P/N 413 711 400)

3. Loosely install screws.
4. Apply engine oil on sprag clutch and sprag clutch gear needle bearing.



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

5. Install *ROTOR*, see procedure in this subsection.
6. Tighten sprag clutch housing screws to the specified torque.

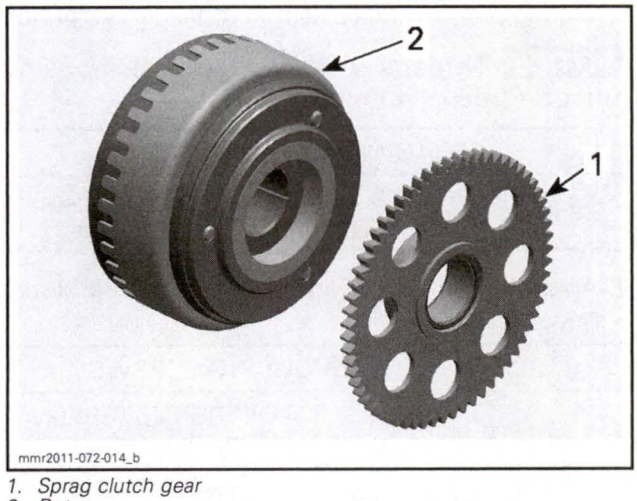
SPRAG CLUTCH HOUSING SCREWS	
Tightening torque	30 N•m ± 2 N•m (22 lbf•ft ± 1 lbf•ft)

7. Install all other removed parts.

SPRAG CLUTCH GEAR

Sprag Clutch Gear Removal

1. Remove rotor and sprag clutch gear together. Refer to *ROTOR* in this subsection.
2. Pull sprag clutch gear out of the rotor.

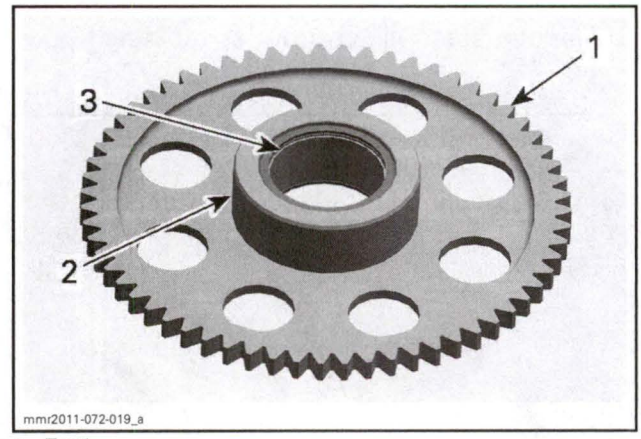


1. Sprag clutch gear
2. Rotor

Sprag Clutch Gear Inspection

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

Check needle bearing for wear and pittings.



1. Teeth
2. Collar
3. Needle bearing

Replace sprag clutch gear if necessary.

Sprag Clutch Gear Installation

Reverse the removal procedure. However, pay attention to the following.

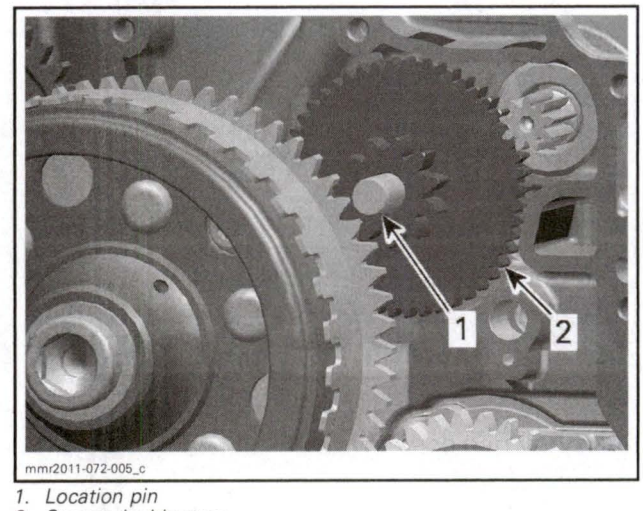
NOTE: Apply engine oil on needle bearing and collar of sprag clutch gear.

STARTER DRIVE GEARS

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

Starter Drive Gear Removal

1. Remove *MAGNETO COVER*, see procedure in this subsection.
2. Remove location pin and starter double gear.



1. Location pin
2. Starter double gear

Starter Drive Gear Inspection

Inspect starter drive gears and location pin for wear and damage.

Replace parts if necessary.

Starter Drive Gear Installation

Reverse the removal procedure. However, pay attention to the following.

Apply engine oil on the location pin.

STARTER

Starter Operation Test

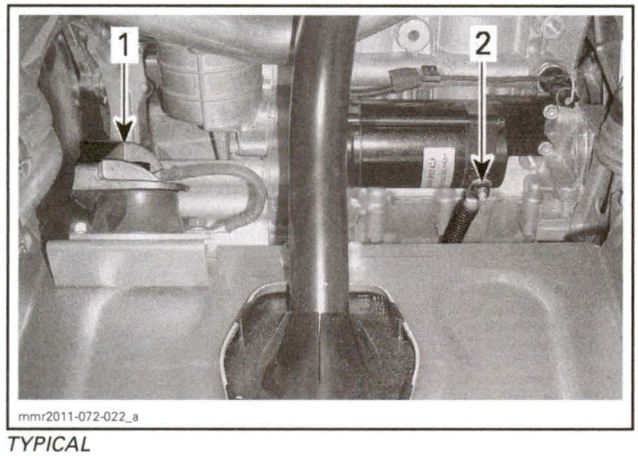
Before carrying out any starter test, make sure:
- Battery is fully charged and in good condition
- Cable connections at battery, starter and solenoid are tight
- Cables are in good condition.

1. Disconnect the negative battery cable.

⚠ WARNING

Sparks can occur when connecting jumper cables. To avoid fire hazard, be sure that no flammable liquids or fuel vapors are in the test area.

2. Using booster cables and a fully charged battery (or a power pack), carefully supply current directly to the starter.
   2.1 Connect the negative booster cable or power pack cable to a good ground such as an engine support.
   2.2 Momentarily touch the starter positive terminal.



TYPICAL
1. Engine support
2. Starter positive terminal

If starter turns at normal speed, test the starting circuit. Refer to *STARTING SYSTEM* subsection.

If starter turns slowly, carry out the *STARTER VOLTAGE DROP TEST (AT BATTERY).*

If starter does not turn, replace starter.

Starter Voltage Drop Test (at Battery)

NOTE: This test will confirm if starter draws too much current. Battery must be fully charged and in good condition.

1. Set the multimeter to Vdc.
2. Probes battery posts.
3. Crank engine in drowned mode (accelerator held all the way in).
4. Read voltage while cranking.

NOTE: Battery voltage will drop approximately 2 Vdc and fluctuate with starter cranking load.

If the result is close to battery voltage, the starter is in good condition.

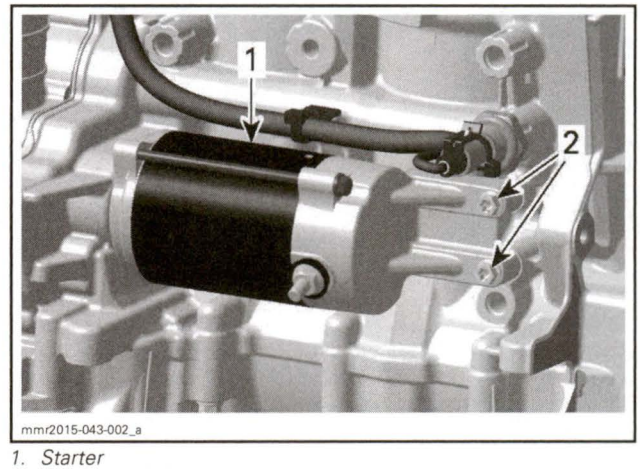
If the result is below battery voltage (- 2 Vdc and more), the starter may be defective.

Starter Access

Refer to appropriate section and remove:
- LH side panel
- Drive belt guard.

Starter Removal

1. Disconnect the BLACK (-) cable from the battery.
2. Remove starter cable from starter.
3. Remove starter retaining screws.



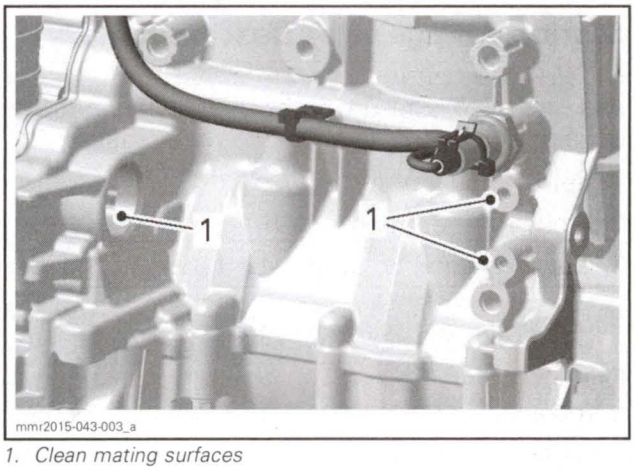
1. Starter
2. Starter retaining screws

4. Remove starter from engine.

Starter Installation

1. Ensure starter and engine mating surfaces are free of debris.

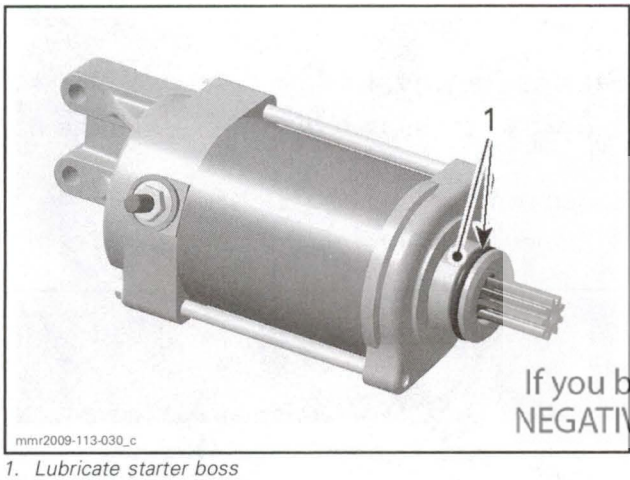
NOTICE Serious problems may arise if the starter is not properly aligned.



1. Clean mating surfaces

2. Lubricate starter boss and starter O-ring before installation.

STARTER BOSS +O-RING	
Service product	KLÜEBER PASTE 46 MR 401 (P/N 420 297 616)



1. Lubricate starter boss
2. Lubricate starter O-ring

3. Insert starter gear in engine.
4. Install starter screws and tighten to specified torque.

STARTER SCREWS	
Tightening torque	9 N•m ± 1 N•m (80 lbf•**in** ± 9 lbf•**in**)

5. Connect starter cable to starter terminal and tighten nut to specified torque.

STARTER CABLE NUT	
Tightening torque	7 N•m ± 1 N•m (62 lbf•**in** ± 9 lbf•**in**)

6. Install all other removed parts.
7. Reconnect BLACK (-) cable on battery post.

⚠ WARNING

Always connect RED (+) starter cable first, and BLACK (-) battery cable last. Whenever connecting the RED (+) cable to the starter motor, always make sure the BLACK (-) battery cable is disconnected to prevent electric shock.

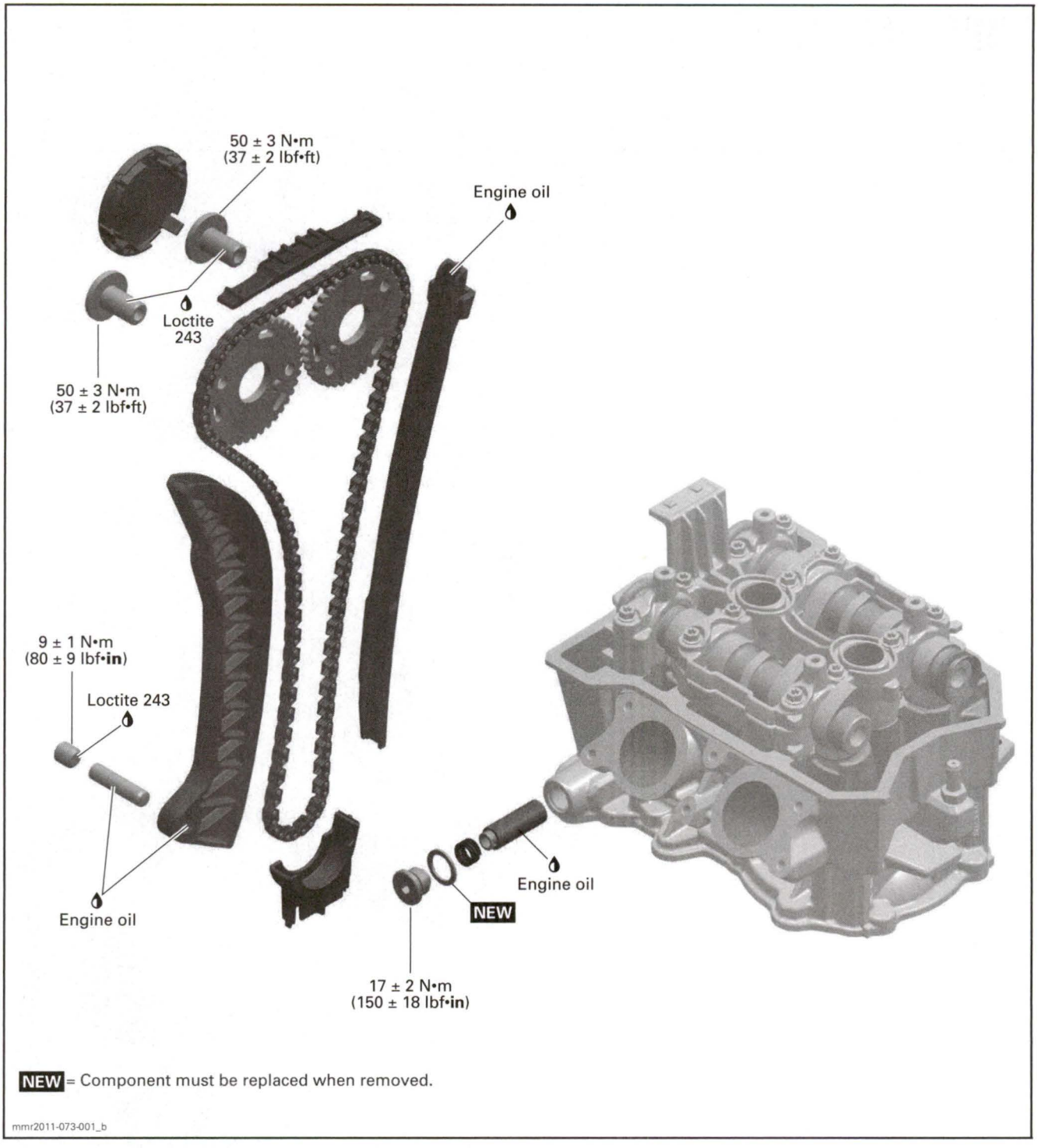
8. Test for proper starter operation.

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TIMING CHAIN

SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 243 (BLUE)	293 800 060	100, 105
LOCTITE 767 (ANTISEIZE LUBRICANT)	293 800 070	103
SUPER LUBE GREASE	293 550 030	103



NEW = Component must be replaced when removed.

mmr2011-073-001_b

GENERAL

Engine removal is necessary to work on the following components:

- Timing chain
- Timing chain guide (tensioner side).

When disassembling parts that are duplicated in the engine, (e.g.: valves, springs, etc.), it is strongly recommended to note their position and to keep the parts of the same assembly as a "group". If you find a defective component, it will be much easier to find the cause of the failure. Since parts were broken-in together during engine operation, they will maintain their matched fit when reassembled together within their "group".

TROUBLESHOOTING

The following is provided to help in diagnosing the probable source of troubles. It is a guideline and should not be assumed to provide solutions to every cause of all problems.

UNUSUAL ENGINE NOISE OR VIBRATIONS

1. **Faulty chain tensioner.**
   - *Replace chain tensioner.*
2. **Chain guide(s) worn out.**
   - *Replace chain guide(s).*
3. **Stretched timing chain or worn sprockets.**
   - *Replace timing chain and sprockets.*
4. **Camshaft timing gear screws loose.**
   - *Retighten screws to recommended torque.*
5. **Incorrect camshaft timing adjustment.**
   - *Replace damaged components and readjust camshaft timing.*

ENGINE LACKS ACCELERATION OR POWER

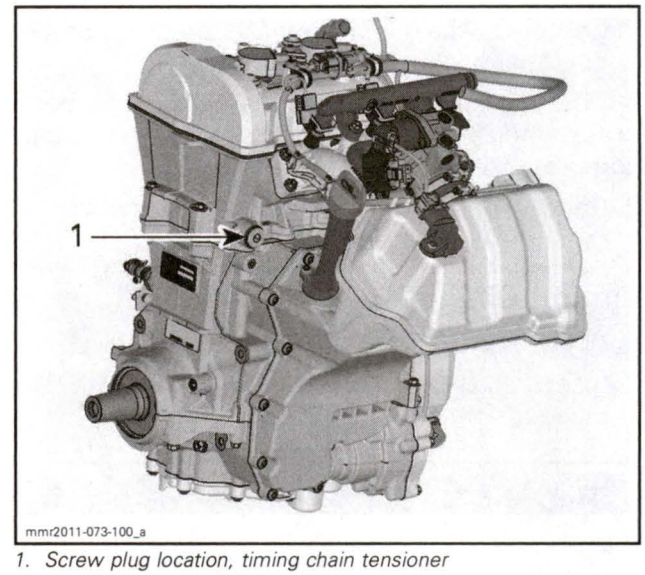
1. **Incorrect camshaft timing adjustment.**
   - *Replace damaged components and readjust camshaft timing.*

PROCEDURES

TIMING CHAIN TENSIONER

Timing Chain Tensioner Location

The timing chain tensioner is located in the cylinder head beside the intake port of the PTO cylinder.



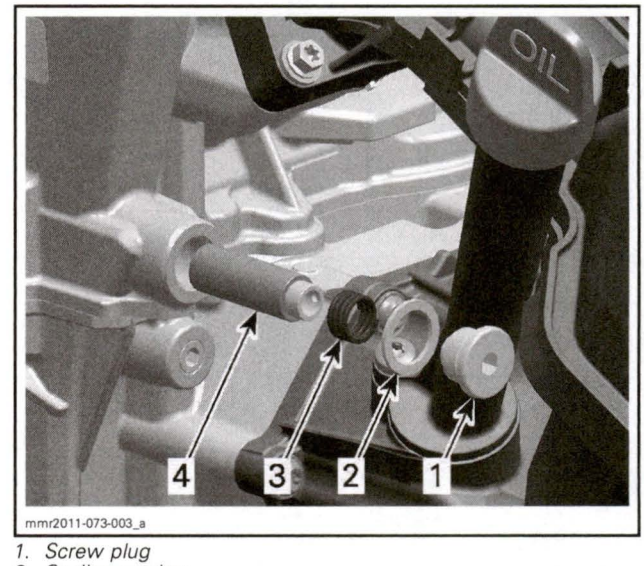
1. Screw plug location, timing chain tensioner

Timing Chain Tensioner Access

Remove driven pulley and countershaft. Refer to *DRIVEN PULLEY AND COUNTERSHAFT* subsection.

Timing Chain Tensioner Removal

1. Lock crankshaft, refer to *BOTTOM END* subsection.
2. Remove screw plug and discard the sealing washer.
3. Pull out spring and chain tensioner.



1. Screw plug
2. Sealing washer
3. Spring
4. Chain tensioner

Timing Chain Tensioner Inspection

1. Check chain tensioner for scoring and freedom of movement in bore.

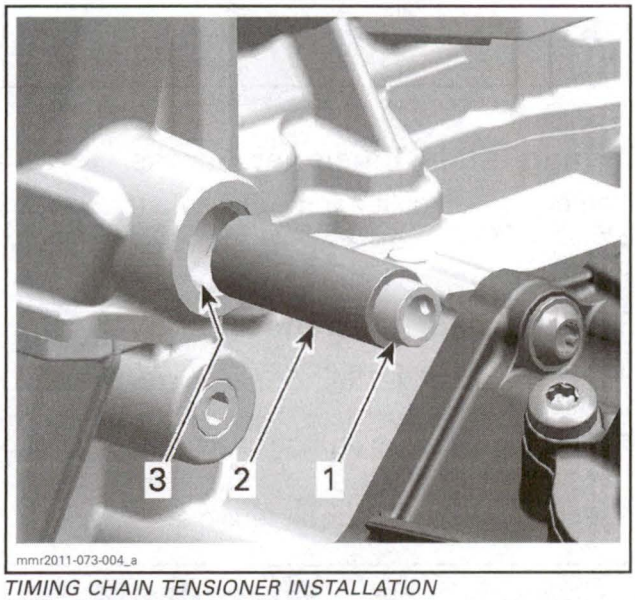
2. Compress chain tensioner and check for proper operation.

NOTE: The chain tensioner is difficult to compress when properly charged with oil, and easily compressed when it is not.

3. Check spring for straightness, corrosion and other visible damage.

Timing Chain Tensioner Installation

1. Apply engine oil on chain tensioner.
2. Insert chain tensioner in its bore with the plunger pointing outwards.



TIMING CHAIN TENSIONER INSTALLATION
1. *Plunger*
2. *Chain tensioner*
3. *Tensioner bore in cylinder head*

3. Install spring on chain tensioner.
4. Tighten screw plug to specified torque.

SCREW PLUG TIMING CHAIN TENSIONER	
Sealing washer	NEW
Tightening torque	17 N•m ± 2 N•m (150 lbf•**in** ± 18 lbf•**in**)

5. Install all other removed parts.

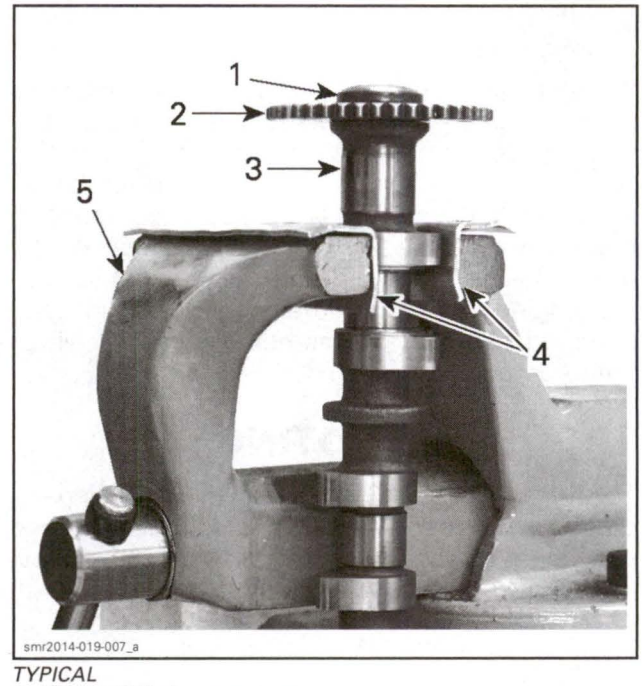
CAMSHAFT TIMING GEARS

Camshaft Timing Gear Removal

1. Remove camshaft assembly. Refer to *BOTTOM END* subsection.
2. Clamp camshaft in a vice using aluminium protectors.

NOTICE Take care not damaging the cams.

3. Unscrew and remove camshaft timing gear screw.
4. Remove camshaft timing gear.



TYPICAL
1. *Camshaft timing gear screw*
2. *Camshaft timing chain gear*
3. *Camshaft*
4. *Aluminium protectors*
5. *Vice*

Camshaft Timing Gear Inspection

Check camshaft timing gears for wear or deterioration. If a gear is worn or damaged, replace camshaft timing gears and timing chain as a set.

NOTE: For crankshaft timing gear inspection, refer to *BOTTOM END* subsection.

Camshaft Timing Gear Installation

Reverse the removal procedure. However, pay attention to the following details.

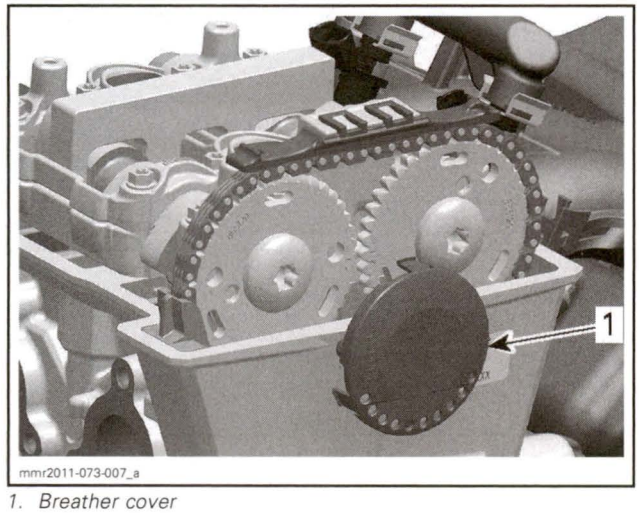
Tighten camshaft timing gear screw to specification.

NOTICE Do not torque timing gear screws when camshafts are installed in cylinder head to avoid overstressing timing chain.

TIMING GEAR SCREWS	
Service product	LOCTITE 243 (BLUE) (P/N 293 800 060)
Tightening torque	50 N•m ± 3 N•m (37 lbf•ft ± 2 lbf•ft)

NOTICE Improper camshaft timing will damage engine components. Make sure camshafts and crankshaft are still locked. If not, lock them before beginning this procedure. Refer to *CAMSHAFTS* in the *TOP END* subsection.

Install breather cover on exhaust camshaft.



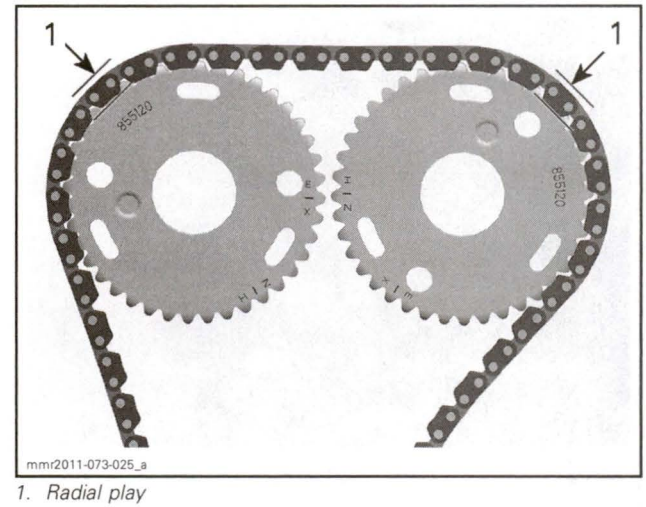
1. Breather cover

Install remaining parts.

TIMING CHAIN

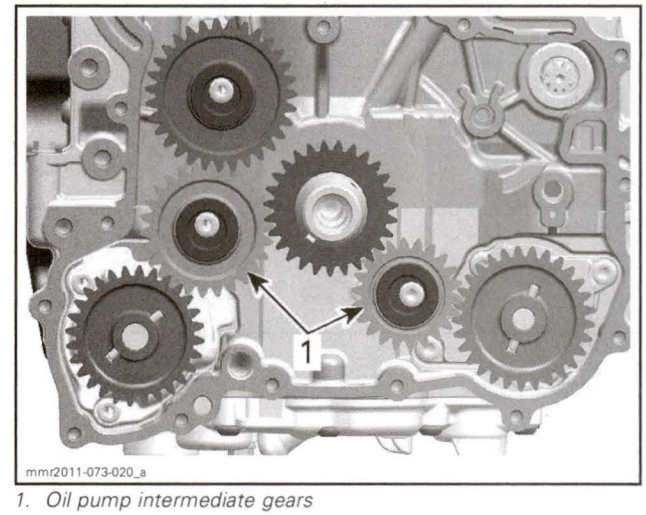
Timing Chain Removal

1. Remove engine from vehicle. Refer to *ENGINE REMOVAL AND INSTALLATION* subsection.
2. Remove air intake manifold, refer to *AIR INTAKE SYSTEM* subsection.
3. Remove valve cover, refer to *BOTTOM END* subsection.
4. Refer to *LUBRICATION SYSTEM* subsection and remove the following parts:
   - Oil tank
   - Oil pressure regulator valve
   - Oil cooler
   - Oil sump cover.
5. Refer to *COOLING SYSTEM* subsection and remove following parts:
   - Water pump housing
   - Thermostat.
6. Check timing chain for excessive radial play while still installed on timing gears.



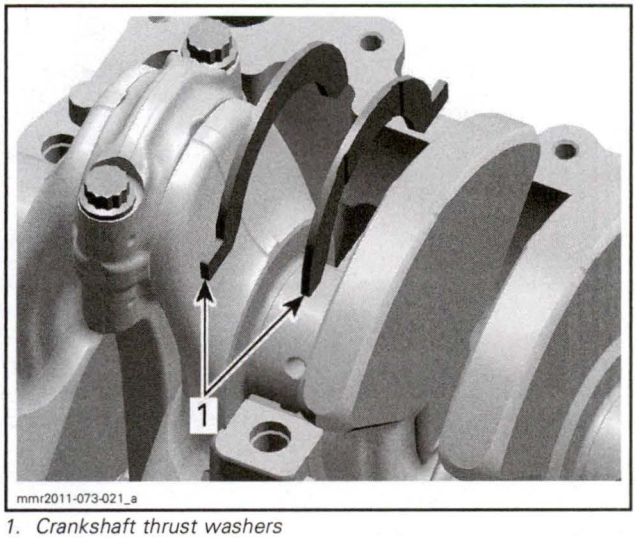
1. Radial play

7. Remove the *CAMSHAFTS*, refer to *BOTTOM END* subsection.
8. Refer to *MAGNETO AND STARTER* subsection and remove the following parts:
   - Magneto cover
   - Rotor
   - Starter drive gears.
9. Remove oil pump intermediate gears, refer to *LUBRICATION SYSTEM* subsection.



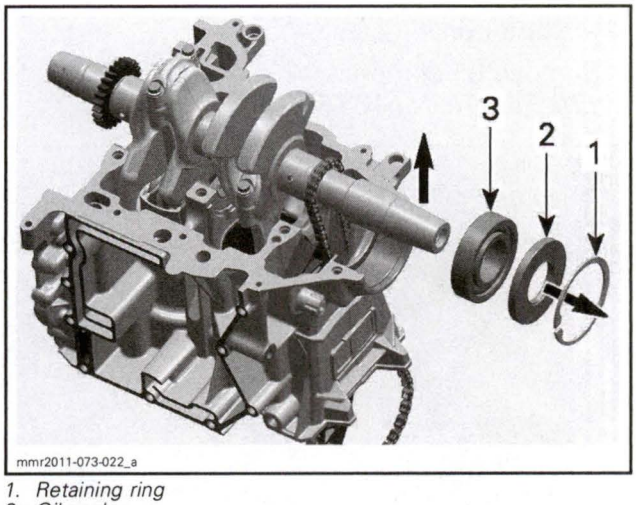
1. Oil pump intermediate gears

10. Remove crankshaft locking bolt.
11. Separate cylinder block, refer to *BOTTOM END* subsection.
12. Remove crankshaft thrust washers.



1. Crankshaft thrust washers

13. Remove retaining ring that secures the oil seal and PTO ball bearing.
14. Slightly lift the crankshaft and remove oil seal and PTO ball bearing.

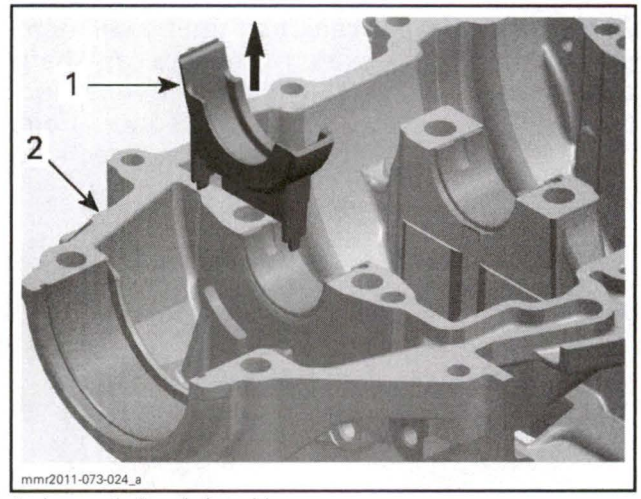


1. Retaining ring
2. Oil seal
3. Ball bearing

15. Remove timing chain.

NOTE: Make a mark on the timing chain to indicate the operating direction of the chain before removal.

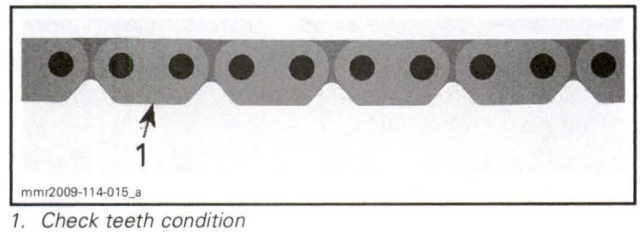
16. Remove lower timing chain guide from lower half of cylinder block.



1. Lower timing chain guide
2. Lower half of cylinder block

Timing Chain Inspection

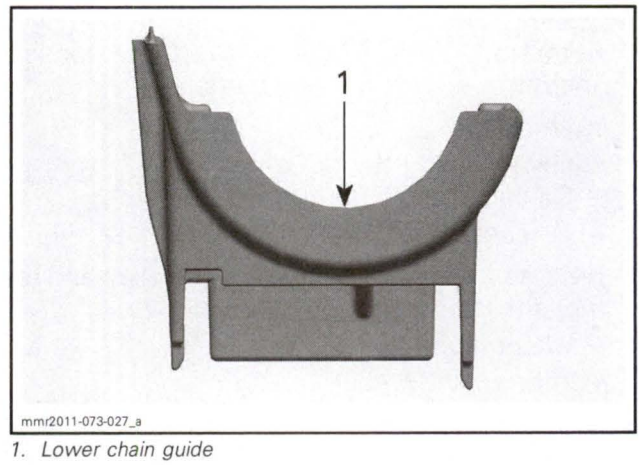
Check timing chain for wear and teeth condition.



1. Check teeth condition

NOTICE **If timing chain is excessively worn or damaged, replace timing chain and camshaft timing gears as a set.**

Check lower chain guide for wear, cracks or deformation. Replace as required.



1. Lower chain guide

Replace lower chain guide if timing chain wear grooves are visible.

CHAIN GUIDE GROOVE DEPTH	
SERVICE LIMIT	No timing chain wear groove allowed

NOTE: Also check the chain guide, tensioner side. Refer to *CHAIN GUIDE INSPECTION (TENSIONER SIDE)* further in this subsection.

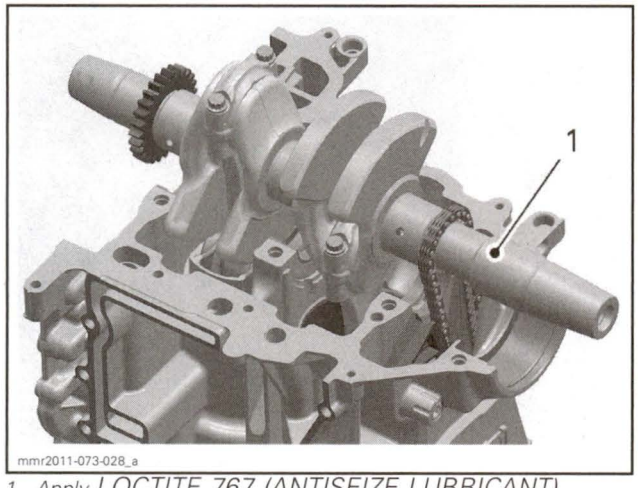
Timing Chain Installation

Reverse of the removal procedure. However, pay attention to the following details.

1. Install timing chain.

NOTE: If the same timing chain is reinstalled, be sure to reinstall it in the same operating direction as marked during removal procedure.

2. Apply LOCTITE 767 (ANTISEIZE LUBRICANT) (P/N 293 800 070) on crankshaft at PTO bearing surface area.

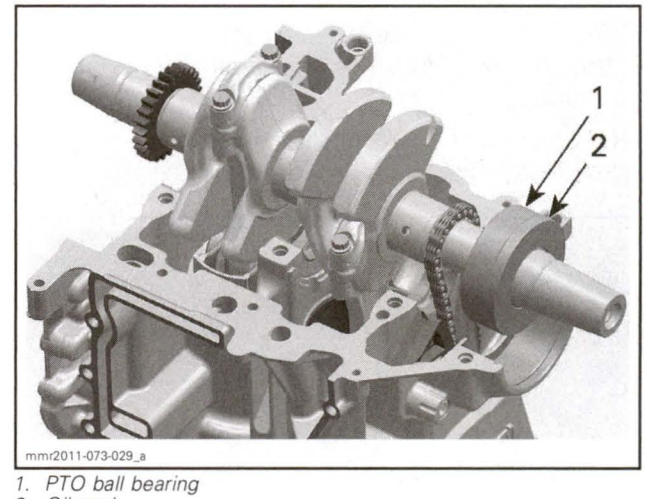


1. Apply LOCTITE 767 (ANTISEIZE LUBRICANT) (P/N 293 800 070) here

NOTE: After bearing installation, clean oil seal running surface on crankshaft.

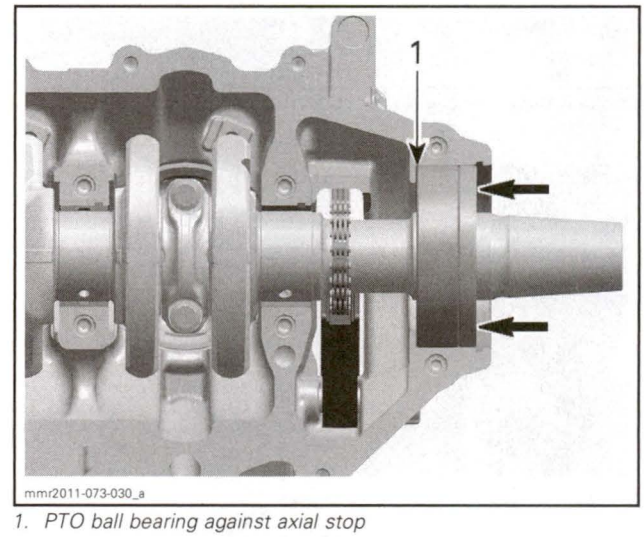
3. Lubricate sealing lip of oil seal with SUPER LUBE GREASE (P/N 293 550 030).
4. Reinstall PTO ball bearing and oil seal on crankshaft.

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



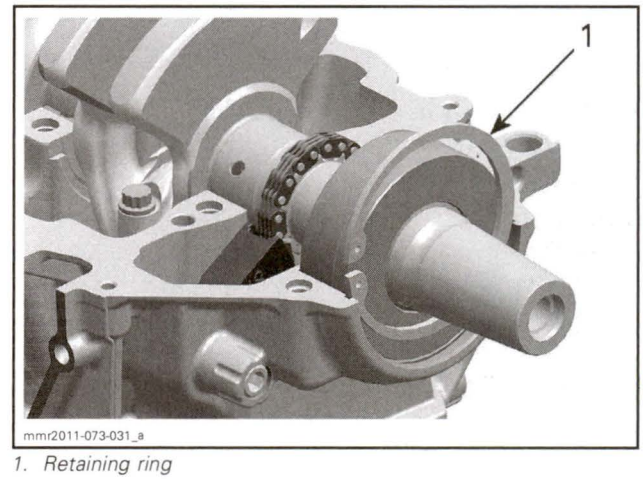
1. PTO ball bearing
2. Oil seal

5. Install crankshaft and push ball bearing and oil seal against axial stop.



1. PTO ball bearing against axial stop

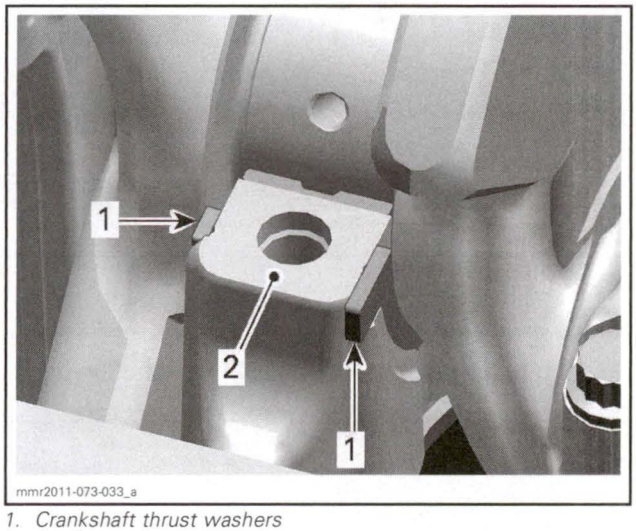
6. Install retaining ring.



1. Retaining ring

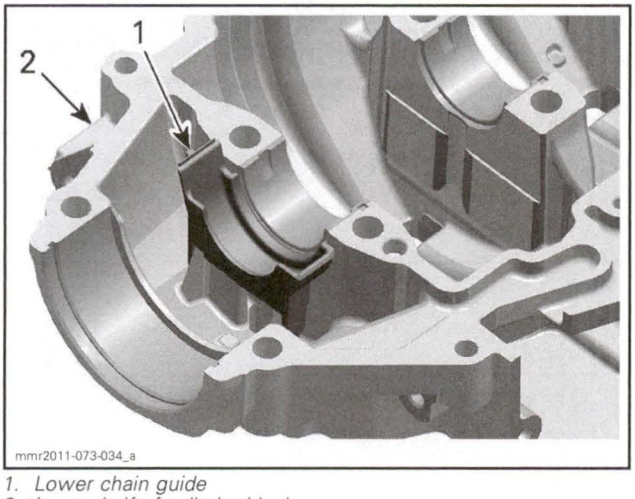
7. Properly install the crankshaft thrust washers with the slots facing against crankshaft counterweights.

NOTE: Crankshaft thrust washers must be flush with the cylinder block sealing surface.



1. Crankshaft thrust washers
2. Sealing surface

8. Reinstall lower chain guide in lower half of cylinder block.



1. Lower chain guide
2. Lower half of cylinder block

9. Reassemble cylinder block, refer to *BOTTOM END* subsection.
10. Reinstall timing chain properly on camshaft timing gears. Refer to *CAMSHAFT INSTALLATION* in the *BOTTOM END* subsection.

NOTICE Improper camshaft timing will damage engine components.

11. Install all other removed parts.

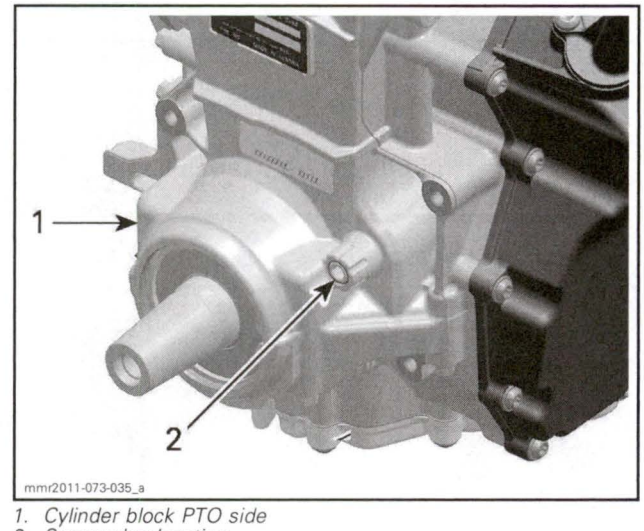
NOTE: Be sure to remove camshaft and crankshaft locking tools when timing chain is completely installed.

CHAIN GUIDE (TENSIONER SIDE)

Chain Guide Removal (Tensioner Side)

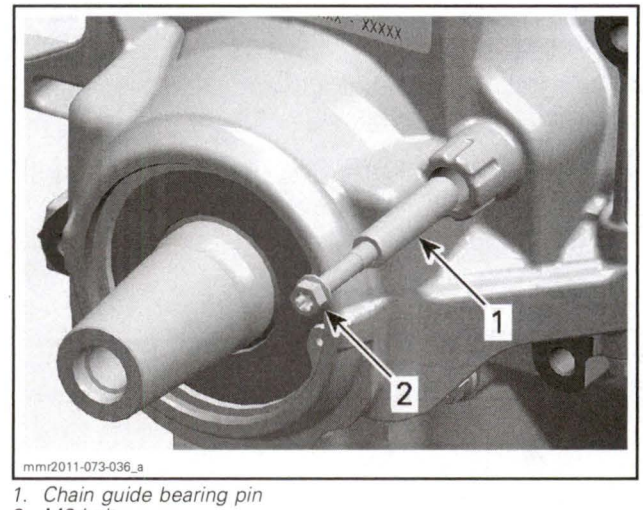
NOTE: Removal of chain guide is not recommended if there is no need for replacement.

1. Remove the *CAMSHAFTS*. Refer to *BOTTOM END* subsection.
2. Remove screw plug that covers the chain guide bearing pin.



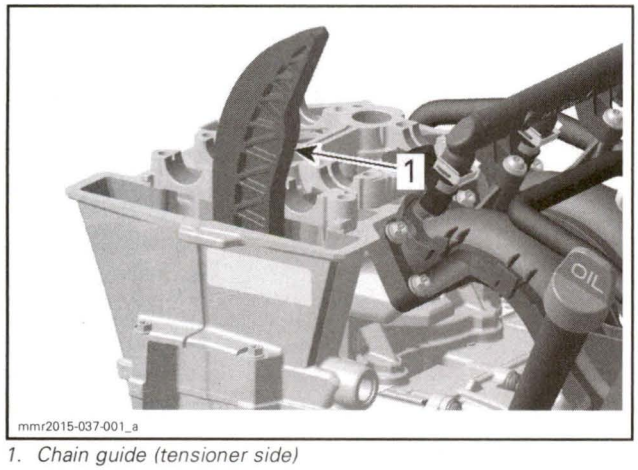
1. Cylinder block PTO side
2. Screw plug location

3. Use an M6 bolt to pull chain guide bearing pin out of cylinder block.



1. Chain guide bearing pin
2. M6 bolt

4. Remove chain guide (tensioner side).



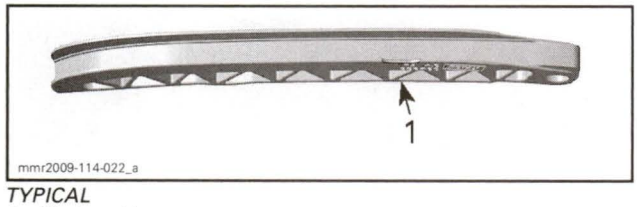
1. Chain guide (tensioner side)

Chain Guide Inspection (Tensioner Side)

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

Replace chain guide if groove depth caused by timing chain exceeds service limit.

CHAIN GUIDE GROOVE DEPTH	
SERVICE LIMIT	1 mm (.039 in)



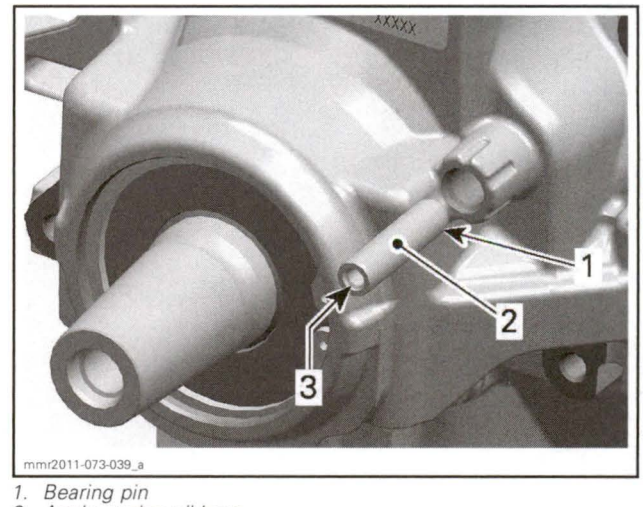
TYPICAL
1. Chain guide

Chain Guide Installation (Tensioner Side)

Reverse of the removal procedure. However, pay attention to the following details.

1. Insert chain guide.
2. Apply engine oil on bearing pin and install it with M6 threads facing outwards.

NOTICE **Ensure chain guide bearing pin is properly inserted in the chain guide.**



1. Bearing pin
2. Apply engine oil here
3. M6 threads facing outwards

3. Tighten screw plug as specified.

NOTE: Install screw plug only in final assembled cylinder block to avoid warping of sealing surface.

SCREW PLUG	
Service product	LOCTITE 243 (BLUE) (P/N 293 800 060)
Tightening torque	9 N•m ± 1 N•m (80 lbf•**in** ± 9 lbf•**in**)

4. Properly reinstall camshaft timing gears. Refer to *CAMSHAFTS* in the *TOP END* subsection.

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

TOP END

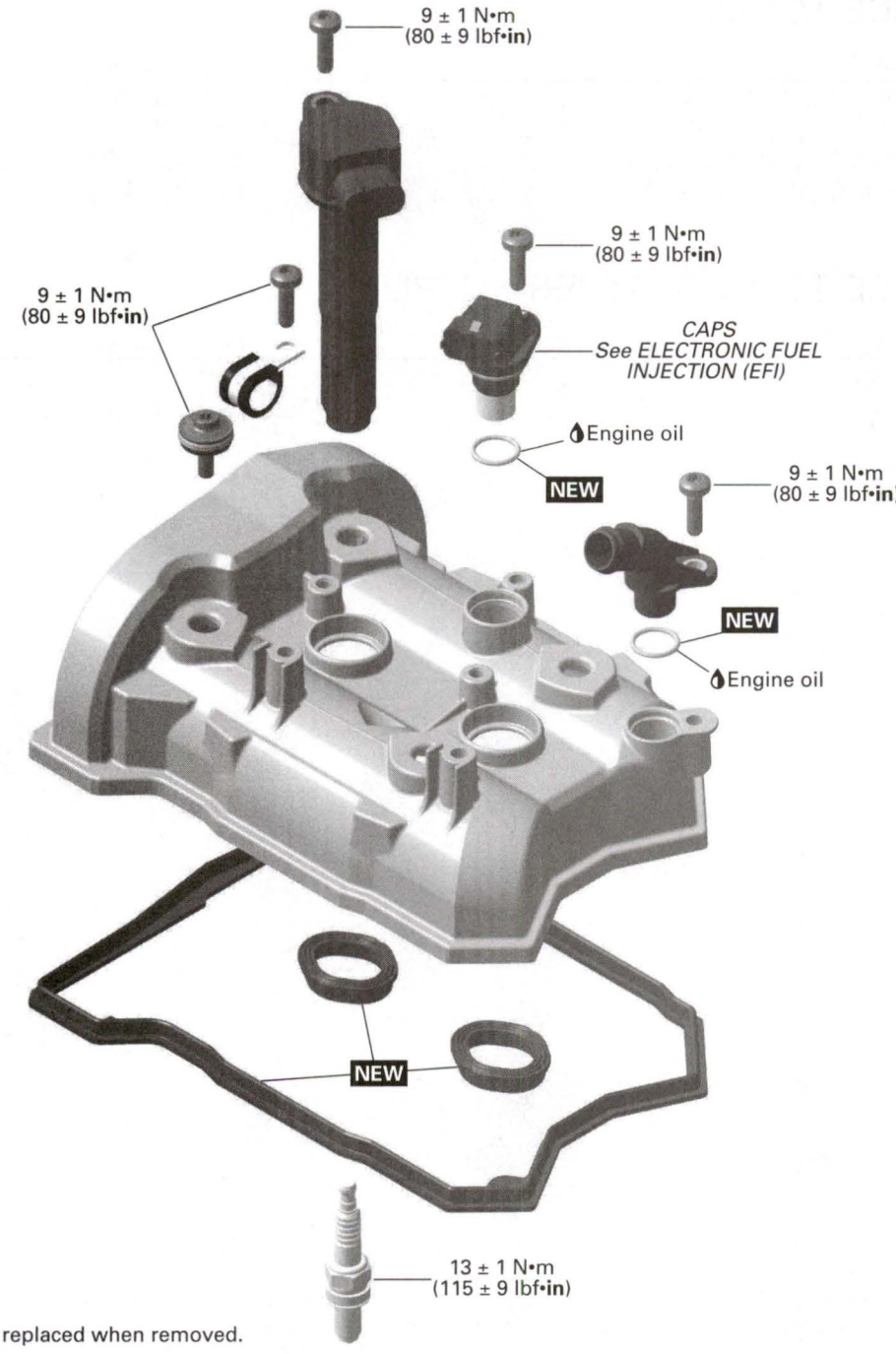
SERVICE TOOLS

Description	Part Number	Page
CAMSHAFT LOCKING TOOL	529 036 206	119
ENGINE LEAK DOWN TEST KIT	529 035 661	111
VALVE SPRING COMPRESSOR CUP	529 036 209	125
VALVE SPRING COMPRESSOR	529 035 724	125

SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
SNAP-ON VALVE HOLDER	VL2	128
SNAP-ON VALVE STEM SEAL PLIERS	YA 8230	126

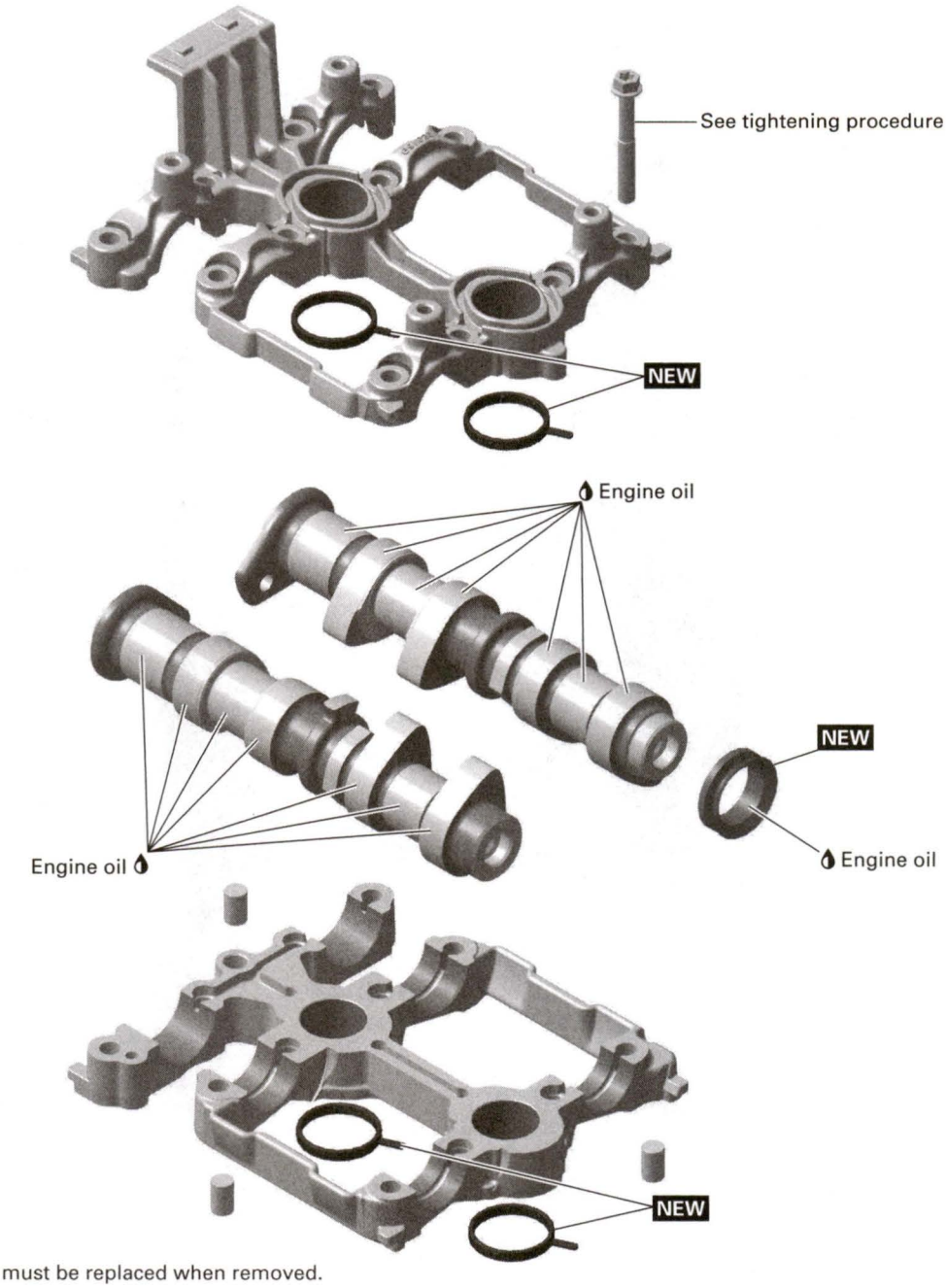
VALVE COVER



NEW = Component must be replaced when removed.

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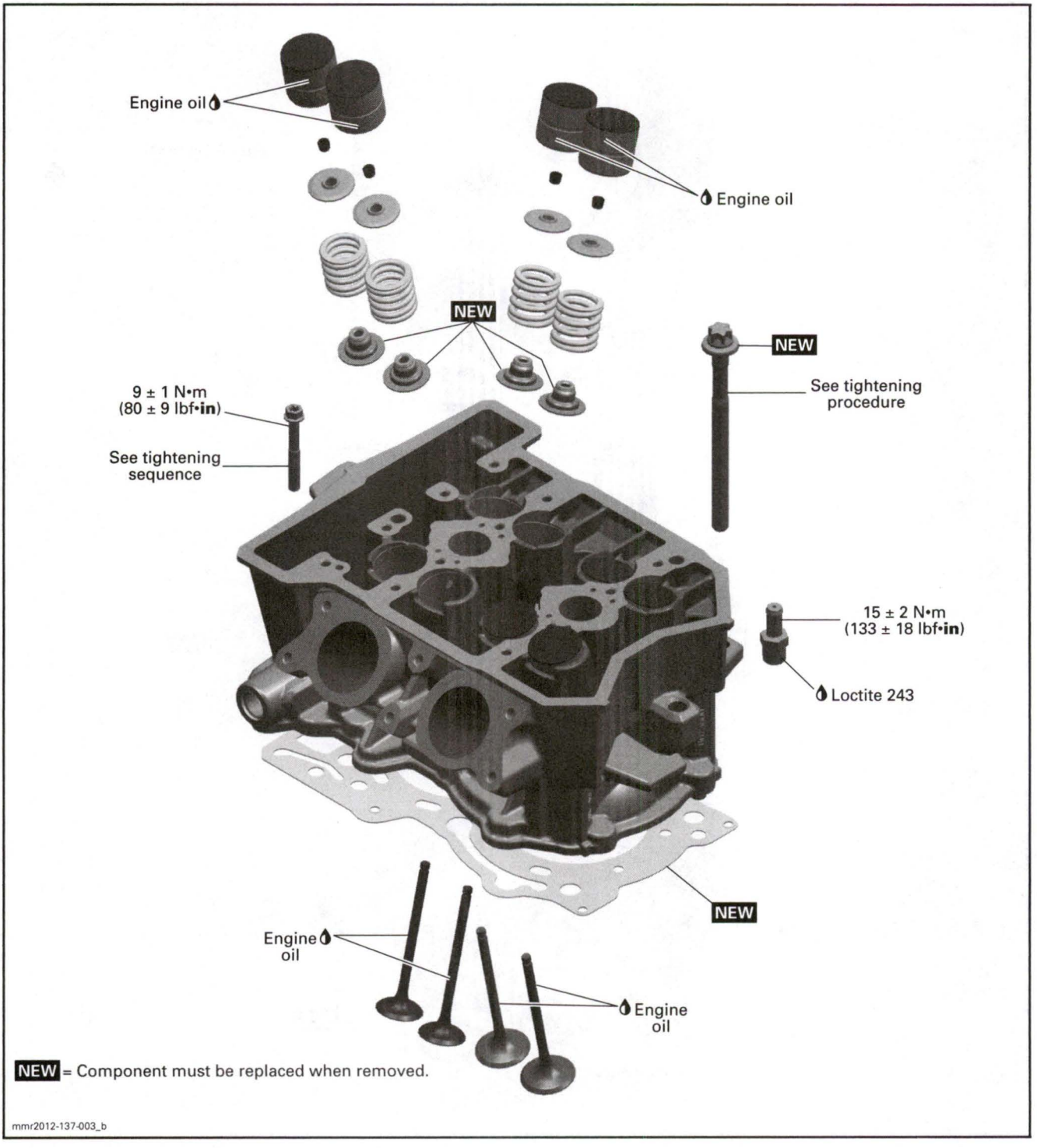
CAMSHAFTS



NEW = Component must be replaced when removed.

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CYLINDER HEAD



GENERAL

NOTE: For a better understanding, some illustrations are taken with engine out of the vehicle.

Disconnect the battery before working on the engine.

⚠ WARNING

Always disconnect BLACK (-) cable first and reconnect last.

When disassembling parts that are duplicated in the engine, (e.g.: valves, springs, etc.), it is strongly recommended to note their position and to keep the parts of the same assembly as a "group". If you find a defective component, it will be much easier to find the cause of the failure. Since parts were break-in together during the engine operation, they will keep their matched fit when parts are reassemble together within their "group".

INSPECTION

CYLINDER LEAK TEST

General

Before performing the cylinder leak test, verify the following:

- Clamp tightness
- Hoses condition.

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

⚠ CAUTION Engine parts could be hot.

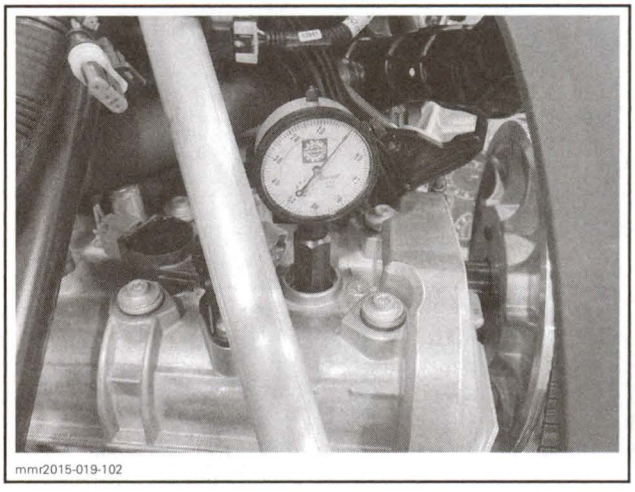
NOTE: The following steps are the same for each cylinder.

Preparation

1. Remove the *VALVE COVER*, see procedure in this subsection.
2. Remove spark plug.
3. Using the drive pulley, turn the engine counterclockwise to bring piston to TDC of compression stoke. Use a dial gauge or a suitable tool to position the piston to TDC.

NOTE: The piston must be set precisely to TDC of compression stroke. If not, the engine will continue to rotate when pressure builds up.

RECOMMENDED TOOLS	
Dial gauge	
Dial gauge extension/adapter	



mmr2015-019-102

Leak Test

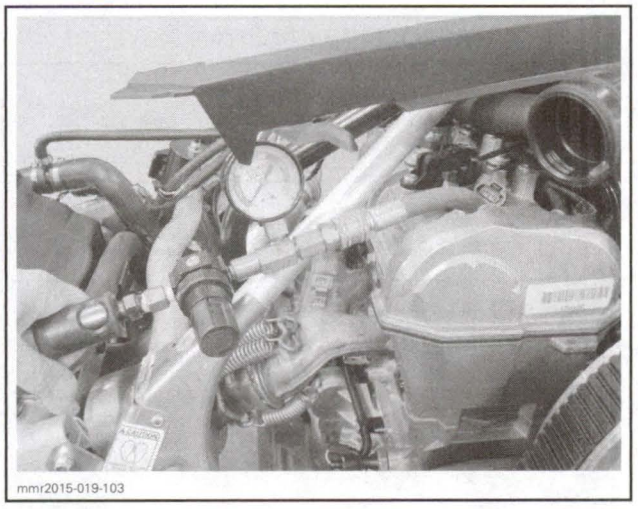
1. Install a gauge adaptor into spark plug hole.

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

2. Connect the leak down tester to an adequate air supply.
3. Set gauge needle to zero.

NOTE: All testers have specific instructions on gauge operation and required pressure. Refer to manufacturer's instructions.

4. Supply combustion chamber with air pressure.


mmr2015-019-103

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

LEAKAGE PERCENTAGE	ENGINE CONDITION
0% to 15%	Excellent condition
16% to 25%	Good condition
26% to 40%	Fair condition; reduced engine performance
41% and higher	Poor condition, diagnose and repair engine

Diagnosis

Listen for air leaks.

- Air escaping on intake port or throttle body means leaking intake valve(s).
- Air escaping on exhaust port means leaking exhaust valve(s).
- Air bubbles out of coolant tank means leaking cylinder head gasket.
- Air or coolant escaping from cylinder head means damaged gasket or loosened screws.
- Air escaping into crankcase area means excessively worn cylinder or broken piston rings.
- Air or oil escaping from crankcase means damaged gasket or loosened screws.

Repair Tips

Blue exhaust gas means damaged or worn piston rings or valve stem seals.

White exhaust gas means damaged cylinder head gasket.

Coolant tank cap opening without overheat means damaged cylinder head gasket.

Leaking valves can be caused by carbon deposits or burnt valve face.

Assembly

Reverse the preparation procedure.

TROUBLESHOOTING

Always check for fault codes. If a fault code is detected, service the fault code first. Refer to *DIAGNOSTIC AND FAULT CODES* subsection.

NOTE: When diagnosing an engine problem, always perform the cylinder leak test. This will help pinpoint a problem. Refer to *CYLINDER LEAK TEST* in this subsection.

UNUSUAL ENGINE NOISE OR VIBRATIONS

1. **Discharged or defective valve lifters.**
   - *Check engine oil pressure, refer to LUBRICATION SYSTEM subsection.*
   - *Replace valve lifters.*
2. **Camshaft(s) or camshaft holder(s) worn out.**
   - *Check and replace damaged parts.*
3. **Faulty chain tensioner.**
   - *Replace chain tensioner. Refer to TIMING CHAIN subsection.*
4. **Chain guide(s) worn out.**
   - *Replace chain guide(s). Refer to TIMING CHAIN subsection.*
5. **Stretched timing chain or worn out sprockets.**
   - *Replace timing chain and sprockets. Refer to TIMING CHAIN subsection.*
6. **Loose timing chain gear screws.**
   - *Retighten screws with recommended torque.*
7. **Incorrect camshaft timing.**
   - *Replace damaged components and readjust camshaft timing.*

OIL LEAKAGE FROM CYLINDER HEAD

1. **Leaking valve cover gasket.**
   - *Replace valve cover gaskets and retighten valve cover with recommended torque.*
   - *Check valve cover for cracks or other damage.*
2. **Leaking spark plug tube O-rings.**
   - *Replace spark plug tube O-rings.*
   - *Clean spark plug area from oil spillage.*
3. **Blow-by connector is leaking.**
   - *Replace blow by connector O-ring.*

4. Leaking cylinder head gasket.
   - *Check cylinder head for damage.*
   - *Replace cylinder head gasket and retighten screws with recommended torquing procedure.*

ENGINE SUDDENLY TURNS OFF OR LACKS ACCELERATION OR POWER

1. Incorrect camshaft timing.
   - *Replace damaged components and readjust camshaft timing.*
2. Leaking intake or exhaust valves.
   - *Perform a CYLINDER LEAK TEST. Repair or replace damaged components.*
3. Broken valve spring(s).
   - *Replace defective parts.*

PROCEDURES

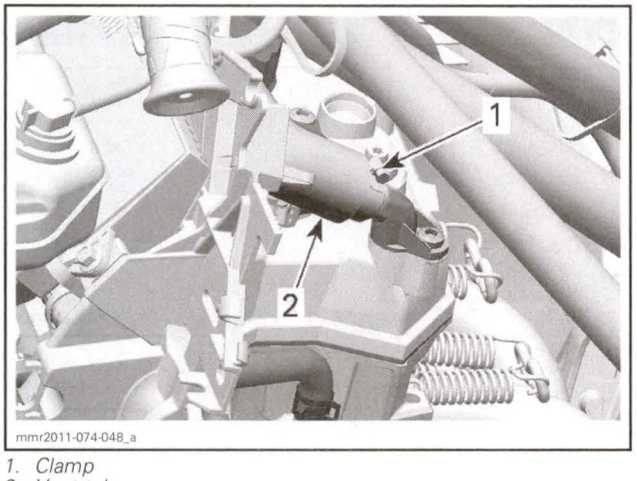
VALVE COVER

Valve Cover Access

1. Remove the air intake silencer and headlights/gauge support module as a unit. Refer to *AIR INTAKE SYSTEM* subsection.
2. Remove pulley guard.

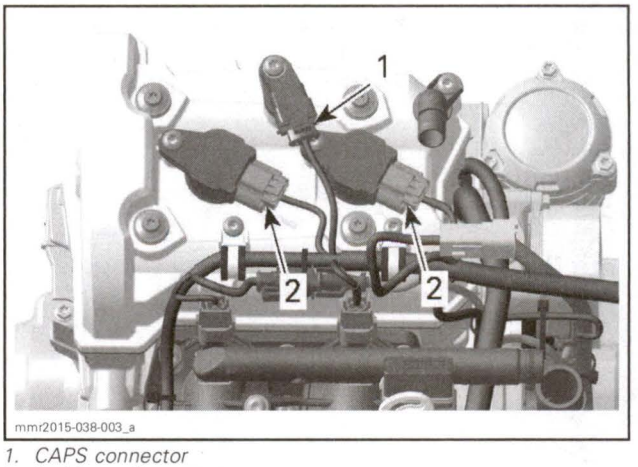
Valve Cover Removal

1. Refer to *EXHAUST SYSTEM* subsection and remove the exhaust manifold.
2. Disconnect vent tube from the blow-by-connector.



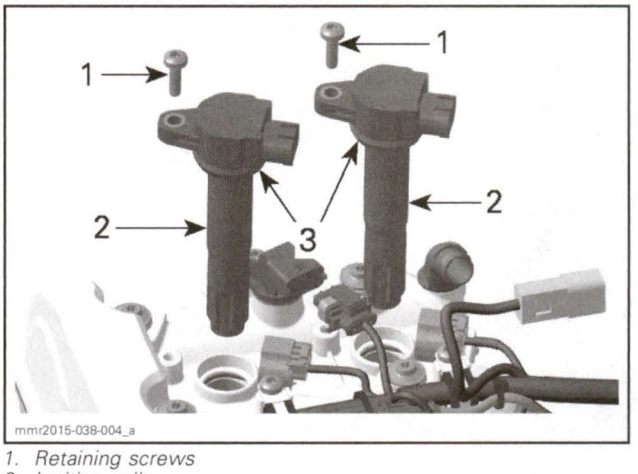
1. *Clamp*
2. *Vent tube*

3. Unplug CAPS (camshaft position sensor).
4. Unplug ignition coils.



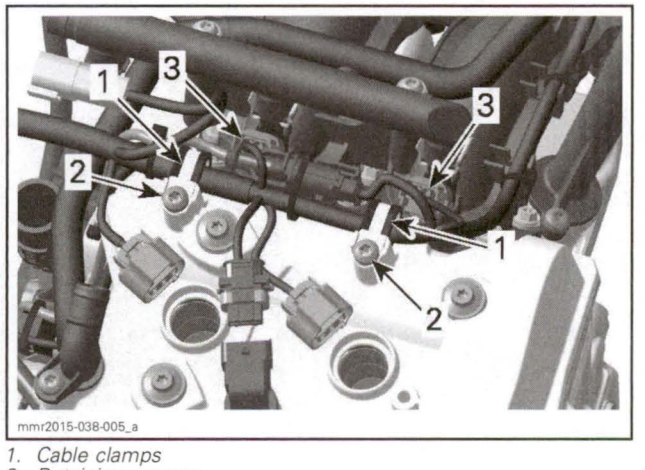
1. *CAPS connector*
2. *Ignition coil connectors*

5. Remove ignition coils with gaskets.



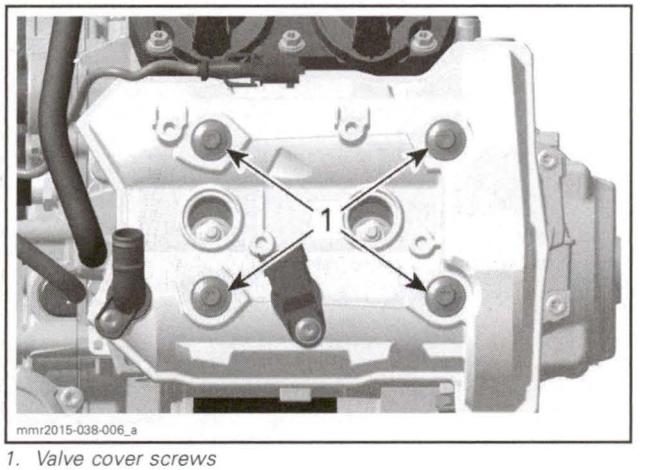
1. *Retaining screws*
2. *Ignition coils*
3. *Gaskets*

6. Remove screws securing the electrical harness to the valve cover.
7. Unplug both fuel injectors.



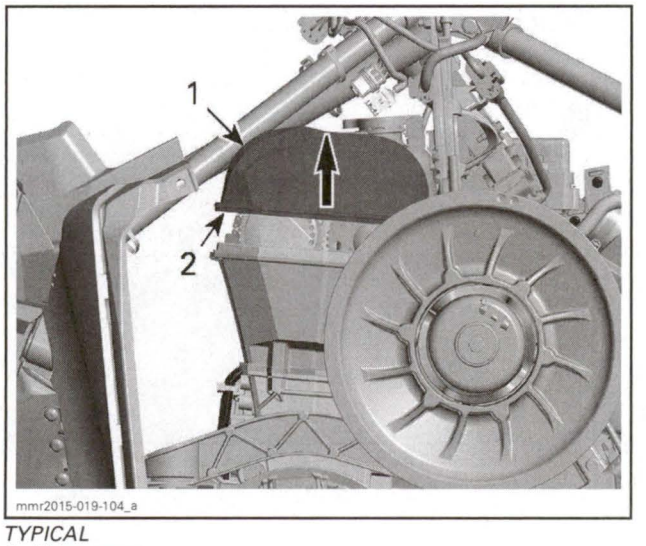
1. Cable clamps
2. Retaining screws
3. Fuel injector connector

8. Remove valve cover retaining screws.

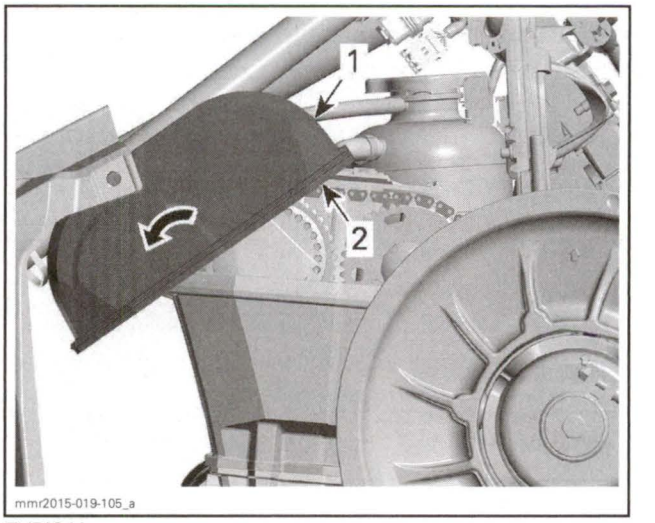


1. Valve cover screws

9. Lift and tilt valve cover with gasket towards front of engine.

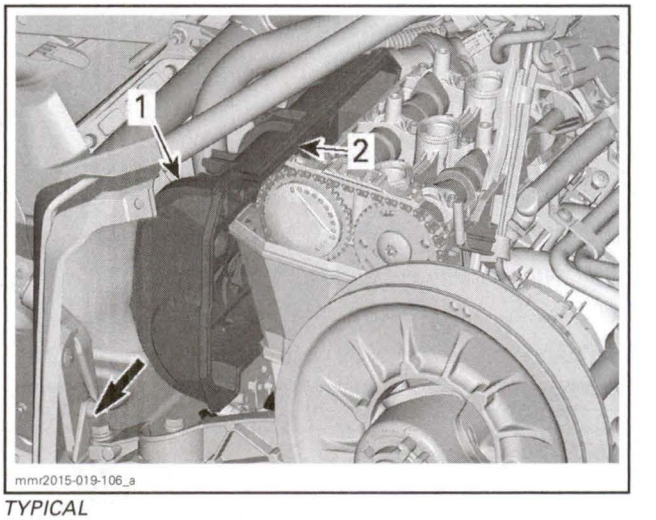


TYPICAL
1. Valve cover
2. Gasket



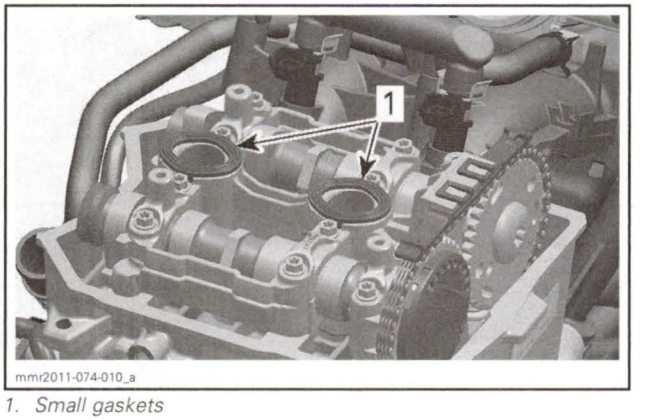
TYPICAL
1. Valve cover
2. Gasket

10. Pull valve cover and gasket out through LH side of vehicle.



TYPICAL
1. Valve cover
2. Gasket

11. Remove valve cover small gaskets (spark plug tubes).



1. Small gaskets

Valve Cover Inspection

Check the valve cover for cracks or other damage.

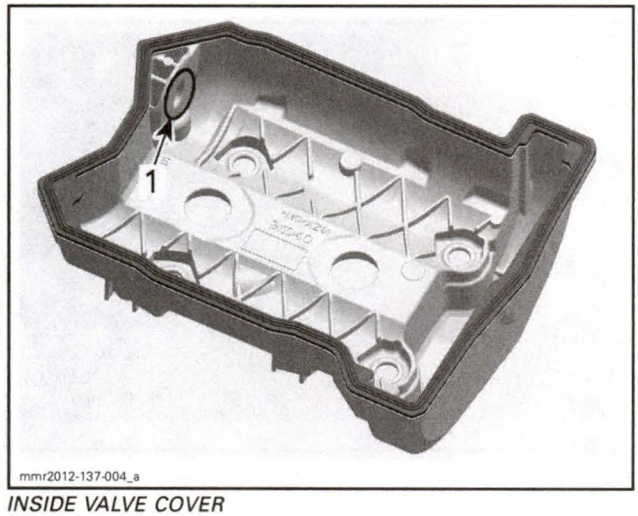
Check if the valve cover gaskets are brittle, hard or otherwise damaged.

Replace defective parts.

Valve Cover Installation

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

1. Properly fit small gaskets into camshaft holder grooves.
2. Properly fit large gasket into valve cover groove.
3. Apply engine oil to sealing surface of V-ring.

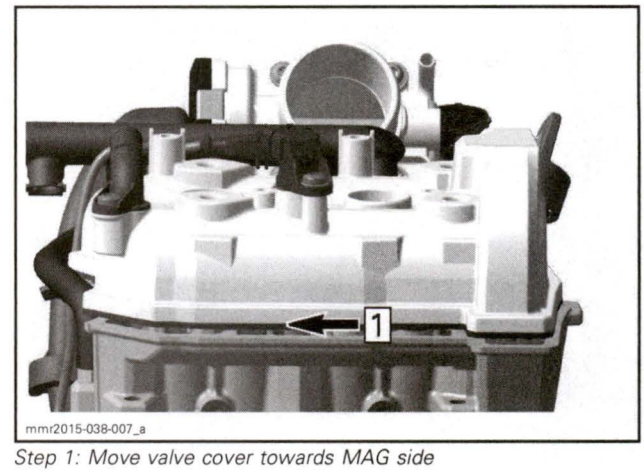


INSIDE VALVE COVER
1. Apply engine oil here

4. Install valve cover.

NOTICE Adhere to the following procedure, otherwise damage to the V-ring will occur causing crankcase venting malfunction.

4.1 Move valve cover towards MAG side.

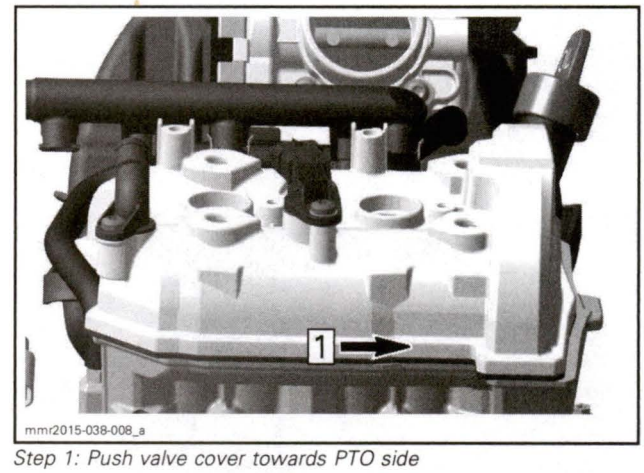


Step 1: Move valve cover towards MAG side

4.2 Put valve cover onto cylinder head.

NOTICE Make sure the valve cover gasket is well positioned in the cover groove.

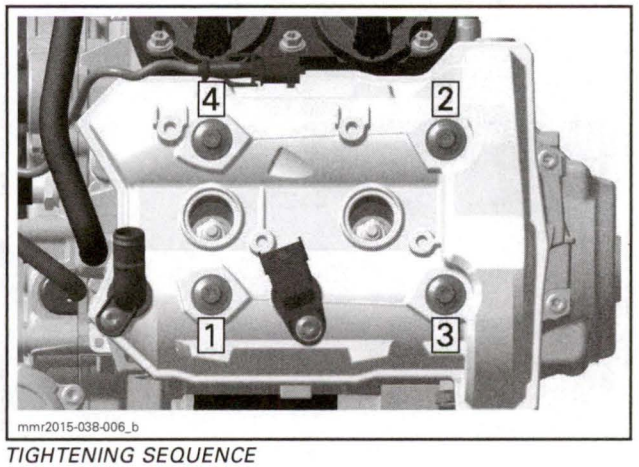
4.3 Push valve cover towards the PTO side to ensure the V-ring properly seals on sealing surface inside the cover.



Step 1: Push valve cover towards PTO side

5. Install valve cover screws and tighten as per following sequence:

VALVE COVER SCREWS	
Tightening torque	9 N•m ± 1 N•m (80 lbf•**in** ± 9 lbf•**in**)



TIGHTENING SEQUENCE

CAMSHAFTS

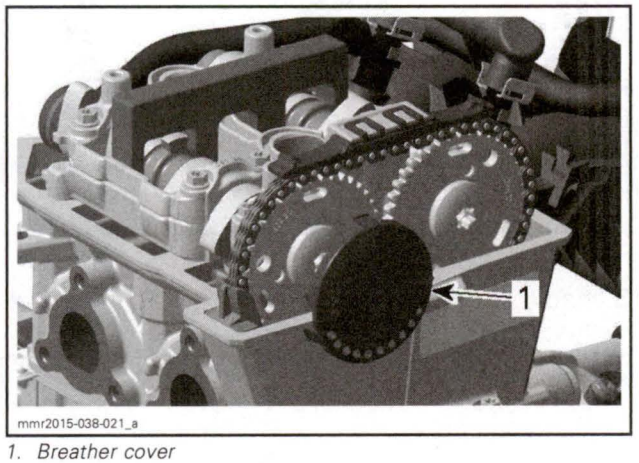
Camshaft Removal

1. Remove *VALVE COVER*, see procedure in this subsection.
2. Lock crankshaft, refer to *CRANKSHAFT LOCKING PROCEDURE* in the *BOTTOM END* subsection.

Remove timing chain tensioner. Refer to *TIMING CHAIN* subsection.

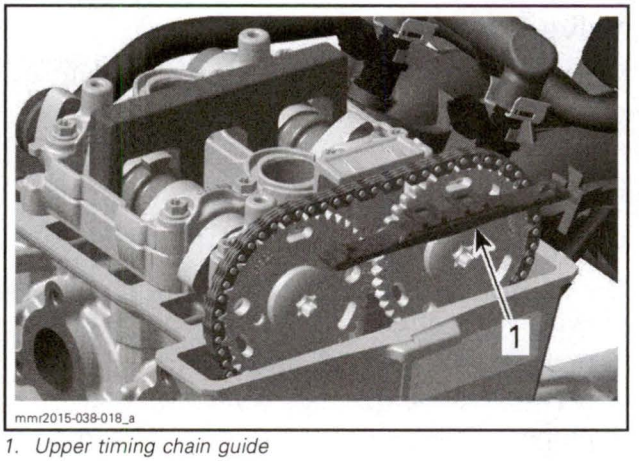
3. Remove:

3.1 Breather cover



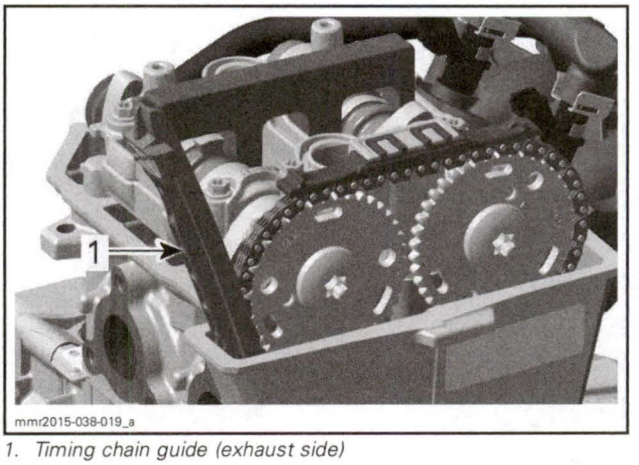
1. Breather cover

3.2 Upper timing chain guide



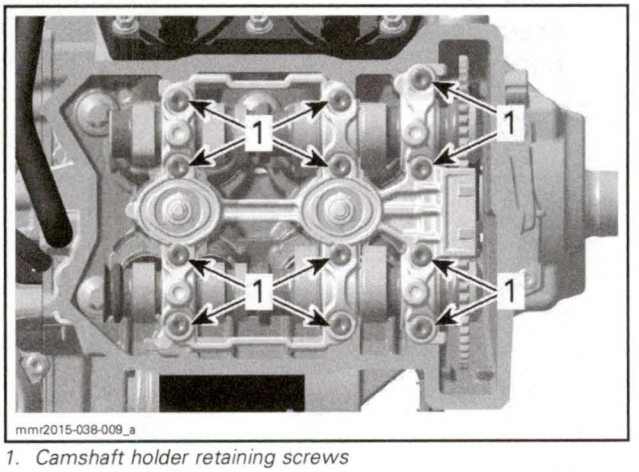
1. Upper timing chain guide

3.3 Timing chain guide.



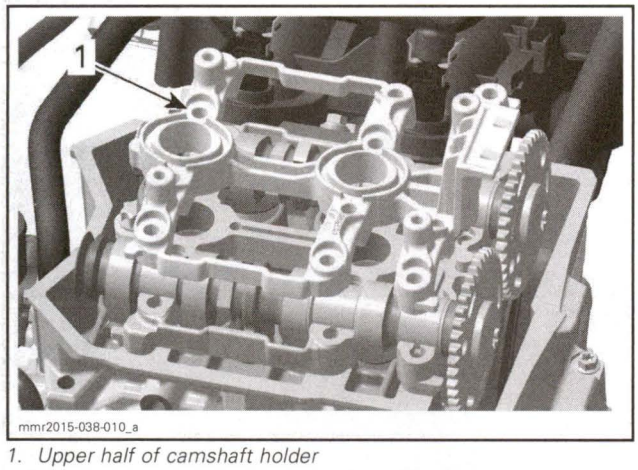
1. Timing chain guide (exhaust side)

4. Remove timing chain from camshaft timing gears.
5. Remove camshaft holder retaining screws (x12).



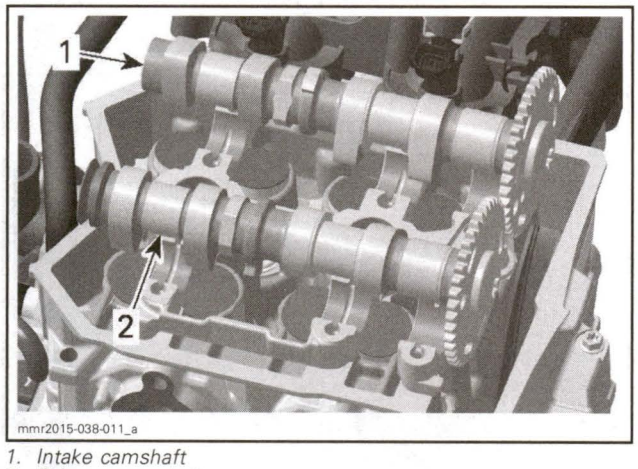
1. Camshaft holder retaining screws

6. Remove upper half of camshaft holder.



1. Upper half of camshaft holder

7. Remove camshafts with timing gears.

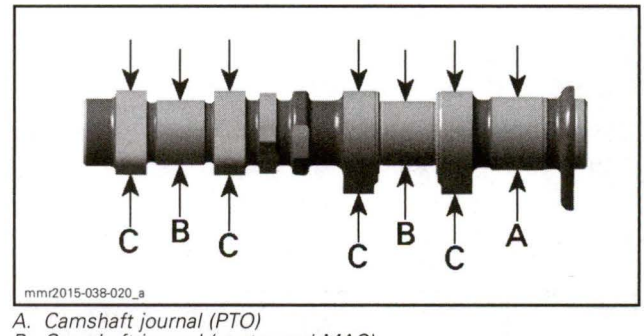


1. Intake camshaft
2. Exhaust camshaft

NOTE: Remove camshaft timing gears only if necessary. Refer to *TIMING CHAIN* subsection.

Camshaft Inspection

1. Check each lobe and bearing journal for scoring, scuffing, cracks, or other signs of wear.
2. Check if V-ring is brittle, hard or otherwise damaged.
3. Measure camshaft bearing journal diameter and lobe height, using a micrometer.



A. Camshaft journal (PTO)
B. Camshaft journal (center and MAG)
C. Camshaft lobes

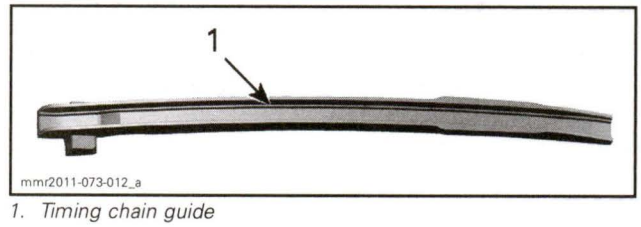
CAMSHAFT JOURNAL DIAMETER	
PTO JOURNAL (A)	
NEW	25.947 mm to 25.960 mm (1.0215 in to 1.022 in)
SERVICE LIMIT	25.920 mm (1.0205 in)
CENTER AND MAG JOURNAL (B)	
NEW	22.947 mm to 22.960 mm (.9034 in to .9039 in)
SERVICE LIMIT	22.920 mm (.9024 in)

CAMSHAFT LOBE HEIGHT	
INTAKE CAMSHAFT (C)	
NEW	38.70 mm to 38.90 mm (1.524 in to 1.531 in)
SERVICE LIMIT	38.67 mm (1.522 in)
EXHAUST CAMSHAFT (C)	
NEW	39.40 mm to 39.60 mm (1.551 in to 1.559 in)
SERVICE LIMIT	39.38 mm (1.55 in)

For camshaft journal radial clearance and camshaft holder bearing diameter refer to *CAMSHAFT HOLDER* in this subsection.

4. Check timing chain guide for wear, cracks or deformation. Replace as required.
5. Replace timing chain guide if any groove caused by timing chain exceeds service limit.

CHAIN GUIDE GROOVE DEPTH	
SERVICE LIMIT	1 mm (.039 in)



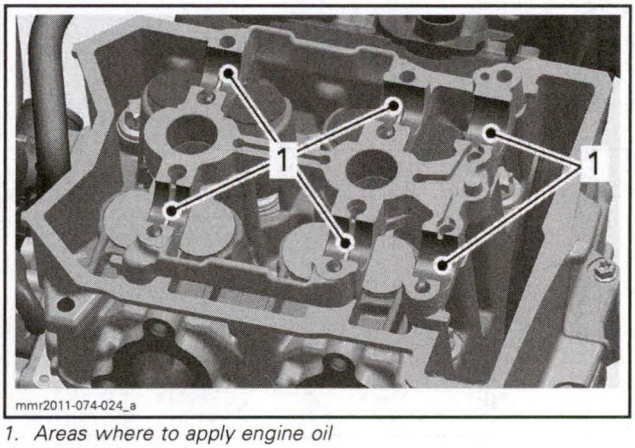
1. Timing chain guide

Replace parts if necessary.

Camshaft Installation

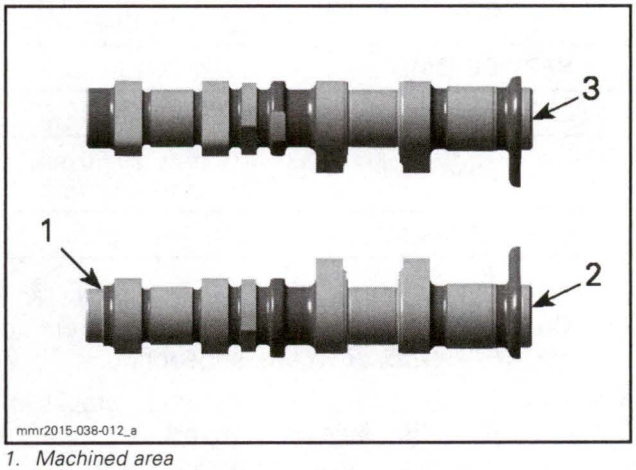
Reverse of the removal procedure. However pay attention to the following details.

1. Ensure crankshaft is still locked.
2. Apply engine oil on camshaft bearings.



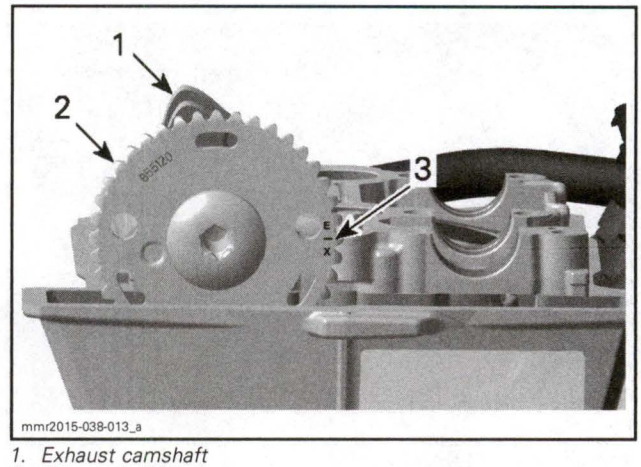
1. Areas where to apply engine oil

NOTE: The camshafts are not identical. Any mix-up of the components would lead to engine damage. The exhaust camshaft has a machined area on MAG side for the V-ring.



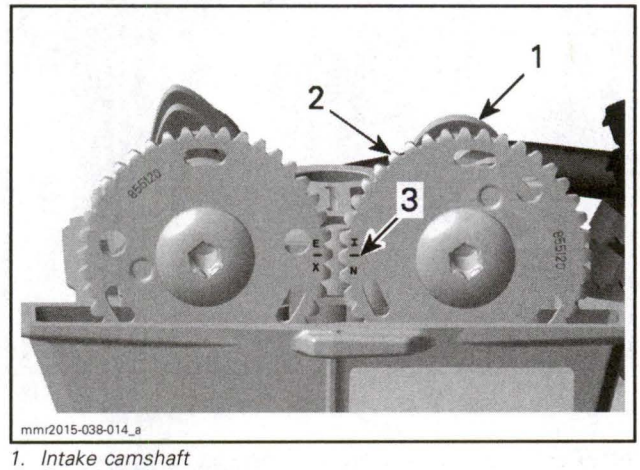
1. Machined area
2. Exhaust camshaft
3. Intake camshaft

3. If removed, reinstall camshaft timing gears on camshafts. Refer to *CAMSHAFT TIMING GEARS* in the *TIMING CHAIN* subsection.
4. Apply engine oil on camshaft journal diameter.
5. Install exhaust camshaft assembly with mark "EX" parallel to cylinder head gasket.



1. Exhaust camshaft
2. Camshaft timing gear
3. Mark "EX"

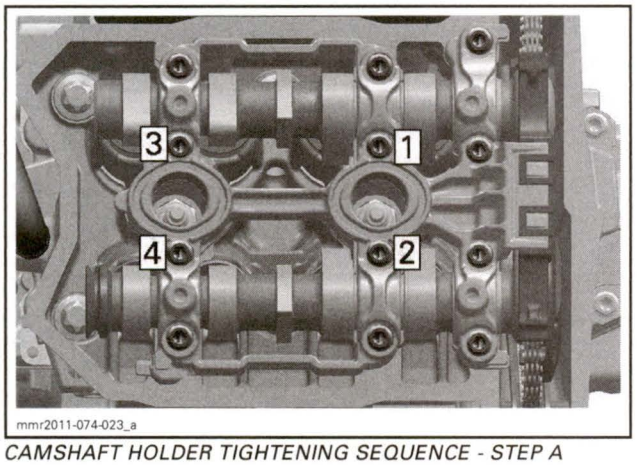
6. Install intake camshaft assembly with mark "IN" parallel to cylinder head gasket.



1. Intake camshaft
2. Camshaft timing gear
3. Mark "EX"

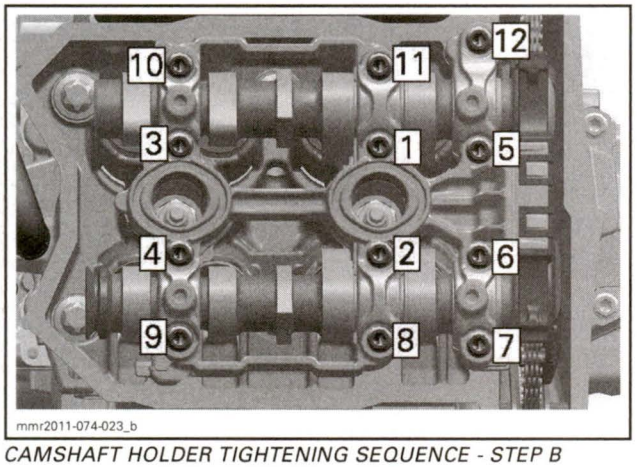
7. Install upper half of camshaft holder, then tighten screws as per following sequence:

CAMSHAFT HOLDER TIGHTENING PROCEDURE	
STEP A	5 N•m ± 0.5 N•m (44 lbf•**in** ± 4 lbf•**in**)



CAMSHAFT HOLDER TIGHTENING SEQUENCE - STEP A

CAMSHAFT HOLDER TIGHTENING PROCEDURE	
STEP B	9 N•m ± 1 N•m (80 lbf•**in** ± 9 lbf•**in**)

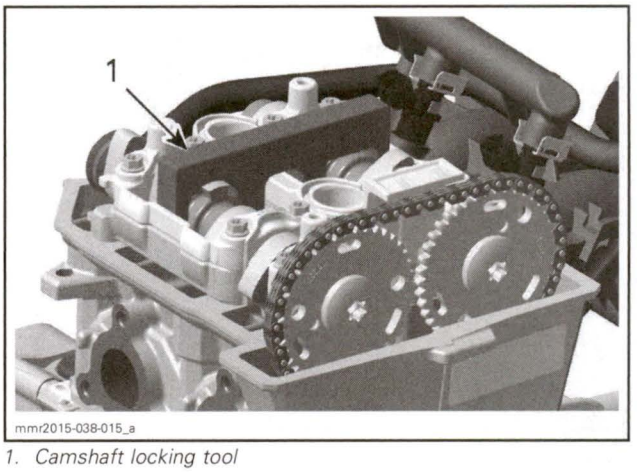


CAMSHAFT HOLDER TIGHTENING SEQUENCE - STEP B

NOTE: After reassembly of camshafts is completed, check if camshafts can be turned easily.

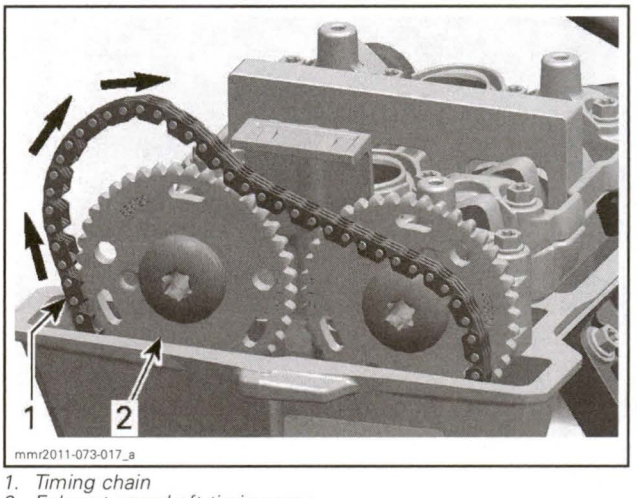
8. Lock camshafts.

REQUIRED TOOL	
CAMSHAFT LOCKING TOOL (P/N 529 036 206)	



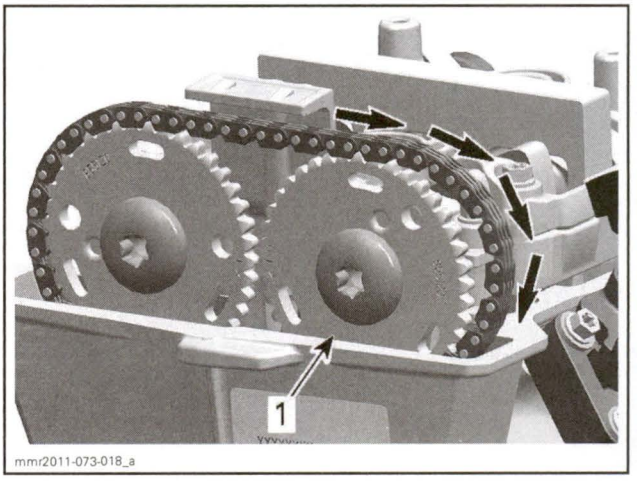
1. Camshaft locking tool

9. Lift timing chain out of timing chain compartment.
10. Pull timing chain up on exhaust side and install it on the exhaust camshaft timing gear.

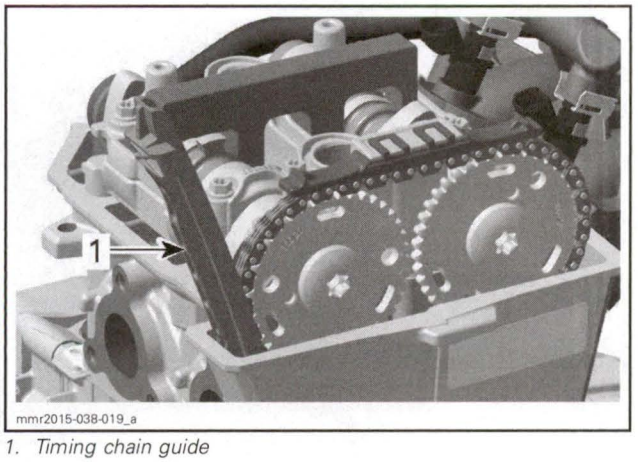


1. Timing chain
2. Exhaust camshaft timing gear

11. Pull timing chain towards intake side and install it on the intake camshaft timing gear.

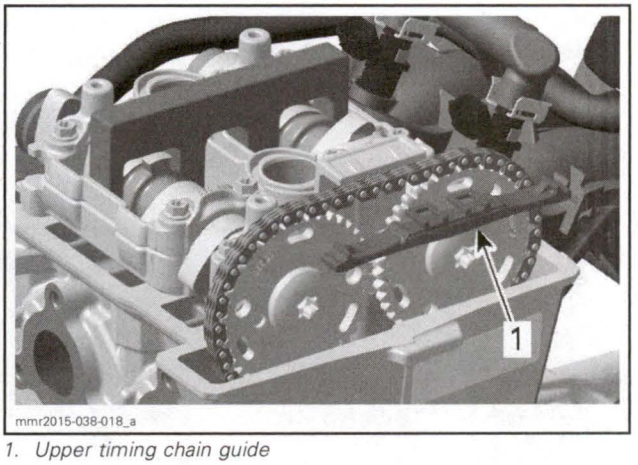


12. Install timing chain guide.



1. Timing chain guide

13. Install upper timing chain guide on camshaft holder.

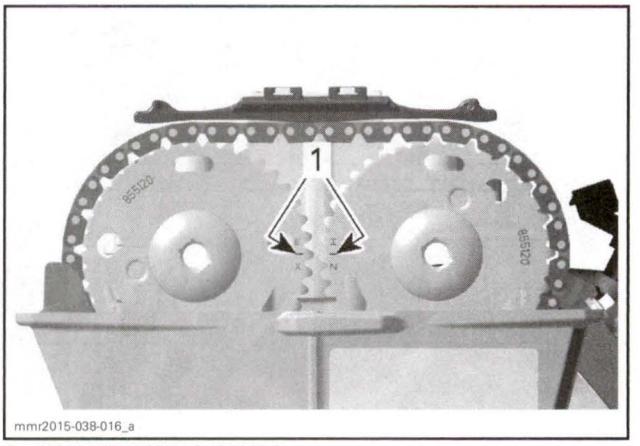


1. Upper timing chain guide

14. Install *TIMING CHAIN TENSIONER*, refer to *TIMING CHAIN* subsection.

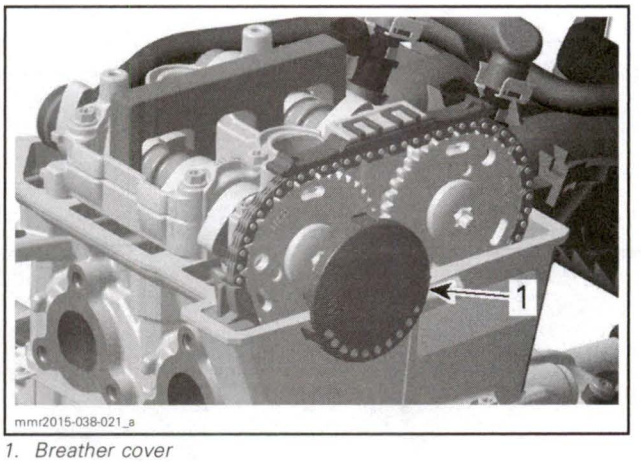
15. Ensure marks on camshaft timing gears are still aligned. If not, repeat procedure.

NOTICE **After installation of timing chain tensioner, the marks "IN" on intake and "EX" on exhaust camshafts must be aligned.**



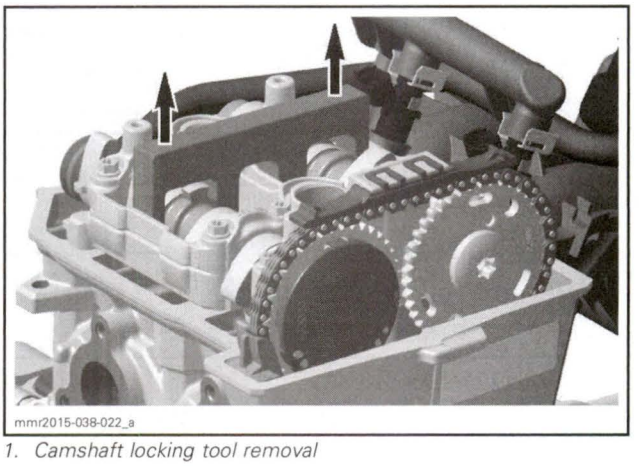
CAMSHAFT TIMING GEARS
1. Marks must be aligned

16. Install breather cover.



1. Breather cover

17. Remove camshaft locking tool.



1. Camshaft locking tool removal

18. Remove crankshaft locking tool.

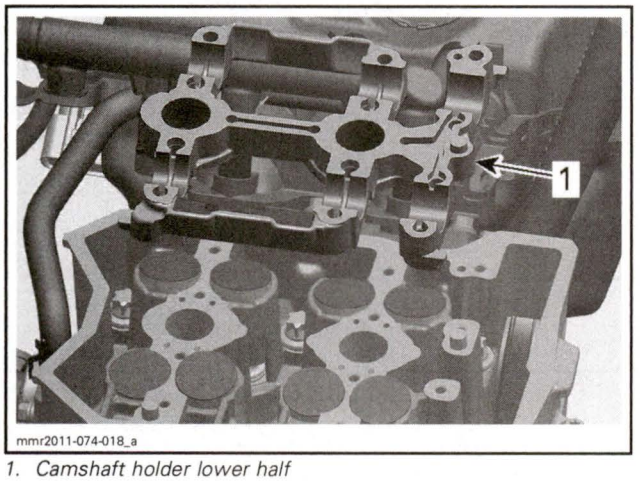
CAMSHAFT HOLDER

Camshaft Holder Removal

Remove camshafts, see procedure in this subsection.

Remove lower half of camshaft holder with gaskets from cylinder head.

Remove gaskets from camshaft holder halves and discard gaskets.

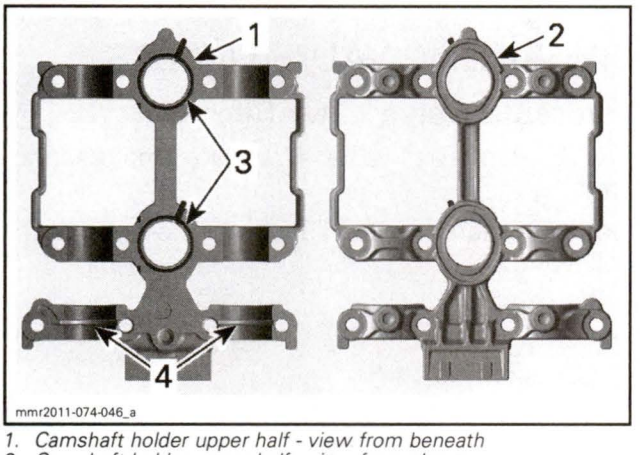


1. Camshaft holder lower half

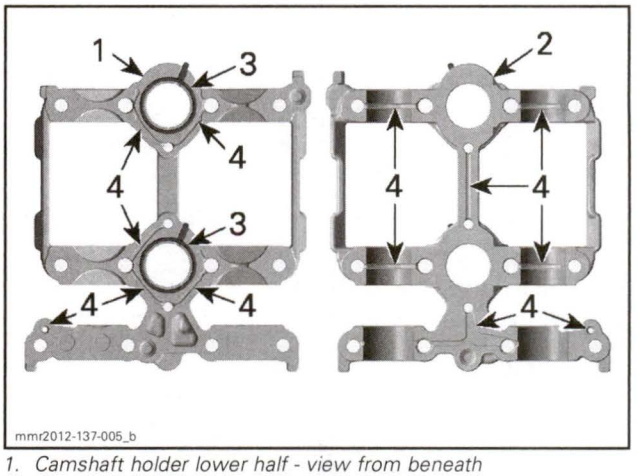
Camshaft Holder Inspection

Check camshaft holder for scoring, scuffing, cracks, or other signs of wear.

Make sure oil orifices are not clogged. Blow them out with pressurized air.



1. Camshaft holder upper half - view from beneath
2. Camshaft holder upper half - view from above
3. Gaskets
4. Oil orifices

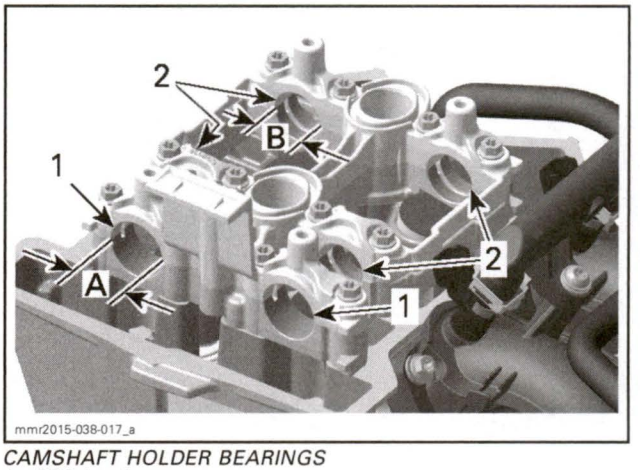


1. Camshaft holder lower half - view from beneath
2. Camshaft holder lower half - view from above
3. Gaskets
4. Oil orifices

Install camshaft holder on cylinder head.

Tighten camshaft holder screws to specification, refer to *CAMSHAFT INSTALLATION* in this subsection.

Measure camshaft holder bearing diameter.



CAMSHAFT HOLDER BEARINGS
1. PTO bearings
2. Center and MAG bearings
A. Diameter PTO bearing
B. Diameter center and MAG bearing

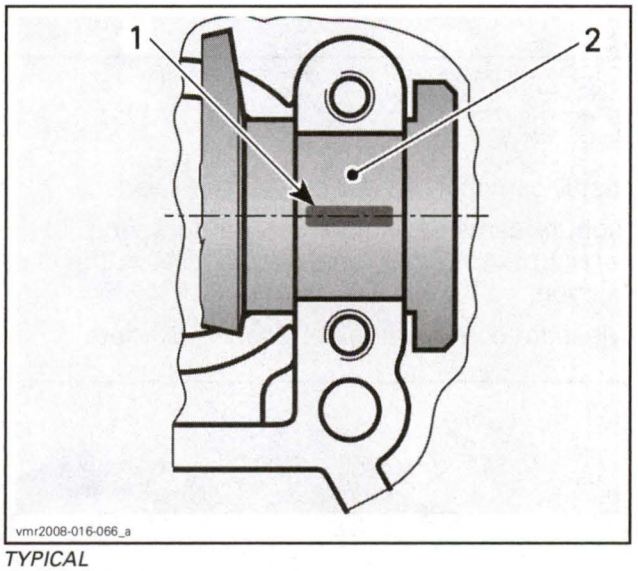
CAMSHAFT HOLDER BEARING DIAMETER	
PTO BEARING	
NEW	26.000 mm to 26.021 mm (1.024 in to 1.024 in)
SERVICE LIMIT	26.050 mm (1.026 in)
CENTER AND MAG BEARING	
NEW	23.000 mm to 23.021 mm (.906 in to .906 in)
SERVICE LIMIT	23.050 mm (.907 in)

Measure the clearance between camshaft journals and camshaft holder, using the plastic feeler gauge.

NOTE: The plastic feeler gauge is available at automotive parts retailer.

Install camshaft holder lower half on cylinder head.

Place camshafts in lower half of camshaft holder and apply a plastic-gauge on the camshaft bearing journal.

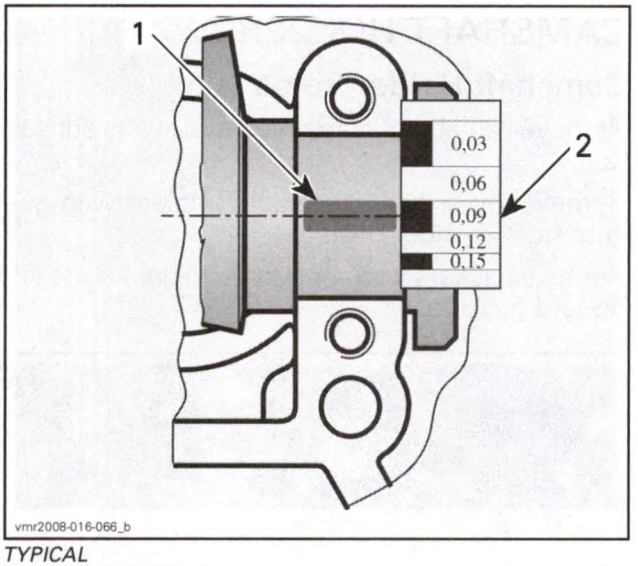


TYPICAL
1. *Plastic gauge*
2. *Camshaft bearing journal*

Install camshaft holder upper half in its proper position and tighten screws to specification, refer to *CAMSHAFT INSTALLATION* in this subsection.

Unfasten camshaft holder.

Measure the maximum width of the pressed plastic gauge with the corresponding graduated scale.



TYPICAL
1. *Pressed plastic gauge*
2. *Graduated scale*

CAMSHAFT JOURNAL RADIAL CLEARANCE	
PTO, CENTER AND MAG BEARING	
NEW	0.020 mm to 0.054 mm (.001 in to .002 in)
SERVICE LIMIT	0.080 mm (.003 in)

Replace parts if necessary.

Camshaft Holder Installation

Install camshaft holder lower half.

Continue procedure as explained in *CAMSHAFT INSTALLATION* in this subsection.

HYDRAULIC VALVE LIFTERS

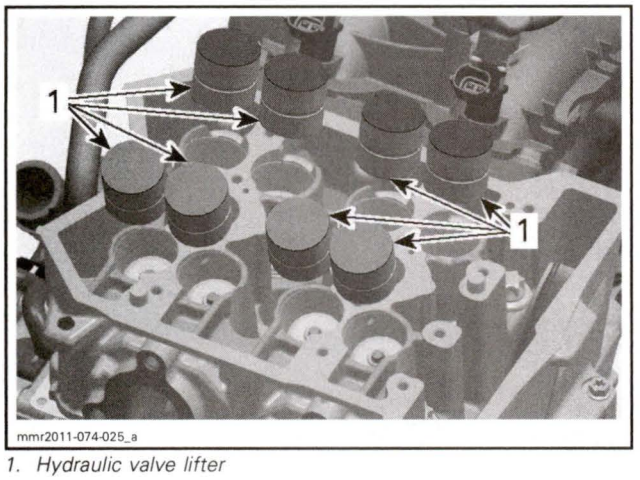
Hydraulic Valve Lifter Removal

NOTE: Hydraulic valve lifter are maintenance free.

See procedures in this subsection to remove the following:
- Valve cover
- Camshafts
- Camshaft holder.

Pull hydraulic valve lifter out of cylinder head.

NOTE: When disassembling the hydraulic valve lifter, it is strongly recommended to note their original position.



1. Hydraulic valve lifter

Hydraulic Valve Lifter Inspection

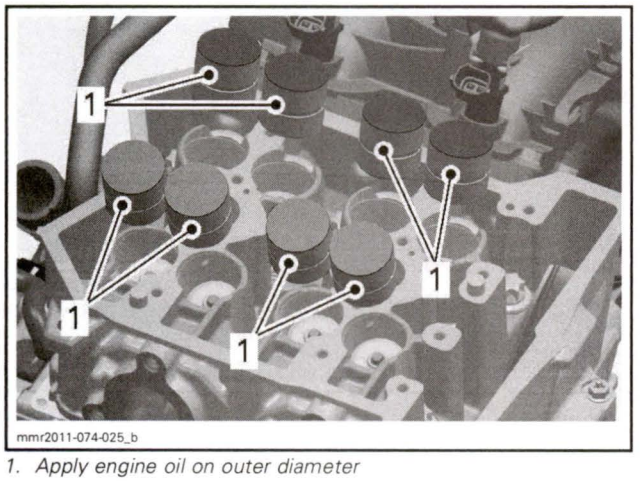
1. Check surface of hydraulic valve lifter for scoring or other damage.
2. Measure valve lifter diameter. Replace if out of specification.

HYDRAULIC VALVE LIFTER	
NEW	28.354 mm to 28.370 mm (1.1163 in to 1.1169 in)
SERVICE LIMIT	28.340 mm (1.1157 in)
HYDRAULIC VALVE LIFTER RADIAL CLEARANCE	
SERVICE LIMIT	0.100 mm (.0039 in)

Hydraulic Valve Lifter Installation

Reverse the removal procedure. However pay attention to the following details.

Apply engine oil on the outside diameter of the hydraulic valve lifter.



1. Apply engine oil on outer diameter

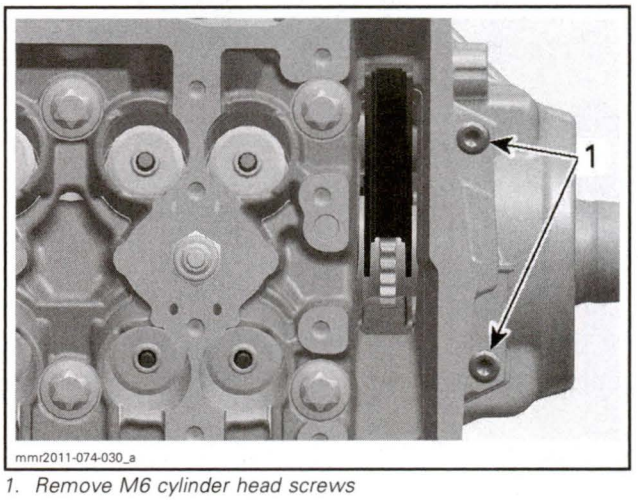
CYLINDER HEAD

Cylinder Head Access

Remove engine from vehicle. Refer to *ENGINE REMOVE AND INSTALLATION* subsection.

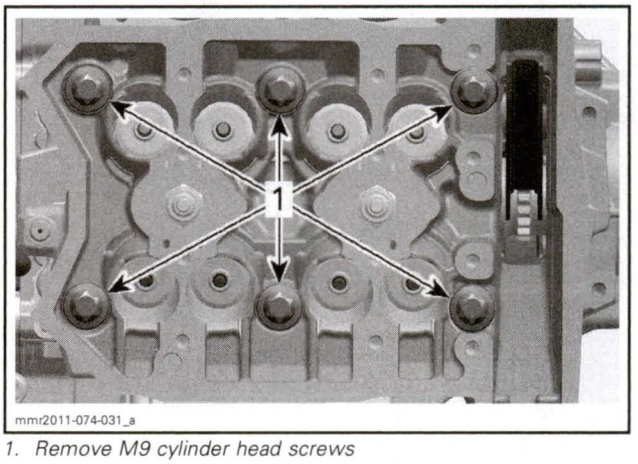
Cylinder Head Removal

1. See procedures in this subsection to remove:
   - Valve cover
   - Camshafts
   - Camshaft holder
   - Hydraulic valve lifters.
2. Remove M6 cylinder head screws.



1. Remove M6 cylinder head screws

3. Remove and discard M9 cylinder head screws.



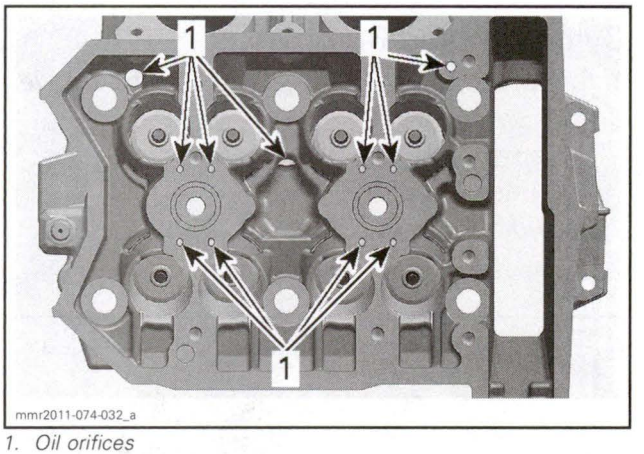
1. Remove M9 cylinder head screws

4. Pull cylinder head off the cylinder block.
5. Remove and discard cylinder head gasket.

Cylinder Head Cleaning

1. Remove carbon deposits from combustion chambers, exhaust ports and piston tops.

2. Clean cylinder head, especially cylinder head screw surface from oil spillage.
3. Blow out the oil orifices with pressurized air and make sure they are not clogged.



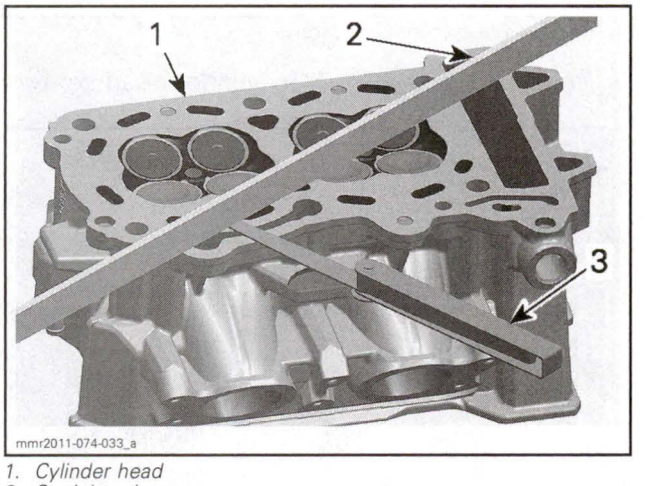
1. Oil orifices

Cylinder Head Inspection

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

Check cylinder head mating surface for flatness using a straight edge.

Check hydraulic valve lifter bores for scoring or other damage, if so, replace cylinder head.



1. Cylinder head
2. Straight edge
3. Feeler gauge

Check for cylinder head warping.

CYLINDER HEAD WARPAGE	
Maximum	0.15 mm (.0059 in)

If warping exceeds specification, resurface the cylinder head as follows.

Use a 400 - 600 grit wet sandpaper on a surface plate and gently grind off the mating surface.

NOTE: To ensure an even surface, rotate cylinder head several times during resurfacing.

Replace cylinder head, if resurfacing fails.

Cylinder Head Installation

Reverse the removal procedure. However, pay attention to the following details.

1. Install a NEW cylinder head gasket.

NOTICE Each installation of the cylinder head requires a NEW cylinder head gasket. Using a gasket twice would cause engine damage.

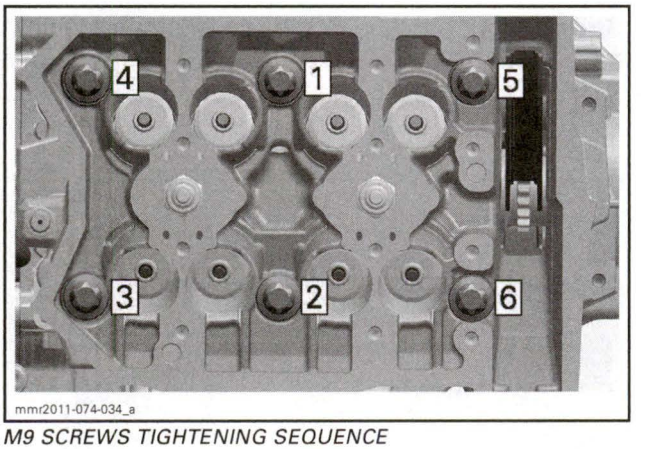
2. Install cylinder head on the cylinder block.
3. Install NEW M9 cylinder head screws.

NOTICE This assembly uses stretch screws. Always use NEW screws and strictly adhere to the tightening procedure.

4. Tighten cylinder head screws as follows:

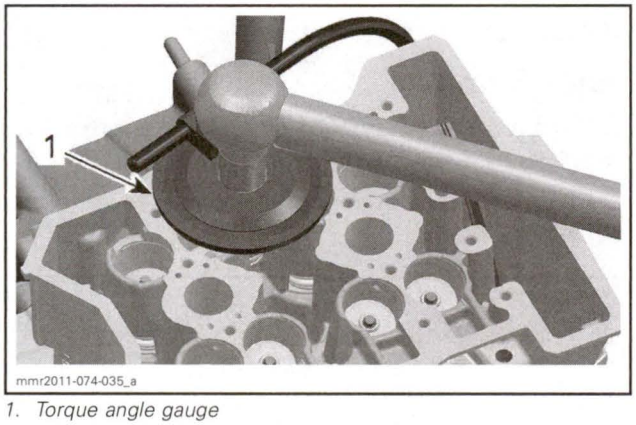
NOTE: Always perform step 1 on all M9 cylinder head screws before going to the next step.

CYLINDER HEAD M9 SCREWS TIGHTENING PROCEDURE	
STEP A	20 N•m ± 2 N•m (15 lbf•ft ± 1 lbf•ft)
STEP B	Additional 150° ± 5°



M9 SCREWS TIGHTENING SEQUENCE

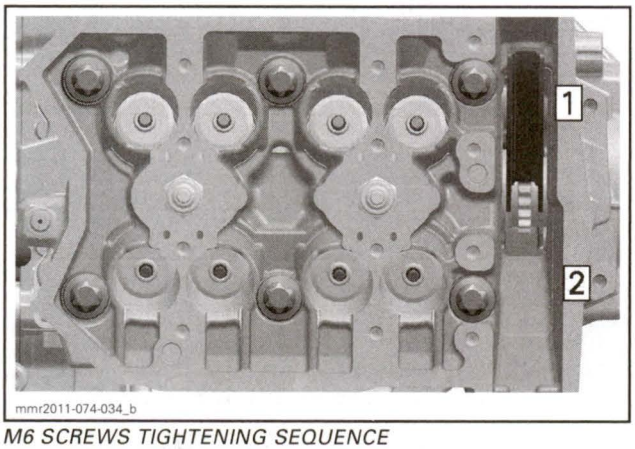
NOTE: Use a torque angle gauge to carry out step B.



1. Torque angle gauge

5. Install M6 screws. Tighten as follows.

M6 CYLINDER HEAD SCREWS	
Tightening torque	9 N•m ± 1 N•m (80 lbf•**in** ± 9 lbf•**in**)



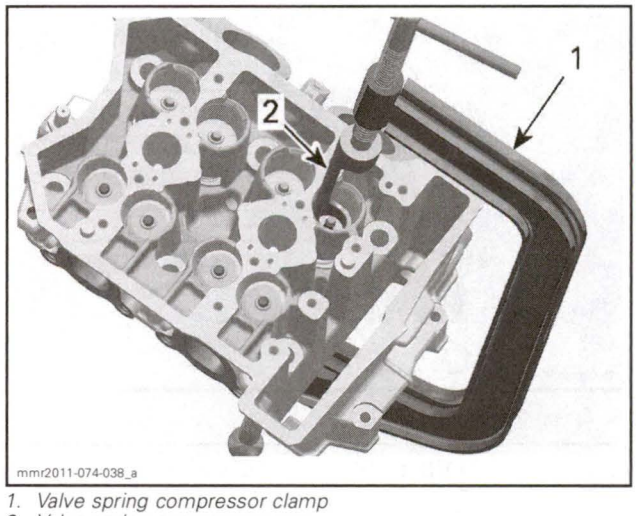
M6 SCREWS TIGHTENING SEQUENCE

VALVE SPRINGS

Valve Spring Removal

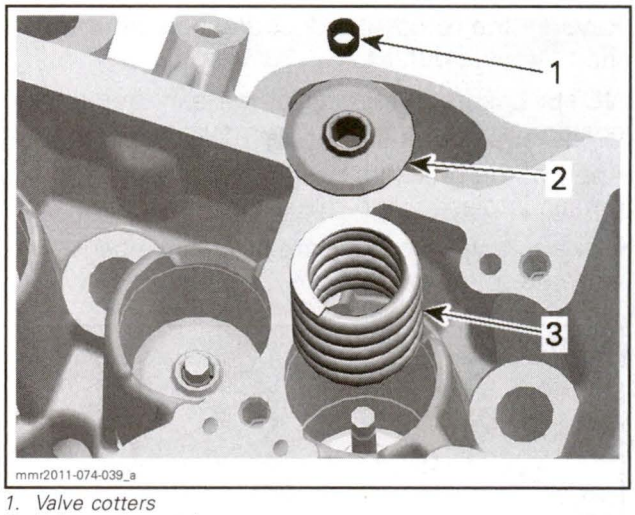
1. Remove *CYLINDER HEAD*, see procedure in this subsection.
2. Compress valve spring.

REQUIRED TOOLS	
VALVE SPRING COMPRESSOR (P/N 529 035 724)	
VALVE SPRING COMPRESSOR CUP (P/N 529 036 209)	



1. Valve spring compressor clamp
2. Valve spring compressor cup

3. Remove valve cotters.
4. Withdraw valve spring compressor tools.
5. Remove valve spring retainer and valve spring.

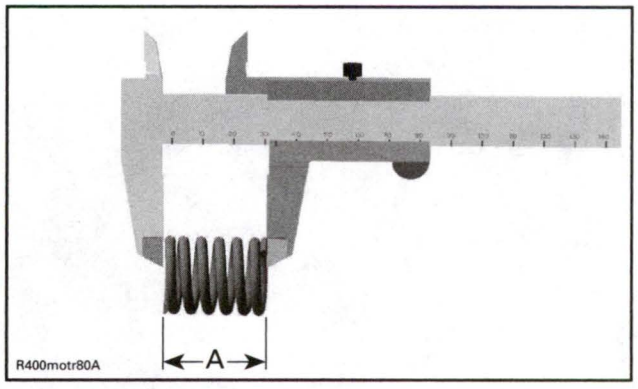


1. Valve cotters
2. Valve spring retainer
3. Valve spring

NOTE: Identify the position of each part very carefully, so it can be reinstalled in its original place.

Valve Spring Inspection

1. Check valve spring for rust, corrosion or other visible damage.
2. Check valve spring free length and straightness.



A. Spring free length

VALVE SPRING FREE LENGTH	
NEW	31.35 mm (1.2343 in)
SERVICE LIMIT	29.50 mm (1.1614 in)

Replace valve spring, if out of specification.

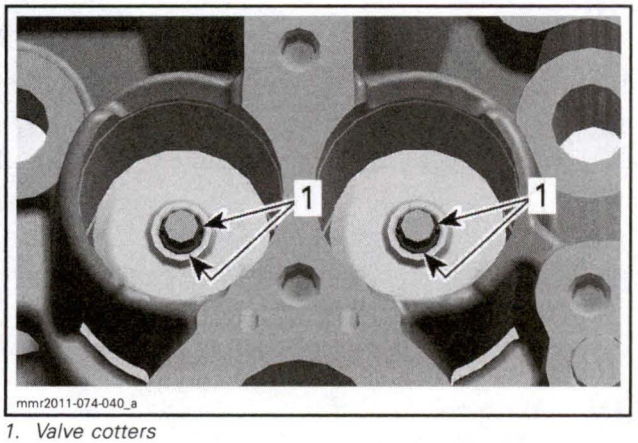
Valve Spring Installation

Reverse the removal procedure. Pay attention to the following details.

NOTE: Ensure to reinstall all parts in their original position as marked during removal.

Apply some grease on valve cotters, so that they remain in place while releasing the valve spring.

Make sure valve cotters are properly engaged into valve stem groove.



1. Valve cotters

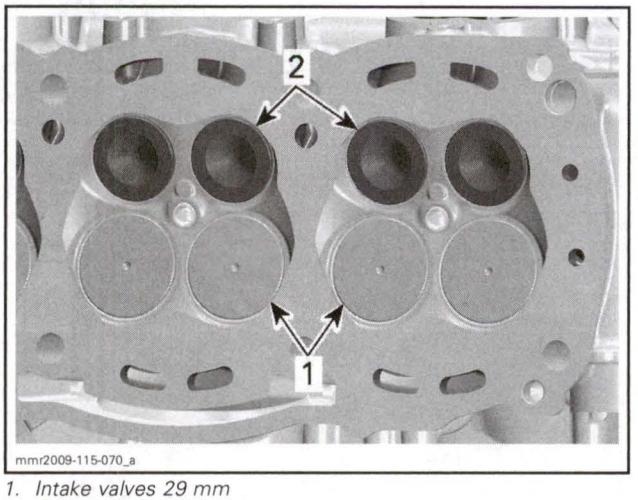
After spring is installed, ensure it is properly locked by lightly tapping on valve stem end with a soft hammer so that valve opens and closes a few times.

NOTICE Improperly locked valve spring will cause severe engine damage and hitting the valve stem end with excessive force could damage the valve.

VALVES

Valve Removal

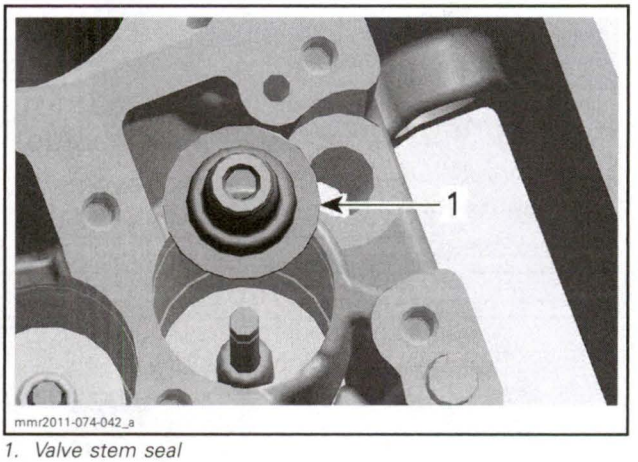
1. Remove *VALVE SPRING*, see procedure in this subsection.
2. Push on the valve stem, then pull valves out of cylinder head.



1. Intake valves 29 mm
2. Exhaust valves 25 mm

3. Remove and discard valve stem seal using special pliers.

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

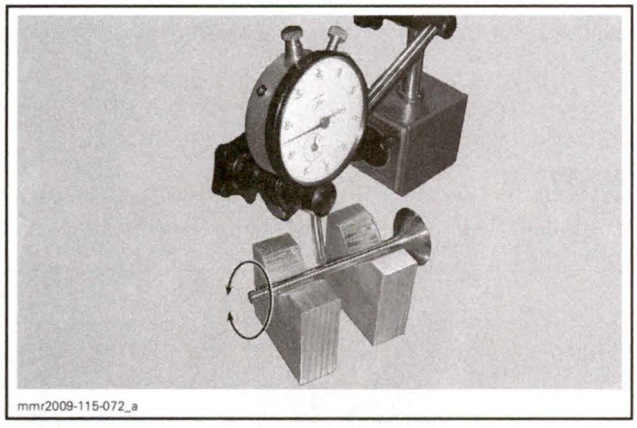


1. Valve stem seal

NOTE: Identify the position of each part very carefully, so it can be reinstalled in its original place.

Valve Inspection

Inspect valve surface, check for abnormal stem wear and bending.

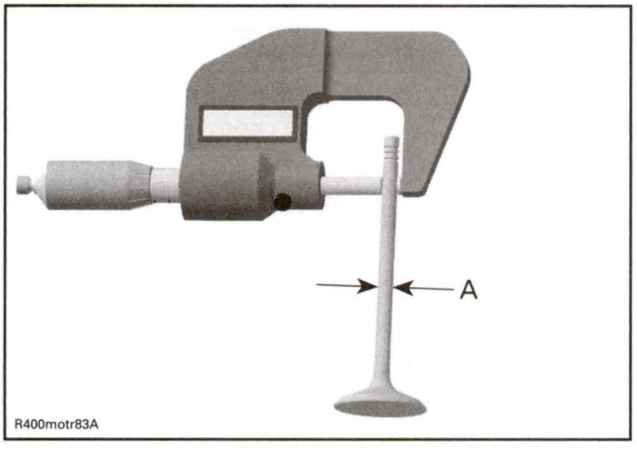

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VALVE OUT OF ROUND INTAKE AND EXHAUST VALVE	
NEW	0.005 mm (.0002 in)
SERVICE LIMIT	0.060 mm (.0024 in)

Replace valve if out of specification.

Valve Stem and Valve Guide Clearance

1. Measure valve stem at three places, using a micrometer.



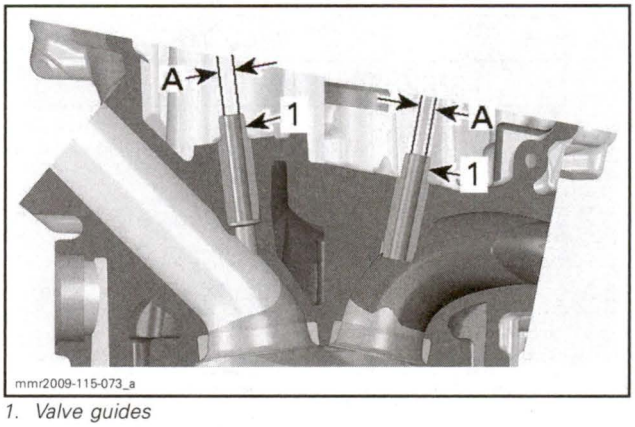
A. Valves stem diameter

VALVE STEM DIAMETER	
INTAKE VALVE	
NEW	4.958 mm to 4.972 mm (.1952 in to .1957 in)
SERVICE LIMIT	4.940 mm (.1945 in)
EXHAUST VALVE	
NEW	4.956 mm to 4.970 mm (.1951 in to .1957 in)
SERVICE LIMIT	4.940 mm (.1945 in)

Replace valve if stem is out of specification or if its surface is damaged or worn.

2. Measure valve guide inner diameter, using a small bore gauge.

NOTE: Clean valve guide from carbon deposits before measuring.

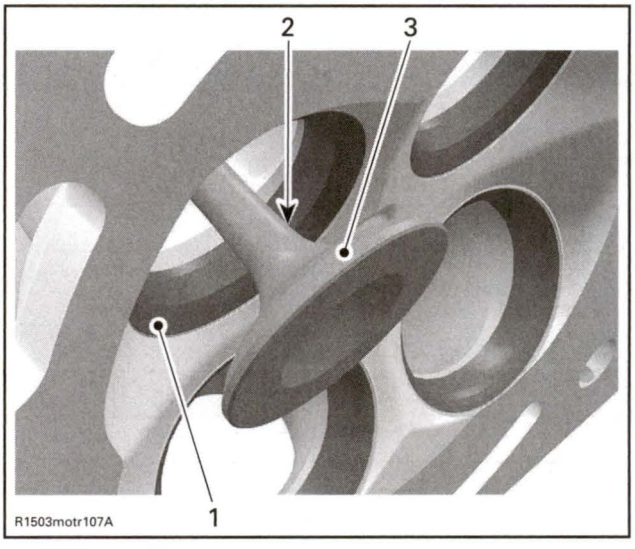


1. Valve guides
A. Valve guide inner diameter

VALVE GUIDE INNER DIAMETER	
NEW	5.000 mm to 5.020 mm (.1969 in to .1976 in)
SERVICE LIMIT	5.050 mm (.1988 in)

Replace cylinder head, if valve guide is out of specification.

Valve Face and Seat



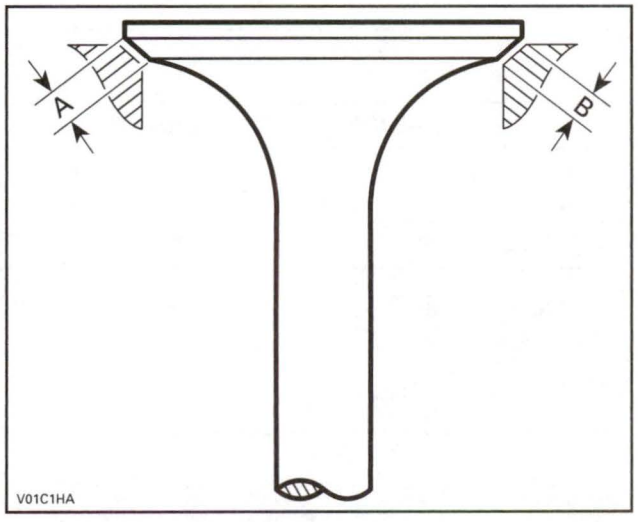
TYPICAL
1. Valve seat
2. Exhaust valve contaminated area
3. Valve face (contact surface to valve seat)

1. Check valve face and seat for burning, pitting and other signs of damage.

2. Check if valve seats properly in cylinder head. Proceed as follows.
   2.1 Apply some lapping compound on valve face and work valve on its seat with a lapping tool.

REQUIRED TOOL
SNAP-ON VALVE HOLDER (P/N VL2)

   NOTE: The location of contact area should be in center of valve face.
   2.2 Repeat procedure until valve seat and valve face fit together.
3. Measure valve seat contact width, using a caliper.



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

VALVE SEAT CONTACT WIDTH	
INTAKE VALVE	
NEW	1.05 mm to 1.35 mm (.041 in to .053 in)
SERVICE LIMIT	1.70 mm (.067 in)
EXHAUST VALVE	
NEW	1.25 mm to 1.45 mm (.049 in to .057 in)
SERVICE LIMIT	1.80 mm (.071 in)

Replace parts if out of specification.

Valve Installation

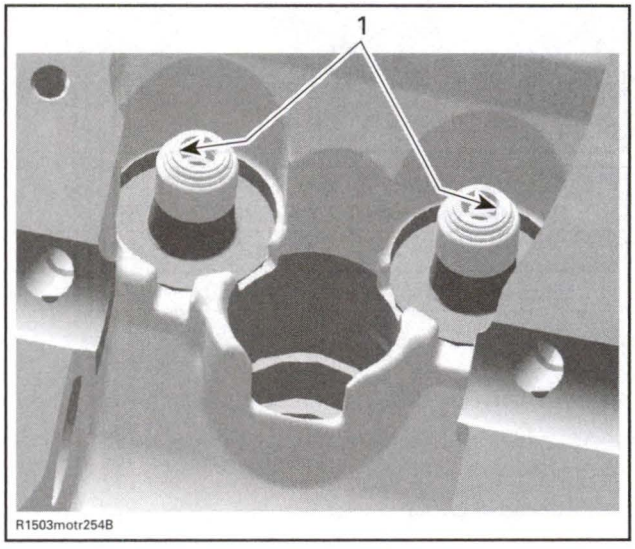
For installation reverse the removal procedure. Pay attention to the following details.

NOTE: Ensure to reinstall all parts in their original position as marked during removal.

Install a NEW valve stem seal whenever valve is removed.

Apply engine oil on valve stem and carefully slide through cylinder head and valve stem seal.

NOTICE Be careful when passing the valve stem through the sealing lip of the seal.



TYPICAL
1. Sealing lips of valve stem seal

Install *VALVE SPRING*. See procedure in this subsection.

Install all other removed parts.

BOTTOM END

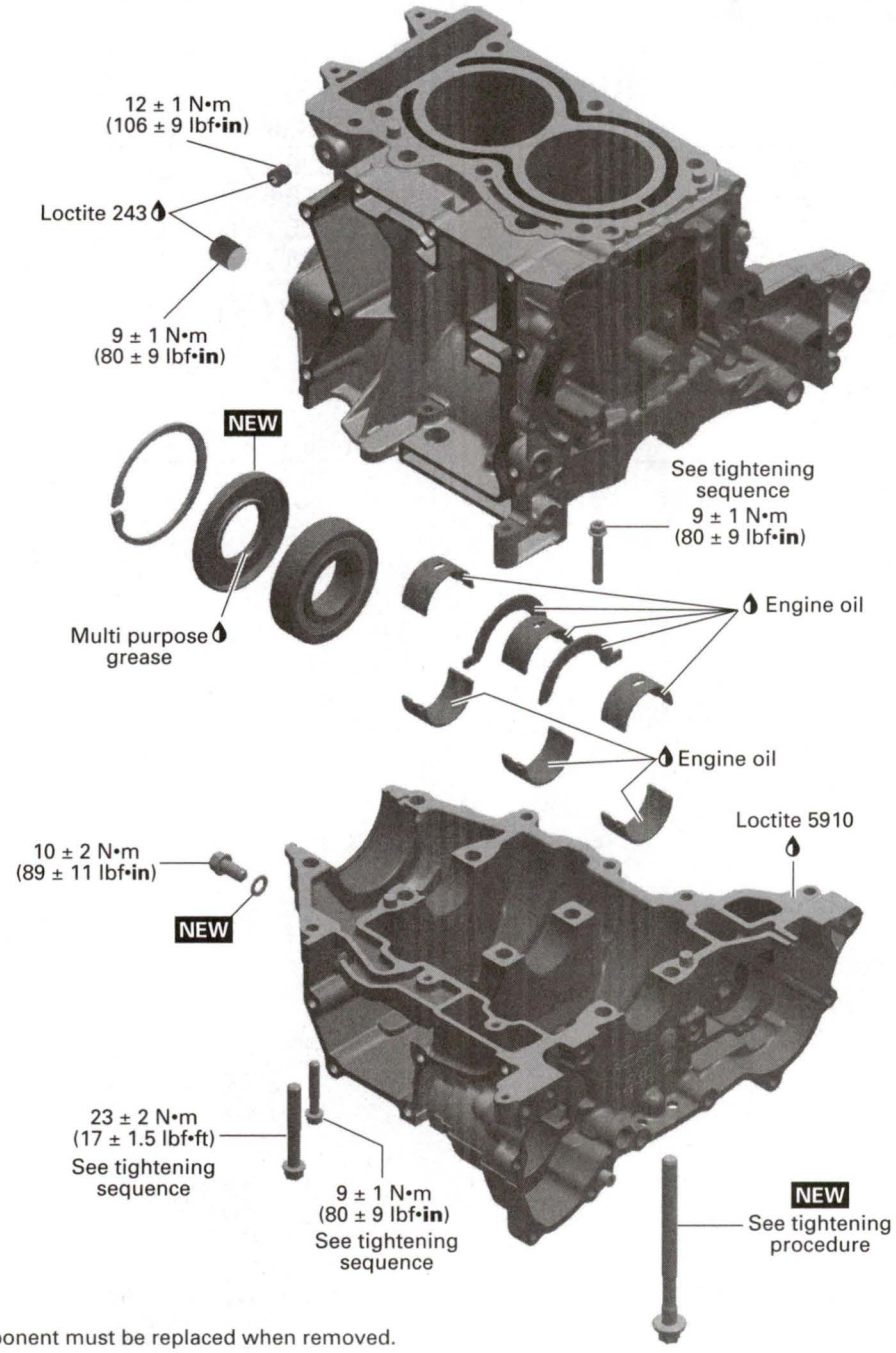
SERVICE TOOLS

Description	Part Number	Page
CRANKSHAFT LOCKING TOOL	529 036 205	140
CRANKSHAFT PROTECTOR (PTO)	420 876 552	132
PISTON CIRCLP INSTALLER	529 036 207	146
PISTON RING COMPRESSOR	529 036 208	148
PTO OIL SEAL INSTALLER	529 036 216	133

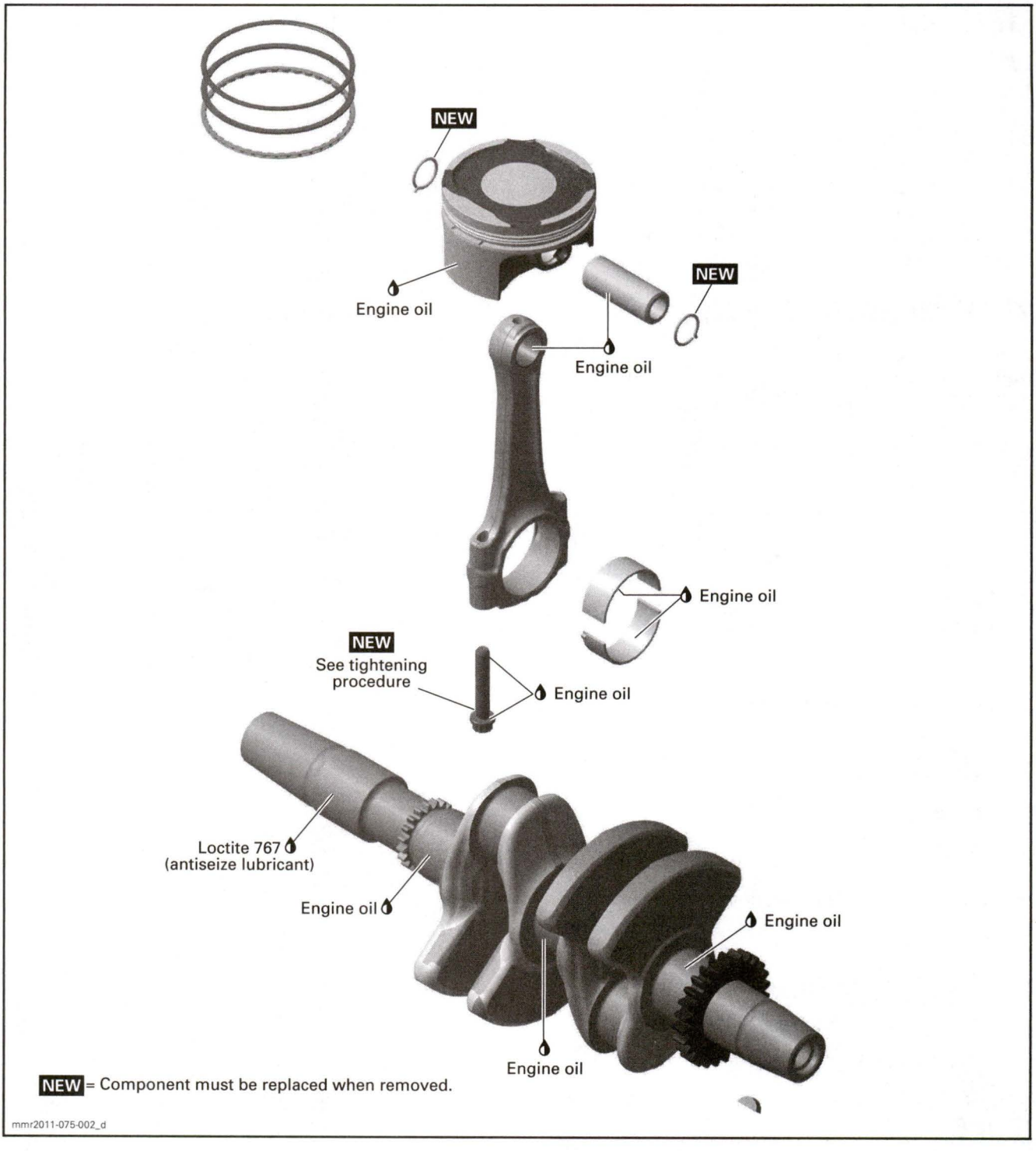
SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 5910	293 800 081	138
LOCTITE CHISEL (GASKET REMOVER)	413 708 500	136
SUPER LUBE GREASE	293 550 030	133

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NEW
Engine oil
NEW
Engine oil
Engine oil
NEW
See tightening procedure
Engine oil
Loctite 767 (antiseize lubricant)
Engine oil
Engine oil
Engine oil
NEW = Component must be replaced when removed.
mmr2011-075-002_d

GENERAL

When disassembling parts that are duplicated in the engine, (e.g.: pistons, connecting rods etc.), it is strongly recommended to note their position and to keep the parts of the same assembly as a "group". If you find a defective component, it would be much easier to find the cause of the failure. Since parts were broken-in during engine operation, they will maintain their matched fit when reassembled together within their "group".

TROUBLESHOOTING

Always check for fault codes. If a fault code is detected, service the fault code first. Refer to *DIAGNOSTIC AND FAULT CODES* subsection.

UNUSUAL ENGINE NOISE OR VIBRATIONS

1. Heavy wear on plain bearings.
   - *Check radial play of plain bearings. Replace if out of specification.*
2. Crankshaft axial play out of specification.
   - *Measure crankshaft axial play. If crankshaft axial play is out of specification, replace thrust washers.*
3. Connecting rod axial play out of specification.
   - *Measure connecting rod axial play on crankshaft. Replace connecting rod or crankshaft if out of specification.*
4. Connecting rod screws got loose.
   - *Replace damaged components and retighten screws with the recommended torque.*
5. Crankshaft PTO ball bearing is worn.
   - *Separate crankcase and check ball bearing for excessive play. Replace ball bearing if necessary.*

BLUE SMOKE IN THE EXHAUST

1. Oil scraper rings worn out.
   - *Replace piston rings.*

ENGINE SUDDENLY TURNS OFF (POOR IDLING)

1. Piston rings worn out.
   - *Replace piston rings.*
2. Piston/cylinder clearance out of specification.
   - *Check piston/cylinder clearance. Replace if out of specification.*
3. Melted or broken piston.
   - *Replace piston and cylinder block if necessary.*

PROCEDURES

PTO OIL SEAL

PTO Oil Seal Replacement

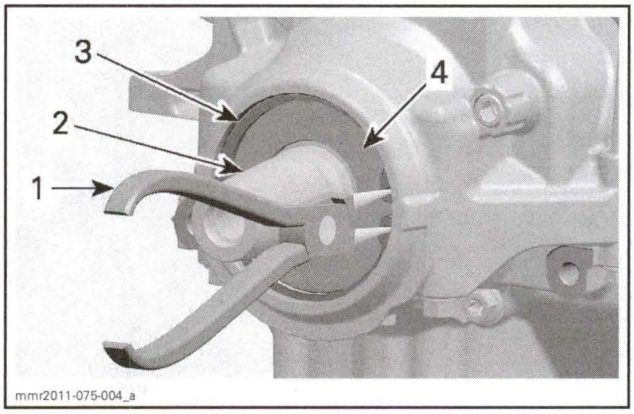
NOTE: To replace the PTO oil seal, it is not necessary to remove engine from the vehicle.

PTO Oil Seal Access

Remove drive pulley. Refer to *DRIVE PULLEY (eDRIVE)* subsection.

PTO Oil Seal Removal

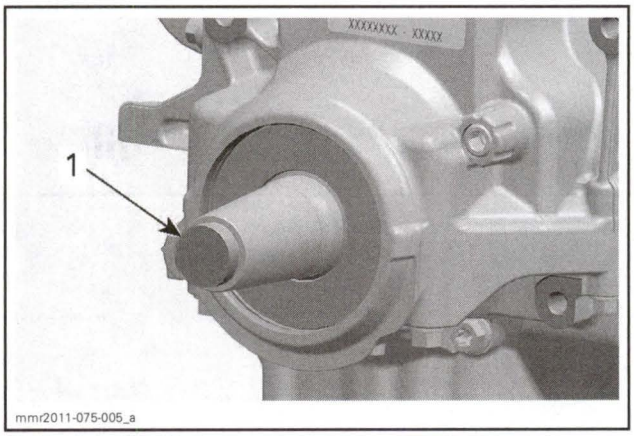
1. Use pliers to remove retaining ring.



1. *Pliers*
2. *Crankshaft PTO journal*
3. *Retaining ring*
4. *Oil seal*

2. Protect crankshaft.

REQUIRED TOOL	
CRANKSHAFT PROTECTOR (PTO) (P/N 420 876 552)	



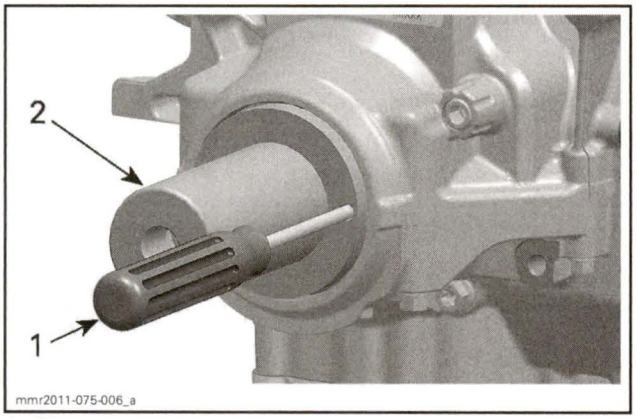
1. *Crankshaft protector*

3. Install the oil seal installer over the crankshaft end PTO.

REQUIRED TOOL	
PTO OIL SEAL INSTALLER (P/N 529 036 216)	

4. Carefully punch two holes in the old oil seal using a suitable pin.

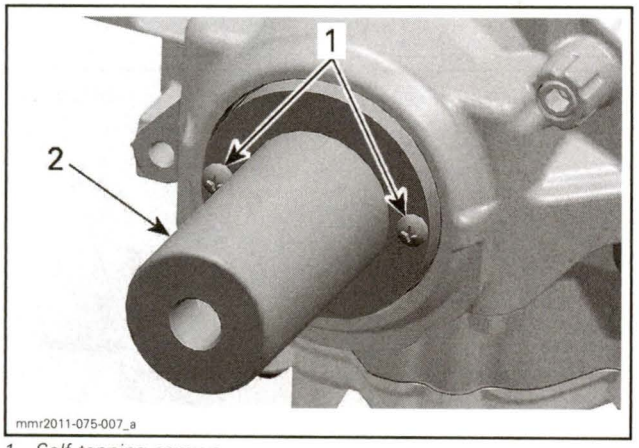
NOTE: The holes punched in the old seal must allow the self tapping screws to bite into the seal.



1. Pin
2. Oil seal installer

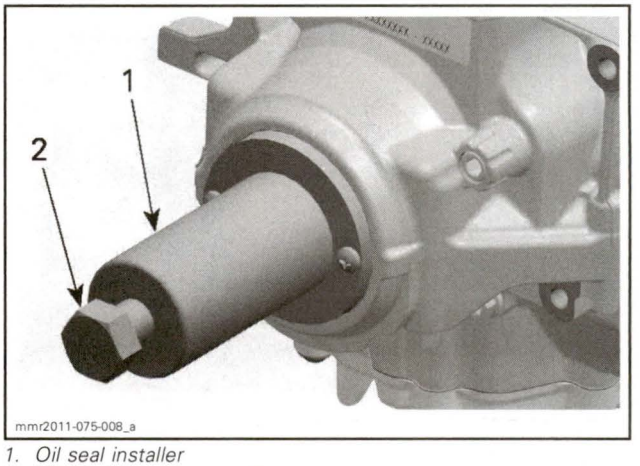
5. Thread the self tapping screws provided through the seal installer holes and into the oil seal.

NOTICE If self tapping screws other than the ones provided are used, their length must not exceed 16 mm (5/8 in).



1. Self tapping screws
2. Oil seal installer

6. Thread the M16 x 1.5 x 40 mm screw provided into the seal installer, then pull the old seal off the crankcase by turning screws in.



1. Oil seal installer
2. M16 x 1.5 x 40 mm screw

7. Remove crankshaft protector and clean oil seal area.

PTO Oil Seal Installation

NOTE: Check the oil seal running surface of crankshaft for grooves, before installation of NEW oil seal.

1. Clean crankshaft PTO side of deposits.
2. Lubricate oil seal sealing lip and outer diameter.

OIL SEAL SEALING LIP AND OUTER DIAMETER	
Service product	SUPER LUBE GREASE (P/N 293 550 030)

3. Place the NEW oil seal on crankshaft and install it.

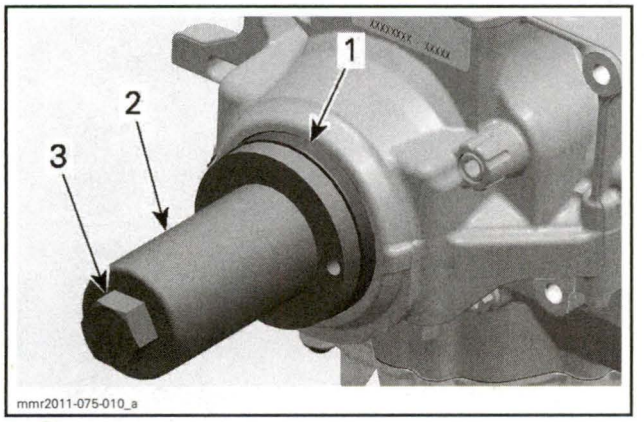
NOTICE Oil seal must be installed with sealing lip in, towards engine.

REQUIRED TOOL	
PTO OIL SEAL INSTALLER (P/N 529 036 216)	

3.1 Install oil seal installer tool over the crankshaft PTO end.

3.2 Thread the provided M14 x 1.5 x 55 mm screw in the crankshaft.

3.3 Turn screw in to push the seal in place.



1. Oil seal
2. Oil seal installer
3. M14 x 1.5 x 55 mm hex. screw

4. Install retaining ring.

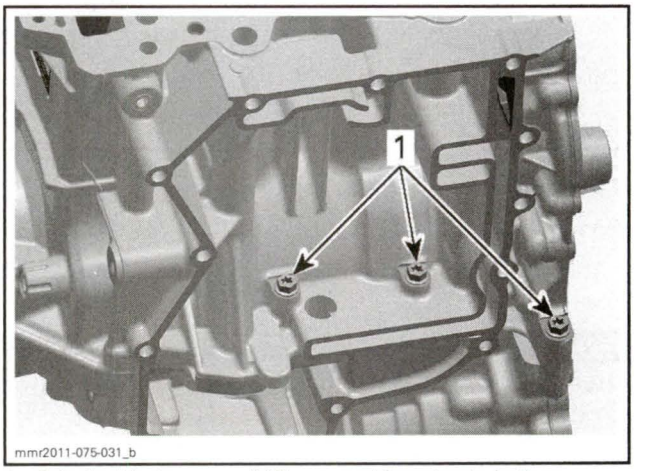
CYLINDER BLOCK

Cylinder Block Disassembly

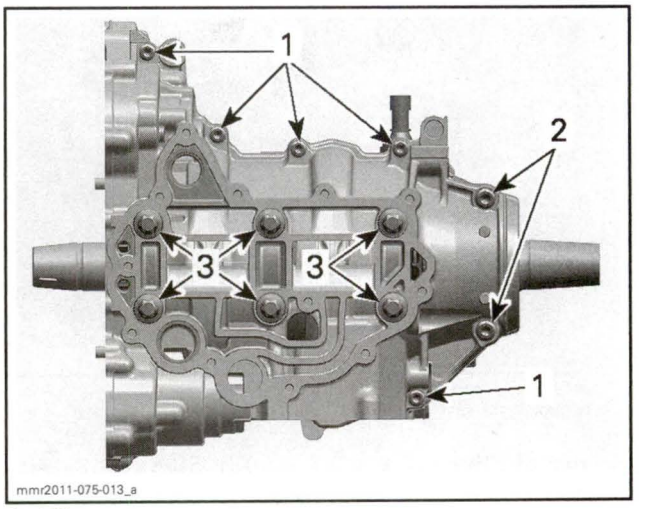
1. Remove engine from vehicle. Refer to *ENGINE REMOVAL AND INSTALLATION* subsection.
2. Refer to *PERIODIC MAINTENANCE PROCEDURES* and drain engine oil.
3. Refer to *TOP END* subsection and remove:
   - Ignition coils
   - Valve cover
   - Spark plugs.
4. Lock crankshaft, refer to *CRANKSHAFT LOCKING PROCEDURE* in this subsection.
5. Remove air intake manifold. Refer to *AIR INTAKE SYSTEM* subsection.
6. Refer to *COOLING SYSTEM* subsection and remove:
   - Water pump housing
   - Thermostat
   - Water pump drive gear.
7. Refer to *LUBRICATION SYSTEM* subsection and remove:
   - Oil tank
   - Oil cooler
   - Oil pressure regulator
   - Oil pump drive gears and oil pumps
   - Oil sump cover
   - Oil strainers.
8. Refer to *MAGNETO AND STARTER* subsection and remove:
   - Magneto cover
   - Rotor
   - Starter drive gears
   - Electric starter.
9. Refer to *TIMING CHAIN* subsection and remove:
   - Timing chain tensioner
   - Timing chain guides.
10. Refer to *TOP END* subsection and remove:
    - Camshaft holders
    - Cylinder head.

NOTE: Before splitting the cylinder block, measure crankshaft axial play. Refer to *CRANKSHAFT* in this subsection.

11. Remove crankshaft locking tool.
12. Remove cylinder block screws.
    12.1 Start by removing M6 screws.
    12.2 Then remove M8 screws.
    12.3 Finally remove and discard M9 screws.



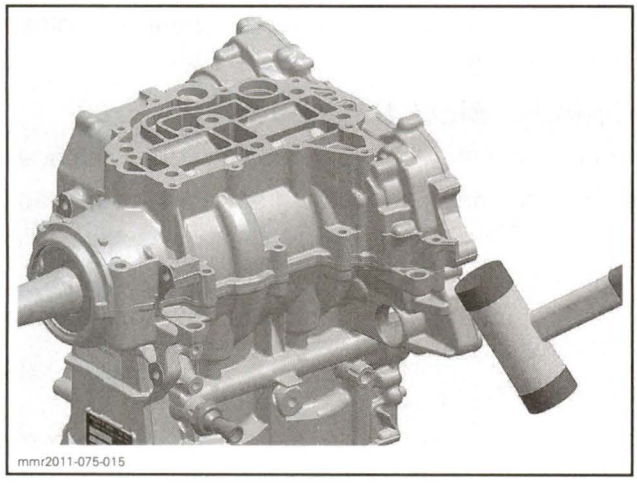
1. Cylinder block screws (M6) screwed from top to bottom



1. M6 screws
2. M8 screws
3. M9 screws (discard)

13. Carefully remove cylinder block lower half using a soft hammer.

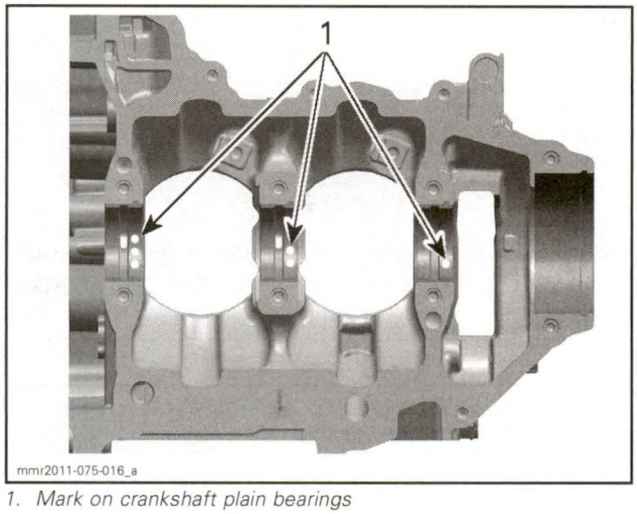
NOTE: Take care not to damage the sealing surfaces of the cylinder block halves.



14. Remove connecting rod caps. Refer to *PISTONS AND CONNECTING RODS* in this subsection.
15. Refer to *CRANKSHAFT* in this subsection and remove:
    - Crankshaft thrust washers
    - Crankshaft.
16. Remove pistons and connecting rods. See procedure in this subsection.

Plain Bearing Removal

When the plain bearings need to be removed from the cylinder block, mark them to identify the correct position at installation. See the illustration as an example.

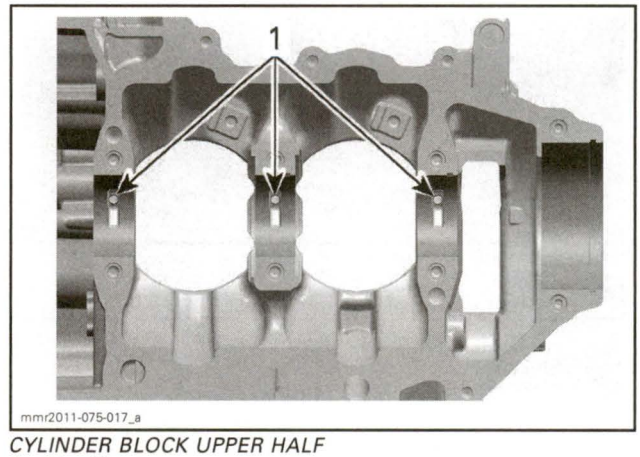


1. Mark on crankshaft plain bearings

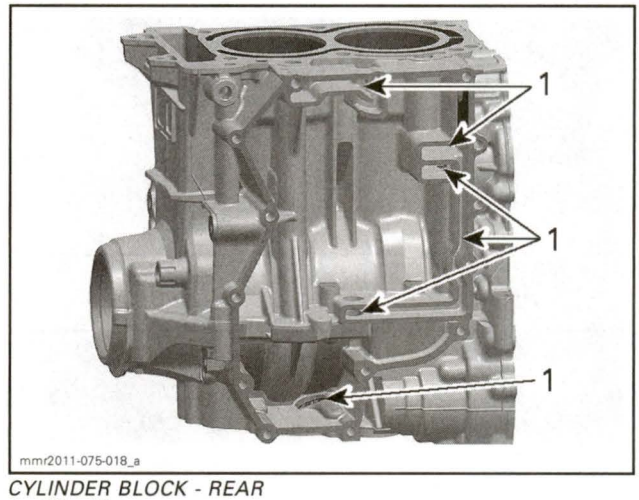
Cylinder Block Cleaning

Clean cylinder block using a part cleaner, then use compressed air to dry it.

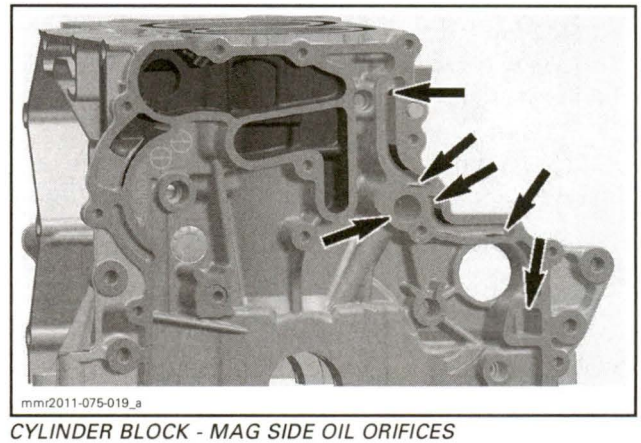
Blow out the oil orifices using compressed air and make sure they are not clogged.



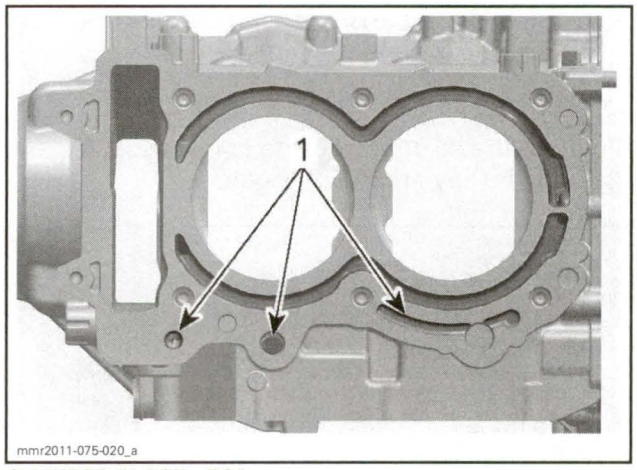
CYLINDER BLOCK UPPER HALF
1. Oil orifices



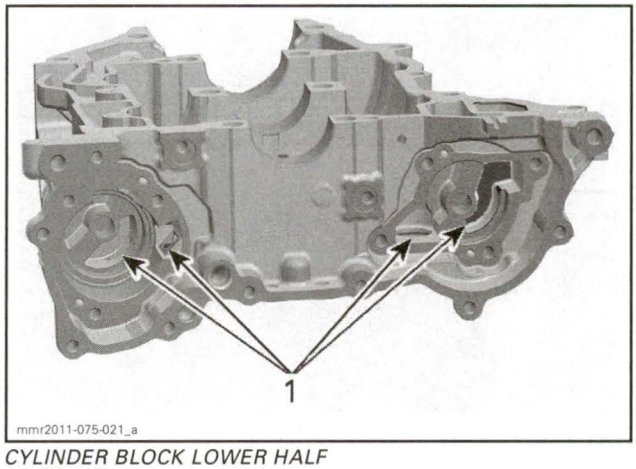
CYLINDER BLOCK - REAR
1. Oil orifices



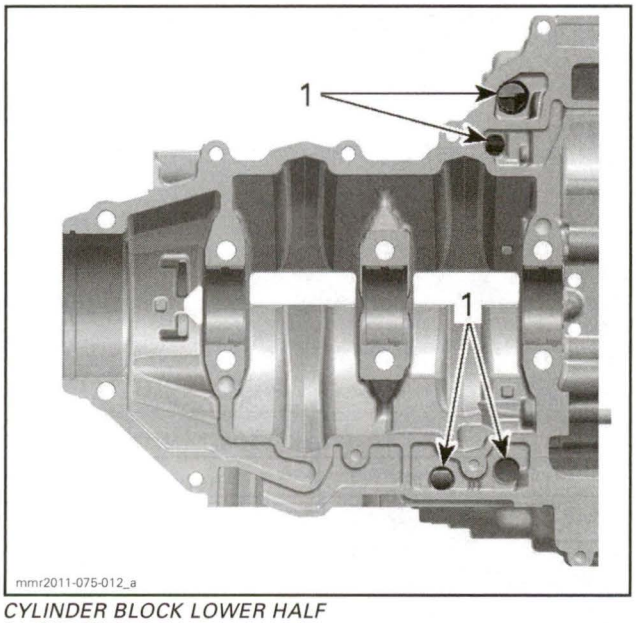
CYLINDER BLOCK - MAG SIDE OIL ORIFICES



CYLINDER BLOCK - TOP
1. Oil orifices



CYLINDER BLOCK LOWER HALF
1. Oil orifices



CYLINDER BLOCK LOWER HALF
1. Oil orifices

Clean all metal components in a solvent.

Clean cylinder block mating surfaces with LOCTITE CHISEL (GASKET REMOVER) (P/N 413 708 500) and a brass wire brush. Brush a first pass in one direction, then make the final brushing perpendicularly (90°) to the first pass (cross hatch).

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

Cylinder Block Inspection

Check cylinder block for cracks or other damage.

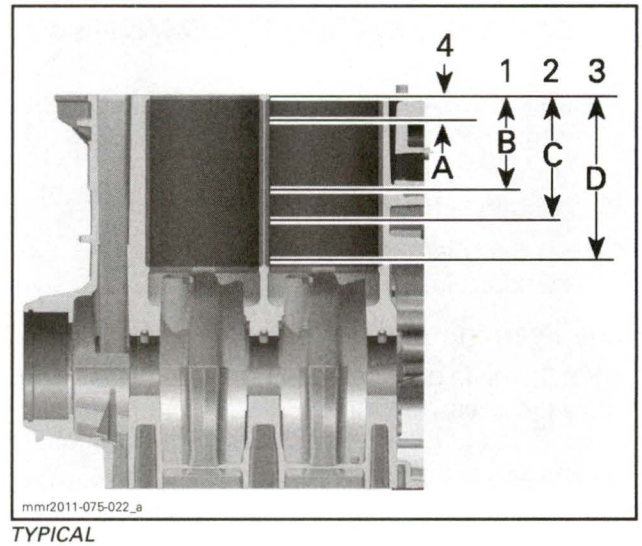
Check cylinder block mating surfaces for flatness using a straight edge.

Replace cylinder block if necessary.

Check cylinder bores for cracks, scoring and wear ridges on top and bottom of the cylinders.

Cylinder Taper

Measure cylinder bore diameter at 4 recommended positions. See illustration.



TYPICAL
1. First measure
2. Second measure
3. Third measure
4. Fourth measure

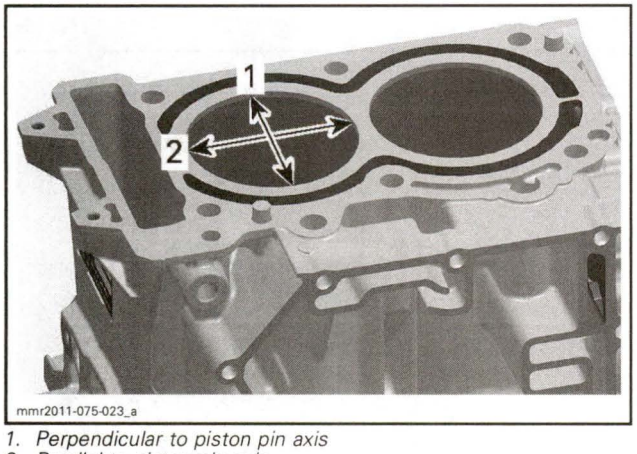
A. 5 mm to 10 mm (.197 in to .394 in)
B. 30 mm to 35 mm (1.181 in to 1.378 in)
C. 57 mm to 62 mm (2.244 in to 2.441 in)
D. 111 mm to 113 mm (4.37 in to 4.449 in)

The difference between measurements should not exceed the service limit mentioned in next table.

CYLINDER TAPER	
NEW MAXIMUM	0.030 mm (.0012 in)
SERVICE LIMIT	0.050 mm (.002 in)

Cylinder Out of Round

Measure cylinder bore diameter as shown, and at same measuring points as for *CYLINDER TAPER*.



1. *Perpendicular to piston pin axis*
2. *Parallel to piston pin axis*

To obtain the cylinder out of round, calculate the difference between the perpendicular measures.

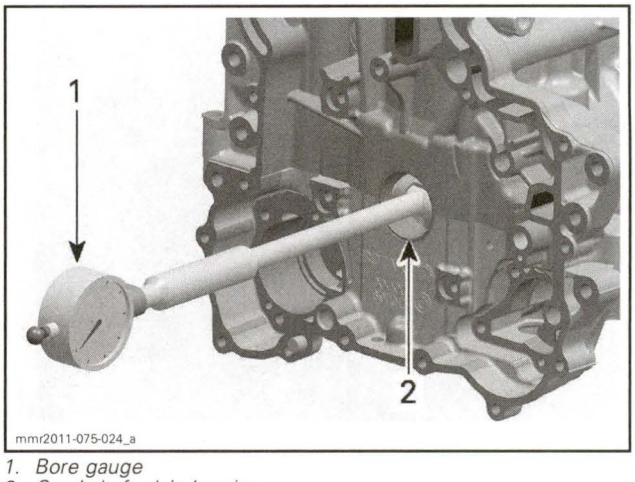
CYLINDER OUT OF ROUND	
NEW MAXIMUM	0.008 mm (.0003 in)
SERVICE LIMIT	0.030 mm (.0012 in)

Crankshaft Plain Bearings Inside Diameter

Check the plain bearings for scoring or other damages.

Measure plain bearing inside diameter and compare with crankshaft bearing journal diameter (refer to *CRANKSHAFT* in this subsection). Proceed as follows.

- Using the OLD plain bearings, assemble both cylinder block halves together.
- Tighten screws as described in *CYLINDER BLOCK ASSEMBLY*.
- Measure the inside diameter of the crankshaft plain bearings using a bore gauge.



1. *Bore gauge*
2. *Crankshaft plain bearing*

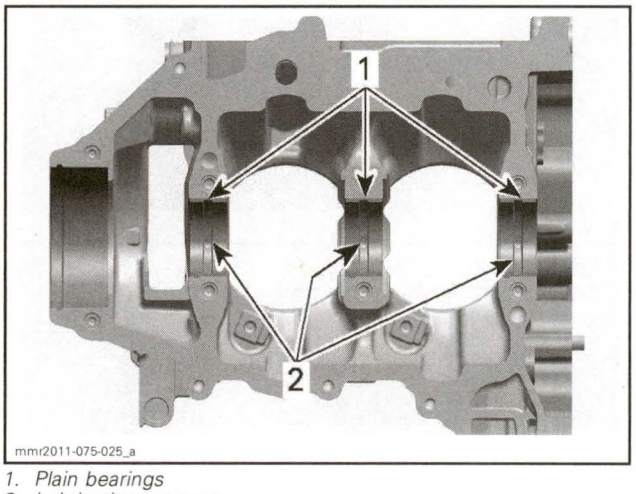
CRANKSHAFT PLAIN BEARING INSIDE DIAMETER	
SERVICE LIMIT	36.080 mm (1.4205 in)

Replace bearings if out of specifications.

Cylinder Block Assembly

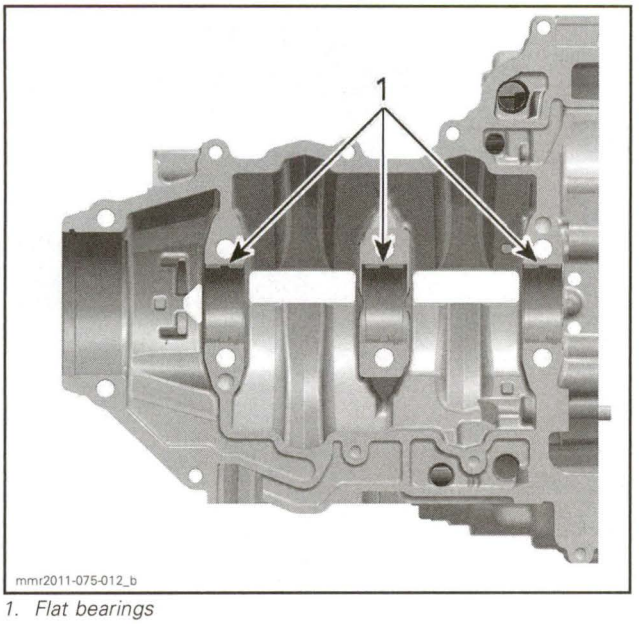
Reverse the disassembly procedure. Pay attention to the following details.

1. Correctly reinstall plain bearings as follows.
   - 1.1 Use NEW bearings if diameters are out of specification. Refer to *PLAIN BEARING INSPECTION* in this subsection.
   - 1.2 Install bearings with lubrication grooves in the cylinder block upper half.



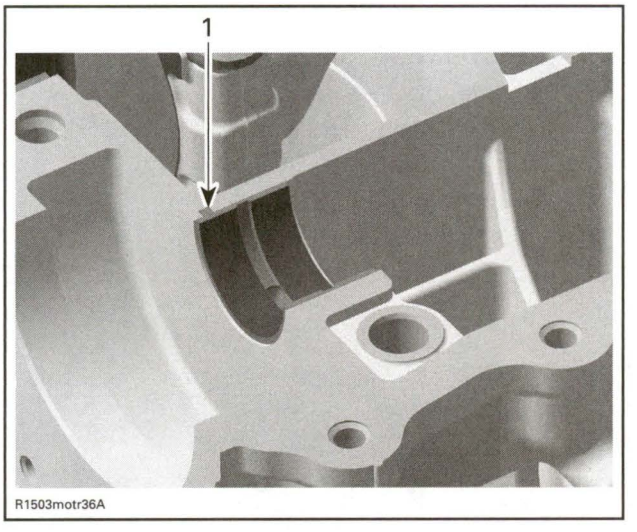
1. *Plain bearings*
2. *Lubrication grooves*

   - 1.3 Install flat bearings in cylinder block lower half.



1. Flat bearings

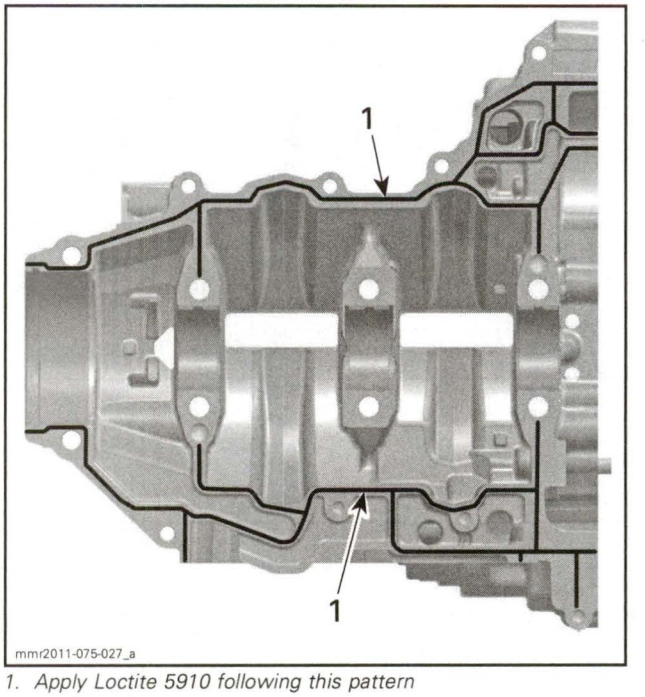
NOTICE Bearings must be flush with the cylinder block split surface, and their protrusions must fit in the notched areas in the cylinder block seat.



TYPICAL
1. Bearing protrusion in cylinder block notch

2. Install pistons, refer to *PISTONS AND CONNECTING RODS* in this subsection.
3. Apply engine oil on all plain bearings.
4. Install the following components:
   - Crankshaft and thrust washers (refer to *CRANKSHAFT*)
   - Connecting rod caps (refer to *PISTONS AND CONNECTING RODS*).
5. Apply LOCTITE 5910 (P/N 293 800 081) on mating surface of cylinder block lower half as shown in following illustration.

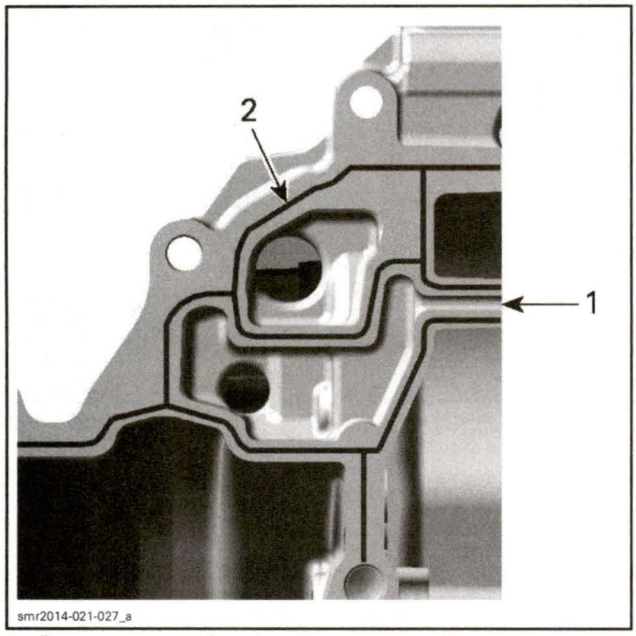
IMPORTANT: When beginning the application of the cylinder block sealant, the assembly and first tightening must be done within 12 minutes. It is suggested to have all you need on hand to save time.



1. Apply Loctite 5910 following this pattern

NOTICE Ensure not to apply too much sealant, as it will spread out inside the cylinder block.

NOTICE Take care to ensure the bypass passage of the engine oil pressure regulator is not clogged with sealant.



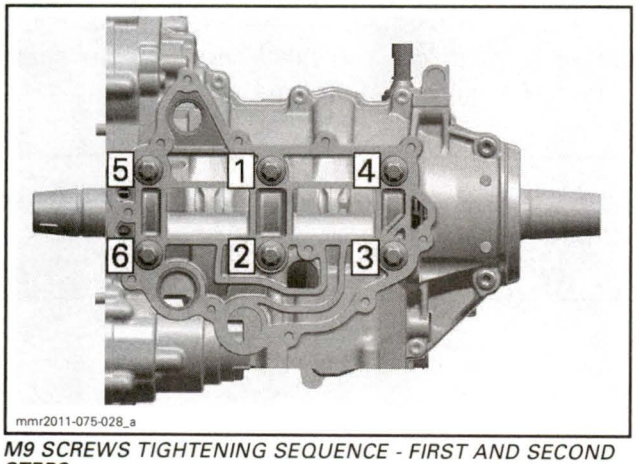
1. *Bypass passage of engine oil pressure regulator*
2. *Loctite 5910 applied*

6. Install **NEW** cylinder block M9 screws and tighten as follows.

NOTICE **This assembly uses stretch screws. Always use NEW screws and strictly adhere to the tightening procedure.**

6.1 Torque the M9 screws according to following sequence.

CYLINDER BLOCK M9 SCREWS TIGHTENING PROCEDURE	
FIRST STEP	20 N•m ± 2 N•m (15 lbf•ft ± 1 lbf•ft)



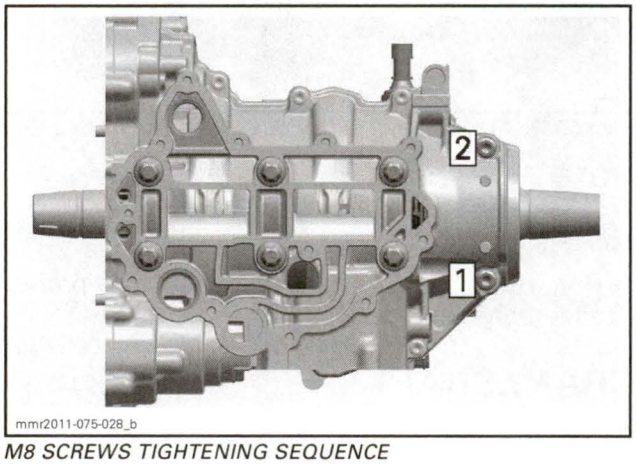
M9 SCREWS TIGHTENING SEQUENCE - FIRST AND SECOND STEPS

6.2 Use a torque angle gauge to carry out the second step, following the same sequence.

CYLINDER BLOCK M9 SCREWS TIGHTENING PROCEDURE	
SECOND STEP	Additional 150° ± 5°

7. Install M8 screws and tighten as follows.

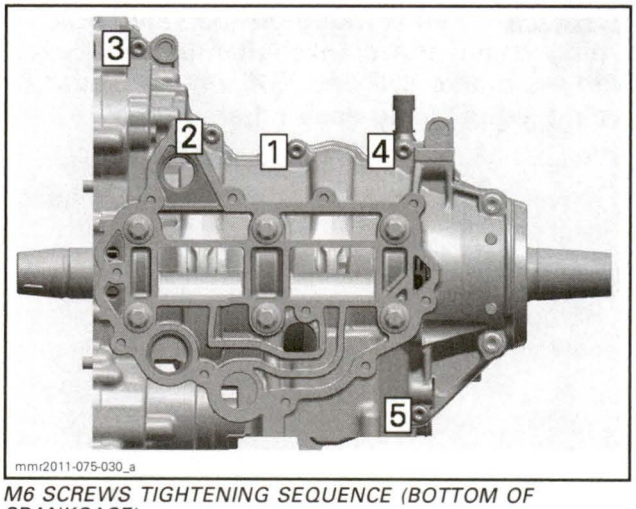
CYLINDER BLOCK M8 SCREWS	
Tightening torque	23 N•m ± 2 N•m (17 lbf•ft ± 1 lbf•ft)



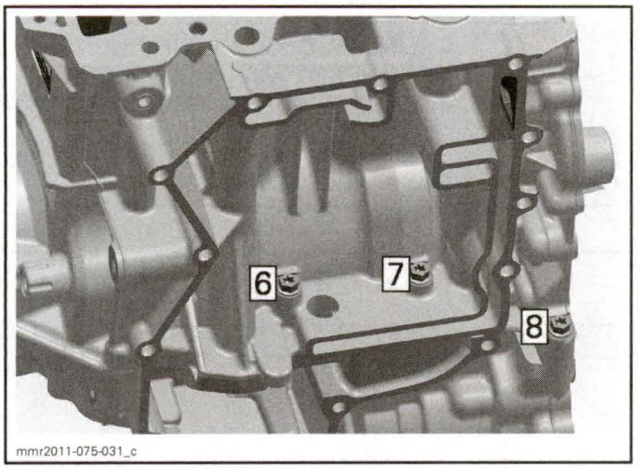
M8 SCREWS TIGHTENING SEQUENCE

8. Install M6 screws and tighten as follows.

CYLINDER BLOCK M6 SCREWS	
Tightening torque	9 N•m ± 1 N•m (80 lbf•**in** ± 9 lbf•**in**)



M6 SCREWS TIGHTENING SEQUENCE (BOTTOM OF CRANKCASE)



M6 SCREWS TIGHTENING SEQUENCE (REAR OF CRANKCASE)

NOTE: Check crankshaft axial play before continuing the assembly. Refer to *CRANKSHAFT* in this subsection.

9. Reassemble engine in accordance with proper assembly procedures.

CRANKSHAFT

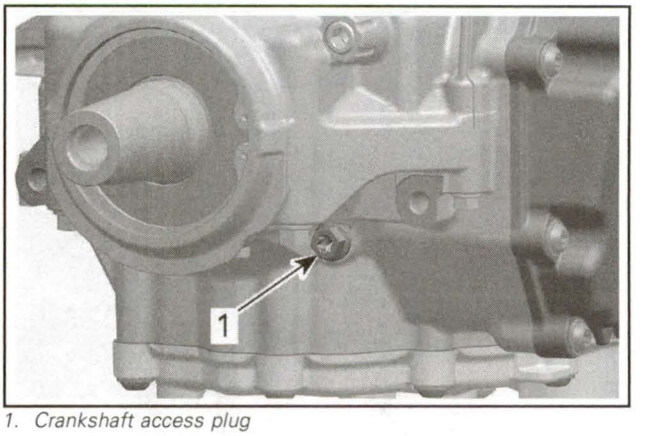
Crankshaft Locking Procedure

NOTICE When the crankshaft is locked, neither first nor second cylinder is set to TDC.

The crankshaft must be locked whenever the magneto rotor retaining nut has to be removed, or whenever working on the valve train.

NOTICE When working on the valve train or timing chain, the crankshaft must be locked with the marks "IN" and "EX" on the camshaft timing gears facing each other.

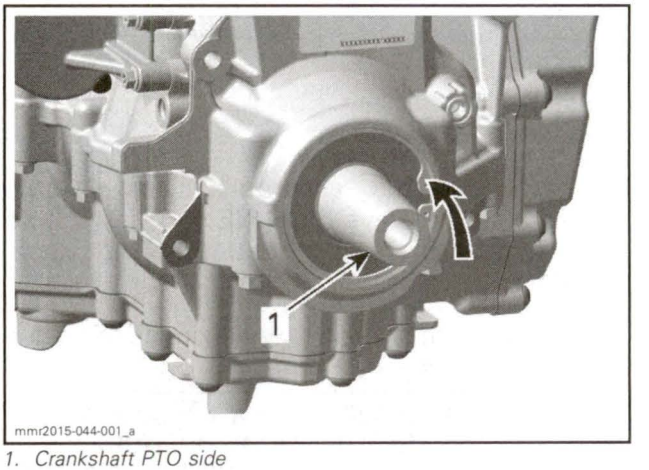
1. If working on the valve train or timing chain, remove the valve cover. Refer to *TOP END* subsection.
2. Remove spark plugs.
3. Remove crankshaft access plug and discard gasket ring.



1. Crankshaft access plug

4. On PTO side , turn engine crankshaft counterclockwise to the locking position.

To turn the crankshaft, install the drive pulley, or use a suitable screw locked by a counter nut.

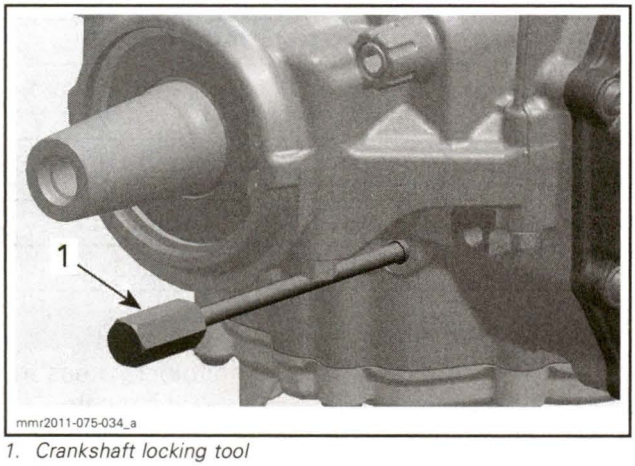


1. Crankshaft PTO side

NOTICE Crankshaft locking position is reached when marks "IN" and "EX" on the camshaft timing gears face each other.

5. Use a flashlight to check if the crankshaft groove is aligned with the hole.
6. Lock crankshaft.

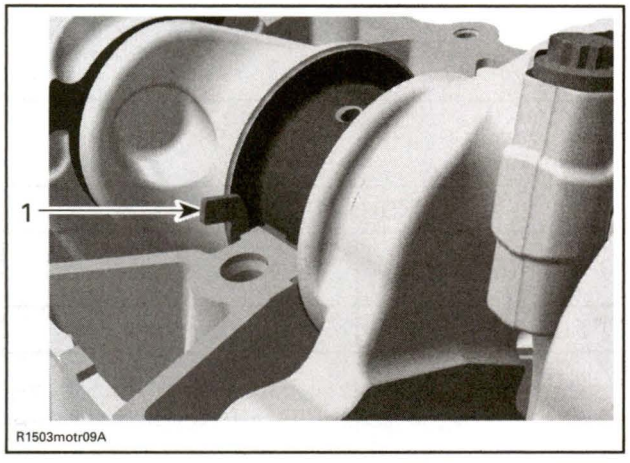
REQUIRED TOOL	
CRANKSHAFT LOCKING TOOL (P/N 529 036 205)	



1. Crankshaft locking tool

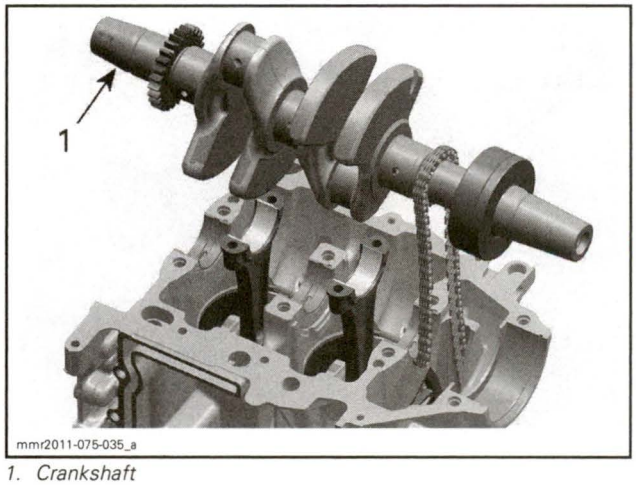
Crankshaft Removal

1. Disassemble *CYLINDER BLOCK,* see procedure in this subsection.
2. Remove connecting rod caps. Refer to *PISTONS AND CONNECTING RODS* in this subsection.
3. Remove crankshaft thrust washers.



TYPICAL
1. Thrust washer

4. Remove crankshaft from cylinder block.

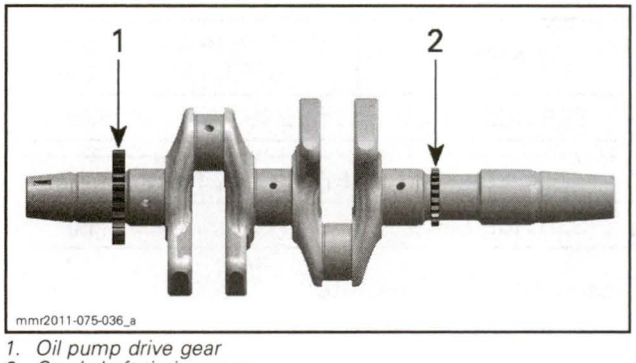


1. Crankshaft

Crankshaft Inspection

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

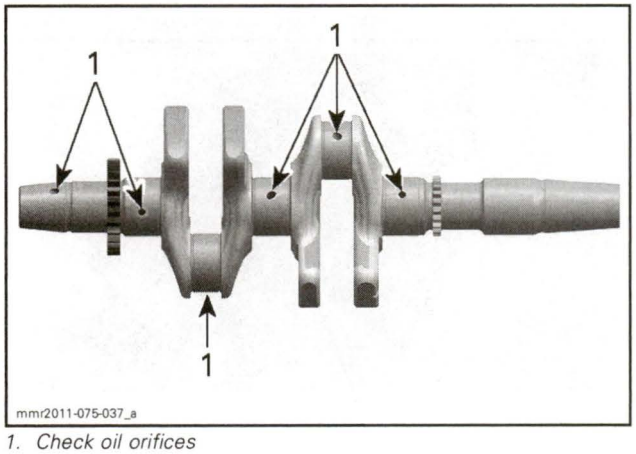
Check crankshaft gears for wear or other damage.



1. Oil pump drive gear
2. Crankshaft timing gear

Replace crankshaft if damaged.

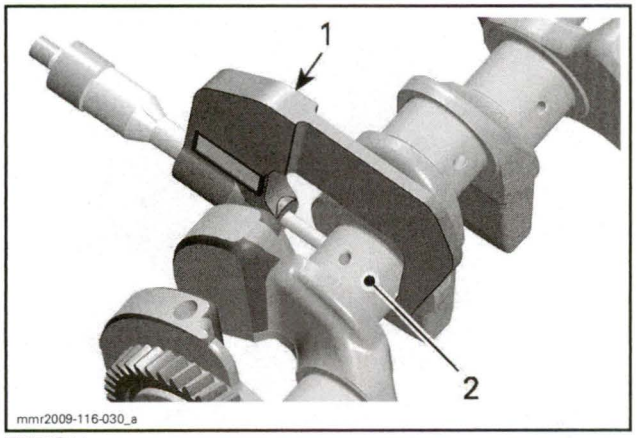
Blow the oil orifices using compressed air and ensure they are not clogged.



1. Check oil orifices

Crankshaft Radial Play

Measure crankshaft bearing journal diameter using a micrometer.



TYPICAL
1. *Micrometer*
2. *Crankshaft area for plain bearing*

To obtain crankshaft radial play, calculate the difference between the bearing journal diameter and the crankshaft plain bearings inner diameter (see *CYLINDER BLOCK*) in this subsection.

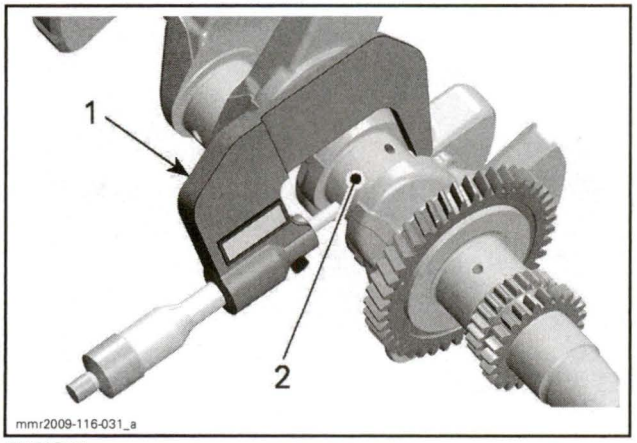
CRANKSHAFT BEARING JOURNAL DIAMETER	
NEW	35.990 mm to 36.006 mm (1.4169 in to 1.4176 in)
SERVICE LIMIT	35.960 mm (1.4157 in)

CRANKSHAFT RADIAL PLAY	
SERVICE LIMIT	0.080 mm (.0031 in)

Crankshaft Pin Diameter

Measure crankshaft pin diameter using a micrometer.

To obtain connecting rod radial play (big end), calculate the difference between the crankshaft pin diameter and the inner diameter of the connecting rod plain bearings (see *CONNECTING ROD INSPECTION*) in this subsection.



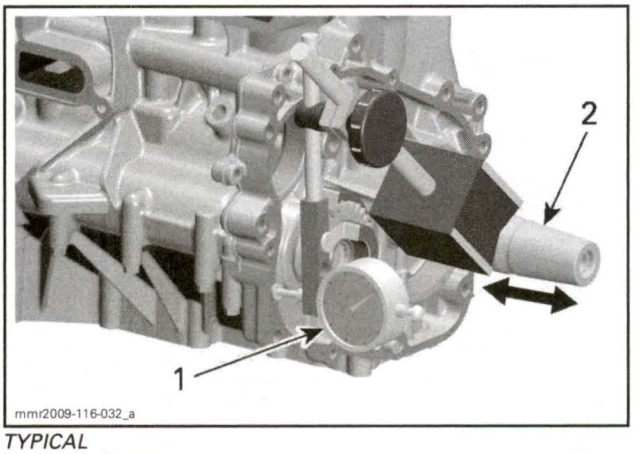
TYPICAL
1. *Micrometer*
2. *Crankshaft pin area for plain bearing*

CRANKSHAFT PIN DIAMETER	
NEW	35.979 mm to 35.995 mm (1.416 in to 1.417 in)
SERVICE LIMIT	35.969 mm (1.416 in)

CONNECTING ROD BIG END RADIAL PLAY	
SERVICE LIMIT	0.080 mm (.0031 in)

Crankshaft Axial Play

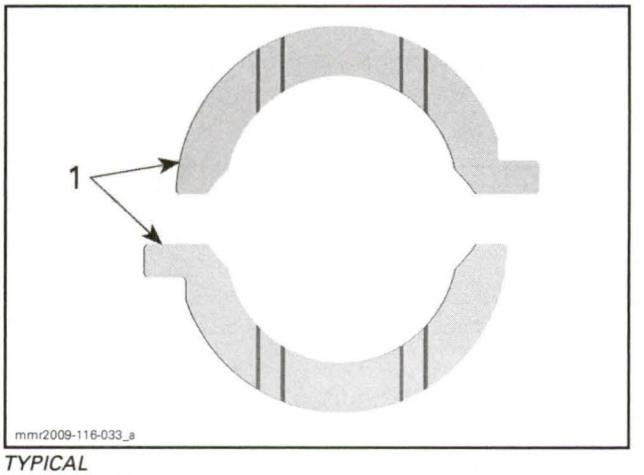
With the crankshaft in the cylinder block, measure the crankshaft axial play, using a dial indicator.



TYPICAL
1. *Dial indicator*
2. *Crankshaft*

CRANKSHAFT AXIAL PLAY	
NEW	0.120 mm to 0.392 mm (.005 in to .015 in)
SERVICE LIMIT	0.450 mm (.018 in)

If axial play is out of specification, replace the crankshaft thrust washers and repeat measurement.



TYPICAL
1. *Crankshaft thrust washers*

Crankshaft Installation

Reverse the removal procedure. However, pay attention to following details.

Turn cylinder block upside down.

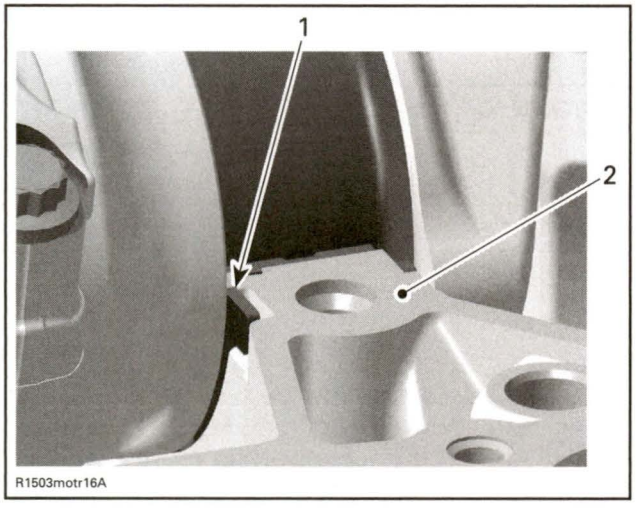
NOTICE Be careful that connecting rods do not hit the cylinder block.

Apply engine oil on all plain bearings before installing them.

Install crankshaft along with the timing chain.

Lubricate (both sides) and reinstall crankshaft thrust washers with the slots facing against crankshaft counterweights.

NOTE: Thrust washers must be flush with cylinder block sealing surface.



TYPICAL
1. *Thrust washer*
2. *Sealing surface*

Install connecting rod caps. Refer to *PISTONS AND CONNECTING RODS* in this subsection.

NOTICE It is absolutely necessary to follow this procedure. Otherwise, severe engine damage can occur.

Install cylinder block lower half. Refer to *CYLINDER BLOCK* in this subsection.

Lock crankshaft before further assembly of the engine. See *CRANKSHAFT LOCKING PROCEDURE* in this subsection.

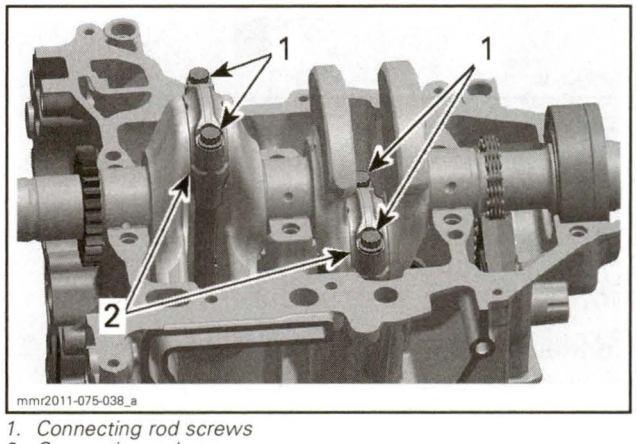
PISTONS AND CONNECTING RODS

Piston and Connecting Rod Removal

NOTE: It is recommended to measure connecting rod big end axial play prior to removing connecting rod. Refer to *CONNECTING ROD INSPECTION* in this subsection.

1. Disassemble *CYLINDER BLOCK* as per procedure in this subsection.
2. Remove connecting rod cap.

NOTICE Mark cylinder position of connecting rod before disassembly.

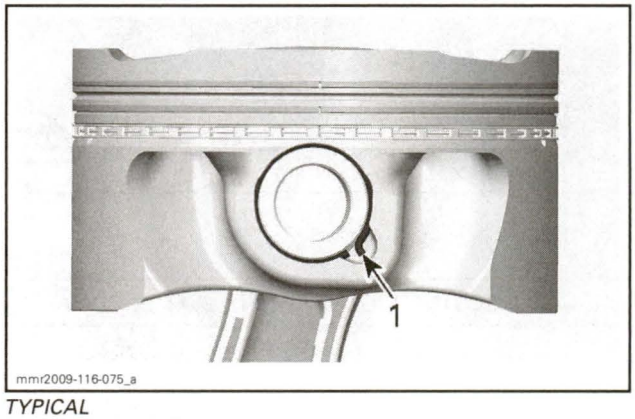


1. *Connecting rod screws*
2. *Connecting rod cap*

3. Remove *CRANKSHAFT* as per procedure in this subsection.
4. Turn cylinder block and push piston and connecting rod out of the cylinder.

Piston and Connecting Rod Disassembly

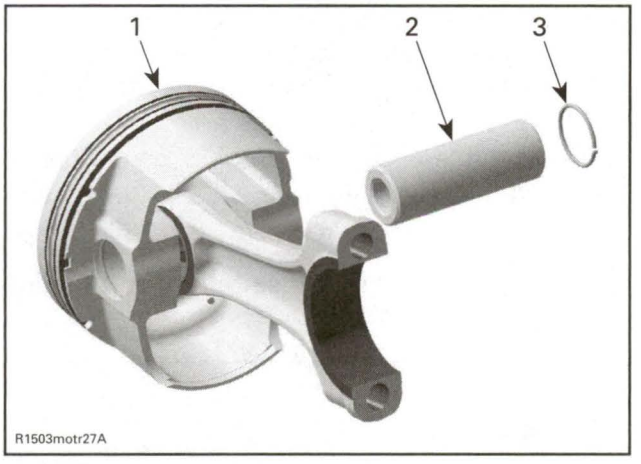
1. Remove one piston pin circlip and discard it.



TYPICAL
1. *Piston pin circlip*

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

2. Push piston pin out of the piston.



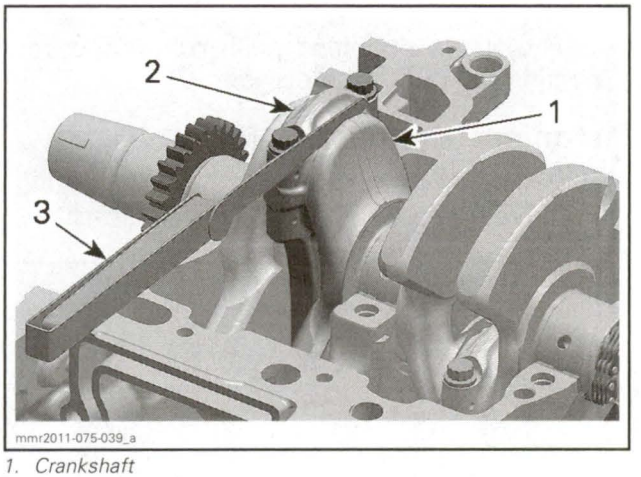
TYPICAL
1. *Piston*
2. *Piston pin*
3. *Circlip*

3. Detach piston from connecting rod.

Connecting Rod Inspection

Connecting Rod Big End Axial Play

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

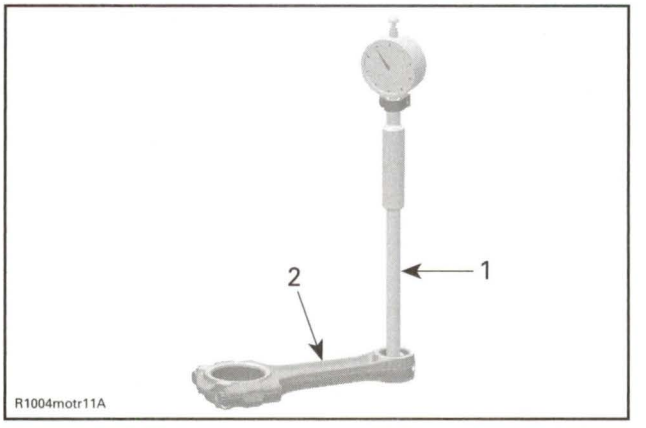


1. *Crankshaft*
2. *Connecting rod*
3. *Feeler gauge*

CONNECTING ROD BIG END AXIAL PLAY	
NEW	0.100 mm to 0.352 mm (.004 in to .014 in)
SERVICE LIMIT	0.450 mm (.018 in)

Connecting Rod Small End Radial Play

Measure connecting rod small end using a bore gauge.



TYPICAL
1. *Bore gauge*
2. *Connecting rod*

CONNECTING ROD SMALL END DIAMETER	
NEW	17.010 mm to 17.020 mm (.6697 in to .6701 in)
SERVICE LIMIT	17.060 mm (.6717 in)

If the connecting rod small end diameter is out of specification, replace the connecting rod.

To obtain the connecting rod radial play (small end), calculate the difference between the piston pin diameter (*PISTON PIN INSPECTION*) and the inner diameter of the connecting rod small end.

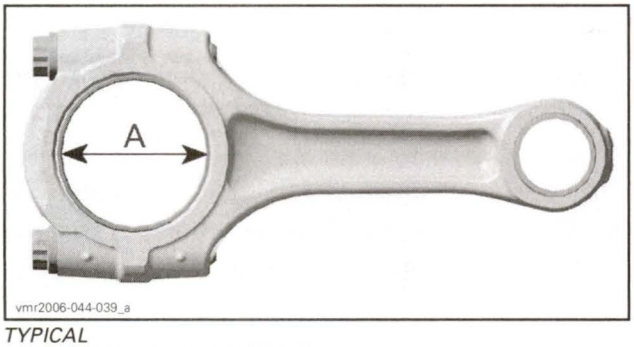
CONNECTING ROD SMALL END RADIAL PLAY	
SERVICE LIMIT	0.040 mm (.0016 in)

Connecting Rod Big End Radial Play

1. Measure inside diameter of connecting rod big end.
   - 1.1 Install the OLD plain bearings as they were mounted initially.
   - 1.2 Perform the tightening procedure as described in *PISTON AND CONNECTING ROD INSTALLATION* in this subsection.

   NOTE: To measure the connecting rod big end diameter, ALWAYS use the OLD connecting rod screws.

   - 1.3 Measure inside diameter in longitudinal direction of the connecting rod.



TYPICAL
A. Connecting rod big end bearing

CONNECTING ROD BIG END DIAMETER	
SERVICE LIMIT	36.060 mm (1.4197 in)

To obtain the connecting rod big end radial play, calculate the difference between the big end diameter and the crankshaft pin diameter (see *CRANKSHAFT INSPECTION*) in this subsection.

CONNECTING ROD BIG END RADIAL PLAY	
SERVICE LIMIT	0.080 mm (.0031 in)

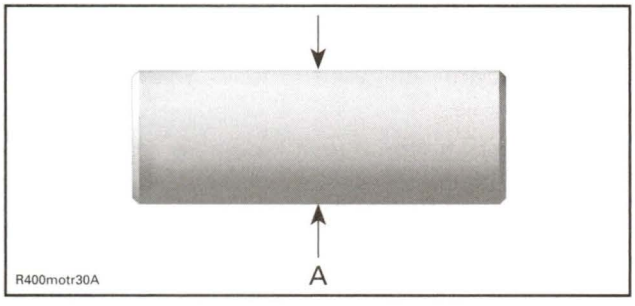
If connecting rod big end diameter is out of specification, install NEW plain bearings.

Piston Pin Inspection

Using a woven synthetic abrasive, clean piston pin of deposits.

Inspect piston pin for scoring, cracks or other damage.

Measure piston pin diameter, using a micrometer. See following illustration for proper measurement position.



TYPICAL
A. Measure piston pin diameter here

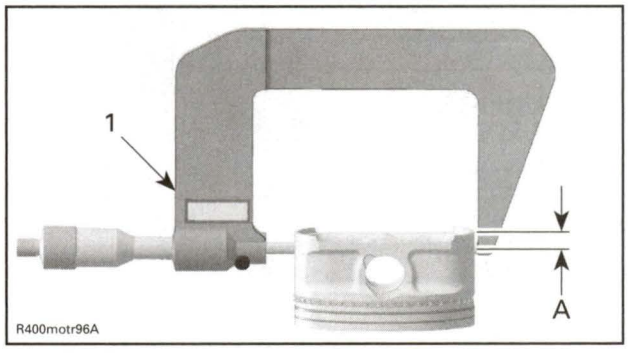
PISTON PIN DIAMETER	
NEW	16.996 mm to 17.000 mm (.6691 in to .6693 in)
SERVICE LIMIT	16.986 mm (.6687 in)

Replace piston pin if out of specification.

Piston Inspection

Inspect piston for scoring, scuffing, cracks or other damage. Replace piston and piston rings if necessary.

Using a micrometer, measure piston perpendicularly (90°) to piston pin axis at 8.5 mm (11/32 in) from the skirt edge.



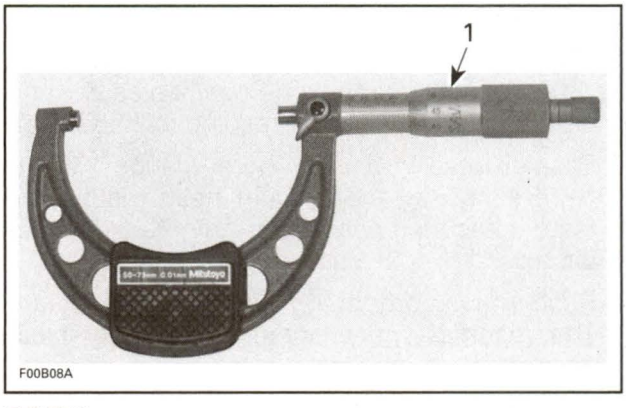
TYPICAL
1. Measuring perpendicularly (90°) to piston pin axis
A. 8.5 mm (11/32 in)

PISTON MEASUREMENT	
NEW	73.950 mm to 73.966 mm (2.911 in to 2.912 in)
SERVICE LIMIT	73.920 mm (2.9102 in)

Replace piston if out of specification.

Piston/Cylinder Clearance

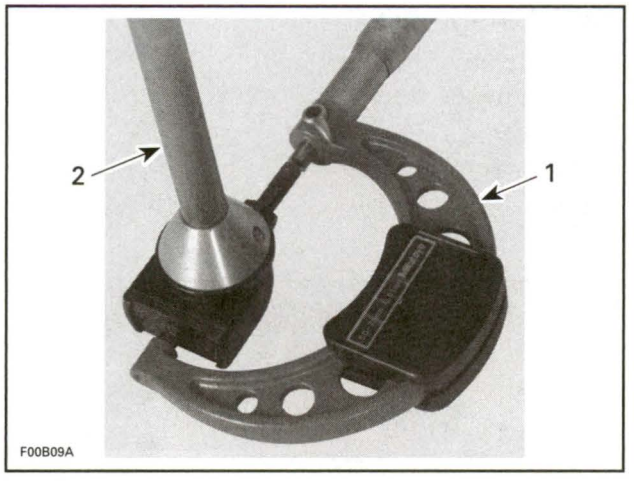
1. Adjust and lock a micrometer to the piston dimension.



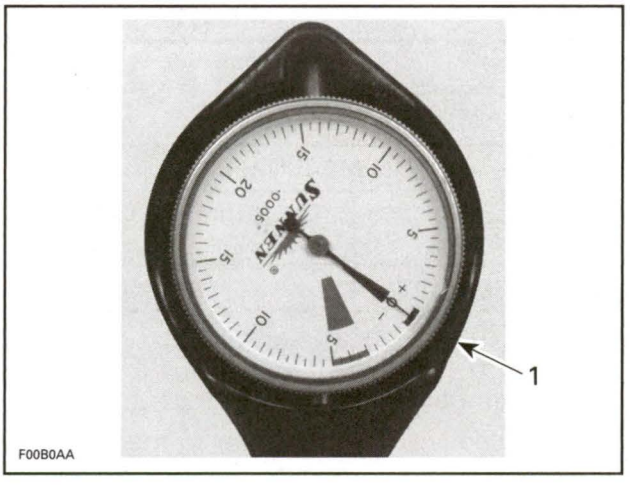
TYPICAL
1. Micrometer set to the piston dimension

NOTE: Make sure used piston is not worn.

2. With the micrometer locked at step 1, adjust a cylinder bore gauge to the micrometer dimension and set the indicator to 0 (zero).



TYPICAL
1. *Use the micrometer to set the cylinder bore gauge*
2. *Cylinder bore gauge*



TYPICAL
1. *Indicator set to 0 (zero)*

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.

3. Position the cylinder bore gauge 35 mm (1-3/8 in) below the cylinder head mating surface, measuring perpendicularly (90°) to piston pin axis.
4. Read measurement on cylinder bore gauge. The result is the exact piston/cylinder clearance.

PISTON/CYLINDER CLEARANCE	
NEW	0.037 mm to 0.067 mm (.0015 in to .0026 in)
SERVICE LIMIT	0.080 mm (.0031 in)

If clearance exceeds specified tolerance, replace piston and repeat measurement procedure.

Piston and Connecting Rod Assembly

Reverse the disassembly procedure. However, pay attention to the following details.

1. Apply engine oil on piston pin.
2. Insert piston pin in piston and connecting rod.

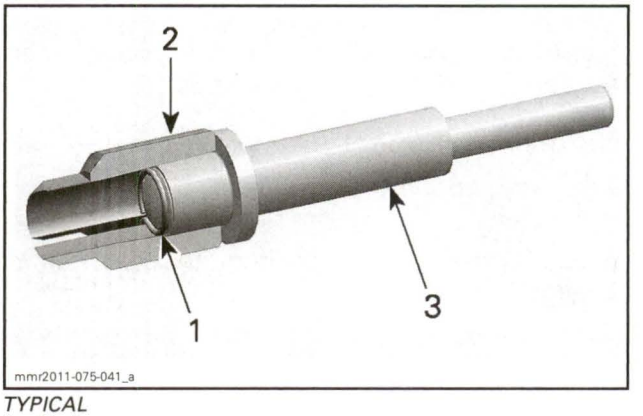
NOTE: Be sure to reinstall all parts in their original position as marked during removal.

3. Install NEW piston pin circlip(s).

REQUIRED TOOL	
PISTON CIRCLP INSTALLER (P/N 529 036 207)	

NOTICE **Always replace removed piston pin circlips by NEW ones.**

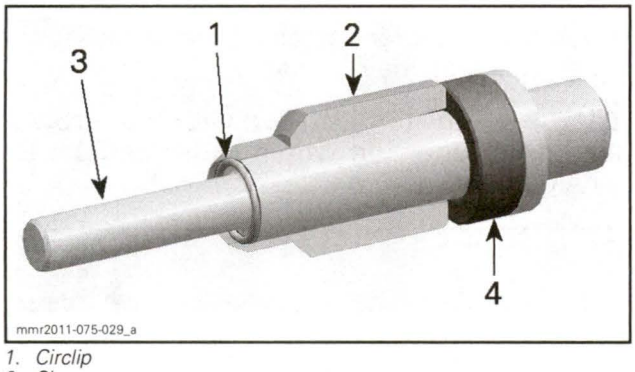
3.1 Place the circlip in the sleeve and push piston circlip installer handle until circlip reaches the mid position in the sleeve.



TYPICAL
1. *Circlip*
2. *Sleeve*
3. *Installer handle*

3.2 Put the distance sleeve on the installer handle.

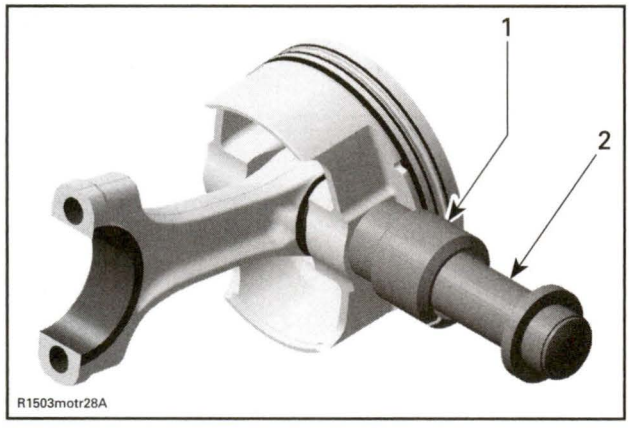
3.3 Push piston circlip installer handle until distance sleeve makes contact with the sleeve.



1. *Circlip*
2. *Sleeve*
3. *Installer handle*
4. *Distance sleeve*

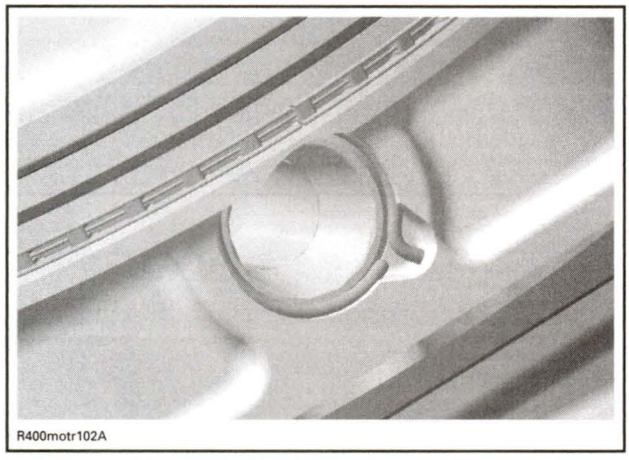
3.4 Remove distance sleeve and insert installer handle into the sleeve.

3.5 Insert the end of the handle into the piston pin, then push to engage the circlip in the piston groove.



TYPICAL
1. *Sleeve with piston circlip inside*
2. *Piston clip installer handle*

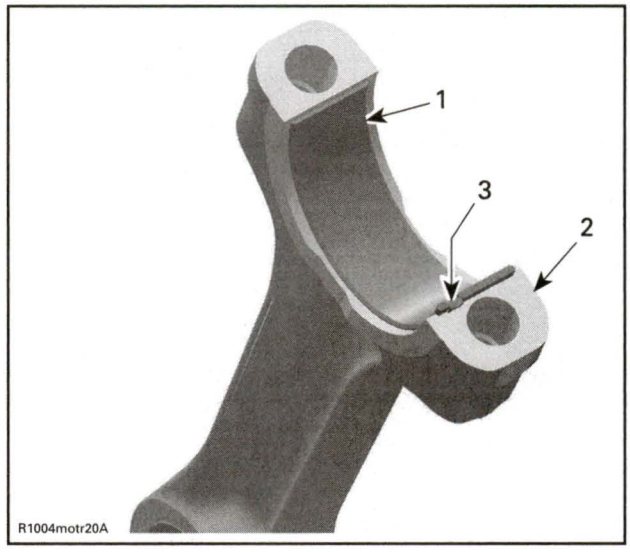
NOTE: Ensure the hook of the piston pin circlip is properly positioned.



CORRECT POSITION OF PISTON PIN CIRCLIP

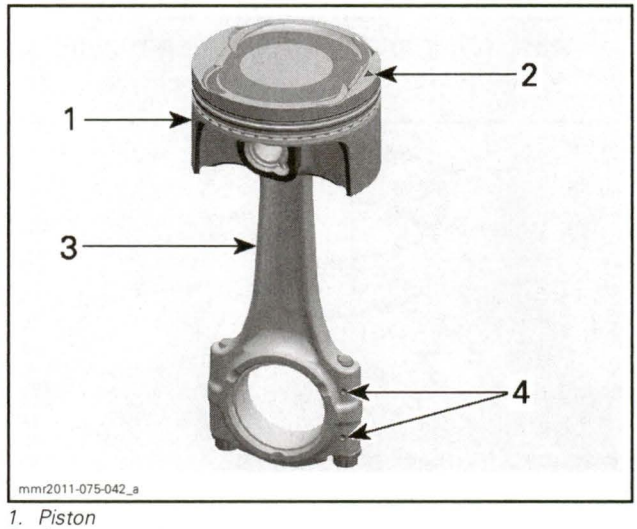
NOTICE If piston pin circlip installation fails, repeat step 3 by using a NEW circlip.

4. Correctly install plain bearings and carefully clean split surface on both sides (cracked area) with compressed air.



TYPICAL
1. *Half bearing of connecting rod big end*
2. *Split surface of the connecting rod*
3. *Protrusion of bearing in line with connecting rod groove*

NOTICE The arrow on top of the piston and the punch marks on the connecting rods must always point towards the exhaust.



1. *Piston*
2. *Arrow on top*
3. *Connecting rod*
4. *Punch marks*

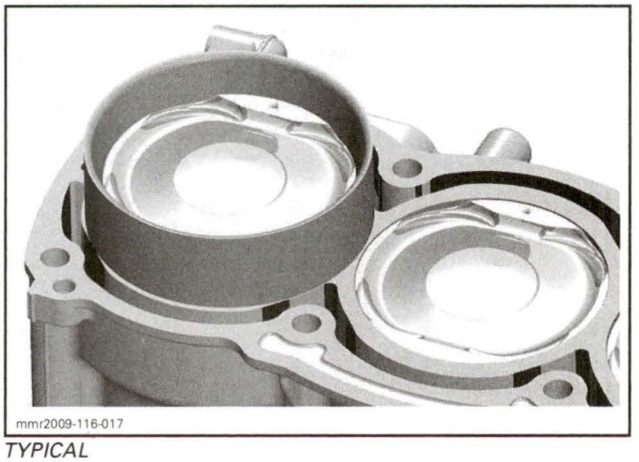
Piston and Connecting Rod Installation

1. Using recommended engine oil, lubricate:
   - Piston
   - Piston rings

- Cylinder bore
- Connecting rod bearings.

2. Slide piston in cylinder bore. Pay attention to the following.

REQUIRED TOOL	
PISTON RING COMPRESSOR (P/N 529 036 208)	

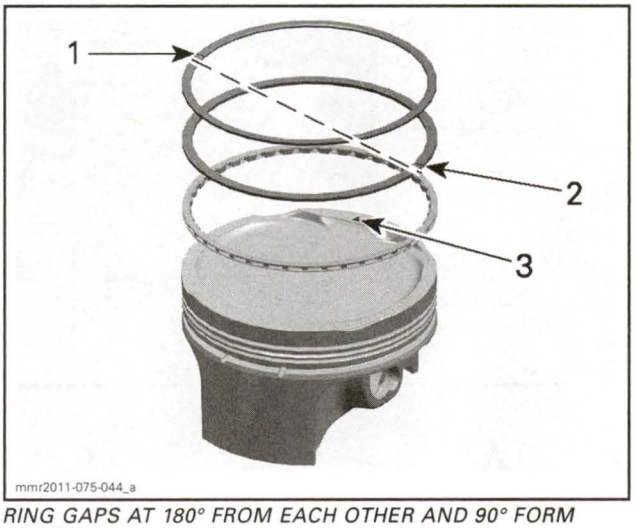


TYPICAL

2.1 If reused, install piston in its original bore.

2.2 Make sure piston rings are properly spaced.

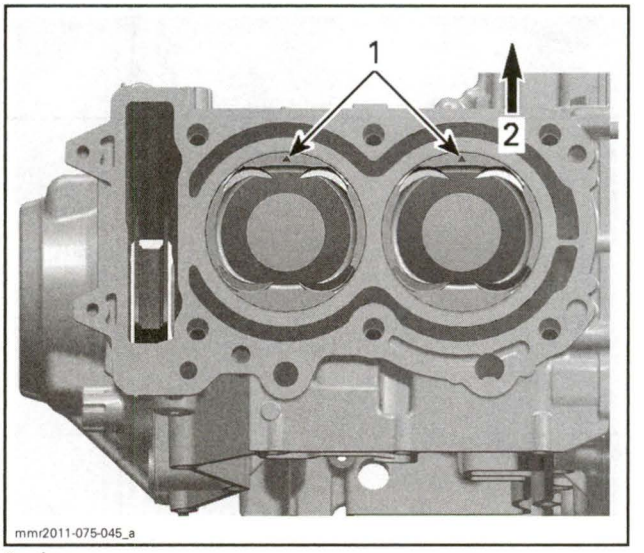
NOTICE **The ring gaps of both compression rings should always be 180° from each other and 90° from the arrow on top of the piston.**



RING GAPS AT 180° FROM EACH OTHER AND 90° FORM ARROW
1. *Rectangular ring - ring gap*
2. *Taper-face ring - ring gap*
3. *Arrow*

2.3 The arrow on top of the piston must point towards the exhaust.

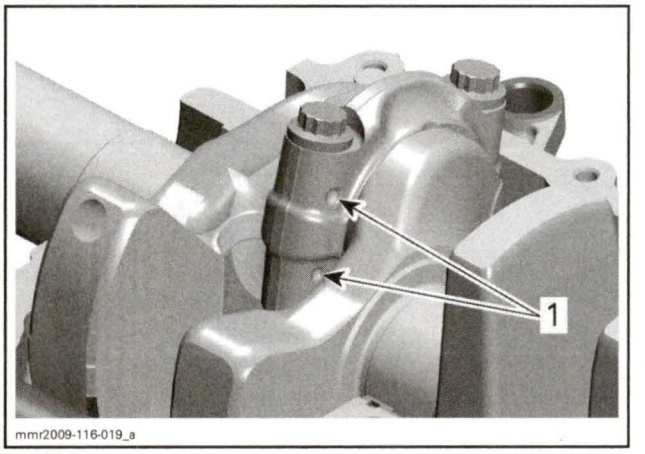
NOTICE **A piston installed with the arrow in the wrong direction would cause serious engine damage.**



1. *Arrows*
2. *Exhaust*

3. Turn cylinder block upside down.
4. Install *CRANKSHAFT* as per procedure in this subsection.
5. Oil crankshaft pin.
6. Install connecting rod caps.

NOTE: Printed marks on connecting rod and cap must point together.



TYPICAL
1. *Printed marks*

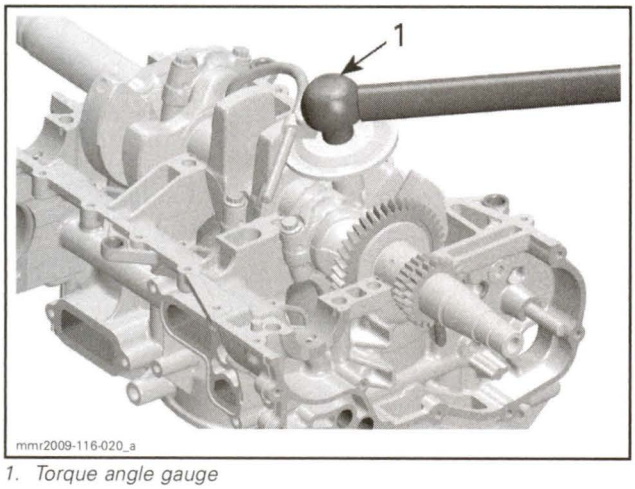
NOTICE **This assembly uses stretch screws. Always use NEW screws and strictly adhere to the tightening procedure.**

7. Tighten connecting rod screws as follows:
   7.1 Apply oil on connecting rod screw heads.
   7.2 Torque both connecting rod screws of a connecting rod.

CONNECTING ROD SCREWS TIGHTENING PROCEDURE	
FIRST STEP	12 N•m ± 2 N•m (106 lbf•**in** ± 18 lbf•**in**)

   7.3 Use a torque angle gauge to carry out the second step.

CONNECTING ROD SCREWS TIGHTENING PROCEDURE	
SECOND STEP	Additional 70° ± 5°



1. Torque angle gauge

NOTICE Failure to strictly follow this procedure may cause screws to loosen and lead to severe engine damage.

8. Install all other removed parts.

PISTON RINGS

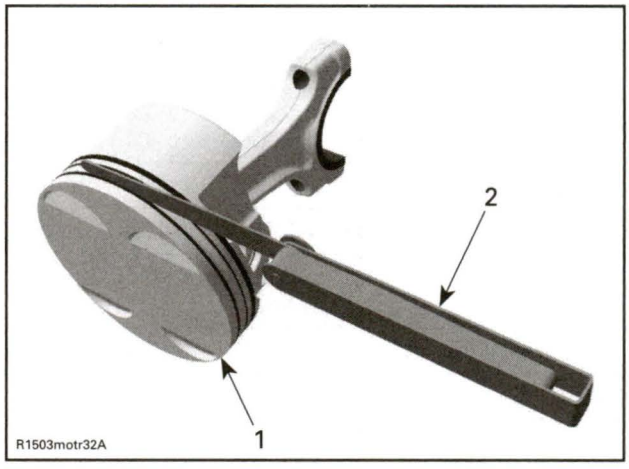
Piston Ring Removal

1. Remove piston, see procedure in this subsection.
2. Remove rings from piston.

Piston Ring Inspection

Ring/Piston Groove Clearance

Using a feeler gauge measure each ring/piston groove clearance.



TYPICAL
1. Piston
2. Feeler gauge

RING/PISTON GROOVE CLEARANCE	
UPPER COMPRESSION RING	
NEW	0.030 mm to 0.066 mm (.0012 in to .0026 in)
SERVICE LIMIT	0.120 mm (.0047 in)
LOWER COMPRESSION RING	
NEW	0.020 mm to 0.056 mm (.0008 in to .0022 in)
SERVICE LIMIT	0.120 mm (.0047 in)
OIL SCRAPER RING	
NEW	0.010 mm to 0.040 mm (.0004 in to .0016 in)
SERVICE LIMIT	0.150 mm (.0059 in)

If clearance is out of specification, the piston and rings should be replaced.

Ring End Gap

1. Place piston ring in cylinder bore between 8 mm to 16 mm (5/16 in to 5/8 in) from the top of cylinder.

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

2. Using a feeler gauge, check ring end gap.

RING END GAP	
UPPER COMPRESSION RING	
NEW	0.20 mm to 0.35 mm (.008 in to .014 in)
SERVICE LIMIT	1.20 mm (.047 in)
LOWER COMPRESSION RING	
NEW	0.30 mm to 0.50 mm (.012 in to .02 in)
SERVICE LIMIT	1.20 mm (.047 in)
OIL SCRAPER RING	
NEW	0.20 mm to 0.70 mm (.0079 in to .0276 in)
SERVICE LIMIT	1.20 mm (.047 in)

If ring end gap is out of specification, replace piston rings.

Piston Ring Installation

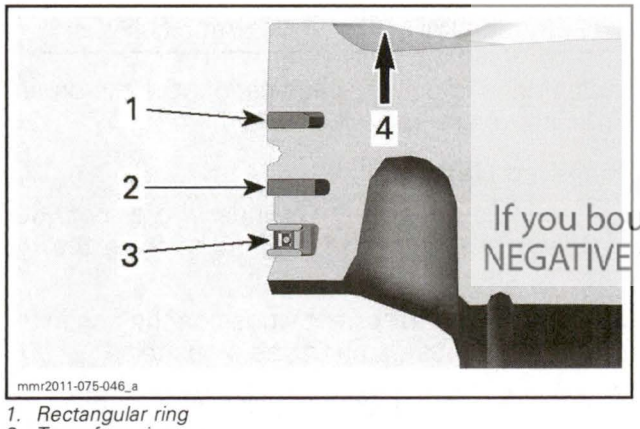
1. Install piston rings in the following order.

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

   1.1 Install oil scraper ring.

   1.2 Install the lower compression ring with the letter "N" facing up.

   1.3 Install upper compression ring with the letter "N" facing up.



1. Rectangular ring
2. Taper-face ring
3. Oil scraper ring
4. Letter "N" facing up

NOTICE Ensure the upper and lower compression rings are not interchanged.

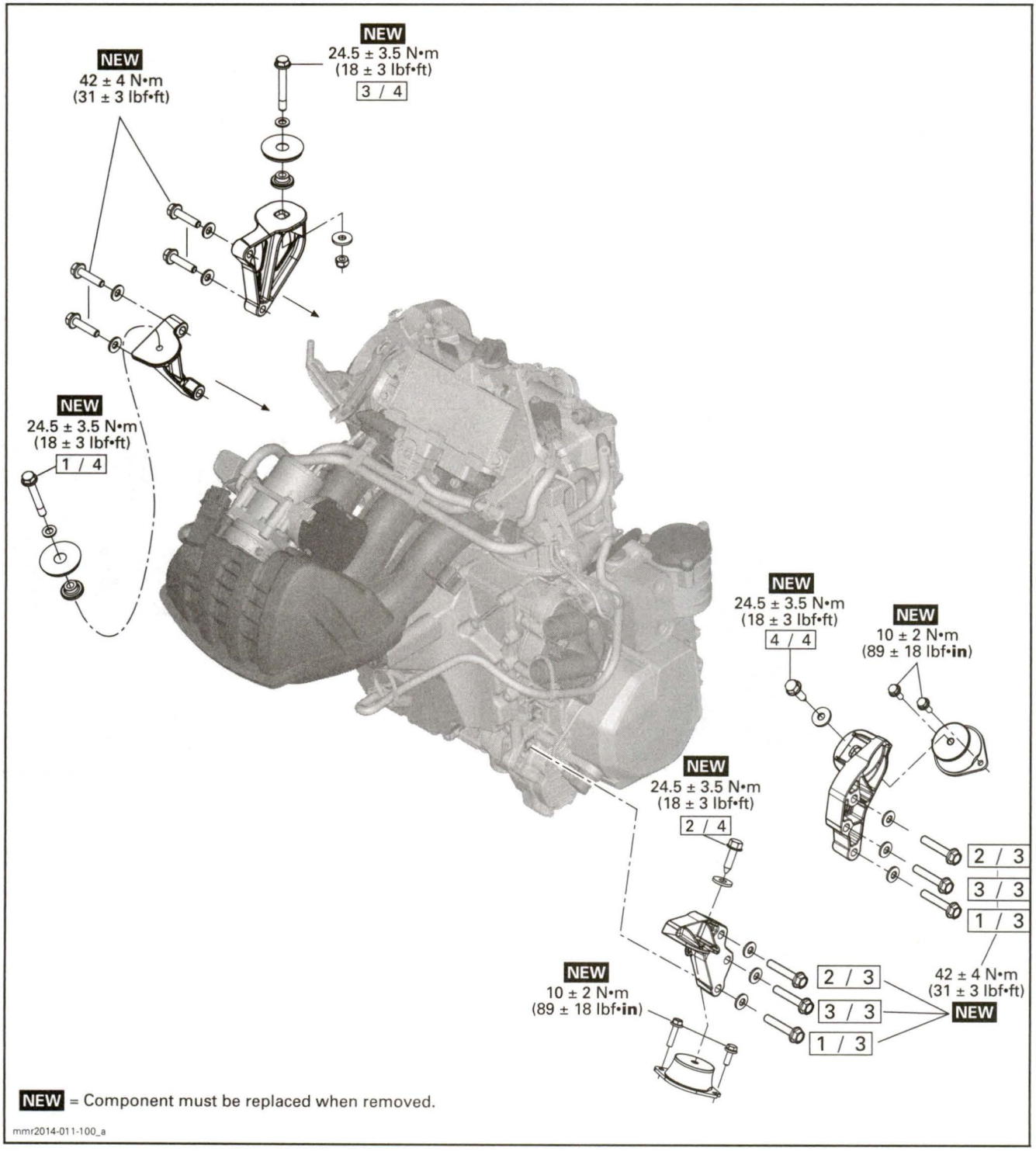
2. Ensure rings rotate smoothly after installation.

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ENGINE REMOVAL AND INSTALLATION

SERVICE TOOLS

Description	Part Number	Page
ENGINE LIFTING TOOL	529 036 217	155



PROCEDURES

ENGINE

Engine Removal

Place vehicle on a workstation equipped with an engine-lifting hoist.

1. Refer to appropriate subsection and remove:

Skandic Models

- LH and RH upper side panels
- LH and RH lower side panels
- Hood
- LH and RH upper bottom pans.

Expedition Models

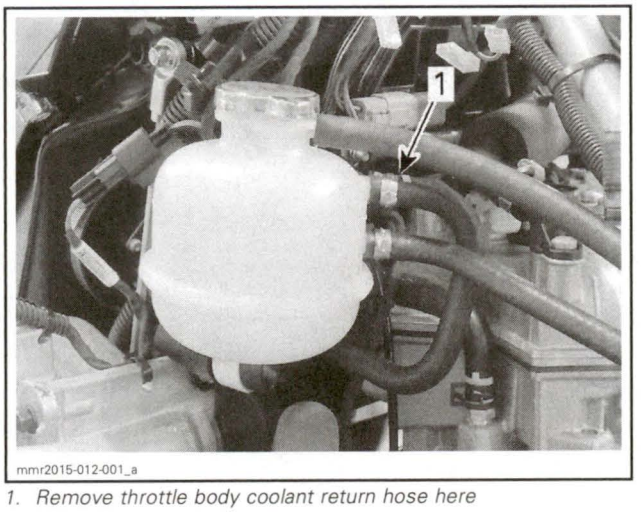
- LH and RH side panels
- LH and RH lower side panels
- Hood.

All Models

2. Remove air intake silencer and headlights/gauge support module as a unit. Refer to *AIR INTAKE SYSTEM* subsection.
3. Move fuel tank rearward without removing it. Refer to *FUEL TANK AND FUEL PUMP* subsection.
4. Disconnect black (–) cable from battery, refer to *CHARGING SYSTEM)* subsection.

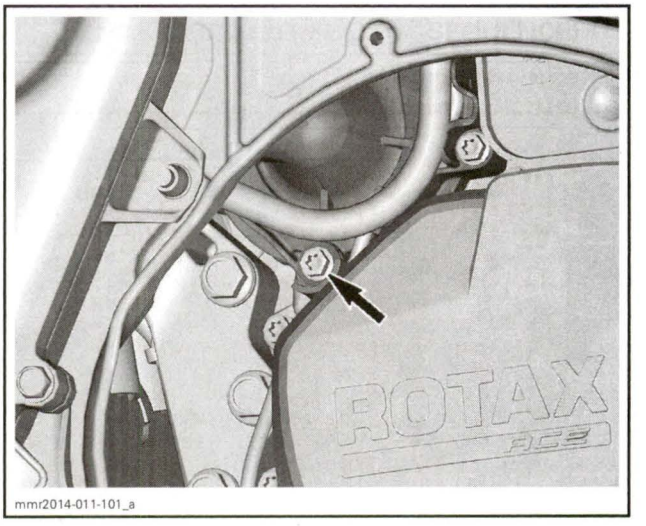
MAG Side Operations

1. Remove throttle body coolant return hose from coolant reservoir. Discard Oetiker clamp.



1. Remove throttle body coolant return hose here

2. Refer to *EXHAUST SYSTEM* subsection and remove:
   - Muffler
   - Exhaust pipe
   - Exhaust manifold.
3. Drain engine coolant by removing lower screw from water pump.

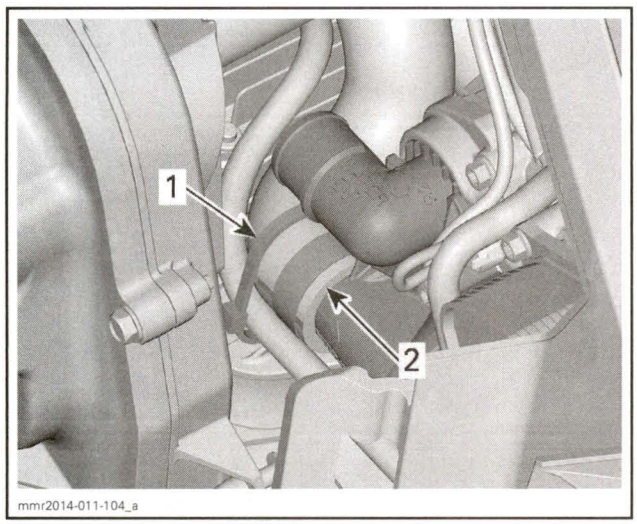


4. Disconnect outlet hose from thermostat housing.



1. Thermostat housing outlet hose

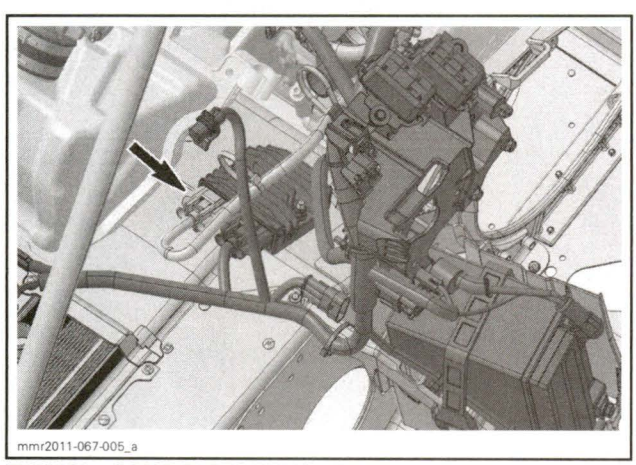
5. Remove locking tie on water pump inlet hose.
6. Disconnect coolant inlet hose from water pump.



TYPICAL - RH FRAME MEMBER REMOVED FOR CLARITY

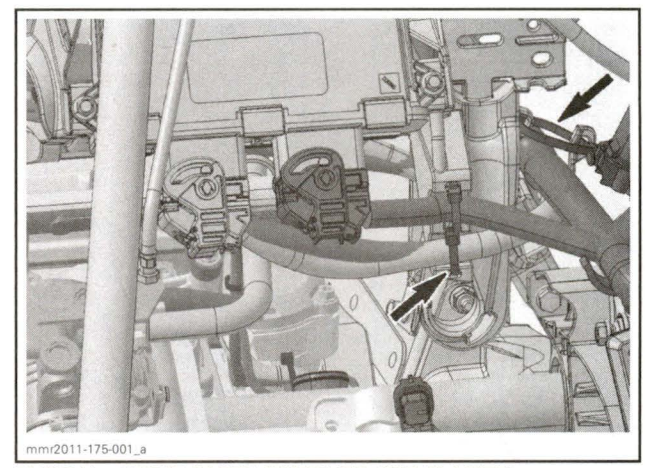
1. *Locking tie*
2. *Water pump inlet hose*

7. Remove locking tie securing magneto connector wires.
8. Disconnect magneto connector from voltage regulator.



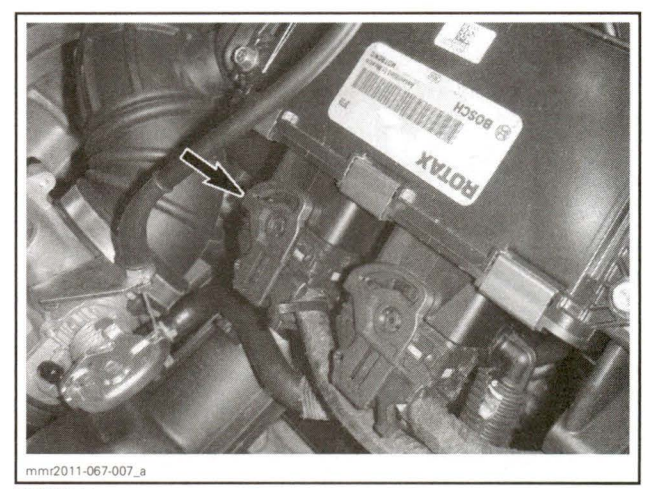
TYPICAL - SOME PARTS REMOVED FOR CLARITY

9. Remove locking ties securing harness of ECM connector A to ECM support.



TYPICAL - SOME PARTS REMOVED FOR CLARITY

10. Disconnect both ECM connector from ECM.

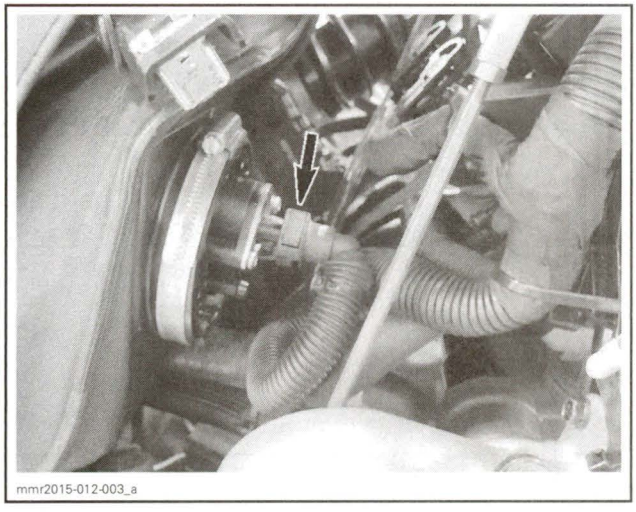


TYPICAL

11. Disconnect engine harness connector located in front of ECM support.



12. Disconnect fuel hose from fuel pump.


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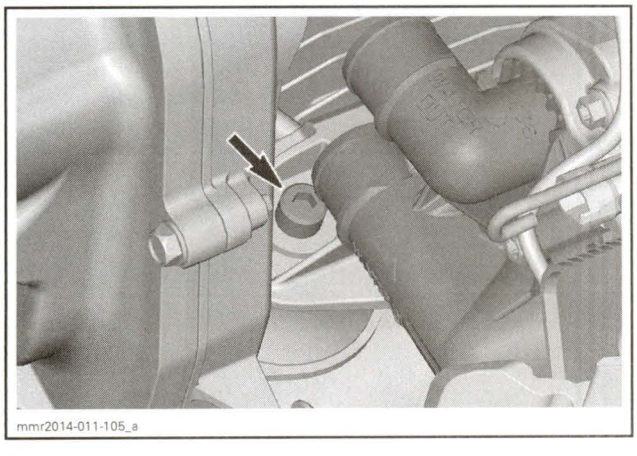
NOTE: Wrap a rag around fuel hose end to catch any fuel leakage.

⚠ CAUTION Wipe up any fuel leakage.

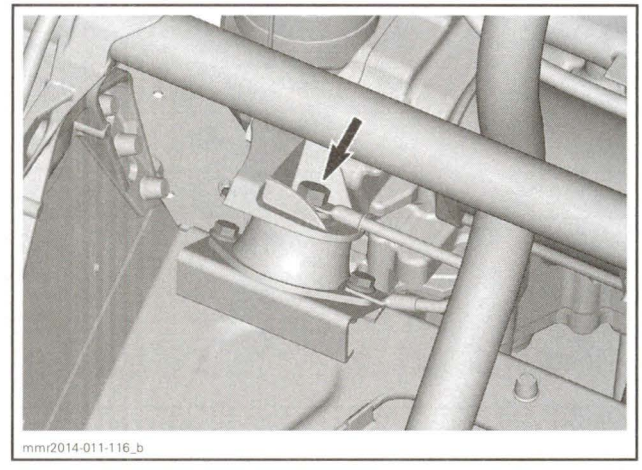
13. Disconnect breather hose from valve cover.


mmr2011-067-011_a

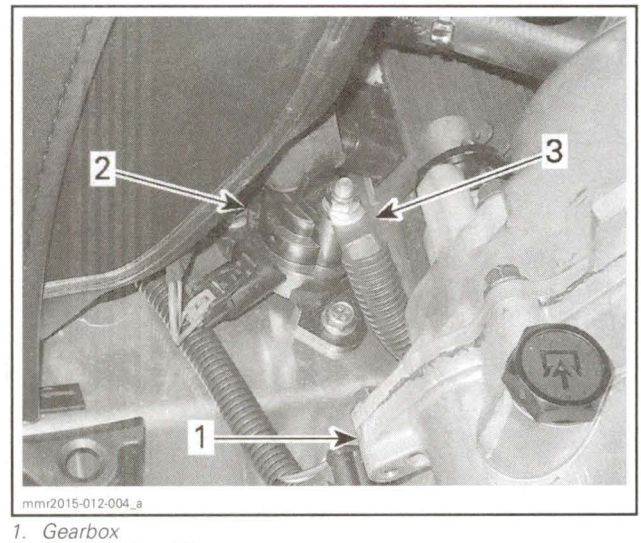
14. Remove screw securing rear rubber mount to engine support.


mmr2014-011-105_a

15. Remove screw securing front rubber mount to engine support.


mmr2014-011-116_b

16. Disconnect starter cable from solenoid.

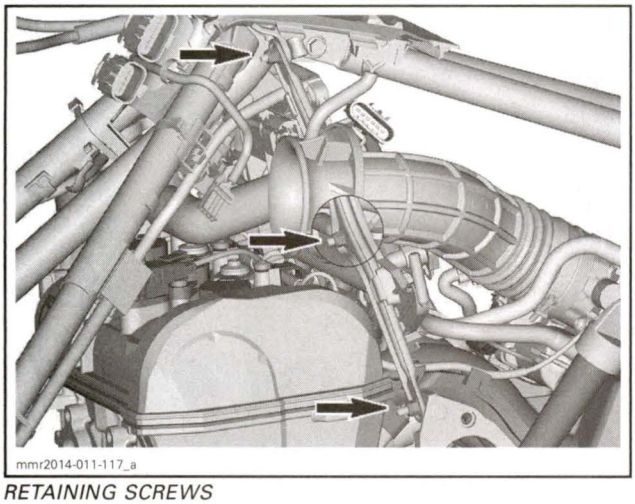


mmr2015-012-004_a

1. *Gearbox*
2. *Starter solenoid*
3. *Starter cable to disconnect*

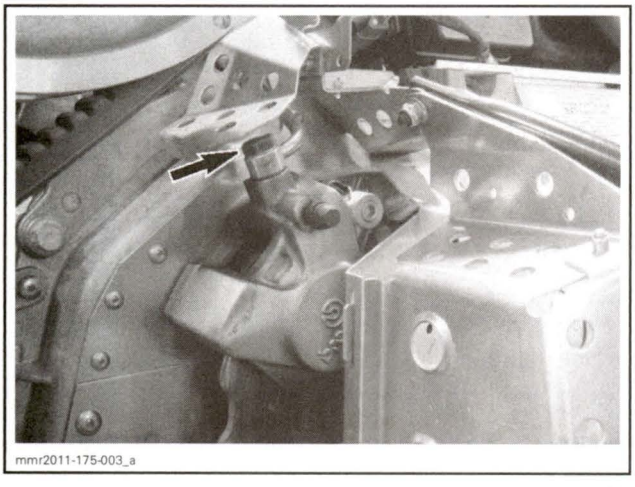
PTO Side Operations

1. Remove drive pulley. Refer to *DRIVE PULLEY (e-Drive)* subsection.
2. Refer to *DRIVE SYSTEM* subsection and remove:
   - Driven pulley
   - Countershaft.
3. Remove LH side upper column support.



RETAINING SCREWS

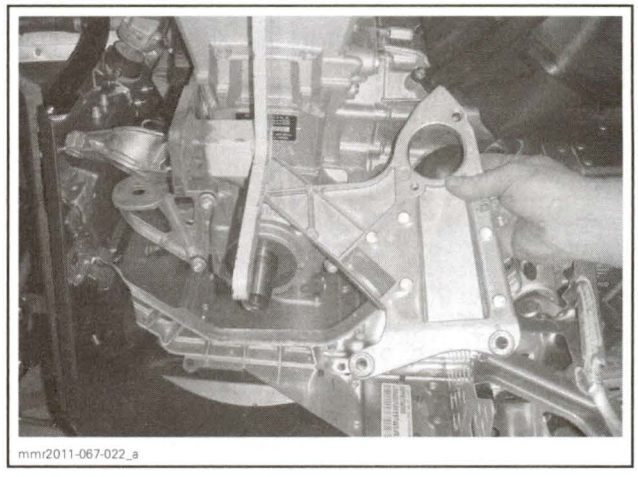
4. Remove brake hose from brake caliper and discard sealing washers.



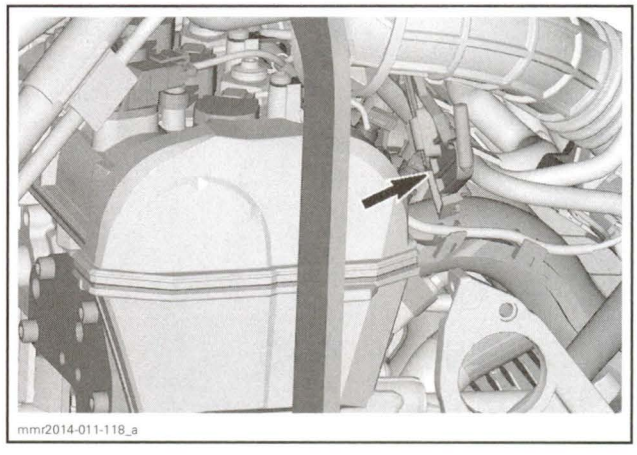
5. Install engine lifting tool in place of exhaust manifold.

REQUIRED TOOL	
ENGINE LIFTING TOOL (P/N 529 036 217)	

6. Secure lifting tool using exhaust manifold screws.
7. **Slightly** lift engine.
8. Remove countershaft bearing support. Refer to *DRIVEN PULLEY AND COUNTERSHAFT* subsection.



NOTICE Move ECM support rearward to avoid damaging fuel rail during engine removal.



9. Move engine out of vehicle.

NOTICE Make sure the starter cable moves out freely from behind the chaincase.

Engine Installation

Reverse the removal procedure, however pay attention to the following.

Ensure engine supports and engine rubber mounts are in good condition before engine installation.

Install **NEW** self-locking screws where required, refer to exploded view at the beginning of this subsection.

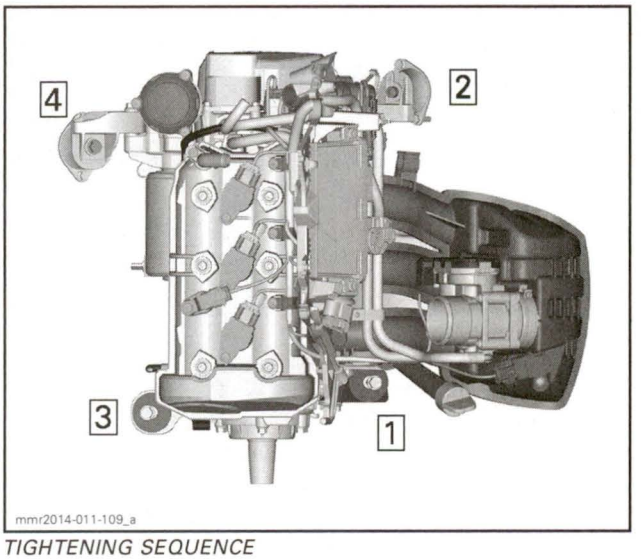
Install Banjo fitting on brake caliper using **NEW** sealing washers. Refer to *BRAKE* subsection for tightening torque.

Refill and bleed brake system. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

Properly tighten countershaft bearing support. Refer to *DRIVEN PULLEY AND COUNTERSHAFT* subsection for tightening sequence.

Tighten engine mounting screws to specification as per the following sequence.

TIGHTENING TORQUE	
Engine mounting screws (M8)	24.5 N•m ± 3.5 N•m (18 lbf•ft ± 3 lbf•ft)



TIGHTENING SEQUENCE

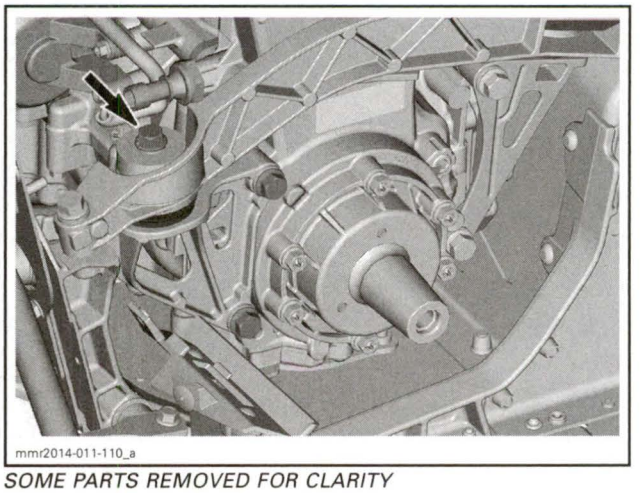
ENGINE SUPPORTS

Engine Support Inspection

Check if engine supports are cracked, bent or damaged. Replace if necessary.

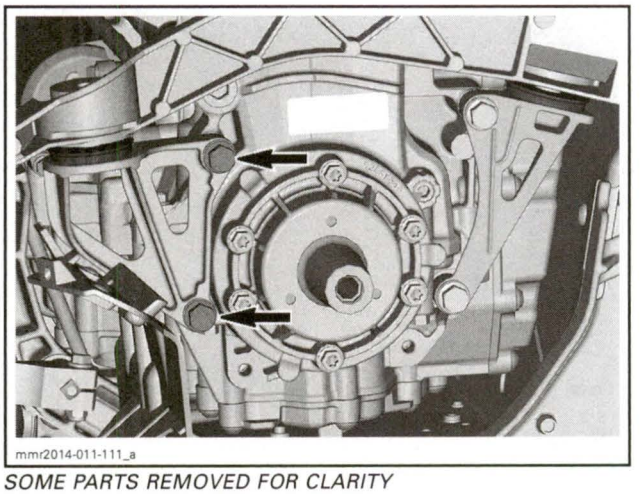
Front Engine Support Replacement (PTO Side)

1. Remove body parts and components as required to access engine support.
2. Remove and discard screw securing rubber mount to engine support.



SOME PARTS REMOVED FOR CLARITY

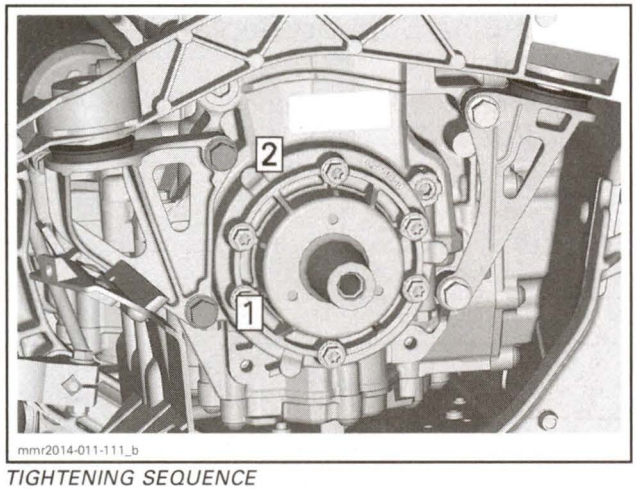
3. Remove and discard screws securing engine support to engine.



SOME PARTS REMOVED FOR CLARITY

4. Replace engine support.
5. Install **NEW** screws to secure engine support to engine.
6. Tighten engine support screws to specification as per the following sequence.

TIGHTENING TORQUE	
Engine support screws	42 N•m ± 4 N•m (31 lbf•ft ± 3 lbf•ft)

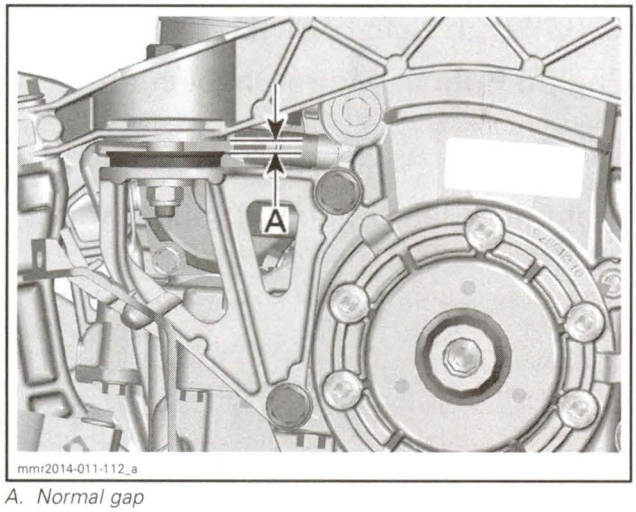


TIGHTENING SEQUENCE

7. Install **NEW** screw to secure engine rubber mount to engine support.
8. Tighten engine rubber mount screw to specification.

TIGHTENING TORQUE	
Rubber mount screw (M8)	24.5 N•m ± 3.5 N•m (18 lbf•ft ± 3 lbf•ft)

NOTE: It is normal that a gap (4 mm (5/32 in)) is visible between engine stopper and countershaft bearing support. This gap will allow engine to move and reduce vibration.



A. Normal gap

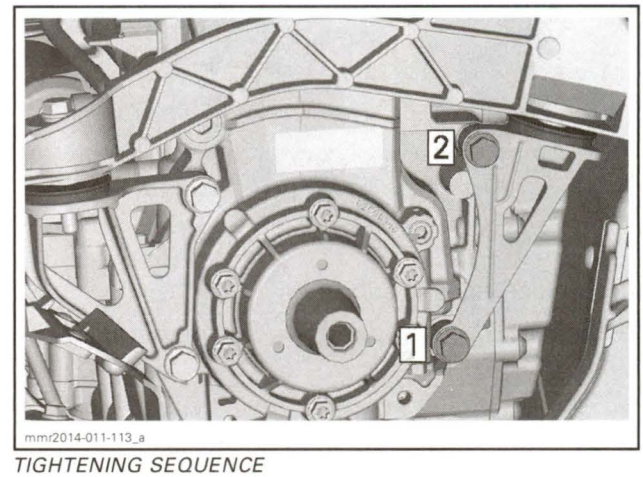
9. Install body parts and components in the reverse order of the removal procedure.

Rear Engine Support Replacement (PTO Side)

To replace rear engine support, refer to *FRONT ENGINE SUPPORT REPLACEMENT (PTO SIDE)* in this subsection. However pay attention to the following.

Tighten engine support screws to specification as per the following sequence.

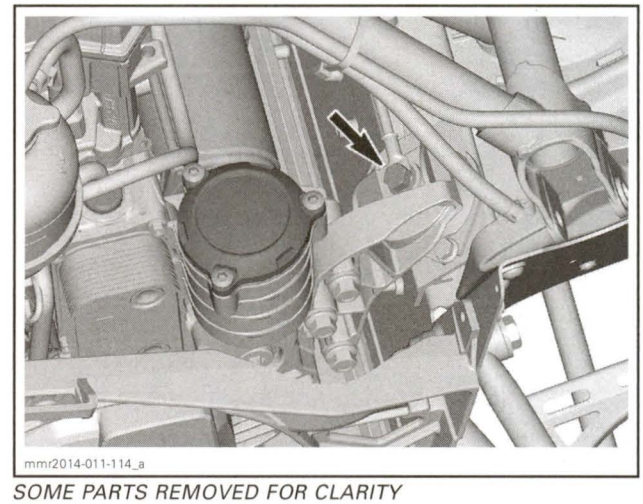
TIGHTENING TORQUE	
Engine support screws	42 N•m ± 4 N•m (31 lbf•ft ± 3 lbf•ft)



TIGHTENING SEQUENCE

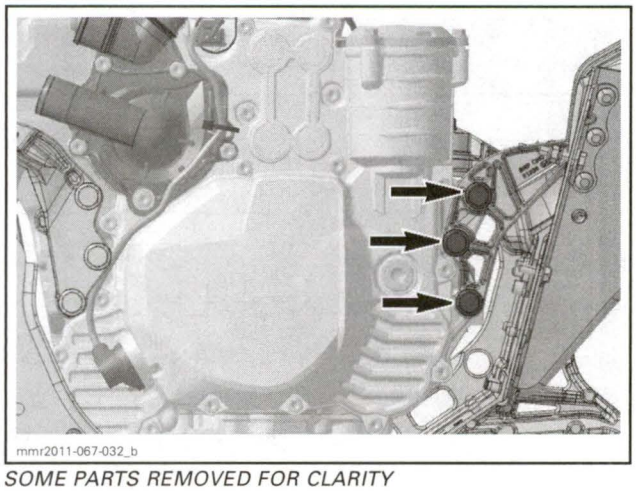
Front Engine Support Replacement (MAG Side)

1. Remove body parts and components as required to access engine support.
2. Remove and discard screw securing engine support to rubber mount.



SOME PARTS REMOVED FOR CLARITY

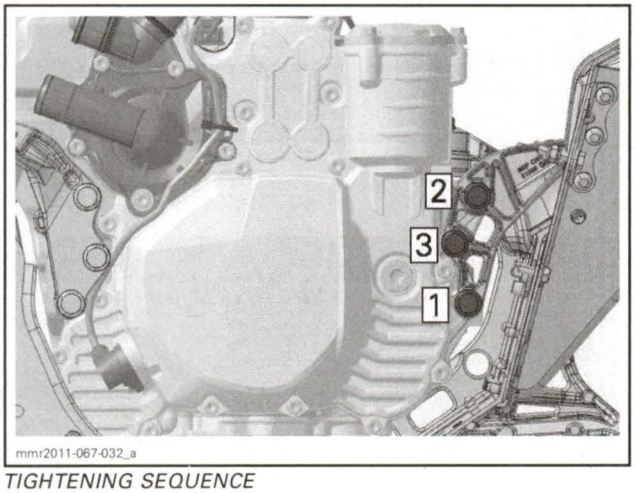
3. Remove and discard screws securing engine support to engine.



SOME PARTS REMOVED FOR CLARITY

4. Replace engine support.
5. Install **NEW** screws to secure engine support to engine.
6. Tighten engine support screws to specification as per the following sequence.

TIGHTENING TORQUE	
Engine support screws	42 N•m ± 4 N•m (31 lbf•ft ± 3 lbf•ft)



TIGHTENING SEQUENCE

7. Install **NEW** screw to secure engine support to rubber mount.
8. Tighten engine mounting screw to specification.

TIGHTENING TORQUE	
Engine mounting screws (M8)	24.5 N•m ± 3.5 N•m (18 lbf•ft ± 3 lbf•ft)

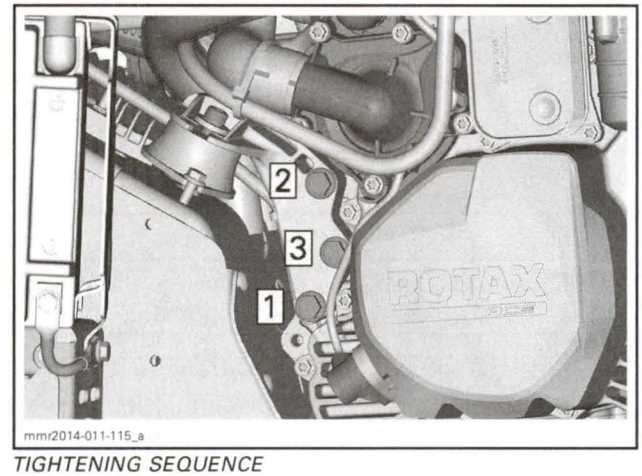
9. Install body parts and components in the reverse order of the removal procedure.

Rear Engine Support Replacement (MAG Side)

To replace rear engine support, refer to *FRONT ENGINE SUPPORT REPLACEMENT (MAG SIDE)* in this subsection. However pay attention to the following.

Tighten engine support screws to specification as per the following sequence.

TIGHTENING TORQUE	
Engine support screws	42 N•m ± 4 N•m (31 lbf•ft ± 3 lbf•ft)



TIGHTENING SEQUENCE

ENGINE RUBBER MOUNTS

Engine Rubber Mount Inspection

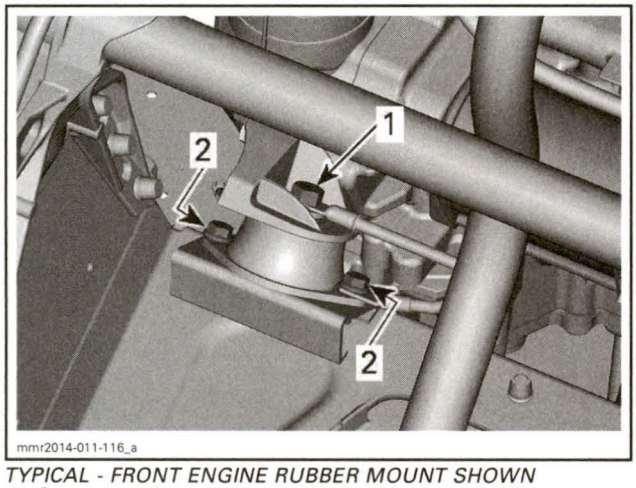
Check rubber mounts. Replace them if brittle, cracked or damaged.

Front and Rear Engine Rubber Mount Replacement (PTO Side)

1. Remove countershaft bearing support. Refer to *DRIVEN PULLEY AND COUNTERSHAFT* subsection.
2. Replace engine rubber mount.
3. Install countershaft bearing support. Refer to *DRIVEN PULLEY AND COUNTERSHAFT* subsection.

Front and Rear Engine Rubber Mount Replacement (MAG Side)

1. Remove body parts and components as required to access engine rubber mount.
2. Remove and discard screw securing engine support to rubber mount.
3. Remove and discard screws securing rubber mount to frame.



TYPICAL - FRONT ENGINE RUBBER MOUNT SHOWN
1. *Screw securing engine support to rubber mount (M8)*
2. *Screws securing rubber mount to frame (M6)*

4. Replace engine rubber mount.
5. Install **NEW** screws to secure engine and rubber mount.
6. Tighten rubber mount screws to specification.

TIGHTENING TORQUE	
Rubber mount screws (M6)	10 N•m ± 2 N•m (89 lbf•**in** ± 18 lbf•**in**)

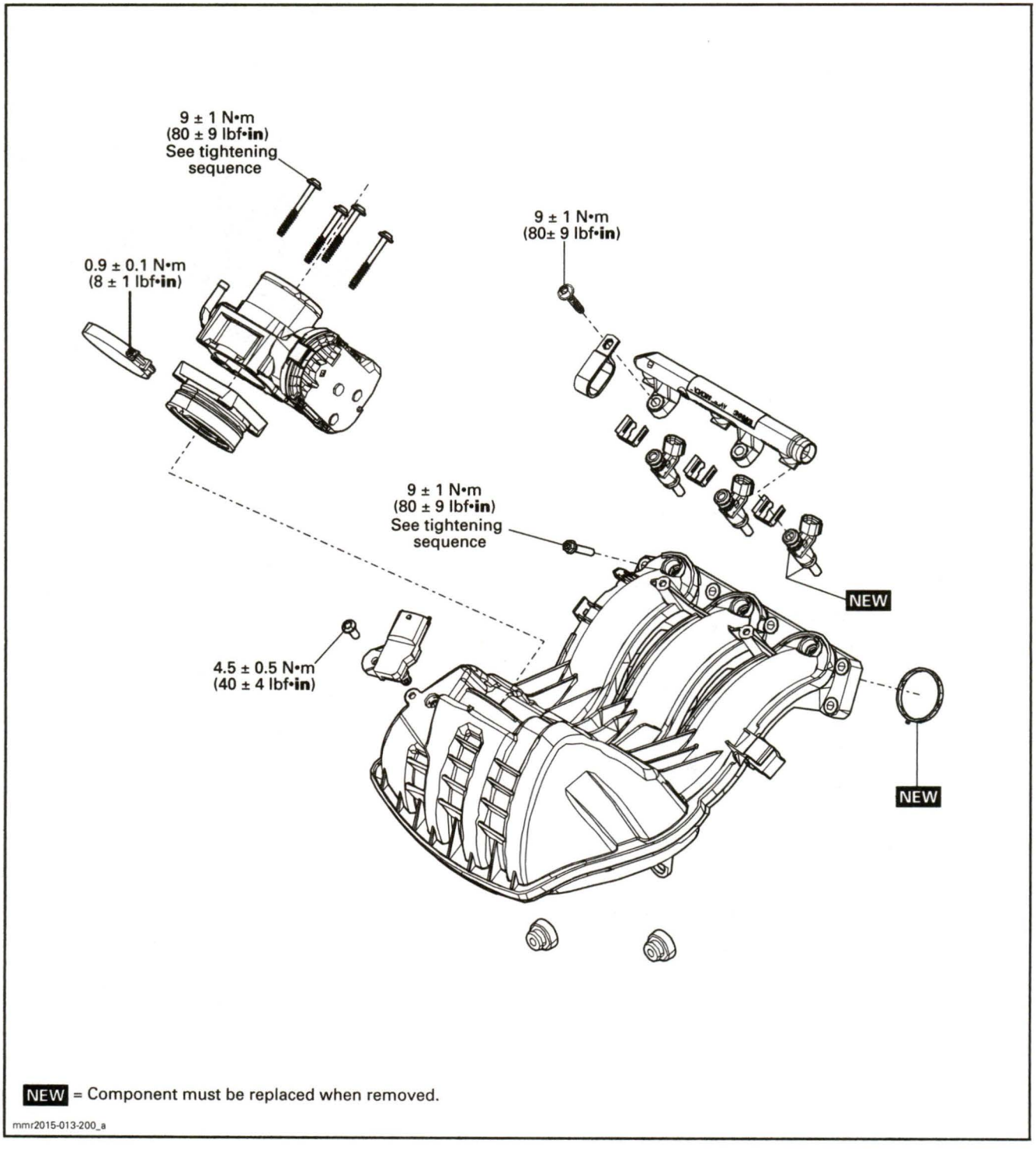
TIGHTENING TORQUE	
Engine mounting screw (M8)	24.5 N•m ± 3.5 N•m (18 lbf•ft ± 3 lbf•ft)

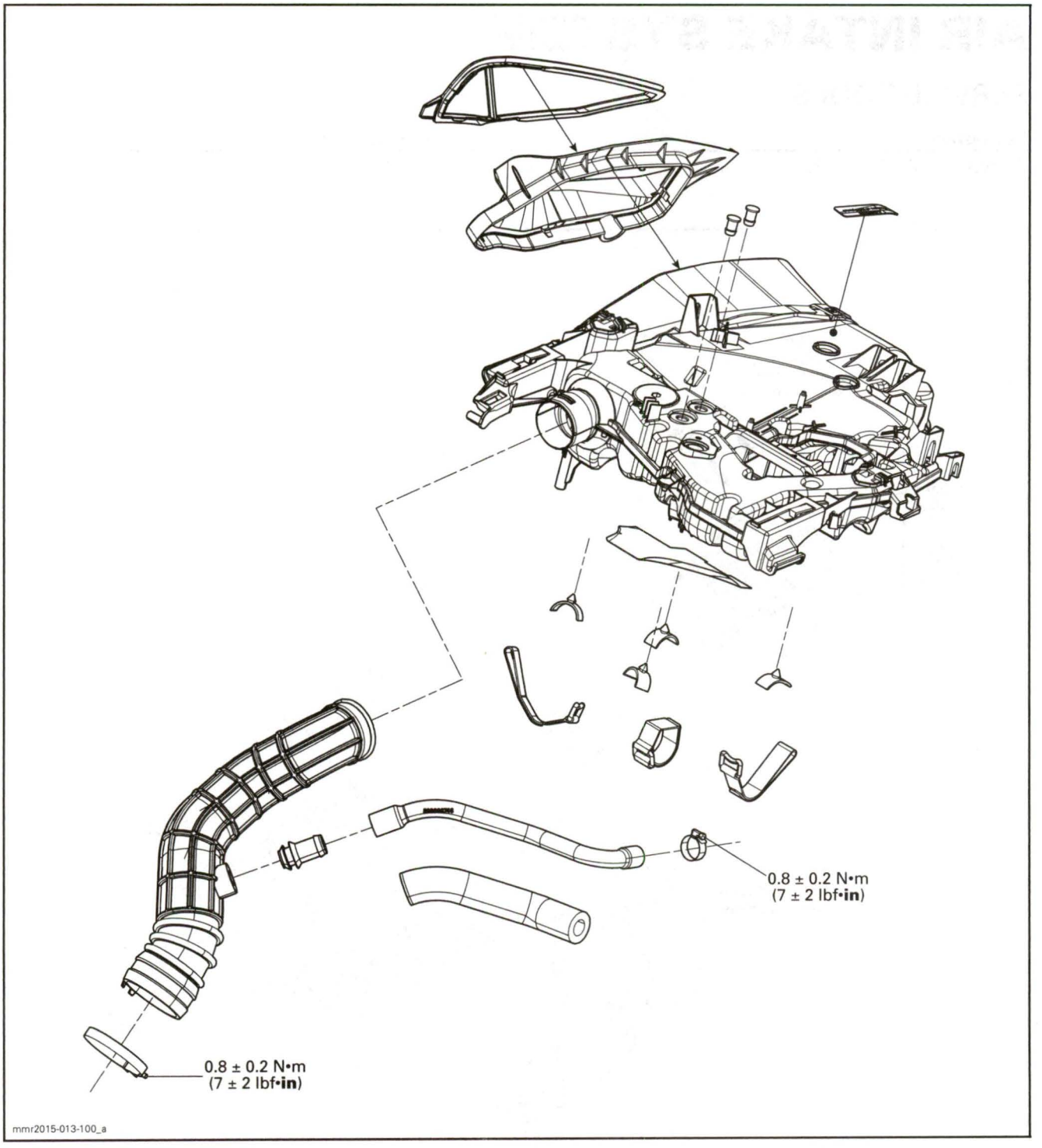
7. Install body parts and components as the reverse of removal procedure.

AIR INTAKE SYSTEM

SERVICE TOOLS

Description	Part Number	Page
SMALL HOSE PINCHER	295 000 076	167



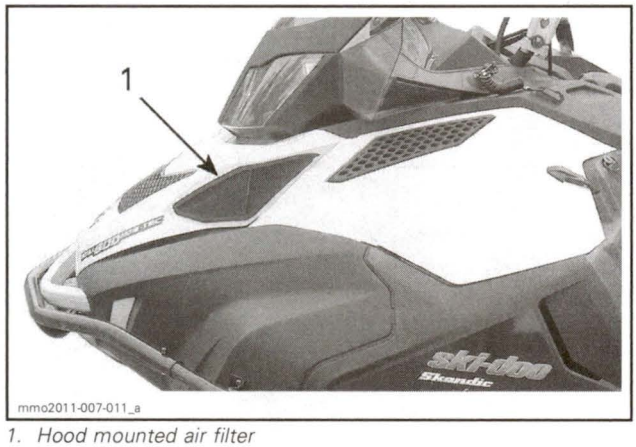

0.8 ± 0.2 N•m
(7 ± 2 lbf•in)
0.8 ± 0.2 N•m
(7 ± 2 lbf•in)
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PROCEDURES

AIR INLET FILTERS

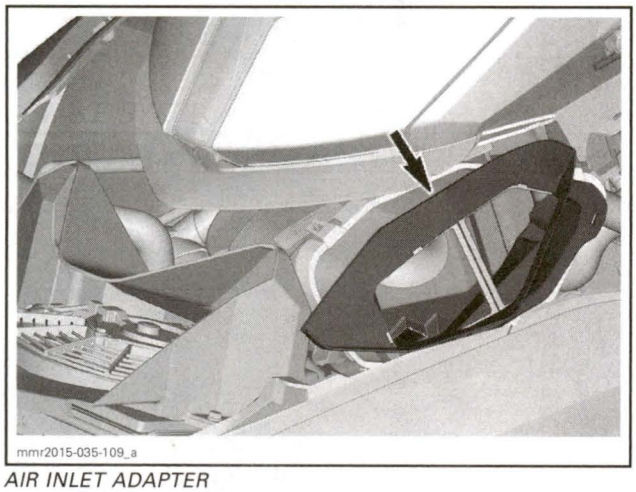
Air Filter Removal

1. Refer to *BODY* subsection and remove the following:
   - LH and RH upper side panels
   - Hood.
2. To remove hood mounted filter, simply pull it out.



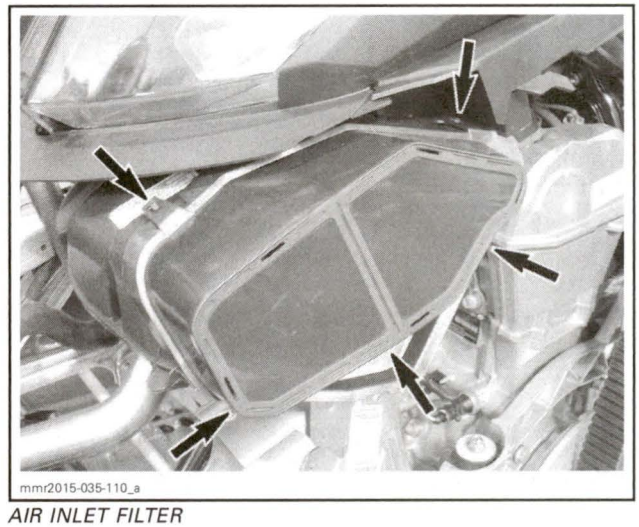
1. Hood mounted air filter

3. To remove filter from air intake silencer:
   3.1 Remove hood adapter from air inlet of air intake silencer.



AIR INLET ADAPTER

   3.2 Release retaining tabs and pull filter off air inlet.



AIR INLET FILTER

Air Filter Cleaning

Gently clean with fresh water and mild soap.

Replace air filter as required.

NOTE: If the filter is very dirty, clean the interior of air intake silencer at the same time.

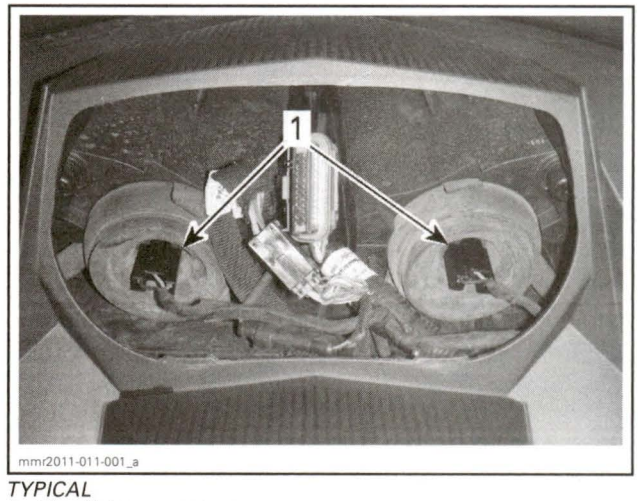
Air Filter Installation

Reverse the removal procedures. Make sure filters are properly secured.

AIR INTAKE SILENCER

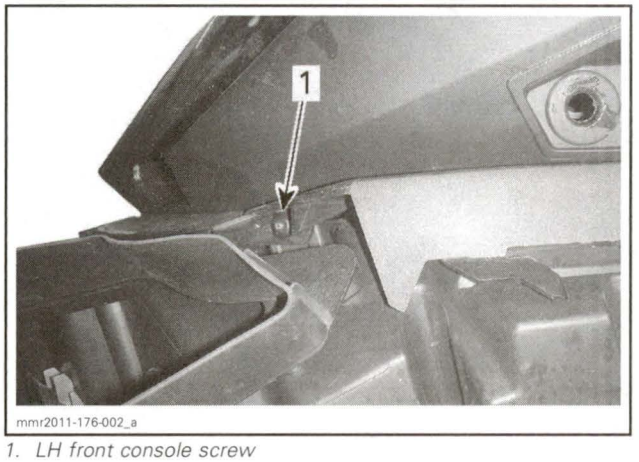
Air Intake Silencer Removal as a Unit with Headlight/Gauge Module

1. Remove multifunction gauge. Refer to *LIGHTS, GAUGE AND ACCESSORIES* subsection.
2. Disconnect headlight connectors.



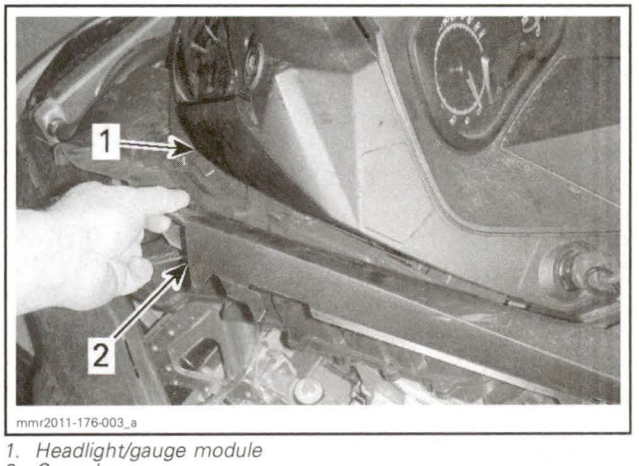
TYPICAL
1. Headlight connectors

3. Refer to *BODY* subsection and remove:
   - LH and RH upper side panels
   - Hood.
4. Remove front console screws on each side.



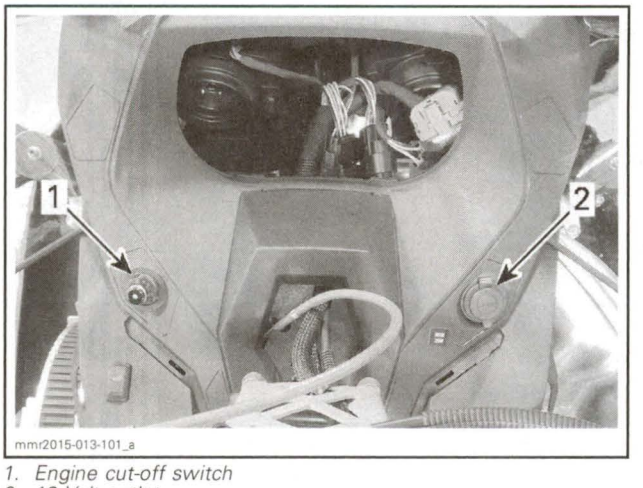
1. LH front console screw

5. Detach front of console from headlight/gauge module.



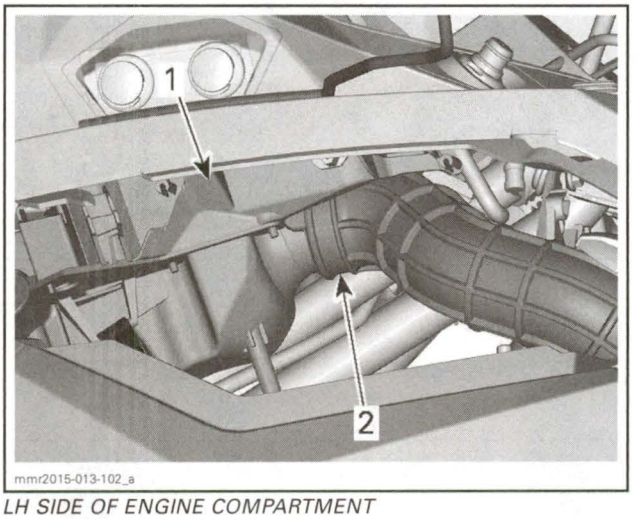
1. Headlight/gauge module
2. Console

6. Disconnect 12-volt outlet and engine cut-off switch.



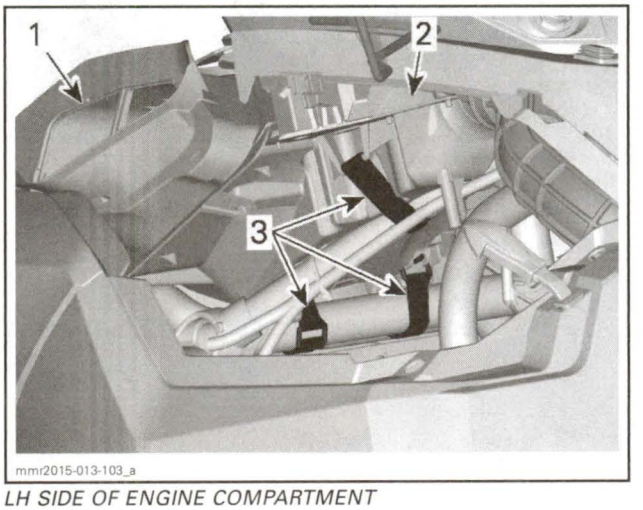
1. Engine cut-off switch
2. 12 Volt outlet

7. Disconnect intake hose from air intake silencer.



LH SIDE OF ENGINE COMPARTMENT
1. Air intake silencer
2. Intake hose

8. Detach the hook-and-loop fasteners (3).



LH SIDE OF ENGINE COMPARTMENT
1. Air inlet
2. Air intake silencer
3. Hook-and-loop fasteners

9. Remove air intake silencer and headlight/gauge module from vehicle.

Air Intake Silencer Removal

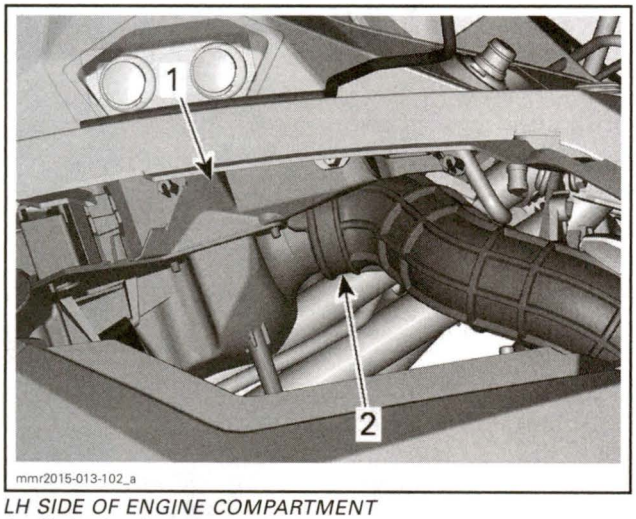
1. Proceed with *AIR INTAKE SILENCER REMOVAL AS A UNIT WITH HEADLIGHT/GAUGE MODULE.*
2. Separate air intake silencer from headlight/gauge module. Refer to *BODY* subsection.

Air Intake Silencer Installation

Reverse the removal procedure. However, pay attention to the following.

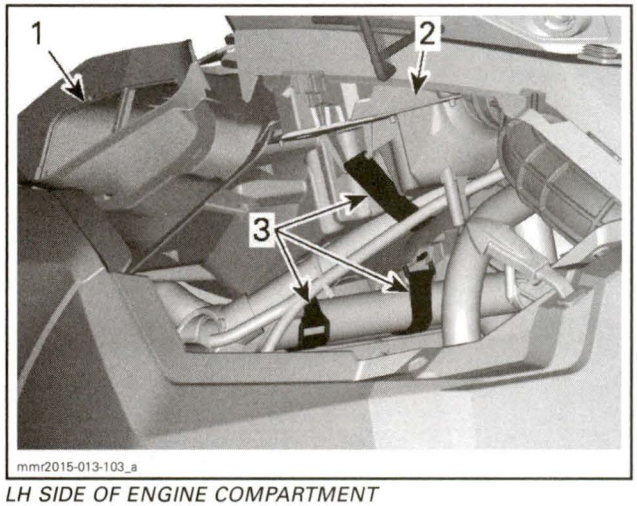
Ensure all parts are reinstalled as specified in their applicable subsection.

Ensure intake hose is completely inserted on air intake silencer.



LH SIDE OF ENGINE COMPARTMENT
1. *Air intake silencer*
2. *Intake hose flange*

Ensure hook-and-loop fasteners are properly installed.



LH SIDE OF ENGINE COMPARTMENT
1. *Air inlet*
2. *Air intake silencer*
3. *Hook-and-loop fasteners*

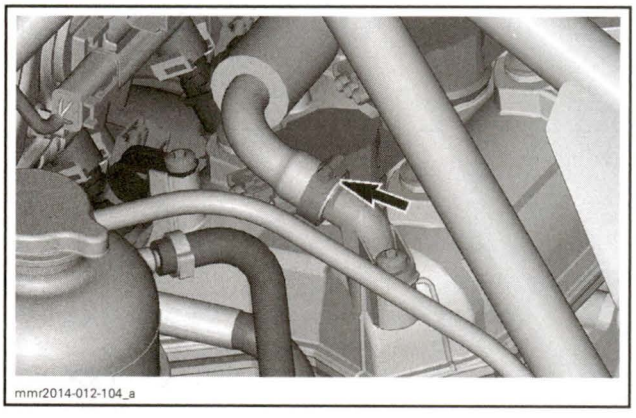
INTAKE MANIFOLD

Intake Manifold Access

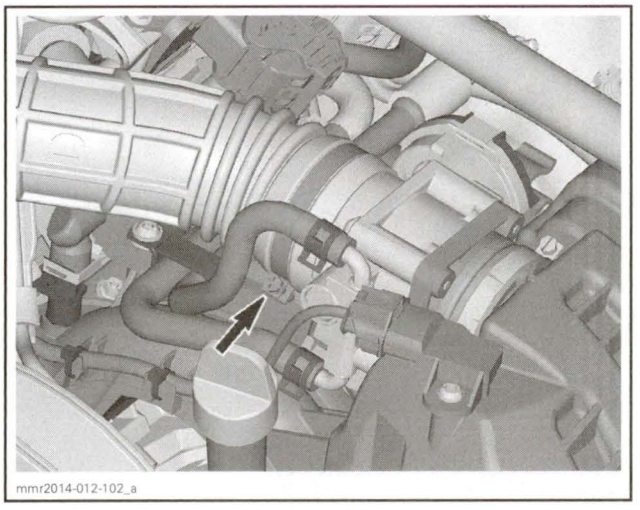
Refer to appropriate subsections and remove:
- Side panels (both sides)
- Air intake silencer and gauge support module
- Pulley guard
- Fuel tank
- Driven pulley and countershaft.

Intake Manifold Removal

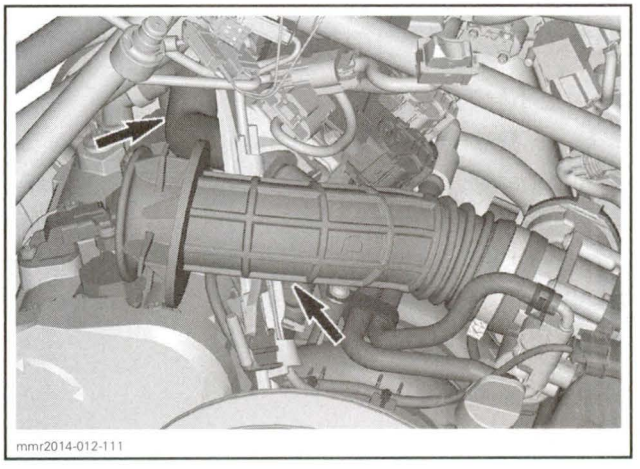
1. Loosen clamp securing breather hose to engine and disconnect hose.



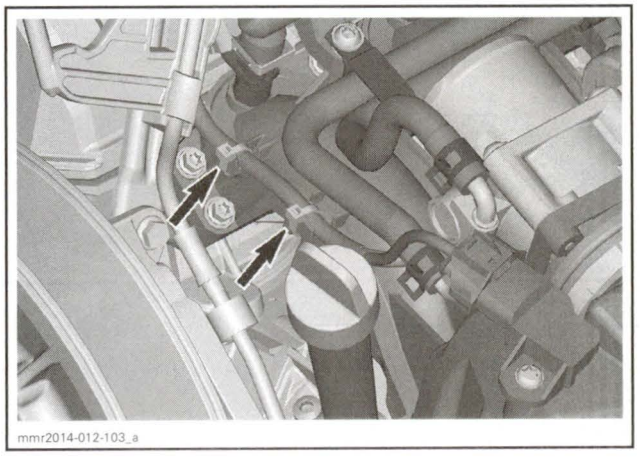
2. Loosen clamp securing air intake hose to throttle body.


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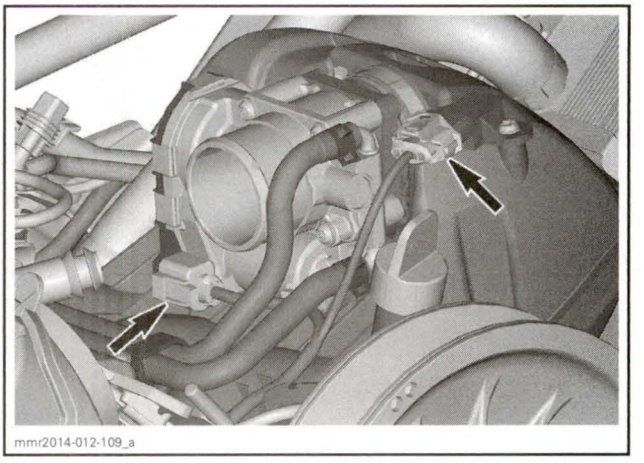
3. Remove air intake and breather hoses.


mmr2014-012-111

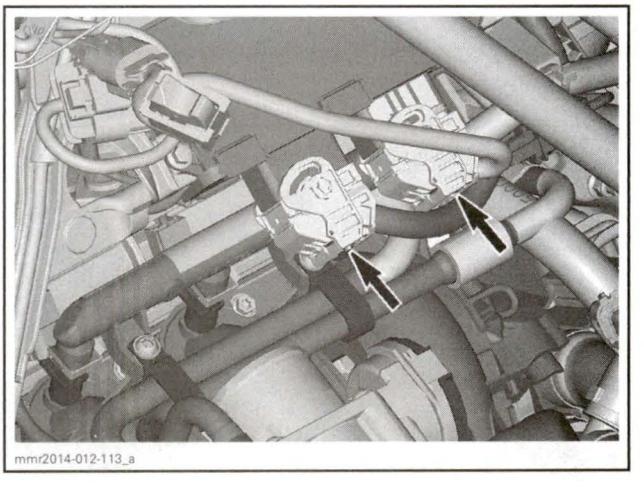
4. Cut locking ties securing MAPTS (manifold absolute pressure and temperature sensor) and ETC (electric throttle control) harness to intake manifold.


mmr2014-012-103_a

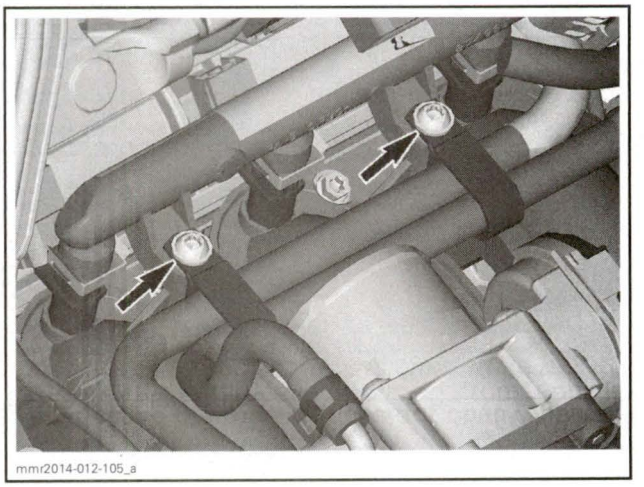
5. Disconnect MAPTS and ETC connectors.


mmr2014-012-109_a

6. Disconnect both ECM connectors

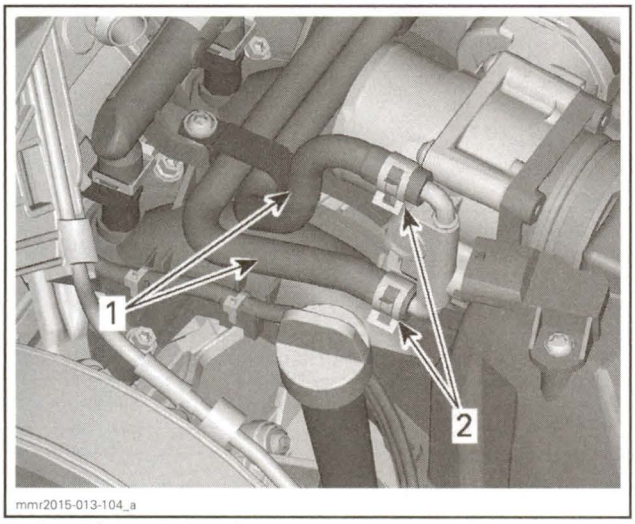

mmr2014-012-113_a

7. Remove screws securing fuel rail and coolant hoses to intake manifold.


mmr2014-012-105_a

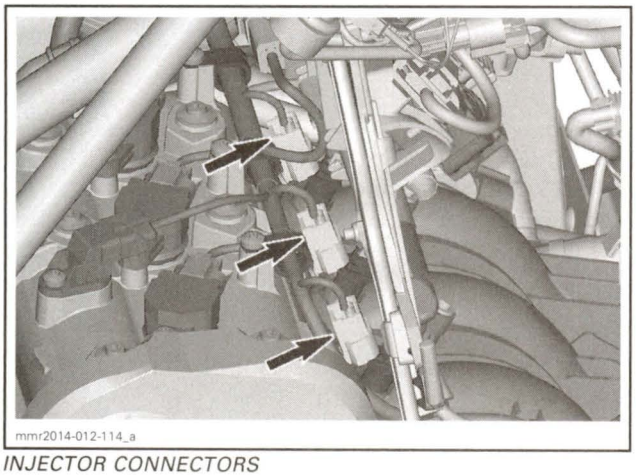
8. Install a hose pincher on each coolant hose connected to throttle body and disconnect the hoses from the throttle body.

REQUIRED TOOL	
SMALL HOSE PINCHER (P/N 295 000 076)	



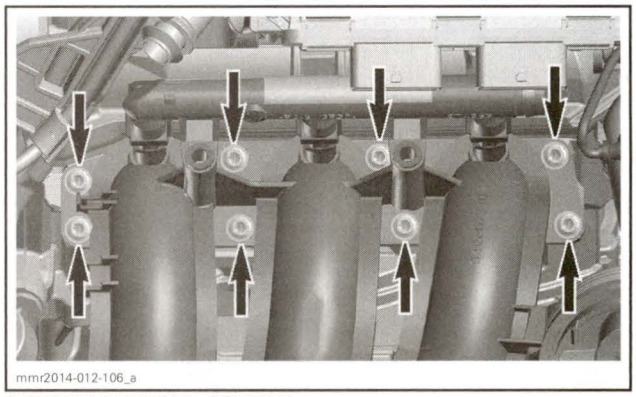
1. *Install hose pinchers here*
2. *Disconnect hoses here*

9. Disconnect fuel injector connectors.



INJECTOR CONNECTORS

10. Remove screws securing intake manifold to cylinder head.



INTAKE MANIFOLD SCREWS

11. Remove intake manifold from engine.
12. Remove and discard intake manifold gaskets.
13. If required, remove following parts from intake manifold:
    - Throttle body with connecting socket. Refer to *ELECTRONIC FUEL INJECTION (EFI)* subsection.
    - MAPTS, refer to *ELECTRONIC FUEL INJECTION (EFI)* subsection.
    - Fuel rail with injectors. Refer to *ELECTRONIC FUEL INJECTION (EFI)* subsection.

Intake Manifold Inspection

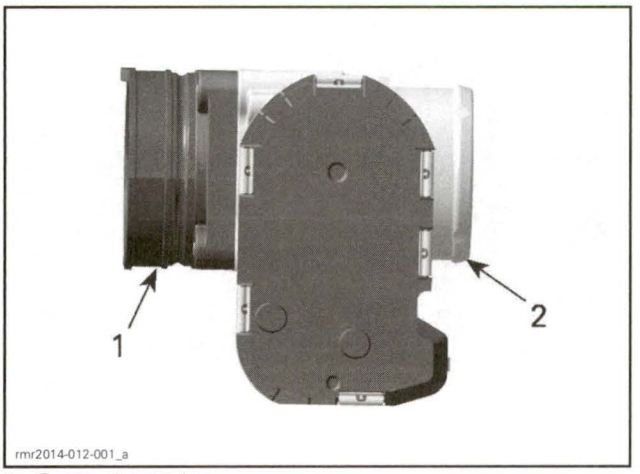
Check intake manifold for cracks, warping at flanges or any other visible damage. Replace if required.

Drain intake manifold of any accumulated liquids.

Flush intake manifold with solvent and let dry.

Connecting Socket Inspection

Check connecting socket for cracks, warping at flanges or any other visible damage. If required, remove it from throttle body and replace it.



1. Connecting socket
2. Throttle body

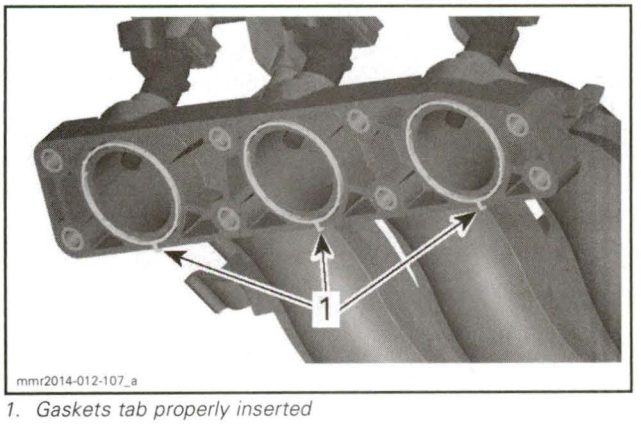
Intake Manifold Installation

Reverse the removal procedure. However, pay attention to the following.

If removed, refer to *ELECTRONIC FUEL INJECTION (EFI)* subsection to install:

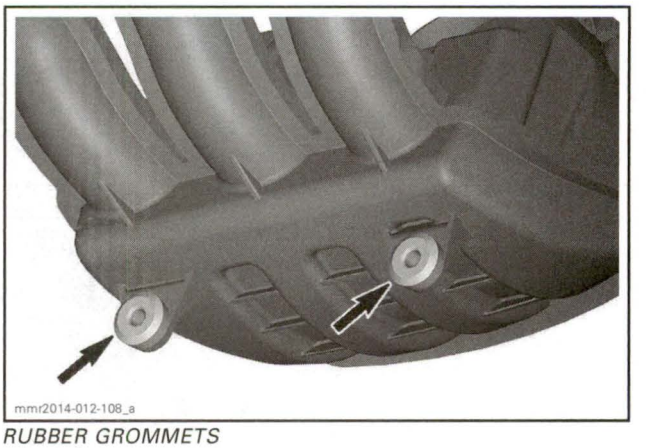
- MAPTS
- Fuel rail with injectors.

Install **NEW** gaskets with tab properly inserted in notch.



1. Gaskets tab properly inserted

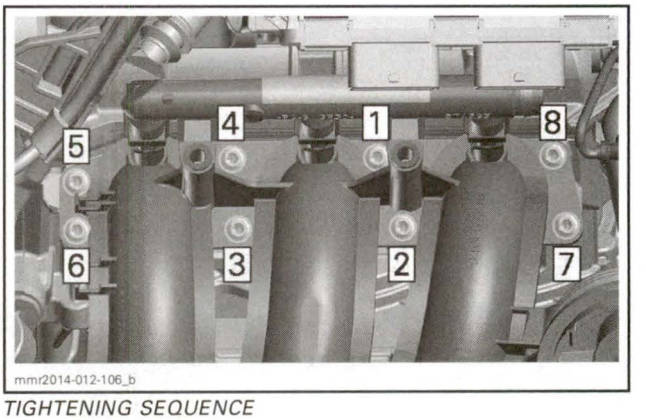
Ensure rubber grommets are properly inserted.



RUBBER GROMMETS

Tighten intake manifold screws to specification as per the following sequence.

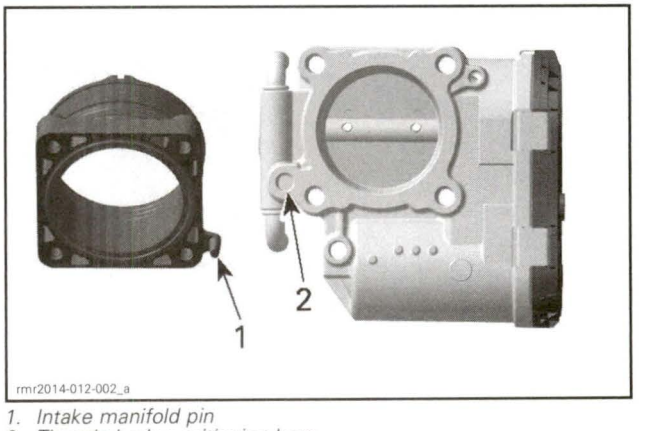
INTAKE MANIFOLD SCREWS	
Tightening torque	9 N•m ± 1 N•m (80 lbf•**in** ± 9 lbf•**in**)



TIGHTENING SEQUENCE

If removed, install throttle body on connecting socket.

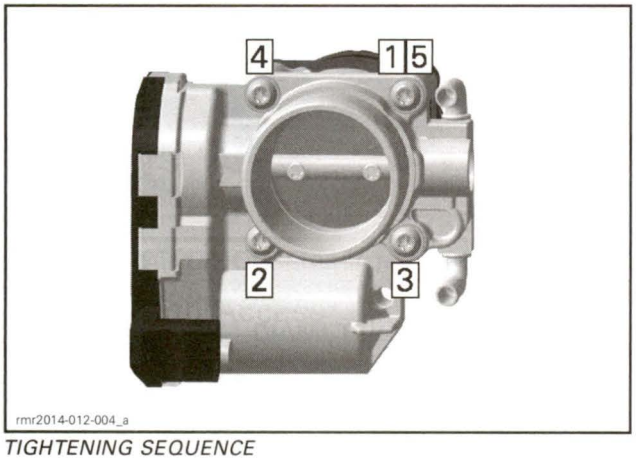
Make sure to index intake manifold pin with throttle body positioning bore.



1. Intake manifold pin
2. Throttle body positioning bore

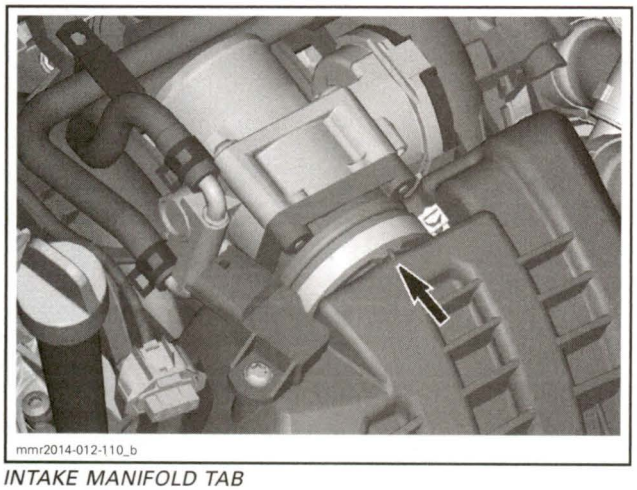
Tighten throttle body screws to specification as per the following sequence.

THROTTLE BODY SCREWS	
Tightening torque	9 N•m ± 1 N•m (80 lbf•**in** ± 9 lbf•**in**)



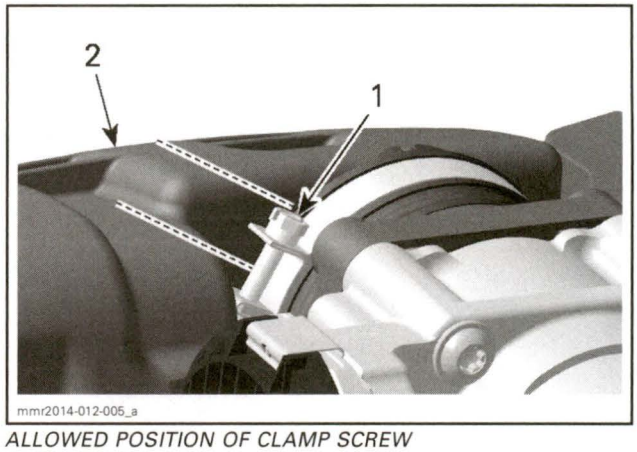
TIGHTENING SEQUENCE

Make sure to index connecting socket notch with the intake manifold tab.



INTAKE MANIFOLD TAB

Install connecting socket clamp in proper position and tighten to specification.



ALLOWED POSITION OF CLAMP SCREW
1. *Screw of clamp*
2. *Intake manifold*

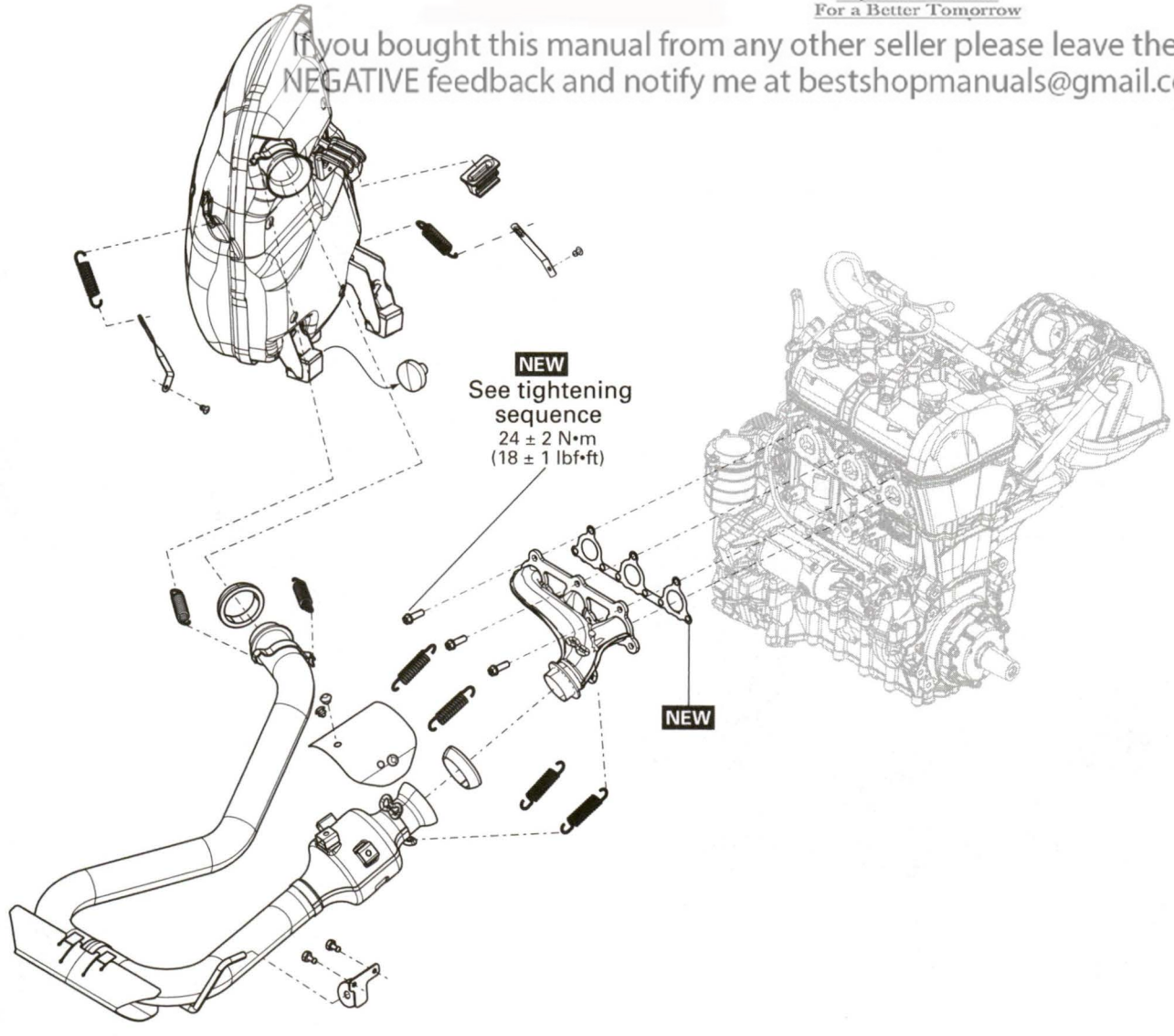
CONNECTING SOCKET CLAMP	
Tightening torque	0.9 N•m ± 0.1 N•m (8 lbf•**in** ± 1 lbf•**in**)

EXHAUST SYSTEM

SERVICE TOOLS

Description	Part Number	Page
SPRING INSTALLER/REMOVER	529 035 983	172–173

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GENERAL

⚠ WARNING

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

PROCEDURES

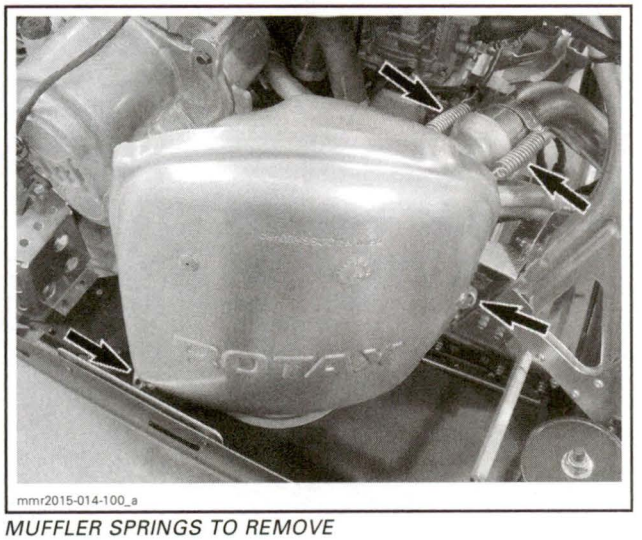
MUFFLER

Muffler Removal

1. Refer to appropriate subsection and remove:
- Both RH side panels
- Hood.

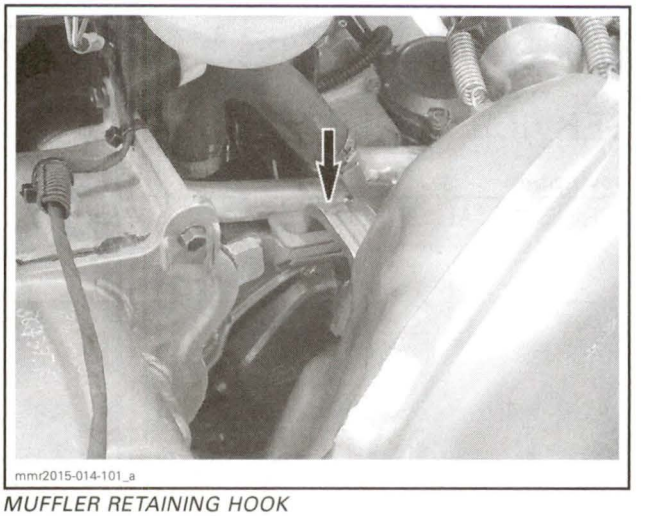
REQUIRED TOOL	
SPRING INSTALLER/REMOVER (P/N 529 035 983)	

2. Remove springs securing muffler.
3. Remove springs securing the exhaust pipe to the muffler.



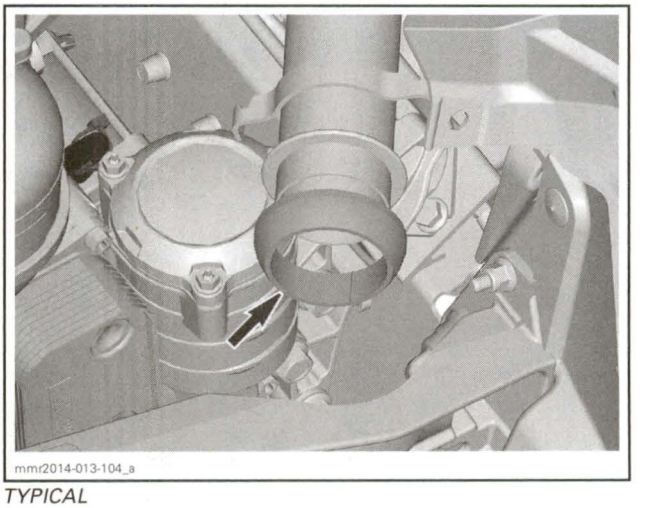
MUFFLER SPRINGS TO REMOVE

4. Lift up muffler to disengage the retaining hook.



MUFFLER RETAINING HOOK

5. Remove muffler from vehicle.
6. Remove exhaust gasket.

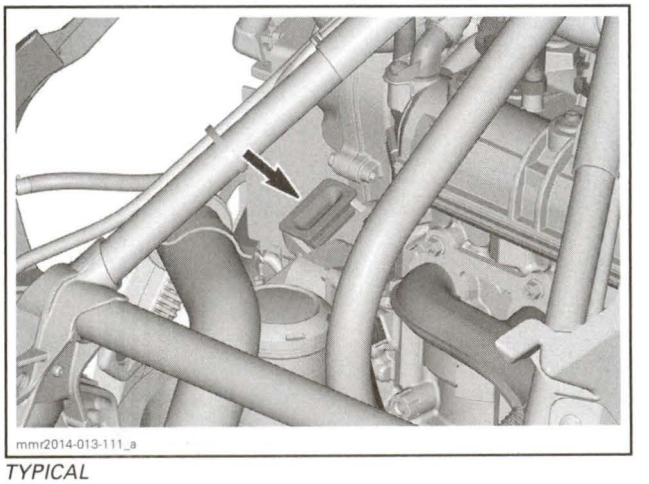


TYPICAL

Muffler Inspection

Check muffler for leaks, cracks, or other damages.

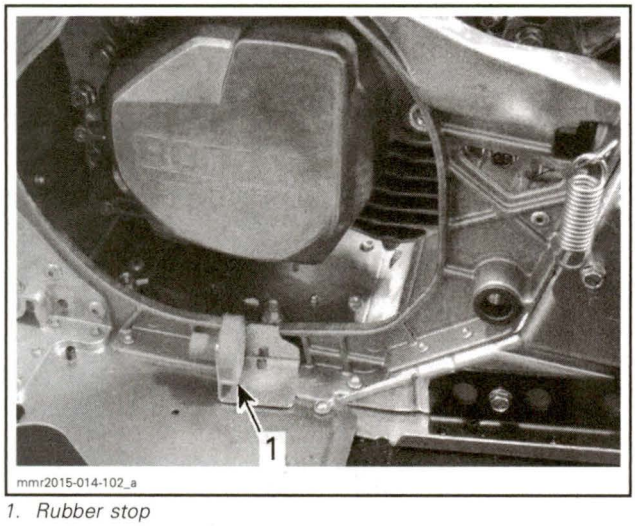
Check hook grommet condition.



TYPICAL

Inspect exhaust pipe gasket condition. Replace as required.

Ensure rubber stop is in good condition and properly inserted in its holder.



1. Rubber stop

Ensure retaining springs are in good condition.

Muffler Installation

Reverse the removal procedure. However, pay attention to the following:

Ensure proper insertion of muffler on exhaust pipe gasket.

When inserting muffler hook in grommet, ensure muffler is properly positioned against rubber stop at bottom of muffler.

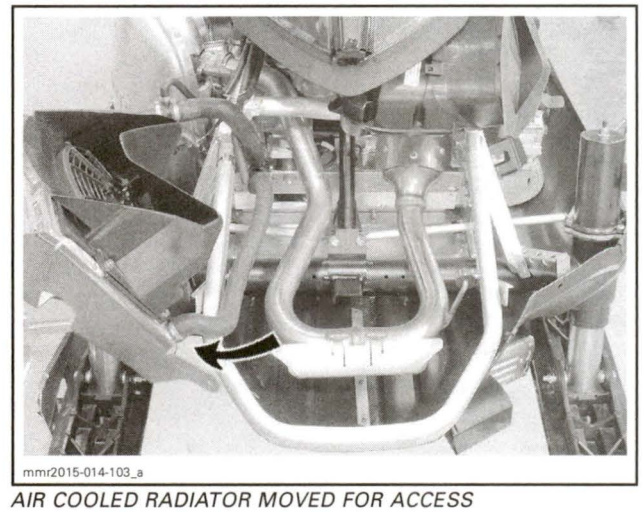
Install muffler retaining springs first, then exhaust pipe springs.

EXHAUST PIPE

Exhaust Pipe Removal

1. Remove muffler. Refer to *MUFFLER REMOVAL* in this subsection.
2. Remove drive belt guard. Refer to *DRIVE BELT* subsection.
3. Move air cooled radiator aside for access to exhaust pipe. Refer to *AIR COOLED RADIATOR REMOVAL* for access in the *COOLING SYSTEM* subsection.

NOTE: It is not necessary to disconnect it or disassemble it from the air deflector pan.

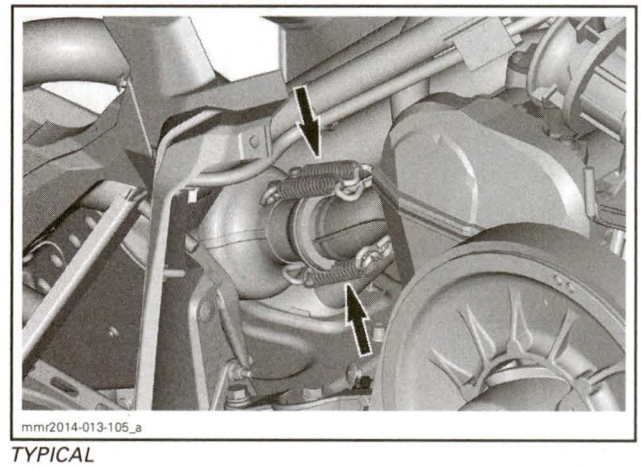


AIR COOLED RADIATOR MOVED FOR ACCESS

REQUIRED TOOL	
SPRING INSTALLER/REMOVER (P/N 529 035 983)	

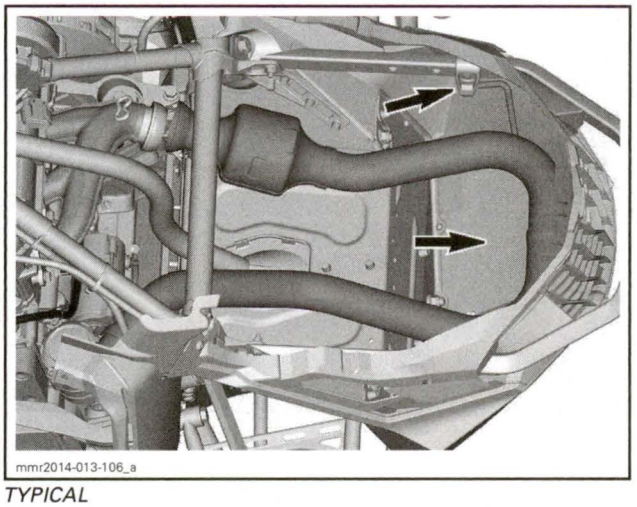
4. Remove exhaust pipe springs (4) from exhaust manifold.

NOTE: Start with the two springs under the pipe.



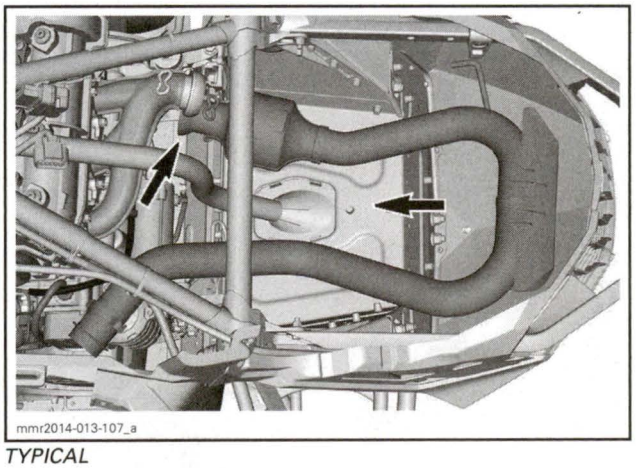
TYPICAL

5. Move exhaust pipe forward to disengage forward exhaust pipe hanger from anti vibration mount.


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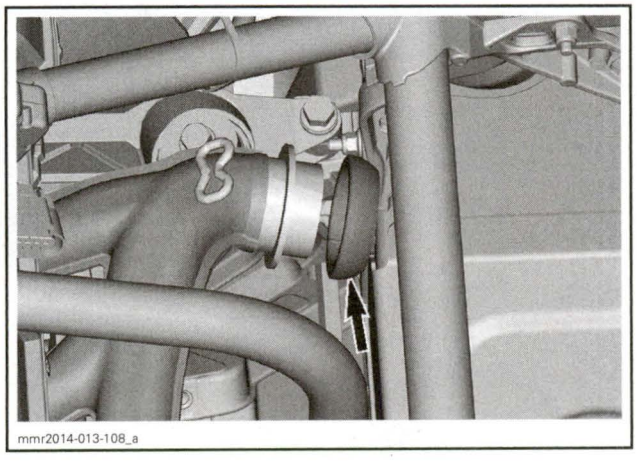
TYPICAL

6. To remove the exhaust pipe, move it towards the engine and under exhaust manifold to allow the middle section of the pipe to clear the bottom pan.


mmr2014-013-107_a

TYPICAL

7. Remove exhaust gasket.


mmr2014-013-108_a

Exhaust Pipe Inspection

Check exhaust pipe for:
- Leaks
- Cracks
- Other damages.

Inspect exhaust pipe gaskets (2). Replace as required.

Ensure anti-vibration mount and retaining springs are in good condition.

Exhaust Pipe Installation

Reverse the removal procedure. However, pay attention to the following:

Ensure both exhaust gaskets are properly installed to prevent exhaust leakage.

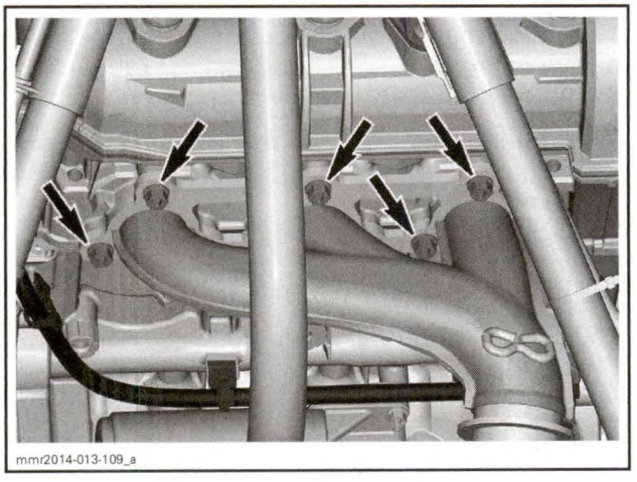
EXHAUST MANIFOLD

Exhaust Manifold Access

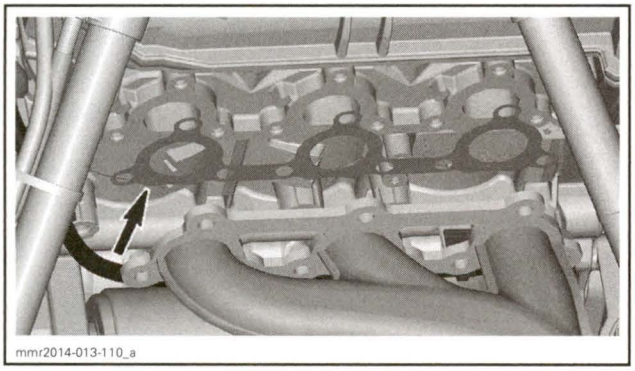
Refer to procedures in this subsection and remove:
- Muffler
- Exhaust pipe.

Exhaust Manifold Removal

1. Remove exhaust manifold screws (9).


mmr2014-013-109_a

2. Remove exhaust manifold.
3. Remove and discard exhaust manifold gasket.



Exhaust Manifold Inspection

Check if the manifold is cracked or damaged. Replace if necessary.

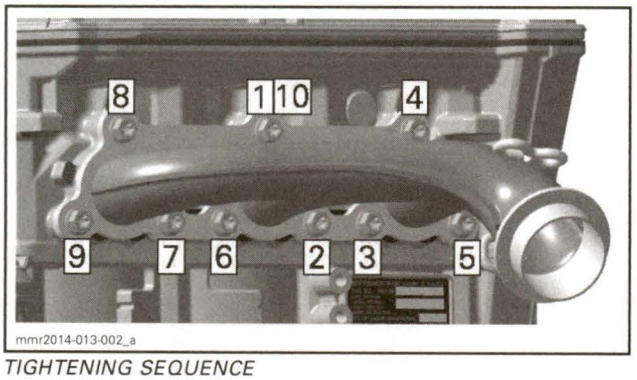
Exhaust Manifold Installation

Reverse the removal procedure. However, pay attention to the following:

Install exhaust manifold with a **NEW** gasket.

Tighten exhaust manifold screws to specification as per following tightening sequence.

EXHAUST MANIFOLD SCREWS	
Tightening torque	23 N•m ± 2 N•m (17 lbf•ft ± 1 lbf•ft)



TIGHTENING SEQUENCE

LUBRICATION SYSTEM

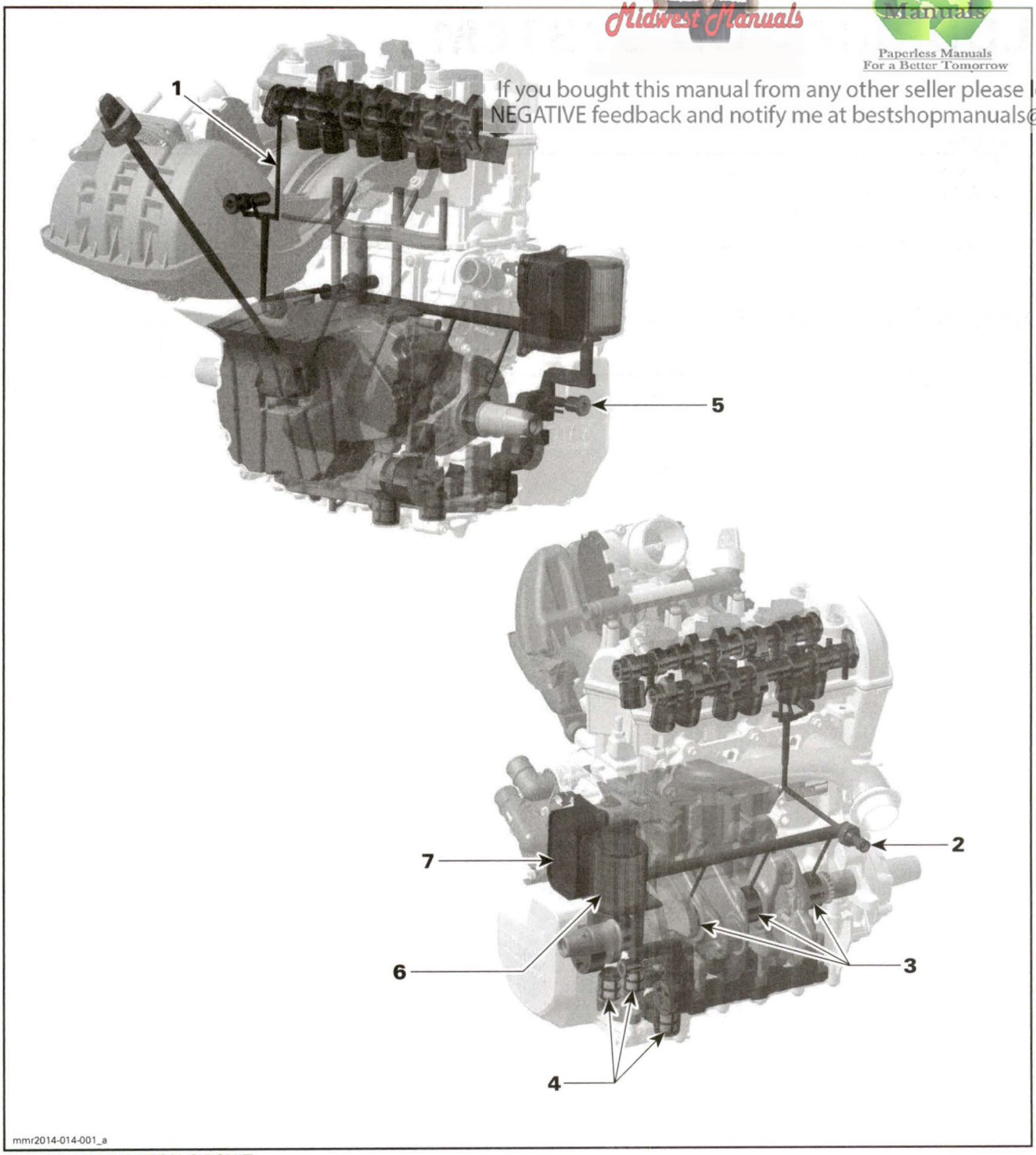
SERVICE TOOLS

Description	Part Number	Page
ADAPTER HOSE	529 035 652	180
ECM ADAPTER TOOL	529 036 166	182
FLUKE 115 MULTIMETER	529 035 868	182
PRESSURE GAUGE	529 035 709	180

SERVICE PRODUCTS

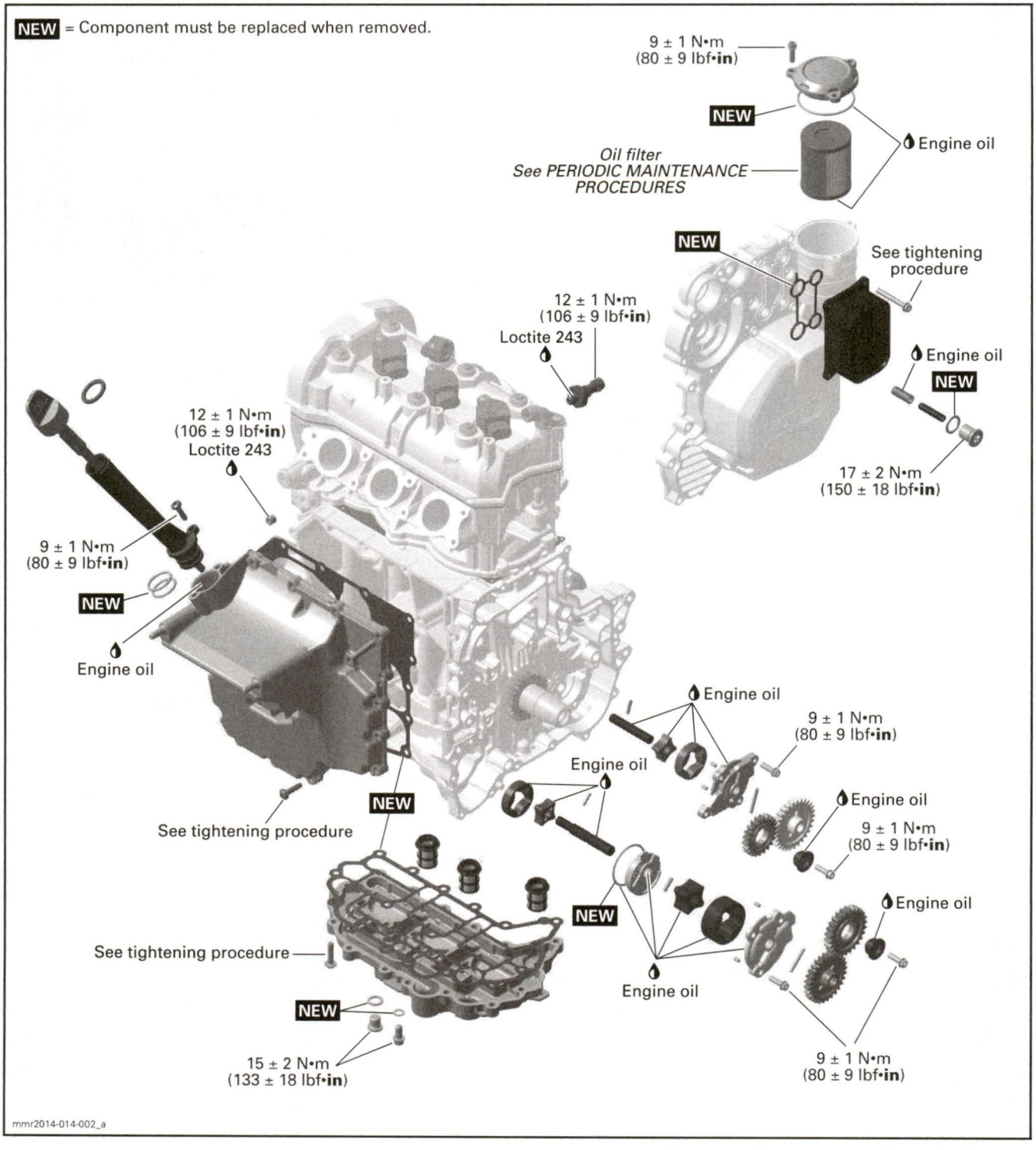
Description	Part Number	Page
LOCTITE 243 (BLUE)	293 800 060	180, 183

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ENGINE LUBRICATION CIRCUIT

1. Oil channel to camshaft bearings
2. Oil pressure switch
3. Crankshaft main bearings
4. Oil strainers
5. Oil pressure regulator
6. Oil filter
7. Oil cooler


NEW = Component must be replaced when removed.
9 ± 1 N•m
(80 ± 9 lbf•in)
NEW
Engine oil
Oil filter
See PERIODIC MAINTENANCE PROCEDURES
NEW
See tightening procedure
12 ± 1 N•m
(106 ± 9 lbf•in)
Loctite 243
Engine oil
NEW
17 ± 2 N•m
(150 ± 18 lbf•in)
12 ± 1 N•m
(106 ± 9 lbf•in)
Loctite 243
9 ± 1 N•m
(80 ± 9 lbf•in)
NEW
Engine oil
Engine oil
9 ± 1 N•m
(80 ± 9 lbf•in)
Engine oil
NEW
See tightening procedure
Engine oil
9 ± 1 N•m
(80 ± 9 lbf•in)
Engine oil
NEW
See tightening procedure
Engine oil
NEW
15 ± 2 N•m
(133 ± 18 lbf•in)
9 ± 1 N•m
(80 ± 9 lbf•in)
mmr2014-014-002_a

GENERAL

SYSTEM DESCRIPTION

This engine uses dry sump lubrication. The oil from the cylinder block, timing chain chamber and magneto cover is pumped by two suction pumps.

Both suction pumps are integrated into one module.

The 20 mm (.79 in) large oil suction pump returns the crankshaft and magneto chamber oil to the reservoir.

The 11 mm (.43 in) small oil suction pump returns the timing chain chamber oil to the oil reservoir.

An oil filter and three oil strainers are used to filter dirt and debris from the oil circuit.

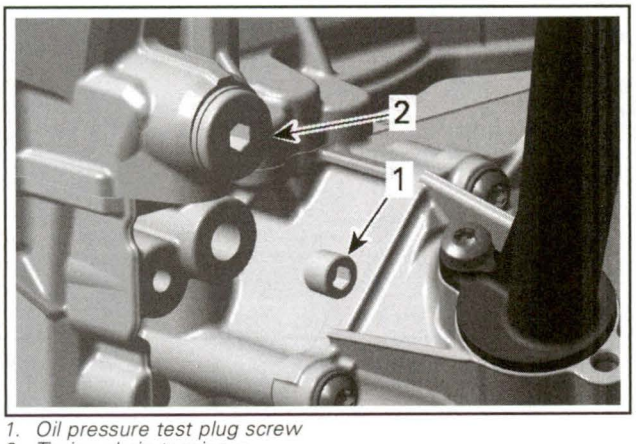
The oil strainers are located between oil sump cover and crankcase lower underneath the oil pressure pump.

The oil pressure is provided by a pump and regulated by a spring loaded pressure regulator.

INSPECTION

ENGINE OIL PRESSURE TEST

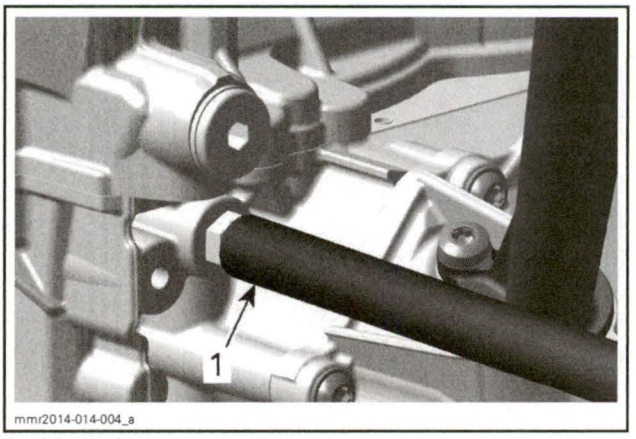
1. Remove countershaft bearing support. Refer to *COUNTERSHAFT BEARING SUPPORT REMOVAL* in *DRIVEN PULLEY AND COUNTERSHAFT* subsection.
2. Remove oil pressure test plug screw from cylinder block.



1. Oil pressure test plug screw
2. Timing chain tensioner

3. Install adapter hose on cylinder block.

REQUIRED TOOLS	
ADAPTER HOSE (P/N 529 035 652)	



1. Adapter hose

4. Connect pressure gauge to adapter hose.

REQUIRED TOOL	
PRESSURE GAUGE (P/N 529 035 709)	

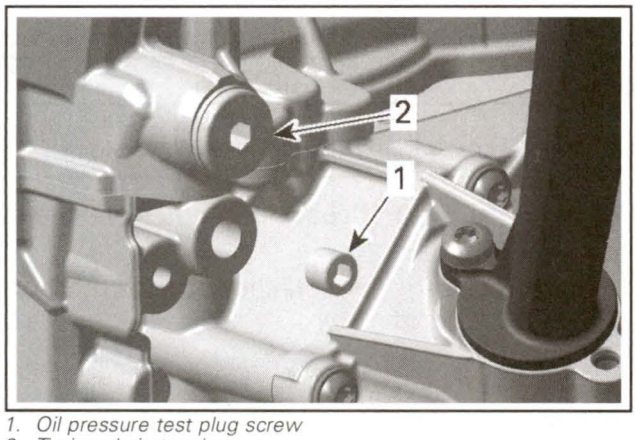
5. Start engine and check oil pressure.

ENGINE OIL PRESSURE @ 100°C (212°F)	
ENGINE SPEED	MINIMUM PRESSURE
Idle	80 kPa (11.6 PSI)
4000 RPM	270 kPa (39.16 PSI)
6000 to 7250 RPM	350 kPa (50.76 PSI)

If the engine oil pressure is out of specification, refer to *TROUBLESHOOTING* in this subsection.

6. Remove engine oil pressure test tools.
7. Clean threads of oil pressure test plug screw before installing it.
8. Tighten oil pressure test plug screw to specification.

OIL PRESSURE TEST PLUG SCREW	
Service product	LOCTITE 243 (BLUE) (P/N 293 800 060)
Tightening torque	12 N•m ± 1 N•m (106 lbf•**in** ± 9 lbf•**in**)



1. *Oil pressure test plug screw*
2. *Timing chain tensioner*

9. Reinstall all removed parts. Refer to applicable subsection.

TROUBLESHOOTING

Always check for fault codes. If a fault code is detected, service the fault code first.

LOW OR NO ENGINE OIL PRESSURE

1. **Oil level is too low.**
   - *Refill engine oil.*
   - *Check for high oil consumption. See below.*
   - *Check for oil leaks (oil leaking out of leak indicator hole, gaskets, oil seal or O-rings). Repair or replace.*
2. **Defective or clogged oil filter**
   - *Replace engine oil and filter.*
3. **Use of a bad grade oil**
   - *Replace engine oil with BRP recommended oil.*
4. **Oil pressure regulator valve sticks open, or spring load is insufficient.**
   - *Clean oil regulator piston and its bore. Replace if necessary.*
   - *Measure spring free length. Replace if out of specification.*
5. **Oil pump(s) worn or damaged.**
   - *Check if oil pump drive gears are damaged. Replace if necessary.*
   - *Check oil pump rotors and its bore for wear limits. Replace if out of specification.*
6. **Engine oil strainer is clogged.**
   - *Remove and clean engine oil strainer.*
7. **Heavy wear on plain bearings.**
   - *Check radial clearance of plain bearings. Replace if out of specification.*

HIGH OIL CONSUMPTION

1. **Oil in breathing system.**
   - *Check if breather V-ring is brittle, hard or damaged. Replace V-ring.*
   - *Check if oil separator cover is damaged or missing.*
2. **Valve stem seals worn or damaged.**
   - *Replace valve stem seals.*
3. **Piston rings worn out (blue colored exhaust smoke).**
   - *Replace piston rings.*

OIL CONTAMINATION (WHITE APPEARANCE)

1. **Oil seal and rotary seal on water pump shaft leaking.**
   - *Replace oil seal, rotary seal and water pump shaft. Change engine oil.*
2. **Cylinder head gasket leaking.**
   - *Replace cylinder head gasket. Change engine oil.*
3. **Cylinder head screws not properly tightened.**
   - *Retighten screws with recommended torque. Change engine oil.*
4. **Oil cooler gasket leaking.**
   - *Replace gasket. Change engine oil.*

PROCEDURES

OPS (OIL PRESSURE SWITCH)

OPS Activation

The oil pressure switch activates when the engine oil pressure is lower than following specified pressure range.

NOTE: ECM does not trigger the OPS signal below 4500 rpm.

OIL PRESSURE SWITCH ACTIVATION RANGE
20 kPa to 40 kPa (2.9 PSI to 5.8 PSI)

OPS Access

1. Remove LH side panels.
2. Remove drive belt. Refer to *DRIVE BELT* subsection.

OPS Inspection

First, ensure oil pressure is adequate. Refer to *ENGINE OIL PRESSURE TEST* in this subsection.

If the oil pressure is good, check the resistance of the oil pressure switch.

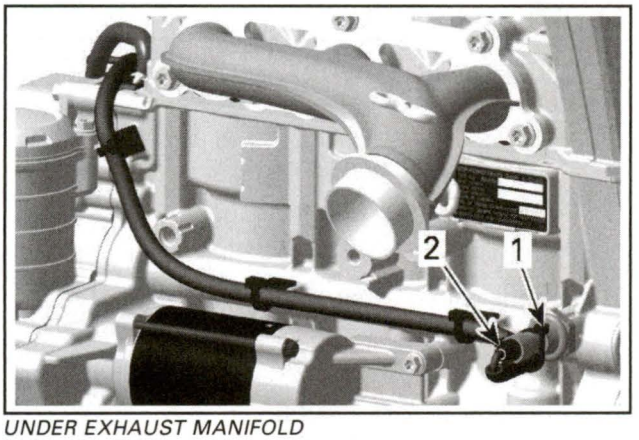
OPS Resistance Test

The engine must be warm to check the oil pressure switch properly.

⚠ WARNING

Be careful when working near hot parts. To avoid potential burns, never touch exhaust system components immediately after the engine has been running as these components are very hot. Always wear long sleeves and gloves.

1. Cut locking tie and disconnect OPS connector.



UNDER EXHAUST MANIFOLD
1. *Locking tie*
2. *OPS connector*

2. Check oil pressure switch resistance.

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

3. Read result and compare to table.

RESISTANCE (Ω)		
ENGINE NOT RUNNING		
OPS pin	Engine ground	Close to 0 Ω (normally closed switch)

If resistance is out of specification, replace the oil pressure switch.

If the resistance is correct, continue procedure. It will be necessary to use jumper wires.

4. Install drive belt guard.
5. Start engine.
6. Read result and compare to table.

RESISTANCE (Ω)		
ENGINE RUNNING		
OPS pin	Engine ground	Infinitely high (OL)

If resistance is out of specification, replace the oil pressure switch.

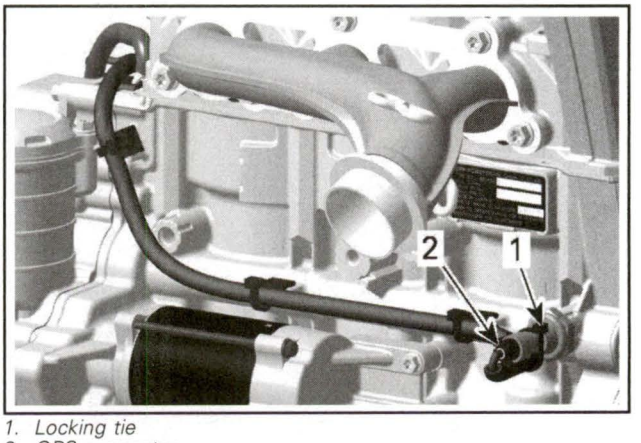
If the resistance is correct, check the oil pressure switch circuit continuity.

OPS Circuit Continuity Test

1. Disconnect ECM connector A. Refer to *ECM CONNECTOR ACCESS* in *ELECTRONIC FUEL INJECTION) (900ACE)* subsection.
2. Install connector A on the ECM adapter tool.

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

3. Cut locking tie and disconnect the OPS connector.



1. *Locking tie*
2. *OPS connector*

4. Check continuity as follows.

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

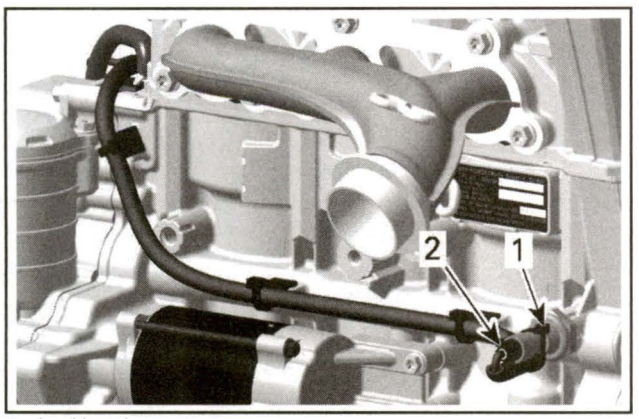
CIRCUIT CONTINUITY		
OPS connector	ECM A pin E3	Close to 0 Ω

If the continuity is good and all other tests are performed, try a **NEW** ECM.

If the continuity is bad, repair or replace defective wire or connectors.

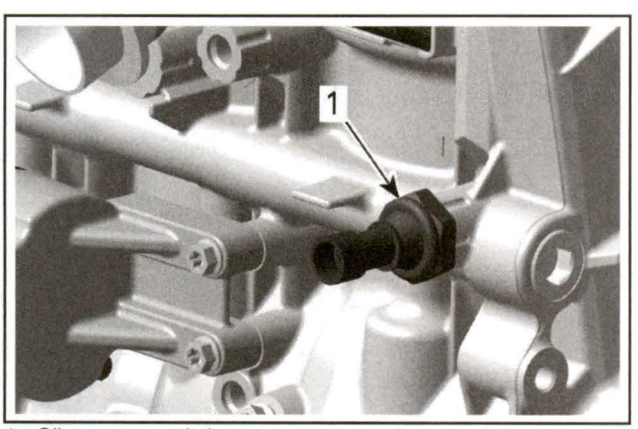
OPS Removal

1. Cut locking tie and unplug the OPS switch connector.



1. Locking tie
2. OPS connector

2. Unscrew and remove the OPS.



1. Oil pressure switch

OPS Installation

Install oil pressure switch as per following information.

OIL PRESSURE SWITCH	
Service product	LOCTITE 243 (BLUE) (P/N 293 800 060)
Tightening torque	12 N•m ± 1 N•m (106 lbf•**in** ± 9 lbf•**in**)

Install all other removed parts.

NOTICE **When installing the locking tie on the OPS connector, avoid making a sharp bend in the wires.**

OIL FILLER TUBE

Oil Filler Tube Access

Remove drive belt guard, refer to *DRIVE BELT* subsection.

Oil Filler Tube Removal

1. Remove oil filler tube retaining screw.

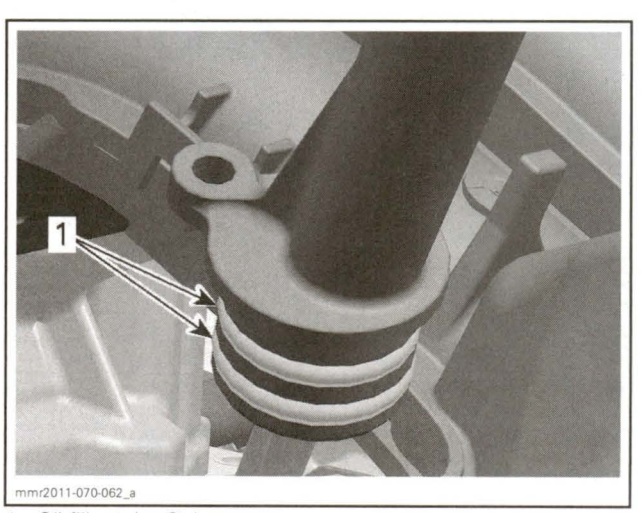


1. Oil filler tube
2. Retaining screw

2. Pull filler tube out of oil tank cover

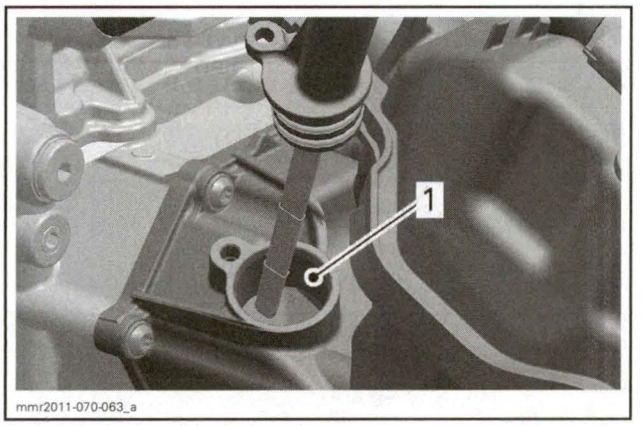
Oil Filler Tube Installation

1. Install **NEW** O-rings on oil filler tube.



1. Oil filler tube O-rings

2. Lubricate oil tank cover bore with engine oil.



1. Lubricate the oil tank cover bore

3. Install oil filler tube.
4. Tighten retaining screw to specified torque.

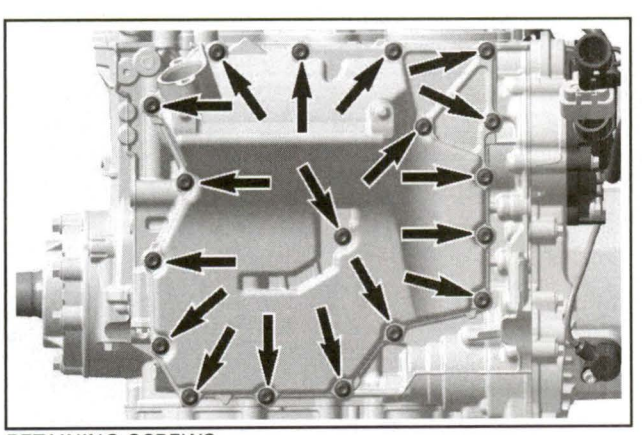
OIL FILLER TUBE SCREW	
Tightening torque	9 N•m ± 1 N•m (80 lbf•**in** ± 9 lbf•**in**)

5. Install all other removed parts.

OIL TANK

Oil Tank Cover Removal

1. Drain engine oil. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.
2. Remove engine from vehicle. Refer to *ENGINE REMOVAL AND INSTALLATION* subsection.
3. Remove intake manifold. Refer to *AIR INTAKE SYSTEM* subsection.
4. Place a drain pan underneath oil tank.
5. Unscrew oil tank cover retaining screws.



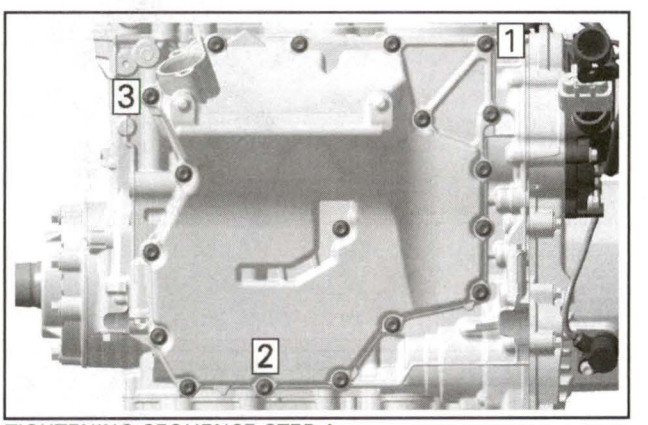
RETAINING SCREWS
1. Oil tank

6. Remove oil tank from the engine.

Oil Tank Cover Installation

1. Install **NEW** gasket.
2. Install oil tank on engine, then tighten screws in two steps as follows:
   2.1 Tighten screws to the following specified torque using the specified sequence.

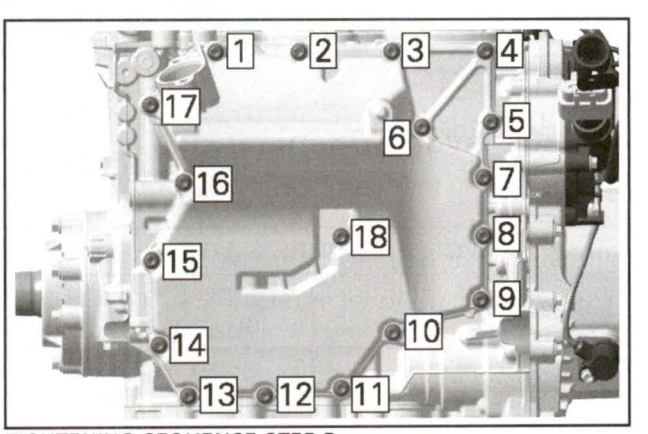
OIL TANK SCREWS TIGHTENING TORQUE (FOLLOW SEQUENCE)	
STEP A	5 N•m ± 0.6 N•m (44 lbf•**in** ± 5 lbf•**in**)



TIGHTENING SEQUENCE STEP A

   2.2 Tighten screws to the following specified torque using the specified sequence.

OIL TANK SCREWS TIGHTENING TORQUE (FOLLOW SEQUENCE)	
STEP B	9 N•m ± 1 N•m (80 lbf•**in** ± 9 lbf•**in**)



TIGHTENING SEQUENCE STEP B

3. Wipe up any oil spillage.
4. Install intake manifold. Refer to *AIR INTAKE SYSTEM* subsection.
5. Install engine in vehicle. Refer to *ENGINE REMOVAL AND INSTALLATION* subsection.
6. Fill up oil tank and check oil level. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

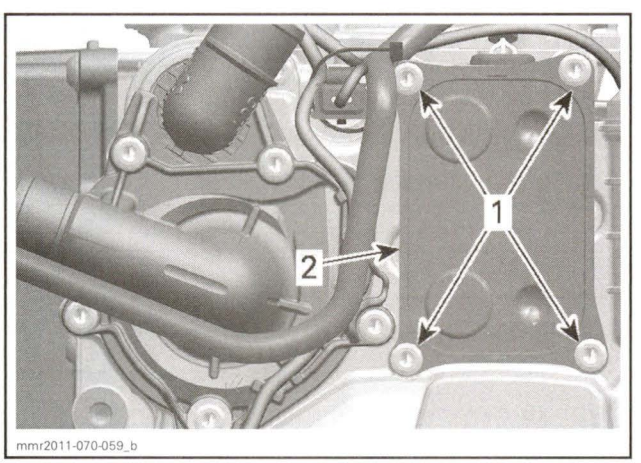
OIL COOLER

Oil Cooler Access

Remove muffler, refer to *EXHAUST SYSTEM* subsection.

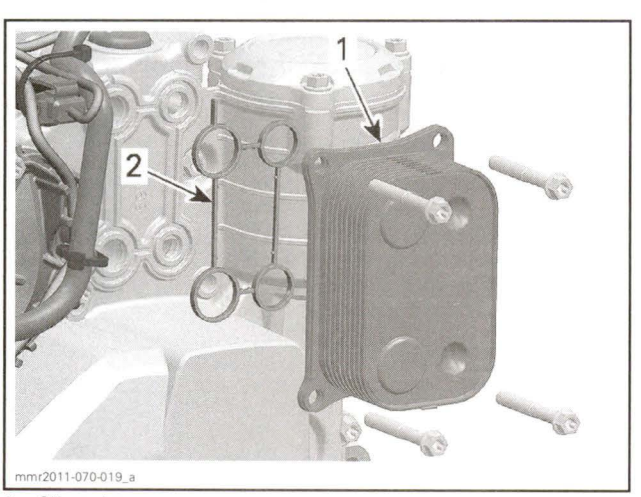
Oil Cooler Removal

1. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection to :
   - Drain engine oil
   - Drain cooling system.
2. Remove oil cooler retaining screws.



1. Retaining screws
2. Oil cooler

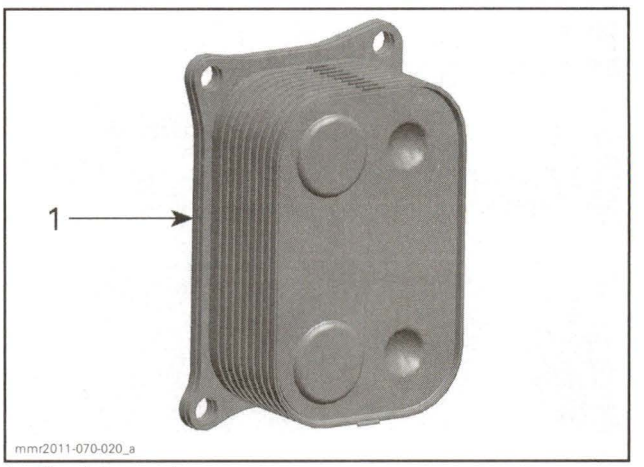
3. Place rags or towels under oil cooler to catch remaining oil and coolant.
4. Remove oil cooler and its gasket.



1. Oil cooler
2. Gasket

Oil Cooler Inspection

Check oil cooler for cracks and other damage.



1. Check for cracks

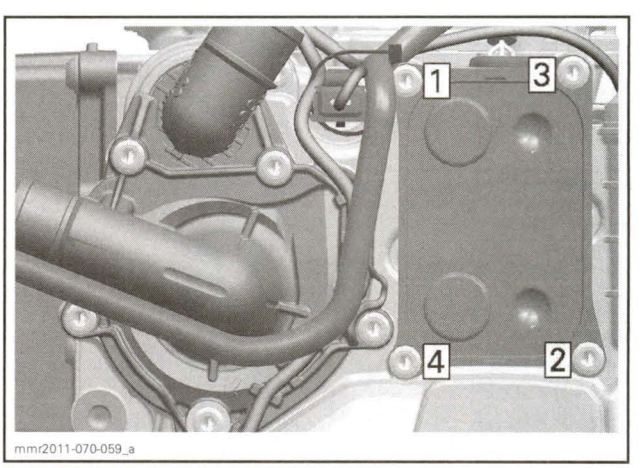
Replace parts as necessary.

Oil Cooler Installation

Reverse the removal procedure. However, pay attention to the following.

Tighten oil cooler screws in two steps to the specified torques using the illustrated sequence.

TIGHTENING TORQUE		
OIL COOLER SCREWS	STEP A	5 N•m ± 0.6 N•m (44 lbf•**in** ± 5 lbf•**in**)
	STEP B	9 N•m ± 1 N•m (80 lbf•**in** ± 9 lbf•**in**)



TIGHTENING SEQUENCE OIL-COOLER

Wipe up any oil and coolant spillage.

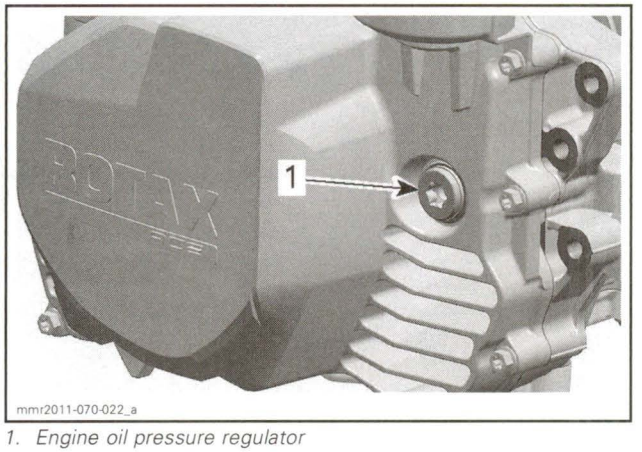
Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection to:

- Fill up oil tank and check oil level
- Refill and bleed cooling system.

ENGINE OIL PRESSURE REGULATOR

Oil Pressure Regulator Location

The engine oil pressure regulator is located inside the magneto cover.



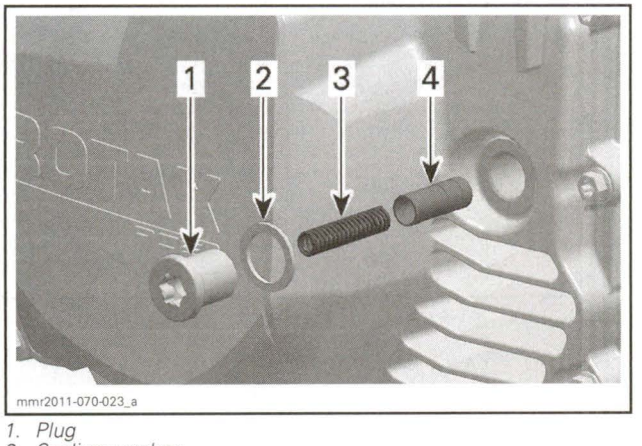
1. Engine oil pressure regulator

Oil Pressure Regulator Access

Remove muffler, refer to *EXHAUST SYSTEM* subsection.

Oil Pressure Regulator Removal

1. Drain engine oil. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.
2. Remove regulator plug and sealing washer. Discard sealing washer.
3. Pull oil pressure regulator parts out of the magneto cover.



1. Plug
2. Sealing washer
3. Regulator spring
4. Regulator piston

Oil Pressure Regulator Inspection

Clean bore and thread in the magneto cover of any contamination.

Inspect oil pressure regulator piston and bore in cylinder block for scoring or other damages.

Check if piston moves easily in its bore.

Check compression spring for free length.

SPRING FREE LENGTH	
NEW NOMINAL	46 mm (1.811 in)
SERVICE LIMIT	45 mm (1.772 in)

Visually check compression spring for squareness.

Replace worn or damaged components.

Oil Pressure Regulator Installation

Reverse the removal procedure. However, pay attention to the following.

Install a **NEW** sealing washer on plug.

Tighten regulator plug to the specified torque.

OIL PRESSURE REGULATOR PLUG	
Sealing washer	NEW
Tightening torque	17 N•m ± 2 N•m (150 lbf•**in** ± 18 lbf•**in**)

Wipe up any oil spillage.

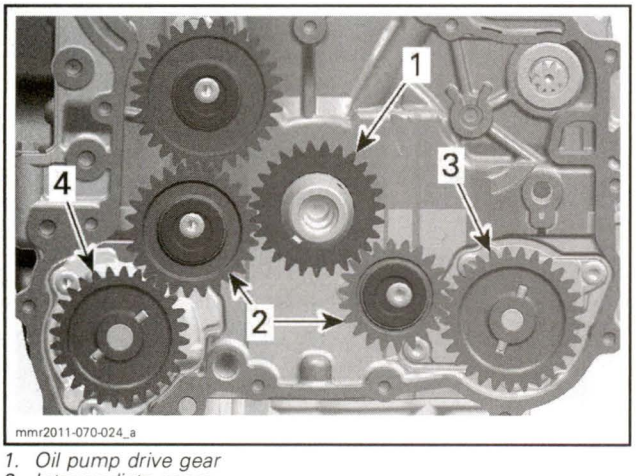
Fill up oil tank and check oil level. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

Install all other removed parts. Refer to applicable subsections.

OIL PUMP DRIVE GEARS

Oil Pump Drive Gear Location

The oil pump gears are located on the MAG side, behind the magneto cover.



1. *Oil pump drive gear*
2. *Intermediate gears*
3. *Oil pressure pump gear*
4. *Oil suction pump gear*

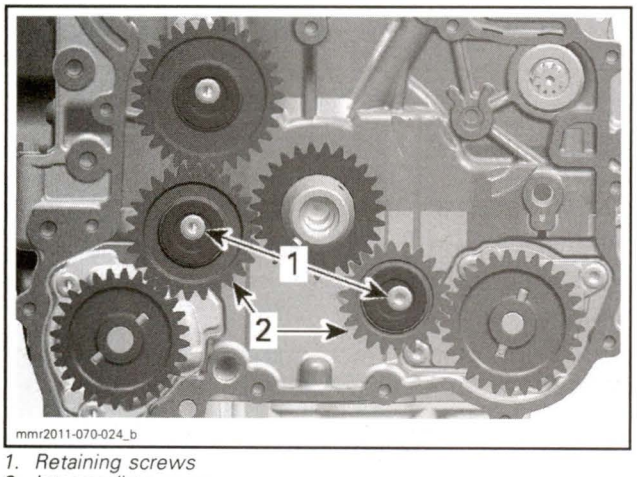
Oil Pump Drive Gear Access

Refer to *MAGNETO AND STARTER* subsection to remove:

- Magneto cover
- Rotor
- Sprag clutch gear.

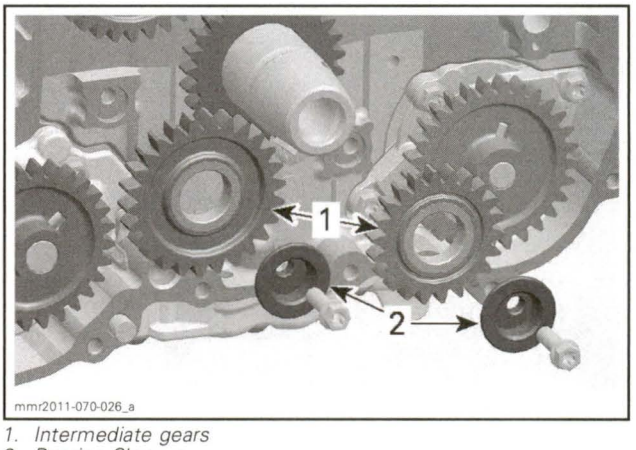
Oil Pump Drive Gear Removal

1. Unscrew oil pump intermediate gear screws.



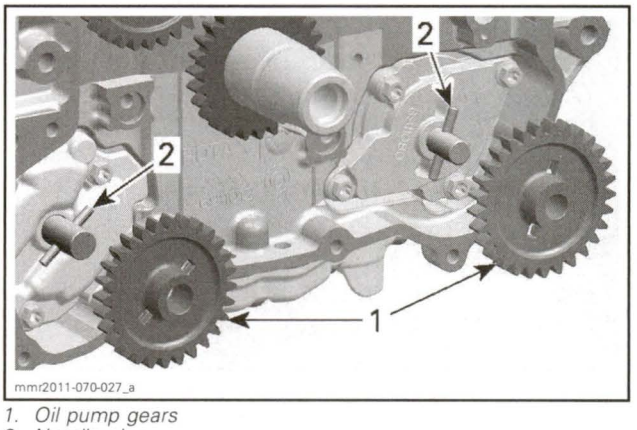
1. *Retaining screws*
2. *Intermediate gears*

2. Remove bearing sleeves and oil pump intermediate gears.



1. *Intermediate gears*
2. *Bearing Sleeves*

3. Remove oil pump gears and needle pins.



1. *Oil pump gears*
2. *Needle pins*

Oil Pump Drive Gear Inspection

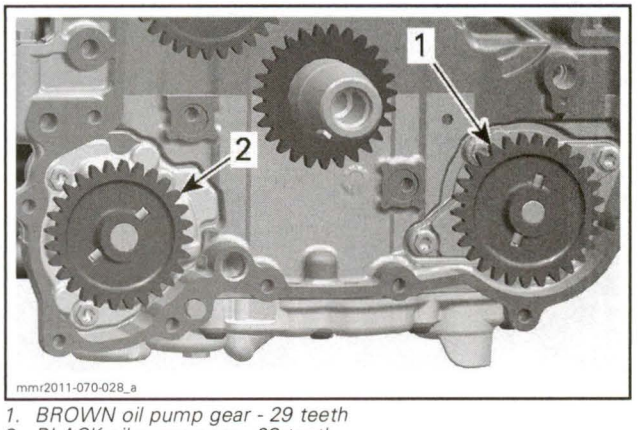
Inspect gears for wear, cracks or other damage.

Replace if damaged.

Oil Pump Drive Gear Installation

Reverse the removal procedure, however, pay attention to the following.

1. Be sure to not intermix oil pump gears, see next illustration.
   - 1.1 Install the BROWN oil pump gear (29 teeth) on oil pressure pump.
   - 1.2 Install the BLACK oil pump gear (28 teeth) on oil suction pump.



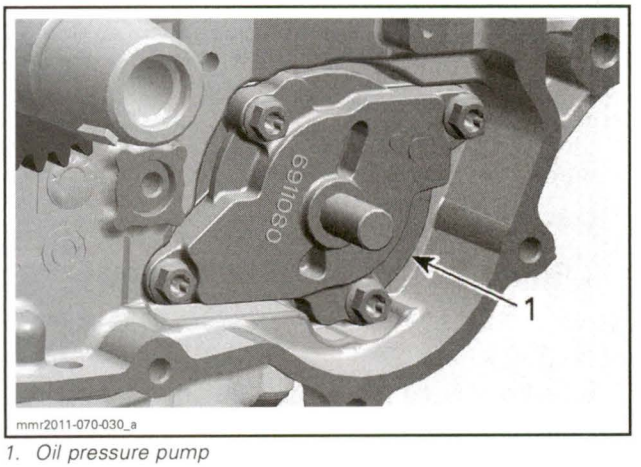
1. BROWN oil pump gear - 29 teeth
2. BLACK oil pump gear - 28 teeth

2. Lubricate intermediate gears bearing sleeves with engine oil, then install gears.
3. Install all other removed parts.
4. Fill up oil tank and check oil level. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

OIL PRESSURE PUMP

Oil Pressure Pump Location

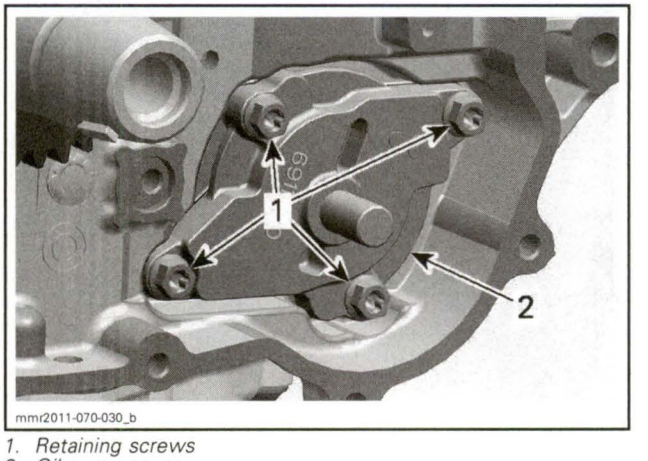
The oil pressure pump is located in the cylinder block, behind the magneto cover.



1. Oil pressure pump

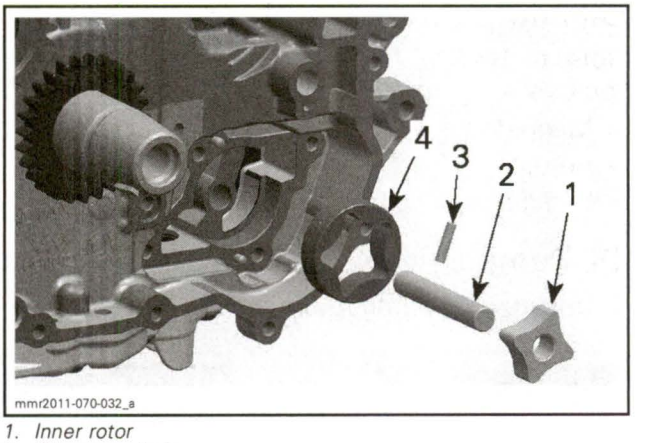
Oil Pressure Pump Removal

1. Remove *OIL PUMP DRIVE GEARS*, see procedure in this subsection.
2. Remove oil pump cover.



1. Retaining screws
2. Oil pump cover

3. Remove following parts.



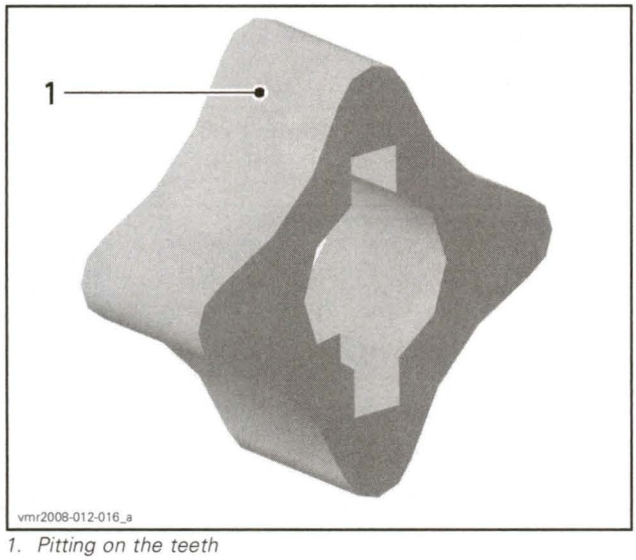
1. Inner rotor
2. Oil pump shaft
3. Needle pin
4. Outer rotor

Oil Pressure Pump Inspection

Inspect oil pump and oil pump cover bore for marks, scratches or other damage. Replace any damaged parts.

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

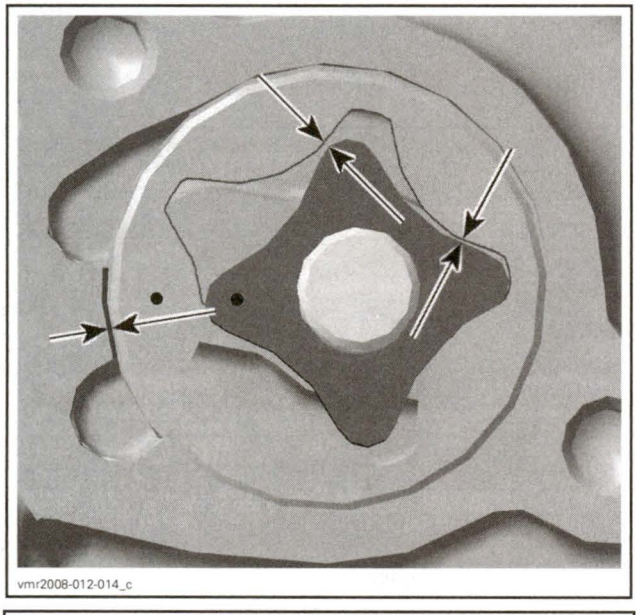
Check inner rotor for corrosion, worn pin slots or other damages. If so, replace inner and outer rotor at the same time.



1. Pitting on the teeth

Radial Clearance

Using a feeler gauge, measure the clearance of outer rotor and inner rotor as indicated by the arrows.

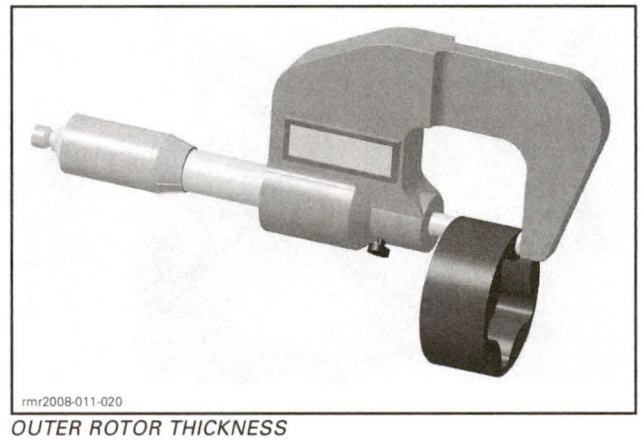


OIL PUMP RADIAL CLEARANCE	
SERVICE LIMIT	0.25 mm (.0098 in)

NOTE: If clearance of inner and outer rotors exceeds the tolerance, replace oil pump.

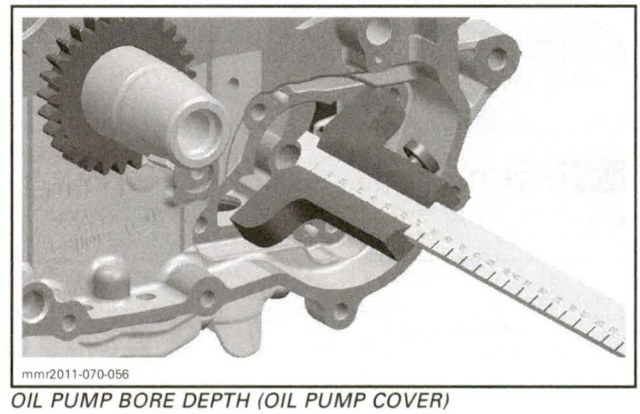
Axial Clearance

Measure outer rotor thickness with a micrometer.



OUTER ROTOR THICKNESS

Using a depth gauge, measure the depth of oil pump bore in the lower crankcase.



OIL PUMP BORE DEPTH (OIL PUMP COVER)

Substract bore depth from rotor thickness to obtain axial clearance.

OIL PUMP AXIAL CLEARANCE	
SERVICE LIMIT	0.15 mm (.0059 in)

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

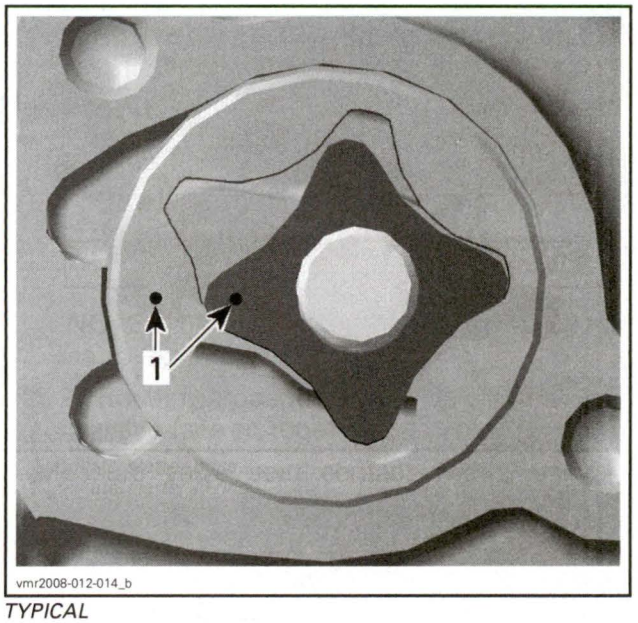
Oil Pressure Pump Installation

Reverse the removal procedure, however, pay attention to the following.

1. Lubricate outer rotor with engine oil.

NOTICE **Install rotors with the marks outwards.**

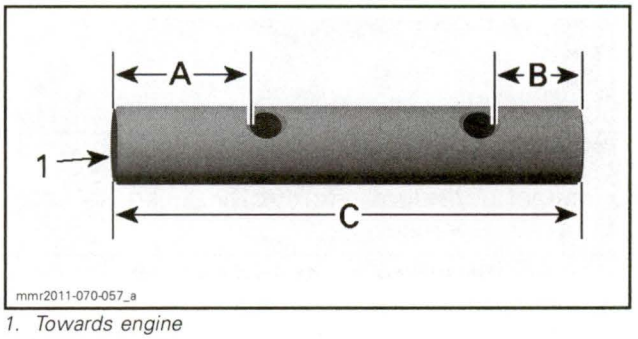
2. Install outer rotor in crankcase oil pump bore.



TYPICAL
1. Marks on inner and outer rotor

3. Install needle pin in oil pump shaft.

NOTICE The oil pump shaft is not symmetrical, the longer side must be installed inward.



1. Towards engine
A. 16.96 mm (.67 in)
B. 11.43 mm (.45 in)
C. 60.5 mm (2.38 in)

4. Place inner rotor on the oil pump shaft. Lubricate oil pump shaft and inner rotor with engine oil.
5. Install oil pump assembly in the crankcase.

After installation of the remaining parts, check for smooth operation of the oil pump assembly and axial play of the oil pump shaft.

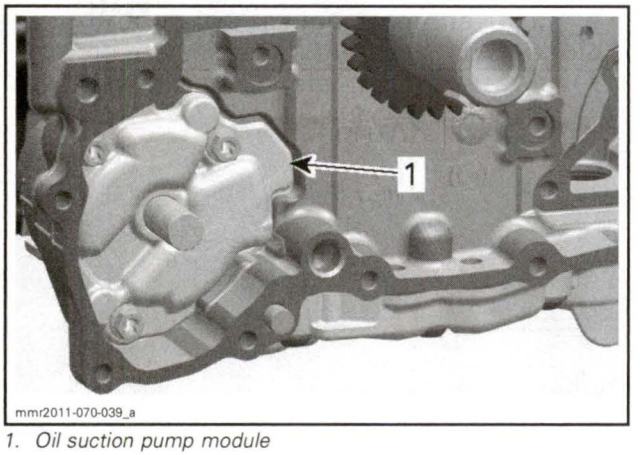
6. Fill up oil tank and check oil level. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

Start engine and make sure oil pressure is within specifications (refer to *ENGINE OIL PRESSURE TEST* in this subsection).

OIL SUCTION PUMP MODULE

Oil Suction Pump Module Location

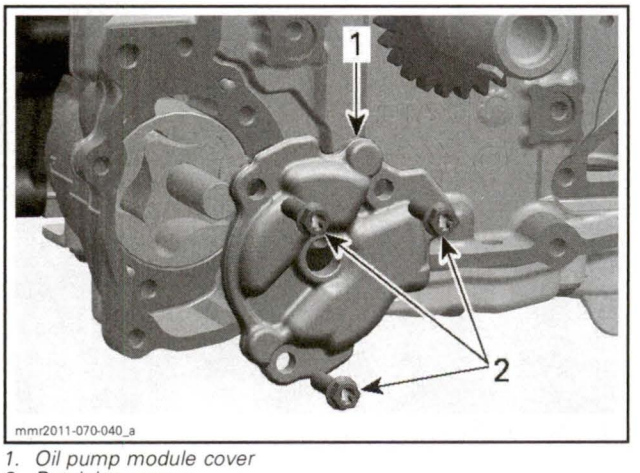
The oil suction pump module is located in the cylinder block, behind the magneto cover.



1. Oil suction pump module

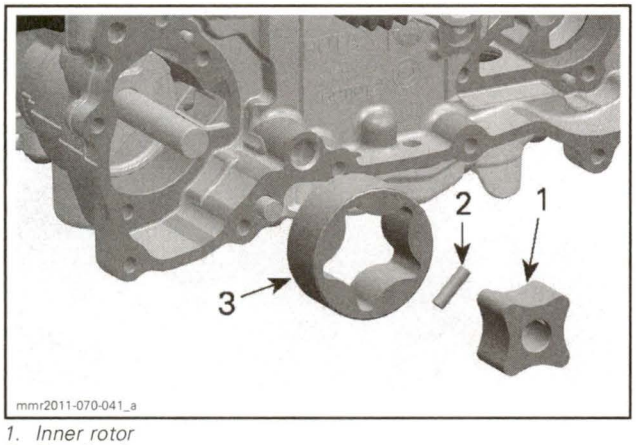
Oil Suction Pump Module Disassembly

1. Remove *OIL PUMP DRIVE GEARS*, see procedure in this subsection.
2. Remove oil pump module cover.



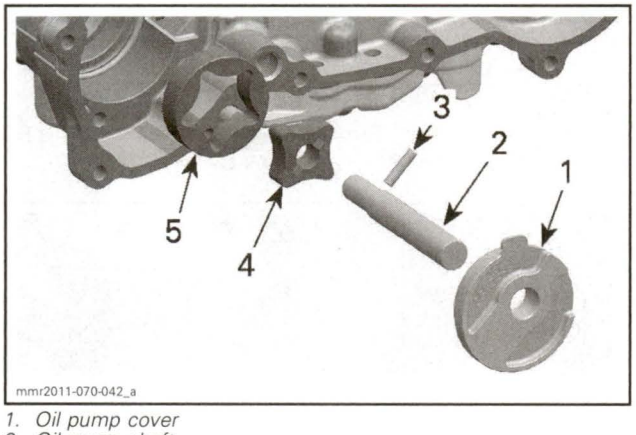
1. Oil pump module cover
2. Retaining screws

3. Disassemble the large oil suction pump as shown.



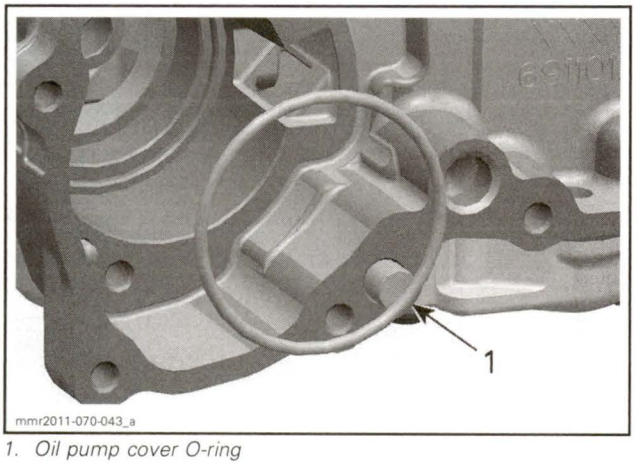
1. *Inner rotor*
2. *Needle pin*
3. *Outer rotor*

4. Disassemble the small oil suction pump as shown.



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

5. Remove and discard the oil pump cover O-ring.



1. *Oil pump cover O-ring*

Oil Suction Pumps Inspection

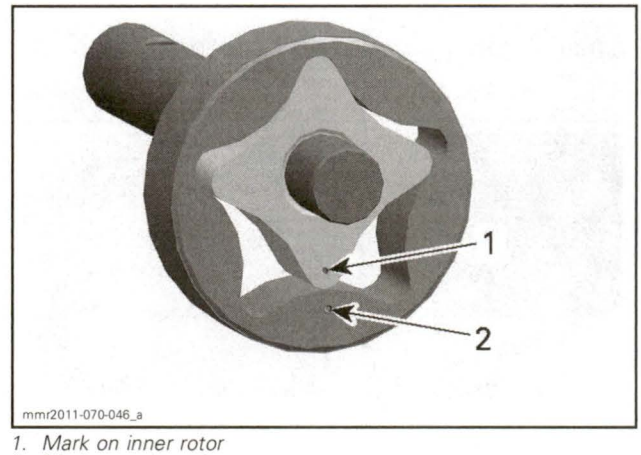
The inspection of both oil suction pumps is the same as for the oil pressure pump. Refer to *OIL PRESSURE PUMP* in this subsection.

Oil Suction Pump Module Assembly

Reverse the removal procedure, however, pay attention to the following.

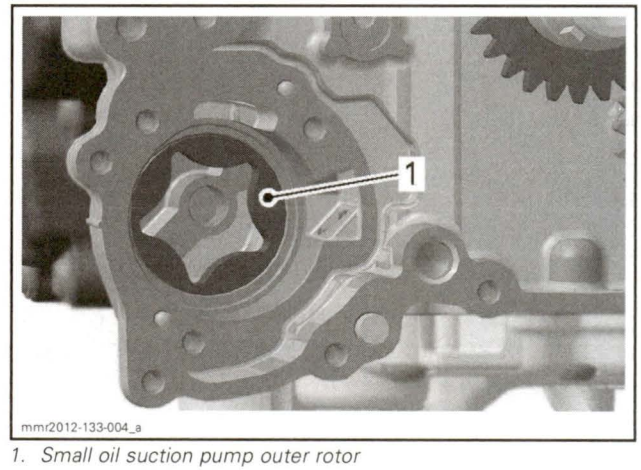
1. Lubricate small oil suction pump outer rotor with engine oil.

NOTICE **When installing the oil pump rotors, make sure both marks are pointing toward the inside of the crankcase.**



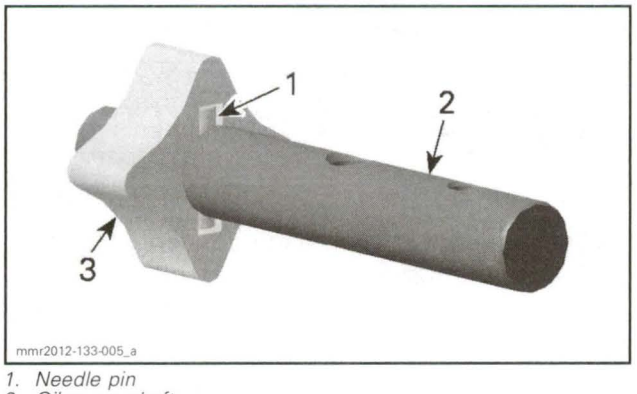
1. *Mark on inner rotor*
2. *Mark on outer rotor*

2. Install small oil suction pump outer rotor into crankcase oil pump bore.



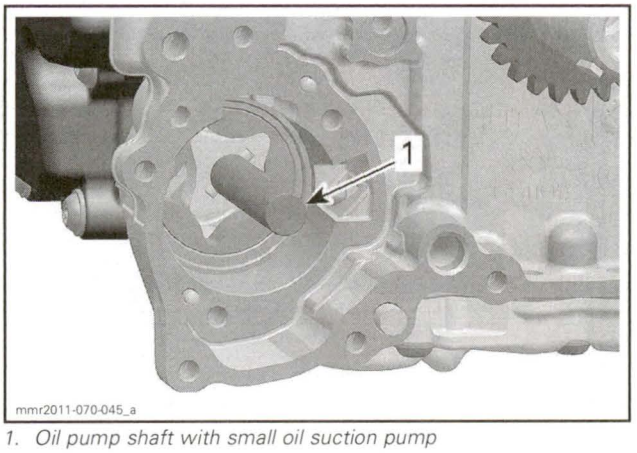
1. *Small oil suction pump outer rotor*

3. Install the needle pin in the bore of the oil pump shaft and place the small inner rotor on the shaft.



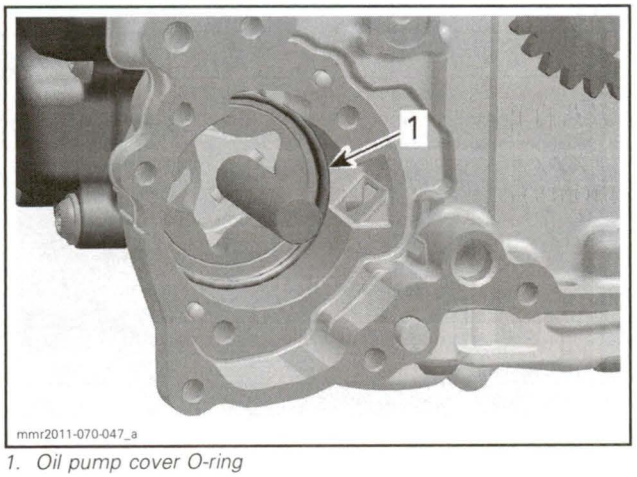
1. Needle pin
2. Oil pump shaft
3. Small suction pump inner rotor

4. Lubricate oil pump shaft and inner rotor with engine oil.
5. Install oil pump shaft assembly into the crankcase.



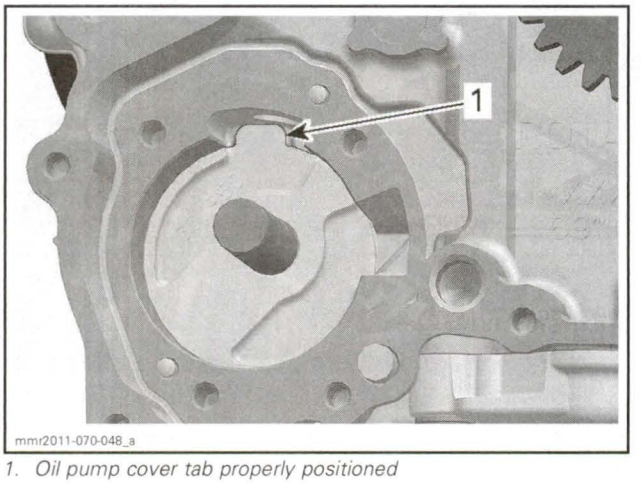
1. Oil pump shaft with small oil suction pump

6. Install a **NEW** oil pump cover O-ring.



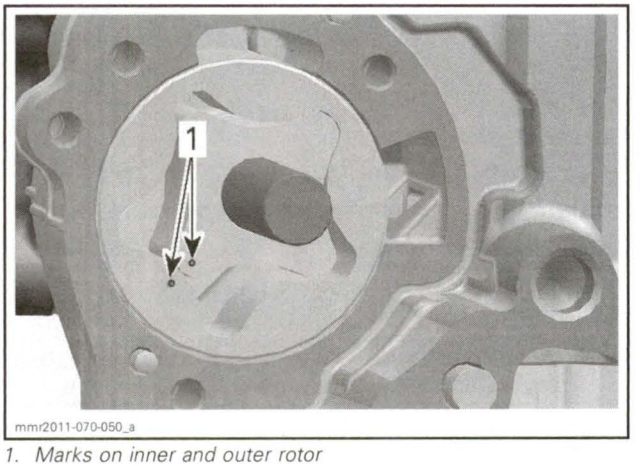
1. Oil pump cover O-ring

7. Lubricate both sides of the oil pump cover with engine oil.
8. Align tab of the oil pump cover with the upper recess in the crankcase. Push cover in until a click is heard, indicating the cover is properly installed.



1. Oil pump cover tab properly positioned

9. Install large oil suction pump needle pin.
10. Install large oil suction pump inner rotor and outer rotor with the marks outwards.



1. Marks on inner and outer rotor

11. Lubricate large oil suction pump parts with engine oil.
12. Install other removed parts.

After installation is complete, check for smooth operation of the oil pump assembly and axial play of the oil pump shaft.

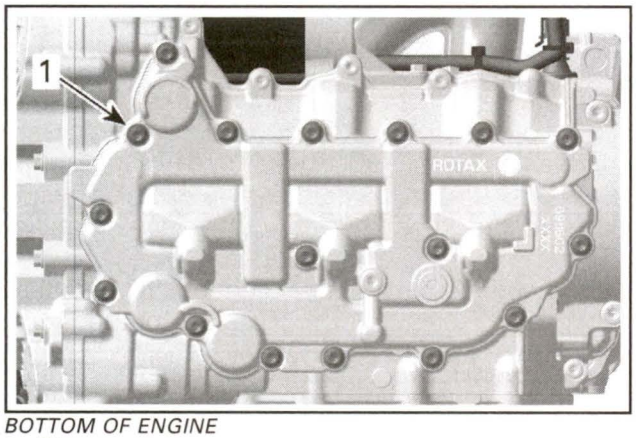
13. Fill up oil tank and check oil level. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

Start engine and make sure oil pressure is within specifications (refer to *ENGINE OIL PRESSURE TEST* in this subsection).

OIL SUMP COVER

Oil Sump Cover Location

The oil sump cover is located on the engine bottom.



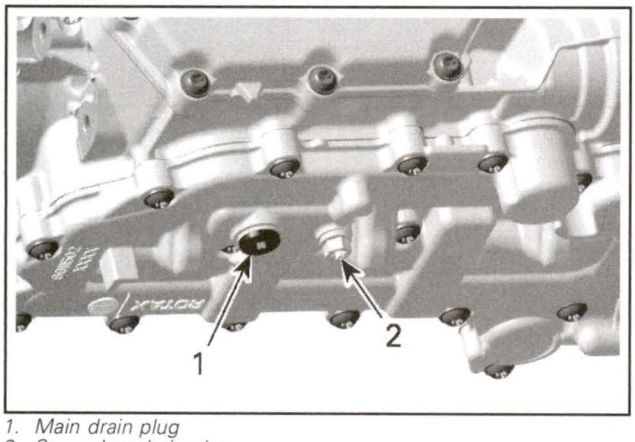
BOTTOM OF ENGINE
1. Oil sump cover

Oil Sump Cover Access

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

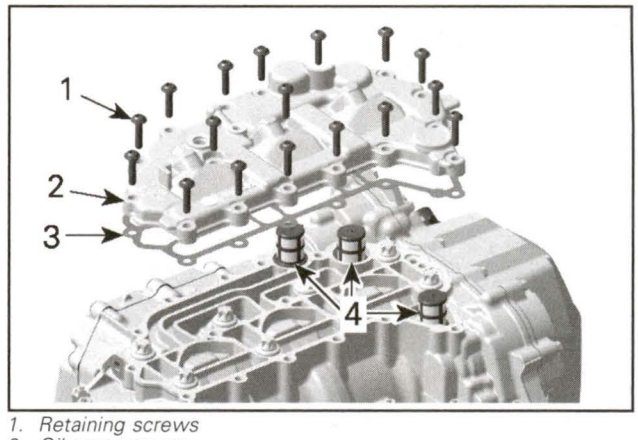
Oil Sump Cover Removal

1. Drain engine oil, refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.



1. Main drain plug
2. Secondary drain plug

2. Unscrew oil sump cover retaining screws.
3. Remove oil sump cover. Discard gasket.
4. Remove and clean engine oil strainers.

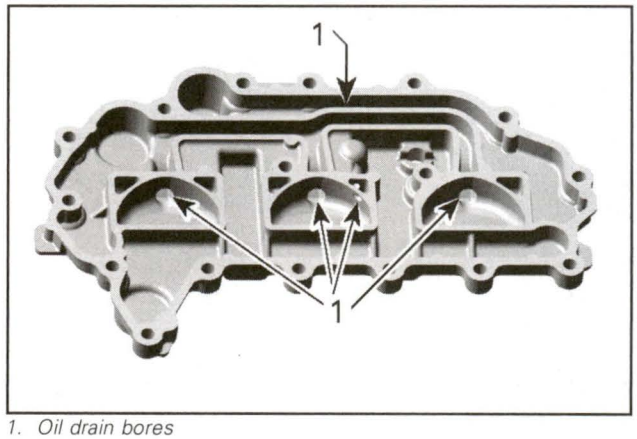


1. Retaining screws
2. Oil sump cover
3. Gasket
4. Engine oil strainers

Oil Sump Cover Inspection

Clean oil sump cover and engine oil strainers with a part cleaner, then use an air gun to dry it.

Blow out the oil orifices and check if they are not clogged.



1. Oil drain bores

Check oil sump cover for cracks or other damage.

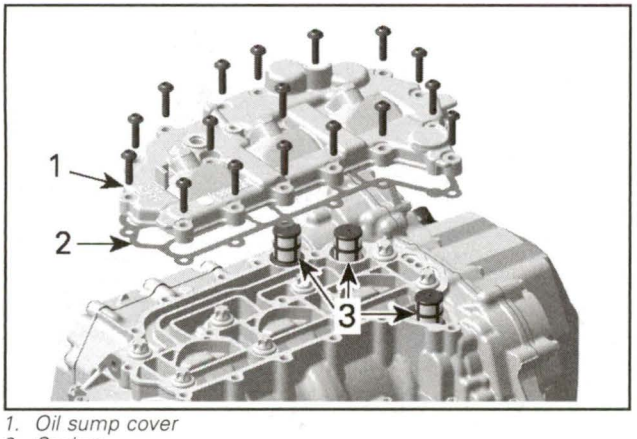
Check oil sump cover for flatness with straight edge.

Replace oil sump cover if necessary.

Check engine oil strainer for damage and change if necessary.

Oil Sump Cover Installation

1. Install a **NEW** oil sump cover gasket.
2. Install the strainers as shown.

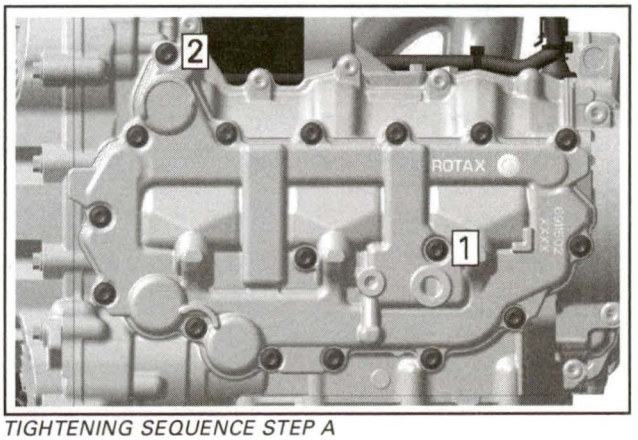


1. *Oil sump cover*
2. *Gasket*
3. *Oil strainers*

3. Install oil sump cover on engine, then tighten screws in two steps as follows:

   3.1 Tighten screws to the following specified torque using the specified sequence.

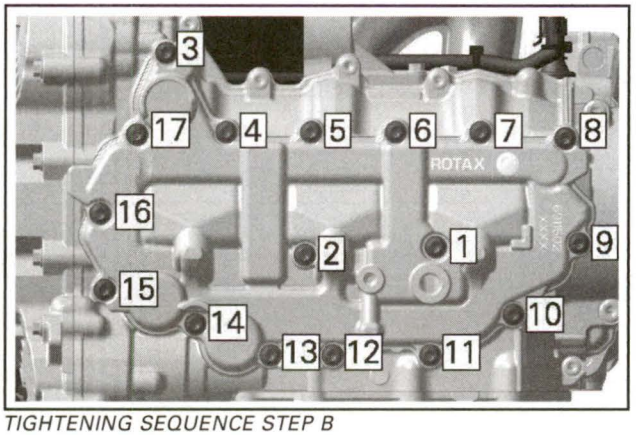
OIL SUMP COVER SCREWS TIGHTENING TORQUE (FOLLOW SEQUENCE)	
STEP A	5 N•m ± 0.6 N•m (44 lbf•**in** ± 5 lbf•**in**)



TIGHTENING SEQUENCE STEP A

   3.2 Tighten screws to the following specified torque using the specified sequence.

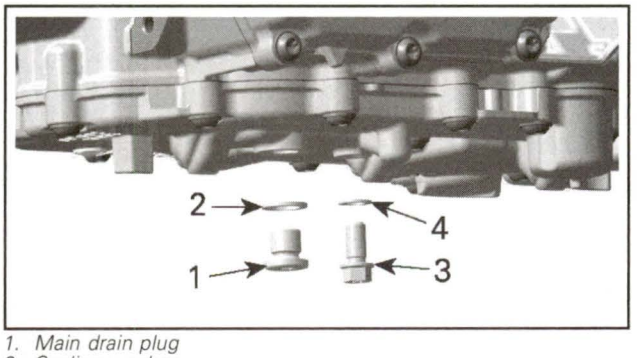
OIL SUMP COVER SCREWS TIGHTENING TORQUE (FOLLOW SEQUENCE)	
STEP B	9 N•m ± 1 N•m (80 lbf•**in** ± 9 lbf•**in**)



TIGHTENING SEQUENCE STEP B

4. Reinstall oil drain plugs using **NEW** sealing washers.

MAIN AND SECONDARY DRAIN PLUG	
Sealing washer	NEW
Tightening torque	15 N•m ± 2 N•m (133 lbf•**in** ± 18 lbf•**in**)



1. *Main drain plug*
2. *Sealing washer*
3. *Secondary drain plug*
4. *Sealing washer*

5. Install engine in vehicle. Refer to *ENGINE REMOVAL AND INSTALLATION* subsection.
6. Fill up oil tank and check oil level. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

COOLING SYSTEM

SERVICE TOOLS

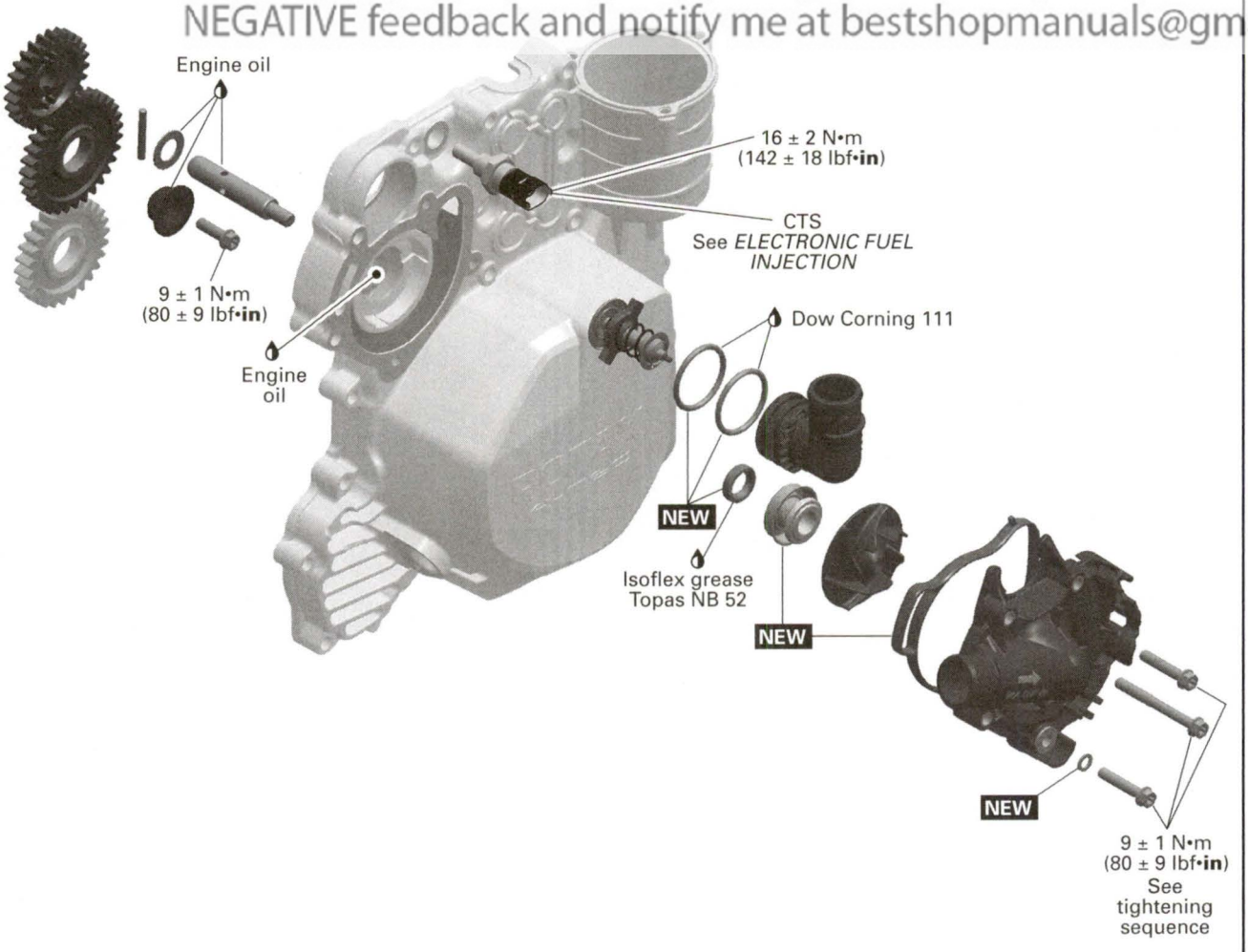
Description	Part Number	Page
HANDLE	420 877 650	203
OIL SEAL PUSHER	529 036 210	203
ROTARY SEAL INSTALLER	529 036 211	204
TEST CAP	529 035 991	198
VACUUM/PRESSURE PUMP	529 021 800	198

SERVICE PRODUCTS

Description	Part Number	Page
DOW CORNING 111	413 707 000	200
ISOFLEX GREASE TOPAS NB 52	293 550 021	203

ENGINE COMPONENTS

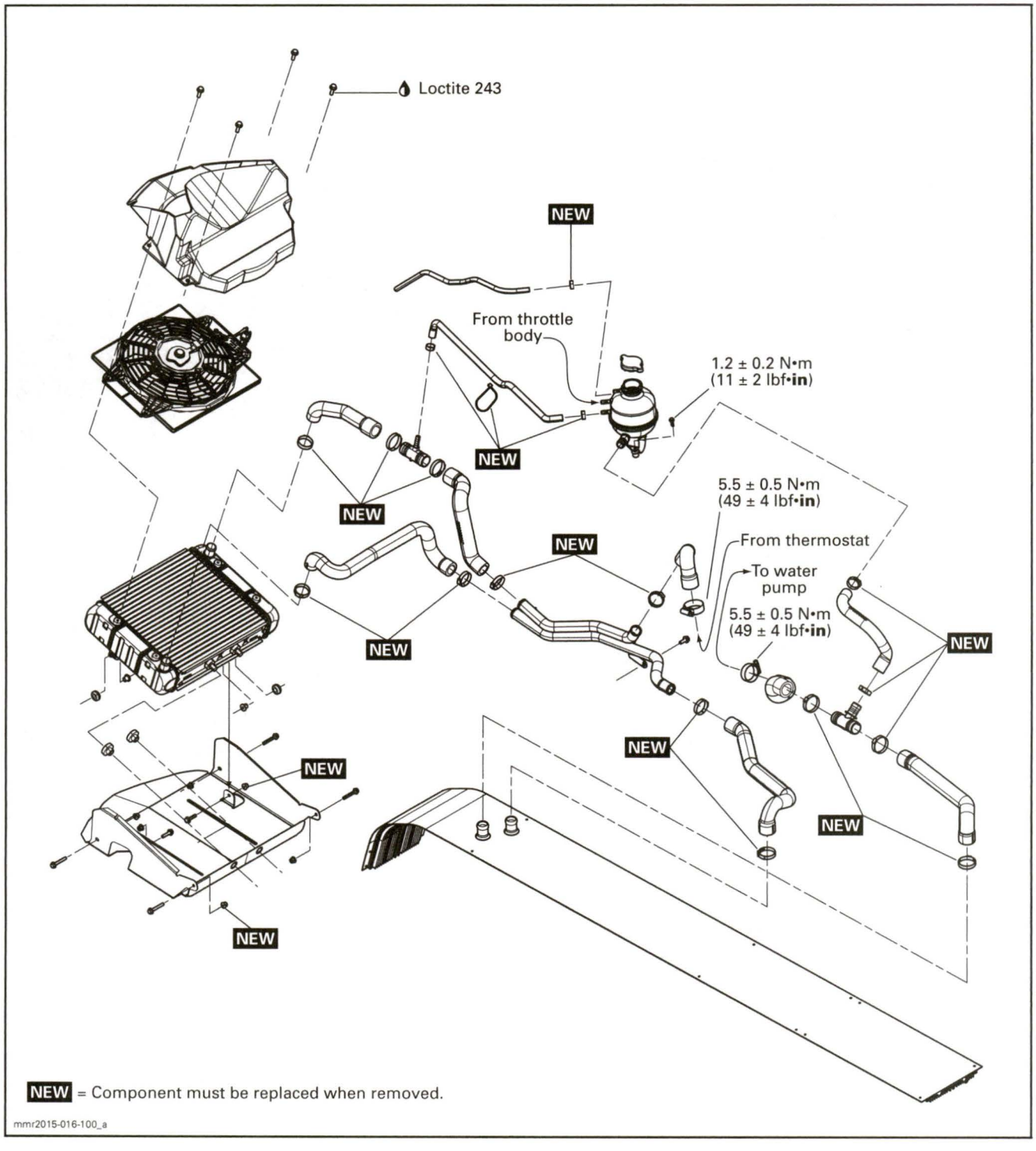
Midwest Manuals
Green Manuals
Paperless Manuals
For a Better Tomorrow
If you bought this manual from any other seller please leave them NEGATIVE feedback and notify me at bestshopmanuals@gmail.com



NEW = Component must be replaced when removed

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VEHICLE COMPONENTS



GENERAL

For a better understanding, some illustrations were taken with engine out of vehicle.

NOTE: It is a good practice to check for fault codes using B.U.D.S. software as a first troubleshooting step. Refer to the *DIAGNOSTIC AND FAULT CODES* subsection.

⚠ WARNING

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

INSPECTION

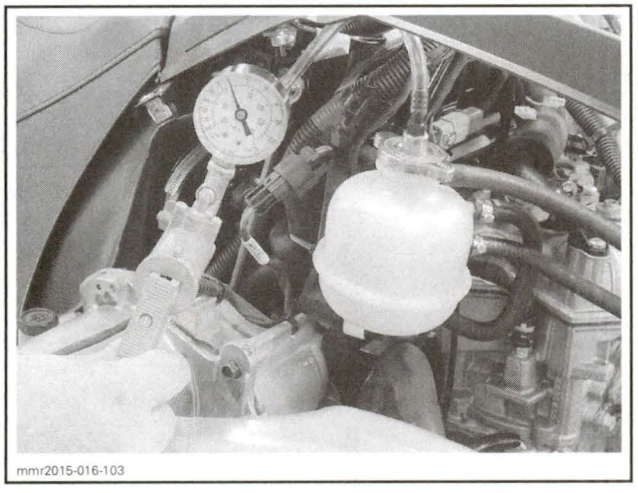
COOLING SYSTEM LEAK TEST

NOTE: This test confirms if there is a leak in the cooling system, including the engine.

Pressurize cooling system through coolant reservoir.

REQUIRED TOOL	
TEST CAP (P/N 529 035 991)	
VACUUM/PRESSURE PUMP (P/N 529 021 800)	

COOLING SYSTEM LEAK TEST
100 kPa (15 PSI)

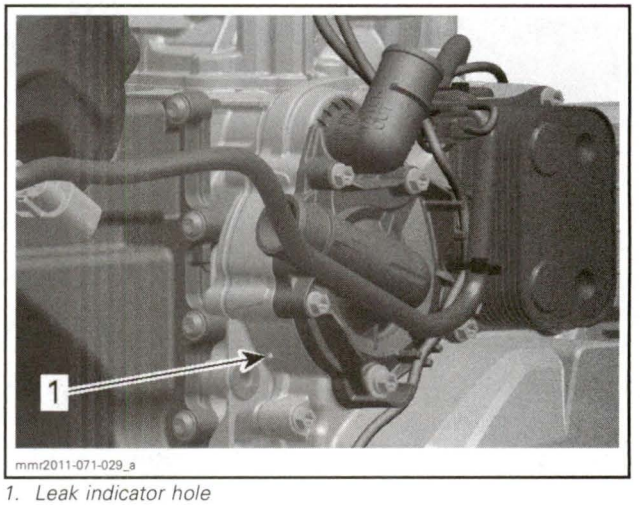


mmr2015-016-103

If pressure drops, check all hoses and engine for coolant leaks. Spray a soap/water solution and look for air bubbles.

Check the leak indicator hole for an oil or coolant leak.

NOTE: In general leaking coolant indicates a damaged rotary seal. Leaking oil indicates a damaged oil seal. If either seal is leaking, both seals must be replaced at the same time. Refer to *WATER PUMP* in this subsection.



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1. Leak indicator hole

TROUBLESHOOTING

The following is provided to help in diagnosing the probable source of troubles. It is a guideline and should not be assumed to show all causes for all problems.

Always check for fault codes. If a fault code is detected, service the fault code first.

ENGINE OVERHEATING

1. Low coolant level.
   - *Refill and check for leaks (coolant leaking out of leak indicator hole, hoses or clamps missing or defective, or cylinder head gaskets leaks). Repair or replace.*
2. Dirty heat exchanger.
   - *Clean heat exchanger fins. Replace heat exchanger as required.*
3. Air in cooling system.
   - *Refill and bleed cooling system.*
4. Defective thermostat (does not open when engine is warm up).
   - *Replace thermostat.*
5. Defective water pump.
   - *Inspect and replace defective components.*
6. Coolant temperature sensor defective.
   - *Check and replace.*

7. Wrong coolant concentration.
   - *Check and adjust coolant concentration according to BRP's recommendations or replace coolant.*
8. Defective coolant reservoir cap.
   - *Replace cap.*
9. Defective cooling fan.
   - *Check cooling fan motor operation.*
   - *Check fuse and relay of cooling fan motor.*
   - *Check wiring harness of cooling fan motor.*
10. Snow guard is too high.
    - *Check and adjust rear suspension.*

PROCEDURES

COOLANT RESERVOIR CAP

Coolant Reservoir Cap Test

Using a pressure cap tester, check the efficiency of coolant reservoir cap. If the efficiency is weak, replace the cap.

CAP OPENING PRESSURE
110 kPa (16 PSI)

COOLANT RESERVOIR

Coolant Reservoir Removal

1. Install hose pinchers on coolant hoses attached to reservoir.
2. Siphon coolant from reservoir.
3. Disconnect coolant hoses from reservoir.
4. Remove coolant reservoir from vehicle.

Coolant Reservoir Installation

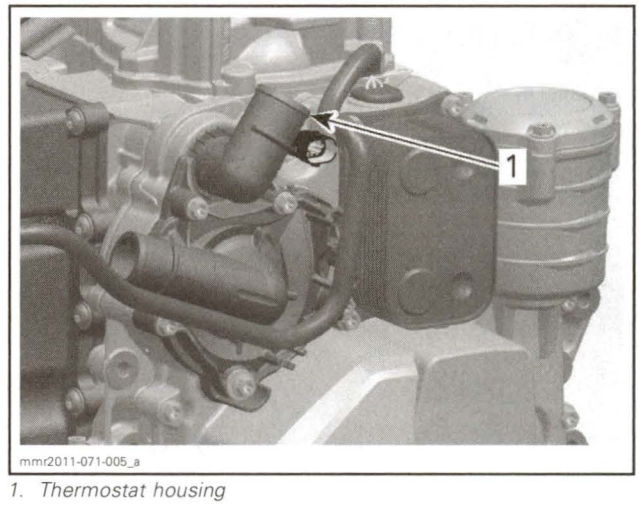
Reverse the removal procedure. However, pay attention to the following.

Refill and bleed cooling system as described in *PERIODIC MAINTENANCE PROCEDURES* subsection.

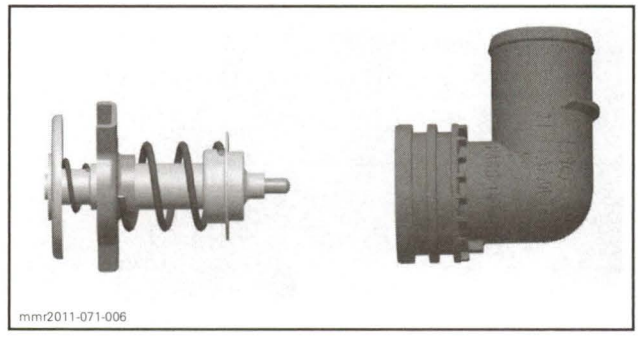
THERMOSTAT

Thermostat Location

The thermostat is located on engine MAG side.



1. Thermostat housing

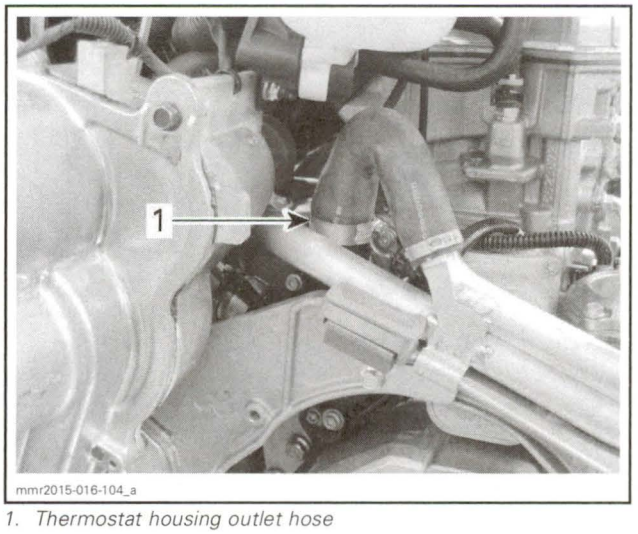


Thermostat Access

1. Remove RH side panels.
2. Remove muffler. Refer to *EXHAUST SYSTEM* subsection.

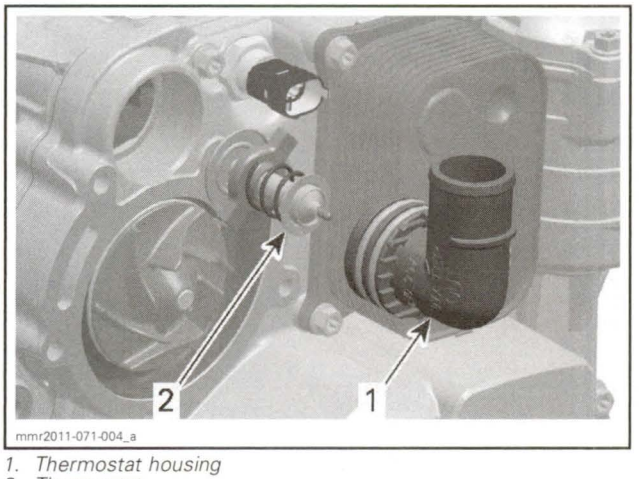
Thermostat Removal

1. Drain engine coolant. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.
2. Disconnect outlet hose from thermostat housing.



1. Thermostat housing outlet hose

3. Proceed with *WATER PUMP HOUSING REMOVAL*. See procedure in this subsection.
4. Remove thermostat housing then thermostat.



1. Thermostat housing
2. Thermostat

NOTE: Use shop rags to catch any spilled engine coolant.

Thermostat Test

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

THERMOSTAT TEMPERATURE	
Starts to open	75°C (167°F)
Fully open	90°C (194°F)

Replace thermostat if out of specification.

Thermostat Installation

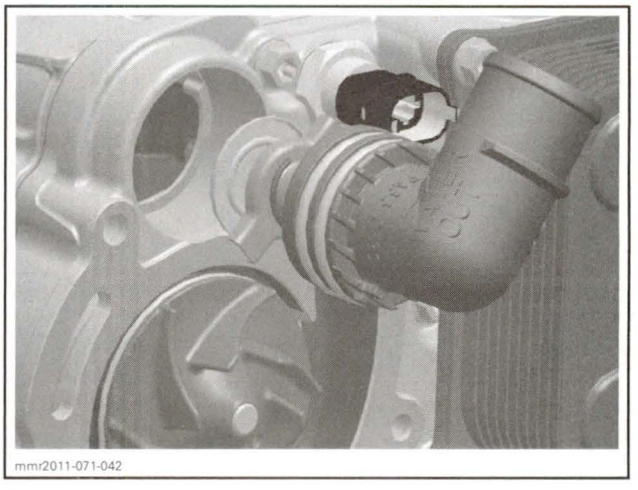
Reverse the removal procedure, however pay attention to the following.

Install NEW O-rings on thermostat housing.

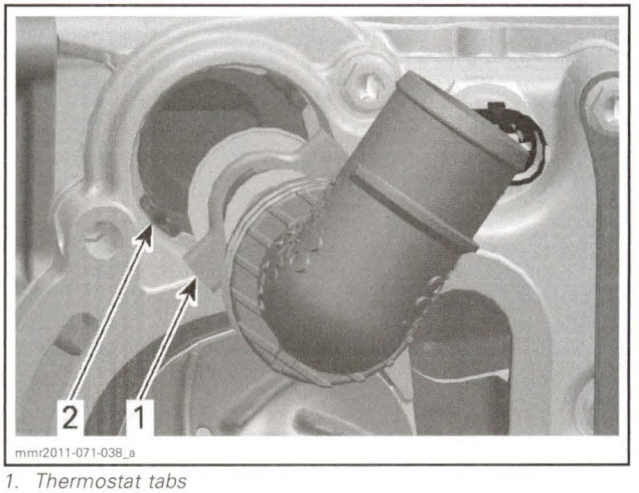
Lubricate O-rings.

THERMOSTAT HOUSING O-RING	
Service product	DOW CORNING 111 (P/N 413 707 000)

Insert thermostat in thermostat housing.



Align both tabs of thermostat with the recess in the magneto cover.



1. Thermostat tabs
2. Magneto cover recess

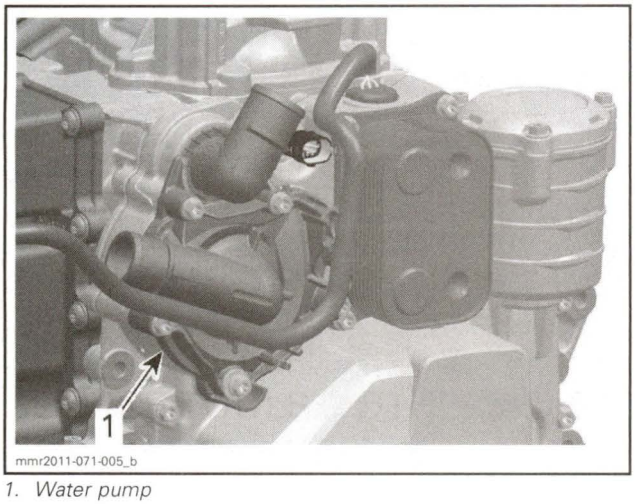
Install water pump housing, refer to *WATER PUMP HOUSING INSTALLATION* in this subsection.

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

WATER PUMP

Water Pump Location

The water pump is located on engine MAG side.



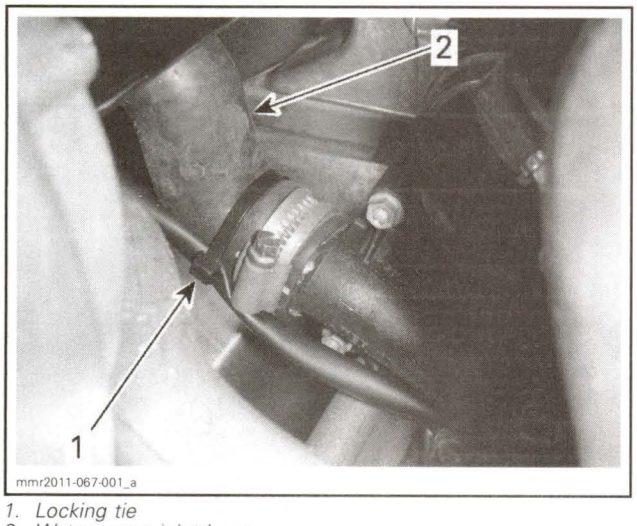
1. Water pump

Water Pump Access

1. Remove RH side panels.
2. Remove muffler. Refer to *EXHAUST SYSTEM* subsection.

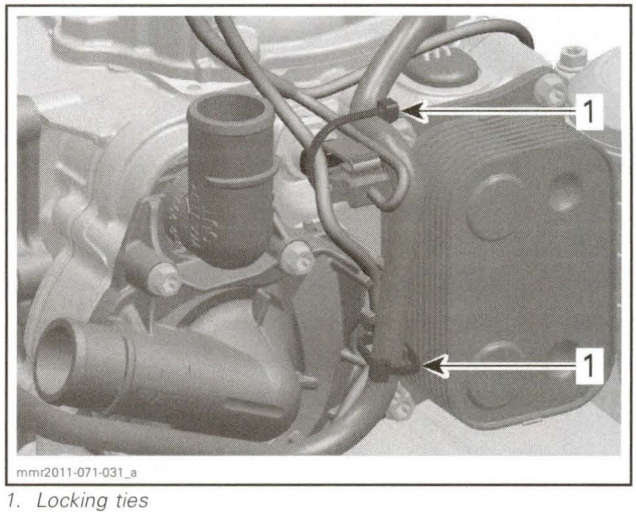
Water Pump Housing Removal

1. Drain engine coolant. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.
2. Remove locking tie on water pump inlet hose.
3. Disconnect outlet hose from thermostat housing.
4. Disconnect inlet hose from water pump.



1. Locking tie
2. Water pump inlet hose

5. Remove both locking ties securing magneto wires.

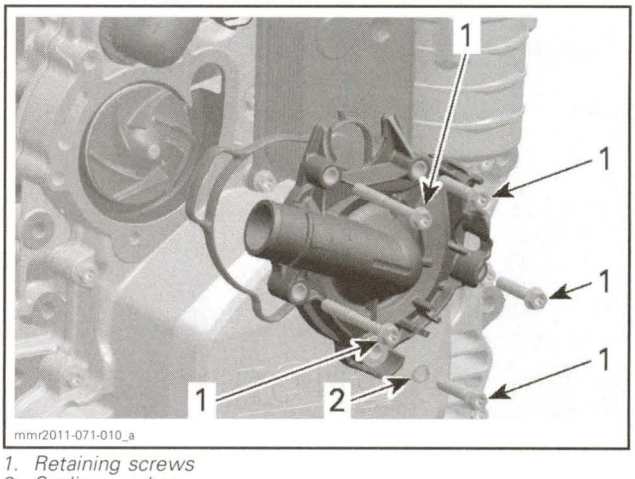


1. Locking ties

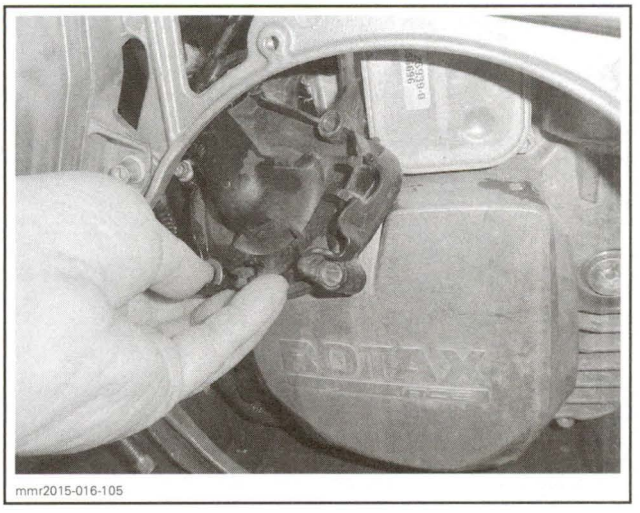
6. Remove the RH front engine support, refer to *FRONT ENGINE SUPPORT REPLACEMENT (MAG SIDE)* in *ENGINE REMOVAL AND INSTALLATION (900ACE)* subsection.

NOTE: Removal of RH front engine support will allow sufficient movement of engine for pump housing removal.

7. Remove retaining screws of water pump housing.
8. Discard sealing washer.
9. Remove water pump housing from magneto cover.



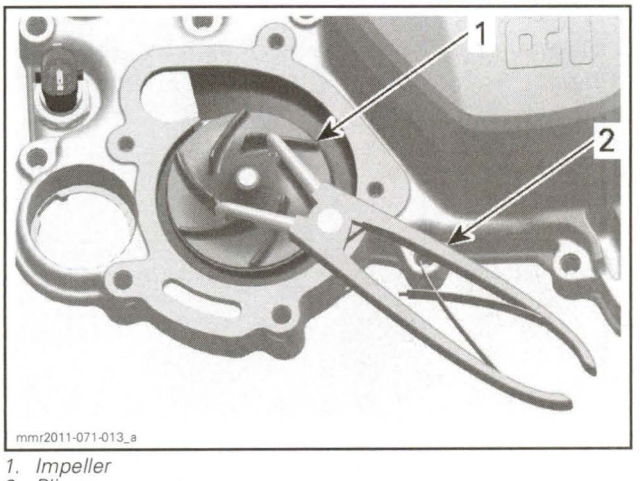
1. Retaining screws
2. Sealing washer


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NOTE: Use shop rags to catch any spilled engine coolant.

Water Pump Disassembly

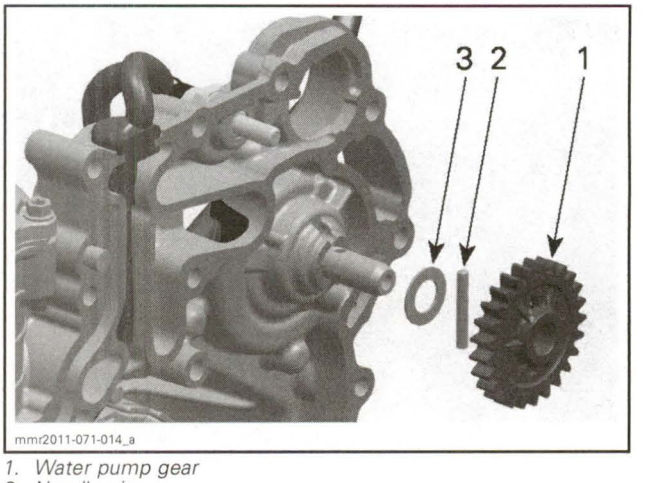
1. Unscrew impeller counterclockwise using appropriate pliers.



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1. Impeller
2. Pliers

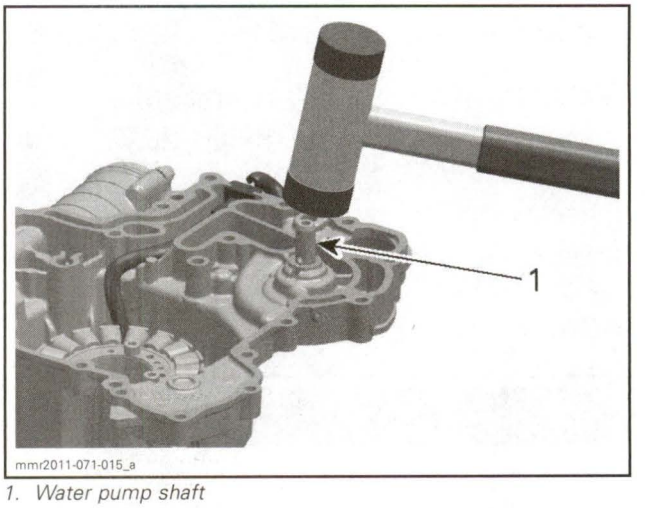
2. Remove magneto cover. Refer to *MAGNETO AND STARTER* subsection.
3. Remove the following components from magneto cover:
   - Water pump gear
   - Needle pin
   - Thrust washer.



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

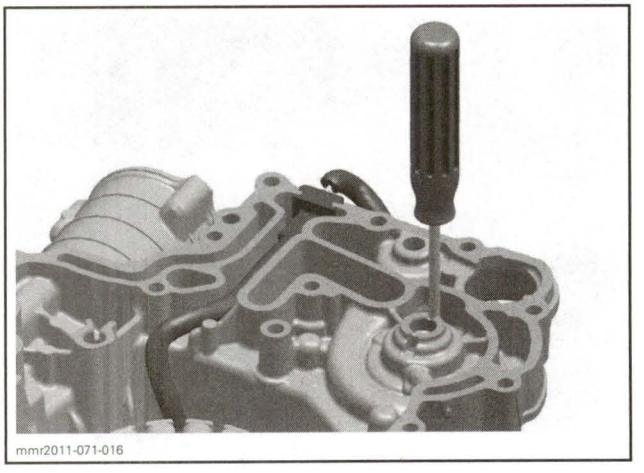
4. Remove water pump shaft using a plastic mallet.



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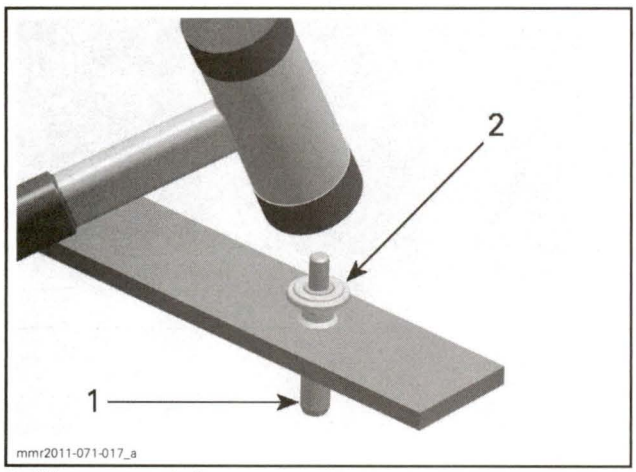
1. Water pump shaft

5. Remove the following components from magneto cover:
   - Oil seal
   - Remaining parts of rotary seal.


mmr2011-071-016

NOTICE Be careful not to damage the surface of the rotary seal bore in the magneto cover.

6. Separate rotary seal from water pump shaft.



1. Water pump shaft.
2. Rotary seal

Water Pump Inspection

Check area of water pump housing for cracks or other visible damage.

Check water pump gear for wear or broken teeth.

Check if housing gasket is brittle, hard or damaged.

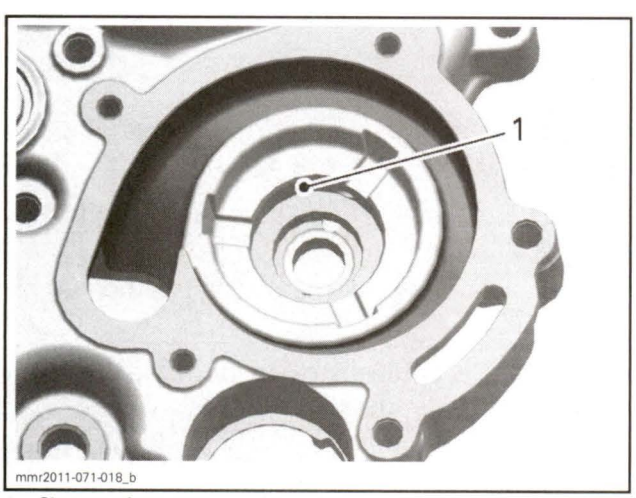
Check water pump shaft for visible damage.

Replace parts if necessary.

Water Pump Assembly

NOTE: Always replace oil seal and rotary seal at the same time.

1. Clean rotary seal surface from old sealant.



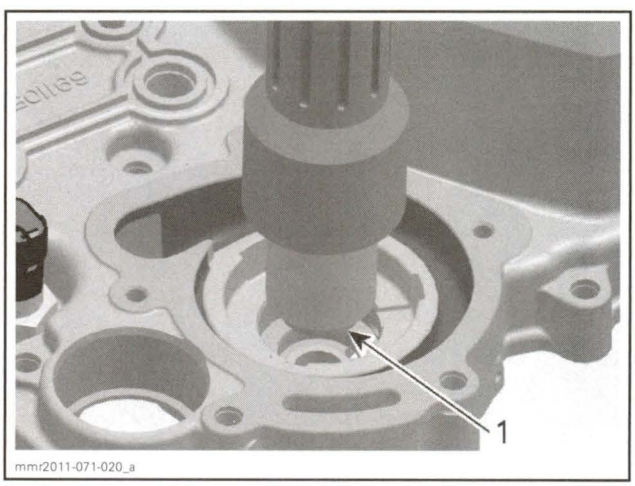
1. Clean surface

2. Apply engine oil on press fit area of oil seal.

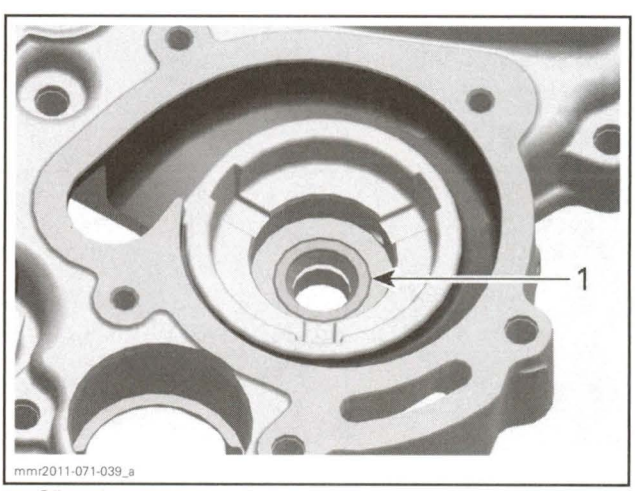
NOTICE Never use engine oil on the press fit area of the rotary seal.

3. Install NEW oil seal in magneto cover.

REQUIRED TOOL	
OIL SEAL PUSHER (P/N 529 036 210)	
HANDLE (P/N 420 877 650)	



1. Oil seal



1. Oil seal correctly installed

4. Lubricate sealing lip of the oil seal.

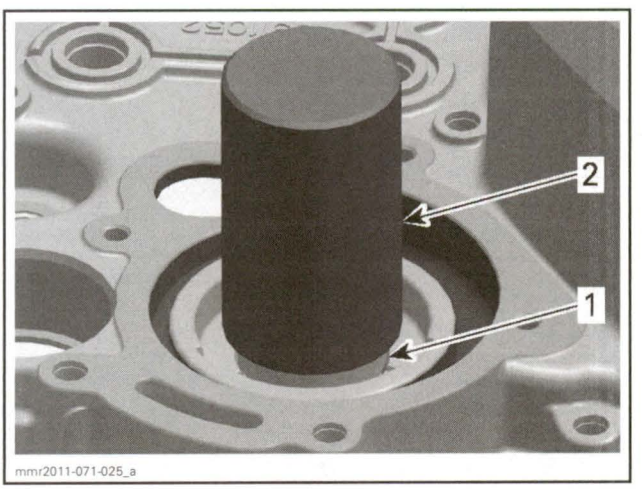
OIL SEAL	
Service product	ISOFLEX GREASE TOPAS NB 52 (P/N 293 550 021)

5. Install NEW rotary seal on magneto cover using a press.

NOTE: Prior to installing, ensure that sealing lip of rotary seal is not damaged.

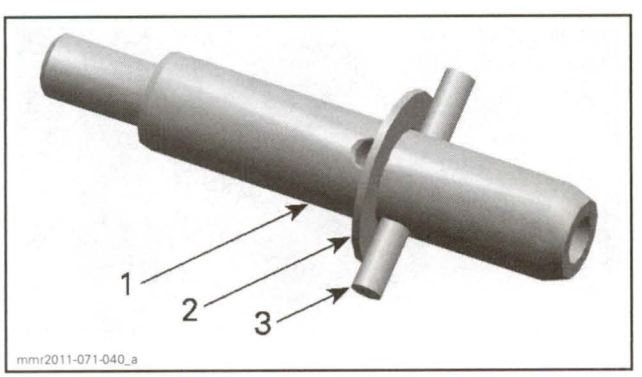
REQUIRED TOOL
Press
ROTARY SEAL INSTALLER (P/N 529 036 211)

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



1. *Rotary seal*
2. *Rotary seal installer*

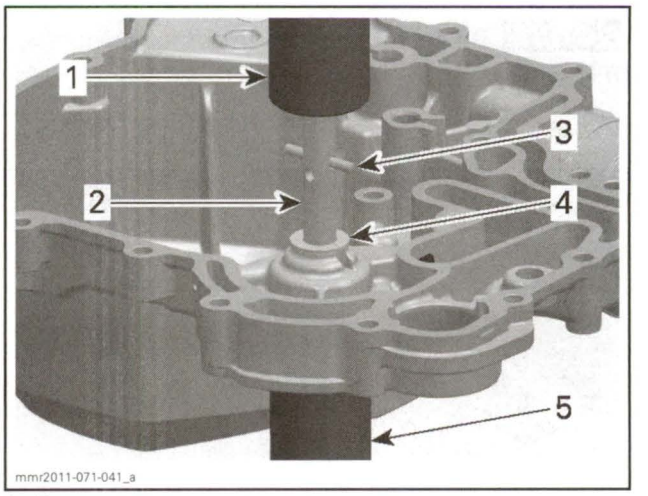
6. Assemble the following components onto water pump shaft.
   - Needle pin
   - Thrust washer.



1. *Water pump shaft*
2. *Thrust washer*
3. *Needle pin*

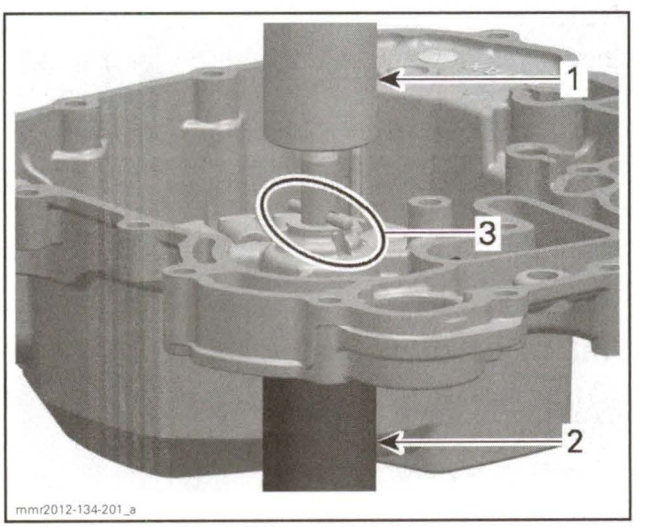
7. Slide water pump shaft into rotary seal using a press.

NOTE: To avoid damaging the rotary seal and to achieve the proper preload support the rotary seal with the ROTARY SEAL INSTALLER (P/N 529 036 211).



1. *Press*
2. *Water pump shaft*
3. *Needle pin*
4. *Thrust washer*
5. *Rotary seal installer*

8. Carefully press water pump shaft until needle pin touches thrust washer.



1. *Press*
2. *Rotary seal installer*
3. *Needle pin touches thrust washer*

NOTICE Never use a hammer to install water pump shaft into rotary seal.

NOTE: After installation, water pump shaft must rotate freely.

9. Screw impeller clockwise using appropriate pliers.

NOTICE Be careful not to damage impeller vanes during its installation.

10. Install magneto cover. Refer to *MAGNETO AND STARTER* subsection.

Water Pump Housing Installation

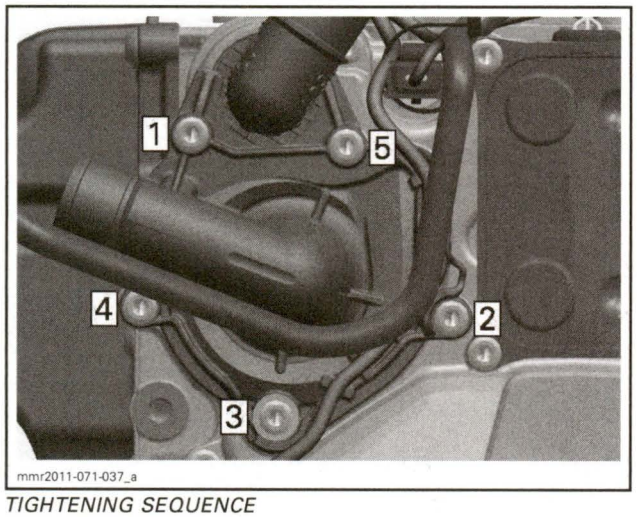
Reverse of the removal procedure. However, pay attention to the following.

NOTICE **When installing the water pump housing, ensure the NEW gasket is precisely positioned in the pump housing groove to prevent leakage.**

Install a **NEW** sealing washer on drain screw.

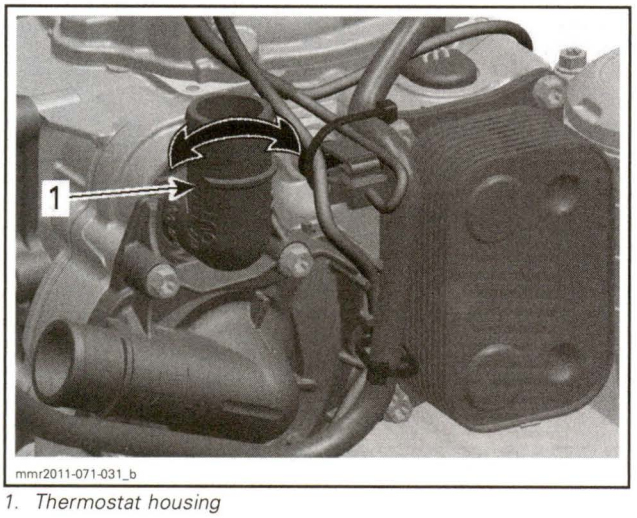
Tighten water pump housing retaining screws to specification as per the following procedure.

WATER PUMP HOUSING RETAINING SCREWS	
Tightening torque	9 N•m ± 1 N•m (80 lbf•**in** ± 9 lbf•**in**)



TIGHTENING SEQUENCE

Turn thermostat housing to proper position.



1. Thermostat housing

Tighten hose clamps to specification.

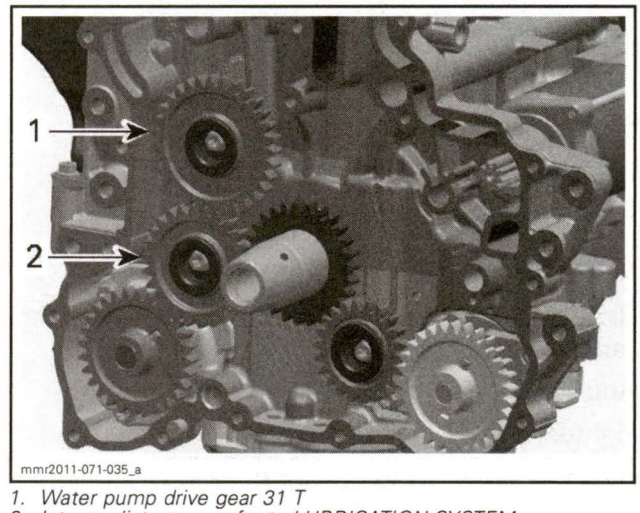
COOLANT HOSE CLAMPS	
Tightening torque	5.5 N•m ± 0.5 N•m (49 lbf•**in** ± 4 lbf•**in**)

Install remaining parts. Refer to their applicable subsection.

WATER PUMP DRIVE GEAR

Water Pump Drive Gear Location

The water pump drive gear is located behind the magneto cover.



1. Water pump drive gear 31 T
2. Intermediate gear, refer to LUBRICATION SYSTEM

Water Pump Drive Gear Access

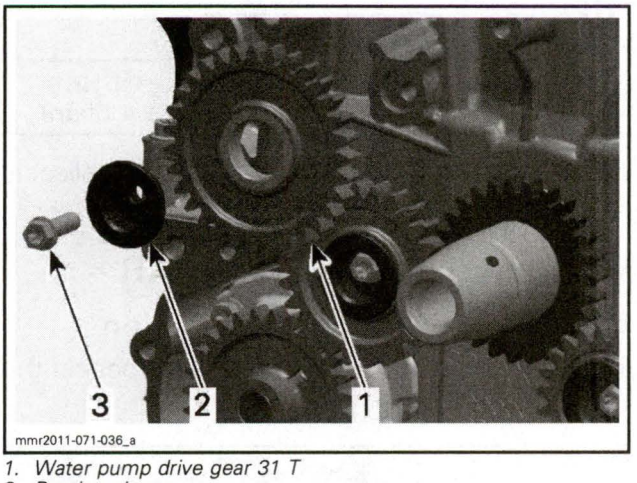
Remove engine from vehicle. Refer to *ENGINE REMOVAL AND INSTALLATION* subsection.

Refer to *MAGNETO AND STARTER* subsection and remove:

- Magneto cover
- Magneto flywheel.

Water Pump Drive Gear Removal

1. Remove screw securing water pump drive gear.
2. Remove bearing sleeve.
3. Slide off water pump drive gear.



1. Water pump drive gear 31 T
2. Bearing sleeve
3. M6 x 20 screw

Water Pump Drive Gear Inspection

Inspect gear for wear or other damage.

Replace gear if necessary.

Water Pump Drive Gear Installation

Reverse the removal procedure. However, pay attention to the following.

Apply engine oil on bearing sleeve.

Tighten water pump drive gear to specification.

WATER PUMP DRIVE GEAR RETAINING SCREW	
Tightening torque	9 N•m ± 1 N•m (80 lbf•**in** ± 9 lbf•**in**)

HEAT EXCHANGER

Heat Exchanger Cleaning and Inspection

Remove all debris between heat exchanger fins.

Check if heat exchanger fins are damaged. Replace if necessary.

NOTE: A heat exchanger with many broken fins does not work properly.

Heat Exchanger Removal

1. Drain cooling system, refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.
2. Remove engine, refer to *ENGINE REMOVAL AND INSTALLATION* subsection.
3. Remove fuel tank. Refer to *FUEL TANK AND FUEL PUMP* subsection.
4. Remove rear suspension. Refer to the *REAR SUSPENSION (SC-5U)* subsection.
5. Disconnect coolant hoses from heat exchanger.
6. Drill or grind all rivets retaining the heat exchanger to the tunnel. Refer to *FRAME* subsection for drilling procedure.

NOTE: When pushing the rivets out, support the frame around the rivet with a socket on the opposite side to prevent the frame from warping.

7. Remove heat exchanger from the vehicle.

Heat Exchanger Installation

Reverse the removal procedure.

Refill cooling system as described in *PERIODIC MAINTENANCE PROCEDURES* subsection.

FRONT AIR COOLED RADIATOR

Radiator Access

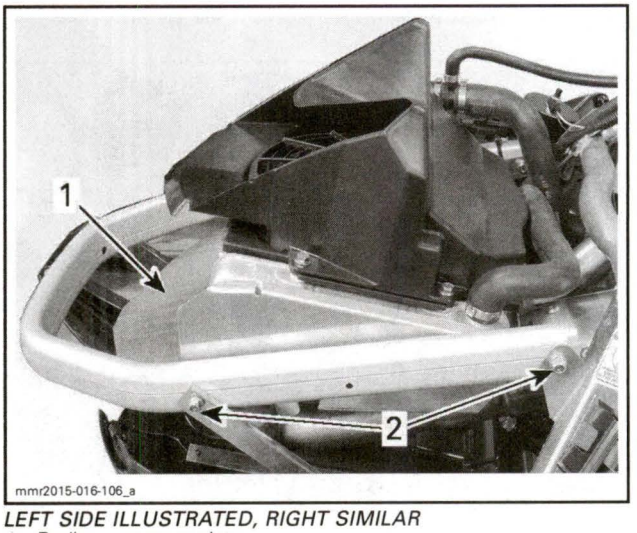
Refer to *BODY* subsection and remove the following:

- Upper and lower side panels (both sides)
- Hood
- Upper bottom pan panels (both sides)
- Front grill.

Radiator Removal for Access

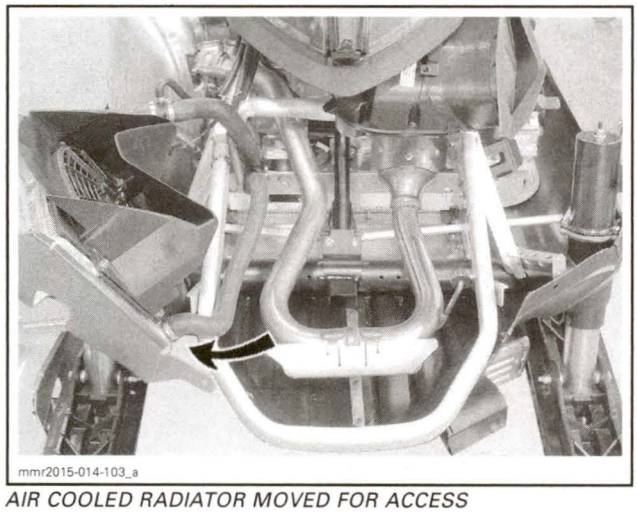
NOTE: It is not necessary to disconnect of disassemble radiator when removed for access.

1. Remove body parts listed in *RADIATOR ACCESS*.
2. Remove the fasteners that secure the radiator support plate to the front bumper.



LEFT SIDE ILLUSTRATED, RIGHT SIMILAR
1. Radiator support plate
2. Screws and nuts to remove (both sides)

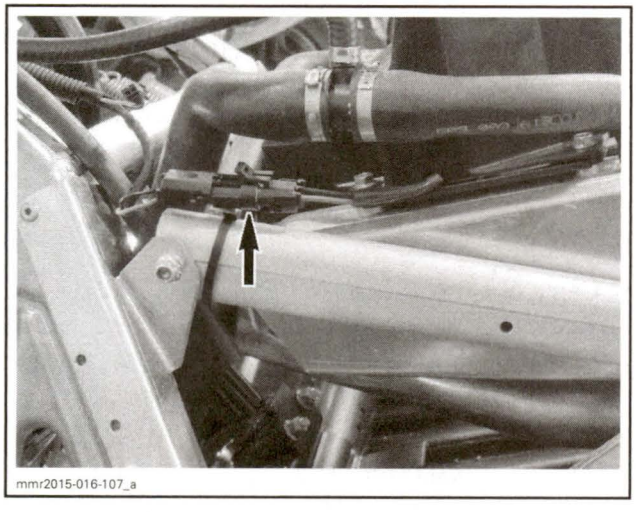
3. Move radiator to RH side of vehicle.



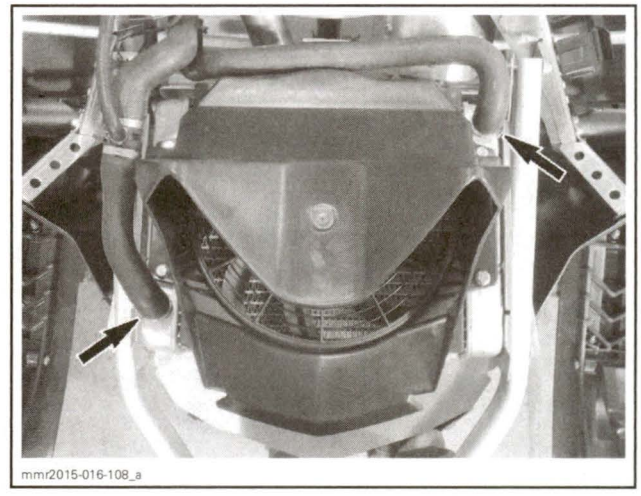
AIR COOLED RADIATOR MOVED FOR ACCESS

Radiator Removal for Replacement

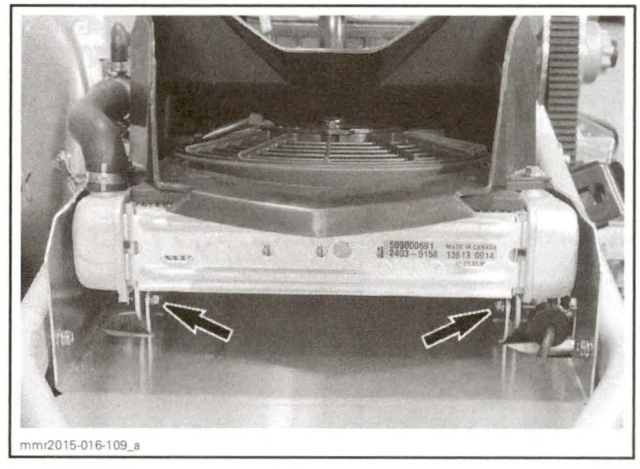
1. Remove body parts listed in *RADIATOR ACCESS*.
2. Drain cooling system, Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.
3. Disconnect radiator cooling fan connector.



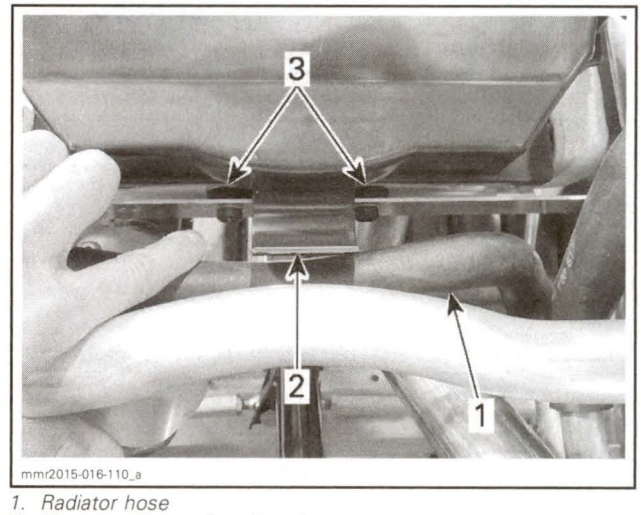
4. Disconnect coolant hoses from radiator. Discard Oetiker clamps.



5. Remove screws retaining the the radiator to the radiator support.



6. At the back of the fan shroud, remove the radiator hose from its support.



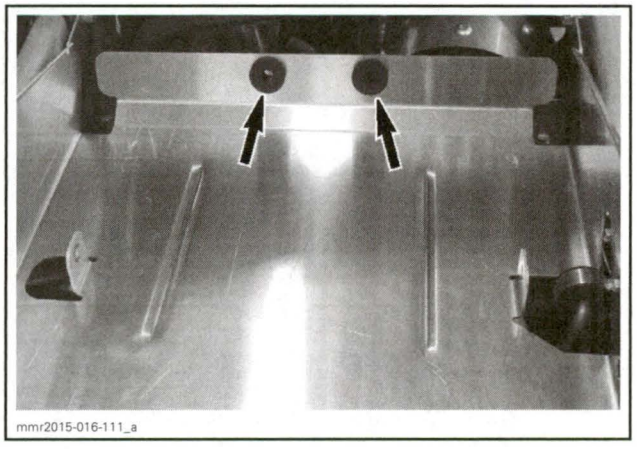
1. *Radiator hose*
2. *Hose support on fan shroud*
3. *Grommets in radiator support*

7. Pull radiator forward off its support grommets and remove radiator from vehicle.
8. Remove fan from radiator. See procedure in this subsection.

Radiator Installation

Reverse the removal procedure. However, pay attention to the following.

Ensure grommets are installed in radiator support.


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Install **NEW** Oetiker clamps to secure coolant hoses.

Fill and bleed cooling system as described in *PERIODIC MAINTENANCE PROCEDURES* subsection.

RADIATOR COOLING FAN

Cooling Fan Operating Condition

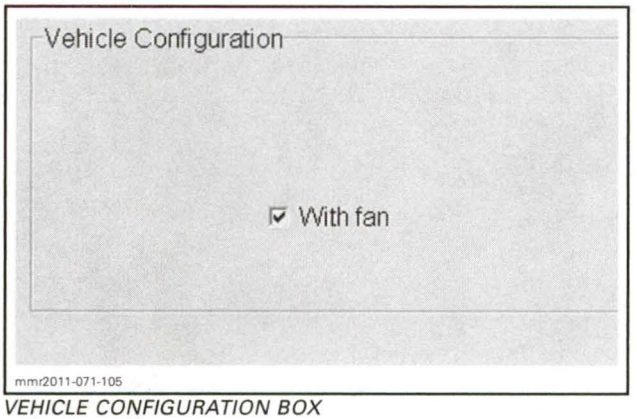
RADIATOR COOLING FAN		
ENGINE TEMPERATURE	COOLING FAN RELAY	COOLING FAN OPERATION
> 100°C (212°F)	Close	Starts
< 95°C (203°F)	Open	Stops

Cooling Fan Relay Location

The cooling fan relay is located in the fuse box. Refer to *POWER DISTRIBUTION* subsection.

Cooling Fan Configuration in B.U.D.S.

1. Connect vehicle to B.U.D.S., refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. In B.U.D.S., select the following:
   - **Read Data** button
   - **Setting** tab
   - **ECM** page.
3. Ensure that **With fan** box is properly checked.



VEHICLE CONFIGURATION BOX

Cooling Fan Testing Sequence

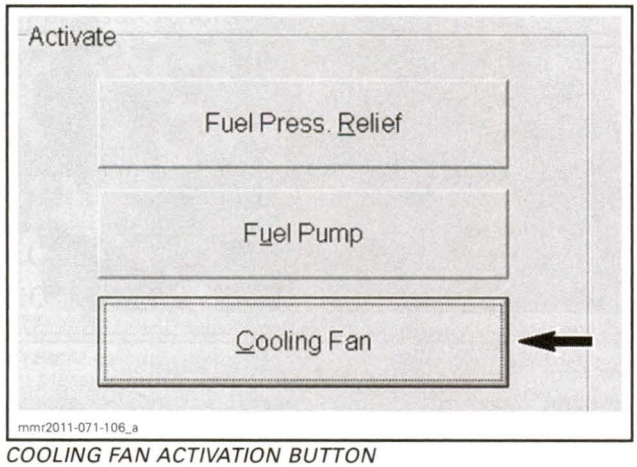
If B.U.D.S is properly configured and cooling fan does not work, follow this testing sequence to diagnose problem.

1. Check for a fault code in B.U.D.S.. Refer to *DIAGNOSTICS AND FAULT CODES* subsection.
2. Check cooling fan fuse. Refer to *POWER DISTRIBUTION* subsection.
3. Carry out the *COOLING FAN TEST USING B.U.D.S.* in this subsection.
4. Retest fan using B.U.D.S. while touching fan relay (R4).
   - If a "click" is felt, see *COOLING FAN MOTOR OPERATION TEST* in this subsection.
   - If a NO "click" is felt, test cooling fan relay. Refer to *POWER DISTRIBUTION* subsection.
5. Carry out the *COOLING FAN INPUT VOLTAGE TEST* in this subsection.
6. Carry out the *COOLING FAN RELAY INPUT VOLTAGE TEST* further in this subsection.
7. Carry out the *COOLING FAN RELAY CONTROL CIRCUIT TEST* further in this subsection.
8. Test for continuity of the following. Refer to wiring diagram.
   - Fan ground circuit
   - Relay control circuit.

Cooling Fan Test Using B.U.D.S.

1. Connect vehicle to B.U.D.S., refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. Depress vehicle start button once to activate the ECM.
3. In B.U.D.S., select the following:
   - **Read Data** button
   - **Activation** tab
   - **ECM** page.

4. Press **Cooling Fan** button to activate cooling fan motor.



COOLING FAN ACTIVATION BUTTON

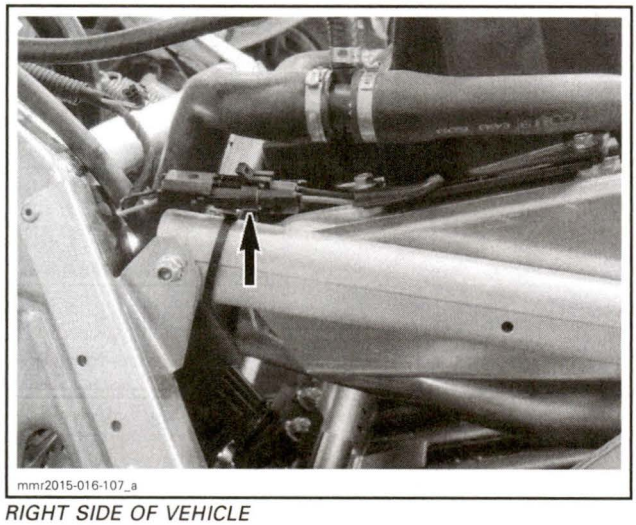
If cooling fan functions properly, test the coolant temperature sensor.

If cooling fan motor does not work, refer back to *COOLING FAN TESTING SEQUENCE* in this subsection.

NOTE: The engine must be started and the engine temperature must attain > 100°C (212°F) before the coolant temperature sensor signal tells the ECM to turn on the cooling fan. Refer to *COOLING FAN OPERATING CONDITIONS* in this subsection.

Cooling Fan Motor Operation Test

1. Disconnect radiator cooling fan connector.



RIGHT SIDE OF VEHICLE

2. Check cooling fan connector and terminal condition.
3. Connect a 12 volt battery directly to the fan motor connector.

If motor does not work, replace it.

If motor works, check:

- Fan ground circuit wiring continuity
- Carry out the *COOLING FAN INPUT VOLTAGE TEST* in this subsection.

Cooling Fan Input Voltage Test

Test conditions:

- Engine running with coolant temperature above 100°C (212°F)
- **OR** cooling fan activated using B.U.D.S. Refer to *COOLING FAN TEST USING B.U.D.S.*

Check input voltage at cooling fan connector (harness side).

COOLING FAN INPUT VOLTAGE TEST	
TEST PROBES	VOLTAGE
GRAY/GREEN	Battery voltage (± 12 Vdc)
BLACK	

Cooling Fan Relay Input Voltage Test

RELAY INPUT VOLTAGE TEST (CONTACTS)	
TEST PROBES	VOLTAGE
Fuse box pin 10C	Battery voltage (± 12 Vdc)
Battery negative (-) post	

RELAY INPUT VOLTAGE TEST (WINDING)	
TEST PROBES	VOLTAGE
Fuse box pin 10D	Battery voltage (± 12 Vdc)
Battery negative (-) post	

Cooling Fan Relay Control Circuit Test

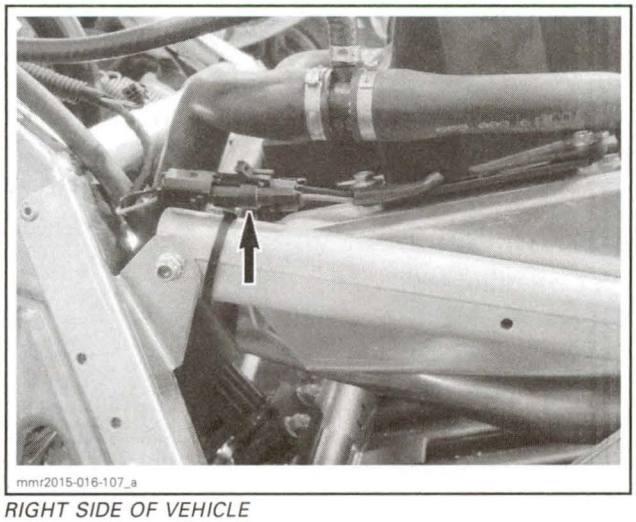
Test conditions:

- Engine running with coolant temperature above 100°C (212°F)
- **OR** cooling fan activated using B.U.D.S. Refer to *COOLING FAN TEST USING B.U.D.S.*

COOLING FAN RELAY CONTROL CIRCUIT TEST	
TEST PROBES	VOLTAGE
Fuse box pin 12C	Approximately battery voltage (± 12 Vdc)
Battery positive (+) post	

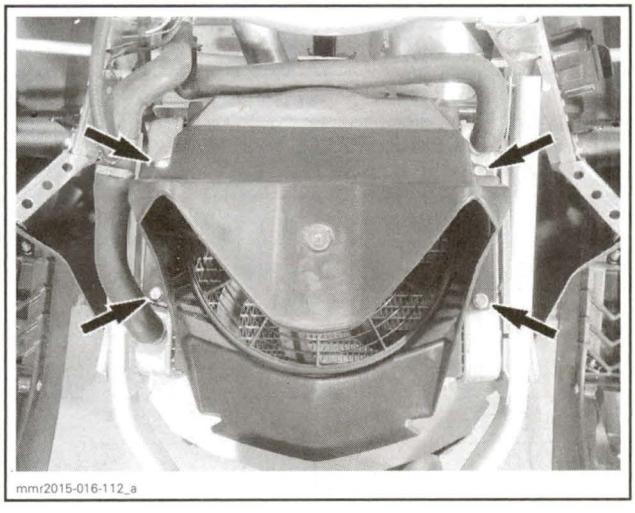
Cooling Fan Removal

1. Disconnect radiator cooling fan connector.



RIGHT SIDE OF VEHICLE

2. Remove the 4 screws that secure the fan shroud and fan to the radiator.



Cooling Fan Installation

Reverse the removal procedure.

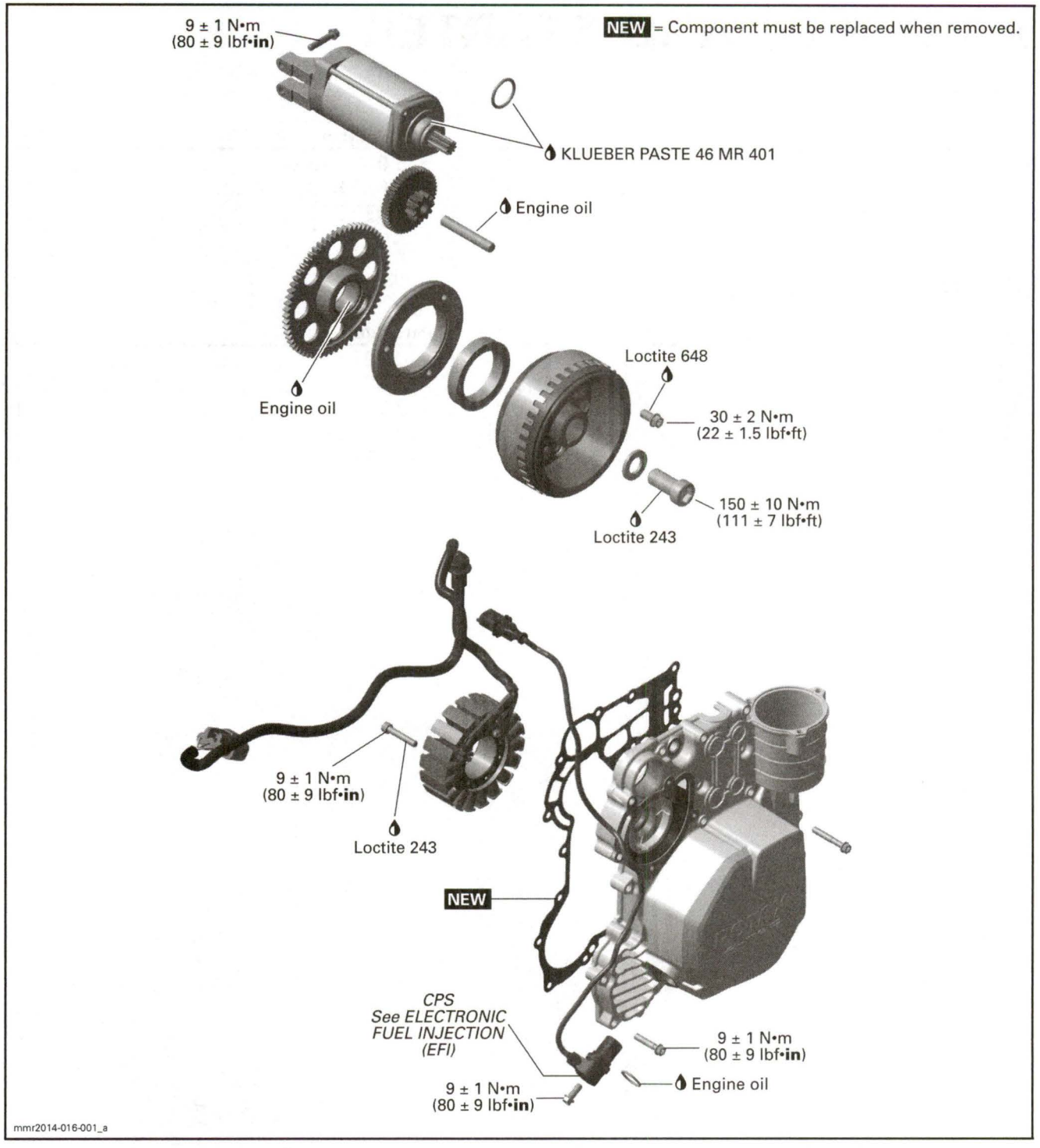
MAGNETO AND STARTER

SERVICE TOOLS

Description	Part Number	Page
CRANKSHAFT PROTECTOR	529 036 213	217
FLUKE 115 MULTIMETER	529 035 868	215
FLYWHEEL PULLER	420 976 235	217

SERVICE PRODUCTS

Description	Part Number	Page
KLÜEBER PASTE 46 MR 401	420 297 616	221
LOCTITE 243 (BLUE)	293 800 060	216, 218
LOCTITE 648 (GREEN)	413 711 400	219
LOCTITE CHISEL (GASKET REMOVER)	413 708 500	213
PULLEY FLANGE CLEANER	413 711 809	217, 219


NEW = Component must be replaced when removed.
9 ± 1 N•m
(80 ± 9 lbf•in)
KLUEBER PASTE 46 MR 401
Engine oil
Engine oil
Loctite 648
30 ± 2 N•m
(22 ± 1.5 lbf•ft)
150 ± 10 N•m
(111 ± 7 lbf•ft)
Loctite 243
9 ± 1 N•m
(80 ± 9 lbf•in)
Loctite 243
NEW
CPS
See ELECTRONIC
FUEL INJECTION
(EFI)
9 ± 1 N•m
(80 ± 9 lbf•in)
Engine oil
9 ± 1 N•m
(80 ± 9 lbf•in)
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TROUBLESHOOTING

Always check for fault codes. If a fault code is detected, service the fault code first. Refer to *DIAGNOSTIC AND FAULT CODES* subsection.

ENGINE DOES NOT CRANK

1. **Battery voltage too low.**
   - *Check battery condition.*
2. **Starter is turning but engine does not crank.**
   - *Check sprag clutch for wear or other damages.*
3. **Starter is defective.**
   - *Check starter condition. Perform STARTER OPERATION TEST and STARTER VOLTAGE DROP TEST.*
4. **Engine is only cranking 1 - 2 seconds before it stops.**
   - *Check battery condition.*

PROCEDURES

MAGNETO COVER

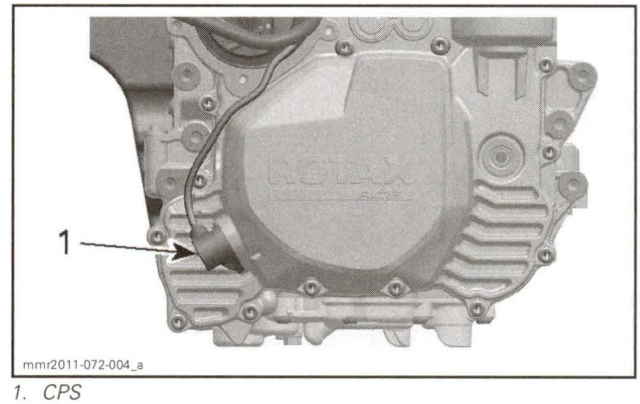
Magneto Cover Access

Refer to appropriate subsection and remove:
- RH side panels
- Muffler and exhaust pipe.

NOTE: Magneto cover cannot be removed without removing engine from vehicle.

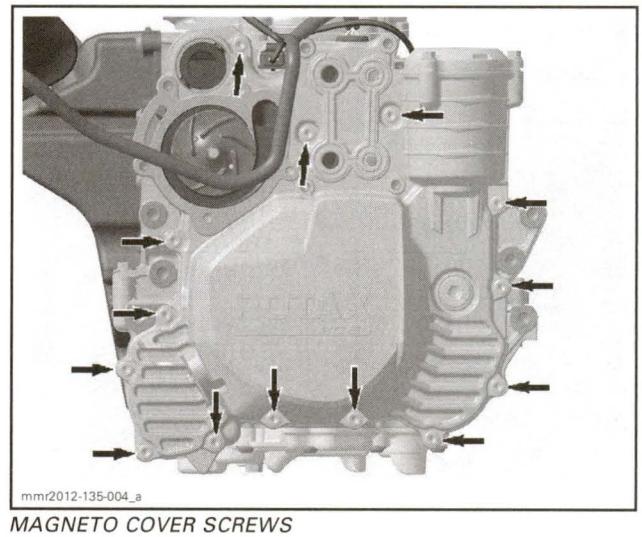
Magneto Cover Removal

1. Refer to *ENGINE REMOVAL AND INSTALLATION* and remove engine.
2. Refer to *PERIODIC MAINTENANCE PROCEDURES* and drain engine oil.
3. Refer to *COOLING SYSTEM* and remove:
   - Water pump housing
   - Thermostat housing.
4. Refer to *LUBRICATION SYSTEM* subsection and remove:
   - Oil pressure regulator
   - Oil cooler.
5. Remove the CPS.



1. CPS

6. Remove magneto cover retaining screws.



MAGNETO COVER SCREWS

7. Place an oil pan under magneto area to catch remaining oil.
8. Pull magneto cover off.

Magneto Cover Inspection

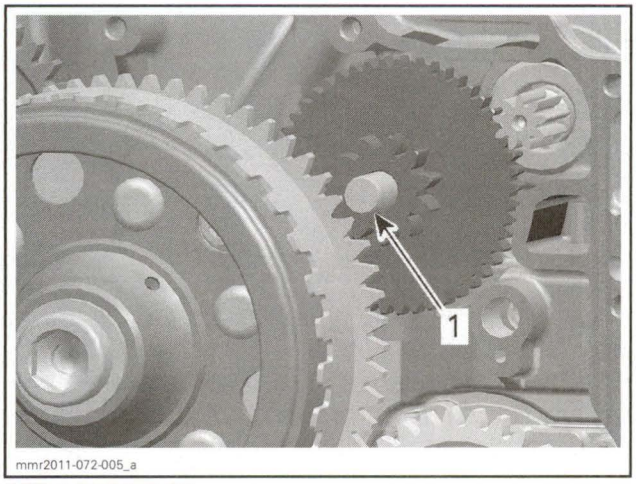
Check magneto cover for cracks or other damage. Replace if necessary.

Magneto Cover Installation

1. Clean magneto cover.

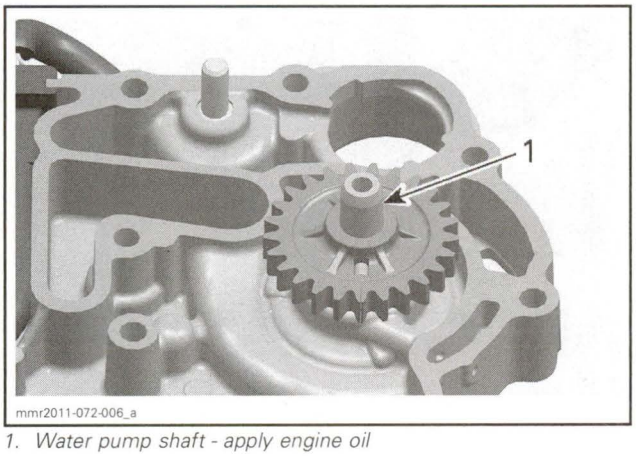
MAGNETO COVER CLEANING	
Service product	LOCTITE CHISEL (GASKET REMOVER) (P/N 413 708 500)

2. Install a NEW magneto cover gasket.
3. Ensure starter drive gear pin is in place.
4. Apply engine oil on starter drive gear pin.



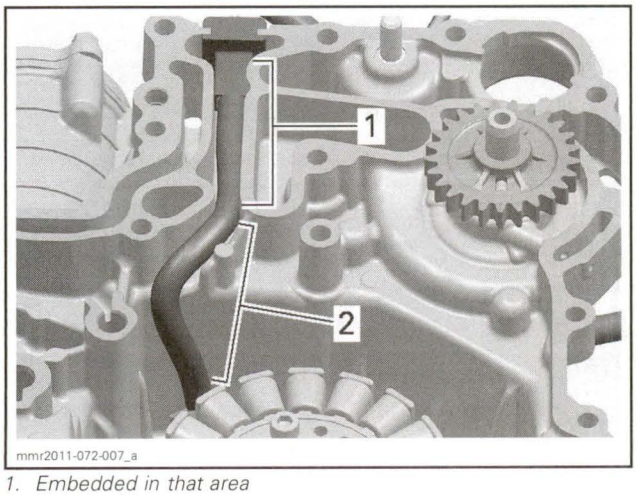
APPLY ENGINE OIL
1. Starter drive gear pin

5. Apply engine oil on water pump shaft.



1. Water pump shaft - apply engine oil

NOTICE Make sure the stator cable harness is embedded in the cover channel provided. The part of the harness that is out of the channel must be tight, otherwise it might chafe or jam.



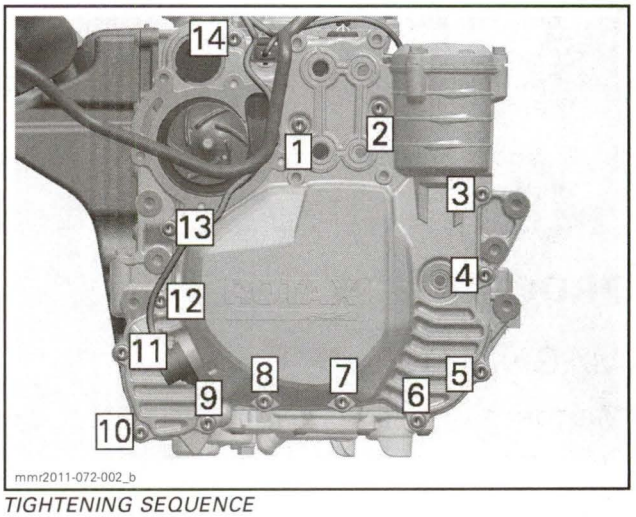
1. Embedded in that area
2. Tight in this area

6. Carefully install magneto cover.

⚠ CAUTION Magnetic force between magneto flywheel and stator is very high. Avoid finger contusions.

7. Tighten to specification magneto cover screws according to the following sequence.

MAGNETO COVER SCREWS	
Tightening torque	9 N•m ± 1 N•m (80 lbf•**in** ± 9 lbf•**in**)



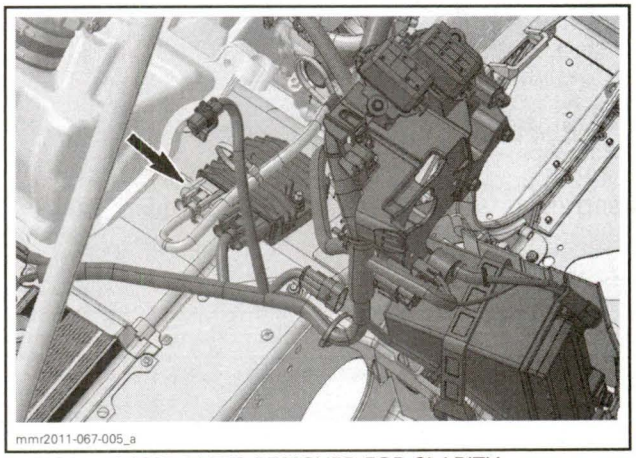
TIGHTENING SEQUENCE

8. Install all other removed parts, refer to applicable subsections.

STATOR

Stator Connector Access

1. Move fuel tank backward. Refer to *MOVING FUEL TANK REARWARD FOR SERVICING* in *FUEL TANK AND FUEL PUMP* subsection.



TYPICAL - SOME PARTS REMOVED FOR CLARITY

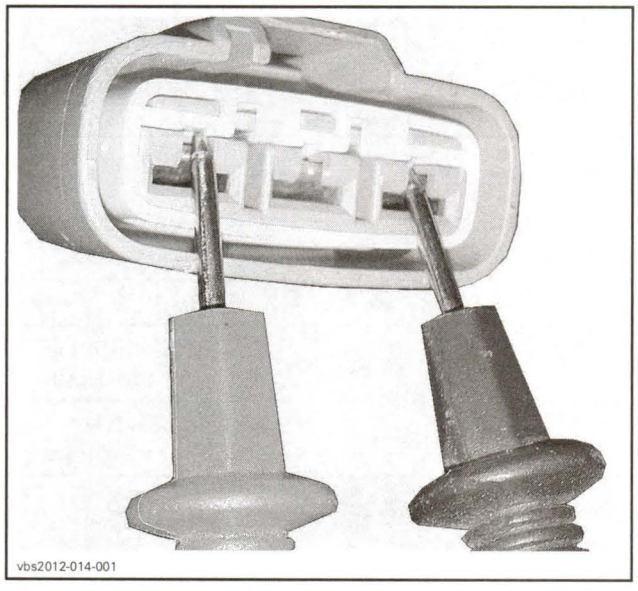
Stator Continuity Test

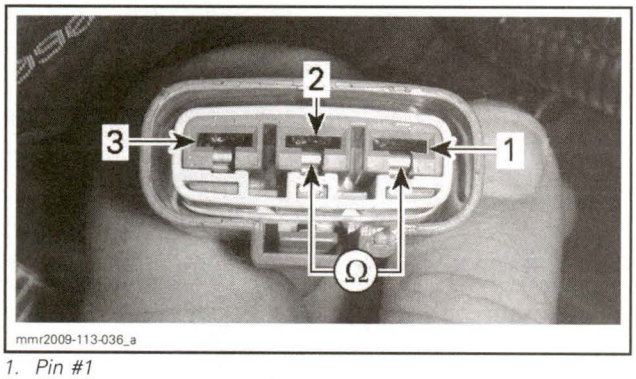
1. Disconnect the stator connector from voltage regulator, refer to *STATOR CONNECTOR ACCESS* in this subsection.
2. Set multimeter to Ω.

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

3. Probe each pair of YELLOW wires by touching (NOT inserting) terminals lock tabs as shown.

NOTICE **Never insert a multimeter probe into a terminal as it would ruin the terminal.**


vbs2012-014-001



mmr2009-113-036_a

1. *Pin #1*
2. *Pin #2*
3. *Pin #3*

4. Read resistance as per following table.

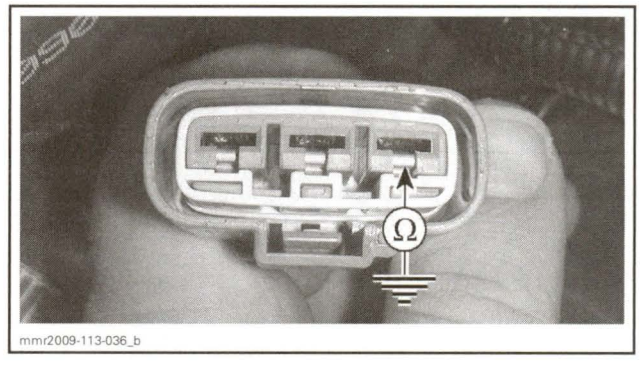
STATOR CONTINUITY TEST	
YELLOW WIRES (EACH PAIR)	RESISTANCE @ 20°C (68°F)
Pins 1 and 2	0.1 - 1 Ω
Pins 1 and 3	
Pins 2 and 3	

If any resistance reading is not as specified, the stator or the wiring (including connector) is open and needs to be repaired or replaced.

If resistance is good, perform the stator insulation test.

Stator Insulation Test

1. Connect multimeter between any YELLOW wire and chassis ground.



mmr2009-113-036_b

2. Read resistance.

STATOR INSULATION TEST	
PROBE POSITIONS	RESISTANCE @ 20°C (68°F)
Any YELLOW wire and chassis ground	Infinity (OL)

If any resistance reading is not as specified, the stator or the wiring is shorted to ground and needs to be repaired or replaced.

If the insulation test is good, perform the output voltage test.

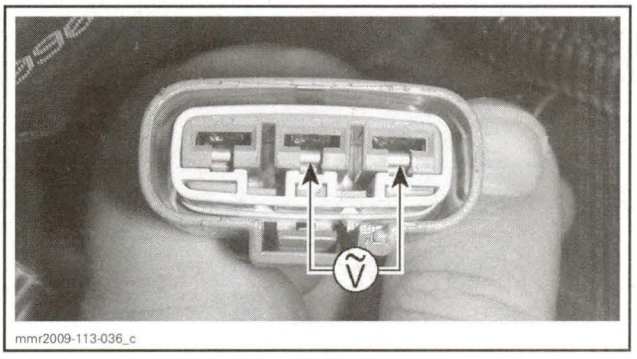
Stator Output Voltage Test

1. Disconnect stator at voltage regulator.

NOTE: To ease access, move fuel tank back carefully, but do not disconnect. Refer to *FUEL TANK AND FUEL PUMP*.

2. Start engine and let it reach its operating temperature.
3. Set multimeter to Vac scale.

4. With engine idling, connect multimeter between each pair of YELLOW wires.



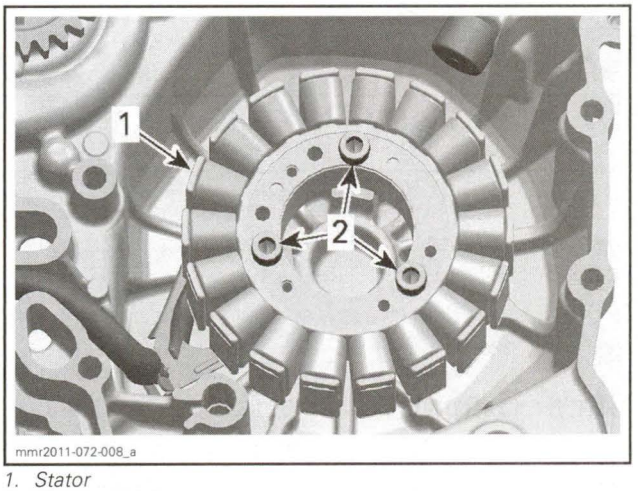
5. Read voltage.

STATOR OUTPUT VOLTAGE TEST		
TEST ENGINE SPEED	TERMINAL	VOLTAGE
Idle speed	1 and 2	± 25 Vac
	1 and 3	
	2 and 3	

If any voltage reading is significantly lower than specification, replace the stator.

Stator Removal

1. Remove the *MAGNETO COVER*, see procedure in this subsection.
2. Remove stator retaining screws.



1. Stator
2. Stator retaining screws

3. Remove stator.

Stator Inspection

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

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

Stator Installation

1. Ensure stator cable is underneath cable holder during installation of stator.



1. Cable holder
2. Stator cable

2. Install stator retaining screws and tighten to specified torque.

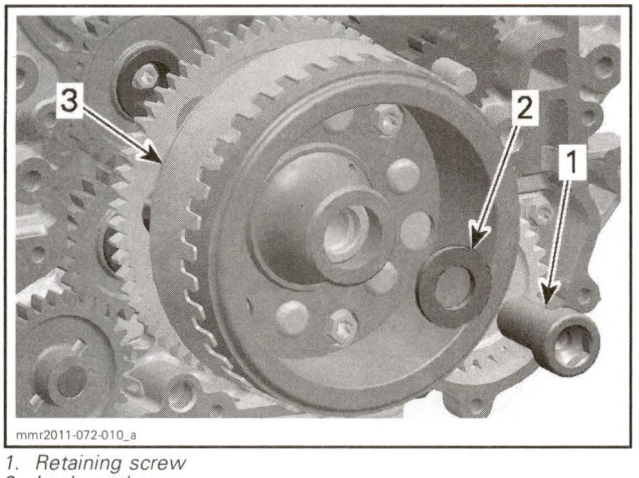
STATOR RETAINING SCREWS	
Service product	LOCTITE 243 (BLUE) (P/N 293 800 060)
Tightening torque	9 N•m ± 1 N•m (80 lbf•**in** ± 9 lbf•**in**)

3. Reinstall *MAGNETO COVER*, see procedure in this subsection.

ROTOR

Rotor Removal

1. Remove *MAGNETO COVER*, see procedure in this subsection.
2. Lock crankshaft. Refer to *BOTTOM END* subsection.
3. Remove rotor retaining screw and lock washer.

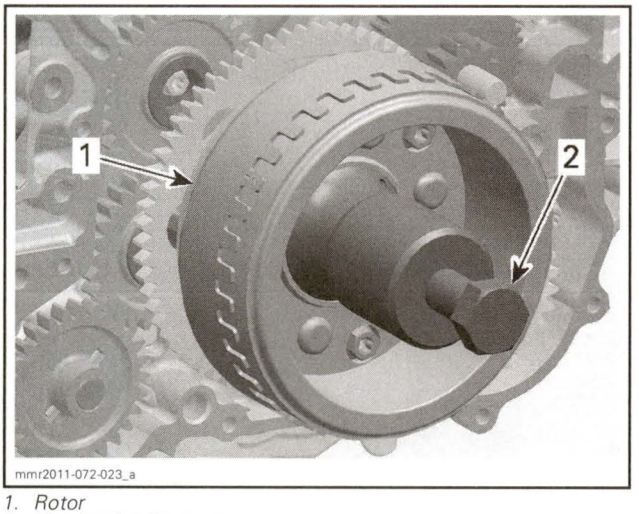


1. *Retaining screw*
2. *Lock washer*
3. *Rotor*

4. Remove rotor.

REQUIRED TOOL	
CRANKSHAFT PROTECTOR (P/N 529 036 213)	
FLYWHEEL PULLER (P/N 420 976 235)	

NOTE: Apply some grease on the crankshaft protector surface to ease puller operation.



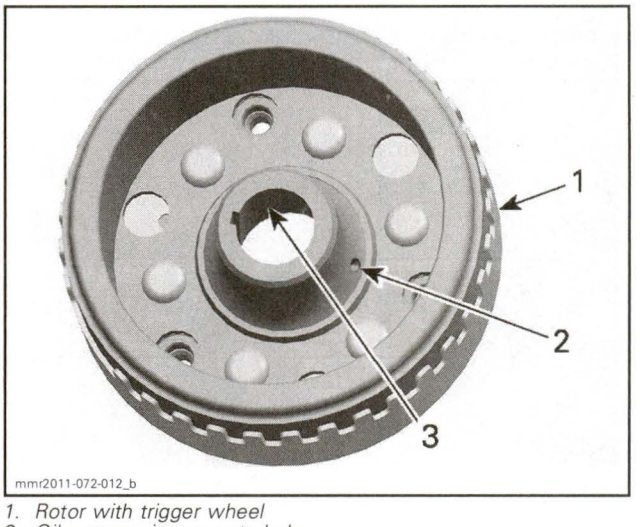
1. *Rotor*
2. *Flywheel puller screw*

Rotor Inspection

Check the inner side of the rotor for scratches or other damage.

Check keyway for wear or damages.

Check if trigger wheel teeth are bent or otherwise damaged.



1. *Rotor with trigger wheel*
2. *Oil passage in magneto hub*
3. *Rotor taper*

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

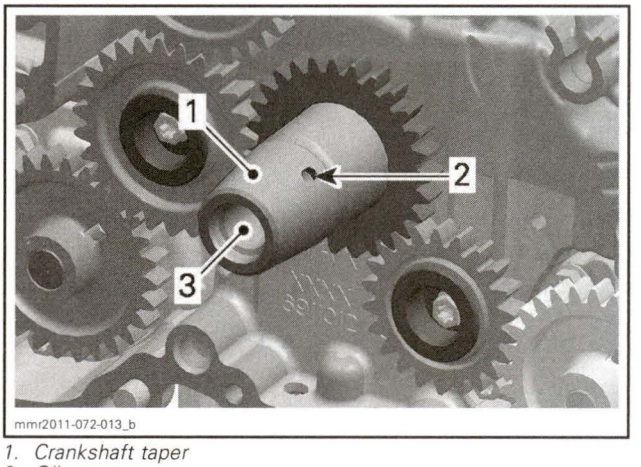
Replace parts as necessary.

Rotor Installation

Reverse the removal procedure. However, pay attention to the following.

1. Blow compressed air through oil passage in magneto hub. Check if it is clogged.
2. Using PULLEY FLANGE CLEANER (P/N 413 711 809), clean:
   - The oil passage
   - The crankshaft thread
   - The crankshaft taper
   - The rotor taper.

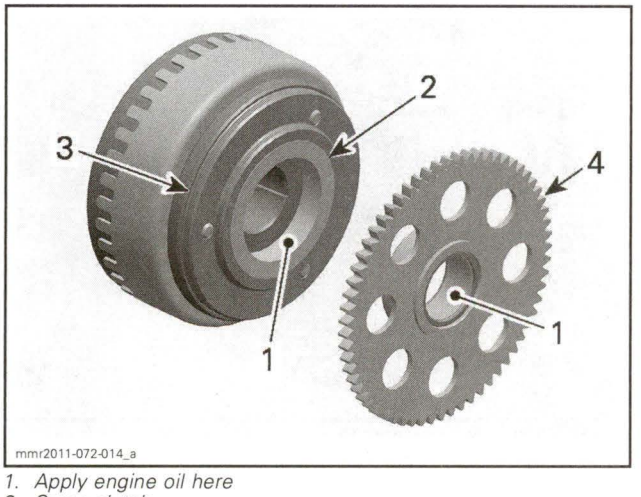
NOTICE **Taper on crankshaft and rotor must be free of grease.**



1. *Crankshaft taper*
2. *Oil passage*
3. *Thread*

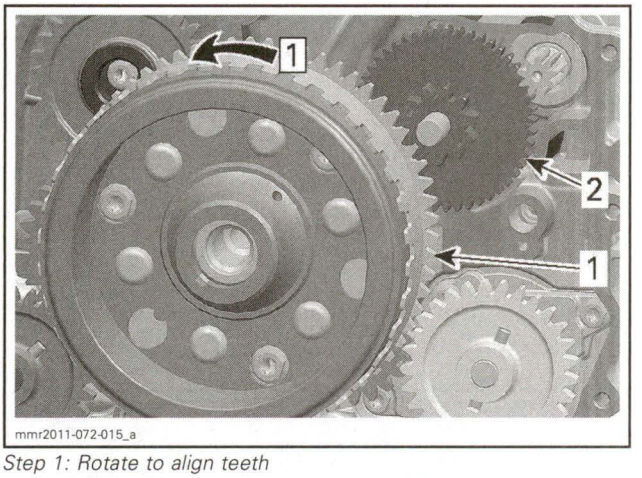
3. Apply oil on sprag clutch and needle bearing.

4. Install sprag clutch gear onto the rotor.



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

5. Slide rotor along with the sprag clutch gear onto the crankshaft. The woodruff key and keyway must be aligned.
6. Rotate sprag clutch gear counterclockwise to align with starter double gear.



Step 1: Rotate to align teeth

1. Sprag clutch gear
2. Starter double gear

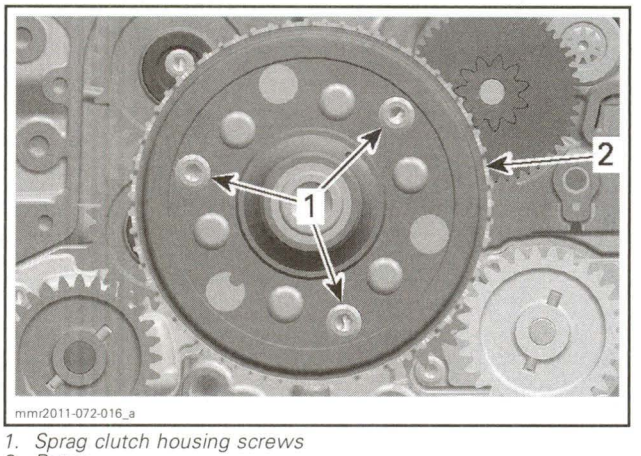
7. Install washer and retaining screw.
8. Tighten to specified torque.

ROTOR RETAINING SCREW	
Service product	LOCTITE 243 (BLUE) (P/N 293 800 060)
Tightening torque	150 N•m ± 10 N•m (111 lbf•ft ± 7 lbf•ft)

SPRAG CLUTCH

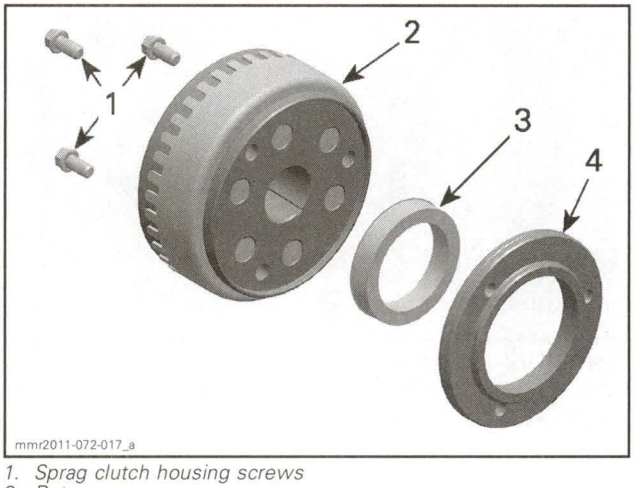
Sprag Clutch Removal

1. Remove the *MAGNETO COVER*, see procedure in this subsection.
2. Lock crankshaft. Refer to *BOTTOM END* subsection.
3. Loosen and remove sprag clutch housing screws.



1. Sprag clutch housing screws
2. Rotor

4. Remove *ROTOR*, see procedure in this subsection.
5. Remove sprag clutch housing.
6. Remove sprag clutch from sprag clutch housing.



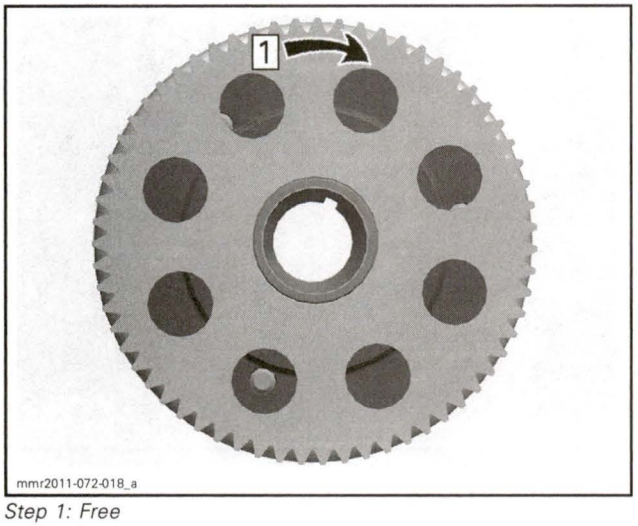
1. Sprag clutch housing screws
2. Rotor
3. Sprag clutch
4. Sprag clutch housing

Sprag Clutch Inspection

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

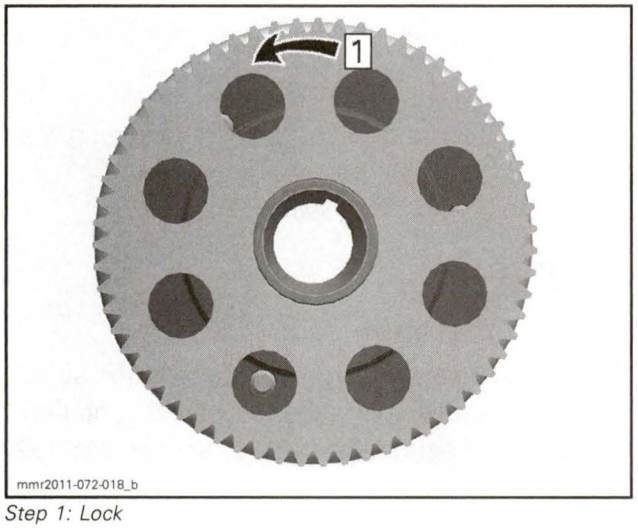
Check the collar of the sprag clutch gear, refer to *SPRAG CLUTCH GEAR* in this subsection.

Rotate sprag clutch gear clockwise. Gear must rotate freely.



Step 1: Free

Rotate sprag clutch gear counterclockwise. Gear must lock.



Step 1: Lock

Sprag Clutch Installation

1. Clean sprag clutch housing with a parts cleaner.

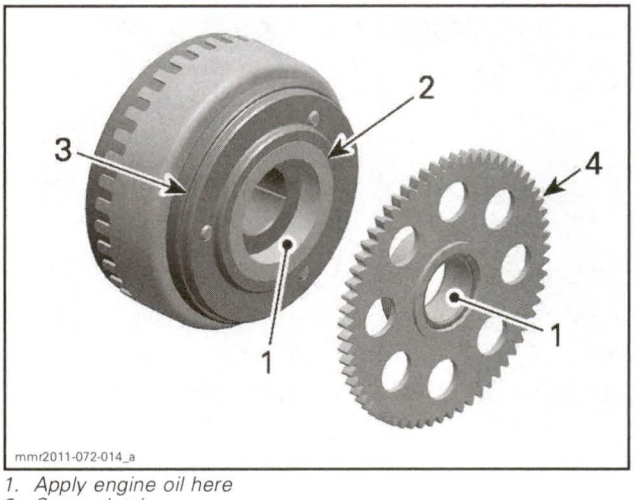
NOTICE Threads of sprag clutch housing must be free of any lubricants.

SPRAG CLUTCH HOUSING	
Service product	PULLEY FLANGE CLEANER (P/N 413 711 809)

2. Apply thread locker on threads of sprag clutch housing screws.

SPRAG CLUTCH HOUSING SCREWS	
Service product	LOCTITE 648 (GREEN) (P/N 413 711 400)

3. Loosely install screws.
4. Apply engine oil on sprag clutch and sprag clutch gear needle bearing.



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

5. Install *ROTOR*, see procedure in this subsection.
6. Tighten sprag clutch housing screws to the specified torque.

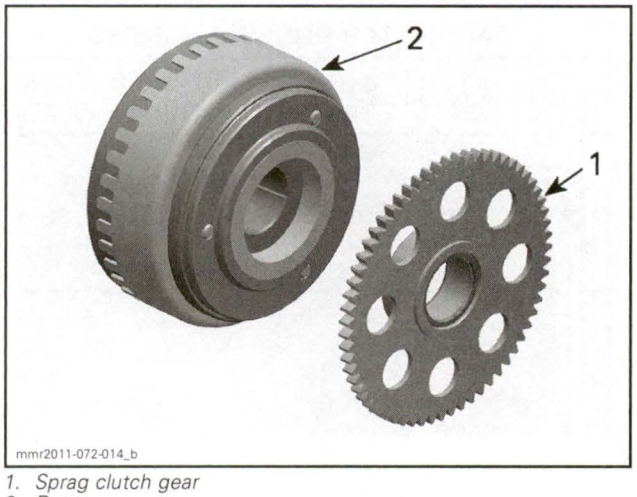
SPRAG CLUTCH HOUSING SCREWS	
Tightening torque	30 N•m ± 2 N•m (22 lbf•ft ± 1 lbf•ft)

7. Install all other removed parts.

SPRAG CLUTCH GEAR

Sprag Clutch Gear Removal

1. Remove rotor and sprag clutch gear together. Refer to *ROTOR* in this subsection.
2. Pull sprag clutch gear out of the rotor.

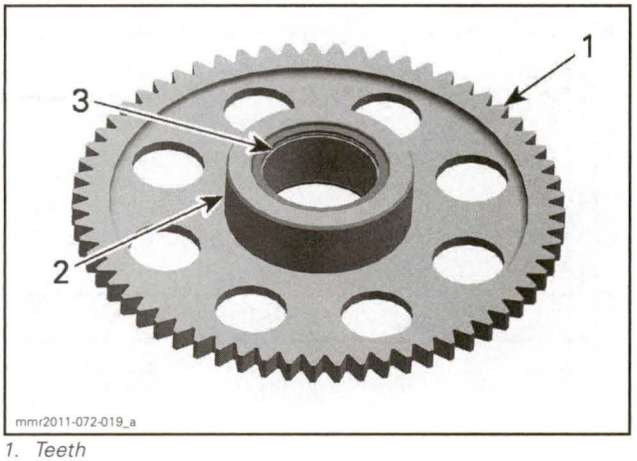


1. Sprag clutch gear
2. Rotor

Sprag Clutch Gear Inspection

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

Check needle bearing for wear and pittings.



1. Teeth
2. Collar
3. Needle bearing

Replace sprag clutch gear if necessary.

Sprag Clutch Gear Installation

Reverse the removal procedure. However, pay attention to the following.

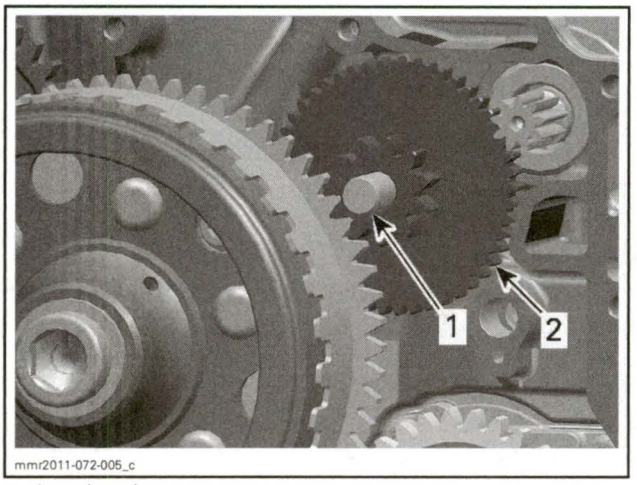
NOTE: Apply engine oil on needle bearing and collar of sprag clutch gear.

STARTER DRIVE GEARS

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

Starter Drive Gear Removal

1. Remove *MAGNETO COVER*, see procedure in this subsection.
2. Remove location pin and starter double gear.



1. Location pin
2. Starter double gear

Starter Drive Gear Inspection

Inspect starter drive gears and location pin for wear and damage.

Replace parts if necessary.

Starter Drive Gear Installation

Reverse the removal procedure. However, pay attention to the following.

Apply engine oil on the location pin.

STARTER

Starter Operation Test

Before carrying out any starter test, make sure:
- Battery is fully charged and in good condition.
- Cable connections at battery, starter and solenoid are tight.
- Cables are in good condition.

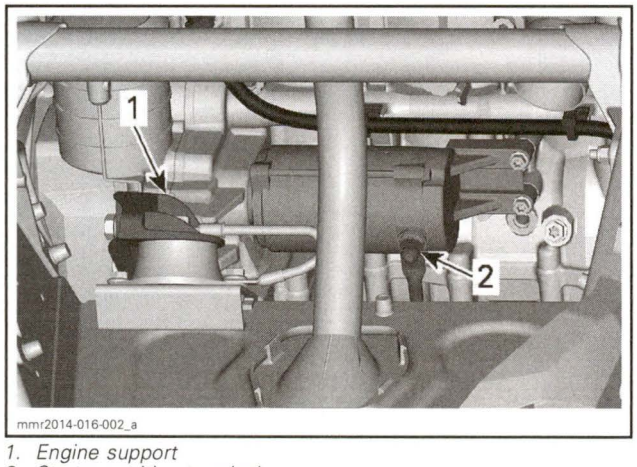
1. Disconnect the negative battery cable.

⚠ WARNING

Sparks can occur when connecting jumper cables. To avoid fire hazard, be sure that no flammable liquids or fuel vapors are in the test area.

2. Using booster cables and a fully charged battery (or a power pack), carefully supply current directly to the starter.
   2.1 Connect the negative booster cable or power pack cable to a good ground such as an engine support.

2.2 Momentarily touch the starter positive terminal.



1. Engine support
2. Starter positive terminal

If starter turns at normal speed, test the starting circuit. Refer to *STARTING SYSTEM* subsection.

If starter turns slowly, carry out the *STARTER VOLTAGE DROP TEST (AT BATTERY)*.

If starter does not turn, replace starter.

Starter Voltage Drop Test (at Battery)

NOTE: This test will confirm if starter draws too much current. Battery must be fully charged and in good condition.

1. Set multimeter to Vdc.
2. Probe battery posts.
3. Crank engine in drowned mode (accelerator held all the way in).
4. Read voltage while cranking.

NOTE: Battery voltage will drop approximately 2 Vdc and fluctuate with starter cranking load.

If the result is close to battery voltage, the starter is in good condition.

If the result is below battery voltage (- 2 Vdc and more), the starter may be defective.

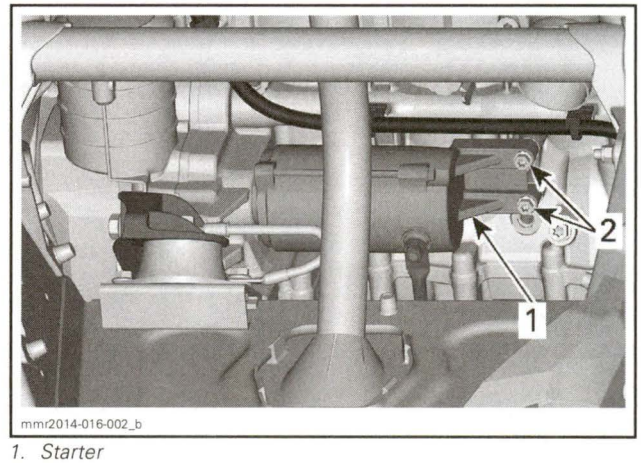
Starter Access

Refer to appropriate subsection and remove:

- LH side panel
- Drive belt guard.

Starter Removal

1. Disconnect the BLACK (–) cable from the battery.
2. Remove starter cable from starter.
3. Remove starter retaining screws.



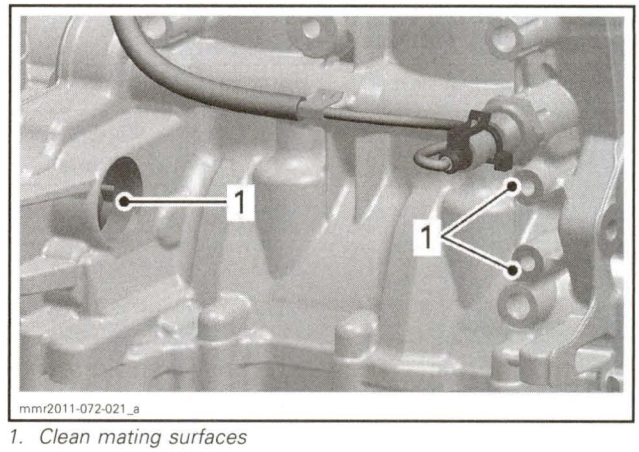
1. Starter
2. Starter retaining screws

4. Remove starter from engine.

Starter Installation

1. Ensure starter and engine mating surfaces are free of debris.

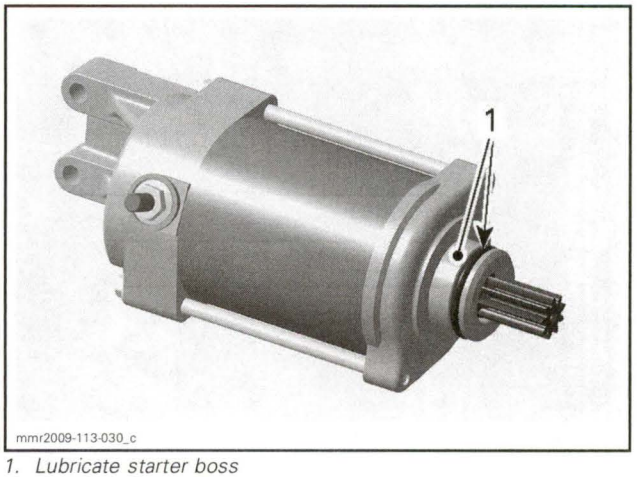
NOTICE Serious problems may arise if the starter is not properly aligned.



1. Clean mating surfaces

2. Lubricate starter boss and starter O-ring before installation.

STARTER BOSS +O-RING	
Service product	KLÜEBER PASTE 46 MR 401 (P/N 420 297 616)



1. Lubricate starter boss
2. Lubricate starter O-ring

3. Insert starter gear in engine.
4. Install starter screws and tighten to the specified torque.

STARTER SCREWS	
Tightening torque	9 N•m ± 1 N•m (80 lbf•**in** ± 9 lbf•**in**)

5. Connect starter cable to starter terminal and tighten nut to specified torque.

STARTER CABLE NUT	
Tightening torque	7 N•m ± 1 N•m (62 lbf•**in** ± 9 lbf•**in**)

6. Install all other removed parts.
7. Reconnect BLACK (–) cable on battery post.

⚠ WARNING

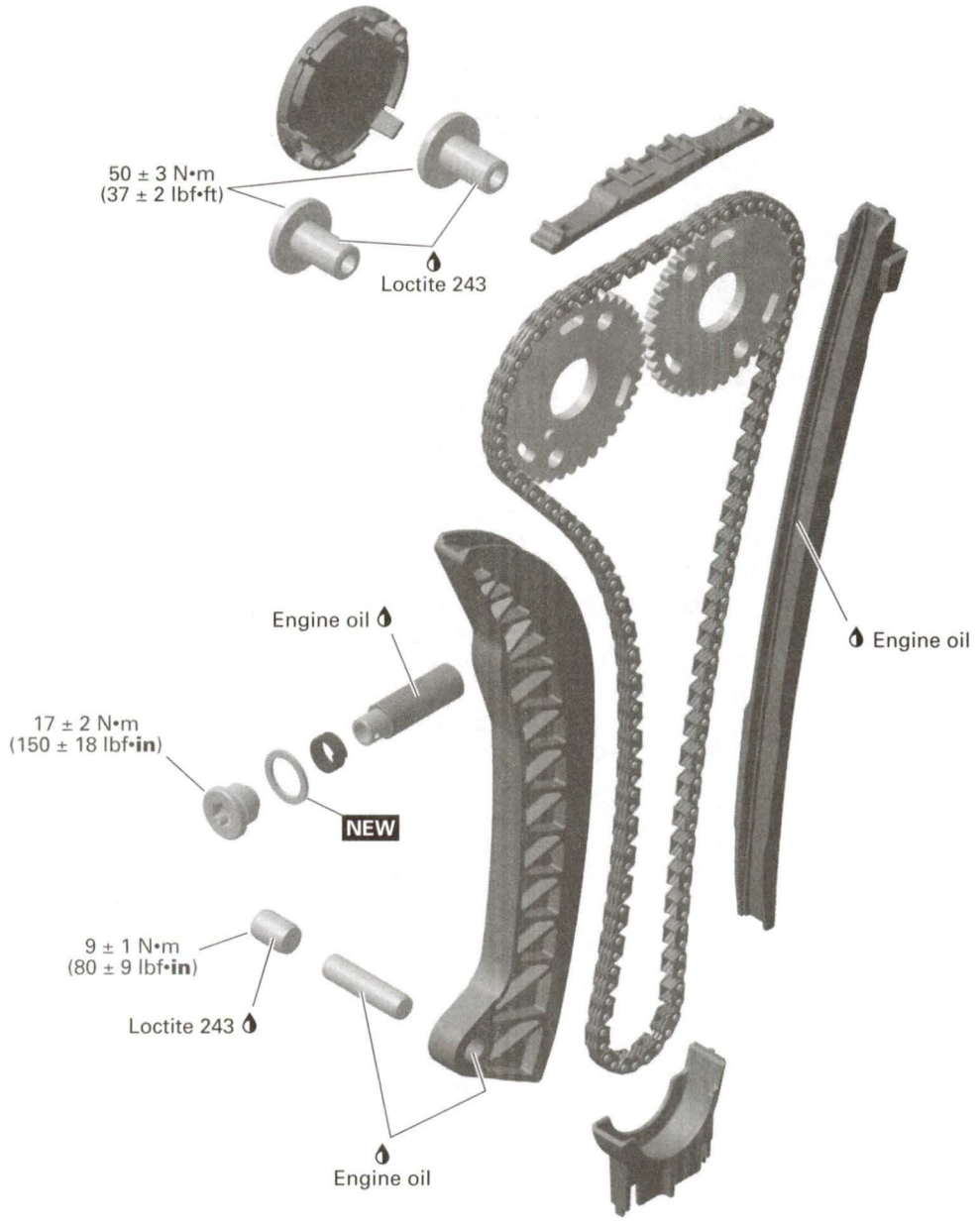
Always connect RED (+) starter cable first, and BLACK (-) battery cable last. Whenever connecting the RED (+) cable to the starter motor, always make sure the BLACK (-) battery cable is disconnected to prevent electric shock.

8. Test for proper starter operation.

TIMING CHAIN

SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 243 (BLUE)	293 800 060	226, 231



NEW = Component must be replaced when removed.

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GENERAL

Engine removal is necessary to work on the following components:

- Timing chain
- Timing chain guide (tensioner side).

When disassembling parts that are duplicated in the engine, (e.g.: valves, springs, etc.), it is strongly recommended to note their position and to keep the parts of the same assembly as a "group". If you find a defective component, it will be much easier to find the cause of the failure. Since parts were broken-in together during engine operation, they will maintain their matched fit when reassembled together within their "group".

TROUBLESHOOTING

The following is provided to help in diagnosing the probable source of troubles. It is a guideline and should not be assumed to provide solutions to every cause of all problems.

UNUSUAL ENGINE NOISE OR VIBRATIONS

1. **Faulty chain tensioner.**
   - *Replace chain tensioner.*
2. **Chain guide(s) worn out.**
   - *Replace chain guide(s).*
3. **Stretched timing chain or worn sprockets.**
   - *Replace timing chain and sprockets.*
4. **Camshaft timing gear screws loose.**
   - *Retighten screws to recommended torque.*
5. **Incorrect camshaft timing adjustment.**
   - *Replace damaged components and readjust camshaft timing.*

ENGINE LACKS ACCELERATION OR POWER

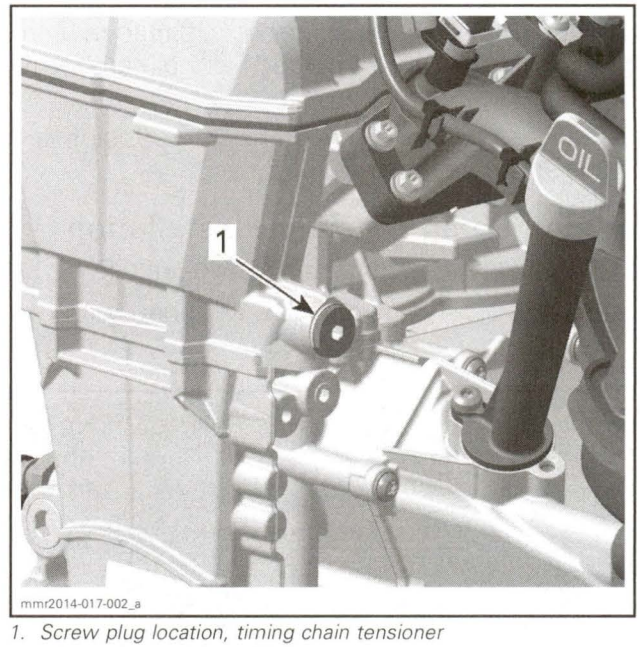
1. **Incorrect camshaft timing adjustment.**
   - *Replace damaged components and readjust camshaft timing.*

PROCEDURES

TIMING CHAIN TENSIONER

Timing Chain Tensioner Location

The timing chain tensioner is located in the cylinder head beside the intake port of the PTO cylinder.



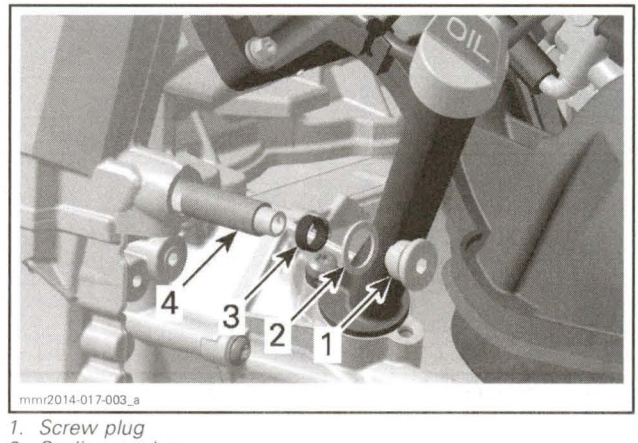
1. Screw plug location, timing chain tensioner

Timing Chain Tensioner Access

Remove driven pulley and countershaft. Refer to *DRIVEN PULLEY AND COUNTERSHAFT* subsection.

Timing Chain Tensioner Removal

1. Lock crankshaft, refer to *BOTTOM END* subsection.
2. Remove screw plug and discard the sealing washer.
3. Pull out spring and chain tensioner.



1. Screw plug
2. Sealing washer
3. Spring
4. Chain tensioner

Timing Chain Tensioner Inspection

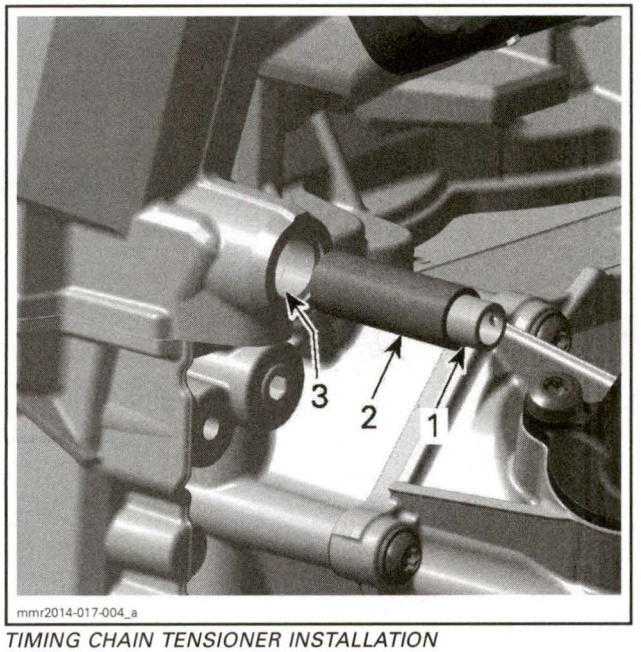
1. Check chain tensioner for scoring and freedom of movement in bore.
2. Compress chain tensioner and check for proper operation.

NOTE: The chain tensioner is difficult to compress when properly charged with oil, and easily compressed when it is not.

3. Check spring for straightness, corrosion and other visible damage.

Timing Chain Tensioner Installation

1. Apply engine oil on chain tensioner.
2. Insert chain tensioner in its bore with the plunger pointing outwards.



TIMING CHAIN TENSIONER INSTALLATION
1. *Plunger*
2. *Chain tensioner*
3. *Tensioner bore in cylinder head*

3. Install spring on chain tensioner.
4. Tighten screw plug to specified torque.

SCREW PLUG TIMING CHAIN TENSIONER	
Sealing washer	NEW
Tightening torque	17 N•m ± 2 N•m (150 lbf•**in** ± 18 lbf•**in**)

5. Install all other removed parts.

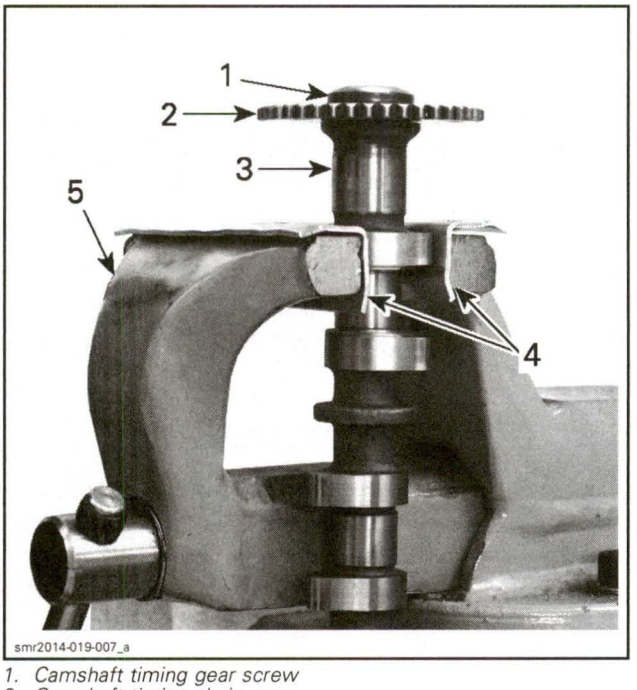
CAMSHAFT TIMING GEARS

Camshaft Timing Gear Removal

1. Remove camshaft assembly. Refer to *TOP END* subsection.
2. Clamp camshaft in a vice using aluminium protectors.

NOTICE **Take care not damaging the cams.**

3. Unscrew and remove camshaft timing gear screw.
4. Remove camshaft timing gear.



1. *Camshaft timing gear screw*
2. *Camshaft timing chain gear*
3. *Camshaft*
4. *Aluminium protectors*
5. *Vice*

Camshaft Timing Gear Inspection

Check camshaft timing gears for wear or deterioration. If a gear is worn or damaged, replace camshaft timing gears and timing chain as a set.

NOTE: For crankshaft timing gear inspection, refer to *BOTTOM END* subsection.

Camshaft Timing Gear Installation

Reverse of removal procedure. However, pay attention to the following details.

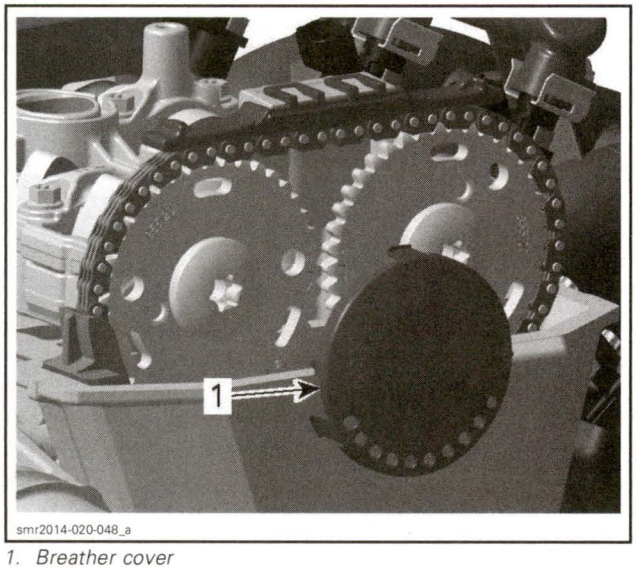
Tighten camshaft timing gear screw to specification.

NOTICE **Do not torque timing gear screws when camshafts are installed in cylinder head to avoid overstressing timing chain.**

TIMING GEAR SCREWS	
Service product	LOCTITE 243 (BLUE) (P/N 293 800 060)
Tightening torque	50 N•m ± 3 N•m (37 lbf•ft ± 2 lbf•ft)

NOTICE Improper camshaft timing will damage engine components. Make sure camshafts and crankshaft are still locked. If not, lock them before beginning this procedure. Refer to *CAMSHAFTS* in the *TOP END* subsection.

Install breather cover on exhaust camshaft.



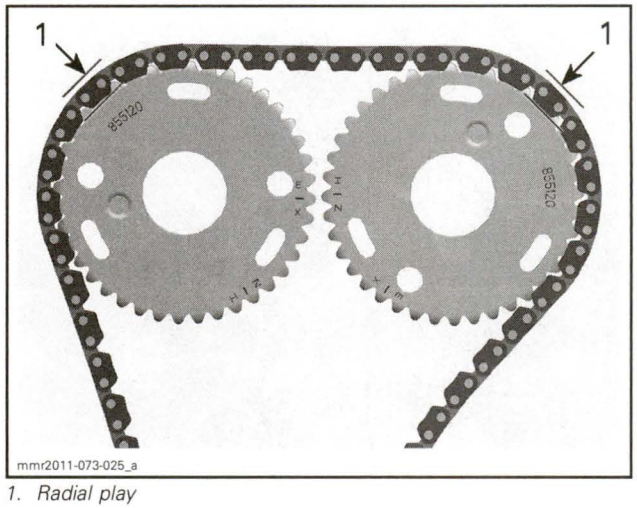
1. Breather cover

Install remaining parts.

TIMING CHAIN

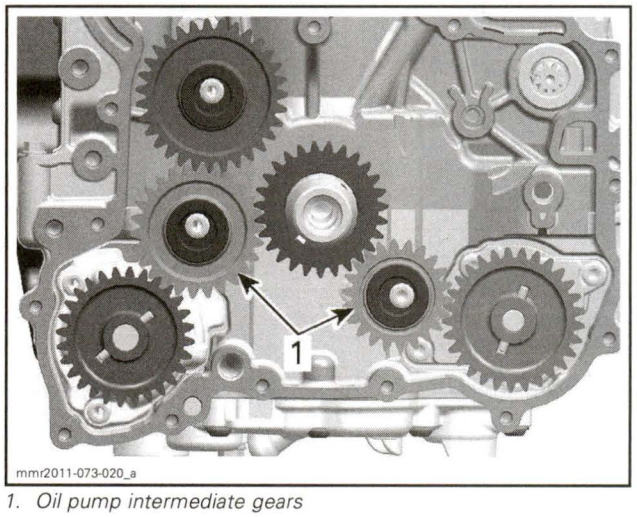
Timing Chain Removal

1. Remove engine from vehicle. Refer to *ENGINE REMOVAL AND INSTALLATION* subsection.
2. Remove air intake manifold, refer to *AIR INTAKE SYSTEM* subsection.
3. Remove valve cover, refer to *TOP END* subsection.
4. Refer to *LUBRICATION SYSTEM* subsection and remove the following parts:
   - Oil tank
   - Oil pressure regulator valve
   - Oil cooler
   - Oil sump cover.
5. Refer to *COOLING SYSTEM* subsection and remove following parts:
   - Water pump housing
   - Thermostat.
6. Check timing chain for excessive radial play while still installed on timing gears.



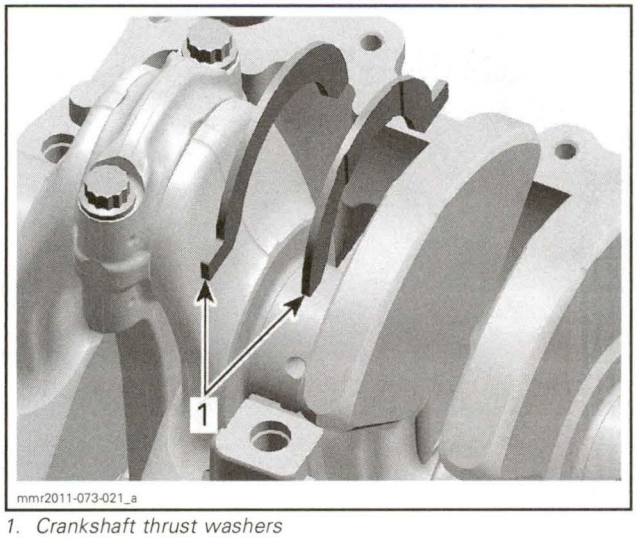
1. Radial play

7. Remove the *CAMSHAFTS*, refer to *TOP END* subsection.
8. Refer to *MAGNETO AND STARTER* subsection and remove the following parts:
   - Magneto cover
   - Rotor
   - Starter drive gears.
9. Remove oil pump intermediate gears, refer to *LUBRICATION SYSTEM* subsection.



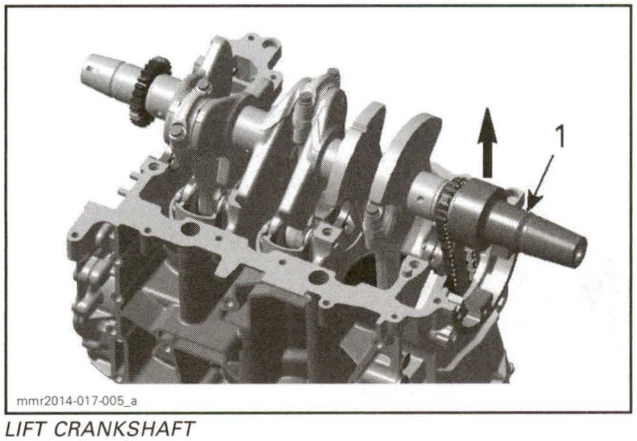
1. Oil pump intermediate gears

10. Remove crankshaft locking bolt.
11. Separate cylinder block, refer to *BOTTOM END* subsection.
12. Remove crankshaft thrust washers.



1. Crankshaft thrust washers

13. Slightly lift the crankshaft.

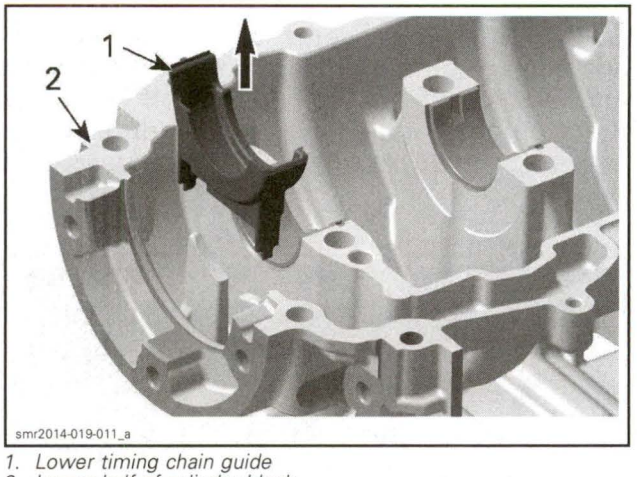


LIFT CRANKSHAFT
1. Crankshaft

14. Remove timing chain.

NOTE: Make a mark on the timing chain to indicate the operating direction of the chain before removal.

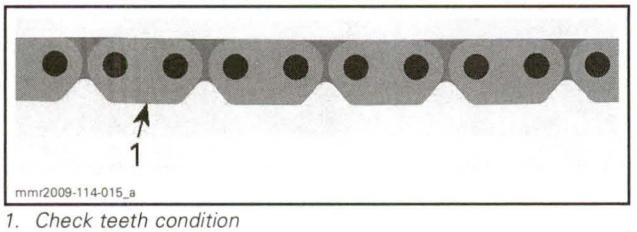
15. Remove lower timing chain guide from lower half of cylinder block.



1. Lower timing chain guide
2. Lower half of cylinder block

Timing Chain Inspection

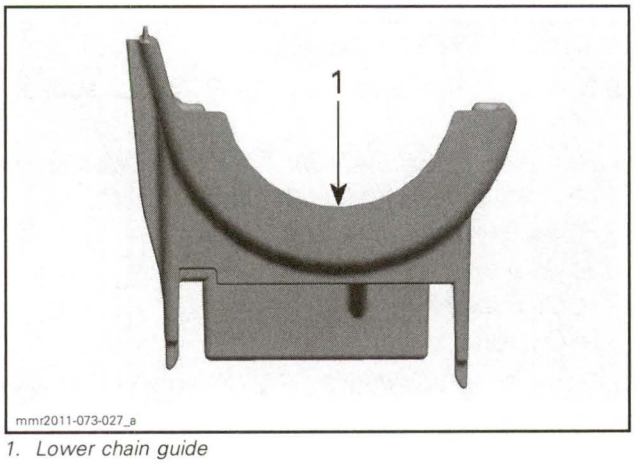
Check timing chain for wear and teeth condition.



1. Check teeth condition

NOTICE If timing chain is excessively worn or damaged, replace timing chain and camshaft timing gears as a set.

Check lower chain guide for wear, cracks or deformation. Replace as required.



1. Lower chain guide

Replace lower chain guide if timing chain wear grooves are visible.

CHAIN GUIDE GROOVE DEPTH	
SERVICE LIMIT	No timing chain wear groove allowed

NOTE: Also check the chain guide, tensioner side. Refer to *CHAIN GUIDE INSPECTION (TENSIONER SIDE)* in this subsection.

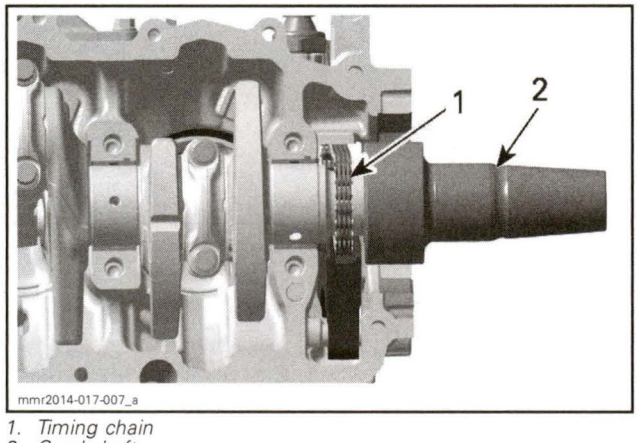
Timing Chain Installation

Reverse the removal procedure. However, pay attention to the following details.

1. Install timing chain on crankshaft timing gear.

NOTE: If the same timing chain is reinstalled, be sure to reinstall it in the same operating direction as marked during removal procedure.

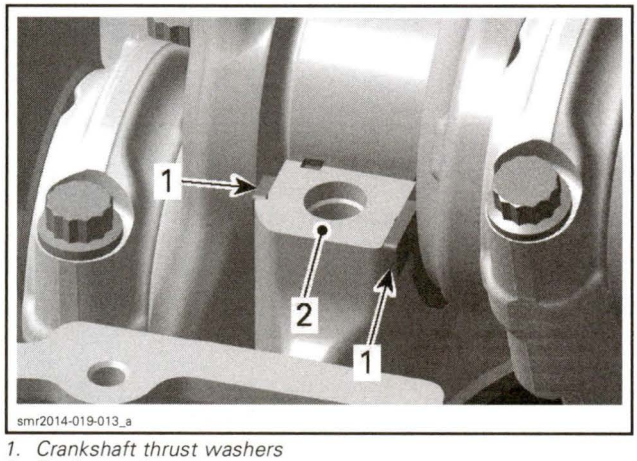
2. Install crankshaft.



1. Timing chain
2. Crankshaft

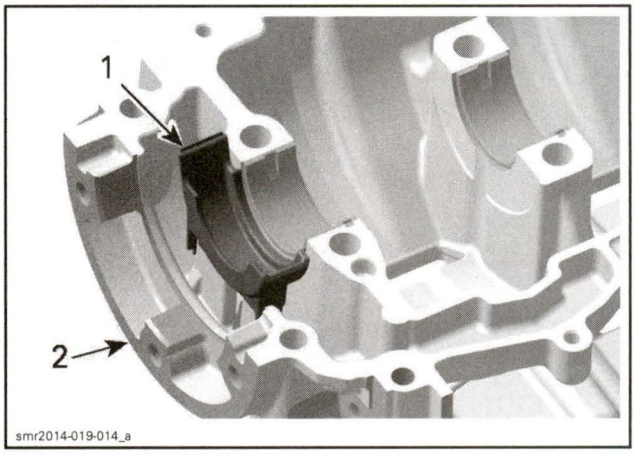
3. Properly install the crankshaft thrust washers with the slots facing against crankshaft counterweights.

NOTE: Crankshaft thrust washers must be flush with the cylinder block sealing surface.



1. Crankshaft thrust washers
2. Sealing surface

4. Reinstall lower chain guide in lower half of cylinder block.



1. Lower chain guide
2. Lower half of cylinder block

5. Reassemble cylinder block, refer to *BOTTOM END* subsection.
6. Lock crankshaft, refer to *CRANKSHAFT LOCKING PROCEDURE* in the *BOTTOM END* subsection.
7. Reinstall timing chain properly on camshaft timing gears. Refer to *CAMSHAFT INSTALLATION* in the *TOP END* subsection.

NOTICE Improper camshaft timing will damage engine components.

8. Install all other removed parts.

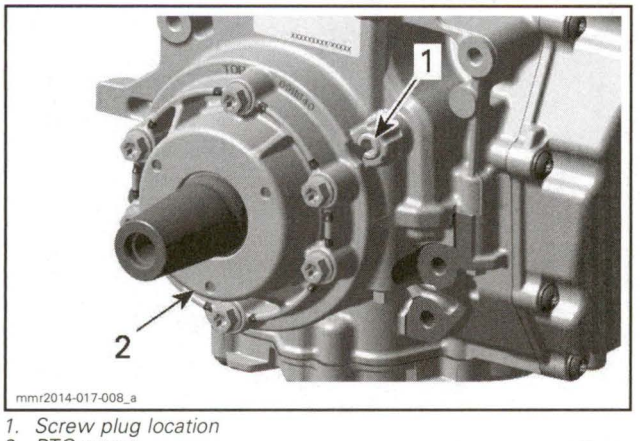
NOTE: Be sure to remove camshaft and crankshaft locking tools when timing chain is completely installed.

CHAIN GUIDE (TENSIONER SIDE)

Chain Guide Removal (Tensioner Side)

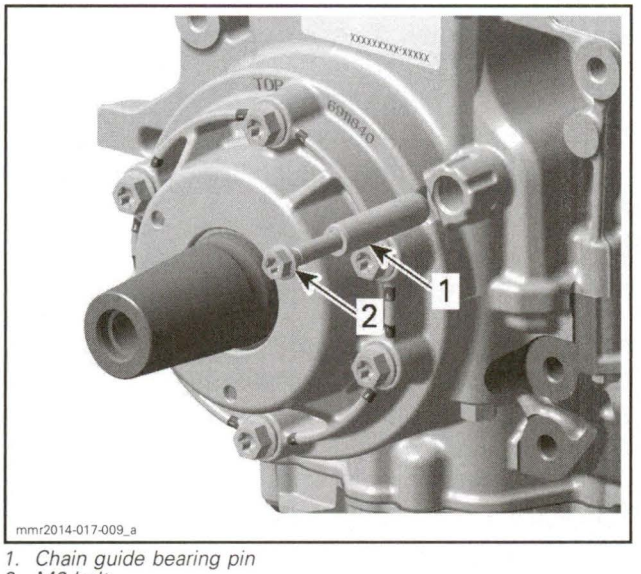
NOTE: Removal of chain guide is not recommended if there is no need for replacement.

1. Remove the *CAMSHAFTS*. Refer to *TOP END* subsection.
2. Remove screw plug that covers the chain guide bearing pin.



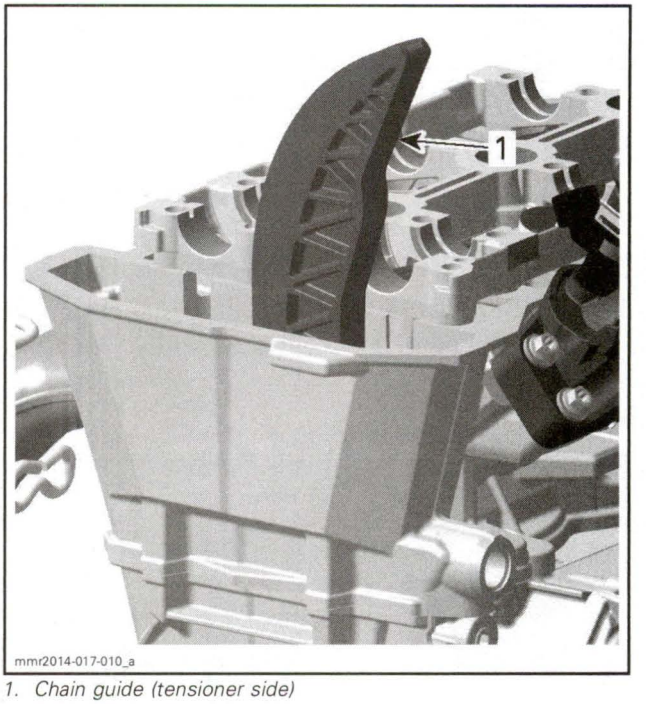
1. *Screw plug location*
2. *PTO cover*

3. Use an M6 bolt to pull chain guide bearing pin out of cylinder block.



1. *Chain guide bearing pin*
2. *M6 bolt*

4. Remove chain guide (tensioner side).



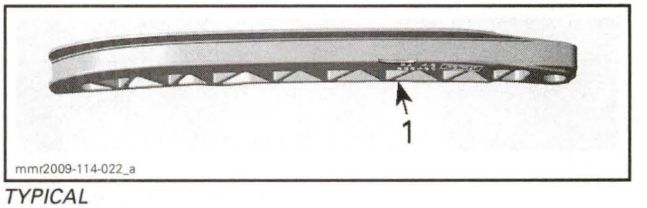
1. *Chain guide (tensioner side)*

Chain Guide Inspection (Tensioner Side)

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

Replace chain guide if groove depth caused by timing chain exceeds service limit.

CHAIN GUIDE GROOVE DEPTH	
SERVICE LIMIT	1 mm (.039 in)



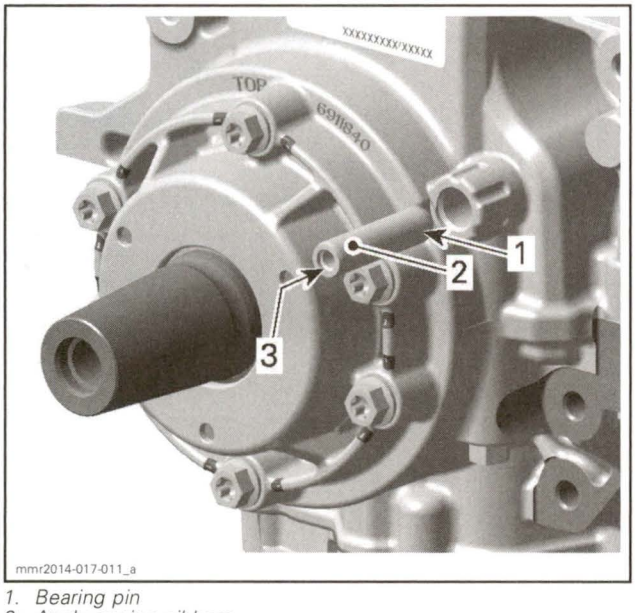
TYPICAL
1. *Chain guide*

Chain Guide Installation (Tensioner Side)

Reverse of the removal procedure however, pay attention to the following details.

1. Insert chain guide.
2. Apply engine oil on bearing pin and install it with M6 threads facing outwards.

NOTICE **Ensure chain guide bearing pin is properly inserted in the chain guide.**



1. Bearing pin
2. Apply engine oil here
3. M6 threads facing outwards

3. Tighten screw plug as specified.

NOTE: Install screw plug only in final assembled cylinder block to avoid warping of sealing surface.

SCREW PLUG	
Service product	LOCTITE 243 (BLUE) (P/N 293 800 060)
Tightening torque	9 N•m ± 1 N•m (80 lbf•**in** ± 9 lbf•**in**)

4. Properly reinstall camshafts. Refer to *CAMSHAFTS* in the *TOP END* subsection.

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

TOP END

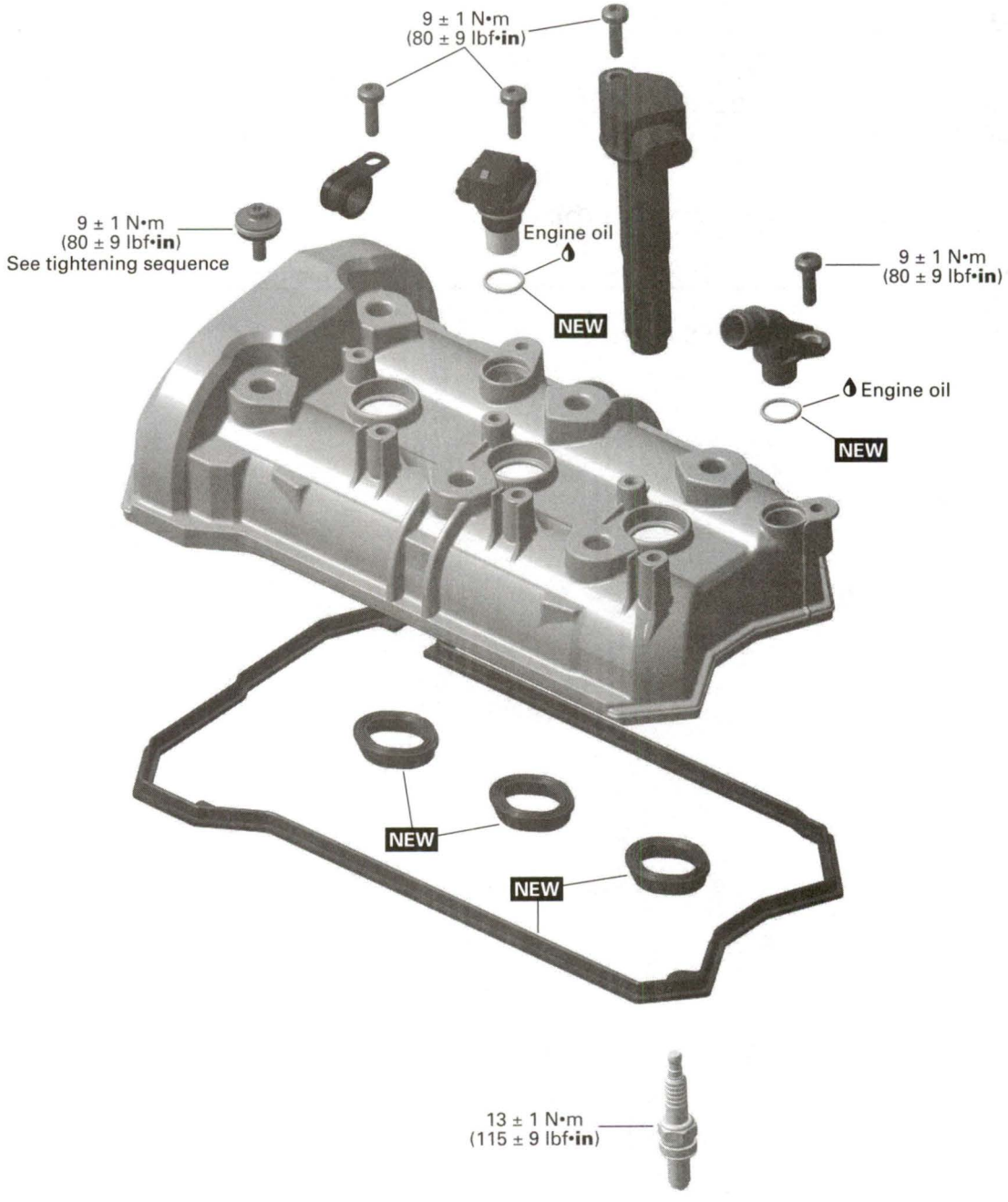
SERVICE TOOLS

Description	Part Number	Page
CAMSHAFT LOCKING TOOL	529 036 206	245
ENGINE LEAK DOWN TEST KIT	529 035 661	237
VALVE SPRING COMPRESSOR CUP	529 036 209	251
VALVE SPRING COMPRESSOR	529 035 724	251

SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
SNAP-ON VALVE HOLDER	VL2	254
SNAP-ON VALVE STEM SEAL PLIERS	YA 8230	252

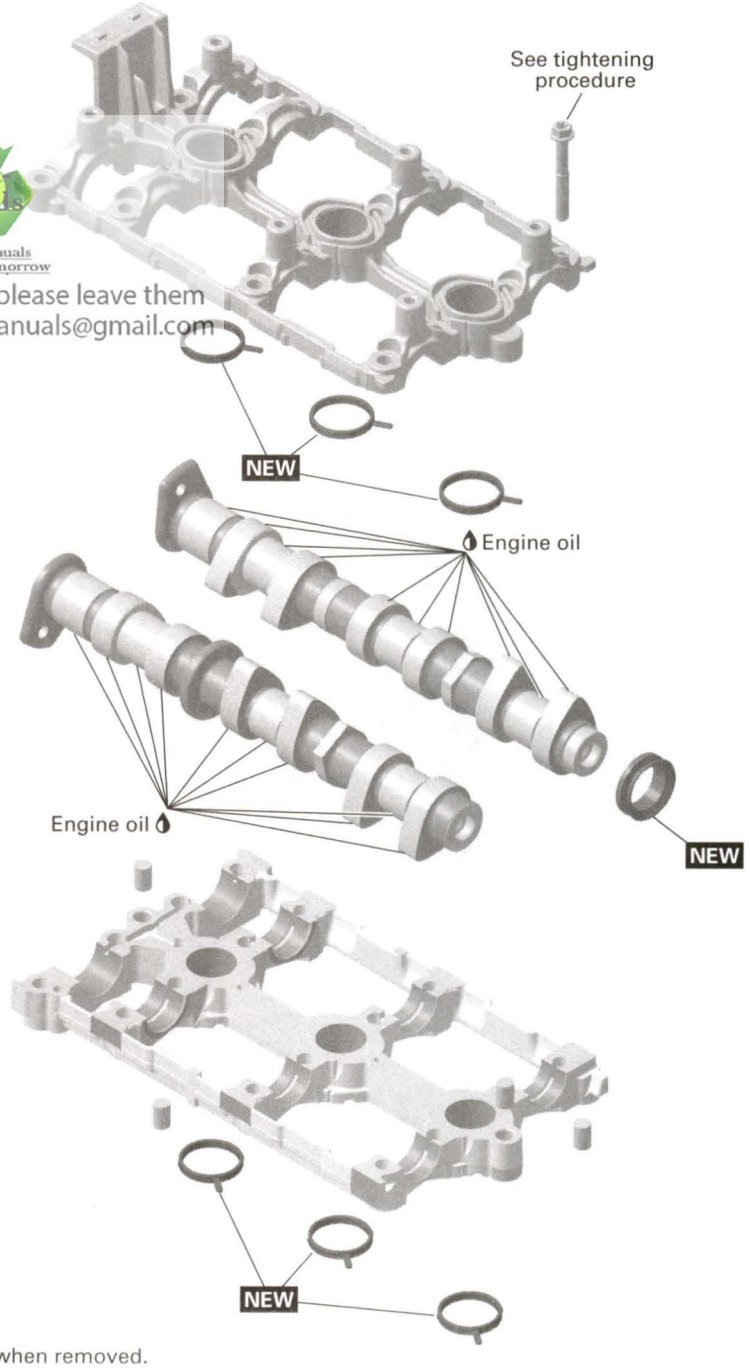
VALVE COVER



NEW = Component must be replaced when removed.

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CAMSHAFTS

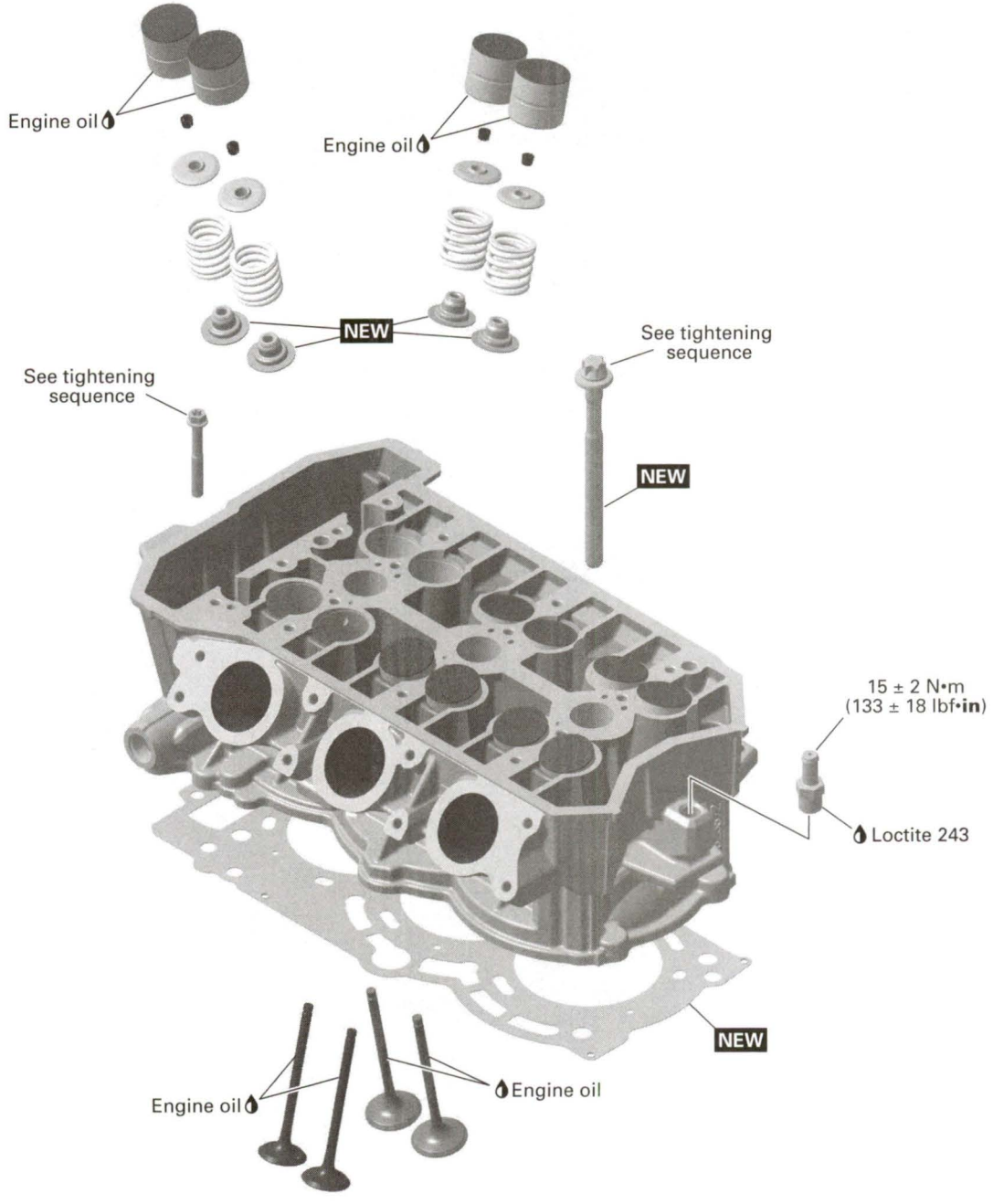


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NEW = Component must be replaced when removed.

smr2014-020-002_a

CYLINDER HEAD



NEW = Component must be replaced when removed.

smr2014-020-003_a

GENERAL

NOTE: For a better understanding, some illustrations are taken with engine out of the vehicle.

Disconnect the battery before working on the engine.

⚠ WARNING

Always disconnect BLACK (-) cable first and reconnect last.

When disassembling parts that are duplicated in the engine, (e.g.: valves, springs, etc.), it is strongly recommended to note their position and to keep the parts of the same assembly as a "group". If you find a defective component, it will be much easier to find the cause of the failure. Since parts were break-in together during the engine operation, they will keep their matched fit when parts are reassemble together within their "group".

INSPECTION

CYLINDER LEAK TEST

General

Before performing the cylinder leak test, verify the following:

- Clamp tightness
- Hoses condition.

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

⚠ CAUTION Engine parts could be hot.

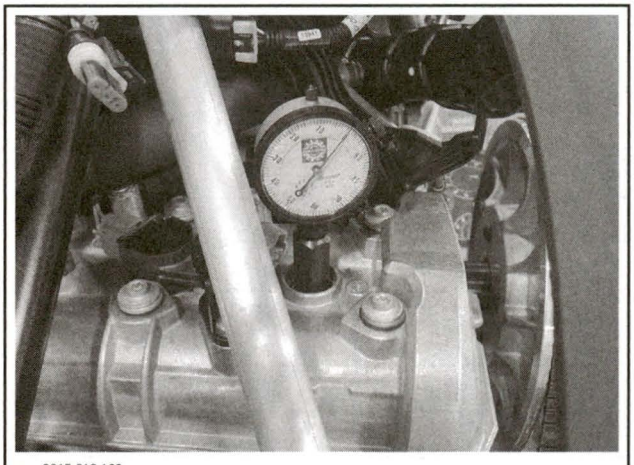
NOTE: The following steps are the same for each cylinder.

Preparation

1. Remove the *VALVE COVER*, see procedure in this subsection.
2. Remove spark plug.
3. Using the drive pulley, turn the engine counterclockwise to bring piston to TDC of compression stoke. Use a dial gauge or a suitable tool to position the piston to TDC.

NOTE: The piston must be set precisely to TDC of compression stroke. If not, the engine will continue to rotate when pressure builds up.

RECOMMENDED TOOLS	
Dial gauge	
Dial gauge extension/adapter	



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Leak Test

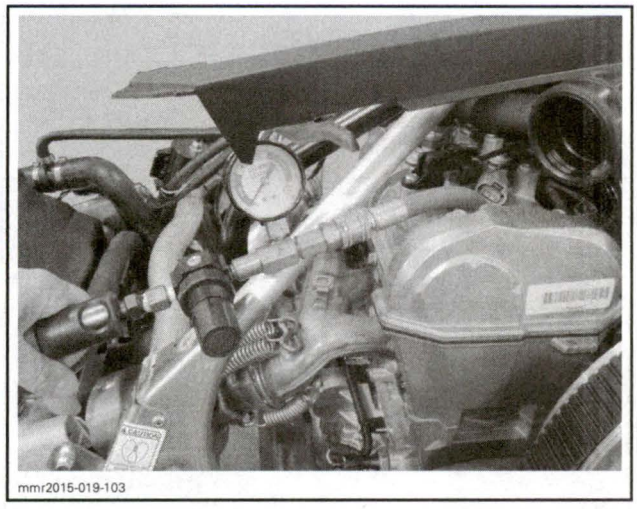
1. Install a gauge adaptor into spark plug hole.

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

2. Connect the leak down tester to an adequate air supply.
3. Set gauge needle to zero.

NOTE: All testers have specific instructions on gauge operation and required pressure. Refer to manufacturer's instructions.

4. Supply combustion chamber with air pressure.


mmr2015-019-103

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

LEAKAGE PERCENTAGE	ENGINE CONDITION
0% to 15%	Excellent condition
16% to 25%	Good condition
26% to 40%	Fair condition; reduced engine performance
41% and higher	Poor condition, diagnose and repair engine

Diagnosis

Listen for air leaks.

- Air escaping on intake port or throttle body means leaking intake valve(s).
- Air escaping on exhaust port means leaking exhaust valve(s).
- Air bubbles out of coolant tank means leaking cylinder head gasket.
- Air or coolant escaping from cylinder head means damaged gasket or loosened screws.
- Air escaping into crankcase area means excessively worn cylinder or broken piston rings.
- Air or oil escaping from crankcase means damaged gasket or loosened screws.

Repair Tips

Blue exhaust gas means damaged or worn piston rings or valve stem seals.

White exhaust gas means damaged cylinder head gasket.

Coolant tank cap opening without overheat means damaged cylinder head gasket.

Leaking valves can be caused by carbon deposits or burnt valve face.

Assembly

Reverse the preparation procedure.

TROUBLESHOOTING

Always check for fault codes. If a fault code is detected, service the fault code first. Refer to *DIAGNOSTIC AND FAULT CODES* subsection.

NOTE: When diagnosing an engine problem, always perform the cylinder leak test. This will help pinpoint a problem. Refer to *CYLINDER LEAK TEST* in this subsection.

UNUSUAL ENGINE NOISE OR VIBRATIONS

1. **Discharged or defective valve lifters.**
   - *Check engine oil pressure, refer to LUBRICATION SYSTEM subsection.*
   - *Replace valve lifters.*
2. **Camshaft(s) or camshaft holder(s) worn out.**
   - *Check and replace damaged parts.*
3. **Faulty chain tensioner.**
   - *Replace chain tensioner. Refer to TIMING CHAIN subsection.*
4. **Chain guide(s) worn out.**
   - *Replace chain guide(s). Refer to TIMING CHAIN subsection.*
5. **Stretched timing chain or worn out sprockets.**
   - *Replace timing chain and sprockets. Refer to TIMING CHAIN subsection.*
6. **Loose timing chain gear screws.**
   - *Retighten screws with recommended torque.*
7. **Incorrect camshaft timing.**
   - *Replace damaged components and readjust camshaft timing.*

OIL LEAKAGE FROM CYLINDER HEAD

1. **Leaking valve cover gasket.**
   - *Replace valve cover gaskets and retighten valve cover with recommended torque.*
   - *Check valve cover for cracks or other damage.*
2. **Leaking spark plug tube O-rings.**
   - *Replace spark plug tube O-rings.*
   - *Clean spark plug area from oil spillage.*
3. **Blow-by connector is leaking.**
   - *Replace blow by connector O-ring.*

4. Leaking cylinder head gasket.
   - *Check cylinder head for damage.*
   - *Replace cylinder head gasket and retighten screws with recommended torquing procedure.*

ENGINE SUDDENLY TURNS OFF OR LACKS ACCELERATION OR POWER

1. Incorrect camshaft timing.
   - *Replace damaged components and readjust camshaft timing.*
2. Leaking intake or exhaust valves.
   - *Perform a CYLINDER LEAK TEST. Repair or replace damaged components.*
3. Broken valve spring(s).
   - *Replace defective parts.*

PROCEDURES

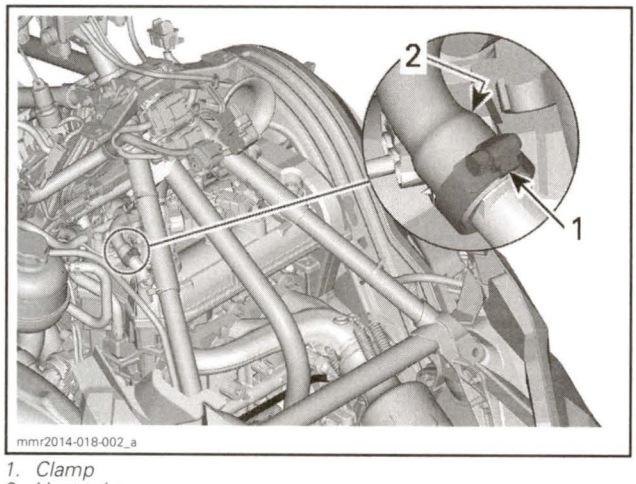
VALVE COVER

Valve Cover Access

1. Remove the air intake silencer and headlights/gauge support module as a unit. Refer to *AIR INTAKE SYSTEM* subsection.
2. Remove pulley guard.

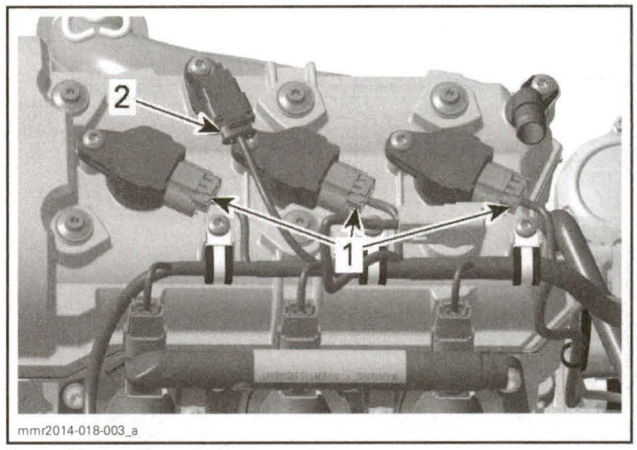
Valve Cover Removal

1. Refer to *EXHAUST SYSTEM* subsection and remove the exhaust manifold.
2. Disconnect vent tube from the blow-by-connector.



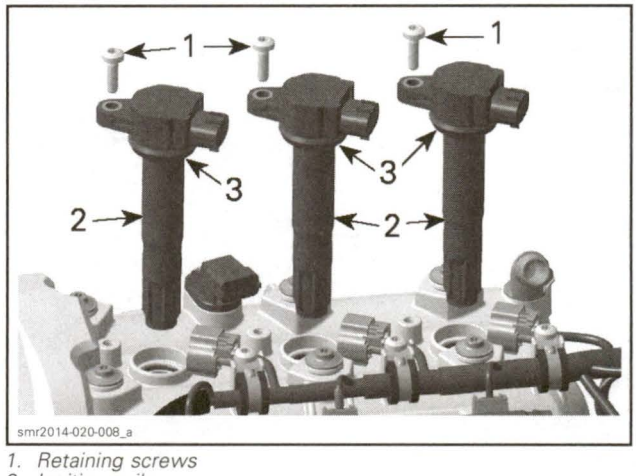
1. *Clamp*
2. *Vent tube*

3. Unplug CAPS (camshaft position sensor).
4. Unplug ignition coils.



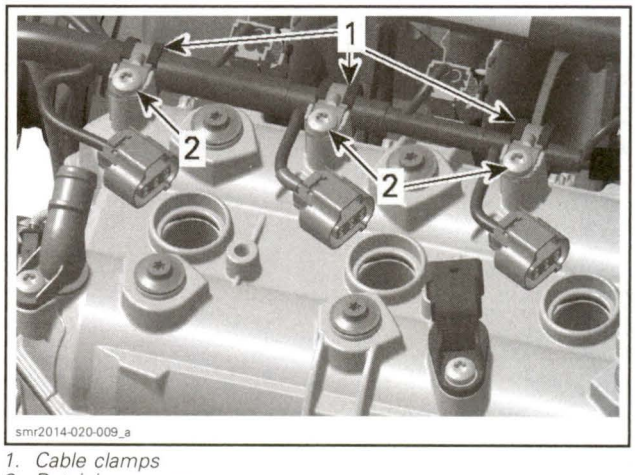
1. *Ignition coil connectors*
2. *CAPS connector*

5. Remove ignition coils with gaskets.



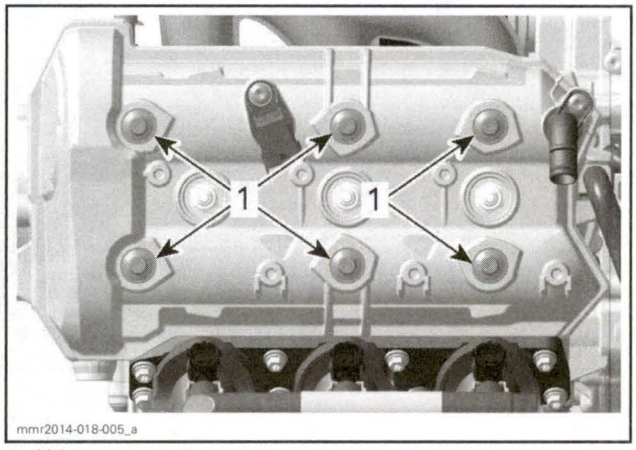
1. *Retaining screws*
2. *Ignition coils*
3. *Gaskets*

6. Remove screws securing the electrical harness to the valve cover.



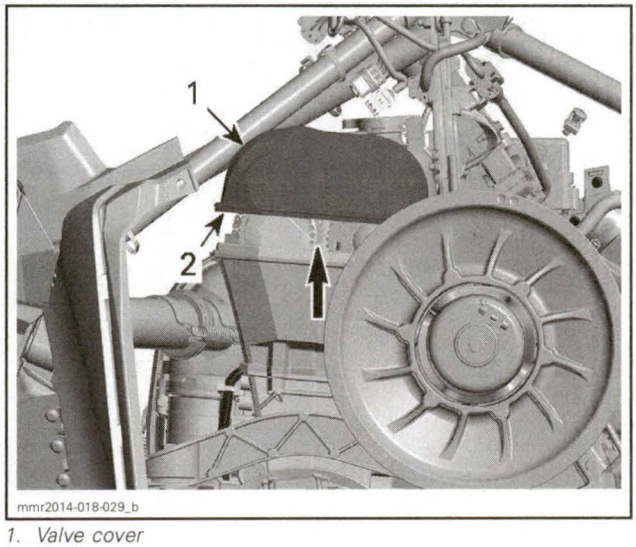
1. *Cable clamps*
2. *Retaining screws*

7. Remove valve cover retaining screws.

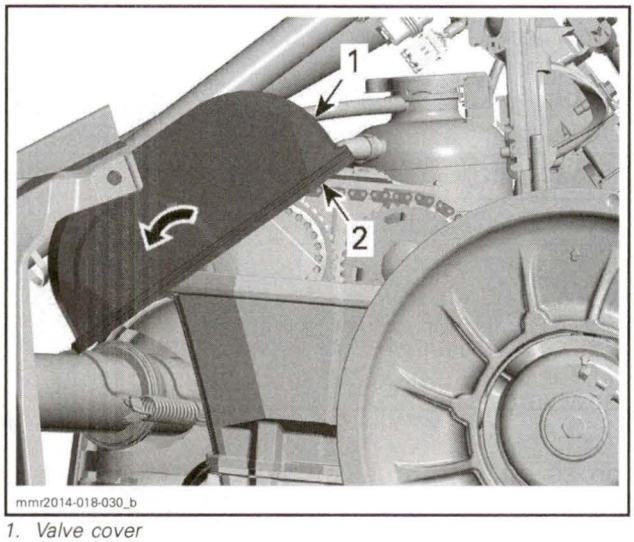


1. Valve cover screws

8. Lift and tilt valve cover with gasket towards front of engine.



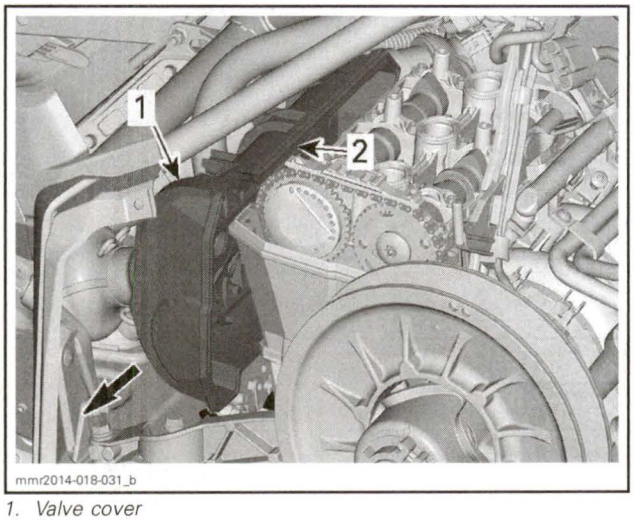
1. Valve cover
2. Gasket



1. Valve cover
2. Gasket

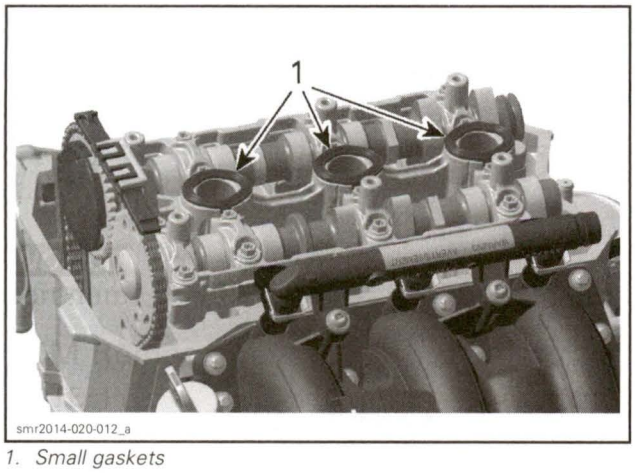
NOTE: On vehicle with lower position steering column, it may be necessary to pull with sufficient force to slide the valve cover between the cylinder head and the steering column.

9. Pull valve cover and gasket out through LH side of vehicle.



1. Valve cover
2. Gasket

10. Remove the small valve cover gaskets (spark plug holes).



1. Small gaskets

Valve Cover Inspection

Check the valve cover for cracks or other damage.

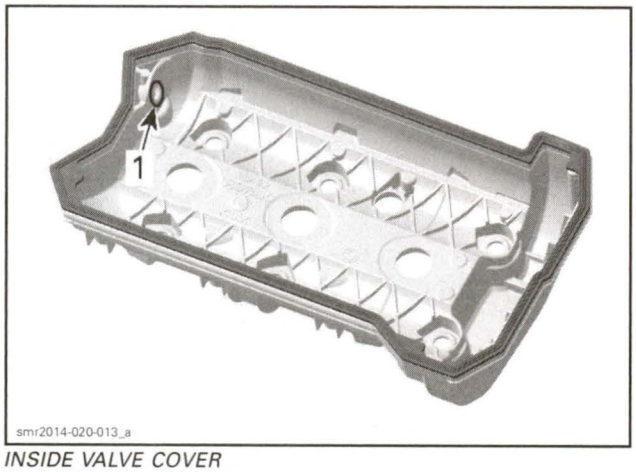
Check if the valve cover gaskets are brittle, hard or otherwise damaged.

Replace defective parts.

Valve Cover Installation

Reverse the removal procedure. However, pay attention to the following details.

1. Properly fit small gaskets into camshaft holder grooves.
2. Properly lay large gasket onto cylinder head flat surface.
3. Apply engine oil to sealing surface of V-ring.

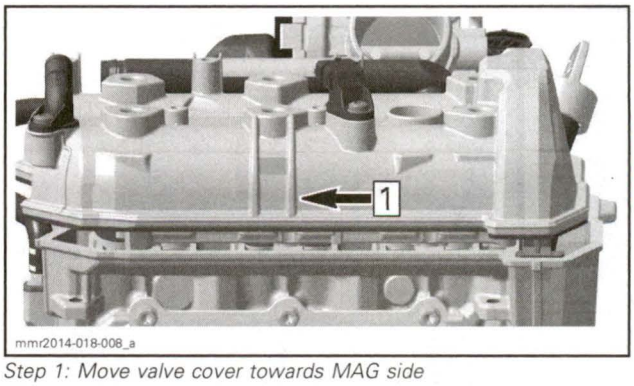


INSIDE VALVE COVER
1. Apply engine oil here

4. Install valve cover.

NOTICE **Adhere to the following procedure, otherwise damage to the V-ring will occur causing crankcase venting malfunction.**

4.1 Move valve cover towards MAG side.

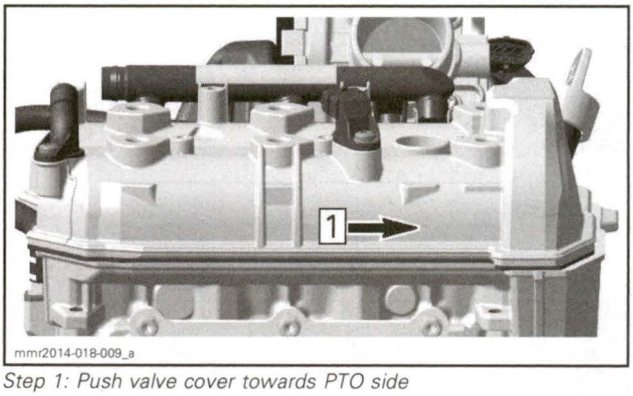


Step 1: Move valve cover towards MAG side

4.2 Place valve cover onto cylinder head.

NOTICE **Make sure the valve cover gasket is well positioned in the cover groove.**

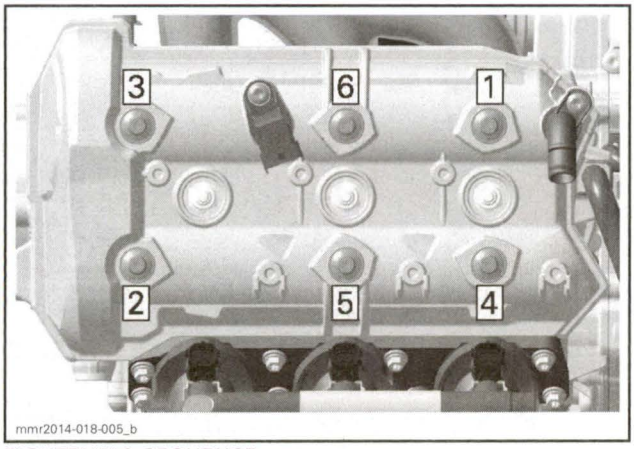
4.3 Push valve cover towards PTO side to ensure the V-ring properly seals on sealing surface inside the cover.



Step 1: Push valve cover towards PTO side

5. Install valve cover screws and tighten as per following sequence:

VALVE COVER SCREWS TIGHTENING PROCEDURE	
Step A	9 N•m ± 1 N•m (80 lbf•**in** ± 9 lbf•**in**)
Step B	9 N•m ± 1 N•m (80 lbf•**in** ± 9 lbf•**in**)



TIGHTENING SEQUENCE

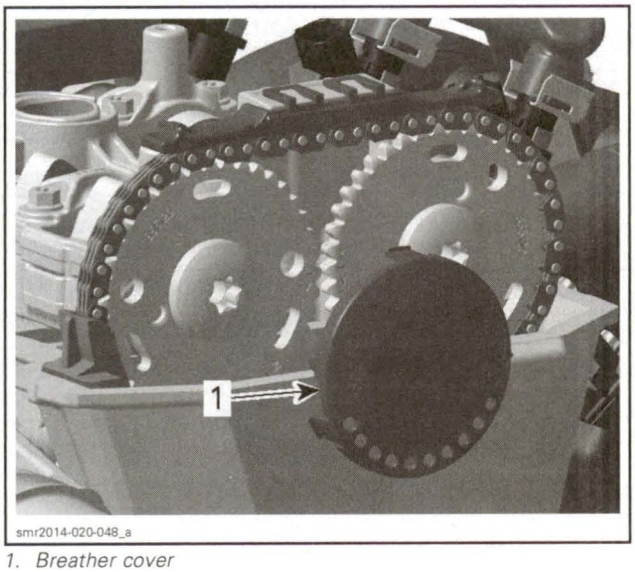
CAMSHAFTS

Camshaft Removal

1. Remove *VALVE COVER*, see procedure in this subsection.
2. Lock crankshaft, refer to *CRANKSHAFT LOCKING PROCEDURE* in the *BOTTOM END* subsection.

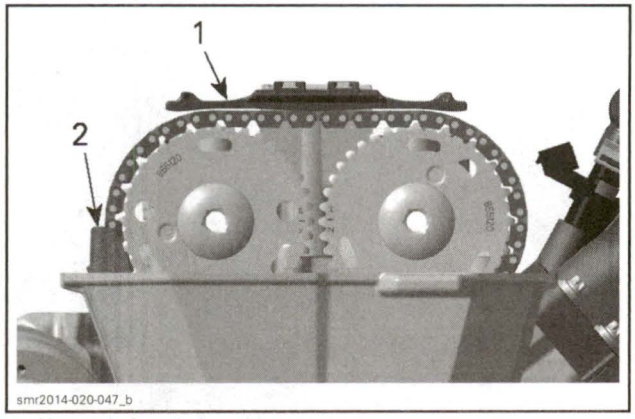
Remove timing chain tensioner. Refer to *TIMING CHAIN* subsection.

3. Remove:
   - 3.1 Breather cover



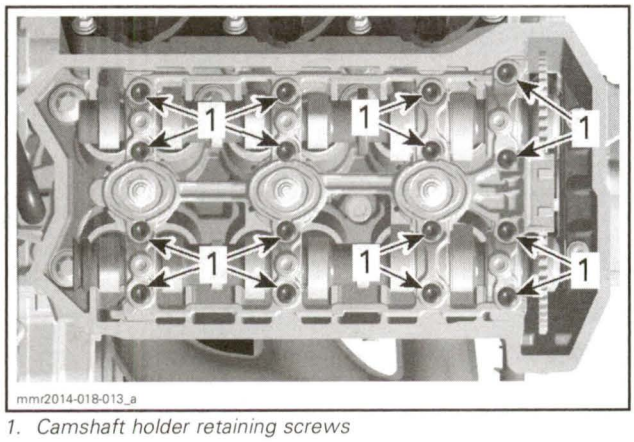
1. Breather cover

   - 3.2 Upper timing chain guide
   - 3.3 Timing chain guide.



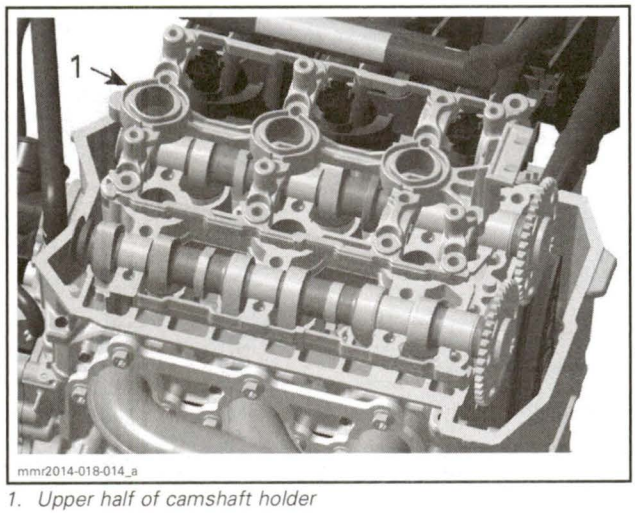
1. Upper timing chain guide
2. Timing chain guide

4. Remove timing chain from camshaft timing gears.
5. Remove camshaft holder retaining screws (x16).



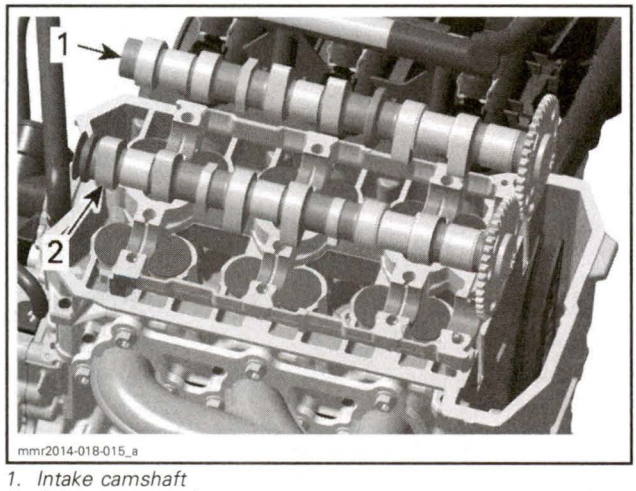
1. Camshaft holder retaining screws

6. Remove upper half of camshaft holder.



1. Upper half of camshaft holder

7. Put timing chain aside.
8. Remove camshafts with timing gears.

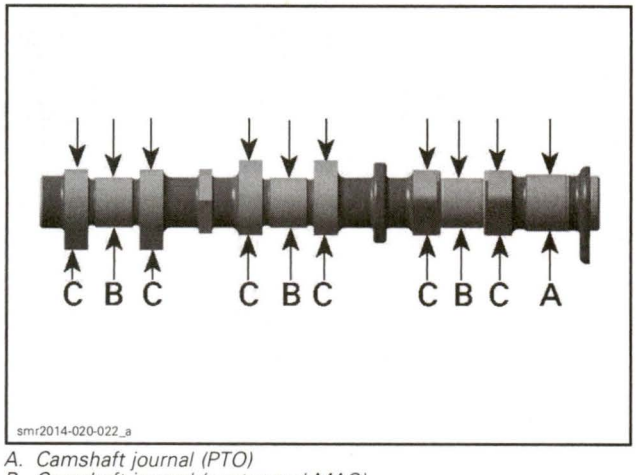


1. Intake camshaft
2. Exhaust camshaft

NOTE: Remove camshaft timing gears only if necessary. Refer to *TIMING CHAIN* subsection.

Camshaft Inspection

1. Check each lobe and bearing journal for scoring, scuffing, cracks, or other signs of wear.
2. Check if V-ring is brittle, hard or otherwise damaged.
3. Measure camshaft bearing journal diameter and lobe height, using a micrometer.



A. Camshaft journal (PTO)
B. Camshaft journal (center and MAG)
C. Camshaft lobes

CAMSHAFT JOURNAL DIAMETER	
PTO JOURNAL (A)	
NEW	25.967 mm to 25.980 mm (1.0223 in to 1.0228 in)
SERVICE LIMIT	25.940 mm (1.0213 in)
CENTER AND MAG JOURNAL (B)	
NEW	22.957 mm to 22.970 mm (.9038 in to .9043 in)
SERVICE LIMIT	22.930 mm (.9028 in)

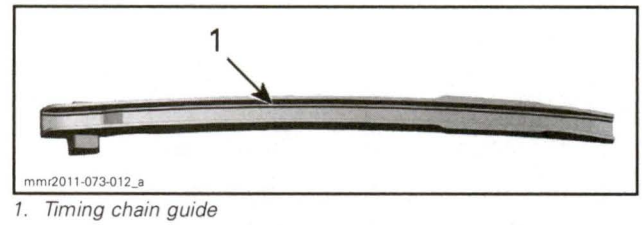
CAMSHAFT LOBE HEIGHT	
EXHAUST and INTAKE CAMSHAFT (C)	
NEW	38.35 mm to 38.55 mm (1.51 in to 1.518 in)
SERVICE LIMIT	38.33 mm (1.509 in)

Replace parts if necessary.

For camshaft journal radial clearance and camshaft holder bearing diameter refer to *CAMSHAFT HOLDER* in this subsection.

4. Check timing chain guide for wear, cracks or deformation. Replace as required.
5. Replace timing chain guide if any groove caused by timing chain exceeds service limit.

CHAIN GUIDE GROOVE DEPTH	
SERVICE LIMIT	1 mm (.039 in)

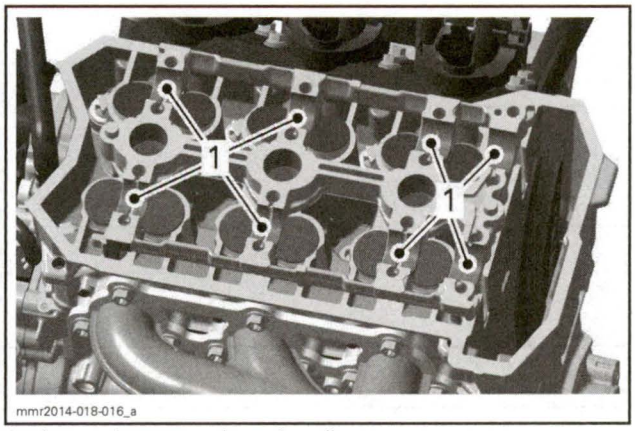


1. Timing chain guide

Camshaft Installation

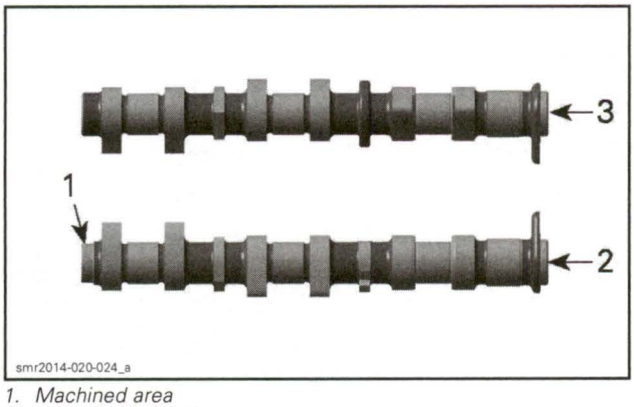
Reverse the removal procedure. However pay attention to the following details.

1. Ensure crankshaft is still locked.
2. Apply engine oil on camshaft bearings.



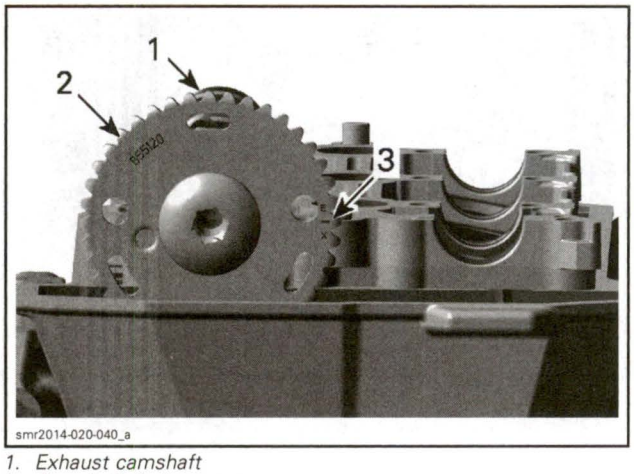
1. Areas where to apply engine oil

NOTE: The camshafts are not identical. Any mix-up of the components would lead to engine damage. The exhaust camshaft has a machined area on MAG side for the V-ring.



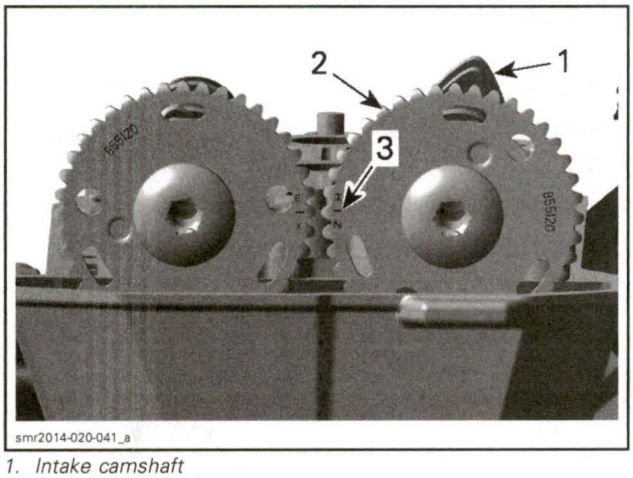
1. Machined area
2. Exhaust camshaft
3. Intake camshaft

3. If removed, reinstall camshaft timing gears on camshafts. Refer to *CAMSHAFT TIMING GEARS* in the *TIMING CHAIN* subsection.
4. Apply engine oil on camshaft journal diameter.
5. Install exhaust camshaft assembly with mark "EX" parallel to cylinder head gasket.



1. Exhaust camshaft
2. Camshaft timing gear
3. Mark "EX"

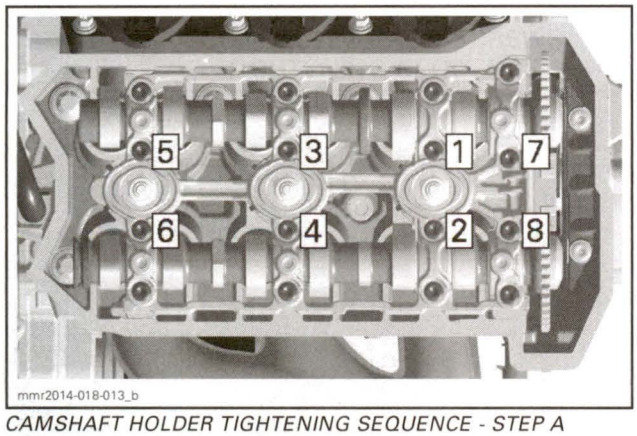
6. Install intake camshaft assembly with mark "IN" parallel to cylinder head gasket.



1. Intake camshaft
2. Camshaft timing gear
3. Mark "IN"

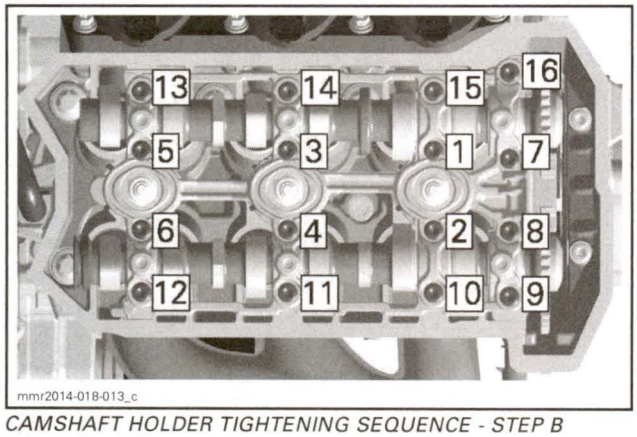
7. Install upper half of camshaft holder, then tighten screws as per following sequence:

CAMSHAFT HOLDER TIGHTENING PROCEDURE	
STEP A	5 N•m ± 0.5 N•m (44 lbf•**in** ± 4 lbf•**in**)



CAMSHAFT HOLDER TIGHTENING SEQUENCE - STEP A

CAMSHAFT HOLDER TIGHTENING PROCEDURE	
STEP B	9 N•m ± 1 N•m (80 lbf•**in** ± 9 lbf•**in**)

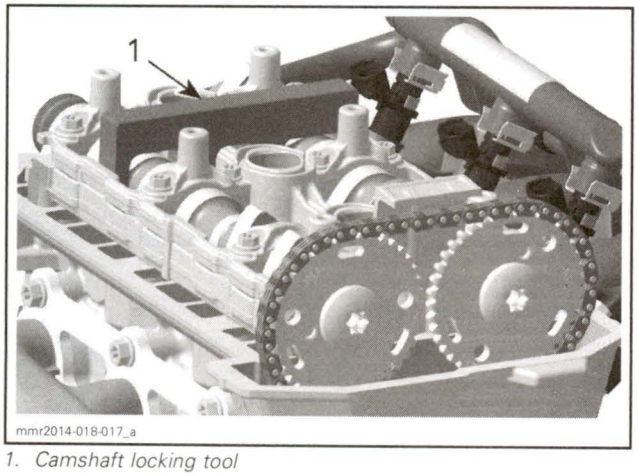


CAMSHAFT HOLDER TIGHTENING SEQUENCE - STEP B

NOTE: After reassembly of camshafts is completed, check if camshafts can be turned easily.

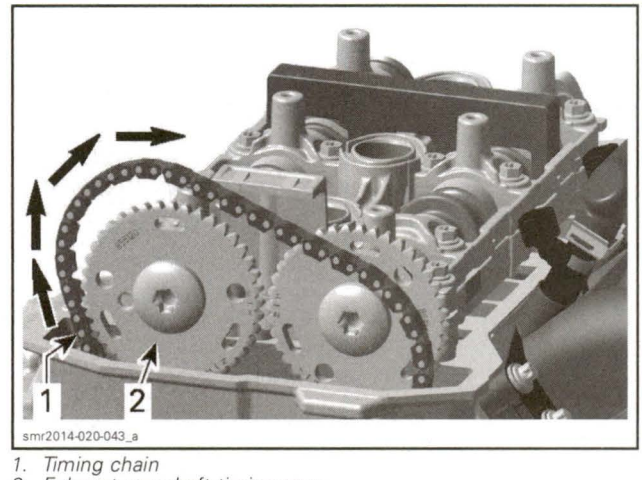
8. Lock camshafts.

REQUIRED TOOL	
CAMSHAFT LOCKING TOOL (P/N 529 036 206)	



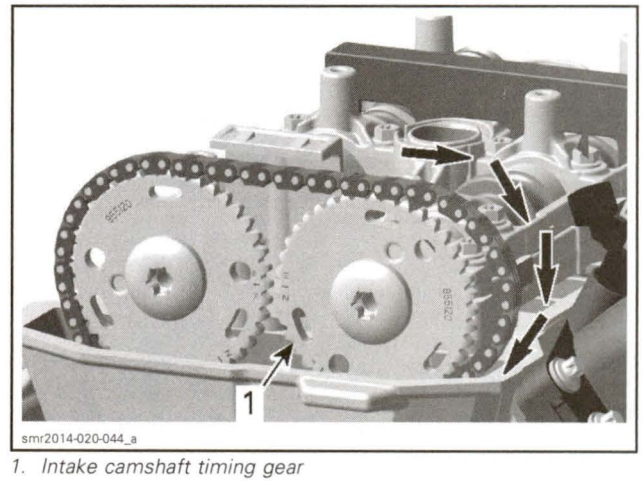
1. Camshaft locking tool

9. Lift timing chain out of timing chain compartment.
10. Pull timing chain up on exhaust side and install it on the exhaust camshaft timing gear.



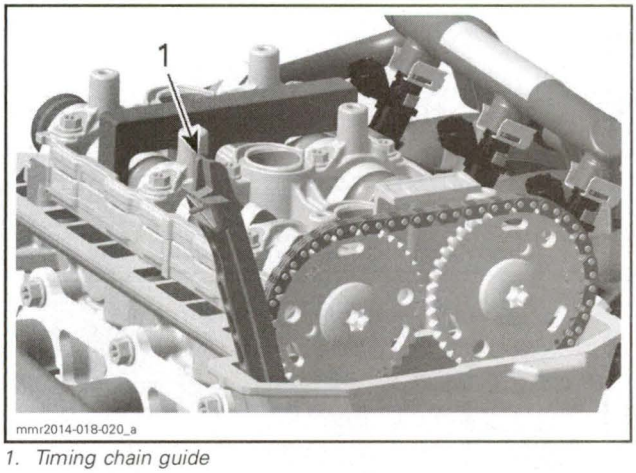
1. Timing chain
2. Exhaust camshaft timing gear

11. Pull timing chain towards intake side and install it on the intake camshaft timing gear.



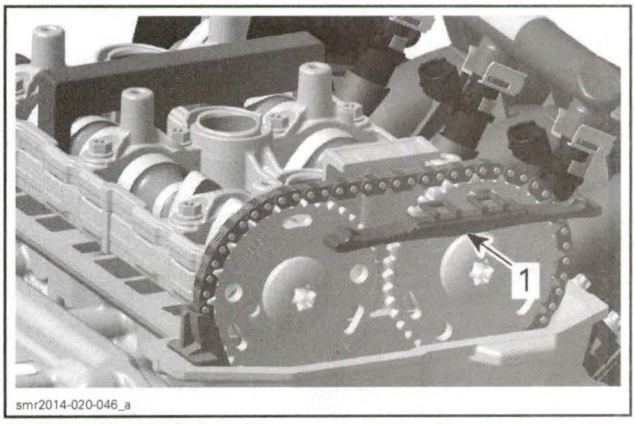
1. Intake camshaft timing gear

12. Install timing chain guide.



1. Timing chain guide

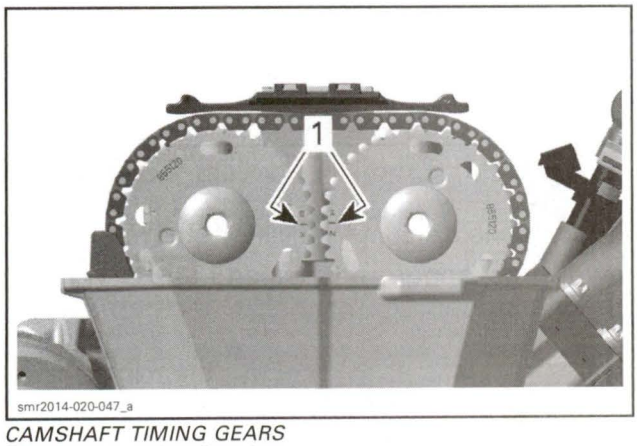
13. Install upper timing chain guide on camshaft holder.



1. Upper timing chain guide

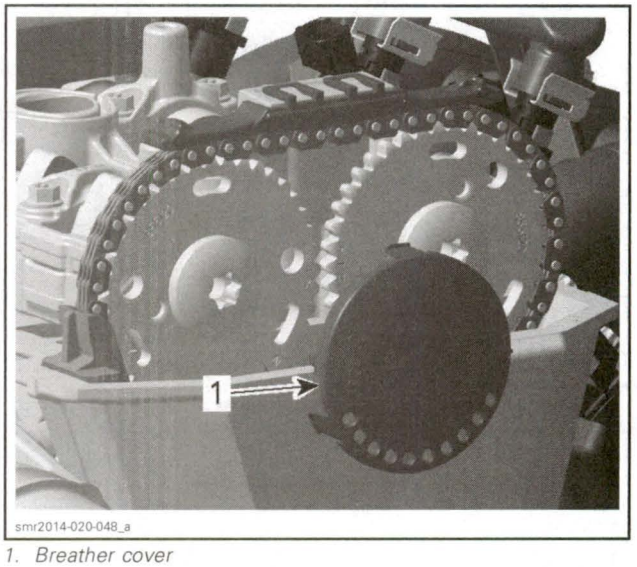
14. Install *TIMING CHAIN TENSIONER*, refer to *TIMING CHAIN* subsection.
15. Ensure marks on camshaft timing gears are still aligned. If not, repeat procedure.

NOTICE **After installation of timing chain tensioner, the marks "IN" on intake and "EX" on exhaust camshafts must be aligned.**



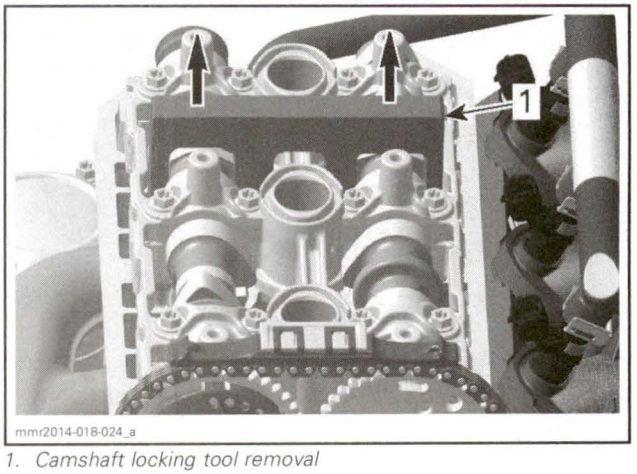
CAMSHAFT TIMING GEARS
1. Marks must be aligned

16. Install breather cover.



1. Breather cover

17. Remove camshaft locking tool.



1. Camshaft locking tool removal

18. Remove crankshaft locking tool.

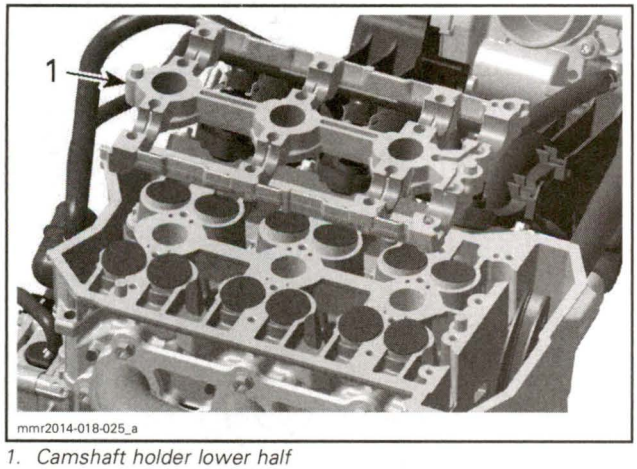
CAMSHAFT HOLDER

Camshaft Holder Removal

Remove camshafts, see procedure in this subsection.

Remove lower half of camshaft holder with gaskets from cylinder head.

Remove gaskets from camshaft holder halves and discard gaskets.

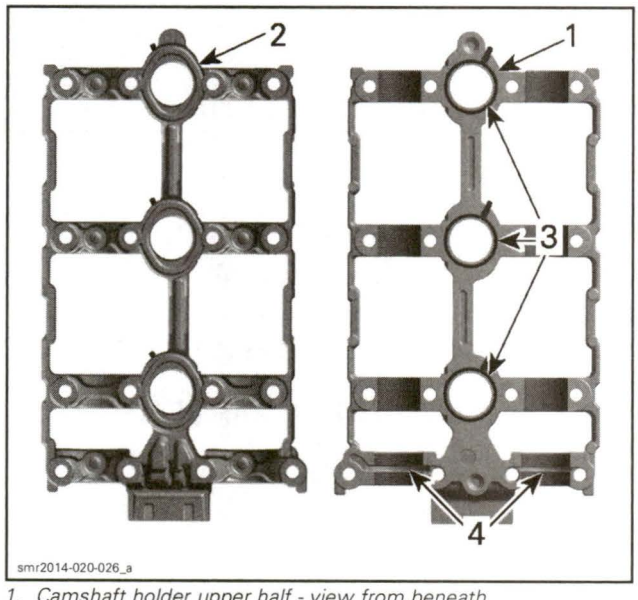


1. Camshaft holder lower half

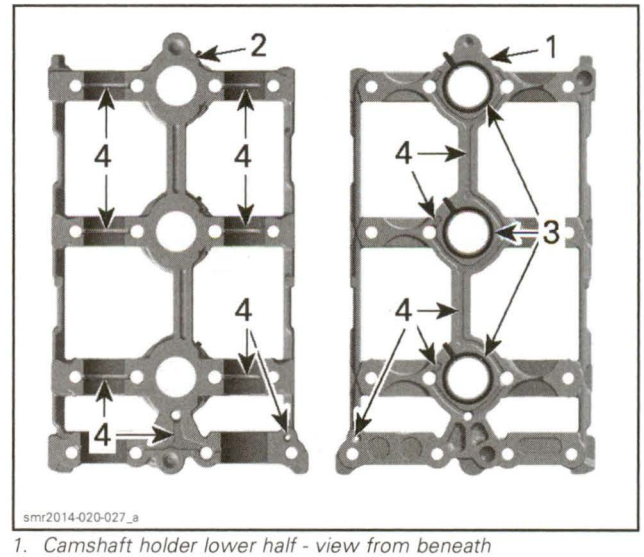
Camshaft Holder Inspection

Check camshaft holder for scoring, scuffing, cracks, or other signs of wear.

Make sure oil orifices are not clogged. Blow them out with pressurized air.



1. Camshaft holder upper half - view from beneath
2. Camshaft holder upper half - view from above
3. Gaskets
4. Oil orifices

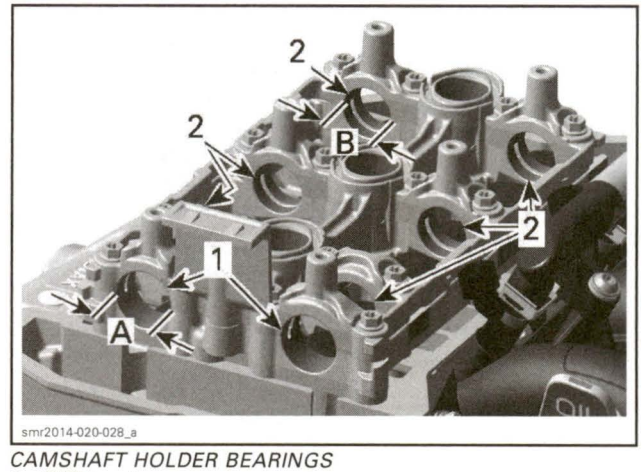


1. Camshaft holder lower half - view from beneath
2. Camshaft holder lower half - view from above
3. Gaskets
4. Oil orifices

Install camshaft holder on cylinder head.

Tighten camshaft holder screws to specification, refer to *CAMSHAFT INSTALLATION* in this subsection.

Measure camshaft holder bearing diameter.



CAMSHAFT HOLDER BEARINGS
1. PTO bearings
2. Center and MAG bearings
A. Diameter PTO bearing
B. Diameter center and MAG bearing

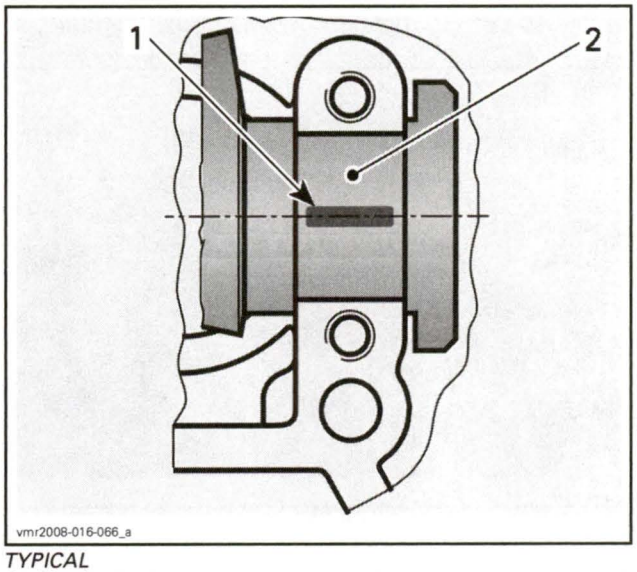
CAMSHAFT HOLDER BEARING DIAMETER	
PTO BEARING	
NEW	26.000 mm to 26.021 mm (1.024 in to 1.024 in)
SERVICE LIMIT	26.050 mm (1.026 in)
CENTER AND MAG BEARING	
NEW	23.000 mm to 23.021 mm (.906 in to .906 in)
SERVICE LIMIT	23.050 mm (.907 in)

Measure the clearance between camshaft journals and camshaft holder, using the plastic feeler gauge.

NOTE: The plastic feeler gauge is available at automotive parts retailer.

Install camshaft holder lower half on cylinder head.

Place camshafts in lower half of camshaft holder and apply a plastic-gauge on the camshaft bearing journal.

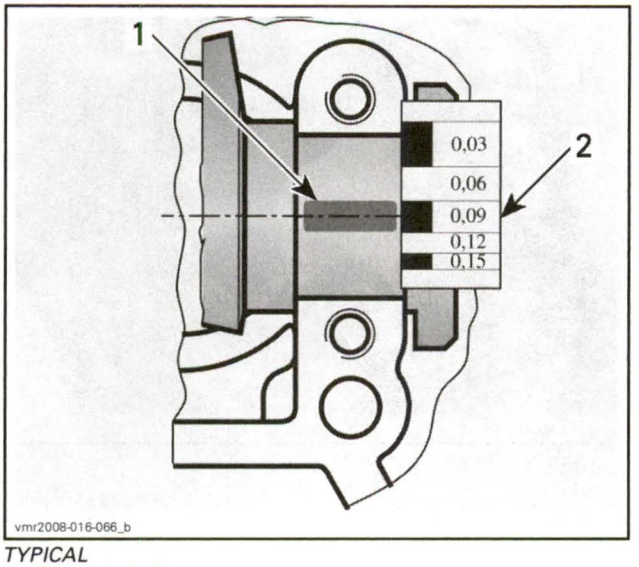


TYPICAL
1. *Plastic gauge*
2. *Camshaft bearing journal*

Install camshaft holder upper half in its proper position and tighten screws to specification, refer to *CAMSHAFT INSTALLATION* in this subsection.

Unfasten camshaft holder.

Measure the maximum width of the pressed plastic gauge with the corresponding graduated scale.



TYPICAL
1. *Pressed plastic gauge*
2. *Graduated scale*

CAMSHAFT JOURNAL RADIAL CLEARANCE	
PTO, CENTER AND MAG BEARING	
NEW	0.020 mm to 0.054 mm (.001 in to .002 in)
SERVICE LIMIT	0.080 mm (.003 in)

Replace parts if necessary.

Camshaft Holder Installation

Install camshaft holder lower half.

Continue procedure as explained in *CAMSHAFT INSTALLATION* in this subsection.

HYDRAULIC VALVE LIFTERS

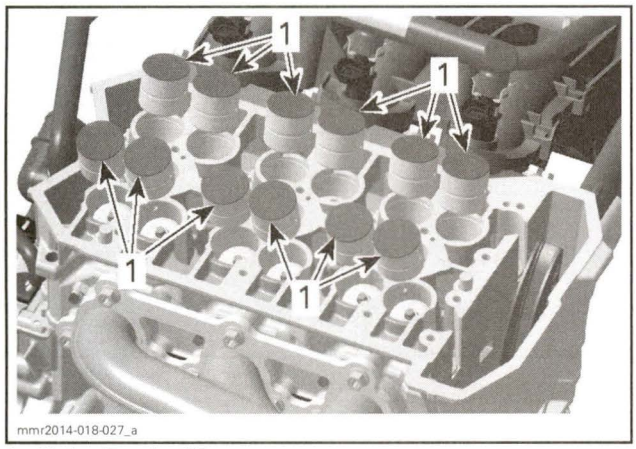
Hydraulic Valve Lifter Removal

NOTE: Hydraulic valve lifter are maintenance free.

See procedures in this subsection to remove the following:
- Valve cover
- Camshafts
- Camshaft holder.

Pull hydraulic valve lifter out of cylinder head.

NOTE: When disassembling the hydraulic valve lifter, it is strongly recommended to note their original position.



1. Hydraulic valve lifter

Hydraulic Valve Lifter Inspection

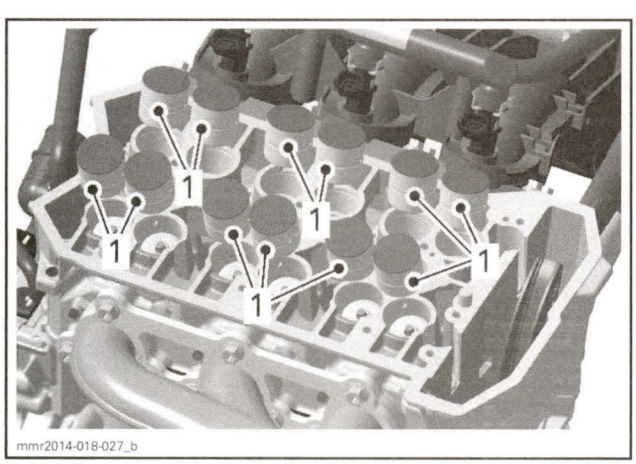
1. Check surface of hydraulic valve lifter for scoring or other damage.
2. Measure valve lifter diameter. Replace if out of specification.

HYDRAULIC VALVE LIFTER	
NEW	28.354 mm to 28.370 mm (1.1163 in to 1.1169 in)
SERVICE LIMIT	28.340 mm (1.1157 in)
HYDRAULIC VALVE LIFTER RADIAL CLEARANCE	
SERVICE LIMIT	0.100 mm (.0039 in)

Hydraulic Valve Lifter Installation

Reverse the removal procedure. However pay attention to the following details.

Apply engine oil on the outside diameter of the hydraulic valve lifter.



1. Apply engine oil on outer diameter

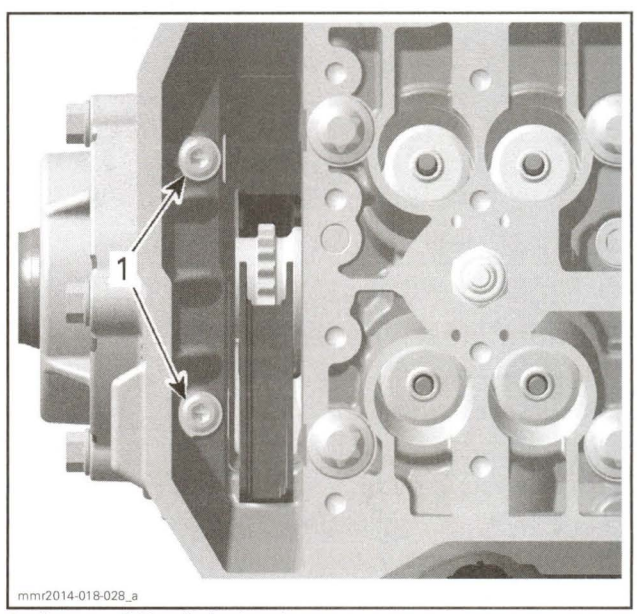
CYLINDER HEAD

Cylinder Head Access

Remove engine from vehicle. Refer to *ENGINE REMOVE AND INSTALLATION* subsection.

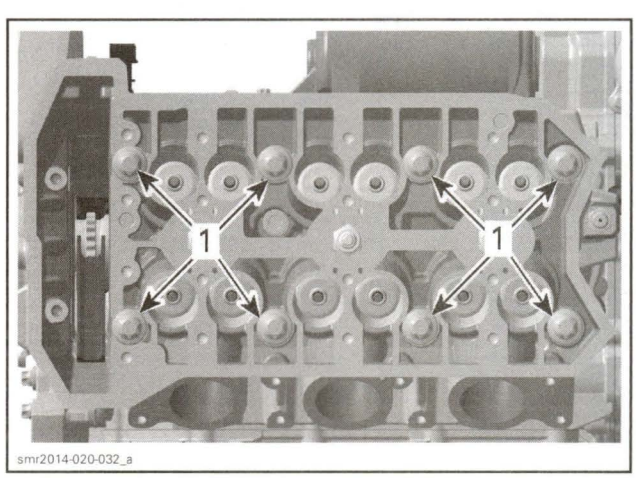
Cylinder Head Removal

1. See procedures in this subsection to remove:
   - Valve cover
   - Camshafts
   - Camshaft holder
   - Hydraulic valve lifters.
2. Remove M6 cylinder head screws.



1. Remove M6 cylinder head screws

3. Remove and discard M9 cylinder head screws.

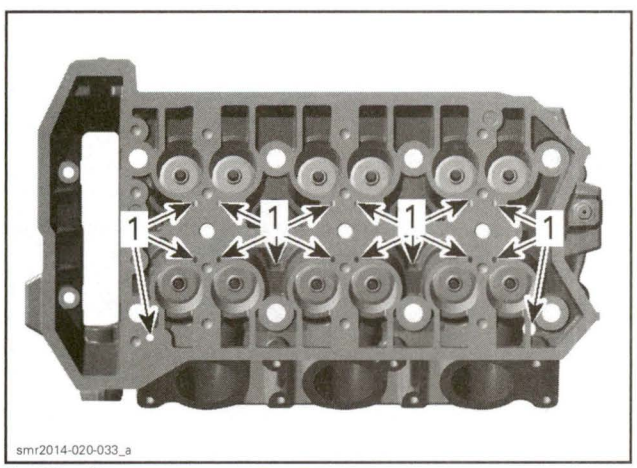


1. Remove M9 cylinder head screws

4. Pull cylinder head off the cylinder block.
5. Remove and discard cylinder head gasket.

Cylinder Head Cleaning

1. Remove carbon deposits from combustion chambers, exhaust ports and piston tops.
2. Clean cylinder head, especially cylinder head screw surface from oil spillage.
3. Blow out the oil orifices with pressurized air and make sure they are not clogged.



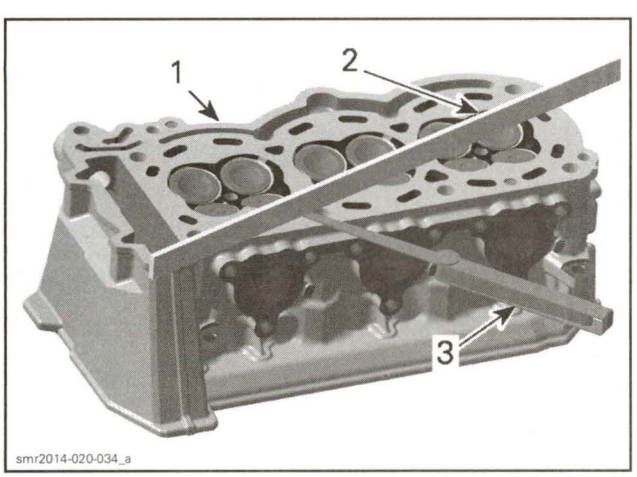
1. Oil orifices

Cylinder Head Inspection

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

Check cylinder head mating surface for flatness using a straight edge.

Check hydraulic valve lifter bores for scoring or other damage, if so, replace cylinder head.



1. Cylinder head
2. Straight edge
3. Feeler gauge

Check for cylinder head warping.

CYLINDER HEAD WARPAGE	
SERVICE LIMIT	0.15 mm (.0059 in)

If warping exceeds specification, resurface the cylinder head as follows.

Use a 400 - 600 grit wet sandpaper on a surface plate and gently grind off the mating surface.

NOTE: To ensure an even surface, rotate cylinder head several times during resurfacing.

Replace cylinder head, if resurfacing fails.

Cylinder Head Installation

Reverse the removal procedure. However, pay attention to the following details.

1. Install a NEW cylinder head gasket.

NOTICE **Each installation of the cylinder head requires a NEW cylinder head gasket. Using a gasket twice would cause engine damage.**

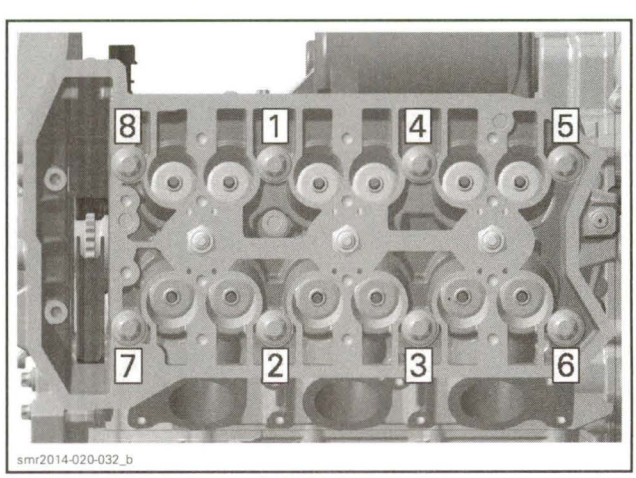
2. Install cylinder head on the cylinder block.
3. Install NEW M9 cylinder head screws.

NOTICE **This assembly uses stretch screws. Always use NEW screws and strictly adhere to the tightening procedure.**

4. Tighten cylinder head screws as follows:

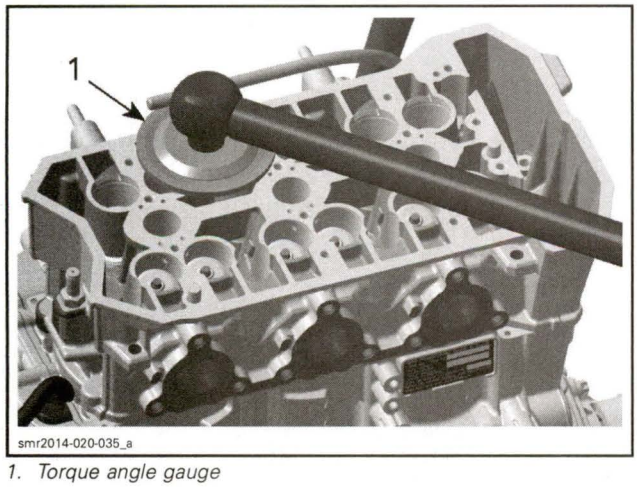
NOTE: Always perform step A on all M9 cylinder head screws before going to step B.

CYLINDER HEAD M9 SCREWS TIGHTENING PROCEDURE	
STEP A	20 N•m ± 2 N•m (15 lbf•ft ± 1 lbf•ft)
STEP B	Additional 150° ± 5°



M9 SCREWS TIGHTENING SEQUENCE

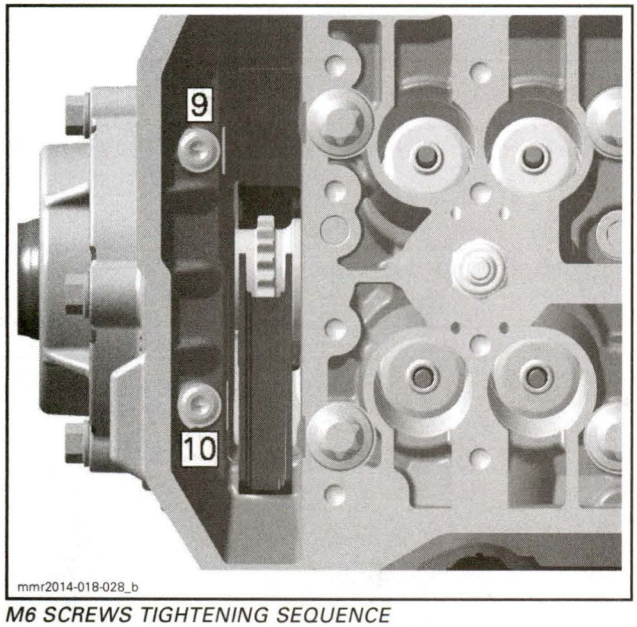
NOTE: Use a torque angle gauge to carry out step B.



1. Torque angle gauge

5. Install M6 screws. Tighten as follows.

M6 CYLINDER HEAD SCREWS	
Tightening torque	9 N•m ± 1 N•m (80 lbf•**in** ± 9 lbf•**in**)



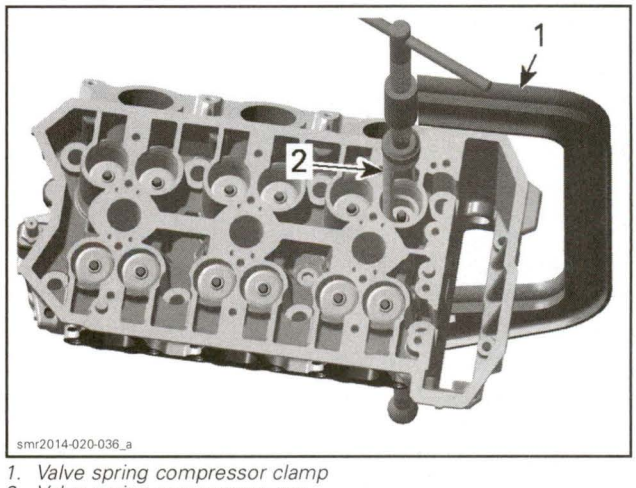
M6 SCREWS TIGHTENING SEQUENCE

VALVE SPRINGS

Valve Spring Removal

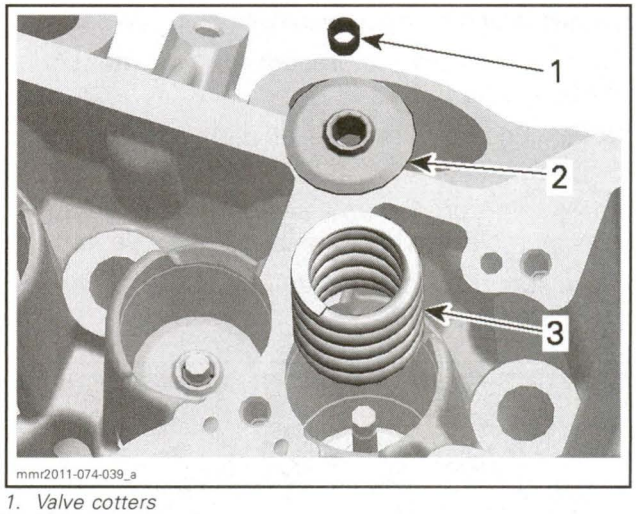
1. Remove *CYLINDER HEAD*, see procedure in this subsection.
2. Compress valve spring.

REQUIRED TOOLS	
VALVE SPRING COMPRESSOR (P/N 529 035 724)	
VALVE SPRING COMPRESSOR CUP (P/N 529 036 209)	



1. Valve spring compressor clamp
2. Valve spring compressor cup

3. Remove valve cotters.
4. Withdraw valve spring compressor tools.
5. Remove valve spring retainer and valve spring.

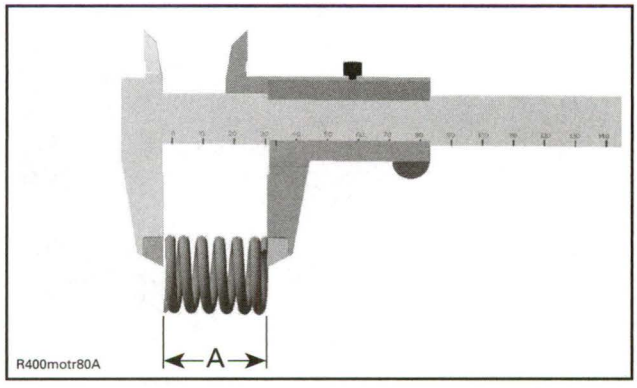


1. Valve cotters
2. Valve spring retainer
3. Valve spring

NOTE: Identify the position of each part very carefully, so it can be reinstalled in its original place.

Valve Spring Inspection

1. Check valve spring for rust, corrosion or other visible damage.
2. Check valve spring free length and straightness.



A. Spring free length

VALVE SPRING FREE LENGTH	
NEW	31.35 mm (1.2343 in)
SERVICE LIMIT	29.50 mm (1.1614 in)

Replace valve spring, if out of specification.

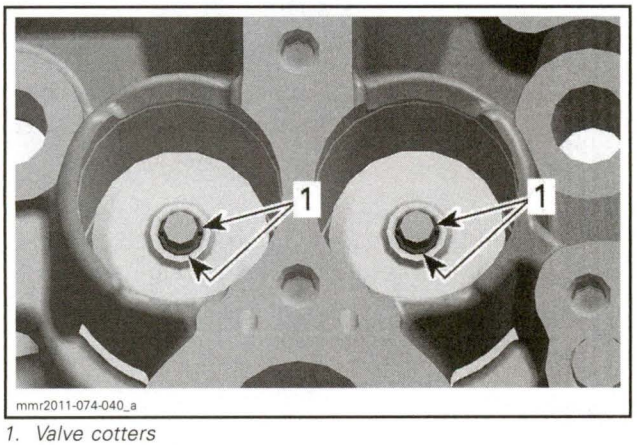
Valve Spring Installation

Reverse the removal procedure. Pay attention to the following details.

NOTE: Ensure to reinstall all parts in their original position as marked during removal.

Apply some grease on valve cotters, so that they remain in place while releasing the valve spring.

Make sure valve cotters are properly engaged into valve stem groove.



1. Valve cotters

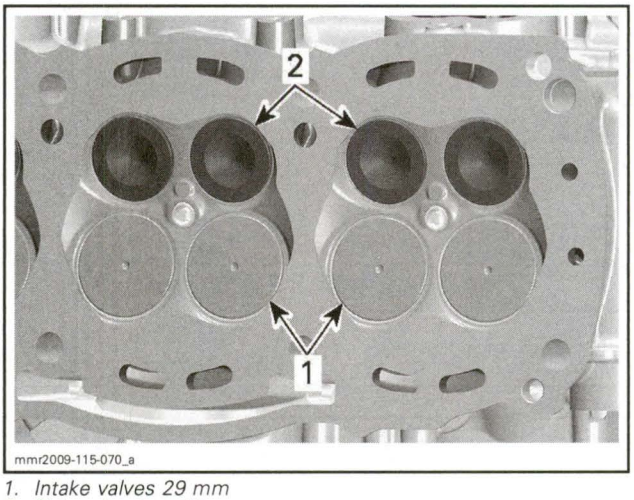
After spring is installed, ensure it is properly locked by lightly tapping on valve stem end with a soft punch and a hammer so that valve opens and closes a few times.

NOTICE **Improperly locked valve spring will cause severe engine damage and hitting the valve stem end with excessive force could damage the valve.**

VALVES

Valve Removal

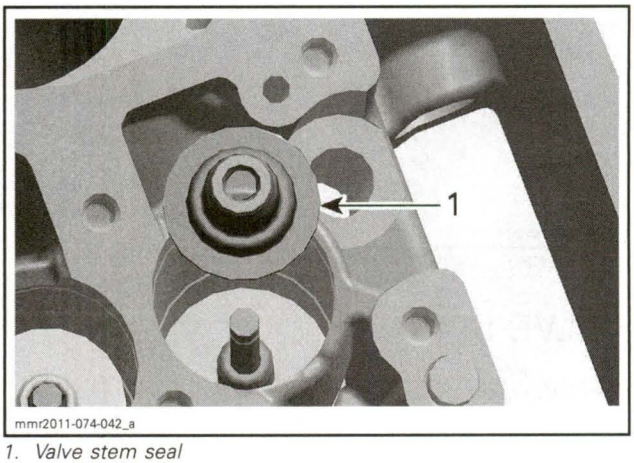
1. Remove *VALVE SPRING*, see procedure in this subsection.
2. Push on the valve stem, then pull valves out of cylinder head.



1. Intake valves 29 mm
2. Exhaust valves 25 mm

3. Remove and discard valve stem seal using special pliers.

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

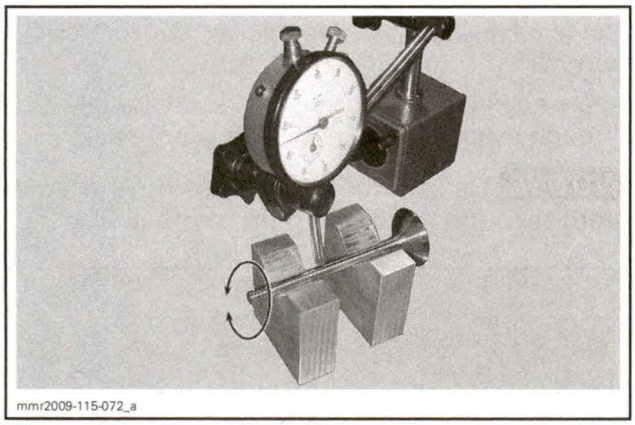


1. Valve stem seal

NOTE: Identify the position of each part very carefully, so it can be reinstalled in its original place.

Valve Inspection

Inspect valve surface, check for abnormal stem wear and bending.

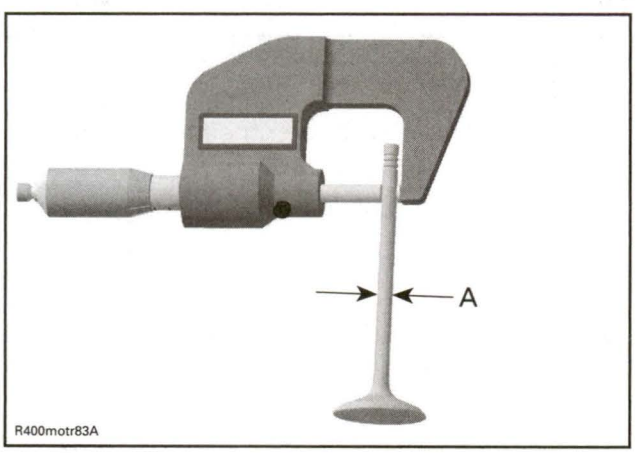

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VALVE OUT OF ROUND INTAKE AND EXHAUST VALVE	
NEW	0.005 mm (.0002 in)
SERVICE LIMIT	0.060 mm (.0024 in)

Replace valve if out of specification.

Valve Stem and Valve Guide Clearance

1. Measure valve stem at three places, using a micrometer.



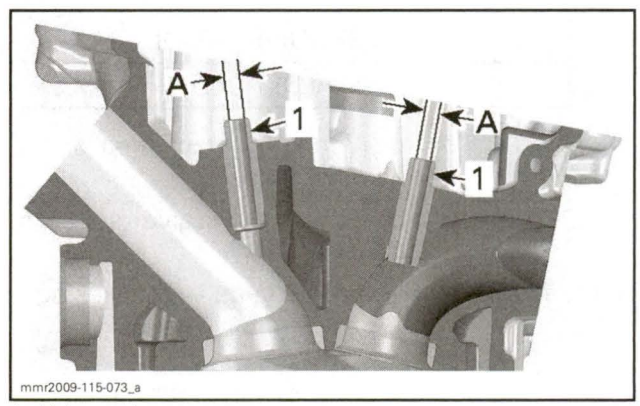
A. Valves stem diameter

VALVE STEM DIAMETER	
INTAKE VALVE	
NEW	4.958 mm to 4.972 mm (.1952 in to .1957 in)
SERVICE LIMIT	4.940 mm (.1945 in)
EXHAUST VALVE	
NEW	4.956 mm to 4.970 mm (.1951 in to .1957 in)
SERVICE LIMIT	4.940 mm (.1945 in)

Replace valve if stem is out of specification or if its surface is damaged or worn.

2. Measure valve guide inner diameter, using a small bore gauge.

NOTE: Clean valve guide from carbon deposits before measuring.

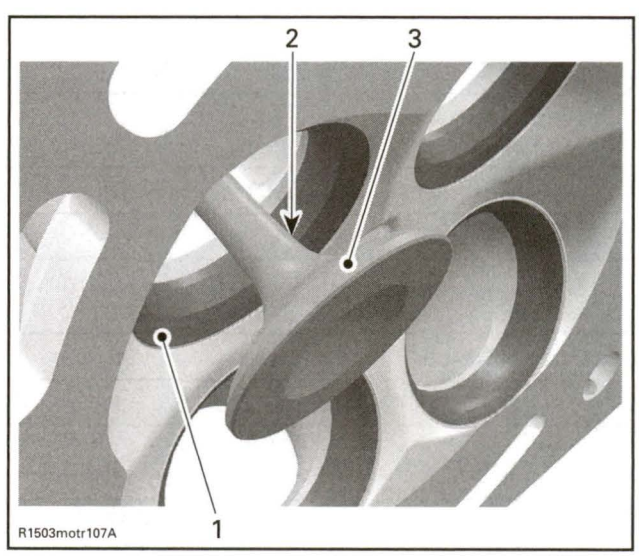


1. Valve guides
A. Valve guide inner diameter

VALVE GUIDE INNER DIAMETER	
NEW	5.000 mm to 5.020 mm (.1969 in to .1976 in)
SERVICE LIMIT	5.050 mm (.1988 in)

Replace cylinder head, if valve guide is out of specification.

Valve Face and Seat



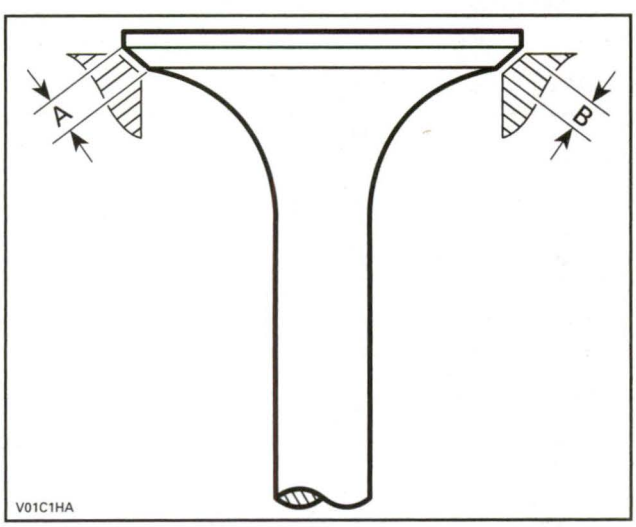
TYPICAL
1. Valve seat
2. Exhaust valve contaminated area
3. Valve face (contact surface to valve seat)

1. Check valve face and seat for burning, pitting and other signs of damage.

2. Check if valve seats properly in cylinder head. Proceed as follows.
   2.1 Apply some lapping compound on valve face and work valve on its seat with a lapping tool.

REQUIRED TOOL
SNAP-ON VALVE HOLDER (P/N VL2)

   NOTE: The location of contact area should be in center of valve face.
   2.2 Repeat procedure until valve seat and valve face fit together.
3. Measure valve seat contact width, using a caliper.



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

VALVE SEAT CONTACT WIDTH (B)	
INTAKE VALVE	
NEW	1.05 mm to 1.35 mm (.041 in to .053 in)
SERVICE LIMIT	1.70 mm (.067 in)
EXHAUST VALVE	
NEW	1.25 mm to 1.45 mm (.049 in to .057 in)
SERVICE LIMIT	1.80 mm (.071 in)

Replace parts if out of specification.

Valve Installation

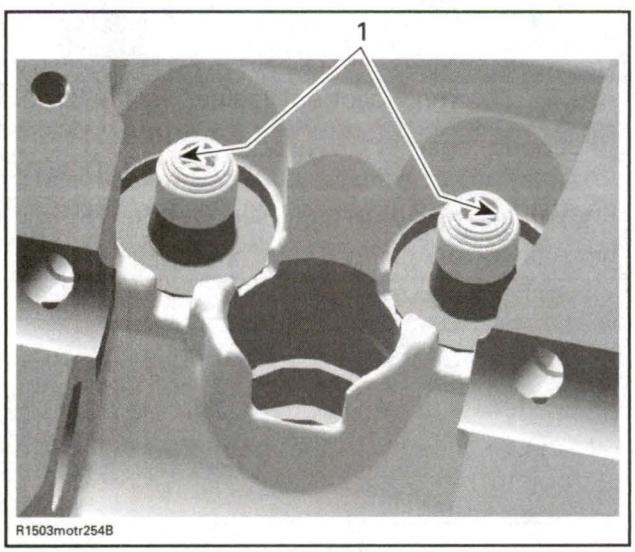
Reverse the removal procedure. Pay attention to the following details.

NOTE: Ensure to reinstall all parts in their original position as marked during removal.

Install a NEW valve stem seal whenever valve is removed.

Apply engine oil on valve stem and carefully slide through cylinder head and valve stem seal.

NOTICE Be careful when passing the valve stem through the sealing lip of the seal.



TYPICAL
1. Sealing lips of valve stem seal

Install *VALVE SPRING*. See procedure in this subsection.

Install all other removed parts.

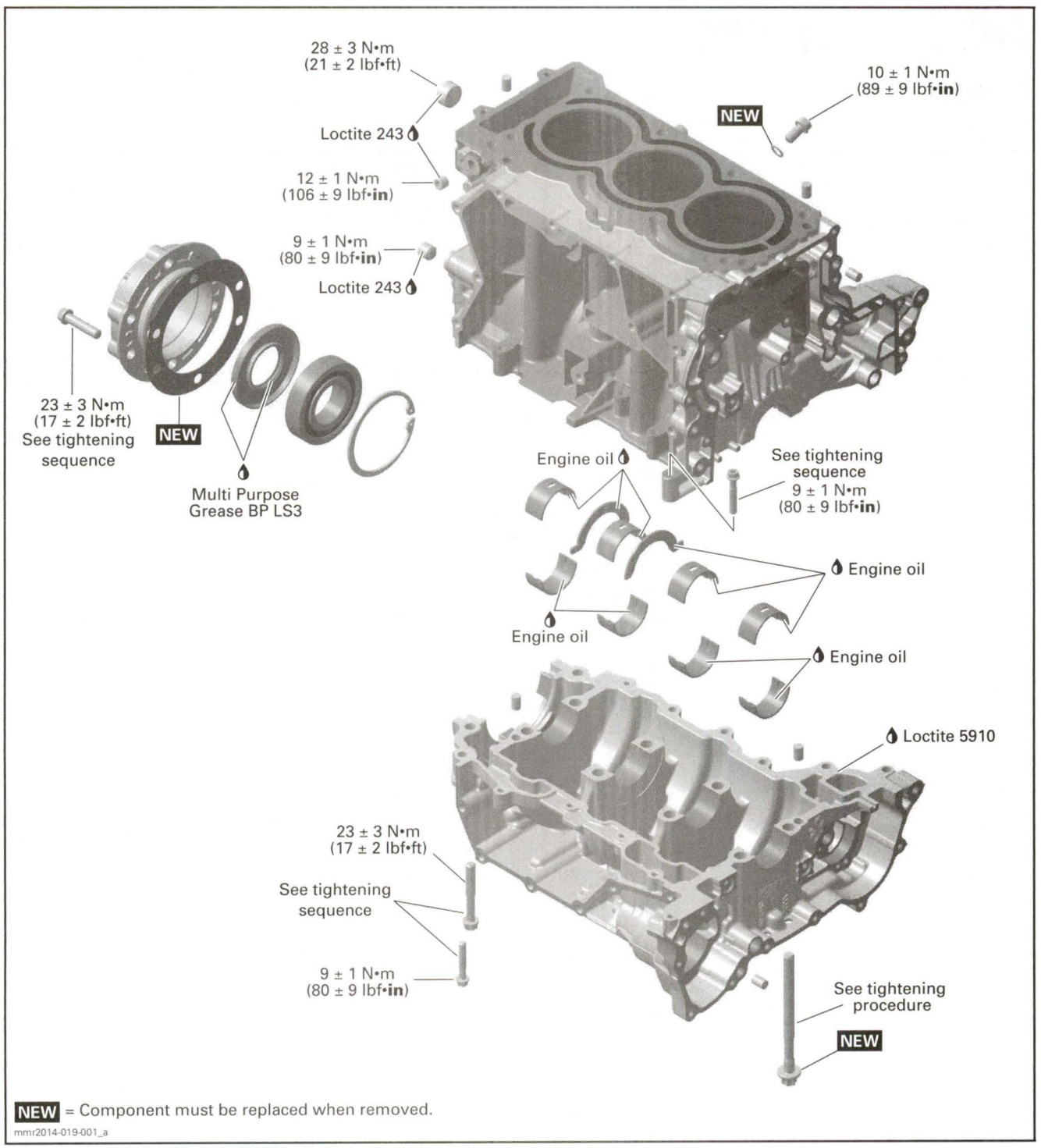
BOTTOM END

SERVICE TOOLS

Description	Part Number	Page
CRANKSHAFT LOCKING TOOL	529 036 272	268
OIL SEAL/BEARING PUSHER	529 036 284	259–260
PISTON CIRCLP INSTALLER	529 036 207	274
PISTON RING COMPRESSOR	529 036 208	276

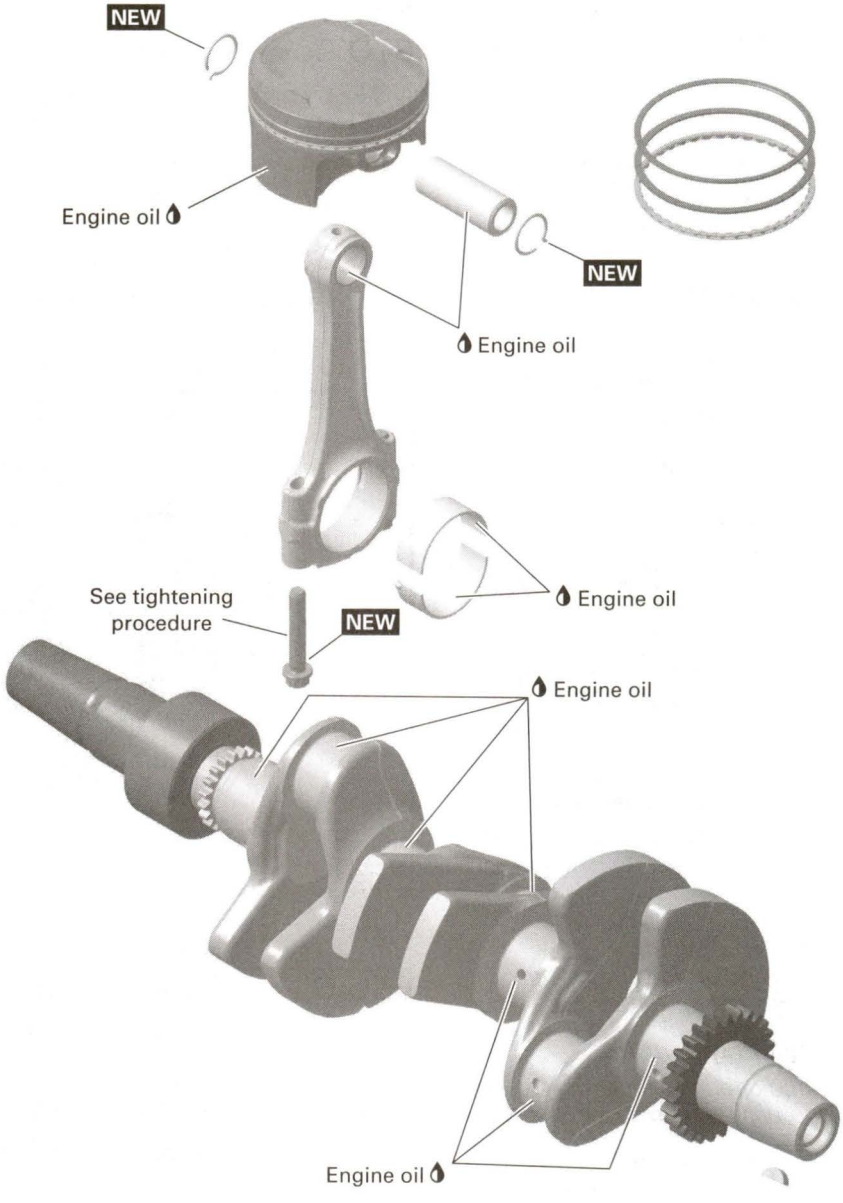
SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 5910	293 800 081	265
LOCTITE CHISEL (GASKET REMOVER)	413 708 500	264
SUPER LUBE GREASE	293 550 030	259



NEW = Component must be replaced when removed.

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NEW = Component must be replaced when removed.

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GENERAL

When disassembling parts that are duplicated in the engine, (e.g.: pistons, connecting rods etc.), it is strongly recommended to note their position and to keep the parts of the same assembly as a "group". If you find a defective component, it would be much easier to find the cause of the failure. Since parts were broken-in during engine operation, they will maintain their matched fit when reassembled together within their "group".

TROUBLESHOOTING

Always check for fault codes. If a fault code is detected, service the fault code first. Refer to *DIAGNOSTIC AND FAULT CODES* subsection.

UNUSUAL ENGINE NOISE OR VIBRATIONS

1. **Heavy wear on plain bearings.**
   - *Check radial play of plain bearings. Replace if out of specification.*
2. **Crankshaft axial play out of specification.**
   - *Measure crankshaft axial play. If crankshaft axial play is out of specification, replace thrust washers.*
3. **Connecting rod axial play out of specification.**
   - *Measure connecting rod axial play on crankshaft. Replace connecting rod or crankshaft if out of specification.*
4. **Connecting rod screws got loose.**
   - *Replace damaged components and retighten screws with the recommended torque.*
5. **Crankshaft PTO ball bearing is worn.**
   - *Remove PTO cover and check ball bearing for excessive play. Replace ball bearing if necessary.*

BLUE SMOKE IN THE EXHAUST

1. **Oil scraper rings worn out.**
   - *Replace piston rings.*

ENGINE SUDDENLY TURNS OFF (POOR IDLING)

1. **Piston rings worn out.**
   - *Replace piston rings.*
2. **Piston/cylinder clearance out of specification.**
   - *Check piston/cylinder clearance. Replace if out of specification.*
3. **Melted or broken piston.**
   - *Replace piston and cylinder block if necessary.*

PROCEDURES

PTO COVER AND PTO OIL SEALS

PTO Cover Access

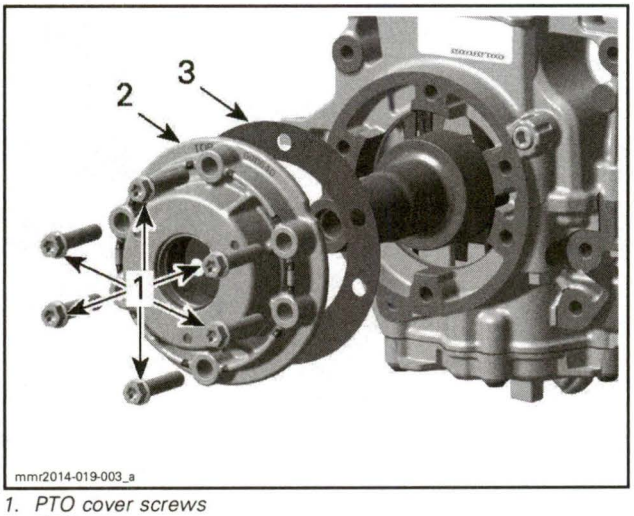
NOTE: To replace the PTO oil seal, it is not necessary to remove engine from the vehicle.

Remove drive pulley. Refer to *DRIVE PULLEY (e-Drive)* subsection.

PTO Cover Removal

Remove screws retaining the PTO cover.

Remove PTO cover and discard gasket.



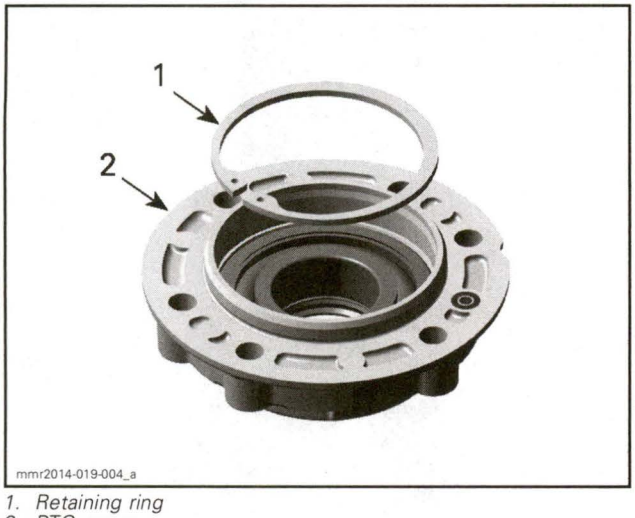
1. *PTO cover screws*
2. *PTO cover*
3. *Gasket*

PTO Oil Seal and Bearing Replacement

NOTE: Always replace PTO oil seal and ball bearing at the same time.

PTO Oil Seal and Bearing Removal

1. Use pliers to remove inner retaining ring.



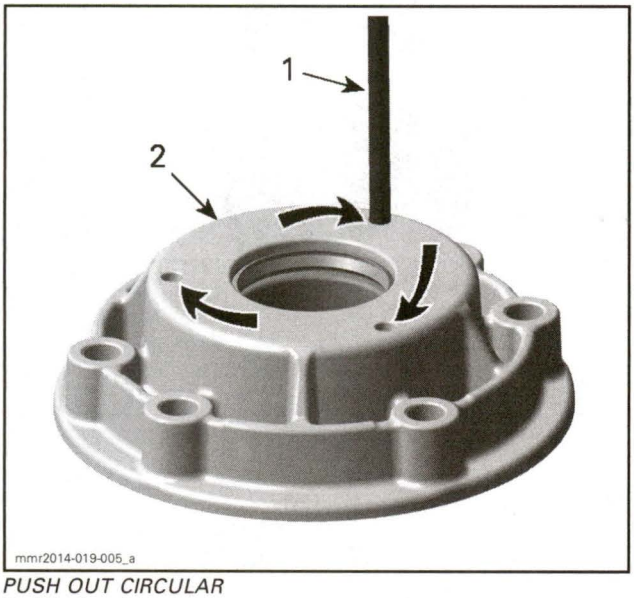
1. Retaining ring
2. PTO cover

2. Heat PTO cover to 130°C (266°F) before removing ball bearing and oil seal.

NOTICE Clean PTO cover of oil before heating.

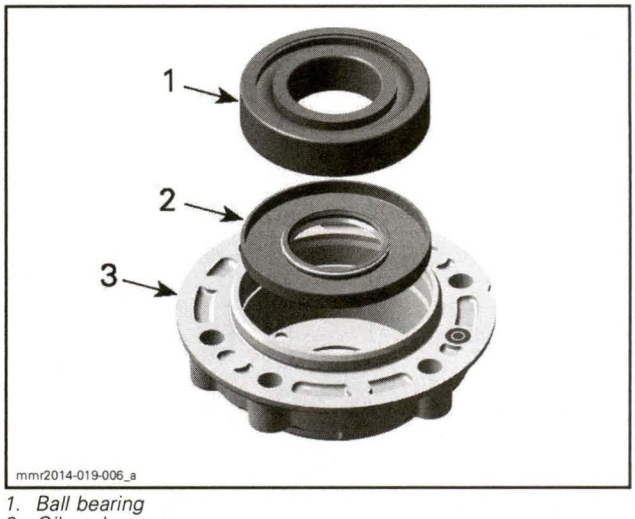
3. Carefully push out oil seal and ball bearing.

REQUIRED TOOL
Punch 4 mm (.157 in)



PUSH OUT CIRCULAR
1. Punch
2. PTO cover

4. Remove and discard ball bearing and oil seal.



1. Ball bearing
2. Oil seal
3. PTO cover

PTO Oil Seal and Bearing Installation

NOTE: Check the oil seal running surface on the crankshaft for grooves and deposits before installation of a NEW oil seal.

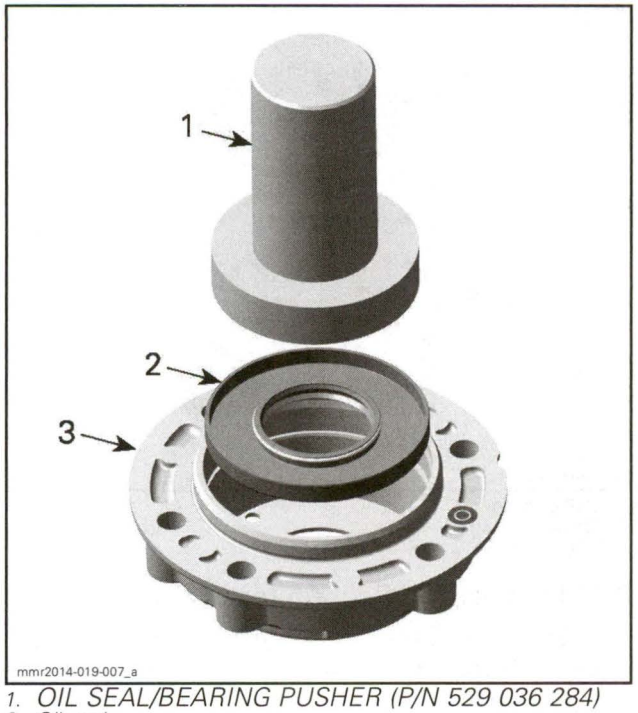
1. Clean crankshaft PTO side of deposits.
2. Clean oil seal and ball bearing areas in PTO cover.
3. Lubricate oil seal sealing lip and outer diameter.

OIL SEAL SEALING LIP AND OUTER DIAMETER	
Service product	SUPER LUBE GREASE (P/N 293 550 030)

4. Press **NEW** oil seal in PTO cover.

NOTICE Oil seal must be installed with sealing lip in, towards the engine.

REQUIRED TOOL	
OIL SEAL/BEARING PUSHER (P/N 529 036 284)	

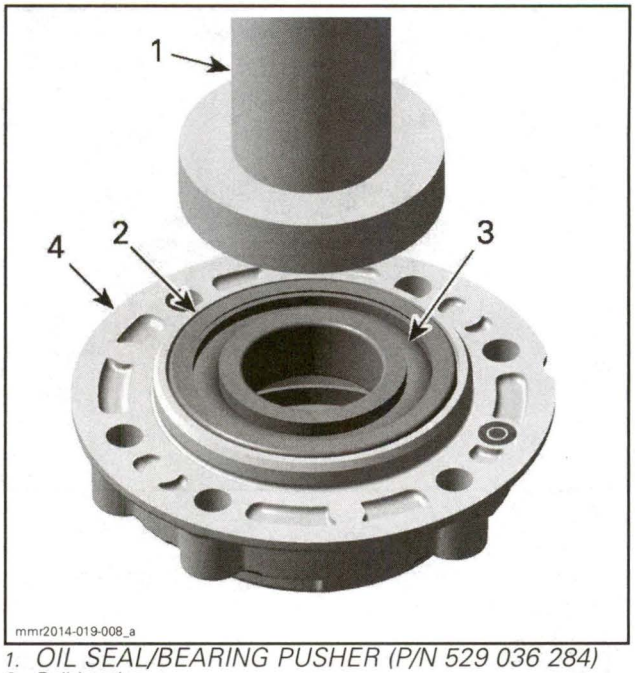


1. OIL SEAL/BEARING PUSHER (P/N 529 036 284)
2. Oil seal
3. PTO cover

5. Place **NEW** ball bearing in PTO cover with open side of plastic cage facing towards the engine.
6. Carefully press in the ball bearing.

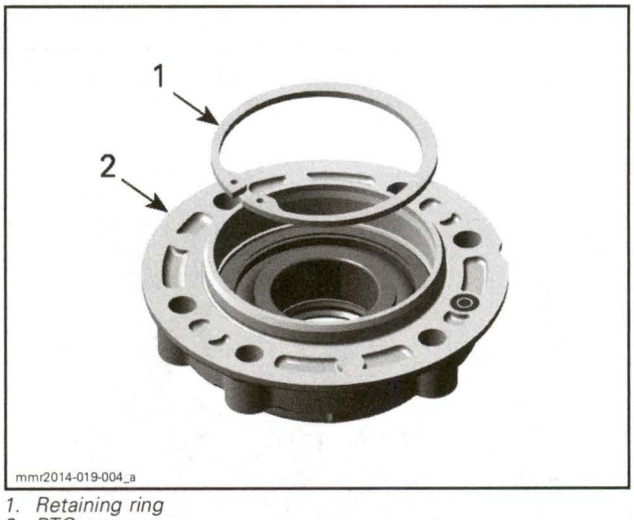
NOTICE **During installation never push on the inner race of the bearing.**

REQUIRED TOOL	
OIL SEAL/BEARING PUSHER (P/N 529 036 284)	



1. OIL SEAL/BEARING PUSHER (P/N 529 036 284)
2. Ball bearing
3. Open side of plastic cage
4. PTO cover

7. Install retaining ring.

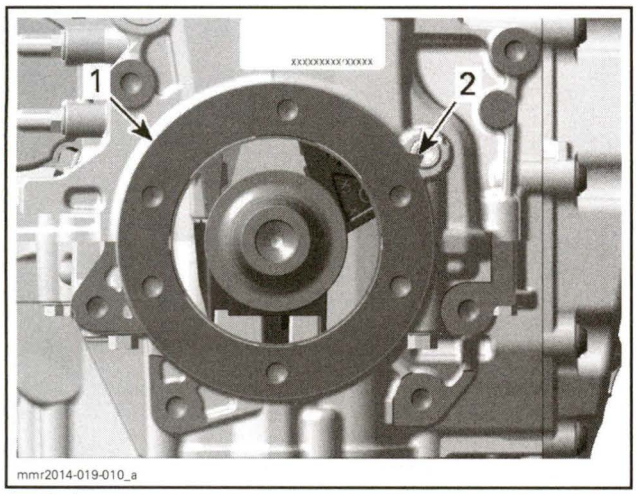


1. Retaining ring
2. PTO cover

PTO Cover Installation

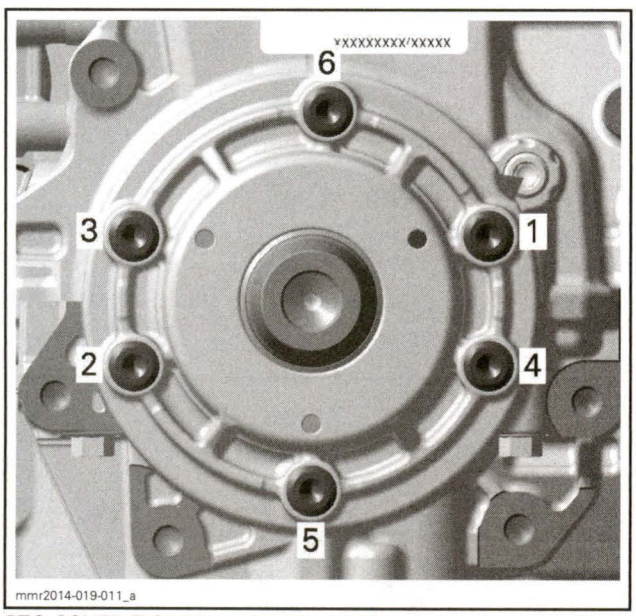
Reverse the removal procedure. However, pay attention to following details.

Install a **NEW** PTO cover gasket in proper position.



1. Gasket
2. Tab

Tighten PTO cover screws as per following sequence and specified torque.



PTO COVER TIGHTENING SEQUENCE

PTO COVER SCREWS	
Tightening torque	23 N•m ± 3 N•m (17 lbf•ft ± 2 lbf•ft)

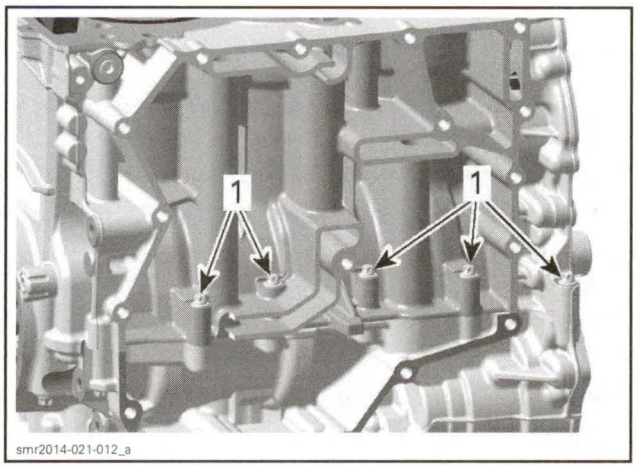
CYLINDER BLOCK

Cylinder Block Disassembly

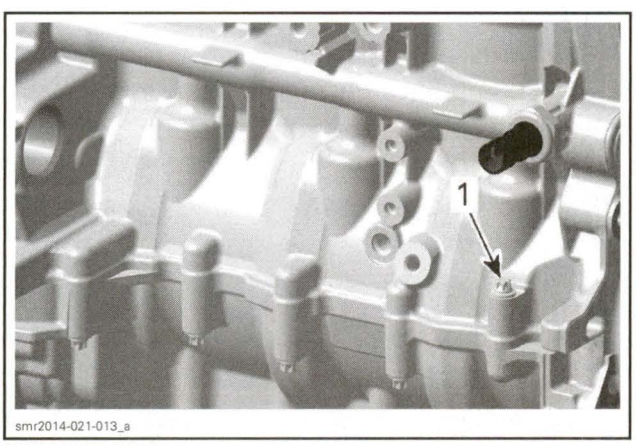
1. Remove engine from vehicle. Refer to *ENGINE REMOVAL AND INSTALLATION* subsection.
2. Refer to *PERIODIC MAINTENANCE PROCEDURES* and drain engine oil.
3. Refer to *TOP END* subsection and remove:
   - Ignition coils
   - Valve cover
   - Spark plugs.
4. Lock crankshaft, refer to *CRANKSHAFT LOCKING PROCEDURE* in this subsection.
5. Remove air intake manifold. Refer to *AIR INTAKE SYSTEM* subsection.
6. Refer to *COOLING SYSTEM* subsection and remove:
   - Water pump housing
   - Thermostat
   - Water pump drive gear.
7. Refer to *LUBRICATION SYSTEM* subsection and remove:
   - Oil tank
   - Oil cooler
   - Oil pressure regulator
   - Oil pump drive gears and oil pumps
   - Oil sump cover
   - Oil strainers.
8. Refer to *MAGNETO AND STARTER* subsection and remove:
   - Magneto cover
   - Rotor
   - Starter drive gears
   - Electric starter.
9. Refer to *TIMING CHAIN* subsection and remove:
   - Timing chain tensioner
   - Timing chain guides.
10. Refer to *TOP END* subsection and remove:
    - Camshaft holders
    - Cylinder head.
11. Remove PTO cover. Refer to *PTO COVER AND PTO OIL SEAL* in this subsection.

NOTE: Before splitting the cylinder block, measure crankshaft axial play. Refer to *CRANKSHAFT* in this subsection.

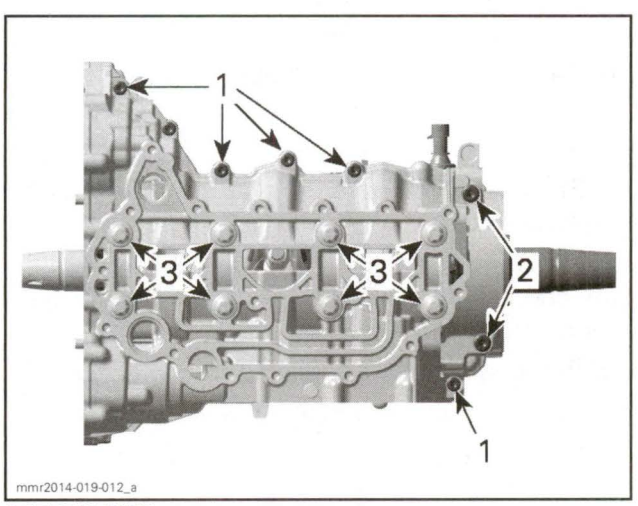
12. Remove crankshaft locking tool.
13. Remove cylinder block screws.
    13.1 Start by removing M6 screws.
    13.2 Then remove M8 screws.
    13.3 Finally remove and discard M9 screws.



INTAKE SIDE
1. Cylinder block screws (M6) screwed from top to bottom



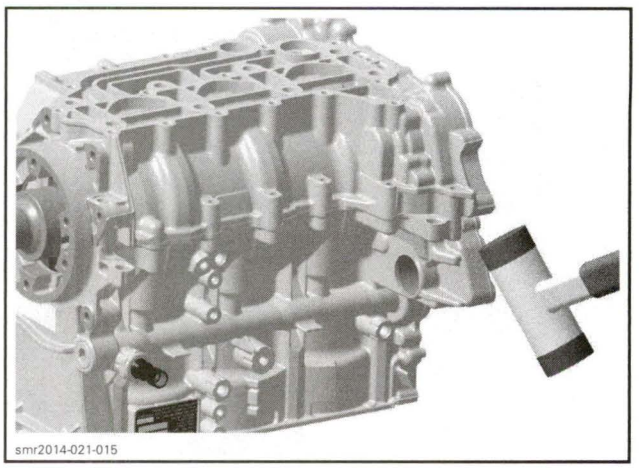
EXHAUST SIDE
1. Cylinder block screw (M6) screwed from top to bottom



BOTTOM SIDE
1. M6 screws
2. M8 screws
3. M9 screws (discard)

14. Carefully remove cylinder block lower half using a soft hammer.

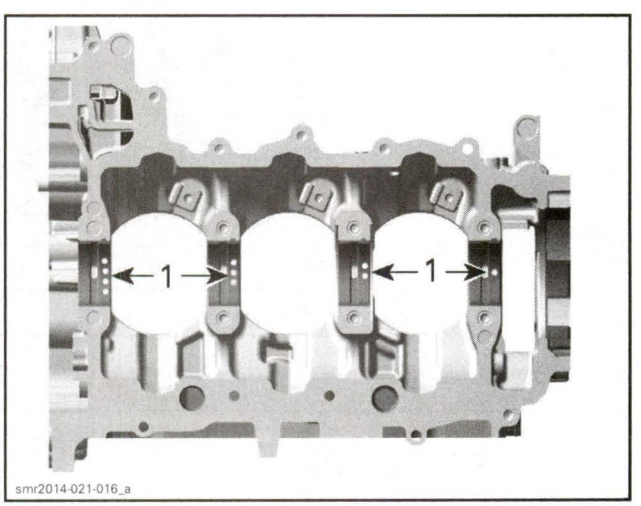
NOTE: Take care not to damage the sealing surfaces of the cylinder block halves.



15. Remove connecting rod caps. Refer to *PISTONS AND CONNECTING RODS* in this subsection.
16. Refer to *CRANKSHAFT* in this subsection and remove:
    - Crankshaft thrust washers
    - Crankshaft.
17. Remove pistons and connecting rods. See procedure in this subsection.

Plain Bearing Removal

When the plain bearings need to be removed from the cylinder block, mark them to identify the correct position at installation. See the illustration as an example.

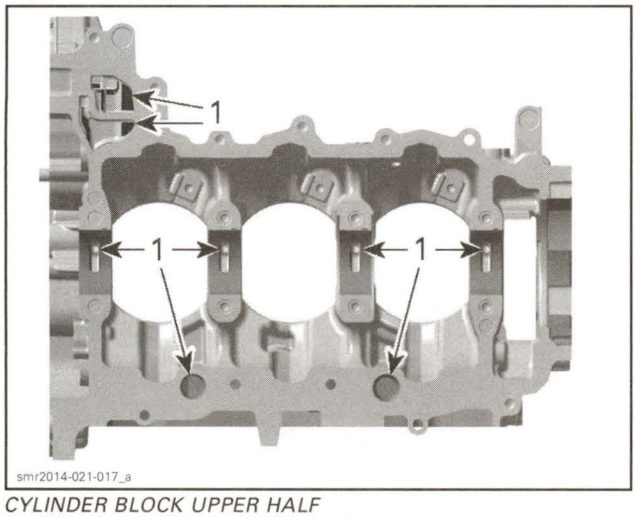


1. Mark on crankshaft plain bearings

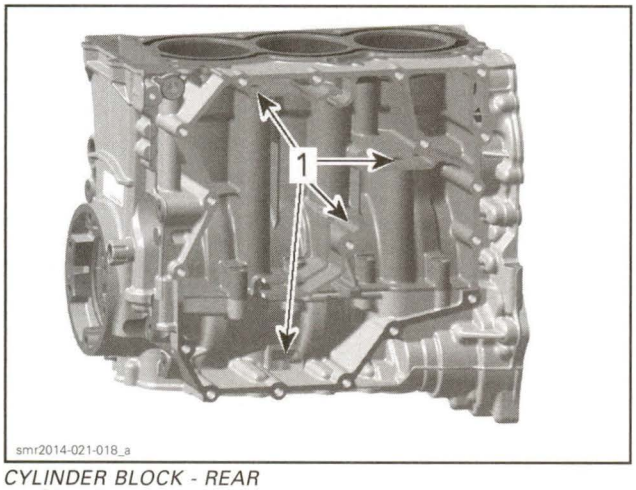
Cylinder Block Cleaning

Clean cylinder block using a part cleaner, then use compressed air to dry it.

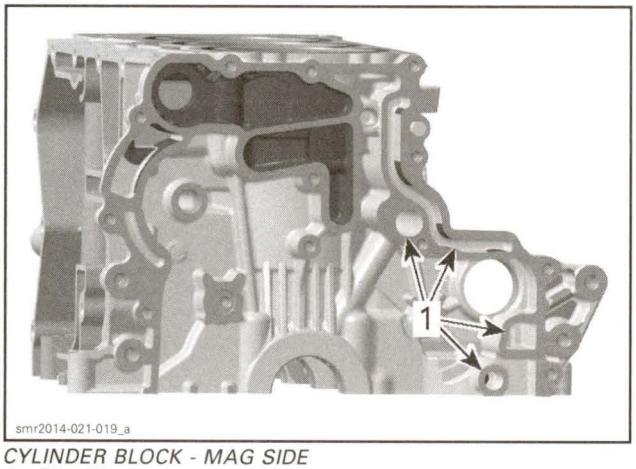
Blow out the oil orifices using compressed air and make sure they are not clogged.



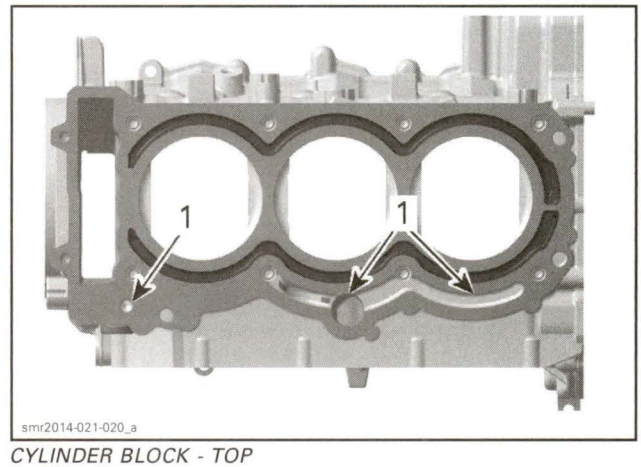
CYLINDER BLOCK UPPER HALF
1. Oil orifices



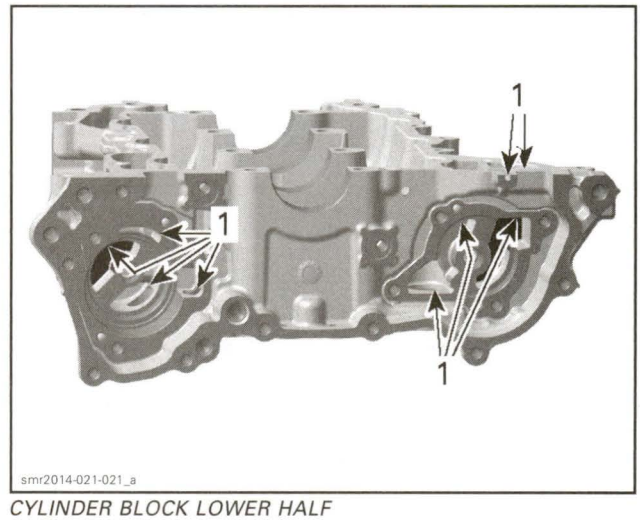
CYLINDER BLOCK - REAR
1. Oil orifices



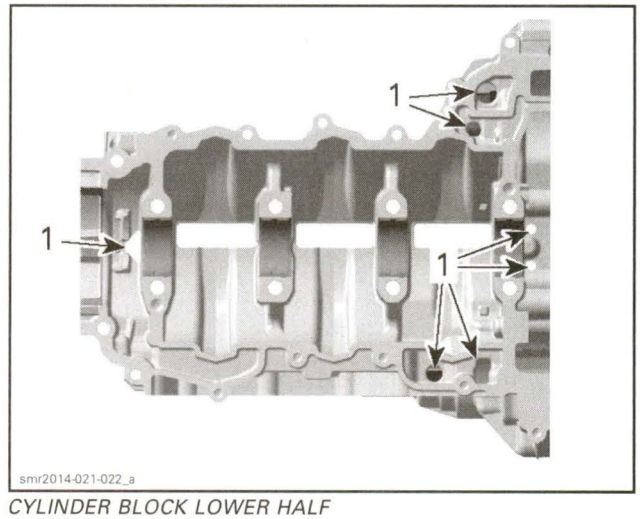
CYLINDER BLOCK - MAG SIDE
1. Oil orifices



CYLINDER BLOCK - TOP
1. Oil orifices



CYLINDER BLOCK LOWER HALF
1. Oil orifices



CYLINDER BLOCK LOWER HALF
1. Oil orifices

Clean all metal components in a solvent.

Clean cylinder block mating surfaces with LOCTITE CHISEL (GASKET REMOVER) (P/N 413 708 500) and a brass wire brush. Brush a first pass in one direction then make the final brushing perpendicularly (90°) to the first pass (cross hatch).

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

Cylinder Block Inspection

Check cylinder block for cracks or other damage.

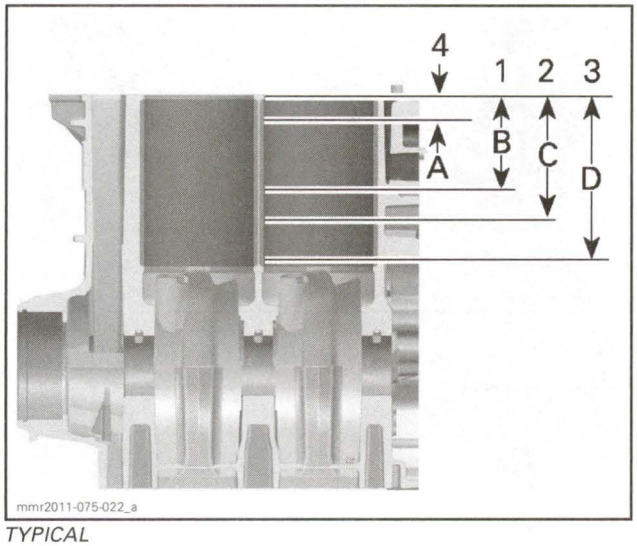
Check cylinder block mating surfaces for flatness using a straight edge.

Replace cylinder block if necessary.

Check cylinder bores for cracks, scoring and wear ridges on top and bottom of the cylinders.

Cylinder Taper

Measure cylinder bore diameter at 4 recommended positions. See illustration.



TYPICAL
1. *First measure*
2. *Second measure*
3. *Third measure*
4. *Fourth measure*

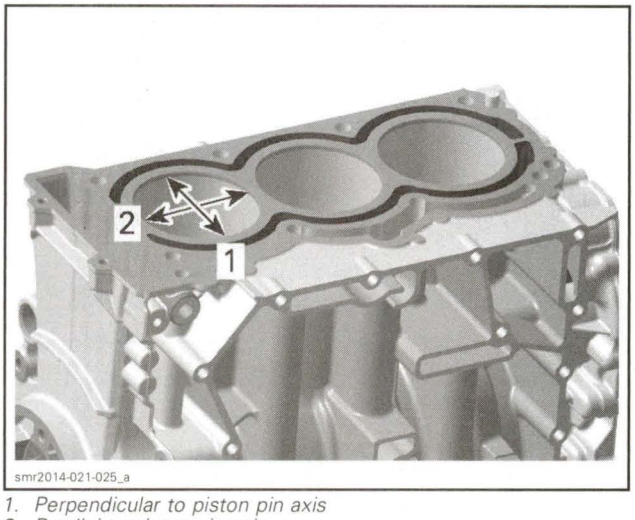
A. 5 mm to 10 mm (.197 in to .394 in)
B. 30 mm to 35 mm (1.181 in to 1.378 in)
C. 57 mm to 62 mm (2.244 in to 2.441 in)
D. 111 mm to 113 mm (4.37 in to 4.449 in)

The difference between measurements should not exceed the service limit mentioned in next table.

CYLINDER TAPER	
NEW MAXIMUM	0.030 mm (.0012 in)
SERVICE LIMIT	0.050 mm (.002 in)

Cylinder Out of Round

Measure cylinder bore diameter as shown, and at same measuring points as for *CYLINDER TAPER*.



1. *Perpendicular to piston pin axis*
2. *Parallel to piston pin axis*

To obtain the cylinder out of round, calculate the difference between the perpendicular measures.

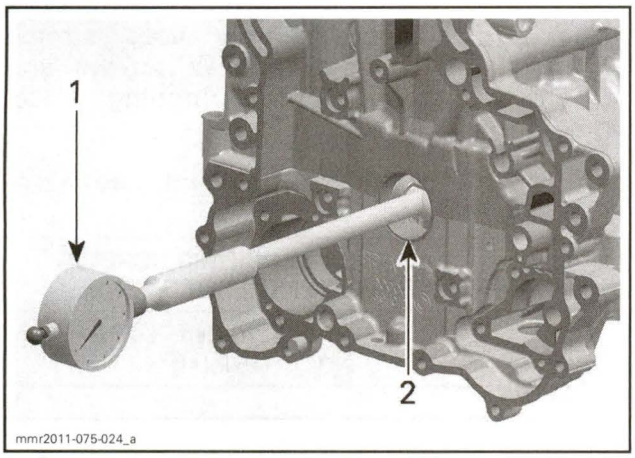
CYLINDER OUT OF ROUND	
NEW MAXIMUM	0.008 mm (.0003 in)
SERVICE LIMIT	0.030 mm (.0012 in)

Crankshaft Plain Bearings Inside Diameter

Check the plain bearings for scoring or other damages.

Measure plain bearing inside diameter and compare with crankshaft bearing journal diameter (refer to *CRANKSHAFT* in this subsection). Proceed as follows.

- Using the OLD plain bearings, assemble both cylinder block halves together.
- Tighten screws as described in *CYLINDER BLOCK ASSEMBLY*.
- Measure the inside diameter of the crankshaft plain bearings using a bore gauge.



1. *Bore gauge*
2. *Crankshaft plain bearing*

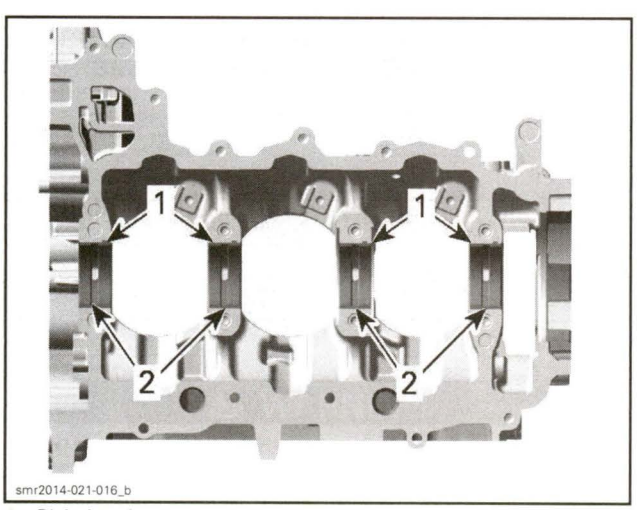
CRANKSHAFT PLAIN BEARING INSIDE DIAMETER	
SERVICE LIMIT	36.080 mm (1.4205 in)

Replace bearings if tout of specifications.

Cylinder Block Assembly

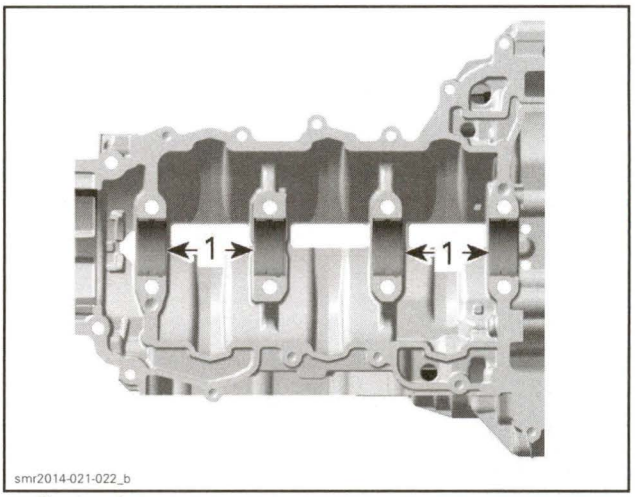
For assembly, reverse the disassembly procedure. Pay attention to the following details.

1. Correctly reinstall plain bearings as follows.
   1.1 Use NEW bearings if diameters are out of specification. Refer to *PLAIN BEARING INSPECTION* in this subsection.
   1.2 Install bearings with lubrication grooves in the cylinder block upper half.



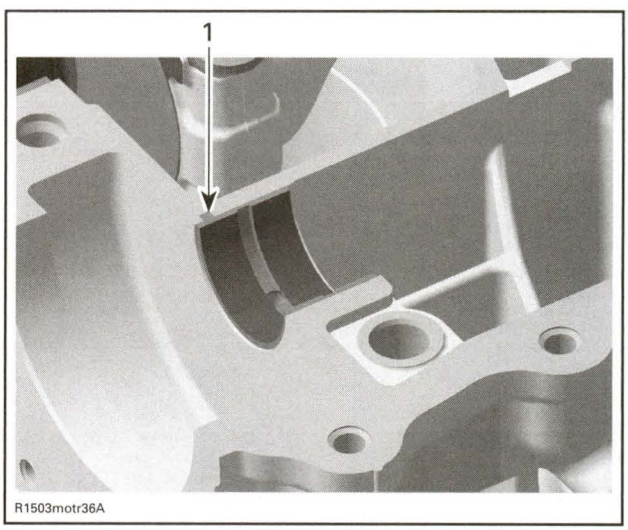
1. *Plain bearings*
2. *Lubrication grooves*

   1.3 Install flat bearings in cylinder block lower half.



1. *Flat bearings*

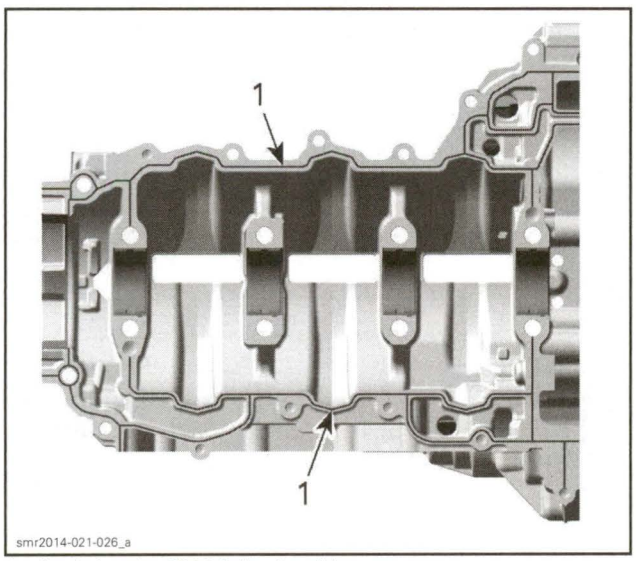
NOTICE Bearings must be flush with the cylinder block split surface, and their protrusions must fit in the notched areas in the cylinder block seat.



TYPICAL
1. *Bearing protrusion in cylinder block notch*

2. Install pistons, refer to *PISTONS AND CONNECTING RODS* in this subsection.
3. Apply engine oil on all plain bearings.
4. Install the following components:
   - Crankshaft and thrust washers (refer to *CRANKSHAFT*)
   - Connecting rod caps (refer to *PISTONS AND CONNECTING RODS*).
5. Apply LOCTITE 5910 (P/N 293 800 081) on mating surface of cylinder block lower half as shown on next illustration.

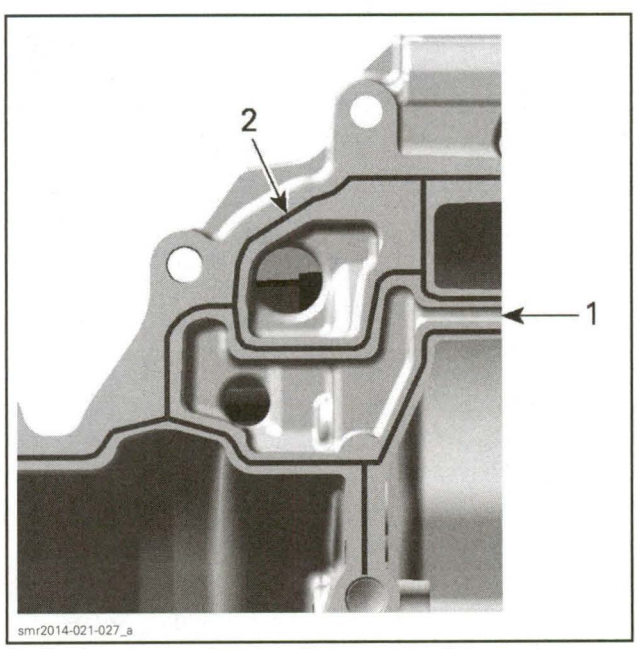
IMPORTANT: When beginning the application of the cylinder block sealant, the assembly and first tightening must be done within 12 minutes. It is suggested to have all you need on hand to save time.



1. Apply Loctite 5910 following this pattern

NOTICE Ensure not to apply too much sealant, as it will spread out inside the cylinder block.

NOTICE Take care to ensure the bypass passage of the engine oil pressure regulator is not clogged with sealant.



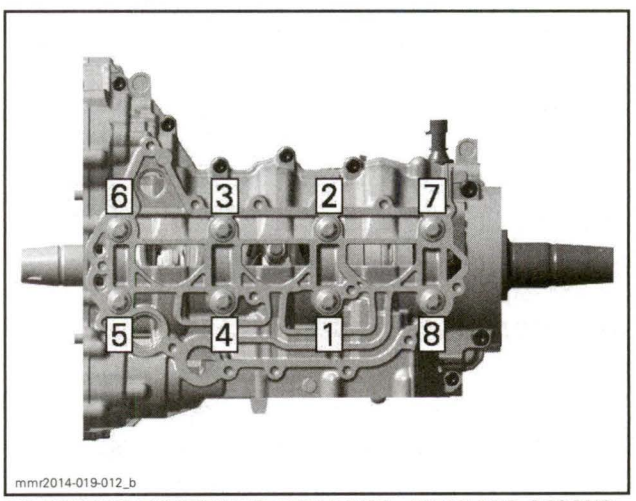
1. Bypass passage of engine oil pressure regulator
2. Loctite 5910 applied

6. Install **NEW** cylinder block M9 screws and tighten as follows.

NOTICE This assembly uses stretch screws. Always use NEW screws and strictly adhere to the tightening procedure.

6.1 Torque the M9 screws according to following sequence.

CYLINDER BLOCK M9 SCREWS TIGHTENING PROCEDURE	
STEP A	20 N•m ± 2 N•m (15 lbf•ft ± 1 lbf•ft)



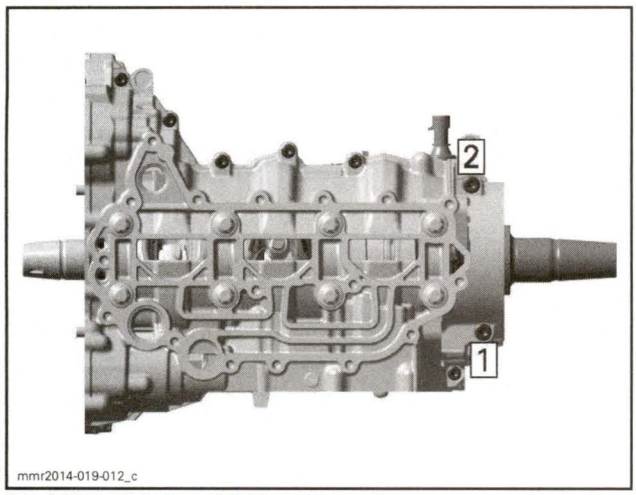
M9 SCREWS TIGHTENING SEQUENCE - FIRST AND SECOND STEPS

6.2 Use a torque angle gauge to carry out the second step, following the same sequence.

CYLINDER BLOCK M9 SCREWS TIGHTENING PROCEDURE	
STEP B	Additional 150° ± 5°

7. Install M8 screws and tighten as follows.

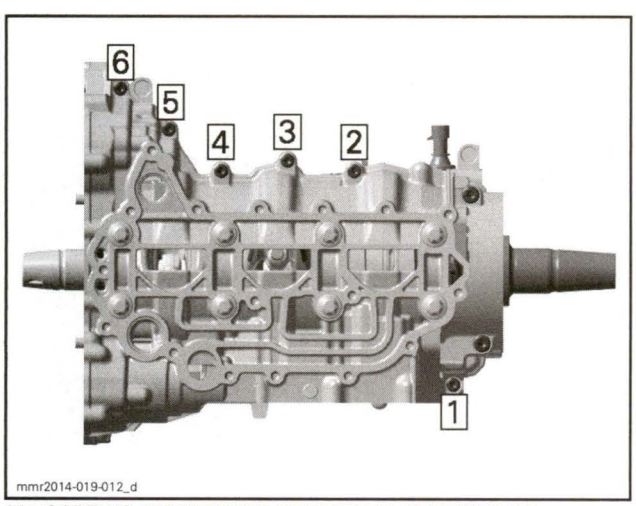
CYLINDER BLOCK M8 SCREWS	
Tightening torque	23 N•m ± 2 N•m (17 lbf•ft ± 1 lbf•ft)



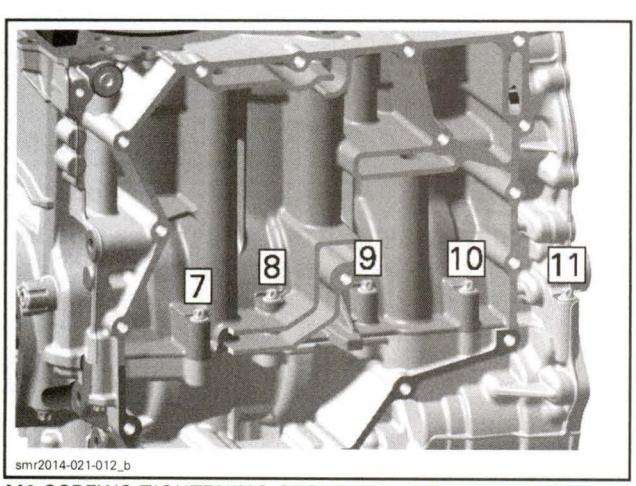
M8 SCREWS TIGHTENING SEQUENCE

8. Install the screws and tighten as follows.

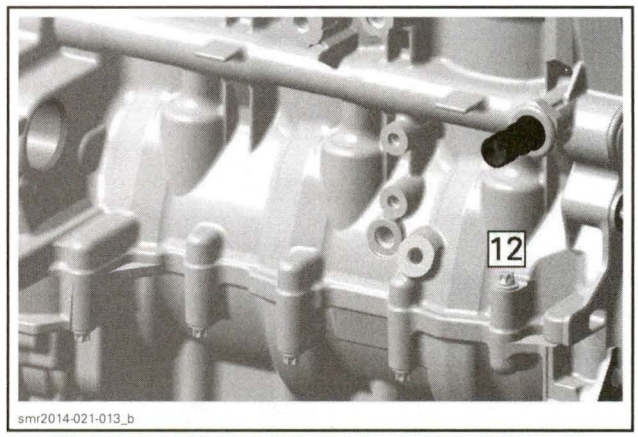
CYLINDER BLOCK M6 SCREWS	
Tightening torque	9 N•m ± 1 N•m (80 lbf•**in** ± 9 lbf•**in**)



M6 SCREWS TIGHTENING SEQUENCE (BOTTOM OF CRANKCASE)



M6 SCREWS TIGHTENING SEQUENCE (INTAKE SIDE OF CRANKCASE)



M6 SCREW TIGHTENING SEQUENCE (EXHAUST SIDE OF CRANKCASE)

NOTE: Check crankshaft axial play before continuing the assembly. Refer to *CRANKSHAFT* in this subsection.

9. Lubricate PTO oil seals properly before reinstalling the PTO cover. Refer to *PTO COVER AND PTO OIL SEALS* in this subsection.
10. Reassemble engine in accordance with proper assembly procedures.

CRANKSHAFT

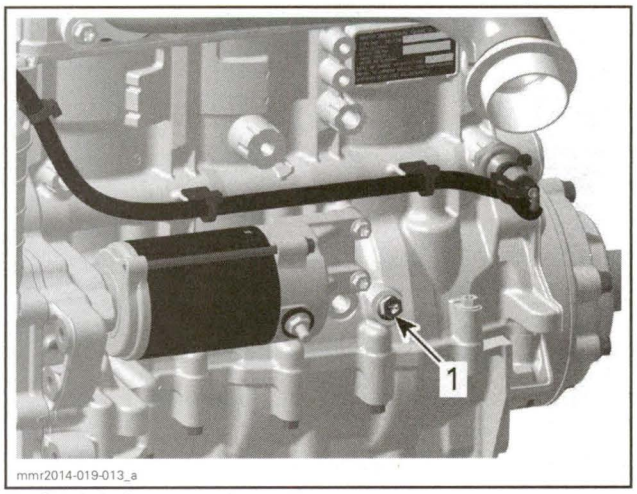
Crankshaft Locking Procedure

NOTICE When the crankshaft is locked, the second cylinder is set to TDC.

The crankshaft must be locked whenever the magneto rotor retaining nut has to be removed, or whenever working on the valve train.

NOTICE When working on the valve train or timing chain, the crankshaft must be locked with the marks "IN" and "EX" on the camshaft timing gears facing each other.

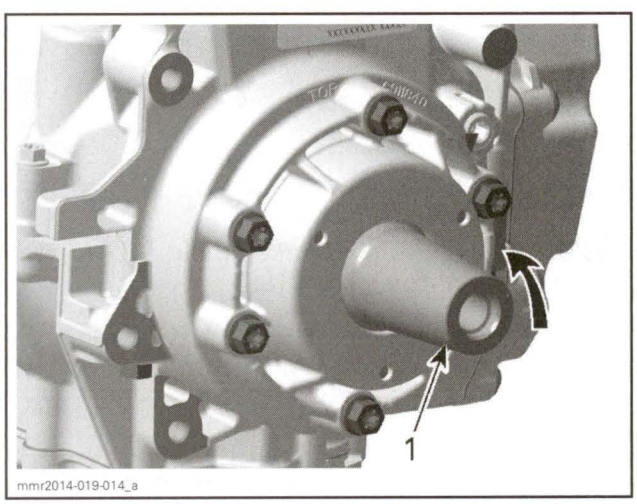
1. If working on the valve train or timing chain, remove the valve cover. Refer to *TOP END* subsection.
2. Remove spark plugs.
3. Remove crankshaft access plug and discard gasket ring.



1. Crankshaft access plug

4. On PTO side , turn engine crankshaft counterclockwise to bring it to the locking position.

To turn the crankshaft, install the drive pulley, or use a suitable screw locked by a counter nut.

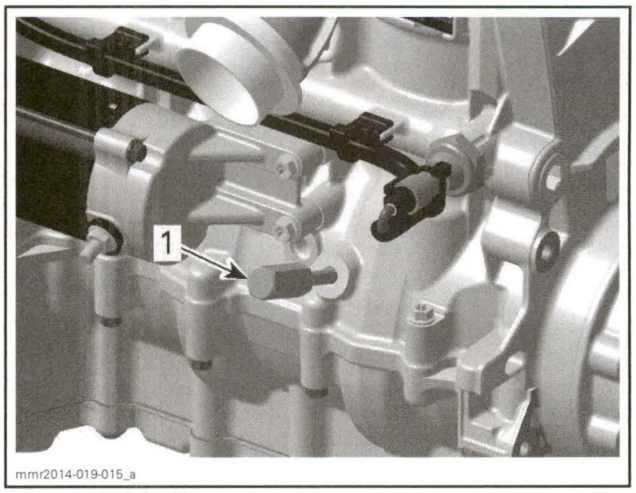


1. Crankshaft PTO side

NOTICE **Crankshaft locking position is reached when marks "IN" and "EX" on the camshaft timing gears face each other.**

5. Use a flashlight to check if the crankshaft groove is aligned with the hole.
6. Lock crankshaft.

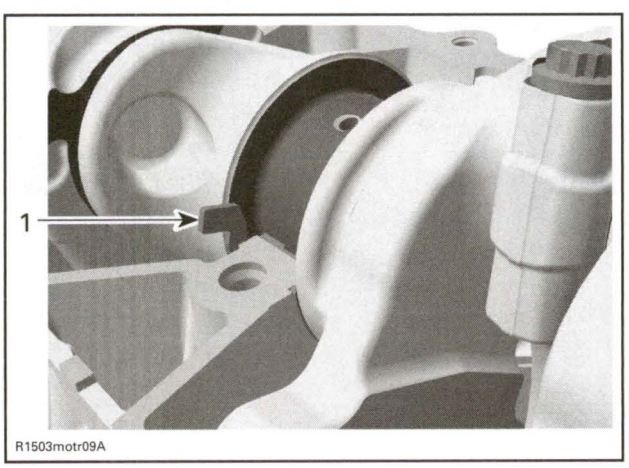
REQUIRED TOOL	
CRANKSHAFT LOCKING TOOL (P/N 529 036 272)	



1. Crankshaft locking tool

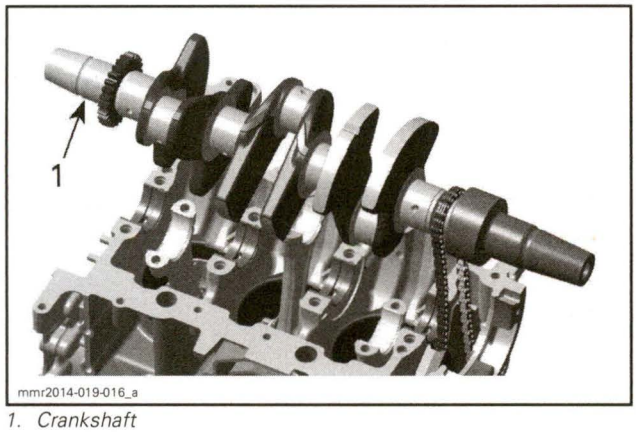
Crankshaft Removal

1. Disassemble *CYLINDER BLOCK*, see procedure in this subsection.
2. Remove connecting rod caps. Refer to *PISTONS AND CONNECTING RODS* in this subsection.
3. Remove crankshaft thrust washers.



TYPICAL
1. Thrust washer

4. Remove crankshaft from cylinder block.

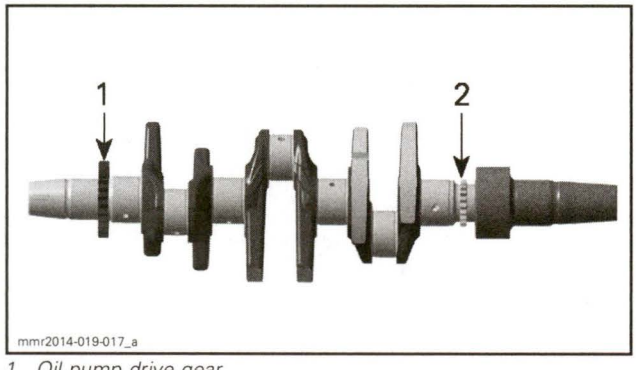


1. Crankshaft

Crankshaft Inspection

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

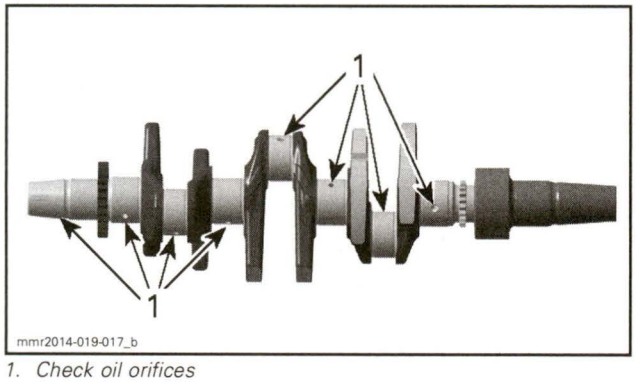
Check crankshaft gears for wear or other damage.



1. Oil pump drive gear
2. Crankshaft timing gear

Replace crankshaft if damaged.

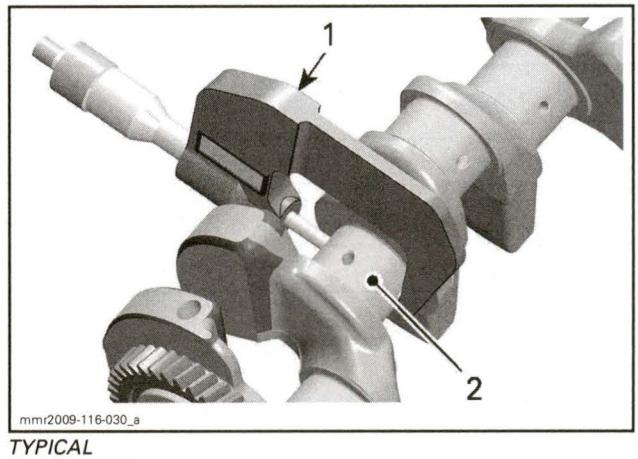
Blow the oil orifices using compressed air and ensure they are not clogged.



1. Check oil orifices

Crankshaft Radial Play

Measure crankshaft bearing journal diameter, using a micrometer.



TYPICAL
1. Micrometer
2. Crankshaft area for plain bearing

To obtain crankshaft radial play, calculate the difference between the bearing journal diameter and the crankshaft plain bearings inner diameter (see *CYLINDER BLOCK* in this subsection).

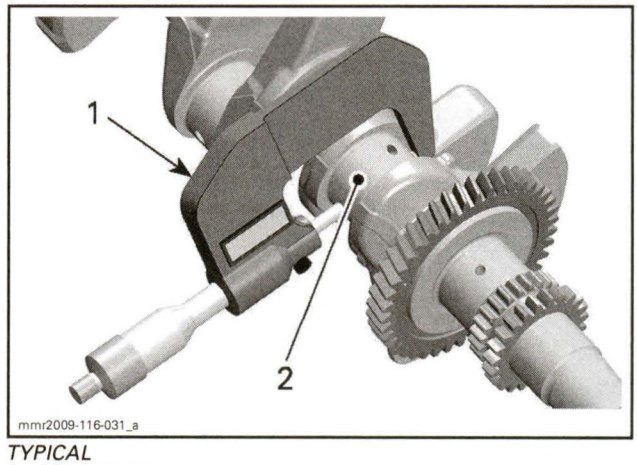
CRANKSHAFT BEARING JOURNAL DIAMETER	
NEW	35.990 mm to 36.006 mm (1.4169 in to 1.4176 in)
SERVICE LIMIT	35.960 mm (1.4157 in)

CRANKSHAFT RADIAL PLAY	
SERVICE LIMIT	0.08 mm (.0031 in)

Crankshaft Pin Diameter

Measure crankshaft pin diameter, using a micrometer.

To obtain connecting rod radial play (big end), calculate the difference between the crankshaft pin diameter and the inner diameter of the connecting rod plain bearings inner diameter (see *CONNECTING ROD INSPECTION*) in this subsection.



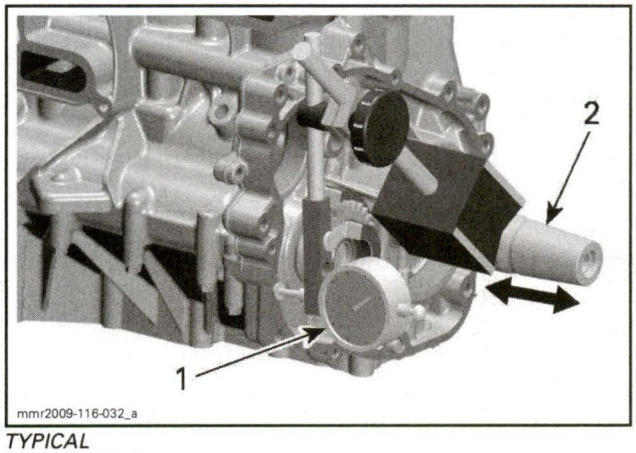
TYPICAL
1. Micrometer
2. Crankshaft pin area for plain bearing

CRANKSHAFT PIN DIAMETER	
NEW	35.979 mm to 35.995 mm (1.416 in to 1.417 in)
SERVICE LIMIT	35.969 mm (1.416 in)

CONNECTING ROD BIG END RADIAL PLAY	
SERVICE LIMIT	0.08 mm (.0031 in)

Crankshaft Axial Play

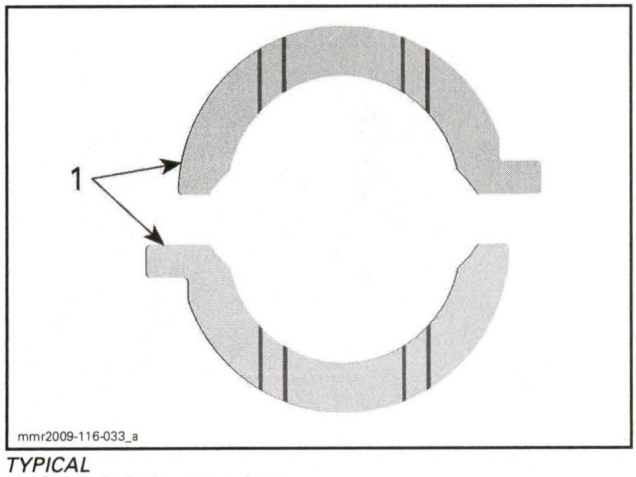
With the crankshaft in the cylinder block, measure the crankshaft axial play, using a dial indicator.



TYPICAL
1. *Dial indicator*
2. *Crankshaft*

CRANKSHAFT AXIAL PLAY	
NEW	0.120 mm to 0.352 mm (.005 in to .014 in)
SERVICE LIMIT	0.450 mm (.018 in)

If axial play is out of specification, replace the crankshaft thrust washers and repeat measurement.



TYPICAL
1. *Crankshaft thrust washers*

Crankshaft Installation

Reverse the removal procedure. Pay attention to following details.

Turn cylinder block upside down.

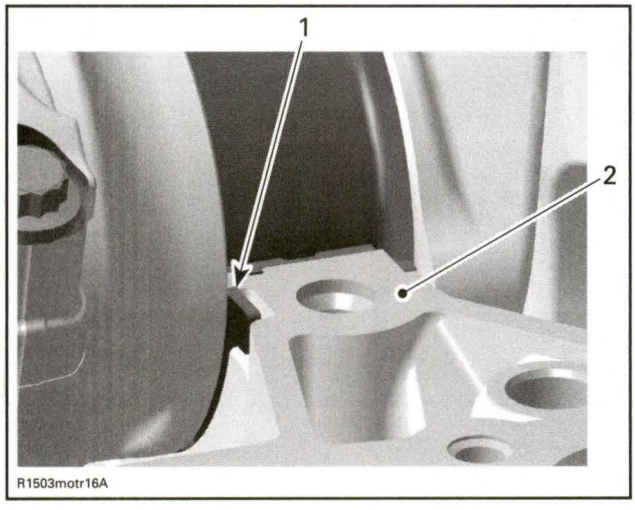
NOTICE Be careful that connecting rods do not hit the cylinder block.

Apply engine oil on all plain bearings before installing them.

Install crankshaft along with the timing chain.

Lubricate (both sides) and reinstall crankshaft thrust washers with the slots facing against crankshaft counterweights.

NOTE: Thrust washers have to be flush with the cylinder block sealing surface.



TYPICAL
1. *Thrust washer*
2. *Sealing surface*

Install connecting rod caps. Refer to *PISTONS AND CONNECTING RODS* in this subsection.

NOTICE It is absolutely necessary to follow this procedure. Otherwise severe engine damage can occur.

Install cylinder block lower half. Refer to *CYLINDER BLOCK* in this subsection.

Lock crankshaft before further assembly of the engine. See *CRANKSHAFT LOCKING PROCEDURE* in this subsection.

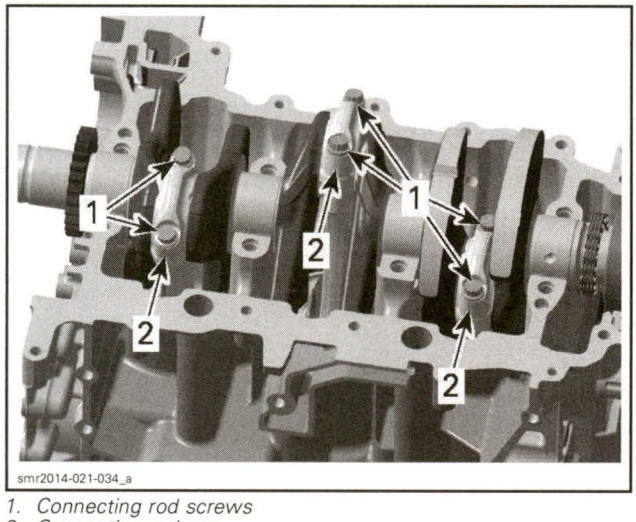
PISTONS AND CONNECTING RODS

Piston and Connecting Rod Removal

NOTE: It is recommended to measure connecting rod big end axial play prior to remove connecting rod. Refer to *CONNECTING ROD INSPECTION* in this subsection.

1. Disassemble *CYLINDER BLOCK* as per procedure in this subsection.
2. Remove connecting rod cap.

NOTICE **Mark cylinder position of connecting rod before disassembly.**

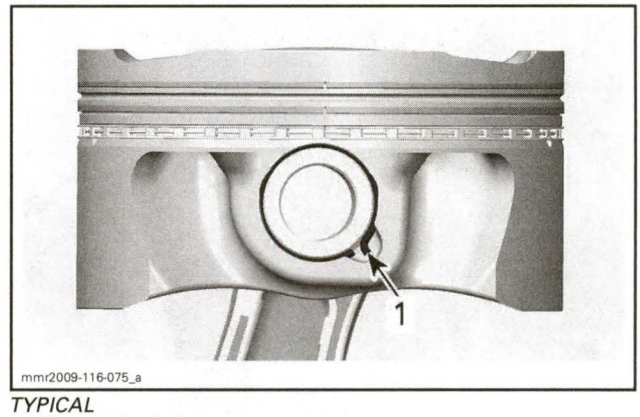


1. Connecting rod screws
2. Connecting rod cap

3. Remove *CRANKSHAFT* as per procedure in this subsection.
4. Turn cylinder block and push piston and connecting rod out of the cylinder.

Piston and Connecting Rod Disassembly

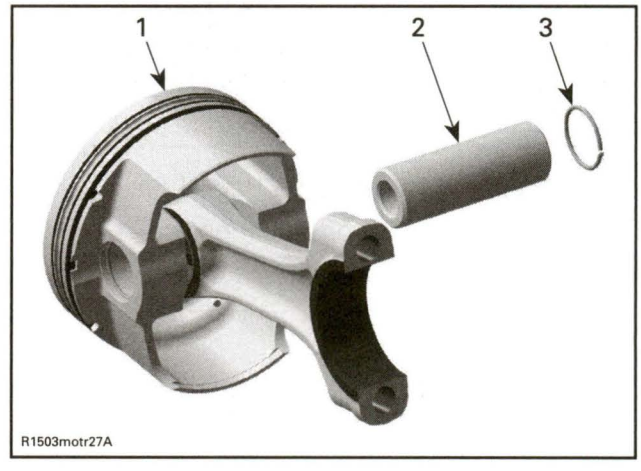
1. Remove one piston pin circlip and discard it.



TYPICAL
1. Piston pin circlip

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

2. Push piston pin out of the piston.



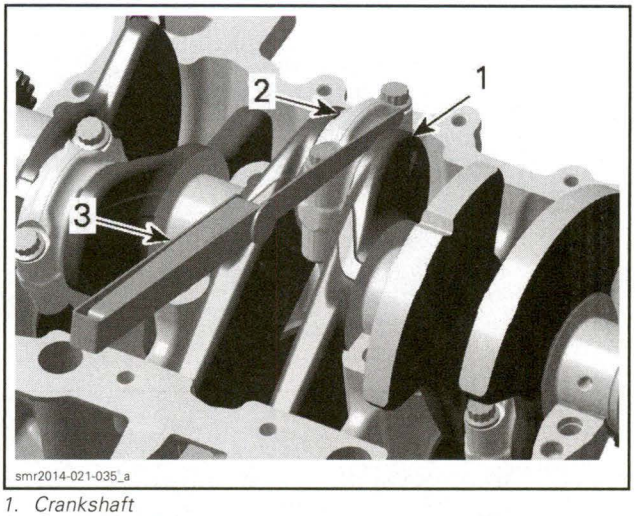
TYPICAL
1. Piston
2. Piston pin
3. Circlip

3. Detach piston from connecting rod.

Connecting Rod Inspection

Connecting Rod Big End Axial Play

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

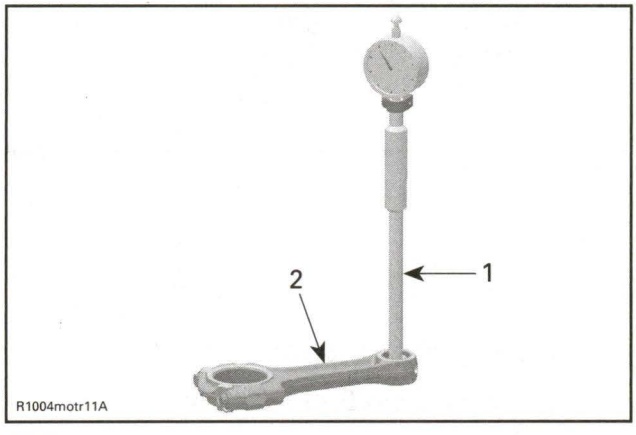


1. Crankshaft
2. Connecting rod
3. Feeler gauge

CONNECTING ROD BIG END AXIAL PLAY	
NEW	0.100 mm to 0.352 mm (.004 in to .014 in)
SERVICE LIMIT	0.450 mm (.018 in)

Connecting Rod Small End Radial Play

Measure connecting rod small end using a bore gauge.



TYPICAL
1. Bore gauge
2. Connecting rod

CONNECTING ROD SMALL END DIAMETER	
NEW	17.010 mm to 17.020 mm (.6697 in to .6701 in)
SERVICE LIMIT	17.060 mm (.6717 in)

If the connecting rod small end diameter is out of specification, replace the connecting rod.

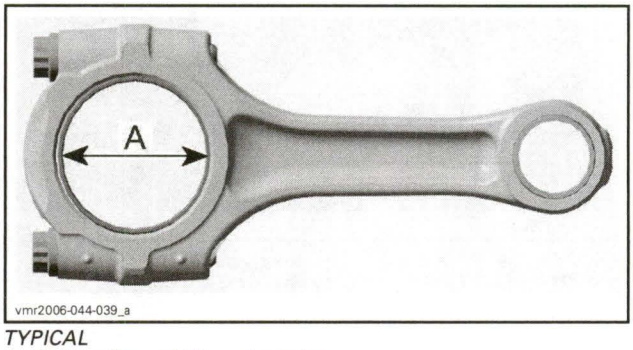
To obtain the connecting rod radial play (small end), calculate the difference between the piston pin diameter (*PISTON PIN INSPECTION*) and the inner diameter of the connecting rod small end.

CONNECTING ROD SMALL END RADIAL PLAY	
SERVICE LIMIT	0.040 mm (.0016 in)

Connecting Rod Big End Radial Play

1. Measure inside diameter of connecting rod big end.
   - 1.1 Install the OLD plain bearings as they were mounted initially.
   - 1.2 Perform the tightening procedure as described in *PISTON AND CONNECTING ROD INSTALLATION* in this subsection.

   NOTE: To measure the connecting rod big end diameter, ALWAYS use the OLD connecting rod screws.
   - 1.3 Measure inside diameter in longitudinal direction of the connecting rod.



TYPICAL
A. Connecting rod big end bearing

CONNECTING ROD BIG END DIAMETER	
SERVICE LIMIT	36.06 mm (1.4197 in)

To obtain the connecting rod big end radial play, calculate the difference between the big end diameter and the crankshaft pin diameter (see *CRANKSHAFT INSPECTION*) in this subsection.

CONNECTING ROD BIG END RADIAL PLAY	
SERVICE LIMIT	0.080 mm (.0031 in)

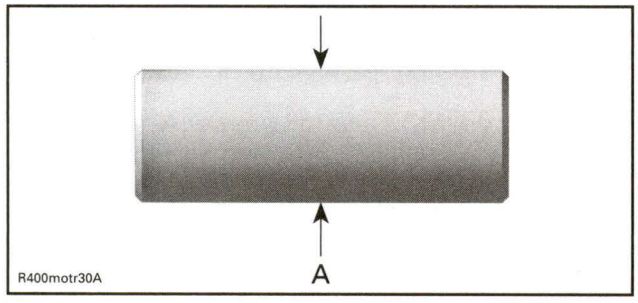
If connecting rod big end diameter is out of specification, install NEW plain bearings.

Piston Pin Inspection

Using woven synthetic abrasive, clean piston pin of deposits.

Inspect piston pin for scoring, cracks or other damage.

Measure piston pin diameter, using a micrometer. See following illustration for proper measurement position.



TYPICAL
A. Measure piston pin diameter here

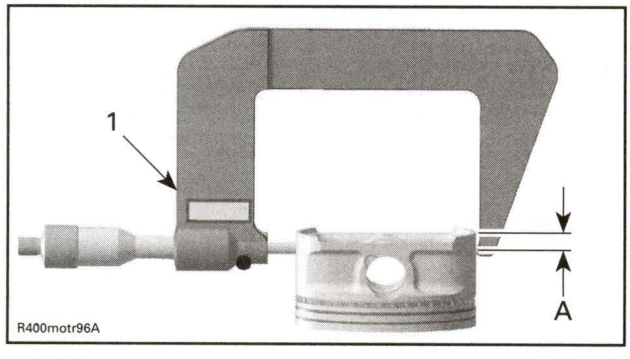
PISTON PIN DIAMETER	
NEW	16.996 mm to 17.000 mm (.6691 in to .6693 in)
SERVICE LIMIT	16.986 mm (.6687 in)

Replace piston pin if out of specification.

Piston Inspection

Inspect piston for scoring, scuffing, cracks or other damage. Replace piston and piston rings if necessary.

Using a micrometer, measure piston perpendicularly (90°) to piston pin axis at 8.5 mm (11/32 in) from the skirt edge.



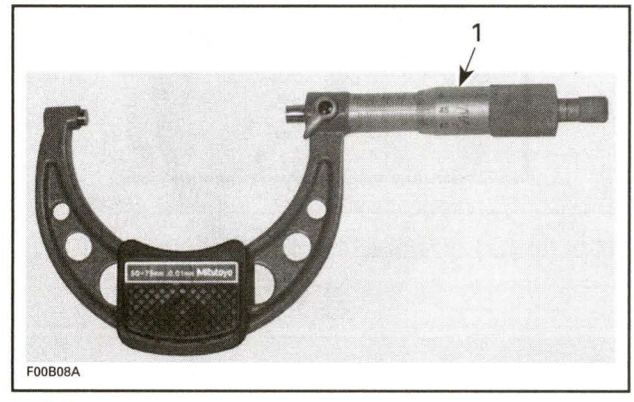
TYPICAL
1. Measuring perpendicularly (90°) to piston pin axis
A. 8.5 mm (11/32 in)

PISTON MEASUREMENT	
NEW	73.950 mm to 73.966 mm (2.911 in to 2.912 in)
SERVICE LIMIT	73.920 mm (2.9102 in)

Replace piston if out of specification.

Piston/Cylinder Clearance

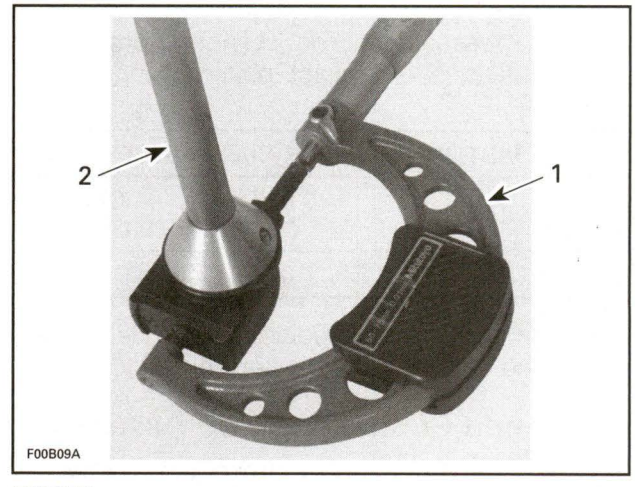
1. Adjust and lock a micrometer to the piston dimension.



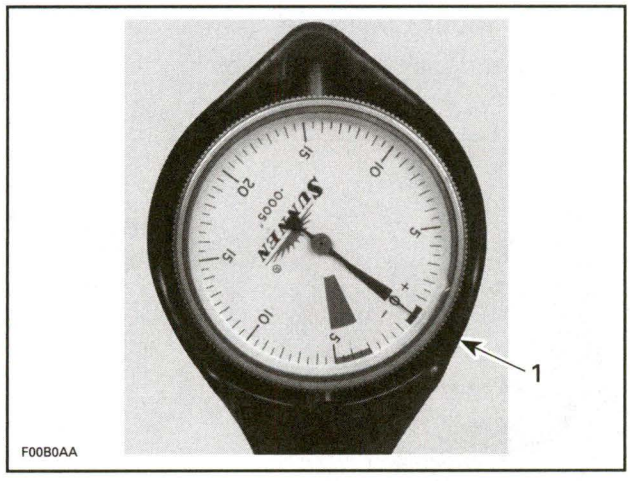
TYPICAL
1. Micrometer set to the piston dimension

NOTE: Make sure used piston is not worn.

2. With the micrometer locked at step 1, adjust a cylinder bore gauge to the micrometer dimension and set the indicator to 0 (zero).



TYPICAL
1. Use the micrometer to set the cylinder bore gauge
2. Cylinder bore gauge



TYPICAL
1. Indicator set to 0 (zero)

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.

3. Position the cylinder bore gauge 35 mm (1-3/8 in) below the cylinder head mating surface, measuring perpendicularly (90°) to piston pin axis.
4. Read measurement on cylinder bore gauge. The result is the exact piston/cylinder clearance.

PISTON/CYLINDER CLEARANCE	
NEW	0.037 mm to 0.067 mm (.0015 in to .0026 in)
SERVICE LIMIT	0.080 mm (.0031 in)

If clearance exceeds specified tolerance, replace piston and repeat measurement procedure.

Piston and Connecting Rod Assembly

Reverse the disassembly procedure. However, pay attention to the following details.

1. Apply engine oil on piston pin.
2. Insert piston pin in piston and connecting rod.

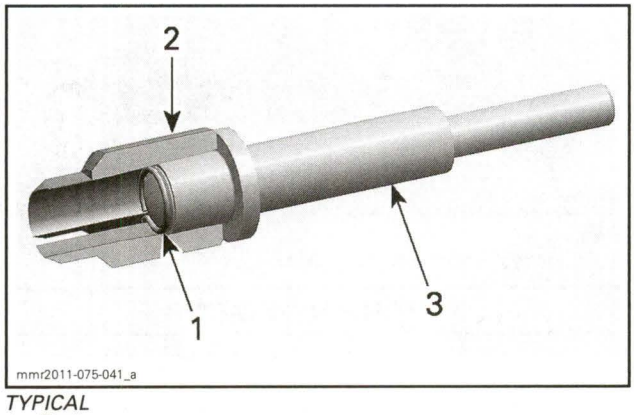
NOTE: Be sure to reinstall all parts in their original position as marked during removal.

3. Install **NEW** piston pin circlip(s).

REQUIRED TOOL	
PISTON CIRCLP INSTALLER (P/N 529 036 207)	

NOTICE Always replace removed piston pin circlips by NEW ones.

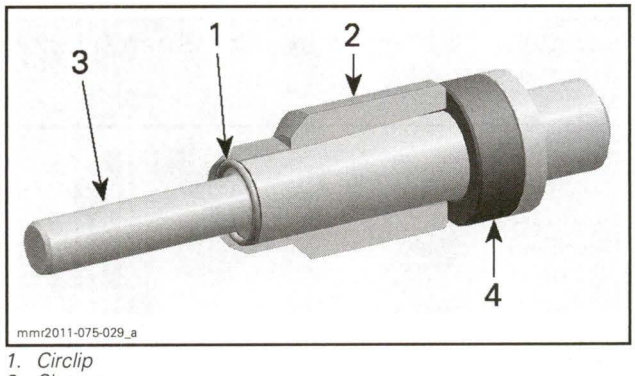
3.1 Place the circlip in the sleeve and push piston circlip installer handle until circlip reaches the mid position in the sleeve.



TYPICAL
1. Circlip
2. Sleeve
3. Installer handle

3.2 Put the distance sleeve on the installer handle.

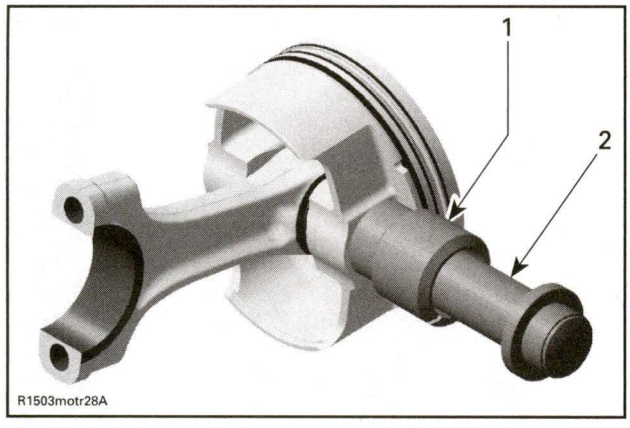
3.3 Push piston circlip installer handle until distance sleeve makes contact with the sleeve.



1. Circlip
2. Sleeve
3. Installer handle
4. Distance sleeve

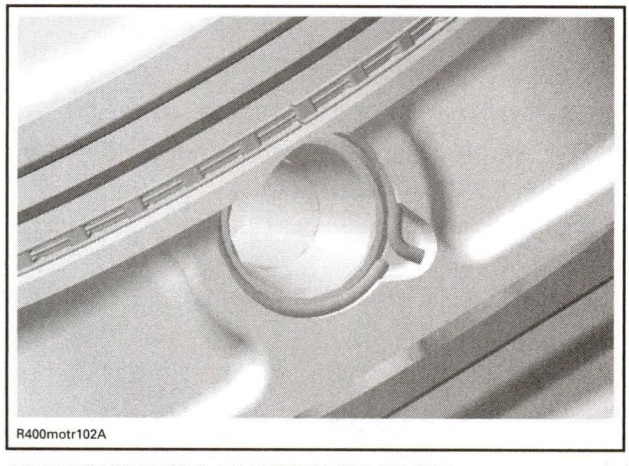
3.4 Remove distance sleeve and insert installer handle into the sleeve.

3.5 Insert the end of the handle into the piston pin, then push to engage the circlip into the piston groove.



TYPICAL
1. *Sleeve with piston circlip inside*
2. *Piston clip installer handle*

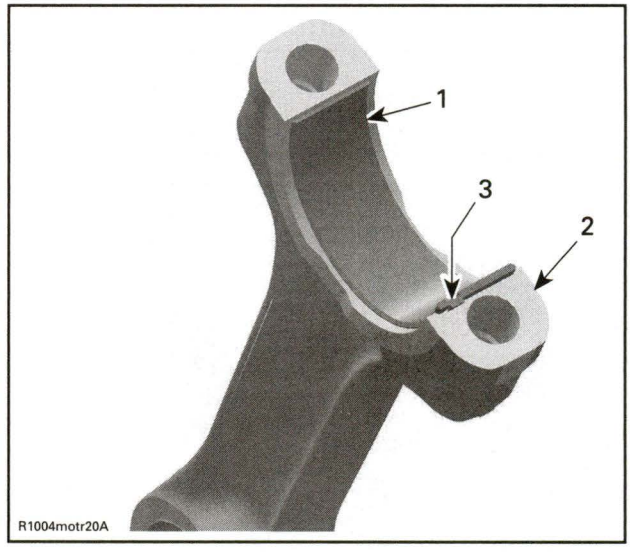
NOTE: Ensure the hook of the piston pin circlip is properly positioned.



CORRECT POSITION OF PISTON PIN CIRCLIP

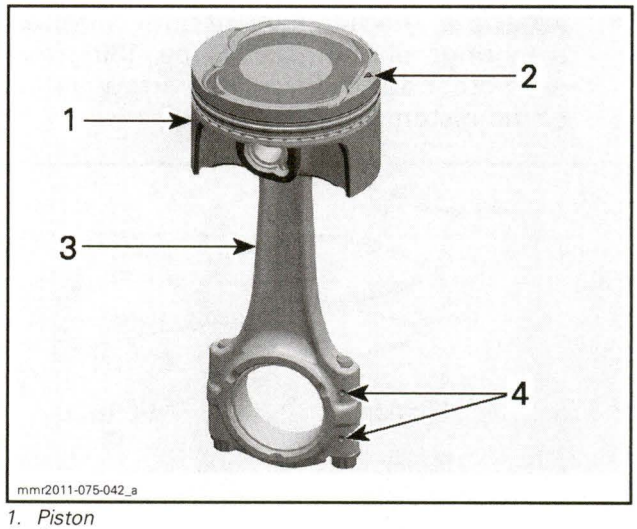
NOTICE **If piston pin circlip installation fails, repeat step 3 by using a NEW circlip.**

4. Correctly install plain bearings and carefully clean split surface on both sides (cracked area) with compressed air.



TYPICAL
1. *Half bearing of connecting rod big end*
2. *Split surface of the connecting rod*
3. *Protrusion of bearing in line with connecting rod groove*

NOTICE **The arrow on top of the piston and the punch marks on the connecting rods must always point towards the exhaust.**

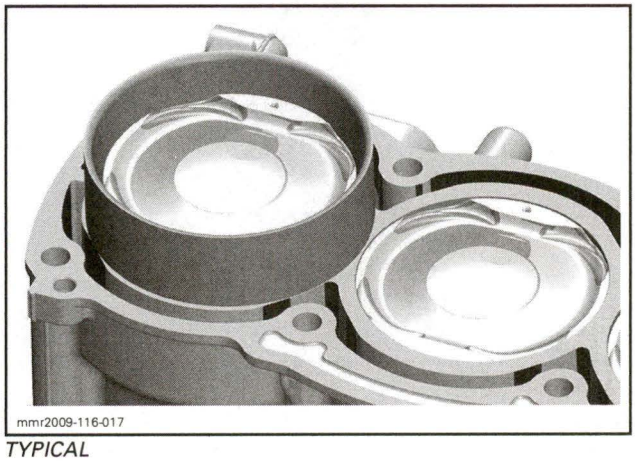


1. *Piston*
2. *Arrow on top*
3. *Connecting rod*
4. *Punched marks*

Piston and Connecting Rod Installation

1. Use engine oil and lubricate:
   - Piston
   - Piston rings
   - Cylinder bore
   - Connecting rod bearings.
2. Slide piston in cylinder bore. Pay attention to the following.

REQUIRED TOOL	
PISTON RING COMPRESSOR (P/N 529 036 208)	

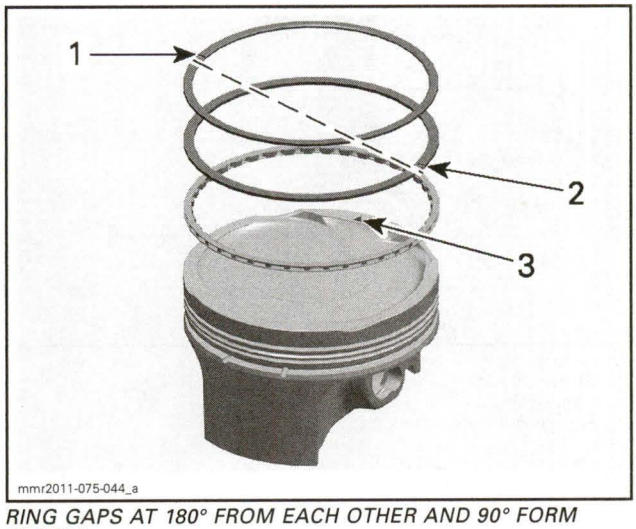


TYPICAL

2.1 If reused, install piston in its original bore.

2.2 Make sure piston rings are properly spaced.

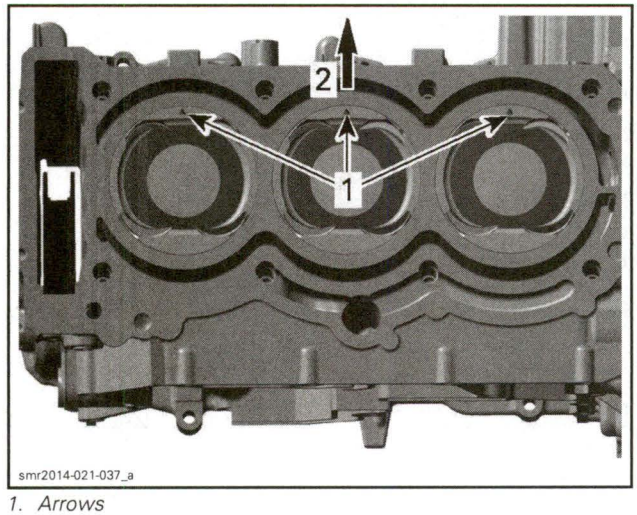
NOTICE **The ring gaps of both compression rings should always be 180° from each other and 90° from the arrow on top of the piston.**



RING GAPS AT 180° FROM EACH OTHER AND 90° FORM ARROW
1. *Rectangular ring - ring gap*
2. *Taper-face ring - ring gap*
3. *Arrow*

2.3 The arrow on top of the piston must point towards exhaust.

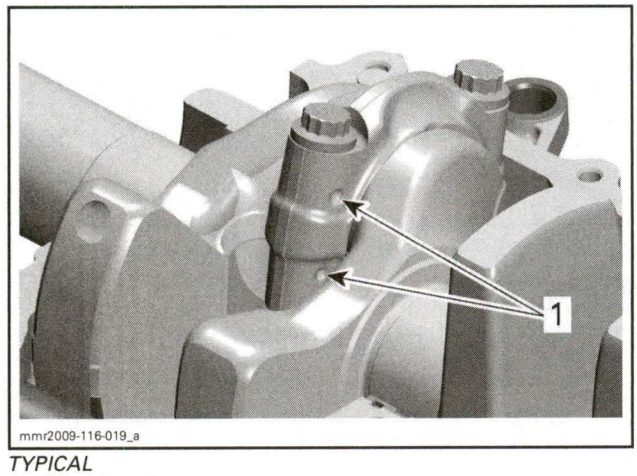
NOTICE **A piston installed with the arrow in the wrong direction would cause serious engine damage.**



1. *Arrows*
2. *Exhaust*

3. Turn cylinder block upside down.
4. Install *CRANKSHAFT* as per procedure in this subsection.
5. Oil crankshaft pin.
6. Install connecting rod caps.

NOTE: Printed marks on connecting rod and cap must point together.



TYPICAL
1. *Printed marks*

NOTICE **This assembly uses stretch screws. Always use NEW screws and strictly adhere to the tightening procedure.**

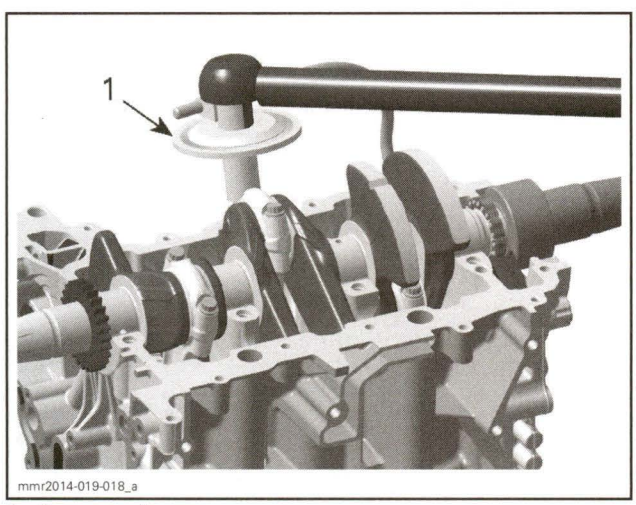
7. Tighten connecting rod screws as follows:

7.1 Torque both connecting rod screws of a connecting rod.

CONNECTING ROD SCREWS TIGHTENING SEQUENCE	
FIRST STEP	12 N•m ± 2 N•m (106 lbf•**in** ± 18 lbf•**in**)

7.2 Use a torque angle gauge to carry out the second step.

CONNECTING ROD SCREWS TIGHTENING SEQUENCE	
SECOND STEP	Additional 70° ± 5°



1. Torque angle gauge

NOTICE Failure to strictly follow this procedure may cause screws to loosen and lead to severe engine damage.

8. Install all other removed parts.

PISTON RINGS

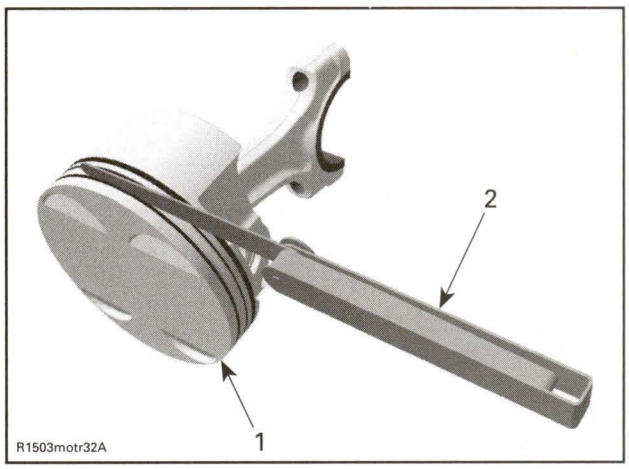
Piston Ring Removal

1. Remove piston, see procedure in this subsection.
2. Remove rings from piston.

Piston Ring Inspection

Ring/Piston Groove Clearance

Using a feeler gauge measure each ring/piston groove clearance.



TYPICAL
1. Piston
2. Feeler gauge

RING/PISTON GROOVE CLEARANCE	
UPPER COMPRESSION RING	
NEW	0.030 mm to 0.066 mm (.0012 in to .0026 in)
SERVICE LIMIT	0.120 mm (.0047 in)
LOWER COMPRESSION RING	
NEW	0.020 mm to 0.056 mm (.0008 in to .0022 in)
SERVICE LIMIT	0.120 mm (.0047 in)
OIL SCRAPER RING	
NEW	0.010 mm to 0.040 mm (.0004 in to .0016 in)
SERVICE LIMIT	0.150 mm (.0059 in)

If clearance is out of specification, the piston and rings should be replaced.

Ring End Gap

1. Place piston ring in cylinder bore between 8 mm to 16 mm (5/16 in to 5/8 in) from the top of cylinder.

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

2. Using a feeler gauge, check ring end gap.

RING END GAP	
UPPER COMPRESSION RING	
NEW	0.20 mm to 0.35 mm (.008 in to .014 in)
SERVICE LIMIT	1.20 mm (.047 in)
LOWER COMPRESSION RING	
NEW	0.30 mm to 0.50 mm (.012 in to .02 in)
SERVICE LIMIT	1.20 mm (.047 in)
OIL SCRAPER RING	
NEW	0.20 mm to 0.70 mm (.0079 in to .0276 in)
SERVICE LIMIT	1.20 mm (.047 in)

If ring end gap is out of specification, replace piston rings.

Piston Ring Installation

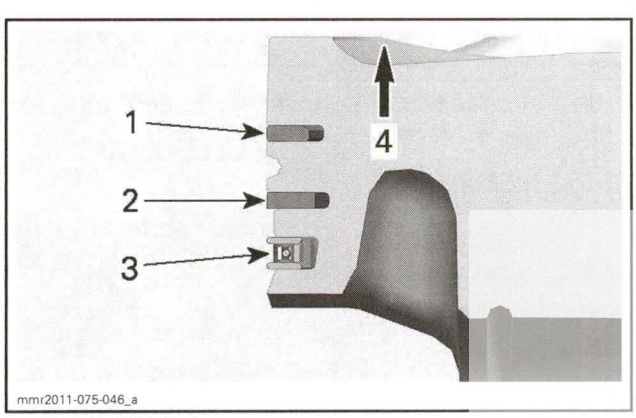
1. Install piston rings in the following order.

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

   1.1 Install oil scraper ring.

   1.2 Install the lower compression ring with the letter "N" facing up.

   1.3 Install upper compression ring with the letter "N" facing up.



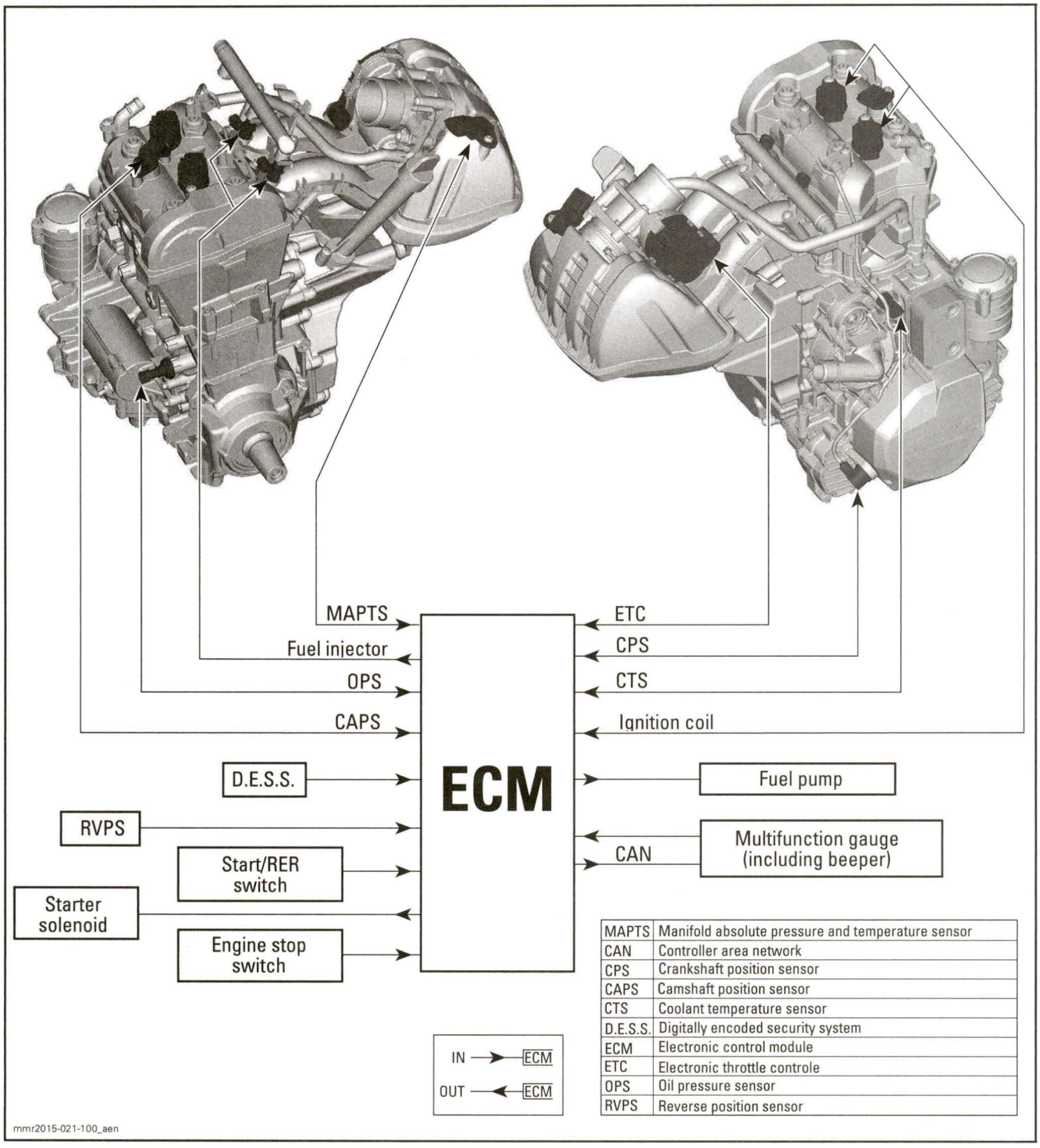
1. Rectangular ring
2. Taper-face ring
3. Oil scraper ring
4. Letter "N" facing up

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NOTICE Ensure the upper and lower compression rings are not interchanged.

2. Ensure rings rotate smoothly after installation.

OVERVIEW (600 ACE)



MAPTS	Manifold absolute pressure and temperature sensor
CAN	Controller area network
CPS	Crankshaft position sensor
CAPS	Camshaft position sensor
CTS	Coolant temperature sensor
D.E.S.S.	Digitally encoded security system
ECM	Electronic control module
ETC	Electronic throttle controle
OPS	Oil pressure sensor
RVPS	Reverse position sensor

GENERAL

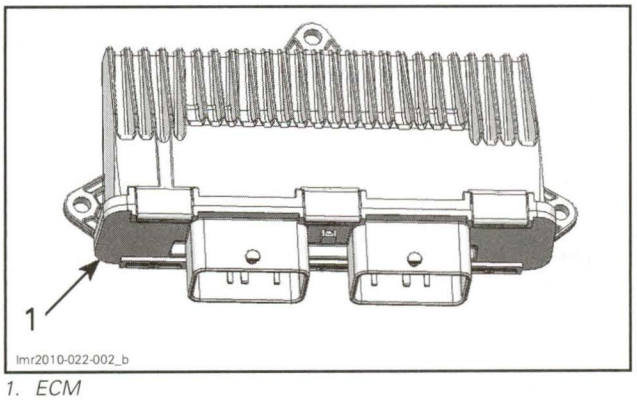
SYSTEM DESCRIPTION

The engine management system (EMS) controls or interacts with the following systems:

- Electronic fuel injection (EFI)
- Digitally Encoded Security System (D.E.S.S.)
- Starting system
- Ignition system
- Lubrication system
- Electrical accessories.

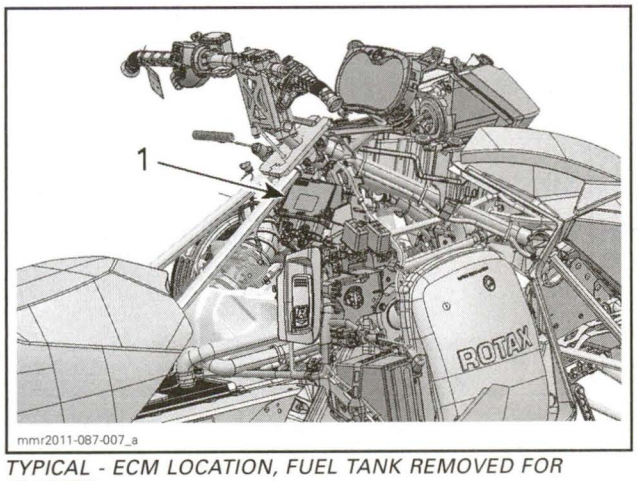
The EMS also features a monitoring system and diagnostic mode to help troubleshooting some problems. Refer to *DIAGNOSTIC AND FAULT CODES* subsection.

Engine Control Module (ECM)



1. ECM

The ECM is located above the air intake manifold.



TYPICAL - ECM LOCATION, FUEL TANK REMOVED FOR CLARITY
1. ECM

The ECM is the central point of the engine management system. It reads inputs, makes computations, uses predetermined parameters and sends signals to the outputs for proper engine management.

The ECM features a permanent memory that will store fault codes, customer information and other engine information when the engine is stopped, and when the battery is removed.

Throttle Protection

If the throttle is not completely closed during engine startup, the engine will not start.

To revert to normal operation, release the throttle completely.

Engine Drowned Mode

This mode is used to expel fuel by cranking an engine that is fuel flooded. When this mode is active, fuel injectors and ignition coils are disabled.

To activate the drowned mode:

1. Fully squeeze throttle lever and hold.
2. Press the START/RER button.

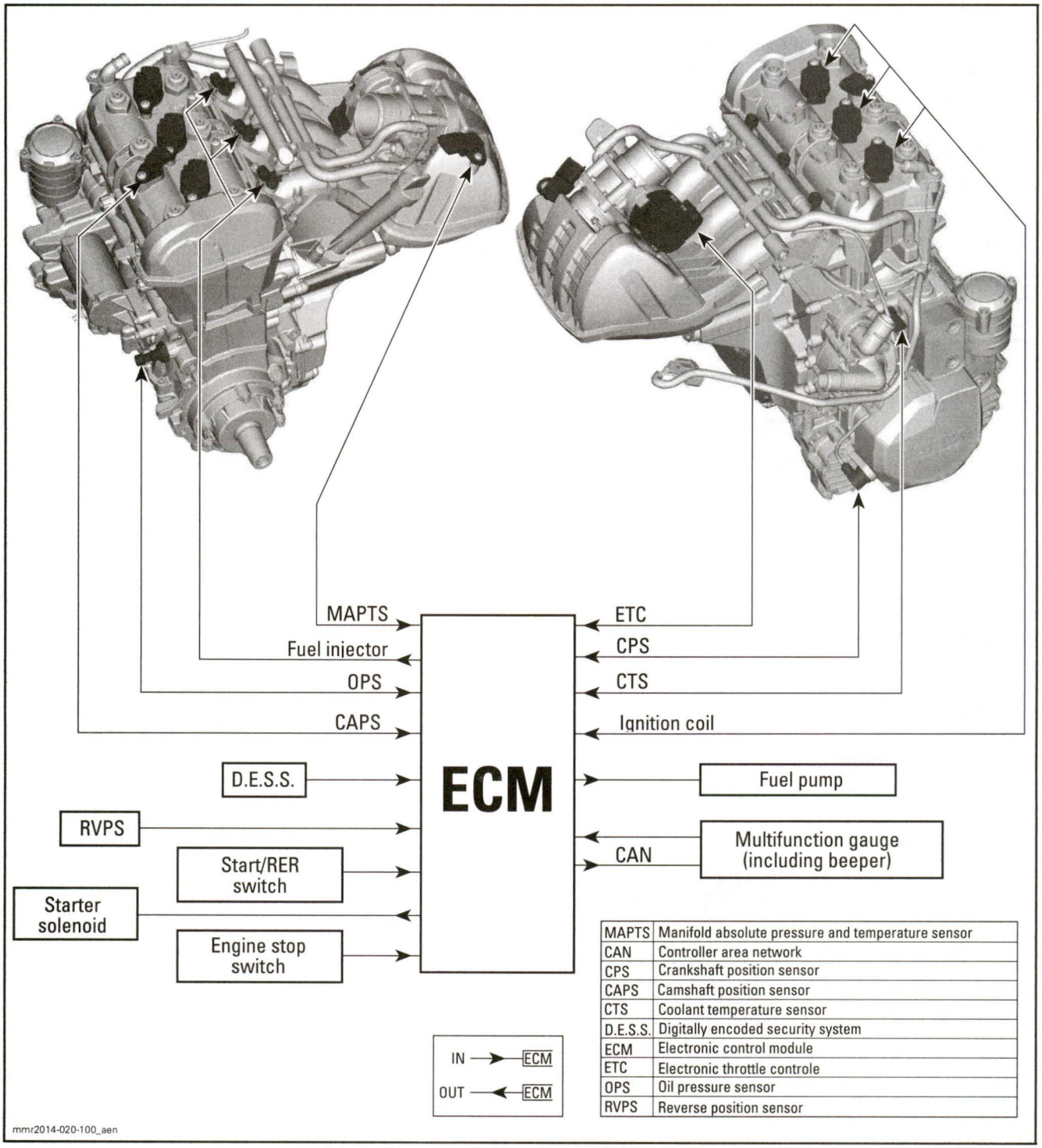
Drowned mode is now active.

To exit this mode, release throttle and start engine normally.

Engine Overheat Protection

COOLANT TEMP.	ENGINE OPERATING CONDITION	EMS ACTION
Above 70°C (158°F)	Idling more than 12 minutes	Engine is stopped. 5 seconds before stopping engine: • Beeper is activated. • SHUTDOWN is displayed in multifunction gauge (premium gauge).
Within 111°C (232°F) and 117°C (243°F)	Idling more than 12 minutes	Beeper is continuously activated. Temperature light is turned ON. ENGINE_TEMP is displayed in multifunction gauge (premium gauge).
Above 110°C (230°F)	Riding	
Above 118°C (244°F)	Idling more than 30 seconds	Engine is stopped. 5 seconds before stopping engine: • Beeper is activated. • SHUTDOWN is displayed in multifunction gauge (premium gauge).
	Riding	Beeper is activated. Temperature light is turned ON. ENGINE_TEMP is displayed in multifunction gauge (premium gauge). Check engine light is turned ON. Engine speed is limited to 5500 RPM. A fault code is set.

OVERVIEW (900 ACE)



MAPTS	Manifold absolute pressure and temperature sensor
CAN	Controller area network
CPS	Crankshaft position sensor
CAPS	Camshaft position sensor
CTS	Coolant temperature sensor
D.E.S.S.	Digitally encoded security system
ECM	Electronic control module
ETC	Electronic throttle controle
OPS	Oil pressure sensor
RVPS	Reverse position sensor

GENERAL

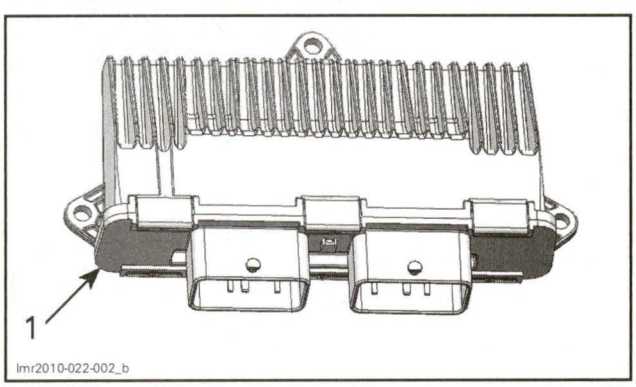
SYSTEM DESCRIPTION

The engine management system (EMS) controls or interacts with the following systems:

- Electronic fuel injection (EFI)
- Digitally Encoded Security System (D.E.S.S.)
- Starting system
- Ignition system
- Lubrication system
- Electrical accessories.

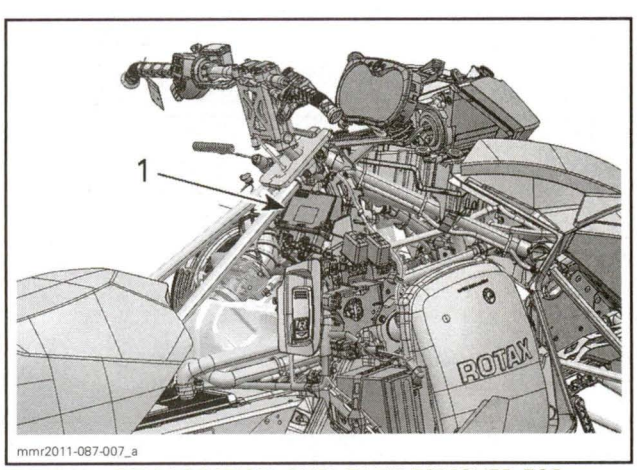
The EMS also features a monitoring system and diagnostic mode to help troubleshooting some problems. Refer to *DIAGNOSTIC AND FAULT CODES* subsection.

Engine Control Module (ECM)



1. ECM

The ECM is located above the air intake manifold.



TYPICAL - ECM LOCATION, FUEL TANK REMOVED FOR CLARITY
1. ECM

The ECM is the central point of the engine management system. It reads inputs, makes computations, uses predetermined parameters and sends signals to the outputs for proper engine management.

The ECM features a permanent memory that will store fault codes, customer information and other engine information when the engine is stopped, and when the battery is removed.

Throttle Protection

If the throttle is not completely closed during engine startup, the engine will not start.

To revert to normal operation, release the throttle completely.

Engine Drowned Mode

This mode is used to expel fuel by cranking an engine that is fuel flooded. When this mode is active, fuel injectors and ignition coils are disabled.

To activate the drowned mode:

1. Fully squeeze throttle lever and hold.
2. Press the START/RER button.

Drowned mode is now active.

To exit this mode, release throttle and start engine normally.

Engine Overheat Protection

COOLANT TEMP.	ENGINE OPERATING CONDITION	EMS ACTION
Above 70°C (158°F)	Idling more than 12 minutes	Engine is stopped. 5 seconds before stopping engine: • Beeper is activated. • SHUTDOWN is displayed in multifunction gauge (premium gauge).
Within 111°C (232°F) and 117°C (243°F)	Idling more than 12 minutes	Beeper is continuously activated. Temperature light is turned ON. ENGINE_TEMP is displayed in multifunction gauge (premium gauge).
Above 110°C (230°F)	Riding	
Above 118°C (244°F)	Idling more than 30 seconds	Engine is stopped. 5 seconds before stopping engine: • Beeper is activated. • SHUTDOWN is displayed in multifunction gauge (premium gauge).
	Riding	Beeper is activated. Temperature light is turned ON. ENGINE_TEMP is displayed in multifunction gauge (premium gauge). Check engine light is turned ON. Engine speed is limited to 5500 RPM. A fault code is set.

iCONTROL SYSTEM

GENERAL

iControl™ (intelligent Control systems) provides an environment whereby the operator can control many systems while constantly maintaining a proper grip on handlebar.

Throttle is at the operator's finger tips and is activated by activating a throttle lever. The operator's attention can thus remain focused on driving the snowmobile.

The throttle is electronic and provides a command signal to an electronic module whose function is to assure proper operation of its system within set parameters.

This system provides improved snowmobile response to operator inputs and increased maneuverability and control.

iTC (INTELLIGENT THROTTLE CONTROL)

The system uses an electronic throttle control (ETC) that provides command signals to the ECM (Engine Control Module). With this system, there is no need for a traditional throttle cable.

The iTC allows the following operating modes:
- Standard mode
- Sport mode
- ECO mode.

For a comprehensive and complete description of this system, refer to *INTELLIGENT THROTTLE CONTROL (ITC)* subsection.

DIAGNOSTIC AND FAULT CODES

GENERAL

MONITORING SYSTEM

This system monitors the electronic components of the EMS (engine management system), the multifunction gauge, and other components of the electrical system to detect if they are faulty or defective. The monitoring system becomes active when the START button is pressed.

NOTE: Some components require the engine to be running to be monitored (fuel injectors for example).

The following components or functions are monitored.

EMS MONITORING
Battery voltage
EMS sensors (TAS, TPS, CPS, CAPS, MAPTS, CTS, OPS). Throttle actuator, ignition coils and fuel injectors
ECM
CAN
Engine starter solenoid (SD)
Fuel pump (FP)
Multifunction gauge (MG)
Cooling Fan Module (CFM)
Eco Mode Switch (ECO)
Radio Frequency Identification (RFID)
Relays

MULTIFUNCTION GAUGE MONITORING
Multifunction gauge
Light Switch
Vehicle Speed Sensor (VSS)
MODE switch
CAN
Fuel level sensor
ECM

When a malfunction is currently detected, the related electronic module:

- Sets an active fault code.
- Adapts the proper protection strategy according to the failure.
- Sends out warning signals to the multifunction gauge which provides beeper codes, fault indicators and fault messages to inform the rider of a particular condition.

When a minor or transient fault occurs, the fault and beeper will cease automatically if the condition that caused the fault no longer exists.

If a minor fault is active, the engine will operate without a noticeable loss of performance.

Releasing the throttle and letting the engine return to idle speed may allow normal operation to resume. If this does not work, try the following:

- Remove tether cord from the engine cut-off switch.
- Wait 3 minutes to allow the ECM to shut down.
- Start engine.
- Check if the fault code is still active.

The electronic system will react differently depending on the fault type. If a severe failure occurs, the engine may not be allowed to be started. In other cases, the engine may operate in limp home mode (reduced RPM) or not be affected at all.

These strategies are used to protect the engine system from damage and to maintain safe operation of the vehicle.

Engine Overheat Protection

COOLANT TEMPERATURE	ENGINE OPERATING CONDITION	EMS ACTION
Above 70°C (158°F)	Idling more than: – 12 minutes (with radiator fan) – 5 minutes (without radiator fan)	Engine is stopped. 5 seconds before stopping engine: – Beeper is activated. – SHUTDOWN is displayed in multifunction gauge.
Above 110°C (230°F)	Riding	Beeper is continuously activated. Temperature light is turned ON. ENGINE_TEMP is displayed in multifunction gauge.
Above 118°C (244°F)	Idling more than 30 seconds	Engine is stopped. 5 seconds before stopping engine: – Beeper is activated. – SHUTDOWN is displayed in multifunction gauge.
	Riding	Beeper is activated. Temperature light is turned ON. ENGINE_TEMP is displayed in multifunction gauge. Check engine light is turned ON. Engine speed is limited to 5500 RPM. A fault code is set.

HOW TO FIND FAULT CODE DESCRIPTIONS

For the latest fault code table, use the **Info Center** submenu in BOSSWeb and search for: Ski-Doo DTC.

NOTE: Only select "TST" in the advanced search when searching for a DTC table.

DIAGNOSTIC AND FAULT CODES

GENERAL

FAULT CODE TABLES

PCODE	MODULE	DESCRIPTION	CAUSE	ACTION
P0106	ECM	Manifold air pressure sensor voltage not plausible.	Vacuum leakage between throttle body and plenum (ex: rubber hose disconnected, loose screws, missing gasket at cylinder head flange, missing injector o-rings, cracks) Air intake duct or filter severely clogged MAPTS sensor Defective Damaged circuit wires, damaged connector or damaged ECM pins, ECM voltage supply.	Make sure sensor connector is fully inserted. Measure voltage between harness connector MAPTS-1and MAPTS-3 (expected value: 4.8 to 5.1 volts).
P0107	ECM	Manifold air pressure sensor voltage too low.	Voltage on system circuit MAPTS-4 reached a low value. Sensor may be disconnected. Circuit wires MAPTS-3 or MAPTS-4 may be disconnected. MAPTS-4 is shorted to ground No 5 volts supply on MAPTS-3 circuit. Damaged sensor.	Make sure sensor's connector is fully inserted. Measure voltage between harness connector MAPTS-1 and MAPTS-3 with the vehicle turned on (expected value: 4.8 to 5.1 volts) Check continuity between ECMA-H2 and MAPTS-1. Check continuity between ECMA-B4 and MAPTS-3. Check continuity between ECMA-G4 and MAPTS-4.
P0108	ECM	Manifold air pressure sensor voltage too high.	Voltage on system circuit MAPTS-4 reached a high value. Circuit wire MAPTS-4 shorted to a supply Circuit wire MAPTS-1 is not connected. Damaged sensor.	Make sure sensor's connector is fully inserted. Measure voltage between harness connector MAPTS-1 and MAPTS-3 with the vehicle turned on (expected value: 4.8 to 5.1 volts) Check continuity between ECMA-H2 and MAPTS-1. Check continuity between ECMA-B4 and MAPTS-3. Check continuity between ECMA-G4 and MAPTS-4.

PCODE	MODULE	DESCRIPTION	CAUSE	ACTION
P0112	ECM	Manifold air temperature sensor voltage too high.	Voltage on system circuit MAPTS-2 reached a high value. Sensor may be disconnected. Circuit wires MAPTS-1 or MAPTS-2 may be disconnected. Damaged sensor.	Make sure sensor's connector is fully inserted. If it is correct then disconnect it and perform the following tests. Check MAPTS sensor pins 1 and 2 for approximately 2280 to 2736 ohms at 19 to 21°C (66 to 70°F). If the sensor resistivity is out of range replace the sensor. Check system circuits ECMA-H3 for continuity to terminal 2 of the MAPTS sensor. Check system circuits ECMA-H2 for continuity to terminal 1 of the MAPTS sensor.
P0113	ECM	Manifold air temperature sensor voltage too low.	Voltage on system circuit MAPTS-2 reached a low value. System circuit MAPTS-2 shorted to ground. Damaged sensor.	Disconnect the sensor and check for a change in the fault code. If the fault code stays the same, look for a short circuit on the harness. If the fault code is different, replace the sensor. Check MAPTS sensor pins 1 and 2 for approximately 2280 to 2736 ohms at 19 to 21°C (66 to 70°F). If the sensor resistivity is out of range replace the sensor. If the sensor resistivity is correct according to the specified temperature range then check circuit wire MAPTS-2 for a short to the ground.
P0117	ECM	Engine coolant temperature sensor voltage too high.	Voltage on system circuit CTS-2 reached a high value. Sensor may be disconnected. Circuit wires CTS-1 or CTS-2 may be disconnected. Circuit CTS-2 shorted to 5 or 12 volts. Damaged sensor.	Make sure sensor's connector is fully inserted. Check system circuit ECMA-1A for continuity to terminal 1 of the CTS connector and ECMA-J2 for continuity to terminal 2 of the CTS connector. Check CTS resistivity on the sensor pins for approximately 2280 to 2736 ohms at 19 to 21°C (66 to 70°F). If the sensor resistivity is out of range replace the sensor.

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PCODE	MODULE	DESCRIPTION	CAUSE	ACTION
P0118	ECM	Engine coolant temperature sensor voltage too low.	Voltage on system circuit CTS-2 reached a low value. Circuit wire CTS-2 shorted to ground. Damaged sensor.	Disconnect the sensor and check for a change in the fault code. If the fault code stays the same, look for a short circuit on the harness. If the fault code is different, replace the sensor. Check system circuit CTS-2 for resistivity to ground (Expected value = 1.2 Kohms when ECMA connector is still connected). Check system circuit ECMA-1A for continuity to terminal 1 of the CTS connector and ECMA-J2 for continuity to terminal 2 of the CTS connector. Check CTS sensor pins for approximately 2280 to 2736 ohms at 19 to 21°C (66 to 70°F). If the sensor resistivity is out of range replace the sensor.
P0122	ECM	First Throttle Accelerator Sensor (TAS) Short circuit to GND	Damaged circuit wires, damaged throttle position sensor or damaged ECM pins.	Make sure sensor connector is fully inserted. Measure resistance from connector: ECMB-K1 to TAS-D (expected value: < 2 ohms). Measure resistance from connector: ECMB-K3 to TAS-E (expected value: < 2 ohms). Measure resistance from connector: ECMB-E1 to TAS-F (expected value: < 2 ohms).
P0123	ECM	First Throttle Accelerator Sensor (TAS) shorted to supply	Damaged circuit wires, damaged throttle position sensor or damaged ECM pins.	Make sure sensor connector is fully inserted. Measure resistance from connector: ECMB-K1 to TAS-D (expected value: < 2 ohms). Measure resistance from connector: ECMB-K3 to TAS-E (expected value: < 2 ohms). Measure resistance from connector: ECMB-E1 to TAS-F (expected value: < 2 ohms).

PCODE	MODULE	DESCRIPTION	CAUSE	ACTION
P0127	ECM	Torque reduction due to high manifold air temperature.	Temperature detected by the MAPTS sensor exceeded the maximum limit. Could happen during extended idling at high ambient temperatures or very low speed with load	
P0201	ECM	Injector Cyl. #1 (PTO) open circuit.	Circuit wires INJ1-1 or INJ1-2 open circuit. Blown fuse. Disconnected injector connector. Disconnected HIC connector. Injector coil open circuit,	Check fuel injector fuse. Make sure injector connector is fully inserted. Make sure HIC connector is connected. Check system circuit ECMA-B3 for continuity to pin 2 of INJ1 connector. Check system circuit INJ-1 for continuity to the fusebox. Check injector resistivity for approximately 14.5 ohms.
P0202	ECM	Injector Cyl. #2 (MAG) open circuit.	Circuit wires INJ2-1 or INJ2-2 open circuit. Blown fuse. Disconnected injector connector. Disconnected HIC connector. Injector coil open circuit.	Check fuel injector fuse. Make sure injector connector is fully inserted. Make sure HIC connector is connected. Check system circuit ECMA-K1 for continuity to pin 2 of INJ1 connector. Check system circuit INJ-1 for continuity to the fusebox. Check injector resistivity for approximately 14.5 ohms.
P0217	ECM	Torque reduction due to high engine coolant temperature.	Warm riding condition, lack of cooling.	Check coolant level. Check for air pocket in cooling system.
P0222	ECM	2nd Throttle Accelerator Sensor (TAS) shorted to GND	Damaged circuit wires, damaged throttle position sensor or damaged ECM pins.	Make sure sensor connector is fully inserted. Measure resistance from connector: ECMB-J3 to TAS-A (expected value: < 2 ohms). Measure resistance from connector: ECMB-B3 to TAS-B (expected value: < 2 ohms). Measure resistance from connector: ECMB-A3 to TAS-C (expected value: < 2 ohms).

PCODE	MODULE	DESCRIPTION	CAUSE	ACTION
P0223	ECM	2nd Throttle Accelerator Sensor (TAS) shorted to supply	Damaged circuit wires, damaged throttle position sensor, or damaged ECM pins.	Make sure sensor connector is fully inserted. Measure resistance from connector: ECMB-J3 to TAS-A (expected value: < 2 ohms). Measure resistance from connector: ECMB-B3 to TAS-B (expected value: < 2 ohms). Measure resistance from connector: ECMB-A3 to TAS-C (expected value: < 2 ohms).
P0231	ECM	Fuel pump open circuit or shorted to ground.	There is no load on circuit wire ECMB-M1 or it is shorted to ground. Blown fuse. Fuel pump connector is not connected. Fuel pump motor is open.	Check fuse. Make sure the fuel pump connector is fully inserted. Open ECM ACTIVATION page in B.U.D.S. Activate fuel pump and check if it reacts as expected. With vehicule power ON check voltage on FP-C connector (Expected value = battery voltage). Check system circuit ECMB-M1 for continuity to FP-A connector. Measure resistance between FP-C and FP-A (expected value: < 2 ohms)
P0232	ECM	Fuel pump shorted to battery.	Circuit wire ECMB-M1 is shorted to 12 volts. Fuel pump motor is stuck or shorted.	Disconnect the fuel pump and check if the fault disapears. If it does then replace the fuel pump. Ckeck if system circuits FP-A and FP-C are shorted together.
P0261	ECM	Injector Cyl. #1 (PTO) shorted to ground.	Circuit wire INJ1-1 is shorted to ground.	Disconnect injector 1. Measure resistance between injector pin 1 and 2 (Expected value = 10 to 15 ohms). With vehicule power ON and engine not running, check the voltage on pin 2 of the INJ2 connector (Expected value = around 3.3 volts). If the voltage is close to 12 volts check for a short to 12 volts on this circuit.

PCODE	MODULE	DESCRIPTION	CAUSE	ACTION
P0262	ECM	Injector Cyl. #1 (PTO) shorted to battery.	Circuit wire INJ1-1 is shorted to battery. Injector coil is shorted.	Disconnect injector 1. Measure resistance between injector pin 1 and 2 (Expected value = 10 to 15 ohms). With vehicule power ON and engine not running, check the voltage on pin 2 of the INJ2 connector (Expected value = around 3.3 volts). If the voltage is close to 12 volts check for a short to 12 volts on this circuit.
P0264	ECM	Injector Cyl. #2 (MAG) shorted to ground.	Circuit wire INJ2-1 is shorted to ground. Injector coil is open	Disconnect injector 2. Measure resistance between injector pin 1 and 2 (Expected value = 10 to 15 ohms). With vehicule power ON and engine not running, check the voltage on pin 2 of the INJ2 connector (Expected value = around 3.3 volts). If the voltage is close to 12 volts check for a short to 12 volts on this circuit.
P0265	ECM	Injector Cyl. #2 (MAG) shorted to battery.	Circuit wire INJ2-1 is shorted to battery. Injector coil is shorted.	Disconnect injector 2. Measure resistance between injector pin 1 and 2 (Expected value = 10 to 15 ohms). With vehicule power ON and engine not running, check the voltage on pin 2 of the INJ2 connector (Expected value = around 3.3 volts). If the voltage is close to 12 volts check for a short to 12 volts on this circuit.
P0335	ECM	Crankshaft signal fault.	Slow engine cranking due to low battery voltage Intermittent signal from crankshaft position sensor. Damaged circuit wires, damaged sensor. Sensor may not be properly secured.	Verify that the battery is properly charged Make sure sensor connector is fully inserted. Measure resistance from connector: ECMA-H1 to CPS-1 (Expected value: < 2 ohms). Measure resistance from connector: ECMA-K2 to CPS-2 (Expected value: < 2 ohms).

PCODE	MODULE	DESCRIPTION	CAUSE	ACTION
P0340	ECM	Engine phase determination error.	CAPS signal not plausible, damaged circuit wires, damaged connector or damaged tooth wheel.	Make sure sensor connector is fully inserted. Measure voltage between harness connector CAPS-3 and CAPS-1 (expected value: 11 to 13 volts). Measure resistance between connector ECMA-E2 to CAPS-2. (expected value : <2 ohms)
P0359	ECM	Ignition coil Cyl. #2 (MAG) shorted to battery.	Circuit wire IGN2-3 is shorted to battery. Ignition coil is damaged.	Disconnect ignition coil #2. With vehicule power ON and engine not running check voltage on pin 3 of IGN2 connector. (Expected value = 0 volt). If voltage is close to 12 volts, check for a short on this circuit.
P0360	ECM	Ignition coil Cyl. #1 (PTO) shorted to battery.	Circuit wire IGN1-3 is shorted to battery. Ignition coil is damaged.	Disconnect ignition coil #1. With vehicule power ON and engine not running check voltage on pin 3 of IGN1 connector. (Expected value = 0 volt). If voltage is close to 12 volts, check for a short on this circuit.
P0361	ECM	ECM ignition coil driver #2 (MAG) fault	Ignition coil or HIC connector not connected or damaged. Blown fuse. Broken wire or terminal.	Check if HIC connector connected. Check ignition fuse. Check circuit wire IGN2-3.
P0362	ECM	ECM ignition coil driver #1 (PTO) fault	Ignition coil or HIC connector not connected or damaged. Blown fuse. Broken wire or terminal.	Check if HIC connector connected. Check ignition fuse. Check circuit wire IGN1-3.
P0480	ECM	Fan relay circuit	Blown fuse, damaged or disconnected relay, damaged circuit wires, damaged connectors or damaged ECM output pins.	Check fuse. Disconnect Fan relay. Measure voltage between harness connector CFM-4 and ground (expected value: 11 to 13 volts). Measure resistance from harness connector: ECMB-J4 to CFM-2 (expected value: < 2 ohms). With the engine turned off measure voltage between CFM-2 and ground (expected value: 11 to 13 volts). Use BUDS to activate the fan and measure voltage between CFM-2 and ground (expected value: close to 0 volts). Check fuse F4

PCODE	MODULE	DESCRIPTION	CAUSE	ACTION
P0513	ECM	Invalid Access Key Detected	A non stored access key was detected when key switch was turned to ON. If no access key is available, program a new one and retry.	
P0520	ECM	Engine oil pressure switch functional problem.	Defective oil pressure switch, damaged circuit wires, damaged connector or loose terminals, damaged ECM pins.	Measure resistance between harness connector EOP and ground when engine stopped (expected value < 2 ohms). Measure resistance between harness connector EOP and ground when engine running (expected value = open). Measure resistance from harness connector: EOP to ECMA-E3 (expected value: < 2 ohms). Check if HIC connector is properly connected (engine harness to the vehicle harness).
P0523	ECM	Engine oil pressure switch sticking	Disconnected oil pressure switch Damaged oil pressure switch, damaged circuit wires, damaged connector, damaged ECM pins.	Measure resistance between harness connector EOP and ground when engine stopped (expected value < 2 ohms). Measure resistance between harness connector EOP and ground when engine running (expected value = open). Measure resistance from harness connector: EOP to ECMA-E3 (expected value: < 2 ohms). Check if HIC connector is properly connected (engine harness to the vehicle harness).
P0524	ECM	Low oil pressure.	Oil level too low Engine mechanical problem Defective oil pressure switch, damaged circuit wires, damaged connector, damaged ECM pins. Vehicle was turned upside down with the engine running	Check oil level. Check system circuit ECMA-E3 for continuity to the terminal of the OPS connector. Check oil pressure. If the vehicle was turned upside down while the engine was running, delete the fault
P0560	ECM	Non-plausibility error on system voltage	ECU internal failure in reading system voltage	Replace ECU if fault is persisting

PCODE	MODULE	DESCRIPTION	CAUSE	ACTION
P0562	ECM	Battery voltage too low.	Battery voltage dropped under 11 volts.	Check battery voltage for 11 to 13 volts with engine stopped. Check battery voltage for 13.5 to 14.5 volts with engine speed above 2500 RPM. Check connections on regulator. Check charging system.
P0563	ECM	Battery voltage too high.	Battery voltage exceeded 15.6 volts.	Check battery voltage for 11 to 13 volts with engine stopped. Check battery voltage for 13.5 to 14.5 volts with engine speed above 2500 RPM. Check connections on regulator. Check charging system.
P060D	ECM	Throttle Accelerator Sensor (TAS) signals not synchronized.	Throttle Accelerator Sensors (TAS) plausibility check error.	Make sure sensor connector is fully inserted. Check voltages on connector TAS-F and TAS-C. Voltage on pin TAS-F must be 2 times greater than voltage on pin TAS-C at any given position of the lever. Check for 5 volts on pin TAS-A and TAS-D.
P060E	ECM	Electrical Throttle Actuator (ETA) control fault	Damaged wiring harness Damaged TPS Damaged ECM	Disconnect throttle body Measure resistance between ETC pin 3 and 5 (expected value = 2 to 3 ohms). Disconnect ECMA. Measure resistance from harness connector: ETC-5 to ECMA-L1 (expected value: < 2 ohms). Measure resistance from harness connector: ETC-3 to ECMA-L2 (expected value: < 2 ohms).
P0610	ECM	Variant Coding error.	Faulty variant coding, faulty programming, wrong ECM after replacement	

PCODE	MODULE	DESCRIPTION	CAUSE	ACTION
P062C	ECM	Loss of vehicle speed information from multifunction gauge.	ECM lost communication with the cluster. Multifunction gauge may be disconnected. Loss of power on the multidunction gauge. Loss of communication with the multidunction gauge via the CAN bus. CAN bus lines shorted together. CAN bus line shorted to ground.	Make sure the multidunction gauge connector is fully inserted. Check for bent pin on the cluster connector Measure voltage between harness connector MG-8 and ground with the vehicle turned on (expected value: 11 to 13 volts). Measure voltage between harness connector MG-9 and ground with the vehicle turned off (expected value: 11 to 13 volts). Measure resistivity between harness connector MG-11 for continuity to the ground (Expected value < 2 ohms). Check continuity between harness connector MG-24 and ECMB-C1 Check continuity between harness connector MG-23 and ECMB-C2 Resistance between harness connector MG-23 and MG-24 should be around 120 ohms Verify that harness connector MG-23 and MG-24 are not shorted to ground or anything else

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PCODE	MODULE	DESCRIPTION	CAUSE	ACTION
P0685	ECM	Lighting relay circuit	Blown fuse, damaged or disconnected relay, damaged circuit wires, damaged connectors or damaged ECM output pins.	Check fuse. Disconnect lighting relay. Measure voltage between harness connector FB-D1 and ground (expected value: 11 to 13 volts). Measure voltage between harness connector FB-D2 and ground (expected value: 11 to 13 volts). Measure resistance from harness connector: ECMB-G1 to FB-C2 (expected value: < 2 ohms). With the engine turned off measure voltage between FB-C2 and ground (expected value: 11 to 13 volts). With the engine turned on measure voltage between FB-C2 and ground (expected value: close to 0 volts). Measure resistance between terminals 85 and 86 on the 2 relays (expected value: 70 to 90 ohms).
P0686	ECM	Lighting relay circuit shorted to ground or open circuit	Blown fuse, damaged or disconnected relay, damaged circuit wires, damaged connectors or damaged ECM output pins.	Check fuse. Disconnect lighting relay. Measure voltage between harness connector FB-D1 and ground (expected value: 11 to 13 volts). Measure voltage between harness connector FB-D2 and ground (expected value: 11 to 13 volts). Measure resistance from harness connector: ECMB-G1 to FB-C2 (expected value: < 2 ohms). With the engine turned off measure voltage between FB-C2 and ground (expected value: 11 to 13 volts). With the engine turned on measure voltage between FB-C2 and ground (expected value: close to 0 volts). Measure resistance between terminals 85 and 86 on the 2 relays (expected value: 70 to 90 ohms).

PCODE	MODULE	DESCRIPTION	CAUSE	ACTION
P0687	ECM	Lighting relay circuit shorted to battery +	Damaged relay, damaged circuit wires, damaged connector or damaged ECM output pins.	Check fuse. Disconnect lighting relay. Measure voltage between harness connector FB-D1 and ground (expected value: 11 to 13 volts). Measure voltage between harness connector FB-D2 and ground (expected value: 11 to 13 volts). Measure resistance from harness connector: ECMB-G1 to FB-C2 (expected value: < 2 ohms). With the engine turned off measure voltage between FB-C2 and ground (expected value: 11 to 13 volts). With the engine turned on measure voltage between FB-C2 and ground (expected value: close to 0 volts). Measure resistance between terminals 85 and 86 on the 2 relays (expected value: 70 to 90 ohms).
P0691	ECM	Fan relay circuit shorted to ground or open circuit	Blown fuse, damaged or disconnected relay, damaged circuit wires, damaged connectors or damaged ECM output pins.	Check fuse. Disconnect Fan relay. Measure voltage between harness connector CFM-4 and ground (expected value: 11 to 13 volts). Measure resistance from harness connector: ECMB-J4 to CFM-2 (expected value: < 2 ohms). With the engine turned off measure voltage between CFM-2 and ground (expected value: 11 to 13 volts). Use BUDS to activate the fan and measure voltage between CFM-2 and ground (expected value: close to 0 volts). Check fuse F4

PCODE	MODULE	DESCRIPTION	CAUSE	ACTION
P0692	ECM	Fan relay circuit shorted to battery +	Damaged relay, damaged circuit wires, damaged connector or damaged ECM output pins.	Check fuse. Disconnect Fan relay. Measure voltage between harness connector CFM-4 and ground (expected value: 11 to 13 volts). Measure resistance from harness connector: ECMB-J4 to CFM-2 (expected value: < 2 ohms). With the engine turned off measure voltage between CFM-2 and ground (expected value: 11 to 13 volts). Use BUDS to activate the fan and measure voltage between CFM-2 and ground (expected value: close to 0 volts). Check fuse F4
P1120	ECM	Wrong ratio between both throttle position sensor (TPS)	Damaged wiring harness Damaged TPS Damaged ECM	Make sure the TPS connector is fully inserted. Reset TPS postion. Measure voltage between harness connector ETC-6 and ETC-2 with the vehicle turned on (expected value: 3.3 volts) Check for short between ETC-1 or ETC-4 and a supply or a ground Check continuity between harness connector ETC-1 and ECMA-F3 Check continuity between harness connector ETC-4 and ECMA-K3 Check continuity between harness connector ETC-6 and ECMA-K4 Check continuity between harness connector ETC-2 and ECMA-A2
P160E	ECM	Electrical Throttle Actuator (ETA) control fault	Damaged wiring harness Damaged TPS Damaged ECM	Disconnect throttle body Measure resistance between ETC pin 3 and 5 (expected value = 2 to 3 ohms). Disconnect ECMA. Measure resistance from harness connector: ETC-5 to ECMA-L1 (expected value: < 2 ohms). Measure resistance from harness connector: ETC-3 to ECMA-L2 (expected value: < 2 ohms).

PCODE	MODULE	DESCRIPTION	CAUSE	ACTION
P1610	ECM	Electrical Throttle Actuator (ETA) shorted to supply	Damaged ETC module, damaged circuit wires, damaged connector or damaged ECM output pins.	Disconnect ETC module. Check for a short between ECMA-L1 or ECMA-L2 and a supply Measure resistance from connector: ECMA-L1 to ETC-5 (expected value: < 2 ohms). Measure resistance from connector: ECMA-L2 to ETC-3 (expected value: < 2 ohms).
P1611	ECM	Electrical Throttle Actuator (ETA) shorted to ground	Damaged ETC module, damaged circuit wires, damaged connector or damaged ECM output pins.	Disconnect ETC module. Check for a short between ECMA-1L or ECMA-L2 and gnd Measure resistance from connector: ECMA-L1 to ETC-5 (expected value: < 2 ohms). Measure resistance from connector: ECMA-L2 to ETC-3 (expected value: < 2 ohms).
P1612	ECM	Electrical Throttle Actuator (ETA) signal not plausible	Damaged ETC module, damaged circuit wires, damaged connector or damaged ECM output pins.	Disconnect ETC module. Measure resistance from connector: ECMA-L1 to ETC-5 (expected value: < 2 ohms). Measure resistance from connector: ECMA-L2 to ETA-3 (expected value: < 2 ohms).
P1613	ECM	Electrical Throttle Actuator (ETA) open electrical load	Damaged ETC module, damaged circuit wires, damaged connector or damaged ECM output pins.	Disconnect ETC module. Measure resistance from connector: ECMA-L1 to ETC-5 (expected value: < 2 ohms). Measure resistance from connector: ECMA-L2 to ETA-3 (expected value: < 2 ohms). Measure resistance between ETC-5 and ETC-3 (expected value < 5 ohms)

PCODE	MODULE	DESCRIPTION	CAUSE	ACTION
P1614	ECM	Electronic throttle control (ETC) return spring check not passed	Throttle mechanical adjustment. No TPS reset after throttle body/ECM replacement. Damaged throttle body	Check throttle plate movement. Check idle stop for wear. Check throttle position sensor angle at idle, expected value 1-4.5 degrees Perform THROTTLE POSITION SENSOR RESET in B.U.D.S. with throttle grip accelerator not activated since at least 30 seconds. Refer to the SERVICE MANUAL for more details.
P1615	ECM	Electronic throttle control (ETC) position deviation fault	Throttle mechanical adjustment. No TPS reset after throttle body/ECM replacement.	Check throttle plate movement. Check idle stop for wear. Check throttle position sensor angle at idle, expected value 1-4.5 degrees Perform THROTTLE POSITION SENSOR RESET in B.U.D.S. with throttle grip accelerator not activated since at least 30 seconds. Refer to the SERVICE MANUAL for more details.
P1616	ECM	Electronic throttle control (ETC) check of limp-home position failed	Throttle mechanical stop. No TPS reset after throttle body/ECM replacement.	Check throttle plate movement. Check idle stop for wear. Check throttle position sensor angle at idle, expected value 1-4.5 degrees Perform THROTTLE POSITION SENSOR RESET in B.U.D.S. with throttle grip accelerator not activated since at least 30 seconds. Refer to the SERVICE MANUAL for more details.
P1619	ECM	TPS adaptation failure	Wrong throttle body mechanical position during reset of closed TPS or no TPS reset after ECM replacement.	Check idle stop for wear. Perform THROTTLE POSITION SENSOR RESET in B.U.D.S. with throttle grip accelerator not activated since at least 30 seconds.
P1620	ECM	TPS adaptation failure	Wrong throttle body mechanical position during reset of closed TPS or no TPS reset after ECM replacement.	Check idle stop for wear. Perform THROTTLE POSITION SENSOR RESET in B.U.D.S. with throttle grip accelerator not activated since at least 30 seconds.

PCODE	MODULE	DESCRIPTION	CAUSE	ACTION
P1621	ECM	TPS adaptation cancelled lower mechanical stop failed	Throttle mechanical stop. No TPS reset after throttle body/ECM replacement.	Check idle stop for wear. Ensure throttle plate is against throttle stop. Check throttle Position sensor angle at idle. Perform THROTTLE POSITION SENSOR RESET in B.U.D.S. with throttle grip accelerator not activated since at least 30 seconds. Refer to the SERVICE MANUAL for more details.
P1622	ECM	TPS adaptation failed	Throttle mechanical stop. No TPS reset after throttle body/ECM replacement.	Check idle stop for wear. Check throttle position sensor angle at idle. Perform THROTTLE POSITION SENSOR RESET in B.U.D.S. with throttle grip accelerator not activated since at least 30 seconds. Refer to the SERVICE MANUAL for more details.
P1672	ECM	Accessories relay circuit shorted to battery +	Damaged relay, damaged circuit wires, damaged connector or damaged ECM output pins.	Check fuse. Disconnect lighting relay. Measure voltage between harness connector FB-C6 and ground (expected value: 11 to 13 volts). Measure voltage between harness connector FB-C5 and ground (expected value: 11 to 13 volts). Measure resistance from harness connector: ECMB-J2 to FB-D5 (expected value: < 2 ohms). With the engine turned off measure voltage between FB-D5 and ground (expected value: 11 to 13 volts). With the engine turned on measure voltage between FB-D5 and ground (expected value: close to 0 volts). Measure resistance between terminals 85 and 86 on the 2 relays (expected value: 70 to 90 ohms).

PCODE	MODULE	DESCRIPTION	CAUSE	ACTION
P1673	ECM	Accessories relay circuit shorted to ground or open circuit	Blown fuse, damaged or disconnected relay, damaged circuit wires, damaged connectors or damaged ECM output pins.	Check fuse. Disconnect lighting relay. Measure voltage between harness connector FB-C6 and ground (expected value: 11 to 13 volts). Measure voltage between harness connector FB-C5 and ground (expected value: 11 to 13 volts). Measure resistance from harness connector: ECMB-J2 to FB-D5 (expected value: < 2 ohms). With the engine turned off measure voltage between FB-D5 and ground (expected value: 11 to 13 volts). With the engine turned on measure voltage between FB-D5 and ground (expected value: close to 0 volts). Measure resistance between terminals 85 and 86 on the 2 relays (expected value: 70 to 90 ohms).
P1674	ECM	Accessories relay circuit	Blown fuse, damaged or disconnected relay, damaged circuit wires, damaged connectors or damaged ECM output pins.	Check fuse. Disconnect lighting relay. Measure voltage between harness connector FB-C6 and ground (expected value: 11 to 13 volts). Measure voltage between harness connector FB-C5 and ground (expected value: 11 to 13 volts). Measure resistance from harness connector: ECMB-J2 to FB-D5 (expected value: < 2 ohms). With the engine turned off measure voltage between FB-D5 and ground (expected value: 11 to 13 volts). With the engine turned on measure voltage between FB-D5 and ground (expected value: close to 0 volts). Measure resistance between terminals 85 and 86 on the 2 relays (expected value: 70 to 90 ohms).
P16C0	ECM	ECU ADC plausibility check	Monitoring plausibility check failed.	Check for ECM fault.
P16C1	ECM	ECU ADC test failed	Monitoring plausibility check failed.	Check for ECM fault.

PCODE	MODULE	DESCRIPTION	CAUSE	ACTION
P16C2	ECM	ECU monitoring error	Monitoring plausibility check failed.	Check for ECM fault.
P16C3	ECM	Throttle Accelerator Sensors (TAS) monitoring check fault	Monitoring plausibility check failed.	Check for ECM fault.
P16C4	ECM	Engine speed monitoring check fault	Monitoring plausibility check failed.	Check for ECM fault.
P16C5	ECM	Safety fuel cut-off activated monitoring check level 1	Monitoring plausibility check failed.	Check for ECM fault.
P16C6	ECM	Safety fuel cut-off activated monitoring check level 2	Monitoring plausibility check failed.	Check for ECM fault.
P16C7	ECM	Throttle valve plausibility check failed	Monitoring plausibility check failed.	Check for ECM fault.
P16C8	ECM	Permitted throttle valve position monitoring check exceeded	Monitoring plausibility check failed.	Check for ECM fault.
P16C9	ECM	function monitoring: monitoring of the emergency switch in level 2 (DFC_MoFEmgcySwOff)	Monitoring plausibility check failed.	Check for ECM fault.
P1790	ECM	Driving mode selector switch	Driving mode selector switch has the up and down selection pressed at the same time	Check for a short between ECMB-D3 or ECO-A with ECM-A1 or ECO-B Check for a short between ECMB-E3 or ECO-C with ECM-A1 or ECO-B
P20EB	ECM	Main relay de-energized too late or sticking	Damaged circuit wires Damaged connectors Damaged ECM output pins Damaged main relay	Disconnect main relay. Measure resistance between terminals 85 and 86 on relay (expected value: 70 to 90 ohms). Measure resistance between terminals 30 and 87 on relay (expected value: open circuit). Disconnect relay and measure resistance between terminals FB-A4 and ground (expected value: open circuit).

PCODE	MODULE	DESCRIPTION	CAUSE	ACTION
P212C	ECM	Throttle position sensor #2 voltage too low.	Low voltage or short to ground on circuit wire ETC-4. No 3.3 volts supply on ETC-6. ETC-1 is shorted to ground Damaged sensor.	Make sure the TPS connector is fully inserted. Reset TPS postion. Measure voltage between harness connector ETC-6 and ETC-2 with the vehicle turned on (expected value: 3.3 volts) Check continuity between harness connector ETC-4 and ECMA-K3 Check continuity between harness connector ETC-6 and ECMA-K4 Check continuity between harness connector ETC-2 and ECMA-A2 Check for a short between ETC-4 and a supply
P212D	ECM	Throttle position sensor #2 voltage too high.	Voltage on circuit wire ETC-4 too high. Circuit wire ETC-4 shorted to a supply. Circuit wire ETC-2 is open.	Make sure the TPS connector is fully inserted. Reset TPS postion. Measure voltage between harness connector ETC-6 and ETC-2 with the vehicle turned on (expected value: 3.3 volts) Check continuity between harness connector ETC-4 and ECMA-K3 Check continuity between harness connector ETC-6 and ECMA-K4 Check continuity between harness connector ETC-2 and ECMA-A2 Check for a short between ETC-4 and a supply
P2279	ECM	Air leak from intake plenum	Cracked plenum Leak in air intake system. TPS learning position not done correctly. MAP Sensor problem. Throttle body air leakage.	Reset TPS postion. Check for faulty Air Pressure Sensor. Check for faulty TPS. Check for cracked plenum. Check for leak on the throttle body
P2299	ECM	Throttle and break paddle are used at the same time		

PCODE	MODULE	DESCRIPTION	CAUSE	ACTION
P2621	ECM	Throttle position sensor #1 voltage too low.	Low voltage or short to ground on circuit wire ETC-1. No 3.3 volts supply on ETC-6. ETC-1 is shorted to ground Damaged sensor.	Make sure the TPS connector is fully inserted. Reset TPS postion. Measure voltage between harness connector ETC-6 and ETC-2 with the vehicle turned on (expected value: 3.3 volts) Check continuity between harness connector ETC-1 and ECMA-F3 Check continuity between harness connector ETC-6 and ECMA-K4 Check continuity between harness connector ETC-2 and ECMA-A2 Check for a short between ETC-1 and a supply
P2622	ECM	Throttle position sensor #1 voltage too high.	Voltage on circuit wire ETC-1 too high. Circuit wire ETC-1 shorted to a supply. Circuit wire ETC-2 is open.	Make sure the TPS connector is fully inserted. Reset TPS postion. Measure voltage between harness connector ETC-6 and ETC-2 with the vehicle turned on (expected value: 3.3 volts) Check continuity between harness connector ETC-1 and ECMA-F3 Check continuity between harness connector ETC-6 and ECMA-K4 Check continuity between harness connector ETC-2 and ECMA-A2 Check for a short between ETC-1 and a supply
U0167	ECM	No communication with DESS key.	Damaged circuit wires, damaged or disconnected DESS post, damaged DESS key.	Measure voltage between harness connector RFID-D and ground (expected value: 11 to 13 volts). Check continuity betweem hesness connector RFID-A and ECMB-F2 Check continuity betweem hesness connector RFID-B and ECMB-E4 Check continuity betweem hesness connector RFID-C and ECMB-B2

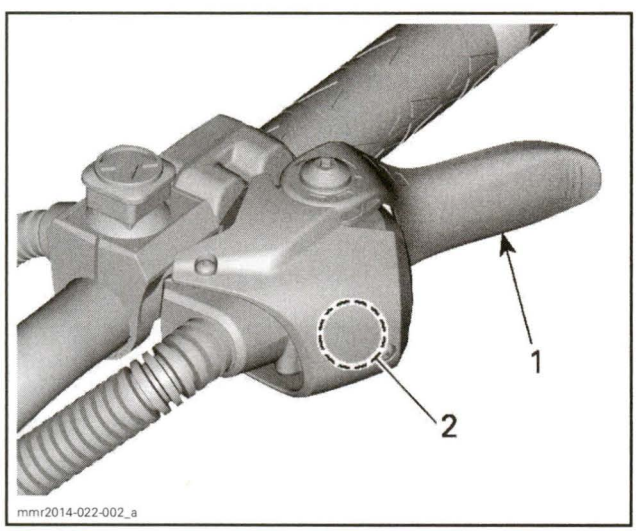
PCODE	MODULE	DESCRIPTION	CAUSE	ACTION
U0400	ECM	Variant coding failure software incompatibility	Faulty variant coding. Faulty programming.	Try updating the ECM. If the problem persists, make sure the ECM part number is correct for the model it is installed on.
U0426	ECM	DESS key communication error.	Damaged circuit wires, damaged or disconnected DESS post, damaged DESS key.	Measure voltage between harness connector RFID-D and ground (expected value: 11 to 13 volts). Check continuity betweem hesness connector RFID-A and ECMB-F2 Check continuity betweem hesness connector RFID-B and ECMB-E4 Check continuity betweem hesness connector RFID-C and ECMB-B2
U300A	ECM	State of the DESS key switch not plausible	Damaged wiring harness Damaged RFID module	Measure voltage between harness connector RFID-D and ground (expected value: 11 to 13 volts). Check continuity betweem hesness connector RFID-A and ECMB-F2 Check continuity betweem hesness connector RFID-B and ECMB-E4 Check continuity betweem hesness connector RFID-C and ECMB-B2

INTELLIGENT THROTTLE CONTROL (iTC)

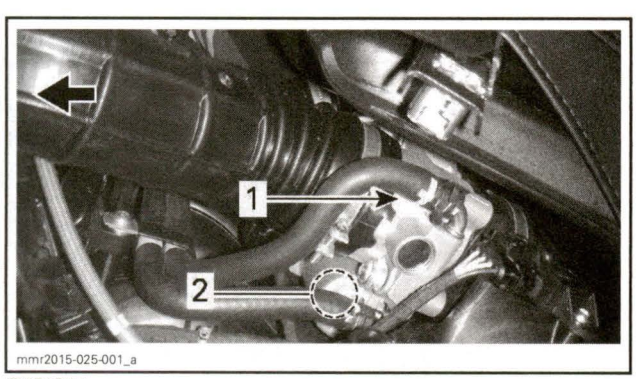
GENERAL

SYSTEM DESCRIPTION

The iTC is an electronic throttle control system that includes a cableless throttle accelerator sensor (TAS) located on the RH side of handlebar, an electronic throttle control (ETC) located on the throttle body and the engine control module (ECM). The iTC is often referred to as a "throttle by wire" system.



TYPICAL
1. *Throttle lever*
2. *Throttle accelerator sensor (TAS)*



TYPICAL
1. *Throttle body*
2. *Throttle actuator*

The ETC is equipped with a motor which controls the throttle opening.

The position of the throttle is measured with two potentiometers.

The ECM evaluates the throttle position with these two measures and controls the motor to reach the desired position.

These potentiometers are powered by the ECM with a voltage of 3.3 volts.

The signals given by these potentiometers vary from 0.33V to 2.97V for (SIGNAL 1) and 2.97V to 0.33V for (SIGNAL 2).

The relation between these two signals is (SIGNAL 1) + (SIGNAL 2) = 3.3V.

When ECM is woken up, throttle body will close completely to reinitialize. For both signals to be properly set at idle position.

If a problem occurs with any of these controls or signals then a diagnostic fault code will be generated.

Learning Key

The Ski-Doo™ learning key limits the torque and speed of the snowmobile therefore enabling first time users and less experienced operators to learn how to operate the snowmobile while gaining the necessary confidence and control.

Limitations

The ability of a novice to operate the snowmobile can be exceeded even when a learning key is used.

Refer to *OPERATING MODES* subsection for details.

OPERATING MODES

ECO Mode (Fuel Economy Mode)

When ECO mode is selected (fuel economy mode), vehicle torque and speed are limited whereby an optimal cruising speed is maintained in order to reduce fuel consumption.

Once activated, ECO mode will remain active until it is deactivated by the operator.

Standard Mode

A Standard mode indicator is ON in the multifunction gauge to confirm the active mode of operation.

Sport Mode

⚠ WARNING

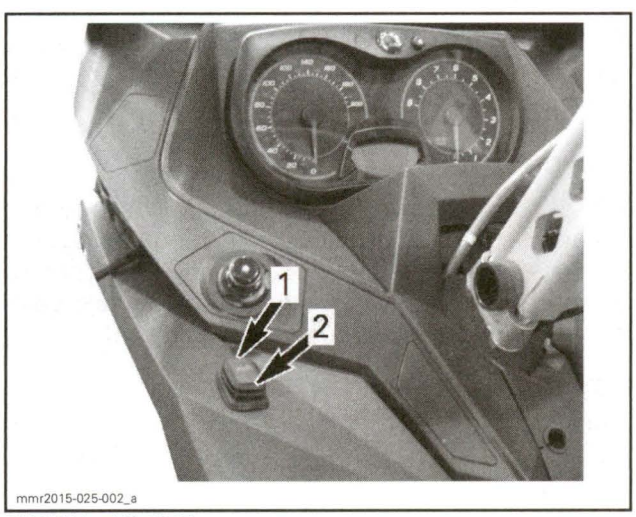
Ensure passenger is advised to hold on tightly before activating Sport mode. Sport mode provides increased acceleration.

When selected, Sport mode provides for instant throttle response and more rapid accelerations than Standard or ECO mode.

Navigating Operating Modes

Use ECO mode switch to navigate between modes, from ECO (reduced power) to Standard (full power) to Sport (increased power).

To increase power, press the switch upwards. To decrease power, press the switch downwards.



TYPICAL - LH SIDE
1. *Upwards*
2. *Downwards*

⚠ WARNING

When adjusting modes, be sure to maintain situational awareness of other snowmobiles, obstacles, or persons .

Activating Standard Mode

To activate Standard mode when in Sport mode, press bottom end of switch once.

To activate Standard mode when in ECO mode, press top end of switch once.

Activating Eco Mode

To activate ECO mode when in Sport mode, press bottom end of switch twice.

To activate ECO mode when in Standard mode, press bottom end of switch once.

Activating Sport Mode

⚠ WARNING

Ensure passenger is advised to hold on tightly before activating Sport mode. Sport mode provides increased acceleration.

To activate Sport mode when in Standard mode, press top end of switch once.

To activate Sport mode when in ECO mode, press top end of switch twice.

Learning Key Modes

The learning key provides a mode of operation whereby engine torque and speed are limited.

NOTE: The initial learning key programming can limit the speed to 40 km/h (25 MPH) or 70 km/h (43 MPH).

There are 3 levels available for the learning key mode.

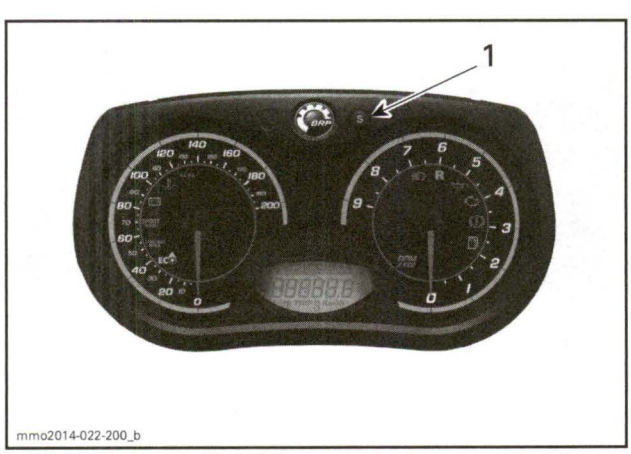
Changing Learning Key Settings

To change learning key setting, carry out the following:

1. Press the START/electronic reverse button to wake up the electrical system and install the NORMAL key on the engine cut-off switch.
2. Wait for the multifunction gauge to complete its self-test and display the key recognition message.

Analog/Digital Gauge

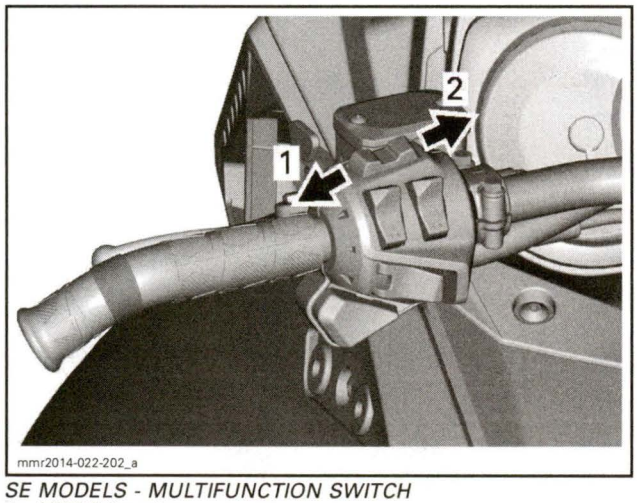
3. Press the SET button until LEARN is visible in the digital screen of the multifunction gauge.



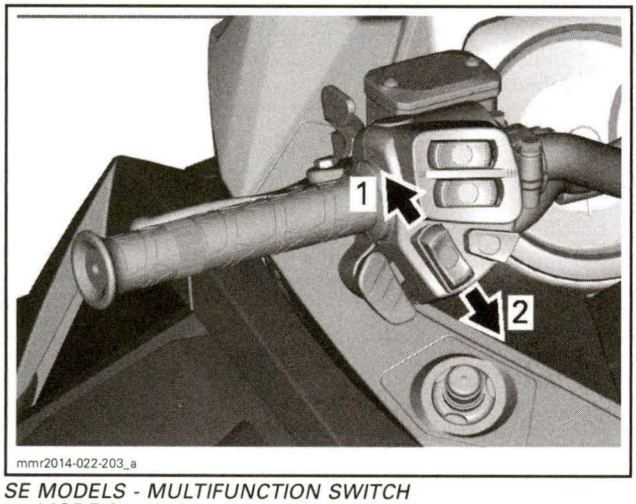
ALL MODELS EXCEPT SE
1. *SET function*

Multifunction Analog/Digital Gauge

4. Press the MODE button once, then press the SET button until LEARN is visible in the digital center of the gauge.



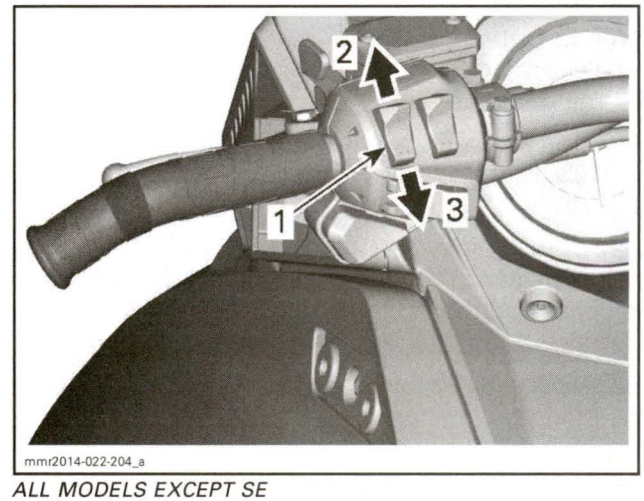
SE MODELS - MULTIFUNCTION SWITCH
1. *MODE function*
2. *SET function*



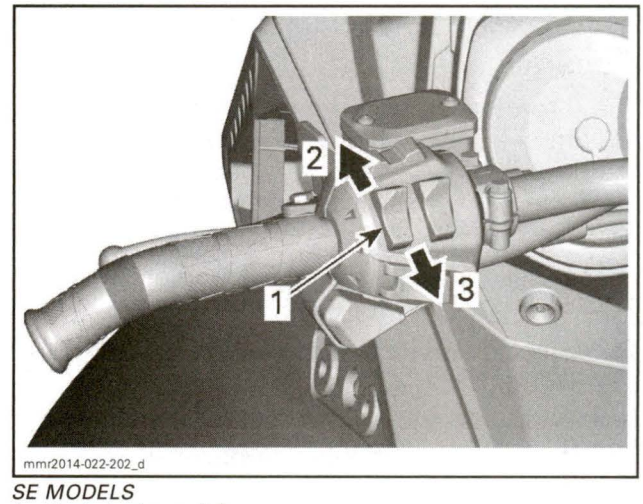
SE MODELS - MULTIFUNCTION SWITCH
1. *MODE function*
2. *SET function*

All Models

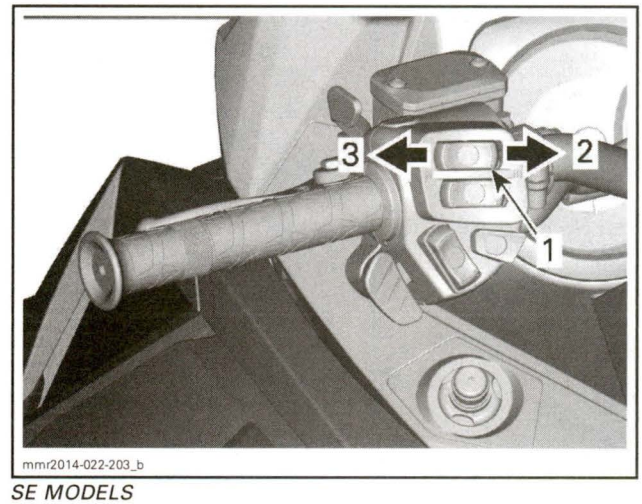
5. Use the heated grip switch to toggle the key setting between 1 and 3.



ALL MODELS EXCEPT SE
1. *Heated grips switch*
2. *Increase*
3. *Decrease*



SE MODELS
1. *Heated grips switch*
2. *Increase*
3. *Decrease*



SE MODELS
1. *Heated grips switch*
2. *Increase*
3. *Decrease*

NOTE: Setting 1 is the lowest available torque, while setting 3 is the highest available torque for learning key.

6. After a few seconds, the setting is automatically confirmed and saved.

NOTE: The key speed setting is applicable to any key of the same type used on a specific snowmobile. The same key type used on a different snowmobile may therefore have a different key speed setting.

NOTE: Vehicle performance may vary depending on riding conditions.

PROCEDURES

THROTTLE ACCELERATOR SENSOR (TAS)

General

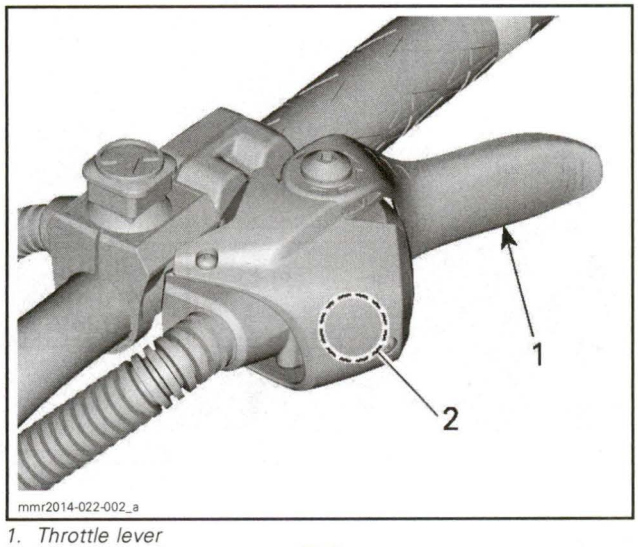
The throttle accelerator sensor (TAS) is a double hall effect sensor, which translates the position of the lever into two analog voltage and sends a signal to the ECM which is proportional to the throttle lever angle.

These Hall effect sensors are powered by the ECM with a voltage of 5.0 volts.

The signals given by these sensors vary from 0.6V to 2.97V for (SIGNAL 1) and 0.3V to 1.49V for (SIGNAL 2).

The relation between these two signals is (Signal 1) = (Signal 2) X 2.

If a problem occurs with any of these signals then a diagnostic fault code will be generated.

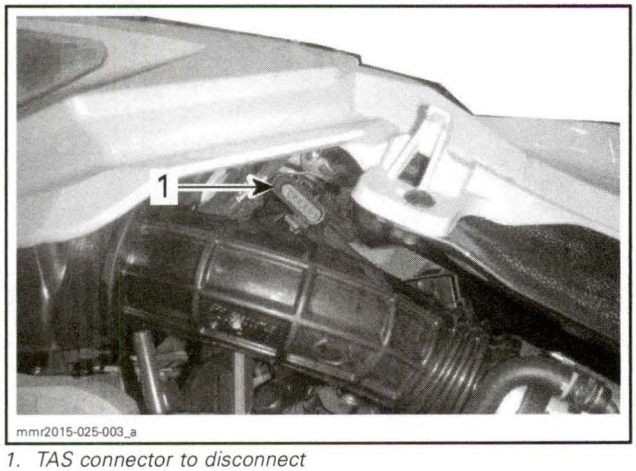


1. Throttle lever
2. Throttle accelerator sensor (TAS)

First ensure the throttle lever functions adequately. Apply throttle lever fully then release it. It must reach the wide open position and return to the idle position freely when released. Otherwise, refer to *STEERING SYSTEM* for an inspection.

TAS Voltage Test

Disconnect TAS connector and measure voltage on the main harness side.



1. TAS connector to disconnect

TAS CONNECTOR TEST	
Pin	Voltage
B to A	5V
D to E	5V

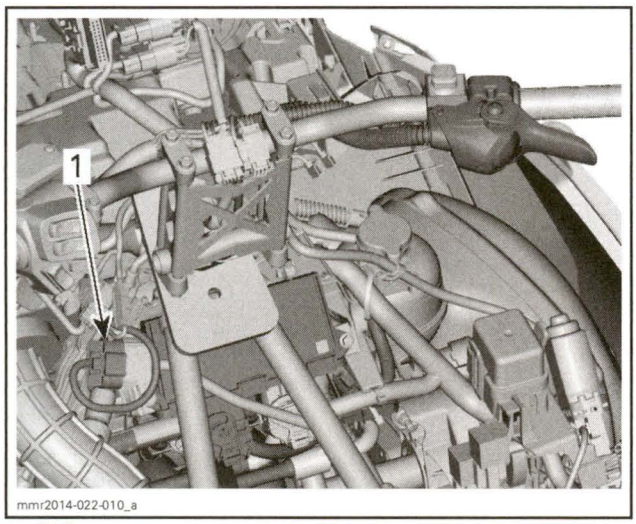
If not 5V, ECM might be defective, oxidation might be present in circuits or terminals might not have good contact.

Reconnect TAS connector and backprobe to measure voltage.

If 2 for 1 relation is not met for signal 1 and 2 ratio, then TAS sensor is defective. Refer to *TAS REPLACEMENT* in this subsection for replacement procedure.

TAS Replacement

1. Remove throttle lever housing from vehicle. Refer to *STEERING SYSTEM* and note harness routing.
2. Disconnect TAS connector.



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1. TAS connector to disconnect

3. Replace TAS connector

ETC Voltage Test

Disconnect ETC connector on throttle body and measure on the engine harness.

ETC CONNECTOR TEST	
Pin	Voltage
6 to 2	3.3V

If not 3.3V, ECM is might be defective, oxidation might be present in circuits or terminals might not have good contact.

Reconnect ETC connector and backprobe to measure voltage.

If (Signal 1) + (Signal 2) does not equal 3.3V, then the ETC is defective. Refer to *ETC REPLACEMENT* in this subsection for replacement procedure.

ETC Replacement

The ETC comes assembled with the complete throttle body unit.

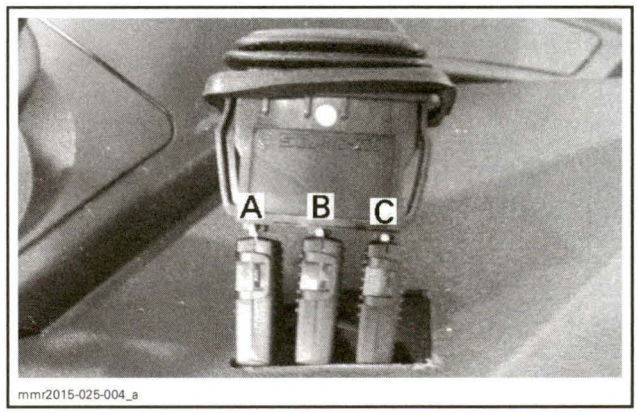
To replace throttle body assembly. Refer to *AIR INTAKE SYSTEM*.

Initialize the Throttle Position Sensor. Refer to *ELECTRONIC FULE INJECTION* subsection for B.U.D.S. procedure.

ECO MODE SWITCH

ECO Mode Switch Operation Test

1. Unclip and raise switch.
2. Disconnect the ECO mode switch connectors.



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1. Driving mode switch
2. Driving mode switch connector

3. Set multimeter to Ω.
4. Test the ECO mode switch for continuity as per following table.

ECO MODE SWITCH CONNECTOR TEST		
Position	Pin	Resistance
UP	B to A	0 Ω
Released	B to A	Infinite (OL)
DOWN	B to C	0 Ω
Released	B to C	Infinite (OL)

ELECTRONIC FUEL INJECTION (600 ACE_iTC)

SERVICE TOOLS

Description	Part Number	Page
ECM ADAPTER TOOL	529 036 166	302–304, 319, 325–327
FLUKE 115 MULTIMETER	529 035 868	302–303, 310, 319, 322, 324–325, 327
FUEL HOSE DISCONNECT TOOL	529 036 037	312
POWER INTERFACE	515 177 223	309

SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
FLUKE AUTOMOTIVE BACK PROBE PIN	TP40	322
FLUKE SUREGRIP INSULATED TEST LEADS	TL224	322

SERVICE PRODUCTS

Description	Part Number	Page
DIELECTRIC GREASE	293 550 004	323

GENERAL

⚠ WARNING

When electrically disconnecting or removing the throttle body from the intake manifold, always remove the tether cord from the engine cut-off switch and disconnect the battery.

⚠ WARNING

Always disconnect battery prior to working on the fuel system. Always disconnect battery exactly in the specified order, BLACK (-) cable first. Electrical connections should be disconnected prior to disconnecting fuel lines.

⚠ WARNING

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

⚠ WARNING

Proceed with care and use appropriate safety equipment when working on the fuel system. Wipe off any fuel spillage in the engine compartment. Do not allow fuel to spill on hot engine parts and/or on electrical connectors.

Cover the fuel line connection with an absorbent shop rag before disconnecting them. Slowly disconnect the fuel hose to minimize spilling.

⚠ WARNING

Replace any damaged, leaking or deteriorated fuel lines or connections. After working on the fuel system, always pressurize the fuel system and check for fuel leaks. Refer to *FUEL SYSTEM PRESSURIZATION* in *FUEL TANK AND FUEL PUMP* subsection.

SYSTEM DESCRIPTION

The electronic fuel injection system (EFI) is comprised of various sensors used for detecting ongoing operating conditions of the engine and vehicle, and includes all the components that perform the required adjustments to the engine.

Electrical System

ECM (Electronic Control Module)

The ECM controls the engine operation and the vehicule power management. To control the engine, the ECM reads the inputs from the sensors which it compares to predetermined parameters stored in the ECM (fuel and ignition maps), makes computations, and activates the outputs accordingly (injectors, ignition coils etc.).

EFI Sensors

To control the injection system, the engine management uses input signals from the following sensors:

- Camshaft position sensor (CAPS)
- Crankshaft position sensor (CPS)
- Manifold absolute pressure and temperature sensor (MAPTS)
- Throttle position sensor (TPS) which is integrated to the throttle body (Electronic Throttle Control (ETC))
- Throttle accelerator sensor (TAS).
- Coolant Temperature Sensor (CTS)

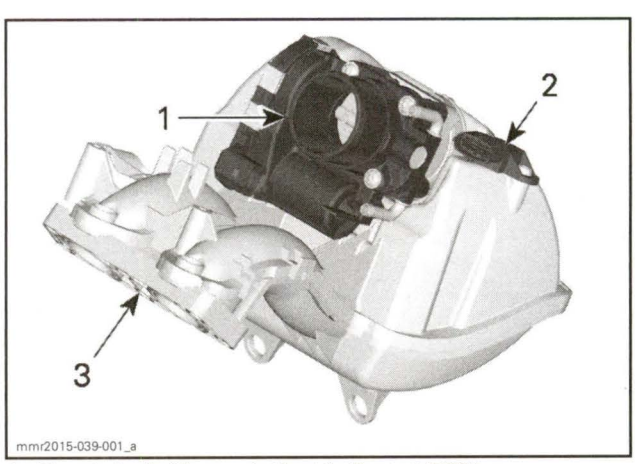
Air Intake System

Air Filter

Air flows through a mesh screen filter in the air intake silencer mounted over the engine. The mesh filter prevents snow from being drawn into the engine.

Air is then drawn in through the throttle body, the air intake manifold and into the engine.

Manifold absolute pressure and temperature are measured in the intake manifold.



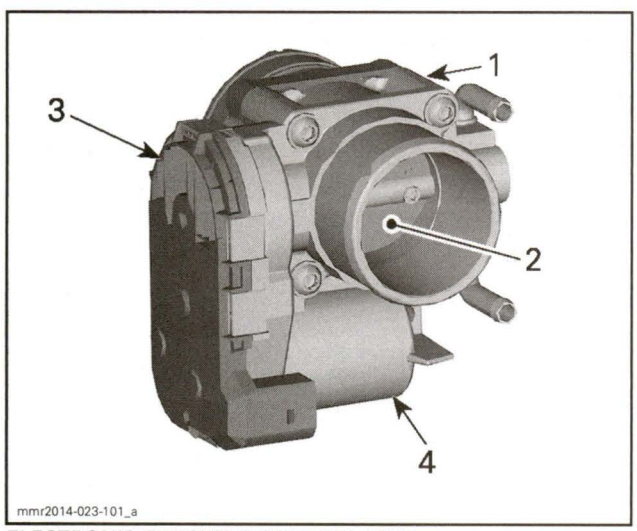
1. *Throttle body (Electronic Throttle Control (ETC))*
2. *Manifold absolute pressure and temperature sensor (MAPTS)*
3. *Intake manifold*

Throttle Body ((ETC) Electronic Throttle Control)

Air for combustion is drawn in by the engine. The air flows through the throttle body (ETC) and is controlled by a throttle plate.

The Electronic Throttle Control (ETC) is a heated single 46 mm throttle body with integrated dual throttle position sensors (TPS) and electric throttle actuator (ETA) and is mounted on the intake manifold.

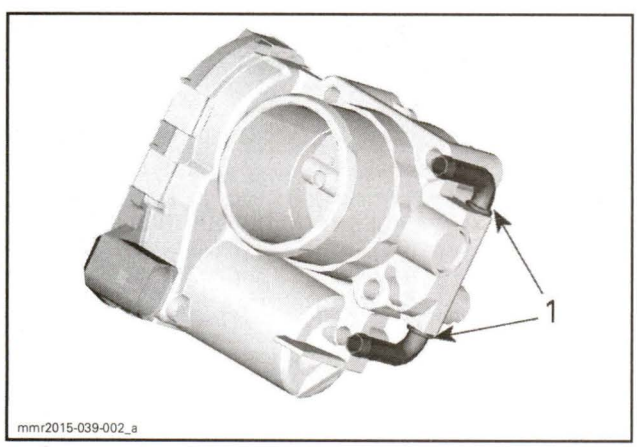
The ETA allows the ECM to electronically control the throttle plate opening which regulates the amount of air that enters the engine, and therefore engine speed.



ELECTRONIC THROTTLE CONTROL (ETC)

1. *Throttle body*
2. *Throttle plate*
3. *Dual Throttle Position Sensor (TPS)*
4. *Electric throttle actuator (ETA) (electric motor)*

Engine coolant flows through the throttle body (ETC) to prevent potential freezing of the throttle plate.



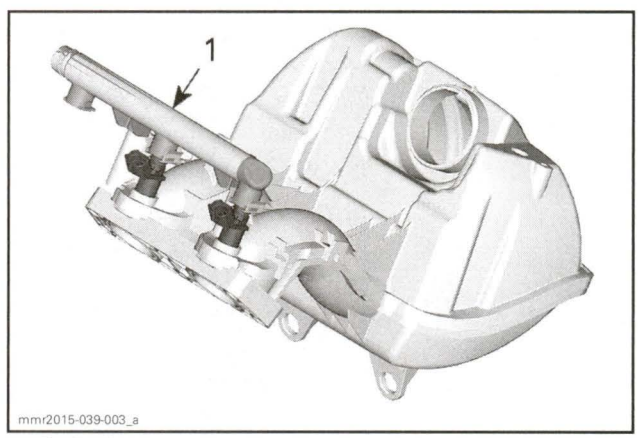
1. *Coolant-heated lines*

Fuel System

Fuel Rail

A fuel rail is mounted on the intake manifold. The fuel rail, which is used to secure the injectors to the manifold, also provides to the injectors the fuel pressure that it receives from the fuel pump.

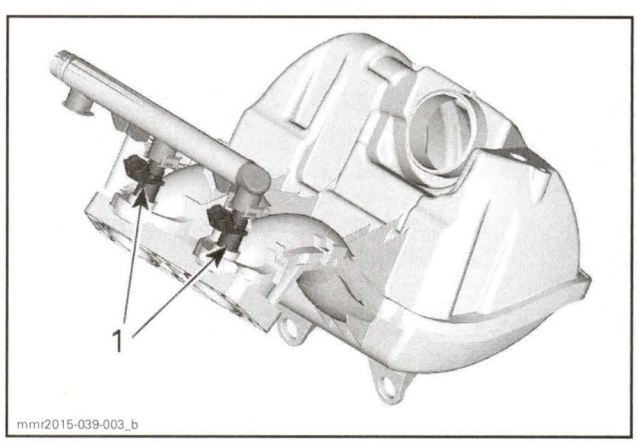
The fuel pressure applied to the fuel rail is regulated by the fuel pressure regulator located in the fuel pump module.



1. *Fuel rail*

Fuel Injectors

Three fuel injectors are used to inject fuel into the intake ports of the cylinder head. One injector is used per cylinder.



1. *Fuel injectors*

Fuel is injected in accordance with injection signals received from the ECM.

Fuel Pump

An electric fuel pump with an integrated pressure regulator and fuel system filters is used. For more details on the fuel pump unit, refer to *FUEL TANK AND FUEL PUMP* subsection.

ADJUSTMENT

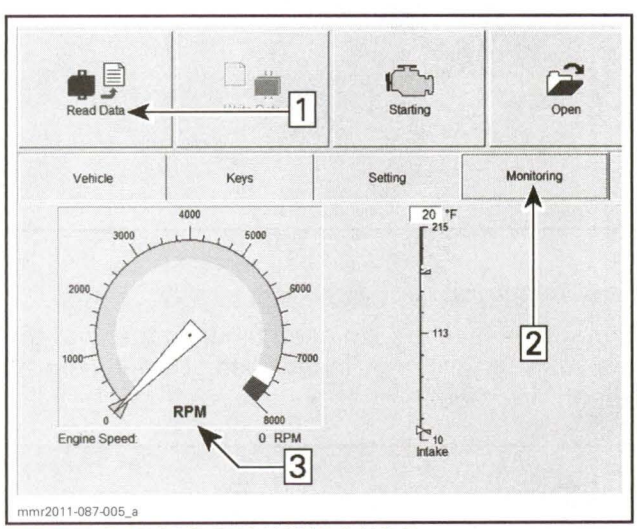
IDLE SPEED

Idle speed is not adjustable. The EMS (Engine Management System) controls the idle speed of the engine through the iTC system by controlling throttle plate opening using the ETA (electric throttle actuator).

The vehicle multifunction gauge can provide a readout of the engine's idle RPM.

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

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



VERIFYING ENGINE RPM USING B.U.D.S.
Step 1: Click on the **Read Data button**
Step 2: Select the **Monitoring** *page tab*
Step 3: Read the engine **RPM** *indication*

NOTE: The gauge and B.U.D.S. use the same signal to provide the engine RPM indication.

TROUBLESHOOTING

DIAGNOSTIC TIPS

Engine problems are not necessarily related to the fuel injection system.

It is important to ensure that the engine and propulsion system, fuel delivery and electrical systems are functioning normally.

For diagnostics purposes, use B.U.D.S. software. See *COMMUNICATION TOOLS AND B.U.D.S.* subsection.

After a problem has been solved, be sure to clear the fault(s) recorded in the ECM using the B.U.D.S. software.

⚠ WARNING

Electrical actuators and electronic modules may be powered up as soon as the START/RER button is depressed. Always disconnect the battery prior to disconnecting any electrical or electronic parts.

Never use a battery charger to temporarily substitute the battery as it may cause the ECM to function erratically, or not at all.

Check related-circuit fuse solidity and condition with an ohmmeter. A visual inspection could lead to a false diagnosis.

Poor Idling

If poor idling is experienced, check the following:
- Poor quality fuel or water in the fuel
- Fault codes using B.U.D.S.
- Throttle body cleanliness
- Engine leaks or other mechanical problem.

Electrical Related Problems

It is important to check the following in the electrical system:
- Battery voltage
- Fuses
- Ground connections
- Wiring and connectors.

Ensure that all electronic components are original BRP recommended components. Any modification to the wiring harness may lead to poor system operation or generate fault codes.

Electrical Connections

Pay particular attention to ensure that terminals and pins are not out of their connectors, corroded, or out of shape.

When probing terminals, pay attention not to deform the terminals as this could cause a loose or intermittent connection that would be difficult to troubleshoot.

NOTE: Do not apply dielectric grease or other lubricants on the ECM connectors.

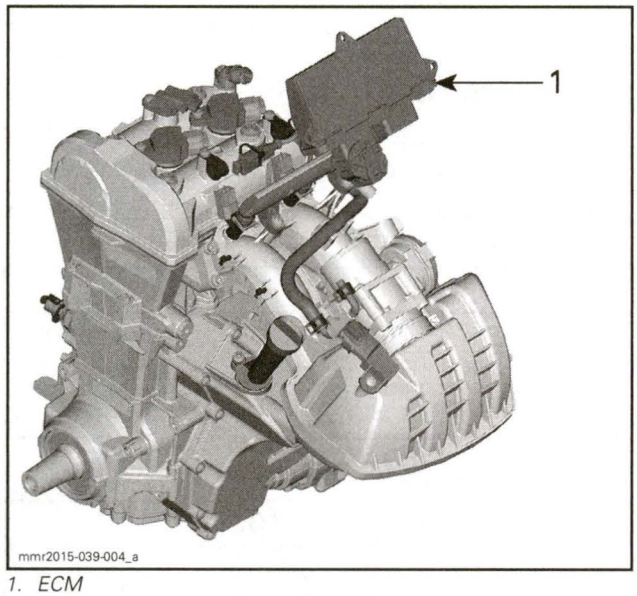
PROCEDURES

ENGINE CONTROL MODULE (ECM)

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

ECM Location

The ECM is located above the air intake manifold.

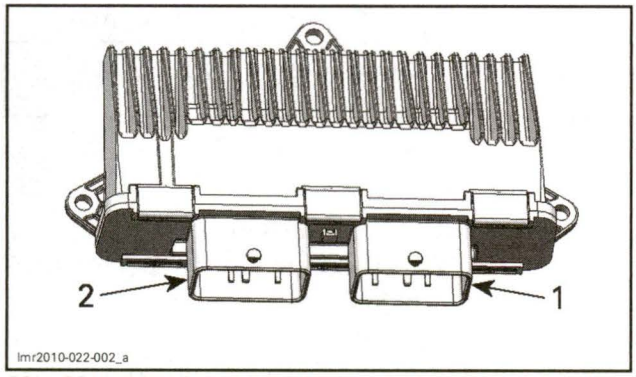


1. ECM

ECM Connector Identification

There are 2 connectors connected to the ECM:

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



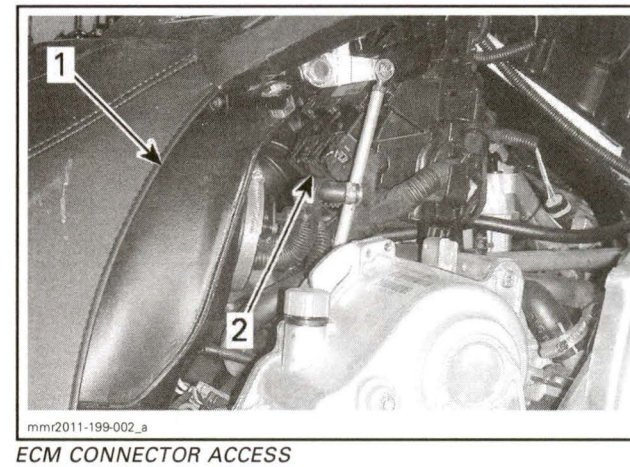
ECM CONNECTOR IDENTIFICATION - COOLING FINS FACING OUT
1. Connector A
2. Connector B

The ECM connectors have 48 pins.

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

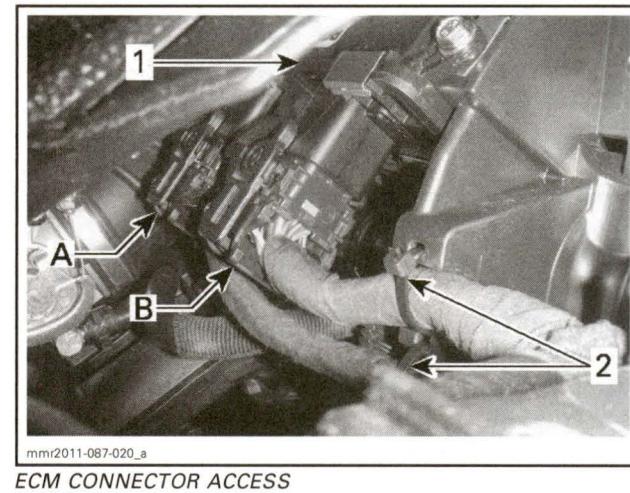
ECM Connector Access

1. Refer to *BODY* subsection and remove the RH side panel.
2. Reach in above the gearbox, between the fuel tank and shift rod.



ECM CONNECTOR ACCESS
1. Fuel tank
2. ECM connectors

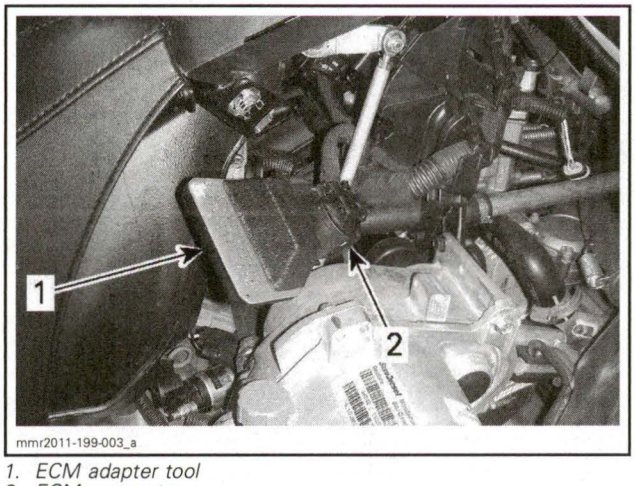
3. Cut the locking tie(s) that secure the ECM connector harnesses to the ECM support.



ECM CONNECTOR ACCESS
1. ECM
2. Harness locking ties
A. ECM-A connector
B. ECM-B connector

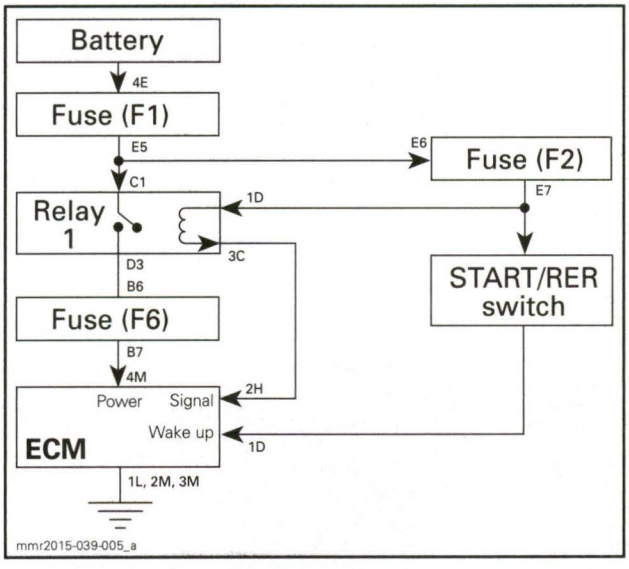
NOTE: The ECM is mounted with the cooling fins facing forward. Therefore, ECM A connector is on the LH side of the vehicle, and ECM B connector is on the RH side.

4. Disconnect the ECM connector(s) and pull them outwards for installation on the ECM adapter tool.



1. ECM adapter tool
2. ECM connector

ECM Power Circuit Diagram



ECM Power Circuit Validation

Briefly press START/RER button.

This should wake up the ECM . The ECM will then activate relay 1 for approximately 12 seconds after which it will turn off all power. If the tether cord is installed when the START/RER button is pressed, the power will stay on for approximately 40 seconds.

QUICK INDICATION THAT ECM IS POWERED (ASSUMING THE OBSERVED COMPONENT IS WORKING)
Multifunction gauge comes ON.
Fuel pump turns on for approx. 2 seconds (if tether cord installed).

If ECM does not turn on, check the following:
- Fuse F1, F2 and F6
- Battery voltage. Refer to *CHARGING SYSTEM*
- Relay R1
- START/RER switch. Refer to *STARTING SYSTEM*
- ECM power circuit wires and ground wires.

For testing of fuses and relay R1, refer to *POWER DISTRIBUTION* subsection.

NOTE: When relay 1 is not working, the EMS (engine management system) and the complete vehicle electrical system will not be powered.

ECM Wake Up Circuit Test

1. Disconnect ECM-B connector, refer to *ECM CONNECTOR ACCESS* in this subsection.
2. Install ECM-B connector on the ECM adapter tool.

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

3. Use a multimeter and select Vdc.

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

4. While pressing START/RER button, read voltage as follows.

ECM ADAPTER	BATTERY	READING
PIN	TERMINAL	VOLTAGE
1D	Negative (Ground)	Battery Voltage

If voltage is as per specification, refer to *ECM POWER CIRCUIT TEST.*

If voltage is out of specification:
- Test the START/RER switch, refer to *STARTING SYSTEM* subsection.
- If START/RER switch tests good, test wiring and connectors from battery to ECM. Refer to *WIRING DIAGRAM.*

ECM Power Circuit Test

1. Connect ECM-B connector on the ECM adapter tool.

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

2. Install an appropriate fused jumper wire between the following terminals on the ECM adapter tool.

JUMPER WIRE COORDINATES ON ECM ADAPTER	
2H	2M, 3M or 1L

NOTE: When the jumper is installed, the multifunction gauge should come on.

If the multifunction gauge did not come on, check the following:
- Fuses F1, F2 and F6
- Relay R1
- Wiring between ECM-B contact 2H and fuse F2
- ECM ground circuit, refer to *CONTINUITY TEST OF ECM GROUND CIRCUITS* in this subsection.

For testing of fuses and relay R1, refer to *POWER DISTRIBUTION* subsection.

If gauge came on, carry on with the following step.

3. Remove fuse F1
4. Set multimeter to Ω.

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

5. Check resistance as follows.

ECM ADAPTER	BATTERY	READING
PIN	TERMINAL	Ω
4M	Negative (Ground)	Close to 0 Ω

If voltage is not measured, check the wiring and connections between ECM and fuse F6, refer to the *WIRING DIAGRAM* subsection.

If all items mentioned in this test and in *ECM WAKE UP CIRCUIT TEST* tested good, try a new ECM.

Continuity Test of ECM Ground Circuits

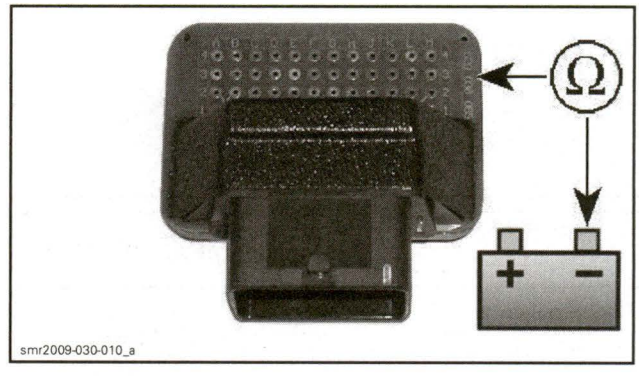
1. Connect ECM-B connector on the ECM adapter tool.

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

2. Set multimeter to Ω and probe adapter terminals as per following table.

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

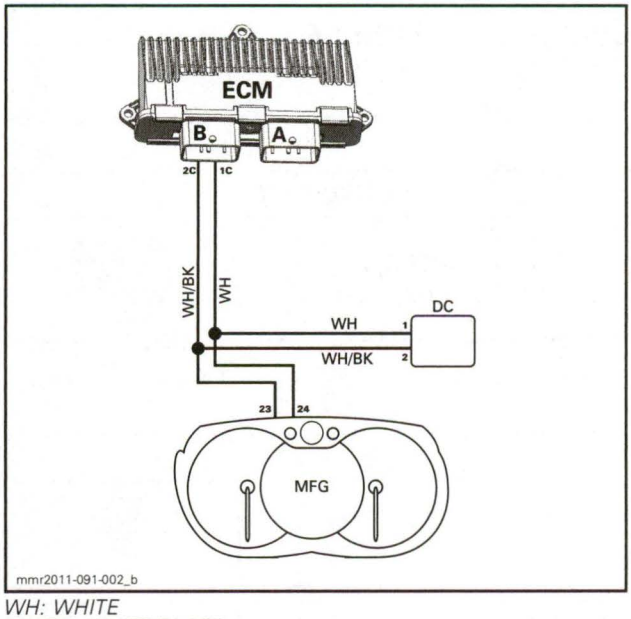
ECM ADAPTER	BATTERY	READING
PIN	TERMINAL	Ω
1L	Negative (Ground)	Close to 0 Ω
2M		
3M		



If any measurement is out of specification refer to *POWER DISTRIBUTION* subsection and check the following:
- Wiring and connections
- Engine ground
- Battery ground
- Frame ground.

ECM CAN Line Test

CAN lines link the ECM, multifunction gauge and vehicle diagnostic connector.



WH: WHITE
WH/BK: WHITE/BLACK
MFG (multifunction gauge)
ECM (electronic control module)
DC (diagnostic connector)

Test CAN wire continuity as follows.

1. Disconnect ECM connector "B".
2. Disconnect multifunction gauge connector. Refer to *LIGHTS, GAUGE AND ACCESSORIES* subsection.
3. Check wire resistance as follows.

ECM ADAPTER TOOL (P/N 529 036 166)	

ECM ADAPTER	GAUGE CONNECTOR	MEASUREMENT
Pin 2C	Pin 23	Close to 0 Ω
Pin 1C	Pin 24	

If continuity is out of specification, repair or replace wiring harness between ECM and multifunction gauge.

If continuity is as per specification, carry out the following test.

4. Disconnect vehicle diagnostic connector from its protective cap.
5. Read wire resistance as follows.

DIAGNOSTIC CONNECTOR	GAUGE CONNECTOR	MEASUREMENT
Pin 2	Pin 23	Close to 0 Ω
Pin 1	Pin 24	

If continuity is out of specification, repair or replace wiring harness between diagnostic connector and multifunction gauge.

If continuity is as per specification, CAN lines are functional.

Reconnect connectors and reinstall removed parts.

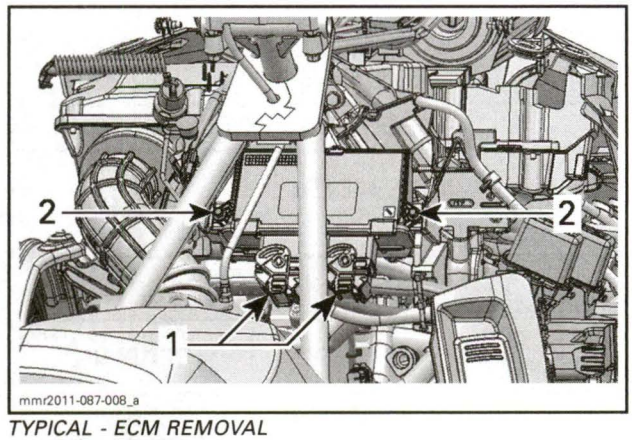
ECM Removal

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

1. Disconnect battery cables.

NOTICE Always disconnect the BLACK negative (–) battery cable first, then disconnect RED positive (+) cable.

2. Refer to *BODY* subsection and remove the LH and RH side panels.
3. Remove the air intake silencer and headlight/gauge module as a unit, refer to *AIR INTAKE SYSTEM* subsection.
4. Disconnect both ECM connectors from ECM.
5. Remove ECM retaining screws and remove the ECM from its support.



TYPICAL - ECM REMOVAL
1. ECM connectors
2. ECM retaining screws

ECM Installation

1. Reverse removal procedure however, pay attention to the following.

ECM SCREW TIGHTENING TORQUE
2.5 N•m (22 lbf•**in**)

2. Reconnect ECM connectors.
3. Reconnect battery cables.

⚠ WARNING

Always reconnect the RED (+) battery cable first, then reconnect BLACK (–) cable.

4. If a new ECM is installed, refer to *ECM REPLACEMENT* in this subsection.

NOTICE **Always replace ECM by the same part number or by a BRP approved equivalent.**

ECM Replacement

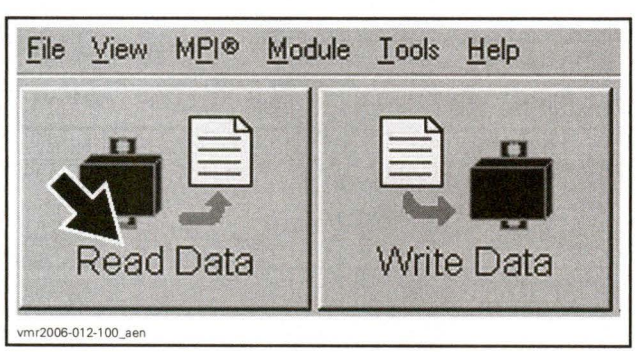
NOTE: Prior to replacing an ECM, ensure that all the recommendations in the general introduction of this subsection have been followed and all applicable testing procedures have been carried out.

When the ECM is replaced, data must be entered into the new ECM . Refer to *ECM DATA TRANSFER* further in this subsection.

ECM Data Transfer

To transfer the original ECM recorded information to the new ECM, use the B.U.D.S. software and proceed as follows.

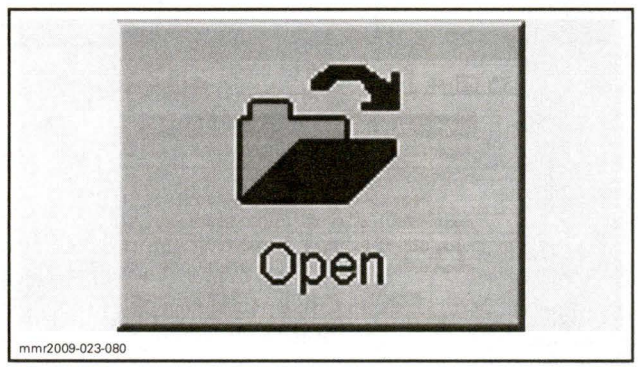
1. Connect the original ECM to vehicle.
2. In B.U.D.S., click the Read Data button to load the information from the original ECM.



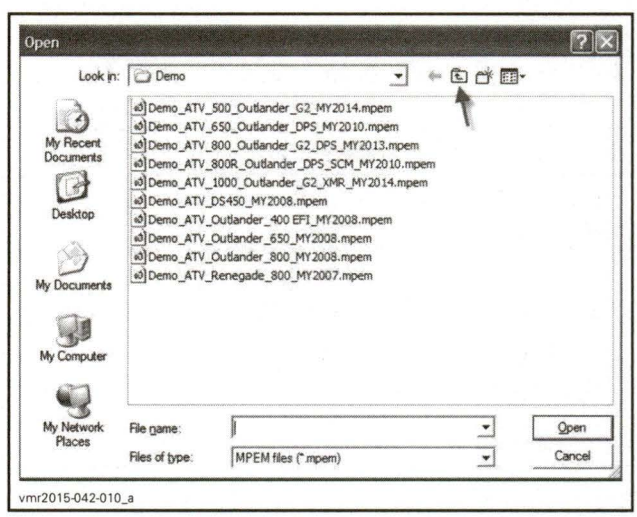
NOTE: Keep B.U.D.S. running while replacing ECMs. The data will remain stored in the PC computer as long as B.U.DS. is running.

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

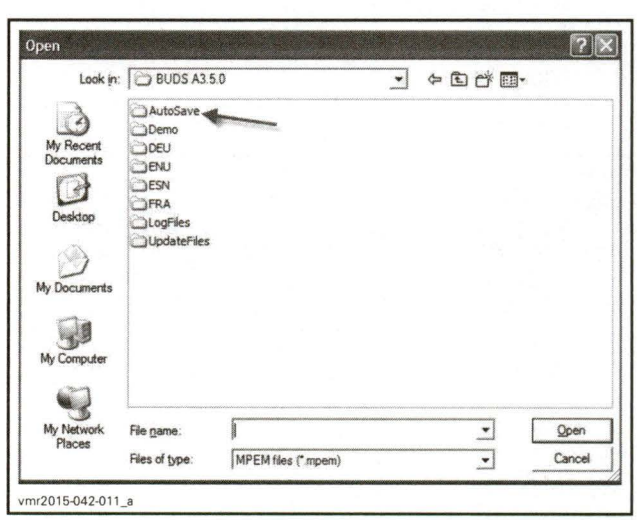
   3.1 Click on the Open button.



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

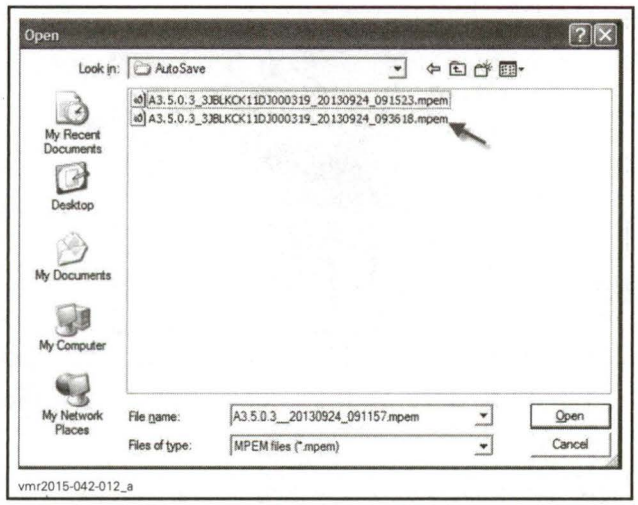


   3.3 Double click on the AutoSave folder.



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

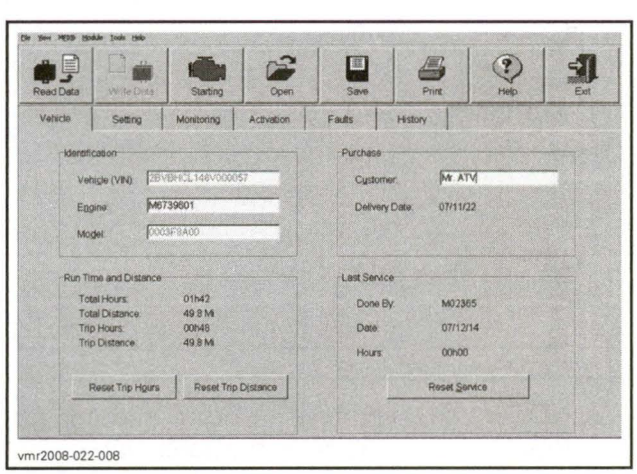
   3.4 Choose the latest file saved for this specific vehicle.



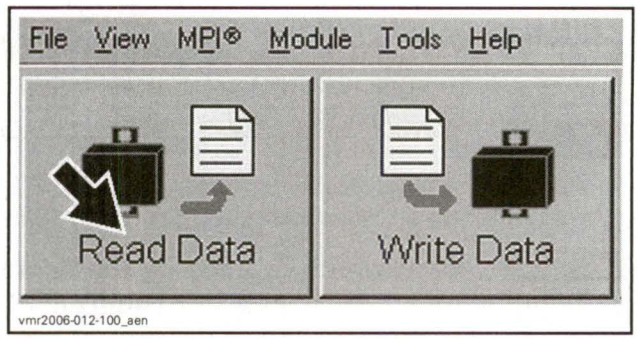
IMPORTANT: Ensure to use the file that specifically matches the vehicle you are servicing.

NOTE: The file name structure is as follows:
BUDS version_VIN_date read (yyyymmdd)_hour read (hhmmss).mpem
Example: **A3.5.0.3_3JBLKCK11DJ000319_20130924_093618.mpem** B.U.D.S. version = A3.5.0.3 VIN = 3JBLKCK11DJ000319 Date file was read = 2013-09-24 Hour file was read = 09h 36m 18s

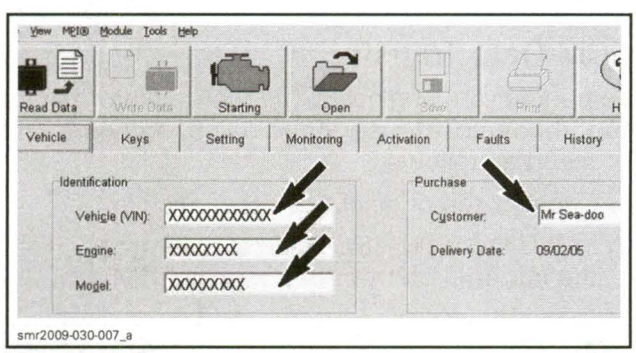
4. Go to the Vehicle tab and record the following information.
   - Vehicle (V.I.N.) number
   - Engine number (without the leading "M")
   - Model number
   - Customer.



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

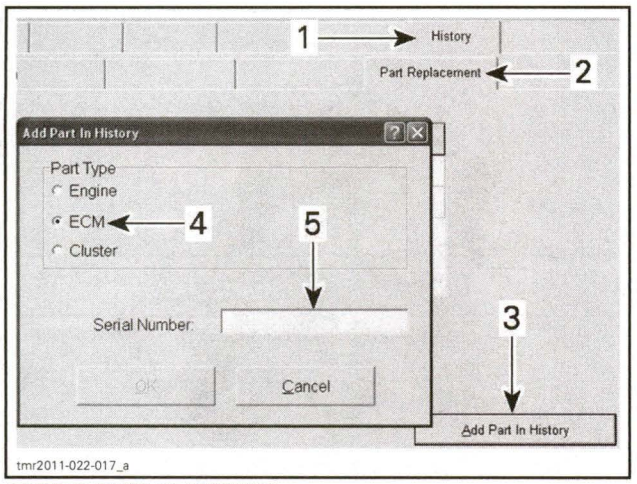


8. Select the **Vehicle** tab and enter the information you recorded previously.
   - Vehicle serial number
   - Engine number (do not enter the "M" at the beginning of the engine number)
   - Enter model number.
   - Customer name.



VEHICLE TAB

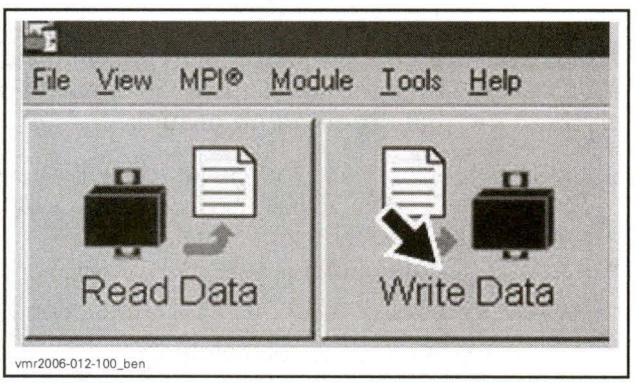
9. Click on the following tabs:
   - **History**
   - **Part Replacement**
   - **Add Part in History**.
10. Enter the **old** ECM serial number in the Add Part In History window.



ADDING PART IN HISTORY
1. **History** *tab*
2. **Part Replacement** *tab*
3. **Add part in history** *button*
4. **ECM** *selection*
5. *Add ECM serial number here*

NOTE: The ECM serial number can be found on the ECM sticker that also identifies the part number.

11. Click on the **OK** button.
12. Click on the **Write Data** button.

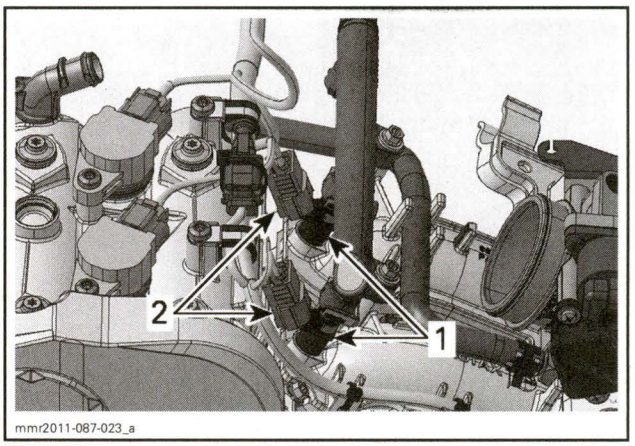


13. Perform the *CLOSED THROTTLE RESET (TPS)* procedure, refer to *THROTTLE POSITION SENSOR (TPS)* further in this subsection.
14. Program the tether cord cap (D.E.S.S. key(s)) into the new ECM, refer to *DIGITAL ENCODED SECURITY SYSTEM (D.E.S.S.)* subsection.
15. Set the gauge units of display. Refer to *LIGHTS, GAUGE AND ACCESSORIES* subsection.
16. Start the engine and ensure proper operation.
17. Reinstall any remaining removed parts.

FUEL INJECTOR

Fuel Injector Access

1. Refer to *BODY* subsection and remove both side body panels.
2. Refer to *AIR INTAKE SYSTEM* subsection and remove the following parts:
   - Air intake silencer and headlight/gauge module (as a unit)
   - Air intake hose from throttle body.

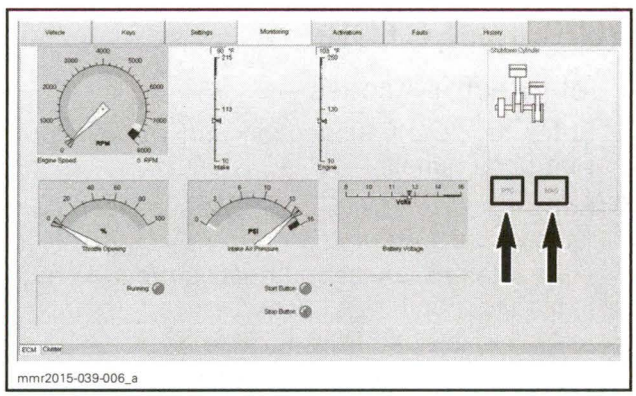


TYPICAL
1. *Fuel Injectors*
2. *Fuel Injector connectors*

3. If removing injectors, also disconnect the ECM connectors. Refer to *ECM CONNECTOR ACCESS* in this subsection.

Fuel Injector Operation Test with B.U.D.S. (Dynamic)

1. Connect vehicle to B.U.D.S. software. Refer to *COMMUNICATION TOOLS AND B.U.D.S.*
2. Start engine.
3. In B.U.D.S., click the following:
   - **Read Data** button
   - **Monitoring** tab.
4. Using the B.U.D.S. software, shut down each engine cylinder one at a time by clicking on the button under the applicable cylinder.



MONITORING AND ECM TABS
Click on cylinder number to be tested

If the engine RPM drops when clicking on a cylinder, the injector and the ignition of this cylinder are functioning normally.

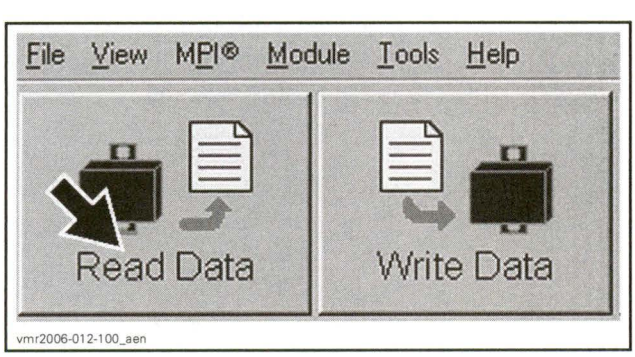
If the engine RPM does not drop when clicking on a cylinder, this cylinder is not functioning properly. Check the following:

- Fuel injector operation. Refer to *FUEL INJECTOR OPERATION TEST WITH B.U.D.S. (STATIC).*
- Spark plug and ignition coil. Refer to *IGNITION SYSTEM.*
- Engine condition.

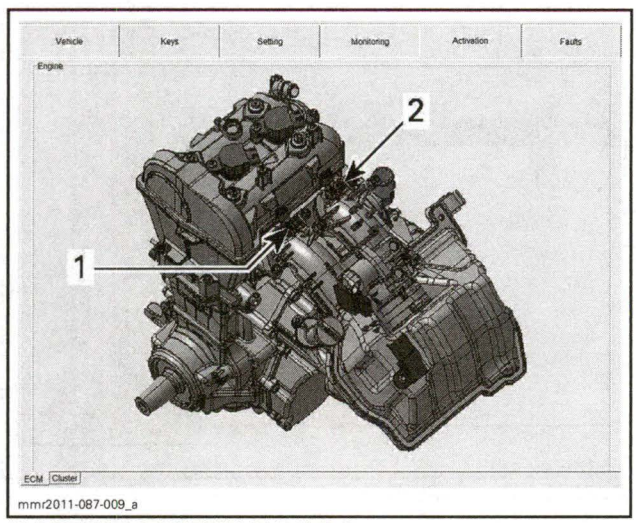
Fuel Injector Operation Test with B.U.D.S. (Static)

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

1. Connect vehicle to B.U.D.S.. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. In B.U.D.S., click the **Read Data** button to read the new ECM.



3. On the **Activation** page of B.U.D.S. software, energize the fuel injector to be tested.



INJECTOR ACTIVATION IN B.U.D.S.
1. *Click on PTO injector to activate*
2. *Click on MAG injector to activate*

You should hear the injector functioning.

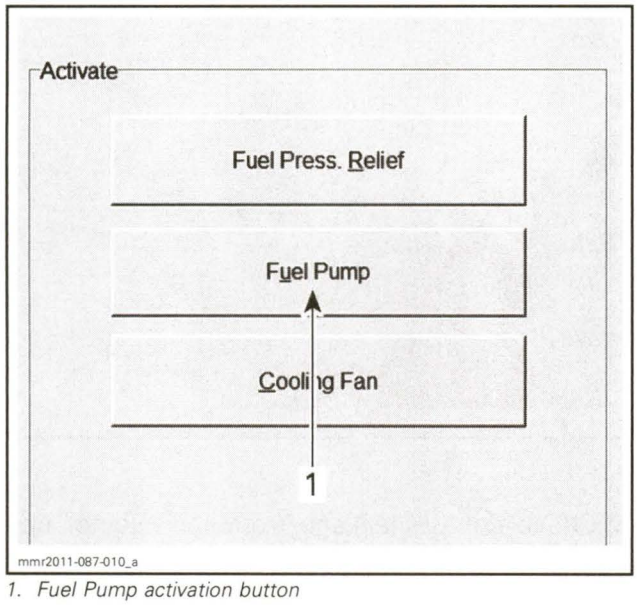
This will validate the injector mechanical and electrical operation.

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

Fuel Injector Balance Test

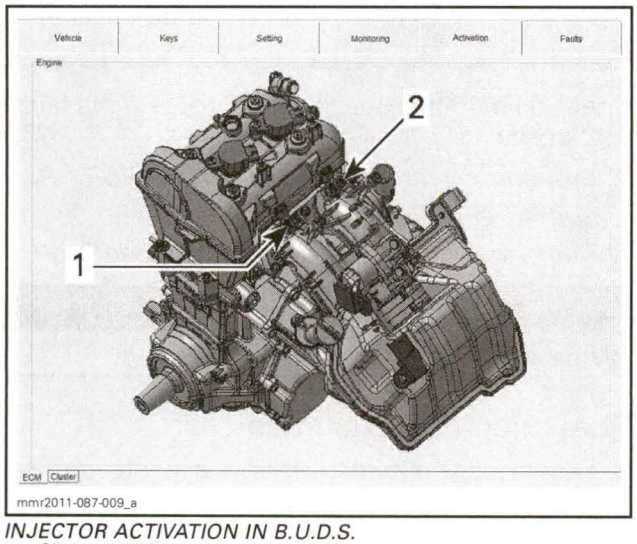
NOTICE After fuel injector activation using B.U.D.S., always crank engine in drowned mode to ventilate the engine of fuel.

1. Install a fuel pressure gauge as described in *FUEL PUMP PRESSURE TEST* of *FUEL TANK AND FUEL PUMP* subsection.
2. Connect vehicle to B.U.D.S. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
3. In B.U.D.S., select the following:
   - **Read Data** button
   - **Activation** page tab.
4. In B.U.D.S., click on the **Fuel Pump** button to activate fuel pump.



1. Fuel Pump activation button

5. Fuel pressure must be within specification. Refer to *FUEL TANK AND FUEL PUMP* subsection. Re-activate fuel pump as necessary.
6. In B.U.D.S., energize fuel injector **no. 1**.



INJECTOR ACTIVATION IN B.U.D.S.
1. Click on PTO injector to activate
2. Click on MAG injector to activate

7. Record the fuel pressure drop for injector **no. 1**.
8. In B.U.D.S., click on the **Fuel Pump** button to activate fuel pump.
9. Repeat the procedure for fuel injector **no. 2** and record the pressure drop for each injector.
10. The maximum fuel pressure drop between injectors should not exceed the following specification:

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

If the pressure drop between fuel injectors is greater than the specification, replace the injector with the least pressure drop, then repeat the test.

11. Using the valve on the fuel pressure gauge, release the pressure in the system (if so equipped).
12. Remove fuel pressure gauge and reinstall removed parts.
13. Set engine emergency shut off switch to OFF.
14. Crank engine in drowned mode (accelerator held all the way in) to ventilate the engine of the fuel that was injected during the test.

⚠ WARNING

Always crank engine in drowned mode to ventilate all fuel that was injected during the test. Failure to do so may result in severe engine damage and injury.

Fuel Injector Leakage Test

Test Setup

1. Ensure there is enough fuel in fuel tank.
2. Ensure fuel pressure from fuel pump is within specification. Refer to *FUEL TANK AND FUEL PUMP* subsection.

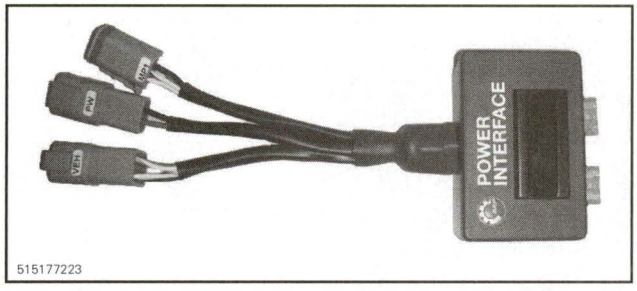
NOTE: Keep the pressure gauge installed for the leakage test.

3. Remove tether cord from engine cut-off switch.
4. Set engine emergency stop switch to STOP.

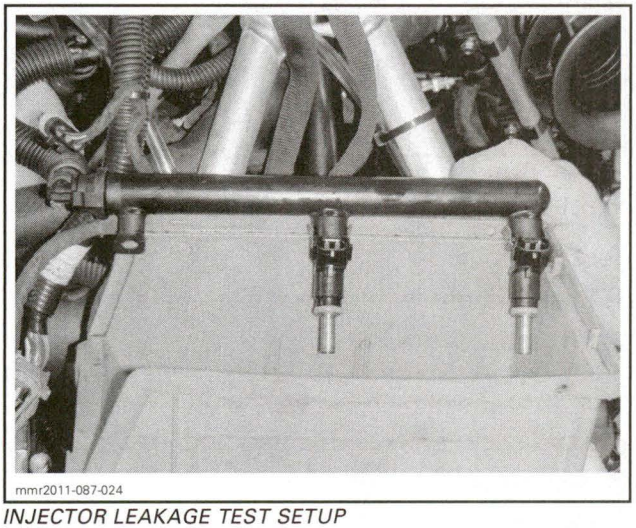
⚠ WARNING

The engine emergency stop switch is set to STOP to prevent any spark in the engine compartment should the engine be cranked. Fuel vapors may ignite in presence of a spark creating a fire hazard.

5. Disconnect the vehicle from B.U.D.S. by disconnecting the POWER INTERFACE (P/N 515 177 223) from the vehicle diagnostic connector.



6. Wait for vehicle electrical power to shut off; the multifunction gauge will turn off.
7. Remove fuel rail with injectors from engine however, **do not** disconnect fuel pump pressure hose from fuel rail. Refer to *FUEL INJECTORS* in this subsection.
8. Position fuel rail so that an appropriate container may be placed under the injectors to collect any fuel leakage.

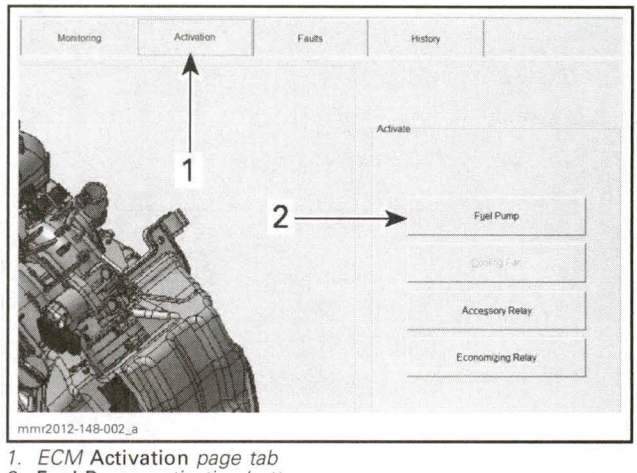


INJECTOR LEAKAGE TEST SETUP

9. Install tether cord on engine cut-off switch.
10. Connect vehicle to B.U.D.S. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection

Leakage Test

1. In B.U.D.S., select the following:
   - **Activation** page tab
   - **ECM** page.
2. Click on the **Fuel Pump** button to activate fuel pump for a few seconds.



1. *ECM* **Activation** *page tab*
2. **Fuel Pump** *activation button*

3. Check for fuel leakage from the injector nozzles.
4. Monitor fuel pressure at fuel pressure gauge. If pressure drops below 372 kPa (54 PSI) during the test, re-activate fuel pump as necessary.

FUEL INJECTOR LEAKAGE	
TEST DURATION	SPECIFICATION
2 minutes	1 drop per minute maximum

If test is not within specification, replace the faulty fuel injector.

5. Properly reinstall fuel rail. Refer to *FUEL RAIL* in this subsection.
6. Reinstall remaining removed components.

⚠ WARNING

Wipe up any spilled fuel.

Fuel Injector Resistance Test

1. Ensure vehicle electrical power is off, remove fuse F1.
2. Disconnect connector "A" from the ECM, refer to *ECM CONNECTOR ACCESS* in this subsection.
3. Remove cover from the front fuse box and locate fuse F5.
4. Check resistance value between fuse box and ECMA connector terminals as follows.

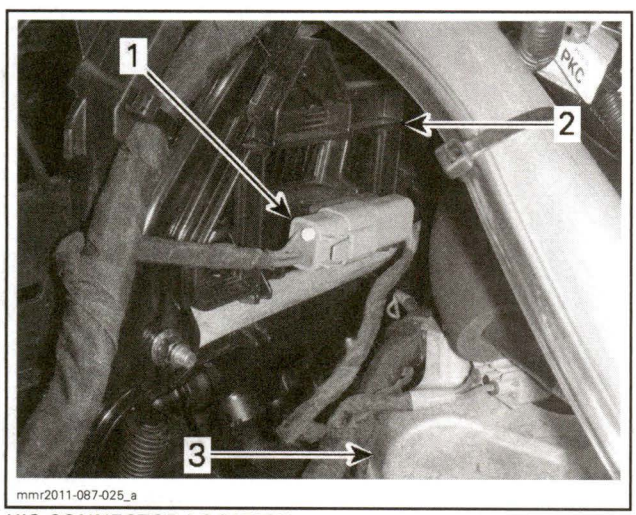
REQUIRED TOOL	
FLUKE 115 MULTIMETER (P/N 529 035 868)	

INJECTOR	ECM	FUSE BOX	READING
CYLINDER	PIN	TERMINAL	Ω @ 20°C (68°F)
1	1J	5B	12 ± 0.6 Ω
2	1K		

If resistance value obtained is correct, carry out a *FUEL INJECTOR INPUT VOLTAGE TEST.*

If resistance value obtained is incorrect, repeat test at HIC connector located on front side of ECM support.

INJECTOR	ECM	HIC	READING
CYLINDER	PIN		Ω @ 20°C (68°F)
1	1J	1	12 ± 0.6 Ω
2	1K		



HIC CONNECTOR LOCATION
1. *HIC connector*
2. *ECM support*
3. *Engine valve cover*

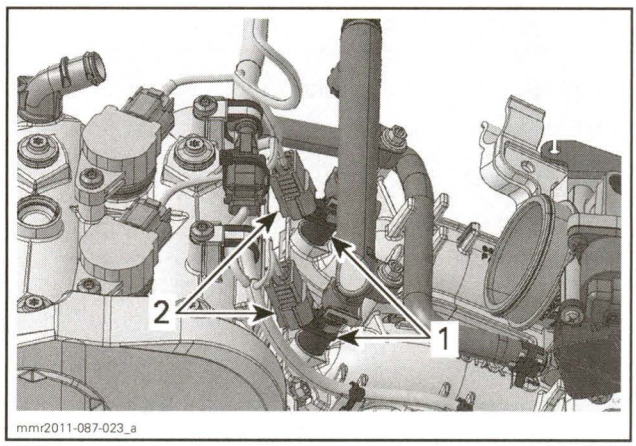
If resistance value obtained is incorrect, remove injector connector and check resistance value between injector pins as follows. Refer to *FUEL INJECTOR ACCESS* in this subsection.

INJECTOR		READING
PIN		Ω @ 20°C (68°F)
1	2	12 ± 0.6 Ω

If readings are out of specifications, replace injector.

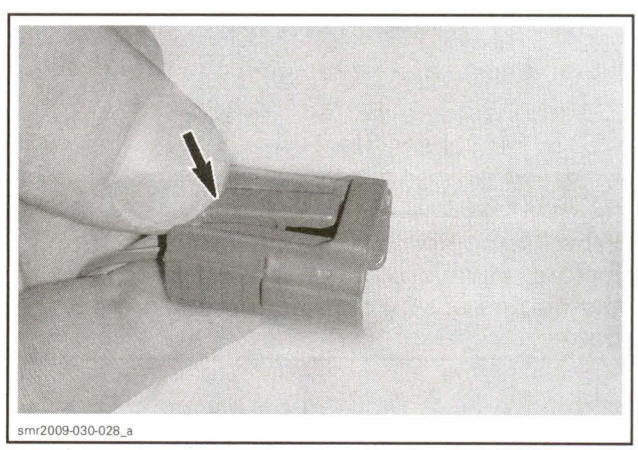
Fuel Injector Input Voltage Test

1. Ensure both ECM connectors are properly connected.
2. Ensure the HIC connector is properly connected.
3. Disconnect the fuel injector connector. Refer to *FUEL INJECTOR CONNECTOR ACCESS* in this subsection.



TYPICAL
1. *Fuel Injectors*
2. *Fuel Injector connectors*

NOTE: Press against tab underneath connector as illustrated to unlock it.



PRESS HERE TO UNLOCK

4. Ensure fuse F5 (HIC fuse) is properly installed.
5. Set engine emergency stop switch to STOP to prevent engine starting.
6. Install tether cord on engine cut-off switch.

NOTE: With tether cord installed on engine cut-off switch, vehicle electrical power will stay on for approximately 20 seconds.

7. Momentarily press the START/RER button to wake up the ECM.

NOTE: It is not necessary to activate the injector since it is continuously powered when the ECM is awake.

8. Use a multimeter and set it to Vdc. Read voltage.

INJECTOR CYLINDER	INJECTOR WIRE	BATTERY TERMINAL	READING VOLTAGE
1	VIOLET/ GREEN	Battery Ground	Battery voltage
2			

If injector input voltage is good, carry out the following:
- Circuit continuity test between injector and ECM, refer to *WIRING DIAGRAM* subsection.
- *FUEL INJECTOR SIGNAL TEST* further in this subsection.

If injector input voltage is not good, check the following:
- Fuse F5
- Circuit continuity between fuse F1 and injector. Refer to *POWER DISTRIBUTION* and *WIRING DIAGRAM* subsections.

Fuel Injector Removal

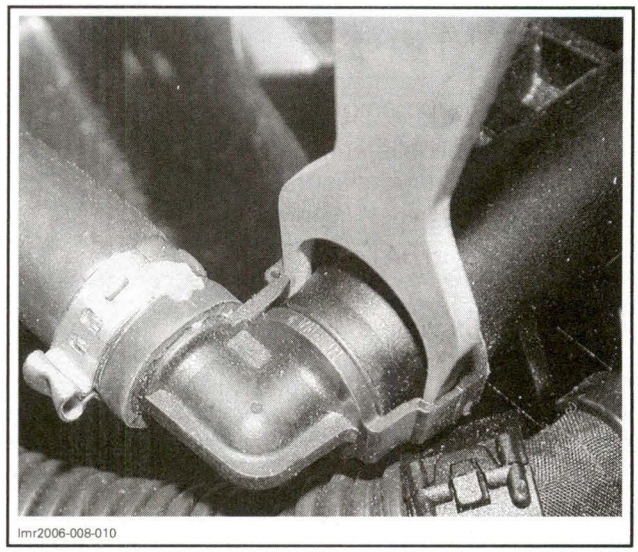
1. Disconnect fuel pump electrical connector, refer to *FUEL TANK AND FUEL PUMP* subsection.
2. Start engine and let run until it runs out of fuel.
3. Disconnect the battery, refer to *CHARGING SYSTEM* subsection.

⚠ WARNING

When removing or disconnecting the fuel injectors, always remove the tether cord from the engine cut-off switch and disconnect the battery.

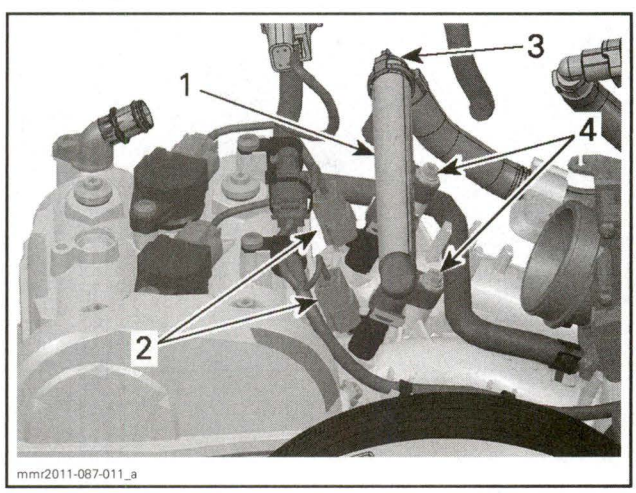
4. Remove parts required for access to the fuel rail and fuel injectors, refer to *FUEL INJECTOR ACCESS*.
5. Disconnect the fuel injector electrical connectors.
6. Disconnect the fuel pressure hose from the fuel rail.

REQUIRED TOOL	
FUEL HOSE DISCONNECT TOOL (P/N 529 036 037)	


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NOTE: Wrap a rag around the hose end to catch any fuel leakage.

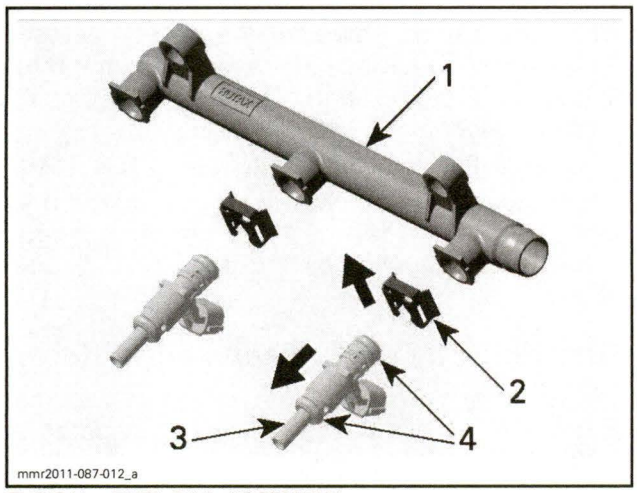
7. Remove the fuel rail mounting screws (2).



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TYPICAL
1. *Fuel rail*
2. *Injector connectors*
3. *Fuel pressure hose disconnect*
4. *Fuel rail mounting screws*

8. Pull on fuel rail to remove the fuel rail and injectors from the engine.
9. Remove the fuel injector retaining clips (2) from the fuel rail.



TYPICAL - FUEL RAIL ASSEMBLY
1. *Fuel rail*
2. *Fuel injector retaining clip*
3. *Injector*
4. *Injector O-rings*

10. Pull the fuel injector(s) out of the fuel rail.

Fuel Injector Installation

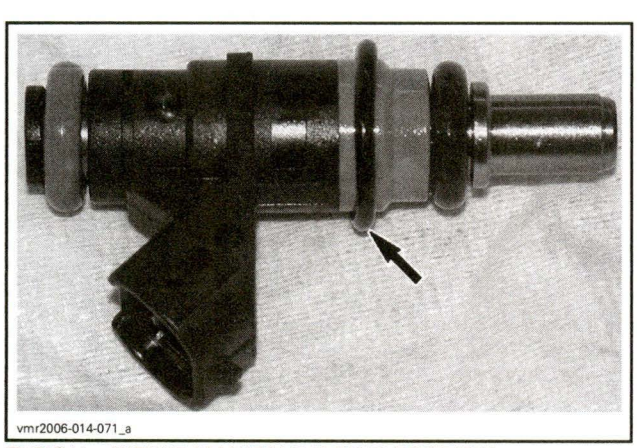
For the installation, reverse the removal procedure however, pay attention to the following details.

NOTICE **If installing the removed injector(s), ensure injector O-rings are in good condition. Replace O-rings as required.**

1. Apply a thin film of engine oil to O-rings to ease insertion in rail.
2. Install fuel injector with your hand. Do not use any tool.

FUEL INJECTOR INSTALLATION		
O-RINGS	New	Lubricate with engine oil

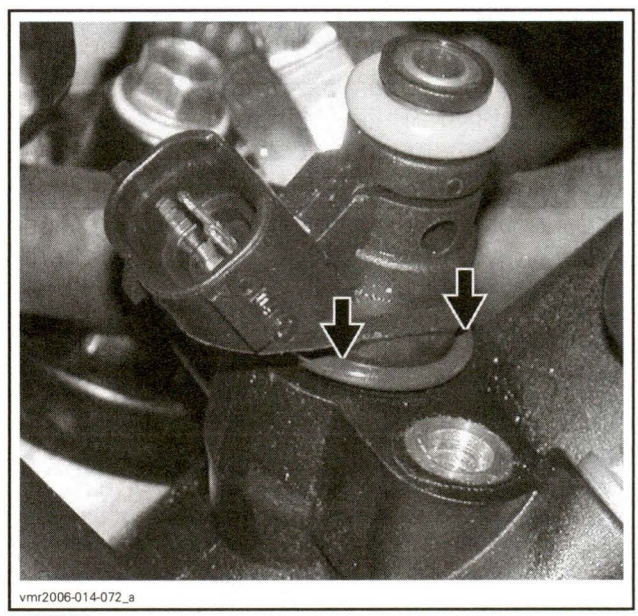
3. Ensure proper positioning of the intake manifold O-ring on injector as in following illustration.



TYPICAL - INTAKE MANIFOLD O-RING POSITION

4. Carefully insert injector in air intake manifold paying attention to the manifold O-ring.

NOTICE **Gently push O-ring in evenly all around while inserting injector. O-ring must be completely inserted and not visible, before completing the insertion of the injector.**

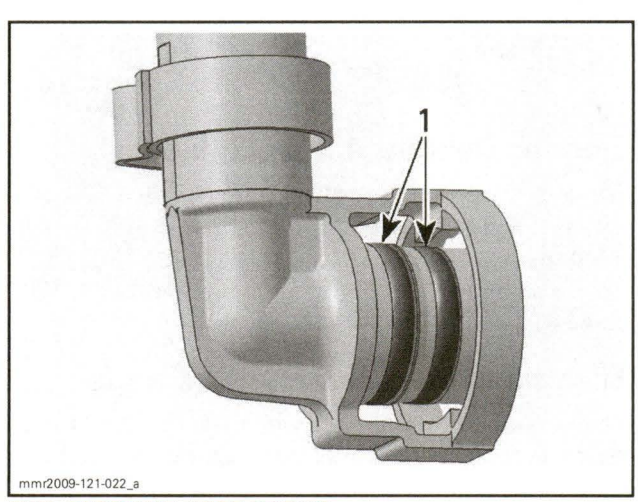


TYPICAL

5. Firmly push injector until it bottoms out.
6. Install fuel rail.

FUEL RAIL RETAINING SCREW	
Tightening torque	9 N•m ± 1 N•m (80 lbf•**in** ± 9 lbf•**in**)

7. Apply engine oil on O-rings of fuel pressure hose fitting.



FUEL PRESSURE HOSE FITTING
1. *Apply oil on O-rings*

8. Connect fuel pressure hose to fuel rail.

IMPORTANT: Push fuel hose fitting on fuel rail until you hear a "click". Try pulling on fuel hose fitting to ensure it is properly locked.

Pressurize the fuel system and check for fuel leaks. Refer to *FUEL SYSTEM PRESSURIZATION* in *FUEL TANK AND FUEL PUMP* subsection.

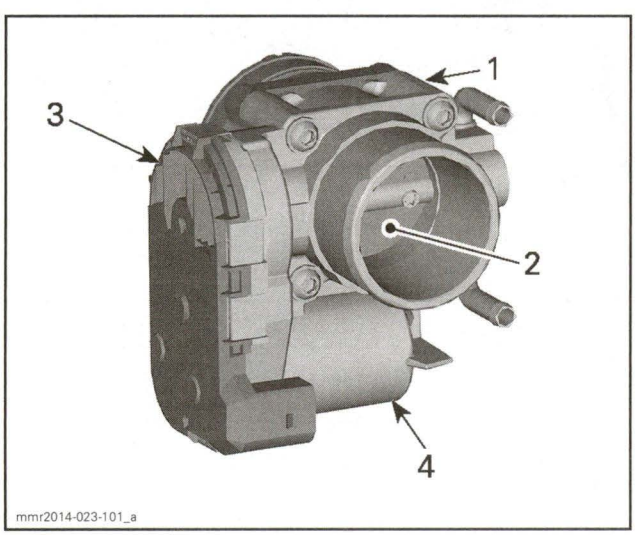
⚠ WARNING

Failure to pressurize the fuel system and checking for fuel leaks may result in severe injury or a life threatening situation should a leak occur.

9. Reinstall all remaining removed parts.

THROTTLE BODY (ETC (ELECTRONIC THROTTLE CONTROL))

Throttle Body (ETC) Description



1. *Throttle body*
2. *Throttle plate*
3. *TPS (Throttle Position Sensor) (inside)*
4. *ETA (Electric Throttle Actuator) (electric motor inside)*

Electric Throttle Actuator (ETA)

The electric throttle actuator (ETA) is a DC motor on the throttle body that regulates the throttle plate via a drive gear. It receives its control signal from the ECM. Pulse width modulation (PWM) is used to control the motor.

Throttle Plate Operating Positions

Two torsional springs are connected to the throttle plate. A main spring and another one in a plunger mechanism.

When there is no power to the throttle actuator (ETA), the plunger mechanism maintains the throttle plate at a rest position. This also serves as the limp home position.

When the throttle plate is opened by the ETA as commanded by the ECM, it acts against the main spring. If the ETA failed, the return spring would bring the throttle plate back to the limp home position.

Throttle Body (ETC) Faults and Effects

NOTE: Among other things, a weak or broken spring and a sticky throttle plate are validated by the throttle body diagnostic mode.

FAULT	EFFECT
Partial failure of TAS sensor (one internal sensor only)	Limp home mode. Engine speed limited to idle. ECM will use the remaining TAS sensor. Fault code set and beeper activated to emit warning signals. Check engine light is turned ON. Driveability could be reset by releasing and reapplying the throttle.
Complete failure of TAS sensor (both internal sensors)	Limp home mode. Engine speed limited to 2500 RPM. Fault code set and beeper activated to emit warning signals. Check engine light is turned ON.
Any throttle body failure	Limp home mode. Engine speed limited to 2500 RPM. Engine speed can still be increased up to 3200 RPM using the throttle lever. Fault code set and beeper activated to emit warning signals. Check engine light is turned ON.

NOTE: Refer to *DIAGNOSTIC AND FAULT CODES* and *INTELLIGENT THROTTLE CONTROL* (iTC) subsections for more informations.

Throttle Body (ETC) Access

1. Refer to appropriate subsection to remove:
   - LH side panel
   - Drive belt guard
   - Air intake hose.

Throttle Body (ETC) Lubrication

No lubrication is required.

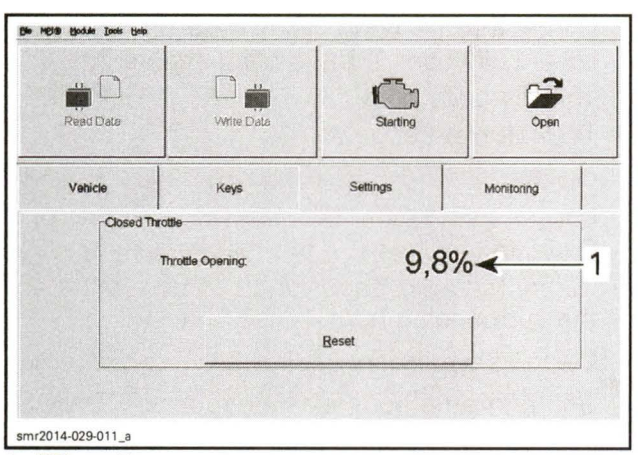
Electric Throttle Actuator (ETA) Test

Electric Throttle Actuator (ETA) Test with B.U.D.S.

1. Connect vehicle to the latest B.U.D.S. version. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. Press the START/RER button to wake up the ECM.
3. Install the tether cord on the engine cut-off switch.
4. In B.U.D.S., select:
   - **Read Data** button
   - **Setting** page tab.

NOTE: Use the **Setting** page to confirm ETA movement. The Monitoring page will not read the actual ETA movement.

5. Slowly depress the throttle lever from the idle to WOT. The ETA should go from almost 10% to 100%.



1. ETA position

If result is out of specification, carry out a *THROTTLE POSITION SENSOR INITIALIZATION*. Refer to *THROTTLE POSITION SENSOR (TPS)* in this subsection.

NOTE: The ETA is reset at the same time as the TPS.

After the reset, test ETA again.

If the result is still out of specification, check wire continuity between ECM and throttle body before assuming the ETA is at fault.

Throttle Body (ETC) Inspection

1. Remove parts required to access throttle body, refer to *THROTTLE BODY (ETC) ACCESS*.
2. Carry out the following:
   - Inspect throttle body for cleanliness.
   - Ensure throttle plate opens fully and smoothly.
   - Check for corroded or damaged wiring or damaged ETC connectors.

Throttle Body (ETC) Dynamic Tests

1. Remove the parts required to access the throttle body (ETC), refer to *THROTTLE BODY (ETC) REMOVAL*.
2. Remove the air inlet hose from the throttle body.
3. Observe the throttle plate with the engine stopped.

NOTE: The throttle plate should be in the rest position (slightly opened).

⚠ WARNING

Keep your fingers out of the throttle plate area while the ECM turns on. The throttle actuator will cycle. This could cause serious finger injuries as throttle plate quickly moves.

4. As you observe the throttle plate, have someone press the START/RER button to wake up the ECM.

NOTE: The throttle plate should cycle quickly from the rest position to a partially open position (approximately 15°), then back to the rest position.

5. Install the tether cord on the engine cut-off switch.

NOTE: The throttle plate should cycle again.

6. As you observe the throttle plate, have someone gradually and evenly pull in the throttle lever, then release it in the same way.

NOTE: The throttle plate should open then close according to throttle lever position however, the movement of the throttle plate may not be linear with the displacement of the throttle lever.

If any test failed, proceed with the *THROTTLE BODY (ETC) STATIC TESTS*.

Throttle Body (ETC) Static Tests

⚠ WARNING

First ensure the ECM is off. Do not move the throttle plate using your fingers. Otherwise, should the START/RER button be pressed, the ECM would turn on and quickly cycle the throttle plate which could cause serious finger injury.

1. Using a blunt tool, push in on the throttle plate and ensure it opens smoothly within the throttle body.



1. Push here to open

NOTE: The throttle plate must open fully and return freely to the rest position (slightly opened) when released.

2. Push throttle plate closed as indicated in following illustration. It must close completely and return freely to the rest position (slightly opened) when released.



1. Push here to close

If the throttle plate does not move smoothly or does not return freely to the rest position, the problem is mechanical. Check for dirt accumulation on throttle plate shaft. It may also be an actuator or gear problem. Replace throttle body as necessary.

If throttle plate operates normally, the problem is electrical. Check electric throttle actuator (ETA) wiring continuity, throttle position sensor (TPS) and throttle accelerator sensor (TAS).

⚠ WARNING

If the throttle plate does not return to its rest position properly after a proper cleaning, replace the throttle body.

Throttle Body (ETC) Cleaning

1. Remove throttle body from intake manifold without disconnecting heating hoses. Refer to *THROTTLE BODY (ETC) REMOVAL* further in this subsection.
2. Check throttle body cleanliness using a flashlight. Fully open throttle plate and verify:
- Throttle body bore
- Throttle plate edge.

Look for:
- Dirt
- Oily surfaces
- Carbon and dirt deposits on throttle plate and the surrounding bore.

3. Clean as necessary.
4. Use a throttle body cleaner such as GUNK INTAKE MEDIC or an equivalent.

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

⚠ CAUTION Use the product in a well ventilated area. Refer to product manufacturer's warnings.

5. To avoid getting dirt into engine, spray cleaner on a clean rag then rub rag against throttle plate and bore. A toothbrush may also be used.

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

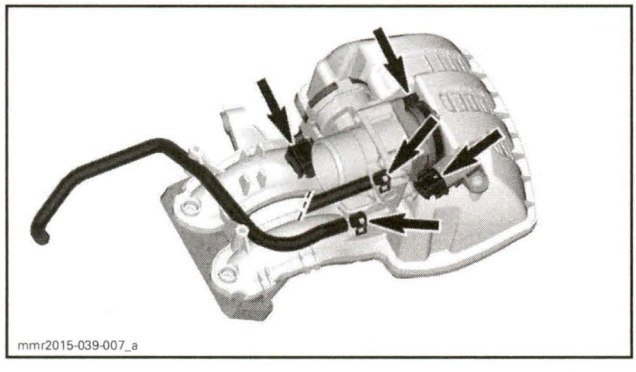
6. Gently open throttle plate and hold fully open to clean all surfaces.
7. To remove residual dirt, spray cleaner on throttle plate and throttle bore.
8. Reinstall all removed parts.

Throttle Body (ETC) Removal

⚠ WARNING

When electrically disconnecting or removing the throttle body from the intake manifold, always remove the tether cord from the engine cut-off switch and disconnect the battery.

1. Remove parts required to access throttle body, refer to *THROTTLE BODY (ETC) ACCESS*.
2. Remove fuel tank. Refer to *FUEL TANK AND FUEL PUMP* subsection.
3. Loosen gear clamp and remove throttle body from intake manifold.
4. Disconnect MAPTS and ETC connectors.
5. Disconnect coolant hoses from throttle body.



Throttle Body (ETC) Installation

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

1. Install coolant hoses on throttle body; replace clamps as required.
2. Refill and bleed cooling system as required. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.
3. Perform the *THROTTLE POSITION SENSOR INITIALIZATION* reset procedure. Refer to *THROTTLE POSITION SENSOR (TPS)* in this subsection.
4. Install all remaining removed parts, refer to applicable subsections.
5. Start engine and ensure proper idle and throttle control.

THROTTLE POSITION SENSOR (TPS)

TPS Description

NOTE: The TPS is part of the throttle body (ETC).

The throttle position sensor (TPS) is a double potentiometer that sends signals to the ECM that are proportional to the throttle plate angle.

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

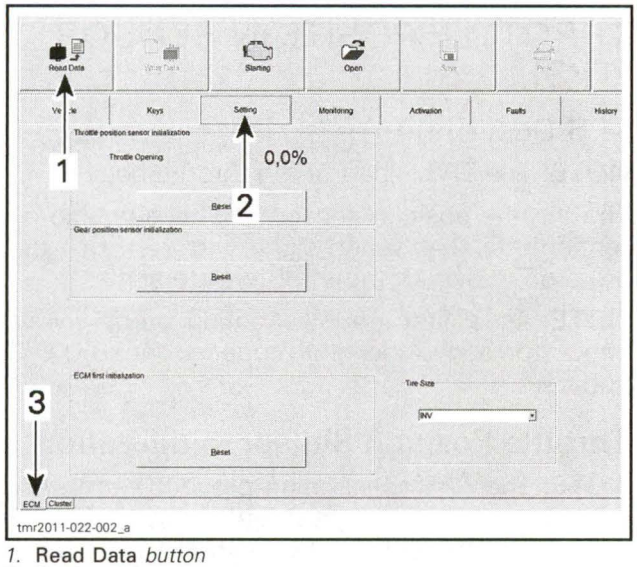
Throttle Position Sensor Initialization

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

This operation performs a reset of the TPS basic values in the ECM. This reset is very important as the TPS values are part of the basic parameters for all fuel mapping calculations and control of several settings such as for idle speed, LIMP HOME mode and maximum RPM of the engine.

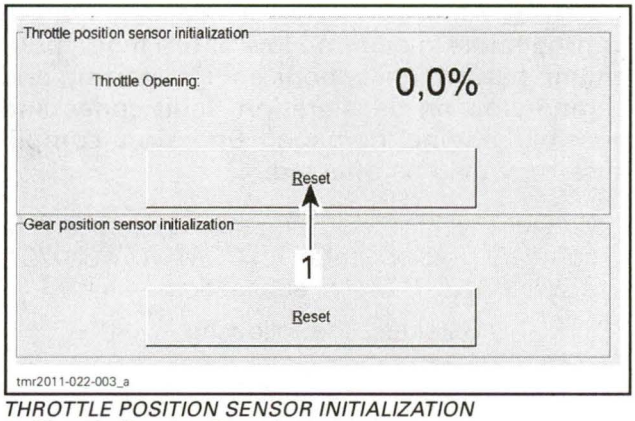
NOTICE **An improperly set TPS may lead to improper idle speed (too low or too high), poor engine performance, poor engine starting and engine stop on deceleration, fault codes and possible engine damage. Emission compliance may also be affected.**

1. Connect vehicle to the applicable B.U.D.S. software version, refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. In B.U.D.S., select the following:
   - **Read Data** button
   - **Setting** tab
   - **ECM** tab.



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

3. Ensure the throttle lever is fully released and at the idle position.
4. In the **Throttle position sensor initialization** field, click on the **Throttle Opening Reset** button.



THROTTLE POSITION SENSOR INITIALIZATION
1. **Throttle Opening Reset** *button*

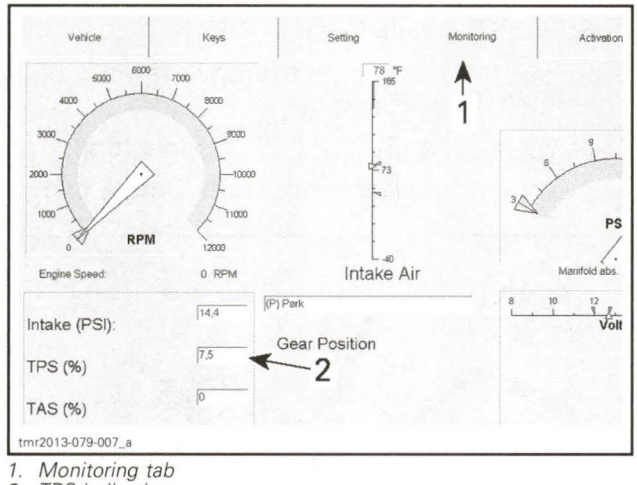
A message will be displayed if the operation is successful.

If an error occurred or the TPS is not within the allowed range while resetting, the ECM will generate a fault code and will not accept the setting.

5. If a fault message is displayed, follow the instructions in the message(s).
6. Check for fault codes.
7. If a fault code is generated,
   - Carry out the service actions.
   - Reset the fault.
   - Repeat the reset procedure.
8. Start engine and make sure it operates normally throughout its full engine RPM range.

TPS Wear Test

1. With the engine turned off, slowly press on the throttle lever and pay attention for smooth operation without physical stops.
2. Activate the electrical system to wake up the ECM.
3. Connect vehicle to the applicable B.U.D.S. software version. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
4. In B.U.D.S., select the following:
   - **Monitoring** tab
   - **ECM** tab.
5. Slowly and regularly move the throttle lever.
6. Observe the Throttle Opening indication movement in B.U.D.S.



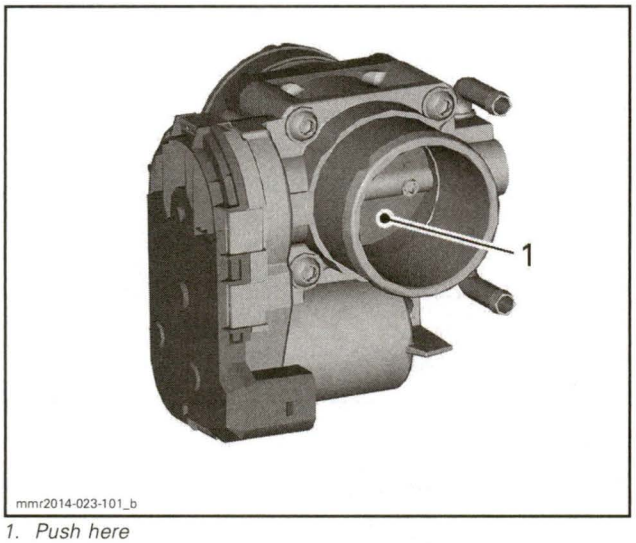
1. *Monitoring tab*
2. *TPS indication*

NOTE: The indication should move gradually and regularly as you move the throttle lever. If the TPS indication is erratic or suddenly drops off, it may indicate a worn TPS that needs to be replaced. An initial slight delay after the throttle lever is moved and before the indication starts to move is normal.

If the indication behavior is not as expected, proceed with the following steps.

7. Manually move the throttle plate in the throttle body using a blunt tool (without sharp tip).

⚠ CAUTION Do not move throttle plate with your fingers. Otherwise, if ECM should turn off, it would quickly close the throttle plate which could cause finger injury.



1. Push here

8. Check the indication movement again.
- If the indication moves as expected, check the throttle accelerator sensor (TAS). Refer to *THROTTLE ACCELERATOR SENSOR (TAS)* in this subsection.
- If the indication does not move as expected, perform the *TPS RESISTANCE TEST* in this subsection.

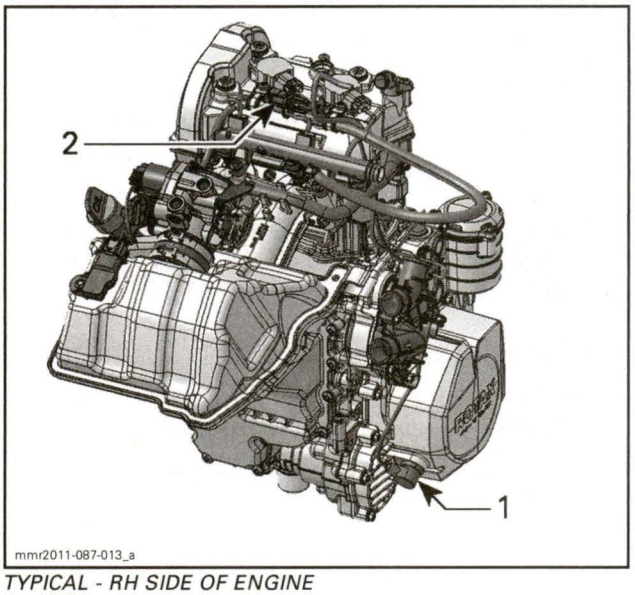
CRANKSHAFT POSITION SENSOR (CPS)

CPS TROUBLESHOOTING

When troubleshooting a CPS fault, take into account that a CPS fault can be triggered by bent or missing encoder wheel teeth.

Push START/RER button and crank engine. If engine does not start within 15 seconds check for fault codes using B.U.D.S.

CPS and CPS Connector Location



TYPICAL - RH SIDE OF ENGINE
1. CPS location
2. CPS connector location

CPS Access

1. Remove both side body panels, refer to *BODY* subsection.
2. Remove air intake silencer and headlight/gauge module as a unit, refer to *AIR INTAKE SYSTEM* subsection.
3. Remove muffler, refer to *EXHAUST SYSTEM* subsection.

CPS Resistance Test at ECM connector

1. Remove parts required to access ECM-A connector, refer to *ECM CONNECTOR ACCESS* in this subsection.
2. Disconnect ECM-A connector from the ECM and connect it to the ECM adapter.

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

3. Set multimeter to Ω.

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

4. Measure the resistance of the sensor as per following table.

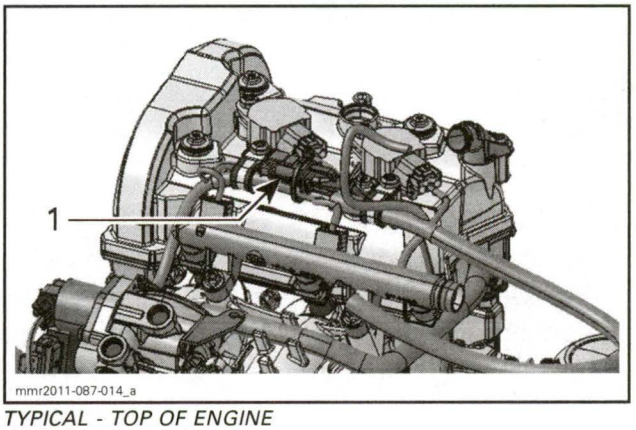
ECM ADAPTER		READING
PIN		Ω @ 20°C (68°F)
1H	2K	775 - 950 Ω

If resistance is as specified, test continuity of wiring between ECM-A and CPS connectors. Refer to *WIRING DIAGRAM* subsection.

If resistance value is not as specified, reconnect ECM-A connector to the ECM and refer to *CPS RESISTANCE TEST AT CPS CONNECTOR*.

CPS Resistance Test at CPS Connector

1. Cut locking tie securing CPS connector to ECM support and disconnect CPS connector.



TYPICAL - TOP OF ENGINE
1. CPS connector location

2. Probe CPS connector terminals as per following table.

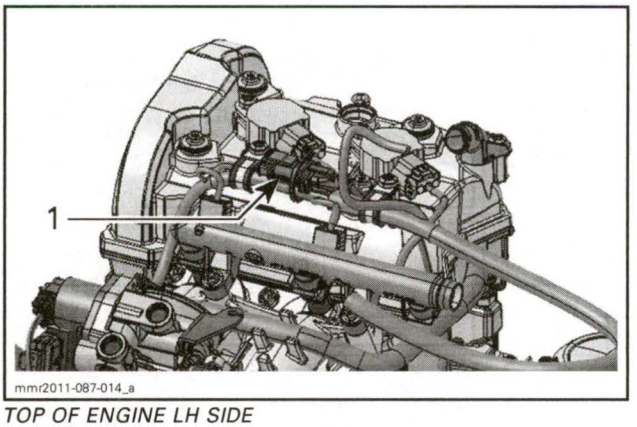
CPS		READING
PIN		Ω @ 20°C (68°F)
1	2	775 - 950 Ω

If resistance is not within specifications, replace the CPS.

If resistance tests good, carry out a *CPS OUTPUT VOLTAGE TEST*.

CPS Output Voltage Test

1. Remove fuse F5, refer to *POWER DISTRIBUTION* subsection.
2. Cut locking tie securing CPS connector to ECM support and disconnect the CPS connector.



TOP OF ENGINE LH SIDE
1. CPS connector location

3. Probe CPS connector terminals while cranking engine as per following table.

CPS		READING
PIN		VOLTAGE
1	2	1 - 2 Vac min.

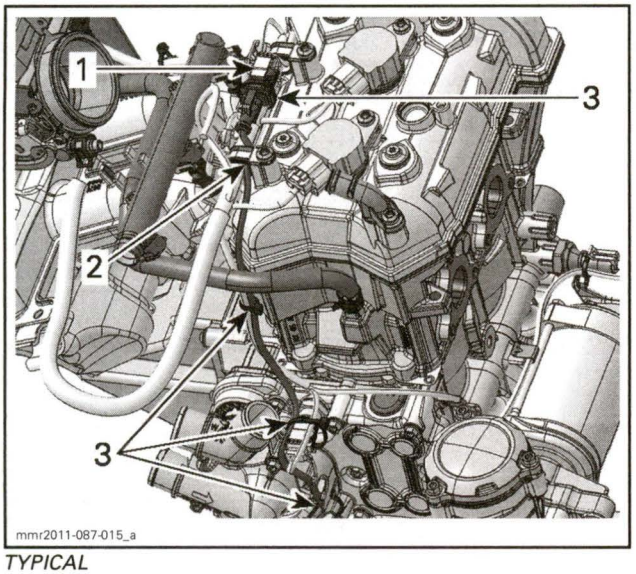
If voltage is out of specification, inspect wiring/connectors. Replace CPS if wiring is good.

If voltage is within specification, the problem may be related to the ECM.

4. Reconnect CPS connector and install all removed parts.

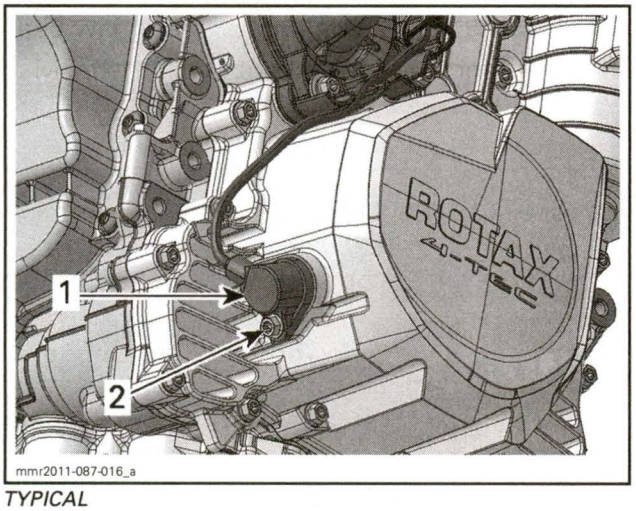
CPS Replacement

1. Remove parts required to access the CPS, refer to *CPS ACCESS* in this subsection.
2. Take note of factory CPS wire harness routing for reinstallation.
3. Cut harness locking ties and disconnect CPS connector.



TYPICAL
1. *CPS connector*
2. *Retaining clamp*
3. *Locking ties (4)*

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



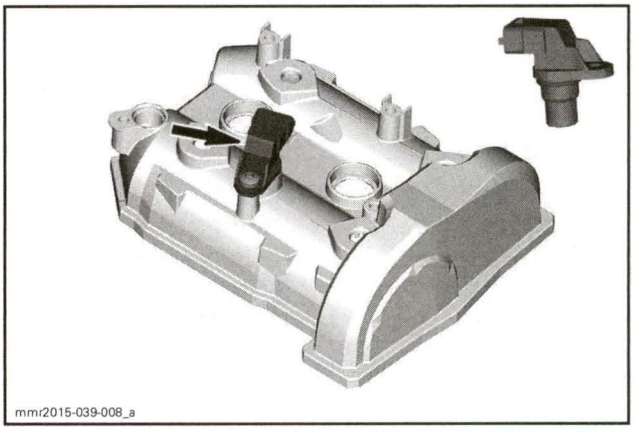
TYPICAL
1. *CPS*
2. *Retaining screw*

5. Install new CPS.

CPS INSTALLATION	
O-RING	SERVICE PRODUCT
	APPLY ENGINE OIL ON O-RING
RETAINING SCREW	TORQUE
	9 N•m ± 1 N•m (80 lbf•**in** ± 9 lbf•**in**)

6. Route and secure CPS harness using harness clamp and locking ties as noted prior to removal.

CAMSHAFT POSITION SENSOR (CAPS)



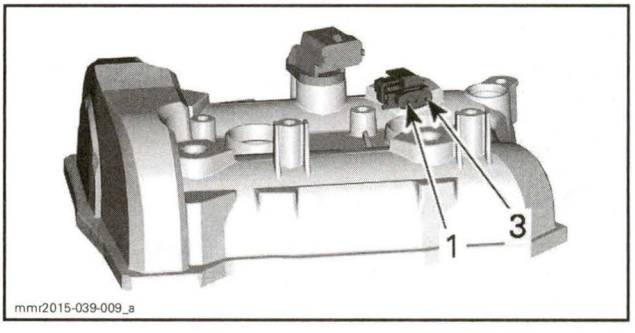
CAPS Access

Refer to appropriate subsection and remove:
- Side Panels

CAPS Voltage Test (Harness Side)

1. Remove the parts required to access the CAPS, refer to *CAPS ACCESS*.
2. Disconnect CAPS connector.
3. Press the START/RER button to wake up the ECM.
4. Install tether cord on engine cut-off switch.
5. Probe harness connector terminals as per following table.

CAPS		READING
PIN		VOLTAGE
3	1	Battery Voltage



If battery voltage is read, proceed with *CAPS DYNAMIC TEST* further in this subsection.

If battery voltage is not read, probe circuit as per following table.

CAPS	BATTERY	READING
PIN	TERMINAL	VOLTAGE
3	Battery Ground	Battery Voltage

If voltage is read to battery ground, check continuity of ground circuit between CAPS pin 1 and ECM-A connector pin 4D. Repair or replace wiring and connectors.

If voltage is not read to battery ground, carry out a *CONTINUITY TEST OF CAPS POWER CIRCUIT*.

Continuity Test of CAPS Power Circuit

1. Remove cover from fuse box. Refer to *POWER DISTRIBUTION*.
2. Remove fuse (F6).
3. Use the FLUKE 115 MULTIMETER (P/N 529 035 868) and select Ω.
4. Read resistance of the CAPS circuit as per following table.

CAPS	FUSE BOX	READING
PIN	TERMINAL	Ω
3	B7	Close to 0 Ω

If continuity is good, wiring and connectors are functional.

If a high resistance or an open circuit is measured, refer to *WIRING DIAGRAM* and check the following:

- Continuity from CAPS connector pin 3 to engine connector pin 4
- Continuity from engine connector pin 1 to fuse box contact B7

Pay attention to connector pin contact and junction JT (GY/RD).

Repair or replace wiring and connectors as required.

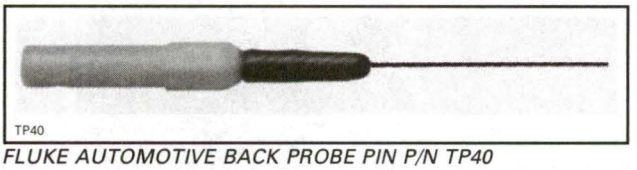
5. Reinstall all removed parts.

CAPS Dynamic Test

1. Remove the parts required to access the CAPS, refer to *CAPS ACCESS*.
2. Remove CAPS sensor from engine.
3. Back-probe connector and read voltage as follows.

NOTE: To safely probe wire terminals through the back of the connector, use the following tool or an equivalent.

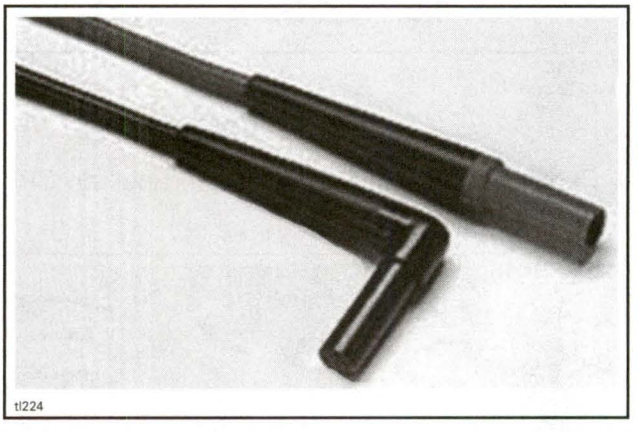
REQUIRED TOOL
FLUKE AUTOMOTIVE BACK PROBE PIN (P/N TP40)



FLUKE AUTOMOTIVE BACK PROBE PIN P/N TP40

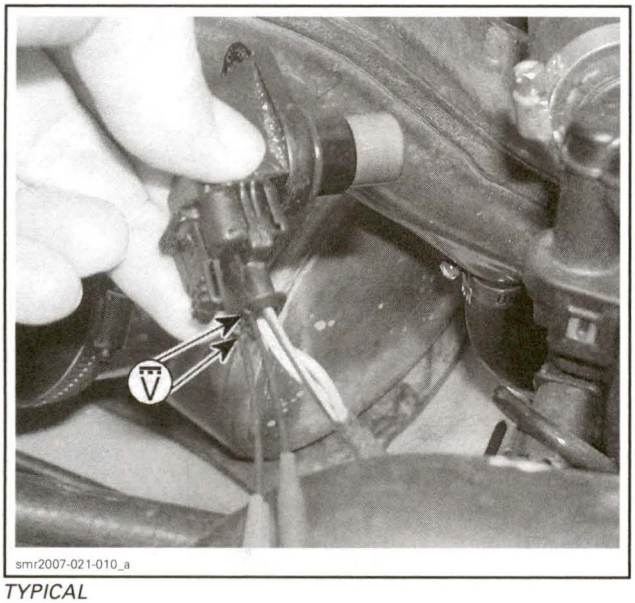
NOTICE Do not use sharp end probes. They could damage the connector seal.

Probes can be inserted at the end of the FLUKE SUREGRIP INSULATED TEST LEADS (P/N TL224).



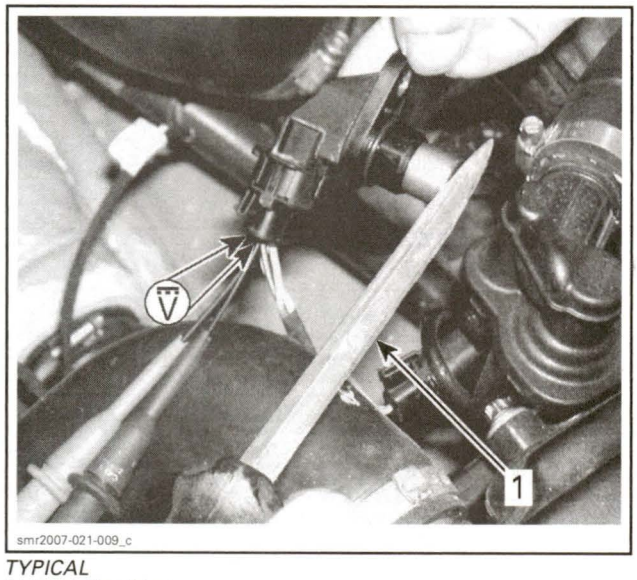
4. Set engine emergency stop switch to STOP to prevent engine starting.
5. Install the tether cord cap on the engine cut-off switch.
6. Briefly press the START/RER button to wake up the ECM.
7. Read voltage as per following tables.

CAPS		CAPS CONDITION	READING
PIN		SENSOR END	VOLTAGE
3	2	Free	Close to 0 Vdc



TYPICAL

CAPS		CAPS CONDITION	READING
PIN		SENSOR END	VOLTAGE
3	2	Metallic Object on Sensor	Battery Voltage



TYPICAL
1. Metallic object

If voltage is as specified, repair or replace wiring and connectors between sensor and ECM.

If wiring is good, check ECM. Refer to *ENGINE CONTROL MODULE (ECM)*.

If battery voltage is not measured as specified, try a new CAPS.

CAPS Replacement

1. Disconnect CAPS connector.
2. Unscrew the CAPS retaining screw.
3. Pull CAPS from engine.
4. Install the new CAPS.

NOTICE Be sure to install new O-ring on the new CAPS.

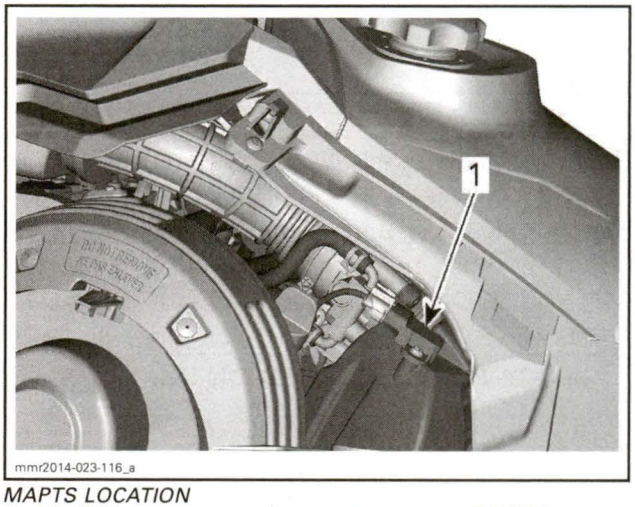
CAPS INSTALLATION	
O-RING	SERVICE PRODUCT
	APPLY ENGINE OIL ON O-RING
CONNECTOR	SERVICE PRODUCT
	DIELECTRIC GREASE (P/N 293 550 004)
RETAINING SCREW	TORQUE
	9 N•m ± 1 N•m (80 lbf•**in** ± 9 lbf•**in**)

MANIFOLD ABSOLUTE PRESSURE AND TEMPERATURE SENSOR (MAPTS)

NOTE: This sensor is a multifunction device. It measures manifold absolute pressure and intake temperature for air flow calculations.

MAPTS Access

To access the MAPTS, remove the LH side panel.



MAPTS LOCATION
1. Manifold air pressure and temperature sensor (MAPTS)

MAPTS Pressure Function

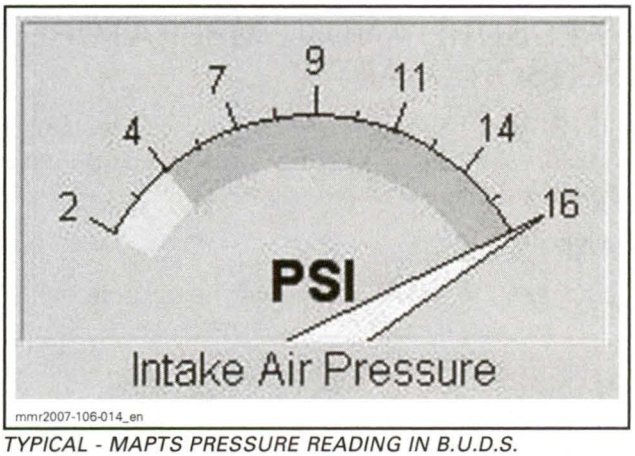
Before the engine is started, when power is applied to the system, the sensor measures the ambient air atmospheric pressure. The ambient pressure is, at that moment, stored in the ECM.

Thereafter, once the engine is started, it measures the air pressure in the intake manifold at operating RPMs.

The sensor must be correctly installed on the intake manifold. Otherwise, the MAPTS could generate a fault code for an unexpected sensor range at idle when it reads the atmospheric pressure. If this is the case, remove sensor and check for oil or dirt on its end and if problem persists, check throttle plate condition/position and the wiring harness. Perform the following tests.

MAPTS Quick Test (Pressure Function)

1. Connect vehicle to B.U.D.S. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. In B.U.D.S., select the following:
   - **Read Data**
   - **Monitoring** page tab
   - **ECM** page.



TYPICAL - MAPTS PRESSURE READING IN B.U.D.S.

3. Look for and take note of the MAPTS pressure reading while the engine is stopped.

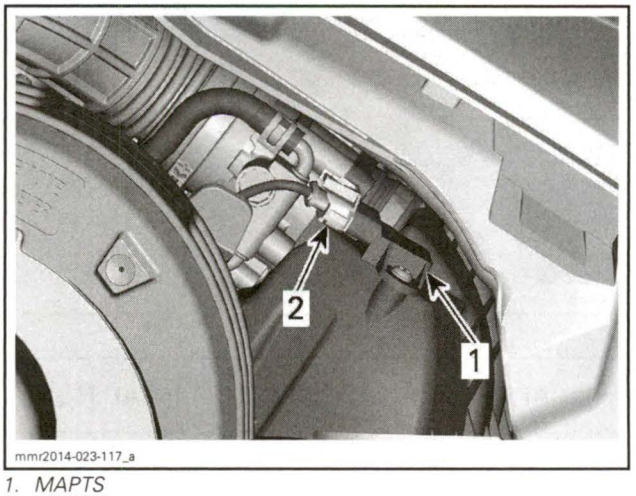
NOTE: The indicated intake air pressure in B.U.D.S. must be within 3.4 kPa (.5 PSI) of local atmospheric pressure when the engine is stopped.

MAPTS PRESSURE FUNCTION QUICK TEST			
RESULT	SERVICE ACTION		
NO READING	Circuit Continuity Test of MAPTS Pressure Function	MAPTS Input Voltage Test	Repair or replace wiring
VALUE IS OUT OF RANGE	Replace MAPTS		

4. Perform the same test with a new MAPTS and compare both readings.

MAPTS Input Voltage Test

1. Remove parts required to access the MAPTS, refer to *MAPTS ACCESS*.
2. Remove electrical connector from MAPTS.



1. *MAPTS*
2. *MAPTS connector to remove*

3. Briefly push START/RER button.
4. Set multimeter to Vdc, measure for MAPTS input voltage as per following table.

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

MAPTS		READING
PIN		VOLTAGE
1	3	5 Vdc

If voltage test is good, replace the MAPTS.

If voltage test is not good, carry out the *MAPTS CIRCUIT CONTINUITY TEST (PRESSURE FUNCTION)*.

MAPTS Circuit Continuity Test (Pressure Function)

1. Remove parts required to access ECM connectors, refer to *ECM CONNECTOR ACCESS* in this subsection.
2. Disconnect the ECM-A connector from the ECM and connect it to the ECM adapter tool.

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

3. Set multimeter to Ω and check continuity of the following circuits.

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

ECM ADAPTER	MAPTS	READING
PIN		Ω
4B	3	Close to 0 Ω
4G	4	
2H	1	

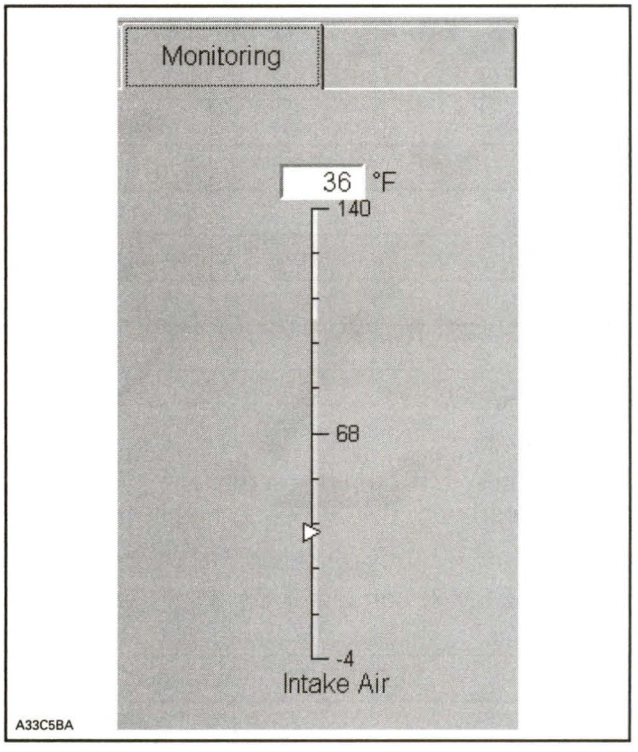
If resistance is not within specification, repair or replace the wiring harness between ECM connector and the MAPTS. Refer to *WIRING DIAGRAM.*

MAPTS Temperature Function

The MAPTS also monitors the temperature of the air in the intake manifold.

MAPTS Quick Test (Temperature Function)

1. Connect vehicle to B.U.D.S. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. In B.U.D.S., select the following:
   - **Read Data**
   - **Monitoring** page tab
   - **ECM** page.
3. Look for the **Intake Air** temperature reading while the engine is stopped.



TYPICAL - MONITORING PAGE TAB, ECM

NOTE: If the complete vehicle is at room temperature, B.U.D.S. should display the ambient air temperature at the intake manifold.

4. Perform the same test with a new MAPTS and compare both readings.

If the engine's MAPTS temperature reading is significantly different than the new MAPTS, replace it.

NOTE: Both sensors must feel same ambient air temperature.

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

MAPTS Resistance Test (Temperature Function)

1. Disconnect the MAPTS connector.
2. Test MAPTS resistance at the sensor as per following tables.

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

MAPTS		READING
PIN		Ω
1	2	Refer to MAPTS TEMPERATURE SENSOR TABLE

MAPTS TEMPERATURE SENSOR TABLE		
TEMPERATURE		Ω
°C	°F	MAPTS
- 40	- 40	40528 to 56935
- 10	- 14	8103 to 10919
20	68	2193 to 2863
80	176	294 to 368
120	248	98 to 122

If resistance is not within specification, replace the MAPTS.

If resistance tests good, **reconnect** the MAPTS and proceed with the following steps.

3. Disconnect the ECM-A connector.
4. Install ECM-A connector on the ECM adapter tool.

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

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

ECM ADAPTER		READING
PIN		Ω
2H	3H	Refer to MAPTS TEMPERATURE SENSOR TABLE

MAPTS TEMPERATURE SENSOR TEST RESULTS			
RESULT	SERVICE ACTION		
NO READING	Circuit Continuity Test of MAPTS Temperature Function	MAPTS Input Voltage Test	Repair or replace wiring
INCORRECT RESISTANCE VALUE	Check condition of connector pins, replace MAPTS		
CORRECT RESISTANCE VALUE	Try a new ECM		

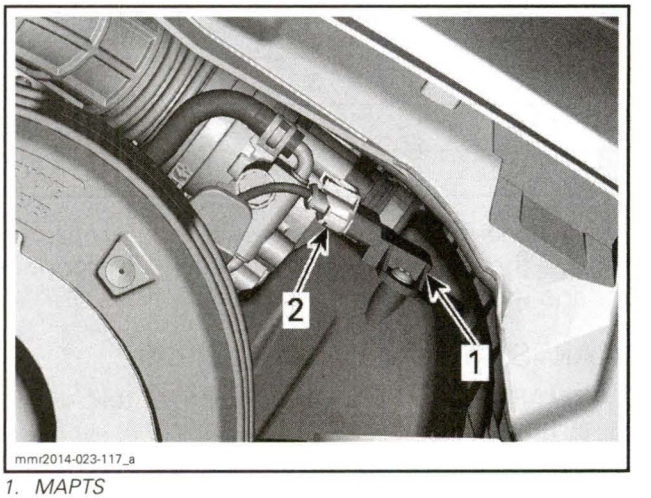
MAPTS Circuit Continuity Test (Temperature Function)

ECM ADAPTER	MAPTS	READING
PIN		Ω
2H	1	Close to 0 Ω
3H	2	

Repair or replace wiring as required.

MAPTS Replacement

1. Disconnect MAPTS connector and remove the MAPTS from the intake manifold.



1. MAPTS
2. MAPTS connector

2. Install new MAPTS as per following table.

MAPTS RETAINING SCREW	
Tightening torque	4.5 N•m ± 0.5 N•m (40 lbf•**in** ± 4 lbf•**in**)

COOLANT TEMPERATURE SENSOR (CTS)

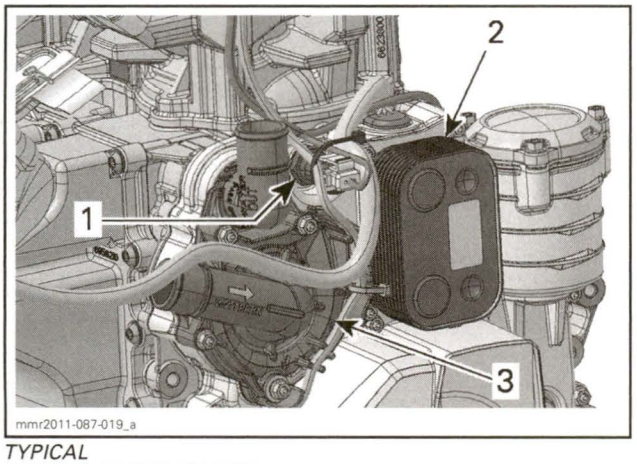
Overheat Warning

The CTS will cause the engine overheat warning to come on when the coolant temperature is above 110°C (230°F).

CTS Access

The CTS is located on the RH side of the engine, between the water pump and oil cooler.

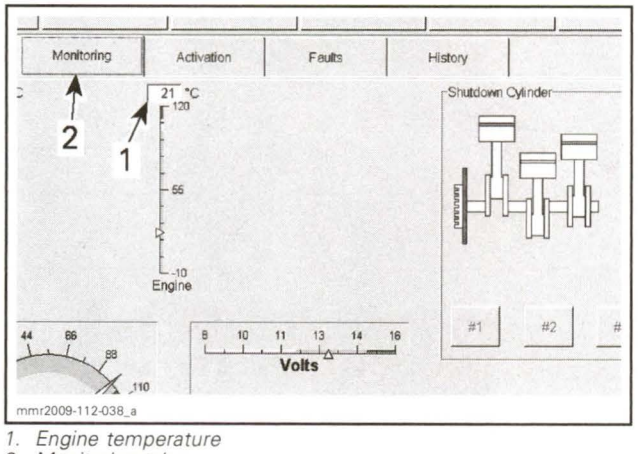
To access the CTS, remove the RH side panel.



TYPICAL
RH SIDE OF THE ENGINE
1. *Coolant temperature sensor (CTS)*
2. *Oil cooler*
3. *Water pump*

CTS Quick Test

1. Connect the vehicle B.U.D.S. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. In B.U.D.S., select the following:
   - **Read Data** button
   - **Monitoring** page tab
   - **ECM** page.
3. Look for the engine temperature indication.



1. *Engine temperature*
2. *Monitoring tab*

The engine temperature gauge in B.U.D.S. should provide an indication of the actual engine coolant temperature. Otherwise, perform the *CTS RESISTANCE TEST.*

CTS Resistance Test

1. Disconnect the CTS connector.
2. Test the resistance of the sensor as per following tables.

CTS		READING
PIN		Refer to CTS TEMPERATURE SENSOR TABLE
1	2	

CTS TEMPERATURE SENSOR TABLE			
TEMPERATURE		Ω	
°C	°F	LOW	HIGH
- 40	- 40	38400	52600
- 10	14	8200	10,600
0	32	5900	6900
20	68	2200	2800
80	176	295	350
120	248	105	120

NOTE: To test sensor at various temperatures, remove sensor and use a heat gun, ice and a thermometer.

If resistance is out of specification, replace the CTS.

If resistance test is good, proceed with the following steps.

3. Reconnect the CTS connector.
4. Remove parts required to access ECM connectors, refer to *ECM CONNECTOR ACCESS* in this subsection.
5. Disconnect the ECM-A connector.
6. Install ECM-A connector on adapter tool.

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

7. Recheck resistance from the ECM connector as per following table.

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

ECM ADAPTER		READING
PIN		Refer to CTS TEMPERATURE SENSOR TABLE
1A	2J	

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

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

CTS Replacement

1. Drain coolant, refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.
2. Cut locking ties of wiring harnesses and move wiring aside for access.

NOTE: Take note of wiring and locking tie position before removal.

3. Disconnect CTS connector.
4. Remove CTS from engine.
5. Install new CTS and torque as specified.

CTS	
Tightening torque	16 N•m ± 2 N•m (142 lbf•**in** ± 18 lbf•**in**)

6. Reinstall remaining removed parts.

NOTE: Ensure to reinstall wiring harness as noted prior to removal.

7. Refill and bleed the cooling system, refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

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ELECTRONIC FUEL INJECTION (900 ACE)

SERVICE TOOLS

Description	Part Number	Page
ECM ADAPTER TOOL	529 036 166	335, 354, 359, 361–362
FLUKE 115 MULTIMETER	529 035 868	335, 343–344, 354, 356, 359–360, 362
FUEL HOSE DISCONNECT TOOL	529 036 037	345
POWER INTERFACE	515 177 223	342
SMALL HOSE PINCHER	295 000 076	351

SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
FLUKE AUTOMOTIVE BACK PROBE PIN	TP40	356
FLUKE SUREGRIP INSULATED TEST LEADS	TL224	356

SERVICE PRODUCTS

Description	Part Number	Page
DIELECTRIC GREASE	293 550 004	358

GENERAL

⚠ WARNING

When electrically disconnecting or removing the throttle body from the intake manifold, always remove the tether cord from the engine cut-off switch and disconnect the battery.

⚠ WARNING

Always disconnect battery prior to working on the fuel system. Always disconnect battery exactly in the specified order, BLACK (-) cable first. Electrical connections should be disconnected prior to disconnecting fuel lines.

⚠ WARNING

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

⚠ WARNING

Proceed with care and use appropriate safety equipment when working on the fuel system. Wipe off any fuel spillage in the engine compartment. Do not allow fuel to spill on hot engine parts and/or on electrical connectors.

Cover the fuel line connection with an absorbent shop rag before disconnecting them. Slowly disconnect the fuel hose to minimize spilling.

⚠ WARNING

Replace any damaged, leaking or deteriorated fuel lines or connections. After working on the fuel system, always pressurize the fuel system and check for fuel leaks. Refer to *FUEL SYSTEM PRESSURIZATION* in *FUEL TANK AND FUEL PUMP* subsection.

SYSTEM DESCRIPTION

The electronic fuel injection system (EFI) is comprised of various sensors used for detecting ongoing operating conditions of the engine and vehicle, and includes all the components that perform the required adjustments to the engine.

Electrical System

ECM (Electronic Control Module)

The ECM controls the engine operation and the vehicule power management. To control the engine, the ECM reads the inputs from the sensors which it compares to predetermined parameters stored in the ECM (fuel and ignition maps), makes computations, and activates the outputs accordingly (injectors, ignition coils etc.).

EFI Sensors

To control the injection system, the engine management uses input signals from the following sensors:

- Camshaft position sensor (CAPS)
- Crankshaft position sensor (CPS)
- Manifold absolute pressure and temperature sensor (MAPTS)
- Throttle position sensor (TPS) which is integrated to the throttle body (Electronic Throttle Control (ETC))
- Throttle accelerator sensor (TAS).
- Coolant Temperature Sensor (CTS)
- Oil Pressure Sensor (OPS)

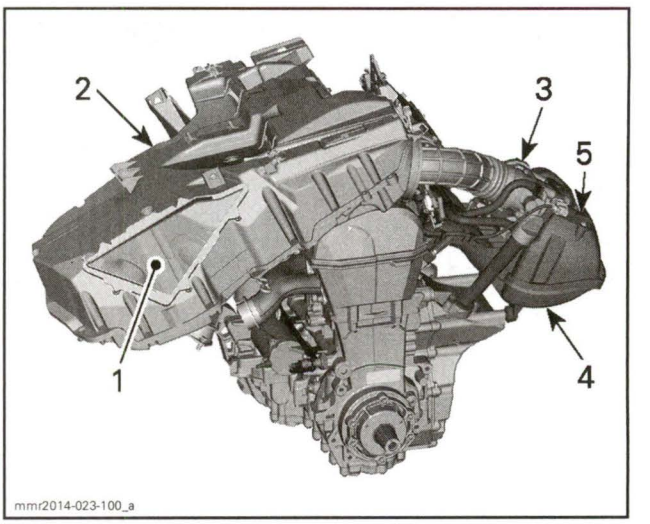
Air Intake System

Air Filter

Air flows through a mesh screen filter in the air intake silencer mounted over the engine. The mesh filter prevents snow from being drawn into the engine.

Air is then drawn in through the throttle body, the air intake manifold and into the engine.

Manifold absolute pressure and temperature are measured in the intake manifold.



1. *Mesh screen filter*
2. *Air intake system*
3. *Throttle body (Electronic Throttle Control (ETC))*
4. *Intake manifold*
5. *Manifold absolute pressure and temperature sensor (MAPTS)*

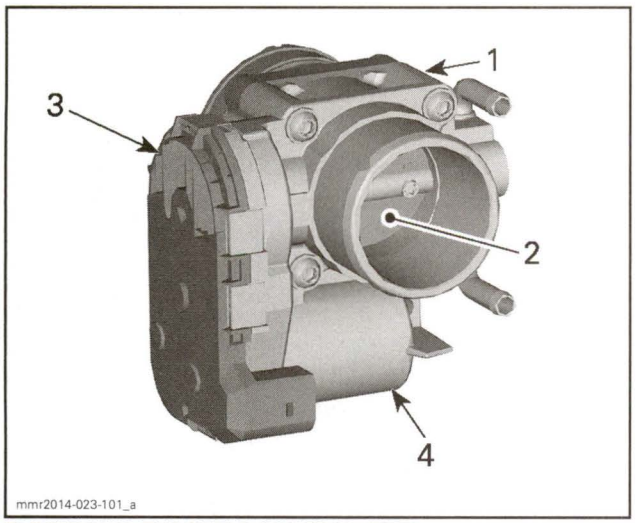
Throttle Body ((ETC) Electronic Throttle Control)

Air for combustion is drawn in by the engine. The air flows through the throttle body (ETC) and is controlled by a throttle plate.

The Electronic Throttle Control (ETC) is a heated single 46 mm throttle body with integrated dual throttle position sensors (TPS) and electric throttle actuator (ETA) and is mounted on the intake manifold.

The ETA allows the ECM to electronically control the throttle plate opening which regulates the amount of air that enters the engine, and therefore engine speed.

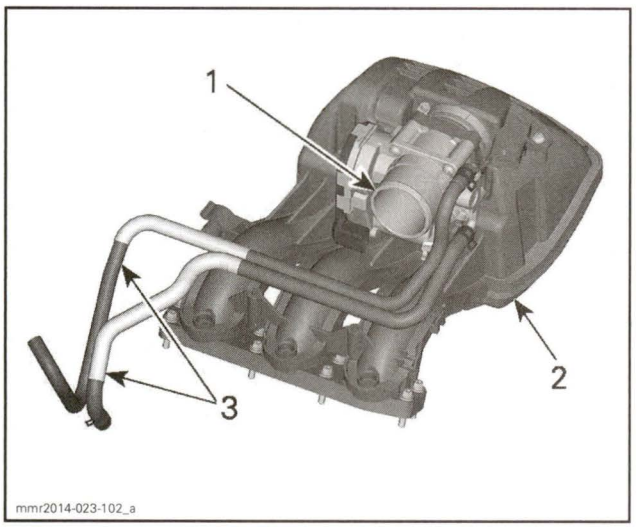
There is no idle air control valve (IACV).



ELECTRONIC THROTTLE CONTROL (ETC)

1. *Throttle body*
2. *Throttle plate*
3. *Dual Throttle Position Sensor (TPS)*
4. *Electric throttle actuator (ETA) (electric motor)*

Engine coolant flows through the throttle body (ETC) to prevent potential freezing of the throttle plate.



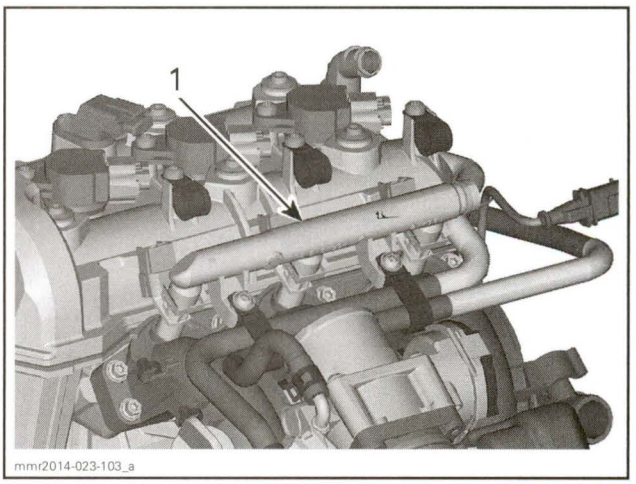
1. *Throttle body (ETC)*
2. *Intake manifold*
3. *Coolant-heated lines*

Fuel System

Fuel Rail

A fuel rail is mounted on the intake manifold. The fuel rail, which is used to secure the injectors to the manifold, also provides to the injectors the fuel pressure that it receives from the fuel pump.

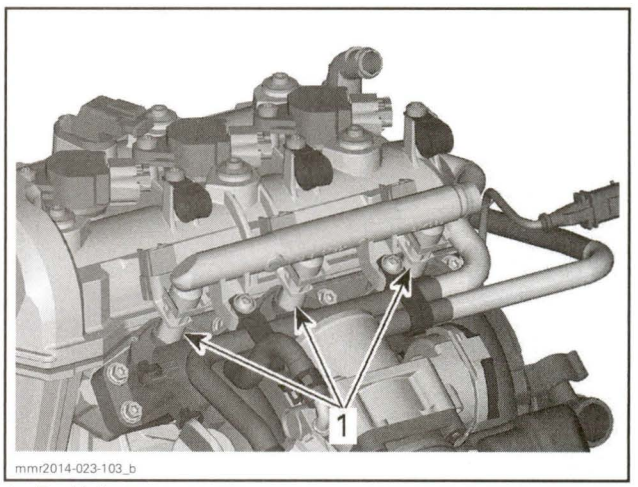
The fuel pressure applied to the fuel rail is regulated by the fuel pressure regulator located in the fuel pump module.



1. *Fuel rail*

Fuel Injectors

Three fuel injectors are used to inject fuel into the intake ports of the cylinder head. One injector is used per cylinder.



1. *Fuel injectors*

Fuel is injected in accordance with injection signals received from the ECM.

Fuel Pump

An electric fuel pump with an integrated pressure regulator and fuel system filters is used. For more details on the fuel pump unit, refer to *FUEL TANK AND FUEL PUMP* subsection.

ADJUSTMENT

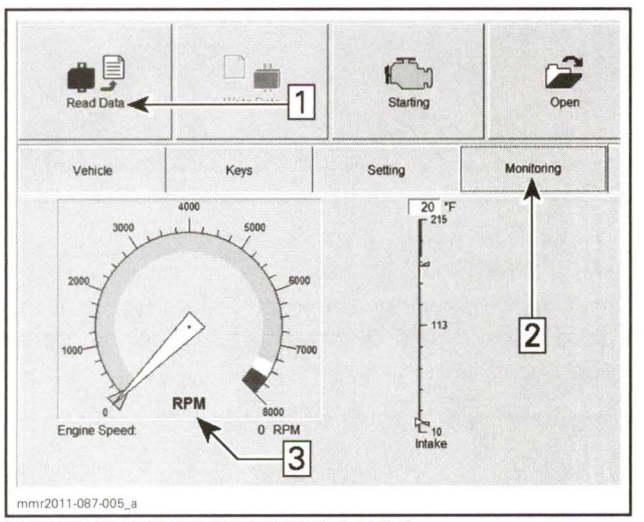
IDLE SPEED

Idle speed is not adjustable. The EMS (Engine Management System) controls the idle speed of the engine through the iTC system by controlling throttle plate opening using the ETA (electric throttle actuator).

The vehicle multifunction gauge can provide a readout of the engine's idle RPM.

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

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



VERIFYING ENGINE RPM USING B.U.D.S.
Step 1: Click on the **Read Data button**
Step 2: Select the **Monitoring** *page tab*
Step 3: Read the engine **RPM** *indication*

NOTE: The gauge and B.U.D.S. use the same signal to provide the engine RPM indication.

TROUBLESHOOTING

DIAGNOSTIC TIPS

Engine problems are not necessarily related to the fuel injection system.

It is important to ensure that the engine and propulsion system, fuel delivery and electrical systems are functioning normally.

For diagnostics purposes, use B.U.D.S. software. See *COMMUNICATION TOOLS AND B.U.D.S.* subsection.

After a problem has been solved, be sure to clear the fault(s) recorded in the ECM using the B.U.D.S. software.

⚠ WARNING

Electrical actuators and electronic modules may be powered up as soon as the START/RER button is depressed. Always disconnect the battery prior to disconnecting any electrical or electronic parts.

Never use a battery charger to temporarily substitute the battery as it may cause the ECM to function erratically, or not at all.

Check related-circuit fuse solidity and condition with an ohmmeter. A visual inspection could lead to a false diagnosis.

Poor Idling

If poor idling is experienced, check the following:
- Poor quality fuel or water in the fuel
- Fault codes using B.U.D.S.
- Throttle body cleanliness
- Engine leaks or other mechanical problem.

Electrical Related Problems

It is important to check the following in the electrical system:
- Battery voltage
- Fuses
- Ground connections
- Wiring and connectors.

Ensure that all electronic components are original BRP recommended components. Any modification to the wiring harness may lead to poor system operation or generate fault codes.

Electrical Connections

Pay particular attention to ensure that terminals and pins are not out of their connectors, corroded, or out of shape.

When probing terminals, pay attention not to deform the terminals as this could cause a loose or intermittent connection that would be difficult to troubleshoot.

NOTE: Do not apply dielectric grease or other lubricants on the ECM connectors.

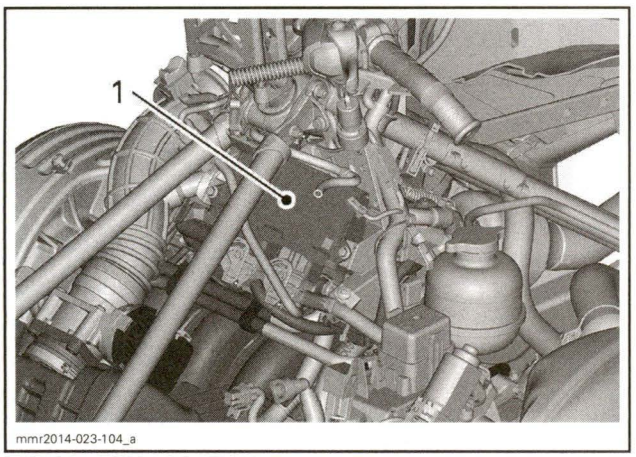
PROCEDURES

ENGINE CONTROL MODULE (ECM)

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

ECM Location

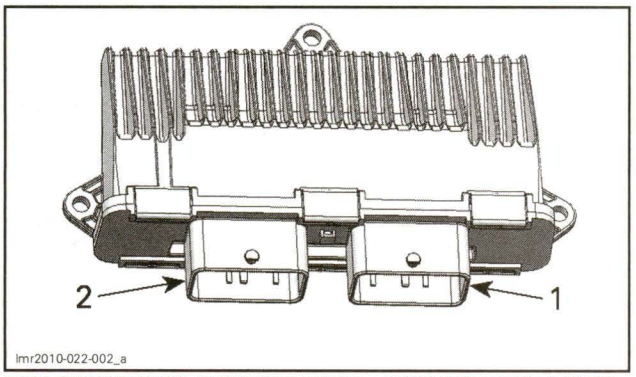
The ECM is located above the air intake manifold.



TYPICAL ECM LOCATION
1. ECM

ECM Connector Identification

There are 2 connectors connected to the ECM:
- Engine harness connected to ECM-A
- Vehicle system control harness connected to ECM-B.



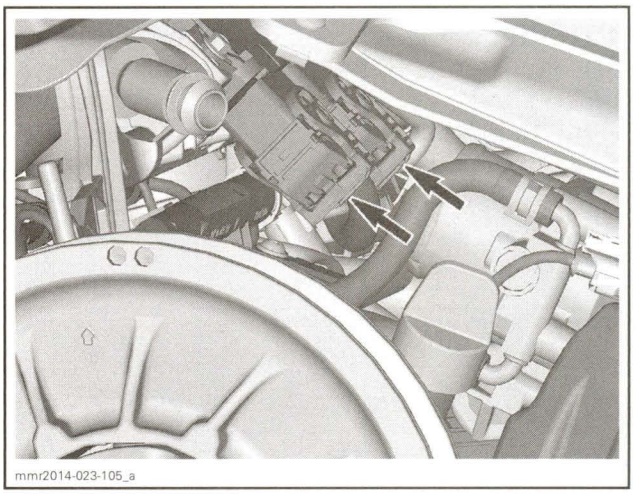
ECM CONNECTOR IDENTIFICATION - COOLING FINS FACING OUT
1. Connector A
2. Connector B

The ECM connectors have 48 pins.

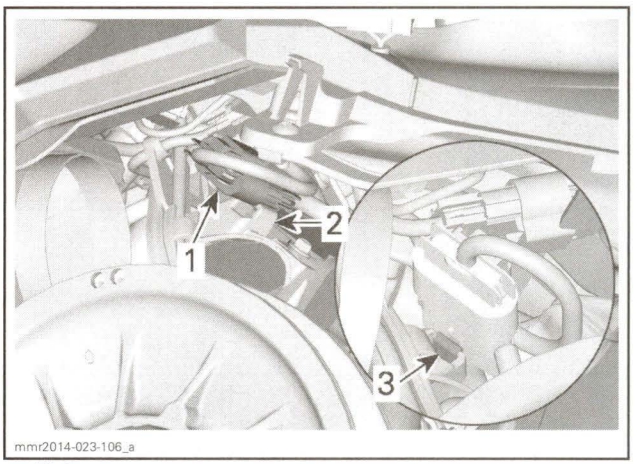
NOTE: For connector information, cleaning and probing, refer to *CONNECTOR INFORMATION* subsection.

ECM Connector Access

1. Refer to appropriate subsection to remove;
   - Side panels
   - Vent hoses.
2. Reach in above the driven pulley, between the fuel tank and ECM support.

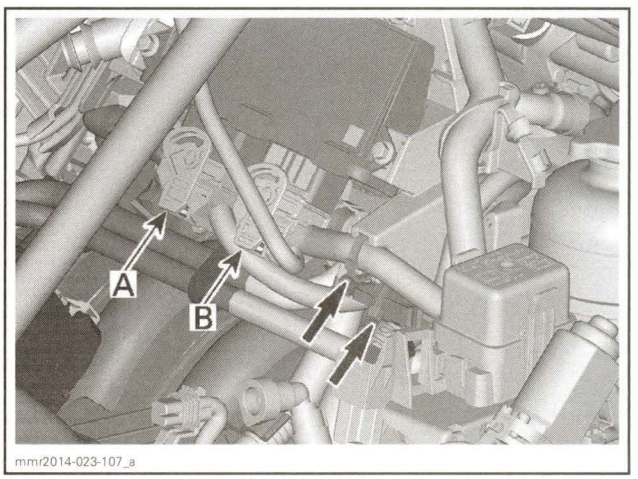


3. Remove throttle accelerator sensor (TAS) connector from ECM support and disconnect it.



1. TAS connector
2. ECM support
3. TAS clip

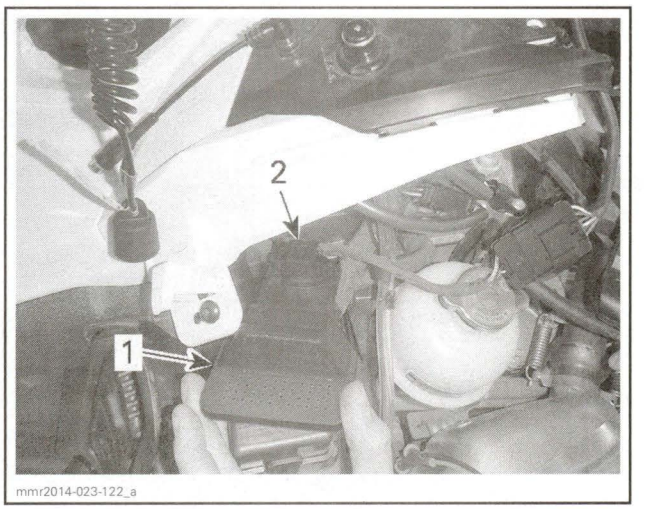
4. Cut the locking tie(s) that secure the ECM connector harnesses to the ECM support.



FUEL TANK REMOVED FOR CLARITY
A. ECM-A connector
B. ECM-B connector

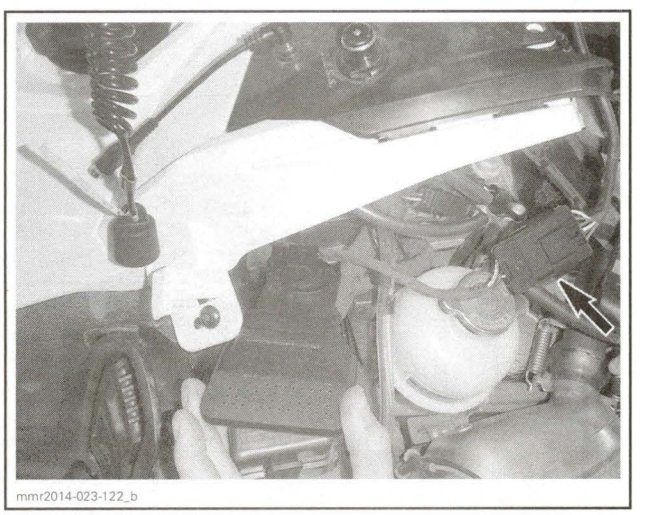
NOTE: The ECM is mounted with the cooling fins facing forward. Therefore, ECM A connector is on the LH side of the vehicle, and ECM B connector is on the RH side.

5. Disconnect the ECM connector(s) from the LH side of the vehicle and pull them outwards from the RH side for installation on the ECM adapter tool.

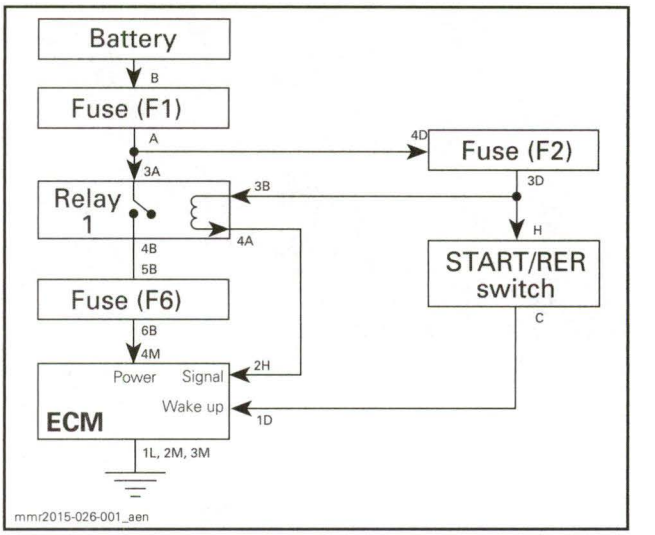


1. ECM adapter tool
2. ECM connector

6. Reconnect TAS connector on the RH side of vehicle for testing.



ECM Power Circuit Diagram



ECM Power Circuit Validation

Briefly press START/RER button.

This should wake up the ECM . The ECM will then activate relay 1 for approximately 12 seconds after which it will turn off all power. If the tether cord is installed when the START/RER button is pressed, the power will stay on for approximately 40 seconds.

QUICK INDICATION THAT ECM IS POWERED (ASSUMING THE OBSERVED COMPONENT IS WORKING)
Multifunction gauge comes ON.
Fuel pump turns on for approx. 2 seconds (if tether cord installed).

If ECM does not turn on, check the following:

- Fuse F1, F2 and F6.
- Battery voltage. Refer to *CHARGING SYSTEM* subsection.
- Relay R1.
- START/RER switch. Refer to *STARTING SYSTEM* subsection.
- ECM power circuit wires and ground wires.

For testing of fuses and relay R1, refer to *POWER DISTRIBUTION* subsection.

NOTE: When relay 1 is not working, the ECM and the complete vehicle electrical system will not be powered.

ECM Wake Up Circuit Test

1. Disconnect ECM-B connector, refer to *ECM CONNECTOR ACCESS* in this subsection.

2. Install ECM-B connector on the ECM adapter tool.

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

3. Use a multimeter and select Vdc.

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

4. While pressing START/RER button, read voltage as follows.

ECM ADAPTER	BATTERY	READING
PIN	TERMINAL	VOLTAGE
1D	Negative (Ground)	Battery Voltage

If voltage is as per specification, refer to *ECM POWER CIRCUIT TEST.*

If voltage is out of specification:

- Test the START/RER switch, refer to *STARTING SYSTEM* subsection.
- If START/RER switch tests good, test wiring and connectors from battery to ECM. Refer to *WIRING DIAGRAM.*

ECM Power Circuit Test

1. Connect ECM-B connector on the ECM adapter tool.

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

2. Install an appropriate fused jumper wire between the following terminals on the ECM adapter tool.

JUMPER WIRE COORDINATES ON ECM ADAPTER	
2H	2M, 3M or 1L

NOTE: When the jumper is installed, the multifunction gauge should come on.

If the multifunction gauge did not come on, check the following:

- Fuses F1, F2 and F6
- Relay 1
- Wiring between ECM-B contact 2H and fuse FA, refer to the *WIRING DIAGRAM* subsection
- ECM ground circuit, refer to *CONTINUITY TEST OF ECM GROUND CIRCUITS* in this subsection.

For testing of fuses and relay R1, refer to *POWER DISTRIBUTION* subsection.

If gauge came on, carry on with the following step.

3. Set multimeter to Vdc.

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

4. Check for voltage as follows.

ECM ADAPTER	BATTERY	READING
PIN	TERMINAL	VDC
4M	Negative (Ground)	Close to battery voltage

If voltage is not measured, check the wiring and connections between ECM and fuse F6, refer to the *WIRING DIAGRAM* subsection.

If all items mentioned in this test and in *ECM WAKE UP CIRCUIT TEST* tested good, try a new ECM.

Continuity Test of ECM Ground Circuits

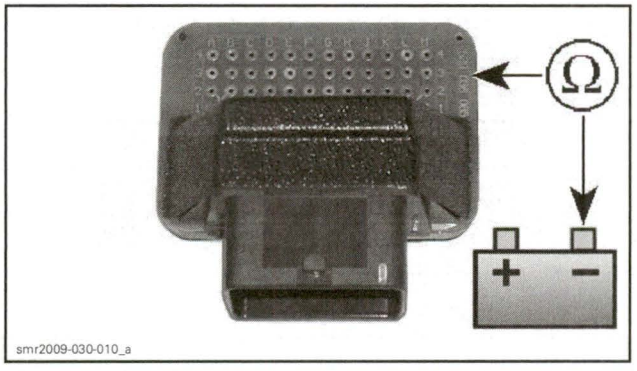
1. Connect ECM-B connector on the ECM adapter tool.

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

2. Set multimeter to Ω and probe adapter terminals as per following table.

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

ECM ADAPTER	BATTERY	READING
PIN	TERMINAL	Ω
1L	Negative (Ground)	Close to 0 Ω
2M		
3M		



If any measurement is out of specification refer to *POWER DISTRIBUTION* subsection and check the following:
- Wiring and connections
- Engine ground
- Battery ground
- Frame ground.

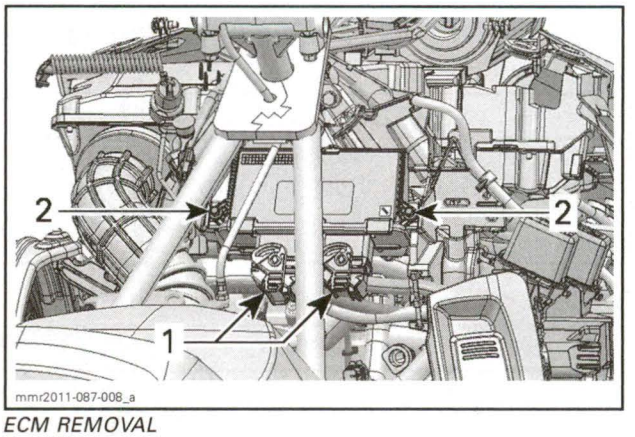
ECM Removal

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

1. Disconnect battery cables.

NOTICE Always disconnect the BLACK (–) battery cable first, then disconnect RED (+) cable.

2. Refer to appropriate subsection and remove:
   - Side panels
   -
   - Air intake silencer and gauge support assembly
   - Vent hoses.
3. Disconnect both ECM connectors from ECM.
4. Remove ECM retaining screws and remove the ECM from its support.



ECM REMOVAL
1. ECM connectors
2. ECM retaining screws

ECM Installation

1. Reverse removal procedure however, pay attention to the following.

ECM SCREW TIGHTENING TORQUE
2.5 N•m (22 lbf•**in**)

2. Reconnect ECM connectors.
3. Reconnect battery cables.

⚠ WARNING
Always reconnect the RED (+) battery cable first, then reconnect BLACK (–) cable.

4. If a new ECM is installed, refer to *ECM REPLACEMENT* in this subsection.

NOTICE Always replace ECM by the same part number or by a BRP approved equivalent.

ECM Replacement

NOTE: Prior to replacing an ECM, ensure that all the recommendations in the general introduction of this subsection have been followed and all applicable testing procedures have been carried out.

When the ECM is replaced, data must be entered into the new ECM . Refer to *ECM MANUAL DATA ENTRY FOR ECM REPLACEMENT* further in this subsection.

ECM Manual Data Entry for ECM Replacement

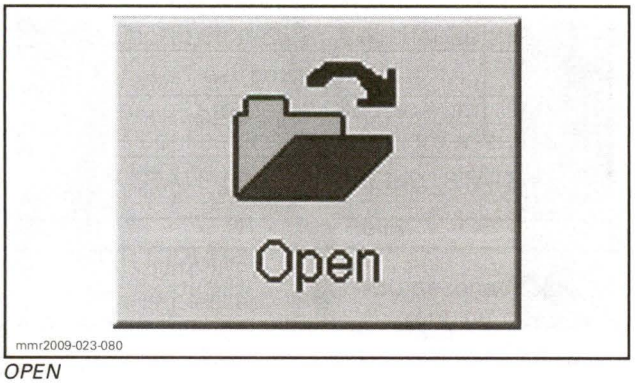
Once the required information has been collected, refer to *ENTERING THE COLLECTED INFORMATION INTO THE ECM.*

Obtaining the Data from a Saved .mpem File

1. Start B.U.D.S.

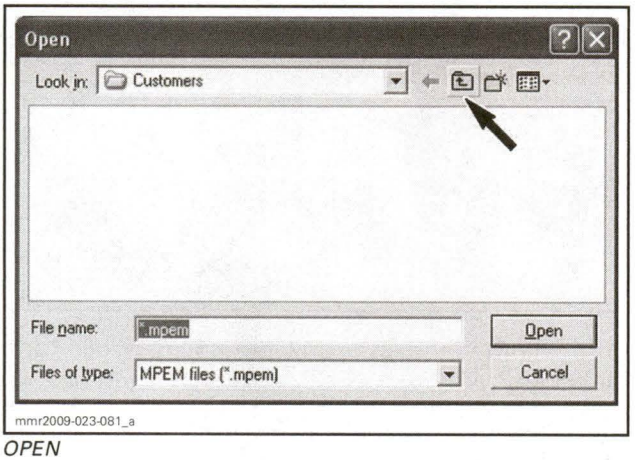
NOTE: It is not necessary to perform any connection. The PC computer can be used alone.

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



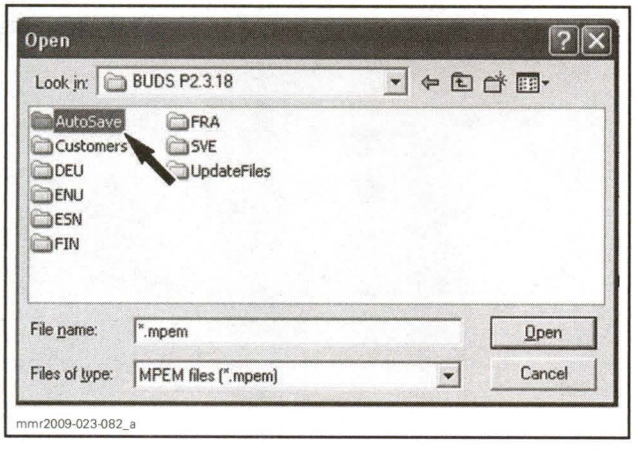
OPEN

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



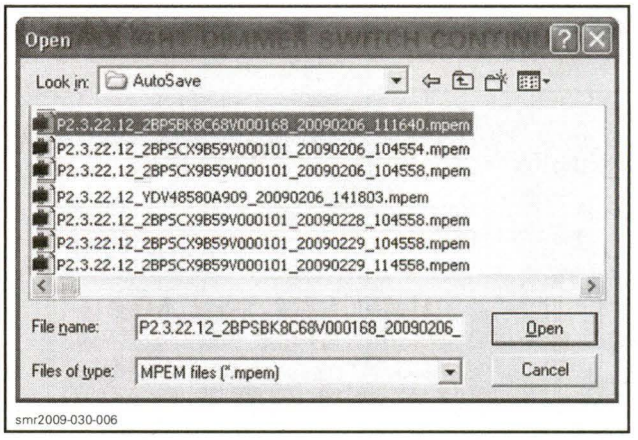
OPEN

Double click on the **AutoSave** folder.



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

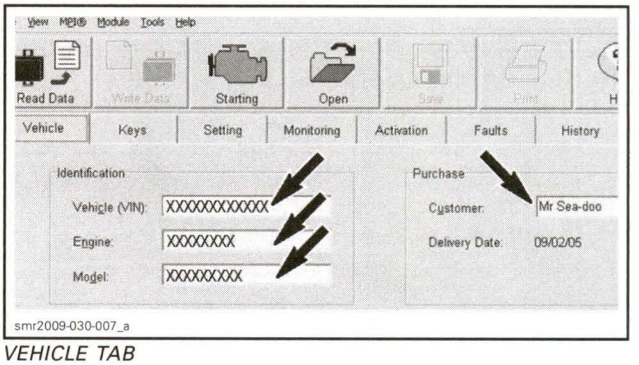
4. Choose the latest file saved for this specific vehicle.



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

NOTE: The file name structure is as follows:
B.U.D.S. version_VIN_date read (yyyymmdd)_hour read (hhmmss).mpem
Example: **S3.5.1BPSBK8C68V000168_20090206_111640.mpem** Therefore: B.U.D.S. version: S3.5.1 VIN: 2BPSBK8C68V000168 Date:2014.02.14 Hour: 11h 16m 40s

5. Select the **Vehicle** page tab and record (write down) the following information.
   1. Vehicle serial number
   2. Engine serial number (without the leading "M")
   3. Vehicle model number
   4. Customer name.

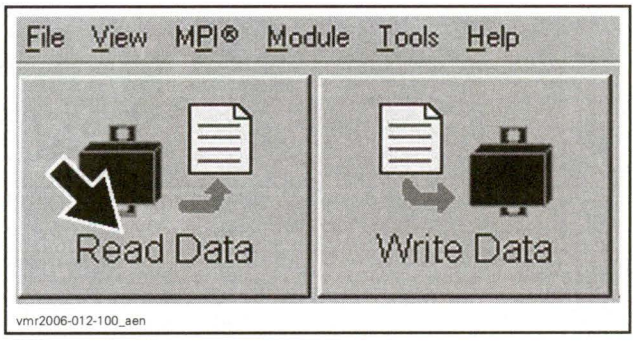


VEHICLE TAB

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

Entering the Collected Information Into the ECM

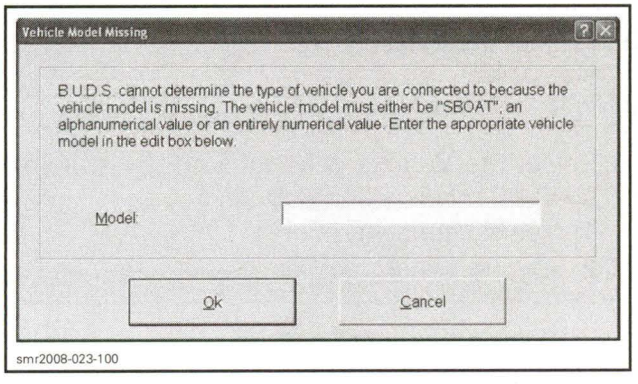
1. Connect the vehicle to B.U.D.S.. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. In B.U.D.S., click the **Read Data** button to read the new ECM.



vmr2006-012-100_aen

NOTE: A BEEP will sound repeatedly until the tether cord cap (D.E.S.S. key) is programmed into the new ECM.

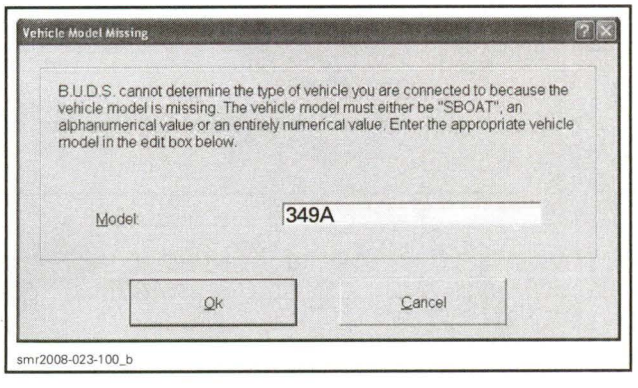
The following screen window will pop up.



smr2008-023-100

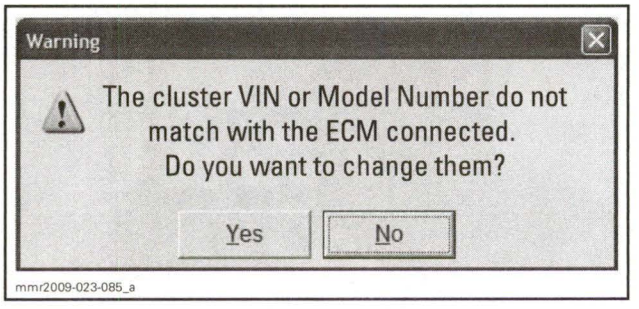
3. Enter the vehicle model number.

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



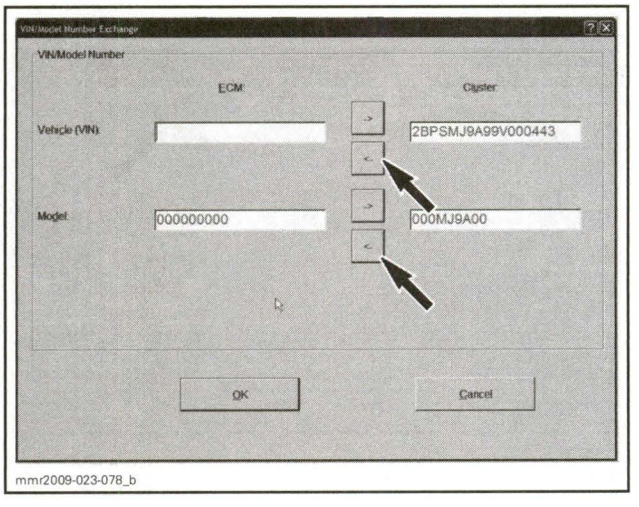
smr2008-023-100_b

4. Click **Ok** once the required data has been entered.
5. The following message will appear on B.U.D.S. screen.

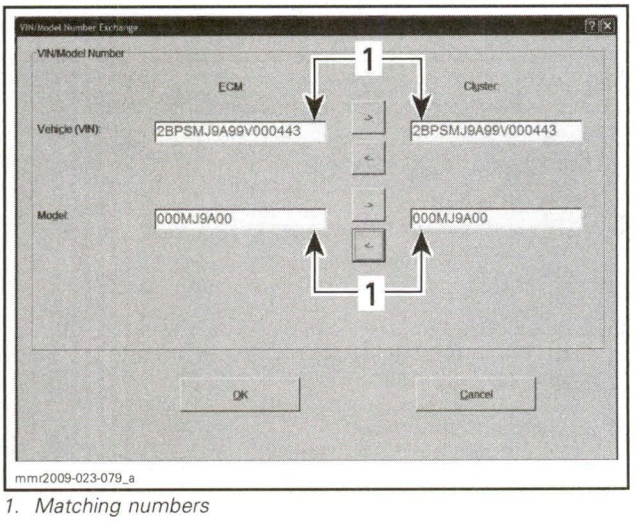


mmr2009-023-085_a

6. Click **Yes** to match ECM and gauge.
7. The serial numbers are purposely missing as seen in B.U.D.S. Click the arrows indicated in the following illustration to transfer the gauge numbers into the ECM.



mmr2009-023-078_b

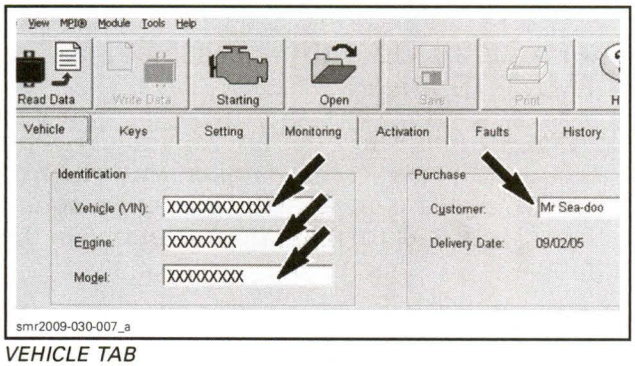


mmr2009-023-079_a

1. Matching numbers

8. Click the **OK** button to complete the procedure.

9. Select the **Vehicle** page tab and ensure all of the following information you recorded previously is precisely entered in the new ECM.
   1. Vehicle serial number (VIN)
   2. Engine serial number (do not enter the "M" at the beginning of the engine number)
   3. Vehicle model number
   4. Customer name.

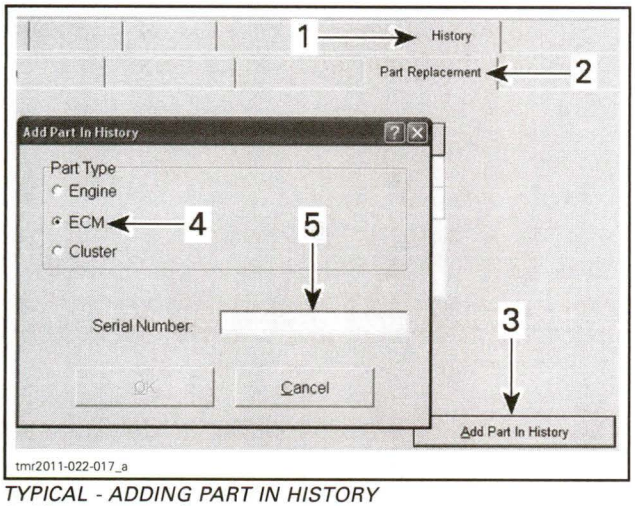


VEHICLE TAB

10. Enter all missing information.

NOTICE **Pay particular attention when typing the V.I.N. and model numbers. Once Write Data button is pressed, the data cannot be modified.**

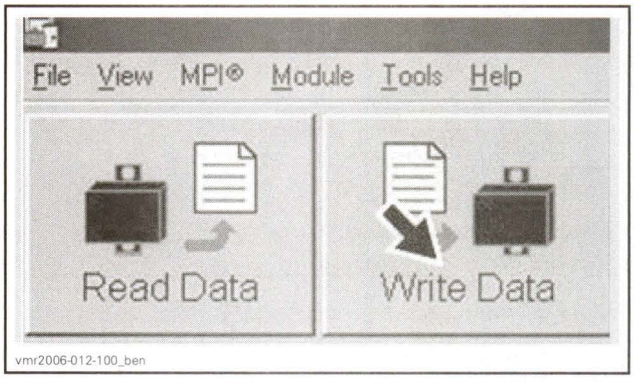
11. Click on the following tabs:
    - **History**
    - **Part Replacement**
    - **Add Part in History.**
12. Enter the **old** ECM serial number in the **Add Part In History** window.



TYPICAL - ADDING PART IN HISTORY
1. **History** *page tab*
2. **Part Replacement** *tab*
3. **Add part in history** *button*
4. **ECM** *selection*
5. *Add ECM serial number here*

NOTE: The ECM serial number can be found on the ECM sticker that also identifies the part number.

13. Click on the **OK** button.
14. Click on the **Write Data** button.

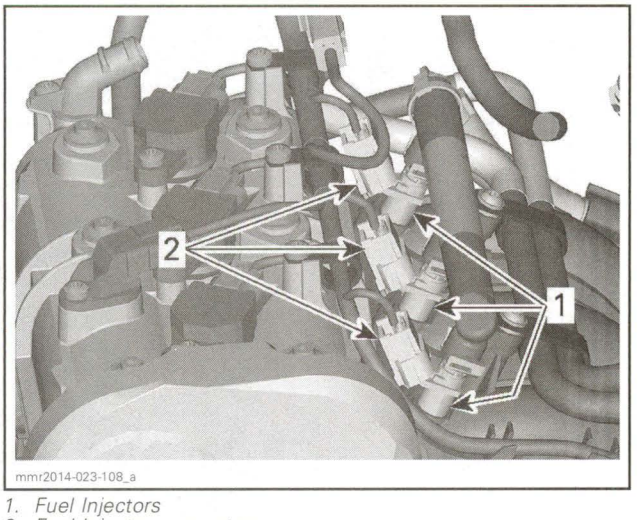


15. Perform the *THROTTLE POSITION SENSOR INITIALIZATION* procedure, refer to *THROTTLE POSITION SENSOR (TPS)* further in this subsection.
16. Program the tether cord cap (D.E.S.S. key) into the new ECM, refer to *DIGITAL ENCODED SECURITY SYSTEM (D.E.S.S.)* subsection.
17. Set the gauge units of display. Refer to *LIGHTS, GAUGE AND ACCESSORIES* subsection.
18. Start the engine and ensure proper operation.
19. Reinstall any remaining removed parts.

FUEL INJECTOR

Fuel Injector Connector Access

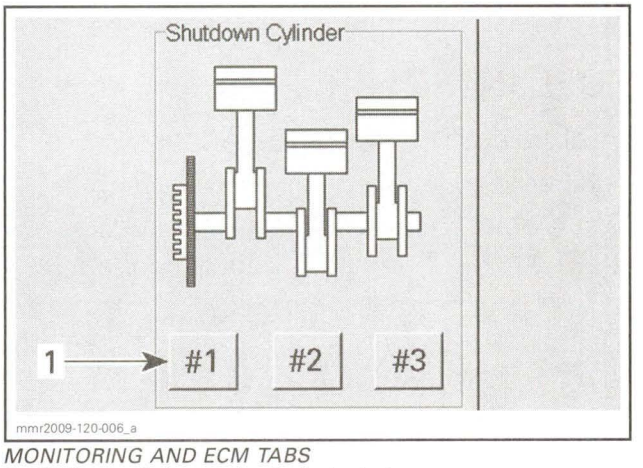
1. Refer to appropriate subsection to remove:
   - Side panels
   - Console
   - Air intake hose.



1. Fuel Injectors
2. Fuel Injector connectors

Fuel Injector Operation Test with B.U.D.S. (Dynamic)

1. Connect vehicle to B.U.D.S. software. Refer to *COMMUNICATION TOOLS AND B.U.D.S.*
2. Start engine.
3. In B.U.D.S., click the following:
   - **Read Data** button
   - **Monitoring** tab.
4. Using the B.U.D.S. software, shut down each engine cylinder one at a time by clicking on the button under the applicable cylinder.



MONITORING AND ECM TABS
1. Click on cylinder number to be tested

If the engine RPM drops when clicking on a cylinder, the injector and the ignition of this cylinder are functioning normally.

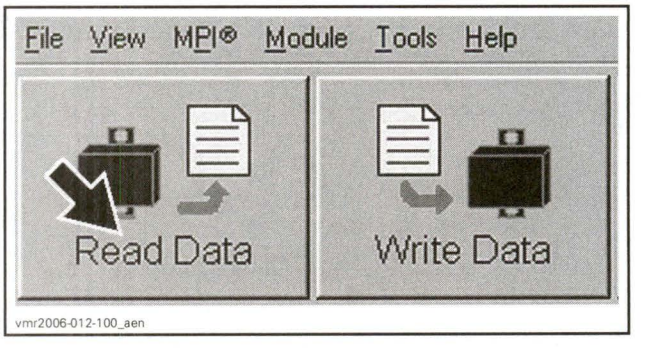
If the engine RPM does not drop when clicking on a cylinder, this cylinder is not functioning properly. Check the following:

- Fuel injector operation. Refer to *FUEL INJECTOR OPERATION TEST WITH B.U.D.S. (STATIC).*
- Spark plug and ignition coil. Refer to *IGNITION SYSTEM.*
- Engine condition.

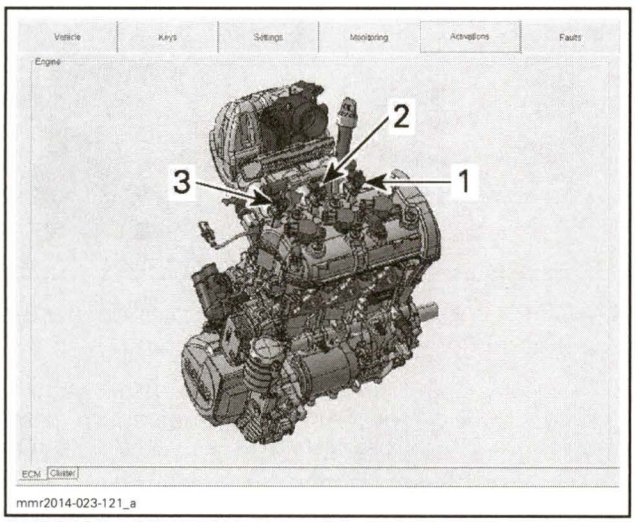
Fuel Injector Operation Test with B.U.D.S. (Static)

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

1. Connect vehicle to B.U.D.S.. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. In B.U.D.S., click the **Read Data** button to read the new ECM.



3. On the **Activation** page of B.U.D.S. software, energize the fuel injector to be tested.



INJECTOR ACTIVATION IN B.U.D.S.
1. *Click on injector 1 to activate*
2. *Click on injector 2 to activate*
3. *Click on injector 3 to activate*

You should hear the injector functioning.

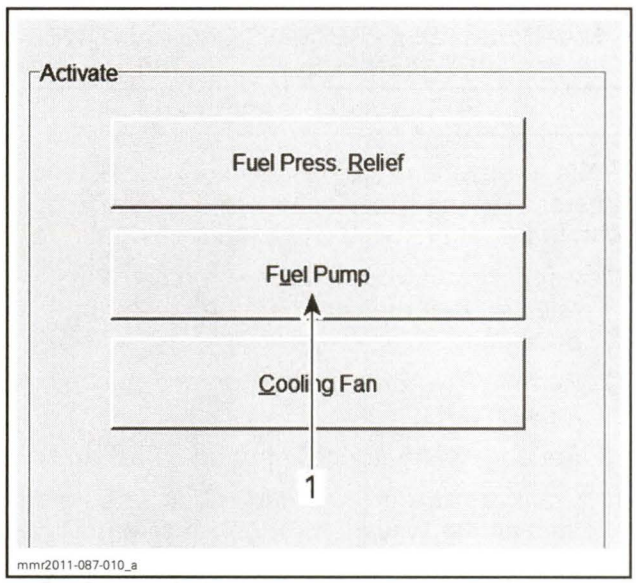
This will validate the injector mechanical and electrical operation.

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

Fuel Injector Balance Test

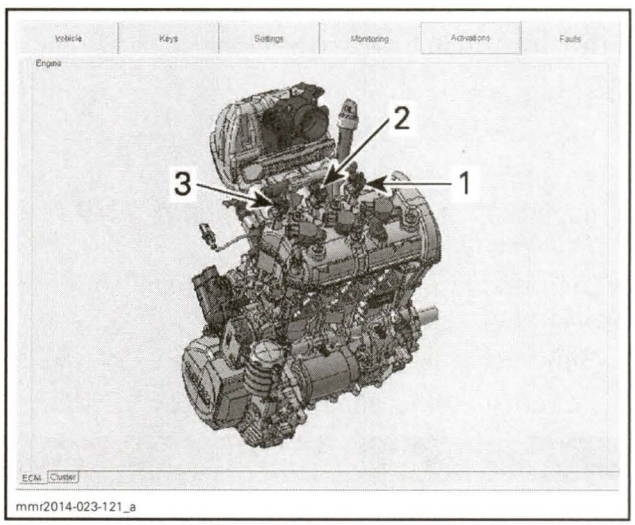
NOTICE **After fuel injector activation using B.U.D.S., always crank engine in drowned mode to ventilate the engine of fuel.**

1. Install a fuel pressure gauge as described in *FUEL PUMP PRESSURE TEST* of *FUEL TANK AND FUEL PUMP* subsection.
2. Connect vehicle to B.U.D.S. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
3. In B.U.D.S., select the following:
   - **Read Data** button
   - **Activation** page tab.
4. In B.U.D.S., click on the **Fuel Pump** button to activate fuel pump.



1. *Fuel Pump activation button*

5. Fuel pressure must be within specification. Refer to *FUEL TANK AND FUEL PUMP* subsection. Re-activate fuel pump as necessary.
6. In B.U.D.S., energize fuel injector **no. 1**.



INJECTOR ACTIVATION IN B.U.D.S.
1. *Click on injector 1 to activate*
2. *Click on injector 2 to activate*
3. *Click on injector 3 to activate*

7. Record the fuel pressure drop for injector **no. 1**.
8. In B.U.D.S., click on the **Fuel Pump** button to activate fuel pump.
9. Repeat the procedure for fuel injector **no. 2** and **no. 3** and record the pressure drop for each injector.
10. The maximum fuel pressure drop between injectors should not exceed the following specification:

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

If the pressure drop between fuel injectors is greater than the specification, replace the injector with the least pressure drop, then repeat the test.

11. Using the valve on the fuel pressure gauge, release the pressure in the system (if so equipped).
12. Remove fuel pressure gauge and reinstall removed parts.
13. Set engine emergency shut off switch to OFF.
14. Crank engine in drowned mode (accelerator held all the way in) to ventilate the engine of the fuel that was injected during the test.

⚠ WARNING

Always crank engine in drowned mode to ventilate all fuel that was injected during the test. Failure to do so may result in severe engine damage and injury.

Fuel Injector Leakage Test

Test Setup

1. Ensure there is enough fuel in fuel tank.
2. Ensure fuel pressure from fuel pump is within specification. Refer to *FUEL TANK AND FUEL PUMP* subsection.

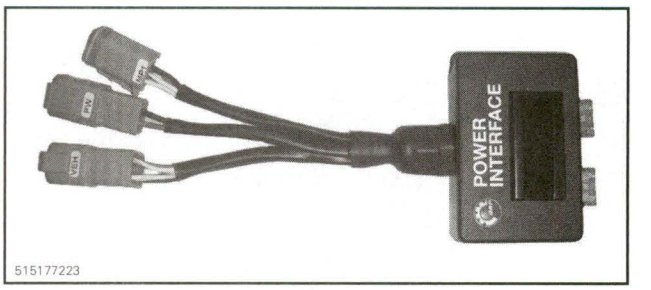
NOTE: Keep the pressure gauge installed for the leakage test.

3. Remove tether cord from engine cut-off switch.
4. Set engine emergency stop switch to STOP.

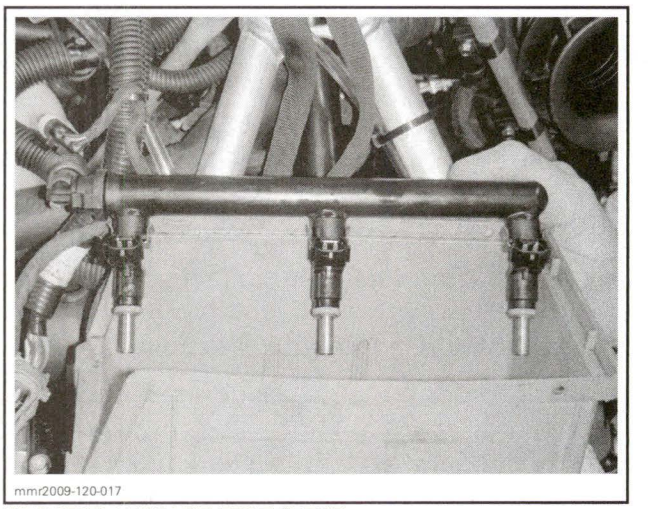
⚠ WARNING

The engine emergency stop switch is set to STOP to prevent any spark in the engine compartment should the engine be cranked. Fuel vapors may ignite in presence of a spark creating a fire hazard.

5. Disconnect the vehicle from B.U.D.S. by disconnecting the POWER INTERFACE (P/N 515 177 223) from the vehicle diagnostic connector.



6. Wait for vehicle electrical power to shut off; the multifunction gauge will turn off.
7. Remove fuel rail with injectors from engine however, **do not** disconnect fuel pump pressure hose from fuel rail. Refer to *FUEL INJECTORS* in this subsection.
8. Position fuel rail so that an appropriate container may be placed under the injectors to collect any fuel leakage.

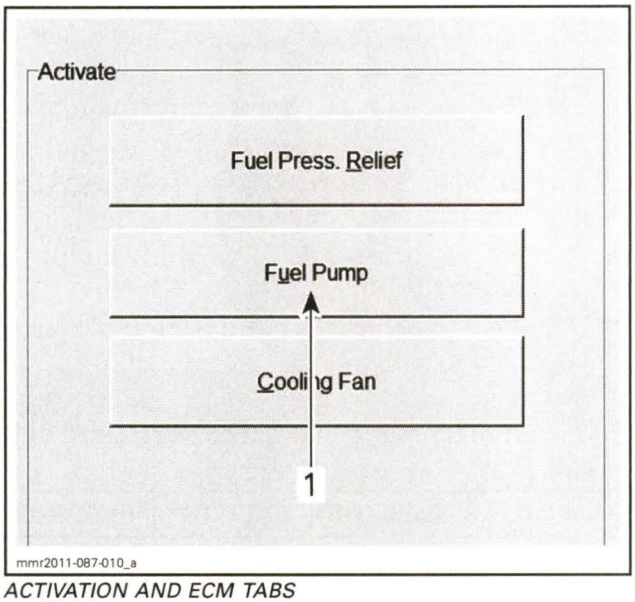


INJECTOR LEAKAGE TEST SETUP

9. Install tether cord on engine cut-off switch.
10. Connect vehicle to B.U.D.S. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection

Leakage Test

1. In B.U.D.S., select the following:
   - **Activation** page tab
   - **ECM** page.
2. Click on the **Fuel Pump** button to activate fuel pump for a few seconds.



ACTIVATION AND ECM TABS
1. Click here

3. Check for fuel leakage from the injector nozzles.
4. Monitor fuel pressure at fuel pressure gauge. If pressure drops below 372 kPa (54 PSI) during the test, re-activate fuel pump as necessary.

FUEL INJECTOR LEAKAGE	
TEST DURATION	SPECIFICATION
2 minutes	1 drop per minute maximum

If test is not within specification, replace the faulty fuel injector.

5. Properly reinstall fuel rail. Refer to *FUEL RAIL* in this subsection.
6. Reinstall remaining removed components.

⚠ WARNING

Wipe up any spilled fuel.

Fuel Injector Resistance Test

1. Ensure vehicle electrical power is off.
2. Disconnect connector "A" from the ECM, refer to *ECM CONNECTOR ACCESS* in this subsection.
3. Remove cover from the front fuse box and locate fuse F5 (HIC fuse).
4. Check resistance value between fuse box and ECM connector terminals as follows.

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

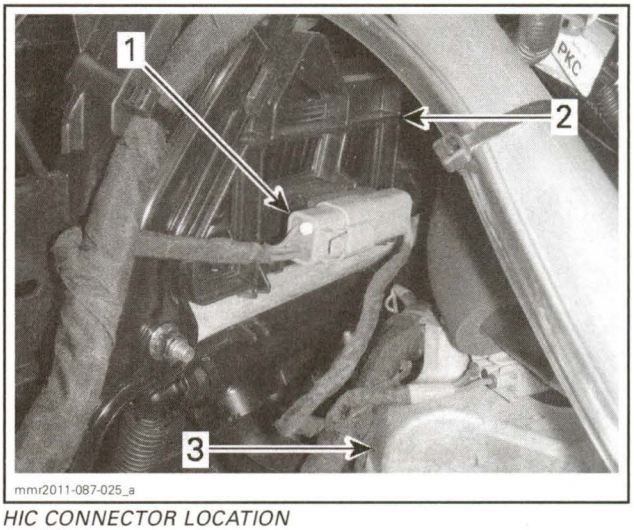
NOTE: It is not necessary to remove the fuse. Refer to *POWER DISTRIBUTION* subsection for fuse box information.

INJECTOR	ECM	FUSE BOX	READING
CYLINDER	PIN	TERMINAL	Ω @ 20°C (68°F)
1	3B	5B	12 ± 0.6 Ω
2	1K		
3	1J		

If resistance value obtained is correct, carry out a *FUEL INJECTOR INPUT VOLTAGE TEST.*

If resistance value obtained is incorrect, repeat test at 3-HIC connector located on front side of ECM support.

INJECTOR	ECM	HIC	READING
CYLINDER	PIN		Ω @ 20°C (68°F)
1	3B	2	12 ± 0.6 Ω
2	1K	3	
3	1J	4	



HIC CONNECTOR LOCATION
1. HIC connector
2. ECM support
3. Engine valve cover

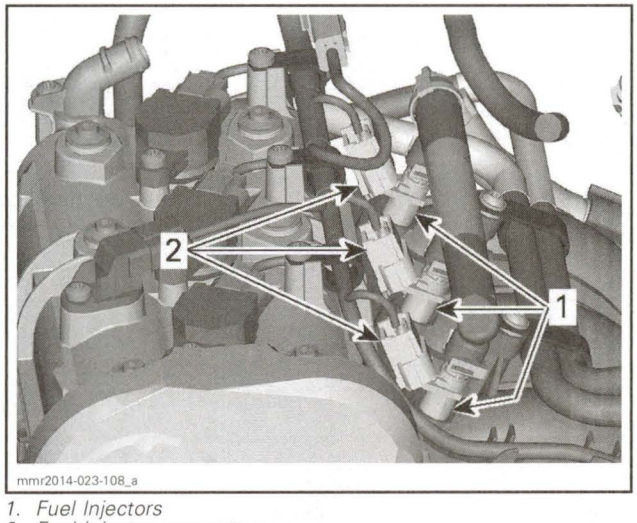
If resistance value obtained is incorrect, remove injector connector and check resistance value between injector pins as follows. Refer to *FUEL INJECTOR ACCESS* in this subsection.

INJECTOR		READING
PIN		Ω @ 20°C (68°F)
1	2	12 ± 0.6 Ω

If readings are out of specifications, replace injector.

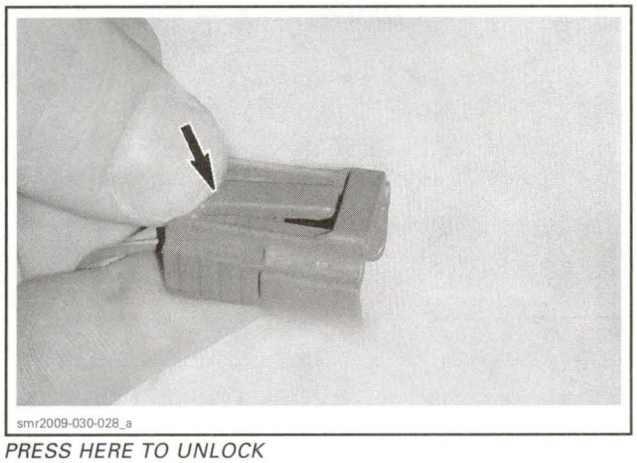
Fuel Injector Input Voltage Test

1. Ensure both ECM connectors are properly connected.
2. Ensure the HIC connector is properly connected.
3. Disconnect the fuel injector connector. Refer to *FUEL INJECTOR CONNECTOR ACCESS* in this subsection.



1. Fuel Injectors
2. Fuel Injector connectors

NOTE: Press against tab underneath connector as illustrated to unlock it.



PRESS HERE TO UNLOCK

4. Ensure fuse F5 (HIC fuse) is properly installed.
5. Set engine emergency stop switch to STOP to prevent engine starting.
6. Install tether cord on engine cut-off switch.

NOTE: With tether cord installed on engine cut-off switch, vehicle electrical power will stay on for approximately 20 seconds.

7. Momentarily press the START/RER button to wake up the ECM.

NOTE: It is not necessary to activate the injector since it is continuously powered when the ECM is awake.

8. Use a multimeter and set it to Vdc. Read voltage.

INJECTOR	INJECTOR	BATTERY	READING
CYLINDER	WIRE	TERMINAL	VOLTAGE
1	VIOLET/ BLUE	Battery Ground	Vdc
2			
3			

If injector input voltage is good, carry out the following:

- Circuit continuity test between injector and ECM, refer to *WIRING DIAGRAM* subsection.
- *FUEL INJECTOR SIGNAL TEST* further in this subsection.

If injector input voltage is not good, check the following:

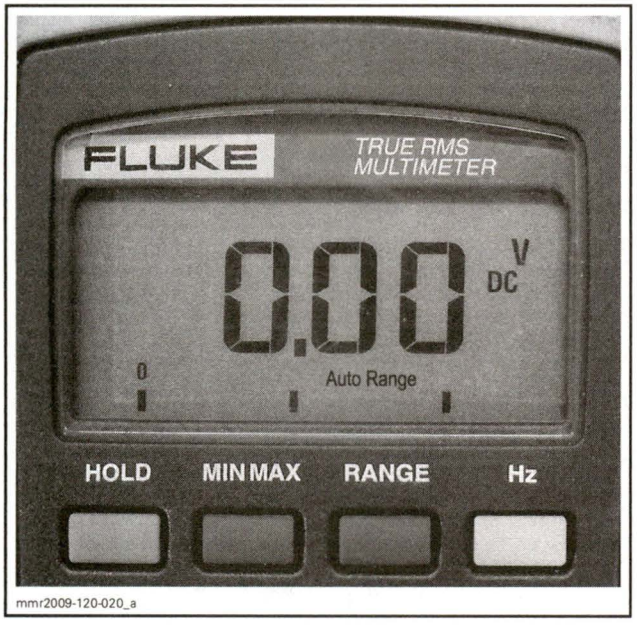
- Fuse F5
- Circuit continuity between fuse F5 and injector. Refer to *POWER DISTRIBUTION* and *WIRING DIAGRAM* subsections.

Fuel Injector Signal Test

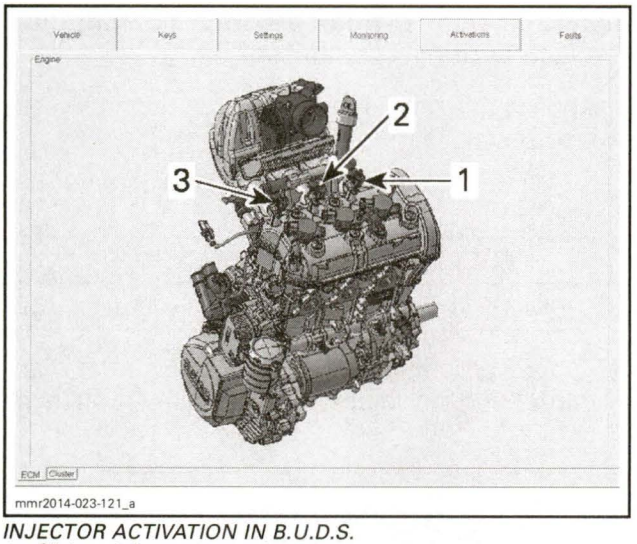
1. Connect vehicle to B.U.D.S. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. In B.U.D.S., select the **Activation** page tab.
3. Set multimeter to Vdc.

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

NOTE: Make sure multimeter is in the **Auto Range** mode.



4. Press the **Hz** button so that the display shows Hz.
5. Connect the multimeter probes as indicated in the following table and using the B.U.D.S. software, activate each injector and read the frequency on the multimeter.



INJECTOR ACTIVATION IN B.U.D.S.
1. *Click on injector 1 to activate*
2. *Click on injector 2 to activate*
3. *Click on injector 3 to activate*

NOTE: The multimeter counts the pulses per seconds (Hertz) of current the ECM sends to the injector.

INJECTOR CYLINDER	INJECTOR WIRE	BATTERY TERMINAL	READING FREQ.
1	BROWN/ RED	Battery Ground	9 Hz
2	BROWN/ BLUE		
3	BROWN/ GREY		

If reading is good, the control circuit is functional.

If there is no reading, check continuity of control circuit (ECM to injectors). Refer to *WIRING DIAGRAM* for circuit details.

Fuel Injector Access

1. Refer to appropriate subsection to remove:
   - Side panels
   - Console.
2. Disconnect both ECM connectors.

Fuel Injector Removal

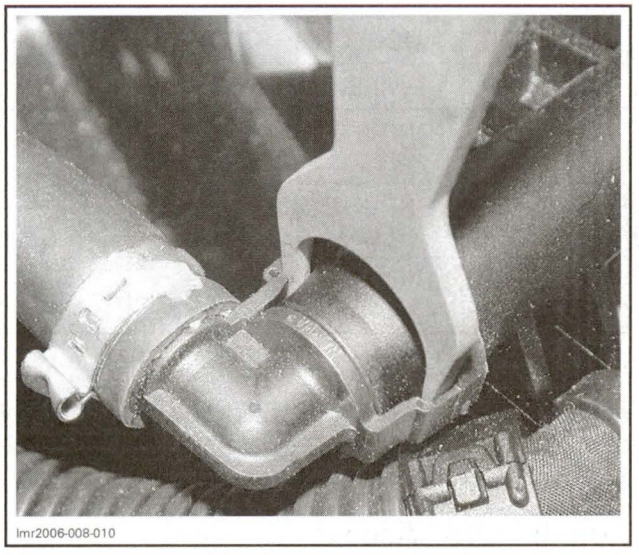
1. Disconnect fuel pump electrical connector, refer to *FUEL TANK AND FUEL PUMP* subsection.
2. Start engine and let run until it runs out of fuel.
3. Disconnect the battery, refer to *CHARGING SYSTEM* subsection.

⚠ WARNING

When removing or disconnecting the fuel injectors, always remove the tether cord from the engine cut-off switch and disconnect the battery.

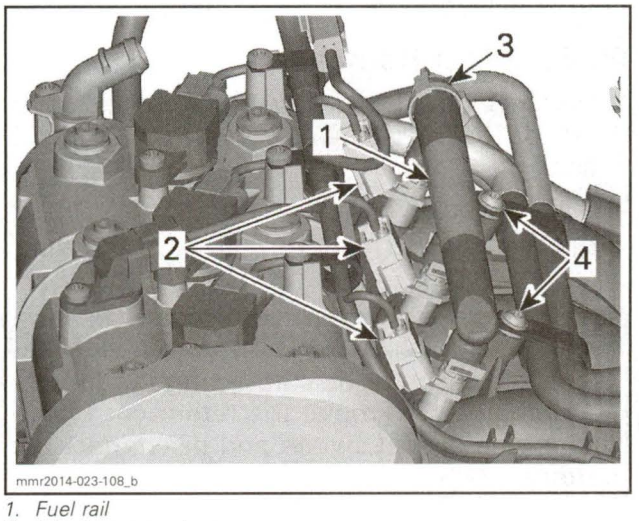
4. Remove parts required for access to the fuel rail and fuel injectors, refer to *FUEL INJECTOR ACCESS*.
5. Disconnect the fuel injector electrical connectors.
6. Disconnect the fuel pressure hose from the fuel rail.

REQUIRED TOOL	
FUEL HOSE DISCONNECT TOOL (P/N 529 036 037)	


lmr2006-008-010

NOTE: Wrap a rag around the hose end to catch any fuel leakage.

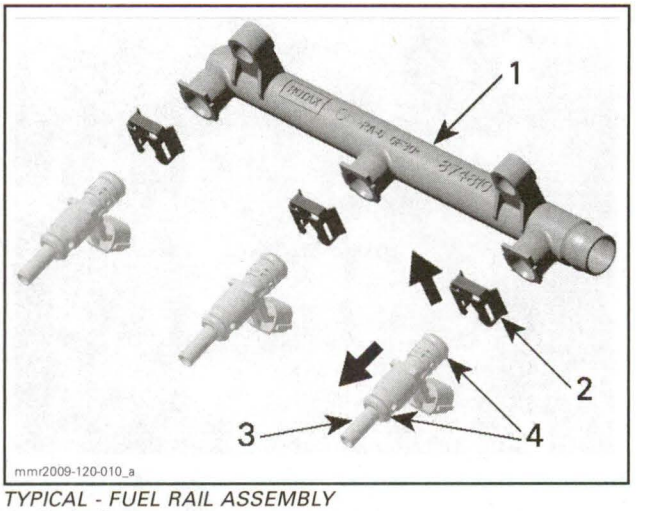
7. Remove the fuel rail mounting screws (2).



mmr2014-023-108_b

1. Fuel rail
2. Injector connectors
3. Fuel pressure hose disconnect
4. Fuel rail mounting screws

8. Pull on fuel rail to remove the fuel rail and injectors from the engine.
9. Remove the fuel injector retaining clips (2) from the fuel rail.



mmr2009-120-010_a

TYPICAL - FUEL RAIL ASSEMBLY
1. Fuel rail
2. Fuel injector retaining clip
3. Injector
4. Injector O-rings

10. Pull the fuel injector(s) out of the fuel rail.

Fuel Injector Installation

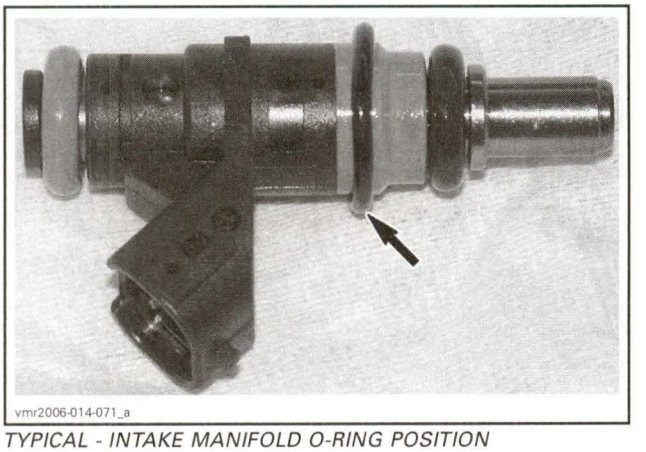
For the installation, reverse the removal procedure however, pay attention to the following details.

NOTICE If installing the removed injector(s), ensure injector O-rings are in good condition. Replace O-rings as required.

1. Apply a thin film of engine oil to O-rings to ease insertion in rail.
2. Install fuel injector with your hand. Do not use any tool.

FUEL INJECTOR INSTALLATION		
O-RINGS	New	Lubricate with engine oil

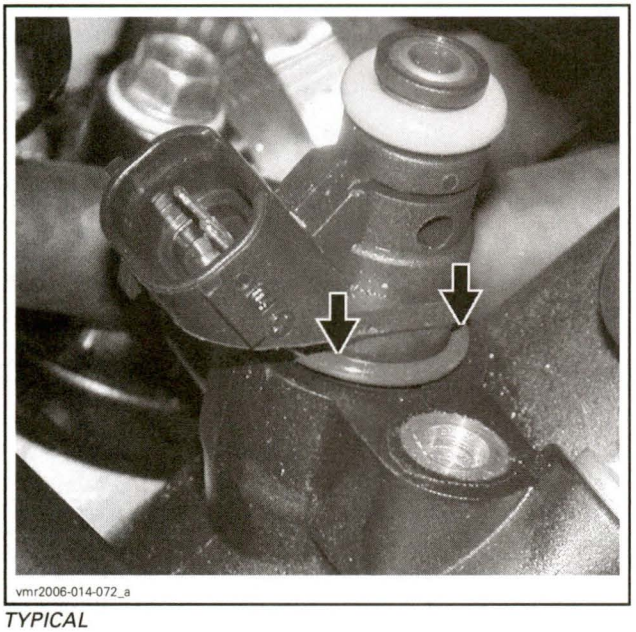
3. Ensure proper positioning of the intake manifold O-ring on injector as in following illustration.


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TYPICAL - INTAKE MANIFOLD O-RING POSITION

4. Carefully insert injector in air intake manifold paying attention to the manifold O-ring.

NOTICE **Gently push O-ring in evenly all around while inserting injector. O-ring must be completely inserted and not visible, before completing the insertion of the injector.**

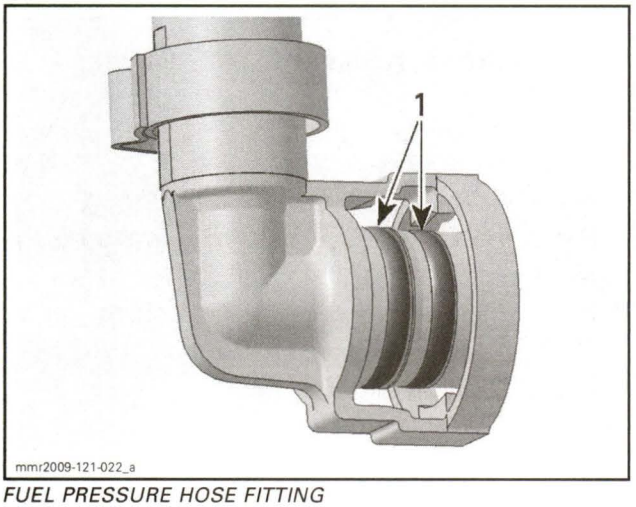


TYPICAL

5. Firmly push injector until it bottoms out.
6. Install fuel rail.

FUEL RAIL RETAINING SCREW	
Tightening torque	9 N•m ± 1 N•m (80 lbf•**in** ± 9 lbf•**in**)

7. Apply engine oil on O-rings of fuel pressure hose fitting.



FUEL PRESSURE HOSE FITTING
1. Apply oil on O-rings

8. Connect fuel pressure hose to fuel rail.

IMPORTANT: Push fuel hose fitting on fuel rail until you hear a "click". Try pulling on fuel hose fitting to ensure it is properly locked.

Pressurize the fuel system and check for fuel leaks. Refer to *FUEL SYSTEM PRESSURIZATION* in *FUEL TANK AND FUEL PUMP* subsection.

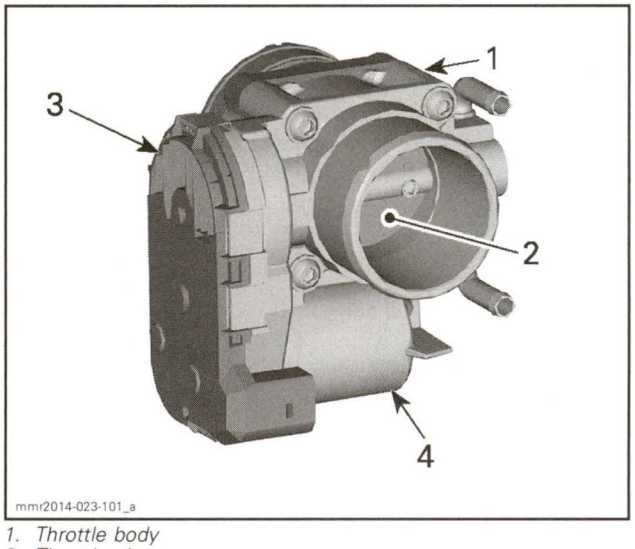
⚠ WARNING

Failure to pressurize the fuel system and checking for fuel leaks may result in severe injury or a life threatening situation should a leak occur.

9. Reinstall all remaining removed parts.

THROTTLE BODY (ETC (ELECTRONIC THROTTLE CONTROL))

Throttle Body (ETC) Description



1. Throttle body
2. Throttle plate
3. TPS (Throttle Position Sensor) (inside)
4. ETA (Electric Throttle Actuator) (electric motor inside)

Electric Throttle Actuator (ETA)

The electric throttle actuator (ETA) is a DC motor on the throttle body that regulates the throttle plate via a drive gear. It receives its control signal from the ECM. Pulse width modulation (PWM) is used to control the motor.

Throttle Plate Operating Positions

Two torsional springs are connected to the throttle plate. A main spring and another one in a plunger mechanism.

When there is no power to the throttle actuator (ETA), the plunger mechanism maintains the throttle plate at a rest position. This also serves as the limp home position.

When the throttle plate is opened by the ETA as commanded by the ECM, it acts against the main spring. If the ETA failed, the return spring would bring the throttle plate back to the limp home position.

ECM	ENGINE	THROTTLE BODY
OFF	Stopped	Throttle actuator: Off. Throttle plate: Rest position, maintained opened at approximately 8° (1). This is also the limp home position.
ON	Not started	Throttle actuator: On. Throttle plate: Moves from the rest position to approximately 15°. It then moves back to the rest position. This is the diagnostic mode where the rest position, actuator opening force to overcome the return springs and the motor return rate are monitored. If any of these parameters are out of range, a fault code is initiated.
ON	Not started. Very cold environment	Throttle actuator: On. Throttle plate: Execute check for ice on throttle plate. If throttle plate does not reach the fully closed position, throttle plate is moving until closed position can be reached.
ON	Started. Normal operation at idle	Throttle actuator: On. Throttle plate: Moves from the rest position to idle position (approximately 1-3°) according to ECM injection and ignition maps. Throttle plate is opened and closed as necessary to control the idle speed.
ON	Started. Normal operation at various RPM	Throttle actuator: On. Throttle plate: Opens and closes according to ECM torque management priorities.
(1) Degree values are given from the fully closed position.		

Throttle Body (ETC) Faults and Effects

NOTE: Among other things, a weak or broken spring and a sticky throttle plate are validated by the throttle body diagnostic mode.

FAULT	EFFECT
Partial failure of TAS sensor (one internal sensor only)	Limp home mode. Engine speed limited to idle. ECM will use the remaining TAS sensor. Fault code set and beeper activated to emit warning signals. Check engine light is turned ON. Driveability could be reset by releasing and reapplying the throttle.
Complete failure of TAS sensor (both internal sensors)	Limp home mode. Engine speed limited to 2500 RPM. Fault code set and beeper activated to emit warning signals. Check engine light is turned ON.
Any throttle body failure	Limp home mode. Engine speed limited to 2500 RPM. Engine speed can still be increased up to 3200 RPM using the throttle lever. Fault code set and beeper activated to emit warning signals. Check engine light is turned ON.

NOTE: Refer to *DIAGNOSTIC AND FAULT CODES* and *INTELLIGENT THROTTLE CONTROL* (iTC) subsections for more informations.

Throttle Body (ETC) Access

1. Refer to appropriate subsection to remove:
   - LH side panel
   - Drive belt guard
   - Air intake hose.

Throttle Body (ETC) Lubrication

No lubrication is required.

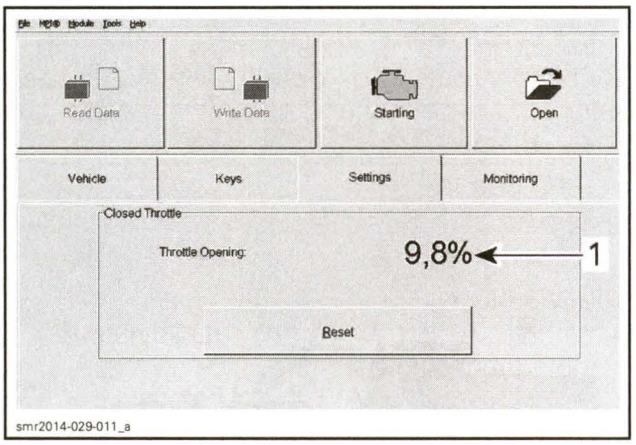
Electric Throttle Actuator (ETA) Test

Electric Throttle Actuator (ETA) Test with B.U.D.S.

1. Connect vehicle to the latest B.U.D.S. version. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. Press the START/RER button to wake up the ECM.
3. Install the tether cord on the engine cut-off switch.
4. In B.U.D.S., select:
   - **Read Data** button
   - **Setting** page tab.

NOTE: Use the **Setting** page to confirm ETA movement. The Monitoring page will not read the actual ETA movement.

5. Slowly depress the throttle lever from the idle to WOT. The ETA should go from almost 10% to 100%.



1. ETA position

If result is out of specification, carry out a *THROTTLE POSITION SENSOR INITIALIZATION*. Refer to *THROTTLE POSITION SENSOR (TPS)* in this subsection.

NOTE: The ETA is reset at the same time as the TPS.

After the reset, test ETA again.

If the result is still out of specification, check wire continuity between ECM and throttle body before assuming the ETA is at fault.

Throttle Body (ETC) Inspection

1. Remove parts required to access throttle body, refer to *THROTTLE BODY (ETC) ACCESS*.
2. Carry out the following:
   - Inspect throttle body for cleanliness.
   - Ensure throttle plate opens fully and smoothly.
   - Check for corroded or damaged wiring or damaged ETC connectors.

Throttle Body (ETC) Dynamic Tests

1. Remove the parts required to access the throttle body (ETC), refer to *THROTTLE BODY (ETC) REMOVAL*.
2. Remove the air inlet hose from the throttle body.
3. Observe the throttle plate with the engine stopped.

NOTE: The throttle plate should be in the rest position (slightly opened).

⚠ WARNING

Keep your fingers out of the throttle plate area while the ECM turns on. The throttle actuator will cycle. This could cause serious finger injuries as throttle plate quickly moves.

4. As you observe the throttle plate, have someone press the START/RER button to wake up the ECM.

NOTE: The throttle plate should cycle quickly from the rest position to a partially open position (approximately 15°), then back to the rest position.

5. Install the tether cord on the engine cut-off switch.

NOTE: The throttle plate should cycle again.

6. As you observe the throttle plate, have someone gradually and evenly pull in the throttle lever, then release it in the same way.

NOTE: The throttle plate should open then close according to throttle lever position however, the movement of the throttle plate may not be linear with the displacement of the throttle lever.

If any test failed, proceed with the *THROTTLE BODY (ETC) STATIC TESTS*.

Throttle Body (ETC) Static Tests

⚠ WARNING

First ensure the ECM is off. Do not move the throttle plate using your fingers. Otherwise, should the START/RER button be pressed, the ECM would turn on and quickly cycle the throttle plate which could cause serious finger injury.

1. Using a blunt tool, push in on the throttle plate and ensure it opens smoothly within the throttle body.



1. Push here to open

NOTE: The throttle plate must open fully and return freely to the rest position (slightly opened) when released.

2. Push throttle plate closed as indicated in following illustration. It must close completely and return freely to the rest position (slightly opened) when released.



1. Push here to close

If the throttle plate does not move smoothly or does not return freely to the rest position, the problem is mechanical. Check for dirt accumulation on throttle plate shaft. It may also be an actuator or gear problem. Replace throttle body as necessary.

If throttle plate operates normally, the problem is electrical. Check electric throttle actuator (ETA) wiring continuity, throttle position sensor (TPS) and throttle accelerator sensor (TAS).

⚠ WARNING

If the throttle plate does not return to its rest position properly after a proper cleaning, replace the throttle body.

Throttle Body (ETC) Cleaning

1. Remove throttle body from intake manifold without disconnecting heating hoses. Refer to *THROTTLE BODY (ETC) REMOVAL* further in this subsection.
2. Check throttle body cleanliness using a flashlight. Fully open throttle plate and verify:
- Throttle body bore
- Throttle plate edge.

Look for:
- Dirt
- Oily surfaces
- Carbon and dirt deposits on throttle plate and the surrounding bore.

3. Clean as necessary.
4. Use a throttle body cleaner such as GUNK INTAKE MEDIC or an equivalent.

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

⚠ CAUTION Use the product in a well ventilated area. Refer to product manufacturer's warnings.

5. To avoid getting dirt into engine, spray cleaner on a clean rag then rub rag against throttle plate and bore. A toothbrush may also be used.

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

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

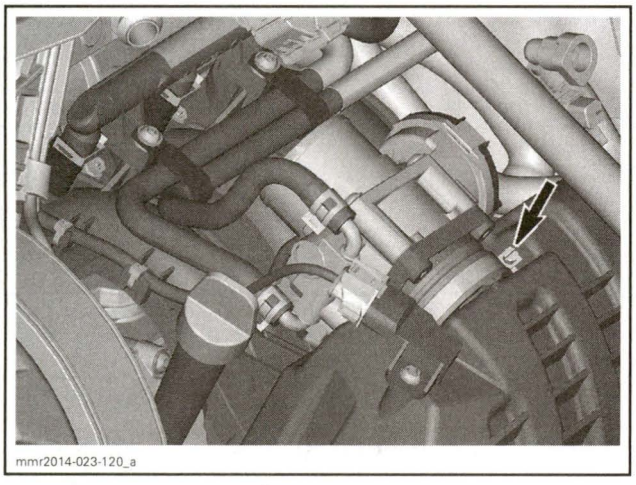
Throttle Body (ETC) Removal

⚠ WARNING

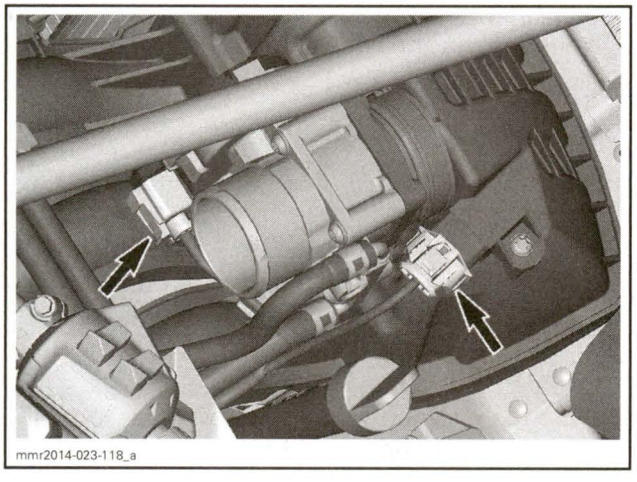
When electrically disconnecting or removing the throttle body from the intake manifold, always remove the tether cord from the engine cut-off switch and disconnect the battery.

1. Remove parts required to access throttle body, refer to *THROTTLE BODY (ETC) ACCESS*.

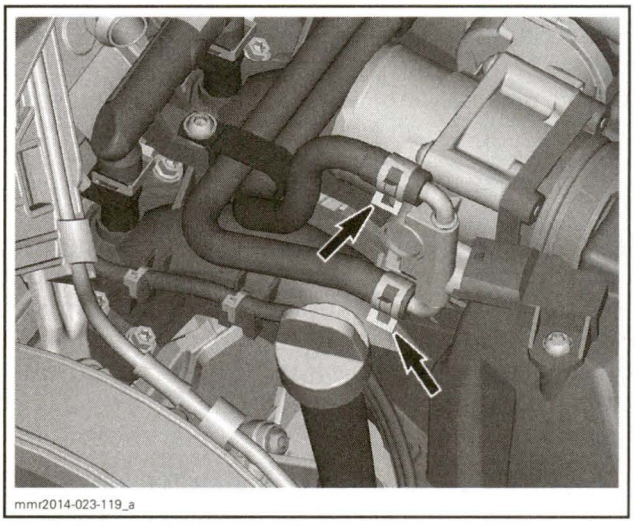
2. Loosen gear clamp and remove throttle body from intake manifold.


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3. Disconnect MAPTS and ETC connectors.


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4. Install a SMALL HOSE PINCHER (P/N 295 000 076) on each coolant hose connected to throttle body.
5. Disconnect coolant hoses from throttle body.


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Throttle Body (ETC) Installation

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

1. Install coolant hoses on throttle body; replace clamps as required.
2. Refill and bleed cooling system as required. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.
3. Perform the *THROTTLE POSITION SENSOR INITIALIZATION* reset procedure. Refer to *THROTTLE POSITION SENSOR (TPS)* in this subsection.
4. Install all remaining removed parts, refer to applicable subsections.
5. Start engine and ensure proper idle and throttle control.

THROTTLE POSITION SENSOR (TPS)

TPS Description

NOTE: The TPS is part of the throttle body (ETC).

The throttle position sensor (TPS) is a double potentiometer that sends signals to the ECM that are proportional to the throttle plate angle.

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

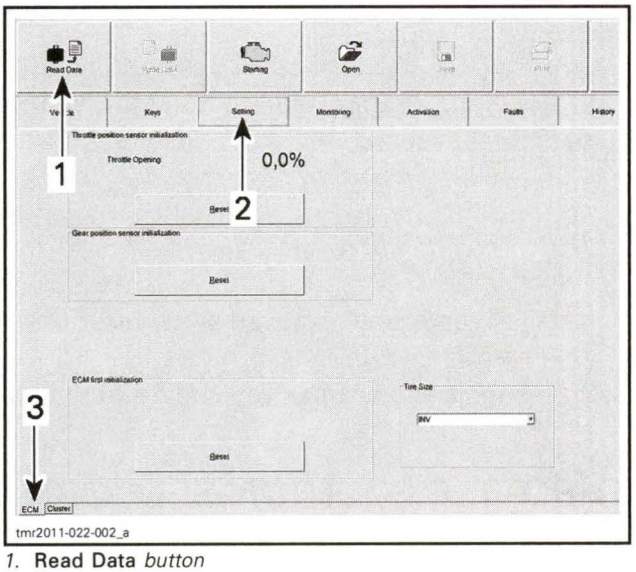
Throttle Position Sensor Initialization

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

This operation performs a reset of the TPS basic values in the ECM. This reset is very important as the TPS values are part of the basic parameters for all fuel mapping calculations and control of several settings such as for idle speed, LIMP HOME mode and maximum RPM of the engine.

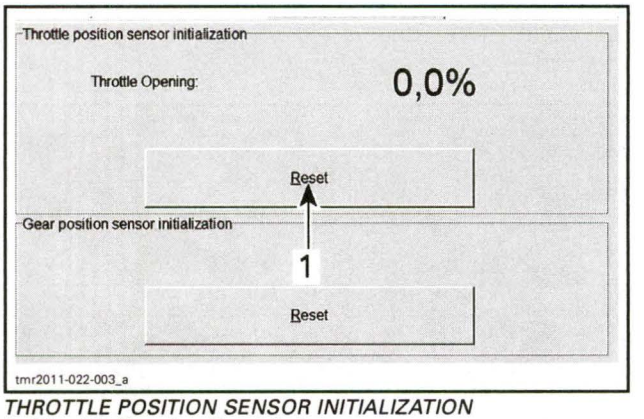
NOTICE **An improperly set TPS may lead to improper idle speed (too low or too high), poor engine performance, poor engine starting and engine stop on deceleration, fault codes and possible engine damage. Emission compliance may also be affected.**

1. Connect vehicle to the applicable B.U.D.S. software version, refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. In B.U.D.S., select the following:
   - **Read Data** button
   - **Setting** tab
   - **ECM** tab.



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

3. Ensure the throttle lever is fully released and at the idle position.
4. In the **Throttle position sensor initialization** field, click on the **Throttle Opening Reset** button.



THROTTLE POSITION SENSOR INITIALIZATION
1. **Throttle Opening Reset** *button*

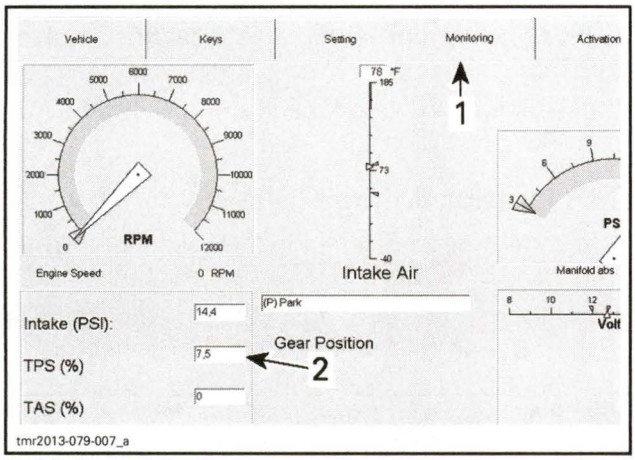
A message will be displayed if the operation is successful.

If an error occurred or the TPS is not within the allowed range while resetting, the ECM will generate a fault code and will not accept the setting.

5. If a fault message is displayed, follow the instructions in the message(s).
6. Check for fault codes.
7. If a fault code is generated,
   - Carry out the service actions.
   - Reset the fault.
   - Repeat the reset procedure.
8. Start engine and make sure it operates normally throughout its full engine RPM range.

TPS Wear Test

1. With the engine turned off, slowly press on the throttle lever and pay attention for smooth operation without physical stops.
2. Activate the electrical system to wake up the ECM.
3. Connect vehicle to the applicable B.U.D.S. software version. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
4. In B.U.D.S., select the following:
   - **Monitoring** tab
   - **ECM** tab.
5. Slowly and regularly move the throttle lever.
6. Observe the Throttle Opening indication movement in B.U.D.S.



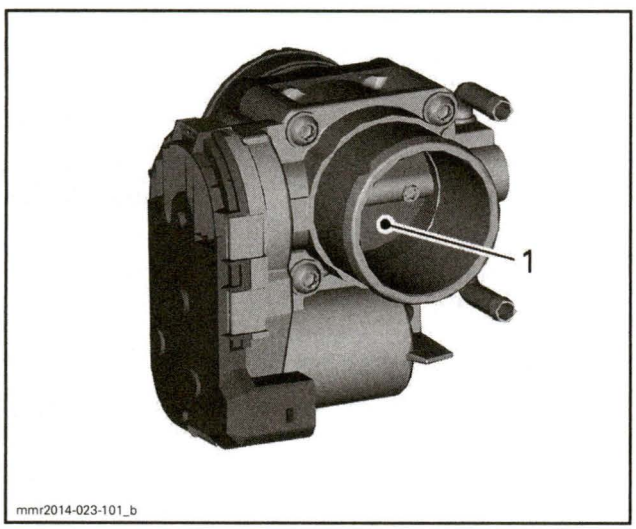
1. Monitoring tab
2. TPS indication

NOTE: The indication should move gradually and regularly as you move the throttle lever. If the TPS indication is erratic or suddenly drops off, it may indicate a worn TPS that needs to be replaced. An initial slight delay after the throttle lever is moved and before the indication starts to move is normal.

If the indication behavior is not as expected, proceed with the following steps.

7. Manually move the throttle plate in the throttle body using a blunt tool (without sharp tip).

⚠ CAUTION Do not move throttle plate with your fingers. Otherwise, if ECM should turn off, it would quickly close the throttle plate which could cause finger injury.



1. Push here

8. Check the indication movement again.

– If the indication moves as expected, check the throttle accelerator sensor (TAS). Refer to *THROTTLE ACCELERATOR SENSOR (TAS)* in this subsection.
– If the indication does not move as expected, perform the *TPS RESISTANCE TEST* in this subsection.

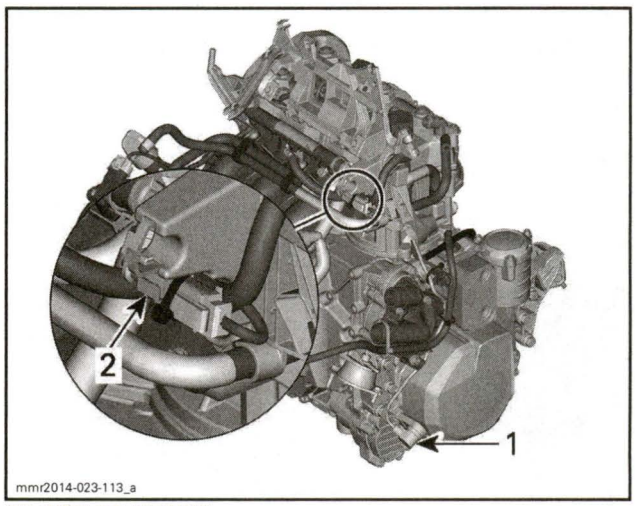
CRANKSHAFT POSITION SENSOR (CPS)

CPS TROUBLESHOOTING

When troubleshooting a CPS fault, take into account that a CPS fault can be triggered by bent or missing encoder wheel teeth.

Push START/RER button and crank engine. If engine does not start within 15 seconds check for fault codes using B.U.D.S.

CPS and CPS Connector Location



RH SIDE OF ENGINE
1. CPS location
2. CPS connector location

CPS Access

1. Refer to appropriate subsection to remove;
2. RH side panel
3. Muffler.

CPS Resistance Test at ECM connector

1. Remove parts required to access ECM-A connector, refer to *ECM CONNECTOR ACCESS* in this subsection.
2. Disconnect ECM-A connector from the ECM and connect it to the ECM adapter.

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

3. Set multimeter to Ω.

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

4. Measure the resistance of the sensor as per following table.

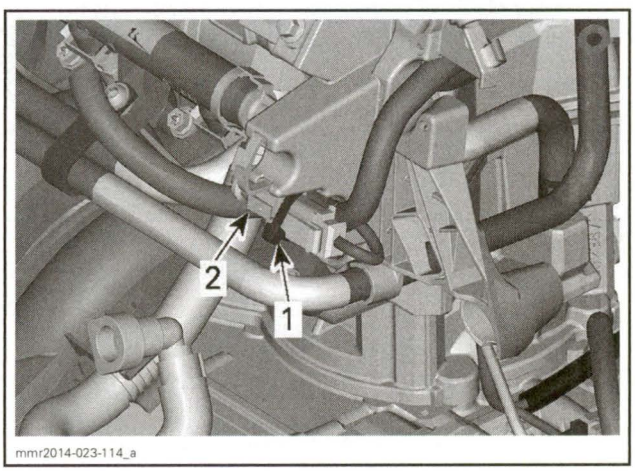
ECM ADAPTER		READING
PIN		Ω @ 20°C (68°F)
1H	2K	775 - 950 Ω

If resistance is as specified, test continuity of wiring between ECM-A and CPS connectors. Refer to *WIRING DIAGRAM* subsection.

If resistance value is not as specified, reconnect ECM-A connector to the ECM and refer to *CPS RESISTANCE TEST AT CPS CONNECTOR*.

CPS Resistance Test at CPS Connector

1. Cut locking tie securing CPS connector to ECM support and disconnect CPS connector.



1. Locking tie
2. CPS connector

2. Probe CPS connector terminals as per following table.

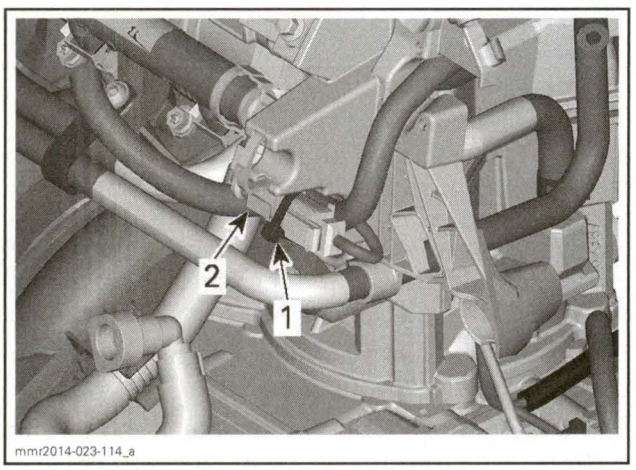
CPS		READING
PIN		Ω @ 20°C (68°F)
1	2	775 - 950 Ω

If resistance is not within specifications, replace the CPS.

If resistance tests good, carry out a *CPS OUTPUT VOLTAGE TEST*.

CPS Output Voltage Test

1. Remove fuse F5 (Ignition/Injection fuse), refer to *POWER DISTRIBUTION* subsection.
2. Cut locking tie securing CPS connector to ECM support and disconnect the CPS connector.



1. Locking tie
2. CPS connector

3. Probe CPS connector terminals while cranking engine as per following table.

CPS		READING
PIN		VOLTAGE
1	2	1 - 2 Vac min.

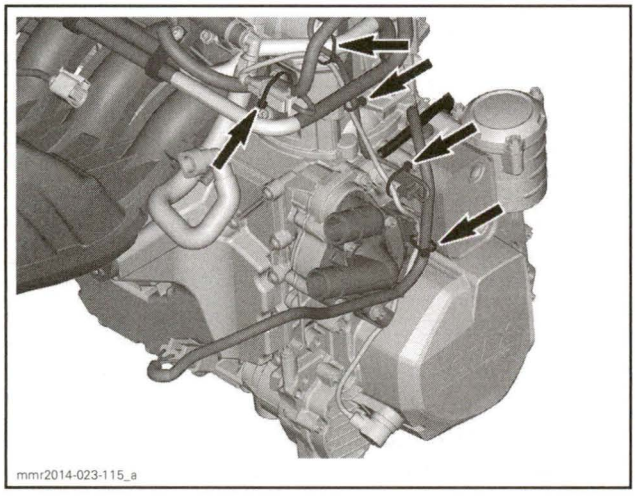
If voltage is out of specification, inspect wiring/connectors. Replace CPS if wiring is good.

If voltage is within specification, the problem may be related to the ECM.

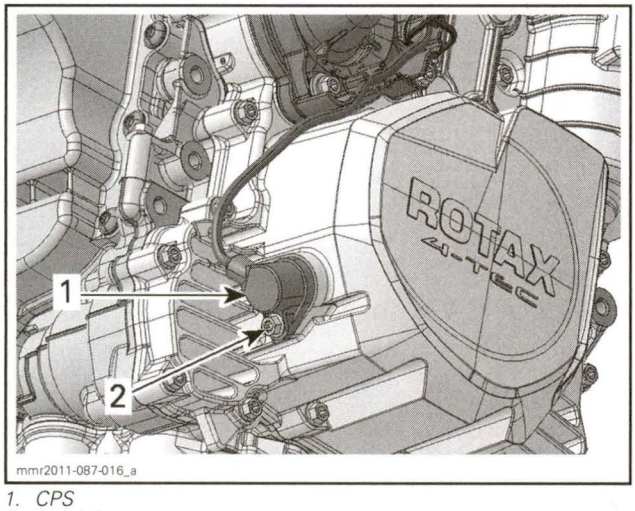
4. Reconnect CPS connector and install all removed parts.

CPS Replacement

1. Remove parts required to access the CPS, refer to *CPS ACCESS* in this subsection.
2. Take note of factory CPS wire harness routing for reinstallation.
3. Cut harness locking ties and disconnect CPS connector.


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



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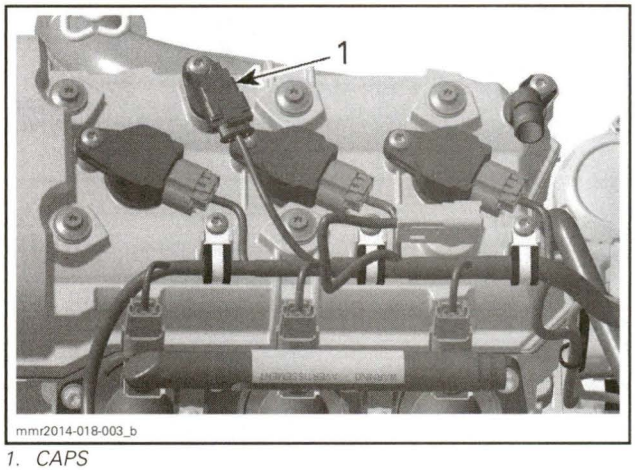
1. CPS
2. Retaining screw

5. Install new CPS.

CPS INSTALLATION	
O-RING	SERVICE PRODUCT
	APPLY ENGINE OIL ON O-RING
RETAINING SCREW	TORQUE
	9 N•m ± 1 N•m (80 lbf•**in** ± 9 lbf•**in**)

6. Route and secure CPS harness using harness clamp and locking ties as noted prior to removal.

CAMSHAFT POSITION SENSOR (CAPS)



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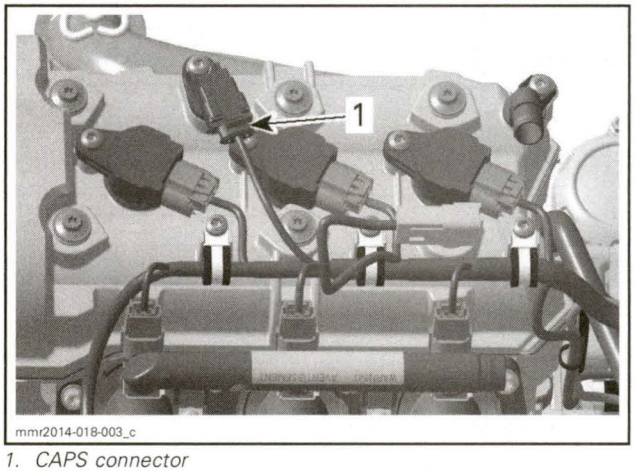
1. CAPS

CAPS Access

Refer to appropriate subsection and remove:
- Side Panels

CAPS Voltage Test (Harness Side)

1. Remove the parts required to access the CAPS, refer to *CAPS ACCESS.*
2. Disconnect CAPS connector.

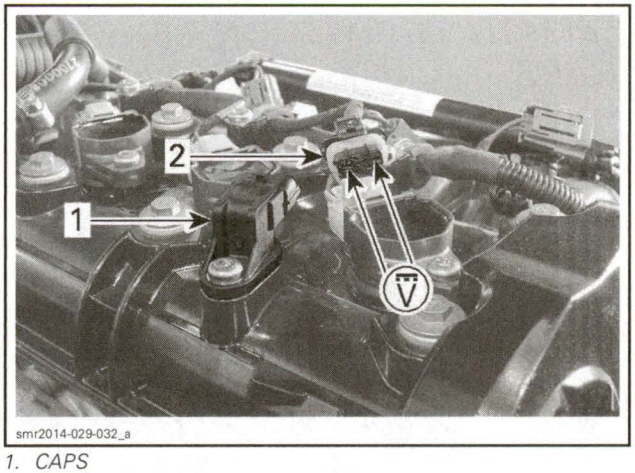


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1. CAPS connector

3. Press the START/RER button to wake up the ECM.
4. Install tether cord on engine cut-off switch.
5. Probe harness connector terminals as per following table.

CAPS		READING
PIN		VOLTAGE
3	1	Battery Voltage

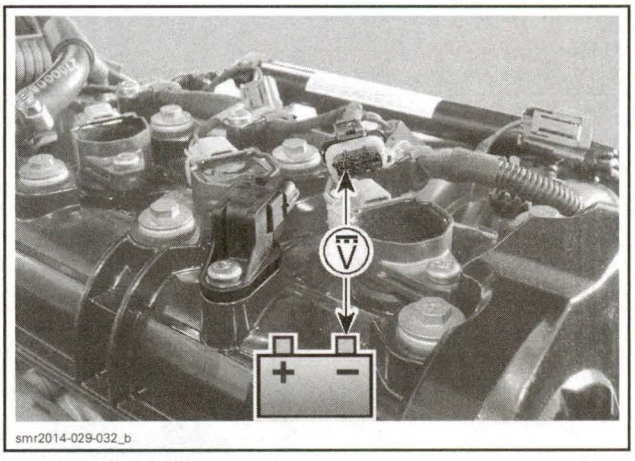


1. *CAPS*
2. *CAPS connector*

If battery voltage is read, proceed with *CAPS DYNAMIC TEST* further in this subsection.

If battery voltage is not read, probe circuit as per following table.

CAPS	BATTERY	READING
PIN	TERMINAL	VOLTAGE
3	Battery Ground	Battery Voltage



If voltage is read to battery ground, check continuity of ground circuit between CAPS pin 1 and ECM-A connector pin 4D. Repair or replace wiring and connectors.

If voltage is not read to battery ground, carry out a *CONTINUITY TEST OF CAPS POWER CIRCUIT.*

Continuity Test of CAPS Power Circuit

1. Remove cover from fuse box. Refer to *POWER DISTRIBUTION.*
2. Remove 10 amp HIC / GAUGE fuse (F6).
3. Use the FLUKE 115 MULTIMETER (P/N 529 035 868) and select Ω.
4. Read resistance of the CAPS circuit as per following table.

CAPS	FUSE BOX	READING
PIN	TERMINAL	Ω
3	7B	Close to 0 Ω

If continuity is good, wiring and connectors are functional.

If a high resistance or an open circuit is measured, refer to *WIRING DIAGRAM* and check the following:

- Continuity from CAPS connector pin 3 to engine connector pin 4
- Continuity from engine connector pin 4 to fuse box contact 6B

Pay attention to connector pin contact and junction JT-1 (VT/GY).

Repair or replace wiring and connectors as required.

5. Reinstall all removed parts.

CAPS Dynamic Test

1. Remove the parts required to access the CAPS, refer to *CAPS ACCESS.*
2. Remove CAPS sensor from engine.
3. Back-probe connector and read voltage as follows.

NOTE: To safely probe wire terminals through the back of the connector, use the following tool or an equivalent.

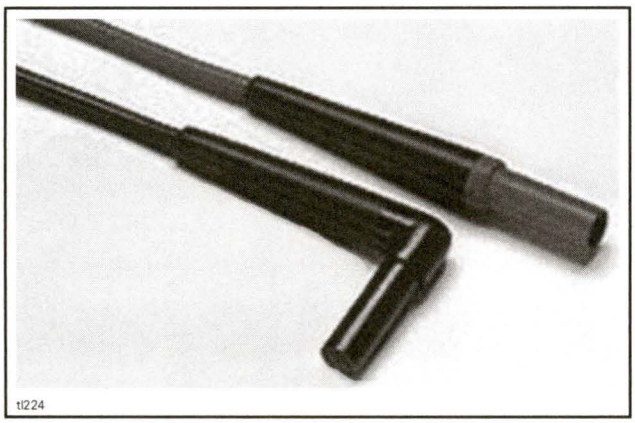
REQUIRED TOOL
FLUKE AUTOMOTIVE BACK PROBE PIN (P/N TP40)



FLUKE AUTOMOTIVE BACK PROBE PIN P/N TP40

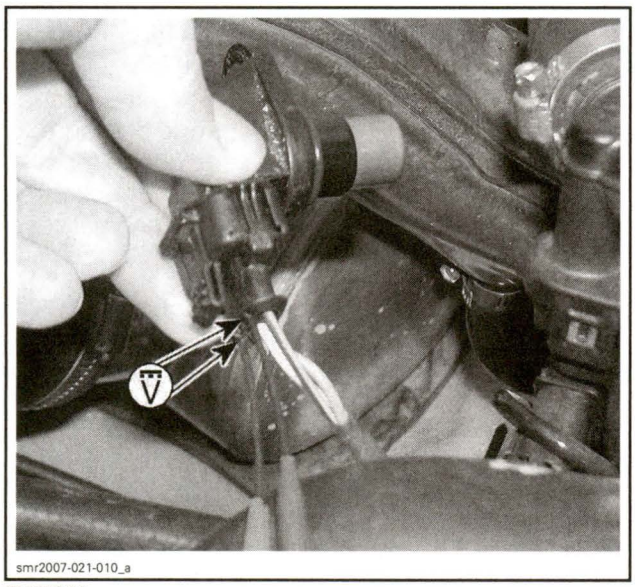
NOTICE Do not use sharp end probes. They could damage the connector seal.

Probes can be inserted at the end of the FLUKE SUREGRIP INSULATED TEST LEADS (P/N TL224).



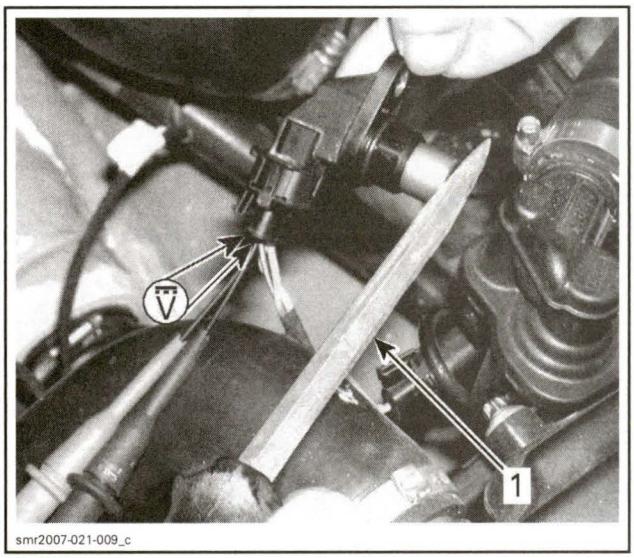
4. Briefly press the START/RER button to wake up the ECM.
5. Install the tether cord cap on the engine cut-off switch.
6. Read voltage as per following tables.

CAPS		CAPS CONDITION	READING
PIN		SENSOR END	VOLTAGE
3	2	Free	Close to 0 Vdc



TYPICAL

CAPS		CAPS CONDITION	READING
PIN		SENSOR END	VOLTAGE
3	2	Metallic Object on Sensor	Battery Voltage



TYPICAL
1. Metallic object

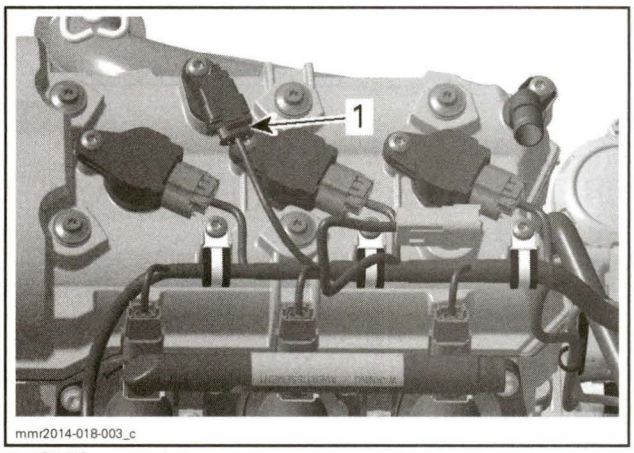
If voltage is as specified, repair or replace wiring and connectors between sensor and ECM.

If wiring is good, check ECM. Refer to *ENGINE CONTROL MODULE (ECM).*

If battery voltage is not measured as specified, try a new CAPS.

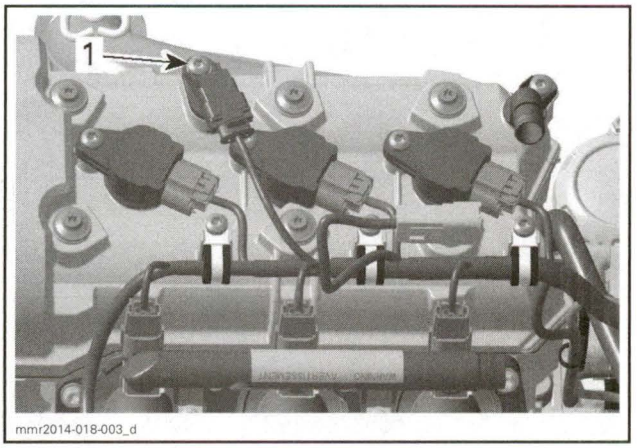
CAPS Replacement

1. Disconnect CAPS connector.



1. CAPS connector

2. Unscrew the CAPS retaining screw.



1. CAPS retaining screw

3. Pull CAPS from engine.
4. Install the new CAPS.

NOTICE Be sure to install new O-ring on the new CAPS.

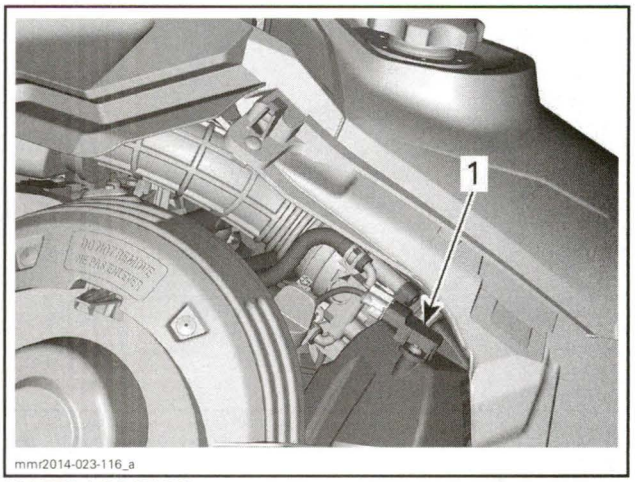
CAPS INSTALLATION	
O-RING	SERVICE PRODUCT
	APPLY ENGINE OIL ON O-RING
CONNECTOR	SERVICE PRODUCT
	DIELECTRIC GREASE (P/N 293 550 004)
RETAINING SCREW	TORQUE
	9 N•m ± 1 N•m (80 lbf•**in** ± 9 lbf•**in**)

MANIFOLD ABSOLUTE PRESSURE AND TEMPERATURE SENSOR (MAPTS)

NOTE: This sensor is a multifunction device. It measures manifold absolute pressure and intake temperature for air flow calculations.

MAPTS Access

To access the MAPTS, remove the LH side panel.



MAPTS LOCATION
1. Manifold air pressure and temperature sensor (MAPTS)

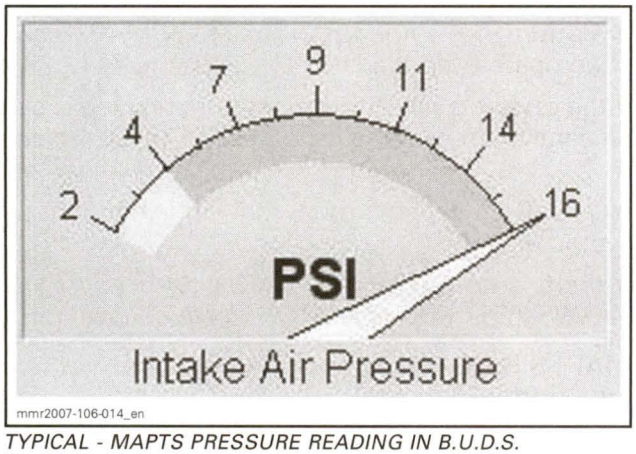
MAPTS Pressure Function

Before the engine is started, when power is applied to the system, the sensor measures the ambient air atmospheric pressure. The ambient pressure is, at that moment, stored in the ECM. Thereafter, once the engine is started, it measures the air pressure in the intake manifold at operating RPMs.

The sensor must be correctly installed on the intake manifold. Otherwise, the MAPTS could generate a fault code for an unexpected sensor range at idle when it reads the atmospheric pressure. If this is the case, remove sensor and check for oil or dirt on its end and if problem persists, check throttle plate condition/position and the wiring harness. Perform the following tests.

MAPTS Quick Test (Pressure Function)

1. Connect vehicle to B.U.D.S. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. In B.U.D.S., select the following:
   - **Read Data**
   - **Monitoring** page tab
   - **ECM** page.



TYPICAL - MAPTS PRESSURE READING IN B.U.D.S.

3. Look for and take note of the MAPTS pressure reading while the engine is stopped.

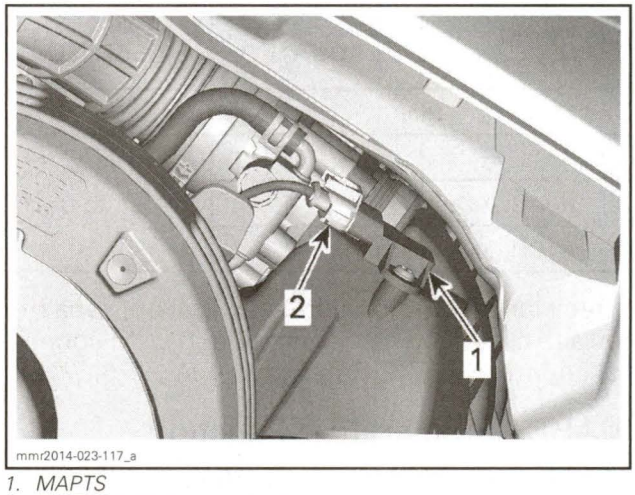
NOTE: The indicated intake air pressure in B.U.D.S. must be within 3.4 kPa (.5 PSI) of local atmospheric pressure when the engine is stopped.

MAPTS PRESSURE FUNCTION QUICK TEST			
RESULT	SERVICE ACTION		
NO READING	Circuit Continuity Test of MAPTS Pressure Function	MAPTS Input Voltage Test	Repair or replace wiring
VALUE IS OUT OF RANGE	Replace MAPTS		

4. Perform the same test with a new MAPTS and compare both readings.

MAPTS Input Voltage Test

1. Remove parts required to access the MAPTS, refer to *MAPTS ACCESS*.
2. Remove electrical connector from MAPTS.



1. *MAPTS*
2. *MAPTS connector to remove*

3. Briefly push START/RER button.
4. Set multimeter to Vdc, measure for MAPTS input voltage as per following table.

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

MAPTS		READING
PIN		VOLTAGE
1	3	5 Vdc

If voltage test is good, replace the MAPTS.

If voltage test is not good, carry out the *MAPTS CIRCUIT CONTINUITY TEST (PRESSURE FUNCTION)*.

MAPTS Circuit Continuity Test (Pressure Function)

1. Remove parts required to access ECM connectors, refer to *ECM CONNECTOR ACCESS* in this subsection.
2. Disconnect the ECM-A connector from the ECM and connect it to the ECM adapter tool.

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

3. Set multimeter to Ω and check continuity of the following circuits.

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

ECM ADAPTER	MAPTS	READING
PIN		Ω
4B	3	Close to 0 Ω
4G	4	
2H	1	

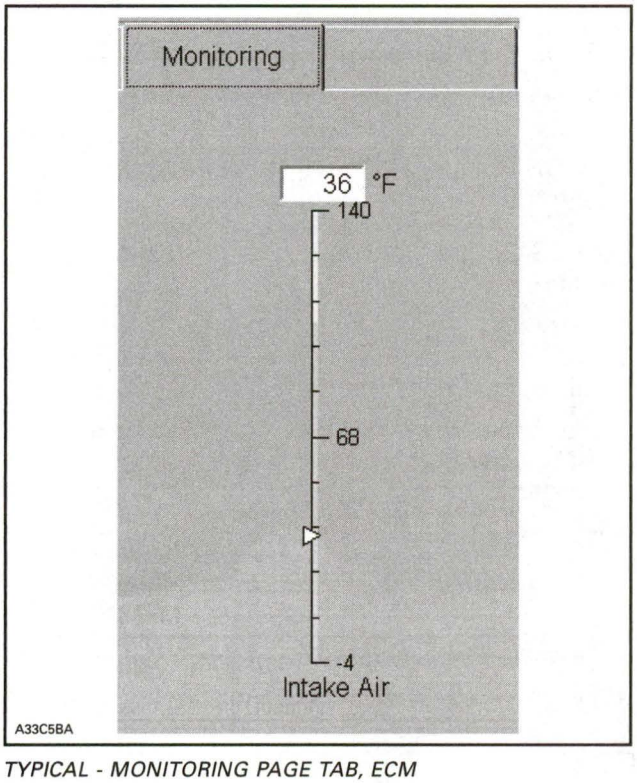
If resistance is not within specification, repair or replace the wiring harness between ECM connector and the MAPTS. Refer to *WIRING DIAGRAM.*

MAPTS Temperature Function

The MAPTS also monitors the temperature of the air in the intake manifold.

MAPTS Quick Test (Temperature Function)

1. Connect vehicle to B.U.D.S. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. In B.U.D.S., select the following:
   - **Read Data**
   - **Monitoring** page tab
   - **ECM** page.
3. Look for the **Intake Air** temperature reading while the engine is stopped.



TYPICAL - MONITORING PAGE TAB, ECM

NOTE: If the complete vehicle is at room temperature, B.U.D.S. should display the ambient air temperature at the intake manifold.

4. Perform the same test with a new MAPTS and compare both readings.

If the engine's MAPTS temperature reading is significantly different than the new MAPTS, replace it.

NOTE: Both sensors must feel same ambient air temperature.

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

MAPTS Resistance Test (Temperature Function)

1. Disconnect the MAPTS connector.
2. Test MAPTS resistance at the sensor as per following tables.

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

MAPTS		READING
PIN		Ω
1	2	Refer to MAPTS TEMPERATURE SENSOR TABLE

MAPTS TEMPERATURE SENSOR TABLE		
TEMPERATURE		Ω
°C	°F	MAPTS
- 40	- 40	40528 to 56935
- 10	- 14	8103 to 10919
20	68	2193 to 2863
80	176	294 to 368
120	248	98 to 122

If resistance is not within specification, replace the MAPTS.

If resistance tests good, **reconnect** the MAPTS and proceed with the following steps.

3. Disconnect the ECM-A connector.
4. Install ECM-A connector on the ECM adapter tool.

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

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

ECM ADAPTER		READING
PIN		Ω
2H	3H	Refer to MAPTS TEMPERATURE SENSOR TABLE

MAPTS TEMPERATURE SENSOR TEST RESULTS			
RESULT	SERVICE ACTION		
NO READING	Circuit Continuity Test of MAPTS Temperature Function	MAPTS Input Voltage Test	Repair or replace wiring
INCORRECT RESISTANCE VALUE	Check condition of connector pins, replace MAPTS		
CORRECT RESISTANCE VALUE	Try a new ECM		

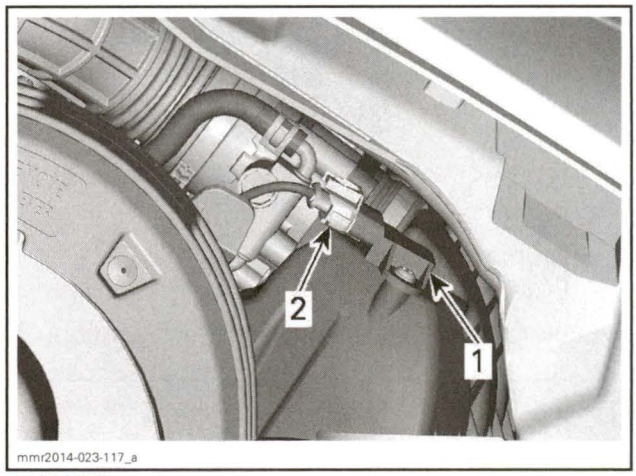
MAPTS Circuit Continuity Test (Temperature Function)

ECM ADAPTER	MAPTS	READING
PIN		Ω
2H	1	Close to 0 Ω
3H	2	

Repair or replace wiring as required.

MAPTS Replacement

1. Disconnect MAPTS connector and remove the MAPTS from the intake manifold.



1. MAPTS
2. MAPTS connector

2. Install new MAPTS as per following table.

MAPTS RETAINING SCREW	
Tightening torque	4.5 N•m ± 0.5 N•m (40 lbf•**in** ± 4 lbf•**in**)

COOLANT TEMPERATURE SENSOR (CTS)

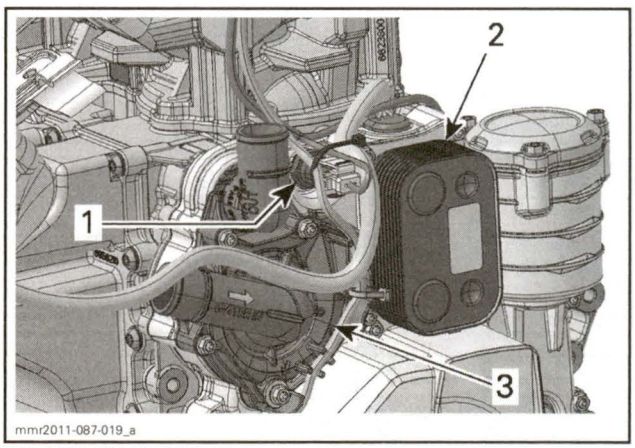
Overheat Warning

The CTS will cause the engine overheat warning to come on when the coolant temperature is above 110°C (230°F).

CTS Access

The CTS is located on the RH side of the engine, between the water pump and oil cooler.

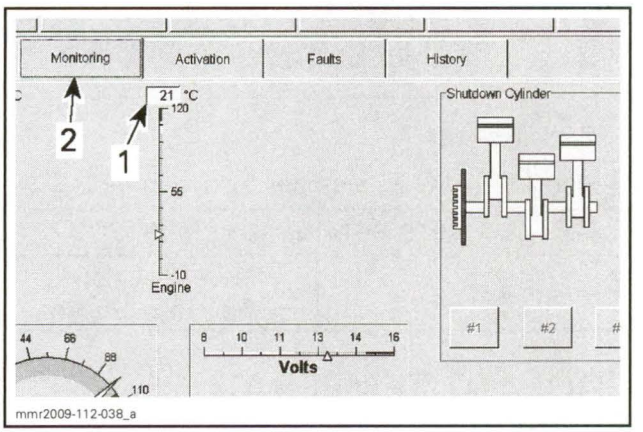
To access the CTS, remove the RH side panel.



RH SIDE OF THE ENGINE
1. Coolant temperature sensor (CTS)
2. Oil cooler
3. Water pump

CTS Quick Test

1. Connect the vehicle B.U.D.S. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. In B.U.D.S., select the following:
   - **Read Data** button
   - **Monitoring** page tab
   - **ECM** page.
3. Look for the engine temperature indication.



1. Engine temperature
2. Monitoring tab

The engine temperature gauge in B.U.D.S. should provide an indication of the actual engine coolant temperature. Otherwise, perform the *CTS RESISTANCE TEST.*

CTS Resistance Test

1. Disconnect the CTS connector.
2. Test the resistance of the sensor as per following tables.

CTS		READING
PIN		Refer to CTS TEMPERATURE SENSOR TABLE
1	2	

CTS TEMPERATURE SENSOR TABLE			
TEMPERATURE		Ω	
°C	°F	LOW	HIGH
- 40	- 40	38400	52600
- 10	14	8200	10,600
0	32	5900	6900
20	68	2200	2800
80	176	295	350
120	248	105	120

NOTE: To test sensor at various temperatures, remove sensor and use a heat gun, ice and a thermometer.

If resistance is out of specification, replace the CTS.

If resistance test is good, proceed with the following steps.

3. Reconnect the CTS connector.
4. Remove parts required to access ECM connectors, refer to *ECM CONNECTOR ACCESS* in this subsection.
5. Disconnect the ECM-A connector.
6. Install ECM-A connector on adapter tool.

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

7. Recheck resistance from the ECM connector as per following table.

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

ECM ADAPTER		READING
PIN		Refer to CTS TEMPERATURE SENSOR TABLE
1A	2J	

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

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

CTS Replacement

1. Drain coolant, refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.
2. Cut locking ties of wiring harnesses and move wiring aside for access.

NOTE: Take note of wiring and locking tie position before removal.

3. Disconnect CTS connector.
4. Remove CTS from engine.
5. Install new CTS and torque as specified.

CTS	
Tightening torque	16 N•m ± 2 N•m (142 lbf•**in** ± 18 lbf•**in**)

6. Reinstall remaining removed parts.

NOTE: Ensure to reinstall wiring harness as noted prior to removal.

7. Refill and bleed the cooling system, refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

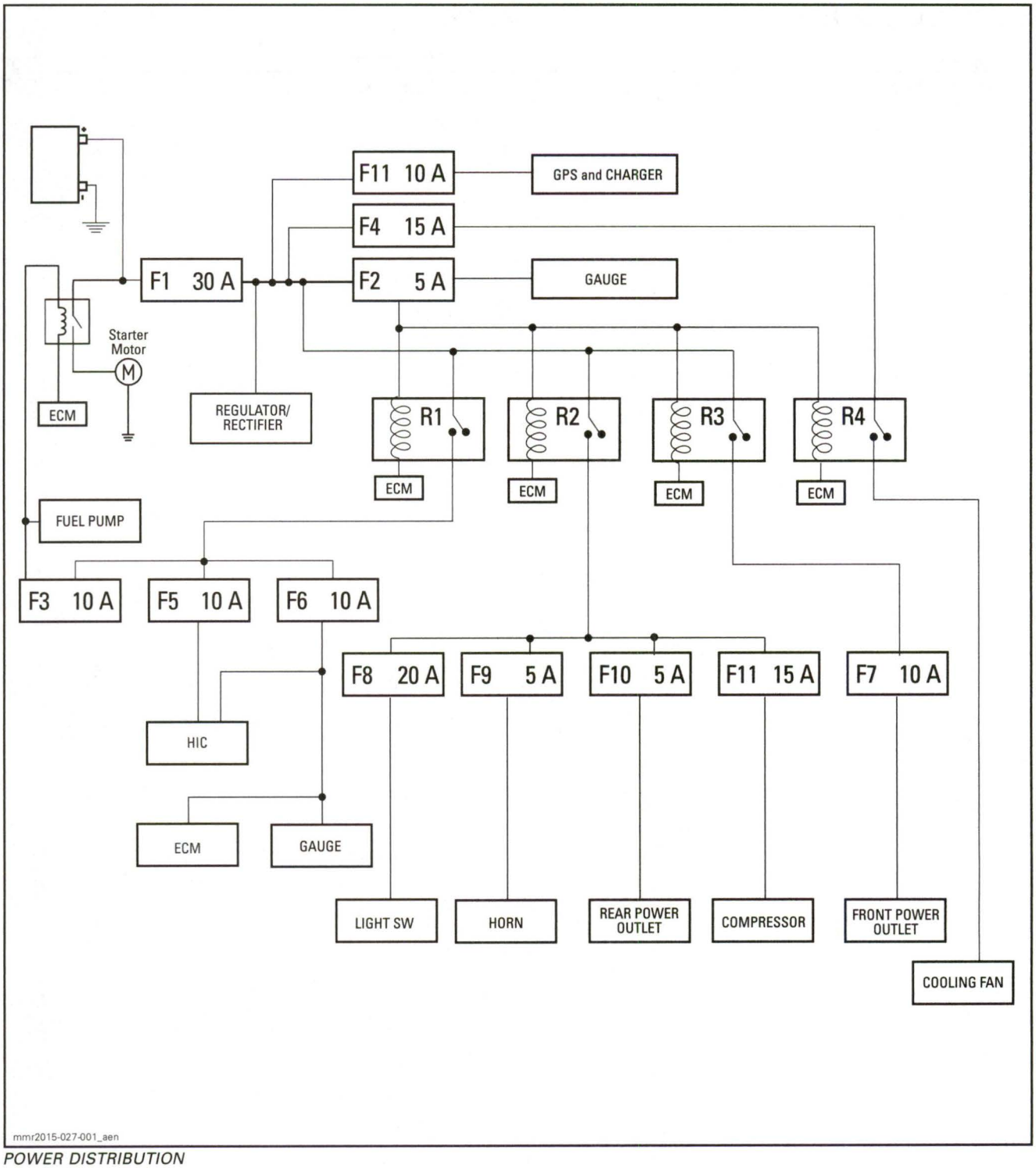
POWER DISTRIBUTION AND GROUNDS (600 ACE)

SERVICE TOOLS

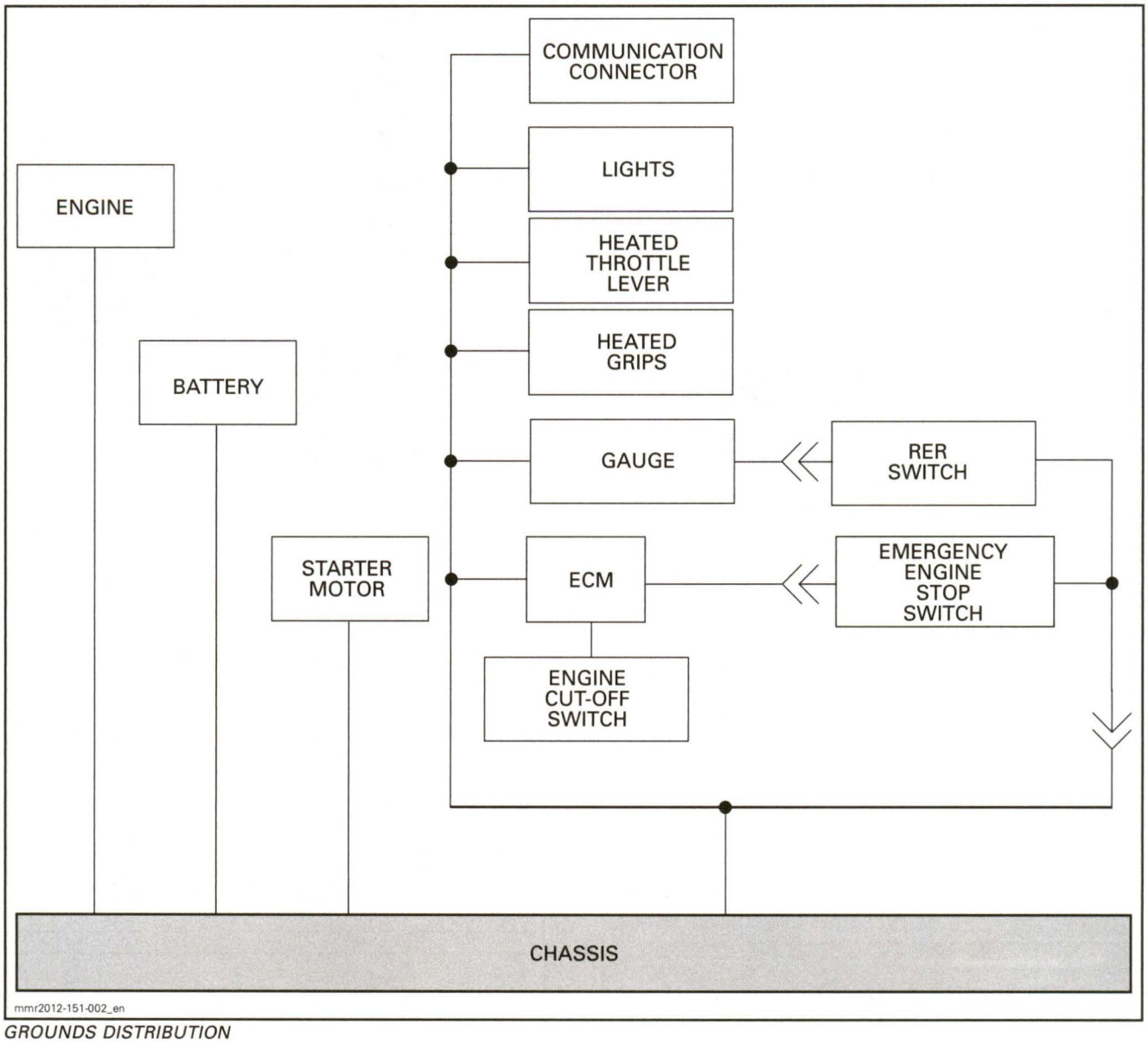
Description	Part Number	Page
FLUKE 115 MULTIMETER	529 035 868	370

GENERAL

OVERVIEW



POWER DISTRIBUTION



GROUNDS DISTRIBUTION

All the electrical system is powered by DC current supplied by a 12 V battery. The battery charge is maintained by the charging system.

Electrical system is protected by fuses located in one fuse box.

The system uses 3 relays that control different electrical components.

Automatic Power Cut-Off

The ECM features an automatic power cut-off that will completely turn off the ECM (after engine was running) and thus cutting all power to components. All the vehicle electrical loads will be turned off (except the clock in the multifunction gauge). This feature prevents the battery from discharging if the tether cord cap is left on engine cut-off switch when the engine is not running.

The cut-off time is as follows.

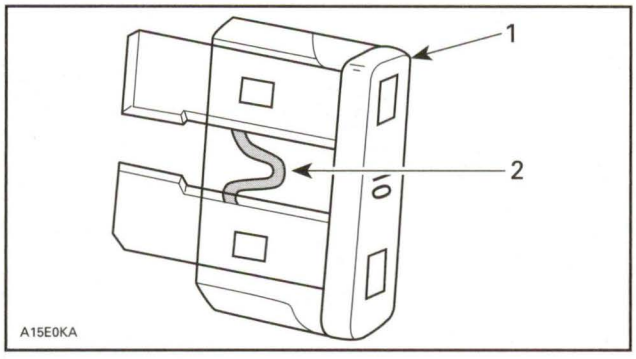
ACTION	POWER CUT-OFF TIME
Removing tether cord cap	Approximately 15 seconds
Setting emergency engine stop switch to STOP (tether cord cap connected)	Approximately 20 seconds

NOTE: The ECM will remain off until the START/RER button is pressed.

FUSES

Fuse Inspection

Check if filament is melted. Replace as necessary.



1. Fuse
2. Check if melted

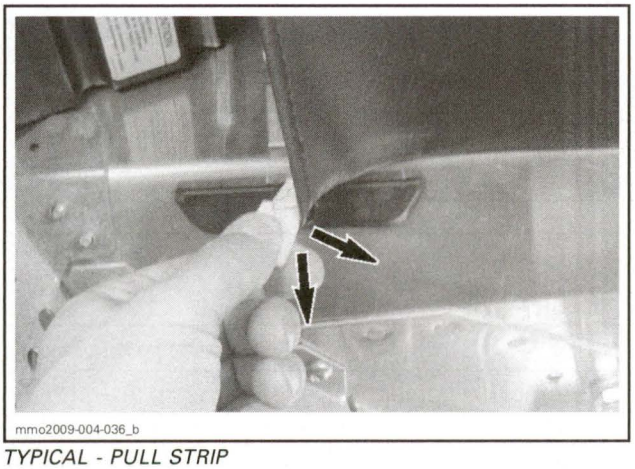
⚠ WARNING

Do not use a higher rated fuse as this can cause severe damage to electric components and/or a fire. If fuse has burnt out, the cause of the malfunction should be determined and corrected before restarting.

Fuse Box Location

The fuse box is located behind the front seat upholstery at the LH front lower portion of seat.

To access the fuse box, carefully pull seat upholstery out of the aluminum extrusion by pulling the plastic strip downwards and sideways at the same time.



TYPICAL - PULL STRIP

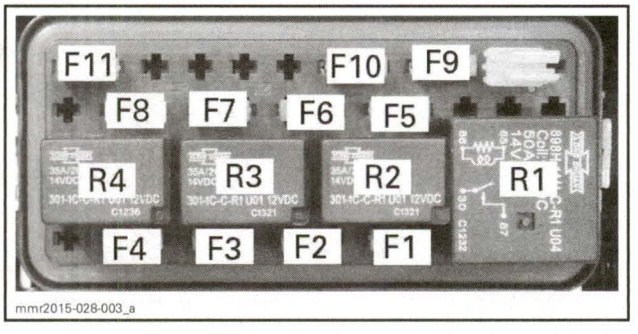


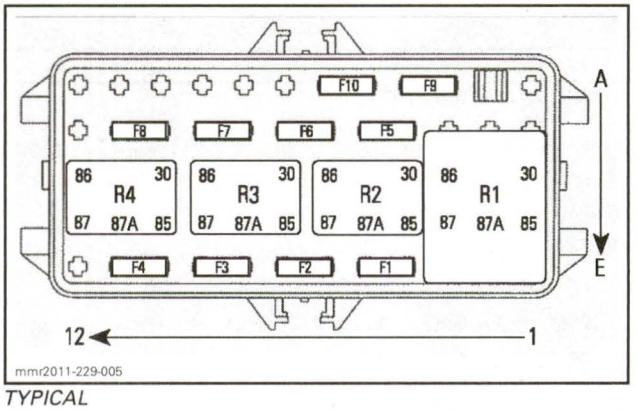
1. Fuse box

Refer to the decal inside the fuse box cover for fuse identification.

Close upholstery by pushing the strip back in the aluminum extrusion when finished.

FUSE BOX





TYPICAL

F1	Main fuse	30 A
F2	Relay / start button	5 A
F3	Starter solenoid	10 A
F4	Fan	15 A
F5	HIC	10 A

F6	HIC / gauge	10 A
F7	Front power outlet and heaters	10 A
F8	Lighting	20 A
F9	Horn	5 A
F10	Rear power outlet	5 A
F11	GPS and charger	15 A

RELAY STATE (ON)	RELAY STATE (OFF)
R1 - Run Relay	
When START/RER button is pressed When engine is running	30 seconds after engine off
R2 - Load Relay	
When engine reaches 800 RPM	Approximately 30 seconds after ignition key is turned OFF OR If engine drops below 800 RPM
R3 - Load Relay	
When engine reaches 2000 RPM	If battery voltage is lower than 12 V for 10 seconds
R4 - Cooling Fan	
See *COOLING SYSTEM*	

The following actions will be taken by the ECM to preserve electrical power for the most important functions.

CONDITION	ECM CORRECTIVE ACTION
If battery voltage is lower than 12 V for 10 seconds	Relay 3 is disabled.
If battery voltage is lower than 11.5 V	Idle speed is increased.
If battery voltage is lower than 11 V	Low battery pilot lamp turns on.

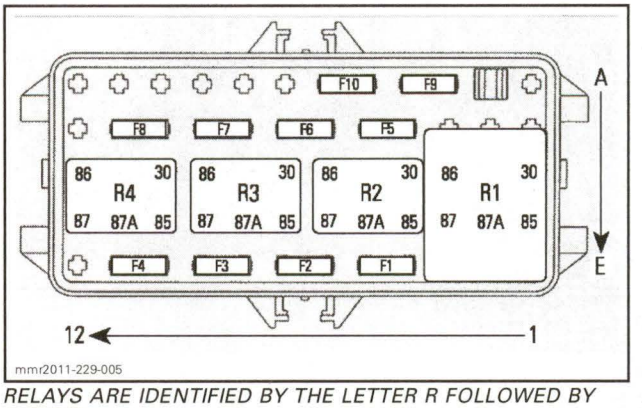
Fuse box contacts are identified as seen from the top of the fuse box with letters to identify rows and numbers to identify columns. The combined letter and number identify the coordinate of a contact that is used in the wiring diagram and procedures.

NOTICE **Do not apply any lubricant or sealant product to the terminal contacts in fuse box.**

RELAYS

Relay Location

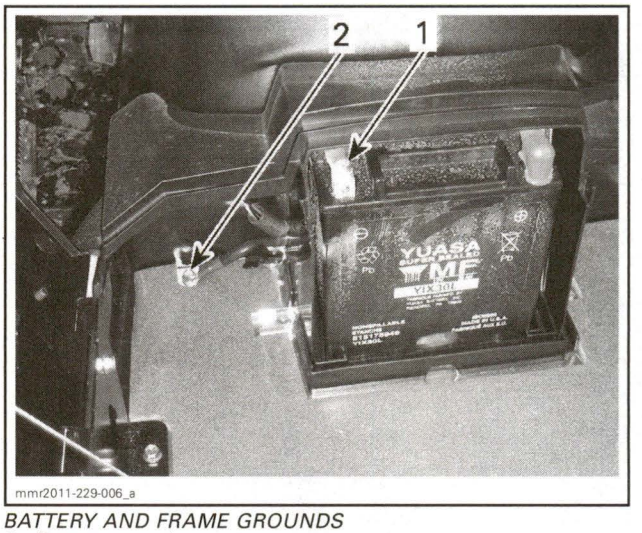
Relays are in the fuse box.



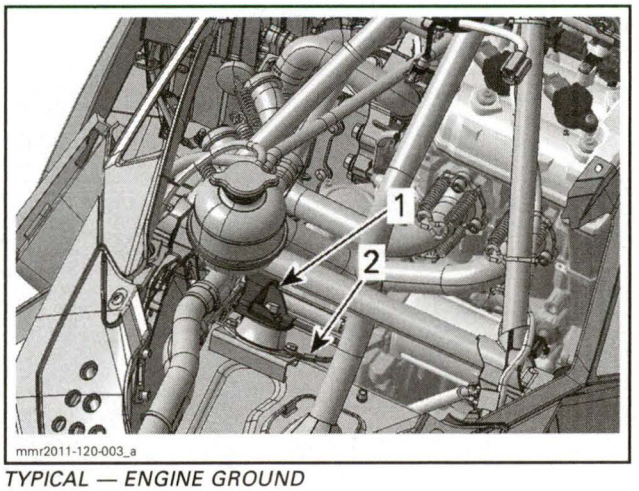
RELAYS ARE IDENTIFIED BY THE LETTER R FOLLOWED BY A DIGIT

GROUNDS

Ground Location



BATTERY AND FRAME GROUNDS
1. *Battery ground*
2. *Frame ground*



TYPICAL — ENGINE GROUND
1. *Engine mount*
2. *Ground*

PROCEDURES

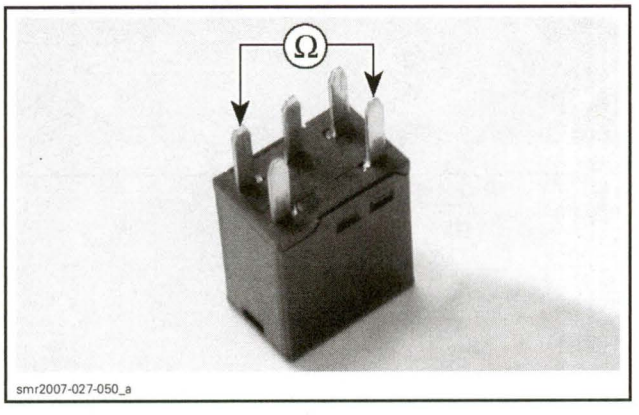
RELAY CONTINUITY TEST

1. Remove relay.
2. Set multimeter to Ω.

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

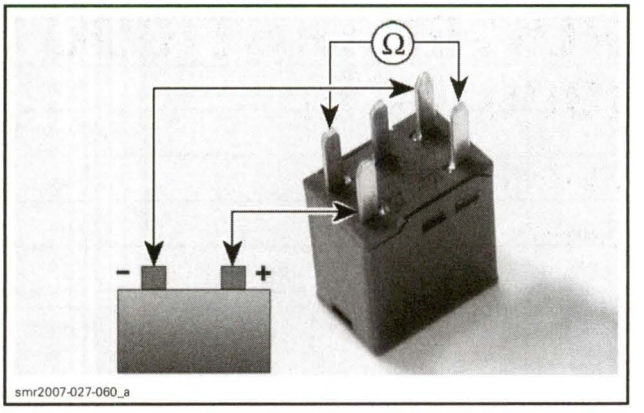
3. Probe relay as follows.

TERMINAL		RESISTANCE
30	87	Open circuit (OL)



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

TERMINAL		RESISTANCE
30	87	0.5 Ω max. (continuity)



If relay failed any test, replace it.

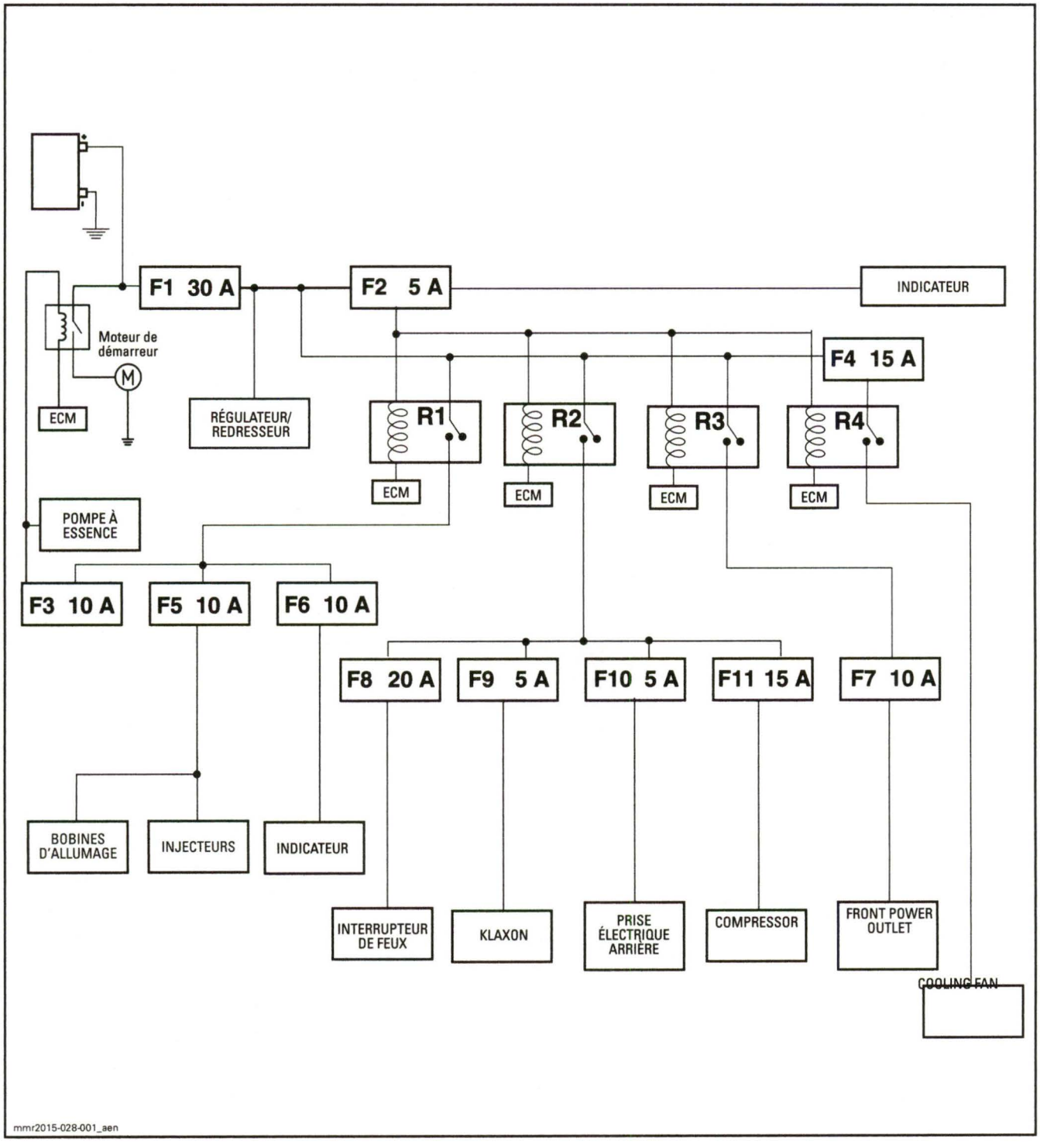
POWER DISTRIBUTION AND GROUNDS (900 ACE)

SERVICE TOOLS

Description	Part Number	Page
FLUKE 115 MULTIMETER	529 035 868	374

GENERAL

POWER DISTRIBUTION DIAGRAM



OVERVIEW

All the electrical system is powered by DC current supplied by a 12 V battery. The battery charge is maintained by the charging system.

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The system uses 3 relays that control different electrical components.

Automatic Power Cut-Off

The ECM features an automatic power cut-off that will completely turn off the ECM (after engine was running) and thus cutting all power to components. All the vehicle electrical loads will be turned off (except the clock in the multifunction gauge). This feature prevents the battery from discharging if the tether cord cap is left on engine cut-off switch when the engine is not running.

NOTE: If a power cable is connected to the communication connector power cut-off will not occur.

The cut-off time is as follows.

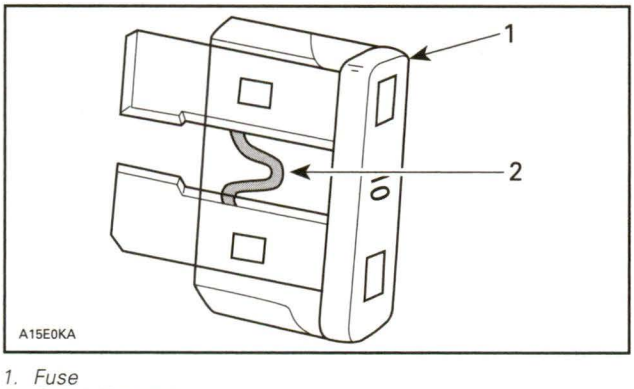
ACTION	POWER CUT-OFF TIME
Removing tether cord cap	Approximately 15 seconds
Setting emergency engine stop switch to STOP (tether cord cap connected)	Approximately 20 seconds

NOTE: The ECM will remain off until the START/RER button is pressed.

FUSES

Fuse Inspection

Check if filament is melted. Replace as necessary.



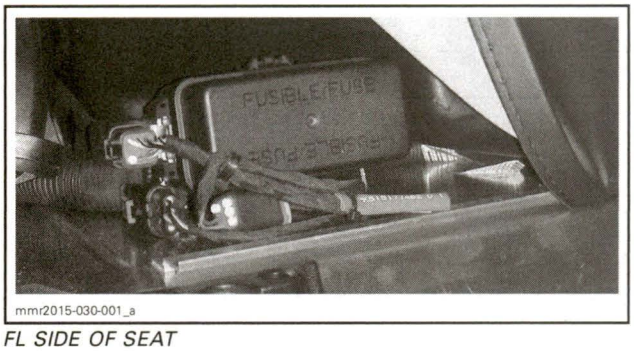
1. *Fuse*
2. *Check if melted*

⚠ WARNING

Do not use a higher rated fuse as this can cause severe damage to electric components and/or a fire. If fuse has burnt out, the cause of the malfunction should be determined and corrected before restarting.

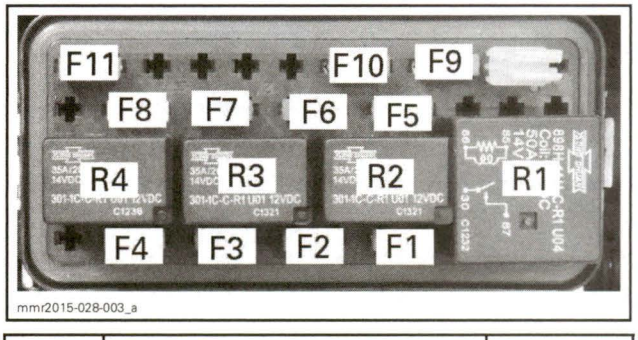
Fuse Box Location

The fuse box is located under the front left side of the seat.



FL SIDE OF SEAT

Fuse Box



F1	Main fuse	30 A
F2	Relay / start button	5 A
F3	Starter solenoid	10 A
F4	Fan	15 A
F5	HIC	10 A
F6	HIC / gauge	10 A
F7	Front power outlet and heaters	10 A
F8	Lighting	20 A
F9	Horn	5 A
F10	Rear power outlet	5 A
F11	Compressor	15 A

RELAY STATE (ON)	RELAY STATE (OFF)
R1 - Run Relay	
When START/RER button is pressed When engine is running	30 seconds after engine off
R2 - Load Relay	
When engine reaches 800 RPM	Approximately 30 seconds after ignition key is turned OFF **OR** If engine drops below 800 RPM
R3 - Load Relay	
When engine reaches 2000 RPM	If battery voltage is lower than 12 V for 10 seconds
R4 - Cooling Fan	
See *COOLING SYSTEM*	

The following actions will be taken by the ECM to preserve electrical power for the most important functions.

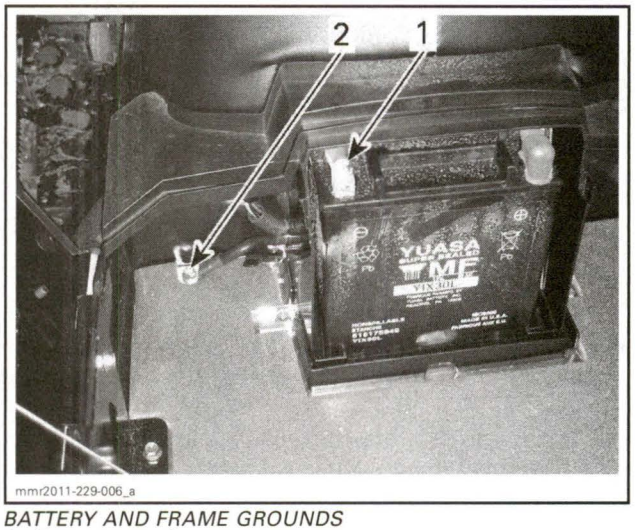
CONDITION	ECM CORRECTIVE ACTION
If battery voltage is lower than 12 V for 10 seconds	Relay 3 is disabled.
If battery voltage is lower than 11.5 V	Idle speed is increased.
If battery voltage is lower than 11 V	Low battery pilot lamp turns on.

Fuse box contacts are identified as seen from the top of the fuse box with letters to identify rows and numbers to identify columns. The combined letter and number identify the coordinate of a contact that is used in the wiring diagram and procedures.

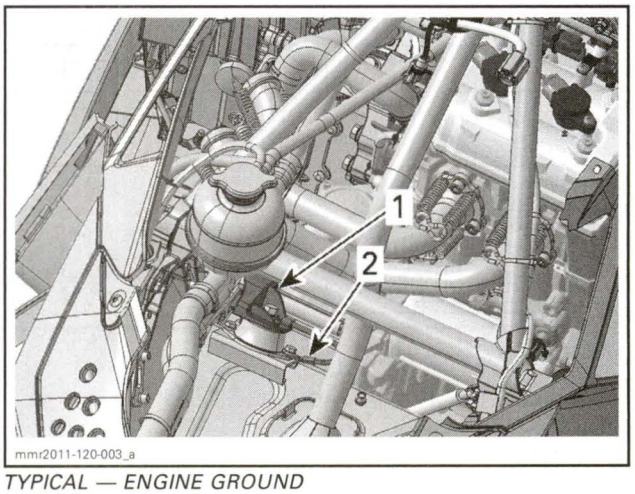
NOTICE **Do not apply any lubricant or sealant product to the terminal contacts in fuse box.**

GROUNDS

Ground Location



BATTERY AND FRAME GROUNDS
1. *Battery ground*
2. *Frame ground*



TYPICAL — ENGINE GROUND
1. *Engine mount*
2. *Ground*

PROCEDURES

RELAY CONTINUITY TEST

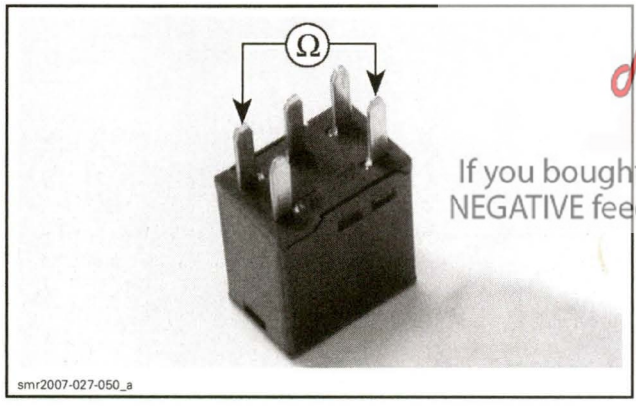
1. Remove relay.
2. Set multimeter to Ω.

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

3. Probe relay as follows.

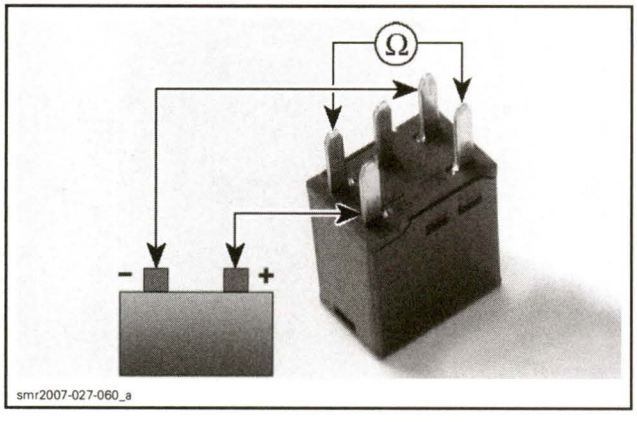
TERMINAL		RESISTANCE
30	87	Open circuit (OL)

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Paperless Manuals
For a Better Tomorrow
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4. Connect battery as shown and probe relay again as follows.

TERMINAL		RESISTANCE
30	87	0.5 Ω max. (continuity)



If relay failed any test, replace it.

IGNITION SYSTEM (600 ACE ITC)

SERVICE TOOLS

Description	Part Number	Page
ECM ADAPTER TOOL	529 036 166	379, 381
FLUKE 115 MULTIMETER	529 035 868	378, 380

GENERAL

Cables and locking ties removed during a procedure must be reinstalled as per factory standards.

NOTICE Never force a multimeter probe into an electrical terminal.

SYSTEM DESCRIPTION

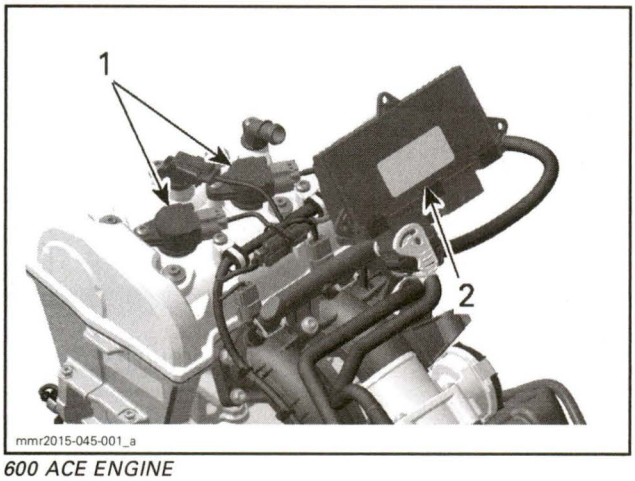
The ignition system is a digital inductive type (IDI) system.

Ignition system parameters such as ignition timing, spark duration, and firing order, are controlled by the ECM in order to meet engine operational requirements.

Direct ignition coils (stick coils) are used for each cylinder.

When a ground signal is provided by the ECM to an ignition coil primary winding, a high voltage is induced in the ignition coil secondary winding that is used to produce a spark at the spark plug electrode.

Cylinder 1 is on the PTO side of the engine.



600 ACE ENGINE
1. Ignition coils
2. ECM

Ignition Timing

Ignition timing is not adjustable.

The ECM is programmed with data (ignition mappings), used along with data received from a variety of sensors to establish optimum ignition timing under all engine operating conditions.

The firing of each spark plug is independent of the other(s).

TROUBLESHOOTING

IGNITION SYSTEM TESTING

The ECM controls the ignition system.

If a fault is detected by the ECM, the check engine light will turn on.

A check engine message will be displayed in the gauge digital display and a beep code will be emitted. Refer to *DIAGNOSTIC AND FAULT CODES* subsection for details.

The ECM can detect a problem on the primary winding or circuit of the ignition coils.

The secondary winding of the ignition coils is not monitored by the ECM.

Other sensors in relation with the ignition system are also monitored by the ECM.

Ignition System Testing Sequence

Check for fault codes using B.U.D.S. software as a first troubleshooting step. Refer to *DIAGNOSTIC AND FAULT CODES* subsection.

Check the following fuse(s):

IGNITION/INJECTOR FUSE (HIC)
Fuse 5

If a fuse is burnt, test for a short circuit or faulty component on that fuse circuit before replacing the fuse. Refer to *POWER DISTRIBUTION AND GROUNDS* subsection.

Check ignition spark, refer to *IGNITION COIL QUICK TEST USING B.U.D.S.* in this subsection.

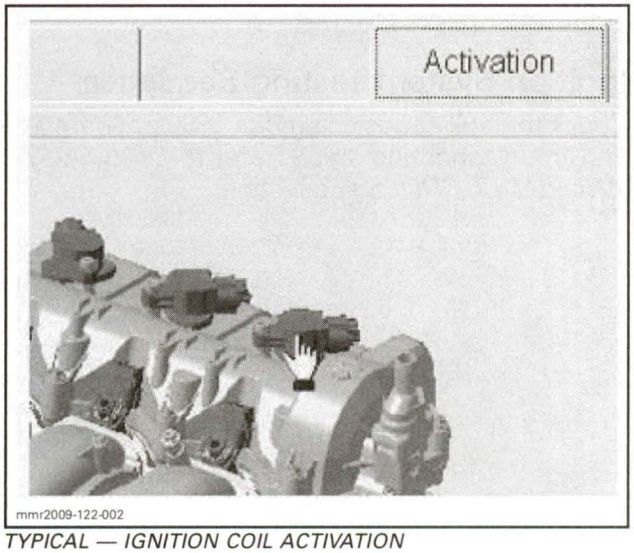
PROCEDURES

IGNITION COILS

Ignition Coil Quick Test using B.U.D.S.

This test confirms the working condition of the ignition circuit and ignition coil for the cylinder tested.

1. Remove ignition coil, refer to *IGNITION COIL REMOVAL* in this subsection.
2. Install a spark tester on the ignition coil.
3. Connect to the latest applicable B.U.D.S. version, refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
4. In B.U.D.S., select;
   - **Read Data**
   - **Activation**page tab
5. Energize the **ignition** coil by selecting it on the engine illustration.



TYPICAL — IGNITION COIL ACTIVATION

If there is no spark, carry out the following tests.

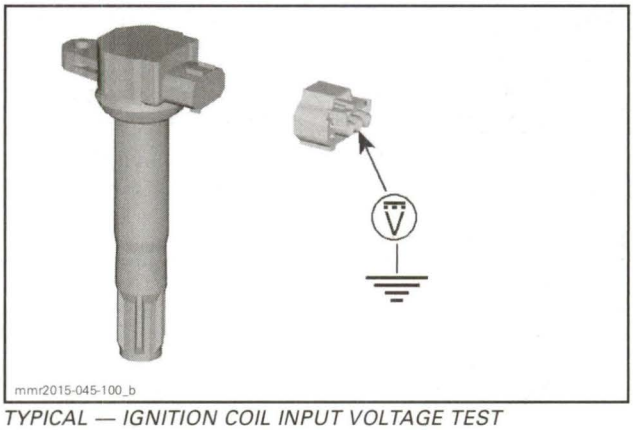
Ignition Coil Input Voltage Test

1. Disconnect the ignition coil connector.
2. Install tether cord cap on engine cut-off switch.
3. Set emergency engine stop switch to RUN.
4. Briefly press on START/RER switch to wake up ECM.
5. Measure voltage as per following table.

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

NOTE: Test is valid only if ECM is active (gauge will be on).

IGNITION COIL INPUT VOLTAGE TEST		
TEST PROBES		VOLTAGE
PTO coil VIOLET/BLUE wire	Battery ground	Battery voltage
MAG coil VIOLET/GREEN wire		



TYPICAL — IGNITION COIL INPUT VOLTAGE TEST

TEST RESULT	SERVICE ACTION
Battery voltage **is** read	Refer to *IGNITION COIL CIRCUIT CONTINUITY TEST*
Battery voltage **NOT** read	Refer to *IGNITION COIL CIRCUIT CONTINUITY TEST*

6. Remove tether cord cap from engine cut-off switch.

Ignition Coil Circuit Continuity Test

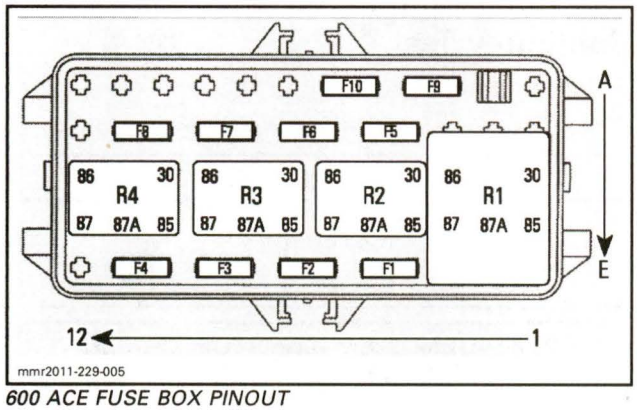
Power Input Wire (Ignition Coil)

1. Ensure that tether cord cap is removed from engine cut-off switch.
2. Ensure emergency engine stop switch is set to STOP.

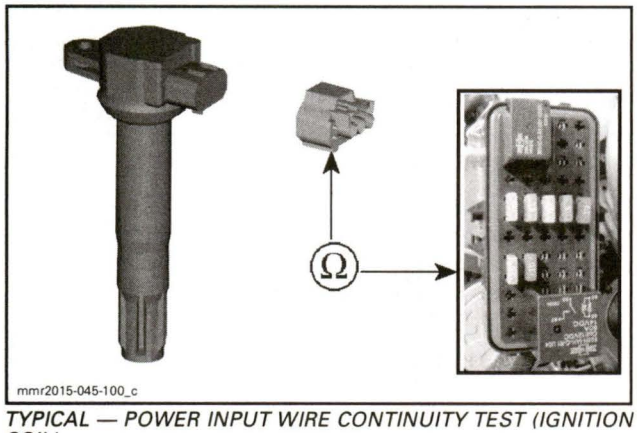
3. Locate the applicable ignition/injector fuse (F5) in the fuse box. Refer to *POWER DISTRIBUTION AND GROUNDS* subsection.
4. Disconnect ignition coil connector.
5. Remove applicable fuse.
6. Test for continuity of circuit as per following table.

NOTE: Probe the metallic part on top of the fuse.

POWER INPUT WIRE CONTINUITY TEST (IGNITION COIL) FUSE BOX			
IGNITION COIL	**IGNITION COIL CONNECTOR WIRE**	**FUSE BOX CONTACT**	**RESISTANCE**
PTO	VIOLET/ BLUE	5B (fuse 5)	Close to 0 Ω (continuity)
MAG	VIOLET/ GREEN		



600 ACE FUSE BOX PINOUT



TYPICAL — POWER INPUT WIRE CONTINUITY TEST (IGNITION COIL)

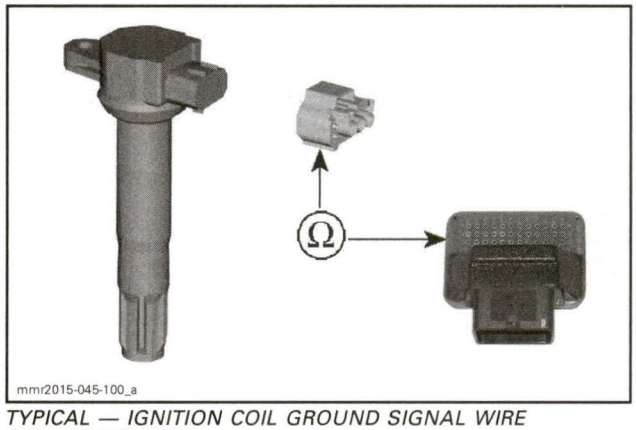
If continuity is not measured as specified, test the engine and vehicle harnesses.

Ground Signal Wire (Ignition Coil)

1. Disconnect ECM connector A. Refer to *ELECTRONIC FUEL INJECTION* subsection.
2. Disconnect ignition coil connector.
3. Test for continuity of ignition coil ground signal circuit as per following table.

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

GROUND SIGNAL WIRE CONTINUITY TEST (IGNITION COIL)			
IGNITION COIL	**IGNITION COIL CONNECTOR WIRE**	**ECM PIN**	**RESISTANCE**
PTO	BROWN/ BLACK	M1	Close to 0 Ω (continuity)
MAG	BROWN/ ORANGE	M2	



TYPICAL — IGNITION COIL GROUND SIGNAL WIRE CONTINUITY TEST

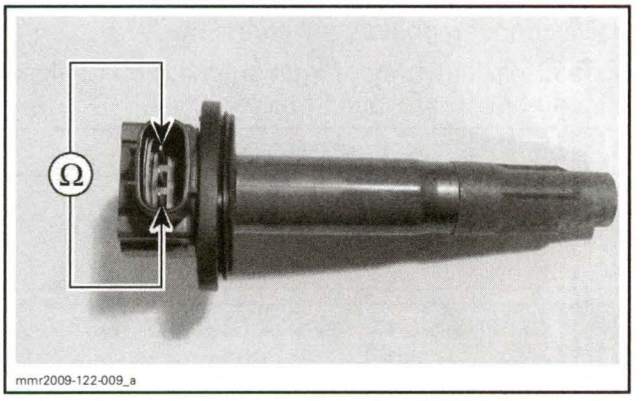
If continuity is not measured as specified, repair the connector or replace the engine wiring harness.

Ignition Coil Resistance Test

An ignition coil with a good resistance measurement can still be faulty. Current leakage can occur at high voltage levels which is not detectable with an ohmmeter. Replacing the ignition coil may be necessary as a test.

Primary Winding

1. Remove ignition coil. Refer to *IGNITION COIL REMOVAL* in this subsection.
2. Set the multimeter to Ω and measure primary winding resistance as specified.



CIRCUIT	PIN	RESISTANCE @ 20°C (68°F)
Primary	1 and 3	0.8 - 0.97 Ω

If resistance is not within specification, replace ignition coil.

Secondary Winding

The secondary winding on this type of ignition coil cannot be tested.

Ignition Coil Removal

1. Disconnect ignition coil connector.
2. Remove ignition coil retaining screw.

NOTICE **Do not pry on ignition coil with a tool.**

3. Remove ignition coil from spark plug by rotating coil side to side as you pull up.

NOTE: For cylinder 2, turn steering column to ease ignition coil removal.

Ignition Coil Installation

1. Align the retaining screw hole of the ignition coil with the threaded hole on the valve cover.
2. Install the ignition coil on the spark plug and push it all the way down until it rests on the valve cover.
3. Install the retaining screw an tighten to specification.

IGNITION COIL RETAINING SCREW	
Tightening torque	9 N•m ± 1 N•m (80 lbf•**in** ± 9 lbf•**in**)

4. Connect ignition coil connector.

SPARK PLUGS

Spark Plug Application

ENGINE	SPARK PLUG
600 ACE	MR7BI8

EMERGENCY ENGINE STOP SWITCH

Emergency Engine Stop Switch Operation

The emergency engine stop switch provides a ground signal to the ECM when STOP is selected.

The ground signal is applied to the ECM connector as per following table.

MODEL	ECM PIN
600 ACE	B-4C

Emergency Engine Stop Switch Continuity Test

Remove gauge.

Check switch continuity as per following table.

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

EMERGENCY ENGINE STOP SWITCH CONTINUITY TEST			
SWITCH POSITION	**TEST PROBES**		**RESISTANCE**
RUN	BK wire	YE/BK wire	Infinite (OL)
STOP			Close to 0 Ω

If readings are not as specified in table, check wiring and connections going to switch. If good, replace switch.

ENGINE CUT-OFF SWITCH

Engine Cut-Off Switch Continuity Test

Disconnect engine cut-off switch connector.

Carry out the following continuity tests.

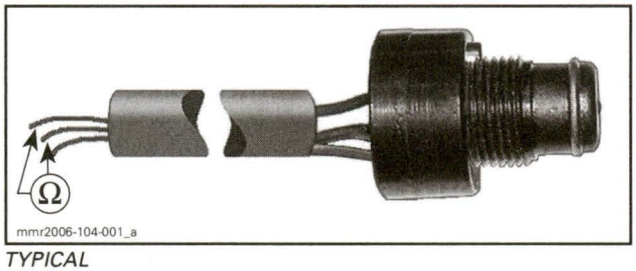
REQUIRED TOOL	
FLUKE 115 MULTIMETER (P/N 529 035 868)	

Tether Cord Cap Removed from Engine Cut-Off Switch

Set multimeter to Ω.

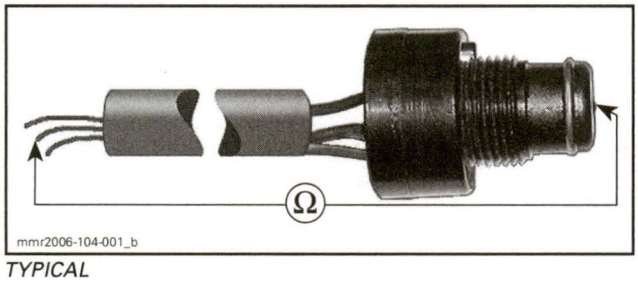
Connect test probes to engine cut-off switch and its connector as per tables and measure resistance.

ENGINE CUT-OFF SWITCH		
PROBE WIRES		RESISTANCE Ω @ 20°C (68°F)
GREEN/BLACK	WHITE/BLACK	Open circuit



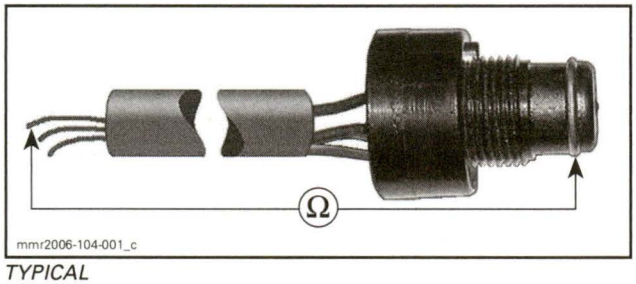
TYPICAL

ENGINE CUT-OFF SWITCH		
PROBE		RESISTANCE Ω @ 20°C (68°F)
WHITE/ GRAY	Switch center contact	Close to 0 Ω



TYPICAL

ENGINE CUT-OFF SWITCH		
PROBE		RESISTANCE Ω @ 20°C (68°F)
GREEN/BLACK	Switch ring	Close to 0 Ω

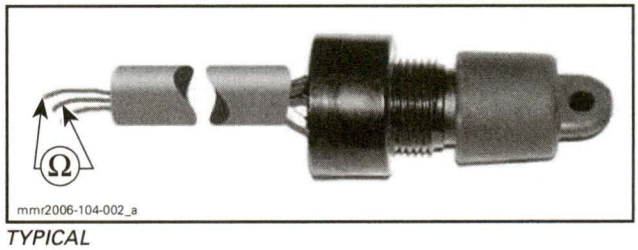


TYPICAL

Tether Cord Cap on Engine Cut-Off Switch

Connect test probes to engine cut-off switch connector as per table and measure resistance.

ENGINE CUT-OFF SWITCH		
PROBE WIRES		RESISTANCE Ω @ 20°C (68°F)
GREEN/BLACK	WHITE/BLACK	Close to 0 Ω



TYPICAL

If any resistance test fails, replace engine cut-off switch.

Engine Cut-Off Switch Vehicle Harness Continuity Test

Disconnect engine cut-off switch connector.

Disconnect ECM connector B. Refer to *ELECTRONIC FUEL INJECTION* subsection.

Check wire continuity between engine cut-off switch connector of main wiring harness and ECM as follows.

TOOL	TOOL VIEW
ECM ADAPTER TOOL (P/N 529 036 166)	

ENGINE CUT-OFF SWITCH CONNECTOR (MAIN WIRING HARNESS SIDE)	ECM ADAPTER	RESISTANCE Ω @ 20°C (68°F)
WIRE	PIN	
WHITE/GRAY (3)	B-2B	Close to 0 Ω
WHITE/BLACK (1)	B-4E	
GREEN/BLACK (2)	B-2F	

If any continuity test failed, repair or replace wiring connectors/terminals.

If the problem persists and all tests have been performed, check the ECM. Refer to *(ENGINE CONTROL MODULE ECM)* in the *ELECTRONIC FUEL INJECTION (EFI)* subsection.

IGNITION SYSTEM (900 ACE)

SERVICE TOOLS

Description	Part Number	Page
ECM ADAPTER TOOL	529 036 166	385, 387
FLUKE 115 MULTIMETER	529 035 868	384, 386

GENERAL

Cables and locking ties removed during a procedure must be reinstalled as per factory standards.

NOTICE **Never force a multimeter probe into an electrical terminal.**

SYSTEM DESCRIPTION

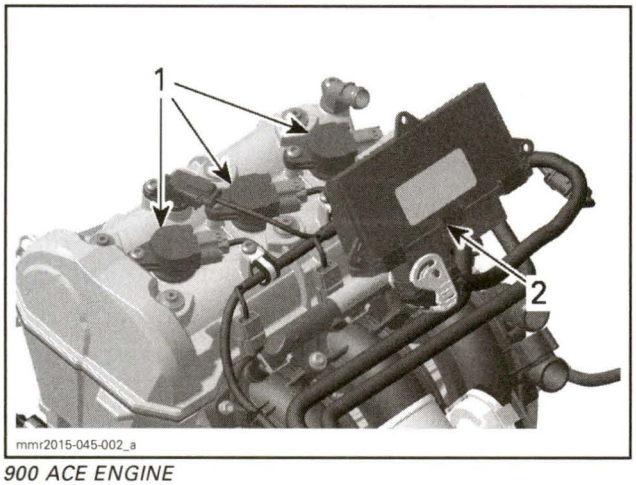
The ignition system is a digital inductive type (IDI) system.

Ignition system parameters such as ignition timing, spark duration, and firing order, are controlled by the ECM in order to meet engine operational requirements.

Direct ignition coils (stick coils) are used for each cylinder.

When a ground signal is provided by the ECM to an ignition coil primary winding, a high voltage is induced in the ignition coil secondary winding that is used to produce a spark at the spark plug electrode.

Cylinder 1 is on the PTO side of the engine.



900 ACE ENGINE
1. Ignition coils
2. ECM

Ignition Timing

Ignition timing is not adjustable.

The ECM is programmed with data (ignition mappings), used along with data received from a variety of sensors to establish optimum ignition timing under all engine operating conditions.

The firing of each spark plug is independent of the other(s).

TROUBLESHOOTING

IGNITION SYSTEM TESTING

The ECM controls the ignition system.

If a fault is detected by the ECM, the check engine light will turn on.

A check engine message will be displayed in the gauge digital display and a beep code will be emitted. Refer to *DIAGNOSTIC AND FAULT CODES* subsection for details.

The ECM can detect a problem on the primary winding or circuit of the ignition coils.

The secondary winding of the ignition coils is not monitored by the ECM.

Other sensors in relation with the ignition system are also monitored by the ECM.

Ignition System Testing Sequence

Check for fault codes using B.U.D.S. software as a first troubleshooting step. Refer to *DIAGNOSTIC AND FAULT CODES* subsection.

Check the following fuse(s):

IGNITION/INJECTOR FUSE (HIC)
Fuse 5

If a fuse is burnt, test for a short circuit or faulty component on that fuse circuit before replacing the fuse. Refer to *POWER DISTRIBUTION AND GROUNDS* subsection.

Check ignition spark, refer to *IGNITION COIL QUICK TEST USING B.U.D.S.* in this subsection.

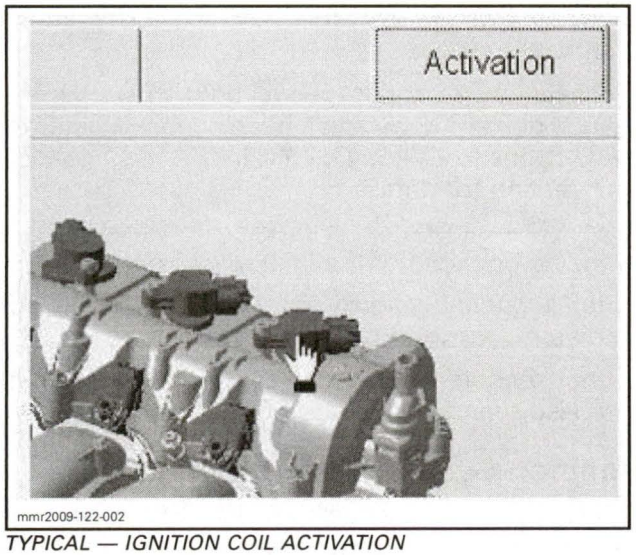
PROCEDURES

IGNITION COILS

Ignition Coil Quick Test using B.U.D.S.

This test confirms the working condition of the ignition circuit and ignition coil for the cylinder tested.

1. Remove ignition coil, refer to *IGNITION COIL REMOVAL* in this subsection.
2. Install a spark tester on the ignition coil.
3. Connect to the latest applicable B.U.D.S. version, refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
4. In B.U.D.S., select;
   - **Read Data**
   - **Activation** page tab
5. Energize the **ignition** coil by selecting it on the engine illustration.



TYPICAL — IGNITION COIL ACTIVATION

If there is no spark, carry out the following tests.

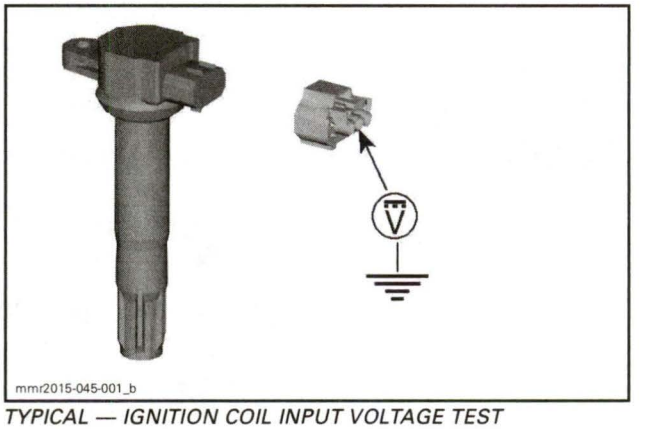
Ignition Coil Input Voltage Test

1. Disconnect the ignition coil connector.
2. Install tether cord cap on engine cut-off switch.
3. Set emergency engine stop switch to RUN.
4. Briefly press on START/RER switch to wake up ECM.
5. Measure voltage as per following table.

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

NOTE: Test is valid only if ECM is active (gauge will be on).

IGNITION COIL INPUT VOLTAGE TEST		
TEST PROBES		VOLTAGE
PTO, Center and MAG coil VIOLET/GREEN wire	Battery ground	Battery voltage



TYPICAL — IGNITION COIL INPUT VOLTAGE TEST

TEST RESULT	SERVICE ACTION
Battery voltage **is** read	Refer to *IGNITION COIL CIRCUIT CONTINUITY TEST*
Battery voltage **NOT** read	Refer to *IGNITION COIL CIRCUIT CONTINUITY TEST*

6. Remove tether cord cap from engine cut-off switch.

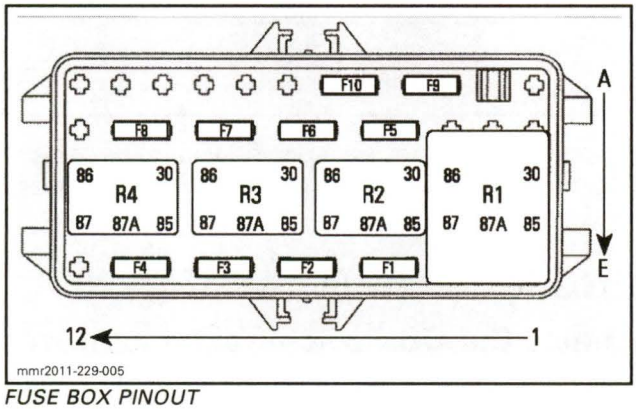
Ignition Coil Circuit Continuity Test

Power Input Wire (Ignition Coil)

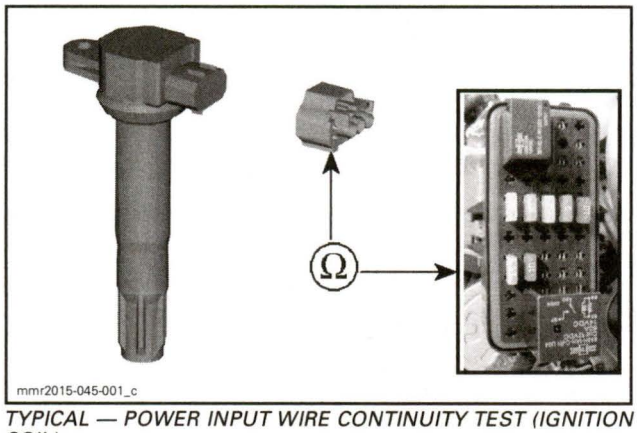
1. Ensure that tether cord cap is removed from engine cut-off switch.
2. Ensure emergency engine stop switch is set to STOP.
3. Locate the applicable ignition/injector fuse (F5) in the fuse box. Refer to *POWER DISTRIBUTION AND GROUNDS* subsection.
4. Disconnect ignition coil connector.
5. Remove applicable fuse.
6. Test for continuity of circuit as per following table.

NOTE: Probe the metallic part on top of the fuse.

POWER INPUT WIRE CONTINUITY TEST (IGNITION COIL) FUSE BOX			
IGNITION COIL	**IGNITION COIL CONNECTOR WIRE**	**FUSE BOX CONTACT**	**RESISTANCE**
PTO	VIOLET/ BLUE	5B (fuse 5)	Close to 0 Ω (continuity)
CENTER	VIOLET/ GREEN		
MAG	VIOLET ORANGE		



FUSE BOX PINOUT



TYPICAL — POWER INPUT WIRE CONTINUITY TEST (IGNITION COIL)

If continuity is not measured as specified, test the engine and vehicle harnesses.

Ground Signal Wire (Ignition Coil)

1. Disconnect ECM connector A. Refer to *ELECTRONIC FUEL INJECTION* subsection.
2. Disconnect ignition coil connector.
3. Test for continuity of ignition coil ground signal circuit as per following table.

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

GROUND SIGNAL WIRE CONTINUITY TEST (IGNITION COIL)			
IGNITION COIL	**IGNITION COIL CONNECTOR WIRE**	**ECM PIN**	**RESISTANCE**
PTO	BROWN/ BLACK	M4	Close to 0 Ω (continuity)
CENTER	BROWN/ ORANGE	M2	
MAG	BROWN/ YELLOW	M1	

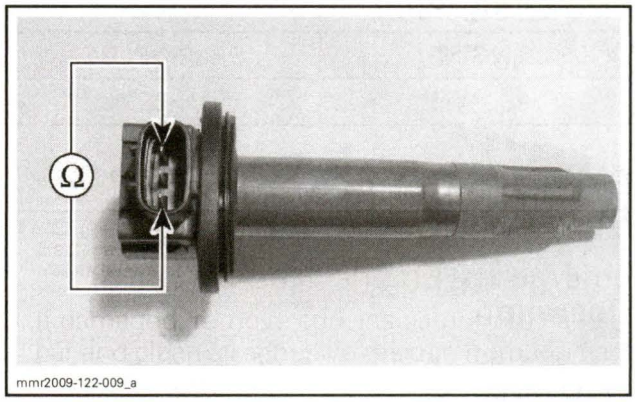
If continuity is not measured as specified, repair the connector or replace the engine wiring harness.

Ignition Coil Resistance Test

An ignition coil with a good resistance measurement can still be faulty. Current leakage can occur at high voltage levels which is not detectable with an ohmmeter. Replacing the ignition coil may be necessary as a test.

Primary Winding

1. Remove ignition coil. Refer to *IGNITION COIL REMOVAL* in this subsection.
2. Set the multimeter to Ω and measure primary winding resistance as specified.



CIRCUIT	PIN	RESISTANCE @ 20°C (68°F)
Primary	1 and 3	0.8 - 0.97 Ω

If resistance is not within specification, replace ignition coil.

Secondary Winding

The secondary winding on this type of ignition coil cannot be tested.

Ignition Coil Removal

1. Disconnect ignition coil connector.
2. Remove ignition coil retaining screw.

NOTICE **Do not pry on ignition coil with a tool.**

3. Remove ignition coil from spark plug by rotating coil side to side as you pull up.

NOTE: For cylinder 2, turn steering column to ease ignition coil removal.

Ignition Coil Installation

1. Align the retaining screw hole of the ignition coil with the threaded hole on the valve cover.
2. Install the ignition coil on the spark plug and push it all the way down until it rests on the valve cover.
3. Install the retaining screw an tighten to specification.

IGNITION COIL RETAINING SCREW	
Tightening torque	9 N•m ± 1 N•m (80 lbf•**in** ± 9 lbf•**in**)

4. Connect ignition coil connector.

SPARK PLUGS

Spark Plug Application

ENGINE	SPARK PLUG
900 ACE	MR8BI8

EMERGENCY ENGINE STOP SWITCH

Emergency Engine Stop Switch Operation

The emergency engine stop switch provides a ground signal to the ECM when STOP is selected.

The ground signal is applied to the ECM connector as per following table.

MODEL	ECM PIN
900 ACE	B-4C

Emergency Engine Stop Switch Continuity Test

Remove gauge.

Check switch continuity as per following table.

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

EMERGENCY ENGINE STOP SWITCH CONTINUITY TEST			
SWITCH POSITION	**TEST PROBES**		**RESISTANCE**
RUN	BK wire	YE/BK wire	Infinite (OL)
STOP			Close to 0 Ω

If readings are not as specified in table, check wiring and connections going to switch. If good, replace switch.

ENGINE CUT-OFF SWITCH

Engine Cut-Off Switch Continuity Test

Disconnect engine cut-off switch connector.

Carry out the following continuity tests.

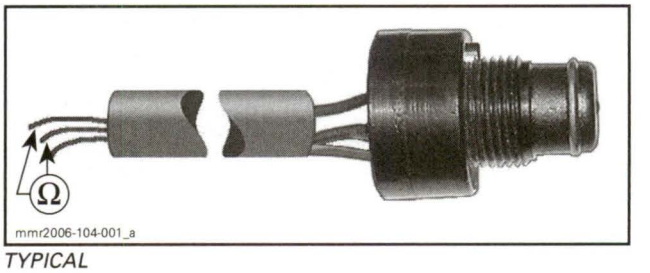
REQUIRED TOOL	
FLUKE 115 MULTIMETER (P/N 529 035 868)	

Tether Cord Cap Removed from Engine Cut-Off Switch

Set multimeter to Ω.

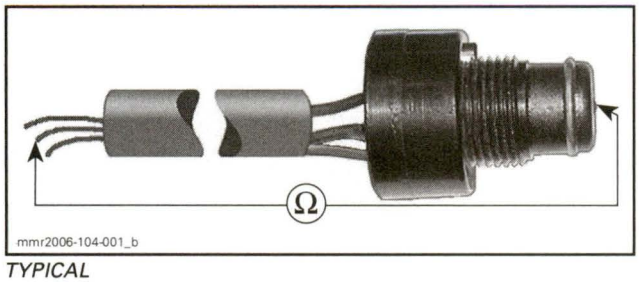
Connect test probes to engine cut-off switch and its connector as per tables and measure resistance.

ENGINE CUT-OFF SWITCH		
PROBE WIRES		RESISTANCE Ω @ 20°C (68°F)
GREEN/BLACK	WHITE/BLACK	Open circuit



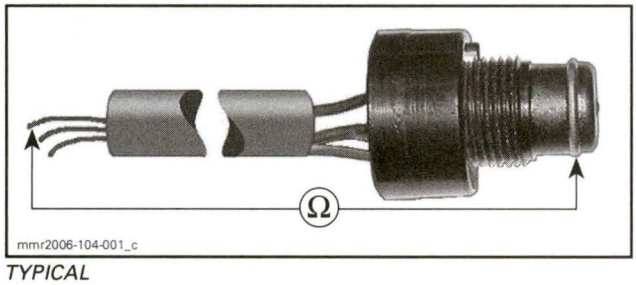
TYPICAL

ENGINE CUT-OFF SWITCH		
PROBE		RESISTANCE Ω @ 20°C (68°F)
WHITE/ GRAY	Switch center contact	Close to 0 Ω



TYPICAL

ENGINE CUT-OFF SWITCH		
PROBE		RESISTANCE Ω @ 20°C (68°F)
GREEN/BLACK	Switch ring	Close to 0 Ω

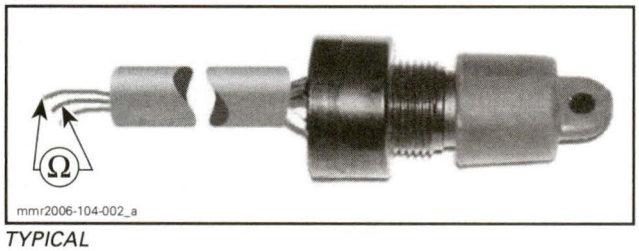


TYPICAL

Tether Cord Cap on Engine Cut-Off Switch

Connect test probes to engine cut-off switch connector as per table and measure resistance.

ENGINE CUT-OFF SWITCH		
PROBE WIRES		RESISTANCE Ω @ 20°C (68°F)
GREEN/BLACK	WHITE/BLACK	Close to 0 Ω



TYPICAL

If any resistance test fails, replace engine cut-off switch.

Engine Cut-Off Switch Vehicle Harness Continuity Test

Disconnect engine cut-off switch connector.

Disconnect ECM connector B. Refer to *ELECTRONIC FUEL INJECTION* subsection.

Check wire continuity between engine cut-off switch connector of main wiring harness and ECM as follows.

TOOL	TOOL VIEW
ECM ADAPTER TOOL (P/N 529 036 166)	

ENGINE CUT-OFF SWITCH CONNECTOR (MAIN WIRING HARNESS SIDE)	ECM ADAPTER	RESISTANCE Ω @ 20°C (68°F)
WIRE	PIN	
WHITE/GRAY (3)	B-2B	Close to 0 Ω
WHITE/BLACK (1)	B-4E	
GREEN/BLACK (2)	B-2F	

If any continuity test failed, repair or replace wiring connectors/terminals.

If the problem persists and all tests have been performed, check the ECM. Refer to *(ENGINE CONTROL MODULE ECM)* in the *ELECTRONIC FUEL INJECTION (EFI)* subsection.

DIGITALLY ENCODED SECURITY SYSTEM (D.E.S.S.)

GENERAL

SYSTEM DESCRIPTION

The following components are specially designed for this system: ECM, D.E.S.S. key (inside tether cord cap) and engine cut-off switch.

This system allows the engine to reach pulley engagement speed only if a D.E.S.S. key is installed on engine cut-off switch and the key is recognized as valid by the ECM.

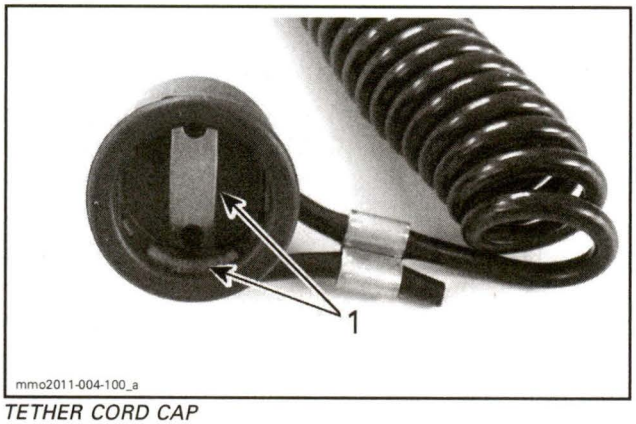
The D.E.S.S. key contains a magnet and a ROM chip.

- The magnet closes the reed switch inside the engine cut-off switch. It is the equivalent of a rotary mechanical ignition switch.
- The ROM chip contains a unique digital code. It is the equivalent of the tooth-pattern cut on a conventional ignition key.

The D.E.S.S. system is quite flexible. Up to 8 D.E.S.S. keys may be programmed in the ECM memory using the B.U.D.S. software. The keys can also be erased individually.

NOTE: If desired, a D.E.S.S. key can be used on another vehicle equipped with the D.E.S.S. system. It only needs to be programmed for that vehicle.

D.E.S.S. Key Types



TETHER CORD CAP
1. Free of dirt or snow

In addition to the normal D.E.S.S. key, other special keys can be programmed so that the vehicle can only be operated at a limited speed. Such a feature is ideal for first time riders or renters.

Two types of keys can be used:

- Normal key
- Learning key.

To ease key type recognition, the tether cord comes in different colors.

KEY TYPE	COLOR
Normal	Black
Learning	Green

The Ski-Doo learning key, limits the speed of the snowmobile and the engine torque, therefore enabling first time users and less experienced operators to learn how to operate the snowmobile while gaining the necessary confidence and control.

NOTE: The initial learning key programming can limit the speed to 40 km/h (25 MPH) or 70 km/h (43 MPH).

D.E.S.S. Key Beeper Codes

When starting the engine with a D.E.S.S. key on the engine cut-off switch, the key is read by the ECM and D.E.S.S. signals will be issued according to the key recognition. See table.

D.E.S.S. SIGNAL		DESCRIPTION	COMMENT
BEEPER	DISPLAYED MESSAGE (1)		
2 shorts beeps	SKI-DOO	Welcome message, good key	Working D.E.S.S. key.
Shorts beeps repeating slowly	CHECK KEY	Unable to read key (bad connection)	– Make sure the key contacts are free of dirt, snow or ice. – Reinstall key and restart engine. – Vehicle can not be driven.
Shorts beeps repeating rapidly	BAD KEY	Invalid key or key not programmed	– Use the proper key for this vehicle or have the key programmed. – Vehicle can not be driven.
(1) Only available on premium gauge.			

TROUBLESHOOTING

DIAGNOSTIC GUIDELINES

The following is provided to help in diagnosing the probable cause of a problem. It is a guideline and should not be assumed to list all possible causes.

NO BEEP CODE WHEN KEY IS INSTALLED ON ENGINE CUT-OFF SWITCH — ENGINE CAN NOT BE STARTED

1. **Gauge shuts-down after its WOW test: Defective engine cut-off switch**
   - *Check engine cut-off switch. Refer to IGNTION SYSTEM subsection.*

NO BEEP CODE WHEN KEY IS INSTALLED ON ENGINE CUT-OFF SWITCH — ENGINE CAN BE STARTED

1. **Defective gauge beeper**
   - *Check gauge beeper. Refer to INFORMATION CENTER (GAUGE).*

GAUGE DISPLAYS "CHECK KEY" AND THERE IS NO KEY INSTALLED ON ENGINE CUT-OFF SWITCH

1. **Gauge shuts-down after 3 minutes: Defective engine cut-off switch**
   - *Check engine cut-off switch.*

PROCEDURES

D.E.S.S. KEY

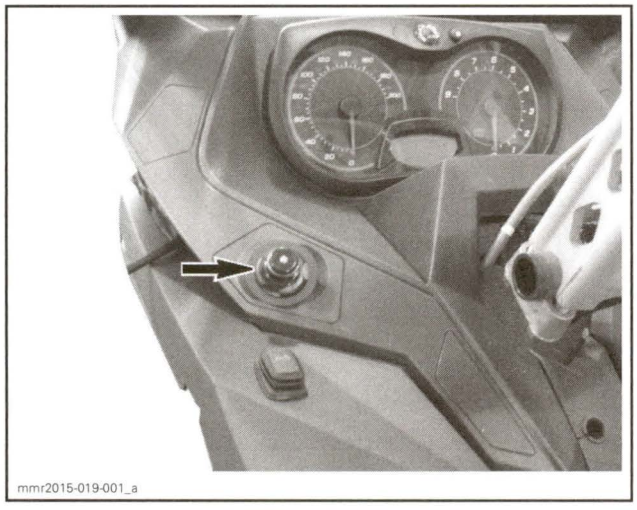
D.E.S.S. Key Recognition

To allow key recognition, carry out the following steps:

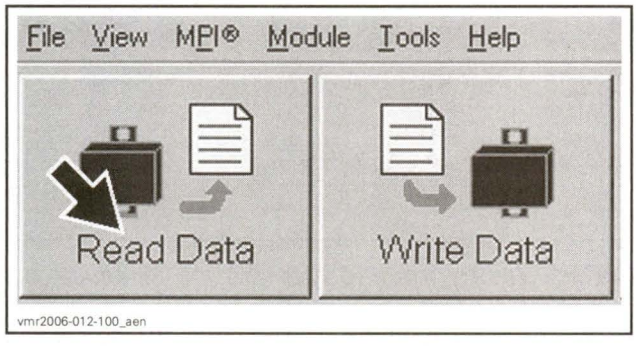
1. Briefly press the START/STOP button to wake up the ECM.
2. Securely install the tether cord on snowmobile engine cut-off switch.
3. Press and hold the START/STOP button to start engine.

D.E.S.S. Key Programming

1. Connect the snowmobile to latest applicable B.U.D.S. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. **IMPORTANT:** Ensure all connections have been made **before starting B.U.D.S.** to allow proper operation.
3. Briefly press START/STOP button to power the ECM.
4. Install a tether cord on the engine cut-off switch to program a D.E.S.S. key.

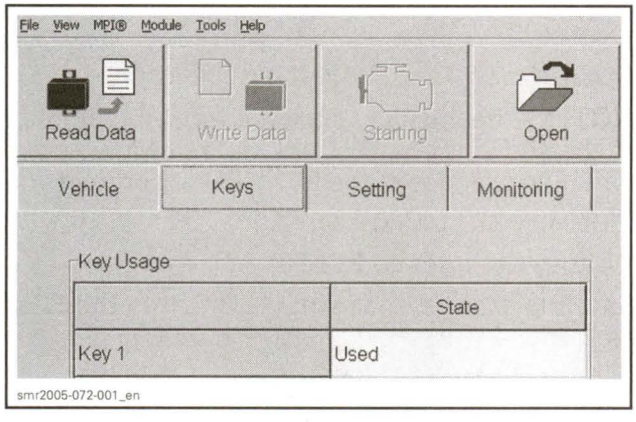

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5. Read ECM using **Read Data** button.



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6. Click on **Keys** tab.



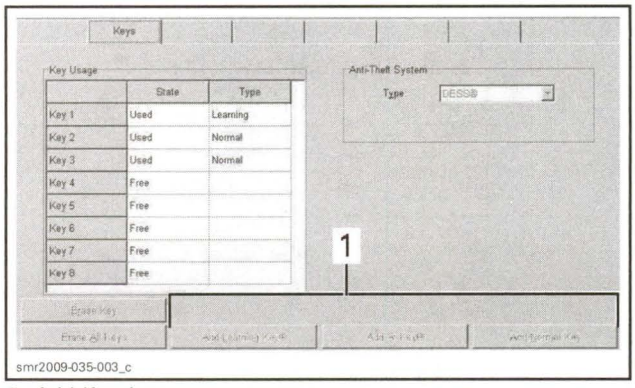
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Adding a Key

1. Click on the **Add Key** button at the bottom of the screen according to the key type you want to program.

⚠ WARNING

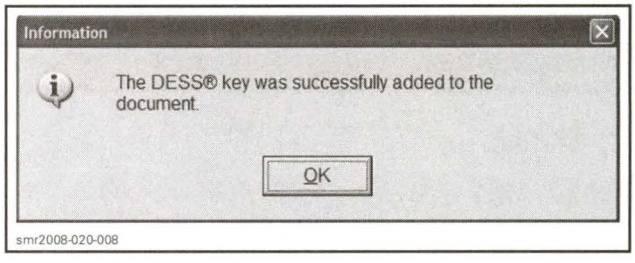
If programming a Learning key, be sure to use the proper key type (color) to avoid possible confusion.



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*1. **Add Key** buttons*

2. After approximately 10 seconds, the following window will pop up confirming the new key has been saved **in the PC computer**.



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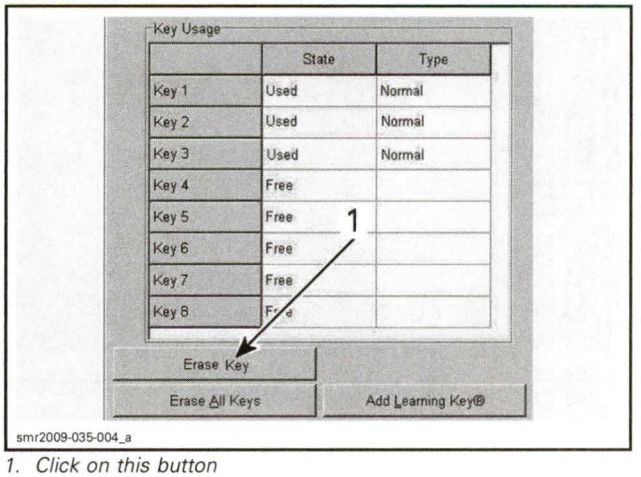
3. If programming is complete, write the changes to the ECM. Refer to *WRITING CHANGES TO ECM* in this subsection.

Adding Another Key

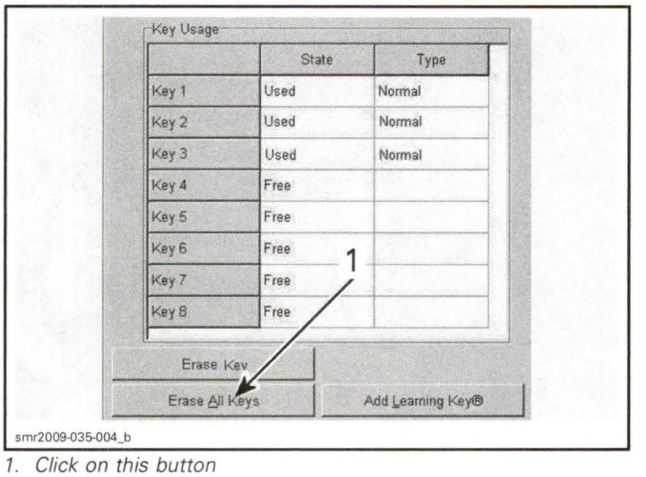
1. Remove the tether cord from the engine cut-off switch.
2. Install the next tether cord on the engine cut-off switch.
3. Click on the **Add Key** button.
4. If programming is complete, write the changes to the ECM. Refer to *WRITING CHANGES TO ECM* in this subsection.

Erasing a Key

1. Install the tether cord on the engine cut-off switch.
2. Click on **Erase Key** button at bottom of B.U.D.S. screen.

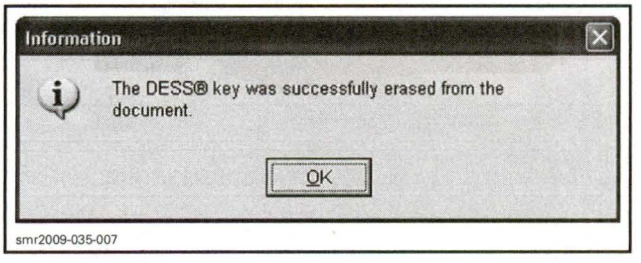


1. Click on this button



1. Click on this button

After approximately 10 seconds the following message will appear.



The key is now erased **in the PC computer**.

3. If programming is complete, write the changes to the ECM. Refer to *WRITING CHANGES TO ECM* in this subsection.

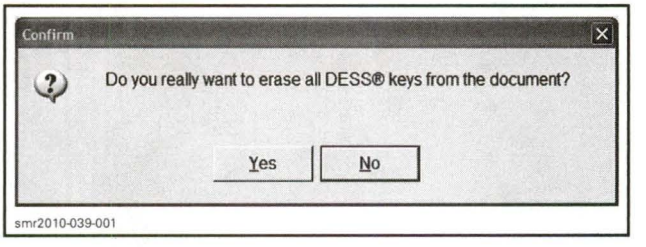
Erasing Another Key

1. Remove the tether cord from the engine cut-off switch.
2. Install the next tether cord to be erased on the engine cut-off switch.
3. Click on **Erase Key** button.
4. If programming is complete, write the changes to the ECM. Refer to *WRITING CHANGES TO ECM* in this subsection.

Erasing All Keys

1. Click on **Erase All Keys** button at bottom of screen.

NOTE: The following message will be displayed in B.U.D.S.



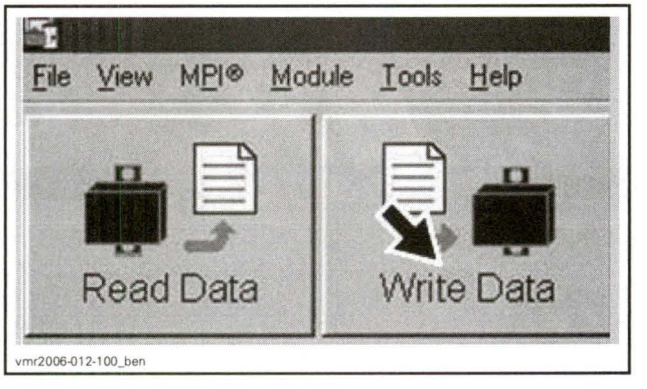
2. Click **Yes** to proceed with erasing all keys.
3. When done, program at least one new key to the vehicle. Refer to *ADDING A KEY* in this subsection.
4. When programming is complete, write the changes to the ECM. Refer to *WRITING CHANGES TO ECM* in this subsection.

NOTE: If there isn't at least one key programmed to the snowmobile, B.U.D.S. will not allow you to write the changes to the ECM and will prompt you to add a key.

Writing Changes to ECM

Save the changes made in B.U.D.S. **into the ECM** as follows.

1. Click the **Write Data** button.



NOTE: If for some reason the writing operation fails, exit B.U.D.S. Restart B.U.D.S. and reenter all the previously lost information.

2. After the write operation, remove key from D.E.S.S. post.
3. Try the key(s) on the snowmobile.

LIGHTS, GAUGE AND ACCESSORIES (900 ACE)

SERVICE TOOLS

Description	Part Number	Page
12 V BATTERY SUPPLY CABLE	529 035 997	398
FLUKE 115 MULTIMETER	529 035 868	401, 406, 413, 416
POWER INTERFACE	515 177 223	398

SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
MULTILOCK - TERMINAL EXTRACTION TOOL	755430-2	417

SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 5900	293 800 066	411

GENERAL

NOTE: It is a good practice to check for fault codes using B.U.D.S. software as a first troubleshooting step. Refer to *DIAGNOSTIC AND FAULT CODES* subsection.

⚠ CAUTION The battery charging fuse should always be removed before carrying out any maintenance on the vehicle to prevent any unexpected electrical activation. Removal of this fuse isolates the battery from the vehicle electrical system, except for the starter relay input terminal.

⚠ WARNING

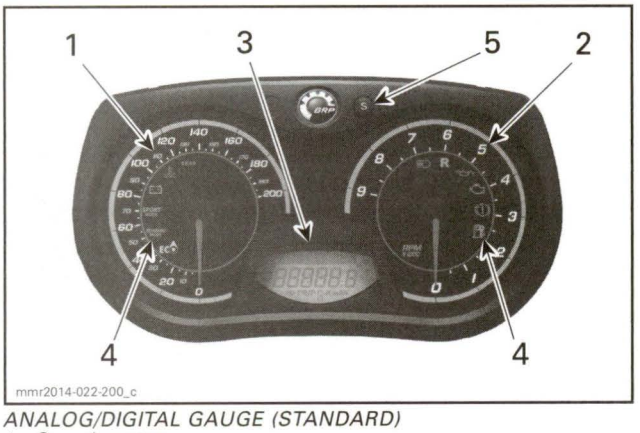
Torque wrench tightening specifications must be strictly adhered to. Locking devices must be replaced with new ones when removed (e.g.: locking tabs, elastic stop nuts, self-locking fasteners, cotter pins, etc.).

SYSTEM DESCRIPTION (GAUGE)

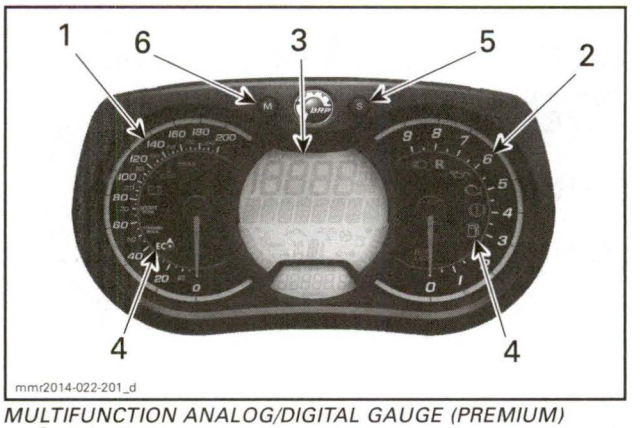
Two different type gauges which provide all indications in a single unit are used. An **analog/digital gauge (standard gauge)** and a **multifunction analog/digital gauge (premium gauge)**.

The premium gauge provides more functions and display features.

Both units can be set to indicate in metric or imperial units.



ANALOG/DIGITAL GAUGE (STANDARD)
1. *Speedometer*
2. *Tachometer (RPM)*
3. *Gauge Digital Display*
4. *Gauge Pilot Lamps*
5. *Gauge SET "S" button*



MULTIFUNCTION ANALOG/DIGITAL GAUGE (PREMIUM)
1. *Speedometer*
2. *Tachometer (RPM)*
3. *Gauge Multifunction Digital Display*
4. *Gauge Pilot Lamps*
5. *Gauge SET "S" button*
6. *Gauge MODE "M" button*

The premium gauge is also used to control 9 heating intensity settings for the heated hand grips and the heated throttle lever.

Mode and Set Buttons

These buttons allow you to toggle through the different functions and settings of the indicator.

All vehicles that are factory equipped with the premium gauge also come with a remote **M/S** button on the LH multifunction switch. It can be used instead of the buttons on the gauge simply by pressing the "**M**" for **MODE** and "**S**" for **SET**.

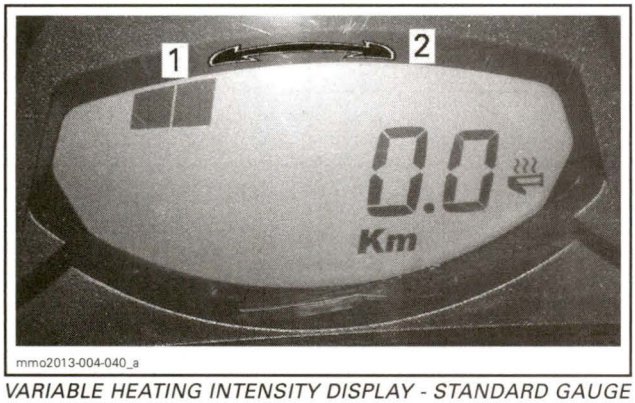
SYSTEM DESCRIPTION (HEATED THROTTLE LEVER)

The type of system used is usually determined by the gauge package installed at the factory, standard gauge or premium gauge.

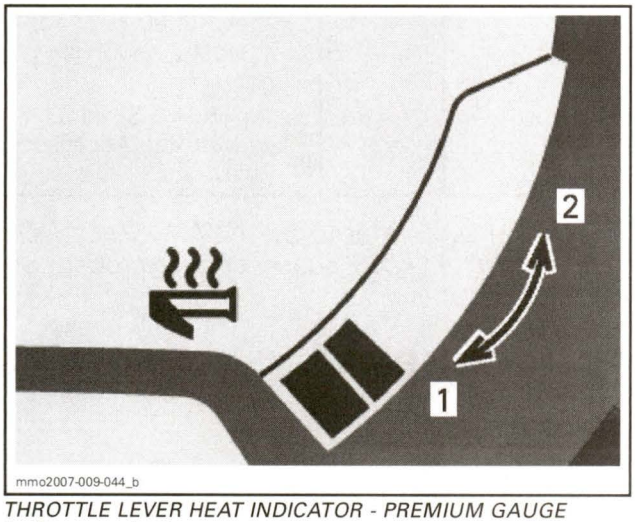
The throttle lever heat is controlled through the gauge.

A three position switch on the LH multifunction switch allows selection of 9 heat levels, which are displayed in the indicator.

NOTE: The heating intensity is displayed via the digital display with the activation of the throttle lever switch. When released, display will return to fuel tank level.

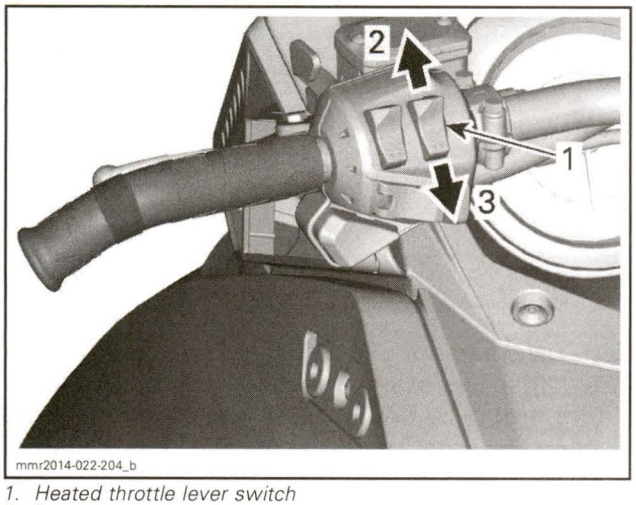


VARIABLE HEATING INTENSITY DISPLAY - STANDARD GAUGE
1. *Less heat*
2. *More heat*



THROTTLE LEVER HEAT INDICATOR - PREMIUM GAUGE
1. *Decrease heat*
2. *Increase heat*

The switch selection sends a signal to the premium gauge to increase or decrease heat.



1. *Heated throttle lever switch*
2. *Increase*
3. *Decrease*

The gauge then applies the appropriate amount of current to the heater according to the selection.

To turn OFF the heaters, select heat down until there is no more indication on the bar graph.

When released, the switch springs back to the center neutral position.

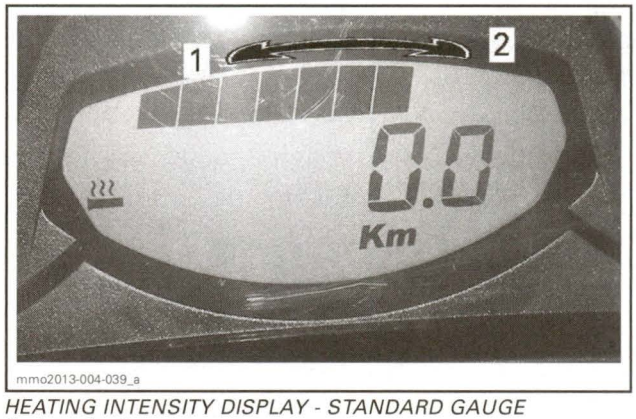
SYSTEM DESCRIPTION (HEATED HANDLEBAR GRIPS)

The type of system used is usually determined by the gauge package installed at the factory, standard gauge or premium gauge.

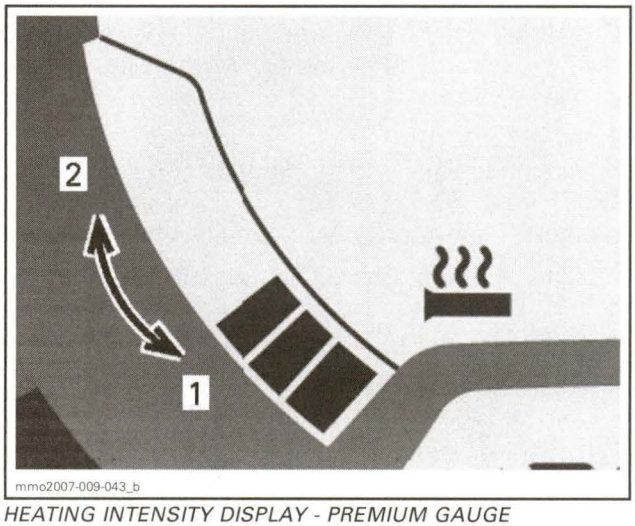
The grip heat is controlled through the gauge.

A three position switch on the LH multifunction switch allows selection of 9 heat levels, which are displayed in the indicator.

NOTE: The heating intensity is displayed via the digital display with the activation of the heated grips switch. When released, display will return to fuel tank level.

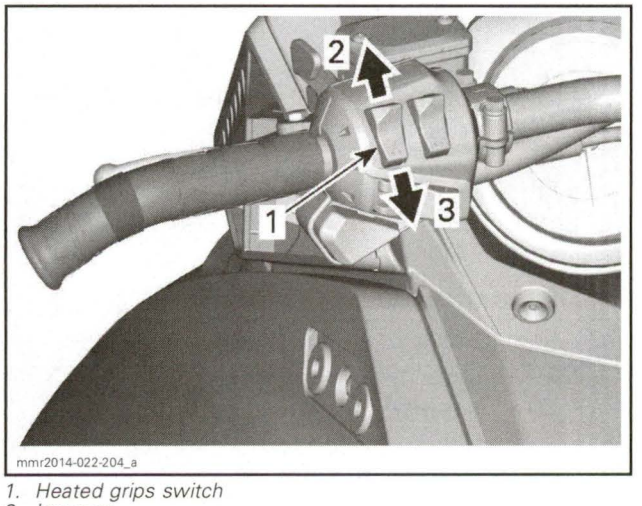


HEATING INTENSITY DISPLAY - STANDARD GAUGE
1. *Less heat*
2. *More heat*



HEATING INTENSITY DISPLAY - PREMIUM GAUGE
1. *Decrease heat*
2. *Increase heat*

The switch selection sends a signal to the premium gauge to increase or decrease heat.



1. *Heated grips switch*
2. *Increase*
3. *Decrease*

The gauge then applies the appropriate amount of current to the heater according to the selection.

To turn OFF the heaters, select heat down until there is no more indication on the bar graph.

When released, the switch springs back to the center neutral position.

TROUBLESHOOTING

LIGHTING AND ACCESSORIES SYSTEM TESTING

All vehicle lights are powered from the primary 12 Vdc circuit. This circuit is powered from and controlled by the ECM when the engine reaches 800 RPM. The accessories circuit is powered from and controlled by the ECM when the engine reaches 2000 RPM.

There are no relays or fuses outside the ECM to test or replace for the light circuits. Refer to *CHARGING SYSTEM* for more information on testing the primary 12 Vdc circuits.

If a light does not come ON, carry out the following:

- Obtain access to the bulb and make sure it is not burnt.
- Test for input voltage to the bulb.
- Test for continuity of the ground circuit.
- Test the applicable control switch (brake switch, headlight switch).

Refer to *WIRING DIAGRAM* for circuit details.

To provide power to specific circuits, refer to the following chart to meet the required conditions.

SYSTEM	MODEL	CONDITIONS REQUIRED
– Lights – Gauge – Heaters	All	– POWER INTERFACE (P/N 515 177 223) – 12 V BATTERY SUPPLY CABLE (P/N 529 035 997) (for **manual start**) – 12-volt battery (for **manual start**)
– Heaters	All	– Start engine and rev above 2000 RPM for at least 2 seconds – OR Use B.U.D.S. and activate the Accessory Relay

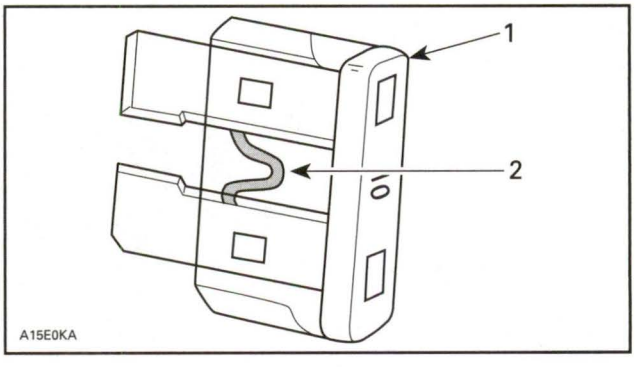
To use B.U.D.S., refer to the *COMMUNICATION TOOLS AND B.U.D.S.* subsection for proper connections.

PROCEDURES

FUSES

Fuse Inspection

Check if filament is melted. Replace as necessary.

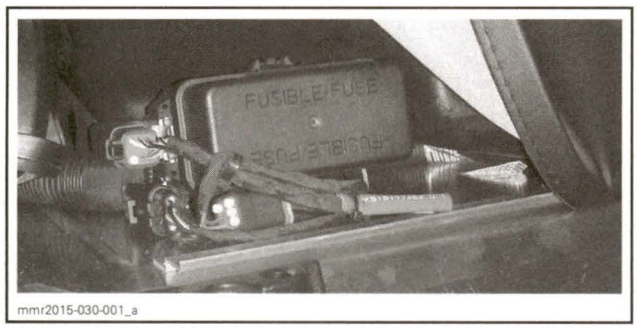


1. *Fuse*
2. *Check if melted*

NOTICE **Do not use a higher rated fuse as this can cause severe damage to electric components and/or a fire. If fuse has burnt out, the cause of the malfunction should be determined and corrected before restarting.**

Fuse Location

All fuses are located under the seat.



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FL SIDE OF SEAT

Fuse Description

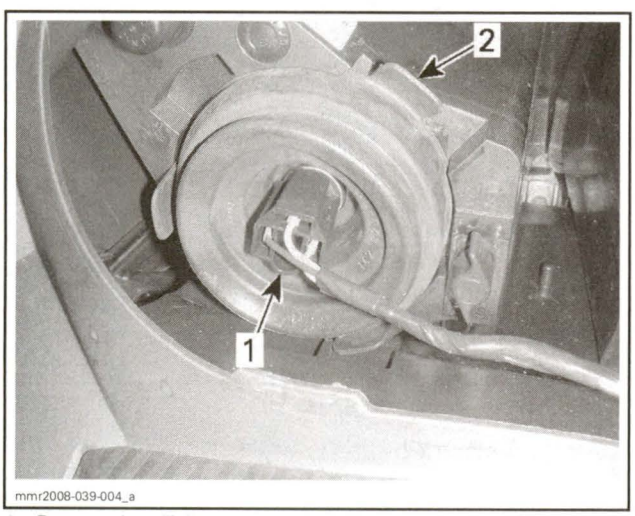
FUSE	DESCRIPTION	LOCATION
30 A	Battery charging (F1)	Fuse box
5 A	START (F2)	Fuse box

HEADLIGHTS

Headlight Bulb Removal

If a headlight bulb is burnt, proceed as follows.

1. Remove multifunction gauge to gain access to headlight bulbs, see procedure in this section.
2. Remove bulb connector.
3. Remove top and center portion of rubber boot from headlight.



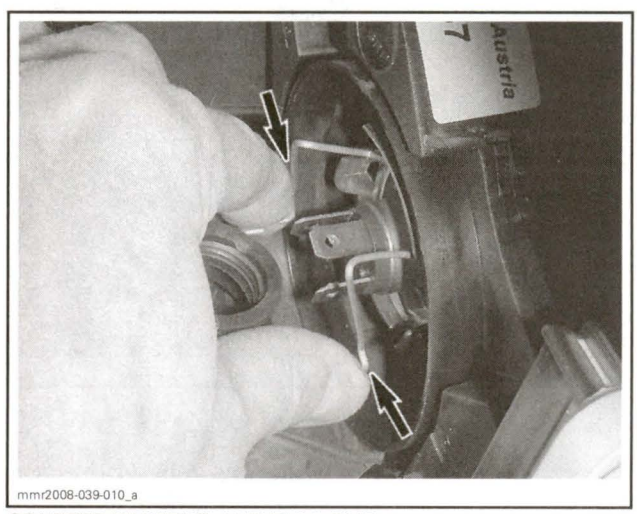
mmr2008-039-004_a

1. Remove headlight connector
2. Remove rubber boot

NOTE: It is not necessary to fully remove rubber boot.


mmr2008-039-005

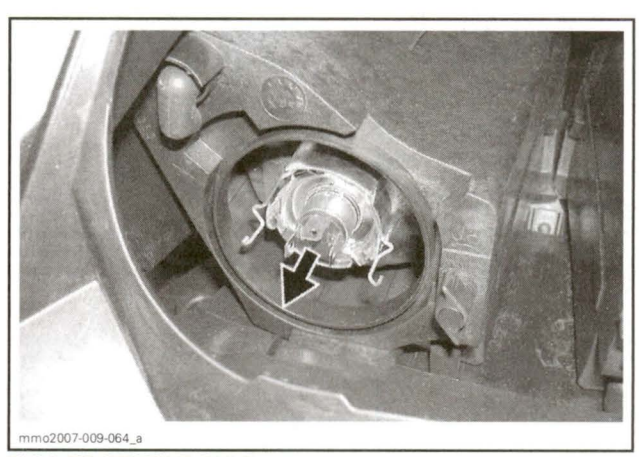
4. Press both sides of the bulb holder (spring clip) inwards at the same time, and pull it out to release it from the bulb support.



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SQUEEZE INWARDS AND PULL OUT

5. Pull bulb from headlight.


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PULL TO REMOVE BULB

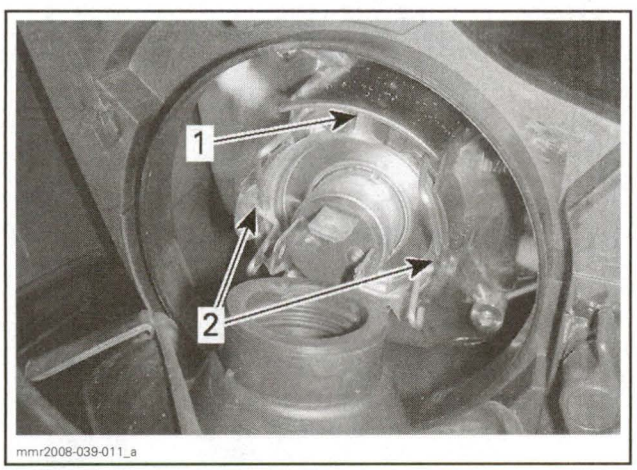
Headlight Bulb Installation

NOTICE **Never touch glass portion of a halogen bulb with bare fingers, it shortens its operating life. If glass is touched, clean it with isopropyl alcohol which will not leave a film on the bulb.**

1. Insert bulb in headlight.

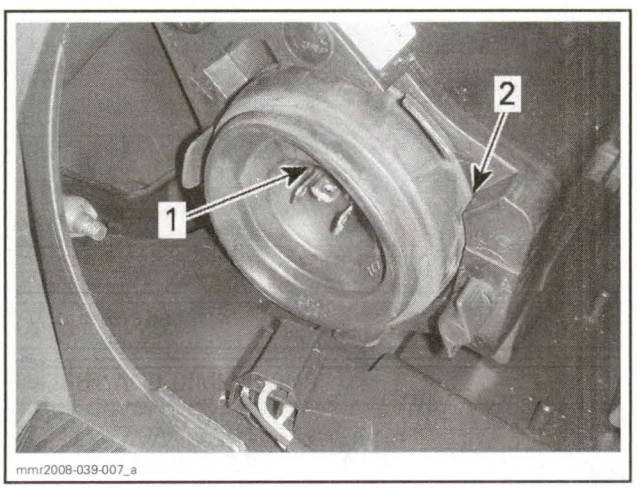
NOTE: Widest alignment tab on bulb should be at top of headlight.

2. Insert top of bulb holder (spring clip) as you squeeze the two sides inwards. Release bulb holder so that it locks in the grooves on either side of headlight.



1. Wide bulb tab
2. Bulb holder locked

3. Install rubber boot. Ensure cover is properly inserted in groove provided in the headlight, and around the base of the bulb.



1. Insert around bulb
2. Insert in groove provided

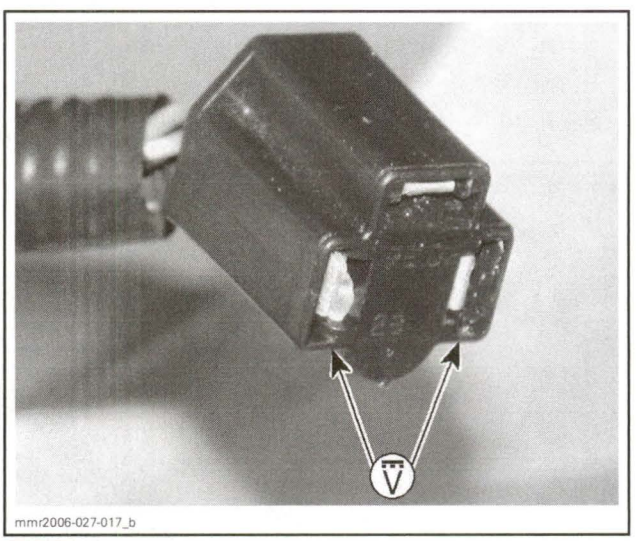
4. Install light connector.
5. Always test light operation after bulb replacement.
6. Install gauge, see procedure in this section.

Headlight Input Voltage Test

If a headlight does not function, proceed as follows.

1. Remove multifunction gauge, see procedure in this subsection.
2. Disconnect headlight connector(s).
3. Provide electrical power to the headlights for testing. Refer to *LIGHTING AND ACCESSORIES SYSTEM TESTING* in the *TROUBLESHOOTING* topic at the beginning of this subsection for proper procedure.
4. Read voltage at headlight connector as follows.

SWITCH POSITION	WIRE COLOR (HEADLIGHT CONNECTOR)		VOLTAGE
LO beam	GY	BK	Battery voltage (Vdc)
HI beam	GY/WH	BK	



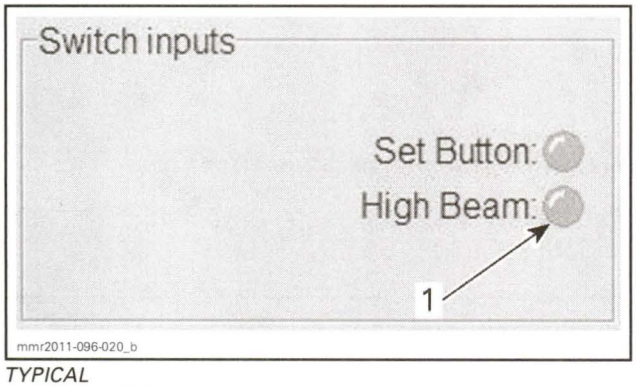
TYPICAL

If voltage is inadequate, carry out the following to find the source of the problem:

- Test headlights dimmer switch. Refer to *HEADLIGHT DIMMER SWITCH CONTINUITY TESTING* in this subsection.
- Test wiring harness and connectors.
- Test primary 12 Vdc system. Refer to *CHARGING SYSTEM*.

Headlight Dimmer Switch Test with B.U.D.S.

1. Using the B.U.D.S. software, select the **Monitoring** tab.
2. On the bottom of the page, choose the **Cluster** tab.
3. Set vehicle dimmer switch to High Beam and look for applicable indicator light in the **Switch inputs** field to turn green.

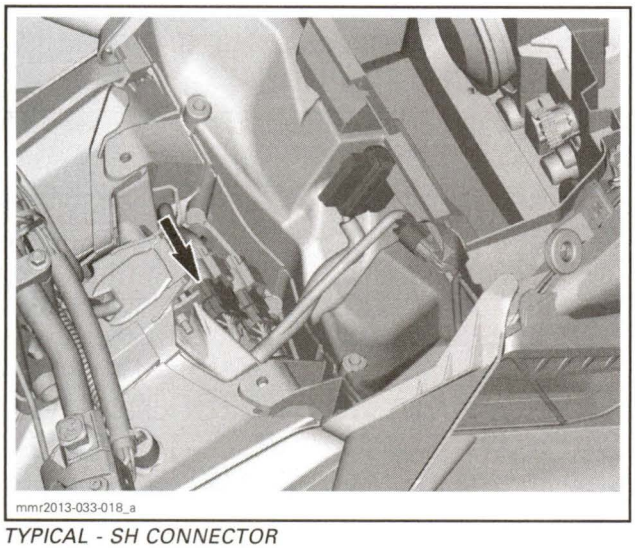


TYPICAL
1. Indicator light

If the indicator light come ON in B.U.D.S., the dimmer switch is functioning correctly.

Headlight Dimmer Switch Continuity Test

1. Remove the gauge.
2. Disconnect the SH-2 connector (12 positions).



TYPICAL - SH CONNECTOR

3. Using the FLUKE 115 MULTIMETER (P/N 529 035 868), select the Ω position.
4. Test switch circuits on SH-1 connector (12 positions) on harness side as per table.

HEADLIGHT DIMMER SWITCH CONTINUITY TEST			
SWITCH POSITION	SH-1		RESISTANCE
HIGH	M	L	Close to 0 Ω
	F	L	Infinite (OL)
LOW	F	L	Infinite (OL)
	M	L	Close to 0 Ω

If tests were good, switch is functioning properly.

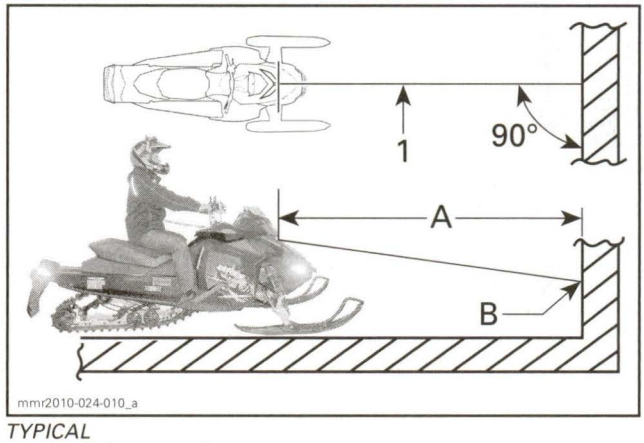
If any test failed, check wiring and connections going to switch.

If test of wiring and connections was good, replace switch.

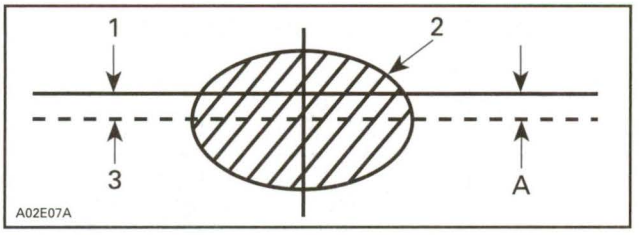
Headlight Beam Aiming

Beam aiming is correct when center of high beam is 25 mm (1 in) below the headlight horizontal center line, scribed on a test surface, 381 cm (12 ft 6 in) away.

1. Place the vehicle on a flat surface perpendicular to test surface (wall or screen) and 381 cm (12 ft 6 in) away from it.
2. Ask rider to sit on vehicle seat, or apply equivalent weight on the vehicle.
3. Select **high** beam.
4. Measure headlight center distance from ground. Scribe a line at this height on test surface (wall or screen). Light beam center should be 25 mm (1 in) below scribed line.



TYPICAL
1. Headlight center line
A. 381 cm (12 ft 6 in)
B. 25 mm (1 in) below center line



1. Headlight horizontal
2. Light beam (high beam) (projected on the wall)
3. Light beam center
A. 25 mm (1 in)

Beam Aiming Adjustment

Open the front storage compartment.

Turn knob clockwise to lower the beam height.

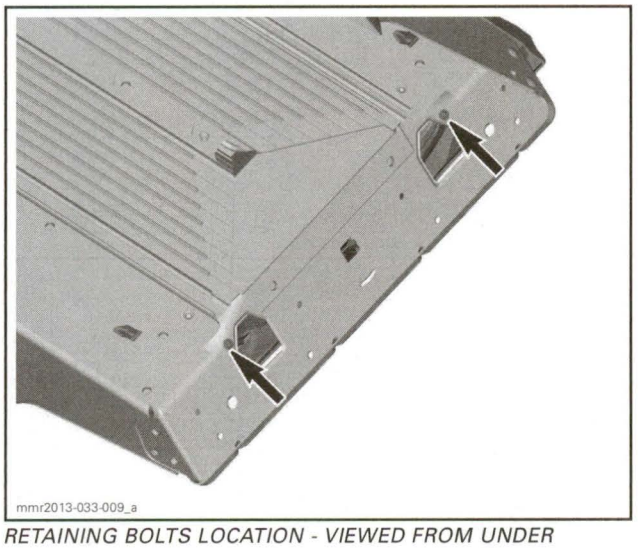
Turn knob counterclockwise to raise the beam height.

NOTE: Avoid reaching extreme adjustments as the headlight assembly might move out of position.

TAILLIGHT

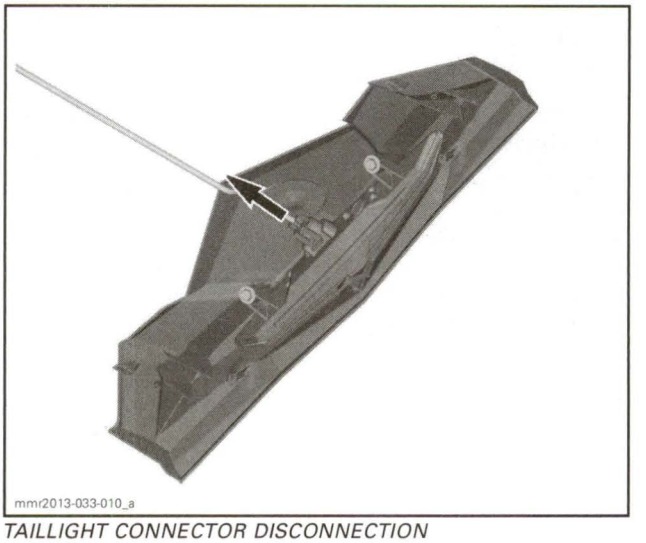
Taillight Replacement

Remove both retaining bolts securing rear taillight to frame.



RETAINING BOLTS LOCATION - VIEWED FROM UNDER

Pull rear taillight support out of location and disconnect taillight connector.



TAILLIGHT CONNECTOR DISCONNECTION

Remove both retaining screws securing taillight to taillight support.



RETAINING BOLTS SECURING TAILLIGHT TO TAILLIGHT SUPPORT

Replace taillight.

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

TIGHTENING TORQUE	
Taillight retaining screw	0.4 N•m (4 lbf•**in**)

GAUGE

Gauge Self Test Function

On **ECM wake-up**, the gauge will perform a self-test. All indications should come ON and gauge pointers will cycle once. You will have a few seconds to ensure the indications (**LEDs** and **LCDs**) are functioning correctly.

During wake-up, the gauge will display the key type installed on the post (normal or learning). Refer to *INTELLIGENT THROTTLE CONTROL (ITC)* subsection for more information on key types.

NOTE: This test only validates the gauge operation of the **LEDs**, **LCDs** in the gauge digital display and the pointers. It does not test the actual circuit functions related to each indication.

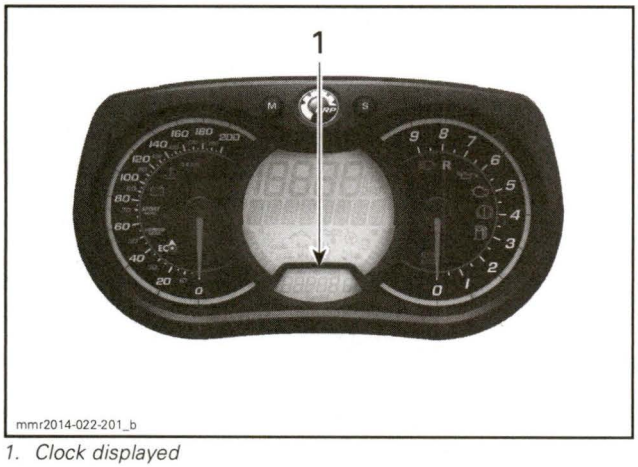
If the self test does not take place, proceed with the *GAUGE POWER INPUT TEST*.

Gauge Setup

Clock Activation (Premium Gauge)

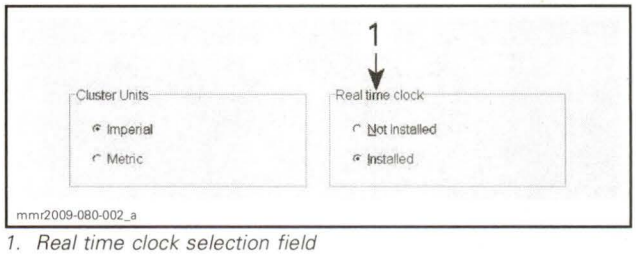
The gauge has an internal clock that can display the time of day in the lower digital display (when selected).

This clock requires power from the vehicle battery to maintain the proper time of day.



1. Clock displayed

1. Provide electrical power to the gauge, refer to *LIGHTING AND ACCESSORIES SYSTEM TESTING* in the *TROUBLESHOOTING* topic at the beginning of this subsection.
2. In B.U.D.S., select the **Setting** tab.
3. At the bottom of the page, select the **Cluster** tab.
4. Select the **Installed** in the **Real time clock** field if the vehicle is equipped with a battery. Choose **Not installed** if the vehicle does not have a battery.



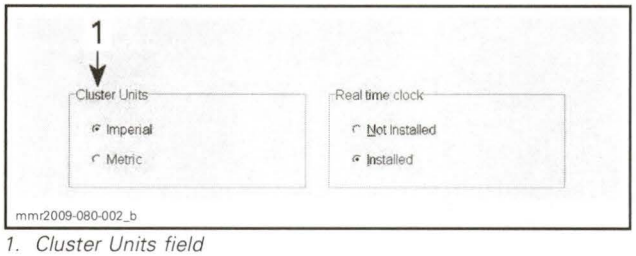
1. Real time clock selection field

Changing Gauge Units of Measurement

The gauges are factory preset to indicate in metric units and can be changed using the B.U.D.S. software.

To change the gauge units of measurement in B.U.D.S.:

1. Provide electrical power to the gauge, refer to *LIGHTING AND ACCESSORIES SYSTEM TESTING* in the *TROUBLESHOOTING* topic at the beginning of this subsection for proper procedure.
2. In B.U.D.S., select the **Setting** tab.
3. At the bottom of the page, select the **Cluster** tab.
4. Select **Imperial** or **Metric** in the **Cluster Units** field.

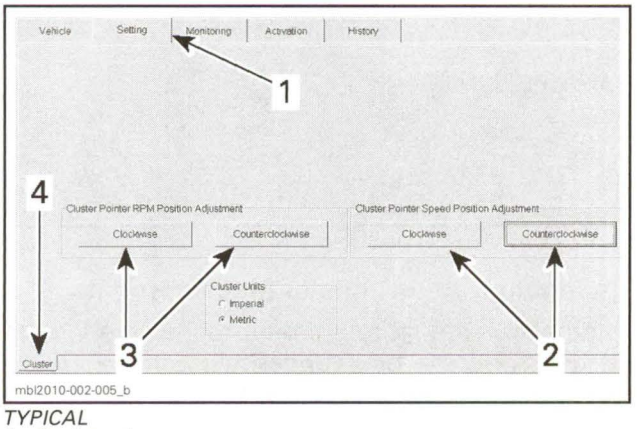


1. Cluster Units field

NOTE: Speedometer, odometer and trip meter will have their units (kilometer or miles) changed simultaneously.

Speedometer and Tachometer Pointer Adjustment

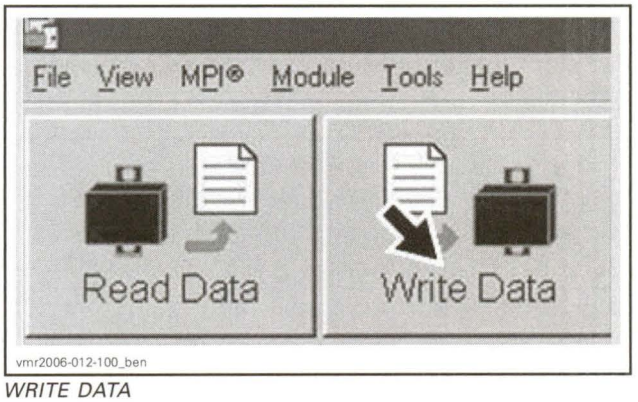
1. Make connections to use B.U.D.S. Refer to *COMMUNICATION TOOLS AND B.U.D.S.*
2. In B.U.D.S., select the **Setting** tab.
3. At the bottom of the page, select the **Cluster** tab.
4. Ensure to be facing gauge to prevent parallax error.
5. Click on **Clockwise** or **Counterclockwise** button to align gauge pointer with the zero (0).



TYPICAL
1. *Setting tab*
2. *Speedometer pointer buttons*
3. *Tachometer pointer buttons*
4. *Cluster tab*

NOTE: Because of the fine tuning of the pointer, the button must be pressed several times before perceiving pointer movement.

6. Click on **Write Data** to save the new setting in the gauge.



WRITE DATA

Displaying "P" Codes (Premium Gauge Only)

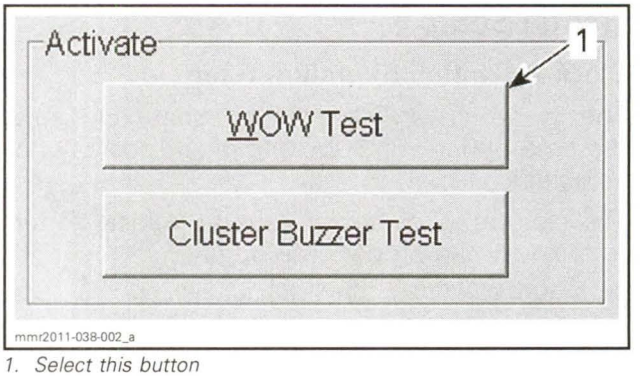
1. To activate **P CODE** mode, push and hold the "M" button for 2 seconds.
2. As you hold the "**M**" button, quickly turn ON and OFF the high beams a few times. The gauge will enter **P CODE** mode.
3. While in **P CODE** mode, use the "**M**" or "**S**" button to scroll over available failure codes.
4. Push and hold the "**M**" button to exit **P CODE** mode.

A **NO ACTIVE P CODE** message is displayed if there are no **P CODES** in memory.

Gauge Test With B.U.D.S.

The *GAUGE SELF TEST* can be duplicated using B.U.D.S.

1. Connect vehicle to B.U.D.S. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. In B.U.D.S.,choose the **Activation** tab.
3. At the bottom of the page, select the **Cluster** tab.
4. Select **WOW Test** in the **Activate** field.



1. *Select this button*

Gauge Power Input Test (Main 12 Vdc)

If the gauge does not come on when the engine is started, carry out the following test.

1. Remove multifunction gauge.
2. Disconnect the gauge connector.
3. Set multimeter to Vdc.
4. Start engine.
5. Measure voltage with the battery ground as per following table.

GAUGE CONNECTOR	VOLTAGE
Pin 8 (RD/GY)	Approximately 14 Vdc

6. If gauge main power input test was as specified, carry out the gauge *GROUND CIRCUIT CONTINUITY TEST.*
7. If no voltage was read, test wiring continuity. Refer to *WIRING DIAGRAM* for details.

NOTE: The gauge receives its main power input directly from the primary 12 Vdc bus. There are no fuses or relays to test, only wiring and connectors.

Gauge Ground Circuit Continuity Test

1. Set multimeter to Ω selection.
2. Measure for continuity of gauge ground wire as per following table.

GAUGE CONNECTOR	RESISTANCE
Pin 11 (BK)	Close to 0 Ω

If ground test failed, check vehicle ground. Refer to *POWER DISTRIBUTION* subsection.

If gauge power input test and ground circuit continuity tests are good, replace gauge.

Clock 12 Vdc Input Test (Premium Gauge)

If the clock function in the premium gauge does not hold the proper time of day when the engine is not running, carry out the following test.

NOTE: The clock receives 12 Vdc from the battery through (F2) in order to maintain correct time when the engine is not running.

1. Remove multifunction gauge.
2. Disconnect the gauge connector.
3. Set multimeter to Vdc.
4. Measure voltage as per following table.

MODELS	GAUGE CONNECTOR	VOLTAGE
All	Pin 9 (RD/BN)	Battery voltage

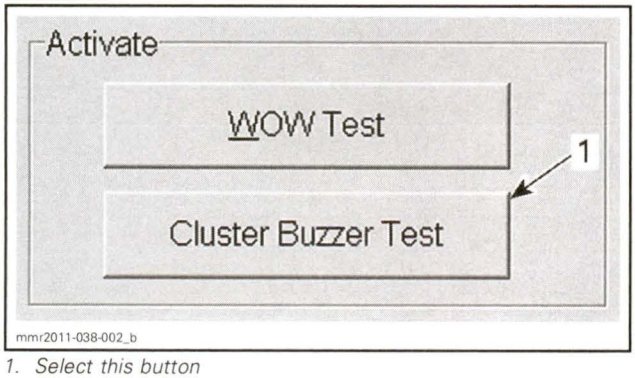
NOTE: If the START fuse was open, the electrical start function, as well as the electro-mechanical reverse would not be operational.

5. If there is no voltage read, test input wire continuity. Refer to *WIRING DIAGRAM* for circuit details.

Gauge Beeper Test

To test beeper, perform the following test with B.U.D.S.

1. Connect vehicle to B.U.D.S. Refer to *COMMUNICATION TOOLS AND B.U.D.S.*
2. In B.U.D.S., choose the **Activation** tab.
3. At the bottom of the page, select the **Cluster** tab.
4. Select **Cluster Buzzer Test** in the **Activate** field.



1. Select this button

You should hear a few beeps.

– If you do not hear the beeper, replace gauge.

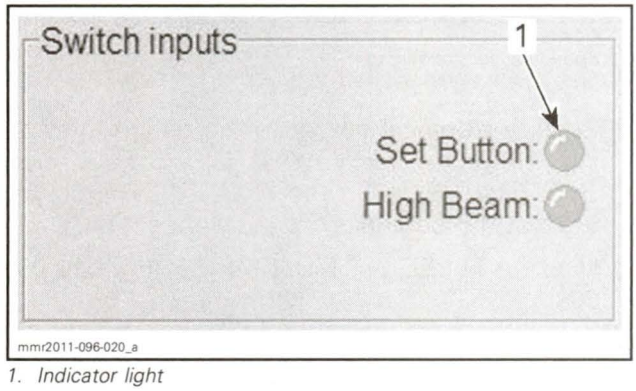
Gauge Button Test with B.U.D.S.

Using the B.U.D.S. software, select the **Monitoring** tab.

On the bottom of the page, choose the **Cluster** tab.

Standard Gauge

Press on the gauge "S" button and look for applicable indicator light in the **Switch inputs** field to turn green.



1. Indicator light

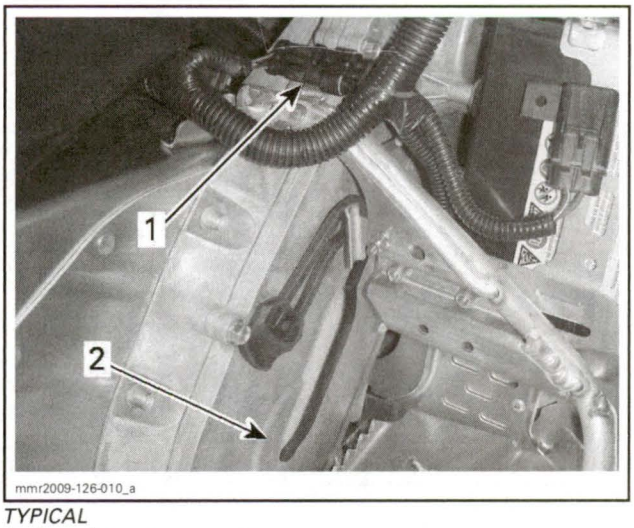
If the indicator light(s) come ON in B.U.D.S., the gauge button(s) is(are) functioning correctly.

If the indicator light(s) do not come ON, check button(s). If they are in good condition, replace gauge.

Gauge Speedometer Function Test

First ensure the gauge pointer is not stuck. Refer to *GAUGE TEST WITH B.U.D.S.* in this subsection.

1. Unplug speed sensor connector.



TYPICAL
1. *Speed sensor connector*
2. *Speed sensor (inside cover)*

2. Provide electrical power to the gauge for testing. Refer to *LIGHTING AND ACCESSORIES SYSTEM TESTING* in the *TROUBLESHOOTING* topic at the beginning of this subsection.
3. Use the FLUKE 115 MULTIMETER (P/N 529 035 868).
4. Set multimeter to Vdc.
5. Probe connector on vehicle harness side as per table.

GAUGE VOLTAGE TEST		
SPEED SENSOR CONNECTOR (MAIN HARNESS SIDE)		VOLTAGE
RD/BK	BK/RD	Close to battery voltage
GN/WH	BK/RD	Close to battery voltage

If test succeeded, gauge is good, proceed with *SPEED SENSOR SIGNAL TEST.*

If test failed, check wiring harness going to gauge. If wiring harness is good, replace gauge.

Gauge Fuel Level Function Test

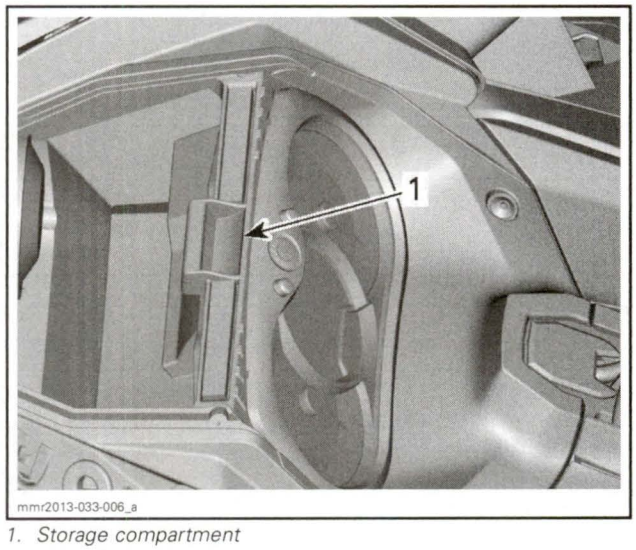
1. Unplug fuel pump connector.
2. Provide electrical power to the gauge for testing. Refer to *LIGHTING AND ACCESSORIES SYSTEM TESTING* in the *TROUBLESHOOTING* topic at the beginning of this subsection.
3. Use the FLUKE 115 MULTIMETER (P/N 529 035 868).
4. Set multimeter to Vdc.
5. Probe connector on vehicle harness side as per table.

GAUGE VOLTAGE TEST		
FUEL LEVEL SENSOR CONNECTOR (MAIN HARNESS SIDE)		VOLTAGE
BU	RD/BK	Approximately 5 V

If test succeeded, gauge is good, proceed with *FUEL LEVEL SENSOR TEST* in *FUEL TANK AND FUEL PUMP* subsection.

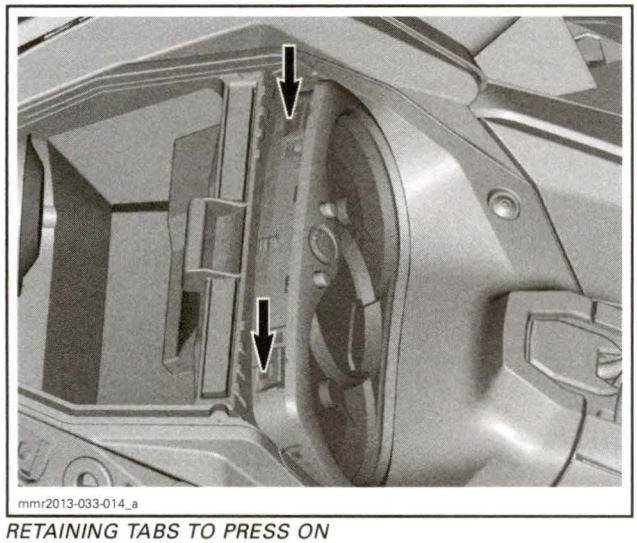
If test failed, check wiring harness going to gauge. If wiring harness is good, replace gauge.

Gauge Removal



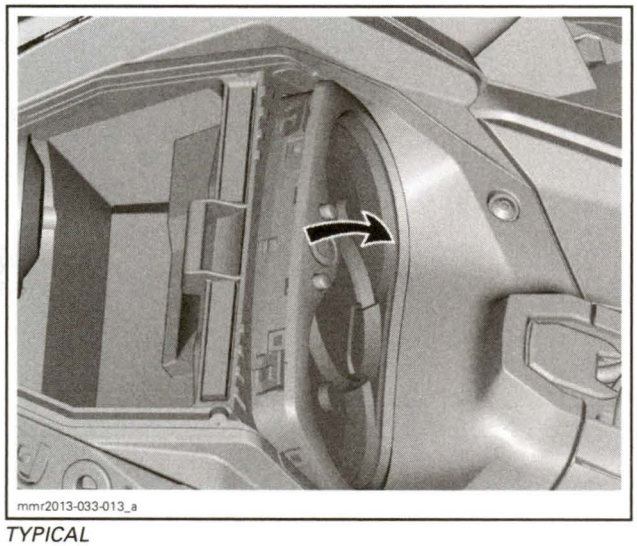
1. *Storage compartment*

1. Insert a small screwdriver in one of the rectangular slots at top of gauge.
2. As you gently press down on the screwdriver to release multifunction gauge locking tab, pull out and hold gauge in position.
3. Insert screwdriver in second hole and press to release other tab.


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RETAINING TABS TO PRESS ON

4. Gently pull multifunction gauge from gauge support.


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TYPICAL

5. Press on connector locking tab and pull connector off gauge.
6. Store gauge in a secure area to prevent it from being damaged.

Gauge Installation

1. Carefully align and install gauge connector, pressing it in until connector lock engages.
2. Insert bottom of gauge in gauge holder.
3. Press top of gauge in holder until you feel locking tabs engage in holder.
4. Start vehicle engine and test gauge functions.

NOTE: If a new gauge is installed, refer to *GAUGE TO ECM MATCHING*.

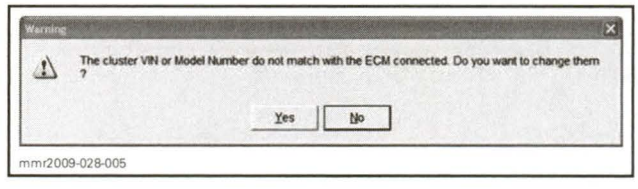
Gauge to ECM Matching

NOTE: If the gauge is replaced, the VIN (Vehicle Identification Number) and the vehicle model number must be entered in the gauge memory so they match those stored in the ECM.

If the numbers stored in the gauge do not match those stored in the ECM, the engine will start but the new gauge will stop operating within 10 seconds after the engine is started. The indicator needles will function normally but the LCD display will remain blank and the D.E.S.S. LED will be turned ON. This is a gauge antitheft feature.

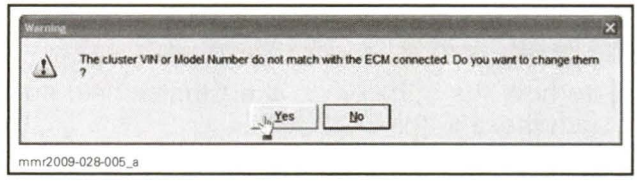
NOTE: If the ECM is replaced, the numbers stored in the ECM and gauge must match. Refer to *ECM REPLACEMENT* and *ECM DATA ENTRY*.

1. To write the VIN number and model number into the gauge, connect to the applicable B.U.D.S. version from BOSSWeb. Refer to the *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. Follow the instructions in the referenced subsection and in the software.
3. Once connected and activated, select the **Read Data** button. You will see a message similar to the following illustration.



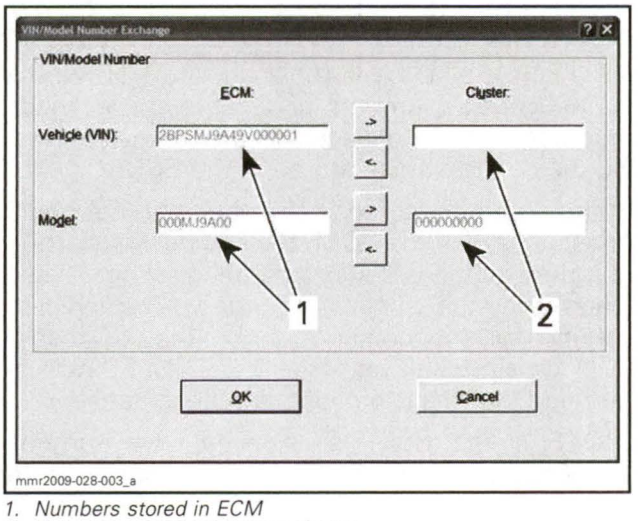
mmr2009-028-005

4. Select **Yes** in the displayed window.



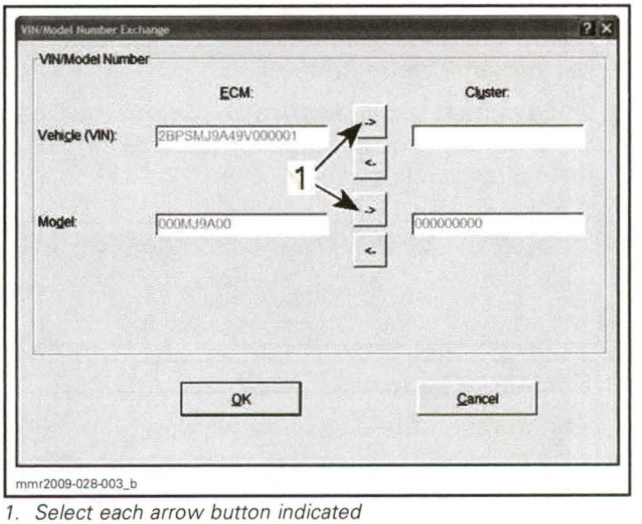
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The following window illustrates that the VIN number or model number in the ECM and cluster are not the same.



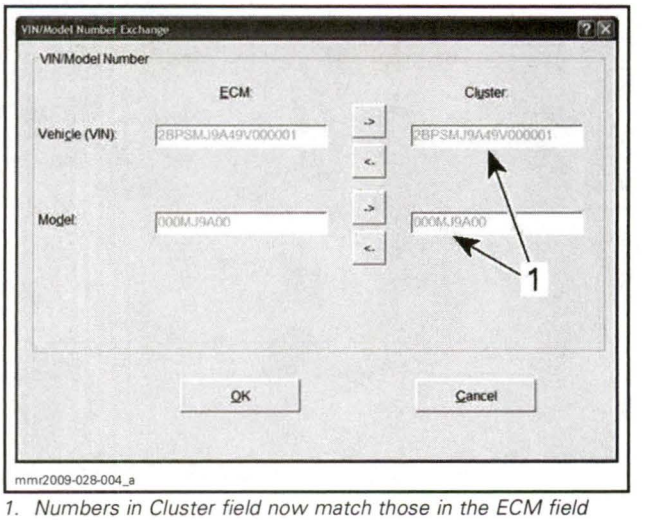
1. Numbers stored in ECM
2. No numbers stored in new cluster

5. Select each of the arrows indicated in the following illustration to copy the VIN and model numbers from the ECM to the cluster.



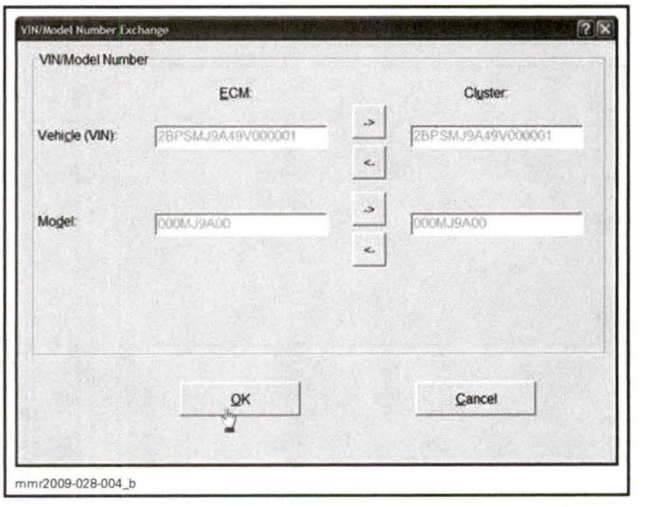
1. Select each arrow button indicated

Note how the numbers in the **Cluster** field now match those in the **ECM** field.



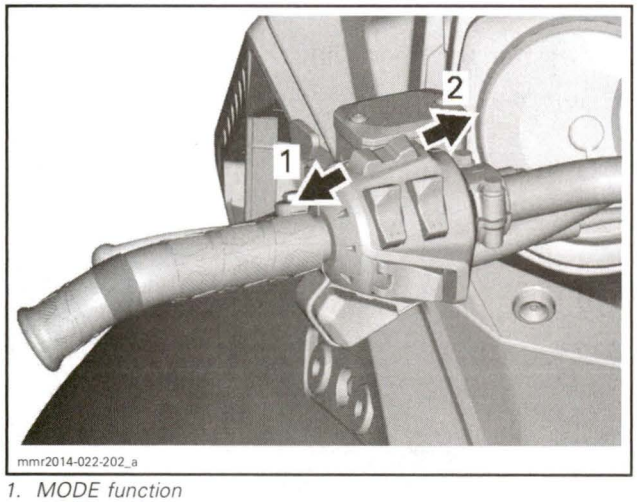
1. Numbers in Cluster field now match those in the ECM field

6. Select **OK** to continue.



7. Once the gauge has been matched to the ECM, you will need to set the units of measurement (imperial or metric). See procedures in this subsection.
8. Ensure the gauge functions properly and that all settings and indications are within parameters.
9. Be sure to set the clock function according to gauge and vehicle type, refer to *CLOCK ACTIVATION (PREMIUM GAUGE)* in this subsection.
10. Shut down vehicle and disconnect the communication tools.

REMOTE MODE AND SET BUTTONS (PREMIUM GAUGE)

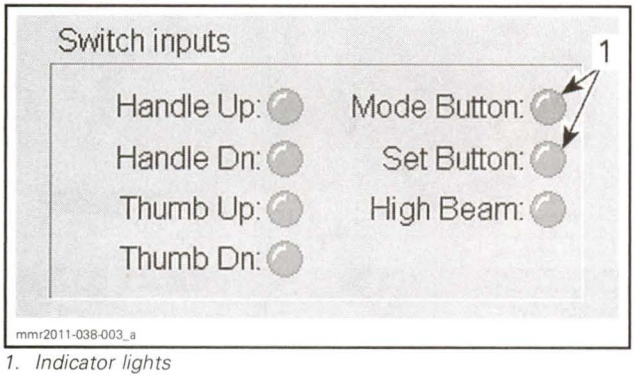


1. *MODE function*
2. *SET function*

Remote M/S Button Test with B.U.D.S.

1. Connect vehicle to the latest applicable B.U.D.S. version. Refer to the *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. Using the B.U.D.S. software, select the **Monitoring** tab.
3. On the bottom of the page, choose the **Cluster** tab.
4. Alternately press on the remote "**M**" and "**S**" buttons and look for the applicable indicator light in the **Switch inputs** field to turn GREEN.

NOTE: Indicator lights should not be GREEN when no button is pressed.



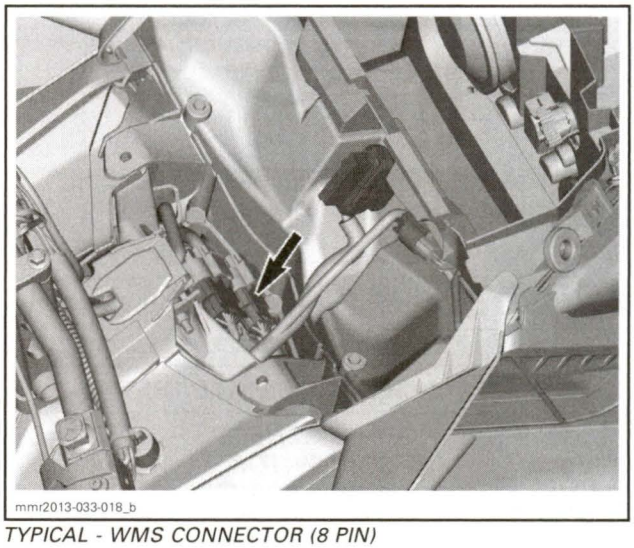
1. *Indicator lights*

If the indicator lights come ON in B.U.D.S., the remote **M/S** button is functioning correctly and the gauge receives the signals from the switches.

If the indicator lights do not come ON, verify the switch is not damaged internally, then carry out the *REMOTE M/S BUTTON CONTINUITY TEST* procedure in this subsection.

Remote M/S Button Continuity Test

1. If using the remote **M/S** button does not affect the indication, try using the buttons on the gauge. If they function, the remote **M/S** button circuit may be open.
2. Remove the gauge.
3. Disconnect the WMS connector (8 pin).



TYPICAL - WMS CONNECTOR (8 PIN)

4. Using a multimeter set to Ω, carry out the following continuity test.

REMOTE M/S BUTTON TEST			
SWITCH SELECTION	WMS CONNECTOR (8 PIN) WIRE		RESISTANCE
Centered	Pin B (YE/BN)	Pin A (BK)	Infinite Ω
	Pin G (YE/GN)		
M	Pin B (YE/BN)	Pin A (BK)	Close to 0 Ω
S	Pin G (YE/GN)		

If you do not obtain the values as specified, repair or replace switch, wiring and connections.

SPEED SENSOR

Speed Sensor Location

The speed sensor is mounted in the chaincase cover.

Speed Sensor Signal Test

First proceed with the *GAUGE SPEEDOMETER FUNCTION TEST* in this subsection.

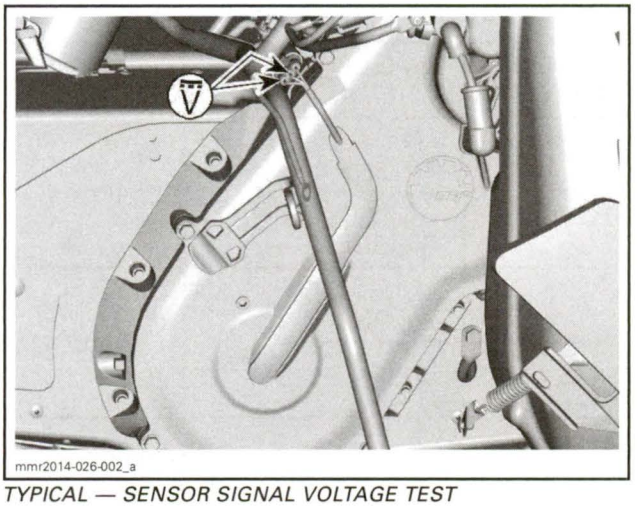
1. Lift and support rear of vehicle.

⚠ CAUTION Use proper lifting techniques, notably using your leg force. Do not attempt to lift the vehicle if it is above your limits.

2. Ensure speed sensor connector is properly connected.
3. Provide electrical power to the gauge for testing. Refer to *LIGHTING AND ACCESSORIES SYSTEM TESTING* in the *TROUBLESHOOTING* topic at the beginning of this subsection for proper procedure.
4. Rotate driven pulley so that tracks rotates slowly.
5. Back-probe connector with Fluke TP88 rigid back probe pins or equivalent, between wires as per table.

NOTICE Be careful not to damage connector seals when back probing.

SPEED SENSOR SIGNAL TEST			
ROTATE DRIVEN PULLEY	SPEED SENSOR CONNECTOR (SENSOR SIDE)		VOLTAGE
	GN	BK	Alternate 7 Vdc and 0 Vdc



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TYPICAL — SENSOR SIGNAL VOLTAGE TEST

The signal voltage should alternate between approximately 12 Vdc and 0 Vdc.

If test failed, replace the speed sensor.

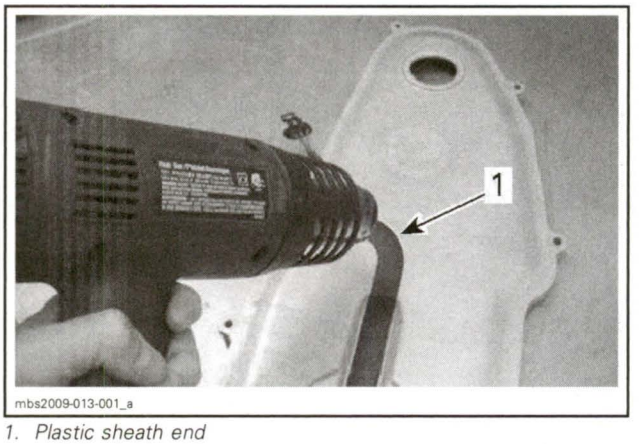
Speed Sensor Replacement

The sensor can be replaced with the chaincase cover as an assembly. In such a case, refer to *CHAINCASE* subsection.

To replace sensor only, proceed as follows.

Speed Sensor Removal

1. Remove chaincase cover, refer to *CHAINCASE* subsection.
2. Using a heat gun, heat the speed sensor at plastic sheath end.

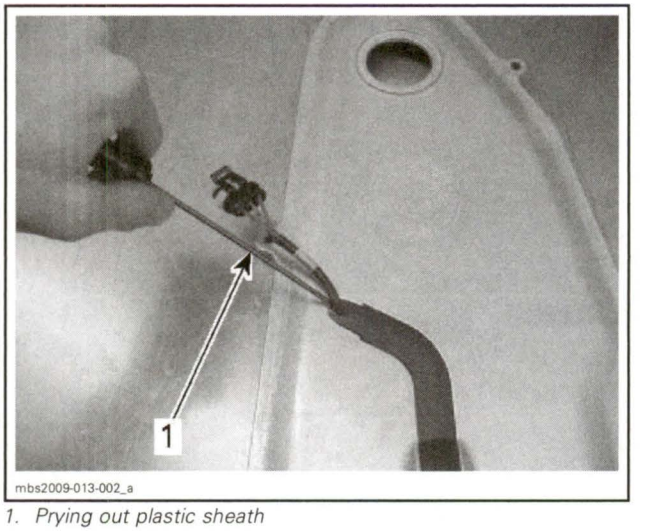


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1. Plastic sheath end

NOTE: Plastic sheath color will slightly change, which tells it is adequately heated.

3. Use a flat screwdriver to pry out the end of the plastic sheath from chaincase cover.



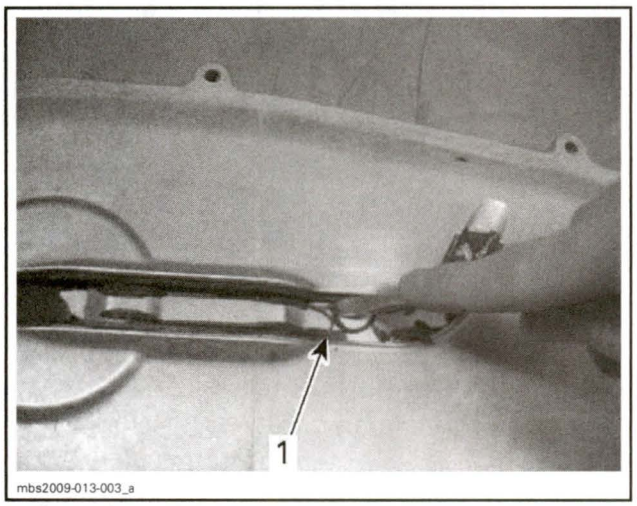
mbs2009-013-002_a

1. Prying out plastic sheath

NOTICE Use care when prying out the plastic sheath not to damage the chaincase cover.

4. Heat the next section of the plastic sheath.
5. Pry out the heated section using the flat screwdriver.

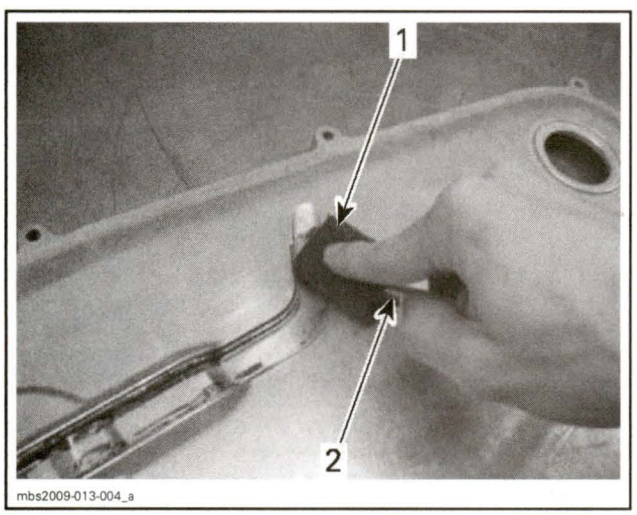
6. Repeat steps 4 and 5 until the plastic sheath is completely removed.
7. Use the flat screwdriver to remove the remaining sealant from the chaincase cover.



1. Remaining sealant

NOTICE **Do not apply excessive pressure when removing the remaining sealant not to damage the chaincase cover.**

8. Rub the sealant using a scouring pad.



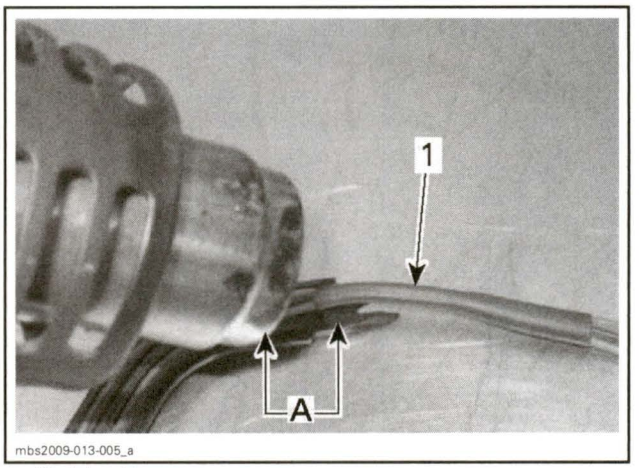
1. Scouring pad
2. Flat screwdriver

Speed Sensor Installation

1. Thoroughly clean the surface where the speed sensor is to be stuck.

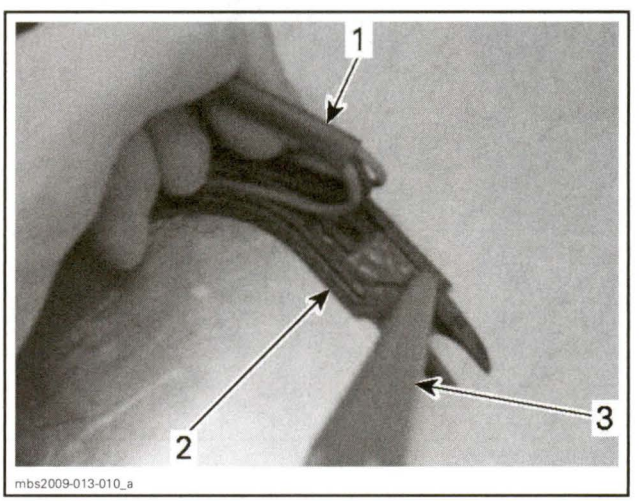
NOTE: Make sure surface is clean and free of grease.

2. Slide the shrink tubing into sensor plastic housing. The end of tubing must be inside sensor plastic housing about 15 mm (19/32 in).



1. Shrink tubing
A. 15 mm (19/32 in)

3. Apply LOCTITE 5900 (P/N 293 800 066) under the sensor wires, between the end of the guide grooves and the plastic sheath extremity.

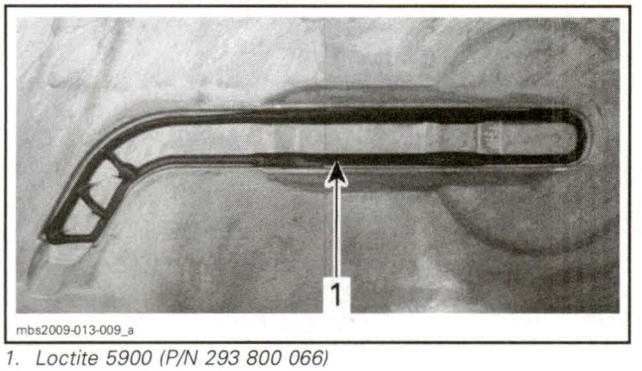


1. Sensor wires
2. Plastic sheath extremity
3. Loctite 5900 (P/N 293 800 066) bottle tip

NOTE: The assembly must be watertight.

4. Apply LOCTITE 5900 (P/N 293 800 066) all around the plastic sheath location on the chaincase cover.

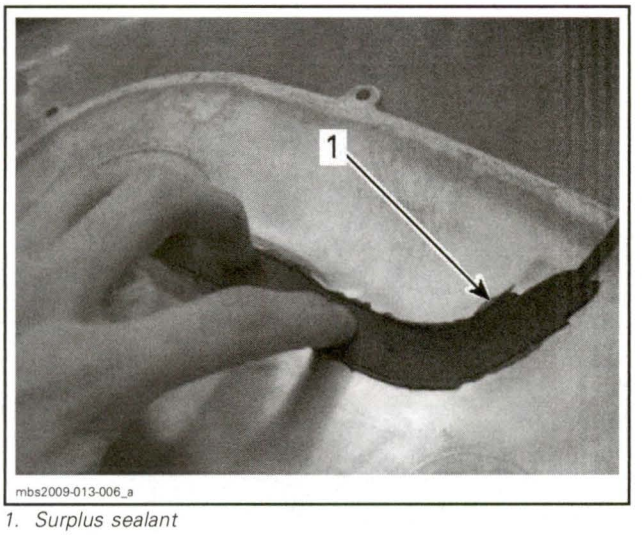
Follow the pattern shown on the next picture.



1. Loctite 5900 (P/N 293 800 066)

NOTE: Make sure the plastic sheath circumference is well covered.

5. Place the plastic sheath in position and firmly push in order to evacuate all the surplus sealant. Keep pressure for at least 1 minute.

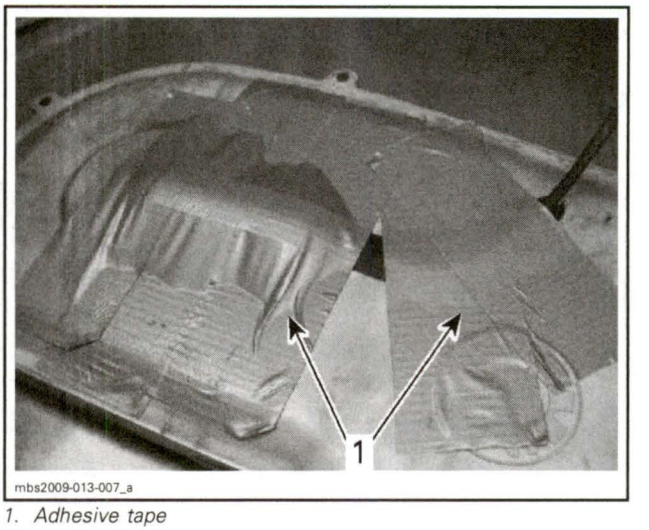


1. Surplus sealant

6. Wipe off all the sealant surplus around the plastic sheath.
7. Once cleaned up, inspect all the circumference for sealant lacks.

NOTE: Sealant must be visible all around.

8. Place some adhesive tape on the sensor to maintain a pressure on the sensor for at least 24 hours.



1. Adhesive tape

NOTE: Wait for at least 1 hour before exposing vehicle to cold temperature.

9. Reinstall chaincase cover, refer to *CHAINCASE* subsection.

FUEL LEVEL SENSOR

First proceed with the *GAUGE FUEL LEVEL FUNCTION TEST* in this subsection.

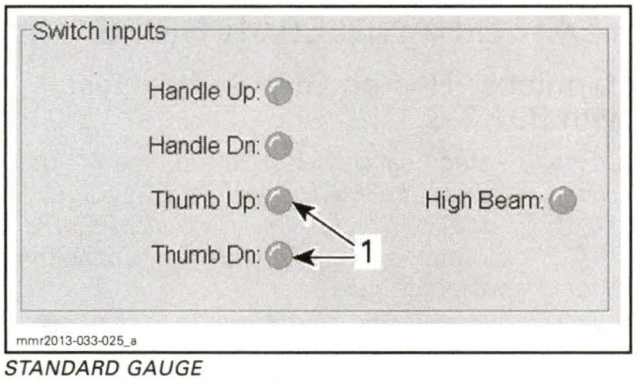
Refer to *FUEL TANK AND FUEL PUMP* for *FUEL SENSOR RESISTANCE TEST*.

HEATED THROTTLE LEVER

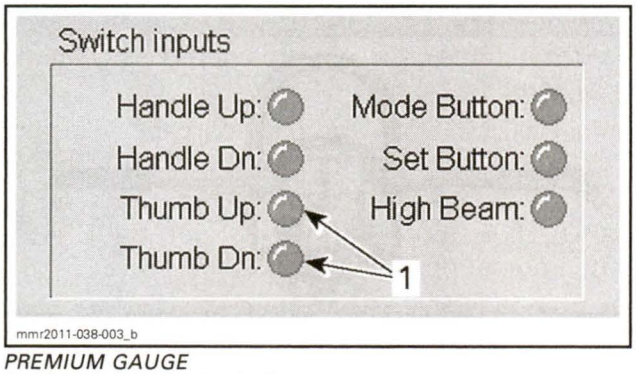
Throttle Lever Heat Switch Test with B.U.D.S.

1. Provide electrical power to the gauge for testing. Refer to *LIGHTING AND ACCESSORIES SYSTEM TESTING* in the *TROUBLESHOOTING* topic at the beginning of this subsection for proper procedure.
2. Using the B.U.D.S. software, select the **Monitoring** tab.
3. On the lower LH side of the page, choose the **Cluster** tab.
4. Press on the vehicle thumb lever heat switch to alternately increase or decrease heat.
5. In B.U.D.S., look for the applicable indicator light in the **Switch inputs** field to turn GREEN (Thumb Up or Thumb Dn).

NOTE: Indicator lights should not be GREEN when no button is pressed.



STANDARD GAUGE
1. *Throttle lever heat selection*



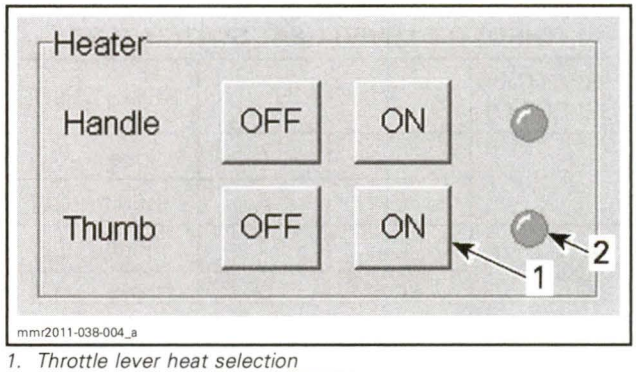
PREMIUM GAUGE
1. *Throttle lever heat selection*

If test is good, proceed with *GAUGE HEATER OUTPUT TEST WITH B.U.D.S.* in this subsection.

If test failed, proceed with *THROTTLE LEVER HEAT SWITCH TEST* in this subsection.

Gauge Heater Power Output Test with B.U.D.S.

1. Provide electrical power to the gauge for testing. Refer to *LIGHTING AND ACCESSORIES SYSTEM TESTING* in the *TROUBLESHOOTING* topic at the beginning of this subsection for proper procedure.
2. Using the B.U.D.S. software, select the **Activation** tab.
3. On the lower LH side of the page, choose the **Cluster** tab.
4. In B.U.D.S., select the **ON** button next to **Thumb**
5. Look for the indicator light next to the **ON** button to turn GREEN and touch throttle lever to confirm it heats up.



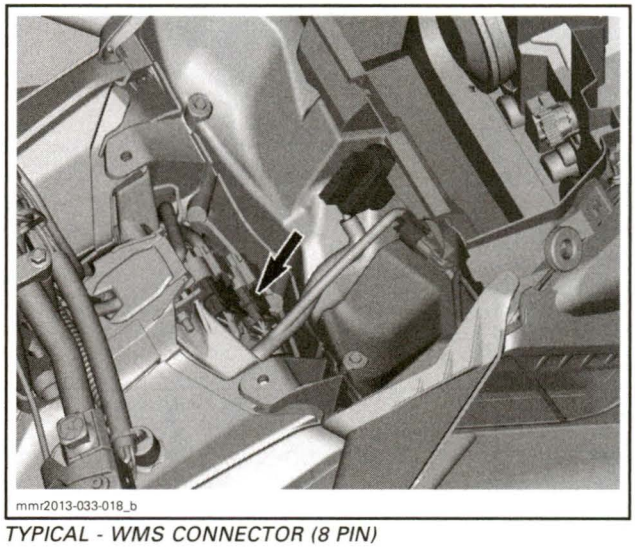
1. *Throttle lever heat selection*
2. *Indicator light should turn GREEN*

6. If test is good, the gauge output to throttle lever heater is good. Proceed with *THROTTLE LEVER HEATING ELEMENT TEST* in this subsection.
7. If the test failed, replace the gauge.

NOTE: When finished testing, ensure to select the **OFF** button next to **Thumb** in B.U.D.S.

Throttle Lever Heat Switch Test

1. Remove the gauge.
2. Disconnect the WMS connector (8 pin).



TYPICAL - WMS CONNECTOR (8 PIN)

3. Using the FLUKE 115 MULTIMETER (P/N 529 035 868), select the Ω position.
4. Test throttle lever heat switch and circuits as per table.

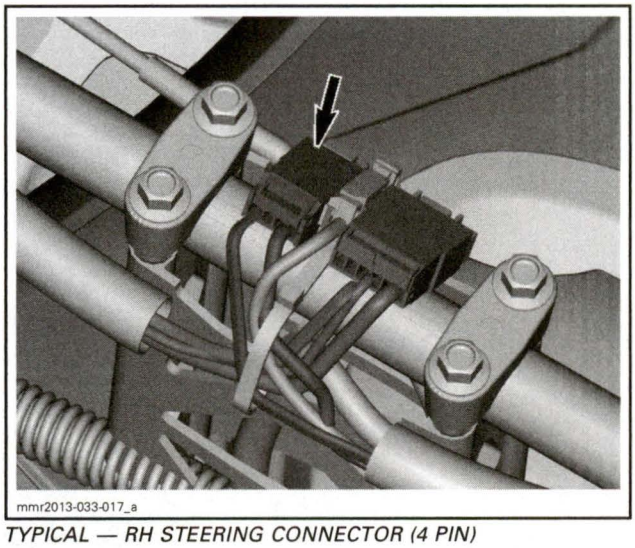
THROTTLE LEVER HEAT SWITCH TEST			
SWITCH SELECTION	WMS PIN		RESISTANCE
UP	D	A	Close to 0 Ω
	C	A	Infinite (OL)
DOWN	D	A	Infinite (OL)
	C	A	Close to 0 Ω

If continuity test is as per specification, proceed with *THROTTLE LEVER HEATING ELEMENT TEST* in this subsection.

If continuity test is out of specification, check switch circuit as per wiring diagram. If good, replace switch.

Throttle Lever Heating Element Test

1. Disconnect the RH steering connector (4 pin) located under the steering cover.



TYPICAL — RH STEERING CONNECTOR (4 PIN)

2. Carry out a resistance check of the heating elements as follows.

THROTTLE LEVER HEATING ELEMENT TEST STANDARD GAUGE			
SWITCH SELECTION	HEATER WIRE		RESISTANCE @ 20°C (68°F)
DOWN	BN/YE	BK	5.7 to 18.5 Ω
UP	BN		1.7 to 4.2 Ω

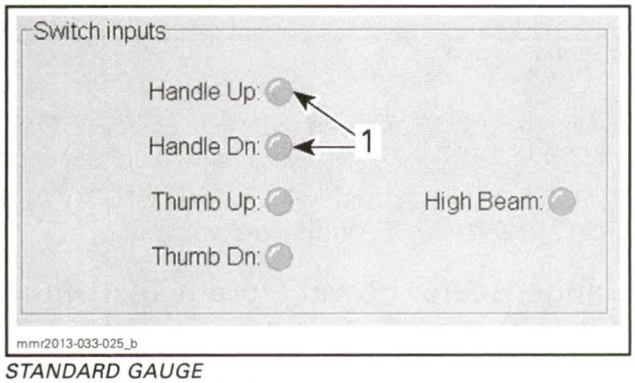
3. If readings are out of specifications, replace throttle lever.
4. If heating element readings are within specifications, check wiring and connections.
5. Reconnect connectors.

HEATED HANDLEBAR GRIPS

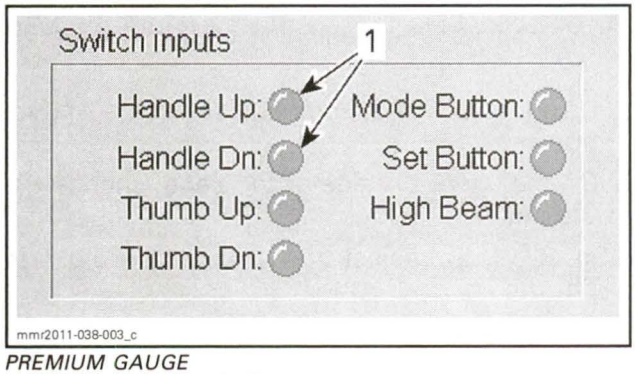
Handlebar Heated Grip Switch Test with B.U.D.S.

1. Provide electrical power to the gauge for testing. Refer to *LIGHTING AND ACCESSORIES SYSTEM TESTING* in the *TROUBLESHOOTING* topic at the beginning of this subsection for proper procedure.
2. Using the B.U.D.S. software, select the **Monitoring** tab.
3. On the lower LH side of the page, choose the **Cluster** tab.
4. Press on the vehicle handle grip heat switch to alternately increase or decrease heat.
5. In B.U.D.S., look for the applicable indicator light in the **Switch inputs** field to turn GREEN (Handle Up or Handle Dn).

NOTE: Indicator lights should not be GREEN when no button is pressed.



STANDARD GAUGE
1. Handle grip heat selection



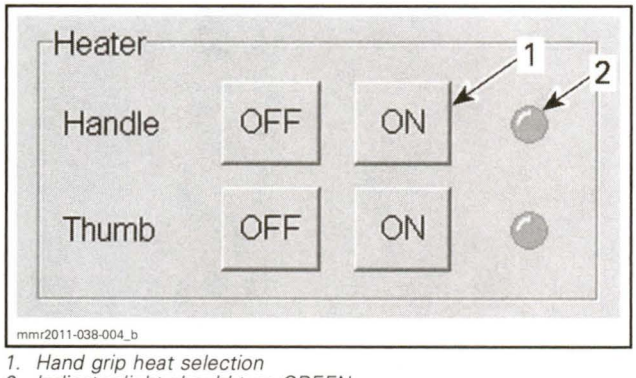
PREMIUM GAUGE
1. Handle grip heat selection

If test is good, proceed with *GAUGE HEATER OUTPUT TEST WITH B.U.D.S.* in this subsection.

If test failed, proceed with *HANDLEBAR GRIP HEAT SWITCH TEST* in this subsection.

Gauge Heater Power Output Test with B.U.D.S.

1. Provide electrical power to the gauge for testing. Refer to *LIGHTING AND ACCESSORIES SYSTEM TESTING* in the *TROUBLESHOOTING* topic at the beginning of this subsection for proper procedure.
2. Using the B.U.D.S. software, select the **Activation** tab.
3. On the lower LH side of the page, choose the **Cluster** tab.
4. In B.U.D.S., select the **ON** button next to **Handle**
5. Look for the indicator light next to the **ON** button to turn GREEN.



1. *Hand grip heat selection*
2. *Indicator light should turn GREEN*

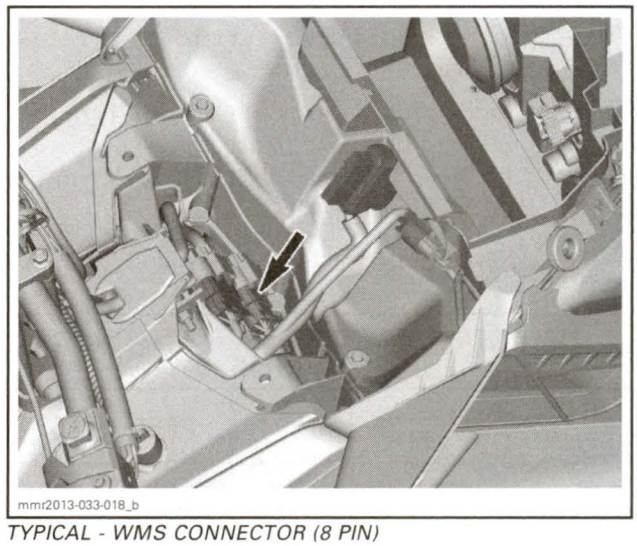
6. If test is good, the gauge heater to handlebar grip heater is good. Proceed with *HANDLEBAR GRIP HEATING ELEMENT TEST* in this subsection.
7. If the test failed, replace the gauge.

NOTE: When finished testing, ensure to select the **OFF** button next to **Handle** in B.U.D.S.

Handlebar Heated Grip Switch Test

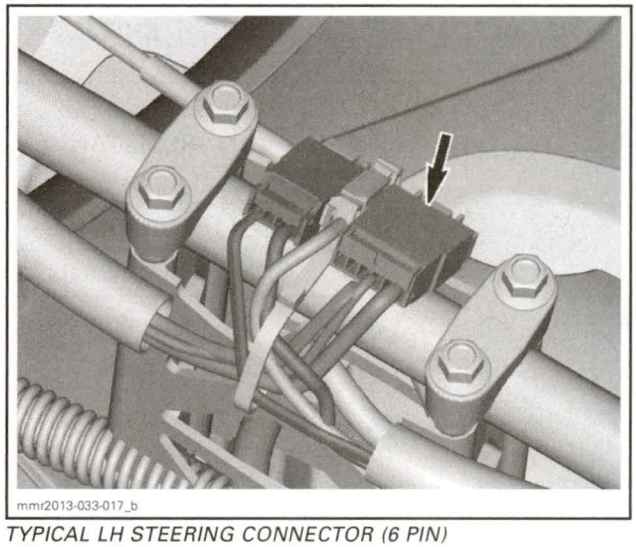
Remove the gauge.

Disconnect the WMS connector (8 pin).

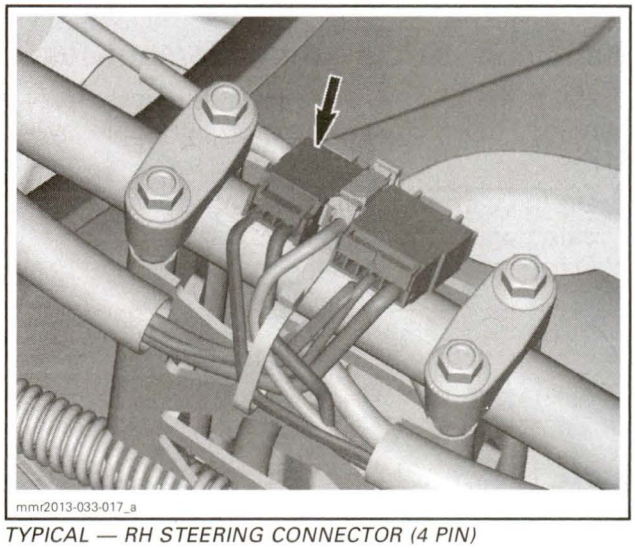


TYPICAL - WMS CONNECTOR (8 PIN)

Disconnect both LH (6 pin) and RH (4 pin) connectors under the steering cover.



TYPICAL LH STEERING CONNECTOR (6 PIN)



TYPICAL — RH STEERING CONNECTOR (4 PIN)

To test the RH heater circuit, probe the RH steering connector (4 pin).

To test the LH heater circuit, probe the LH steering connector (6 pin).

Using the FLUKE 115 MULTIMETER (P/N 529 035 868), select the Ω position.

Test handlebar grips switch and circuits as per table.

HANDLEBAR HEATED GRIP SWITCH TEST RH HEATER			
SWITCH SELECTION	WMS PIN	RH PIN	RESISTANCE
UP	F	1	Close to 0 Ω
		4	Infinite (OL)
DOWN	E	4	Infinite (OL)
		1	Close to 0 Ω

HANDLEBAR HEATED GRIP SWITCH TEST LH HEATER			
SWITCH SELECTION	CONNECTORS		RESISTANCE
	WMS PIN	LH PIN	
UP	F	2	Close to 0 Ω
		1	Infinite (OL)
DOWN	E	1	Infinite (OL)
		2	Close to 0 Ω

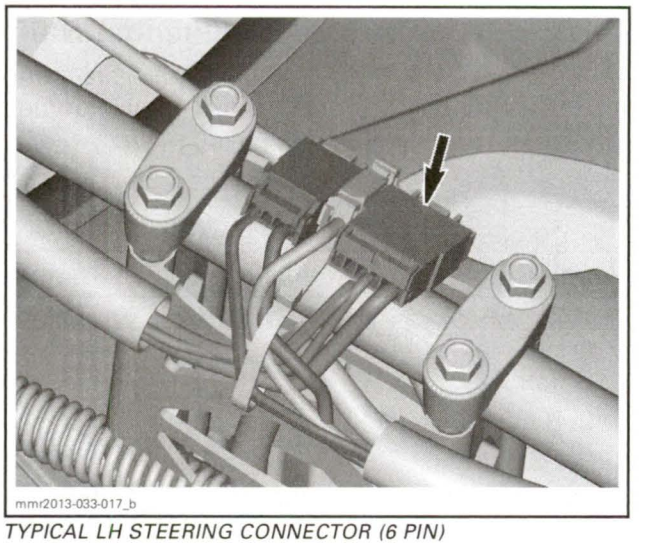
If continuity test is as per specification, proceed with *HANDLEBAR GRIP HEATING ELEMENT TEST* in this subsection.

If continuity test is out of specification, check switch circuit. If good, replace switch.

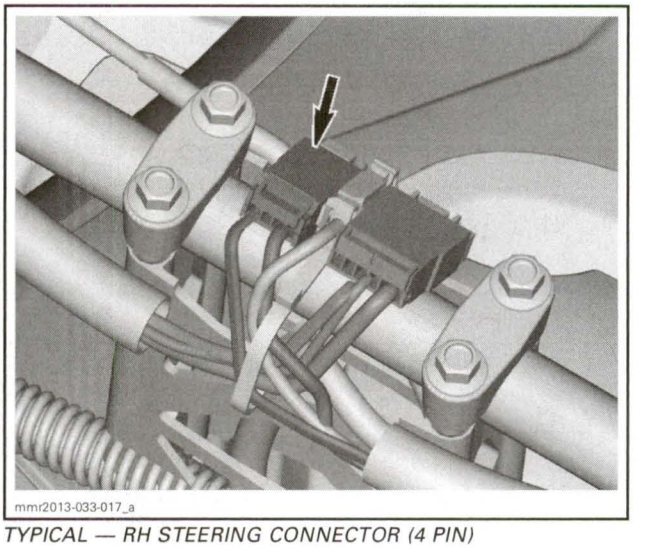
Handlebar Grip Heating Element Test

If you cannot feel the temperature increase of a hand grip heating element, carry out the following steps.

1. Disconnect the two steering connectors located under the steering cover.



TYPICAL LH STEERING CONNECTOR (6 PIN)



TYPICAL — RH STEERING CONNECTOR (4 PIN)

2. Test heating elements on either side as per following specifications.

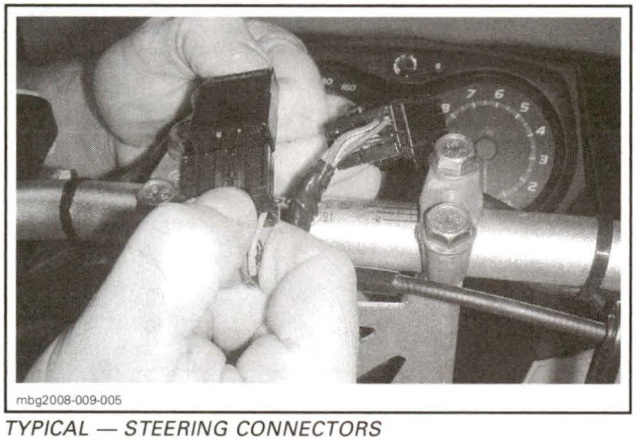
HANDLEBAR GRIP HEATING ELEMENT TEST 32 W ADHESIVE FILM HEATERS FOR ALUMINUM HANDLEBAR		
HEATER WIRE		RESISTANCE @ 20°C (68°F)
OG	BK	5.3 to 6.6 Ω

3. If readings are out of specifications, replace applicable handle grip heating element.
4. If heating element readings are within specifications, check wiring and connections.
5. Reconnect connectors.

Heater Element Removal

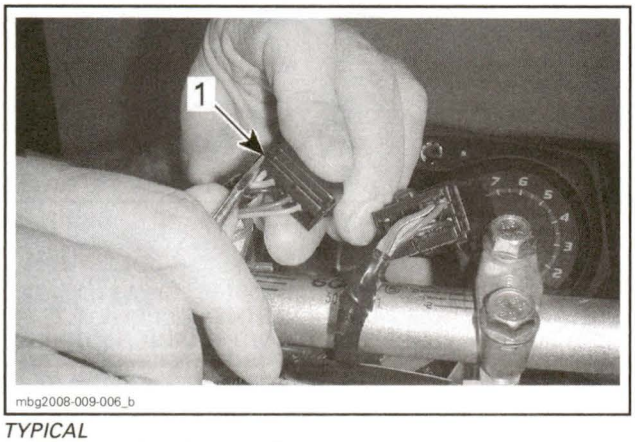
NOTICE Heater wire routing may vary significantly due to different type handlebars and vehicles. Its highly important to take note of exact positioning of grip heaters, locking ties, and wire routing before removing them from the handlebars. Failure to properly route wires may lead to equipment damage or failure.

1. Remove the following items as applicable, refer to *STEERING SYSTEM* subsection for details.
   - Steering cover
   - Rubber hand grip
   - Multifunction switch cover.
2. Disconnect the LH (6 pin) or RH (4 pin) steering connectors under the steering cover (as applicable).



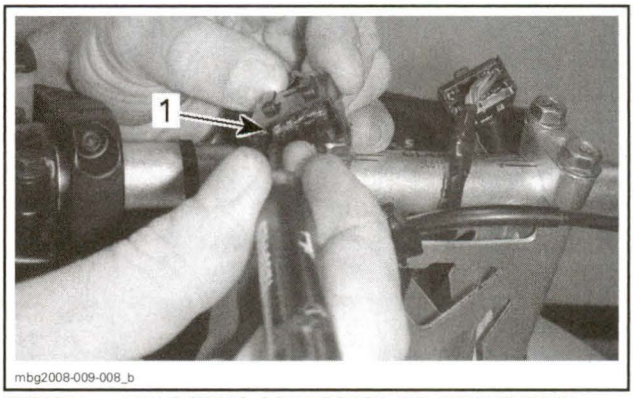
TYPICAL — STEERING CONNECTORS

3. Open the cover on the back of the connector housing using a small screwdriver or a suitable tool.



TYPICAL
1. Connector housing cover locks (one each side)

4. Using an appropriate tool such as the MULTILOCK - TERMINAL EXTRACTION TOOL (P/N 755430-2), unlock the heater wire terminals and push them out of the connector housing.

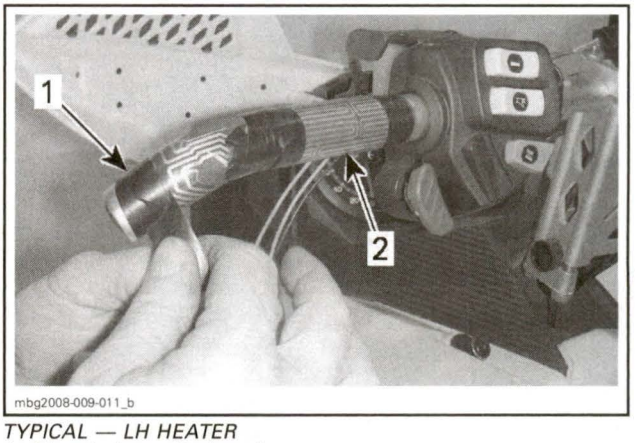


TYPICAL — UNLOCKING CONNECTOR PIN (FRONT SIDE)
1. Pin removal tool inserted above pin

NOTE: Terminals are unlocked and pushed out from the front (pin side) of the connector housing.

NOTICE Be sure to take note of exact positioning of grip heaters, locking ties, and wire routing before removing them from the handlebars.

5. Cut locking ties securing heater wires to handlebars.
6. Pull wires from harness protective sheath, multifunction switch housing or throttle lever housing.
7. Cut and remove black electrical tape from heater element and remove heater from cork insulator.

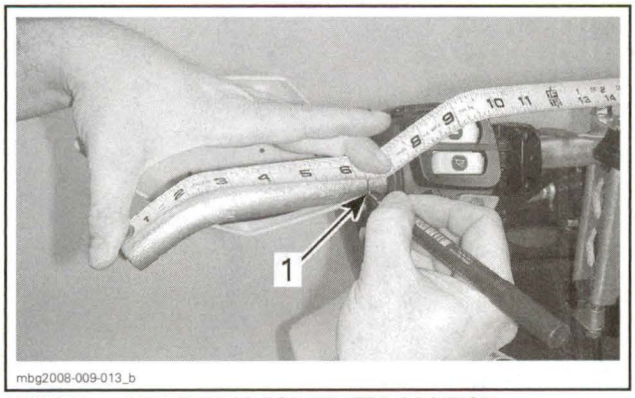


TYPICAL — LH HEATER
1. Electrical tape (4 places)
2. Heater element

8. If damaged, remove cork insulator from handlebar and clean all adhesive residue from the handlebar.

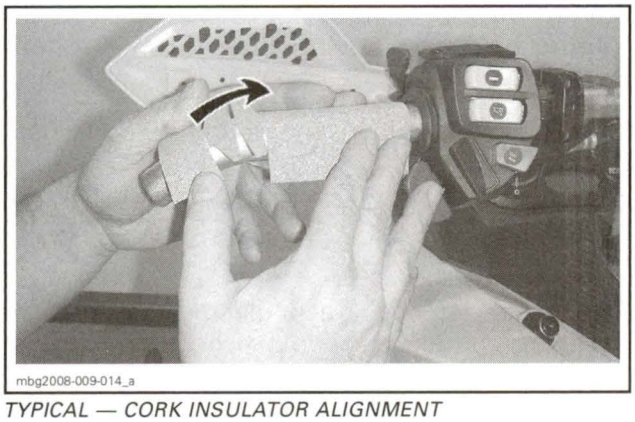
Heater Element Installation

1. Measure 159 mm (6.25 in) from the end of the handlebar, and across the top of the bend in the bar. Trace a reference line with a marker at that point on the handlebar.



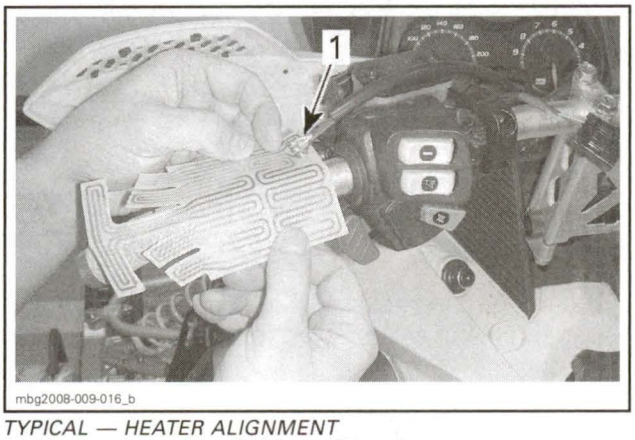
TYPICAL — MEASURING FOR HEATER POSITION
1. Trace reference line

2. Align the edge of the cork insulator with the reference line centered with the handlebar folding axis as illustrated.



TYPICAL — CORK INSULATOR ALIGNMENT

3. Apply firm pressure to cork insulator to assure proper adherence to handlebar.
4. Align the film heater element with the cork insulator and center of handlebar folding axis as illustrated.

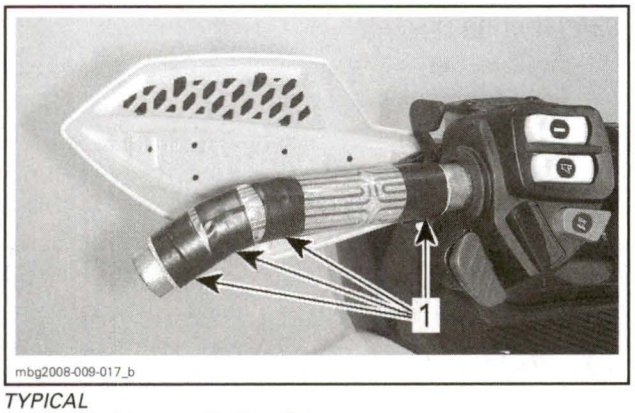


TYPICAL — HEATER ALIGNMENT
1. Heater wire position (LH front, RH rear)

5. Apply firm pressure to heater to assure proper adherence to cork insulator.

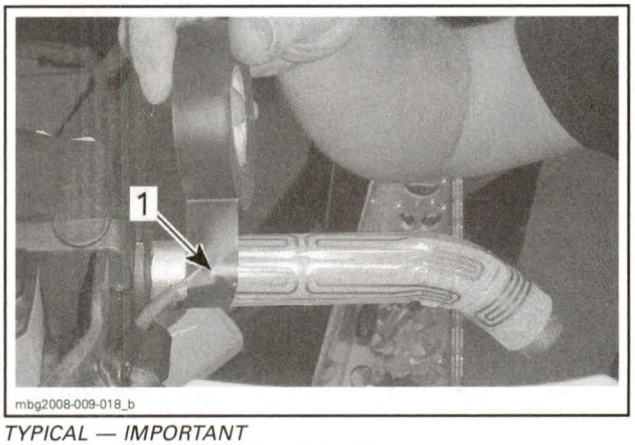
NOTE: The same heater element is used for both the LH and RH sides. Therefore, the electrical wiring will be in front of the handlebar on the LH side, and behind the handlebar (towards driver) on the RH side.

6. Apply two turns of black electrical tape at each of the four locations illustrated so that it covers the edges of the heater element and prevents snagging and damage to the element during rubber grip installation.



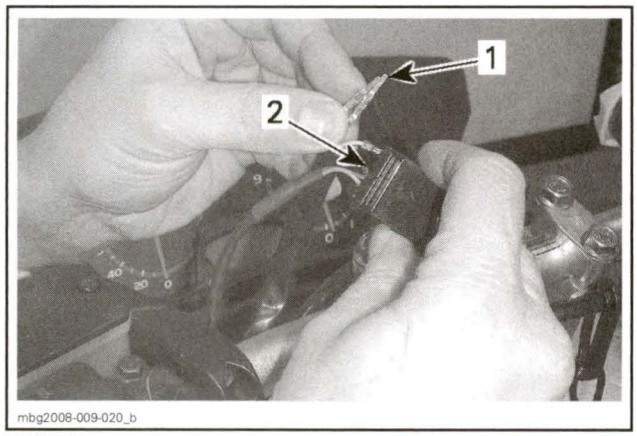
TYPICAL
1. Electrical tape application (4x)

NOTE: It is highly important to apply tape so that it fully secures the electrical wire connections. This will ease installation of the rubber hand grip and prevent undue stress to the connections.



TYPICAL — IMPORTANT
1. Tape application over wire connections

7. Install rubber hand grip, refer to *STEERING SYSTEM* subsection for detail.
8. Route wiring as noted during the removal procedure.
9. Insert wire connectors in steering connector housing, refer to *WIRING DIAGRAM* for wire color and pin number locations.

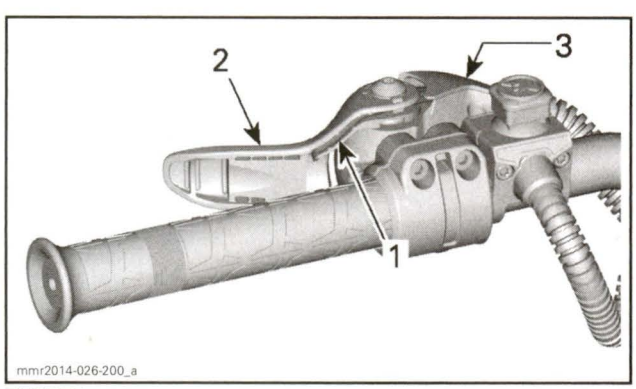


TYPICAL
1. *Heater wire terminals*
2. *Insertion through back of connector*

10. Install locking ties to secure the heater wire tightly against the handlebar.

⚠ WARNING

To ensure RH heater wires does not prevent smooth operation of throttle lever, it must be passed straight through the housing without any slack, and secured with a locking tie immediately after the lever housing.



TYPICAL
1. *Heater wire straight through throttle lever housing*
2. *Throttle lever*
3. *Lever housing*

NOTICE **Ensure LH heater wires are properly routed through multifunction switch housing to prevent them from being pinched when installing housing cover. Pinched or damaged wires may result in a short circuit.**

11. Provide electrical power to the heaters for testing. Refer to *LIGHTING AND ACCESSORIES SYSTEM TESTING* in the *TROUBLESHOOTING* topic at the beginning of this subsection for proper procedure.
12. Using the hand grip heat switch, turn on the hand grip heaters and ensure they are functioning correctly.

DRIVEN PULLEY AND COUNTERSHAFT

SERVICE TOOLS

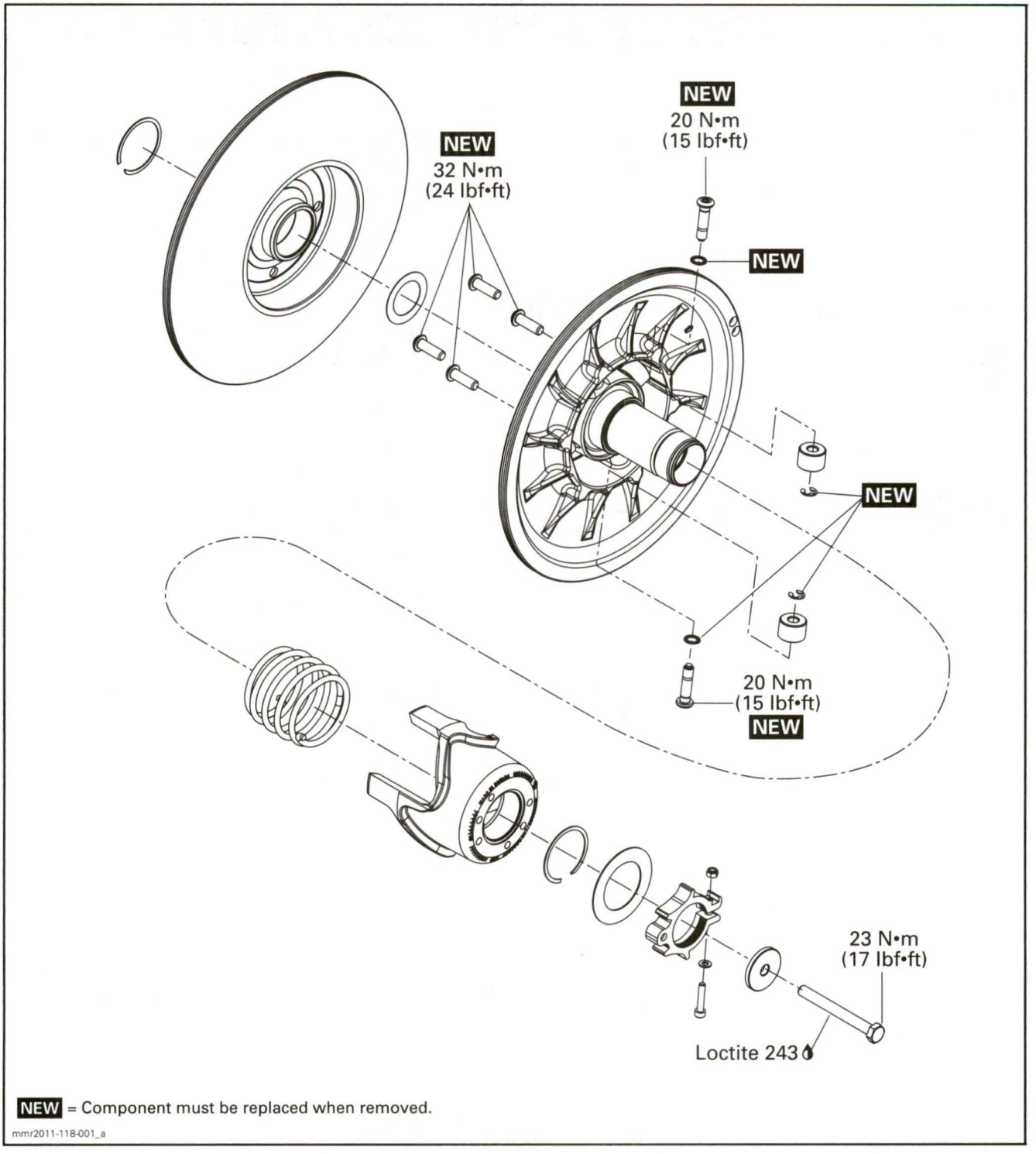
Description	Part Number	Page
ALIGNMENT BAR	529 036 157	424
DRIVEN PULLEY SPRING COMPRESSOR	529 036 182	427
ENGINE LIFTING TOOL	529 036 217	433
PRELOAD TESTER	529 036 164	425

SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
ROTOR CLIP® APPLICATOR	A-150	430

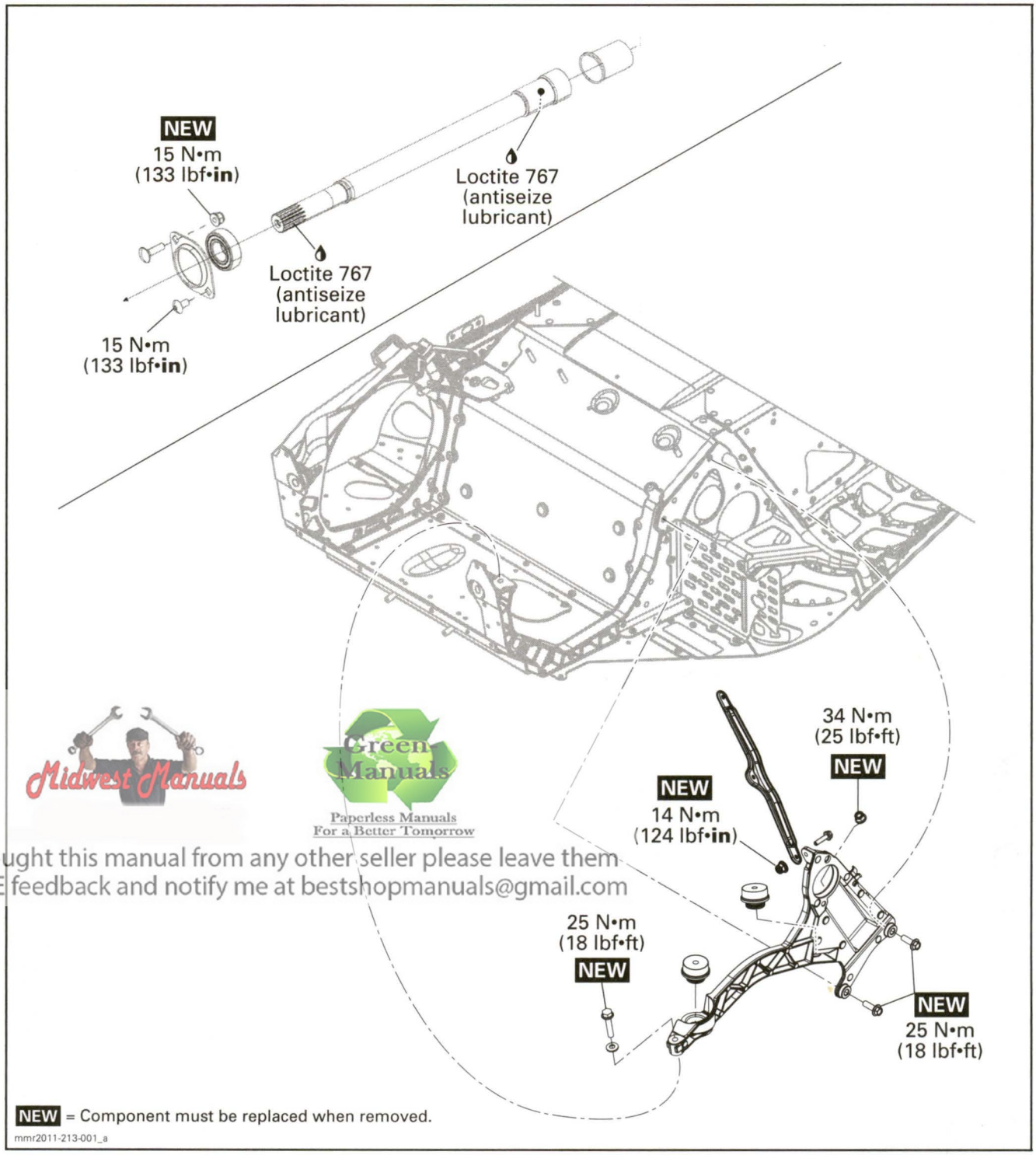
SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 243 (BLUE)	293 800 060	431
LOCTITE 609	413 703 100	432
LOCTITE 767 (ANTISEIZE LUBRICANT)	293 800 070	430, 432
PULLEY FLANGE CLEANER	413 711 809	432



NEW = Component must be replaced when removed.

mmr2011-118-001_a



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GENERAL

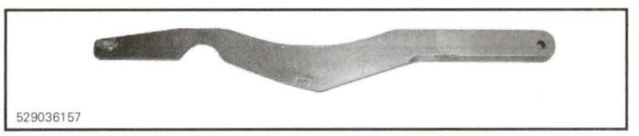
⚠ WARNING

Never start engine when the pulley guard is removed.

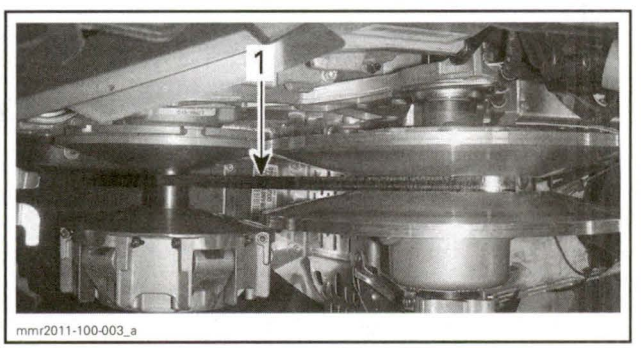
ADJUSTMENT

DRIVEN PULLEY ALIGNMENT

1. Remove drive belt, refer to *DRIVE BELT* subsection.
2. Completely open driven pulley.
3. Insert ALIGNMENT BAR (P/N 529 036 157) between the pulley sheaves. The half moon recess must match the drive pulley fixed sheave shaft.

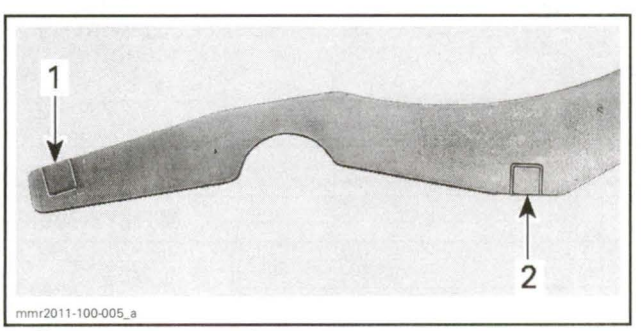


4. Close the driven pulley on the alignment bar. Make sure it stays against the pulley bottom.



1. Alignment bar

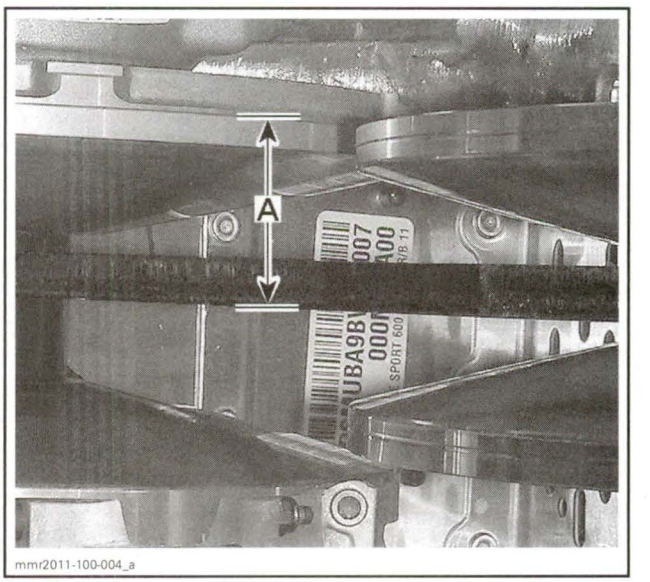
5. Locate the measurement points on the alignment bar.



1. Front measurement point
2. Aft measurement point

6. Measure "X" distance as per the following illustration.

NOTE: Always measure "X" distance from the farther alignment bar side to the fixed sheave inner edge (including alignment bar thickness).

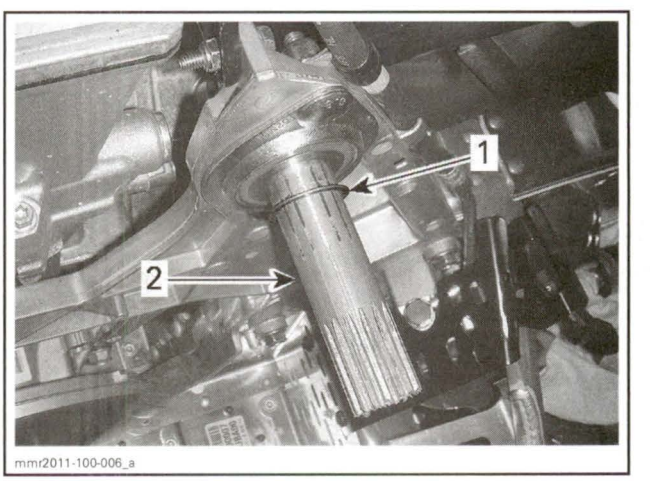


A. "X" distance

7. Compare the result to the specification.

"X" DISTANCE SPECIFICATION	
Minimum	36.7 mm (1.445 in)
Maximum	37.7 mm (1.484 in)

8. If an alignment is necessary:
   8.1 Remove driven pulley, see *DRIVEN PULLEY REMOVAL* in this subsection.
   8.2 Add or remove shim(s) to obtain the specified alignment.



1. Shim
2. Countershaft

   8.3 Refer to the following table to use the proper shim thickness.

SHIM THICKNESS	
(P/N 504 112 000)	0.42 mm ± 0.05 mm (.017 in ± .002 in)
(P/N 417 300 265)	1.02 mm ± 0.10 mm (.04 in ± .004 in)

NOTICE **Total shim thickness must not exceed 3 mm (.118 in).**

9. Install drive belt, refer to *DRIVE BELT INSTALLATION* in *DRIVE BELT* subsection.

PROCEDURES

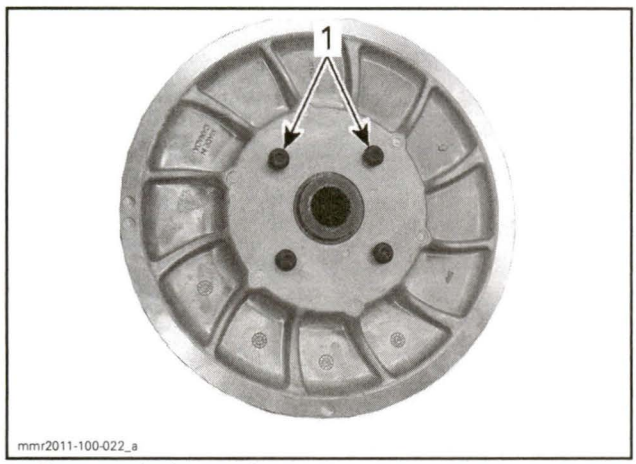
DRIVEN PULLEY

Driven Pulley Spring Preload Verification

1. Remove driven pulley, see procedure in this subsection.
2. Loosen 2 cam screws without removing them.

NOTE: Heat the cam screws to ease loosening.

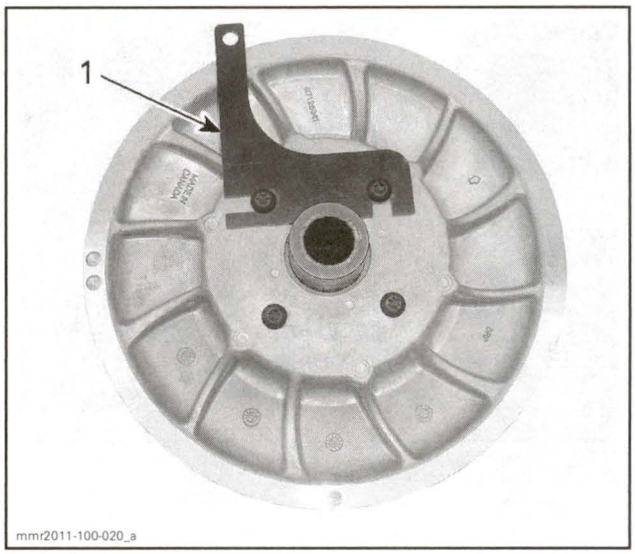
NOTICE **If screws are completely removed, they must be replaced.**



1. Screws to be loosened

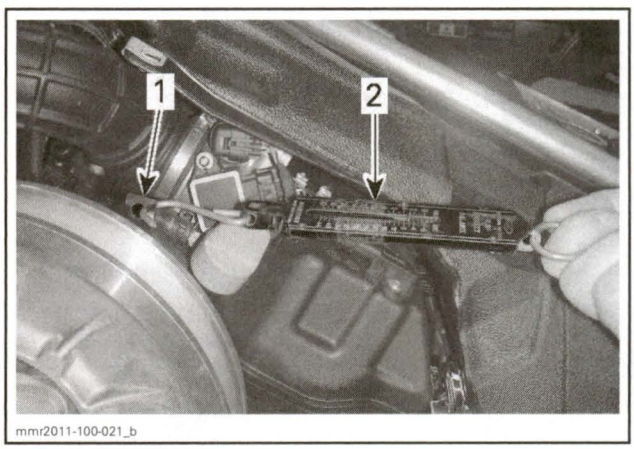
3. Install the specified service tool.

REQUIRED TOOL	
PRELOAD TESTER (P/N 529 036 164)	



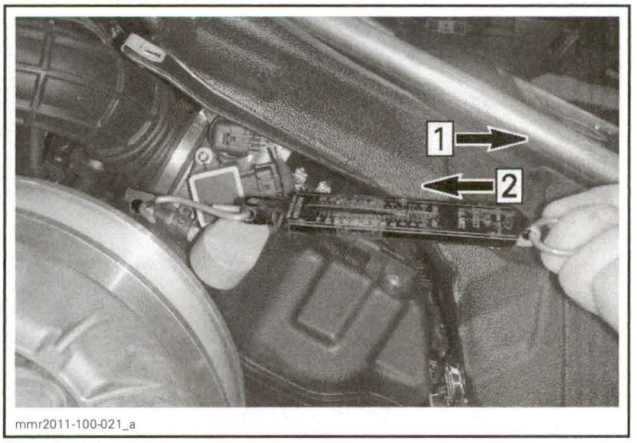
1. Preload tester

4. Install driven pulley.
5. Hook a fish scale to the preload tester.



1. Preload tester
2. Fish scale

6. Pull the preload tester using the fish scale, then read the torsion force as follows:
   - 6.1 Take a 1st measurement when sliding sheave begins to turn.
   - 6.2 Hold fish scale in this position.
   - 6.3 Slowly release tension and take a 2nd measurement when sliding sheave begins to return.



Step 1: 1st measurement
Step 2: 2nd measurement

7. Calculate the average of the two readings.

$$\frac{\text{1ST MEASUREMENT (WHEN OPENING)} + \text{2ND MEASUREMENT (WHEN CLOSING)}}{2} = \text{SPRING PRELOAD}$$

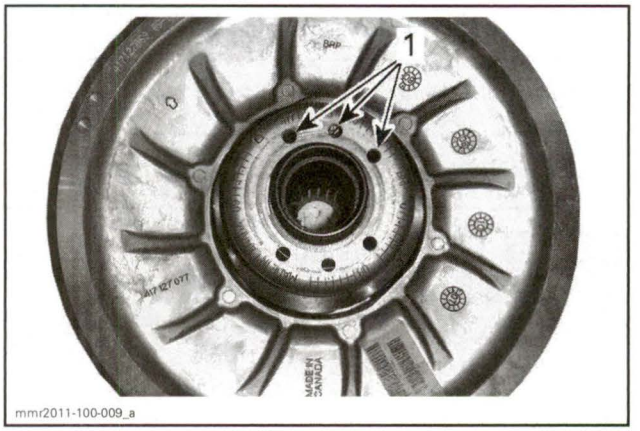
Example:

$$\frac{\text{6.8 KG (15 LB) (WHEN OPENING)} + \text{6.4 KG (14 LB) (WHEN CLOSING)}}{2} = \text{6.6 KG (15 LB) ACTUAL SPRING PRELOAD}$$

8. Compare the result to the specifications.

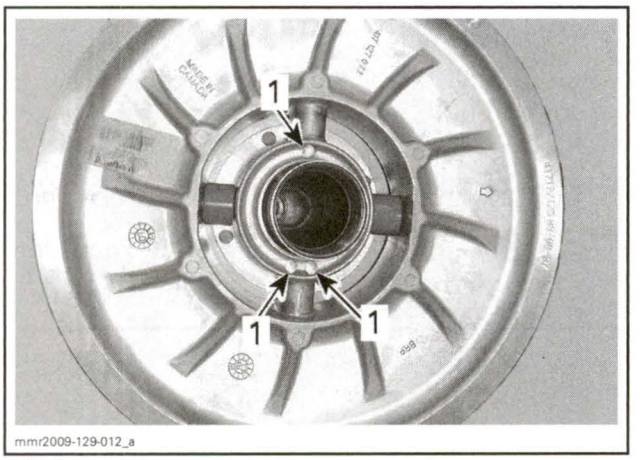
ENGINE	SPRING PRELOAD SPECIFICATION	
600 ACE	Minimum	6.4 kg (14 lb)
	Maximum	7.0 kg (15 lb)
900 ACE	Minimum	7.5 kg (17 lb)
	Maximum	8.3 kg (18 lb)

If spring preload is out of specification, move the spring hook in another cam hole to increase or decrease preload.



1. Spring holes

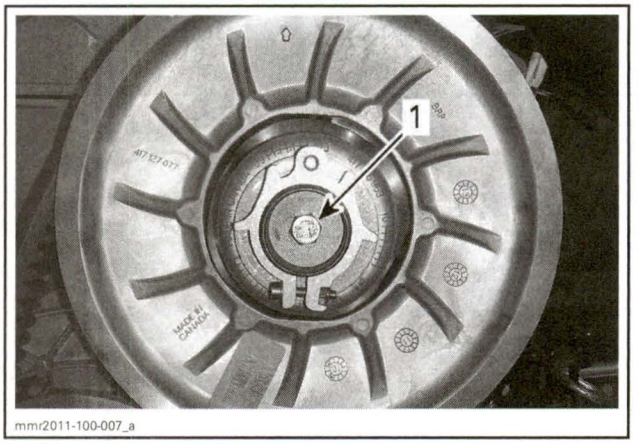
If correct spring preload is unattainable, use the fixed sheave holes.



TYPICAL
1. Fixed sheave holes

Driven Pulley Removal

1. Apply parking brake.
2. Remove drive belt, refer to *DRIVE BELT* subsection.
3. Remove driven pulley retaining screw and shouldered washer.



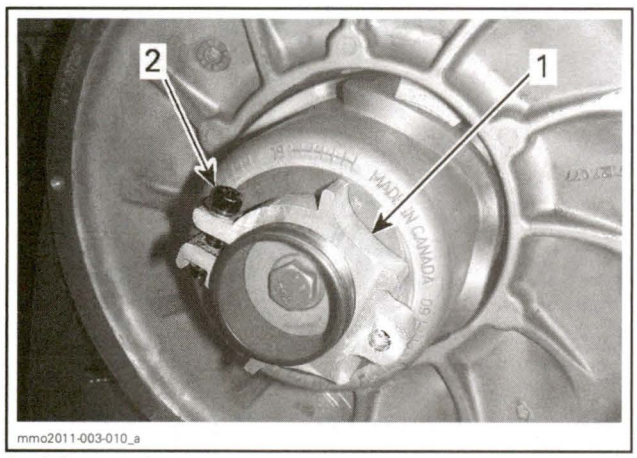
1. Driven pulley retaining screw

4. Remove driven pulley from countershaft.

Driven Pulley Disassembly

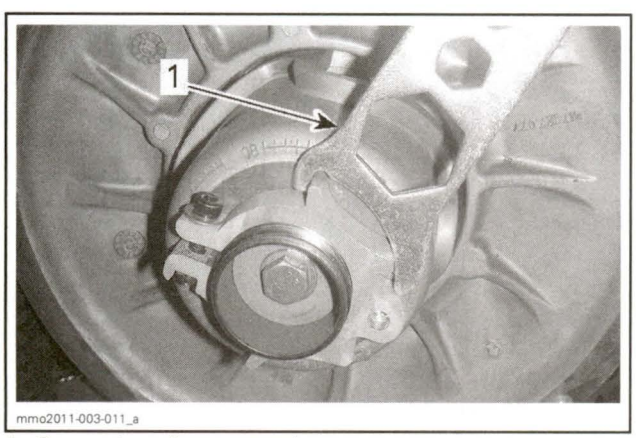
Cam and Spring Removal

1. Loosen the adjuster ring clamping screw.



1. Adjuster hub
2. Clamping screw

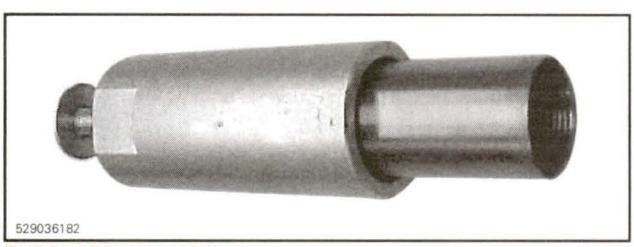
2. Unscrew the adjuster hub **clockwise**, using the suspension adjustment tool.



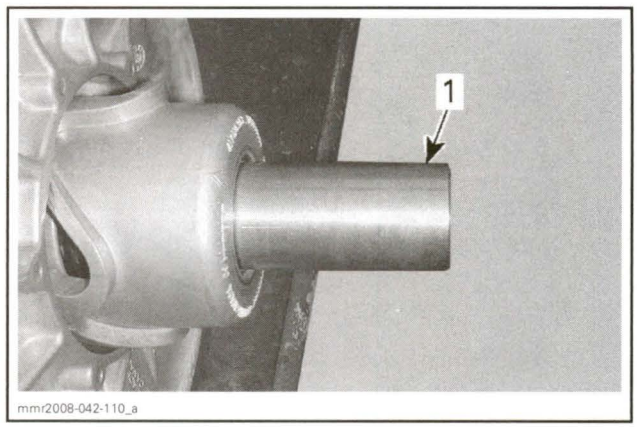
1. Suspension adjustment tool

NOTE: When reaching the end of the threads, slightly spread the adjuster ring to remove it from the pulley.

3. Install the threaded adapter of the DRIVEN PULLEY SPRING COMPRESSOR (P/N 529 036 182) on the driven pulley.

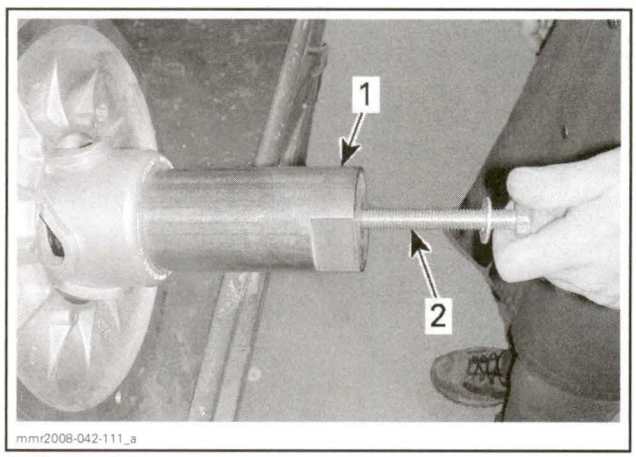


THREADED ADAPTER



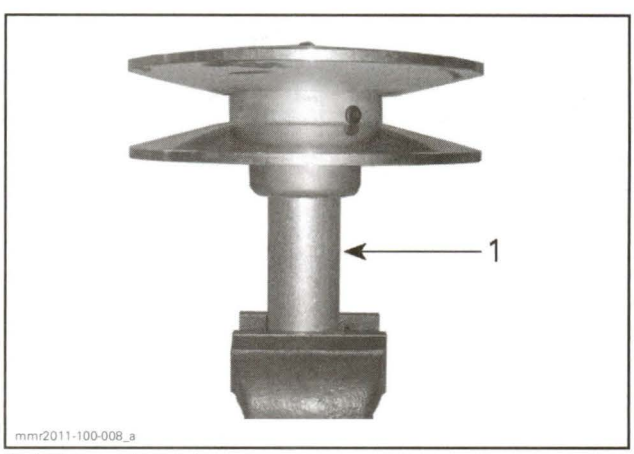
1. Threaded adapter

4. Install the external sleeve over the threaded adapter and secure sleeve with the tool screw.



1. External sleeve
2. Driven pulley spring compressor screw

5. Tighten the tool screw to compress the cam.
6. Install the tool in a vice.



1. Driven pulley spring compressor

7. Note in which hole the spring hook is inserted in the cam.



1. Spring holes

8. Using a heat gun, heat cam screws to break the thread locker.

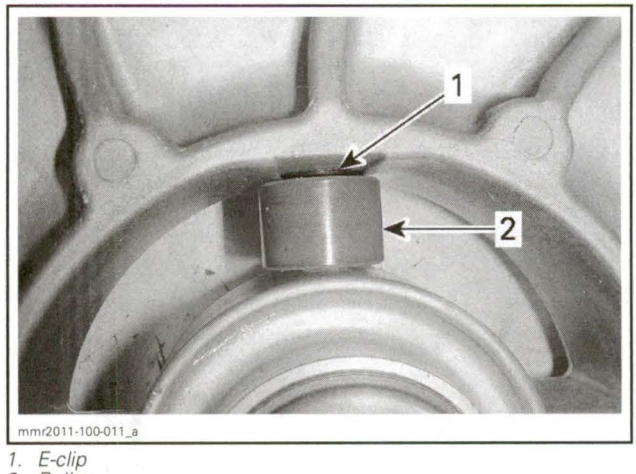


1. Heat cam screws

9. Remove and discard cam screws.
10. Remove the sliding sheave.
11. Unscrew the tool screw completely.
12. Note in which hole the spring hook is inserted to the fixed sheave.
13. Remove cam and spring.
14. Remove the tool threaded adapter.

Driven Pulley Rollers Removal

1. Remove and discard the E-clips.



1. E-clip
2. Roller

2. Remove and **discard** pivot screws.



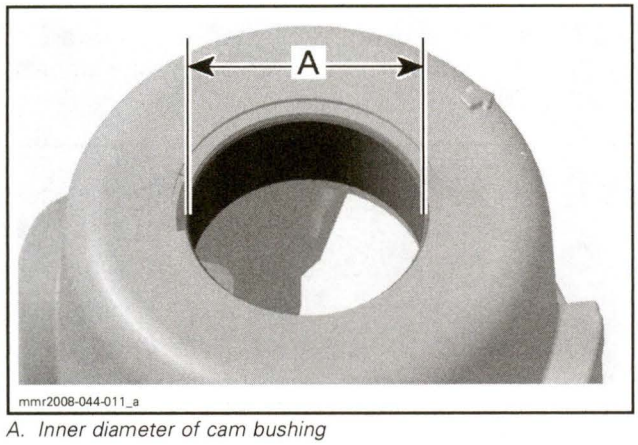
1. Pivot screw

3. Remove rollers.

Driven Pulley Inspection

Cam and Spring

1. Verify contact surfaces of cam for visible damage. Ensure circlip properly locks the inner bushing. Replace part if necessary.
2. Using a dial bore gauge, measure the inner diameter of cam bushing. Measuring point must be at least 6 mm (1/4 in) from bushing edge.



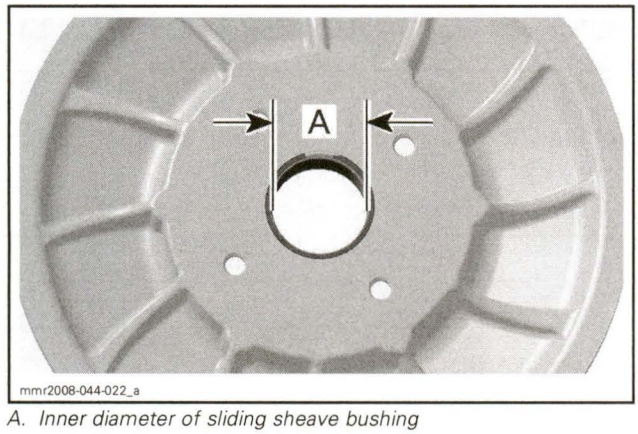
A. Inner diameter of cam bushing

BUSHING	SERVICE LIMIT
Cam bushing	41.5 mm (1.634 in)

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

Sliding Sheave

1. Inspect pulley sheave for marks or scratches.
2. Ensure circlip properly locks the inner bushing. Replace part if necessary.
3. Using a dial bore gauge, measure the inner diameter of sliding sheave bushing. Measuring point must be at least 6 mm (1/4 in) from bushing edge.



A. Inner diameter of sliding sheave bushing

BUSHING	SERVICE LIMIT
Sliding sheave bushing	41.5 mm (1.634 in)

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

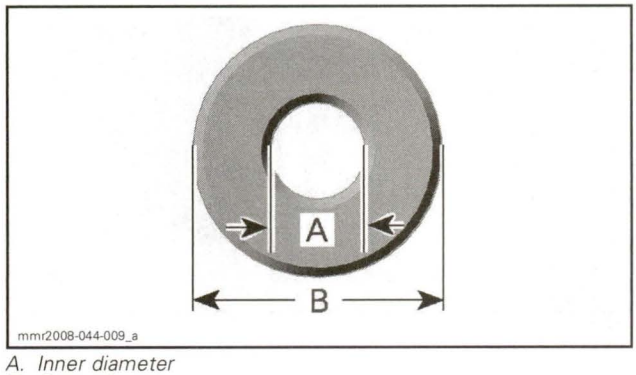
Fixed Sheave

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

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

Driven Pulley Rollers

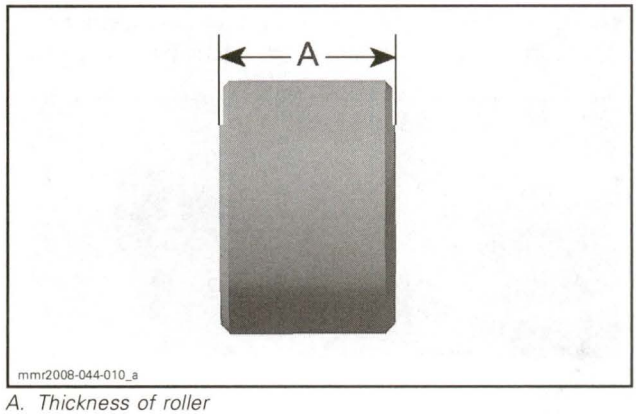
1. Check the rollers for flat spots, cracks or other visible damage. Replace if necessary (as a set).
2. Measure inner and outer diameter of rollers.



A. Inner diameter
B. Outer diameter

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

3. Measure the roller thickness.



A. Thickness of roller

ROLLER THICKNESS	
SERVICE LIMIT	14.75 mm (.581 in)

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

Driven Pulley Assembly

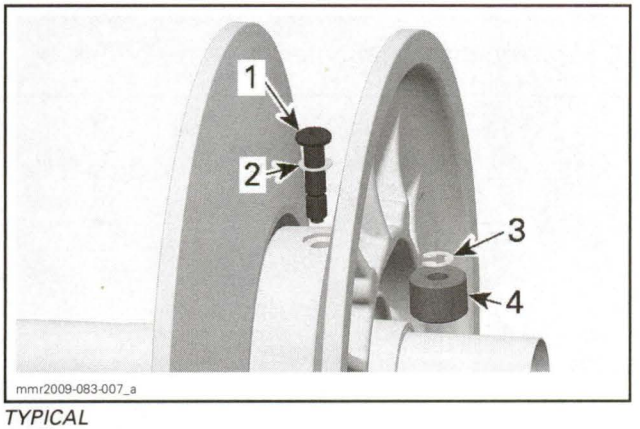
Driven Pulley Rollers Installation

1. Using a screw tap, clean pivot screw threaded holes into fixed sheave.

2. Install rollers into fixed sheave using **NEW** pivot screws with ribbed lock washers.

NOTICE **Always use new pivot screws with pre-applied threadlocker.**

3. Tighten pivot screws to the specified torque.

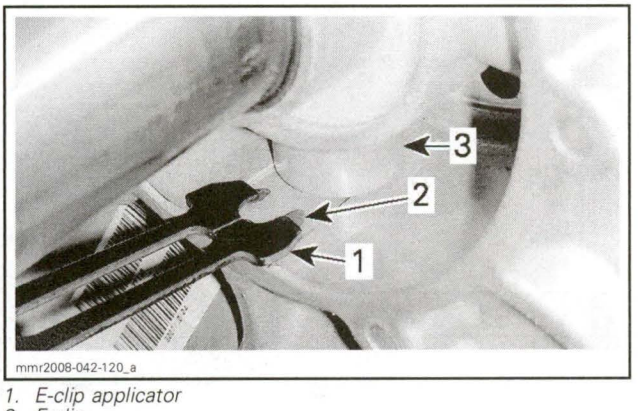


TYPICAL
1. *Pivot screw*
2. *Ribbed lock washer*
3. *E-clip*
4. *Roller*

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

4. Using a ROTOR CLIP® APPLICATOR (P/N A-150), install **NEW** E-clips to lock pivot screws.

NOTE: To purchase an applicator, contact Rotor Clip Company at **www.rotorclip.com**.

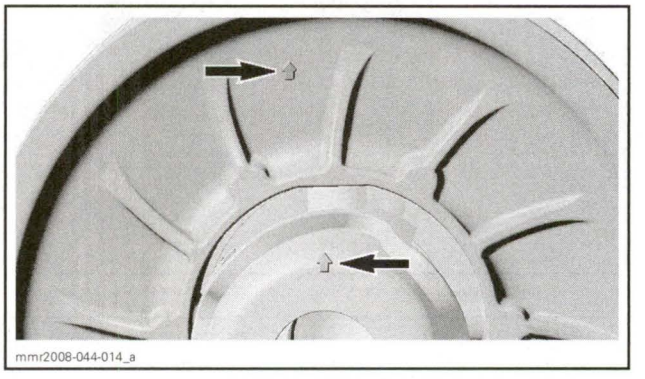


1. *E-clip applicator*
2. *E-clip*
3. *Roller*

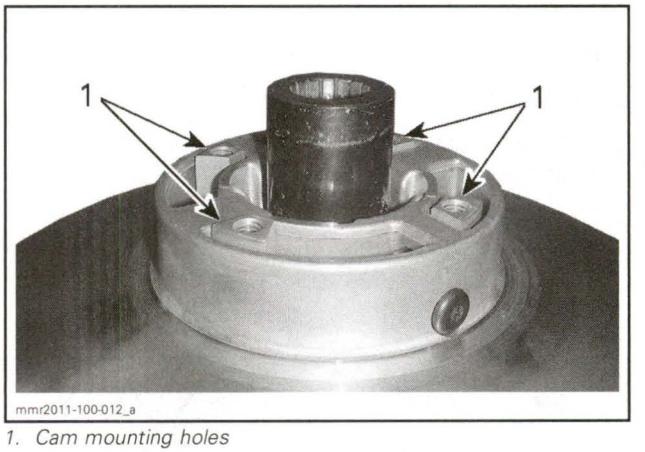
Cam and Spring Installation

1. Install the spring compressor threaded adapter on the fixed sheave.
2. Slide the cam over the tool threaded adapter.
3. Turn cam against the spring and align its arrow with the arrow on the fixed sheave.

NOTE: At the end of cam installation, the arrow on the cam should have moved clockwise (approximately 30°).



4. Compress spring until cam mounting holes exceed the fixed sheave.



1. *Cam mounting holes*

5. Install the sliding sheave on the cam using 4 **NEW** screws.
6. Tighten cam screws to the specified torque.

TIGHTENING TORQUE	
Cam screws	32 N•m (24 lbf•ft)

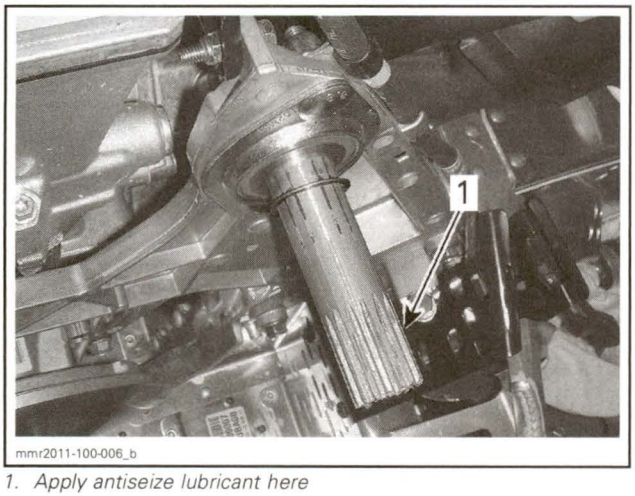
7. Remove the tool.

Driven Pulley Installation

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

Apply LOCTITE 767 (ANTISEIZE LUBRICANT) (P/N 293 800 070) on countershaft splines.

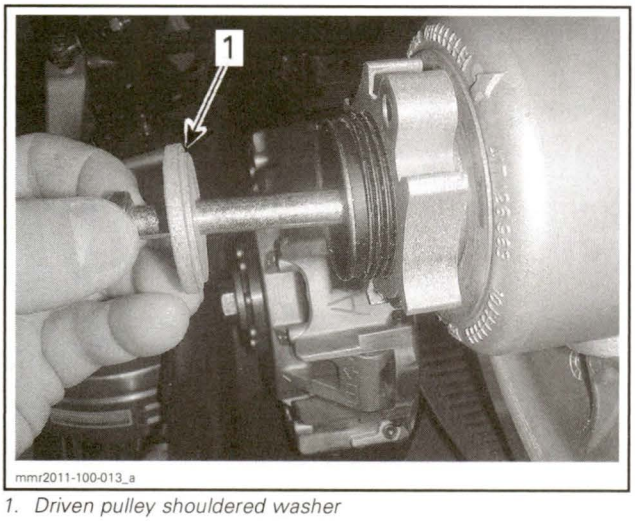
Rotor Clip® is a trademark of Rotor Clip Company, Inc.



1. Apply antiseize lubricant here

Check pulley alignment, refer to *DRIVEN PULLEY ALIGNMENT* in this subsection.

Install driven pulley shouldered washer as per illustration.



1. Driven pulley shouldered washer

Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on driven pulley retaining screw threads.

Tighten driven pulley retaining screw to the specified torque.

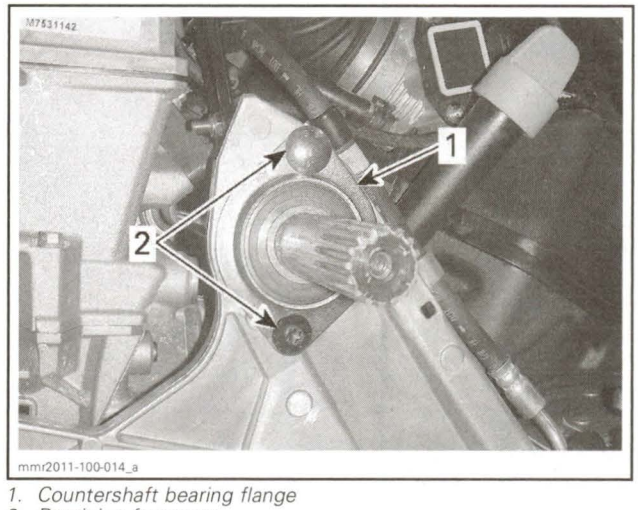
TIGHTENING TORQUE	
Driven pulley retaining screw	23 N•m (17 lbf•ft)

NOTICE **Driven pulley alignment must always be checked whenever pulleys have been removed, disassembled or replaced.**

COUNTERSHAFT

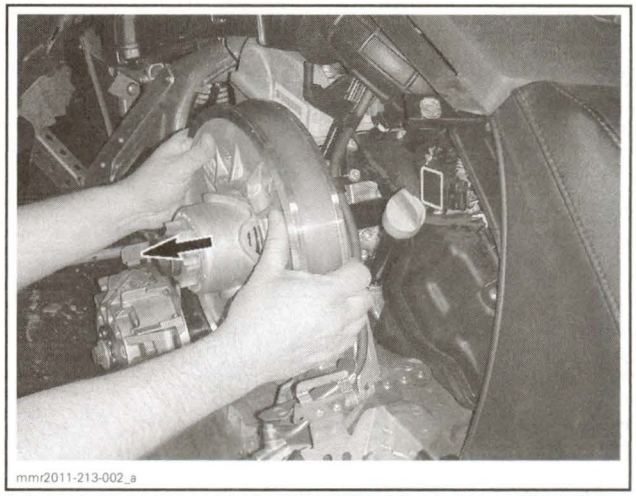
Countershaft Removal

1. Remove side panels, refer to *BODY* subsection.
2. Remove driven pulley, see *DRIVEN PULLEY REMOVAL* in this subsection.
3. Remove countershaft bearing flange as follows:
   3.1 Remove retaining fasteners.



1. Countershaft bearing flange
2. Retaining fasteners

   3.2 Be careful not to loose the brake hose retainer.
   3.3 Remove countershaft bearing flange from support.
4. Install drive pulley.
5. Firmly grab the drive pulley and pull the assembly out.



REMOVE PULLEY AND COUNTERSHAFT AS AN ASSEMBLY

6. Remove pulley from countershaft.

Countershaft Inspection

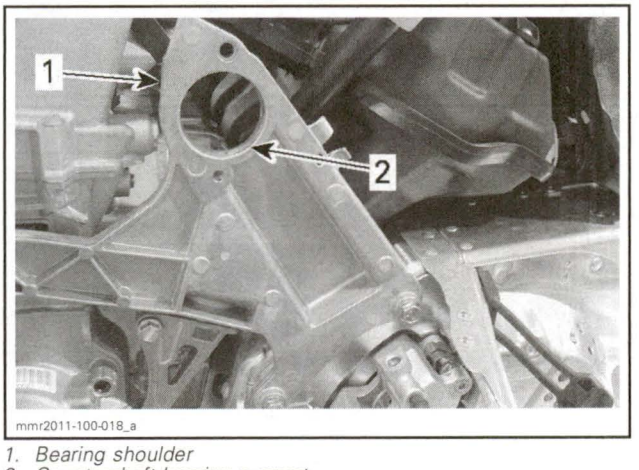
Replace countershaft if one of the following problem is detected:

- Bent, twisted or otherwise damaged countershaft.
- Defective splines and threads at the end of countershaft.

Countershaft Installation

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

Remove any rust on bearing shoulder of countershaft bearing support using sand paper (600-grit or 1000-grit) or steel wool.



1. Bearing shoulder
2. Countershaft bearing support

Apply LOCTITE 767 (ANTISEIZE LUBRICANT) (P/N 293 800 070):

- Bearing shoulder
- Countershaft internal splines (gearbox end).

Ensure countershaft bearing is installed properly into the countershaft bearing support.

Secure the brake hose using the upper flange retaining screw.

Tighten countershaft bearing flange screws to the specified torque.

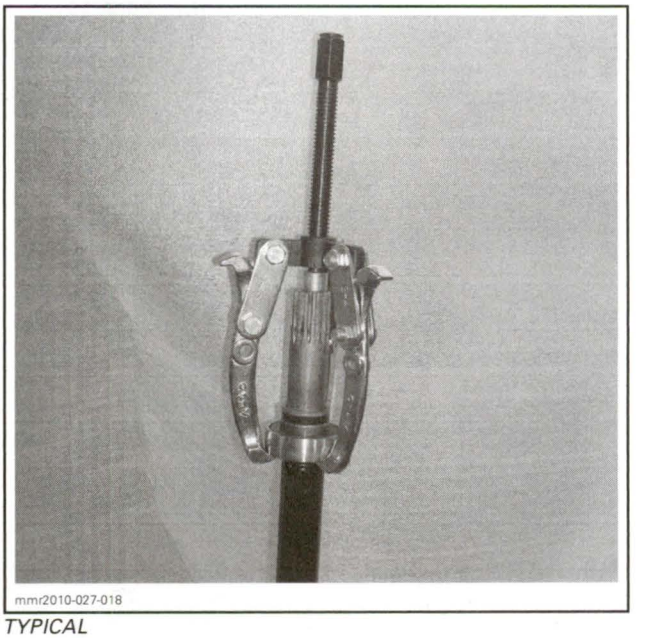
TIGHTENING TORQUE	
Countershaft bearing fasteners	25 N•m (18 lbf•ft)

Install driven pulley. Refer to *DRIVEN PULLEY INSTALLATION* in this subsection.

COUNTERSHAFT BEARING

Countershaft Bearing Removal

1. Proceed with *COUNTERSHAFT REMOVAL*, see procedure in this subsection.
2. Install an appropriate puller on the countershaft bearing.

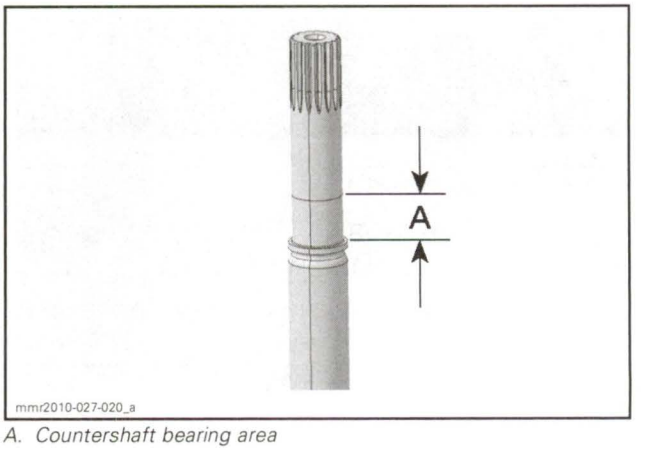


TYPICAL

3. Tighten puller to extract the bearing.
4. Discard the bearing.

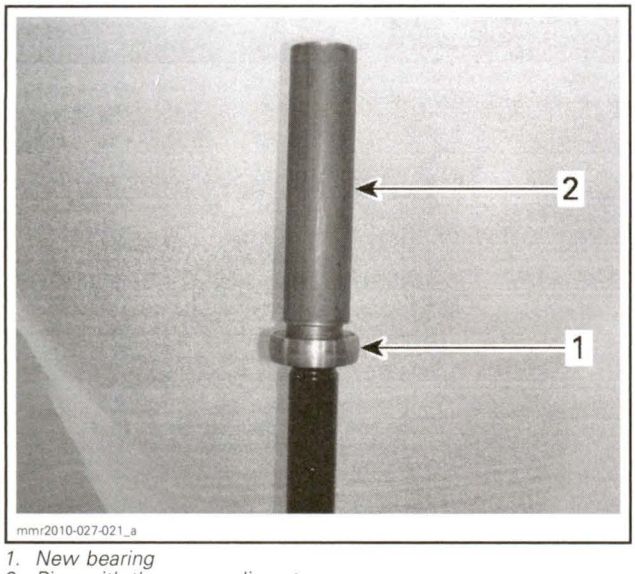
Countershaft Bearing Installation

1. Clean residues on countershaft bearing area using PULLEY FLANGE CLEANER (P/N 413 711 809).



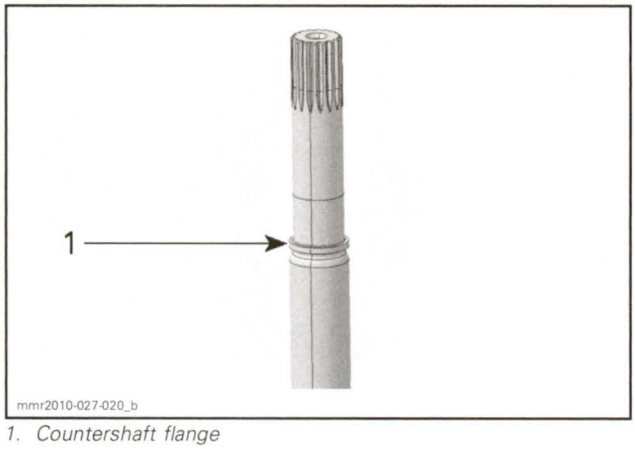
A. Countershaft bearing area

2. Apply LOCTITE 609 (P/N 413 703 100) on countershaft bearing area.
3. Install a **NEW** bearing on countershaft using a press and a pipe with the proper diameter.



1. New bearing
2. Pipe with the proper diameter

4. Press bearing until it is properly seated on countershaft flange.



1. Countershaft flange

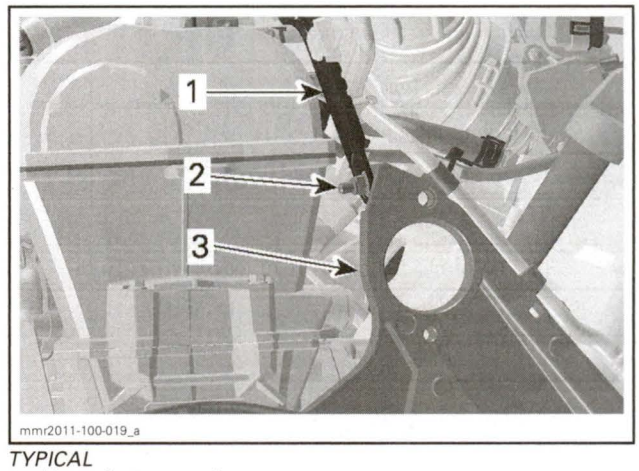
5. Clean the surplus of Loctite with a rag to avoid having Loctite on sliding sheave bushing.

NOTICE **Always use a press, never tap on countershaft bearing installer with an hammer to avoid damaging bearing and countershaft. Always apply force on the inner race of the bearing.**

COUNTERSHAFT BEARING SUPPORT

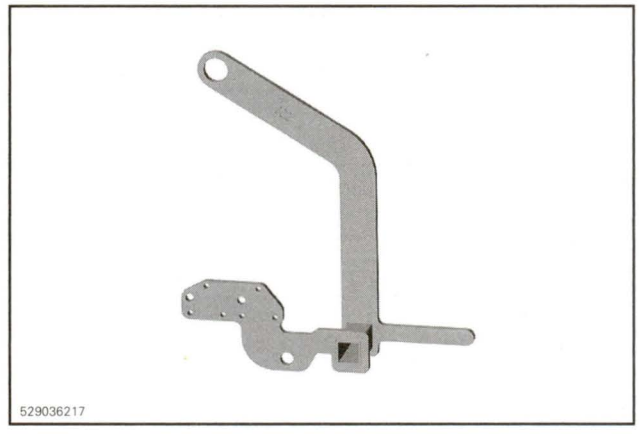
Countershaft Bearing Support Removal

1. Remove countershaft, see *COUNTERSHAFT REMOVAL* in this subsection.
2. Remove the nut and screw attaching the upper frame member to the countershaft bearing support.

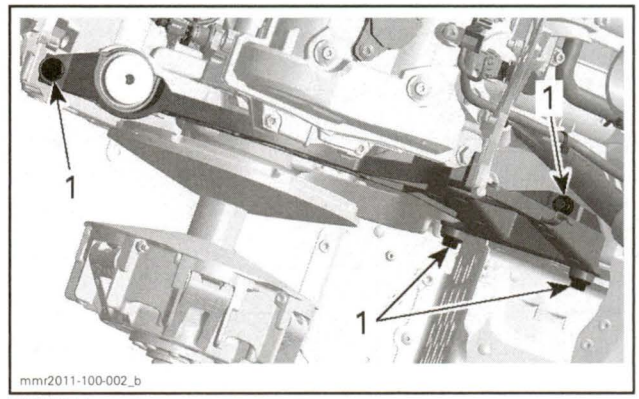


TYPICAL
1. Upper frame member
2. Nut and screw
3. Countershaft bearing support

3. Install the ENGINE LIFTING TOOL (P/N 529 036 217) in order to support the LH side of the engine. Refer to *ENGINE REMOVAL AND INSTALLATION*.



4. Remove the screws securing the engine to the LH rubber mounts.
5. Remove the countershaft bearing support retaining fasteners.

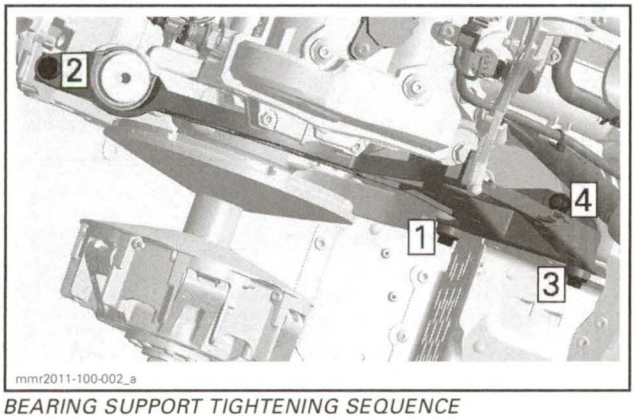


TYPICAL
1. Countershaft bearing support retaining fasteners

6. Remove the countershaft bearing support.

Countershaft Bearing Support Installation

1. Thread the fasteners retaining the bearing support to the chassis and both engine rubber mounts screws without tightening yet.
2. Tighten the retaining fasteners to the specified torque following the illustrated sequence.



BEARING SUPPORT TIGHTENING SEQUENCE

COUNTERSHAFT BEARING SUPPORT FASTENERS TIGHTENING TORQUE	
Bearing support to side of tunnel screws	25 N•m (18 lbf•ft)
Front of bearing support retaining screw	25 N•m (18 lbf•ft)
Bearing support to top of tunnel nut	34 N•m (25 lbf•ft)

3. Tighten the rear engine rubber mount screw to the specified torque.

TIGHTENING TORQUE	
Rear rubber mount screw	25 N•m (18 lbf•ft)

4. Tighten the front engine rubber mount screw to the specified torque.

TIGHTENING TORQUE	
Front rubber mount screw	25 N•m (18 lbf•ft)

5. Install the upper frame member to the bearing support and tighten screw to the specified torque.

TIGHTENING TORQUE	
Bearing support to upper frame member screw	14 N•m (124 lbf•**in**)

6. Install all other removed parts.

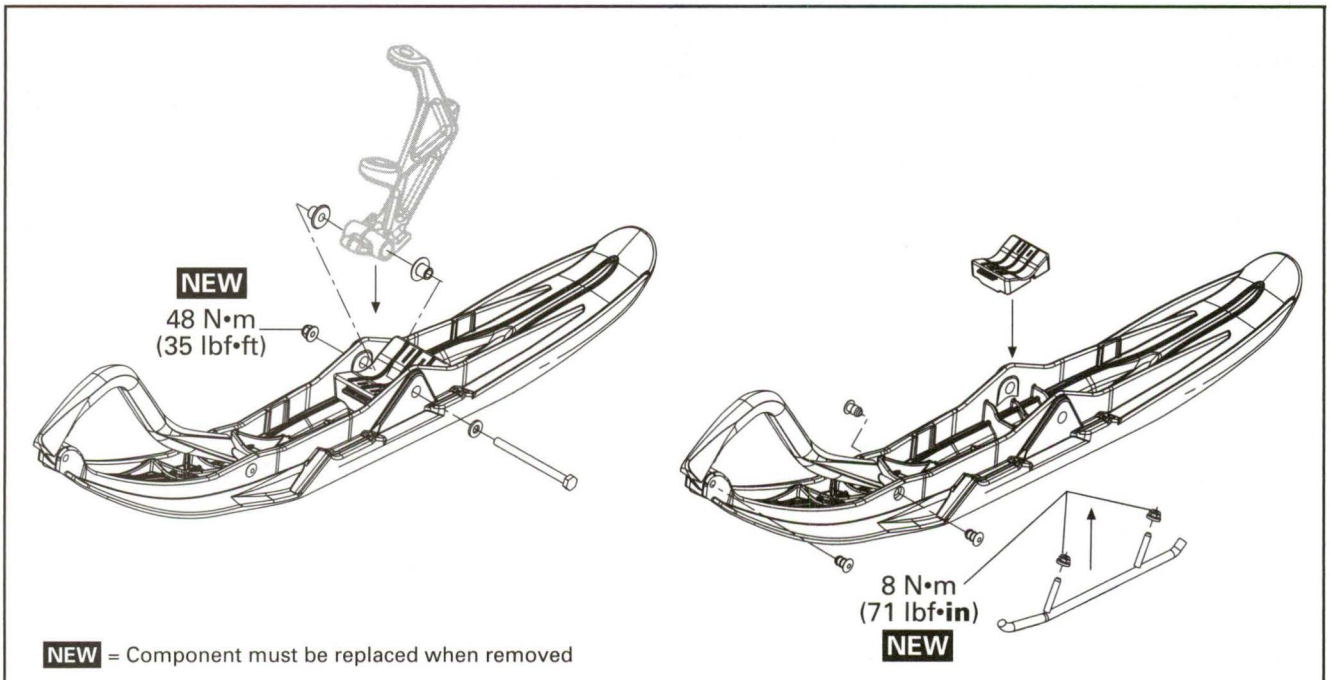
STEERING SYSTEM

SERVICE PRODUCTS

Description	Part Number	Page
SUSPENSION GREASE	293 550 033	451

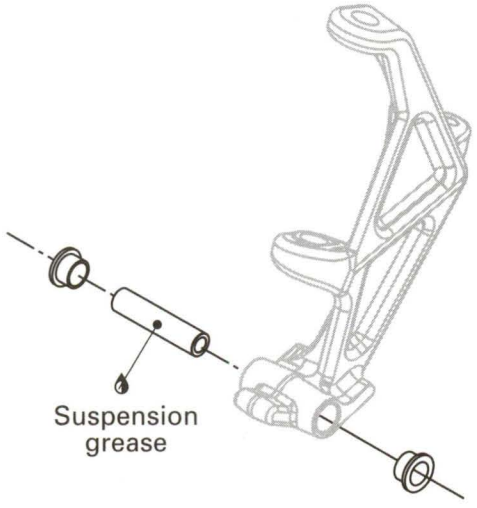
SKIS

Expedition Models

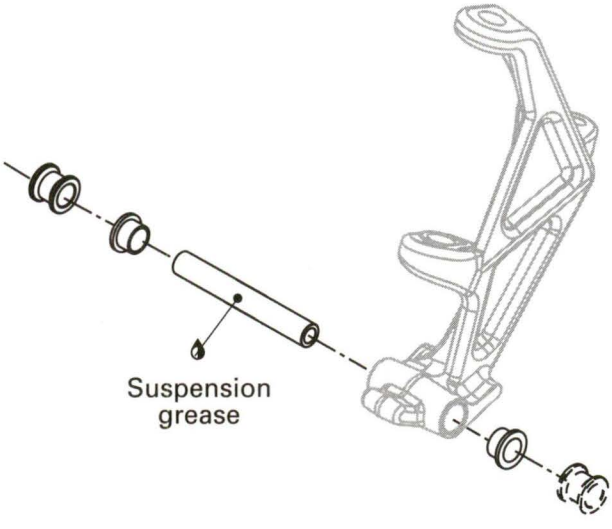


NEW = Component must be replaced when removed

Models without adjustable stance

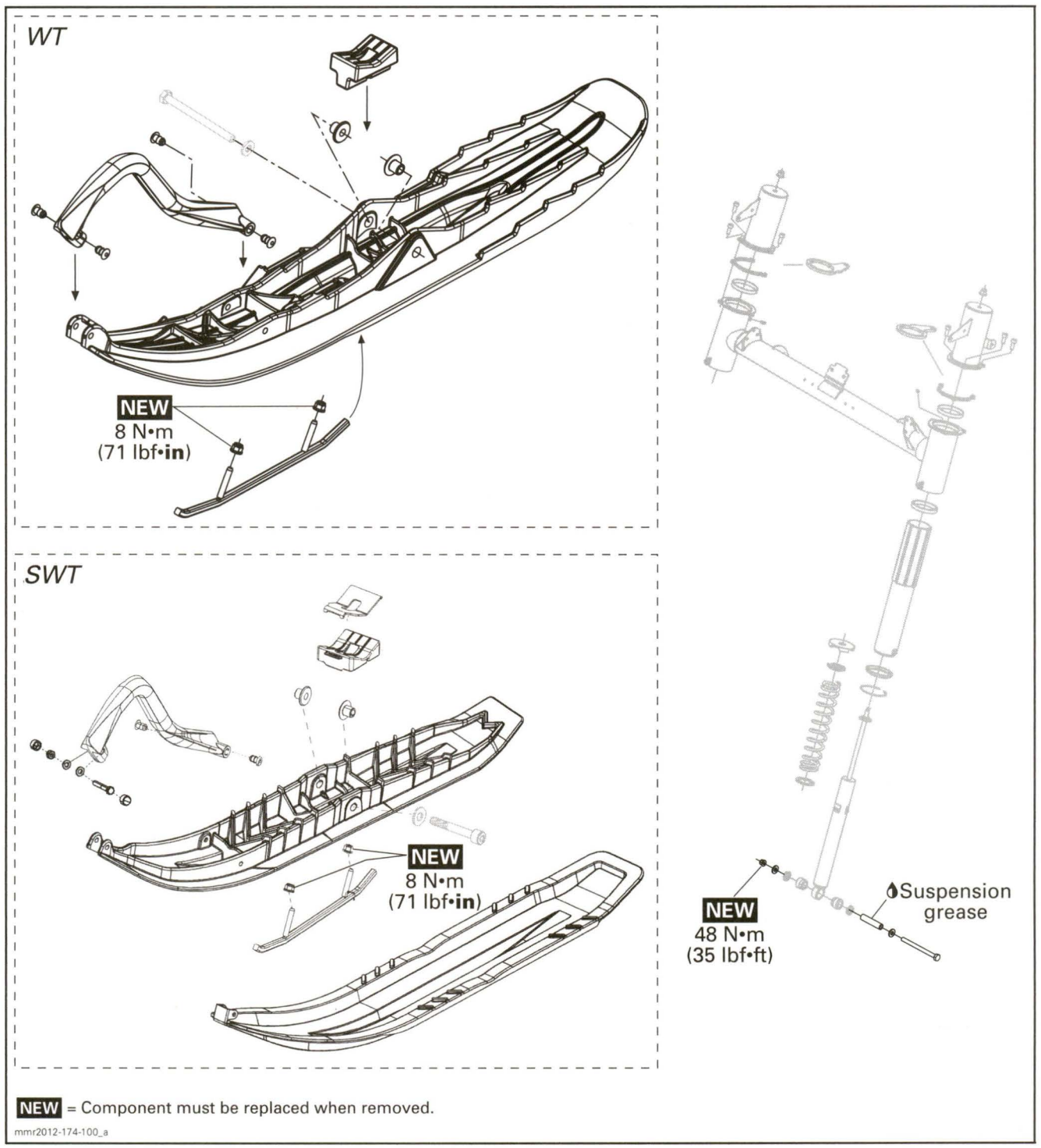


Models with adjustable stance



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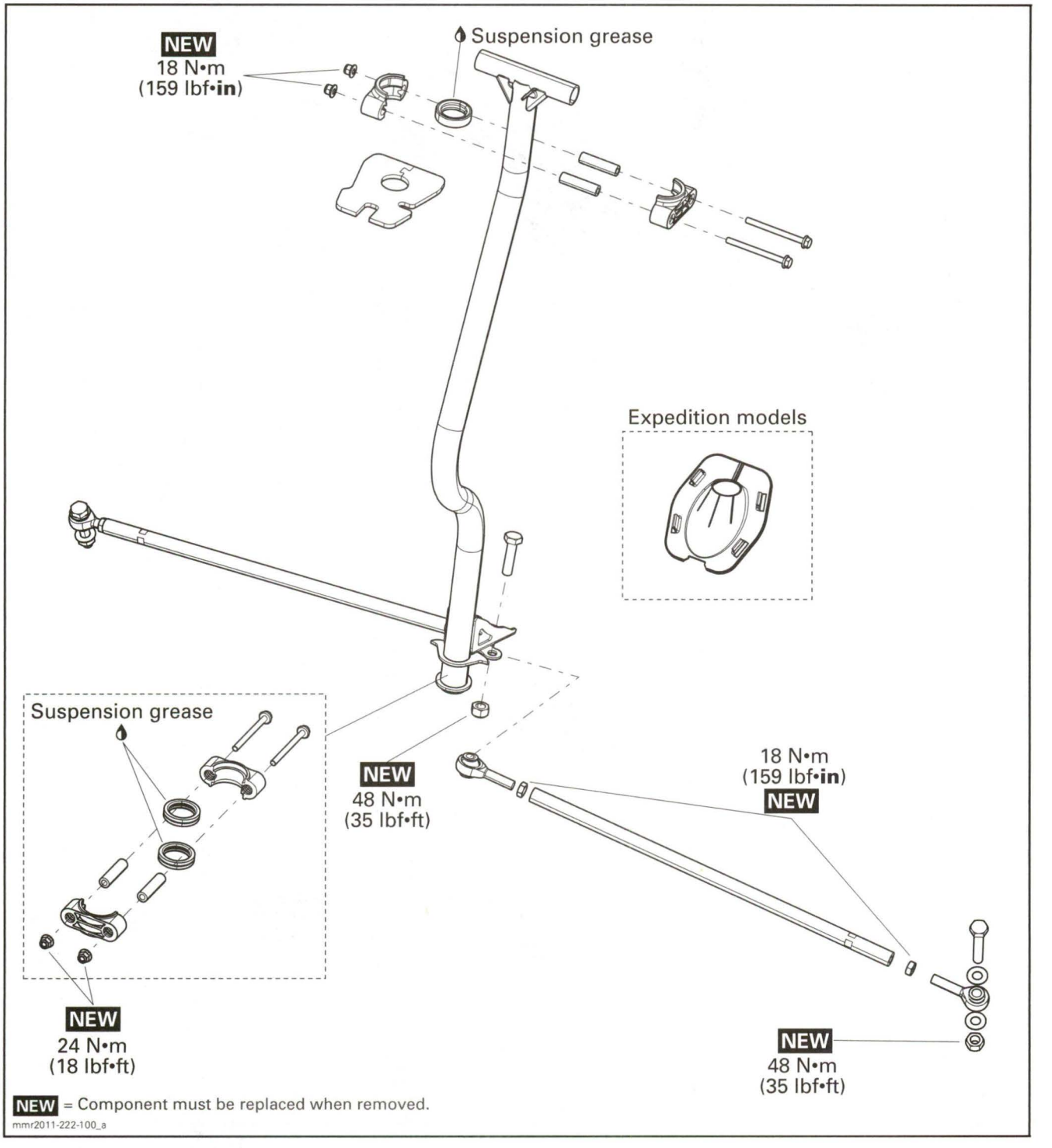
Skandic



NEW = Component must be replaced when removed.

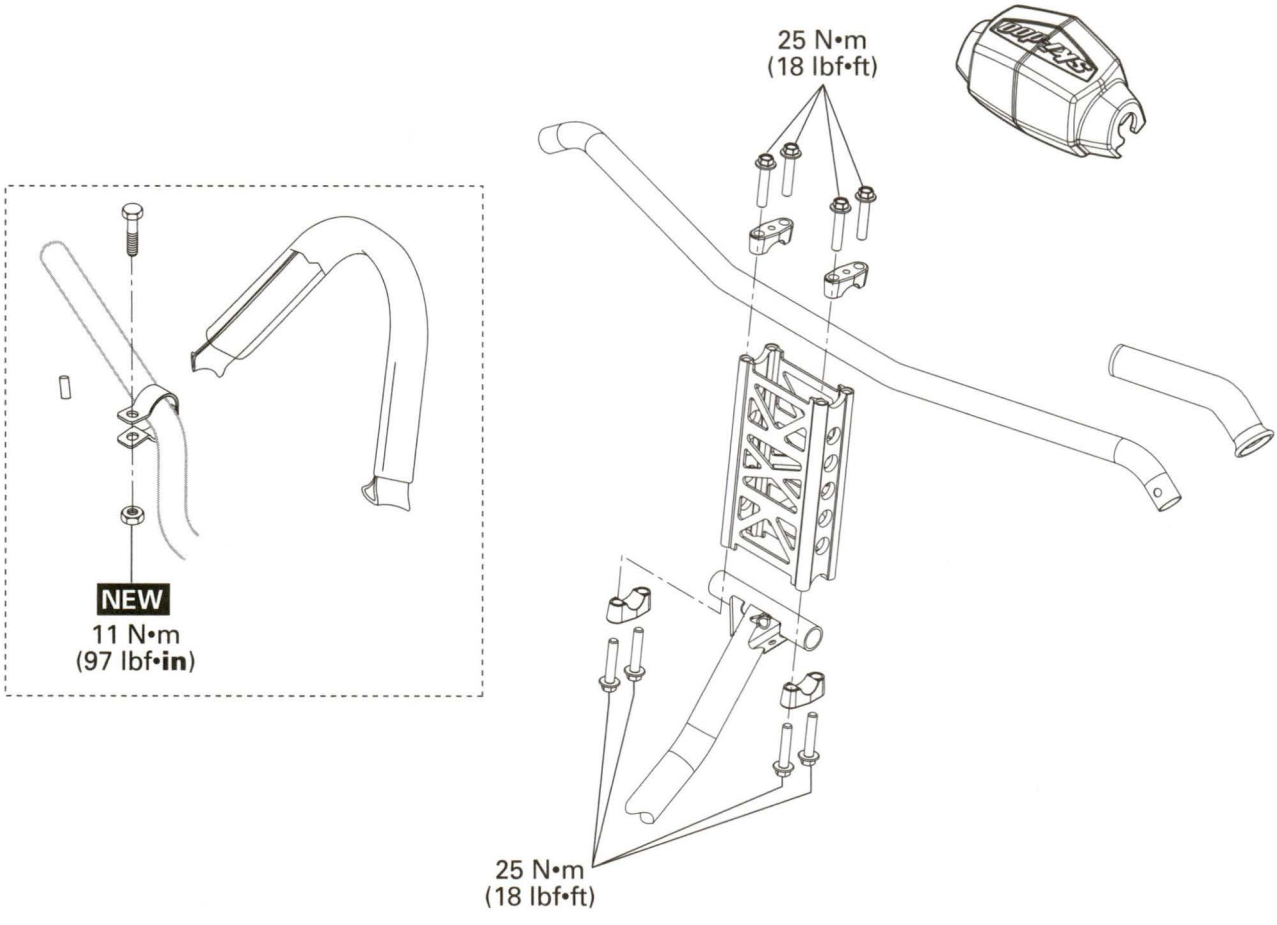
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STEERING COLUMN AND TIE-RODS



HANDLEBAR

Models without Adjustable Steering



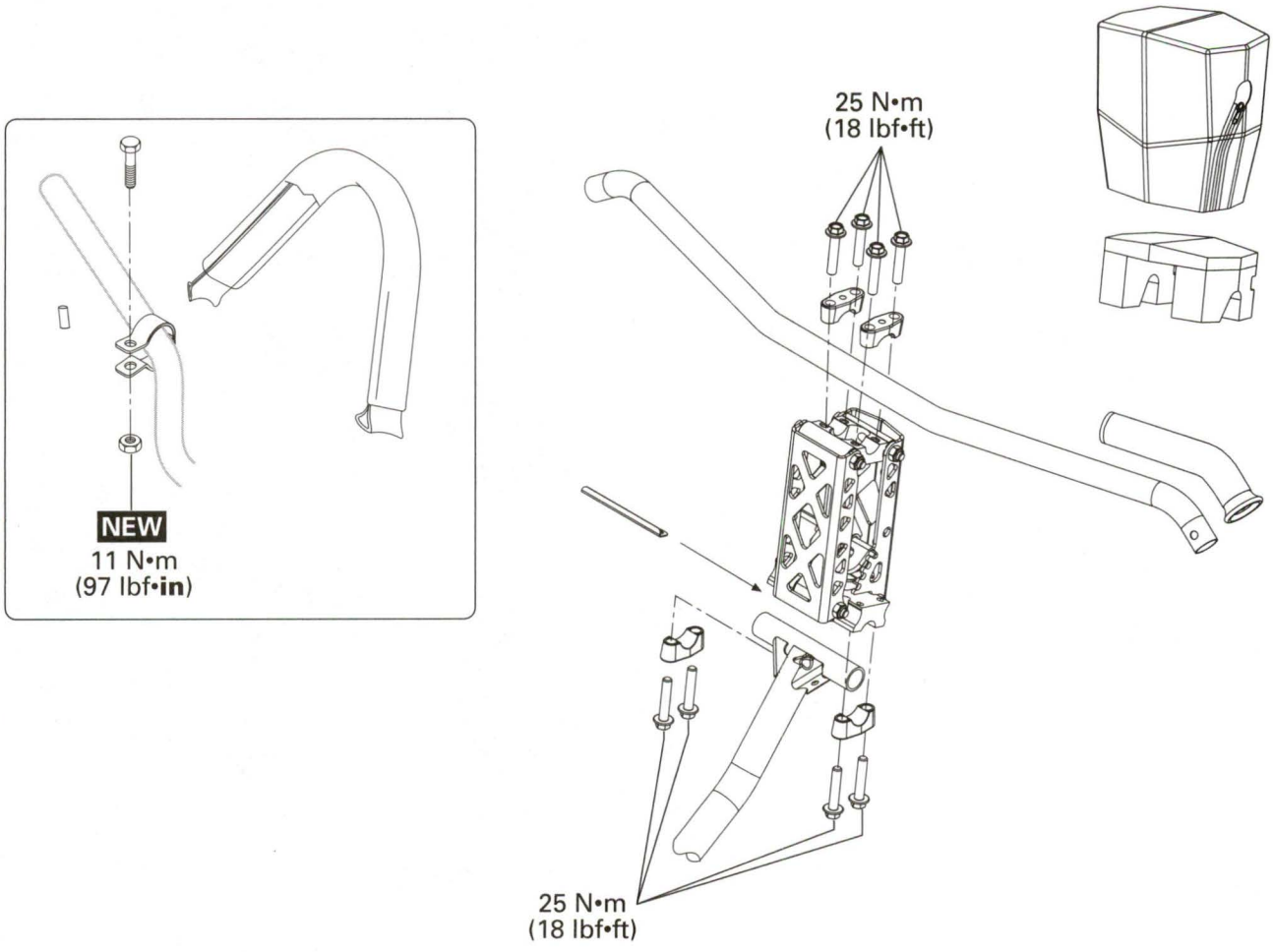
NEW = Component must be replaced when removed.

mmr2015-032-100_a

HANDLEBAR

Models with Adjustable Steering

Paperless Manuals
For a Better Tomorrow
If you bought this manual from any other seller please leave them
NEGATIVE feedback and notify me at bestshopmanuals@gmail.com



NEW = Component must be replaced when removed.

mmr2011-135-209_a

GENERAL

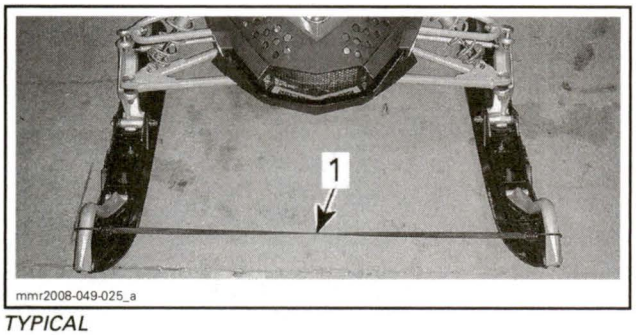
When removing or replacing a part of the steering mechanism, perform the steering alignment. Refer to *STEERING ALIGNMENT* in this subsection.

ADJUSTMENT

STEERING ALIGNMENT

Ski alignment is performed by adjusting the length of left and right tie-rods.

1. Leave the vehicle on the ground on its own weight.
2. Attach ski handles together with a bungee cord.

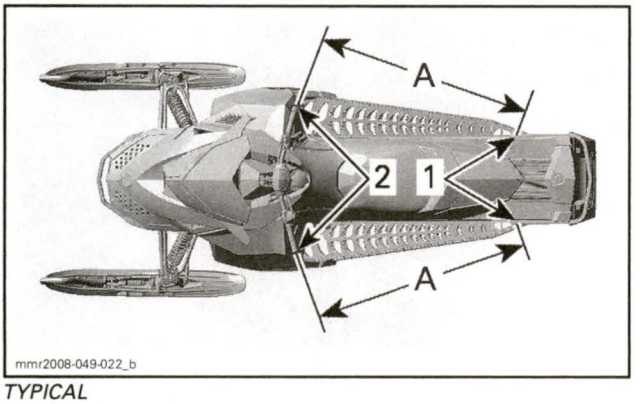


TYPICAL

1. Bungee cord

3. Position handlebar so that it is straight ahead position by measuring from the extremities of the grips to the rear most edge of the tunnel, as shown.

NOTE: The reference point must be the same to each side.

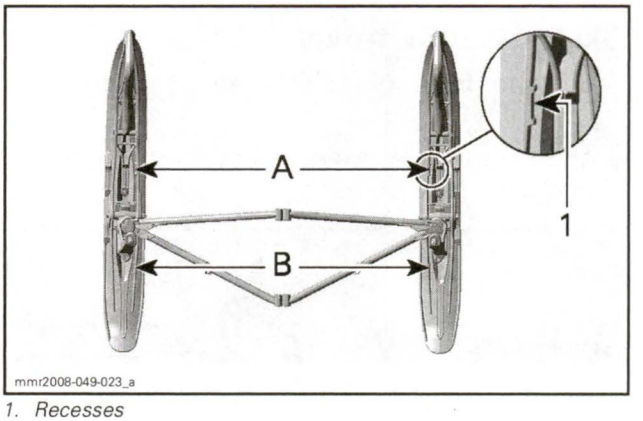


TYPICAL

1. Same fixed reference point
2. Handlebar end

A. Equal distance on each side

4. Verify if skis are in straight-ahead position by placing a straight edge against adjusted track and measuring distance between front and rear ski recesses and straight edge.
5. When skis are in straight ahead position, adjust the toe-out.
6. Measure the distance between front and rear ski recesses.
7. Use the following illustration and this equation to determine the perfect steering adjustment.



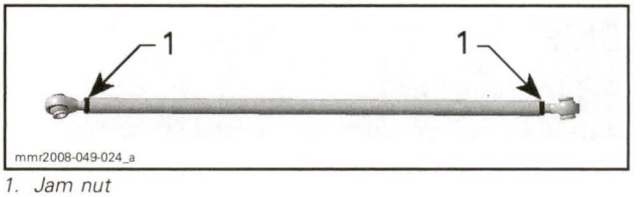
1. Recesses

A – B = 5 mm (.197 in)

STEERING ALIGNMENT	
Toe-out	5 mm (.197 in)

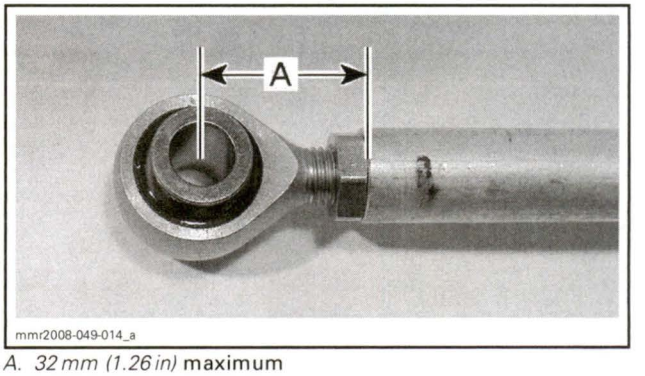
8. If adjustment is needed, loosen tie-rod jam nuts then turn tie-rods to change their length.
9. Tighten jam nuts as specified.

JAM NUT TORQUE, TIE-ROD END
18 N•m (159 lbf•**in**)



1. Jam nut

NOTE: The maximum tie-rod end length not engaged in the tie rod must not exceed 32 mm (1.26 in) to ensure proper thread engagement.



A. 32 mm (1.26 in) **maximum**

PROCEDURES

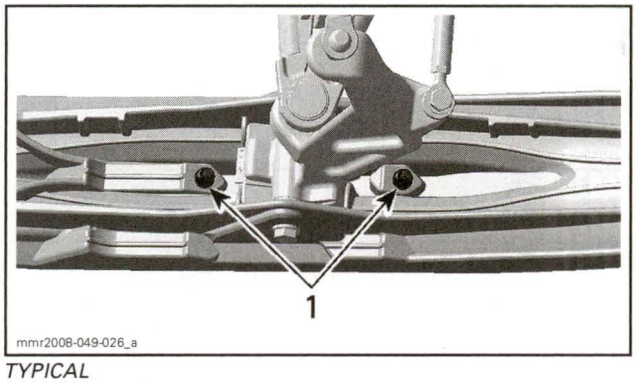
SKI RUNNERS

Ski Runner Inspection

Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

Ski Runner Removal

1. Lift the front of vehicle and support it off ground.
2. Unscrew the ski runner nuts then remove ski runners.



TYPICAL
1. Ski runner nuts

Ski Runner Installation

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

Torque ski runner nuts to 8 N•m (71 lbf•**in**).

SKIS

Ski Inspection

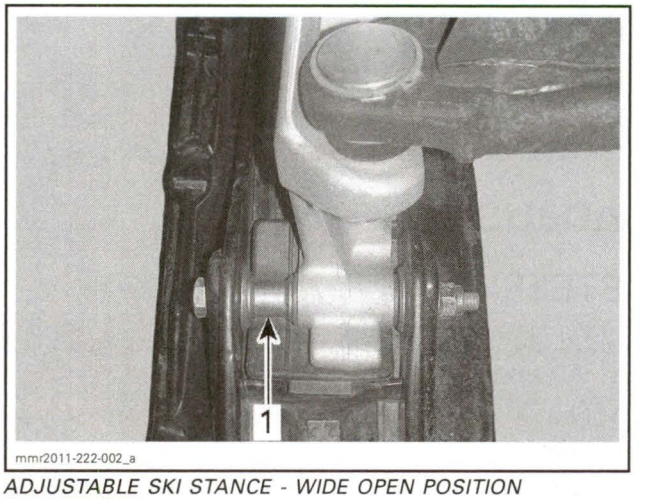
Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

Ski Removal

1. Lift front of vehicle and support it off the ground.

Expedition Models

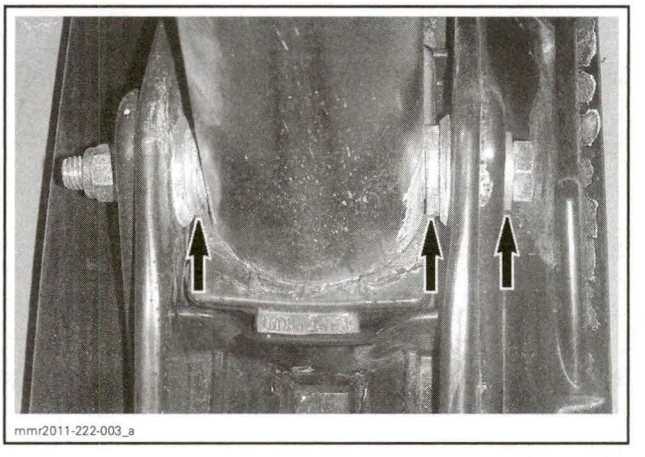
Observe and note position of ski bushing for ski stance.



ADJUSTABLE SKI STANCE - WIDE OPEN POSITION ILLUSTRATED
1. Ski bushing

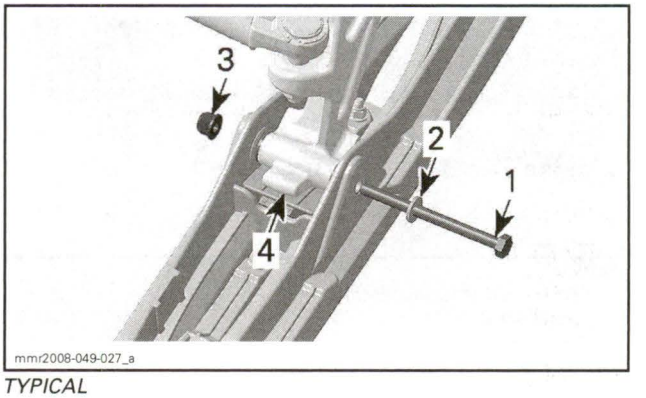
Skandic Models

Observe and note position and size of washer and spacers for reinstallation.



All Models

2. Unscrew nut then pull ski bolt out.

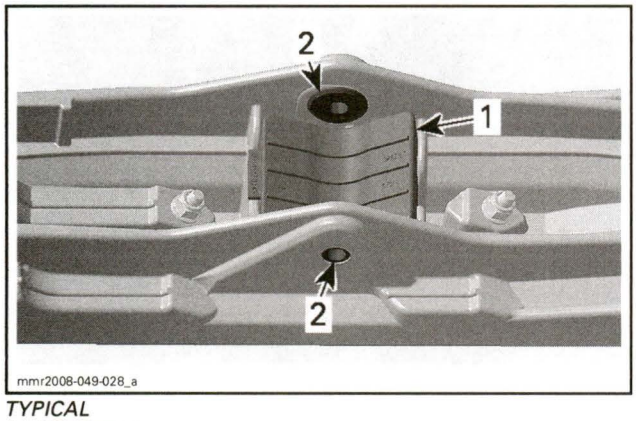


TYPICAL
1. Ski bolt
2. Washer
3. Nut
4. Ski leg

3. Remove ski from vehicle.

Ski Installation

1. Make sure bushings are installed in ski holes.
2. Install the ski stopper. Position indicator towards the front and make sure the bump in the ski is in the groove of the ski stopper.



TYPICAL
1. *Ski stopper*
2. *Bushings*

3. Install ski bolt and tighten as specified.

SKI BOLT TORQUE
48 N•m (35 lbf•ft)

Expedition SE Model

NOTE: Be sure to install ski bushing on both skis as noted prior to removal.

Skandic WT Models

NOTE: Be sure to install washer and spacers as noted prior to removal.

SKI HANDLES

Ski Handle Removal

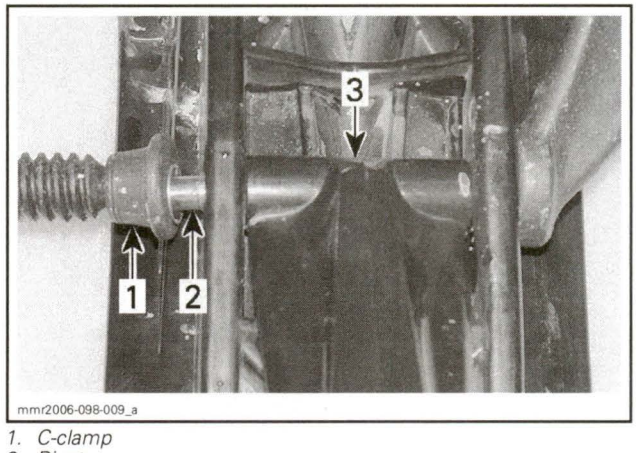
1. Remove ski from vehicle.
2. Using a 9 mm (3/8 in) drill bit, remove ski handle rivets.

NOTE: Drill only the rivet head. Do not try to drill all the way through the rivet. Angle the drill bit to reduce the chance of spinning the rivet in the ski.

3. Remove handle from ski.
4. Place handle in hot water for 10 minutes then using a punch, drive the rivet shank out of the handle.

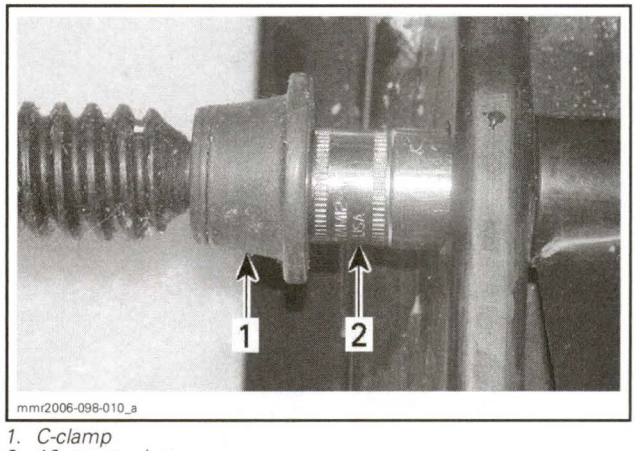
Ski Handle Installation

1. To install rivets, use a C-clamp and a short 10 mm socket.
2. Place a rivet in position and insert it into the ski and ski handle. Repeat the procedure for the other side.



1. *C-clamp*
2. *Rivet*
3. *Handle*

3. When both rivets are installed, use the short 10 mm socket to push rivet heads against the ski.



1. *C-clamp*
2. *10 mm socket*

SKI LEGS

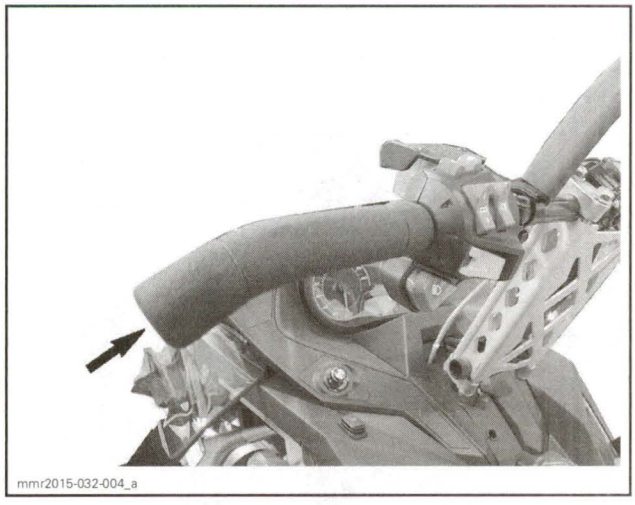
To replace a ski leg, refer to *FRONT SUSPENSION* subsection.

HANDLEBAR GRIPS

NOTE: To verify or replace heating elements, refer to *LIGHTS, GAUGE AND ACCESSORIES* subsection.

Handlebar Grip Removal

Blow compressed air in the grip hole , while pulling on the grip.



Handlebar Grip Installation

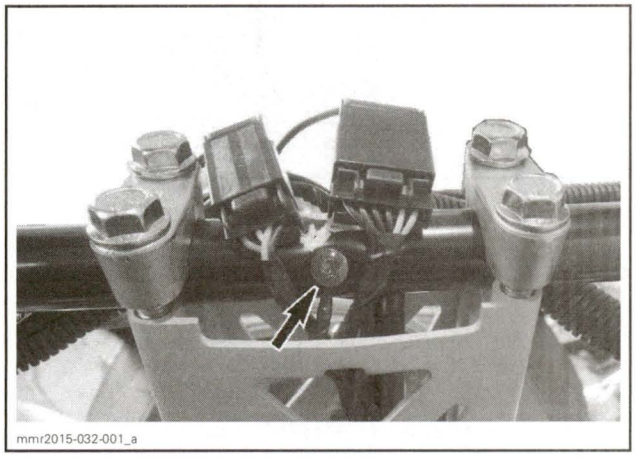
Insert the handlebar grip on handlebar while blowing compressed air like the removal procedure.

HANDLEBAR

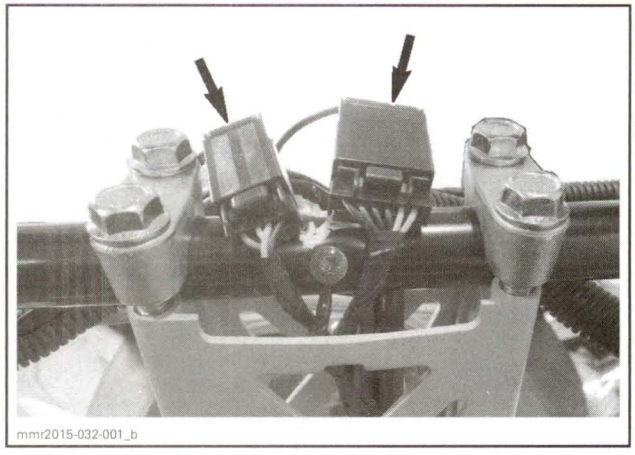
Handlebar Removal

NOTE: If the handlebar must be changed, remove all components (handle grip, Intelligent Throttle Control housing, etc.) before removing it from vehicle. Refer to applicable subsection.

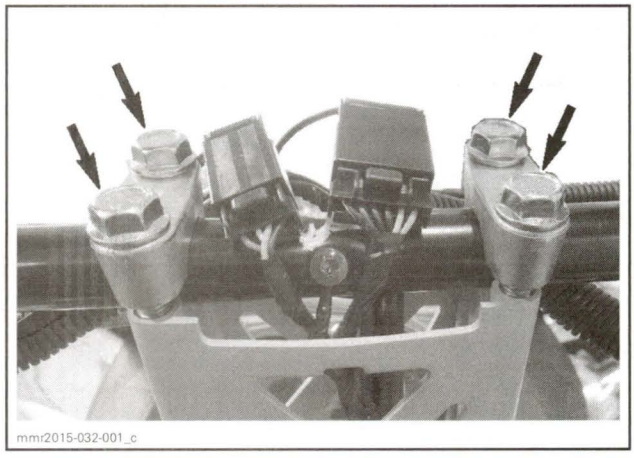
1. Remove steering cover.
2. Remove steering ground cable screw.



3. Disconnect electrical connectors.



4. Remove handlebar retaining clamp screws.



5. Remove handlebar from handlebar extension.

Handlebar Inspection

1. Inspect the handlebar for:
   - Damages
   - Cracks
   - Bending.
2. Replace if any of these problems is detected.

⚠ WARNING

Do not try to repair a defective handlebar.

3. Check handlebar clamps for cracks or distortion, replace if necessary.

Handlebar Installation

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

Tighten handlebar clamp screws to specification.

HANDLEBAR CLAMP SCREW TORQUE
25 N•m (18 lbf•ft)

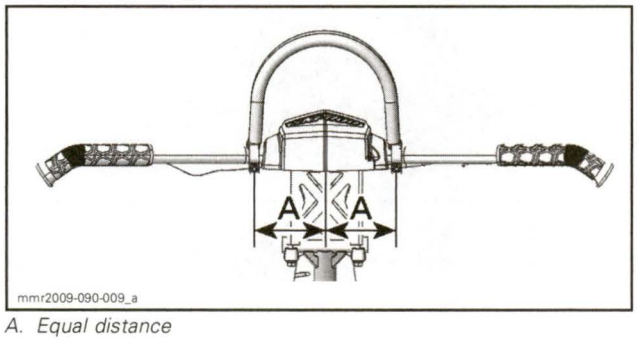
Tighten handlebar ground cable screw to specification.

HANDLEBAR GROUND SCREW TORQUE
5 N•m (44 lbf•**in**)

Turn handlebar completely from side to side making sure it does not exert unwanted tension on handlebar wires.

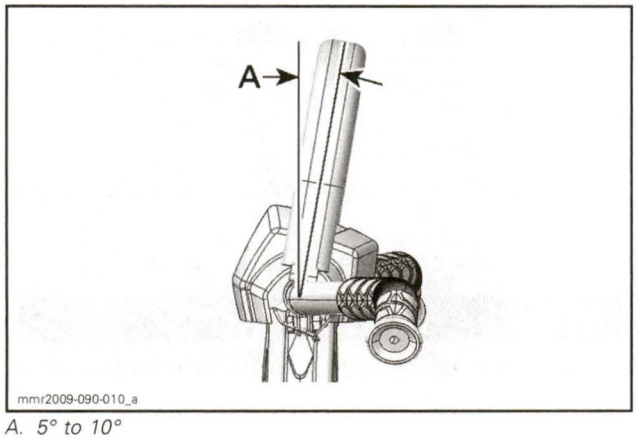
Handlebar Strap (if equipped)

1. Ensure to position strap symmetrically each side of handlebar retaining clamps.



A. Equal distance

2. Tilt strap 5° to 10° towards driver relative to handlebar extension.



A. 5° to 10°

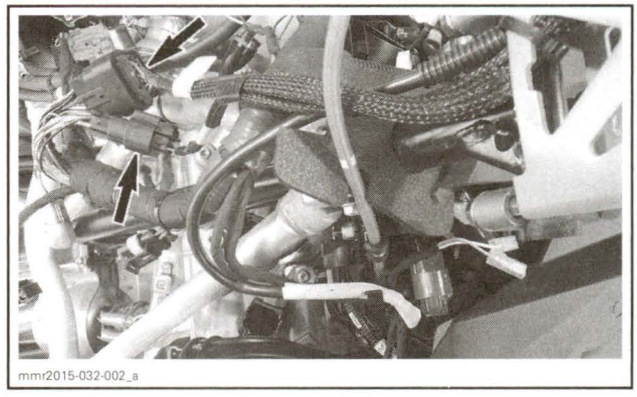
Make sure the strap clamps and bolts do not interfere with cables or wires.

STRAP RETAINING SCREW TORQUE
11 N•m (97 lbf•**in**)

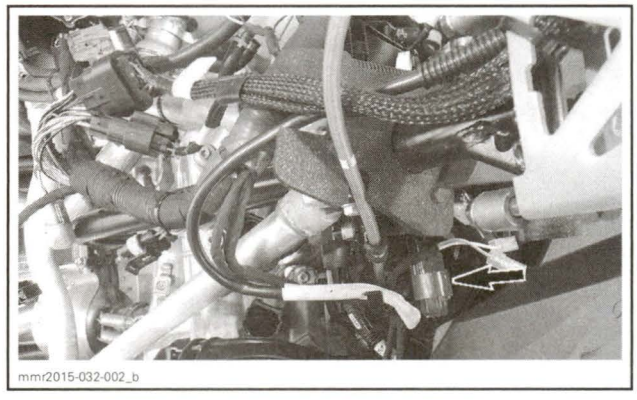
HANDLEBAR EXTENSION (FIXED)

Handlebar Extension Removal

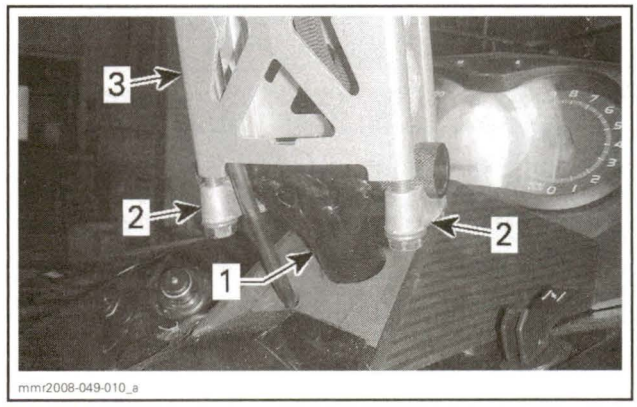
1. Proceed with *HANDLEBAR REMOVAL*, see procedure in this subsection.
2. Remove second air intake silencer and headlight/gauge module as a unit. Refer to *AIR INTAKE SYSTEM* subsection.
3. Disconnect the multifunction switch harness connectors and cut the locking tie on the handlebar extention.



4. Disconnect ITC connector.



5. Remove screws retaining the extension to steering column.



TYPICAL
1. Steering column
2. Handlebar extension clamps
3. Handlebar extension

6. Remove handlebar extension from vehicle.

Handlebar Extension Inspection

Check handlebar extension for:
- Cracks
- Deformation
- Other damages.

Replace if any of these problems is detected.

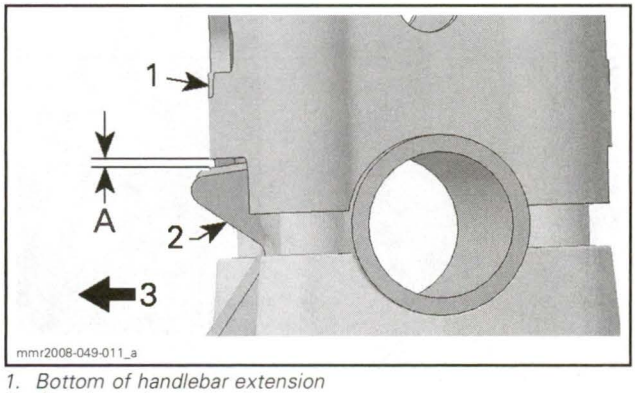
⚠ WARNING

Do not try to repair a defective handlebar extension.

Handlebar Extension Installation

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

When installing handlebar extension, ensure to leave a gap between handlebar extension and stop block on steering column.



1. Bottom of handlebar extension
2. Steering column stop block
3. Front of vehicle

A. 1 mm (.039 in) minimum

Torque handlebar extension retaining screws.

HANDLEBAR EXTENSION SCREW TORQUE
25 N•m (18 lbf•ft)

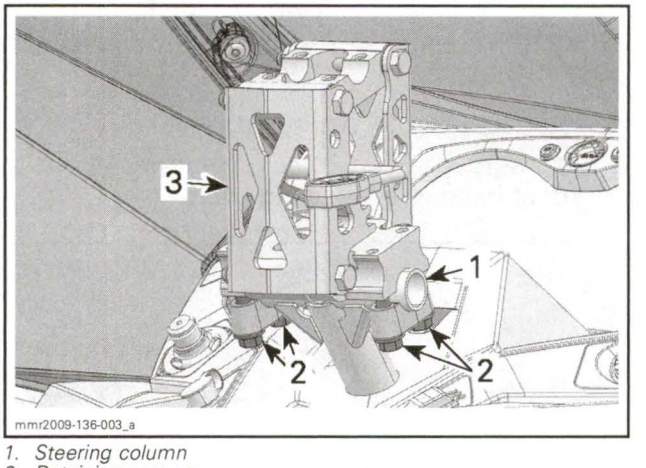
⚠ WARNING

The handlebar and it's components must not make contact with any other parts (windshield, fuel tank cap, etc.) when steering is turned.

HANDLEBAR EXTENSION (ADJUSTABLE)

Adjustable Handlebar Extension Removal

1. Proceed with *HANDLEBAR REMOVAL*, see procedure in this subsection.
2. Disconnect the multifunction switch harness connectors and cut the locking tie on the handlebar extention.
3. Remove screws retaining the adjustable extension to steering column.



1. Steering column
2. Retaining screws
3. Adjustable handlebar extension

4. Remove the adjustable handlebar extension from vehicle.

Adjustable Handlebar Extension Inspection

Check adjustable handlebar extension for:
- Cracks
- Deformation
- Other damages.

Check the proper operation of the locking mechanism.

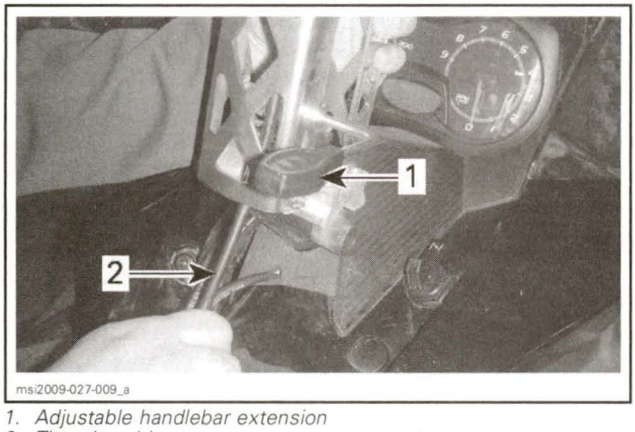
Replace if any of these problems is detected.

⚠ WARNING

Do not try to repair a defective adjustable handlebar extension.

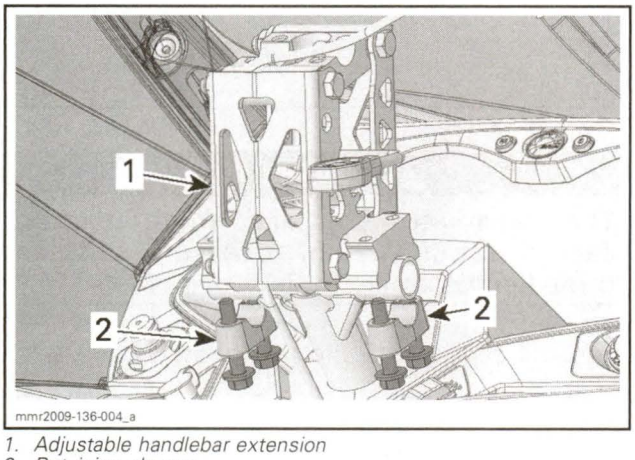
Adjustable Handlebar Extension Installation

1. Insert throttle cable in the adjustable handlebar extension.



1. *Adjustable handlebar extension*
2. *Throttle cable*

2. Secure adjustable handlebar extension to steering column.

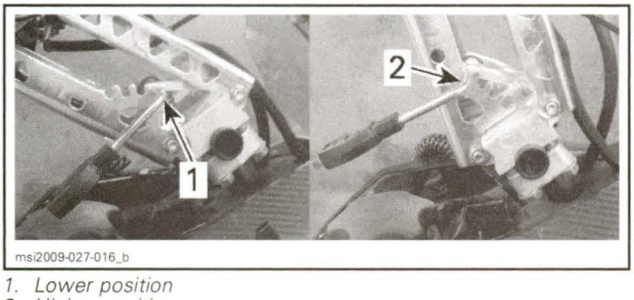


1. *Adjustable handlebar extension*
2. *Retaining clamps*

NOTE: Make sure adjustable extension is well centered on steering column.

⚠ WARNING

Handlebar and it's components, settled in any position, must not make contact with any other parts (windshield, fuel tank cap, etc.) when steering is turned.



1. *Lower position*
2. *Higher position*

3. Torque handlebar extension screws as specified.

HANDLEBAR EXTENSION SCREW TORQUE
25 N•m (18 lbf•ft)

4. Reconnect multifunction switch harness connectors and secure with a locking tie to the handlebar extention as prior to removal.
5. Reinstall all other removed parts. Refer to appropriate subsection for details.

TIE-RODS

NOTE: The same procedure is applied on RH and LH side.

Tie-Rod Inspection

Check tie-rod ends for looseness. If play is excessive, replace tie-rod.

Check if the tie-rod is bent, cracked or otherwise damaged. Replace if necessary.

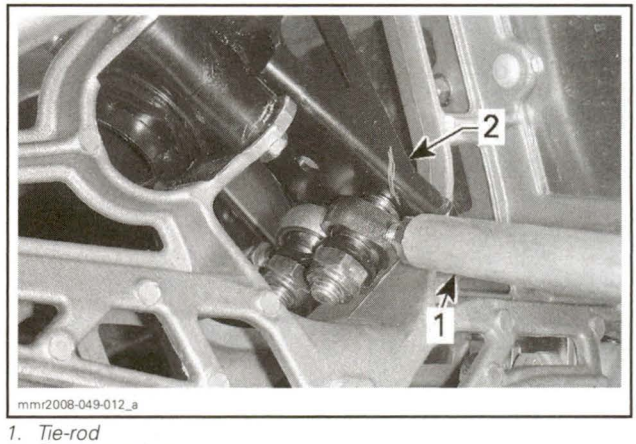
Tie-Rod Access

1. Refer to *BODY* subsection and remove:
   - Side panels
   - Hood.

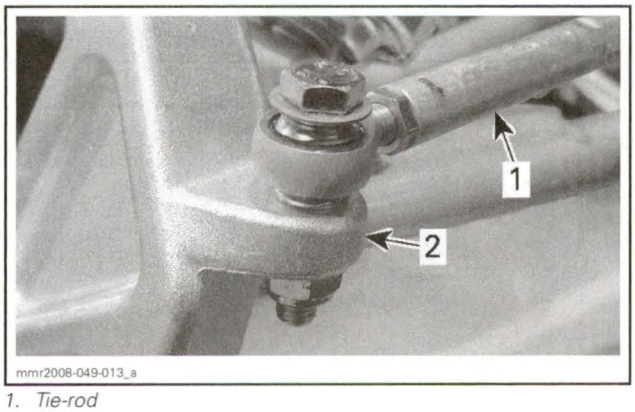
Tie-Rod Removal

1. Remove the tie-rod ends from the steering column and ski leg.

Expedition Models

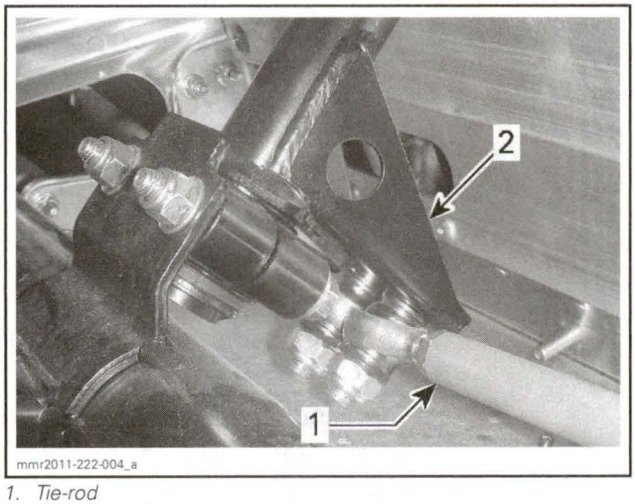


1. *Tie-rod*
2. *Steering column*

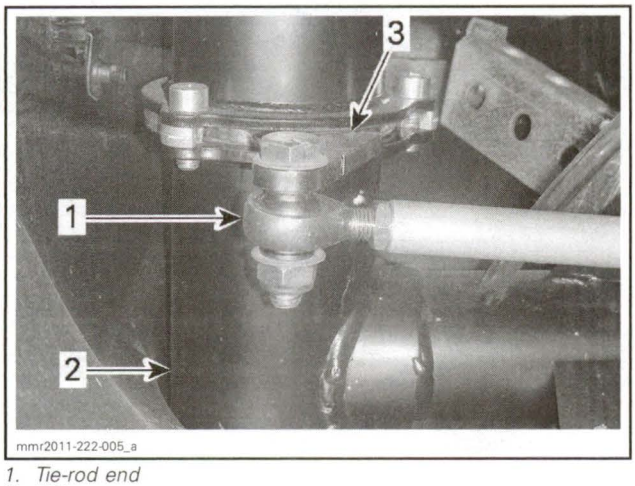


1. *Tie-rod*
2. *Ski leg*

Skandic Models



1. *Tie-rod*
2. *Steering column*



1. *Tie-rod end*
2. *LTS*
3. *Steering arm*

All Models

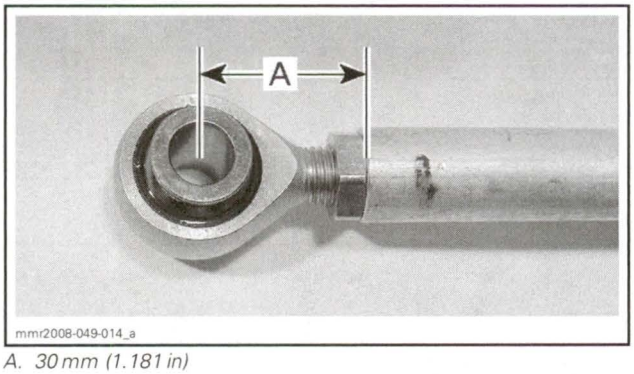
2. Remove tie-rod from vehicle.

Tie-Rod Installation

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

1. Adjust the tie-rod ends to their nominal length without tightening the jam nuts.

NOMINAL LENGTH ADJUSTMENT, TIE-ROD END
30 mm (1.181 in)

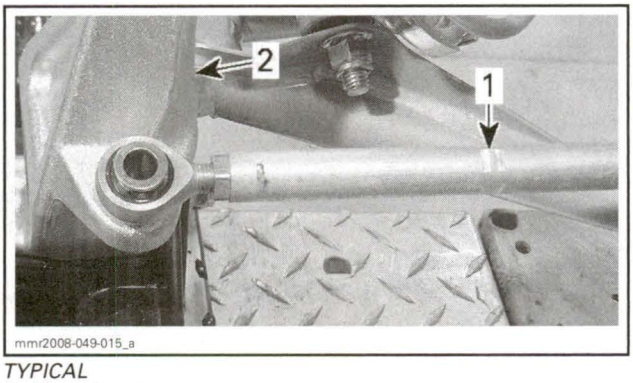


A. 30 mm (1.181 in)

⚠ WARNING

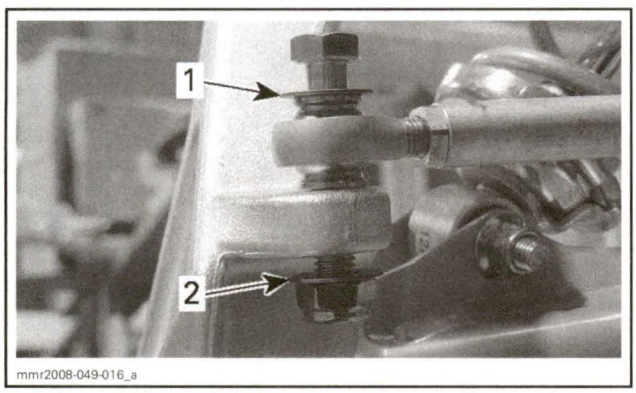
The maximum tie-rod end length must not exceed 32 mm (1.26 in) to ensure sufficient thread engagement in tie-rod.

2. Install tie-rod with the grooved end on the ski leg side.

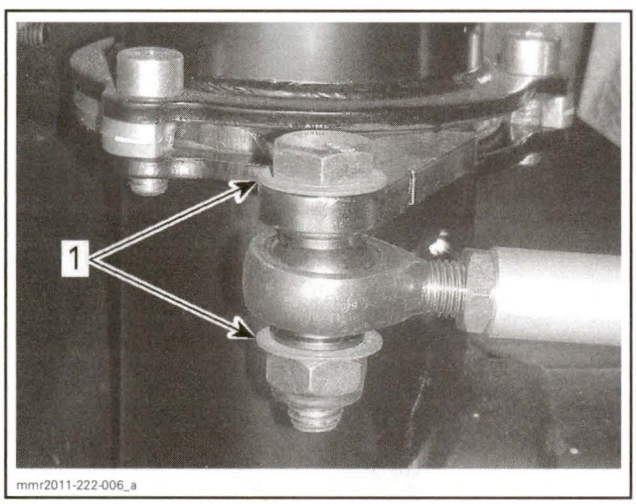


TYPICAL
1. *Tie-rod groove*
2. *Ski leg*

3. On ski leg side, install hardened washers as illustrated.



TYPICAL - EXPEDITION MODEL
1. *Large hardened washer*
2. *Small hardened washer*



TYPICAL - SKANDIC MODELS
1. *Hardened washers*

4. Install nuts retaining tie-rod ends and tighten them as specified.

RETAINING NUT TORQUE, TIE-ROD END
48 N•m (35 lbf•ft)

5. Perform a *STEERING ALIGNMENT*, see procedure in this subsection.

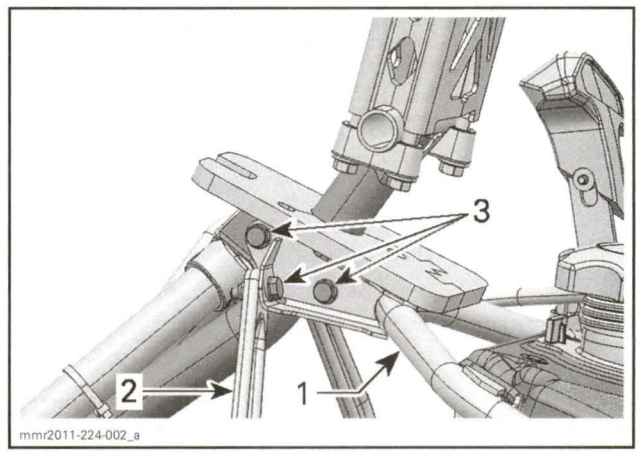
STEERING COLUMN

Steering Column Removal

1. Refer to *BODY* subsection to remove the following parts:
   - Side panels
   - Hood
   - Console.
2. Remove second air intake silencer and headlight/gauge module as a unit. Refer to *AIR INTAKE SYSTEM* subsection.

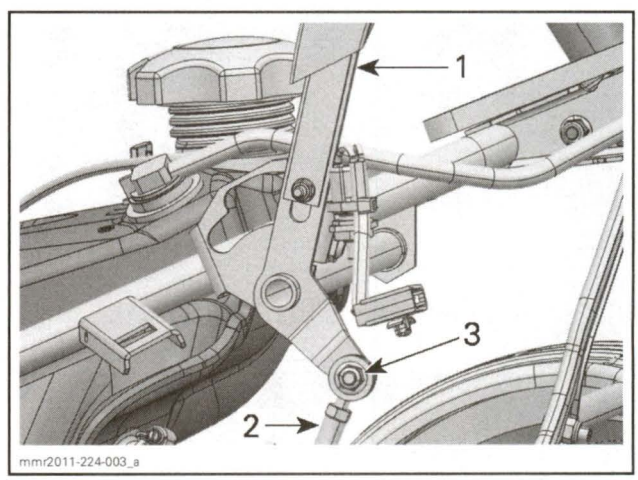
All Models

3. Remove *HANDLEBAR EXTENSION* from steering column, see procedure in this subsection.
4. Remove bolts and nuts securing upper steering column support.
5. Remove bolts and nuts securing side frame members to rear frame member at upper steering column support.



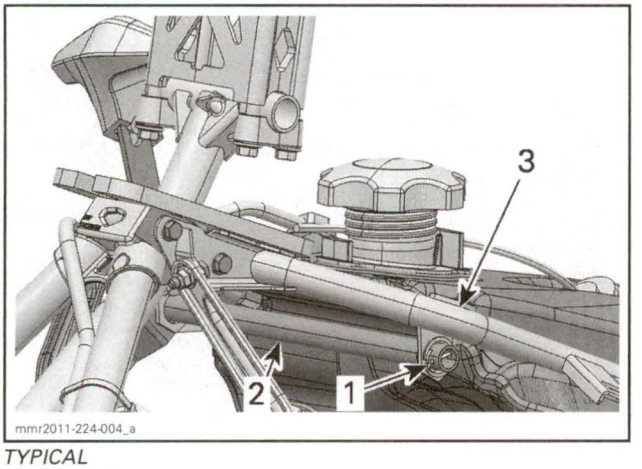
LH SIDE ILLUSTRATED
1. *Rear frame member*
2. *Side frame member*
3. *Bolts to remove*

6. Disconnect the shift rod from the shift lever.



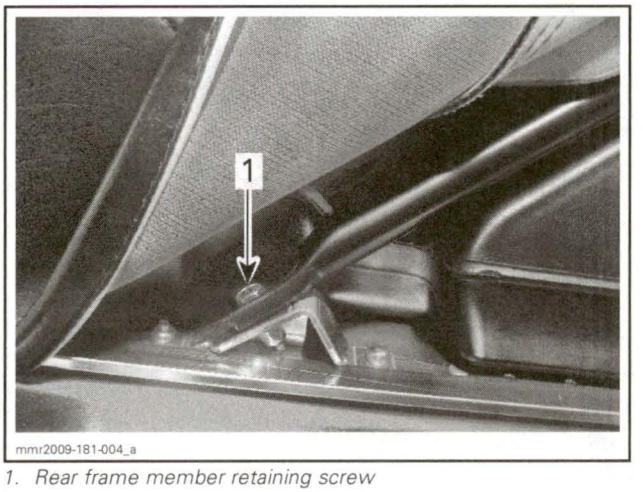
TYPICAL
1. *Shift lever*
2. *Shift rod*
3. *Remove this bolt and nut*

7. Remove the cotter pin that retains the shift lever shaft to the rear frame member and remove the shift lever.



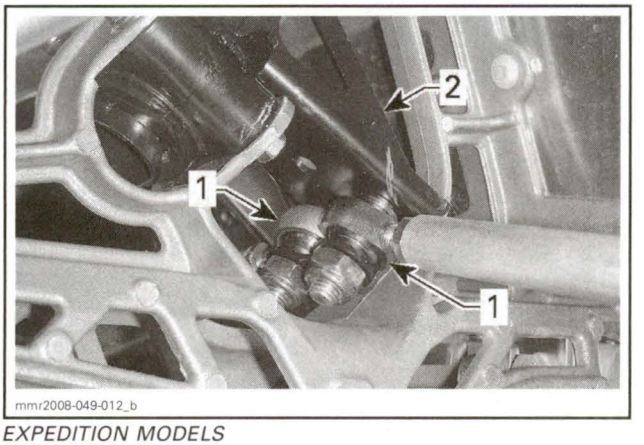
TYPICAL
1. *Cotter pin to remove*
2. *Shift lever shaft*
3. *Rear frame member*

8. Remove steering pad covering upper steering support halves.
9. Remove screw retaining the rear frame members (one each side) to the tunnel.

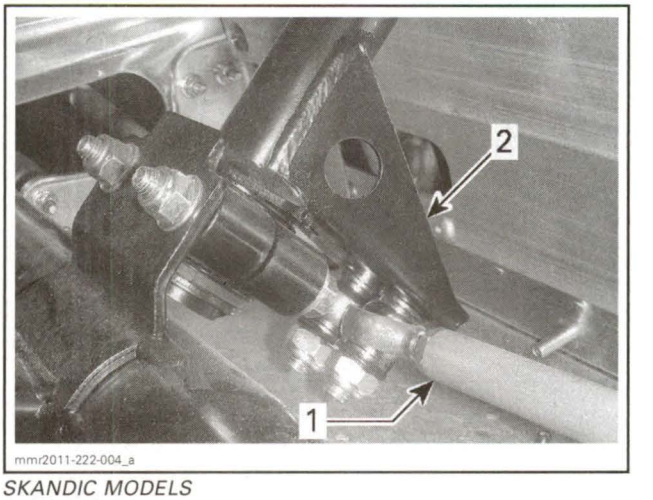


1. *Rear frame member retaining screw*

10. Remove tie-rod ends from steering column.

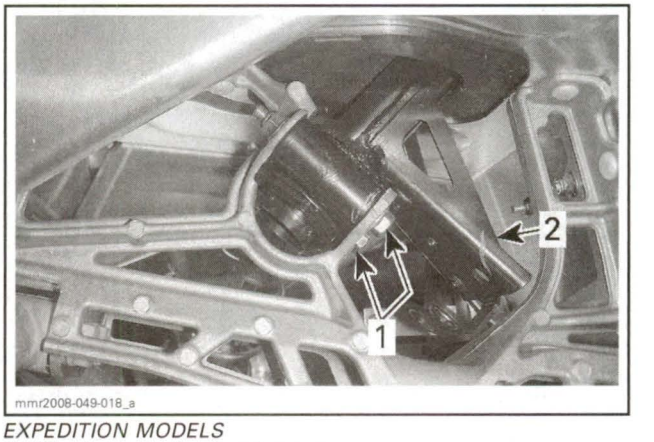


EXPEDITION MODELS
1. *Tie-rod ends*
2. *Steering column*

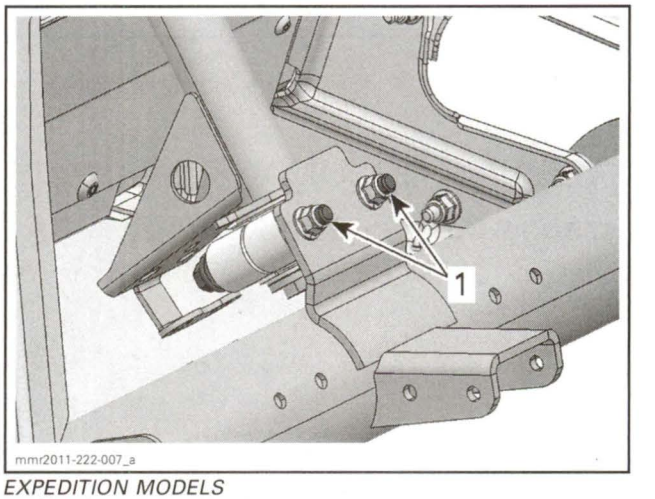


SKANDIC MODELS
1. *Tie-rod*
2. *Steering column*

11. Remove screws securing the steering column lower support.



EXPEDITION MODELS
1. *Steering column support screws*
2. *Steering column*

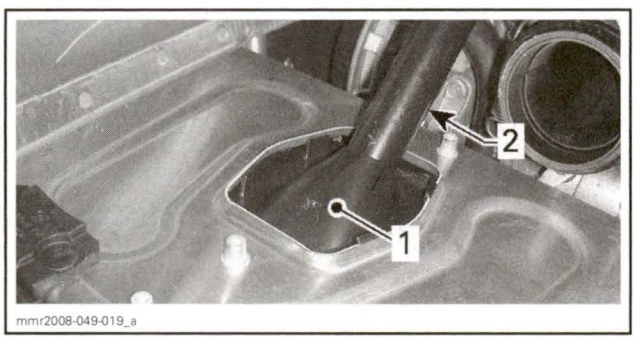


EXPEDITION MODELS
1. *Steering column support screws*

12. Remove lower steering support halves.

Expedition Models

13. Remove the steering column plate.



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1. Steering column plate
2. Steering column

All Models

14. Pull steering column from top.
15. Remove the upper steering column support halves as you pull up on the steering column.

NOTE: Move the rear frame member aside as you remove the steering column. Be wary of upper and lower steering dampers.

Steering Column Inspection

Check if steering column is:
- Cracked
- Bent
- Twisted
- Otherwise damaged.

Replace steering column if necessary.

⚠ WARNING

Do not try to repair a defective steering column.

Steering Column Installation

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

Apply SUSPENSION GREASE (P/N 293 550 033) on vibration dampers in steering column supports before installing upper and lower supports.

Replace all elastic nuts with NEW ones.

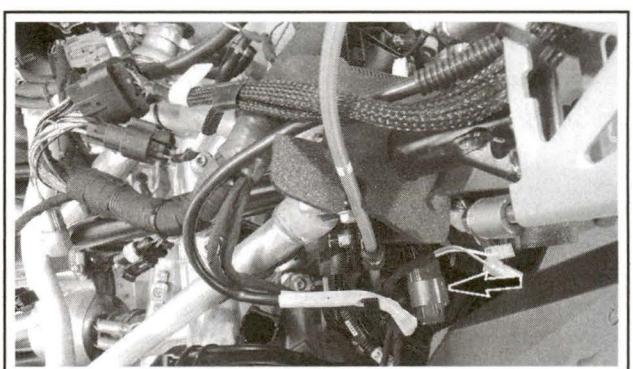
Ensure proper operation of steering and shift lever.

MOUNTING BOLT TORQUE	
UPPER STEERING COLUMN SUPPORT	18 N•m (159 lbf•**in**)
SIDE FRAME MEMBER	17 N•m (150 lbf•**in**)
AFT REAR FRAME MEMBER	14 N•m (124 lbf•**in**)
LOWER STEERING COLUMN SUPPORT	24 N•m (18 lbf•ft)
TIE-ROD END TO STEERING	48 N•m (35 lbf•ft)

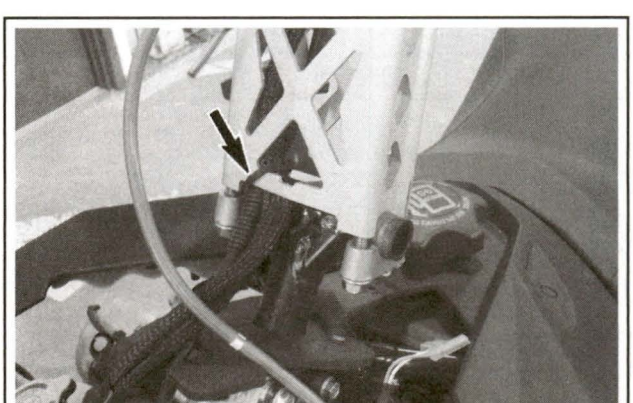
INTELLIGENT THROTTLE CONTROL (ITC) HOUSING

ITC Housing Removal

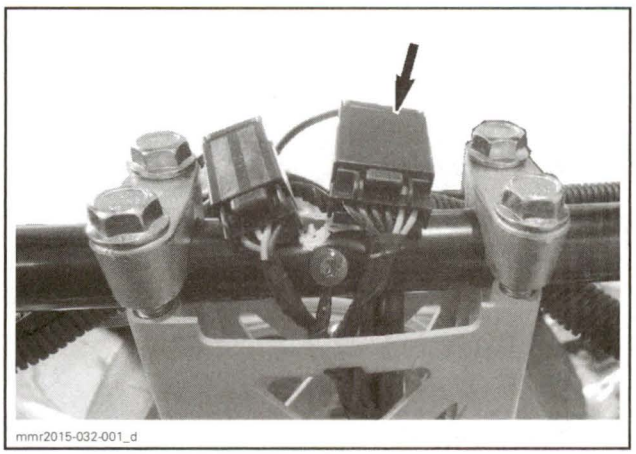
1. Remove second air intake silencer and headlight/gauge module as a unit. Refer to *AIR INTAKE SYSTEM* subsection.
2. Remove steering cover from handlebar.
3. Disconnect ITC connector.


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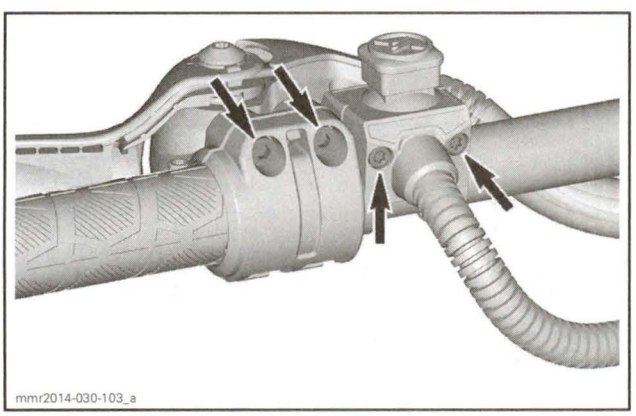
4. Cut locking ties securing ITC housing harness.


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5. Disconnect GD steering connector.



6. Remove ITC housing and emergency stop support retaining screws.



ITC Housing Installation

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

Tighten emergency stop support retaining screws to specification.

TIGHTENING TORQUE	
Emergency stop support retaining screws	2.2 N•m ± 0.2 N•m (19 lbf•**in** ± 2 lbf•**in**)

Tighten ITC housing retaining screws to specification.

TIGHTENING TORQUE	
ITC housing retaining screws	1.9 N•m ± 0.1 N•m (17 lbf•**in** ± 1 lbf•**in**)

Turn handlebar completely from side to side making sure it does not exert unwanted tension on handlebar wires.

600 ACE ITC

ENGINE			
Engine type			ROTAX® 600 ACE 4-stroke, Double Over Head Camshaft (DOHC), dry sump, liquid cooled
Number of cylinders			2
Number of valves			8 valves (self adjusting hydraulic valve lifters)
Bore			74 mm (2.91 in)
Stroke			69.7 mm (2.74 in)
Displacement			599.54 cm^3 (36.59 in^3)
Compression ratio			12.0 : 1
Decompressor type			N.A.
Maximum HP RPM			7250 (± 100) RPM
Intake valve opening			3° BTDC
Intake valve closing			37° ABDC
Exhaust valve opening			44° BBDC
Exhaust valve closing			6° ATDC
Valve stem diameter	Intake	New	4.958 mm to 4.972 mm (.1952 in to .1957 in)
		Service limit	4.94 mm (.1945 in)
	Exhaust	New	4.956 mm to 4.970 mm (.1951 in to .1957 in)
		Service limit	4.94 mm (.194 in)
Valve guide inner diameter		New	5.000 mm to 5.020 mm (.1969 in to .1976 in)
		Service limit	5.050 mm (.1988 in)
Valve spring free length		New	31.35 mm (1.2343 in)
		Service limit	29.50 mm (1.1614 in)
Valve seat contact width	Intake	New	1.05 mm to 1.35 mm (.0413 in to .0531 in)
		Service limit	1.70 mm (.067 in)
	Exhaust	New	1.25 mm to 1.45 mm (.0492 in to .0571 in)
		Service limit	1.80 mm (.071 in)
Piston measurement		New	73.95 mm to 73.966 mm (2.9114 in to 2.912 in)
		Service limit	73.92 mm (2.91 in)
Piston/cylinder wall clearance		New	0.037 mm to 0.067 mm (.0015 in to .0026 in)
		Service limit	0.08 mm (.0031 in)
Piston ring type		1st	Upper compression ring, rectangular
		2nd	Lower compression ring, tapered face
		3rd	Oil scraper ring

ENGINE			
Ring end gap	Rectangular	New	0.20 mm to 0.35 mm (.0079 in to .0138 in)
		Service limit	1.20 mm (.0472 in)
	Taper-face	New	0.30 mm to 0.50 mm (.0118 in to .0197 in)
		Service limit	1.20 mm (.0472 in)
	Oil scraper ring	New	0.20 mm to 0.70 mm (.0079 in to .0276 in)
		Service limit	1.20 mm (.0472 in)
Ring/piston groove clearance	Rectangular	New	0.030 mm to 0.066 mm (.0012 in to .0026 in)
		Service limit	0.12 mm (.0047 in)
	Taper-face	New	0.020 mm to 0.056 mm (.0008 in to .0022 in)
		Service limit	0.12 mm (.0047 in)
	Oil scraper ring	New	0.010 mm to 0.040 mm (.0004 in to .0016 in)
		Service limit	0.15 mm (.0059 in)
Cylinder bore		New	74.003 mm to 74.017 mm (2.9135 in to 2.9141 in)
Cylinder taper		Maximum New	0.030 mm (.0012 in)
		Service limit	0.05 mm (.002 in)
Cylinder out of round		Maximum New	0.008 mm (.0003 in)
		Service limit	0.03 mm (.0012 in)
Camshaft bearing journal diameter	PTO	New	25.947 mm to 25.960 mm (1.0215 in to 1.022 in)
		Service limit	25.92 mm (1.0205 in)
	MAG/Center	New	22.947 mm to 22.960 mm (.9034 in to .9039 in)
		Service limit	22.92 mm (.9024 in)
Camshaft holder bore diameter	PTO	New	26.00 mm to 26.021 mm (1.0236 in to 1.0244 in)
		Service limit	26.05 mm (1.0256 in)
	MAG/Center	New	23.00 mm to 23.021 mm (.9055 in to .9063 in)
		Service limit	23.05 mm (.9075 in)
Camshaft lobe height	Intake	New	38.70 mm to 38.90 mm (1.5236 in to 1.5315 in)
		Service limit	38.68 mm (1.5228 in)
	Exhaust	New	39.40 mm to 39.60 mm (1.5512 in to 1.5591 in)
		Service limit	39.38 mm (1.5504 in)
Crankshaft bearing journal diameter		New	35.990 mm to 36.006 mm (1.4169 in to 1.4176 in)
		Service limit	35.960 mm (1.4157 in)
Crankshaft radial play		Service limit	0.080 mm (.0031 in)
Crankshaft axial play		New	0.120 mm - 0.392 mm (.0047 in - .0154 in)
		Service limit	0.450 mm (.0177 in)
Crankshaft pin diameter		New	35.979 mm to 35.995 mm (1.416 in to 1.417 in)
		Service limit	35.969 mm (1.416 in)

ENGINE			
Crankshaft deflection	MAG	Maximum	0.050 mm (.002 in)
	Center	Maximum	0.050 mm (.002 in)
	PTO	Maximum	0.050 mm (.002 in)
Crankshaft plain bearing inside diameter		Service limit	36.08 mm (1.4205 in)
Connecting rod big end diameter		Service limit	36.06 mm (1.4197 in)
Connecting rod big end radial play		Service limit	0.08 mm (.0031 in)
Connecting rod big end axial play		New	0.100 mm to 0.352 mm (.0039 in to .0139 in)
		Service limit	0.450 mm (.0177 in)
Connecting rod small end diameter		New	17.010 mm to 17.020 mm (.6697 in to .6701 in)
		Service limit	17.060 mm (.6717 in)
Piston pin diameter		New	16.996 mm to 17.000 mm (.6691 in to .6693 in)
		Service limit	16.986 mm (.6687 in)
Connecting rod small end radial play		Service limit	0.04 mm (.0016 in)

COOLING SYSTEM		
Coolant	Type	Ethyl glycol and distilled water (50%/50%). Use BRP premixed coolant (P/N 219 700 362) or coolant specifically formulated for aluminum engines
	Quantity	5.0 L (1.32 U.S. gal.)
Thermostat opening temperature		75°C (167°F)
Radiator cap opening pressure		110 kPa (16 PSI)

LUBRICATION SYSTEM			
Lubrication	Type		Dry sump. Replaceable oil filter
	Oil filter		BRP Rotax paper type, replaceable
	Engine oil pressure	Minimum	60 kPa (8.7 PSI) @ 1400 RPM
			400 kPa (58 PSI) @ 4000 RPM
	Engine oil	Capacity (oil change with filter)	2.1 L (2.22 qt (U.S. liq.))
		Recommended	XPS Synthetic 4-Stroke oil (All climate) (P/N 293 600 112) or a SAE 0W 40 API service SM synthetic oil

FUEL SYSTEM			
Fuel injection type			Mulitpoint fuel injection
Throttle body type			46mm heated Dell'Orto throttle body with iTC (intelligent Throttle Control)
Idle speed	Normal idle	Standard/ECO mode	1500 ± 100 RPM
		Sport	1650 ± 100 RPM
	Fast idle at -40°C (-40°F)		2100 ± 100 RPM
Gasoline type			Regular Unleaded

FUEL SYSTEM		
Minimum octane rating	Inside North America ((R+M)/2)	87 (No ethanol)
		91 (10% MAX ethanol)
	Outside North America (RON)	92 (No ethanol)
		95 (10% MAX ethanol)
Fuel tank capacity		45 L (12 U.S. gal.)

ELECTRICAL SYSTEM		
Magneto generator output		650 W @ 6000 RPM @ 14 V
Magneto stator resistance (between any pair of yellow wires)		0.1 to 1 Ohm @ 20°C (68°F)
Ignition type		IDI (Inductive Digital Ignition)
Spark plug	Make and type	NGK MR7BI-8
	Gap	.70 mm to 0.80 mm (.028 in to .031 in)
Ignition timing		Not adjustable
Battery		12 volt 30 A.h. YIX30L
Headlamp LOW/HI beam		2 X 55/60 W (H4)
Taillight and stoplight		2 X P 5/21 W
Fuses	F 1: Fuse 2, fuse 4, relay 1, relay 2, relay 3, voltage regulator	30 A
	F 2: Relay coils, start button, gauge	5 A
	F 3: Fuel pump, starter solenoid	10 A
	F 4: Fan relay (R4)	10 A
	F 5: Fuel injectors, ignition coils	10 A
	F 6: Gauge, ECM, camshaft position sensor	10 A
	F 7: 12-volt power outlet, heated grips, heated throttle lever	10 A
	F 8: Lights	20 A
	F 9: Horn (optional)	5 A
	F 10: Rear 12-volt power outlet (optional)	5 A
Relays	Relay 1	Fuse 3, fuse 5, fuse 6
	Relay 2	Fuse 8, fuse 9, fuse 10
	Relay 3	Fuse 7
	Relay 4	Cooling fan

DRIVE SYSTEM		
Gearbox oil	Type	XPS synthetic gearbox oil (P/N 293 600 140)
	Quantity	700 ml (23.7 U.S. oz)
Gear ratio	1st	3.86 : 1
	2nd	2.3 : 1
	R	4.06 : 1

DRIVE SYSTEM		
Drive pulley	Type	eDrive
	Clutch engagement	2200 ± 100 RPM
	Spring color	Red/White
	Spring length	114.7 mm (4.5 in)
	Pin	N.A.
	Ramp	716
	Screw position	N.A.
Driven pulley	Type	QRS-NTC
	Spring preload (New)	7.0 kgf ± 0.7 kgf (15.4 lbf ± 1.5 lbf)
	Spring preload (After break-in)	6.4 kgf ± 0.7 kgf (14.1 lbf ± 1.5 lbf)
	Spring color	Orange
	Cam angle	37°/45°
Pulley distance	Z	21.40 mm (.843 in)
Pulley offset	X	37.2 mm ± 0.5 mm (1.465 in ± .02 in)
Drive belt	Width	36.3 mm (1.43 in)
	Wear limit	33.9 mm (1.33 in)
Track	Width	500 mm (20 in)
	Length	392 cm (154 in)
	Profile height	38.1 mm (1.5 in)
Track adjustment	Deflection	40 mm to 50 mm (1.575 in to 1.969 in)

BRAKE SYSTEM		
Brake lining minimum thickness		1 mm (.039 in)
Brake disk minimum thickness		4.5 mm (.177 in)
Brake fluid	Type	DOT 4
	Quantity	65 ml (2.2 U.S. oz)

FRONT SUSPENSION	
Suspension type	XU-LTS
Suspension maximum travel	150 mm (6 in)
Shock absorber type	Motion control

REAR SUSPENSION		
Suspension type		SC-5U
Suspension maximum travel		340 mm (13.4 in)
Shock absorber type	Center	Motion control
	Rear	HPG
Stroke limiter standard position		3

STEERING SYSTEM	
Ski type	Pilot DS 2
Toe-out	5 mm (.197 in)
Camber	0°

WEIGHT AND DIMENSIONS	
Dry weight	284 kg (626 lb)
Length	324 cm (128 in)
Width	107.6 cm (42.4 in)
Height	133 cm (52.4 in)
Ski stance	900 mm (35.4 in)
Ski width	165 mm (6.5 in)

900 ACE

ENGINE			
Engine type			ROTAX® 900 ACE 4-stroke, Double Over Head Camshaft (DOHC), dry sump, liquid cooled
Number of cylinders			3
Number of valves			12 valves (self adjusting hydraulic valve lifters)
Bore			74 mm (2.91 in)
Stroke			69.7 mm (2.74 in)
Displacement			899.31 cm^3 (54.88 in^3)
Compression ratio			12.0 : 1
Maximum HP RPM			7250 ± 200 RPM
Intake valve opening			5° ATDC
Intake valve closing			40° ABDC
Exhaust valve opening			40° BBDC
Exhaust valve closing			5° BTDC
Valve stem diameter	Intake	New	4.958 mm to 4.972 mm (.1952 in to .1957 in)
		Service limit	4.940 mm (.1945 in)
	Exhaust	New	4.956 mm to 4.970 mm (.1951 in to .1957 in)
		Service limit	4.940 mm (.1945 in)
Valve guide diameter		New	5.000 mm to 5.020 mm (.1969 in to .1976 in)
		Service limit	5.050 mm (.1988 in)
Valve out of round		New	0.005 mm (.0002 in)
		Service limit	0.060 mm (.0024 in)
Valve spring free length		New	31.35 mm (1.2343 in)
		Service limit	29.50 mm (1.1614 in)
Valve seat contact width	Intake	New	1.05 mm to 1.35 mm (.0413 in to .0531 in)
		Service limit	1.70 mm (.0669 in)
	Exhaust	New	1.25 mm to 1.45 mm (.0492 in to .0571 in)
		Service limit	1.80 mm (.0709 in)
Cylinder head warpage		Service limit	0.15 mm (.0059 in)
Piston measurement		New	73.950 mm to 73.966 mm (2.9114 in to 2.912 in)
		Service limit	73.920 mm (2.9102 in)
Piston/cylinder wall clearance		New	0.037 mm to 0.067 mm (.0015 in to .0026 in)
		Service limit	0.080 mm (.0031 in)
Piston ring type		1st	Upper compression ring, rectangular
		2nd	Lower compression ring, tapered face
		3rd	Oil scraper ring

ENGINE			
Ring end gap	Rectangular	New	0.20 mm to 0.35 mm (.0079 in to .0138 in)
		Service limit	1.20 mm (.0472 in)
	Taper-face	New	0.30 mm to 0.50 mm (.0118 in to .0197 in)
		Service limit	1.20 mm (.0472 in)
	Oil scraper ring	New	0.20 mm to 0.70 mm (.0079 in to .0276 in)
		Service limit	1.20 mm (.0472 in)
Ring/piston groove clearance	Rectangular	New	0.030 mm to 0.066 mm (.0012 in to .0026 in)
		Service limit	0.120 mm (.0047 in)
	Taper-face	New	0.020 mm to 0.056 mm (.0008 in to .0022 in)
		Service limit	0.120 mm (.0047 in)
	Oil scraper ring	New	0.010 mm to 0.040 mm (.0004 in to .0016 in)
		Service limit	0.150 mm (.0059 in)
Cylinder bore		New	74.003 mm to 74.017 mm (2.9135 in to 2.9141 in)
Cylinder taper		Maximum New	0.030 mm (.0012 in)
		Service limit	0.050 mm (.002 in)
Cylinder out of round		Maximum New	0.008 mm (.0003 in)
		Service limit	0.03 mm (.0012 in)
Camshaft bearing journal diameter	PTO	New	25.967 mm to 25.980 mm (1.0223 in to 1.0228 in)
		Service limit	25.940 mm (1.0213 in)
	MAG/Center	New	22.957 mm to 22.970 mm (.9038 in to .9043 in)
		Service limit	22.930 mm (.9028 in)
Camshaft holder bore diameter	PTO	New	26.00 mm to 26.021 mm (1.0236 in to 1.0244 in)
		Service limit	26.05 mm (1.0256 in)
	MAG/Center	New	23.00 mm to 23.021 mm (.9055 in to .9063 in)
		Service limit	23.05 mm (.9075 in)
Camshaft journal radial play	All	New	0.020 mm to 0.054 mm (.0008 in to .0021 in)
		Service limit	0.080 mm (.0031 in)
Camshaft lobe height	Intake	New	38.35 mm to 38.55 mm (1.51 in to 1.518 in)
		Service limit	38.33 mm (1.509 in)
	Exhaust	New	38.35 mm to 38.55 mm (1.51 in to 1.518 in)
		Service limit	38.33 mm (1.509 in)
Crankshaft bearing journal diameter		New	35.990 mm to 36.006 mm (1.4169 in to 1.4176 in)
		Service limit	35.960 mm (1.4157 in)
Crankshaft radial play		Service limit	0.08 mm (.003 in)
Crankshaft axial play		New	0.120 mm to 0.353 mm (.0047 in to .0139 in)
		Service limit	0.450 mm (.0177 in)

ENGINE			
Crankshaft deflection	MAG	Maximum	0.050 mm (.002 in)
	Center	Maximum	0.050 mm (.002 in)
	PTO	Maximum	0.080 mm (.003 in)
Crankshaft plain bearing inside diameter		Service limit	36.08 mm (1.4205 in)
Connecting rod big end diameter		Service limit	36.06 mm (1.4197 in)
Connecting rod big end radial play		Service limit	0.08 mm (.0031 in)
Connecting rod big end axial play		New	0.100 mm to 0.352 mm (.0039 in to .0139 in)
		Service limit	0.450 mm (.0177 in)
Connecting rod small end diameter		New	17.010 mm to 17.020 mm (.6697 in to .6701 in)
		Service limit	17.060 mm (.6717 in)
Piston pin diameter		New	16.996 mm to 17.000 mm (.6691 in to .6693 in)
		Service limit	16.986 mm (.6687 in)
Connecting rod small end radial play		Service limit	0.04 mm (.0016 in)
Chain guide groove depth		Service limit	1 mm (.039 in)
Oil pressure regulator spring free length		New	46 mm (1.811 in)
		Service limit	45 mm (1.772 in)
Oil pump radial clearance		Service limit	0.25 mm (.0098 in)
Oil pump axial clearance		Service limit	0.15 mm (.0059 in)

COOLING SYSTEM		
Coolant	Type	Ethyl glycol and distilled water (50%/50%). Use BRP premixed coolant (P/N 219 700 362) or coolant specifically formulated for aluminum engines
	Quantity	6 L (1.59 U.S. gal.)
Thermostat opening temperature		75°C (167°F)
Radiator cap opening pressure		110 kPa (16 PSI)

LUBRICATION SYSTEM			
Lubrication	Type		Dry sump. Replaceable oil filter
	Oil filter		BRP Rotax paper type, replaceable
	Engine oil pressure at 100°C (212°F)	Minimum	80 kPa (11.6 PSI) @ idle speed
			350 kPa (50.8 PSI) @ 6000 to 7250 RPM
	Engine oil	Capacity (oil change with filter)	3.3 L (3.5 qt (U.S. liq.))
		Recommended	XPS Synthetic 4-Stroke oil (All climate) (P/N 293 600 112) or a SAE 0W 40 API service SM synthetic oil

FUEL SYSTEM	
Fuel injection type	Multipoint fuel injection
Throttle body type	46 mm heated Dell'Orto throttle body with iTC (intelligent Throttle Control)

FUEL SYSTEM			
Idle speed	Normal idle	Standard/ECO Mode	1300 ± 100 RPM
		Sport Mode	1500 ± 100 RPM
	Fast idle at -40°C (-40°F)		1850 ± 100 RPM
Gasoline type			Regular Unleaded
Minimum octane rating	Inside North America ((R+M)/2)		87 (No ethanol)
			91 (10% MAX ethanol)
	Outside North America (RON)		92 (No ethanol)
			95 (10% MAX ethanol)
Fuel tank capacity			45 L (11.9 U.S. gal.)

ELECTRICAL SYSTEM			
Magneto generator output			650 W @ 6000 RPM @ 14 V
Magneto stator resistance (between any pair of yellow wires)			0.1 to 1 Ohm @ 20°C (68°F)
Ignition type			IDI (Inductive Digital Ignition)
Spark plug	Make and type		NGK MR7BI-8
	Gap		.70 mm to 0.80 mm (.028 in to .031 in)
Ignition timing			Not adjustable
Ignition coil	Primary		0.80 to 0.97 Ω
	Secondary		9.5 to 13.5 Ω
Engine speed limiter setting			8000 RPM
Battery		Skandic / Expedition LE	12 volt 18 A.h. YTX20HL-BS
		Expedition SE	12 volts 30 A.h. YIX30L
Headlamp LOW/HI beam			2 x 60/55 Watts (H-4)
Taillight and stoplight			2.6 W / 139m W LED
Fuses and relays (Skandic)	F A	Main	40 A
	F 1	Ignition coils, fuel injectors, fuel pump, starter solenoid	10 A
	F 2	Accessories	20 A
	F 3	Electro Mechanical Reverse	20 A
	F 4	Start clock, cooling fan	15 A
	F 5	Headlights, taillight, brake light	20 A
	F 6	ECM, gauge and CAPS	10 A
	Relay 1		Main relay
	Relay 2		Lighting relay
	Relay 3		Accessory relay

ELECTRICAL SYSTEM			
Fuses and relays (Expedition)	F 1	Battery	30 A
	F 2	Relay / Start button	5 A
	F 3	Starter Solenoid	10 A
	F 4	Cooling fan	15 A
	F 5	HIC	10 A
	F 6	HIC / Gauge	10 A
	F 7	Front power outlet and heaters	10 A
	F 8	Lighting	20 A
	F 9	Horn	5 A
	F 10	Rear power outlet	5 A
	F 11	Compressor	15 A
	Relay 1		Main
	Relay 2		Lighting
	Relay 3		Accessory
	Relay 4		Fan

DRIVE SYSTEM		
Gearbox oil	Type	XPS synthetic gear oil (75W140) (P/N 293 600 140)
	Quantity	700 ml (23.7 U.S. oz)
Gear ratio	1st	3.86 : 1
	2nd	2.3 : 1
	R	4.06 : 1
Drive pulley	Type	eDrive
	Clutch engagement	2200 ± 100 RPM
	Spring color	Yellow / Red
	Spring length	120 mm (4.724 in)
	Pin	N.A.
	Ramp	716
	Screw position	N.A.
Driven pulley	Type	QRS-NTC
	Spring preload (New)	8.3 kgf ± 0.7 kgf (18.3 lbf ± 1.5 lbf)
	Spring preload (After break-in)	7.5 kgf ± 0.7 kgf (16.5 lbf ± 1.5 lbf)
	Spring color	Orange
	Cam angle	44°/40°
Pulley distance	Z	21.40 mm (.843 in)
Pulley offset	X	37.2 mm ± 0.5 mm (1.465 in ± .02 in)
Drive belt	Width	36.3 mm (1.43 in)
	Wear limit	33.9 mm (1.33 in)

DRIVE SYSTEM			
Track	Width	WT/Expedition	500 mm (20 in)
		SWT	600 mm (24 in)
	Length	WT/Expedition	392 cm (154 in)
		SWT	396 cm (156 in)
	Profile height	WT/Expedition	38.1 mm (1.5 in)
		SWT	31.8 mm (1.25 in)
Track adjustment	Deflection		40 mm to 50 mm (1.575 in to 1.969 in)

BRAKE SYSTEM		
Brake lining minimum thickness		1 mm (.039 in)
Brake disk minimum thickness		4.5 mm (.177 in)
Brake fluid	Type	DOT 4
	Quantity	65 ml (2.2 U.S. oz)

FRONT SUSPENSION		
Suspension type	WT/SWT	XU-LTS
	Expedition	Double A-arm
Suspension maximum travel	WT/SWT	150 mm (6 in)
	Expedition	210 mm (8.3 in)
Shock absorber type		Motion control

REAR SUSPENSION			
Suspension type			SC-5U
Suspension maximum travel		WT/SWT/Expedition LE	340 mm (13.4 in)
		Expedition SE	394 mm (15.5 in)
Shock absorber type	Center		Motion control
	Rear	WT/SWT/Expedition LE	HPG
		Expedition SE	ACS (Air Controlled Suspension)
Stroke limiter standard position			3

STEERING SYSTEM	
Ski type	Pilot DS 2 (SWT with liner)
Toe-out	5 mm (.197 in)
Camber	0°

WEIGHT AND DIMENSIONS		
Dry weight	WT	297 kg (655 lb)
	SWT	315 kg (694 lb)
	Expedition LE	290 kg (639 lb)
	Expedition SE	313 kg (690 lb)
Length		324 cm (128 in)

WEIGHT AND DIMENSIONS		
Width	WT/SWT	107.6 cm (42.4 in)
	Expedition	115 cm to 119.2 cm (45.3 in to 46.9 in)
Height		133 cm (52.4 in)
Ski stance	WT/SWT	900 mm (35.4 in)
	Expedition	97.5 cm to 101.8 cm (38.4 in to 40.1 in)
Ski width		165 mm (6.5 in)
Liner width (SWT)		226.06 mm (8.9 in)





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ECMA

ECMA

ELECTRONIC THROTTLE CONTROL
ETC
3.3 VOLTS — 6 — BG/YE-18 — K4
MOTOR (+) — 5 — BG/RD-18 — L1
SIGNAL 2 — 4 — BG/GN-18 — K3
MOTOR (-) — 3 — BG/BK-18 — L2
GROUND — 2 — BG/GY-18 — A2
SIGNAL 1 — 1 — BG/WH-18 — F3

MANIFOLD ABSOLUTE PRESSURE AND TEMPERATURE SENSOR
MAPTS
PRESSURE SIGNAL — 4 — WH/BU-18 — G4
5 VOLTS — 3 — PK/BU-18 — B4
TEMP. SIGNAL — 2 — WH/GY-18 — H3
GROUND — 1 — BK/BU-18 — H2

COOLANT TEMPERATURE SENSOR
CTS
SIGNAL — 1 — BK/OG-18 — J2
GROUND — 2 — BG/OG-18 — A1

CRANKSHAFT POSITION SENSOR
CPS
SIGNAL — 1 — BU/YE-18 — H1
SIGNAL — 2 — YE/WH-18 — K2

OIL PRESSURE SWITCH
OPS
SIGNAL — LT BU-18 — E3

D4 — BK/GN-18 — CAMSHAFT POSITION SENSOR CAPS 1 GROUND
E2 — YE/GN-18 — CAPS 2 SIGNAL
OR/GN-18 — CAPS 3 12 VOLTS

HARNESS INTER CONNECTOR
HIC
OR/GN-18 — 4 — 12 VOLTS
C1 — OG/BU-18 — 3
VT/GN-16 — 2 — 12 VOLTS
VT/BU-16 — 1 — 12 VOLTS

INJECTOR CYLINDER 1
INJ_1
VT/BU-18 — 1 — 12 VOLTS
B3 — BN/RD-18 — 2 — CONTROL

IGNITION COIL CYLINDER 1
COIL_1
VT/GN-16 — 1 — 12 VOLTS
M4 — BN/BK-16 — 3 — CONTROL

JT VT/BU

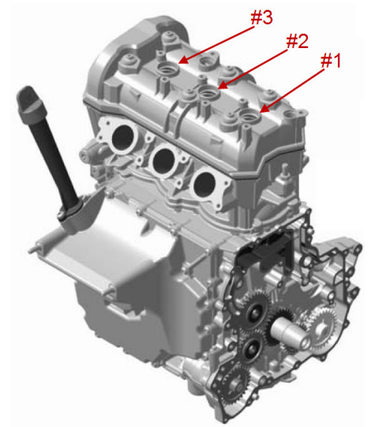
JT VT/GN

INJECTOR CYLINDER 2
INJ_2
VT/BU-18 — 1 — 12 VOLTS
K1 — BN/BU-18 — 2 — CONTROL

IGNITION COIL CYLINDER 2
COIL_2
VT/GN-16 — 1 — 12 VOLTS
M2 — BN/OG-16 — 3 — CONTROL

INJECTOR CYLINDER 3
INJ_3
VT/BU-18 — 1 — 12 VOLTS
J1 — BN/GY-18 — 2 — CONTROL

IGNITION COIL 3
COIL_3
VT/GN-16 — 1 — 12 VOLTS
M1 — BN/YE-16 — 3 — CONTROL



REF 666 096 REV

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ECMA

ELECTRONIC THROTTLE CONTROL
ETC
3.3 VOLTS — 6 — BG/YE-18 — K4
MOTOR (+) — 5 — BG/RD-18 — L1
SIGNAL 2 — 4 — BG/GN-18 — K3
MOTOR (-) — 3 — BG/BK-18 — L2
GROUND — 2 — BG/GY-18 — A2
SIGNAL 1 — 1 — BG/WH-18 — F3

MANIFOLD ABSOLUTE PRESSURE AND TEMPERATURE SENSOR
MAPTS
PRESSURE SIGNAL — 4 — WH/BU-18 — G4
5 VOLTS — 3 — PK/BU-18 — B4
TEMP. SIGNAL — 2 — WH/GY-18 — H3
GROUND — 1 — BK/BU-18 — H2

COOLANT TEMPERATURE SENSOR
CTS
SIGNAL — 1 — BK/OG-18 — J2
GROUND — 2 — BG/OG-18 — A1

CRANKSHAFT POSITION SENSOR
CPS
SIGNAL — 1 — BU/YE-18 — H1
SIGNAL — 2 — YE/WH-18 — K2

OIL PRESSURE SWITCH
OPS
SIGNAL — LT BU-18 — E3

ECMA

D4 — BK/GN-18 — 1 GROUND
E2 — YE/GN-18 — 2 SIGNAL
OR/GN-18 — 3 12 VOLTS

CAMSHAFT POSITION SENSOR
CAPS

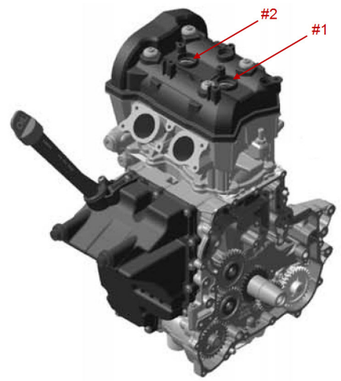
HARNESS INTER CONNECTOR
HIC
C1
OR/GN-18 — 4 — 12 VOLTS
OG/BU-18 — 3
VT/GN-16 — 2 — 12 VOLTS
VT/BU-16 — 1 — 12 VOLTS

INJECTOR CYLINDER 1
INJ_1
J1
VT/BU-18 — 1 — 12 VOLTS
BN/RD-18 — 2 — CONTROL

IGNITION COIL CYLINDER 1
COIL_1
JT VT/BU
VT/BU-16 — 1 — 12 VOLTS
M1
BN/BK-16 — 3 — CONTROL

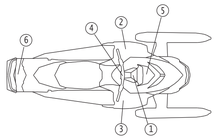
INJECTOR CYLINDER 2
INJ_2
K1
VT/GN-18 — 1 — 12 VOLTS
BN/BU-18 — 2 — CONTROL

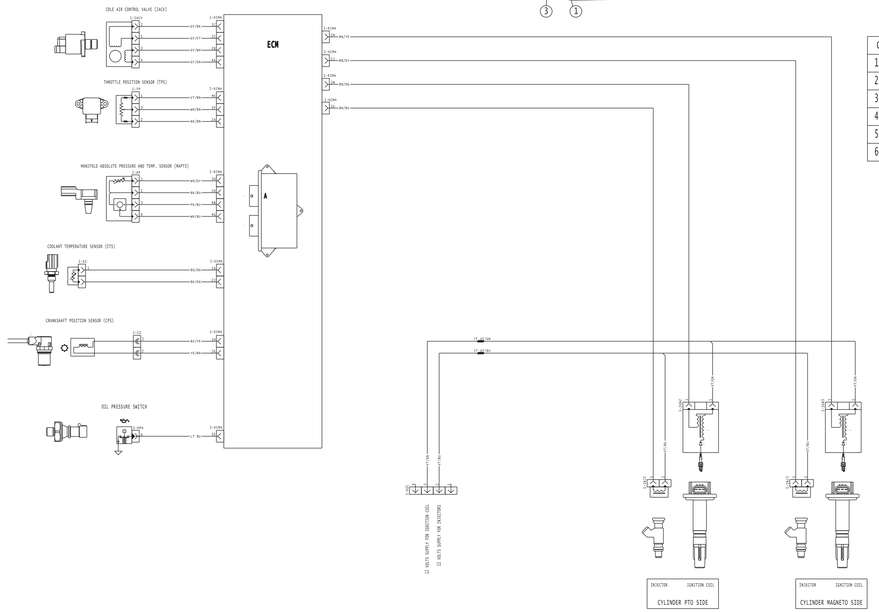
IGNITION COIL CYLINDER 2
COIL_2
JT VT/GN
VT/GN-16 — 1 — 12 VOLTS
M2
BN/OG-16 — 3 — CONTROL



REF 864 340 REV

2015 REV-XP REV-XU ENGINE HARNESS 600 ACE

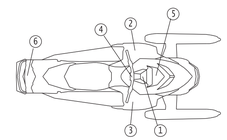


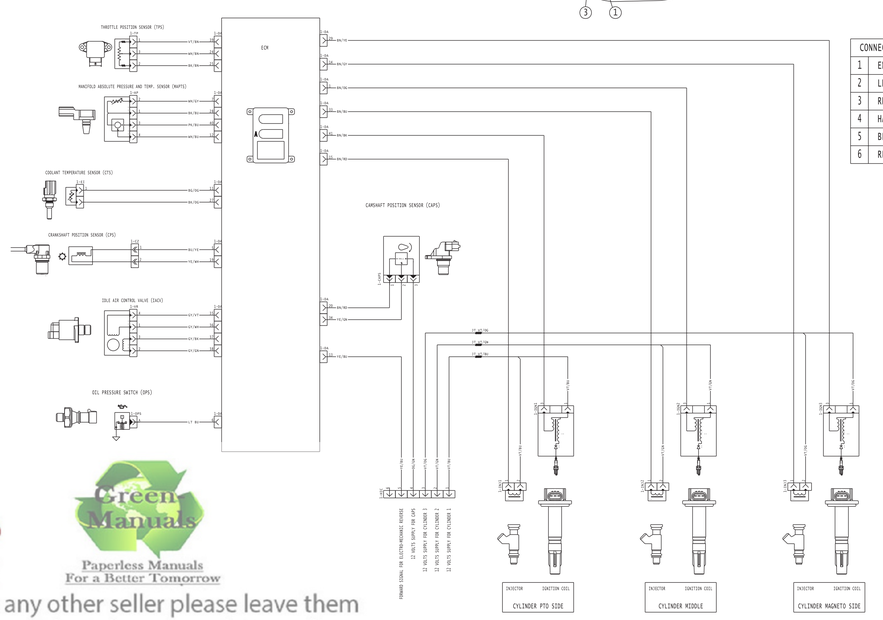


CONNECTOR LOCATION	
1	ENGINE RELATED CONNECTOR
2	LH SIDE PANEL
3	RH SIDE PANEL
4	HANDLEBAR AREA
5	BEHIND MULTIFUNCTION GAUGE
6	REAR PART OF FRAME

COLOR CODE	
BG	BEIGE
BK	BLACK
BN	BROWN
BU	BLUE
GN	GREEN
GY	GRAY
OG	ORANGE
PK	PINK
RD	RED
VT	VIOLET
WH	WHITE
YE	YELLOW
LT	LIGHT COLOR
JT	JUNCTION/SPLICE

2015 REV-XR ENGINE HARNESS 1200 4-TEC



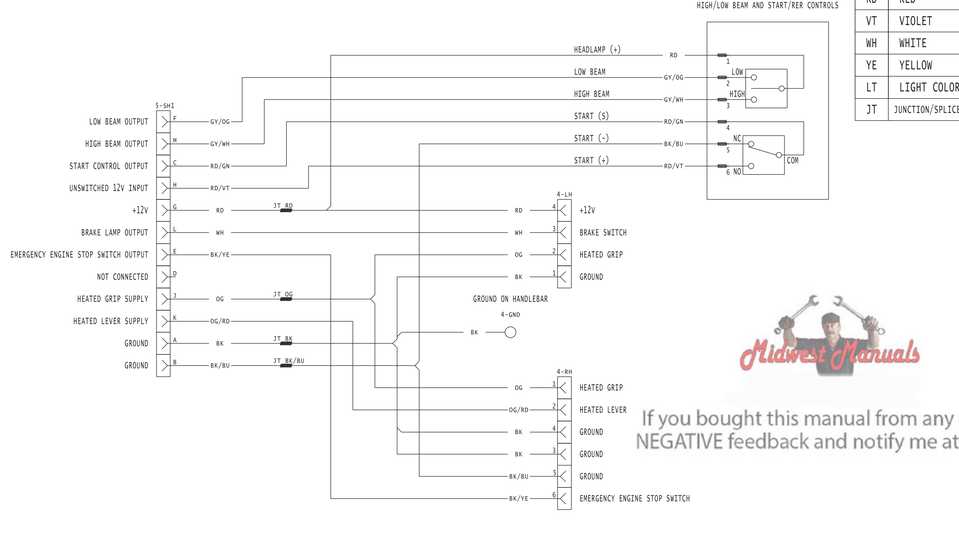


CONNECTOR LOCATION	
1	ENGINE RELATED CONNECTOR
2	LH SIDE PANEL
3	RH SIDE PANEL
4	HANDLEBAR AREA
5	BEHIND MULTIFUNCTION GAUGE
6	REAR PART OF FRAME

COLOR CODE	
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OG	ORANGE
PK	PINK
RD	RED
VT	VIOLET
WH	WHITE
YE	YELLOW
LT	LIGHT COLOR
JT	JUNCTION/SPLICE

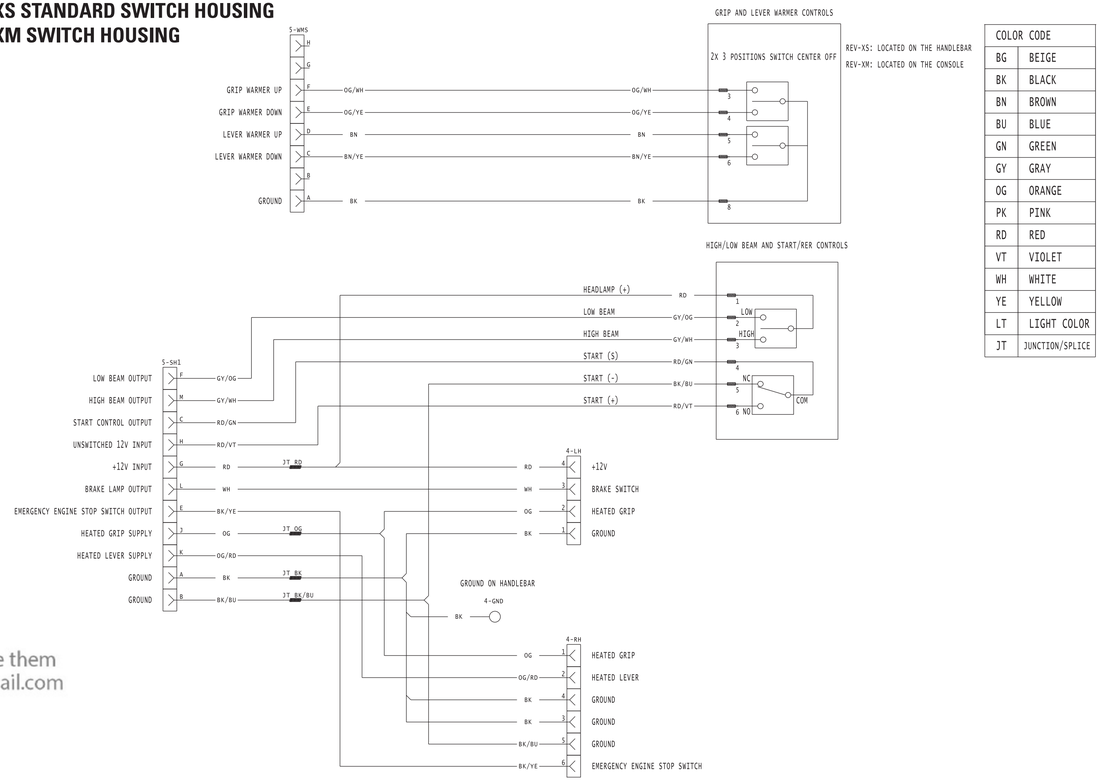
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2015 REV-XS PREMIUM SWITCH HOUSING



COLOR CODE	
BG	BEIGE
BK	BLACK
BN	BROWN
BU	BLUE
GN	GREEN
GY	GRAY
OG	ORANGE
PK	PINK
RD	RED
VT	VIOLET
WH	WHITE
YE	YELLOW
LT	LIGHT COLOR
JT	JUNCTION/SPLICE

2015 REV-XS STANDARD SWITCH HOUSING
2015 REV-XM SWITCH HOUSING



COLOR CODE	
BG	BEIGE
BK	BLACK
BN	BROWN
BU	BLUE
GN	GREEN
GY	GRAY
OG	ORANGE
PK	PINK
RD	RED
VT	VIOLET
WH	WHITE
YE	YELLOW
LT	LIGHT COLOR
JT	JUNCTION/SPLICE

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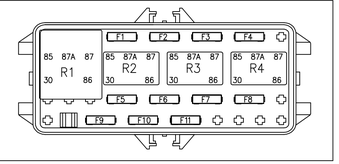
2015 600 ACE iTC
2015 SKANDIC WT

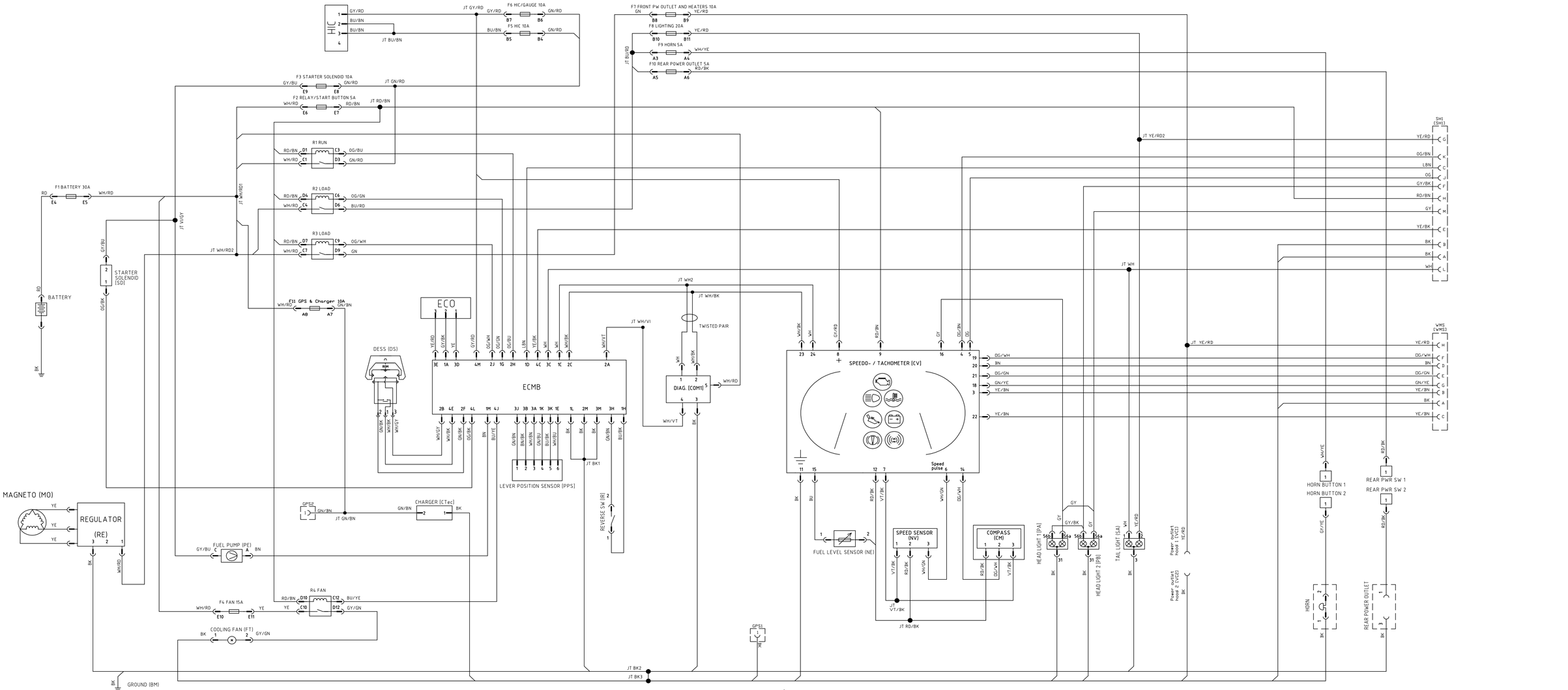
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COLOR	CODE
BLACK	BK
BLUE	BU,BL
GREEN	GN
ORANGE	OG, OR
PINK, ROSA	PK, RS
WHITE	WH
RED	RD
YELLOW	YE, YL
GRAY	GY, GR
BROWN	BN, BR
VIOLET	VT, VI
DARK BLUE	DBU, DBL
DARK GREEN	DGN
LIGHT BROWN	LBN, LBR, BE
LIGHT GREEN	LGN
LIGHT BLUE	LBU, LBL

515177631

R1 RUN RELAY
R2 LOAD RELAY
R3 LOAD RELAY
R4 FAN RELAY
F1 BATTERY 30A
F2 RELAY/START BUTTON 5A
F3 STARTER SOLENOID 10A
F4 FAN 15A
F5 HIC 10A
F6 HIC/GAUGE 10A
F7 FRONT PW OUTLET AND HEATERS 10A
F8 LIGHTING 20A
F9 HORN 5A
F10 REAR POWER OUTLET 5A
F11 GPS & CHARGER 10A





2015 900 ACE
2015 EXPEDITION LE/SE
2015 SKANDIC WT/SWT





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COLOUR	CODE	COLOUR	CODE
BEIGE	BE	LIGHT BROWN	LT BR
BLACK	BK	ORANGE	OR
BLUE	BU	RED	RD
BROWN	BR	PINK (ROSA)	PK
GREEN	GN	VIOLET	VI
GRAY	GY	WHITE	WH
LIGHT BLUE	LT BU	YELLOW	YE

515177482 rev. G.2

NOTES

NOTES

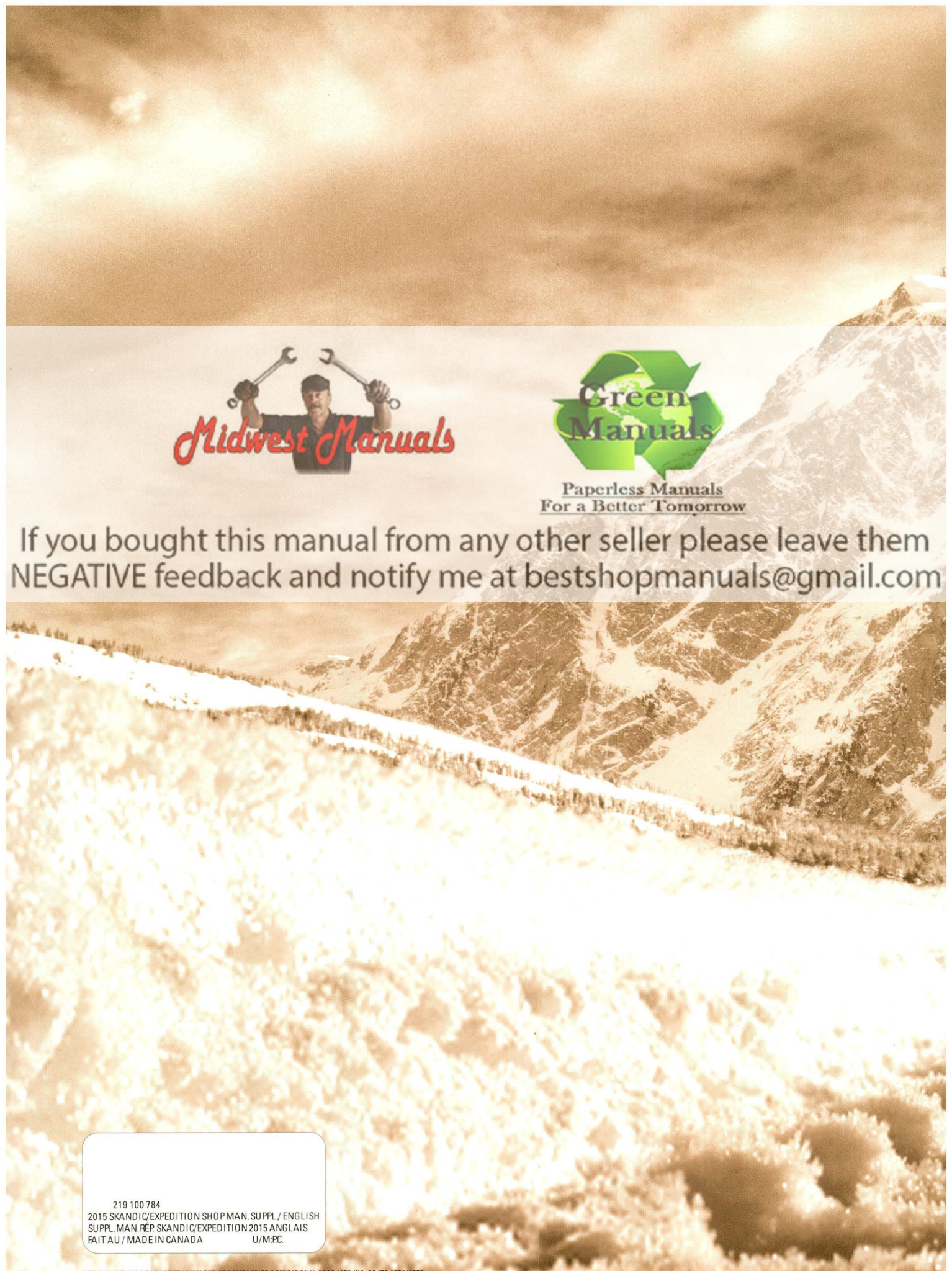
NOTES

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219 100 784
2015 SKANDIC/EXPEDITION SHOP MAN. SUPPL./ ENGLISH
SUPPL. MAN. RÉP. SKANDIC/EXPEDITION 2015 ANGLAIS
FAIT AU / MADE IN CANADA U/M:P.C.

SKI-DOO®

SERVICE BULLETIN

May 13, 2014 Subject: **Suspension Spring Chart** No. **2015-1**

REVISION ▶1 January 12, 2015◀

▶TEXT(S) BETWEEN ARROWS IS (ARE) MODIFIED ELEMENT(S) TO THE PREVIOUS PUBLICATION.◀

MODIFICATION OVERVIEW	
MODEL	MODIFICATION
GSX LE 900 ACE	In center springs table: P/N Standard
Grand Touring 600 ACE	In front springs table: P/N Softer P/N Standard P/N Harder
Grand Touring SE 1200 4-TEC	In front springs table: P/N Softer P/N Standard
Grand Touring LE/SE	In center springs table: P/N Standard
MX Z X / TNT	In center springs table: P/N Standard
▶MX Z X-RS IRON DOG 600 HO E-TEC/800R E-TEC◀	▶In front springs table: P/N Softer P/N Standard P/N Harder◀
	▶In center springs table: Model added with MX Z X-RS◀
	▶In rear springs table: P/N Softer P/N Standard P/N Harder◀
Renegade Sport 600 ACE (EUR) / X-RS	In front springs table: P/N Softer P/N Standard P/N Harder
Renegade Adrenaline / X / Backcountry / Backcountry X	In center springs table: P/N Standard
Renegade Adrenaline / X / Backcountry / Backcountry X / X-RS	In rear springs table: P/N Softer P/N Standard P/N Harder

Printed in Canada. (mbs2015-005_rev1 en ML/AP)
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MODIFICATION OVERVIEW	
MODEL	MODIFICATION
Summit X 800R E-TEC	In front springs table: P/N Standard
Summit X	In center springs table: P/N Standard
Expedition Sport 900 ACE (CAN / US)	In front springs table: P/N Harder
Expedition Sport 900 ACE (EUR)	In front springs table: P/N Softer P/N Standard P/N Harder
Expedition LE 900 ACE	In front springs table: P/N Standard P/N Harder
Expedition Sport 900 ACE (EUR)	In rear springs table: P/N Softer P/N Standard P/N Harder

YEAR	MODEL	MODEL NUMBER	SERIAL NUMBER
2015	All	All	All

This bulletin is divided into 3 main sections:

Section 1: Spring Identification

– Spring identification guideline. Gives information on color codes, part number and spring shape.

Section 2: Spring Applications

– Quick reference chart which provides authorized spring application for each Ski-Doo model. It contains the standard spring part number (in gray shading) as installed at the factory, as well as 1 softer spring and 1 harder spring recommendation.

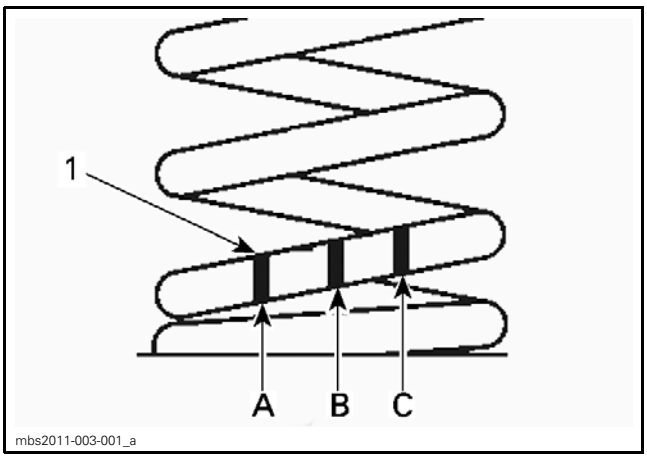
Section 3: Spring Specifications

– Refers to spring specifications table.

SECTION 1: SPRING IDENTIFICATION

Coil Spring Identification

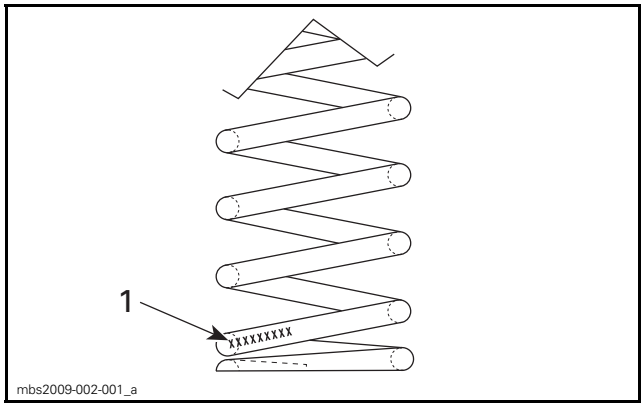
Spring identification is done by color code stripes **or** by its part number printed on the spring with white ink within the first 1-1/4 coils.



IDENTIFICATION BY COLOR STRIPES

1. Color stripes when spring is upright with the stripes down

A. 1st stripe
B. 2nd stripe
C. 3rd stripe



IDENTIFICATION BY THE SPRING PART NUMBER

1. Part number

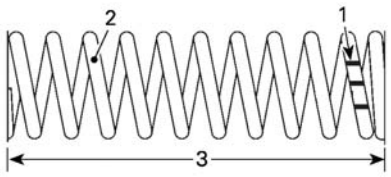
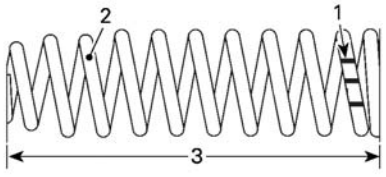
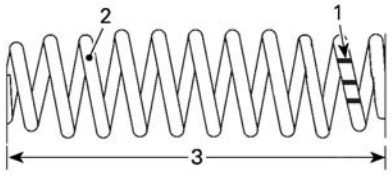
Color Code Legend

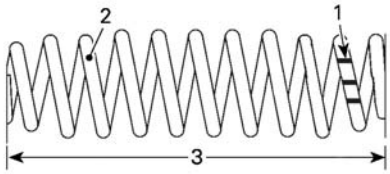
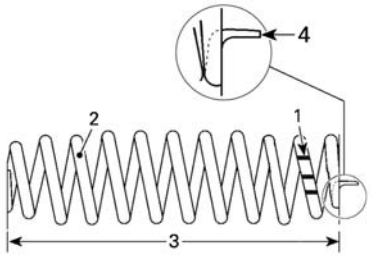
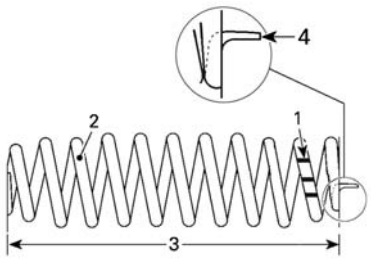
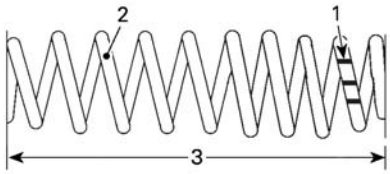
COLOR CODE					
BL	—	BLUE	PI	—	PINK
BK	—	BLACK	RD	—	RED
GD	—	GOLD	SI	—	SILVER
GN	—	GREEN	WH	—	WHITE
OR	—	ORANGE	YL	—	YELLOW

Coil Spring Types

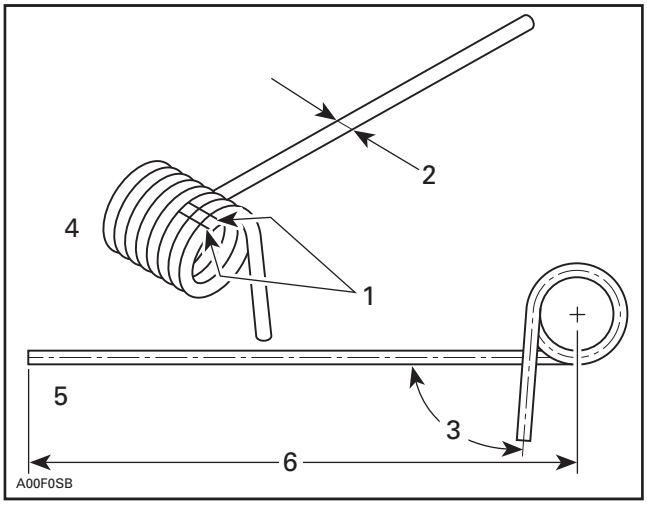
All call-outs below each following illustrations (except torsion springs) refer to:

1. Color code stripes
2. Wire diameter
3. Free length
4. Positioning tab (where applicable).

Spring type		
Type R (straight at both ends)	Single Rate Spring	
Type S (barrel shape at one end)	Single Rate Spring	
Type T (barrel shape at both ends)	Single Rate Spring	

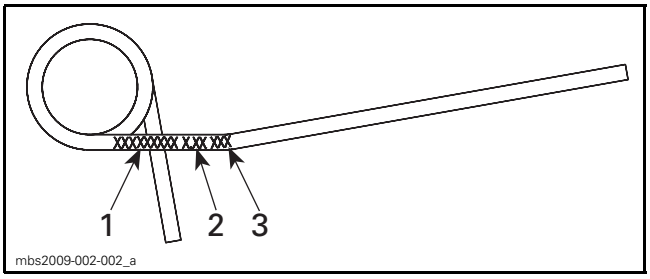
Spring type		
Type V (barrel shape at both ends)	Single Rate Spring	
Type Y (barrel shape at both ends with positioning tab at the identification code coils end)	Single Rate Spring	
Type Z (barrel shape at both ends with positioning tab at identification code coils end and 2 different diameter ends)	Single Rate Spring	
Type 2 (barrel shape at both ends)	Dual Rate Spring	

Torsion Spring Identification



IDENTIFICATION BY COLOR STRIPES
1. *Color code stripes*
2. *Wire diameter*
3. *Opening angle (°)*
4. *Left hand (LH)*
5. *Right hand (RH)*
6. *Length*

Spring identification is done by color code stripes (as shown above) **or** by its part number printed on the spring with white ink (as shown below).



IDENTIFICATION BY THE SPRING PART NUMBER
1. *Spring Part Number*
2. *Spring rate*
3. *Angle dimension*

Color Code Legend

COLOR CODE					
BL	—	BLUE	PI	—	PINK
BK	—	BLACK	RD	—	RED
GD	—	GOLD	SI	—	SILVER
GN	—	GREEN	WH	—	WHITE
OR	—	ORANGE	YL	—	YELLOW

SECTION 2: SPRING APPLICATIONS

FRONT SPRINGS



MODEL	(PART NUMBER) SOFTER	(PART NUMBER) STANDARD	(PART NUMBER) HARDER
Freeride			
Freeride 137 - 146 - 154	N.A.	505 072 760	505 073 315
GSX Series			
GSX SE 800R E-TEC / LE 600 HO E-TEC / SE 600 HO E-TEC	505 072 792	**505 072 119**	505 072 993
GSX LE 900 ACE	505 072 119	**505 072 767**	505 072 993
GSX SE 1200 4-TEC / LE 1200 4-TEC	505 072 119	**505 072 993**	N.A.
Grand Touring Series			
Grand Touring Sport 550F	505 072 668	**505 072 897**	505 072 518
Grand Touring Sport 600 ACE	505 072 897	**505 073 521**	505 072 518
Grand Touring LE 600 HO E-TEC	505 072 414	**505 071 842**	505 072 518
Grand Touring LE 900 ACE	505 072 897	**505 071 849**	505 072 518
Grand Touring LE 1200 4-TEC	505 071 842	**505 072 518**	N.A.
Grand Touring SE 1200 4-TEC	505 072 767	**505 072 993**	N.A.
MX Z Series			
MX Z RACING 600 RS	505 073 315	**505 073 537**	N.A.
MX Z Sport 600/600 ACE (CAN / US)	505 072 763	**505 073 265**	505 072 116
MX Z Sport 600 ACE (EUR)	505 072 526	**505 072 537**	505 072 528
MX Z TNT 600 HO E-TEC/800R E-TEC	505 072 526	**505 072 537**	505 072 528
MX Z TNT 900 ACE	505 072 537	**505 073 332**	505 072 528
MX Z TNT 1200 4-TEC	505 072 537	**505 072 528**	N.A.
MX Z X 1200 4-TEC	505 072 741	**505 072 761**	N.A.
MX Z X 600 HO E-TEC/800R E-TEC	505 072 846	**505 072 741**	505 072 761
MX Z X-RS 600 HO E-TEC/800R E-TEC	N.A.	**505 072 760**	505 073 315
► MX Z XR-S IRON DOG 600HO E-TEC/800R E-TEC ◄	► 505 072 760 ◄	► **505 073 315** ◄	► 505 073 537 ◄
Renegade Series			
Renegade Sport 600ACE (CAN/US)	505 072 763	**505 073 265**	505 072 993
Renegade Adrenaline 600 HO E-TEC/800R E-TEC	505 072 526	**505 072 537**	505 072 528
Renegade Adrenaline 900 ACE / Renegade Sport 600 ACE (EUR)	505 072 537	**505 073 332**	505 072 528
Renegade Adrenaline 1200 4-TEC	505 072 537	**505 072 528**	N.A.
Renegade X-RS	N.A.	**505 072 760**	505 073 315
Renegade Backcountry X	505 072 726	**505 072 846**	505 072 741
Renegade X 600 HO E-TEC/800R E-TEC	505 072 846	**505 072 741**	505 072 761
Renegade X 1200 4-TEC	505 072 741	**505 072 761**	N.A.

FRONT SPRINGS



MODEL	(PART NUMBER) SOFTER	(PART NUMBER) STANDARD	(PART NUMBER) HARDER
SUMMIT Series			
Summit Sport 600	505 072 792	**505 072 763**	505 072 791
Summit Sport 800R PTEK	505 072 792	**505 072 763**	505 072 791
Summit SP 600 HO E-TEC/800R E-TEC	N.A.	**505 072 792**	505 072 119
Summit X 800R E-TEC	N.A.	**505 073 783**	505 072 741
Expedition Series			
Expedition Sport 550F/600 ACE	505 072 668	**505 072 897**	505 072 518
Expedition Sport 900 ACE (CAN/US)	505 072 897	**505 073 521**	505 072 518
Expedition Sport 900 ACE (EUR)	505 073 521	**505 072 518**	N.A.
Expedition LE 600 HO E-TEC / Expedition SE 600 HO E-TEC	N.A.	**503 192 286**	505 072 882
Expedition LE 900 ACE/1200 4-TEC / Expedition SE 1200 4-TEC	503 192 286	**505 072 879**	505 072 518
Skandic Series			
Skandic WT 550F/600 ACE/600 HO E-TEC/900 ACE	505 072 557	**505 072 745**	505 073 327
Skandic SWT 600 ACE/900 ACE	505 072 557	**505 072 745**	505 073 204
Tundra LT 550F / Tundra Sport 550F	N.A.	**505 072 557**	505 072 745
Tundra Sport 600 ACE	505 072 557	**505 072 745**	505 073 327
Tundra LT 600 ACE	505 072 557	**505 072 745**	505 073 327
Tundra LT EUR 600 ACE	505 072 745	**505 073 327**	505 073 204
Tundra Xtreme (CAN / USA)	505 072 745	**505 073 327**	505 073 204
Tundra Xtreme (EUR)	505 073 327	**505 073 204**	N.A.

CENTER SPRINGS



MODEL	(PART NUMBER) SOFTER	(PART NUMBER) STANDARD	(PART NUMBER) HARDER
Freeride			
Freeride 137 - 146 - 154	N.A.	503 193 479 503 193 065	503 192 724 503 192 744
GSX Series			
GSX LE 600 HO E-TEC	N.A.	**503 193 837** **503 193 067**	503 191 343 503 192 279
GSX LE 900 ACE	N.A.	**503 193 837** **503 193 067**	503 191 343 503 192 279
GSX LE 1200 4-TEC / GSX SE 1200 4-TEC	503 193 480 503 193 067	**503 193 837** **503 193 160**	503 191 343 503 192 279
GSX SE 600 HO E-TEC/800R E-TEC	N.A.	**503 193 837** **503 193 067**	503 191 343 503 192 279
Grand Touring Series			
Grand Touring Sport 550F/600/600 ACE	503 191 879	**503 191 882**	503 191 880
Grand Touring LE 600 HO E-TEC	N.A.	**503 193 837** **503 193 067**	503 191 343 503 192 279
Grand Touring LE 900 ACE/1200 4-TEC / SE 1200 4-TEC	503 193 480 503 193 067	**503 193 837** **503 193 160**	503 191 343 503 192 279
MX Z Series			
MX Z Sport 550F/600	503 191 476	**503 191 329**	503 191 879
MX Z Sport 600 ACE	503 191 329	**503 191 879**	503 191 882
MX Z TNT/ MX Z X 600 HO E-TEC/800R E-TEC	N.A.	**503 193 837** **503 193 067**	503 191 343 503 192 279
MX Z TNT 1200 4-TEC/ MX Z X 1200 4-TEC	503 193 480 503 193 067	**503 193 837** **503 193 160**	503 191 343 503 192 279
► MX Z X-RS / MX Z X-RS IRON DOG 600 HO E-TEC/800R E-TEC ◄	N.A.	**503 193 479** **503 193 065**	503 192 724 503 192 744
Renegade Series			
Renegade Sport 600/600 ACE	503 191 879	**503 191 882**	503 191 880
Renegade Adrenaline/Backcountry/Backcountry X 600 HO E-TEC/800R E-TEC / 900 ACE (CAN/US)	N.A.	**503 193 837** **503 193 067**	503 191 343 503 192 279
Renegade Adrenaline 1200 4-TEC / Renegade X 1200 4-TEC / Renegade Adrenaline 900 ACE (EUR)	503 193 480 503 193 067	**503 193 837** **503 193 160**	503 191 343 503 192 279
Renegade X-RS	N.A.	**503 193 479** **503 193 065**	503 192 724 503 192 744
SUMMIT Series			
Summit Sport & SP	503 191 879	**503 191 882**	503 191 880
Summit X	N.A.	**503 193 657**	N.A.
Expedition Series			
Expedition Sport 550F	503 191 879	**503 191 882**	503 191 880
Expedition Sport 600 ACE / 900 ACE (CAN / US)	503 191 882	**503 191 880**	503 189 686

CENTER SPRINGS



MODEL	(PART NUMBER) SOFTER	(PART NUMBER) STANDARD	(PART NUMBER) HARDER
Expedition Series (cont'd)			
Expedition LE 600 HO E-TEC / Expedition SE 600 HO E-TEC	503 191 882	**503 191 880**	503 189 686
Expedition LE 900 ACE/1200 4-TEC / Expedition SE 1200 4-TEC	503 191 880	**503 189 686**	N.A.
Skandic Series			
Skandic WT 550F/600ACE/600 HO E-TEC/900 ACE	503 191 882	**503 191 880**	503 189 686
Skandic SWT 900 ACE/600 HO E-TEC	503 191 882	**503 191 880**	503 189 686
Tundra LT 550F/ Tundra Sport 550F	503 191 879	**503 191 882**	503 191 880
Tundra Sport 600 ACE	503 191 882	**503 191 880**	503 189 686
Tundra LT 600 ACE	503 191 882	**503 191 880**	503 189 686
Tundra Xtreme / Expedition Sport 900 ACE (EUR)	503 190 476 503 190 478	**503 191 343** **503 192 279**	503 190 982 503 190 854

REAR SPRINGS



MODEL	(PART NUMBER) SOFTER	(PART NUMBER) STANDARD	(PART NUMBER) HARDER
Freeride			
Freeride 137	503 192 137 (right) 503 192 136 (left)	503 192 104 (right) 503 192 105 (left)	503 192 270 (right) 503 192 271 (left)
Freeride 146/154	503 192 080 (right) 503 192 081 (left)	503 192 137 (right) 503 192 136 (left)	503 192 270 (right) 503 192 271 (left)
GSX Series			
GSX LE 600 HO E-TEC	503 192 080 (right) 503 192 081 (left)	**503 193 159 (right)** **503 193 158 (left)**	503 192 270 (right) 503 192 271 (left)
GSX LE 1200 4-TEC	503 192 080 (right) 503 192 081 (left)	**503 193 159 (right)** **503 193 158 (left)**	503 192 270 (right) 503 192 271 (left)
GSX SE 600 HO E-TEC/800R E-TEC/1200 4-TEC	N.A.	**503 193 636 (right)** **503 193 637 (left)**	503 193 159 (right) 503 193 158 (left)
Grand Touring Series			
Grand Touring Sport 550F/600 ACE (CAN / US)	503 191 287 (right) 503 191 289 (left)	**503 192 270 (right)** **503 192 271 (left)**	503 191 247 (right) 503 191 249 (left)
Grand Touring LE / Grand Touring Sport 600 ACE (EUR)	503 192 270 (right) 503 192 271 (left)	**503 193 538 (right)** **503 193 539 (left)**	503 191 481 (right) 503 191 483 (left)
Grand Touring SE	503 193 159 (right) 503 193 158 (left)	**503 192 270 (right)** **503 192 271 (left)**	503 193 538 (right) 503 193 539 (left)
MX Z Series			
MX Z Sport	N.A.	**503 191 612 (right)** **503 191 613 (left)**	503 191 614 (right) 503 191 615 (left)
MX Z X-RS (EUR)	503 193 158 (right) 503 193 159 (left)	**503 192 270 (right)** **503 192 271 (left)**	503 191 247 (right) 503 191 249 (left)
MX Z X E-TEC / TNT E-TEC	503 192 080 (right) 503 192 081 (left)	**503 193 159 (right)** **503 193 158 (left)**	503 192 270 (right) 503 192 271 (left)
MX Z X 1200 4-TEC / TNT 1200 4-TEC/900 ACE	503 192 080 (right) 503 192 081 (left)	**503 193 159 (right)** **503 193 158 (left)**	503 192 270 (right) 503 192 271 (left)
MX Z X-RS (CAN / US)	503 192 080 (right) 503 192 081 (left)	**503 193 159 (right)** **503 193 158 (left)**	503 192 270 (right) 503 192 271 (left)
▶ MX Z X-RS IRON DOG 600 HO E-TEC/800R E-TEC ◀	▶ 503 193 159 (right) 503 193 158 (left) ◀	▶ 503 192 270 (right) 503 192 271 (left) ◀	▶ 503 193 538 (right) 503 193 539 (left) ◀
Renegade Series			
Renegade Sport (CAN / US)	N.A.	**503 192 080 (right)** **503 192 081 (left)**	503 192 270 (right) 503 192 271 (left)
Renegade Sport (EUR)	503 193 159 (right) 503 193 158 (left)	**503 192 270 (right)** **503 192 271 (left)**	503 191 247 (right) 503 191 249 (left)
Renegade Adrenaline / Backcountry / Backcountry X / X (CAN / US)	503 192 080 (right) 503 192 081 (left)	**503 193 159 (right)** **503 193 158 (left)**	503 192 270 (right) 503 192 271 (left)
Renegade Adrenaline (EUR) / X (EUR) / Backcountry X (EUR) / X-RS	503 192 137 (right) 503 192 136 (left)	**503 192 104 (right)** **503 192 105 (left)**	503 192 270 (right) 503 192 271 (left)
SUMMIT Series			
All Summit	503 190 712 (right) 503 190 714 (left)	**503 193 002 (right)** **503 193 003 (left)**	503 191 287 (right) 503 191 289 (left)

REAR SPRINGS



MODEL	(PART NUMBER) SOFTER	(PART NUMBER) STANDARD	(PART NUMBER) HARDER
Expedition Series			
Expedition Sport 550F/600 ACE/900 ACE (CAN / US)	503 191 287 (right) 503 191 289 (left)	**503 192 270 (right)** **503 192 271 (left)**	503 191 247 (right) 503 191 249 (left)
Expedition Sport 900 ACE (EUR)	503 192 270 (right) 503 192 271 (left)	**503 193 538 (right)** **503 193 539 (left)**	503 191 481 (right) 503 191 483 (left)
Expedition LE 600 HO E-TEC/900 ACE / Expedition SE 600 HO E-TEC/900 ACE	N.A.	**503 192 377 (right)** **503 192 378 (left)**	N.A.
Expedition LE 1200 4-TEC / Expedition SE 1200 4-TEC	N.A.	**503 192 377 (right)** **503 192 378 (left)**	N.A.
Skandic Series			
All Skandic WT	N.A.	**503 192 377 (right)** **503 192 378 (left)**	503 192 910 (right) 503 192 911 (left)
All Skandic SWT	503 192 377 (right) 503 192 378 (left)	**503 192 910 (right)** **503 192 911 (left)**	N.A.
Tundra Sport 550F/600 ACE	N.A.	**503 192 080 (right)** **503 192 081 (left)**	503 192 270 (right) 503 192 271 (left)
Tundra LT / Tundra Xtreme	503 192 080 (right) 503 192 081 (left)	**503 192 136 (right)** **503 192 137 (left)**	503 192 270 (right) 503 192 271 (left)

SECTION 3: SPRING SPECIFICATIONS

Coil Springs Specifications

(PART NUMBER)	TYPE	SPRING RATE (LB/IN) ±10	FREE LENGTH (MM) ±3	WIRE DIAMETER (MM) ±.05	COLOR CODE	COLOR OF SPRING
503 189 686	T	200	242	9,19	RD/SI/YL	BLACK
503 190 476	R	210	64.6	6.65	BL/SI/YL	BLACK
503 190 478	S	240	178	9.19	GN/SI/YL	BLACK
503 190 854	R	325	189	8.84	SI/WH/YL	BLACK
503 190 982	R	319	72	7.14	GD/YL/RD	BLACK
503 191 329	T	110	242	6.95	GD/RD/RD	BLACK
503 191 343	R	223	56	5.94	SI/RD/RD	BLACK
503 191 476	T	90	242	6.65	GD/RD/GN	BLACK
503 191 879	T	135	242	7.49	detail "A" WH/WH/OR	BLACK
503 191 880	T	180	242	8.25	detail "A"	BLACK
503 191 882	T	150	242	7.77	detail "A"	BLACK
503 192 279	T	275	184	8.71	detail "A"	BLACK
503 192 724	S	275	155	9.19	detail "A"	BLACK
503 192 744	R	222	59	6.17	detail "A"	BLACK
503 192 286	T	300	80	7.49	–	FULL MOON
503 193 065	S	190	162	8.25	detail "A"	BLACK
503 193 067	S	190	189	7.92	detail "A"	BLACK
503 193 160	V	275	189	9.19	detail "A"	BLACK
503 193 479	R	197	52	5,94	–	BLACK
503 193 480	R	175	51	5.54	–	BLACK
503 193 657	Z	150	242	7,49	detail "A"	BLACK
503 193 837	R	178	51	5,94	–	BLACK
505 071 842	T	90	280	7.77	WH/GD/RD	FULL MOON
505 071 849	T	105	280	7.77	GD/WH/RD	FULL MOON
505 072 116	T	125	280	7.77	OR/SI/BL	BLACK
505 072 119	T	90	280	7.77	WH/SI/BL	BLACK
505 072 414	T	80	280	7.14	WH/BK/GD	FULL MOON
505 072 518	T	120	280	8.25	detail "A"	FULL MOON
505 072 526	Y	80	280	7.14	detail "A"	BLACK
505 072 528	Y	120	280	8.25	detail "A"	BLACK
505 072 537	Y	90	280	7.49	detail "A"	BLACK
505 072 557	T	70	263	5.94	detail "A"	BLACK
505 072 668	T	80	300	7.49	–	FULL MOON
505 072 726	Z	75	280	7.14	detail "A"	BLACK
505 072 741	Z	90	280	7.49	detail "A"	BLACK
505 072 745	T	60	263	6.17	detail "A"	BLACK
505 072 760	V	90	280	7.49	detail "A"	BLACK
505 072 761	Z	120	280	8.25	detail "A"	BLACK
505 072 763	T	80	300	7.49	detail "A"	BLACK

(PART NUMBER)	TYPE	SPRING RATE (LB/IN) ±10	FREE LENGTH (MM) ±3	WIRE DIAMETER (MM) ±.05	COLOR CODE	COLOR OF SPRING
505 072 767	T	105	280	7.92	–	BLACK
505 072 791	T	90	300	7.92	detail "A"	YELLOW
505 072 792	T	75	280	7.14	detail "A"	BLACK
505 072 846	Z	80	280	7.14	detail "A"	BLACK
505 072 879	T	105	300	8	–	BLACK
505 072 882	T	90	300	8	–	BLACK
505 072 897	T	90	300	7.92	detail "A"	FULL MOON
505 072 993	T	120	280	8.25	detail "A"	BLACK
505 073 204	T	88	266	6.65	detail "A"	BLACK
505 073 265	T	90	280	7.92	detail "A"	BLACK
505 073 315	V	105	280	7.92	detail "A"	BLACK
505 073 327	T	80	266	6,65	detail "A"	BLACK
505 073 332	Y	105	280	7,92	detail "A"	BLACK
505 073 521	T	105	300	8,25	detail "A"	FULL MOON
505 073 537	V	185	305	9,98	detail "A"	BLACK
505 073 783	Z	75	280	6,81	detail "A"	BLACK

Torsion Springs Specifications

Torsion Springs for SC-5M and rMotion Suspensions

(PART NUMBER)	WIRE DIAMETER (MM)	OPENING ANGLE ± 7°	COLOR CODE	COLOR OF SPRING	CONSTANT (N•MM / DEGREE)
503 190 712 (RIGHT) 503 190 714 (LEFT)	8.85 (SQUARE)	75°	BL/BL	BLACK	1.13
503 191 247 (Right) 503 191 249 (Left)	11.0 x 9.25 (rectangular)	90°	WH/YL	BLACK	1.99
503 191 287 (Right) 503 191 289 (Left)	9.525 (square)	80°	GN/YL/YL	BLACK	1.44
503 191 481 (Right) 503 191 483 (Left)	11.0 x 9.25 (rectangular)	100°	WH/BL	BLACK	2.30
503 192 080 (Right) 503 192 081 (Left)	8.85 (square)	80°	detail "B"	BLACK	1.27
503 192 104 (Right) 503 192 105 (Left)	9.525 (square)	90°	detail "B"	BLACK	1.50
503 192 137 (Right) 503 192 136 (Left)	9.0 (square)	80°	detail "B"	BLACK	1.35
503 192 270 (Right) 503 192 271 (Left)	9.86 (square)	80°	detail "B"	BLACK	1.66
503 193 002 (Right) 503 193 003 (Left)	8.46 (square)	80°	detail "B"	BLACK	1.27
503 193 159 (Right) 503 193 158 (Left)	9.14 (square)	80°	detail "B"	BLACK	1.35
503 193 538 (Right) 503 193 539 (Left)	11.0 x 9,25 (Rectangular)	90°	detail "B"	BLACK	1.94
503 193 636 (Right) 503 193 637 (Left)	8.46 (square)	90°	detail "B"	BLACK	1,13

Torsion Springs for SC-5 Suspension

(PART NUMBER)	WIRE DIAMETER (MM)	OPENING ANGLE ± 7°	COLOR CODE	COLOR OF SPRING	CONSTANT (N•MM / DEGREE)
503 191 612 (Right) 503 191 613 (Left)	8.85 (square)	95°	GN/RD/YL	BLACK	1.28
503 191 614 (Right) 503 191 615 (Left)	9.53 (square)	100°	GN/BL/YL	BLACK	1.56

Torsion Springs for SC-5U Suspension

(PART NUMBER)	WIRE DIAMETER (MM)	OPENING ANGLE ± 7°	COLOR CODE	COLOR OF SPRING	CONSTANT (N•MM / DEGREE)
503 192 377 (Right) 503 192 378 (Left)	11 x 9.25 (rectangular)	75°	detail "B"	BLACK	1.92
503 192 910 (Right) 503 192 911 (Left)	11 x 11 (square)	75°	detail "B"	BLACK	2.45

SERVICE BULLETIN

June 9, 2014 Subject: **High Altitude / Sea Level Specifications** No. **2015-5**

REVISION ▶2 January 12, 2015◀

▶TEXT(S) BETWEEN ARROWS IS (ARE) MODIFIED ELEMENT(S) TO THE PREVIOUS PUBLICATION.◀

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GENERAL INFORMATION

Previous Model Year Vehicles

This bulletin supplies all the information **required to modify** current year vehicles for **high altitude and/or sea level** riding.

MODEL YEAR	LATEST REVISION OF BULLETIN NO.
2014	2014-4
2013	2013-2
2012	2012-4
2011	2011-6
2010	2010-5
2009	2009-5
2008	2008-6

NOTE: Throughout this entire document, shaded areas give factory settings (that could apply through different altitudes) while N/A stands for "not applicable".

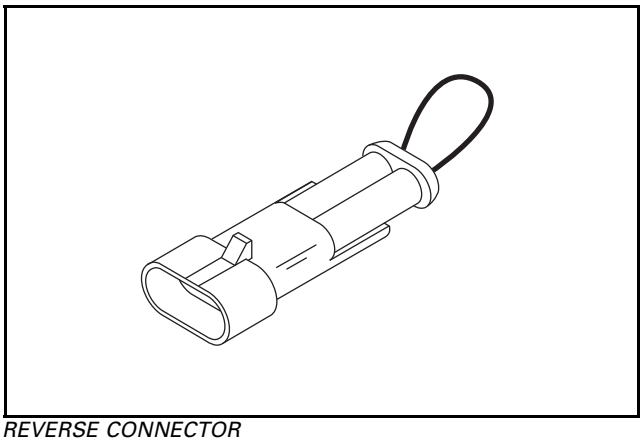
NOTICE **The following modifications and adjustments apply for high altitude operation as well as sea level operation.**

PARTS AND LABOR COST ARE NOT COVERED BY BRP LIMITED WARRANTY.

Reverse Connector

The reverse connector (P/N 515 174 700) is used at 1 800 m (6,000 ft) altitude and higher for all FAN cooled models with electronic reverse device. To use Reverse Connector proceed as follows:

1. Unplug existing sea level cap from the ECM.
2. Plug-in the reverse connector.



REVERSE CONNECTOR

Table Format

The shady portions of the table indicate factory settings.

ALTITUDE	
Part to be modified	Recommended Adjustment

Sea Level Calibration Kit

When the high altitude calibration must be modified to sea level calibration on Freeride™ and Summit™ models (146" and up), the following kits may be used. These kits include all required parts to set-up the vehicle.

MODEL	PART NUMBER
Summit Sport 800 Power TEK	
154"	860 200 394
Freeride and Summit 800R E-TEC	
146"	860 201 118
154"	860 201 119
163"	860 201 120
163" (T3™ Package)	860 201 194
174" (T3 Package)	860 201 120

Kit Description

SEA LEVEL CALIBRATION KIT (P/N 860 200 394)		
DESCRIPTION	PART NUMBER	QTY
Ramp 413	417 222 508	3
Long solid Pin 35,75 mm/18,8 g	417 222 594	3
Cotter pin	250 400 060	3
Spring (Blue/Purple)	414 817 800	1
M14 Spring washer	250 200 006	1

SEA LEVEL CALIBRATION KIT (P/N 860 201 118)		
DESCRIPTION	PART NUMBER	QTY
Ramp 413	417 222 508	3
Long solid pin 35,75 mm/18,8 g	417 222 594	3
Cotter pin	250 400 060	3
Spring (Yellow/green)	414 742 100	1
M14 spring washer	250 200 006	1

SEA LEVEL CALIBRATION KIT (P/N 860 201 119)		
DESCRIPTION	PART NUMBER	QTY
Ramp 413	417 222 508	3

SEA LEVEL CALIBRATION KIT (P/N 860 201 119)		
DESCRIPTION	PART NUMBER	QTY
Long solid pin 35,75 mm/18,8 g	417 222 594	3
Cotter pin	250 400 060	3
Spring (Yellow/green)	414 742 100	1
M14 spring washer	250 200 006	1
Upper gear - 21 teeth	504 096 200	1
Chain - 106 links	504 152 630	1

SEA LEVEL CALIBRATION KIT (P/N 860 201 120)		
DESCRIPTION	PART NUMBER	QTY
Ramp 413	417 222 508	3
Long solid pin 35,75 mm/18,8 g	417 222 594	3
Cotter pin	250 400 060	3
Spring (Yellow/green)	414 742 100	1
M14 spring washer	250 200 006	1
Upper gear - 21 teeth	504 096 200	1

SEA LEVEL CALIBRATION KIT (P/N 860 201 194)		
DESCRIPTION	PART NUMBER	QTY
Ramp 413	417 222 508	3
Long solid pin 35,75 mm/18,8 g	417 222 594	3
Cotter pin	250 400 060	3
Spring (Yellow/green)	414 742 100	1
M14 spring washer	250 200 006	1
Upper gear - 23 teeth	504 091 000	1

GRAND TOURING™ SPORT 550F

Drive Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Red/Orange (P/N 417 223 316)	Red/Green (P/N 417 223 459)	Red/Red (P/N 417 223 186)	Red/Yellow (P/N 417 223 315)	Red/Orange (P/N 417 223 316)	Red/Green (P/N 417 223 459)
Ramp	730 (P/N 417 223 558)		734 (P/N 417 223 678)			
Ramp quantity	6					
Engagement RPM ± 100	2600					
Maximum RPM ± 100	6800					

Driven Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Brown (P/N 417 127 061)					
Spring tension Kg ± 0.7 (lb ± 1.5)	N/A					
Cam angle (degrees)	47-44° (P/N 417 127 109)					

Carburation

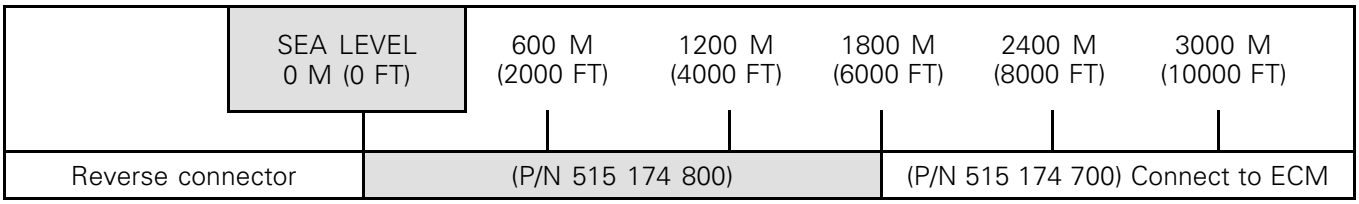
NOTICE These adjustments are guidelines only. Specific adjustments vary with temperature, altitude and snow condition. Always observe spark plug condition for proper jetting.

		SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)	
Main jet	MAG	190	180	170	160	140	130	1
	PTO	200	190					1
Jet needle		6BFY46						2
MAG Needle position		3	2					—
PTO Needle position		4	2					—
Slide cut-away		2.5						2
Pilot jet		35	45			55		2
MAG mixture screw		1.25						—
PTO mixture screw		1	1.25					—
Valve seat		1.2						2
Needle jet		P-8 (159)				P-6 (159)		2
Float level (± 1 mm)		23.9						—
Idle RPM (± 200)		1650						—
Idle throttle valve position (± 0.1 mm)		1.6	1.8	2	2.2	2.4		—

Main Jet Chart

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)	
-40°C (-40°F)	MAG	200	190	180	170	150	140
	PTO	210	200				
-30°C (-22°F)	MAG	195	185	175	165	145	135
	PTO	205	195				
-20°C (-4°F)	MAG	190	180	170	160	140	130
	PTO	200	190				
-10°C (14°F)	MAG	185	175	165	155	135	125
	PTO	195	185				
0°C (32°F)	MAG	180	170	160	150	130	120
	PTO	190	180				
10°C (50°F)	MAG	175	165	155	145	125	115
	PTO	185	175				
20°C (68°F)	MAG	170	160	150	140	120	110
	PTO	180	170				

Additional Information



EXPEDITION® SPORT 550F / TUNDRA™ SPORT 550F / TUNDRA LT 550F / SKANDIC™ WT LIGHT 550F

Drive Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Red/Orange (P/N 417 223 316)	Red/Green (P/N 417 223 459)	Red/Red (P/N 417 223 186)	Red/Yellow (P/N 417 223 315)	Red/Orange (P/N 417 223 316)	Red/Green (P/N 417 223 459)
Ramp	700 (P/N 417 223 457)		734 (P/N 417 223 678)			
Ramp quantity	6					
Engagement RPM ± 100	2600					
Maximum RPM ± 100	6800					

Driven Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Brown (P/N 417 127 061)					
Spring tension Kg ± 0.7 (lb ± 1.5)	N/A					
Cam angle (degrees)	44° (P/N 417 127 011)					

Carburation

NOTICE These adjustments are guidelines only. Specific adjustments vary with temperature, altitude and snow condition. Always observe spark plug condition for proper jetting.

		SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)	
Main jet	MAG	190	180	170	160	140	130	1
	PTO	200	190					1
Jet needle		6BFY46						2
MAG needle position		3	2					—
PTO needle position		4	2					
Slide cut-away		2.5						2
Pilot jet		35	45			55		2
MAG mixture screw		1.25						—
PTO mixture screw		1	1.25					
Valve seat		1.2						2
Needle jet		P-8 (159)				P-6 (159)		2
Float level (± 1 mm)		23.9						—
Idle RPM (± 200)		1650						—
Idle throttle valve position (± 0.1 mm)		1.6	1.8	2	2.2	2.4		—

Main Jet Chart

		SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
-40°C (-40°F)	MAG	200	190	180	170	150	140
	PTO	210	200				
-30°C (-22°F)	MAG	195	185	175	165	145	135
	PTO	205	195				
-20°C (-4°F)	MAG	190	180	170	160	140	130
	PTO	200	190				
-10°C (14°F)	MAG	185	175	165	155	135	125
	PTO	195	185				
0°C (32°F)	MAG	180	170	160	150	130	120
	PTO	190	180				
10°C (50°F)	MAG	175	165	155	145	125	115
	PTO	185	175				
20°C (68°F)	MAG	170	160	150	140	120	110
	PTO	180	170				

Additional Information

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Reverse connector	(P/N 515 174 800)			(P/N 515 174 700) Connect to ECM		

SKANDIC WT 550F / SKANDIC SWT 550F

Drive Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Red/Orange (P/N 417 223 316)	Red/Green (P/N 417 223 459)	Red/Red (P/N 417 223 186)	Red/Yellow (P/N 417 223 315)	Red/Orange (P/N 417 223 316)	Red/Green (P/N 417 223 459)
Ramp	700 (P/N 417 223 457)		734 (P/N 417 223 678)			
Ramp quantity	6					
Engagement RPM ± 100	2600					
Maximum RPM ± 100	6800					

Driven Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Pink 2 (P/N 417 127 236)					
Spring tension Kg ± 0.7 (lb ± 1.5)	6.4 kgf (14.1 lbf)					
Cam angle (degrees)	47° - 44° (P/N 417 127 148)					

Carburation

NOTICE These adjustments are guidelines only. Specific adjustments vary with temperature, altitude and snow condition. Always observe spark plug condition for proper jetting.

		SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)	
Main jet	MAG	190	180	170	160	150	140	1
	PTO	200						1
Jet needle		6BFY46						2
MAG needle position		3	2		1			—
PTO needle position		4						
Slide cut-away		2.0						2
Pilot jet		35	40					2
MAG mixture screw		2.5			2			—
PTO mixture screw		1						
Valve seat		1.2						2
Needle jet		P-8 (159)						2
Float level (± 1 mm)		23.9						—
Idle RPM (± 200)		1650						—
Idle throttle valve position (± 0.1 mm)		1.5	1.7	1.8	2	2.1	2.2	—

Main Jet Chart

		SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
-40°C (-40°F)	MAG	210	200	190	180	170	160
	PTO						
-30°C (-22°F)	MAG	200	190	180	170	160	150
	PTO						
-20°C (-4°F)	MAG	190	180	170	160	150	140
	PTO						
-10°C (14°F)	MAG	180	170	160	150	140	130
	PTO						
0°C (32°F)	MAG	170	160	150	140	130	120
	PTO						
10°C (50°F)	MAG	160	150	140	130	120	110
	PTO						
20°C (68°F)	MAG	150	140	130	120	110	100
	PTO						

MX Z™ SPORT 600

Drive Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Purple/Purple (P/N 414 817 900)			Pink/Purple (P/N 414 754 200)		
Ramp	412 (P/N 417 222 515)					
Calibration Screw Position	3	4	5	4	5	6
Pin	Short solid 32 mm/16,75 g (P/N 417 004 308)			Short no thread 32 mm/9,9 g (P/N 417 004 309)		
Engagement RPM ± 100	3800			3900	4100	
Maximum RPM ± 100	8100					

Driven Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Black (P/N 417 127 039)					
Spring tension Kg ± 0.7 (lb ± 1.5)	N/A					
Cam angle (degrees)	42° (P/N 417 127 012)					

Carburation

NOTICE These adjustments are guidelines only. Specific adjustments vary with temperature, altitude and snow condition. Always observe spark plug condition for proper jetting.

		SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)	
Main jet	MAG	390	370	350	330	300	280	1
	PTO							1
Jet needle		9CEY2-58						2
Needle position		2						—
Slide cut-away		2.0						2
Pilot jet		17.5						2
Mixture screw		1.5			2			—
Valve seat		1.5						2
Needle jet		P-0M						2
Float level (± 1 mm)		N/A						—
Idle RPM (± 200)		1600						—
Idle throttle valve position (± 0.1 mm)		1.5	1.6	1.7	1.8	1.9		—

Main Jet Chart

		SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
-40°C (-40°F)	MAG	410	390	370	350	320	300
	PTO						
-30°C (-22°F)	MAG	400	380	360	340	310	290
	PTO						
-20°C (-4°F)	MAG	390	370	350	330	300	280
	PTO						
-10°C (14°F)	MAG	380	360	340	320	290	270
	PTO						
0°C (32°F)	MAG	370	350	330	310	280	260
	PTO						
10°C (50°F)	MAG	360	340	320	300	270	250
	PTO						
20°C (68°F)	MAG	350	330	310	290	260	240
	PTO						

RENEGADE™ SPORT 600

Drive Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)	
Spring	Blue/Purple (P/N 414 817 900)			??Pink/Purple (P/N 414 754 200)			
Ramp	412 (P/N 417 222 515)						
Calibration Screw Position	3	4	5	4	5	6	
Pin	Short solid 32 mm/16,75 g (P/N 417 004 308)			Short no thread 32 mm/9,9 g (P/N 417 004 309)			
Engagement RPM ± 100	3400			4100			
Maximum RPM ± 100	8100						

Driven Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)	
Spring	Black (P/N 417 127 039)						
Spring tension Kg ± 0.7 (lb ± 1.5)	N/A						
Cam angle (degrees)	42° (P/N 417 127 012)						

Carburation

NOTICE These adjustments are guidelines only. Specific adjustments vary with temperature, altitude and snow condition. Always observe spark plug condition for proper jetting.

		SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)	
Main jet	MAG	390	370	350	330	300	280	1
	PTO							1
Jet needle		9CEY2-58						2
Needle position		2						—
Slide cut-away		2.0						2
Pilot jet		17.5						2
Mixture screw		1.5			2			—
Valve seat		1.5						2
Needle jet		P-0M						2
Float level (± 1 mm)		N/A						—
Idle RPM (± 200)		1600						—
Idle throttle valve position (± 0.1 mm)		1.5	1.6	1.7	1.8	1.9		—

Main Jet Chart

		SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
-40°C (-40°F)	MAG	410	390	370	350	320	300
	PTO						
-30°C (-22°F)	MAG	400	380	360	340	310	290
	PTO						
-20°C (-4°F)	MAG	390	370	350	330	300	280
	PTO						
-10°C (14°F)	MAG	380	360	340	320	290	270
	PTO						
0°C (32°F)	MAG	370	350	330	310	280	260
	PTO						
10°C (50°F)	MAG	360	340	320	300	270	250
	PTO						
20°C (68°F)	MAG	350	330	310	290	260	240
	PTO						

SUMMIT™ SPORT 146" 600

Drive Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)	
Spring	Blue/Pink (P/N 414 916 300)		Green/Pink (P/N 414 756 900)				
Ramp	417 (P/N 417 222 552)						
Calibration Screw Position	3	4	2	3	4	5	
Pin	Short solid 32 mm/16,75 g (P/N 417 004 308)		Short threaded 32 mm/10,88 g (P/N 417 222 477) 1 x set screw 20 mm (P/N 206 262 099)		Short threaded 32 mm/10,88 g (P/N 417 222 477)		
Engagement RPM ± 100	3400		4100				
Maximum RPM ± 100	8100						

Driven Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)	
Spring	Black (P/N 417 127 039)						
Spring tension Kg ± 0.7 (lb ± 1.5)	N/A						
Cam angle (degrees)	43° - 47° (P/N 417 127 133)						

Carburation

NOTICE These adjustments are guidelines only. Specific adjustments vary with temperature, altitude and snow condition. Always observe spark plug condition for proper jetting.

		SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)	
Main jet	MAG	390	370	350	330	300	280	1
	PTO							1
Jet needle		9CEY2-58						2
Needle position		2						—
Slide cut-away		2.0						2
Pilot jet		17.5						2
Mixture screw		1.5			2			—
Valve seat		1.5						2
Needle jet		P-0M						2
Float level (± 1 mm)		N/A						—
Idle RPM (± 200)		1600						—
Idle throttle valve position (± 0.1 mm)		1.5	1.6	1.7	1.8	1.9		—

Main Jet Chart

		SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
-40°C (-40°F)	MAG	410	390	370	350	320	300
	PTO						
-30°C (-22°F)	MAG	400	380	360	340	310	290
	PTO						
-20°C (-4°F)	MAG	390	370	350	330	300	280
	PTO						
-10°C (14°F)	MAG	380	360	340	320	290	270
	PTO						
0°C (32°F)	MAG	370	350	330	310	280	260
	PTO						
10°C (50°F)	MAG	360	340	320	300	270	250
	PTO						
20°C (68°F)	MAG	350	330	310	290	260	240
	PTO						

Vehicle Calibration

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Stopper Strap	4		3		2	

EXPEDITION LE 600 HO E-TEC® / EXPEDITION SE 600 HO E-TEC

Drive Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)	
Spring	Yellow/Red (P/N 414 993 000)						
Ramp	600 (P/N 417 222 444)						
Calibration Screw Position	2	3	4	2	3	4	
Pin	Long solid 35.75 mm/18,8 g (P/N 417 222 594)			Short threaded 32 mm/10,88 g (P/N 417 222 477) 1 X set screw 16 mm (P/N 206 261 699)			
Engagement RPM ± 100	3000						
Maximum RPM ± 100	8100						

Driven Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)	
Spring	White 2 (P/N 417 127 243)						
Spring tension Kg ± 0.7 (lb ± 1.5)	6.8 kgf (15 lbf)						
Cam angle (degrees)	40° (P/N 417 127 205)						

SKANDIC WT 600 HO E-TEC / SKANDIC SWT 600 HO E-TEC

Drive Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Yellow/Red (P/N 414 993 000)					
Ramp	600 (P/N 417 222 444)					
Calibration Screw Position	2	3	4	2	3	4
Pin	Long solid 35.75 mm/18,8 g (P/N 417 222 594)			Short threaded 32 mm/10,88 g (P/N 417 222 477)		
Engagement RPM ± 100	3000					
Maximum RPM ± 100	8100					

Driven Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	White 2 (P/N 417 127 243)					
Spring tension Kg ± 0.7 (lb ± 1.5)	6.8 kgf (15 lbf)					
Cam angle (degrees)	41° - 45° (P/N 417 127 105)					

GSX™ LE 600 HO E-TEC

Drive Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Yellow/Green (P/N 414 742 100)			Blue/Yellow (P/N 414 689 500)		
Ramp	412 (P/N 417 222 515)					
Calibration Screw Position	3	4	5	2	3	4
Pin	Short solid 32 mm/16,75 g (P/N 417 004 308)			Short no thread 32 mm/10.88 g (P/N 417 222 477)		
Engagement RPM ± 100	3400			3800		
Maximum RPM ± 100	8100					

Driven Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Green (P/N 417 127 137)					
Spring tension Kg ± 0.7 (lb ± 1.5)	N/A					
Cam angle (degrees)	48° (P/N 417 127 083)			40° (P/N 417 126 956)		

GRAND TOURING LE 600 HO E-TEC / GSX SE 600 HO E-TEC

Drive Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Red/Green (P/N 414 689 200)			Blue/Yellow (P/N 414 689 500)		
Ramp	414 (P/N 417 222 546)					
Calibration Screw Position	3	4	5	3	4	5
Pin	Short solid 32 mm/16,75 g (P/N 417 004 308)			Short no thread 32 mm/9,9 g (P/N 417 004 309)		
Engagement RPM ± 100	3400			3600		
Maximum RPM ± 100	8100					

Driven Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Green (P/N 417 127 137)					
Spring tension Kg ± 0.7 (lb ± 1.5)	N/A					
Cam angle (degrees)	48° (P/N 417 127 083)			42° - 40° (P/N 417 127 106)		

MX Z™ TNT 600 HO E-TEC /
MX Z X™ 600 HO E-TEC /
MX Z X-RS™ 600 HO E-TEC /
►MX Z X-RS IRON DOG 600 HO E-TEC /◄
RENEGADE™ ADRENALINE™ 600 HO E-TEC /
RENEGADE BACKCOUNTRY™ 600 HO E-TEC /
RENEGADE BACKCOUNTRY X 600 HO E-TEC /
RENEGADE X 600 HO E-TEC

Drive Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Blue/Green (P/N 414 817 700)			Purple/Yellow (P/N 415 015 300)		
Ramp	412 (P/N 417 222 515)					
Calibration Screw Position	3	4	5	2	3	4
Pin	Short solid 32 mm/16,75 g (P/N 417 004 308)			Short threaded 32 mm/10.88 g (P/N 417 222 477)		
Engagement RPM ± 100	3400			3800		
Maximum RPM ± 100	8100					

Driven Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Green (P/N 417 127 137)					
Spring tension Kg ± 0.7 (lb ± 1.5)	N/A					
Cam angle (degrees)	48° (P/N 417 127 083)			40° (P/N 417 126 956)		

TUNDRA Xtreme 600 HO E-TEC (CAN/USA)

Drive Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Red/Orange (P/N 415 015 200)			Blue/Green (P/N 414 817 700)		
Ramp	417 (P/N 417 222 552)					
Calibration Screw Position	3	4	5	3	4	5
Pin	Short solid 32 mm/16,75 g (P/N 417 004 308)			Short threaded 32 mm/10,88 g (P/N 417 222 477)		
Engagement RPM ± 100	2800			3800		
Maximum RPM ± 100	8100					

Driven Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Black (P/N 417 127 039)					
Spring tension Kg ± 0.7 (lb ± 1.5)	N/A					
Cam angle (degrees)	44° - 42° (P/N 417 126 973)			41° - 45° (P/N 417 127 105)		

Vehicle Calibration

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Stopper Strap	3					
Rear suspension extension	Locked		Free			

TUNDRA Xtreme 600 HO E-TEC (EUROPE)

Drive Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Blue/Green (P/N 414 817 700)					
Ramp	412 (P/N 417 222 515)			417 (P/N 417 222 552)		
Calibration Screw Position	3	4	5	2	3	4
Pin	Short solid 32 mm/16,75 g (P/N 417 004 308)			Short threaded 32 mm/10,88 g (P/N 417 222 477)		
Engagement RPM ± 100	3400			3800		
Maximum RPM ± 100	8100					

Driven Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Black (P/N 417 127 039)					
Spring tension Kg ± 0.7 (lb ± 1.5)	N/A					
Cam angle (degrees)	41° - 45° (P/N 417 127 105)					

Vehicle Calibration

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Stopper Strap	3					
Rear suspension extension	Locked		Free			

SUMMIT SP 146" AND 154" 600 HO E-TEC (CAN/USA)

Drive Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Blue/Green (P/N 414 817 700)		Purple/Green (P/N 415 015 400)			
Ramp	412 (P/N 417 222 515)		440 (P/N 417 223 096)			
Calibration Screw Position	3	4	3	3	4	5
Pin	Short solid 32 mm/16,75 g (P/N 417 004 308)		Short threaded 32 mm/10,88 g (P/N 417 222 477) 1 x set screw/16 mm (P/N 206 261 699)	Short threaded 32 mm/10,88 g (P/N 417 222 477)		
Engagement RPM ± 100	3300		4000			
Maximum RPM ± 100	8100					

Driven Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Black (P/N 417 127 039)					
Spring tension Kg ± 0.7 (lb ± 1.5)	N/A					
Cam angle (degrees)	41° - 45° (P/N 417 127 105)					

Vehicle Calibration

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Stopper Strap	4		3		2	

SUMMIT SP 146" 600 HO E-TEC (EUROPE)

Drive Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Blue/Green (P/N 414 817 700)		Purple/Green (P/N 415 015 400)			
Ramp	412 (P/N 417 222 515)		440 (P/N 417 223 096)			
Calibration Screw Position	3	4	2	3	4	5
Pin	Short solid 32 mm/16,75 g (P/N 417 004 308)		Short threaded 32 mm/10,88 g (P/N 417 222 477)			
Engagement RPM ± 100	3300		4000			
Maximum RPM ± 100	8100					

Driven Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Black (P/N 417 127 039)					
Spring tension Kg ± 0.7 (lb ± 1.5)	N/A					
Cam angle (degrees)	41° - 45° (P/N 417 127 105)					

Vehicle Calibration

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Stopper Strap	4		3		2	

SUMMIT SPORT 154" 800R POWER TEK™

Drive Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Blue/Purple (P/N 414 817 800)		Green/Purple (P/N 414 762 800)			
Ramp	413 (P/N 417 222 508)		441 (P/N 417 223 098)			
Calibration Screw Position	3	4	1	2	3	4
Pin	Long solid 35,75 mm/18,8 g (P/N 417 222 594)		Long threaded 35,75 mm/12,4 g (P/N 417 222 595) 1 set screw/12 mm (P/N 206 261 299)		Short threaded 32 mm/10,88 g (P/N 417 222 477)	
Engagement RPM ± 100	3000		3800			
Maximum RPM ± 100	8150					

Sea Level Calibration Kit

MODEL	PART NUMBER
SUMMIT SPORT 154" 800R Power TEK	860 200 394

Driven Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Purple (P/N 417 127 062)					
Spring tension Kg ± 0.7 (lb ± 1.5)	N/A					
Cam angle (degrees)	43° - 47° (P/N 417 127 133)					

Carburation

NOTICE These adjustments are guidelines only. Specific adjustments vary with temperature, altitude and snow condition. Always observe spark plug condition for proper jetting.

		SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)	
Main jet	MAG	480						1
	PTO							1
Jet needle		9EGI04-58						2
Needle position		N/A						—
Slide cut-away		2.0						2
Pilot jet		17,5						2
Mixture screw		1.5						—
Valve seat		1.5						2
Needle jet		P-0M						2
Float level (± 1 mm)		N/A						—
Idle RPM (± 200)		1900						—
Idle throttle valve position (± 0.1 mm)		1.6		1.8		2		—

Main Jet Chart

		SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
-40°C (-40°F)	MAG	520 N					
	PTO						
-30°C (-22°F)	MAG	500					
	PTO						
-20°C (-4°F)	MAG	480					
	PTO						
-10°C (14°F)	MAG						
	PTO						
0°C (32°F)	MAG						
	PTO						
10°C (50°F)	MAG						
	PTO						
20°C (68°F)	MAG						
	PTO						

Vehicle Calibration

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Stopper Strap	4			3		2

FREERIDE™ 137" 800R E-TEC
(Track with profile of 44.5 mm (1-3/4 in))

Drive Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Purple/Blue (P/N 415 034 900)		Purple/Pink (P/N 414 949 500)			
Ramp	413 (P/N 417 222 508)		441 (P/N 417 223 098)			
Calibration Screw Position	3	4	3	4	5	6
Pin	Long solid 35.75 mm/18,8 g (P/N 417 222 594)		Long threaded 35,75 mm/12,4 g (P/N 417 222 595) 1 set screw/12 mm (P/N 206 261 299)			
Engagement RPM ± 100	3800		3900	4000		4100
Maximum RPM ± 100	7900					

Driven Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Green (P/N 417 127 137)		Blue (P/N 417 127 118)			
Spring tension Kg ± 0.7 (lb ± 1.5)	N/A					
Cam angle (degrees)	44° - 42° (P/N 417 126 973)		40° (P/N 417 126 956)			

Vehicle Calibration

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Stopper Strap	4		3		2	

FREERIDE 137" 800R E-TEC
(Track with profile of 57 mm (2-1/4 in))

Drive Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Purple/Blue (P/N 415 034 900)		Purple/Pink (P/N 414 949 500)			
Ramp	413 (P/N 417 222 508)		441 (P/N 417 223 098)			
Calibration Screw Position	3	4	3	4	5	6
Pin	Long solid 35.75 mm/18,8 g (P/N 417 222 594)		Long threaded 35,75 mm/12,4 g (P/N 417 222 595) 1 set screw/12 mm (P/N 206 261 299)			
Engagement RPM ± 100	3800		3900	4000		4100
Maximum RPM ± 100	7900					

Driven Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Blue (P/N 417 127 118)					
Spring tension Kg ± 0.7 (lb ± 1.5)	N/A					
Cam angle (degrees)	40° (P/N 417 126 956)					

Vehicle Calibration

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Stopper Strap	4		3		2	

FREERIDE 146" AND 154" 800R E-TEC SEA-LEVEL / SUMMIT X 146", 154" AND 163" 800R E-TEC SEA-LEVEL (Track with profile of 63.5 mm (2-1/2 in)) / SUMMIT SP 154" AND 163" 800R E-TEC SEA-LEVEL (EUROPE) (Track with profile of 63.5 mm (2-1/2 in))

Drive Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Yellow/Green 414 742 100		Purple/Pink (P/N 414 949 500)			
Ramp	413 (P/N 417 222 508)		441 (P/N 417 223 098)			
Calibration Screw Position	2	3	2	3	4	5
Pin	Long solid 35.75 mm/18,8 g (P/N 417 222 594)		Long threaded 35,75 mm/12,4 g (P/N 417 222 595) 1 set screw/16 mm (P/N 206 261 699)		Long threaded 35,75 mm/12,4 g (P/N 417 222 595)	
Engagement RPM ± 100	3000		3800			
Maximum RPM ± 100	7900					

Driven Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Blue (P/N 417 127 118)					
Spring tension Kg ± 0.7 (lb ± 1.5)	N/A					
Cam angle (degrees)	40° (P/N 417 126 956)					

Vehicle Calibration

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Stopper Strap	4		3		2	

Chaincase Gears

146" MODELS (EXCEPT FREERIDE CAN/US)						
	Sea level 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Upper gear	21 (P/N 504 096 200)		19 (P/N 504 152 030)			
Lower gear	49 (P/N 504 152 581)					
Chain	106 (P/N 504 152 630)		104 (P/N 504 152 629)			

146" MODELS (FREERIDE CAN/US)						
	Sea level 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Upper gear	23 (P/N 504 091 000)		21 (P/N 504 096 200)			
Lower gear	51 (P/N 504 152 971)					
Chain	108 (P/N 504 152 631)		106 (P/N 504 152 630)			

154" MODELS						
	Sea level 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Upper gear	21 (P/N 504 096 200)		19 (P/N 504 152 030)			
Lower gear	49 (P/N 504 152 581)					
Chain	106 (P/N 504 152 630)		104 (P/N 504 152 629)			

163" MODELS (EUROPE)						
	Sea level 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M FT
Upper gear	19 (P/N 504 152 030)					
Lower gear	51 (P/N 504 152 971)					
Chain	106 (P/N 504 152 630)					

163" MODELS (CAN/US)						
	Sea level 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M FT
Upper gear	21 (P/N 504 096 200)					
Lower gear	51 (P/N 504 152 971)					
Chain	106 (P/N 504 152 630)					

FREERIDE 146" AND 154" 800R E-TEC HIGH ALTITUDE / SUMMIT SP 146", 154" AND 163" 800R E-TEC HIGH ALTITUDE (Track with profile of 63.5 mm (2-1/2 in)) / SUMMIT X 146" 800R E-TEC HIGH ALTITUDE (Track with profile of 63.5 mm (2-1/2 in)) / SUMMIT X 154" AND 163" 800R E-TEC HIGH ALTITUDE (Track with profile of 63.5 mm (2-1/2 in))

Drive Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Yellow/green (P/N 414 742 100)		Purple/Pink (P/N 414 949 500)			
Ramp	413 (P/N 417 222 508)		441 (P/N 417 223 098)			
Calibration Screw Position	3	4	3	4	5	6
Pin	Long solid 35.75 mm/18,8 g (P/N 417 222 594)		Long threaded 35,75 mm/12,4 g (P/N 417 222 595) 1 set screw/16 mm (P/N 206 261 699)	Long threaded 35,75 mm/12,4 g (P/N 417 222 595)		
Engagement RPM ± 100	3000		3800			
Maximum RPM ± 100	7900					

Driven Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Blue (P/N 417 127 118)					
Spring tension Kg ± 0.7 (lb ± 1.5)	N/A					
Cam angle (degrees)	40° (P/N 417 126 956)					

Vehicle Calibration

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Stopper Strap	4		3		2	

Chaincase Gears

146" MODELS						
	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Upper gear	21 (P/N 504 096 200)					
Lower gear	49 (P/N 504 152 581)					
Chain	106 (P/N 504 152 630)					

154" MODELS						
	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M FT
Upper gear	21 (P/N 504 096 200)		19 (P/N 504 152 030)			
Lower gear	49 (P/N 504 152 581)					
Chain	106 (P/N 504 152 630)		104 (P/N 504 152 629)			

163" MODELS						
	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Upper gear	21 (P/N 504 096 200)		19 (P/N 504 152 030)			
Lower gear	51 (P/N 504 152 971)					
Chain	106 (P/N 504 152 630)					

Sea Level Calibration Kit

MODEL	PART NUMBER
146"	860 201 118
154"	860 201 119
163"	860 201 120

Summit 800R E-TEC Theoretical Speed (Excluding European Models)

MODEL	UPPER GEAR	LOWER GEAR	CHAIN	THEORETICAL SPEED (KM/H / MPH)
Summit, Freeride 146*	21	49	106	131 km/h (81 MPH)
Summit, Freeride 146***	23	49	106	144 km/h (89 MPH)
Summit, Freeride 154*	19	49	104	119 km/h (74 MPH)
Summit, Freeride 154**	21	49	106	131 km/h (81 MPH)
Summit, Freeride 154***	23	49	106	144 km/h (89 MPH)
Summit 163*	19	51	106	114 km/h (71 MPH)
Summit 163**	21	51	106	126 km/h (78 MPH)
Summit 163***	23	51	108	138 km/h (86 MPH)

Summit 800R E-TEC Sea-Level Gear Ratio Recommendation (Excluding European Models)

TRACK LENGTH	GEAR RATIO	RECOMMENDATION	PRO'S	CON'S
146''	21/49*	Deep snow / Best all around gear ratio	Better belt life / Better deep snow performance	Max Speed 131 km/h
146''	23/49***	Trail / Lake	Higher maximum speed	Performance and Belt life Reduced in deep snow condition
154''	19/49*	For Extreme deep snow condition only	Increase performance and belt life in extreme deep and heavy snow condition	119 km/h max speed. Rev limiter can often turn on.
154''	21/49**	Deep snow / Best all around gear ratio	Better belt life in all around condition	131 km/h max speed
154''	23/49	Trail / Lake	Higher maximum speed	Performance and Belt life Reduced in deep snow condition
163''	19/49*	For Extreme deep snow condition only	Increase performance and belt life in extreme deep and heavy snow condition	114 km/h max speed. Rev limiter can often turn on.
163''	21/49**	Deep snow / Best all around gear ratio	Better belt life in all around condition	131 km/h max speed
163''	23/49	Trail / Lake	Higher maximum speed	Performance and Belt life Reduced in deep snow condition

* Factory Installed
** Included in Sea-Level calibration kit
*** Optional calibration

SUMMIT X 163" AND 174" 800R E-TEC WITH T3 PACKAGE (Track with profile of 76.2 mm (3 in))

Drive Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Yellow/green (P/N 414 742 100)		Purple/Pink (P/N 414 949 500)			
Ramp	413 (P/N 417 222 508)		438 (P/N 417 223 049)			
Calibration Screw Position	3	4	3	4	5	6
Pin	Long solid 35.75 mm/18,8 g (P/N 417 222 594)		Long threaded 35,75 mm/12,4 g (P/N 417 222 595) 1 set screw/16 mm (P/N 206 261 699)	Long threaded 35,75 mm/12,4 g (P/N 417 222 595)		
Engagement RPM ± 100	3000		3800			
Maximum RPM ± 100	7900					

Driven Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Blue (P/N 417 127 118)					
Spring tension Kg ± 0.7 (lb ± 1.5)	N/A					
Cam angle (degrees)	40° (P/N 417 127 386)					

Vehicle Calibration

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Stopper Strap	4		3		2	

Chaincase Gears

163" T3 MODEL						
	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Upper gear	23 (P/N 504 091 000)			21 (P/N 504 096 200)		
Lower gear	51 (P/N 504 153 227)					
Chain	112 (P/N 504 153 268)					

174" T3 MODEL						
	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Upper gear	21 (P/N 504 096 200)			19 (P/N 504 152 030)		
Lower gear	49 (P/N 504 153 267)					
Chain	110 (P/N 504 153 266)					

Sea Level Calibration Kit

MODEL	PART NUMBER
163" T3	860 201 194
174" T3	860 201 120

Summit 800R E-TEC Theoretical Speed (Excluding European Models)

NOTE: Summit X with T3 package are equipped with 7 tooth sprocket instead of 8 tooth sprocket like none T3 Summit. Theoretical speed and gear ratio recommendation for Summit X with T3 package will differ from a Summit without T3 package, with same gear ratio.

MODEL	UPPER GEAR	LOWER GEAR	CHAIN	THEORETICAL SPEED (KM/H / MPH)
Summit X 163 T3*	21	51	112	123 km/h (76 MPH)
Summit X 163 T3**	23	51	112	134 km/h (83 MPH)
Summit X 174 T3*	19	49	110	116 km/h (72 MPH)
Summit X 174 T3**	21	49	110	127 km/h (79 MPH)

Summit 800R E-TEC Sea-Level Gear Ratio Recommendation (Excluding European Models)

NOTE: Summit X with T3 package are equipped with 7 tooth sprocket instead of 8 tooth sprocket like none T3 Summit. Theoretical speed and gear ratio recommendation for Summit X with T3 package may differ from a Summit without T3 package, with same gear ratio.

TRACK LENGTH	GEAR RATIO	RECOMMENDATION	PRO'S	CON'S
163'' T3	21/51*	Deep snow / Best all around gear ratio	Better belt life in all around condition	123 km/h max speed. Rev limiter can turn on

TRACK LENGTH	GEAR RATIO	RECOMMENDATION	PRO'S	CON'S
163'' T3	23/51**	Trail / Lake	Higher maximum speed	Performance and belt life reduced in deep snow condition
174" T3	19/49*	For extreme deep snow condition only	Increase performance and belt life in extreme deep and heavy snow condition	116 Km/h max speed. Rev limiter can often turn on
174" T3	21/49**	Deep snow / Best all around gear ratio	Better belt life in all around condition	127 Km/h max speed

* Factory Installed
** Included in Sea-Level calibration kit
*** Optional calibration

GSX SE 800R E-TEC

Drive Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Yellow/Green (P/N 414 742 100)		Yellow/Blue (P/N 414 818 000)			
Ramp	414 (P/N 417 222 546)					
Calibration Screw Position	3	4	2	3	4	5
Pin	Long solid 35.75 mm/18,8 g (P/N 417 222 594)		Long threaded 35,75 mm/12,4 g (P/N 417 222 595) 1 set screw / 20 mm (P/N 206 262 099)			
Engagement RPM ± 100	3800					
Maximum RPM ± 100	7900					

Driven Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Green (P/N 417 127 137)		Purple (P/N 417 127 062)			
Spring tension Kg ± 0.7 (lb ± 1.5)	N/A					
Cam angle (degrees)	50°-44° (P/N 417 127 111)					

MX Z TNT 800R E-TEC / MX Z X 800R E-TEC / MX Z X-RS 800R E-TEC / ►MX Z X-RS IRON DOG 800R E-TEC◄

Drive Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Blue/Green (P/N 414 817 700)		Purple/Yellow (P/N 415 015 300)			
Ramp	414 (P/N 417 222 546)					
Calibration Screw Position	3	4	2	3	4	5
Pin	Long solid 35.75 mm/18.8 g (P/N 417 222 594)		Long threaded 35.75 mm/12.4 g (P/N 417 222 595) 1 x set screw 12 mm (P/N 206 261 299)			
Engagement RPM ± 100	3800					
Maximum RPM ± 100	7900					

Driven Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Green (P/N 417 127 137)		Purple (P/N 417 127 062)			
Spring tension Kg ± 0.7 (lb ± 1.5)	N/A					
Cam angle (degrees)	47° - 44° (P/N 417 127 109)		44° (P/N 417 127 011)			

RENEGADE ADRENALINE 800R E-TEC / RENEGADE X 800R E-TEC / RENEGADE X-RS 800R E-TEC (CAN / USA) (Track with profile of 31.8 mm and 38.1 mm (1-1/4 in and 1-1/2 in))

Drive Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)	
Spring	Blue/Green (P/N 414 817 700)		Blue/Purple (P/N 414 817 800)				
Ramp	414 (P/N 417 222 546)						
Calibration Screw Position	3	4	2	3	4	5	
Pin	Long solid 35.75 mm/18.8 g (P/N 417 222 594)		Long threaded 35.75 mm/12.4 g (P/N 417 222 595) 1 set screw/12 mm (P/N 206 261 299)				
Engagement RPM ± 100	3800		3900	4000		4100	
Maximum RPM ± 100	7900						

Driven Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)	
Spring	Green (P/N 417 127 137)						
Spring tension Kg ± 0.7 (lb ± 1.5)	N/A						
Cam angle (degrees)	44° - 42° (P/N 417 126 973)						

RENEGADE BACKCOUNTRY 800R E-TEC / RENEGADE BACKCOUNTRY X 800R E-TEC / RENEGADE X-RS 800R E-TEC (EUROPE) (Track with profile of 44.5 mm (1-3/4 in))

Drive Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)	
Spring	Purple/Blue (P/N 415 034 900)		Purple/Pink (P/N 414 949 500)				
Ramp	413 (P/N 417 222 508)		441 (P/N 417 223 098)				
Calibration Screw Position	3	4	3	4	5	6	
Pin	Long solid 35.75 mm/18.8 g (P/N 417 222 594)		Long threaded 35.75 mm/12.4 g (P/N 417 222 595) 1 set screw/12 mm (P/N 206 261 299)				
Engagement RPM ± 100	3800		3900	4000		4100	
Maximum RPM ± 100	7900						

Driven Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)	
Spring	Green (P/N 417 127 137)						
Spring tension Kg ± 0.7 (lb ± 1.5)	N/A						
Cam angle (degrees)	44° - 42° (P/N 417 126 973)						

TUNDRA SPORT 600 ACE / TUNDRA LT 600 ACE / EXPEDITION SPORT 600 ACE / RENEGADE SPORT 600 ACE

Drive Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Red/White (P/N 417 223 747)	Red/Red (P/N 417 223 745)	Red/Yellow (P/N 417 223 748)	Red/White (P/N 417 223 747)		Red/Red (P/N 417 223 745)
Ramp	716 (P/N 417 223 450)			725 (P/N 417 223 601)		
Ramp quantity	6					
Engagement RPM ± 100	2200					
Maximum RPM ± 100	7250					

Driven Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Pink 3 (P/N 417 127 344)					
Spring tension Kg ± 0.7 (lb ± 1.5)	6.4 kgf (14.1 lbf)					
Cam angle (degrees)	41°-45° (P/N 417 127 235)					

GRAND TOURING SPORT 600 ACE / MX Z SPORT 600 ACE

Drive Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	80 - 150 Red/Red (P/N 417 223 745)	Red/Yellow (P/N 417 223 748)	Red/Orange (P/N 417 223 749)	Red/White (P/N 417 223 747)		Red/Red (P/N 417 223 745)
Ramp	715 (P/N 417 223 452)		725 (P/N 417 223 601)			
Ramp quantity	6					
Engagement RPM ± 100	2200					
Maximum RPM ± 100	7250					

Driven Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Pink 3 (P/N 417 127 344)					
Spring tension Kg ± 0.7 (lb ± 1.5)	6.4 kgf (14.1 lbf)					
Cam angle (degrees)	41°-45° (P/N 417 127 235)					

SKANDIC WT 600 ACE

Drive Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Red/White (P/N 417 223 314)	Red/Red (P/N 417 223 186)	Red/White (P/N 417 223 314)	Red/Red (P/N 417 223 186)	Red/Yellow (P/N 417 223 315)	Red/Orange (P/N 417 223 316)
Ramp	716 (P/N 417 223 450)		725 (P/N 417 223 601)			
Ramp quantity	6					
Engagement RPM ± 100	2200					
Maximum RPM ± 100	7250					

Driven Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Pink 3 (P/N 417 127 344)					
Spring tension Kg ± 0.7 (lb ± 1.5)	6.4 kgf (14.1 lbf)					
Cam angle (degrees)	37°-45° (P/N 417 127 240)					

GSX LE 1200 4-TEC / GSX SE 1200 4-TEC / GRAND TOURING LE 1200 4-TEC / GRAND TOURING SE 1200 4-TEC / MX Z TNT 1200 4-TEC / MX Z X 1200 4-TEC / RENEGADE ADRENALINE 1200 4-TEC / RENEGADE X 1200 4-TEC

Drive Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Yellow/Orange (P/N 417 223 746)		Red/White (P/N 417 223 747)	Yellow/Red (P/N 417 223 751)		Yellow/Orange (P/N 417 223 746)
Ramp	735 (P/N 417 223 679)		739 (P/N 417 223 828)			
Engagement RPM ± 100	2200					
Maximum RPM ± 100	7900					

Driven Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Red/Red (P/N 417 127 467)					
Spring tension Kg ± 0.7 (lb ± 1.5)	7 kg (15.4 lb)					
Cam angle (degrees)	44° - 40° (P/N 417 127 476)					

EXPEDITION SE 1200 4-TEC

Drive Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Yellow/Red (P/N 417 223 751)		Red/White (P/N 417 223 747)	Yellow/Red (P/N 417 223 751)		Yellow/Orange (P/N 417 223 746)
Ramp	735 (P/N 417 223 679)		739 (P/N 417 223 828)			
Engagement RPM ± 100	2200					
Maximum RPM ± 100	7900					

Driven Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Pink 4 (P/N 417 127 421)					
Spring tension Kg ± 0.7 (lb ± 1.5)	7 kg (15.4 lb)					
Cam angle (degrees)	44° - 40 (P/N 417 127 424)					

EXPEDITION SPORT 900 ACE / GRAND TOURING LE 900 ACE / MX Z TNT 900 ACE / RENEGADE ADRENALINE 900 ACE

Drive Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Yellow/Red (P/N 417 223 751)		Yellow/Orange (P/N 417 223 746)		Yellow/Red (P/N 417 223 751)	Yellow/Orange (P/N 417 223 746)
Ramp	735 (P/N 417 223 679)		742 (P/N 417 223 918)			
Engagement RPM ± 100	2200					
Maximum RPM ± 100	7250					

Driven Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Red/Red (P/N 417 127 467)					
Spring tension Kg ± 0.7 (lb ± 1.5)	7 kg (15.4 lb)					
Cam angle (degrees)	47° - 40° (P/N 417 127 474)					

GSX LE 900 ACE

Drive Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Yellow/Red (P/N 417 223 751)		Yellow/Orange (P/N 417 223 746)		Yellow/Red (P/N 417 223 751)	Yellow/Orange (P/N 417 223 746)
Ramp	740 (P/N 417 223 906)		742 (P/N 417 223 918)			
Engagement RPM ± 100	2200					
Maximum RPM ± 100	7250					

Driven Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Red/Red (P/N 417 127 467)					
Spring tension Kg ± 0.7 (lb ± 1.5)	7 kg (15.4 lb)					
Cam angle (degrees)	47° - 40° (P/N 417 127 474)					

SKANDIC WT/SWT 900 ACE / SKANDIC SWT 900 ACE / EXPEDITION LE 900 ACE / EXPEDITION SE 900 ACE

Drive Pulley

	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Yellow/Red (P/N 417 223 751)		Yellow/Orange (P/N 417 223 746)		Yellow/Red (P/N 417 223 751)	Yellow/Orange (P/N 417 223 746)
Ramp	740 (P/N 417 223 679)		742 (P/N 417 223 918)			
Engagement RPM ± 100	2200					
Maximum RPM ± 100	7250					

Driven Pulley

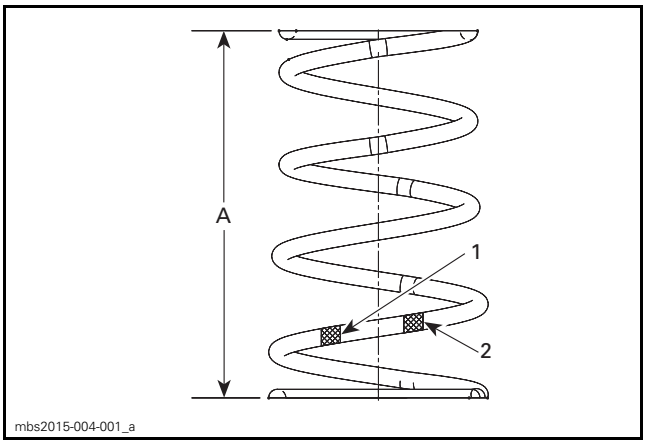
	SEA LEVEL 0 M (0 FT)	600 M (2000 FT)	1200 M (4000 FT)	1800 M (6000 FT)	2400 M (8000 FT)	3000 M (10000 FT)
Spring	Orange/ Orange (P/N 417 127 434)					
Spring tension Kg ± 0.7 (lb ± 1.5)	7 kg (15.4 lb)					
Cam angle (degrees)	44° - 40° (P/N 417 127 412)					

OPTIONAL DRIVE PULLEY SPRING RATES AND SPECIFICATIONS

The springs for eDrive™ I and eDrive II pulleys are different.

– eDrive I: cone shaped springs
– eDrive II: straight shaped springs.

The springs for TRA pulleys can not be installed on eDrive II.



TYPICAL - COLOR CODE
1. 1st color
2. 2nd color

eDrive I (550F)

SPRING SPECIFICATIONS							
PART NUMBER	WIRE DIA.	FREE LENGHT	LOAD ± 10% WHEN "A" = 60.6 MM		LOAD ± 10% WHEN "A" = 28 MM		COLOR CODE
	MM		N	LBS	N	LBS	
417 223 186	4.50	96.0	356	80	667	150	Red / Red
417 223 223	4.80	130.0	489	110	845	190	Yellow / Orange
417 223 314	4.30	114.7	356	80	578	130	Red / White
417 223 315	4.80	90.4	356	80	756	170	Red / Yellow
417 223 316	4.95	84.7	356	80	845	190	Red / Orange
417 223 459	5.08	81.7	356	80	934	210	Red / Green
417 223 536	4.30	125	445	100	667	150	Yellow / Red

eDrive II (600 ACE / 900 ACE / 1200 4-TEC)

SPRING SPECIFICATIONS							
PART NUMBER	WIRE DIA.	FREE LENGHT	LOAD ± 10% WHEN "A" = 60.6 MM		LOAD ± 10% WHEN "A" = 28 MM		COLOR CODE
	MM		N	LBS	N	LBS	
417 223 745	4.50	97.9	356	80	667	150	Red / Red
417 223 746	4.50	105.4	489	110	845	190	Yellow / Orange
417 223 747	4.30	108.0	356	80	600	135	Red / White
417 223 748	4.80	87.3	355	80	789	177	Red / Yellow
417 223 749	4.80	84.3	355	80	845	190	Red / Orange
417 223 750	5.0	80.5	355	80	934	210	Red / Green
417 223 751	4.30	120.0	446	100	690	155	Yellow / Red

Flat rate times are what the manufacturer pays the authorized dealer for warranty work, the times listed are usually unrealistic for even the most experienced mechanic and will take longer to actually complete.

Because of this dealers will usually charge more than the times posted.

I cannot be held responsible for any errors BRP has made in these service flat rate or parts manuals.

If you bought this manual from any other seller, they could be reselling my work.

Please leave them negative feedback & email me at bestshopmanuals@gmail.com .

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Thank you for choosing us.





ski-doo®

2015

FLAT RATE
Time Schedule
Volume 5

BARÈME DE TEMPS
à taux fixe

EXPEDITION
Sport 600 ACE

RENEGADE
Sport 600 ACE

GRANDTOURING
Sport 600 ACE

SKANDIC
WT 600 ACE
SWT 600 ACE

TUNDRA
LT 600 ACE
Sport 600 ACE

MXZ
Sport 600 ACE

Effective May 21th, 2014
En vigueur le 21 mai 2014

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INTRODUCTION

This publication governs all warranty labor allowances for 2015 snowmobiles.

1. HOW DOES IT WORK

We follow the procedures detailed in the *Snowmobiles Shop Manual*. The flat rate time is the maximum time allowed for a repair involving any given part. FLAT RATE TIME IS NOT CUMULATIVE. You must use the flat rate time given for the longest lasting operation.

NOTE: The *Flat Rate Time Schedule* was prepared by skilled mechanics using the hand tool usually found in workshops and all the special tools mentioned in the *Shop Manual*.

2. COMPILATION

The *Flat Rate Time Schedule* is compiled as follows:

The actual required time to perform the repair plus (+) 30% correction factor up to 3.0 hours or (+) 15% over 3.0 hours time to take into account, among others:

- Vehicle handling
- Obtaining the parts
- Diagnosis
- Cleaning
- Special compensation (rusted bolts).

3. HOW TO USE IT

Refer to the system you need, locate part of series of parts replaced. List JOB CODE in the appropriate column on claim.

SYSTEM		PAGE
01	ENGINE	4
02	FUEL SYSTEM	19
03	IGNITION SYSTEM	23
04	STARTER SYSTEM	25
05	TRANSMISSION SYSTEM	26

SYSTEM		PAGE
06	BRAKE SYSTEM	32
07	STEERING SYSTEM AND FRONT SUSPENSION	34
08	REAR SUSPENSION SYSTEM AND TRACK	39
09	BODY	45
10	ELECTRICAL SYSTEM	58

NOTE: Unless otherwise specified, dismantling order is: top to bottom, exterior to interior, front to rear.

All fractions of hours are in tenths:

0.1 = 6 minutes
0.2 = 12 minutes, and so on

LEGEND:

* REQUIRES PRIOR AUTHORIZATION BY DISTRIBUTOR.
** INDICATE LABOUR TIME ON LINE "LABOUR ONLY" OF CLAIM.
*** INDICATE $$$ AMOUNT ON "SUB-CONTRACTED LABOUR" OF CLAIM.

IMPORTANT: Always use the longest flat rate time applicable to the repair performed.

4. JOB REQUIREMENTS

All the flat rate times mentioned in the following pages include the required operations such as: engine timing (rotary valve and ignition), connecting rod(s) alignment, cylinder head(s) torque or use of parallel bar, use of ignition tester, piston clearance/ring end gap measurement, crankshaft to crankcase measurement, cylinder honing, engine leak test.

5. ILLUSTRATIONS

The illustrations contained in this manual do not necessarily show every components of a given system as *Parts Catalog* do. Their purpose is to facilitate recognition of parts related to a flat rate time. **Item numbers on illustrations correspond to the four digit Job Code.**

6. SUGGESTION (FORM REQUEST)

INTRODUCTION

Cette publication détermine le temps de main-d'oeuvre couvert par la garantie pour les motoneiges 2015.

1. UTILISATION DU MANUEL

En procédant de la façon indiquée dans le *Manuel de réparation motoneiges*, chaque temps donné représente le maximum permis pour une réparation portant sur cette pièce. LES TEMPS NE SONT PAS CUMULATIFS. On doit inscrire le temps donné pour l'opération qui prend le plus de temps.

REMARQUE: Le *Barème de temps à taux fixe* a été préparé par des mécaniciens compétents utilisant les outils que l'on retrouve normalement dans les ateliers de réparation, en plus de tous les outils spéciaux mentionnés dans le *Manuel de réparation*.

2. COMPILATION

Le *Barème de temps à taux fixe* a été établi en compilant le temps nécessaire pour faire la réparation plus (+) un facteur de correction de 30% lorsqu'un travail dure 3.0 heures et moins, ou (+) 15% lorsqu'un travail dure plus de 3.0 heures. Cette compilation comprends, entre autres les étapes suivantes:

- Manutention du véhicule
- Nettoyage
- Aller chercher les pièces, essais physique
- Compensation spéciale (boulons rouillés)
- Diagnostic.

3. UTILISATION DU BARÈME

Se reporter à la section désirée, repérer la pièce ou l'ensemble de pièces remplacées et inscrire le CODE DE TRAVAIL dans la colonne appropriée sur la formule de réclamation.

SYSTÈME		PAGE
01	MOTEUR	4
02	SYSTÈME DESSENCE	19
03	SYSTÈME D'ALLUMAGE	23
04	DÉMARREUR	25
05	SYSTÈME DE TRANSMISSION	26

SYSTÈME		PAGE
06	SYSTÈME DE FREIN	32
07	SYSTÈME DE DIRECTION ET SUSPENSION AVANT	34
08	SUSPENSION ARRIÈRE ET CHENILLE	39
09	CARROSSERIE	45
10	SYSTÈME ÉLECTRIQUE	58

REMARQUE: Sauf indication contraire, le démontage doit s'effectuer de haut en bas, de l'extérieur vers l'intérieur, de l'avant vers l'arrière.

Toutes les fractions d'heures sont exprimées en dixièmes:

0.1 = 6 minutes
0.2 = 12 minutes, et ainsi de suite

LÉGENDE:

* AUTORISATION REQUISE AVANT LE REMPLACEMENT.
** INSCRIRE LE TEMPS À LA LIGNE «MAIN D'OEUVRE SEULEMENT».
*** INSCRIRE LE MONTANT $$$ À LA LIGNE «OUVRAGE SOUS-CONTRACTÉE».

IMPORTANT: Toujours utiliser le temps donné à l'opération qui nécessite le plus de temps.

4. TRAVAUX REQUIS

Tous les temps mentionnés dans les pages suivantes incluent les opérations telles que: réglage du moteur (valve rotative et allumage), alignement de la ou des bielles, couple de serrage de la ou des culasses ou l'utilisation de barres parallèles, utilisation du vérificateur d'allumage, mesure du jet des pistons/jeu en bout des segments, mesure de l'écart entre le vilebrequin et le carter, rectification du cylindre, vérification de fuite du moteur.

5. ILLUSTRATIONS

Contrairement aux *Catalogues de pièces*, les illustrations de ce manuel ne montrent pas nécessairement chacune des pièces qu'elles représentent, leur raison d'être étant plutôt de faciliter la reconnaissance des pièces reliées à un barème de temps à taux fixe. **Les numéros d'items sur les illustrations correspondent aux quatre derniers chiffres du code de travail.**

6. SUGGESTION DE CHANGEMENT (FORMULAIRE)

2015

LIQUID COOLED 4-STROKE
4 TEMPS REFROIDIS PAR LIQUIDE

TABLE	DESCRIPTION	MODEL MODÈLE	ENGINE MOTEUR	CHASSIS TYPE TYPE DE CHÂSSIS	REVERSE MARCHE ARRIÈRE	REAR SUSPENSION SUSPENSION ARRIÈRE	ELECTRIC STARTER DÉMARREUR ÉLECTRIQUE
19	MXZ Sport 600 ACE	UCFA/UCFB	602 ACE 602 ACE	REV-XP 120″	MEC MEC	SC-5 SC-5	STD STD
	RENEGADE Sport 600 ACE	MCFA/MCFB		REV-XP 137″			
20	GRAND TOURING Sport 600 ACE	ETFA/ETFB	602 ACE	REV-XP 137″	MEC	SC-5	STD
21	EXPEDITION Sport 600 ACE	KCFA	602 ACE	REV-XP 154″	MEC	SC-5U	STD
22	TUNDRA Sport 600 ACE	GMFA	602 ACE 602 ACE	REV-XP 137″	MEC MEC	SC-5	STD STD
	TUNDRA LT 600 ACE	GHFA/GHFB		REV-XU 154″		SC-5U	
23	SKANDIC WT 600 ACE	FHFA/FHFB	602 ACE	REV-XU 154″	MEC	SC-5U	STD

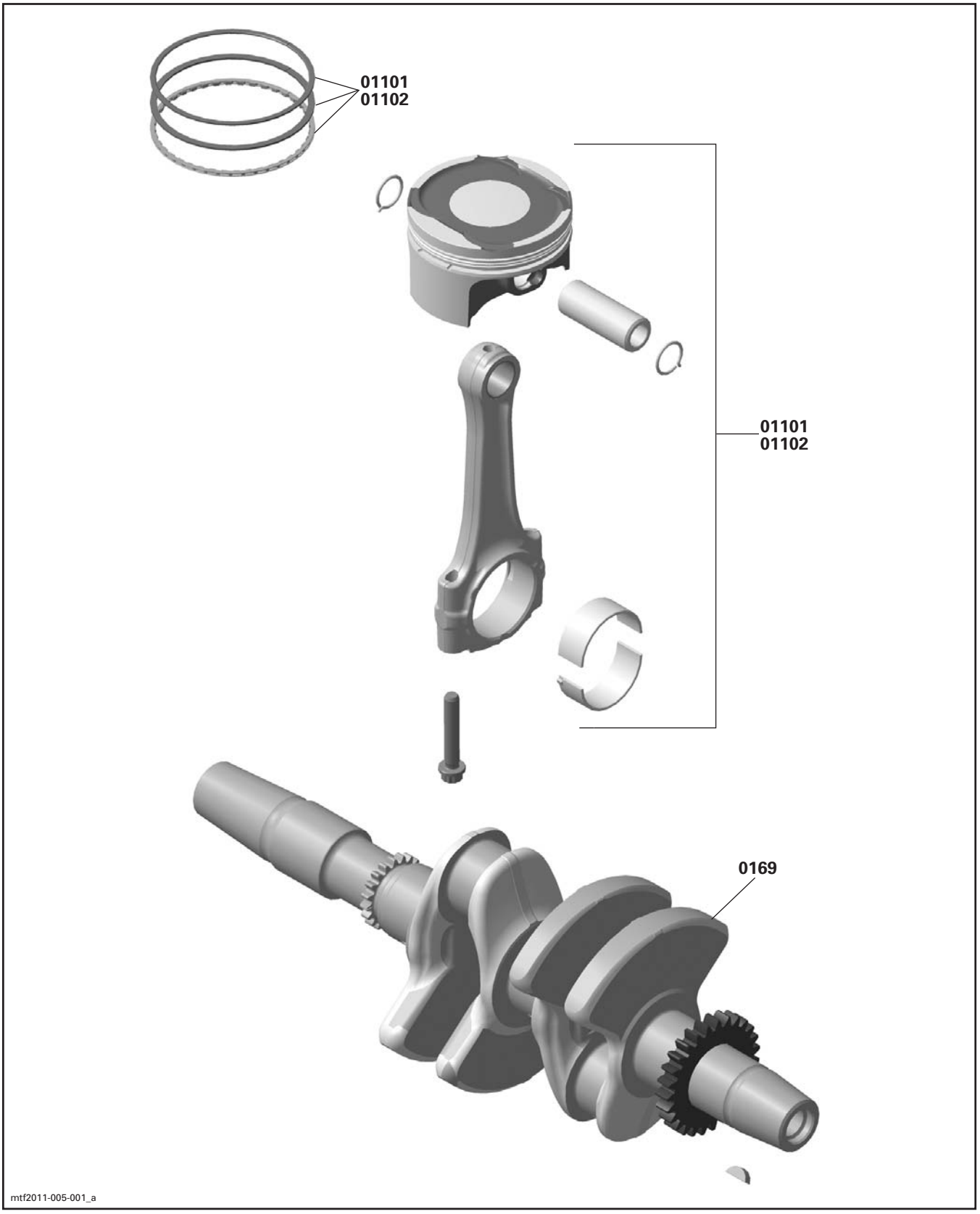
STD: STANDARD

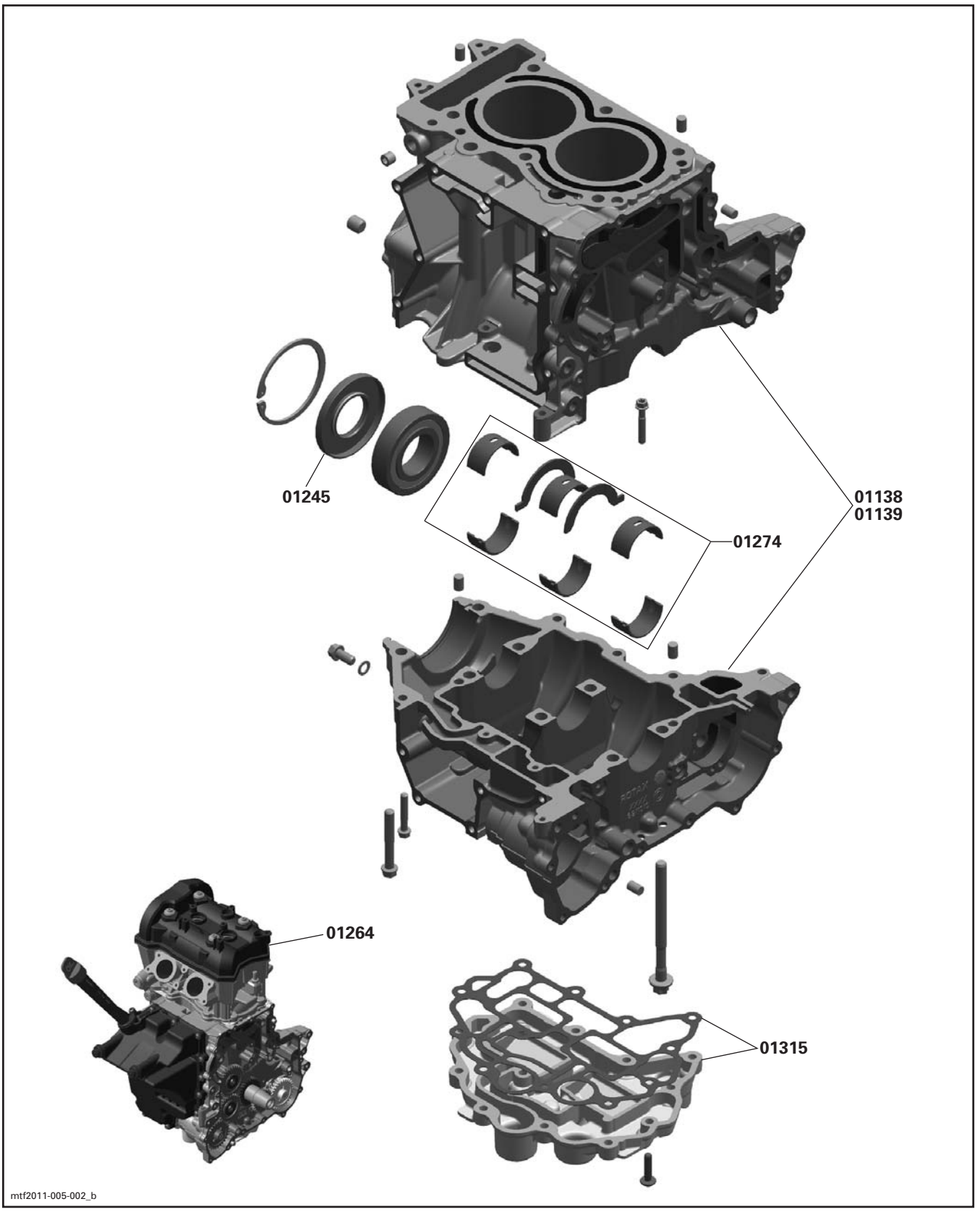
SYSTEM SYSTÈME	CODE	DESCRIPTION	MXZ / RENEGADE 600 ACE	GRAND TOURING 600 ACE	EXPEDITION 600 ACE	TUNDRA 600 ACE	SKANDIC 600 ACE
			19	20	21	22	23
01	**00**	**NO LABOR INVOLVED AUCUNE MAIN-D'OEUVRE IMPLIQUÉE**	**0**	**0**	**0**	**0**	**0**
01*	**01**	**REMOVE AND REPLACE ENGINE (ASS'Y) REMPLACEMENT MOTEUR (COMPLET)**	**3.5**	**3.5**	**3.5**	**3.5**	**3.5**
01	03	OIL PRESSURE SWITCH INTERRUPTEUR DE PRESSION D'HUILE	0.3	0.3	0.3	0.3	0.3
01	07	AIR DUCT CONDUIT D'AIR				0.3	
01	08	FAN VENTILATEUR		0.3	0.3	0.4	0.3
01	18	COOLANT TEMPERATURE SENDER CAPTEUR DE TEMPÉRATURE LIQUIDE DE REFROIDISSEMENT	0.4	0.4	0.4	0.4	0.4
01	19	THERMOSTAT THERMOSTAT	0.6	0.6	0.6	0.6	0.6
01	38	WATER PUMP SHAFT (ALL PARTS) ARBRE DE LA POMPE À EAU (TOUTES LES PIÈCES)	2.7	2.7	2.7	3.0	2.7
01	39	OIL TANK RÉSERVOIR D'HUILE	3.8	3.8	3.8	3.8	3.8
01	46	RADIATOR AND/OR GROMMET RADIATEUR ET/OU PASSE FILS		0.6	0.6	0.6	0.6
01	51	CYLINDER HEAD GASKET JOINT DE CULASSE	4.3	4.3	4.3	4.3	4.3
01	69	CRANKSHAFT VILEBREQUIN	7.0	7.0	7.0	7.0	7.0
01	75	MUFFLER AND/OR EXHAUST GROMMET/SUPPORT SILENCIEUX ET/OU BAGUE D'ÉCHAPPEMENT/SUPPORT	0.3	0.3	0.3	0.3	0.3
01	79	COOLANT HOSE (TANK TO ENGINE) BOYAU SYSTÈME DE REFROIDISSEMENT (RÉSERVOIR AU MOTEUR)	1.0	1.0	1.0	1.0	1.0
01	83	EXHAUST MANIFOLD (FRONT) COLLECTEUR D'ÉCHAPPEMENT (AVANT)	0.4	0.4	0.4	0.4	0.4
01	88	RUBBER MOUNT (MUFFLER) TAMPON D'ANCRAGE (SILENCIEUX)	0.3	0.3	0.3	0.3	0.3
01	90	ENGINE OIL FILTER FILTRE À HUILE DU MOTEUR	0.3	0.3	0.3	0.3	0.3
01	94	REAR RADIATOR RADIATEUR ARRIÈRE	4.3	4.3	4.3	4.3	4.9
01	96	OIL SIEVE CRIBLE D'HUILE	4.2	4.2	4.2	4.2	4.2
01	98	COOLING RESERVOIR RÉSERVOIR D'ANTIGEL	0.4	0.4	0.4	0.4	0.4
01	100	RADIATOR OUTLET HOSE BOYAU DE SORTIE DU RADIATEUR	0.6	0.6	0.6	0.6	0.6
01	101	PISTON, PIN, CIRCLIP, RING (1) PISTON, AXE, FREIN D'AXE, SEGMENT (1)	6.0	6.0	6.0	6.0	6.0

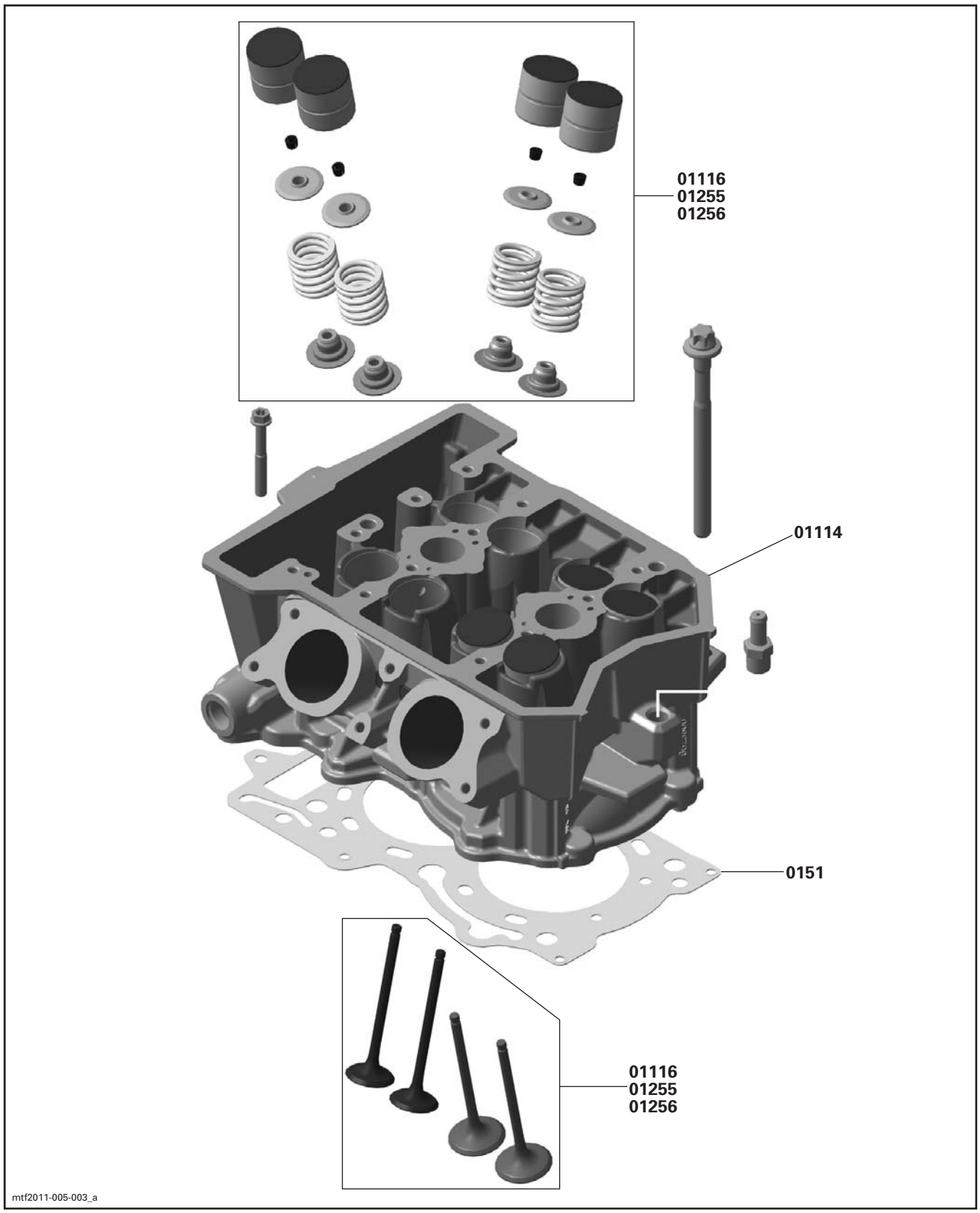
SYSTEM SYSTÈME	CODE	DESCRIPTION	MXZ / RENEGADE 600 ACE	GRAND TOURING 600 ACE	EXPEDITION 600 ACE	TUNDRA 600 ACE	SKANDIC 600 ACE
			19	20	21	22	23
01	102	PISTONS, PINS, CIRCLIPS, RINGS (2) PISTONS, AXES, FREINS D'AXE, SEGMENTS (2)	6.1	6.1	6.1	6.1	6.1
01	109	VALVE COVER AND/OR GASKET COUVERCLE DE SOUPAPE ET/OU JOINT D'ÉTANCHÉITÉ	0.5	0.5	0.5	0.5	0.5
01	111	TIMING GEARS ENGRENAGES DE LA DISTRIBUTION	1.4	1.4	1.4	1.4	1.4
01	114	CYLINDER HEAD AND/OR GASKET CULASSE ET/OU JOINT D'ÉTANCHÉITÉ	3.5	3.5	3.5	3.5	3.5
01	116	EXHAUST AND/OR INLET VALVE AND/OR SPRING AND/OR SEAL VALVE D'ADMISSION ET/OU D'ÉCHAPPEMENT ET/OU RESSORT ET/OU ANNEAU D'ÉTANCHÉITÉ	3.0	3.0	3.0	3.0	3.0
01	119	WATER PUMP HOUSING AND/OR IMPELLER CARTER DE POMPE À EAU ET/OU ROUE AILETTES	0.8	0.8	0.8	0.8	0.8
01	132	OIL PUMP GEAR ENGRENAGE DE LA POMPE À HUILE	3.0	3.0	3.0	3.0	3.0
01	138	CRANKCASE RESEAL AND/OR GASKET RESCELLEMENT CARTER ET/OU JOINT D'ÉTANCHÉITÉ	5.0	5.0	5.0	5.0	5.0
01	139	CRANKCASE REPLACEMENT REMPLACEMENT DU CARTER	6.3	6.3	6.3	6.3	6.3
01	146	OIL PUMP GEAR (2) ENGRENAGE POMPE À L'HUILE (2)	3.0	3.0	3.0	3.0	3.0
01	154	TIMING CHAIN (PTO SIDE) CHAÎNE D'ENGRENAGE (CÔTÉ PDM)	5.8	5.8	5.8	5.8	5.8
01	179	CHAIN GUIDE GUIDE DE CHAÎNE	1.2	1.2	1.2	1.2	1.2
01	182	OIL RADIATOR AND/OR O-RING RADIATEUR D'HUILE ET/OU JOINT	0.5	0.5	0.5	0.5	0.5
01	183	OIL PUMP COVER AND/OR SHAFT AND/OR ROTOR COUVERCLE POMPE ET/OU ARBRE ET/OU ROTOR	3.2	3.2	3.2	3.2	3.2
01	184	OIL PUMP HOUSING AND/OR ALL PARTS BOÎTIER POMPE HUILE ET/OU TOUTES LES PIÈCES	3.2	3.2	3.2	3.2	3.2
01	191	CHAIN TENSION GUIDE GUIDE DE TENSION DE CHAÎNE	5.0	5.0	5.0	5.0	5.0
01	192	CHAIN TENSIONER (ASS'Y) TENDEUR DE CHAÎNE (COMPLET)	0.4	0.4	0.4	0.4	0.4
01	200	WATER PUMP GEAR ENGRENAGE POMPE À EAU	3.0	3.0	3.0	3.0	3.0
01	206	COOLANT HOSE (REAR RADIATOR TO FRONT RADIATOR) BOYAU REFROIDISSEMENT (RADIATEUR ARRIÈRE AU RADIATEUR AVANT)	1.1	1.1	1.1	1.1	1.3
01	207	COOLANT HOSE (ENGINE TO REAR RADIATOR) BOYAU DE REFROIDISSEMENT (MOTEUR AU RADIATEUR ARRIÈRE)	1.1	1.1	1.1	1.1	1.3
01	215	OIL DIPSTICK JAUGE À L'HUILE	0.3	0.3	0.3	0.3	0.3
01	216	PRESSURE CAP BOUCHON DU RADIATEUR	0.3	0.3	0.3	0.3	0.3

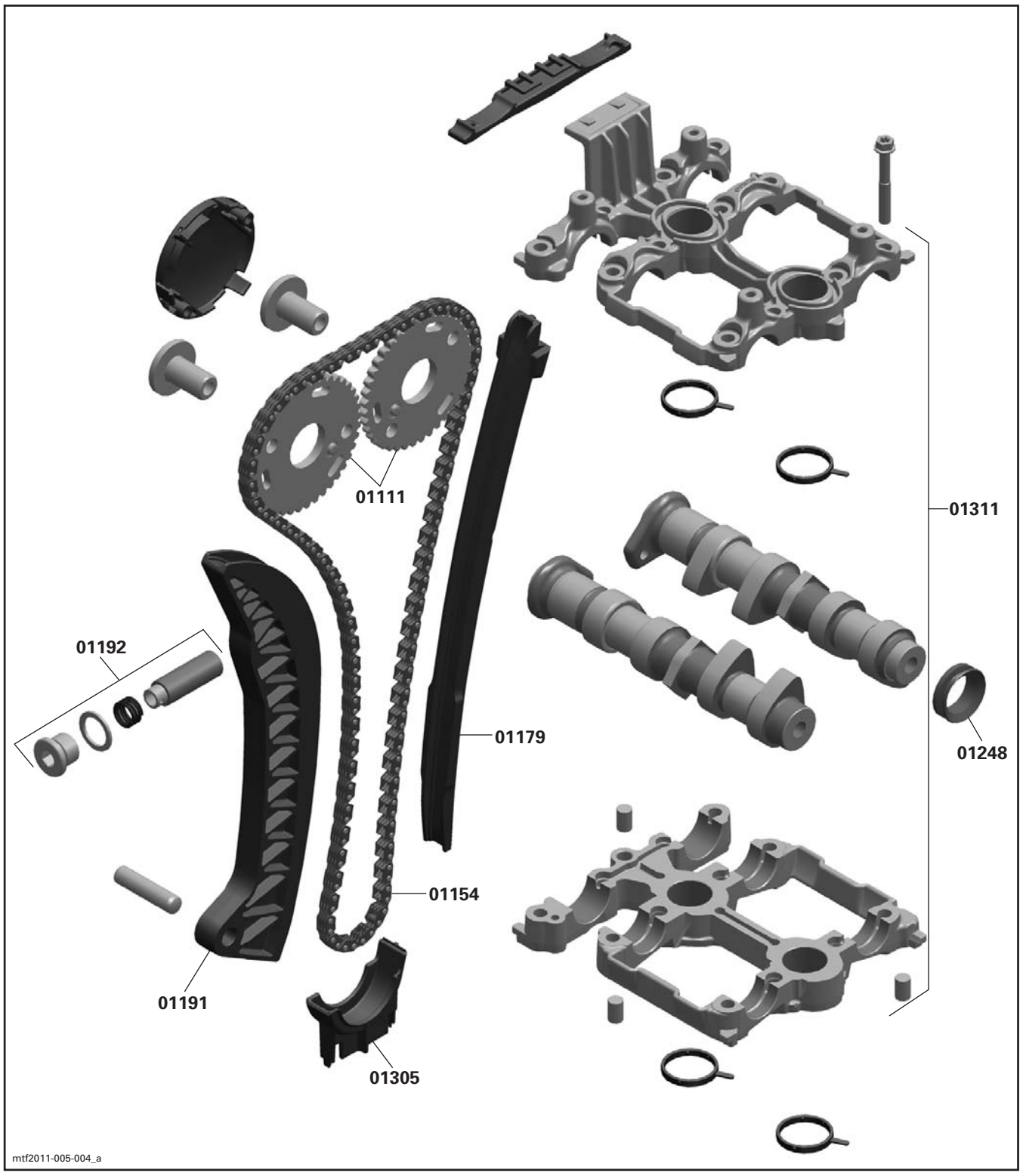
SYSTEM SYSTÈME	CODE	DESCRIPTION	MXZ / RENEGADE 600 ACE	GRAND TOURING 600 ACE	EXPEDITION 600 ACE	TUNDRA 600 ACE	SKANDIC 600 ACE
			19	20	21	22	23
01	245	OUTPUT CRANKSHAFT SEAL (PTO SIDE) ANNEAU D'ÉTANCHÉITÉ SORTIE VILEBREQUIN (CÔTÉ PDM)	0.4	0.4	0.4	0.4	0.4
01	246	WATER PUMP GEARS AND/OR SEAL ENGRENAGES POMPE À EAU ET/OU JOINT D'ÉTANCHÉITÉ	3.0	3.0	3.0	3.0	3.0
01	248	BREATHER GEAR AND/OR V-RING RENIFLARD ET/OU ANNEAU D'ÉTANCHÉITÉ EN V	1.0	1.0	1.0	1.0	1.0
01	250	CRANKSHAFT POSITION SENSOR (CPS) CAPTEUR POSITION DU VILEBREQUIN (CPV)	0.4	0.4	0.4	0.4	0.4
01	255	EXHAUST/INLET VALVES AND/OR SPRINGS AND/OR SEALS (4) VALVES D'ADMISSION/D'ÉCHAPPEMENT ET/OU RESSORTS ET/OU ANNEAUX (4)	3.3	3.3	3.3	3.3	3.3
01	256	EXHAUST/INLET VALVES AND/OR SPRINGS AND/OR SEALS (8) VALVES D'ADMISSION/D'ÉCHAPPEMENT ET/OU RESSORTS ET/OU ANNEAUX (8)	3.5	3.5	3.5	3.5	3.5
01	264	LONG BLOCK ENSEMBLE CARTER-CYLINDRE-CULASSE	5.0	5.0	5.0	5.0	5.0
01	274	CRANKSHAFT PLAIN BEARINGS PALIERS LISSE DU VILEBREQUIN	7.0	7.0	7.0	7.0	7.0
01	289	FRONT ENGINE SUPPORT (PTO SIDE) SUPPORT MOTEUR AVANT (CÔTÉ PDM)	0.6	0.6	0.6	0.6	0.6
01	290	REAR ENGINE SUPPORT (PTO SIDE) SUPPORT MOTEUR ARRIÈRE (CÔTÉ PDM)	0.6	0.6	0.6	0.6	0.6
01	291	FRONT ENGINE SUPPORT (MAG SIDE) SUPPORT MOTEUR AVANT (CÔTÉ MAG)	0.6	0.6	0.6	0.6	0.6
01	292	REAR ENGINE SUPPORT (MAG SIDE) SUPPORT MOTEUR ARRIÈRE (CÔTÉ MAG)	0.6	0.6	0.6	0.6	0.6
01	293	FRONT RUBBER MOUNT (PTO SIDE) TAMPON D'ANCRAGE AVANT (CÔTÉ PDM)	0.6	0.6	0.6	0.6	0.6
01	294	REAR RUBBER MOUNT (PTO SIDE) TAMPON D'ANCRAGE ARRIÈRE (CÔTÉ PDM)	1.0	1.0	1.0	1.0	1.0
01	295	FRONT RUBBER MOUNT (MAG SIDE) TAMPON D'ANCRAGE AVANT (CÔTÉ MAG)	0.6	0.6	0.6	0.6	0.6
01	296	REAR RUBBER MOUNT (MAG SIDE) TAMPON D'ANCRAGE ARRIÈRE (CÔTÉ MAG)	0.8	0.8	0.8	0.8	0.8
01	311	CAMSHAFT INTAKE/EXHAUST AND/OR CAMSHAFT BRACKETS ARBRE À CAME D'ADMISSION/ÉCHAPPEMENT ET/OU SUPPORTS D'ARBRE À CAME	2.0	2.0	2.0	2.0	2.0
01	315	OIL SUMP COVER AND GASKET COUVERCLE DU CARTER D'HUILE ET JOINT D'ÉTANCHÉITÉ	3.9	3.9	3.9	3.9	3.9
01	318	RADIATOR SUPPORT SUPPORT DE RADIATEUR				0.3	0.3
01	321	MODULE SUPPORT SUPPORT DU MODULE	1.3	1.3	1.3	1.3	1.3
01	322	WATER PIPE TUYAU D'EAU		0.4	0.4	0.4	0.4

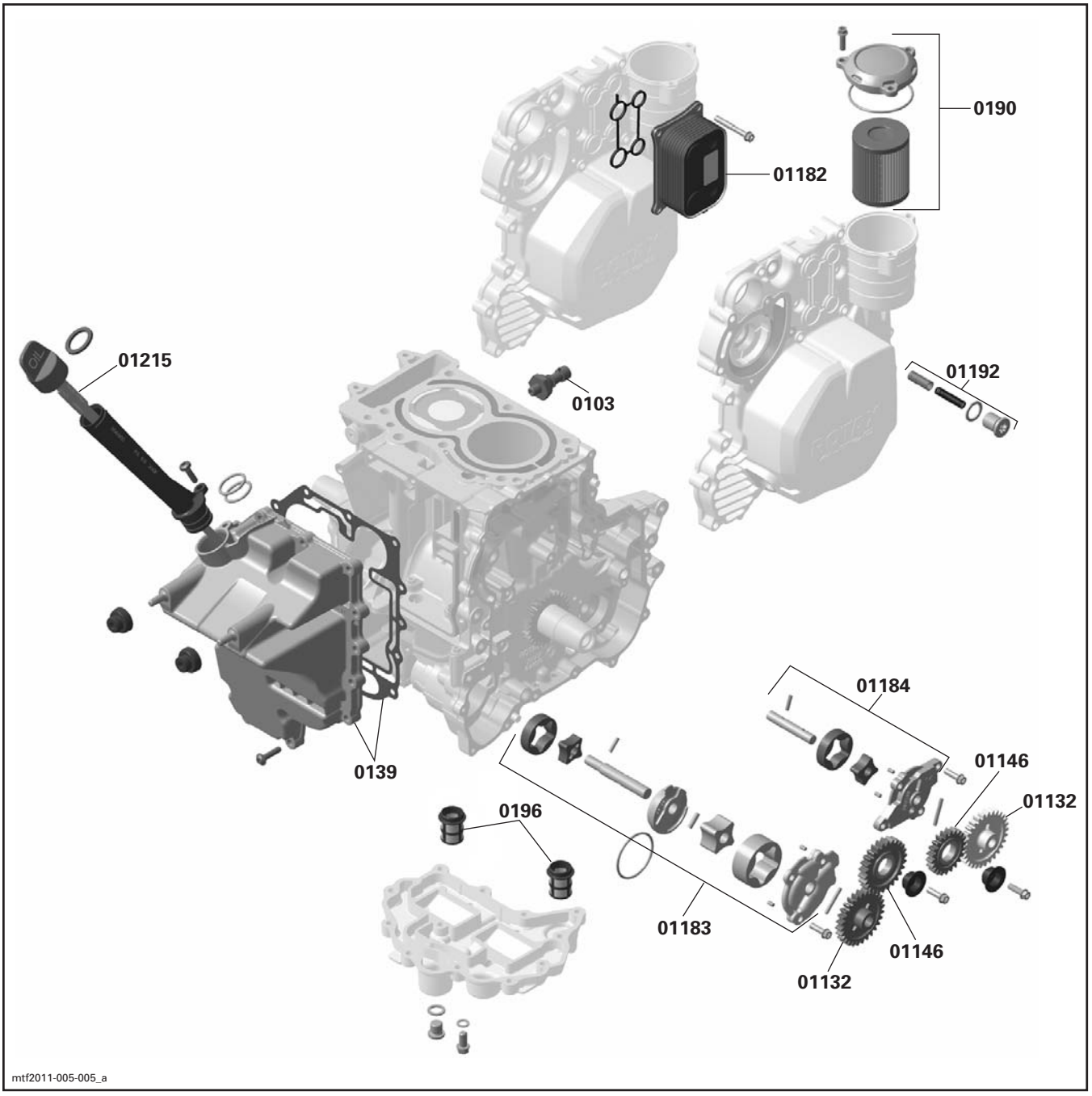
SYSTEM SYSTÈME	CODE	DESCRIPTION	MXZ / RENEGADE 600 ACE	GRAND TOURING 600 ACE	EXPEDITION 600 ACE	TUNDRA 600 ACE	SKANDIC 600 ACE
			19	20	21	22	23
01	323	WATER PIPE DOUBLE TUYAU D'EAU DOUBLE		0.6	0.6	0.6	0.6
01	324	FAN SUPPORT SUPPORT DU VENTILATEUR		0.5	0.5		
01	325	COOLANT HOSE (WATER PUMP HOUSING TO RADIATOR) BOYAU DE REFROIDISSEMENT (BOÎTIER DE LA POMPE À EAU AU RADIATEUR)	0.6	0.6	0.6	0.6	0.6
01	326	EXHAUST MANIFOLDS (FRONT) (2) COLLECTEURS D'ÉCHAPPEMENT (AVANT) (2)	0.5	0.5	0.5	0.5	0.5
01	327	EXHAUST PIPE (MAG) TUYAU D'ÉCHAPPEMENT (MAG)	0.3	0.3	0.3	0.3	0.3
01	328	EXHAUST PIPE (PTO) TUYAU D'ÉCHAPPEMENT (PDM)	0.3	0.3	0.3	0.3	0.3
01	353	INJECTOR (ONE OR ALL) INJECTEUR (UN OU TOUS)	0.8	0.8	0.8	0.8	0.8

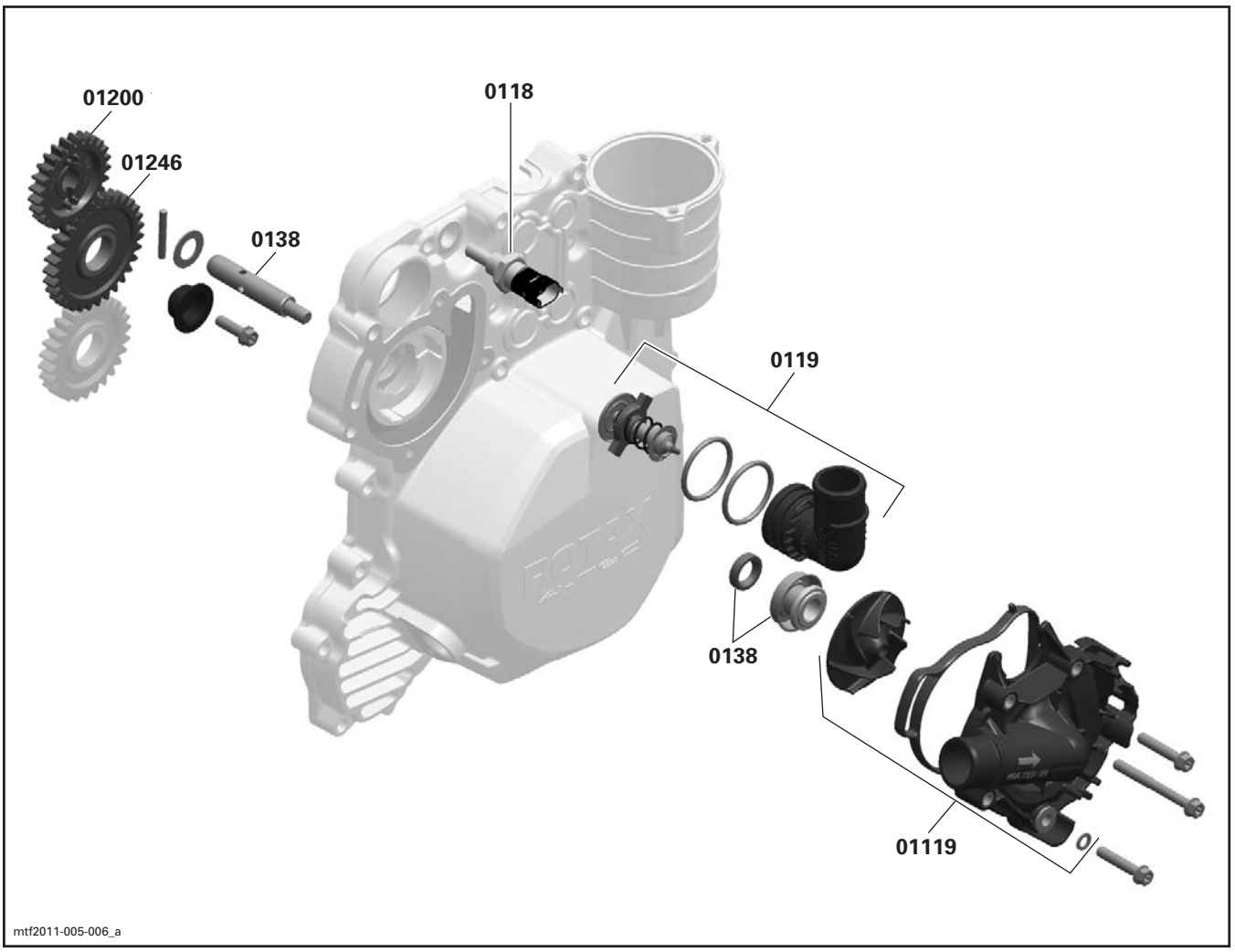

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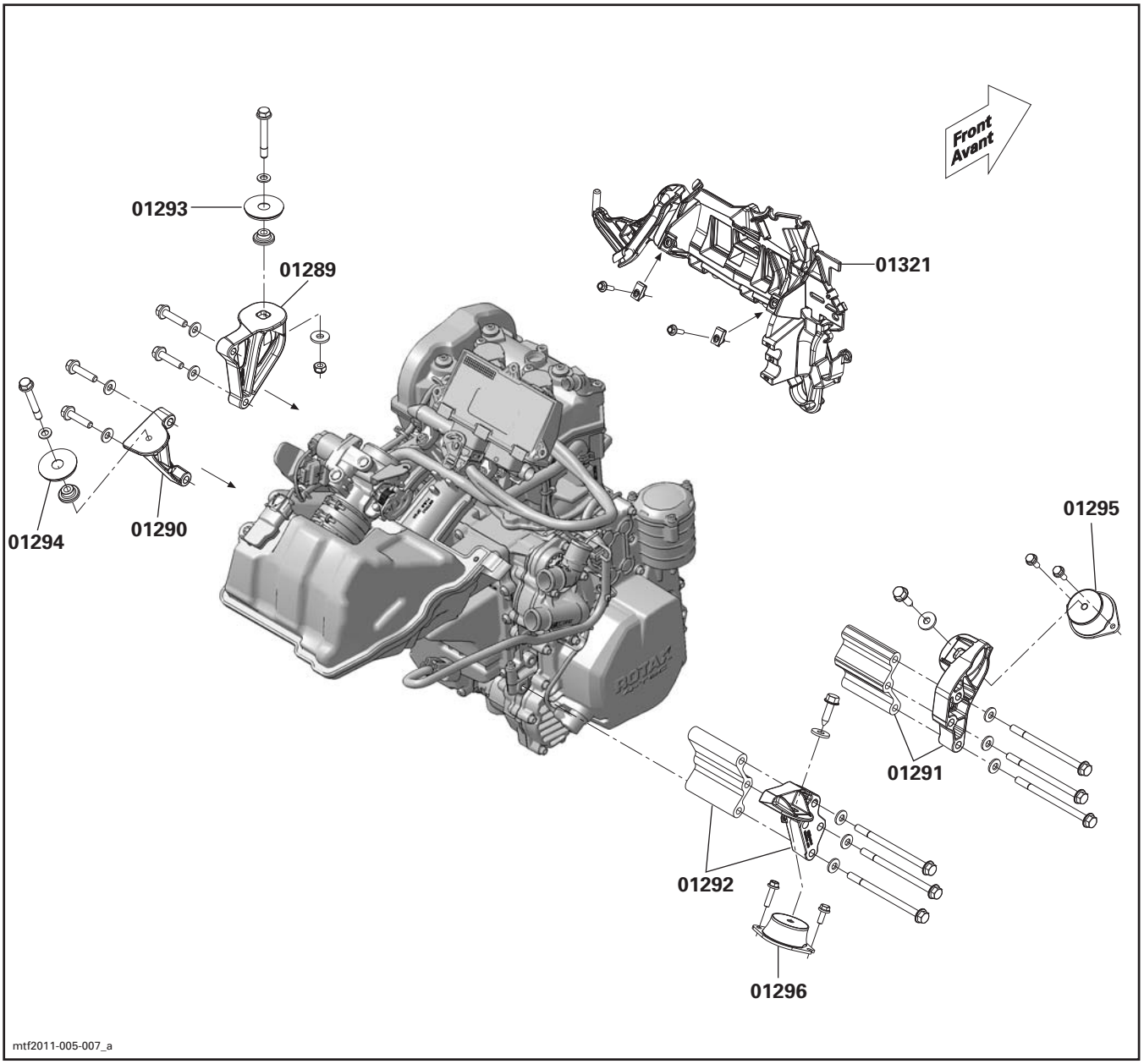

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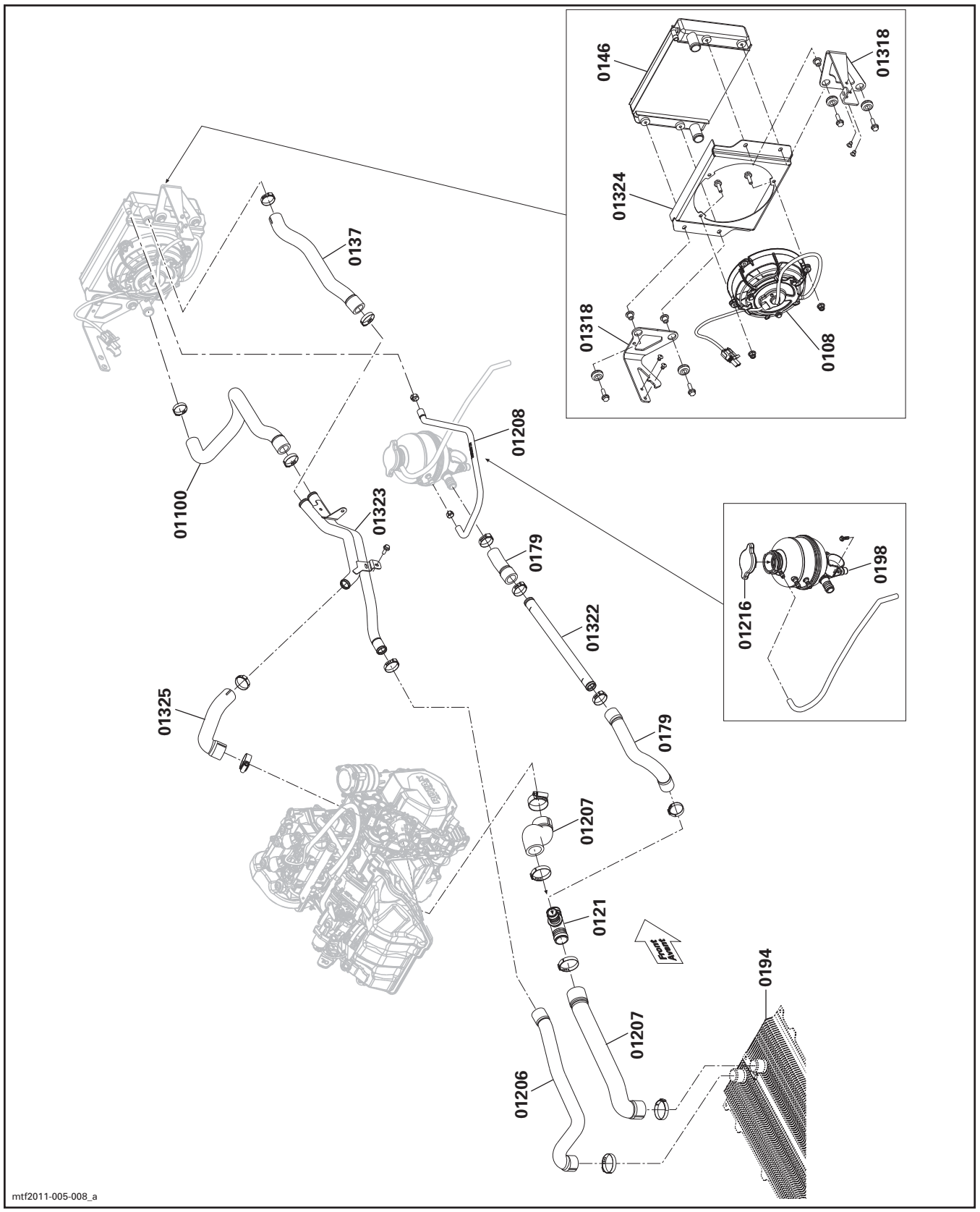

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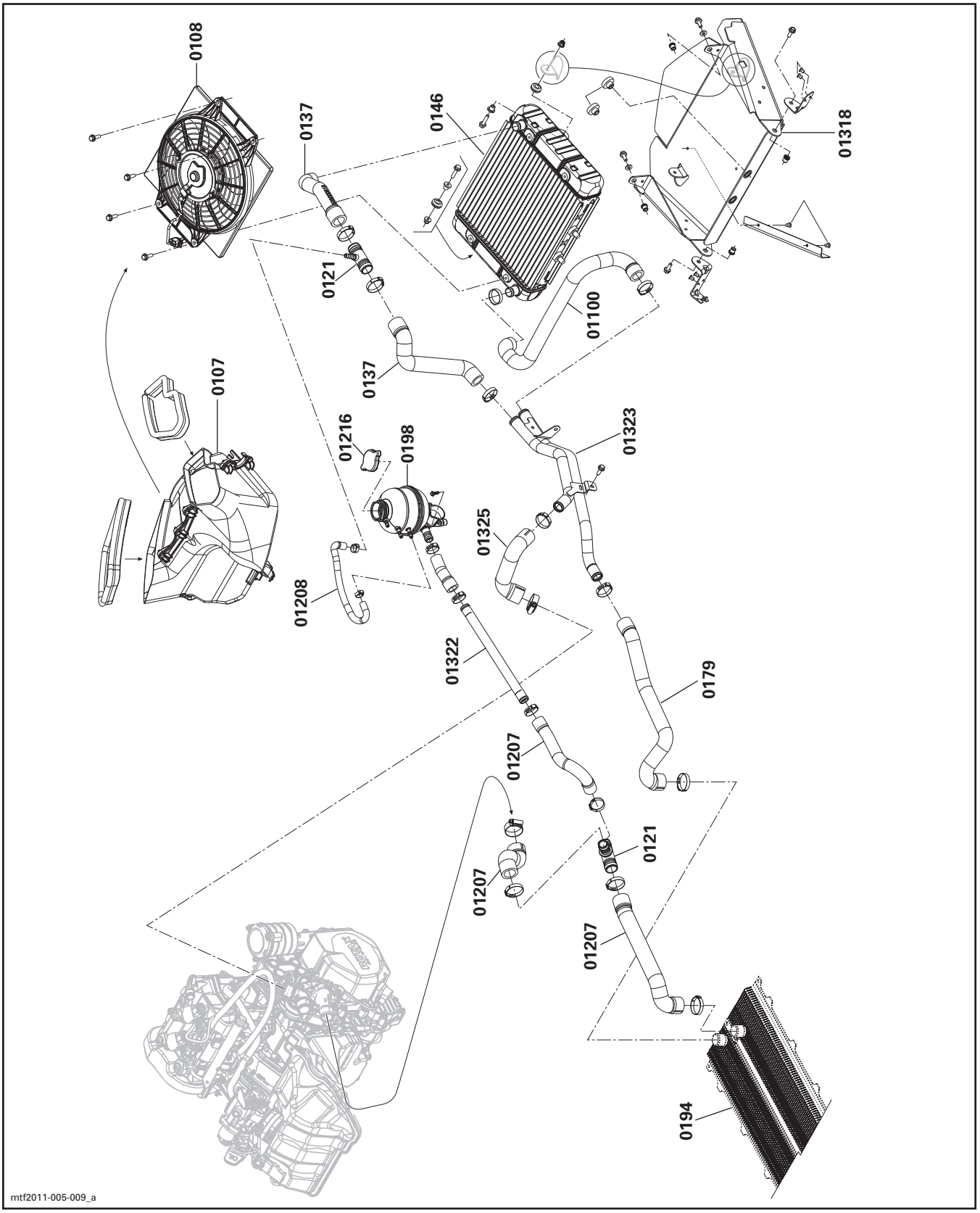

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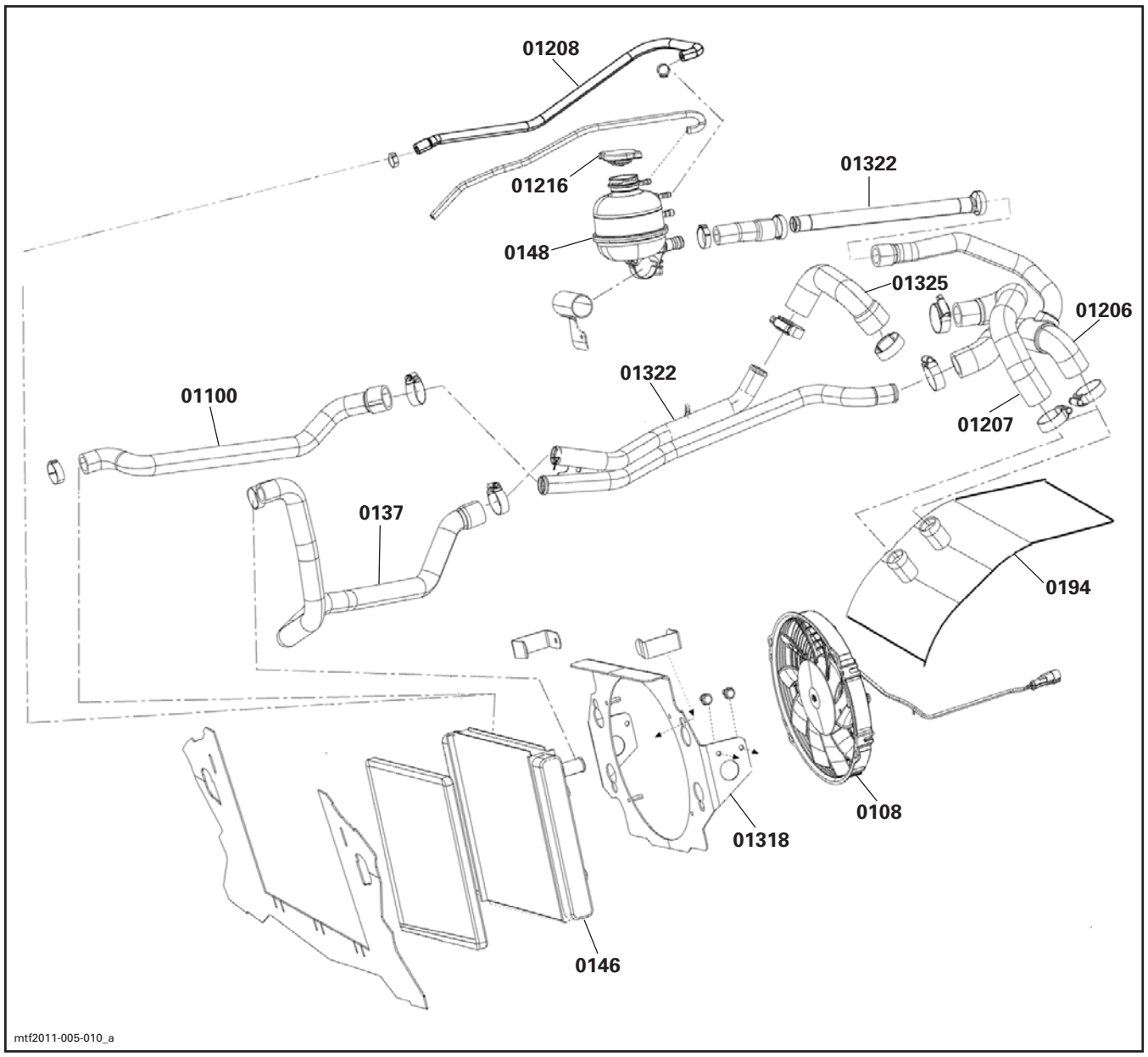

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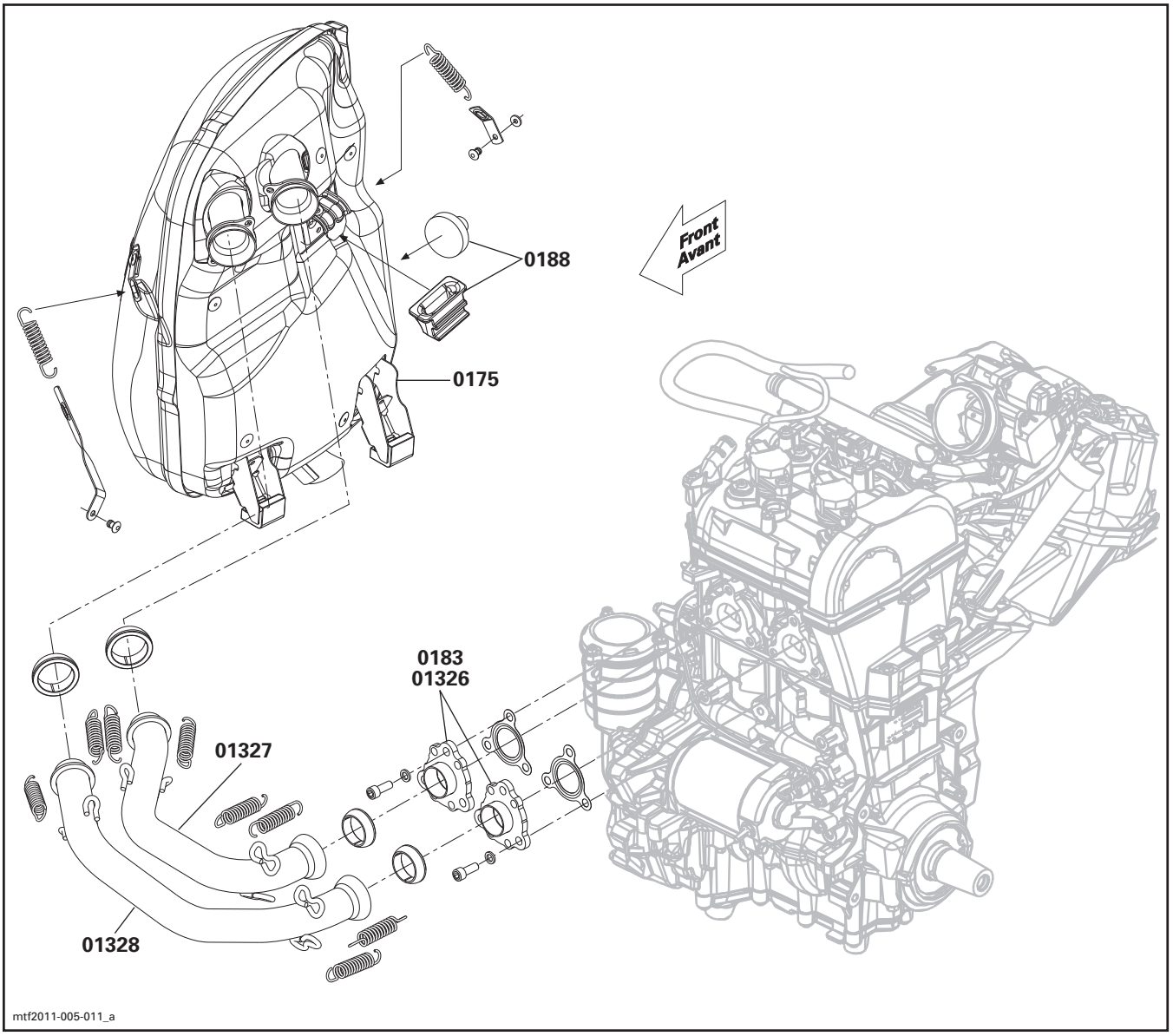

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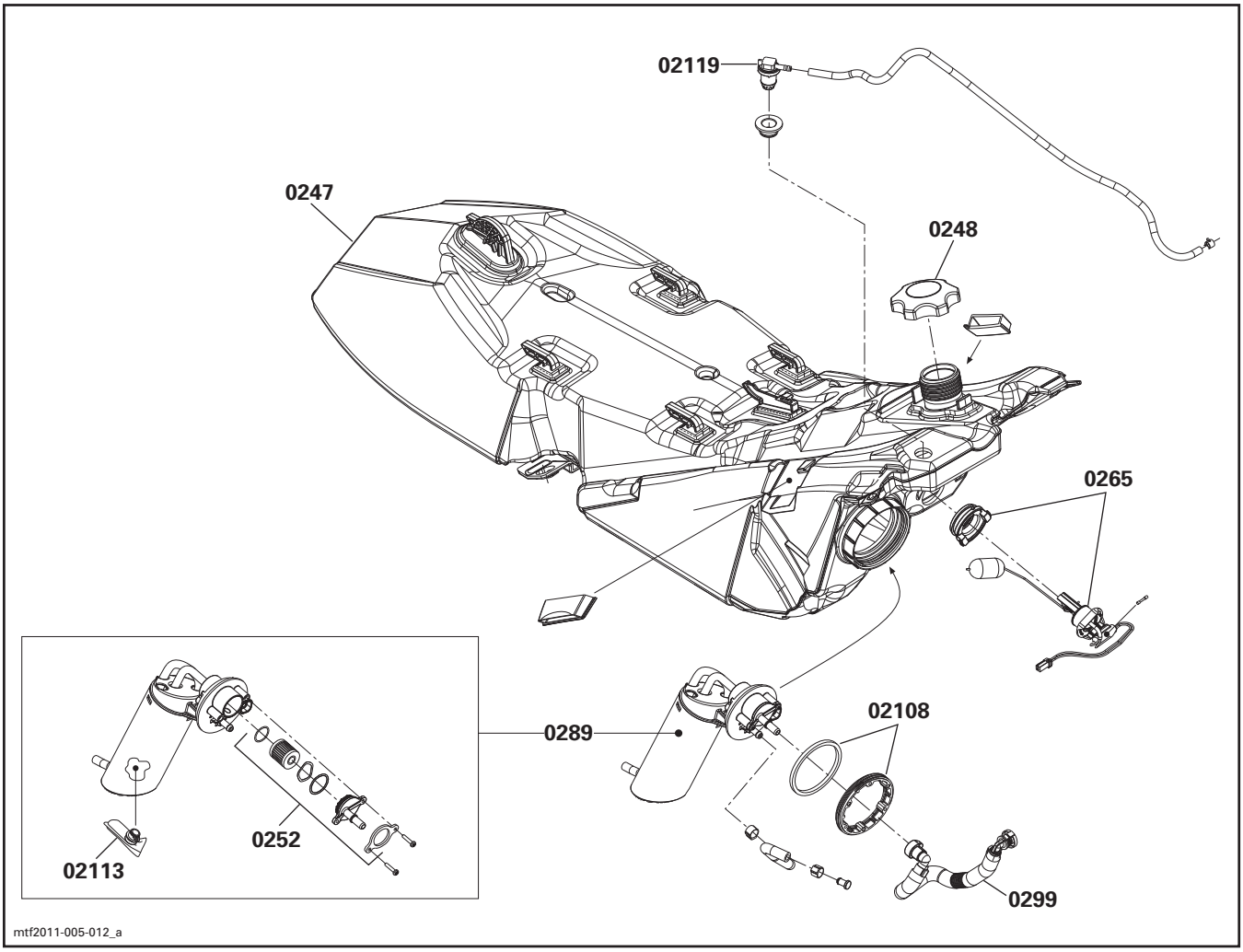

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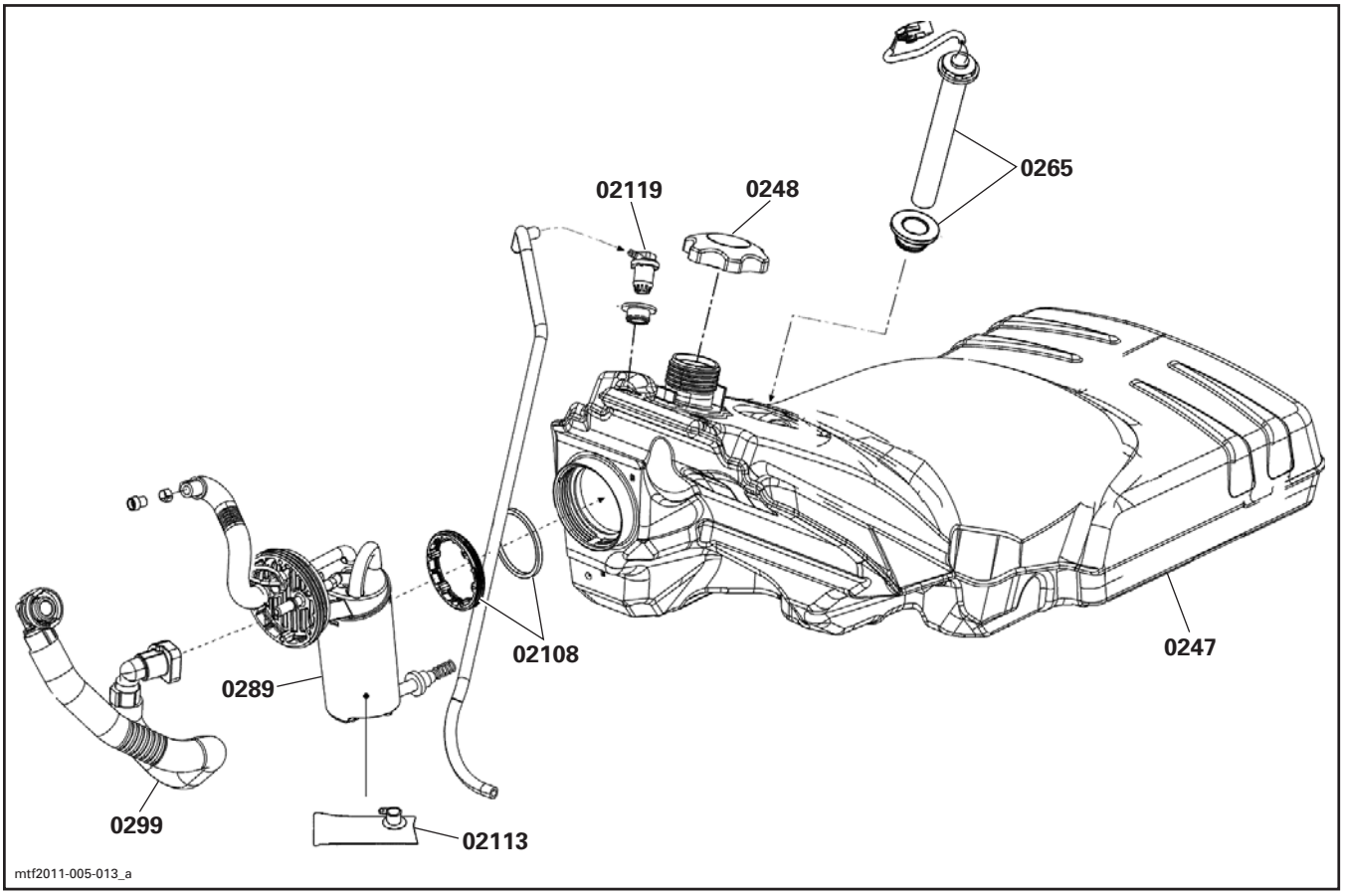

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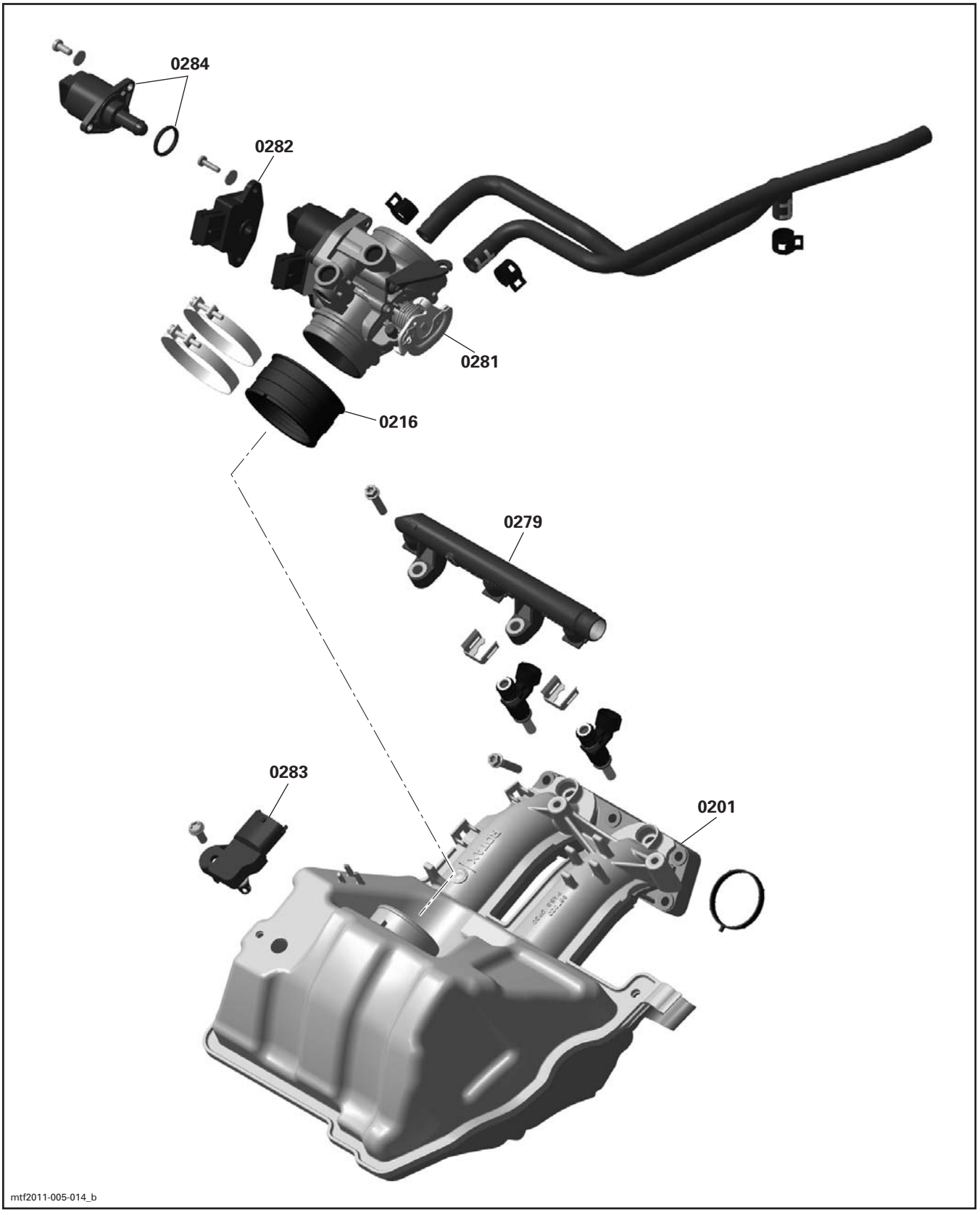

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SYSTEM SYSTÈME	CODE	DESCRIPTION	MXZ / RENEGADE 600 ACE	GRAND TOURING 600 ACE	EXPEDITION 600 ACE	TUNDRA 600 ACE	SKANDIC 600 ACE
			19	20	21	22	23
02	**00**	**NO LABOR INVOLVED** **AUCUNE MAIN-D'OEUVRE IMPLIQUÉE**	**0**	**0**	**0**	**0**	**0**
02	01	AIR SILENCER (ASS'Y) (ALL PARTS) SILENCIEUX D'ADMISSION (COMPLET) (TOUTES LES PIÈCES)	1.5	1.5	1.5	1.5	1.5
02	06	THROTTLE CABLE CÂBLE D'ACCÉLÉRATEUR	0.8	0.8	0.8	0.8	0.8
02	16	INTAKE ADAPTOR ADAPTATEUR D'ADMISSION	0.4	0.4	0.4	0.4	0.4
02	19	AIR INTAKE TUBE TUYAU D'ADMISSION D'AIR	0.3	0.3	0.3	0.3	0.3
02	47	FUEL TANK RÉSERVOIR À ESSENCE	1.5	1.5	1.5	1.5	1.5
02	48	FUEL TANK CAP BOUCHON DU RÉSERVOIR À ESSENCE	0.3	0.3	0.3	0.3	0.3
02	50	THROTTLE HANDLE HOUSING LOGEMENT MANETTE ACCÉLÉRATEUR	0.3	0.3	0.3	0.3	0.3
02	52	FUEL FILTER FILTRE À ESSENCE	1.2	1.2	1.2	1.2	1.2
02	65	FUEL SENSOR (ASS'Y) CAPTEUR DE NIVEAU D'ESSENCE (COMPLET)	0.8	0.8	0.8	0.8	0.8
02	79	FUEL RAIL RAMPE D'ESSENCE	0.8	0.8	0.8	0.8	0.8
02	81	THROTTLE BODY (ASS'Y) CARTER ACCÉLÉRATEUR (COMPLET)	0.8	0.8	0.8	0.8	0.8
02	82	THROTTLE SENSOR CAPTEUR POSITION ACCÉLÉRATEUR	0.3	0.3	0.3	0.3	0.3
02	83	AIR PRESSURE SENSOR CAPTEUR PRESSION D'AIR	0.3	0.3	0.3	0.3	0.3
02	84	IDLE BY-PASS-VALVE VALVE DU RALENTI	0.3	0.3	0.3	0.3	0.3
02	89	FUEL PUMP MODULE MODULE POMPE À ESSENCE	1.5	1.5	1.5	1.5	1.5
02	99	FUEL INJECTION HOSE (ASS'Y) BOYAU D'ESSENCE À INJECTION (COMPLET)	1.0	1.0	1.0	1.0	1.0
02	105	SECONDARY CHAMBER (ASS'Y) CHAMBRE SECONDAIRE (COMPLET)	0.4	0.4	0.4	0.4	0.4
02	108	FUEL PUMP NUT AND/OR GASKET ÉCROU DE LA POMPE À ESSENCE ET/OU JOINT D'ÉTANCHÉITÉ	1.5	1.5	1.5	1.5	1.5
02	113	FUEL PUMP INLET FILTER FILTRE INTERNE DE LA POMPE À ESSENCE	1.5	1.5	1.5	1.5	1.5
02	119	CHECK VALVE SOUPAPE À ESSENCE	0.3	0.3	0.3	0.3	0.3

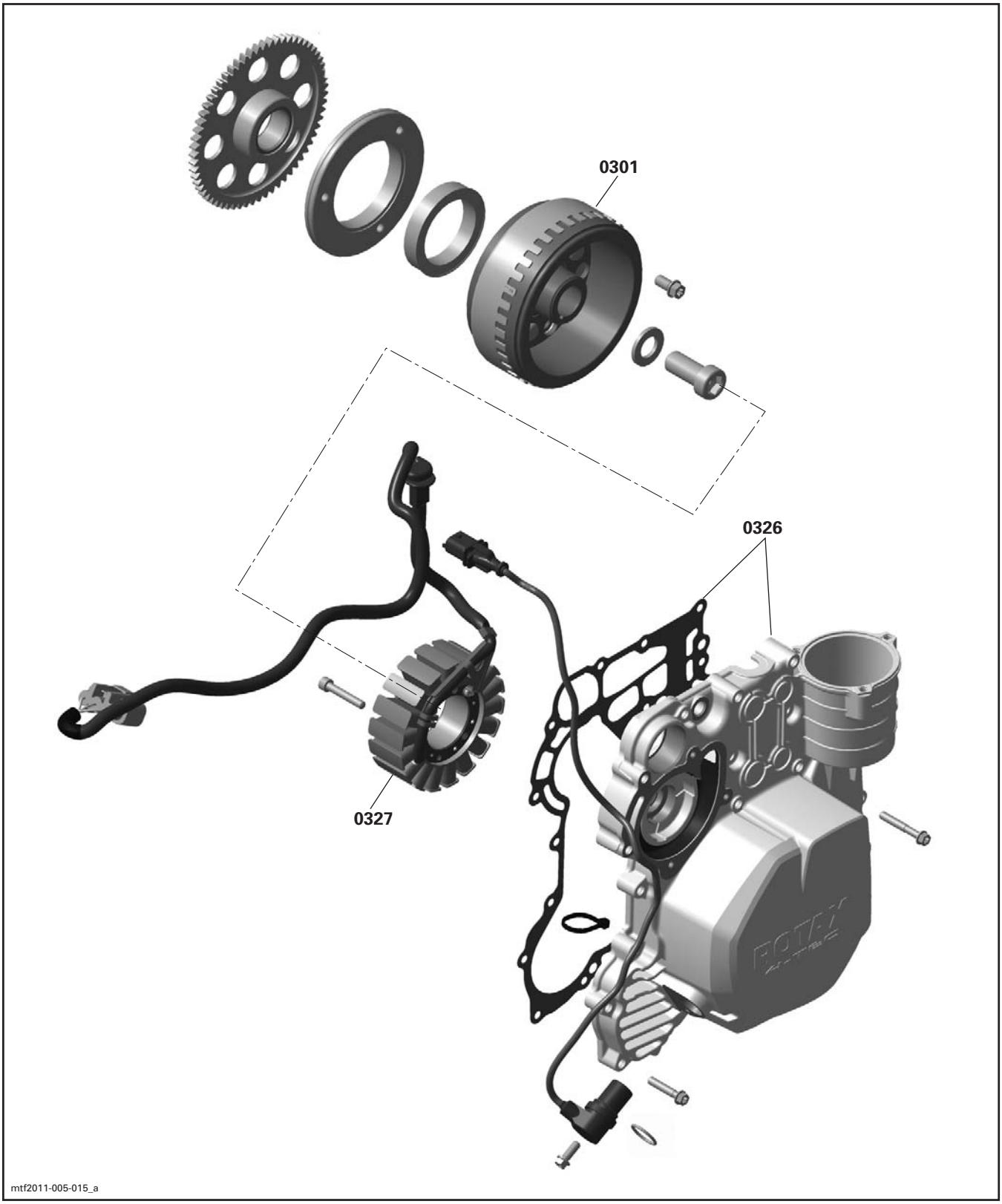

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SYSTEM SYSTÈME	CODE	DESCRIPTION	MXZ / RENEGADE 600 ACE 19	GRAND TOURING 600 ACE 20	EXPEDITION 600 ACE 21	TUNDRA 600 ACE 22	SKANDIC 600 ACE 23
03	**00**	**NO LABOR INVOLVED AUCUNE MAIN-D'OEUVRE IMPLIQUÉE**	**0**	**0**	**0**	**0**	**0**
03	01	FLYWHEEL VOLANT MOTEUR	3.0	3.0	3.0	3.0	3.0
03	08	IGNITION COIL BOBINE D'ALLUMAGE	0.3	0.3	0.3	0.3	0.3
03	26	MAGNETO COVER AND/OR GASKET COUVERCLE DU MAGNÉTO ET/OU JOINT D'ÉTANCHÉITÉ	2.7	2.7	2.7	2.7	2.7
03	27	STATOR (ASS'Y) STATOR (COMPLET)	2.7	2.7	2.7	2.7	2.7

IGNITION SYSTEM
SYSTÈME D'ALLUMAGE



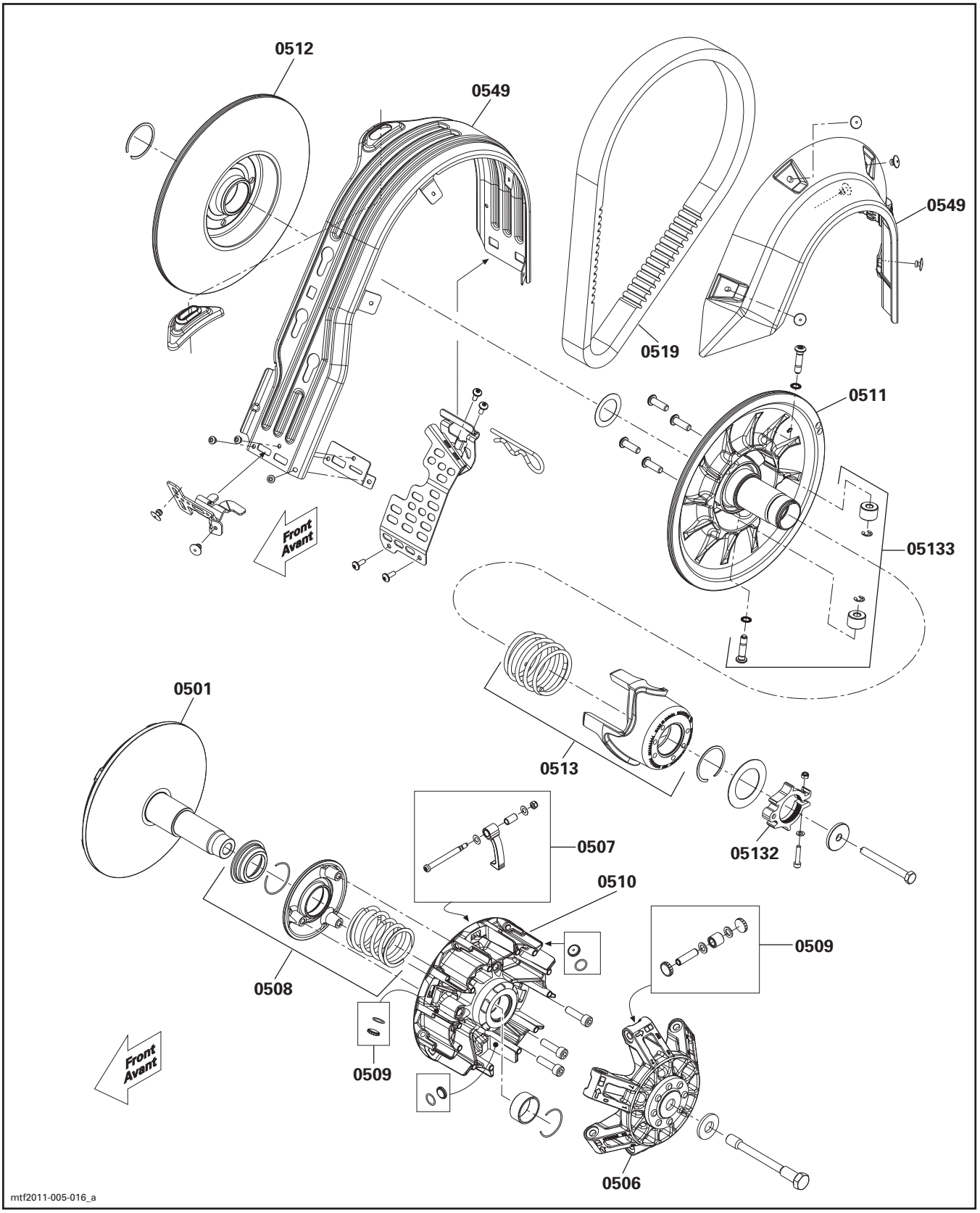
SYSTEM SYSTÈME	CODE	DESCRIPTION	MXZ / RENEGADE 600 ACE	GRAND TOURING 600 ACE	EXPEDITION 600 ACE	TUNDRA 600 ACE	SKANDIC 600 ACE
			19	20	21	22	23
04	**00**	**NO LABOR INVOLVED AUCUNE MAIN-D'OEUVRE IMPLIQUÉE**	**0**	**0**	**0**	**0**	**0**
04	02	ELECTRIC STARTER (ASS'Y) DÉMARREUR ÉLECTRIQUE (COMPLET)	0.3	0.3	0.3	0.4	0.3
04	03	STARTER RELAY SOLÉNOÏDE DE DÉMARREUR	0.3	0.3	0.3	0.3	0.3
04	19	STARTER DRIVE LANCEUR DÉMARREUR	3.0	3.0	3.0	3.0	3.0

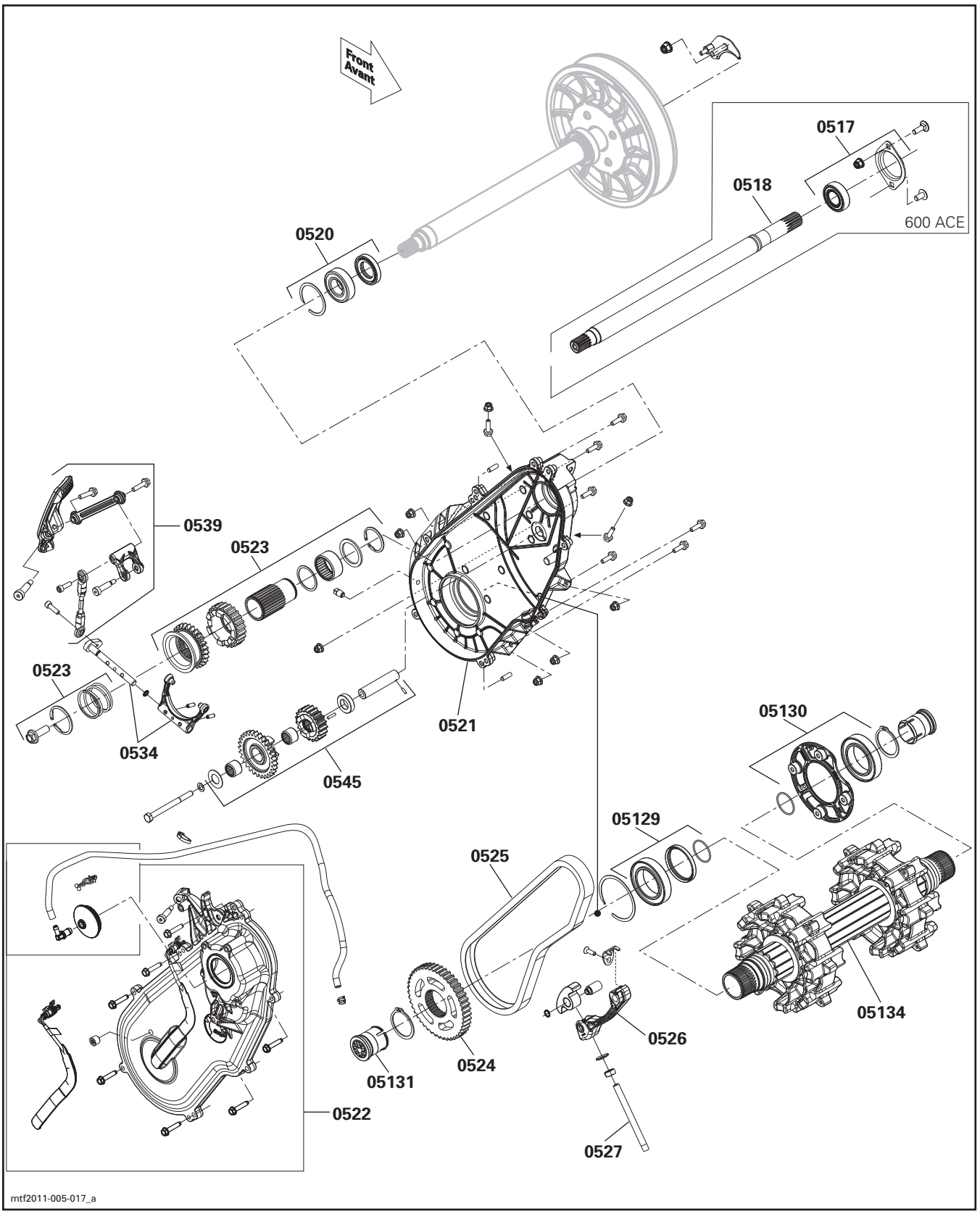
TRANSMISSION SYSTEM
SYSTÈME DE TRANSMISSION

SYSTEM SYSTÈME	CODE	DESCRIPTION	MXZ / RENEGADE 600 ACE	GRAND TOURING 600 ACE	EXPEDITION 600 ACE	TUNDRA 600 ACE	SKANDIC 600 ACE
			19	20	21	22	23
05	00	**NO LABOR INVOLVED AUCUNE MAIN-D'OEUVRE IMPLIQUÉE**	0	0	0	0	0
05	01	DRIVE PULLEY (ASS'Y) OR SLIDDING FLANGE POULIE MOTRICE (COMPLET) OU FLASQUE COULISSANTE	0.3	0.3	0.3	0.3	0.3
05	06	GOVERNOR CUP AND/OR FIXED HALF CUVETTE DE RÉGULATEUR ET/OU PARTIE FIXE	0.3	0.3	0.3	0.3	0.3
05	07	RAMPS AND/OR ADJUSTMENT SCREW RAMPES ET/OU VIS DE RÉGLAGE DE POULIE	0.5	0.5	0.5	0.5	0.5
05	08	SPRING COVER AND/OR SPRING AND/OR BUSHING COUVERCLE DU RESSORT ET/OU RESSORT ET/OU DOUILLE	0.5	0.5	0.5	0.5	0.5
05	09	SLIDER SHOES AND/OR SPRINGS GLISSIÈRE ET/OU RESSORTS	0.3	0.3	0.3	0.3	0.3
05	10	SLIDING HALF, BUSHING AND/OR LEVER (ASS'Y) DEMI-POULIE COULISSANTE, DOUILLE ET/OU LEVIER (COMPLET)	0.8	0.8	0.8	0.8	0.8
05	11	DRIVEN PULLEY FIXED HALF DEMI-POULIE MENÉE FIXE	0.7	0.7	0.7	0.7	0.7
05	12	DRIVEN PULLEY SLIDING HALF DEMI-POULIE MENÉE COULISSANTE	0.5	0.5	0.5	0.5	0.5
05	13	DRIVEN PULLEY CAM AND/OR SPRING CAME ET/OU RESSORT DE POULIE MENÉE	0.6	0.6	0.6	0.6	0.6
05	17	COUNTERSHAFT BALL BEARING AND/OR FLANGE ROULEMENT À BILLE DE L'ARBRE DE RENVOI ET/OU FLASQUE	1.0	1.0	1.0	1.0	1.0
05	18	COUNTERSHAFT ARBRE DE RENVOI	1.0	1.0	1.0	1.0	3.0
05	19	DRIVE BELT AND/OR BELT GUARD COURROIE D'ENTRAÎNEMENT ET/OU GARDE-COURROIE	0.1	0.1	0.1	0.1	0.1
05	20	CHAINCASE SEAL AND/OR BEARING ANNEAU D'ÉTANCHÉITÉ DE CARTER ET/OU ROULEMENT	1.3	1.3	1.3	1.3	
05	21	CHAINCASE CARTER DE CHAÎNE	3.9	3.9	3.9	3.9	
05	22	CHAINCASE COVER COUVERCLE DE CARTER DE CHAÎNE	1.3	1.3	1.3	1.3	
05	23	CHAINCASE UPPER SPROCKET AND/OR CENTRAL SPROCKET PIGNON SUPÉRIEUR DE CARTER ET/OU PIGNON CENTRAL	1.4	1.4	1.4	1.4	
05	24	CHAINCASE LOWER SPROCKET PIGNON INFÉRIEUR DE CARTER DE CHAÎNE	1.4	1.4	1.4	1.4	
05	25	CHAINCASE DRIVE CHAIN CHAÎNE D'ENTRAÎNEMENT DE CARTER DE CHAÎNE	1.4	1.4	1.4	1.4	
05	26	CHAINCASE TENSIONERS TENDEURS DE CARTER DE CHAÎNE	1.3	1.3	1.3	1.3	
05	27	TENSIONER ADJUSTING SCREW VIS DE RÉGLAGE DE TENDEUR	0.4	0.4	0.4	0.4	
05	34	SLIDING SLEEVE AND/OR FORK AND/OR FORK SHAFT CRABOT ET/OU FOURCHETTE ET /OU ARBRE DE FOURCHETTE	1.4	1.4	1.4	1.4	3.0
05	39	SHIFT LEVER AND/OR SHIFT ROD LEVIER DE TRANSMISSION ET/OU TIGE	0.4	0.4	0.4	0.4	
05	45	REVERSE GEAR WHEEL AND SHAFT ENGRENAGE ET ARBRE DE MARCHE ARRIÈRE	1.4	1.4	1.4	1.4	3.0

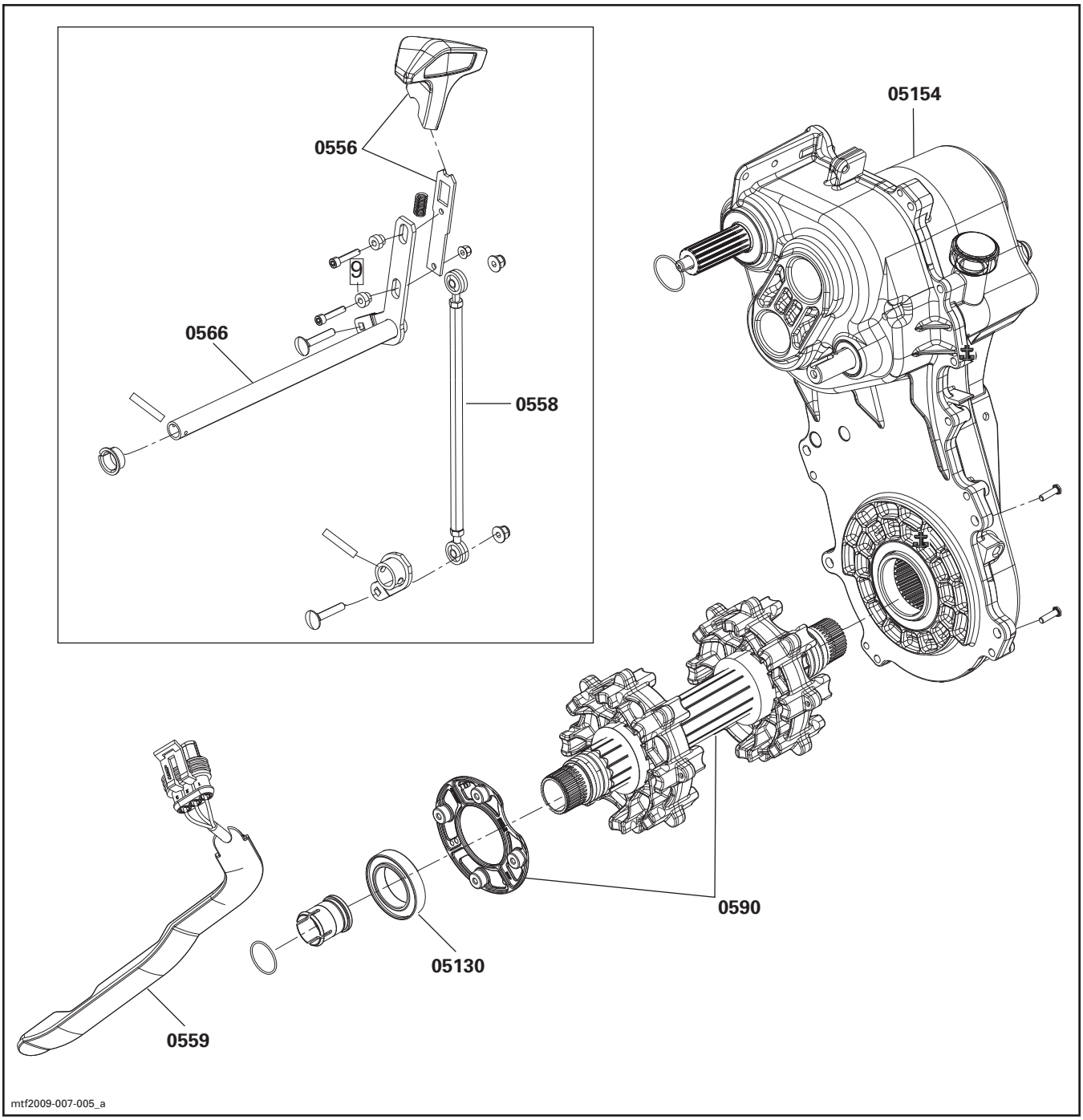
SYSTEM SYSTÈME	CODE	DESCRIPTION	MXZ / RENEGADE 600 ACE	GRAND TOURING 600 ACE	EXPEDITION 600 ACE	TUNDRA 600 ACE	SKANDIC 600 ACE
			19	20	21	22	23
05	49	DRIVE PULLEY GUARD GARDE DE POULIE MOTRICE	0.3	0.3	0.3	0.3	0.3
05	56	LEVER (ASS'Y) AND/OR LEVER SPRING LEVIER (COMPLET) ET/OU RESSORT DE LEVIER					0.3
05	58	TIE ROD AND/OR BALL JOINT BARRE D'ACCOMPAGNEMENT ET/OU JOINT ROTULE					0.6
05	59	SPEED SENSOR CAPTEUR DE VITESSE	1.3	1.3	1.3	1.3	0.9
05	66	GEARSHIFT LEVER LEVIER D'EMBRAYAGE					0.5
05	90	DRIVE AXLE (ASS'Y) AXE D'ENTRAÎNEMENT (COMPLET)					2.0
05	91	MAIN SHAFT (ASS'Y) ARBRE DE RENVOI (COMPLET)					3.0
05	103	SHIFT DRUM TAMBOUR D'EMBRAYAGE					3.0
05	114	SHIFT SHAFT SEAL ANNEAU D'ÉTANCHÉITÉ DE L'ARBRE D'EMBRAYAGE					1.0
05	129	CHAINCASE LOWER BEARING AND SEAL (MAG SIDE) ROULEMENT À BILLES INFÉRIEUR DU CARTER DE CHAÎNE ET ANNEAU ÉTANCHE (CÔTÉ MAG)	3.0	3.0	3.0	3.0	
05	130	BEARING HOUSING AND/OR BEARING (PTO SIDE) LOGEMENT DU ROULEMENT À BILLES ET/OU ROULEMENT À BILLES (CÔTÉ PTO)	2.4	2.4	2.4	2.4	2.4
05	131	MAGNETIC CAP CAPUCHON MAGNÉTIQUE	0.7	0.7	0.7	0.7	3.0
05	132	ADJUSTMENT RING (ASS'Y) ANNEAU DE RÉGLAGE (COMPLET)	0.3	0.3	0.3	0.3	0.3
05	133	STUDS AND/OR ROLLERS PIVOTS ET/OU ROULEAUX	0.8	0.8	0.8	0.8	0.8
05	134	DRIVE AXLE (ASS'Y) (WITH BATTERY) AXE D'ENTRAÎNEMENT (COMPLET) (AVEC BATTERIE)	2.4	2.4	2.4	2.4	
05	154	GEARBOX (ASS'Y) BOÎTE DE VITESSE (COMPLET)					0.6
05	155	BUSHINGS, SLIDERS AND ROLLERS (DRIVE PULLEY REPAIR) COUSSINETS, GLISSIÈRES ET ROULEAUX (RÉPARATION DE POULIE MOTRICE)	0.8	0.8	0.8	0.8	0.8
05	156	CAM, SLIDING FLANGE AND ROLLERS (DRIVEN PULLEY REPAIR) CAME, FLASQUE COULISSANTE ET ROULEAUX (RÉPARATION DE POULIE MENÉE)	0.8	0.8	0.8	0.8	0.8
05	158	TRANSMISSION BOTTOM SEAL JOINT D'ÉTANCHÉITÉ INFÉRIEUR DE LA TRANSMISSION					1.0
05	162	MIDDLE GEAR ENGRENAGE DU MILIEU					3.0
05	163	LOWER GEAR ENGRENAGE DU BAS					3.0
05	164	COUNTERSHAFT SEAL ANNEAU D'ÉTANCHÉITÉ DE L'ARBRE DE RENVOI					1.0

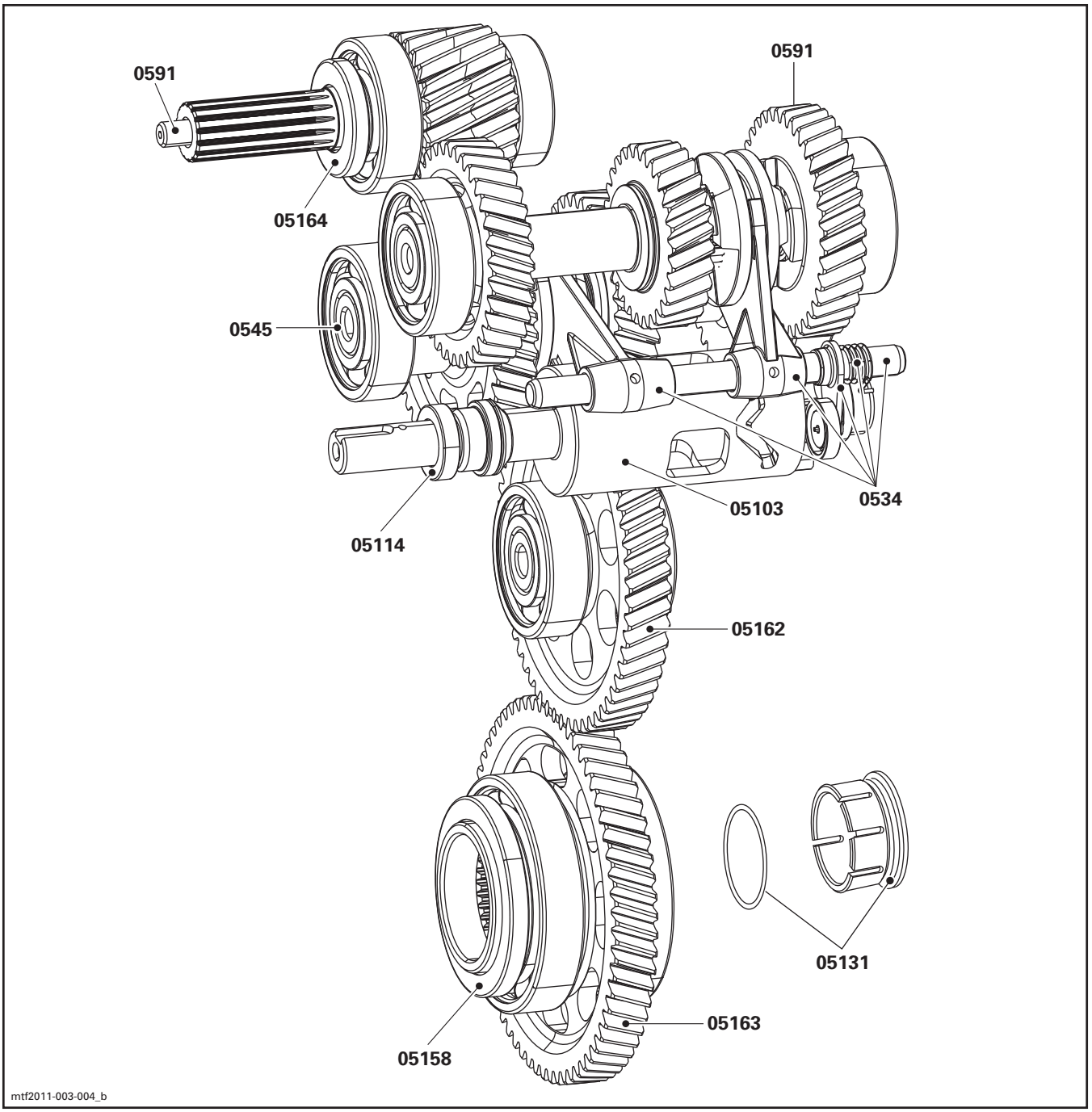
TRANSMISSION SYSTEM
SYSTÈME DE TRANSMISSION




Front
Avant
0517
0518
600 ACE
0520
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0523
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05130
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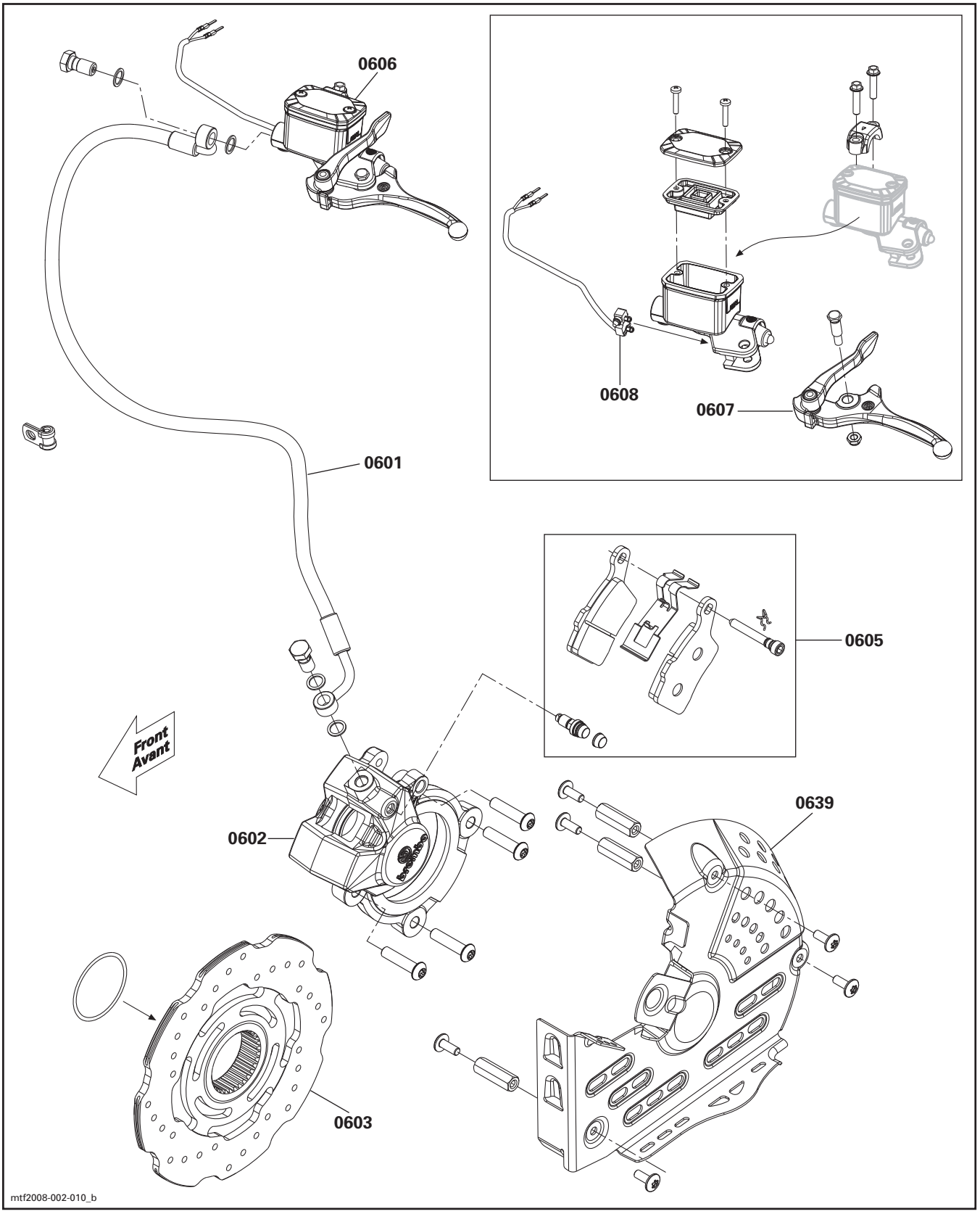
TRANSMISSION SYSTEM
SYSTÈME DE TRANSMISSION




0591
0591
05164
0545
0534
05103
05114
05162
05131
05163
05158
mtf2011-003-004_b

BRAKE SYSTEM
SYSTÈME DE FREIN

SYSTEM SYSTÈME	CODE	DESCRIPTION	MXZ/RENEGADE 600 ACE	GRAND TOURING 600 ACE	EXPEDITION 600 ACE	TUNDRA 600 ACE	SKANDIC 600 ACE
			19	20	21	22	23
06	**00**	**NO LABOR INVOLVED AUCUNE MAIN-D'OEUVRE IMPLIQUÉE**	**0**	**0**	**0**	**0**	**0**
06	01	BRAKE OIL HOSE BOYAU À HUILE POUR FREIN	0.5	0.5	0.5	0.5	0.5
06	02	BRACKET, CALIPER, BRAKE PAD, RELEASE SPRING SUPPORT, ÉTRIER, PLAQUETTE DE FREIN, CLIQUET, LEVIER	0.8	0.8	0.8	0.8	0.8
06	03	DISC DISQUE	0.7	0.7	0.7	0.7	0.7
06	05	BRAKE PADS PLAQUETTES DE FREIN	0.4	0.4	0.4	0.4	0.4
06	06	MASTER CYLINDER MAÎTRE CYLINDRE	0.4	0.4	0.4	0.4	0.4
06	07	BRAKE LEVER (ASS'Y) LEVIER DE FREIN (COMPLET)	0.3	0.3	0.3	0.3	0.3
06	08	MICROSWITCH BRAKE (ASS'Y) INTERRUPTEUR MICRO-CONTACT DE FREIN (COMPLET)	0.3	0.3	0.3	0.3	0.3
06	39	DISC PROTECTOR PROTECTEUR DE DISQUE	0.3	0.3	0.3	0.3	0.3

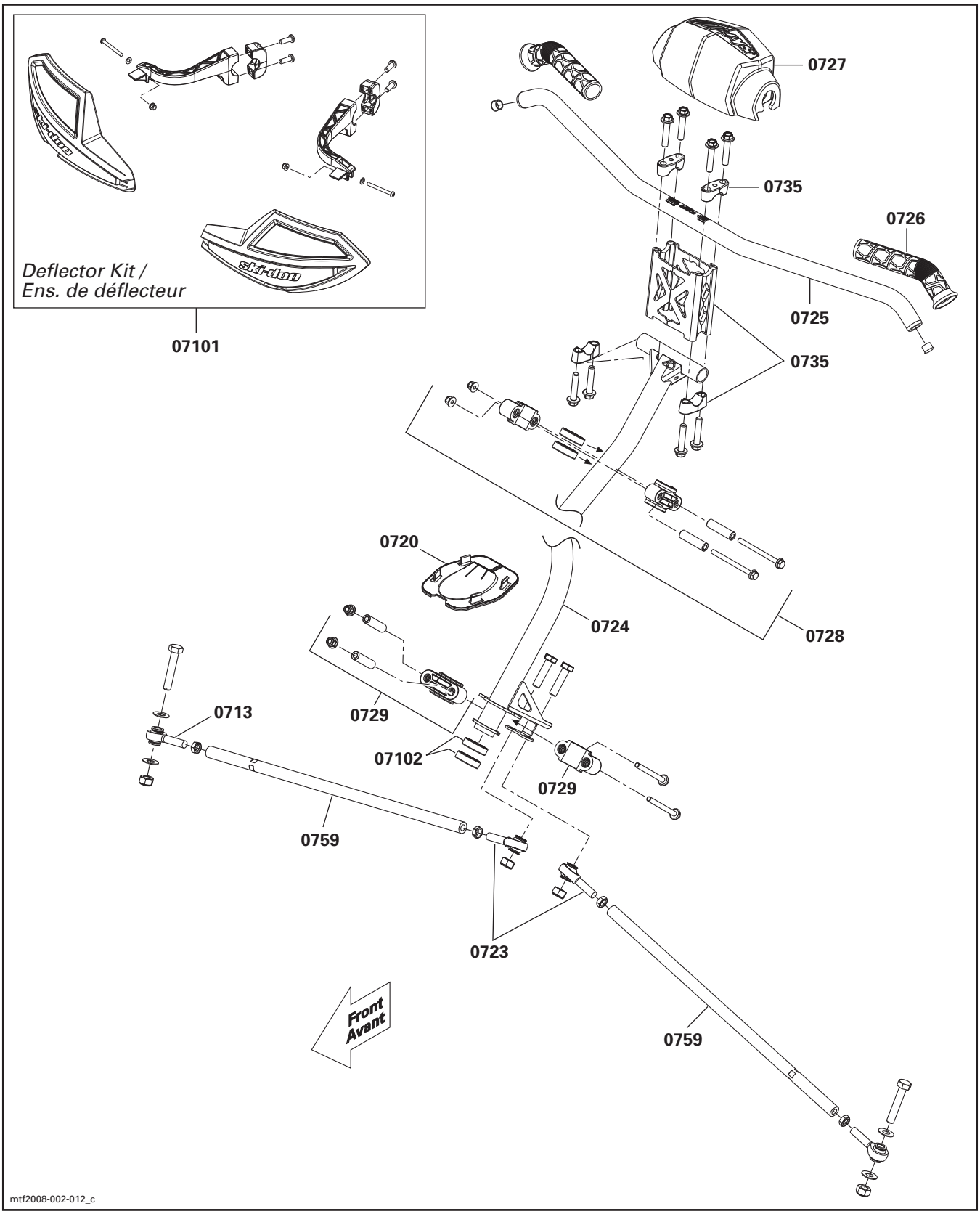

0606
0608
0607
0601
0605
Front
Avant
0602
0639
0603
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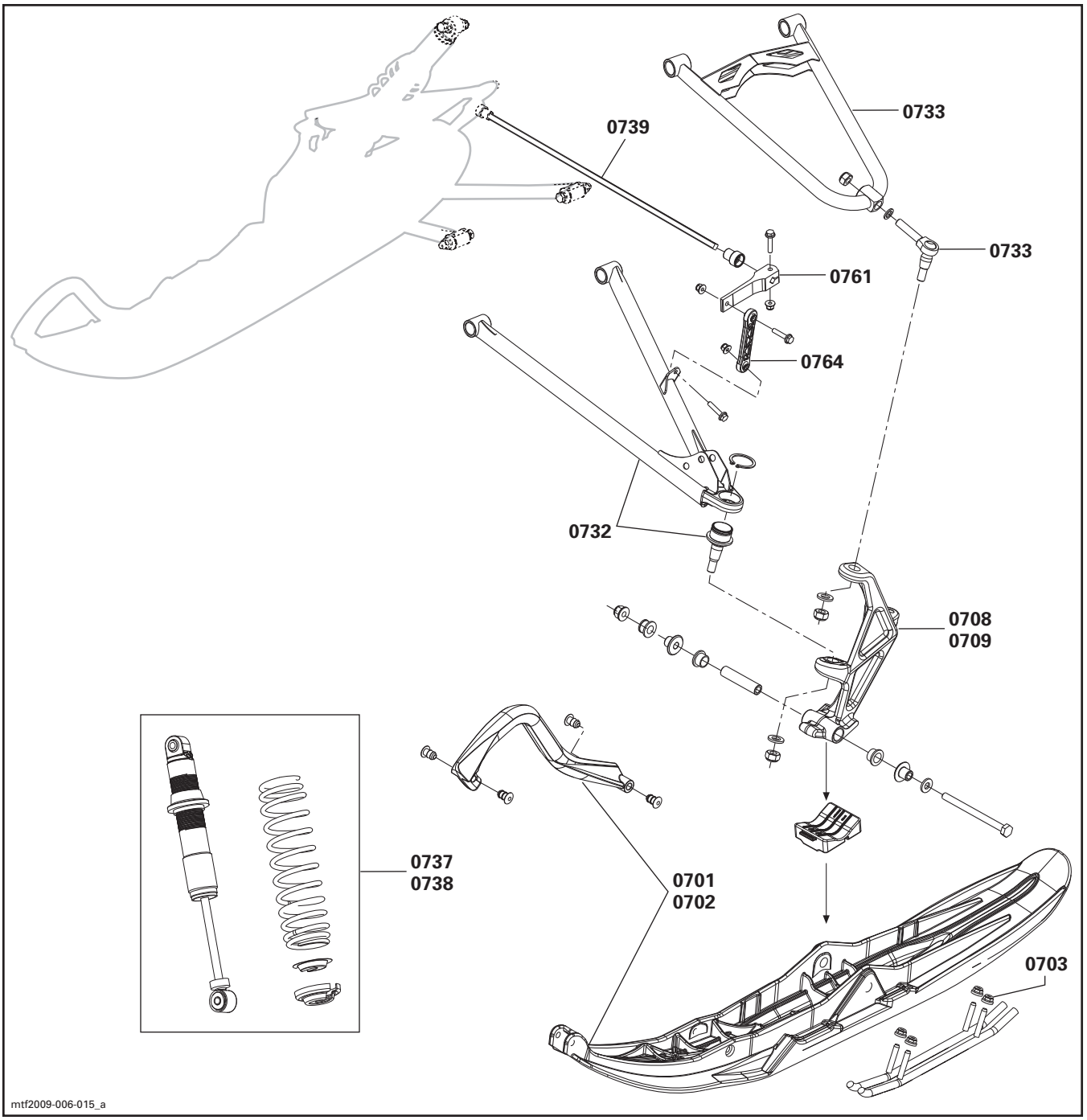
STEERING SYSTEM AND FRONT SUSPENSION
SYSTÈME DE DIRECTION ET SUSPENSION AVANT

SYSTEM SYSTÈME	CODE	DESCRIPTION	MXZ / RENEGADE 600 ACE	GRAND TOURING 600 ACE	EXPEDITION 600 ACE	TUNDRA 600 ACE	SKANDIC 600 ACE
			19	20	21	22	23
07	00	**NO LABOR INVOLVED** **AUCUNE MAIN-D'OEUVRE IMPLIQUÉE**	**0**	**0**	**0**	**0**	**0**
07	01	SKI (1) SKI (1)	0.3	0.3	0.3	0.3	0.3
07	02	SKIS (2) SKIS (2)	0.4	0.4	0.4	0.4	0.4
07	03	SKI RUNNER LISSES	0.3	0.3	0.3	0.3	0.3
07	08	SKI LEG (RH) AND/OR BUSHING JAMBE DE SKI (DROITE) ET/OU DOUILLE	0.5	0.5	0.5	0.5	0.5
07	09	SKI LEG (LH) AND/OR BUSHING JAMBE DE SKI (GAUCHE) ET/OU DOUILLE	0.5	0.5	0.5	0.5	0.5
07	10	STEERING ARM (RH) BRAS DE DIRECTION (DROIT)				0.5	0.5
07	11	STEERING ARM (LH) BRAS DE DIRECTION (GAUCHE)				0.5	0.5
07	12	STEERING ARM BALL JOINT (RH) JOINT À ROTULE DE BRAS DE DIRECTION (DROIT)	0.3	0.3	0.3	0.3	0.3
07	13	STEERING ARM BALL JOINT (LH) JOINT À ROTULE DE BRAS DE DIRECTION (GAUCHE)	0.3	0.3	0.3	0.3	0.3
07	14	TELESCOPIC TUBE, SPRING, BUSHINGS TUBE TÉLESCOPIQUE, RESSORT, DOUILLES				0.6	0.6
07	17	TOP CAP CAPUCHON SUPÉRIEUR				0.3	0.3
07	20	TIE ROD COVER CAPUCHON DE TIMONERIE	0.3	0.3	0.3		
07	23	STEERING MAIN TUBE BALL JOINT JOINT À ROTULE DE COLONNE DE DIRECTION	0.6	0.6	0.6	0.6	0.6
07	24	STEERING MAIN TUBE COLONNE DE DIRECTION	1.4	1.4	1.4	1.4	1.4
07	25	HANDLE BAR GUIDON	1.1	1.1	1.1	1.1	1.1
07	26	HANDLE BAR GRIP (RIGHT AND/OR LEFT) GAINE DE GUIDON (DROITE ET/OU GAUCHE)	0.3	0.3	0.3	0.3	0.3
07	27	HANDLE BAR PADDING COUSSINET DE GUIDON	0.3	0.3	0.3	0.3	0.3
07	28	UPPER STEERING MAIN TUBE BUSHING DOUILLE SUPÉRIEURE DE COLONNE DE DIRECTION	0.5	0.5	0.5	0.5	0.5
07	29	LOWER STEERING MAIN TUBE BUSHING DOUILLE INFÉRIEURE DE COLONNE DE DIRECTION	0.5	0.5	0.5	0.5	0.5
07	32	LOWER ARM (LH OR RH) BRAS DE SUSPENSION INFÉRIEUR (GAUCHE OU DROIT)	0.6	0.6	0.6		

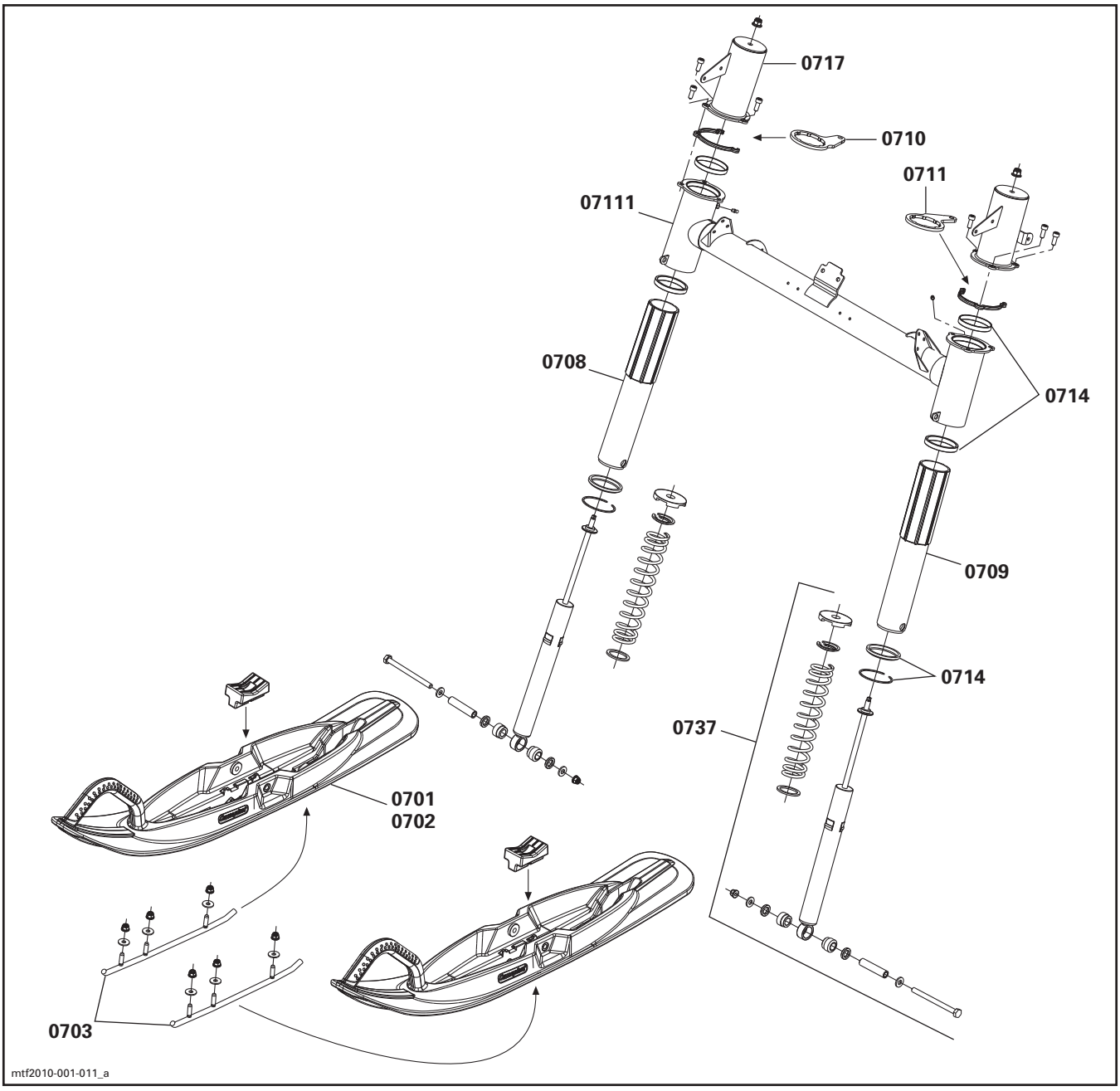
SYSTEM SYSTÈME	CODE	DESCRIPTION	MXZ / RENEGADE 600 ACE	GRAND TOURING 600 ACE	EXPEDITION 600 ACE	TUNDRA 600 ACE	SKANDIC 600 ACE
			19	20	21	22	23
07	33	UPPER ARM (LH OR RH) BRAS DE SUSPENSION SUPÉRIEUR (GAUCHE OU DROIT)	0.5	0.5	0.5		
07	35	HANDLE BAR SUPPORT SUPPORT DE GUIDON	0.3	0.3	0.3	0.3	0.3
07	37	SHOCK AND/OR SPRING (1) AMORTISSEUR ET/OU RESSORT (1)	0.3	0.3	0.3	0.6	0.6
07	38	SHOCKS AND/OR SPRINGS (2) AMORTISSEURS ET/OU RESSORTS (2)	0.4	0.4	0.4	0.4	1.0
07	39	STABILIZER BAR BARRE STABILISATRICE	0.5	0.5	0.5		
07	51	STEERING MAIN TUBE BALL JOINT JOINT DE ROTULE DE LA COLONNE DE DIRECTION				0.5	0.5
07	59	TIE ROD (LH) BARRE D'ACCOUPLEMENT (GAUCHE)	0.3	0.3	0.3	0.3	0.3
07	60	TIE ROD (RH) BARRE D'ACCOUPLEMENT (DROITE)	0.3	0.3	0.3	0.3	0.3
07	61	LEVER STABILIZER LEVIER STABILISATEUR	0.3	0.3	0.3		
07	64	DOUBLE BALL JOINT JOINT À ROTULE DOUBLE	0.3	0.3	0.3		
07	102	LOWER DAMPER AMORTISSEUR VIBRATION INFÉRIEUR	0.5	0.5	0.5		
07	111	LTS MODULE MODULE LTS				3.5	3.5
07	124	STRAP SANGLE				0.3	0.3

STEERING SYSTEM AND FRONT SUSPENSION
SYSTÈME DE DIRECTION ET SUSPENSION AVANT




0739
0733
0733
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STEERING SYSTEM AND FRONT SUSPENSION
SYSTÈME DE DIRECTION ET SUSPENSION AVANT



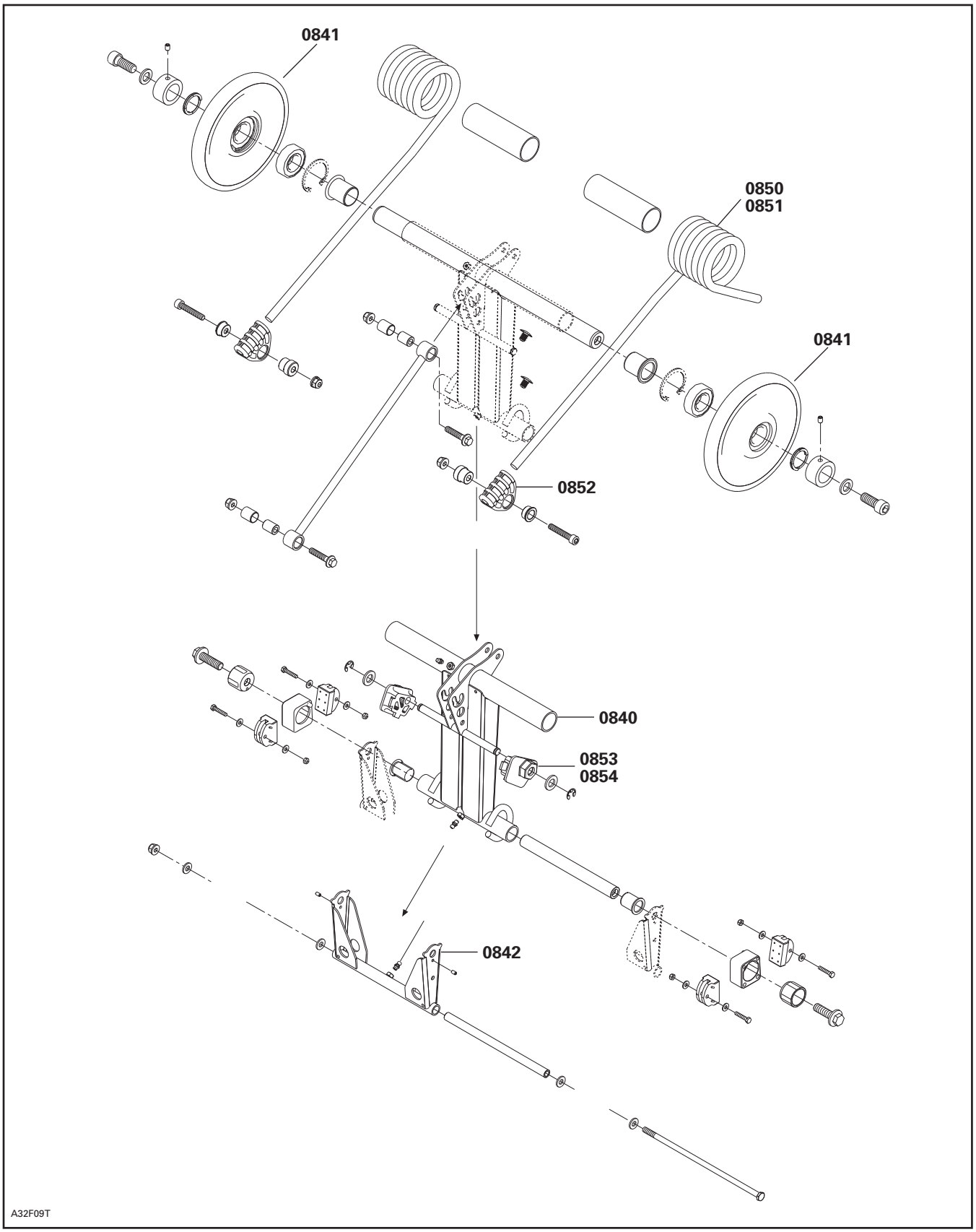
SYSTEM SYSTÈME	CODE	DESCRIPTION	MXZ / RENEGADE 600 ACE	GRAND TOURING 600 ACE	EXPEDITION 600 ACE	TUNDRA 600 ACE	SKANDIC 600 ACE
			19	20	21	22	23
08	00	**NO LABOR INVOLVED AUCUNE MAIN-D'OEUVRE IMPLIQUÉE**	0	0	0	0	0
08	01	SLIDER SHOE (1) GLISSIÈRE (1)	0.5	0.5	0.5	0.5	0.5
08	02	SLIDER SHOES (2) GLISSIÈRES (2)	0.7	0.7	0.7	0.7	0.7
08	03	RUNNER (1) PORTE-GLISSIÈRE (1)	1.2	1.2	1.5	1.5	1.5
08	04	RUNNERS (2) PORTE-GLISSIÈRES (2)	1.5	1.5	1.9	1.9	1.9
08	09	FRONT IDLER WHEEL AND/OR BEARING (1) ROUE DE SUPPORT AVANT ET/OU ROULEMENT (1)	0.3	0.3	0.3	0.3	0.3
08	10	FRONT IDLER WHEELS AND/OR BEARINGS AND/OR SHAFTS (2) ROUES DE SUPPORT AVANT ET/OU ROULEMENTS ET/OU ARBRES (2)	0.4	0.4	0.4	0.4	0.4
08	11	FRONT IDLER WHEEL SUPPORT (1) SUPPORT DE ROUE AVANT (1)	0.3	0.3			
08	12	FRONT IDLER WHEELS SUPPORTS (2) SUPPORTS DE ROUE AVANT (2)	0.4	0.4			
08	13	CENTER IDLER WHEEL AND/OR BEARING (1) ROUE DE SUPPORT CENTRALE ET/OU ROULEMENT (1)	0.3	0.3	0.3	0.3	0.3
08	14	CENTER IDLER WHEELS AND/OR BEARINGS AND/OR SHAFTS (2) ROUES DE SUPPORT CENTRALES ET/OU ROULEMENTS ET/OU ARBRES (2)	0.4	0.4	0.4	0.4	0.4
08	15	CENTER IDLER WHEEL SUPPORT (1) SUPPORT DE ROUE CENTRALE (1)	0.3	0.3	0.3	0.3	0.3
08	17	REAR IDLER AND/OR BEARING (1) ROUE DE SUPPORT ARRIÈRE ET/OU ROULEMENT (1)	0.4	0.4	0.3	0.3	0.3
08	18	REAR IDLERS AND/OR BEARINGS (2) ROUES DE SUPPORT ARRIÈRE ET/OU ROULEMENTS (2)	0.5	0.5	0.4	0.4	0.4
08	19	REAR IDLER WHEELS AXLE ESSIEU DE ROUES DE SUPPORT ARRIÈRE	0.5	0.5	0.5	0.5	0.5
08	22	TAIL PIVOT IDLER WHEEL, INSIDE (1) ROUE SUPPORT DE PIVOT ARRIÈRE ET/OU ROULEMENT INTÉRIEUR (1)			0.3	0.3	0.3
08	23	TAIL PIVOT IDLER WHEELS OR AXLE (2) ROUES SUPPORT DE PIVOT ARRIÈRE/ROULEMENT OU ESSIEU (2)			0.3	0.3	0.3
08	29	AXEL (STOPPER STRAP) AXE (COURROIE D'ARRÊT)	0.3	0.3	0.3	0.3	0.3
08	31	TRACK TENSION ADJUSTER (1) PLAQUE DE RÉGLAGE TENSION CHENILLE (1)	0.4	0.4	0.4	0.4	0.4
08	32	TRACK TENSION ADJUSTERS (2) PLAQUES DE RÉGLAGE TENSION CHENILLE (2)	0.5	0.5	0.5	0.5	0.5
08	33	RUNNER RUBBER STOPPER (1) BUTÉE DE CAOUTCHOUC DE PORTE-GLISSIÈRE (1)	0.3	0.3	0.3	0.3	0.3
08	34	RUNNER RUBBER STOPPERS (2) BUTÉES DE CAOUTCHOUC DE PORTE-GLISSIÈRE (2)	0.4	0.4	0.4	0.4	0.4
08	35	FRONT ARM AND/OR AXLE BRAS AVANT ET/OU ESSIEU	0.8	0.8	0.8	0.8	0.8

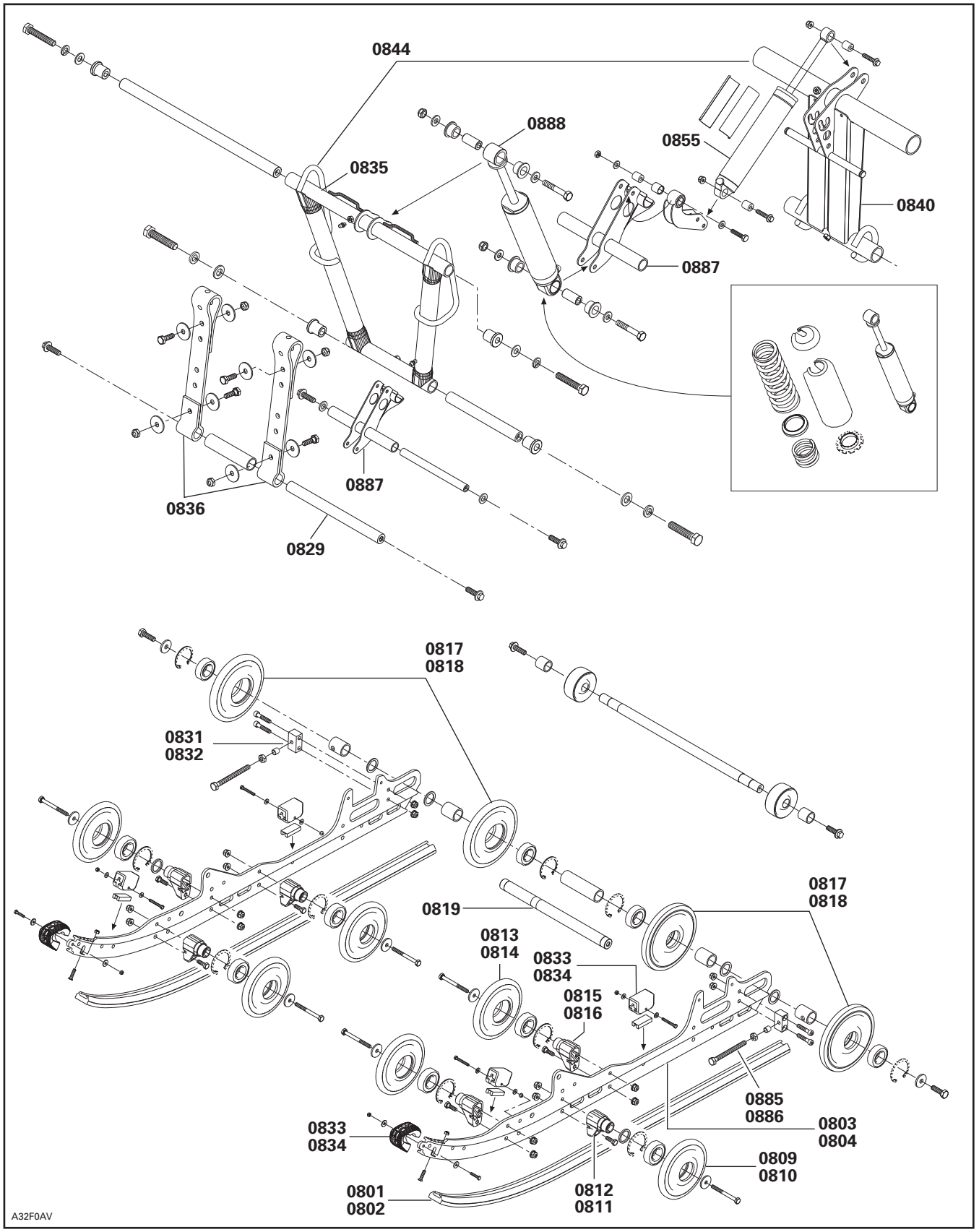
REAR SUSPENSION SYSTEM AND TRACK
SYSTÈME DE SUSPENSION ARRIÈRE ET CHENILLE

SYSTEM SYSTÈME	CODE	DESCRIPTION	MXZ / RENEGADE 600 ACE	GRAND TOURING 600 ACE	EXPEDITION 600 ACE	TUNDRA 600 ACE	SKANDIC 600 ACE
			19	20	21	22	23
08	36	FRONT ARM STOPPER STRAP/STOPPER BOLT COURROIE D'ARRÊT BRAS AVANT/BOULON D'ARRÊT	0.3	0.3	0.3	0.3	0.3
08	37	FRONT ARM SUPPORT SUPPORT DE BRAS AVANT			0.6	0.6	0.6
08	40	REAR ARM AND/OR AXLE BRAS ARRIÈRE ET/OU ESSIEU	0.7	0.7	0.7	0.7	0.7
08	41	REAR ARM IDLER WHEELS (1-2) AND/OR SHAFT-CROSS ROUES DE SUPPORT BRAS ARRIÈRE (1-2) ET/OU AXE TRANSVERSALE	0.3	0.3	0.3	0.3	0.3
08	42	REAR ARM SHACKLE JUMELLE DE BRAS ARRIÈRE	0.3	0.3	0.3	0.3	0.3
08	44	REAR AND FRONT ARMS BRAS ARRIÈRE ET AVANT	1.5	1.5	1.5	1.5	1.5
08	50	REAR TORSION SPRING AND/OR WHEEL (1) RESSORT DE TORSION ARRIÈRE ET/OU ROUE (1)	0.3	0.3	0.3	0.3	0.3
08	51	REAR TORSION SPRINGS AND/OR WHEELS (2) RESSORTS DE TORSION ET/OU ROUES (2)	0.4	0.4	0.4	0.4	0.4
08	52	TORSION SPRING SUPPORT SUPPORT DE RESSORT DE TORSION	0.3	0.3	0.3	0.3	0.3
08	53	SPRING ADJUSTMENT CAM (1) CAME DE RÉGLAGE DE RESSORT (1)	0.3	0.3	0.3	0.3	0.3
08	54	SPRING ADJUSTMENT CAMS (2) CAMES DE RÉGLAGE DE RESSORT (2)	0.4	0.4	0.4	0.4	0.4
08	55	SHOCK AND/OR SPRING AND/OR BUSHING AMORTISSEUR ET/OU RESSORT ET/OU DOUILLE	0.5	0.5	0.5	0.5	0.5
08	69	TRACK (1) CHENILLE (1)	2.2	2.2	2.2	2.2	2.2
08	71	CLEATS AND/OR GUIDES (0-9) SEGMENTS GUIDE ET/OU GUIDES (0-9)	0.3	0.3	0.3	0.3	0.3
08	72	CLEATS AND/OR GUIDES (10-14) SEGMENTS GUIDE ET/OU GUIDES (10-14)	0.4	0.4	0.4	0.4	0.4
08	73	CLEATS AND/OR GUIDES (15-19) SEGMENTS GUIDE ET/OU GUIDES (15-19)	0.5	0.5	0.5	0.5	0.5
08	74	CLEATS AND/OR GUIDES (20-24) SEGMENTS GUIDE ET/OU GUIDES (20-24)	0.6	0.6	0.6	0.6	0.6
08	75	CLEATS AND/OR GUIDES (25-29) SEGMENTS GUIDE ET/OU GUIDES (25-29)	0.7	0.7	0.7	0.7	0.7
08	76	CLEATS AND/OR GUIDES (30-34) SEGMENTS GUIDE ET/OU GUIDES (30-34)	0.8	0.8	0.8	0.8	0.8
08	77	CLEATS AND/OR GUIDES (35-39) SEGMENTS GUIDE ET/OU GUIDES (35-39)	0.9	0.9	0.9	0.9	0.9
08	78	CLEATS AND/OR GUIDES (40-44) SEGMENTS GUIDE ET/OU GUIDES (40-44)	1.0	1.0	1.0	1.0	1.0
08	79	CLEATS AND/OR GUIDES (45-49) SEGMENTS GUIDE ET/OU GUIDES (45-49)	1.1	1.1	1.1	1.1	1.1
08	80	CLEATS AND/OR GUIDES (50-54) SEGMENTS GUIDE ET/OU GUIDES (50-54)			1.2	1.2	1.2

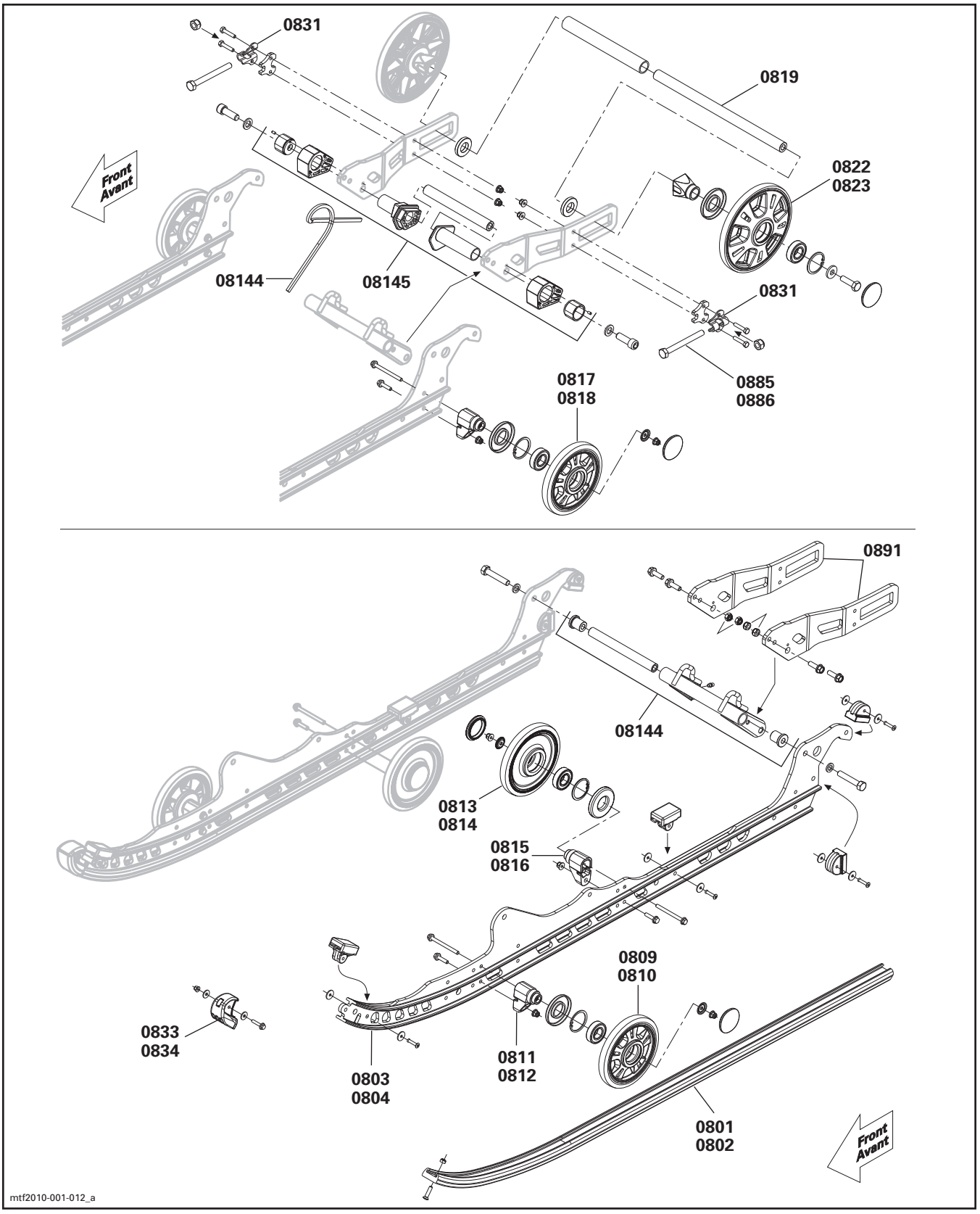
SYSTEM SYSTÈME	CODE	DESCRIPTION	MXZ / RENEGADE 600 ACE	GRAND TOURING 600 ACE	EXPEDITION 600 ACE	TUNDRA 600 ACE	SKANDIC 600 ACE
			19	20	21	22	23
08	81	CLEATS AND/OR GUIDES (55-59) SEGMENTS GUIDE ET/OU GUIDES (55-59)			1.3	1.3	1.3
08	82	CLEATS AND/OR GUIDES (60-64) SEGMENTS GUIDE ET/OU GUIDES (60-64)			1.4	1.4	1.4
08	83	CLEATS AND/OR GUIDES (65-70) SEGMENTS GUIDE ET/OU GUIDES (65-70)			1.5	1.5	1.5
08	85	ADJUSTMENT SCREW (1) VIS D'AJUSTEMENT (1)	0.3	0.3	0.3	0.3	0.3
08	86	ADJUSTMENT SCREWS (2) VIS D'AJUSTEMENT (2)	0.4	0.4	0.4	0.4	0.4
08	87	SHOCK SUPPORT AND/OR AXLE SUPPORT D'AMORTISSEUR ET/OU AXE	0.4	0.4	0.4	0.4	0.4
08	88	FRONT SHOCK AND/OR SPRING AMORTISSEUR AVANT ET/OU RESSORT	0.5	0.5	0.5	0.5	0.5
08	89	FRONT WHEELS SUPPORT AND/OR BEARINGS (3) ROUES DE SUPPORT AVANT ET/OU ROULEMENTS À BILLE (3)	0.5	0.5	0.5	0.5	0.5
08	91	REAR PIVOT ARM BRAS DE PIVOT ARRIÈRE			0.7	0.7	0.7
08	144	CAM AXLE, SPRING, SHAFT AND CUSHIONS AXE DE CAME, RESSORT, ARBRE ET COUSSINETS			0.5	0.5	0.5
08	145	BLOCK, GUIDE, CAM AND PIVOT BLOC, GUIDE, CAME ET PIVOT			0.7	0.7	0.7

REAR SUSPENSION SYSTEM AND TRACK
SYSTÈME DE SUSPENSION ARRIÈRE ET CHENILLE




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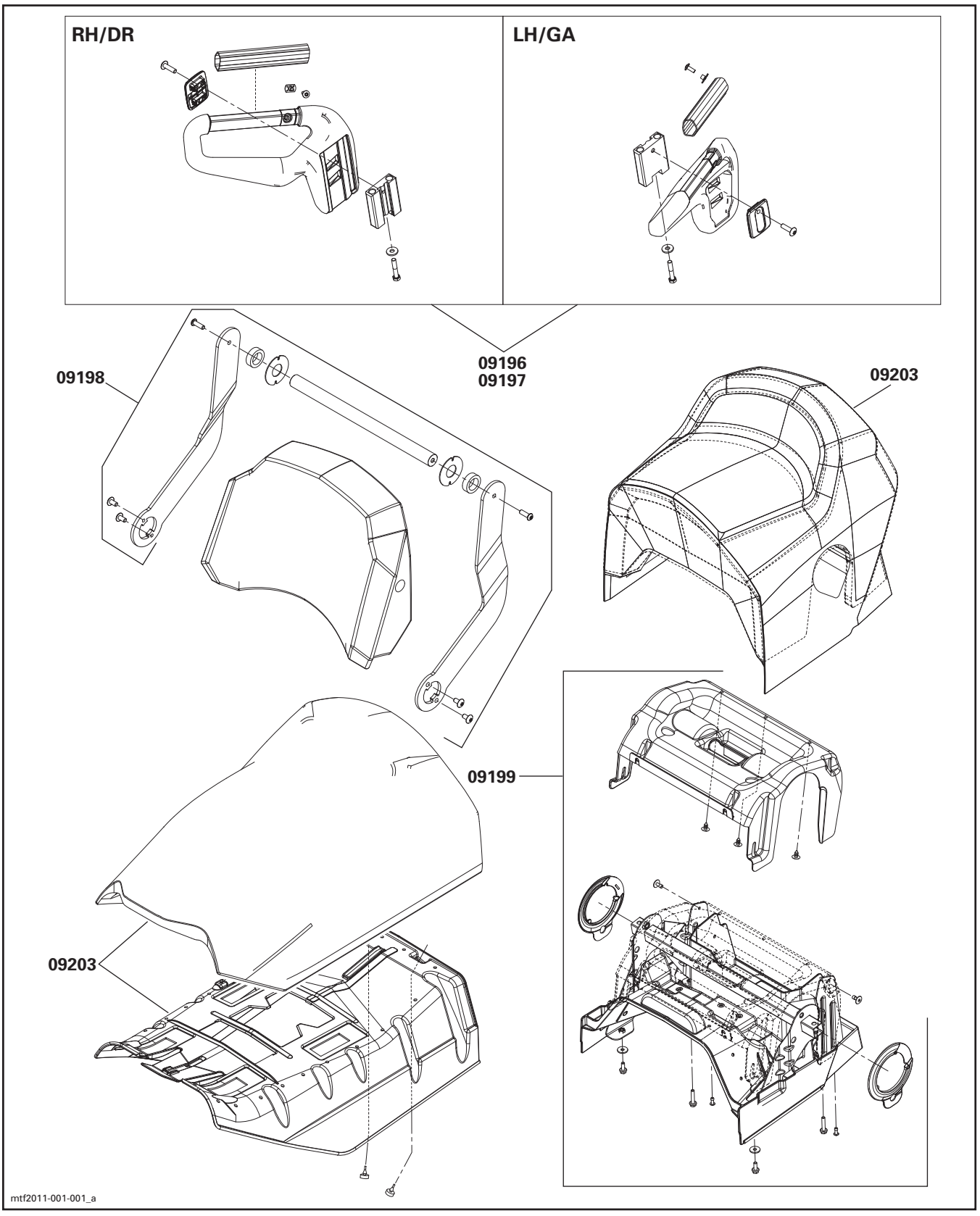
REAR SUSPENSION SYSTEM AND TRACK
SYSTÈME DE SUSPENSION ARRIÈRE ET CHENILLE

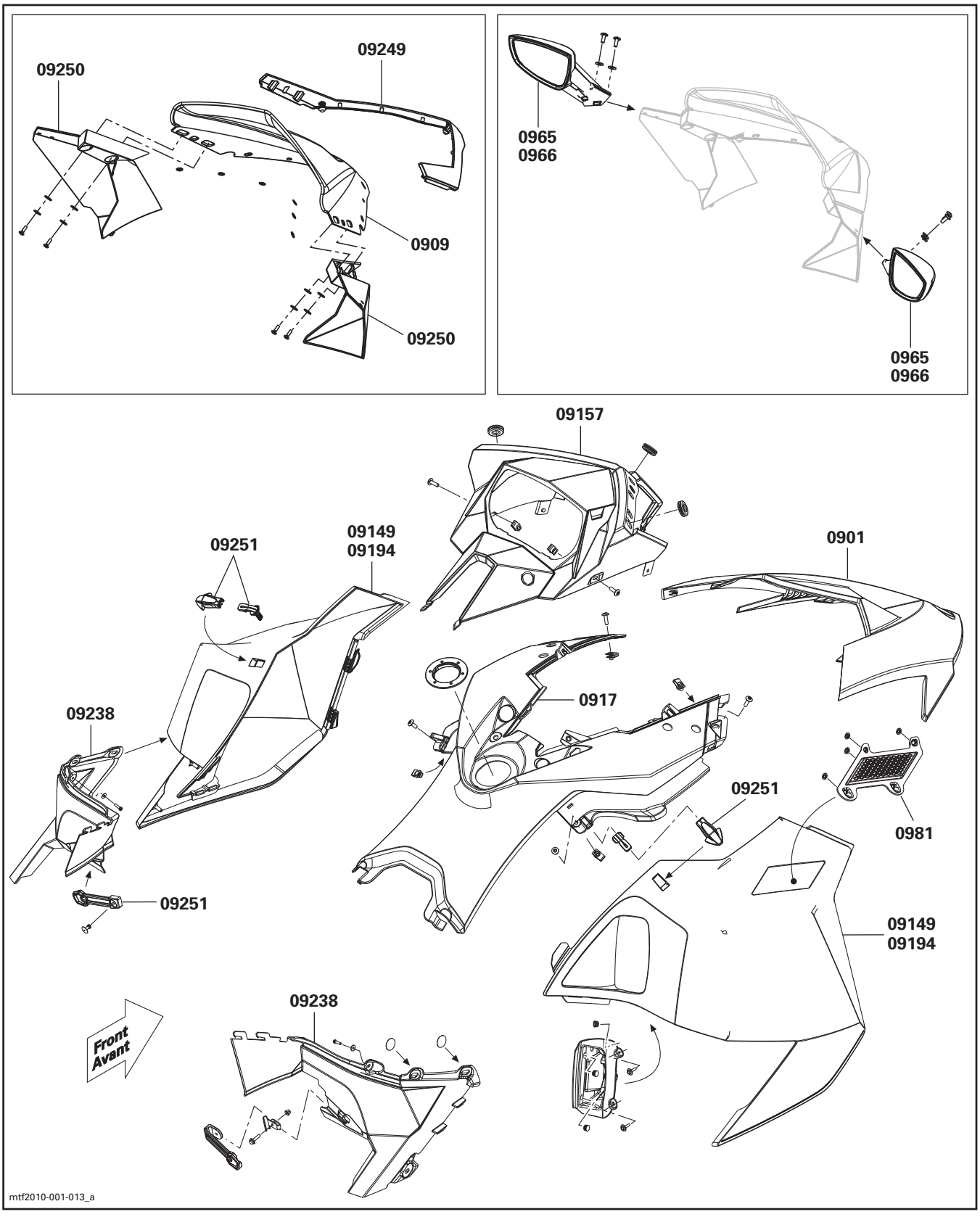


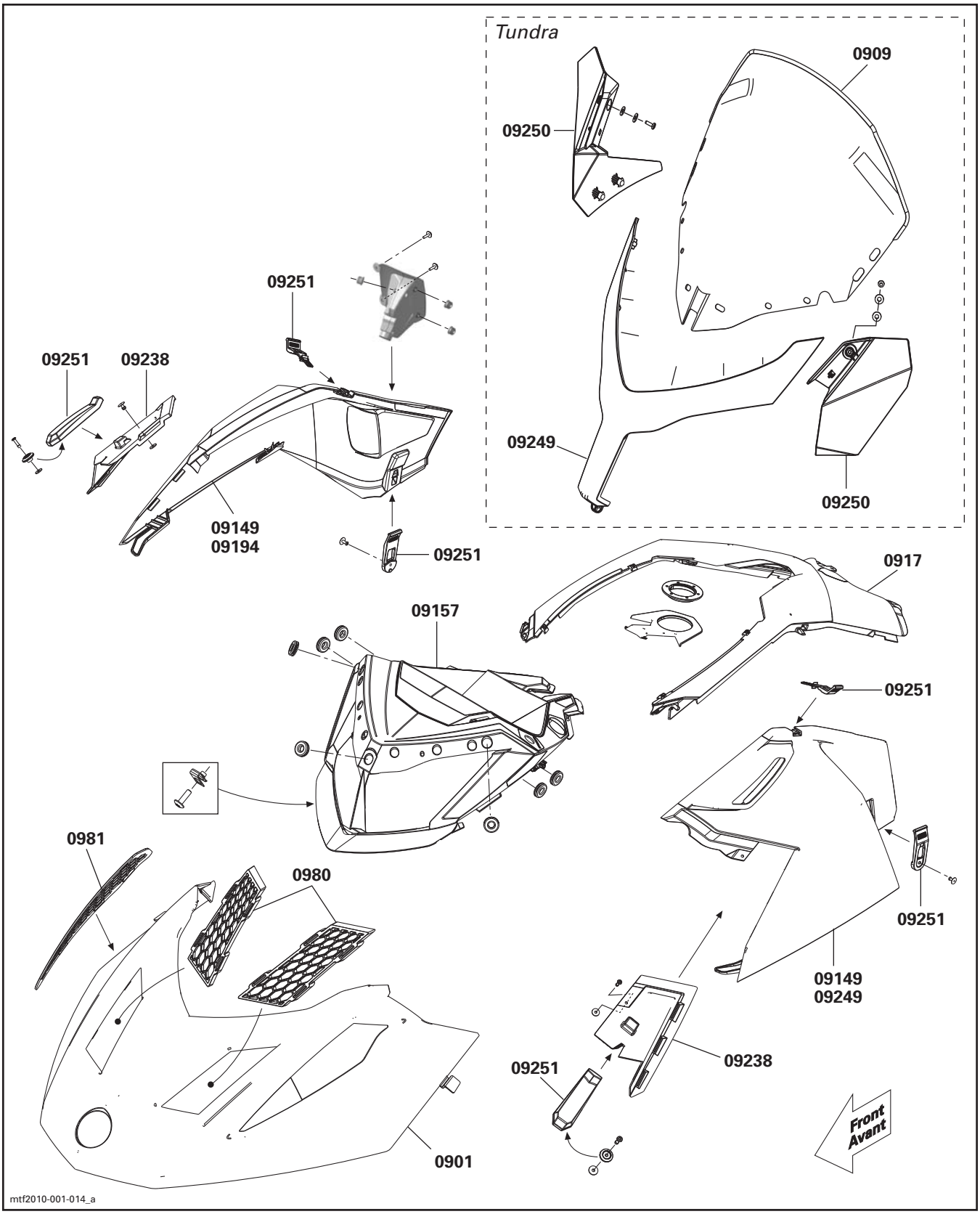
SYSTEM SYSTÈME	CODE	DESCRIPTION	MXZ / RENEGADE 600 ACE	GRAND TOURING 600 ACE	EXPEDITION 600 ACE	TUNDRA 600 ACE	SKANDIC 600 ACE
			19	20	21	22	23
09	**00**	**NO LABOR INVOLVED AUCUNE MAIN-D'OEUVRE IMPLIQUÉE**	**0**	**0**	**0**	**0**	**0**
09	01	HOOD CAPOT	0.3	0.3	0.3	0.3	0.3
09	05	HOOD DECALS (LH OR RH) AUTOCOLLANTS DU CAPOT (GAUCHE OU DROIT)	0.3	0.3	0.3	0.3	0.3
09	06	HOOD DECALS (ALL) AUTOCOLLANTS DU CAPOT (TOUS)	0.5	0.5	0.5	0.5	0.5
09	09	WINDSHIELD PARE-BRISE	0.3	0.3	0.3	0.3	0.3
09	13	CARGO RACK SUPPORT À BAGAGES		0.4	0.4	0.4	
09	14	FRONT BUMPER PARE-CHOCS AVANT	0.4	0.4	0.4	0.4	0.4
09	17	CONSOLE CONSOLE	0.3	0.3	0.3	0.3	0.3
09	21	SEAT (ASS'Y) SIÈGE (COMPLET)	0.3	0.3	0.3	0.3	
09	22	SEAT COVER AND/OR FOAM HOUSSE DE SIÈGE ET/OU MOUSSE	1.0	1.0	1.0	1.0	0.7
09	23	SEAT FOAM CAOUTCHOUC MOUSSE DE SIÈGE	1.0	1.0	1.0	1.0	0.7
09	34	REAR BUMPER PARE-CHOCS ARRIÈRE	0.3	0.3	0.3	0.3	0.3
09	35	HITCH SUPPORT (ALL PARTS) SUPPORT D'ATTELAGE (TOUTES LES PIÈCES)			0.3	0.3	0.3
09	48	FRONT FOOTREST (LH OR RH) REPOSE-PIED AVANT (GAUCHE OU DROIT)		0.3	0.3		
09*	49	**FRAME (ASS'Y) OR FRONT MEMBER CHÂSSIS (COMPLET) OU CADRE AVANT**	**13.5**	**13.8**	**13.8**	**13.8**	**14.5**
09	51	REAR CAP PARTIE ARRIÈRE DU CHÂSSIS	0.8	0.8	0.8	0.8	
09	55	SNOW GUARD (1) GARDE-NEIGE (1)	0.3	0.3	0.3	0.3	0.3
09	58	BACKREST AND/OR COVER DOSSIER ET/OU HOUSSE		0.3	0.3		
09	65	MIRROR (1) RÉTROVISEUR (1)		0.3	0.3		0.3
09	66	MIRRORS (2) RÉTROVISEURS (2)		0.3	0.3		0.3
09	72	TUNNEL DECAL (1 OR 2) DÉCALQUE DE TUNNEL (1 OU 2)	0.3	0.3	0.3	0.3	0.3
09	77	BOTTOM PAN (RH) COQUE CÔTÉ (DROITE)	0.7	0.7	0.7	0.6	0.7

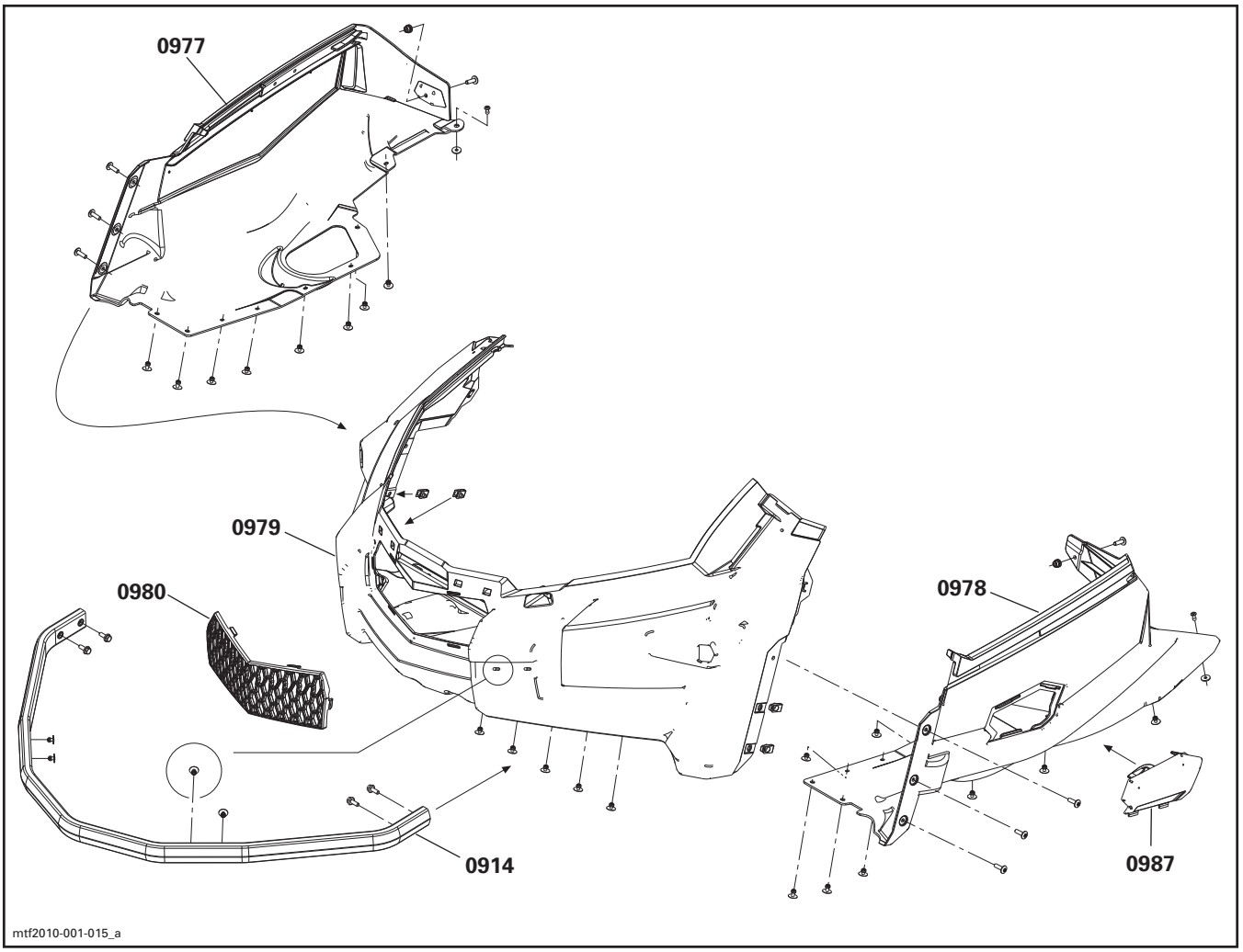
SYSTEM SYSTÈME	CODE	DESCRIPTION	MXZ / RENEGADE 600 ACE	GRAND TOURING 600 ACE	EXPEDITION 600 ACE	TUNDRA 600 ACE	SKANDIC 600 ACE
			19	20	21	22	23
09	78	BOTTOM PAN (LH) COQUE CÔTÉ (GAUCHE)	0.7	0.7	0.7	0.6	0.7
09	79	BOTTOM PAN (CENTER) COQUE PARTIE (CENTRALE)	0.5	0.5	0.5	0.7	0.8
09	80	FRONT GRILL (LH AND/OR RH) GRILLE AVANT (GAUCHE ET/OU DROIT)				0.3	0.3
09	81	SIDE GRILL (LH AND/OR RH) GRILLE LATÉRALE (GAUCHE ET/OU DROIT)	0.3	0.3	0.3	0.3	0.3
09	82	CABLE RETAINER (LH AND/OR RH) CÂBLE DE RETENUE (GAUCHE ET/OU DROIT)					0.3
09	86	ROLLER ROULEAU	0.5	0.5	0.5	0.5	
09	87	BOTTOM PAN DOOR PORTE DE COQQUE				0.3	0.3
09	96	FOOT PROTECTOR AND/OR SUPPORT (LH OR RH) PROTÈGE PIED ET/OU SUPPORT (GAUCHE OU DROIT)	1.0	1.0	1.0	1.0	1.0
09	149	ENGINE SIDE PANELS (2) PANNEAUX MOTEUR (2)	0.9	0.9	0.9	0.7	0.9
09	157	UPPER CONSOLE CONSOLE SUPERIEUR	0.3	0.3	0.3	0.3	0.4
09	163	MEMBER (LH OR RH) MEMBRURE (GAUCHE OU DROIT)	0.4	0.4	0.4	0.4	0.5
09	168	FRONT GRILL GRILLE AVANT					0.3
09	191	SIDE PANEL DECAL (LH OR RH) (1) DÉCALQUES DE PANNEAU (GAUCHE OU DROIT) (1)	0.3	0.3	0.3	0.3	0.3
09	192	SIDE PANEL DECALS (LH OR RH) (ALL) DÉCALQUES DE PANNEAU (GAUCHE OU DROIT) (TOUS)	0.6	0.6	0.6	0.6	0.6
09	194	ENGINE SIDE PANEL (LH OR RH) PANNEAU MOTEUR (GAUCHE OU DROIT)	0.5	0.5	0.5	0.4	0.5
09	195	FRONT PLATE PLAQUE AVANT	4.5	4.5	4.5		
09	196	REAR HANDLE AND/OR GRIP POIGNÉE ARRIÈRE ET/OU GAINE		0.5			0.3
09	197	REAR HANDLES AND/OR GRIPS (2) POIGNÉES ARRIÈRE ET/OU GAINES (2)		0.9			0.3
09	198	BACKREST PARTS PIÈCES DU DOSSIER		0.3	0.3		
09	199	REAR SEAT BASE AND/OR ALL PARTS BASE SIÈGE ARRIÈRE ET/OU TOUTES LES PIÈCES		1.9	1.9		1.9
09	203	REAR SEAT COVER OR FOAM HOUSSE OU MOUSSE DU SIÈGE ARRIÈRE		1.1	1.1		1.1
09	233	UPPER SIDE PANEL (LH OR RH) PANNEAU LATÉRAL SUPÉRIEUR (GAUCHE OU DROIT)					0.3

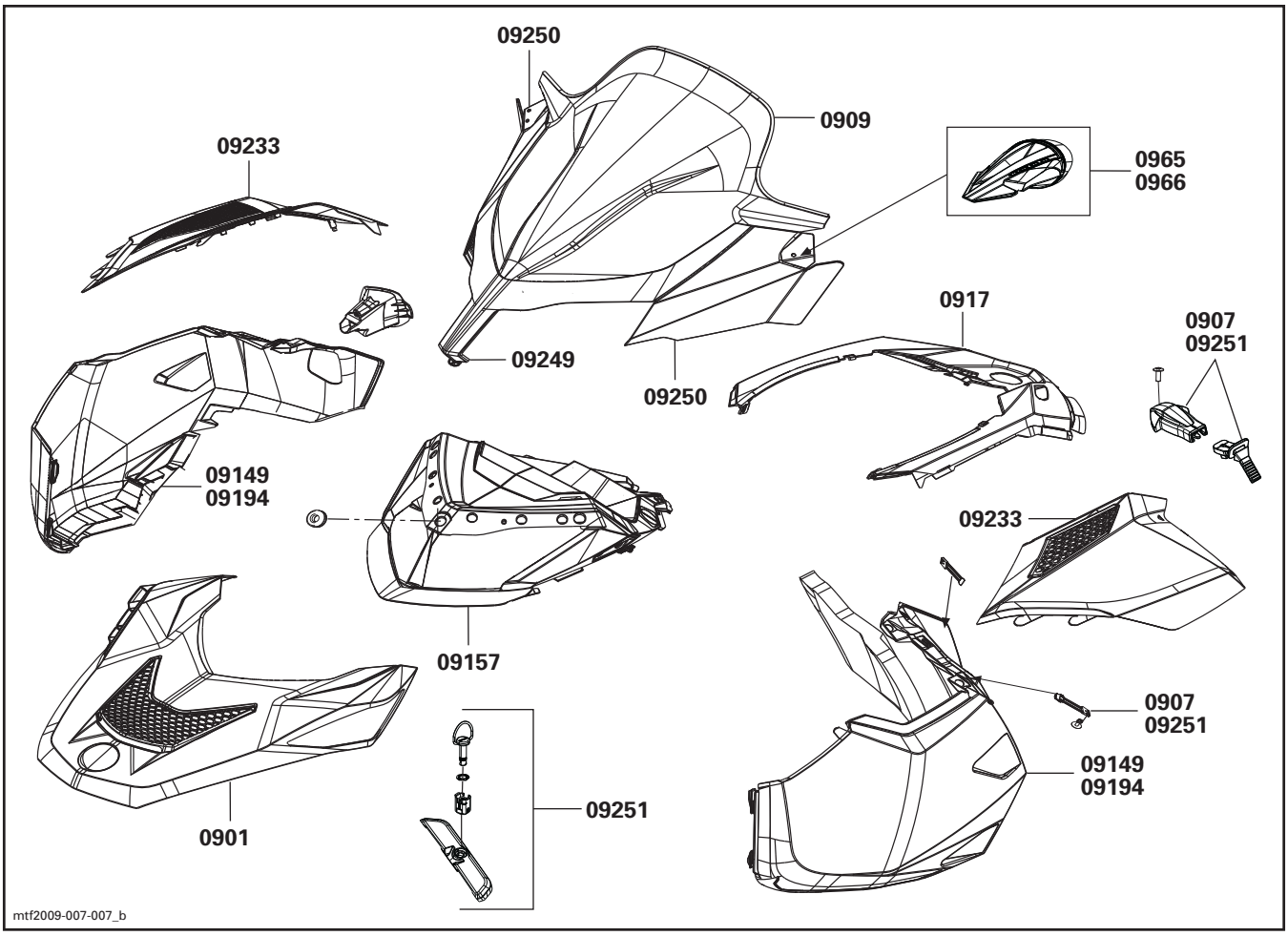
SYSTEM SYSTÈME	CODE	DESCRIPTION	MXZ / RENEGADE 600 ACE	GRAND TOURING 600 ACE	EXPEDITION 600 ACE	TUNDRA 600 ACE	SKANDIC 600 ACE
			19	20	21	22	23
09	238	LOWER SIDE PANEL (LH OR RH) PANNEAU LATÉRAL INFÉRIEUR (GAUCHE OU DROIT)	0.3	0.3	0.3		
09	249	WINDSHIELD SUPPORT SUPPORT PARE-BRISE	0.3	0.3	0.3	0.3	0.3
09	250	AIR DEFLECTOR (LH OR RH) DÉFLECTEUR D'AIR (GAUCHE OU DROIT)	0.3	0.3	0.3	0.3	0.3
09	251	PANEL LATCHES (ALL) LOQUETS DE PANNEAU (TOUS)	0.3	0.3	0.3	0.3	0.3
09	252	FOOTREST REINFORCEMENT (LH OR RH) RENFORT DE MARCHE-PIED (GAUCHE OU DROIT)	1.1	1.1	1.1	1.1	0.6
09	261	FRONT MEMBER MEMBRURE AVANT	2.0	2.0	2.0	2.0	2.0
09	284	BOX DOOR PORTE DE COFFRE					0.4
09	293	PUSH LATCH LOQUET POUSSOIR					0.3
09	310	SEAT BOX BASE SIÈGE					1.3
09	311	E-MODULE MODULE E	5.8	5.8	5.8	6.0	6.0
09	312	S-MODULE MODULE S	3.5	3.5	3.5	3.5	3.5
09*	313	SEAT BOX FRAME CHÂSSIS BASE DE SIÈGE					0.4
09	367	LOCK VERROU					0.3
09	378	BRACE BRETELLE	1.0	1.0	1.0	1.0	1.0
09	379	BATTERY SUPPORT SUPPORT DE BATTERIE	0.5	0.5	0.5	0.5	
09	384	RADIATOR COVER COUVERCLE DE RADIATEUR	0.5	0.5			
09	439	MEMBER CAP CAPUCHON DE MEMBRURE	0.3		0.3	0.3	

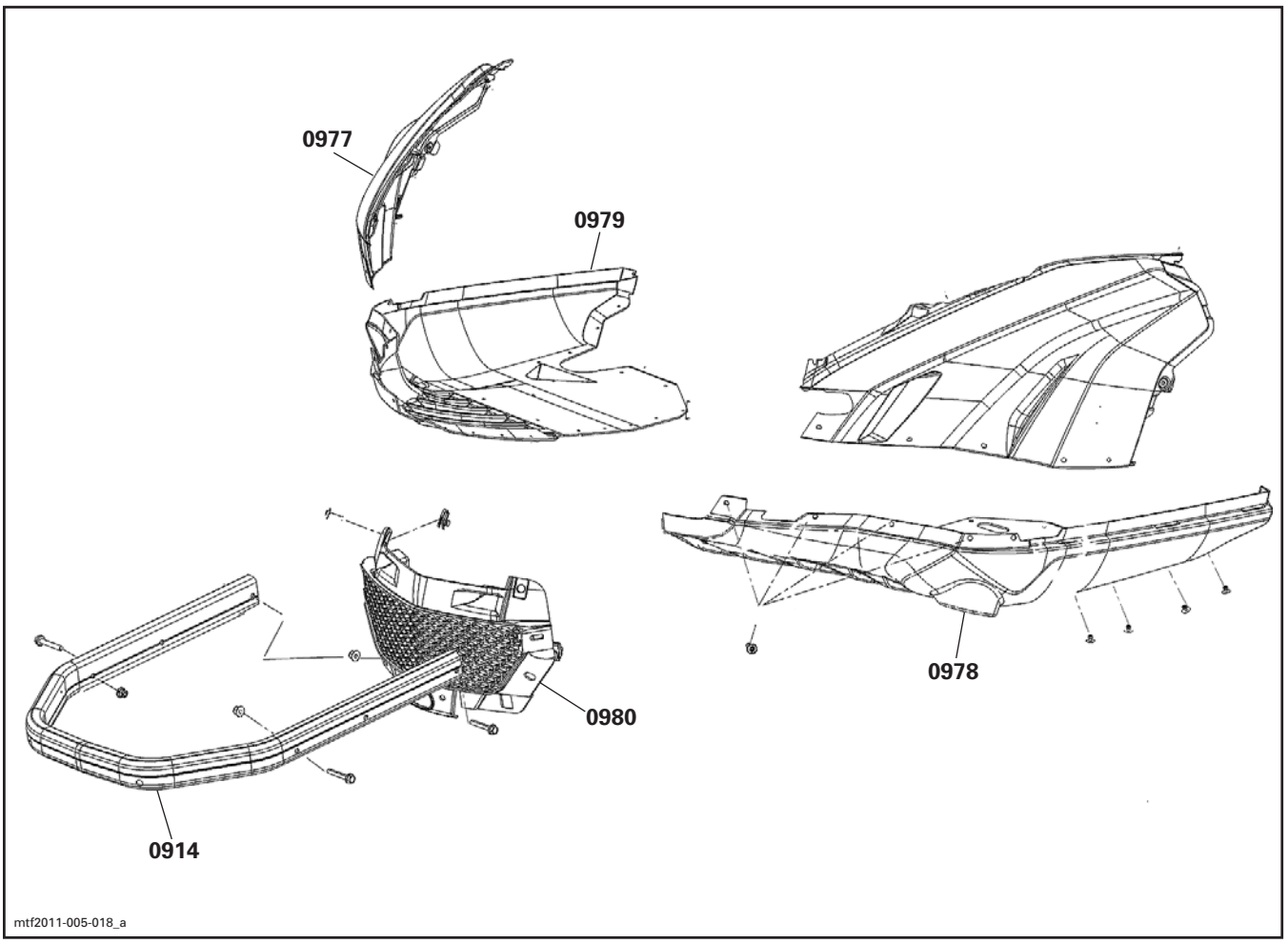

RH/DR
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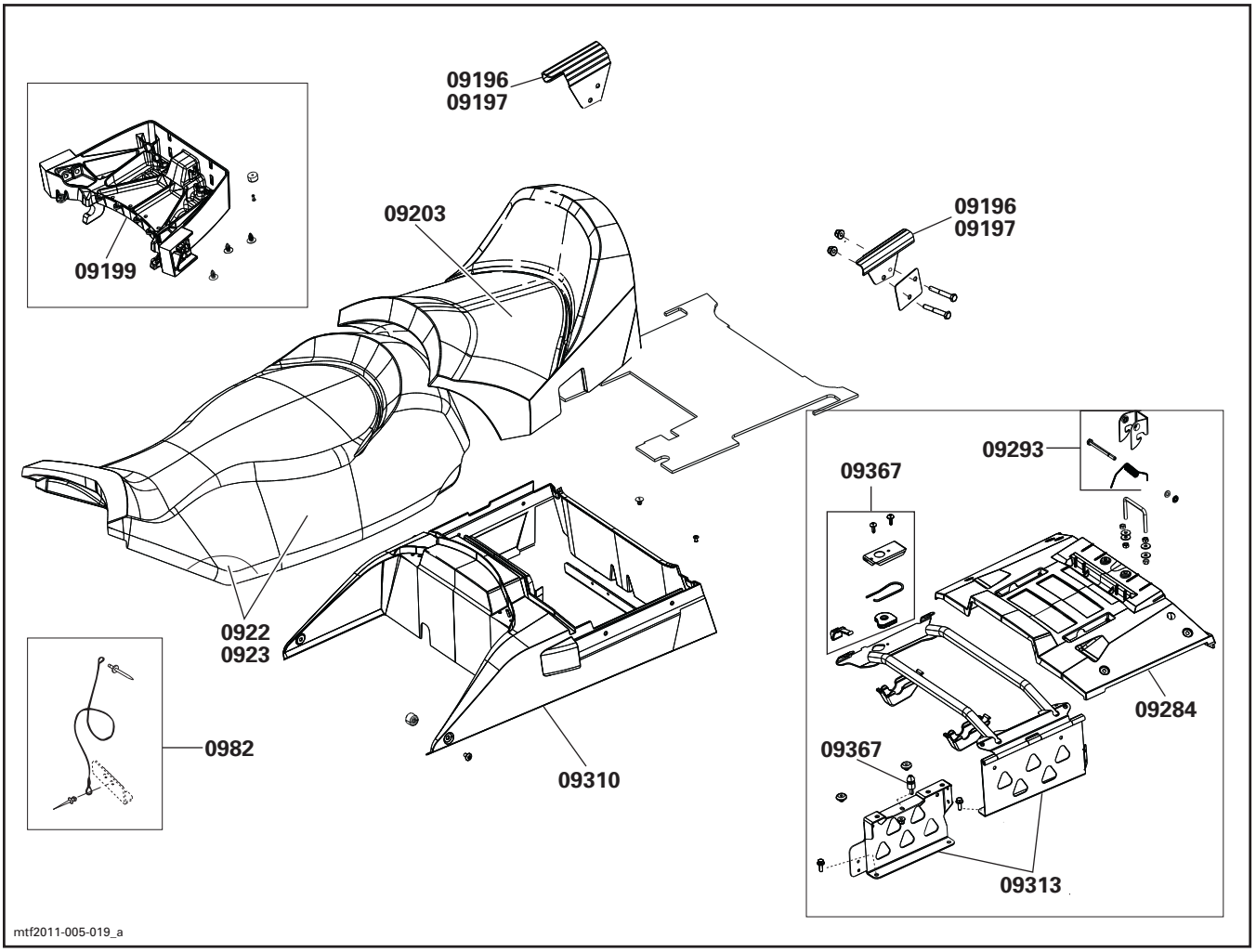

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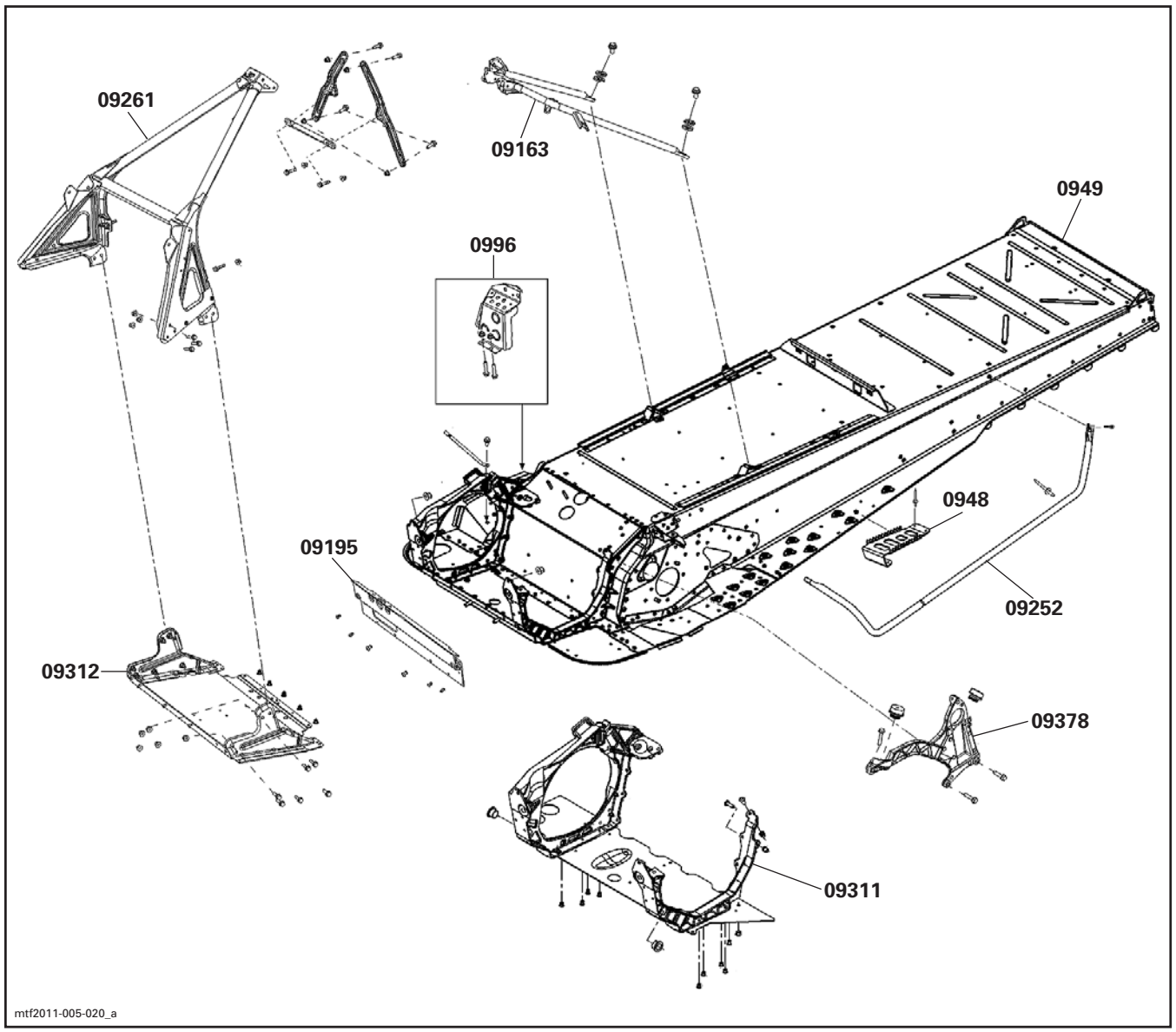

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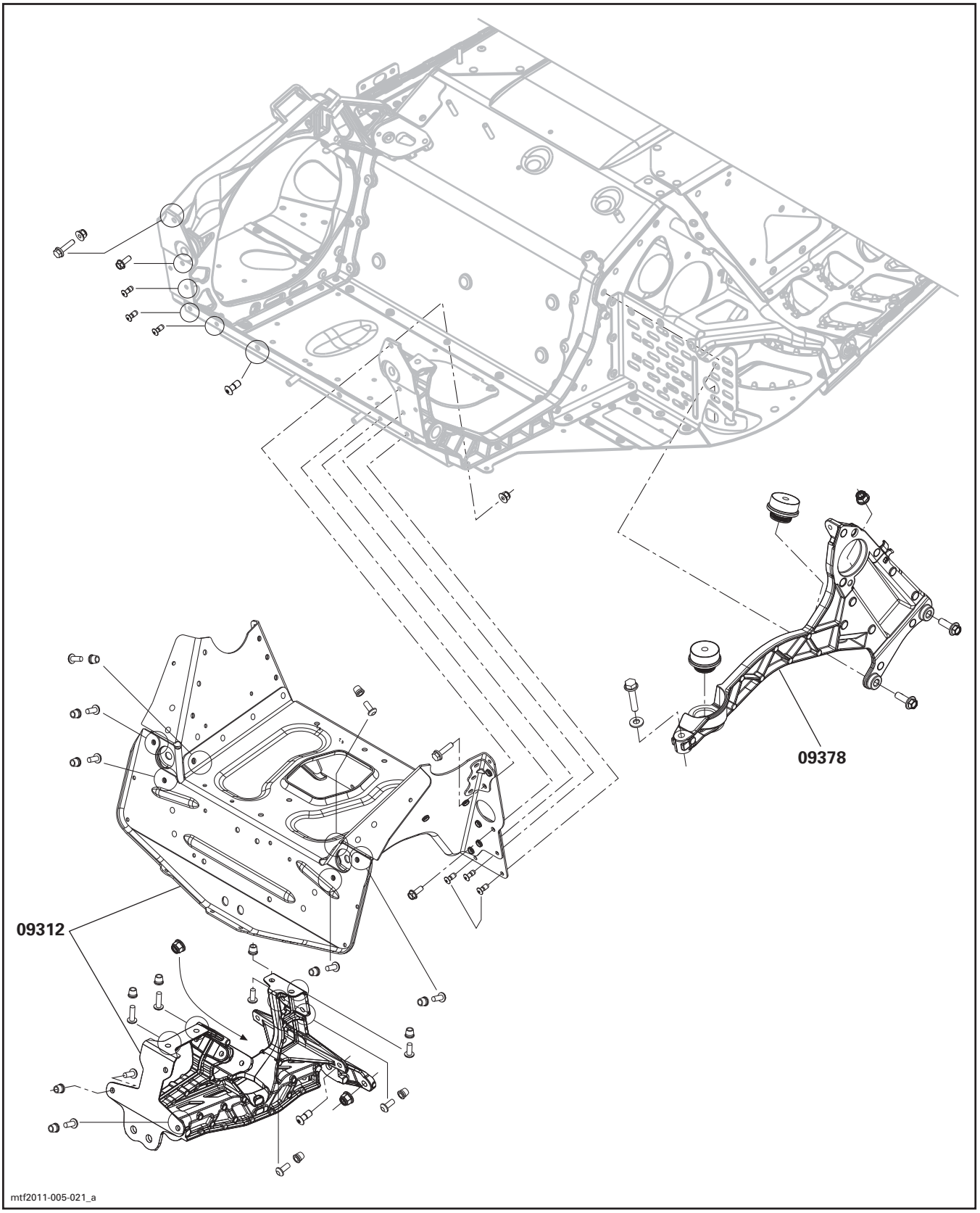

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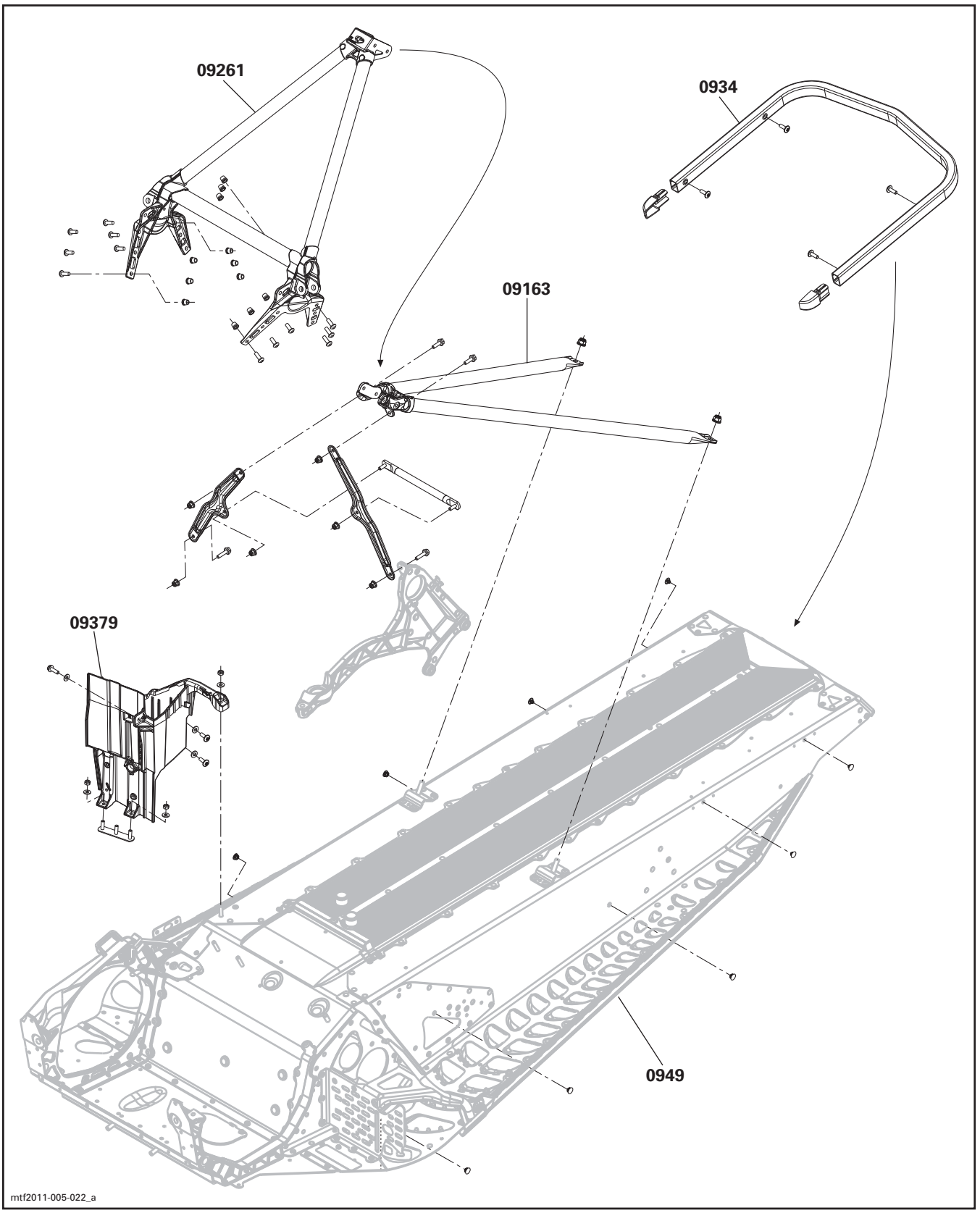

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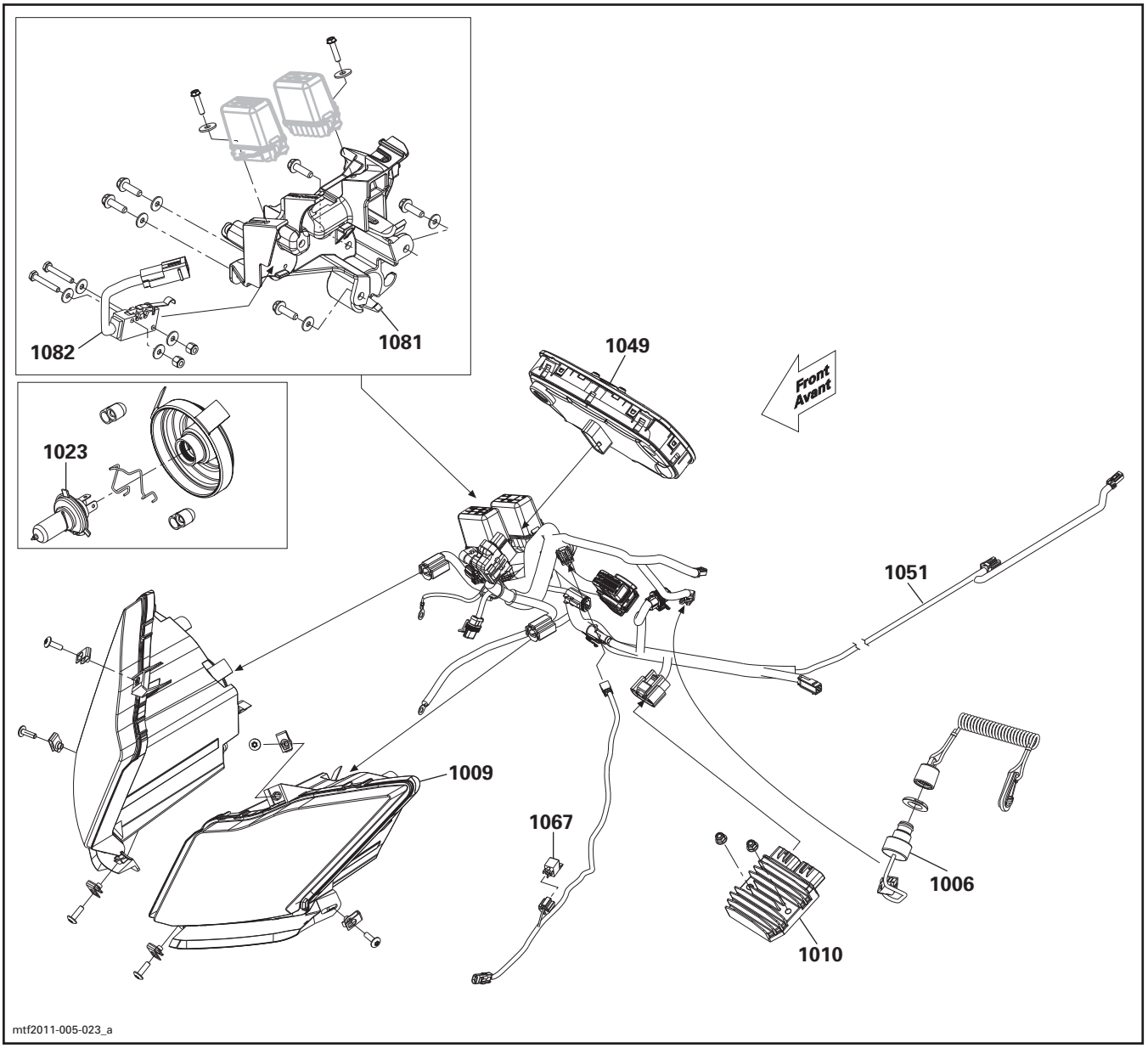

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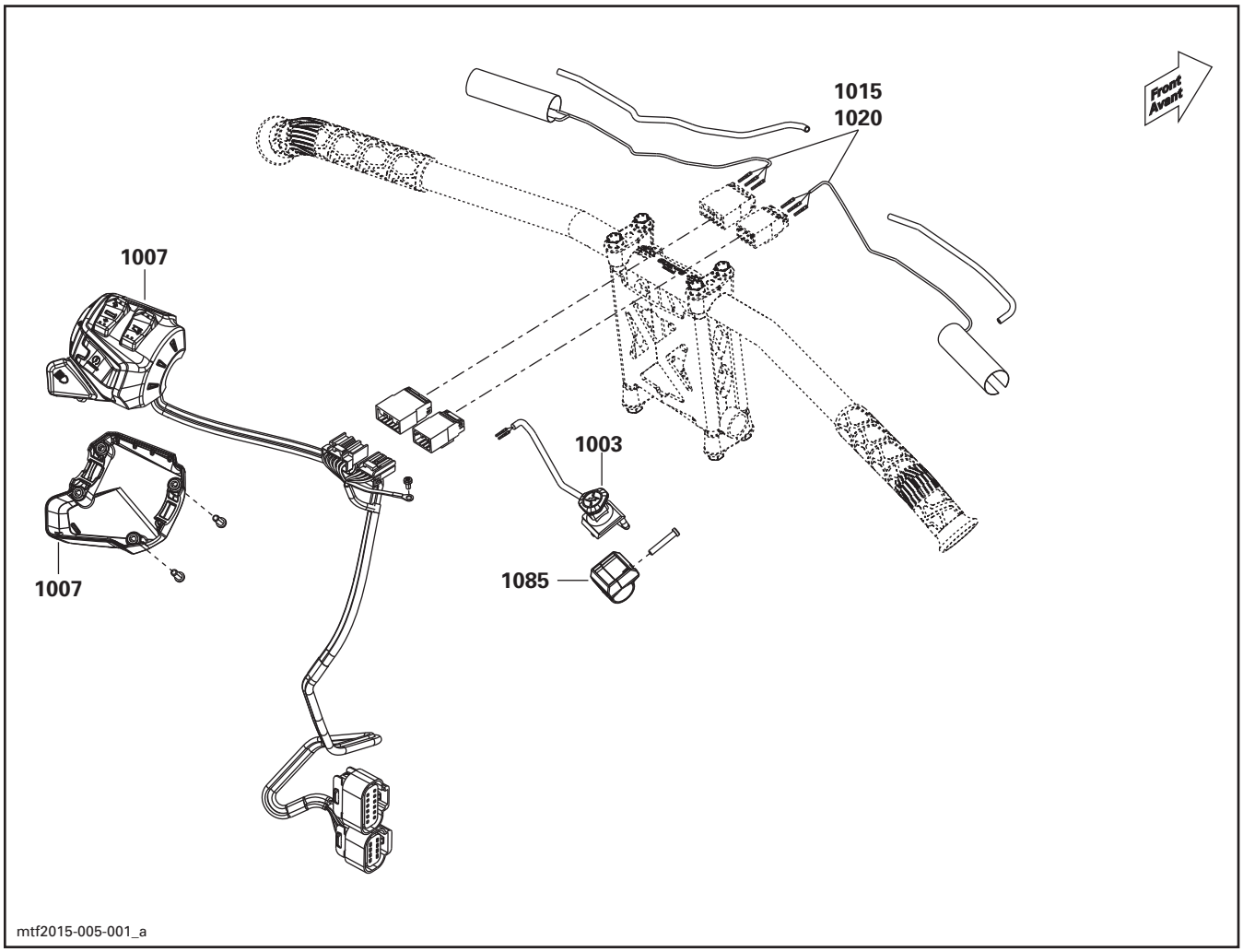

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SYSTEM SYSTÈME	CODE	DESCRIPTION	MXZ / RENEGADE 600 ACE	GRAND TOURING 600 ACE	EXPEDITION 600 ACE	TUNDRA 600 ACE	SKANDIC 600 ACE
			19	20	21	22	23
10	00	**NO LABOR INVOLVED AUCUNE MAIN-D'OEUVRE IMPLIQUÉE**	0	0	0	0	0
10	01	IGNITION SWITCH INTERRUPTEUR D'ALLUMAGE	0.3	0.3	0.3	0.3	0.3
10	03	KILL SWITCH D'INTERRUPTEUR D'URGENCE	0.3	0.3	0.3	0.3	0.3
10	05	BRAKE LIGHT SWITCH INTERRUPTEUR DE FEU D'ARRÊT	0.3	0.3	0.3	0.3	0.3
10	06	TETHER CORD SWITCH OR D.E.S.S. CAPUCHON COUPE-CIRCUIT OU D.E.S.S.	0.3	0.3	0.3	0.3	0.3
10	07	IGNITION SWITCH BLOCK LOGEMENT DE RÉCEPTACLE (INTERRUPTEUR)	0.3	0.3	0.3	0.3	0.3
10	08	CURRENT OR GROUND WIRE FIL DE BATTERIE OU DE MASSE	0.3	0.3	0.3	0.3	0.3
10	09	HEADLAMP (ASS'Y) (ALL PARTS) PHARE (COMPLET) (TOUTES LES PIÈCES)	0.3	0.3	0.3	0.3	0.3
10	10	VOLTAGE REGULATOR RÉGULATEUR DE TENSION	0.7	0.7	0.7	0.7	0.7
10	12	TAIL LIGHT (ASS'Y) (ALL PARTS) FEU ARRIÈRE (COMPLET) (TOUTES LES PIÈCES)	0.3	0.3	0.3	0.3	0.3
10	13	BATTERY BATTERIE	0.3	0.3	0.3	0.3	0.3
10	15	HEATED GRIP (1) POIGNÉES CHAUFFANTE (1)	0.5	0.5	0.5	0.5	0.5
10	16	BULBS (ONE OR ALL) AMPOULES (UNE OU TOUTES)	0.3	0.3	0.3	0.3	0.3
10	17	HEATED THROTTLE LEVER MANETTE D'ACCÉLÉRATEUR CHAUFFANTE	0.3	0.3	0.3	0.3	0.3
10	23	HALOGEN BULB AMPOULE HALOGÈNE	0.3	0.3	0.3	0.3	0.3
10	31	DC OUTLET PLUG PRISE D'ACCESSOIRE DC			0.3		0.3
10	34	ELECTRONIC MODULE MODULE ÉLECTRONIQUE	0.7	0.7	0.7	0.7	0.7
10	41	ENGINE HARNESS CÂBLAGE DU MOTEUR	1.5	1.5	1.5	1.5	1.5
10	49	MULTIFUNCTION GAUGE CADRAN MULTIFONCTION	0.3	0.3	0.3	0.3	0.3
10	50	HEATED GRIPS (2) POIGNÉES CHAUFFANTES (2)	0.9	0.9	0.9	0.9	0.9
10	51	MAIN HARNESS CÂBLAGE PRINCIPAL	1.8	1.8	1.8	1.8	1.8
10	59	REAR HEATED GRIP (1) POIGNÉE CHAUFFANTE ARRIÈRE (1)		0.5			

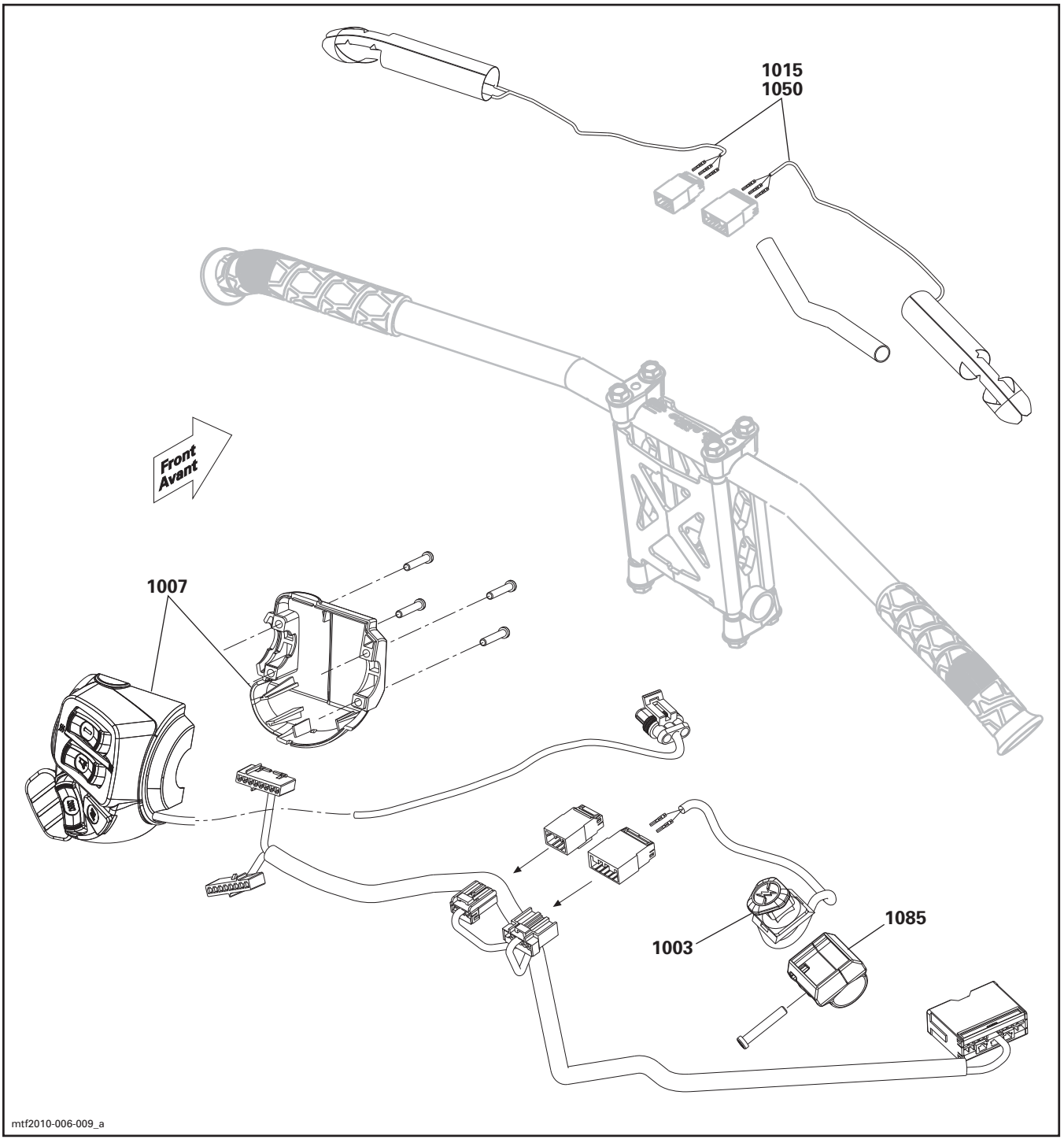
SYSTEM SYSTÈME	CODE	DESCRIPTION	MXZ / RENEGADE 600 ACE	GRAND TOURING 600 ACE	EXPEDITION 600 ACE	TUNDRA 600 ACE	SKANDIC 600 ACE
			19	20	21	22	23
10	60	REAR HEATED GRIPS (2) POIGNÉES CHAUFFANTES ARRIÈRE (2)		0.9			
10	67	RELAY RELAIS	0.3	0.3	0.3	0.3	0.3
10	81	MULTIFUNCTION PLATE PLAQUE MULTIFONCTION	0.4	0.4	0.4	0.4	0.4
10	82	REVERSE SWITCH INTERRUPTEUR DE RENVERSE	0.3	0.3	0.3	0.3	0.3
10	85	KILL SWITCH SUPPORT SUPPORT D'INTERRUPTEUR D'URGENCE	0.3	0.3	0.3	0.3	0.3
10	118	STEERING HARNESS CÂBLAGE DU GUIDON	1.0	1.0	1.0	1.0	1.0
10	133	FAN HARNESS CABLAGE DU VENTILATEUR		0.3	0.3	0.3	

ELECTRICAL SYSTEM
SYSTÈME ÉLECTRIQUE




Front
Avant
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1007
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ELECTRICAL SYSTEM
SYSTÈME ÉLECTRIQUE



Flat rate times are what the manufacturer pays the authorized dealer for warranty work, the times listed are usually unrealistic for even the most experienced mechanic and will take longer to actually complete.

Because of this dealers will usually charge more than the times posted.

I cannot be held responsible for any errors BRP has made in these service flat rate or parts manuals.

If you bought this manual from any other seller, they could be reselling my work.

Please leave them negative feedback & email me at bestshopmanuals@gmail.com .

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Thank you for choosing us.





ski-doo®

BRP

2015

FLAT RATE
Time Schedule
Volume 6

BARÈME DE TEMPS
à taux fixe

EXPEDITION
Sport 900 ACE
LE 900 ACE
SE 900 ACE

RENEGADE
Adrenaline 900 ACE

SKANDIC
WT 900 ACE
SWT

GRAND TOURING
LE 900 ACE

GSX
LE 900 ACE

MXZ
TNT 900 ACE

Effective May 25th, 2014
En vigueur le 25 mai 2014

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INTRODUCTION

This publication governs all warranty labor allowances for 2015 snowmobiles.

1. HOW DOES IT WORK

We follow the procedures detailed in the *Snowmobiles Shop Manual*. The flat rate time is the maximum time allowed for a repair involving any given part. FLAT RATE TIME IS NOT CUMULATIVE. You must use the flat rate time given for the longest lasting operation.

NOTE: The *Flat Rate Time Schedule* was prepared by skilled mechanics using the hand tool usually found in workshops and all the special tools mentioned in the *Shop Manual*.

2. COMPILATION

The *Flat Rate Time Schedule* is compiled as follows:

The actual required time to perform the repair plus (+) 30% correction factor up to 3.0 hours or (+) 15% over 3.0 hours time to take into account, among others:

- Vehicle handling
- Obtaining the parts
- Diagnosis
- Cleaning
- Special compensation (rusted bolts).

3. HOW TO USE IT

Refer to the system you need, locate part of series of parts replaced. List JOB CODE in the appropriate column on claim.

SYSTEM		PAGE
01	ENGINE	4
02	FUEL SYSTEM	16
03	IGNITION SYSTEM	19
04	STARTER SYSTEM	21
05	TRANSMISSION SYSTEM	22

SYSTEM		PAGE
06	BRAKE SYSTEM	28
07	STEERING SYSTEM AND FRONT SUSPENSION	30
08	REAR SUSPENSION SYSTEM AND TRACK	35
09	BODY	41
10	ELECTRICAL SYSTEM	52

NOTE: Unless otherwise specified, dismantling order is: top to bottom, exterior to interior, front to rear.

All fractions of hours are in tenths:

0.1 = 6 minutes
0.2 = 12 minutes, and so on

LEGEND:

* REQUIRES PRIOR AUTHORIZATION BY DISTRIBUTOR.
** INDICATE LABOUR TIME ON LINE "LABOUR ONLY" OF CLAIM.
*** INDICATE $$$ AMOUNT ON "SUB-CONTRACTED LABOUR" OF CLAIM.

IMPORTANT: Always use the longest flat rate time applicable to the repair performed.

4. JOB REQUIREMENTS

All the flat rate times mentioned in the following pages include the required operations such as: engine timing (rotary valve and ignition), connecting rod(s) alignment, cylinder head(s) torque or use of parallel bar, use of ignition tester, piston clearance/ring end gap measurement, crankshaft to crankcase measurement, cylinder honing, engine leak test.

5. ILLUSTRATIONS

The illustrations contained in this manual do not necessarily show every components of a given system as *Parts Catalog* do. Their purpose is to facilitate recognition of parts related to a flat rate time. Item numbers on illustrations correspond to the four digit Job Code.

6. SUGGESTION (FORM REQUEST)

INTRODUCTION

Cette publication détermine le temps de main-d'oeuvre couvert par la garantie pour les motoneiges 2015.

1. UTILISATION DU MANUEL

En procédant de la façon indiquée dans le *Manuel de réparation motoneiges*, chaque temps donné représente le maximum permis pour une réparation portant sur cette pièce. LES TEMPS NE SONT PAS CUMULATIFS. On doit inscrire le temps donné pour l'opération qui prend le plus de temps.

REMARQUE: Le *Barème de temps à taux fixe* a été préparé par des mécaniciens compétents utilisant les outils que l'on retrouve normalement dans les ateliers de réparation, en plus de tous les outils spéciaux mentionnés dans le *Manuel de réparation*.

2. COMPILATION

Le *Barème de temps à taux fixe* a été établi en compilant le temps nécessaire pour faire la réparation plus (+) un facteur de correction de 30% lorsqu'un travail dure 3.0 heures et moins, ou (+) 15% lorsqu'un travail dure plus de 3.0 heures. Cette compilation comprends, entre autres les étapes suivantes:

- Manutention du véhicule
- Nettoyage
- Aller chercher les pièces, essais physique
- Compensation spéciale (boulons rouillés)
- Diagnostic.

3. UTILISATION DU BARÈME

Se reporter à la section désirée, repérer la pièce ou l'ensemble de pièces remplacées et inscrire le CODE DE TRAVAIL dans la colonne appropriée sur la formule de réclamation.

SYSTÈME		PAGE
01	MOTEUR	4
02	SYSTÈME DESSENCE	16
03	SYSTÈME D'ALLUMAGE	19
04	DÉMARREUR	21
05	SYSTÈME DE TRANSMISSION	22

SYSTÈME		PAGE
06	SYSTÈME DE FREIN	28
07	SYSTÈME DE DIRECTION ET SUSPENSION AVANT	30
08	SUSPENSION ARRIÈRE ET CHENILLE	35
09	CARROSSERIE	41
10	SYSTÈME ÉLECTRIQUE	52

REMARQUE: Sauf indication contraire, le démontage doit s'effectuer de haut en bas, de l'extérieur vers l'intérieur, de l'avant vers l'arrière.

Toutes les fractions d'heures sont exprimées en dixièmes:

0.1 = 6 minutes
0.2 = 12 minutes, et ainsi de suite

LÉGENDE:

* AUTORISATION REQUISE AVANT LE REMPLACEMENT.
** INSCRIRE LE TEMPS À LA LIGNE «MAIN D'OEUVRE SEULEMENT».
*** INSCRIRE LE MONTANT $$$ À LA LIGNE «OUVRAGE SOUS-CONTRACTÉE».

IMPORTANT: Toujours utiliser le temps donné à l'opération qui nécessite le plus de temps.

4. TRAVAUX REQUIS

Tous les temps mentionnés dans les pages suivantes incluent les opérations telles que: réglage du moteur (valve rotative et allumage), alignement de la ou des bielles, couple de serrage de la ou des culasses ou l'utilisation de barres parallèles, utilisation du vérificateur d'allumage, mesure du jet des pistons/jeu en bout des segments, mesure de l'écart entre le vilebrequin et le carter, rectification du cylindre, vérification de fuite du moteur.

5. ILLUSTRATIONS

Contrairement aux *Catalogues de pièces*, les illustrations de ce manuel ne montrent pas nécessairement chacune des pièces qu'elles représentent, leur raison d'être étant plutôt de faciliter la reconnaissance des pièces reliées à un barème de temps à taux fixe. **Les numéros d'items sur les illustrations correspondent aux quatre derniers chiffres du code de travail.**

6. SUGGESTION DE CHANGEMENT (FORMULAIRE)

2015

LIQUID COOLED 4-STROKES
4 TEMPS REFROIDIS PAR LIQUIDE

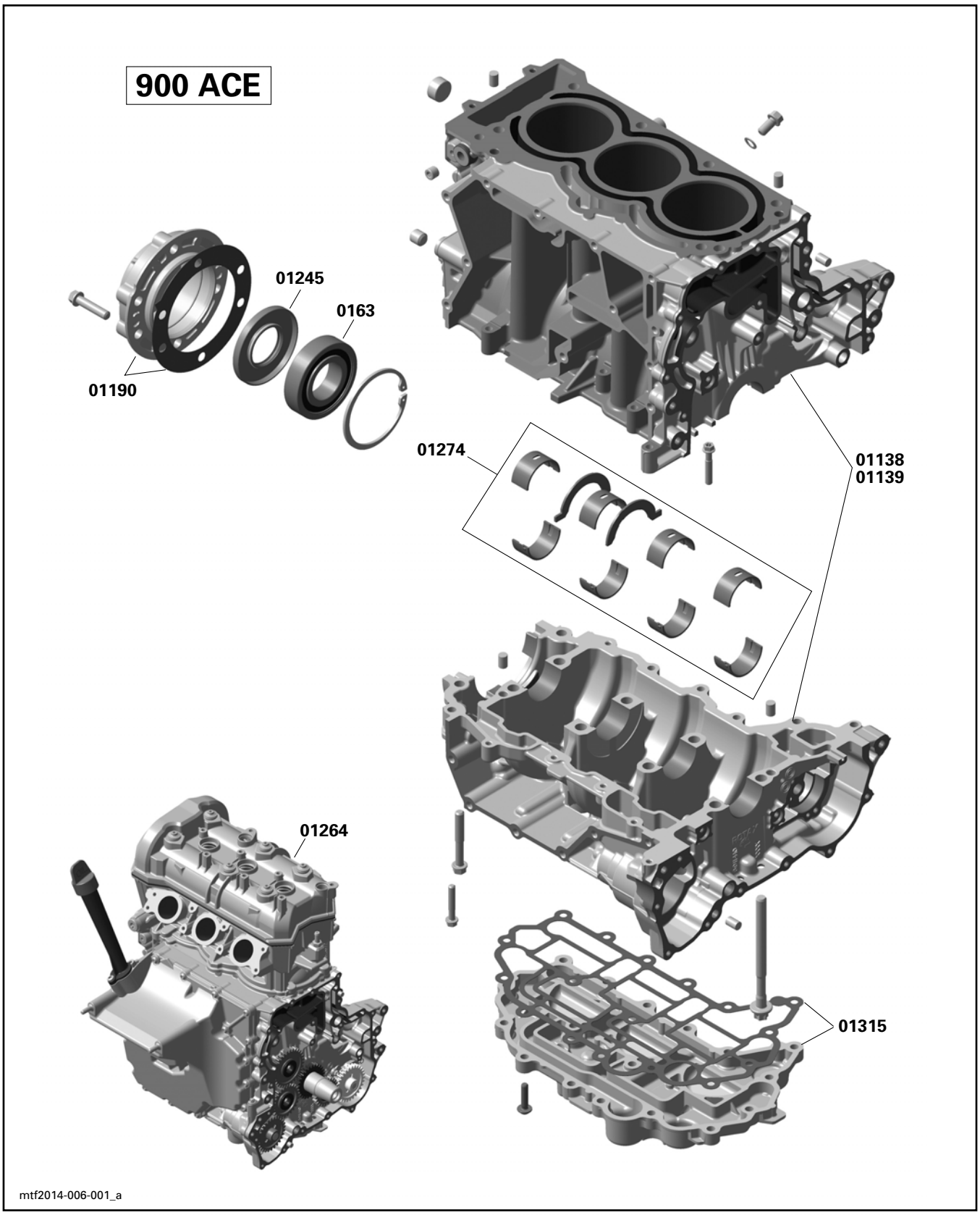
TABLE	DESCRIPTION	MODEL/ *MODÈLE*	ENGINE/ *MOTEUR*	CHASSIS TYPE/ *TYPE DE CHÂSSIS*	REVERSE/ *MARCHE ARRIÈRE*	REAR SUSPENSION/ *SUSPENSION ARRIÈRE*	ELECTRIC STARTER/ *DÉMARREUR ÉLECTRIQUE*
24	MXZ TNT 900 ACE	MAFA/MAFB	902 ACE	REV-XP 120″	MEC	SC-5	STD
	RENEGADE Adrenaline 900 ACE	MBFA/MBFB		REV-XP 137″			
25	GRAND TOURING LE 900 ACE	EAFA	902 ACE	REV-XP 137″	MEC	SC-5	STD
	GSX LE 900 ACE	DRFA					
26	EXPEDITION Sport 900 ACE	KDFA/KDFB	902 ACE	REV-XP 154″	MEC	SC-5U	STD
27	EXPEDITION LE 900 ACE	SRFA/SRFB	902 ACE	REV-XU 154″	MEC	SC-5U	STD
	EXPEDITION SE 900 ACE	SRFE					
28	SKANDIC WT 900 ACE	FRFA	902 ACE	REV-XU 154″	MEC	SC-5U	STD
	SKANDIC SWT 900 ACE	LDFA					

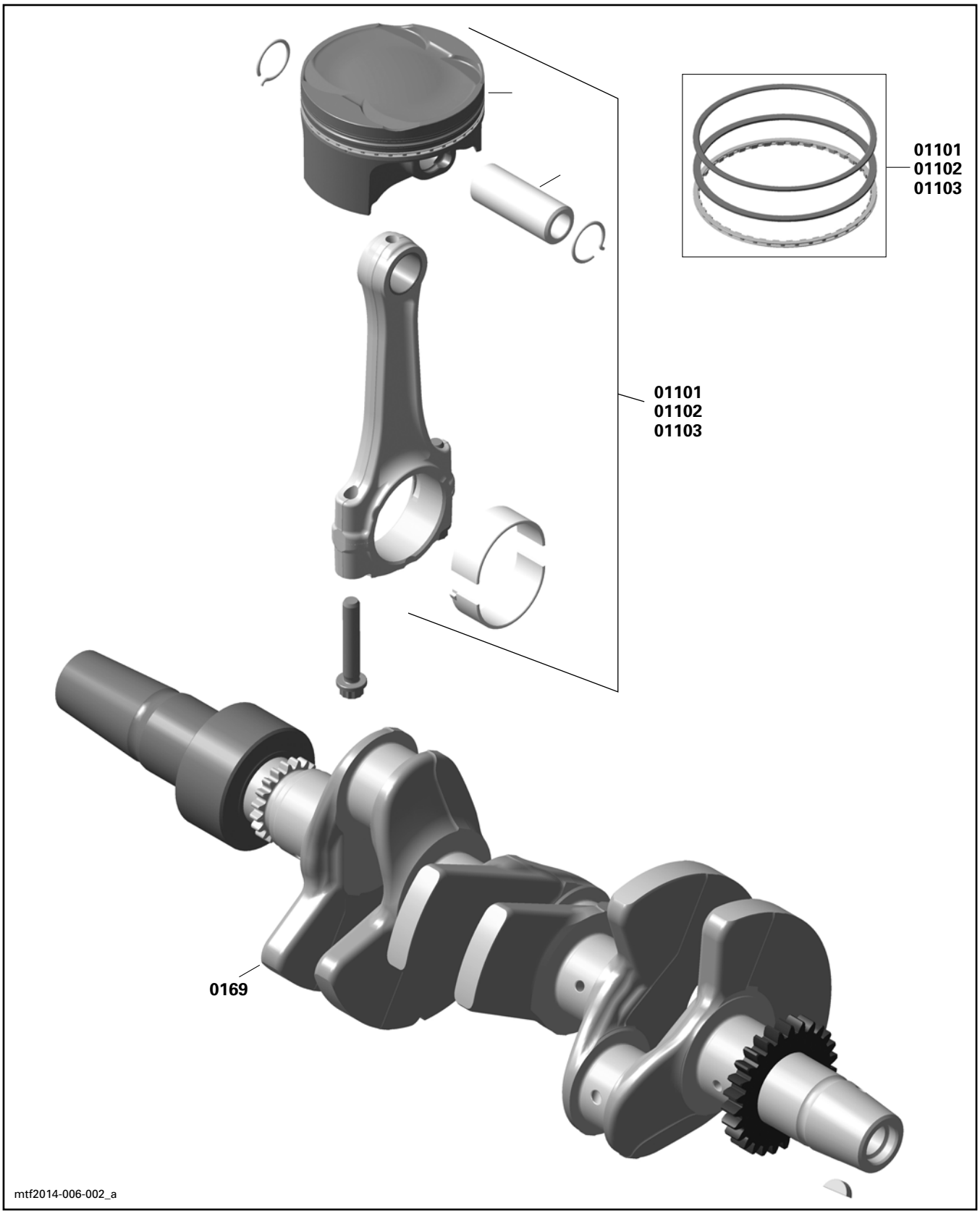
SYSTEM SYSTÈME	CODE	DESCRIPTION	MXZ / RENEGADE 900 ACE	GRAND TOURING GSX 900 ACE	EXPEDITION 900 ACE SPORT	EXPEDITION LE/SE 900 ACE	SKANDIC 900 ACE
			24	25	26	27	28
01	**00**	**NO LABOR INVOLVED AUCUNE MAIN-D'OEUVRE IMPLIQUÉE**	**0**	**0**	**0**	**0**	**0**
01*	**01**	**REMOVE AND REPLACE ENGINE (ASS'Y) REMPLACEMENT MOTEUR (COMPLET)**	**3.7**	**3.7**	**3.7**	**3.7**	**3.7**
01	03	OIL PRESSURE SWITCH INTERRUPTEUR DE PRESSION D'HUILE	0.3	0.3	0.3	0.3	0.3
01	08	FAN VENTILATEUR		0.3	0.3	0.3	0.3
01	18	COOLANT TEMPERATURE SENDER CAPTEUR DE TEMPÉRATURE LIQUIDE DE REFROIDISSEMENT	0.4	0.4	0.4	0.4	0.4
01	19	THERMOSTAT THERMOSTAT	1.0	1.0	1.0	1.0	1.0
01	38	WATER PUMP SHAFT (ALL PARTS) ARBRE DE LA POMPE À EAU (TOUTES LES PIÈCES)	6.0	6.0	6.0	6.0	6.0
01	39	OIL TANK RÉSERVOIR D'HUILE	4.0	4.0	4.0	4.0	4.0
01	46	RADIATOR AND/OR GROMMET RADIATEUR ET/OU PASSE FILS		0.6	0.6	0.6	0.6
01	51	CYLINDER HEAD GASKET JOINT DE CULASSE	4.5	4.5	4.5	4.5	4.5
01	63	CRANKSHAFT BEARING PTO ROULEMENT DE VILEBREQUIN, COTE PDM	0.5	0.5	0.5	0.5	0.5
01	69	CRANKSHAFT VILEBREQUIN	7.5	7.5	7.5	7.5	7.5
01	71	EXHAUST MANIFOLD COLLECTEUR D'ECHAPPEMENT	0.5	0.5	0.5	0.5	0.5
01	75	MUFFLER AND/OR EXHAUST GROMMET/SUPPORT SILENCIEUX ET/OU BAGUE D'ÉCHAPPEMENT/SUPPORT	0.3	0.3	0.3	0.3	0.3
01	79	COOLANT HOSE (TANK TO ENGINE) BOYAU SYSTÈME DE REFROIDISSEMENT (RÉSERVOIR AU MOTEUR)	1.0	1.0	1.0	1.0	1.0
01	88	RUBBER MOUNT (MUFFLER) TAMPON D'ANCRAGE (SILENCIEUX)	0.3	0.3	0.3	0.3	0.3
01	90	ENGINE OIL FILTER FILTRE À HUILE DU MOTEUR	0.3	0.3	0.3	0.3	0.3
01	94	REAR RADIATOR RADIATEUR ARRIÈRE	4.3	4.3	4.3	4.3	4.3
01	96	OIL SIEVE CRIBLE D'HUILE	4.5	4.5	4.5	4.5	4.5
01	98	COOLING RESERVOIR RÉSERVOIR D'ANTIGEL	0.4	0.4	0.4	0.4	0.4
01	100	RADIATOR OUTLET HOSE BOYAU DE SORTIE DU RADIATEUR	0.6	0.6	0.6	0.6	0.6
01	101	PISTON, PIN, CIRCLIP, RING (1) PISTON, AXE, FREIN D'AXE, SEGMENT (1)	6.2	6.2	6.2	6.2	6.2

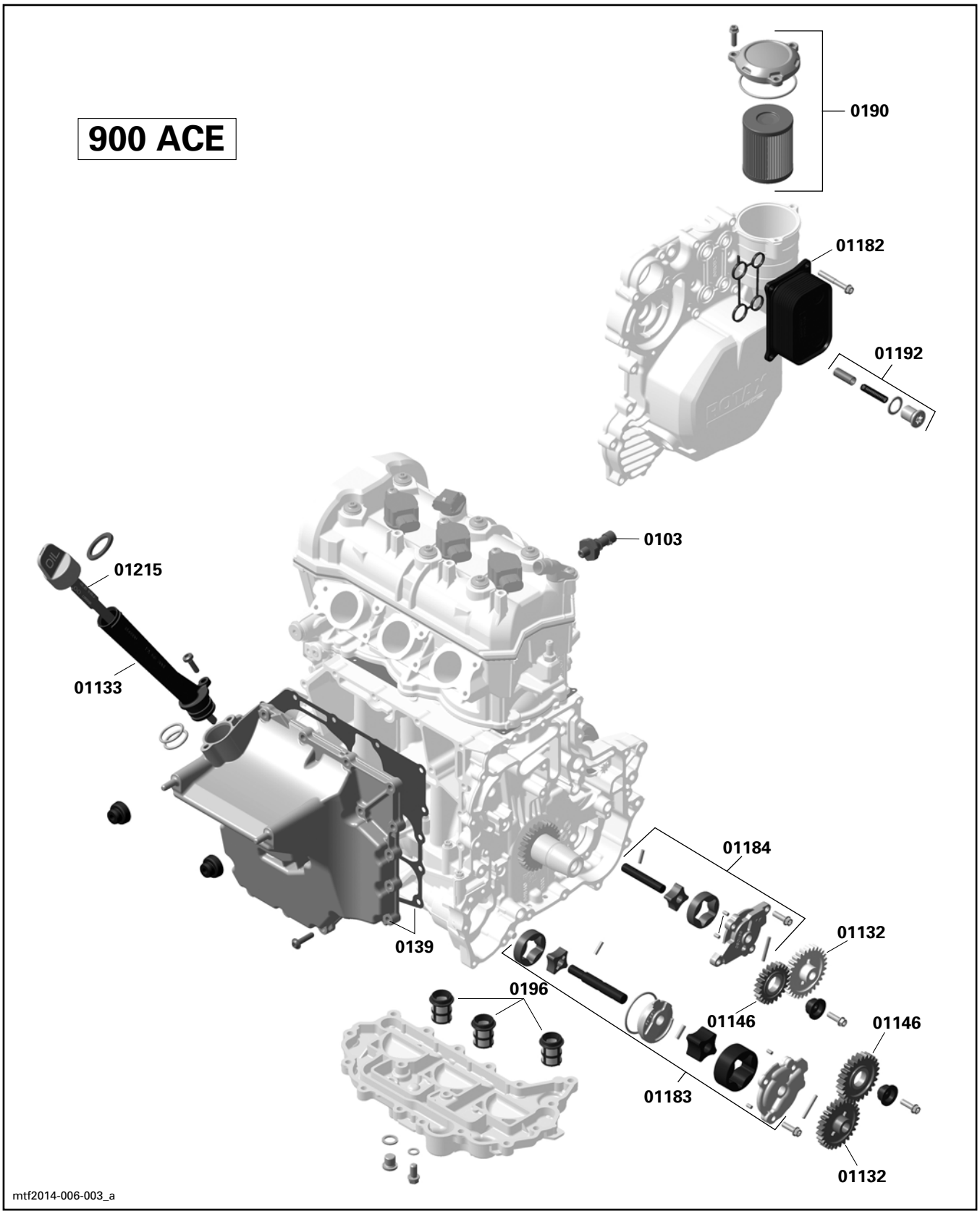
SYSTEM SYSTÈME	CODE	DESCRIPTION	MXZ / RENEGADE 900 ACE	GRAND TOURING GSX 900 ACE	EXPEDITION 900 ACE SPORT	EXPEDITION LE/SE 900 ACE	SKANDIC 900 ACE
			24	25	26	27	28
01	102	PISTONS, PINS, CIRCLIPS, RINGS (2) PISTONS, AXES, FREINS D'AXE, SEGMENTS (2)	6.3	6.3	6.3	6.3	6.3
01	103	PISTON, BEARING, PIN (3 PISTON) PISTON,ROULEMENT,AXE (3 PISTONS)	6.5	6.5	6.5	6.5	6.5
01	109	VALVE COVER AND/OR GASKET COUVERCLE DE SOUPAPE ET/OU JOINT D'ÉTANCHÉITÉ	0.7	0.7	0.7	0.7	0.7
01	111	TIMING GEARS ENGRENAGES DE LA DISTRIBUTION	1.6	1.6	1.6	1.6	1.6
01	114	CYLINDER HEAD AND/OR GASKET CULASSE ET/OU JOINT D'ÉTANCHÉITÉ	5.0	5.0	5.0	5.0	5.0
01	116	EXHAUST AND/OR INLET VALVE AND/OR SPRING AND/OR SEAL VALVE D'ADMISSION ET/OU D'ÉCHAPPEMENT ET/OU RESSORT ET/OU ANNEAU D'ÉTANCHÉITÉ	4.0	4.0	4.0	4.0	4.0
01	119	WATER PUMP HOUSING AND/OR IMPELLER CARTER DE POMPE À EAU ET/OU ROUE AILETTES	1.0	1.0	1.0	1.0	1.0
01	132	OIL PUMP GEAR ENGRENAGE DE LA POMPE À HUILE	4.2	4.2	4.2	4.2	4.2
01	133	OIL PIPE TUYAU À L'HUILE	0.3	0.3	0.3	0.3	0.3
01	138	CRANKCASE RESEAL AND/OR GASKET RESCELLEMENT CARTER ET/OU JOINT D'ÉTANCHÉITÉ	6.0	6.0	6.0	6.0	6.0
01	139	CRANKCASE REPLACEMENT REMPLACEMENT DU CARTER	7.5	7.5	7.5	7.5	7.5
01	146	OIL PUMP GEAR (2) ENGRENAGE POMPE À L'HUILE (2)	4.2	4.2	4.2	4.2	4.2
01	154	TIMING CHAIN (PTO SIDE) CHAÎNE D'ENGRENAGE (CÔTÉ PDM)	6.0	6.0	6.0	6.0	6.0
01	179	CHAIN GUIDE GUIDE DE CHAÎNE	1.5	1.5	1.5	1.5	1.5
01	182	OIL RADIATOR AND/OR O-RING RADIATEUR D'HUILE ET/OU JOINT	0.5	0.5	0.5	0.5	0.5
01	183	OIL PUMP COVER AND/OR SHAFT AND/OR ROTOR COUVERCLE POMPE ET/OU ARBRE ET/OU ROTOR	4.4	4.4	4.4	4.4	4.4
01	184	OIL PUMP HOUSING AND/OR ALL PARTS BOÎTIER POMPE HUILE ET/OU TOUTES LES PIÈCES	4.4	4.4	4.4	4.4	4.4
01	190	PTO HOUSING AND/OR GASKET BOITIER PDM ET/OU JOINT	0.5	0.5	0.5	0.5	0.5
01	191	CHAIN TENSION GUIDE GUIDE DE TENSION DE CHAÎNE	5.2	5.2	5.2	5.2	5.2
01	192	CHAIN TENSIONER (ASS'Y) TENDEUR DE CHAÎNE (COMPLET)	0.4	0.4	0.4	0.4	0.4
01	200	WATER PUMP GEAR ENGRENAGE POMPE À EAU	4.2	4.2	4.2	4.2	4.2
01	206	COOLANT HOSE (REAR RADIATOR TO FRONT RADIATOR) BOYAU REFROIDISSEMENT (RADIATEUR ARRIÈRE AU RADIATEUR AVANT)	1.1	1.1	1.1	1.1	1.1

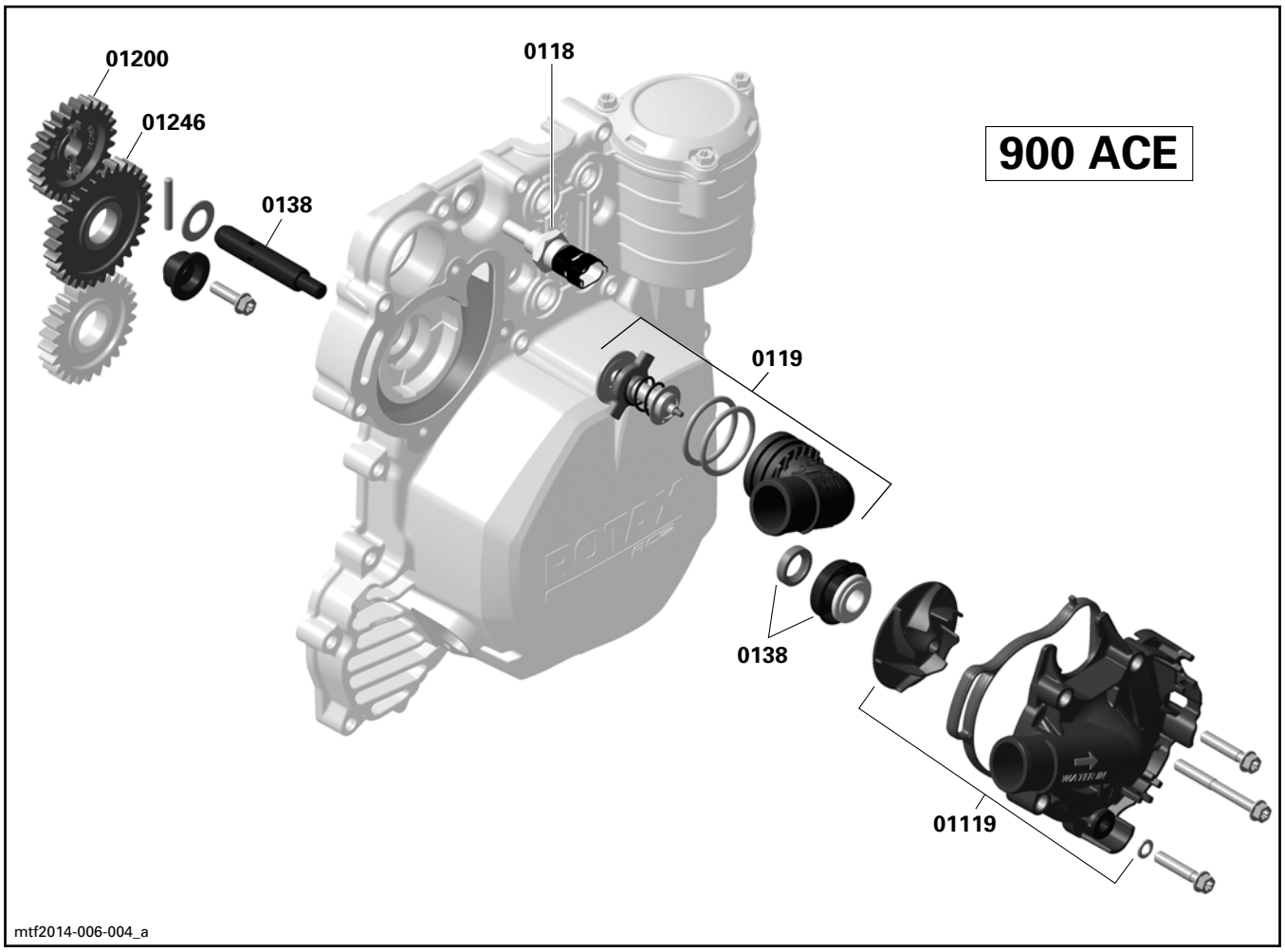
SYSTEM SYSTÈME	CODE	DESCRIPTION	MXZ / RENEGADE 900 ACE	GRAND TOURING GSX 900 ACE	EXPEDITION 900 ACE SPORT	EXPEDITION LE/SE 900 ACE	SKANDIC 900 ACE
			24	25	26	27	28
01	207	COOLANT HOSE (ENGINE TO REAR RADIATOR) BOYAU DE REFROIDISSEMENT (MOTEUR AU RADIATEUR ARRIÈRE)	1.1	1.1	1.1	1.1	1.1
01	215	OIL DIPSTICK JAUGE À L'HUILE	0.3	0.3	0.3	0.3	0.3
01	216	PRESSURE CAP BOUCHON DU RADIATEUR	0.3	0.3	0.3	0.3	0.3
01	245	OUTPUT CRANKSHAFT SEAL (PTO SIDE) ANNEAU D'ÉTANCHÉITÉ SORTIE VILEBREQUIN (CÔTÉ PDM)	0.5	0.5	0.5	0.5	0.5
01	246	WATER PUMP GEARS AND/OR SEAL ENGRENAGES POMPE À EAU ET/OU JOINT D'ÉTANCHÉITÉ	4.5	4.5	4.5	4.5	4.5
01	248	BREATHER GEAR AND/OR V-RING RENIFLARD ET/OU ANNEAU D'ÉTANCHÉITÉ EN V	1.0	1.0	1.0	1.0	1.0
01	250	CRANKSHAFT POSITION SENSOR (CPS) CAPTEUR POSITION DU VILEBREQUIN (CPV)	0.4	0.4	0.4	0.4	0.4
01	255	EXHAUST/INLET VALVES AND/OR SPRINGS AND/OR SEALS (4) VALVES D'ADMISSION/D'ÉCHAPPEMENT ET/OU RESSORTS ET/OU ANNEAUX (4)	4.3	4.3	4.3	4.3	4.3
01	256	EXHAUST/INLET VALVES AND/OR SPRINGS AND/OR SEALS (8) VALVES D'ADMISSION/D'ÉCHAPPEMENT ET/OU RESSORTS ET/OU ANNEAUX (8)	4.5	4.5	4.5	4.5	4.5
01	257	EXHAUST/INLET VALVE A/O SPRINGS A/O SEALS (12) VALVES ADMISSION/ÉCHAPPEMENT E/O RESSORTS E/O ANNEAUX (12)	4.7	4.7	4.7	4.7	4.7
01	264	LONG BLOCK ENSEMBLE CARTER-CYLINDRE-CULASSE	5.4	5.4	5.4	5.4	5.4
01	274	CRANKSHAFT PLAIN BEARINGS PALIERS LISSE DU VILEBREQUIN	7.5	7.5	7.5	7.5	7.5
01	289	FRONT ENGINE SUPPORT (PTO SIDE) SUPPORT MOTEUR AVANT (CÔTÉ PDM)	0.6	0.6	0.6	0.6	0.6
01	290	REAR ENGINE SUPPORT (PTO SIDE) SUPPORT MOTEUR ARRIÈRE (CÔTÉ PDM)	0.6	0.6	0.6	0.6	0.6
01	291	FRONT ENGINE SUPPORT (MAG SIDE) SUPPORT MOTEUR AVANT (CÔTÉ MAG)	0.6	0.6	0.6	0.6	0.6
01	292	REAR ENGINE SUPPORT (MAG SIDE) SUPPORT MOTEUR ARRIÈRE (CÔTÉ MAG)	1.0	1.0	1.0	1.0	1.0
01	293	FRONT RUBBER MOUNT (PTO SIDE) TAMPON D'ANCRAGE AVANT (CÔTÉ PDM)	0.6	0.6	0.6	0.6	0.6
01	294	REAR RUBBER MOUNT (PTO SIDE) TAMPON D'ANCRAGE ARRIÈRE (CÔTÉ PDM)	1.0	1.0	1.0	1.0	1.0
01	295	FRONT RUBBER MOUNT (MAG SIDE) TAMPON D'ANCRAGE AVANT (CÔTÉ MAG)	0.6	0.6	0.6	0.6	0.6
01	296	REAR RUBBER MOUNT (MAG SIDE) TAMPON D'ANCRAGE ARRIÈRE (CÔTÉ MAG)	1.2	1.2	1.2	1.2	1.2
01	311	CAMSHAFT INTAKE/EXHAUST AND/OR CAMSHAFT BRACKETS ARBRE À CAME D'ADMISSION/ÉCHAPPEMENT ET/OU SUPPORTS D'ARBRE À CAME	2.3	2.3	2.3	2.3	2.3

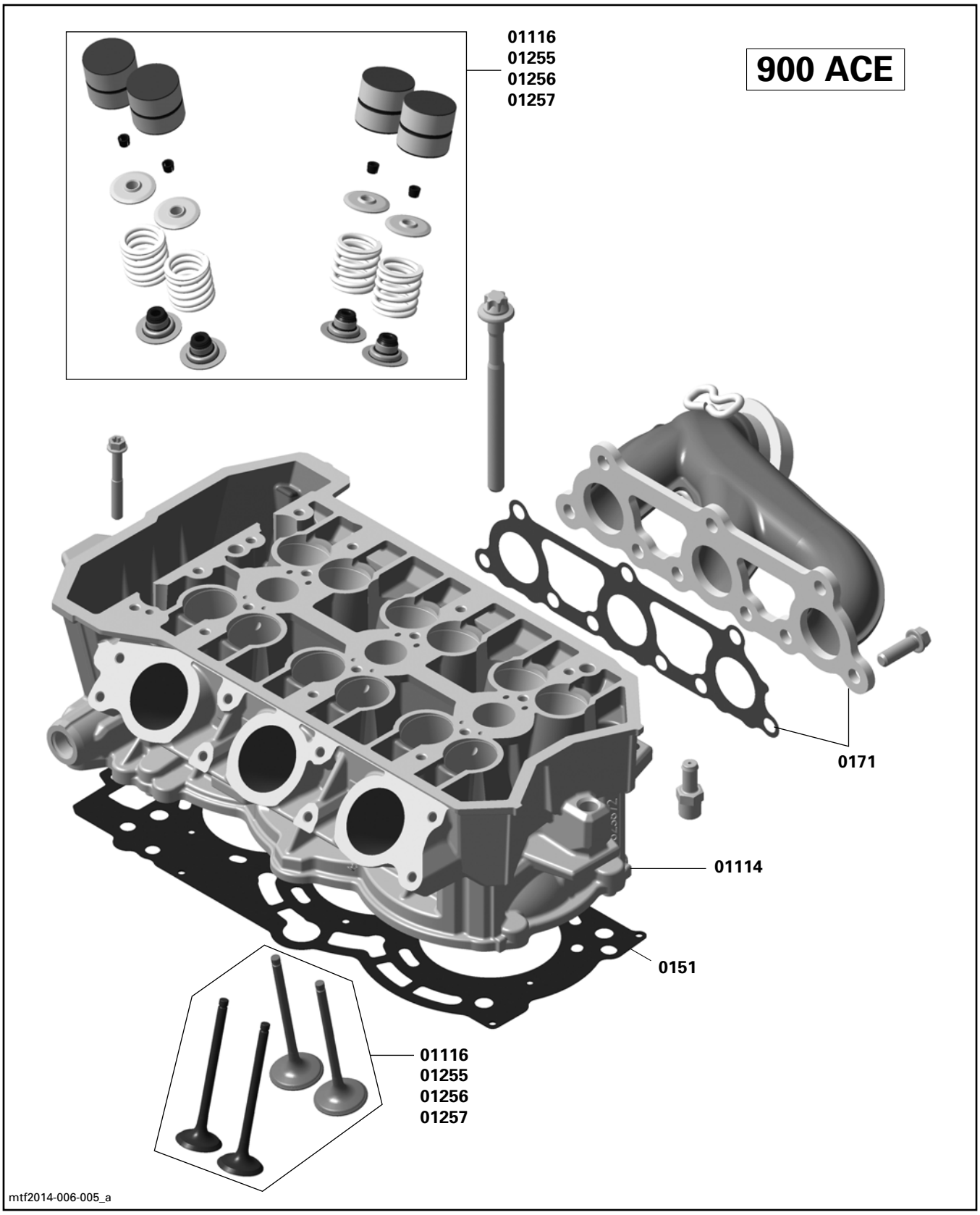
SYSTEM SYSTÈME	CODE	DESCRIPTION	MXZ / RENEGADE 900 ACE	GRAND TOURING GSX 900 ACE	EXPEDITION 900 ACE SPORT	EXPEDITION LE/SE 900 ACE	SKANDIC 900 ACE
			24	25	26	27	28
01	315	OIL SUMP COVER AND GASKET COUVERCLE DU CARTER D'HUILE ET JOINT D'ÉTANCHÉITÉ	4.2	4.2	4.2	4.2	4.2
01	318	RADIATOR SUPPORT SUPPORT DE RADIATEUR				0.3	0.3
01	321	MODULE SUPPORT SUPPORT DU MODULE	1.3	1.3	1.3	1.3	1.3
01	322	WATER PIPE TUYAU D'EAU		0.6	0.6	0.6	0.6
01	323	WATER PIPE DOUBLE TUYAU D'EAU DOUBLE		0.8	0.8	0.8	0.8
01	324	FAN SUPPORT SUPPORT DU VENTILATEUR		0.5	0.5	0.5	0.5
01	325	COOLANT HOSE (WATER PUMP HOUSING TO RADIATOR) BOYAU DE REFROIDISSEMENT (BOÎTIER DE LA POMPE À EAU AU RADIATEUR)	0.6	0.6	0.6	0.6	0.6
01	353	ENJECTORS (ALL) INJECTEUR (TOUS)	1.2	1.2	1.2	1.2	1.2

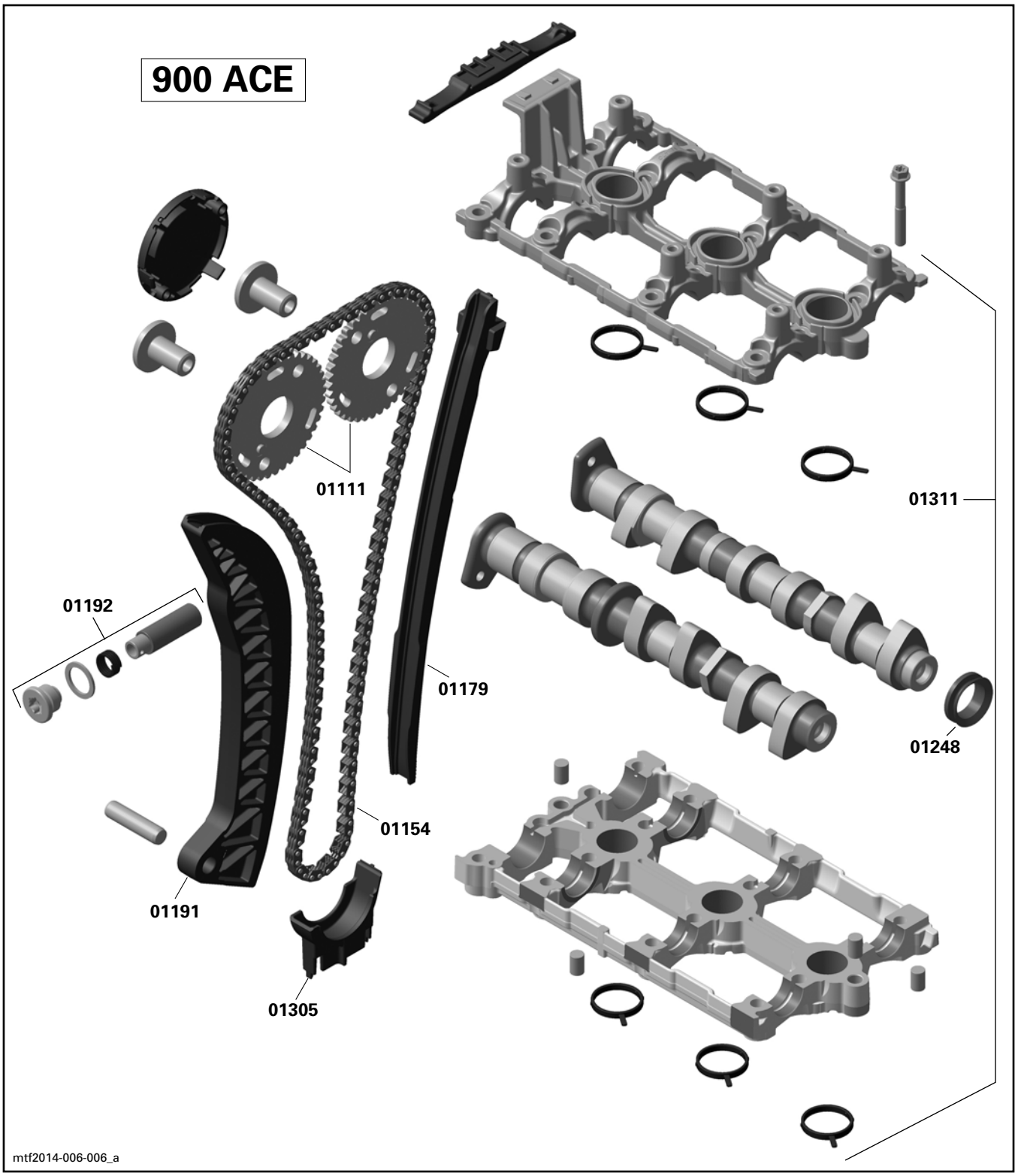

900 ACE
01245
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01190
01274
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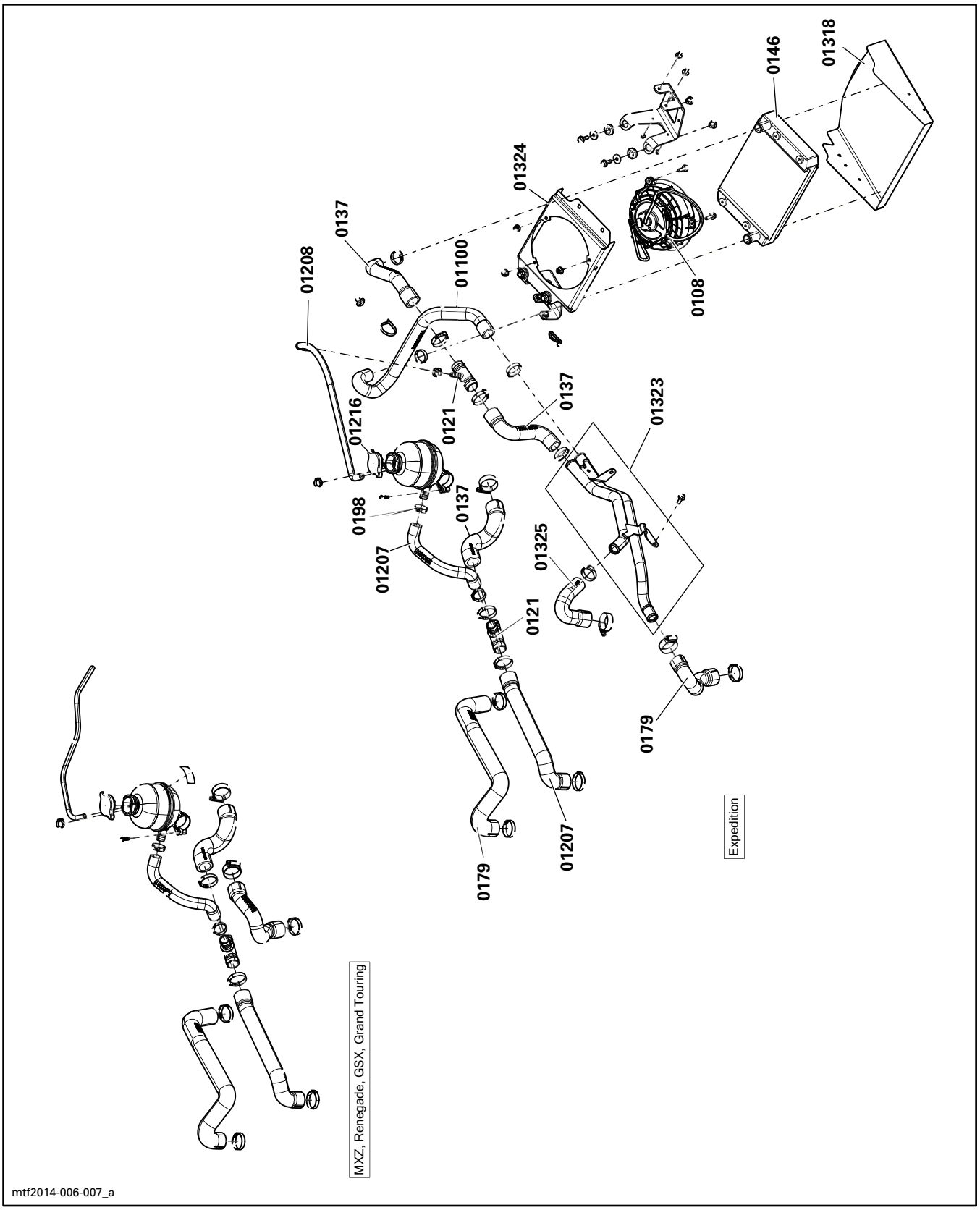

01101
01102
01103
01101
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01103
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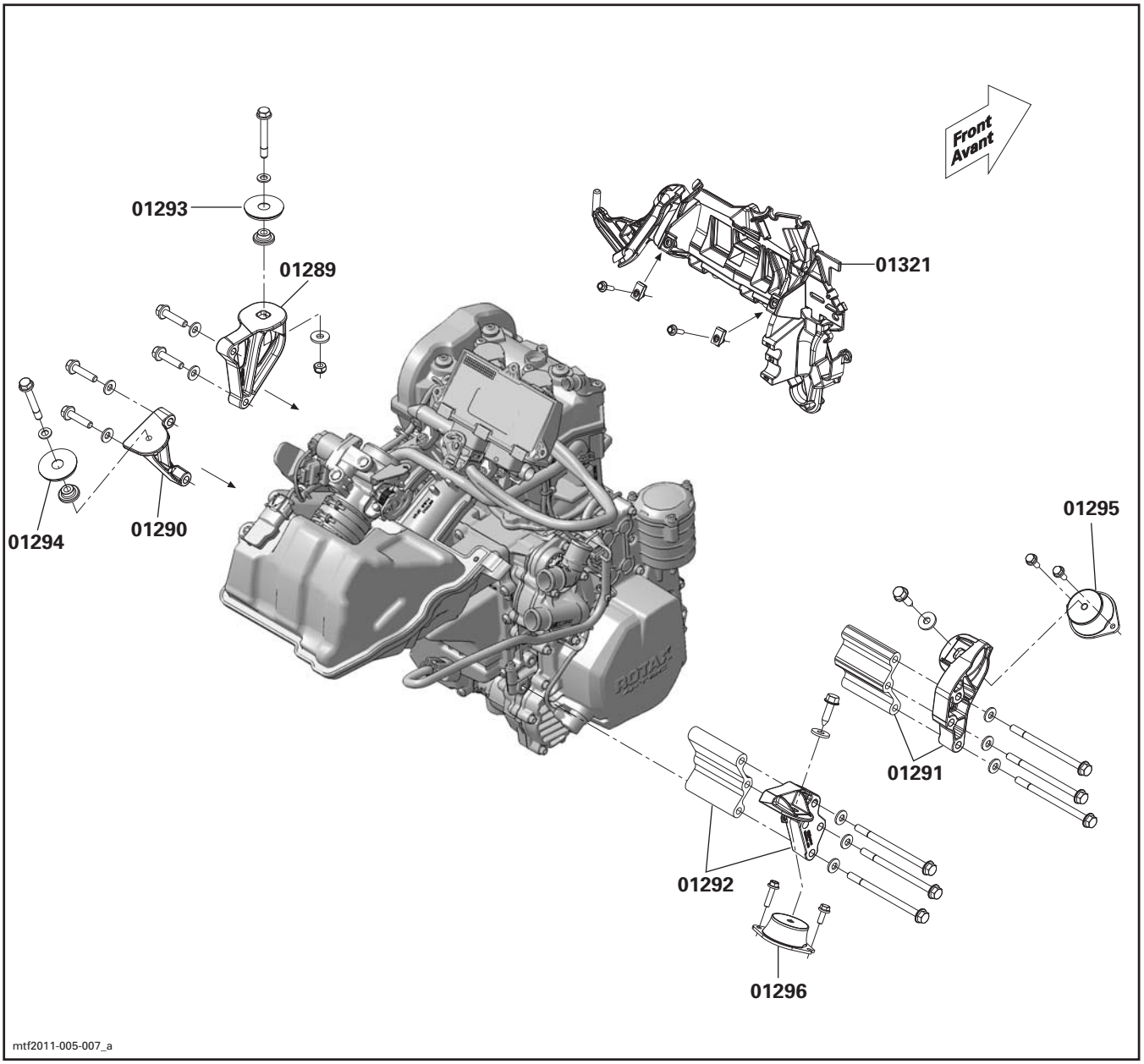

900 ACE
0190
01182
01192
0103
01215
01133
01184
01132
0139
0196
01146
01146
01183
01132
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01200
01246
0138
0118
900 ACE
0119
0138
01119
mtf2014-006-004_a


01116
01255
01256
01257
900 ACE
0171
01114
0151
01116
01255
01256
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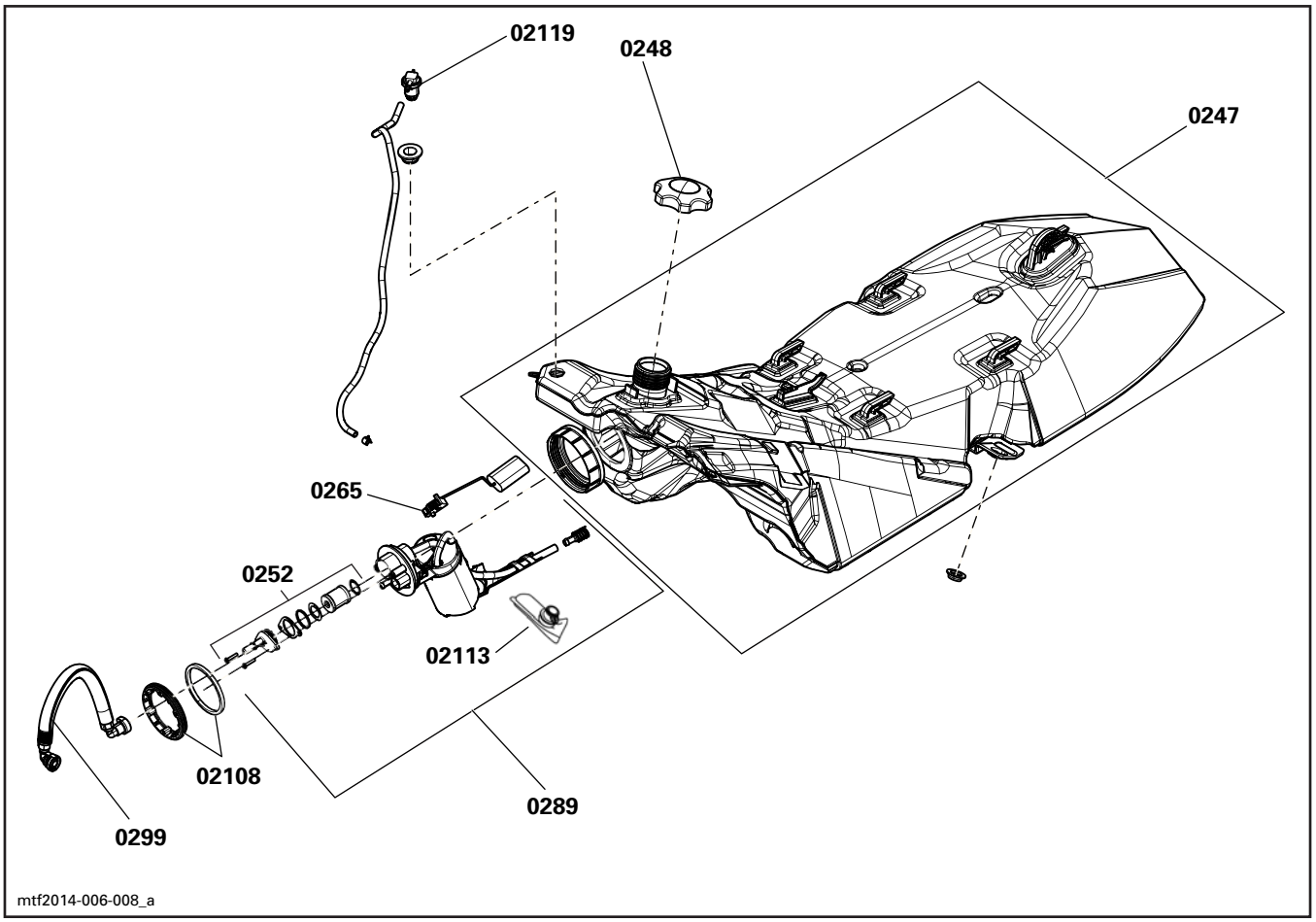

900 ACE
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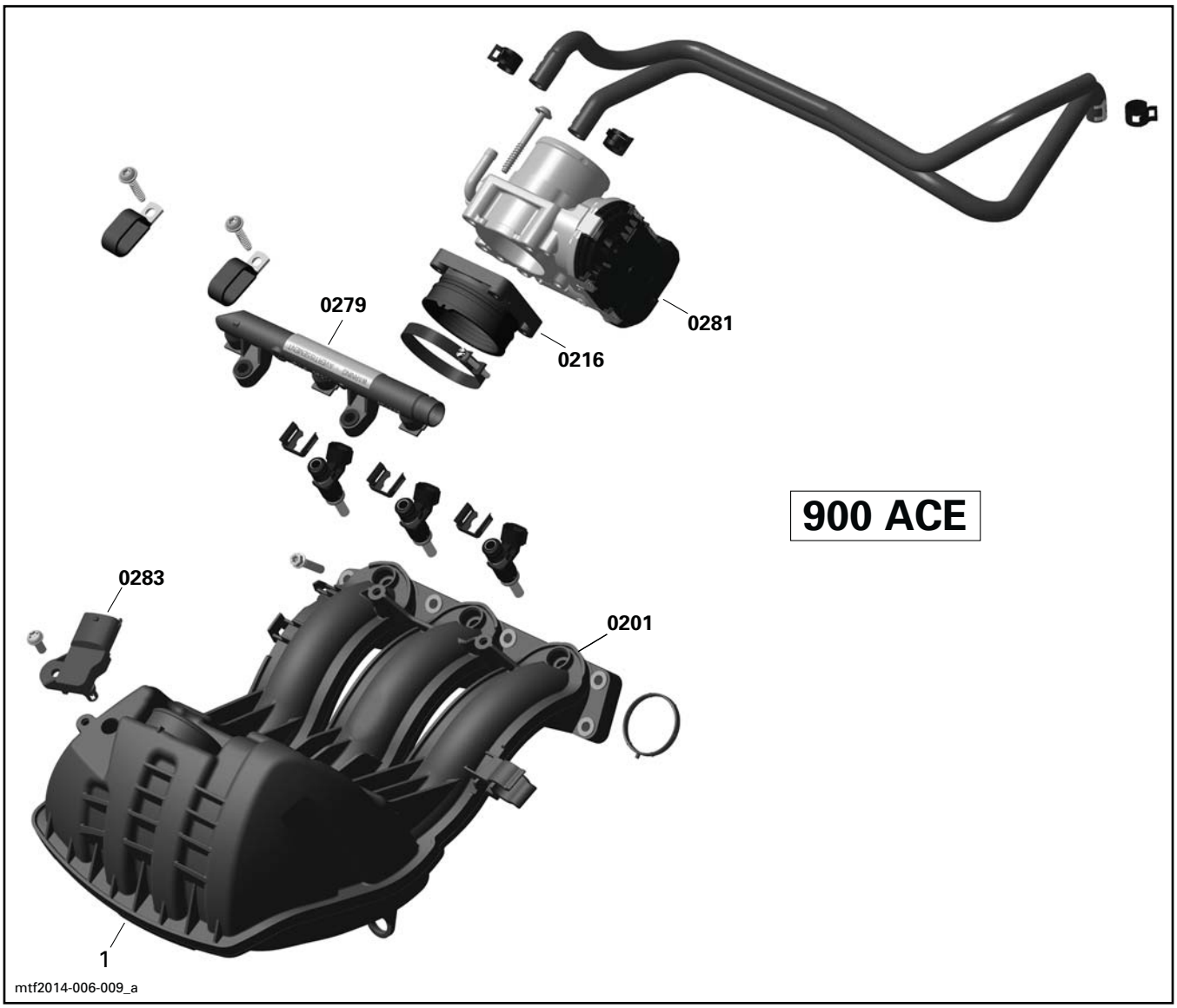

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Expedition
MXZ, Renegade, GSX, Grand Touring
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Front
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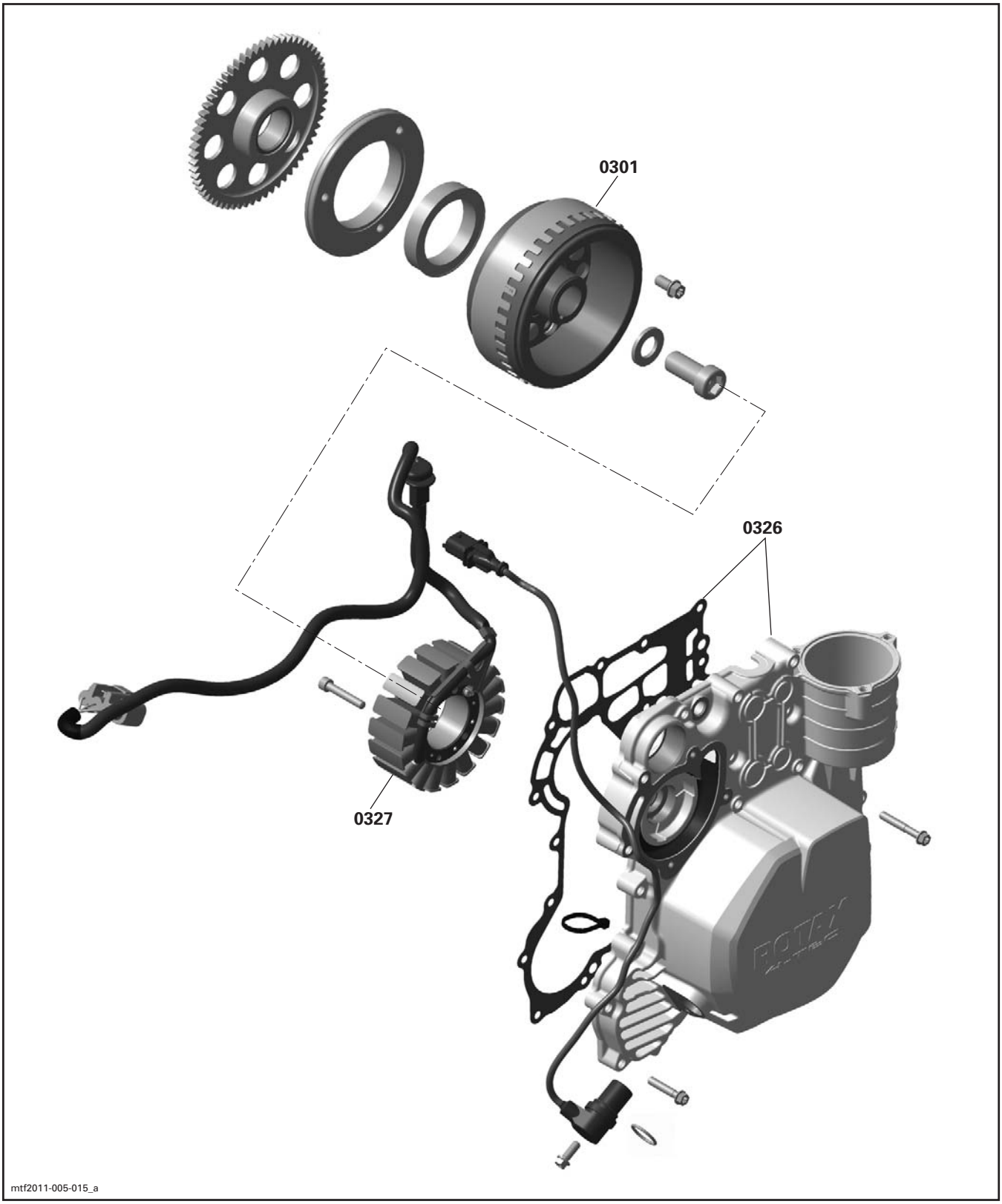
FUEL SYSTEM
SYSTÈME D'ESSENCE

SYSTEM SYSTÈME	CODE	DESCRIPTION	MXZ / RENEGADE 900 ACE	GRAND TOURING GSX 900 ACE	EXPEDITION 900 ACE SPORT	EXPEDITION LE/SE 900 ACE	SKANDIC 900 ACE
			24	25	26	27	28
02	**00**	**NO LABOR INVOLVED AUCUNE MAIN-D'OEUVRE IMPLIQUÉE**	**0**	**0**	**0**	**0**	**0**
02	01	AIR SILENCER (ASS'Y) (ALL PARTS) SILENCIEUX D'ADMISSION (COMPLET) (TOUTES LES PIÈCES)	1.5	1.5	1.5	1.5	1.5
02	16	INTAKE ADAPTOR ADAPTATEUR D'ADMISSION	0.5	0.5	0.5	0.5	0.5
02	19	AIR INTAKE TUBE TUYAU D'ADMISSION D'AIR	0.3	0.3	0.3	0.3	0.3
02	47	FUEL TANK RÉSERVOIR À ESSENCE	1.5	1.5	1.5	1.5	1.5
02	48	FUEL TANK CAP BOUCHON DU RÉSERVOIR À ESSENCE	0.3	0.3	0.3	0.3	0.3
02	50	THROTTLE HANDLE HOUSING LOGEMENT MANETTE ACCÉLÉRATEUR	0.3	0.3	0.3	0.3	0.3
02	52	FUEL FILTER FILTRE À ESSENCE	1.5	1.5	1.5	1.5	1.5
02	65	FUEL SENSOR (ASS'Y) CAPTEUR DE NIVEAU D'ESSENCE (COMPLET)	1.5	1.5	1.5	1.5	1.5
02	79	FUEL RAIL RAMPE D'ESSENCE	1.0	1.0	1.0	1.0	1.0
02	81	THROTTLE BODY (ASS'Y) CARTER ACCÉLÉRATEUR (COMPLET)	0.8	0.8	0.8	0.8	0.8
02	83	AIR PRESSURE SENSOR CAPTEUR PRESSION D'AIR	0.3	0.3	0.3	0.3	0.3
02	89	FUEL PUMP MODULE MODULE POMPE À ESSENCE	1.5	1.5	1.5	1.5	1.5
02	99	FUEL INJECTION HOSE (ASS'Y) BOYAU D'ESSENCE À INJECTION (COMPLET)	1.0	1.0	1.0	1.0	1.0
02	105	SECONDARY CHAMBER (ASS'Y) CHAMBRE SECONDAIRE (COMPLET)	0.4	0.4	0.4	0.4	0.4
02	108	FUEL PUMP NUT AND/OR GASKET ÉCROU DE LA POMPE À ESSENCE ET/OU JOINT D'ÉTANCHÉITÉ	1.5	1.5	1.5	1.4	1.4
02	113	FUEL PUMP INLET FILTER FILTRE INTERNE DE LA POMPE À ESSENCE	1.5	1.5	1.5	1.5	1.5
02	119	CHECK VALVE SOUPAPE À ESSENCE	0.3	0.3	0.3	0.3	0.3


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SYSTEM SYSTÈME	CODE	DESCRIPTION	MXZ / RENEGADE 900 ACE	GRAND TOURING GSX 900 ACE	EXPEDITION 900 ACE SPORT	EXPEDITION LE/SE 900 ACE	SKANDIC 900 ACE
			24	25	26	27	28
03	**00**	**NO LABOR INVOLVED** **AUCUNE MAIN-D'OEUVRE IMPLIQUÉE**	**0**	**0**	**0**	**0**	**0**
03	01	FLYWHEEL VOLANT MOTEUR	4.2	4.2	4.2	4.2	4.2
03	08	IGNITION COIL BOBINE D'ALLUMAGE	0.3	0.3	0.3	0.3	0.3
03	26	MAGNETO COVER AND/OR GASKET COUVERCLE DU MAGNÉTO ET/OU JOINT D'ÉTANCHÉITÉ	4.0	4.0	4.0	4.0	4.0
03	27	STATOR (ASS'Y) STATOR (COMPLET)	4.0	4.0	4.0	4.0	4.0


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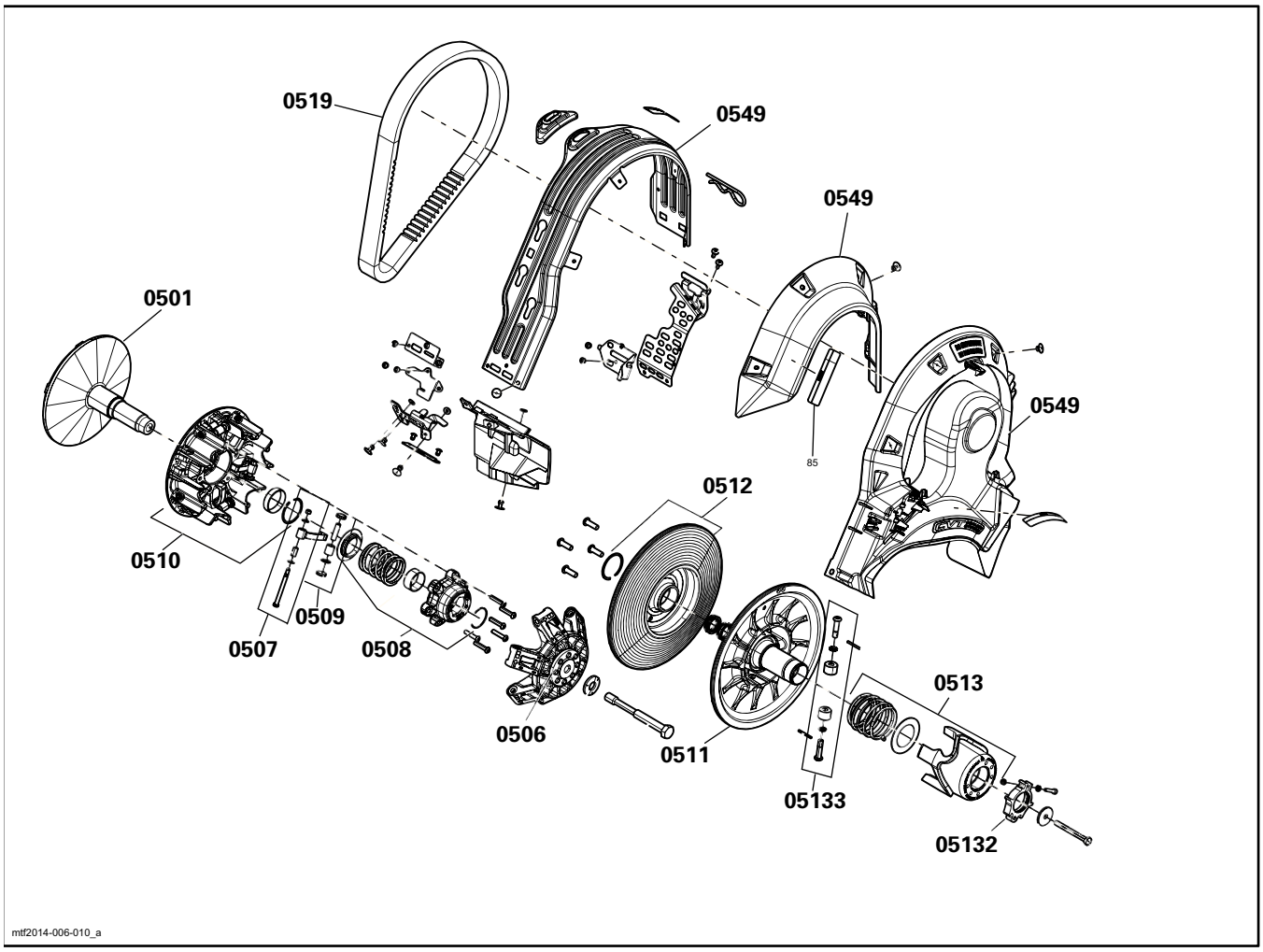
SYSTEM SYSTÈME	CODE	DESCRIPTION	MXZ / RENEGADE 900 ACE	GRAND TOURING XGS 900 ACE	EXPEDITION 900 ACE SPORT	EXPEDITION LE/SE 900 ACE	SKANDIC 900 ACE
			24	25	26	27	28
04	**00**	**NO LABOR INVOLVED AUCUNE MAIN-D'OEUVRE IMPLIQUÉE**	**0**	**0**	**0**	**0**	**0**
04	02	ELECTRIC STARTER (ASS'Y) DÉMARREUR ÉLECTRIQUE (COMPLET)	0.4	0.4	0.4	0.4	0.4
04	03	STARTER RELAY SOLÉNOÏDE DE DÉMARREUR	0.3	0.3	0.3	0.3	0.3
04	19	STARTER DRIVE LANCEUR DÉMARREUR	4.2	4.2	4.2	4.2	4.2

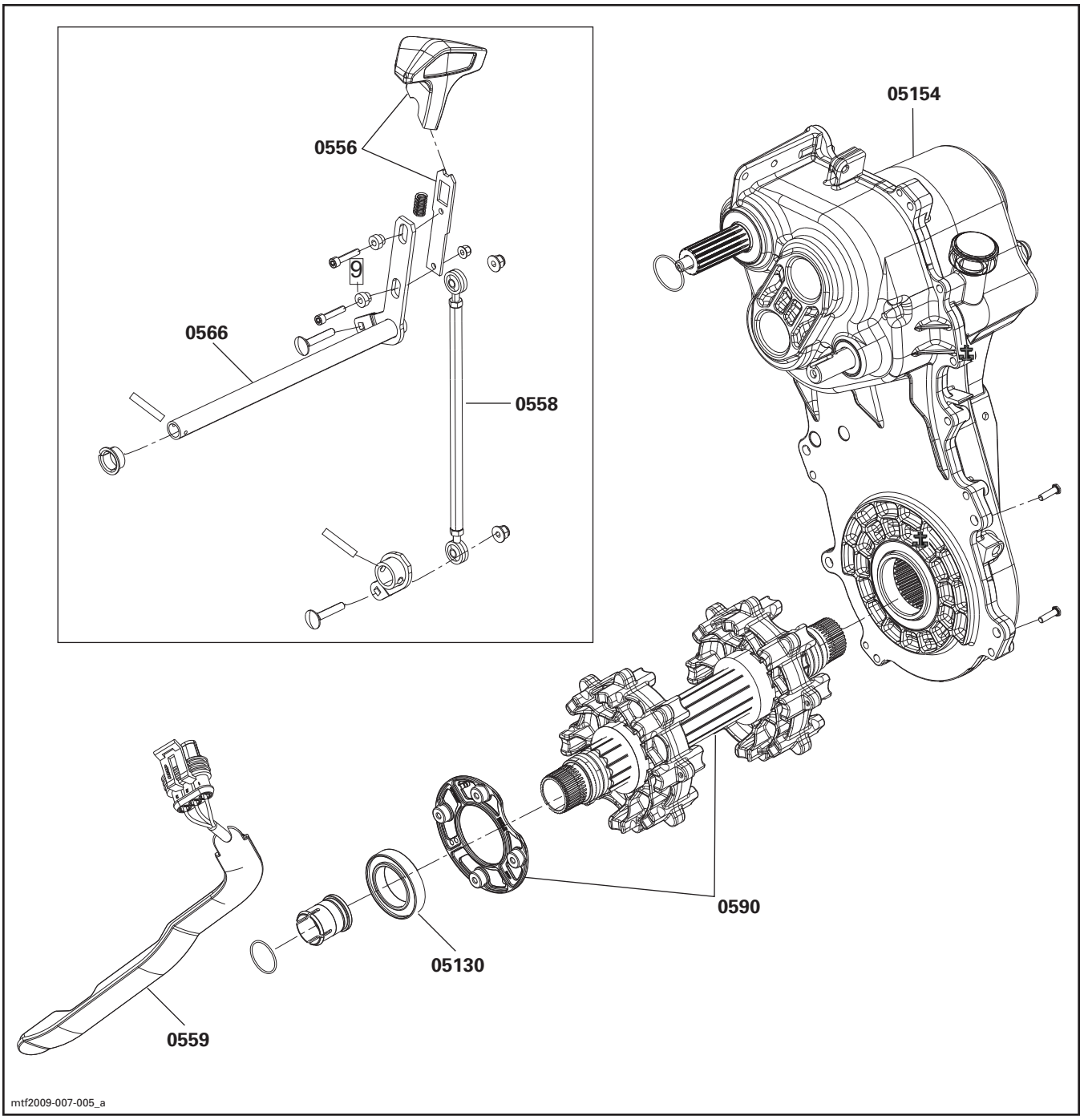
TRANSMISSION SYSTEM
SYSTÈME DE TRANSMISSION

SYSTEM SYSTÈME	CODE	DESCRIPTION	MXZ / RENEGADE 900 ACE	GRAND TOURING GSX 900 ACE	EXPEDITION 900 ACE SPORT	EXPEDITION LE/SE 900 ACE	SKANDIC 900 ACE
			24	25	26	27	28
05	00	**NO LABOR INVOLVED AUCUNE MAIN-D'OEUVRE IMPLIQUÉE**	0	0	0	0	0
05	01	DRIVE PULLEY (ASS'Y) OR SLIDDING FLANGE POULIE MOTRICE (COMPLET) OU FLASQUE COULISSANTE	0.3	0.3	0.3	0.3	0.3
05	06	GOVERNOR CUP AND/OR FIXED HALF CUVETTE DE RÉGULATEUR ET/OU PARTIE FIXE	0.8	0.8	0.8	0.8	0.8
05	07	RAMPS AND/OR ADJUSTMENT SCREW RAMPES ET/OU VIS DE RÉGLAGE DE POULIE	0.5	0.5	0.5	0.5	0.5
05	08	SPRING COVER AND/OR SPRING AND/OR BUSHING COUVERCLE DU RESSORT ET/OU RESSORT ET/OU DOUILLE	0.5	0.5	0.5	0.5	0.5
05	09	SLIDER SHOES AND/OR SPRINGS GLISSIÈRE ET/OU RESSORTS	0.8	0.8	0.8	0.8	0.8
05	10	SLIDING HALF, BUSHING AND/OR LEVER (ASS'Y) DEMI-POULIE COULISSANTE, DOUILLE ET/OU LEVIER (COMPLET)	0.8	0.8	0.8	0.8	0.8
05	11	DRIVEN PULLEY FIXED HALF DEMI-POULIE MENÉE FIXE	0.7	0.7	0.7	0.7	0.7
05	12	DRIVEN PULLEY SLIDING HALF DEMI-POULIE MENÉE COULISSANTE	0.5	0.5	0.5	0.5	0.5
05	13	DRIVEN PULLEY CAM AND/OR SPRING CAME ET/OU RESSORT DE POULIE MENÉE	0.6	0.6	0.6	0.6	0.6
05	17	COUNTERSHAFT BALL BEARING AND/OR FLANGE ROULEMENT À BILLE DE L'ARBRE DE RENVOI ET/OU FLASQUE	1.0	1.0	1.0	1.0	1.0
05	18	COUNTERSHAFT ARBRE DE RENVOI	1.0	1.0	1.0	1.0	1.0
05	19	DRIVE BELT AND/OR BELT GUARD COURROIE D'ENTRAÎNEMENT ET/OU GARDE-COURROIE	0.1	0.1	0.1	0.1	0.1
05	20	CHAINCASE SEAL AND/OR BEARING ANNEAU D'ÉTANCHÉITÉ DE CARTER ET/OU ROULEMENT	1.3	1.3	1.3		
05	21	CHAINCASE CARTER DE CHAÎNE	3.9	3.9	3.9		
05	22	CHAINCASE COVER COUVERCLE DE CARTER DE CHAÎNE	1.3	1.3	1.3		
05	23	CHAINCASE UPPER SPROCKET AND/OR CENTRAL SPROCKET PIGNON SUPÉRIEUR DE CARTER ET/OU PIGNON CENTRAL	1.4	1.4	1.4		
05	24	CHAINCASE LOWER SPROCKET PIGNON INFÉRIEUR DE CARTER DE CHAÎNE	1.4	1.4	1.4		
05	25	CHAINCASE DRIVE CHAIN CHAÎNE D'ENTRAÎNEMENT DE CARTER DE CHAÎNE	1.4	1.4	1.4		
05	26	CHAINCASE TENSIONERS TENDEURS DE CARTER DE CHAÎNE	1.3	1.3	1.3		
05	27	TENSIONER ADJUSTING SCREW VIS DE RÉGLAGE DE TENDEUR	0.4	0.4	0.4		
05	34	SLIDING SLEEVE AND/OR FORK AND/OR FORK SHAFT CRABOT ET/OU FOURCHETTE ET /OU ARBRE DE FOURCHETTE	1.4	1.4	1.4	1.4	1.4
05	39	SHIFT LEVER AND/OR SHIFT ROD LEVIER DE TRANSMISSION ET/OU TIGE	0.4	0.4	0.4		
05	45	REVERSE GEAR WHEEL AND SHAFT ENGRENAGE ET ARBRE DE MARCHE ARRIÈRE	1.4	1.4	1.4	3.0	3.0

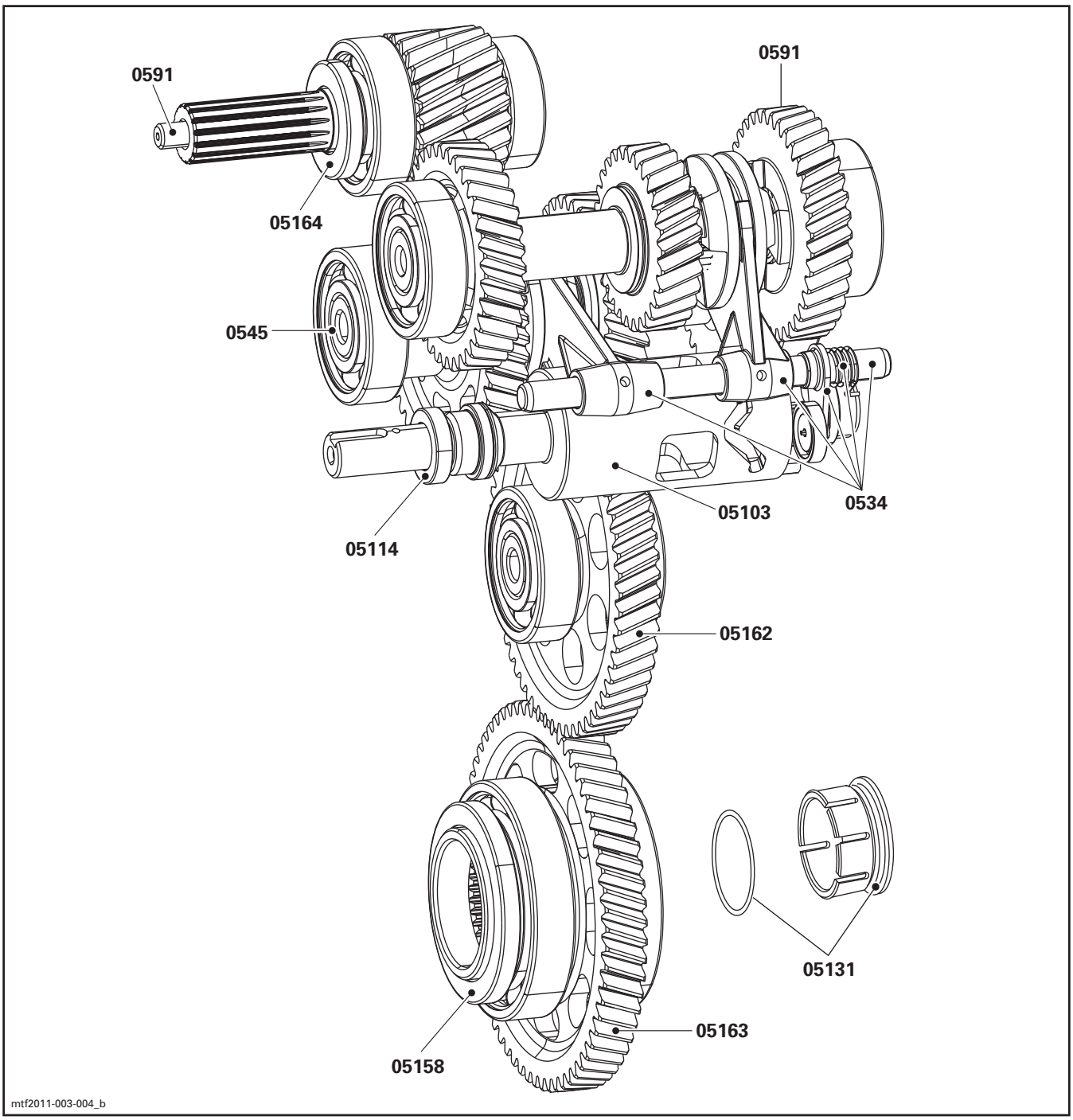
SYSTEM SYSTÈME	CODE	DESCRIPTION	MXZ / RENEGADE 900 ACE	GRAND TOURING GSX 900 ACE	EXPEDITION 900 ACE SPORT	EXPEDITION LE/SE 900 ACE	SKANDIC 900 ACE
			24	25	26	27	28
05	49	DRIVE PULLEY GUARD GARDE DE POULIE MOTRICE	0.3	0.3	0.3	0.3	0.3
05	56	LEVER ASS'Y A/O LEVER SPRING LEVIER ASS E/O RESSORT DE LEVIER				0.3	0.3
05	58	TIE ROD A/O BALL JOINT BARRE D'ACCOUPLEMENT E/O JOINT ROTUL				0.6	0.6
05	59	SPEED SENSOR CAPTEUR DE VITESSE	1.3	1.3	1.3	0.9	0.9
05	66	GEARSHIFT LEVER LEVIER D'EMBRAYAGE				0.5	0.5
05	90	DRIVE AXLE ASS'Y AXE ENTRAINEMENT COMPLET				2.0	2.0
05	91	MAIN SHAFT ASS'Y ARBRE DE RENVOI COMPLET				3.0	3.0
05	103	SHIFT DRUM TAMBOUR D'EMBRAYAGE				3.0	3.0
05	114	SHIFT SHAFT SEAL ANNEAU ETANCHE DE L'ABRE D'EMBRAYAGE				1.0	1.0
05	129	CHAINCASE LOWER BEARING AND SEAL (MAG SIDE) ROULEMENT À BILLES INFÉRIEUR DU CARTER DE CHAÎNE ET ANNEAU ÉTANCHE (CÔTÉ MAG)	3.0	3.0	3.0		
05	130	BEARING HOUSING AND/OR BEARING (PTO SIDE) LOGEMENT DU ROULEMENT À BILLES ET/OU ROULEMENT À BILLES (CÔTÉ PTO)	2.4	2.4	2.4	2.4	2.4
05	131	MAGNETIC CAP CAPUCHON MAGNÉTIQUE	0.7	0.7	0.7	3.0	3.0
05	132	ADJUSTMENT RING (ASS'Y) ANNEAU DE RÉGLAGE (COMPLET)	0.3	0.3	0.3	0.3	0.3
05	133	STUDS AND/OR ROLLERS PIVOTS ET/OU ROULEAUX	0.8	0.8	0.8	0.8	0.8
05	134	DRIVE AXLE (ASS'Y) (WITH BATTERY) AXE D'ENTRAÎNEMENT (COMPLET) (AVEC BATTERIE)	2.4	2.4	2.4		
05	154	GEARBOX ASS'Y BOITE DE VITESSE (COMPLET)				0.6	0.6
05	155	BUSHINGS, SLIDERS AND ROLLERS (DRIVE PULLEY REPAIR) COUSSINETS, GLISSIÈRES ET ROULEAUX (RÉPARATION DE POULIE MOTRICE)	0.8	0.8	0.8	0.8	0.8
05	156	CAM, SLIDING FLANGE AND ROLLERS (DRIVEN PULLEY REPAIR) CAME, FLASQUE COULISSANTE ET ROULEAUX (RÉPARATION DE POULIE MENÉE)	0.8	0.8	0.8	0.8	0.8
05	158	TRANSMISSION BOTTOM SEAL JOINT D'ÉTANCHEITE INFERIEUR DE LA TRANSMISSION				1.0	1.0
05	162	MIDDLE GEAR ENGRENAGE DU MILIEU				3.0	3.0
05	163	LOWER GEAR ENGRENAGE DU BAS				3.0	3.0
05	164	COUNTERSHAFT SEAL ANNEAU D'ÉTANCHÉITÉ DE L'ABRE DE RENVOI				1.0	1.0

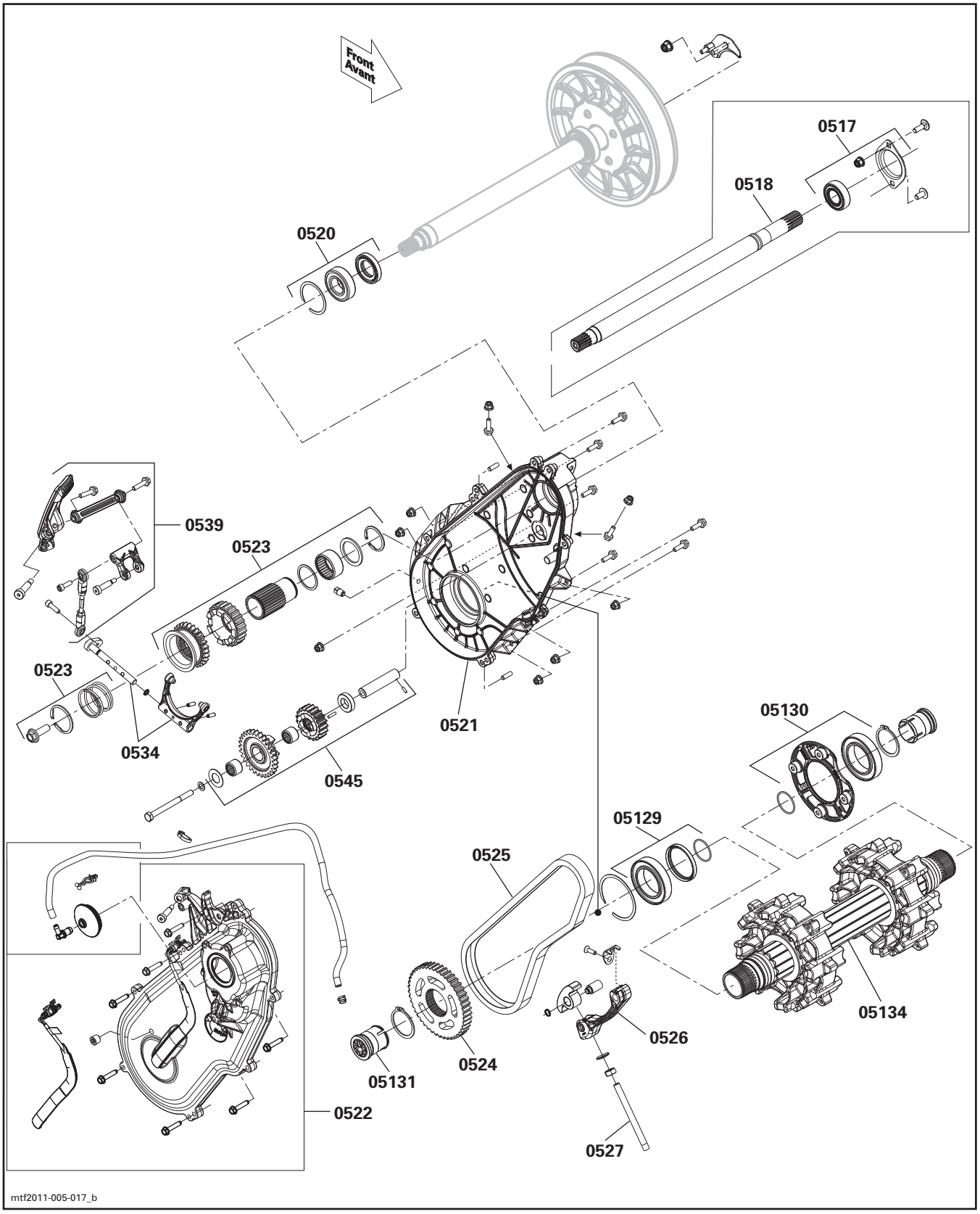
TRANSMISSION SYSTEM
SYSTÈME DE TRANSMISSION




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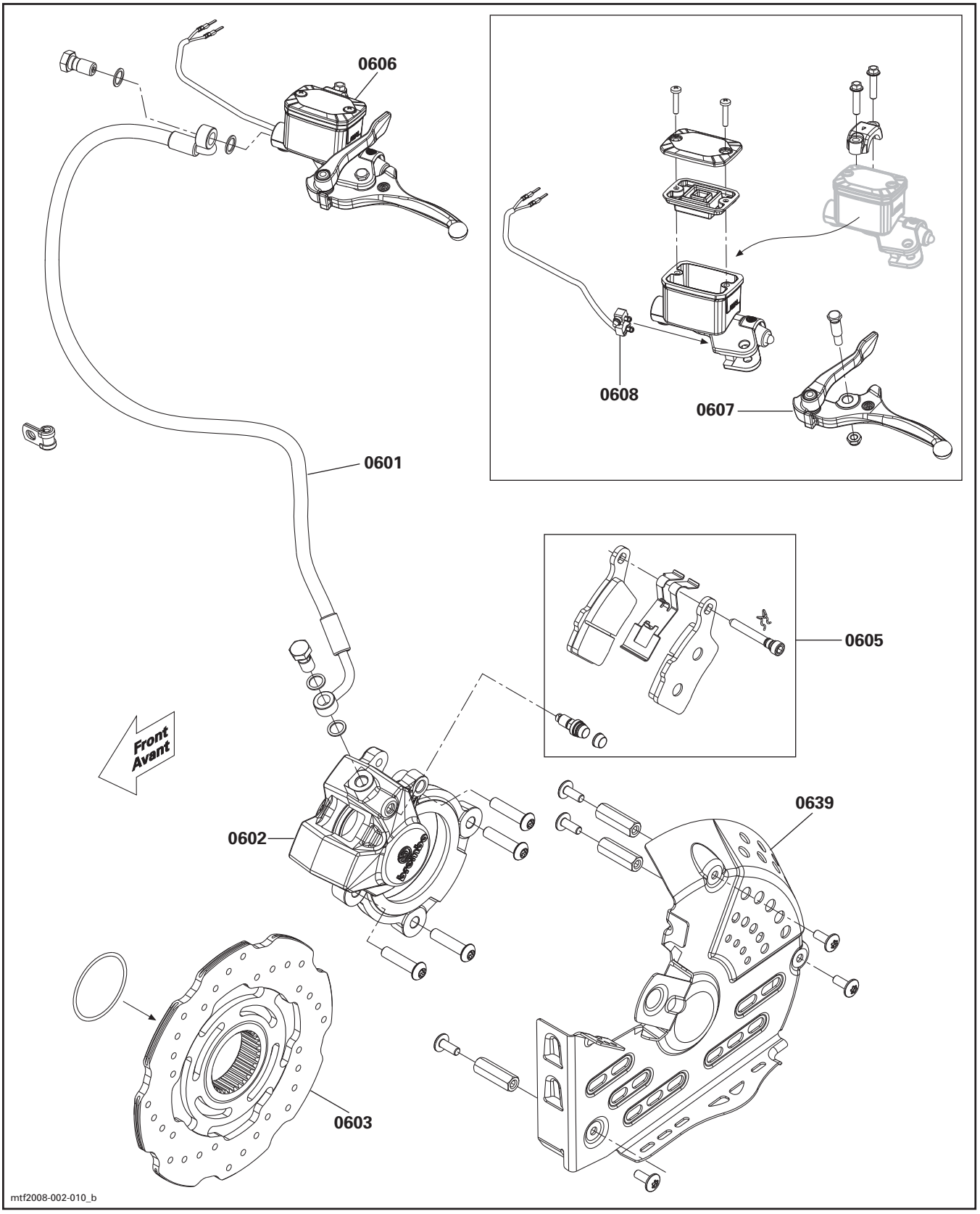
TRANSMISSION SYSTEM
SYSTÈME DE TRANSMISSION




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BRAKE SYSTEM
SYSTÈME DE FREIN

SYSTEM SYSTÈME	CODE	DESCRIPTION	MXZ/RENEGADE 900 ACE	GRAND TOURING GSX 900 ACE	EXPEDITION 900 ACE SPORT	EXPEDITION LE/SE 900 ACE	SKANDIC 900 ACE
			24	25	26	27	28
06	**00**	**NO LABOR INVOLVED AUCUNE MAIN-D'OEUVRE IMPLIQUÉE**	**0**	**0**	**0**	**0**	**0**
06	01	BRAKE OIL HOSE BOYAU À HUILE POUR FREIN	0.5	0.5	0.5	0.5	0.5
06	02	BRACKET, CALIPER, BRAKE PAD, RELEASE SPRING SUPPORT, ÉTRIER, PLAQUETTE DE FREIN, CLIQUET, LEVIER	0.8	0.8	0.8	0.8	0.8
06	03	DISC DISQUE	0.7	0.7	0.7	0.7	0.7
06	05	BRAKE PADS PLAQUETTES DE FREIN	0.4	0.4	0.4	0.4	0.4
06	06	MASTER CYLINDER MAÎTRE CYLINDRE	0.4	0.4	0.4	0.4	0.4
06	07	BRAKE LEVER (ASS'Y) LEVIER DE FREIN (COMPLET)	0.3	0.3	0.3	0.3	0.3
06	08	MICROSWITCH BRAKE (ASS'Y) INTERRUPTEUR MICRO-CONTACT DE FREIN (COMPLET)	0.3	0.3	0.3	0.3	0.3
06	39	DISC PROTECTOR PROTECTEUR DE DISQUE	0.3	0.3	0.3	0.3	0.3

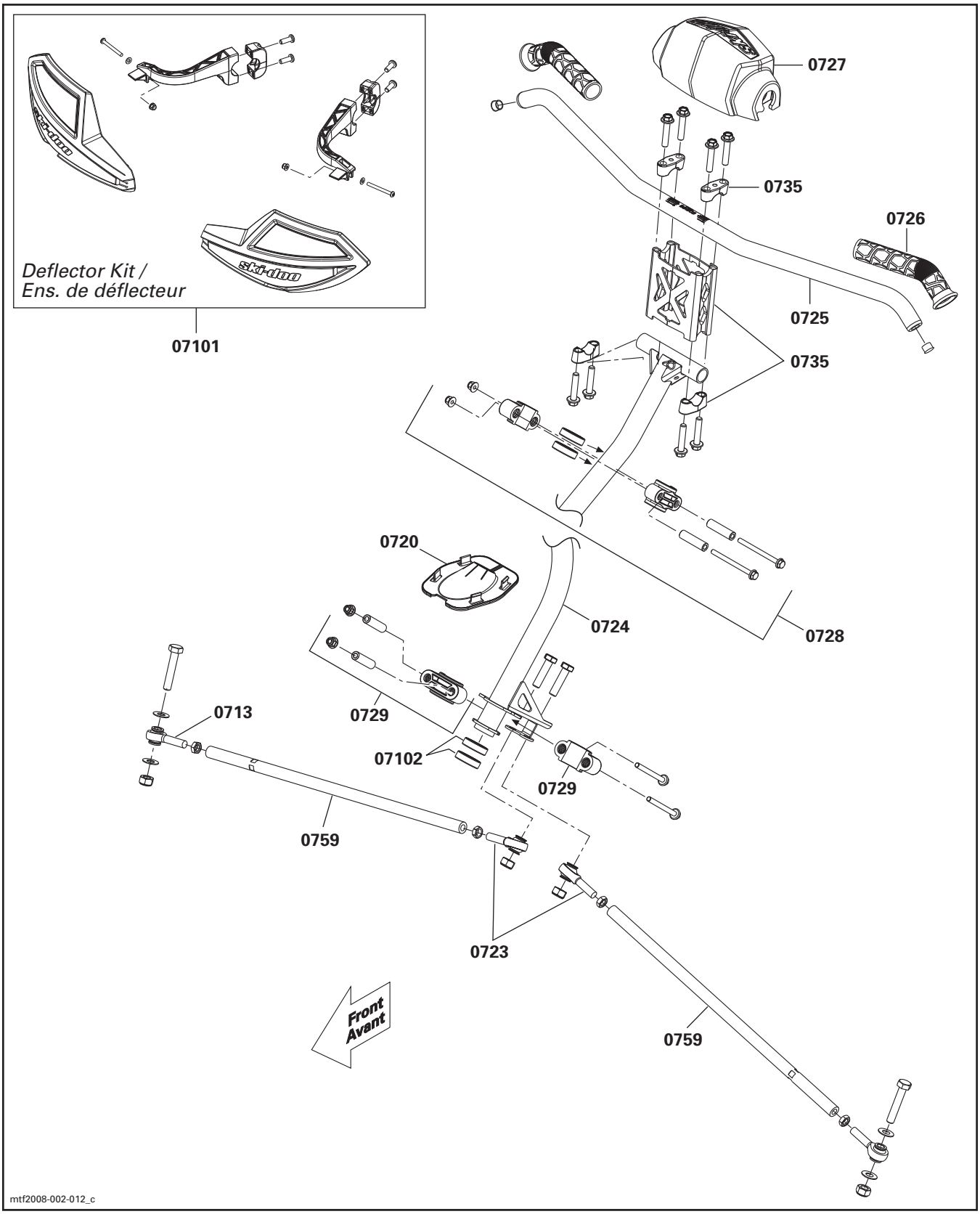

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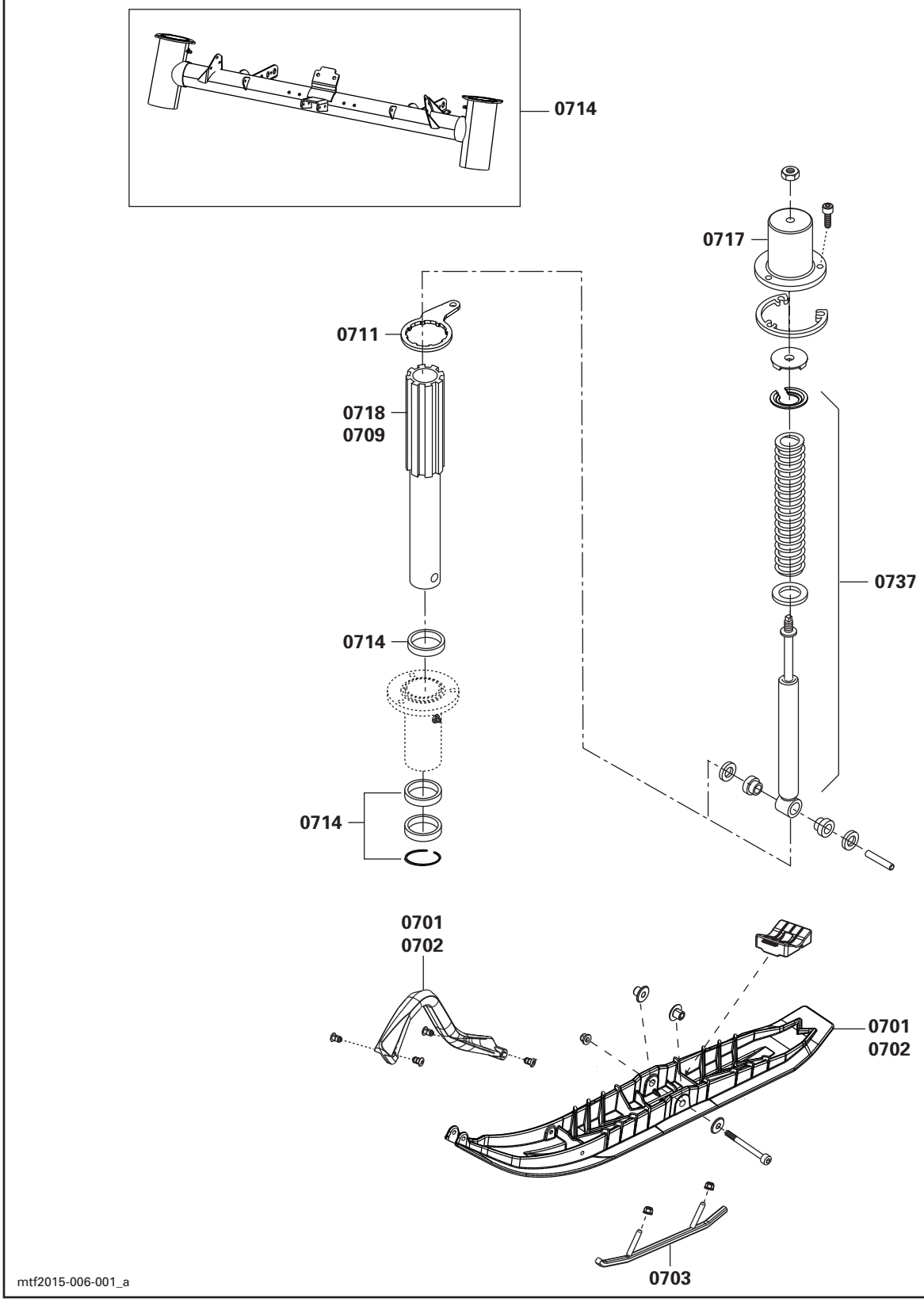
STEERING SYSTEM AND FRONT SUSPENSION
SYSTÈME DE DIRECTION ET SUSPENSION AVANT

SYSTEM SYSTÈME	CODE	DESCRIPTION	MXZ / RENEGADE 900 ACE	GRAND TOURING GSX 900 ACE	EXPEDITION 900 ACE SPORT	EXPEDITION LE/SE 900 ACE	SKANDIC 900 ACE
			24	25	26	27	28
07	00	**NO LABOR INVOLVED** **AUCUNE MAIN-D'OEUVRE IMPLIQUÉE**	0	0	0	0	0
07	01	SKI (1) SKI (1)	0.3	0.3	0.3	0.3	0.3
07	02	SKIS (2) SKIS (2)	0.4	0.4	0.4	0.4	0.4
07	03	SKI RUNNER LISSES	0.3	0.3	0.3	0.3	0.3
07	08	SKI LEG (RH) AND/OR BUSHING JAMBE DE SKI (DROITE) ET/OU DOUILLE	0.5	0.5	0.5	0.5	0.5
07	09	SKI LEG (LH) AND/OR BUSHING JAMBE DE SKI (GAUCHE) ET/OU DOUILLE	0.5	0.5	0.5	0.5	0.5
07	10	STEERING ARM (R.H.) BRAS DE DIRECTION (DROIT)					0.5
07	11	STEERING ARM (L.H.) BRAS DE DIRECTION (GAUCHE)					0.5
07	12	STEERING ARM BALL JOINT (RH) JOINT À ROTULE DE BRAS DE DIRECTION (DROIT)	0.3	0.3	0.3	0.3	0.3
07	13	STEERING ARM BALL JOINT (LH) JOINT À ROTULE DE BRAS DE DIRECTION (GAUCHE)	0.3	0.3	0.3	0.3	0.3
07	14	TELESC TUBE/SPRING/BUSHING/SAUCER TUBE TELESC/RESS/DOUILLES/SOUPAPE					0.6
07	17	TOP CAP CAPUCHON SUPERIEUR					0.3
07	20	TIE ROD COVER CAPUCHON DE TIMONERIE	0.3	0.3	0.3	0.3	
07	23	STEERING MAIN TUBE BALL JOINT JOINT À ROTULE DE COLONNE DE DIRECTION	0.6	0.6	0.6	0.6	0.6
07	24	STEERING MAIN TUBE COLONNE DE DIRECTION	1.4	1.4	1.4	1.4	1.4
07	25	HANDLE BAR GUIDON	1.1	1.1	1.1	1.1	1.1
07	26	HANDLE BAR GRIP (RIGHT AND/OR LEFT) GAINE DE GUIDON (DROITE ET/OU GAUCHE)	0.3	0.3	0.3	0.3	0.3
07	27	HANDLE BAR PADDING COUSSINET DE GUIDON	0.3	0.3	0.3	0.3	0.3
07	28	UPPER STEERING MAIN TUBE BUSHING DOUILLE SUPÉRIEURE DE COLONNE DE DIRECTION	0.5	0.5	0.5	0.5	0.5
07	29	LOWER STEERING MAIN TUBE BUSHING DOUILLE INFÉRIEURE DE COLONNE DE DIRECTION	0.5	0.5	0.5	0.5	0.5
07	32	LOWER ARM (LH OR RH) BRAS DE SUSPENSION INFÉRIEUR (GAUCHE OU DROIT)	0.6	0.6	0.6	0.6	

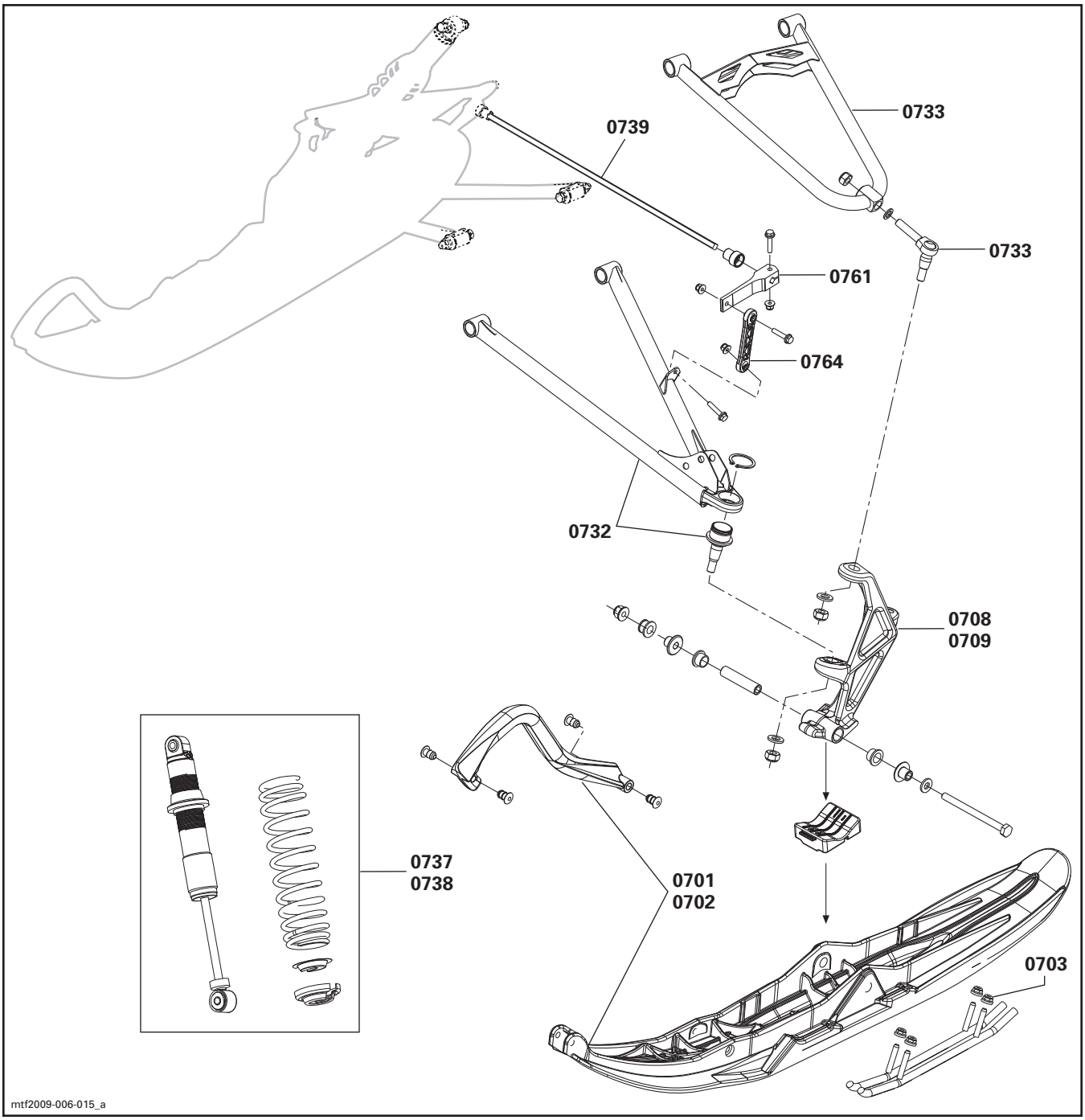
SYSTEM SYSTÈME	CODE	DESCRIPTION	MXZ / RENEGADE 900 ACE	GRAND TOURING GSX 900 ACE	EXPEDITION 900 ACE SPORT	EXPEDITION LE/SE 900 ACE	SKANDIC 900 ACE
			24	25	26	27	28
07	33	UPPER ARM (LH OR RH) BRAS DE SUSPENSION SUPÉRIEUR (GAUCHE OU DROIT)	0.5	0.5	0.5	0.5	
07	35	HANDLE BAR SUPPORT SUPPORT DE GUIDON	0.3	0.3	0.3	0.3	0.3
07	37	SHOCK AND/OR SPRING (1) AMORTISSEUR ET/OU RESSORT (1)	0.3	0.3	0.3	0.3	0.3
07	38	SHOCKS AND/OR SPRINGS (2) AMORTISSEURS ET/OU RESSORTS (2)	0.4	0.4	0.4	0.4	1.0
07	39	STABILIZER BAR BARRE STABILISATRICE	0.5	0.5	0.5	0.5	
07	51	STEERING MAIN TUBE BALL JOINT JOINT ROTULE DE COLONNE DIRECTION					0.5
07	59	TIE ROD (LH) BARRE D'ACCOUPLEMENT (GAUCHE)	0.3	0.3	0.3	0.3	0.3
07	60	TIE ROD (RH) BARRE D'ACCOUPLEMENT (DROITE)	0.3	0.3	0.3	0.3	0.3
07	61	LEVER STABILIZER LEVIER STABILISATEUR	0.3	0.3	0.3	0.3	
07	64	DOUBLE BALL JOINT JOINT À ROTULE DOUBLE	0.3	0.3	0.3	0.3	
07	102	LOWER DAMPER AMORTISSEUR VIBRATION INFÉRIEUR	0.5	0.5	0.5	0.5	
07	111	LTS MODULE MODULE LTS					3.5
07	124	STRAP SANGLE				0.3	0.3

STEERING SYSTEM AND FRONT SUSPENSION
SYSTÈME DE DIRECTION ET SUSPENSION AVANT




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STEERING SYSTEM AND FRONT SUSPENSION
SYSTÈME DE DIRECTION ET SUSPENSION AVANT



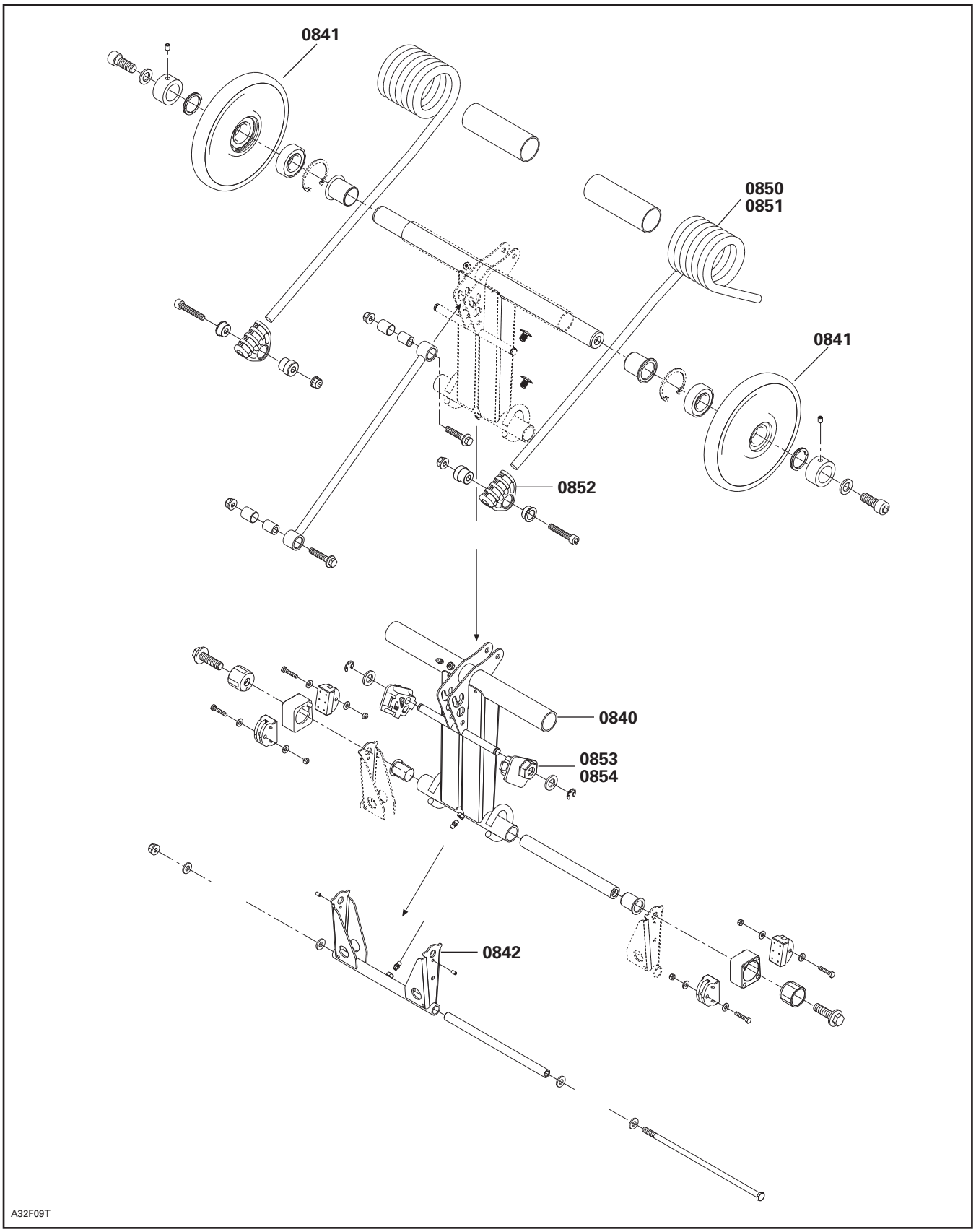
SYSTEM SYSTÈME	CODE	DESCRIPTION	MXZ / RENEGADE 900 ACE	GRAND TOURING GSX 900 ACE	EXPEDITION 900 ACE SPORT	EXPEDITION LE/SE 900 ACE	SKANDIC 900 ACE
			24	25	26	27	28
08	**00**	**NO LABOR INVOLVED AUCUNE MAIN-D'OEUVRE IMPLIQUÉE**	**0**	**0**	**0**	**0**	**0**
08	01	SLIDER SHOE (1) GLISSIÈRE (1)	0.5	0.5	0.5	0.5	0.5
08	02	SLIDER SHOES (2) GLISSIÈRES (2)	0.7	0.7	0.7	0.7	0.7
08	03	RUNNER (1) PORTE-GLISSIÈRE (1)	1.2	1.2	1.5	1.5	1.5
08	04	RUNNERS (2) PORTE-GLISSIÈRES (2)	1.5	1.5	1.9	1.9	1.9
08	09	FRONT IDLER WHEEL AND/OR BEARING (1) ROUE DE SUPPORT AVANT ET/OU ROULEMENT (1)	0.3	0.3	0.3	0.3	0.3
08	10	FRONT IDLER WHEELS AND/OR BEARINGS AND/OR SHAFTS (2) ROUES DE SUPPORT AVANT ET/OU ROULEMENTS ET/OU ARBRES (2)	0.4	0.4	0.4	0.4	0.4
08	11	FRONT IDLER WHEEL SUPPORT (1) SUPPORT DE ROUE AVANT (1)	0.3	0.3	0.3	0.3	0.3
08	12	FRONT IDLER WHEELS SUPPORTS (2) SUPPORTS DE ROUE AVANT (2)	0.4	0.4	0.3	0.3	0.3
08	13	CENTER IDLER WHEEL AND/OR BEARING (1) ROUE DE SUPPORT CENTRALE ET/OU ROULEMENT (1)	0.3	0.3	0.3	0.3	0.3
08	14	CENTER IDLER WHEELS AND/OR BEARINGS AND/OR SHAFTS (2) ROUES DE SUPPORT CENTRALES ET/OU ROULEMENTS ET/OU ARBRES (2)	0.4	0.4	0.4	0.4	0.4
08	15	CENTER IDLER WHEEL SUPPORT (1) SUPPORT DE ROUE CENTRALE (1)	0.3	0.3	0.3	0.3	0.3
08	17	REAR IDLER AND/OR BEARING (1) ROUE DE SUPPORT ARRIÈRE ET/OU ROULEMENT (1)	0.4	0.4	0.3	0.3	0.3
08	18	REAR IDLERS AND/OR BEARINGS (2) ROUES DE SUPPORT ARRIÈRE ET/OU ROULEMENTS (2)	0.5	0.5	0.4	0.3	0.3
08	19	REAR IDLER WHEELS AXLE ESSIEU DE ROUES DE SUPPORT ARRIÈRE	0.5	0.5	0.5	0.5	0.5
08	22	TAIL PIVOT IDLER WHEEL, INSIDE (1) ROUE SUPPORT DE PIVOT ARRIÈRE ET/OU ROULEMENT INTÉRIEUR (1)			0.3	0.3	0.3
08	23	TAIL PIVOT IDLER WHEELS OR AXLE (2) ROUES SUPPORT DE PIVOT ARRIÈRE/ROULEMENT OU ESSIEU (2)			0.3	0.3	0.3
08	29	AXEL (STOPPER STRAP) AXE (COURROIE D'ARRÊT)	0.3	0.3	0.3	0.3	0.3
08	31	TRACK TENSION ADJUSTER (1) PLAQUE DE RÉGLAGE TENSION CHENILLE (1)	0.4	0.4	0.4	0.4	0.4
08	32	TRACK TENSION ADJUSTERS (2) PLAQUES DE RÉGLAGE TENSION CHENILLE (2)	0.5	0.5	0.5	0.5	0.5
08	33	RUNNER RUBBER STOPPER (1) BUTÉE DE CAOUTCHOUC DE PORTE-GLISSIÈRE (1)	0.3	0.3	0.3	0.3	0.3
08	34	RUNNER RUBBER STOPPERS (2) BUTÉES DE CAOUTCHOUC DE PORTE-GLISSIÈRE (2)	0.4	0.4	0.4	0.4	0.4
08	35	FRONT ARM AND/OR AXLE BRAS AVANT ET/OU ESSIEU	0.8	0.8	0.8	0.8	0.8

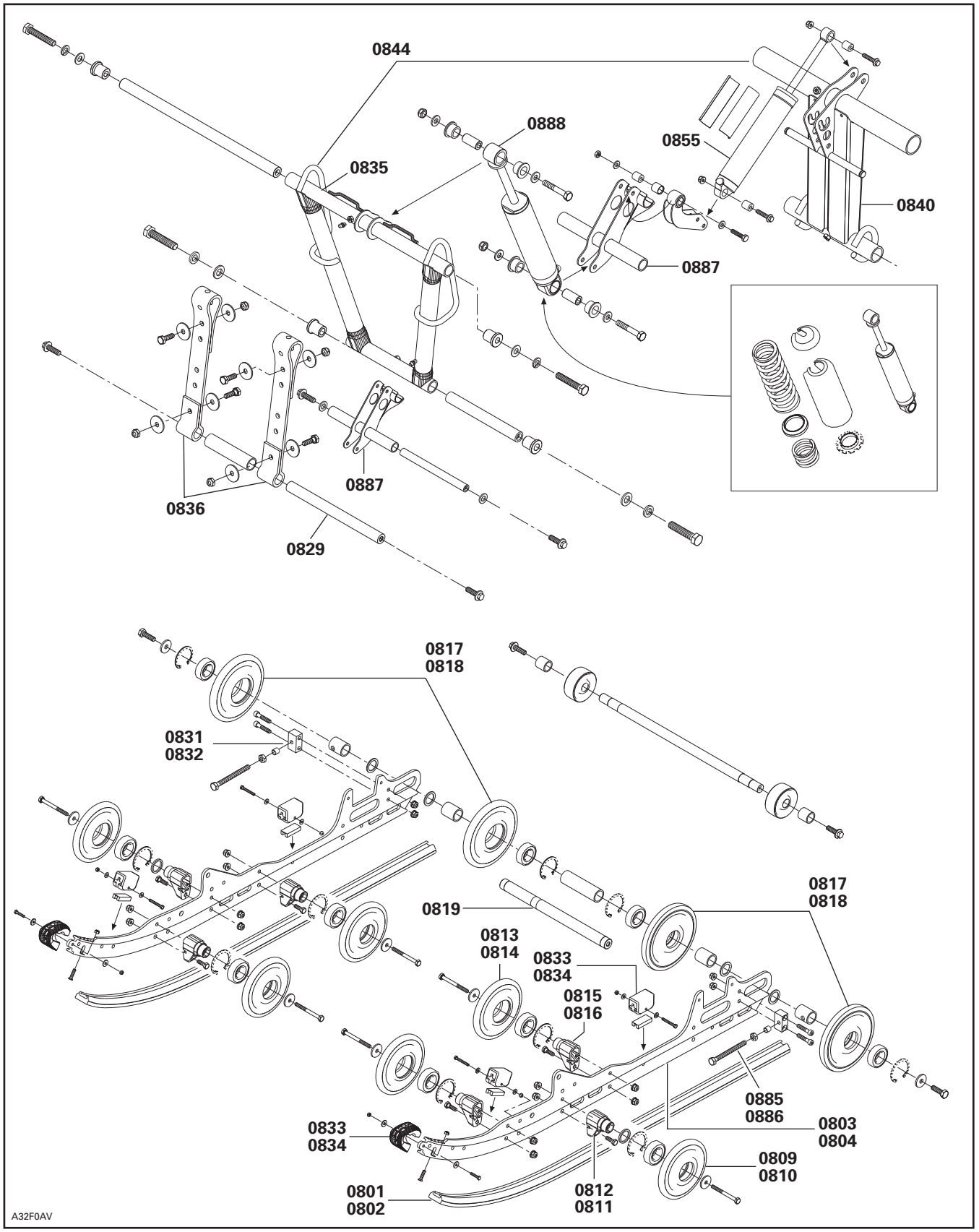
REAR SUSPENSION SYSTEM AND TRACK
SYSTÈME DE SUSPENSION ARRIÈRE ET CHENILLE

SYSTEM SYSTÈME	CODE	DESCRIPTION	MXZ / RENEGADE 900 ACE	GRAND TOURING GSX 900 ACE	EXPEDITION 900 ACE SPORT	EXPEDITION LE/SE 900 ACE	SKANDIC 900 ACE
			24	25	26	27	28
08	36	FRONT ARM STOPPER STRAP/STOPPER BOLT COURROIE D'ARRÊT BRAS AVANT/BOULON D'ARRÊT	0.3	0.3	0.3	0.3	0.3
08	37	FRONT ARM SUPPORT SUPPORT DE BRAS AVANT			0.6	0.6	0.6
08	40	REAR ARM AND/OR AXLE BRAS ARRIÈRE ET/OU ESSIEU	0.7	0.7	0.7	0.7	0.7
08	41	REAR ARM IDLER WHEELS (1-2) AND/OR SHAFT-CROSS ROUES DE SUPPORT BRAS ARRIÈRE (1-2) ET/OU AXE TRANSVERSALE	0.3	0.3	0.3	0.3	0.3
08	42	REAR ARM SHACKLE JUMELLE DE BRAS ARRIÈRE	0.3	0.3	0.3	0.3	0.3
08	44	REAR AND FRONT ARMS BRAS ARRIÈRE ET AVANT	1.5	1.5	1.5	1.5	1.5
08	50	REAR TORSION SPRING AND/OR WHEEL (1) RESSORT DE TORSION ARRIÈRE ET/OU ROUE (1)	0.3	0.3	0.3	0.3	0.3
08	51	REAR TORSION SPRINGS AND/OR WHEELS (2) RESSORTS DE TORSION ET/OU ROUES (2)	0.4	0.4	0.4	0.4	0.4
08	52	TORSION SPRING SUPPORT SUPPORT DE RESSORT DE TORSION	0.3	0.3	0.3	0.3	0.3
08	53	SPRING ADJUSTMENT CAM (1) CAME DE RÉGLAGE DE RESSORT (1)	0.3	0.3	0.3	0.3	0.3
08	54	SPRING ADJUSTMENT CAMS (2) CAMES DE RÉGLAGE DE RESSORT (2)	0.4	0.4	0.4	0.4	0.4
08	55	SHOCK AND/OR SPRING AND/OR BUSHING AMORTISSEUR ET/OU RESSORT ET/OU DOUILLE	0.5	0.5	0.5	0.5	0.5
08	69	TRACK (1) CHENILLE (1)	2.2	2.2	2.2	2.2	2.2
08	71	CLEATS AND/OR GUIDES (0-9) SEGMENTS GUIDE ET/OU GUIDES (0-9)	0.3	0.3	0.3	0.3	0.3
08	72	CLEATS AND/OR GUIDES (10-14) SEGMENTS GUIDE ET/OU GUIDES (10-14)	0.4	0.4	0.4	0.4	0.4
08	73	CLEATS AND/OR GUIDES (15-19) SEGMENTS GUIDE ET/OU GUIDES (15-19)	0.5	0.5	0.5	0.5	0.5
08	74	CLEATS AND/OR GUIDES (20-24) SEGMENTS GUIDE ET/OU GUIDES (20-24)	0.6	0.6	0.6	0.6	0.6
08	75	CLEATS AND/OR GUIDES (25-29) SEGMENTS GUIDE ET/OU GUIDES (25-29)	0.7	0.7	0.7	0.7	0.7
08	76	CLEATS AND/OR GUIDES (30-34) SEGMENTS GUIDE ET/OU GUIDES (30-34)	0.8	0.8	0.8	0.8	0.8
08	77	CLEATS AND/OR GUIDES (35-39) SEGMENTS GUIDE ET/OU GUIDES (35-39)	0.9	0.9	0.9	0.9	0.9
08	78	CLEATS AND/OR GUIDES (40-44) SEGMENTS GUIDE ET/OU GUIDES (40-44)	1.0	1.0	1.0	1.0	1.0
08	79	CLEATS AND/OR GUIDES (45-49) SEGMENTS GUIDE ET/OU GUIDES (45-49)	1.1	1.1	1.1	1.1	1.1
08	80	CLEATS AND/OR GUIDES (50-54) SEGMENTS GUIDE ET/OU GUIDES (50-54)			1.2	1.2	1.2

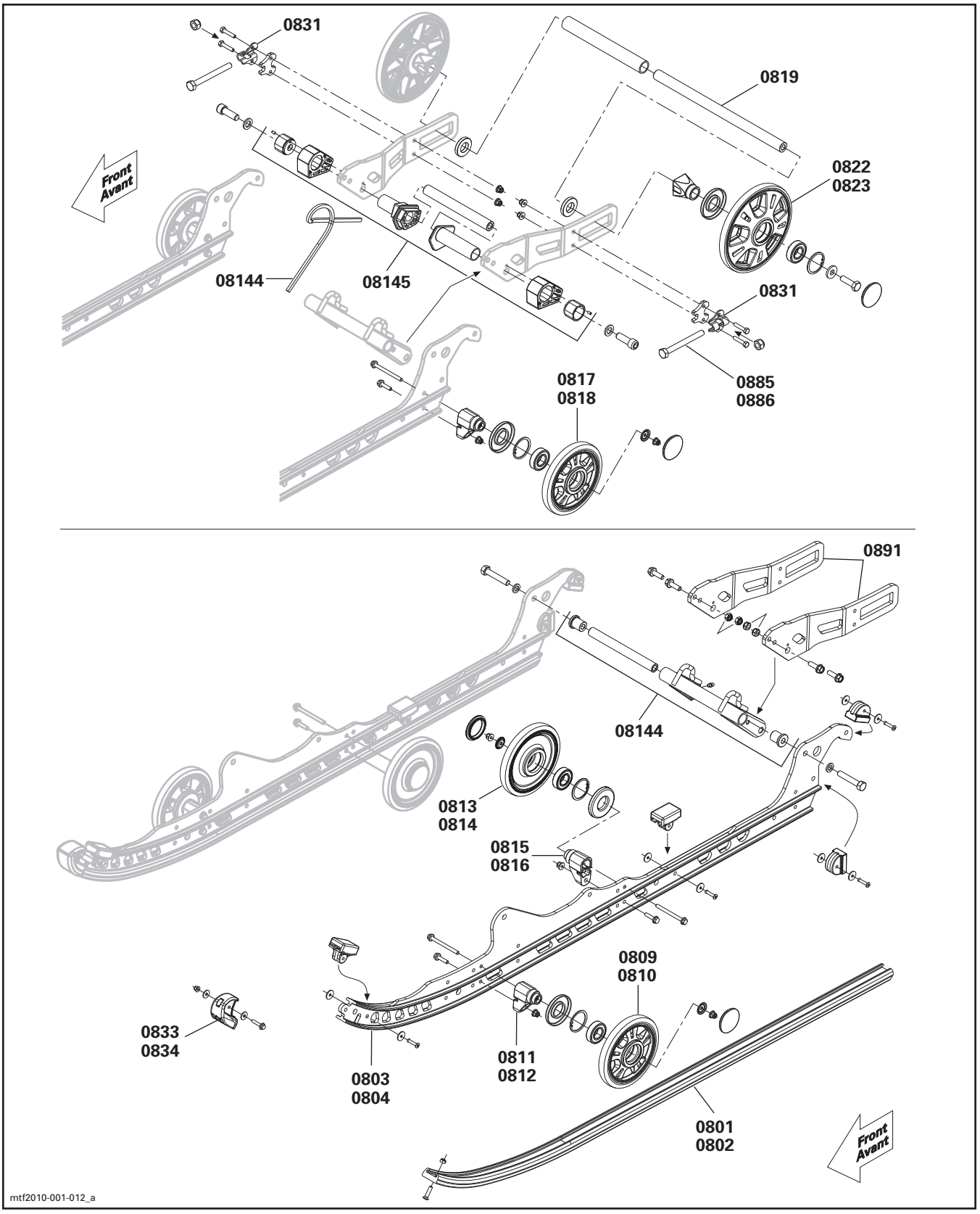
SYSTEM SYSTÈME	CODE	DESCRIPTION	MXZ / RENEGADE 900 ACE	GRAND TOURING GSX 900 ACE	EXPEDITION 900 ACE SPORT	EXPEDITION LE/SE 900 ACE	SKANDIC 900 ACE
			24	25	26	27	28
08	81	CLEATS AND/OR GUIDES (55-59) SEGMENTS GUIDE ET/OU GUIDES (55-59)			1.3	1.3	1.3
08	82	CLEATS AND/OR GUIDES (60-64) SEGMENTS GUIDE ET/OU GUIDES (60-64)			1.4	1.4	1.4
08	83	CLEATS AND/OR GUIDES (65-70) SEGMENTS GUIDE ET/OU GUIDES (65-70)			1.5	1.5	1.5
08	85	ADJUSTMENT SCREW (1) VIS D'AJUSTEMENT (1)	0.3	0.3	0.3	0.3	0.3
08	86	ADJUSTMENT SCREWS (2) VIS D'AJUSTEMENT (2)	0.4	0.4	0.4	0.4	0.4
08	87	SHOCK SUPPORT AND/OR AXLE SUPPORT D'AMORTISSEUR ET/OU AXE	0.4	0.4	0.4	0.4	0.4
08	88	FRONT SHOCK AND/OR SPRING AMORTISSEUR AVANT ET/OU RESSORT	0.5	0.5	0.5	0.5	0.5
08	89	FRONT WHEELS SUPPORT AND/OR BEARINGS (3) ROUES DE SUPPORT AVANT ET/OU ROULEMENTS À BILLE (3)	0.5	0.5	0.5	0.5	0.5
08	91	REAR PIVOT ARM BRAS DE PIVOT ARRIÈRE			0.7	0.7	0.7
08	144	CAM AXLE, SPRING, SHAFT AND CUSHIONS AXE DE CAME, RESSORT, ARBRE ET COUSSINETS			0.5	0.5	0.5
08	145	BLOCK, GUIDE, CAM AND PIVOT BLOC, GUIDE, CAME ET PIVOT			0.7	0.7	0.7

REAR SUSPENSION SYSTEM AND TRACK
SYSTÈME DE SUSPENSION ARRIÈRE ET CHENILLE




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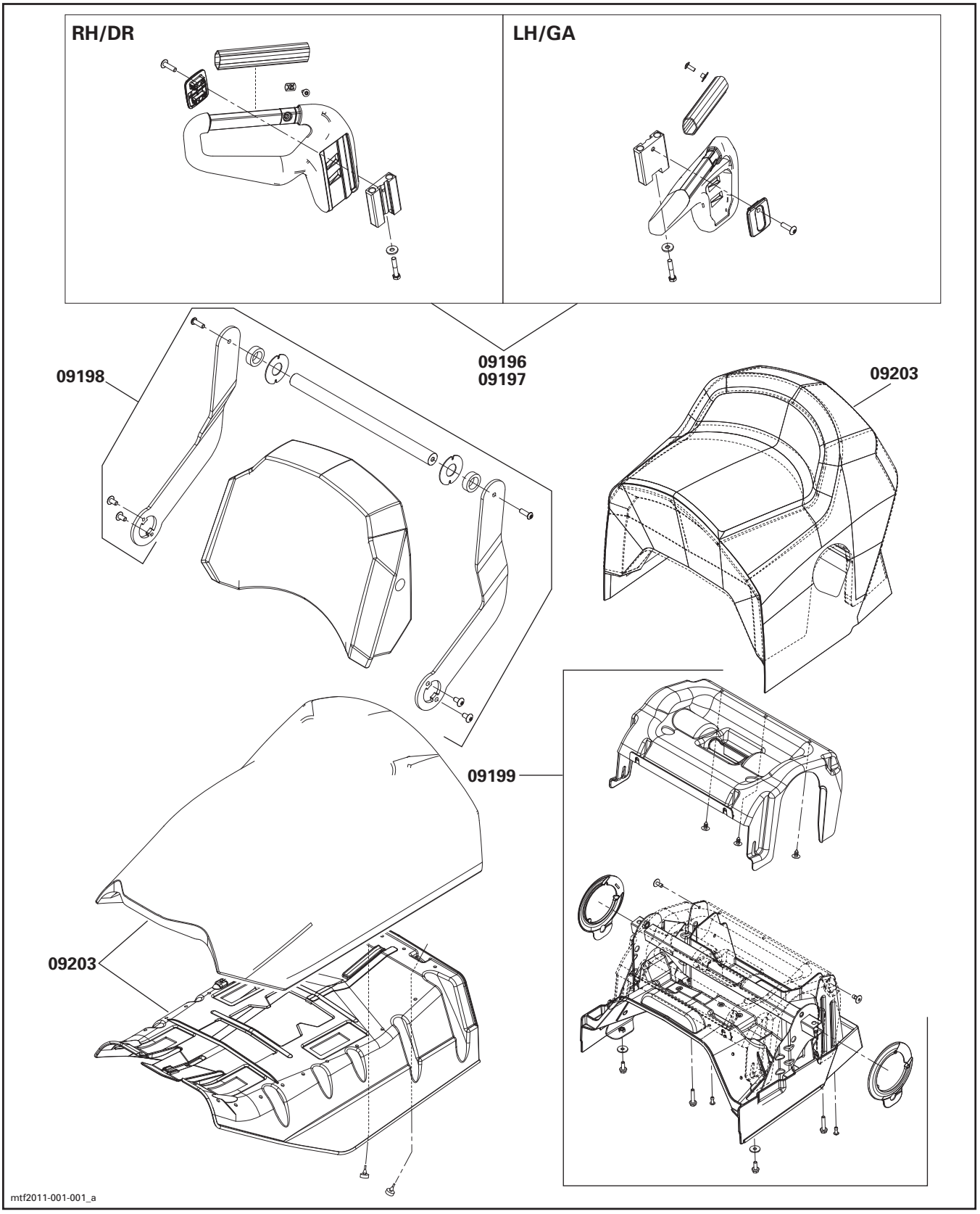
REAR SUSPENSION SYSTEM AND TRACK
SYSTÈME DE SUSPENSION ARRIÈRE ET CHENILLE

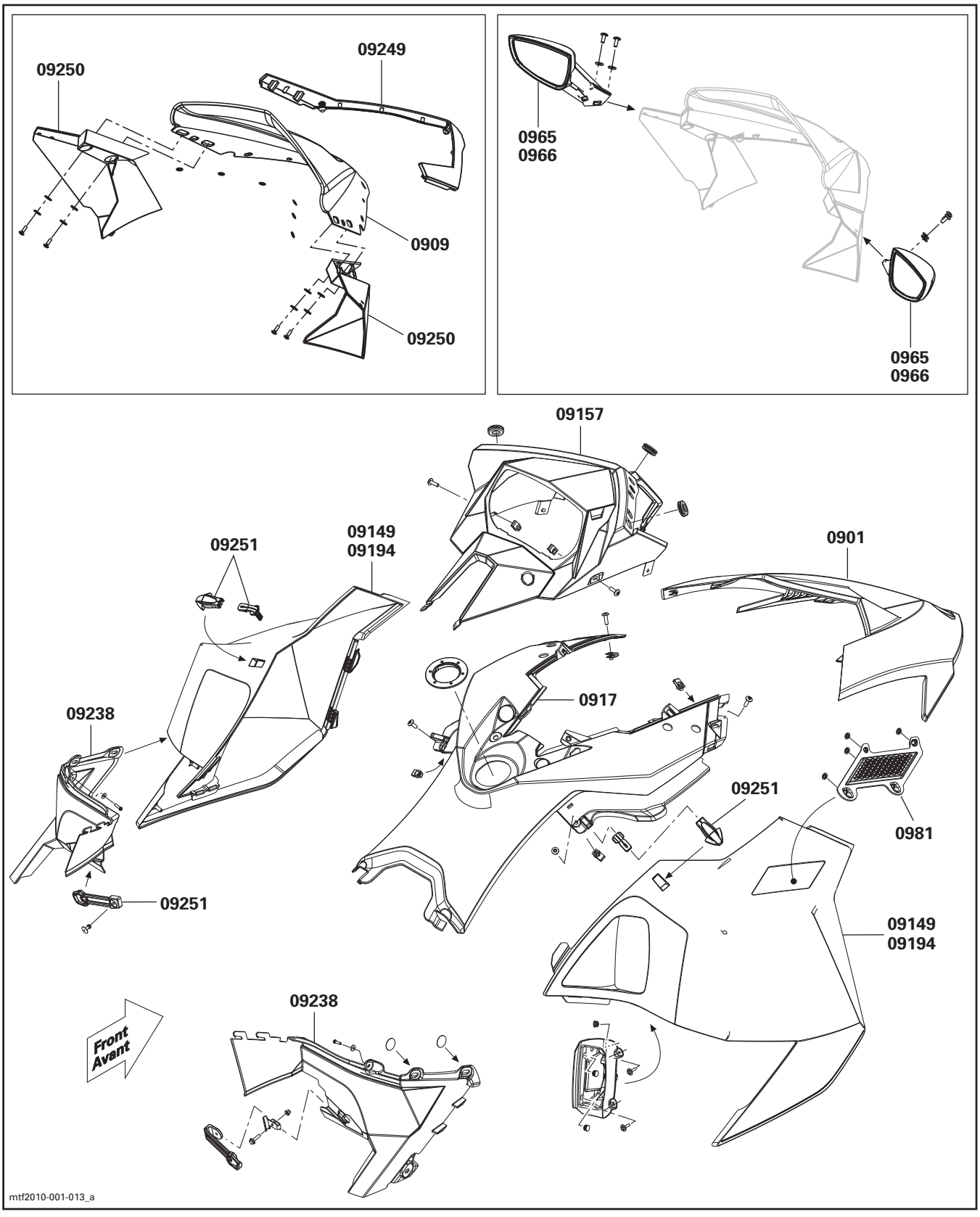


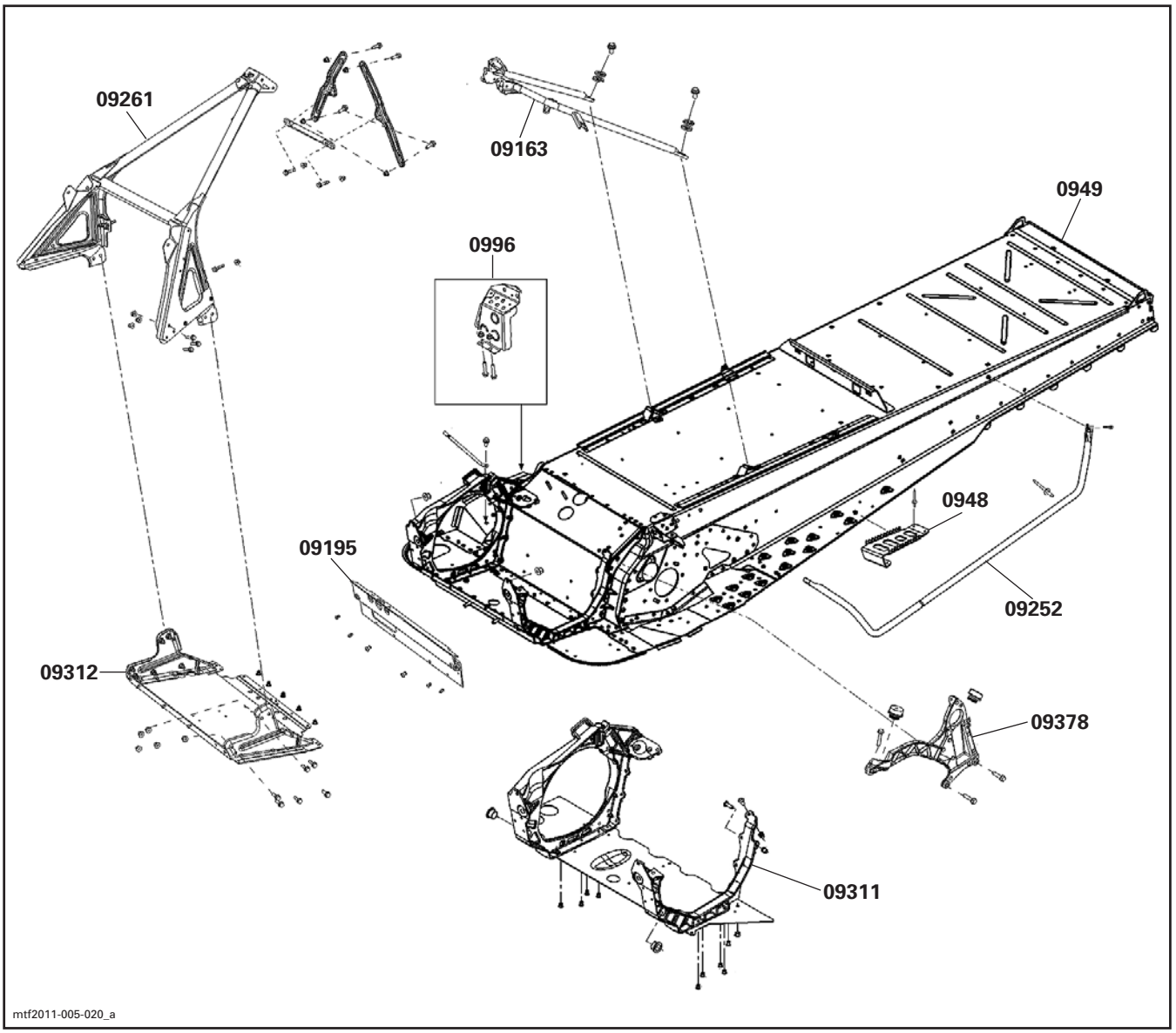
SYSTEM SYSTÈME	CODE	DESCRIPTION	MXZ / RENEGADE 900 ACE	GRAND TOURING GSX 900 ACE	EXPEDITION 900 ACE SPORT	EXPEDITION LE/SE 900 ACE	SKANDIC 900 ACE
			24	25	26	27	28
09	**00**	**NO LABOR INVOLVED AUCUNE MAIN-D'OEUVRE IMPLIQUÉE**	**0**	**0**	**0**	**0**	**0**
09	01	HOOD CAPOT		0.3		0.3	0.3
09	05	HOOD DECALS (LH OR RH) AUTOCOLLANTS DU CAPOT (GAUCHE OU DROIT)	0.3	0.3	0.3	0.5	0.5
09	06	HOOD DECALS (ALL) AUTOCOLLANTS DU CAPOT (TOUS)	0.5	0.5	0.5	0.5	0.5
09	09	WINDSHIELD PARE-BRISE	0.3	0.3	0.3	0.3	0.3
09	13	CARGO RACK SUPPORT À BAGAGES		0.4	0.4		
09	14	FRONT BUMPER PARE-CHOCS AVANT	0.5	0.4	0.5	0.4	0.4
09	17	CONSOLE CONSOLE	0.3	0.3	0.3	0.3	0.3
09	21	SEAT (ASS'Y) SIÈGE (COMPLET)	0.3	0.3	0.3		
09	22	SEAT COVER AND/OR FOAM HOUSSE DE SIÈGE ET/OU MOUSSE	1.0	1.0	1.0	0.7	0.7
09	23	SEAT FOAM CAOUTCHOUC MOUSSE DE SIÈGE	1.0	1.0	1.0	0.7	0.7
09	34	REAR BUMPER PARE-CHOCS ARRIÈRE	0.3	0.3	0.3	0.3	0.3
09	35	HITCH SUPPORT (ALL PARTS) SUPPORT D'ATTELAGE (TOUTES LES PIÈCES)			0.3	0.3	0.3
09	48	FRONT FOOTREST (LH OR RH) REPOSE-PIED AVANT (GAUCHE OU DROIT)		0.3	0.3		
09*	49	**FRAME (ASS'Y) OR FRONT MEMBER CHÂSSIS (COMPLET) OU CADRE AVANT**	**13.5**	**13.8**	**13.8**	**14.7**	**14.7**
09	51	REAR CAP PARTIE ARRIÈRE DU CHÂSSIS	0.7	0.8	0.8		
09	55	SNOW GUARD (1) GARDE-NEIGE (1)	0.3	0.3	0.3		0.3
09	58	BACKREST AND/OR COVER DOSSIER ET/OU HOUSSE		0.3	0.3	0.3	
09	65	MIRROR (1) RÉTROVISEUR (1)		0.3	0.3	0.3	0.3
09	66	MIRRORS (2) RÉTROVISEURS (2)		0.3	0.3	0.3	0.3
09	77	BOTTOM PAN (RH) COQUE CÔTÉ (DROITE)	0.7	0.7	0.7	0.7	0.7
09	78	BOTTOM PAN (LH) COQUE CÔTÉ (GAUCHE)	0.7	0.7	0.7	0.7	0.7

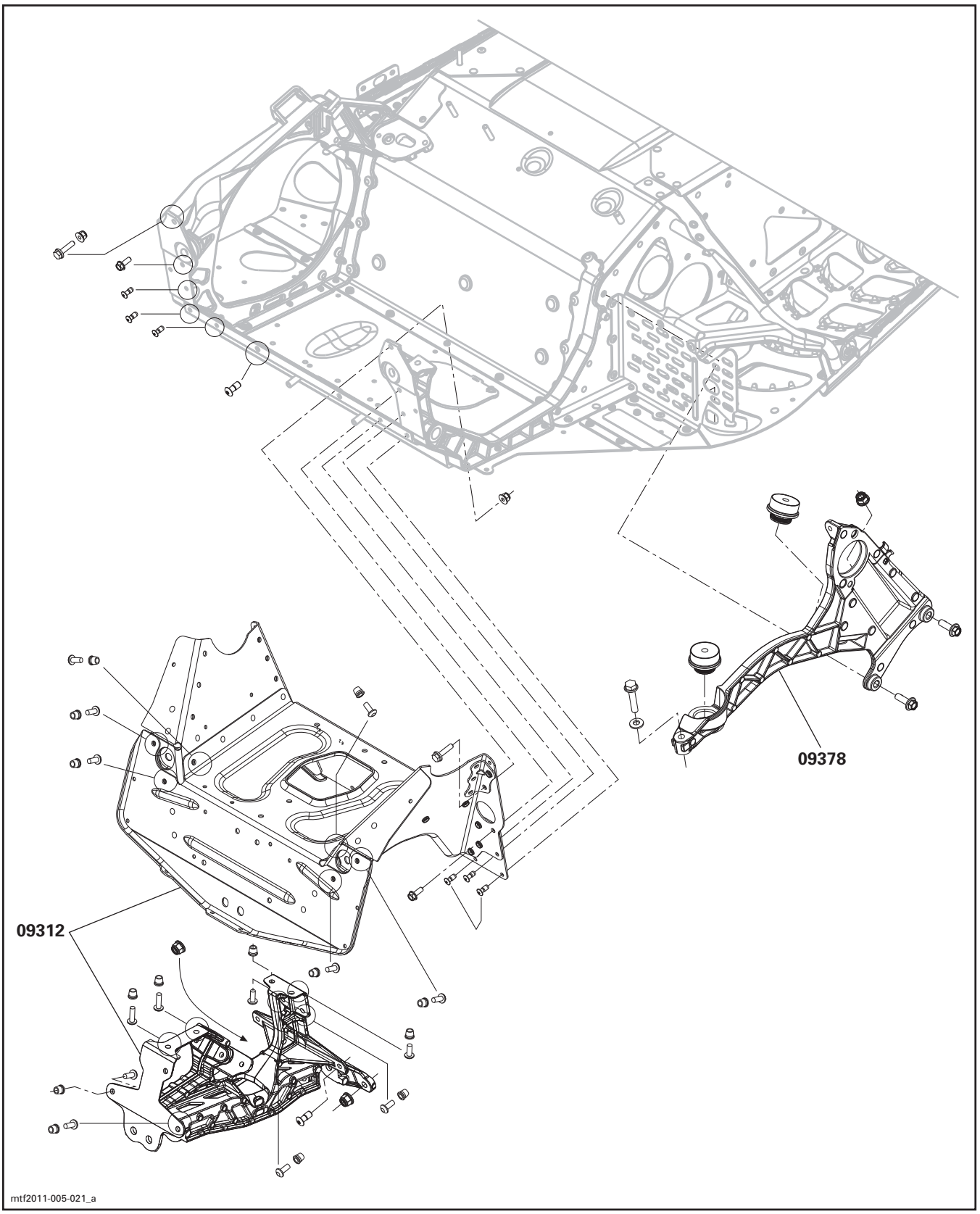
SYSTEM SYSTÈME	CODE	DESCRIPTION	MXZ / RENEGADE 900 ACE	GRAND TOURING GSX 900 ACE	EXPEDITION 900 ACE SPORT	EXPEDITION LE/SE 900 ACE	SKANDIC 900 ACE
			24	25	26	27	28
09	79	BOTTOM PAN (CENTER) COQUE PARTIE (CENTRALE)	0.8	0.8	0.8	0.8	0.8
09	80	FRONT GRILL (LH AND/OR RH) GRILLE AVANT (GAUCHE ET/OU DROIT)		0.3		0.3	0.3
09	81	SIDE GRILL (LH AND/OR RH) GRILLE LATÉRALE (GAUCHE ET/OU DROIT)	0.3	0.3	0.3	0.3	0.3
09	86	ROLLER ROULEAU	0.5	0.5	0.5	1.5	1.5
09	87	BOTTOM PAN DOOR PORTE DE COQUE					0.3
09	96	FOOT PROTECTOR AND/OR SUPPORT (LH OR RH) PROTÈGE PIED ET/OU SUPPORT (GAUCHE OU DROIT)	2.2	2.2	2.2	1.0	1.0
09	149	ENGINE SIDE PANELS (2) PANNEAUX MOTEUR (2)		0.9		0.9	0.9
09	157	UPPER CONSOLE CONSOLE SUPERIEUR		0.3		0.4	0.4
09	163	MEMBER (LH OR RH) MEMBRURE (GAUCHE OU DROIT)	0.4	0.4	0.4	0.5	0.5
09	191	SIDE PANEL DECAL (LH OR RH) (1) DÉCALQUES DE PANNEAU (GAUCHE OU DROIT) (1)	0.3	0.3	0.3	0.3	0.3
09	192	SIDE PANEL DECALS (LH OR RH) (ALL) DÉCALQUES DE PANNEAU (GAUCHE OU DROIT) (TOUS)	0.6	0.6	0.6	0.6	0.6
09	194	ENGINE SIDE PANEL (LH OR RH) PANNEAU MOTEUR (GAUCHE OU DROIT)		0.5		0.5	0.5
09	195	FRONT PLATE PLAQUE AVANT	4.5	4.5	4.5	4.5	
09	196	REAR HANDLE AND/OR GRIP POIGNÉE ARRIÈRE ET/OU GAINE		0.5		0.5	0.3
09	197	REAR HANDLES AND/OR GRIPS (2) POIGNÉES ARRIÈRE ET/OU GAINES (2)		0.9		0.9	0.3
09	198	BACKREST PARTS PIÈCES DU DOSSIER		0.3	0.3	0.3	
09	199	REAR SEAT BASE AND/OR ALL PARTS BASE SIÈGE ARRIÈRE ET/OU TOUTES LES PIÈCES		1.9	1.9	1.9	1.9
09	203	REAR SEAT COVER OR FOAM HOUSSE OU MOUSSE DU SIÈGE ARRIÈRE		1.1	1.1	1.0	1.0
09	233	UPPER SIDE PANEL (LH OR RH) PANNEAU LATÉRAL SUPÉRIEUR (GAUCHE OU DROIT)	0.6	0.6	0.6	0.3	
09	238	LOWER SIDE PANEL (LH OR RH) PANNEAU LATÉRAL INFÉRIEUR (GAUCHE OU DROIT)	0.6	0.3	0.6	0.5	0.5
09	249	WINDSHIELD SUPPORT SUPPORT PARE-BRISE	0.3	0.3	0.3	0.3	0.3
09	250	AIR DEFLECTOR (LH OR RH) DÉFLECTEUR D'AIR (GAUCHE OU DROIT)	0.3	0.3	0.3	0.3	0.3

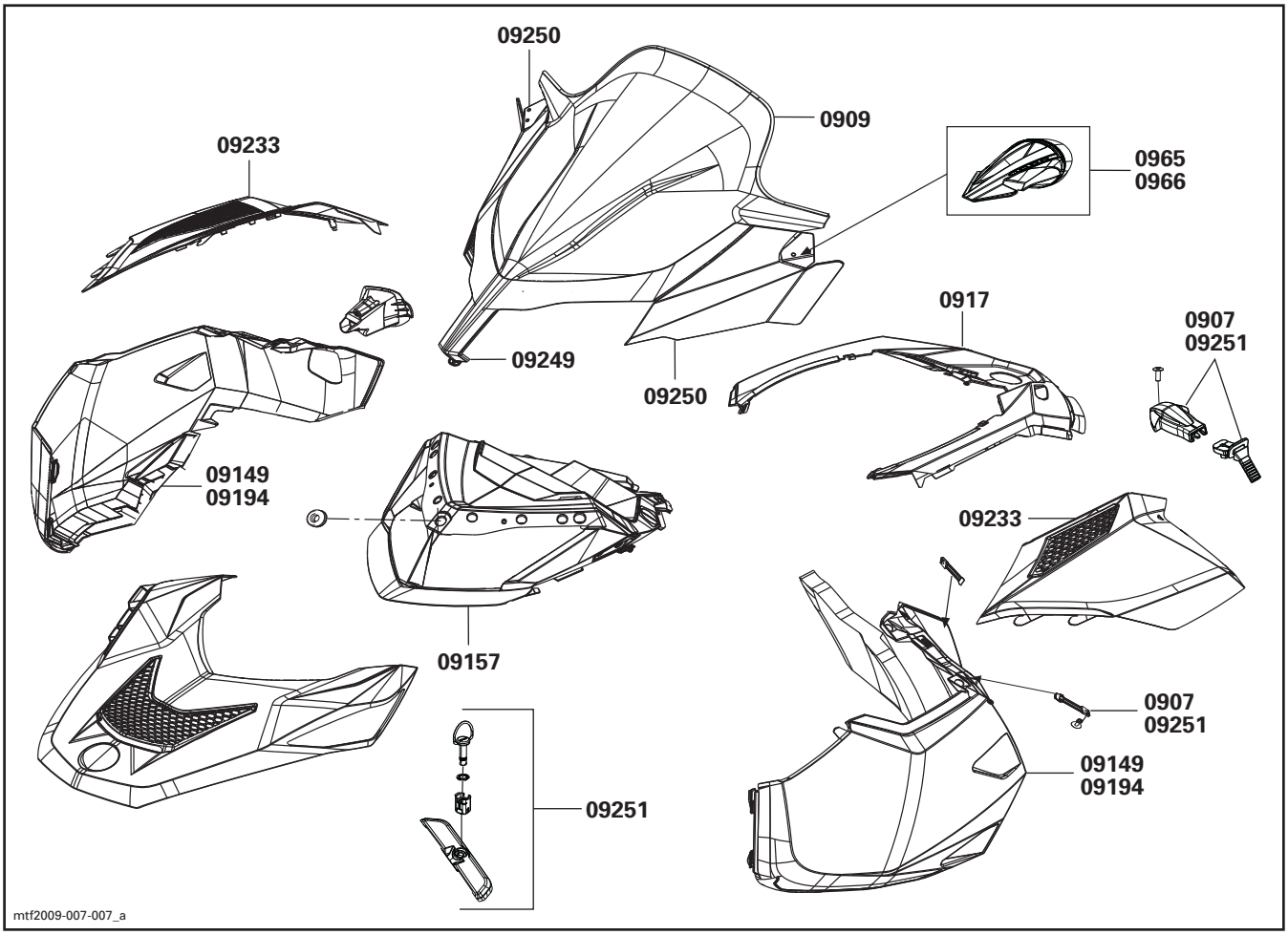
SYSTEM SYSTÈME	CODE	DESCRIPTION	MXZ / RENEGADE 900 ACE	GRAND TOURING GSX 900 ACE	EXPEDITION 900 ACE SPORT	EXPEDITION LE/SE 900 ACE	SKANDIC 900 ACE
			24	25	26	27	28
09	251	PANEL LATCHES (ALL) LOQUETS DE PANNEAU (TOUS)	0.3	0.3	0.3	0.3	0.3
09	252	FOOTREST REINFORCEMENT (LH OR RH) RENFORT DE MARCHE-PIED (GAUCHE OU DROIT)	1.1	1.1	1.1	0.6	0.6
09	259	FRONT CROSS MEMBER LONGERON AVANT DU CHASSIS				2.3	
09	261	FRONT MEMBER MEMBRURE AVANT	2.0	2.0	2.0	2.2	
09	284	BOX DOOR PORTE DE COFFRE	0.3		0.3	0.4	
09	289	GLOVES BOX BOITE À GANTS	0.6		0.6		
09	310	SEAT BOX BASE SIEGE				1.3	1.3
09	311	E-MODULE MODULE E	5.8	5.8	5.8	6.4	6.4
09	312	S-MODULE MODULE S	3.5	3.5	3.5	3.5	
09	313	SEAT BOX FRAME CHASSIS BASE DE SIEGE				0.4	0.4
09	378	BRACE BRETELLE	1.0	1.0	1.0	1.0	1.0
09	379	BATTERY SUPPORT SUPPORT DE BATTERIE	0.5	0.5	0.5		
09	384	RADIATOR COVER COUVERCLE DE RADIATEUR	0.5	0.5			
09	400	CENTER HOOD CAPOT CENTRAL	0.8		0.8		
09	401	HOOD (RH OR LH) CAPOT (DROIT OU GAUCHE)	0.7		0.7		
09	439	MEMBER CAP CAPUCHON DE MEMBRURE	0.3				

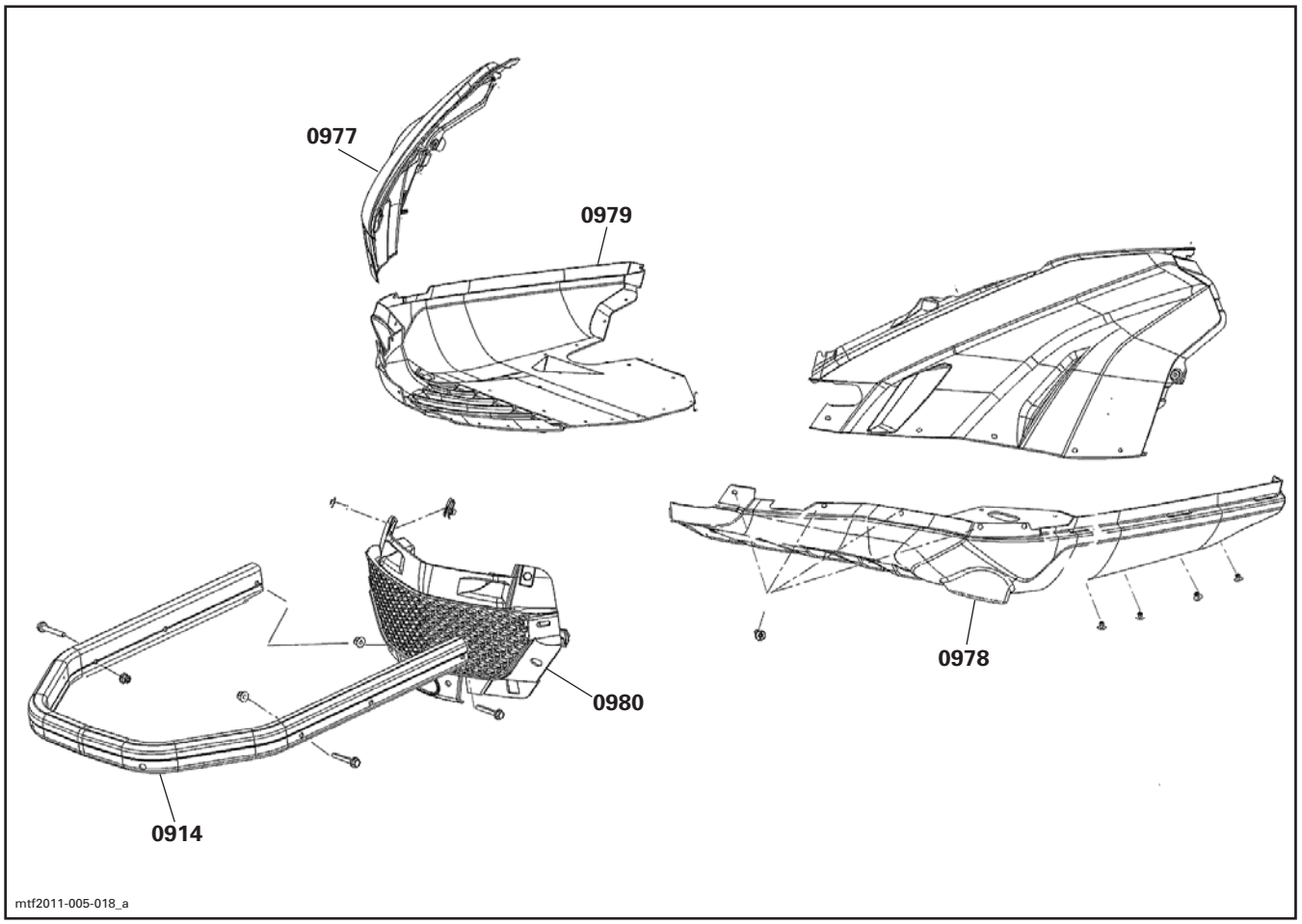

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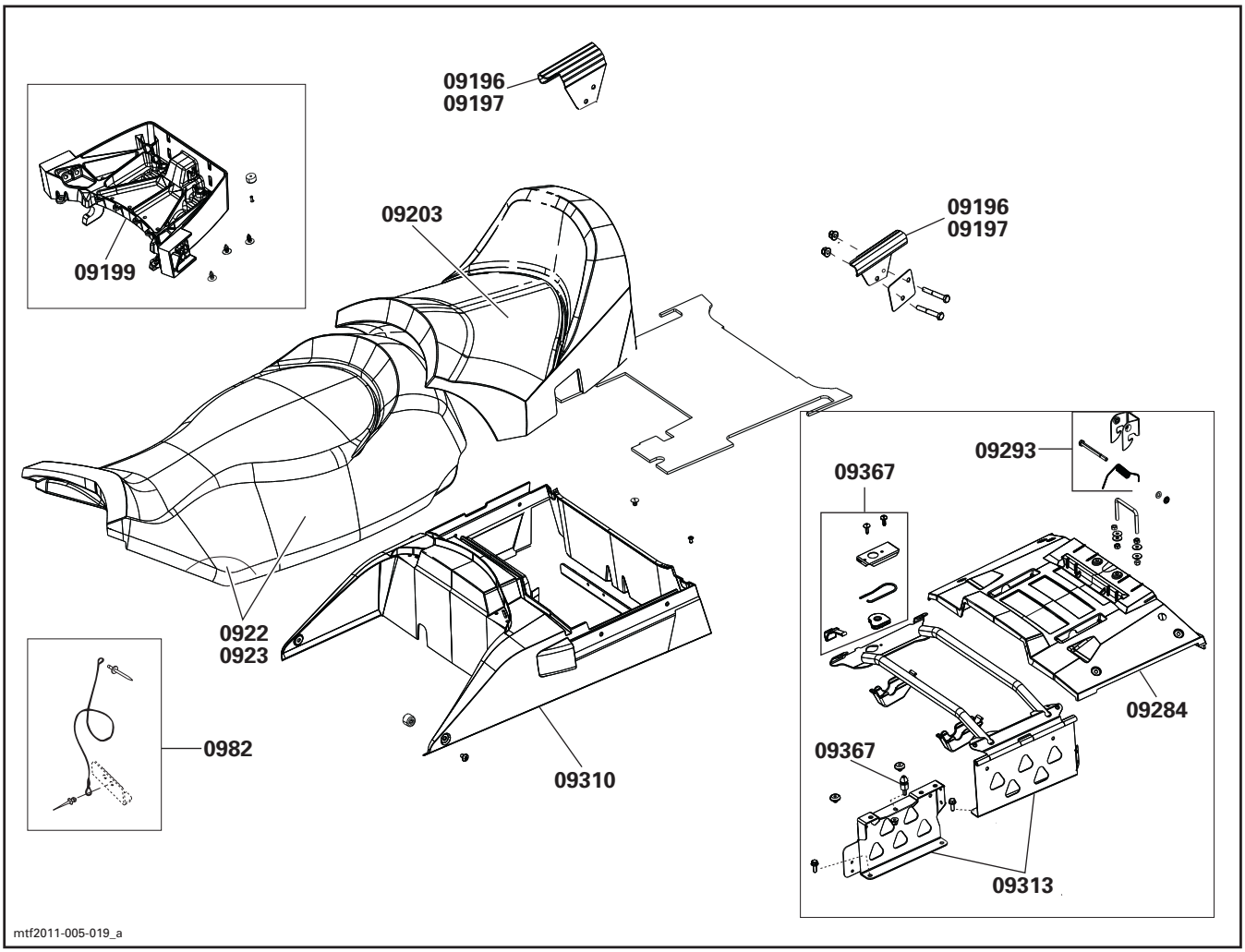

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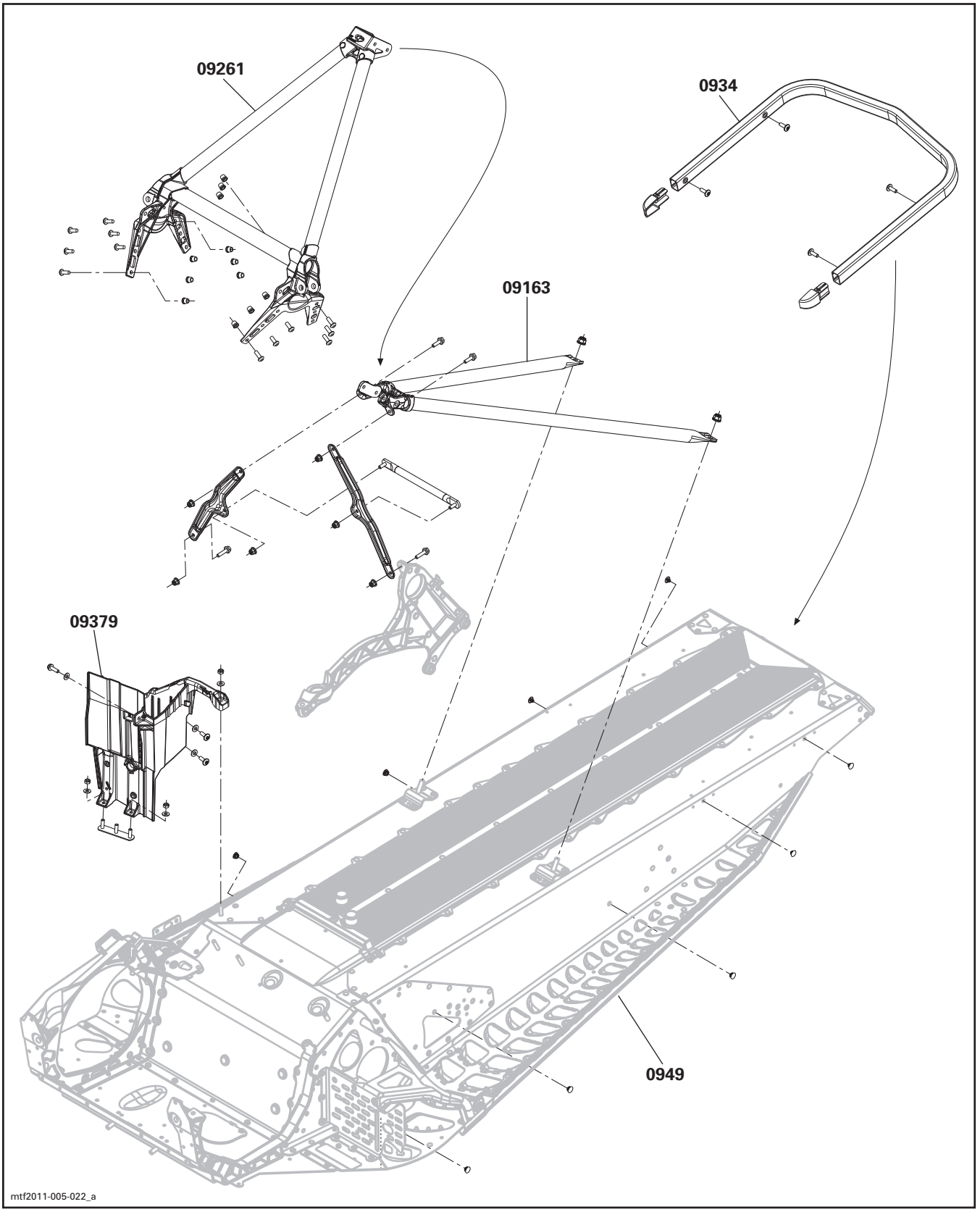

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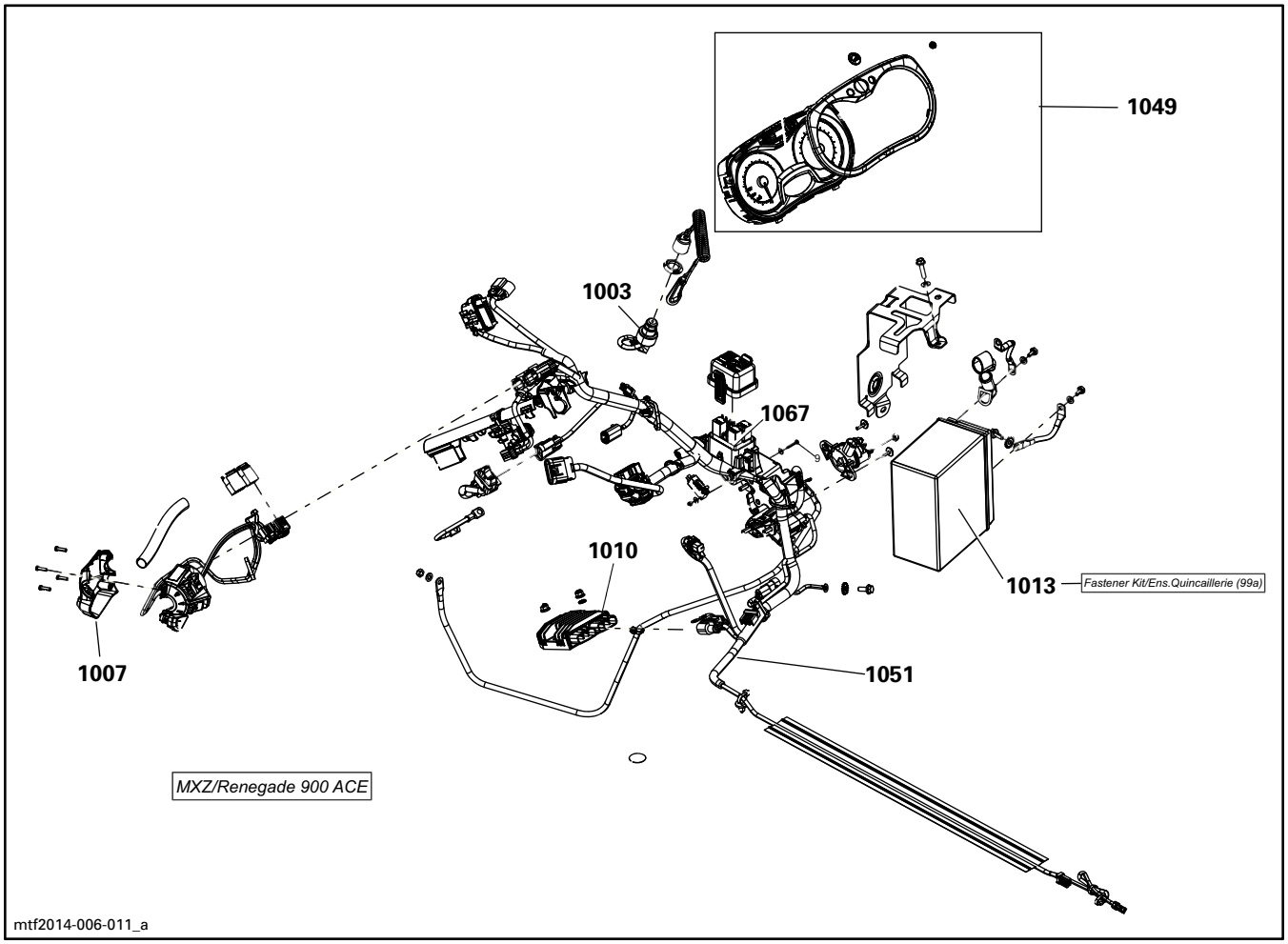

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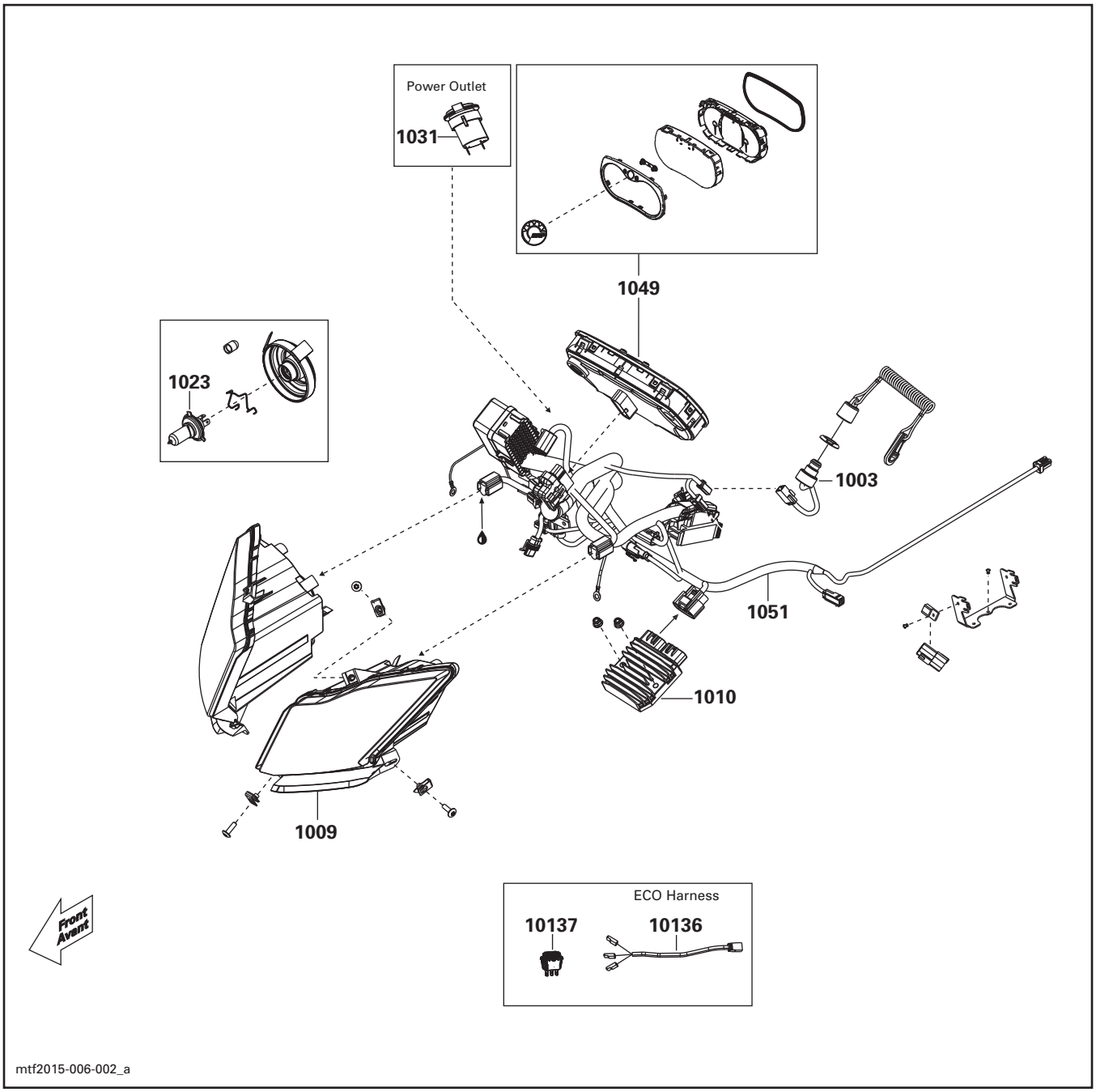

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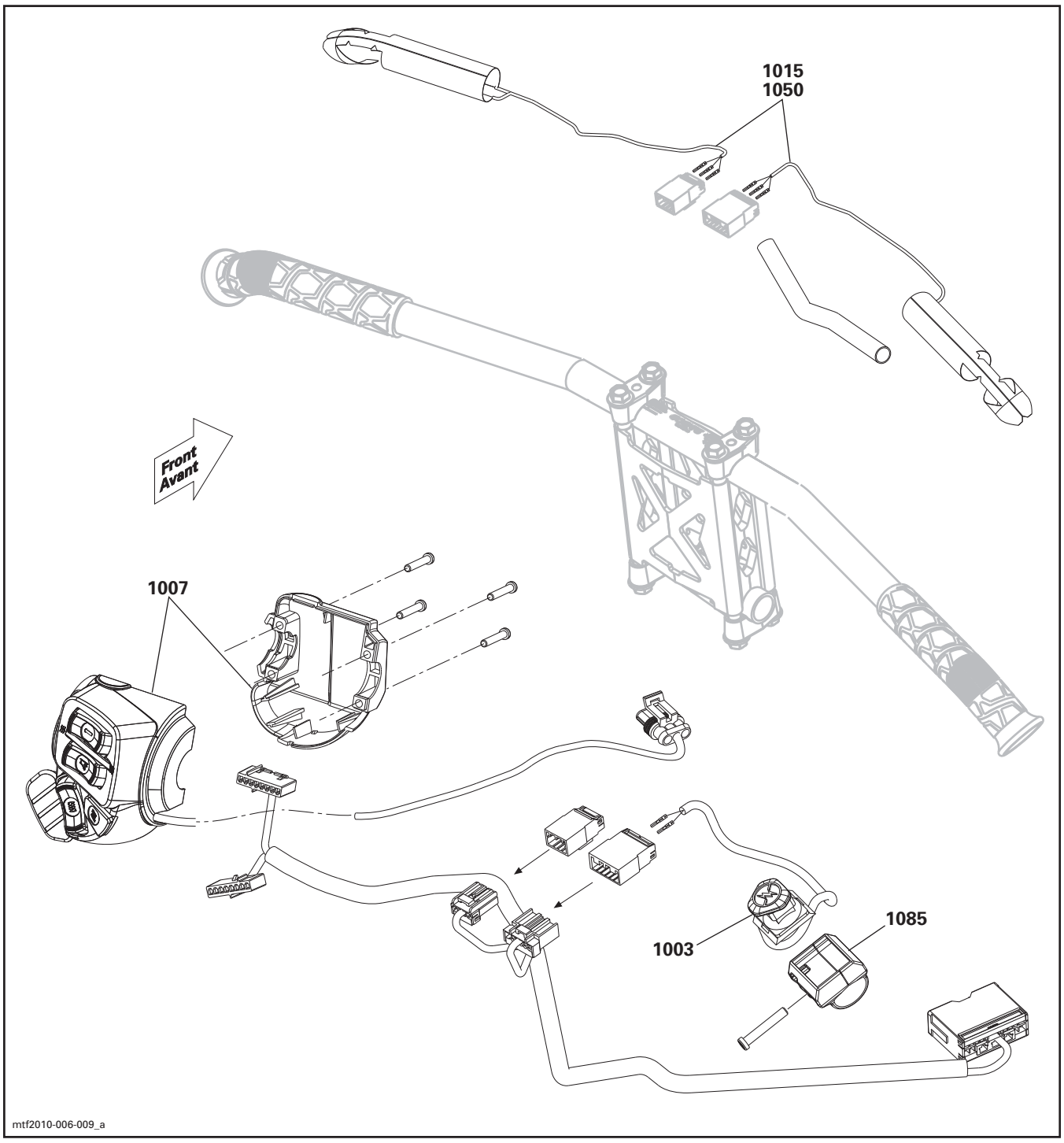
SYSTEM SYSTÈME	CODE	DESCRIPTION	MXZ / RENEGADE 900 ACE	GRAND TOURING GSX 900 ACE	EXPEDITION 900 ACE SPORT	EXPEDITION LE/SE 900 ACE	SKANDIC 900 ACE
			24	25	26	27	28
10	**00**	**NO LABOR INVOLVED AUCUNE MAIN-D'OEUVRE IMPLIQUÉE**	**0**	**0**	**0**	**0**	**0**
10	01	IGNITION SWITCH INTERRUPTEUR D'ALLUMAGE	0.3	0.3	0.3	0.3	0.3
10	03	KILL SWITCH D'INTERRUPTEUR D'URGENCE	0.3	0.3	0.3	0.3	0.3
10	05	BRAKE LIGHT SWITCH INTERRUPTEUR DE FEU D'ARRÊT	0.3	0.3	0.3	0.3	0.3
10	06	TETHER CORD SWITCH OR D.E.S.S. CAPUCHON COUPE-CIRCUIT OU D.E.S.S.	0.3	0.3	0.3	0.3	0.3
10	07	IGNITION SWITCH BLOCK LOGEMENT DE RÉCEPTACLE (INTERRUPTEUR)	0.3	0.3	0.3	0.3	0.3
10	08	CURRENT OR GROUND WIRE FIL DE BATTERIE OU DE MASSE	0.3	0.3	0.3	0.3	0.3
10	09	HEADLAMP (ASS'Y) (ALL PARTS) PHARE (COMPLET) (TOUTES LES PIÈCES)	0.3	0.3	0.3	0.3	0.3
10	10	VOLTAGE REGULATOR RÉGULATEUR DE TENSION	0.7	0.7	0.7	0.7	0.7
10	12	TAIL LIGHT (ASS'Y) (ALL PARTS) FEU ARRIÈRE (COMPLET) (TOUTES LES PIÈCES)	0.3	0.3	0.3	0.3	0.3
10	13	BATTERY BATTERIE	0.3	0.3	0.3	0.3	0.3
10	15	HEATED GRIP (1) POIGNÉES CHAUFFANTE (1)	0.5	0.5	0.5	0.5	0.5
10	16	BULBS (ONE OR ALL) AMPOULES (UNE OU TOUTES)	0.3	0.3	0.3	0.3	0.3
10	17	HEATED THROTTLE LEVER MANETTE D'ACCÉLÉRATEUR CHAUFFANTE	0.3	0.3	0.3	0.3	0.3
10	23	HALOGEN BULB AMPOULE HALOGÈNE	0.3	0.3	0.3	0.3	0.3
10	31	DC OUTLET PLUG PRISE D'ACCESSOIRE DC			0.3	0.3	0.3
10	34	ELECTRONIC MODULE MODULE ÉLECTRONIQUE	0.7	0.7	0.7	0.7	0.7
10	41	ENGINE HARNESS CABLAGE DU MOTEUR	1.5	1.5	1.5	1.5	1.5
10	49	MULTIFUNCTION GAUGE CADRAN MULTIFONCTION	0.3	0.3	0.3	0.3	0.3
10	50	HEATED GRIPS (2) POIGNÉES CHAUFFANTES (2)	0.9	0.9	0.9	0.9	0.9
10	51	MAIN HARNESS CÂBLAGE PRINCIPAL	1.8	1.8	1.8	1.8	1.8
10	59	REAR HEATED GRIP (1) POIGNÉE CHAUFFANTE ARRIÈRE (1)		0.5		0.5	

SYSTEM SYSTÈME	CODE	DESCRIPTION	MXZ / RENEGADE 900 ACE	GRAND TOURING GSX 900 ACE	EXPEDITION 900 ACE SPORT	EXPEDITION LE/SE 900 ACE	SKANDIC 900 ACE
			24	25	26	27	28
10	60	REAR HEATED GRIPS (2) POIGNÉES CHAUFFANTES ARRIÈRE (2)		0.9		0.9	
10	67	RELAY RELAIS	0.3	0.3	0.3	0.3	0.3
10	80	ELECTRONIC REVERSE MOTOR MOTEUR DE LA RENVERSE ÉLECTRONIQUE		0.4			
10	81	MULTIFUNCTION PLATE PLAQUE MULTIFONCTION	0.4	0.4	0.4	0.4	0.4
10	82	REVERSE SWITCH INTERRUPTEUR DE RENVERSE	0.3	0.3	0.3	0.3	0.3
10	85	KILL SWITCH SUPPORT SUPPORT D'INTERRUPTEUR D'URGENCE	0.3	0.3	0.3	0.3	0.3
10	118	STEERING HARNESS CÂBLAGE DU GUIDON	1.0	1.0	1.0	1.0	1.0
10	136	ECO HARNESS CABLAGE ECO				0.3	0.3
10	137	ECO SWITCH INTERRUPTEUR ECO	0.3	0.3	0.3	0.3	0.3


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Fastener Kit/Ens.Quincaillerie (99a)
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MXZ/Renegade 900 ACE
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Power Outlet
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1023
1003
1051
1010
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Front
Avant
ECO Harness
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10136
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ELECTRICAL SYSTEM
SYSTÈME ÉLECTRIQUE



ski-doo®

BRP

2015

OPERATOR'S GUIDE

Includes Safety, Vehicle and Maintenance Information

Skandic™ WT/SWT

⚠ WARNING

Read this guide thoroughly. It contains important safety information.
Minimum recommended operator's age: 16 years old.
Keep this Operator's Guide in the vehicle.

619 900 515

⚠ WARNING

Disregarding any of the safety precautions and instructions contained in this Operator's Guide, *SAFETY DVD* video and on-product safety labels could cause injury including the possibility of death!

⚠ WARNING

This vehicle may exceed the performance of other vehicles you may have ridden in the past. Take time to familiarize yourself with your new vehicle.

FOREWORD

Deutsch	Dieses Handbuch ist möglicherweise in Ihrer Landessprache verfügbar. Bitte wenden Sie sich an Ihren Händler oder besuchen Sie: **www.operatorsguide.brp.com**.
English	This guide may be available in your language. Check with your dealer or go to: **www.operatorsguide.brp.com**.
Français	Ce guide peut être disponible dans votre langue. Vérifier avec votre concessionaire ou aller à: **www.operatorsguide.brp.com**.
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Svenska	Denna bok kan finnas tillgänglig på ditt språk. Kontakta din återförsäljare eller gå till: **www.operatorsguide.brp.com**.

Congratulations on your purchase of a new Ski-Doo® snowmobile. Whatever model you have chosen, it is backed by the Bombardier Recreational Products Inc. (BRP) warranty and a network of authorized Ski-Doo snowmobile dealers ready to provide the parts, service or accessories you may require.

Your dealer is committed to your satisfaction. He has taken training to perform the initial set-up and inspection of your snowmobile as well as completed the final adjustment required to suit your specific weight and riding environment before you took possession

At delivery, you were informed of the warranty coverage and signed the *PREDELIVERY CHECK LIST* to ensure your new vehicle was prepared to your entire satisfaction.

Know Before you Go

To learn how to reduce the risk for you, your passenger or bystanders being injured or killed, read the following sections before you operate the vehicle:

– *SAFETY INFORMATION*
– *VEHICLE INFORMATION*.

Also read all safety labels on your snowmobile and watch attentively your *SAFETY DVD* video.

We highly recommend that you take a safety riding course. Please check with your dealer or local authorities for availability in your area.

Failure to follow the warnings contained in this Operator's Guide can result in SERIOUS INJURY or DEATH.

Safety Messages

The types of safety messages, what they look like and how they are used in this guide are explained as follows:

The safety alert symbol ⚠ indicates a potential injury hazard.

⚠ WARNING

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

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

NOTICE Indicates an instruction which, if not followed, could severely damage vehicle components or other property.

About this Operator's Guide

This Operator's Guide has been prepared to acquaint the owner/operator and passenger with this snowmobile and its various controls, safe riding and maintenance instructions.

Keep this Operator's Guide in the vehicle as you can refer to it for things such as maintenance, troubleshooting and instructing others.

Note that this guide is available in several languages. In the event of any discrepancy, the English version shall prevail.

If you want to view and/or print an extra copy of your Operator's Guide, simply visit the following website www.operatorsguide.brp.com.

The informations contained in this document are correct at the time of publication. BRP, however, maintains a policy of continuous improvement of its products without imposing upon itself any obligation to install them on products previously manufactured. Due to late changes, some differences between the manufactured product and the descriptions and/or specifications in this guide may occur. BRP reserves the right at any time to discontinue or change specifications, designs, features, models or equipment without incurring any obligation upon itself.

This Operator's Guide and the *SAFETY DVD* video should remain with the vehicle when it's sold.

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SAFETY INFORMATION

GENERAL PRECAUTIONS

Avoid Carbon Monoxide Poisoning

All engine exhaust contains carbon monoxide, a deadly gas. Breathing carbon monoxide can cause headaches, dizziness, drowsiness, nausea, confusion and eventually death.

Carbon monoxide is a colorless, odorless, tasteless gas that may be present even if you do not see or smell any engine exhaust. Deadly levels of carbon monoxide can collect rapidly, and you can quickly be overcome and unable to save yourself. Also, deadly levels of carbon monoxide can linger for hours or days in enclosed or poorly ventilated areas. If you experience any symptoms of carbon monoxide poisoning, leave the area immediately, get fresh air and seek medical treatment.

To prevent serious injury or death from carbon monoxide:

- Never run the vehicle in poorly ventilated or partially enclosed areas such as garages, carports or barns. Even if you try to ventilate engine exhaust with fans or open windows and doors, carbon monoxide can rapidly reach dangerous levels.
- Never run the vehicle outdoors where engine exhaust can be drawn into a building through openings such as windows and doors.

Avoid Gasoline Fires and Other Hazards

Gasoline is extremely flammable and highly explosive. Fuel vapors can spread and be ignited by a spark or flame many feet away from the engine. To reduce the risk of fire or explosion, follow these instructions:

- Use only an approved gasoline container to store fuel.
- Strictly adhere to instructions in *FUELING PROCEDURE*.
- Never start or operate the engine if the fuel cap is not properly installed.

Gasoline is poisonous and can cause injury or death.

- Never siphon gasoline by mouth.
- If you swallow gasoline, get any in your eye or inhale gasoline vapor, see your doctor immediately.

If gasoline spills on you, wash with soap and water and change your clothes.

Avoid Burns from Hot Parts

The exhaust system and engine become hot during operation. Avoid contact during and shortly after operation to avoid burns.

Accessories and Modifications

Do not make unauthorized modifications, or use attachments or accessories that are not approved by BRP. Since these changes have not been tested by BRP, they may increase the risk of crashes or injuries, and they can make the vehicle illegal.

See your authorized Ski-Doo dealer for available accessories for your vehicle.

SPECIAL SAFETY MESSAGES

SEVERE INJURY OR DEATH can result if you do not follow these instructions:

- Always make a pre-ride inspection BEFORE you start the engine.
- Throttle mechanism should be checked for free movement and return to idle position before starting engine.
- Always attach tether cord eyelet to clothing before starting the engine.
- Never operate the engine without the drive belt guard and brake disk guard securely installed or, with hood or side panels opened or removed. Never run the engine without drive belt installed. Running an unloaded engine such as without drive belt or with track raised, can be dangerous.
- Always engage parking brake before starting the engine.
- Everyone is a beginner the first time he sits behind the controls of a snowmobile regardless of previous experience in driving any other type of vehicle. The safe use of your snowmobile depends on many conditions such as visibility, speed, weather, environment, traffic, vehicle condition and the condition of the driver.
- Basic training is required for the safe operation of any snowmobile. Study your Operator's Guide paying particular attention to cautions and warnings. Join your local snowmobile club: its social activities and trail systems are planned for both fun and safety. Obtain basic instructions from your snowmobile dealer, friend, fellow club member or enroll in your state or provincial safety training program.
- Any new operator must read and understand all safety labels on the snowmobile, the Operator's Guide and watch the *SAFETY DVD* video before operating the snowmobile. Only allow a new operator to operate the snowmobile in a restricted flat area — at least until he is completely familiar with its operation. If snowmobile operator training course is offered in your area, have him enroll.
- The performance of some snowmobiles may significantly exceed that of other snowmobiles you have operated. Therefore, use by novice or inexperienced operators is not recommended.
- Snowmobiles are used in many areas and in many snow conditions. Not all models perform the same in similar conditions. Always consult your snowmobile dealer when selecting the snowmobile model for your particular needs and uses.
- Injury or death may result to the snowmobile operator, passenger or bystander if the snowmobile is used in risky conditions which are beyond the driver's, passenger's or snowmobile's capabilities or intended use.
- BRP recommends the operator has at least 16 years old of age.
- It is very important to inform any operator, regardless of his experience, of the handling characteristics of this snowmobile. The snowmobile configuration, such as ski stance, ski type, suspension type, track length, width and type vary from a model to another. The snowmobile handling is greatly influenced by these characteristics.
- The novice driver should become familiar with the snowmobile through practice on a level area at slow speeds before venturing far afield.
- Know your local laws. Federal, state, provincial and local government agencies have enacted laws and regulations pertaining to the safe use and operation of snowmobiles. It is your responsibility as a snowmobiler to learn and obey these laws and regulations. Respect and observance will result in safer snowmobiling for all. Be aware of the liability property damages and insurance laws regarding your equipment.

- Speeding can be fatal. In many cases, you cannot react or respond quickly enough to the unexpected. Always ride at a speed which is suitable to the trail, weather conditions and your own ability. Know your local rules. Speed limit may be in effect and meant to be observed.
- Always keep right hand side of the trail.
- Always keep a safe distance from other snowmobiles and bystanders.
- Remember, promotional material may show risky maneuvers performed by professional riders under ideal and/or controlled conditions. You should never attempt any such risky maneuvers if they are beyond your level of riding ability.
- Never use this vehicle with alcohol or drugs. They slow reaction time and impair judgement.
- Your snowmobile is not designed to be operated on public streets, roads or highways.
- Avoid road traveling. If you must do so, and it is permitted, reduce speed. The snowmobile is not designed to operate or turn on paving. When crossing a road, make a full stop, then look carefully in both directions before crossing at a 90° angle. Be wary of parked vehicles.
- Snowmobiling at night can be a delightful experience but because of reduced visibility, be extra cautious. Avoid unfamiliar terrain and be sure your lights are working. Always carry a flashlight and spare light bulbs.
- Never remove any original equipment from your snowmobile. Each vehicle has many built in safety features. Such features include various guards and consoles, plus reflective materials and safety labels.
- Nature is wonderful but don't let it distract your attention from driving. If you want to truly appreciate winter's scenery, stop your snowmobile on the side of the trail so that you don't become a hazard to others.
- Fences represent a very serious threat for both you and your snowmobile. Give a wide berth to telephone poles or posts.
- Hidden wires unseen from a distance can cause serious accidents.
- Always wear an approved safety helmet, eye protection and a face shield. This also applies to your passenger.
- Be aware of inherent risks associated with riding off trails, such as avalanche and other natural or man made hazards or obstacles.
- Tailgating another snowmobile should be avoided. If the snowmobile in front of you slows for any reason, its driver and passenger could be harmed through your neglect. Maintain a safe stopping distance between you and the snowmobile in front of you. Depending on the terrain condition, stopping may require a little more space than you think. Play it safe. Be prepared to use evasive driving.
- Venturing out alone with your snowmobile could also be hazardous. You could run out of fuel, have an accident, or damage your snowmobile. Remember, your snowmobile is capable of traveling further in half an hour than you may be able to walk in a day. Use the "buddy system". Always ride with a friend or member of your snowmobile club. Even then, tell someone where you are going and the approximate time you plan to return.

- Meadows sometimes have low areas where water accumulate and freezes over in winter. This ice is usually glare ice. Attempting to turn or brake on this surface could cause your vehicle to spin out of control. Never brake or attempt speeding or turning on glare ice. If you do happen to travel over such a condition, reduce speed by carefully releasing the throttle.
- Never "jump" with your snowmobile.
- When riding in a group, do not "gun" the throttle. Snow and ice can be thrown back into the path of a following snowmobile. In addition, when "gunning" the throttle, the vehicle digs into and leaves an irregular snow surface for others.
- Riding in a group is fun and enjoyable but don't show off or overtake others in the group. A less experienced operator might try to do the same as you and fail. When riding with others, limit your abilities to the experience of others.
- In case of an emergency, press down on the engine emergency stop switch, and apply brake.
- Never run the engine in a non-ventilated area and/or if vehicle is left unattended.
- Always engage parking brake before starting the engine.
- Never charge or boost a battery while installed on snowmobile.
- E-TEC engines: Never attempt any fuel system or electrical system maintenance or repair. Any maintenance or repair of these systems must by performed by an authorized Ski-Doo dealer.
- Ensure the path behind is clear of obstacles or bystanders before proceeding in reverse.
- Always remove the tether cord cap from engine cut-off switch when vehicle is not in operation in order to prevent accidental engine starting, to avoid unauthorized use by children or others or theft.
- NEVER stand behind or near a rotating track. Debris could be projected causing severe injuries. To remove packed snow or ice, stop engine, tilt and hold vehicle on its side and use screwdriver from tool kit.
- You may stud the track on this vehicle model. However, you MUST only use the BRP approved type stud for use on Ski-Doo snowmobiles. DO NOT EVER use conventional studs, the track thickness is thinner compared to some other tracks. The stud could tear off track and be projected.
- Never ride as a passenger unless the snowmobile is equipped with a passenger seat and passenger handholds or holding strap. Sit only on the designated passenger seat.
- Always wear an approved helmet and follow the same dressing guidelines as those recommended for the operator and described in this guide.
- Make sure that you are able to achieve a stable stance, both feet resting positively on the footboards of footrests with good grip, and that you are able to hold on firmly to the handholds.
- Once underway, if you feel uncomfortable or insecure for any reason, don't wait, tell the driver to slow down or stop.

ACTIVE TECHNOLOGIES (iTC) (600 ACE / 900 ACE)

Introduction

NOTE: Some functions or features described in this section may not apply to every model, or may be available as an option.

The throttle is electronic and provides a command signal to an electronic module whose function is to assure proper operation of its system within set parameters.

It is extremely important for operators to read all information contained in this operator's guide so as to become familiar with this snowmobile, its systems, controls, capabilities and limitations.

iTC (intelligent Throttle Control)

The system uses an electronic throttle control (ETC) that provides command signals to the ECM (Engine Control Module). With this system, there is no need for a traditional throttle cable.

The iTC allows the following operating modes:

- ECO mode
- Standard mode
- Sport mode.

ECO Mode

When ECO mode is selected (fuel economy mode), vehicle torque and speed are limited whereby an optimal cruising speed is maintained in order to reduce fuel consumption.

Refer to *OPERATING MODES* subsection for detailed instructions.

Standard Mode

In standard mode, acceleration is reduced when accelerating from a complete stop and when operating in the low vehicle speed range under certain conditions.

Sport Mode

In sport mode, maximum engine power is available throughout the engine operational range.

Refer to *OPERATING MODES* subsection for detailed instructions.

Learning Key Modes

The Ski-Doo™ learning key limits the torque and speed of the snowmobile therefore enabling first time users and less experienced operators to learn how to operate the snowmobile while gaining the necessary confidence and control.

Limitations

The ability of a novice to operate the snowmobile can be exceeded even when a learning key is used.

Refer to *OPERATING MODES* subsection for details.

Each operator has a responsibility to ensure the safety of other recreationists or bystanders.

You are responsible for proper operation of your vehicle as well as training those whom you allow to ride or drive. There may be noticeable handling and performance differences from one snowmobile to the other.

A snowmobile is relatively simple to operate but like any other vehicle or mechanical equipment, it can be hazardous if you or a passenger are reckless, thoughtless or inattentive. We encourage you to have an Annual Safety Inspection of your snowmobile. Please contact an authorized Ski-Doo dealer for further details. Finally, we urge you to visit an authorized Ski-Doo dealer periodically for regular and safety maintenance, as well as snowmobile accessories you may require.

Before venturing on the trails, operate the snowmobile in a restricted flat area until you are completely familiar with its operation and feel comfortable that you can safely tackle a more demanding task. Have an enjoyable and safe ride.

Pre-Ride Inspection

⚠ WARNING

The pre-operation check is very important prior to operating the vehicle. Always check the proper operation of critical controls, safety features and mechanical components before starting.

Before Starting the Engine

1. Remove snow and ice from body including lights, seat, footrests, controls and instruments.
2. Verify that air silencer prefilter is free of snow.
3. Verify that skis and steering operate freely. Check corresponding action of skis versus handlebar.
4. Check fuel and oil for levels and leaks. Replenish if necessary and see an authorized Ski-Doo dealer in case of any leaks.
5. All storage compartments must be properly latched and they must not contain any heavy or breakable objects. Hood and side panels must be also properly latched.
6. Activate the throttle control lever several times to check that it operates easily and smoothly. It must return to idle position when released.
7. Activate the brake lever and make sure the brake fully applies before the brake control lever touches the handlebar grip. It must fully return when released.
8. Apply parking brake and check if it operates properly. Leave parking brake applied.

After Engine is Started

For proper engine starting procedure, refer to *ENGINE STARTING PROCEDURE* in the *OPERATING INSTRUCTIONS* subsection.

1. Check headlights high beam and low beam, taillight, stop light and pilot lamps operation.

NOTE: You may need to detach tether cord your clothes to check lights. In such a case, attach cord as soon as you get back at the controls of the snowmobile.

2. Check the engine cut-off switch (by pulling tether cord cap) and emergency engine stop switch operation.
3. Release parking brake.
4. Refer to the *VEHICLE WARM UP* section and follow instructions.

Pre-Ride Check List

ITEM	OPERATION
Body including seat, footrests, lights, air filter, controls and instruments	Check condition and remove snow or ice.
Skis and steering	Check for free movement and proper action.
Fuel and oil	Check for proper level and no leaks.
Coolant	Check for proper level and no leaks.
Storage compartment	Check for proper latching and no heavy or breakable objects.
Throttle lever	Check for proper action.
Track	Check condition and remove snow or ice.
Brake lever	Check for proper action.
Parking brake	Check for proper action.
Emergency engine stop switch and engine cut-off switch (tether cord cap)	Check for proper action. Tether cord must be attached to driver clothing eyelet.
Lights	Check for proper operation.

How to Ride

Riding Gear

Proper snowmobile clothing should be worn. It should be comfortable and not too tight. Always check the weather forecast before going on a ride. Dress for the coldest weather expected. Thermal underwear next to the skin also provides a good insulation.

Wear an approved helmet at all times for safety and comfort. A stocking type cap, balaclava and face mask should always be carried or worn. Goggles or a face shield that attaches to the helmet are indispensable.

Hands should be protected by a pair of snowmobile gloves or mitts which have sufficient insulation and allow use of thumbs and fingers for operation of controls.

Rubber bottom boots with either a nylon or a leather top, with removable felt liners are best suited for snowmobiling.

You should keep yourself as dry as possible when snowmobiling. When you come indoors, take your snowmobile suit and boots off and make certain they dry properly.

Do not wear long scarves and loose apparels that could get caught in moving parts.

Carry colored lens goggles.

What to Bring

First aid kit	Provided tool kit
Flashlight	Spare drive belt
Friction tape	Spare spark plugs
Knife	Snack
Mobile phone	Trail map

Rider Position (Forward Operation)

Your riding position and balance are the two basic principles of making your snowmobile go where you want it to. When turning on the side of a hill, you and your passenger must be ready to shift body weight to help it turn in the desired direction. Driver and passenger(s) must never attempt this maneuvering by placing feet outside of the vehicle. Experience will teach you how much lean to put into turns at different speeds and how much you will have to lean into a slope to maintain proper balance.

Generally, the riding position for best balance and control is sitting. However, the posting, kneeling or standing positions are also used under certain conditions.

⚠ WARNING

Do not attempt any maneuvers if they are beyond your abilities.

Sitting

Feet on the running boards, body midway back on seat is an ideal position when operating the snowmobile over familiar, smooth terrain. Knees and hips should remain flexible to absorb shocks.



mmo2008-003-001

Posting

A semi-sitting position with the body off the seat and the feet under the body in a sort of squatting posture, thus allowing the legs to absorb the shocks when traveling over uneven terrain. Avoid abrupt stops.



mmo2008-003-002

Kneeling

This position is achieved by placing one foot firmly on the running board and the opposite knee on the seat. Avoid abrupt stops.



mmo2008-003-003

Standing

Place both feet on the running boards. Knees should be flexed to absorb the shock from surface bumps. This is an effective position to see better and to shift weight as conditions dictate. Avoid abrupt stop.



mmo2008-003-004

Rider Position (Reverse Operation)

We recommend sitting on your snowmobile when operating in reverse.

Avoid standing up. Your weight could shift forward against throttle lever while operating in reverse, causing an unexpected acceleration.

⚠ WARNING

Unexpected acceleration when snowmobile operates in reverse can cause a loss of control.

Carrying a Passenger

Certain snowmobiles are designed for an operator only, others can allow one passenger only, and others can allow up to two passengers. Refer to the indications on the vehicles to know if any particular snowmobile can accommodate passengers or not, and if so, how many. Always respect those indications. Overloading is dangerous because snowmobiles are not designed for it.

Even when passengers are allowed, you must make sure that the persons who would like to become passengers are physically fit for snowmobiling.

⚠ WARNING

Any passenger must be able to firmly lay his feet on the footrests and keep his hands on the handholds or seat strap at all times when seated. Respecting those physical criteria is important to ensure that the passenger is stable and to reduce the risks of ejection.

On snowmobiles allowing two passengers, if you have an adult and a child for passenger, BRP recommends that the child sits in the center location. This allows an adult sitting in the rear seat to keep a visual contact with the child and hold him if necessary. In addition, the child is best protected against the wind and cold temperature if seated in the center location.

Each operator has a responsibility to ensure the safety of his passengers and should inform them of snowmobiling basics.

⚠ WARNING

- Passengers must only sit on designated passenger seats. Never allow anyone to sit between the handlebar and the operator.
- Each passenger seat must have a strap or handholds and meet SSCC standards.
- Passengers and operators must always wear an approved helmets and warm clothing appropriate for snowmobiling. Make sure that no skin is exposed.
- Once underway, if a passenger feels uncomfortable or insecure for any reason, he must not wait, and tell the driver to slowdown or stop.

Riding with passengers on board is different than riding alone. The operator has the benefit of knowing what will be the next maneuver and is able to prepare himself accordingly. The operator also benefits from the support of his grip on the handlebar. In contrast, the passengers have to rely on the operator's careful and safe operation of the vehicle. In addition, "body english" is limited with passengers, and the operator can sometimes see more of the trail ahead than the passengers. Therefore, smooth starting and stopping are required with passengers, and the operator must slow down. The operator must also warn passengers of side hills, bumps, branches, etc. An unforeseen bump can leave you passenger-less. Remind your passengers to lean into the turn with you, without causing the vehicle to topple. Be extremely careful, go more slowly and check the passengers frequently.

⚠ WARNING

When riding with a passenger:

- Braking ability and steering control are reduced. Decrease speed and allow extra space to maneuver.
- Adjust suspension according to weight.

For complete information on how to adjust the suspension, please refer to the *TUNE YOUR RIDE* subsection.

Use extra caution and go even more slowly with young passengers. Check frequently to make certain the child has a firm grip and is properly positioned with his feet on the running boards.

Terrain/Riding Variations

Groomed Trail

On a maintained trail, sitting is the most preferred riding position. Do not race and, above all, keep to the right hand side of the trail. Be prepared for the unexpected. Observe all trail signs. Do not zigzag from one side of the trail to the other.

Ungroomed Trail

Unless there has been a fresh snowfall you can expect "washboard" and snowdrift conditions. Taken at excessive speeds, such conditions can be physically harmful. Slow down. Hold on the handlebar and assume a posting position. Feet should be under the body assuming a crouched position to absorb any jarring effect. On longer stretches of "washboard" trails, the kneeling position of one knee on the seat can be adopted. This provides a certain amount of comfort, while at the same time keeps the body loose and capable of vehicle control. Beware of hidden rocks or tree stumps partially hidden by a recent snowfall.

Deep Snow

In deep "powder" snow, your vehicle could begin to "bog" down. If this occurs, turn in as wide an arc as possible and look for a firmer base. If you do get "bogged", and it happens to everyone, do not spin your track as this makes the vehicle sink deeper. Instead, turn the engine off, get off and move the back of the vehicle onto new snow. Then tramp a clear path ahead of the vehicle. A few feet will generally suffice. Restart the engine. Assume the standing position and rock the vehicle gently as you steadily and slowly apply the throttle. Depending on whether the front or rear end of the vehicle is sinking, your feet should be placed on the opposing end of the running boards. Never place foreign material beneath the track for support. Do not allow anyone to stand in front of, or to the rear of, the snowmobile with the engine running. Stay away from the track. Personal injury will result if contact is made with the revolving track.

Frozen Water

Traveling frozen lakes and rivers can be fatal. Avoid waterways. If you are in an unfamiliar area, ask the local authorities or residents about the ice condition, inlets, outlets, springs, fast moving currents or other hazards. Never attempt to operate your snowmobile on ice that may be too weak to support you and the vehicle. Operating a snowmobile on ice or icy surfaces can be very dangerous if you do not observe certain precautions. The very nature of ice is foreign to good control of a snowmobile or any vehicle. Traction for starting, turning or stopping is much less than that on snow. Thus, these distances can be multiplied manyfold. Steering is minimal, and uncontrolled spins are an ever present danger. When operating on ice, drive slowly with caution. Allow yourself plenty of room for stopping and turning. This is especially true at night.

Hard Packed Snow

Don't underestimate hard packed snow. It can be difficult to negotiate as both skis and track do not have as much traction. Best advice is to slow down and avoid rapid acceleration, turning or braking.

Uphill

There are two types of hills you can encounter — the open hill on which there are few trees, cliffs or other obstacles, and a hill that can only be climbed directly. On an open hill, the approach is to climb it by side hilling or slaloming. Approach at an angle. Adopt a kneeling position. Keep your weight on the uphill side at all times. Maintain a steady, safe speed. Continue as far as you can in this direction, then switch to an opposite hill angle and riding position.

A direct climb could present problems. Choose the standing position, accelerate before you start the climb and then reduce throttle pressure to prevent track slippage.

In either case, vehicle speed should be as fast as the incline demands. Always slow down as you reach the crest. If you cannot proceed further, don't spin your track. Turn the engine off, free the skis by pulling them out and downhill, place the rear of the snowmobile uphill restart the engine and ease it out with slow even throttle pressure. Position yourself to avoid tipping over, then descend.

Downhill

Downhill driving requires that you have full control of your vehicle at all times. On steeper hills, keep your center of gravity low and both hands on the handlebar. Maintain slight throttle pressure and allow the machine to run downhill with the engine operating. If a higher than safe speed is reached, slow down by braking but apply the brake with frequent light pressure. Never jam the brake and lock the track.

Side Hill

When crossing a side hill or traversing up or downhill, certain procedures must be followed. All riders should lean towards the slope as required for stability. The preferred operating positions are the kneeling position, with the knee of the down hill leg on the seat and the foot of the uphill leg on the running board, or the posting position. Be prepared to shift your weight quickly as needed. Side hills and steep slopes are not recommended for a beginner or a novice snowmobiler.

Avalanche Hazard

When riding on mountainous terrain, you should be aware of the risk of avalanches. Avalanches vary in size and shapes and generally occur in steep terrain and on unstable snow.

New snow, animals, people, wind and snowmobiles can all trigger an avalanche. Avoid high marking or traversing steep terrain when avalanche conditions are possible. When in unstable snow conditions, travel should be restricted to lower angle slopes. Wind formed cornices should be avoided. Staying off unstable conditions is the key to safe mountain riding. Probably most important is to be aware of the conditions and dangers on a daily basis when in the mountains. Check local avalanche forecasts and threats each day before heading out to ride and heed forecasters advice.

You should always carry a snow shovel, probe and avalanche beacon while riding on mountains. We recommend that all mountain riders take a local avalanche safety training course to become more familiar with snow conditions and learn how to properly use their equipment.

Here are some web sites that can help you finding important information:

– US: www.avalanche.org
– Europe: www.avalanches.org
– Canada: www.avalanche.ca

Slush

Slush should be avoided at all times. Always check for slush before starting across any lake or river. If dark spots appear in your tracks, get off the ice immediately. Ice and water can be thrown rearward into the path of a following snowmobile. Getting a vehicle out of a slush area is strenuous and in some cases, impossible.

Fog or Whiteout Conditions

On land or water, fog or visibility-limiting snow can form. If you have to proceed into the fog or heavy snow, do so slowly with your lights on and watch intently for hazards. If you are not sure of your way, do not proceed. Keep a safe distance behind other snowmobilers to improve visibility and reaction time.

Unfamiliar Territory

Whenever you enter an area that is new to you, drive with extreme caution. Go slow enough to recognize potential hazards such as fences or fence posts, brooks crossing your path, rocks, sudden dips, guy wires and countless other obstacles which could result in a termination of your snowmobile ride. Even when following existing tracks, be cautious. Travel at a speed so you can see what is around the next bend or over the top of the hill.

Bright Sunshine

Bright sunny days can considerably reduce your vision. The glare from sun and snow may blind you to the extent that you cannot easily distinguish ravines, ditches or other obstacles. Goggles with colored lenses should always be worn under these conditions.

Unseen Obstruction

There may be obstructions hidden beneath the snow. Driving off established trails and in the woods requires reduced speed and increased vigilance. Driving too fast in an area can make even minor obstacles very hazardous. Even hitting a small rock or stump could throw your snowmobile out of control and cause injury to its riders. Stay on established trails to reduce your exposure to hazards. Be safe, slow down and enjoy the scenery.

Hidden Wires

Always be on the lookout for hidden wires, especially in areas that may have been farmed at one time or another. Too many accidents have been caused by running into wires in the fields, guy wires next to poles and

roads, and into chains and wires used as road closures. Slow speeds are a must.

Obstacles and Jumping

Unplanned jumps of snowdrifts, snowplow ridges, culverts or indistinguishable objects can be dangerous. You can avoid them by wearing the proper color lenses or face shields and by operating at a lower speed.

Jumping a snowmobile can be a hazardous situation. Be prepared before landing to absorb the shock and brace yourself for the impact. Knees must be flexed to act as shock absorbers.

If the trail does suddenly drop away from you, crouch (stand) towards the rear of the vehicle and keep the skis up and straight ahead. Apply partial throttle and brace yourself for the impact. Knees must be flexed to act as shock absorbers.

Turning

Depending on terrain conditions, there are two preferred ways to turn or corner a snowmobile. For most snow surfaces, "body english" is the key to turning. Leaning towards the inside of the turn and positioning body weight on the inside foot will create a "banking" condition beneath the track. By adopting this position and positioning yourself as far forward as possible, weight will be transferred to the inside ski.

On occasion, you will find that the only way to turn the vehicle about in deep snow is to pull the snowmobile around. Do not over-exert yourself. Get assistance. Remember to always lift using your legs as opposed to your back.



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Road Crossing

In some cases, you will be approaching the road from a ditch or snowbank. Choose a place where you know you can climb without difficulty. Use the standing position and proceed with only as much speed needed to crest the bank. Stop completely at the top of the bank and wait for all traffic to clear. Judge the drop to the roadway. Cross the road at a 90° angle. If you encounter another snowbank on the opposite side, position your feet near the rear of the vehicle. Remember, your snowmobile is not designed to operate on bare pavement and steering on this type of surface is more difficult.

Railroad Crossing

Never ride on railroad tracks. It is illegal. Railroad tracks and railroad rights-of-way are private property. A snowmobile is no match for a train. Before crossing a railroad track, stop, look and listen.

Night Rides

The amount of natural and artificial light at a given time can effect your ability to see or to be seen. Nighttime snowmobiling is delightful. It can be a unique experience if you acknowledge your reduced visibility. Before you start, make certain your lights are clean and work properly. Drive at speeds that will allow you to stop in time when you see an unknown or dangerous object ahead. Stay on es-

tablished trails and never operate in unfamiliar territory. Avoid rivers and lakes. Guy wires, barbed wire fences, cabled road entrances and other objects such as tree limbs are difficult to see at night. Never drive alone. Always carry a flashlight. Keep away from residential areas and respect the right of others to sleep.

Riding in Group

Before starting out, designate a "trail boss" to lead the party and another person to follow-up at the end of the party. Ensure that all members of the party are aware of the proposed route and destination. Make certain that you are carrying all necessary tools and equipment and that you have sufficient fuel to complete the trip. Never overtake the trail boss or, for that matter, any other snowmobile. Use down-the-line hand signals to indicate hazards or intent of direction change. Assist others whenever necessary.

It is always IMPORTANT to keep a safe distance between each snowmobile. Always maintain a safe interval and allow sufficient stopping distance. Don't be a tailgater. Know the position of the machine ahead.

Signals

If you intend to stop, raise either hand straight above your head. A left turn is indicated by extending your left hand straight out in the proper direction. For right turns, extend the left arm and raise the hand to a vertical position so it forms a right angle at the elbow. Every snowmobiler should relay any signal to the ones behind.

Trail Stops

Whenever possible, pull off the trail when you stop. This will reduce the hazard to other snowmobilers using the trail.

Trails and Signs

Trail signs are used to control, direct or regulate the use of snowmobiles on trails. Become familiar with all signs used in the area where you are snowmobiling.

Environment

Wildlife compliments your snowmobiling day. Snowmobile tracks provide firm ground over which animals can travel from area to area. Do not violate this privilege by chasing or harassing wildlife. Fatigue and exhaustion can lead to animal's death. Avoid areas posted for the protection or feeding of wildlife.

If you happen to be fortunate enough to see an animal, stop your snowmobile and observe quietly.

The guidelines that we support are not designed to limit your snowmobiling fun, but to preserve the beautiful freedom that you can experience only on a snowmobile! These guidelines will keep snowmobilers healthy, happy and able to introduce others to what they know and enjoy about their favorite winter pastime. So, the next time you hit the trails on a cool, crisp and clear winter day, we ask you to remember that you are paving the way for the future of our sport. Help us lead it down the right path! From all of us at BRP, thank you for doing your share.

There is nothing more exhilarating than snowmobiling. Venturing onto snowmobile trails that cross wild areas is an exciting and healthy winter sport. However, as the number of people using these recreational parks increases, so does the potential for damage to the environment. Abuse of land, facilities and resources inevitably leads to restrictions and closures of both private and public land.

In essence, the greatest threat to our sport, is all around us. Which leaves us with one logical choice. When we snowmobile, we must always ride responsibly.

The vast majority respect the law and the environment. Each of us must set an example for those who are new to the sport, young and old alike.

It is in every one's best interest to tread lightly into our recreational areas. Because, in the long run, to protect the sport we must preserve the environment.

Recognizing the importance of this issue and the need for snowmobilers to do their share in preserving areas that make it possible to enjoy our sport, BRP has developed the "Light Treading Is Smart Sledding" campaign for snowmobilers.

Light Treading refers to more than the thread of our tracks. It's a statement of concern, respect and willingness to take the lead and take action. It applies to the environment in general, its proper care and maintenance, its natural inhabitants and all enthusiasts and the public at large who enjoy the great outdoors. With this theme, we invite all snowmobilers to remember that respecting the environment is not only critical to the future of our industry but to future generations.

Light Treading in no way suggests you should curb your appetite for snowmobiling fun! It simply means tread with respect!

The fundamental objective of Light Treading is one of respect for where and how you ride a snowmobile. You're a light treader when you follow the principles below.

Become informed. Obtain maps, regulations and other information from the Forest Service or from other public land agencies. Learn the rules and follow them and that goes for speed limits, too!

Avoid running over young trees, shrubs, and grasses and don't cut wood. On flatlands or areas where trail riding is popular, it's important to ride only where authorized. Remember, there is a link between protecting your environment and your own safety.

Respect wildlife and be particularly sensitive of animals that are rearing young or suffering from food shortage. Stress can sap scarce energy reserves. Refrain from riding in areas where only animals are intended to tread!

Obey gate closures and regulatory signs and remember, light treaders don't litter!

Stay out of wilderness areas. They're closed to all vehicles. Know where the boundaries are.

Obtain permission to travel across private land. Respect the rights of landowners and other people's privacy. Remember, snowmobile technology has lowered the noise factor considerably, but you still shouldn't rev your engines where quiet "is the order of the day".

Snowmobilers know all too well the efforts that have been made throughout the sport's history to enjoy access to areas where people can snowmobile safely and responsibly. This effort continues today, as strong as ever.

Respecting the areas where we ride... wherever they may be... is the only way to ensure their future enjoyment. That's one major reason why we know you'll agree that Light Treading is smart sledding! And there are more.

Enjoying the opportunity to see winter and all its natural majestic wonders, is an experience cherished by snowmobilers. Light Treading will preserve this opportunity and will make it possible for us to expose others to the beauty of winter and the unique thrill of our sport! Light Treading will help our sport to grow!

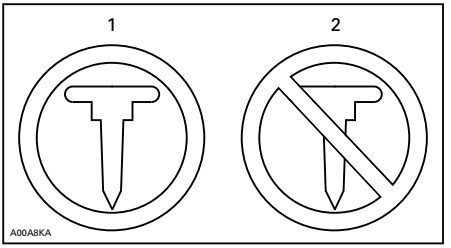
Finally, Light Treading is the sign of a smart snowmobiler. You don't have to leave big tracks or careen through a virgin forest to show you can ride. So whether you're driving a high performance Ski-Doo, a sporty MX Z snowmobile or any other make or model, show you know what you're doing. Show you know how to send snow flying and make tracks with a light touch!

TRACTION ENHANCING PRODUCTS

NOTE: This section is applicable to snowmobiles equipped with a factory installed track that has been approved by BRP for special studs installation.

⚠ WARNING

Never stud a track that has not been approved for studs. Approved tracks can be identified by a stud symbol (see illustration below) molded into the track surface. Installing studs on an unapproved track could increase the risk of the track tearing or severing.



TRACK SYMBOLS
1. *Approved*
2. *NOT Approved*

⚠ WARNING

Use only the BRP approved type stud for these Ski-Doo snowmobiles. DO NOT EVER use conventional studs as the track thickness is thinner then other standard tracks. The stud could tear off of track and separate from vehicle. See an authorized Ski-Doo dealer for current specific studding availability and applications.

Using traction enhancing products such as, more aggressive ski carbide runners and/or studs on your snowmobile will change its behavior, particularly in terms of manoeuvrability, acceleration, and braking.

Using traction enhancing products gives a better grip on packed snow and ice, but has no noticeable effect on soft snow. For this reason, driving a snowmobile equipped with traction enhancing products requires a certain adaptation period. If your snowmobile is equipped with traction enhancing products, be sure to take plenty of time to get used to the way it handles when turning, accelerating, and braking.

Also, always check local regulations concerning the use of traction enhancing products on snowmobiles. Always drive your snowmobile in a responsible manner, respecting the environment and other people's property.

Manoeuvrability

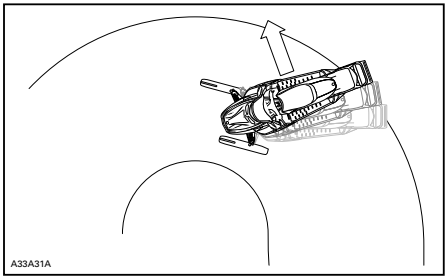
Using traction enhancing products such as, more aggressive ski carbide runners and/or studs makes the snowmobile grip the ground better at both the front and at the rear. The use of carbide runners is therefore required to give the skis a better grip, so that the front and rear of the snowmobile are in balance. While off-the-shelf carbide ski runners are adequate, they don't necessarily give you optimal control, since that depends on your personal preferences, your riding style, and how your suspension is adjusted.

⚠ WARNING

If the front and rear of the snowmobile are out of balance due to an incorrect combination of traction enhancing products, the snowmobile may tend to oversteer or understeer, which could lead to a loss of control.

Oversteering

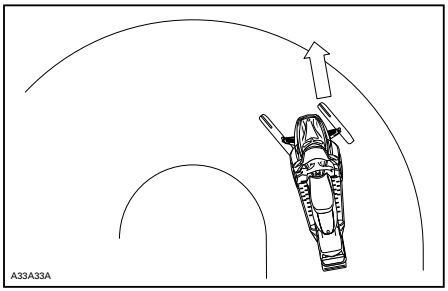
In certain conditions, using more aggressive ski carbide runners without studs on the rear track could make the snowmobile prone to oversteering, see illustration.



OVERSTEERING

Understeering

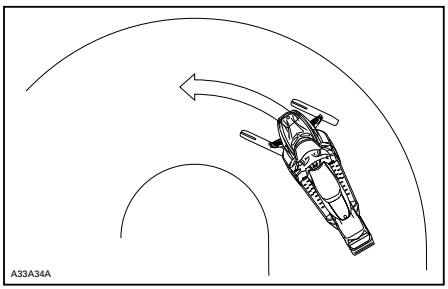
In certain conditions, the use of studs on the track could make the snowmobile prone to understeering if the skis are not equipped with more aggressive ski carbide runners, see illustration.



UNDERSTEERING

Controlled Driving

A balanced combination of carbide ski runners and studs on the track ensures adequate control and better handling, see illustration.



CONTROLLED DRIVING

Acceleration

Using studs on the track will allow your sled to accelerate better on packed snow and ice but will have no noticeable effect on soft snow. This can cause sudden variations in traction under certain conditions.

⚠ WARNING

To prevent surprises that could lead to a loss of control of the snowmobile:

- Always go easy on the throttle.
- NEVER try to spin the track to make the rear of the snowmobile skid.

This could cause debris or ice to be thrown violently backwards, possibly injuring others nearby or on snowmobiles behind you.

Braking

As in the case of acceleration, using studs on the track will give you better braking capacity on packed snow or ice but will have no noticeable effect on soft snow. Braking may thus vary suddenly under certain conditions. Be sure to use restraint in braking to keep from blocking the track in order to avoid surprises that could lead to a loss of control.

Important Safety Rules

⚠ WARNING

To prevent serious injury to individuals near the snowmobile:
- NEVER stand behind or near a moving track.
- Always use a wide-base snowmobile stand with a rear deflector panel if it is necessary to rotate track.
- When the track is raised off the ground, only run it at the lowest possible speed.

Centrifugal force could cause debris, damaged or loose studs, pieces of torn track, or an entire severed track to be violently thrown backwards out of the tunnel with tremendous force.

Effects of Having a Studded Track on the Life of the Snowmobile

The use of traction enhancing products can increase the load and the stress on certain snowmobile components, as well as the vibration level. This can cause premature wear on parts such as drive belts, brake linings, bearings, chain, chaincase sprocket, and on approved studded tracks, shorten track life. Always proceed with a visual inspection of your track before each use. For more information, refer to the *TRACK* in *MAINTENANCE PROCEDURES*.

Studs on the track can also cause serious damage to your snowmobile if it is not equipped with the tunnel protectors designed for your particular model. Damage to the electrical wiring or perforation of the heat exchangers are potential hazards, that could cause the engine to overheat and be severely damaged.

⚠ WARNING

If tunnel protectors are excessively worn or not installed, the gas tank could be punctured, causing a fire.

NOTICE Ask your dealer for the appropriate tunnel protectors model and kit number required for your snowmobile.

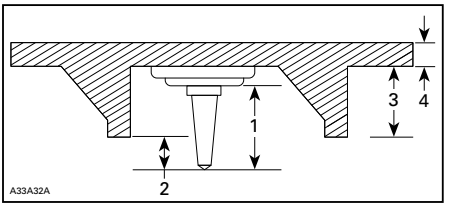
NOTE: Consult the BRP limited warranty to find out what warranty limitations are related to the use of studs.

Installation of Studs on BRP Approved Tracks

⚠ WARNING

Never stud a track that has not been approved for studs. Installing studs on an unapproved track could increase the risk of the track tearing or severing.

To ensure safe and proper installation, BRP recommends to have the studs installed by your dealer.
- Use only the BRP approved special studs.
- Never use studs that exceed the height of your snowmobile's track profile by more than 9.5 mm (3/8 in).



INSTALLATION OF STUDS
1. *Stud size*
2. *Penetration range 6.4 mm to 9.5 mm (1/4 ft to 3/8 ft)*
3. *Track lug height*
4. *Track belt thickness*

⚠ WARNING

- See an authorized Ski-Doo dealer for current specific studding availability and applications.
- DO NOT EVER use conventional stud because, the track thickness is thinner then our standard tracks and the stud could tear off of track and separate from vehicle.
- Studs should only be installed in the locations indicated by molded bulges in the track surface. Some track models have two types of molded bulges; triangles and circles. See the warning molded into the track surface to know which one to use.
- Never stud a track with a profile of 35 mm (1.375 in) or more.
- The number of studs installed must always perfectly match the pattern of molded bulges in the track.
- Always consult the traction product manufacturer's installation instructions and recommendations before having your dealer install studs and runners. It is very important to follow the torque specifications for the stud bolts.

INSTALLING AN INCORRECT NUMBER OF STUDS OR AN IMPROPER INSTALLATION CAN INCREASE THE RISK OF THE TRACK TEARING OR SEVERING.

Inspection of a Studded Track

PROCEED WITH A VISUAL INSPECTION OF YOUR TRACK BEFORE EACH RIDE.

Look for any defects, such as:

- Perforations in the track
- Tears in the track (particularly around traction holes on studded tracks)
- Lugs that are broken or torn off, exposing portions of rods
- Delamination of the rubber
- Broken rods
- Broken studs (studded tracks)
- Bent studs (studded tracks)
- Missing studs
- Studs that are torn off the track
- Missing track guide(s)
- Loose studs.

On approved studded tracks, replace broken or damaged studs immediately. If your track shows signs of deterioration, it must be replaced immediately. When in doubt, ask your dealer. Always proceed with a visual inspection of your track before each use.

⚠ WARNING

Riding with a damaged track or studs could lead to loss of control.

IMPORTANT ON-PRODUCT LABELS

Hang Tag



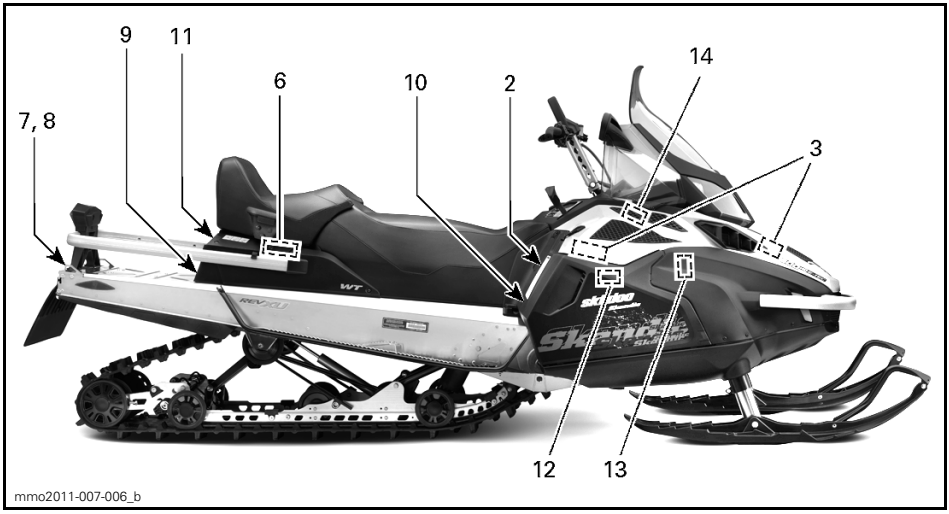
TYPICAL

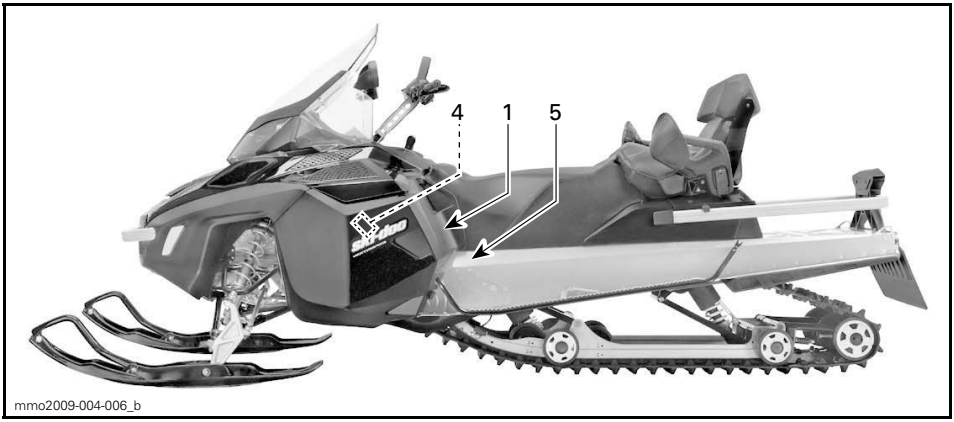
Vehicle Safety Labels

Read and understand all the safety labels on your vehicle. These labels are affixed to the vehicle for the safety of the operator, passenger or bystander.

The following labels are on your vehicle and they should be considered permanent parts of the vehicle. If missing or damaged, the decals can be replaced free of charge. See an authorized Ski-Doo dealer.

NOTE: In the event of any discrepancy between this guide and the vehicle, the safety labels on the vehicle have precedence over the labels in this guide.


9
11
6
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13
mmo2011-007-006_b


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mmo2009-004-006_b

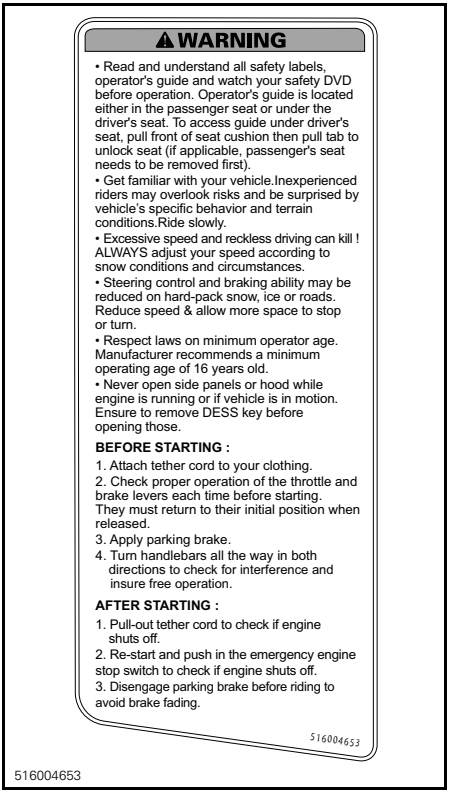
TYPICAL


18
15
mmo2011-007-009_a



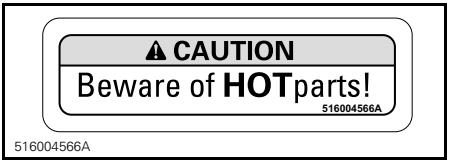
516004652B

LABEL 1



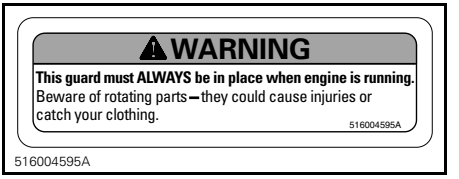
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LABEL 2



516004566A

LABEL 3

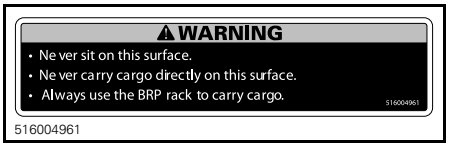


516004595A

LABEL 4



LABEL 5



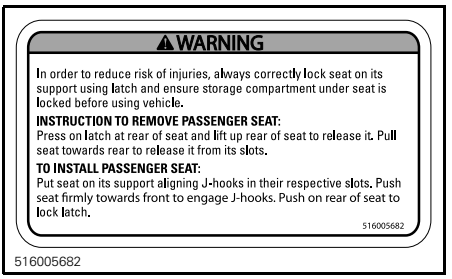
LABEL 6



LABEL 7



LABEL 8



LABEL 9



mmo2006-003-007_a

LABEL 10 - EUROPEAN MODELS



516005111

LABEL 11

CAUTION

ENGINE OIL AND CERTAIN COMPOMENTS IN THE ENGINE COMPARTMENT MAY BE HOT. DIRECT CONTACT MAY RESULT IN SKIN BURN.

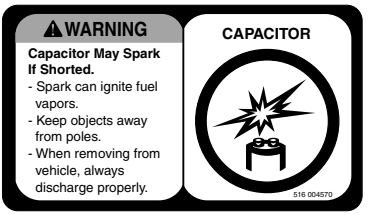
CHECKING ENGINE OIL LEVEL

- Make sure engine is at operating temperature.
- Vehicle must be level to perform verification.
- Let engine running at idle for at least 30 seconds.
- Stop engine and wait at least 30 seconds.
- Check oil level using the dipstick.
- The engine of this snowmobile has been developed and validated using the BRP XPS™ Synthetic 4-stroke oil (293 600 112). BRP strongly recommends the use of its XPS™ Synthetic 4-stroke oil at all times. Damages caused by oil which is not suitable for the engine will not be covered by the BRP limited warranty.

5160045718

516004718

LABEL 12 - 600 ACE MODELS



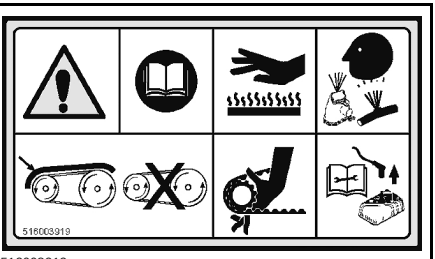
516004570

LABEL 13 - E-TEC MODELS



mmo2008-003-007

LABEL 14



516003919

ON PULLEY GUARD

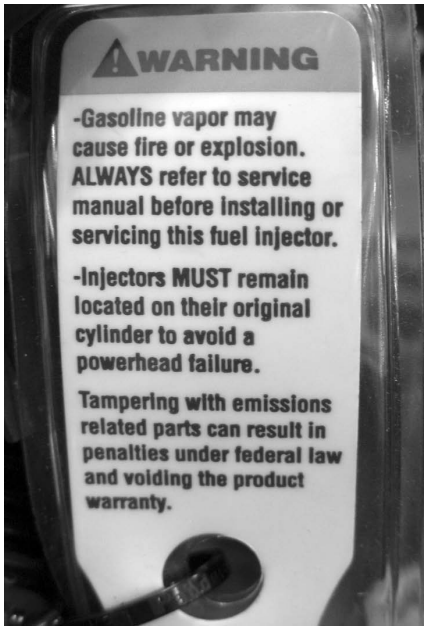
WARNING

Always electrically disconnect both fuel injectors prior to testing for ignition spark. Otherwise, fuel vapors may ignite in presence of a spark creating a fire hazard.

5583A

516005583A

ON FUEL INJECTORS - E-TEC MODELS



mmo2013-004-046_a

ON FUEL INJECTORS - E-TEC MODELS

Compliance Labels

EPA Compliance Label

EMISSION CONTROL INFORMATION

THIS VEHICLE IS CERTIFIED TO OPERATE ON UNLEADED GASOLINE AND MEETS XXXX U.S. EPA REGULATIONS FOR SNOWMOBILE SI ENGINES.

EC 121

ENGINE FAMILY	XXXX.XXXXXXX	FAMILLE DE MOTEUR
PERMEATION FAMILY	XXXXXXXXXXX	FAMILLE DE PERMÉATION
FEL	XX g/kW-hr HC XXX g/kW-hr CO	LIMITE DES ÉMISSIONS DE LA FAMILLE
ENGINE DISPLACEMENT	XXX.X cm³	CYLINDRÉE
EXHAUST EMISSION CONTROL SYSTEM	XXX	SYSTÈME DE CONTRÔLE DES ÉMISSIONS

RENSEIGNEMENTS SUR LE DISPOSITIF ANTIPOLLUTION

CE VÉHICULE EST CERTIFIÉ POUR FONCTIONNER À L'ESSENCE SANS PLOMB ET IL RÉPOND AUX NORMES XXXX DE L'EPA DES É.-U. POUR LES MOTONEIGES À MOTEUR SI.

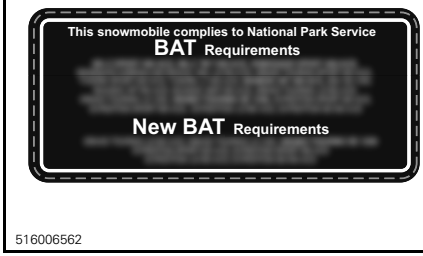
SEE OPERATOR'S GUIDE FOR MAINTENANCE SPECIFICATIONS
VOIR GUIDE DU CONDUCTEUR POUR LES SPÉCIFICATIONS D'ENTRETIENS

BOMBARDIER RECREATIONAL PRODUCTS INC.

516 005 052

516005052

IN ENGINE COMPARTMENT



516006562

ACE MODELS

SSCC Label

Safety standards for snowmobiles have been adopted by the Snowmobile Safety and Certification Committee (SSCC) of which BRP is a proud participating member. Assurance that your snowmobile meets these standards is easily checked by locating the Certification Label on a right vertical portion of the vehicle.

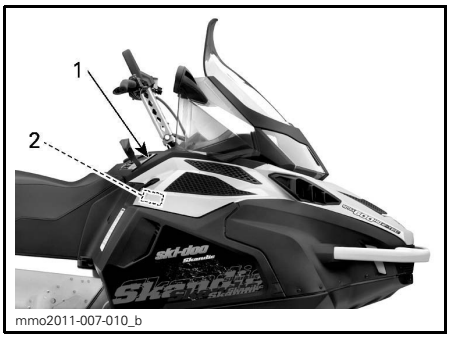
The following label shows that an independent testing laboratory has verified compliance with the SSCC safety standards.



A00A1MA

ON TUNNEL

Technical Information Labels



mmo2011-007-010_b



mmo2011-007-009_c

NOTICE

- **To comply with noise regulations, this engine is designed to operate with an air intake silencer.**
- **Operation without air intake silencer or with one not properly installed may cause engine damage.**

516004572

516004572

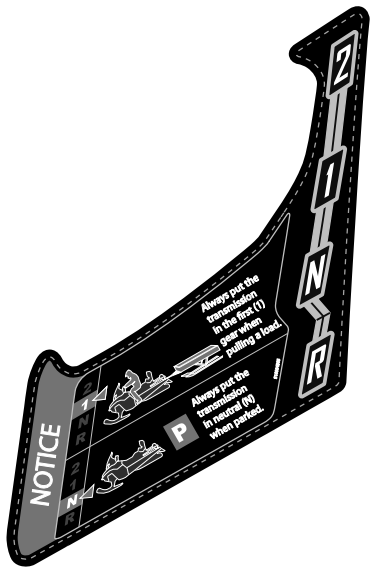
LABEL 1 - E-TEC MODELS

NOTICE

The engine of this snowmobile has been developed and validated using the BRP XPS™ approved lubricant. BRP strongly recommends the use of its XPS™ approved lubricant at all times. Damages caused by oil which is not suitable for the engine will not be covered by the BRP limited warranty.

mmo2015-008-104

IN ENGINE COMPARTMENT



mmo2010-002-014_en

LABEL 3

NOTICE

Drive pulley bolt recommended torque
92-99 lbf-ft / 125-135 N-m

Not applying the recommended torque may result in a major failure of the drive pulley and the engine. Refer to the shop manual for the complete assembly procedure.

Couple de serrage recommandé pour le boulon de la poulie motrice
125-135 N-m / 92-99 lbf-pi

Ne pas appliquer le couple de serrage recommandé pourrait entraîner un bris majeur à la poulie motrice et au moteur. Référer au manuel de réparation pour avoir la procédure complète d'assemblage.

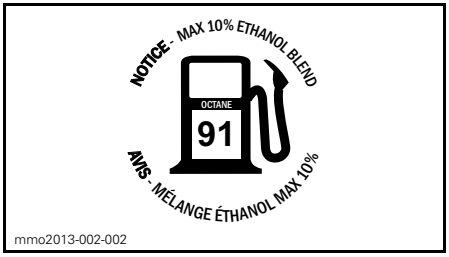
516004303

LABEL 4

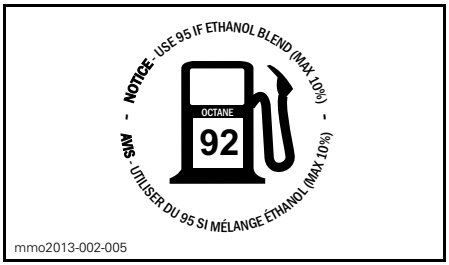


mmo2013-002-003

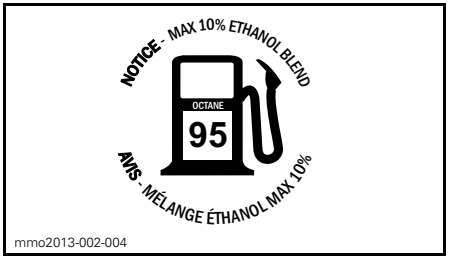
LOCATED ON FUEL CAP - ON 550F , 600 ACE AND 900 ACE ENGINES (IN COUNTRIES USING PUMP POSTED AKI (RON+MON)/2 OCTANE RATINGS)



LOCATED ON FUEL CAP - ON 600 HO E-TEC ENGINE (IN COUNTRIES USING PUMP POSTED AKI (RON+MON)/2 OCTANE RATINGS)



LOCATED ON FUEL CAP - ON 550F, 600 ACE AND 900 ACE ENGINES (IN COUNTRIES USING RON OCTANE RATINGS)



LOCATED ON FUEL CAP - ON 600 HO E-TEC ENGINE (IN COUNTRIES USING RON OCTANE RATINGS)

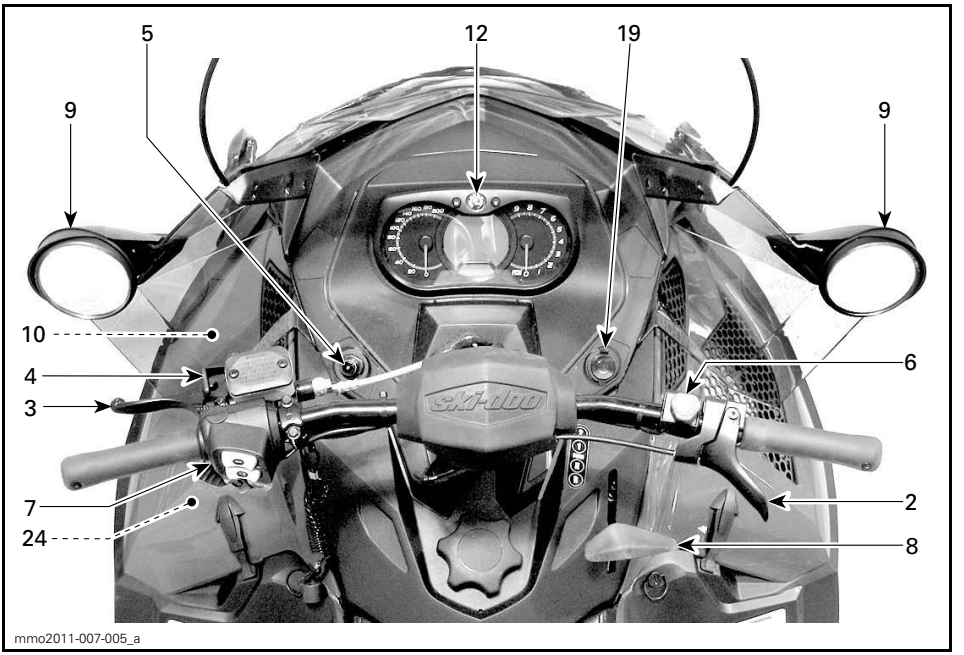
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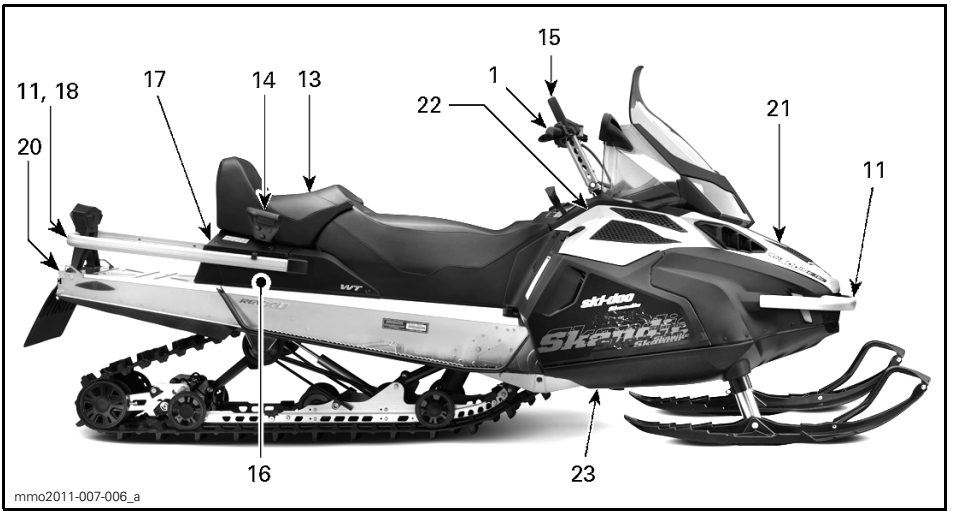
VEHICLE INFORMATION

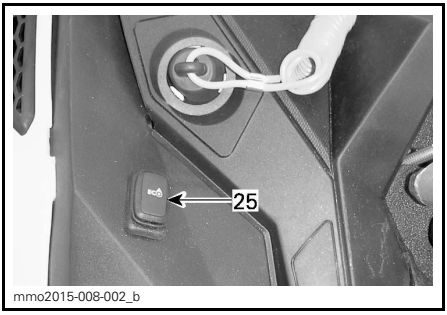
CONTROLS, INSTRUMENTS AND EQUIPMENT

NOTE: Some features may not apply to your model or could be optional.

NOTE: Some vehicle safety labels are not shown on illustrations. For information on vehicle safety labels, refer to *VEHICLE SAFETY LABELS* subsection.







TYPICAL - LH SIDE OF FUEL TANK - 600 ACE AND 900 ACE ONLY

1) Handlebar

The handlebar controls the steering of the snowmobile. As the handlebar is rotated to right or left, the skis are turned right or left to steer the snowmobile.

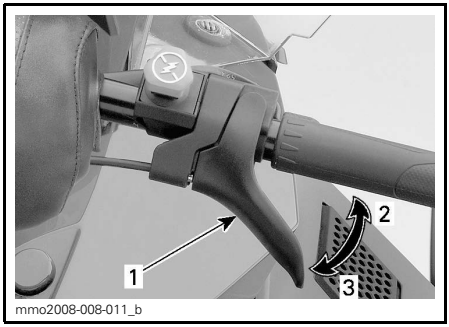
⚠ WARNING

Fast reverse while turning, could result in loss of stability and control.

2) Throttle Lever (All except 600 ACE-900 ACE)

Throttle lever is located on the RH side of handlebar.

Designed to be thumb activated. When squeezed, it increases the engine speed. When released, engine speed returns automatically to idle.



TYPICAL
1. *Throttle lever*
2. *To accelerate*
3. *To decelerate*

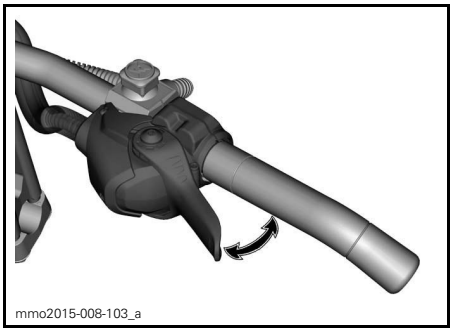
⚠ WARNING

Test the throttle lever operation each time before starting the engine. The lever must return to its the rest position once released. Otherwise, do not start engine.

3) Throttle Lever (600 ACE - 900 ACE)

Throttle lever is located on the RH side of handlebar.

Designed to be either thumb activated or finger activated. When squeezed, it increases the engine speed. When released, engine speed returns automatically to idle.



TYPICAL

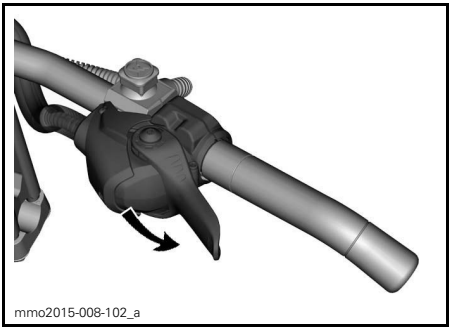
⚠ WARNING

Test the throttle lever operation each time before starting the engine. The lever must return to its the rest position once released. Otherwise, do not start engine.

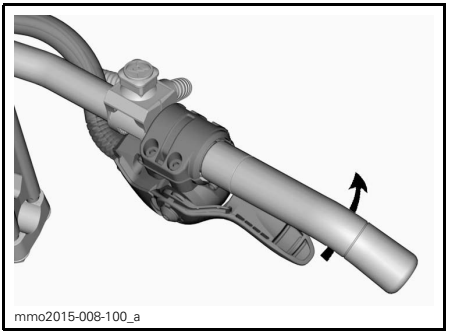
Switching from Thumb to Finger Throttle Position

⚠ CAUTION It is highly recommended to immobilize the snowmobile before attempting any modification to the throttle position as it could lead to a hazardous situation.

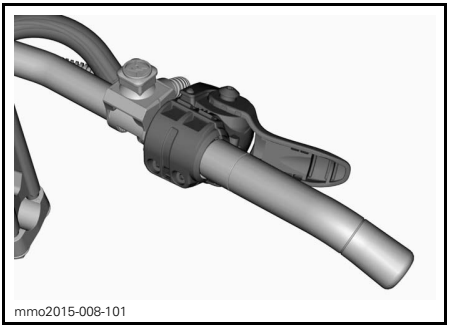
There are mainly three positions to choose from when going from the thumb to the finger throttle position and the best one will be to the rider's preference and in direct relation with the riding style and conditions.



THUMB THROTTLE POSITION : PUSH DOWNWARD TO ROTATE THROTTLE HOUSING



IF WANTED, CONTINUE TO ROTATE THE THROTTLE HOUSING



FINGER THROTTLE POSITION

⚠ CAUTION

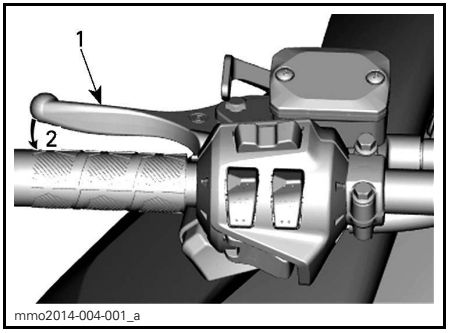
- It is HIGHLY recommended to use gloves and NOT mitts when using the finger throttle position.
- It is not recommended to use the finger throttle position while riding in dense off trail areas.

The procedure to go back to the thumb throttle position is the reverse of the one shown above.

4) Brake Lever

Brake lever is located on the LH side of handlebar.

When squeezed, the brake is applied. When released, it automatically returns to its the rest position. Braking effect is proportional to the pressure applied on the lever and to the type of terrain and its snow coverage.

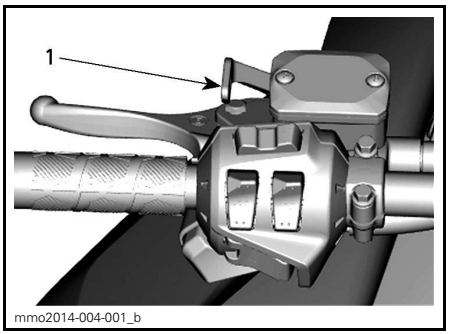


TYPICAL
1. *Brake lever*
2. *To apply brake*

5) Parking Brake Lever

Parking brake lever is located on the LH side of handlebar.

Parking brake should be used whenever snowmobile is parked.



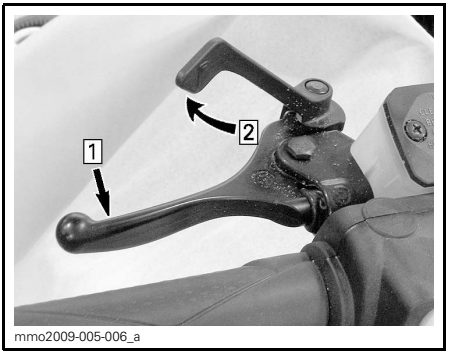
TYPICAL
1. *Parking brake lever*

⚠ WARNING

Make sure parking brake is fully disengaged before operating the snowmobile. When you ride the vehicle, brake pads that are caused to drag by a continuous pressure on the lever may cause damage to the brake system and cause loss of braking capacity and/or fire.

To Engage Parking Brake

Apply and hold brake, then lock brake lever using the parking brake lever as shown.



TYPICAL — ENGAGE MECHANISM
Step 1: Apply and hold regular brake
Step 2: Lock brake lever using parking brake lever

To Release Parking Brake

Squeeze brake lever. Parking brake lever will automatically return to its original position. Always release parking brake before riding.

6) Engine Cut-Off Switch

The engine cut-off switch is located to on the LH side of console.

The tether cord cap must be securely snapped to the engine cut-off switch to allow vehicle operation.

⚠ WARNING

Always attach the tether cord eyelet to clothing before starting the engine.

Pulling the tether cord cap from the engine cut-off switch shuts the engine off.

D.E.S.S. (Digitally Encoded Security System)

600 ACE, 900 ACE and 600 HO E-TEC Models

After engine starting, 2 short beeps should be heard if a programmed D.E.S.S. key (tether cord cap) is correctly snapped on engine cut-off switch. If another beep code is heard,

refer to *MONITORING SYSTEM* for D.E.S.S. malfunction codes information.

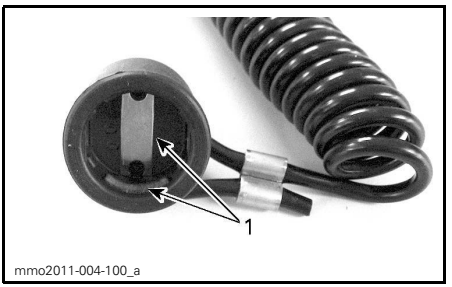
The tether cord cap has an integrated D.E.S.S. key to provide you and your snowmobile with the equivalent security of a conventional lock key.

The D.E.S.S. key contains an electronic chip which features a unique permanently memorized digital code.

Your authorized Ski-Doo dealer has programed the D.E.S.S. of your snowmobile to recognize the D.E.S.S. key in the tether cord cap to allow vehicle operation.

If another tether cord is used without programming the D.E.S.S., the engine will start but will not reach drive pulley engagement speed to move vehicle.

Make sure the tether cord cap is free of dirt or snow.



TETHER CORD CAP
1. Free of dirt or snow

D.E.S.S. Flexibility

The D.E.S.S. of your snowmobile can be programmed by your authorized Ski-Doo dealer to accept up to 8 different keys.

We recommend the purchase of additional tether cords from your authorized Ski-Doo dealer. If you have more than one D.E.S.S. equipped Ski-Doo snowmobile, each can be programmed by your authorized Ski-Doo dealer to accept the other vehicles D.E.S.S. keys.

D.E.S.S. Key Types (600ACE / 900 ACE)

Two types of keys can be used:
– Normal key
– Learning key.

To ease key type recognition, the tether cord comes in different colors.

KEY TYPE	COLOR
Normal	Black
Learning	Green

The Ski-Doo learning key, limits the speed of the snowmobile and the engine torque, therefore enabling first time users and less experienced operators to learn how to operate the snowmobile while gaining the necessary confidence and control.

NOTE: The initial learning key programming can limit the speed to 40 km/h (25 MPH) or 70 km/h (43 MPH). Refer to your authorized Ski-Doo dealer to modify this setting.

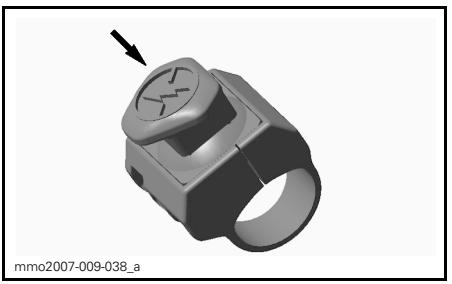
Refer to *OPERATING MODES* subsection for details.

7) Emergency Engine Stop Switch

The emergency engine stop switch is located on the RH side of handlebar.

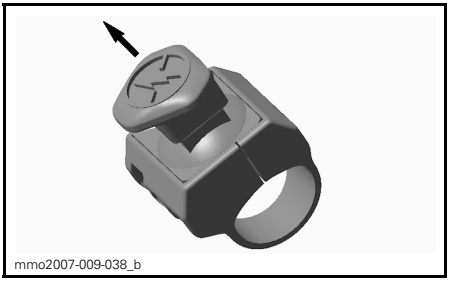
Use the emergency stop switch to stop engine in a emergency situation.

To stop the engine, push switch down (OFF position).



OFF POSITION

To allow engine starting, the switch must be in the ON position (UP).



ON POSITION

All operators of the snowmobile should familiarize themselves with the function of the emergency engine stop switch by using it several times on first outing and whenever stopping the engine thereafter. This engine stopping procedure will become a reflex and will prepare operators for emergency situations requiring its use.

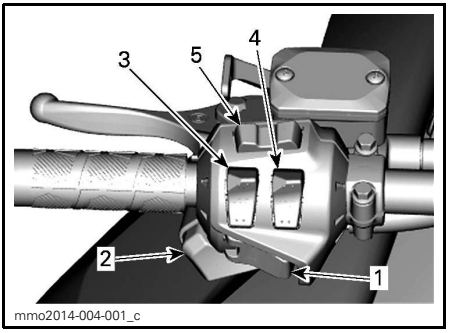
⚠ WARNING

If the switch has been used in an emergency caused by a suspected malfunction, the source of the malfunction should be determined and corrected before restarting engine. See an authorized Ski-Doo dealer for servicing.

8) Multifunction Switch

E-TEC and ACE Models

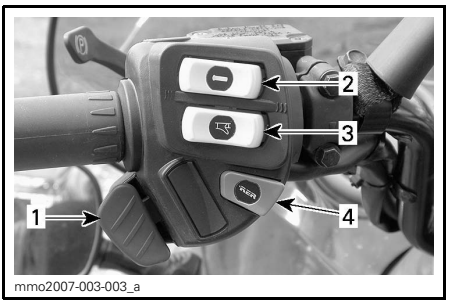
Multifunction switch is located on the LH side of handlebar.



ALL MODELS EXCEPT 550F
1. *Start button*
2. *Headlights dimmer switch*
3. *Heated grips*
4. *Heated throttle lever*
5. *Mode/set button*

550F

Multifunction switch is located on the LH side of handlebar.



550F MODELS
1. *Headlights dimmer switch*
2. *Heated grips switch*
3. *Heated throttle lever switch*
4. *Start button*

Start Button

Press to start engine. Refer to *ENGINE STARTING PROCEDURE* in the *OPERATING INSTRUCTIONS* subsection.

Headlights Dimmer Switch

Press to select HI or LOW beam. Lights are automatically ON when the engine is running.

Heated Grips and Throttle Lever Switch

E-TEC

NOTE: Under 1900 RPM, heated grips or throttle lever will be limited at 50%.

600 ACE

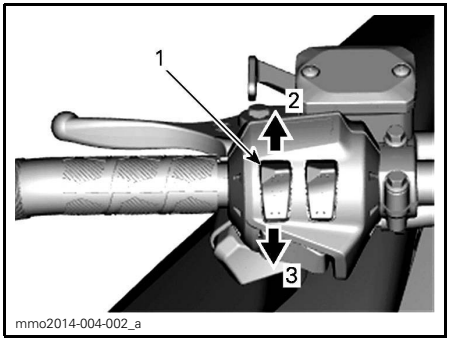
NOTE: Heated grips or throttle lever are enabled above 1900 engine RPM.

All Models

Depress switch as required to select heating intensity to keep your hands at a comfortable temperature.

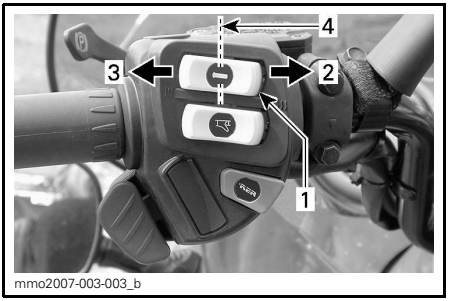
Heated Grips Switch

E-TEC and ACE Models



TYPICAL
1. *Heated grip switch*
2. *Increase heat*
3. *Decrease heat*

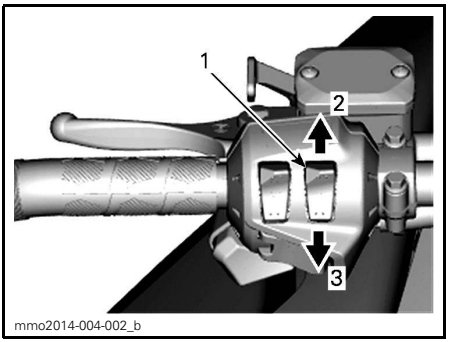
550F Models



TYPICAL
1. *Heated grip switch*
2. *Hot*
3. *Warm*
4. *Off*

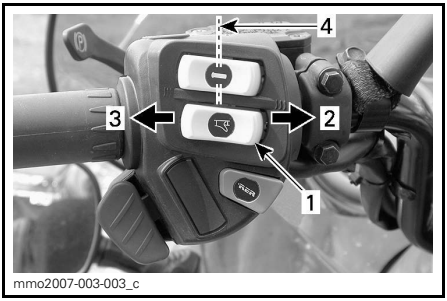
Heated Throttle Lever Switch

E-TEC and ACE Models



TYPICAL
1. *Heated throttle lever switch*
2. *Increase heat*
3. *Decrease heat*

550F Models



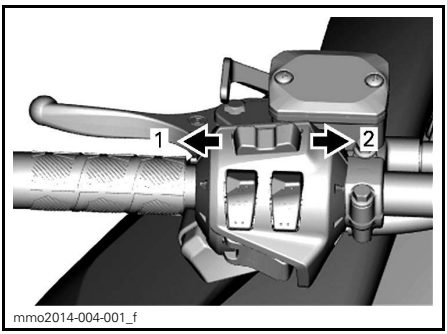
TYPICAL
1. *Heated throttle lever switch*
2. *Hot*
3. *Warm*
4. *Off*

Mode/Set Button

E-TEC and ACE

This button can be used instead of the two buttons on top of the analog/digital gauge to facilitate gauge adjustments.

– When pressed left, it has the same functions as the MODE (M) button.
– When pressed right, it has the same functions as the SET (S) button.



MULTIFUNCTION GAUGE
1. *MODE function*
2. *SET function*

9) Gearshift Lever

Use this lever to select gears. The gearbox has two forward gears, a reverse gear and a neutral.

Refer to *GEARBOX OPERATION* in *OPERATING INSTRUCTIONS* for details.

NOTE: It is necessary to push shift lever knob down to move it from neutral to reverse gear.

10) Adjustable Mirrors

Each mirror can be adjusted to suit driver's preference by gently rotating the mirror glass.

⚠ WARNING

Adjust with vehicle at rest in a safe place.

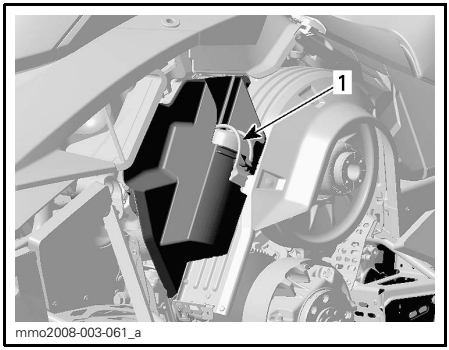
11) Tool Kit

A tool kit containing tools for basic maintenance is supplied with the vehicle.

The tool kit support is located in engine compartment on pulley guard.

NOTICE **Make sure tool kit is secured properly to avoid contact with drive belt or drive pulley.**

To remove the tool kit support from the pulley guard, unlock the tab from underneath the pulley guard and pull the tool kit support towards front to release it.

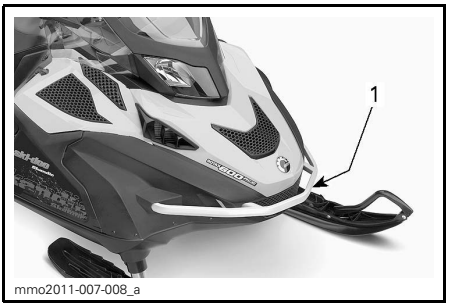


TYPICAL
1. *Tool kit*

12) Front Bumper and Rack Rail

To be used whenever snowmobile requires manual lifting.

CAUTION Use proper lifting techniques, notably using your legs force. Do not attempt to lift either end of the vehicle if it is above your limits. Use appropriate lifting device or have assistance to share lifting stress if possible.



TYPICAL
1. Front bumper



TYPICAL
1. Rear rack rail

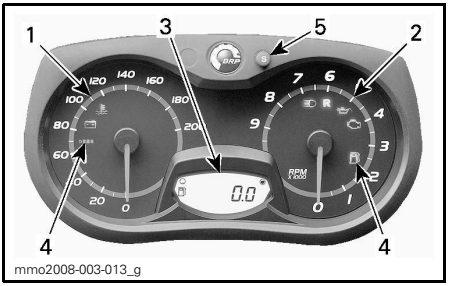
NOTICE Do not use skis to pull or lift snowmobile.

13) Gauge

WARNING

Never adjust or set functions on the multifunction gauge while riding the vehicle.

Gauge Description

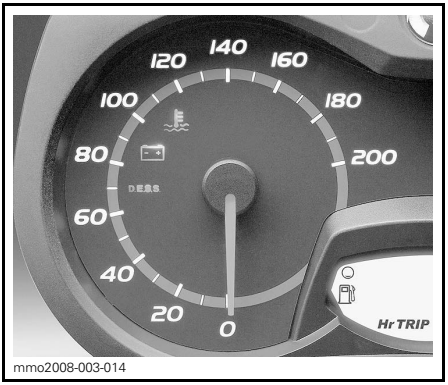


ANALOG/DIGITAL GAUGE (STANDARD)
1. Speedometer
2. Tachometer (RPM)
3. Gauge digital display
4. Gauge pilot lamps
5. Gauge SET "S" button

NOTE: The gauge is factory preset in Imperial units but it is possible to change it to metric units, contact an authorized Ski-Doo dealer for unit settings.

1) Speedometer

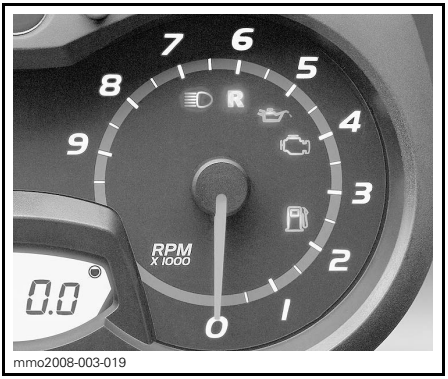
Measures vehicle speed (in miles per hour or kilometers per hour depending on the setting).



LH PORTION OF GAUGE

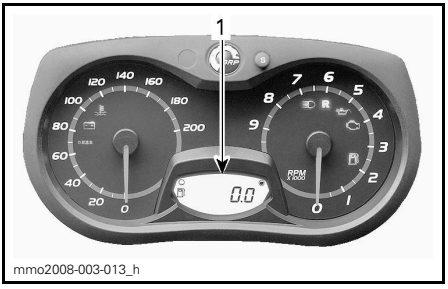
2) Tachometer (RPM)

Measures engine revolution per minute (RPM). Multiply by 1000 to obtain the actual revolutions.



RH PORTION OF GAUGE

3) Digital Display



1. Digital display

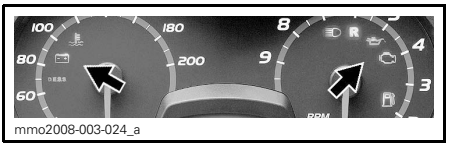
⚠ WARNING

Never adjust or set functions on the multifunction gauge while riding the vehicle, you could lose control.

The multifunction display is used to:

- Display the WELCOME message on power up
- Display the KEY recognition message
- Provide various indications as selected by the operator
- Activating or changing various functions or modes of operation
- Display scrolling messages of function activation or system faults
- Display fault codes.

4) Pilot Lamps and Messages



TYPICAL — PILOT LAMPS

See table below for usual pilot lamps information. Refer to *MONITORING SYSTEM* for details on malfunction pilot lamps.

PILOT LAMP(S) ON	BEEPER	DESCRIPTION
	4 short beeps every 5 minutes	Two stroke engine: Injection oil level is low. Stop vehicle in a safe place then, replenish injection oil reservoir.
		Four stroke engines: Low engine oil pressure. Stop vehicle in a safe place then, check oil level. Fill to proper level. If oil level was correct, discontinue use and contact an authorized Ski-Doo dealer.
	—	Low fuel level. One (1) bar left in fuel level display. Replenish fuel tank as soon as possible.
	Long beeps repeating slowly	Reverse is selected.
	3 short beeps	Reverse did not engage, try again.
	—	High beam headlights are selected.
ACE Only		
	—	ECO mode is selected.
	—	Standard mode is selected.
	—	Sport mode is selected.

5) SET (S) Button

Button used to navigate, adjust or reset gauge multifunction display.

In order to memorize settings, engine must be running.

Gauge Features

AVAILABLE INDICATIONS IN NUMERICAL DISPLAY				
Functions	WT 550F	WT 600 HO E-TEC	WT 600 ACE	WT 900 ACE
A) Odometer	X	X	X	X
B) Trip meter "A" or "B"	N.A.	X	X	X
C) Trip hour meter	N.A.	X	X	X
D) Fuel level	X	X	X	X
E) E-TEC engine storage mode	N.A.	X	N.A.	N.A.
X = An X indicates a standard feature Opt = Feature available as an option N.A. = Not available				

AVAILABLE INDICATIONS IN NUMERICAL DISPLAY		
Functions	SWT 600 HO E-TEC	SWT 900 ACE
A) Odometer	X	X
B) Trip meter "A" or "B"	X	X
C) Trip hour meter	X	X
D) Fuel level	X	X
E) E-TEC engine storage mode	X	N.A.
X = An X indicates a standard feature Opt = Feature available as an option N.A. = Not available		

When the information center is first powered up, the numerical display defaults to the last selected indication.

A) Odometer

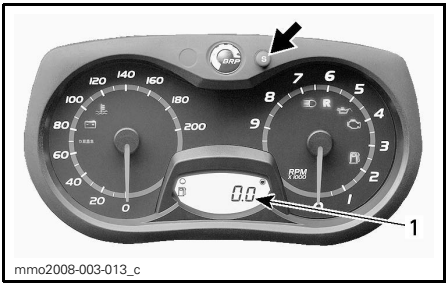
Records the total distance travelled.

550F

The odometer is displayed on the digital display.

600 HO E-TEC and 600 ACE Models

Press the SET (S) button to select odometer mode.

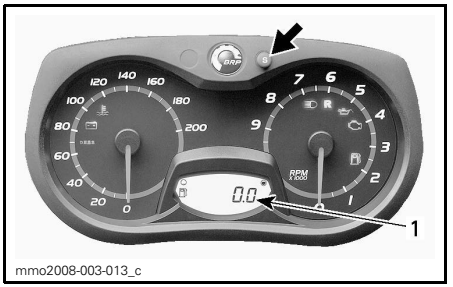


1. Odometer (km/mi) mode

B) Trip Meter "A" or "B"

Trip meters records distance travelled since it has been reset.

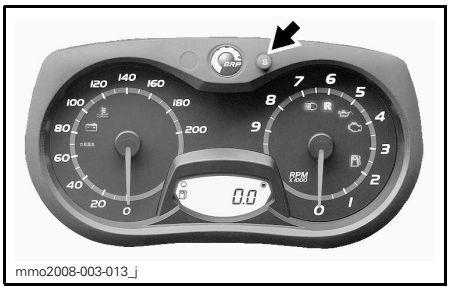
Press the SET (S) button to select trip meter (TRIP A/TRIP B) mode.



1. Trip meter (TRIP A/TRIP B) mode

Press and hold the SET (S) button to reset.

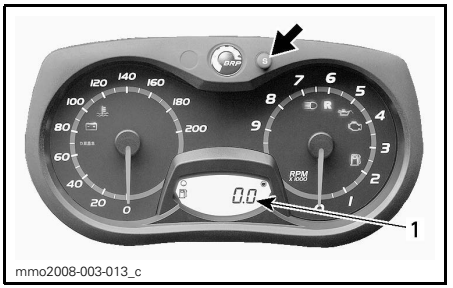
NOTE: On E-TEC models, resetting TRIP B mode will also reset TOTAL FUEL CONSUMPTION.



C) Trip Hour Meter

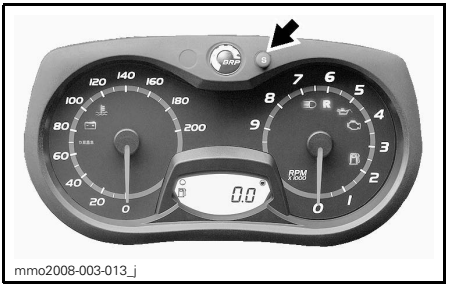
Records vehicle running time when the electrical system is activated since it has been reset.

Press the SET (S) button to select trip hour meter (HrTRIP) mode.



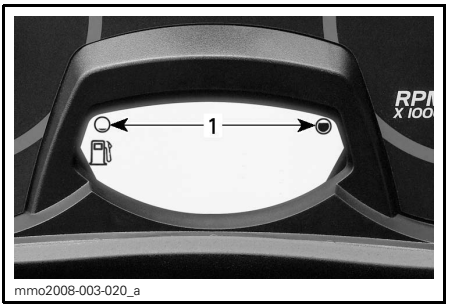
1. Trip hour meter (HrTRIP) mode

Press and hold the SET (S) button to reset.



D) Fuel Level

Bar gauge that continuously indicates the amount of fuel left in the fuel tank.



FUEL LEVEL
1. Operating range

E) E-TEC Engine Storage Mode

Displays OIL when the storage mode procedure is initiated.

14) Passenger (1+1) Seat

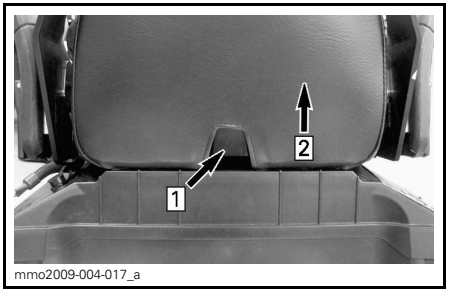
A 1+1 passenger seat is provided as standard equipment.

⚠ WARNING

Any passenger must be able to firmly lay is feet on the footrests and keep his hands on the grab handles at all times when seated. Respecting those physical criteria is important to ensures that the passenger is stable and to reduce the risks of ejection.

Passenger Seat Removal

1. Push the latch tab in and lift-up the rear of seat.

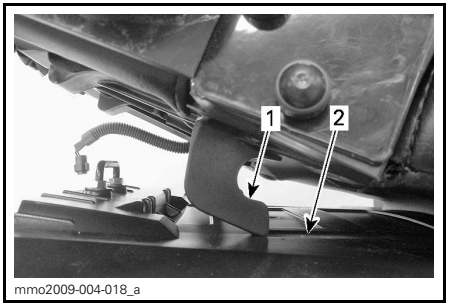


Step 1: Push tab
Step 2: Lift rear of seat

2. Slide seat rearward and set aside.

Passenger Seat Installation

1. Place the passenger seat facing forward on the storage compartment lid.
2. Slightly incline the passenger seat towards front and engage both seat hooks in the storage compartment lid slots.



1. Seat hook
2. Slot

3. Push the passenger seat towards the driver's seat and firmly push the rear portion down to lock the passenger seat in position.

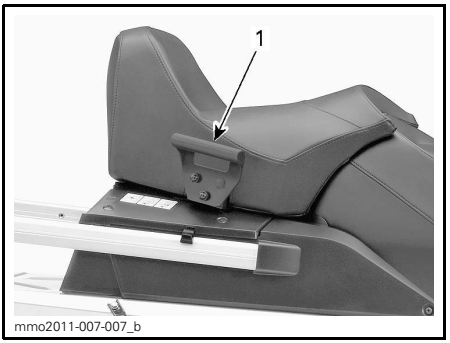
NOTE: A distinctive snap will be felt. Double check that the seat is secure by giving it a tug to confirm proper latching.

⚠ WARNING

Make sure seat is securely latched before riding.

15) Passengers Handholds

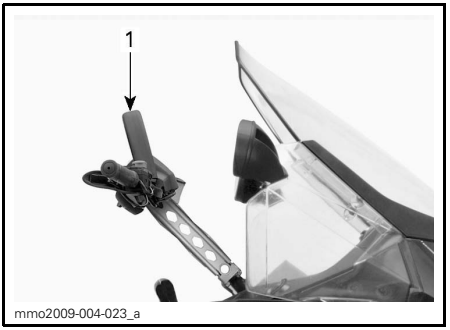
Fixed handholds on each side of the passenger seat.



1. Passenger handhold

16) Mountain Strap

Mountain strap provides a grip for the driver when side-hilling.



TYPICAL
1. Mountain strap

⚠ WARNING

This strap is not for towing, lifting or other purpose than temporary use as a grab handle when a leverage is needed at very low speeds.

17) Operator's Guide

The Operator's Guide is located in the storage compartment.

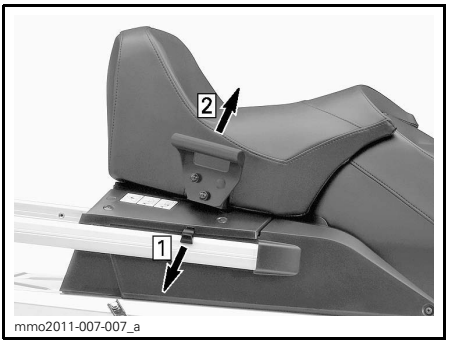
18) Storage Compartment

The storage compartment is located behind the driver's seat.

⚠ WARNING

The storage compartment must be properly latched and must not contain any sharp, heavy or breakable objects.

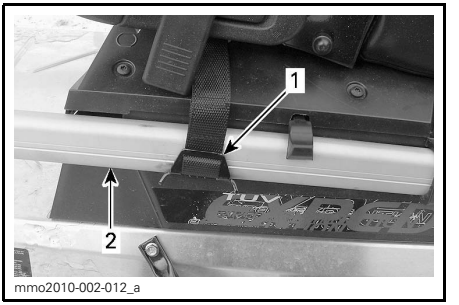
To open the lid, pull and hold the rubber tab sideways, then lift the RH side of the lid or passenger seat if installed.



Step 1: Pull rubber tab
Step 2: Lift RH side

To close lid, simply push it down until it latches.

In addition, when passenger seat is installed, hook the retaining strap to the rear rack rail as shown.



TYPICAL
1. *Retaining strap*
2. *Rear rack rail*

⚠ CAUTION When closing lid with the passenger seat installed, secure with the retaining strap.

19) Rear Rack

⚠ WARNING

All objects in rear rack must be properly latched. Do not carry any breakable objects. Excessive weight in rack may reduce steering ability.

⚠ WARNING

Always readjust suspension according to the load. The capacity of this rack is limited, the MAXIMUM cargo load is 30 kg (66 lb). Ride at very low speed when loaded. Avoid speed over bumps.

20) 12-Volt Power Outlet

A 12-volt power outlet is installed at front, near steering column.

A 12-volt electric appliance may be connected to that jack connector.

21) Hitch

Use the hitch in conjunction with a tow bar to tow an accessory.

When attaching any accessory, always refer to the manufacturer's recommendations.

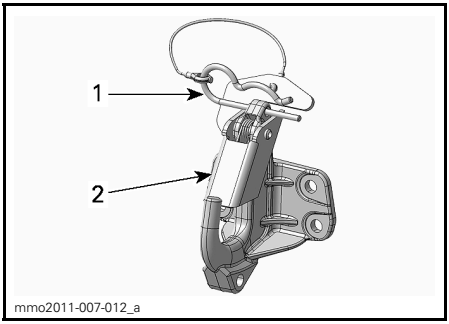
NOTE: Refer to decal on vehicle for towing weight capacities.

⚠ WARNING

Never tow an accessory with a rope. Always use a rigid tow bar. Using a rope would result in a collision between the object and the snowmobile and possibly in a tip over in case of a rapid deceleration or on a downward slope.

J-Type Hitch (European Models)

Attaching an Equipment



1. Hairpin clip
2. Safety tab

1. Remove the hairpin clip.
2. Align accessory attachment hole with the hitch hook.
3. Push the accessory attachment passed the safety tab.
4. Secure safety tab using the hairpin clip.

Detaching an Equipment

1. Remove the hairpin clip.
2. Push safety tab forward to free accessory attachment from the hitch.
3. Detach accessory attachment.
4. Install hairpin clip.

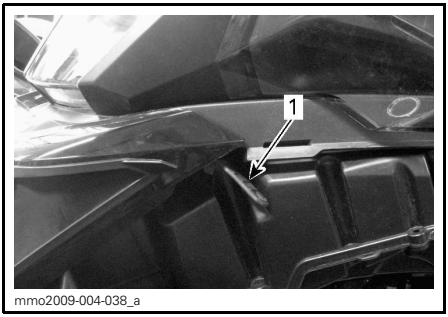
22) Hood

⚠ WARNING

Never operate engine with hood removed from vehicle.

Hood Removal

1. Remove upper side panels as explained in this subsection.
2. Unhook the rubber ties on both sides.

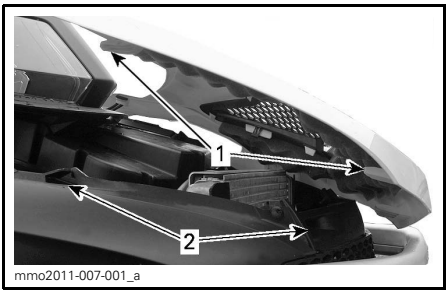


1. Rubber tie

3. Slide hood towards front to free the tabs from their slots.

Hood Installation

1. Engage the tabs located at front and center of the hood into the bottom pan slots.



TYPICAL
1. Hood tabs
2. Bottom pan slots

2. Slide hood towards headlights until it stops.

3. Hook the rubber ties.

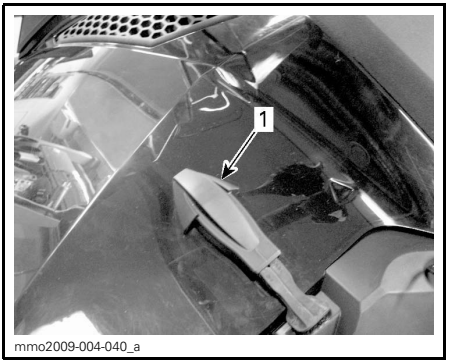
23) Upper Side Panels

⚠ WARNING

Never operate engine with side panels opened or removed from vehicle.

Upper Side Panel Removal

1. Unhook the rubber tie.

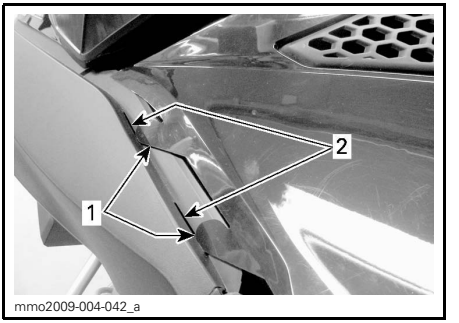


TYPICAL
1. *Rubber tie*

2. Lift the rear portion of panel to free the plastic tab from the console.
3. Slide panel towards rear.

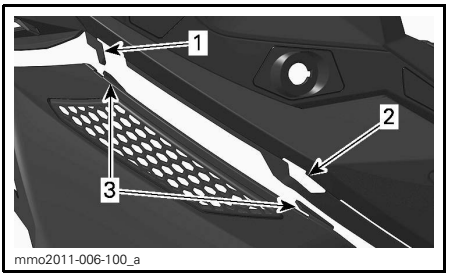
Upper Side Panel Installation

1. Insert the panel lower tabs into the bottom pan slots.



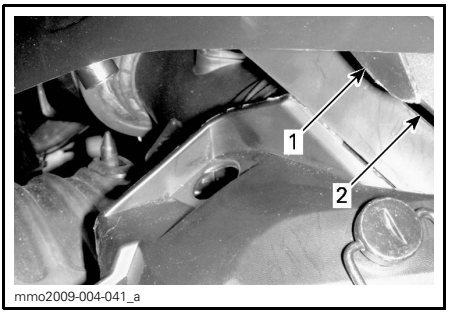
TYPICAL
1. *Panel lower tabs*
2. *Bottom pan slots*

2. Hook the panel top center tabs to the console.



TYPICAL
1. *Console hook*
2. *Console slot*
3. *Panel center tabs*

3. Insert the rear tab into the console slot.



TYPICAL
1. *Rear tab*
2. *Console slot*

4. Hook rubber tie.

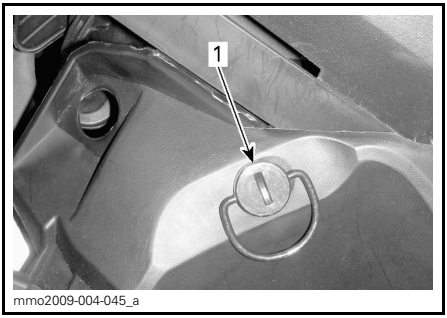
24) Lower Side Panels

⚠ WARNING

Never operate engine with side panels opened or removed from vehicle.

Lower Side Panel Removal

1. Remove upper side panel as explained above.
2. Turn the clip 1/4 turn counterclockwise to unlock.



1. Clip

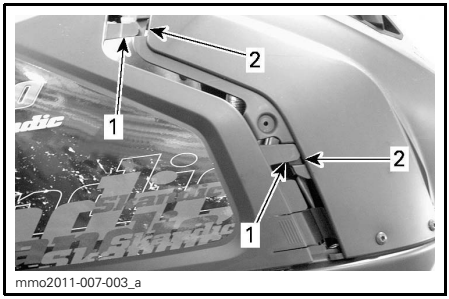
3. Push and hold lock tab in, then pull panel up and rearward.



1. Lock tab

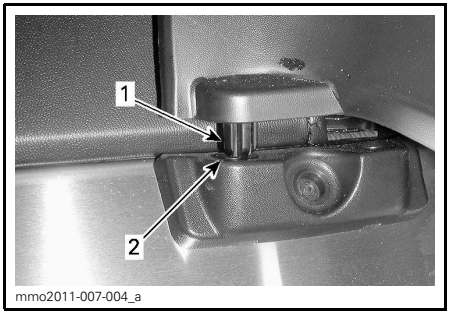
Lower Side Panel Installation

1. Align panel front tabs in the bottom pan slots.



1. Panel front tabs
2. Bottom pan slots

2. Insert panel lower tabs in the bottom pan slots.
3. Push panel towards front.
4. Insert the panel dowel into the tunnel hole.



1. Panel dowel
2. Tunnel hole

5. Lock the clip by turning it 1/4 turn clockwise.

25) Drive Belt Guard

Drive Belt Guard Removal

⚠ WARNING

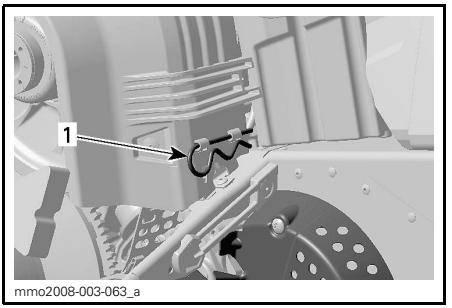
NEVER operate engine:
- Without shields and drive belt guard securely installed.
- With hood and/or side panels opened or removed.

NEVER attempt to make adjustments to moving parts while engine is running.

Remove the tether cord cap from engine cut-off switch.

Remove LH side panels, see procedure in this subsection.

Remove retaining pin.



TYPICAL
1. Retaining pin

Lift rear portion of drive belt guard, then release from front tabs by pivoting the guard outwards.

Drive Belt Guard Installation

When reinstalling drive belt guard, position its cutaway toward front of snowmobile.

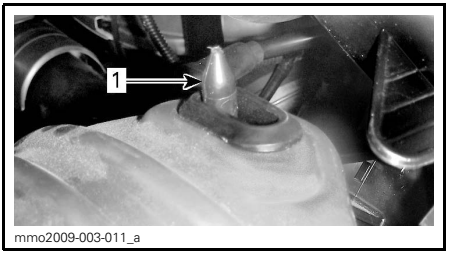
Place the front LH slot of the drive belt guard over the longest tab.

Pivot the guard inward to engage the shortest tab in the RH slot.



1. Tabs

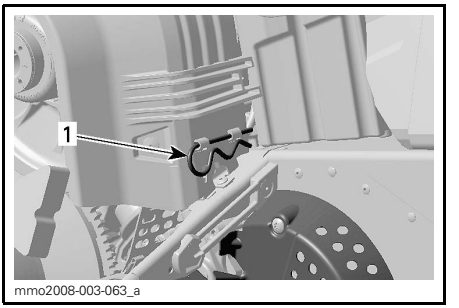
Position the grommet over the retaining rod.



1. Retaining rod

Position rear portion of the drive belt guard over the retainer and secure it using the retaining pin.

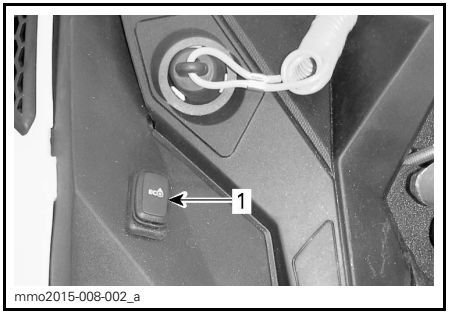
NOTE: Drive belt guard is purposely made slightly oversize to maintain tension on its pins and retainers preventing undue noise and vibration. It is important that this tension be maintained when reinstalling.



1. Retaining pin

26) ECO/Standard/Sport Mode Switch (600 ACE and 900 ACE Only)

The Mode switch is located on the LH side of fuel tank.



TYPICAL - LH SIDE OF FUEL TANK
1. Mode switch

It is used to activate or deactivate Eco/Standard/Sport modes.

Refer to *OPERATING MODES* subsection for details.

Fuel Requirements

NOTICE Always use fresh gasoline. Gasoline will oxidize; the result is loss of octane, volatile compounds, and the production of gum and varnish deposits which can damage the fuel system.

Alcohol fuel blending varies by country and region. Your vehicle has been designed to operate using the recommended fuels, however, be aware of the following:

– Use of fuel containing alcohol above the percentage specified by government regulations is not recommended and can result in the following problems in the fuel system components:
  - Starting and operating difficulties.
  - Deterioration of rubber or plastic parts.
  - Corrosion of metal parts.
  - Damage to internal engine parts.
– Inspect frequently for the presence of fuel leaks or other fuel system abnormalities if you suspect the presence of alcohol in gasoline exceeds the current government regulations.
– Alcohol blended fuels attract and hold moisture which may lead to fuel phase separation and can result in engine performance problems or engine damage.

Recommended Fuel

Use unleaded gasoline containing MAXIMUM 10% ethanol. The gasoline must have the following minimum octane requirements:

FUEL TYPE	ENGINE	MINIMUM OCTANE RATING
Fuel with NO ethanol	550F 600 ACE 900 ACE	87 AKI (RON+MON)/2 92 RON
	600 HO E-TEC	91 AKI (RON+MON)/2 95 RON
Fuel which may contain up to 10% MAX ethanol	550F 600 HO E-TEC 600 ACE 900 ACE	91 AKI (RON+MON)/2 95 RON

NOTICE Never experiment with other fuels. Engine or fuel system damages may occur with the use of an inadequate fuel.

NOTICE Do NOT use fuel from fuel pumps labeled E85.

Use of fuel labeled E15 is prohibited by U.S. EPA Regulations.

Fuel Antifreeze Additives

When using oxygenated fuel, additional gas line antifreeze or water absorbing additives are not required and should not be used. When using non oxygenated fuel, isopropyl base gas line antifreeze can be used in a proportion of 150 ml (5 U.S. oz) of gas line antifreeze added to 40 L (10.6 U.S. gal.) of gas.

This precaution is in order to reduce the risk of frost buildup in carburetors or other fuel system components which may lead, in certain cases, to severe damage to engine.

NOTE: Use only methyl hydrate free gas line antifreeze.

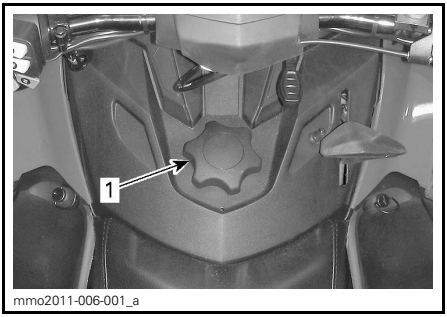
Fueling Procedure

Unscrew to fill up tank then fully tighten.

⚠ WARNING

- Always stop engine before refueling. Open cap slowly.
- If a differential pressure condition is noticed (whistling sound heard when loosening fuel tank cap) have vehicle inspected and/or repaired before further operation.
- Fuel is flammable and explosive under certain conditions.
- Never use an open flame to check fuel level.
- Never smoke or allow flame or spark in vicinity.
- Always work in a well-ventilated area.
- Never top up the fuel tank before placing the vehicle in a warm area. As temperature increases, fuel expands and may overflow.
- Always wipe off any fuel spillage from the vehicle.

NOTE: Do not sit or lean on seat when fuel tank cap is not properly installed.



1. Fuel tank cap

Recommended Oil

550F and 600 HO E-TEC

RECOMMENDED INJECTION OIL		
ENGINES	XPS INJECTION OIL (P/N 293 600 117)	XPS SYNTHETIC 2-STROKE OIL (P/N 293 600 132)
550F	✓	✓
600 HO E-TEC		✓

NOTICE The engine of this snowmobile has been developed and validated using the recommended BRP XPS™ oil. BRP strongly recommends the use of its recommended XPS oil at all times. Damages caused by oil which is not suitable for the engine will not be covered by the BRP limited warranty.

600 ACE and 900 ACE

ENGINE	RECOMMENDED ENGINE OIL
600 ACE 900 ACE	XPS 4-STROKE SYNTHETIC OIL (ALL CLIMATE) (P/N 293 600 112)

NOTICE The engine of this snowmobile has been developed and validated using the BRP XPS™ Synthetic 4-stroke oil. BRP strongly recommends the use of its XPS Synthetic 4-stroke oil at all times. Damages caused by oil which is not suitable for the engine will not be covered by the BRP limited warranty.

If the recommended oil is not available, use SAE 0W-40 synthetic-based oil that meets or exceeds the requirements for API service classification SM.

Injection Oil Level Verification

The injection oil reservoir is located behind the RH side panel. See *CONTROLS, INSTRUMENTS AND EQUIPMENT* for opening procedure.

Always maintain a sufficient amount of recommended injection oil in the injection oil reservoir.



TYPICAL
1. Oil reservoir

NOTICE Check level and refill every time you refuel.

To Add Injection Oil

Remove injection oil reservoir cap.

Add injection oil.

Reinstall cap and fully tighten.

NOTE: Do not overfill. Do not pass the MAX range in the reservoir filler neck.

NOTICE Do not mismatch oil reservoir cap with fuel tank cap.

⚠ WARNING

Wipe off any oil spills. Oil is highly flammable when heated.

BREAK-IN PERIOD

Operation During Break-In

A break-in period of 10 operating hours or 500 km (300 mi) is required for the vehicle.

After the break-in period, the vehicle should be inspected by an authorized Ski-Doo dealer. Refer to *MAINTENANCE* section.

Engine

During the break-in period:

- Avoid prolonged full throttle operation.
- Avoid sustained accelerations.
- Avoid prolonged cruising speeds.
- Avoid engine overheating.

However, brief accelerations and speed variations contribute to a good break-in.

During the first few hours of break-in, the engine management system controls some engine parameters which will slightly reduce the engine performance.

E-TEC Models

During a predetermined period, the engine management system controls some engine parameters.

The duration is based on fuel volume. It will take approximately two fuel tanks to complete the break-in.

During this period:

- The engine performance and behavior will not be optimal.
- The fuel and oil consumption will be higher.

Drive Belt

A new drive belt requires a break in period of 50 km (30 mi).

During the break-in period:

- Avoid strong acceleration and deceleration.
- Avoid pulling a load.
- Avoid high speed cruising.

OPERATING MODES (600 ACE AND 900 ACE ONLY)

⚠ WARNING

Whenever changing operating mode, make sure to maintain situational awareness while riding.

ECO Mode (Fuel Economy Mode)

When ECO mode is selected (fuel economy mode), vehicle torque and speed are limited whereby an optimal cruising speed is maintained in order to reduce fuel consumption.

Once activated, ECO mode will remain active until it is deactivated by the operator.

Standard Mode

A Standard mode indicator is ON in the multifunction gauge to confirm the active mode of operation.

Sport Mode

⚠ WARNING

Ensure passenger is advised to hold on tightly before activating Sport mode. Sport mode provides increased acceleration.

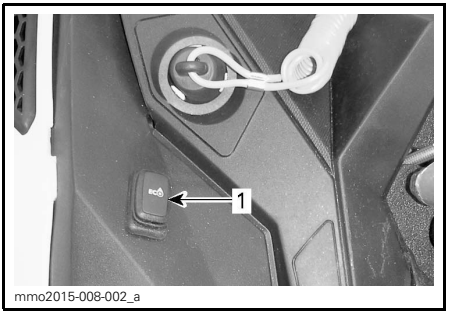
When selected, Sport mode provides for instant throttle response and more rapid accelerations than Standard or ECO mode.

Once activated, Sport mode will remain active until it is deactivated by the operator.

Navigating Operating Modes

Use ECO/Standard/Sport Mode switch to navigate between power levels, from ECO (reduced power) to Standard (full power) to Sport (increased response).

To increase power, press the switch upwards. To decrease power, press the switch downwards.

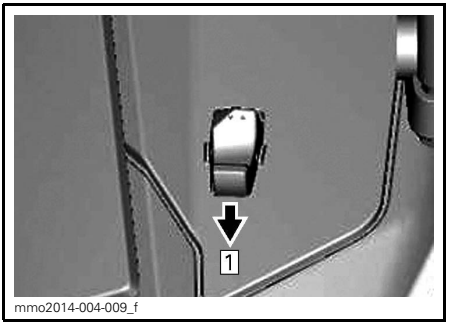


TYPICAL - LH SIDE OF FUEL TANK
1. Mode switch

To activate Standard mode when in Sport mode, press bottom end of switch once.

To activate ECO mode when in Sport mode, press bottom end of switch twice.

To activate ECO mode when in Standard mode, press bottom end of switch once.



TYPICAL
Step 1: Press bottom end of switch

⚠ WARNING

Ensure passenger is advised to hold on tightly before activating Sport mode. Sport mode provides increased acceleration.

To activate Sport mode when in Standard mode, press top end of switch once.

To activate Sport mode when in ECO mode, press top end of switch twice.

To activate Standard mode when in ECO mode, press top end of switch once.

⚠ WARNING

When adjusting modes, be sure to maintain situational awareness of other snowmobiles, obstacles, or persons .

Learning Key Modes

The learning key provides a mode of operation whereby engine torque and speed are limited.

NOTE: The initial learning key programming can limit the speed to 40 km/h (25 MPH) or 70 km/h (43 MPH). Refer to your authorized Ski-Doo dealer to modify this setting.

There are 3 levels available for the learning key mode.

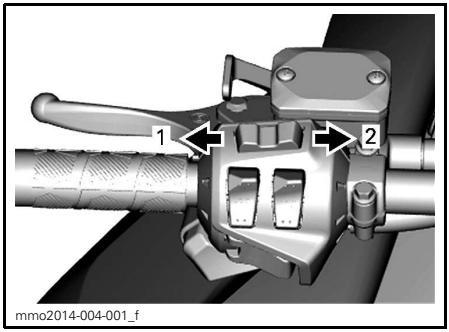
Changing Learning Key Settings

To change learning key setting, carry out the following:

1. Press the START/electronic reverse button to wake up the electrical system and install the NORMAL key on the engine cut-off switch.
2. Wait for the information center to complete its self-test and display the key recognition message.

Analog/Digital Gauge

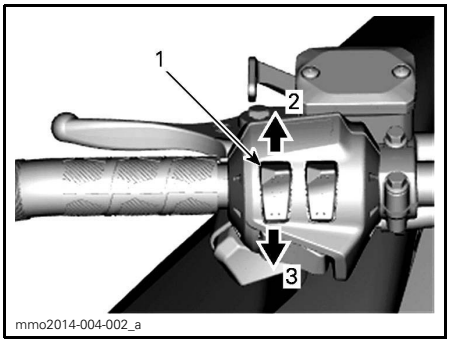
3. Press the SET button until LEArn is visible in the digital screen of the information center.



MULTIFUNCTION GAUGE
1. *MODE function*
2. *SET function*

All Models

4. Use the heated grip switch to toggle the key setting between 1 and 3.



TYPICAL
1. *Heated grip switch*
2. *Increase*
3. *Decrease*

NOTE: Setting 1 is the lowest available torque, while setting 3 is the highest available torque for learning key.

5. After a few seconds, the setting is automatically confirmed and saved.

NOTE: The key speed setting is applicable to any key of the same type used on a specific snowmobile. The same key type used on a different snowmobile may therefore have a different key speed setting.

NOTE: Vehicle performance may vary depending on riding conditions.

Engine Starting Procedure

Procedure

1. Apply parking brake.
2. Recheck throttle lever operation.
3. Put your helmet on.
4. Ensure that the tether cord cap is installed on the engine cut-off switch and that the cord is attached to your clothing eyelet.
5. Ensure that the emergency engine stop switch is in the ON position (up).
6. Depress the START button to engage the electric starter and start the engine. Release button immediately when engine has started.

⚠ WARNING

Never depress throttle while starting engine.

NOTICE Do not engage electric starter for more than 10 seconds at a time. A rest period of at least 30 seconds should be observed between the cranking cycles to allow electric starter to cool down.

7. Release parking brake.

NOTE: For an initial cold start, do not release parking brake. Perform the *VEHICLE WARM-UP* procedure as explained below.

Emergency Starting

600 ACE, 900 ACE and 550 F Models

Do not attempt any emergency starting procedure. Have the battery charged or replaced.

600 HO E-TEC Models

If the starter does not operate and you have followed the steps in *ENGINE STARTING PROCEDURE*, start engine with the rewind starter or the emergency cord as follows:

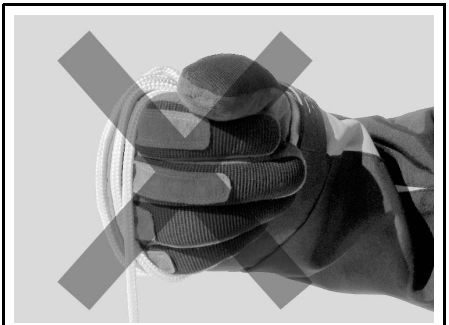
Starting Using an Emergency Starter Rope

The engine can be started with the emergency starter rope supplied with the tool kit. Proceed as follows:

1. Remove drive belt guard.

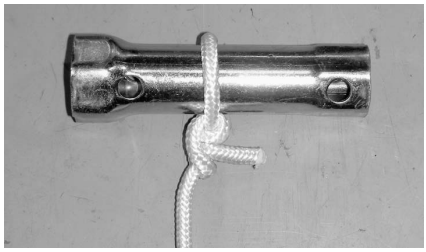
⚠ WARNING

Do not wind starting rope around your hand. Hold rope by the handle only. Do not start the snowmobile by the drive pulley unless it is a true emergency situation. Have the snowmobile repaired as soon as possible.

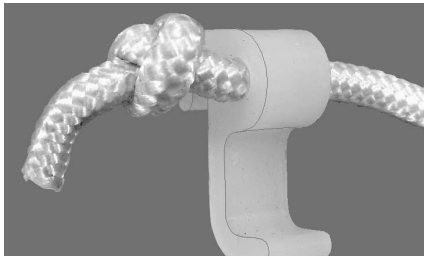

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2. Attach one end of emergency rope to rewind handle.

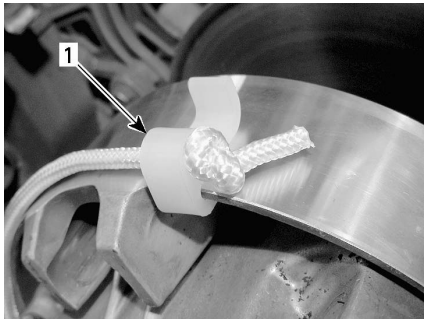
NOTE: The spark plug socket can be used as an emergency handle.


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3. Attach the other end of emergency rope to the starter clip supplied in the tool kit.


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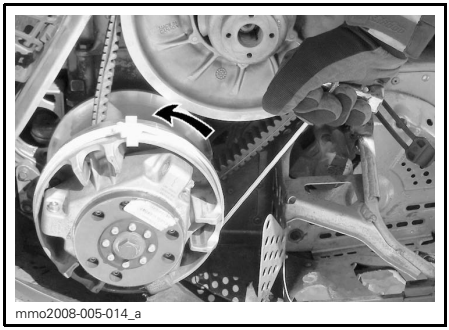
4. Hook up clip on drive pulley.



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1. Clip installation location

5. Wind the rope tightly around drive pulley. When pulled, pulley must rotate counterclockwise.


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6. Pull the rope using a sharp, crisp pull so the rope comes free of the drive pulley.

⚠ WARNING

When starting the snowmobile in an emergency situation, using drive pulley, do not reinstall the drive belt guard and return slowly to have snowmobile repaired.

Vehicle Warm-Up

Before every ride, vehicle has to be warmed up as follows:

1. Start engine as explained in *ENGINE STARTING PROCEDURE* above.
2. Allow engine to warm up one or two minutes at idle speed.

NOTE: It is not recommended to let engine running at idle speed for more than 10 minutes.

3. Disengage parking brake.
4. Apply throttle until drive pulley engages. Drive at low speed the first two or three minutes.

NOTICE If vehicle does not move when throttle is applied, stop engine, remove tether cord cap from the engine cut-off switch, then do the following.

– Check if skis are stuck on the ground. Lift one ski at a time by the handle, then put it down.
– Check if track is stuck on the ground. Lift rear of snowmobile enough to clear track from the ground, then drop.
– Check rear suspension for hard snow or ice accumulation that could interfere with track rotation. Clean the area.

CAUTION Use proper lifting techniques, notably using your legs force. Do not attempt to lift the either end of the vehicle if it is above your limits.

WARNING

Make sure tether cord cap is removed before standing in front the vehicle, getting close to the track or rear suspension components.

NOTE: On E-TEC models, warm-up is electronically controlled. During this period (up to 10 minutes depending on ambient temperature), engine RPM is limited.

Gearbox Operation

NOTICE

– Always put gearbox in 1st gear when pulling a load.
– Always put gearbox in neutral (N) when parked.
– Come to a complete stop and hold brake before shifting to or from reverse. Wait until the reverse alarm sounds before operating throttle.

Neutral

When set in neutral (N), the gearbox disengages the pulleys from the track.

Shifting in Reverse

To engage reverse gear, proceed as follows:

1. Bring vehicle to a complete stop.
2. Apply and hold brake.
3. With engine at idle speed, select reverse (R) gear using the gearshift lever.

NOTE: It is necessary to push shift lever knob down to move it from neutral to reverse gear.

4. Gently depress throttle lever.

WARNING

The reverse speed is not limited. Always proceed with caution as fast reverse could result in loss of vehicle stability. Always remain seated. Ensure the path behind is clear of obstacles or bystanders before proceeding.

Shifting in Forward

There are two forward gears.

To engage a forward gear, proceed as follows:

1. Bring vehicle to a complete stop.
2. Apply and hold brake.
3. With engine at idle speed, select low (1) or high (2) gear using the gearshift lever.
4. Gently depress throttle lever.

NOTE: Do not shift when vehicle is moving.

Shutting Off the Engine

Release throttle lever and wait until engine has returned to idle speed.

Shut off the engine using either the emergency engine stop switch or by pulling off the tether cord cap from the engine cut-off switch.

⚠ WARNING

Always remove the tether cord cap from engine cut-off switch when vehicle is not in operation in order to prevent accidental engine starting, theft or use by unauthorized persons.

Towing an Accessory

Always use a rigid tow bar to tow an accessory. Any towed accessory should have reflectors on both sides and at the rear. Check local laws for brake light(s) requirements.

⚠ WARNING

Never tow an accessory with a rope. Always use a rigid tow bar. Using a rope would result in a collision between the object and the snowmobile and possibly in a tip over in case of a rapid deceleration or on a downward slope.

Towing Another Snowmobile

If a snowmobile is disabled and must be towed use a rigid tow bar. Remove the drive belt from disabled snowmobile, refer to *DRIVE BELT* in the *MAINTENANCE PROCEDURES* subsection and tow at moderate speed.

NOTICE **Always remove the drive belt of the snowmobile that is to be towed to prevent damage to its drive belt and drive system.**

In an emergency situation only, if a rigid tow bar is not available, a rope can be used. Proceed with extra caution. In some areas, it may be illegal to do so. Check with state or local authorities.

Remove the drive belt, attach the rope to the ski legs (spindles), have someone sit on the towed snowmobile to activate the brake, and tow at low speed.

NOTICE **In order to prevent damage to the steering system, never attach the tow rope to the ski loops (handles).**

⚠ WARNING

Never ride at high speed when towing a disabled snowmobile. Proceed slowly with extra caution.

⚠ WARNING

Suspension adjustment could affect vehicle handling. Always take time to familiarize yourself with the vehicle's behavior after any suspension adjustment have been made.

Snowmobile handling and comfort depend upon suspension adjustments.

Choice of suspension adjustments vary with carrying load, driver's weight, personal preference, riding speed and field condition.

⚠ WARNING

Before proceeding with any suspension adjustment, remember:

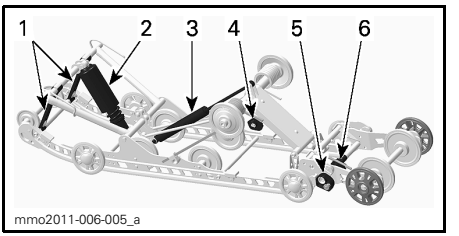
- Park in a safe place.
- Remove the tether cord cap from the engine cut-off switch.
- If the front or rear of vehicle have to be lifted, make sure the lifting device is stable and secure.

⚠ CAUTION Do not attempt to lift the vehicle by hand alone. Use appropriate lifting device to avoid risk of strain injuries.

Following are guidelines to fine-tune suspension.

Customize each adjustment one at a time. It may be necessary to readjust center spring after adjusting front springs for instance. Test run the snowmobile under the same conditions; trail, speed, snow, driver riding position, etc. Change one adjustment and retest. Proceed methodically until you are satisfied.

Rear Suspension Adjustments



SC5-U REAR SUSPENSION
1. *Stopper straps*
2. *Center spring and shock absorber*
3. *Rear shock absorber*
4. *Rear spring preload cams*
5. *Extension stabilizer cam*
6. *Extension spring preload cam*

NOTICE Whenever adjusting rear suspension, check track tension and adjust if necessary.

Stopper Strap Length

Stopper straps length has an effect on the amount of weight the center spring has to carry especially during acceleration, therefore on the front end uplift.

Stopper straps length also has an effect on center spring travel.

NOTICE Always adjust both stopper straps to the same length. Whenever stopper straps length is changed, track tension must be checked.

ACTION	RESULT
Increasing stopper straps length	Lighter ski pressure under acceleration
	More center spring travel
	More bump absorption capability
Decreasing stopper straps length	Heavier ski pressure under acceleration
	Less center spring travel
	Less bump absorption capability

When operating the snowmobile in deep snow, it may be necessary to vary stopper strap length and/or riding position, to change the angle at which the track rides on the snow. Operator's familiarity with the various adjustments as well as snow conditions will dictate the most efficient combination.

Generally, a longer stopper strap setting gives better performance in deep snow on a flat landscape.

Rear Spring Preload

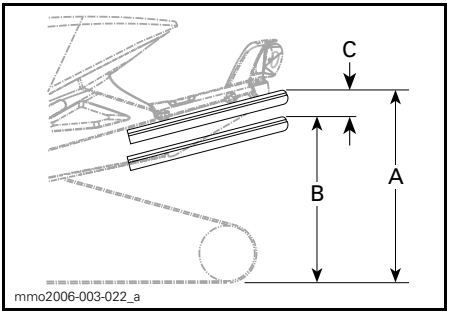
Rear spring preload has an effect on comfort, ride height and load compensation.

Also, adjusting rear spring preload shifts more or less weight to the snowmobile front end. As a result, more or less weight is applied to the skis. This has an effect on performance in deep snow, steering effort and handling.

Slight suspension bottoming occurring under the worst riding conditions indicates a good choice of spring preload.

ACTION	RESULT
Increasing preload	Firmer rear suspension
	Higher rear end
	More bump absorption capability
	Heavier steering
Decreasing preload	Softer rear suspension
	Lower rear end
	Less bump absorption capability
	Lighter steering
	Better performance and handling in deep snow

Refer to the following to determine if preload is correct.



TYPICAL — PROPER ADJUSTMENT
A. Suspension fully extended
B. Suspension has collapsed with driver, passenger(s) and load added
C. Distance between dimension "A" and "B", see table below

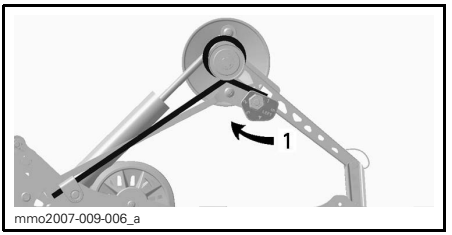
"C"	WHAT TO DO
50 to 75 mm (2 to 3 in)	No adjustment required
More than 75 mm (3 in)	Adjusted too soft, increase preload
Less than 50 mm (2 in)	Adjusted too firm, decrease preload

NOTE: If the specification is unattainable with the original springs, see an authorized Ski-Doo dealer for other available springs.

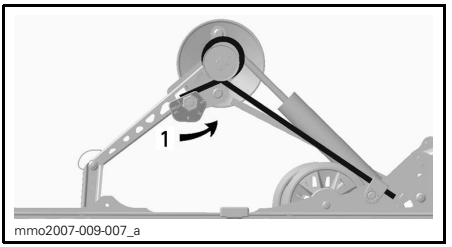
NOTICE To increase spring preload, always turn the left side adjustment cam in a clockwise direction, and the right side cam in a counterclockwise direction.

⚠ CAUTION Never set preload cams directly from position 5 to 1 or directly from position 1 to 5.

The adjustment cams have 5 different settings, 1 being the softest.



TYPICAL — LH SIDE
1. *Adjust spring preload*



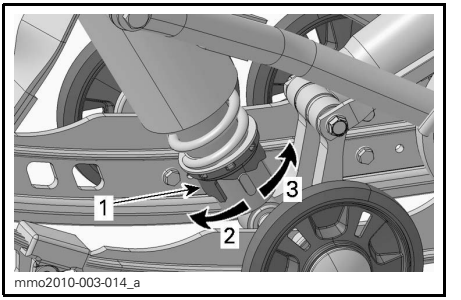
TYPICAL — RH SIDE
1. *Adjust spring preload*

Center Spring Preload

Center spring preload has an effect on steering effort, handling and bump absorption.

Also, since center spring preload adjustment puts more or less pressure on the front of the track, it has an effect on the performance in deep snow.

ACTION	RESULT
Increasing preload	Lighter steering
	More bump absorption capability
	Better deep snow starts
	Better deep snow performance and handling
Decreasing preload	Heavier steering
	Less bump absorption capability
	Better trail handling



CAM TYPE - MOTION CONTROL SHOCK ABSORBER
1. *Spring preload adjustment cam*
2. *Increase preload*
3. *Decrease preload*

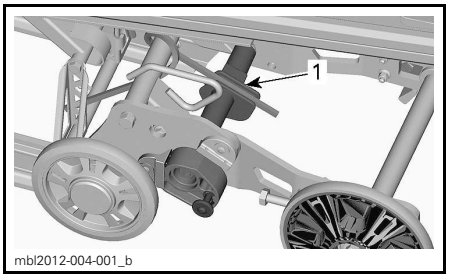
NOTE: For cam type preload adjuster, use the suspension adjustment tool provided in the tool kit.

Rear Suspension Extension Spring Preload

Suspension extension spring preload has an effect on the reverse capability and track ground contact.

To adjust spring preload, turn the adjustment cam.

ACTION	RESULT
Increasing preload	More track surface on the ground
	Less extension lift
Decreasing preload	Better reverse capability especially in deep snow
	More extension lift

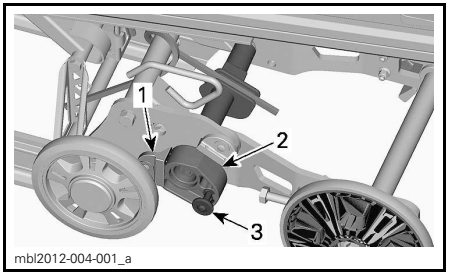


1. Preload cam

Rear Suspension Extension Stabilizer Cam

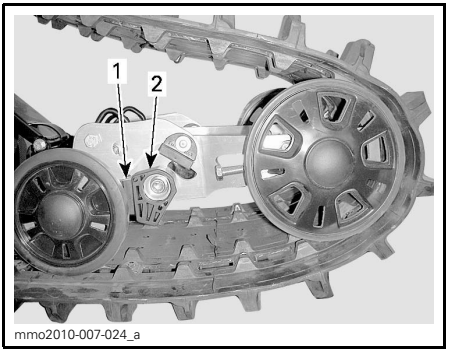
Stabilizer cam is used to control the suspension extension stroke.

Stabilizer cam setting has an effect on manoeuvrability, traction and reverse capability.

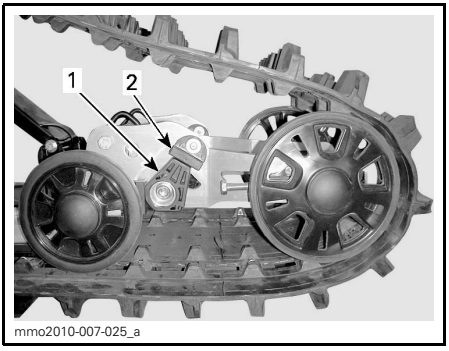


1. Stop block
2. Stabilizer cam
3. Lock

CAM SETTING	RESULT
Away from stop block	Allows free movement of the suspension extension on its entire stroke
	General use
	Good reverse capability
Leaning on stop block	Locks the suspension extension in line with the suspension rails
	Better traction, full track contact surface
	Better towing capability



PARTIALLY LIFTED
1. Adjustment cam
2. Lower stop block



LOCKED
1. Adjustment cam
2. Upper stop block

Vehicle Behavior Related to Suspension Adjustment

PROBLEM	CORRECTIVE MEASURES
Front suspension wandering	Check ski alignment and camber angle adjustment. See an authorized Ski-Doo dealer. Reduce ski ground pressure. – Increase center spring preload. – Reduce rear spring preload.
Snowmobile seems unstable and seems to pivot around its center	Reduce rear suspension front arm pressure. – Reduce center spring preload. – Increase rear spring preload.
Steering feels too heavy	Reduce ski ground pressure. – Increase center spring preload.
Rear of snowmobile seems too stiff	Reduce rear spring preload.
Rear of snowmobile seems too soft	Increase rear spring preload.
Rear suspension front shock absorber is frequently bottoming	Lengthen stopper strap. Increase center spring preload.
Track spins too much at start	Lengthen stopper strap.

VEHICLE TRANSPORTATION

Make sure that oil reservoir and fuel tank caps are properly installed.

Tilt bed trailers can easily be equipped with a winch mechanism to afford maximum safety in loading. Simple as it may seem, never drive your snowmobile onto a tilt bed trailer or any other kind of trailer or vehicle. Many serious accidents have resulted from driving up and over a trailer. Anchor your vehicle securely, front and rear, even on short hauls. Be certain all equipment is securely fastened. Cover your snowmobile when trailering to prevent road grime from causing damage.

Be certain your trailer meets state or provincial requirements. Ensure the hitch and safety chains are secure and the brake, turn indicators and clearance lights all function.

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MAINTENANCE

BREAK-IN INSPECTION

We suggest that after the first 10 hours or 500 km (300 mi) of operation, whichever comes first, your vehicle be inspected by an authorized Ski-Doo dealer. The break-in inspection is very important and must not be neglected.

NOTE: The break-in inspection is at the expense of the vehicle owner.

We recommend that this inspection be signed by an authorized Ski-Doo dealer.

Date of inspection

Authorized dealer signature

Dealer name

BREAK-IN INSPECTION (550F)
Inspect exhaust system and check for leaks
Inspect fuel lines and connections
Inspect throttle cable
Inspect drive belt
Visually inspect drive pulley
Tighten drive pulley retaining screw to specified torque
Inspect driven pulley
Adjust and align track
Change gearbox oil
Check brake fluid level
Inspect brake hose, pads and disk
Inspect steering mechanism
Inspect skis and runners
Inspect front suspension
Inspect rear suspension (including stopper straps and slider shoes)
Adjust oil injection pump

BREAK-IN INSPECTION (600 HO E-TEC)
Inspect exhaust system and check for leaks
Tighten exhaust manifold screws to specified torque
Check coolant level
Inspect fuel lines and connections
Inspect throttle cable
Inspect drive belt
Visually inspect drive pulley
Tighten drive pulley retaining screw to specified torque
Inspect driven pulley
Adjust and align track
Change gearbox oil
Check brake fluid level
Inspect brake hose, pads and disk
Inspect steering mechanism
Inspect skis and runners
Inspect front suspension
Inspect rear suspension (including stopper straps and slider shoes)

BREAK-IN INSPECTION (600 ACE AND 900 ACE)
Inspect engine seals and gaskets for leaks
Inspect exhaust system and check for leaks
Inspect all heat shields
Check coolant level
Change engine oil and filter
Inspect fuel lines and connections
Inspect drive belt
Visually inspect drive pulley
Tighten drive pulley retaining screw to specified torque
Inspect driven pulley
Check driven pulley preload
Adjust and align track
Change gearbox oil
Check brake fluid level
Inspect brake hose, pads and disk
Inspect steering mechanism
Inspect skis and runners
Inspect front suspension
Inspect rear suspension (including stopper straps and slider shoes)

MAINTENANCE SCHEDULE

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

The maintenance schedule does not exempt the pre-ride inspection.

⚠ WARNING

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

550F Models

EVERY 3 000 KM (2,000 MI) OR 1 YEAR (WHICHEVER COMES FIRST)
Inspect engine rubber mounts
Inspect exhaust system and check for leaks
Adjust engine stopper
Visually inspect and clean drive pulley
Tighten drive pulley retaining screw to specified torque
Clean driven pulley
Adjust and align track
Inspect brake hose, pads and disk
Inspect steering mechanism
Inspect front suspension
Inspect rear suspension (including stopper straps and slider shoes)
Lubricate rear suspension (lubricate whenever the vehicle is used in wet conditions (rain, puddles)

EVERY 6 000 KM (4,000 MI) OR 2 YEARS (WHICHEVER COMES FIRST)
Inspect fuel pump strainer and replace if necessary
Replace brake fluid
Inspect throttle cable
Clean and lubricate rewind starter
Lubricate gearbox and driven shaft spline

600 HO E-TEC Models

EVERY 3 000 KM (2,000 MI) OR 1 YEAR (WHICHEVER COMES FIRST)
Inspect heat shields
Inspect engine rubber mounts
Inspect exhaust system and check for leaks
Adjust engine stopper
Visually inspect and clean drive pulley
Tighten drive pulley retaining screw to specified torque
Clean driven pulley
Adjust and align track
Inspect brake hose, pads and disk
Inspect steering mechanism
Inspect front suspension
Inspect rear suspension (including stopper straps and slider shoes)
Lubricate rear suspension (lubricate whenever the vehicle is used in wet conditions (rain, puddles)

EVERY 6 000 KM (4,000 MI) OR 2 YEARS (WHICHEVER COMES FIRST)
Inspect fuel pump strainer and replace if necessary
Replace brake fluid
Inspect throttle cable
Clean and lubricate rewind starter

EVERY 10 000 KM (6,000 MI) OR 3 YEARS (WHICHEVER COMES FIRST)
Replace spark plugs must be replaced by an authorized Ski-Doo dealer)
Inspect oil pump strainer and clean if needed

EVERY 5 YEARS
Replace engine coolant
Replace in-line fuel filter

600 ACE and 900 ACE Models

EVERY 3 000 KM (2,000 MI) OR 1 YEAR (WHICHEVER COMES FIRST)
Inspect heat shields
Visually inspect and clean drive pulley
Tighten drive pulley retaining screw to specified torque
Clean driven pulley
Check driven pulley preload
Adjust and align track
Inspect brake hose, pads and disk
Inspect steering mechanism
Inspect front suspension
Inspect rear suspension (including stopper straps and slider shoes)
Lubricate rear suspension. Lubricate whenever the vehicle is used in wet conditions (rain, puddles)

EVERY 6 000 KM (4,000 MI) OR AT PRE-SEASON (WHICHEVER COMES FIRST)
Change engine oil and filter

EVERY 6 000 KM (4,000 MI) OR 2 YEARS (WHICHEVER COMES FIRST)
Replace fuel pump outlet filter
Replace brake fluid
Inspect drive pulley slider shoes and ramps and replace if needed

EVERY 10 000 KM (6,000 MI) OR 3 YEARS (WHICHEVER COMES FIRST)
Replace spark plugs (must be replaced by an authorized Ski-Doo dealer)

EVERY 5 YEARS
Replace engine coolant

This subsection includes instructions for basic maintenance procedures. If you have the necessary mechanical skills and the required tools, you can perform these procedures. If not, see your authorized Ski-Doo dealer.

Other important items in the maintenance schedule that are more difficult and require special tools are best performed by your authorized Ski-Doo dealer.

⚠ WARNING

Turn off the engine, remove tether cord cap and follow these maintenance procedures when performing maintenance. If you do not follow proper maintenance procedures you can be injured by hot parts, moving parts, electricity, chemicals or other hazards.

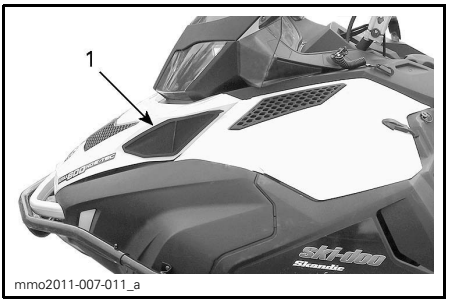
⚠ WARNING

Should removal of a locking device be required (e.g. lock tabs, self-locking fasteners, etc.) when undergoing disassembly/assembly, always replace with a new one.

Air Intake Silencer Prefilter

Air Intake Silencer Prefilter Verification

Ensure that air intake silencer prefilter is properly installed, clean and in good condition.



1. Prefilter

To remove prefilter, simply pull it out.

To install prefilter, push it back in place making sure it is properly secured.

Engine Coolant (Except 550F)

⚠ WARNING

Never open coolant tank cap when engine is hot.

Engine Coolant level

The engine coolant tank is located behind the upper RH side panel. See *CONTROLS, INSTRUMENTS AND EQUIPMENT* for removal procedure.

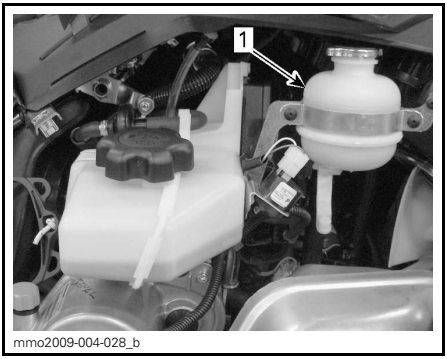
The cold level line is just above the retaining clamp.

Check coolant level at room temperature with the cap removed. Liquid should be at cold level line (engine cold) of coolant tank.

NOTE: When checking coolant level at low temperature it may be slightly below the cold level line.

To add coolant, remove front coolant tank fixation and slightly pull the tank outwards to make room for the cap.

If additional a large amount of coolant has to be added or if entire system has to be refilled, refer to an authorized Ski-Doo dealer.



TYPICAL
1. Coolant tank

Recommended Engine Coolant

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

Cooling system must be filled with BRP PREMIXED COOLANT (P/N 219 700 362) or with distilled water and antifreeze solution (50% distilled water, 50% antifreeze).

Engine Oil (600 ACE / 900 ACE)

Recommended Engine Oil

ENGINE	RECOMMENDED ENGINE OIL
600 ACE 900 ACE	XPS 4-STROKE SYNTHETIC OIL (ALL CLIMATE) (P/N 293 600 112)

NOTICE The engine of this snowmobile has been developed and validated using the BRP XPS™ Synthetic 4-stroke oil. BRP strongly recommends the use of its XPS Synthetic 4-stroke oil at all times. Damages caused by oil which is not suitable for the engine will not be covered by the BRP limited warranty.

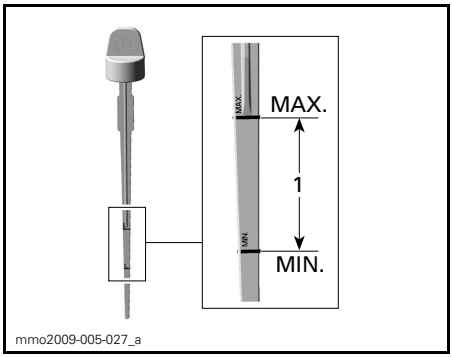
If the recommended oil is not available, use SAE 0W40 synthetic-based oil that meets or exceeds the requirements for API service classification SM

Engine Oil Level Verification

NOTICE Check level every 10 hours of use and refill if necessary. Do not overfill. Operating the engine with an improper level may severely damage engine. Wipe off any spillage.

Place vehicle on a level surface and proceed as follows to check oil level:

1. Start engine and let it reach its normal operating temperature. Engine is at normal temperature when rear radiator gets warm, indicating that the thermostat is open.
2. Let engine run at idle for 30 more seconds.
3. Stop engine.
4. Remove the drive belt guard, refer to *CONTROLS, INSTRUMENTS AND EQUIPMENT*.
5. Remove dipstick from the filler tube, then wipe it clean.
6. Completely insert dipstick in the filler tube.
7. Remove dipstick and check the oil level. Oil level should be between the MIN. and MAX. marks as shown, add if necessary.



1. Oil level between MIN. and MAX.

CAUTION Engine oil can be very hot.

WARNING

Wipe off any oil spills. Oil is highly flammable when heated.

Exhaust System

Exhaust System Verification

The tail pipe of the muffler should be centered with the exit hole in the bottom pan. Exhaust system must be free of rust or leaks. Make sure that all parts are securely in place.

Check retaining springs condition and replace if necessary.

The exhaust system is designed to reduce noise and to improve the total performance of the engine. Modification may be in violation of local laws.

NOTICE If any exhaust system component is removed, modified or damaged, severe engine damage may result.

Spark Plugs

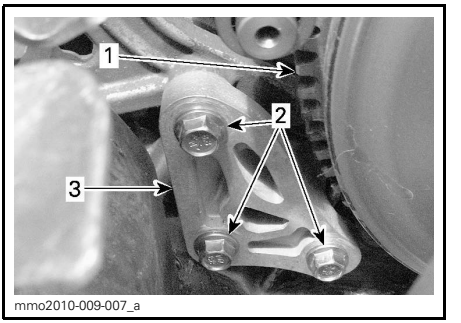
Spark plugs inspection or replacement must be done by an authorized Ski-Doo dealer.

Engine Stopper (600 HO E-TEC)

Engine Stopper Adjustment

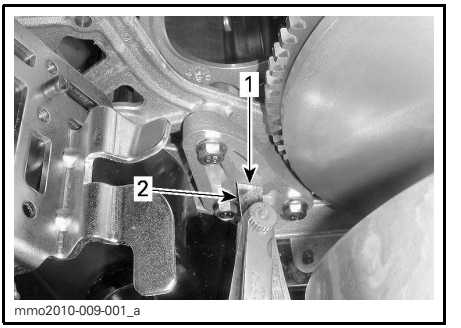
The engine stopper is located on the LH front engine support, in front of the drive pulley.

1. Remove tether cord cap from engine cut-off switch.
2. Remove the LH lower side panel, refer to *BODY*.
3. Remove drive belt guard, refer to *DRIVE BELT GUARD REMOVAL* in this subsection.
4. Loosen the three screws retaining the engine stopper to the engine support just enough to allow a vertical play (1/2 to one turn).



1. Drive pulley
2. Engine stopper screws
3. Engine stopper

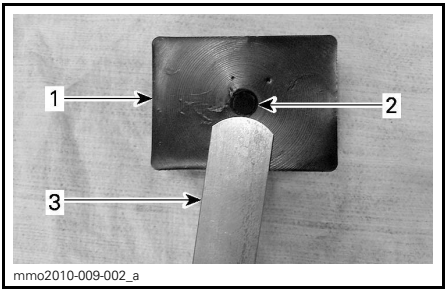
5. Insert a 0.5 mm (.02 in) feeler gauge in the engine stopper opening (see illustration).



1. Opening
2. Feeler gauge

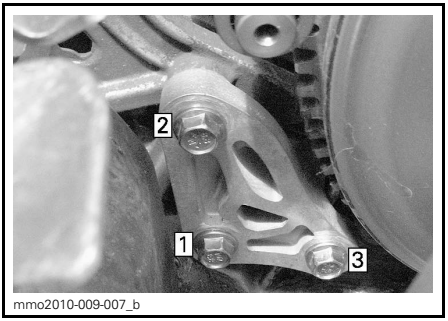
6. Place feeler gauge between engine stopper and rubber stop block (on engine).

NOTE: Do not insert the feeler gauge too deep, as it will pass over the bump at the surface of the rubber stop block and alter adjustment. See illustration.



1. Rubber stop block
2. Bump
3. Feeler gauge

7. Tighten screws to the specified torque, following the illustrated sequence. Take care not to pinch the feeler gauge.



TIGHTENING SEQUENCE

STOPPER SCREW TIGHTENING TORQUE
10 N•m ± 2 N•m (89 lbf•**in** ± 18 lbf•**in**)

NOTICE Serious pulley damage can occur if the engine stopper and its screws are not properly installed.

Brake Fluid

Recommended Fluid

Use only DOT 4 brake fluid from a sealed container. An opened container may be contaminated or may have absorbed moisture from the air.

⚠ WARNING

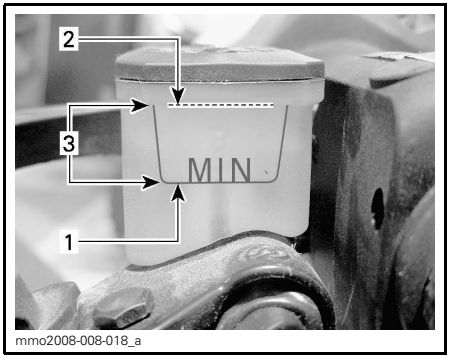
Use only DOT 4 brake fluid from a sealed container. To avoid serious damage to the braking system, do not use fluids other than the recommended one, nor mix different fluids for topping up.

NOTICE Brake fluid can damage painted and plastic parts. Handle with care. Rinse thoroughly in case of spillage.

Brake Fluid Level Verification

Place vehicle on a level surface.

Check brake fluid in reservoir for proper level. Add recommended brake fluid as required.



1. Minimum
2. Maximum
3. Operating range

⚠ CAUTION Avoid getting brake fluid on skin or eyes - it may cause severe burns. In case of contact skin, wash thoroughly. In case of contact with the eyes, immediately rinse with plenty of water for at least 10 minutes and then consult a doctor immediately.

Gearbox Oil

Recommended Gearbox Oil

RECOMMENDED GEARBOX OIL
XPS SYNTHETIC GEAR OIL (75W 140) (P/N 293 600 140)

NOTICE The gearbox of this snowmobile has been developed and validated using the XPS™ Synthetic gear oil. BRP strongly recommends the use of its XPS Synthetic gear oil at all times. Damages caused by oil which is not suitable for the gearbox will not be covered by the BRP limited warranty.

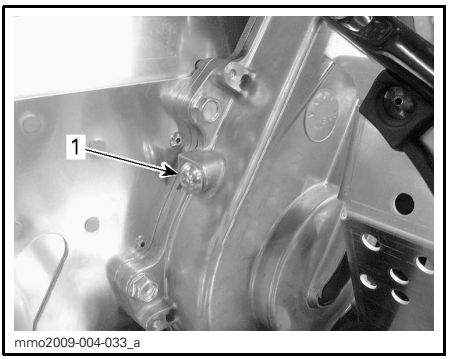
Access to Gearbox

Remove upper and lower side panels, refer to *CONTROLS, INSTRUMENTS AND EQUIPMENT*.

Gearbox Oil Level Verification

With the vehicle on a level surface, check the oil level by removing the check plug on the left side of gearbox.

Oil level must reach the threaded hole's lower edge.



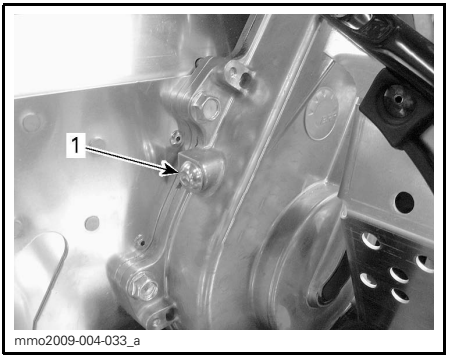
1. Check plug

1. Reinstall check plug and torque to specification.

CHECK PLUG TORQUE
10 N•m ± 1 N•m (89 lbf•**in** ± 9 lbf•**in**)

Adding Gearbox Oil

1. Remove the check plug located on the left side of gearbox.



1. Check plug

2. Remove the filler cap.



TYPICAL
1. Filler cap

3. Pour recommended oil in gearbox by the filler hole until oil comes out by the check plug hole.
4. Reinstall check plug and torque to specification.

CHECK PLUG TORQUE
10 N•m ± 1 N•m (89 lbf•**in** ± 9 lbf•**in**)

Drive Belt

Drive Belt Inspection

Inspect drive belt for cracks, fraying or abnormal wear (uneven wear, wear on one side, missing cogs, cracked fabric). If abnormal wear is noted, probable cause could be pulley misalignment, excessive RPM with frozen track, fast starts without warm-up period, burred or rusty sheave, oil on drive belt or distorted spare drive belt. Contact an authorized Ski-Doo dealer.

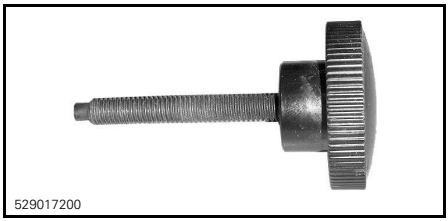
Spare Drive Belt

A spare drive belt can be stored in the storage box.

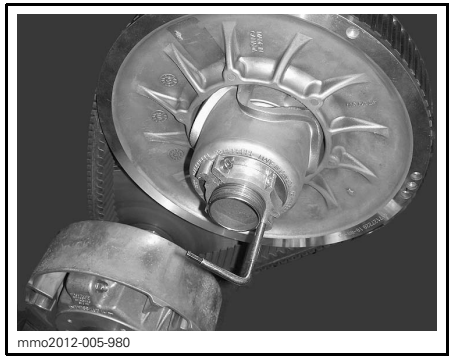
Drive Belt Replacement

Drive Belt Removal

1. Remove the drive belt guard refer to *CONTROLS, INSTRUMENTS AND EQUIPMENT*.
2. Insert the DRIVEN PULLEY OPENING TOOL (P/N 529 017 200) (or the pulley expander provided in the tool box) in the threaded hole on the adjuster hub.



DRIVEN PULLEY OPENING TOOL



PULLEY EXPANDER INSTALLED ON ADJUSTER HUB

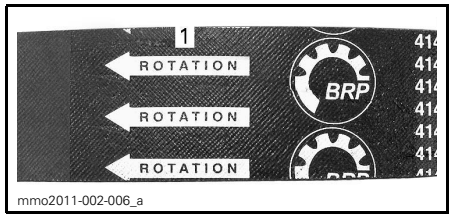
3. Open the driven pulley by screwing the tool in.
4. To remove belt, slip the belt over the top of driven pulley, then over the drive pulley.

Drive Belt Installation

1. If necessary, open the driven pulley, refer to *DRIVE BELT REMOVAL* above.
2. Slip the drive belt over the drive pulley, then over the driven pulley.

NOTICE **Do not force or use tools to pry the drive belt into place, as this could cut or break the cords in the drive belt.**

NOTE: The maximum drive belt life span is obtained when drive belt is installed with arrows in the direction of rotation.



1. To be pointed in the direction of rotation

3. Unscrew and remove the driven pulley expander from the pulley.

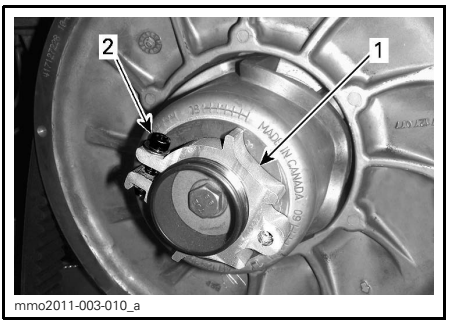
4. Rotate the driven pulley several times to properly set the drive belt between the sheaves.
5. If a new drive belt was installed, adjust the drive belt height. Refer to *DRIVE BELT HEIGHT ADJUSTMENT* below.
6. Install drive belt guard and close side panel. Refer to *CONTROLS, INSTRUMENTS AND EQUIPMENT*.

Drive Belt Height Adjustment

The drive belt height must be checked every time a new drive belt is installed.

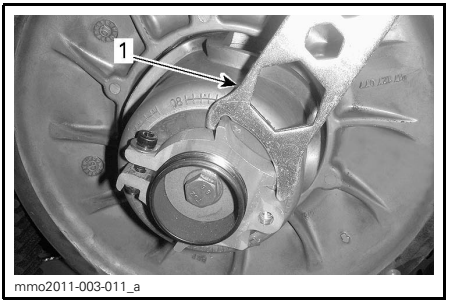
To adjust the drive belt height, proceed as follows:

1. Remove tether cord cap from engine cut-off switch.
2. Remove drive belt guard.
3. Loosen the clamping bolt.



1. Adjuster hub
2. Clamping bolt

4. Using the suspension adjustment tool provided in the tool kit, turn the ring 1/4 turn at a time then rotate the driven pulley to properly set the drive belt between the pulley sheaves.



1. Suspension adjustment tool

NOTE: The adjustment ring has **left hand treads**.

Repeat step 4 until the external surface of drive belt is even with the driven pulley edge.

NOTE: Turning the ring counterclockwise lowers the drive belt in the pulley. Turning the ring clockwise raises the drive belt in the pulley.

5. Firmly tighten the clamping bolt. If possible, tighten to specified torque using a torque wrench.

CLAMPING BOLT TIGHTENING TORQUE
5.5 N•m ± 0.5 N•m (49 lbf•**in** ± 4 lbf•**in**)

6. Install drive belt guard.
7. Install side panel.

NOTE: This setting is correct as a preliminary adjustment for most models. In some cases, when starting the engine, the vehicle could creep, indicating that the drive belt is too tight.

If the vehicle creeps, lower the drive belt height from the preliminary setting. Repeat procedure until creeping stops.

Reverse Activation

NOTE: The reverse may not activate or may be harder to activate if the drive belt is positioned too high in the driven pulley. If reverse activation does not work properly, ensure the drive belt is properly adjusted. Adjust the drive belt lower in the driven pulley if needed.

Drive Pulley

Drive Pulley Adjustment

All drive pulleys are factory calibrated for sea level operation.

550F and 600 ACE Models

Not adjustable.

600 HO E-TECModels

Drive pulley on 600 HO E-TEC are fully adjustable.

⚠ WARNING

Remove the tether cord cap from engine cut-off switch before performing any adjustment. Vehicle must be parked in a safe place, away from the trail.

The drive pulley is factory calibrated to transmit maximum engine power at a predefined RPM. Factors such as ambient temperature, altitude or surface condition may vary this critical engine RPM thus affecting snowmobile efficiency.

This adjustable drive pulley allows setting maximum engine RPM to maintain maximum power.

Calibration screws should be adjusted so that actual maximum engine RPM matches the maximum horsepower RPM.

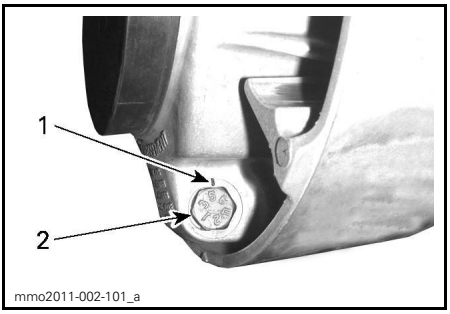
ENGINE	MAXIMUM HORSEPOWER RPM
600 HO E-TEC	8100 RPM (± 100)

NOTE: Use precision digital tachometer for engine RPM adjustment.The adjustment has an effect on high RPM only.

There are 6 positions numbered 1 to 6.

The calibration screws have 6 different settings identified by numbers scribed on their head.

The actual setting is the screw head number aligned with the mark on the pulley.



PULLEY SETTING
1. Mark
2. Number

Each position modifies maximum engine RPM by approximately 200 RPM.

Lower position numbers decrease engine RPM in steps of 200 RPM and higher position numbers increase it in steps of 200 RPM.

Example:

Calibration screws initially set at position 4 and changed to position 6 will increase maximum engine RPM by 400 RPM.

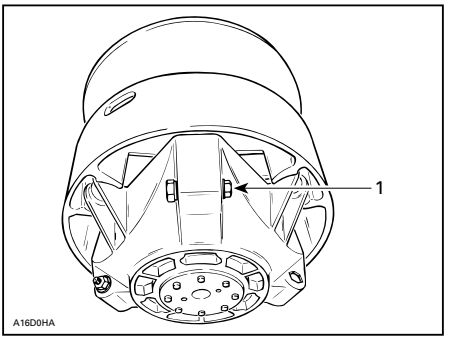
Procedure

Loosen the lock nut just enough to get the calibration screw head out of the pulley and rotate to the desired position. Do not completely remove the lock nut.

Set all 3 calibration screws to the same position.

Tighten lock nuts to 10 N•m ± 2 N•m (89 lbf•**in** ± 18 lbf•**in**).

NOTICE Do not completely remove calibration screw otherwise internal washers will fall off. Always adjust all 3 calibration screws and make sure they are all set to the same position.



TYPICAL
1. *Loosen just enough to permit rotating of calibrate screw*

⚠ WARNING

NEVER disassemble or modify the drive pulley.
Improper assembly or modifications could cause the pulley to explode violently under the stress generated by the high rotational speed.
See your Ski-Doo dealer to maintain or service the drive pulley. Improper servicing or maintenance may affect performance and reduce drive belt life. Always respect maintenance schedules.

⚠ WARNING

NEVER operate engine:
- Without shields and drive belt guard securely installed.
- With hood and/or side panels opened or removed.

NEVER attempt to make adjustments to moving parts while engine is running.

Track

Track Inspection

⚠ WARNING

Remove the tether cord cap from engine cut-off switch before performing any maintenance or adjustment, unless otherwise specified. Vehicle must be parked in a safe place, away from the trail.

Remove the tether cord cap from engine cut-off switch.

Lift the rear of the snowmobile and support it with a wide-base snowmobile mechanical stand with a rear deflector panel. With the engine off, rotate the track by hand, and inspect condition. If worn or cut, or if track fibers are exposed, or if missing or defective inserts or guides are noted; contact an authorized Ski-Doo dealer.

Snowmobiles Equipped with Traction Enhancing Products

If your snowmobile is equipped with a BRP approved studded track, PROCEED WITH A VISUAL INSPECTION OF YOUR TRACK BEFORE EACH USE.

Look for any defects, such as:
- Perforations in the track
- Tears in the track (particularly around traction holes on studded tracks)
- Lugs that are broken or torn off, exposing portions of rods
- Delamination of the rubber
- Broken rods
- Broken studs (studded tracks)
- Bent studs (studded tracks)
- Missing studs
- Studs that are torn off the track
- Missing track guide(s)
- Also, ensure that studs nut are tighten to the recommended torque.

On approved studded tracks, replace broken or damaged studs immediately. If your track shows signs of deterioration, it must be replaced immediately. When in doubt, ask your dealer.

⚠ WARNING

Riding with a damaged track or studs could lead to a loss of control, resulting in a risk of serious injury or death.

For complete information on traction enhancing products, refer to the section entitled *TRACTION ENHANCING PRODUCTS* in the *SAFETY INFORMATION* section at the beginning of this Operator's Guide.

Track Tension and Alignment

NOTE: Track tension and alignment are interrelated. Do not adjust one without the other.

⚠ WARNING

To prevent serious injury to individuals near the snowmobile:

- **NEVER stand behind or near a moving track.**
- **Always use a wide-base snowmobile stand with a rear deflector panel if it is necessary to rotate track.**
- **When the track is raised off the ground, only run it at the lowest possible speed.**

Centrifugal force could cause debris, pieces of torn track, or an entire severed track to be violently thrown backwards out of the tunnel with tremendous force.

Track Tension Verification

NOTE: Ride the snowmobile in snow about 15 to 20 minutes prior to adjusting track tension.

1. Remove tether cord cap from engine cut-off switch.
2. Lift rear of vehicle and support it off the ground.

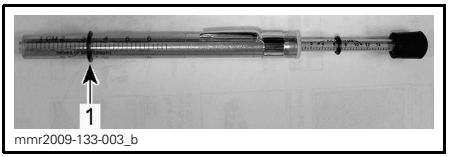
⚠ CAUTION Use proper lifting techniques, notably using your legs force. Do not attempt to lift the rear of vehicle if it is above your limits.

3. Allow rear suspension to fully extend.
4. Use the TENSIOMETER (P/N 414 348 200).



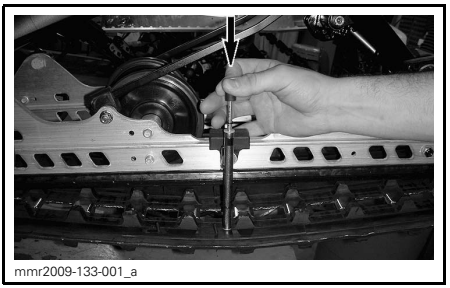
5. Set deflection using bottom O-ring.

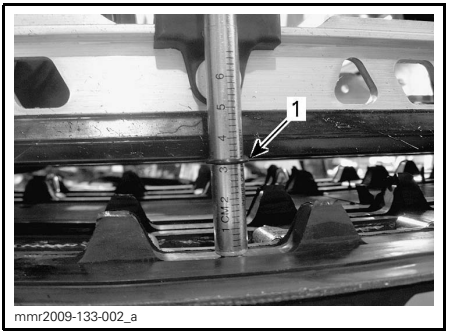
DEFLECTION
40 mm to 50 mm (1.5 in to 2 in)



DEFLECTION SETTING
1. Bottom O-ring set to specification

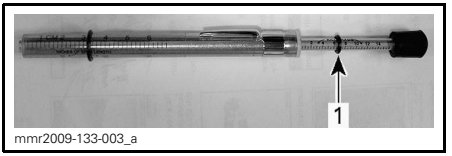
6. Place upper O-ring to 0 kgf (0 lbf).
7. Position the tensiometer on track, halfway between front and rear idler wheels.
8. Push the tensiometer downwards until bottom O-ring (deflection) be aligned with the bottom of slider shoe.





1. Deflection O-ring aligned with slider shoe

9. Read load recorded by the upper O-ring on the tensiometer.



LOAD READING
1. Upper O-ring

10. Load reading must be as per the following table.

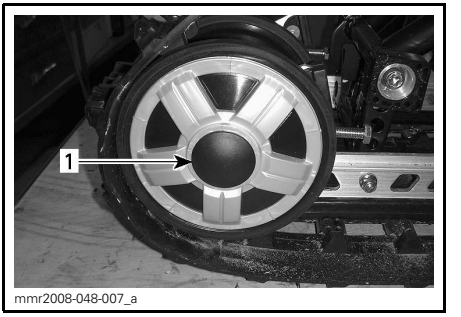
TRACK ADJUSTMENT SPECIFICATION	
TRACK DEFLECTION SETTING	40 mm to 50 mm (1.5 in to 2 in)
TRACK LOAD READING	7.3 kg (16 lb)

11. If load reading is not in accordance with the specification, adjust track tension. Refer to *TRACK TENSION ADJUSTMENT*.

NOTICE Too much tension will result in power loss and excessive stresses on suspension components.

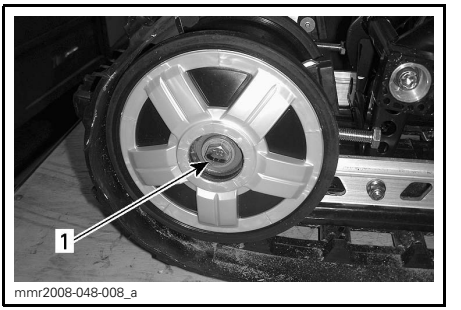
Track Tension Adjustment

1. Remove the tether cord cap from engine cut-off switch.
2. Remove rear wheel caps (if so equipped).



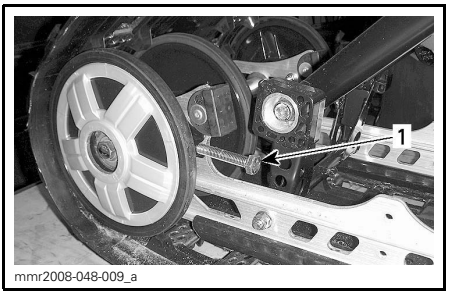
1. RH rear idler wheel cap

3. Loosen the rear idler wheel retaining bolts.



1. RH rear idler wheel bolt

4. Tighten or loosen both adjustment screws to increase or decrease track tension.



1. RH adjustment screw

5. If correct tension is unattainable, contact an authorized Ski-Doo dealer.
6. Retighten retaining bolts to specification.

TORQUE
48 N•m ± 6 N•m (35 lbf•ft ± 4 lbf•ft)

7. Check track alignment as described below.

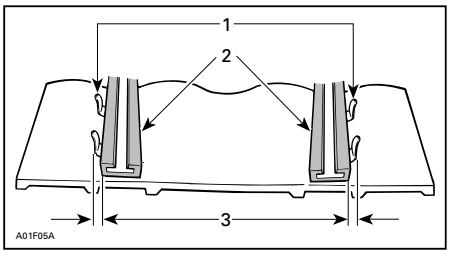
Track Alignment

⚠ WARNING

Before checking track alignment, ensure that the track is free of all particles which could be thrown out while track is rotating. Keep hands, tools, feet and clothing clear of track. Always lift the snowmobile on a wide-base stand with a rear deflector panel. Ensure no one is standing in close proximity to the snowmobile, especially at the rear of the track. Never rotate track at high speed.
Centrifugal force could cause debris, damaged or loose studs, pieces of torn track, or an entire severed track to be violently thrown backwards out of the tunnel with tremendous force.

Start the engine and accelerate slightly so that track barely turns. This must be done in a short period of time (about 5 seconds).

Check that the track is well centered; equal distance on both sides between edges of track guides and slider shoes.



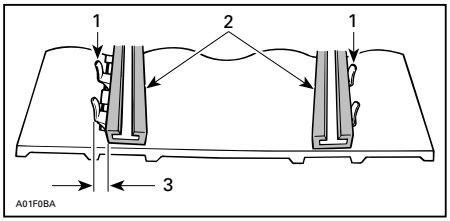
1. Guides
2. Slider shoes
3. Equal distance

If off center, perform alignment as follows:

⚠ WARNING

Remove the tether cord cap from engine cut-off switch before performing any maintenance or adjustment, unless otherwise specified. Vehicle must be parked in a safe place, away from the trail.

1. Remove the tether cord cap from engine cut-off switch.
2. Loosen rear idler wheel retaining bolts.
3. Tighten the adjustment bolt on side where the slider shoe is the farthest from the track insert guides.

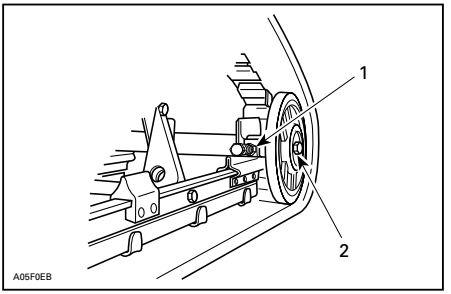


1. Guides
2. Slider shoes
3. Tighten on this side

4. Tighten lock nuts.
5. Torque idler wheels retaining bolts to 48 N•m ± 6 N•m (35 lbf•ft ± 4 lbf•ft).

⚠ WARNING

Make sure all fasteners are properly tightened to avoid loosing an idler wheel or causing the track to lock.



TYPICAL
1. *Locknut*
2. *Retaining bolts*

6. Start engine and rotate track slowly to recheck alignment.
7. Reposition snowmobile on ground.
8. Install rear wheel caps if so equipped.

Suspension

Rear Suspension Condition

Visually inspect all suspension components including slider shoes, springs, wheels, etc.

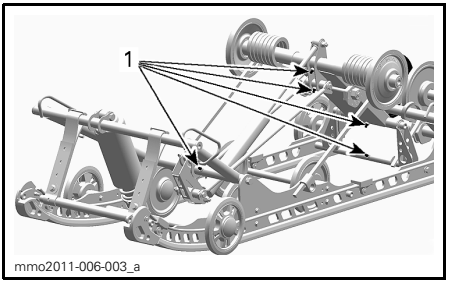
NOTE: During normal driving, snow will act as a lubricant and coolant for the slider shoes. Extensive riding on ice or sanded snow, will create excessive heat build-up and cause premature slider shoe wear.

Suspension Stopper Strap Condition

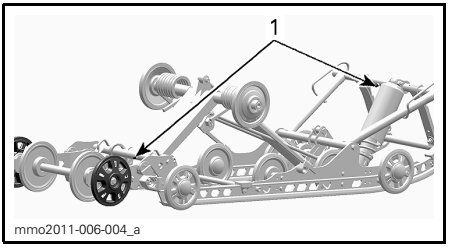
Inspect stopper strap for wear and cracks, bolt and nut for tightness. If loose inspect holes for deformation. Replace as required. Torque nut to 9 N•m ± 1 N•m (80 lbf•**in** ± 9 lbf•**in**).

Rear Suspension Lubrication

Lubricate rear suspension at grease fittings using SUSPENSION GREASE (P/N 293 550 033). Refer to *MAINTENANCE SCHEDULE* for maintenance frequency.



1. Grease fittings



1. Grease fittings

Steering and Front Suspension Condition

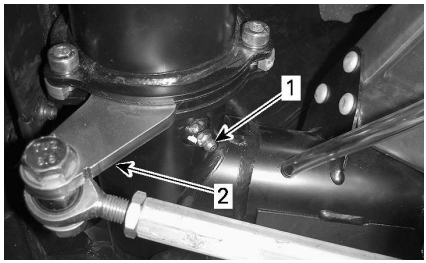
Visually inspect steering and front suspension for tightness of components (steering arms, tie rods, ski bolts, ski legs, etc.). If necessary, contact an authorized Ski-Doo dealer.

Front Suspension Lubrication

Lubricate front suspension at grease fittings using suspension synthetic grease (P/N 293 550 033).

Generally, 4 to 5 grease gun strokes is sufficient.

NOTE: If too much grease is injected, the overflow will come out at steering levers and ski legs. Wipe off any excess of grease to avoid contact with other parts.



LH SIDE SHOWN
1. *Grease fitting*
2. *Steering arm*

Skis

Wear and Condition of Skis and Runners

Check the condition of the skis and ski runner carbides. If worn, contact an authorized Ski-Doo dealer.

⚠ WARNING

Excessively worn skis and/or ski runners will adversely affect snowmobile control.

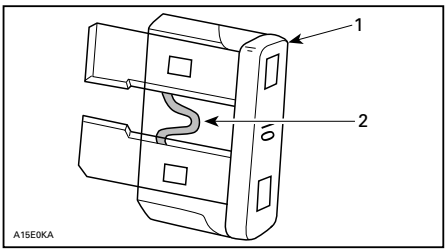
Fuses

Fuse Inspection

The electrical system is protected with fuses.

Check fuse condition and replace it if necessary.

To remove fuse from holder, pull fuse out. Check if filament is melted.



1. *Fuse*
2. *Check if melted*

⚠ WARNING

Do not use a higher rated fuse.

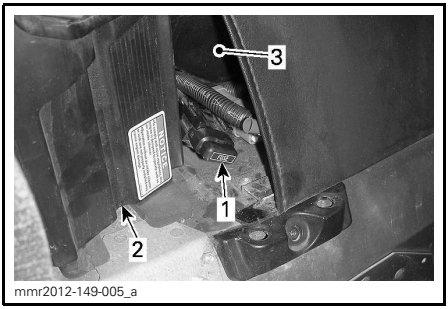
⚠ WARNING

If fuse has burnt out, source of malfunction should be determined and corrected before restarting. See an authorized Ski-Doo dealer for servicing.

Fuse Location

550F

The 20A charging system fuse is located on on left side of vehicle, between fuel tank and primary air intake silencer.



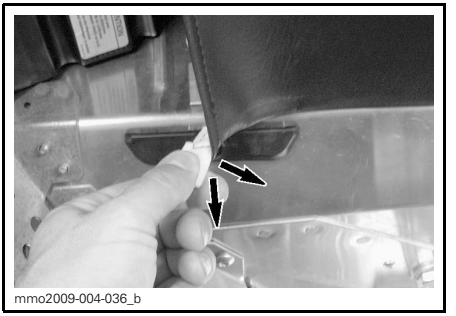
1. *20 A charging system fuse*
2. *Primary air intake silencer*
3. *Fuel tank*

Other Models

The fuse box is located behind the front seat upholstery at the LH front lower portion of seat.

Refer to the decal inside the fuse box cover or the *SPECIFICATIONS* subsection for fuse identification.

To access the fuse box, carefully pull seat upholstery out of the aluminum extrusion by pulling the plastic strip downwards and sideways at the same time.


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TYPICAL - PULL STRIP



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1. Fuse box

Close upholstery by pushing the strip back in the aluminium extrusion.

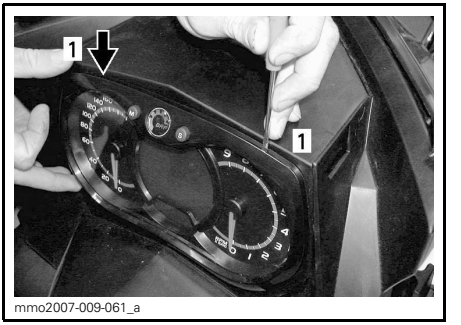
Lights

Always check light operation after bulb replacement.

Headlights Bulb Replacement

NOTICE **Never touch glass portion of an halogen bulb with bare fingers, it shortens its operating life. If glass is touched, clean it with isopropyl alcohol which will not leave a film on the bulb.**

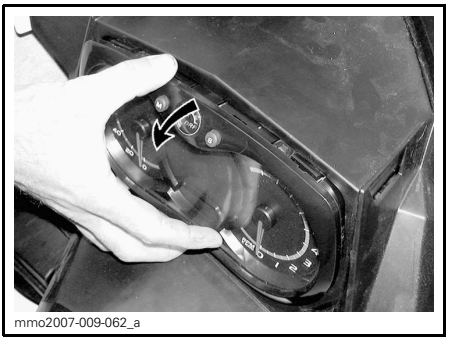
1. By using a small screwdriver, release multifunction gauge locking tabs.



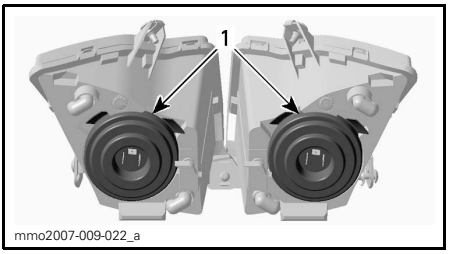
mmo2007-009-061_a

1. Locking tab

2. Gently pull on multifunction gauge and set aside.


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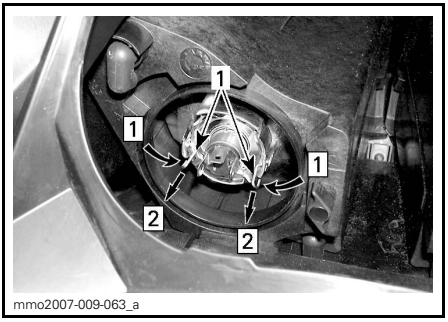
3. Unplug burnt bulb connector. Remove the rubber boot.



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1. Rubber boots

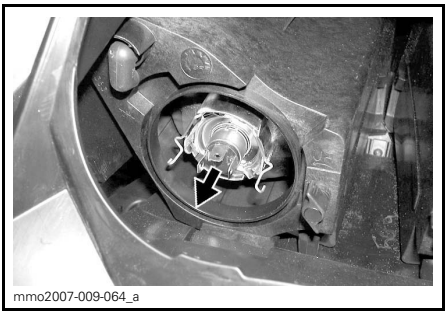
4. Press and pull both sides of the retaining clip at the same time to release it from bulb support.



Step 1: Push both sides
Step 2: Pull to release

1. Retaining clip

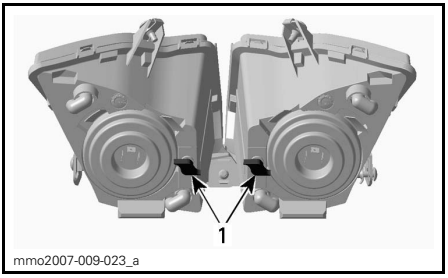
5. Pull bulb and replace. Properly reinstall parts.



PULL BULB AND REPLACE

Headlights Beam Aiming

Remove multifunction gauge, refer to *HEADLIGHTS BULB REPLACEMENT*. Turn knob to adjust beam height.

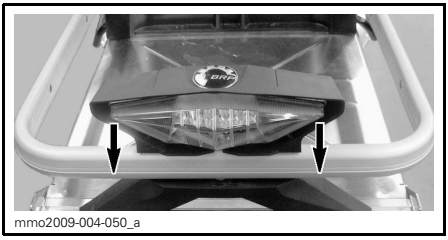


TYPICAL
1. Knobs

Taillight Bulb Replacement

1. Remove taillight housing by carefully pulling on lens at both ends using an equal force.

NOTICE If taillight housing is not removed perpendicularly to the taillight holder, mounting pins may break and taillight housing will have to be replaced.



NOTICE Do not pull taillight housing out too far to avoid damaging wiring.

2. Remove lamp socket from taillight housing.
   2.1 Turn socket counterclockwise.
   2.2 Pull socket out.
3. Replace bulb.
4. Secure socket into taillight housing.
5. Push taillight housing back in place.

Post-Operation Care

Remove snow and ice from rear suspension, track, front suspension, steering mechanism and skis.

⚠ WARNING

Make sure tether cord cap is away from engine cut-off switch before standing in front the vehicle, getting close to the track or rear suspension components.

Always cover your snowmobile when leaving it outside overnight or during extended periods of inactivity. This will protect it from frost and snow as well as help retain its appearance.

Vehicle Cleaning and Protection

Wash vehicle with water mixed with a mild detergent. Use only flannel cloths or an equivalent.

NOTICE **It is necessary to use flannel cloths or equivalent on windshield and hood to avoid scratching the surfaces.**

To remove grease, oil and grime, use BRP HEAVY DUTY CLEANER (P/N 293 110 001).

NOTICE **Do not use Heavy duty cleaner on decals or vinyl.**

To remove stubborn dirt from all plastic and vinyl surfaces, use XPS ALL PURPOSE CLEANER (P/N 219 701 709).

To remove scratches on windshield or hood use the SCRATCH REMOVER KIT (P/N 861 774 800).

NOTICE **Never clean plastic parts or hood with strong detergent, degreasing agent, paint thinner, acetone, products containing chlorine, etc.**

Wax painted portion of the vehicle for better protection.

NOTE: Apply wax on glossy finish only.

STORAGE

During summer, or when a snowmobile is not in use for more than three months, proper storage is necessary.

STORAGE
Clean the vehicle
Protect fuel system by adding fuel stabilizer to fuel following the product manufacturer recommendations Run the engine after adding the product to the fuel
550F models: lubricate engine. See *ENGINE LUBRICATION PROCEDURE 500F* in this subsection
600 HO E-TEC models: lubricate engine. See *ENGINE STORAGE MODE (E-TEC)* in this subsection
Lubricate brake lever pivot
Inspect and lubricate rear suspension
Charge battery monthly to keep it fully charge during storage
Block muffler with rags
Lift rear of vehicle until track is clear of the ground. Do not release track tension

⚠ CAUTION Use appropriate lifting device or have assistance to share lifting stress. If a lifting device is not used, use proper lifting techniques, notably using your legs force. Do not attempt to lift the rear of vehicle if it is above your limits.

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

Engine Lubrication

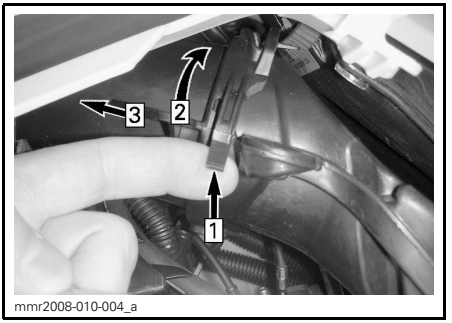
Engine Lubrication Procedure (550F)

NOTICE Fuel stabilizer should be added prior to engine lubrication to ensure carburetor protection against varnish deposits.

Engine internal parts must be lubricated to protect them from possible corrosion during the storage period.

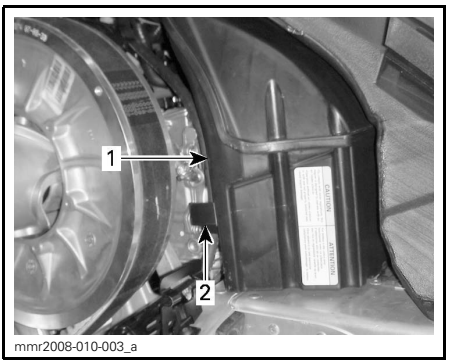
Proceed as follows:

1. Place the vehicle in a well ventilated area and start the engine.
2. Start the engine and let it run at idle speed until it reaches its operating temperature.
3. Stop the engine.
4. Remove the primary air intake silencer as follows:
   - 4.1 Remove LH side panel. Refer to *CONTROLS, INSTRUMENTS AND EQUIPMENT* section.
   - 4.2 Remove drive belt guard. Refer to *CONTROLS, INSTRUMENTS AND EQUIPMENT* section.
   - 4.3 Lift tab on rear section of connector tube.
   - 4.4 Twist tube adapter counter clockwise and pull it off the primary silencer slightly.



TYPICAL
Step 1: Lift tab
Step 2: Twist adapter
Step 3: Pull off

4.5 Press locking tab securing the primary air intake silencer and pull silencer out of adapter plate.



1. Primary air intake silencer
2. Primary intake silencer locking tab

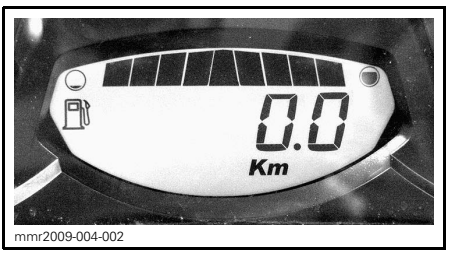
5. Restart engine and run at idle speed.
6. Inject storage oil into each carburetor/throttle body until the engine stalls, or until a sufficient quantity of oil has entered the engine (approximately half a can).
7. With the engine stopped, remove the spark plugs and spray XPS STORAGE OIL (EXCEPT U.S. COUNTRY) (P/N 413 711 600) or XPS STORAGE OIL (U.S. COUNTRY ONLY) (P/N 413 711 900) into each cylinder.
8. Slowly crank engine 2 or 3 revolutions to lubricate cylinders.
9. Reinstall spark plugs and primary air intake silencer.

Engine Storage Mode (E-TEC)

Like other engines, the E-TEC has to be properly lubricated at storage for internal parts protection. The E-TEC system offers a built-in engine lubrication function can be initiated by the operator.

To engage procedure, do the following:

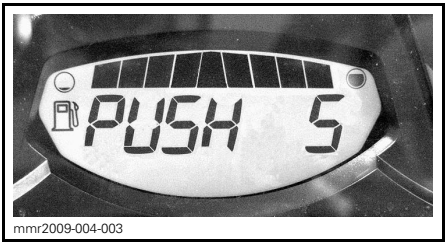
1. Place the vehicle in a well ventilated area.
2. Start the engine and let it run at idle speed until it reaches its operating temperature.
3. Push the SET (S) button repeatitively until odometer is displayed (total mileage).



NOTE: The storage mode does not function in other modes (trip A, trip B and hr trip).

4. Repeatedly depress the HI/LOW beam switch rapidly, then, **while doing this**, press and hold the **SET button** until **"PUSH S"** appears on the display.

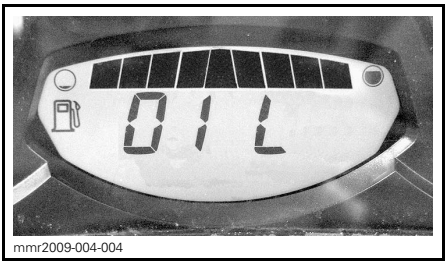
NOTE: It is critical for this procedure to depress the HI/LOW beam switch repeatedly **before** holding down the SET button.



mmr2009-004-003

5. When the gauge displays "PUSH S", release all buttons.
6. Again, press and hold the SET button for 2 - 3 seconds.

The gauge will display **"OIL"** when the engine enters storage procedure (summerization feature).



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Do not touch anything during engine lubrication cycle.

The engine will increase its RPM to approximately 1600, then the oil pump will "fog with oil" the engine for 30 - 60 seconds.

When completed, the engine will stop by itself.

Remove D.E.S.S. key.

NOTICE **Do not start the engine during storage period.**

PRESEASON PREPARATION

PRESEASON PREPARATION (550F)
Inspect engine rubber mounts
Check exhaust system condition and check for leaks
Inspect crankshaft PTO seal
Inspect fuel lines and connections
Clean, inspect and adjust carburetors
Adjust oil injection pump
Inspect throttle cable
Replace spark plugs after starting the engine with the old spark plugs to burn the excess of storage oil
Inspect drive belt (adjust at every drive belt replacement)
Clean and visually inspect drive pulley
Clean and inspect driven pulley
Inspect, adjust and align track
Change Gearbox oil
Check brake fluid level
Inspect brake hose, pads and disk
Inspect steering mechanism
Inspect skis and runners
Inspect front suspension
Inspect rear suspension (including stopper straps and slider shoes)
Charge battery (if so equipped)
Adjust headlight beam aiming

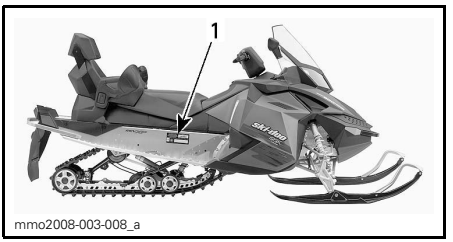
PRESEASON PREPARATION (600 HO E-TEC)
Inspect engine rubber mounts
Check exhaust system condition and check for leaks
Check coolant density
Inspect crankshaft PTO seal
Inspect fuel lines and connections
Clean and inspect throttle body
Inspect throttle cable
Inspect drive belt (adjust at every drive belt replacement)
Clean and visually inspect drive pulley
Clean and inspect driven pulley
Inspect, adjust and align track
Change gearbox oil
Check brake fluid level
Inspect brake hose, pads and disk
Inspect steering mechanism
Inspect skis and runners
Inspect front suspension
Inspect rear suspension (including stopper straps and slider shoes)
Charge battery
Adjust headlight beam aiming

PRESEASON PREPARATION (600 ACE / 900 ACE)
Visually inspect engine seals and gaskets and check for leaks
Check exhaust system condition and check for leaks
Change engine oil and filter
Check coolant density
Inspect fuel lines and connections
Clean and inspect throttle body
Inspect drive belt (adjust at every drive belt replacement)
Clean and visually inspect drive pulley
Clean and inspect driven pulley
Inspect, adjust and align track
Change gearbox oil
Check brake fluid level
Inspect brake hose, pads and disk
Inspect steering mechanism
Inspect skis and runners
Inspect front suspension
Inspect rear suspension (including stopper straps and slider shoes)
Charge battery
Adjust headlight beam aiming

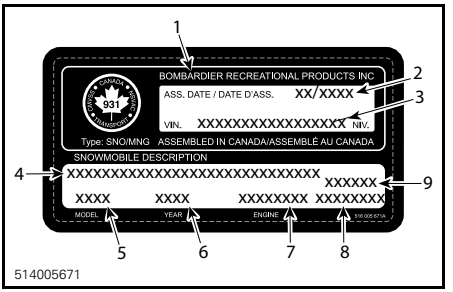
TECHNICAL INFORMATION

Vehicle Description Decal

Vehicle description decal is located on right hand side of the tunnel.



TYPICAL
1. *Vehicle description decal*



VEHICLE DESCRIPTION DECAL
1. *Manufacturer name*
2. *Manufacturing date*
3. *Vehicle identification number (VIN)*
4. *Model and package name*
5. *Model number*
6. *Model year*
7. *Engine type*
8. *Vehicle weight (European models)*
9. *Vehicle engine power (European models)*

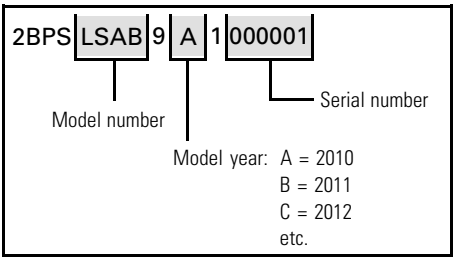
Identification Numbers

The main components of your snowmobile (engine and frame) are identified by different identification numbers. It may sometimes become necessary to locate these numbers for warranty purposes or to trace your snowmobile in the event of loss. These numbers are required by the authorized Ski-Doo dealer to complete warranty claims properly. No warranty will be allowed by BRP if the engine identification number or vehicle identification number (VIN) is removed or mutilated in any way. We strongly recommend that you take note of all the identification numbers on your snowmobile and supply them to your insurance company.

Vehicle Identification Number (VIN)

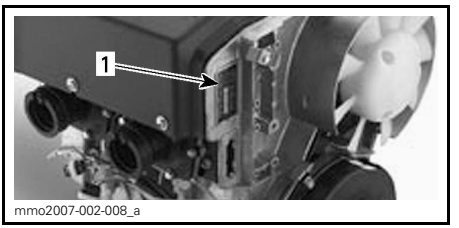
VIN is scribed on the vehicle description decal. See above. It is also engraved on the tunnel, near the vehicle description decal.

Model number and model year are part of the information found in the VIN. See illustration.

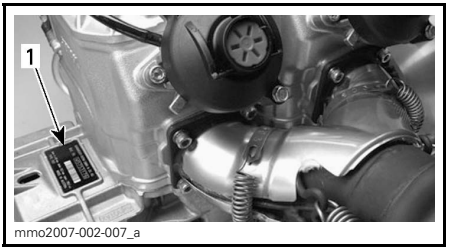


Engine Identification Number

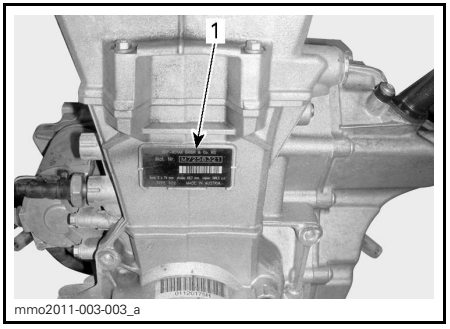
Refer to the following illustrations to locate the engine identification number on the applicable engine.



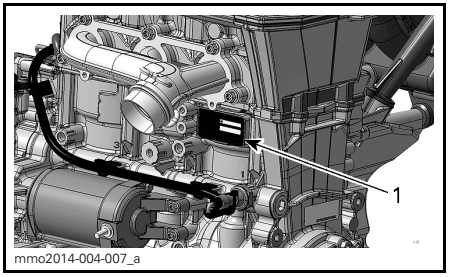
550F ENGINE
1. *Engine identification number*



TYPICAL - 600 HO E-TEC ENGINE
1. Engine serial number



600 ACE ENGINE
1. Engine identification number



900 ACE ENGINE
1. Engine identification number

The EC-Declaration of Conformity does not appear in this version of the Operator's Guide.

Please refer to the printed version that was delivered with your vehicle.

EPA CERTIFIED ENGINES

Maintenance, replacement, or repair of the emission control devices and systems may be performed by any snowmobile SI (spark ignition) engine repair establishments or individual.

Engine Emissions Information

Manufacturer's Responsibility

Beginning with 2007 model year engines, snowmobile manufacturers of snowmobile engines need to determine the exhaust emission levels for each engine family and certify these engines with the United States of America Environmental Protection Agency (EPA). An emissions control information label, showing emission levels and engine specifications, must be placed on each vehicle at the time of manufacture.

Dealer's Responsibility

When performing service on a certified Ski-Doo snowmobiles that carry an emissions control information label, adjustments must be kept within published factory specifications.

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

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

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

Owner Responsibility

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

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

EPA Emission Regulations

All Ski-Doosnowmobiles manufactured by BRP are certified to the EPA as conforming to the requirements of the regulations for the control of air pollution from new snowmobile engines. This certification is contingent on certain adjustments being set to factory standards. For this reason, the factory procedure for servicing the product must be strictly followed and, whenever practicable, returned to the original intent of the design.

The responsibilities listed above are general and in no way a complete listing of the rules and regulations pertaining to the EPA requirements on exhaust emissions for snowmobile products. For more detailed information on this subject, you may contact the following locations:

Mail:

U.S. Environmental
Protection Agency
Office of Transportation and Air Quality
1200 Pennsylvania Ave. NW
Mail Code 6403J
Washington D.C. 20460

Internet WEB Site:

www.epa.gov/otaq/

SPECIFICATIONS

SYSTEM	MODELS
ENGINE	***550F***
Engine type	Rotax® 552, fan-cooled (axial fan), cylinder reed porting
Cylinders	2
Displacement	553.4 cm³ (33.8 in³)
Bore	76 mm (3 in)
Stroke	61 mm (2.4 in)
Maximum horsepower RPM	6800 RPM
Carburetion	2 x VM-30
Exhaust system	Single tuned pipe, baffle muffler
Injection oil	XPS INJECTION OIL (P/N 293 600 117)
Injection oil tank capacity	3.7 L (3.9 qt (U.S. liq.))
Recommended fuel	Regular unleaded (Fuel containing MAXIMUM 10% ethanol)
Minimum octane rating. Refer to *FUEL REQUIREMENTS*	87 Pump Posted AKI (RON+MON)/2 (Fuel with NO ethanol)
	92 RON (Fuel with NO ethanol)
	91 Pump Posted AKI (RON+MON)/2 (Fuel which may contain up to 10% MAX ethanol)
	95 RON (Fuel which may contain up to 10% MAX ethanol)
Fuel tank capacity	45 L (11.9 U.S. gal.)

SYSTEM	MODELS
ENGINE	***600 HO E-TEC***
Engine type	Rotax® 593, liquid cooled w/Reed valve, 3D-RAVE
Cylinders	2
Displacement	594.4 cm³ (36.27 in³)
Bore	72 mm (2.83 in)
Stroke	73 mm (2.87 in)
Maximum horsepower engine RPM	8100 RPM
Fuel injection system	E-TEC direct injection
Exhaust system	Single tuned pipe, baffle muffler
Engine oil	XPS SYNTHETIC 2-STROKE OIL (P/N 293 600 132)
Engine oil tank capacity	2.8 L (3 qt (U.S. liq.))
Engine coolant	Ethyl glycol/water mix (50% coolant, 50% distilled water). Use BRP premix coolant or coolant specifically designed for aluminum engines
Recommended fuel type	Premium unleaded (Fuel with NO ethanol and Fuel which may contain up to 10% MAX ethanol)
Minimum octane rating. Refer to *FUEL REQUIREMENTS*	91 Pump Posted AKI (RON+MON)/2
	95 RON
Fuel tank capacity	45 L (11.9 U.S. gal.)

SYSTEM	MODELS
ENGINE	***600 ACE***
Engine type	Rotax 602, liquid cooled, 4-stroke, D.O.H.C., dry sump.
Cylinders	2
Displacement	600 cm^3 (36.6 in^3)
Bore	74 mm (2.91 in)
Stroke	69.7 mm (2.74 in)
Maximum horsepower RPM	7250 RPM
Fuel injection system	Multi point EFI, 46 mm throttle body
Exhaust system	Double front pipe, baffle muffler
Engine oil	XPS 4-STROKE SYNTHETIC OIL (ALL CLIMATE) (P/N 293 600 112) or SAE 0W40 API SM synthetic oil
Engine oil tank capacity	Oil change, 2.1 L (2.22 qt (U.S. liq.))
Engine coolant	Ethyl glycol/water mix (50% coolant, 50% distilled water). Use BRP premix coolant or coolant specifically designed for aluminum engines
Recommended fuel	Regular unleaded (Fuel containing maximum 10% ethanol)
Minimum octane rating. Refer to *FUEL REQUIREMENTS*	87 Pump Posted AKI (RON+MON)/2 (Fuel with NO ethanol)
	92 RON (Fuel with NO ethanol)
	91 Pump Posted AKI (RON+MON)/2 (Fuel which may contain up to 10% MAX ethanol)
	95 RON (Fuel which may contain up to 10% MAX ethanol)
Fuel tank capacity	45 L (11.9 U.S. gal.)

SYSTEM	MODELS
ENGINE	***900 ACE***
Engine type	Rotax 903, liquid cooled, 4-stroke, D.O.H.C., dry sump
Cylinders	3
Displacement	899 cm^3 (54.9 in^3)
Bore	74 mm (2.9 in)
Stroke	69.7 mm (2.74 in)
Maximum horsepower RPM	7250 RPM
Exhaust system	Single front pipe, baffle muffler
Engine oil	XPS 4-STROKE SYNTHETIC OIL (ALL CLIMATE) (P/N 293 600 112) or SAE 0W 40 API SM synthetic oil
Engine oil capacity	Oil change, 3.3 L (3.5 qt (U.S. liq.))
Engine coolant	Ethyl glycol/water mix (50% coolant, 50% distilled water). Use BRP premix coolant or coolant specifically designed for aluminum engines
Fuel injection system	Multi point EFI, 46 mm throttle body
Recommended fuel	Regular unleaded (fuel containing MAXIMUM 10% ethanol)
Minimum octane rating. Refer to *FUEL REQUIREMENTS*	87 Pump Posted AKI (RON+MON)/2 (fuel with NO ethanol)
	92 RON (fuel with NO ethanol)
	91 Pump Posted AKI (RON+MON)/2 (fuel which may contain up to 10% MAX ethanol)
	95 RON (fuel which may contain up to 10% MAX ethanol)
Fuel tank capacity	45 L (11.9 U.S. gal.)

SYSTEM			MODELS
DRIVE SYSTEM			***ALL MODELS***
Drive pulley	Type	550F	eDrive II
		600 HO E-TEC	TRA III™
		600 ACE / 900 ACE	eDrive II
	Engagement	550F	2600 ± 100 RPM
		600 HO E-TEC	3000 RPM ± 100
		600 ACE / 900 ACE	2200 RPM ± 100
Driven pulley type			QRS
Drive sprocket number of teeth	WT	550F	7
	WT	600 HO E-TEC	8
	WT	600 ACE	7
	WT	900 ACE	8
	SWT	600 HO E-TEC	8
	SWT	900 ACE	8
Gearbox oil			XPS SYNTHETIC GEAR OIL (75W 140) (P/N 293 600 140)
Gearbox oil capacity			700 ml (23.7 U.S. oz)
Track nominal width	WT		500 mm (20 in)
	SWT		600 mm (24 in)
Track nominal length	WT		392 cm (154 in)
	SWT		396 cm (156 in)
Track profile height	WT		38.1 mm (1.5)
	SWT		31.8 mm (1.252 in)
Track tension	Deflection		40 mm to 50 mm (1.575 in to 1.969 in)
	Force (1)		7.3 kg (16 lb)
Track alignment			Equal distance between edges of track guides and slider shoes

SYSTEM		MODELS
BRAKE SYSTEM		***ALL MODELS***
Brake system		Hydraulic, REV-XP brake type
Brake fluid		DOT 4
SUSPENSION		***ALL MODELS***
Front suspension		REV-XP
Front shock		Motion control
Front suspension max. travel		150 mm (6 in)
Rear suspension		SC-5U
Front arm shock		Motion control
Rear arm shock		HPG
Rear suspension max. travel		340 mm (13.4 in)
ELECTRICAL SYSTEM		***550F***
Lightning system output		340 Watts @ 6000 RPM
Headlights bulb HI/LOW beam		2 x 60/55 Watts (H-4)
Taillight bulb		2 x P 21/5 W
Spark plug	Type	NGK BR9ECS[2]
	Gap	0.45 mm ± 0.05 mm (.018 in ± .002 in) (not adjustable)
Fuses		Refer to *FUSES* section

SYSTEM		MODELS
ELECTRICAL SYSTEM		***600 HO E-TEC***
Lightning system output		12V/1200 W
Headlights bulb HI/LOW beam		2 x 60/55 Watts (H-4)
Taillight bulb		P 21/5 W
Spark plug	Type	NGK PZFR6F (2)
	Gap	0.75 mm ± 0.05 mm (.03 in ± .002 in) (not adjustable)
Fuses/ Relays/ Capacitor	F 1: Battery	30 A
	F 2: Relay 2 coil, start button, gauge	5 A
	F 3: Horn (optional)	10 A
	F 4: Relay 2 power (cooling fan)	15 A
	R 1:	Fuse 1, fuse 2, fuse 4
	R 2:	Cooling fan relay

SYSTEM		MODELS
ELECTRICAL SYSTEM		***600 ACE***
Lightning system output		12V/650 W
Headlights bulb HI/LOW beam		2 x 60/55 Watts (H-4)
Taillight bulb		2 x P 21/5 W
Spark plug	Type	NGK CR7EB
	Gap	.8 mm (.031 in)
Fuses	F 1: Fuse 2, fuse 4, relay 1, relay 2, relay 3, voltage regulator	30 A
	F 2: Relay coils, start button, gauge	5 A
	F 3: Fuel pump, starter solenoid	10 A
	F 4: Relay 4	10 A
	F 5: Fuel injectors, ignition coils	10 A
	F 6: Gauge, ECM, camshaft position sensor	10 A
	F 7: 12-volt power outlet, heated grips, heated throttle lever	10 A
	F 8: Lights	20 A
	F 9: Horn (optional)	5 A
	F 10: Rear 12-volt power outlet (optional)	5 A
Relays	R 1:	Fuse 3, fuse 5, fuse 6, communication connector
	R 2:	Fuse 8, fuse 9, fuse 10
	R 3:	Fuse 7
	R 4:	Cooling fan

SYSTEM		MODELS
ELECTRICAL SYSTEM		***900 ACE***
Lightning system output		650 Watts @ 6000 RPM
Headlights bulb HI/LOW beam		2 x 60/55 Watts (H-4)
Taillight bulb		2.6 W / 139m W LED
Spark Plug	Type	MR7B1
	Gap	0.8 mm (.031 in)
Fuses and relays	FA: Main	40 A
	F1: Ignition coils, fuel injectors, fuel pump, starter solenoid	10 A
	F2: Accessories	20 A
	F3: Electro mechanical reverse	20 A
	F4: Start clock, cooling fan	15 A
	F5: Headlights, taillight, brake light	20 A
	F6: ECM, gauge, CAPS	10 A
	Relay 1	Main relay
	Relay 2	Lighting relay
	Relay 3	Accessory relay

SYSTEM			MODELS
WEIGHT AND DIMENSIONS			***ALL MODELS***
Dry weight	WT	550F	269 kg (593 lb)
	WT	600 ACE	284 kg (626.1 lb)
	WT	600 HO E-TEC	285 kg (628.3 lb)
	WT	900 ACE	297 kg (655 lb)
	SWT	600 HO E-TEC	303 kg (668 lb)
	SWT	900 ACE	315 kg (694.5 lb)
Vehicle overall length			324 cm (128 in)
Vehicle overall width			107.6 cm (42.4 in)
Vehicle overall height			133 cm (52.4 in)
Ski stance			97.5 cm to 101.8 cm (38.4 in to 40.1 in)
Ski width			165 mm (6.496 in)

(1) Measure gap between slider shoe and bottom inside track when exerting a downward pull to the track.

(2) **Notice** Do not attempt to adjust gap on this spark plug.

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TROUBLESHOOTING

TROUBLESHOOTING GUIDELINES

ELECTRIC STARTER DOES NOT WORK

1. Emergency engine stop switch in OFF position or tether cord cap not installed on engine cut-off switch.
   – *Place the emergency engine stop switch in the ON position and install tether cord cap (on engine cut-off switch.*
2. Throttle applied while attempting an engine start.
   – *Release throttle while cranking.*

ENGINE RPM DOES NOT REACH CLUTCH ENGAGEMENT POINT (EXCEPT 550F)

1. D.E.S.S. key not recognized. D.E.S.S. pilot lamp blinks (slow short beeps/repetitive).
   – *Properly install tether cord cap.*
   – *Install a tether cord cap with the D.E.S.S. key for which this snowmobile was programmed.*
2. ECM does not recognize the D.E.S.S. key (600 ACE / 900 ACE).
   – *Refer to an authorized Ski-Doo dealer.*

ENGINE OVERHEATS (EXCEPT 550F)

1. Insufficient snow or hard packed snow.
   – *Drive in loose snow. If there is no loose snow near, pull over, stop engine and let it cool down. Once engine has cooled down, reach loose snow as soon as possible.*
2. Low coolant level.
   – *Check coolant level, see MAINTENANCE PROCEDURES.*
3. Clogged heat exchangers.
   – *Clean heat exchangers.*

ENGINE LACKS ACCELERATION OR POWER

1. Learning key used (600 ACE / 900 ACE).
   – *Use a Normal key.*
2. Sport mode not activated (600 ACE / 900 ACE).
   – *Refer to ACTIVATING SPORT MODE in OPERATING MODES.*
3. Engine warm-up in progress (E-TEC).
   – *Drive vehicle at low speeds for a few minutes.*
4. Engine break-in period not completed (E-TEC).
   – *Complete break-in period.*
5. Incorrect drive pulley adjustment.
   – *Adjust drive pulley, refer to MAINTENANCE PROCEDURES.*
6. Drive and driven pulleys require servicing.
   – *Contact an authorized Ski-Doo dealer.*

ENGINE LACKS ACCELERATION OR POWER (cont'd)

7. Drive belt worn too thin.
   – *If the drive belt has lost more than 3 mm (1/8 in) of its original width, it will affect vehicle performance.*
   – *Replace drive belt.*
8. Incorrect track adjustment.
   – *See MAINTENANCE and/or an authorized Ski-Doo dealer for proper alignment and tension adjustments.*
9. RAVE valves problem (E-TEC).
   – *Contact an authorized Ski-Doo dealer.*

ENGINE BACKFIRES

1. Engine is running too hot.
   – *See ENGINE OVERHEATS.*
2. Ignition timing is incorrect or ignition system failure.
   – *Contact an authorized Ski-Doo dealer.*
3. Exhaust system leak.
   – *Contact an authorized Ski-Doo dealer.*
4. Fuel pressure too low.
   – *Contact an authorized Ski-Doo dealer.*

ENGINE MISFIRES

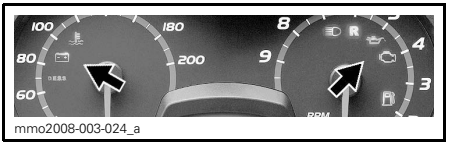
1. Water in fuel.
   – *Drain fuel system and refill with fresh fuel.*
2. RAVE valves malfunction (E-TEC).
   – *Have RAVE valves system inspected by an authorized Ski-Doo dealer.*

HEATED GRIPS/THUMB WARMERS ARE NOT WORKING

1. Engine RPM is too low.
   – *Make sure engine RPM is above 1900 (600 ACE).*

Pilot Lamps, Messages and Beeper Codes

Gauge pilot lamp(s) will inform you if an anomaly occurs or to inform you of a particular condition.



TYPICAL — PILOT LAMPS

Pilot lamp can flash alone or in combination with another lamp.

Beeper codes will be emitted to catch your attention.

See table below for details.

NOTE: Some of the listed pilot lamps do not apply to all models.

PILOT LAMP(S) ON	BEEPER	DESCRIPTION
	4 short beeps every 30 seconds	Engine is overheating, reduce snowmobile speed and run in loose snow or stop engine immediately and let engine cool down. Check coolant level, refer to *MAINTENANCE*. If coolant level is correct and overheating persists, contact an authorized Ski-Doo dealer. Do not run the engine if condition persists.
		Reduce speed or stop engine. Let engine cool down and restart. If overheating persists, contact an authorized Ski-Doo dealer. Do not run the engine if condition persists.
	Short beeps repeating rapidly	Critical overheat. Stop engine immediately and let engine cool down. Check coolant level, refer to *MAINTENANCE*. If coolant level is correct and overheating persists, contact an authorized Ski-Doo dealer. Do not run the engine if condition persists.
		Critical overheat. Stop engine immediately and let engine cool down. If overheating persists, contact an authorized Ski-Doo dealer. Do not run the engine if condition persists. Do not run the engine if condition persists.
	4 short beeps every 5 minutes	Indicate a low or high battery voltage condition. See an authorized Ski-Doo dealer as soon as possible.
	4 short beeps	Engine fault, see an authorized Ski-Doo dealer as soon as possible.
—	4 short beeps every 5 minutes	Engine detonation (RPM is limited when this condition occurs). – Ensure recommended fuel is used. – Check fuel quality, replace if necessary. – If fault still occurs, contact an authorized Ski-Doo dealer.
—	4 short beeps every 5 minutes	Engine RPM limited for protection when certain faults occur.
—	Short beeps repeating rapidly	Shutdown procedure in force due to engine overheating or fuel pump problem, remove tether cord cap from engine cut-off switch and contact an authorized Ski-Doo dealer.

PILOT LAMP(S) ON	BEEPER	DESCRIPTION
D.E.S.S.	2 short beeps	Good key, vehicle ready to operate.
	2 short beeps, repeating slowly	Unable to read key (bad connection). Make sure the key is clean and correctly snapped on post.
	Short beeps repeating rapidly	Invalid key or key not programmed. Use the proper key for the vehicle or have the programmed.
 **(blinking)**	—	Fuel level sensor problem.
—	—	Throttle lever applied while attempting an engine start (engine cranks but won't run). Release throttle while starting.
—	—	Throttle lever wide open while attempting an engine start (engine cranks but won't run). Release throttle while starting.

WARRANTY

BRP LIMITED WARRANTY USA AND CANADA: 2015 SKI-DOO® SNOWMOBILES

1) SCOPE OF THE LIMITED WARRANTY

Bombardier Recreational Products Inc. ("BRP")* warrants its 2015 Ski-Doo snowmobiles sold by authorized BRP dealers (as defined below) in the United States of America ("USA") and in Canada from defects in material or workmanship for the period and under the conditions described below. This limited warranty will become null and void if: (1) the snowmobile was used for racing or any other competitive activity, at any point, even by a previous owner; or (2) the snowmobile has been altered or modified in such a way so as to adversely affect its operation, performance or durability, or has been altered or modified to change its intended use.

Except if otherwise specified, all genuine Ski-Doo parts and accessories, installed by an authorized BRP dealer (as hereinafter defined) at the time of delivery of the 2015 Ski-Doo snowmobile, carry the same warranty as that of the snowmobile.

2) LIMITATIONS OF LIABILITY

THIS WARRANTY IS EXPRESSLY GIVEN AND ACCEPTED IN LIEU OF ANY AND ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. TO THE EXTENT THAT THEY CANNOT BE DISCLAIMED, THE IMPLIED WARRANTIES ARE LIMITED IN DURATION TO THE LIFE OF THE EXPRESS WARRANTY. INCIDENTAL AND CONSEQUENTIAL DAMAGES ARE EXCLUDED FROM COVERAGE UNDER THIS WARRANTY. SOME STATES/PROVINCES DO NOT ALLOW FOR THE DISCLAIMERS, LIMITATIONS AND EXCLUSIONS IDENTIFIED ABOVE, AS A RESULT, THEY MAY NOT APPLY TO YOU. THIS WARRANTY GIVES YOU SPECIFIC RIGHTS, AND YOU MAY ALSO HAVE OTHER LEGAL RIGHTS WHICH MAY VARY FROM STATE TO STATE, OR PROVINCE TO PROVINCE.

Neither the distributor, any BRP dealer nor any other person has been authorized to make any affirmation, representation or warranty regarding the product, other than those contained in this limited warranty, and if made, shall not be enforceable against BRP. BRP reserves the right to modify this warranty at any time, being understood that such modification will not alter the warranty conditions applicable to the products sold while this warranty is in effect.

3) EXCLUSIONS – ARE NOT WARRANTED

The following are not warranted under any circumstances:

- Normal wear and tear;
- Routine maintenance items, tune ups, adjustments;
- Damage caused by failure to provide proper maintenance and/or storage, as described in the Operator's Guide;
- Damage resulting from removal of parts, improper repairs, service, maintenance, modifications or use of parts or accessories not manufactured or approved by BRP or resulting from repairs done by a person that is not an authorized servicing BRP dealer;
- Damage caused by abuse, abnormal use, neglect, use of the product on surfaces other than snow, or operation of the product in a manner inconsistent with the recommended operation described in the Operator's Guide;

– Damage resulting from accident, submersion, fire, theft, vandalism or any act of God;
– Operation with fuels, oils or lubricants which are not suitable for use with the product (see the Operator's Guide);
– Snow or water ingestion;
– Incidental or consequential damages, or damages of any kind including without limitation towing, storage, telephone, rental, taxi, inconvenience, insurance coverage, loan payments, loss of time, loss of income; and
– Damage resulting from studs installed on tracks if the installation does not conform to BRP's instructions.

4) WARRANTY COVERAGE PERIOD

This warranty will be in effect from the date of delivery to the first retail consumer or the date the product is first put into use, whichever occurs first and for the following period:

TWELVE (12) CONSECUTIVE MONTHS, for private or commercial use owners. However, the warranty coverage period on a snowmobile delivered between June 1st and December 1st of a given year will expire November 30th of the following year.

Exhaust emission-related components that are installed on EPA certified snowmobiles registered in the USA are covered for thirty (30) consecutive months or 200 hours or 2500 miles (4000 km) of engine use whichever occurs first. If the 2500 miles (4000 km) are reached during the regular warranty coverage period, the emission-related components are still covered by BRP's standard warranty until the end of regular coverage period. Evaporative emission related components that are installed on EPA certified snowmobiles registered in the USA are warranted for twenty-four (24) consecutive months.

To obtain a list of the current warranted emission-related components, please see an authorized Ski-Doo dealer.

The repair or replacement of parts or the performance of service under this warranty does not extend the life of this warranty beyond its original expiration date.

5) CONDITIONS REQUIRED FOR WARRANTY COVERAGE

This warranty coverage is available **only** if each of the following conditions has been fulfilled:

– The 2015 Ski-Doo snowmobile must be purchased as new and unused by its first owner from a BRP dealer authorized to distribute Ski-Doo snowmobiles in the country in which the sale occurred (**"BRP dealer"**);
– The BRP specified pre-delivery inspection process must be completed and documented and signed by the purchaser;
– The 2015 Ski-Doo snowmobile must have undergone proper registration by an authorized BRP dealer;

– The 2015 Ski-Doo snowmobile must be purchased in the country in which the purchaser resides; and
– Routine maintenance outlined in the Operator's Guide must be timely performed in order to maintain warranty coverage. BRP reserves the right to make warranty coverage contingent upon proof of proper maintenance.

BRP will not honor this limited warranty to any private use owner or commercial use owner if one of the preceding conditions has not been met. Such limitations are necessary in order to allow BRP to preserve both the safety of its products, and also that of its consumers and the general public.

6) WHAT TO DO TO OBTAIN WARRANTY COVERAGE

The customer must cease using the snowmobile upon the appearance of an anomaly. The customer must notify a servicing BRP dealer within three (3) days of the appearance of a defect, and provide it with reasonable access to the product and reasonable opportunity to repair it. The customer must also present to the authorized BRP dealer, proof of purchase of the product and must sign the repair/work order prior to starting the repair in order to validate the warranty repair. All parts replaced under this limited warranty become the property of BRP.

7) WHAT BRP WILL DO

BRP's obligations under this warranty are limited to, at its sole discretion, repairing parts found defective under normal use, maintenance and service, or replacing such parts with new genuine Ski-Doo parts without charge for parts and labor , at any authorized BRP dealer during the warranty coverage period under the conditions described herein. No claim of breach of warranty shall be cause for cancellation or rescission of the sale of the snowmobile to the owner.

In the event that service is required outside of the country of original sale, the owner will bear responsibility for any additional charges due to local practices and conditions, such as, but not limited to, freight, insurance, taxes, license fees, import duties, and any and all other financial charges, including those levied by governments, states, territories and their respective agencies.

BRP reserves the right to improve or modify products from time to time without assuming any obligation to modify products previously manufactured.

8) TRANSFER

If the ownership of a product is transferred during the warranty coverage period, this warranty shall also be transferred and be valid for the remaining coverage period provided that BRP is notified of such transfer of ownership in the following way:

1. The former owner contacts BRP (at the phone number provided below) or an authorized BRP dealer and gives the coordinates of the new owner; or
2. BRP or an authorized BRP dealer receives a proof that the former owner agreed to the transfer of ownership, in addition to the coordinates of the new owner.

BRP INTERNATIONAL LIMITED WARRANTY: 2015 SKI-DOO® SNOWMOBILES

1) SCOPE OF THE LIMITED WARRANTY

Bombardier Recreational Products Inc. ("BRP")* warrants its 2015 Ski-Doo snowmobiles sold by distributors or dealers authorized by BRP to distribute SKI-Doo snowmobiles ("Ski-Doo Distributor/Dealer") outside of the fifty United States, Canada, members of the European Economic Area (which is comprised of the member states of the European Union plus Norway, Iceland and Liechtenstein) ("EEA"), members states of the Commonwealth of the Independent States (including Ukraine and Turkmenistan) ("CIS") and Turkey, from defects in material or workmanship for the period and under the conditions described below.

All genuine Ski-Doo parts and accessories, installed by an authorized Ski-Doo Distributor/Dealer at the time of delivery of the 2015 Ski-Doo snowmobile, carry the same warranty as that of the snowmobile.

This limited warranty will become null and void if: (1) the snowmobile was used for racing or any other competitive activity, at any point, even by a previous owner; or (2) the snowmobile has been altered or modified in such a way so as to adversely affect its operation, performance or durability, or has been altered or modified to change its intended use.

2) LIMITATIONS OF LIABILITY

TO THE EXTENT PERMITTED BY LAW, THIS WARRANTY IS EXPRESSLY GIVEN AND ACCEPTED IN LIEU OF ANY AND ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. TO THE EXTENT THAT THEY CANNOT BE DISCLAIMED, THE IMPLIED WARRANTIES ARE LIMITED IN DURATION TO THE LIFE OF THE EXPRESS WARRANTY. INCIDENTAL AND CONSEQUENTIAL DAMAGES ARE EXCLUDED FROM COVERAGE UNDER THIS WARRANTY. SOME JURISDICTIONS DO NOT ALLOW FOR THE DISCLAIMERS, LIMITATIONS AND EXCLUSIONS IDENTIFIED ABOVE, AS A RESULT, THEY MAY NOT APPLY TO YOU. THIS WARRANTY GIVES YOU SPECIFIC RIGHTS, AND YOU MAY ALSO HAVE OTHER LEGAL RIGHTS WHICH MAY VARY FROM COUNTRY TO COUNTRY. (FOR PRODUCTS PURCHASED IN AUSTRALIA SEE CLAUSE 4 BELOW).

Neither the Ski-Doo Distributor/Dealer nor any other person has been authorized to make any affirmation, representation or warranty regarding the product, other than those contained in this limited warranty, and if made, shall not be enforceable against BRP.

BRP reserves the right to modify this warranty at any time, being understood that such modification will not alter the warranty conditions applicable to the products sold while this warranty is in effect.

3) EXCLUSIONS – ARE NOT WARRANTED

The following are not warranted under this limited warranty under any circumstances:

- Normal wear and tear;
- Routine maintenance items, tune ups, adjustments;
- Damage caused by negligence or failure to provide proper maintenance and/or storage, as described in the Operator's Guide;

– Damage resulting from removal of parts, improper repairs, service, maintenance, modifications or use of parts or accessories not manufactured or approved by BRP which in its reasonable judgement are either incompatible with the product or adversely affect its operation, performance and durability, or resulting from repairs done by a person that is not an authorized servicing Ski-Doo Distributor/Dealer;
– Damage caused by abuse, abnormal use, neglect, racing or operation of the product on surfaces other than snow, or operation of the product in a manner inconsistent with the recommended operation described in the Operator's Guide;
– Damage resulting from accident, submersion, fire, snow or water ingestion, theft, vandalism or any act of God;
– Operation with fuels, oils or lubricants which are not suitable for use with the product (see the Operator's Guide);
– Damage resulting from rust, corrosion or exposure to the elements;
– Incidental or consequential damages, or damages of any kind including without limitation towing, storage, transportation expenses, telephone, rental, taxi, inconvenience, insurance coverage, loan payments, loss of time, loss of income; or time missed for downtime experience due to service work.
– And damage resulting from studs installed on tracks if the installation does not conform to BRP's instructions.

4) WARRANTY COVERAGE PERIOD

This warranty will be in effect from (1) the date of delivery to the first retail consumer or (2) the date the product is first put into use, whichever occurs first and for a period of:

TWELVE (12) CONSECUTIVE MONTHS, for private or commercial use owners. However, the warranty coverage period on a snowmobile delivered between June 1st and December 1st of a given year will expire November 30th of the following year.

The repair or replacement of parts or the performance of service under this warranty does not extend the life of this warranty beyond its original expiration date.

Note that the duration and any other modalities of the warranty coverage are subject to the applicable national or local legislation in the customer's country.

FOR PRODUCTS SOLD IN AUSTRALIA ONLY

Nothing in these Warranty terms and conditions should be taken to exclude, restrict or modify the application of any condition, warranty, guarantee, right or remedy conferred or implied under the Competition and Consumer Act 2010 (Cth), including the Australian Consumer Law or any other law, where to do so would contravene that law, or cause any part of these terms and conditions to be void. The benefits given to you under this limited warranty are in addition to other rights and remedies that you have under Australian law.

Our goods come with guarantees that cannot be excluded under the Australian Consumer Law. You are entitled to a replacement or refund for a major failure and for compensation for any other reasonably foreseeable loss or damage. You are also entitled to have the goods repaired or replaced if the goods fail to be of acceptable quality and the failure does not amount to a major failure.

5) CONDITIONS TO HAVE WARRANTY COVERAGE

This warranty coverage is available **only** if each of the following conditions has been fulfilled:

- The 2015 Ski-Doo snowmobile must be purchased as new and unused by its first owner from a Ski-Doo Distributor/Dealer authorized to distribute Ski-Doo snowmobiles in the country in which the sale occurred;
- The BRP specified pre-delivery inspection process must be completed and documented;
- The product must have undergone proper registration by an authorized Ski-Doo Distributor/Dealer;
- The 2015 Ski-Doo snowmobile must be purchased in the country or union of countries in which the purchaser resides.
- Routine maintenance outlined in the Operator's Guide must be timely performed in order to maintain warranty coverage. BRP reserves the right to make warranty coverage contingent upon proof of proper maintenance.

BRP will not honour this limited warranty to any private use owner or commercial use owner if one of the preceding conditions has not been met. Such limitations are necessary in order to allow BRP to preserve both the safety of its products, and also that of its consumers and the general public.

6) WHAT TO DO TO OBTAIN WARRANTY COVERAGE UNDER THIS WARRANTY

The customer must cease using the snowmobile upon the appearance of an anomaly. The customer must notify a servicing Ski-Doo Distributor/Dealer within two (2) days of the appearance of a defect, and provide it with reasonable access to the product and reasonable opportunity to repair it. The customer must also present to the authorized Ski-Doo Distributor/Dealer, proof of purchase of the product and must sign the repair/work order prior to starting the repair in order to validate the warranty repair. All parts replaced under this limited warranty become the property of BRP.

Note that the notification period is subject to the applicable national or local legislation in customer's country.

7) WHAT BRP WILL DO

To the extent permitted by law, BRP's obligations under this warranty are limited to, at its sole discretion, repairing parts found defective under normal use, maintenance and service, or replacing such parts with new genuine Ski-Doo parts without charge for parts and labour, at any authorized Ski-Doo Distributor/Dealer during the warranty coverage period under the conditions described herein. BRP's responsibility is limited to making the required repairs or replacements of parts. No claim of breach of warranty shall be cause for cancellation or rescission of the sale of the snowmobile to the owner. You may have other legal rights which may vary from country to country.

In the event that service is required outside of the country of original sale, the owner will bear responsibility for any additional charges due to local practices and conditions, such as, but not limited to, freight, insurance, taxes, license fees, import duties, and any and all other financial charges, including those levied by governments, states, territories and their respective agencies.

BRP reserves the right to improve or modify products from time to time without assuming any obligation to modify products previously manufactured.

8) TRANSFER

If the ownership of a product is transferred during the warranty coverage period, this warranty shall also be transferred and be valid for the remaining coverage period provided BRP or an authorized Ski-Doo Distributor/Dealer receives a proof that the former owner agreed to the transfer of ownership, in addition to the co-ordinates of the new owner.

For all other countries, please contact your local Ski-Doo Distributor/Dealer (visit our website at www.brp.com for contact information), or contact our North American office at:

BOMBARDIER RECREATIONAL PRODUCTS INC.

*

BRP LIMITED WARRANTY FOR THE EUROPEAN AND THE COMMONWEALTH OF THE INDEPENDENT STATES (CIS) AREAS AND TURKEY: 2015 SKI-DOO® SNOWMOBILES

1) SCOPE OF THE LIMITED WARRANTY

Bombardier Recreational Products Inc. ("BRP")* warrants its 2015 Ski-Doo snowmobiles sold by distributors or dealers authorized by BRP to distribute Ski-Doo snowmobiles ("Ski-Doo Distributor/Dealer") in member states of the European Economic Area (which is comprised of the member states of the European Union plus Norway, Iceland and Liechtenstein) ("EEA"), in member states of the Commonwealth of the Independent States (including Ukraine and Turkmenistan) ("CIS") and Turkey from defects in material or workmanship for the period and under the conditions described below.

All genuine Ski-Doo parts and accessories, installed by an authorized Ski-Doo Distributor/Dealer (at the time of delivery of the 2015 Ski-Doo snowmobile, carry the same warranty as that of the snowmobile.

This limited warranty will become null and void if: (1) the snowmobile was used for racing or any other competitive activity, at any point, even by a previous owner; or (2) the snowmobile has been altered or modified in such a way so as to adversely affect its operation, performance or durability, or has been altered or modified to change its intended use.

2) LIMITATIONS OF LIABILITY

TO THE EXTENT PERMITTED BY LAW, THIS WARRANTY IS EXPRESSLY GIVEN AND ACCEPTED IN LIEU OF ANY AND ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING WITHOUT LIMITATION ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. TO THE EXTENT THAT THEY CANNOT BE DISCLAIMED, THE IMPLIED WARRANTIES ARE LIMITED IN DURATION TO THE LIFE OF THE EXPRESS WARRANTIES. INCIDENTAL AND CONSEQUENTIAL DAMAGES ARE EXCLUDED FROM COVERAGE UNDER THIS WARRANTY. SOME JURISDICTIONS DO NOT ALLOW FOR THE DISCLAIMERS, LIMITATIONS AND EXCLUSIONS IDENTIFIED ABOVE, AS A RESULT, THEY MAY NOT APPLY TO YOU. THIS WARRANTY GIVES YOU SPECIFIC RIGHTS, AND YOU MAY ALSO HAVE OTHER LEGAL RIGHTS WHICH MAY VARY FROM COUNTRY TO COUNTRY.

Neither the Ski-Doo Distributor/Dealer nor any other person has been authorized to make any affirmation, representation or warranty regarding the product, other than those contained in this limited warranty, and if made, shall not be enforceable against BRP.

BRP reserves the right to modify this warranty at any time, being understood that such modification will not alter the warranty conditions applicable to the products sold while this warranty is in effect.

3) EXCLUSIONS – ARE NOT WARRANTED

The following are not warranted under this limited warranty under any circumstances:

– Normal wear and tear;
– Routine maintenance items, tune ups, adjustments;

– Damage caused by negligence or failure to provide proper maintenance and/or storage, as described in the Operator's Guide;
– Damage resulting from removal of parts, improper repairs, service, maintenance, modifications or use of parts or accessories not manufactured or approved by BRP which in its reasonable judgement are either incompatible with the product or adversely affect its operation, performance and durability, or resulting from repairs done by a person that is not an authorized servicing Ski-Doo Distributor/Dealer;
– Damage caused by abuse, abnormal use, neglect, racing or operation of the product on surfaces other than snow, or operation of the product in a manner inconsistent with the recommended operation described in the Operator's Guide;
– Damage resulting from accident, submersion, fire, snow or water ingestion, theft, vandalism or any act of God;
– Operation with fuels, oils or lubricants which are not suitable for use with the product (see the Operator's Guide);
– Damage resulting from rust, corrosion or exposure to the elements;
– Incidental or consequential damages, or damages of any kind including without limitation towing, transportation expenses, storage, telephone, rental, taxi, inconvenience, insurance coverage, loan payments, loss of time, loss of income or time missed for downtime experience due to service work;
– and damage resulting from studs installed on tracks if the installation does not conform to BRP's instructions.

4) WARRANTY COVERAGE PERIOD

This warranty will be in effect from (1) the date of delivery to the first retail consumer or (2) the date the product is first put into use, whichever occurs first and for a period of:

TWENTY-FOUR (24) CONSECUTIVE MONTHS, for private use owners and TWELVE (12) CONSECUTIVE MONTHS for commercial use owners. However, the warranty coverage period on a snowmobile delivered between June 1st and December 1st of a given year will expire November 30th of the applicable year. A snowmobile is used commercially when it is used in connection with generating income or any work or employment during any part of the warranty period. A snowmobile is also used commercially when, at any point during the warranty period, it has commercial tags or is licensed for commercial use.

The repair or replacement of parts or the performance of service under this warranty does not extend the life of this warranty beyond its original expiration date.

Note that the duration and any other modalities of the warranty coverage are subject to the applicable national or local legislation in the customer's country.

5) CONDITIONS TO HAVE WARRANTY COVERAGE

This warranty coverage is available **only** if each of the following conditions has been fulfilled:

– The 2015 Ski-Doo snowmobile must be purchased as new and unused by its first owner from a Ski-Doo Distributor/Dealer authorized to distribute Ski-Doo products in the country in which the sale occurred;

– The BRP specified pre-delivery inspection process must be completed and documented;
– The product must have undergone proper registration by an authorized Ski-Doo Distributor/Dealer;
– The 2015 Ski-Doo snowmobile must be purchased within the EEA by an EEA resident, in the CIS for residents of the countries comprised in such area and in Turkey for residents of Turkey; and
– Routine maintenance outlined in the Operator's Guide must be timely performed in order to maintain warranty coverage. BRP reserves the right to make warranty coverage contingent upon proof of proper maintenance.

BRP will not honour this limited warranty to any private use owner or commercial use owner if one of the preceding conditions has not been met. Such limitations are necessary in order to allow BRP to preserve both the safety of its products, and also that of its consumers and the general public.

6) WHAT TO DO TO OBTAIN WARRANTY COVERAGE UNDER THIS WARRANTY

The customer must cease using the snowmobile upon the appearance of an anomaly. The customer must notify a servicing Ski-Doo Distributor/Dealer within two (2) months of the appearance of a defect, and provide it with reasonable access to the product and reasonable opportunity to repair it. The customer must also present to the authorized Ski-Doo Distributor/Dealer, proof of purchase of the product and must sign the repair/work order prior to starting the repair in order to validate the warranty repair. All parts replaced under this limited warranty become the property of BRP.

Note that the notification period is subject to the applicable national or local legislation in customer's country.

7) WHAT BRP WILL DO

To the extent permitted by law, BRP's obligations under this warranty are limited to, at its sole discretion, repairing parts found defective under normal use, maintenance and service, or replacing such parts with new genuine Ski-Doo parts without charge for parts and labour, at any authorized Ski-Doo Distributor/Dealer during the warranty coverage period under the conditions described herein. BRP's responsibility is limited to making the required repairs or replacements of parts. No claim of breach of warranty shall be cause for cancellation or rescission of the sale of the snowmobile to the owner. You may have other legal rights which may vary from country to country.

In the event that service is required outside of the EEA, CIS or Turkey, the owner will bear responsibility for any additional charges due to local practices and conditions, such as, but not limited to, freight, insurance, taxes, license fees, import duties, and any and all other financial charges, including those levied by governments, states, territories and their respective agencies.

BRP reserves the right to improve or modify products from time to time without assuming any obligation to modify products previously manufactured.

8) TRANSFER

If the ownership of a product is transferred during the warranty coverage period, this warranty shall also be transferred and be valid for the remaining coverage period provided BRP or an authorized Ski-Doo Distributor/Dealer receives a proof that the former owner agreed to the transfer of ownership, in addition to the co-ordinates of the new owner.

9) CONSUMER ASSISTANCE

1. In the event of a controversy or a dispute in connection with this limited warranty, BRP suggests that you try to resolve the issue at the Ski-Doo Distributor/Dealer level. We recommend discussing the issue with the authorized Ski-Doo Distributor/Dealer's service manager or owner.
2. If further assistance is required, the Ski-Doo Distributor/Dealer service department should be contacted in order to resolve the matter.
3. If the matter still remains unresolved then contact BRP at the address listed below:

For countries within EEA, CIS or Turkey, except Scandinavian countries please contact our European office:
BRP EUROPE N.V.

For Scandinavian countries, please contact our Finland office:
BRP FINLAND OY

You can find your Ski-Doo Distributor/Dealer's coordinates on **www.brp.com**.

* In the EEA, products are distributed and serviced by BRP European Distribution S.A. and other affiliates or subsidiaries of BRP.
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ADDITIONAL TERMS AND CONDITIONS FOR FRANCE ONLY

The following terms and conditions are applicable to products sold in France only:

The seller shall deliver goods that are complying with the contract and shall be responsible for defects existing upon delivery. The seller shall also be responsible for defects resulting from packaging, assembling instructions or the installation when it is its responsibility per the contract or if accomplished under its responsibility. To be compliant with the contract, the good shall:

1. Be fit for normal use for goods similar thereto and, if applicable:
   - Correspond to the description provided by the seller and have the qualities presented to the buyer though sample or model;
   - Have the qualities that a buyer may legitimately expect considering the public declarations of the seller, the manufacturer of its representative, including in advertising or labeling; or
2. Have the characteristics mutually agreed upon as between the parties or be fit for the specific use intended by the buyer and brought to the attention of the seller and which accepted

The action for failure to comply is prescribed after two years after delivery of the goods. The seller is responsible for the warranty for hidden defects of the good sold if such hidden defects are rendering the good unfit for the intended use, or if they diminish its use in such a way that the buyer would not have acquired the good or would have given a lesser price, had he known. The action for such hidden defects shall be taken by the buyer within 2 years of the discovery of the defect.

CUSTOMER INFORMATION

PRIVACY INFORMATION

BRP wishes to inform you that your coordinates will be used for safety and warranty related purposes. Furthermore, BRP and its affiliates may use its customer list to distribute marketing and promotional information about BRP and related products.

To exercise your right to consult or correct your data, or to be removed from the addressee-list for direct marketing, please contact BRP.

CHANGE OF ADDRESS/OWNERSHIP

If your address has changed or if you are the new owner of the snowmobile, be sure to notify BRP by either:

- Mailing one of the change of address cards on the following pages.
- North America only: Calling at 715 848-4957 (USA) or 819 566-3366 (Canada).
- Notifying an authorized Ski-Doo dealer.

In case of change of ownership, please join a proof that the former owner agreed to the transfer.

Notifying BRP, even after the expiration of the limited warranty, is very important as it enables BRP to reach the snowmobile owner if necessary, like when safety recalls are initiated. It is the owner's responsibility to notify BRP.

STOLEN UNITS: If your personal snowmobile is stolen, you should notify BRP or an authorized Ski-Doo dealer. We will ask you to provide your name, address, phone number, the vehicle identification number and the date it was stolen.

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CHANGE OF ADDRESS ☐ CHANGE OF OWNERSHIP ☐

VEHICLE IDENTIFICATION NUMBER

Model Number | Vehicle Identification Number (V.I.N.)

OLD ADDRESS OR PREVIOUS OWNER:

NAME

NO. STREET APT

CITY STATE/PROVINCE ZIP/POSTAL CODE

COUNTRY TELEPHONE

NEW ADDRESS OR NEW OWNER:

NAME

NO. STREET APT

CITY STATE/PROVINCE ZIP/POSTAL CODE

COUNTRY TELEPHONE

E-MAIL ADDRESS

V00A2F

CHANGE OF ADDRESS ☐ CHANGE OF OWNERSHIP ☐

VEHICLE IDENTIFICATION NUMBER

Model Number | Vehicle Identification Number (V.I.N.)

OLD ADDRESS OR PREVIOUS OWNER:

NAME

NO. STREET APT

CITY STATE/PROVINCE ZIP/POSTAL CODE

COUNTRY TELEPHONE

NEW ADDRESS OR NEW OWNER:

NAME

NO. STREET APT

CITY STATE/PROVINCE ZIP/POSTAL CODE

COUNTRY TELEPHONE

E-MAIL ADDRESS

V00A2F

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619 900 XXX CA

OPERATOR'S GUIDE, SKANDIC WT/SWT / ENGLISH
GUIDE DU CONDUCTEUR, SKANDIC WT/SWT / ANGLAIS

U/M:P.C.

2012 Skandic WT/SWT REV-XU Series

This manual may cover later years than listed above.

Some models may need supplemental manuals which have blue titles.

This manual is fully searchable, just hold down the control key and the F key to search on any word.

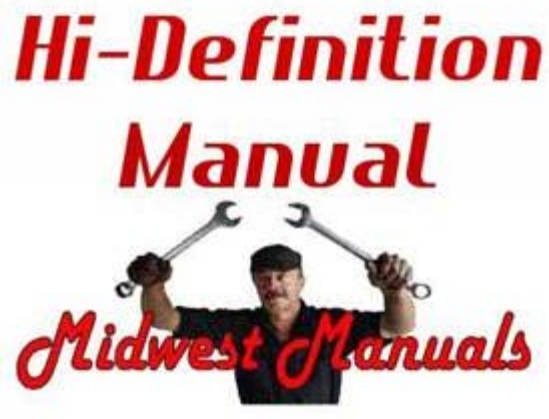
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ski-doo®

BRP





Paperless Manuals
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2012

Shop Manual

Skandic™ WT/SWT (REV-XU™)

550F
600 HO E-TEC®
600 ACE™

219 100 597

2012
Shop Manual





Paperless Manuals
For a Better Tomorrow

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SAFETY NOTICE

This manual has been prepared as a guide to correctly service and repair 2012 Ski-Doo® snowmobiles described in the list in the *INTRODUCTION*.

This edition was primarily published to be used by technicians who are already familiar with service procedures relating to Bombardier Recreational Products Inc. (BRP) products. Mechanical technicians should attend continuous training courses given by B.R.P.T.I.

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

The content of this manual depicts parts and procedures applicable to the particular product at time of writing. *SERVICE* and *WARRANTY BULLETINS* may be published to update the content of this manual. Dealer modifications that were carried out after manufacturing of the product, whether or not authorized by BRP, are not included.

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

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

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

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

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

⚠ WARNING

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

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

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

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

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

Always observe common shop safety practice.

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

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

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

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

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

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

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

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

INTRODUCTION

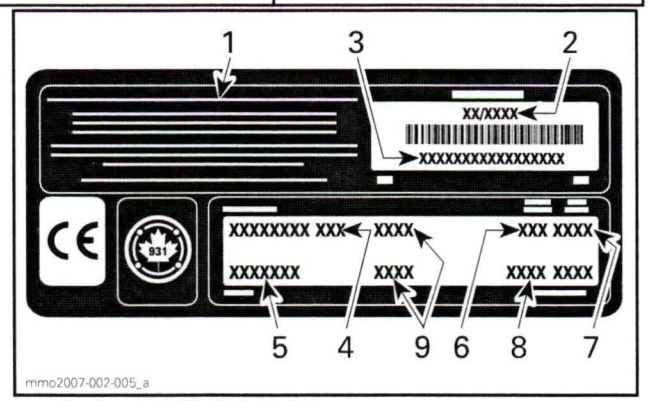
This shop manual covers the following BRP made 2012 Ski-Doo snowmobiles.

MODEL	ENGINE TYPE	CHASSIS
Skandic WT 550F	552	REV-XU
Skandic WT 600 HO E-TEC	593	REV-XU
Skandic WT 600 ACE	602	REV-XU
Skandic SWT 600 HO E-TEC	593	REV-XU
Skandic SWT 600 ACE	602	REV-XU

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

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

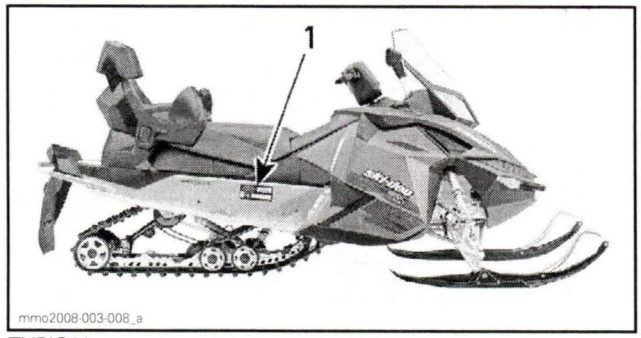
BRP reserves the right at any time to discontinue or change specifications, designs, features, models or equipment without incurring obligation.



VEHICLE DESCRIPTION DECAL
1. *Manufacturer name*
2. *Manufacturing date*
3. *Vehicle identification number (VIN)*
4. *Model name*
5. *Option package*
6. *Engine type*
7. *Model year*
8. *Color codes*
9. *Vehicle weight/engine power (European models)*

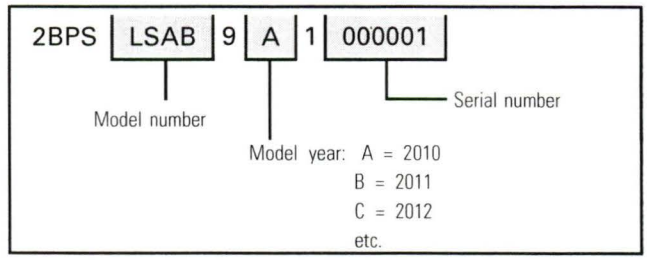
VEHICLE INFORMATION

VEHICLE IDENTIFICATION NUMBER (VIN)

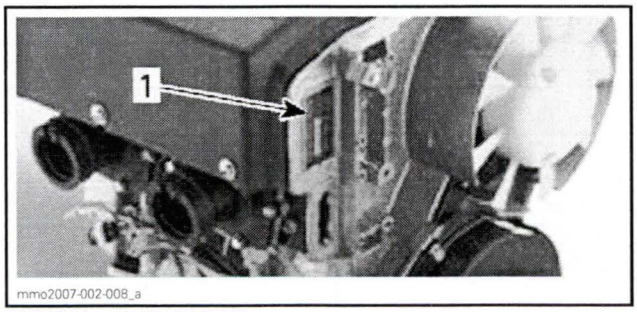


TYPICAL
1. *Vehicle description decal*

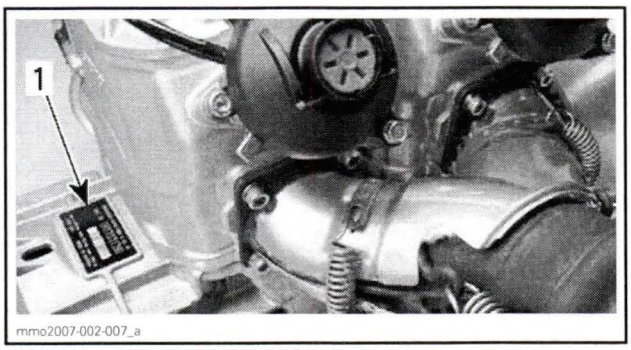
Identification Number Description



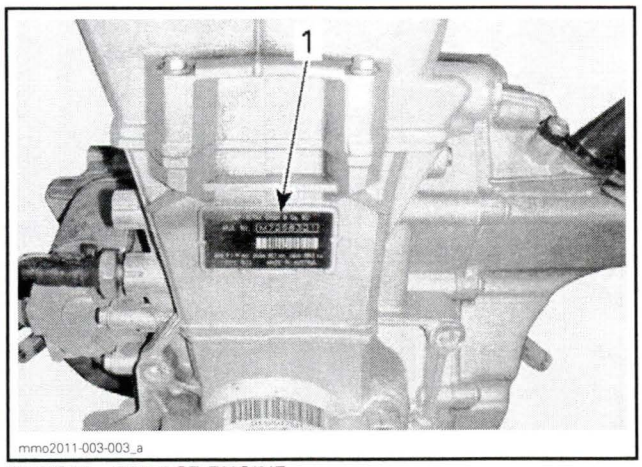
ENGINE SERIAL NUMBER



TYPICAL - 550F ENGINE
1. Engine serial number



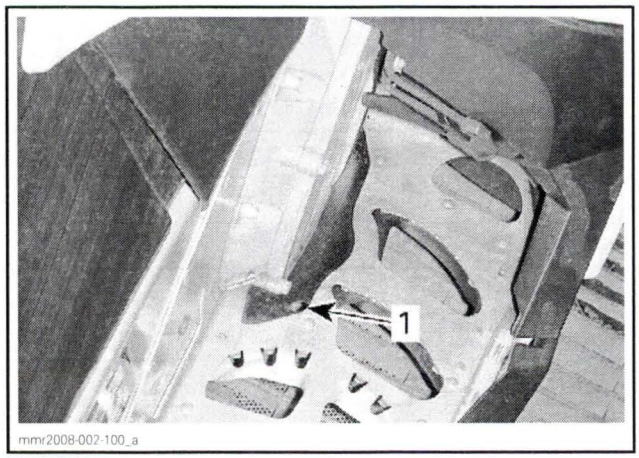
TYPICAL - 600 HO E-TEC ENGINE
1. Engine serial number



TYPICAL - 600 ACE ENGINE
1. Engine serial number

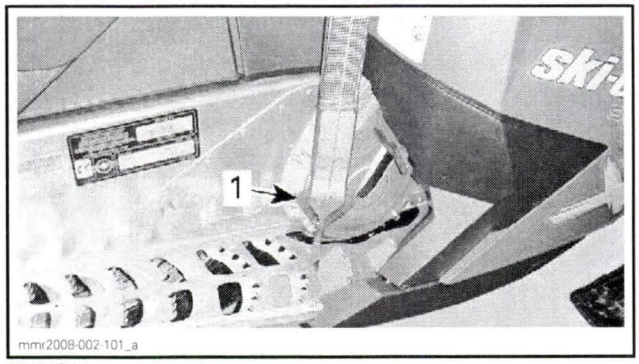
SNOWMOBILE LIFTING

To lift the snowmobile securely, it is important to use the reinforced footrest holes.



TYPICAL
1. Reinforced holes in footrest

Install lifting tool hooks in holes as shown.



TYPICAL
1. Hook of lifting tool

⚠ WARNING

Do not use footrest openings or steering column to lift the snowmobile. These parts are not designed to support the snowmobile weight. Frame or steering system could be seriously damaged and serious injury or death could happen.

ENGINE EMISSIONS INFORMATION

Manufacturer's Responsibility

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

Dealer Responsibility

When performing service on snowmobiles that carry an emissions control information label, adjustments must be kept within published factory specifications.

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

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

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

Owner Responsibility

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

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

EPA Emission Regulations

Some Ski-Doo snowmobiles manufactured by BRP are certified to the EPA as conforming to the requirements of the regulations for the control of air pollution from new snowmobiles engines. This certification is contingent on certain adjustments being set to factory standards. For this reason, the factory procedure for servicing the product must be strictly followed and, whenever practicable, returned to the original intent of the design.

The responsibilities listed above are general and in no way a complete listing of the rules and regulations pertaining to the EPA requirements on exhaust emissions for snowmobiles products. For more detailed information on this subject, you may contact the following locations:

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

Regular US Postal Mail:
1200 Pennsylvania Ave. NW
Mail Code 6403J
Washington D.C. 20460

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

E-Mail: otaqpublicweb@epa.gov

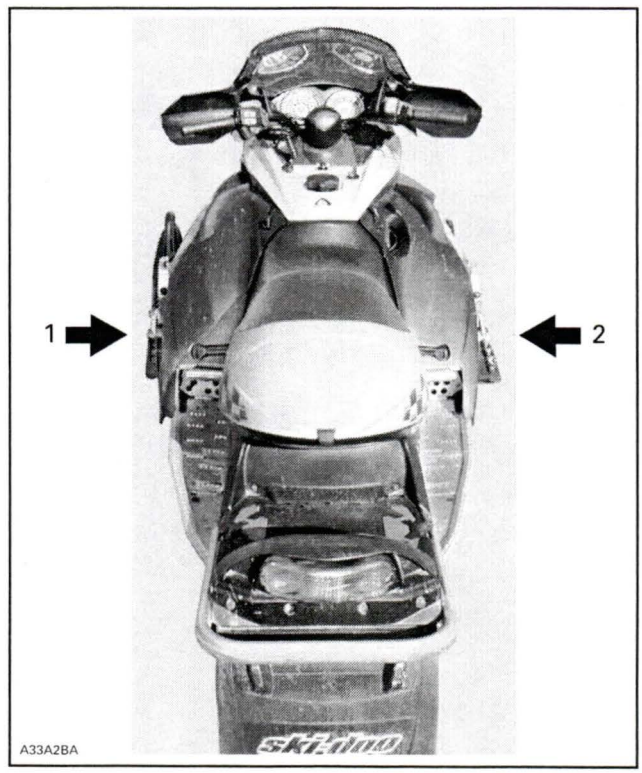
MANUAL INFORMATION

MANUAL PROCEDURES

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

A number of procedures throughout the book require the use of special tools. Before starting any procedure, be sure that you have on hand all required tools, or their approved equivalents.

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



TYPICAL
1. Left
2. Right

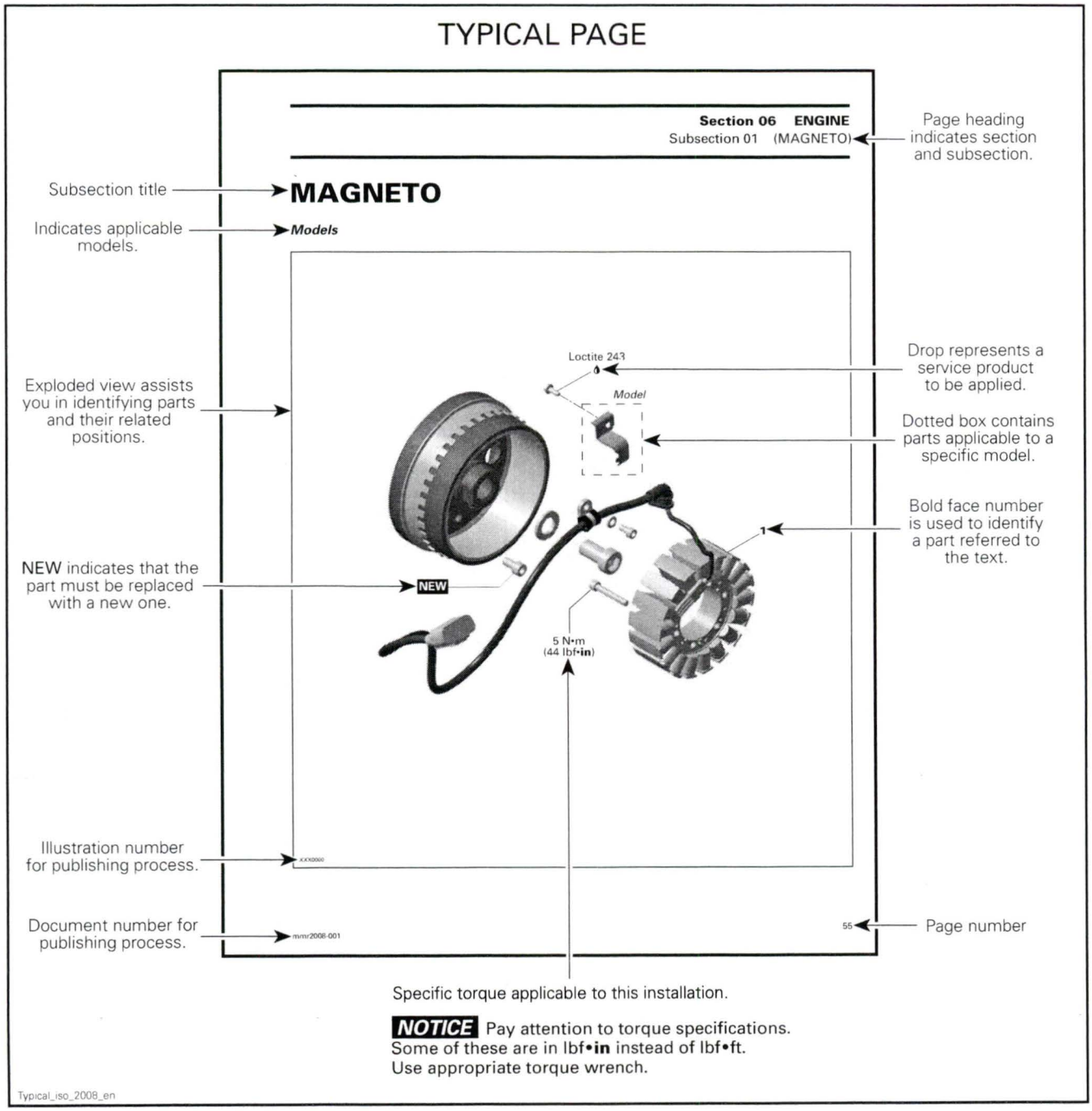
This manual uses technical terms which may be different from the ones of the *PARTS CATALOGS*.

MANUAL LAYOUT

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

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

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



TYPICAL PAGE

Tittle in bold indicates category of information to be carried out.

Reference to a specific section or subsection.

Indicates component procedures apply to.

Indicates specific procedure to be carried out.

"TYPICAL" indicates a general view which may not represent exact details.

Call-outs pertaining to above illustration.

Illustration always follows text to which it applies.

Italic bold face type-setting indicates a procedure applicable to a specific model(s).

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

typical_txt_2008_en

Section 03 ENGINE
Subsection 09 (MAGNETO SYSTEM)

GENERAL

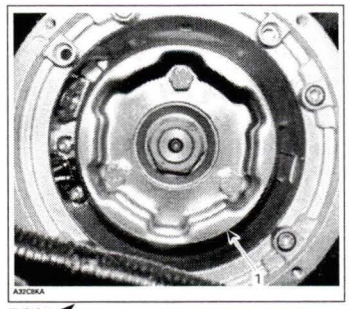
NOTE: The following procedures can be done without removing the engine.

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

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

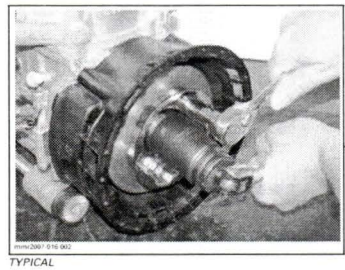
⚠ WARNING

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



TYPICAL
1 Starting pulley

NOTE: To remove starting pulley bolts, hold magneto flywheel with a socket as shown.



TYPICAL

PROCEDURES

MAGNETO FLYWHEEL

Magneto Flywheel Cleaning

Clean all metal components in a non-ferrous metal cleaner.

CAUTION: Clean magneto flywheel using only a clean cloth.

Magneto Flywheel Removal

Remove muffler, refer to the *EXHAUST SYSTEM* section.

Remove acoustic panel.

Remove rewind starter.

Remove starting pulley **no. 2**.

Models

Remove the connecting flange retaining the rewind starter to the engine housing.

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TIGHTENING TORQUE

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

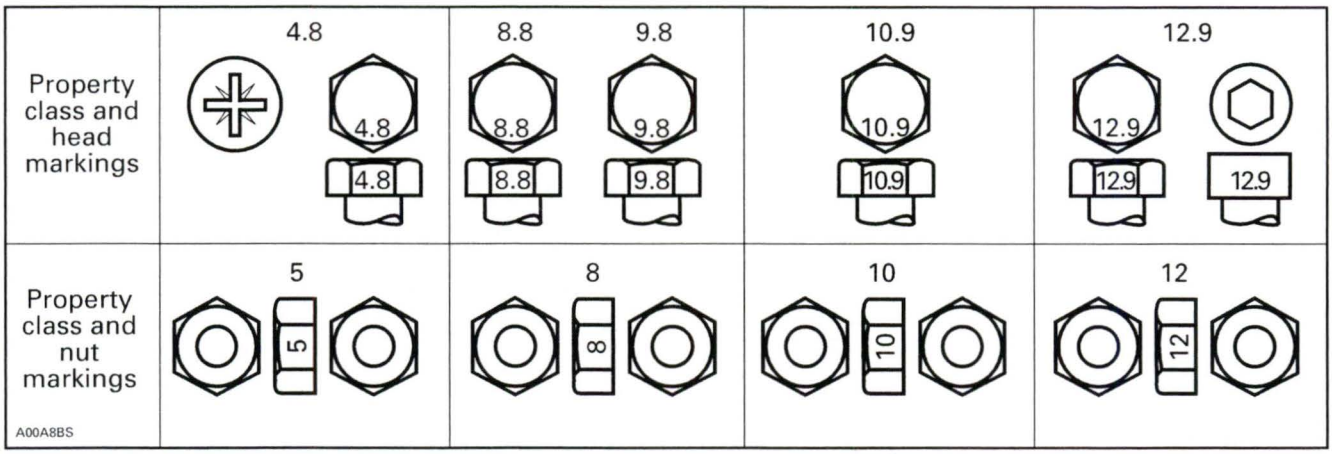
In order to avoid a poor assembly, tighten screws, bolts, or nuts in accordance with the following procedure:

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

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

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

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

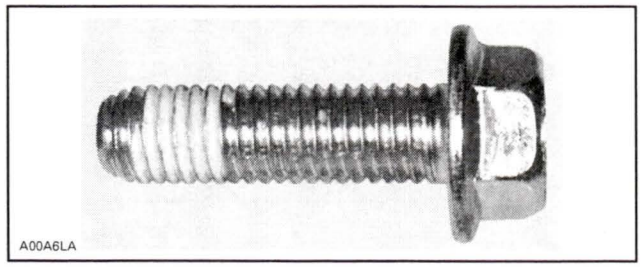


FASTENER SIZE	FASTENER GRADE/TORQUE			
	5.8 Grade	8.8 Grade	10.9 Grade	12.9 Grade
M4	1.5 – 2 N•m (13 – 18 lbf•**in**)	2.5 – 3 N•m (22 – 27 lbf•**in**)	3.5 – 4 N•m (31 – 35 lbf•ft)	4 – 5 N•m (35 – 44 lbf•ft)
M5	3 – 3.5 N•m (27 – 31 lbf•ft)	4.5 – 5.5 N•m (40 – 47 lbf•ft)	7 – 8.5 N•m (62 – 75 lbf•ft)	8 – 10 N•m (71 – 89 lbf•ft)
M6	6.5 – 8.5 N•m (58 – 75 lbf•ft)	8 – 12 N•m (71 – 106 lbf•ft)	10.5 – 15 N•m (93 – 133 lbf•**in**)	16 N•m (142 lbf•**in**)
M8	15 N•m (133 lbf•**in**)	25 N•m (18 lbf•ft)	32 N•m (24 lbf•ft)	40 N•m (30 lbf•ft)
M10	29 N•m (21 lbf•ft)	48 N•m (35 lbf•ft)	61 N•m (45 lbf•ft)	73 N•m (54 lbf•ft)
M12	52 N•m (38 lbf•ft)	85 N•m (63 lbf•ft)	105 N•m (77 lbf•ft)	128 N•m (94 lbf•ft)
M14	85 N•m (63 lbf•ft)	135 N•m (100 lbf•ft)	170 N•m (125 lbf•ft)	200 N•m (148 lbf•ft)

FASTENER INFORMATION

NOTICE Most fasteners are metric. Mismatched or incorrect fasteners could cause damage to the vehicle. Consult the appropriate *PARTS CATALOG* to obtain the correct fasteners.

SELF-LOCKING FASTENERS PROCEDURE



TYPICAL — SELF-LOCKING FASTENER

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

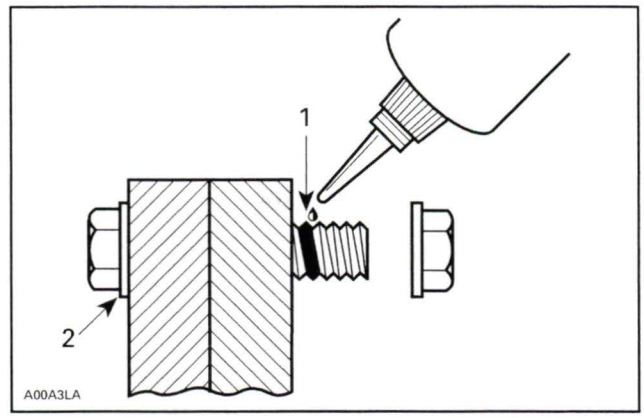
Use a metal brush or a tap to properly clean a threaded hole, then use a solvent. Allow the solvent time to act, approximately 30 minutes, then wipe off. Solvent utilization is to ensure proper adhesion of the product used for locking the fastener.

LOCTITE® APPLICATION PROCEDURE

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

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

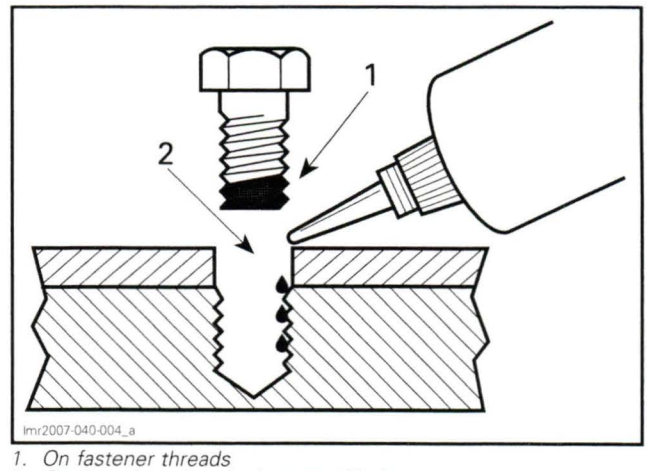
Threadlocker Application for Uncovered Holes (Bolts and Nuts)



1. Apply here
2. Do not apply

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

Threadlocker Application for Blind Holes

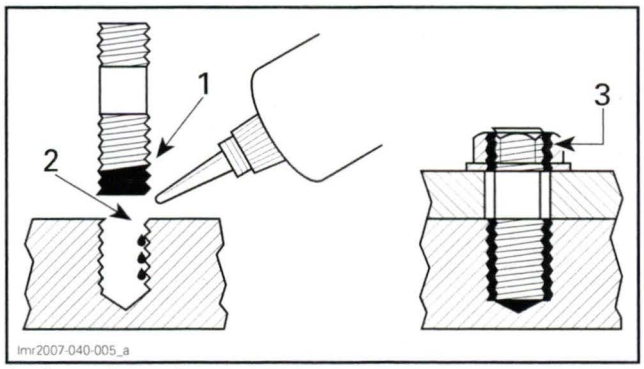


1. On fastener threads
2. On threads and at the bottom of hole

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

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

Threadlocker Application for Stud Installation in Blind Holes



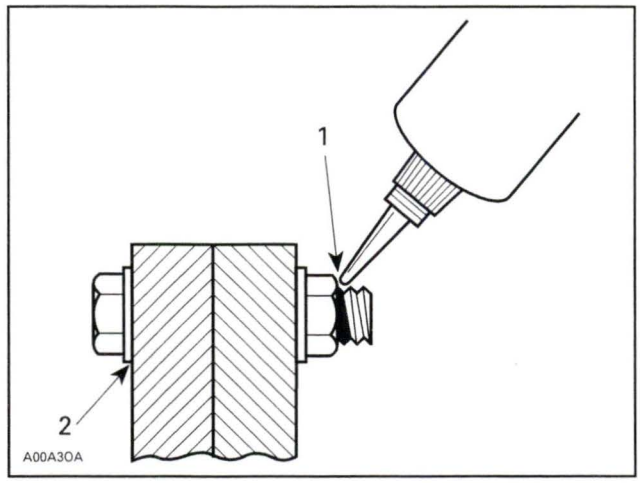
1. On stud threads
2. On threads and in the hole
3. On retaining nut threads

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

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

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

Threadlocker Application for Pre-Assembled Parts

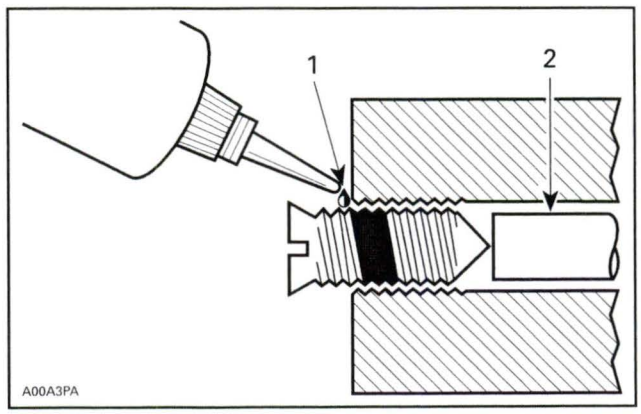


1. Apply here
2. Do not apply

1. Clean bolts and nuts with solvent.
2. Assemble components.
3. Tighten nuts.
4. Apply a few drops of proper strength Loctite on bolt/nut contact surfaces.
5. Avoid touching metal with tip of flask.

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

Threadlocker Application for an Adjustment Screw

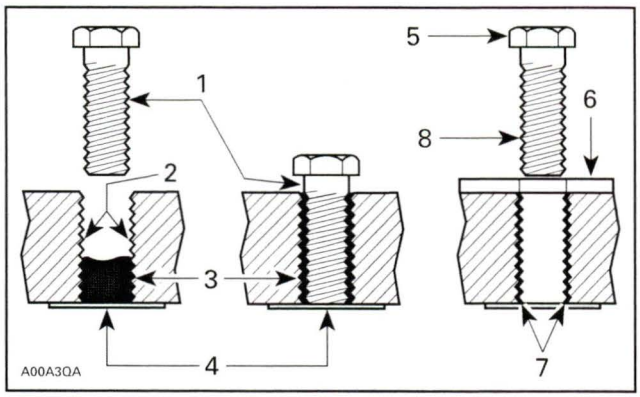


1. Apply here
2. Plunger

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

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

Application for Stripped Thread Repair



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

Standard Thread Repair

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

If a plate is used to align bolt:

1. Apply release agent on mating surfaces.
2. Put waxed paper or similar film on the surfaces.
3. Twist bolt when inserting it to improve thread conformation.

NOTE: NOT intended for engine stud repairs.

Repair of Small Holes/Fine Threads

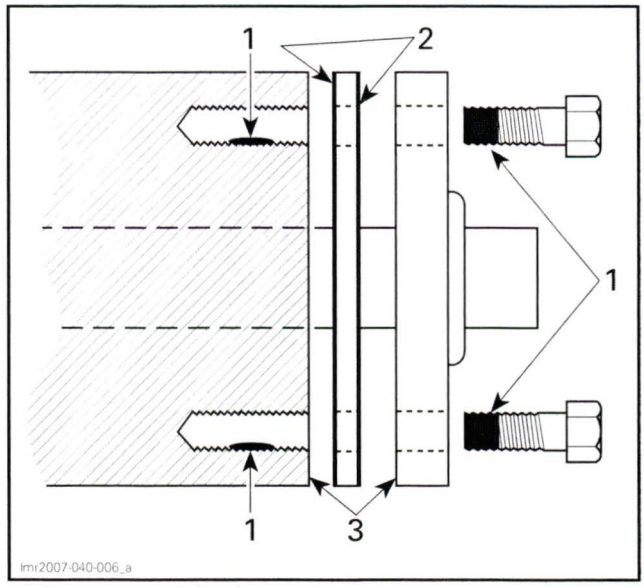
Option 1: Enlarge damaged hole, then follow *STANDARD THREAD REPAIR* procedure.

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

Permanent Stud Installation (Light Duty)

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

Gasket Compound Application



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

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

NOTE: Avoid grinding.

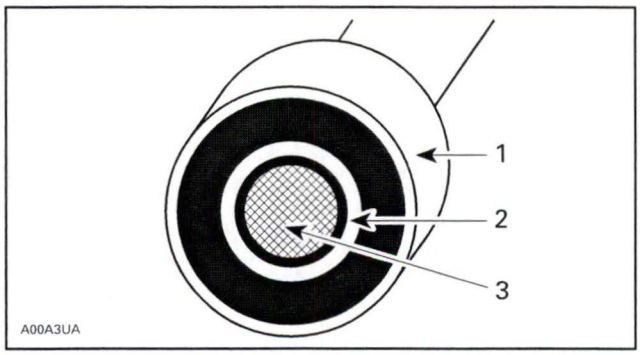
2. Clean both mating surfaces with solvent.
3. Spray Loctite Primer N on both mating surfaces and on both sides of gasket and allow to dry 1 or 2 minutes.
4. Apply LOCTITE 518 (P/N 293 800 038) on both sides of gasket, using a clean applicator.
5. Place gasket on mating surfaces and assemble parts immediately.

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

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

6. Tighten as usual.

Threadlocker Application for Mounting on a Shaft



MOUNTING WITH A PRESS
1. *Bearing*
2. *Proper strength Loctite*
3. *Shaft*

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

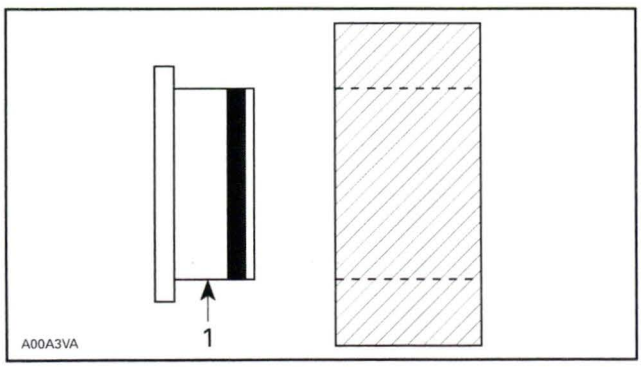
NOTE: Retaining compound is always forced out when applied on shaft.

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

Mounting in Tandem

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

Threadlocker Application for Case-In Components (Metallic Gaskets)



1. *Proper strength Loctite*

1. Clean inner housing diameter and outer gasket diameter.
2. Spray housing and gasket with LOCTITE PRIMER N (P/N 293 800 041).
3. Apply a strip of proper strength Loctite on leading edge of outer metallic gasket diameter.

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

4. Install according to standard procedure.
5. Wipe off excess product.
6. Allow 30 minutes for product to cure.

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

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

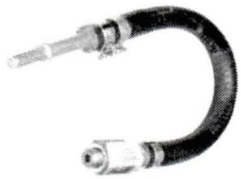
SERVICE TOOLS INDEX

12 V BATTERY SUPPLY CABLE
(P/N 529 035 997)



Page: 385, 390, 597, 670–671

ADAPTER HOSE
(P/N 529 035 652)



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ALIGNMENT BAR
(P/N 529 036 157)



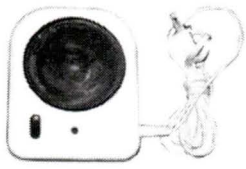
Page: 728

BALL JOINT INSTALLER
(P/N 529 035 975)



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BEARING HEATER
(P/N 529 035 969)



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BEARING INSTALLER (PTO)
(P/N 529 035 990)



Page: 141, 250

BUSHING PULLER/INSTALLER
(P/N 529 031 200)



Page: 717

BUSHING REMOVER/INSTALLER
(P/N 529 035 931)



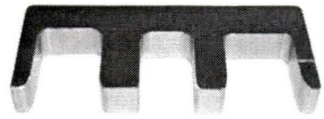
Page: 717, 719

CALIPER PULLER
(P/N 529 036 145)



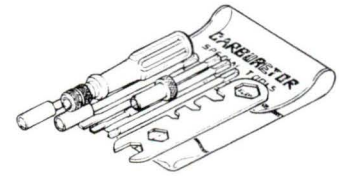
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CAMSHAFT LOCKING TOOL
(P/N 529 036 206)



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CARBURETOR TOOL KIT
(P/N 404 112 000)



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CERAMIC SEAL INSTALLER
(P/N 529 036 014)



Page: 244–245

CHOKE ADJUSTER TOOL
(P/N 529 036 163)



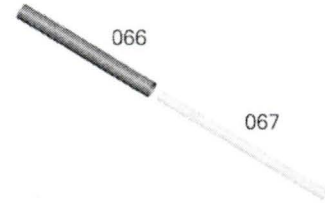
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CLUTCH HOLDER
(P/N 529 036 235)



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COUNTERSHAFT BEARING INSTALLER
(P/N 529 036 066)



Page: 750

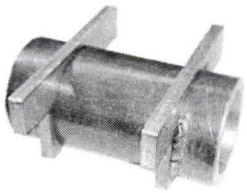
COUNTERSHAFT BEARING REMOVER
(P/N 529 036 065)



Page: 749

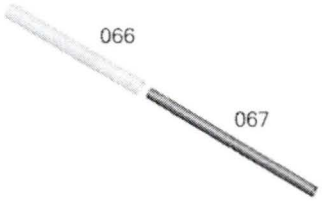
SERVICE TOOLS INDEX

COUNTERSHAFT RETAINING TOOL
(P/N 529 036 165)



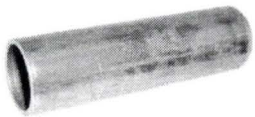
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COUNTERSHAFT SUPPORT
(P/N 529 036 067)



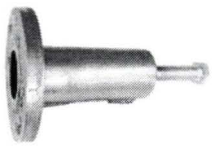
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CRANKSHAFT BEARING INSTALLER (MAG)
(P/N 529 035 980)



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CRANKSHAFT BEARING PULLER
(P/N 529 036 004)



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CRANKSHAFT DISTANCE GAUGE
(P/N 529 035 965)



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CRANKSHAFT DISTANCE GAUGE
(P/N 529 035 968)



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CRANKSHAFT LOCKING TOOL
(P/N 529 036 205)



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CRANKSHAFT PROTECTOR (MAG)
(P/N 420 876 557)



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CRANKSHAFT PROTECTOR (PTO)
(P/N 420 876 552)



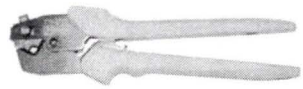
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CRANKSHAFT PROTECTOR
(P/N 529 036 213)



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CRIMPING TOOL (HEAVY GAUGE WIRE)
(P/N 529 035 730)



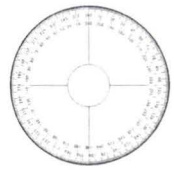
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CRIMPING TOOL (KOSTAL)
(P/N 529 035 909)



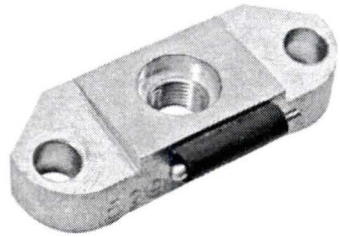
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DEGREE WHEEL
(P/N 529 035 607)



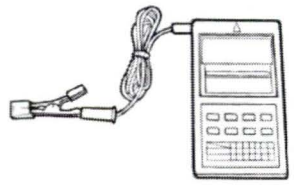
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DIAL INDICATOR ADAPTER
(P/N 529 036 132)



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DIGITAL INDUCTION TACHOMETER
(P/N 529 014 500)



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DRIVE PULLEY HOLDER
(P/N 529 035 674)



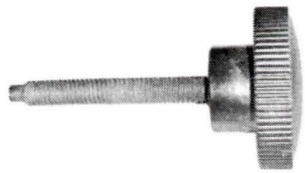
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DRIVE PULLEY PULLER
(P/N 529 000 064)



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DRIVEN PULLEY OPENING TOOL
(P/N 529 017 200)



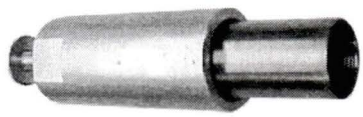
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DRIVEN PULLEY SPRING COMPRESSOR
(P/N 529 036 064)



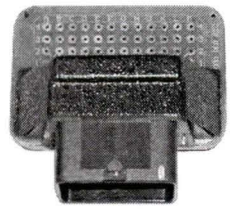
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DRIVEN PULLEY SPRING COMPRESSOR
(P/N 529 036 182)



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ECM ADAPTER TOOL
(P/N 529 036 166)



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ECM TERMINAL REMOVER 2.25
(P/N 529 036 175)



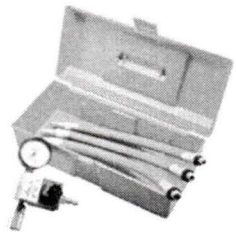
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ECM TERMINAL REMOVER 3.36
(P/N 529 036 174)



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



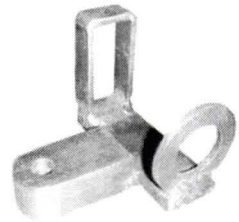
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ENGINE LIFTING HOOK
(P/N 529 035 829)



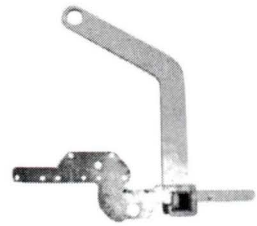
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ENGINE LIFTING TOOL
(P/N 529 036 131)



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ENGINE LIFTING TOOL
(P/N 529 036 217)



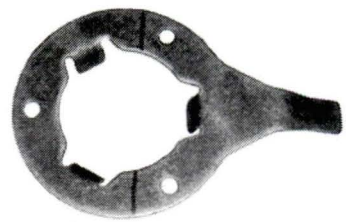
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EXTRACTOR ADAPTOR
(P/N 529 036 136)



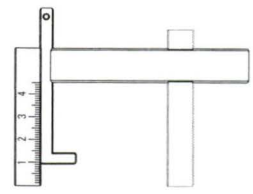
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FAN HOLDER TOOL
(P/N 529 036 006)



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FLOAT LEVEL GAUGE
(P/N 529 035 520)



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SERVICE TOOLS INDEX

FLUKE 115 MULTIMETER
(P/N 529 035 868)



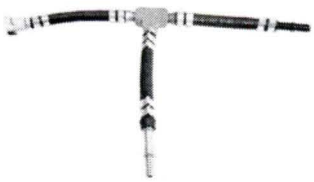
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(P/N 529 036 023)



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FUEL HOSE DISCONNECT TOOL
(P/N 529 036 037)



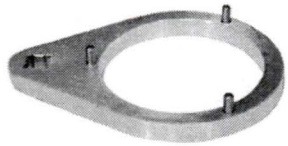
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FUEL PUMP NUT TOOL
(P/N 529 036 118)



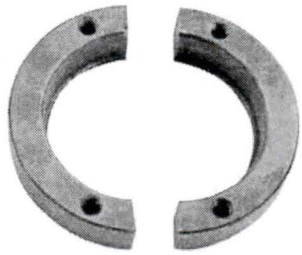
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FUEL PUMP NUT TOOL
(P/N 529 036 214)



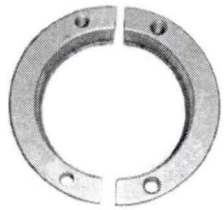
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HALF-RINGS
(P/N 420 977 475)



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HALF-RINGS
(P/N 420 977 479)



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(P/N 420 877 650)



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(P/N 529 036 129)



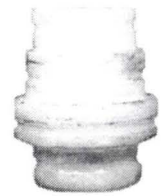
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INJECTOR RETAINER PLATE
(P/N 529 036 137)



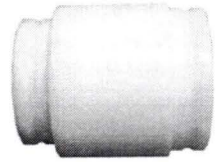
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INTAKE PLUG
(P/N 529 036 128)



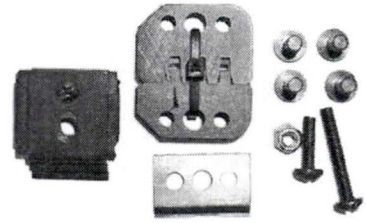
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INTAKE PLUG
(P/N 529 036 203)



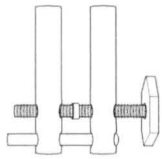
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KOSTAL DIE
(P/N 529 035 906)



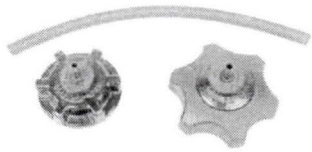
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LARGE HOSE PINCHER
(P/N 529 032 500)



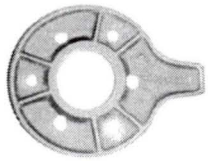
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LEAK TEST KIT
(P/N 529 033 100)



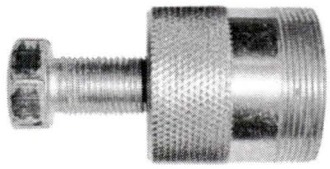
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MAGNETO PULLER RING
(P/N 420 876 081)



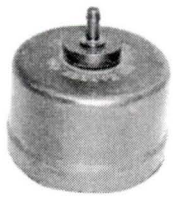
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MAGNETO PULLER
(P/N 529 035 547)



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MANIFOLD PLUG 63 MM (2-1/2")
(P/N 529 035 961)



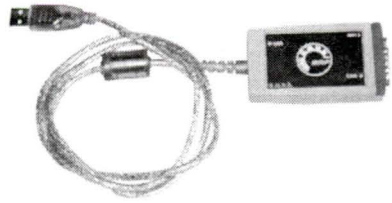
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MPI-2 DIAGNOSTIC CABLE
(P/N 710 000 851)



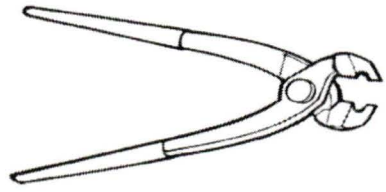
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MPI-2 INTERFACE CARD
(P/N 529 036 018)



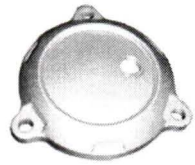
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OIL PRESSURE TEST CAP
(P/N 529 036 158)



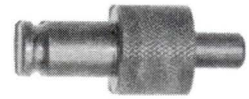
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(P/N 529 035 822)



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OIL SEAL PUSHER
(P/N 529 035 757)



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OIL SEAL PUSHER
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PISTON CIRCLIP INSTALLER
(P/N 529 035 686)



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PISTON CIRCLP INSTALLER
(P/N 529 036 207)



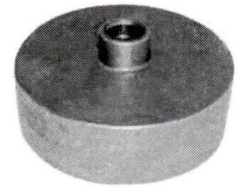
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PISTON PIN PULLER
(P/N 529 035 503)



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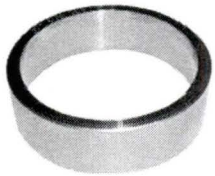
PISTON PROJECTION
(P/N 529 036 215)



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PISTON RING COMPRESSOR
(P/N 529 036 208)



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PRELOAD TESTER
(P/N 529 036 164)



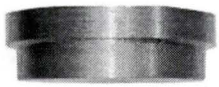
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PRESSURE GAUGE
(P/N 529 035 709)



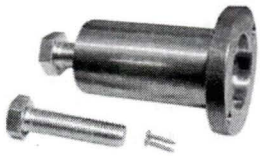
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(P/N 529 036 150)



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PTO OIL SEAL INSTALLER
(P/N 529 036 216)



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PULLER RING
(P/N 420 977 490)

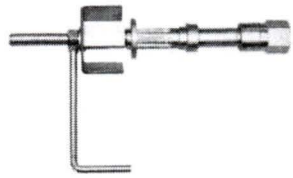
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PULLER RING
(P/N 420 977 494)



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



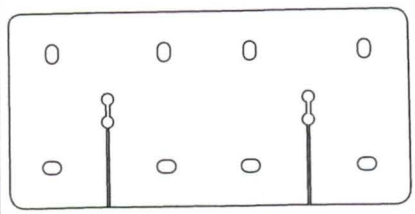
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ROTARY SEAL INSTALLER
(P/N 529 036 211)



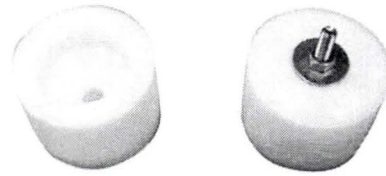
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RUBBER PAD PROTECTOR
(P/N 529 023 400)



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SHOCK ABSORBER SUPPORTS
(P/N 529 036 186)



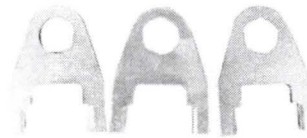
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SLEEVE KIT 20 MM
(P/N 529 035 542)



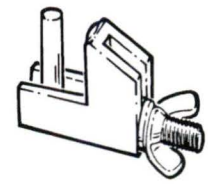
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SLIDER SHOE FORK
(P/N 529 005 500)



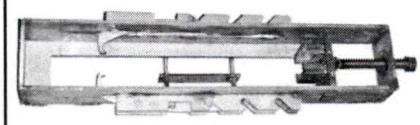
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SMALL HOSE PINCHER
(P/N 295 000 076)



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SPRING COMPRESSOR
(P/N 529 036 184)



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SPRING INSTALLER/REMOVER
(P/N 529 035 983)



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SUCTION PUMP
(P/N 529 035 880)



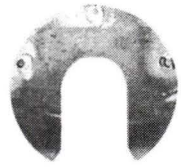
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SUPERTANIUM DRILL BIT 3/16"
(P/N 529 031 800)



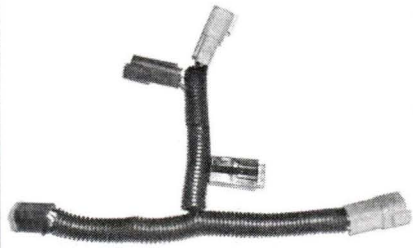
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SUPPORT PLATE
(P/N 529 035 976)



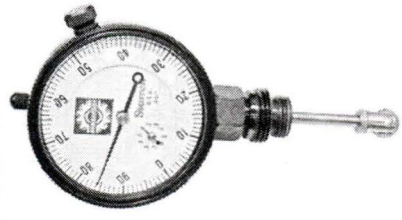
Page: 142, 250

T-HARNESS
(P/N 529 035 869)



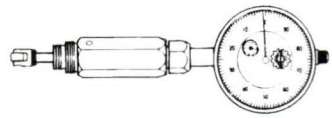
Page: 227, 385, 387, 389, 438, 442, 534, 547, 597, 670–672, 679

TDC DIAL INDICATOR
(P/N 295 000 143)



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TDC DIAL INDICATOR
(P/N 414 104 700)



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TEMPERATURE INDICATOR STICK
(P/N 529 035 970)



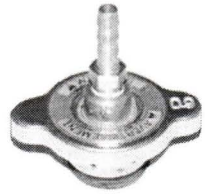
Page: 141, 250

TENSIOMETER
(P/N 414 348 200)



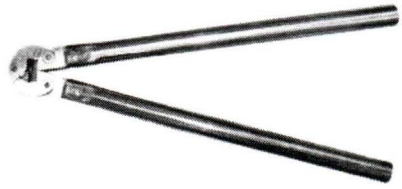
Page: 32

TEST CAP
(P/N 529 035 991)



Page: 197, 294

TRACK CLEAT INSTALLER
(P/N 529 036 044)



Page: 779

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



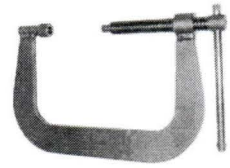
Page: 56, 83, 89, 159, 185, 192, 197, 216, 219, 226–228, 294, 420–421, 438, 440

VALVE SPRING COMPRESSOR CUP
(P/N 529 036 209)



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VALVE SPRING COMPRESSOR
(P/N 529 035 724)



Page: 345

BREAK-IN INSPECTION

Procedures are detailed in *PERIODIC MAINTENANCE PROCEDURES* subsection.

BREAK-IN INSPECTION (550F)
Inspect exhaust system and check for leaks
Inspect fuel lines and connections
Inspect throttle cable
Inspect drive belt
Visually inspect drive pulley
Tighten drive pulley retaining screw to specified torque
Inspect driven pulley
Adjust and align track
Change gearbox oil
Check brake fluid level
Inspect brake hose, pads and disk
Inspect steering mechanism
Inspect skis and runners
Inspect front suspension
Inspect rear suspension and slider shoes
Adjust oil injection pump

BREAK-IN INSPECTION (600 HO E-TEC)
Inspect exhaust system and check for leaks
Tighten exhaust manifold screws to specified torque
Check coolant level
Inspect fuel lines and connections
Inspect throttle cable
Inspect drive belt
Visually inspect drive pulley
Tighten drive pulley retaining screw to specified torque
Inspect driven pulley
Adjust and align track
Change gearbox oil
Check brake fluid level
Inspect brake hose, pads and disk
Inspect steering mechanism
Inspect skis and runners
Inspect front suspension
Inspect rear suspension and slider shoes

BREAK-IN INSPECTION (600 ACE)
Inspect engine seals and gaskets for leaks
Inspect exhaust system and check for leaks
Inspect all heat shields
Check coolant level
Change engine oil and filter
Inspect fuel lines and connections
Inspect throttle cable
Inspect drive belt
Visually inspect drive pulley
Tighten drive pulley retaining screw to specified torque
Inspect driven pulley
Check driven pulley preload
Adjust and align track
Change gearbox oil
Check brake fluid level
Inspect brake hose, pads and disk
Inspect steering mechanism
Inspect skis and runners
Inspect front suspension
Inspect rear suspension and slider shoes

PERIODIC MAINTENANCE SCHEDULE

Procedures are detailed in *PERIODIC MAINTENANCE PROCEDURES* subsection.

550F

EVERY 3 000 KM (2,000 MI) OR 1 YEAR (WHICHEVER COMES FIRST)
Inspect engine rubber mounts
Inspect exhaust system and check for leaks
Adjust engine stopper
Visually inspect and clean drive pulley
Tighten drive pulley retaining screw to specified torque
Clean driven pulley
Adjust and align track
Inspect brake hose, pads and disk
Inspect steering mechanism
Inspect front suspension
Inspect rear suspension and stopper strap
Lubricate rear suspension (lubricate whenever the vehicle is used in wet conditions (rain, puddles)

EVERY 6 000 KM (4,000 MI) OR 2 YEARS (WHICHEVER COMES FIRST)
Inspect fuel pump strainer and replace if necessary
Replace brake fluid
Inspect throttle cable
Clean and lubricate rewind starter





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600 HO E-TEC

EVERY 3 000 KM (2,000 MI) OR 1 YEAR (WHICHEVER COMES FIRST)
Inspect heat shields
Inspect engine rubber mounts
Inspect exhaust system and check for leaks
Adjust engine stopper
Visually inspect and clean drive pulley
Tighten drive pulley retaining screw to specified torque
Clean driven pulley
Adjust and align track
Inspect brake hose, pads and disk
Inspect steering mechanism
Inspect front suspension
Inspect rear suspension and stopper strap
Lubricate rear suspension (lubricate whenever the vehicle is used in wet conditions (rain, puddles)

EVERY 6 000 KM (4,000 MI) OR 2 YEARS (WHICHEVER COMES FIRST)
Inspect fuel pump strainer and replace if necessary
Replace brake fluid
Inspect throttle cable
Clean and lubricate rewind starter

EVERY 10 000 KM (6,000 MI) OR 3 YEARS (WHICHEVER COMES FIRST)
Replace spark plugs (must be replaced by an authorized Ski-Doo dealer)
Inspect oil pump strainer and clean if needed

EVERY 5 YEARS
Replace engine coolant
Replace in-line fuel filter

600 ACE

EVERY 3 000 KM (2,000 MI) OR 1 YEAR (WHICHEVER COMES FIRST)
Inspect heat shields
Visually inspect and clean drive pulley
Tighten drive pulley retaining screw to specified torque
Clean driven pulley
Check driven pulley preload
Adjust and align track
Inspect brake hose, pads and disk
Inspect steering mechanism
Inspect front suspension
Inspect rear suspension and stopper straps
Lubricate rear suspension. Lubricate whenever the vehicle is used in wet conditions (rain, puddles)

EVERY 6 000 KM (4,000 MI) OR AT PRE-SEASON (WHICHEVER COMES FIRST)
Change engine oil and filter

EVERY 6 000 KM (4,000 MI) OR 2 YEARS (WHICHEVER COMES FIRST)
Replace fuel pump outlet filter
Replace brake fluid
Inspect throttle cable

EVERY 10 000 KM (6,000 MI) OR 3 YEARS (WHICHEVER COMES FIRST)
Replace spark plugs

EVERY 5 YEARS
Replace engine coolant

PERIODIC MAINTENANCE PROCEDURES

SERVICE TOOLS

Description	Part Number	Page
TENSIOMETER	414 348 200	32

SERVICE PRODUCTS

Description	Part Number	Page
BRAKE FLUID	293 600 131	34
BRP PREMIXED COOLANT	219 700 362	21
DIELECTRIC GREASE	293 550 004	30
LOCTITE 767 (ANTISEIZE LUBRICANT)	293 800 070	27–28
PULLEY FLANGE CLEANER	413 711 809	27, 31
SUSPENSION GREASE	293 550 033	36
XPS 4-STROKE SYNTHETIC OIL (ALL CLIMATE)	293 600 112	16
XPS FUEL STABILIZER	413 408 601	24
XPS STORAGE OIL (EXCEPT U.S. COUNTRY)	413 711 600	20
XPS STORAGE OIL (U.S. COUNTRY ONLY)	413 711 900	20
XPS SYNTHETIC CHAINCASE OIL	413 803 300	31
XPS SYNTHETIC GREASE	293 550 010	36

GENERAL

This subsection provides general maintenance instructions. Where detailed instructions for disassembly or reassembly is required, refer to the applicable subsection.

PROCEDURES

ENGINE

Axial Fan Belt Inspection (550F)

Break-In	Scheduled Maintenance	Storage	Preseason
			✔

Check fan belt for:
- Evidence of slippage
- Excessive wear
- Cuts
- Cracks
- Fraying.

Replace fan belt as required.

Crankshaft PTO Seal Inspection (550F and 600 HO E-TEC)

Break-In	Scheduled Maintenance	Storage	Preseason
			✔

Check PTO seal for cracks, leaks or other damages.

Engine Seals and Gaskets Inspection (600 ACE)

Break-In	Scheduled Maintenance	Storage	Preseason
✔			✔

Visually inspect the seal and gasket areas for leaks.

Rewind Starter Cleaning and Lubrication (550F and 600 HO E-TEC)

Break-In	Scheduled Maintenance	Storage	Preseason
	✔		

Refer to *REWIND STARTER ASSEMBLY* in *REWIND STARTER* subsection.

ENGINE (SUPPORTS)

Engine Rubber Mount Inspection (550F and 600 HO E-TEC)

Break-In	Scheduled Maintenance	Storage	Preseason
	✔		✔

Check rubber mounts. Replace them if brittle, cracked or damaged.

Engine Stopper Adjustment (550F and 600 HO E-TEC)

Break-In	Scheduled Maintenance	Storage	Preseason
	✔		

Refer to *ENGINE REMOVAL AND INSTALLATION* subsection.

ENGINE (EXHAUST SYSTEM)

Exhaust System Inspection

550F and 600 HO E-TEC			
Break-In	Scheduled Maintenance	Storage	Preseason
✔	✔		✔

600 ACE			
Break-In	Scheduled Maintenance	Storage	Preseason
✔			✔

Check the following components for leaks, cracks, or other damage:
- Springs and retainers
- Exhaust system mounts
- Muffler
- Tuned pipe
- Heat shields
- Manifold.

Visually inspect all heat shields on exhaust system, coolant hoses, electrical harness and body panels. Replace any damaged shield.

NOTE: For the "Break-In" and "Preseason" inspections on the 600 HO E-TEC, also tighten the exhaust manifold screws to specified torque.

ENGINE (LUBRICATION SYSTEM)

Recommended Engine Oil (600 ACE)

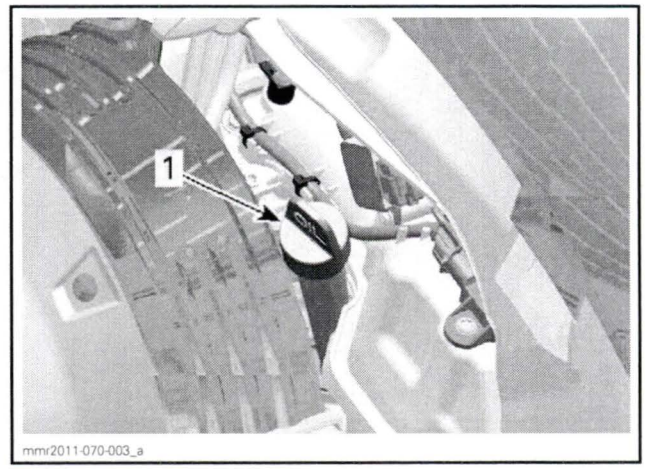
ENGINE	RECOMMENDED ENGINE OIL
600 ACE	XPS 4-STROKE SYNTHETIC OIL (ALL CLIMATE) (P/N 293 600 112)

NOTICE **The engine of this snowmobile has been developed and validated using the BRP XPS™ Synthetic 4-stroke oil. BRP strongly recommends the use of its XPS Synthetic 4-stroke oil at all times. Damages caused by oil which is not suitable for the engine will not be covered by the BRP limited warranty.**

If the recommended oil is not available, use SAE 0W-40 synthetic-based oil that meets or exceeds the requirements for API service classification SM.

Engine Oil Level Verification (600 ACE)

NOTICE **Operating the engine with an improper oil level may cause severe engine damage. Follow this procedure to obtain a precise reading of the engine oil level.**

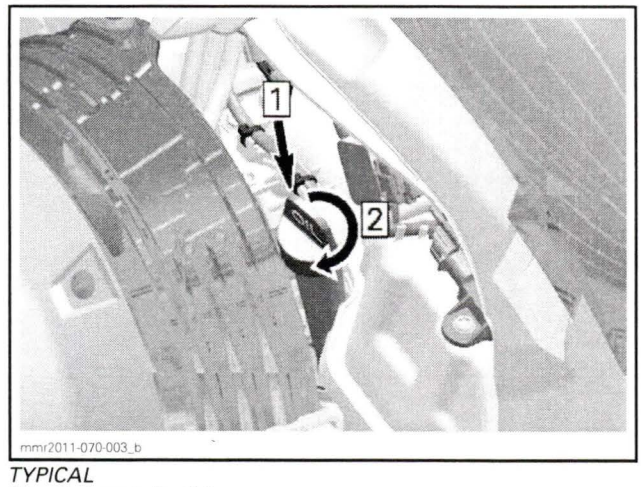


TYPICAL 600 ACE - LH SIDE
1. Oil tank dipstick

With the engine at normal operating temperature, place vehicle on a level surface and proceed as follows to check oil level:

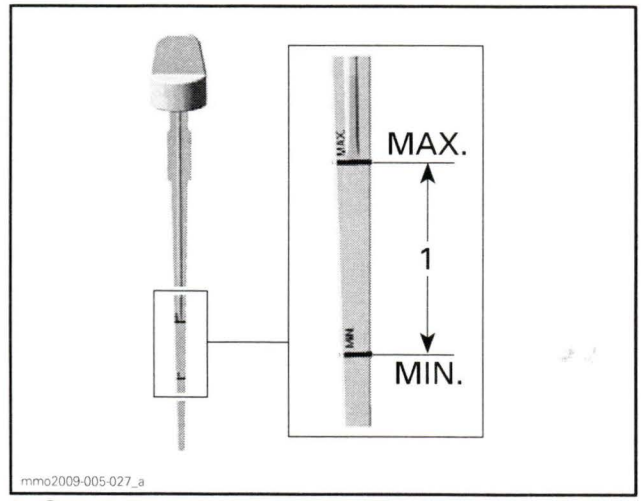
1. Start engine and let it idle for at least 20 seconds.
2. Stop engine.
3. Open the LH side panel.
4. If applicable, remove the drive belt guard. Refer to *DRIVE BELT* subsection.
5. Unscrew and remove dipstick and wipe clean.

6. Insert dipstick in the filler tube and again tighten it.



TYPICAL
Step 1: Insert dipstick
Step 2: Tighten dipstick.

7. Remove dipstick again and check oil level. It should be near or equal to the upper mark.



1. Operating range

8. To add oil, place a funnel into the filler tube to avoid spillage.
   - 8.1 Add a small amount of oil and recheck oil level.
   - 8.2 Repeat the operation until oil level reaches the dipstick's upper mark. Do not overfill.

NOTE: The oil quantity between MIN. and MAX. mark is approximately 500 ml (16.9 U.S. oz).

9. Reinstall dipstick and properly tighten it.
10. Wipe off any oil spillage.
11. Install drive belt guard.
12. Close the LH side panel.

Engine Oil Replacement (600 ACE)

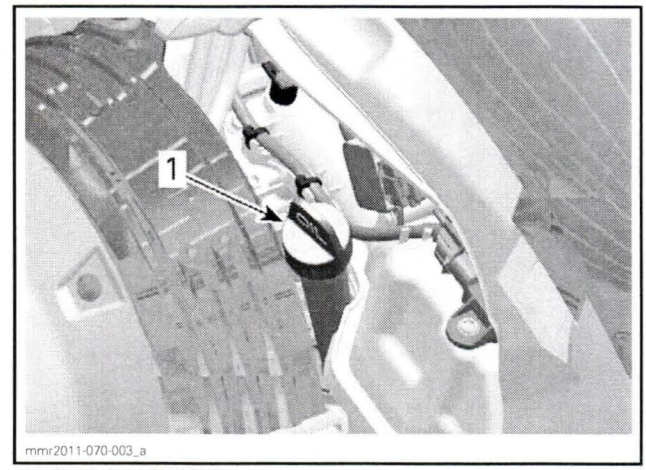
Break-In	Scheduled Maintenance	Storage	Preseason
✔	✔		✔

⚠ WARNING

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

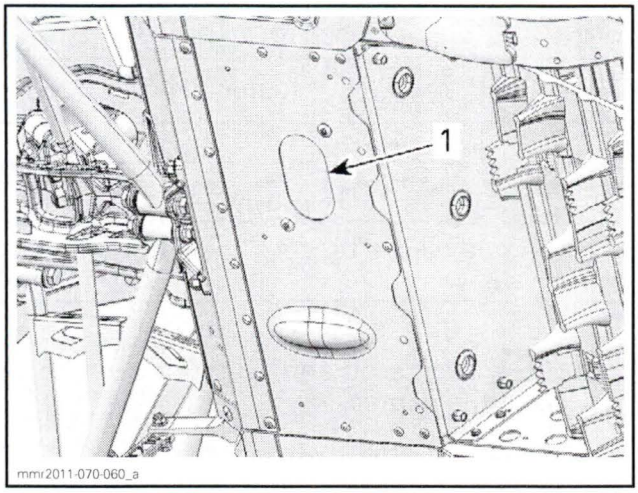
NOTICE **Engine oil and oil filter must be replaced at the same time.**

1. Place vehicle on a level surface.
2. Remove the LH side panel.
3. Remove dipstick.

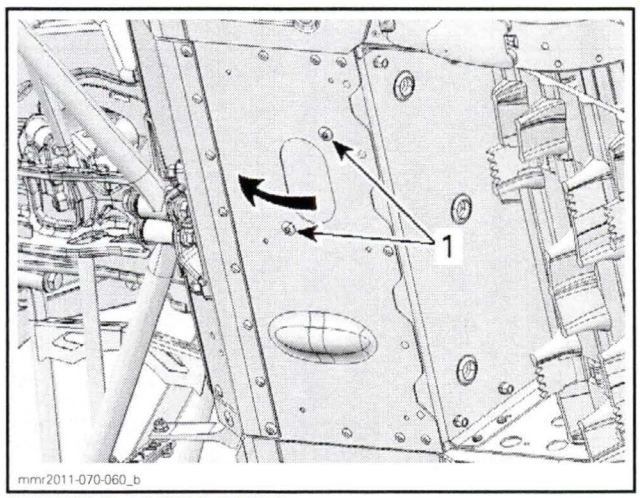


LH SIDE OF VEHICLE
1. Oil tank dipstick

4. From underneath the vehicle, access the drain plug:
   - 4.1 Remove one access cover retaining screw and loosen the other.
   - 4.2 Pivot the access cover to clear the bottom pan opening.

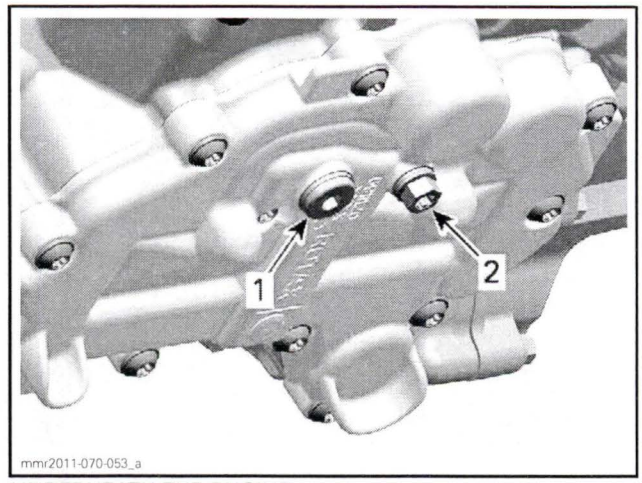


1. Drain plugs access cover



PIVOT THE ACCESS COVER
1. Retaining screws

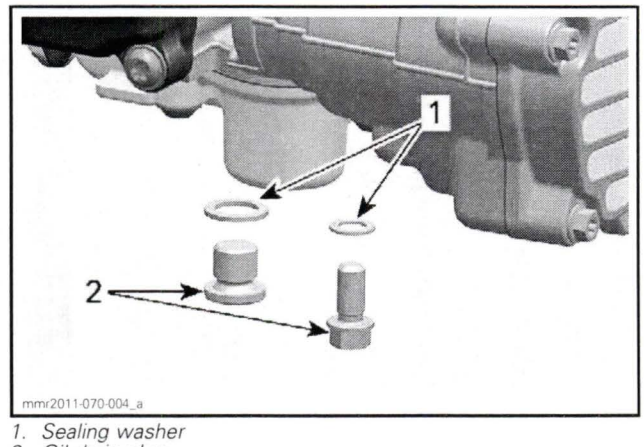
5. Clean drain plug area.
6. Place a drain pan under the bottom pan opening.
7. Remove engine drain plugs in the following order.
   - 7.1 Main drain plug.
   - 7.2 Secondary drain plug.



UNDERNEATH THE ENGINE
1. Main drain plug
2. Secondary drain plug

8. Allow oil to drain completely.
9. Install **NEW** sealing washers on oil drain plugs.

NOTICE **Never use a sealing washer a second time. Always replace with a new one.**



1. Sealing washer
2. Oil drain plug

10. Install drain plugs and tighten to the specified torque.

DRAIN PLUGS TIGHTENING TORQUE
20 N•m ± 2 N•m (15 lbf•ft ± 1.5 lbf•ft)

11. Replace *OIL FILTER*, see procedure in this subsection.
12. Refill oil tank at the proper level with the recommended oil.

APPROXIMATE ENGINE OIL CAPACITY (WITH FILTER)	
600 ACE	2.1 L (2.2 qt (U.S. liq.))

13. Reinstall dipstick in oil tank and properly tighten it.

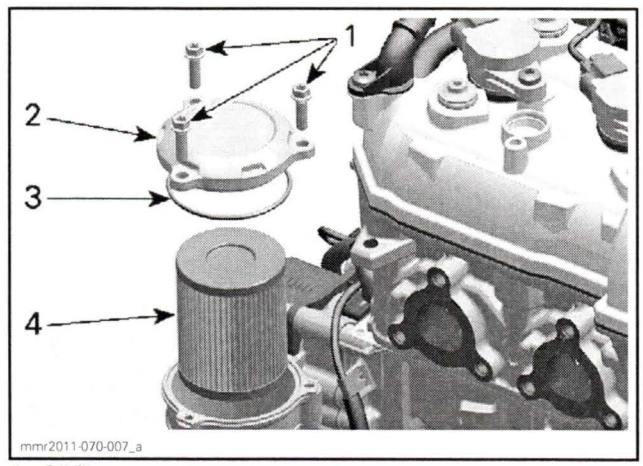
14. Start engine and let it idle for a few minutes.
15. Ensure there are no leaks.
16. Stop engine and check oil level as explained in this subsection. Refill if necessary.
17. Dispose oil and filter as per your local environmental regulations.

Engine Oil Filter Replacement (600 ACE)

Break-In	Scheduled Maintenance	Storage	Preseason
✔	✔		✔

Oil Filter Removal

1. Remove the RH side panel.
2. Clean oil filter area.
3. Remove:
   - Oil filter cover screws
   - Oil filter cover with O-ring
   - Oil filter.

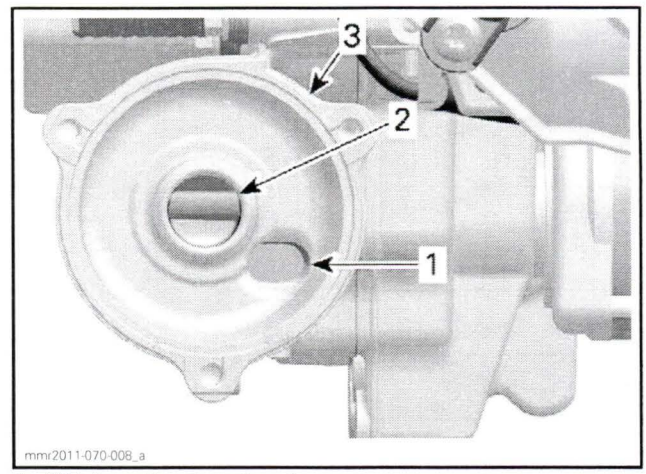


1. Oil filter cover screws
2. Oil filter cover
3. O-ring
4. Oil filter

4. Dispose filter as per your local environmental regulations.

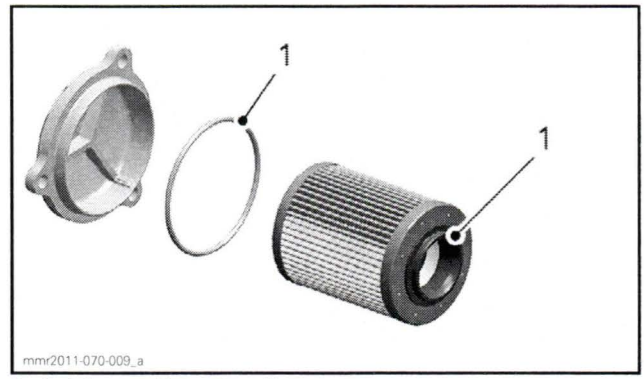
Oil Filter Installation

1. Check the oil filter inlet and outlet orifices inside oil filter receptacle (integrated part of magneto cover) for dirt and contaminations.



1. Oil inlet orifice from the oil pressure pump
2. Oil outlet orifice to the engine lubrication system
3. Oil filter receptacle

2. Install a O-ring on oil filter cover.
3. Lubricate filter seal and cover O-ring with engine oil.



1. Lubricate with engine oil

4. Install the oil filter cover.
5. Tighten oil filter cover screws to the specified torque.

OIL FILTER COVER TIGHTENING TORQUE
10 N•m ± 1 N•m (89 lbf•**in** ± 9 lbf•**in**)

Oil injection Pump Strainer Inspection and Cleaning (600 HO E-TEC)

Break-In	Scheduled Maintenance	Storage	Preseason
	✔		

Refer to *OIL INJECTION PUMP* in *LUBRICATION SYSTEM* subsection.

Oil injection Pump Adjustment (550F)

Break-In	Scheduled Maintenance	Storage	Preseason
✔			✔

Refer to *OIL INJECTION PUMP* in *LUBRICATION SYSTEM* subsection.

Engine Lubrication (550F and 600 HO E-TEC)

Break-In	Scheduled Maintenance	Storage	Preseason
		✔	

Engine Lubrication (550F)

Break-In	Scheduled Maintenance	Storage	Preseason
		✔	

NOTICE Fuel stabilizer should be added prior to engine lubrication to ensure carburetor protection against varnish deposit.

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

Proceed as follows:

1. Place the vehicle in a well ventilated area and start the engine.
2. Start the engine and let it run at idle speed until it reached its operating temperature.
3. Stop the engine.
4. Remove the primary air intake silencer. Refer to *AIR INTAKE SYSTEM* for the removal procedure.
5. Restart engine and run at idle speed.
6. Inject storage oil into each carburetor/throttle body until the engine stalls, or until a sufficient quantity of oil has entered the engine (approximately half a can).
7. With the engine stopped, remove the spark plugs and spray recommended storage oil in each cylinder.

RECOMMENDED SERVICE PRODUCT	
Outside of the U.S.	XPS STORAGE OIL (EXCEPT U.S. COUNTRY) (P/N 413 711 600)
Within the U.S.	XPS STORAGE OIL (U.S. COUNTRY ONLY) (P/N 413 711 900)

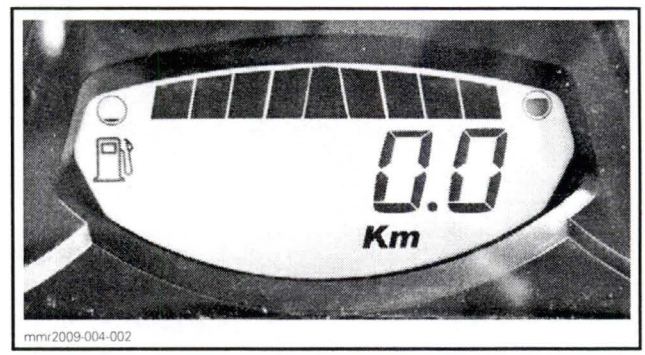
8. Slowly crank engine 2 or 3 revolutions to lubricate cylinders.
9. Reinstall the spark plugs and primary air intake silencer.

Engine Storage Mode (E-TEC)

Like other engines, the E-TEC has to be properly lubricated at storage for internal parts protection. The E-TEC system offers a built-in engine storage lubrication function (summerization) that can be initiated by the operator.

To engage procedure, do the following:

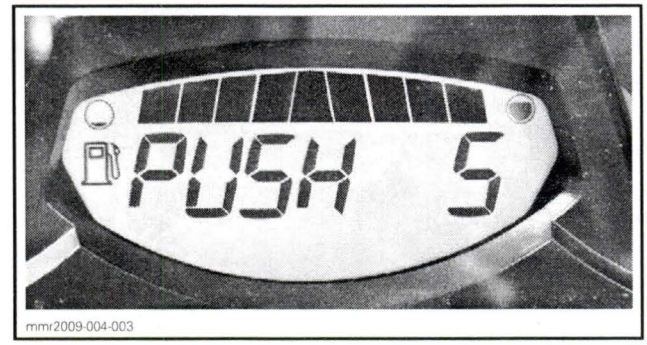
1. Place the vehicle in a well ventilated area.
2. Start the engine and let it run at idle speed until it reaches its operating temperature (watch the coolant temperature on the display or verify that the rear heat exchanger becomes warm).
3. Push the SET (S) button to select odometer mode.



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NOTE: The storage mode does not function in other modes (trip A, trip B and hr trip).

4. Repeatedly depress the HI/LOW beam switch rapidly, then, **while doing this**, press and hold the **SET button** until PUSH "S" appears on the display.

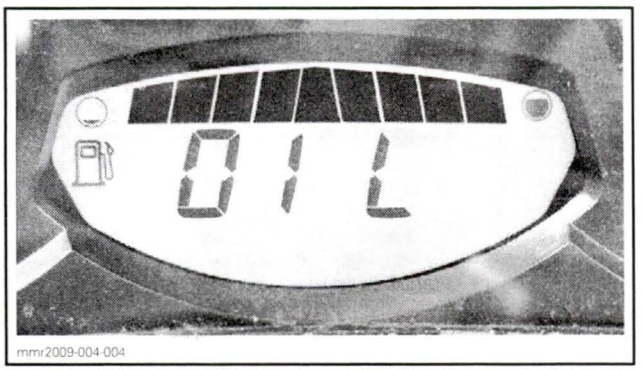


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5. Release all buttons when gauge displays **PUSH "S"** appears.
6. Again, press and hold the SET (S) button for 2 - 3 seconds.

NOTE: The gauge will display OIL when the storage procedure is initiated.

7. When gauge displays **OIL**, release button and wait for the lubrication function to end.



mmr2009-004-004

Do not touch anything during engine lubrication cycle.

The engine lubrication function takes approximately 1 minute. During this time, engine RPM will increase slightly to approximately 1600 RPM and the oil pump will "oil flood" the engine.

At the end of engine lubrication function, the ECM will stop the engine.

8. Remove tether cord cap from engine cut-off switch.

NOTICE **Do not start the engine during storage period.**

ENGINE (COOLING SYSTEM, LIQUID COOLED ENGINES)

Cooling System Inspection

Break-In	Scheduled Maintenance	Storage	Preseason
			✔

Inspect cooling system pressure cap, hoses and clamps for leaks.

Test pressure cap for proper operation.

Recommended Engine Coolant

RECOMMENDED SERVICE PRODUCT	ACCEPTABLE
BRP PREMIXED COOLANT (P/N 219 700 362)	A blend of 50% distilled water with 50% antifreeze (especially formulated for aluminum engines

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

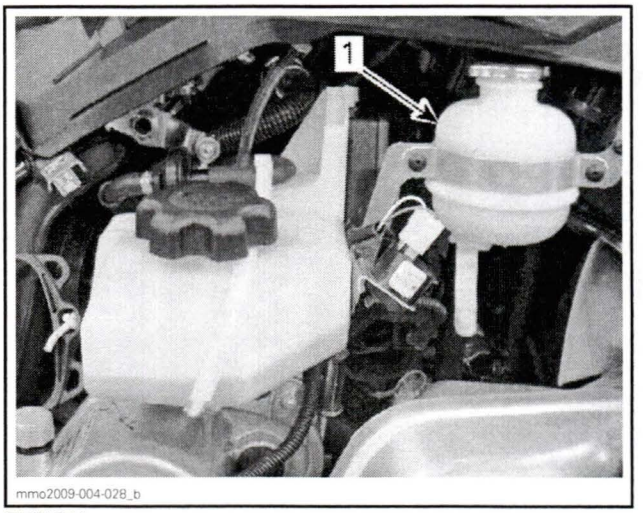
NOTICE To prevent rust formation or freezing condition, always replenish the system with the BRP premixed coolant or with 50% antifreeze and 50% distilled water. Do not use tap water, straight antifreeze or straight water in the system. Tap water contains minerals and impurities which build up in the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

Engine Coolant Level Verification

Break-In	Scheduled Maintenance	Storage	Preseason
✔			

Check coolant level at room temperature with the cap removed. Liquid should be at cold level line (engine cold) of coolant tank.

NOTE: When checking level at low temperature it may be slightly lower then the mark.



mmo2009-004-028_b

TYPICAL
1. Coolant tank

Engine Coolant Strength Verification

Break-In	Scheduled Maintenance	Storage	Preseason
			✔

Remove pressure cap.

Use an antifreeze tester to test coolant strength.

MINIMUM RECOMMENDED COOLANT STRENGTH
-30°C (-22°F)

Engine Coolant Replacement

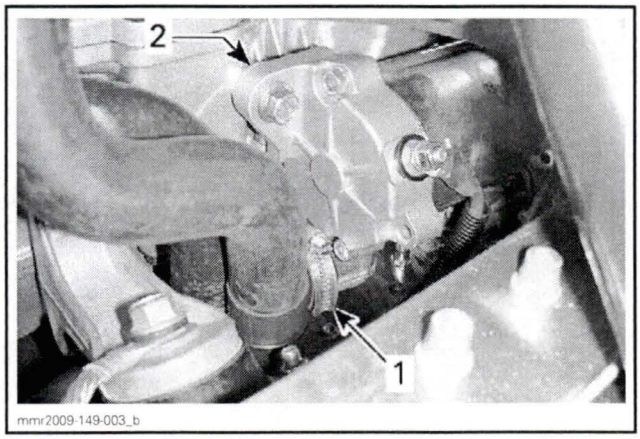
Break-In	Scheduled Maintenance	Storage	Preseason
	✔		

Cooling System Draining (600 HO E-TEC)

⚠ WARNING

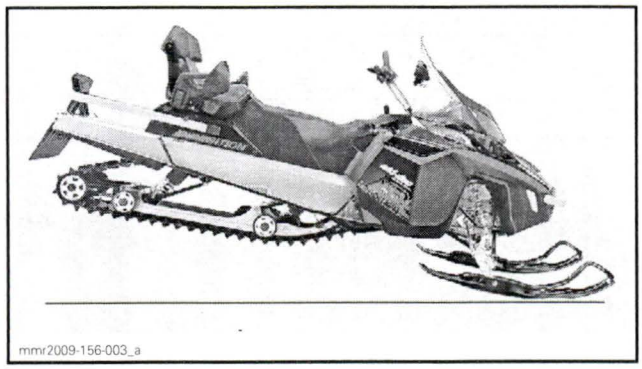
Never drain or refill the cooling system when engine is hot.

1. Remove RH side panel and hood. Refer to *BODY* subsection.
2. Remove muffler and tuned pipe. Refer to *EXHAUST SYSTEM* subsection.
3. Place a large drain pan under the vehicle bottom pan.
4. Unplug coolant hose from water pump to drain coolant.



1. Water pump hose clamp
2. Starter

5. When coolant level is low enough, lift the rear of vehicle to drain the heat exchangers.



6. Install and tighten coolant hose clamp on water pump.

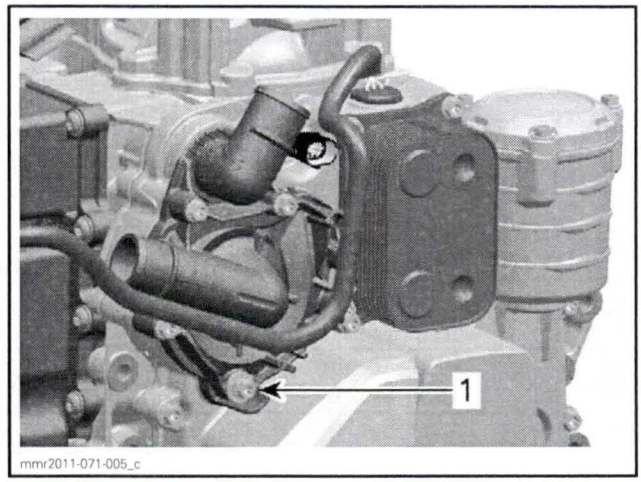
TIGHTENING TORQUE	
Coolant hose clamp	5.5 N•m (49 lbf•**in**)

Cooling System Draining (600 ACE)

⚠ WARNING

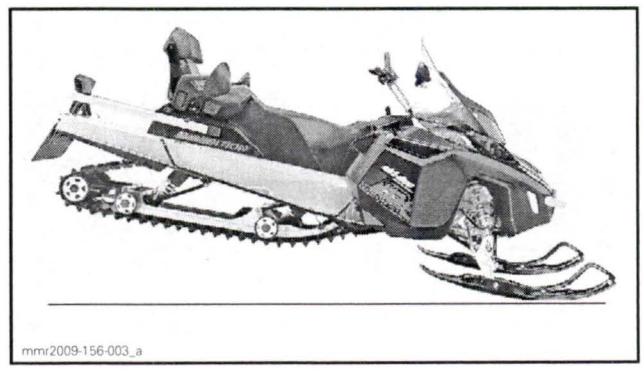
Never drain or refill the cooling system when engine is hot.

1. Remove body parts as required to access to the water pump.
2. Place a large drain pan under the vehicle bottom pan.
3. Remove drain screw at water pump to drain coolant.



600 ACE
1. Drain screw

4. Remove coolant reservoir cap.
5. When coolant level is low enough, lift the rear of vehicle to drain the heat exchangers.

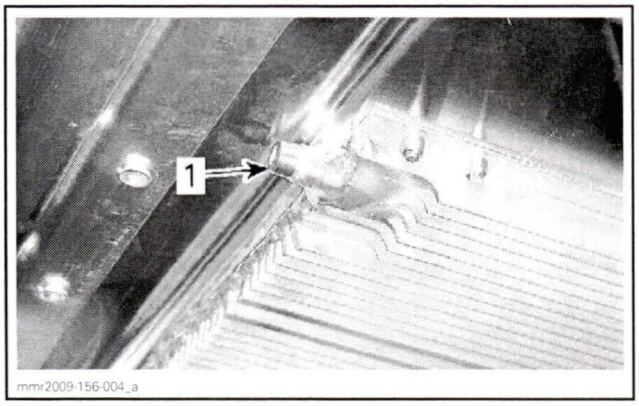


6. Install **new** sealing washer on drain screw.
7. Tighten drain screw to specification.

DRAIN SCREW TORQUE
11 N•m ± 1 N•m (97 lbf•**in** ± 9 lbf•**in**)

Cooling System Refilling and Bleeding

1. Apply parking brake.
2. From underneath the back end of the chassis, remove the heat exchanger drain plug.

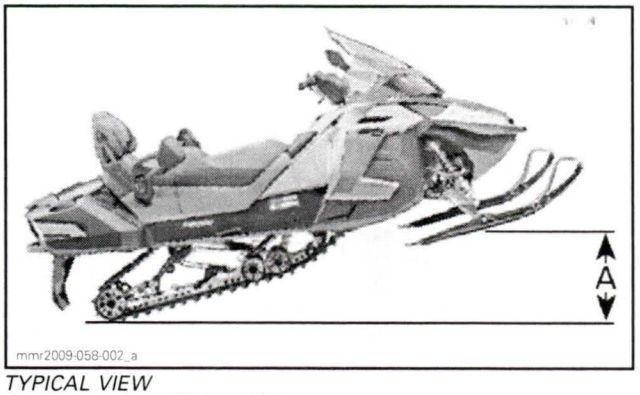


1. Drain plug

3. Fill coolant reservoir until coolant comes out of heat exchanger.
4. Install drain plug and tighten it to specification.

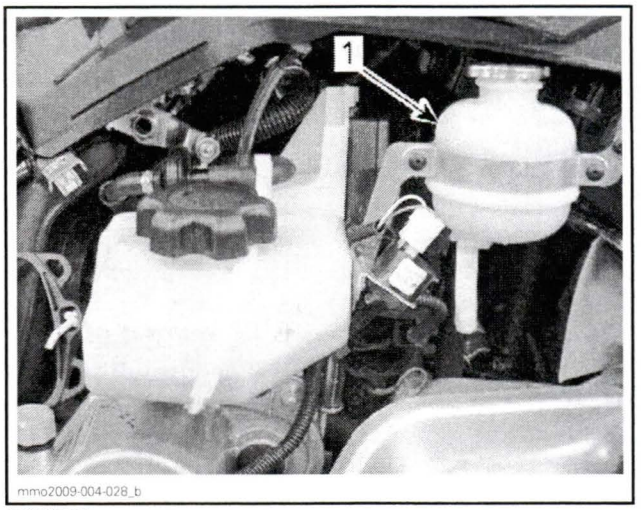
TIGHTENING TORQUE	
Drain plug	10 N•m (89 lbf•**in**)

5. Lift front of vehicle by 25 cm ± 5 cm (10 in ± 2 in) and support safely.



TYPICAL VIEW
A. 25 cm ± 5 cm (10 in ± 2 in)

6. Fill coolant tank up to COLD LEVEL line.



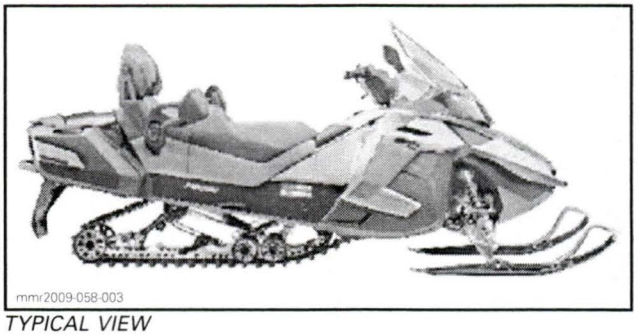
TYPICAL
1. Coolant tank

7. Start engine.
8. Add coolant up to COLD LEVEL line while engine is idling until rear heat exchangers are warm to the touch (about 4 to 5 minutes).

NOTE: Always monitor coolant level while filling coolant tank to avoid an empty coolant reservoir, and thus allow air to enter the system.

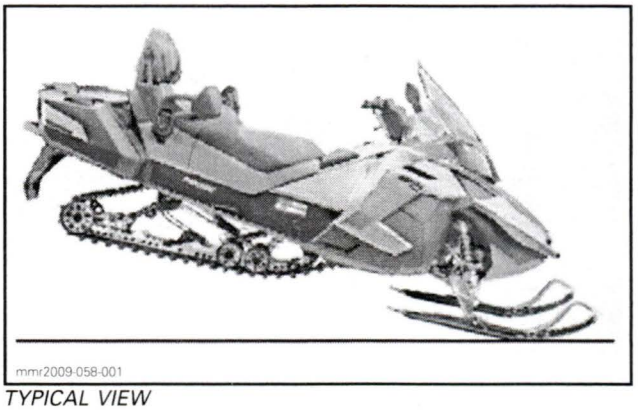
9. Install pressure cap.

Lower vehicle back on the ground.



TYPICAL VIEW

10. Lift rear of vehicle and support it safely.

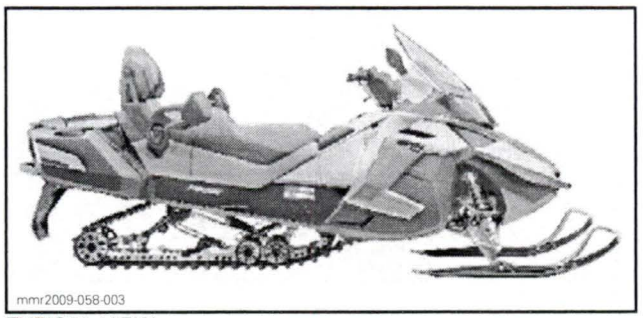


TYPICAL VIEW

⚠ WARNING

Before revving engine, ensure that the track is free of particles which could be thrown out while track is rotating. Keep hands, tools, feet and clothing clear of track. Always lift the snowmobile on a wide-base stand with a rear deflector panel. Ensure no one is standing in close proximity to the snowmobile, especially at the rear of the track. Centrifugal force could cause debris, damaged or loose studs, pieces of torn track, or an entire track to be violently thrown backwards out of the frame with tremendous force, possibly resulting in the loss of a leg or other serious injury.

11. Remove parking brake.
12. Activate throttle lever 3 - 4 times to bring engine speed to 7000 RPM.
13. Apply the brake.
14. Lower vehicle back on ground.



TYPICAL VIEW

15. Stop engine.
16. Add coolant up to 15 mm (1/2 in) above the COLD LEVEL line.
17. When engine has completely cooled down, recheck coolant level in coolant tank and refill up to line if needed.
18. Perform *ENGINE COOLANT STRENGTH VERIFICATION*. See procedure in this subsection.
19. Adjust mixture if necessary.
20. Reinstall removed parts.
21. Run vehicle a few minutes then recheck coolant level.

FUEL SYSTEM

Fuel System Protection

Break-In	Scheduled Maintenance	Storage	Preseason
		✔	

With the new fuel additives used today, it is critical to add a fuel stabilizer to the fuel during storage to prevent fuel deterioration, gum formation and fuel system gumming. Follow manufacturers instructions for proper use.

RECOMMENDED PRODUCT
XPS FUEL STABILIZER (P/N 413 408 601)

NOTICE The fuel stabilizer should be added prior to engine lubrication, to ensure fuel system component protection against varnish deposits.

1. Pour fuel stabilizer in fuel tank.
2. Fill up fuel tank completely.
3. Run engine sufficiently for fuel with stabilizer to be distributed to entire fuel system.
4. Ensure there is no water inside fuel tank.

NOTICE Do not drain fuel system.

Fuel Line and Connection Inspection

Break-In	Scheduled Maintenance	Storage	Preseason
✔			✔

Visually inspect all fuel lines and connections for cracks or leaks.

Fuel Pump Strainer Inspection (550F/600 HO E-TEC)

Break-In	Scheduled Maintenance	Storage	Preseason
	✔		

Inspect strainer for cleanliness, obstruction, or damage. Clean or replace if necessary. Refer to FUEL TANK AND FUEL PUMP subsection.

In-line Fuel Filter Replacement (600 HO E-TEC)

Break-In	Scheduled Maintenance	Storage	Preseason
	✔		

In-line Fuel Filter Removal

1. Release fuel pressure in the system, refer to *FUEL TANK AND FUEL PUMP* subsection.
2. Remove the RH side panel.
3. Disconnect magneto connector.

⚠ WARNING

The magneto connector must be disconnected to prevent any spark in the engine compartment and to remove power from the fuel pump. Otherwise, if the engine is cranked, fuel vapors may ignite in presence of a spark creating a fire hazard.

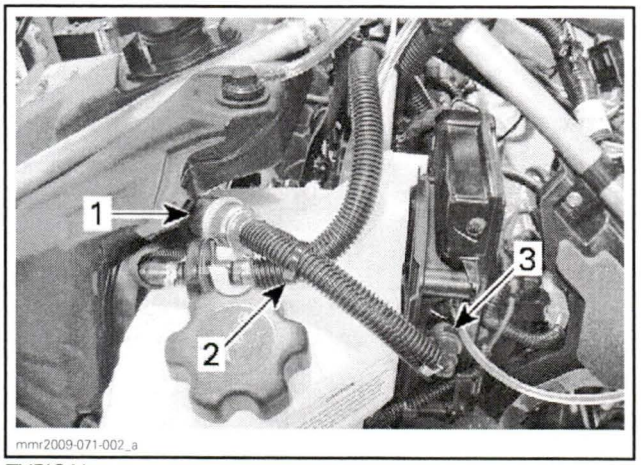
4. Cut the locking ties securing the fuel return hose to the fuel supply hose.

⚠ WARNING

Work in a well ventilated area. Wipe up all spilled fuel.

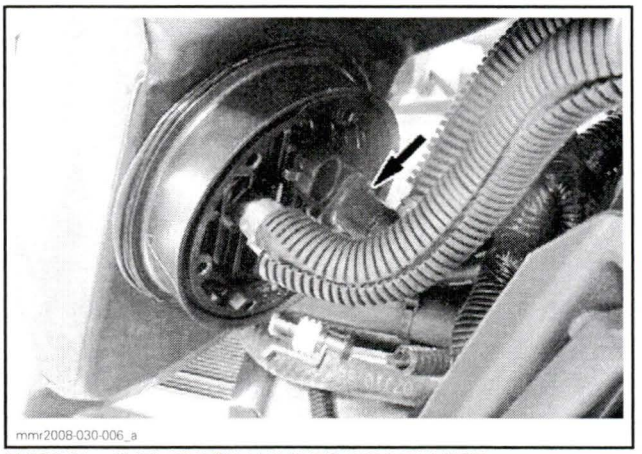
5. Press the release button on the fuel pressure hose quick disconnect fitting and slowly pull the fitting off the ECM.

NOTE: Place several shop rags and a container under the hose fitting to recover residual fuel remaining in the system.



TYPICAL
1. *In line fuel filter*
2. *Locking tie to cut*
3. *Quick disconnect fitting*

6. Place several shop rags under the quick disconnect fitting at the fuel pump and disconnect it from the fuel pump.



TYPICAL - FUEL SUPPLY LINE TO DISCONNECT

7. Remove fuel filter from vehicle.

In-Line Fuel Filter Installation

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

⚠ WARNING

Ensure hose clamp is tight and that hose cannot turn on the fitting.

When reconnecting quick disconnect pressure fittings to fuel pump and ECM, be sure to pull on the each end of the hose to ensure they are properly locked and secure.

When installation is complete, carry out a fuel system leak test, refer to *FUEL SYSTEM PRESSURIZATION AND LEAK TEST* in *FUEL TANK AND FUEL PUMP* subsection.

⚠ WARNING

After working on the fuel system, carry out a fuel system pressurization and leak test to check for fuel leaks. Failure to carry out a fuel system leak test could result in severe injury or a life threatening situation should a leak occur.

Fuel Pump Outlet Filter Replacement (600 ACE)

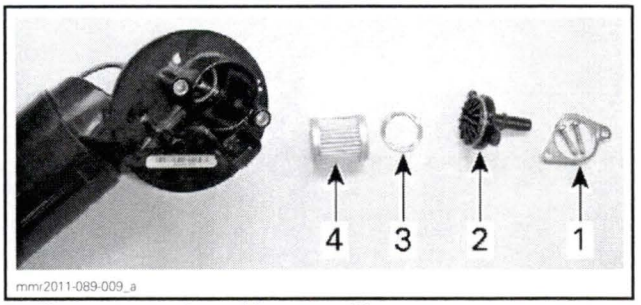
Break-In	Scheduled Maintenance	Storage	Preseason
	✔		

NOTE: The fuel pump outlet filter is housed within the mounting flange of the fuel pump module. It can be replaced without removing the fuel pump module from the fuel tank.

1. Disconnect fuel pump electrical connector to deactivate fuel pump.

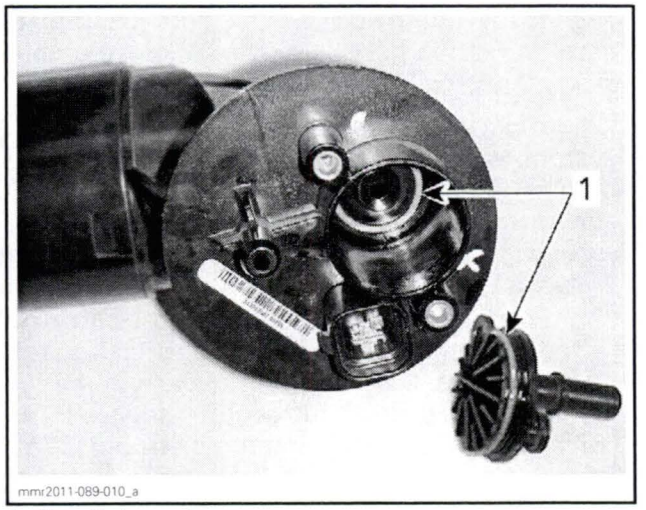
2. Start and run engine until it stalls.
3. Place several shop rags under the fuel pump pressure hose fitting to prevent fuel from leaking onto the connectors of the voltage regulator/rectifier unit.
4. Remove following parts from fuel pump module.

NOTE: Do not remove fuel pump module from fuel tank.



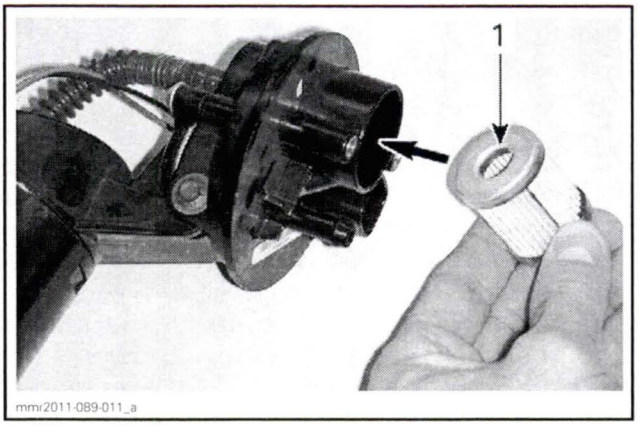
1. *Filter cover retainer with screws (2)*
2. *Filter cover*
3. *Wave spring*
4. *Filter element.*

5. Install **NEW** O-ring seals on filter cover and in filter housing.



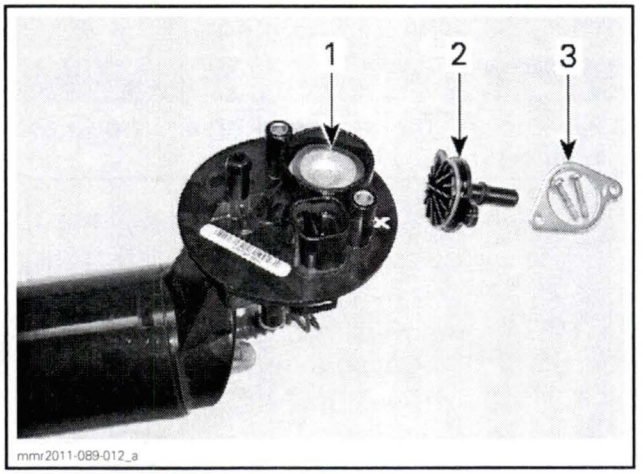
1. *New O-ring seals*

6. Insert filter element as per following illustration.



1. *This end in first*

7. Install remaining filter parts.



1. *Wave spring*
2. *Filter cover*
3. *Cover retainer with screws (2)*

FILTER COVER SCREW TORQUE
3 N•m (27 lbf•**in**)

8. Install and reconnect the fuel pump module (pressure hose and electrical connector), refer to *FUEL PUMP INSTALLATION (600 ACE)* in the *FUEL TANK AND FUEL PUMP* subsection.
9. Carry out a *FUEL SYSTEM PRESSURIZATION AND LEAK TEST* as detailed in the *FUEL TANK AND FUEL PUMP* subsection.
10. Install remaining parts in the reverse order of removal, refer to *FUEL TANK INSTALLATION* in this subsection.

Carburetor Inspection, Cleaning and Adjustment (550F)

Break-In	Scheduled Maintenance	Storage	Preseason
			✔

Refer to *VM CARBURETORS, THROTTLE AND CHOKE CABLE (550F)* subsection.

Throttle Body Inspection and Cleaning (600 HO E-TEC and 600 ACE)

Break-In	Scheduled Maintenance	Storage	Preseason
			✔

Clean throttle plates and throttle body bores using PULLEY FLANGE CLEANER (P/N 413 711 809).

Throttle Cable Inspection

Break-In	Scheduled Maintenance	Storage	Preseason
✔	✔		✔

Visually inspect cable sheath for kinks, wear other damage.

Visually inspect cable at throttle plate and throttle lever for fraying or other damage.

Make sure the throttle cable operates smoothly.

ELECTRICAL SYSTEM (CHARGING)

Battery Charging

Break-In	Scheduled Maintenance	Storage	Preseason
		✔	✔

To charge battery, refer to *CHARGING SYSTEM* subsection.

ELECTRICAL SYSTEM (IGNITION)

Spark Plug Replacement (550F)

550F			
Break-In	Scheduled Maintenance	Storage	Preseason
			✔

NOTE: Replace spark plugs only after excess engine storage oil has been burned off.

Spark Plug Removal

1. Remove LH side panel, refer to *BODY* subsection.
2. Remove air outlet duct, refer to *AXIAL FAN* subsection.
3. Disconnect spark plug wire by twisting and lifting up on cap.
4. Unscrew spark plug 1 turn.
5. Clean spark plug and cylinder head with pressurized air, then completely remove spark plug.

⚠ CAUTION Whenever using compressed air, always wear protective eye wear.

Spark Plug Installation

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

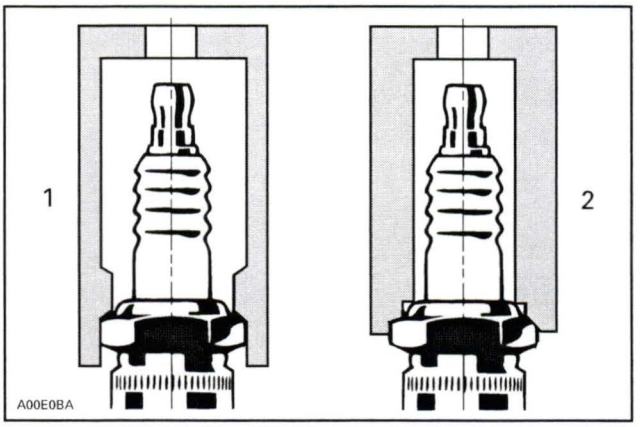
Prior to installation make sure that contact surfaces of the cylinder head and spark plug are free of grime.

Using a feeler gauge, measure spark plug gap.

NOTE: Replace spark plug if gap is out of specification.

ENGINE	SPARK PLUG	GAP
550F	NGK BR9ECS	0.4 mm to 0.5 mm (.016 in to .02 in)

Hand screw spark plug into cylinder head, then tighten to specified torque.



TYPICAL
1. *Proper socket*
2. *Improper socket*

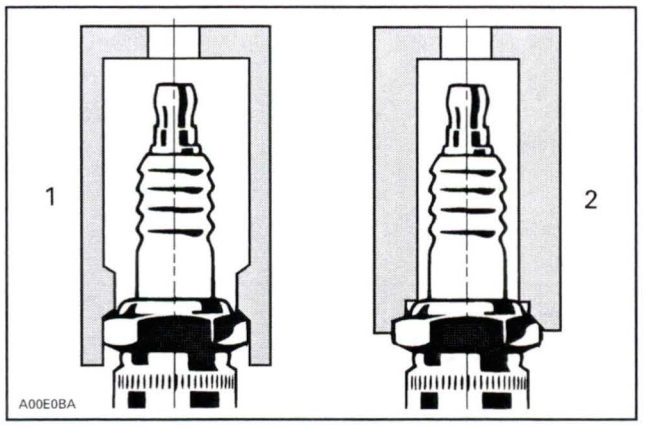
PART	SERVICE PRODUCT	TORQUE
SPARK PLUG THREADS	LOCTITE 767 (ANTISEIZE LUBRICANT) (P/N 293 800 070)	28 N•m (21 lbf•ft)

Spark Plug Replacement (600 ACE)

Break-In	Scheduled Maintenance	Storage	Preseason
	✔		

Spark Plug Removal

1. Remove ignition coil from spark plug. Refer to *IGNITION SYSTEM* subsection.
2. Using an approved spark plug socket, release the torque applied to the spark plug and unscrew a few turns.



1. Aproved socket
2. Improper socket

3. Clean the spark plug and cylinder head with pressurize air.
4. Remove spark plug.

Spark Plug Installation

Prior to installation, ensure the contact surfaces of the cylinder head and spark plug are free of grime.

1. Using a wire feeler gauge, check electrode gap as specified in the following chart.

NOTICE **Do not adjust gap on this type of spark plug. The adjustment could weaken negative electrodes which may lead to electrode breakage and severe engine damage.**

ENGINE	SPARK PLUG	GAP mm (in)	TORQUE
600 ACE	NGK MR7BI-8	0.7 mm to 0.8 mm (.028 in to .031 in) NOT adjustable	13 N•m (115 lbf•**in**)

PART	SERVICE PRODUCT	TORQUE
SPARK PLUG THREADS	LOCTITE 767 (ANTISEIZE LUBRICANT) (P/N 293 800 070)	28 N•m (21 lbf•ft)

2. Hand screw spark plug into cylinder head. Then, tighten the spark plug clockwise to specified torque with an approved spark plug socket.
3. Install ignition coil. Refer to *IGNITION SYSTEM* subsection.
4. Complete the installation in the reverse order of the removal.

Spark Plugs Replacement (600 HO E-TEC)

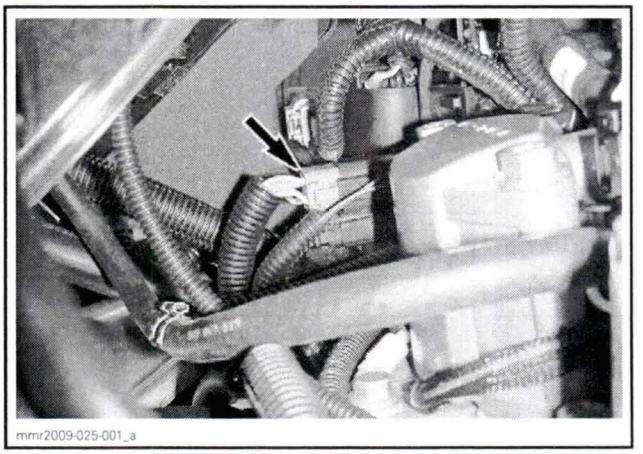
Break-In	Scheduled Maintenance	Storage	Preseason
	✔		

Spark Plug Removal

1. Disconnect the magneto connector.

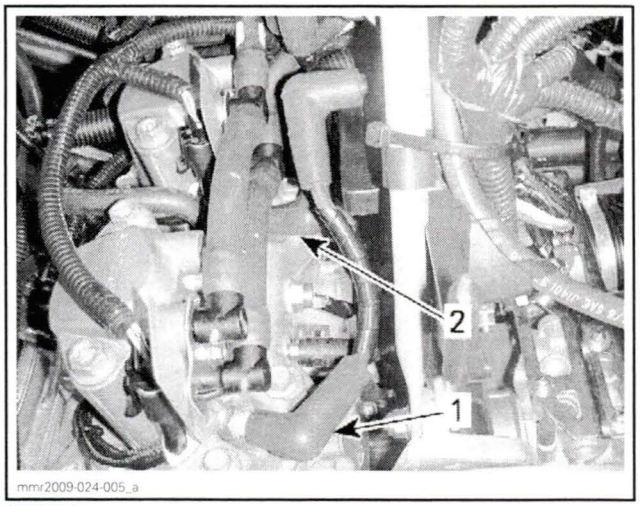
⚠ WARNING

Cranking engine with spark plug removed and without disconnecting the magneto connector may ignite fuel vapors creating a fire hazard.



TYPICAL — MAGNETO CONNECTOR

2. Remove the primary air intake silencer.
3. Remove spark plug cables by gently rotating the cap and pulling it off the plug.



TYPICAL
1. *PTO spark plug*
2. *MAGspark plug*

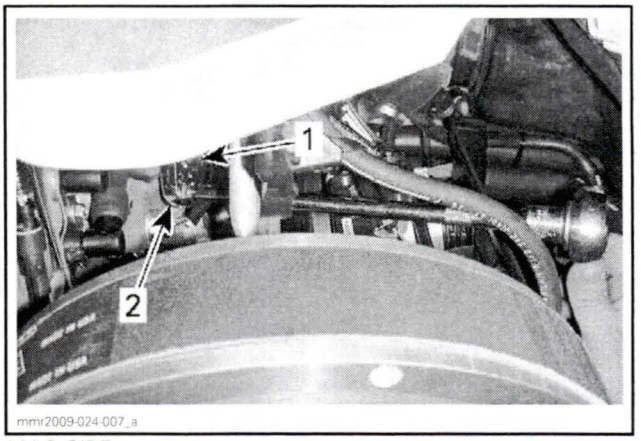
4. Clean the spark plug and cylinder head with pressurized air.

⚠ WARNING

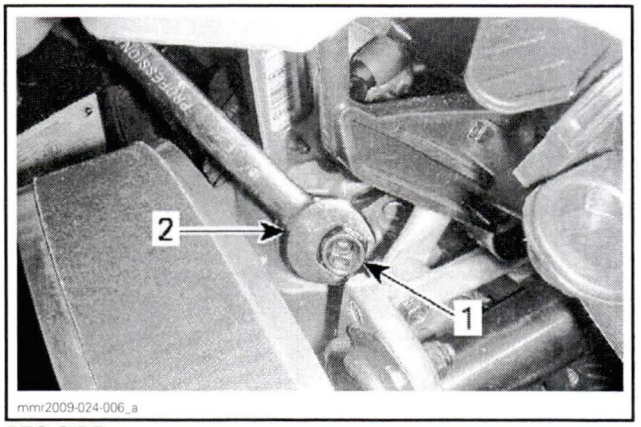
Whenever using compressed air, always wear protective eye wear.

5. Unscrew the spark plug sufficiently to break the applied torque using the appropriate tools.

CYLINDER IDENTIFICATION	REQUIRED TOOLS
MAG side	– Spark plug socket (16 mm (5/8 in)) – Crowfoot (19 mm (3/4 in)) – Ratchet wrench – Extension
PTO side	– Spark plug socket (16 mm (5/8 in)) – Wrench (19 mm (3/4 in))



MAG SIDE
1. *Spark plug socket (16 mm (5/8 in))*
2. *Crowfoot (19 mm (3/4 in))*



PTO SIDE
1. *Spark plug socket (16 mm (5/8 in))*
2. *Wrench (19 mm (3/4 in))*

6. Remove spark plugs by hand.

Spark Plug Installation (OEM spark plug)

1. Prior to installation, ensure the contact surfaces of the cylinder head and spark plug are free of grime.
2. Using a feeler gauge, confirm electrode gap is set as specified.

NOTE: If gap is incorrect, use another spark plug.

3. Hand screw spark plug into cylinder head until it bottoms out.
4. Apply specific torque using a torque wrench, crow foot, and approved spark plug socket.

NOTE: Spark plug tightening torque is particularly important on this engine as it contributes to the proper positioning of the negative electrode.

ENGINE	TYPE	GAP	TORQUE
600 HO E-TEC	NGK PZFR6F (indexed)	0.7 mm to 0.8 mm (.028 in to .031 in) **NOT** adjustable	28 N•m (21 lbf•ft)

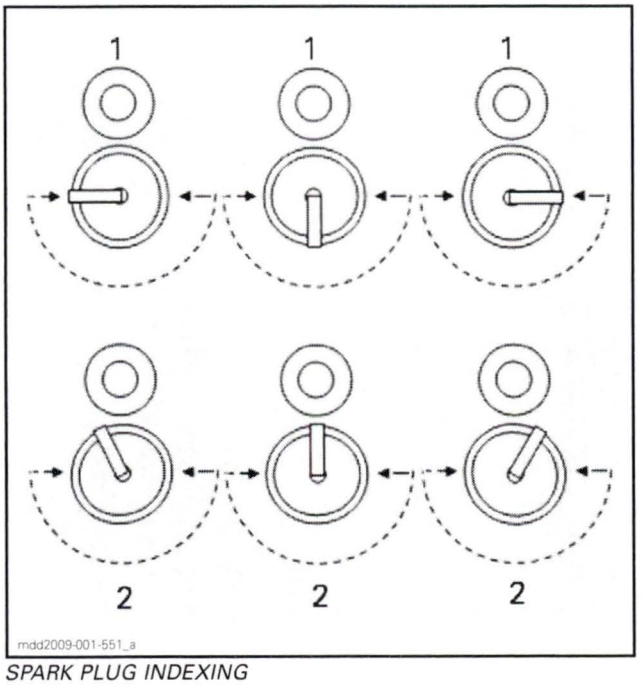
5. Apply DIELECTRIC GREASE (P/N 293 550 004) on contact in spark plug cap of the ignition cable prior to connecting it onto the spark plug.

Spark Plug Installation (Non-OEM)

NOTE: When using a non-OEM spark plug, it must be correctly indexed or engine may experience rough idling and higher emissions.

1. Using a marker, mark the open end of the negative electrode on the plug shell (above threads).
2. Ensure the contact surfaces of the cylinder head and spark plug are free of grime.
3. Install and torque the spark plug, refer to previous table for specific torque.
4. Visually check to ensure the open end of the negative electrode is facing the injector nozzle within 90° each side of nozzle.

NOTE: The following illustration uses the point of attachment of the negative electrode to depict the angle. The injector is illustrated above the spark plug.

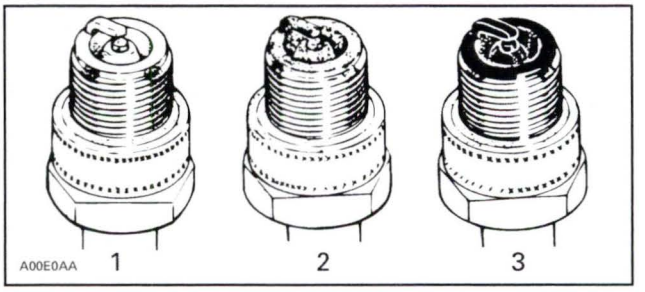


SPARK PLUG INDEXING
1. Acceptable installation
2. Unacceptable installation

If the plug indexing angle is not within specification, repeat procedure with another spark plug until correct indexing is achieved.

Spark Plug Inspection

Spark Plug Analysis



TYPICAL
1. Overheated (light gray, white)
2. Normal (light brown, brown)
3. Fouled (black, wet or dry, dark deposits, gray, melted coating)

The plug face reveals the condition of the engine, operating condition, method of driving and fuel mixture. For this reason it is advisable to inspect the spark plug at prescribed intervals, examining the plug face (i.e. the part of the plug projecting into the combustion chamber).

Troubleshooting a Fouled Spark Plug

Fouling of the spark plug is indicated by irregular running or misfiring of the engine, decreased engine speed due to misfiring, reduced performance, and increased fuel consumption.

Other possible causes are: a incorrect or bad fuel, defective ignition system, incorrect spark plug gap, loss of compression, or lubricating oil entering the combustion chamber.

The plug face of a fouled spark plug has either a wet or dry black carbon deposit. Such coatings form a conductive connection between the center electrode and the ground electrode.

ELECTRICAL SYSTEM (LIGHTS)

Headlights Beam Aiming Adjustment

Break-In	Scheduled Maintenance	Storage	Preseason
			✔

Refer to *LIGHTS, GAUGE AND ACCESSORIES* subsection.

DRIVE SYSTEM (CLUTCHES)

Drive Belt Inspection

Break-In	Scheduled Maintenance	Storage	Preseason
✔			✔

Refer to *DRIVE BELT* subsection.

Drive Pulley Inspection and Cleaning

Break-In	Scheduled Maintenance	Storage	Preseason
✔	✔		✔

Refer to *DRIVE PULLEY* subsection.

Drive Pulley Retaining Screw Tightening

Break-In	Scheduled Maintenance	Storage	Preseason
✔	✔		

Refer to *DRIVE PULLEY* subsection.

Driven Pulley Inspection and Cleaning

Break-In	Scheduled Maintenance	Storage	Preseason
✔	✔		✔

Inspect pulley sheaves for dirt, marks or scratches.

Test sliding sheave operation.

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

NOTE: When removing dust on the cam, avoid altering the teflon coating. Use a dry cloth only.

Driven Pulley Spring Preload (600 ACE)

Break-In	Scheduled Maintenance	Storage	Preseason
✔	✔		

Refer to *DRIVEN PULLEY AND COUNTERSHAFT (600 ACE)* subsection.

DRIVE SYSTEM (GEARBOX)

Recommended Gearbox Oil

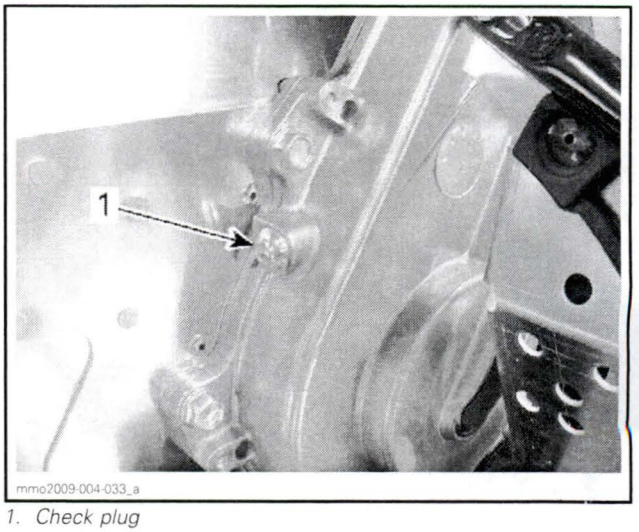
RECOMMENDED GEARBOX OIL
XPS SYNTHETIC CHAINCASE OIL (P/N 413 803 300)

NOTICE The gearbox of this snowmobile has been developed and validated using the XPS™ Synthetic chaincase oil. BRP strongly recommends the use of its XPS Synthetic chaincase oil at all times. Damages caused by oil which is not suitable for the gearbox will not be covered by the BRP limited warranty.

Gearbox Oil Level Verification

With the vehicle on a level surface, check the oil level by removing the check plug on the left side of gearbox.

Oil level must reach the threaded hole's lower edge.



1. Check plug

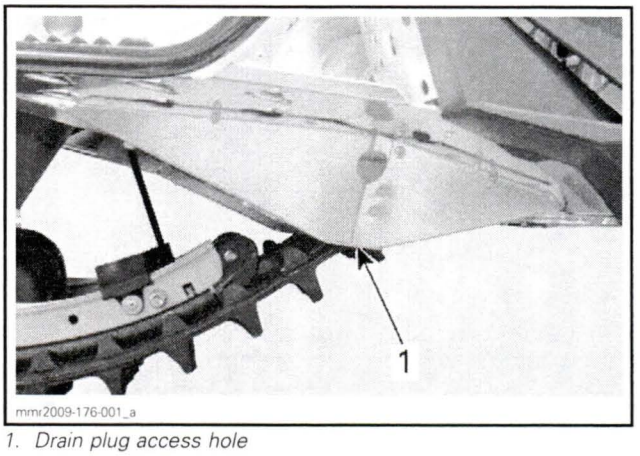
1. Reinstall check plug and torque to 10 N•m ± 1 N•m (89 lbf•**in** ± 9 lbf•**in**).

Gearbox Oil Replacement

Break-In	Scheduled Maintenance	Storage	Preseason
✔			✔

Gearbox Oil Draining

1. Place the vehicle on a level surface.
2. Place a drain pan under gearbox drain plug area.
3. Remove filler cap.
4. Remove the drain plug located at the bottom of gearbox.



1. Drain plug access hole

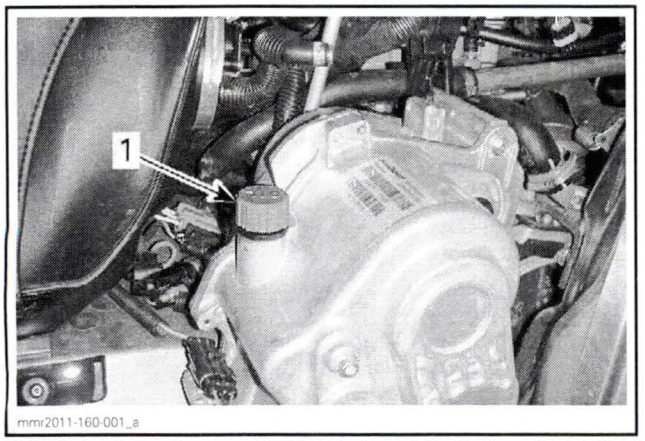
5. Wait a while to allow all oil to drain out of gearbox.
6. Install drain plug and torque to specification.

TIGHTENING TORQUE	
Gearbox drain plug	8 N•m (71 lbf•**in**)

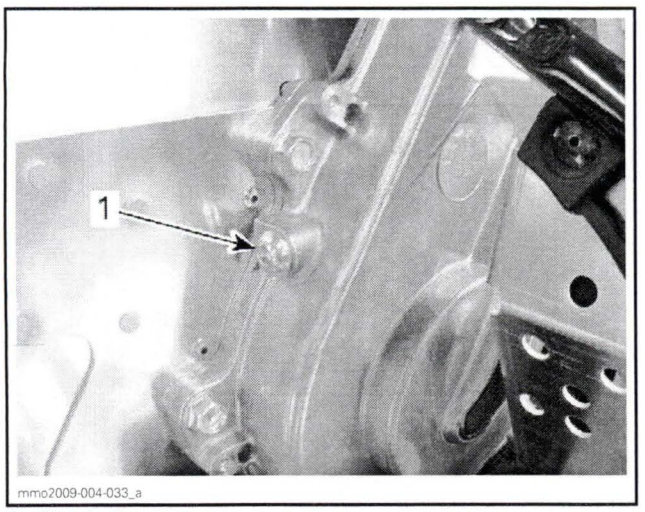
Gearbox Oil Filling

NOTE: Vehicle must be on a level surface.

1. Remove the filler cap.
2. Remove oil level check plug.



TYPICAL
1. Filler cap



1. Check plug

3. Pour recommended oil into gearbox through the filler hole.

NOTE: Oil level is correct when it just begins to come out of the check plug orifice.

4. Reinstall check plug and torque to specification.

TIGHTENING TORQUE	
Oil level check plug	10 N•m (89 lbf•**in**)

DRIVE SYSTEM (TRACK)

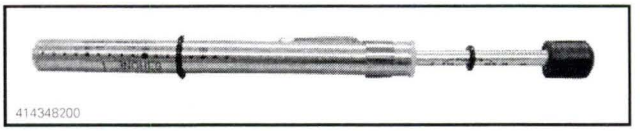
Track Adjustment and Alignment

Break-In	Scheduled Maintenance	Storage	Preseason
✔	✔		✔

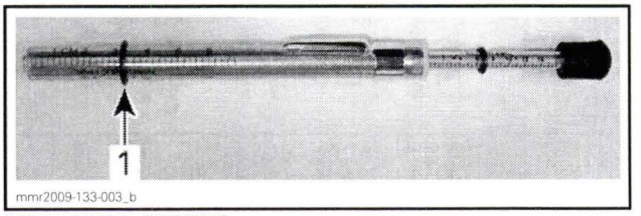
Track tension and alignment are interrelated. Do not adjust one without checking the other. Track tension procedure must be carried out prior to track alignment.

Track Tension Verification

1. Lift rear of vehicle and support it off the ground.
2. Allow rear suspension to fully extend.
3. Preset the TENSIOMETER (P/N 414 348 200) as specified in the following table.

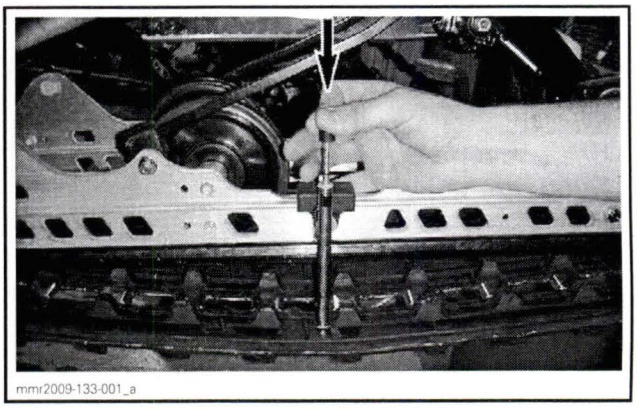


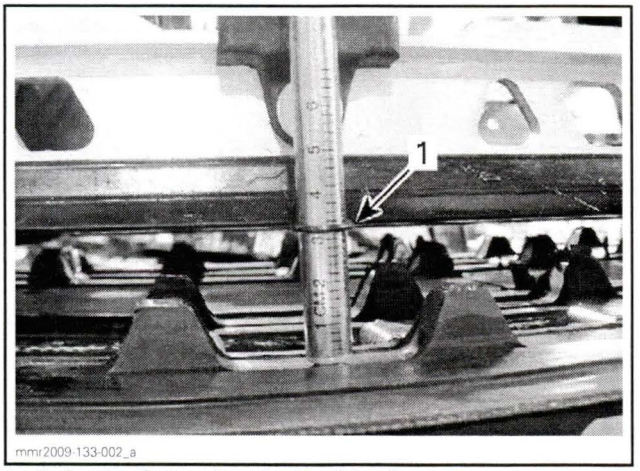
TRACK TENSIOMETER PRESETTING	
DEFLECTION O-RING (BOTTOM)	LOAD O-RING (TOP)
4.5 cm (1.772 in)	0 kgf (0 lbf)



DEFLECTION SETTING
1. Bottom O-ring

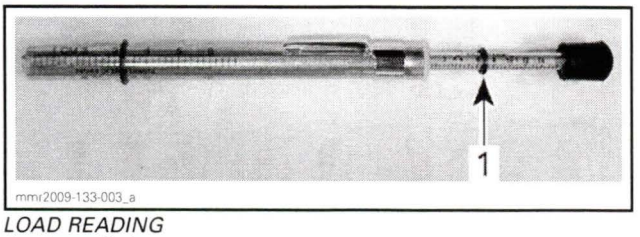
4. Position the tensiometer on track, halfway between front and rear idler wheels.
5. Push the tensiometer downwards until bottom O-ring (deflection) be aligned with the bottom of slider shoe.





1. Deflection O-ring aligned with slider shoe

6. Read load recorded by the upper O-ring on the tensiometer.



LOAD READING
1. Upper O-ring

Load reading must be as per the following table.

TRACK ADJUSTMENT SPECIFICATION	
TRACK DEFLECTION SETTING	4.5 cm (1-9/16 in)
TRACK LOAD READING	6.0 kgf to 8.5 kgf (13 lbf to 19 lbf)

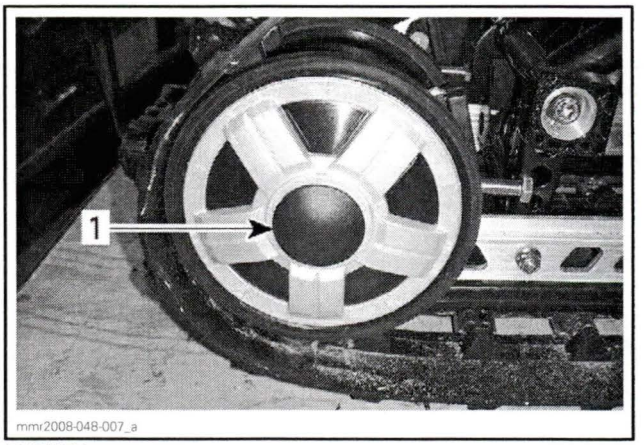
7. If load reading is not in accordance with the specification, adjust track tension. Refer to *TRACK TENSION ADJUSTMENT*.

NOTICE **Too much tension will result in power loss and excessive stresses on suspension components.**

Track Tension Adjustment

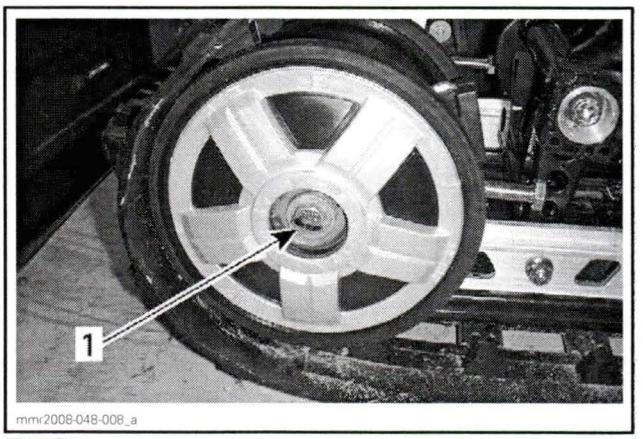
NOTE: After track tension adjustment, ride the snowmobile in snow for 15 to 20 minutes and recheck track tension.

1. Lift rear of vehicle and support it off the ground.
2. Remove rear idler wheel caps.



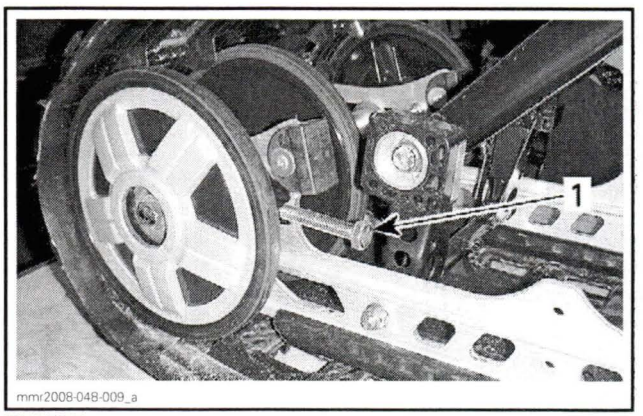
TYPICAL
1. RH rear idler wheel cap

3. Loosen rear axle screws (one each side).



TYPICAL
1. RH rear axle screw

4. Tighten or loosen both adjustment screws to increase or decrease track tension.



TYPICAL
1. RH adjustment screw

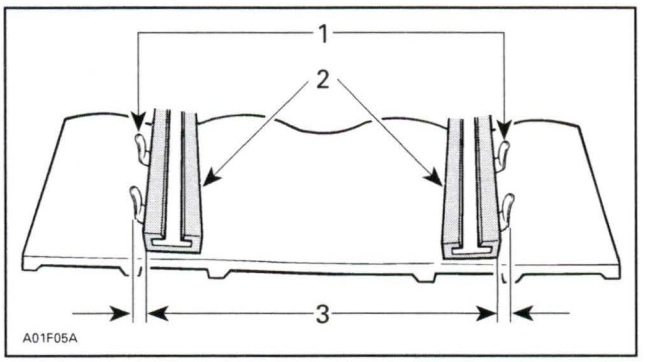
5. Verify track tension, refer to *TRACK TENSION VERIFICATION* in this subsection.

Track Alignment

⚠ WARNING

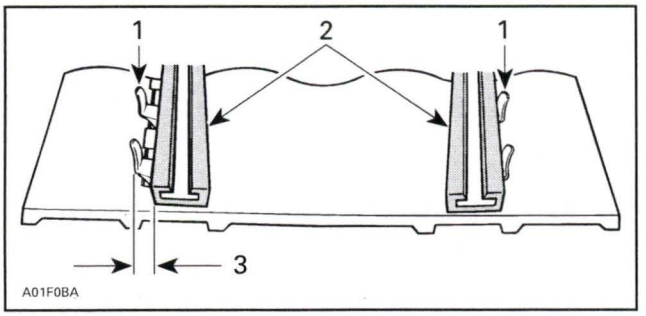
Before checking track alignment, ensure that the track is free of all particles which could be thrown out while track is rotating. Keep hands, tools, feet and clothing clear of track. Ensure no one is standing in close proximity to the vehicle. Never rotate at high speed.

1. Start engine and accelerate slightly until the track barely turns. This must be done in a short period of time (1 to 2 minutes).
2. Ensure the track is well centered; equal distance on both sides between edges of track guides and slider shoes.



1. Guides
2. Slider shoes
3. Equal distance

3. To correct track alignment:
   - 3.1 Stop engine.
   - 3.2 Loosen rear wheel screws.
   - 3.3 Tighten adjustment screw on side where the slider shoe is the farthest from the track inset guides.



1. Track guides
2. Slider shoes
3. Tighten on this side

4. Restart engine.
5. Rotate track slowly and recheck alignment.
6. If satisfactory alignment is achieved:
   - 6.1 Tighten idler wheel retaining screws.

IDLER WHEEL SCREW TIGHTENING TORQUE
48 N•m (35 lbf•ft)

   - 6.2 Reinstall wheel caps.

BRAKE

Recommended Brake Fluid

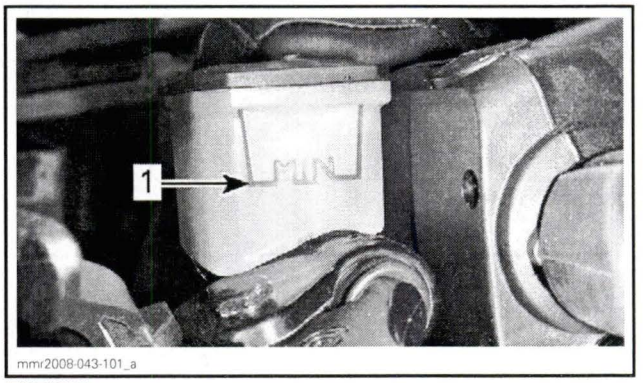
Always use brake fluid meeting the specification DOT 4 such as BRAKE FLUID (P/N 293 600 131).

Brake Fluid Level Verification

Break-In	Scheduled Maintenance	Storage	Preseason
✔			✔

With the vehicle on a level surface, position steering in straight-ahead position to ensure reservoir is level.

Brake fluid must always be above the MIN. line when brake lever is squeezed.



TYPICAL
1. MINIMUM line

Add fluid as required. Do not overfill.

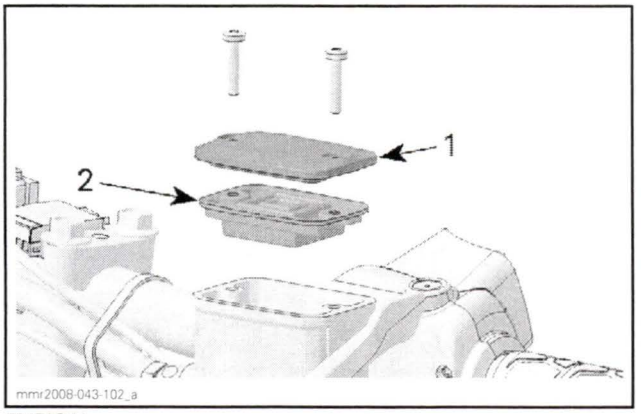
NOTE: A low level may indicate leaks or worn brake pads.

Brake Fluid Replacement

Break-In	Scheduled Maintenance	Storage	Preseason
	✔		

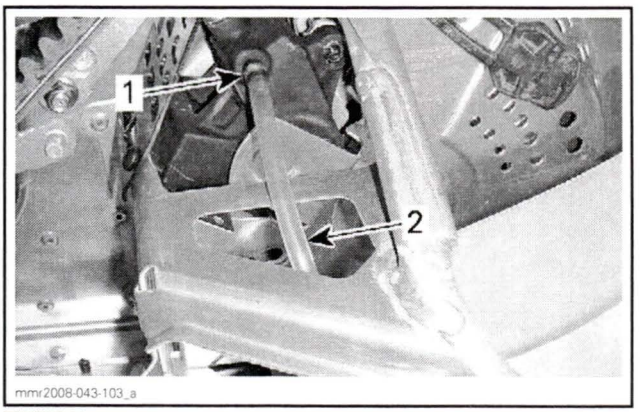
To drain brake fluid, proceed as follows:

1. Place vehicle on a level surface.
2. Remove reservoir cover with its diaphragm.



TYPICAL
1. *Reservoir cover*
2. *Diaphragm*

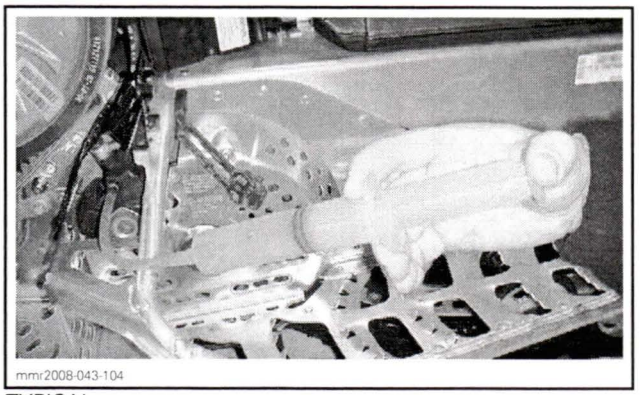
3. Connect a clear hose to caliper bleeder.
4. Place the other end of hose in a container.
5. Loosen bleeder and pump brake lever until no more fluid flows out of bleeder.



TYPICAL
1. *Bleeder*
2. *Clear hose to catch used brake fluid*

To fill brake system when it is empty, proceed as follows:

1. Ensure reservoir cover is removed.
2. Using a large syringe and a suitable tube, inject brake fluid slowly into the caliper.



TYPICAL

3. Continue to inject brake fluid until master cylinder reservoir is half full.
4. Close bleeder.
5. Fill up reservoir and install cover.
6. Squeeze brake lever.
   6.1 If brake lever is firm, bleeding of the brake system is not required. Torque bleeder as specified.

TIGHTENING TORQUE	
Brake caliper bleeder	9 N•m (80 lbf•**in**)

   6.2 If brake lever is spongy, refer to *BRAKE SYSTEM BLEEDING* in this subsection.

Brake System Bleeding

1. Install a clear hose on bleeder.
2. Place the other end in a container partially filled with clean brake fluid.
3. Pump up brake system pressure using the brake lever until lever resistance is felt.
4. Squeeze and hold brake lever and open bleeder. When the lever touches the handlebar, do not release it and close the bleeder.
5. Release brake lever slowly.
6. Repeat the procedure until no more air bubbles appear in hose.

NOTE: Check fluid level often to prevent air from being pumped into the circuit.

7. Install cover on reservoir.
8. Squeeze brake lever.

NOTE: If brake lever feels firm; bleeding procedure is complete. Torque bleeder as specified. If brake lever is still spongy; go to step 9

TIGHTENING TORQUE	
Brake caliper bleeder	9 N•m (80 lbf•**in**)

9. Push back brake pads with caliper still installed and squeeze brake lever.
10. Repeat step 2 to step 5.
11. Torque bleeder as specified.
12. Adjust brake fluid reservoir level.
13. Install diaphragm and cover on reservoir.

Brake Hose, Pads and Disc Inspection

Break-In	Scheduled Maintenance	Storage	Preseason
✔	✔		✔

Break-In Inspection

Visually inspect the brake hose for leaks or any damage.

Visually inspect pads and disc for abnormal wear or any damage.

Scheduled Maintenance and Preseason

Visually inspect the brake hose for leaks or any damage.

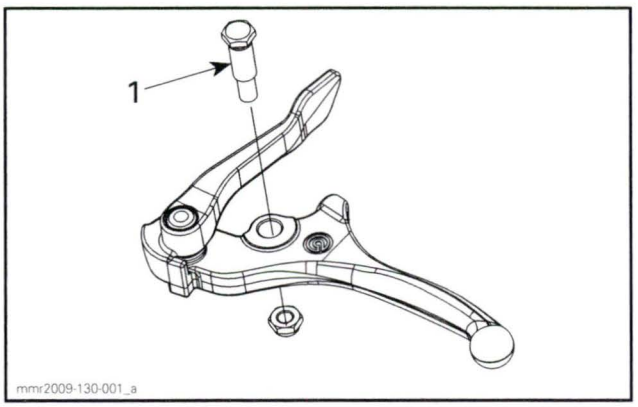
Refer to *BRAKE* subsection and carry out:
- *BRAKE PAD INSPECTION*
- *BRAKE DISC INSPECTION.*

Brake Lever Pivot Lubrication

Break-In	Scheduled Maintenance	Storage	Preseason
		✔	

1. Remove brake lever pivot bolt.
2. Lubricate brake lever pivot bolt using recommended product.

SERVICE PRODUCT	
Brake lever pivot	XPS SYNTHETIC GREASE (P/N 293 550 010)



1. Lubricate this surface

3. Install brake lever pivot bolt.
4. Torque nut on brake lever pivot bolt as specified.

PIVOT BOLT TORQUE, BRAKE LEVER
6 N•m (53 lbf•**in**)

CHASSIS (SUSPENSION)

Front Suspension Inspection

Break-In	Scheduled Maintenance	Storage	Preseason
✔	✔		✔

Visually inspect front suspension for tightness of components:
- Arms
- Stabilizer bar
- Shock absorbers
- Ball joints.

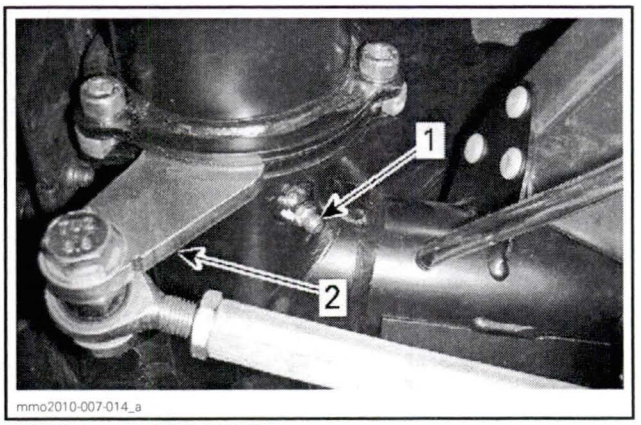
Front Suspension Lubrication

Lubricate front suspension at grease fittings using recommended product.

SERVICE PRODUCT	
Front suspension	SUSPENSION GREASE (P/N 293 550 033)

Generally, 4 to 5 grease gun strokes is sufficient.

NOTE: If too much grease is injected, the overflow will come out at steering levers and ski legs. Wipe off any excess of grease to avoid contact with other parts.



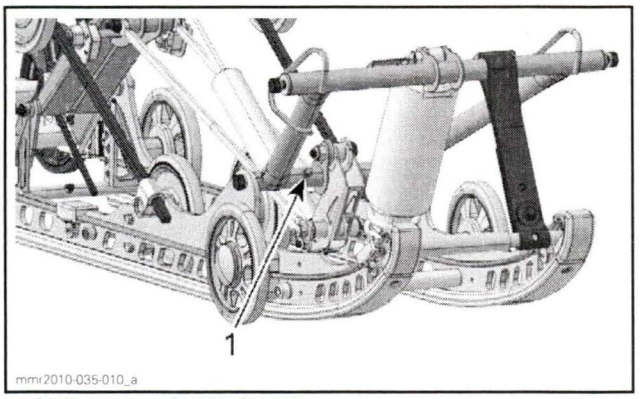
TYPICAL - LH SIDE SHOWN
1. Grease fitting
2. Steering arm

Rear Suspension Lubrication

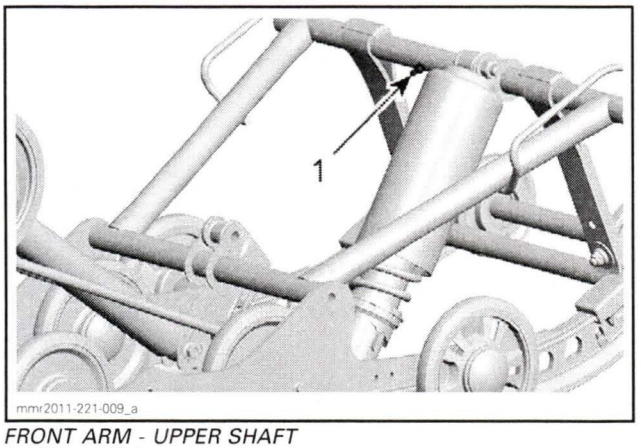
Break-In	Scheduled Maintenance	Storage	Preseason
	✔	✔	

Lubricate the following suspension pivots at grease fittings using recommended product.

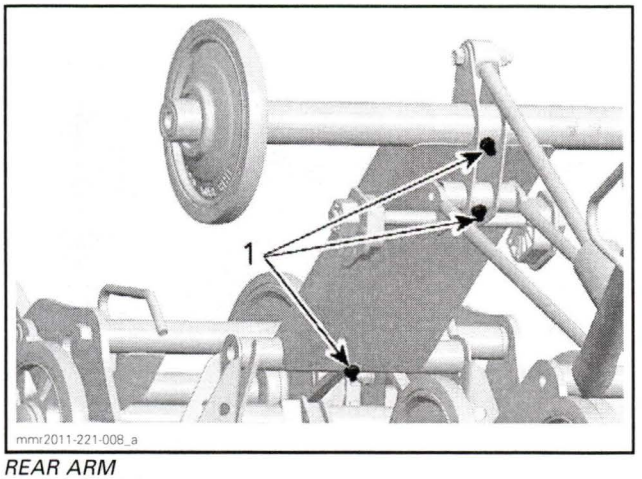
SERVICE PRODUCT	
Rear suspension	SUSPENSION GREASE (P/N 293 550 033)



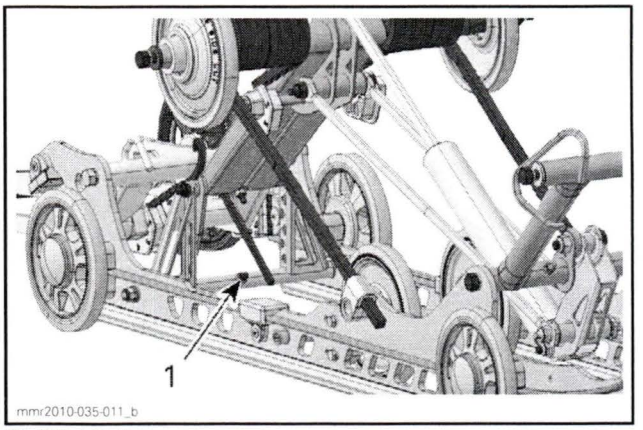
FRONT ARM - LOWER SHAFT
1. Grease fitting



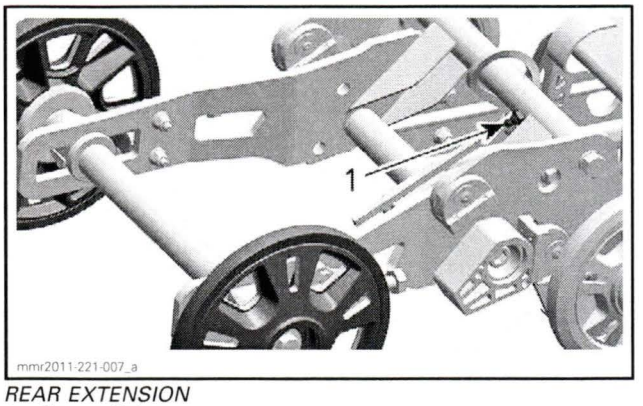
FRONT ARM - UPPER SHAFT
1. Grease fitting



REAR ARM
1. Grease fitting



PIVOT ARM
1. Grease fitting



REAR EXTENSION
1. Grease fitting

Rear Suspension, Stopper Straps and Slider Shoes Inspection

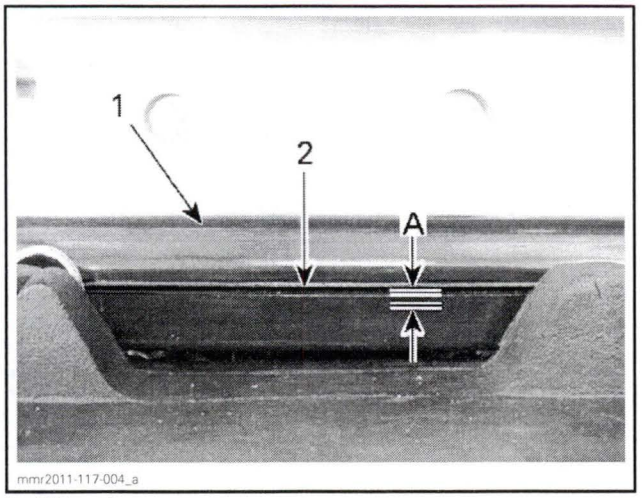
Break-In	Scheduled Maintenance	Storage	Preseason
✔	✔		✔

Rear Suspension Mechanism and Stopper Straps Inspection

1. Inspect rear suspension components for wear, deterioration or damage, replace defective parts if necessary.
2. Inspect stopper straps for wear or cracks.
3. Check bolt and nut securing straps for tightness. If loose, inspect strap holes for deformation. Replace strap if necessary.

Slider Shoe Inspection

Slider shoes are worn out and must be replaced when there is just 1 mm to 2 mm (.04 in to .08 in) of remaining material exceeding the molding line.



1. Slider shoe
2. Molding line
A. Minimum thickness: 1 mm to 2 mm (.04 in to .08 in)

NOTICE Slider shoes must always be replaced in pairs.

CHASSIS (STEERING)

Ski and Runner Inspection

Break-In	Scheduled Maintenance	Storage	Preseason
✔			✔

Lift the front of vehicle and check ski runners for wear or damage (missing or broken carbide). Replace if necessary.

Inspect ski for excessive wear or other damage. Replace if necessary.

Steering Mechanism Inspection

Break-In	Scheduled Maintenance	Storage	Preseason
✔	✔		✔

Visually inspect steering mechanism for tightness of components (steering arms, tie rods, ski bolts, ski legs, etc.).

STORAGE PROCEDURE

During summer, or when a snowmobile is not in use for more than three months, proper storage is a necessity.

Procedures are detailed in *PERIODIC MAINTENANCE PROCEDURES* subsection.

STORAGE
Clean the vehicle
Add fuel stabilizer to fuel following the product manufacturer recommendations. Run the engine after adding the product to the fuel
Lubricate engine (550F and 600 HO E-TEC)
Lubricate brake lever pivot
Inspect and lubricate rear suspension
Charge battery monthly to keep it fully charged during storage
Block muffler outlet with rags
Lift rear of vehicle until track is clear of the ground. Do not release track tension

⚠ CAUTION Use appropriate lifting device or have assistance to share lifting stress. If a lifting device is not used, use proper lifting techniques, notably using your legs force. Do not attempt to lift the rear of vehicle if it is above your limits.

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

PRESEASON PREPARATION

Proper vehicle preparation is required after the summer months or when a vehicle has not been used for more than three months.

Procedures are detailed in *PERIODIC MAINTENANCE PROCEDURES* subsection.

PRESEASON PREPARATION (550F)
Inspect engine rubber mounts
Inspect engine axial fan belt
Check exhaust system condition and check for leaks
Inspect crankshaft PTO seal
Inspect fuel lines and connections
Clean, inspect and adjust carburetors
Adjust oil injection pump
Inspect throttle cable
Replace spark plugs after starting the engine with the old spark plugs to burn the excess of storage oil
Inspect drive belt (adjust at every drive belt replacement)
Clean and visually inspect drive pulley
Clean and inspect driven pulley
Inspect, adjust and align track
Change Gearbox oil
Check brake fluid level
Inspect brake hose, pads and disk
Inspect steering mechanism
Inspect skis and runners
Inspect front suspension
Inspect rear suspension stopper straps
Charge battery (**if so equipped**)
Adjust headlight beam aiming

PRESEASON PREPARATION (600 HO E-TEC)
Inspect engine rubber mounts
Check exhaust system condition and check for leaks
Tighten exhaust manifold screws or nuts to specified torque
Inspect cooling system cap, hoses and clamps
Check coolant density
Inspect crankshaft PTO seal
Inspect fuel lines and connections
Clean and inspect throttle body
Inspect throttle cable
Inspect drive belt (adjust at every drive belt replacement)
Clean and visually inspect drive pulley
Clean and inspect driven pulley
Inspect, adjust and align track
Change gearbox oil
Check brake fluid level
Inspect brake hose, pads and disk
Inspect steering mechanism
Inspect skis and runners
Inspect front suspension
Inspect rear suspension stopper straps
Charge battery (**if so equipped**)
Adjust headlight beam aiming

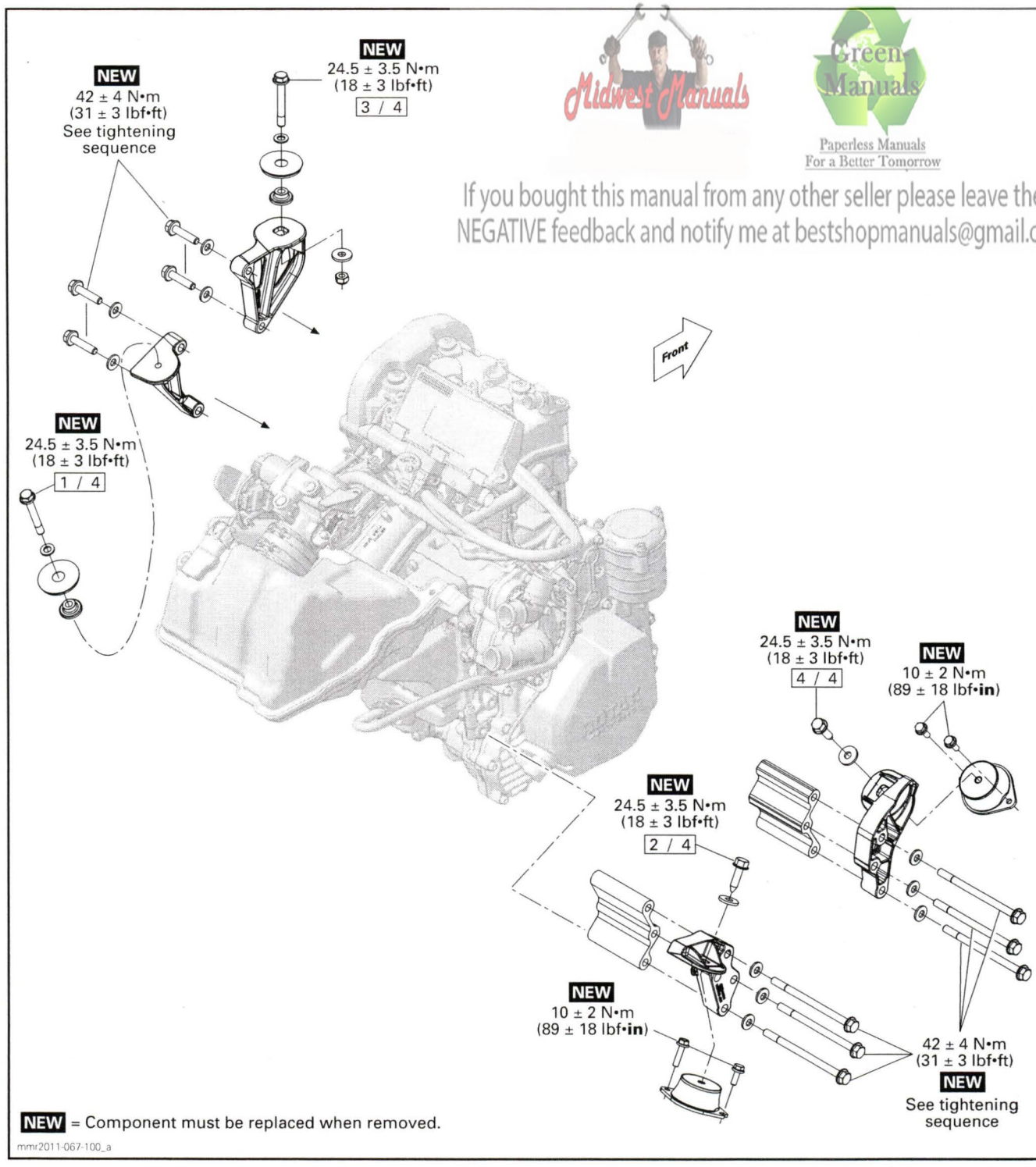
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PRESEASON PREPARATION (600 ACE)
Visually inspect engine seals and gaskets and check for leaks
Check exhaust system condition and check for leaks
Change engine oil and filter
Check coolant density
Inspect fuel lines and connections
Clean and inspect throttle body
Inspect throttle cable
Inspect drive belt (adjust at every drive belt replacement)
Clean and visually inspect drive pulley
Clean and inspect driven pulley
Inspect, adjust and align track
Change gearbox oil
Check brake fluid level
Inspect brake hose, pads and disk
Inspect steering mechanism
Inspect skis and runners
Inspect front suspension
Inspect rear suspension stopper straps
Charge battery
Adjust headlight beam aiming

ENGINE REMOVAL AND INSTALLATION

SERVICE TOOLS

Description	Part Number	Page
ENGINE LIFTING TOOL	529 036 217	257



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PROCEDURES

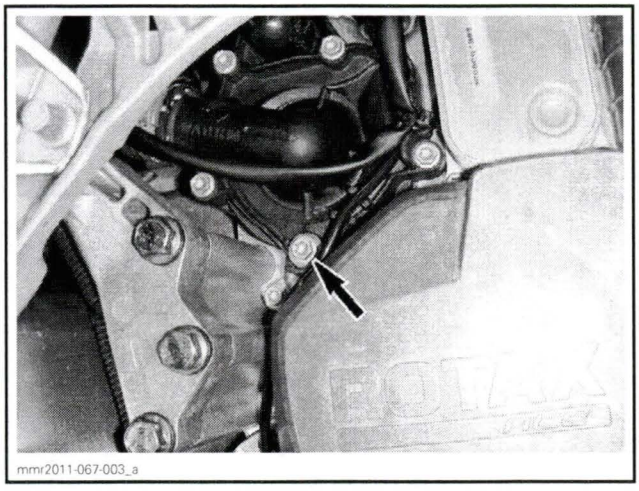
ENGINE

Engine Removal

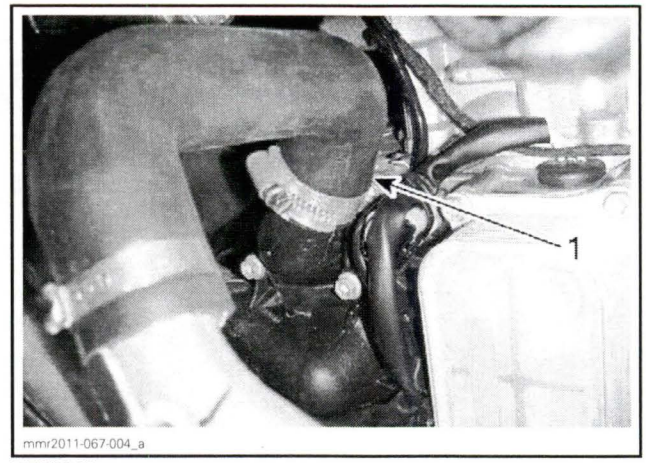
1. Place vehicle on a workstation equipped with an engine-lifting hoist.
2. Refer to *BODY* subsection and remove:
   - Side panels
   - Hood
   - Upper bottom pans.
3. Remove air intake silencer. Refer to *AIR INTAKE SYSTEM* subsection.
4. Move fuel tank rearward without removing it. Refer to *FUEL TANK AND FUEL PUMP (600HO E-TEC AND 600 ACE)* subsection.
5. Disconnect negative (–) cable from battery.

MAG Side Operations

1. Remove breather hose from coolant reservoir. Discard Oetiker clamp.
2. Refer to *EXHAUST SYSTEM* subsection and remove:
   - Muffler
   - Exhaust pipes
   - Exhaust flanges.
3. Drain engine coolant by unscrewing lower screw of water pump.

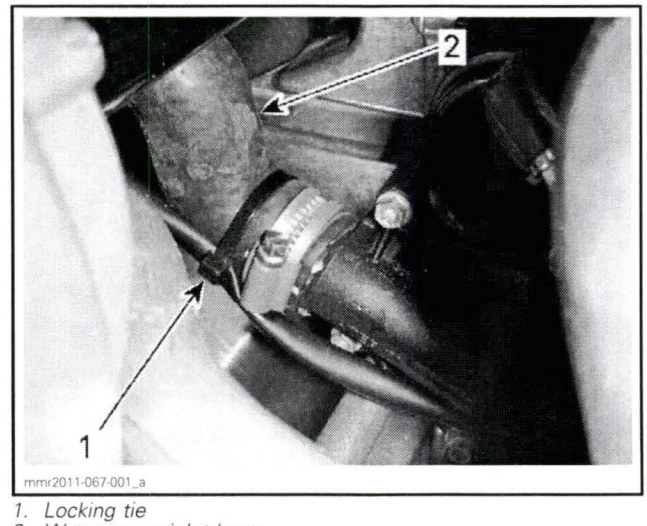


4. Disconnect outlet hose from thermostat housing.



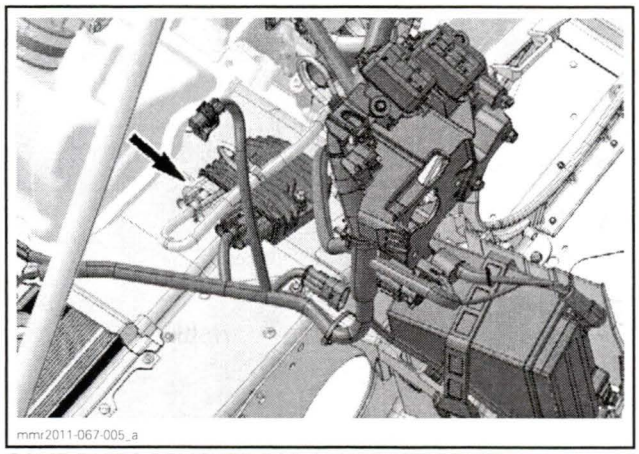
TYPICAL
1. Thermostat housing outlet hose.

5. Remove locking tie on water pump inlet hose.
6. Disconnect coolant inlet hose from water pump.



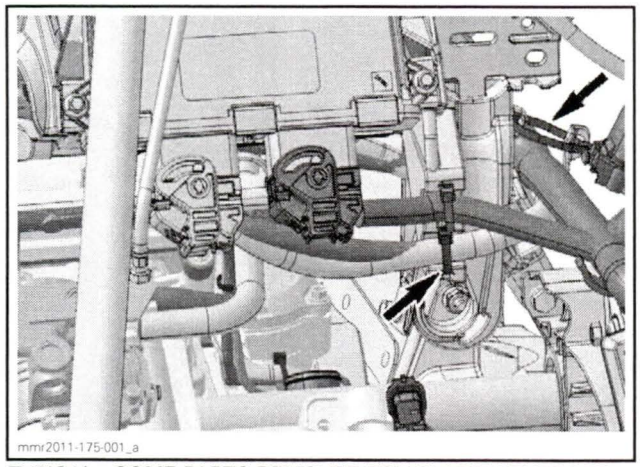
1. Locking tie
2. Water pump inlet hose

7. Remove locking tie securing magneto connector wires.
8. Disconnect magneto connector from voltage regulator.



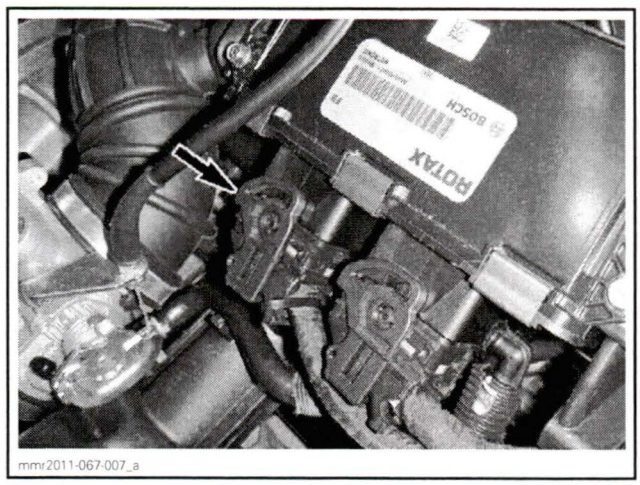
SOME PARTS REMOVED FOR CLARITY PURPOSE

9. Remove locking ties securing harness of ECM connector A to ECM support.

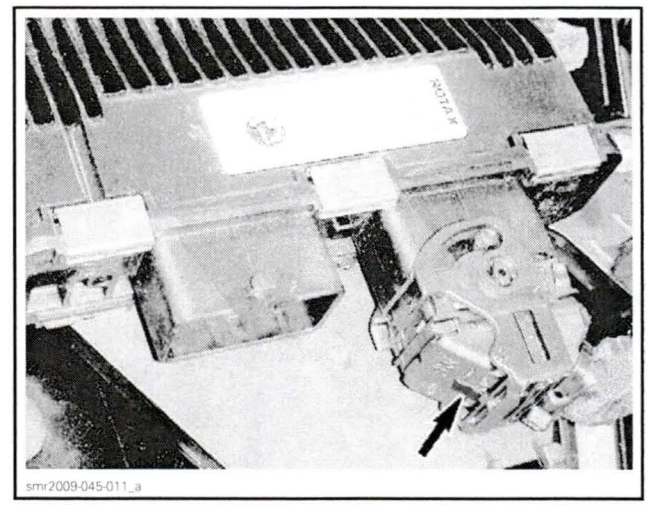


TYPICAL - SOME PARTS REMOVED FOR CLARITY PURPOSE

10. Disconnect ECM connector A from ECM.



10.1 Push **and hold** the locking tab of the desired connector.



TYPICAL

10.2 Rotate connector lock until it stops.



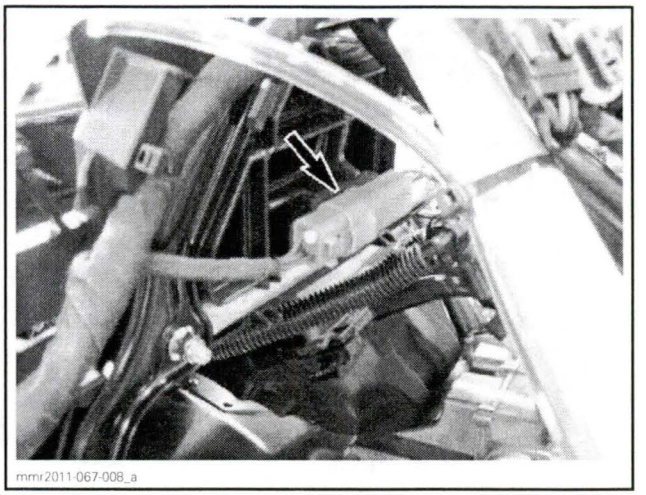
TYPICAL

10.3 Pull out connector.



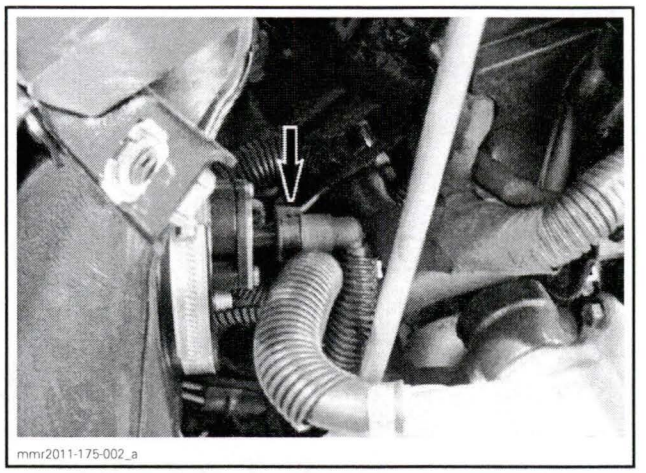
TYPICAL

11. Disconnect engine harness connector located in front of ECM support.


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12. Carefully disconnect fuel hose from fuel tank.

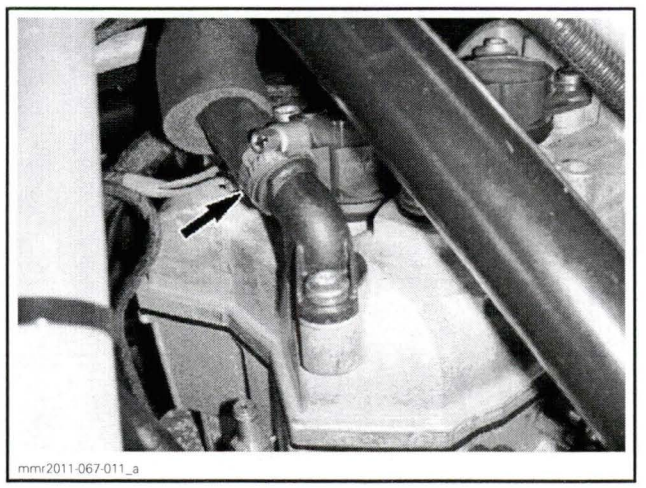
NOTE: Wrap an absorbent shop rag around fuel hose end to catch any fuel leakage.


mmr2011-175-002_a

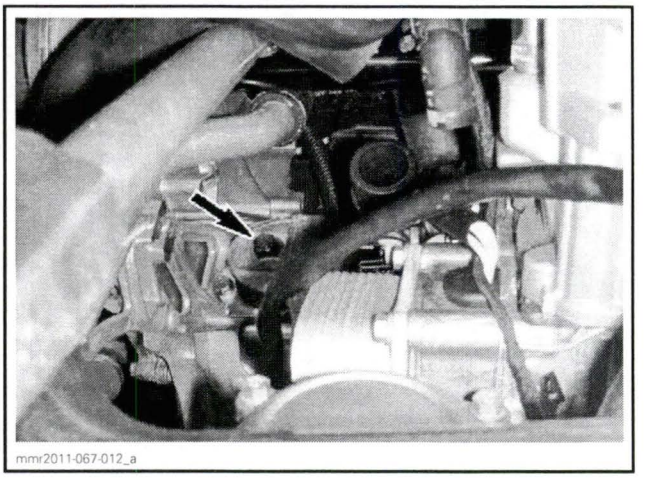
⚠ WARNING

Wipe out any fuel leakage.

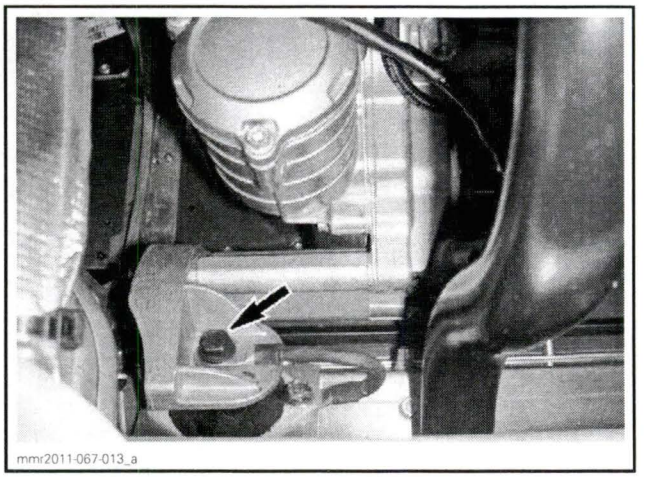
13. Disconnect blow-by hose from valve cover.


mmr2011-067-011_a

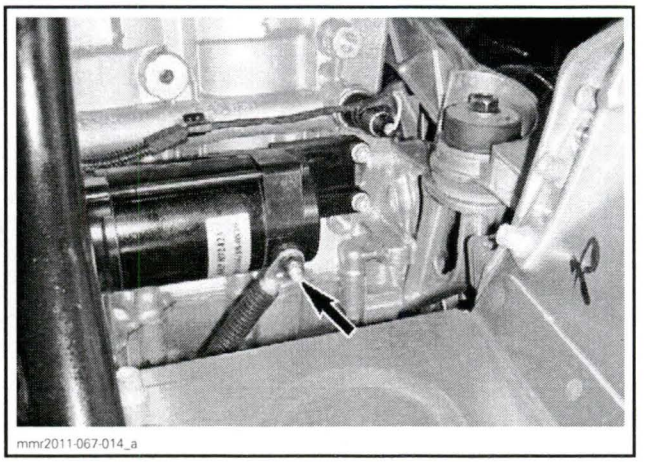
14. Remove screw securing rear MAG rubber mount to engine support.


mmr2011-067-012_a

15. Remove screw securing front MAG rubber mount to engine support.

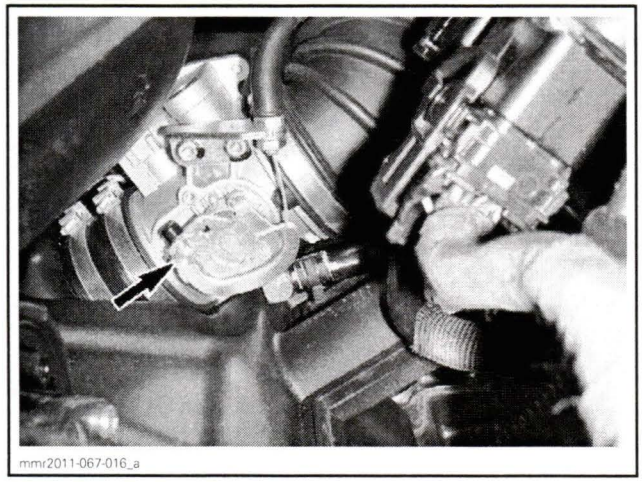

mmr2011-067-013_a

16. Disconnect positive (+) cable from starter.

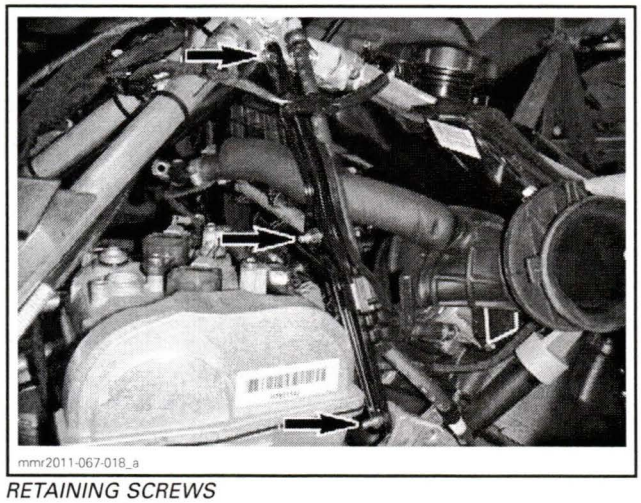

mmr2011-067-014_a

PTO Side Operations

1. Remove drive pulley. Refer to *DRIVE PULLEY (e-Drive)* subsection.
2. Refer to *DRIVEN PULLEY (550F AND 600 ACE)* subsection and remove:
   - Driven pulley
   - Countershaft.
3. Detach throttle cable from throttle body.

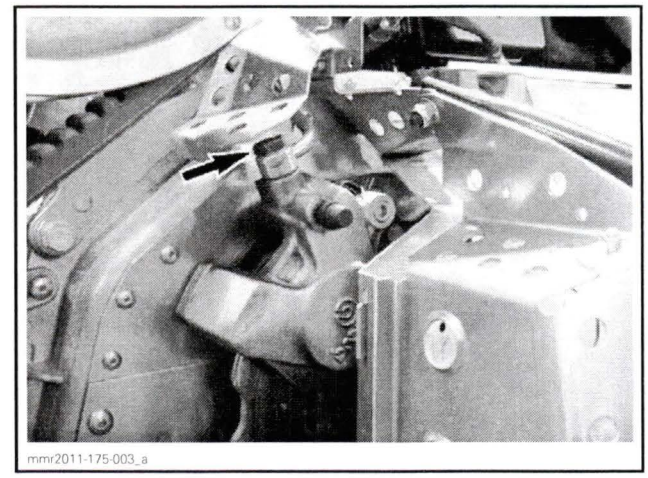


4. Remove LH side frame member.

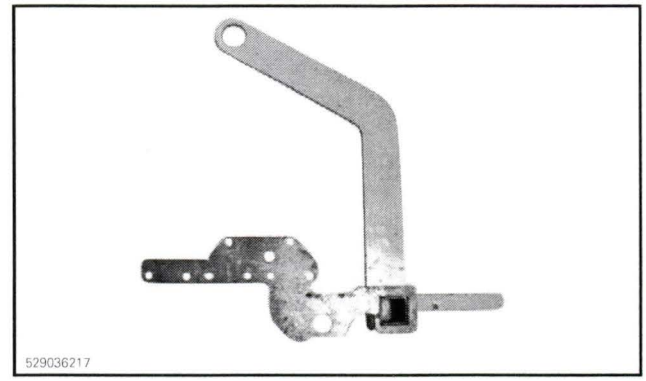


RETAINING SCREWS

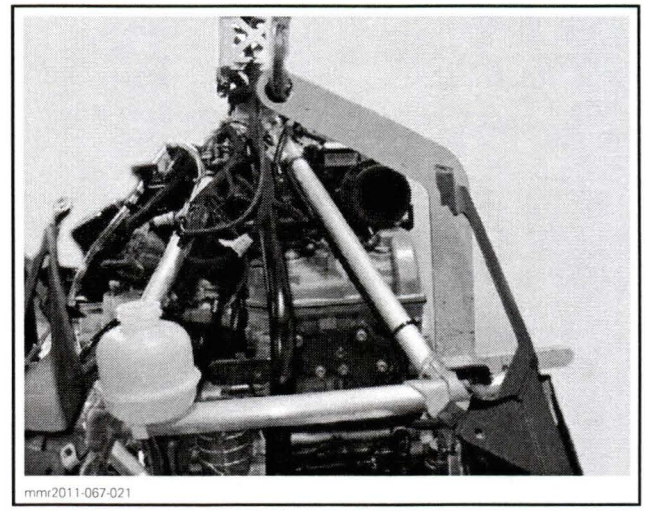
5. Remove Banjo fitting from brake caliper.



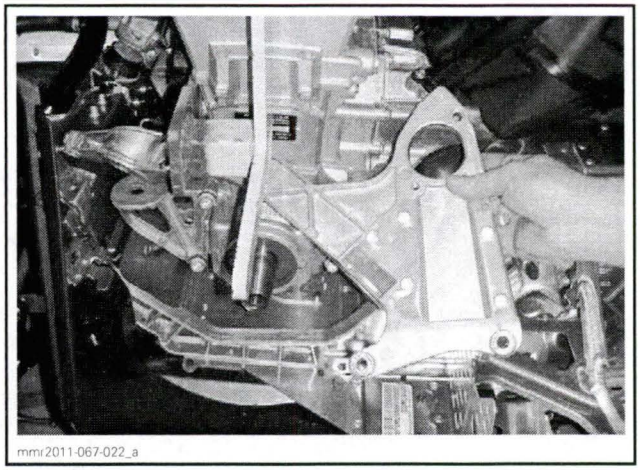
6. Install the ENGINE LIFTING TOOL (P/N 529 036 217) instead of exhaust flanges.



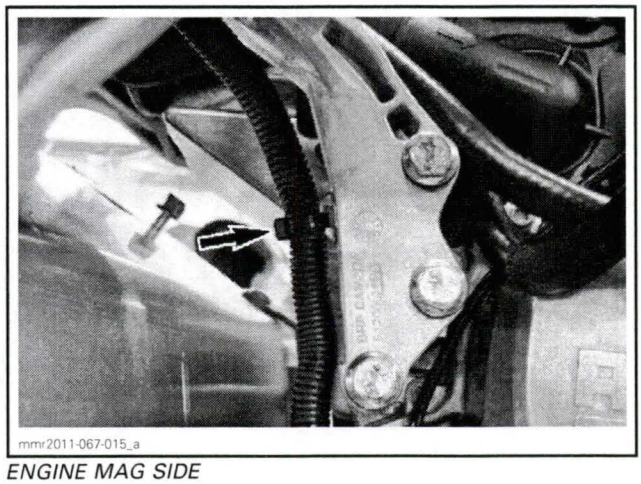
7. Secure lifting tool using exhaust flange screws.
8. **Slightly** lift engine using engine-lifting hoist.



9. Remove countershaft bearing support. Refer to *DRIVEN PULLEY (550F AND 600 ACE).*


mmr2011-067-022_a

10. Remove locking tie of starter positive (+) cable located on rear MAG engine support.


mmr2011-067-015_a

ENGINE MAG SIDE

11. Lift engine then slide it out of vehicle.

NOTICE **Move ECM support rearward to avoid to damage fuel rail during engine removal.**


mmr2011-067-023_a

MOVE ECM SUPPORT REARWARD

Engine Installation

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

Install **NEW** self-locking screws where required, refer to exploded view at the beginning of this subsection.

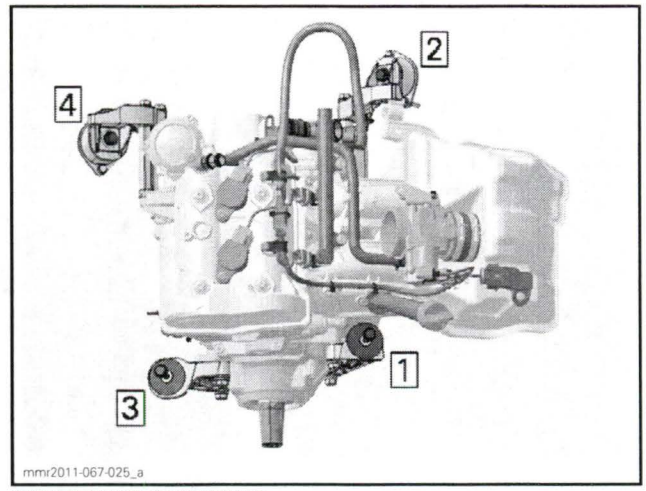
Refill and bleed brake system. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

Tighten Banjo fitting on brake caliper with **NEW** sealing washers. Refer to *BRAKE* subsection for tightening torque.

Properly tighten countershaft bearing support. Refer to *DRIVEN PULLEY (550F AND 600 ACE)* subsection for tightening sequence.

Tighten engine rubber mount screws to specification as per the following sequence.

TIGHTENING TORQUE	
Engine rubber mount screws (M8)	24.5 N•m ± 3.5 N•m (18 lbf•ft ± 3 lbf•ft)



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TIGHTENING SEQUENCE

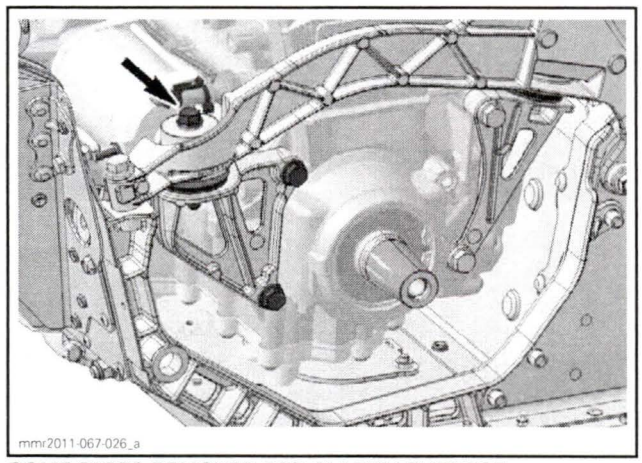
ENGINE SUPPORTS

Engine Support Inspection

Check if engine supports are cracked, bent or damaged. Replace if necessary.

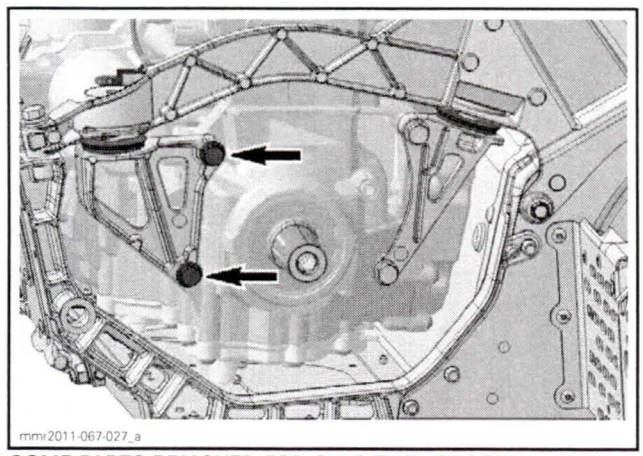
Front Engine Support Replacement (PTO Side)

1. Remove body parts and components as required to access to the engine support.
2. Remove and discard bolt securing rubber mount to engine support.



SOME PARTS REMOVED FOR CLARITY PURPOSE

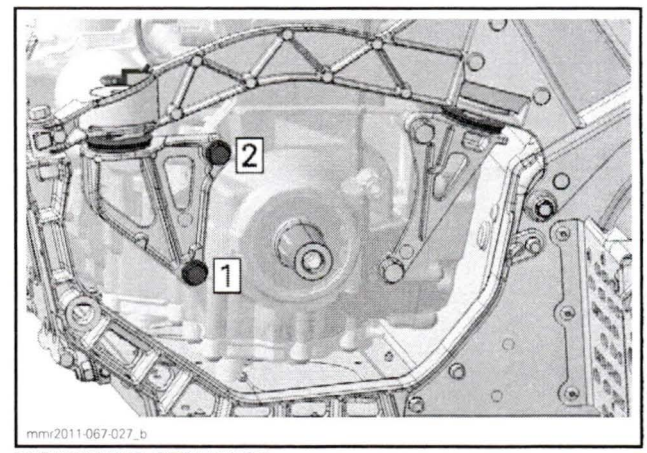
3. Remove and discard screws securing engine to engine support.



SOME PARTS REMOVED FOR CLARITY PURPOSE

4. Replace engine support.
5. Install **NEW** screws to secure engine support on engine.
6. Tighten engine support screws to specification as per the following sequence.

TIGHTENING TORQUE	
Engine support screws	42 N•m ± 4 N•m (31 lbf•ft ± 3 lbf•ft)

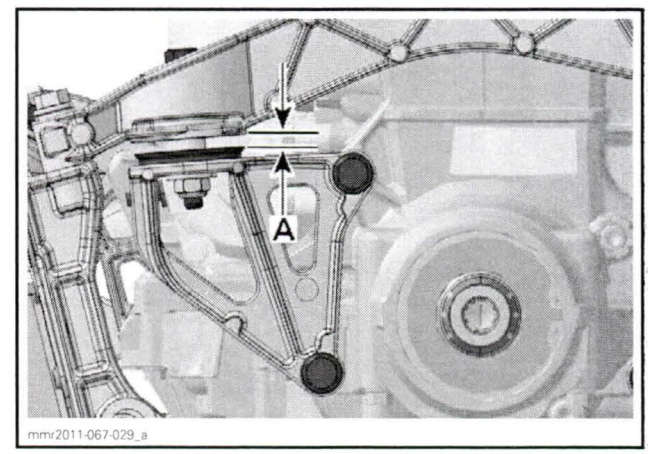


TIGHTENING SEQUENCE

7. Install **NEW** bolt to secure engine rubber mount on engine support.
8. Tighten engine rubber mount screw to specification.

TIGHTENING TORQUE	
Engine rubber mount screws (M8)	24.5 N•m ± 3.5 N•m (18 lbf•ft ± 3 lbf•ft)

NOTE: It is normal that a gap (5 mm (3/16 in)) is visible between engine stopper and countershaft bearing support. This gap will allow engine to move and reduce vibration.



A. Normal gap

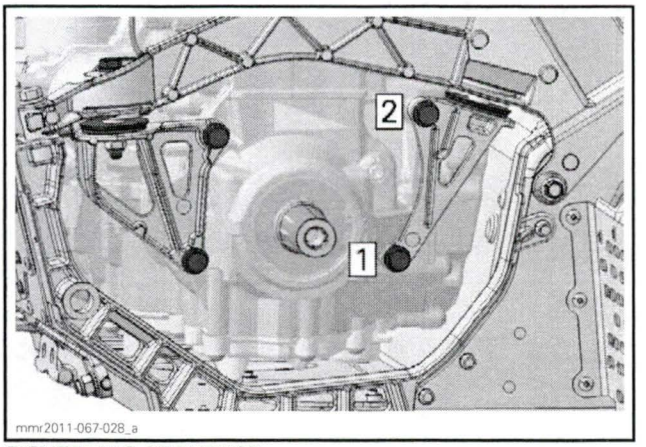
9. Install body parts and components as the reverse of removal procedure.

Rear Engine Support Replacement (PTO Side)

To replace rear engine support, refer to *FRONT ENGINE SUPPORT REPLACEMENT (PTO SIDE)*. However pay attention to the following.

Tighten engine support screws to specification as per the following sequence.

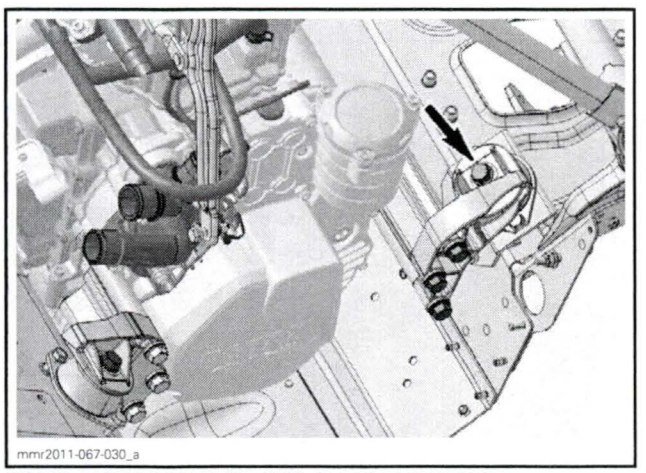
TIGHTENING TORQUE	
Engine support screws	42 N•m ± 4 N•m (31 lbf•ft ± 3 lbf•ft)



TIGHTENING SEQUENCE

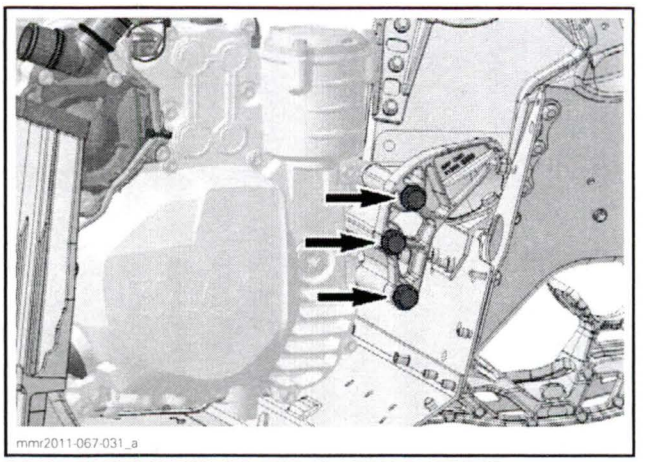
Front Engine Support Replacement (MAG Side)

1. Remove body parts and components as required to access to the engine support.
2. Remove and discard screw securing rubber mount to engine support.



SOME PARTS REMOVED FOR CLARITY PURPOSE

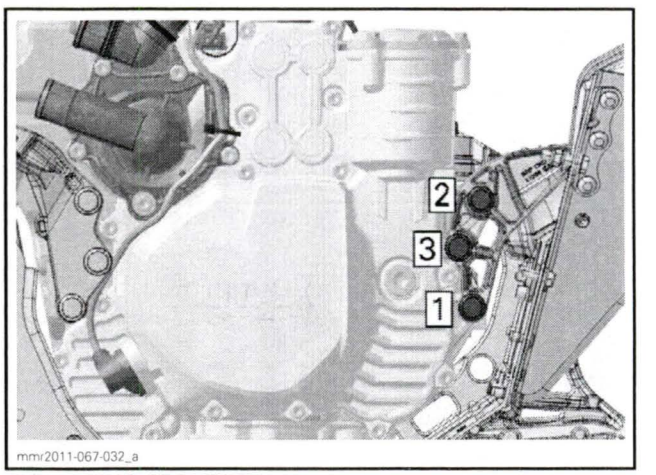
3. Remove and discard screws securing engine to engine support.



SOME PARTS REMOVED FOR CLARITY PURPOSE

4. Replace engine support.
5. Install **NEW** screws to secure engine support on engine.
6. Tighten engine support screws to specification as per the following sequence.

TIGHTENING TORQUE	
Engine support screws	42 N•m ± 4 N•m (31 lbf•ft ± 3 lbf•ft)



TIGHTENING SEQUENCE

7. Install **NEW** screw to secure engine rubber mount on engine support.
8. Tighten engine rubber mount screw to specification.

TIGHTENING TORQUE	
Engine rubber mount screws (M8)	24.5 N•m ± 3.5 N•m (18 lbf•ft ± 3 lbf•ft)

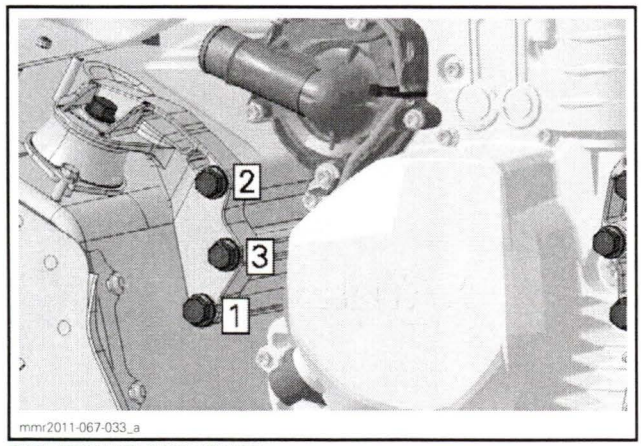
9. Install body parts and components as the reverse of removal procedure.

Rear Engine Support Replacement (MAG Side)

To replace rear engine support, refer to *FRONT ENGINE SUPPORT REPLACEMENT (MAG SIDE)*. However pay attention to the following.

Tighten engine support screws to specification as per the following sequence.

TIGHTENING TORQUE	
Engine support screws	42 N•m ± 4 N•m (31 lbf•ft ± 3 lbf•ft)



TIGHTENING SEQUENCE

ENGINE RUBBER MOUNTS

Engine Rubber Mount Inspection

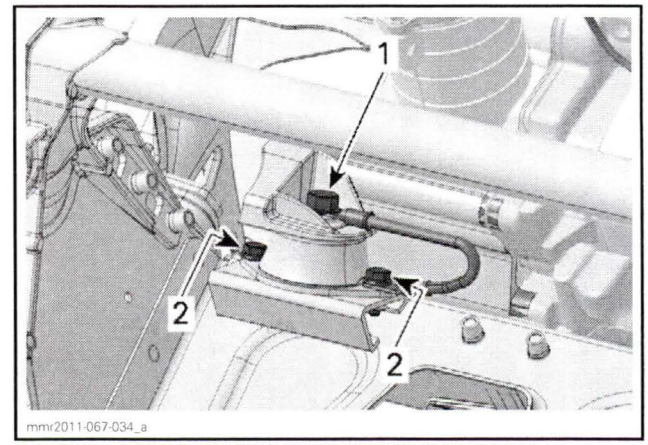
Check rubber mounts. Replace them if brittle, cracked or damaged.

Front and Rear Engine Rubber Mount Replacement (PTO Side)

1. Remove countershaft bearing support. Refer to *DRIVEN PULLEY (550F AND 600 ACE)* subsection.
2. Replace engine rubber mount.
3. Install countershaft bearing support. Refer to *DRIVEN PULLEY (550F AND 600 ACE)* subsection.

Front and Rear Engine Rubber Mount Replacement (MAG Side)

1. Remove body parts and components as required to access to the engine rubber mount.
2. Remove and discard screw securing rubber mount to engine support.
3. Remove and discard screws securing rubber mount to frame.



TYPICAL - FRONT ENGINE RUBBER MOUNT SHOWN
1. *Screw securing rubber mount to engine support (M8)*
2. *Screws securing rubber mount to frame (M6)*

4. Replace engine rubber mount.
5. Install **NEW** screws to secure engine rubber mount.
6. Tighten engine rubber mount screws to specification.

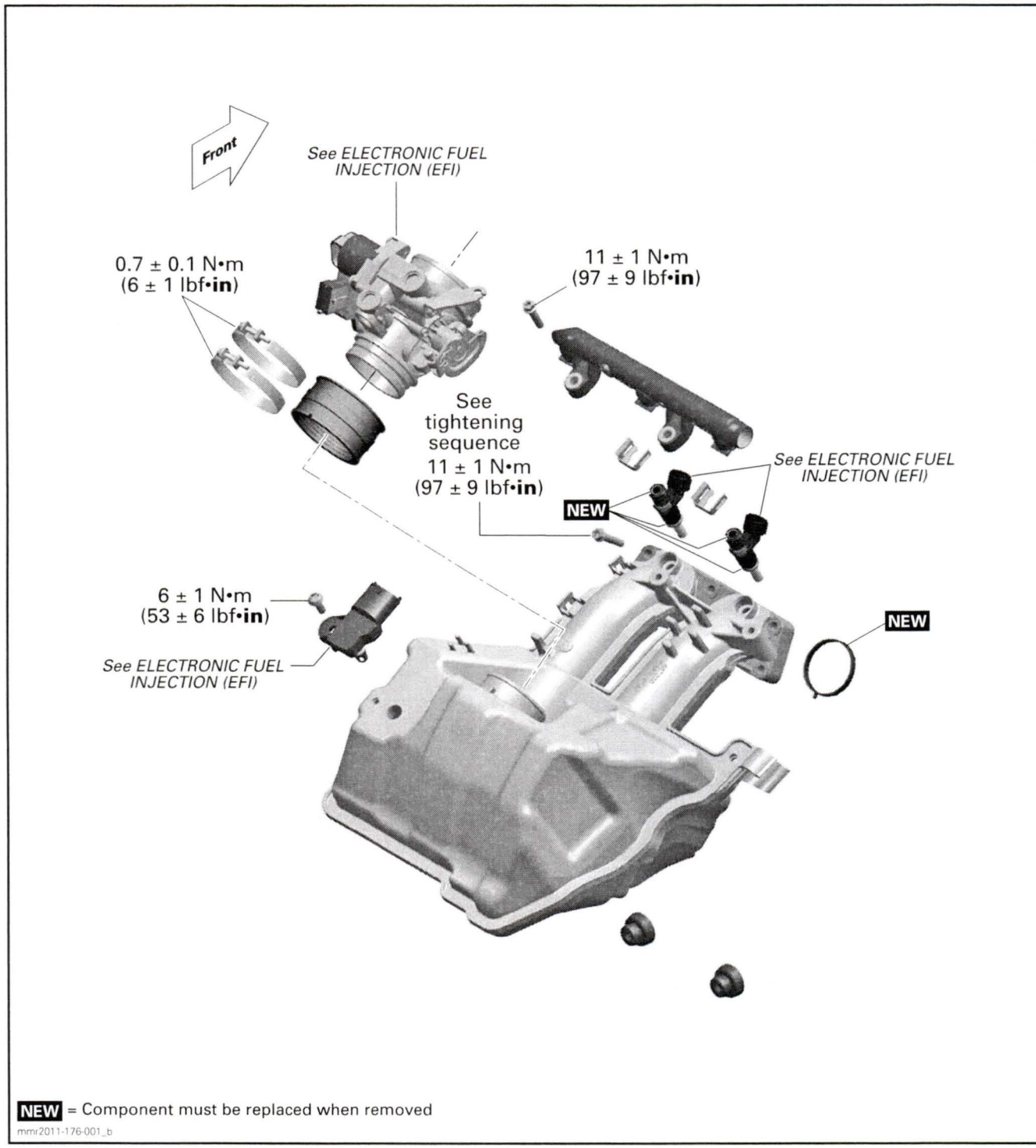
TIGHTENING TORQUE	
Engine rubber mount screws (M8)	24.5 N•m ± 3.5 N•m (18 lbf•ft ± 3 lbf•ft)

TIGHTENING TORQUE	
Engine rubber mount screws (M6)	10 N•m ± 2 N•m (89 lbf•**in** ± 18 lbf•**in**)

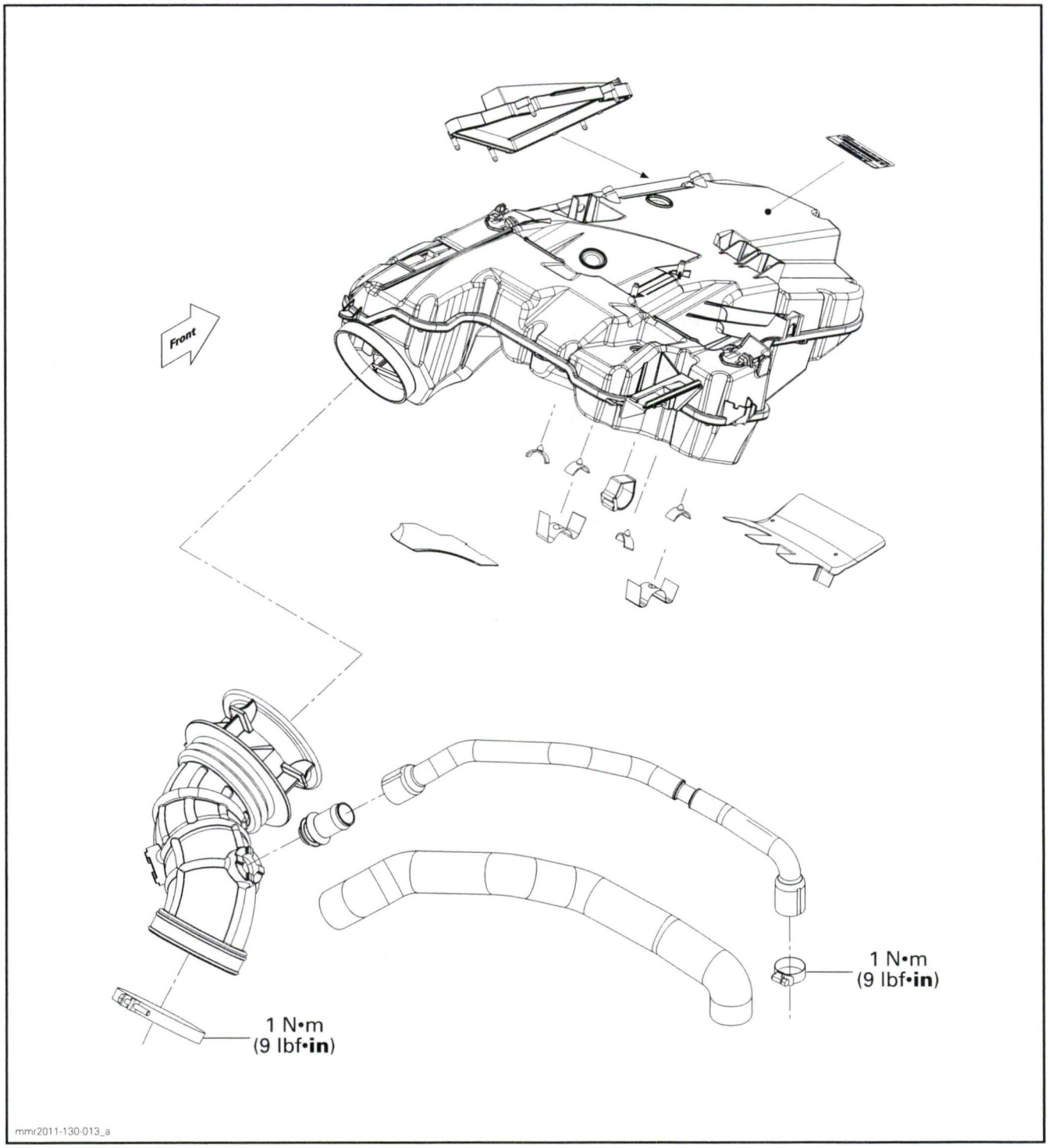
7. Install body parts and components as the reverse of removal procedure.

AIR INTAKE SYSTEM

INTAKE MANIFOLD



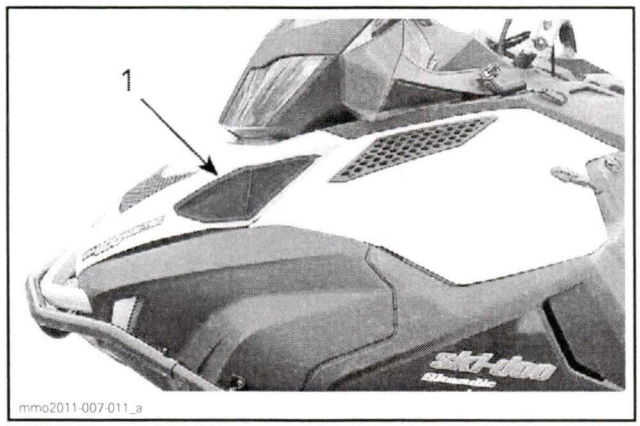
AIR INTAKE SILENCER



PROCEDURES

AIR FILTER

Air Filter Removal



1. Air filter

To remove filter, simply pull it out.

Air Filter Cleaning

Clean with fresh water and mild soap.

Replace air filter as required.

NOTE: If the filter is very dirty, clean the interior of air intake silencer at the same time.

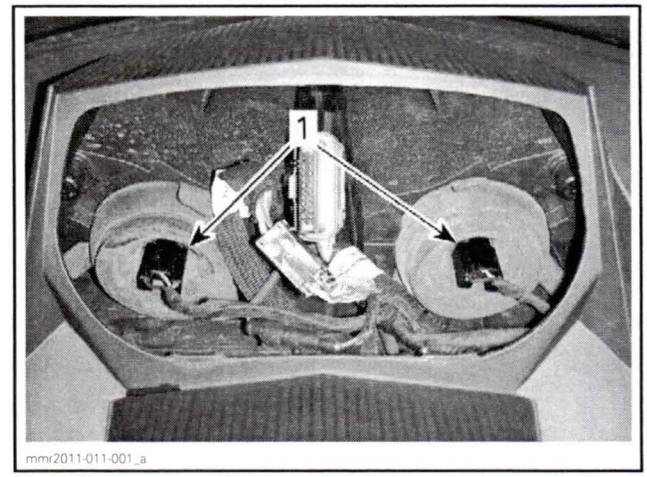
Air Filter Installation

To install filter, push it back in place making sure it is properly secured.

AIR INTAKE SILENCER

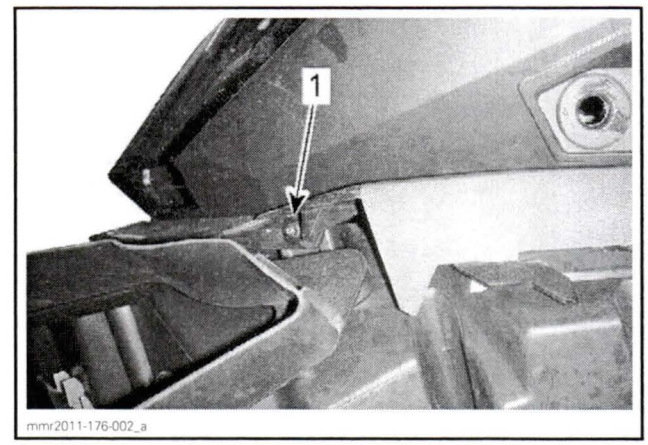
Air Intake Silencer Removal as a Unit with Headlight/Gauge Module

1. Remove multifunction gauge. Refer to *LIGHTS, GAUGE AND ACCESSORIES* subsection.
2. Disconnect headlight connectors.



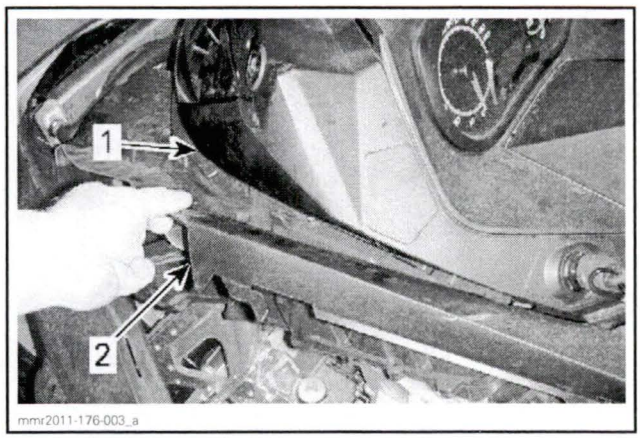
TYPICAL
1. Headlight connectors

3. Refer to *BODY* subsection and remove:
   - Side panels
   - Hood.
4. Remove windshield.
5. Remove the front console screws on each side.



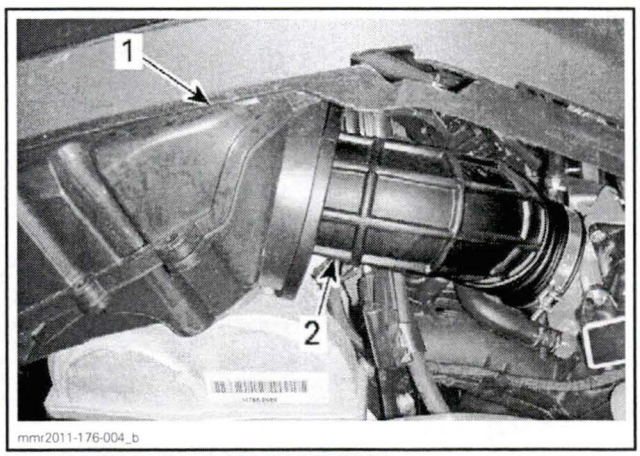
1. LH front console screw

6. Detach the front of console from the headlight/gauge module.



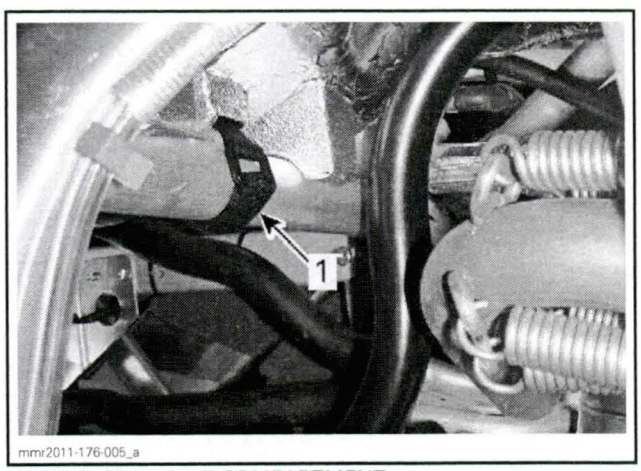
1. Headlight/gauge module
2. Console

7. Disconnect the 12-volt outlet and engine cut-off switch.
8. Disconnect the intake hose from air intake silencer.



RH SIDE OF ENGINE COMPARTMENT
1. Air intake silencer
2. Intake hose

9. Detach the hook-and-loop fastener.



RH SIDE OF ENGINE COMPARTMENT
1. Hook-and-loop fastener

10. Remove air intake silencer and headlight/gauge module from vehicle.

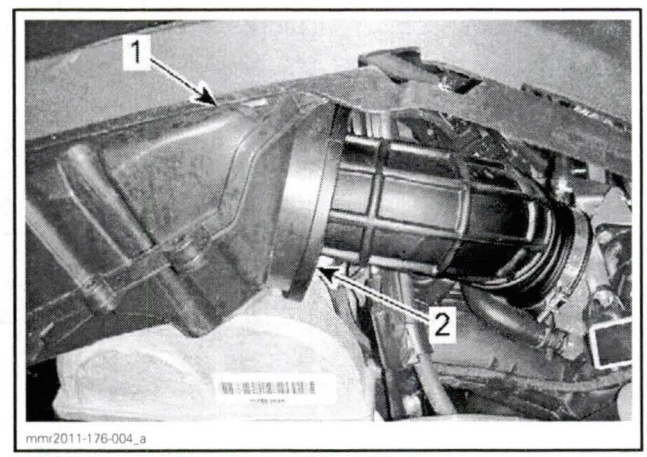
Air Intake Silencer Removal

1. Proceed with *AIR INTAKE SILENCER REMOVAL AS A UNIT WITH HEADLIGHT/GAUGE MODULE.*
2. Separate air intake silencer from headlight/gauge module. Refer to *BODY* subsection.

Air Intake Silencer Installation

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

The intake hose is completely inserted when its flange leans against the air intake silencer.

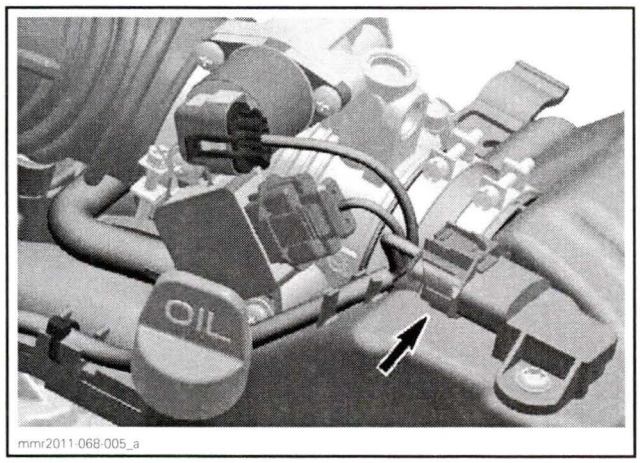


RH SIDE OF ENGINE COMPARTMENT
1. Air intake silencer
2. Intake hose flange

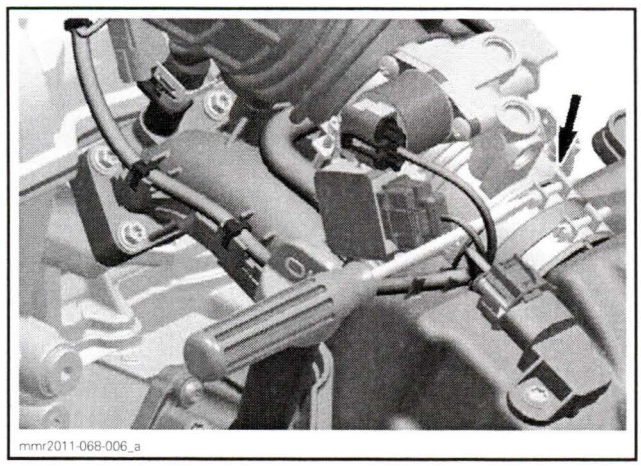
INTAKE MANIFOLD

Intake Manifold Removal

1. Remove the driven pulley, refer to *DRIVEN PULLEY (550F AND 600 ACE)* subsection.
2. Disconnect manifold absolute pressure and temperature sensor (MAPTS).



3. Loosen clamp securing throttle body to intake adapter.

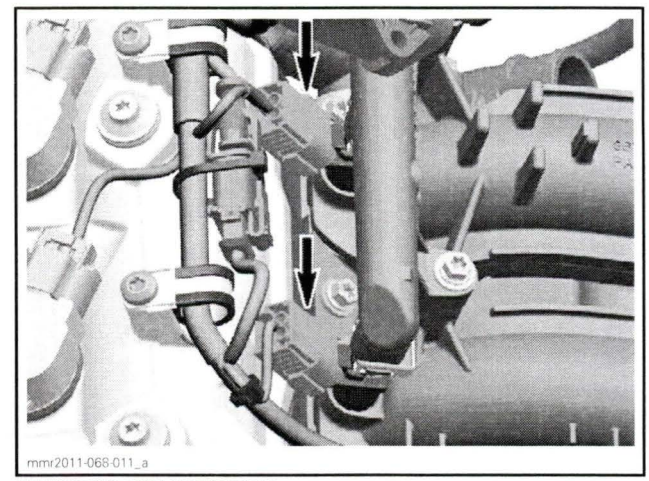


4. Cut locking ties securing TPS harness to fuel rail.



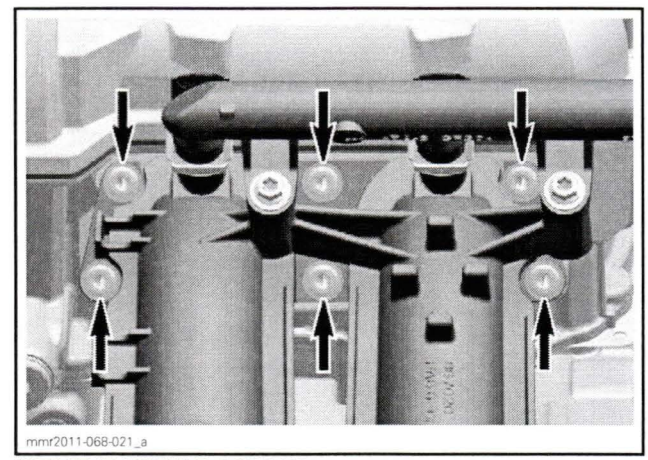
LOCKING TIES

5. Remove throttle body from intake adapter.
6. Move throttle body aside.
7. Disconnect fuel injector connectors.



INJECTOR CONNECTORS

8. Remove screws securing intake manifold to cylinder head.



INTAKE MANIFOLD SCREWS

9. Remove intake manifold from engine.
10. Remove and discard intake manifold gaskets.
11. If required, remove the following parts from intake manifold:
    - Intake adapter
    - MAPTS
    - Fuel rail with injectors. Refer to *ELECTRONIC FUEL INJECTION* subsection.

Intake Manifold Inspection

Check intake manifold for cracks, warping at flanges or any other visible damages. Replace if required.

Check if intake adapter is cracked, brittle or otherwise damaged.

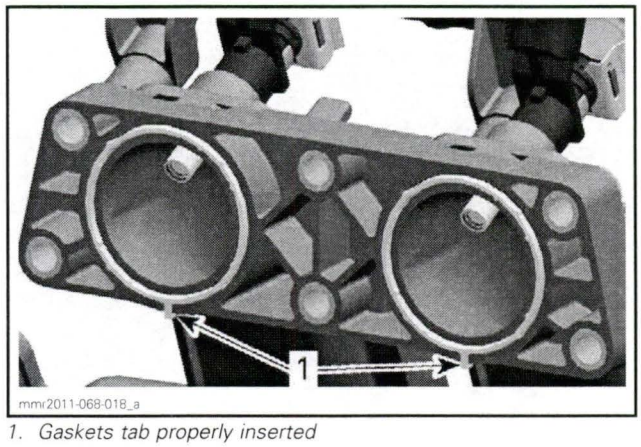


INTAKE ADAPTER

Intake Manifold Installation

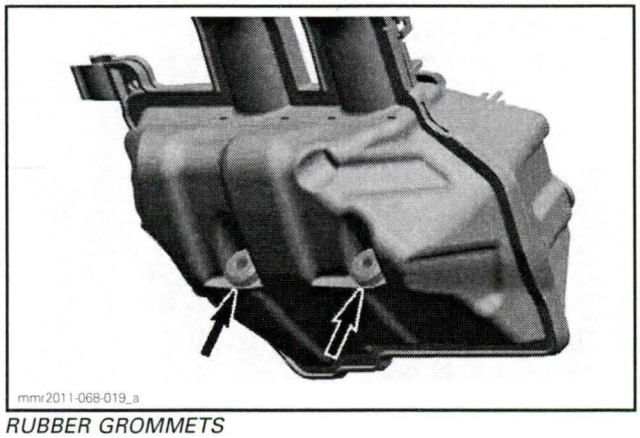
The installation is the reverse of the removal procedure. However, pay attention to the following.

Install **NEW** gaskets with tab properly inserted into notch.



1. Gaskets tab properly inserted

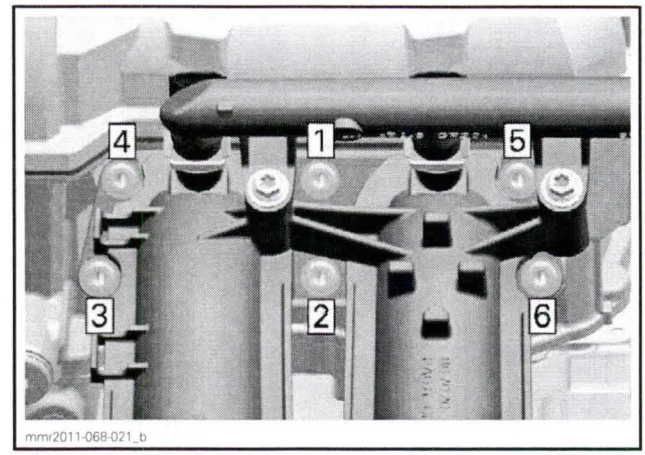
Ensure that rubber grommets are properly inserted.



RUBBER GROMMETS

Tighten intake manifold screws to specification as per the following sequence.

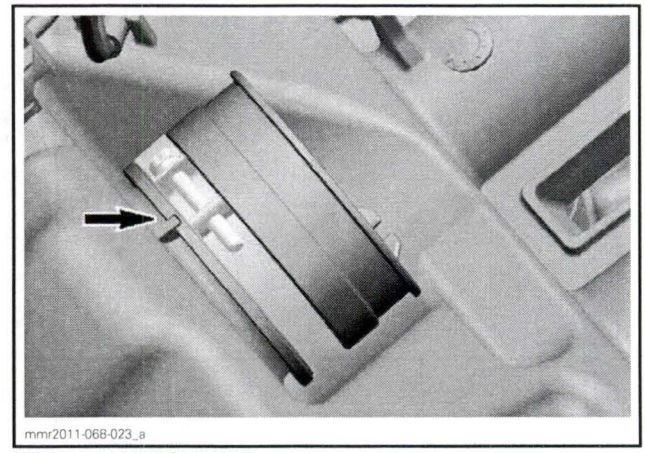
TIGHTENING TORQUE	
Intake manifold screws	11 N•m ± 1 N•m (97 lbf•**in** ± 9 lbf•**in**)



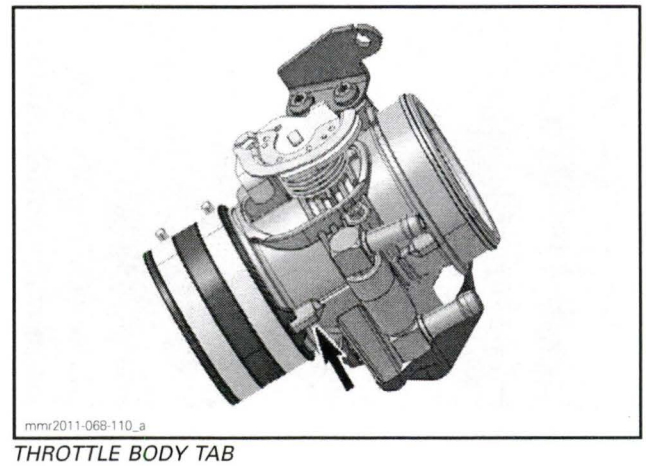
TIGHTENING SEQUENCE

Make sure to index intake adapter notches with the following components:

- Intake manifold tab
- Throttle body tab.



INTAKE MANIFOLD TAB

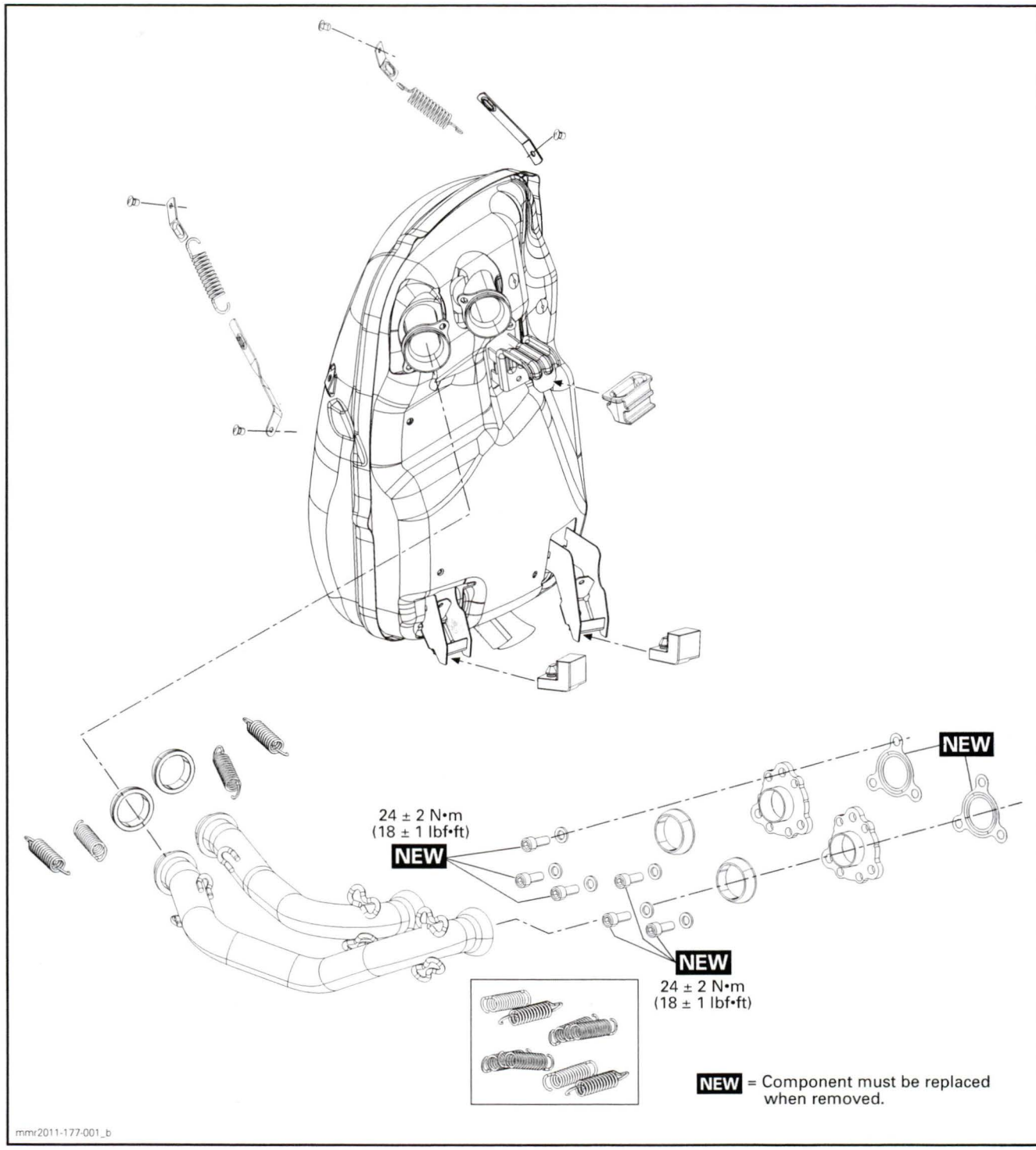


THROTTLE BODY TAB

EXHAUST SYSTEM

SERVICE TOOLS

Description	Part Number	Page
SPRING INSTALLER/REMOVER	529 035 983	270–271



GENERAL

⚠ WARNING

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

⚠ WARNING

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

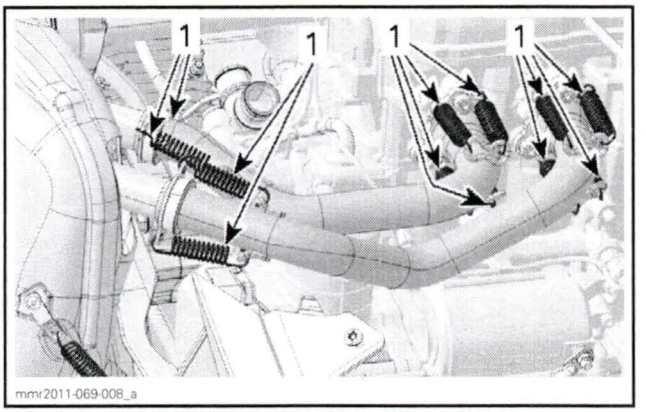
PROCEDURES

EXHAUST PIPES

Exhaust Pipe Removal

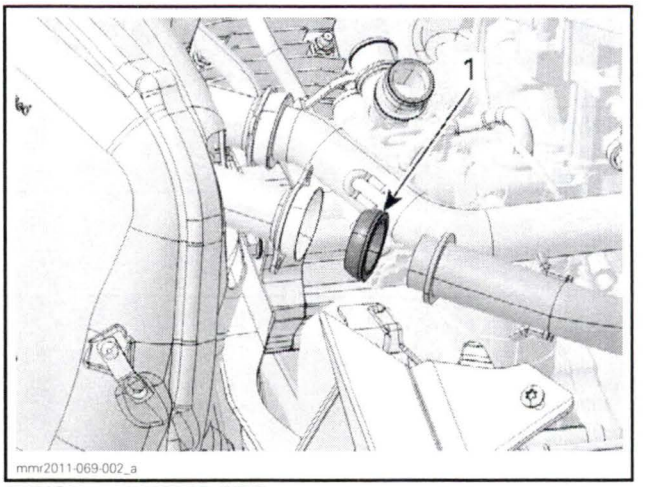
1. Refer to *BODY* subsection and remove:
   - LH and RH side panels
   - Hood.
2. Remove the belt guard. Refer to *DRIVE BELT* subsection.
3. Remove all exhaust springs from exhaust pipes.

REQUIRED TOOL	
SPRING INSTALLER/REMOVER (P/N 529 035 983)	

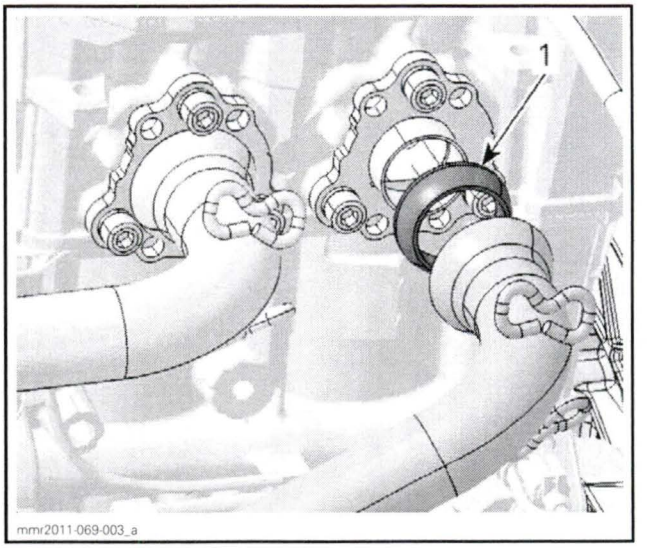


SEVERAL COMPONENTS REMOVED FOR CLARITY
1. Exhaust springs (4+8)

4. Pull out the exhaust pipes.
5. Remove exhaust gaskets at both ends.



TYPICAL - MUFFLER SIDE
1. Exhaust gasket



TYPICAL - ENGINE SIDE
1. Exhaust gasket

Exhaust Pipe Inspection

Check exhaust pipes for:
- Damages
- Cracks.

Inspect gaskets condition. Replace as required.

Exhaust Pipe Installation

1. Install exhaust gaskets.
2. Position exhaust pipes into vehicle.
3. Align the muffler and exhaust pipe hooks together.
4. Install exhaust springs.

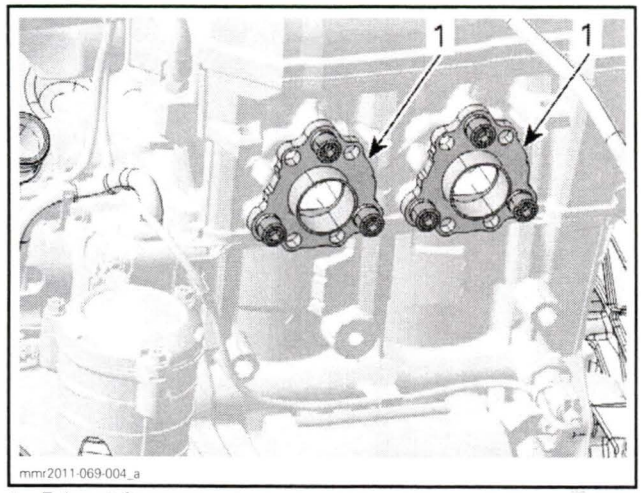
REQUIRED TOOL	
SPRING INSTALLER/REMOVER (P/N 529 035 983)	

5. Ensure springs do not touch each other. Move apart if necessary.
6. Install all other removed parts.

EXHAUST FLANGE

Exhaust Flange Removal

1. Remove *EXHAUST PIPES*, see procedure in this subsection.
2. Remove the exhaust flanges. Discard exhaust flange screws.



1. Exhaust flanges

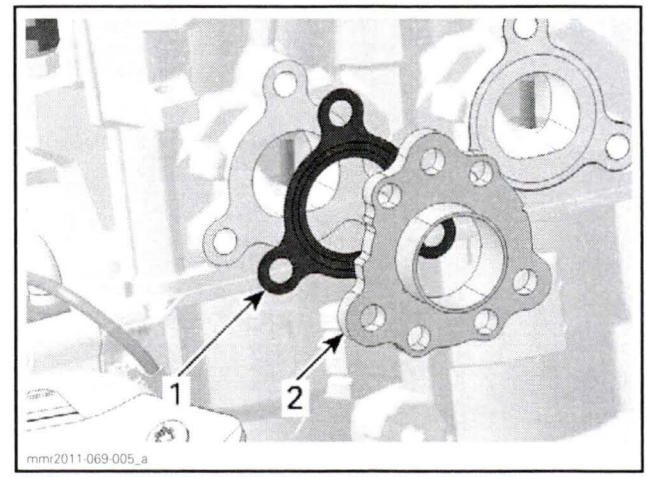
3. Remove and discard the exhaust flange gaskets.

Exhaust Flange Inspection

Check if the flanges are cracked or damaged. Replace if necessary.

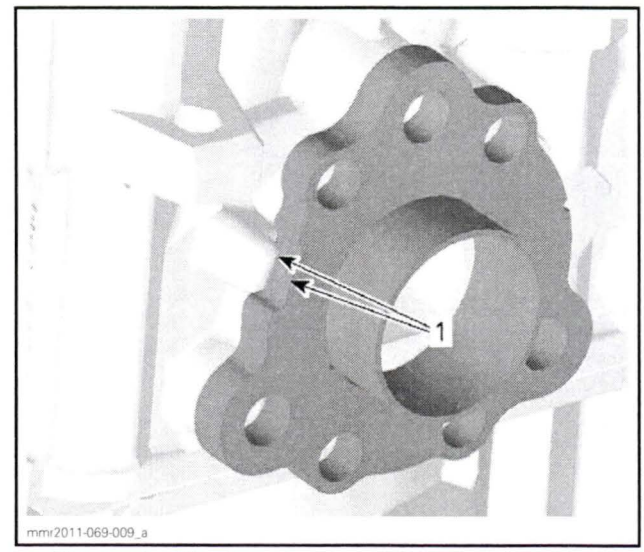
Exhaust Flange Installation

1. Install the exhaust flange with a **NEW** gasket.



SEVERAL COMPONENTS REMOVED FOR CLARITY
1. NEW gasket
2. Exhaust flange

2. Position exhaust flange on cylinder head. Align its notch with the cylinder tab.



1. Align notch with tab

3. Install **NEW** exhaust flange screws.
4. Torque screws as per table.

TIGHTENING TORQUE	
Exhaust flange screws	24 N•m ± 2 N•m (18 lbf•ft ± 1 lbf•ft)

5. Install exhaust pipe.

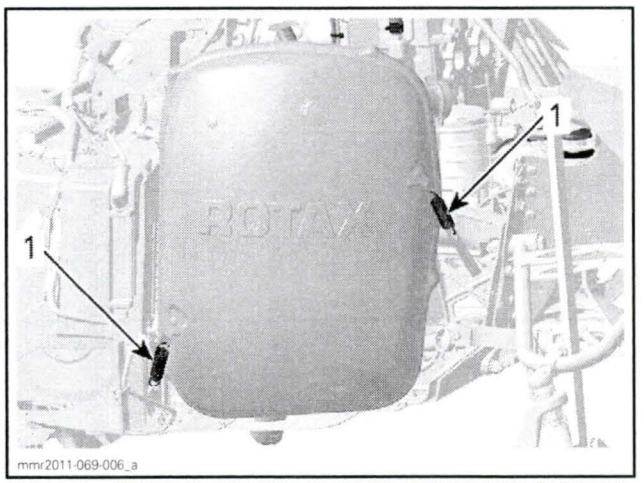
MUFFLER

Muffler Removal

1. Remove the RH side panels.

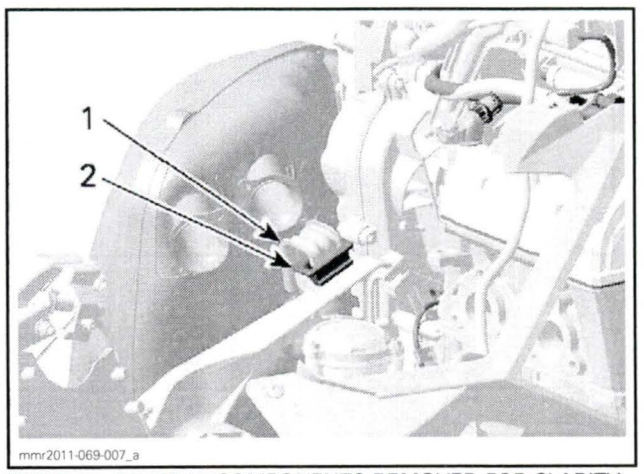
2. Remove:
   - The exhaust springs securing the muffler to the chassis.
   - The exhaust springs securing the muffler to the exhaust pipes.

TIGHTENING TORQUE	
Exhaust flange screws	24 N•m ± 2 N•m (18 lbf•ft ± 1 lbf•ft)



TYPICAL - SEVERAL COMPONENTS REMOVED FOR CLARITY
1. Muffler retaining springs (2)

3. Lift up muffler to free the retaining hook.



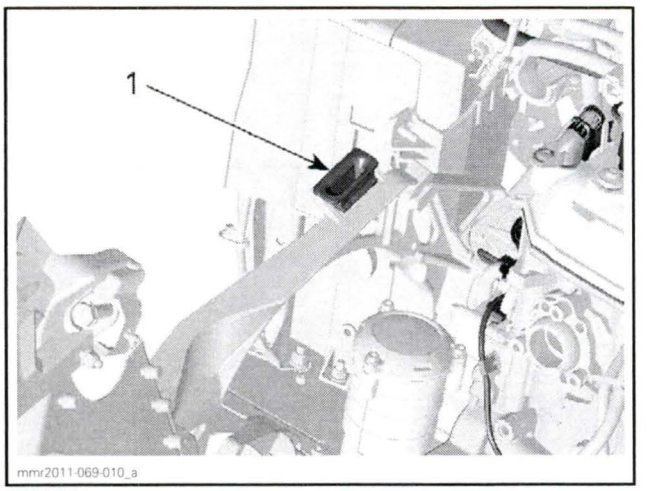
TYPICAL - SEVERAL COMPONENTS REMOVED FOR CLARITY
1. Retaining hook
2. Grommet

4. Remove the muffler.

Muffler Inspection

Check the muffler for cracks or other damage.

Check grommet condition.

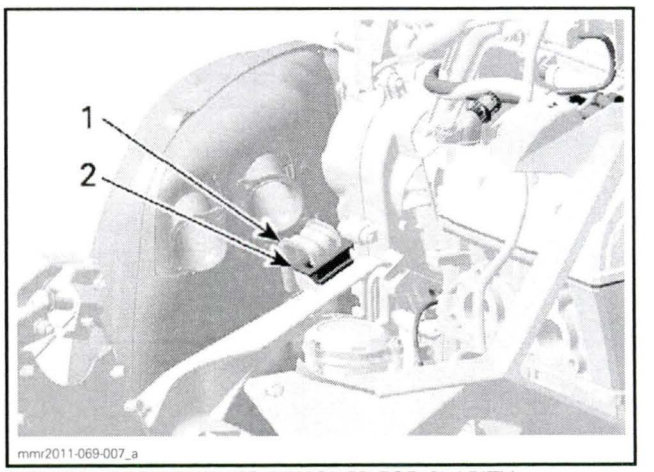


TYPICAL
1. Grommet

Muffler Installation

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

Insert retaining hook into the grommet.



SEVERAL COMPONENTS REMOVED FOR CLARITY
1. Retaining hook
2. Grommet

Align the muffler and exhaust pipe hooks together.

Install retaining springs.

NOTE: Ensure springs do not touch each other. Move apart if necessary.

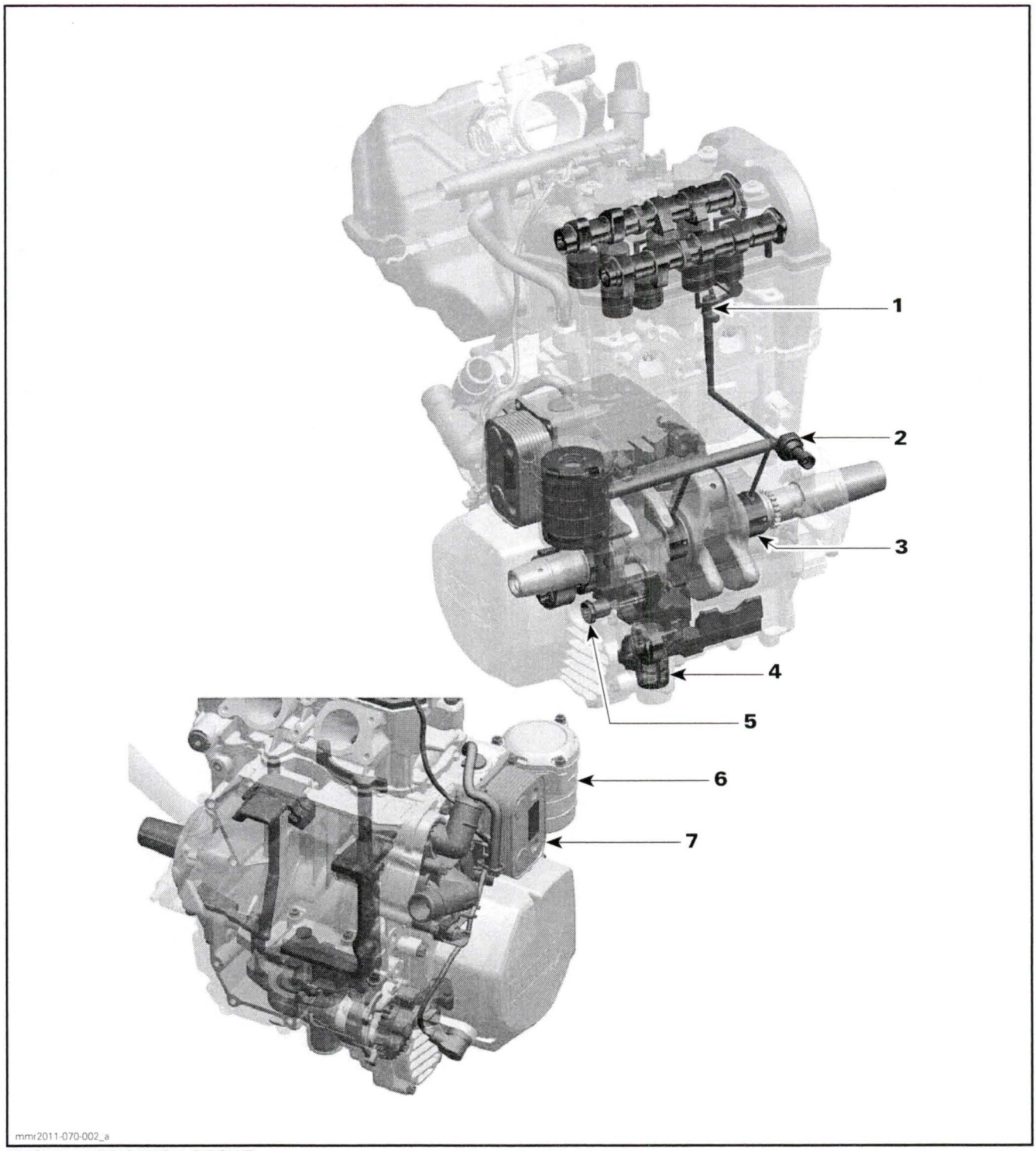
LUBRICATION SYSTEM

SERVICE TOOLS

Description	Part Number	Page
ADAPTER HOSE	529 035 652	276
ECM ADAPTER TOOL	529 036 166	278
FLUKE 115 MULTIMETER	529 035 868	278
OIL PRESSURE TEST CAP	529 036 158	276
PRESSURE GAUGE	529 035 709	276

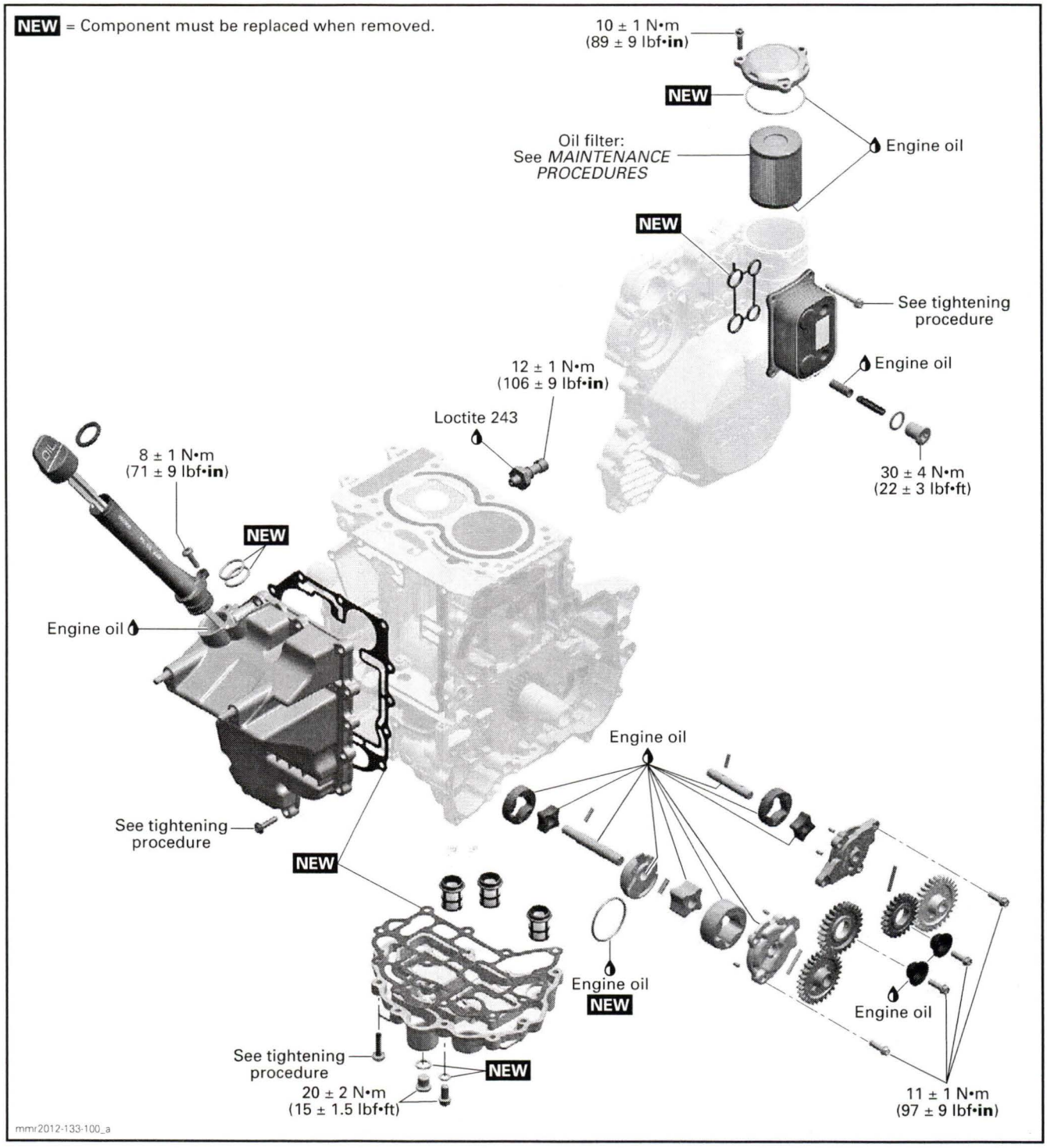
SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 243 (BLUE)	293 800 060	279



ENGINE LUBRICATION CIRCUIT

1. Oil channel to camshaft bearing
2. Oil pressure switch
3. Crankshaft main bearing
4. Oil strainer
5. Oil pressure regulator
6. Oil filter
7. Oil cooler


NEW = Component must be replaced when removed.
10 ± 1 N•m
(89 ± 9 lbf•in)
NEW
Engine oil
Oil filter:
See MAINTENANCE PROCEDURES
NEW
See tightening procedure
Engine oil
12 ± 1 N•m
(106 ± 9 lbf•in)
Loctite 243
30 ± 4 N•m
(22 ± 3 lbf•ft)
8 ± 1 N•m
(71 ± 9 lbf•in)
NEW
Engine oil
Engine oil
See tightening procedure
NEW
Engine oil
NEW
Engine oil
See tightening procedure
NEW
20 ± 2 N•m
(15 ± 1.5 lbf•ft)
11 ± 1 N•m
(97 ± 9 lbf•in)
mmr2012-133-100_a

GENERAL

SYSTEM DESCRIPTION

This engine uses dry sump lubrication. The oil from the cylinder block, timing chain chamber and magneto cover is pumped by two suction pumps.

Both suction pumps are integrated into one module.

The 20 mm (.79 in) large oil suction pump returns the crankshaft and magneto chamber oil to the reservoir.

The 11 mm (.43 in) small oil suction pump returns the timing chain chamber oil to the oil reservoir.

An oil filter and three oil strainers are used to filter dirt and debris from the oil circuit.

The oil strainers are located between oil sump cover and crankcase lower underneath the oil pressure pump.

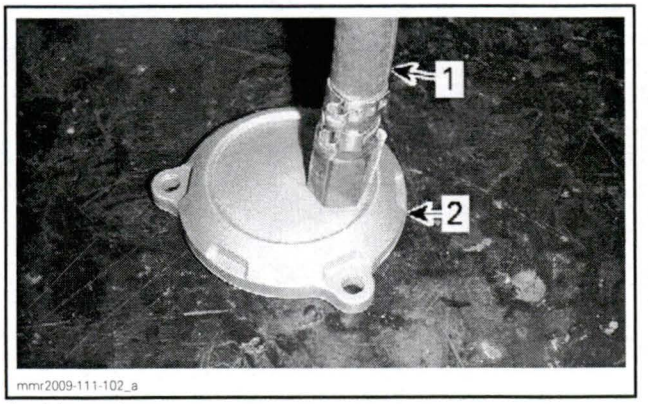
The oil pressure is provided by a pump and regulated by a spring loaded pressure regulator.

INSPECTION

ENGINE OIL PRESSURE

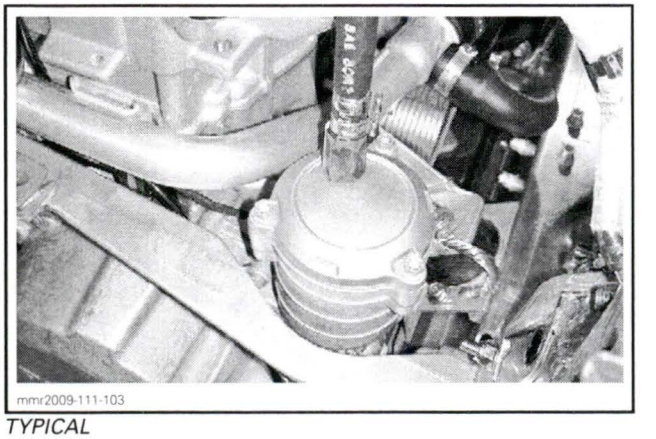
1. Remove the RH side panel.
2. Completely tighten the adapter hose on the oil pressure test cap.

REQUIRED TOOLS	
ADAPTER HOSE (P/N 529 035 652)	
OIL PRESSURE TEST CAP (P/N 529 036 158)	



1. Adapter hose
2. Oil pressure test cap

3. Install the oil pressure test cap on the oil filter reservoir. Position adapter hose near engine.

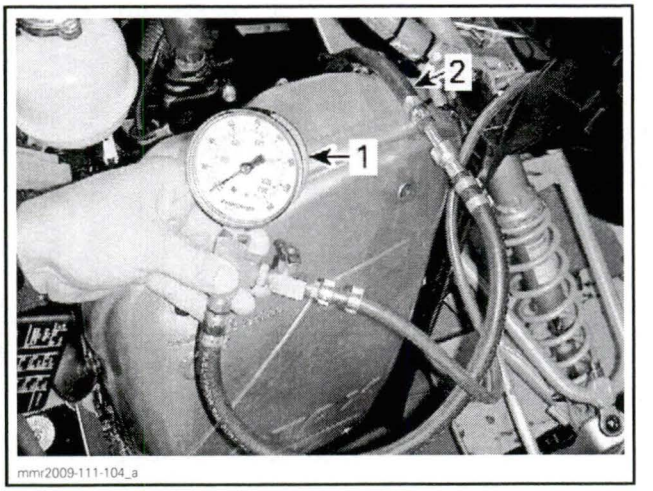


TYPICAL

4. Connect the pressure gauge to adapter hose.

REQUIRED TOOL
PRESSURE GAUGE (P/N 529 035 709)





TYPICAL
1. Pressure gauge
2. Adapter hose

5. Start engine and check the oil pressure.

ENGINE OIL PRESSURE @ 80°C (176°F)	
ENGINE SPEED	MINIMUM PRESSURE
Idle	60 kPa (8.7 PSI)
4000 RPM	400 kPa (58 PSI)

If the engine oil pressure is out of specification, refer to *TROUBLESHOOTING* in this subsection.

6. Remove engine oil pressure test tools.
7. Reinstall all removed parts.

TROUBLESHOOTING

Always check for fault codes. If a fault code is detected, service the fault code first.

LOW OR NO ENGINE OIL PRESSURE

1. **Oil level is too low.**
   - *Refill engine oil.*
   - *Check for high oil consumption. See below.*
   - *Check for oil leaks (oil leaking out of leak indicator hole, gaskets, oil seal or O-rings). Repair or replace.*
2. **Defective or clogged oil filter.**
   - *Replace engine oil and filter.*
3. **Use of a bad grade oil.**
   - *Replace engine oil with BRP recommended oil.*
4. **Oil pressure regulator valve sticks open, or spring load is insufficient.**
   - *Clean oil regulator piston and its bore. Replace if necessary.*
   - *Measure spring free length. Replace if out of specification.*
5. **Oil pump(s) worn or damaged.**
   - *Check if oil pump drive gears are damaged. Replace if necessary.*
   - *Check oil pump rotors and its bore for wear limits. Replace if out of specification.*
6. **Engine oil strainer is clogged.**
   - *Remove and clean engine oil strainer.*
7. **Heavy wear on plain bearings.**
   - *Check radial clearance of plain bearings. Replace if out of specification.*

HIGH OIL CONSUMPTION

1. **Oil in breathing system.**
   - *Check if breather V-ring is brittle, hard or damaged. Replace V-ring.*
   - *Check if oil separator cover is damaged or missing.*
2. **Valve stem seals worn or damaged.**
   - *Replace valve stem seals.*
3. **Piston rings worn out (blue colored exhaust smoke).**
   - *Replace piston rings.*

OIL CONTAMINATION (WHITE APPEARANCE)

1. **Oil seal and rotary seal on water pump shaft leaking.**
   - *Replace oil seal, rotary seal and water pump shaft. Change engine oil.*
2. **Cylinder head gasket leaking.**
   - *Replace cylinder head gasket. Change engine oil.*
3. **Cylinder head screws not properly tightened.**
   - *Retighten screws with recommended torque. Change engine oil.*
4. **Oil cooler gasket leaking.**
   - *Replace gasket. Change engine oil.*

PROCEDURES

OIL PRESSURE SWITCH (OPS)

OPS Activation

The oil pressure switch activates if engine oil pressure falls between 20 kPa and 40 kPa (2.9 PSI and 5.8 PSI).

OPS Access

1. Remove LH side panels.
2. Remove the drive belt guard. Refer to *DRIVE BELT* subsection.

OPS Inspection

First, ensure oil pressure is adequate. Refer to *ENGINE OIL PRESSURE*.

If the oil pressure is good, check the resistance of the oil pressure switch.

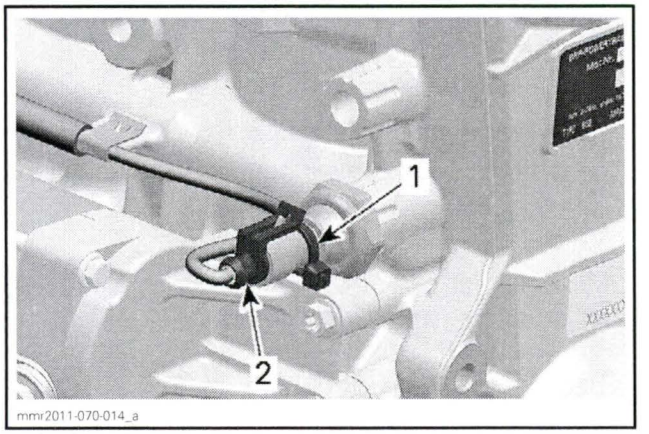
OPS Resistance Test

The engine must be warm to check the oil pressure switch properly.

⚠ WARNING

Be careful when working near hot part. To avoid potential burns, never touch exhaust system components immediately after the engine has been running as these components are very hot. Always use long sleeves and gloves.

1. Cut locking tie and disconnect the OPS connector.



1. Locking tie
2. OPS connector

2. Check the oil pressure switch resistance.

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

3. Read result and compare to table.

RESISTANCE (Ω)		
ENGINE NOT RUNNING		
OPS pin	Engine ground	Close to 0 Ω (normally closed switch)

If resistance is out of specification, replace the oil pressure switch.

If the resistance is correct, continue procedure. It will be necessary to use jumper wires.

4. Install drive belt guard.
5. Start engine.
6. Read result and compare to table.

RESISTANCE (Ω)		
ENGINE RUNNING		
OPS pin	Engine ground	Infinitely high (OL)

If resistance is out of specification, replace the oil pressure switch.

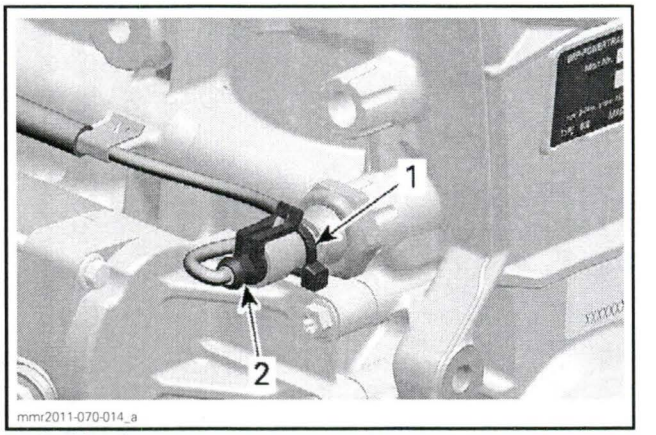
If the resistance is correct, check the oil pressure switch circuit continuity.

OPS Circuit Continuity Test

1. Disconnect ECM connector A. Refer to *ECM CONNECTOR ACCESS* in *ELECTRONIC FUEL INJECTION (600 ACE)* subsection.
2. Install connector A to the ECM adapter.

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

3. Cut locking tie and disconnect the OPS connector.



1. Locking tie
2. OPS connector

4. Check continuity as follows.

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

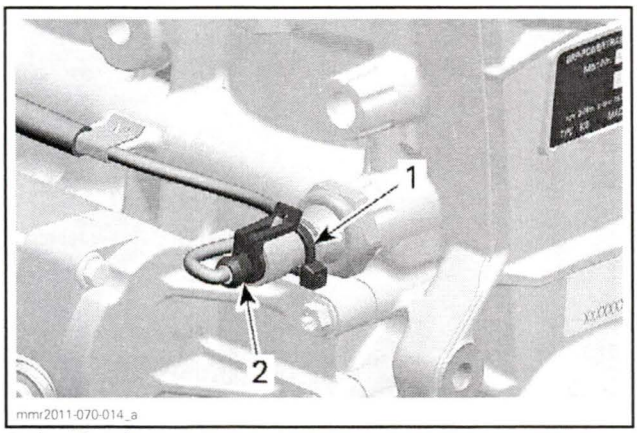
CIRCUIT CONTINUITY		
OPS connector	ECM A pin E3	Close to 0 Ω

If the continuity is good and all other tests, try a **NEW** ECM.

If the continuity is bad, repair or replace defective wire or connectors.

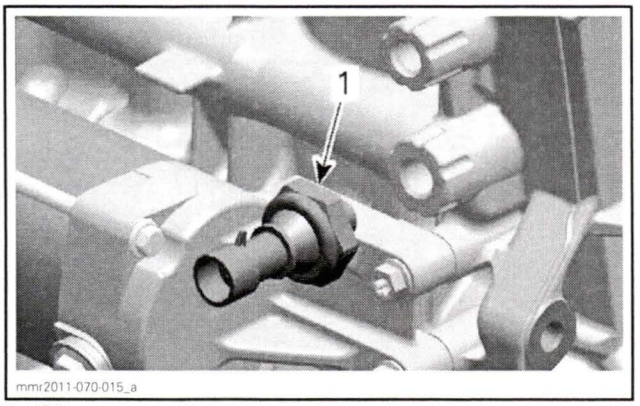
OPS Removal

1. Cut locking tie and unplug the OPS switch connector.



1. Locking tie
2. OPS connector

2. Unscrew and remove the OPS.



1. Oil pressure switch

OPS Installation

Install oil pressure switch as per the following informations.

OIL PRESSURE SWITCH	
Service product	LOCTITE 243 (BLUE) (P/N 293 800 060)
Tightening torque	12 N•m ± 1 N•m (106 lbf•**in** ± 9 lbf•**in**)

Install all other removed parts.

NOTICE **When installing the locking tie on the OPS connector, take care that the wires do not make a sharp bend.**

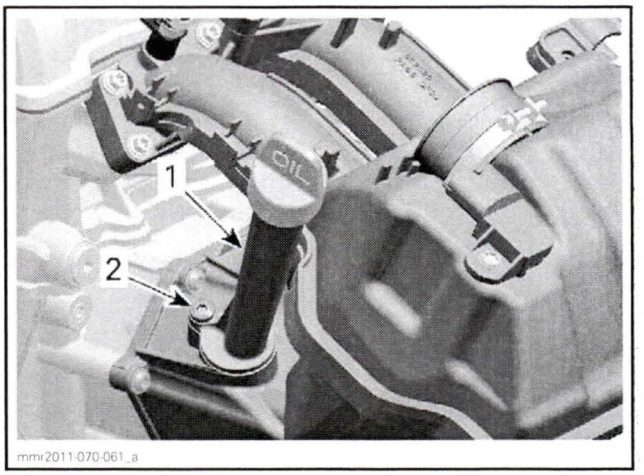
OIL FILLER TUBE

Oil Filler Tube Access

Remove drive belt guard, refer to *DRIVE BELT* subsection.

Oil Filler Tube Removal

1. Remove the oil filler tube retaining screw.

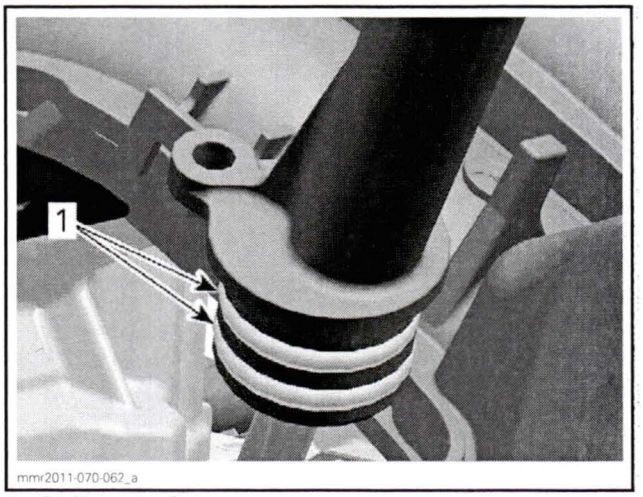


1. Oil filler tube
2. Retaining screw

2. Pull filler tube out of the oil tank cover.

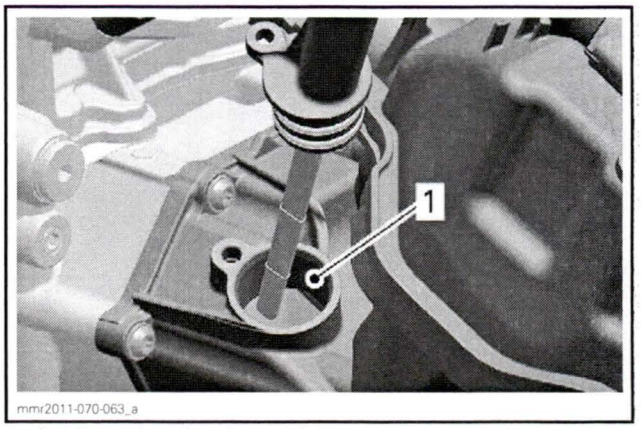
Oil Filler Tube Installation

1. Install **NEW** O-rings on the oil filler tube.



1. Oil filler tube O-rings

2. Lubricate the oil tank cover bore with engine oil.



1. Lubricate the oil tank cover bore

3. Install the oil filler tube.

4. Tighten retaining screw to the specified torque.

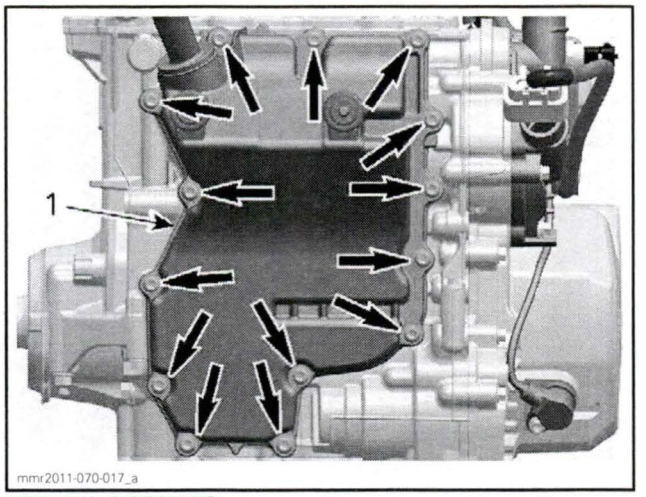
TIGHTENING TORQUE	
Oil filler tube screw	8 N•m ± 1 N•m (71 lbf•**in** ± 9 lbf•**in**)

5. Install all other removed parts.

OIL TANK

Oil Tank Cover Removal

1. Drain engine oil. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.
2. Remove the engine from vehicle. Refer to *ENGINE REMOVAL AND INSTALLATION* subsection.
3. Remove intake manifold. Refer to *AIR INTAKE SYSTEM* subsection.
4. Place a drain pan underneath oil tank.
5. Unscrew oil tank cover retaining screws.



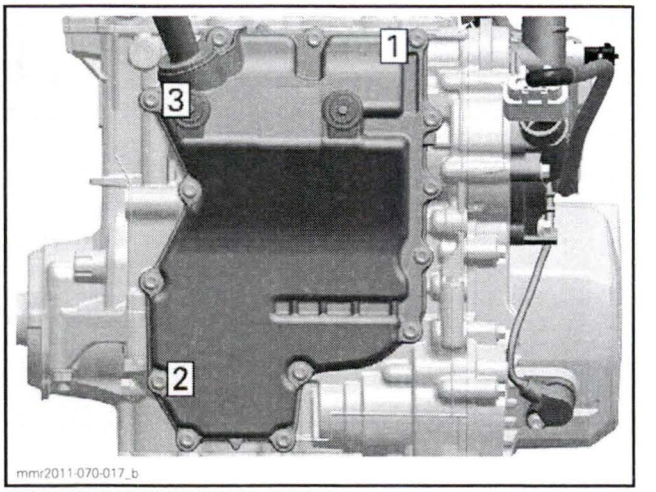
RETAINING SCREWS
1. Oil tank

6. Remove oil tank from the engine.

Oil Tank Cover Installation

1. Install **NEW** gasket.
2. Install the oil tank on the engine, then tighten screws in two steps as follows:
   2.1 Tighten the following screws to the specified torque and sequence.

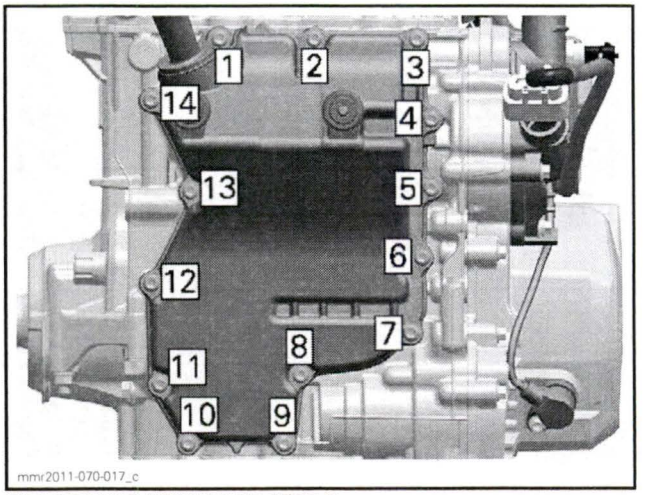
OIL TANK SCREWS TIGHTENING TORQUE (FOLLOW SEQUENCE)	
STEP A	5 N•m ± 0.6 N•m (44 lbf•**in** ± 5 lbf•**in**)



TIGHTENING SEQUENCE STEP A

   2.2 Tighten the following screws to the specified torque and sequence.

OIL TANK SCREWS TIGHTENING TORQUE (FOLLOW SEQUENCE)	
STEP B	ORIGINAL CRANKCASE
	11 N•m ± 1 N•m (97 lbf•**in** ± 9 lbf•**in**)
	NEW CRANKCASE
	14 N•m ± 2 N•m (124 lbf•**in** ± 18 lbf•**in**)



TIGHTENING SEQUENCE STEP B

3. Wipe off any oil spillage.
4. Install the engine in the vehicle. Refer to *ENGINE REMOVAL AND INSTALLATION* subsection.
5. Install intake manifold. Refer to *AIR INTAKE SYSTEM* subsection.

6. Fill up oil tank and check oil level. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

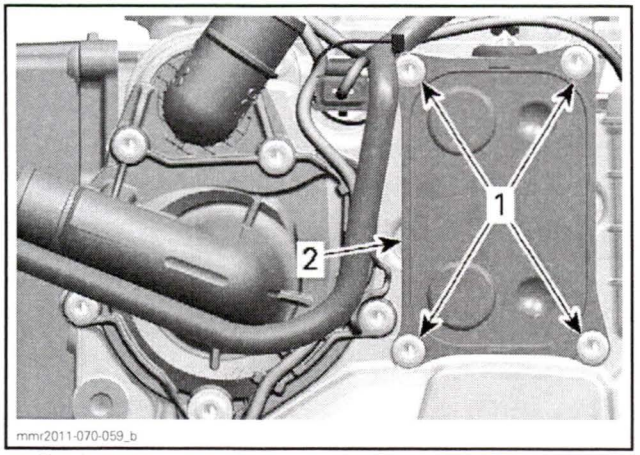
OIL COOLER

Oil Cooler Access

Remove muffler, refer to *EXHAUST SYSTEM* subsection.

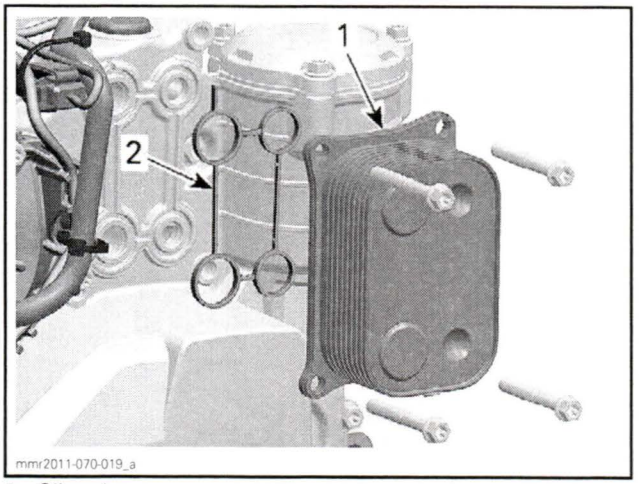
Oil Cooler Removal

1. Drain engine oil. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.
2. Drain cooling system. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.
3. Remove oil cooler retaining screws.



1. *Retaining screws*
2. *Oil cooler*

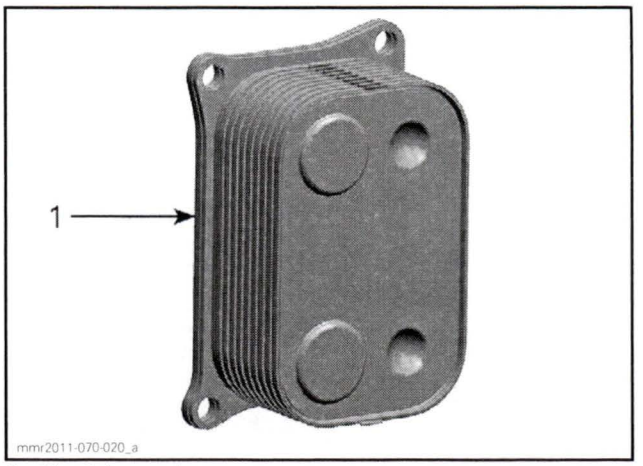
4. Place rags or towels under oil cooler to catch remaining oil and coolant.
5. Remove oil cooler and its gasket.



1. *Oil cooler*
2. *Gasket*

Oil Cooler Inspection

Check oil cooler for cracks and other damage.



1. *Check for cracks*

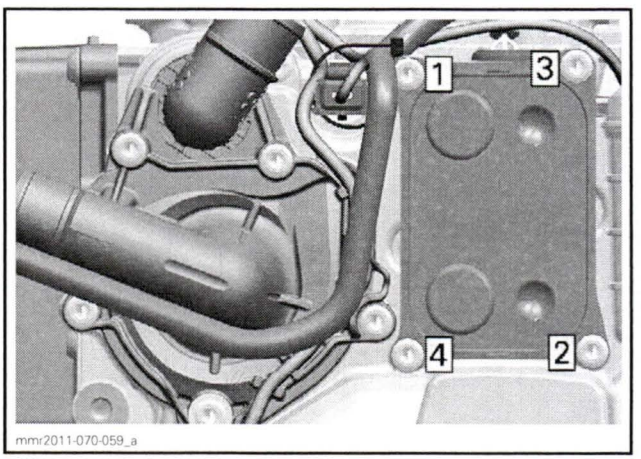
Replace parts as necessary.

Oil Cooler Installation

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

Tighten oil cooler screws in two steps to the specified torque following the illustrated sequence.

TIGHTENING TORQUE		
OIL COOLER SCREWS	STEP A	5 N•m ± 0.6 N•m (44 lbf•**in** ± 5 lbf•**in**)
	STEP B	10 N•m ± 1 N•m (89 lbf•**in** ± 9 lbf•**in**)



TIGHTENING SEQUENCE OIL-COOLER

Wipe off any oil and coolant spillage.

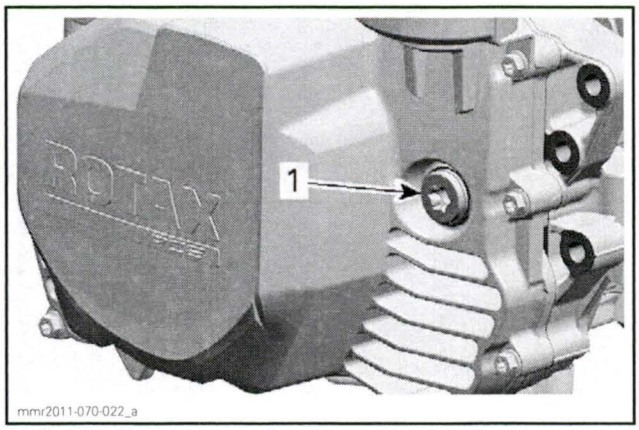
Fill up oil tank and check oil level. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

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

ENGINE OIL PRESSURE REGULATOR

Oil Pressure Regulator Location

The engine oil pressure regulator is located inside the magneto cover.



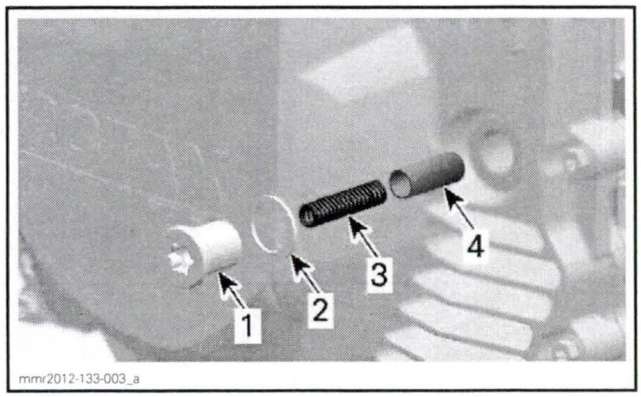
1. Engine oil pressure regulator

Oil Pressure Regulator Access

Remove muffler, refer to *EXHAUST SYSTEM* subsection.

Oil Pressure Regulator Removal

1. Drain engine oil. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.
2. Remove regulator plug and sealing washer. Discard sealing washer.
3. Pull oil pressure regulator parts out of the magneto cover.



1. Plug
2. Sealing washer
3. Regulator spring
4. Regulator piston

Oil Pressure Regulator Inspection

Clean bore and thread in the magneto cover from any contamination.

Inspect oil pressure regulator piston and its bore in cylinder block for scoring or other damages.

Check if piston moves easily in its bore.

Check compression spring for free length.

SPRING FREE LENGTH	
NEW NOMINAL	46 mm (1.811 in)
SERVICE LIMIT	45 mm (1.772 in)

Visually check compression spring for squareness.

Replace worn or damaged components.

Oil Pressure Regulator Installation

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

Install a **NEW** sealing washer on plug.

Tighten regulator plug to the specified torque.

TIGHTENING TORQUE	
Oil pressure regulator plug	30 N•m ± 4 N•m (22 lbf•ft ± 3 lbf•ft)

Wipe off any oil spillage.

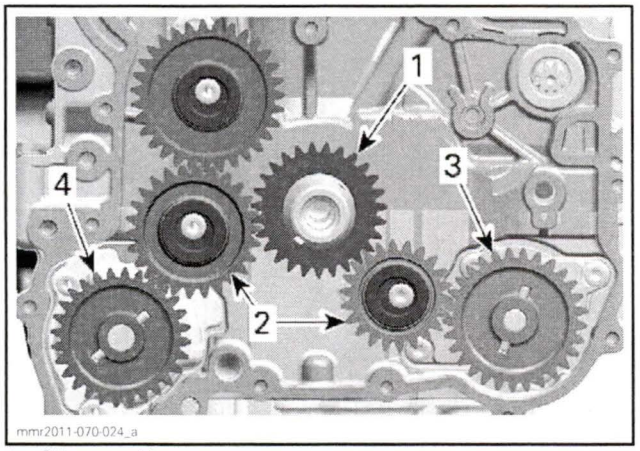
Fill up oil tank and check oil level. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

Install all other removed parts.

OIL PUMP DRIVE GEARS

Oil Pump Drive Gear Location

The oil pump gears are located on the MAG side, behind the magneto cover.



1. *Oil pump drive gear*
2. *Intermediate gears*
3. *Oil pressure pump gear*
4. *Oil suction pump gear*

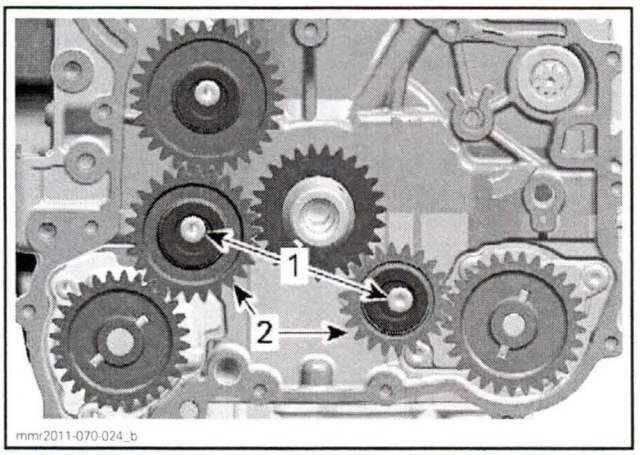
Oil Pump Drive Gear Access

Refer to *MAGNETO SYSTEM* subsection to remove:

- Magneto cover
- Rotor
- Sprag clutch gear.

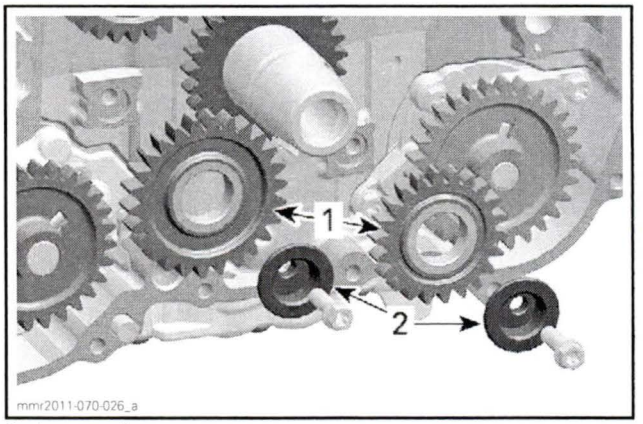
Oil Pump Drive Gear Removal

1. Unscrew oil pump intermediate gear screws.



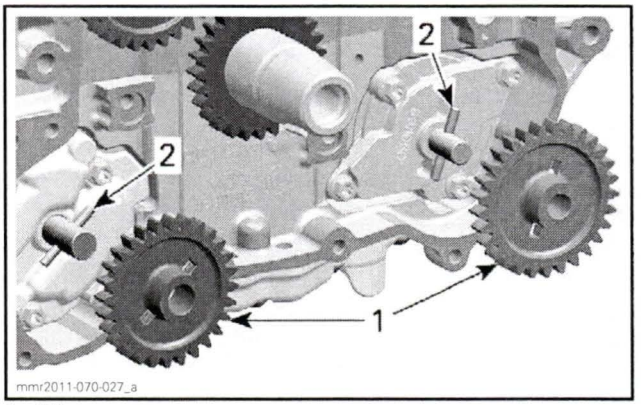
1. *Retaining screws*
2. *Intermediate gears*

2. Remove bearing sleeves and oil pump intermediate gears.



1. *Intermediate gears*
2. *Bearing Sleeves*

3. Remove oil pump gears and needle pins.



1. *Oil pump gears*
2. *Needle pins*

Oil Pump Drive Gear Inspection

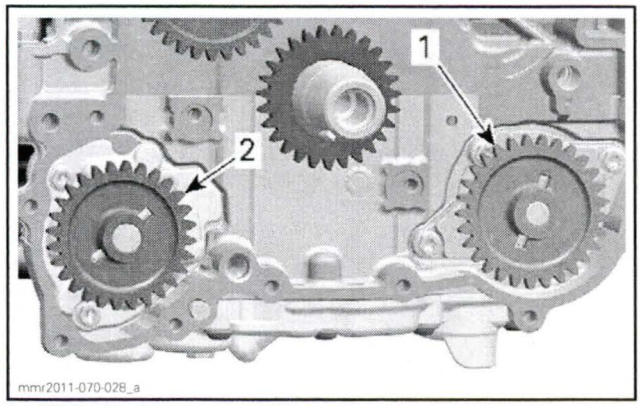
Inspect gears for wear, cracks or other damage.

Replace if damaged.

Oil Pump Drive Gear Installation

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

1. Ensure not to mix up the oil pump gears, see next illustration.
   - 1.1 Install the BROWN oil pump gear (29 teeth) on oil pressure pump.
   - 1.2 Install the BLACK oil pump gear (28 teeth) on oil suction pump.



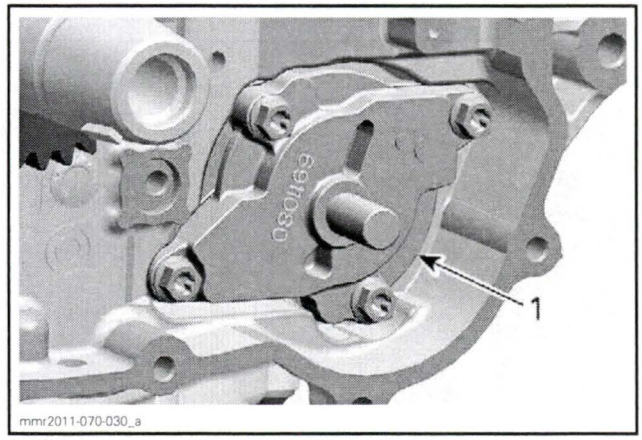
1. BROWN oil pump gear - 29 teeth
2. BLACK oil pump gear - 28 teeth

2. Lubricate intermediate gears bearing sleeves with engine oil, then install gears.
3. Install all other removed parts.
4. Fill up oil tank and check oil level. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

OIL PRESSURE PUMP

Oil Pressure Pump Location

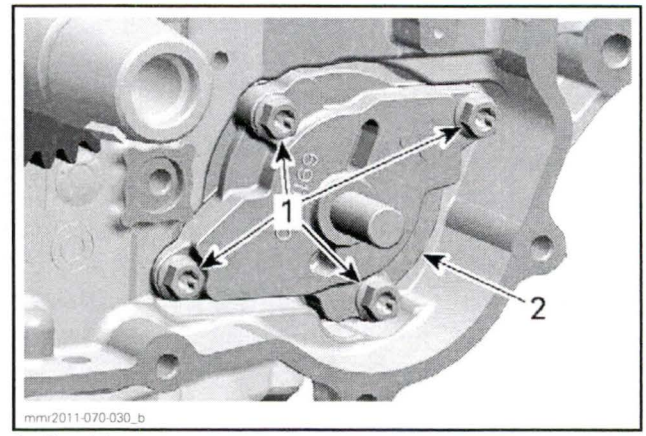
The oil pressure pump is located in the cylinder block, behind the magneto cover.



1. Oil pressure pump

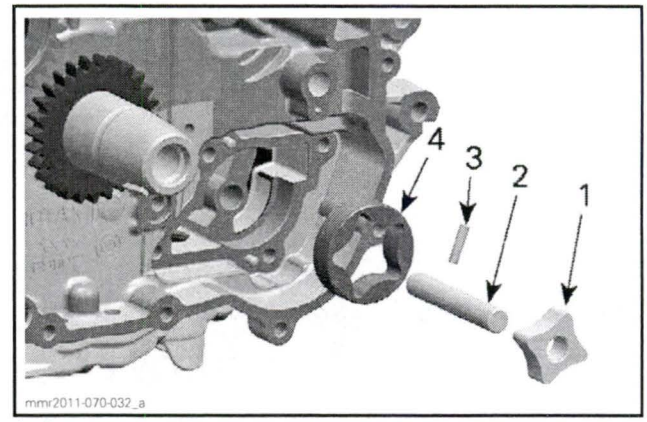
Oil Pressure Pump Removal

1. Remove *OIL PUMP DRIVE GEARS*, see procedure in this subsection.
2. Remove oil pump cover.



1. Retaining screws
2. Oil pump cover

3. Remove the following parts.



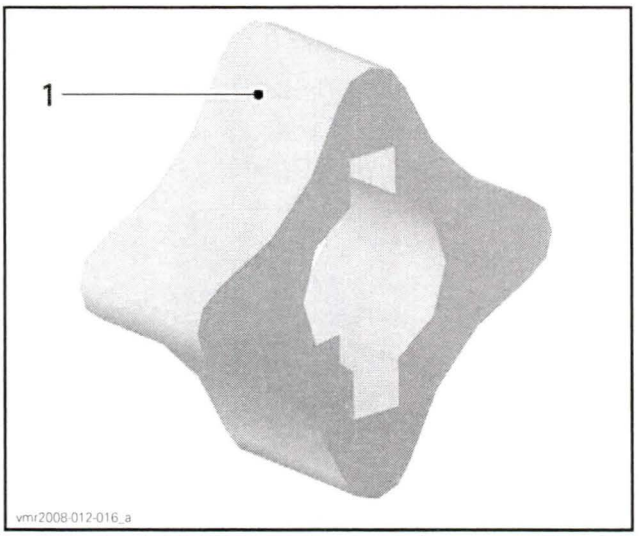
1. Inner rotor
2. Oil pump shaft
3. Needle pin
4. Outer rotor

Oil Pressure Pump Inspection

Inspect oil pump and oil pump cover bore for marks, scratches or other damage. Replace any damaged parts.

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

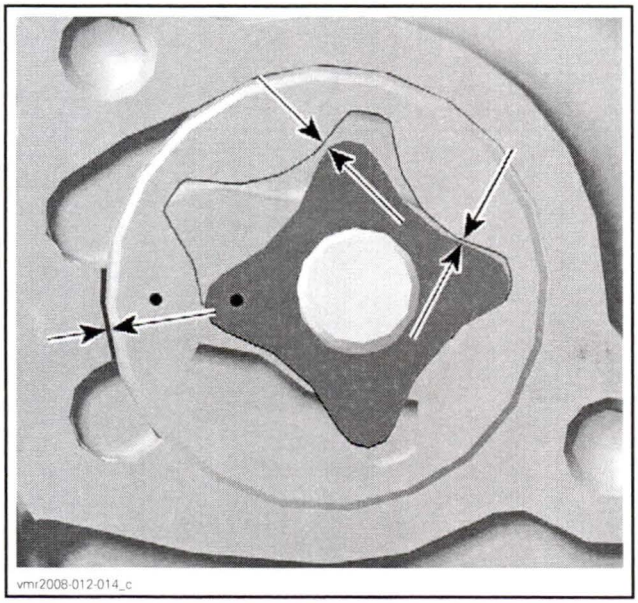
Check inner rotor for corrosion, worn pin slots or other damages. If so, replace inner and outer rotor at the same time.



1. Pitting on the teeth

Radial Clearance

Using a feeler gauge, measure the clearance of outer rotor and inner rotor where shown with the arrows.

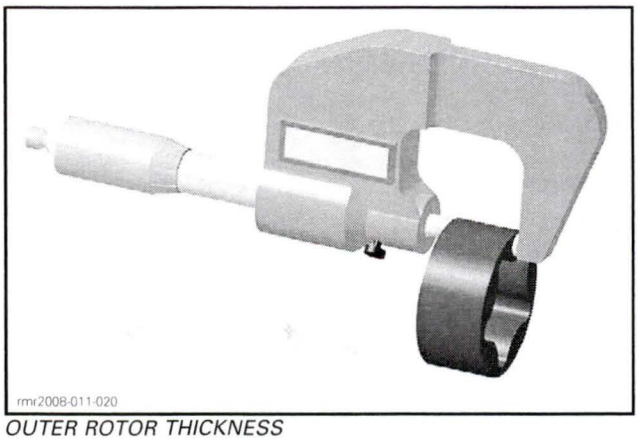


OIL PUMP RADIAL CLEARANCE	
SERVICE LIMIT	0.25 mm (.0098 in)

NOTE: If clearance of inner and outer rotors exceeds the tolerance, replace oil pump.

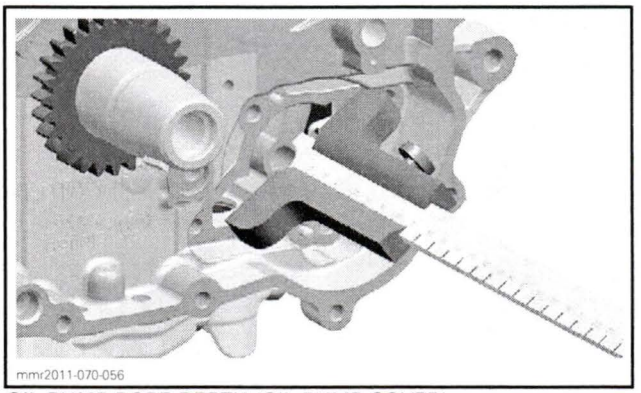
Axial Clearance

Measure outer rotor thickness with a micrometer.



OUTER ROTOR THICKNESS

Using a depth gauge, measure the depth of oil pump bore in the lower crankcase.



OIL PUMP BORE DEPTH (OIL PUMP COVER)

Substract bore depth from rotor thickness to obtain axial clearance.

OIL PUMP AXIAL CLEARANCE	
SERVICE LIMIT	0.15 mm (.0059 in)

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

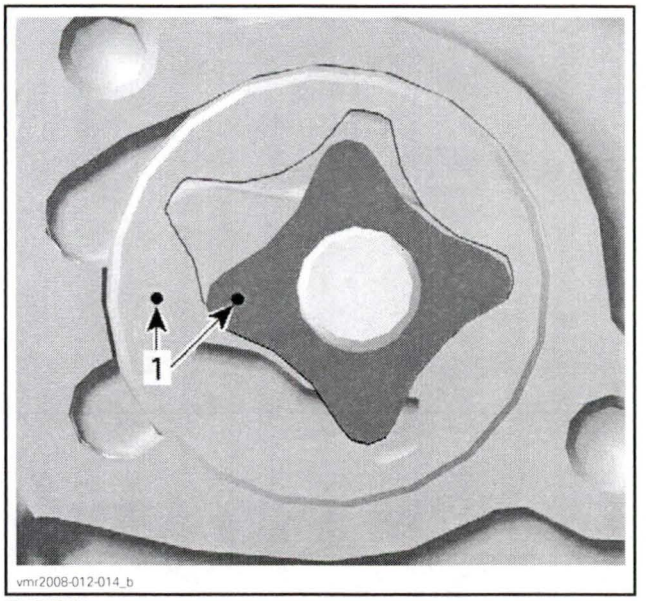
Oil Pressure Pump Installation

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

1. Lubricate outer rotor with engine oil.

NOTICE **Install rotors with the marks outwards.**

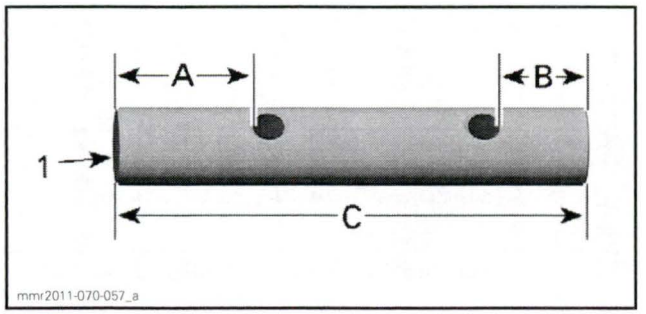
2. Install outer rotor into crankcase oil pump bore.



TYPICAL
1. Marks on inner and outer rotor

3. Install needle pin in oil pump shaft.

NOTICE **The oil pump shaft is not symmetrical, the longer side must be installed inward.**



1. Towards engine
A. 16.96 mm (.67 in)
B. 11.43 mm (.45 in)
C. 60.5 mm (2.38 in)

4. Place inner rotor onto the oil pump shaft. Lubricate oil pump shaft and inner rotor with engine oil.
5. Install oil pump shaft assembly into the crankcase.

After installation of the remaining parts, check for smooth operation of the oil pump assembly and axial play of the oil pump shaft.

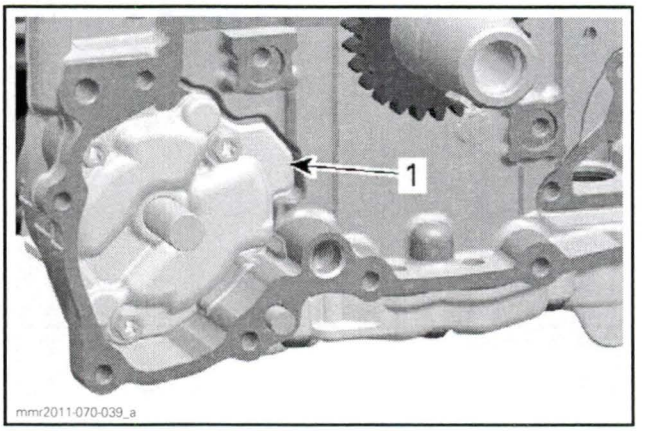
6. Fill up oil tank and check oil level. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

Start engine and make sure oil pressure is within specifications (refer to *ENGINE OIL PRESSURE* in this subsection).

OIL SUCTION PUMP MODULE

Oil Suction Pump Module Location

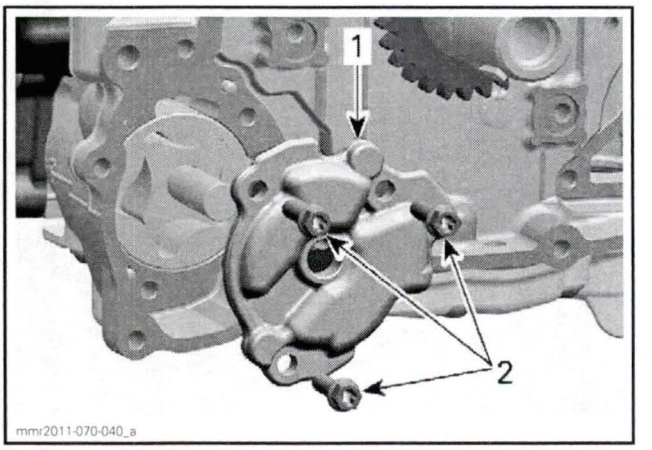
The oil suction pump module is located in the cylinder block, behind the magneto cover.



1. Oil suction pump module

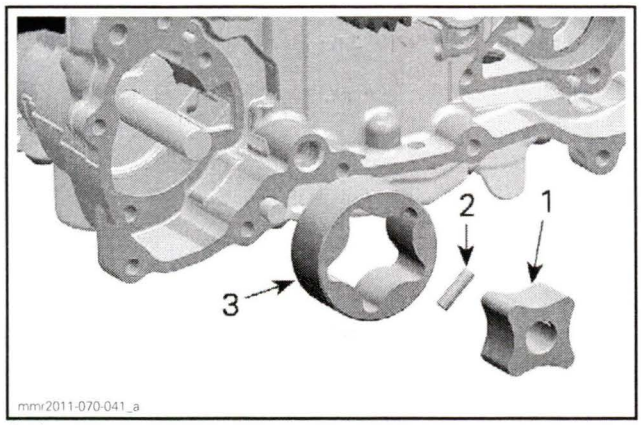
Oil Suction Pump Module Disassembly

1. Remove *OIL PUMP DRIVE GEARS*, see procedure in this subsection.
2. Remove oil pump module cover.



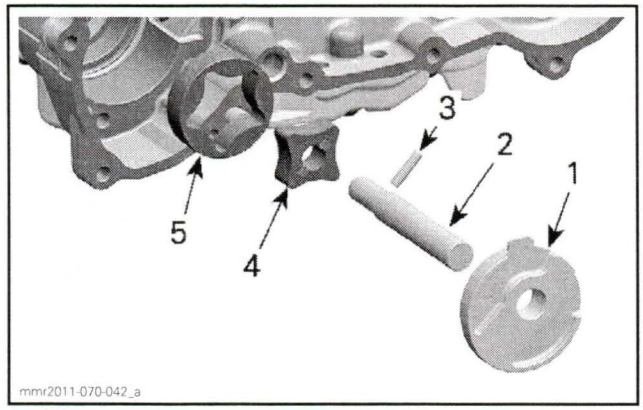
1. Oil pump module cover
2. Retaining screws

3. Disassemble the large oil suction pump as shown.



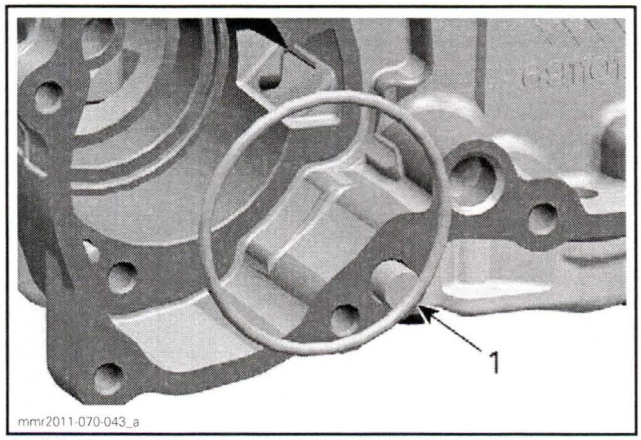
1. *Inner rotor*
2. *Needle pin*
3. *Outer rotor*

4. Disassemble the small oil suction pump as shown.



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

5. Remove and discard the oil pump cover O-ring.



1. *Oil pump cover O-ring*

Oil Suction Pumps Inspection

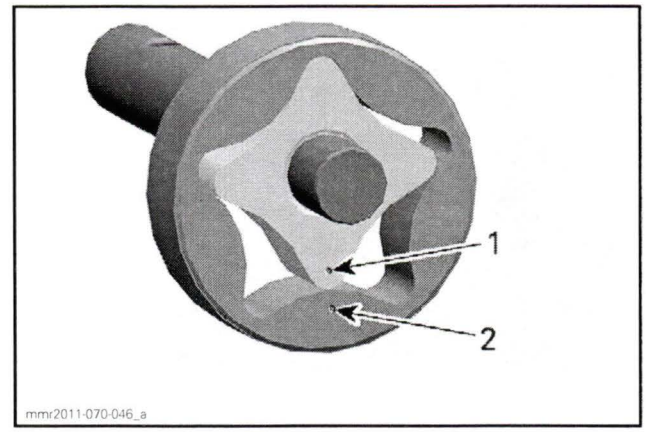
The inspection of both oil suction pumps is the same as for the oil pressure pump. Refer to *OIL PRESSURE PUMP* in this subsection.

Oil Suction Pump Module Assembly

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

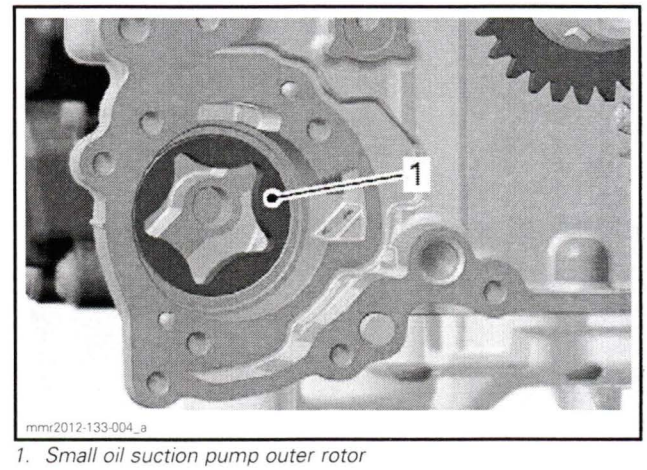
1. Lubricate small oil suction pump outer rotor with engine oil.

NOTICE **When installing the oil pump rotors, make sure both marks are pointing toward the inside of the crankcase.**



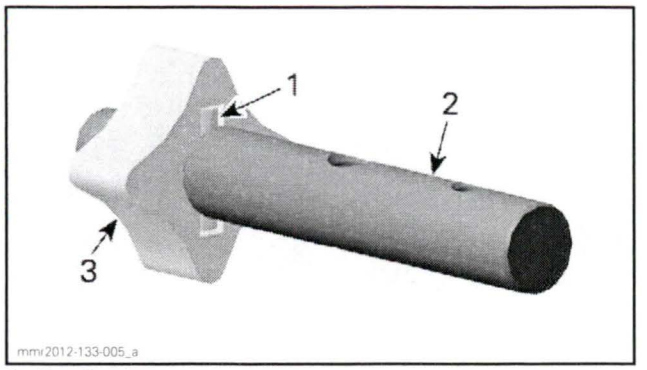
1. *Mark on inner rotor*
2. *Mark on outer rotor*

2. Install small oil suction pump outer rotor into crankcase oil pump bore.



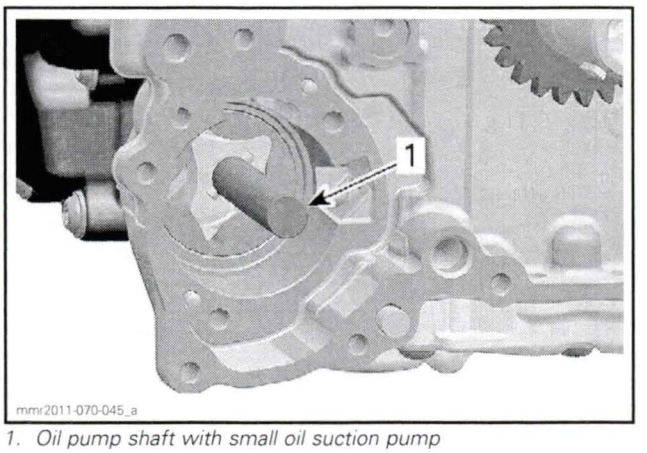
1. *Small oil suction pump outer rotor*

3. Install needle pin in bore of the oil pump shaft and place the small inner rotor on the shaft.



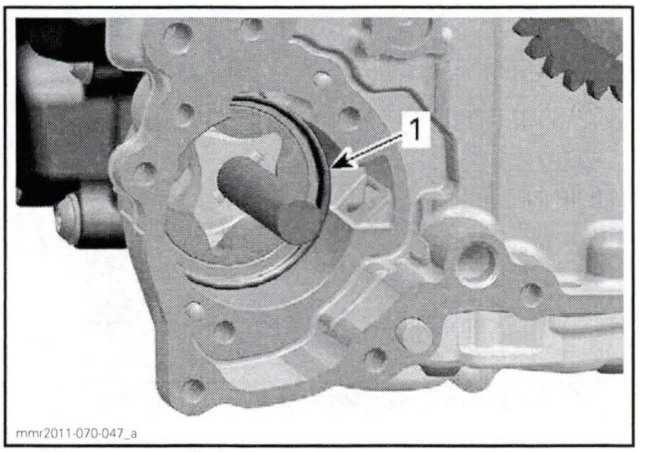
1. *Needle pin*
2. *Oil pump shaft*
3. *Small suction pump inner rotor*

4. Lubricate oil pump shaft and inner rotor with engine oil.
5. Install oil pump shaft assembly into the crankcase.



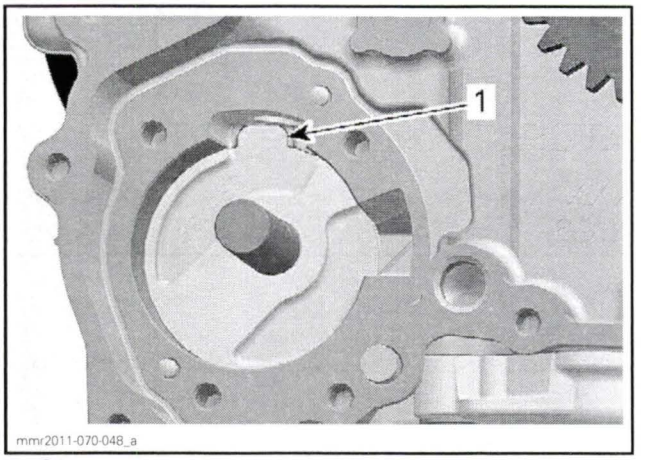
1. *Oil pump shaft with small oil suction pump*

6. Install a **NEW** oil pump cover O-ring.



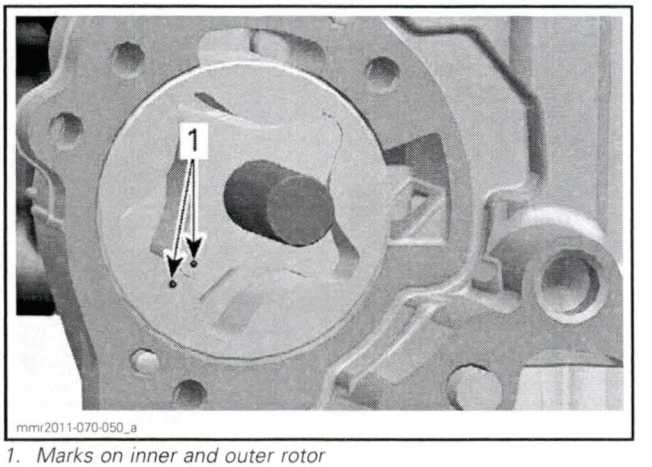
1. *Oil pump cover O-ring*

7. Lubricate both sides of the oil pump cover with engine oil.
8. Align tab of the oil pump cover with the upper recess in the crankcase. Push cover in until a click is heard, indicating the cover is properly installed.



1. *Oil pump cover tab properly positioned*

9. Install large oil suction pump needle pin.
10. Install large oil suction pump inner rotor and outer rotor with the marks outwards.



1. *Marks on inner and outer rotor*

11. Lubricate large oil suction pump parts with engine oil.
12. Install other removed parts.

After installation is complete, check for smooth operation of the oil pump assembly and axial play of the oil pump shaft.

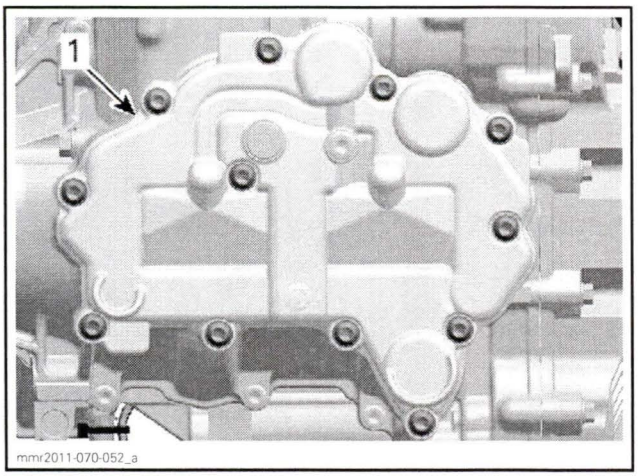
13. Fill up oil tank and check oil level. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

Start engine and make sure oil pressure is within specifications (refer to *ENGINE OIL PRESSURE* in this subsection).

OIL SUMP COVER

Oil Sump Cover Location

The oil sump cover is located on the engine bottom.



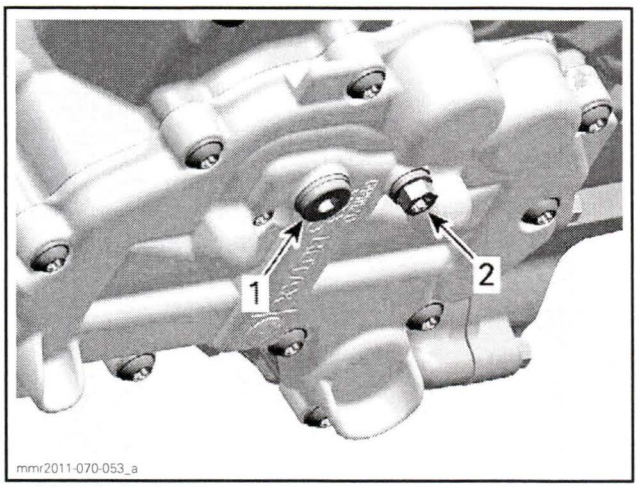
BOTTOM OF ENGINE
1. *Oil sump cover*

Oil Sump Cover Access

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

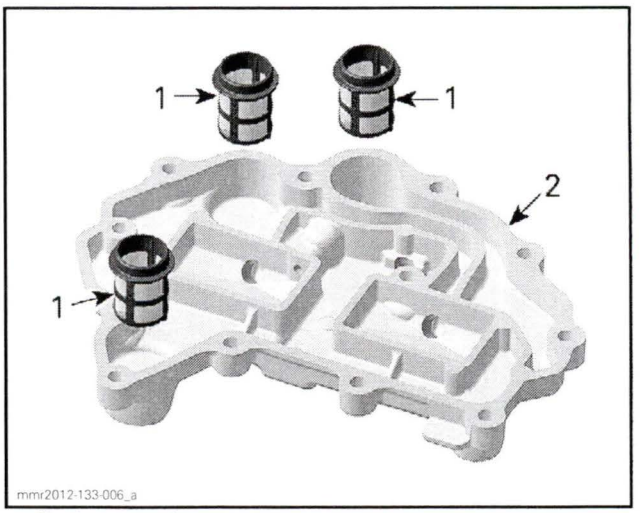
Oil Sump Cover Removal

1. Drain engine oil, refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.



1. *Main drain plug*
2. *Secondary drain plug*

2. Unscrew oil sump cover retaining screws.
3. Remove oil sump cover. Discard gasket.
4. Remove and clean engine oil strainers.

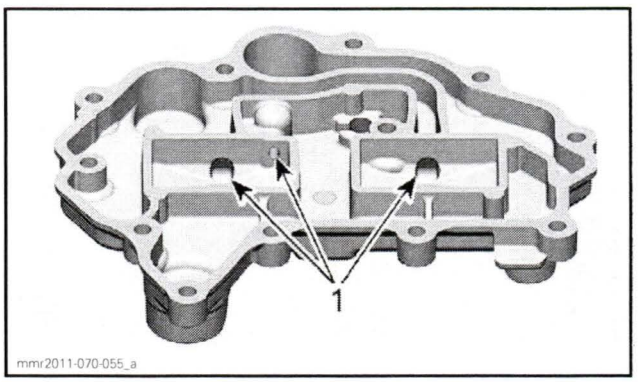


1. *Engine oil strainers*
2. *Oil sump cover*

Oil Sump Cover Inspection

Clean oil sump cover and engine oil strainers with a part cleaner, then use an air gun to dry it.

Blow out the oil orifices and check if they are not clogged.



1. *Oil drain bores*

Check oil sump cover for cracks or other damage.

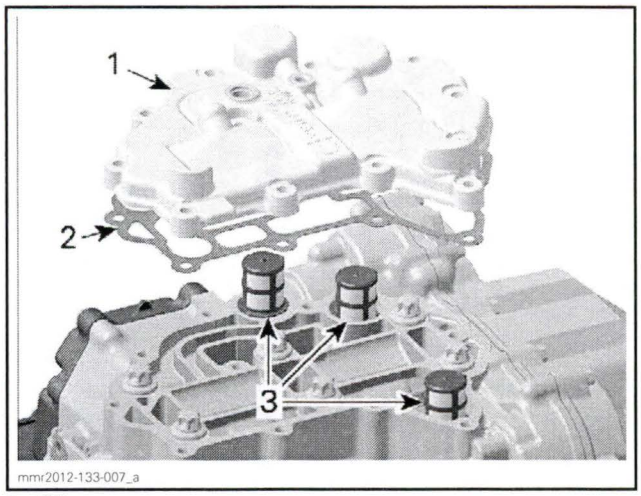
Check oil sump cover for flatness with straight edge.

Replace oil sump cover if necessary.

Check engine oil strainers for damage and change if necessary.

Oil Sump Cover Installation

1. Install a **NEW** oil sump cover gasket.
2. Install the strainers as shown.

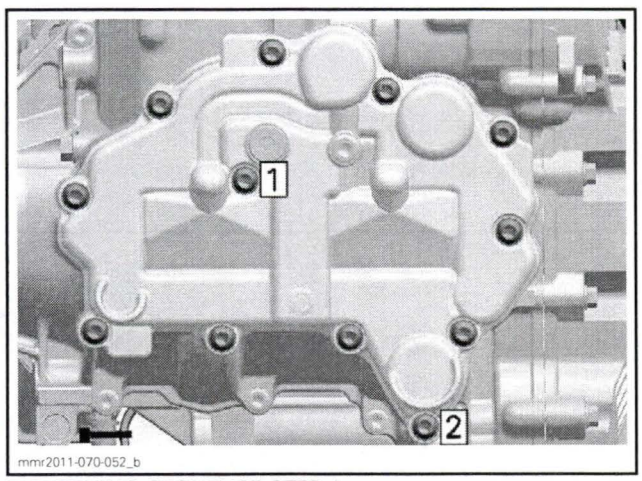


1. *Oil sump cover*
2. *Gasket*
3. *Engine oil strainers*

3. Install the oil sump cover on the engine, then tighten screws in two steps as follows:

   3.1 Tighten the following screws to the specified torque and sequence.

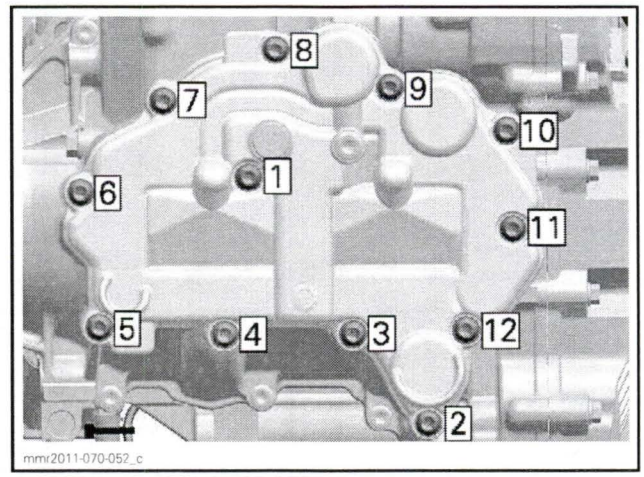
OIL SUMP COVER SCREWS TIGHTENING TORQUE (FOLLOW SEQUENCE)	
STEP A	5 N•m ± 0.6 N•m (44 lbf•**in** ± 5 lbf•**in**)



TIGHTENING SEQUENCE STEP A

   3.2 Tighten the following screws to the specified torque and sequence.

OIL SUMP COVER SCREWS TIGHTENING TORQUE (FOLLOW SEQUENCE)	
STEP B	ORIGINAL CRANKCASE
	11 N•m ± 1 N•m (97 lbf•**in** ± 9 lbf•**in**)
	NEW CRANKCASE
	14 N•m ± 2 N•m (124 lbf•**in** ± 18 lbf•**in**)



TIGHTENING SEQUENCE STEP B

4. Reinstall oil drain plugs using **NEW** sealing washers.

TIGHTENING TORQUE	
Oil drain plugs	20 N•m ± 2 N•m (15 lbf•ft ± 1 lbf•ft)

5. Install engine in vehicle. Refer to *ENGINE REMOVAL AND INSTALLATION* subsection.
6. Fill up oil tank and check oil level. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

COOLING SYSTEM

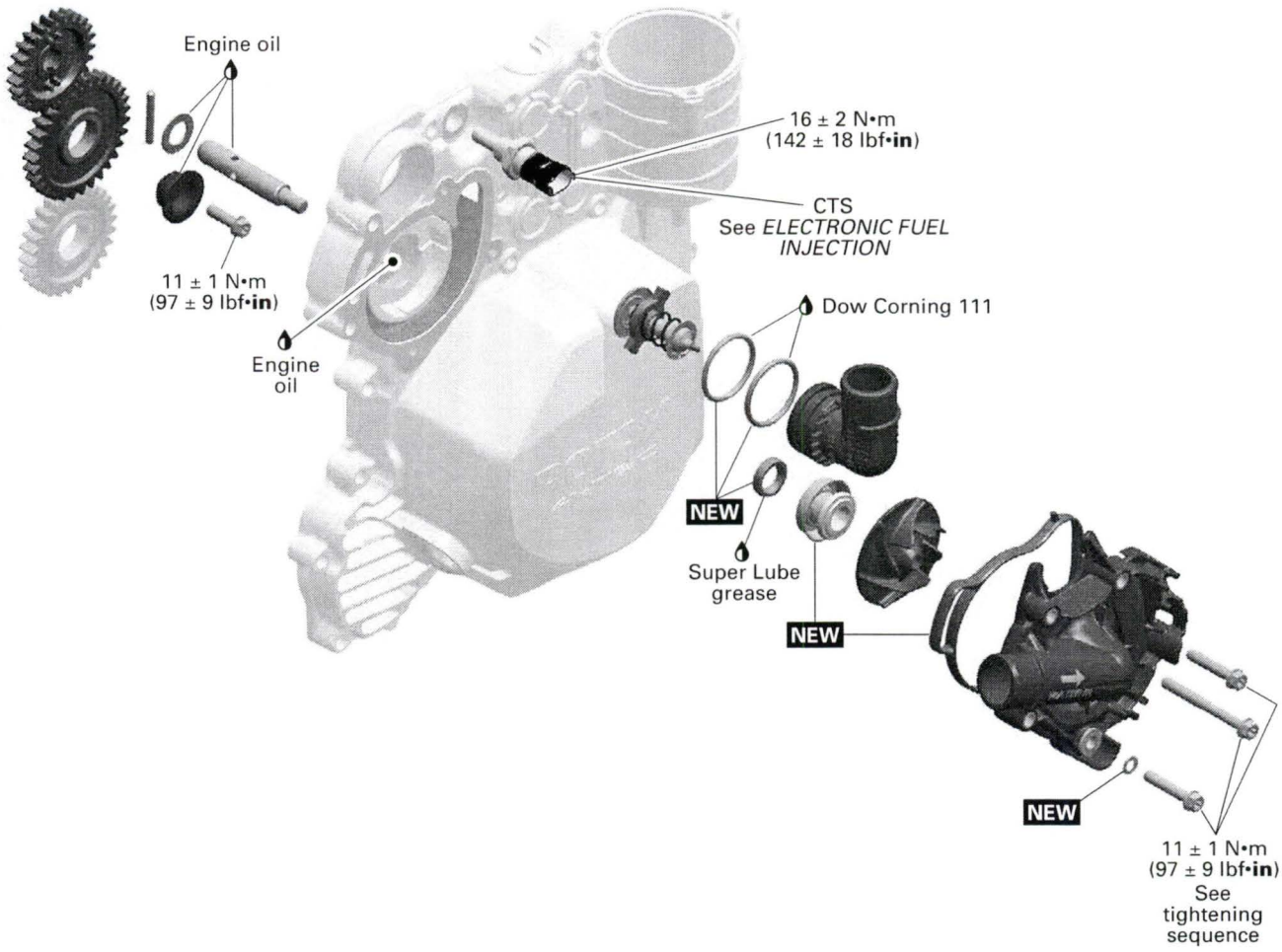
SERVICE TOOLS

Description	Part Number	Page
HANDLE	420 877 650	299
OIL SEAL PUSHER	529 036 210	299
ROTARY SEAL INSTALLER	529 036 211	299–300
TEST CAP	529 035 991	294
VACUUM/PRESSURE PUMP	529 021 800	294

SERVICE PRODUCTS

Description	Part Number	Page
DOW CORNING 111	413 707 000	296
SUPER LUBE GREASE	293 550 030	299

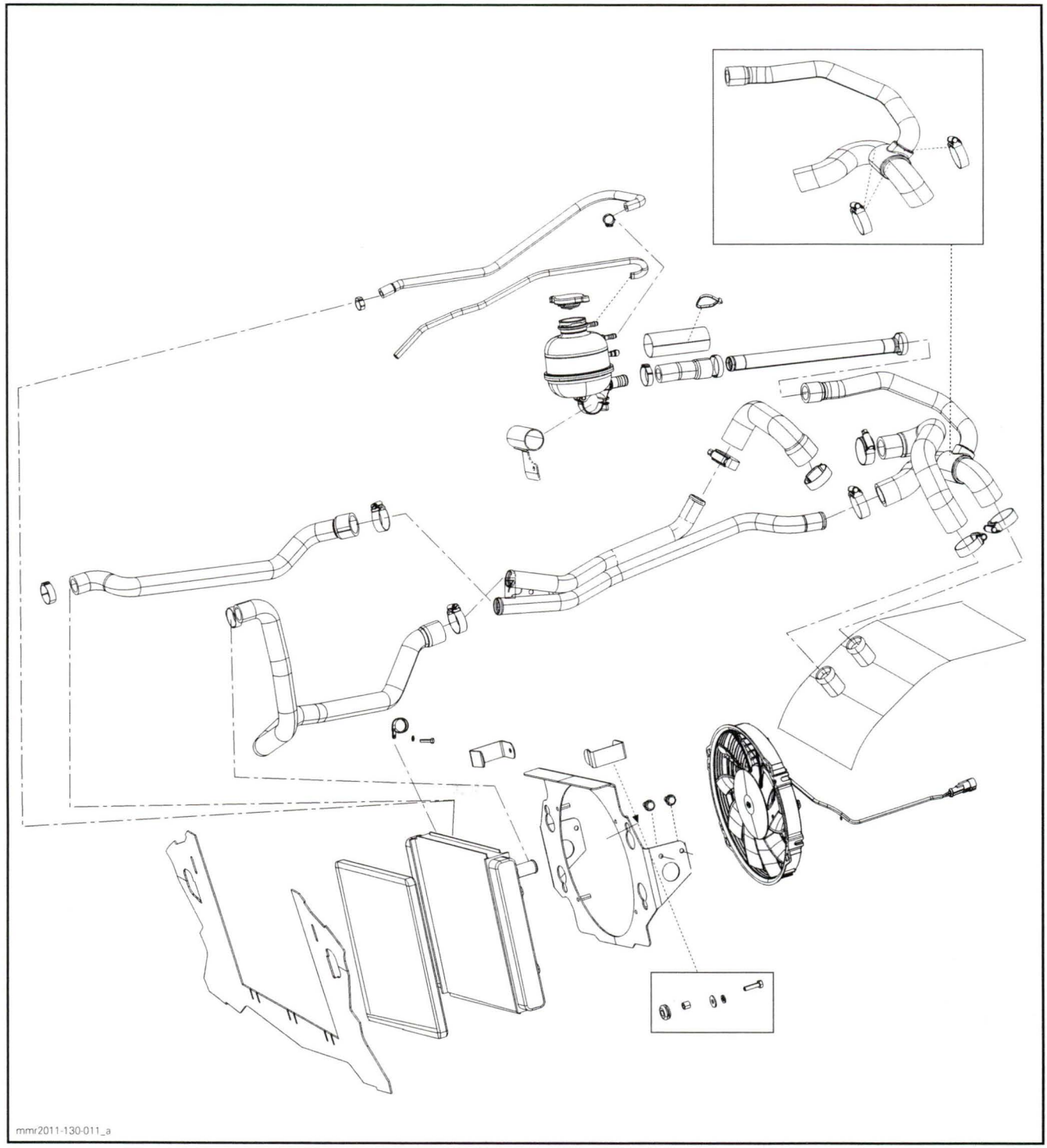
ENGINE COMPONENTS



NEW = Component must be replaced when removed

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VEHICLE COMPONENTS



GENERAL

For a better understanding, some illustrations were taken with engine out of vehicle.

NOTE: It is a good practice to check for fault codes using B.U.D.S. software as a first troubleshooting step. Refer to the *DIAGNOSTIC AND FAULT CODES* subsection.

⚠ WARNING

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

INSPECTION

COOLING SYSTEM LEAK TEST

NOTE: This test confirms if there is a leak in the cooling system, including the engine.

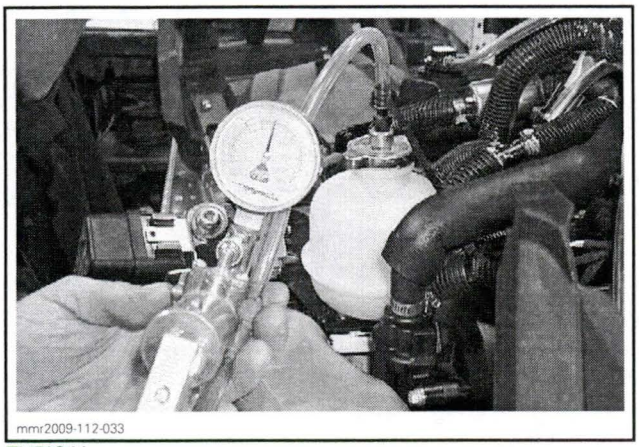
REQUIRED TOOLS	
TEST CAP (P/N 529 035 991)	
VACUUM/PRESSURE PUMP (P/N 529 021 800)	

Install the test cap on coolant reservoir.

Connect the pump to the test cap nipple.

Pressurize system through coolant reservoir.

COOLING SYSTEM LEAK TEST
100 kPa (15 PSI)

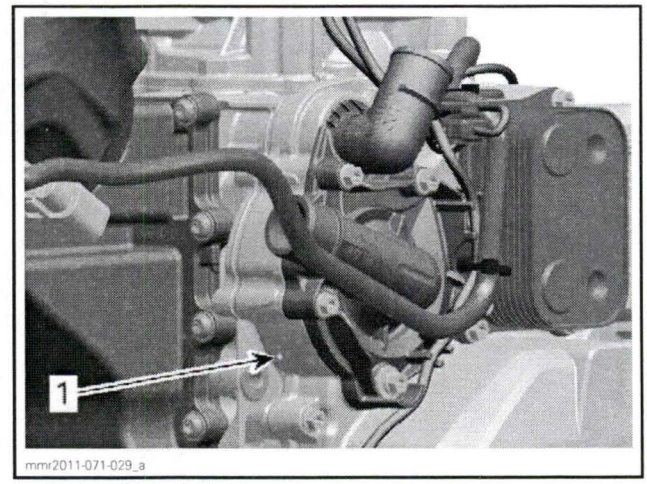

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TYPICAL

If pressure drops, check all hoses and engine for coolant leaks. Spray a soap/water solution and look for air bubbles.

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

NOTE: In general leaking coolant indicates a damaged rotary seal. Leaking oil indicates a damaged oil seal. If either seal is leaking, both seals must be replaced at the same time. Refer to *WATER PUMP* in this subsection.



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1. Leak indicator hole

TROUBLESHOOTING

The following is provided to help in diagnosing the probable source of troubles. It is a guideline and should not be assumed to show all causes for all problems.

Always check for fault codes. If a fault code is detected, service the fault code first.

ENGINE OVERHEATING

1. **Low coolant level.**
   - *Refill and check for leaks (coolant leaking out of leak indicator hole, hoses or clamps missing or defective, or cylinder head gaskets leaks). Repair or replace.*
2. **Dirty heat exchanger.**
   - *Clean heat exchanger fins. Replace heat exchanger as required.*
3. **Air in cooling system.**
   - *Refill and bleed cooling system.*
4. **Defective thermostat (does not open when engine is warm up).**
   - *Replace thermostat.*
5. **Defective water pump.**
   - *Inspect and replace defective components.*
6. **Coolant temperature sensor defective.**
   - *Check and replace.*

7. Wrong coolant concentration.
   - *Check and adjust coolant concentration according to BRP's recommendations or replace coolant.*
8. Defective coolant reservoir cap.
   - *Replace cap.*
9. Cooling fan.
   - *Refer to COOLING FAN DOES NOT OPERATE.*
10. Snow guard is too high.
    - *Check and adjust rear suspension.*

COOLING FAN DOES NOT OPERATE

1. Cooling fan fuse.
   - *Check cooling fan fuse, refer to POWER DISTRIBUTION AND GROUNDS (600ACE) subsection.*
2. Cooling fan configuration.
   - *Check cooling fan configuration in B.U.D.S., refer to COOLING FAN CONFIGURATION IN B.U.D.S. in this subsection.*
3. Defective cooling fan motor.
   - *Check cooling fan motor operation, refer to COOLING FAN MOTOR OPERATION TEST in this subsection.*
4. Cooling fan relay.
   - *Check cooling fan relay and circuits, see refer to COOLING FAN in this subsection.*

PROCEDURES

COOLANT RESERVOIR CAP

Coolant Reservoir Cap Test

Using a pressure cap tester, check the efficiency of coolant reservoir cap. If the cap does not meet specification, replace the cap.

CAP OPENING PRESSURE
110 kPa (16 PSI)

COOLANT RESERVOIR

Coolant Reservoir Removal

1. Siphon coolant from reservoir.
2. Disconnect coolant hoses from reservoir.
3. Remove coolant reservoir from vehicle.

Coolant Reservoir Installation

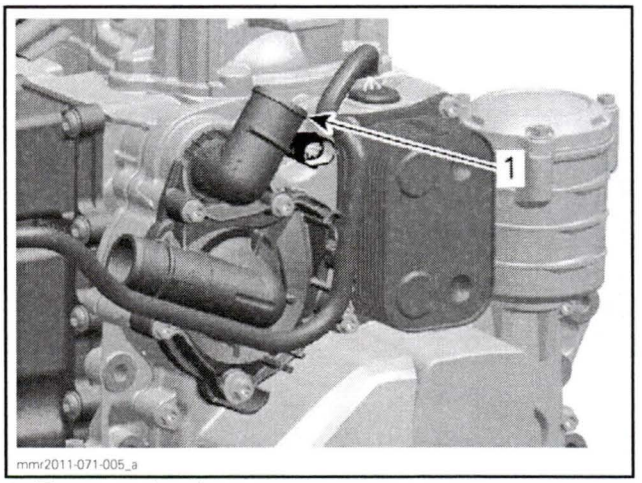
For installation, reverse the removal procedure. However, pay attention to the following.

Refill and bleed cooling system as described in *PERIODIC MAINTENANCE PROCEDURES* subsection.

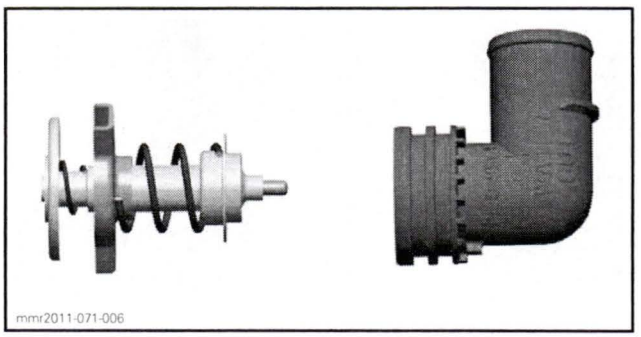
THERMOSTAT

Thermostat Location

The thermostat is located on engine MAG side.



1. Thermostat housing

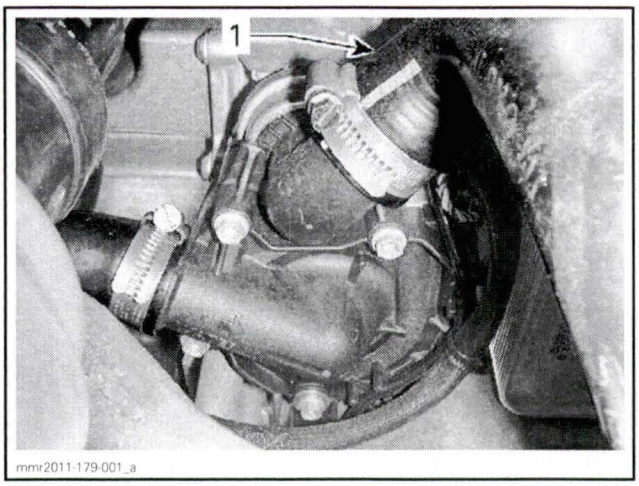


Thermostat Access

Remove upper RH side panel.

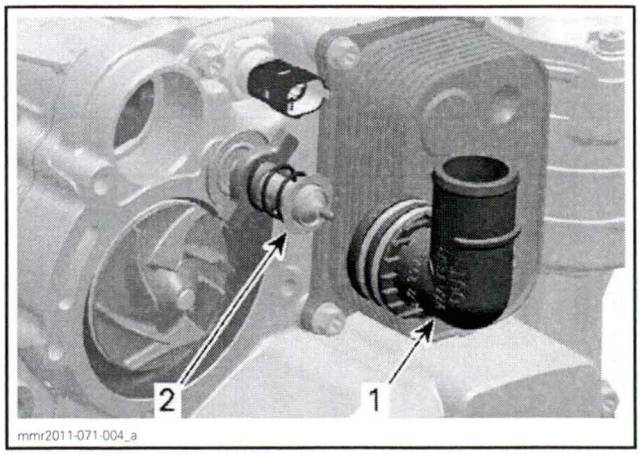
Thermostat Removal

1. Drain engine coolant. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.
2. Disconnect outlet hose from thermostat housing.



1. Thermostat outlet hose

3. Proceed with *WATER PUMP HOUSING REMOVAL*. See procedure in this subsection.
4. Remove thermostat housing then thermostat.



1. Thermostat housing
2. Thermostat

NOTE: Use shop rags to catch any spilled engine coolant.

Thermostat Test

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

THERMOSTAT TEMPERATURE	
Starts to open	75°C (167°F)
Fully open	95°C (203°F)

Replace thermostat if out of specification.

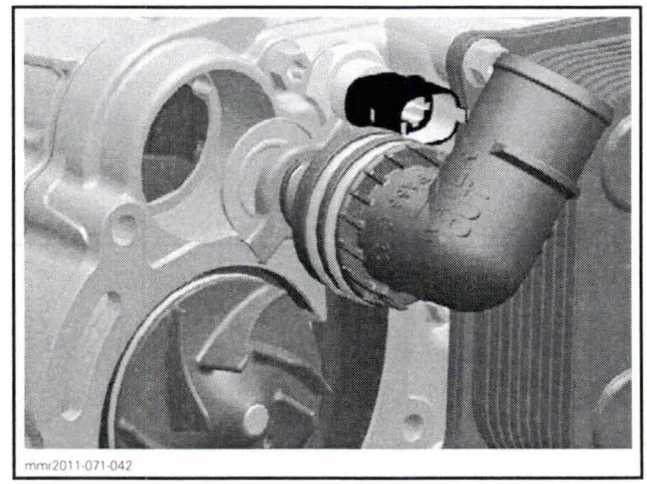
Thermostat Installation

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

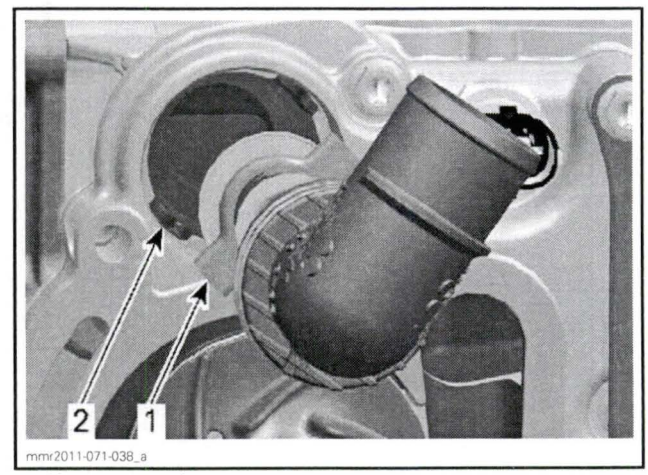
Install **NEW** O-rings on thermostat housing.

Apply DOW CORNING 111 (P/N 413 707 000) on O-rings.

Prior to installing thermostat, assemble thermostat and thermostat housing together.



Align both tabs of thermostat with the recess in the magneto cover.



1. Thermostat tabs
2. Magneto cover recess

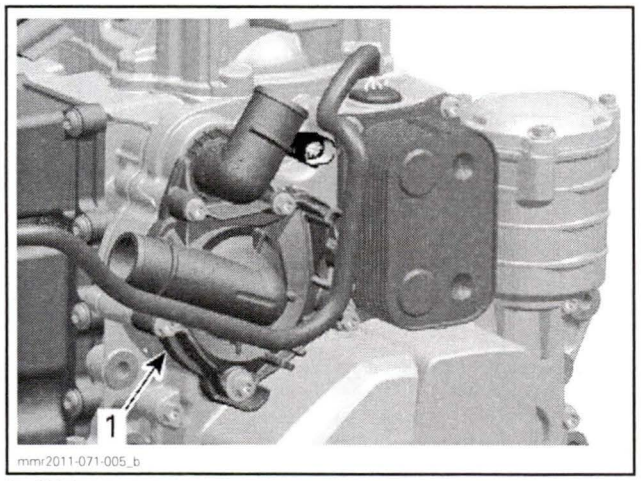
Install thermostat housing as follows:
- Towards the front for vehicle equipped with a front radiator.
- Towards the rear for vehicle not equipped with a front radiator.

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

WATER PUMP

Water Pump Location

The water pump is located on engine MAG side.



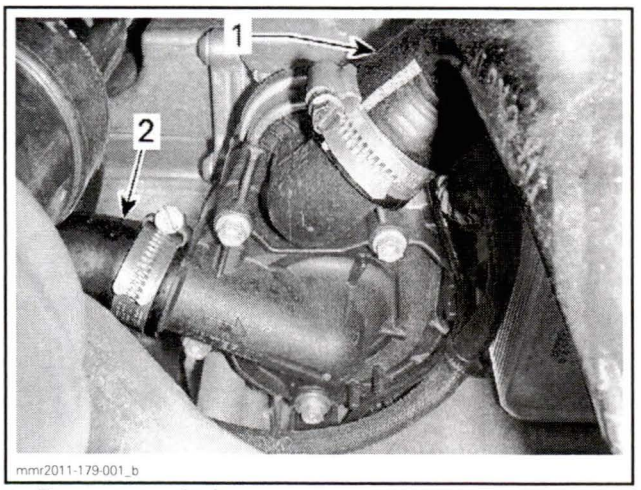
1. Water pump

Water Pump Access

Remove RH side panels.

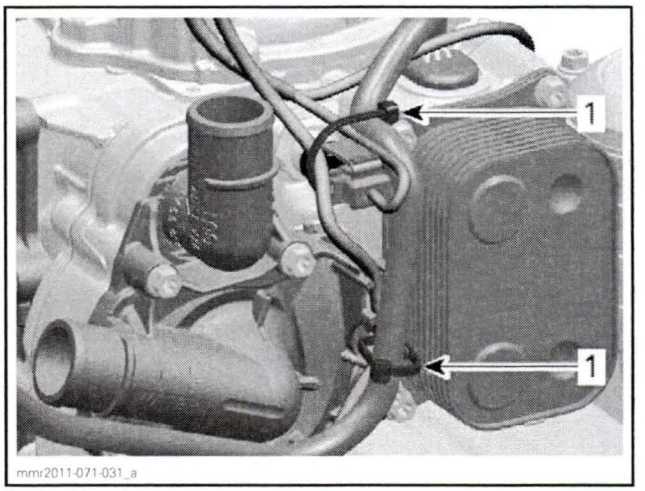
Water Pump Housing Removal

1. Drain engine coolant. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.
2. Disconnect outlet hose from thermostat housing.
3. Disconnect inlet hose from water pump housing.



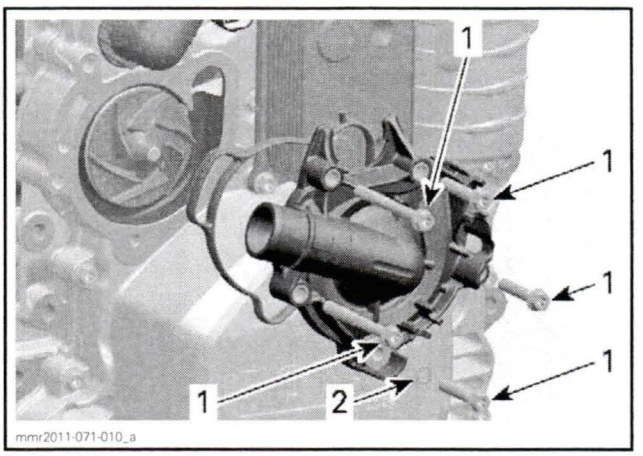
1. Thermostat outlet hose
2. Water pump inlet hose

4. Remove both locking ties securing magneto wires.



1. Locking ties

5. Remove retaining screws of water pump housing.
6. Discard sealing washer.
7. Remove water pump housing from magneto cover.

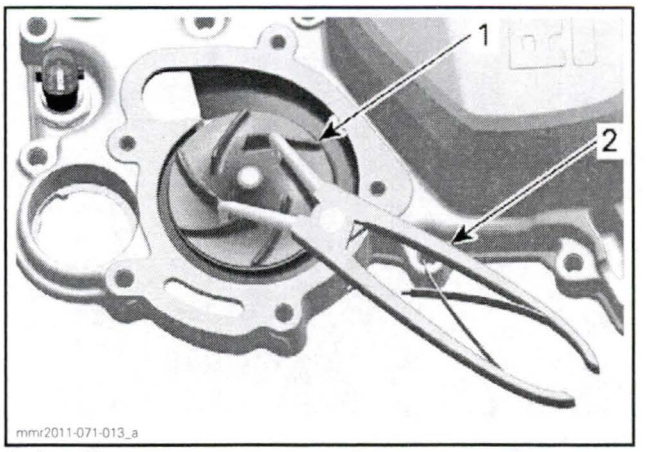


1. Retaining screws
2. Sealing washer

NOTE: Use shop rags to catch any spilled engine coolant.

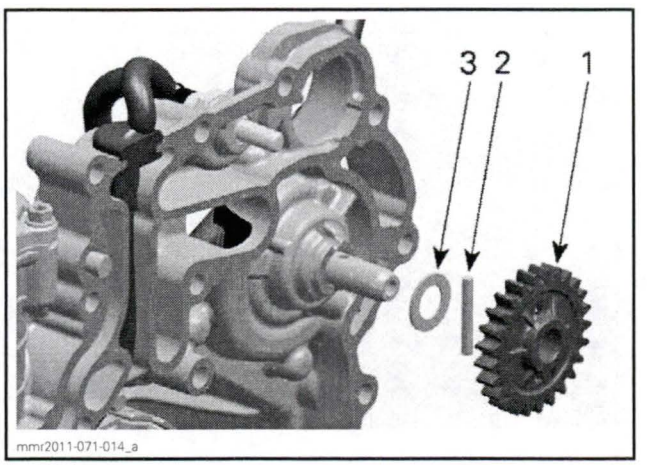
Water Pump Disassembly

1. Remove magneto cover. Refer to *MAGNETO AND STARTER* subsection.
2. Unscrew impeller counterclockwise using appropriate pliers.



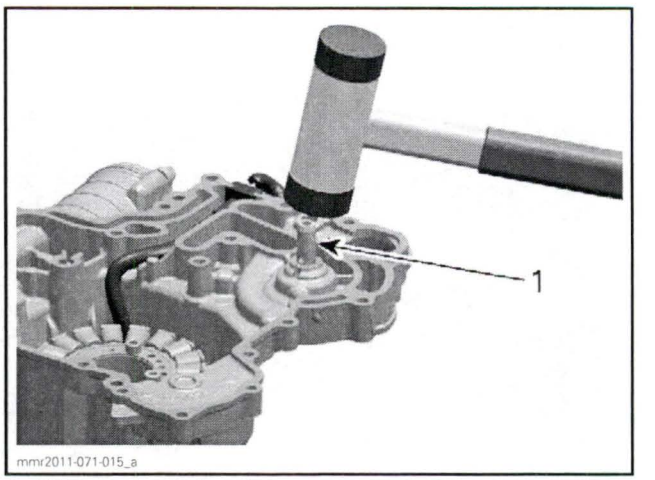
1. Impeller
2. Pliers

3. Remove the following components from magneto cover:
   - Water pump gear
   - Needle pin
   - Thrust washer.



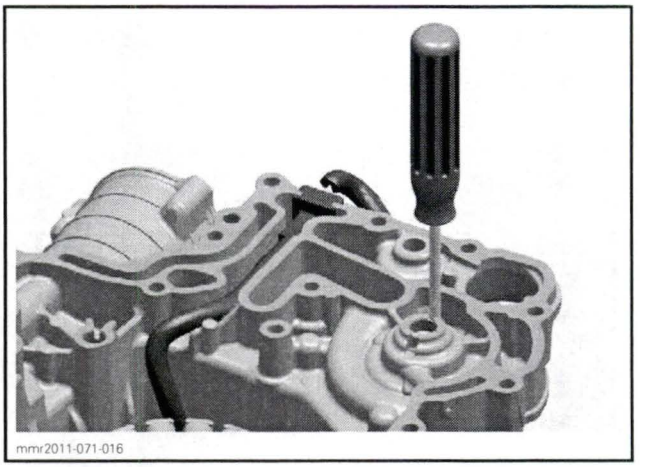
1. Water pump gear
2. Needle pin
3. Thrust washer

4. Remove water pump shaft using a plastic mallet.



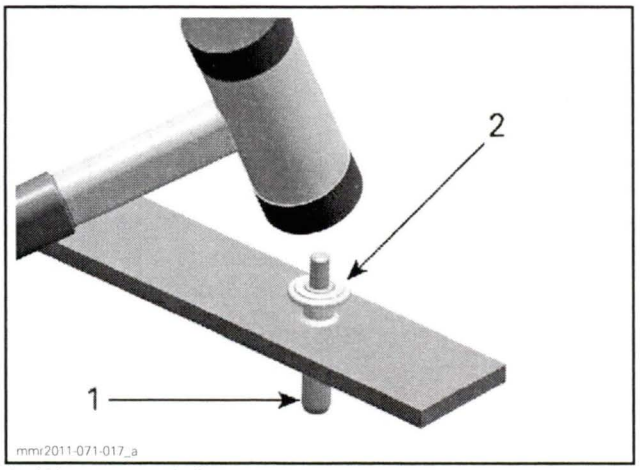
1. Water pump shaft

5. Remove the following components from magneto cover:
   - Oil seal
   - Remaining parts of rotary seal.



NOTICE **Be careful not to damage the surface of the rotary seal bore in the magneto cover.**

6. Separate rotary seal from water pump shaft.



1. Water pump shaft
2. Rotary seal

Water Pump Inspection

Check area of water pump housing for cracks or other visible damage.

Check water pump gear for wear or broken teeth.

Check if housing gasket is brittle, hard or damaged.

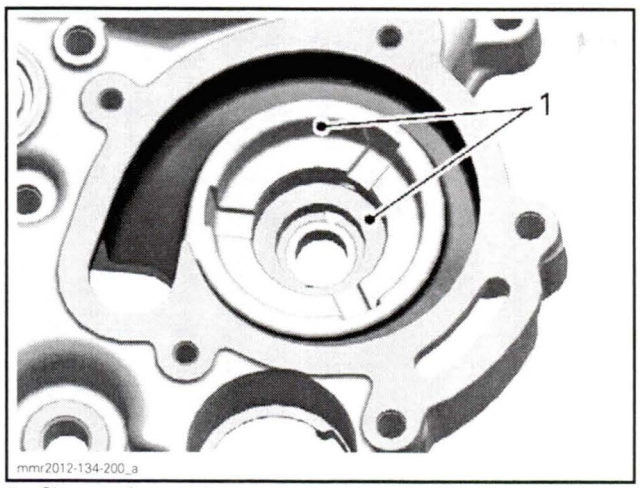
Check water pump shaft for visible damage.

Replace parts if necessary.

Water Pump Assembly

NOTE: Always replace oil seal and rotary seal at the same time.

1. Clean rotary seal surface from old sealant.



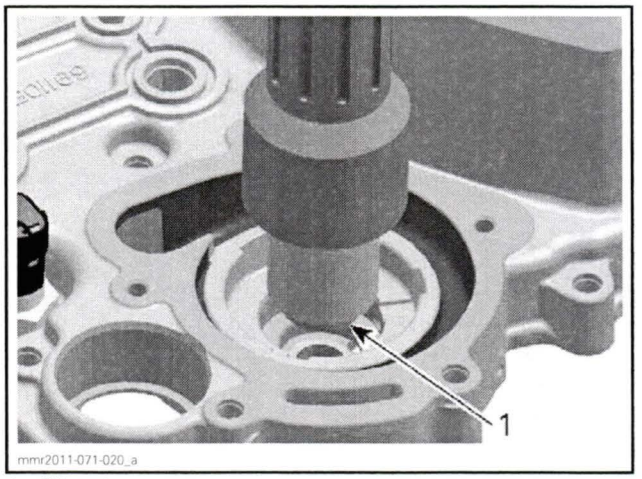
1. Clean surface

2. Apply engine oil on the press fit area of oil seal.

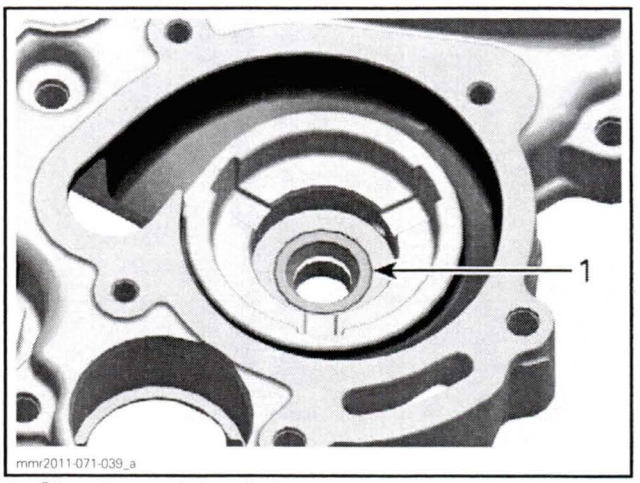
NOTICE Never use engine oil on the press fit area of the rotary seal.

3. Install **NEW** oil seal.

REQUIRED TOOLS	
OIL SEAL PUSHER (P/N 529 036 210)	
HANDLE (P/N 420 877 650)	



1. Oil seal



1. Oil seal correctly installed

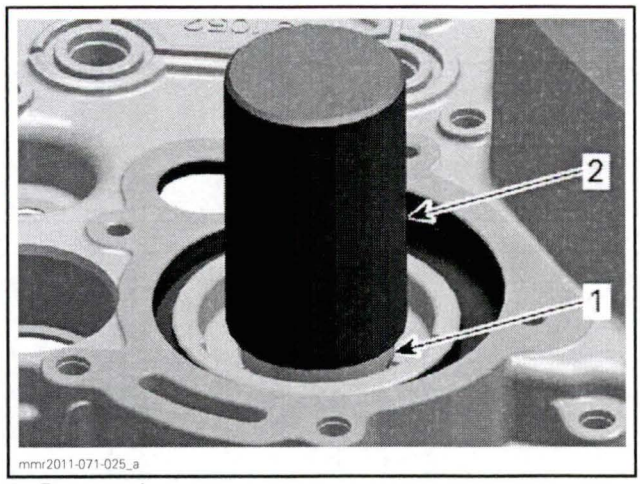
4. Apply SUPER LUBE GREASE (P/N 293 550 030) on sealing lip of the oil seal.

5. Install **NEW** rotary seal.

REQUIRED TOOL	
ROTARY SEAL INSTALLER (P/N 529 036 211)	

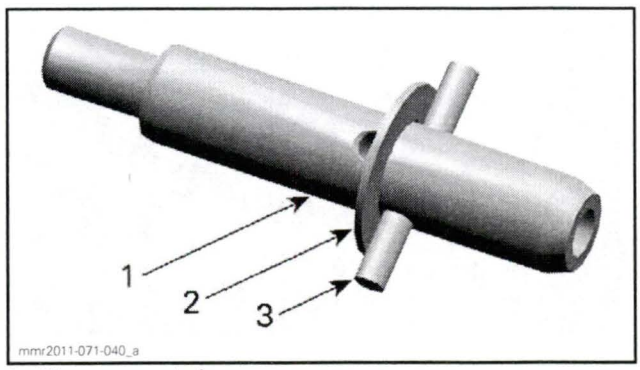
NOTE: Prior to installing, ensure that press fit sealing of rotary seal is not damaged.

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



1. Rotary seal
2. Rotary seal installer

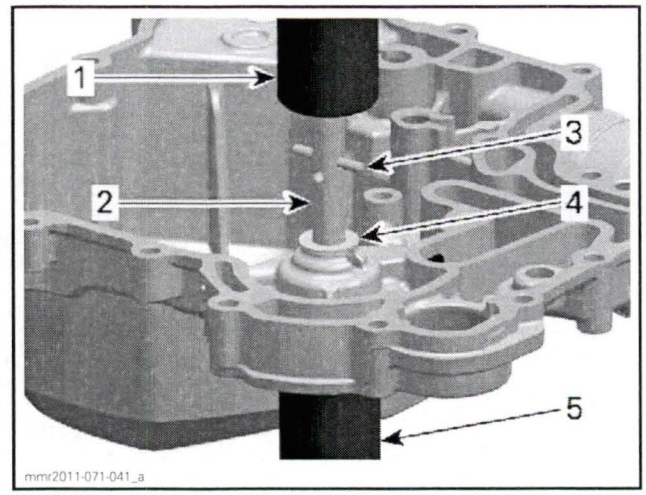
6. Assemble the following components onto water pump shaft.
   - Needle pin
   - Thrust washer.



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

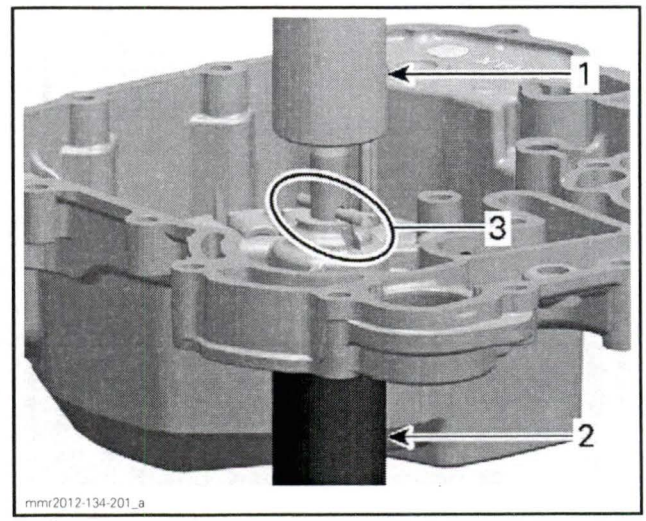
7. Slide water pump shaft into rotary seal using a press.

NOTE: To avoid damaging the rotary seal and to achieve the proper preload support the rotary seal with the ROTARY SEAL INSTALLER (P/N 529 036 211)



1. Press
2. Water pump shaft
3. Needle pin
4. Thrust washer
5. Rotary seal installer

8. Carefully press water pump shaft until needle pin touches thrust washer.



1. Press
2. Rotary seal installer
3. Needle pin touches thrust washer

NOTICE Never use a hammer to install water pump shaft into rotary seal.

NOTE: After installation, water pump shaft must rotate freely.

9. Screw impeller clockwise using appropriate pliers.

NOTICE Be careful not to damage impeller wings during its installation.

10. Install magneto cover. Refer to *MAGNETO AND STARTER* subsection.

Water Pump Housing Installation

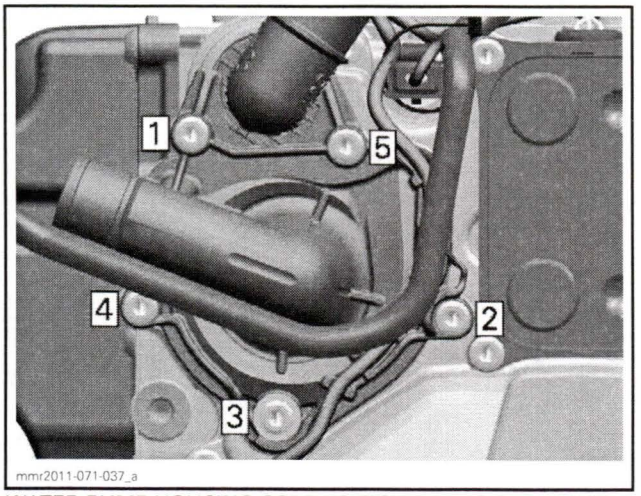
The installation is the reverse of the removal procedure. However, pay attention to the following.

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

Install a NEW sealing washer on drain screw.

Tighten water pump housing retaining screws as per following procedure.

TIGHTENING TORQUE	
Water pump housing screws	11 N•m ± 1 N•m (97 lbf•**in** ± 9 lbf•**in**)



WATER PUMP HOUSING SCREWS TIGHTENING SEQUENCE

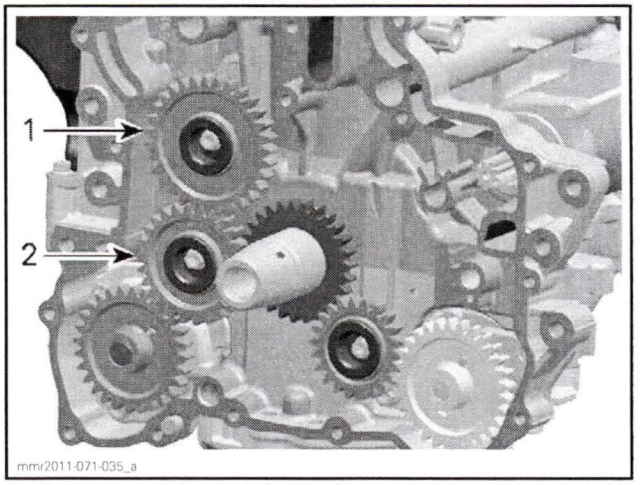
Tighten hose clamps to specification.

TIGHTENING TORQUE	
Coolant hose clamps	5.5 N•m ± 0.5 N•m (49 lbf•**in** ± 4 lbf•**in**)

WATER PUMP DRIVE GEAR

Water Pump Drive Gear Location

The water pump drive gears is located behind the magneto cover.



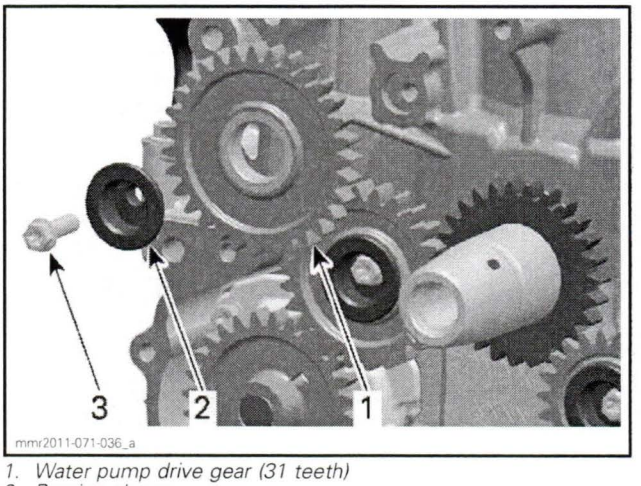
1. Water pump drive gear (31 teeth)
2. Intermediate gear, refer to LUBRICATION SYSTEM

Water Pump Drive Gear Access

Remove magneto cover. Refer to *MAGNETO AND STARTER* subsection.

Water Pump Drive Gear Removal

1. Remove screw securing water pump drive gear.
2. Remove bearing sleeve.
3. Slide off intermediate gear.



1. Water pump drive gear (31 teeth)
2. Bearing sleeve
3. M6 x 20 screw

Water Pump Drive Gears Inspection

Inspect gear for wear or other damage.

Replace gear if necessary.

Water Pump Drive Gear Installation

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

Apply engine oil on bearing sleeve.

Tighten water pump drive gear retaining screw to specification.

TIGHTENING TORQUE	
Water pump drive gear retaining screws	11 N•m ± 1 N•m (97 lbf•**in** ± 9 lbf•**in**)

HEAT EXCHANGER

Heat Exchanger Cleaning and Inspection

Remove all debris between heat exchanger fins.

Check if heat exchanger fins are damaged. Replace if necessary.

NOTE: A heat exchanger with many broken fins does not work properly.

Heat Exchanger Removal

1. Drain cooling system, refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.
2. Remove engine, refer to *ENGINE REMOVAL AND INSTALLATION* subsection.
3. Remove fuel tank. Refer to *FUEL TANK AND FUEL PUMP* subsection.
4. Remove rear suspension. Refer to the *REAR SUSPENSION (SC-5U)* subsection.
5. Unplug coolant hoses from heat exchanger.
6. Drill or grind all rivets retaining the heat exchanger to the tunnel. Refer to *FRAME* subsection for drilling procedure.

NOTE: When pushing the rivets out, support the frame around the rivet with a socket on the opposite side to avoid warpage.

7. Remove heat exchanger from the vehicle.

Heat Exchanger Installation

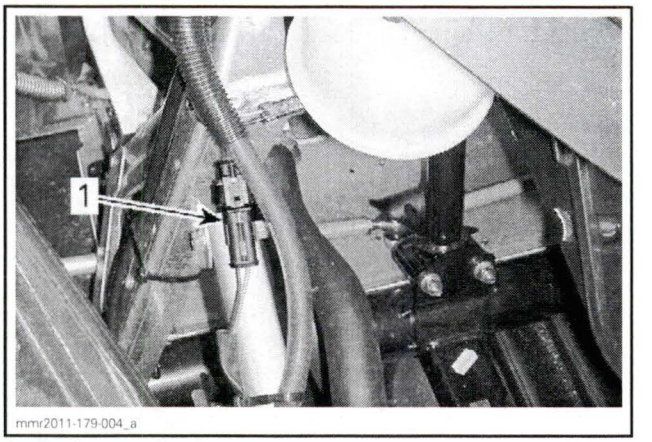
Installation is the reverse of removal procedure.

Refill cooling system as described in *PERIODIC MAINTENANCE PROCEDURES* subsection.

RADIATOR

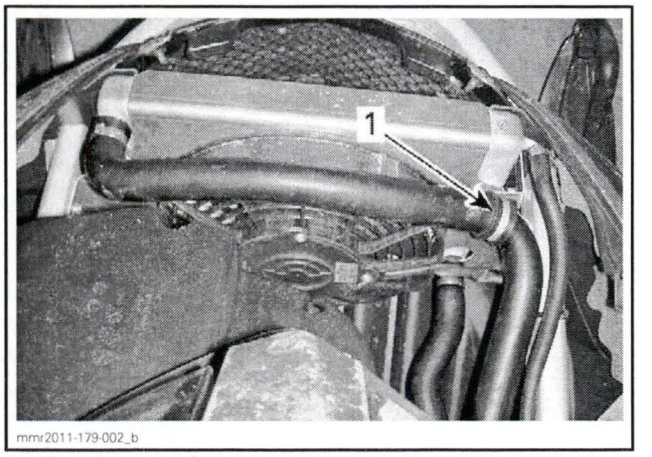
Radiator Removal

1. Drain cooling system, Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.
2. Remove hood.
3. Disconnect front radiator cooling fan connector.



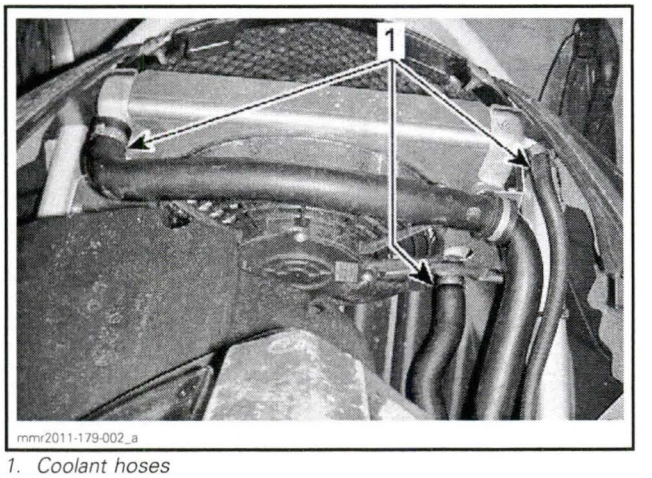
1. Radiator cooling fan connector

4. Cut the locking ties retaining the electrical harness to the front bumper.
5. Remove the hose upper hose retainer.



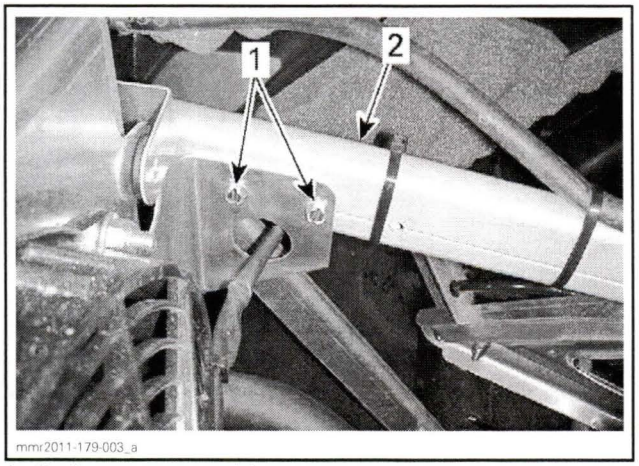
1. Upper hose retainer

6. Disconnect coolant hoses from front the radiator. Discard Oetiker clamps.



1. Coolant hoses

7. Remove screws retaining the radiator support to the front bumper on both sides.



1. Radiator support retaining screws
2. Front bumper

8. Remove front radiator from vehicle.

Front Radiator Installation

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

Install **NEW** Oetiker clamps to secure coolant hoses.

COOLING FAN

Cooling Fan Operating Conditions

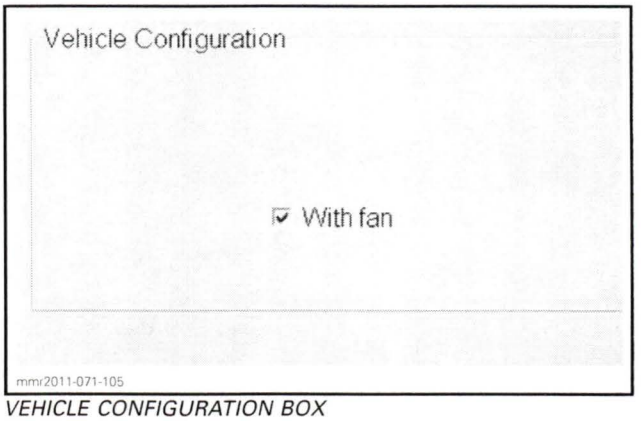
RADIATOR COOLING FAN		
ENGINE TEMPERATURE	COOLING FAN RELAY	COOLING FAN OPERATION
> 100°C (212°F)	Close	Starts
< 95°C (203°F)	Open	Stops

Cooling Fan Relay Location

The cooling fan relay is located in the fuse box. Refer to *POWER DISTRIBUTION (600 ACE)*.

Cooling Fan Configuration in B.U.D.S.

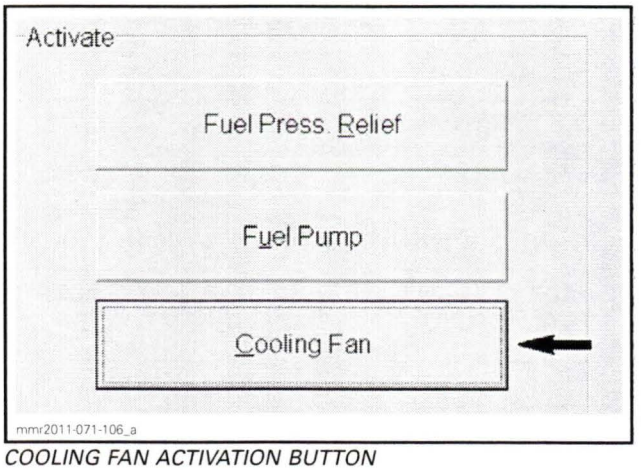
1. Connect vehicle to B.U.D.S., refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. In B.U.D.S., select the following:
   - **Read Data** button
   - **Setting** tab
   - **ECM** page.
3. Ensure that **With fan** box is properly checked.



VEHICLE CONFIGURATION BOX

Cooling Fan Test Using B.U.D.S.

1. Connect vehicle to B.U.D.S., refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. Depress the start button once to activate the ECM.
3. In B.U.D.S., select the following:
   - **Read Data** button
   - **Activation** tab
   - **ECM** page.
4. Press **Cooling Fan** button to activate cooling fan motor.



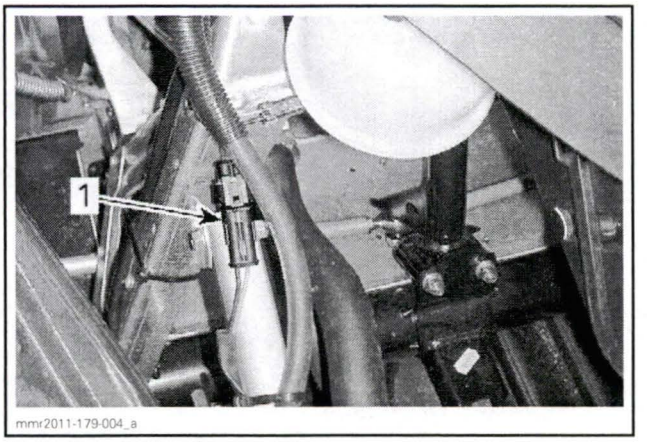
COOLING FAN ACTIVATION BUTTON

If cooling fan motor does not work, retest while touching the relay (R4).

- If a "click" is felt, carry out *COOLING FAN MOTOR OPERATION TEST* in this subsection.
- If a NO "click" is felt, see *COOLING FAN RELAY* under *TROUBLESHOOTING* in this subsection.

Cooling Fan Motor Operation Test

1. Disconnect radiator cooling fan connector.



1. Radiator cooling fan connector

2. Connect a 12 volts battery directly to fan motor connector.

If motor does not work, replace it.

If motor works, check fan motor wiring.

Cooling Fan Motor Input Voltage Test

Test conditions:

- Engine running with coolant temperature above 100°C (212°F)
- **OR** cooling fan activated using B.U.D.S. Refer to *COOLING FAN TEST USING B.U.D.S.*

COOLING FAN MOTOR INPUT VOLTAGE TEST	
TEST PROBES	VOLTAGE
GRAY/GREEN	Battery voltage (± 12 Vdc)
BLACK	

Cooling Fan Relay Input Voltage Test

RELAY INPUT VOLTAGE TEST (CONTACTS)	
TEST PROBES	VOLTAGE
Fuse box pin 10C	Battery voltage (± 12 Vdc)
Battery negative (-) post	

RELAY INPUT VOLTAGE TEST (WINDING)	
TEST PROBES	VOLTAGE
Fuse box pin 10D	Battery voltage (± 12 Vdc)
Battery negative (-) post	

Cooling Fan Relay Control Circuit Test

Test conditions:

- Engine running with coolant temperature above 100°C (212°F)
- **OR** cooling fan activated using B.U.D.S. Refer to *COOLING FAN TEST USING B.U.D.S.*

COOLING FAN RELAY CONTROL CIRCUIT TEST	
TEST PROBES	VOLTAGE
Fuse box pin 12C	Approximately battery voltage (± 12 Vdc)
Battery positive (+) post	

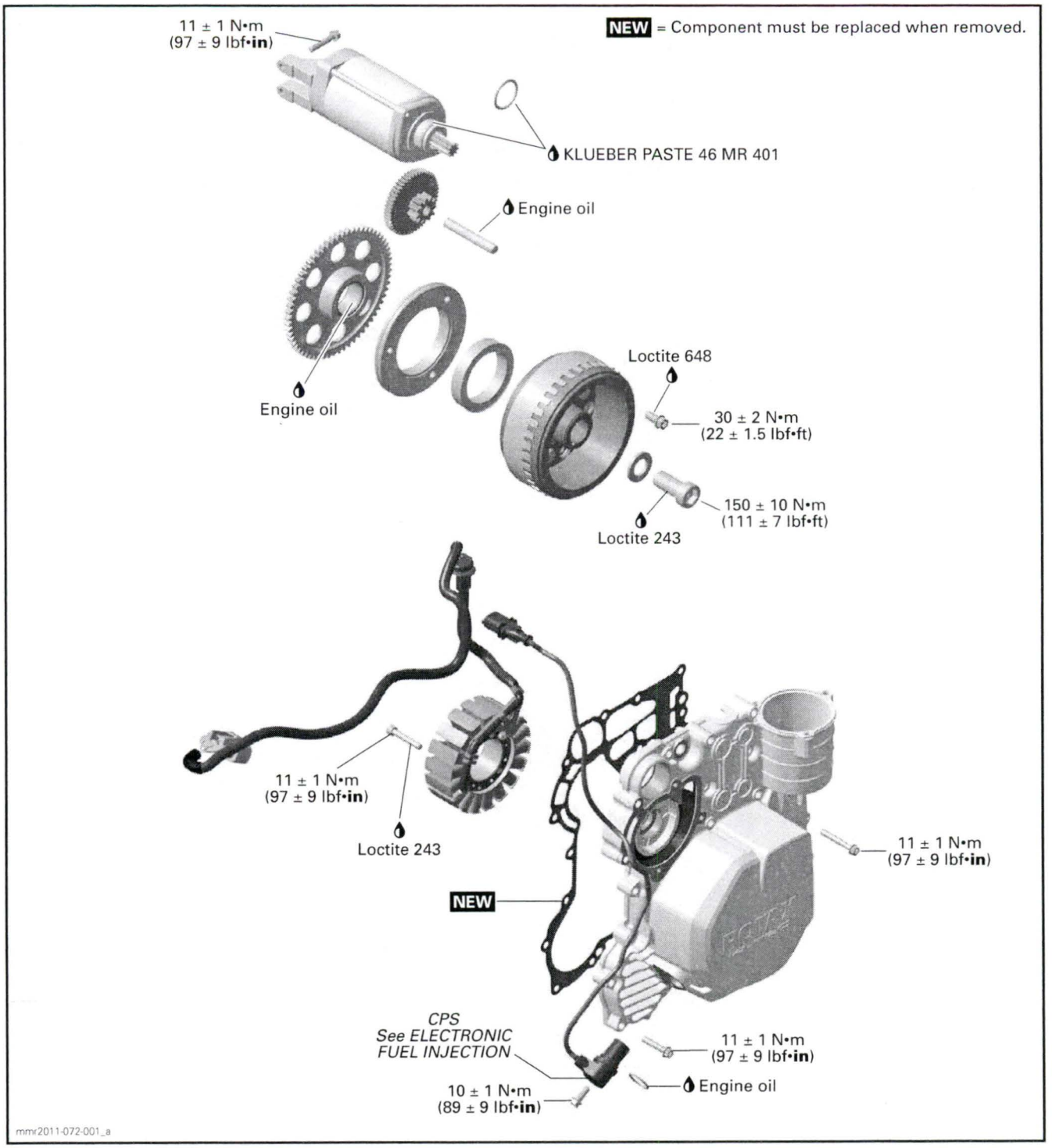
MAGNETO AND STARTER

SERVICE TOOLS

Description	Part Number	Page
CRANKSHAFT PROTECTOR	529 036 213	311
FLUKE 115 MULTIMETER	529 035 868	309–310, 315
FLYWHEEL PULLER	420 976 235	311

SERVICE PRODUCTS

Description	Part Number	Page
KLÜEBER PASTE 46 MR 401	420 297 616	316
LOCTITE 243 (BLUE)	293 800 060	311–312
LOCTITE 648 (GREEN)	413 711 400	313
LOCTITE CHISEL (GASKET REMOVER)	413 708 500	308
PULLEY FLANGE CLEANER	413 711 809	312


NEW = Component must be replaced when removed.
11 ± 1 N•m
(97 ± 9 lbf•in)
KLUEBER PASTE 46 MR 401
Engine oil
Engine oil
Loctite 648
30 ± 2 N•m
(22 ± 1.5 lbf•ft)
150 ± 10 N•m
(111 ± 7 lbf•ft)
Loctite 243
11 ± 1 N•m
(97 ± 9 lbf•in)
Loctite 243
NEW
11 ± 1 N•m
(97 ± 9 lbf•in)
CPS
See ELECTRONIC
FUEL INJECTION
11 ± 1 N•m
(97 ± 9 lbf•in)
10 ± 1 N•m
(89 ± 9 lbf•in)
Engine oil
mmr2011-072-001_a

PROCEDURES

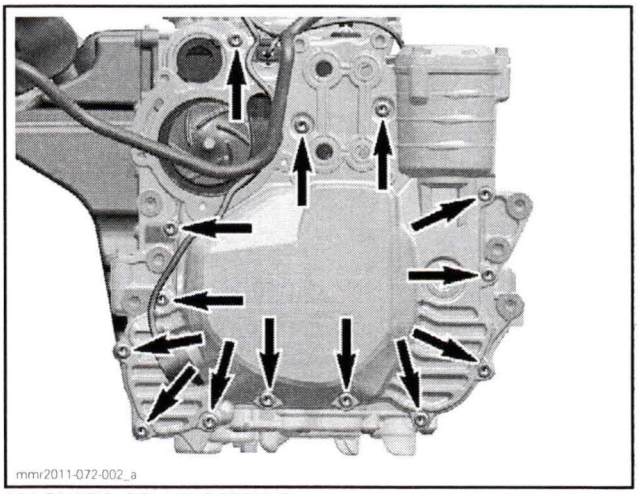
MAGNETO COVER

Magneto Cover Removal (Engine in Vehicle)

1. Refer to *BODY* subsection and remove:
   - Hood
   - LH side panels
   - RH side panels.
2. Refer to *AIR INTAKE SYSTEM* subsection and remove headlight/gauge module and air intake silencer as an assembly.
3. Refer to *EXHAUST SYSTEM* and remove:
   - Muffler
   - Exhaust pipes.
4. Refer to *PERIODIC MAINTENANCE PROCEDURES* and:
   - Drain coolant
   - Drain engine oil.
5. Cut the locking tie securing the stator wiring and disconnect stator connector.
6. Disconnect the CTS connector.
7. Refer to *COOLING SYSTEM* and remove:
   - Water pump housing
   - Thermostat housing with thermostat.

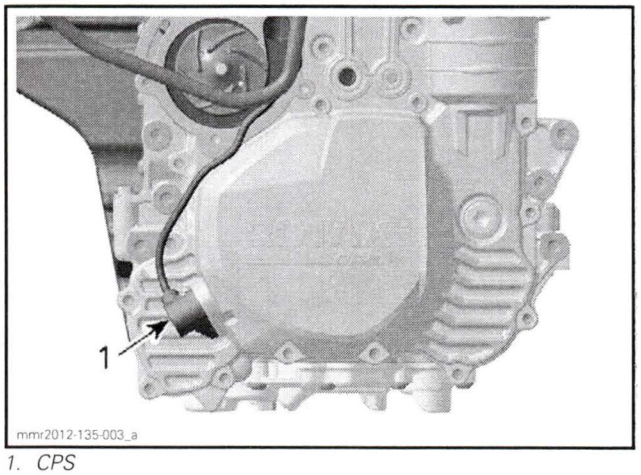
NOTE: Do not remove coolant hose from thermostat housing.

8. Refer to *LUBRICATION SYSTEM* subsection and remove:
   - Oil pressure regulator
   - Oil cooler.
9. Detach the coolant tank from the frame.
10. Detach the radiator coolant pipes from the frame.
11. Place an oil pan under magneto area to catch remaining oil.
12. Remove magneto cover screws and slightly pull on magneto cover to ease CPS access.



MAGNETO COVER SCREWS

13. Remove the CPS.

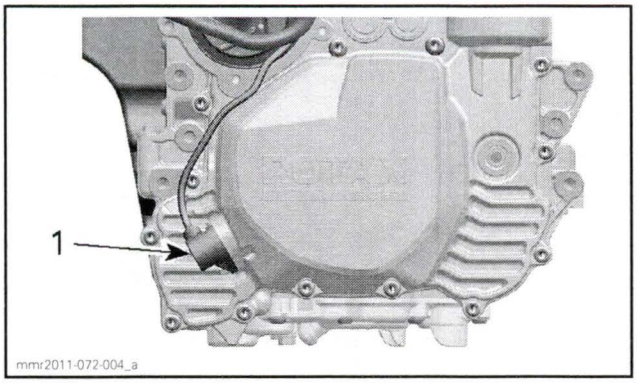


1. CPS

14. Pull magneto cover off, then carefully manoeuvre through the chassis to remove it.

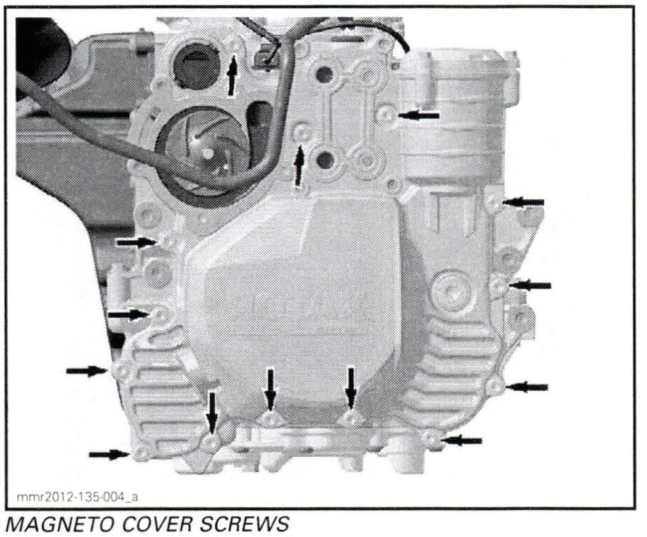
Magneto Cover Removal (Engine Removed)

1. Refer to *COOLING SYSTEM* and remove:
   - Water pump housing
   - Thermostat housing with thermostat.
2. Refer to *PERIODIC MAINTENANCE PROCEDURES* and drain engine oil.
3. Place an oil pan under magneto area to catch remaining oil.
4. Refer to *LUBRICATION SYSTEM* subsection and remove:
   - Oil pressure regulator
   - Oil cooler.
5. Remove the CPS.



1. CPS

6. Remove magneto cover retaining screws.



MAGNETO COVER SCREWS

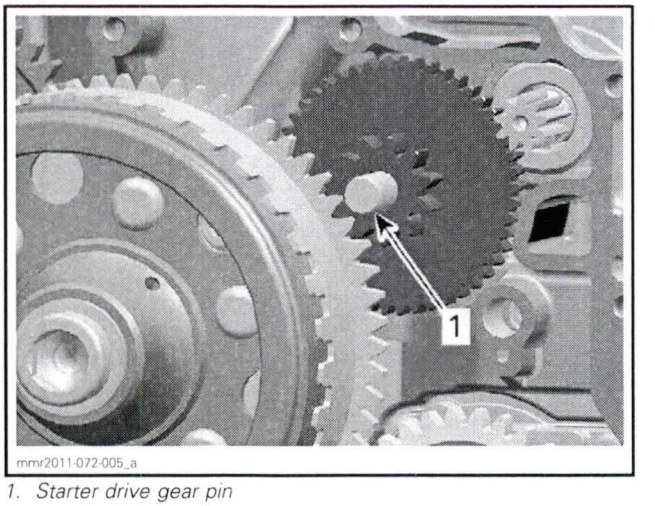
7. Pull magneto cover off.

Magneto Cover Inspection

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

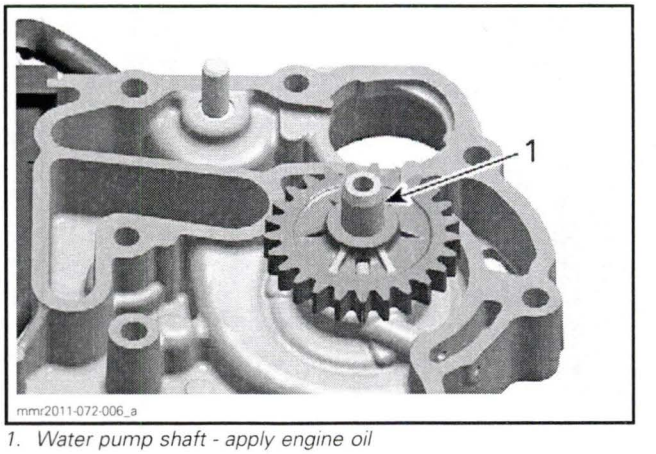
Magneto Cover Installation

1. To clean magneto cover use LOCTITE CHISEL LOCTITE CHISEL (GASKET REMOVER) (P/N 413 708 500).
2. Install a **NEW** magneto cover gasket.
3. Ensure that starter drive gear pin is in place.
4. Apply engine oil on starter drive gear pin.



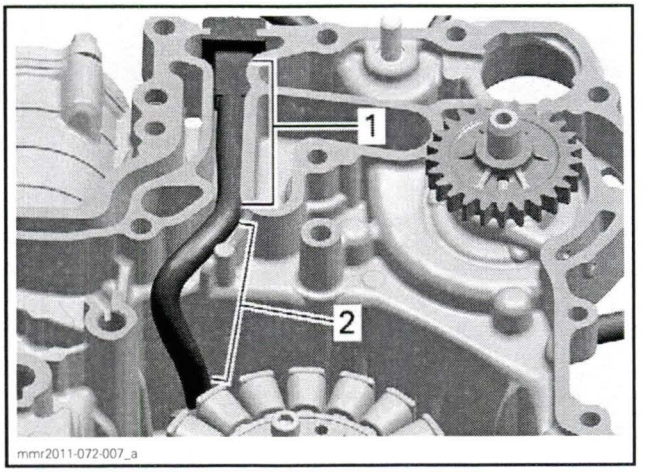
1. Starter drive gear pin

5. Apply engine oil on water pump shaft.



1. Water pump shaft - apply engine oil

NOTICE **Make sure that the stator cable harness is embedded into the channel. The part of the harness that is out of the channel must be tight, otherwise it might chafe or jam.**



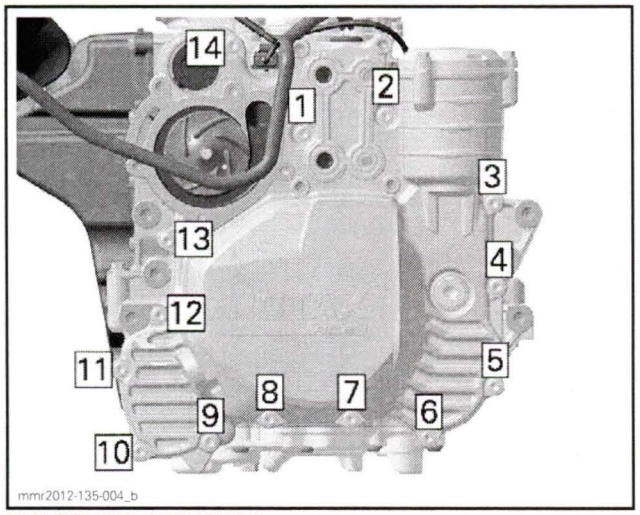
1. Embedded in that area
2. Tight in this area

6. Carefully install magneto cover.

⚠ CAUTION Magnetic force between magneto flywheel and stator is very high. Avoid finger contusions.

7. Tighten magneto cover screws according to the following sequence.

TIGHTENING TORQUE (FOLLOW SEQUENCE)	
Magneto cover screws	11 N•m ± 1 N•m (97 lbf•**in** ± 5 lbf•**in**)



TIGHTENING SEQUENCE

STATOR

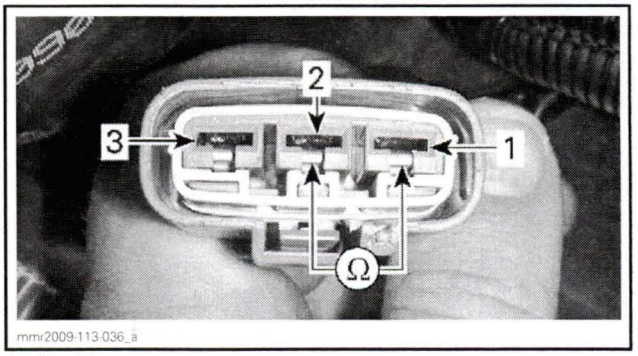
Stator Continuity Test

1. Disconnect battery.
2. Disconnect the magneto connector from voltage regulator.
3. Set the multimeter to Ω.

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



4. Connect multimeter probes between each pair of YELLOW wires.



1. Pin #1
2. Pin #2
3. Pin #3

5. Read resistance as per following table.

STATOR CONTINUITY TEST	
YELLOW WIRES (EACH PAIR)	RESISTANCE @ 20°C (68°F)
Pins 1 and 2	0.1 - 1 Ω
Pins 1 and 3	
Pins 2 and 3	

If any resistance reading is not as specified, the stator or the wiring (including connector) is open and needs to be repaired or replaced.

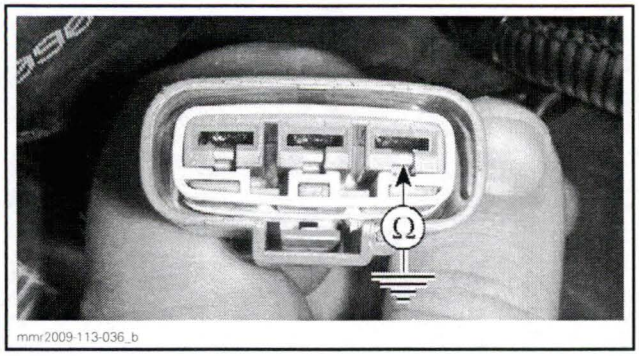
If resistance is good, perform the stator insulation test.

Stator Insulation Test

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



1. Connect multimeter between any YELLOW wire and chassis ground.



2. Read resistance.

STATOR INSULATION TEST	
PROBE POSITIONS	RESISTANCE @ 20°C (68°F)
Any YELLOW wire and chassis ground	Infinity (OL)

If any resistance reading is not as specified, the stator or the wiring is shorted to ground and needs to be repaired or replaced.

If the insulation test is good, perform the output voltage test.

Stator Output Voltage Test

1. Disconnect stator at voltage regulator.

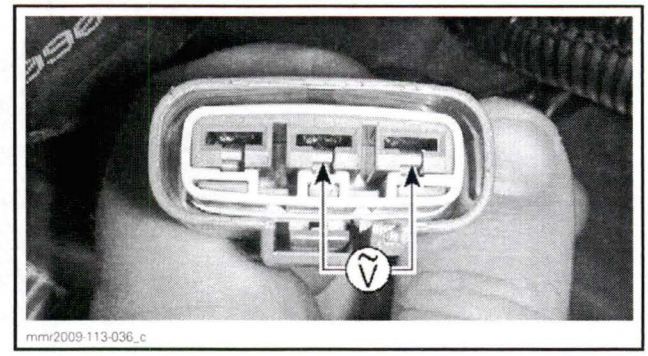
NOTE: To ease access, move fuel tank back. Refer to *FUEL TANK AND FUEL PUMP*.

2. Start engine and let it reach its operating temperature.
3. Set multimeter to Vac scale.

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



4. With engine idling, connect multimeter between each pair of YELLOW wires.



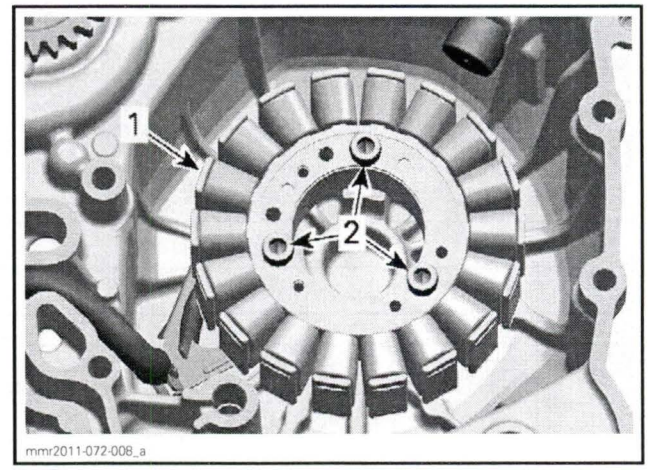
5. Read voltage.

STATOR OUTPUT VOLTAGE TEST		
TEST ENGINE SPEED	TERMINAL	VOLTAGE
Idle speed	1 and 2	± 25 Vac
	1 and 3	
	2 and 3	

If any voltage reading is significantly lower than specification, replace the stator.

Stator Removal

1. Remove the *MAGNETO COVER*, see procedure in this subsection.
2. Remove stator retaining screws.



1. Stator
2. Stator retaining screws

3. Pull stator out.

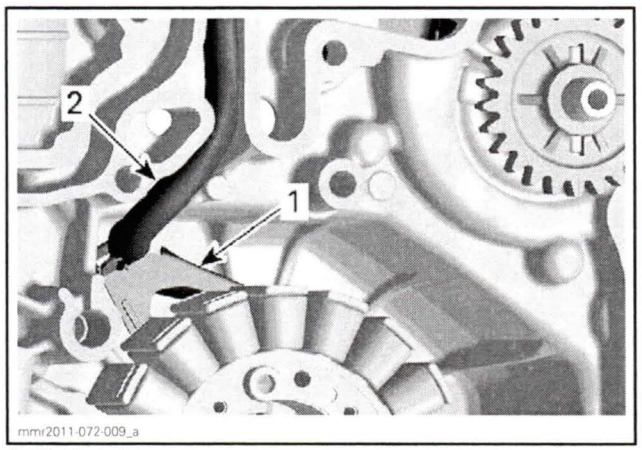
Stator Inspection

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

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

Stator Installation

1. Ensure that the stator cable is underneath the cable holder during installation of the stator.



1. Cable holder
2. Stator cable

2. Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on threads of stator screws.
3. Install stator retaining screws and tighten to the specified torque.

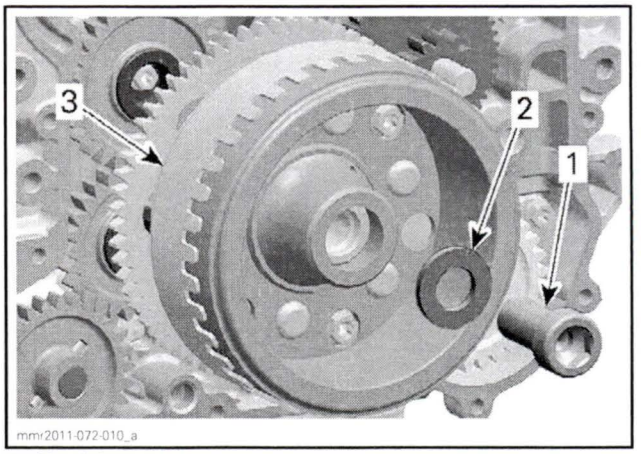
TIGHTENING TORQUE	
Stator retaining screws	11 N•m ± 1 N•m (97 lbf•**in** ± 9 lbf•**in**)

4. Reinstall *MAGNETO COVER*, see procedure in this subsection.

ROTOR

Rotor Removal

1. Remove the *MAGNETO COVER*, see procedure in this subsection.
2. Lock crankshaft. Refer to *CYLINDER BLOCK* subsection.
3. Remove rotor retaining screw and lock washer.



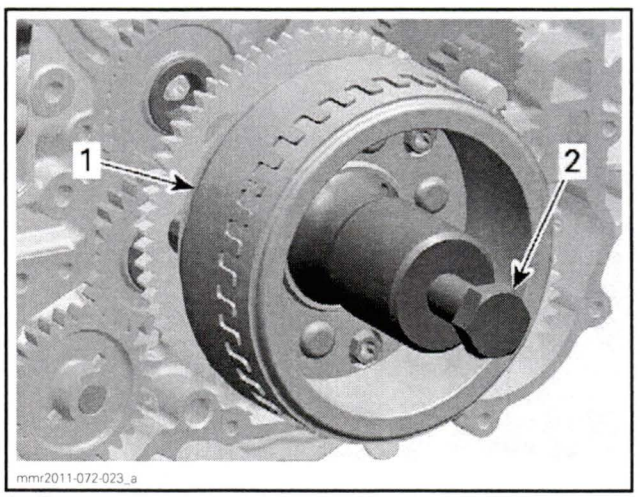
1. Retaining screw
2. Lock washer
3. Rotor

4. Remove rotor.

REQUIRED TOOLS	
CRANKSHAFT PROTECTOR (P/N 529 036 213)	
FLYWHEEL PULLER (P/N 420 976 235)	

NOTE: Apply some grease on the crankshaft protector surface to ease puller operation.

5. Pull rotor out by screwing the flywheel puller screw in.



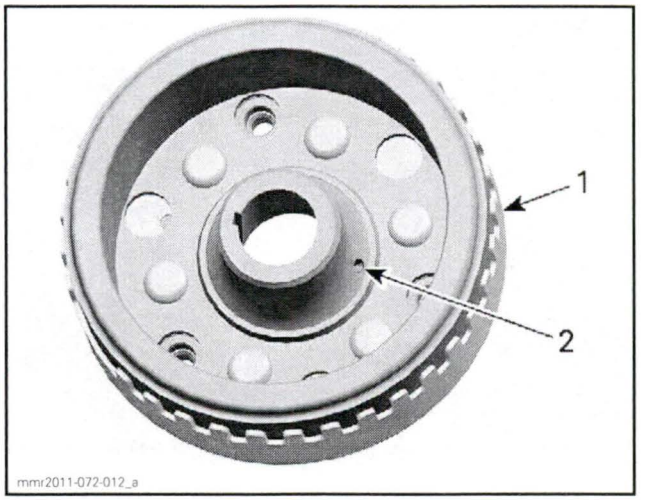
1. Rotor
2. Flywheel puller screw

Rotor Inspection

Check the inner side of the rotor for scratches or other damage.

Check keyway for wear or damages.

Check if trigger wheel teeth are bent or otherwise damaged.



1. Rotor with trigger wheel
2. Oil bore in magneto hub

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

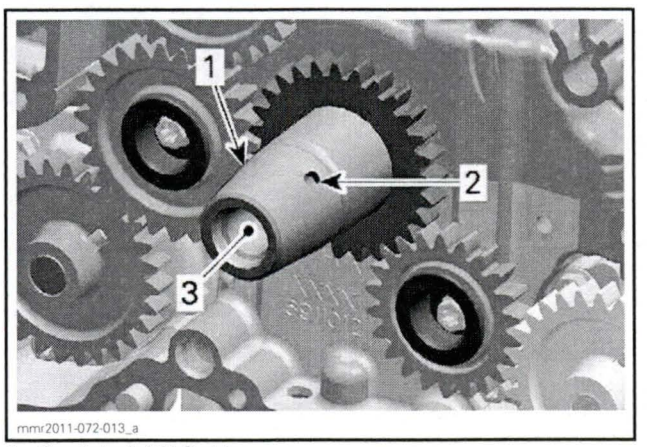
Replace parts as necessary.

Rotor Installation

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

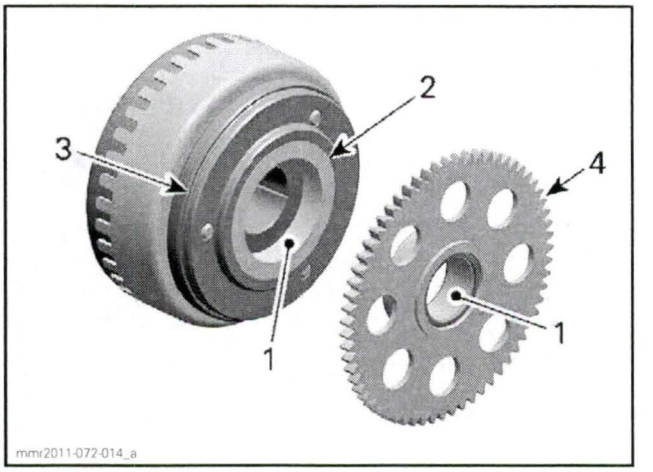
1. Blow the oil passage in the magneto hub using compressed air. Check if it is clogged.
2. Using PULLEY FLANGE CLEANER (P/N 413 711 809), clean:
   - The oil passage
   - The crankshaft threads
   - The crankshaft taper
   - The rotor taper.

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



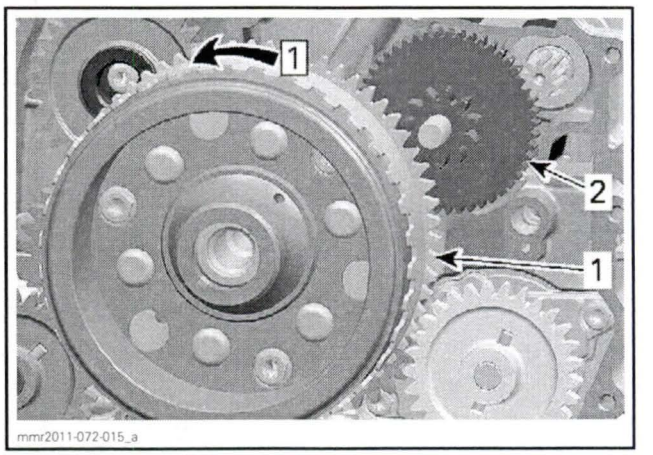
1. Crankshaft MAG side
2. Oil passage
3. Thread

3. Apply oil on sprag clutch and needle bearing.
4. Install sprag clutch gear onto the rotor.



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

5. Slide rotor along with the sprag clutch gear onto the crankshaft. The woodruff key and keyway must be aligned.
6. Rotate sprag clutch gear counterclockwise to align with starter double gear.



Step 1: Rotate to align teeth

1. Sprag clutch gear
2. Starter double gear

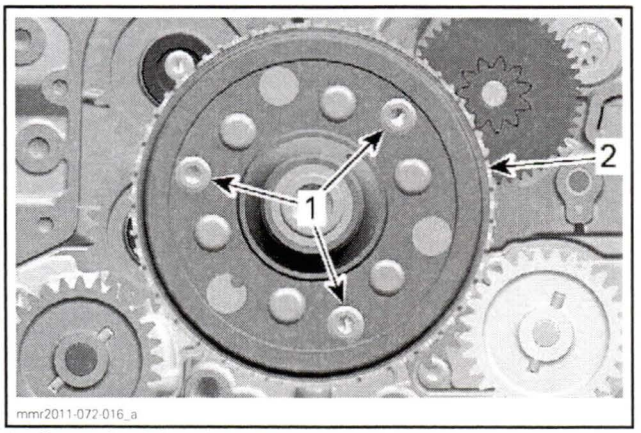
7. Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on threads of rotor retaining screw.
8. Install washer and retaining screw.
9. Tighten to the specified torque.

TIGHTENING TORQUE	
Rotor retaining screw	150 N•m ± 10 N•m (111 lbf•ft ± 7 lbf•ft)

SPRAG CLUTCH

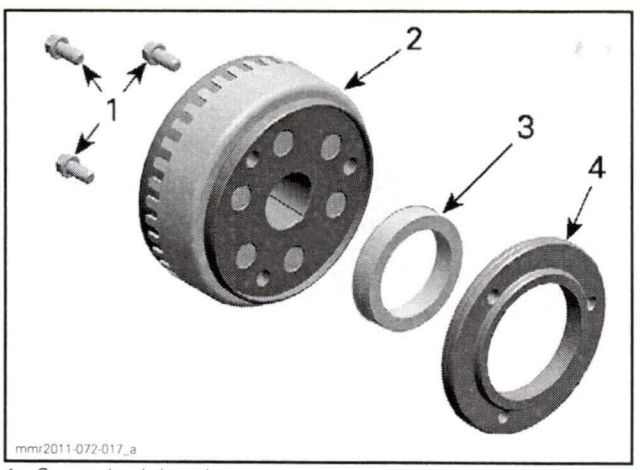
Sprag Clutch Removal

1. Remove the *MAGNETO COVER*, see procedure in this subsection.
2. Lock crankshaft. Refer to *CYLINDER BLOCK* subsection.
3. Loosen and remove sprag clutch housing screws.



1. Sprag clutch housing screws
2. Rotor

4. Remove *ROTOR*, see procedure in this subsection.
5. Remove sprag clutch housing.
6. Remove sprag clutch from sprag clutch housing.



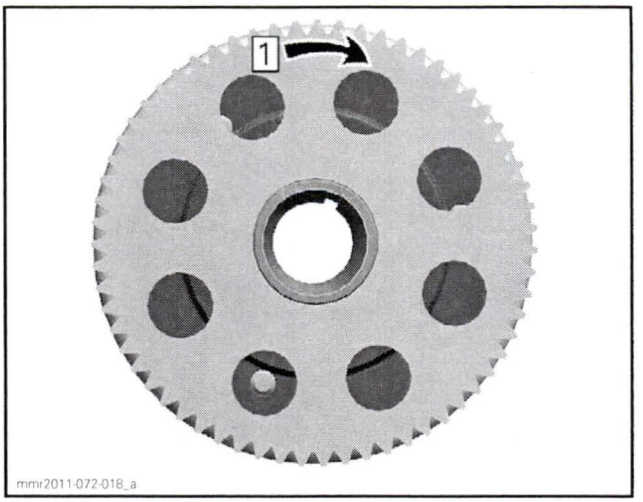
1. Sprag clutch housing screws
2. Rotor
3. Sprag clutch
4. Sprag clutch housing

Sprag Clutch Inspection

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

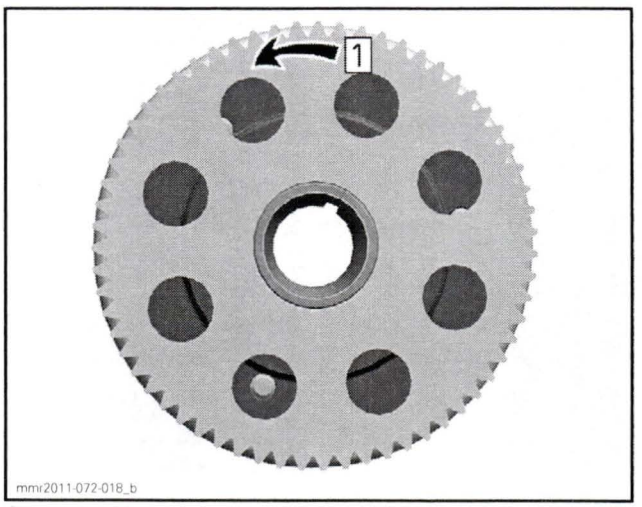
Check the collar of the sprag clutch gear, refer to *SPRAG CLUTCH GEAR*.

Rotate sprag clutch gear clockwise. Gear must rotate freely.



Step 1: Free

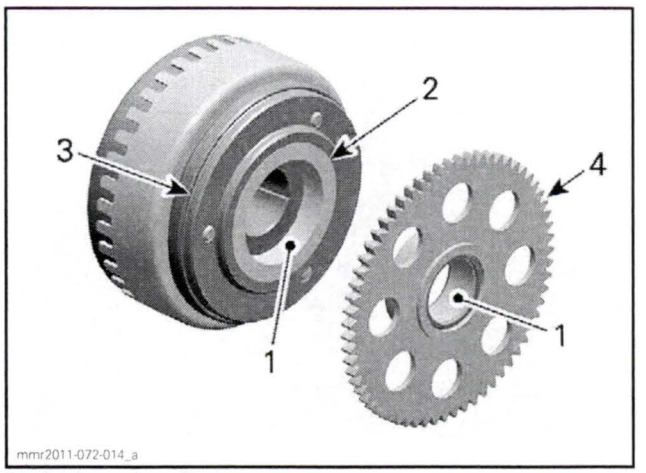
Rotate sprag clutch gear counterclockwise. Gear must lock.



Step 1: Lock

Sprag Clutch Installation

1. Apply LOCTITE 648 (GREEN) (P/N 413 711 400) on threads of sprag clutch housing screws.
2. Loosely install screws.
3. Apply engine oil on sprag clutch and sprag clutch gear needle bearing.



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

4. Install *ROTOR*, see procedure in this subsection.
5. Tighten sprag clutch housing screws to the specified torque.

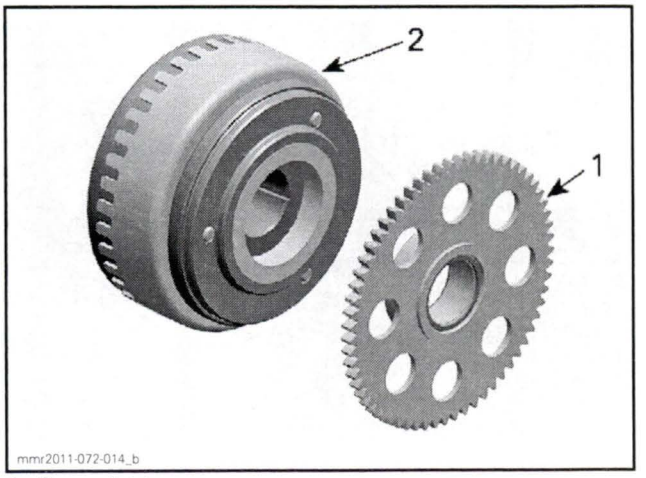
TIGHTENING TORQUE	
Sprag clutch housing screws	30 N•m ± 2 N•m (22 lbf•ft ± 1 lbf•ft)

6. Install all other removed parts.

SPRAG CLUTCH GEAR

Sprag Clutch Gear Removal

1. Remove rotor and sprag clutch gear together. Refer to *ROTOR* in this subsection.
2. Pull sprag clutch gear out of the rotor.

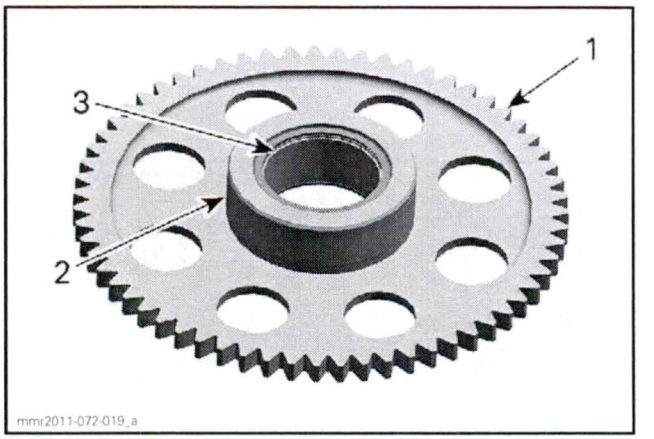


1. *Sprag clutch gear*
2. *Rotor*

Sprag Clutch Gear Inspection

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

Check needle bearing for wear and pittings.



1. *Teeth*
2. *Collar*
3. *Needle bearing*

Replace sprag clutch gear if necessary.

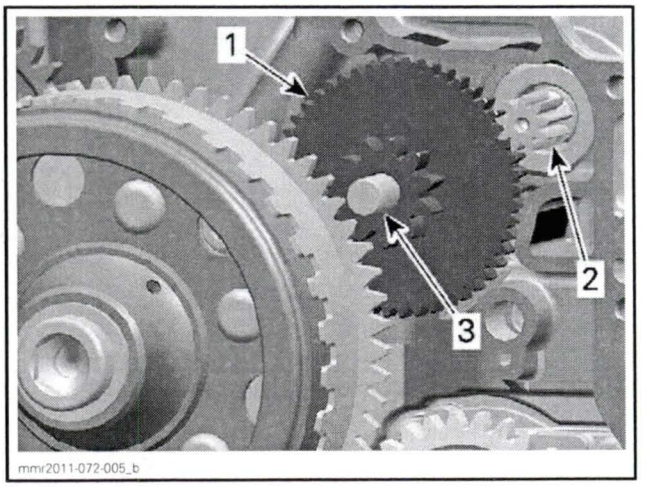
Sprag Clutch Gear Installation

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

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

STARTER DRIVE GEARS

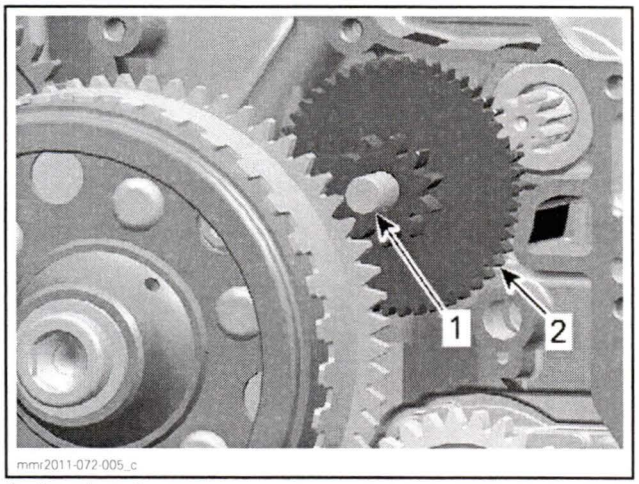
The starter drive gears are located on the engine MAG side behind the magneto cover.



1. *Starter double gear*
2. *Starter gear*
3. *Location pin*

Starter Drive Gear Removal

1. Remove *MAGNETO COVER*, see procedure in this subsection.
2. Remove location pin and starter double gear.



1. Location pin
2. Starter double gear

Starter Drive Gear Inspection

Inspect starter drive gears and location pin for wear and damage.

Replace parts if necessary.

Starter Drive Gear Installation

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

1. Apply engine oil on the location pin.

STARTER

Starter Operation Test

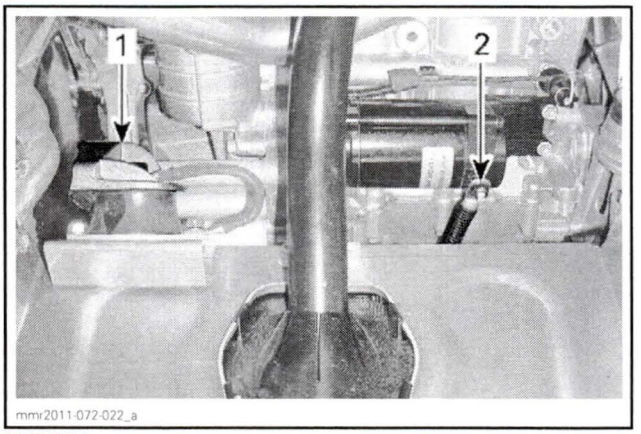
Before carrying out any starter test, make sure:

- Battery is fully charged and in good condition
- Cable connections at battery, starter and solenoid are tight
- Cables are in good condition.

1. Disconnect the negative battery cable.
2. Using booster cables and a fully charged battery or a power pack, carefully supply current directly to the starter.
   - 2.1 Connect the negative booster cable or power pack cable to a good ground such as an engine support.
   - 2.2 Temporarily touch the starter positive terminal.

⚠ WARNING

Sparks can occur when connecting jumper cables. To avoid fire hazard, be sure that no flammable liquids or fuel vapors are in the test area.



TYPICAL
1. Engine support
2. Starter positive terminal

If starter turns at normal speed, test the starting circuit. Refer to *STARTING SYSTEM* subsection.

If starter turns slowly, carry out the *STARTER VOLTAGE DROP TEST (AT BATTERY).*

If starter does not turn, replace starter.

Starter Voltage Drop Test (at Battery)

NOTE: This test will confirm if starter draws too much current. Battery must be fully charged and in good condition.

1. To prevent engine from running, remove fuse F5.
2. Install the tether cord cap on the engine cut-off switch (D.E.S.S. post).
3. Turn the emergency engine stop switch ON.
4. Set the multimeter to Vdc.

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



5. Probes the battery posts.
6. Crank engine and read voltage while cranking.

NOTE: Battery voltage will drop approximately 2 Vdc and fluctuate with starter cranking load.

If the result is close to battery voltage, the starter is in good condition.

If the result is below battery voltage (- 2 Vdc and more), the starter may be defective.

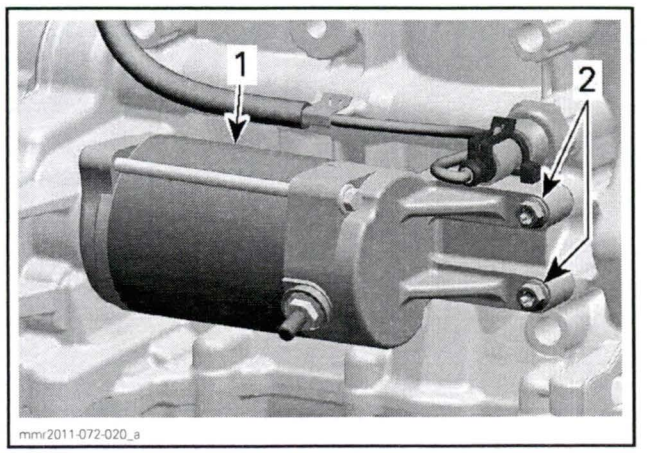
Starter Access

Remove LH and RH side panels.

Remove drive belt guard.

Starter Removal

1. Disconnect the negative battery cable.
2. Remove the starter cable from starter.
3. Remove starter retaining screws.



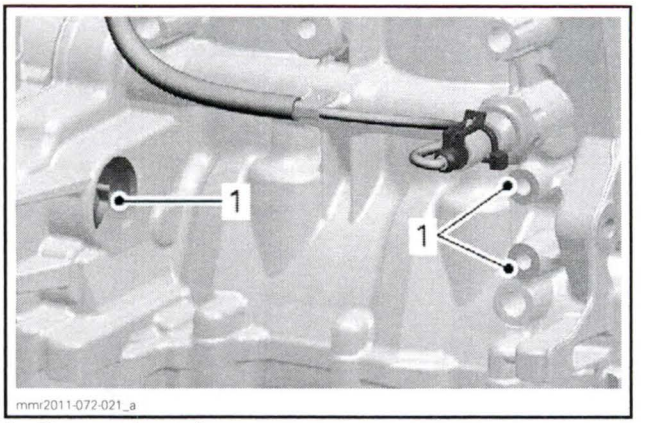
1. Starter
2. Starter retaining screws

4. Pull starter off the cylinder block.

Starter Installation

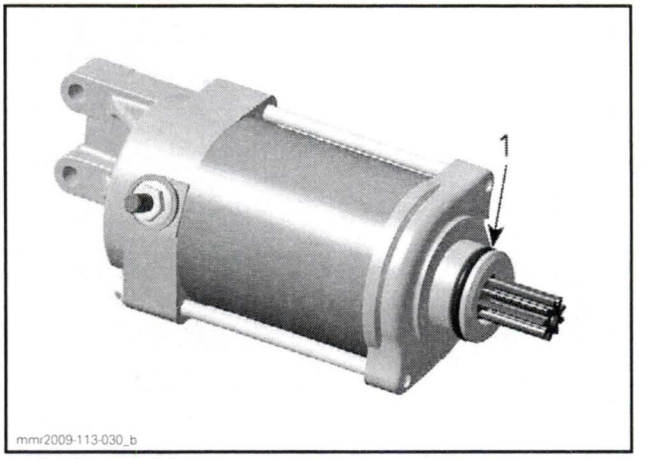
1. Ensure starter and engine mating surfaces are free of debris.

NOTICE **Serious problems may arise if the starter is not properly aligned.**



1. Clean mating surfaces

2. Apply KLÜEBER PASTE 46 MR 401 (P/N 420 297 616) on the starter O-ring before installation.



1. Apply super lube grease

3. Install starter screws and tighten to the specified torque.
4. Connect the starter cable to the starter and tighten nut to the specified torque.

TIGHTENING TORQUE	
Starter retaining screws	11 N•m (97 lbf•**in**)
Starter cable nut	7 N•m (62 lbf•**in**)

5. Install all other removed parts.
6. Reconnect battery cables.

⚠ WARNING

Always connect the RED (+) starter cable first, then the BLACK (-) battery cable last. Whenever connecting the RED (+) cable to the starter motor, always make sure the BLACK (-) battery cable is disconnected to prevent electric shock.

7. Test for proper starter operation.

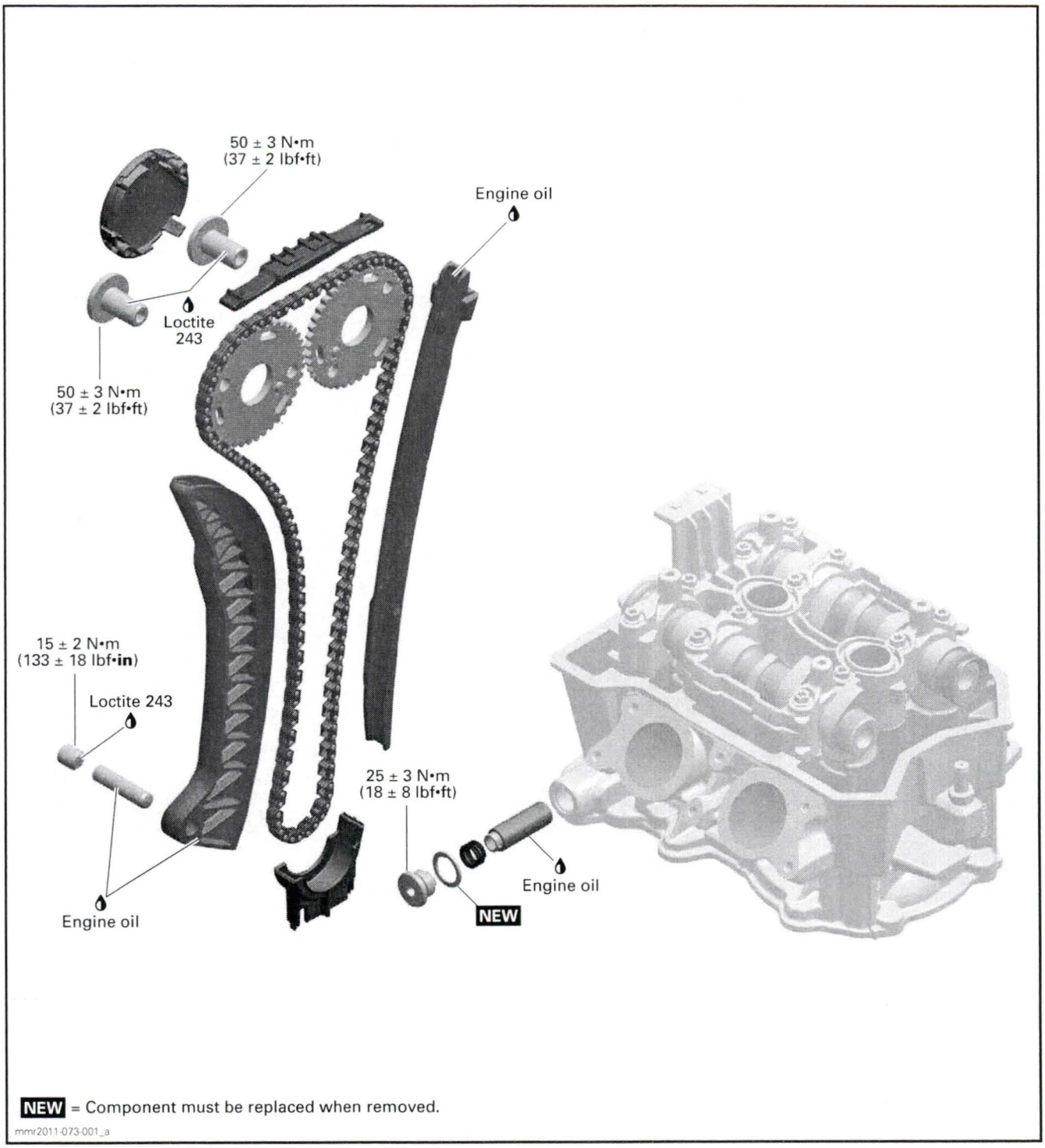
TIMING CHAIN

SERVICE TOOLS

Description	Part Number	Page
CAMSHAFT LOCKING TOOL	529 036 206	321–322

SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 243 (BLUE)	293 800 060	323, 330
LOCTITE 767 (ANTISEIZE LUBRICANT)	293 800 070	327
SUPER LUBE GREASE	293 550 030	327



NEW = Component must be replaced when removed.

mmr2011-073-001_a

GENERAL

Engine removal is necessary to work on the following components:

- Timing chain
- Timing chain guide (tensioner side).

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

⚠ WARNING

Always disconnect BLACK (-) cable first and reconnect last.

When disassembling parts that are duplicated in the engine, (e.g.: valves, springs, etc.), it is strongly recommended to note their position and to keep the parts of the same assembly as a "group". If you find a defective component, it will be much easier to find the cause of the failure. Since parts were broken-in together during engine operation, they will maintain their matched fit when reassembled together within their "group".

TROUBLESHOOTING

The following is provided to help in diagnosing the probable source of troubles. It is a guideline and should not be assumed to provide solutions to every cause of all problems.

UNUSUAL ENGINE NOISE OR VIBRATIONS

1. **Faulty chain tensioner.**
   - *Replace chain tensioner.*
2. **Chain guide(s) worn out.**
   - *Replace chain guide(s).*
3. **Stretched timing chain or worn sprockets.**
   - *Replace timing chain and sprockets.*
4. **Camshaft timing gear screws loose.**
   - *Retighten screws to recommended torque.*
5. **Incorrect camshaft timing adjustment.**
   - *Replace damaged components and readjust camshaft timing.*

ENGINE LACKS ACCELERATION OR POWER

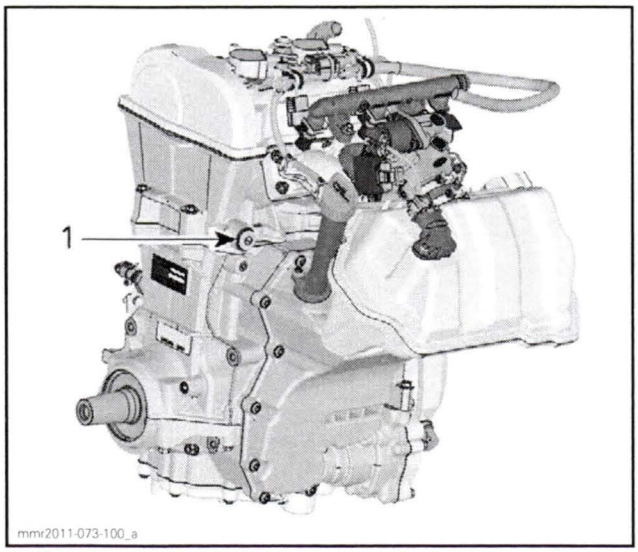
1. **Incorrect camshaft timing adjustment.**
   - *Replace damaged components and readjust camshaft timing.*

PROCEDURES

TIMING CHAIN TENSIONER

Timing Chain Tensioner Location

The timing chain tensioner is located in the cylinder head beside the intake port of the PTO cylinder.



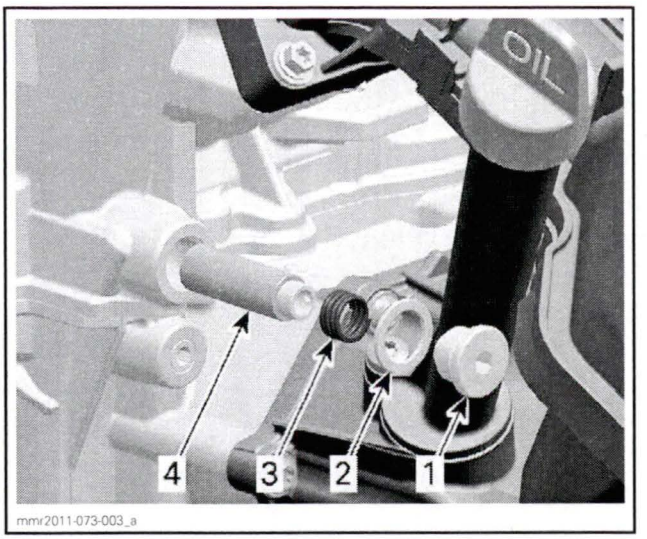
1. Screw plug location, timing chain tensioner

Timing Chain Tensioner Access

Remove driven pulley. Refer to *DRIVEN PULLEY AND COUNTERSHAFT (600 ACE)* subsection.

Timing Chain Tensioner Removal

1. Lock crankshaft, refer to *CYLINDER BLOCK* subsection.
2. Remove screw plug and discard the sealing washer.
3. Pull out spring and chain tensioner.



1. *Screw plug*
2. *Sealing washer*
3. *Spring*
4. *Chain tensioner*

Timing Chain Tensioner Inspection

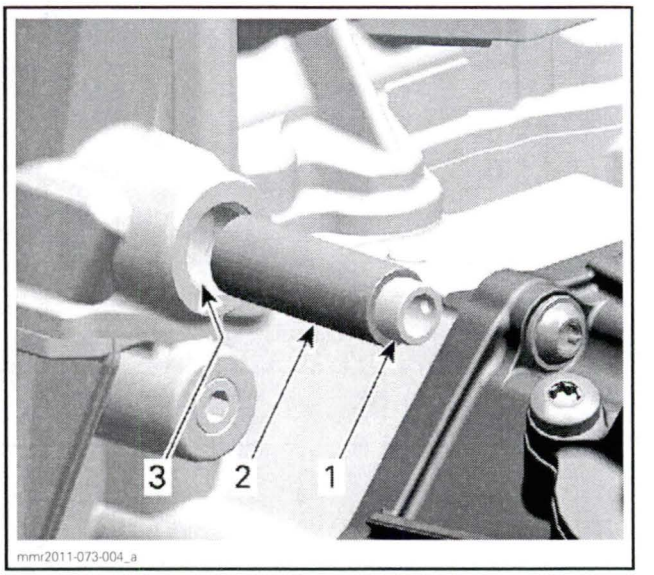
1. Check chain tensioner for scoring and freedom of movement in bore.
2. Compress chain tensioner and check for proper operation.

NOTE: The chain tensioner is difficult to compress when properly charged with oil, and easily compressed when it is not.

3. Check spring for straightness, corrosion and other visible damage.

Timing Chain Tensioner Installation

1. Apply engine oil on chain tensioner.
2. Insert chain tensioner in its bore with the plunger pointing outwards.



TIMING CHAIN TENSIONER INSTALLATION
1. *Plunger*
2. *Chain tensioner*
3. *Tensioner bore in cylinder head*

3. Install spring on chain tensioner.
4. Install screw plug with a NEW sealing washer.
5. Tighten screw plug to specified torque.

SCREW PLUG TORQUE (TIMING CHAIN TENSIONER)
25 N•m ± 3 N•m (18 lbf•ft ± 2 lbf•ft)

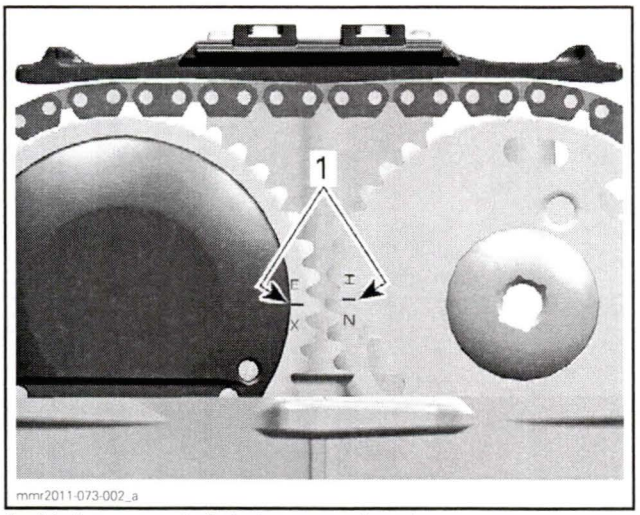
6. Install all other removed parts.

CAMSHAFT TIMING GEARS

Camshaft Timing Gear Removal

1. Remove *VALVE COVER*, see procedure in *CYLINDER HEAD* subsection.
2. Lock crankshaft, refer to procedure in *CYLINDER BLOCK* subsection.

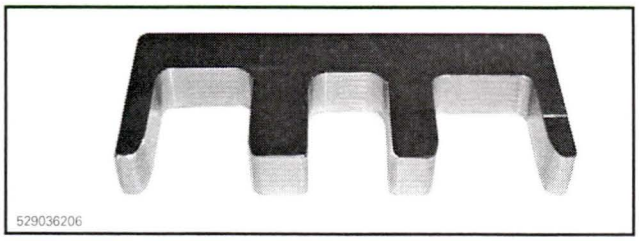
NOTE: When crankshaft is locked, the marks "IN" and "EX" on the camshaft timing gears must be aligned.

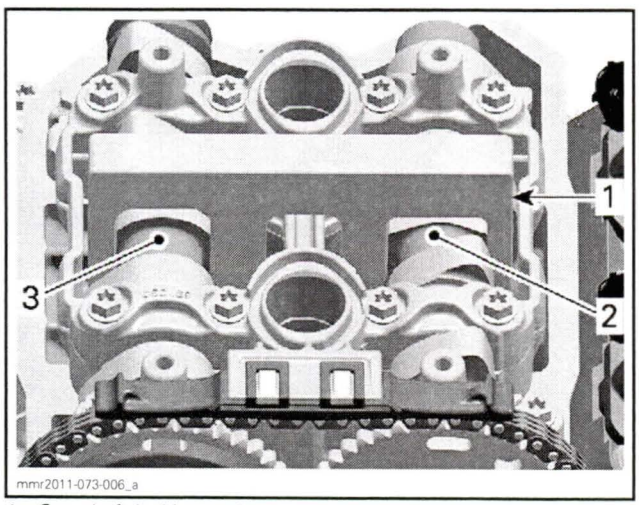


1. Marks on camshaft timing gears aligned

3. Lock camshafts.

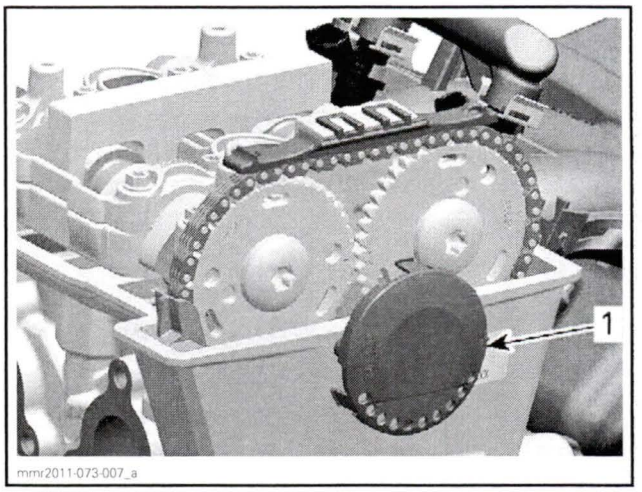
REQUIRED TOOL
CAMSHAFT LOCKING TOOL (P/N 529 036 206)





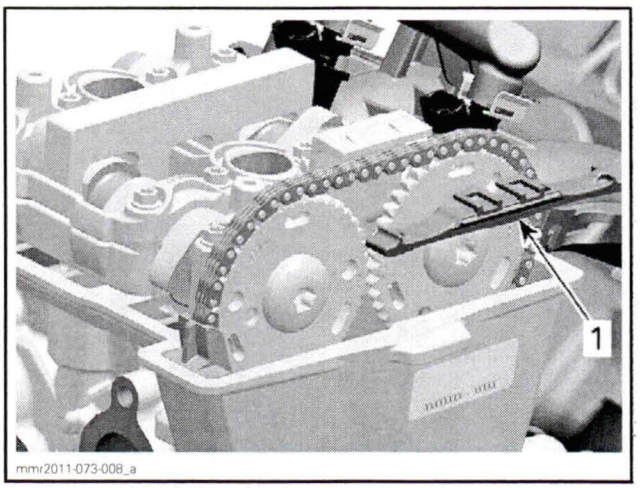
1. Camshaft locking tool
2. Intake camshaft
3. Exhaust camshaft

4. Remove breather cover.



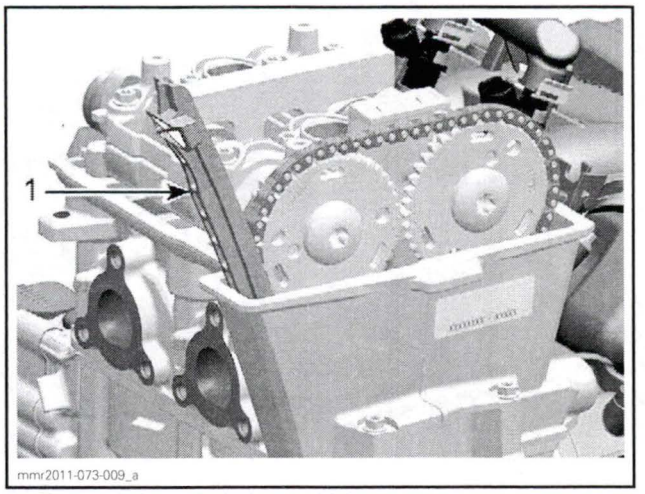
1. Breather cover

5. Remove upper timing chain guide from camshaft holder.



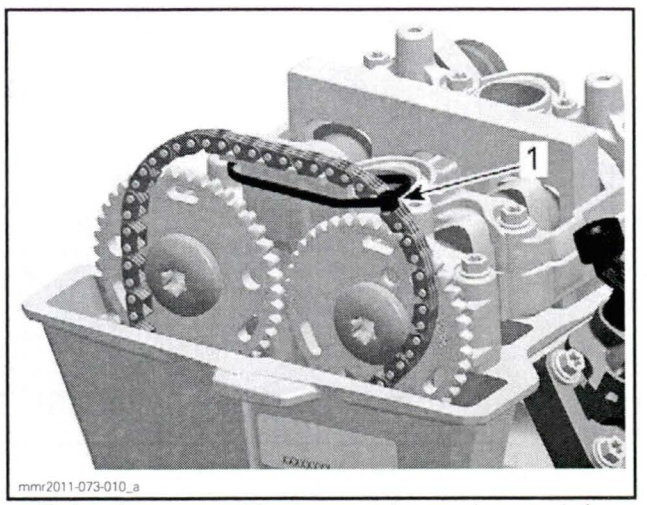
1. Upper timing chain guide

6. Inspect timing chain for radial play while still installed on camshaft timing gears. See *TIMING CHAIN INSPECTION* in this subsection.
7. Remove *TIMING CHAIN TENSIONER*, see procedure in this subsection.
8. Remove timing chain guide (exhaust side).



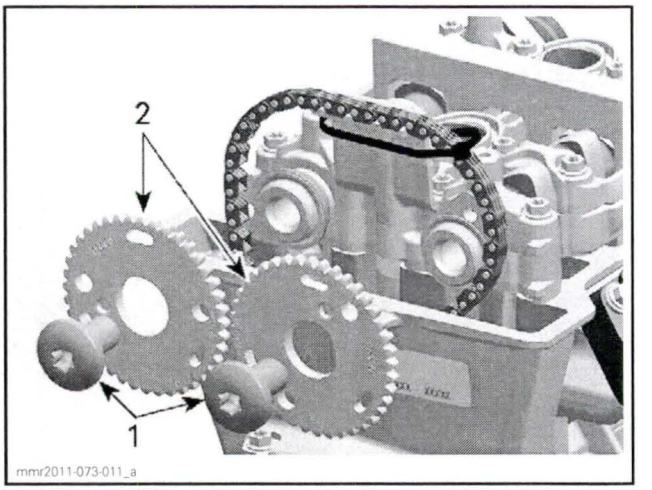
1. Timing chain guide (exhaust side)

9. Remove timing chain from camshaft timing gears and secure it to the camshaft holder using a locking tie.



1. Timing chain removed from gears and secured to camshaft holder

10. Unscrew and remove camshaft timing gear screws.
11. Remove camshaft timing gears.



1. Camshaft timing gear screws
2. Camshaft timing chain gears

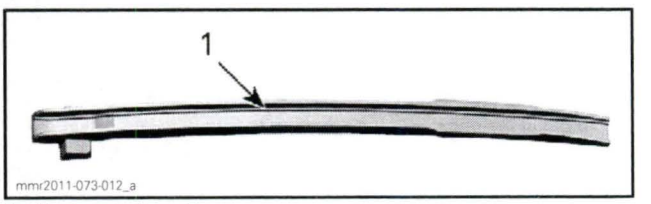
Camshaft Timing Gear Inspection

1. Check camshaft timing gears for wear or deterioration. If a gear is worn or damaged, replace camshaft timing gears and timing chain as a set.

NOTE: For crankshaft timing gear inspection, refer to *CYLINDER BLOCK* subsection.

2. Check timing chain guide for wear, cracks or deformation. Replace as required.
3. Replace timing chain guide if any groove caused by timing chain exceeds service limit.

CHAIN GUIDE GROOVE DEPTH	
SERVICE LIMIT	1 mm (.039 in)



1. Timing chain guide

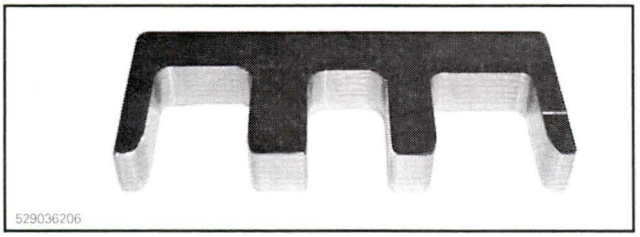
Camshaft Timing Gear Installation

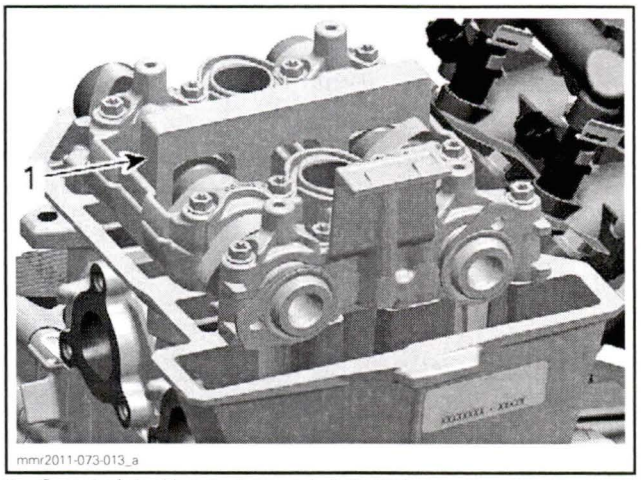
Installation is the reverse of the removal procedure. However, pay attention to the following details.

NOTICE **Improper camshaft timing will damage engine components. Make sure camshafts and crankshaft are still locked. If not, lock them before beginning this procedure.**

1. Ensure camshafts are locked properly.

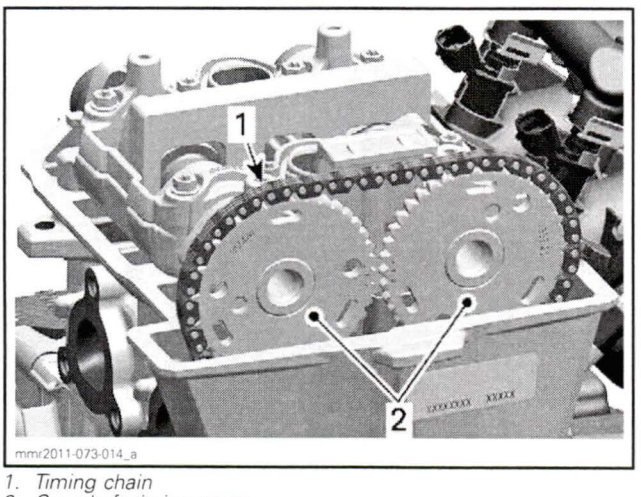
REQUIRED TOOL
CAMSHAFT LOCKING TOOL (P/N 529 036 206)





1. Camshaft locking tool properly installed

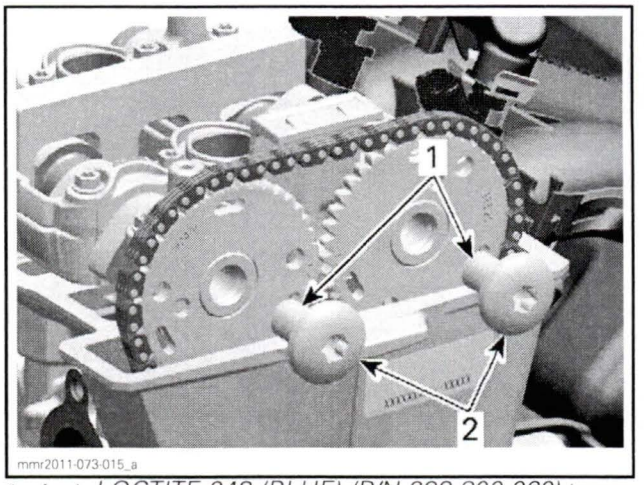
2. Install timing chain with camshaft timing gears.



1. Timing chain
2. Camshaft timing gears

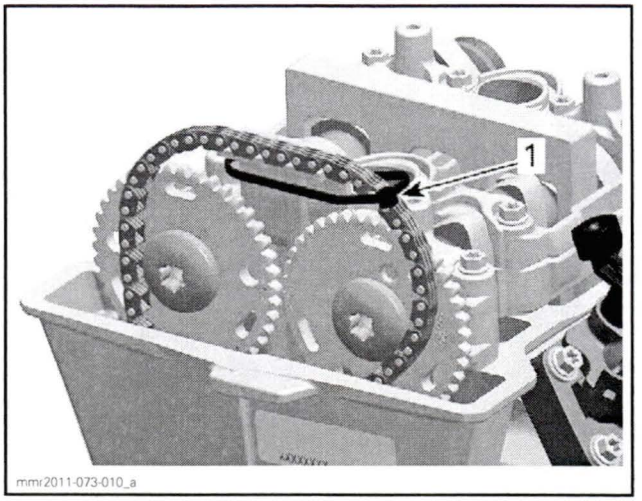
3. Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on threads of camshaft timing gear screws.
4. Install camshaft timing gear screws hand tightened at this time.

NOTICE Do not torque timing gear screws at this time to avoid overstressing timing chain.



1. Apply LOCTITE 243 (BLUE) (P/N 293 800 060) here
2. Screws to be hand tightened at this time

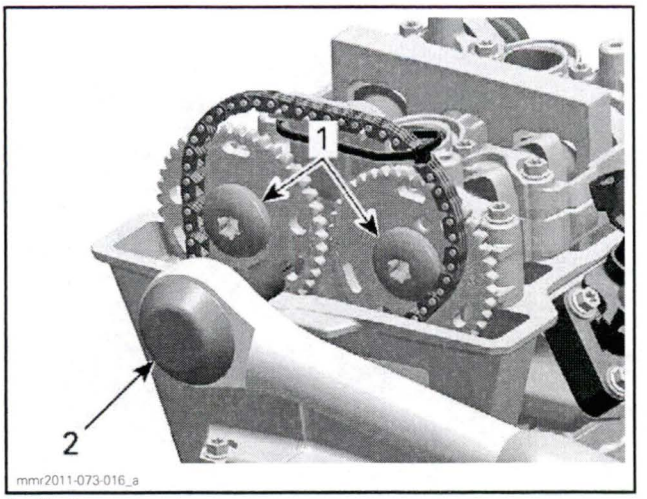
5. Remove timing chain from camshaft timing gears and secure it to the camshaft holder using a locking tie.



1. Timing chain removed from gears and secured to camshaft holder

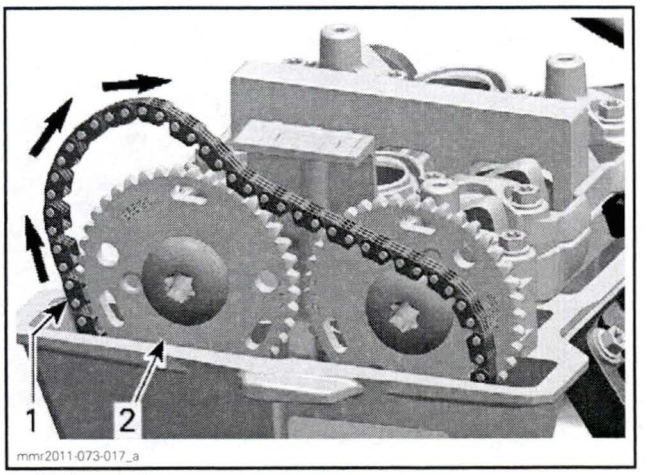
6. Torque both camshaft timing gear screws as specified.

CAMSHAFT TIMING GEAR SCREW TORQUE
50 N•m ± 3 N•m (37 lbf•ft ± 2 lbf•ft)



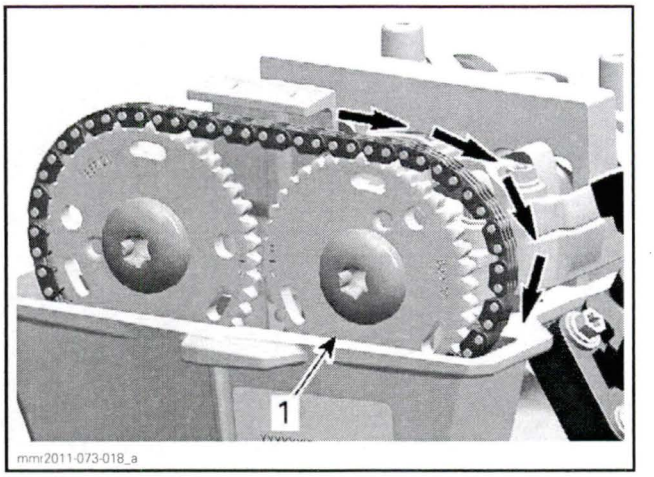
1. *Timing gear screws*
2. *Torque wrench*

7. Cut locking tie and pull timing chain up on exhaust side and install it on the exhaust camshaft timing gear.



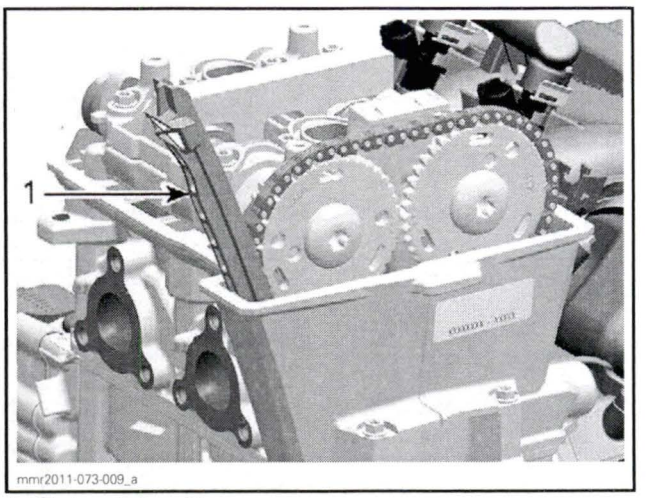
1. *Timing chain*
2. *Exhaust camshaft timing gear*

8. Pull timing chain towards intake side and install it on the intake camshaft timing gear.



1. *Intake camshaft timing gear*

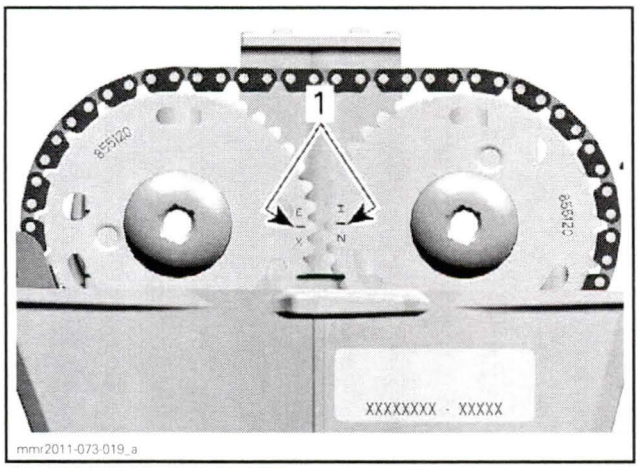
9. Install timing chain guide.



1. *Timing chain guide*

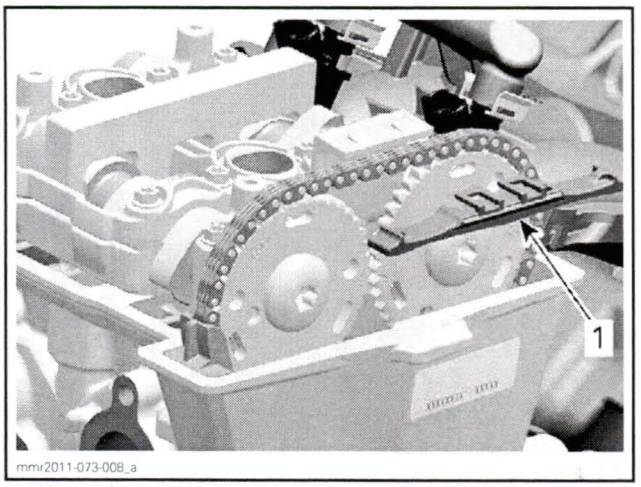
10. Install *TIMING CHAIN TENSIONER*, see procedure in this subsection.
11. Ensure marks on camshaft timing gears are still aligned. If not, repeat procedure.

NOTICE **After installation of timing chain tensioner, the marks "IN" on intake and "EX" on exhaust camshafts must be aligned.**



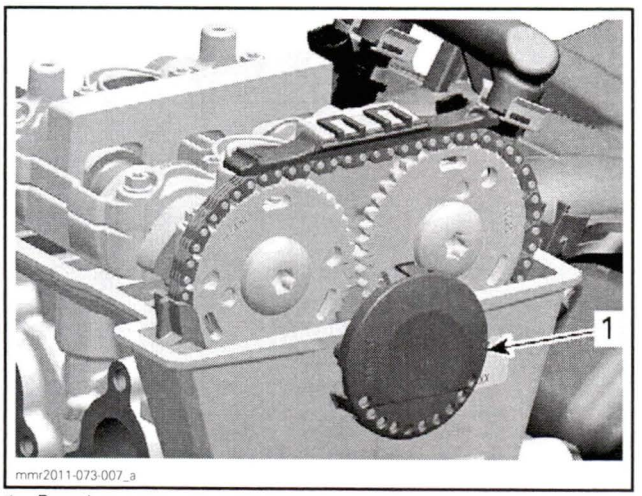
CAMSHAFT TIMING GEARS
1. Marks must be aligned

12. Install upper timing chain guide on camshaft holder.



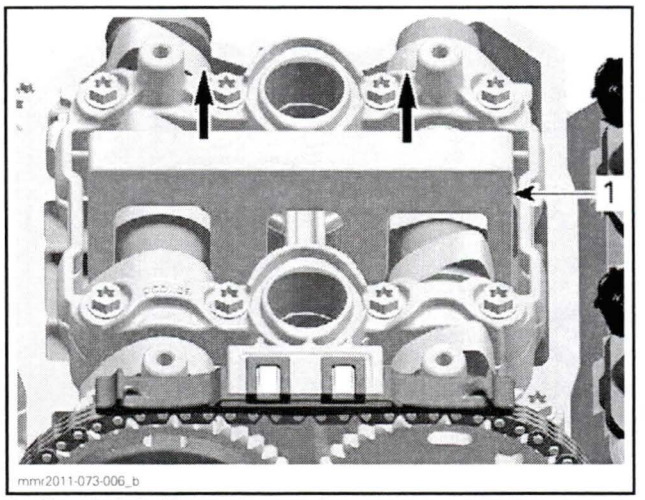
1. Upper timing chain guide

13. Install breather cover.



1. Breather cover

14. Remove camshaft locking tool.



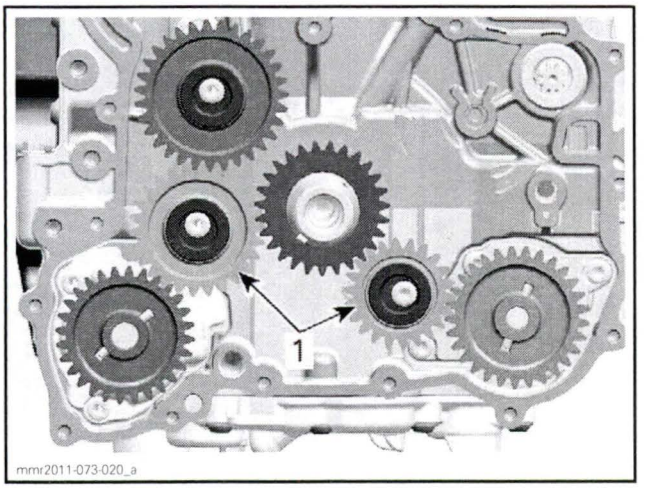
1. Camshaft locking tool removal

15. Remove crankshaft locking tool.
16. Install remaining parts.

TIMING CHAIN

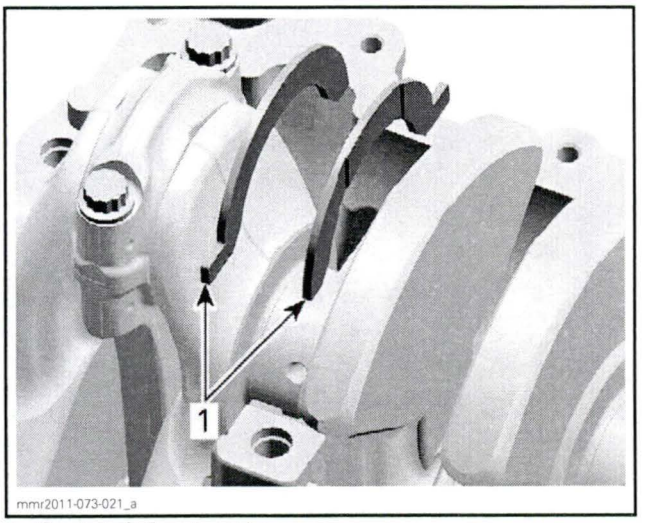
Timing Chain Removal

1. Remove engine from vehicle. Refer to *ENGINE REMOVAL AND INSTALLATION* subsection.
2. Remove air intake manifold, refer to *AIR INTAKE SYSTEM* subsection.
3. Remove valve cover, refer to *CYLINDER HEAD* subsection.
4. Refer to *LUBRICATION SYSTEM* subsection and remove the following parts:
   - Oil tank
   - Oil pressure regulator valve
   - Oil cooler
   - Oil sump cover.
5. Refer to *COOLING SYSTEM* subsection and remove following parts:
   - Water pump housing
   - Thermostat.
6. Check timing chain for excessive radial play while still installed on timing gears. Refer to *TIMING CHAIN INSPECTION* in this subsection.
7. Remove the *CAMSHAFT TIMING GEARS*, see procedure in this subsection.
8. Refer to *MAGNETO AND STARTER* subsection and remove the following parts:
   - Magneto cover
   - Rotor
   - Starter drive gears.
9. Remove oil pump intermediate gears, refer to *LUBRICATION SYSTEM* subsection.



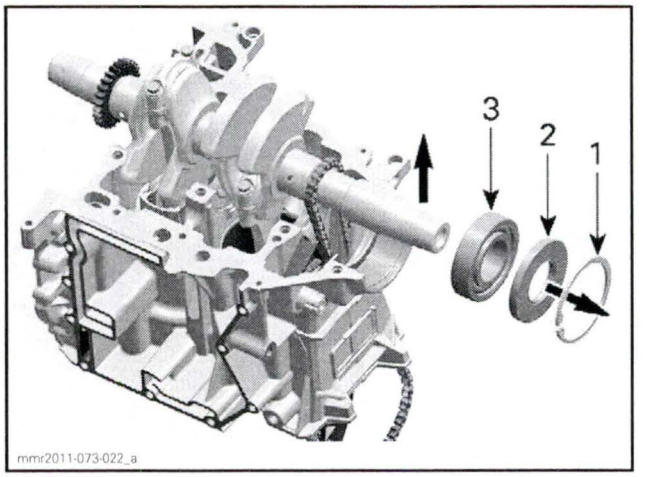
1. Oil pump intermediate gears

10. Remove crankshaft locking bolt.
11. Separate cylinder block, refer to *CYLINDER BLOCK* subsection.
12. Remove crankshaft thrust washers.



1. Crankshaft thrust washers

13. Remove retaining ring that secures the oil seal and PTO ball bearing.
14. Slightly lift the crankshaft and remove oil seal and PTO ball bearing.

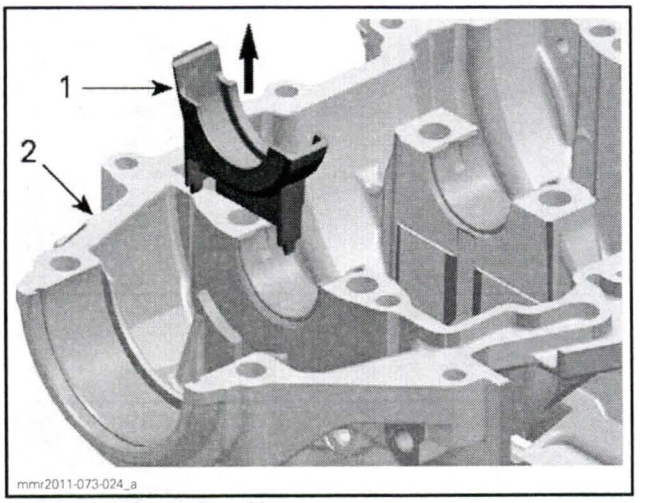


1. Retaining ring
2. Oil seal
3. Ball bearing

15. Remove timing chain.

NOTE: Make a mark on the timing chain to indicate the operating direction of the chain before removal.

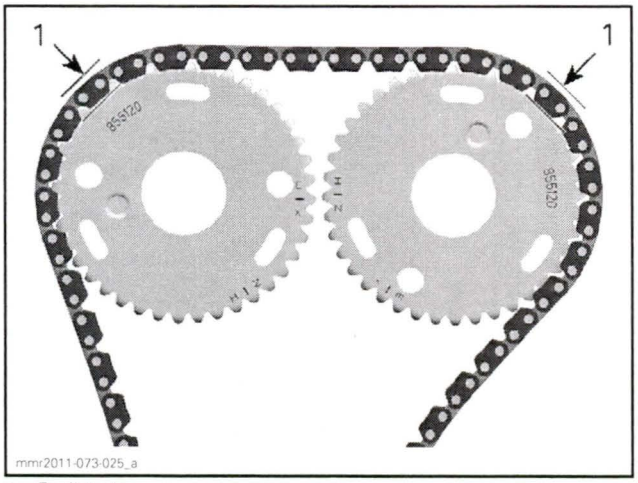
16. Remove lower timing chain guide from lower half of cylinder block.



1. Lower timing chain guide
2. Lower half of cylinder block

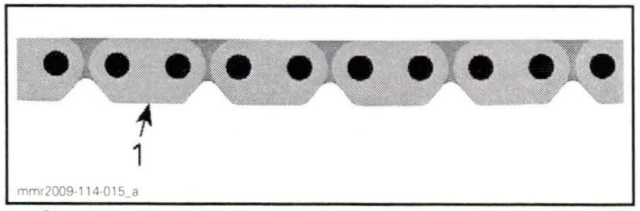
Timing Chain Inspection

1. Check timing chain on camshaft timing gears for excessive radial play while gears are still installed on camshafts and timing chain tensioner is installed.



1. Radial play

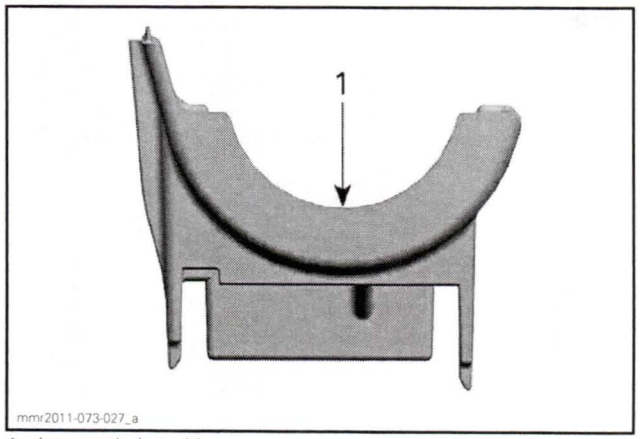
2. Check timing chain for wear and teeth condition.



1. Check teeth condition

NOTICE If timing chain is excessively worn or damaged, replace timing chain and camshaft timing gears as a set.

3. Check lower chain guide for wear, cracks or deformation. Replace as required.



1. Lower chain guide

Replace lower chain guide if timing chain wear grooves are visible.

CHAIN GUIDE GROOVE DEPTH	
SERVICE LIMIT	No timing chain wear groove allowed

NOTE: Also check the chain guide, tensioner side. Refer to *CHAIN GUIDE INSPECTION (TENSIONER SIDE)* further in this subsection.

Timing Chain Installation

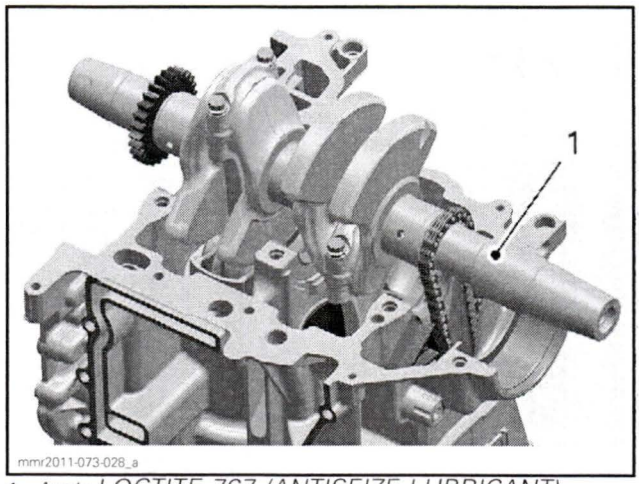
Installation is the reverse of the removal procedure. However, pay attention to the following details.

NOTICE Improper camshaft timing will damage engine components, strictly follow this procedure.

1. Install timing chain.

NOTE: If the same timing chain is reinstalled, be sure to reinstall it in the same operating direction as marked during removal procedure.

2. Apply LOCTITE 767 (ANTISEIZE LUBRICANT) (P/N 293 800 070) on crankshaft at PTO-bearing surface area.

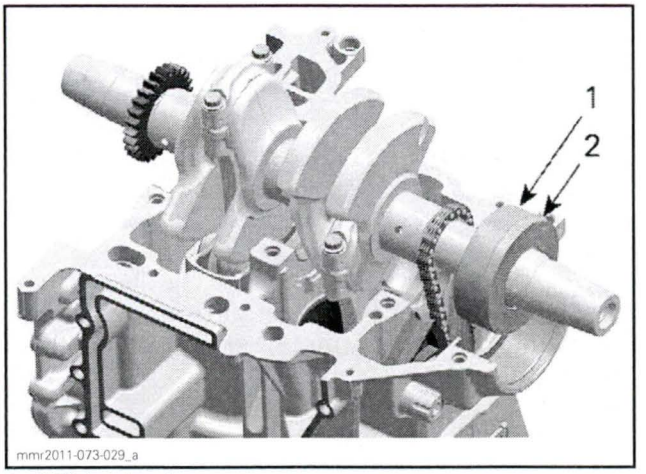


1. Apply LOCTITE 767 (ANTISEIZE LUBRICANT) (P/N 293 800 070) here

NOTE: After bearing installation, clean oil seal running surface on crankshaft.

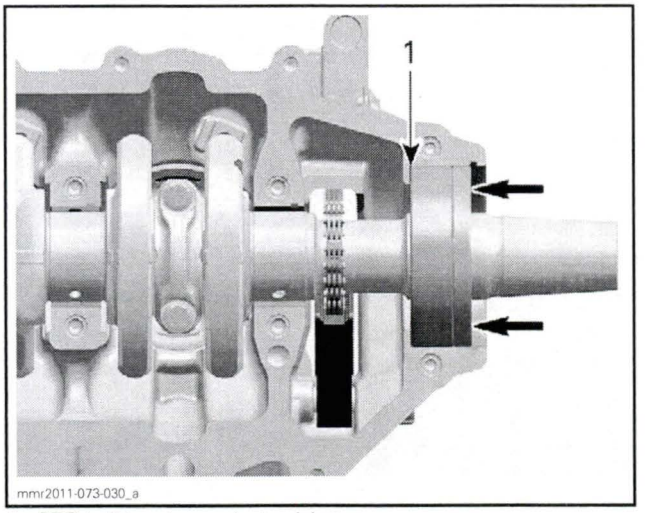
3. Lubricate sealing lip of oil seal with SUPER LUBE GREASE (P/N 293 550 030).
4. Reinstall PTO ball bearing and oil seal on crankshaft.

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



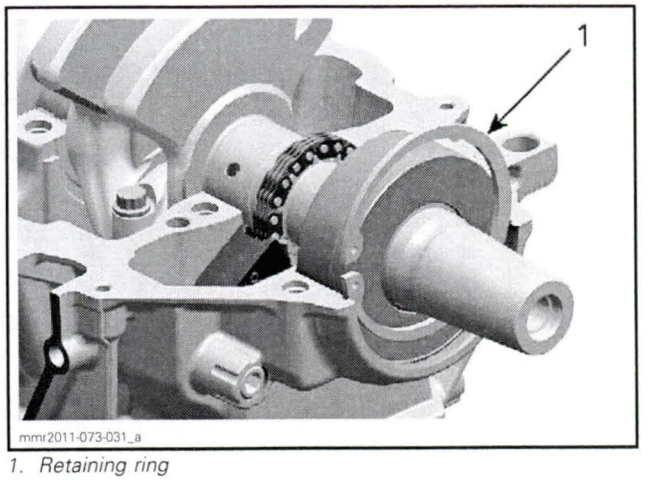
1. *PTO ball bearing*
2. *Oil seal*

5. Properly install crankshaft and push ball bearing and oil seal against axial stop.



1. *PTO ball bearing against axial stop*

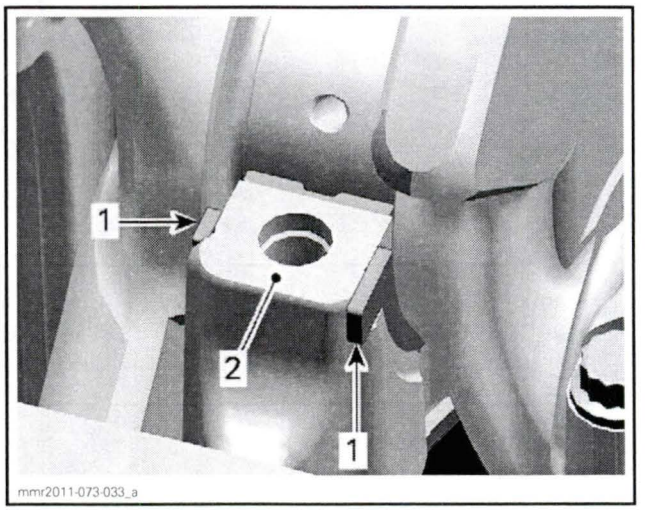
6. Install retaining ring.



1. *Retaining ring*

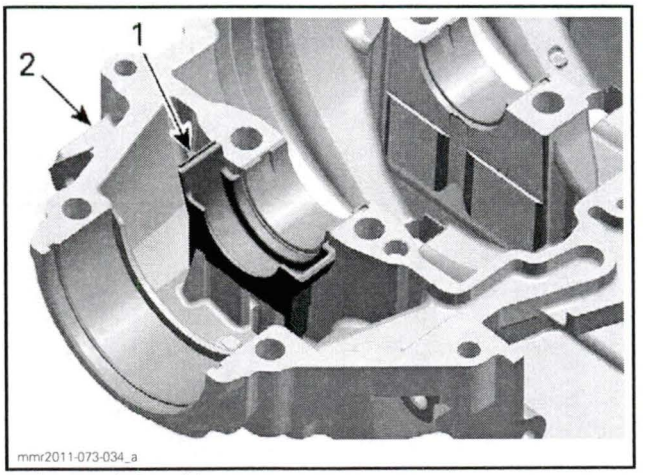
7. Lubricate (on both sides) and reinstall the crankshaft thrust washers with the slots facing against crankshaft counterweights.

NOTE: Crankshaft thrust washers must be flush with the cylinder block sealing surface.



1. *Crankshaft thrust washers*
2. *Sealing surface*

8. Reinstall lower chain guide in lower half of cylinder block.



1. *Lower chain guide*
2. *Lower half of cylinder block*

9. Reassemble cylinder block, refer to *CYLINDER BLOCK* subsection.
10. Lock crankshaft, refer to *CRANKSHAFT LOCKING PROCEDURE* in the *CYLINDER BLOCK* subsection.
11. Lock camshafts and install camshaft timing gears as per *CAMSHAFT TIMING GEAR INSTALLATION* in this subsection.
12. Install all other removed parts.

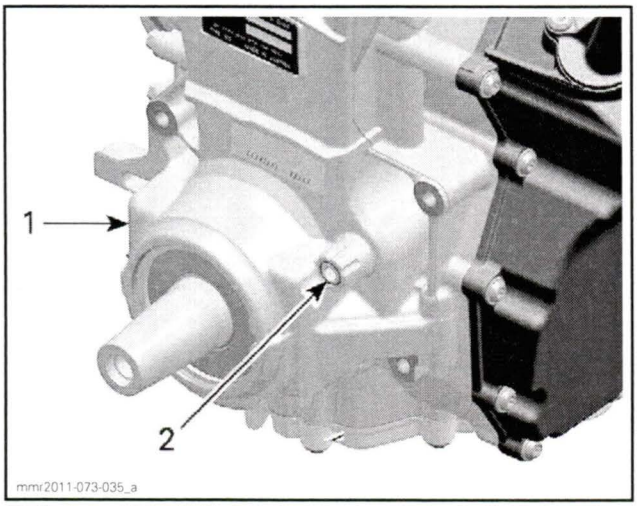
NOTE: Be sure to remove camshaft and crankshaft locking tools when timing chain is completely installed.

CHAIN GUIDE (TENSIONER SIDE)

Chain Guide Removal (Tensioner Side)

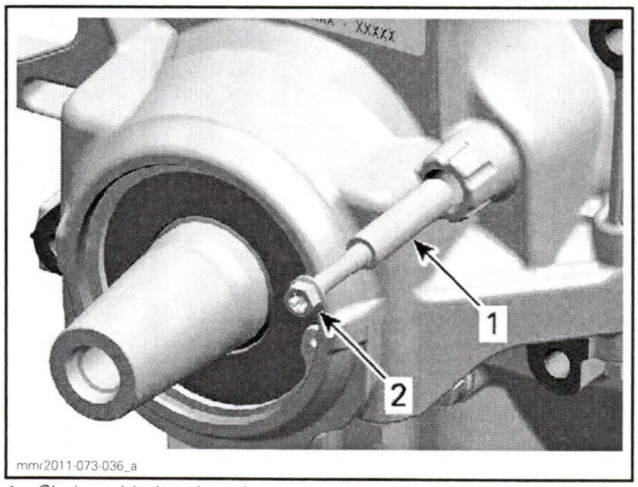
NOTE: Removal of chain guide is not recommended if there is no need for replacement.

1. Remove the *CAMSHAFT TIMING GEARS*, see procedure in this subsection.
2. Remove screw plug that covers the chain guide bearing pin.



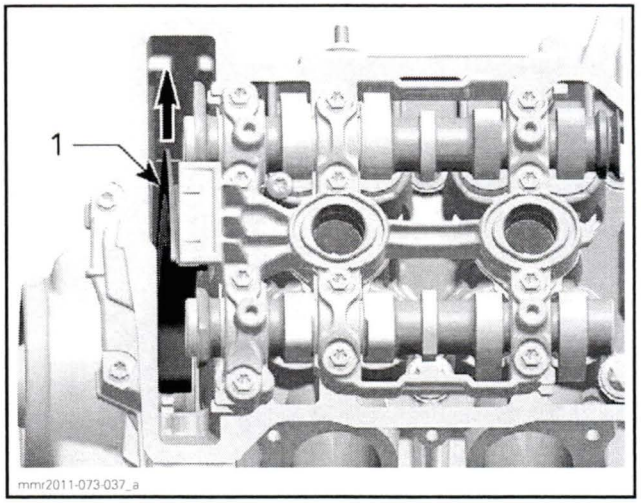
1. Cylinder block PTO side
2. Screw plug location

3. Use an M6 bolt to pull chain guide bearing pin out of cylinder block.



1. Chain guide bearing pin
2. M6 bolt

4. Push chain guide (tensioner side) to the exhaust camshaft side and remove it.



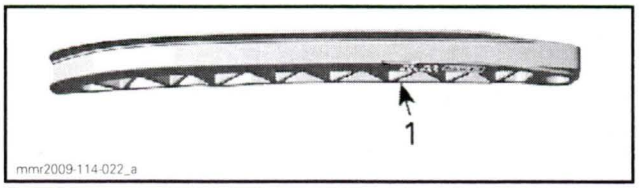
1. Chain guide (tensioner side)

Chain Guide Inspection (Tensioner Side)

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

Replace chain guide if groove depth caused by timing chain exceeds service limit.

CHAIN GUIDE GROOVE DEPTH	
SERVICE LIMIT	1 mm (.039 in)



TYPICAL
1. Chain guide

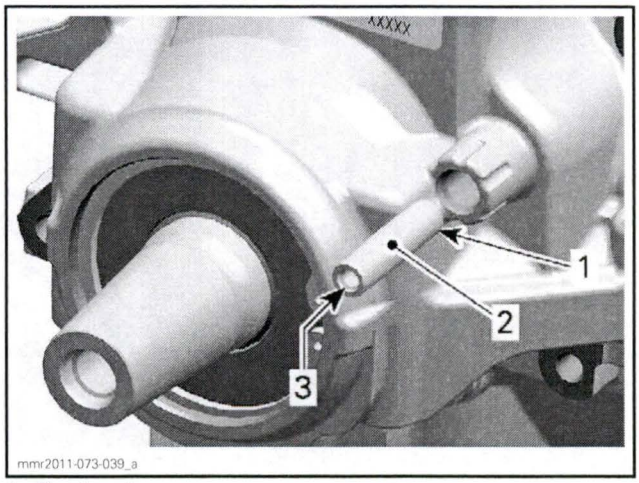
Chain Guide Installation (Tensioner Side)

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

NOTICE Improper camshaft timing will damage engine components. Make sure camshafts and crankshaft are still locked. If not, lock them before beginning this procedure.

1. Insert chain guide.
2. Apply engine oil on bearing pin and install it with M6 threads facing outwards.

NOTICE Ensure chain guide bearing pin is properly inserted in the chain guide.



1. Bearing pin
2. Apply engine oil here
3. M6 threads facing outwards

3. Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on screw plug of chain guide.
4. Tighten screw plug as specified.

SCREW PLUG TORQUE
15 N•m ± 2 N•m (133 lbf•**in** ± 18 lbf•**in**)

5. Properly reinstall camshaft timing gears. Refer to *CAMSHAFT TIMING GEARS* in this subsection.

CYLINDER HEAD

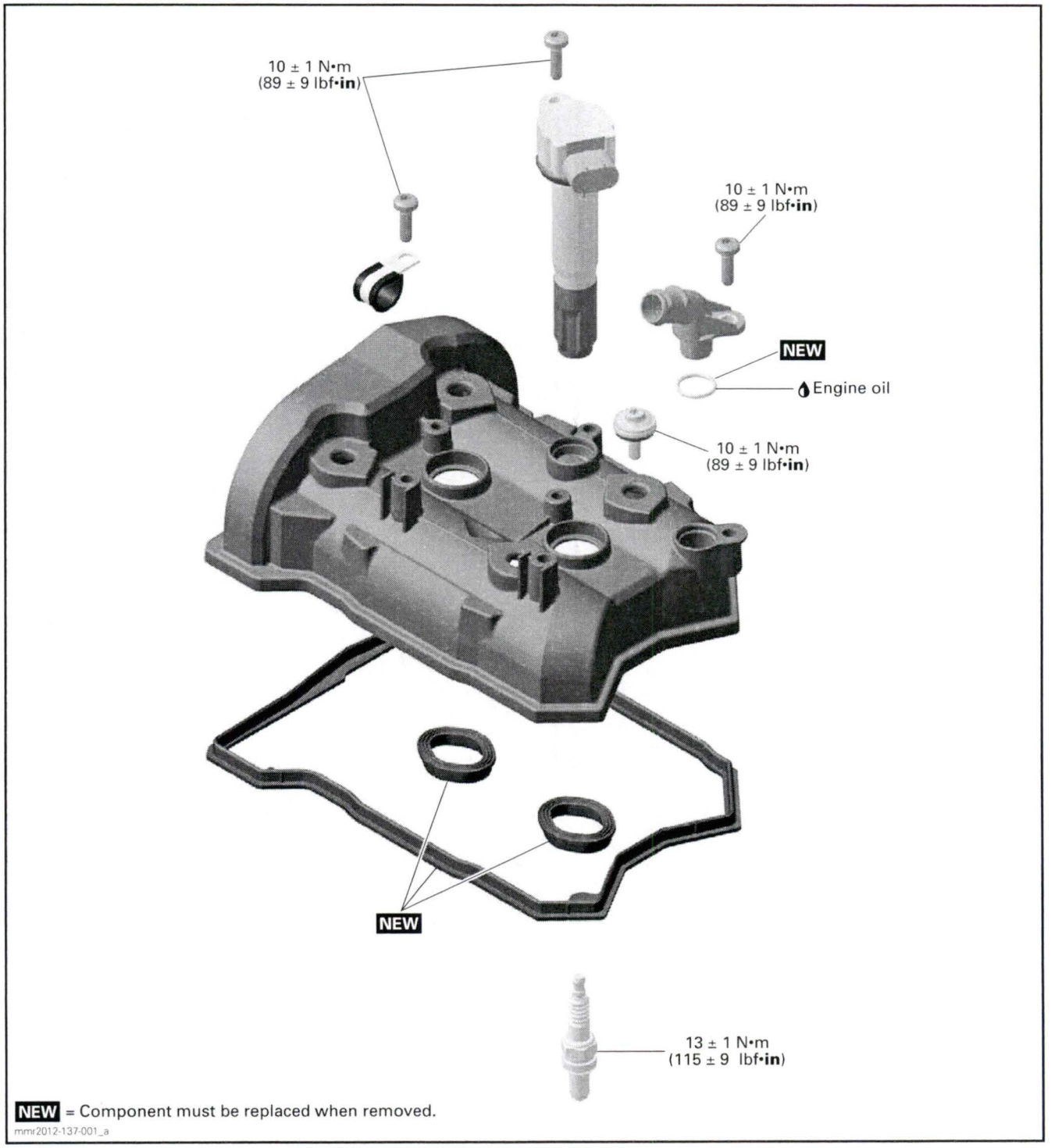
SERVICE TOOLS

Description	Part Number	Page
ENGINE LEAK DOWN TEST KIT	529 035 661	335
VALVE SPRING COMPRESSOR CUP	529 036 209	345
VALVE SPRING COMPRESSOR	529 035 724	345

SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
SNAP-ON VALVE HOLDER	VL2	348
SNAP-ON VALVE STEM SEAL PLIERS	YA 8230	347

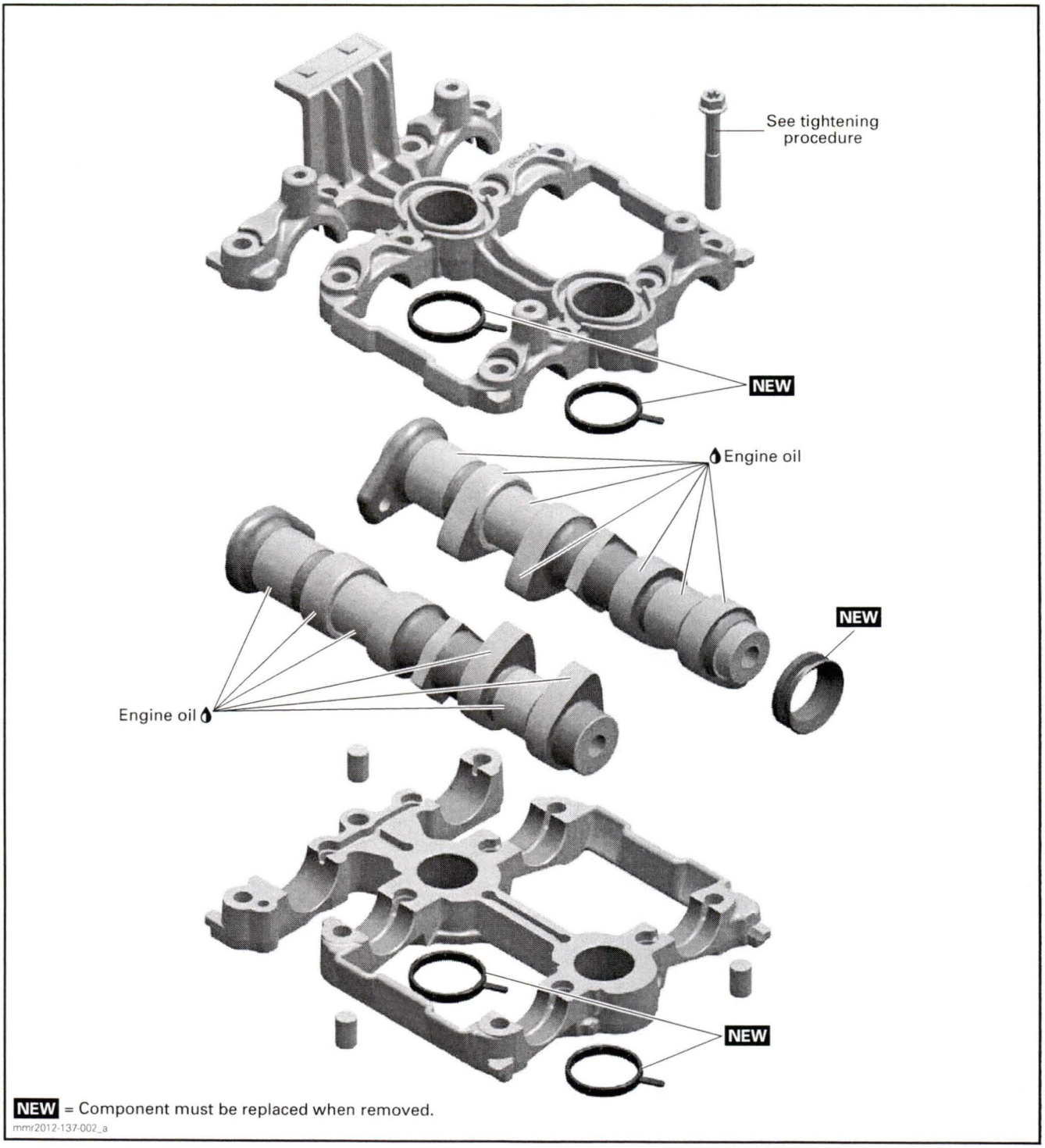
VALVE COVER



NEW = Component must be replaced when removed.

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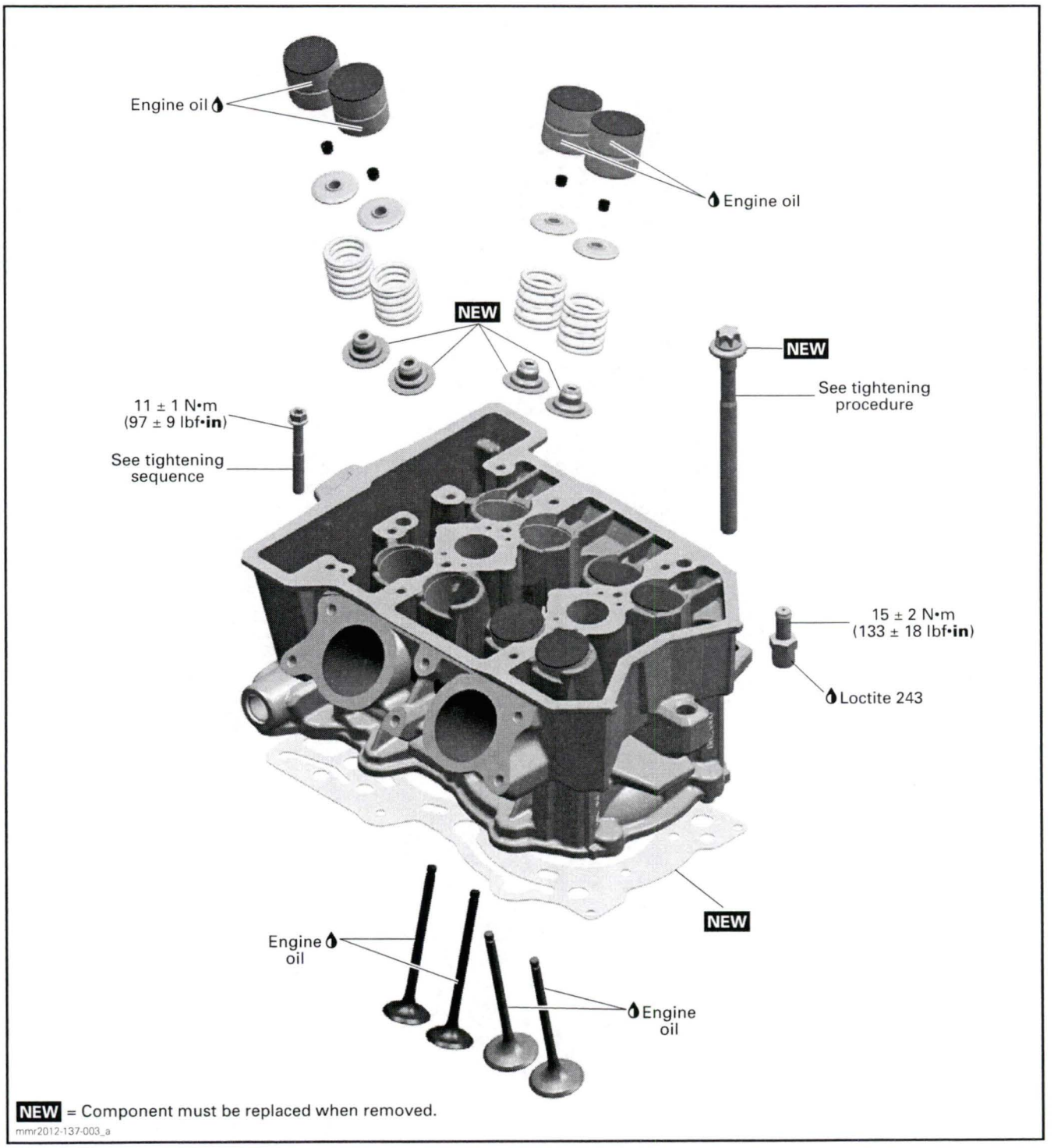
CAMSHAFTS



NEW = Component must be replaced when removed.

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CYLINDER HEAD



NEW = Component must be replaced when removed.

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GENERAL

NOTE: For a better understanding, some illustrations are taken with engine out of the vehicle.

When disassembling parts that are duplicated in the engine, (e.g.: valves, springs, etc.), it is strongly recommended to note their position and to keep the parts of the same assembly as a "group". If you find a defective component, it will be much easier to find the cause of the failure. Since parts were broke-in together during engine operation, they will maintain their matched fit when reassembled together within their "group".

INSPECTION

CYLINDER LEAK TEST

General

Before performing the cylinder leak test, verify the following:

- Clamp tightness
- Hoses condition.

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

⚠ CAUTION Engine parts could be hot.

NOTE: The following steps are the same for each cylinder.

Preparation

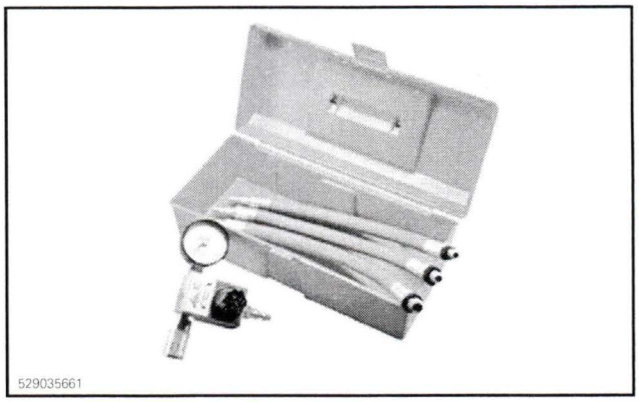
1. Remove the *VALVE COVER*, see procedure in this subsection.
2. Remove spark plug.
3. Using the drive pulley, turn the engine counterclockwise to bring piston to TDC of compression stoke. Use a dial gauge or a suitable tool to position the piston to TDC.

NOTE: The piston must be set precisely to TDC of compression stroke. If not, the engine will continue to rotate when pressure builds up.

Leak Test

1. Install a gauge adaptor into spark plug hole.

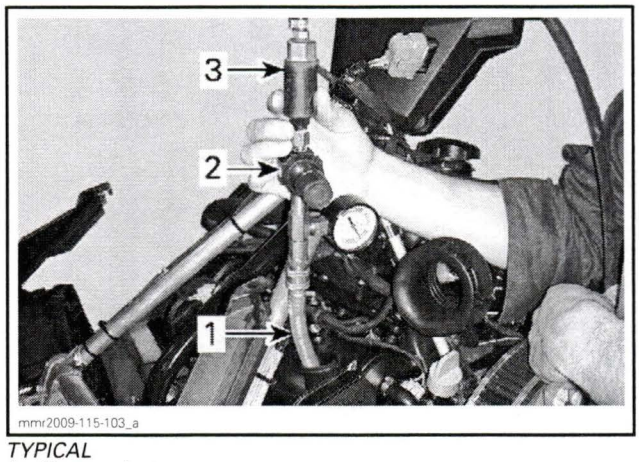
REQUIRED TOOL
ENGINE LEAK DOWN TEST KIT (P/N 529 035 661)



2. Connect the leak down tester to an adequate air supply.
3. Set gauge needle to zero.

NOTE: All testers have specific instructions on gauge operation and required pressure. Refer to manufacturer's instructions.

4. Supply combustion chamber with air pressure.



TYPICAL
1. Gauge adaptor
2. Leak tester
3. Air supply hose

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

LEAKAGE PERCENTAGE	ENGINE CONDITION
0% to 15%	Excellent condition
16% to 25%	Good condition
26% to 40%	Fair condition; reduced engine performance
41% and higher	Poor condition, diagnose and repair engine

Diagnosis

Listen for air leaks.

- Air escaping on intake port or throttle body means leaking intake valve(s).
- Air escaping on exhaust port means leaking exhaust valve(s).
- Air bubbles out of coolant tank means leaking cylinder head gasket.
- Air or coolant escaping from cylinder head means damaged gasket or loosened screws.
- Air escaping into crankcase area means excessively worn cylinder or broken piston rings.
- Air or oil escaping from crankcase means damaged gasket or loosened screws.

Repair Tips

Blue exhaust gas means damaged or worn piston rings or valve stem seals.

White exhaust gas means damaged cylinder head gasket.

Coolant tank cap opening without overheat means damaged cylinder head gasket.

Leaking valves can be caused by carbon deposits or burnt valve face.

Assembly

Reverse the preparation procedure.

TROUBLESHOOTING

Always check for fault codes. If a fault code is detected, service the fault code first. Refer to *DIAGNOSTIC AND FAULT CODES* subsection.

NOTE: When diagnosing an engine problem, always perform the cylinder leak test. This will help pinpoint a problem. Refer to *CYLINDER LEAK TEST* in this subsection.

UNUSUAL ENGINE NOISE OR VIBRATIONS

1. Discharged or defective valve lifters.
   - *Check engine oil pressure, refer to LUBRICATION SYSTEM subsection.*
   - *Replace valve lifters.*
2. Camshaft(s) or camshaft holder(s) worn out.
   - *Check and replace damaged parts.*
3. Faulty chain tensioner.
   - *Replace chain tensioner. Refer to TIMING CHAIN subsection.*
4. Chain guide(s) worn out.
   - *Replace chain guide(s). Refer to TIMING CHAIN subsection.*
5. Stretched timing chain or worn out sprockets.
   - *Replace timing chain and sprockets. Refer to TIMING CHAIN subsection.*
6. Loose timing chain gear screws.
   - *Retighten screws with recommended torque.*
7. Incorrect camshaft timing.
   - *Replace damaged components and readjust camshaft timing.*

OIL LEAKAGE FROM CYLINDER HEAD

1. Leaking valve cover gasket.
   - *Replace valve cover gaskets and retighten valve cover with recommended torque.*
   - *Check valve cover for cracks or other damage.*
2. Leaking spark plug tube O-rings.
   - *Replace spark plug tube O-rings.*
   - *Clean spark plug area from oil spillage.*
3. Blow-by connector is leaking.
   - *Replace blow by connector O-ring.*
4. Leaking cylinder head gasket.
   - *Check cylinder head for damage.*
   - *Replace cylinder head gasket and retighten screws with recommended torquing procedure.*

ENGINE SUDDENLY TURNS OFF OR LACKS ACCELERATION OR POWER

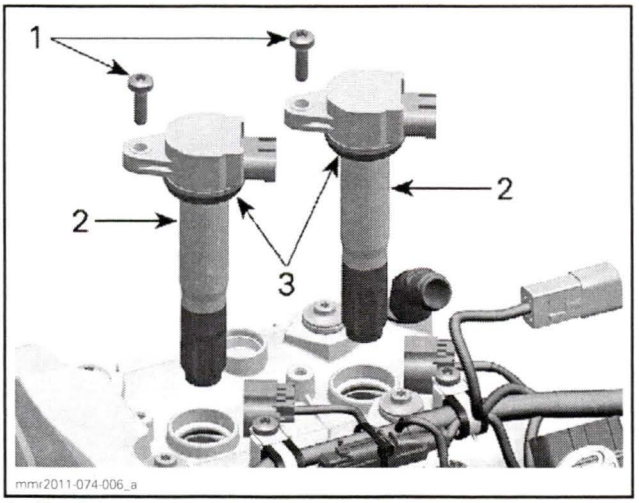
1. Incorrect camshaft timing.
   - *Replace damaged components and readjust camshaft timing.*
2. Leaking intake or exhaust valves.
   - *Perform a CYLINDER LEAK TEST. Repair or replace damaged components.*
3. Broken valve spring(s).
   - *Replace defective parts.*

PROCEDURES

VALVE COVER

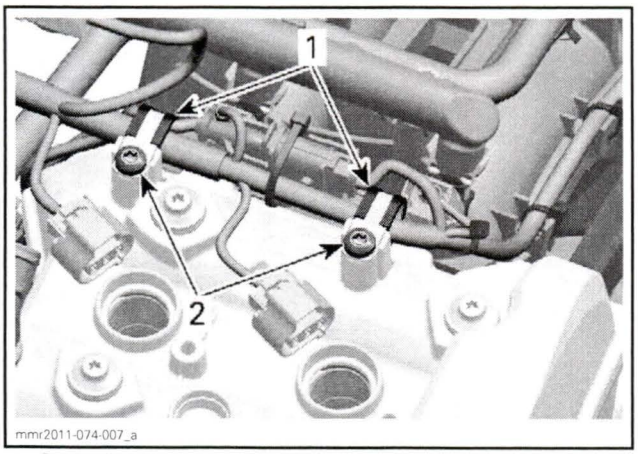
Valve Cover Removal (In Vehicle)

1. Remove the air intake silencer. Refer to *AIR INTAKE SYSTEM* subsection.
2. Unplug ignitions coils.
3. Remove ignition coils with gaskets.



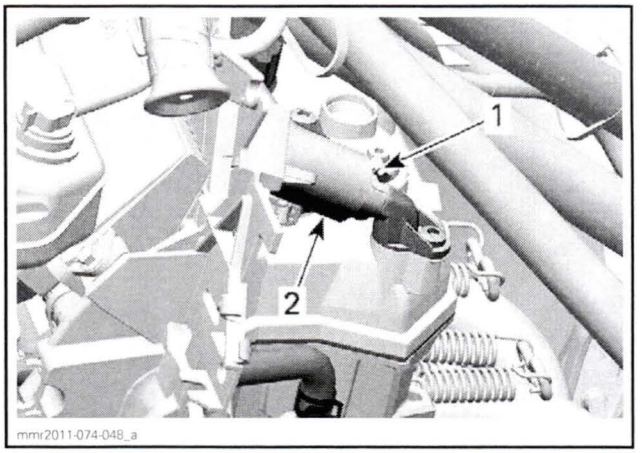
1. Retaining screws
2. Ignition coils
3. Gaskets

4. Remove screws securing the electrical harness to valve cover.



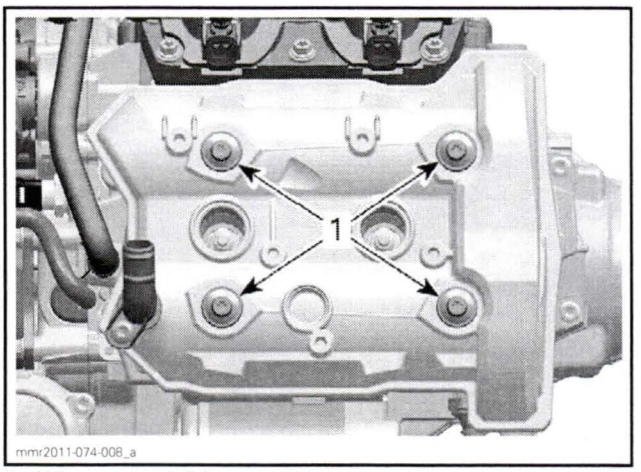
1. Cable clamps
2. Retaining screws

5. Unplug both fuel injectors.
6. Disconnect vent tube from the blow-by-connector.



1. Clamp
2. Vent tube

7. Remove valve cover retaining screws.

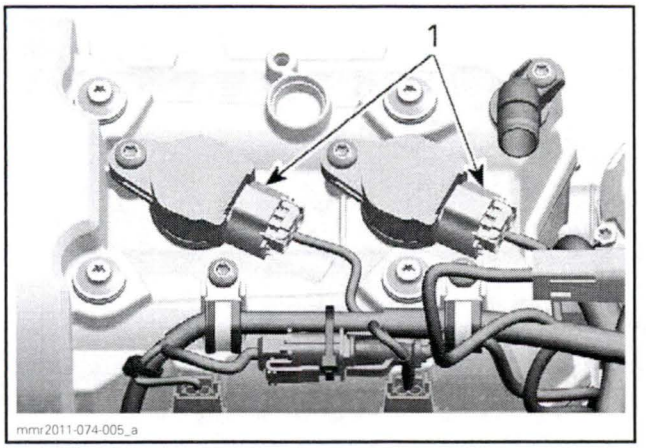


1. Valve cover retaining screws

8. Pull valve cover off the cylinder head.
9. Tilt the front of valve cover towards the exhaust manifold.
10. Remove valve cover by the LH side of the vehicle.

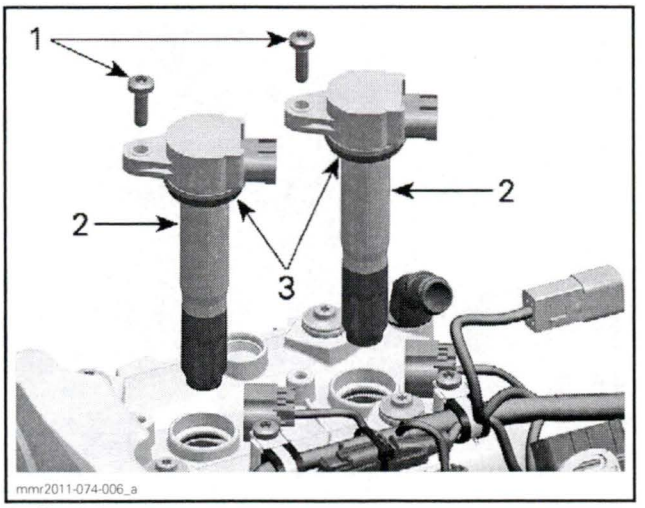
Valve Cover Removal (Engine Removed)

1. Unplug ignition coils.



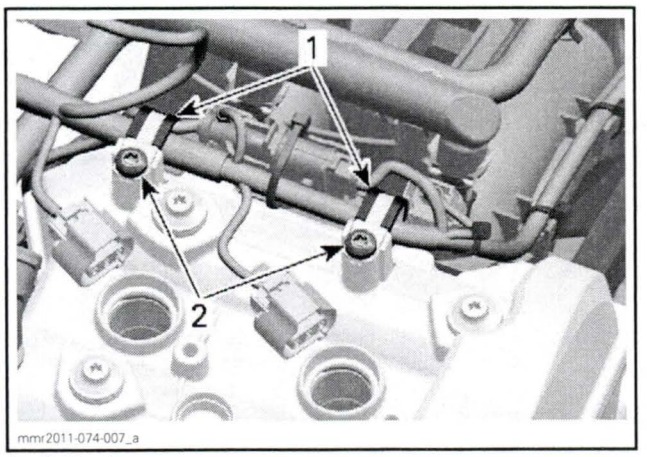
1. Ignition coil connectors

2. Remove ignition coils with gaskets.



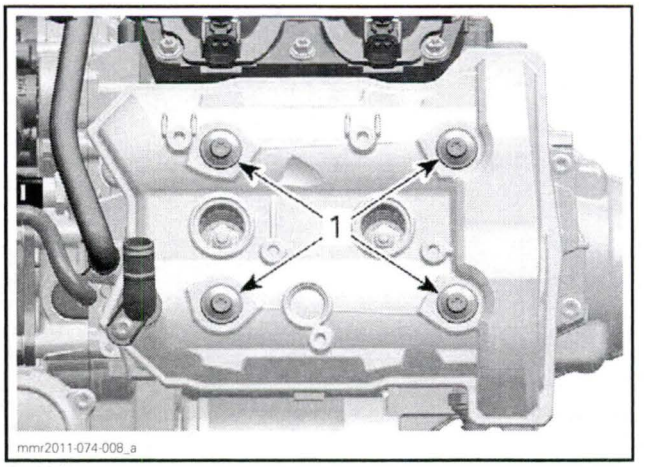
1. Retaining screws
2. Ignition coils
3. Gaskets

3. Remove screws securing the electrical harness to the valve cover.



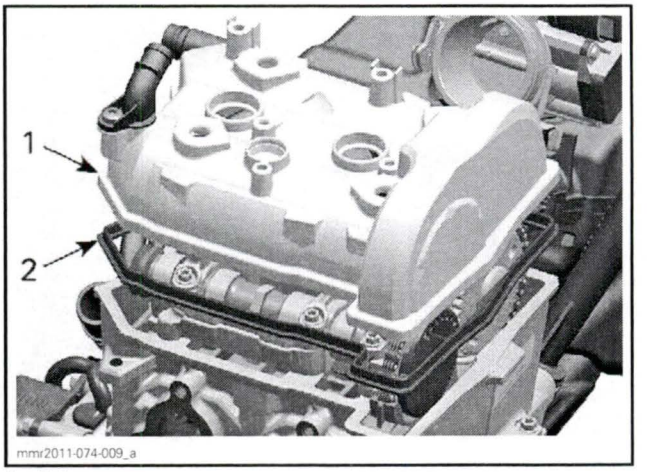
1. Cable clamps
2. Retaining screws

4. Remove valve cover retaining screws.



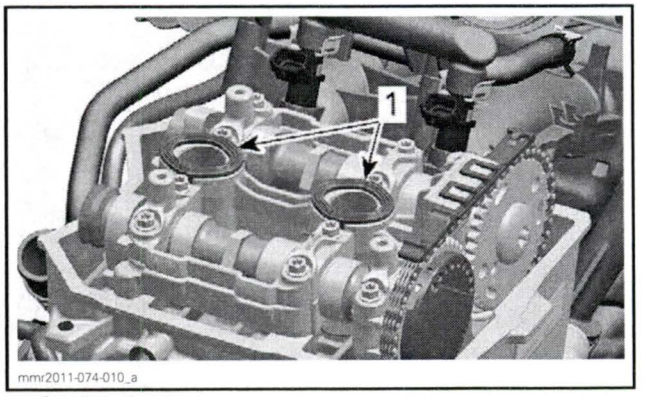
1. Valve cover screws

5. Remove the valve cover and its gasket.



1. Valve cover
2. Gasket

6. Remove valve cover small gaskets (spark plug tubes).



1. Small gaskets

Valve Cover Inspection

Check the valve cover for cracks or other damage.

Check if the valve cover gaskets are brittle, hard or otherwise damaged.

Replace defective parts.

Valve Cover Installation

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

1. Properly fit the small gaskets into the camshaft holder grooves.
2. Properly fit the large gasket into the valve cover groove.
3. Apply engine oil to the sealing surface of the V-ring.

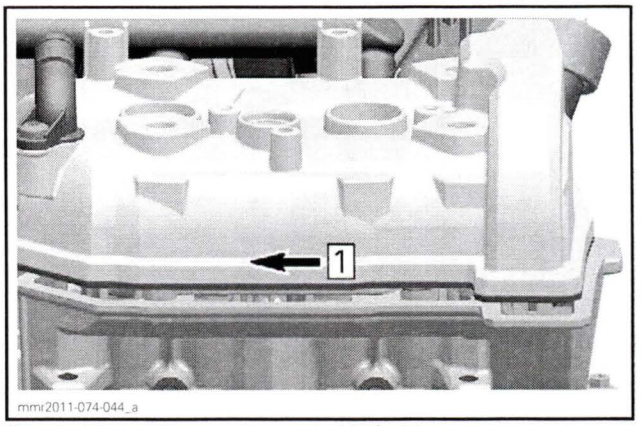


INSIDE VALVE COVER
1. Apply engine oil here

4. If engine is in the vehicle, slide the valve cover inside engine compartment by the LH side of the vehicle.
5. Install valve cover.

NOTICE **Adhere to the following procedure, otherwise damage to the V-ring will occur causing crankcase venting malfunction.**

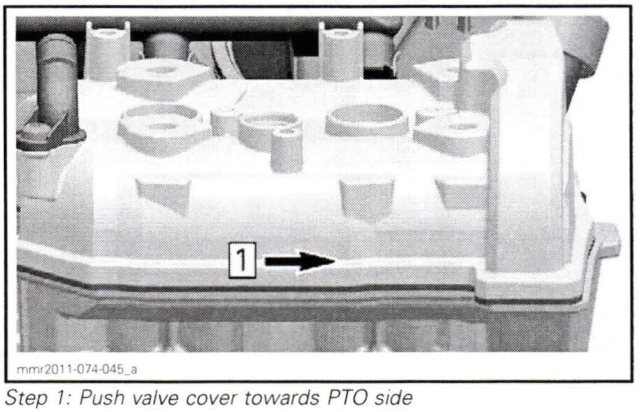
5.1 Move the valve cover towards the MAG side.



Step 1: Move valve cover towards MAG side

5.2 Put valve cover onto cylinder head.

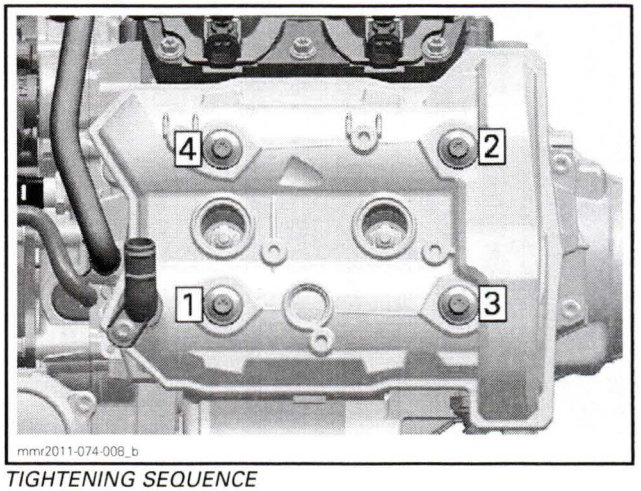
5.3 Push valve cover towards the PTO side to ensure that the V-ring properly seals on sealing surface inside the cover.



Step 1: Push valve cover towards PTO side

6. Install valve cover screws and tighten as per following sequence:

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



TIGHTENING SEQUENCE

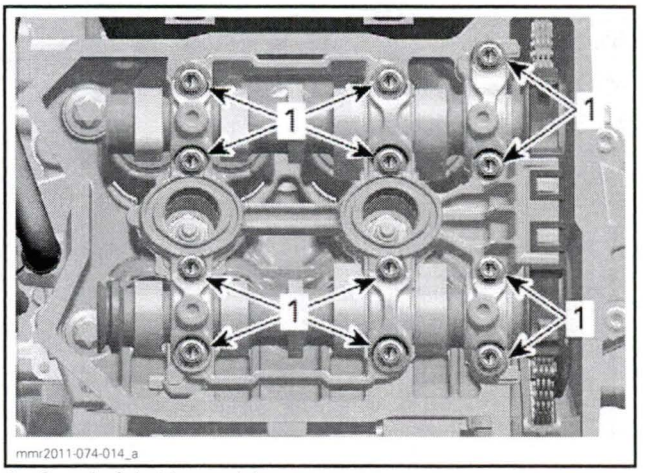
CAMSHAFTS

Camshaft Removal

1. Remove *VALVE COVER*, see procedure in this subsection.

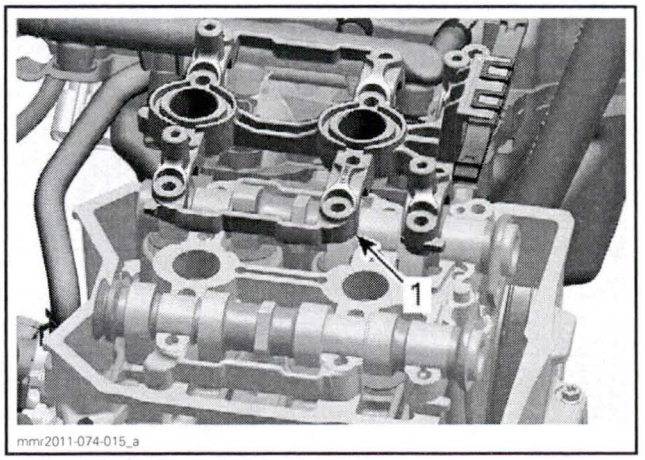
Refer to *TIMING CHAIN* subsection and remove:
- Timing chain tensioner
- Timing chain gears.

2. Remove camshaft holder retaining screws (12).



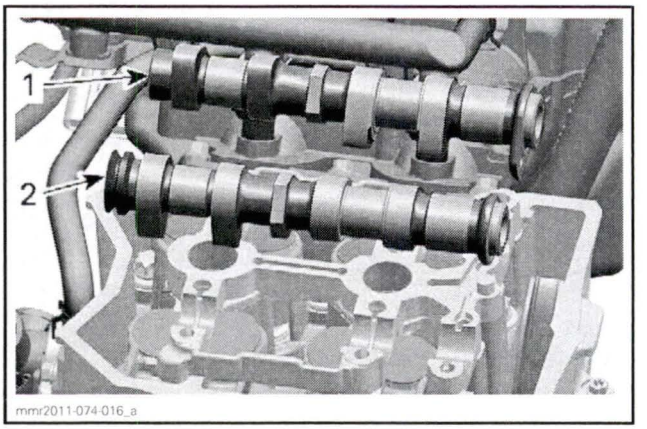
1. Camshaft holder retaining screws

3. Remove the camshaft holder upper half.



1. Upper half of camshaft holder

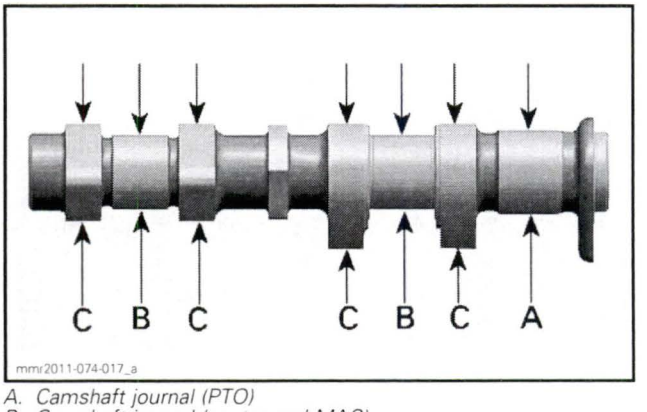
4. Remove camshafts.



1. Intake camshaft
2. Exhaust camshaft

Camshaft Inspection

1. Check each lobe and bearing journal for scoring, scuffing, cracks, or other signs of wear.
2. Check V-ring if it is brittle, hard or otherwise damaged.
3. Measure camshaft bearing journal diameter and lobe height, using a micrometer.



A. Camshaft journal (PTO)
B. Camshaft journal (center and MAG)
C. Camshaft lobes

CAMSHAFT JOURNAL DIAMETER	
PTO JOURNAL	
NEW	25.947 mm to 25.960 mm (1.0215 in to 1.022 in)
SERVICE LIMIT	25.92 mm (1.0205 in)
CENTER AND MAG JOURNAL	
NEW	22.947 mm to 22.960 mm (.9034 in to .9039 in)
SERVICE LIMIT	22.92 mm (.902 in)

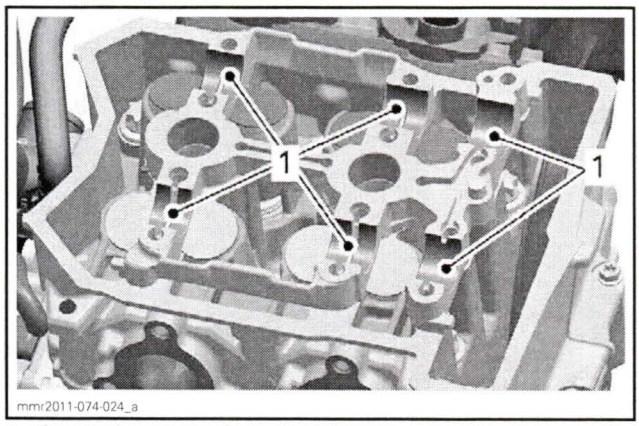
CAMSHAFT LOBE HEIGHT	
INTAKE CAMSHAFT	
NEW	38.70 mm to 38.90 mm (1.524 in to 1.531 in)
SERVICE LIMIT	38.67 mm (1.522 in)
EXHAUST CAMSHAFT	
NEW	39.40 mm to 39.60 mm (1.551 in to 1.559 in)
SERVICE LIMIT	39.38 mm (1.55 in)

Replace parts if necessary.

Camshaft Installation

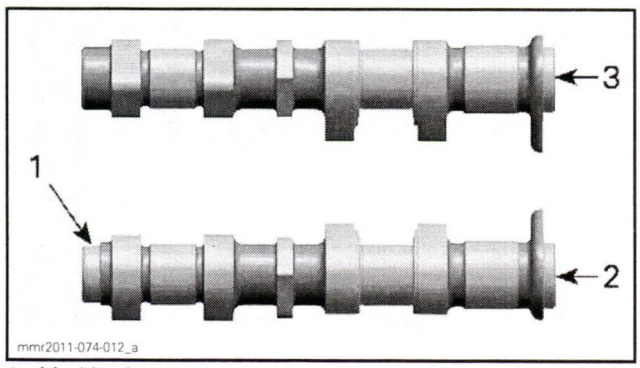
The assembly is the reverse of the removal procedure. However pay attention to the following details.

1. Before assembly of the camshafts apply engine oil on camshaft bearings.



1. Areas where to apply engine oil

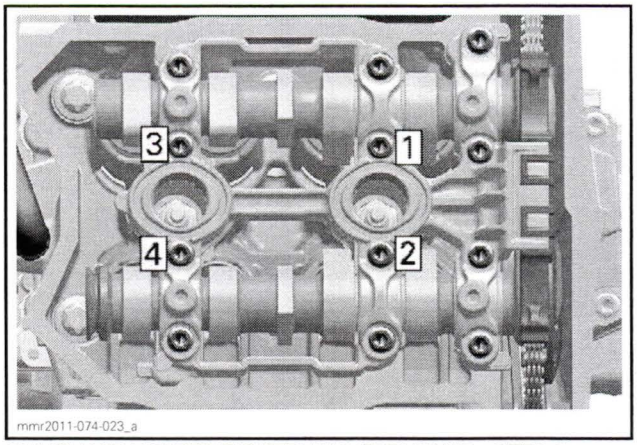
NOTE: The camshafts are not identical. Any mix-up of the components would lead to engine damage. The exhaust camshaft has a machined area on MAG side for the V-ring.



1. Machined area
2. Exhaust camshaft
3. Intake camshaft

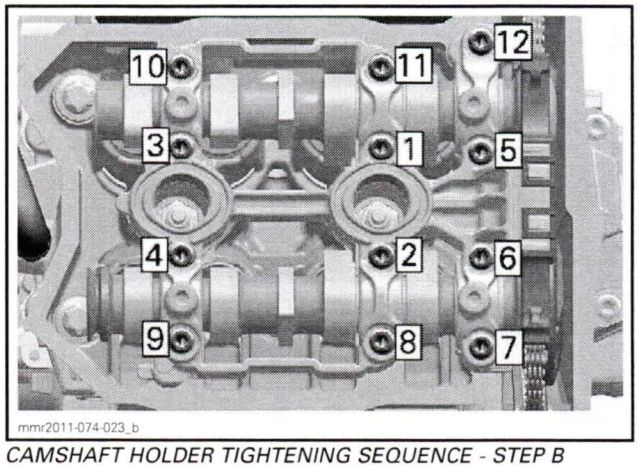
2. Apply engine oil on camshaft journal diameter.
3. Install the camshaft holder upper half, then tighten screws as per following sequence:

CAMSHAFT HOLDER TIGHTENING TORQUE	
STEP A	5 N•m ± 0.5 N•m (44 lbf•**in** ± 4 lbf•**in**)



CAMSHAFT HOLDER TIGHTENING SEQUENCE - STEP A

CAMSHAFT HOLDER TIGHTENING TORQUE	
STEP B	11 N•m ± 1 N•m (97 lbf•**in** ± 9 lbf•**in**)



CAMSHAFT HOLDER TIGHTENING SEQUENCE - STEP B

NOTE: After the reassembly of the camshafts is completed, check if camshafts can be turned easily.

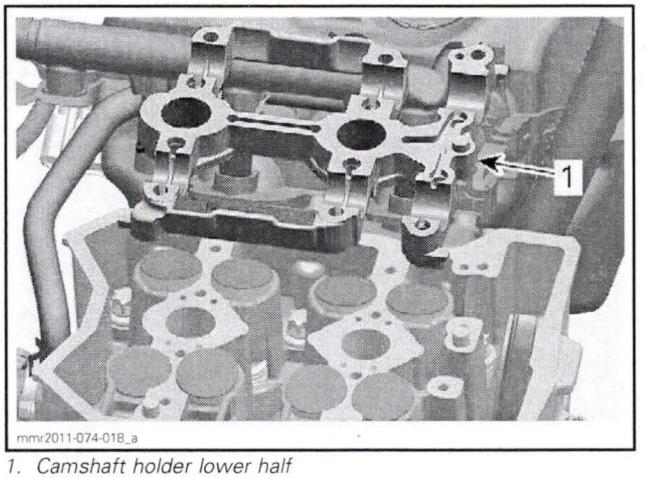
CAMSHAFT HOLDER

Camshaft Holder Removal

Remove camshaft, see procedure in this subsection.

Remove the camshaft holder lower half with gaskets from cylinder head.

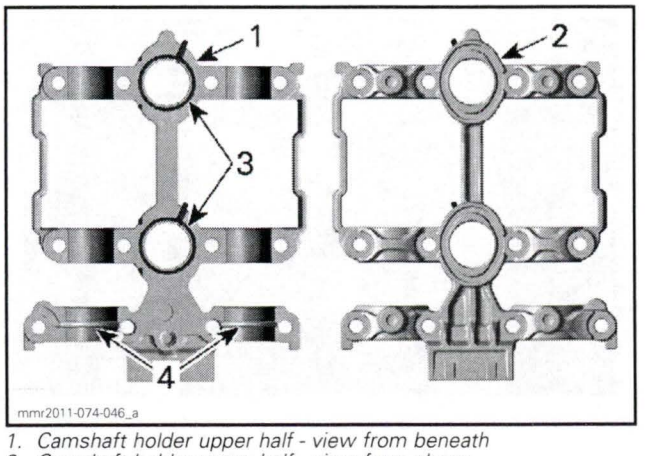
Remove gaskets from camshaft holder halves and discard gaskets.



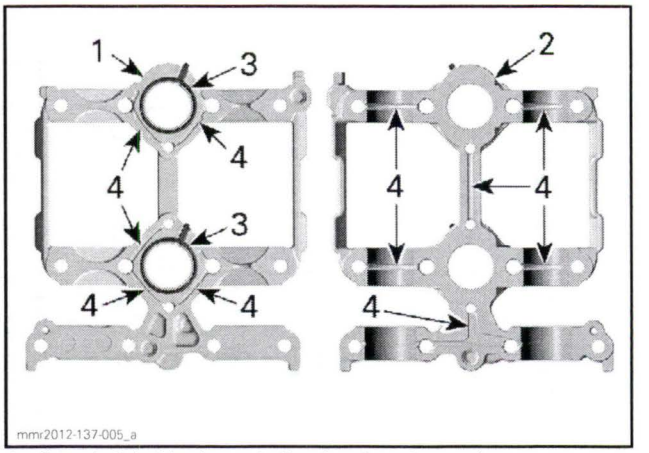
1. Camshaft holder lower half

Camshaft Holder Inspection

1. Check camshaft holder for scoring, scuffing, cracks, or other signs of wear.
2. Check gaskets if brittle hard or damaged. Replace if necessary
3. Make sure oil orifices are not clogged. Blow them out with pressurized air.



1. Camshaft holder upper half - view from beneath
2. Camshaft holder upper half - view from above
3. Gaskets
4. Oil orifices



1. Camshaft holder lower half - view from beneath
2. Camshaft holder lower half - view from above
3. Gaskets
4. Oil orifices

Replace parts if necessary.

Camshaft Holder Installation

Install camshaft holder lower half.

Continue procedure as explained in *CAMSHAFT INSTALLATION* in this subsection.

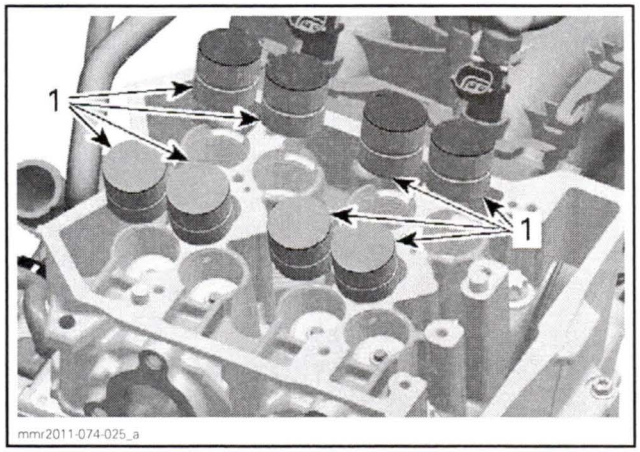
HYDRAULIC VALVE LIFTERS

Hydraulic Valve Lifter Removal

NOTE: Hydraulic valve lifter are maintenance free.

1. Remove valve cover, see procedure in this subsection.
2. Remove timing chain gears, refer to *TIMING CHAIN* subsection.
3. Remove camshafts, see procedure in this subsection.
4. Remove camshaft holder, see procedure in this subsection.
5. Pull hydraulic valve lifter off the cylinder head.

NOTE: When disassembling the hydraulic valve lifter, it is strongly recommended to note their original position.



1. Hydraulic valve lifter

Hydraulic Valve Lifter Inspection

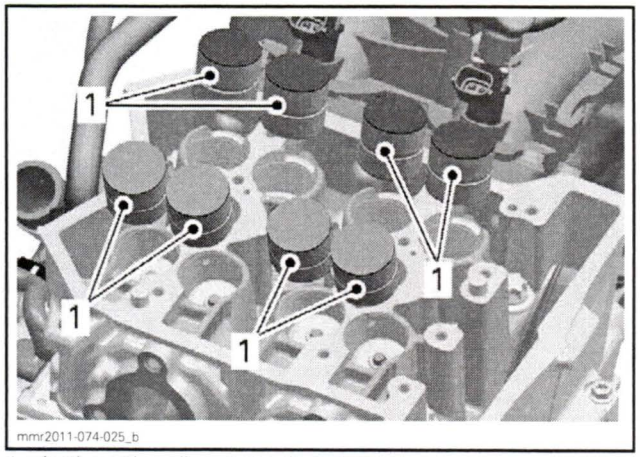
1. Check surface of hydraulic valve lifter for scoring or other damage.
2. Measure valve lifter diameter. Replace if out of specification.

HYDRAULIC VALVE LIFTER	
NEW	28.354 mm to 28.370 mm (1.1163 in to 1.1169 in)
SERVICE LIMIT	28.34 mm (1.1157 in)
HYDRAULIC VALVE LIFTER RADIAL CLEARANCE	
SERVICE LIMIT	0.100 mm (.0039 in)

Hydraulic Valve Lifter Installation

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

1. Apply engine oil on the outside diameter of the hydraulic valve lifter.

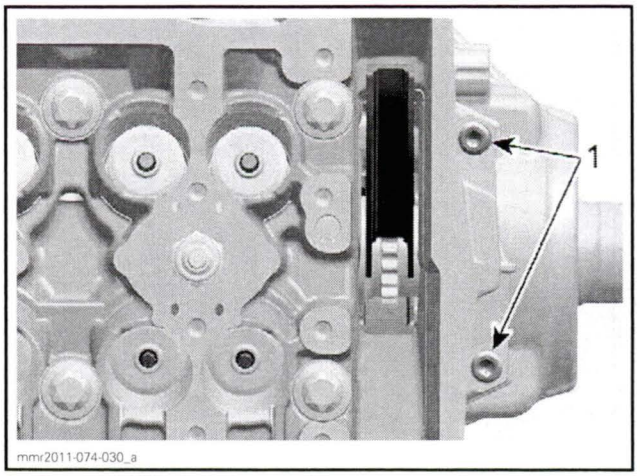


1. Apply engine oil on outer diameter

CYLINDER HEAD

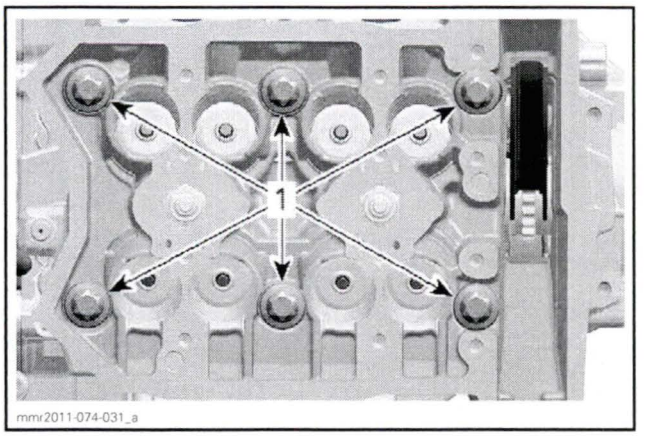
Cylinder Head Removal

1. Remove engine from the vehicle. Refer to *ENGINE REMOVAL AND INSTALLATION* subsection.
2. Remove intake manifold. Refer to *AIR INTAKE SYSTEM* subsection.
3. Remove valve cover. See procedure in this subsection.
4. Remove chain tensioner. Refer to *TIMING CHAIN REMOVAL* subsection.
5. Remove the camshaft timing gears. Refer to *TIMING CHAIN* subsection.
6. Remove camshafts. See procedure in this subsection.
7. Remove camshaft holder. See procedure in this subsection.
8. Remove hydraulic valve lifters. See procedure in this subsection.
9. Remove M6 cylinder head screws.



1. Remove M6 cylinder head screws

10. Remove and discard M9 cylinder head screws.

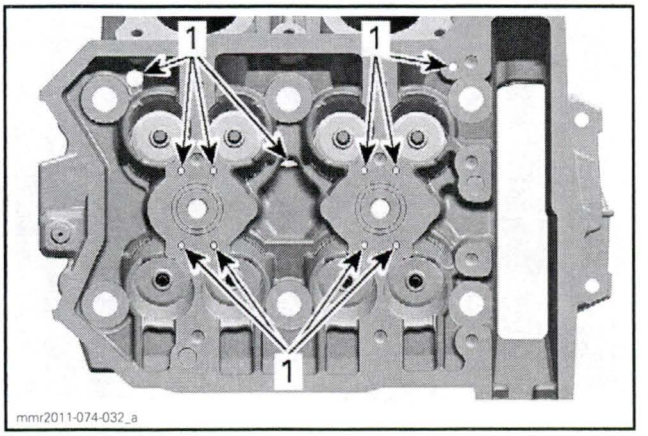


1. Remove M9 cylinder head screws

11. Pull cylinder head off the cylinder block.
12. Remove and discard cylinder head gasket.

Cylinder Head Cleaning

1. Remove carbon deposits from combustion chambers, exhaust ports and piston tops.
2. Clean cylinder head, especially cylinder head screw surface from oil spillage.
3. Blow out the oil orifices with pressurized air and make sure they are not clogged.



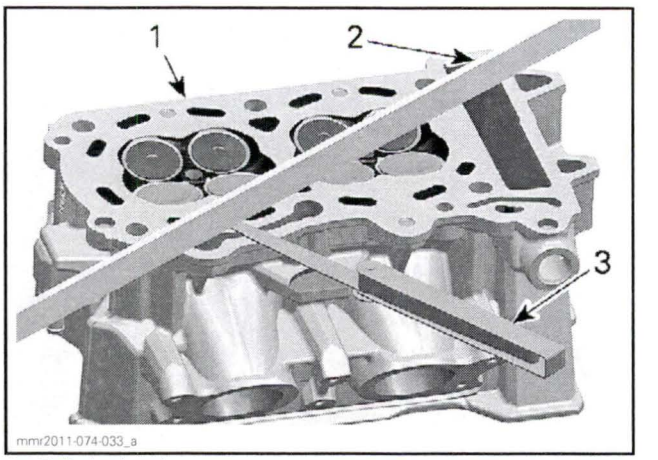
1. Oil orifices

Cylinder Head Inspection

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

Check cylinder head mating surface for flatness using a straight edge.

Check hydraulic valve lifter bores for scoring or other damage, if so, replace cylinder head.



1. Cylinder head
2. Straight edge
3. Feeler gauge

Check cylinder head warpage.

CYLINDER HEAD WARPAGE	
Maximum	0.15 mm (.0059 in)

If warpage exceeds specification, resurface the cylinder head as follows.

Use a 400 - 600 grit wet sandpaper on a surface plate and gently grind off the mating surface.

NOTE: To ensure an even surface, rotate cylinder head several times during resurfacing.

Replace cylinder head, if resurfacing fails.

Cylinder Head Installation

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

1. Install a NEW cylinder head gasket.

NOTICE Each installation of the cylinder head requires a NEW cylinder head gasket. Using a gasket twice would cause engine damage.

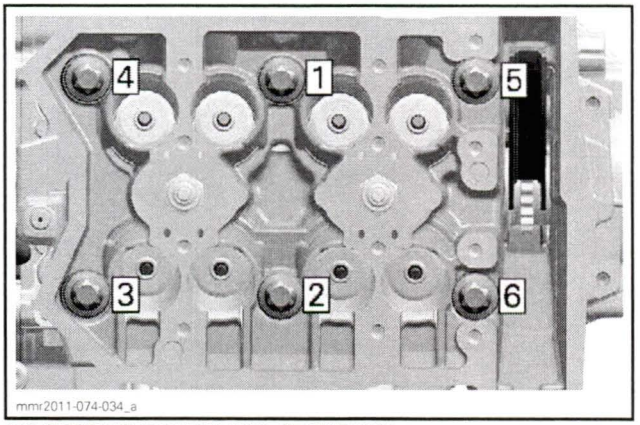
2. Install cylinder head on the cylinder block.
3. Install NEW M9 cylinder head screws.

NOTICE This assembly uses stretch screws. Always use NEW screws and strictly adhere to the tightening procedure.

4. Tighten cylinder head screws as follows:

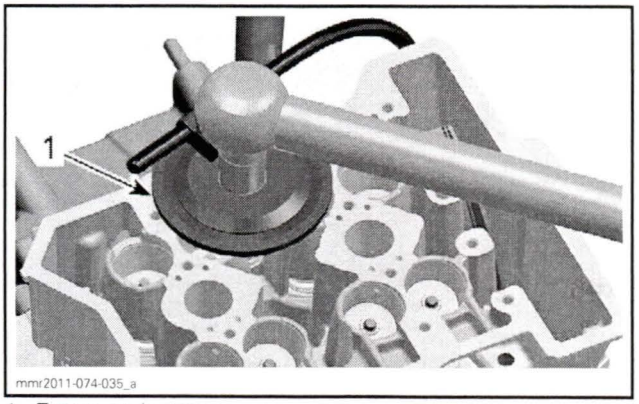
NOTE: Always perform step 1 on all M9 cylinder head screws before going to the next step.

CYLINDER HEAD M9 SCREWS TIGHTENING PROCEDURE	
FIRST STEP	20 N•m ± 2 N•m (15 lbf•ft ± 1 lbf•ft)
SECOND STEP	Additional 120° ± 5°



M9 SCREWS TIGHTENING SEQUENCE

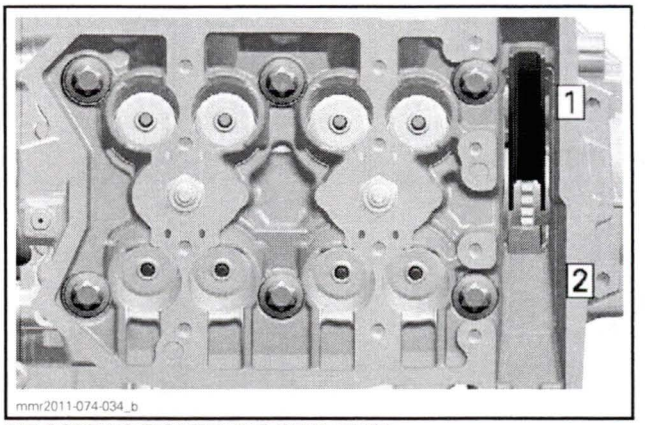
NOTE: Use a torque angle gauge to carry out the **second step**.



1. Torque angle gauge

5. Install M6 screws. Tighten as follows.

TIGHTENING TORQUE	
M6 cylinder head screws	11 N•m ± 1 N•m (97 lbf•**in** ± 9 lbf•**in**)



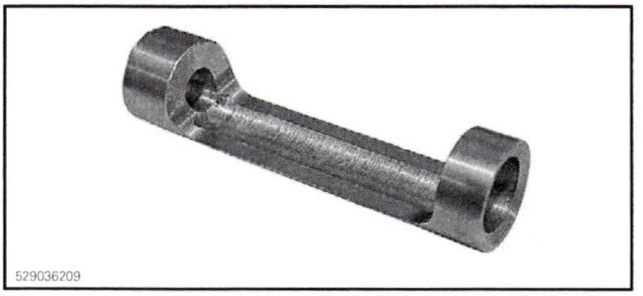
M6 SCREWS TIGHTENING SEQUENCE

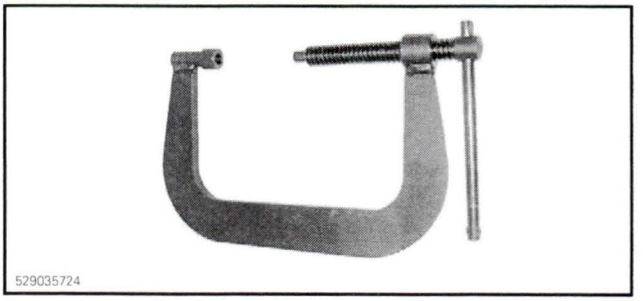
VALVE SPRINGS

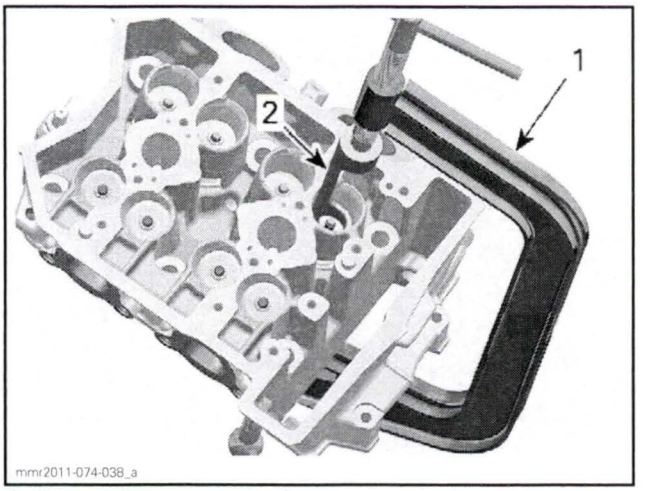
Valve Spring Removal

1. Remove *CYLINDER HEAD*, see procedure in this subsection.
2. Compress valve spring.

REQUIRED TOOLS
VALVE SPRING COMPRESSOR (P/N 529 035 724)
VALVE SPRING COMPRESSOR CUP (P/N 529 036 209)

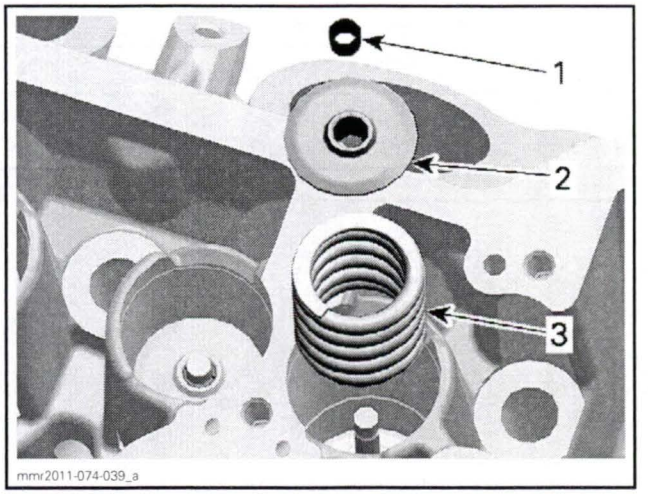






1. Valve spring compressor clamp
2. Valve spring compressor cup

3. Remove valve cotters.
4. Withdraw valve spring compressor tools.
5. Remove valve spring retainer and valve spring.

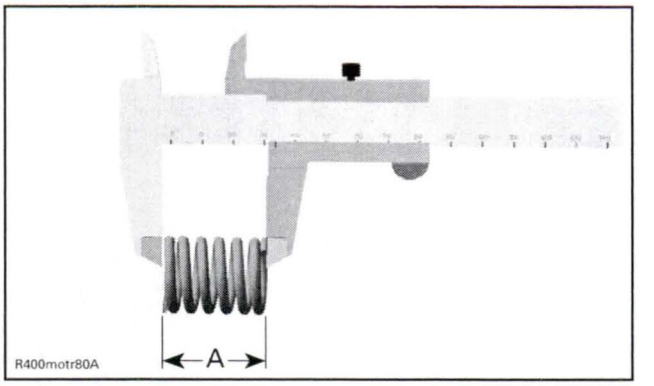


1. Valve cotters
2. Valve spring retainer
3. Valve spring

NOTE: Identify the position of each part very carefully, so it can be reinstalled in its original place.

Valve Spring Inspection

1. Check valve spring for rust, corrosion or other visible damage.
2. Check valve spring free length and straightness.



A. Spring free length

VALVE SPRING FREE LENGTH	
NEW	31.35 mm (1.2343 in)
SERVICE LIMIT	29.5 mm (1.1614 in)

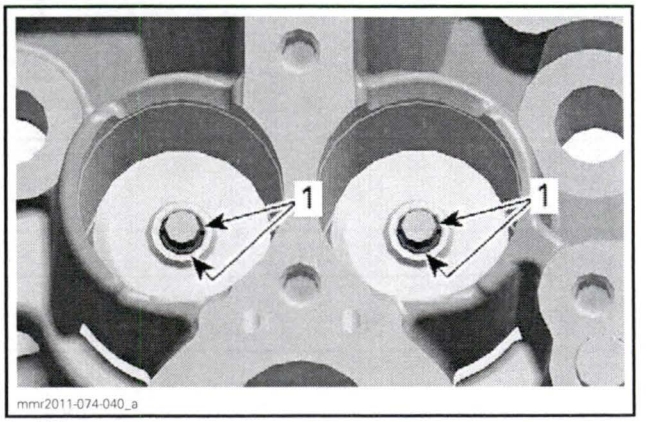
Replace valve spring, if out of specification.

Valve Spring Installation

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

NOTE: Ensure to reinstall all parts in their original position as marked during removal.

1. Apply some grease on valve cotters, so that they remain in place while releasing the valve spring.
2. Make sure valve cotters are properly engaged into valve stem groove.



1. Valve cotters

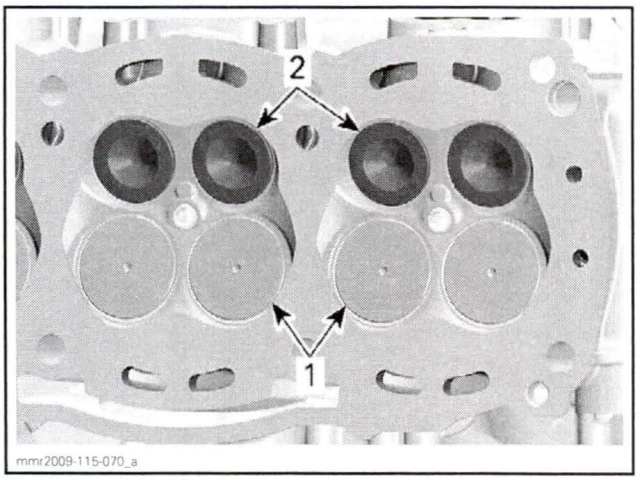
3. After spring is installed, ensure it is properly locked by lightly tapping on valve stem end with a soft hammer so that valve opens and closes a few times.

NOTICE **Improperly locked valve spring will cause severe engine damage and hitting the valve stem end with excessive force could damage the valve.**

VALVES

Valve Removal

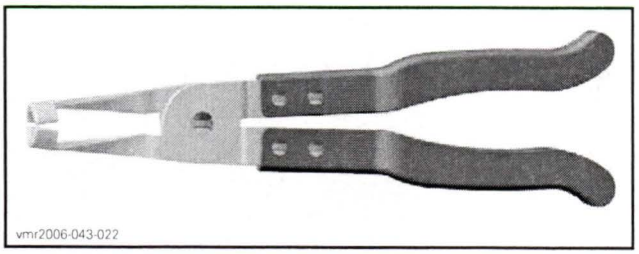
1. Remove *VALVE SPRING*, see procedure in this subsection.
2. Push on the valve stem, then pull valves out of cylinder head.

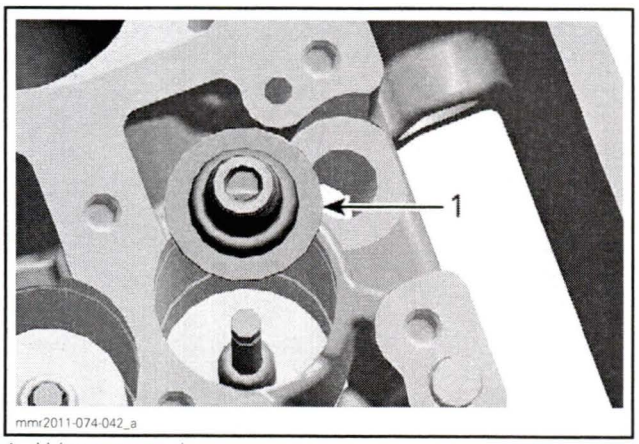


1. Intake valves 29 mm
2. Exhaust valves 25 mm

3. Remove and discard valve stem seal with special pliers.

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



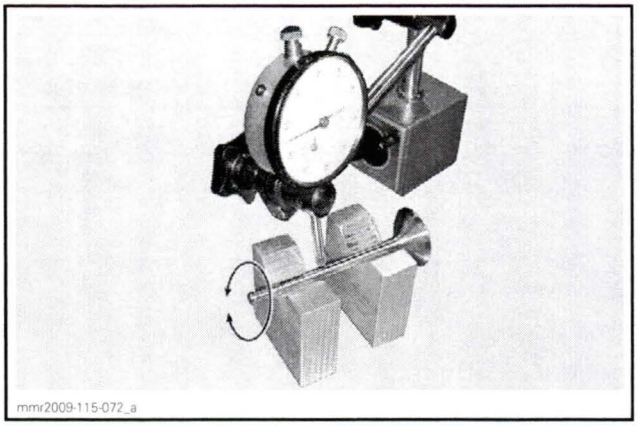


1. Valve stem seal

NOTE: Identify the position of each part very carefully, so it can be reinstalled in its original place.

Valve Inspection

Inspect valve surface, check for abnormal stem wear and bending.

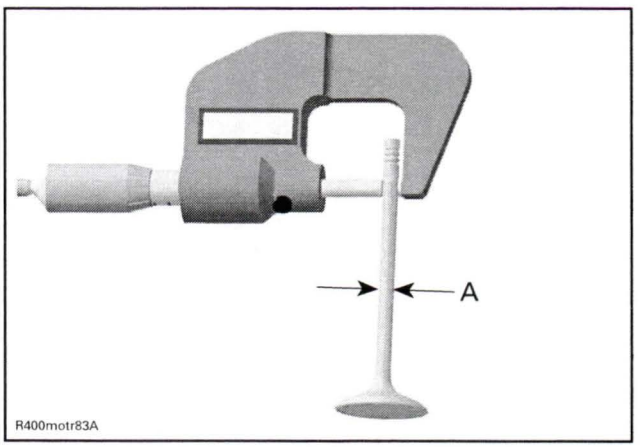


VALVE OUT OF ROUND INTAKE AND EXHAUST VALVE	
NEW	0.005 mm (.0002 in)
SERVICE LIMIT	0.06 mm (.0024 in)

Replace valve if out of specification.

Valve Stem and Valve Guide Clearance

1. Measure valve stem at three places, using a micrometer.



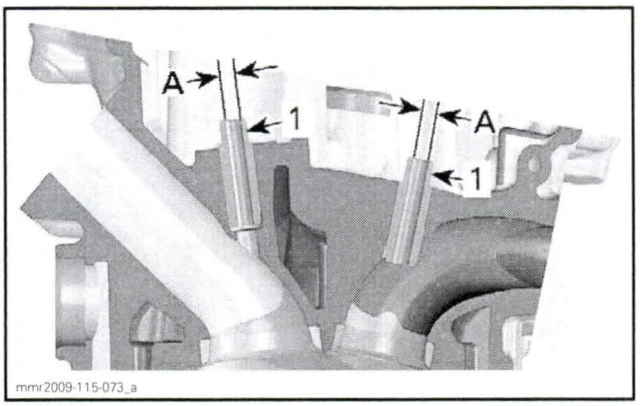
A. Valves stem diameter

VALVE STEM DIAMETER	
INTAKE VALVE	
NEW	4.958 mm to 4.972 mm (.1952 in to .1957 in)
SERVICE LIMIT	4.94 mm (.1945 in)
EXHAUST VALVE	
NEW	4.956 mm to 4.970 mm (.1951 in to .1957 in)
SERVICE LIMIT	4.94 mm (.1945 in)

Replace valve if stem is out of specification or if its surface is damaged or worn.

2. Measure valve guide inner diameter, using a small bore gauge.

NOTE: Clean valve guide from carbon deposits before measuring.

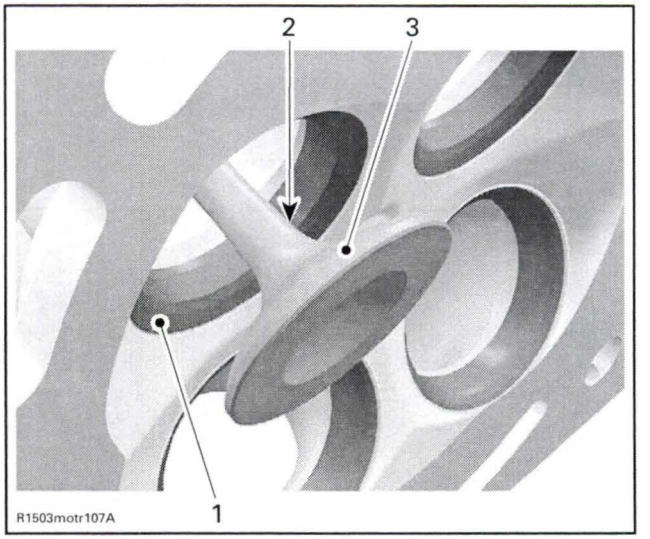


1. Valve guides
A. Valve guide inner diameter

VALVE GUIDE INNER DIAMETER	
NEW	5.000 mm to 5.012 mm (.1969 in to .1973 in)
SERVICE LIMIT	5.05 mm (.1988 in)

Replace cylinder head, if valve guide is out of specification.

Valve Face and Seat



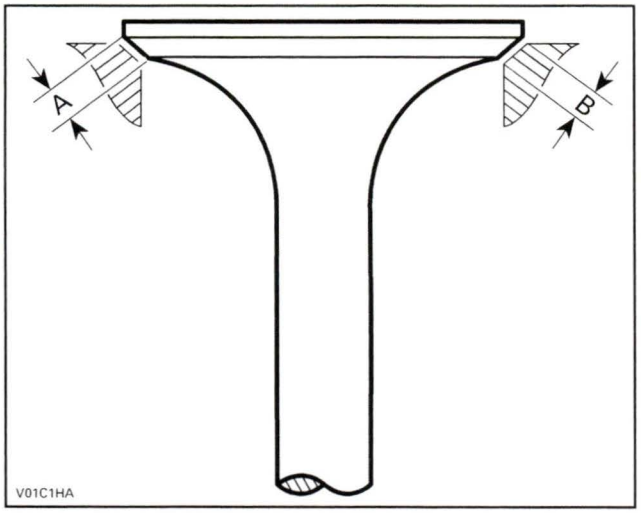
TYPICAL
1. Valve seat
2. Exhaust valve contaminated area
3. Valve face (contact surface to valve seat)

1. Check valve face and seat for burning, pitting and other signs of damage.
2. Check if valve seats properly in cylinder head. Proceed as follows.
   2.1 Apply some lapping compound on valve face and work valve on its seat with a lapping tool.

REQUIRED TOOL
SNAP-ON VALVE HOLDER (P/N VL2)

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

   2.2 Repeat procedure until valve seat and valve face fit together.
3. Measure valve seat contact width, using a caliper.



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

VALVE SEAT CONTACT WIDTH	
INTAKE VALVE	
NEW	1.05 mm to 1.35 mm (.041 in to .053 in)
SERVICE LIMIT	1.7 mm (.067 in)
EXHAUST VALVE	
NEW	1.25 mm to 1.45 mm (.049 in to .057 in)
SERVICE LIMIT	1.8 mm (.0709 in)

Replace parts if out of specification.

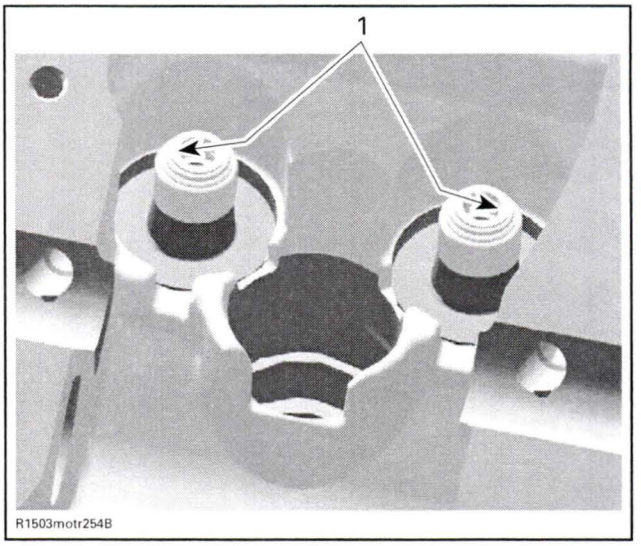
Valve Installation

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

NOTE: Ensure to reinstall all parts in their original position as marked during removal.

1. Install a NEW valve stem seal whenever valve is removed.
2. Apply engine oil on valve stem and carefully slide through cylinder head and valve stem seal.

NOTICE Be careful when passing the valve stem through the sealing lip of the seal.



TYPICAL
1. Sealing lips of valve stem seal

3. Install *VALVE SPRING*. See procedure in this subsection.
4. Install all other removed parts.

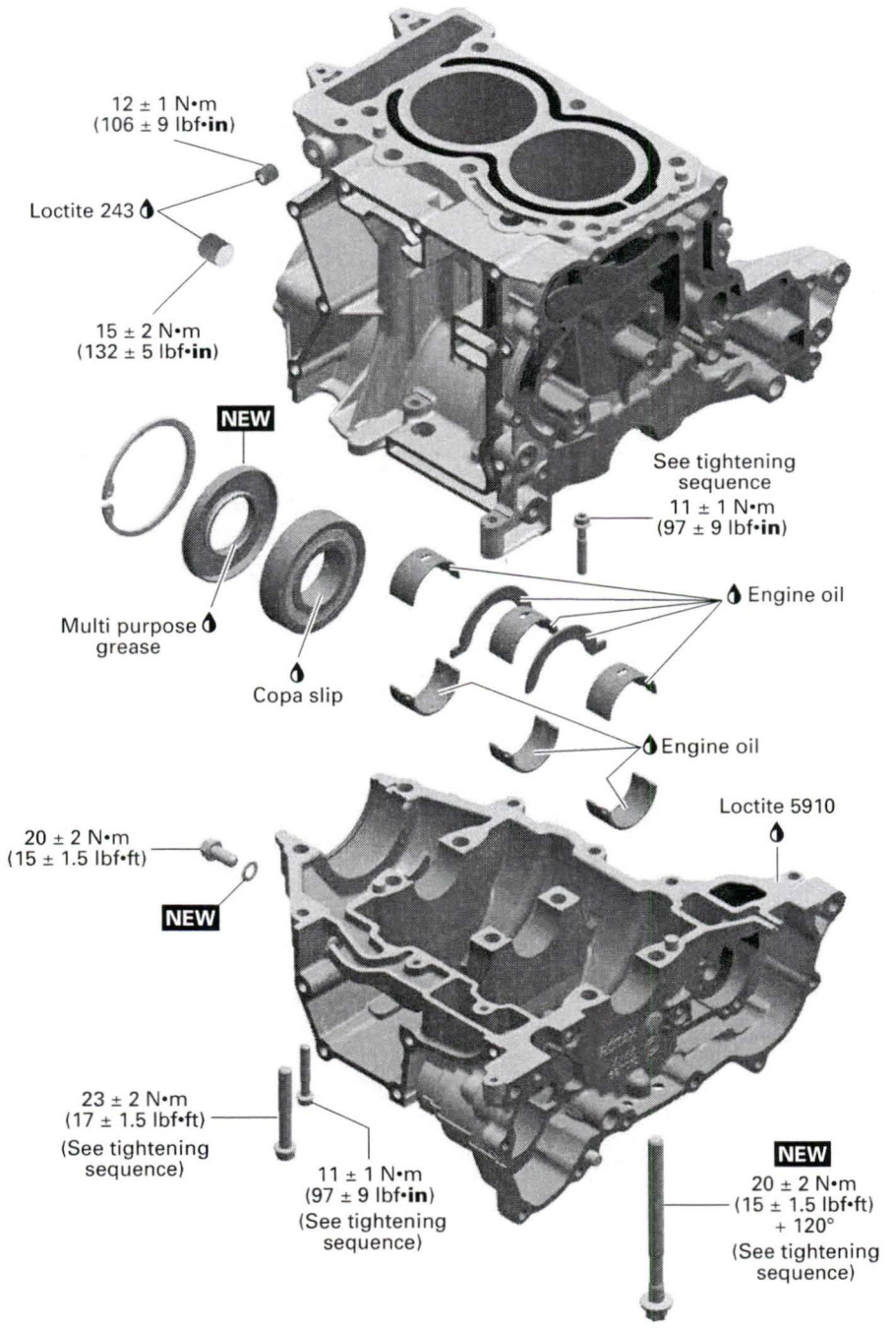
CYLINDER BLOCK

SERVICE TOOLS

Description	Part Number	Page
CRANKSHAFT LOCKING TOOL	529 036 205	362
CRANKSHAFT PROTECTOR (PTO)	420 876 552	354
PISTON CIRCLP INSTALLER	529 036 207	368
PISTON RING COMPRESSOR	529 036 208	370
PTO OIL SEAL INSTALLER	529 036 216	355–356

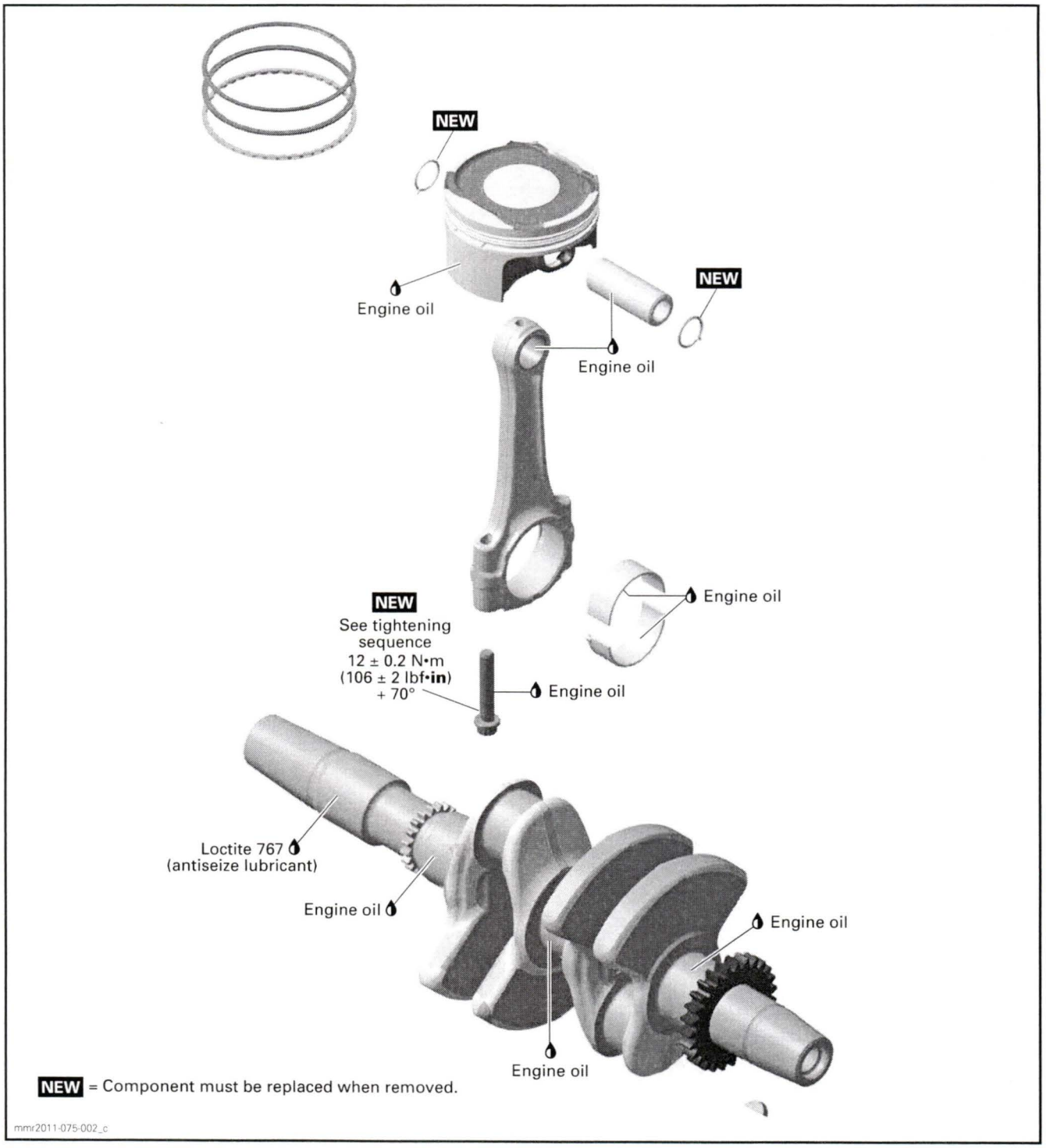
SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 5910	293 800 081	360
LOCTITE CHISEL (GASKET REMOVER)	413 708 500	359
SUPER LUBE GREASE	293 550 030	355



NEW = Component must be replaced when removed.

mmr2011-075-001_b


NEW
Engine oil
NEW
Engine oil
NEW
See tightening sequence
12 ± 0.2 N•m
(106 ± 2 lbf•in)
+ 70°
Engine oil
Engine oil
Loctite 767
(antiseize lubricant)
Engine oil
Engine oil
Engine oil
NEW = Component must be replaced when removed.
mmr2011-075-002_c

GENERAL

When disassembling parts that are duplicated in the engine, (e.g.: pistons, connecting rods etc.), it is strongly recommended to note their position and to keep the parts of the same assembly as a "group". If you find a defective component, it would be much easier to find the cause of the failure. Since parts were broken-in during engine operation, they will maintain their matched fit when reassembled together within their "group".

TROUBLESHOOTING

Always check for fault codes. If a fault code is detected, service the fault code first. Refer to *DIAGNOSTIC AND FAULT CODES* subsection.

UNUSUAL ENGINE NOISE OR VIBRATIONS

1. Heavy wear on plain bearings.
   - *Check radial play of plain bearings. Replace if out of specification.*
2. Crankshaft axial play out of specification.
   - *Measure crankshaft axial play. If crankshaft axial play is out of specification, replace thrust washers.*
3. Connecting rod axial play out of specification.
   - *Measure connecting rod axial play on crankshaft. Replace connecting rod or crankshaft if out of specification.*
4. Connecting rod screws got loose.
   - *Replace damaged components and retighten screws with the recommended torque.*
5. Crankshaft PTO ball bearing is worn.
   - *Separate crankcase and check ball bearing for excessive play. Replace ball bearing if necessary.*

BLUE SMOKE IN THE EXHAUST

1. Oil scraper rings worn out.
   - *Replace piston rings.*

ENGINE SUDDENLY TURNS OFF (POOR IDLING)

1. Piston rings worn out.
   - *Replace piston rings.*
2. Piston/cylinder clearance out of specification.
   - *Check piston/cylinder clearance. Replace if out of specification.*
3. Melted or broken piston.
   - *Replace piston and cylinder block if necessary.*

PROCEDURES

PTO OIL SEAL

PTO Oil Seal Replacement

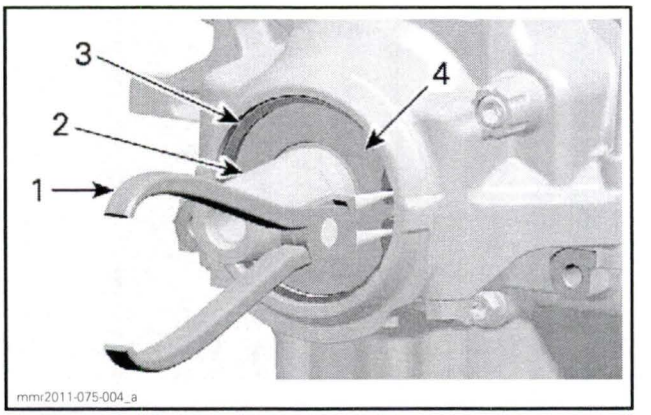
NOTE: To replace the PTO oil seal, it is not necessary to remove engine from the vehicle.

PTO Oil Seal Access

Remove drive pulley. Refer to *DRIVE PULLEY (eDRIVE)* subsection.

PTO Oil Seal Removal

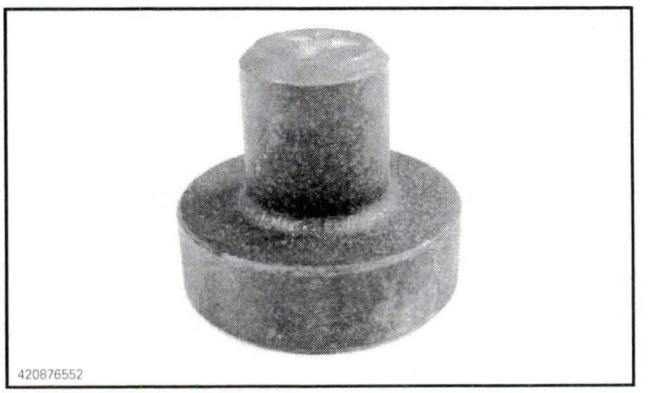
1. Use pliers to remove retaining ring.

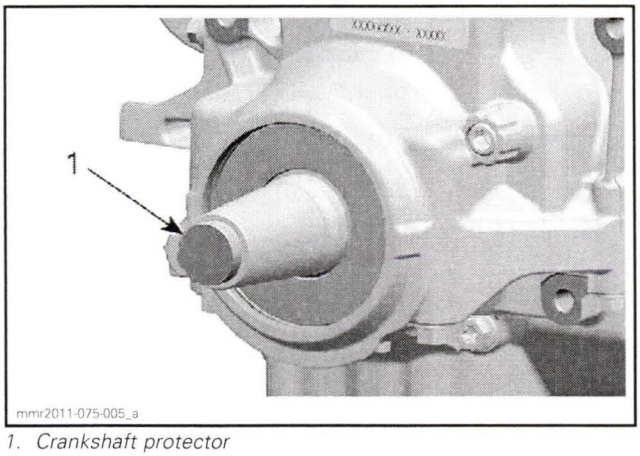


1. *Pliers*
2. *Crankshaft PTO journal*
3. *Retaining ring*
4. *Oil seal*

2. Protect crankshaft.

REQUIRED TOOL
CRANKSHAFT PROTECTOR (PTO) (P/N 420 876 552)

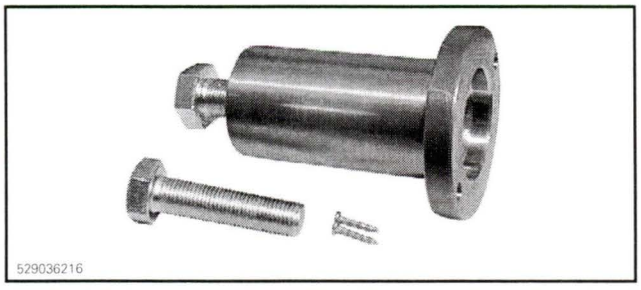




1. Crankshaft protector

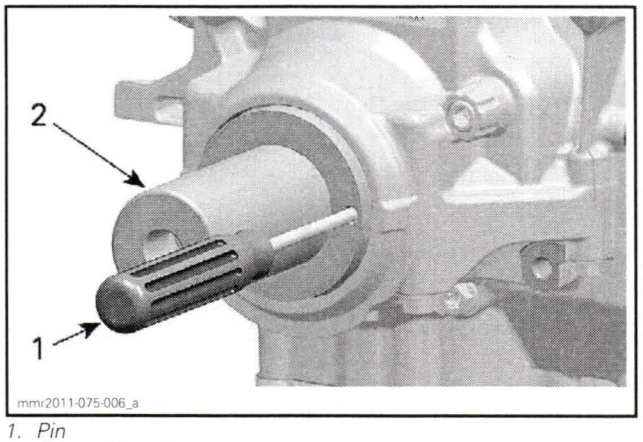
3. Install the oil seal installer over the crankshaft end PTO.

REQUIRED TOOL
PTO OIL SEAL INSTALLER (P/N 529 036 216)



4. Carefully punch two holes into the old oil seal using an suitable pin.

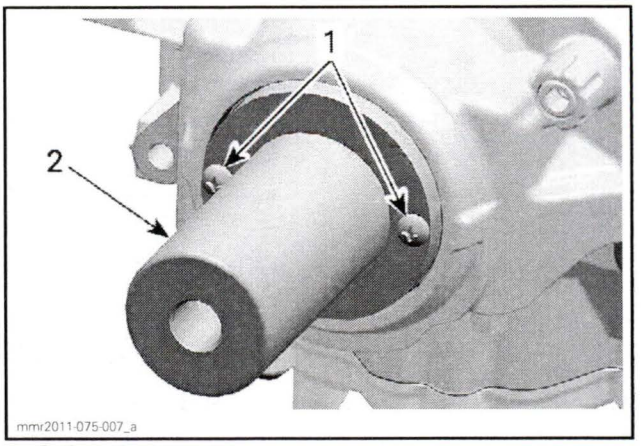
NOTE: The holes punched into the old seal must allow the self tapping screws to bite into the seal.



1. Pin
2. Oil seal installer

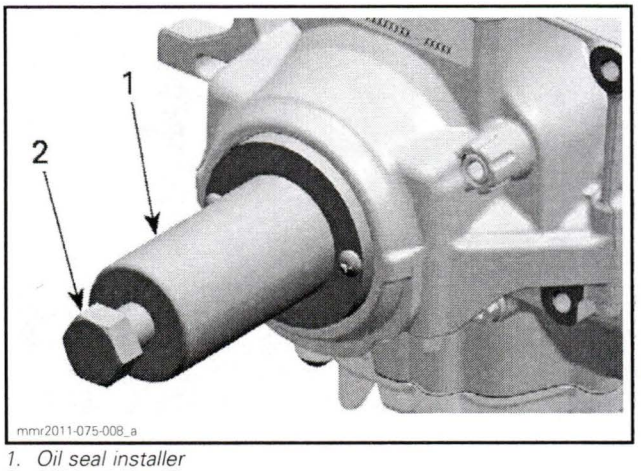
5. Screw the provided self tapping screws through the seal installer holes and into the oil seal.

NOTICE If self tapping screws other than the ones provided are used, their length must not exceed 16 mm (5/8 in).



1. Self tapping screws
2. Oil seal installer

6. Thread the provided M16 x 1.5 x 40 mm screw into the seal installer, then pull the old seal off the crankcase by screwing in.



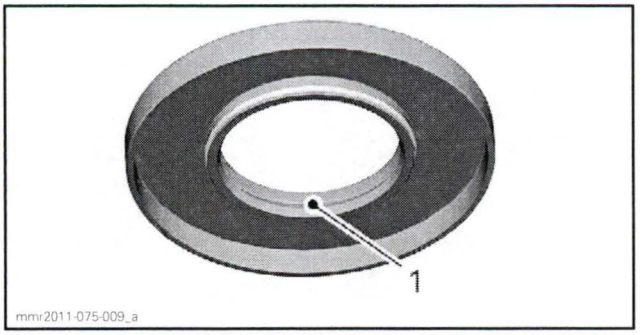
1. Oil seal installer
2. M16 x 1.5 x 40 mm screw

7. Remove crankshaft protector and clean oil seal area.

PTO Oil Seal Installation

NOTE: Check the oil seal running surface of crankshaft for grooves, before installation of NEW oil seal.

1. Lubricate sealing lip of oil seal with SUPER LUBE GREASE (P/N 293 550 030).

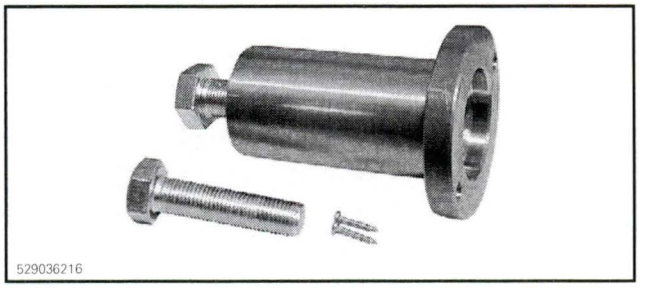


1. Lubricate inner sealing lip

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

2. Place the NEW oil seal on crankshaft and install it.

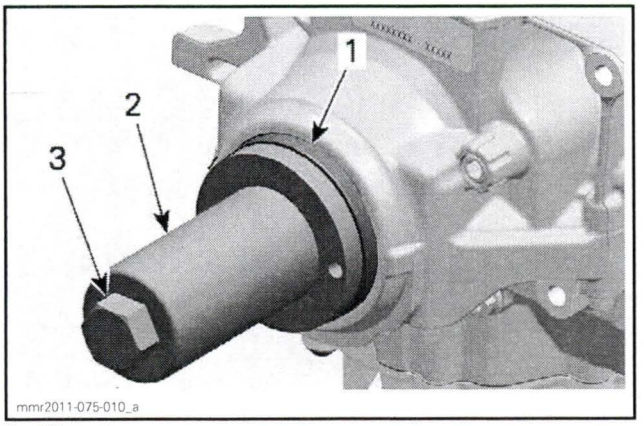
REQUIRED TOOL
PTO OIL SEAL INSTALLER (P/N 529 036 216)



2.1 Install the oil seal installer over the crankshaft PTO end.

2.2 Thread the provided M14 x 1.5 x 55 mm screw in the crankshaft.

2.3 Screw in to push the seal in place.



1. Oil seal
2. Oil seal installer
3. M14 x 1.5 x 55 mm hex. screw

3. Install retaining ring.

CYLINDER BLOCK

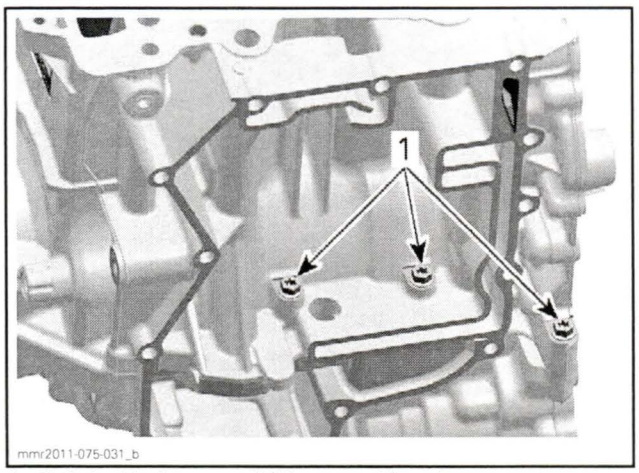
Cylinder Block Disassembly

1. Remove engine from the vehicle. Refer to *ENGINE REMOVAL AND INSTALLATION* subsection.
2. Refer to *PERIODIC MAINTENANCE PROCEDURES* and drain engine oil.
3. Refer to *CYLINDER HEAD* subsection and remove:
   - Ignition coils
   - Valve cover
   - Spark plugs.
4. Lock crankshaft, refer to *CRANKSHAFT LOCKING PROCEDURE* in this subsection.
5. Remove air intake manifold. Refer to *AIR INTAKE SYSTEM* subsection.
6. Refer to *COOLING SYSTEM* subsection and remove:
   - Water pump housing
   - Thermostat
   - Water pump drive gear.
7. Refer to *LUBRICATION SYSTEM* subsection and remove:
   - Oil tank
   - Oil cooler
   - Oil pressure regulator
   - Oil pump drive gears and oil pumps
   - Oil sump cover
   - Oil strainers.
8. Refer to *MAGNETO AND STARTER* subsection and remove:
   - Magneto cover
   - Rotor
   - Starter drive gears
   - Electric starter.
9. Refer to *TIMING CHAIN* subsection and remove:
   - Timing chain tensioner
   - Timing chain
   - Timing chain guides.
10. Refer to *CYLINDER HEAD* subsection and remove:
    - Camshaft holders
    - Cylinder head.

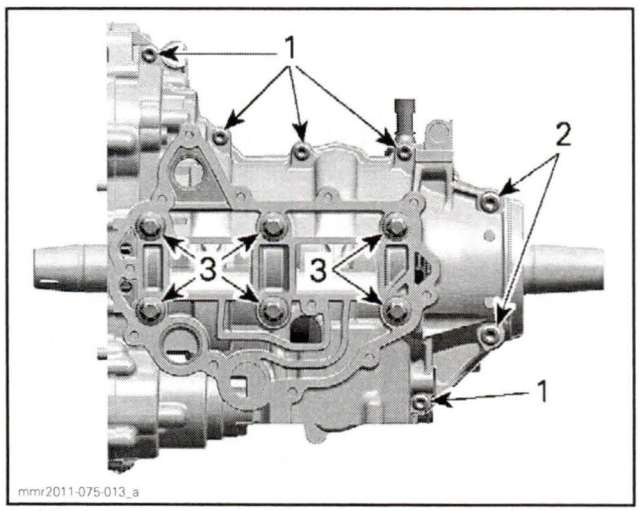
NOTE: Before splitting the cylinder block, measure crankshaft axial play. Refer to *CRANKSHAFT* in this subsection.

11. Remove crankshaft locking tool.

12. Remove cylinder block screws.
    12.1 Start removing the M6 screws.
    12.2 Then remove the M8 screws.
    12.3 Finally remove and discard the M9 screws.



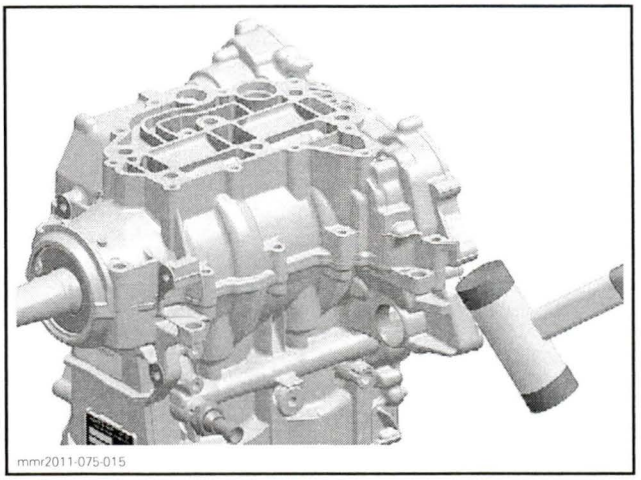
1. Cylinder block screws (M6) screwed from bottom to top



1. M6 screws
2. M8 screws
3. M9 screws (discard)

13. Carefully remove cylinder block lower half by using a soft hammer.

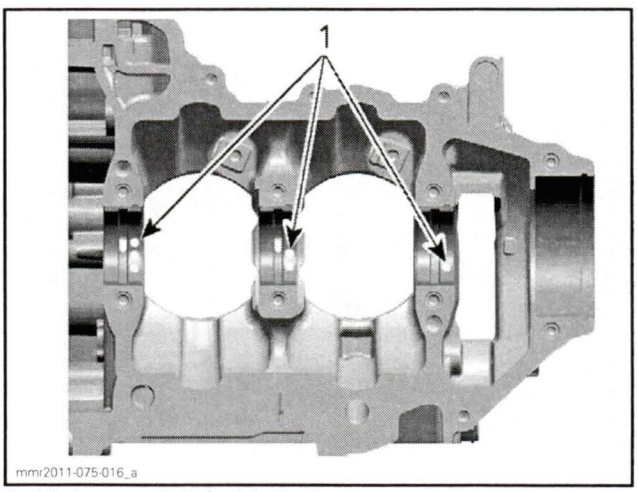
NOTE: Take care not to damage the sealing surfaces of the cylinder block halves.



14. Remove connecting rod caps. Refer to *PISTONS AND CONNECTING RODS* in this subsection.
15. Refer to *CRANKSHAFT* in this subsection and remove:
    - Crankshaft thrust washers
    - Crankshaft.
16. Remove pistons and connecting rods. See procedure in this subsection.

Plain Bearing Removal

When the plain bearings need to be removed from the cylinder block, mark them to identify the correct position at installation. See the illustration as an example.

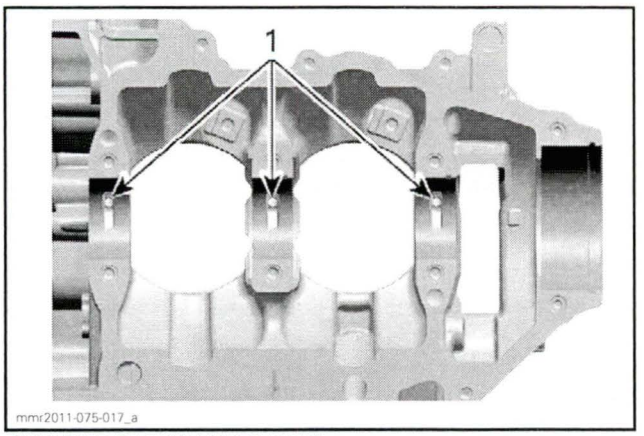


1. Mark on crankshaft plain bearings

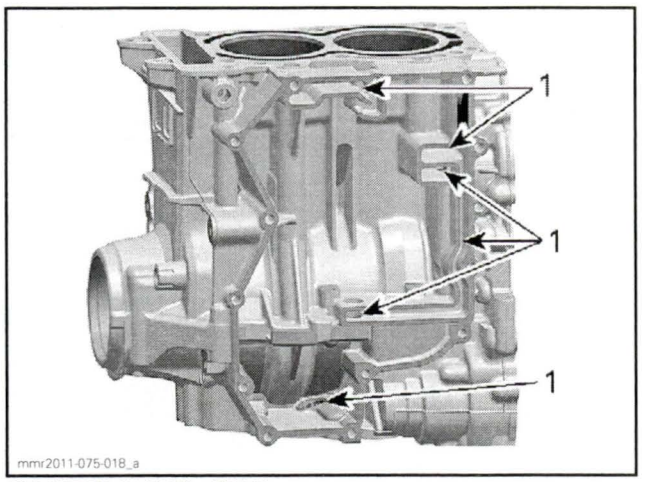
Cylinder Block Cleaning

Clean cylinder block using a part cleaner, then use compressed air to dry it.

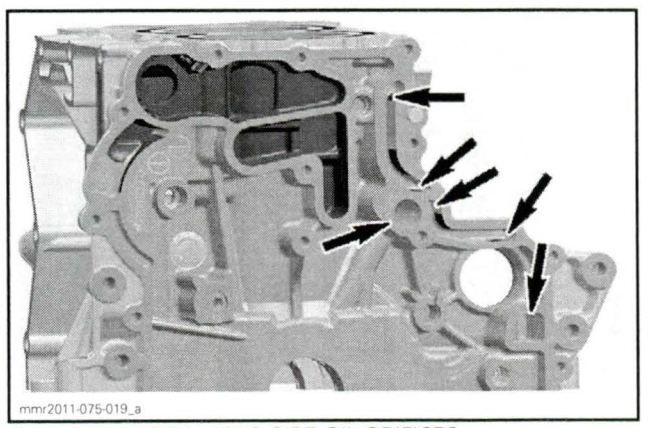
Blow out the oil orifices using compressed air and make sure they are not clogged.



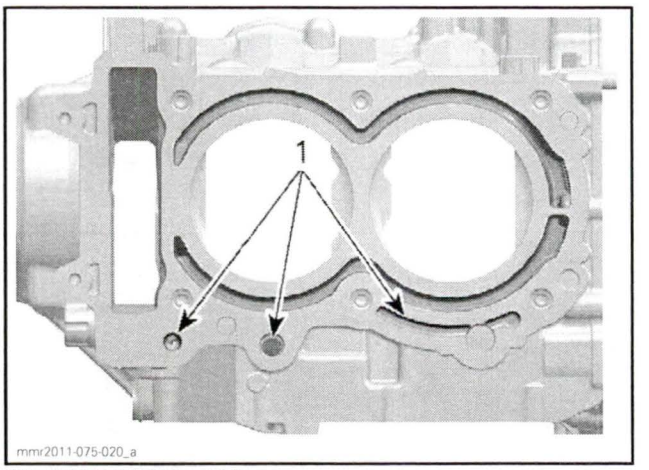
CYLINDER BLOCK UPPER HALF
1. Oil orifices



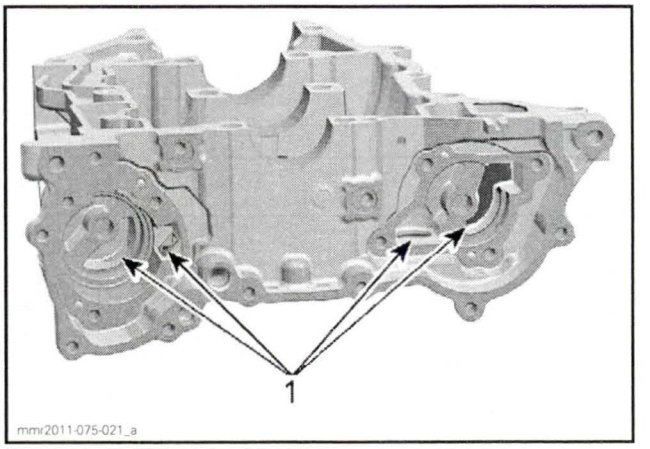
CYLINDER BLOCK - REAR
1. Oil orifices



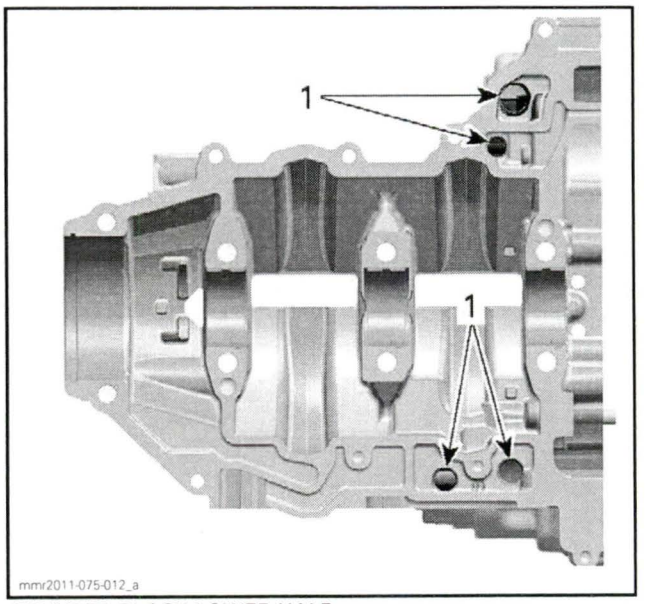
CYLINDER BLOCK - MAG SIDE OIL ORIFICES



CYLINDER BLOCK - TOP
1. Oil orifices



CYLINDER BLOCK LOWER HALF
1. Oil orifices



CYLINDER BLOCK LOWER HALF
1. Oil orifices

Clean all metal components in a solvent.

Clean cylinder block mating surfaces with LOCTITE CHISEL (GASKET REMOVER) (P/N 413 708 500) and a brass brush. Brush a first pass in one direction then make the final brushing perpendicularly (90°) to the first pass (cross hatch).

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

Cylinder Block Inspection

Check cylinder block for cracks or other damage.

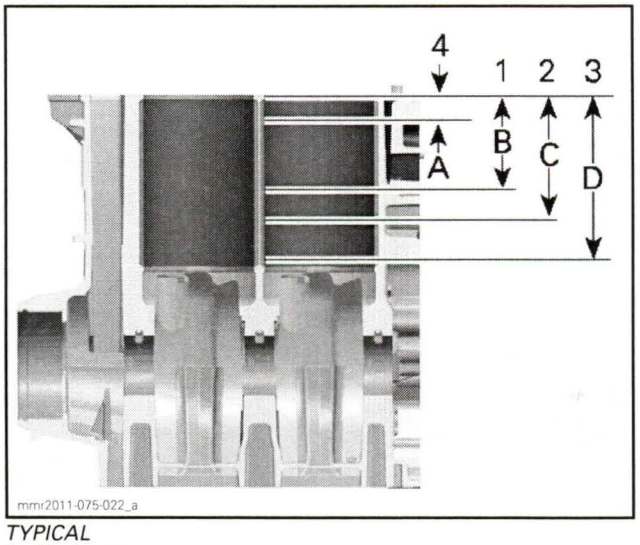
Check cylinder block mating surfaces for flatness using a straight edge.

Replace cylinder block if necessary.

Check cylinder bores for cracks, scoring and wear ridges on top and bottom of the cylinders.

Cylinder Taper

Measure cylinder bore diameter at 4 recommended positions. See illustration.



TYPICAL
1. *First measure*
2. *Second measure*
3. *Third measure*
4. *Fourth measure*

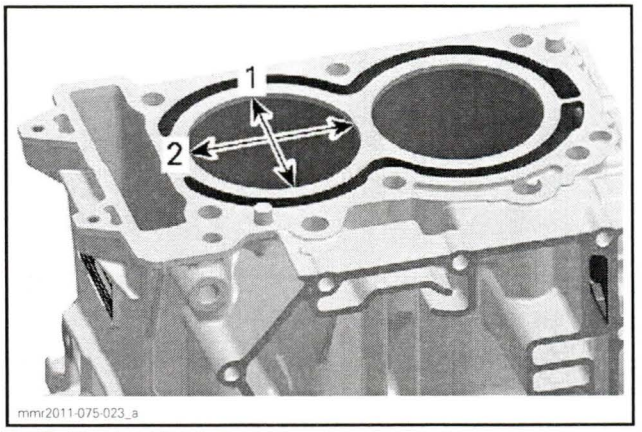
A. 5 mm to 10 mm (.197 in to .394 in)
B. 30 mm to 35 mm (1.181 in to 1.378 in)
C. 57 mm to 62 mm (2.244 in to 2.441 in)
D. 111 mm to 113 mm (4.37 in to 4.449 in)

The difference between measurements should not exceed the service limit mentioned in next table.

CYLINDER TAPER	
NEW MAXIMUM	0.030 mm (.0012 in)
SERVICE LIMIT	0.050 mm (.002 in)

Cylinder Out of Round

Measure cylinder bore diameter as shown and at the same measuring points as for *CYLINDER TAPER*.



1. *Piston pin axis*
2. *Parallel to piston pin axis*

To obtain the cylinder out of round, calculate the difference between the perpendicular measures.

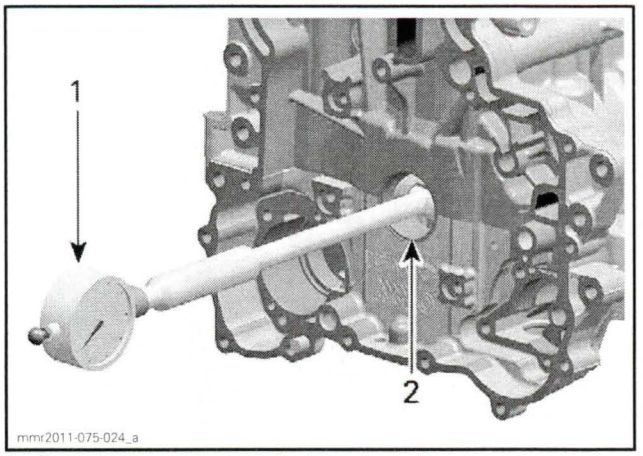
CYLINDER OUT OF ROUND	
NEW MAXIMUM	0.008 mm (.0003 in)
SERVICE LIMIT	0.030 mm (.0012 in)

Crankshaft Plain Bearings Inside Diameter

Check the plain bearings for scoring or other damages.

Measure plain bearing inside diameter and compare with crankshaft bearing journal diameter (refer to *CRANKSHAFT* in this subsection). Proceed as follows.

- Use the OLD plain bearings and put both cylinder block halves together.
- Tighten screws as described in *CYLINDER BLOCK ASSEMBLY*.
- Measure the inside diameter of the crankshaft plain bearings using a bore gauge.



1. Bore gauge
2. Crankshaft plain bearing

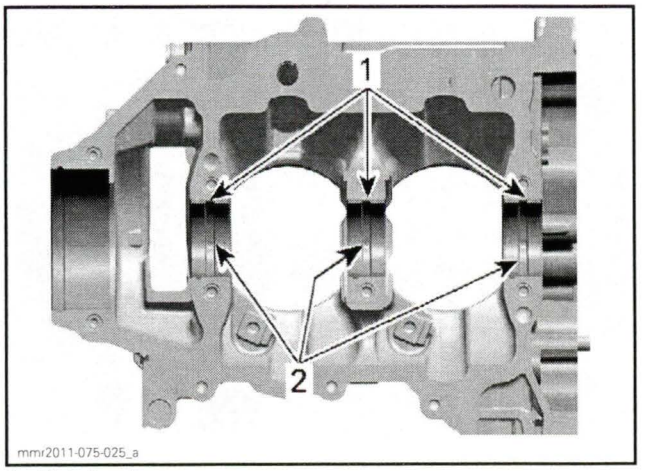
CRANKSHAFT PLAIN BEARING INSIDE DIAMETER	
SERVICE LIMIT	36.080 mm (1.4205 in)

Replace bearings if they are out of specifications.

Cylinder Block Assembly

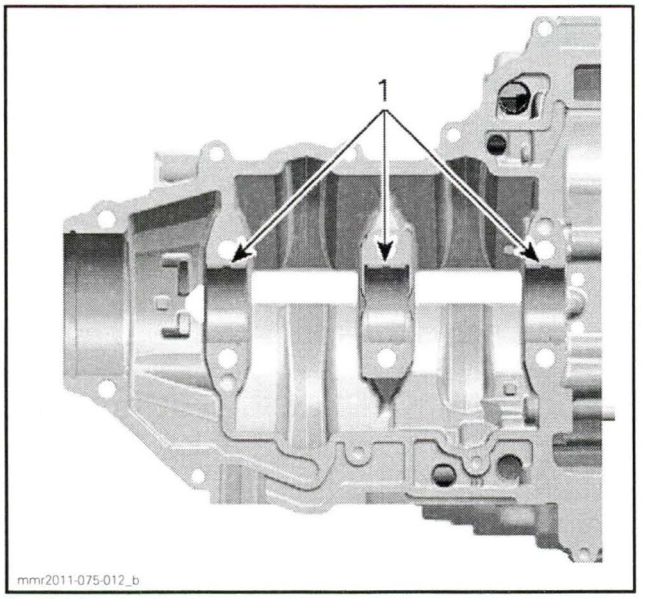
For assembly, reverse the disassembly procedure. Pay attention to the following details.

1. Correctly reinstall plain bearings as follows.
   1.1 Use NEW bearings if diameters are out of specification. Refer to *PLAIN BEARING INSPECTION* in this subsection.
   1.2 Install bearings with lubrication grooves in the cylinder block upper half.



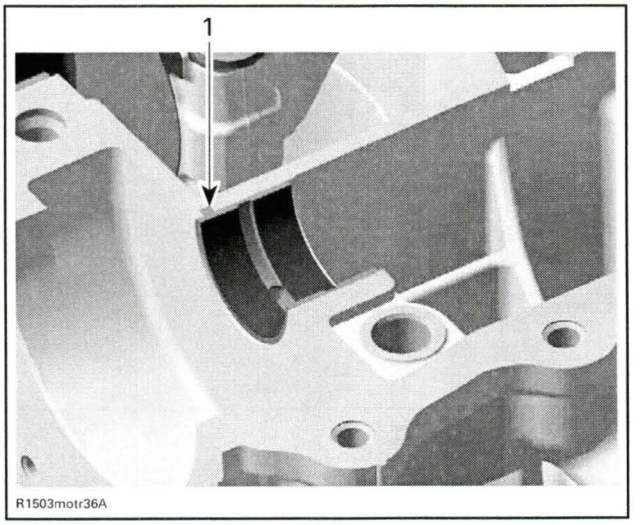
1. Plain bearings
2. Lubrication grooves

   1.3 Install flat bearings in the cylinder block lower half.



1. Flat bearings

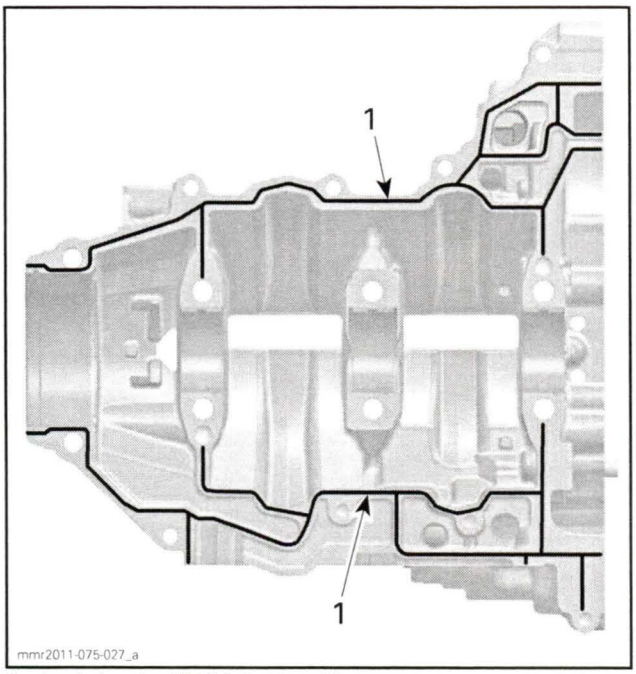
   1.4 Bearings must to be flush with the cylinder block split surface and their protrusions have to fit in the notched areas in the cylinder block seat.



TYPICAL
1. Bearing protrusion in cylinder block notch

2. Install pistons, refer to *PISTONS AND CONNECTING RODS* in this subsection.
3. Apply engine oil on all plain bearings.
4. Install the following components:
   - Crankshaft and thrust washers (refer to *CRANKSHAFT*)
   - Connecting rod caps (refer to *PISTONS AND CONNECTING RODS*).
5. Apply LOCTITE 5910 (P/N 293 800 081) on mating surface of cylinder block lower half as shown on next illustration.

IMPORTANT: When beginning the application of the cylinder block sealant, the assembly and first tightening have to be done within 12 minutes. It is suggested to have all you need on hand to save time.



1. Apply Loctite 5910 following this pattern

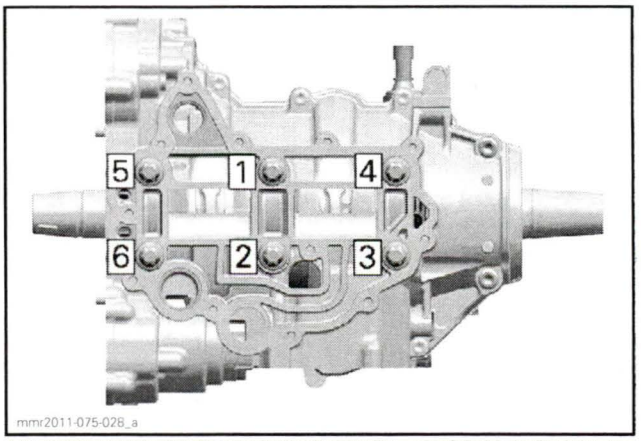
NOTICE Ensure not to apply too much sealant, as it will spread out inside the cylinder block.

6. Install NEW cylinder block M9 screws and tighten as follows.

NOTICE This assembly uses stretch screws. Always use NEW screws and strictly adhere to the tightening procedure.

6.1 Torque the M9 screws according the sequence.

CYLINDER BLOCK M9 SCREWS TIGHTENING PROCEDURE	
FIRST STEP	20 N•m ± 2 N•m (15 lbf•ft ± 1 lbf•ft)



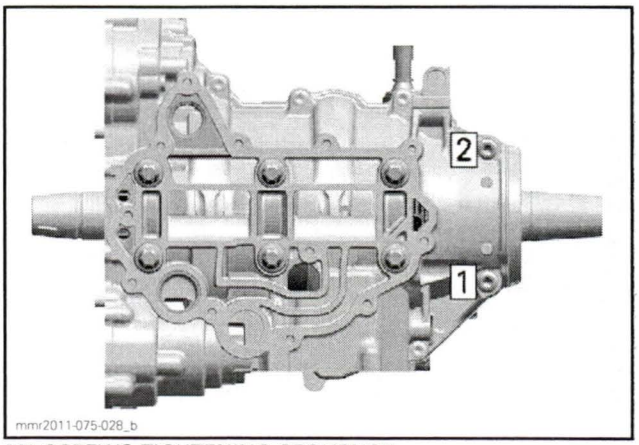
M9 SCREWS TIGHTENING SEQUENCE - FIRST AND SECOND STEPS

6.2 Use a torque angle gauge to carry out the second step, following the same sequence.

CYLINDER BLOCK M9 SCREWS TIGHTENING PROCEDURE	
SECOND STEP	Additional 120° ± 5°

7. Install the M8 screws and tighten as follows.

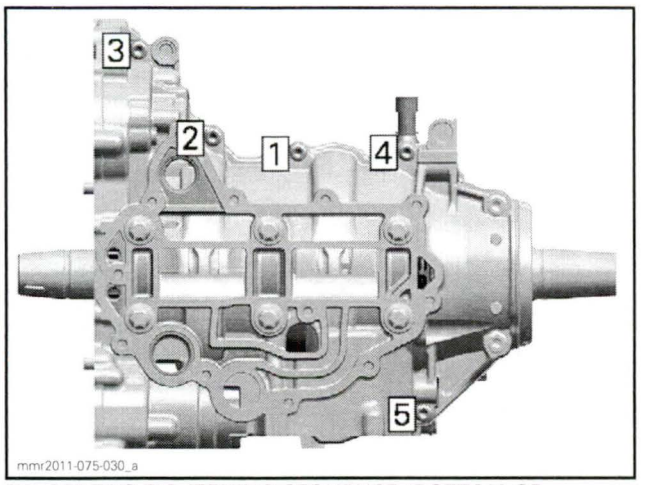
CYLINDER BLOCK M8 SCREWS TIGHTENING TORQUE
23 N•m ± 2 N•m (17 lbf•ft ± 1 lbf•ft)



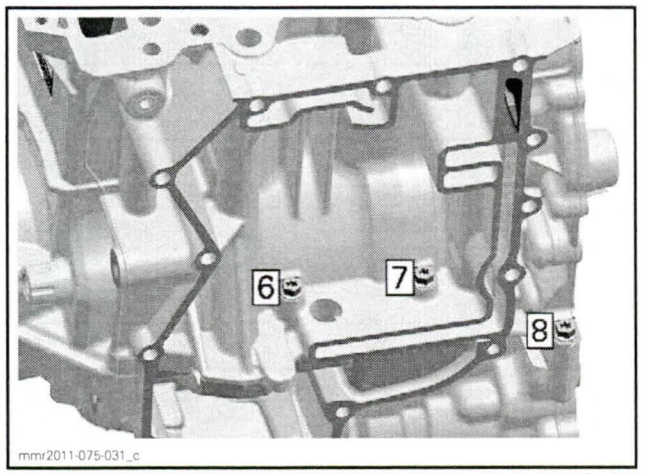
M8 SCREWS TIGHTENING SEQUENCE

8. Install the M6 screws and tighten as follows.

CYLINDER BLOCK M6 SCREWS TIGHTENING TORQUE
11 N•m ± 1 N•m (97 lbf•**in** ± 9 lbf•**in**)



M6 SCREWS TIGHTENING SEQUENCE (BOTTOM OF CRANKCASE)



M6 SCREWS TIGHTENING SEQUENCE (REAR OF CRANKCASE)

NOTE: Check the crankshaft axial play before continuing the assembly. Refer to *CRANKSHAFT* in this subsection for the procedure.

9. Reassemble engine in accordance with the proper assembly procedures.

CRANKSHAFT

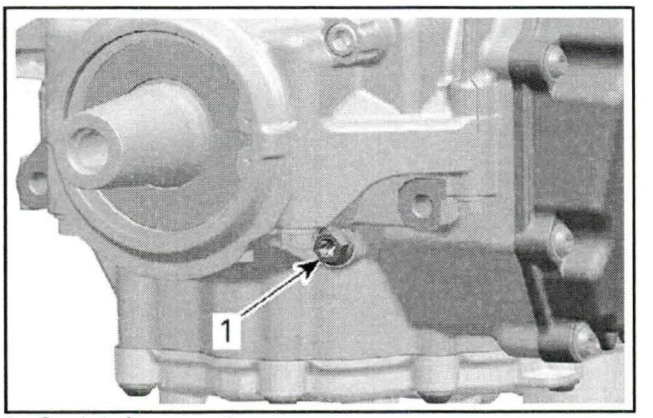
Crankshaft Locking Procedure

NOTICE When crankshaft is locked, neither first nor second cylinder is set to TDC.

Crankshaft must be locked whenever the magneto rotor retaining nut has to be removed or whenever working on the valve train.

NOTICE When working on the valve train or timing chain, crankshaft must be locked with the marks "IN" and "EX" on the camshaft timing gears facing each other.

1. If working on the valve train or timing chain, remove the valve cover. Refer to *CYLINDER HEAD* subsection.
2. Remove spark plugs.
3. If engine is installed in the vehicle, remove drive pulley Refer to *DRIVE PULLEY (eDrive)*.
4. Remove crankshaft access plug and discard gasket ring.



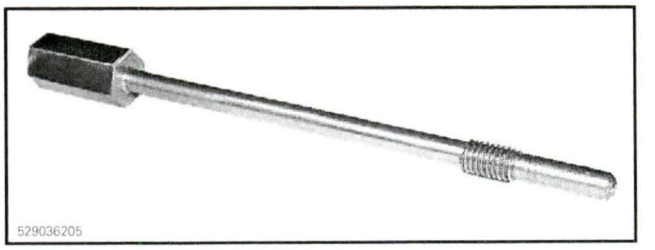
1. Crankshaft access plug

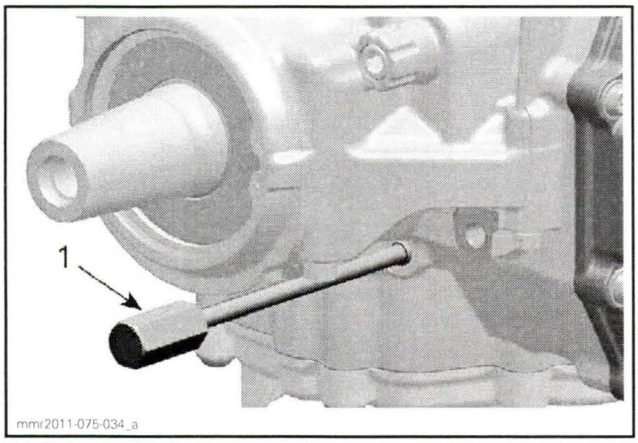
5. Turn engine counterclockwise to bring crankshaft to locking position.

NOTICE Crankshaft locking position is reached when marks "IN" and "EX" on the camshaft timing gears face each other.

6. Use a flashlight to check if the groove in the crankshaft is aligned with the hole.
7. Lock crankshaft.

REQUIRED TOOL
CRANKSHAFT LOCKING TOOL (P/N 529 036 205)

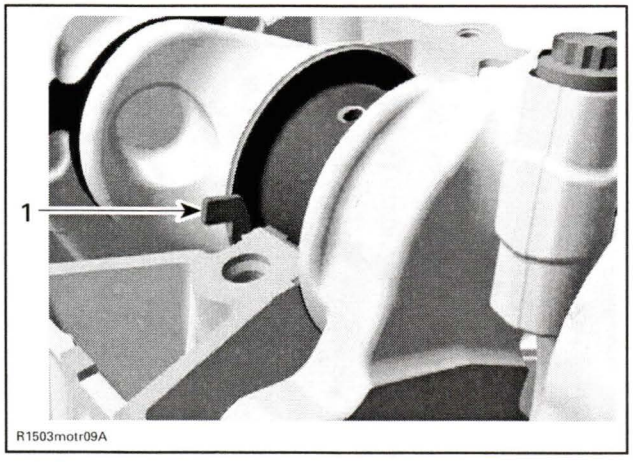




1. Crankshaft locking tool

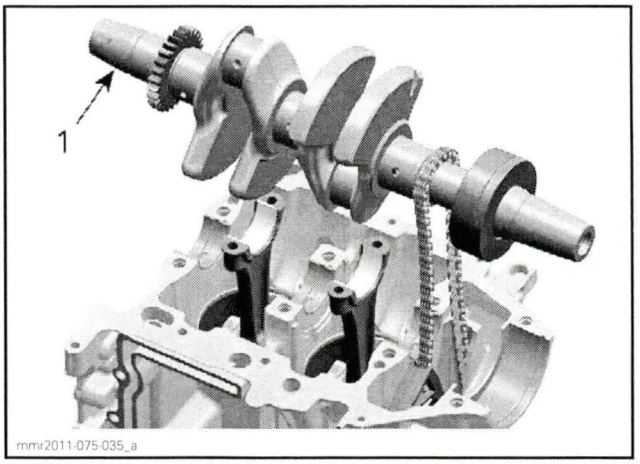
Crankshaft Removal

1. Disassemble *CYLINDER BLOCK*, see procedure in this subsection.
2. Remove connecting rod caps. Refer to *PISTONS AND CONNECTING RODS* in this subsection.
3. Remove crankshaft thrust washers.



TYPICAL
1. Thrust washer

4. Remove crankshaft from cylinder block.

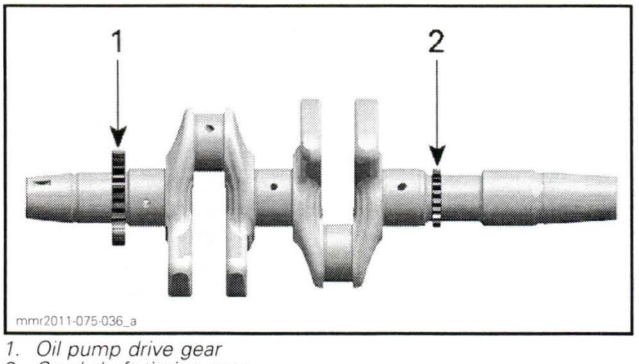


1. Crankshaft

Crankshaft Inspection

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

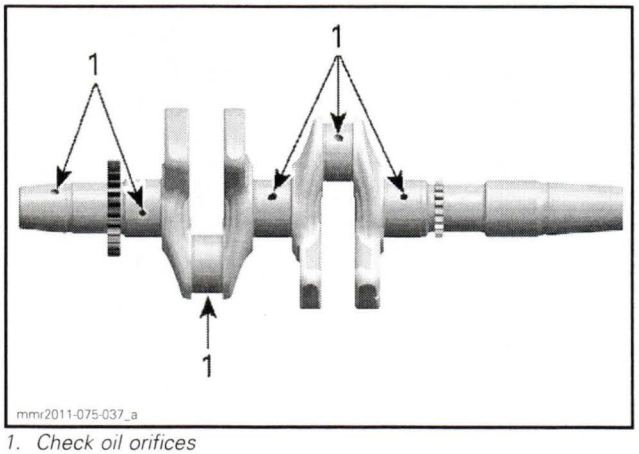
Check if crankshaft gears are worn or otherwise damaged.



1. Oil pump drive gear
2. Crankshaft timing gear

Replace crankshaft if damaged.

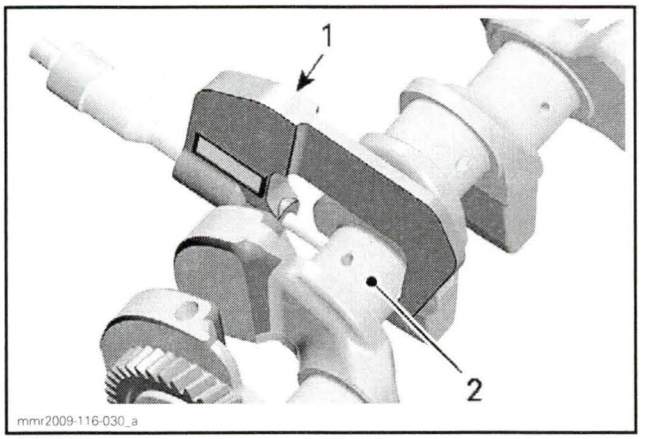
Blow the oil orifices using compressed air and make sure they are not clogged.



1. Check oil orifices

Crankshaft Radial Play

Measure crankshaft bearing journal diameter, using a micrometer.



TYPICAL
1. *Micrometer*
2. *Crankshaft area for plain bearing*

To obtain the radial play, calculate the difference between the bearing journal diameter and the crankshaft plain bearings inner diameter (see *CYLINDER BLOCK*).

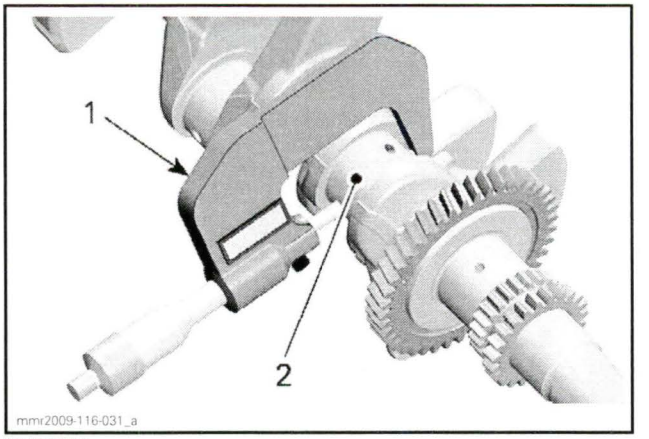
CRANKSHAFT BEARING JOURNAL DIAMETER	
NEW	35.990 mm to 36.006 mm (1.4169 in to 1.4176 in)
SERVICE LIMIT	35.960 mm (1.4157 in)

CRANKSHAFT RADIAL PLAY	
SERVICE LIMIT	0.09 mm (.0035 in)

Crankshaft Pin Diameter

Measure crankshaft pin diameter, using a micrometer.

To obtain the radial play, calculate the difference between the crankshaft pin diameter and the connecting rod plain bearings inner diameter (see *CONNECTING ROD INSPECTION*).



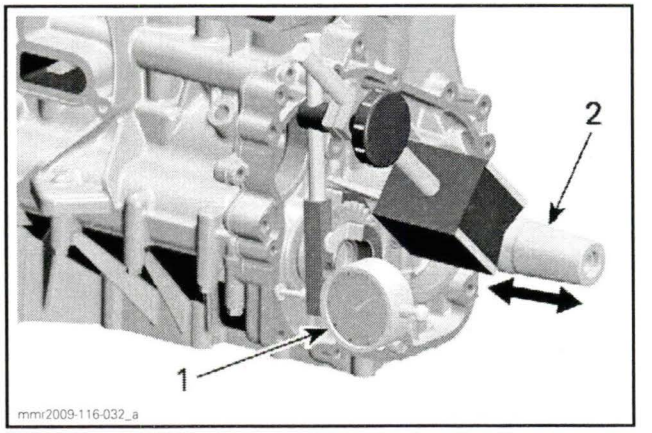
TYPICAL
1. *Micrometer*
2. *Crankshaft pin area for plain bearing*

CRANKSHAFT PIN DIAMETER	
NEW	35.979 mm to 35.995 mm (1.416 in to 1.417 in)
SERVICE LIMIT	35.969 mm (1.416 in)

CONNECTING ROD BIG END RADIAL PLAY	
SERVICE LIMIT	0.08 mm (.0031 in)

Crankshaft Axial Play

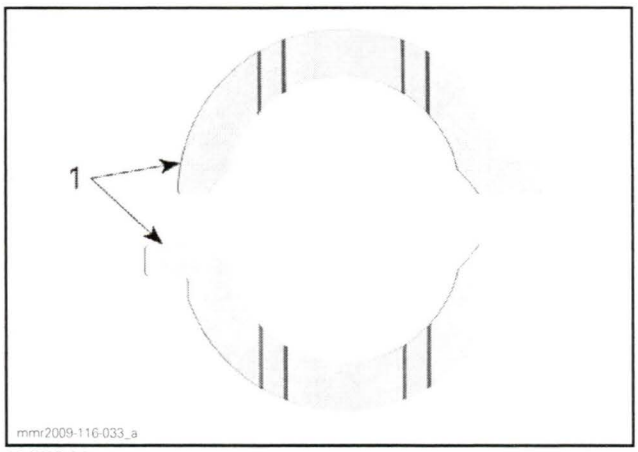
With the crankshaft in the cylinder block, measure the crankshaft axial play, using a dial indicator.



TYPICAL
1. *Dial indicator*
2. *Crankshaft*

CRANKSHAFT AXIAL PLAY	
NEW	0.120 mm to 0.392 mm (.005 in to .015 in)
SERVICE LIMIT	0.450 mm (.018 in)

If play is out of specification, replace the crankshaft thrust washers and repeat measurement.



TYPICAL
1. Crankshaft thrust washers

Crankshaft Installation

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

Turn cylinder block upside down.

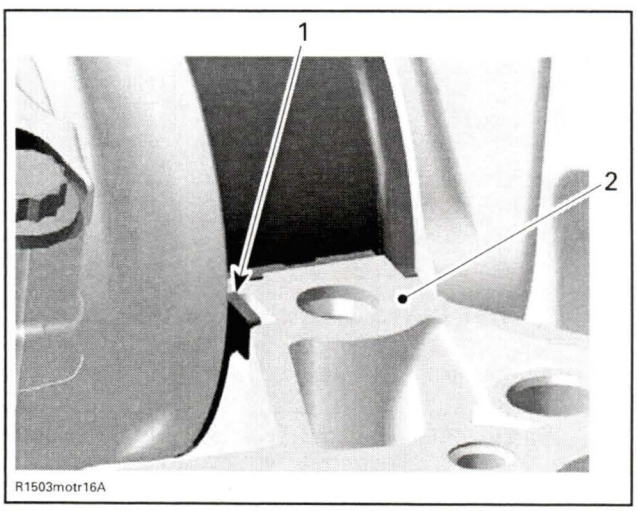
NOTICE **Be careful that connecting rods do not hit the cylinder block.**

Apply engine oil on all plain bearings before installing them.

Install crankshaft along with the timing chain.

Lubricate (both sides) and reinstall crankshaft thrust washers with the slots facing against crankshaft counterweights.

NOTE: Thrust washers have to be flush with the cylinder block sealing surface.



TYPICAL
1. Thrust washer
2. Sealing surface

Install connecting rod caps. Refer to *PISTONS AND CONNECTING RODS* in this subsection.

NOTICE **It is absolutely necessary to follow this procedure. Otherwise severe engine damage can occur.**

Install cylinder block lower half. Refer to *CYLINDER BLOCK* in this subsection.

Lock crankshaft before further assembly of the engine. See *CRANKSHAFT LOCKING PROCEDURE* in this subsection.

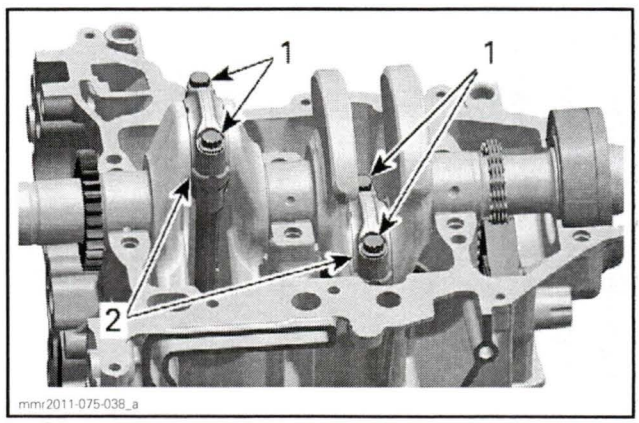
PISTONS AND CONNECTING RODS

Piston and Connecting Rod Removal

NOTE: It is recommended to measure connecting rod big end axial play prior to remove connecting rod. Refer to *CONNECTING ROD INSPECTION*.

1. Disassemble *CYLINDER BLOCK* as per procedure in this subsection.
2. Remove connecting rod cap.

NOTICE **Mark cylinder position of connecting rod before disassembly.**

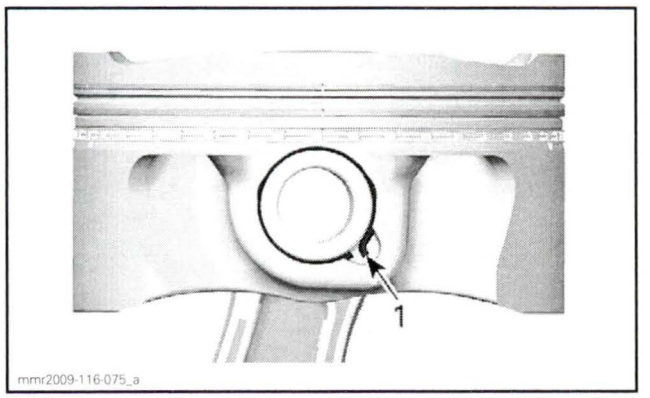


1. Connecting rod screws
2. Connecting rod cap

3. Remove *CRANKSHAFT* as per procedure in this subsection.
4. Turn cylinder block and push piston with connecting rod out of the cylinder.

Piston and Connecting Rod Disassembly

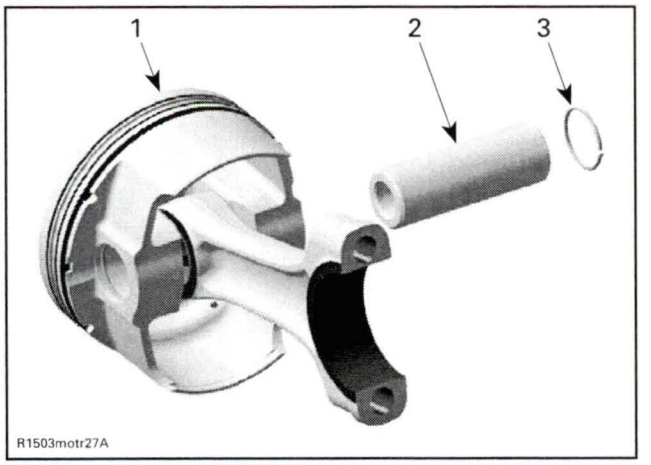
1. Remove one piston pin circlip and discard it.



TYPICAL
1. Piston pin circlip

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

2. Push piston pin out of the piston.



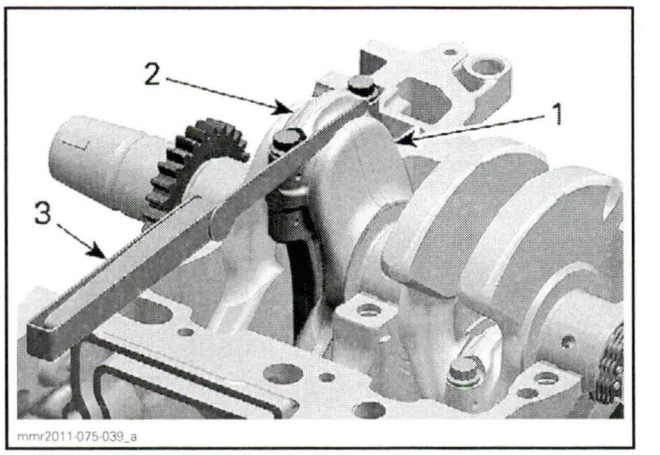
TYPICAL
1. Piston
2. Piston pin
3. Circlip

3. Detach piston from connecting rod.

Connecting Rod Inspection

Connecting Rod Big End Axial Play

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

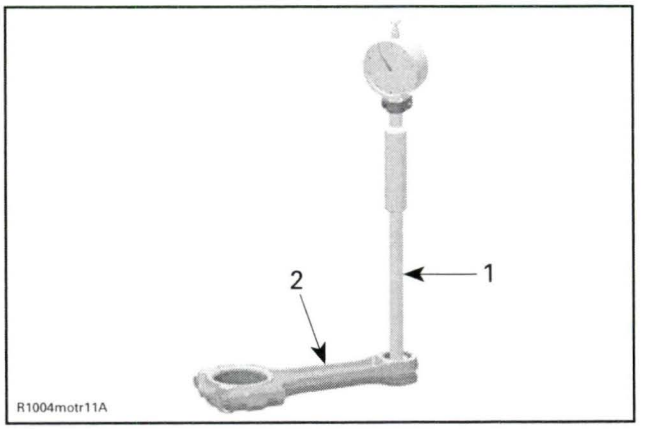


1. Crankshaft
2. Connecting rod
3. Feeler gauge

CONNECTING ROD BIG END AXIAL PLAY	
NEW	0.100 mm to 0.352 mm (.004 in to .014 in)
SERVICE LIMIT	0.450 mm (.018 in)

Connecting Rod Small End Radial Play

Measure connecting rod small end, using a bore gauge.



TYPICAL
1. Bore gauge
2. Connecting rod

CONNECTING ROD SMALL END DIAMETER	
NEW	17.010 mm to 17.020 mm (.6697 in to .6701 in)
SERVICE LIMIT	17.060 mm (.6717 in)

If the connecting rod small end diameter is out of specification, replace the connecting rod.

To obtain the radial play, calculate the difference between the piston pin diameter (*PISTON PIN INSPECTION*) and the connecting rod small end inner diameter.

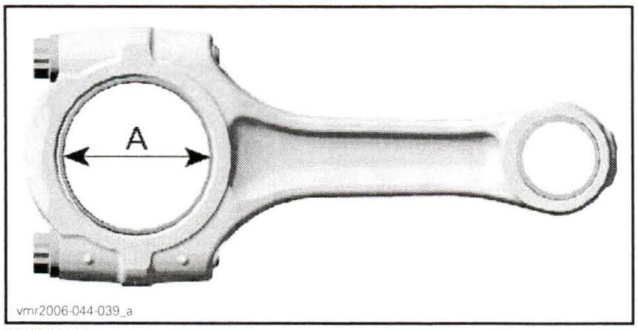
CONNECTING ROD SMALL END RADIAL PLAY	
SERVICE LIMIT	0.040 mm (.0016 in)

Connecting Rod Big End Radial Play

1. Measure inside diameter of connecting rod big end.
   1.1 Install the OLD plain bearings as they were mounted initially.
   1.2 Perform the tightening procedure as described in *PISTON AND CONNECTING ROD INSTALLATION* in this subsection.

   NOTE: To measure the connecting rod big end diameter, ALWAYS use the OLD connecting rod screws.

   1.3 Measure inside diameter in longitudinal direction of the connecting rod.



TYPICAL
A. Connecting rod big end bearing

CONNECTING ROD BIG END DIAMETER	
SERVICE LIMIT	36.06 mm (1.4197 in)

To obtain the connecting rod big end radial play, calculate the difference between the big end diameter and the crankshaft pin diameter (see *CRANKSHAFT INSPECTION*).

CONNECTING ROD BIG END RADIAL PLAY	
SERVICE LIMIT	0.080 mm (.0031 in)

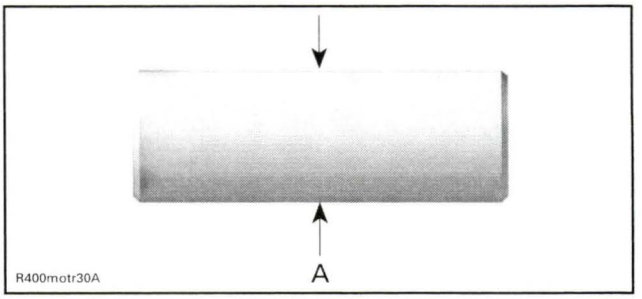
If connecting rod big end diameter is out of specification, install NEW plain bearings.

Piston Pin Inspection

Using synthetic abrasive woven, clean piston pin from deposits.

Inspect piston pin for scoring, cracks or other damage.

Measure piston pin diameter, using a micrometer. See the following illustration for the proper measurement position.



TYPICAL
A. Measure piston pin diameter here

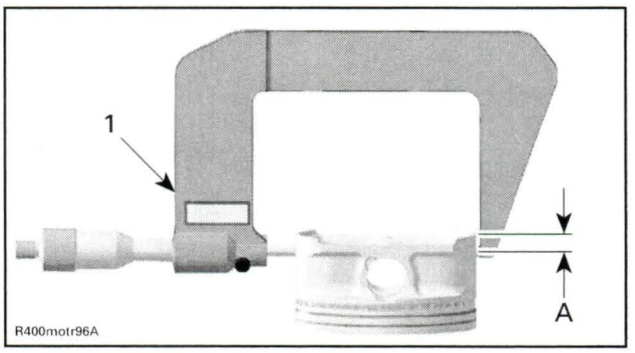
PISTON PIN DIAMETER	
NEW	16.996 mm to 17.00 mm (.6691 in to .6693 in)
SERVICE LIMIT	16.986 mm (.6687 in)

Replace the piston pin if it is out of specification.

Piston Inspection

Inspect piston for scoring, scuffing, cracks or other damage. Replace piston and piston rings if necessary.

Using a micrometer, measure piston perpendicularly (90°) to piston pin axis at 8.5 mm (11/32 in) from the skirt edge.



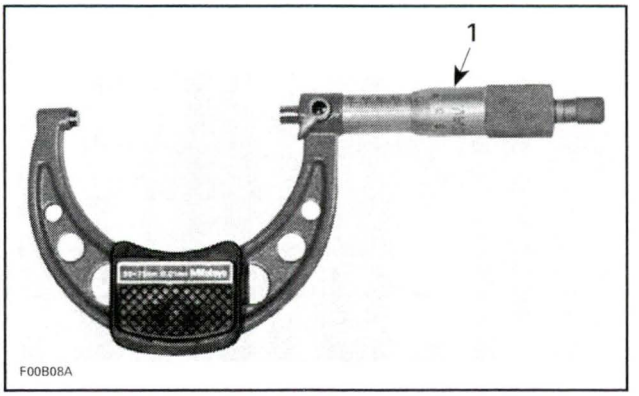
TYPICAL
1. Measuring perpendicularly (90°) to piston pin axis
A. 8.5 mm (11/32 in)

PISTON MEASUREMENT	
NEW NOMINAL	73.950 mm to 73.966 mm (2.911 in to 2.912 in)
SERVICE LIMIT	73.92 mm (2.9102 in)

Replace piston if it is out of specification.

Piston/Cylinder Clearance

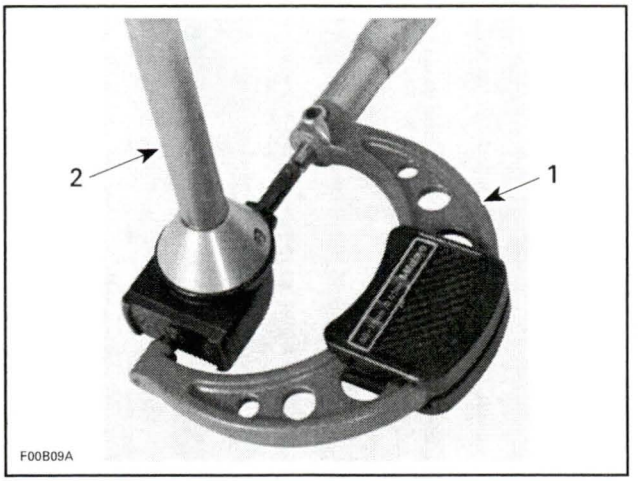
1. Adjust and lock a micrometer to the piston dimension.



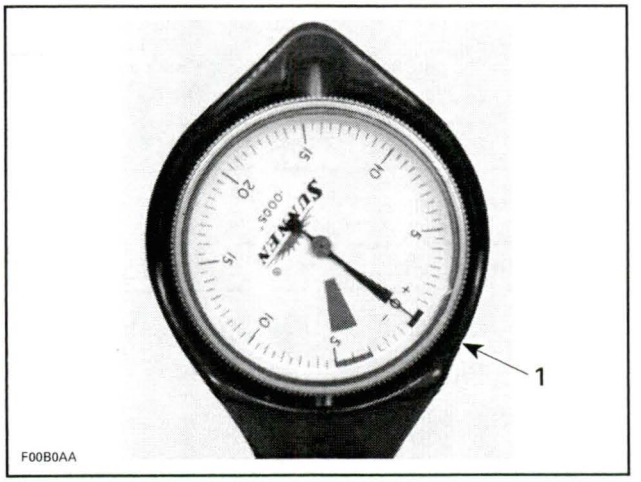
TYPICAL
1. Micrometer set to the piston dimension

NOTE: Make sure used piston is not worn.

2. With the micrometer locked at step 1, adjust a cylinder bore gauge to the micrometer dimension and set the indicator to 0 (zero).



TYPICAL
1. Use the micrometer to set the cylinder bore gauge
2. Cylinder bore gauge



TYPICAL
1. Indicator set to 0 (zero)

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.

3. Position the cylinder bore gauge 35 mm (1-3/8 in) below the cylinder head mating surface, measuring perpendicularly (90°) to piston pin axis.
4. Read the measurement on the cylinder bore gauge. The result is the exact piston/cylinder clearance.

PISTON/CYLINDER CLEARANCE	
NEW NOMINAL	0.037 mm to 0.067 mm (.0015 in to .0026 in)
SERVICE LIMIT	0.08 mm (.0031 in)

If clearance exceeds the specified tolerance, replace the piston and repeat the measurement procedure.

Piston and Connecting Rod Assembly

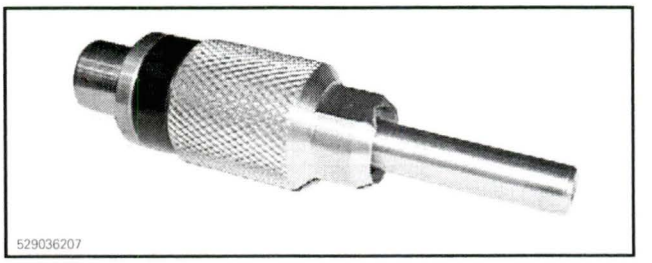
For assembly, reverse the disassembly procedure. Pay attention to the following details.

1. Apply engine oil on the piston pin.
2. Insert piston pin into piston and connecting rod.

NOTE: Ensure to reinstall all parts in their original position as marked during removal.

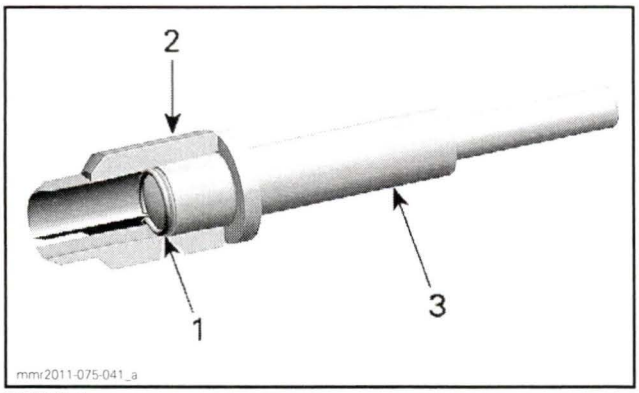
3. Install NEW piston pin circlip(s).

REQUIRED TOOL
PISTON CIRCLP INSTALLER (P/N 529 036 207)



NOTICE **Always replace removed piston pin circlips by NEW ones.**

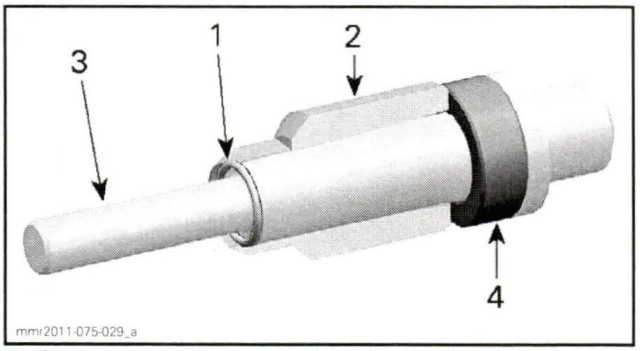
3.1 Place the circlip in the sleeve and push piston circlip installer handle until circlip reaches the mid position in the sleeve.



TYPICAL
1. *Circlip*
2. *Sleeve*
3. *Installer handle*

3.2 Put the distance sleeve on the installer handle.

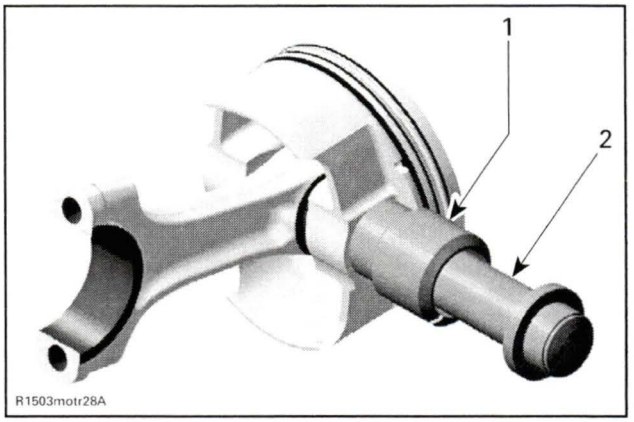
3.3 Push piston circlip installer handle until distance sleeve makes contact with the sleeve.



1. *Circlip*
2. *Sleeve*
3. *Installer handle*
4. *Distance sleeve*

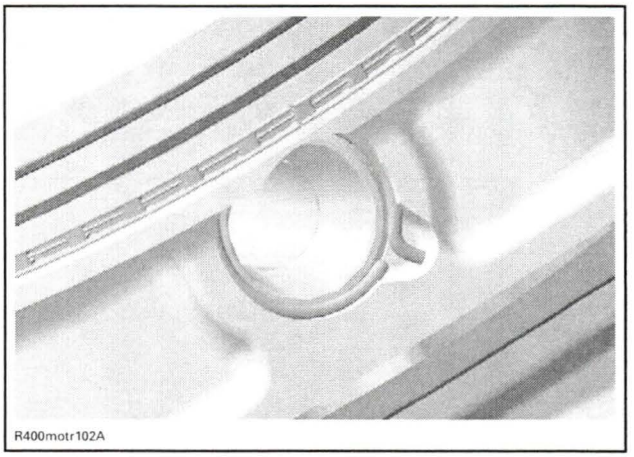
3.4 Remove distance sleeve and insert installer handle into the sleeve.

3.5 Insert the end of the handle into the piston pin, then push to engage the circlip into the piston groove.



TYPICAL
1. *Sleeve with piston circlip inside*
2. *Piston clip installer handle*

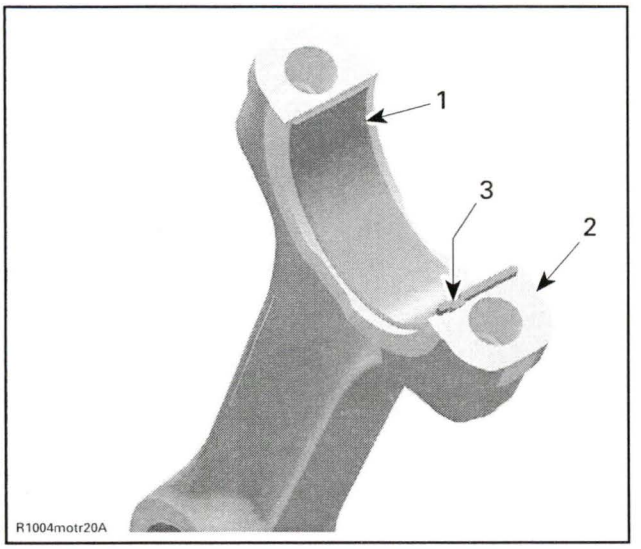
NOTE: Take care that the hook of the piston pin circlip is positioned properly.



CORRECT POSITION OF THE PISTON PIN CIRCLIP

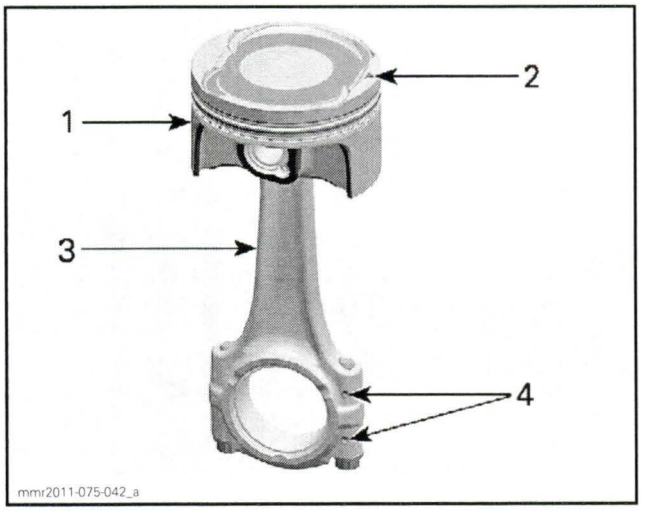
NOTICE **If piston pin circlip installation fails, repeat step 3 by using a NEW circlip.**

4. Correctly install plain bearings and carefully clean split surface on both sides (cracked area) with compressed air.



TYPICAL
1. *Half bearing of connecting rod big end*
2. *Split surface of the connecting rod*
3. *Protrusion of bearing in line with connecting rod groove*

NOTICE The arrow on top of the piston and the punched marks on the connecting rods must always point towards exhaust.



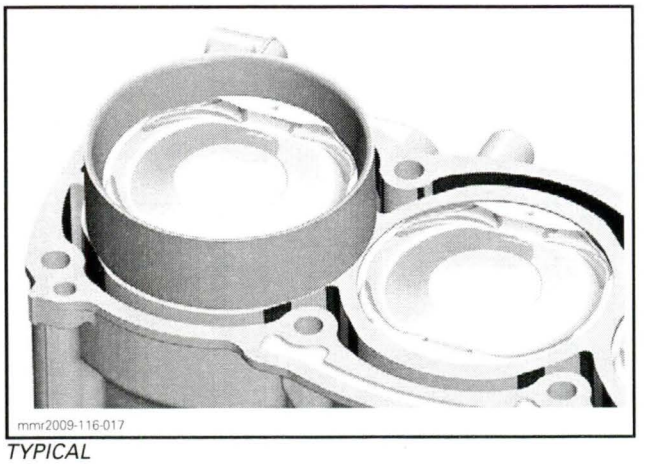
1. *Piston*
2. *Arrow on top*
3. *Connecting rod*
4. *Punched marks*

Piston and Connecting Rod Installation

1. Use engine oil and lubricate:
   - Piston
   - Piston rings
   - Cylinder bore
   - Connecting rod bearings.
2. Slide piston into cylinder bore. Pay attention to the following.

REQUIRED TOOL
PISTON RING COMPRESSOR (P/N 529 036 208)



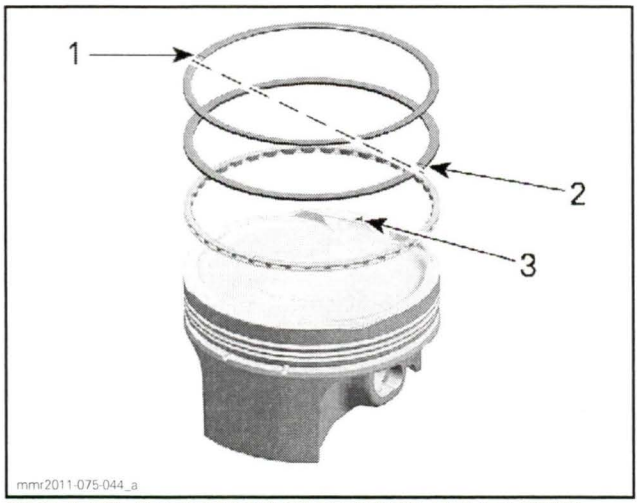


TYPICAL

2.1 If reused, install piston in its original bore.

2.2 Make sure piston rings are properly spaced.

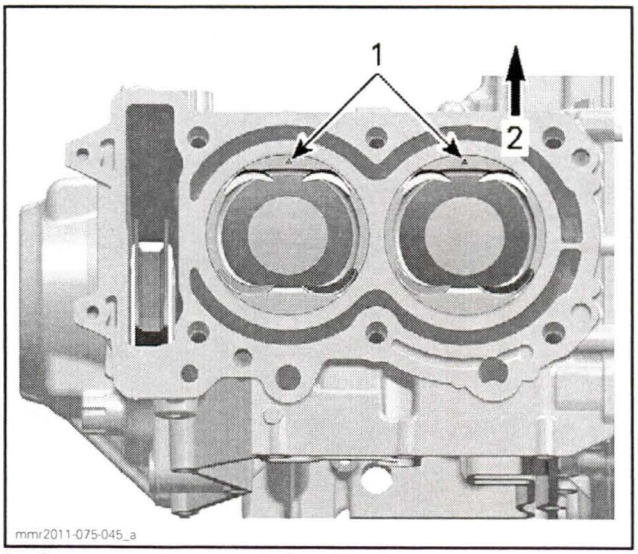
NOTICE The ring gaps of both compression rings should always be 180° from each other and 90° from the arrow on top of the piston.



RING GAPS AT 180° FROM EACH OTHER AND 90° FORM ARROW
1. *Rectangular ring - ring gap*
2. *Taper-face ring - ring gap*
3. *Arrow*

2.3 The arrow on top of the piston must point towards exhaust.

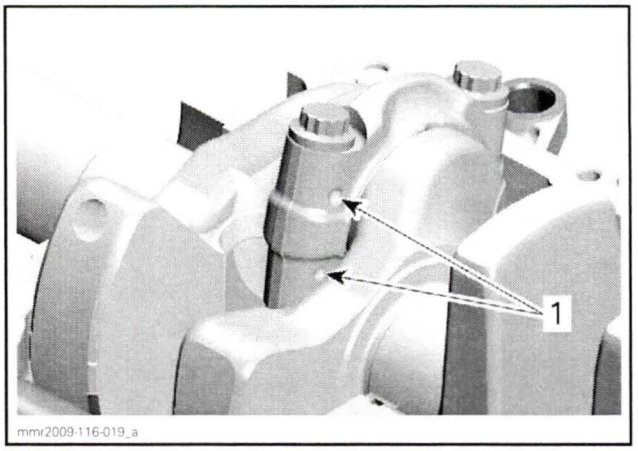
NOTICE **Piston installed with the arrow in the wrong direction would cause serious engine damage.**



1. *Arrows*
2. *Exhaust*

3. Turn cylinder block upside down.
4. Install *CRANKSHAFT* as per procedure in this subsection.
5. Oil the crankshaft pin.
6. Install connecting rod caps.

NOTE: Printed marks on connecting rod and cap must point together.



TYPICAL
1. *Printed marks*

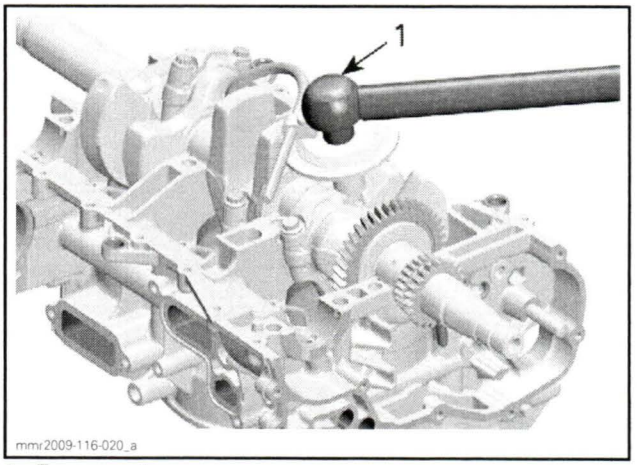
NOTICE **This assembly uses stretch screws. Always use NEW screws and strictly adhere to the tightening procedure.**

7. Tighten connecting rod screws as follows:
   7.1 Apply oil on the connecting rod screw heads.
   7.2 Torque both connecting rod screws of a connecting rod.

CONNECTING ROD SCREWS TIGHTENING SEQUENCE	
FIRST STEP	12 N•m ± 0.2 N•m (106 lbf•**in** ± 2 lbf•**in**)

   7.3 Use a torque angle gauge to carry out the second step.

CONNECTING ROD SCREWS TIGHTENING SEQUENCE	
SECOND STEP	Additional 70° ± 5°



1. *Torque angle gauge*

NOTICE Failure to strictly follow this procedure may cause screws to loosen and lead to severe engine damage.

8. Install all other removed parts.

PISTON RINGS

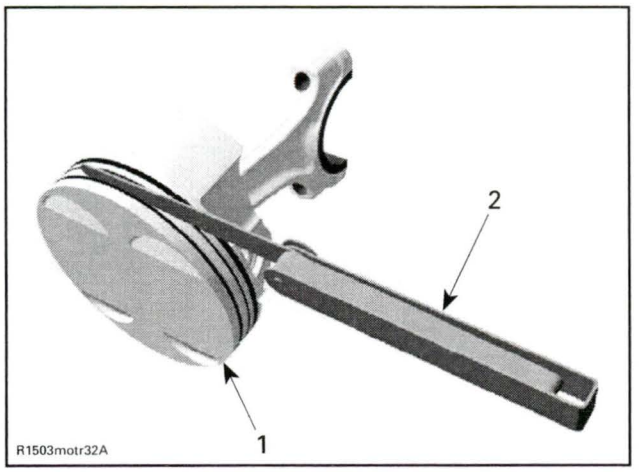
Piston Ring Removal

1. Remove piston, see procedure in this subsection.
2. Remove rings from piston.

Piston Ring Inspection

Ring/Piston Groove Clearance

Using a feeler gauge measure each ring/piston groove clearance.



TYPICAL
1. Piston
2. Feeler gauge

RING/PISTON GROOVE CLEARANCE	
UPPER COMPRESSION RING	
NEW	0.030 mm to 0.066 mm (.0012 in to .0026 in)
SERVICE LIMIT	0.12 mm (.0047 in)
LOWER COMPRESSION RING	
NEW	0.020 mm to 0.056 mm (.0008 in to .0022 in)
SERVICE LIMIT	0.12 mm (.0047 in)
OIL SCRAPER RING	
NEW	0.010 mm to 0.040 mm (.0004 in to .0016 in)
SERVICE LIMIT	0.15 mm (.0059 in)

If clearance is out of specification, the piston and rings should be replaced.

Ring End Gap

1. Place piston ring in the cylinder bore between 8 mm to 16 mm (5/16 in to 5/8 in) from the top of cylinder.

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

2. Using a feeler gauge, check ring end gap.

RING END GAP	
UPPER COMPRESSION RING	
NEW	0.20 mm to 0.35 mm (.008 in to .014 in)
SERVICE LIMIT	1.2 mm (.047 in)
LOWER COMPRESSION RING	
NEW	0.30 mm to 0.50 mm (.012 in to .02 in)
SERVICE LIMIT	1.2 mm (.047 in)
OIL SCRAPER RING	
NEW	0.20 mm to 0.70 mm (.0079 in to .0276 in)
SERVICE LIMIT	1.2 mm (.047 in)

If ring end gap is out of specification, replace piston rings.

Piston Ring Installation

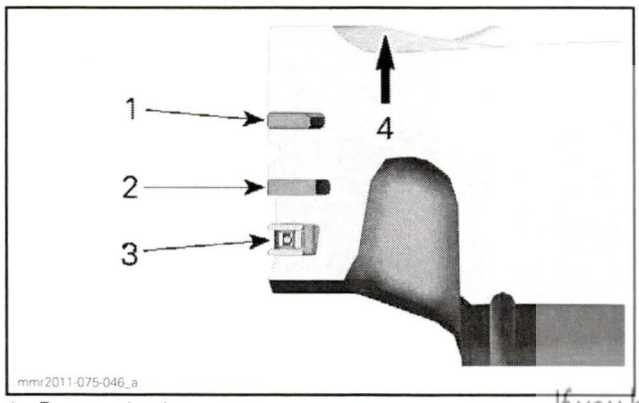
1. Install piston rings in the following order.

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

   1.1 Install oil scraper ring.

   1.2 Install the lower compression ring with the letter "N" facing up.

   1.3 Install upper compression ring with the letter "N" facing up.



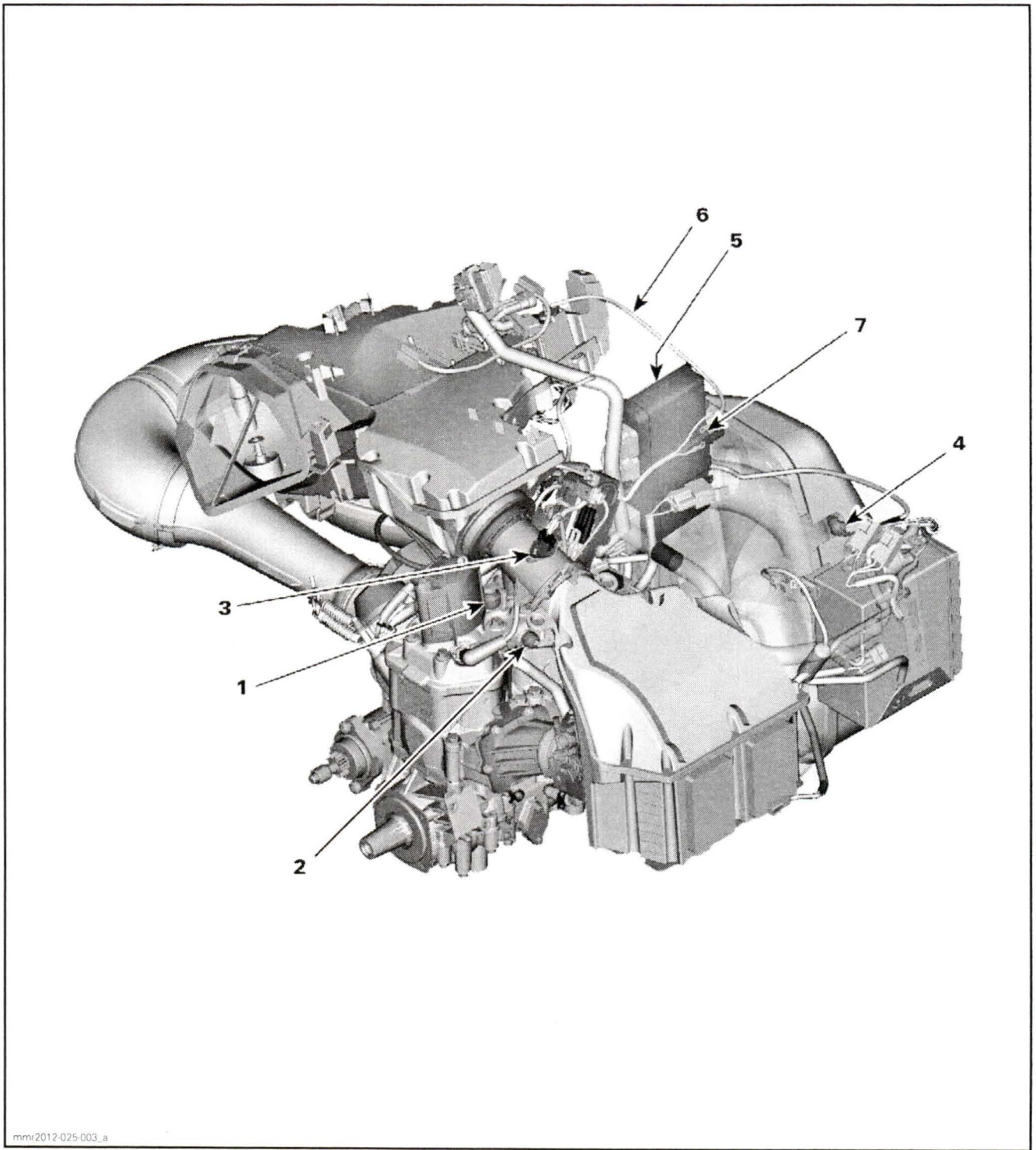
1. *Rectangular ring*
2. *Taper-face ring*
3. *Oil scraper ring*
4. *Letter "N" facing up*

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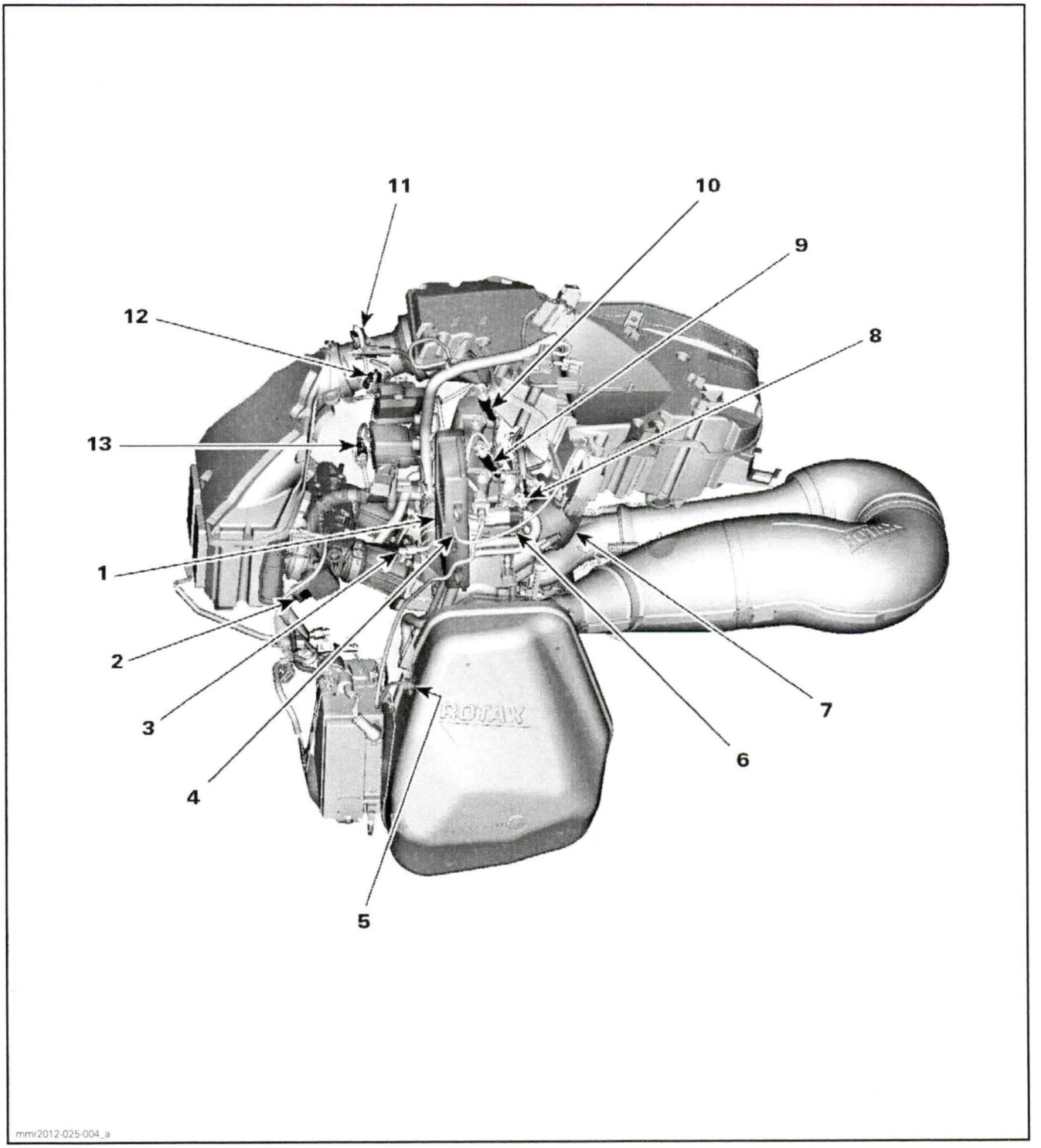
NOTICE Ensure that upper and lower compression rings are not interchanged.

2. Check that rings rotate smoothly after installation.

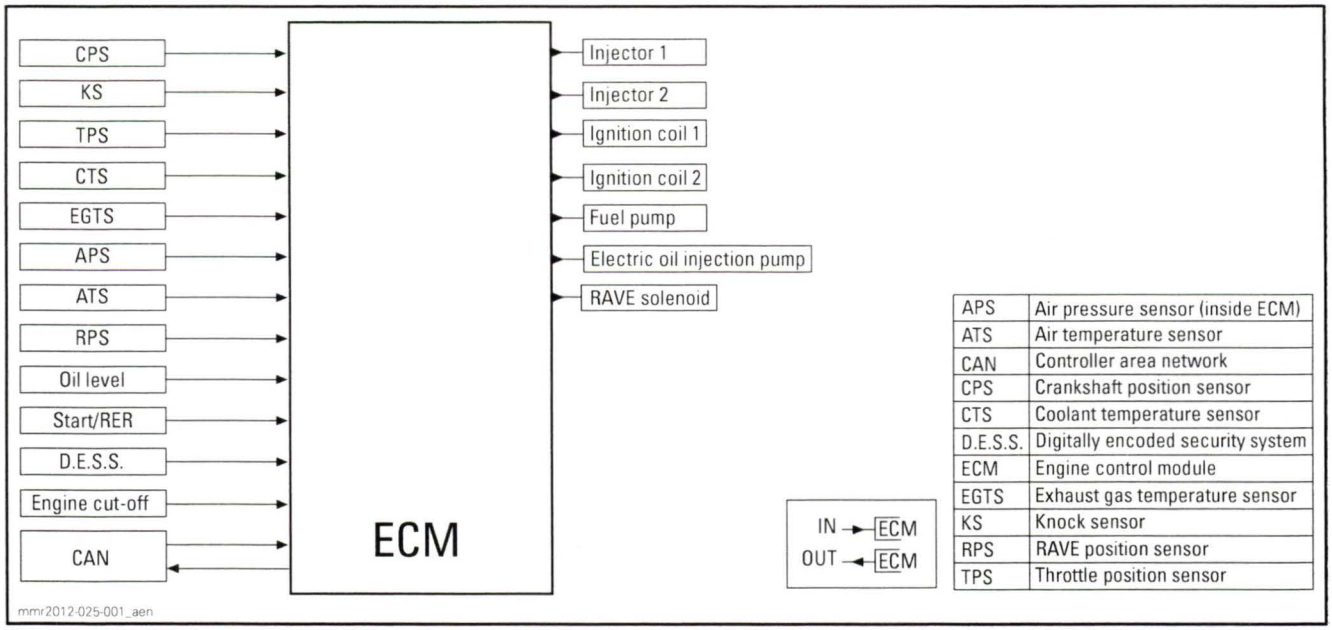
ENGINE MANAGEMENT (600 HO E-TEC)



TYPICAL
1. *Knock sensor (KS)*
2. *Coolant temperature sensor (CTS)*
3. *Air temperature sensor (ATS)*
4. *Exhaust gas temperature sensor EGTS)*
5. *Engine control module (ECM)*
6. *Air pressure sense line*
7. *Air pressure sensor (inside ECM)*



TYPICAL
1. *Engine control module (ECM)*
2. *Throttle position sensor (TPS)*
3. *Oil level sensor connector (OLS)*
4. *Air pressure sensor (APS, inside ECM)*
5. *Exhaust gas temperature sensor (EGTS)*
6. *Crankshaft position sensor connector (CPS)*
7. *RAVE valve*
8. *RAVE valve position sensor (RPS)*
9. *MAG injector*
10. *PTO injector*
11. *Air temperature sensor (ATS)*
12. *MAG ignition coil*
13. *PTO ignition coil*



ENGINE MANAGEMENT DIAGRAM

GENERAL

SYSTEM DESCRIPTION

A highly advanced engine management system (EMS) has been used on this 2-stroke engine to ensure a high power output with a clean combustion with practically no exhaust smoke.

There are 8 main systems that are controlled by the engine management system (EMS):

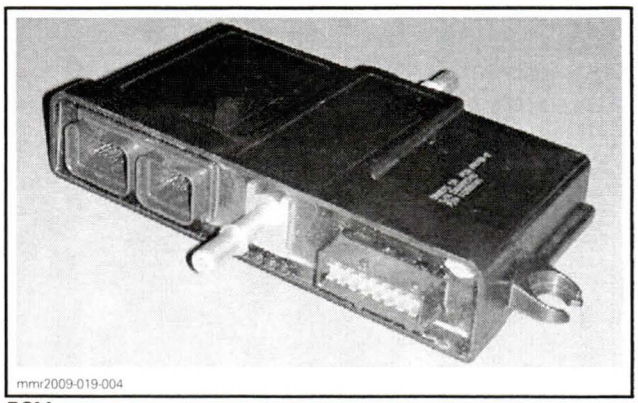
1. E-TEC Direct fuel injection
2. Ignition system
3. Starting system
4. Digitally encoded security system (D.E.S.S.)
5. Lubrication system
6. 3D RAVE
7. Electrical accessories.

The engine management system features a monitoring system that self-diagnoses its electronic components. For more information, refer to *DIAGNOSTIC AND FAULT CODES* subsection.

Electrical power distribution is also controlled by the engine management system. Refer to *POWER DISTRIBUTION AND GROUNDS (600 HO E-TEC)* subsection.

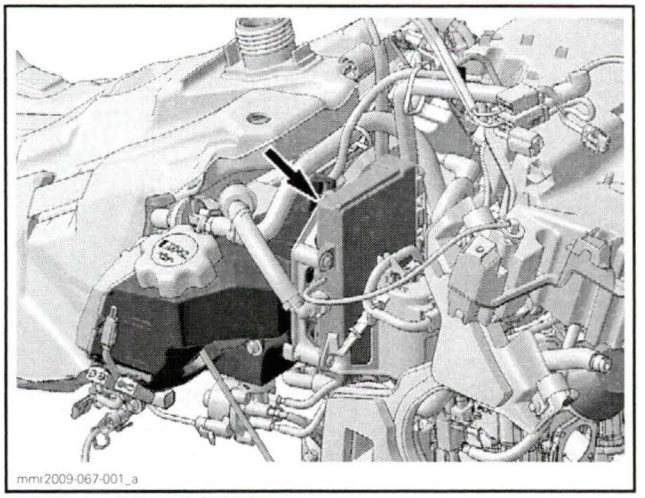
Engine Control Module (ECM)

The ECM is the central point of the engine management system. It reads the inputs and makes computations by comparing them to predetermined parameters, and sends the required control signals to the outputs to ensure proper engine management.



ECM

The ECM is located near the oil injection reservoir.



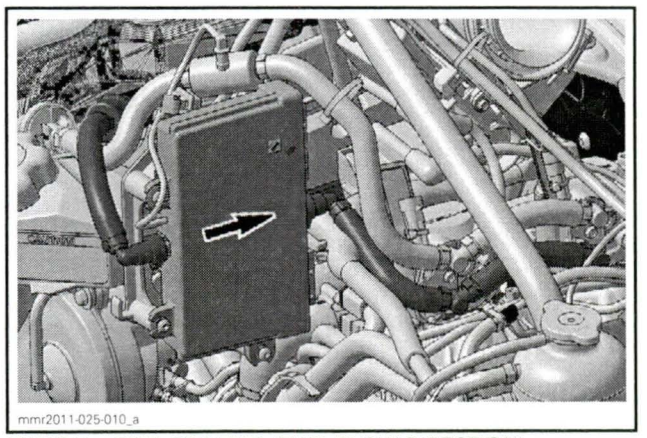
TYPICAL - ECM LOCATION

The ECM also features a permanent memory that will store fault codes, customer information and other engine information when the engine is stopped.

ECM Cooling

Since the ECM manages all the vehicle power needs and incorporates the voltage regulator/ rectifier and other power components, a lot of heat needs to be dissipated.

The constant fresh fuel flow from fuel pump is used to cool down the ECM.



TYPICAL - ECM COOLING (FUEL FLOW DIRECTION)

SYSTEM FEATURES

Throttle Protection

If the throttle is not completely closed during engine startup, engine RPM will be limited to idle speed by the ECM.

To revert to normal operation, release the throttle completely and then depress it again.

Cold Engine Protection

The engine's RPM is limited until the desired engine and injection oil temperatures are obtained (up to 7.5 minutes when driving).

The injection oil warm-up period is time based and is referenced to the air temperature at engine start.

The warm-up period may occur after a restart in very cold weather.

Engine speed is limited to 7000 ± 200 RPM RPM.	Max. RPM allowed to the engine in reverse. RAVE valves are kept closed.
	Max. RPM allowed when engine is cold. Air temperature is below -25°C (-13°F). RAVE valves are kept at mid position. Oil injection pump duty cycle is increased to warm up oil.
	NOTE: When coolant temperature is below 20°C (68°F), RAVE valves are kept at mid position and no RPM limitation takes place. Oil injection pump works in its usual mode.
Engine speed is limited to 8600 RPM.	Maximum engine RPM allowed.

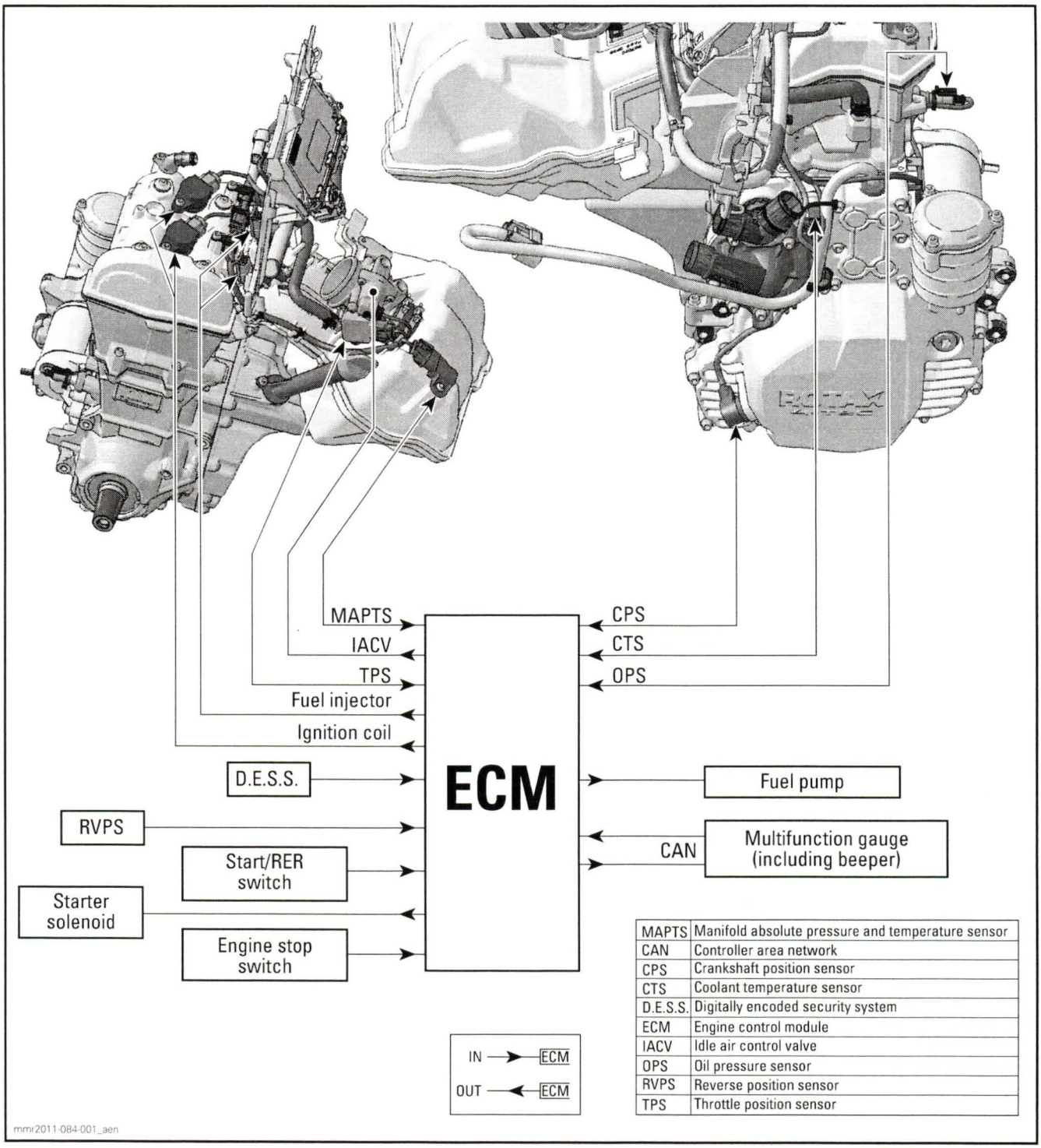
Engine Maximum RPM Protection

Engine speed is limited to 7000 RPM.	Max. RPM allowed to the engine in reverse. RAVE valves are kept closed.
Engine speed is limited to 8600 RPM.	Maximum engine RPM allowed.

Automated Engine Oil Fogging (E-TEC)

An automated engine oil fogging has been implemented to automatically inject the required oil to protect the engine during vehicle storage. Refer to *STORAGE PROCEDURE* subsection for details.

ENGINE MANAGEMENT (600 ACE)



MAPTS	Manifold absolute pressure and temperature sensor
CAN	Controller area network
CPS	Crankshaft position sensor
CTS	Coolant temperature sensor
D.E.S.S.	Digitally encoded security system
ECM	Engine control module
IACV	Idle air control valve
OPS	Oil pressure sensor
RVPS	Reverse position sensor
TPS	Throttle position sensor

GENERAL

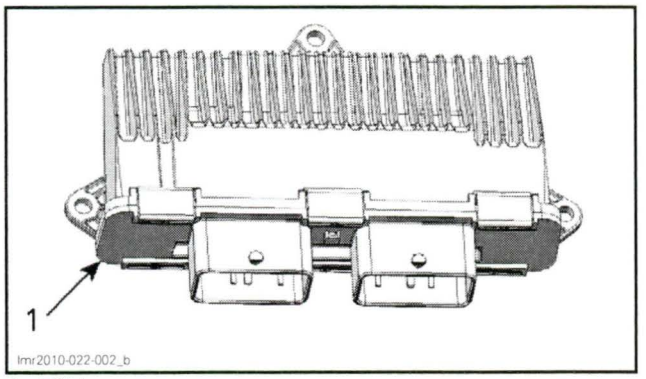
SYSTEM DESCRIPTION

The engine management system (EMS) controls or interacts with the following systems:

- Electronic fuel injection (EFI)
- Digitally Encoded Security System (D.E.S.S.)
- Starting system
- Ignition system
- Lubrication system
- Electrical accessories.

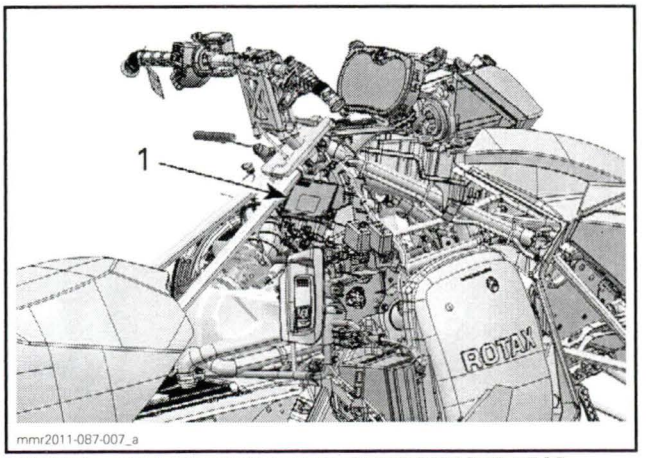
The EMS also features a monitoring system and diagnostic mode to help troubleshooting some problems. Refer to *DIAGNOSTIC AND FAULT CODES* subsection.

Engine Control Module (ECM)



1. ECM

The ECM is located above the air intake manifold.



TYPICAL - ECM LOCATION, FUEL TANK REMOVED FOR CLARITY
1. ECM

The ECM is the central point of the engine management system. It reads inputs, makes computations, uses predetermined parameters and sends signals to the outputs for proper engine management.

The ECM features a permanent memory that will store fault codes, customer information and other engine information when the engine is stopped, and when the battery is removed.

Throttle Protection

If the throttle is not completely closed during engine startup, the engine will not start.

To revert to normal operation, release the throttle completely.

Engine Drowned Mode

This mode is used to expel fuel by cranking an engine that is fuel flooded. When this mode is active, fuel injectors and ignition coils are disabled.

To activate the drowned mode:

1. Fully squeeze throttle lever and hold.
2. Press the START/RER button.

Drowned mode is now active.

To exit this mode, release throttle and start engine normally.

Engine Overheat Protection

COOLANT TEMP.	ENGINE OPERATING CONDITION	EMS ACTION
Above 70°C (158°F)	Idling more than 12 minutes	Engine is stopped. 5 seconds before stopping engine: • Beeper is activated. • SHUTDOWN is displayed in multifunction gauge (premium gauge).
Within 111°C (232°F) and 117°C (243°F)	Idling more than 12 minutes	Beeper is continuously activated. Temperature light is turned ON. ENGINE_TEMP is displayed in multifunction gauge (premium gauge).
Above 110°C (230°F)	Riding	
Above 118°C (244°F)	Idling more than 30 seconds	Engine is stopped. 5 seconds before stopping engine: • Beeper is activated. • SHUTDOWN is displayed in multifunction gauge (premium gauge).
	Riding	Beeper is activated. Temperature light is turned ON. ENGINE_TEMP is displayed in multifunction gauge (premium gauge). Check engine light is turned ON. Engine speed is limited to 5500 RPM. A fault code is set.

CONTROLLER AREA NETWORK (CAN)

GENERAL

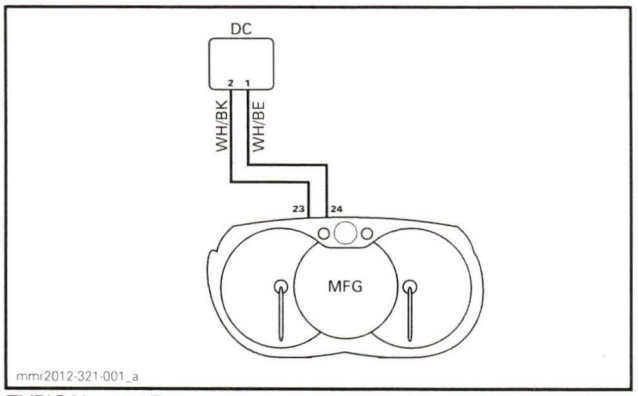
SYSTEM DESCRIPTION

The CAN protocol is an ISO standard for serial data communication.

The CAN lines consist of a twisted pair of wires that form a communication network (CAN bus). All modules or components connected to CAN bus are in constant communication with each other (according to model).

550F Models

The CAN network is comprised of the:
- Gauge
- Diagnostic connector
- CAN bus.

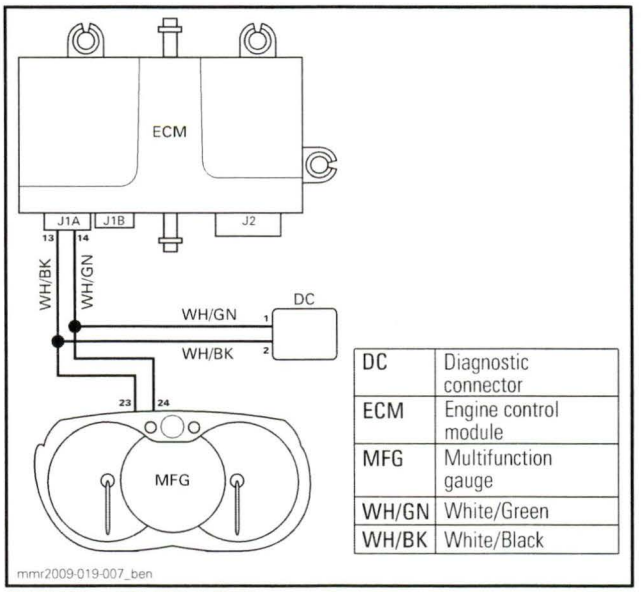


TYPICAL - 550F
1. *WH/BE: WHITE/BEIGE*
2. *WH/BK: WHITE/BLACK*
3. *MFG (multifunction gauge)*
4. *DC (diagnostic connector)*

NOTE: This CAN network is only used for communicating with the gauge using B.U.D.S.

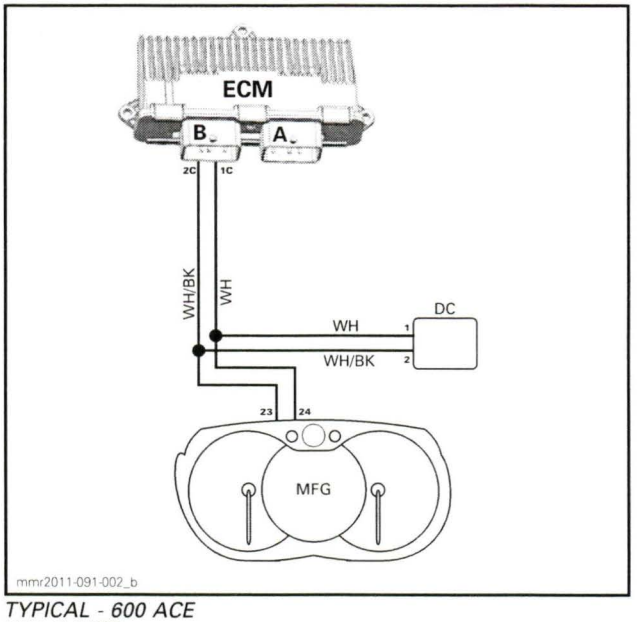
600 HO E-TEC and 600 ACE Models

The network is comprised of the:
- ECM
- Gauge
- Diagnostic connector
- CAN bus.



DC	Diagnostic connector
ECM	Engine control module
MFG	Multifunction gauge
WH/GN	White/Green
WH/BK	White/Black

TYPICAL - 600 HO E-TEC
1. *WH/GN: WHITE/GREEN*
2. *WH/BK: WHITE/BLACK*
3. *MFG (multifunction gauge)*
4. *ECM (electronic control module)*
5. *DC (diagnostic connector)*



TYPICAL - 600 ACE
WH: WHITE
WH/BK: WHITE/BLACK
MFG (multifunction gauge)
ECM (electronic control module)
DC (diagnostic connector)

NOTE: Fault codes are broadcast through the CAN bus and can be displayed in B.U.D.S.

COMMUNICATION TOOLS AND B.U.D.S.

SERVICE TOOLS

Description	Part Number	Page
12 V BATTERY SUPPLY CABLE	529 035 997	385, 390
MPI-2 DIAGNOSTIC CABLE	710 000 851	385, 389
MPI-2 INTERFACE CARD	529 036 018	385, 388
T-HARNESS	529 035 869	385, 387, 389

SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
MALE-FEMALE EXTENSION SERIAL CABLE	DB9	390

GENERAL

Refer to *PROCEDURES* in this subsection for instructions on the communication tools.

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

REQUIRED TOOLS

MANDATORY TOOLS	
A personal computer (laptop or desktop)	
MPI-2 INTERFACE CARD (P/N 529 036 018)	
MPI-2 DIAGNOSTIC CABLE (P/N 710 000 851)	
T-HARNESS (P/N 529 035 869)	
550F and 600 HO E-TEC Models ONLY: 12 V BATTERY SUPPLY CABLE (P/N 529 035 997)	
OPTIONAL TOOL	
Extension cable available at electronic retail outlets. Do not exceed 7.5 m (25 ft)	

TROUBLESHOOTING

COMMUNICATION PROBLEMS

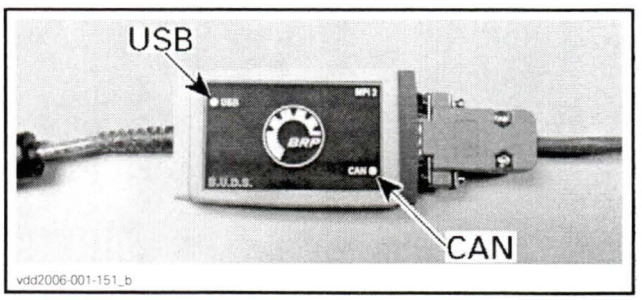
IMPORTANT: Make sure all connections have been made **before starting B.U.D.S.** to allow proper operation.

MPI-2 Connection Troubleshooting

MPI-2 Status Lights

The MPI-2 includes 2 status lights to show the connection conditions: USB and CAN.
Both lights must be GREEN for the MPI-2 to function properly. Otherwise, refer to the following charts.

NOTE: Flashing GREEN lights indicate the communication is active.



Prerequisite for USB Communication:
- PC Computer turned on
- MPI-2 connected to PC computer.

COMMUNICATION PROBLEM (USB)	
STATUS	WHAT TO DO
Light is OFF	– Check USB connection between MPI-2 and PC computer. – Check USB operation on PC computer (hardware or Windows drivers).
Light is GREEN	– Connections are GOOD. Communication can take place on USB side.

Prerequisite for CAN Communication:

1. MPI-2 connected to diagnostic connector.
2. The tether chord cap (D.E.S.S. key) installed on engine cut-off switch.
3. B.U.D.S. started and logged.

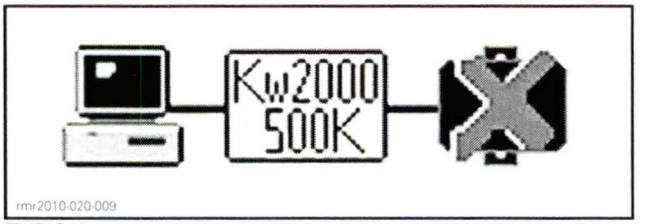
COMMUNICATION PROBLEM (CAN)	
STATUS	WHAT TO DO
Light is OFF	– Check connection between MPI-2 and diagnostic cable connector. – Check connection between diagnostic cable connector and T-harness. – Check connection between T-harness and diagnostic connector. – Check that battery supply cable is connected to a 12 V battery. – Check that ECM is powered.
Light is RED	– Check CAN wires and connectors on vehicle.
Light is GREEN	– Connections are GOOD. Communication can take place on USB side.

Communication Problems with B.U.D.S.

Vehicle not Detected in B.U.D.S.:

Make sure both USB and CAN lights on the MPI-2 are GREEN.

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

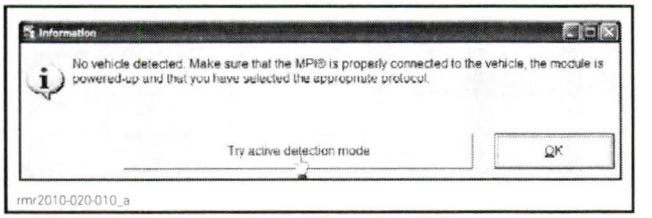


TYPICAL

Check the following:

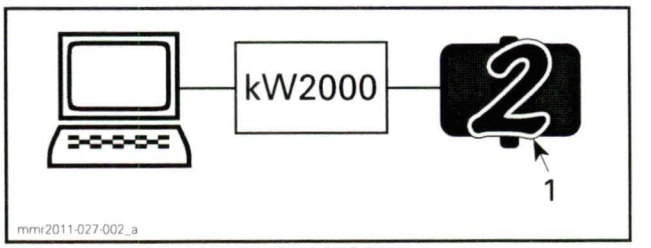
- Connections between the PC computer and the vehicle.
- The multifunction gauge is powered up.

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



One or More ECU is not Communicating with the MPI

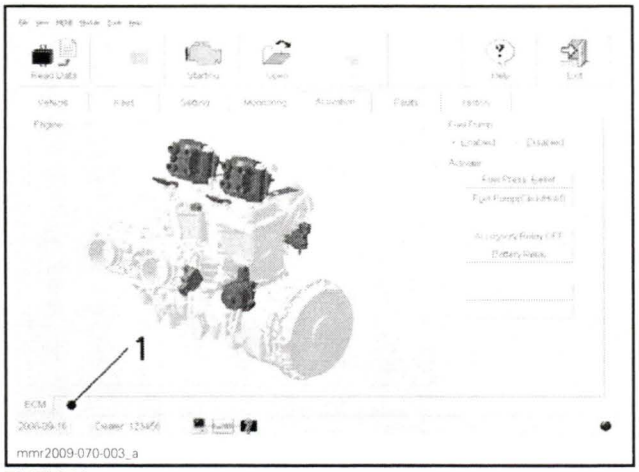
Ensure the status bar shows the appropriate communication protocol and number of modules according to the vehicle model.



TYPICAL — CONNECTION SUCCESSFUL
1. Number of modules

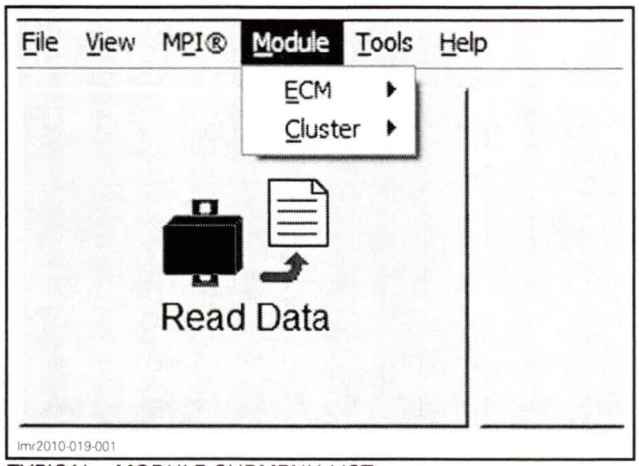
MODEL	NUMBER OF MODULES	PROTOCOL
550F	1 (gauge only)	Kw2000
600 HO E-TEC	2 (ECM and gauge)	
600 ACE		Kw2000/500K

If one or more ECU is (are) not communicating with the MPI, a module may not be properly connected, powered, or is defective. To check which module is missing in B.U.D.S., look for its page tab at the bottom of the B.U.D.S. window. It will not be visible. Then check the wiring and power supply to that module.



TYPICAL
1. Cluster tab not visible meaning this ECU is not communicating

NOTE: The module submenu will also provide a list of modules that are communicating with B.U.D.S.



TYPICAL - MODULE SUBMENU LIST

If the module is missing, check wiring and power supply to that module.

Engine cannot be Started when Using B.U.D.S.

600 ACE Models

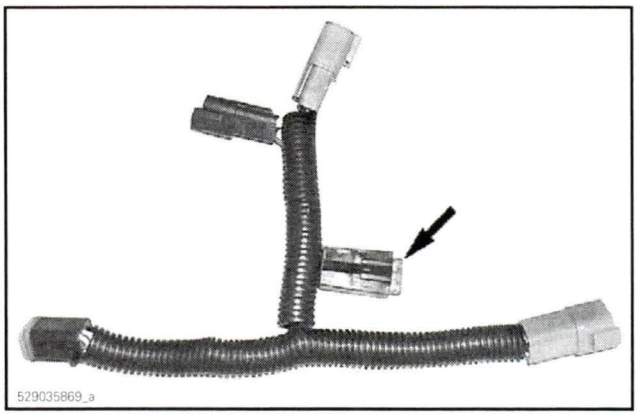
If the engine cannot be started when using B.U.D.S. proceed as follows:

1. Remove tether chord cap (D.E.S.S. key) from engine cut-off switch.
2. Disconnect T-harness from the diagnostic connector.
3. Wait until the ECM shuts down (indicated by the gauge that turns off after approximately 10 seconds).
4. Install tether chord cap on engine cut-off switch.
5. Connect T-harness to the diagnostic connector.
6. Start B.U.D.S. and logon.
7. In B.U.D.S., click **Read Data**.
8. Start engine.

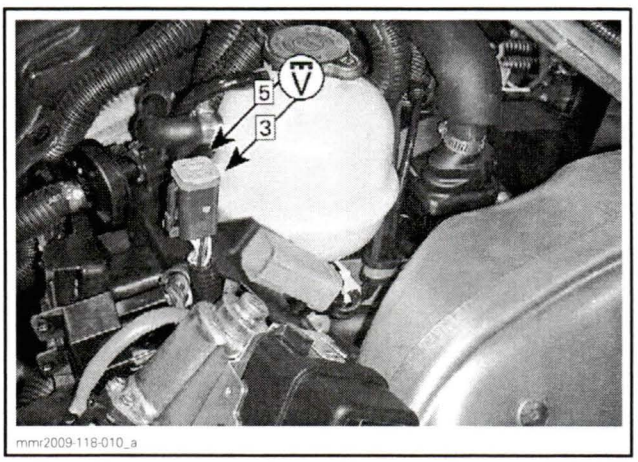
T-Harness Test

When the T-HARNESS (P/N 529 035 869) is connected to the vehicle diagnostic connector, the multifunction gauge should turn on. Otherwise, check the following and repair or replace T-harness if any test failed.

1. T-harness fuse.

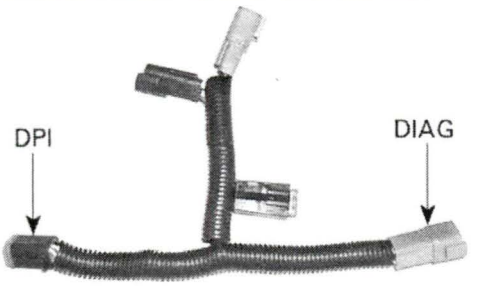


2. Vehicle battery voltage.
   2.1 Charge battery if it is too low.
3. Battery power between pins 5 and 3 of vehicle diagnostic connector.



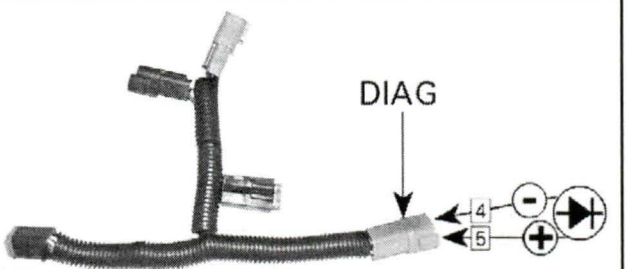
   3.1 If battery voltage is not read, check vehicle wiring harness.
4. Wiring and connectors of the T-harness.

T-HARNESS CONTINUITY TEST			
DPI CONNECTOR	DIAG CONNECTOR	FUNCTION	TEST
1	1	CAN line	Continuity (close to 0 Ω)
2	2	CAN line	
3	3	Ground	
4	4	None	N.A.
5	5	Vehicle battery	Continuity (close to 0 Ω)
6	6	None	N.A.

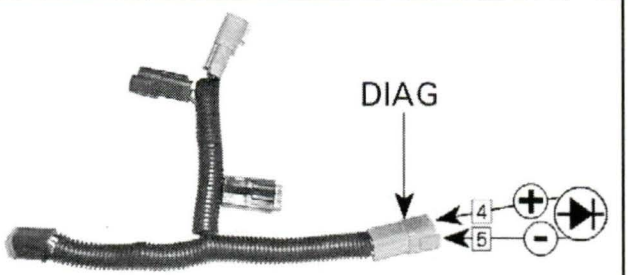


5. Diode in the T-harness.

T-HARNESS DIODE TEST		
DIAG CONNECTOR		TEST
FROM	TO	
5	4	Close to 0.5 V



4	5	Open



NOTES: Set multimeter to: ⊣⊢

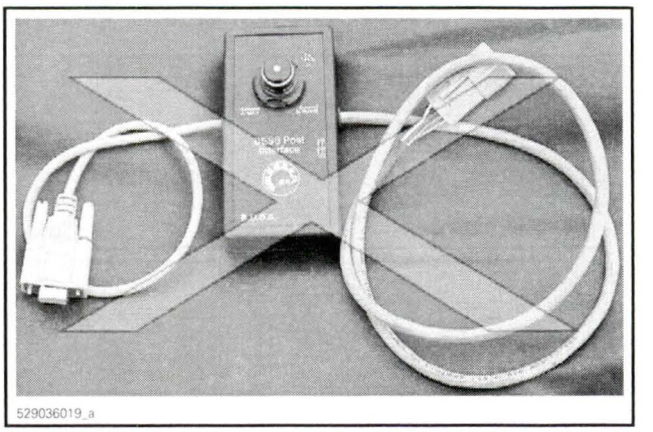
Probe diode paying attention to proper polarity. The + sign indicates the RED probe.

PROCEDURES

MULTI-PURPOSE INTERFACE-2 (MPI-2)

The MPI-2 (Multi-Purpose Interface-2) is used with B.U.D.S to communicate with the ECM (engine control module) and other modules such as the multifunction gauge.

NOTICE Do not use the D.E.S.S. post interface.



MPI-2 Power

The MPI-2 uses the PC computer USB port for its power supply.

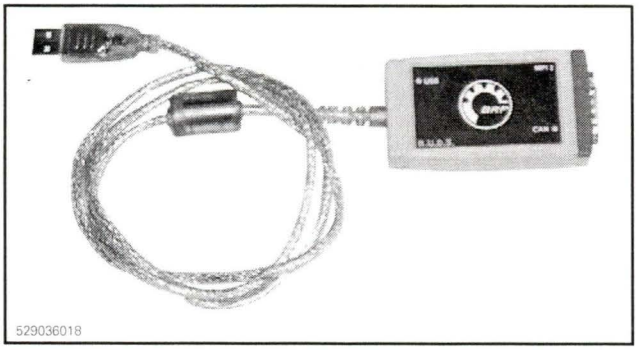
Connecting the PC to the Vehicle

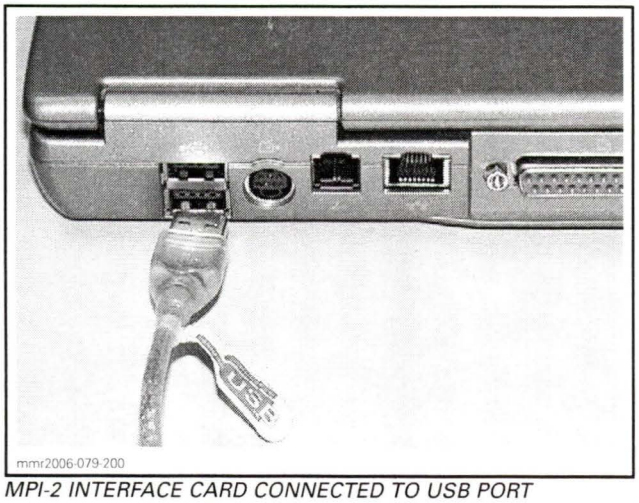
⚠ WARNING

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

NOTE: Some components will generate heat when leaving vehicle in diagnostic mode for a long period. Always disconnect MPI supply harness and supply cable from vehicle/battery when not working on vehicle.

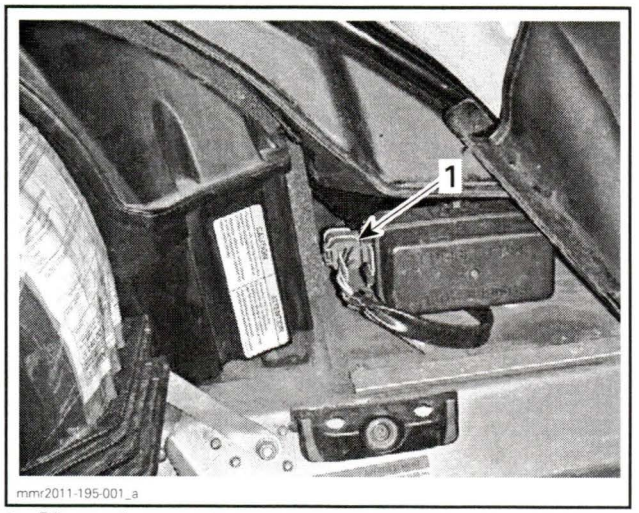
1. Connect the MPI-2 INTERFACE CARD (P/N 529 036 018) to the USB port of a PC (personal computer).





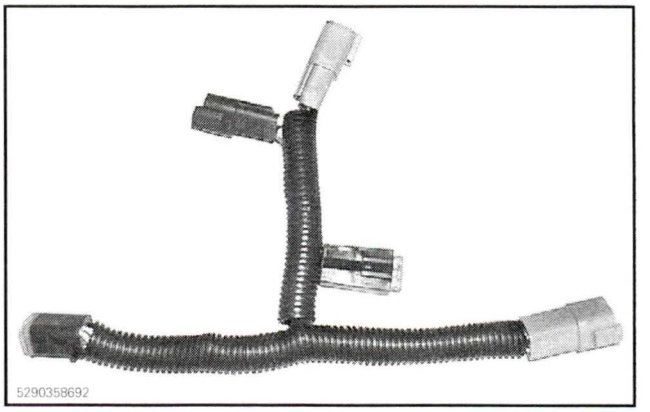
MPI-2 INTERFACE CARD CONNECTED TO USB PORT

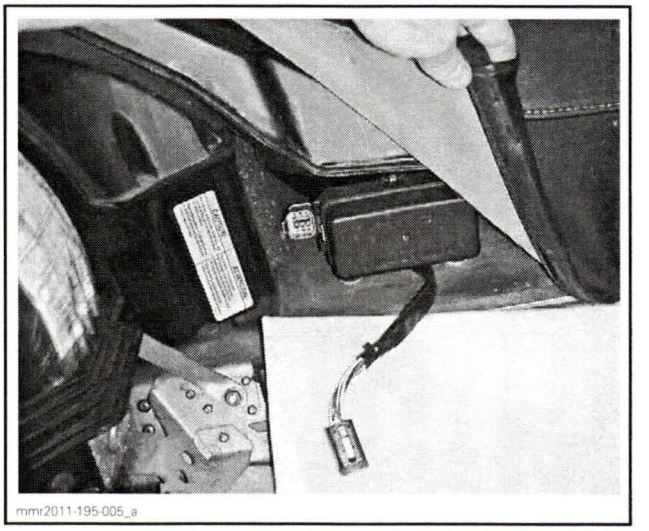
2. Remove the diagnostic connector from the protective cap besides fuse box on the left side of the vehicle.



1. Diagnostic connector

3. Connect the T-HARNESS (P/N 529 035 869) to vehicle diagnostic connector.

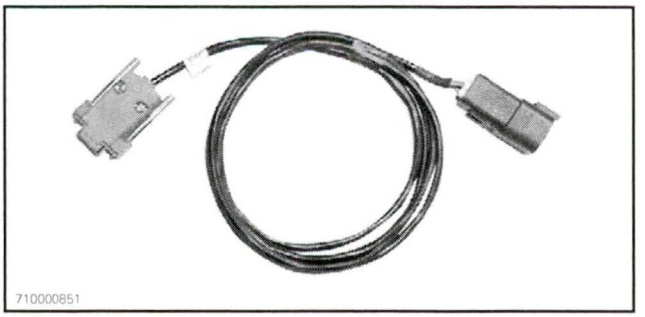


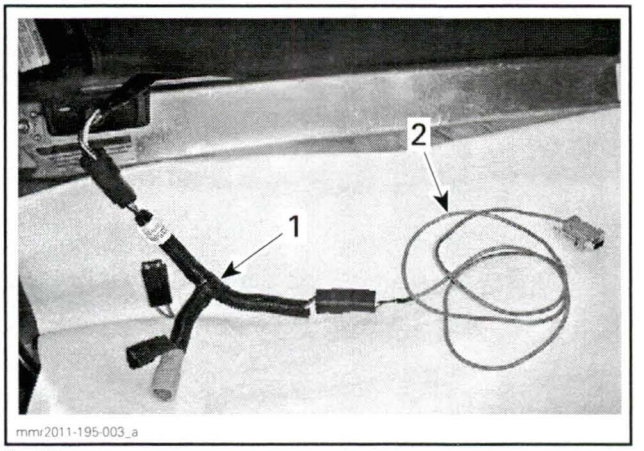




1. Diagnostic connector
2. T-harness

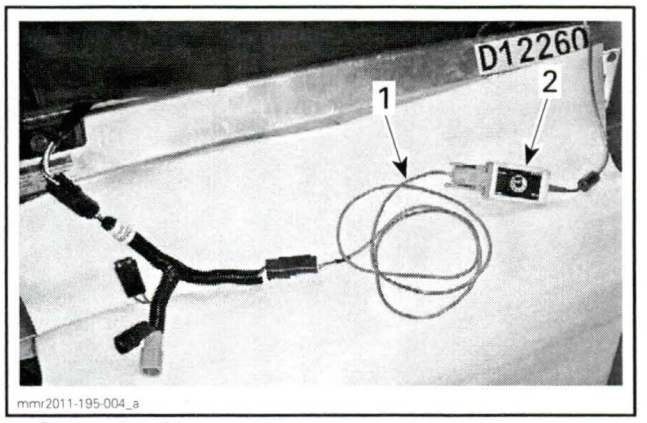
4. Connect the MPI-2 DIAGNOSTIC CABLE (P/N 710 000 851) to the T-harness connector.





1. T-harness
2. Diagnostic cable connected to T-harness

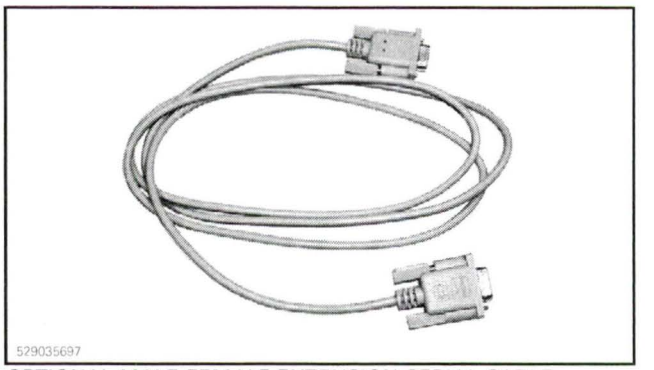
5. Connect the MPI-2 interface card to the diagnostic cable.



1. Diagnostic cable
2. MPI-2 interface card

NOTICE **Connecting MPI-2 directly to diagnostic connector (without T-harness) may prevent proper communication. Always use the T-harness.**

NOTE: An optional MALE-FEMALE EXTENSION SERIAL CABLE (P/N DB9) available at electronic retail outlets can be used. Do not exceed 7.6 m (25 ft).

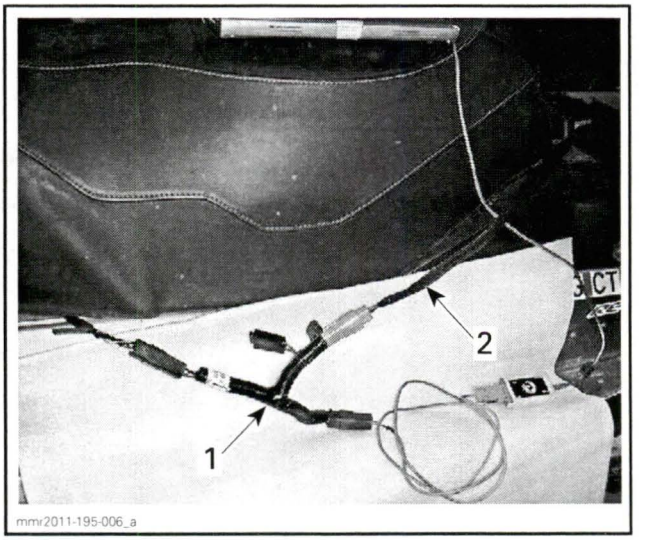


OPTIONAL MALE-FEMALE EXTENSION SERIAL CABLE

550F and 600 HO E-TEC Models

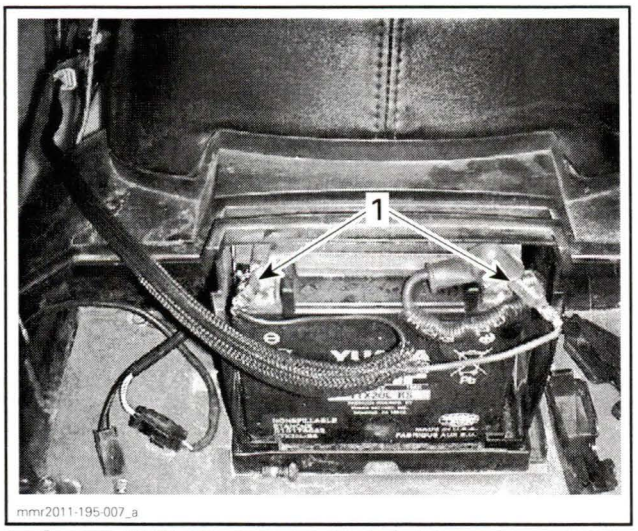
6. Connect the12 V BATTERY SUPPLY CABLE (P/N 529 035 997) to the T-harness.





1. T-harness
2. 12 V battery supply cable

7. Connect the battery supply cable to the vehicle battery posts. Ensure to match harness wire color with battery cable color.



1. Connect 12 V battery supply cable to battery posts

B.U.D.S.

B.U.D.S. (BRP Utility and Diagnostic Software) is designed to allow.

- Electrical and electronic component monitoring
- Making setting changes (such as the Closed throttle reset)
- Diagnostics
- Reading fault codes.

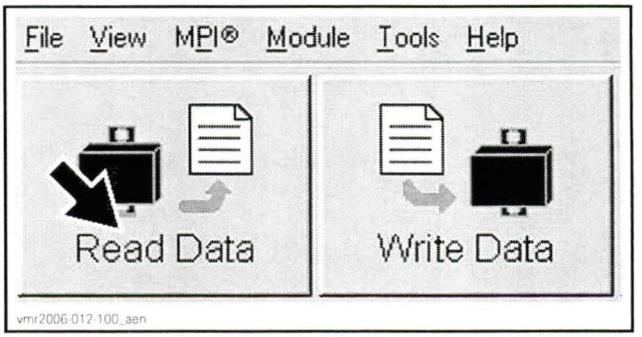
For more information pertaining to the use of the B.U.D.S. software, use its help menu which contains detailed information on its functions.

Use the latest applicable B.U.D.S. version available on BOSSWeb.

IMPORTANT: Make sure tether chord cap is on engine cut-off switch and all connections have been made **before starting B.U.D.S.** to allow proper communication initialization and operation.

Reading Data from Electronic Modules using the B.U.D.S. Software

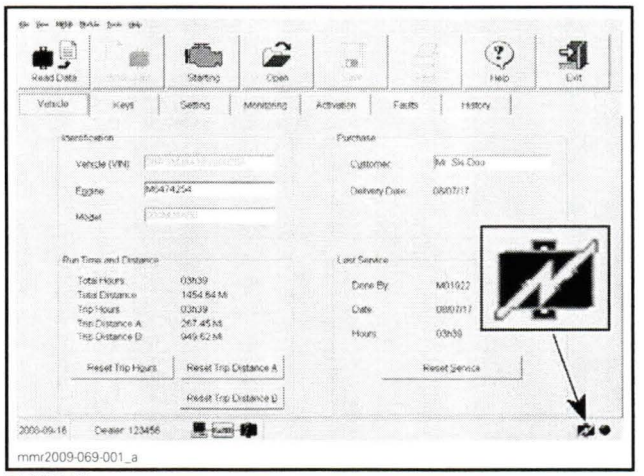
1. Install the tether cord cap (D.E.S.S. key) on the engine cut-off switch.
2. Start B.U.D.S. and logon.
3. Read ECM by clicking the **Read Data** button.



Electronic Modules (ECU) Update

NOTICE **Failure to strictly follow a procedure when updating a module may permanently damage the module.**

Whenever B.U.D.S. is started, check for an update icon in B.U.D.S. status bar.

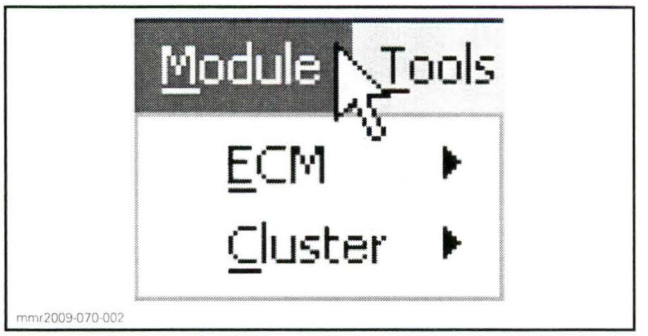


TYPICAL

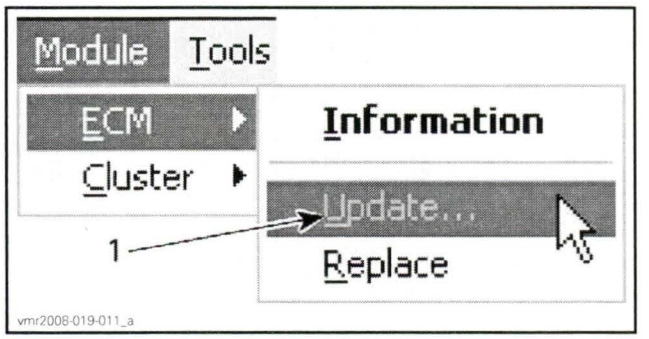
The icon indicates that a file is available in B.U.D.S. to update any of the following electronic modules: ECM or multifunction gauge (as applicable).

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

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

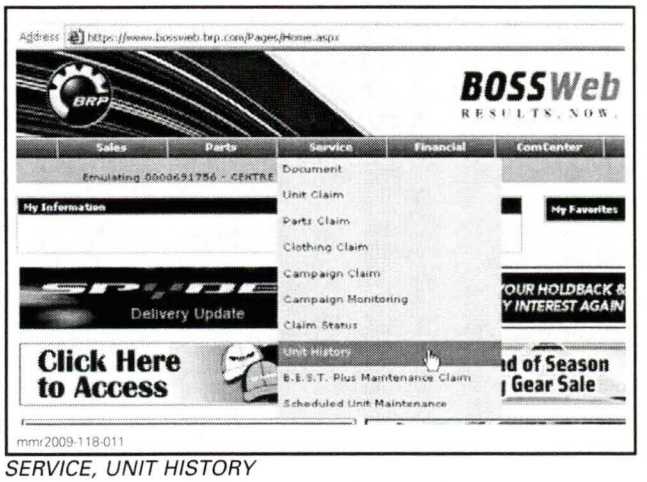


1. If the **Update** option is **greyed out**, no update file is available for this module.
2. If the **Update** option is **black**, an update file is available for this module.



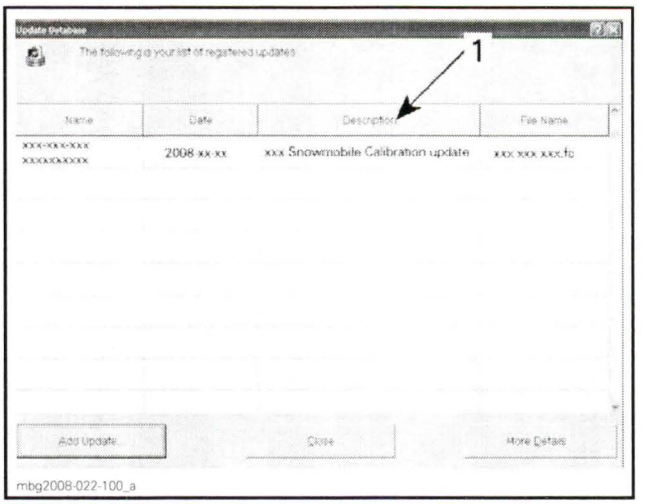
1. Greyed out: No update to perform
Black: Update file available

Before applying an update, log onto BOSSWeb and look in **Service** menu for the **Unit history** to find out if any information or publication related to the vehicle is available. If so, carefully follow the given instructions.



SERVICE, UNIT HISTORY

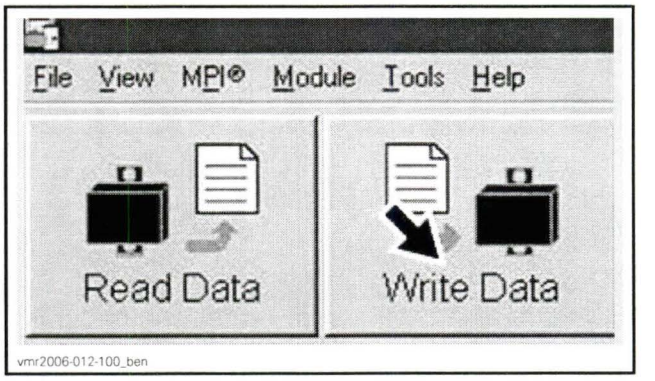
NOTE: When selecting the update menu in B.U.D.S., a dialog box will appear and the update file description may provide some clue to find the vehicle-related information in BOSSWeb.



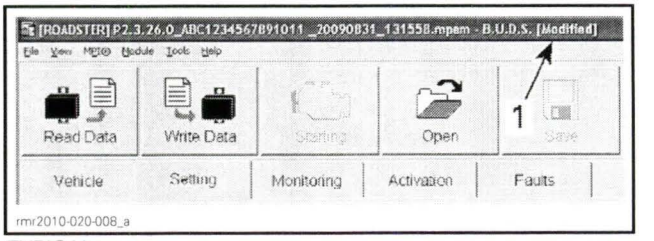
TYPICAL
1. File description

Writing Data Changes (Saving) in a Module

When making a data or setting change in a module using B.U.D.S., save the new data (or setting) in the module by clicking the **Write Data** button.



If the word **Modified** appears in the vehicle file identification number at the top of the B.U.D.S. page, then a change has been made that requires selecting the Write Data to save the change.

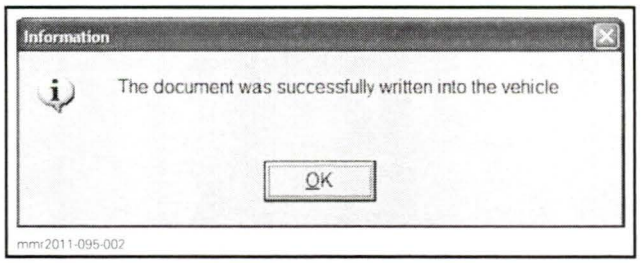


TYPICAL
1. Indicate setting or data modified; Write Data to save

If a message box appears on the PC screen after clicking the Write Data button, follow the on screen instructions.

600 ACE Models

Anytime a change is saved to the ECM through B.U.D.S., wait for the following window that confirms that the ECM has been written properly.



When this occurs, remove tether chord cap and wait until the message disappears (approximately 20 seconds after key removal).

All Models

Disconnect T-harness and other MPI connections.

Reconnect the 6-pin connector in its protective cap.

NOTICE **Failure to secure the diagnostic connector in its protective cap would allow corrosion and damage to the terminals.**

DIAGNOSTIC AND FAULT CODES (600 HO E-TEC AND 600 ACE)

GENERAL

MONITORING SYSTEM

The EMS features a monitoring system that self-diagnose its electronic components.

When a predefined condition (engine overheat for example) or a fault occurs, the ECM sends a signal to the multifunction gauge and/or audible signals to a beeper to inform you of this particular condition.

The ECM monitors the following functions and components.

600 HO E-TEC

COMPONENT
EMS (ECM, TPS, CTS, CPS, knock sensor, RAVE valve solenoids, APS, ATS, EGTS, RPS, ignition coils and fuel injectors)
12 V overload and 55 V voltage
D.E.S.S.
Low oil level, electronic oil injection pump
Engine RPM
Coolant temperature
CAN
CTS
Starter solenoid
Fuel pump
Charging system relay

600 ACE

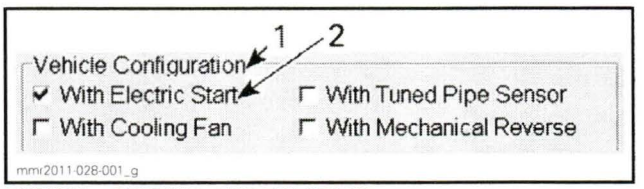
COMPONENT
EMS (ECM, TPS, CPS, MAPTS, OPS, CTS, RVPS, IACV, ignition coils and fuel injectors)
12 V low/high voltage and overload
D.E.S.S.
Relays (R1, R2 and R3)
Engine oil pressure
Engine RPM
Coolant temperature
CAN
Starter solenoid
Fuel pump

Battery Charging Relay Monitoring

600 HO E-TEC

To enable the battery charging relay to be monitored by the ECM, the proper option must be selected in B.U.D.S.

Connect and start B.U.D.S. Check **With Electric Start** in **ECM** page under **Setting** tab.

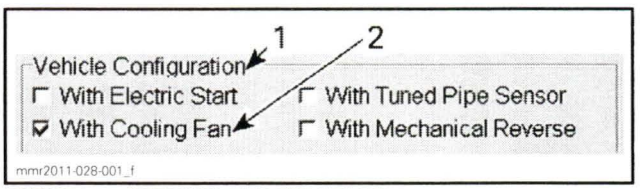


TYPICAL - SETTING AND ECM TABS
1. *Vehicle configuration area*
2. *Check*

Cooling Fan Relay Monitoring

To enable the cooling fan relay to be monitored by the ECM, the proper option must be selected in B.U.D.S.

Connect and start B.U.D.S. Check **With Cooling Fan** in **ECM** page under **Setting** tab.



TYPICAL — SETTING AND ECM TABS
1. *Vehicle configuration area*
2. *Check*

Limp Home Mode

The ECM may automatically set default parameters to ensure the safe operation of the vehicle if a component of the engine management system is not operating properly.

NOTE: Sensor failures will not automatically result in limp home mode. The check engine LED will turn on and in some cases the beeper will sound.

The engine RPM may be limited if some critical components fail. In this case, releasing the throttle and letting the engine return to idle speed may allow normal operation to come back. If it does not, try removing the tether cord, wait until multifunction gauge turns off then reinstall tether cord.

These performance-reduced modes allow the rider to continue on to seek help, or return home while minimizing the risk of a complete power loss due to engine failure.

EMS Action According to Malfunctions

600 HO E-TEC

EMS ACTION	CAUSE
Engine is gradually stopped. Continuous fast short beeps and a shutdown message is displayed in multifunction gauge until shutdown.	Fuel pump wiring short circuit to ground or open circuit.
	Fuel pump current requirement is too high.
	Engine idle overheat protection: - Engine idled more than 5 seconds and engine temperature increased above 95°C (203°F). - Engine idled more than 5 minutes and engine temperature increased above 37°C (99°F).
Engine speed is limited to 2500 RPM.	D.E.S.S. key is not recognized by the ECM. The antitheft system is active. RAVE valves are kept at closed position.
Engine speed is limited to 5500 RPM (RAVE valves are kept closed).	Oil injection pump wiring shorted to ground or open circuit.
	Low voltage in the 55 Vdc system. Voltage dropped by 5 V.
	Engine overheat (85°C (185°F)). ECM overheat (100°C (212°F) and above).
	Exhaust gas temperature too high (800°C (1,472°F) and above).
	High engine detonation.

600 ACE

EMS ACTION	CAUSE
Engine speed is limited to 2000 RPM.	Tether cord cap (D.E.S.S. key) is bad or unread. TPS voltage is too low or too high. Intake leakage. MAPTS (manifold absolute pressure and temperature sensor) is too low or too high.
Engine speed is limited to 2500 RPM.	Low engine oil pressure.
Engine speed is limited to 3000 RPM.	Brake lever is held down. Brake switch is stuck.
Engine speed is limited to 4500 RPM.	TPS connector is disconnected or faulty. IACV (idle air control valve) connector is disconnected or faulty. Low engine oil pressure.
Engine speed is limited to 8500 RPM.	Maximum engine RPM allowed.
Engine power is reduced.	Transmission is set to reverse.

Pilot Lamps and Beep Codes

Warning lights in the multifunction gauge and/or a beeper provide signals as to a vehicle operation feedback, or to indicate a problem.

A pilot™ lamp can flash alone or in combination with another lamp.

Beeper codes will be heard and messages (depending on gauge model) will be displayed to attract your attention and inform you of the situation.

NOTE: Message displayed is not available on all gauges.

PILOT LAMP(S)		BEEPER	MESSAGE DISPLAY (1)	DESCRIPTION
	Blinking	3 short beeps	REV. FAIL	Reverse did not engage, try again. If reverse still fails to engage, see *CHAINCASE AND REVERSE*.
	Blinking, then ON	4 short beeps every 30 seconds	ENGINE OVERHEAT	Engine is overheating, reduce speed and run in loose snow or stop engine immediately and let engine cool down. Check coolant level, refer to *MAINTENANCE*. Do not run the engine if condition persists.
	Blinking, then ON	Short beeps repeating rapidly	ENGINE OVERHEAT	Critical overheat. Stop engine immediately and let engine cool down. Check coolant level, refer to *MAINTENANCE*. Do not run the engine if condition persists.
	ON	4 short beeps every 5 minutes	LOW OIL	Two stroke engine: Injection oil level is low. Stop vehicle in a safe place then, replenish injection oil reservoir.
				Four stroke engine: Low engine oil pressure. Stop vehicle in a safe place then, check oil level. Fill to proper level.
	ON	4 short beeps every 5 minutes	LOW BAT	Indicate a low or high battery voltage condition.
			HIGH BAT	
	Blinking, then ON	4 short beeps	CHECK ENGINE	Engine fault.
—		4 short beeps every 5 minutes	KNOCK	Engine detonation (RPM is limited when this condition occurs). – Ensure recommended fuel is used. – Check fuel quality, replace if necessary.
—		4 short beeps every 5 minutes	REV LIMIT	Engine RPM limited for protection when certain faults occur.
—		Short beeps repeating rapidly	SHUTDOWN	Shutdown procedure in force due to engine overheating or fuel pump problem, remove tether cord cap from engine cut-off switch.
—		—	COMMUNICATION	Communication problem between ECM and gauge. Stop engine, remove D.E.S.S. key (tether cord cap). Wait a few minutes, then start engine.
D.E.S.S.	Blinking	2 short beeps	—	Good key, vehicle ready to operate.
		2 short beeps, repeating slowly	CHECK KEY	Unable to read key (bad connection). Make sure the key is clean and correctly snapped on post.
		Short beeps repeating rapidly	BAD KEY	Invalid key or key not programmed. Use the proper key for the vehicle or have the programmed.
 **(Blinking)**		—	—	Fuel level sender problem.

PILOT LAMP(S)	BEEPER	MESSAGE DISPLAY (1)	DESCRIPTION
—	—	THROTTLE OPEN	Throttle applied while attempting an engine start (engine cranks but won't run). Release throttle while starting.
—	—	DROWN MODE	Throttle wide open while attempting an engine start (engine cranks but won't run). Release throttle while starting.
(1) Message display is only available on premium gauge.			

FAULT CODES

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

When there is a problem, the EMS (engine management system) can provide fault codes to ease troubleshooting.

The faults registered in the ECM (engine control module) are stored in memory even when the battery is disconnected.

Fault codes are broadcast to the CAN bus and can be displayed in B.U.D.S. or in the premium multifunction gauge.

Many simultaneous fault codes are likely caused by burnt fuse(s), a faulty relay or a problem with the vehicle wiring harness.

When troubleshooting using the service actions suggested in the **Fault** section of B.U.D.S., a system circuit may be referred to as follows:

MODEL	SYSTEM CIRCUIT REFERENCE	MEANING
600 HO E-TEC	J1A-26	Connector "J1A" on the ECM at the pin 26
600 ACE	A-J1	Connector "A" on the ECM at the pin J1

IMPORTANT: After a problem has been solved, ensure to clear the fault(s) in the ECM using the B.U.D.S. software. This will properly reset their states.

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

Refer to *COMMUNICATION TOOLS/B.U.D.S. SOFTWARE* subsection.

For more information pertaining to the faults code status and report, refer to B.U.D.S. online help or to the EMS fault code tables.

How to Read Fault Codes on the Premium Multifunction Gauge

Fault codes can also be displayed in the premium multifunction gauge. Refer to *LIGHTS, GAUGE AND ACCESSORIES* subsection.

SPECIFIC FAULT CODES

The following gives additional information related to specific fault codes.

Fault Code P062C

600 ACE

If the speedometer functions properly, you can ignore this fault code.

Fault Code P16C0, P16C1, P16C2 and P16C9

600 ACE

Check emergency engine stop switch and engine cut-off switch. If they test good and function properly, you can ignore these fault codes.

Fault Code P2279

600 ACE

Check intake system for leaks.

- If there is no leak and engine runs normally. Check for a faulty MAPTS (manifold absolute pressure and temperature sensor), a faulty TPS (throttle position sensor) or for a cracked air intake silencer.
- If there is no leak and the fault code persists, check for fault codes pertaining to the IACV (idle air control valve) or MAPTS.

Fault Code U0155

600 ACE

If the tachometer functions properly, you can ignore this fault code.

FAULT CODE TABLE (600 HO E-TEC)

The fault code table uses the same acronyms and connector identification as per wiring diagrams.

NOTE: The following fault code tables were up to date as of printing. For the latest fault codes, use B.U.D.S.

FAULT CODE	REPORTING MODULE	DESCRIPTION	POSSIBLE CAUSE	SERVICE ACTION
P0079	ECM	E-RAVE® solenoid open circuit or shorted to ground	Disconnected E-RAVE solenoid. Damaged E-RAVE solenoid, wires or terminals.	Check for approximately 12 volts between E-RAVE solenoid RD/OR wire and chassis. Check for approximately 30 ohms between E-RAVE solenoid terminals. Check system circuit J1B-22.
P0106	ECM	Intake air pressure sensor functional problem	Damaged air pressure sensor inside in the ECM.	Replace the ECM.
P0107	ECM	Intake air pressure sensor voltage too low	Damaged air pressure sensor inside in the ECM.	Replace the ECM.
P0108	ECM	Intake air pressure sensor voltage too high	Damaged air pressure sensor inside in the ECM.	Replace the ECM.
P0111	ECM	Air temperature sensor functional problem	Intermittent air temperature sensor reading or circuit wires shorted to ground.	Check system circuits J1A-20 for continuity to terminal 2 of the ATS connector and J1A-27 for continuity to terminal 1 of the ATS connector. Check circuits J1A-20 and J1A-27 for resistivity to ground. Sensor can have an intermittent reading, replace the sensor if necessary.
P0112	ECM	Air temperature sensor voltage too low	Air temperature sensor or circuit wires shorted to ground.	Disconnect the sensor and check for a change in the fault code. If the fault code stays the same, look for a short circuit on the harness. If the fault code is different, replace the sensor. Check system circuits J1A-20 for continuity to terminal 2 of the ATS connector. Check system circuits J1A-20 for resistivity to ground.
P0113	ECM	Air temperature sensor voltage too high	Disconnected sensor or sensor's resistance too high.	Check for disconnected air temperature sensor on the airbox. Check the air temperature sensor for approximately 2280 to 2736 ohms at 19 to 21°C (66 to 70°F). Replace the sensor if necessary. Check system circuits J1A-20 for continuity to terminal 2 of the ATS connector and J1A-27 for continuity to terminal 1 of the ATS connector.

FAULT CODE	REPORTING MODULE	DESCRIPTION	POSSIBLE CAUSE	SERVICE ACTION
P0116	ECM	Coolant temperature sensor functional problem	Intermittent coolant temperature sensor reading or circuit wires shorted to ground.	Check system circuit J1A-19 for continuity to terminal 1 of the CTS connector and J1A-27 for continuity to terminal 2 of the CTS connector. Check circuit J1A-19 and J1A-27 for resistivity to ground. Replace the sensor if necessary.
P0117	ECM	Coolant temperature sensor voltage too low	Coolant temperature sensor or circuit wires shorted to ground.	Disconnect the sensor and check for a change in the fault code. If the fault code stays the same, look for a short circuit on the harness. If the fault code is different, replace the sensor. Check for leakage between sensor's connection and ground. Check system circuit J1A-19 for continuity to terminal 1 of the CTS connector and J1A-27 for continuity to terminal 2 of the CTS connector. Check circuit J1A-19 and J1A-27 for resistivity to ground.
P0118	ECM	Coolant temperature sensor voltage too high	Disconnected sensor or sensor's resistance too high.	Check for disconnected coolant temperature sensor. Check the engine temperature sensor for approximately 2280 to 2736 ohms at 19 to 21°C (66 to 70°F). Replace the sensor if necessary. Check system circuit J1A-19 for continuity to terminal 1 of the CTS connector and J1A-27 for continuity to terminal 2 of the CTS connector.
P0121	ECM	Throttle position sensor 1 functional problem	Damaged circuit wires or connector, damaged throttle position sensor.	Check throttle position sensor connector for 5 volts between pin 1 and 2. Check system circuits J1A-10 for continuity to terminal 1 of the TPS connector, J1A-26 for continuity to terminal 2 of the TPS connector and J1A-18 for continuity to terminal 3 of the TPS connector. Refer to the *SHOP MANUAL* for complete throttle position sensor testing procedure.

FAULT CODE	REPORTING MODULE	DESCRIPTION	POSSIBLE CAUSE	SERVICE ACTION
P0122	ECM	Throttle position sensor 1 voltage too low	Damaged circuit wires, damaged throttle position sensor or damaged ECM pins.	Check throttle position sensor connector for 5 volts between pin 1 and 2. Check system circuits J1A-10 for continuity to terminal 1 of the TPS connector, J1A-26 for continuity to terminal 2 of the TPS connector and J1A-18 for continuity to terminal 3 of the TPS connector. Refer to the *SHOP MANUAL* for complete throttle position sensor testing procedure.
P0123	ECM	Throttle position sensor 1 voltage too high	Damaged circuit wires, damaged throttle position sensor or damaged ECM pins.	Check throttle position sensor connector for 5 volts between pin 1 and 2. Check system circuits J1A-10 for continuity to terminal 1 of the TPS connector, J1A-26 for continuity to terminal 2 of the TPS connector and J1A-18 for continuity to terminal 3 of the TPS connector. Refer to the *SHOP MANUAL* for complete throttle position sensor testing procedure.
P0217	ECM	High coolant temperature detected	Poor cooling conditions. Engine may have been idling for too long. Low coolant level. Problem with cooling system.	Check coolant level. Check condition list to find out how it happened. Check cooling system.
P0230	ECM	Fuel pump over current	Damaged circuit wires, damaged fuel pump.	Check system circuit J2-4 for continuity to terminal 1 of the fuel pump connector. Check system circuit J2-4 for resistivity to ground. Replace the fuel pump if necessary.
P0231	ECM	Fuel pump open circuit or shorted to ground	Disconnected fuel pump. Damaged fuel pump, damaged circuit wires or connectors.	Check system circuit J2-4 for continuity to terminal 1 of the fuel pump connector. Check system circuit J2-12 for continuity to terminal 2 of the fuel pump connector. Check circuit J2-4 and J2-12 for resistivity to ground.
P0261	ECM	MAG injector open circuit or shorted to ground	Damaged or disconnected injector, circuit wires or ECM output pins. Damaged ECM output stage.	Check system circuit J1B-8 for continuity to terminal 2 of the MAG injector. Check system circuit J2-13 for continuity to terminal 1 of the MAG injector. Check circuit J1B-8 for resistivity to ground. Check for approximately 2.4 ohms on injector. Replace ECM.

FAULT CODE	REPORTING MODULE	DESCRIPTION	POSSIBLE CAUSE	SERVICE ACTION
P0262	ECM	MAG injector shorted to system voltage (over current)	Damaged injector, circuit wires or ECM output pins. Damaged ECM output stage.	Check for approximately 2.4 ohms on injector. Check if system circuit J1B-8 is shorted to system voltage (55 V). Replace ECM.
P0264	ECM	PTO injector open circuit or shorted to ground	Damaged or disconnected injector, circuit wires or ECM output pins. Damaged ECM output stage.	Check system circuit J1B-1 for continuity to terminal 2 of the PTO injector. Check system circuit J2-13 for continuity to terminal 1 of the PTO injector. Check circuit J1B-1 for resistivity to ground. Check for approximately 2.4 ohms on injector. Replace ECM.
P0265	ECM	PTO injector shorted to system voltage (over current)	Damaged injector, circuit wires or ECM output pins. Damaged ECM output stage.	Check for approximately 2.4 ohms on injector. Check if system circuit J1B-1 is shorted to system voltage (55 V). Replace ECM.
P0326	ECM	Knock sensor below minimum noise	Damaged or disconnected knock sensor, damaged circuit wires or damaged connector.	Check system circuits J1A-33 for continuity to terminal 2 of knock sensor connector and J1A-34 for continuity to terminal 1 of knock sensor connector. Check sensor mounting surface and torque.
P0339	ECM	Crankshaft signal fault (lost of sync)	CPS signal not plausible, damaged circuit wires, damaged connector or damaged tooth wheel.	Check for 190 to 290 ohms between terminals J1A-6 and J1A-7 of ECM connector. Check for 2 volts AC between terminals J1A-6 and J1A-7 of ECM connector while crancking the engine.
P0351	ECM	MAG ignition coil open circuit or shorted to ground	Damaged circuit wires or connector, damaged or disconnected ignition coil.	Check system circuit J1B-26 for continuity to terminal 2 of the ignition coil connector. Check for 55 volts on terminal 3 of ignition coil connector. Check for continuity between terminal 1 of ignition coil connector and chassis.
P0352	ECM	PTO ignition coil open circuit or shorted to ground	Damaged circuit wires or connector, damaged or disconnected ignition coil.	Check system circuit J1B-19 for continuity to terminal 2 of the ignition coil connector. Check for 55 volts on terminal 3 of ignition coil connector. Check for continuity between terminal 1 of ignition coil connector and chassis.

FAULT CODE	REPORTING MODULE	DESCRIPTION	POSSIBLE CAUSE	SERVICE ACTION
P0426	ECM	Exhaust temperature sensor functional problem	Intermittent exhaust temperature sensor reading or circuit wires shorted to ground.	Check system circuits J1A-12 for continuity to terminal 2 of the EGTS connector and J1A-27 for continuity to terminal 1 of the EGTS connector. Check circuits J1A-12 for continuity to ground. Replace the sensor if necessary.
P0427	ECM	Exhaust temperature sensor voltage too low	Exhaust temperature sensor or circuit wires shorted to ground.	Disconnect the sensor and check for a change in the fault code. If the fault code stays the same, check system circuits J1A-12 for continuity to terminal 2 of the EGTS connector and J1A-27 for continuity to terminal 1 of the EGTS connector. Check circuits J1A-12 for continuity to ground. If the fault code is different, replace the sensor.
P0428	ECM	Exhaust temperature sensor voltage too high	Disconnected sensor or sensor's resistance too high.	Check for disconnected exhaust gas temperature sensor. Check the exhaust temperature sensor for 215 to 225 ohms at 19 to 21°C (66 to 70°F). Replace the sensor if necessary. Check system circuits J1A-12 for continuity to terminal 2 of the EGTS connector and J1A-27 for continuity to terminal 1 of the EGTS connector. Check circuits J1A-27 for continuity to ground.
P0480	ECM	Cooling fan relay open circuit or shorted to ground	Damaged or disconnected relay, damaged circuit wires or terminals.	Check for disconnected relay, damaged circuit wires. Check system circuit J1B-18 for continuity to relay connector.
P0484	ECM	Cooling fan relay shorted to battery	Damaged relay or damaged circuit wires.	Check for damaged relay or damaged circuit wires going to J1B-18.
P0562	ECM	12 V primary circuit voltage too low	Battery failure, damaged circuit wires or connection, too much load on electrical system.	Check battery condition, check if additional accessories are connected in the circuit.
P0563	ECM	12 V primary circuit voltage too high	An external battery charger may have been used, damaged ECM.	Measure 12 V primary circuit voltage on diagnostic connector pin 3 and 5 for approximately 14 volts while engine is running. If it's higher than 15.5 volts you may have a damaged ECM. Make sure no external power is connected to the primary 12 volt circuit.
P0601	ECM	ECM memory checksum error	Damaged ECM.	Replace ECM.

FAULT CODE	REPORTING MODULE	DESCRIPTION	POSSIBLE CAUSE	SERVICE ACTION
P0608	ECM	Sensor's power supply voltage too low	Damaged circuit wires, shorted TPS or E-RAVE position sensor.	Disconnect TPS and E-RAVE position sensor. Check E-RAVE positions sensor connector for 5 volts between pin 1 and 3. Check system circuit J1A-10 for resistivity to ground.
P0667	ECM	ECM temperature sensor functional problem	Damaged temperature sensor inside in the ECM.	Replace the ECM.
P0668	ECM	ECM temperature sensor voltage too low	Damaged temperature sensor inside in the ECM.	Replace the ECM.
P0669	ECM	ECM temperature sensor voltage too high	Damaged temperature sensor inside in the ECM.	Replace the ECM.
P1124	ECM	Throttle position sensor 2 functional problem	Damaged circuit wires or connector, damaged throttle position sensor.	Check throttle position sensor connector for 5 volts between pin 1 and 2. Check system circuits J1A-10 for continuity to terminal 1 of the TPS connector, J1A-26 for continuity to terminal 2 of the TPS connector and J1A-18 for continuity to terminal 3 of the TPS connector. Refer to the *SHOP MANUAL* for complete throttle position sensor testing procedure.
P1125	ECM	Throttle position sensor 2 voltage too low	Damaged circuit wires, damaged throttle position sensor or damaged ECM pins.	Check throttle position sensor connector for 5 volts between pin 1 and 2. Check system circuits J1A-10 for continuity to terminal 1 of the TPS connector, J1A-26 for continuity to terminal 2 of the TPS connector and J1A-18 for continuity to terminal 3 of the TPS connector. Refer to the *SHOP MANUAL* for complete throttle position sensor testing procedure.
P1126	ECM	Throttle position sensor 2 voltage too high	Damaged circuit wires, damaged throttle position sensor or damaged ECM pins.	Check throttle position sensor connector for 5 volts between pin 1 and 2. Check system circuits J1A-10 for continuity to terminal 1 of the TPS connector, J1A-26 for continuity to terminal 2 of the TPS connector and J1A-18 for continuity to terminal 3 of the TPS connector. Refer to the *SHOP MANUAL* for complete throttle position sensor testing procedure.

FAULT CODE	REPORTING MODULE	DESCRIPTION	POSSIBLE CAUSE	SERVICE ACTION
P1127	ECM	Throttle position sensor signals do not match	Damaged circuit wires or connector, damaged throttle position sensor.	Check throttle position sensor connector for 5 volts between pin 1 and 2. Check system circuits J1A-10 for continuity to terminal 1 of the TPS connector, J1A-26 for continuity to terminal 2 of the TPS connector and J1A-18 for continuity to terminal 3 of the TPS connector. Refer to the *SHOP MANUAL* for complete throttle position sensor testing procedure.
P1217	ECM	Engine shutdown at idle because overheat occured	Engine coolant temperature reached a high value at idle and the engine was stopped for protection.	Avoid keeping the engine idling for too long. Inspect cooling system for leaks.
P1218	ECM	Major Engine overheat occurred	Poor cooling conditions. Engine may have been idling for too long. Low coolant level. Problem with cooling system.	Check coolant level. Check condition list to find out how it happened. Check cooling system.
P1231	ECM	Oil pump open circuit or shorted to ground	Damaged or disconnected oil pump, circuit wires or ECM output pins.	Check connection on oil pump, check system circuit J1B-23. Check WHITE/RED wire on oil pump connector for 55 volts.
P1326	ECM	High engine detonation detected on MAG side	Poor fuel quality, low fuel pressure, wrong timing offset, damaged spark plug, engine temperature too high, worn piston/ring.	Measure fuel pressure, check timing offset, check spark plug, check coolant system, check for evidence of piston erosion.
P1327	ECM	High engine detonation detected on PTO side	Poor fuel quality, low fuel pressure, wrong timing offset, damaged spark plug, engine temperature too high, worn piston/ring.	Measure fuel pressure, check timing offset, check spark plug, check coolant system, check for evidence of piston erosion.
P1351	ECM	MAG ignition shorted to system voltage	Damaged circuit wires or connector, damaged ignition coil.	Check system circuit J1B-26, check WHITE/RED wire on ignition coil connector for 55 volts.
P1352	ECM	PTO ignition shorted to system voltage	Damaged circuit wires or connector, damaged ignition coil.	Check system circuit J1B-19, check WHITE/RED wire on injector connector for 55 volts.
P1426	ECM	High exhaust gas temperature detected	Damaged sensor, low fuel pump pressure, air leak in exhaust system, poor fuel quality.	Check fuel pump pressure, check sensor and replace if necessary, check components in exhaust system.
P1471	ECM	E-RAVE® position sensor functional problem	Damaged circuit wires or connector, damaged E-RAVE position sensor.	

FAULT CODE	REPORTING MODULE	DESCRIPTION	POSSIBLE CAUSE	SERVICE ACTION
P1472	ECM	E-RAVE® position sensor voltage too low	Damaged circuit wires or connector, damaged E-RAVE position sensor.	Check E-RAVE position sensor connector for 5 volts between pin 1 and 3. Check system circuit J1A-1
P1473	ECM	E-RAVE® position sensor voltage too high	Damaged circuit wires or connector, damaged E-RAVE position sensor.	Check E-RAVE position sensor connector for 5 volts between pin 1 and 3. Check system circuit J1A-1
P1476	ECM	RAVE valve middle position not reached	Damaged bellows. Damaged or disconnected hoses. Damaged E-RAVE solenoid valve. Adjustment of the link between the two E-RAVE valves. Carbon deposit around E-RAVE parts.	Check for damaged bellows. Check for damaged or disconnected vacuum hoses. Check for damaged or disconnected pressure hoses. Check if the E-RAVE valves move freely. Clean and make the necessary adjustment if necessary.
P1477	ECM	RAVE valve close position not reached	Damaged bellows. Damaged or disconnected hoses. Damaged E-RAVE solenoid valve. Adjustment of the link between the two E-RAVE valves. Carbon deposit around E-RAVE parts.	Check for damaged bellows. Check for damaged or disconnected vacuum hoses. Check for damaged or disconnected pressure hoses. Check if the E-RAVE valves move freely. Clean and make the necessary adjustment if necessary.
P1478	ECM	RAVE valve open position not reached	Damaged bellows. Damaged or disconnected hoses. Damaged E-RAVE solenoid valve. Adjustment of the link between the two E-RAVE valves. Carbon deposit around E-RAVE parts.	Check for damaged bellows. Check for damaged or disconnected vacuum hoses. Check for damaged or disconnected pressure hoses. Check if the E-RAVE valves move freely. Clean and make the necessary adjustment if necessary.
P1520	ECM	Critical low oil level detected	Engine has run with oil level lamp lit for too long.	Fill the oil tank with proper oil type.
P1532	ECM	High ECM temperature detected	Poor fuel flow in ECM. Damaged ECM.	Check fuel system for clogged filter, damaged regulator or damaged fuel pump.
P1533	ECM	Major ECM overheat occurred	Low fuel pressure, low fuel circulation in ECM.	Check fuel pump pressure, check fuel line for pinched hose.
P1549	ECM	Major Exhaust gas overheat occurred	Damaged sensor, low fuel pump pressure, air leak in exhaust system, poor fuel quality.	Check fuel pump pressure, check sensor and replace if necessary, check components in exhaust system.

FAULT CODE	REPORTING MODULE	DESCRIPTION	POSSIBLE CAUSE	SERVICE ACTION
P1562	ECM	Low voltage on system voltage circuit	Damaged circuit wires, connector, injector, ignition coil, oil pump, capacitor or ECM.	Check for inverted wires on magneto connector, loose connection on capacitor. Check for defective component as describe in Possible Causes.
P1563	ECM	High voltage on system voltage circuit	Damaged circuit wires, connector or ECM.	Check for inverted wires on magneto connector, loose connection on capacitor.
P1621	ECM	Overload on 12 V primary circuit	Damaged circuit wires or connector.	Check RED/ORANGE circuit for damaged or shorted wires. Check tail light, headlamp or diagnostic connector.
P1622	ECM	Overload on 12 V secondary circuit	Damaged circuit wires or connector.	Check RED/YELLOW circuit for damaged or shorted wire. Check connections on visor outlet, check heated grips if equipped with standard gauge.
P1623	ECM	Overload on 12 V battery circuit	Damaged circuit wires, connector or battery.	Check RED/WHITE circuit for damaged or shorted wire. Check battery condition. A blown 30 amp fuse is a good indication of a problem with the wires or the battery.
P1656	ECM	D.E.S.S.® line shorted to ground	Damaged circuit wires or mixed up connections.	Check system circuits J1A-23 for continuity to terminal 1 of D.E.S.S. post connector, J1A-11 for continuity to terminal 3 of D.E.S.S. post connector and J1A-5 for continuity to terminal 2 of D.E.S.S. post connector. Check system circuit J1A-23 for continuity to circuit J1A-5 when D.E.S.S. key is installed on D.E.S.S. post. Check system circuit J1A-11 for continuity to the center contact of the D.E.S.S. post connector and circuit J1A-5 for continuity to the outer ring of the D.E.S.S. post. Check system circuits J1A-5, J1A-11 and J1A-23 for continuity to ground.
P1676	ECM	Battery relay open circuit or shorted to ground	Damaged or disconnected relay, circuit wires or terminals.	Check for disconnected relay, damaged circuit wires.

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FAULT CODE TABLE (600 ACE)

The fault code table uses the same acronyms and connector identification as per wiring diagrams.

NOTE: The following fault code tables were up to date as of printing. For the latest fault codes, use B.U.D.S.

FAULT CODE	DESCRIPTION	CAUSE	ACTION
P0072	Ambient Air Temperature Sensor voltage too low.	Damaged circuit wires, damaged sensor, sensor shorted to ground.	Disconnect the sensor and check for a change in the fault code. If the fault code stays the same, look for a short circuit on the harness. If the fault code is different, replace the sensor. Check system circuits ECMB-2G for continuity to terminal 2 of the ATS sensor. Check system circuits ECMB-2E for continuity to terminal 1 of the ATS sensor. Check ATS pins 1 and 2 for approximately 2280 to 2736 ohms at 19 to 21°C (66 to 70°F). Replace the sensor.
P0073	Ambient Air Temperature Sensor voltage too high.	Damaged circuit wires, damaged or disconnected sensor, sensor shorted to a supply.	Make sure sensor's connector is fully inserted. Disconnect the sensor and check for a change in the fault code. If the fault code stays the same, look for a short circuit on the harness. Check system circuits ECMA-2G for continuity to terminal 2 of the ATS sensor. Check system circuits ECMA-2E for continuity to terminal 1 of the ATS sensor. Check ATS pins 1 and 2 for approximately 2280 to 2736 ohms at 19 to 21°C (66 to 70°F). Replace the sensor.
P0107	Manifold air pressure sensor voltage too low.	Voltage on system circuit MAPTS-4 reached a low value. Sensor may be disconnected. Circuit wires MAPTS-3 or MAPTS-4 may be disconnected. No 5 volts supply on MAPTS-3 circuit. Damaged sensor.	Make sure sensor's connector is fully inserted. Check for approximately 5 volts between MAPTS sensor pins 1 and 3. Check system circuit ECMA-2H for continuity to terminal 1 of the MAPTS sensor. Check system circuit ECMA-4B for continuity to terminal 3 of the MAPTS sensor. Check system circuit ECMA-4G for continuity to terminal 4 of the MAPTS sensor.
P0108	Manifold air pressure sensor voltage too high.	Voltage on system circuit MAPTS-4 reached a high value. Circuit wire MAPTS-4 shorted to 5 or 12 volts. Circuit wire MAPTS-1 is not connected. Damaged sensor.	Make sure sensor's connector is fully inserted. If it is correct then disconnect it and perform the following tests. Check for approximately 5 volts between MAPTS sensor pins 1 and 3. Check system circuit ECMA-2H for continuity to terminal 1 of the MAPTS sensor. Check system circuit ECMA-4B for continuity to terminal 3 of the MAPTS sensor. Check system circuit ECMA-4G for continuity to terminal 4 of the MAPTS sensor.

FAULT CODE	DESCRIPTION	CAUSE	ACTION
P0112	Manifold air temperature sensor voltage too low.	Voltage on system circuit MAPTS-2 reached a low value. System circuit MAPTS-2 shorted to ground. Damaged sensor.	Disconnect the sensor and check for a change in the fault code. If the fault code stays the same, look for a short circuit on the harness. If the fault code is different, replace the sensor. Check MAPTS sensor pins 1 and 2 for approximately 2280 to 2736 ohms at 19 to 21°C (66 to 70°F). If the sensor resistivity is out of range replace the sensor. If the sensor resistivity is correct accordin to the specified temperature range then check circuit wire MAPTS-2 for a short to the ground.
P0113	Manifold air temperature sensor voltage too high.	Voltage on system circuit MAPTS-2 reached a high value. Sensor may be disconnected. Circuit wires MAPTS-1 or MAPTS-2 may be disconnected. Damaged sensor.	Make sure sensor's connector is fully inserted. If it is correct then disconnect it and perform the following tests. Check MAPTS sensor pins 1 and 2 for approximately 2280 to 2736 ohms at 19 to 21°C (66 to 70°F). If the sensor resistivity is out of range replace the sensor. Check system circuits ECMA-3H for continuity to terminal 2 of the MAPTS sensor. Check system circuits ECMA-2H for continuity to terminal 1 of the MAPTS sensor.
P0117	Engine coolant temperature sensor voltage too low.	Voltage on system circuit CTS-2 reached a low value. Circuit wire CTS-2 shorted to ground. Damaged sensor.	Disconnect the sensor and check for a change in the fault code. If the fault code stays the same, look for a short circuit on the harness. If the fault code is different, replace the sensor. Check system circuit CTS-2 for resistivity to ground (Expected value = 1.2 Kohms when ECMA connector is still connected). Check system circuit ECMA-1A for continuity to terminal 1 of the CTS connector and ECMA-2J for continuity to terminal 2 of the CTS connector. Check CTS sensor pins for approximately 2280 to 2736 ohms at 19 to 21°C (66 to 70°F). If the sensor resistivity is out of range replace the sensor.
P0118	Engine coolant temperature sensor voltage too high.	Voltage on system circuit CTS-2 reached a high value. Sensor may be disconnected. Circuit wires CTS-1 or CTS-2 may be disconnected. Circuit CTS-2 shorted to 5 or 12 volts. Damaged sensor.	Make sure sensor's connector is fully inserted. Check system circuit ECMA-1A for continuity to terminal 1 of the CTS connector and ECMA-2J for continuity to terminal 2 of the CTS connector. Check CTS resistivity on the sensor pins for approximately 2280 to 2736 ohms at 19 to 21°C (66 to 70°F). If the sensor resistivity is out of range replace the sensor.
P0127	Torque reduction due to high manifold air temperature.	Temperature detected by the MAPTS sensor exceeded 75°C (167°F).	

FAULT CODE	DESCRIPTION	CAUSE	ACTION
P0201	Injector Cyl. #1 (PTO) open circuit.	Circuit wires INJ1-1 or INJ1-2 open circuit. Blown fuse. Disconnected injector connector. Disconnected HIC connector. Injector coil open circuit.	Check fuse F5. Make sure sensor's connector is fully inserted. Make sure HIC connector is connected. Check system circuit ECMA-1J for continuity to pin 2 of INJ1 connector. Check system circuit PF1-6B for continuity to pin 1 of INJ1 connector. Check injector resistivity for approximately 14.5 ohms.
P0202	Injector Cyl. #2 (MAG) open circuit.	Circuit wires INJ2-1 or INJ2-2 open circuit. Blown fuse. Disconnected injector connector. Disconnected HIC connector. Injector coil open circuit.	Check fuse F5. Make sure sensor's connector is fully inserted. Make sure HIC connector is connected. Check system circuit ECMA-1K for continuity to pin 2 of INJ1 connector. Check system circuit PF1-6C for continuity to pin 1 of INJ1 connector. Check injector resistivity for approximately 14.5 ohms.
P0217	Torque reduction due to high engine coolant temperature.	Warm riding condition, lack of cooling	Check coolant level. Check for air pocket in cooling system.
P0231	Fuel pump open circuit or shorted to ground.	There is no load on circuit wire PE-A or it is shorted to ground. Blown fuse. Fuel pump connector is not connected. Fuel pump motor is shorted.	Check fuse F3. Make sure the fuel pump connector is fully inserted. With vehicule power ON check voltage on PE-C connector (Expected value = battery voltage). Check system circuit ECMB-1M for continuity to PE-A connector.
P0232	Fuel pump shorted to battery.	Circuit wire PE-A is shorted to 12 volts. Fuel pump motor is stuck or shorted.	Disconnect the fuel pump or remove fuse F3 and check if the fault disapears. If it does then replace the fuel pump. Ckeck if system circuits PE-A and PE-C are shorted together.
P0261	Injector Cyl. #1 (PTO) shorted to ground.	Circuit wire INJ1-2 is shorted to ground.	Disconnect injector 1. With vehicule power ON and engine not running, check the voltage on pin 2 of the INJ1 connector (Expected value = around 3.3 volts). If the voltage is close to 0 volt remove the power from vehicle and check for resistivity to ground on pin2 of the INJ1 connector (Expected value = open circuit). If the reading is close to 0 ohm check for a short to the ground on this circuit.
P0262	Injector Cyl. #1 (PTO) shorted to battery.	Circuit wire INJ1-2 is shorted to battery. Injector coil is shorted.	Disconnect injector 1. Measure resistance between injector pin 1 and 2 (Expected value = 14 to 15 ohms). With vehicule power ON and engine not running, check the voltage on pin 2 of the INJ1 connector (Expected value = around 3.3 volts). If the voltage is close to 12 volts check for a short to 12 volts on this circuit.

FAULT CODE	DESCRIPTION	CAUSE	ACTION
P0264	Injector Cyl. #2 (MAG) shorted to ground.	Circuit wire INJ2-2 is shorted to ground.	Disconnect injector 2. With vehicle power ON and engine not running, check the voltage on pin 2 of the INJ2 connector (Expected value = around 3.3 volts). If the voltage is close to 0 volt remove the power from vehicle and check for resistivity to ground on pin2 of the INJ2 connector (Expected value = open circuit). If the reading is close to 0 ohm check for a short to the ground on this circuit.
P0265	Injector Cyl. #2 (MAG) shorted to battery.	Circuit wire INJ2-2 is shorted to battery. Injector coil is shorted.	Disconnect injector 2. Measure resistance between injector pin 1 and 2 (Expected value = 14 to15 ohms). With vehicule power ON and engine not running, check the voltage on pin 2 of the INJ2 connector (Expected value = around 3.3 volts). If the voltage is close to 12 volts check for a short to 12 volts on this circuit.
P0335	Crankshaft signal fault.	Intermittent signal from crankshaft position sensor. Damaged circuit wires, damaged sensor. Sensor may not be properly secured.	Make sure sensor connector is fully inserted. Measure resistance from connector: ECMA-1H to CPS-1 (Expected value: < 2 ohms) Measure resistance from connector: ECMA-2K to CPS-2 (Expected value: < 2 ohms)
P0359	Ignition coil Cyl. #2 (MAG) shorted to battery.	Circuit wire IGN2-2 is shorted to battery. Ignition coil is damaged.	Disconnect ignition coil #2. With vehicule power ON and engine not running check voltage on pin 3 of IGN2 connector. (Expected value = 0 volt). If voltage is close to 12 volts, check for a short on this circuit.
P0360	Ignition coil Cyl. #1 (PTO) shorted to battery.	Circuit wire IGN1-2 is shorted to battery. Ignition coil is damaged.	Disconnect ignition coil #1. With vehicule power ON and engine not running check voltage on pin 3 of IGN1 connector. (Expected value = 0 volt). If voltage is close to 12 volts, check for a short on this circuit.
P0361	Ignition coil Cyl. #2 (MAG) open circuit.	Low attery Voltage, Blown fuse, damaged or disconnected ignition coil, damaged or disconnected circuit wires, damaged ECM output pins.	
P0362	Ignition coil Cyl. #1 (PTO) open circuit.	Low battery Voltage, Blown fuse, damaged or disconnected ignition coil, damaged or disconnected circuit wires, damaged ECM output pins.	

FAULT CODE	DESCRIPTION	CAUSE	ACTION
P0480	Fan relay open circuit.	Circuit wire FT-2 is open circuit. Blown fuse. Fan harness is not connected. Relay on fan harness is not connected or is damaged.	Check fuse F4. Check if FT connector is properly connected. Check if relay on the fan harness is properly connected. Check relay resistivity (Expected value = 105±2 ohms). Check system circuit FT-2 for continiuty to ECMB-4J.
P0505	Idle air control valve output open circuit.	Any wire on IACV connector may be disconnected. IACV connector is not connected. A coil in IACV actuator is open circuit. Damaged ECM.	Make sure the valve connector is fully inserted. Check resistivity on the valve's pins 1 and 4 (Expected value = 50 ohms). Check resistivity on the valve's pins 2 and 3 (Expected value = 50 ohms). Check system circuit ECMA-2B for continuity to terminal 1 of the Idle Air Control Valve (IACV) connector. Check system circuit ECMA-4A for continuity to terminal 2 of the Idle Air Control Valve (IACV) connector. Check system circuit ECMA-1C for continuity to terminal 3 of the Idle Air Control Valve (IACV) connector. Check system circuit ECMA-2C for continuity to terminal 4 of the Idle Air Control Valve (IACV) connector.
P0508	Idle air control valve output shorted to ground.	Any wire on IACV connector may be shorted to ground. Damaged IACV actuator. Damaged ECM.	Disconnect IACV connector. Check system circuit ECMA-2B for resistivity to ground (Expected value > 1 M ohms). Check system circuit ECMA-4A for resistivity to ground (Expected value > 1 M ohms). Check system circuit ECMA-1C for resistivity to ground (Expected value > 1 M ohms). Check system circuit ECMA-2C for resistivity to ground (Expected value > 1 M ohms).
P0509	Idle air control valve output stage fault.	Any wire on IACV connector may be shorted to ground. Any wire on IACV connector may be shorted to 12 volts. Damaged IACV actuator. Damaged ECM.	Disconnect IACV connector. Check system circuit ECMA-2B for resistivity to ground (Expected value > 1 M ohms). Check system circuit ECMA-4A for resistivity to ground (Expected value > 1 M ohms). Check system circuit ECMA-1C for resistivity to ground (Expected value > 1 M ohms). Check system circuit ECMA-2C for resistivity to ground (Expected value > 1 M ohms).
P0512	Starter control circuit functional problem.	Blown fuse. Starter solenoid coil is shorted. Control wire shorted to battery. Damaged ECM.	Check solenoid coil resistivity (Expected value = 7.3 ohms). With vehicule power ON check voltage on wire ORANGE/BLACK on solenoid (Expected value = Battery voltage). While holding start button check voltage on wire ORANGE/BLACK on solenoid (Expected value = 0 volt). Replace ECM.

FAULT CODE	DESCRIPTION	CAUSE	ACTION
P0520	Engine oil pressure switch functional problem.	Intermittent contact to groung on circuit wire OPS-A. Intermittent contact on oil pressure switch.	Make sure oil pressure switch connector is fully inserted. Check for leaking pressure switch. With engine stopped check switch resistivity to ground (Expected value < 2 ohms). With engine running check resistivity to ground (Expected value > 2 ohms). Check system circuit ECMA-3E for continuity to terminal of the OPS sensor.
P0524	Low oil pressure.	No oil pressure while engine is running above 2500 rpm.	Check oil level. Check system circuit ECMA-3E for continuity to terminal of the OPS sensor.
P0562	Battery voltage too low.	Battery voltage dropped under 11 volts.	Check battery voltage for 11 to 13 volts with engine stopped. Check battery voltage for 13.5 to 14.5 volts with engine speed above 2500 RPM. Check connections on regulator. Check charging system.
P0563	Battery voltage too high.	Battery voltage exceeded 15.6 volts.	Check battery voltage for 11 to 13 volts with engine stopped. Check battery voltage for 13.5 to 14.5 volts with engine speed above 2500 RPM. Check connections on regulator. Check charging system.
P0610	Variant Coding error.	Faulty variant coding, faulty programming, wrong ECM after replacement.	
P062C	Loss of vehicle speed information from cluster.	ECM lost communication with the cluster. Cluster may be disconnected. Loss of power on the cluster. Loss of communication with the cluster via the CAN bus. CAN bus lines shorted together. CAN bus line shorted to ground.	Make sure the gauge connector is fully inserted. If there is no power on the cluster while hte vehicule power is ON then check voltage on circuit CV-8 (Expected value = Battery voltage). Also check circuit CV-11 for continuity to the ground (Expected value < 2 ohms). Check continuity for communication wires WHITE/BEIGE and WHITE/BLACK (refer to wiring diagram).
P0685	Accessory relay (R2) open circuit.	Blown fuse. ECM control line ECMB-1G is open. Relay is missing or relay coil is open. Power to the relay is open.	Check fuse F2. Check relay coil resistivity (Expected value = 130 ohms). Check fuse box circuit PF2-5A voltage (Expected value = battery voltage). Check system circuit PF2-4B to ECMB-1G for continuity.
P0686	Accessory relay (R2) shorted to ground.	ECM control line ECMB-1G is shorted to ground.	With vehicule power OFF check system circuit PF2-4B for resistivity to ground (Expected value = open circuit). With vehicule power ON, engine not running and relay removed check system circuit PF2-4B voltage (Expected value = 3.3 volts).

FAULT CODE	DESCRIPTION	CAUSE	ACTION
P0687	Accessory relay (R2) shorted to battery.	ECM control line ECMB-1G is shorted to battery. Relay coil is short.	Check relay coil resistivity (Expected value = 130 ohms). Check system circuit PF2-4B for a short to 12 volts. With vehicule power OFF check system circuit PF2-4B for resistivity to ground (Expected value = open circuit). With vehicule power ON, engine not running and relay removed check system circuit PF2-4B voltage (Expected value = 3.3 volts).
P0691	Fan relay shorted to ground.	ECM control line ECMB-4J is shorted to ground.	Disconnect fan harness and perform the following tests. With vehicule power OFF check system circuit FT-2 for resistivity to ground (Expected value = open circuit). With vehicule power ON, engine not running check system circuit PF2-1B voltage (Expected value = 3.3 volts).
P0692	Fan relay shorted to battery.	ECM control line ECMB-4J is shorted to battery. Relay coil is short.	Disconnect fan harness and perform the following tests. Check relay coil resistivity (Expected value = 103 ohms). With vehicule power ON check system circuit FT-2 for a short to 12 volts (Expected value = 3.3 volts). With vehicule power OFF check system circuit FT-2 for resistivity to ground (Expected value = open circuit). With vehicule power ON, engine not running check system circuit FT-2 voltage (Expected value = 3.3 volts).
P1339	Engine phase determination error.	CPS signal not plausible, damaged circuit wires, damaged connector or damaged tooth wheel.	Check for 775 to 950 ohms between CPS pins connector.
P1672	Economizing relay (R3) shorted to battery.	ECM control line ECMB-2J is shorted to battery. Relay coil is short.	Check relay coil resistivity (Expected value = 130 ohms). Check system circuit PF2-1B for a short to 12 volts. With vehicule power OFF check system circuit PF2-4B for resistivity to ground (Expected value = open circuit). With vehicule power ON, engine not running and relay removed check system circuit PF2-1B voltage (Expected value = 3.3 volts).
P1673	Economizing relay (R3) shorted to ground.	ECM control line ECMB-2J is shorted to ground.	With vehicule power OFF check system circuit PF2-1B for resistivity to ground (Expected value = open circuit). With vehicule power ON, engine not running and relay removed check system circuit PF2-1B voltage (Expected value = 3.3 volts).

FAULT CODE	DESCRIPTION	CAUSE	ACTION
P1674	Economizing relay (R3) open circuit.	Blown fuse. ECM control line ECMB-2J is open. Relay is missing or relay coil is open. Power to the relay is open.	Check fuse F2. Check relay coil resistivity (Expected value = 130 ohms). Check fuse box circuit PF2-2A voltage (Expected value = battery voltage). Check system circuit PF2-1B to ECMB-2J for continuity.
P16C0	ECU ADC plausibility check.	Monitoring plausibility check failed.	
P16C1	ECU ADC test failed.	Monitoring plausibility check failed.	
P16C2	ECU monitoring error.	Monitoring plausibility check failed.	Check system circuit ECMB-3A for continuity to ECMB-3J.
P16C9	ECU monitoring error.	Monitoring plausibility check failed.	
P2279	Leak from plenum.	Leak in air intake system. Sensor not secured.	Check for faulty Air Pressure Sensor. Check for faulty TPS. Check for cracked plenum.
P2621	Throttle position sensor voltage too low.	Low voltage or short to ground on circuit wire TPS-3. No 3.3 volts supply on circuit wire TPS-3. Damaged sensor.	Make sure the TPS connector is fully inserted. Check for 3.3 volts between TPS connector pins 1 and 2. Check system circuit ECMA-4K for continuity to terminal 1 of the TPS sensor. Check system circuit ECMA-2A for continuity to terminal 2 of the TPS sensor. Check system circuit ECMA-3F for continuity to terminal 3 of the TPS sensor. Check resistivity on TPS sensor pins 1 and 2 (Expected value = 2.2 ± 0.2 Kohms). Check resistivity on TPS sensor pins 1 and 3 (Expected value = 920 ± 10 ohms to 2.9 ± 0.1 Kohms). Check resistivity on TPS sensor pins 2 and 3 (Expected value = 920 ± 10 ohms to 2.9 ± 0.1 Kohms).
P2622	Throttle position sensor voltage too high.	Voltage on circuit wire TPS-3 too high. Circuit wire TPS-3 shorted to 12 volts. Circuit wire TPS-2 is open.	Make sure the TPS connector is fully inserted. Check for 3.3 volts between TPS connector pins 1 and 2. Check system circuit ECMA-4K for continuity to TPS-1 connector. Check system circuit ECMA-2A for continuity to TPS-2 connector. Check system circuit ECMA-3F for continuity to TPS connector.

FAULT CODE	DESCRIPTION	CAUSE	ACTION
U0155	Lost communication on CAN BUS.	ECM lost communication with the cluster. Cluster may be disconnected. Loss of power on the cluster. Loss of communication with the cluster via the CAN bus. CAN bus lines shorted together. CAN bus line shorted to ground.	Make sure the gauge connector is fully inserted. If there is no power on the cluster while hte vehicule power is ON then check voltage on circuit CV-8 (Expected value = Battery voltage). Also check circuit CV-11 for continuity to the ground (Expected value < 2 ohms). Check continuity for communication wires WHITE/BEIGE and WHITE/BLACK (refer to wiring diagram).
U0167	No communication with D.E.S.S. key.	Damaged circuit wires, damaged or disconnected D.E.S.S post, damaged D.E.S.S key.	
U300A	State of the D.E.S.S. key switch not plausible.		

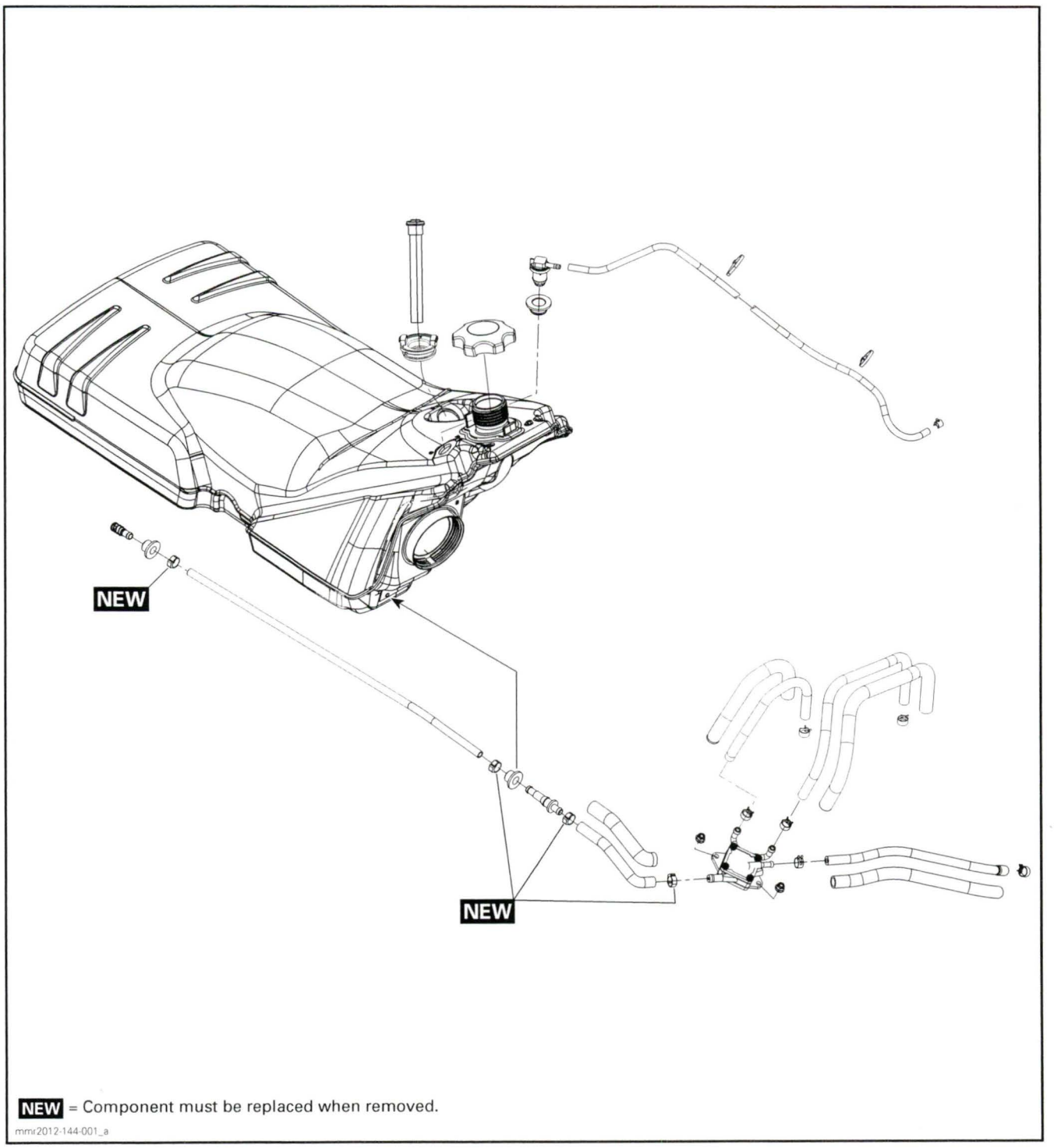
FUEL TANK AND FUEL PUMP (550F)

SERVICE TOOLS

Description	Part Number	Page
FLUKE 115 MULTIMETER	529 035 868	426–427
LEAK TEST KIT	529 033 100	420
OETIKER PLIERS	295 000 070	422
SMALL HOSE PINCHER	295 000 076	419, 422–423
SUCTION PUMP	529 035 880	422, 424
VACUUM/PRESSURE PUMP	529 021 800	420–421

SERVICE PRODUCTS

Description	Part Number	Page
DIELECTRIC GREASE	293 550 004	428
XPS BRAKES AND PARTS CLEANER	219 701 705	425



NEW = Component must be replaced when removed.

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GENERAL

⚠ WARNING

Always disconnect battery prior to working on the fuel system.

Cover the fuel line connection with an absorbent shop rag and slowly disconnect the fuel hose to minimize spilling.

⚠ WARNING

Do not allow fuel to spill on hot engine parts and/or on electrical connectors. Wipe off any fuel spillage in the engine compartment. Fuel is flammable and explosive under certain conditions.

⚠ WARNING

When replacing fuel system components, use only BRP parts. They ensure to meet proper operational and safety requirements.

⚠ WARNING

After working on the fuel system, carry out a fuel system pressurization test to check for leaks. Failure to carry out a fuel system leak test may result in severe injury or a life threatening situation should a leak occur.

SYSTEM DESCRIPTION

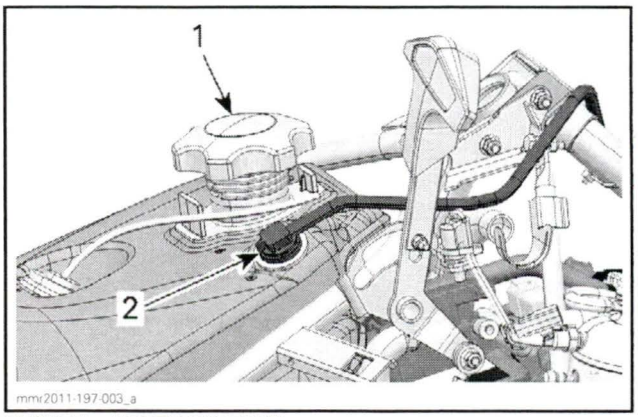
Fuel Pump

The fuel system on these models uses a diaphragm type fuel pump. Engine vacuum pulses are used to activate the diaphragm in the fuel pump when the engine is running.

The pump draws in fuel from the fuel tank outlet and pushes it to the carburetors.

Fuel Tank Vent

A simple fuel tank vent system comprised of a vent check valve is used to protect the fuel system.



TYPICAL - VENT LOCATION
1. *Fuel tank cap*
2. *Fuel tank vent valve*

The check valve, mounted on the fuel tank vent outlet, is a combination type valve. It acts as both a check valve and a pressure relief valve.

Ambient air pressure can enter the fuel tank at all times through the check valve.

As fuel is consumed by the engine, a negative press would occur in the fuel tank. This could eventually prevent the engine from receiving proper fuel press. The **negative pressure relieve function** of the valve allows the higher outside air pressure in.

If pressure in the fuel tank builds up and exceeds 2.0 kPa to 4.8 kPa (.3 PSI to .7 PSI), the **positive pressure relief function** opens the valve and lets excess pressure out of the fuel tank.

Fuel Filter

The system has one level of filtering, a fuel strainer at the fuel pick-up within the fuel tank.

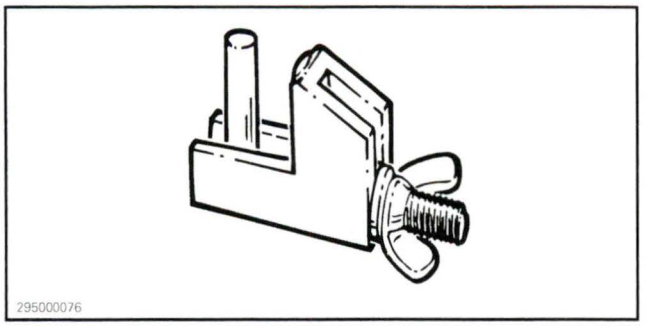
Fuel Level Sensor

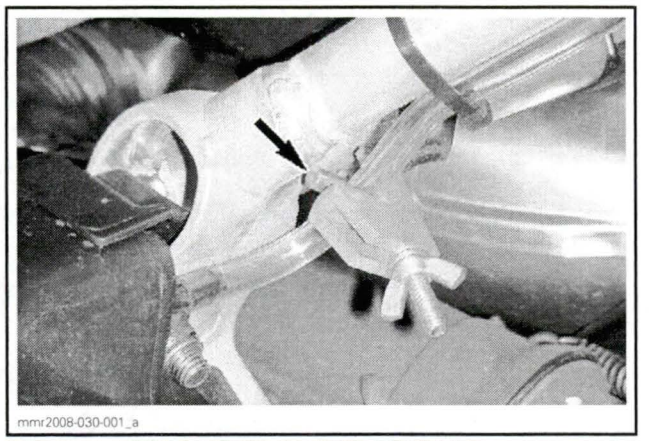
An electric float type fuel level sensor is used with the gauge for fuel level indication.

INSPECTION

FUEL SYSTEM PRESSURIZATION AND LEAK TEST

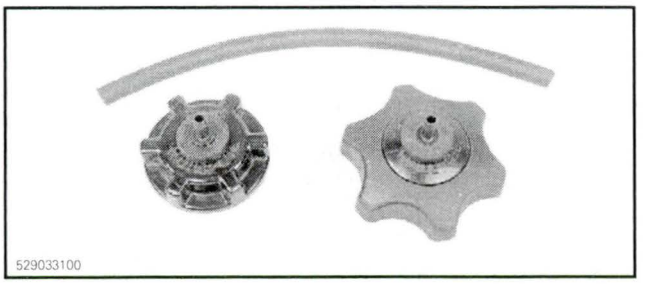
1. Fill up fuel tank.
2. Refer to *BODY* subsection and remove the following to access to fuel vent hose:
   - LH and RH side panels
   - Hood.
3. Install a SMALL HOSE PINCHER (P/N 295 000 076) on the vent line.





TYPICAL - HOSE PINCHER ON FUEL VENT LINE

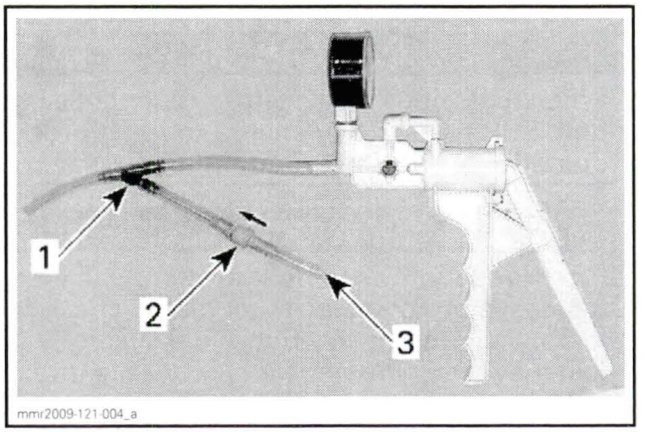
4. Remove primary air intake silencer, refer to *AIR INTAKE SYSTEM* subsection.
5. Install a hose pincher on the fuel feed line of each carburetor.
6. Remove the fuel tank cap and install the appropriate test cap from the LEAK TEST KIT (P/N 529 033 100) on fuel tank inlet.



7. Install VACUUM/PRESSURE PUMP (P/N 529 021 800) on pressure test fuel cap.



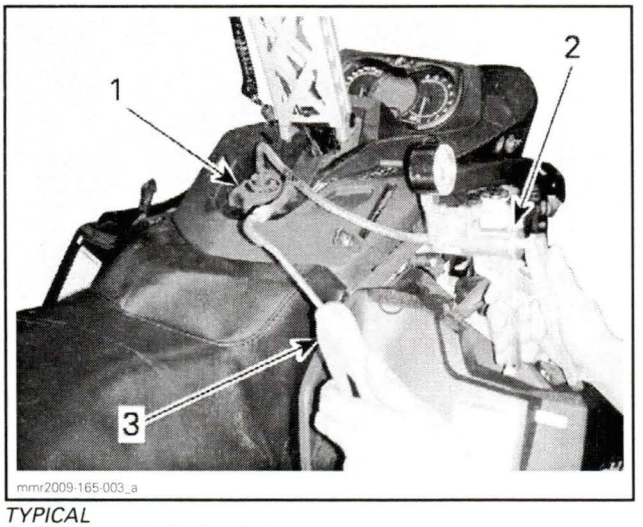
NOTE: A Y-fitting and a check valve can be installed to use compressed air for rapid pressure build-up when fuel tank is not full.



1. *Y-fitting P/N 293 710 059*
2. *Check valve P/N 275 500 505*
3. *Apply compressed air here*

8. Slowly increase air pressure in the fuel tank to near fuel tank test pressure specified in the following table.

NOTICE **Do not exceed the specification when pressurizing the fuel tank.**



TYPICAL
1. *Pressure test fuel tank cap*
2. *Vacuum/pressure pump*
3. *Compressed air supply*

9. Set pump selector to pressure.
10. Pressurize fuel tank as follows.

FUEL TANK LEAK TEST	
TEST PRESSURE	TIME WITHOUT PRESSURE DROP
21 kPa (3 PSI)	3 minutes

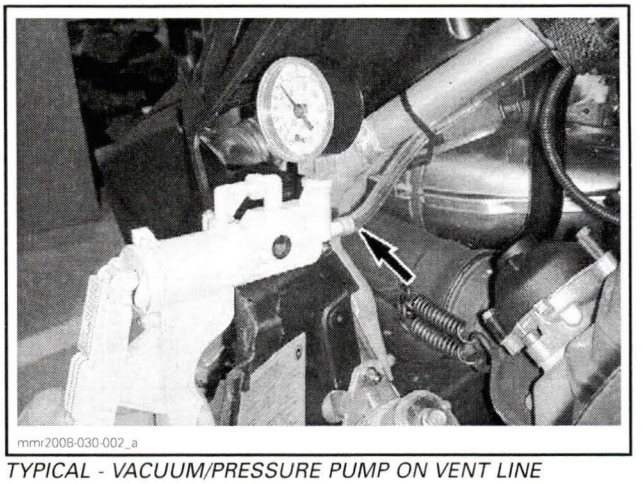
If pressure drops, locate fuel leak(s) and repair or replace leaking component(s).

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

Fuel Tank Vent Valve Test

While the fuel tank is still pressurized as in the previous test, carry out the following:

1. Place a finger over the vent hose outlet.
2. When removing hose pincher, alternately touch and release vent hose outlet. You should feel pressurized air flowing out indicating the pressure relief valve function is working.
3. Release any remaining pressure in the fuel tank by slowly unscrewing pressure test fuel cap.
4. Remove the pressure test fuel cap.
5. Remove the fuel tank vent line from its fitting on the lower left front body panel.
6. Install the VACUUM/PRESSURE PUMP (P/N 529 021 800) on the vent line and apply air pressure through check valve. Air must flow freely towards the fuel tank neck.



TYPICAL - VACUUM/PRESSURE PUMP ON VENT LINE

NOTE: If fuel vent check valve does not function as indicated in test, replace check valve.

7. Remove vacuum/pressure pump.
8. Install vent line on its fitting.
9. Install normal fuel tank cap.

PROCEDURES

FUEL HOSE AND OETIKER CLAMPS

Fuel Hose Replacement

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

⚠ WARNING

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

⚠ WARNING

- **Never change the routing of a fuel hose.**
- **Always reinstall the corrugated protective tubing on fuel hoses.**
- **Secure fuel hoses using the appropriate locking tie or fastener to prevent contact with sharp edges or hot, rotating and moving parts.**
- **After connecting a hose, pull on the hose near the fitting to make sure it is secure.**
- **Always validate fuel system tightness by performing a *FUEL TANK LEAK TEST*.**

Oetiker Clamp Replacement

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

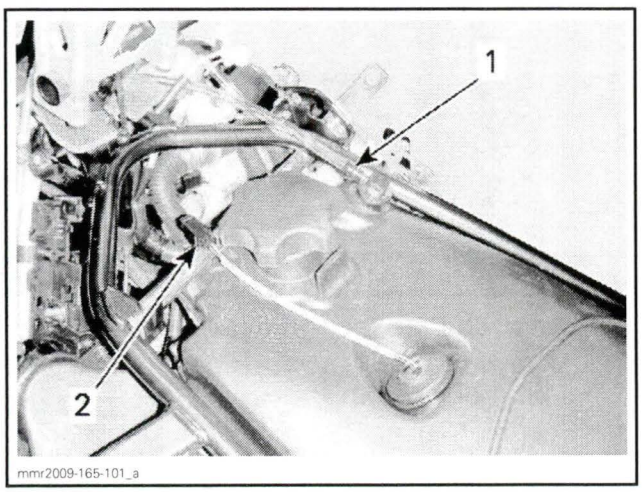
⚠ WARNING

Whenever removing a hose in the fuel system, always use new Oetiker clamps at assembly.

FUEL TANK

Fuel Tank Removal

1. Remove the following items. Refer to *BODY* subsection:
   - Both side panels
   - Hood
   - Seat(s).
2. Remove headlight/gauge module and air intake silencer as a unit, refer to *AIR INTAKE SYSTEM* subsection.
3. Remove console panel, refer to *BODY* subsection.
4. Disconnect fuel vent line from fuel tank elbow.
5. Disconnect fuel level sensor.



TYPICAL
1. *Vent line*
2. *Gauge level sensor connector*

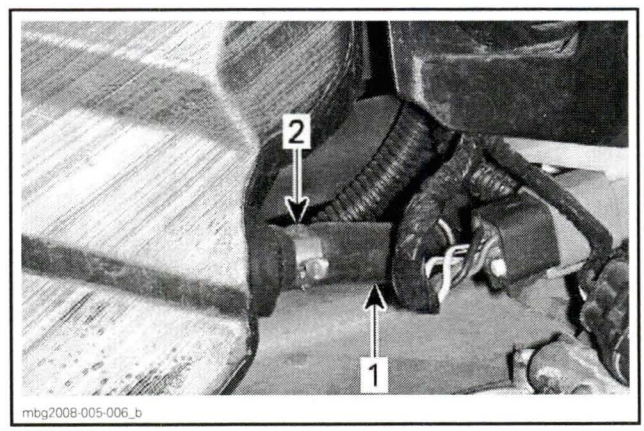
6. Drain fuel tank as much as possible using the SUCTION PUMP (P/N 529 035 880).



7. Remove rear frame member, refer to *FRAME* subsection.
8. Carefully move fuel tank back sufficiently to access the fuel tank outlet hose.
9. Install a small SMALL HOSE PINCHER (P/N 295 000 076) on the fuel tank outlet hose.
10. Disconnect the fuel hose by cutting the Oetiker clamp and pulling the hose off the fitting.

⚠ WARNING

Work in a well ventilated area. Use a shop rag to absorb the residual fuel that will drain from the hose as it is disconnected.



TYPICAL
1. *Install small hose pincher here*
2. *Remove this Oetiker clamp, fuel tank outlet hose*

11. Remove the fuel tank from the vehicle.

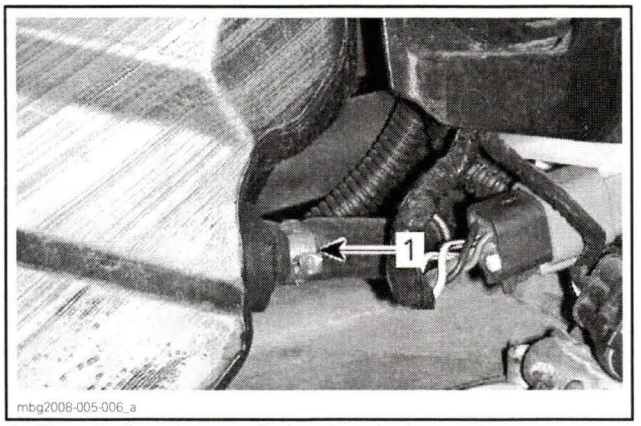
Fuel Tank Installation

Installation procedures are the reverse of the removal procedures however, pay attention to the following.

1. Position fuel tank on vehicle.
2. Connect fuel tank outlet hose to fuel tank fitting using a **NEW** Oetiker clamp, then remove hose pincher.

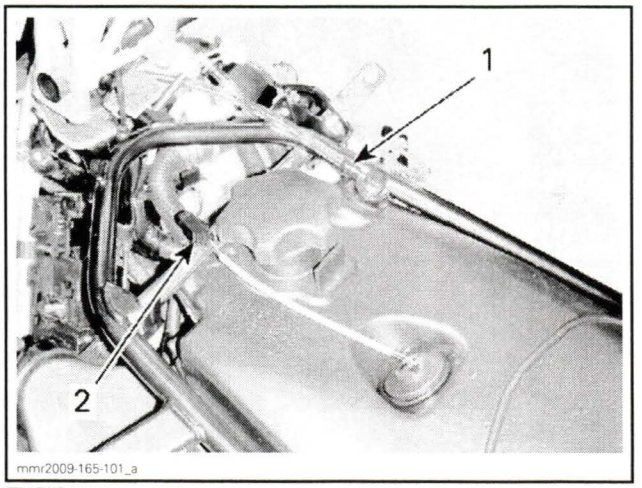
⚠ WARNING

Ensure hose clamp is tight and that hose cannot turn on the fitting.



1. New Oetiker clamp on fuel tank outlet hose

3. Move tank forward into position.
4. Install rear frame member, refer to *FRAME* subsection.
5. Connect the fuel level sensor connector and install the wiring harness locking tie.
6. Install vent tube on vent check valve.



TYPICAL
1. Vent line
2. Gauge level sensor connector

⚠ WARNING

Ensure vent tube is not kinked or pinched.

7. Install all remaining parts in reverse order of removal. Refer to applicable subsection.
8. Carry out a fuel system leak test, refer to *FUEL SYSTEM PRESSURIZATION AND LEAK TEST* in this subsection.

⚠ WARNING

After working on the fuel system, carry out a fuel system pressurization and leak test to check for leaks. Failure to carry out a fuel system leak test could result in severe injury or a life threatening situation should a leak occur.

9. Refuel tank.

DIAPHRAGM FUEL PUMP

Fuel Pump Test

Check operation of fuel pump valves as follows:

1. Empty fuel tank.

NOTE: For the following test, ensure hoses have a tight fit.

2. Disconnect outlet hose from fuel tank.
3. Alternately apply pressure and vacuum with pump from leak test kit to disconnected hose. The inlet valve should release with pressure and hold under vacuum.
4. Disconnect inlet hose from carburetor.
5. Repeat the same procedure to disconnected hose. This time the outlet valve should hold with pressure and release under vacuum.

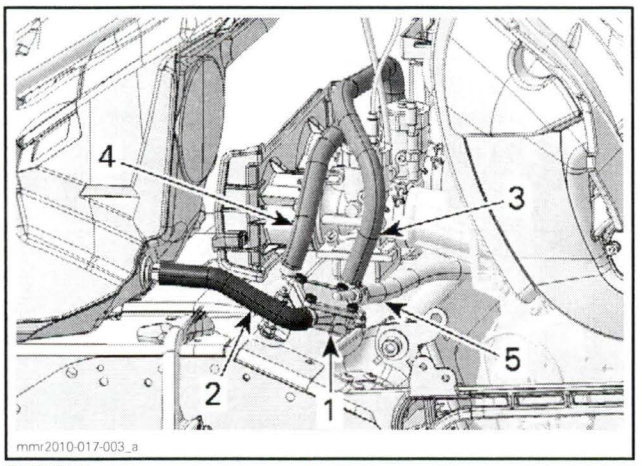
If fuel pump valves fail this test, replace the fuel pump.

Fuel Pump Removal

1. Remove the primary air intake silencer, refer to *AIR INTAKE SYSTEM* subsection.
2. Disconnect carburetors from engine and move them aside for access to the fuel pump.

NOTE: Do not disconnect throttle cables from carburetors.

3. Install a SMALL HOSE PINCHER (P/N 295 000 076) on the fuel tank outlet hose close to the pump inlet fitting.



TYPICAL
1. *Diaphragm fuel pump*
2. *Fuel tank outlet hose*
3. *LH carburetor fuel supply line*
4. *RH carburetor fuel supply line*
5. *Vacuum impulse line*

4. Remove the spring clamps and disconnect the carburetor (2) fuel supply lines at the fuel pump outlets.

NOTE: Use a rag and a container to recover the fuel flowing from the disconnected hoses.

5. Remove the spring clamp and disconnect the impulse (vacuum) line at the fuel pump.
6. Remove screws securing fuel pump to chassis.

Fuel Pump Installation

1. Reverse the removal procedure.
2. Torque fuel pump mounting nuts to 5 N•m (44 lbf•**in**).
3. Torque carburetor mounting clamps to 0.6 N•m (5 lbf•**in**).
4. Carry out a fuel system pressurization and leak test to check for leaks in the fuel system.

⚠ WARNING

After working on the fuel system, carry out a fuel system pressurization and leak test to check for leaks. Failure to carry out a fuel system leak test could result in severe injury or a life threatening situation should a leak occur.

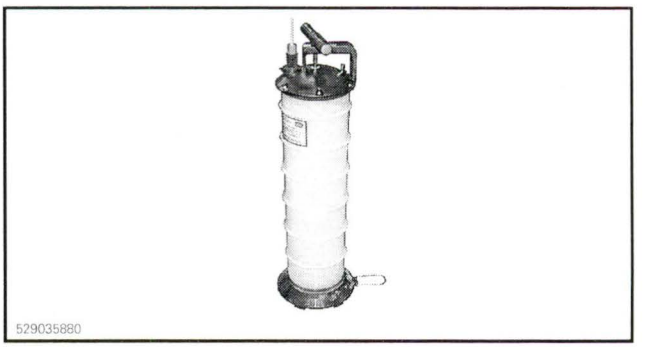
STEEL MESH FILTER

Steel Mesh Filter Location

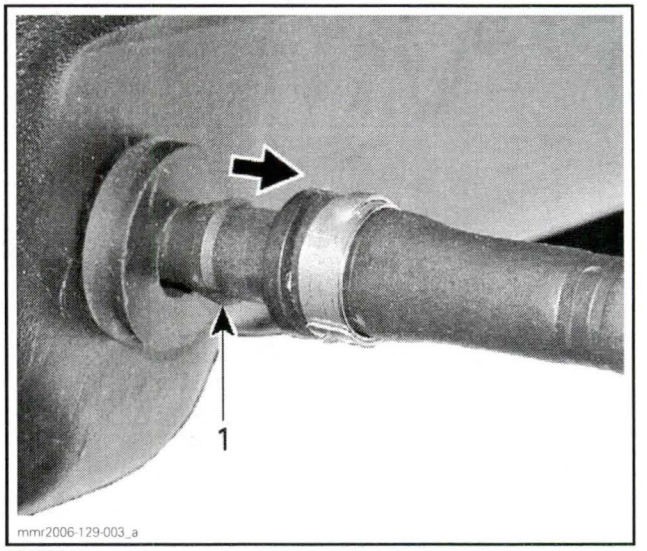
The steel mesh fuel filter is located at the end of the fuel supply hose, within the fuel tank.

Steel Mesh Filter Removal

1. Drain fuel tank as much as possible using the SUCTION PUMP (P/N 529 035 880).

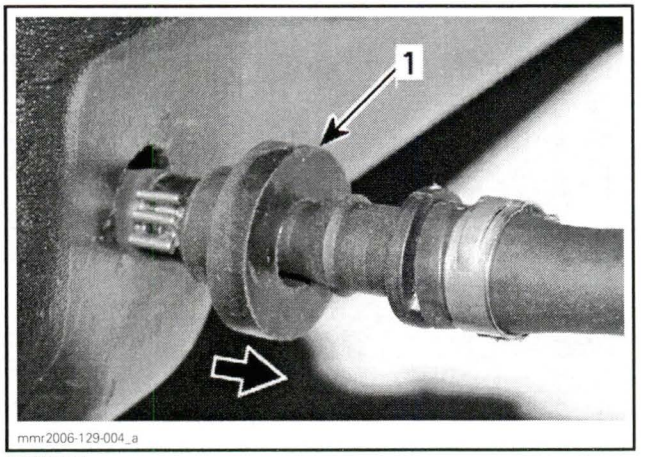


2. Slightly pull out fuel tank outlet fitting from grommet to small part of fitting so that it is loose in the grommet.



TYPICAL
1. *Fuel tank outlet fitting*

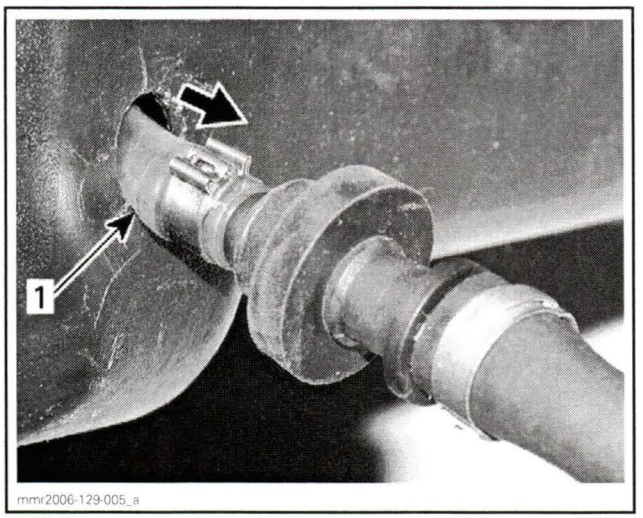
3. Carefully remove grommet from fuel tank.



TYPICAL
1. *Grommet*

NOTE: Although the fuel hose is shown attached to the fitting in the illustrations, it should be removed for the procedure.

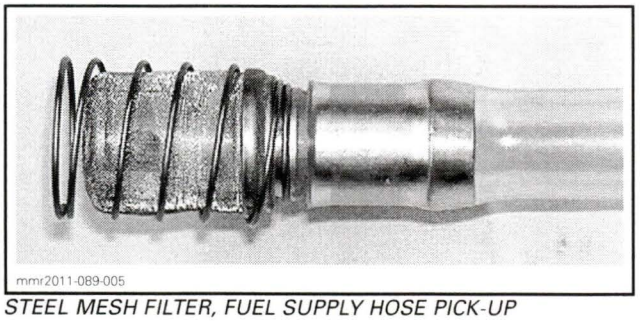
4. Pull fuel pick-up hose out of fuel tank with strainer.



TYPICAL
1. Fuel pick-up hose

Steel Mesh Filter Cleaning

1. Clean steel mesh filter using low pressure filtered air and XPS BRAKES AND PARTS CLEANER (P/N 219 701 705).



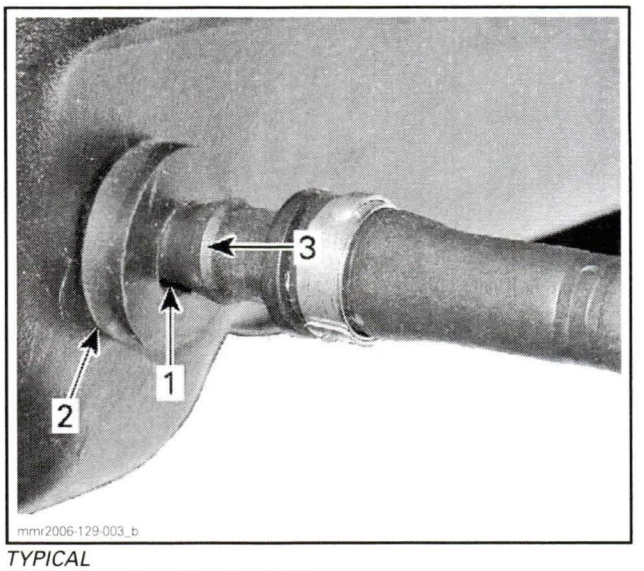
STEEL MESH FILTER, FUEL SUPPLY HOSE PICK-UP

Steel Mesh Filter Installation

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

Install grommet on fuel tank then push fuel tank fitting through grommet.

NOTE: To facilitate installation of the grommet in the fuel tank, it should be on the smaller portion of the fuel tank fitting.



TYPICAL
1. Small portion of fuel tank fitting
2. Grommet inserted in fuel tank
3. Push fitting in grommet

Install grommet in fuel tank.

Push fitting in grommet.

Install and reconnect fuel supply hose using a NEW Oetiker clamp

Carry out a *FUEL SYSTEM PRESSURIZATION AND LEAK TEST* as detailed in this subsection.

Install remaining parts in the reverse order of removal, refer to *FUEL TANK INSTALLATION* in this subsection.

FUEL LEVEL SENSOR

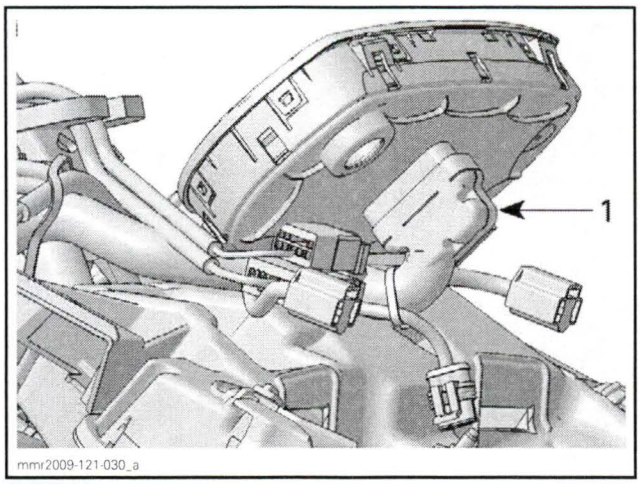
Fuel Level Sensor Troubleshooting

When troubleshooting a fuel level indication, carry out the following:

1. *FUEL LEVEL SENSOR RESISTANCE TEST (IN CIRCUIT)*
2. *FUEL LEVEL SENSOR RESISTANCE TEST (AT COMPONENT)*
3. *FUEL LEVEL SENSOR INPUT VOLTAGE TEST.*

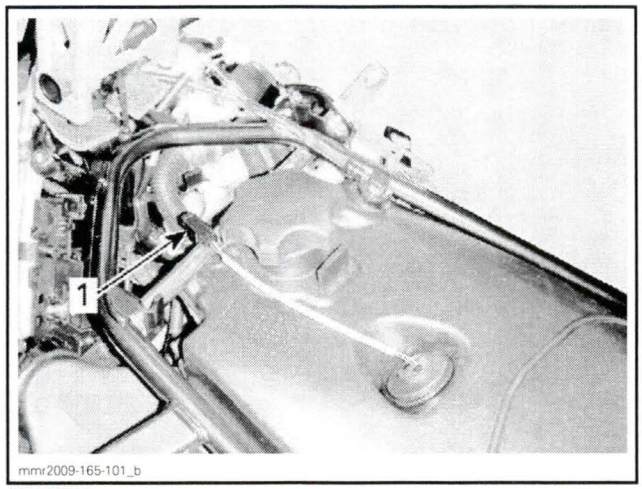
Fuel Level Sensor Input Voltage Test

1. Ensure main wiring harness connector is properly connected to multifunction gauge.



TYPICAL
1. Multifunction gauge connected

2. Disconnect fuel level sensor connector.



TYPICAL
1. Sensor connector

3. Energize the vehicle electrical system, refer to *LIGHTS, GAUGE AND ACCESSORIES* subsection.
4. Measure fuel level sensor input voltage on the vehicle harness side as per following table.

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

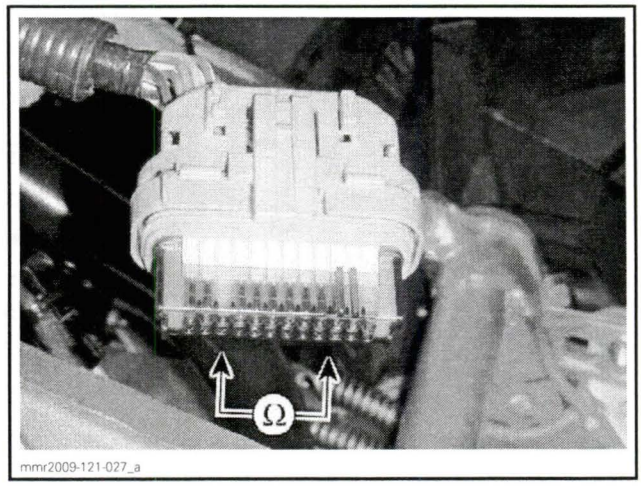
FUEL LEVEL SENSOR INPUT VOLTAGE TEST	
PROBES	READING
Pin 1 to pin 2	Battery voltage (over 12 Vdc)
Pin 1 to engine ground	

TEST RESULT	SERVICE ACTION
Battery voltage is measured	Carry out a *FUEL LEVEL SENSOR RESISTANCE TEST*
Gauge is energized but no voltage measured	Test continuity of wiring between gauge connector (5-CV pin 12) and fuel level sensor connector pin 1 (BK/GN wire)
	If wiring is good, replace the gauge
Voltage is measured to engine ground but not to pin 2 of the sensor connector	Test continuity between gauge connector (5-CV pin 15) and fuel level sensor connector pin 2 (BU wire)
	If the BU wire is good, replace gauge

Fuel Level Sensor Resistance Test (in Circuit)

1. Disconnect the multifunction gauge connector. Refer to *LIGHTS, GAUGE AND ACCESSORIES*.
2. Test fuel level sensor resistance as follows.

FLOAT POSITION (ACCORDING TO FUEL LEVEL)	MULTIFUNCTION GAUGE HARNESS CONNECTOR		RESISTANCE @ 20°C (68°F)
Full	Pin 12	Pin 15	8.8 Ω ± 1.3 Ω
Empty			91.5 Ω ± 5.5 Ω

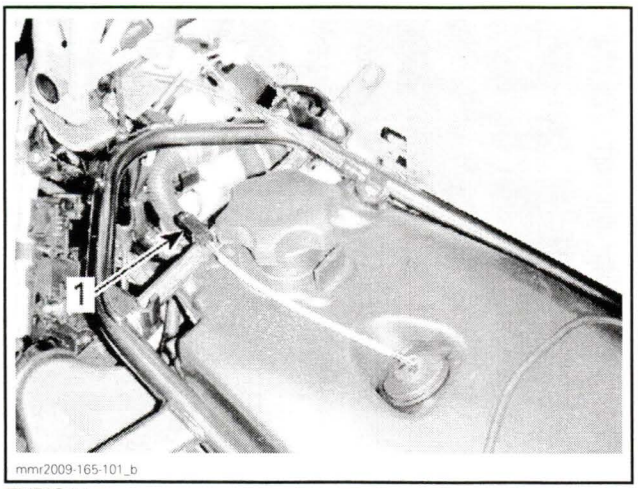


If test succeeded, refer to *FUEL LEVEL SENSOR INPUT VOLTAGE TEST*.

If test failed, refer to *FUEL LEVEL SENSOR RESISTANCE TEST (AT COMPONENT).*

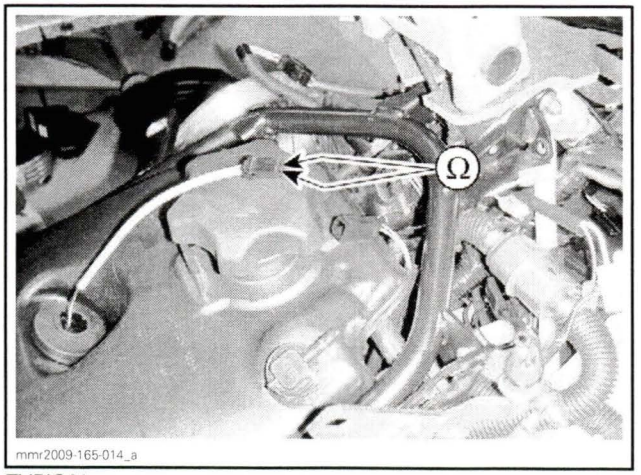
Fuel Level Sensor Resistance Test (At Component)

1. Obtain access to fuel level sensor connector, refer to *FUEL TANK REMOVAL* in this subsection.
2. Disconnect fuel level sensor.



TYPICAL
1. Sensor connector

3. Test resistance of sensor between the two pins in the sensor connector as follows.



TYPICAL

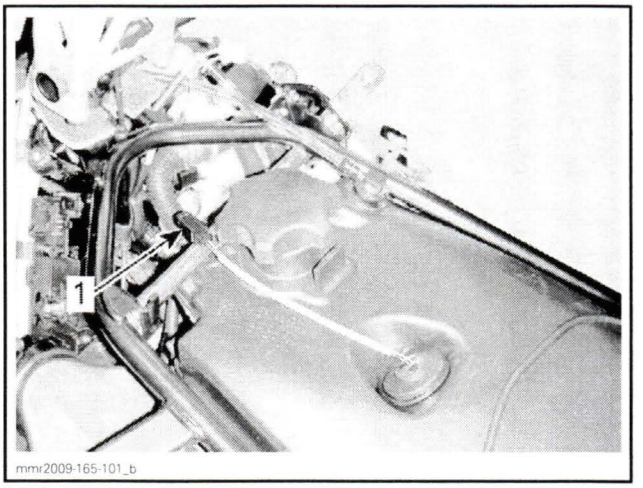
REQUIRED TOOL	
FLUKE 115 MULTIMETER (P/N 529 035 868)	

FUEL LEVEL SENSOR RESISTANCE TEST	
Full level resistance value	8 Ω ± 2 Ω
Empty level resistance value	95 Ω ± 5 Ω

TEST RESULT	SERVICE ACTION
If test failed	Replace fuel level sensor

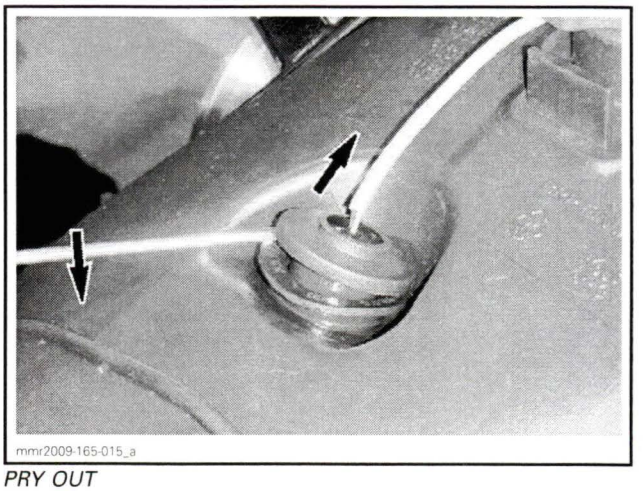
Fuel Level Sensor Removal

1. Drain fuel tank.
2. Remove console. Refer to *BODY* subsection.
3. Disconnect fuel level sensor connector.



1. Sensor connector

4. Insert a screwdriver between grommet and sensor flange. Gently pry out sensor from grommet alternating from side to side.

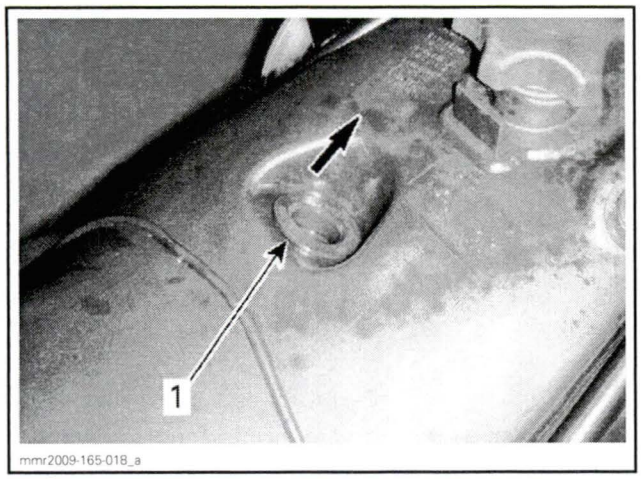


PRY OUT

5. Pull sensor out of fuel tank.



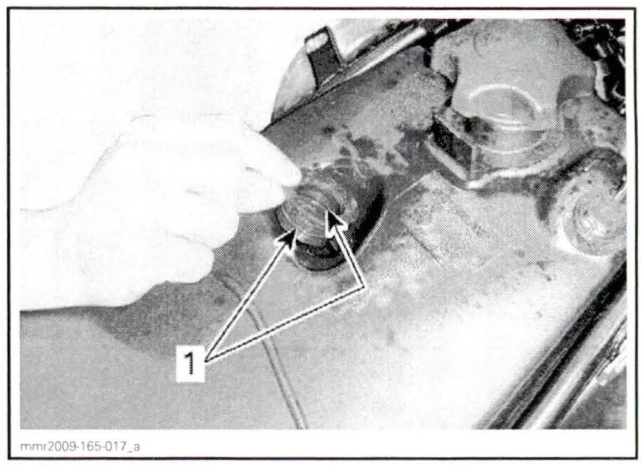
6. Remove grommet from fuel tank.



1. Grommet

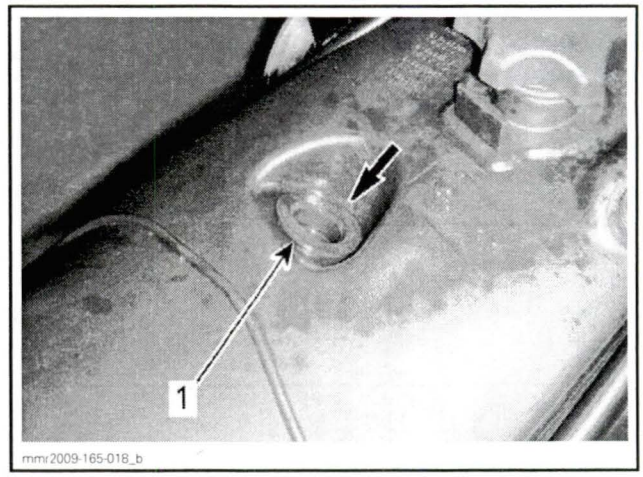
Fuel Level Sensor Installation

1. Fuel level sensor installation is the reverse of removal procedure. However, pay attention to the following.
2. Carry out a resistance test of sensor before installation. Refer to *FUEL LEVEL SENSOR RESISTANCE TEST* in this subsection.
3. To ease grommet and fuel level sensor installation, spray water (**NO SOAP**) on outer and inner surfaces of grommet.



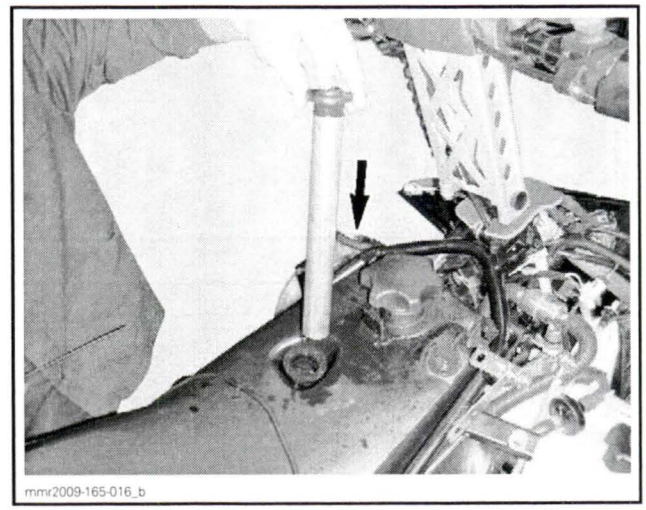
1. Spray water here

4. Insert grommet in fuel tank ensuring it fully locks in position.



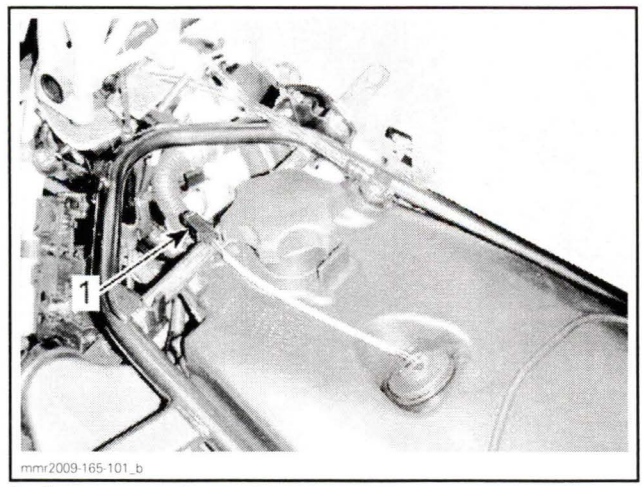
1. Grommet

5. Carefully insert float sensor through hole in grommet gently rotating it into position.



6. Apply DIELECTRIC GREASE (P/N 293 550 004) in connector to prevent corrosion.

7. Plug sensor connector.



1. Sensor connector

8. Carry out a fuel system leak test. Refer to *FUEL TANK LEAK TEST* in this subsection.
9. Test fuel level indication as you fill fuel tank before you complete reassembly of vehicle.

FUEL TANK AND FUEL PUMP (600 HO E-TEC AND 600 ACE)

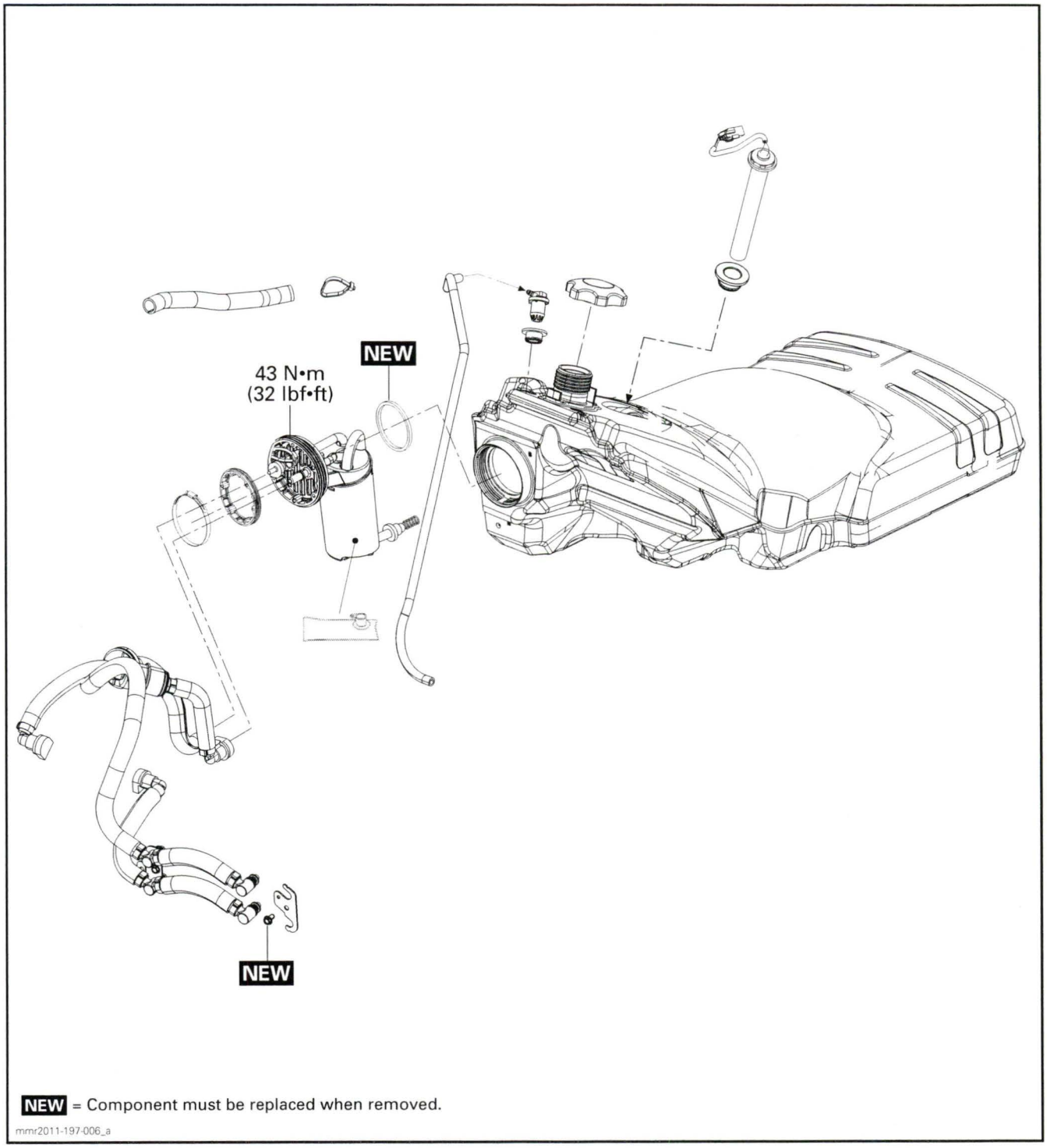
SERVICE TOOLS

Description	Part Number	Page
FLUKE 115 MULTIMETER	529 035 868	448, 452, 454
FUEL HOSE ADAPTER	529 036 023	440, 442
FUEL PUMP NUT TOOL	529 036 118	449
FUEL PUMP NUT TOOL	529 036 214	449
LEAK TEST KIT	529 033 100	438
OETIKER PLIERS	295 000 070	443
PRESSURE GAUGE	529 035 709	440, 442
SMALL HOSE PINCHER	295 000 076	438, 444
T-HARNESS	529 035 869	438, 442
VACUUM/PRESSURE PUMP	529 021 800	438, 440

SERVICE PRODUCTS

Description	Part Number	Page
DIELECTRIC GREASE	293 550 004	455
XPS BRAKES AND PARTS CLEANER	219 701 705	452

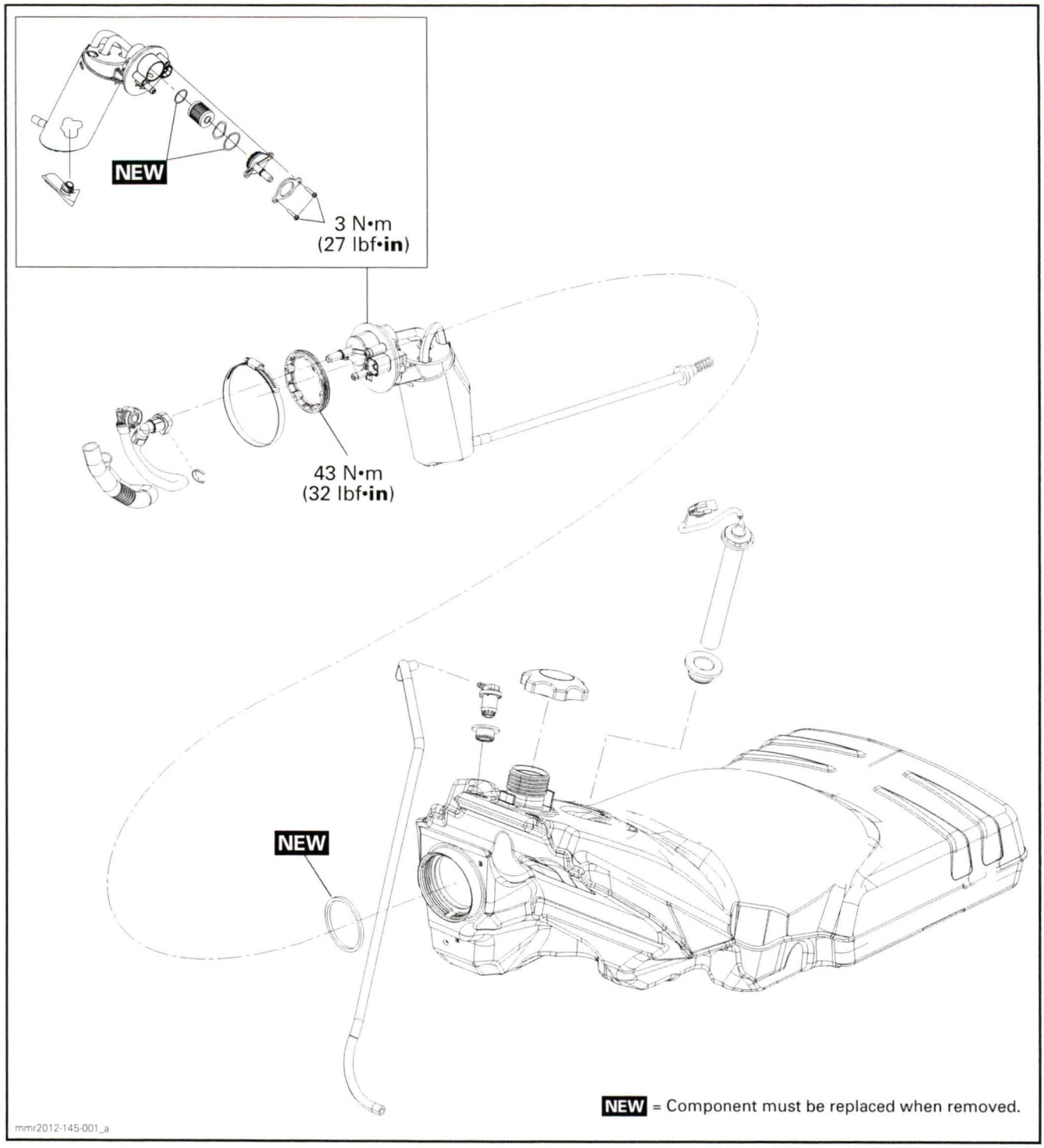
600 HO E-TEC Models



NEW = Component must be replaced when removed.

mmr2011-197-006_a

600 ACE Models



GENERAL

NOTE: It is a good practice to check for fault codes using B.U.D.S. as a first troubleshooting step. Refer to *DIAGNOSTIC AND FAULT CODES*.

⚠ WARNING

Always disconnect battery prior to working on the fuel system.

E-TEC

⚠ WARNING

Always disconnect the magneto connector prior to:
- Disconnecting any fuel hose.
- Removing a fuel injector.
- Removing a spark plug cable or spark plug.

Otherwise, if the engine is cranked, fuel vapors may ignite in presence of a spark creating a fire hazard.

Release fuel pressure prior to removing fuel system components. Refer to *FUEL PUMP (E-TEC)* in this subsection.

All Models

⚠ WARNING

Always proceed with care when working on pressurized fuel system. Wear safety glasses and work in a well ventilated area. Fuel lines remain under pressure at all times.

⚠ WARNING

Cover the fuel line connection with an absorbent shop rag. Slowly disconnect the fuel hose to release the remaining pressure. Do not allow fuel to spill on hot parts. Fuel is flammable and explosive under certain conditions. Wipe off any fuel spillage inside engine compartment.

⚠ WARNING

When replacing fuel system components, use only BRP parts. They ensure to meet proper operational and safety requirements.

⚠ WARNING

After working on the fuel system, pressurize the fuel system to check for leaks. Refer to *FUEL SYSTEM PRESSURIZATION AND LEAK TEST*. Failure to do so may result in severe injury or a life threatening situation should a leak occur.

SYSTEM DESCRIPTION

Fuel Pump

An electric fuel pump is mounted in the upper RH front part of the fuel tank.

A 12 Vdc high pressure fuel pump with an integrated jet pump is used.

When the START/RER button is depressed with the emergency engine stop switch set to ON and the tether cord cap on the engine cut-off switch, the electric fuel pump turns on for a few seconds to pressurize the fuel system in preparation for the engine start. When the engine runs, the fuel pump is ON continuously to provide a constant fuel pressure to the injectors.

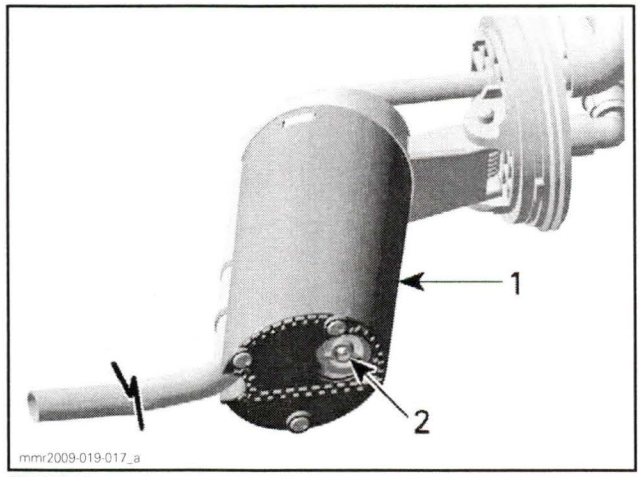
600 HO E-TEC Models

NOTE: Although the fuel pump is connected to the 55 Vdc system, the ECM modulates the voltage (Pulse Width Modulation) between 9 and 16 Vdc depending on the engine RPM. The fuel pump comes on upon engine cranking and its output will change as voltage changes.

All Models

To ensure a constant delivery of fuel to the engine for all riding conditions when the fuel level is low, a rear pickup and a fuel pump reservoir is used.

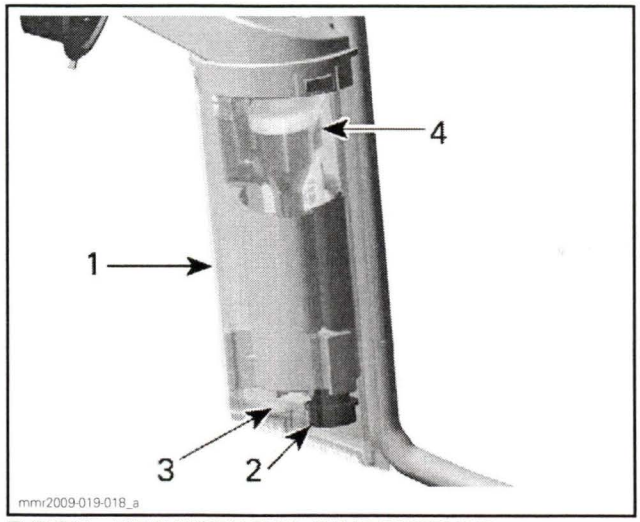
The fuel pump reservoir is actually the housing of the fuel pump module in which the fuel pump is located. A check valve at the bottom of the housing allows the fuel in the tank to enter the fuel pump reservoir.



TYPICAL
1. *Fuel pump reservoir*
2. *Check valve*

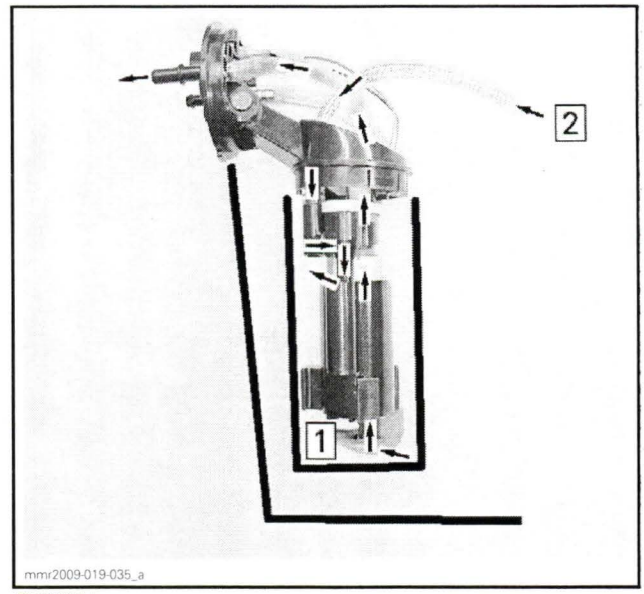
When the fuel pump runs, it draws the fuel from the fuel pump reservoir and feeds it to the injection system. This causes fuel in the tank to be drawn into the fuel pump reservoir through its bottom inlet check valve.

At the same time, a portion of the fuel flow from the electric fuel pump flows through a jet pump that contains a venturi.



TYPICAL - VIEW INSIDE FUEL PUMP RESERVOIR
1. *Fuel pump reservoir*
2. *Bottom inlet*
3. *Check valve (open upwards)*
4. *Venturi*

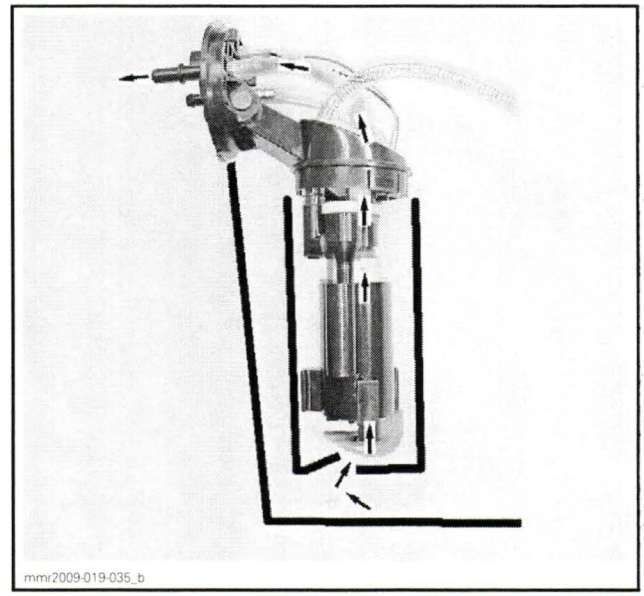
As the fuel accelerates through the venturi, it generates a low pressure area at a connection to the remote pickup, which draws fuel into the fuel pump reservoir from the remote pickup.



TYPICAL
Step 1: Bottom inlet draws fuel from fuel pump reservoir
Step 2: Low pressure from venturi draws fuel from rear pickup into fuel pump reservoir

When riding the vehicle on a level surface, fuel is drawn into the fuel pump reservoir through its check valve and through the remote pickup simultaneously, as long as there is enough fuel in the tank to cover the remote pickup.

When riding downhill with a low amount of fuel in the tank, the fuel moves towards the front of fuel tank. The check valve opens and fuel enters the fuel pump reservoir from the fuel tank through the check valve only as there is no fuel at the remote pickup.



When riding uphill with a low amount of fuel in the tank, the fuel moves towards the rear of the fuel tank. The check valve closes and traps the fuel

in the pump reservoir. The fuel pump continues to draw fuel from the fuel pump reservoir, which is now only fed by the jet pump using the rear pickup. This prevents air from being drawn into the fuel lines from the fuel tank.

The continuous fuel flow is also used to cool the electric fuel pump.

600 HO E-TEC

On these models, the continuous fuel flow also cools down the injectors and the ECM. To cool these components, the fuel circulates as follows:

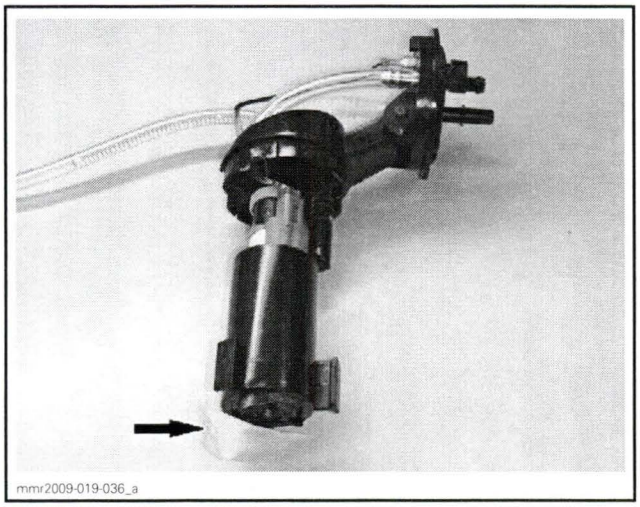
- Out of fuel pump
- Through the ECM
- To the injectors (around the voice coils)
- Through the pressure regulator
- Back to fuel tank.

NOTE: The hose loop between the MAG injector outlet and the ECM dampens the engine torque reaction movement.

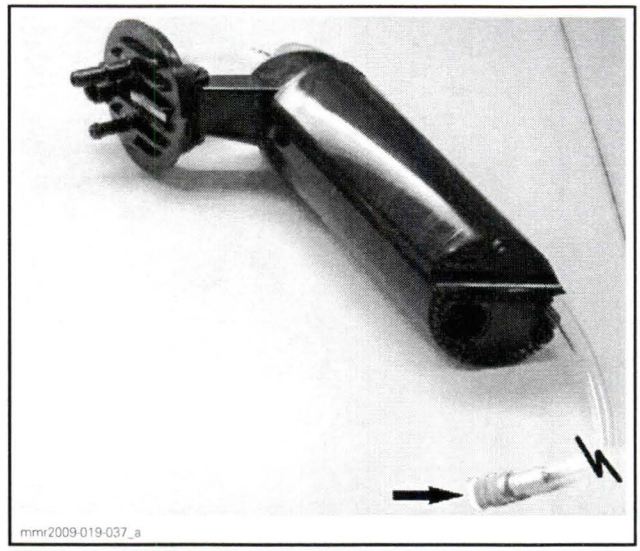
Fuel Pickup

Fuel enters the fuel pump reservoir from either a check valve at the bottom of the fuel pump reservoir, or from a remote pickup in the rear portion of the fuel tank.

The remote pickup uses a replaceable steel mesh strainer to filter out relatively large dirt particles and prevent clogging of the jet pump. The fuel entering the fuel pump reservoir through the check valve will be filtered by the fuel pump prefilter.



TYPICAL - FUEL PUMP PREFILTER



TYPICAL - STEEL MESH STRAINER

Fuel Pressure Regulator

600 HO E-TEC Models

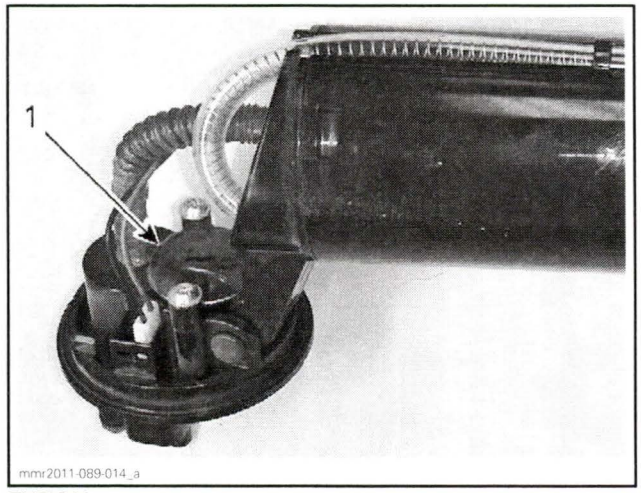
An external in-line fuel pressure regulator is mounted over the oil tank. It is basically a spring loaded valve that opens and closes the path of fuel returning to the tank, thus maintaining a constant fuel pressure in the system.

NOMINAL REGULATED FUEL PRESSURE (600 HO E-TEC)
Approximately 303 kPa (44 PSI) at 2000 RPM (will be lower at idle)

600 ACE Models

A fuel pressure regulator integral to the fuel pump module is used to maintain a constant fuel pressure at the outlet of the fuel pump module.

NOMINAL REGULATED FUEL PRESSURE (600 ACE)
Approximately 400 kPa (58 PSI)



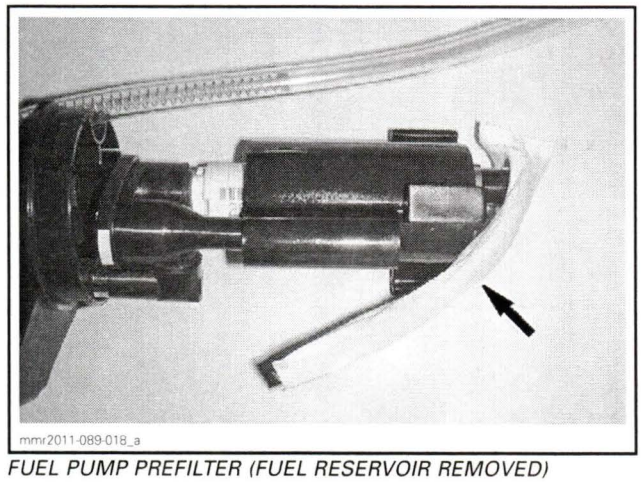
TYPICAL
1. Fuel pressure regulator

If the fuel pump output pressure is not within specification, replace the fuel pump.

Fuel Filters

Other than the steel mesh strainer used on the remote pickup, two other replaceable filters are used to filter the fuel.

A fuel pump prefilter is used at the electric fuel pump inlet. It is a replaceable nylon mesh filter located within the fuel pump module housing (fuel pump reservoir).



FUEL PUMP PREFILTER (FUEL RESERVOIR REMOVED)

The fuel pump prefilter protects the fuel pump and prevents clogging of the fuel passages within the fuel pump module.

600 HO E-TEC Model

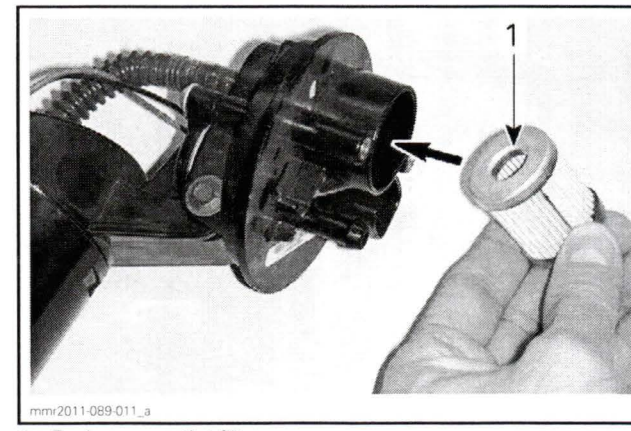
The second filter is an in-line filter on the fuel injector supply hose. It is located above the oil tank.

It is a replaceable canister type filter used to deliver dirt-free fuel to the injectors.

The fuel filter is sold as a kit that comprises an assembly of hoses, the filter, and the quick connect fittings.

600 ACE Models

The second filter is located at the fuel pump module outlet, within the fuel pump module mounting flange.

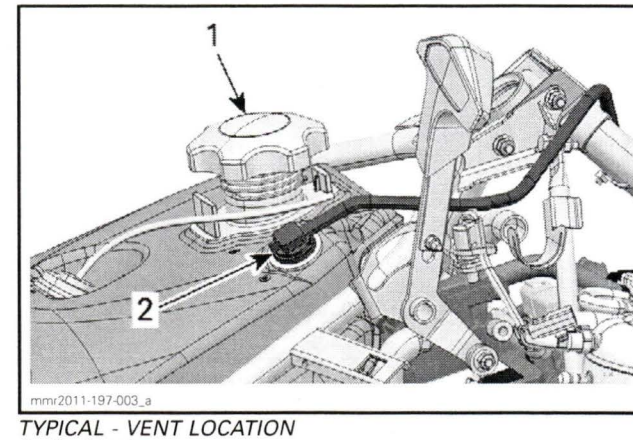


1. Fuel pump outlet filter

It is a replaceable paper cartridge type filter that is used to deliver dirt-free fuel to the injectors.

Fuel Tank Vent

The fuel tank is vented through a combination type check valve that allows ambient air pressure to enter the fuel tank at all times.



TYPICAL - VENT LOCATION
1. Fuel tank cap
2. Fuel tank vent valve

As fuel is consumed by the engine, a negative pressure would occur in the fuel tank. This could eventually prevent the engine from receiving proper fuel pressure. The **zero pressure relieve function** of the valve allows the higher outside air pressure in.

If pressure builds up and exceeds 2.0 kPa to 4.8 kPa (.3 PSI to .7 PSI) in the fuel tank, the check valve opens and lets the excess pressure vent out of the tank.

Fuel Level Sensor

A float type fuel level sensor varies its resistance with fuel level thus providing a signal to the multifunction gauge for fuel level indication.

INSPECTION

FUEL SYSTEM PRESSURIZATION AND LEAK TEST

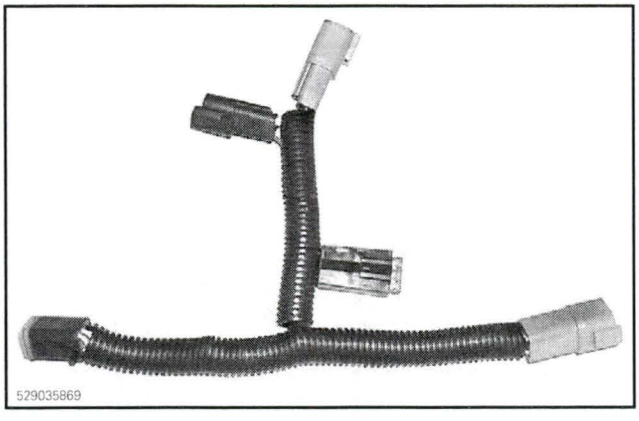
⚠ WARNING

Before starting the engine, carry out a fuel system pressurization and leak test each time a component has been removed from the fuel system.

1. Ensure all fuel lines are properly connected.
2. Set emergency engine stop switch to RUN.

NOTE: DO NOT install the tether cord cap on the engine cut-off switch.

3. Install the T-HARNESS (P/N 529 035 869) on the vehicle diagnostic connector.

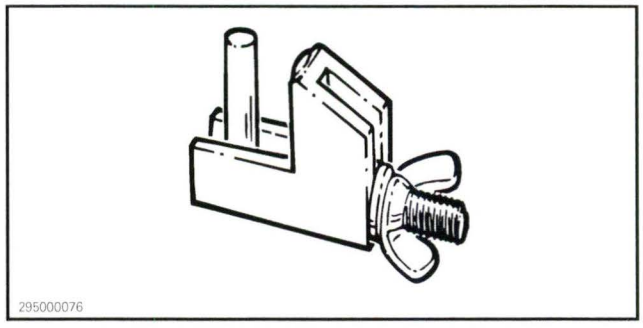


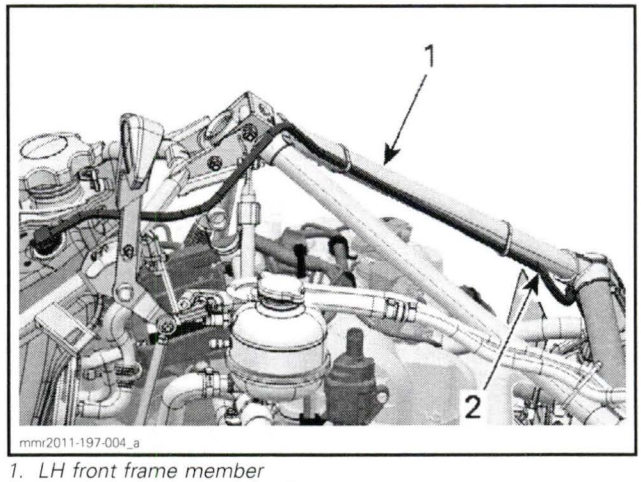
NOTE: This will power the fuel pump and pressurize the fuel system. It may be necessary to disconnect and reconnect the T-harness 3 - 4 times to cycle the fuel pump to bleed air.

4. Inspect engine compartment to detect any fuel leakage or an abnormally strong fuel odor which, may be an indication of a fuel leak that is not readily visible.
5. Repair any leak before using vehicle.

FUEL TANK LEAK TEST

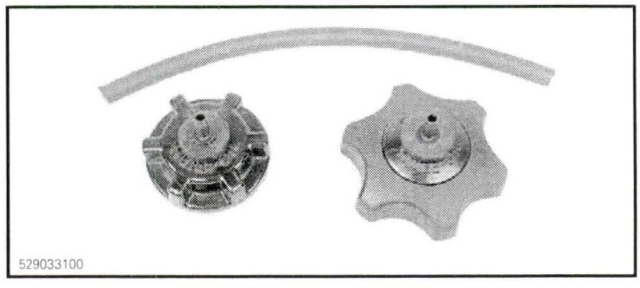
1. Refer to *BODY* subsection and remove the following for access to fuel vent hose:
   - LH and RH side panels
   - Hood.
2. Install a SMALL HOSE PINCHER (P/N 295 000 076) on the vent line.



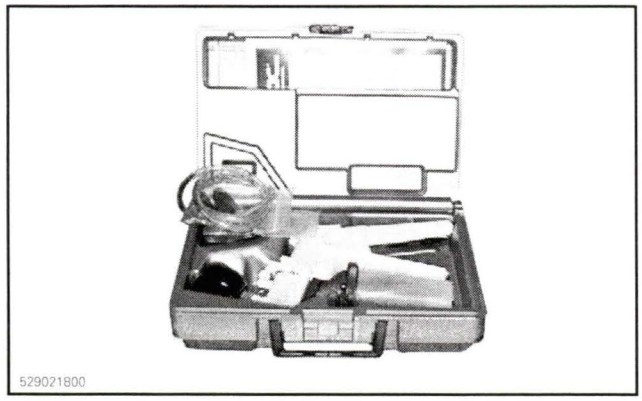


1. LH front frame member
2. Hose pincher on vent line here

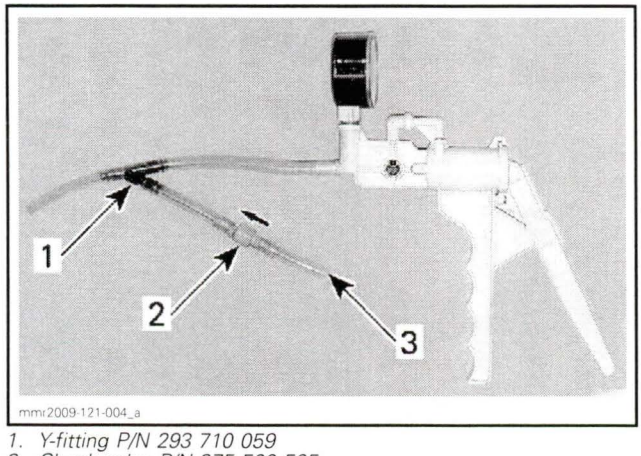
3. Install the appropriate test cap from the LEAK TEST KIT (P/N 529 033 100) on fuel tank neck.



4. Install VACUUM/PRESSURE PUMP (P/N 529 021 800) on pressure test fuel cap.



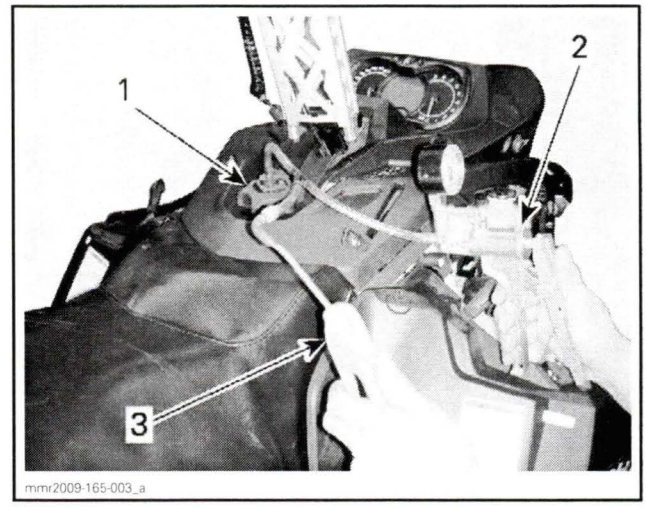
NOTE: A Y-fitting and a check valve can be installed to use compressed air for rapid pressure build-up when fuel tank is not full.



1. Y-fitting P/N 293 710 059
2. Check valve P/N 275 500 505
3. Apply compressed air here

5. Slowly increase air pressure in the fuel tank to near fuel tank test pressure specified in the following table.

NOTICE **Do not exceed the specification when pressurizing the fuel tank.**



TYPICAL
1. Pressure test fuel tank cap
2. Vacuum/pressure pump
3. Compressed air supply

6. Set vacuum/pressure pump selector to pressure.
7. Complete pressurizing fuel tank to specification using the vacuum/pressure pump.

FUEL TANK LEAK TEST	
TEST PRESSURE	TIME WITHOUT PRESSURE DROP
21 kPa (3 PSI)	3 minutes

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

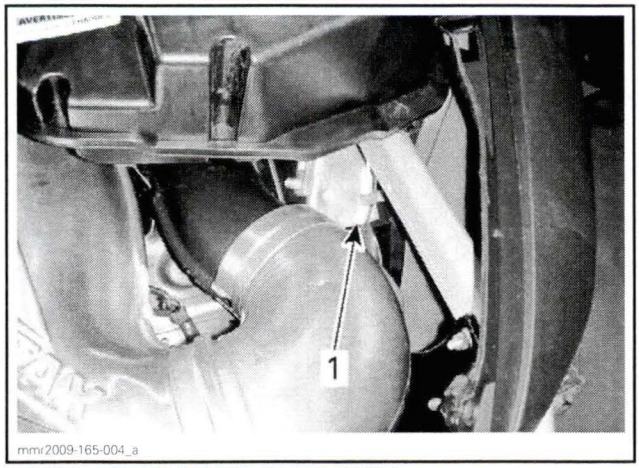
To ease locating a leak, spray soapy water on components; bubbles will indicate the location of the leak.

NOTE: If a leak is detected, always ensure the leak is not in the test equipment before assuming it is in the fuel system.

Fuel Tank Vent Valve Test

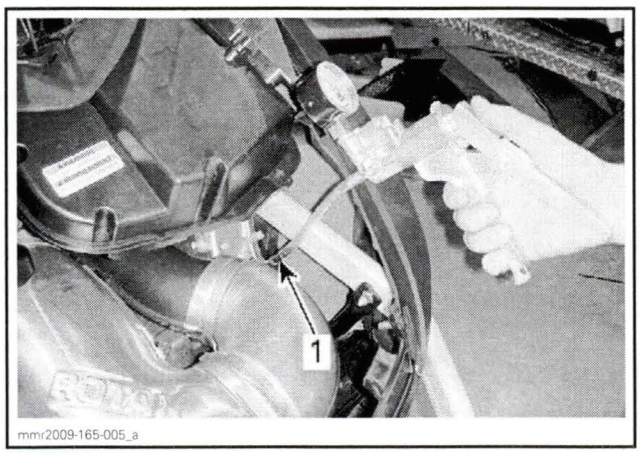
While the fuel tank is still pressurized from the previous test, carry out the following:

1. Place a finger over the fuel tank vent hose outlet.



TYPICAL - E-TEC MODEL ILLUSTRATED
1. Fuel tank vent outlet

2. While removing the hose pincher, alternately touch and release vent hose outlet. You should feel pressurized air flowing out, indicating the pressure relief valve function of the vent valve is working. Otherwise, replace the vent valve.
3. Release any remaining pressure in the fuel tank by slowly unscrewing pressure test cap.
4. Remove the pressure test cap.
5. Install the VACUUM/PRESSURE PUMP (P/N 529 021 800) on the end of the vent line and apply air pressure through the check valve. Air must flow freely towards the fuel tank neck.



TYPICAL
1. Apply pressure through vent hose end

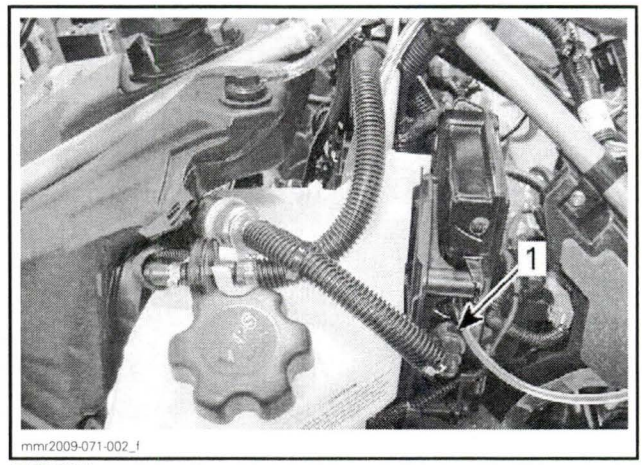
If fuel vent check valve does not function as indicated in test, replace vent valve.

6. Remove vacuum/pressure pump.
7. Secure vent line as prior to vent valve test.
8. Install the vehicle fuel tank cap.

FUEL PUMP PRESSURE TEST (600 HO E-TEC)

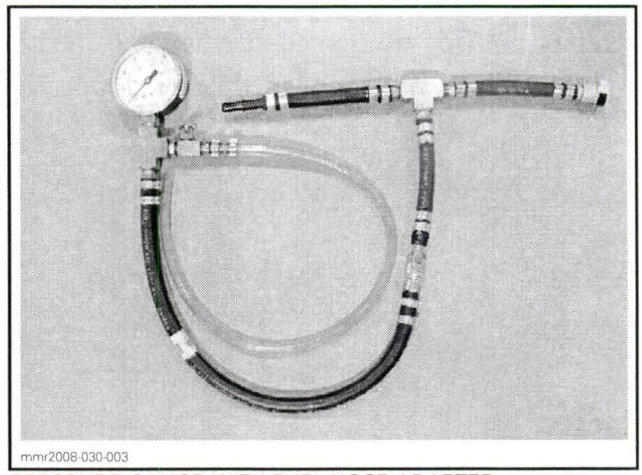
The pressure test provides and indication of the available fuel pressure at the fuel pump outlet. It validates the pressure regulator and the fuel pump.

1. Ensure there is enough gas in fuel tank.
2. Release the fuel pressure in the system. Refer to *FUEL PUMP* in this subsection.
3. Install a rag under the ECM hose quick connect to catch fuel spillage.
4. Disconnect fuel supply hose from ECM.



TYPICAL
1. Disconnect here

5. Install the FUEL HOSE ADAPTER (P/N 529 036 023) and the PRESSURE GAUGE (P/N 529 035 709) between fuel pressure hose and ECM.



PRESSURE GAUGE WITH FUEL HOSE ADAPTER



TYPICAL
1. *ECM*
2. *Fuel pressure hose fitting*
3. *Fuel hose adapter to ECM fitting*
4. *Fuel hose adapter to pressure gauge*

⚠ WARNING

When carrying out pressure test, ensure fuel is not leaking from test equipment onto hot exhaust system or electrical components. Ensure fuel hose do not come into contact with hot engine parts or hot exhaust system.

6. Start engine.
7. Run engine above 2000 RPM and observe the fuel pressure.

FUEL PRESSURE
303 kPa (44 PSI)

If pressure is lower than specified, momentarily block the return hose while monitoring the pressure gauge.

NOTICE Do not block the fuel return for more than 2 seconds.

If pressure rises to reach or exceed specification with the fuel return blocked, replace fuel regulator.

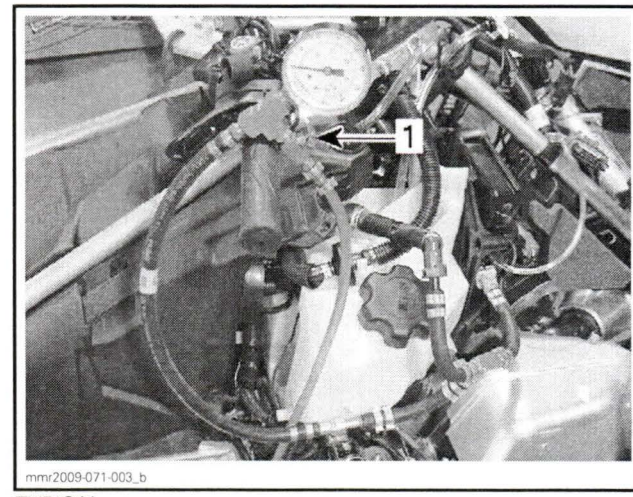
If pressure does not rise with the fuel return blocked, refer to *PRESSURE BELOW SPECIFICATIONS* in the following table.

FUEL PRESSURE TROUBLESHOOTING	
RESULT	POSSIBLE CAUSE
Pressure above specifications	Defective fuel regulator
Pressure below specifications	Clogged fuel filter
	Defective fuel regulator
	Defective fuel pump
	Leak in the fuel system circuit

8. Stop engine.

Fuel pressure should remain stable.

9. If fuel pressure drops, check the following for leaks:
   - Tools
   - Hoses
   - Fuel injectors
   - Fuel pressure regulator
   - Fuel pump.
10. Release fuel pressure in the system. Refer to *FUEL PUMP* in this subsection.
11. Bleed away any remaining fuel in the pressure gauge and fuel hose adapter using the bleed valve on the fuel hose adapter.



TYPICAL
1. *Pressure gauge bleed valve*

12. Remove pressure gauge and fuel hose adapter.
13. Reinstall the fuel pressure hose on ECM and gently but firmly pull on hose to ensure quick disconnect fitting is properly locked and secure on the ECM.
14. Reinstall all remaining removed parts.

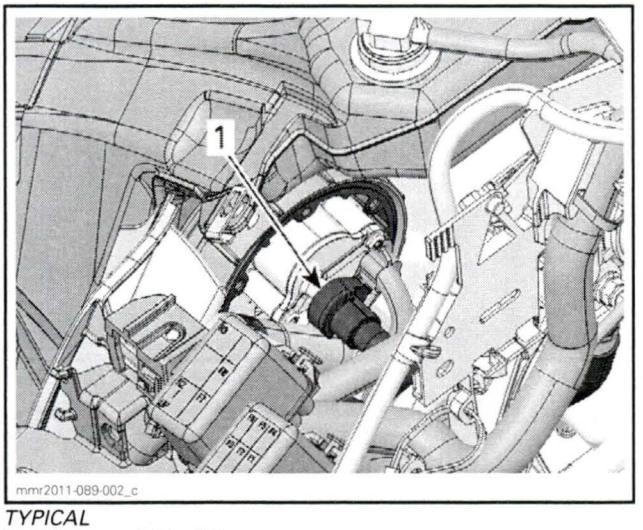
FUEL PUMP PRESSURE TEST (600 ACE)

The pressure test will show the available pressure at the fuel pump outlet. It validates the pressure regulator and the fuel pump.

1. Ensure there is enough gas in fuel tank.
2. Connect latest applicable B.U.D.S. version to the vehicle diagnostic connector. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
3. Release the fuel pressure in the system. Refer to *FUEL PUMP* in this subsection.

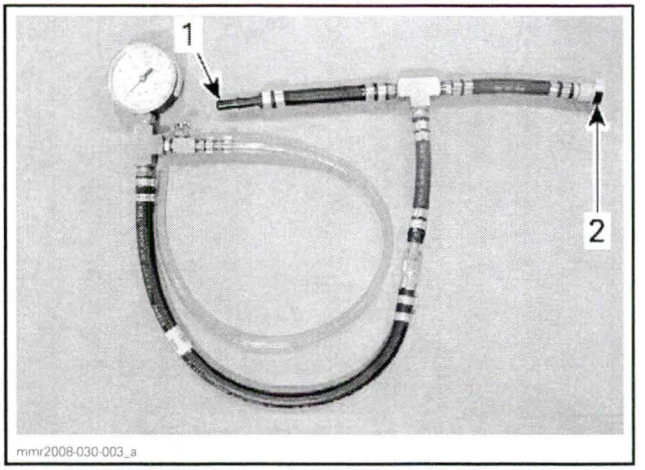
NOTE: Ensure battery cables are connected.

4. Disconnect the quick connect fitting from fuel pump.



TYPICAL
1. Disconnect this fitting

5. Install the FUEL HOSE ADAPTER (P/N 529 036 023) and the PRESSURE GAUGE (P/N 529 035 709) between the disconnected fuel hose and the fuel pump fitting.



PRESSURE GAUGE WITH FUEL HOSE ADAPTER
1. Connects to fuel hose
2. Connects to fuel pump

6. Install pressure gauge to the fuel hose adapter.

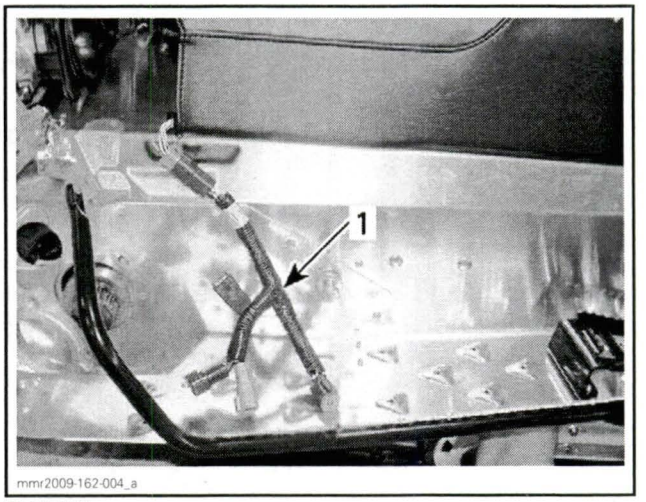
⚠ WARNING

When carrying out pressure test, ensure fuel is not leaking from test equipment. Ensure fuel hose do not come into contact with hot parts.

7. Set emergency engine stop switch to RUN.

NOTE: **DO NOT** install the tether cord cap on the engine cut-off switch.

8. Activate fuel pump by installing the T-HARNESS (P/N 529 035 869) on the vehicle diagnostic connector and observe fuel pressure reading on test gauge.



TYPICAL
1. T-harness connected to diagnostic connector

NOTE: **Do not crank engine** at this time.

NOTE: If fuel pressure drops, refer to *FUEL PUMP PRESSURE TEST* chart further.

9. Install the tether cord cap on the engine cut-off switch.
10. **Start engine** and observe pressure reading.

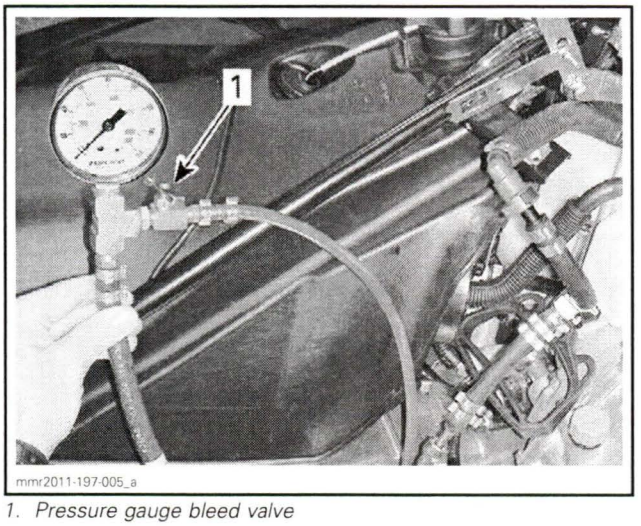
NOMINAL FUEL PUMP PRESSURE
Approximately 400 kPa (58 PSI)

11. Stop engine.

FUEL PRESSURE TEST	
RESULT	POSSIBLE CAUSE
Pressure drops (engine OFF)	Leaking test equipment
	Leaking fuel system hoses
	Leaking fuel injector(s)
	Leaking fuel pressure regulator
Pressure above specifications	Defective fuel pressure regulator.
	Test gauge not properly calibrated.
Pressure below specifications	Clogged fuel filter.
	Defective fuel pressure regulator.
	Leak in the fuel system circuit.
	Defective fuel pump.
	Leaking fuel injector(s) (engine OFF).
	Test gauge not properly calibrated.

NOTE: If the fuel pressure regulator is at fault, the fuel pump module must be replaced.

12. Release any remaining fuel pressure into an appropriate container using the bleed valve on the fuel hose adapter.



1. Pressure gauge bleed valve

13. Remove test equipment.
14. Reconnect fuel hose to fuel pump.
15. Pressurize the fuel system to check for leaks. Refer to *FUEL SYSTEM PRESSURIZATION AND LEAK TEST* in this subsection.
16. Reinstall all remaining removed parts.

PROCEDURES

FUEL HOSE AND OETIKER CLAMPS

Fuel Hose Replacement

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

⚠ WARNING

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

⚠ WARNING

- **Never use a hose pincher on high pressure hoses.**
- **Never change the routing of a fuel hose.**
- **Always reinstall the corrugated protective tubing on fuel hoses.**
- **Secure fuel hoses using the appropriate locking tie or fastener to prevent contact with sharp edges or hot, rotating and moving parts.**
- **After connecting a hose or a quick connect fitting, pull on the hose near the fitting to make sure it is securely locked.**
- **Always validate fuel system tightness by performing a *FUEL SYSTEM PRESSURIZATION AND LEAK TEST*.**

Oetiker Clamp Replacement

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

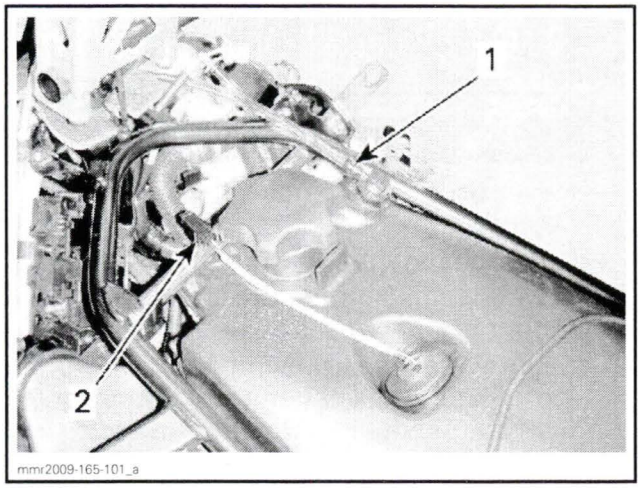
⚠ WARNING

Whenever removing a hose in the fuel system, always use new Oetiker clamps at assembly.

FUEL TANK

Fuel Tank Removal

1. Remove the following items. Refer to *BODY* subsection:
   - Both side panels
   - Hood
   - Seat (s).
2. Remove headlight/gauge module and air intake silencer as a unit, refer to *AIR INTAKE SYSTEM* subsection.
3. Remove console panel, refer to *BODY* subsection.
4. Disconnect fuel vent line from fuel tank elbow.
5. Disconnect fuel level sensor connector.



TYPICAL
1. *Vent line*
2. *Fuel level sensor connector*

6. Remove both rear frame members, refer to *FRAME* subsection.

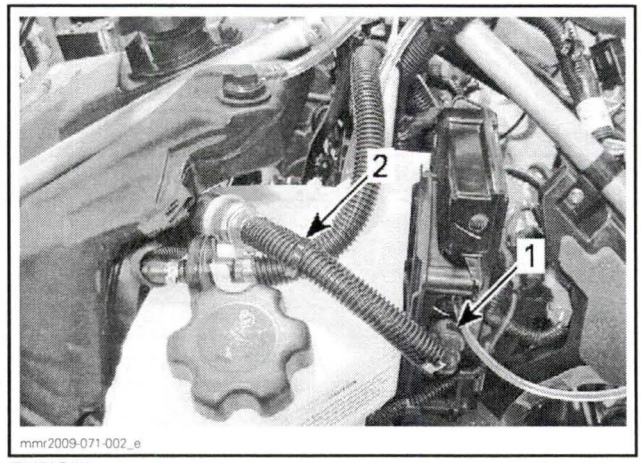
600 HO E-TEC Model

7. Release fuel pressure. Refer to *FUEL PUMP* in this subsection.
8. Disconnect ground cable from battery. Refer to *CHARGING SYSTEM (600 HO E-TEC)* subsection.
9. Disconnect the magneto connector.

⚠ WARNING

The magneto connector must be disconnected to prevent any spark in the engine compartment and to remove power from the fuel pump. Otherwise, if engine is cranked, fuel vapors may ignite in presence of a spark creating a fire hazard.

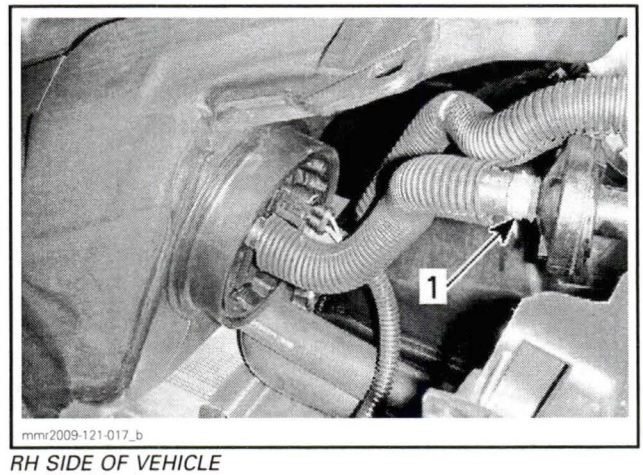
10. Cut the locking tie securing the pressure and return hoses together.
11. Install a rag under the ECM hose quick connect to catch fuel spillage.
12. Disconnect fuel supply hose from ECM.



TYPICAL
1. *Fuel pressure hose fitting at ECM*
2. *Locking tie to remove*

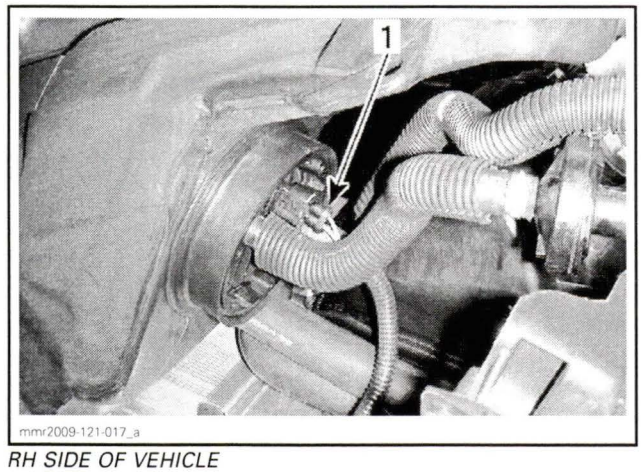
13. Install a SMALL HOSE PINCHER (P/N 295 000 076) on the fuel return hose close to the pump inlet.
14. Cut the Oetiker clamp and disconnect the fuel return hose at the fuel pressure regulator.

NOTE: Use sheet metal snips to cut the Oetiker clamps in order to avoid putting strain on the fuel pump fittings.



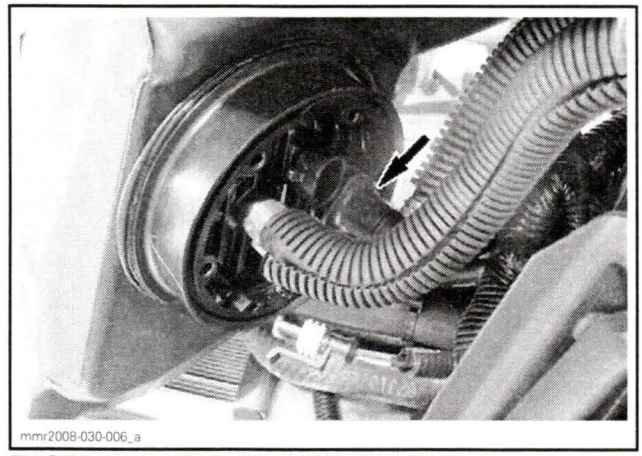
RH SIDE OF VEHICLE
1. *Cut this clamp*

15. Disconnect fuel pump electrical connector.



RH SIDE OF VEHICLE
1. *Fuel pump connector*

16. Carefully disconnect the quick connect fitting from fuel pump.

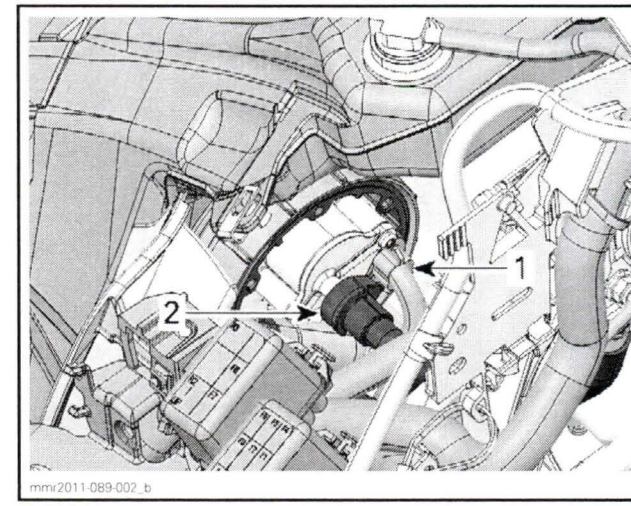


RH SIDE OF VEHICLE - DISCONNECT THIS FITTING

17. Pull out fuel tank.

600 ACE Models

1. Release fuel pressure. Refer to *FUEL PUMP* in this subsection.
2. Disconnect ground cables from battery. Refer to *CHARGING SYSTEM* subsection.
3. Disconnect the electrical connector and fuel pressure hose from the fuel pump.



TYPICAL
1. *Fuel pump electrical connector*
2. *Fuel pressure hose*

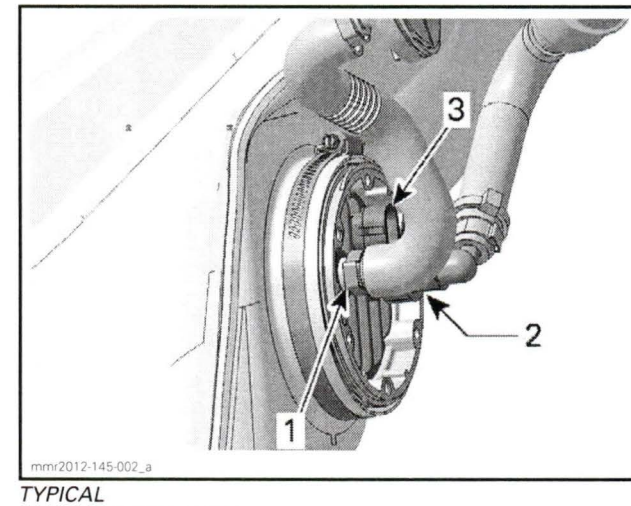
4. Remove fuel tank.

Fuel Tank Installation

Installation procedures are the reverse of the removal procedures. However, pay attention to the following.

600 HO E-TEC Model

1. Position fuel tank on vehicle close to its normal position and make the following connections in the specified order:
   - Fuel return hose to fuel pressure regulator using a NEW Oetiker clamp
   - Fuel pump pressure hose
   - Fuel pump electrical connector.



TYPICAL
1. *NEW Oetiker clamp*
2. *Fitting properly locked*
3. *Electrical connector installed*

⚠ WARNING

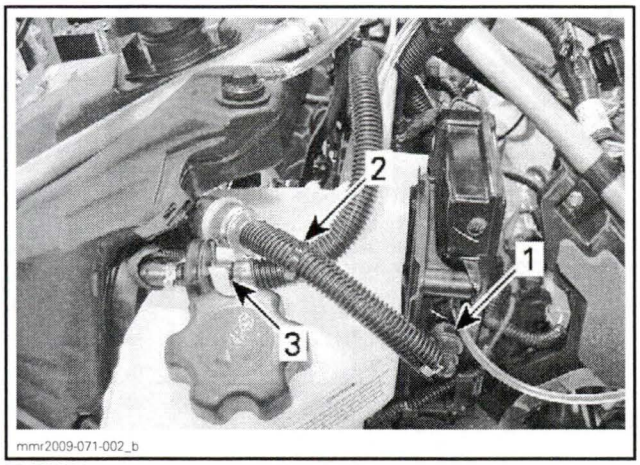
Ensure hose clamp is tight and that hose cannot turn on the fitting. Pull on pressure hose to ensure the fitting is properly locked and secured to the fuel pump.

2. Remove hose pincher and move tank forward to its normal position.
3. Connect pressure hose to ECM and pull on hose to ensure it is properly locked and secure.

⚠ WARNING

Pull on pressure hose to ensure the fitting is properly locked and secured to the ECM.

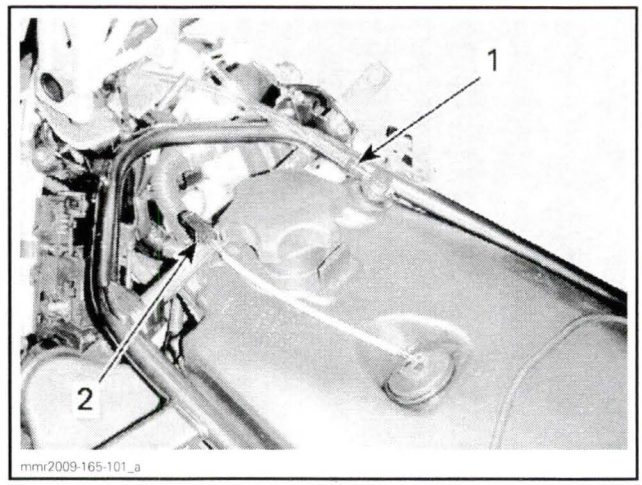
4. Secure the following to oil injector tank as prior to removal
   - Pressure hose
   - Return hose
   - Pressure regulator.



TYPICAL
1. *Ensure quick disconnect secure on ECM*
2. *Locking tie installed*
3. *Pressure regulator in holder*

5. Connect the following:
   - Fuel tank vent hose
   - Fuel level sensor connector.

NOTICE **Ensure vent tube is not kinked or pinched.**



TYPICAL
1. *Vent line*
2. *Fuel level sensor connector*

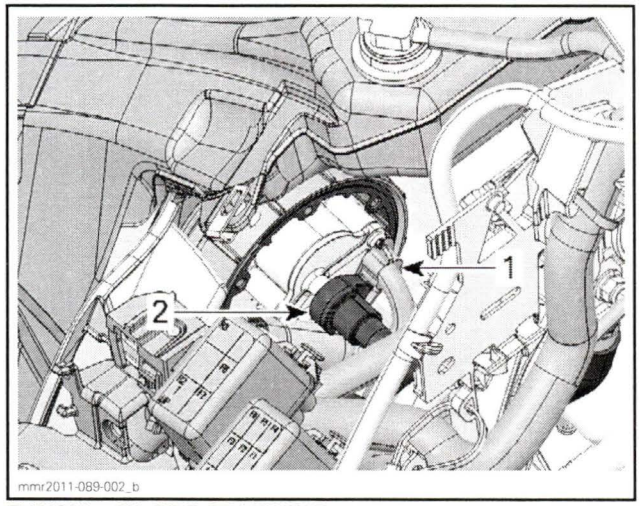
6. Reconnect battery and magneto connector, refer to *CHARGING SYSTEM (600 HO E-TEC)* subsection.
7. Carry out a fuel tank leak test. Refer to *FUEL TANK LEAK TEST* in this subsection.
8. Refuel tank.
9. Pressurize the fuel system to check for leaks. Refer to *FUEL SYSTEM PRESSURIZATION AND LEAK TEST* in this subsection.
10. Install the remaining removed parts, refer to applicable subsections for details.

600 ACE Models

1. Position fuel tank on vehicle close to normal position and make the following connections:
   - Fuel pump electrical connector
   - Fuel pump pressure hose.

⚠ WARNING

Pull on pressure hose to ensure the fitting is properly locked and secured to the fuel pump.



TYPICAL - RH SIDE OF VEHICLE
1. *Fuel pump connector*
2. *Fuel pressure hose*

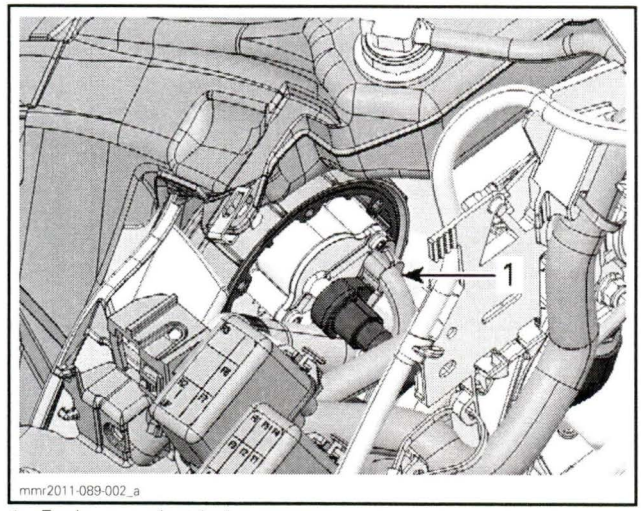
2. Move fuel tank to its normal position and connect:
   - Fuel level sensor connector
   - Fuel tank vent hose.
3. Reconnect battery.
4. Carry out a fuel tank leak test. Refer to *FUEL TANK LEAK TEST* in this subsection.
5. Pressurize the fuel system to check for leaks. Refer to *FUEL SYSTEM PRESSURIZATION AND LEAK TEST*.
6. Install all remaining parts, refer to applicable subsections for details.

FUEL PUMP

Fuel Pump Pressure Release

600 ACE

1. Disconnect fuel pump electrical connector.



1. Fuel pump electrical connector

2. Crank engine and let run until it runs out of fuel.

NOTE: The engine will stall when it runs out of fuel.

600 HO E-TEC Only

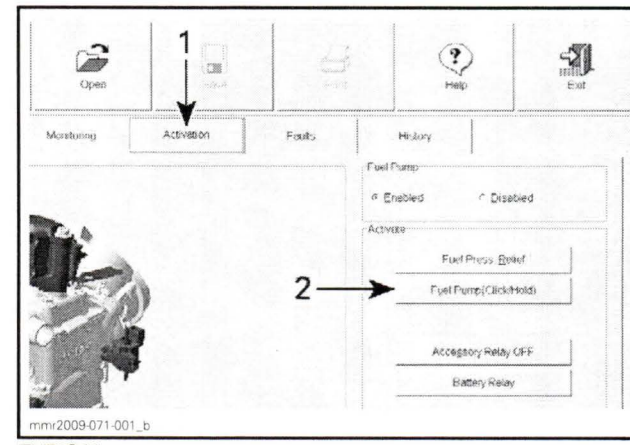
1. Connect B.U.D.S. to the vehicle diagnostic connector. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. Release the fuel pressure in the system by selecting the following in B.U.D.S.:
   2.1 **Read Data**
   2.2 **Activation** tab
   2.3 **ECM** tab in the lower LH corner of the **Activation** page
   2.4 **Fuel Press. Relief** button in the **Activate** area.
3. Wipe up any spilled fuel.
4. Run engine until it runs out of gas.

Fuel Pump Operational Test

600 HO E-TEC

NOTE: Activating the fuel pump as described in this procedure can be used for purging air from the fuel system whenever a fuel hose has been disconnected and reconnected. The pump should be activated for 15 seconds to ensure proper purging of the system.

1. Connect vehicle to the latest applicable B.U.D.S. version, refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. Select the ECM and Activation page tabs.
3. Click on the Fuel Pump (Click/Hold) button in the Activate field.



TYPICAL
1. *Activation tab*
2. *Fuel Pump (Click/Hold) button*

4. Listen for fuel pump operation.

NOTE: The fuel pump should run as long as you hold the Fuel Pump (Click/Hold) button in B.U.D.S.

If you do not hear the pump come ON, select the Faults tab in B.U.D.S. and check for fault codes.

If there is no fault code, connect a known good fuel pump to the vehicle harness (in parallel) and repeat the test.

If the second fuel pump functions when connected to the vehicle harness, then replace the fuel pump installed in the vehicle.

600 ACE

1. Set emergency engine stop switch to RUN.
2. Install the tether cord cap on the engine cut-off switch.
3. Briefly press START/RER button, **DO NOT** crank engine.

You should hear the fuel pump running for approximately 2 seconds.

If the fuel pump does not run:

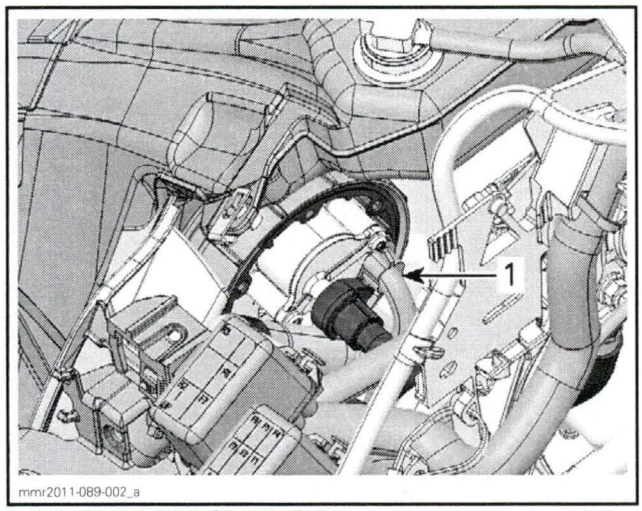
- Ensure ECM is powered. Refer to *ELECTRONIC FUEL INJECTION* subsection.
- Check Fuel Pump/Starter Solenoid fuse. If fuse is faulty, replace it and repeat test. If fuse is good, carry out the *FUEL PUMP INPUT VOLTAGE TEST* in this subsection.

Fuel Pump Input Voltage Test

600 ACE Only

1. Disconnect fuel pump connector.

NOTE: A screwdriver can be used to disconnect and reconnect the connector.



TYPICAL - RH SIDE OF VEHICLE
1. Fuel pump connector

2. Set the FLUKE 115 MULTIMETER (P/N 529 035 868) to Vdc.
3. Set emergency engine stop switch to RUN.
4. Briefly press START/RER button, **DO NOT** crank engine.
5. Probe terminals and read the input voltage as follows.

FUEL PUMP HARNESS CONNECTOR		VOLTAGE
Pin C (+ probe)	Pin A (- probe)	Battery voltage for approximately 2 seconds, then voltage should drop by approximately 0.5 V

If test succeeded, power and ground circuits are good. Replace fuel pump.

If test failed, carry out the following test.

6. Briefly press START/RER button, **DO NOT** crank engine.

FUEL PUMP HARNESS CONNECTOR		VOLTAGE
Pin C (+ probe)	Battery ground (- probe)	Battery voltage

If battery voltage is read, carry out a continuity test of the fuel pump control circuit to the ECM. Refer to the wiring diagram.

If battery voltage is not read, carry out a continuity test of the fuel pump power circuit. Refer to the wiring diagram.

Fuel Pump Removal

1. Release fuel system pressure. Refer to *FUEL PUMP* in this subsection.
2. Disconnect ground cable from battery. Refer to *CHARGING SYSTEM.*

600 HO E-TEC Model

3. Disconnect magneto connector.

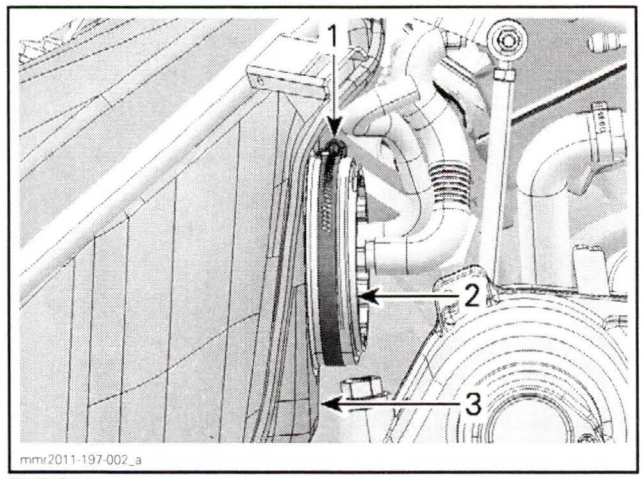
⚠ WARNING

The magneto connector must be disconnected to prevent any spark in the engine compartment and to remove power from the fuel pump. Otherwise, if engine is cranked, fuel vapors may ignite in presence of a spark creating a fire hazard.

All Models

4. Remove fuel tank. Refer to *FUEL TANK REMOVAL* in this subsection.
5. Empty fuel tank.

6. Remove gear clamp from fuel pump mounting flange on fuel tank.

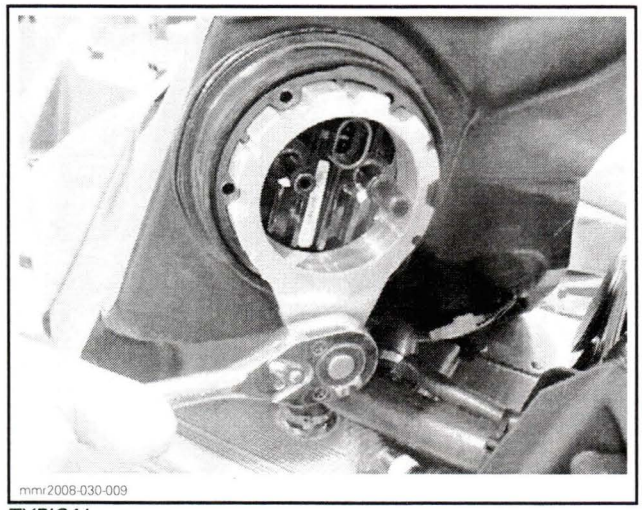


TYPICAL
1. *Gear clamp to remove*
2. *Fuel pump*
3. *Fuel tank*

7. Remove fuel pump retaining nut using appropriate fuel pump nut tool.

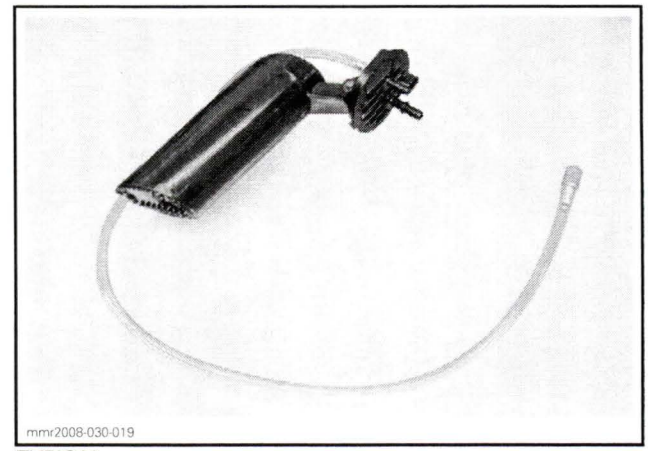
600 HO E-TEC	
FUEL PUMP NUT TOOL (P/N 529 036 118)	

600 ACE	
FUEL PUMP NUT TOOL (P/N 529 036 214)	



TYPICAL

8. Remove fuel pump.



TYPICAL

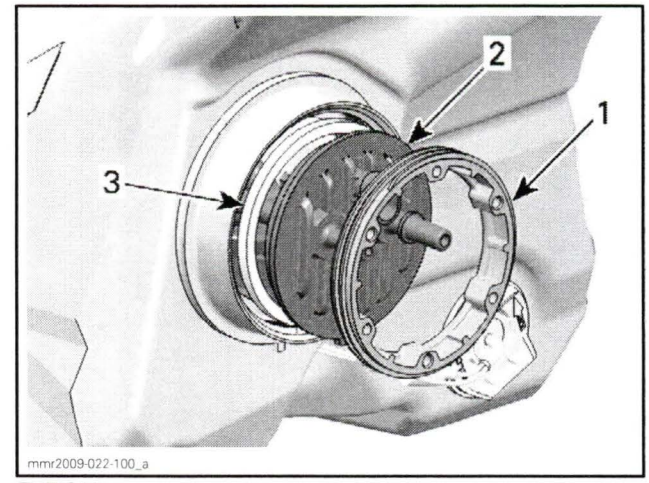
9. Remove and discard fuel pump gasket.

Fuel Pump Installation

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

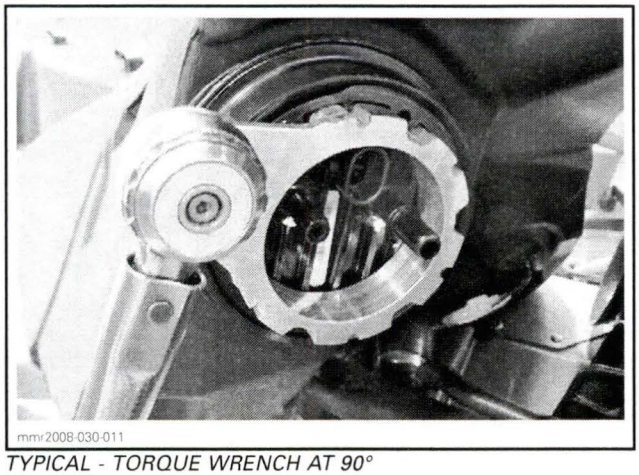
1. Install a **NEW** gasket on the fuel pump.

NOTE: Install gasket between the fuel pump and the fuel tank.



TYPICAL
1. *Nut*
2. *Fuel pump*
3. *Gasket*

2. Install a torque wrench perpendicularly (90°) to the appropriate fuel pump nut tool as indicated in *FUEL PUMP REMOVAL*.
3. Torque fuel pump nut as specified in exploded view.



TYPICAL - TORQUE WRENCH AT 90°

TORQUE - FUEL PUMP NUT
43 N•m (32 lbf•ft)

4. Reinstall fuel tank. Refer to the *FUEL TANK INSTALLATION* in this subsection.
5. Refuel tank.
6. Carry out a fuel tank leak test, refer to *FUEL TANK LEAK TEST* in this subsection.
7. Carry out a fuel system leak test, refer to *FUEL SYSTEM PRESSURIZATION AND LEAK TEST* in this subsection.

⚠ WARNING

After working on the fuel system, carry out a fuel system pressurization and leak test to ensure there aren't any fuel leaks.

FUEL PRESSURE REGULATOR (600 ACE)

The fuel pressure regulator is integral to the fuel pump module. It ensures proper fuel system pressure.

If the fuel pump fails the *FUEL PUMP PRESSURE TEST (600 ACE)*, replace the fuel pump module.

FUEL PRESSURE REGULATOR (600 HO E-TEC)

The fuel pressure regulator is an in-line type and is acquired as an assembly with the fuel return hose.

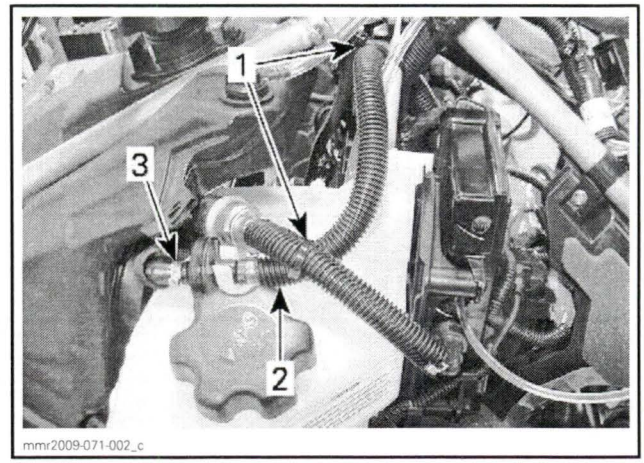
Fuel Pressure Regulator Removal

1. Release fuel pressure in the system. Refer to *FUEL PUMP* in this subsection.
2. Remove both side panels.
3. Disconnect magneto connector.

⚠ WARNING

The magneto connector must be disconnected to prevent any spark in the engine compartment and to remove power from the fuel pump. Otherwise, if engine is cranked, fuel vapors may ignite in presence of a spark creating a fire hazard.

4. Cut the locking ties securing the fuel return hose to the fuel supply hose and to the upper column.
5. Pull back corrugated plastic sheath and install a small hose pincher on the return hose forward of the fuel pressure regulator.
6. Remove and discard Oetiker clamp on the fuel return hose aft of the fuel pressure regulator.



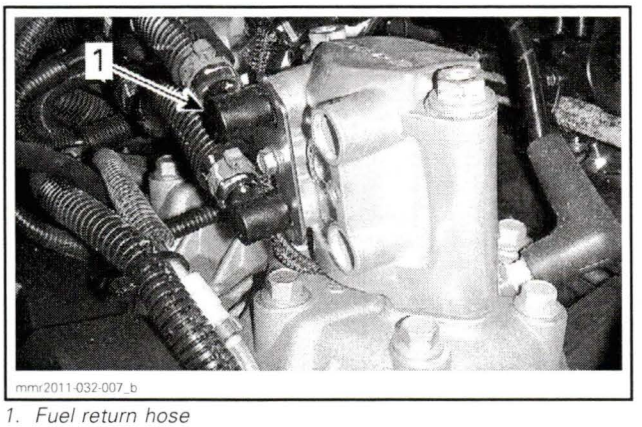
TYPICAL
1. *Locking ties to cut*
2. *Pull back plastic sheath and install hose pincher here*
3. *Remove this Oetiker clamp*

7. Disconnect fuel return hose from the pressure regulator fitting.

NOTE: Place a container under the fuel return hose and drain the fuel remaining in hose.

8. Remove fuel pressure regulator from holder on oil tank.
9. Place a container under the pressure regulator, remove the hose pincher, and drain the fuel in the hose.
10. Disconnect the fuel return hose from both fuel injectors, refer to the *E-TEC DIRECT FUEL INJECTION* subsection for specific details.

NOTE: Be sure to place shop rags around the injector hose fittings to catch the fuel spillage.



1. Fuel return hose

11. Remove fuel pressure regulator hose assembly from vehicle.

Fuel Pressure Regulator Installation

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

Be sure to strictly follow the procedures in the *E-TEC DIRECT FUEL INJECTION* subsection when reconnecting fuel return hose to injectors.

Install a NEW Oetiker clamp to retain the fuel return hose to the fuel pressure regulator.

⚠ WARNING

Ensure hose clamp is tight and that the fuel hose cannot turn on the fitting.

When installation is complete, carry out a fuel system leak test, refer to *FUEL SYSTEM PRESSURIZATION AND LEAK TEST* in this subsection.

⚠ WARNING

After working on the fuel system, carry out a fuel system pressurization and leak test to ensure there aren't any leaks.

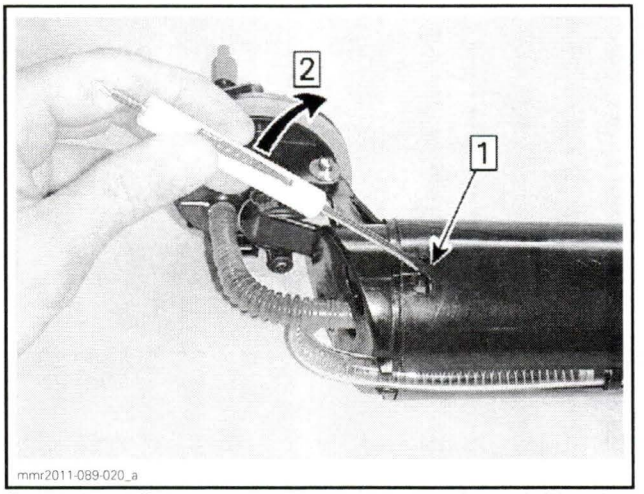
FUEL PUMP INLET FILTER

Fuel Pump Inlet Filter Location

The fuel pump inlet filter is attached to the electric fuel pump inlet, within the fuel pump module housing (fuel pump reservoir).

Fuel Pump Inlet Filter Replacement

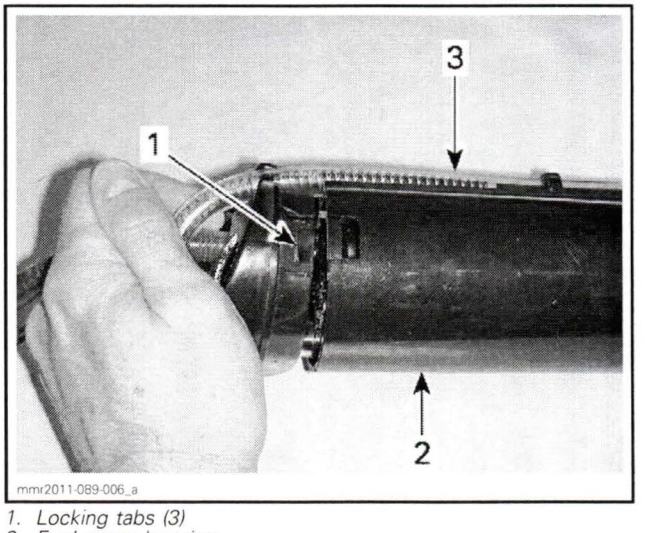
1. Remove fuel pump module from fuel tank, refer to *FUEL PUMP REMOVAL* in this subsection.
2. Remove fuel pump module housing in the following manner.
   2.1 Insert a flat screwdriver between fuel pump module locking tabs (3) and fuel pump module housing.
   2.2 Carefully pry up on screwdriver handle to depress locking tabs and release fuel pump module housing.



Step 1: Insert flat screwdriver between each locking tab (3) and fuel pump module housing
Step 2: Pry up on screwdriver to depress locking tabs and release housing

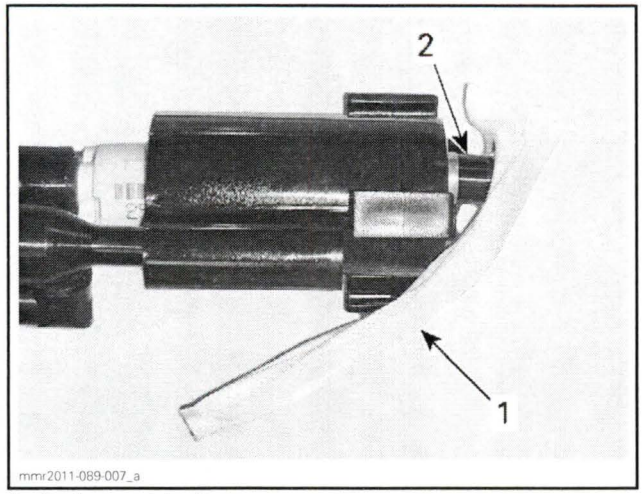
   2.3 Remove housing from fuel pump module.

NOTE: It is not necessary to pull the housing off the remote fuel pickup hose.



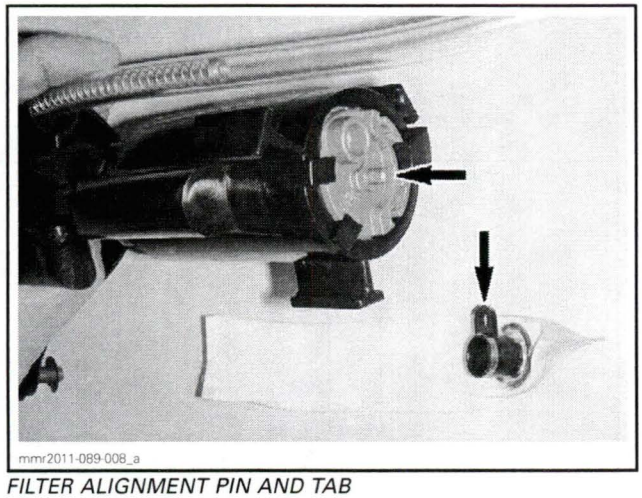
1. Locking tabs (3)
2. Fuel pump housing
3. Remote pickup hose

3. Pull on the flanged portion of inlet filter to remove it from bottom of the fuel pump.



1. *Fuel pump inlet filter*
2. *Inlet filter flange*

4. Install a new filter element by pushing it onto the base of the fuel pump; be sure to insert the tab of the filter element flange onto the alignment pin on the fuel pump base.



FILTER ALIGNMENT PIN AND TAB

5. Install remaining parts in the reverse order of removal.
6. Install and reconnect fuel pump module (pressure hose and electrical connector), refer to *FUEL PUMP INSTALLATION* in this subsection.
7. Carry out a *FUEL TANK LEAK TEST* as detailed in this subsection.
8. Carry out a *FUEL SYSTEM PRESSURIZATION AND LEAK TEST* as detailed in this subsection.
9. Install remaining parts in the reverse order of removal, refer to *FUEL TANK INSTALLATION* in this subsection.

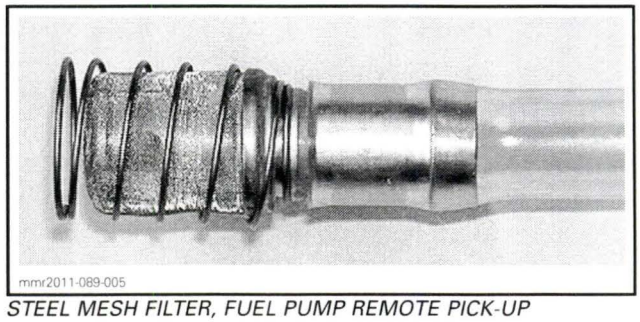
STEEL MESH FILTER

Steel Mesh Filter Location

The steel mesh fuel filter is located on the remote pickup of the fuel pump module.

Steel Mesh Filter Cleaning

1. Remove fuel pump module from fuel tank, refer to *FUEL PUMP REMOVAL* in this subsection.
2. Clean steel mesh filter on fuel pump remote pickup using low pressure filtered air and XPS BRAKES AND PARTS CLEANER (P/N 219 701 705).



STEEL MESH FILTER, FUEL PUMP REMOTE PICK-UP

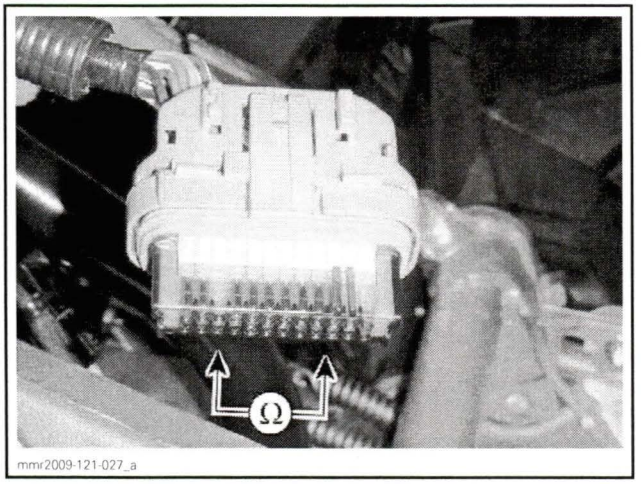
3. Install and reconnect fuel pump module (pressure hose and electrical connector), refer to *FUEL PUMP INSTALLATION* in this subsection.
4. Carry out a *FUEL TANK LEAK TEST* as detailed in this subsection.
5. Carry out a *FUEL SYSTEM PRESSURIZATION AND LEAK TEST* as detailed in this subsection.
6. Install remaining parts in the reverse order of removal, refer to *FUEL TANK INSTALLATION* in this subsection.

FUEL LEVEL SENSOR

Fuel Level Sensor Resistance Test (in Circuit)

1. Disconnect the multifunction gauge connector. Refer to *LIGHTS, GAUGE AND ACCESSORIES*.
2. Use the FLUKE 115 MULTIMETER (P/N 529 035 868).
3. Set multimeter to Ω.
4. Probe terminals and read the sensor resistance as follows.

FLOAT POSITION (ACCORDING TO FUEL LEVEL)	MULTIFUNCTION GAUGE HARNESS CONNECTOR		RESISTANCE @ 20°C (68°F)
Full	Pin 12	Pin 15	8.8 Ω ± 1.3 Ω
Empty			91.5 Ω ± 5.5 Ω



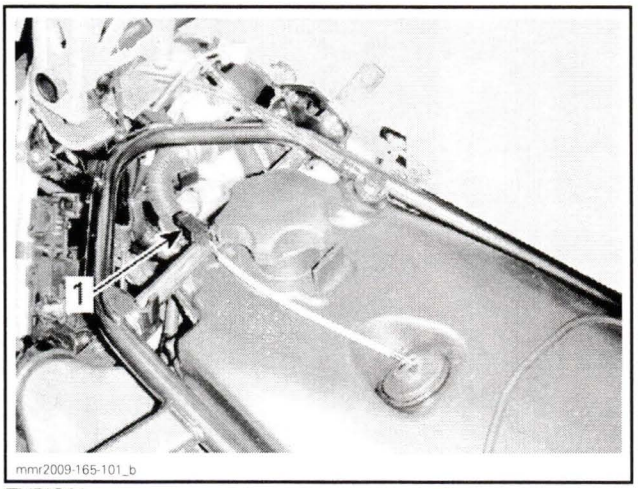
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If test succeeded, refer to *FUEL LEVEL SENSOR INPUT VOLTAGE TEST.*

If test failed, refer to *FUEL LEVEL SENSOR RESISTANCE TEST (SENSOR ONLY).*

Fuel Level Sensor Resistance Test (at Component)

1. Remove console. Refer to *BODY.*
2. Disconnect fuel level sensor connector.



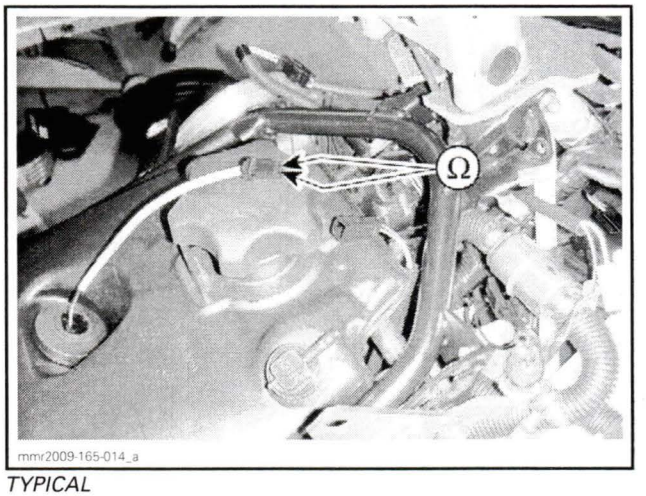
mmr2009-165-101_b

TYPICAL
1. Sensor connector

3. Probe sensor terminals and read the resistance as follows.

IMPORTANT: When the fuel level is changed, it takes approximately 10 seconds before the sensor resistance changes.

FLOAT POSITION (ACCORDING TO FUEL LEVEL)	SENSOR CONNECTOR		RESISTANCE @ 20°C (68°F)
Full	Pin 1	Pin 2	8.8 Ω ± 1.3 Ω
Empty			91.5 Ω ± 5.5 Ω



mmr2009-165-014_a

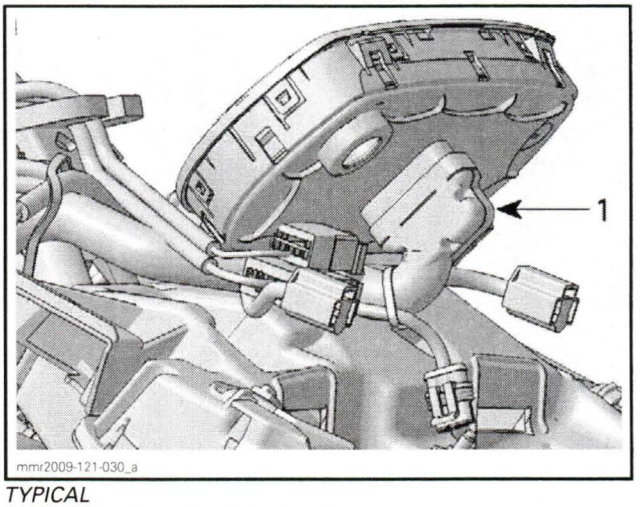
TYPICAL

4. If test failed, replace sensor.
5. If test succeeded, check wiring continuity between multifunction gauge and sensor.

Fuel Level Sensor Input Voltage Test

600 ACE Models

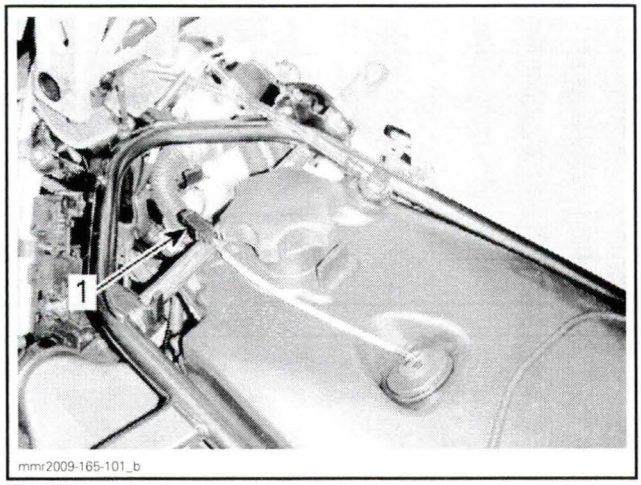
1. Make sure main wiring harness connector is properly connected to multifunction gauge.



mmr2009-121-030_a

TYPICAL
1. Multifunction gauge connected

2. Disconnect fuel level sensor.



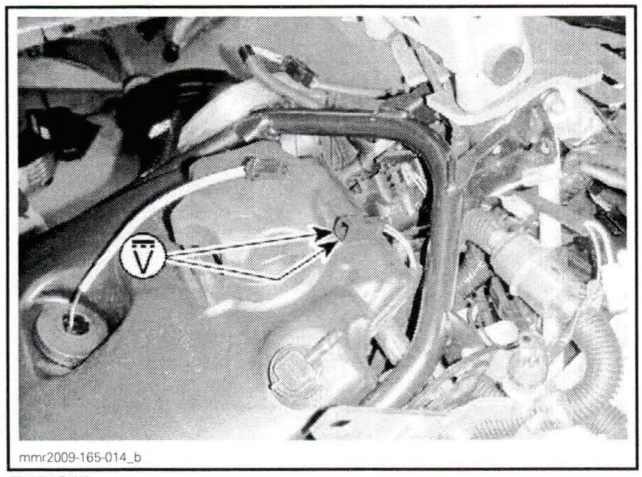
TYPICAL
1. Sensor connector

3. Use the FLUKE 115 MULTIMETER (P/N 529 035 868).
4. Select Vdc.
5. Set emergency engine stop switch to RUN.

Install the tether cord cap on engine cut-off switch.

6. Briefly press START/RER button to wake up multifunction gauge. **DO NOT** crank the engine.
7. Probe terminals of main wiring harness connector and read the voltage as follows.

SENSOR MAIN WIRING HARNESS CONNECTOR		VOLTAGE
Pin 1	Pin 2	Approximately 5 Vdc



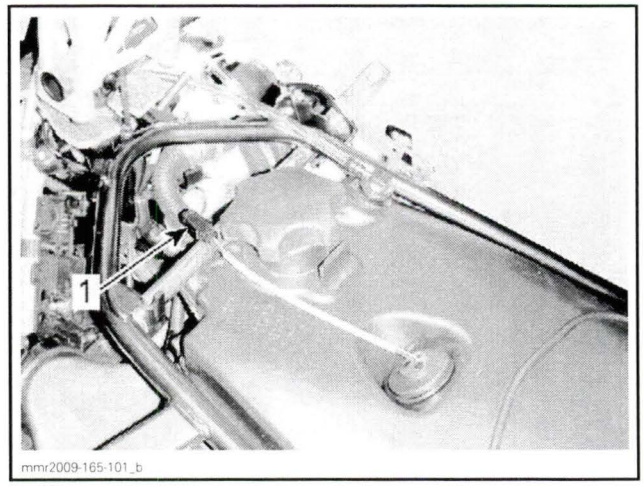
TYPICAL

If test failed, replace multifunction gauge.

If test succeeded, multifunction gauge provides proper voltage to the sensor.

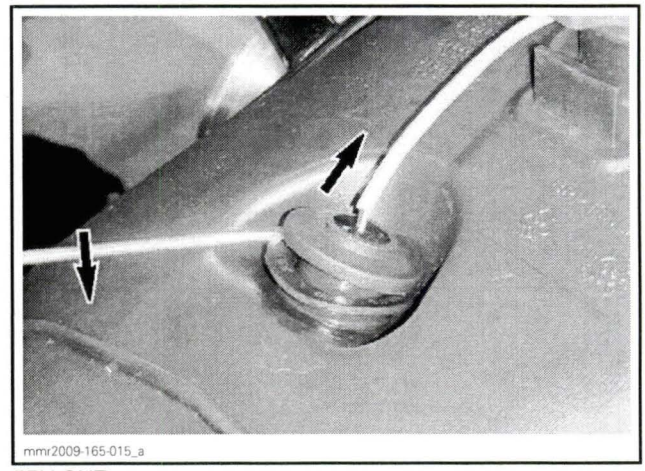
Fuel Level Sensor Removal

1. Drain fuel tank.
2. Remove console. Refer to *BODY* subsection.
3. Disconnect fuel level sensor connector.



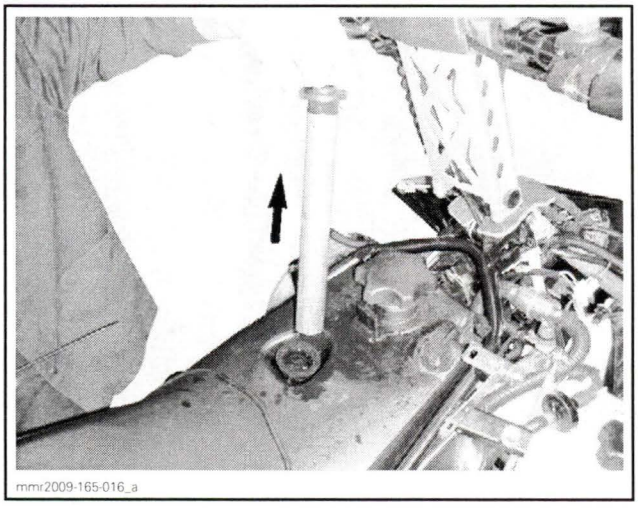
1. Sensor connector

4. Insert a screwdriver between grommet and sensor flange. Gently pry out sensor from grommet alternating from side to side.

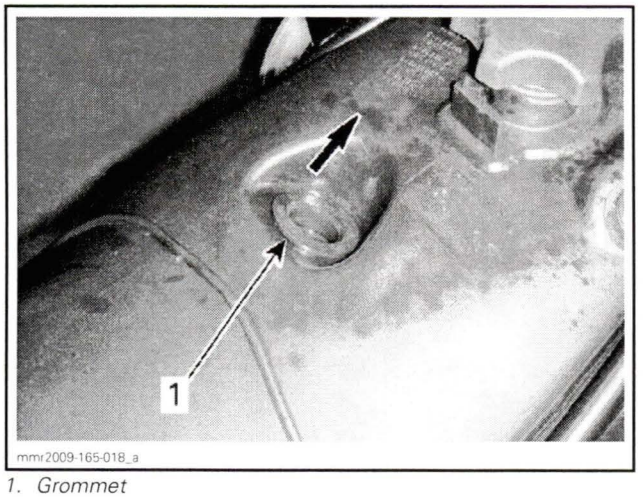


PRY OUT

5. Pull sensor out of fuel tank.



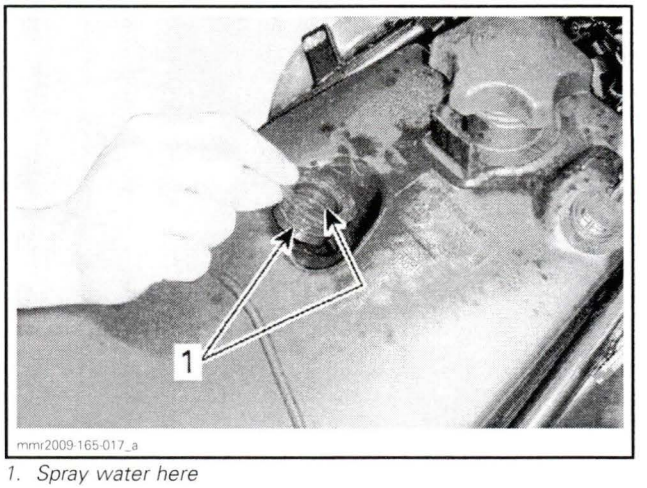
6. Remove grommet from fuel tank.



1. Grommet

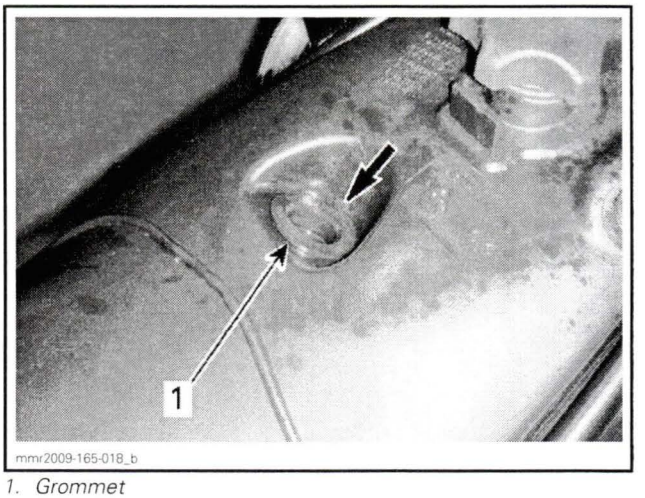
Fuel Level Sensor Installation

1. Fuel level sensor installation is the reverse of removal procedure. However, pay attention to the following.
2. Carry out a resistance test of sensor before installation. Refer to *FUEL LEVEL SENSOR RESISTANCE TEST* in this subsection.
3. To ease grommet and fuel level sensor installation, spray water (**NO SOAP**) on outer and inner surfaces of grommet.



1. Spray water here

4. Insert grommet in fuel tank ensuring it fully locks in position.



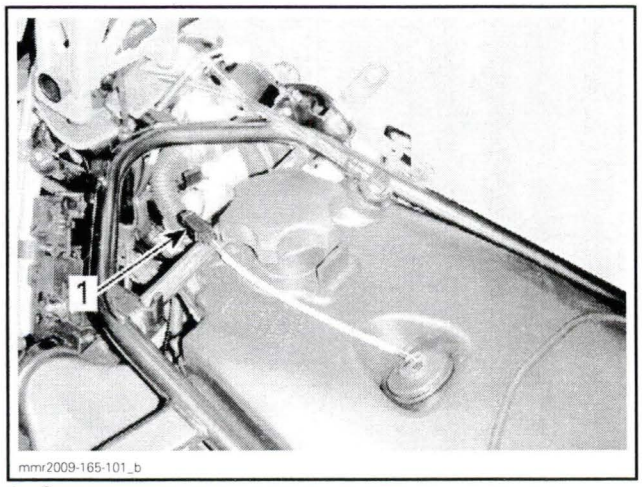
1. Grommet

5. Carefully insert float sensor through hole in grommet gently rotating it into position.



6. Apply DIELECTRIC GREASE (P/N 293 550 004) in connector to prevent corrosion.

7. Plug sensor connector.



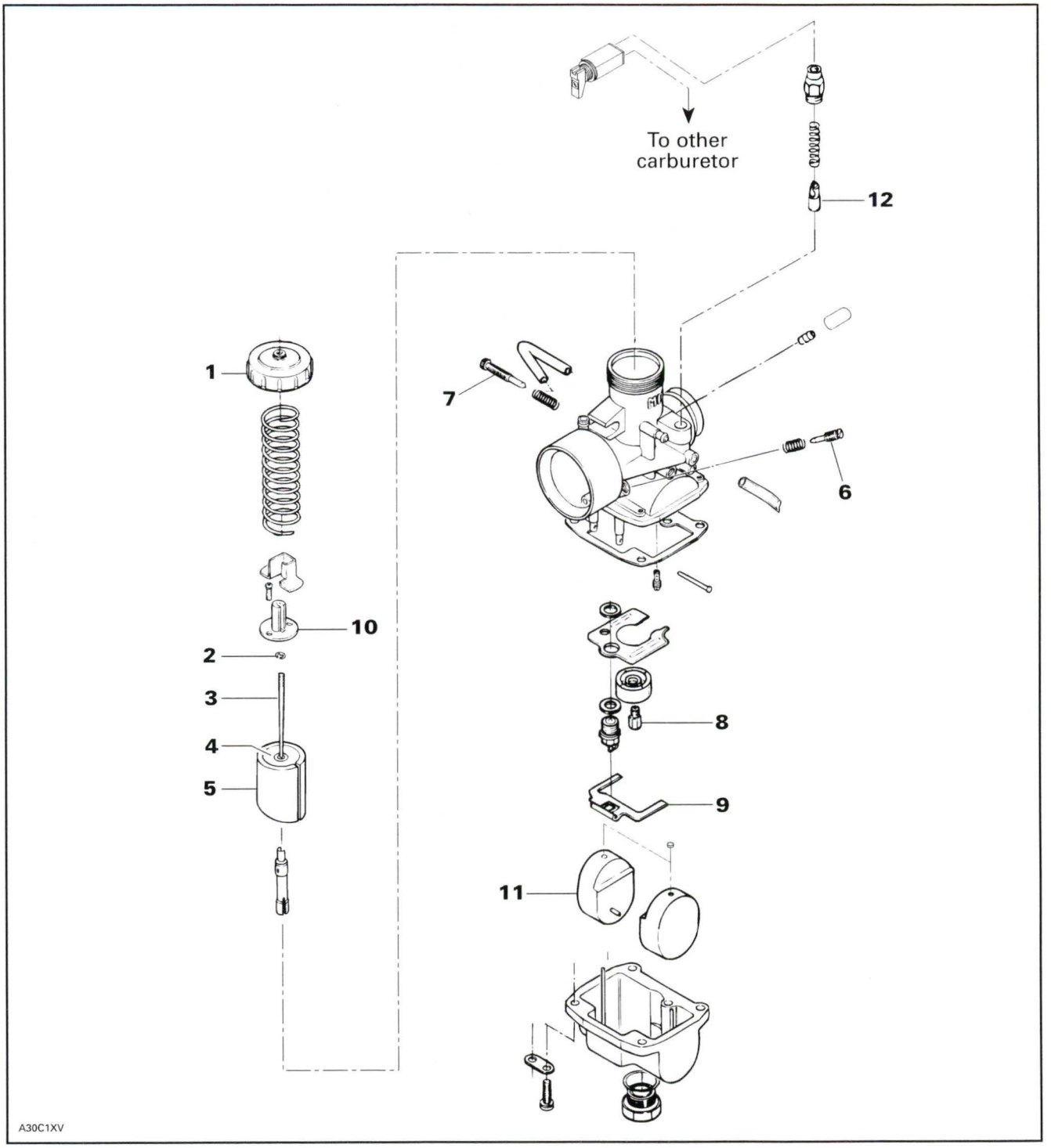
1. Sensor connector

8. Carry out a fuel system leak test. Refer to *FUEL TANK LEAK TEST* in this subsection.
9. Test fuel level indication as you fill fuel tank before you complete reassembly of vehicle.

VM CARBURETORS, THROTTLE AND CHOKE CABLES (550F)

SERVICE TOOLS

Description	Part Number	Page
CARBURETOR TOOL KIT	404 112 000	460
CHOKE ADJUSTER TOOL	529 036 163	469
FLOAT LEVEL GAUGE	529 035 520	462

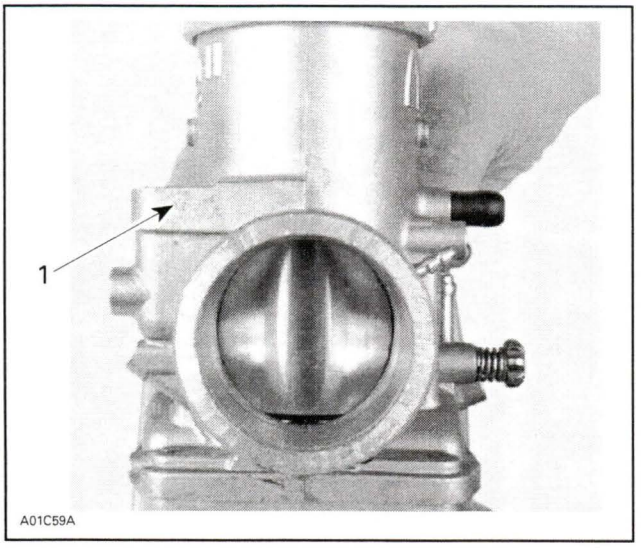

To other carburetor
12
1
7
6
10
2
3
4
5
8
9
11
A30C1XV

PROCEDURES

CARBURETOR

Carburetor Identification

All carburetors are identified on their body.



TYPICAL
1. Identification number

CARBURETOR MODEL		
MAG	VM30-218	Green dot
PTO	VM30-219	Blue dot

Carburetor Factory Calibration

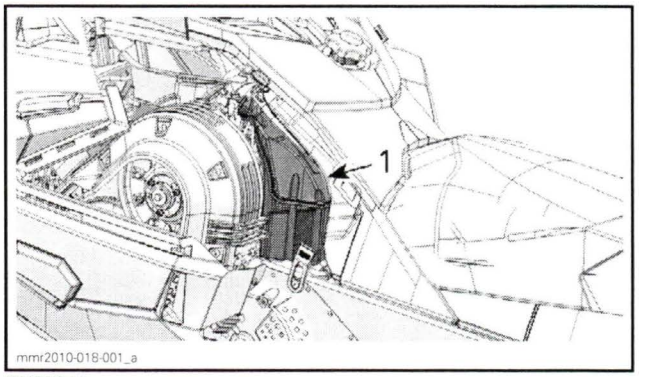
SPECIFICATIONS		
	MAG	PTO
Main jet	190	200
Jet needle identification	6BFY46	
Jet needle clip position	3	4
Needle jet	P-8 (159)	
Pilot jet	35	
Float level	23.9 mm ± 1 mm (.941 in ± .039 in)	
Slide cutaway	2.5	

SPECIFICATIONS		
	MAG	PTO
Air screw adjustment	1.25 (reference only)	1.00 (reference only)
Preliminary idle speed screw adjustment	1.6 mm ± 0.1 mm (.063 in ± .004 in)	
Idle speed	1650 ± 200 RPM	

Carburetor Removal

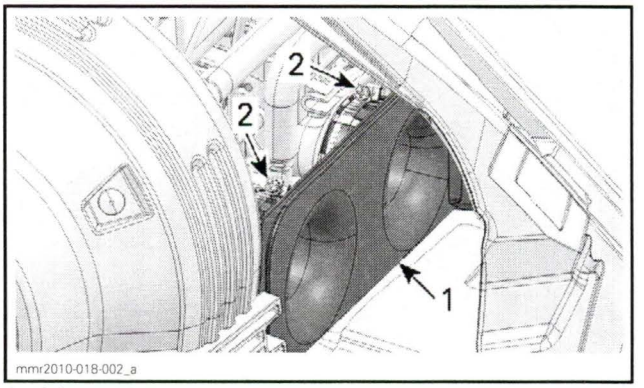
Remove the LH side panel.

Remove the primary air intake silencer. Refer to *AIR INTAKE SYSTEM* subsection.



TYPICAL
1. Primary air intake silencer

Loosen clamps retaining the adapter plate to carburetors.



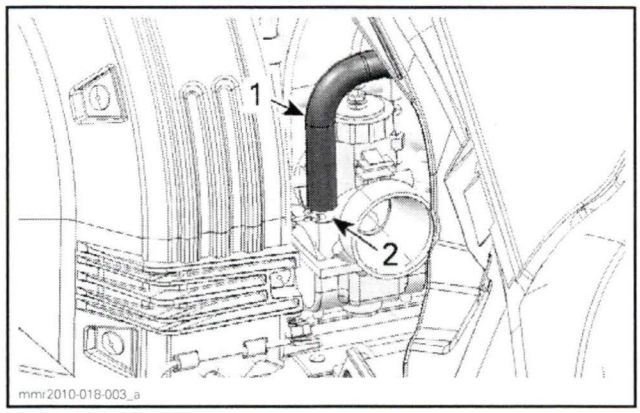
1. Adapter plate
2. Retaining clamps

Remove the adapter plate.

NOTE: The following procedure applies to both carburetors. Carburetors can be removed individually.

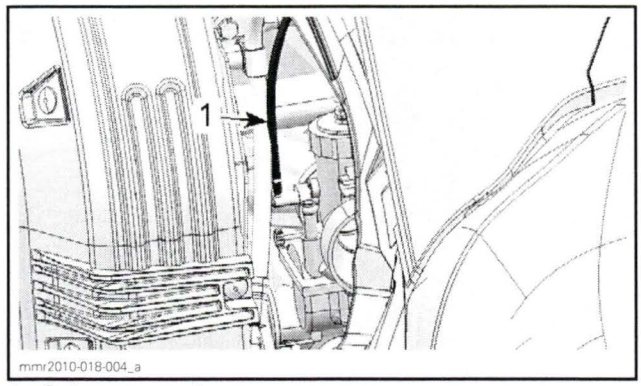
Loosen clamp retaining carburetor to intake adapter.

Disconnect fuel inlet line.



1. *Fuel inlet line*
2. *Spring clamp*

Disconnect the carburetor vent hose.

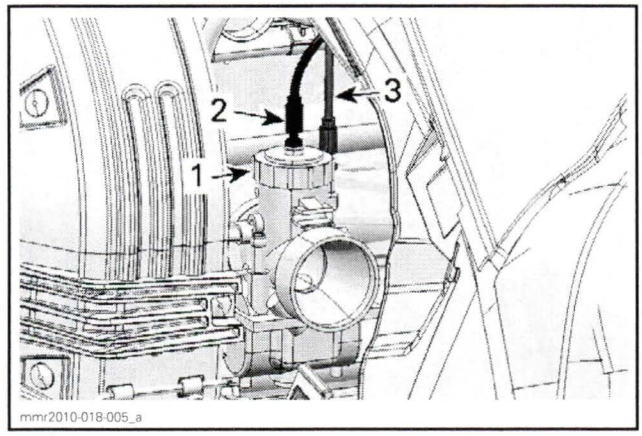


1. *Carburetor vent hose*

Unscrew carburetor cover **no. 1** then pull out throttle slide **no. 5** from carburetor.

Disconnect throttle cable from throttle slide.

Unscrew choke plunger from carburetor.

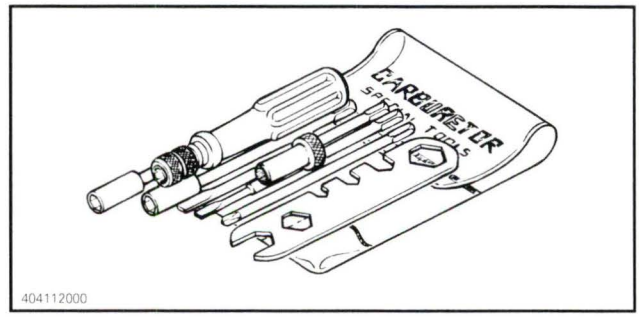


1. *Carburetor cover*
2. *Throttle cable*
3. *Choke cable*

Remove carburetor from engine.

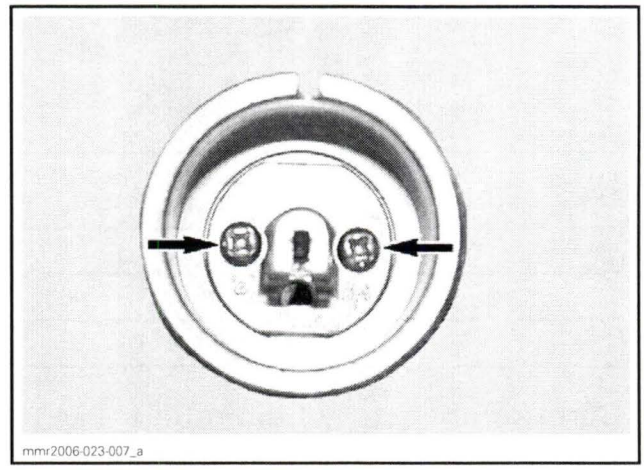
Carburetor Disassembly

NOTE: To ease the carburetor disassembly and assembly procedures it is recommended to use CARBURETOR TOOL KIT (P/N 404 112 000).



E-Clip and Jet Needle Removal

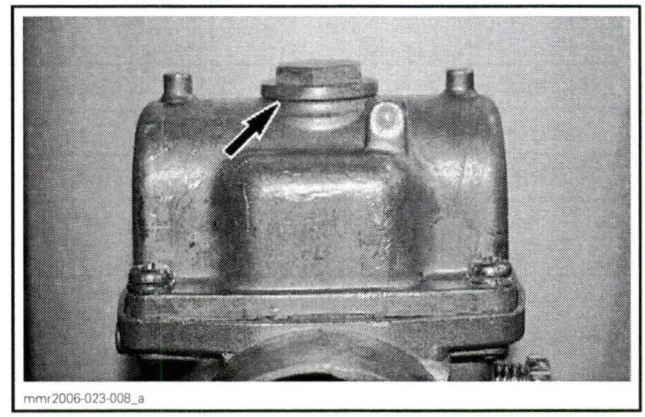
Remove screws from needle retaining plate **no. 10** to remove the jet needle **no. 3**.



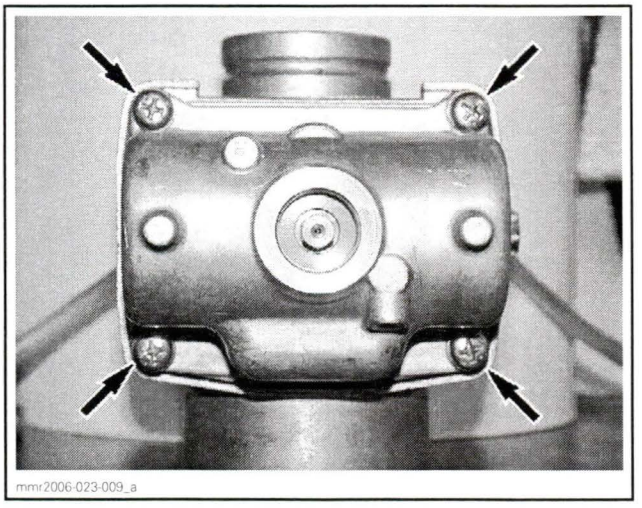
Remove jet needle with its E-clip.

Float Bowl Removal

Unscrew drain plug of float bowl. Recover the remaining fuel in a container.



Unscrew the 4 screws retaining the float bowl to the carburetor body.


mmr2006-023-009_a

Remove float bowl.

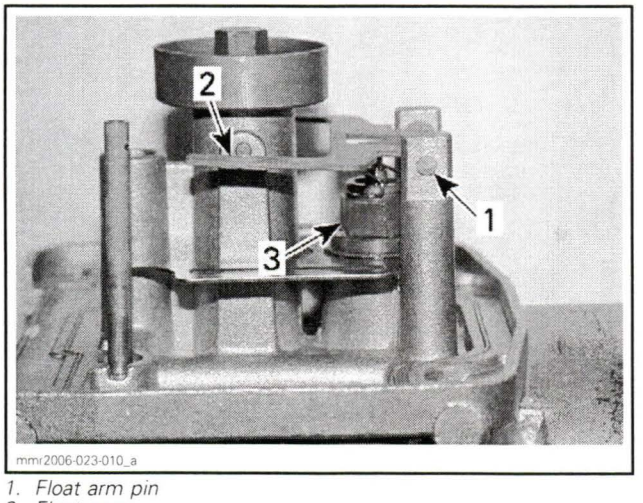
NOTE: Upon float bowl removal, make sure not to drop carburetor floats.

Needle Valve Removal

Remove float bowl as explained above.

Pull out pin retaining float arm to carburetor body. Remove float arm **no. 9**.

Unscrew needle valve.



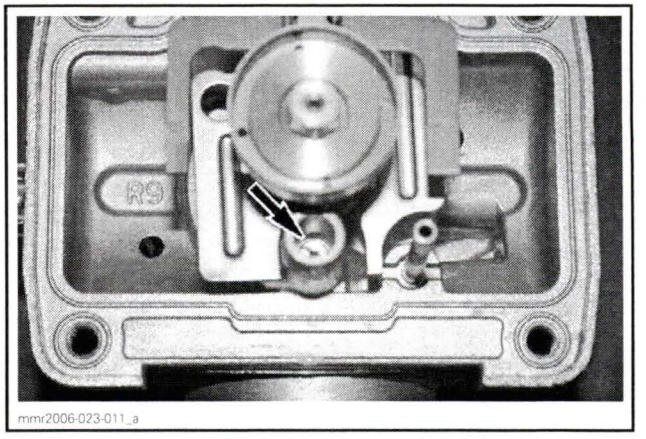
mmr2006-023-010_a

1. *Float arm pin*
2. *Float arm*
3. *Needle valve*

Pilot Jet Removal

Remove float bowl as explained above.

Unscrew pilot jet **no. 8** using a narrow screwdriver.



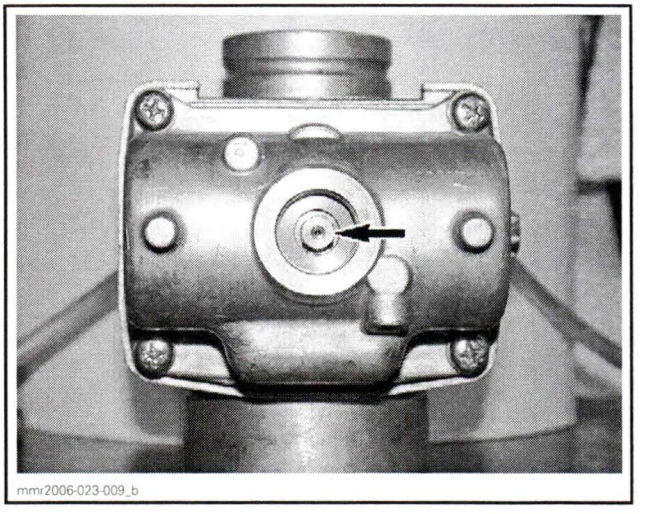
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Main Jet Removal

Remove float bowl as explained above.

Unscrew main jet from carburetor body.

NOTE: To replace main jet by a different size, main jet is accessible through the drain plug without removing float bowl.


mmr2006-023-009_b

Carburetor Cleaning

The entire carburetor should be cleaned with a general solvent and dried with compressed air.

NOTICE Heavy duty carburetor cleaner may be harmful to the float material and to the rubber parts, O-rings, etc. Therefore, it is recommended to remove those parts prior to cleaning.

Carburetor body, pilot jet and main jet should be cleaned in a carburetor cleaner following manufacturer's instructions.

⚠ WARNING

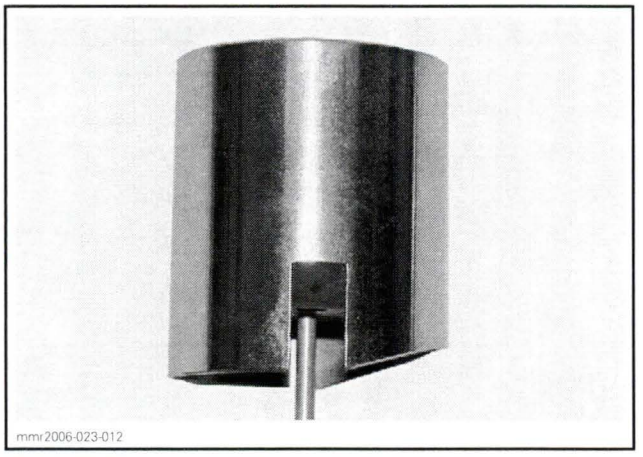
Solvent with a low flash point such as gasoline, naphtha, benzol, etc., should not be used as they are flammable and explosive.

Carburetor Inspection

Check inlet needle tip condition. If worn, the inlet needle and seat must be replaced as a matched set.

NOTE: Install needle valve for snowmobile carburetor only. It is designed to operate with a fuel pump system.

Check throttle slide **no. 5** for wear. Replace as necessary.



Check idle speed screw straightness. Replace as necessary.

Check for fuel soaked into float **no. 11**; replace as necessary.

Check float for cracks or other damages affecting free movement; replace as necessary.

Carburetor Assembly

The assembly is the reverse of the disassembly procedure. Pay attention to the following.

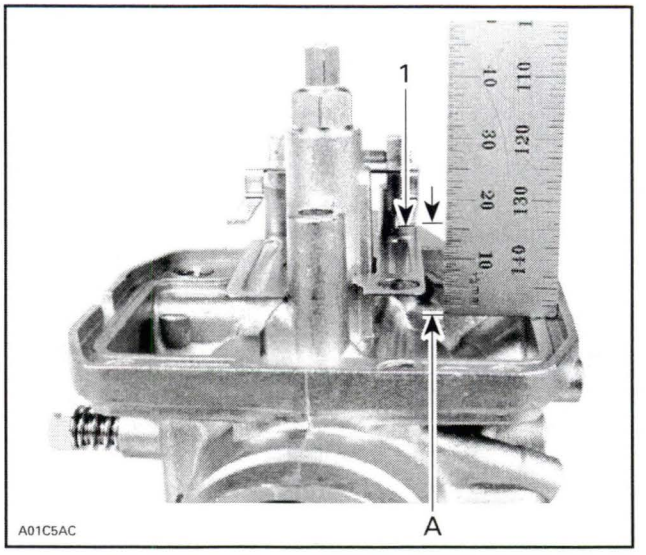
Float Installation

Verify float adjustment after installation.

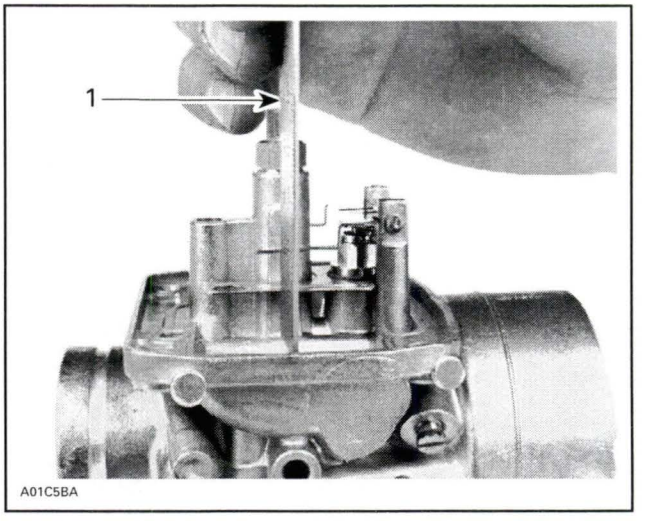
NOTICE Spark plugs will foul if float is adjusted too low. Engine may be damaged if float is adjusted too high.

Correct fuel level in float chamber is vital toward maximum engine efficiency. To check for correct float level proceed as follows:

- Make sure that float arm **no. 9** is symmetrical — not distorted.
- With carburetor chamber upside down on a level surface, measure height between bowl seat and top edge of float arm. Keep ruler perfectly vertical and in line with main jet hole.

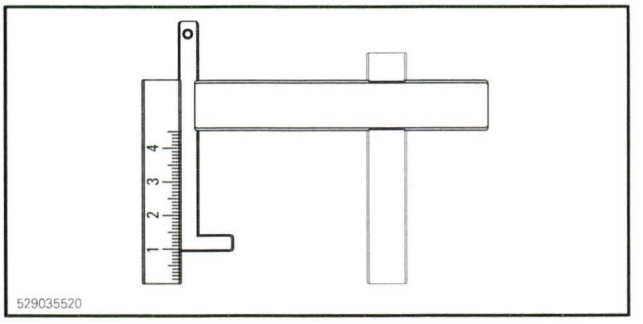


TYPICAL — VM TYPE
1. Measure from top of float arm
A. Float height (including float arm thickness)



TYPICAL — VM TYPE
1. Ruler vertical and in line with main jet

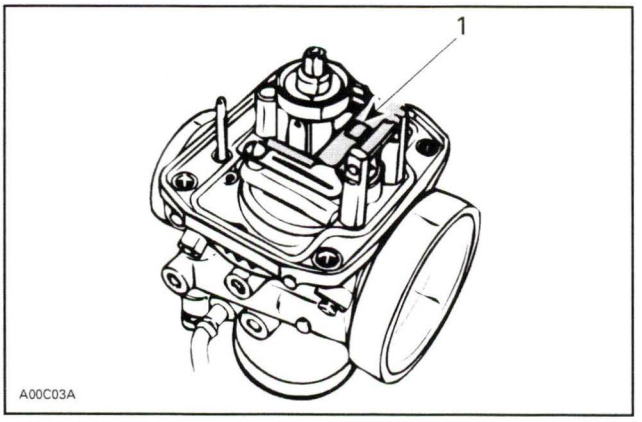
Float level height can be checked using the FLOAT LEVEL GAUGE (P/N 529 035 520). Keep tool in line with main jet as explained above.



To Adjust Height

Bend the contact tab of float arm until the specified height is reached.

FLOAT LEVEL
23.9 mm ± 1 mm (.941 in ± .039 in)



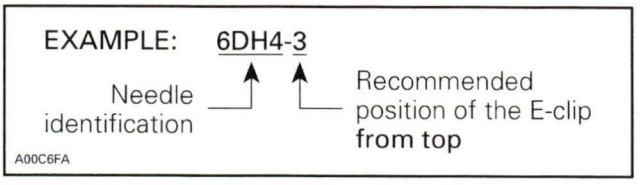
TYPICAL
1. Contact tab

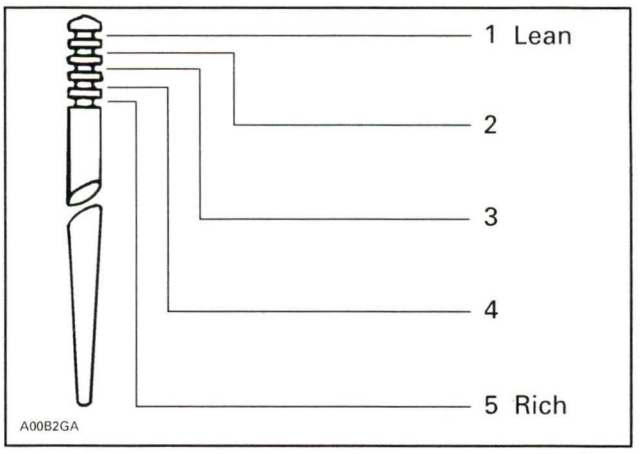
E-Clip and Jet Needle Installation

Make sure E-clip is installed in the proper groove of jet needle.

The position of the needle in the throttle slide is adjustable by means of an E-clip **no. 2** inserted into 1 of 5 grooves located on the upper part of the needle. Position 1 (at top) is the leanest, 5 (at bottom) the richest.

NOTE: The last digit of the needle identification number gives the recommended calibrated position of the E-clip from the top of the needle.



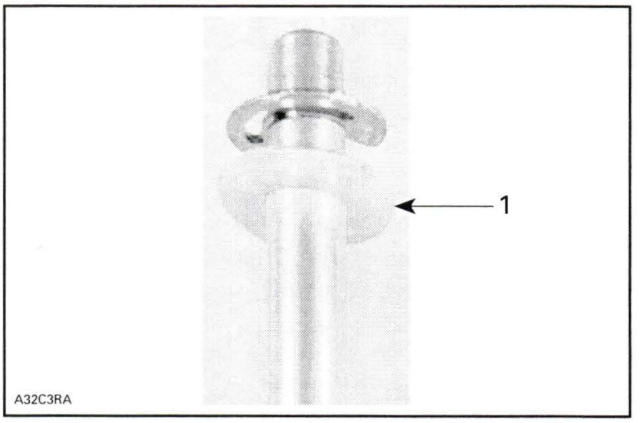


CLIP POSITIONS

NEEDLE - CLIP POSITION	
MAG: 3	PTO: 4

Install the nylon packing **no. 4** underneath jet needle E-clip on all applicable throttle slides.

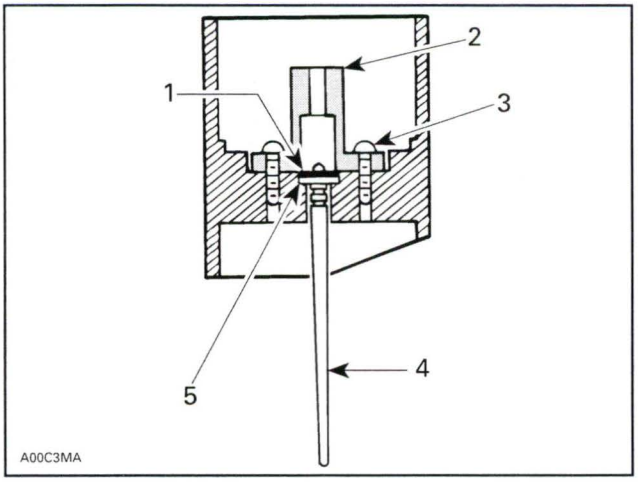
NOTICE **Serious engine damage can occur if this part is not installed.**



TYPICAL
1. Nylon packing

Install jet needle in throttle slide.

When installing jet needle plate, do not obstruct hole in throttle slide.



1. *Clip*
2. *Jet needle plate*
3. *Screw*
4. *Jet needle*
5. *Nylon packing*

Carburetor Installation

To install carburetor on engine, inverse removal procedure. However, pay attention to the following:

Prior to installing carburetor, adjust air screw and preliminary idle speed as described in *CARBURETOR ADJUSTMENTS*.

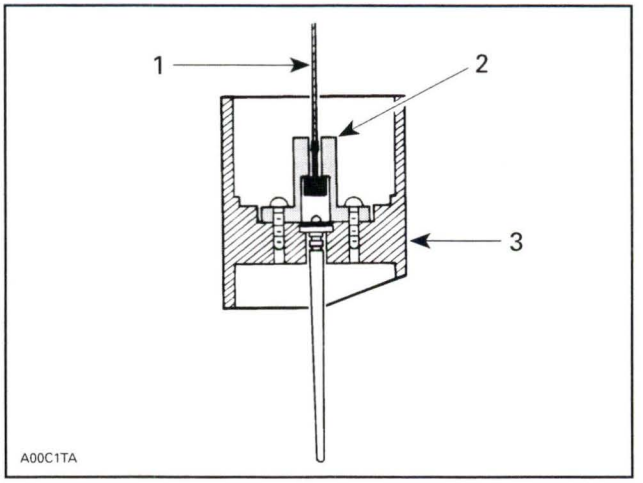
On applicable models, make sure to align tab of carburetor with notch of intake adapter.

NOTICE **The rubber of intake adapter must be checked for cracks and/or damage. At assembly, the intake adapter must match perfectly with carburetor and engine.**

Hook throttle cable into jet needle plate.

⚠ WARNING

Ensure throttle slide return spring is installed.



1. *Throttle cable*
2. *Jet needle plate*
3. *Throttle slide*

Install throttle slide with spring in carburetor.

NOTICE **Never allow throttle slide to snap shut. Be careful not to bent jet needle.**

Tighten carburetor cap.

⚠ WARNING

Ensure throttle lever operates normally.

Carburetor Adjustments

NOTE: Carburetor is calibrated at the factory for a temperature of -20°C (0°F) at sea level. For colder temperature or high altitude applications, carburetor must be recalibrated. A Service Bulletin gives information about carburetor calibration according to altitude and temperature.

Adjustments should be performed following this sequence:

- Float height
- Jet needle
- Air screw
- Preliminary idle speed adjustment
- Throttle cable and carburetor synchronization
- Choke cable
- Final idle speed adjustment.

Float Height

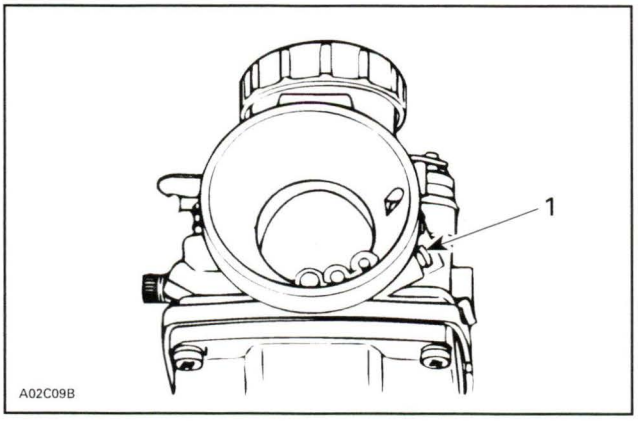
Refer to *CARBURETOR ASSEMBLY* to verify float height.

Jet Needle

Refer to *CARBURETOR ASSEMBLY* to position E-clip in the proper jet needle groove.

Air Screw Adjustment

Completely close the air screw **no. 6** (until a slight seating resistance is felt) then back off as specified.



1. Air screw

NOTE: Turning screw clockwise enriches mixture and turning it counterclockwise leans mixture.

AIR SCREW (REFERENCE ONLY)	
MAG: 1.25	PTO: 1.00

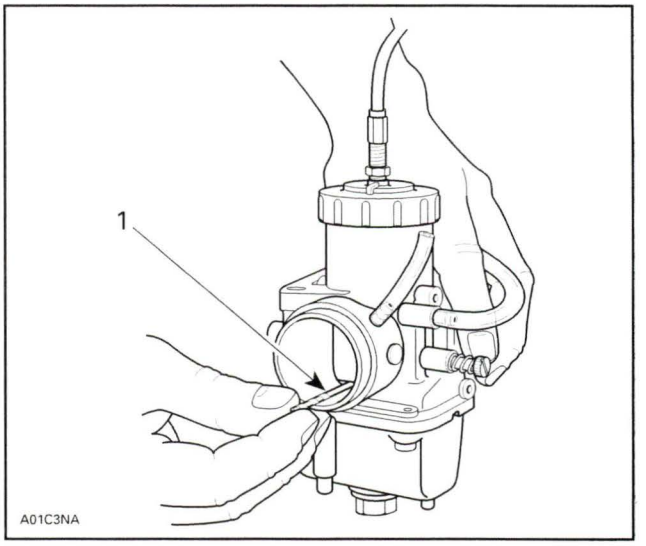
Preliminary Idle Speed Adjustment

Using a drill bit, adjust throttle slide height by turning idle speed screw **no. 7**.

Throttle slide height is measured on outlet side of carburetor (engine side).

NOTE: Make sure that throttle cable does not hold throttle slide. Loosen cable adjuster accordingly.

IDLE THROTTLE SLIDE HEIGHT (DRILL BIT SIZE)
1.6 mm ± 0.1 mm (.063 in ± .004 in)



TYPICAL
1. Drill bit used as gauge for throttle slide height

Throttle Cable and Carburetor Synchronization

Refer to *THROTTLE CABLE* further in this subsection.

Choke Cable

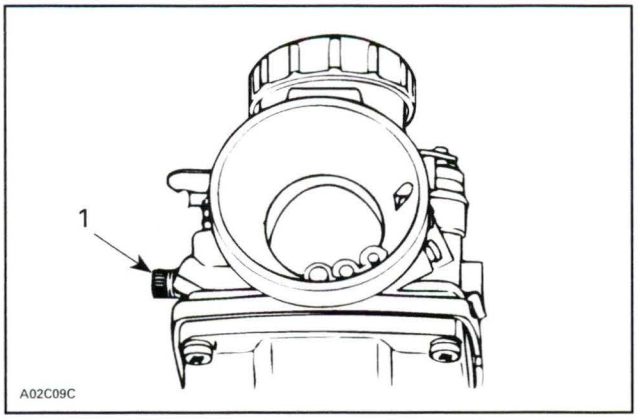
Refer to *CHOKE CABLE* further in this subsection.

Final Idle Speed Adjustment

NOTICE **Before starting engine for the final idle adjustment, make sure that oil pump is adjusted. The oil injection pump adjustment must be checked after each time carburetor idle is adjusted. Refer to *LUBRICATION SYSTEM* subsection.**

Start engine and allow it to warm then adjust idle speed to specifications by turning idle speed screw clockwise to increase engine speed or counterclockwise to decrease it.

NOTICE **Do not attempt to set the idle speed by using the air screw. Severe engine damage can occur.**



1. Idle speed screw

IDLE SPEED (RPM)
1650 ± 200

NOTE: Turn adjustment screw the same amount on each carburetor to keep carburetors synchronized.

Final idle speed adjustment (engine running at idle speed) should be within 1/2 turn of idle speed screw from preliminary adjustment.

THROTTLE CABLE

Throttle Cable Removal

NOTE: Before removing throttle cable from vehicle, note its routing and locking ties location for installation.

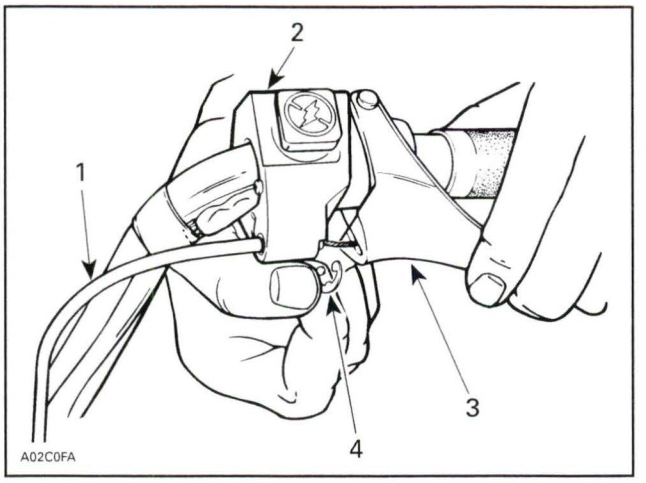
Refer to *BODY* subsection and remove the following parts:

- Hood
- Side panels
- Console.

Remove the primary air intake silencer. Refer to *AIR INTAKE SYSTEM* subsection.

Remove the muffler. Refer to *EXHAUST SYSTEM* subsection.

Remove the circlip retaining throttle cable to throttle cable housing.



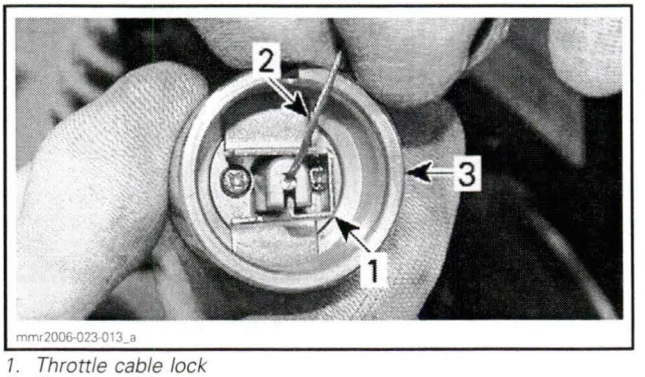
1. Throttle cable housing
2. Throttle lever housing
3. Throttle lever
4. Circlip

Using long nose pliers to hold cable, push the end of cable out of its location in throttle lever.

Remove cable from throttle cable housing.

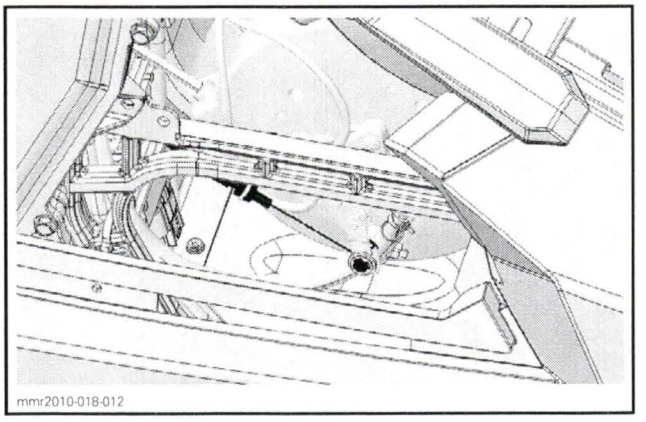
Unscrew carburetor cover then pull out throttle slide from carburetor.

Disconnect throttle cable from throttle slide.



1. Throttle cable lock
2. Throttle cable
3. Throttle slide

Disconnect cable end from oil pump.



Cut all locking ties and remove throttle cable.

Throttle Cable Inspection

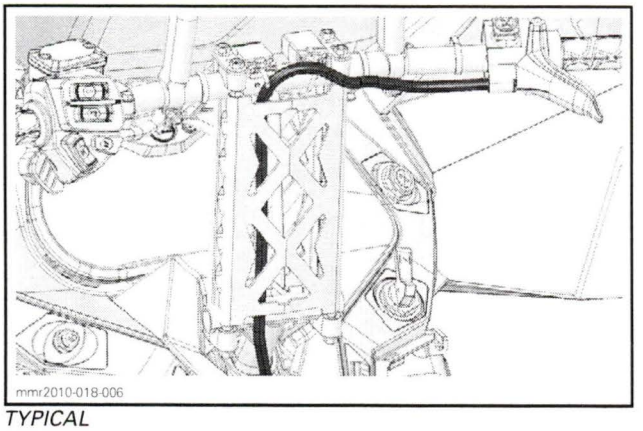
Inspect throttle cable and housing for any damages. Replace as necessary.

Throttle Cable Installation

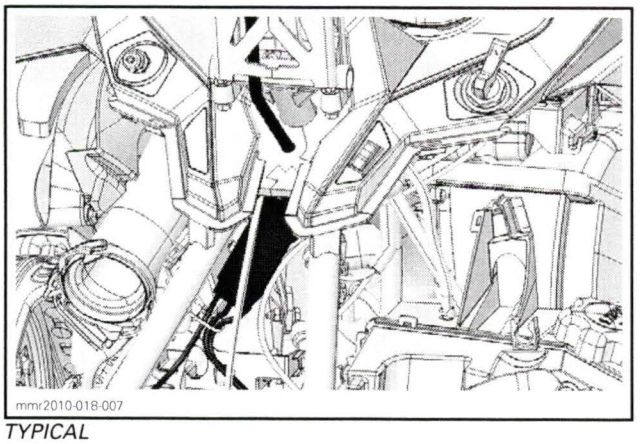
The installation is the reverse of the removal procedure.

NOTICE **Check that throttle cable is routed away from sharp edges, hot or vibrating parts.**

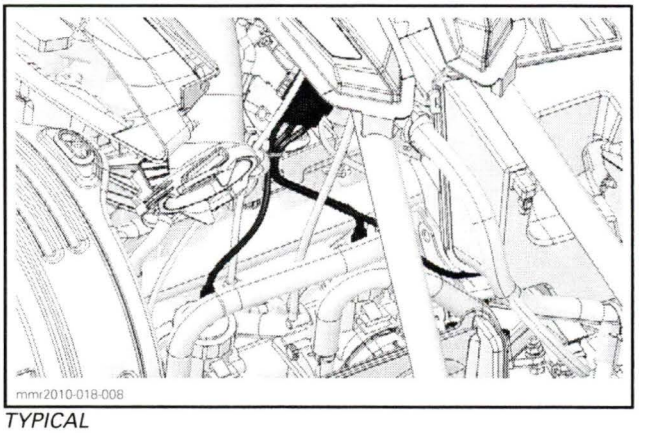
Throttle Cable Routing



TYPICAL

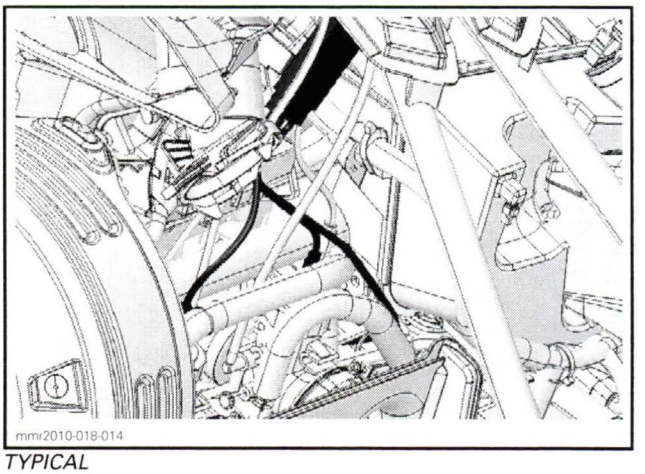


TYPICAL

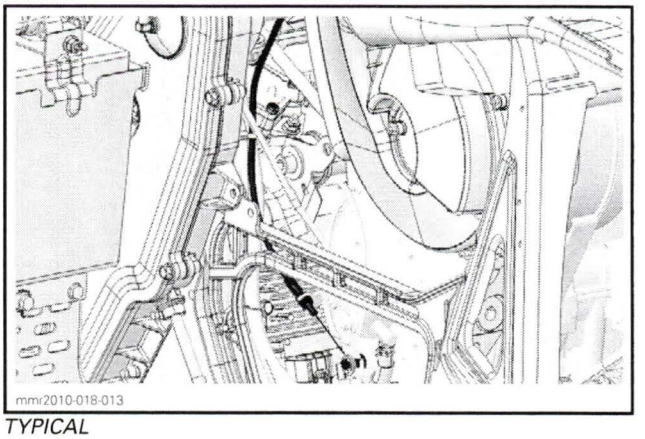


TYPICAL

Oil Pump Cable Routing



TYPICAL



TYPICAL

Throttle Cable Adjustment

⚠ WARNING

Ensure the engine is turned OFF, prior to performing the throttle cable adjustment.

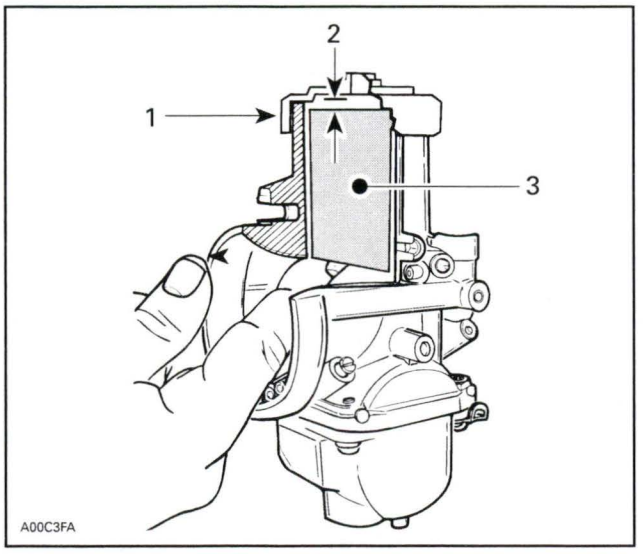
Carburetors must be installed on engine and throttle cable properly routed.

Adjust throttle cable as per following procedure:

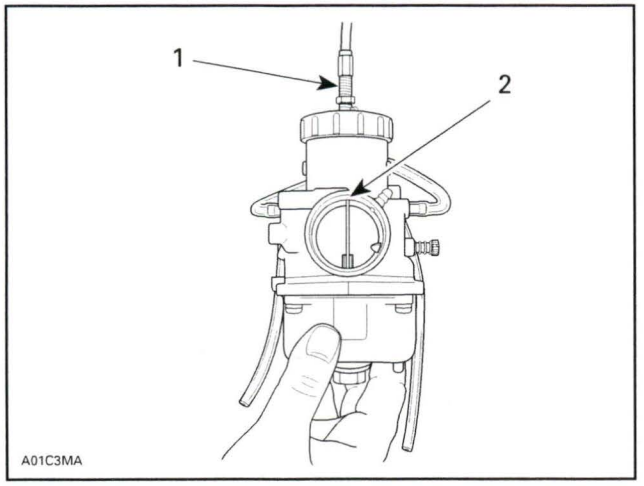
Loosen throttle cable housing adjusting and locking nuts.

While holding throttle lever to wide open throttle position, adjust throttle cable until cut-away lower edge is equal or 1.0 mm (.04 in) lower than the venturi bore on engine side. In this position, turn cable housing adjusting nut and tighten lock nut. Proceed on both carburetors.

NOTICE **If the throttle slide rests against the carburetor cover at full throttle opening, this will create too much strain and may damage the throttle cable or other components in throttle mechanism.**



TYPICAL – FULL OPENING (THROTTLE LEVER AGAINST HANDLE GRIP)
1. *Cover*
2. *Free play*
3. *Throttle slide*



TYPICAL – FULL OPENING (THROTTLE LEVER AGAINST HANDLE GRIP)
1. *Adjusting nut*
2. *Throttle slide flush or 1.0 mm (.040 in) lower than carburetor outlet bore (engine side)*

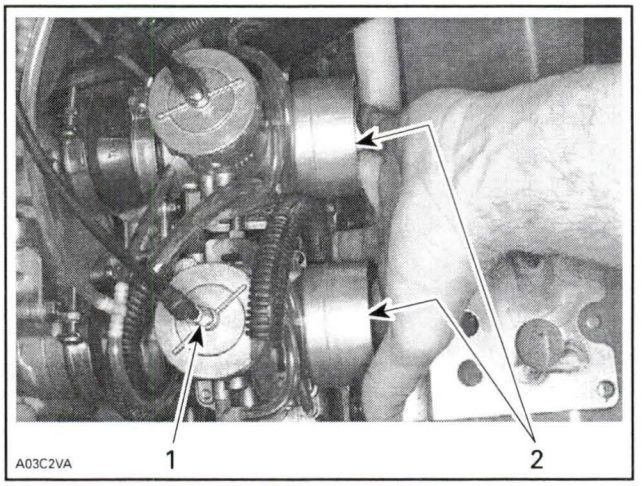
Also ensure that, when throttle is released to idle position, the idle adjusting screw end touches its stopper. No tension should be applied to throttle cable.

Carburetor Synchronization Verification

When depressing throttle lever, both carburetor slides must start to open at same time.

Screw or unscrew cable adjuster until all carburetor slides start to open at the same time. Cable play will be identical on all carburetors. Retighten jam nut.

NOTICE **Make sure carburetors start to operate simultaneously.**



TYPICAL
1. *Screw or unscrew adjuster*
2. *Check that all slides start to open at the same time*

Oil Pump Adjustment Verification

NOTICE **Oil pump cable must be readjusted whenever throttle cable adjustment or idle speed are changed, otherwise serious engine damage may occur.**

CHOKE CABLE

Choke Cable Removal

NOTE: Before removing choke cable, note its routing and locking ties location for installation.

Refer to *BODY* subsection and remove the following parts:
- Hood
- Side panels.

Remove the primary air intake silencer. Refer to *AIR INTAKE SYSTEM* subsection.

Remove choke cable nut and pull cable underneath console.

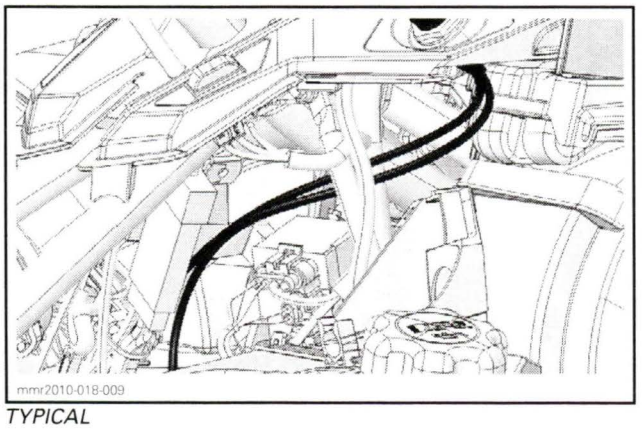
Unscrew choke cable from carburetor.

Cut all locking ties retaining cable and remove it from vehicle.

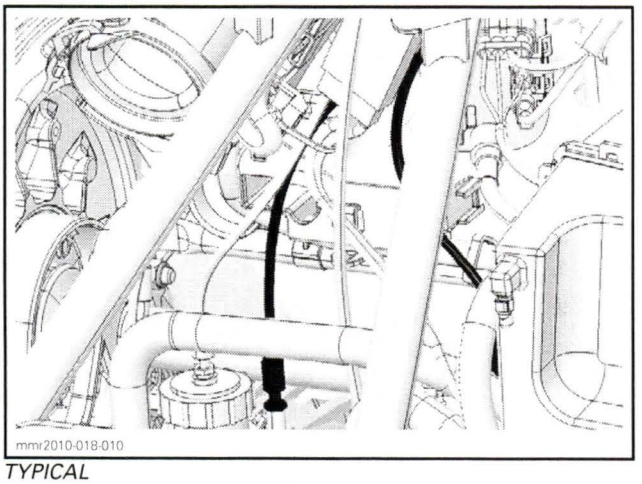
Choke Cable Installation

The installation is the reverse of the removal procedure.

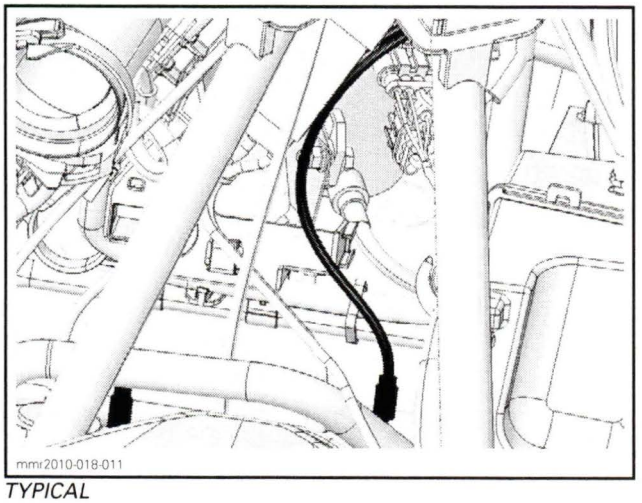
Choke Cable Routing



TYPICAL



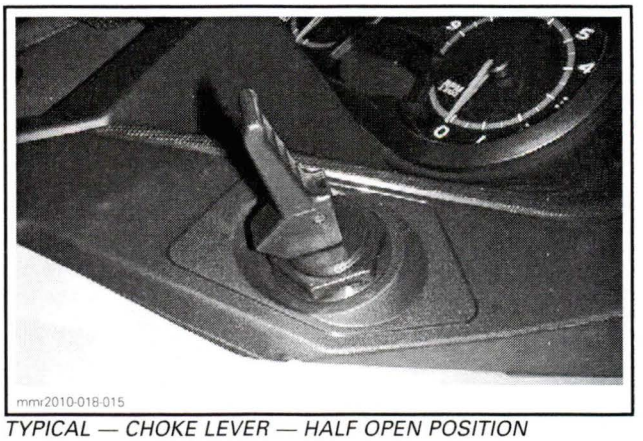
TYPICAL



TYPICAL

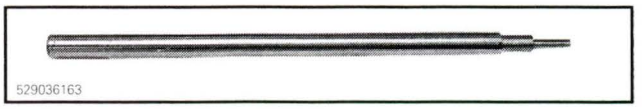
Choke Cable Adjustment

Set choke lever to half open position.

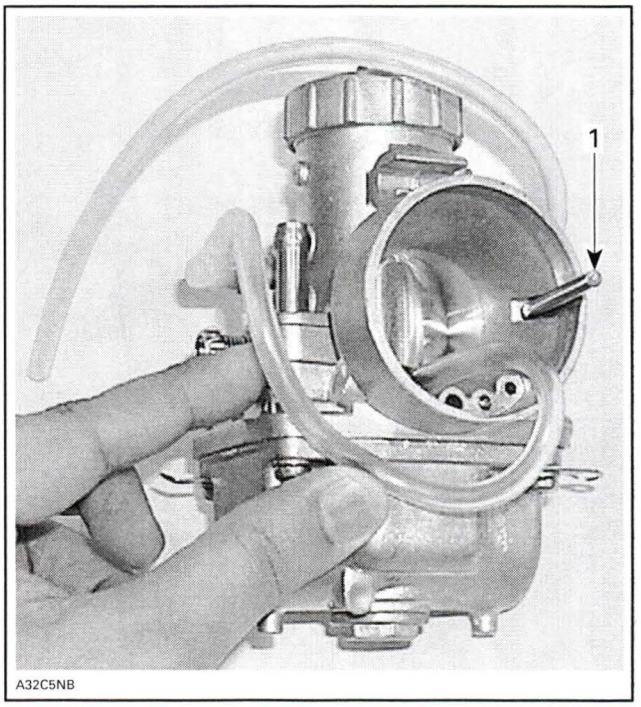


TYPICAL — CHOKE LEVER — HALF OPEN POSITION

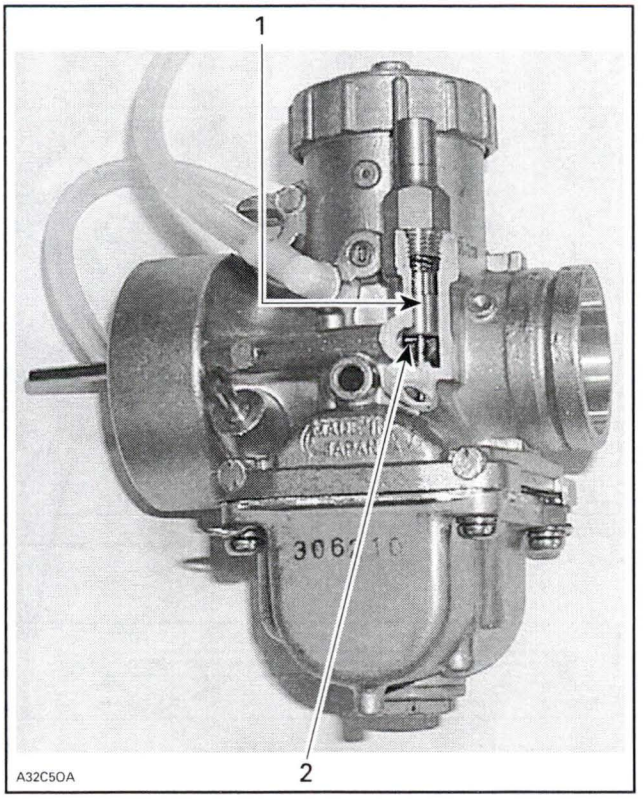
Use the CHOKE ADJUSTER TOOL (P/N 529 036 163).



Insert the choke adjuster tool into choke air inlet of carburetor. Tool stopper may not lean against recess wall.



TYPICAL - AIR SILENCER SIDE SHOWN
1. Choke adjuster tool



TYPICAL – CUT-AWAY — ENGINE SIDE SHOWN
1. Choke plunger
2. Tool properly seated under choke plunger

If tool tip does not seat under choke plunger no. 12, adjust as follows:

Make sure choke lever is at half open position.

Turn choke cable adjustment nut by hand until tool properly seats under choke plunger.

NOTE: A light pressure should be needed to position tool under plunger.

Tighten choke cable lock nut and reinstall protector cap.

Set choke lever to close and open positions and ensure that tool properly seats under plunger only when lever is set to half open position.

Set choke lever to close position and, by pulling and pushing choke lever, make sure there is no tension on cable (free play).

E-TEC DIRECT FUEL INJECTION

SERVICE TOOLS

Description	Part Number	Page
EXTRACTOR ADAPTOR	529 036 136	486
FLUKE 115 MULTIMETER	529 035 868	483–484, 495, 507–508, 512, 514
INJECTOR RETAINER PLATE	529 036 137	481
SMALL HOSE PINCHER	295 000 076	504

SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
SNAP-ON HAMMER	CJ125-6	486
SNAP-ON SCREW	CJ93-1	486

SERVICE PRODUCTS

Description	Part Number	Page
DIELECTRIC GREASE	293 550 004	489
PULLEY FLANGE CLEANER	413 711 809	505

GENERAL

⚠ WARNING

Always disconnect the magneto connector prior to:
- Disconnecting any fuel hose.
- Removing a fuel injector.
- Removing a spark plug cable or spark plug.

Otherwise, fuel vapors may ignite in presence of a spark creating a fire hazard.

⚠ WARNING

The fuel system is under high pressure. Proceed with care when working on the fuel system. Wear safety glasses and work in a well ventilated area.

Release fuel system pressure prior to removing fuel system components. Refer to *FUEL PUMP* in *FUEL TANK AND FUEL PUMP (600 HO E-TEC AND 600 ACE)* subsection.

⚠ WARNING

Perform a fuel pressure test each time a component from the fuel system is removed. Prior to starting the engine when a fuel hose was disconnected or a fuel injector removed:
- Ensure all fuel lines are properly connected.
- Crank engine to pressurize fuel system. Do not let engine run. If it starts, stop it right away.
- Inspect engine compartment to detect any fuel leak or an abnormally strong fuel odor which may be an indication of a fuel leak that is not readily visible.

SYSTEM DESCRIPTION

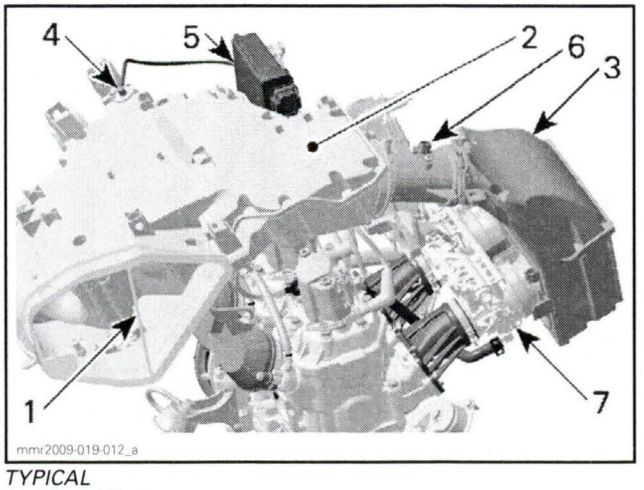
The ECM reads the input signals from different sensors which indicate engine operating conditions at micro-second intervals.

The ECM calculates the proper air/fuel ratio and activates the output to fuel injectors.

Signals from sensors are used by the ECM to determine the injection parameters (fuel maps required for optimum air-fuel ratio).

The crankshaft position sensor (CPS), the throttle position sensor (TPS) are the primary sensors used to control the injection. Other sensors (like temperature sensors, etc.) are used as secondary input.

Air Induction



TYPICAL
1. *Mesh filter*
2. *Secondary air intake silencer*
3. *Primary air intake silencer*
4. *Air pressure fitting and hose*
5. *Air pressure sensor in ECM*
6. *Air temperature sensor*
7. *Throttle body*

Air flows through a mesh filter in the secondary air intake silencer mounted on top of engine. The mesh filter prevents snow from being drawn into the engine.

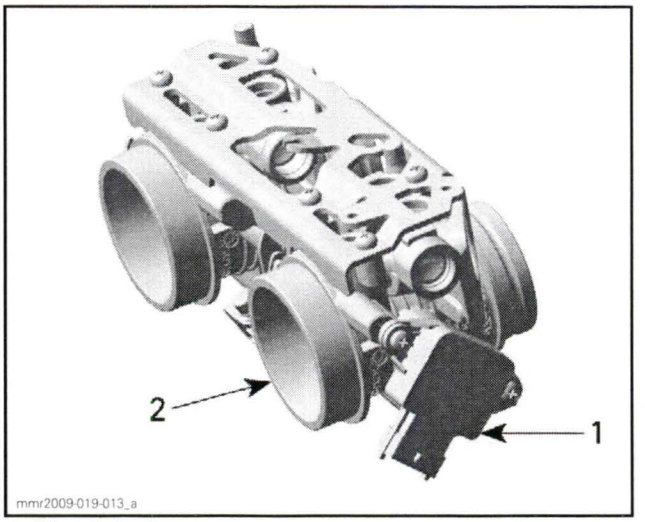
Air pressure is measured in the secondary air intake silencer through a tube connected to the ECM.

Air then flows through the primary air intake silencer.

Air temperature is measured at the inlet of the primary air intake silencer.

Air is then drawn in through a dual throttle bodies mounted on the engine intake side.

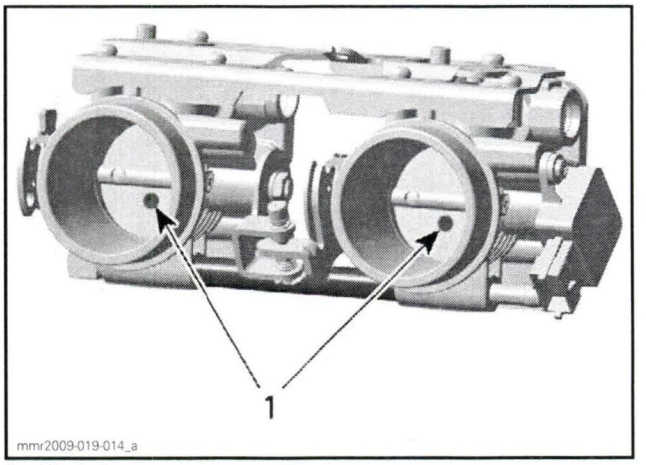
Throttle Body



1. *Throttle body*
2. *TPS (Throttle Position Sensor)*

Dual 46 mm Dell'Orto throttle bodies are directly mounted on the intake flange of each cylinder.

The air flow is controlled by two throttle plates. Each throttle plate has a 6.8 mm (.268 in) idle hole.

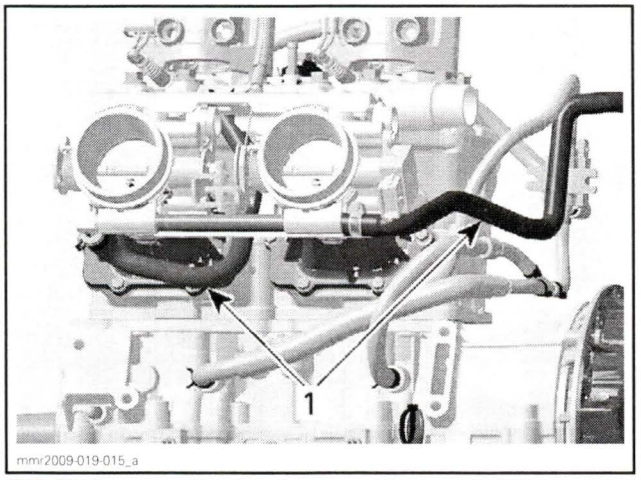


1. *Idle holes*

Since there is a constant airflow through the idle holes of the throttle plates, the idle speed is controlled by the ECM by varying the amount of fuel injected in the combustion chamber and by controlling the injection timing.

The TPS (Throttle Position Sensor) is fitted on the throttle body. The TPS sends throttle angle position to the ECM.

Engine coolant flows through throttle body to prevent potential freezing of throttle plates due to the temperature drop naturally created by the venturi.



TYPICAL
1. Coolant-heated lines

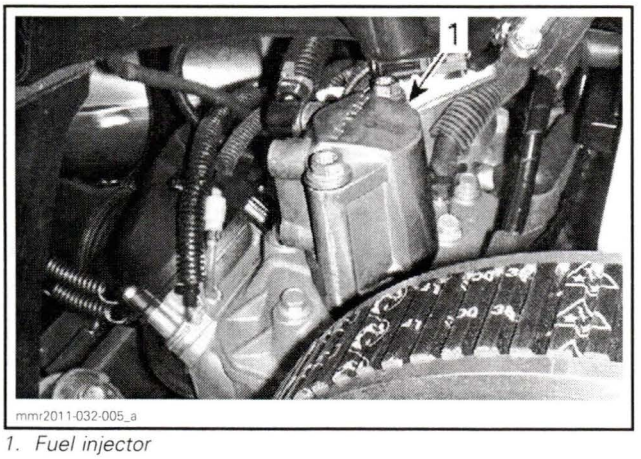
The air then continues through the reed valves into the cylinder base then into the crankcase.

Fuel Injector

The fuel injectors are powered from the 55 Vdc system.

One fuel injector per cylinder is used.

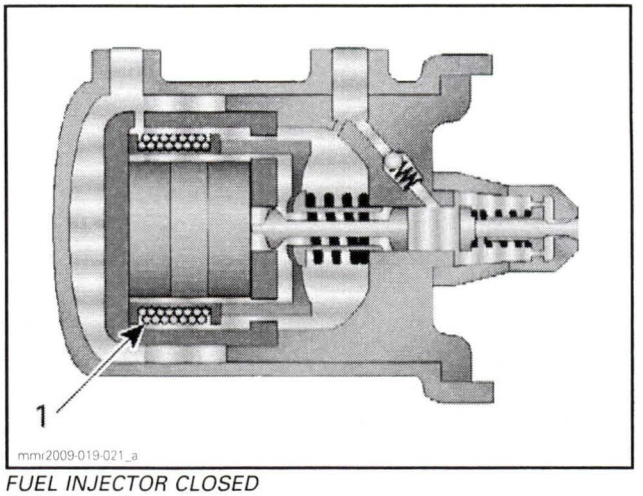
The E-TEC fuel injector is mounted directly on top of the cylinder head.



1. Fuel injector

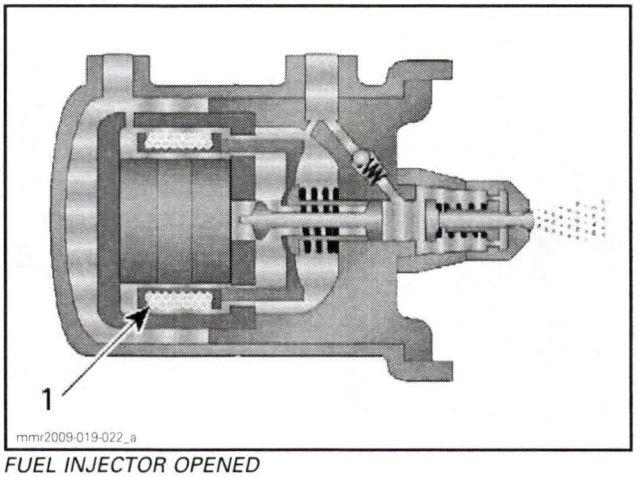
The fuel injector achieves a direct injection right into the combustion chamber. This keeps the piston cooler with less fuel.

A voice coil type is used to open and close the fuel injector nozzle. This allows for quick operation of the fuel injector; opening stage as well as the closing stage. This results in the ability to operate the engine at a higher RPM and lowers unburned fuel to the exhaust port.



FUEL INJECTOR CLOSED
1. Voice coil

When a positive current is supplied to the coil by the ECM, the fuel injector plunger moves towards the spring loaded injector needle. As the injector plunger moves, this builds up a pressure in the fuel injector chamber. When the pressure reaches approximately 1724 kPa (250 PSI), the injector needle spring is overcome and the needle opens. Fuel injection then takes place while the pressure peaks at 3103 kPa (450 PSI).



FUEL INJECTOR OPENED
1. Voice coil

Swirl channels are used in the fuel injector to better atomize the fuel charge.

The quantity of injected fuel is controlled by varying the injector plunger stroke.

To bring the injector plunger backward to its rest position, the current is reversed and the return springs close the injector needle and plunger. Near the end of the return stroke, a brief positive current is applied to "brake" the injector plunger. This results in a quieter operation of the fuel injectors.

In forward engine rotation, the fuel injectors provide a stratified fuel charge to the combustion chamber up to clutch engagement speed. Beyond this RPM, the fuel charge becomes homogeneous.

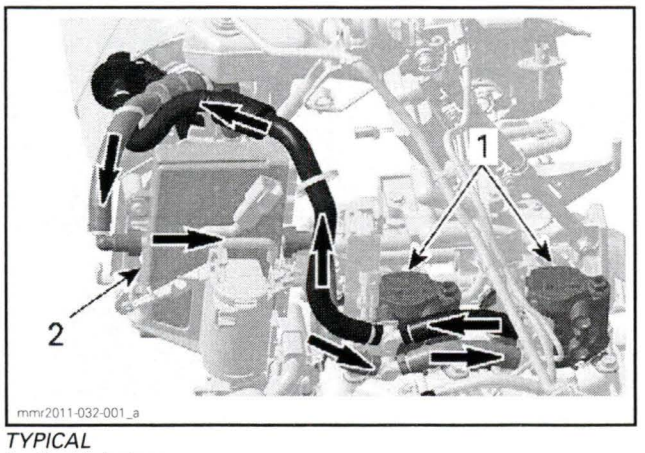
The stratified fuel charge provides a cleaner combustion, better idling and less smoke.

Fuel Injector Cooling

Fuel is used to maintain proper fuel injector operating temperature.

The flow starts from the fuel pump, through the ECM, then around the voice coil inside the fuel injector housing to cool down the fuel injector components.

Fuel enters the inlet port located at the bottom of the fuel injector housing, and exits through the outlet port on top of the fuel injector.



TYPICAL
1. Fuel injectors
2. ECM

NOTE: The 600 HO E-TEC does not have a filter on the outlet hose.

ADJUSTMENT

IDLE SPEED

Idle speed is controlled by the EMS (Engine Management System) and is not adjustable with an idle screw.

If idle speed is not as per specification (refer to *TECHNICAL SPECIFICATIONS*), perform the *CLOSED THROTTLE RESET (TPS)* in this subsection.

CLOSED THROTTLE RESET (TPS)

General Information

This operation performs a reset of the TPS (throttle position sensor) values in the ECM when the throttle is closed. This reset is very important as the setting of the TPS will determine the basic parameters for all fuel mapping and several ECM calculations for idle speed control of the engine.

The closed throttle reset must be carried out **only** if the:

- TPS is loosen, removed or replaced
- TPS is out of tolerance or sets a fault code
- Throttle body is replaced
- ECM is replaced.

NOTE: **Do not** reset TPS needlessly. See *TPS CLOSED THROTTLE VERIFICATION* in this subsection.

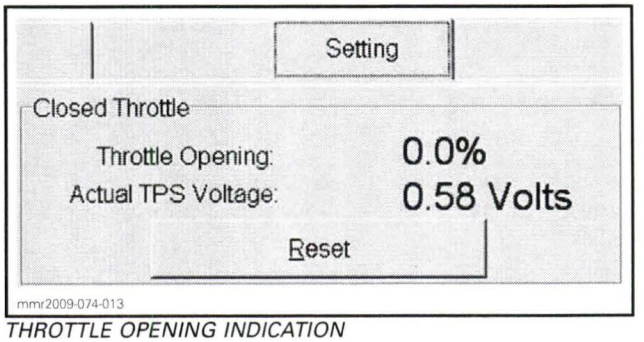
NOTICE **An improperly set TPS may lead to poor engine performance.**

TPS Closed Throttle Verification

1. Connect vehicle to the latest applicable B.U.D.S. version. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. In B.U.D.S., select the **Setting** and **ECM** page tabs.
3. Activate and release throttle lever 2 - 3 times to settle throttle plates.
4. Look for the throttle opening indication in the **Close Throttle** field.

NOTE: The **Throttle Opening** indication must be within the following specification.

THROTTLE OPENING SPECIFICATION
(0 % ± 0.2)



THROTTLE OPENING INDICATION

If the throttle opening is within the % specification, DO NOT carry out the **Closed Throttle Reset** unless the following parts were replaced:

- Engine control module (ECM)

- Throttle body
- Throttle position sensor (TPS).

If TPS is not within specification, carry out the **Closed Throttle** reset procedure that follows.

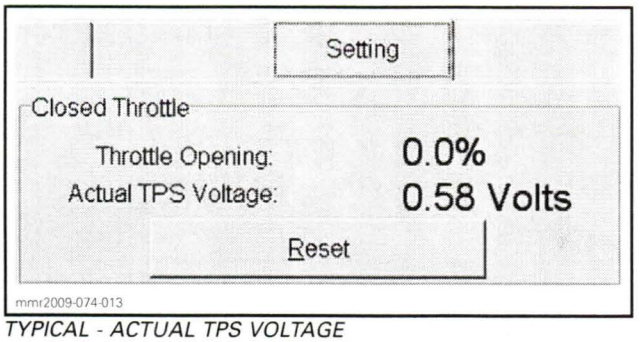
Closed Throttle Reset Procedure (TPS)

1. **Ensure** throttle cable is properly adjusted, refer to *THROTTLE CABLE ADJUSTMENT* in this subsection.
2. Activate throttle lever 2 - 3 times to settle throttle plate.

NOTICE **Proper throttle cable adjustment must be verified before proceeding with the Closed Throttle reset.**

3. In B.U.D.S.
   - 3.1 Select the **Setting** page tab.
   - 3.2 Select the **ECM** page tab.
4. In the **Closed Throttle** field, confirm the **Actual TPS Voltage** is within specification.

ACTUAL TPS VOLTAGE SPECIFICATION
0.3 to 0.7 Volts

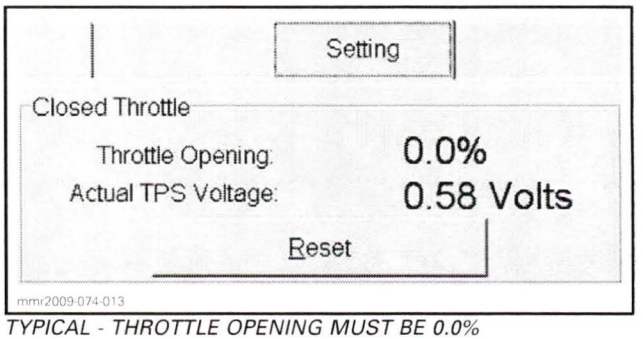


TYPICAL - ACTUAL TPS VOLTAGE

NOTE: If the **Actual TPS Voltage** is out of specification, the TPS cannot be reset. The cause must be found. See *TROUBLESHOOTING ACTUAL TPS VOLTAGE OUT OF RANGE* in this subsection.

5. Press on the **Reset** button.
6. Confirm **Throttle Opening** value indicates 0.0%.

NOTE: A throttle opening of 0.0% after reset indicates the operation is successful.



TYPICAL - THROTTLE OPENING MUST BE 0.0%

Troubleshooting Actual TPS Voltage Out of Range

If the **Actual TPS Voltage** is out of specification, check the following.

- Fault codes related to TPS
- Throttle cable adjustment
- TPS properly installed
- TPS connector and terminal condition.

TROUBLESHOOTING

DIAGNOSTIC TIPS

Engine problems are not necessarily related to the injection system.

It is important to ensure the mechanical integrity of the engine is present.

Spark Plugs

Improper spark plug indexing may lead to engine misfiring. Check if BRP spark plugs are installed or if spark plugs are properly indexed. Refer to *IGNITION SYSTEM (600 HO E-TEC)* subsection.

3D RAVE Valves

Improper position of RAVE valves may lead to engine misfiring. Check RAVE valves. Refer to *ENGINE (600 HO E-TEC)* section, *RAVE* subsection.

Crankshaft Position Sensor (CPS)

Confirm that ECM receives the CPS signal. Refer to *CRANKSHAFT POSITION SENSOR (CPS)* in this subsection.

Electrical System

It is important to check that the electrical system is functioning properly:

- 55 system voltage
- Capacitor (refer to *CHARGING SYSTEM (600 HO E-TEC)* subsection)
- Ground connections
- Wiring and connectors.

Ensure that all electronic components are original BRP recommended components.

Any modification on the wiring harness may lead to fault codes or bad operation.

Always refer to the wiring diagram when diagnosing an electrical problem.

⚠ WARNING

The EMS operates on high voltage (55 Vdc), be careful to avoid electrical shocks.

⚠ WARNING

All electrical actuators (example: fuel injectors, fuel pump, ignition coils and electronic oil injection pump) are powered as soon as engine is cranked when the emergency engine stop switch is at the RUN position.

Electrical Connections

Pay particular attention to ensure that pins are not out of their connectors or out of shape.

Make sure that connections are very tight, make good contact, are corrosion-free, and show no signs of moisture. Particularly check ECM ground connections.

NOTE: Do not apply dielectric grease or other lubricant in the ECM connectors.

Check if wiring harness shows any signs of scoring.

Resistance Measurement

When measuring the resistance with an ohmmeter, all values are given for a temperature of 20°C (68°F). The value of a resistor varies with the temperature. The value for common resistor or windings (such as solenoid) increases as the temperature increases. However, our temperature sensors are NTC types (Negative Temperature Coefficient) except for the EGTS, which means that the value decreases as the temperature increases. Use the provided tables for sensor resistive values at given temperature.

The resistive value of a temperature sensor may test good at a certain temperature but may be defective at other temperatures.

A good test is to put the sensor in a container filled with ice and water and measure resistance. Then, heat the water and read the resistance at different temperatures.

PROCEDURES

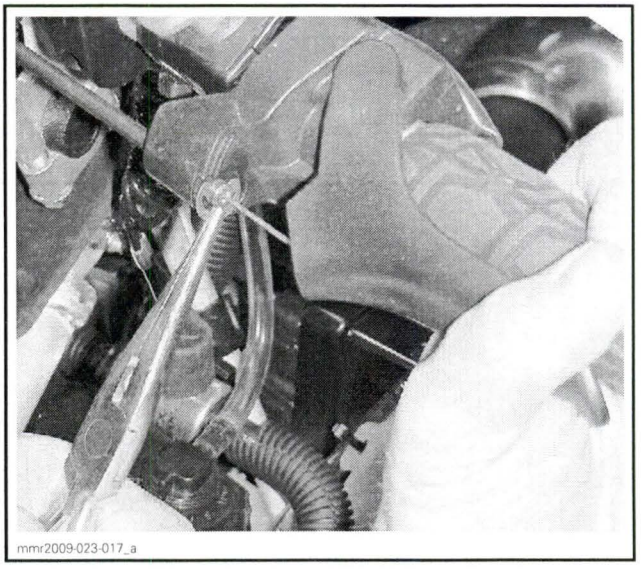
FUEL HOSES AND OETIKER CLAMPS

Refer to *FUEL TANK AND FUEL PUMP (600 HO E-TEC AND 600 ACE)* subsection.

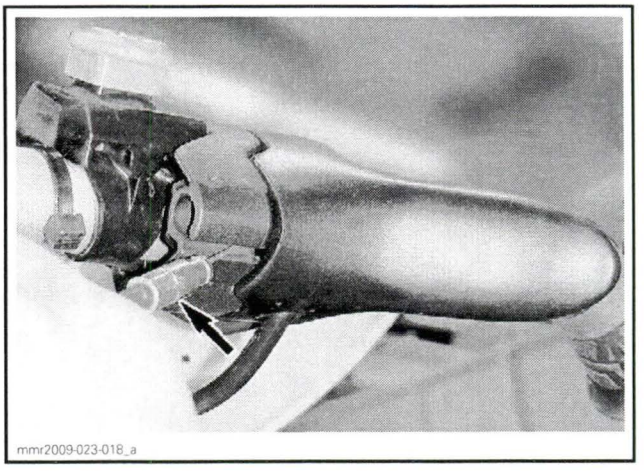
THROTTLE CABLE

Throttle Cable Removal

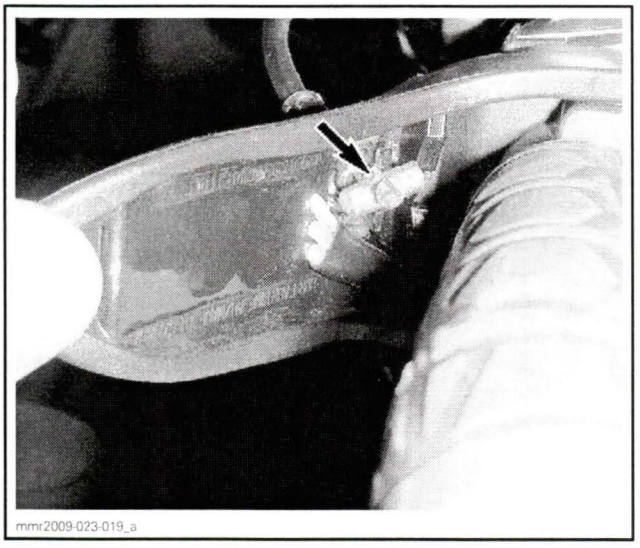
1. Remove handlebar cover.
2. Depress and hold throttle lever.
3. Pull out circlip using long nose pliers. Keep circlip for re-use.



4. Pull throttle cable out of the throttle lever housing.

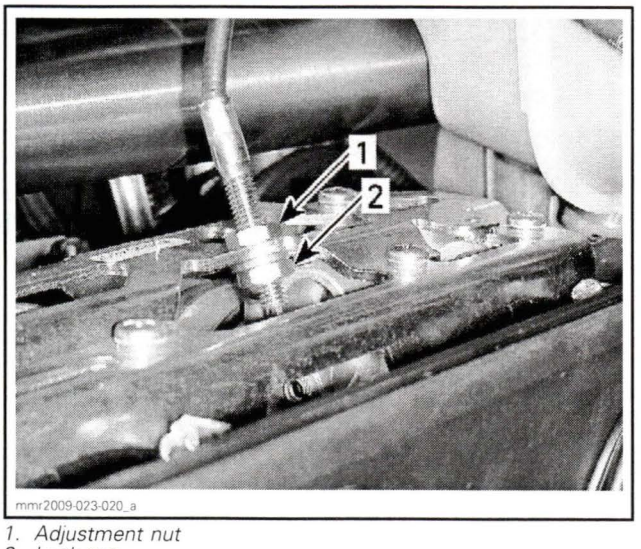


5. Unhook cable end barrel from throttle lever and remove cable.


mmr2009-023-019_a

NOTE: Take note of cable routing before removal.

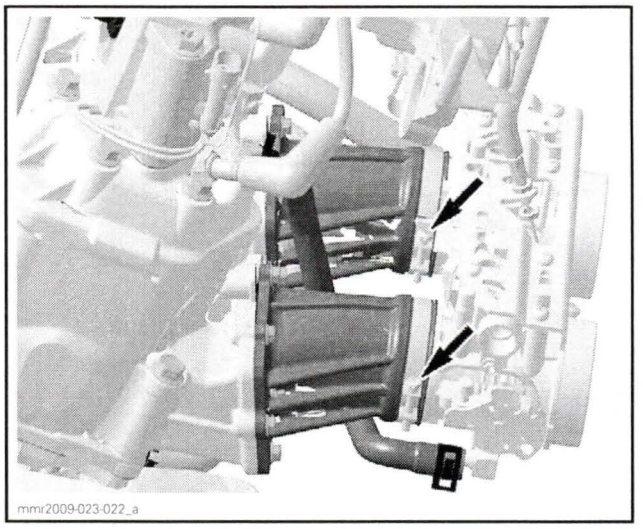
6. Remove drive belt guard. Refer to *DRIVE BELT* subsection.
7. Remove primary air intake silencer. Refer to *ENGINE (600 HO E-TEC)* section, *AIR INTAKE SYSTEM* subsection.
8. At throttle body, fully unscrew cable adjuster lock nut.



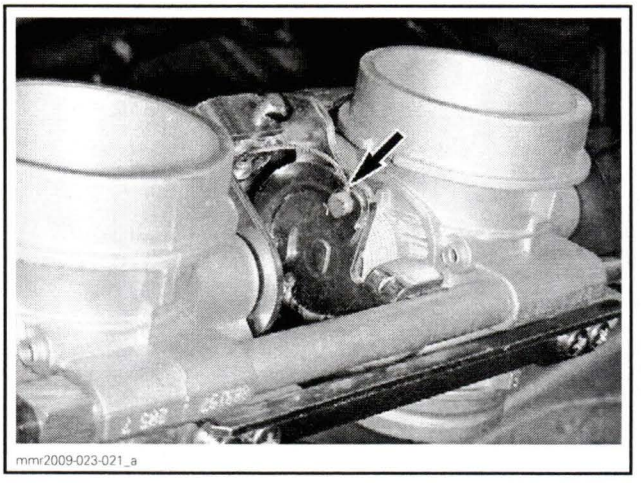
mmr2009-023-020_a

1. Adjustment nut
2. Lock nut

9. Loosen throttle body retaining clamps and remove throttle body from air intake adapters.


mmr2009-023-022_a

10. Pull out throttle body sufficiently to unhook throttle cable end.


mmr2009-023-021_a

11. Remove throttle cable.

Throttle Cable Installation

Reverse removal procedure however, pay attention to the following.

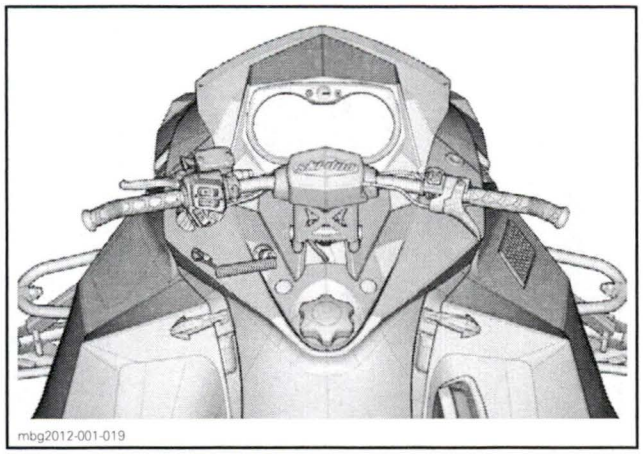
Route cable as noted prior to removal.

Ensure that cable ends are properly secured in their levers.

Proceed with throttle cable adjustment.

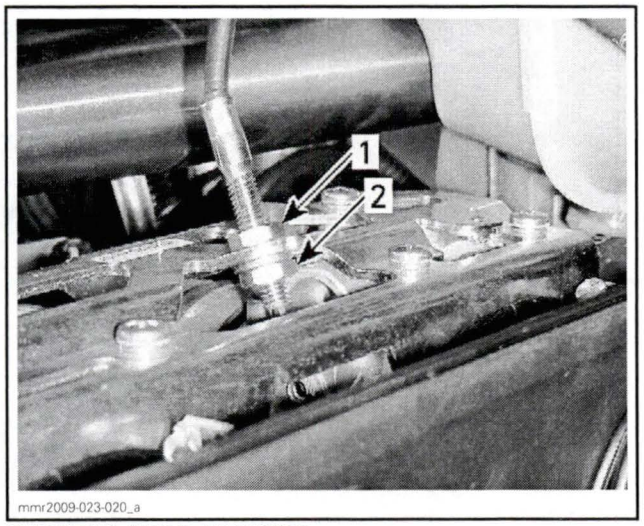
Throttle Cable Adjustment

1. Position handlebar straight and level.

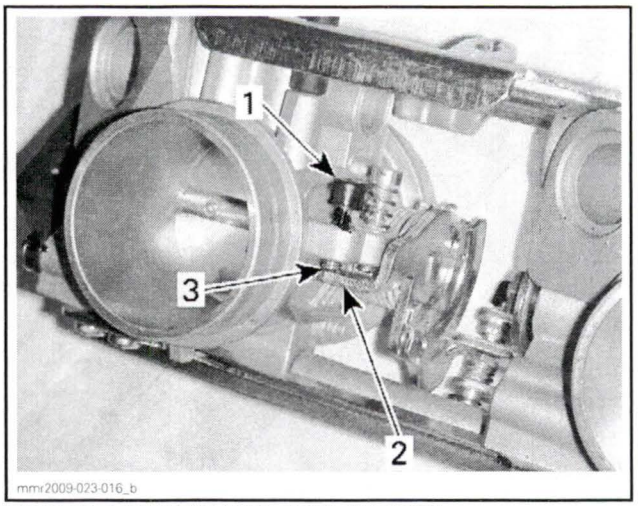


TYPICAL - HANDLEBAR STRAIGHT AND LEVEL

2. Turn throttle cable adjuster nut until the following is observed:
   - Throttle plate stopper is in contact with master zero position screw
   - Throttle cable is slightly loose (cable free play).



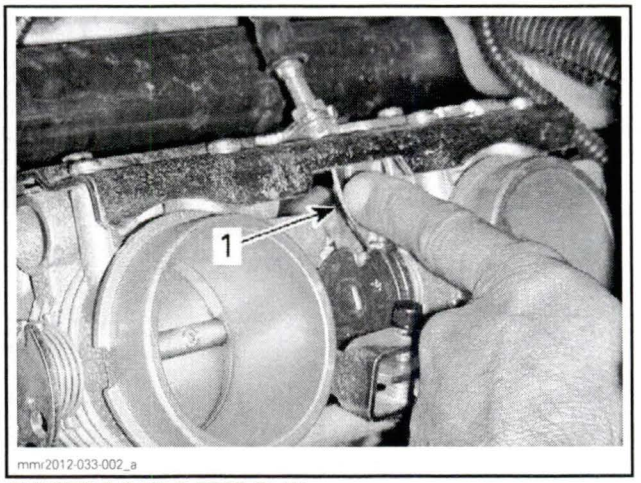
THROTTLE CABLE ADJUSTER
1. *Adjuster nut (top)*
2. *Adjuster lock nut (bottom)*



THROTTLE BODY MASTER ZERO POSITION
1. *Master zero position screw (black)*
2. *Throttle plate stopper*
3. *Contact here*

NOTICE **Do not tamper with any throttle body adjustment screws. Otherwise, throttle body must be replaced.**

NOTE: To ensure cable free play, lightly press on throttle cable as in following illustration.



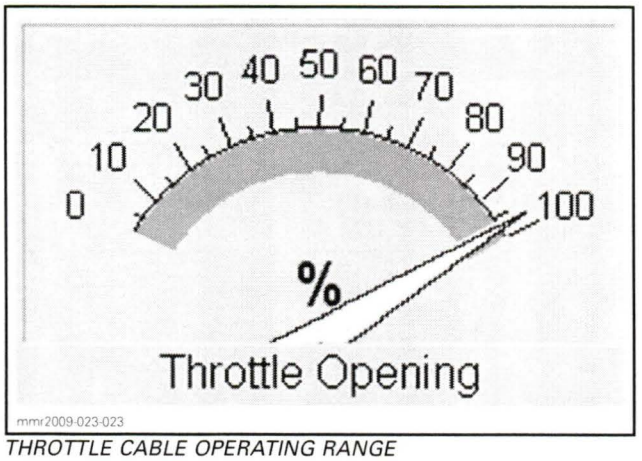
THROTTLE CABLE FREE PLAY
1. *Cable slightly loose here*

3. Activate and release throttle lever 2 - 3 times to settle throttle plate.
4. Confirm throttle plate stopper is STILL in contact with master zero position screw.
5. Readjust throttle cable if necessary.
6. Carry out the *THROTTLE CABLE OPERATING RANGE INSPECTION WITH B.U.D.S.* in this subsection.

Throttle Cable Operating Range Inspection with B.U.D.S.

1. In B.U.D.S.
   1.1 Select the **Monitoring** page tab.
   1.2 Select the **ECM** page tab.
2. Fully depress throttle lever and hold.
   2.1 Confirm throttle opening is within specification.

THROTTLE OPENING SPECIFICATION (WIDE OPEN THROTTLE)
95% to 100%



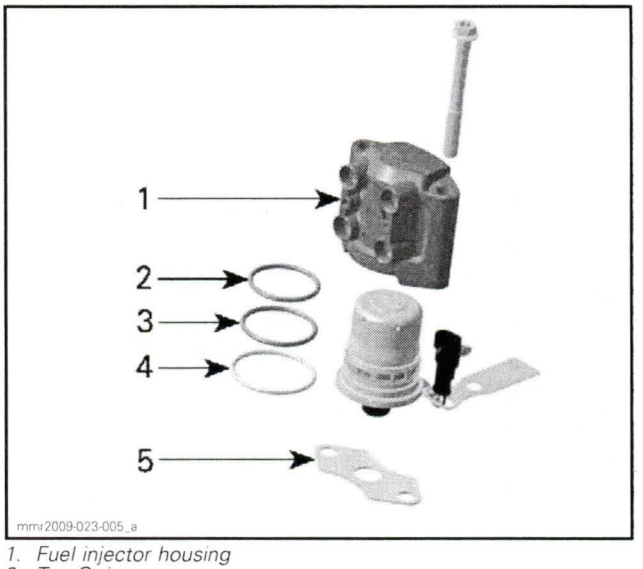
THROTTLE CABLE OPERATING RANGE

3. If throttle opening is out of specification, readjust as follows.

THROTTLE OPENING OUT OF SPECIFICATION	
Above specification	Loosen throttle cable
Below specification	Tighten throttle cable

FUEL INJECTOR

General Information



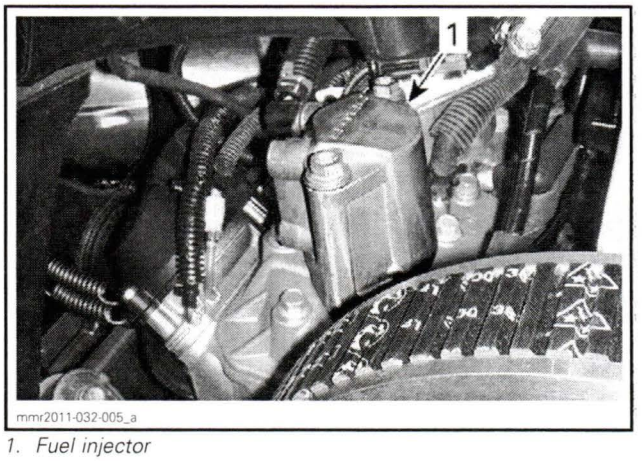
1. *Fuel injector housing*
2. *Top O-ring*
3. *Bottom O-ring*
4. *Crush ring*
5. *Thermal insulator*

Every fuel injector is bench tested. Its electrical and flow characteristics are registered throughout all its operating range in a calibration file.

NOTICE When a fuel injector is replaced, the matching calibrated file must be loaded in the ECM using B.U.D.S. so that the ECM properly controls the fuel injector.

Fuel Injector Visual Inspection

1. Open LH panel.
2. Remove drive belt guard. Refer to *DRIVE BELT* subsection.
3. Observe the fuel injector area.



1. *Fuel injector*

If a fuel leak is noticed in the area of the hoses, inspect hoses and connections.

If a fuel leak is noticed in the fuel injector base area, it indicates a leak of the lower fuel injector O-ring.

If a dark carbon sooted area is noticed in the fuel injector base area, it indicates a leak between the fuel injector nozzle and the cylinder head. The fuel injector retaining screws may not be tight enough.

Fuel Injector Troubleshooting Tips

Usually, a faulty fuel injector will lead to a poor engine idle and a low RPM (around 800 RPM and below). It may also lead to engine misfiring.

Ensure the correct fuel injector is installed on the proper cylinder. Refer to *FUEL INJECTOR POSITION VALIDATION* in this subsection.

While engine is running, try disconnecting a fuel injector connector:

⚠ WARNING

Be careful while working close to rotating parts.

- If engine RPM does not change, the disconnected fuel injector could be faulty.
- If engine RPM decreases, the other fuel injector could be faulty.

If one injector is thought to be faulty, proceed with the injector tests.

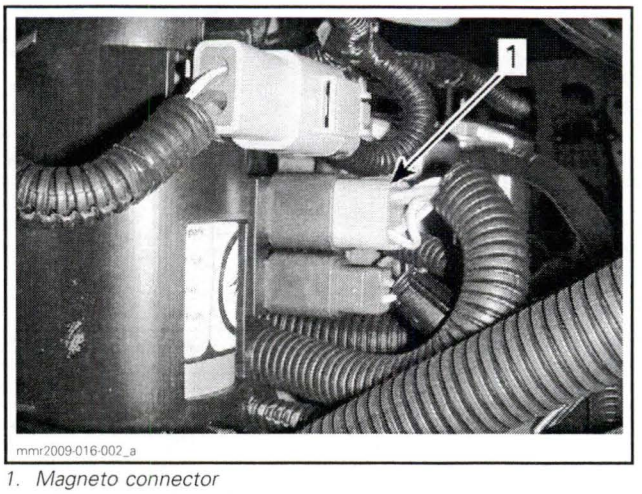
Fuel Injector Leak Test

Test Preparation

1. First make sure fuel pressure is within specifications. Refer to *FUEL TANK AND FUEL PUMP (600 HO E-TEC AND 600 ACE)* subsection.

NOTE: Keep the pressure gauge installed for the leakage test.

2. Disconnect the magneto connector.



1. Magneto connector

⚠ WARNING

The magneto connector must be disconnected to prevent any spark in the engine compartment should the engine be cranked. Fuel vapors may ignite in presence of a spark creating a fire hazard.

3. Release fuel pressure. Refer to *FUEL PUMP* in *FUEL TANK AND FUEL PUMP (600 HO E-TEC AND 600 ACE)* subsection.

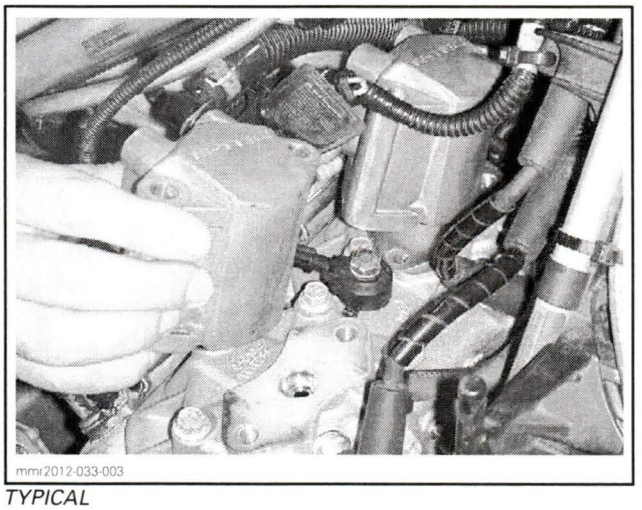
NOTICE If the fuel pressure is not released, the pressure will push the fuel injector out of its housing when removing the fuel injector from the engine. This could damage the fuel injector and lead to an important fuel spill.

4. Remove drive belt guard. Refer to *DRIVE BELT* subsection.
5. Remove secondary air intake silencer. Refer to *AIR INTAKE SYSTEM (600 HO E-TEC)* subsection.
6. Unlock ECM support to move ECM as necessary to lift fuel injectors.

NOTE: Fuel injector leakage test can be done on one injector at a time or on both injectors simultaneously.

7. Unscrew both fuel injectors. Refer to *FUEL INJECTOR REMOVAL* in this subsection.
8. Carefully lift both fuel injectors. Be careful not to pry hoses against their plastic fittings.

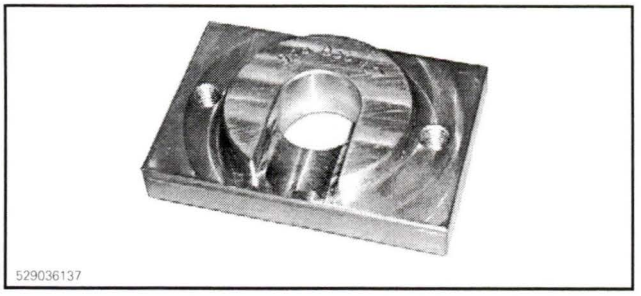
⚠ CAUTION If both fuel injectors are not lifted together with care, the strain on the injector fuel fittings may cause them to crack and leak fuel when pressurized resulting in a fire hazard.

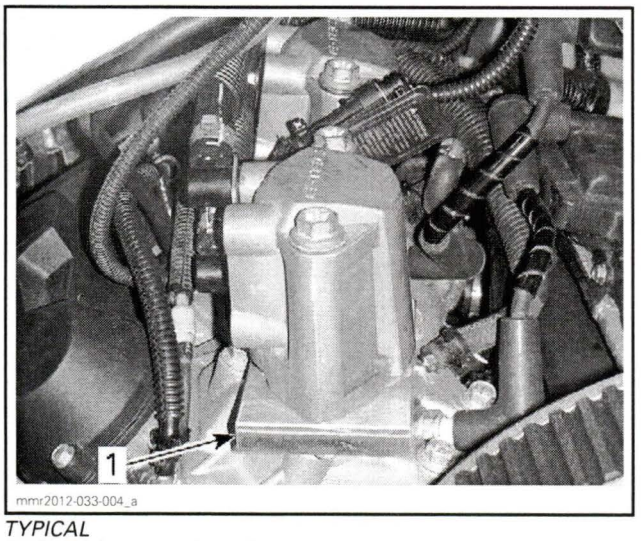


TYPICAL

NOTE: Do not install the thermal insulators against fuel injectors.

9. Secure each fuel injector to an INJECTOR RETAINER PLATE (P/N 529 036 137).





TYPICAL
1. Fuel injector retainer plate

NOTICE Ensure to position machined groove in the retainer plate on the fuel injector wiring side.

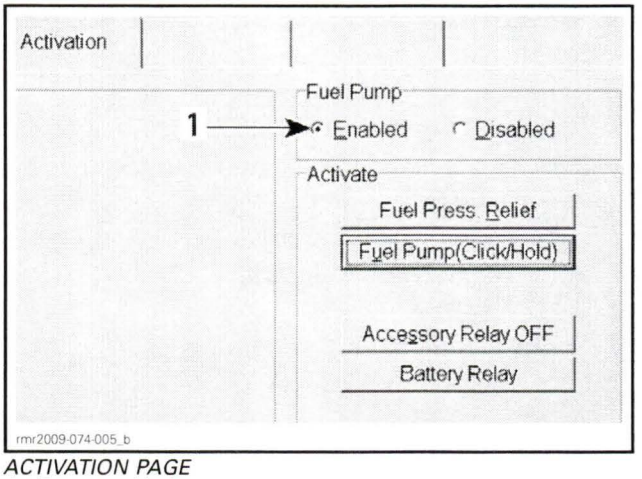
⚠ WARNING

Fuel injector must be secured during the leak test to avoid the fuel injector to be projected.

10. Place an appropriate container under the fuel injectors.
11. Ensure spark plug caps are installed on spark plugs.
12. Ensure there is enough fuel in fuel tank.
13. Connect vehicle to latest applicable B.U.D.S. version. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.

Leak Test

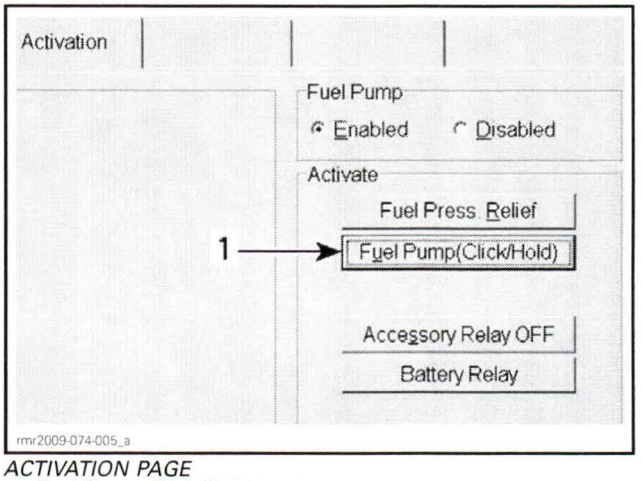
1. In B.U.D.S., select the **Activation** page tab.
2. In the **Fuel Pump** field, ensure fuel pump is enabled.



ACTIVATION PAGE
1. Pump enabled

3. Click and hold the **Fuel Pump** button.

NOTE: Fuel pump will operate as long as button is held depressed.



ACTIVATION PAGE
1. Fuel Pump (Click Hold) button

4. Check for fuel leakage from the fuel injector nozzle.
5. Monitor fuel pressure at fuel pressure gauge. If pressure drops below 275 kPa (40 PSI) during the test, reactivate fuel pump as necessary.

FUEL INJECTOR LEAKAGE	
TEST DURATION	SPECIFICATION
2 minutes	2 drops per minute maximum

If test is not within specification, replace the faulty fuel injector.

6. Properly reinstall fuel injectors. Refer to *FUEL INJECTOR INSTALLATION* in this subsection.
7. Reinstall remaining removed components.
8. Connect magneto connector.

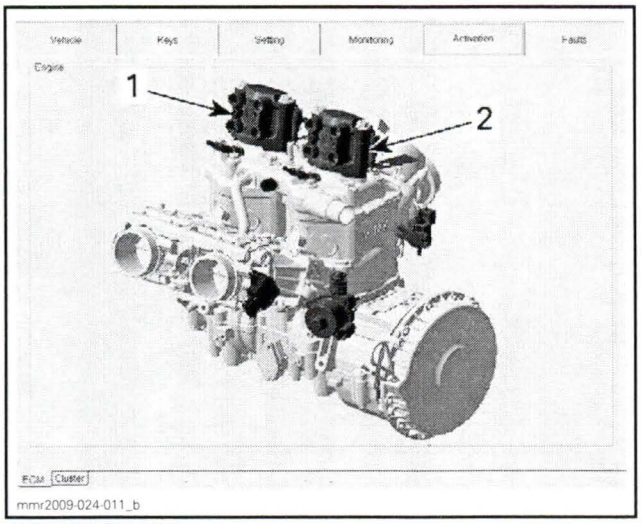
⚠ WARNING

Wipe up any spilled fuel.

Fuel Injector Functional Test

NOTE: This test is valid if one of the fuel injectors functions normally when activated.

1. Connect vehicle to latest applicable B.U.D.S. version. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. Select the **ECM** and **Activation** page tabs.
3. Activate the fuel injector by clicking on it in B.U.D.S.



ACTIVATION TAB
1. Click on PTO fuel injector to activate
2. Click on MAG fuel injector to activate

NOTE: The fuel injector action should be felt. If the fuel injector does not function, connect it to the opposite fuel injector connector, then test again.

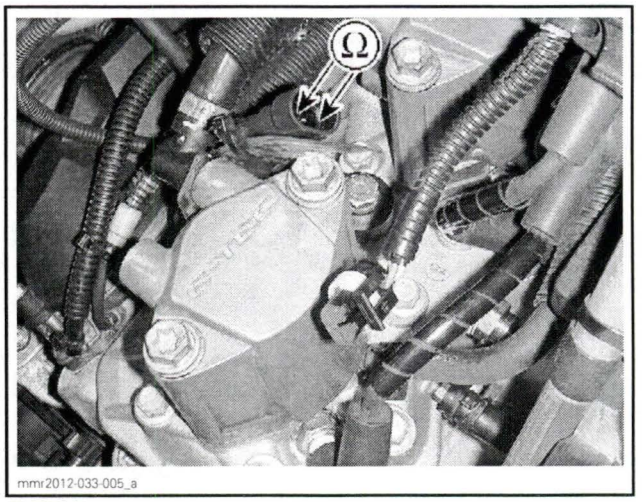
If the suspected fuel injector functions normally with the opposite fuel injector connector, carry out the *FUEL INJECTOR INPUT VOLTAGE TEST* in this subsection.

If the fuel injector still does not function, carry out the *FUEL INJECTOR RESISTANCE TEST* in this subsection.

Fuel Injector Resistance Test

1. Remove drive belt guard. Refer to *DRIVE BELT* subsection.
2. Disconnect the fuel injector connector.
3. Measure fuel injector resistance directly on its terminals.

FUEL INJECTOR		MEASUREMENT @ 22°C (72°F)
Pin 1	Pin 2	Below 2.7 Ω



TYPICAL

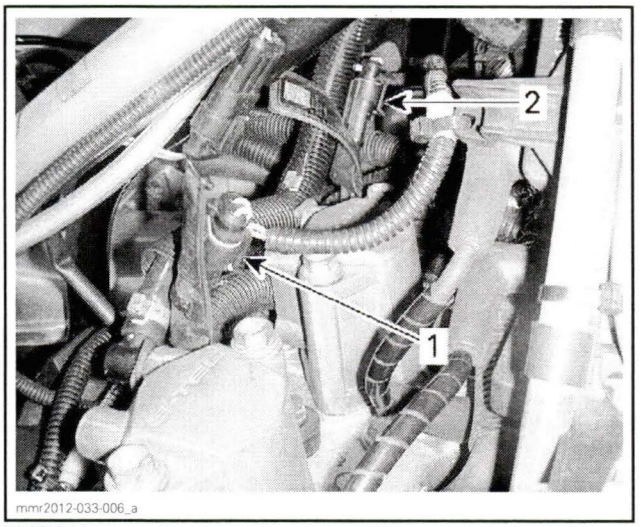
If measurement is out of specification, replace fuel injector.

Fuel Injector Input Voltage Test

1. Set emergency engine stop switch to STOP to disable ignition and injection.

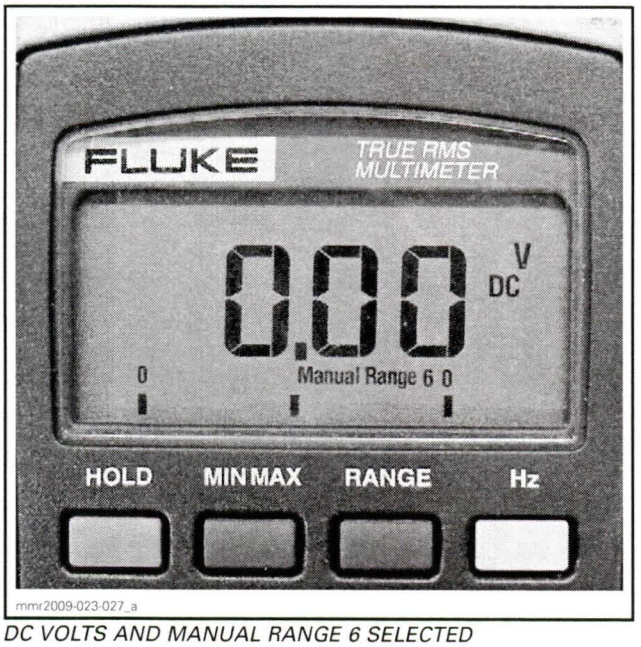
NOTE: Ensure magneto connector is properly connected.

2. Disconnect the electrical connector from the fuel injector.



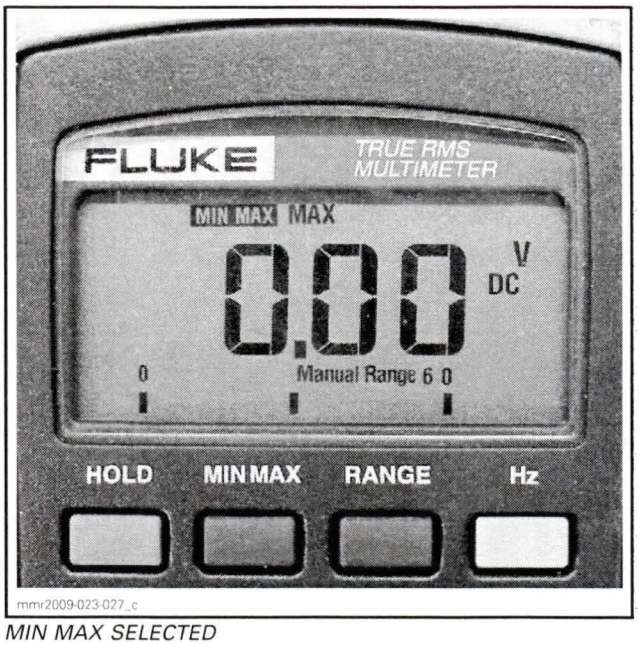
TYPICAL
1. *PTO fuel Injector connector*
2. *MAG fuel injector connector*

3. Use the FLUKE 115 MULTIMETER (P/N 529 035 868) and set it to **Vdc**.
4. Repeatedly press the **RANGE** button until the display shows **Manual Range 6 0**.



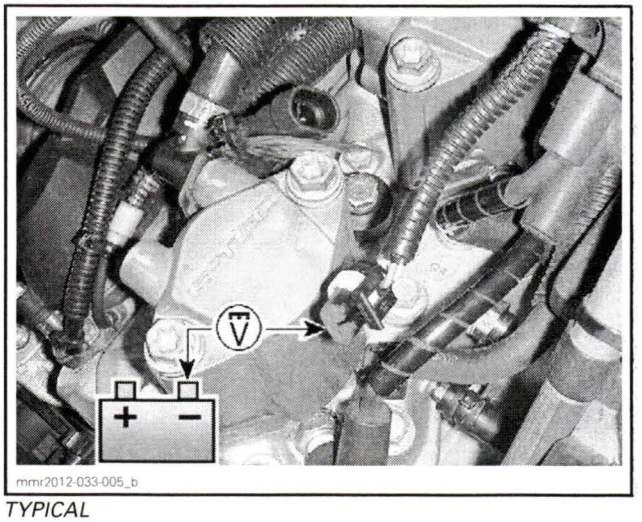
DC VOLTS AND MANUAL RANGE 6 SELECTED

5. Press the **MIN MAX** button so that the display shows **MIN MAX**.



MIN MAX SELECTED

6. Measure voltage while cranking engine.



TYPICAL

7. Read the MAX value.

FUEL INJECTOR CONNECTOR		MEASUREMENT
Pin 1	Battery ground	30 Vdc minimun

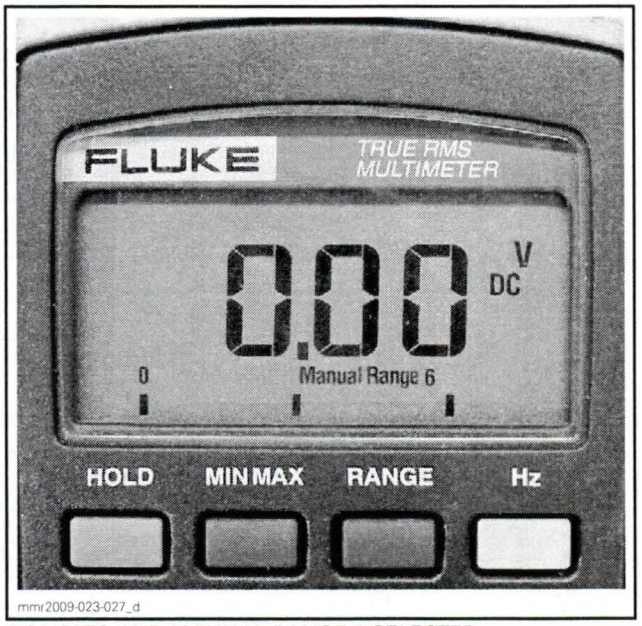
NOTE: Reset multimeter by pressing and holding **MIN MAX** button until meter beeps.

If voltage test is as per specification, carry out the *FUEL INJECTOR CONTROL CIRCUIT SIGNAL TEST* in this subsection.

If voltage test is not as per specification, check wire continuity between ECM and fuel injector connector.

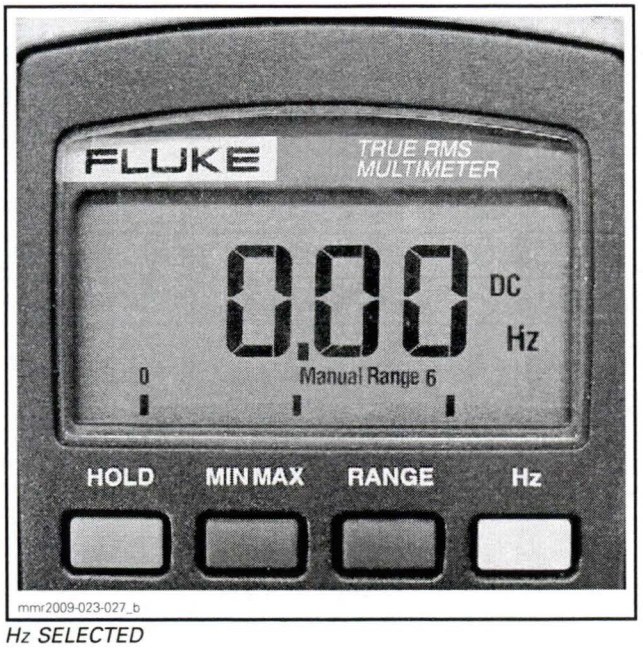
Fuel Injector Control Circuit Signal Test

1. Connect vehicle to the latest applicable B.U.D.S. version. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. Use the FLUKE 115 MULTIMETER (P/N 529 035 868) and set it to **Vdc (Hz)**.
3. Repeatedly press the **RANGE** button until the display shows **Manual Range 6**.



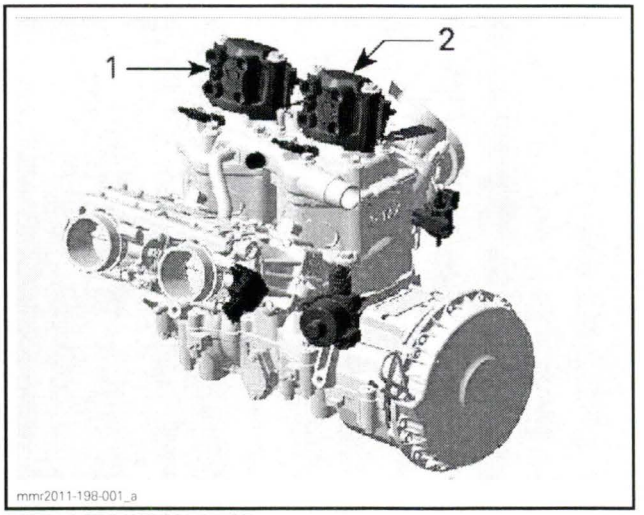
DC VOLTS AND MANUAL RANGE 6 SELECTED

4. Press the **Hz** button so that the display shows **Hz**.



Hz SELECTED

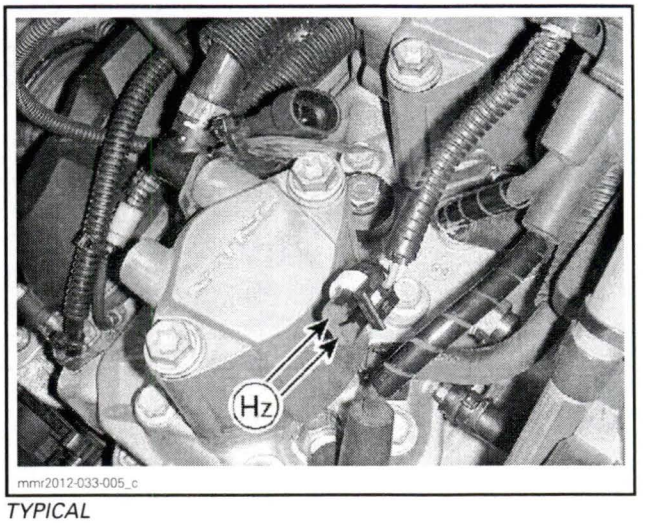
5. In B.U.D.S., select the **Activation** and **ECM** tabs.
6. Activate fuel injector and read the frequency on the multimeter.



ECM, ACTIVATION PAGE
1. PTO injector activation
2. MAG injector activation

NOTE: The multimeter counts the pulses per minute (Hertz) of current the ECM sends to the fuel injector.

FUEL INJECTOR CONNECTOR		MEASUREMENT
Pin 1	Pin 2	Approximately 2 Hz



TYPICAL

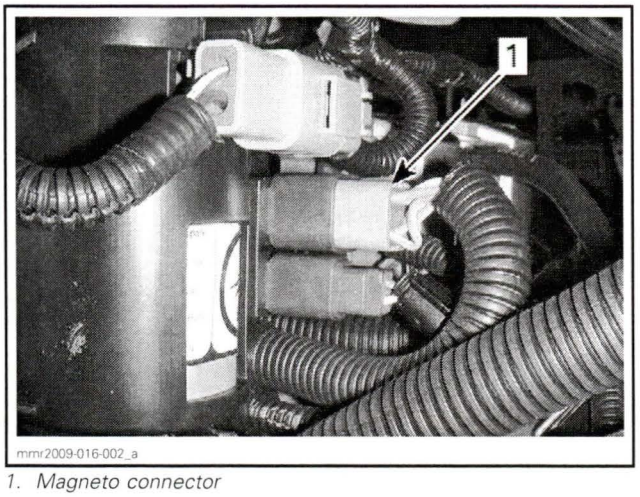
If there is no reading, check continuity of wiring between ECM and fuel injector connector.

If reading is good, the control circuit is functional.

Fuel Injector Removal

IMPORTANT: NEW O-rings and crush ring must be installed if fuel injector is removed (fuel injector disassembly required). Otherwise, leakage or damage to fuel injector/cylinder head might occur.

1. Remove drive belt guard. Refer to *DRIVE BELT* subsection.
2. Remove primary and secondary air intake silencers. Refer to *AIR INTAKE SYSTEM (600 HO E-TEC)* subsection.
3. Disconnect magneto connector.



1. Magneto connector

⚠ WARNING

The magneto connector must be disconnected to prevent any spark in the engine compartment should the engine be cranked. Fuel vapors may ignite in presence of a spark creating a fire hazard.

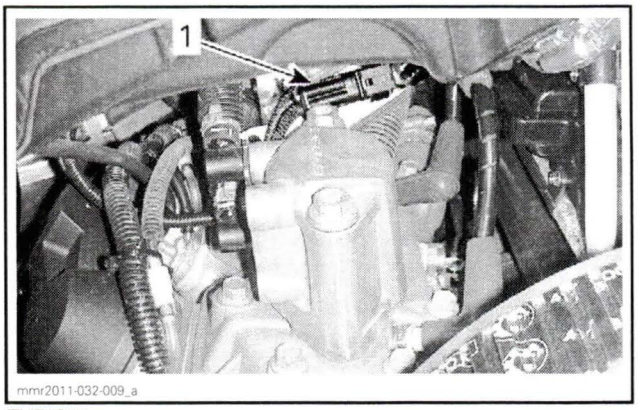
4. Clean fuel injector area.
5. Release the fuel pressure in the system. Refer to *FUEL PUMP* in *FUEL TANK AND FUEL PUMP (600 HO E-TEC AND 600 ACE)* subsection.

NOTICE **If fuel pressure is not released, the pressure will push the fuel injector out of its housing when removing the fuel injector. This could damage the fuel injector and lead to an important fuel spill.**

⚠ WARNING

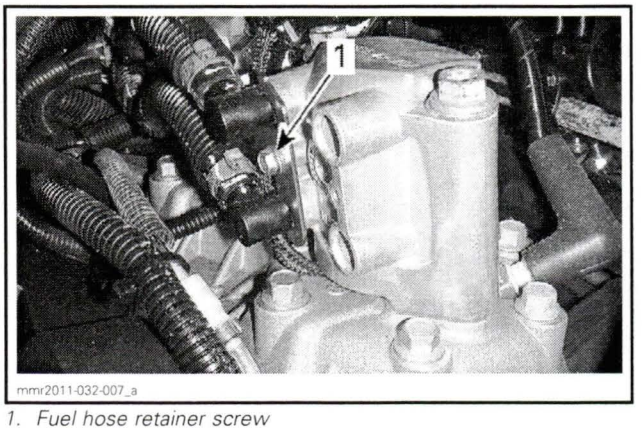
Fuel vapors in the engine compartment could be lit by a spark. This might create a fire.

6. Disconnect fuel injector connector.



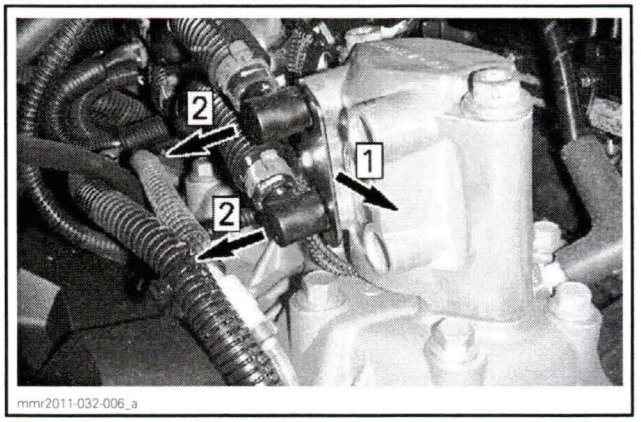
TYPICAL
1. Fuel injector connector

7. Install a rag under the hose ends to catch fuel spillage.
8. Remove fuel hose retainer screw.



1. Fuel hose retainer screw

9. Slide the fuel hose retainer out and disconnect fuel hoses from fuel injector.



Step 1: Remove fuel hose retainer
Step 2: Remove fuel hoses

⚠ WARNING

More fuel than usual will flow out of the fuel injectors. Work in a well ventilated area and wipe up spilled fuel.

10. Remove fuel injector screws.
11. Gently pull up on the fuel injector to remove it.

NOTE: If a fuel injector is to be reinstalled, mark it (MAG or PTO) to reinstall it in the same cylinder position.

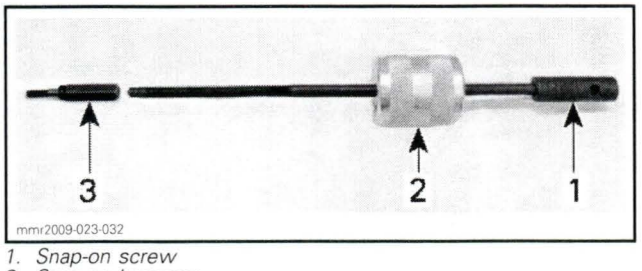
NOTICE **Use caution when handling fuel injector. Never hold injector by its electrical wires. Prevent dirt and debris from entering fuel inlet and outlet ports of fuel injectors or fuel hoses. Cover the fuel injector nozzle port in cylinder head to prevent contamination of combustion chamber.**

Fuel Injector Disassembly

To remove fuel injector from its housing, use a Snap-on slide hammer puller including:

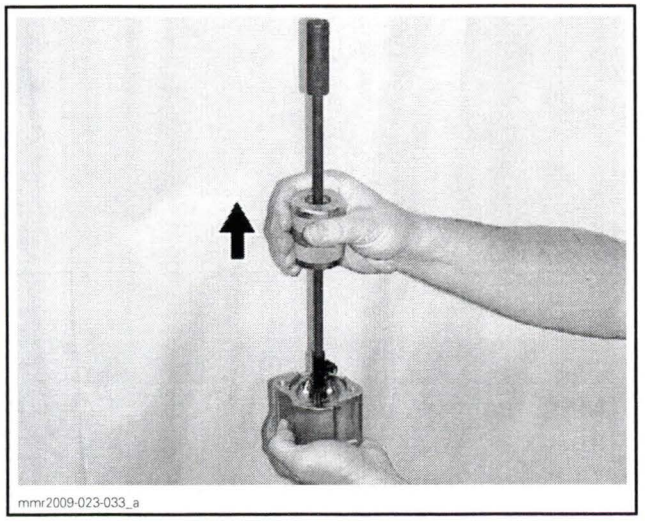
- SNAP-ON SCREW (P/N CJ93-1)
- SNAP-ON HAMMER (P/N CJ125-6).

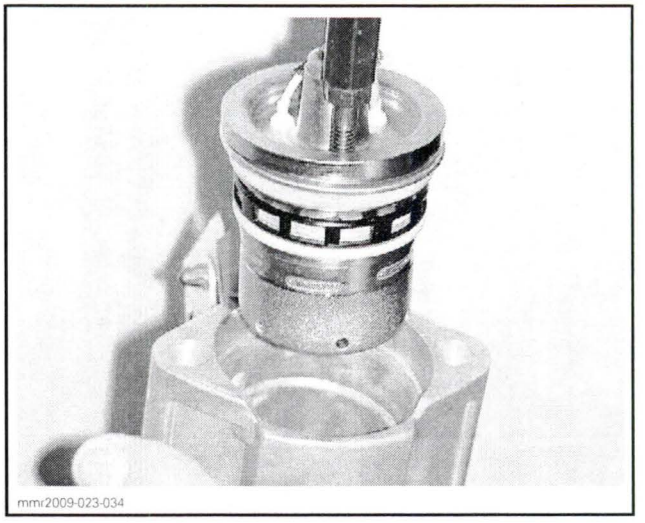
1. Install the EXTRACTOR ADAPTOR (P/N 529 036 136) on the Snap-on screw.



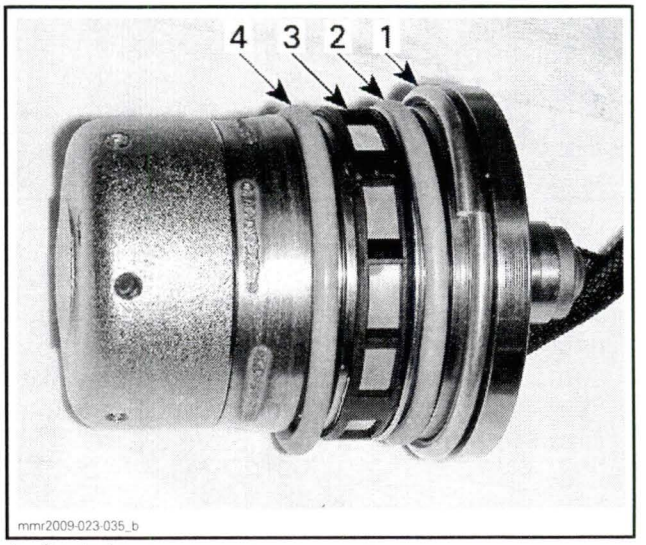
1. Snap-on screw
2. Snap-on hammer
3. Extractor adapter (P/N 529 036 136)

2. Thread the extractor adapter into the fuel injector.
3. Securely hold the fuel injector housing upside down to avoid dropping it.
4. Work slide hammer to pull the fuel injector out.



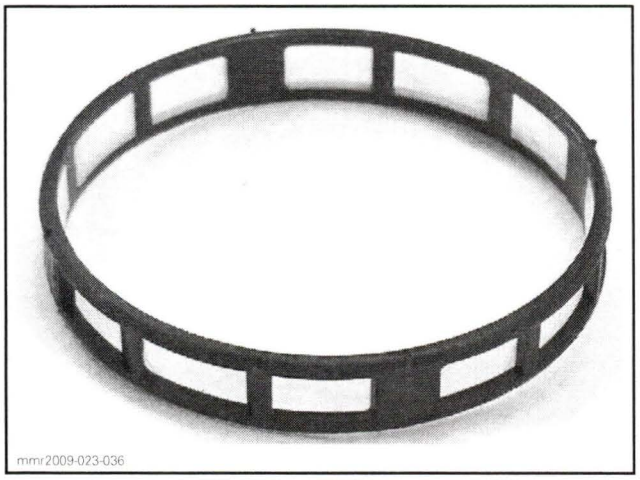


5. Remove the extractor adaptor from the fuel injector.
6. Remove O-rings, crush ring, and filter from the fuel injector.



1. Crush ring
2. ORANGE O-ring
3. Filter
4. BLUE O-ring

7. Inspect and clean fuel injector filter.



Fuel Injector Assembly

The assembly procedure is the reverse of disassembly. However, pay attention to the following:

IMPORTANT: Apply injection oil on O-rings.

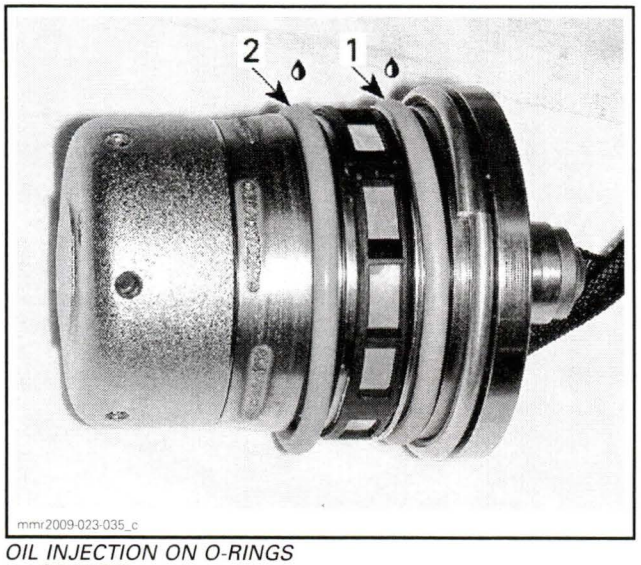
Install a new crush ring.

Install a new orange O-ring on top.

NOTICE **Always use the O-rings specifically designed for these fuel injectors.**

Install filter. Ensure filter is retained firmly on fuel injector. Otherwise, remove it, invert it half a turn, then reinstall. If it still not retained securely, install a new one.

Install a new blue O-ring at bottom.

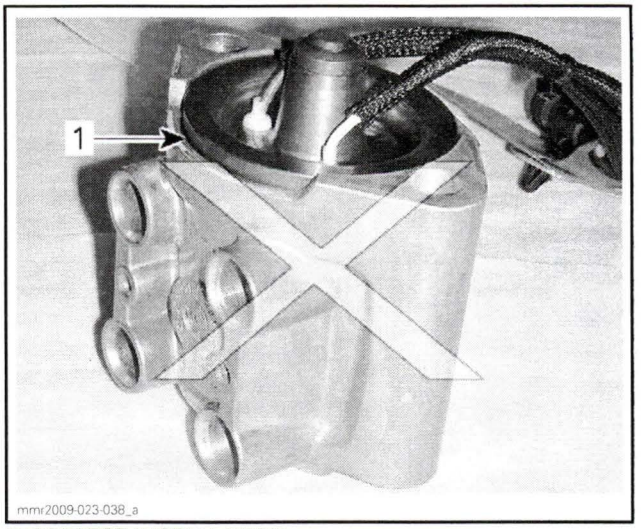


OIL INJECTION ON O-RINGS
1. *ORANGE*
2. *BLUE*

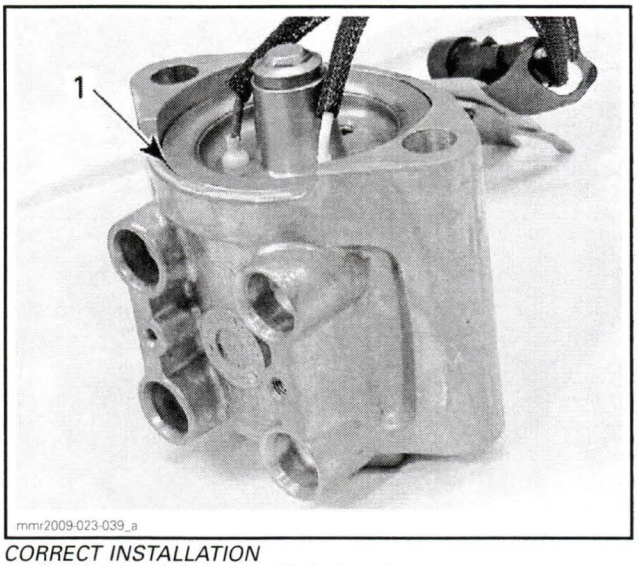
Reinstall fuel injector in its housing.

NOTE: Be sure to fully insert fuel injector in the housing with the wire outlets towards the fuel ports.

NOTICE Never press or tap the fuel injector tip.



INCORRECT INSTALLATION
1. *Fuel injector not fully inserted in its housing*



CORRECT INSTALLATION
1. *Fuel injector fully inserted in its housing*

Fuel Injector Installation

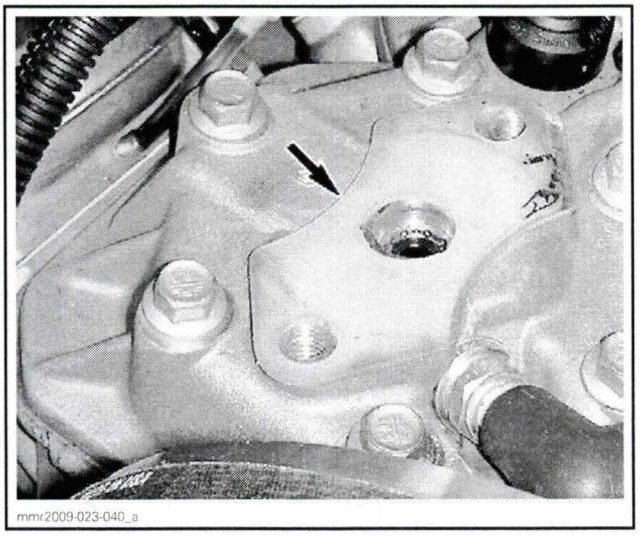
The following items and their mating surfaces must be cleaned and inspected prior to assembly:

- Fuel Injector
- Cylinder head: fuel injector housing and fuel injector tip contact surfaces
- Fuel injector screw threads and cylinder head threads (**must be dry**).

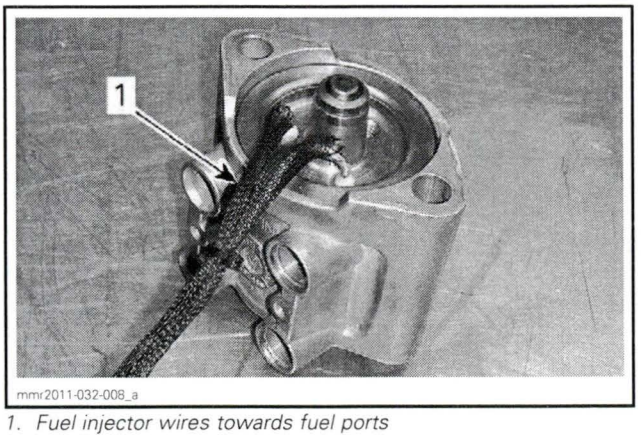
NOTICE **All fuel injector components must be clean to ensure correct torque tightening specifications and to avoid leakage. Carefully follow the installation instructions.**

NOTE: When installing a **used** fuel injector, reinstall the fuel injector in the same location. If it was not marked at removal, verify the correct fuel injector-cylinder match using B.U.D.S. Refer to *FUEL INJECTOR POSITION VALIDATION* in this subsection.

1. Position the thermal insulator on cylinder head.



2. Route the fuel injector wires towards the fuel ports.

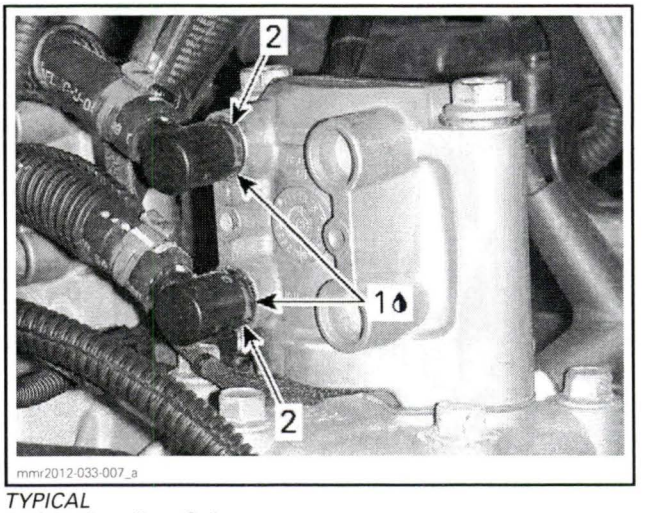


1. Fuel injector wires towards fuel ports

3. Place the fuel injector on the cylinder head, then thread in NEW screws with NEW washers.

NOTICE Torque fuel injector retaining screws prior to installing fuel hoses.

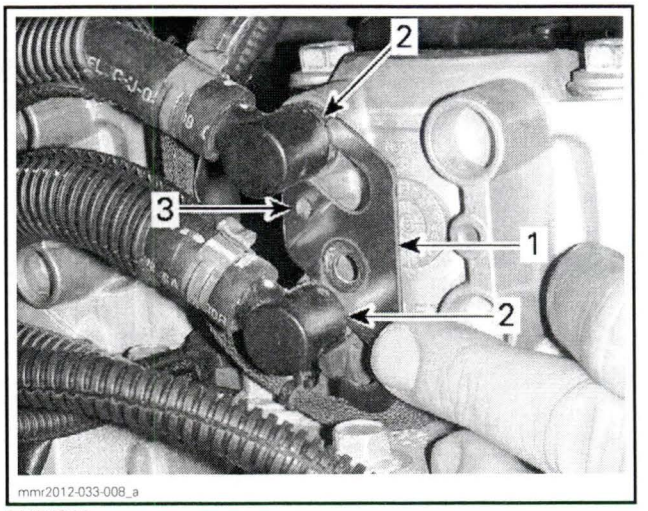
4. Tighten both injector retaining screws alternately in the following sequence:
   - 4.1 Hand tighten until the screw heads contact the fuel injector housing
   - 4.2 5 N•m (44 lbf•**in**)
   - 4.3 25 N•m (18 lbf•ft)
   - 4.4 60 N•m (44 lbf•ft).
5. Check condition of fuel hose O-rings and plastic flange on hose fittings.
6. Apply injection oil on O-rings.
7. Insert fuel hoses in fuel injector housing.



TYPICAL
1. Injection oil on O-rings
2. Hose fittings fully inserted here

NOTE: Both hose fittings must be fully seated in the fuel injector housing.

8. Insert the hose retainer so that it engages the groove in the fuel injector fittings.



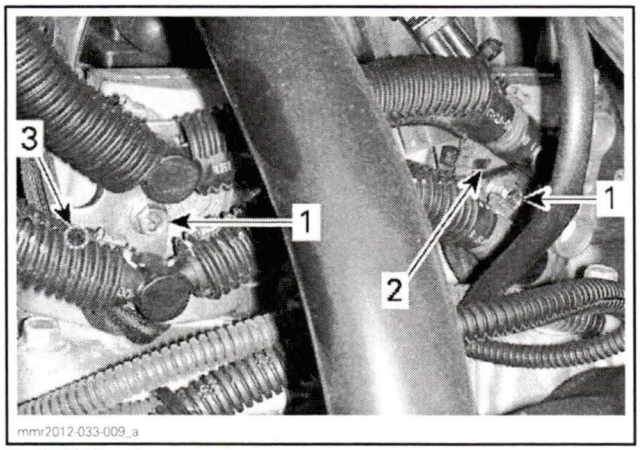
TYPICAL
1. Retainer
2. Retainer engagement in fuel injector fitting groove
3. Hole for securing injector wiring (up on PTO side)

NOTE: Ensure open end of retainer that locks in the fuel hoses faces inboard. The hole in the hose retainer used to secure the injector wiring must be on top for the PTO injector, and on the bottom for the MAG injector.

9. Install a NEW screw to secure hose retainer.

NOTICE The screw features a scotch grip threadlocker coating that is destroyed when loosening screw. Always replace screw with a new one each time it is loosened.

10. Torque fuel hose retainer screw to 5 N•m (44 lbf•**in**).



1. NEW fuel hose retainer screw
2. PTO injector wiring secured with locking tie
3. MAG injector wiring secured with locking tie (not visible)

11. Secure fuel injector wiring using a new locking tie.
12. Apply some DIELECTRIC GREASE (P/N 293 550 004) in fuel injector connector.
13. Reconnect fuel injector connector.

NOTICE Never fasten the electrical connector to the fuel injector. The connector must be "free floating".

14. If installing a **NEW** fuel injector, use B.U.D.S. to configure it in the ECM. Refer to *SETTING A FUEL INJECTOR TO A CYLINDER* in this subsection.

NOTE: The engine will be able to run with an improperly matched fuel injector. However, the engine may misfire, run rough at idle, have poor fuel economy or run lean.

⚠ WARNING

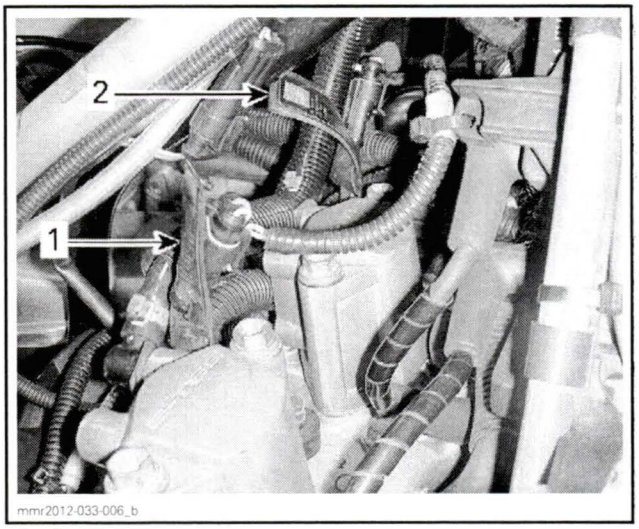
Perform a fuel pressure test and make sure there is no leak.

Fuel Injector Position Validation

When troubleshooting or reinstalling a fuel injector, the correct matching of the fuel injector and cylinder must be confirmed using B.U.D.S. An incorrect match between the fuel injector and cylinder may lead to engine misfiring, improper idling or poor fuel economy.

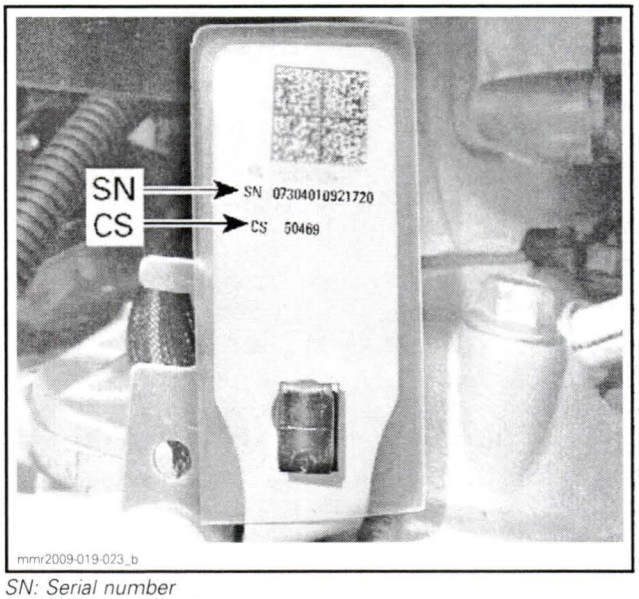
NOTE: To configure a new fuel injector at installation, refer to *SETTING A FUEL INJECTOR TO A CYLINDER* in this subsection.

1. Look for the fuel injector identification tag.



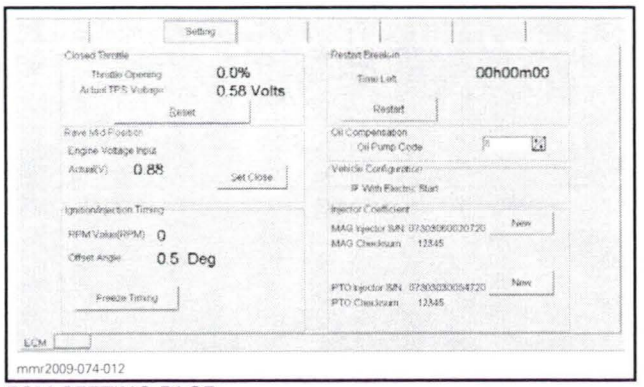
TYPICAL
1. PTO fuel injector tag
2. MAG fuel injector tag

2. Note the fuel injector serial number (SN) on the tag of the fuel injector you wish to validate.



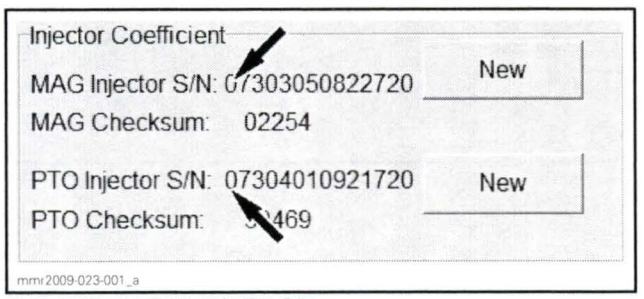
SN: Serial number
CS: Checksum number

3. In B.U.D.S., select **Setting** and **ECM** tabs.



ECM SETTING PAGE

4. In the **Injector Coefficient** box, look for the fuel injector serial numbers (S/N) that are registered in the ECM.



PTO AND MAG INJECTOR S/N

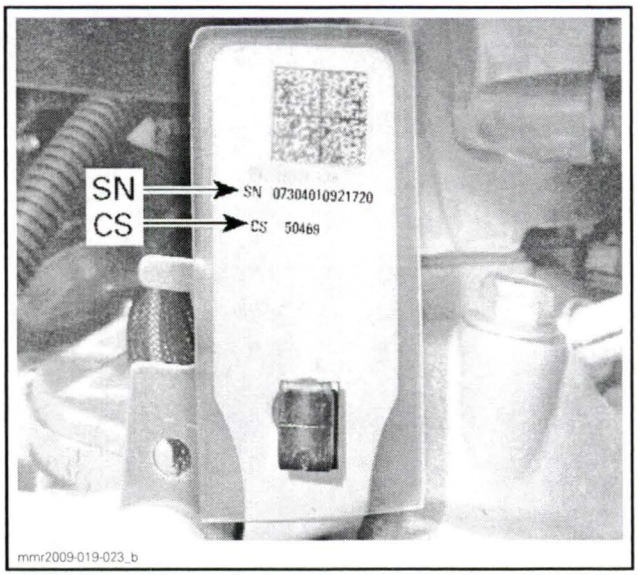
5. Compare the **MAG** or **PTO Injector S/N** that is configured in the ECM with the fuel injector SN installed on the engine.

NOTICE **The actual fuel injector number (SN) must match the number in B.U.D.S. (Injector S/N). If not, check if fuel injectors have been installed in the wrong position (or replaced).**

If numbers do not match, configure the fuel injector in B.U.D.S. Refer to *SETTING A FUEL INJECTOR TO A CYLINDER* in this subsection.

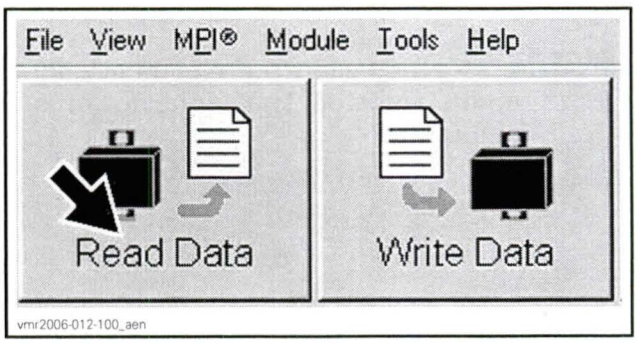
Setting a Fuel Injector to a Cylinder

1. Note the serial number (SN) and the checksum number (CS) on the fuel injector tag.

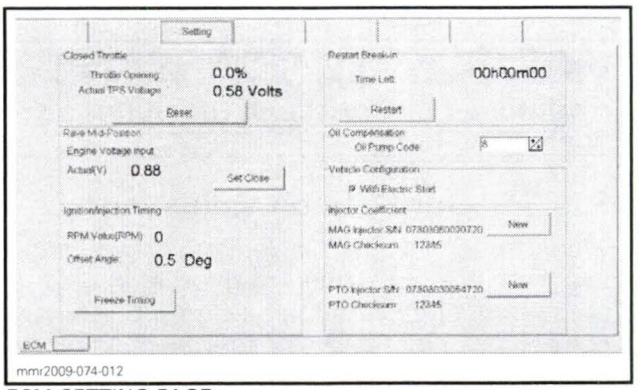


SN: Serial number
CS: Checksum number

2. Using BOSSWeb, download the matching calibration file.
3. Save the calibration file to your PC computer in the folder:
   C:\Program Files\BRP\BUDSCommon\InjectorCoefficients
4. Start B.U.D.S. and click on the **Read Data** button.

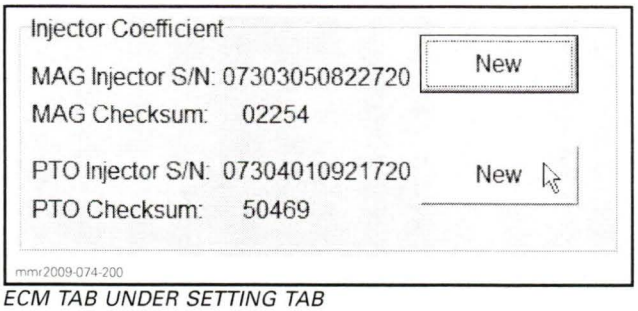


5. Select **Setting** and **ECM** page tabs.



ECM SETTING PAGE

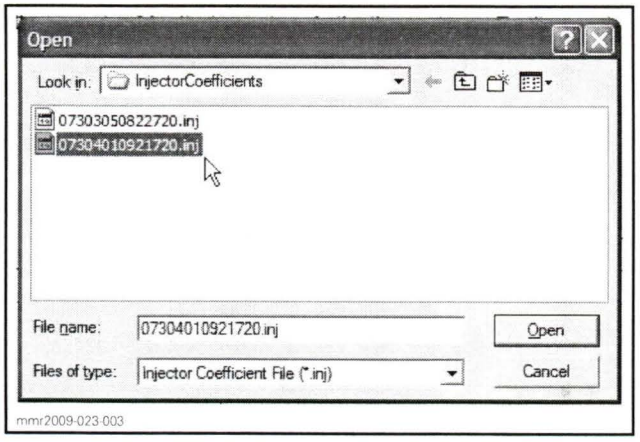
6. In the **Injector Coefficient** box, click on the **New** button of the fuel injector you want to replace (MAG or PTO).



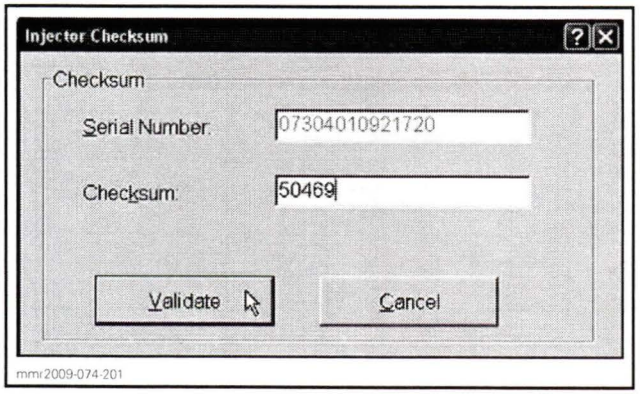
ECM TAB UNDER SETTING TAB

NOTE: Every time the **New** button is clicked, B.U.D.S. will automatically open the **Injector Coefficients** folder.

7. Select and open the fuel injector serial number file that matches the fuel injector installed on the engine.

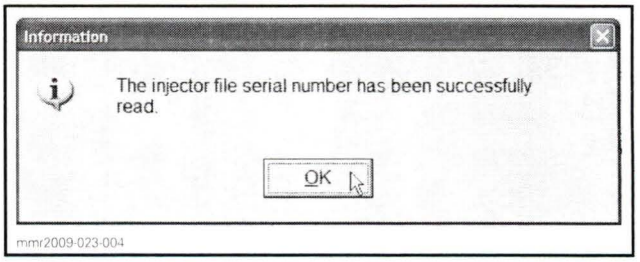


8. Enter the checksum number noted earlier and select **Validate**.

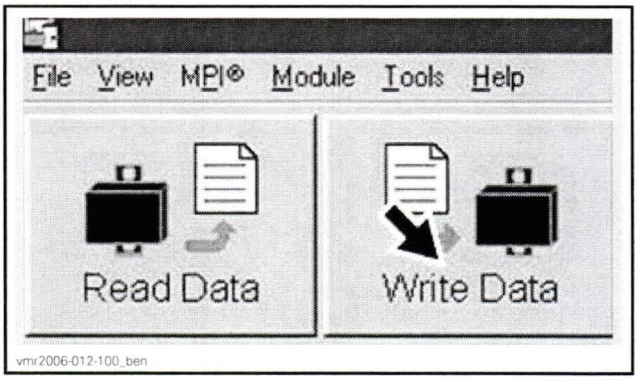


NOTE: The file will be quickly read and loaded in B.U.D.S.

9. Click the **OK** button when the confirmation box appears.

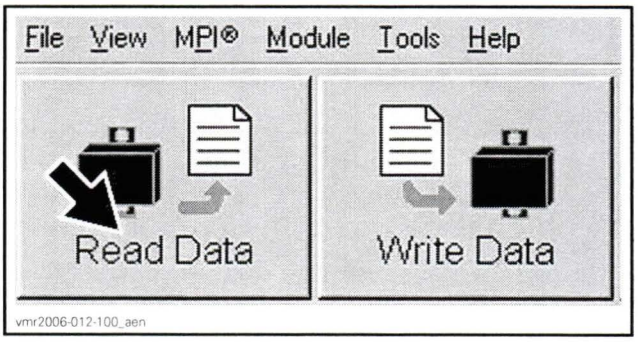


10. Click on the **Write Data** button to save the changes to the ECM.

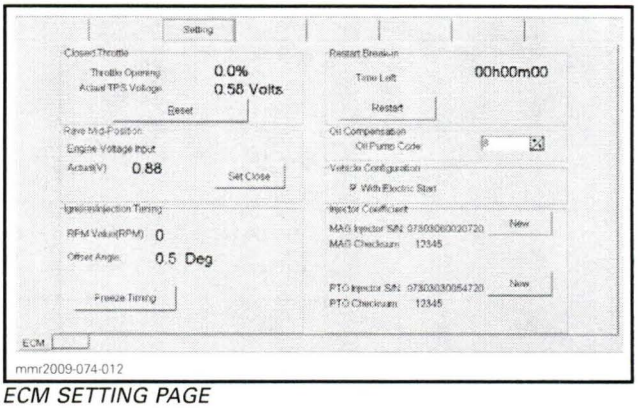


IMPORTANT: To ensure the proper file has been saved in the ECM, do the following:

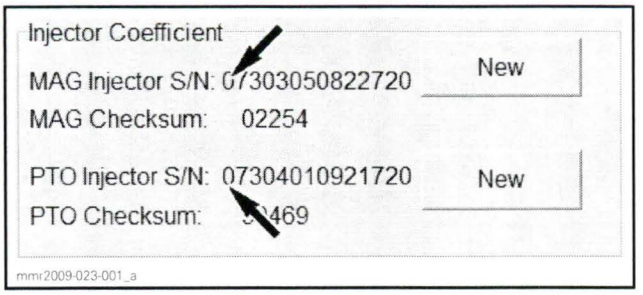
11. Click on the **Read Data** button again in B.U.D.S.



12. Look in the **Injector Coefficient** field in the ECM **Setting** page.



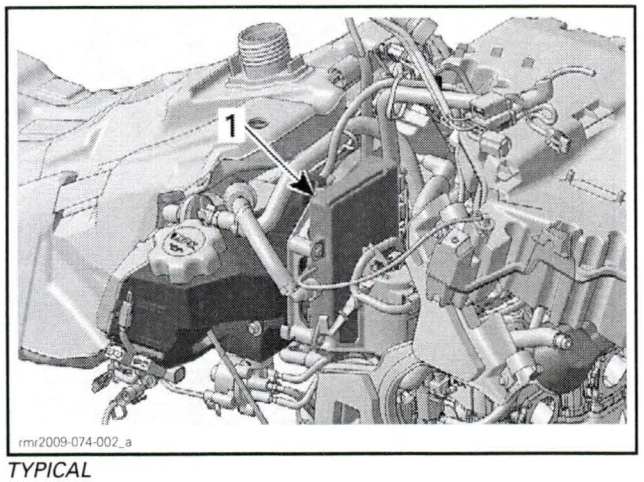
ECM SETTING PAGE



13. Ensure the S/N in B.U.D.S. matches the SN of the fuel injector installed on the engine and the PTO/MAG numbers are not inverted.
14. If there is a mismatch, reload the proper configuration file. Write data and read it again to recheck.

NOTE
Every time an ECM is read or when an **.mpem** file is opened, the fuel injector calibration files (example: 07303050822720 and 07304010921720.inj) are automatically stored on your PC computer under a folder that will be common to all versions of B.U.D.S.: C:\Program Files\BRP\BUDSCommon\InjectorCoefficients. If B.U.D.S. is uninstalled, the files won't be deleted. If you ever replace an ECM from which you were not able to read the data, you could load its latest **.mpem** file, look at the fuel injector serial numbers stored in the ECM and then read the matching calibration files from the common files without the need to download the file from BOSSWeb.

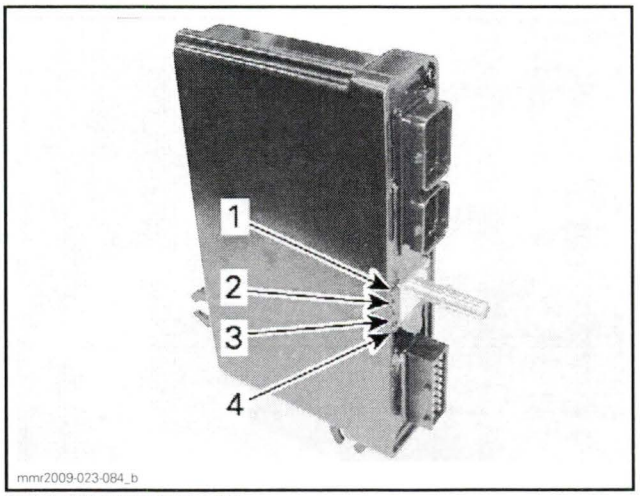
ECM (ENGINE CONTROL MODULE)



TYPICAL
1. ECM

NOTE: Prior to replacing an ECM, carry out all testing procedures.

ECM Self Diagnostic LEDs



SELF DIAGNOSTIC LED
1. LED 1
2. LED 2
3. LED 3
4. LED 4

LED ON	ENGINE STARTING	ENGINE RUNNING
1	Charging OK	Charging fault
2	CPS signal OK	Fuel injection or ignition fault
3	Sensors OK	Sensor fault
4	Emergency and engine cut-off switch OK	No oil or engine overheat

ECM Wire Identification

CONNECTOR J1A		
FUNCTION	PIN	COLOR
RAVE position signal	1	WHITE/BLUE
D.E.S.S. ground	5	GREEN/BLACK
CPS	6	YELLOW
CPS	7	WHITE/YELLOW
Emergency engine stop switch	9	YELLOW/BLACK
TPS/RAVE position sensor +	10	BROWN/BLACK
D.E.S.S. signal	11	WHITE/GRAY
EGTS signal	12	GRAY/BROWN
CAN LO	13	WHITE/BLACK
CAN HI	14	WHITE/GREEN
ECM 12-volt power	15	WHITE/PINK

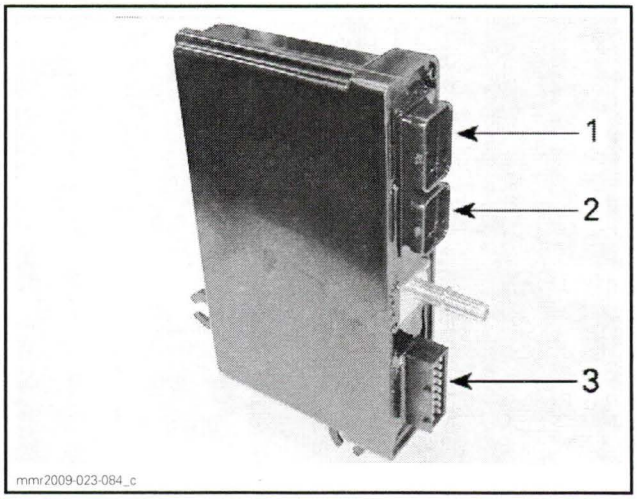
CONNECTOR J1A		
FUNCTION	PIN	COLOR
TPS signal	18	WHITE/BROWN
CTS signal	19	ORANGE/BROWN
ATS signal	20	WHITE/VIOLET
D.E.S.S. switch	23	WHITE/BLACK
TPS/RAVE position sensor ground	26	GRAY/BLACK
ATS/CTS/EGTS ground	27	RED/BLACK
START/RER switch signal	28	GREEN/RED
Oil level sensor +	29	LIGHT BLUE
Knock sensor +	33	BLUE/YELLOW
Knock sensor ground	34	BLUE/BROWN

CONNECTOR J1B		
FUNCTION	PIN	COLOR
PTO fuel injector control	1	GREEN
Run relay control	5	ORANGE/WHITE
MAG fuel injector control	8	BLUE
Starter solenoid control	9	ORANGE/BLACK
ECM 12-volt power from diagnostic connector	10	BLUE/RED
Ground (fuel injectors)	14	BLACK
PTO ignition coil control	19	ORANGE/GREEN
Ground (fuel injectors)	20	BLACK
Ground (fuel injectors)	21	BLACK
E-RAVE solenoid control	22	GREEN/BROWN
Oil injection pump control	23	GREEN/YELLOW
MAG ignition coil control	26	ORANGE/BLUE

CONNECTOR J2		
FUNCTION	PIN	COLOR
Magneto winding	1	YELLOW
Magneto winding	2	BROWN
Magneto winding	3	ORANGE
Fuel pump control	4	PINK/BROWN
Ground	5	BLACK

CONNECTOR J2		
FUNCTION	PIN	COLOR
Secondary 12-volt supply	6	YELLOW/RED
Ground	7	BLACK
Ground	8	BLACK
Magneto winding	9	WHITE/YELLOW
Magneto winding	10	WHITE/BROWN
Magneto winding	11	ORANGE/WHITE
Fuel pump/oil injection pump 12-volt power	12	WHITE/RED
55-volt power	13	WHITE/RED
Secondary 12-volt supply	14	YELLOW/RED
Primary 12-volt supply	15	WHITE/PINK
Primary 12-volt supply	16	WHITE/PINK

ECM Connector Identification

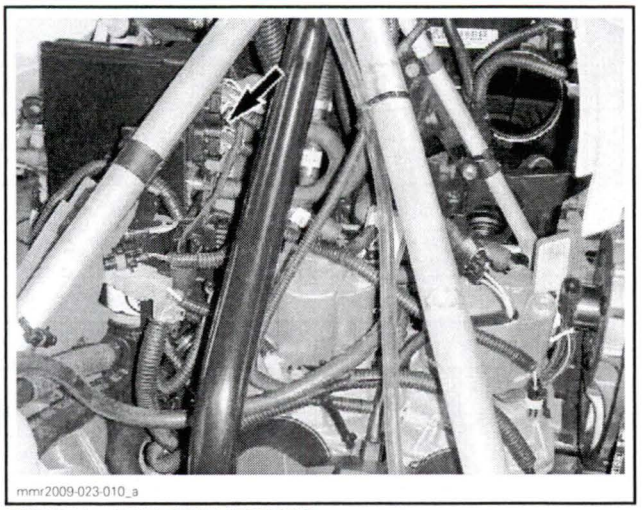


1. *J1A*
2. *J1B*
3. *J2*

ECM Connector Access

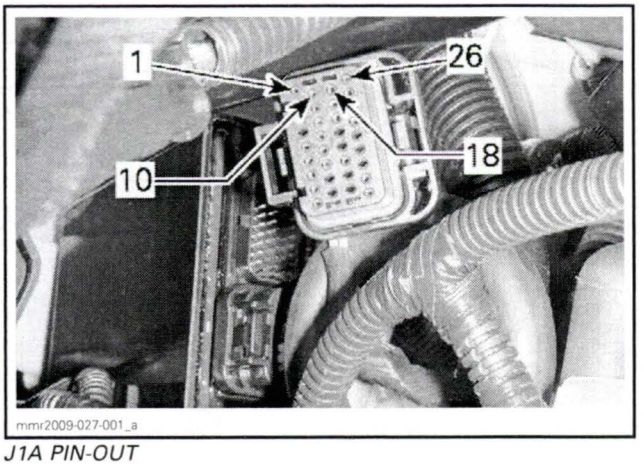
To access ECM connectors:

1. Open LH side panel.
2. Remove secondary air intake silencer. Refer to *AIR INTAKE SYSTEM (600 HO E-TEC)* subsection.
3. Unlock ECM support to move ECM as necessary.


mmr2009-023-010_a

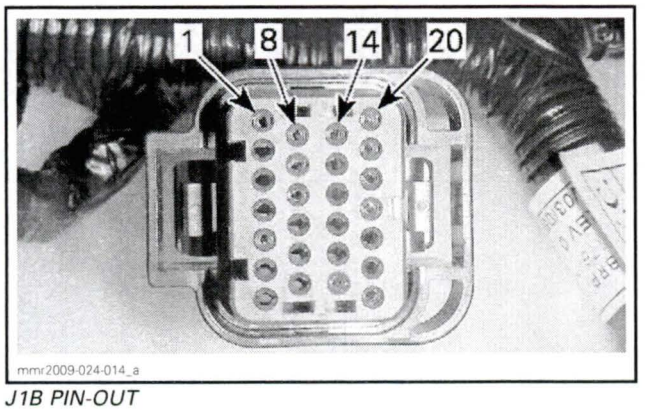
TYPICAL - ECM CONNECTORS

ECM Connector Pin-outs



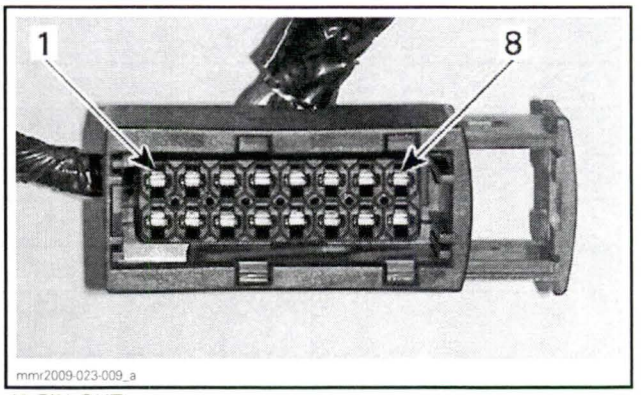
mmr2009-027-001_a

J1A PIN-OUT



mmr2009-024-014_a

J1B PIN-OUT



mmr2009-023-009_a

J2 PIN-OUT

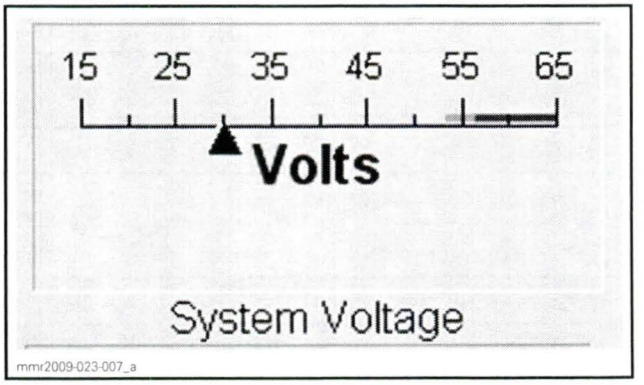
ECM Power Supply Troubleshooting

System Voltage Verification

Connect vehicle to latest applicable B.U.D.S. version. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.

In B.U.D.S., select **Monitoring** page tab, then **ECM** page.

Crank engine while viewing **System Voltage**.



mmr2009-023-007_a

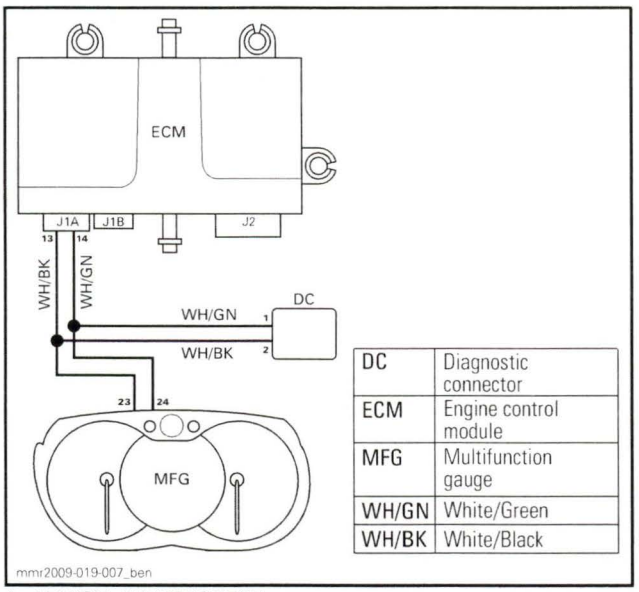
TEST CONDITION	VOLTAGE
Manual crank speed	30 Vdc min.

If voltage is as per specification, ECM is properly powered.

If voltage is out of specification, refer to *CHARGING SYSTEM (600 HO E-TEC)* subsection.

ECM CAN Line Test

CAN lines link the ECM, multifunction gauge and vehicle diagnostic connector.



DC	Diagnostic connector
ECM	Engine control module
MFG	Multifunction gauge
WH/GN	White/Green
WH/BK	White/Black

1. *WH/GN: WHITE/GREEN*
2. *WH/BK: WHITE/BLACK*
3. *MFG (multifunction gauge)*
4. *ECM (electronic control module)*
5. *DC (diagnostic connector)*

Test CAN wire continuity as follows.

1. Disconnect ECM connector "J1A".
2. Disconnect multifunction gauge connector. Refer to *LIGHTS, GAUGE AND ACCESSORIES* subsection.
3. Using the FLUKE 115 MULTIMETER (P/N 529 035 868), read wire resistance as follows.

ECM ADAPTER	GAUGE CONNECTOR	MEASUREMENT
Pin 13	Pin 23	Close to 0 Ω
Pin 14	Pin 24	

If continuity is out of specification, repair or replace wiring harness between ECM and multifunction gauge.

If continuity is as per specification, carry out the following test.

4. Disconnect vehicle diagnostic connector from its protective cap.
5. Read wire resistance as follows.

DIAGNOSTIC CONNECTOR	GAUGE CONNECTOR	MEASUREMENT
Pin 2	Pin 23	Close to 0 Ω
Pin 1	Pin 24	

If continuity is out of specification, repair or replace wiring harness between diagnostic connector and multifunction gauge.

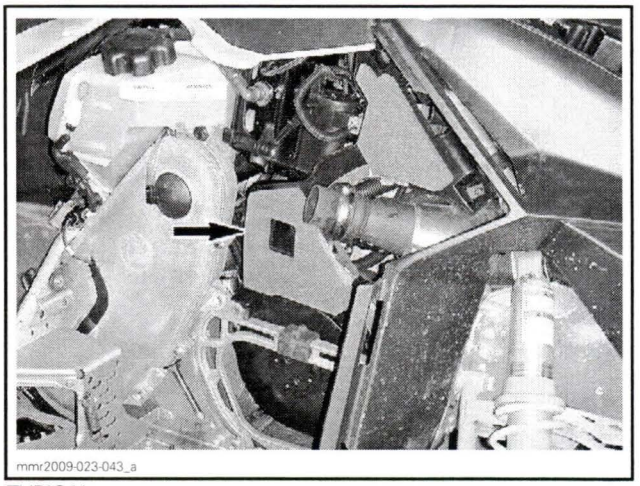
If continuity is as per specification, CAN lines are functional.

6. Reconnect connectors and reinstall removed parts.

ECM Removal

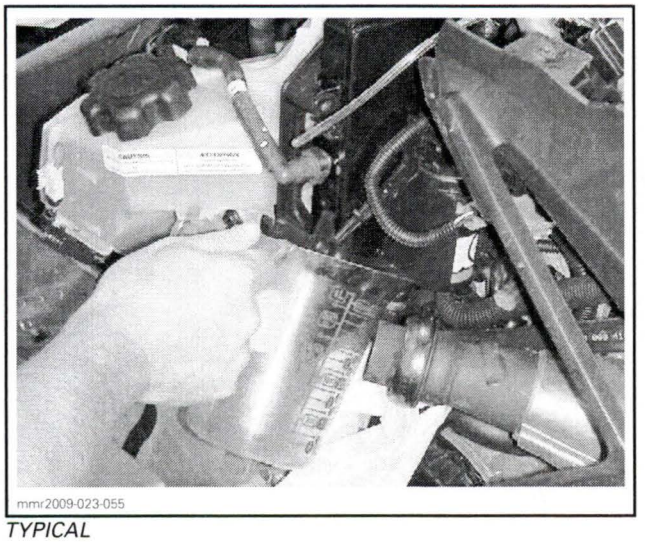
NOTE: If a new ECM is to be installed, read *ECM REPLACEMENT* in this subsection **before** removing the ECM.

1. Remove tether cord cap (D.E.S.S. key) from engine cut-off switch.
2. Set emergency engine stop switch to STOP.
3. Remove muffler. Refer to *ENGINE (600 HO E-TEC)* section, *EXHAUST SYSTEM* subsection.
4. Remove the acoustic panel.



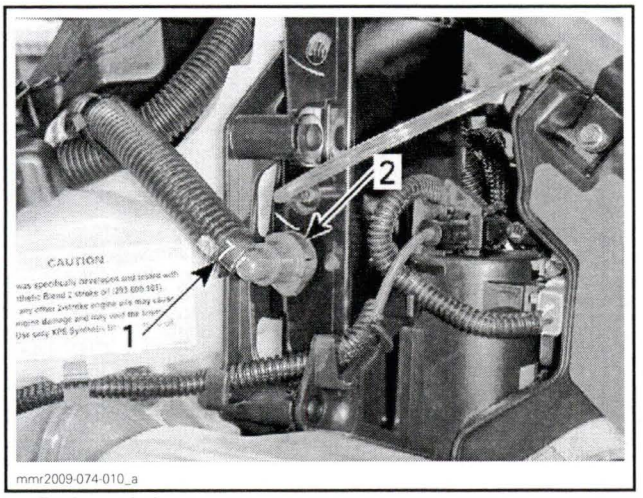
TYPICAL

5. Remove console. Refer to *BODY* subsection.
6. Set emergency engine stop switch to STOP.
7. Install a rag under the ECM fuel hose quick connect to catch fuel spillage.
8. Place a container under the hose connector to recover fuel.


mmr2009-023-055

TYPICAL

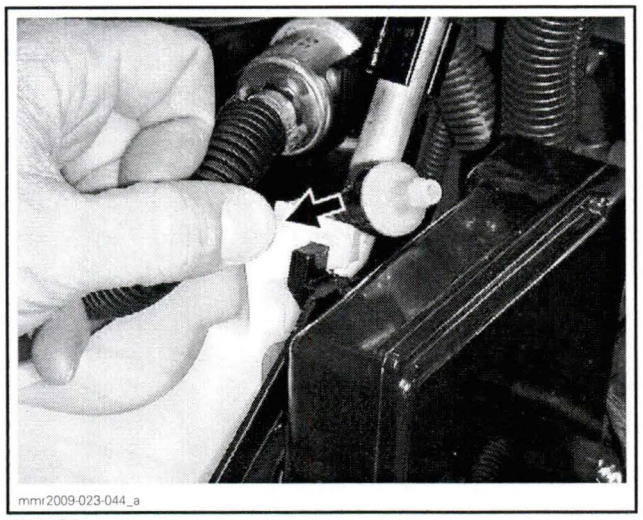
9. Slowly disconnect fuel hose from ECM and drain fuel.



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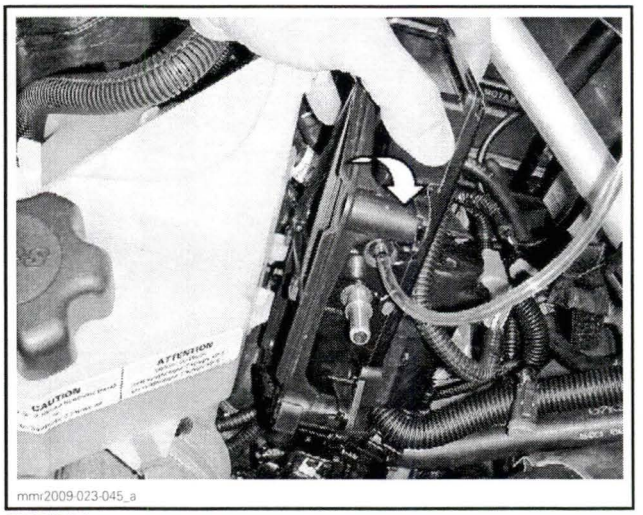
1. *Fuel supply hose*
2. *Release button*

10. Unlock the ECM.


mmr2009-023-044_a

TYPICAL

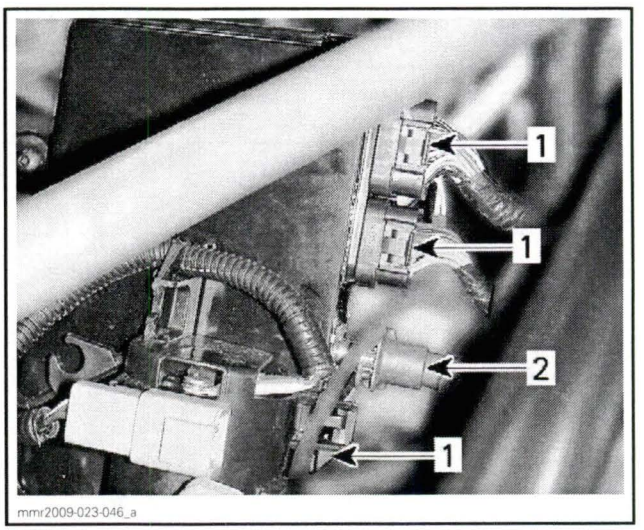
11. Slightly pull ECM out.
12. Tilt ECM in order to drain fuel remaining in ECM.



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TYPICAL

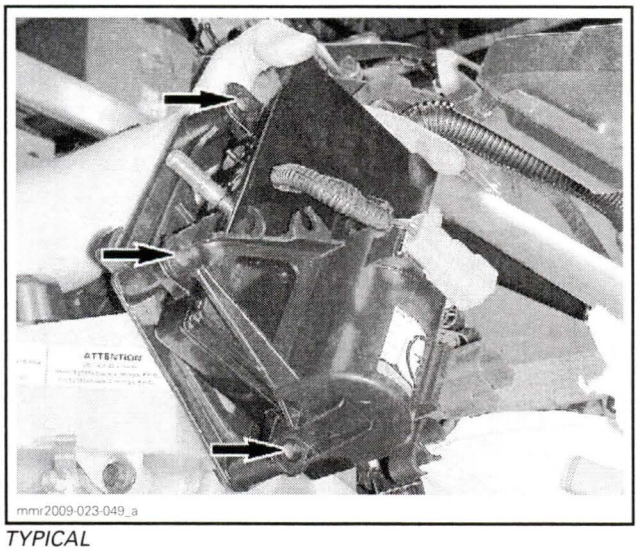
13. Disconnect APS tube (air pressure sensor) from the ECM.
14. Disconnect ECM connectors.
15. Disconnect capacitor connector.
16. Disconnect remaining fuel hose from ECM.



mmr2009-023-046_a

TYPICAL
1. *ECM connectors*
2. *Fuel hose*

17. Remove ECM from its support.

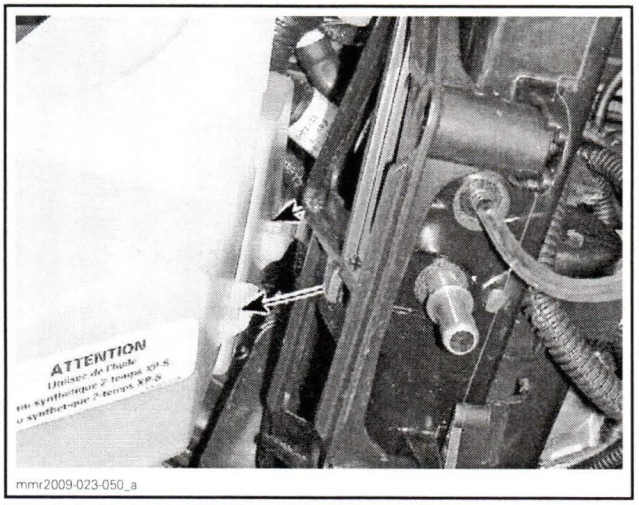


TYPICAL

ECM Installation

Reverse removal procedure however, pay attention to the following.

Ensure the ECM tabs are properly engaged on the oil injection reservoir.



⚠ WARNING

Wipe up all spilled fuel.

Set engine stop switch to RUN.

Install tether cord cap on engine cut-off switch.

Transfer or enter data in new ECM. Refer to *ECM REPLACEMENT* in this subsection.

ECM Replacement

When installing a new ECM, data must be entered and several resets are required to be carried out in B.U.D.S.

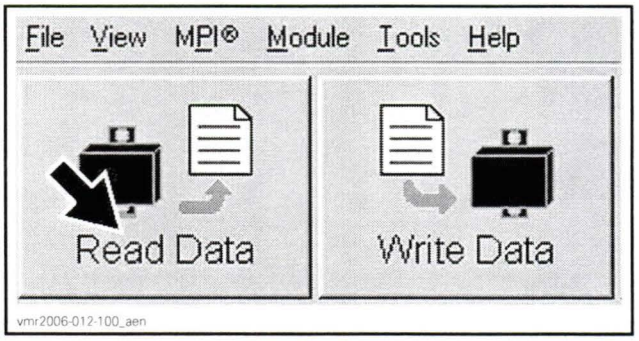
To transfer/enter data to the new ECM, there are 2 possible methods.

- If the faulty ECM can be read with B.U.D.S., refer to *ECM AUTOMATED DATA TRANSFER* in this subsection.
- If the faulty ECM cannot be read with B.U.D.S., refer to *ECM MANUAL DATA ENTRY* in this subsection.

ECM Automated Data Transfer

To transfer the previous ECM recorded information to the new ECM, use the B.U.D.S. software and proceed as follows:

1. In B.U.D.S., click the **Read Data** button to load the information from the faulty ECM.

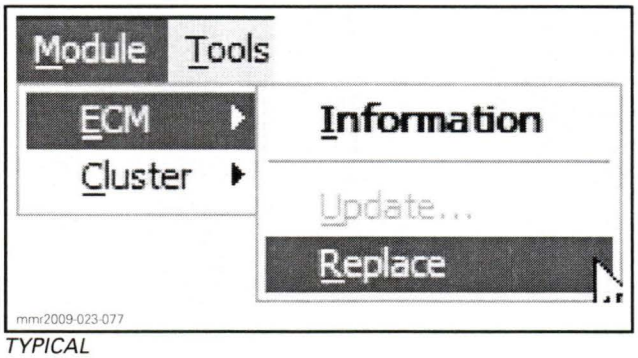


Important: Keep B.U.D.S. running while replacing the ECM. The data will remain stored in the PC computer as long as B.U.DS. is running.

2. Remove the old ECM, refer to *ECM REMOVAL* in this subsection.
3. Install and connect the new ECM, refer to *ECM INSTALLATION* in this subsection.

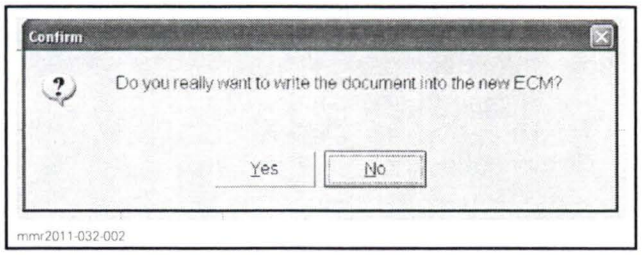
NOTE: The beeper will continuously sound a sequence of 11 beeps meaning that the D.E.S.S. key is not programmed. To stop the beeps, remove key.

In B.U.D.S., select **Module**, **ECM**, then **Replace**.



TYPICAL

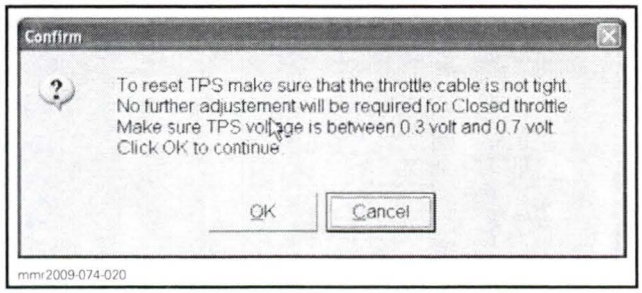
4. In the following window, click **Yes**.



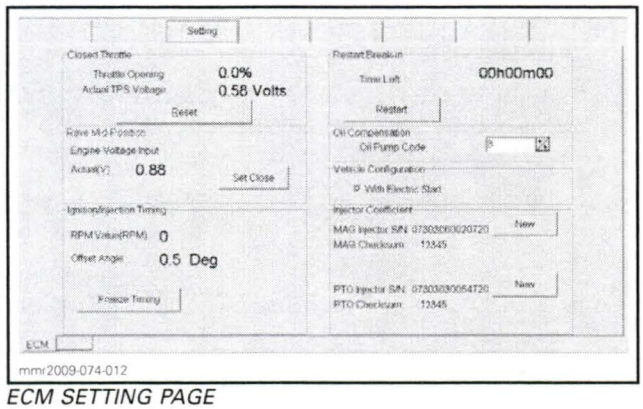
B.U.D.S. will automatically write the data from the PC computer into the new ECM.

Then, B.U.D.S. will display the following box asking you to carry out the **Closed Throttle Reset**.

NOTE: Refer to **Closed Throttle Reset (TPS)** in *ADJUSTMENTS* of this subsection for the specific requirements of this reset.

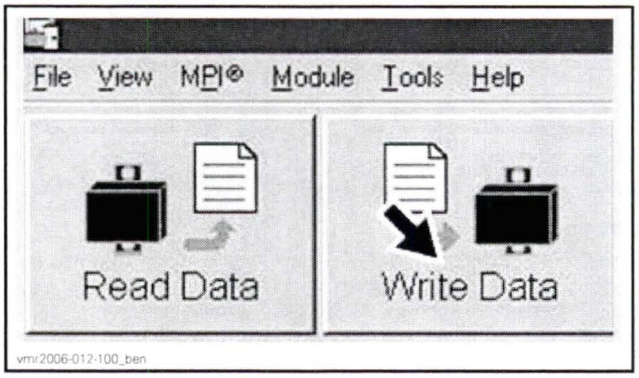


5. Click **OK** to carry out the closed throttle reset.
6. Ensure all the settings in the **Setting** page are correct. Otherwise, carry out the required reset/setting procedures.



ECM SETTING PAGE

7. Click the **Write Data** button to save the information to ECM.



8. Lift rear of vehicle and safely support.
9. Start the engine and increase engine speed above 6000 RPM to be sure no fault codes appear.
10. Let engine run at idle to ensure idle speed is adequate.

If the engine does not run as expected, ensure the fuel injector calibration files are valid. Check with the fuel injectors tags installed on the vehicle.

11. Reinstall remaining removed parts.

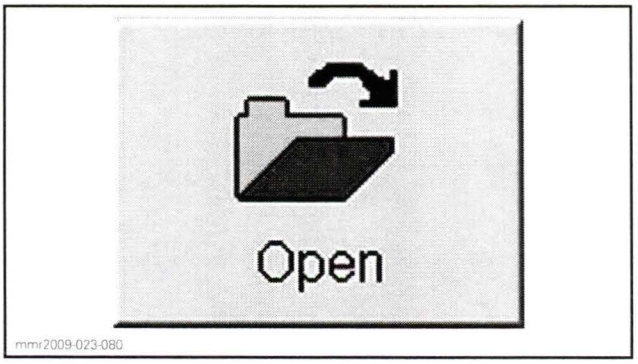
ECM Manual Data Entry

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

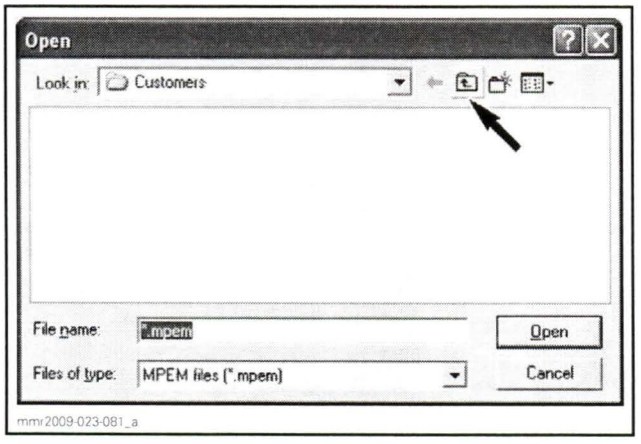
- Use B.U.D.S. software and obtain the data from a saved .mpem file on your PC computer.
- Collect the information from the vehicle and obtain the fuel injector coefficient files from BOSSWeb.

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

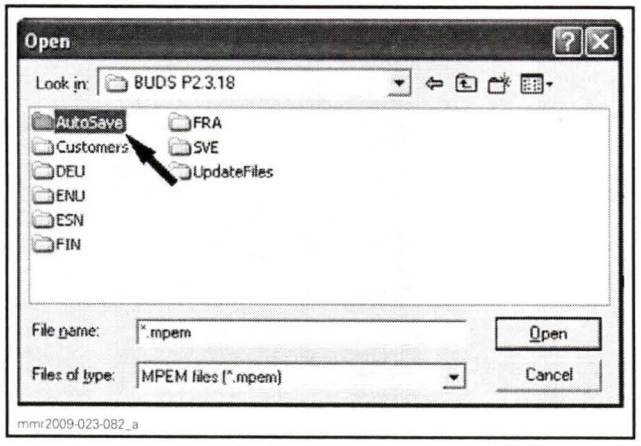
1. Remove the faulty ECM, refer to *ECM REMOVAL* in this subsection.
2. Install and connect the new ECM, refer to *ECM INSTALLATION* in this subsection.
3. Connect vehicle to latest applicable B.U.D.S. version and log on. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
4. Click on the **Open** button.



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

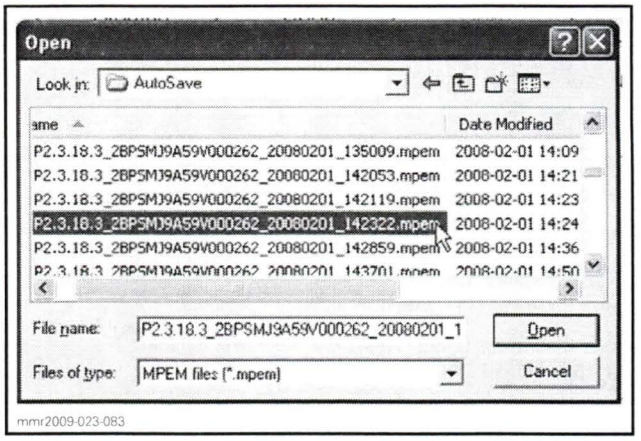


6. Double click on the **AutoSave** folder.



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

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



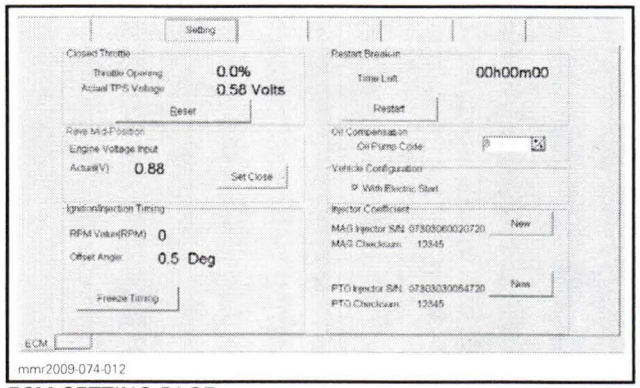
IMPORTANT: Ensure to use the file that specifically matches the vehicle you are servicing.

NOTE: The file name structure is as follows:
BUDS version_VIN_date read (yyyymmdd)_hour read (hhmmss).mpem
Example:
P2.3.18.3_2BPSMJ9A59V000262_20080201_142322.mpem

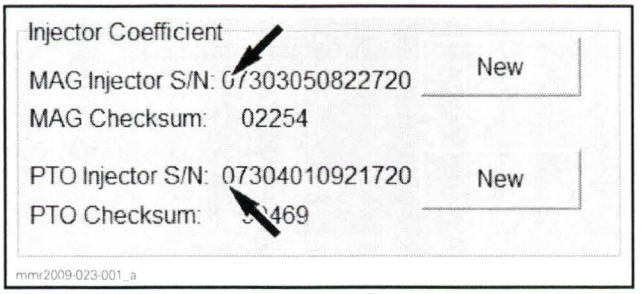
8. In the **Vehicle** page tab, record the following information:
   - Engine number (without the leading "M")
   - Customer name.

NOTE: It is not necessary to record the vehicle (VIN) and model numbers. They will be transferred later.

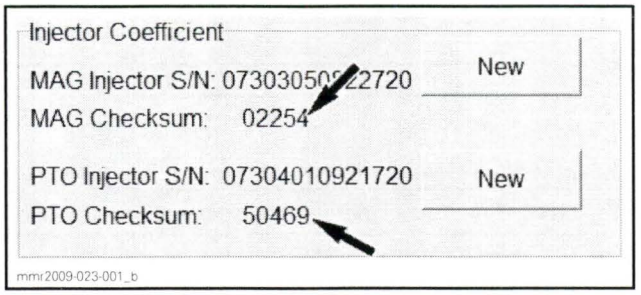
9. Select the **ECM** and **Setting** page tabs and record the following information:
   - Ignition/Injection timing: Offset angle
   - Oil compensation: Oil pump code
   - Fuel injector coefficients: MAG/PTO injectors S/N and Checksums.



ECM SETTING PAGE



FUEL INJECTOR SERIAL NUMBER (S/N)

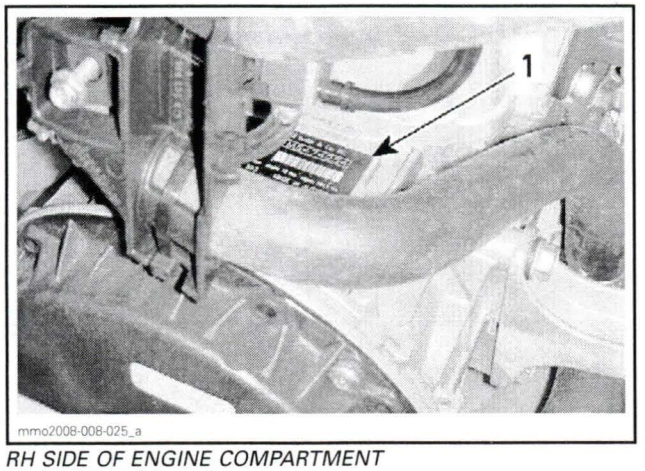


FUEL INJECTOR CHECKSUM (CS)

10. Enter data in ECM as detailed in *ENTERING THE COLLECTED INFORMATION INTO THE ECM* in this subsection.

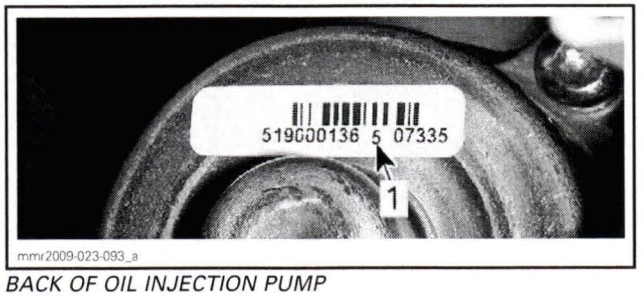
2nd Collecting Method: Collect the Information from the Vehicle

1. Record engine serial number.



RH SIDE OF ENGINE COMPARTMENT
1. Engine serial number

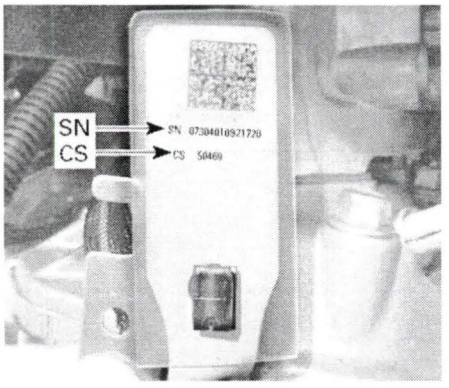
2. Record oil injection pump code.



BACK OF OIL INJECTION PUMP
1. Oil pump code (0 to 9)

3. Record MAG/PTO injector S/N and Checksum numbers.

Record the serial number (SN) and the checksum (CS) on the fuel injector tag.



SN: Serial number
CS: Checksum number

Use BOSSWeb to get the matching calibration file.

Save the calibration file to your PC computer in the folder:

C:\Program Files\BRP\BUDSCommon\InjectorCoefficients.

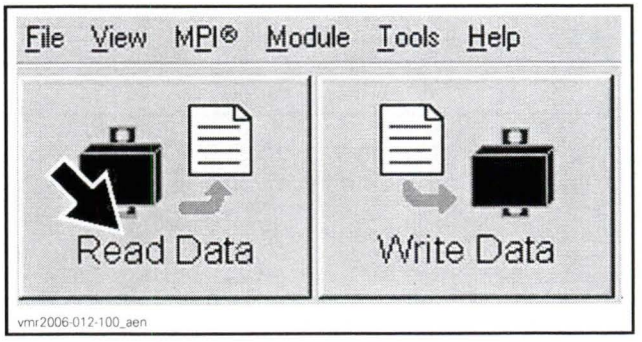
Enter data in ECM as detailed in *ENTERING THE COLLECTED INFORMATION INTO THE ECM* in this subsection.

Entering the Collected Information Into the ECM

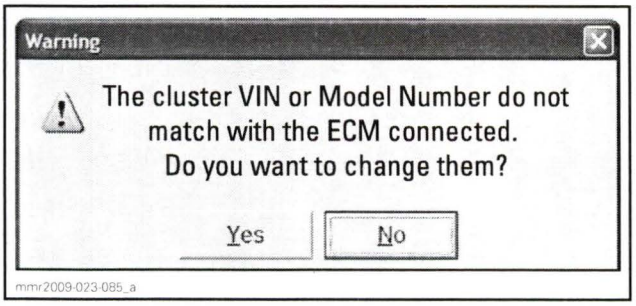
1. Ensure B.U.D.S. is properly connected to the vehicle and logged on.

NOTE: The beeper will continuously sound a sequence of 11 beeps meaning that the D.E.S.S. key is not programmed. To stop the beeps, remove key.

2. In B.U.D.S., click the **Read Data** button to read the new "empty" ECM.



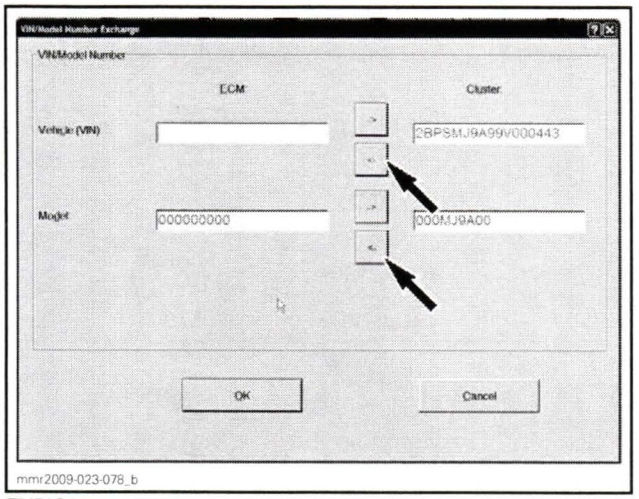
Then, a message will appear saying that the cluster (multifunction gauge) does not recognize the ECM.



3. Click **Yes**.

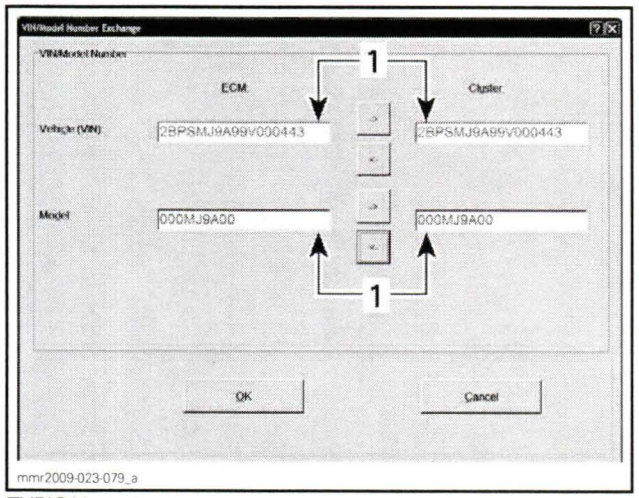
NOTE: If the numbers are not matched, the gauge will stop operating within 10 seconds of engine operation. Only its D.E.S.S. LED will be turned ON.

4. Click on the arrows to transfer the numbers from the **Cluster** column to the **ECM** column.



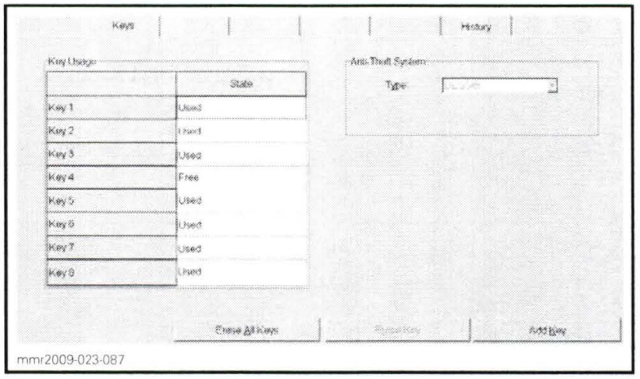
TYPICAL

Ensure the **VIN** and **Model** numbers in the ECM and cluster are exactly matched.

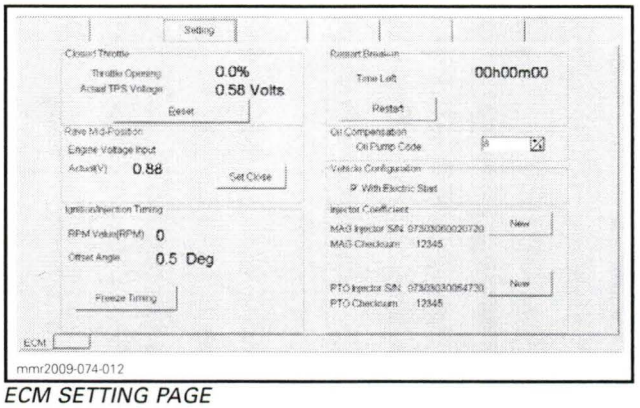


TYPICAL
1. Matching numbers

5. On the **Vehicle** page, enter the information you recorded previously:
   - Engine number (do not enter the leading "M")
   - Customer name.
6. In the **Keys** page tab, select **Erase All Keys**.



7. Program the desired key(s). Refer to *D.E.S.S. SYSTEM* subsection.
8. Select the **ECM** and **Setting** page tabs.

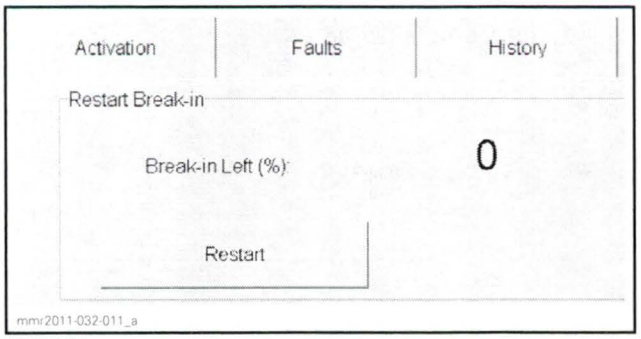


ECM SETTING PAGE

9. Reset the **Closed Throttle** setting as detailed in *CLOSED THROTTLE RESET (TPS)* in this subsection.

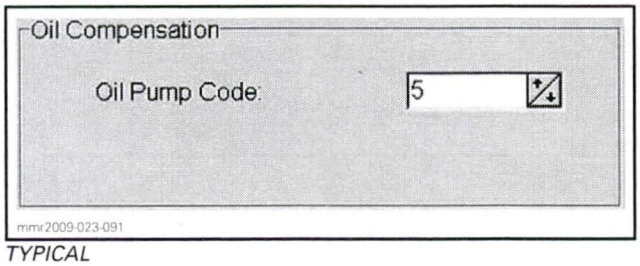
NOTICE **The Closed Throttle Reset must be carried out as described in the specific procedure or engine damage may occur.**

10. Carry the **3D Rave Valves Position Sensor Setting**. Refer to *ENGINE (600 HO E-TEC)* section, *RAVE* subsection.
11. Set the **Ignition/Injection Timing**. Refer to *IGNITION SYSTEM (600 HO E-TEC)* subsection.
12. **Restart Break-In**. Click **Restart** button if the actual engine hours are less than 5 hours.



TYPICAL

13. **Oil Compensation**. Enter the previously recorded **Oil Pump Code**.



TYPICAL

14. MAG and PTO fuel injector S/N.
    - 14.1 If the data was obtained from a saved .mpem file, refer to table A.
    - 14.2 If the fuel injector calibration file was obtained from BOSSWeb, refer to table B.

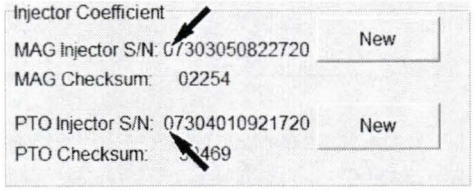
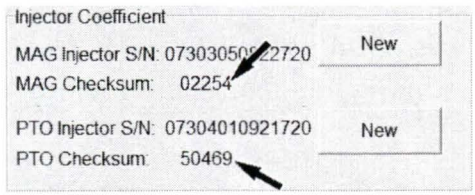
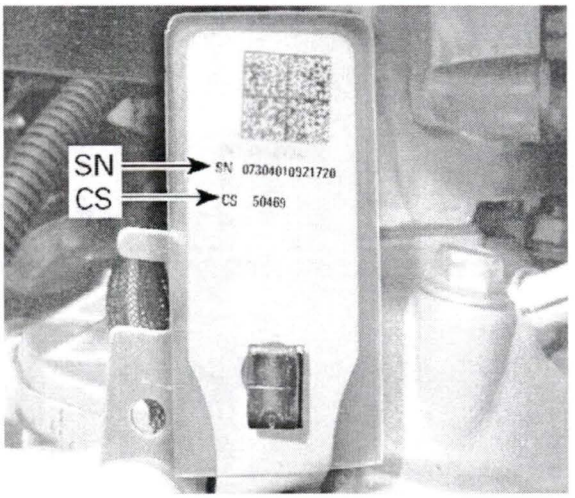
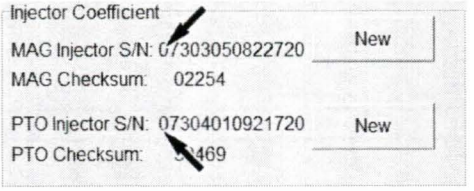
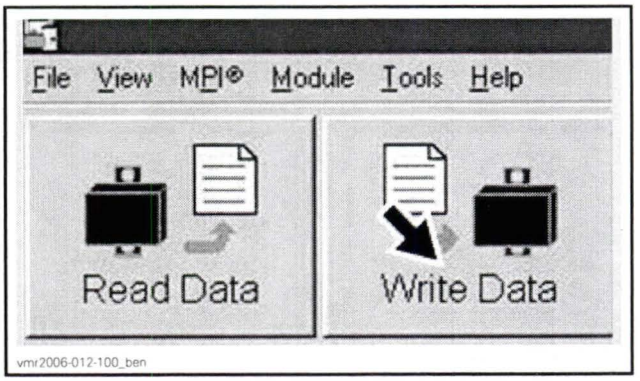
TABLE A (DATA FROM A SAVED .MPEM FILE)
Click on the **New** button and open the file that matches the previously recorded serial number.

Ensure the PTO and MAG side injector S/N correctly match those on the engine.
Once the file has been read, ensure the checksum number (CS) displayed in B.U.D.S. matches the CS previously recorded.

If the numbers do not match, the wrong file was read. Repeat the procedure to record the correct file.

TABLE B (CALIBRATION FILE FROM BOSSWEB)
Click on the **New** button and open the file that you previously saved on your PC computer in the folder: **C:\Program Files\BRP\BUDSCommon\InjectorCoefficient**
Ensure to correctly match the PTO and MAG side injector serial numbers.
Once the file has been read, ensure the fuel injector tag SN and CS matches those shown in B.U.D.S.
 SN: Serial Number CS: Checksum number

If the numbers do not match, the wrong file was read. Repeat the procedure to record the correct file.

15. Click on the **Write Data** button to save the data to the ECM.



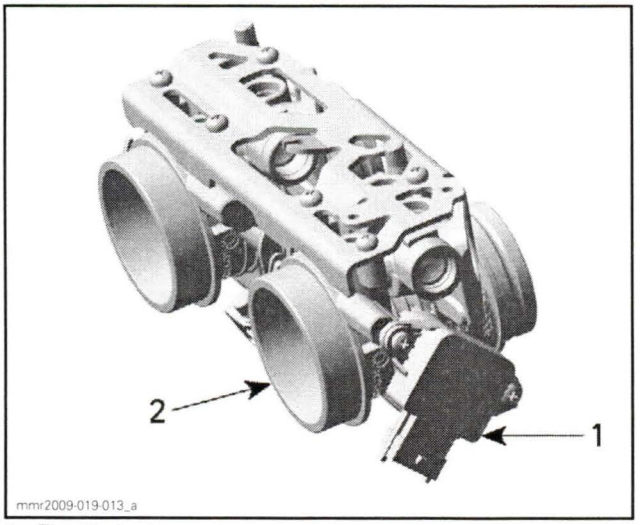
16. Lift rear of vehicle and safely support.

17. Start the engine and increase engine speed above 6000 RPM to be sure no fault codes appear.
18. Let engine idle to ensure idle is adequate.

If engine does not run as expected, ensure that the fuel injector calibration files are valid. Check with the tag of the fuel injectors installed on the engine.

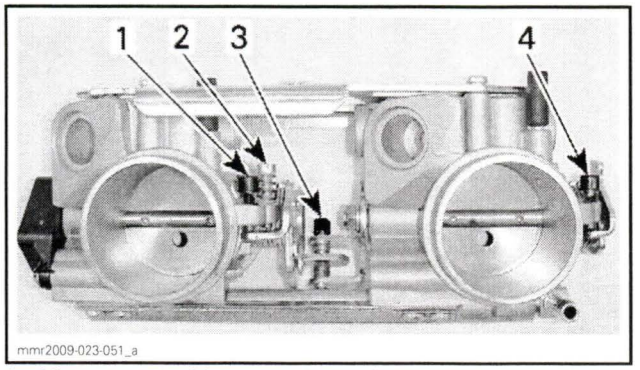
19. Reinstall remaining removed parts.

THROTTLE BODY



1. Throttle body
2. TPS (Throttle Position Sensor)

Throttle Body Screw Identification



1. Master zero position screw (capped)
2. Idle screw
3. Synchronizing screw (capped)
4. Slave zero position screw (capped)

NOTICE Do not tamper with any capped screw, otherwise the throttle body may have to be replaced.

Throttle Body Inspection

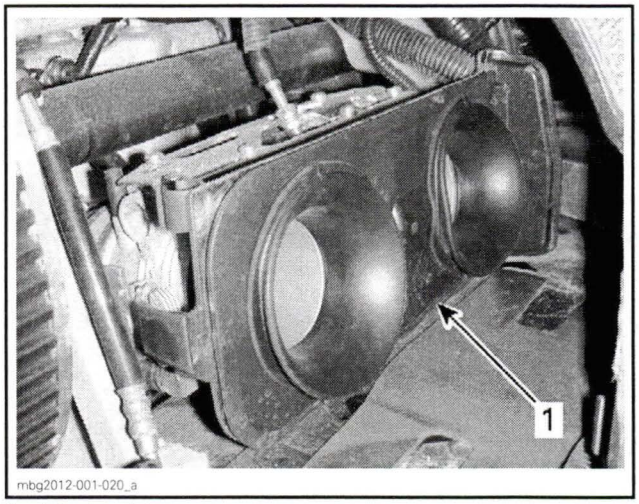
- Ensure throttle plates move freely and smoothly when depressing throttle lever.
- Ensure throttle body master zero position screw is **NOT** loose. If so, replace throttle body.
- Ensure TPS is **NOT** loose.
- Check for corroded or damaged wiring or connectors.

Throttle Body Removal

⚠ WARNING

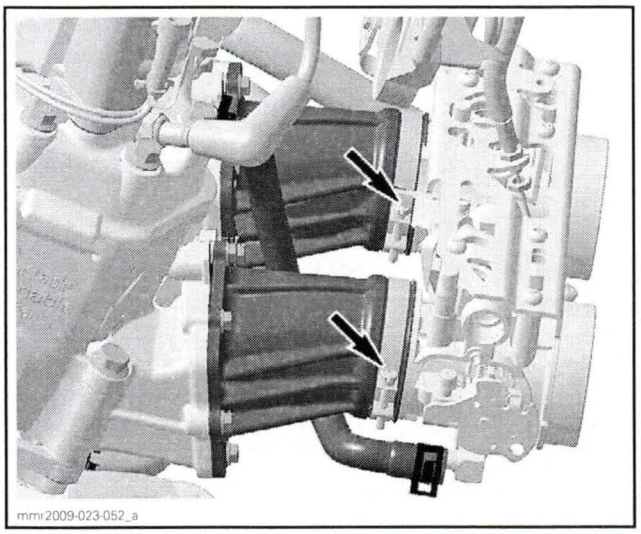
Always remove tether cord cap (D.E.S.S. key) and disconnect battery before removing the throttle body.

1. Remove drive belt guard. Refer to *DRIVE BELT* subsection.
2. Remove primary air intake silencer. Refer to *ENGINE (600 HO E-TEC)* section, *AIR INTAKE SYSTEM* subsection.
3. Remove adapter plate from throttle body.

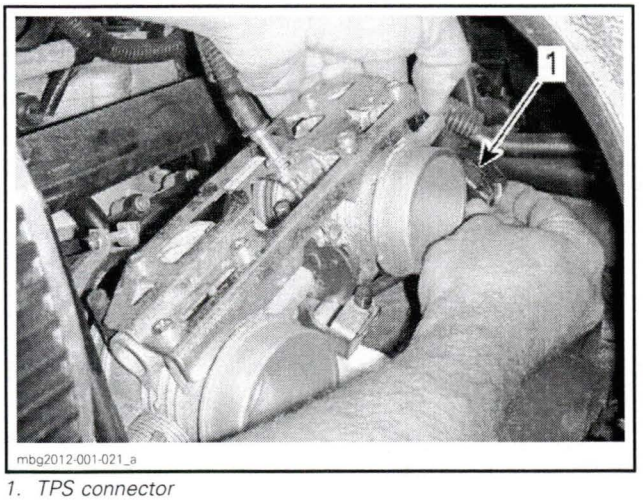


1. Adapter plate

4. Loosen clamps retaining throttle body.

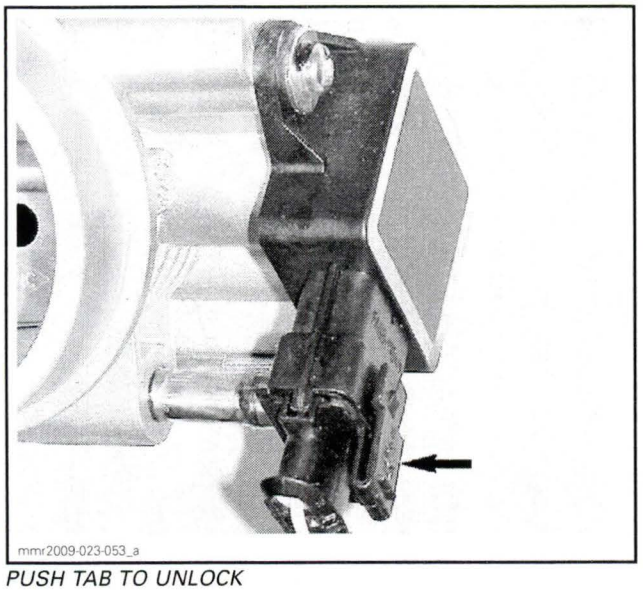

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5. Pull out throttle body sufficiently to access coolant hoses and TPS connector.
6. Disconnect TPS connector.



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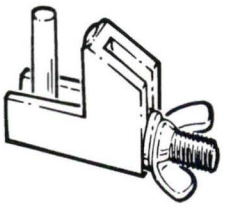
1. TPS connector

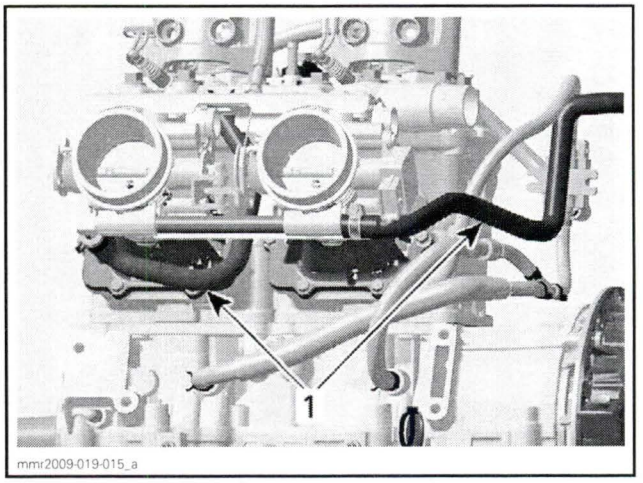

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PUSH TAB TO UNLOCK

7. Install a small hose pincher on coolant hoses connected to throttle body.

REQUIRED TOOL
SMALL HOSE PINCHER (P/N 295 000 076)

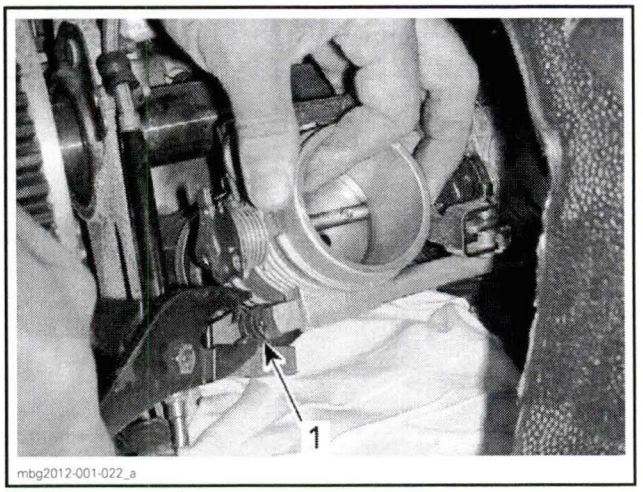




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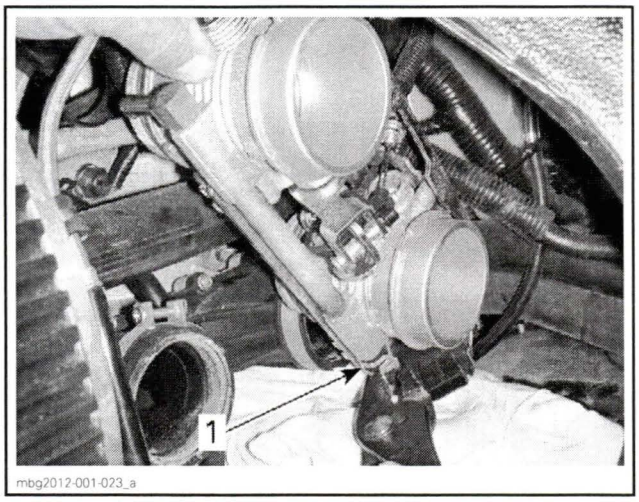
1. Install hose pinchers here

8. Remove coolant hoses from throttle body.



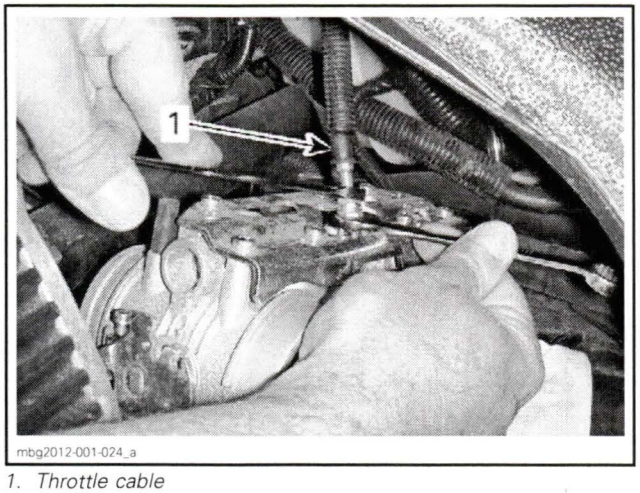
mbg2012-001-022_a

1. Coolant hose clamp to remove



1. Coolant hose clamp to remove

9. Disconnect throttle cable.



1. Throttle cable

10. Remove throttle body from vehicle.

Throttle Body Installation

1. If installing the removed throttle body, clean throttle plates and bores using PULLEY FLANGE CLEANER (P/N 413 711 809) before installation.
2. Install cooling hoses on throttle body.
3. Remove hose pinchers.
4. Connect TPS connector.

NOTICE Ensure TPS connector tab is properly locked.

5. Install throttle body on intake adapters.
6. Tighten throttle body clamps to specification.

TIGHTENING TORQUE	
Throttle body clamps	1.0 N•m ± 0.2 N•m (9 lbf•**in** ± 2 lbf•**in**)

7. Install throttle cable loosely.
8. Carry out the *THROTTLE CABLE ADJUSTMENT* as detailed in this subsection.
9. If a new throttle body or TPS is installed, carry out the *CLOSED THROTTLE RESET (TPS)* as detailed in this subsection.
10. Refill engine coolant.

NOTE: If an important quantity of coolant was spilled, bleed cooling system. Refer to *ENGINE (600 HO E-TEC)* section, *COOLING SYSTEM* subsection.

11. Install adapter plate (primary air intake silencer) on throttle body.

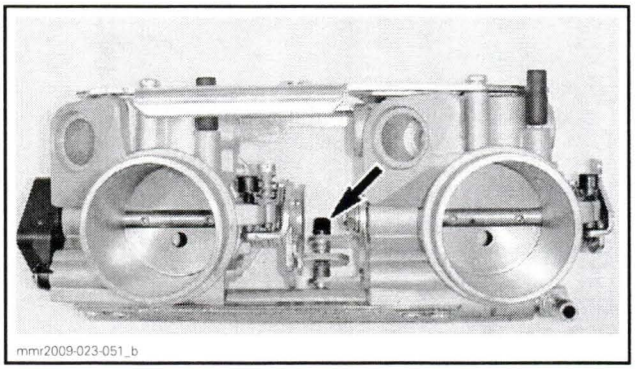
TIGHTENING TORQUE	
Adapter plate clamps	0.7 N•m ± 0.2 N•m (6 lbf•**in** ± 2 lbf•**in**)

12. Install primary air intake silencer, refer to *ENGINE (600 HO E-TEC)* section, *AIR INTAKE SYSTEM* subsection.
13. Install all remaining removed parts.

Throttle Body Synchronization

No synchronization is required as it has already been done at the factory.

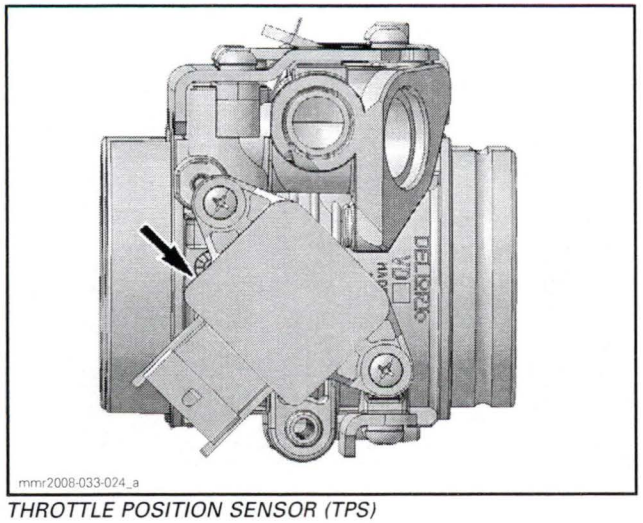
NOTICE Do not alter synchronization screw setting, otherwise the throttle body must be replaced.



THROTTLE POSITION SENSOR (TPS)

Description

The throttle position sensor (TPS) is a potentiometer that sends a signal to the ECM that is proportional to the throttle plate angle.



THROTTLE POSITION SENSOR (TPS)

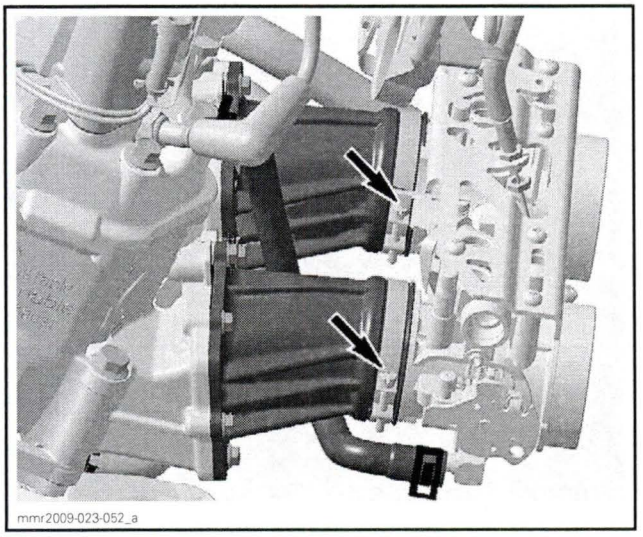
TPS Connector Access

1. Remove drive belt guard. Refer to *DRIVE BELT* subsection.
2. Remove primary air intake silencer. Refer to *ENGINE (600 HO E-TEC)* section, *AIR INTAKE SYSTEM* subsection.

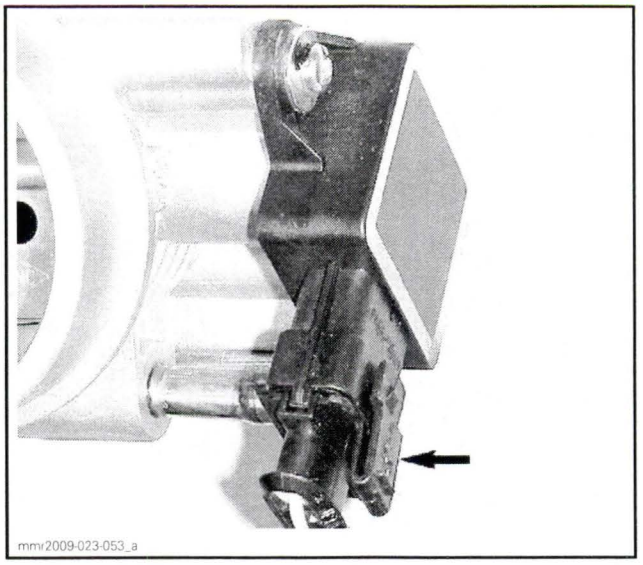
⚠ WARNING

Always remove tether cord cap (D.E.S.S. key) and disconnect battery before removing the throttle body.

3. Loosen clamps retaining throttle body.

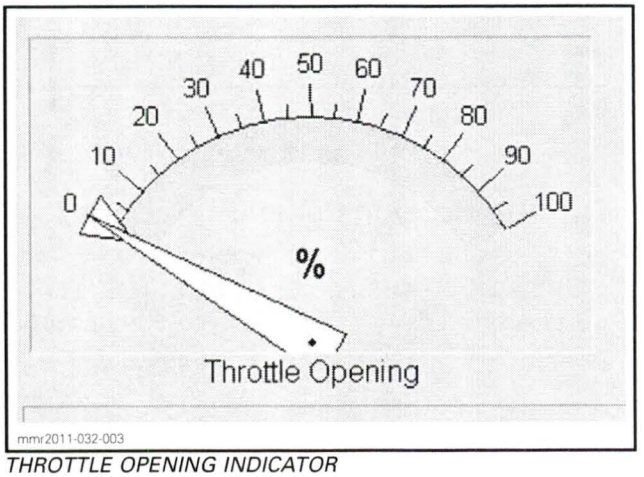


4. Pull out throttle body to access TPS connector.
5. Disconnect TPS connector.



TPS Wear Test

1. Ensure TPS connector is properly connected.
2. While engine is not running, activate throttle and pay attention for smooth operation without physical stops of the cable.
3. Connect vehicle to the applicable B.U.D.S. software.
4. Select the **Monitoring** and **ECM** page tabs.
5. Monitor the TPS using the **Throttle Opening** indicator.



THROTTLE OPENING INDICATOR

6. Slowly and regularly depress the throttle and observe the needle movement. The needle must change gradually and regularly as the throttle is activated.

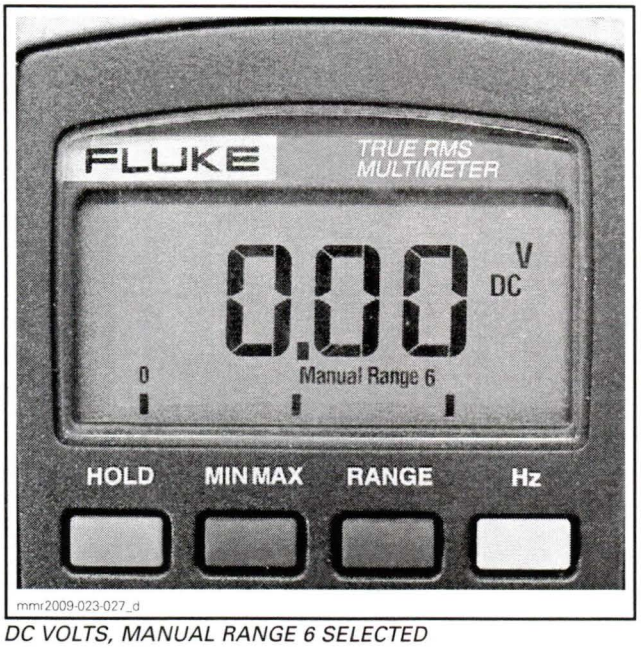
NOTE: If the needle "sticks", bounces, suddenly drops off, or if any discrepancy between the throttle movement and the needle movement is noticed, it indicates a worn TPS that needs to be replaced.

TPS Reset (Closed Throttle)

Refer to *CLOSED THROTTLE RESET (TPS)* in the *ADJUSTMENT* topic of this subsection.

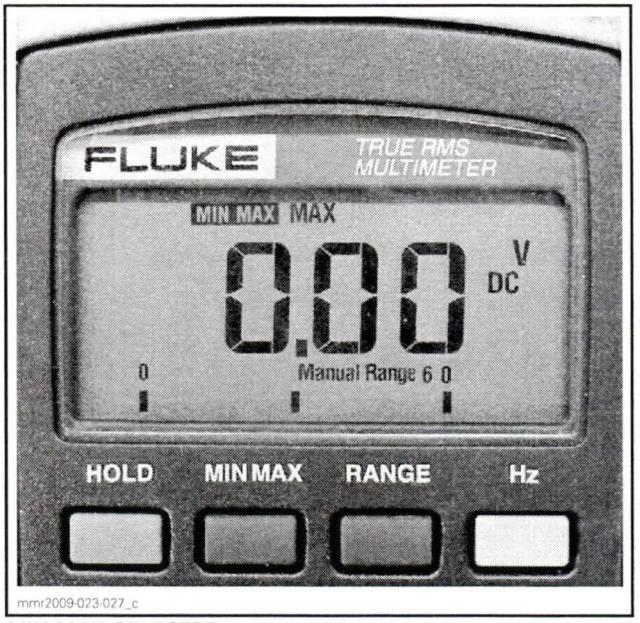
TPS Input Voltage Test

1. Remove parts required for access to the TPS connector, refer to *TPS CONNECTOR ACCESS* in this subsection.
2. Check the voltage output from the ECM to the throttle position sensor.
3. Disconnect TPS connector.
4. Use the FLUKE 115 MULTIMETER (P/N 529 035 868) and set it to Vdc.
5. Repeatedly press the **RANGE** button until the display shows **Manual Range 6**.



DC VOLTS, MANUAL RANGE 6 SELECTED

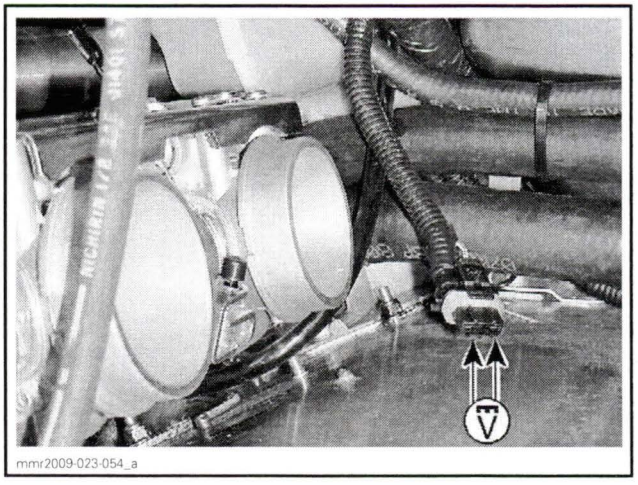
6. Press the **MIN MAX** button so that the display shows **MIN MAX**.



MIN MAX SELECTED

7. Crank engine.
8. Read voltage at TPS harness connector as follows.

TPS HARNESS CONNECTOR		VOLTAGE
Pin 1	Pin 2	5.0 Vdc



9. Read the MAX value.

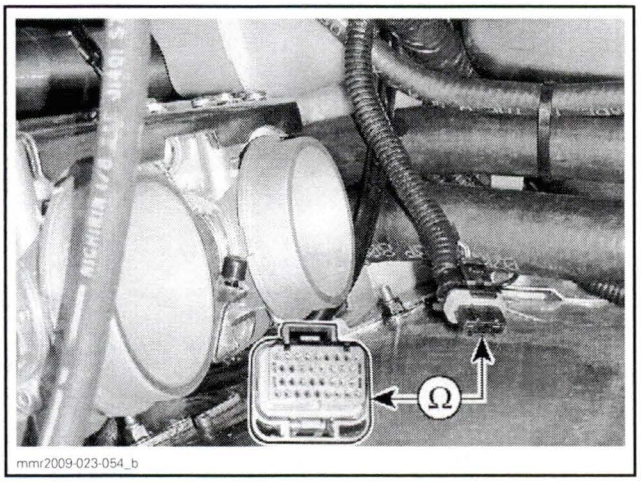
NOTE: Reset multimeter by pressing and holding **MIN MAX** button until meter beeps.

If voltage is good, carry out the *TPS SIGNAL WIRE TEST* in this subsection.

TPS Signal Wire Test

1. Disconnect J1A connector from ECM, refer to *CONNECTOR INFORMATION* subsection.
2. Check the wiring continuity as follows.

TPS HARNESS CONNECTOR	ECM J1A CONNECTOR	RESISTANCE
Pin 3	Pin 18	Close to 0 Ω (continuity)



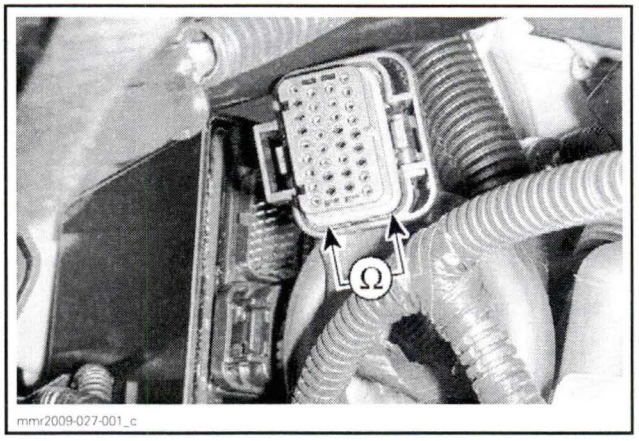
If tests are good, replace the TPS.

If tests are not good, continue to check the resistance of the remainder of the TPS circuit.

TPS Resistance Test

1. Reconnect the TPS connector.
2. Disconnect the J1A connector from the ECM.
3. Using the FLUKE 115 MULTIMETER (P/N 529 035 868), check resistance value as per following table.

ECM CONNECTOR		THROTTLE IDLE POSITION	WIDE OPEN THROTTLE POSITION
PIN		RESISTANCE Ω	
J1A-18	J1A-26	1000	2500
J1A-26	J1A-10	1600 - 2400	1600 - 2400
J1A-18	J1A-10	2500	1000



NOTE: The resistive value should change smoothly and proportionally to the throttle movement. Otherwise, replace TPS.

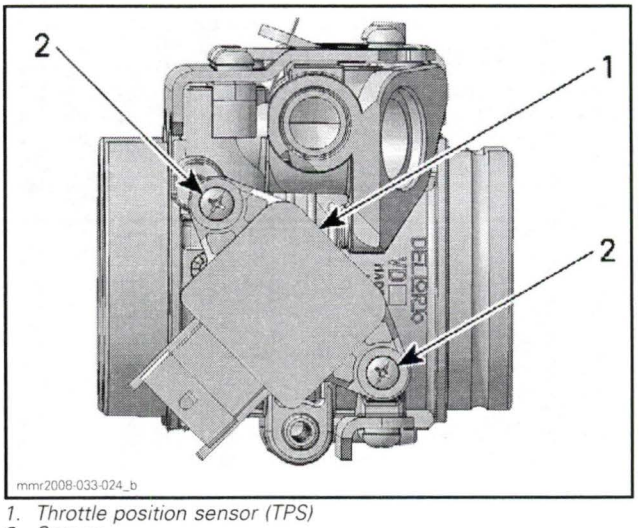
If resistive values are correct, try a new ECM. Refer to *ENGINE CONTROL MODULE (ECM)* in this subsection.

If resistive values are incorrect:

- Repair/replace wiring/connectors
- Replace TPS.

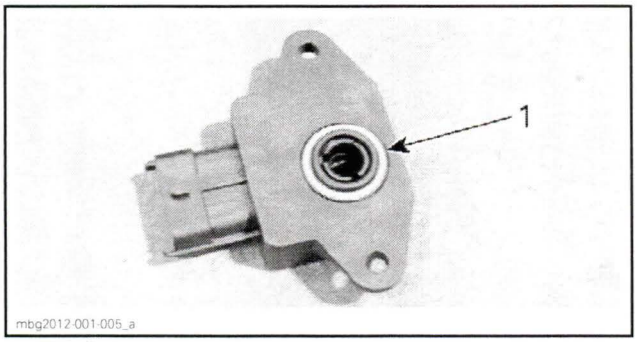
TPS Replacement

1. Remove the throttle body, refer to *THROTTLE BODY REMOVAL* in this subsection.
2. Remove TPS retaining screws.



1. Throttle position sensor (TPS)
2. Screws

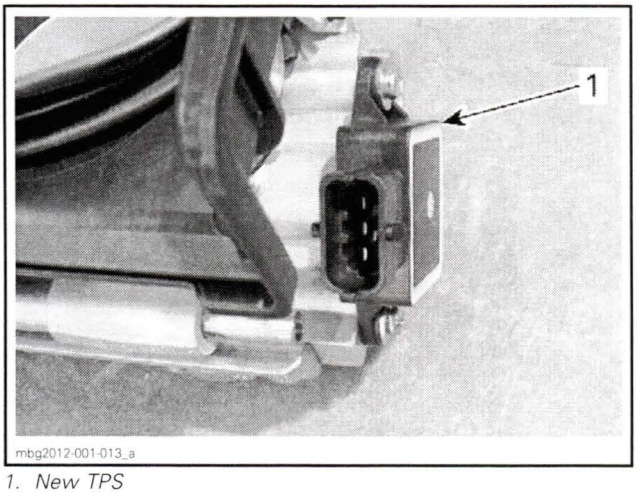
3. Remove TPS.
4. Ensure O-ring is still positioned on TPS after removal.



1. TPS O-ring

NOTE: If O-ring is missing, remove it from throttle body shaft.

5. Install new TPS.

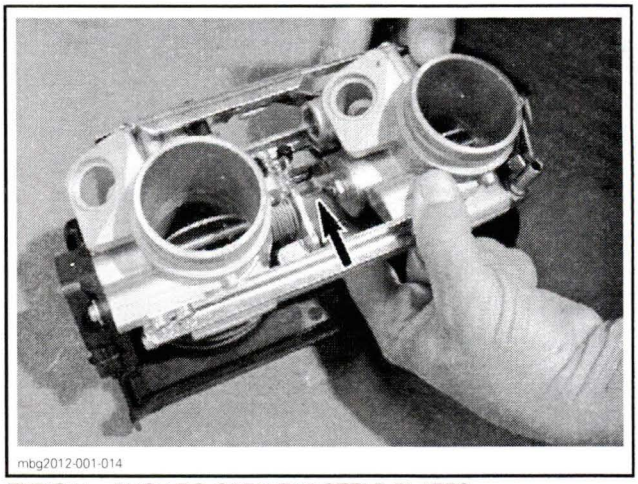


1. New TPS

6. Tighten TPS retaining screws to specification.

TIGHTENING TORQUE	
TPS retaining screws	2.0 N•m ± 0.4 N•m (18 lbf•**in** ± 4 lbf•**in**)

7. Open and quickly release throttle plates 6 times (throttle plates must snap shut).



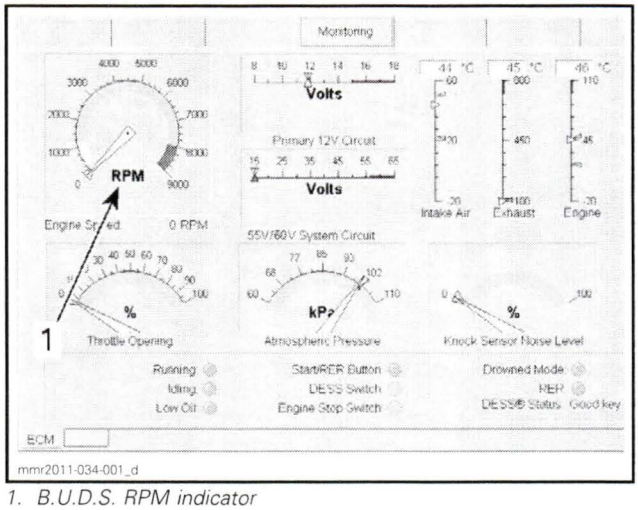
TYPICAL - PUSH TO OPEN THROTTLE PLATES

8. Reinstall remaining removed parts.
9. Reset TPS, refer to *CLOSED THROTTLE RESET (TPS)* in this subsection.

CPS (CRANKSHAFT POSITION SENSOR)

CPS Test with B.U.D.S.

1. Connect vehicle to the latest applicable B.U.D.S. version.
2. In B.U.D.S., select the **Monitoring** and **ECM** page tabs.
3. Monitor the **Engine Speed** (RPM) indicator while cranking engine.



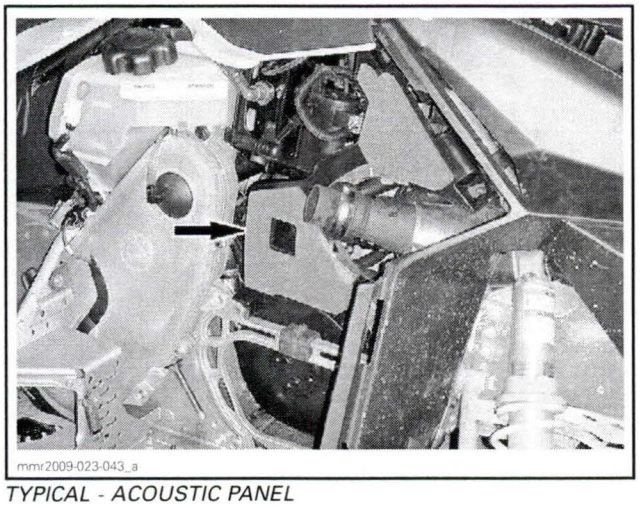
1. B.U.D.S. RPM indicator

The needle should move proportionally to the cranking RPM. If no needle movement is observed, carry out the *CPS OUTPUT VOLTAGE TEST* in this subsection.

NOTE: A loose CPS or CPS connector can send an intermittent signal that can prevent the engine from starting.

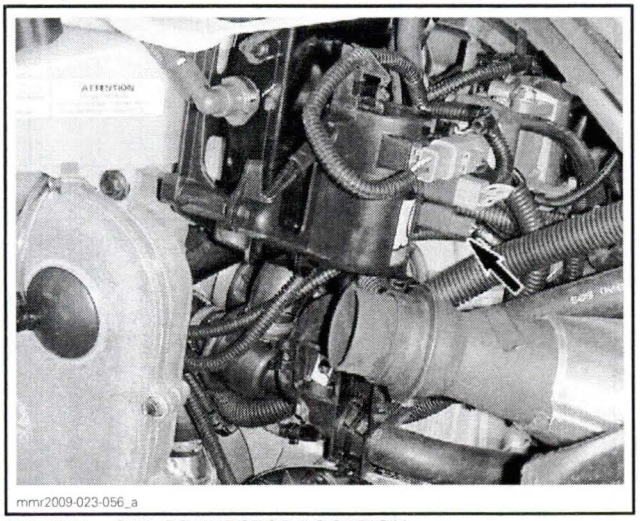
CPS Output Voltage Test

1. Remove muffler. Refer to *ENGINE (600 HO E-TEC)* section, *EXHAUST SYSTEM* subsection.
2. Remove the acoustic panel.



TYPICAL - ACOUSTIC PANEL

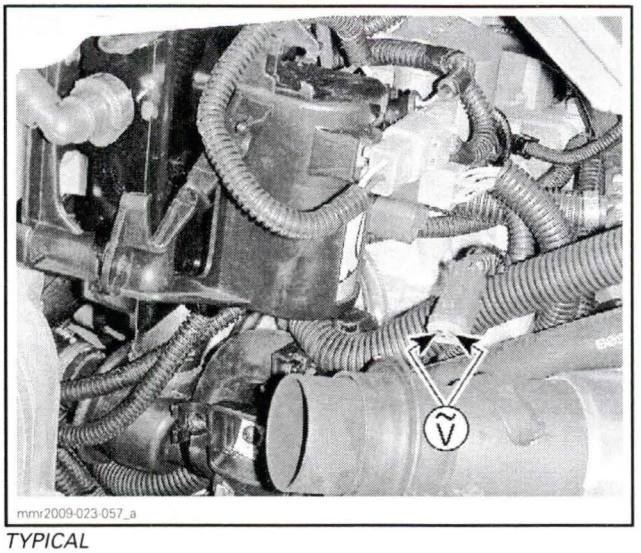
3. Disconnect CPS connector.



TYPICAL - CPS CONNECTOR LOCATION

4. Probe terminals coming from CPS while cranking engine.

CPS CONNECTOR		VOLTAGE
Pin 1	Pin 2	1 - 2 Vac min.



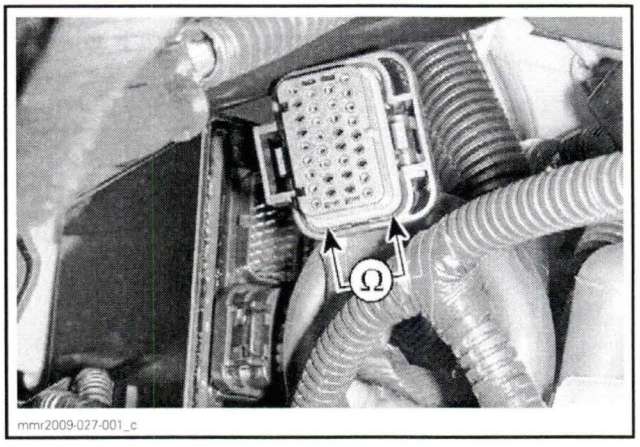
TYPICAL

If voltage is out of specification, inspect wiring/connectors. Replace CPS if wiring is good.

CPS Resistance Test

1. Disconnect connector J1A from ECM.
2. Measure the resistance of the sensor itself.

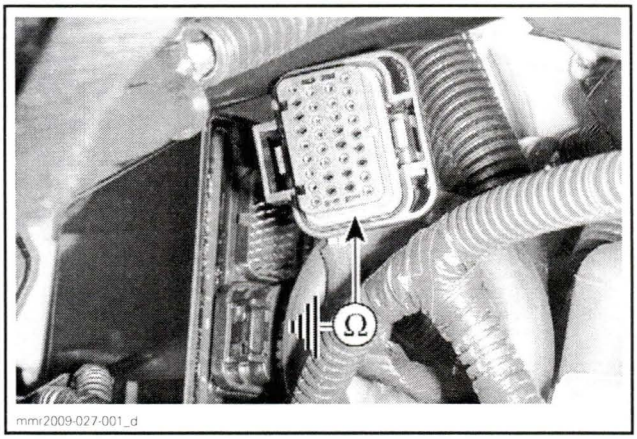
ECM J1A CONNECTOR		RESISTANCE @ 20°C (68°F)
Pin 6	Pin 7	190 - 290 Ω



If measurement is out of specification, check wiring continuity between ECM and CPS. If continuity is good, replace CPS.

3. Check for a bad ground connection as follows.

ECM J1A CONNECTOR		RESISTANCE @ 20°C (68°F)
Pin 6	Engine ground	Open circuit (OL)
Pin 7	Engine ground	



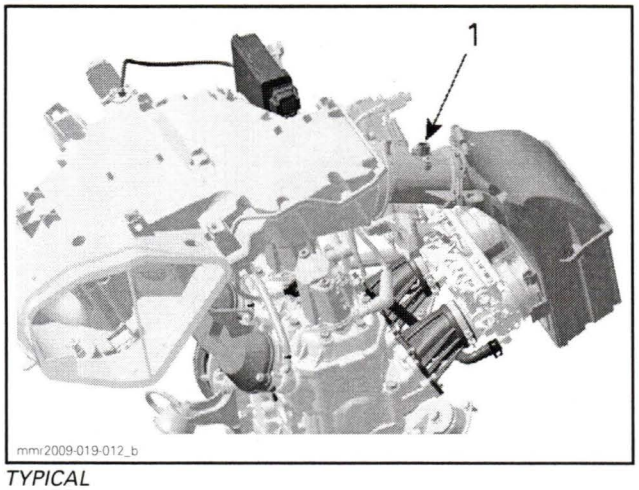
If measurement is out of specification, check wiring between ECM and CPS.

CPS Replacement

Refer to *MAGNETO SYSTEM (600 HO E-TEC)* subsection.

AIR TEMPERATURE SENSOR (ATS)

ATS Location



TYPICAL
1. ATS location

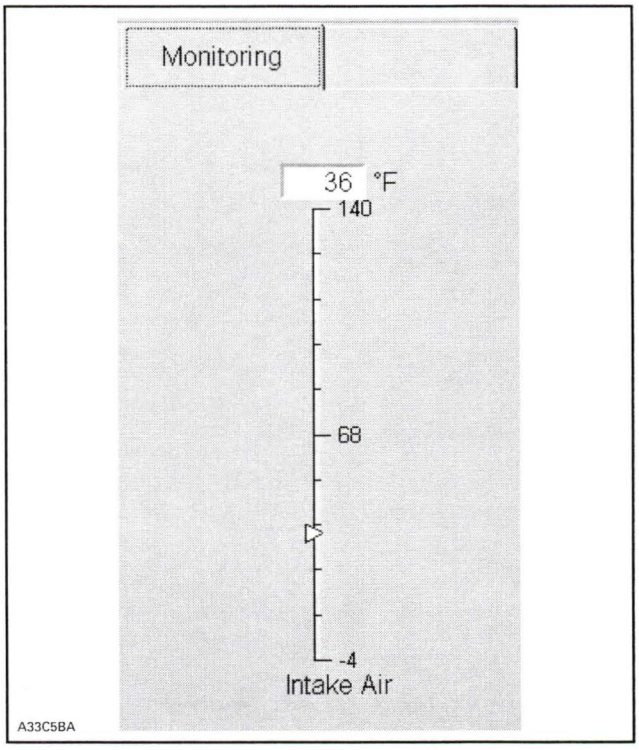
ATS Access

Remove drive belt guard. Refer to *DRIVE BELT* subsection.

Remove primary air intake silencer. Refer to *ENGINE (600 HO E-TEC)* section, *AIR INTAKE SYSTEM* subsection.

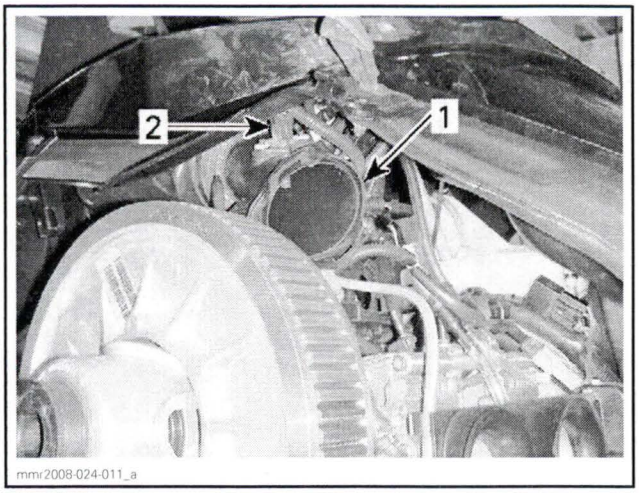
ATS Test with B.U.D.S.

1. Connect vehicle to latest applicable B.U.D.S. version.
2. Select the **Monitoring** and **ECM** page tabs.
3. Monitor the **Intake Air** temperature indicator. It should indicate ambient temperature. Otherwise, perform the *ATS RESISTANCE TEST* in this subsection.



ATS Connector Access

1. Remove drive belt guard. Refer to *DRIVE BELT* subsection.
2. Remove primary air intake silencer. Refer to *ENGINE (600 HO E-TEC)* section, *AIR INTAKE SYSTEM* subsection.
3. Rotate intake adapter to disconnect ATS sensor connector.

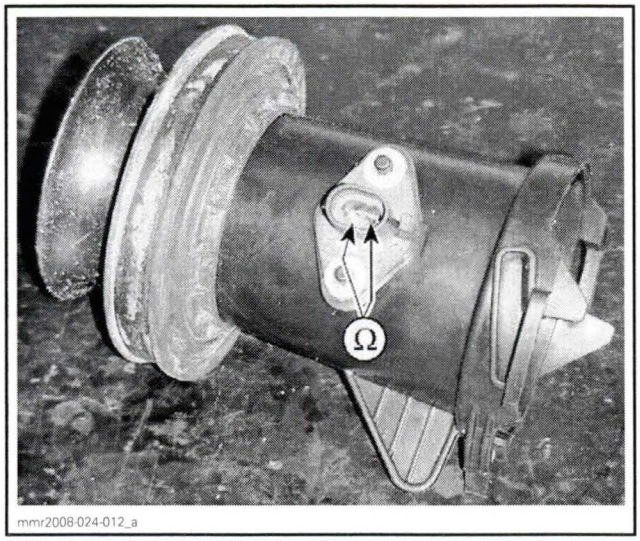


TYPICAL
1. *Rotate intake adapter*
2. *Disconnect sensor connector*

ATS Resistance Test

1. Remove parts required for access to ATS connector, refer to *ATS CONNECTOR ACCESS* in this subsection.
2. Measure sensor resistance.

ATS		MEASUREMENT
Pin 1	Pin 2	Refer to *SENSOR TEMPERATURE TABLE* below



INTAKE ADAPTER REMOVED FOR CLARITY PURPOSE ONLY

SENSOR TEMPERATURE TABLE		
TEMPERATURE		RESISTANCE (ohms)
°C	°F	ATS
- 40	- 40	43610
- 30	- 22	25090
- 20	- 4	14900
- 10	14	9102
0	32	5705
10	50	3680
20	68	2436
25	77	2000
30	86	1651
40	104	1144
50	122	808
60	140	580
70	158	424
80	176	316
90	194	238
100	212	182
110	230	141
120	248	111
130	266	88
140	284	70
150	302	57
160	320	47
170	338	39
180	356	32
190	374	27
200	392	23

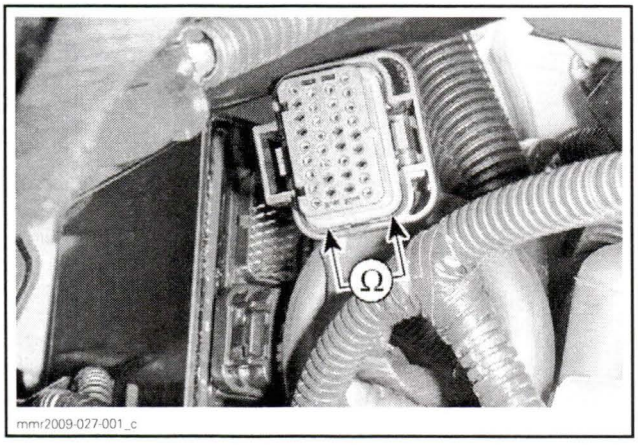
If resistance is out of specifications, replace sensor.

If resistance tests good, carry out the following steps.

3. Reconnect the ATS connector.
4. Disconnect the J1A connector from ECM.
5. Using the FLUKE 115 MULTIMETER (P/N 529 035 868), measure sensor circuit resistance value as follows.

IMPORTANT: Move wiring harness back and forth near the sensor connector while measuring the resistance. If the resistance value varies as the harness is moved, check sensor connections.

J1A CONNECTOR		MEASUREMENT
Pin J1A-20	Pin J1A-27	Refer to *SENSOR TEMPERATURE TABLE* above

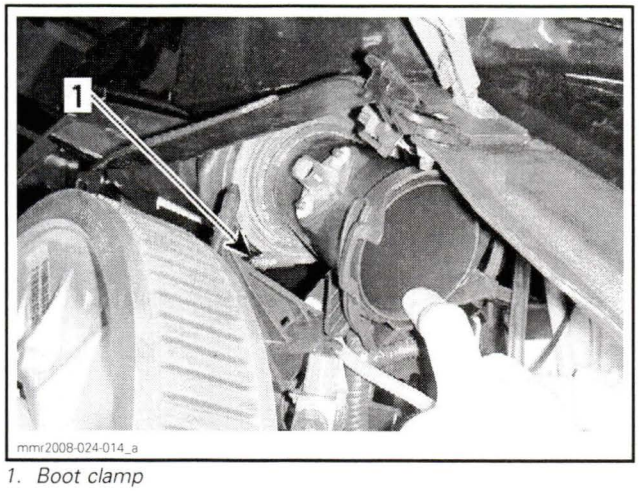


If resistance value is incorrect, repair the connectors or replace the wiring harness between ECM connector and the ATS.

6. Reinstall removed parts. Ensure intake adapter boot is properly installed on the adapter. See below in *ATS REPLACEMENT* in this subsection.

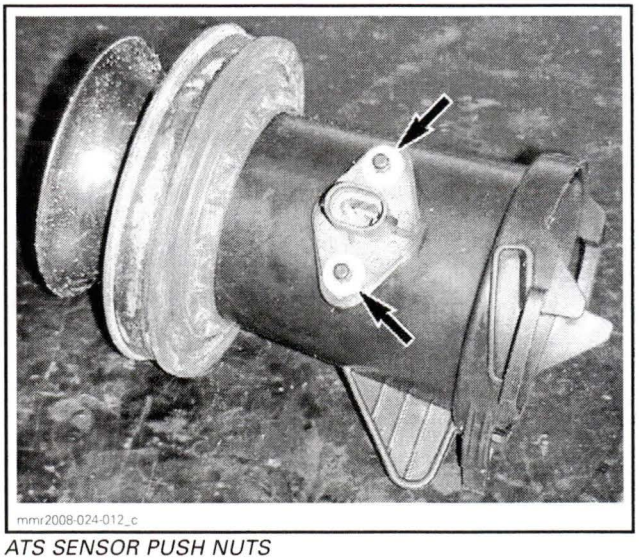
ATS Replacement

1. Remove parts required for access to ATS, refer to *ATS ACCESS* in this subsection.
2. Loosen clamp retaining adapter boot seal.



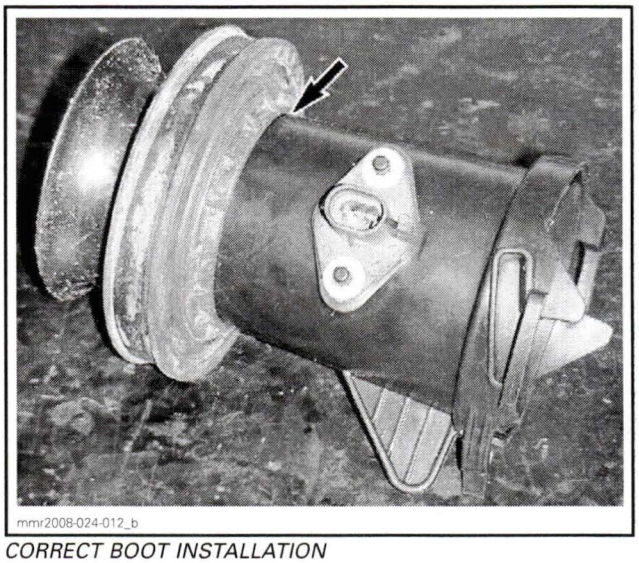
1. Boot clamp

3. Disconnect ATS connector.
4. Pull out intake adapter.
5. Remove sensor push nuts.

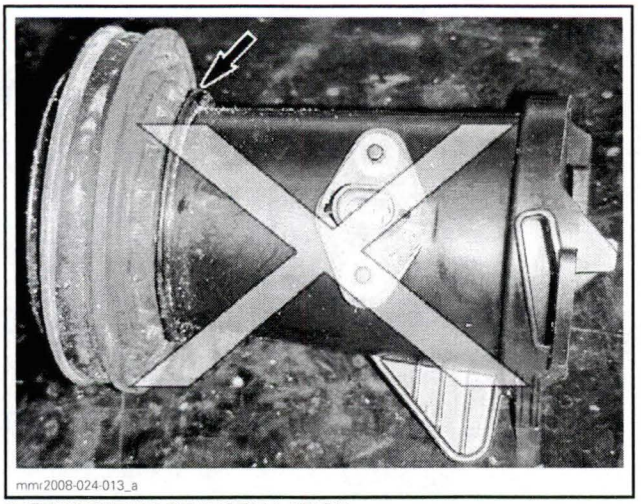


ATS SENSOR PUSH NUTS

6. Pull out sensor.
7. Using new push nuts, secure the new sensor to the adapter.
8. Reconnect ATS.
9. Ensure adapter boot is properly installed as shown.



CORRECT BOOT INSTALLATION



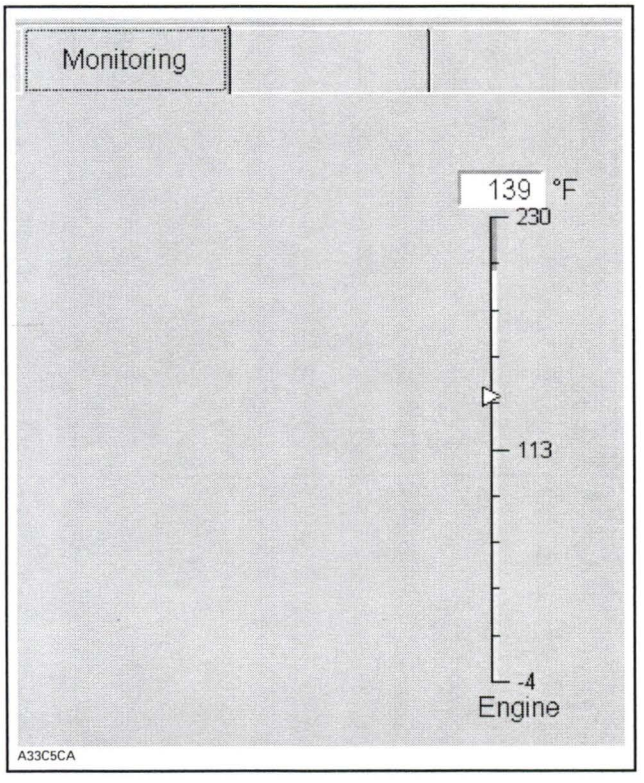
INCORRECT BOOT INSTALLATION

10. Reinstall removed parts.

COOLANT TEMPERATURE SENSOR (CTS)

CTS Test with B.U.D.S.

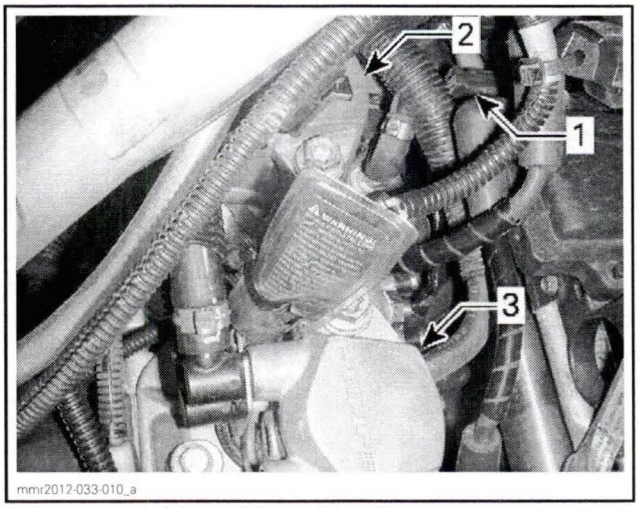
1. Connect vehicle to applicable B.U.D.S.
2. Select the **ECM** and **Monitoring** page tabs.
3. Monitor the **Engine** indicator. It should show the coolant temperature. Otherwise, perform the *CTS RESISTANCE TEST* in this subsection.



CTS Connector Access

Remove drive belt guard. Refer to *DRIVE BELT* subsection.

Remove primary air intake silencer. Refer to *ENGINE (600 HO E-TEC)* section, *AIR INTAKE SYSTEM* subsection.

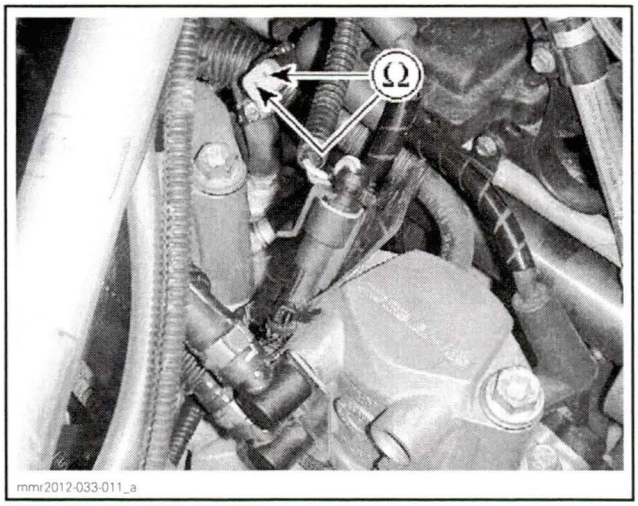


TYPICAL - CTS CONNECTOR LOCATION
1. *CTS connector*
2. *MAG fuel injector*
3. *PTO fuel injector*

CTS Resistance Test

1. Disconnect CTS sensor connector, refer to *CTS CONNECTOR ACCESS* in this subsection.
2. Use the FLUKE 115 MULTIMETER (P/N 529 035 868) and set it to Ω.
3. Measure resistance between sensor terminals.

CTS		MEASUREMENT
Pin 1	Pin 2	Refer to *CTS SENSOR TEMPERATURE TABLE (E-TEC)*



CTS RESISTANCE CHECK

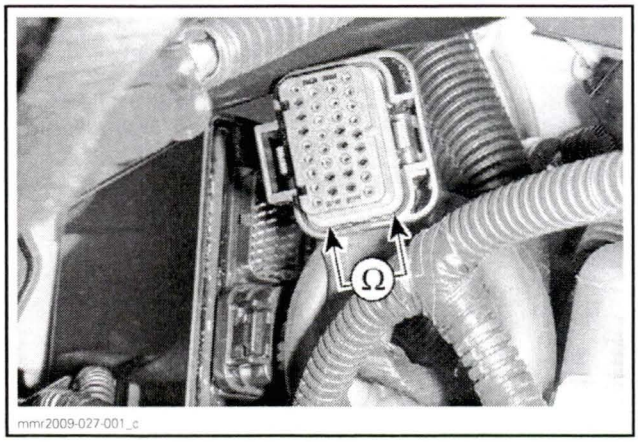
CTS SENSOR TEMPERATURE TABLE (E-TEC)		
TEMPERATURE		RESISTANCE (ohms)
°C	°F	CTS
- 40	- 40	72412
- 30	- 22	38681
- 20	- 4	21529
- 10	14	12431
0	32	7418
10	50	4582
20	68	2919
30	86	1912
40	104	1284
50	122	883
60	140	622
70	158	448
80	176	328
90	194	245
100	212	186
110	230	143
120	248	112
130	266	88
135	275	79
140	284	71
145	293	64
150	302	57

If resistance is out of specifications, replace CTS.

If resistance tests good, carry out the following steps.

4. Reconnect the CTS.
5. Disconnect the J1A connector from ECM.
6. Measure CTS circuit resistance as follows.

J1A CONNECTOR		MEASUREMENT
Pin 19	Pin 27	Refer to *CTS SENSOR TEMPERATURE TABLE (E-TEC)*



If resistance value is correct, sensor and wiring/connectors are good.

If resistance value is incorrect, repair/replace wiring/connectors between ECM and CTS.

CTS Replacement

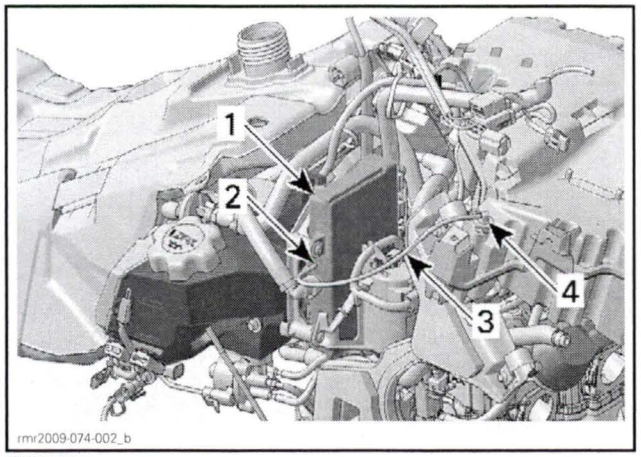
1. Remove drive belt guard. Refer to *DRIVE BELT* subsection.
2. Lift rear of vehicle to minimize coolant spillage.
3. Disconnect CTS connector.
4. Remove CTS.
5. Install new CTS.

CTS INSTALLATION
12 N•m (106 lbf•**in**)

6. Reinstall remaining removed parts.
7. Refill engine coolant. If an important quantity of coolant spilled, bleed cooling system. Refer to *ENGINE (600 HO E-TEC)* section, *COOLING SYSTEM* subsection.

AIR PRESSURE SENSOR (APS)

APS Location

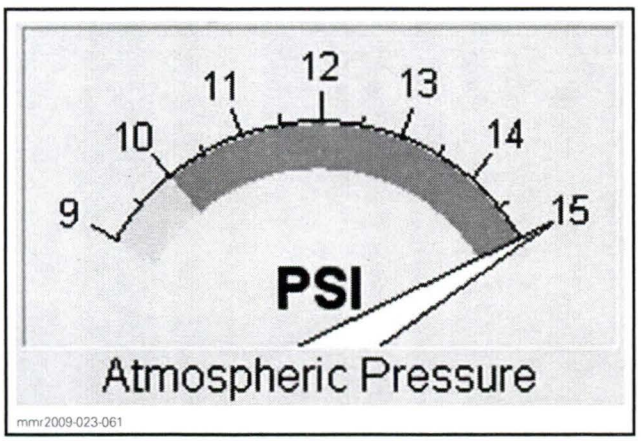


TYPICAL
1. *ECM*
2. *APS (inside ECM)*
3. *APS tube*
4. *APS fitting in secondary air intake silencer*

APS Inspection

1. Open RH side panel.
2. Ensure sensor hose is correctly connected on secondary air intake silencer and on ECM.
3. Check hose for cleanliness, water, or ice. Ensure it is not bent, kinked or burnt.
4. Connect to latest applicable B.U.D.S. version. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
5. Select the **Monitoring** and **ECM** page tabs.
6. In B.U.D.S., monitor the **Atmospheric Pressure** indicator. The gauge should read the local atmospheric pressure of the day.

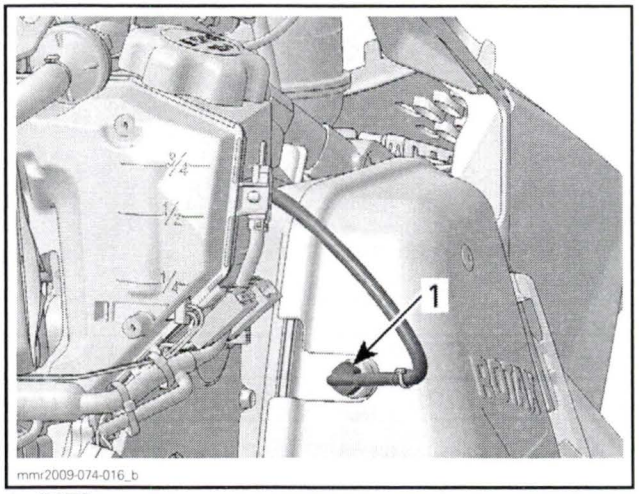
NOTE: At sea level, the atmospheric pressure gauge should read around 101.3 kPa (14.7 PSI) and less as altitude increases.



Otherwise, replace ECM.

EXHAUST GAS TEMPERATURE SENSOR (EGTS)

EGTS Location

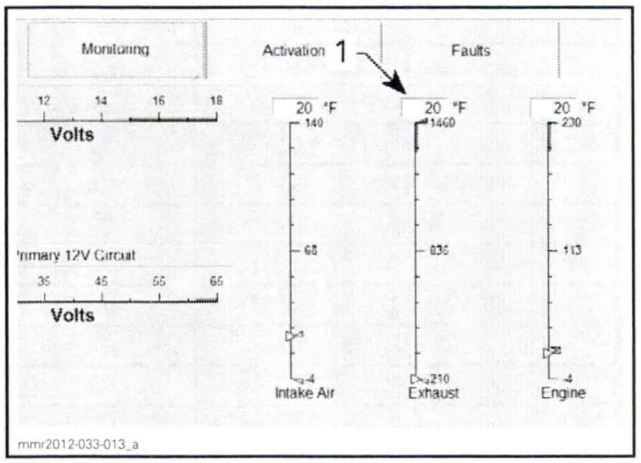


1. EGTS

EGTS Test with B.U.D.S.

In B.U.D.S., select the **Monitoring** and **ECM** page tabs.

Monitor the **Exhaust** temperature indicator. It should show the exhaust temperature, otherwise carry out the *EGTS RESISTANCE TEST* in this subsection.



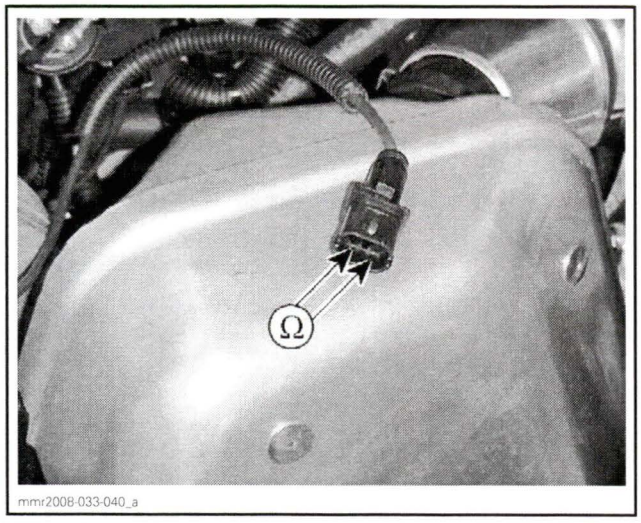
1. Muffler Exhaust temperature indicator

NOTE: If engine runs with the EGTS connected but not installed in the muffler, the reading will be 720°C (1,328°F) steady.

EGTS Resistance Test

1. Open RH side panel.
2. Disconnect EGTS connector.
3. Measure sensor resistance as follows.

EGTS		MEASUREMENT
Pin 1	Pin 2	Refer to *EGTS SENSOR TEMPERATURE TABLE*



mmr2008-033-040_a

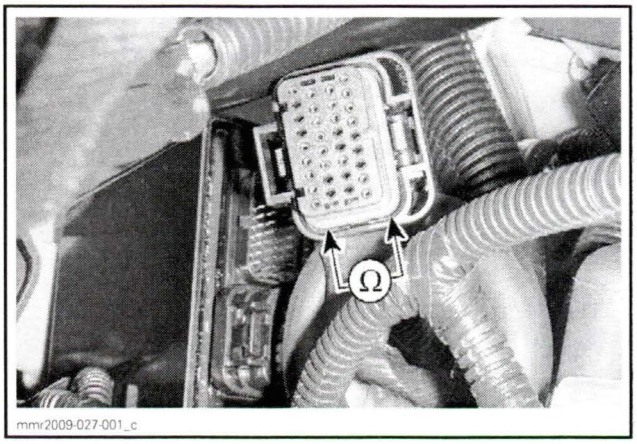
EGTS SENSOR TEMPERATURE TABLE		
TEMPERATURE		RESISTANCE (ohms)
°C	°F	EGTS
- 40	- 40	170
- 20	- 4	185
0	32	201
25	77	220
50	122	239
100	212	276
150	302	313
200	392	349
250	482	385
300	572	420
350	662	454
400	752	488
450	842	521
500	932	554
600	1112	618
700	1292	679
800	1472	738
900	1652	795
1000	1832	849

If resistance is out of specification, replace the sensor.

If resistance is as per specification, carry out the following steps.

4. Reconnect the EGTS.
5. Disconnect the J1A connector from ECM.
6. Measure resistance as follows.

J1A CONNECTOR		MEASUREMENT
Pin 12	Pin 27	Refer to *EGTS SENSOR TEMPERATURE TABLE*



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If resistive value is correct, try a new ECM. Refer to *ENGINE CONTROL MODULE (ECM)* in this subsection.

If resistive value is incorrect, repair the connector or replace the wiring harness between ECM connector and the EGTS.

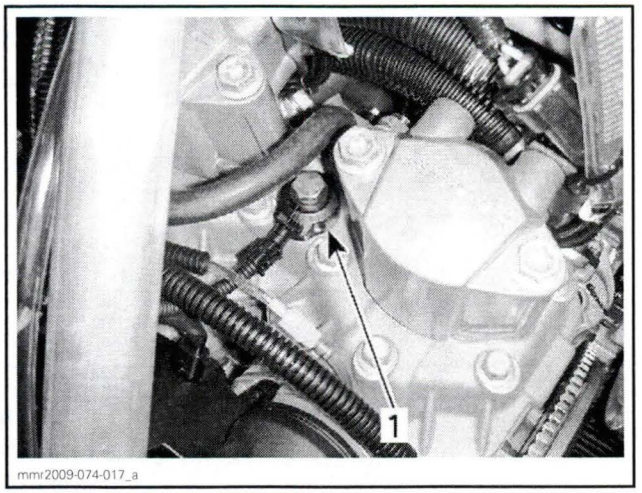
EGTS Replacement

Refer to *EXHAUST SYSTEM* subsection.

KNOCK SENSOR (KS)

Knock Sensor Location

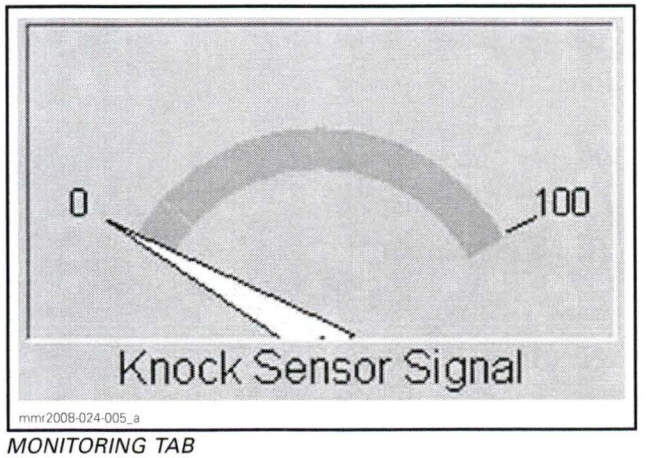
The knock sensor is located on top of the cylinder head, between the fuel injectors.



TYPICAL
1. Knock sensor

KS Test with B.U.D.S.

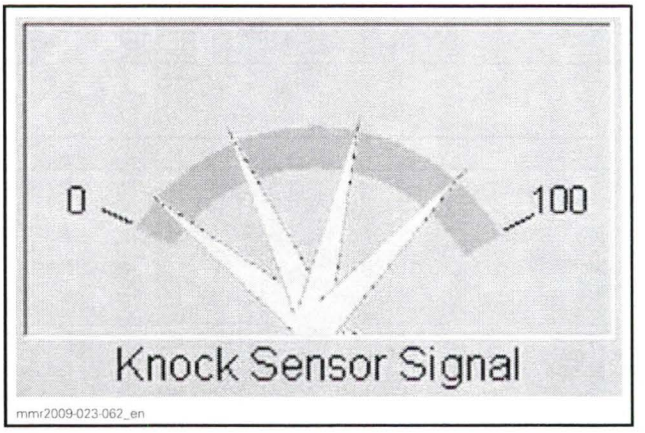
1. Lift rear of vehicle off the ground and support it with a wide-base mechanical stand.
2. Use the latest applicable B.U.D.S. version.
3. Monitor the knock sensor using the **Knock Sensor Signal** indication in the **ECM Monitoring** page of B.U.D.S.



MONITORING TAB

4. Start the engine.
5. Bring engine speed above 5200 RPM and vary engine RPM above 5200 RPM.

The needle of the **Knock Sensor Signal** gauge should move between 0 and 100. The needle movement pattern is of no importance as long as it moves indicating the knock sensor senses the engine vibrations.



If the needle moves as described, the knock sensor should be good.

If the needle sticks either at 0 or 100, there is a problem.

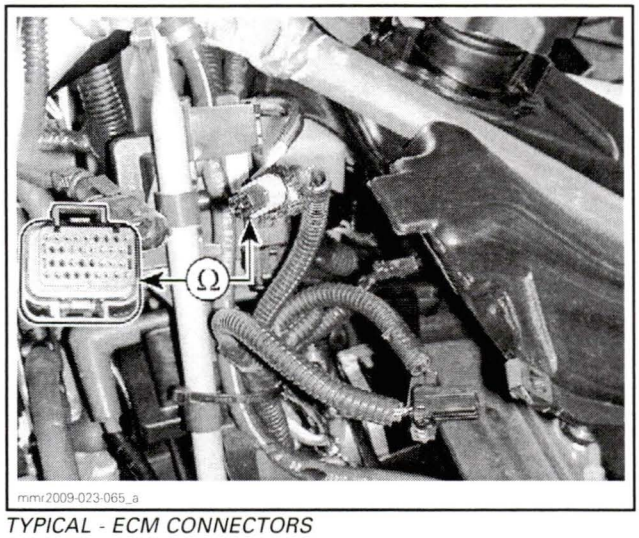
NOTE: Ensure ignition coil cables are not close to knock sensor harness. If so, this might generate a false fault code.

Carry out the *KS CIRCUIT CONTINUITY TEST* in this subsection.

KS Circuit Continuity Test

1. Ensure sensor and cylinder head contact surfaces are clean and mounting bolt and washer are correct and properly torqued down.
2. Disconnect knock sensor connector (DT). Refer to *KNOCK SENSOR REPLACEMENT* in this subsection.
3. Disconnect J1A connector from ECM.
4. Check wire continuity of circuit as per following table.

J1A CONNECTOR	KS CONNECTOR	MEASUREMENT
J1A-34	Pin 1	Close to 0 Ω (continuity)
J1A-33	Pin 2	



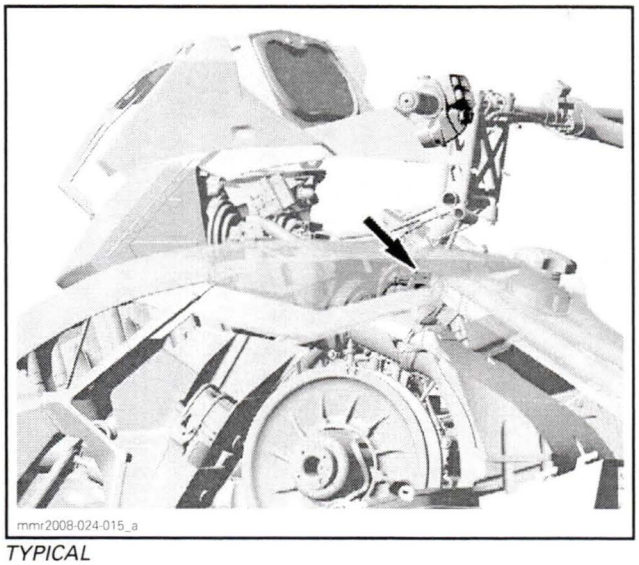
TYPICAL - ECM CONNECTORS

If test is not good, repair/replace wiring/connectors between ECM and knock sensor.

If test is good, try a new knock sensor.

KS Replacement

1. Unscrew and remove knock sensor from cylinder head.
2. Remove drive belt guard. Refer to *DRIVE BELT* subsection.
3. Remove primary air intake silencer. Refer to *ENGINE (600 HO E-TEC)* section, *AIR INTAKE SYSTEM* subsection.
4. Disconnect knock sensor connector located near ATS.



TYPICAL

5. Clean contact surfaces on cylinder head, then install the new knock sensor.
6. Torque knock sensor screw to 29 N•m (21 lbf•ft).

NOTICE Improper torque may prevent sensor from functioning properly possibly leading to severe internal engine component damage.

7. Reconnect connector.
8. Reinstall remaining parts.

ELECTRONIC FUEL INJECTION (600 ACE)

SERVICE TOOLS

Description	Part Number	Page
ECM ADAPTER TOOL	529 036 166	526–528, 547, 549, 551, 554, 556, 558
FLUKE 115 MULTIMETER	529 035 868	527, 535, 537, 547, 551, 554–555
FUEL HOSE DISCONNECT TOOL	529 036 037	538
SMALL HOSE PINCHER	295 000 076	544
T-HARNESS	529 035 869	534, 547

SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 243 (BLUE)	293 800 060	548

GENERAL

⚠ WARNING

When electrically disconnecting or removing the throttle body from the intake manifold, or the idle air control valve (IACV) from the throttle body, always remove the tether cord from the engine cut-off switch and disconnect the battery.

⚠ WARNING

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

⚠ WARNING

The fuel system is under pressure, proceed with care when working on the fuel system. Release fuel pressure prior to removing fuel system components. Wipe off any fuel spillage in the engine compartment. Do not allow fuel to spill on hot engine parts and/or on electrical connectors.

To release fuel pump pressure:

- Place an absorbent shop rag around a fuel hose fitting (such as the fuel tank or fuel rail quick disconnect).
- Carefully unlock the fitting and bleed away the fuel pressure.

⚠ WARNING

Replace any damaged, leaking or deteriorated fuel lines or connections. After working on the fuel system, always pressurize the fuel system and check for fuel leaks. Refer to *FUEL SYSTEM PRESSURIZATION* in *FUEL TANK AND FUEL PUMP* subsection.

SYSTEM DESCRIPTION

The electronic fuel injection system (EFI) is comprised of various sensors used for detecting ongoing operating conditions of the engine and vehicle, and includes all the components that perform the required adjustments to the engine.

Electrical System

ECM (Electronic Control Module)

The ECM reads input signals that it receives from the various sensors. Through calculation of several variables which it compares to stored parameters (fuel maps), the ECM controls the injection system to meet driver demands and to ensure safe engine operation.

Through its management of the engine systems, the ECM ensures the engine is delivering optimum performance and fuel economy. The ECM also controls idle RPM by modulating the idle air control valve (IACV) and, limits maximum engine speed through the ignition and fuel injection systems.

EFI Sensors

To control the injection system, the engine management uses input signals from the following sensors:

- Crankshaft position sensor (CPS)
- Manifold absolute pressure and temperature sensor (MAPTS)
- Throttle position sensor (TPS).

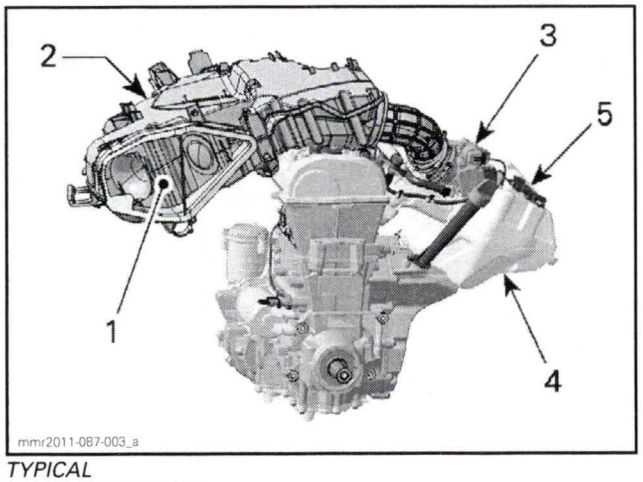
Air Intake System

Air Filter

Air flows through a mesh screen filter in the air intake silencer mounted over the engine. The mesh filter prevents snow from being drawn into the engine.

Air is then drawn in through the throttle body, the air intake manifold and into the engine.

Manifold absolute pressure and temperature are measured in the intake manifold.



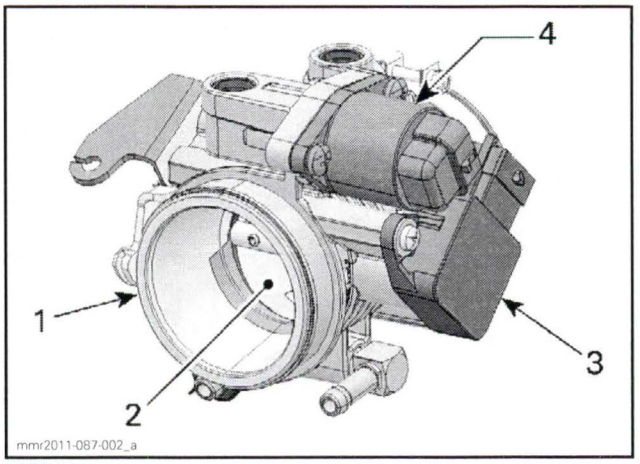
TYPICAL
1. *Mesh screen filter*
2. *Air intake system*
3. *Throttle body*
4. *Intake manifold*
5. *Manifold absolute pressure and temperature sensor*

Throttle Body

The heated single 46 mm throttle body is mounted on intake manifold.

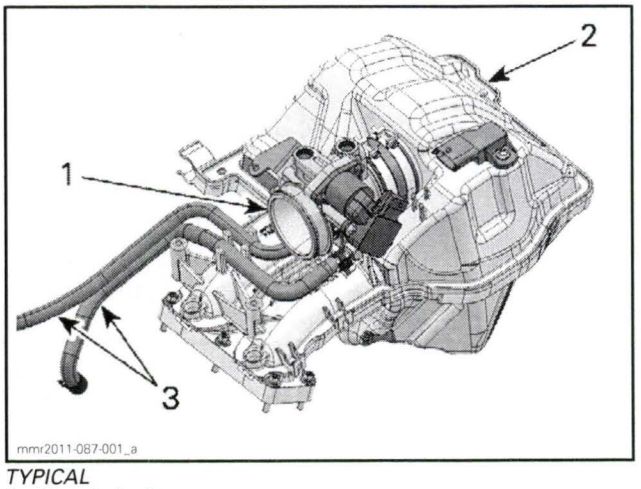
The TPS (Throttle Position Sensor) is fitted on the throttle body. The TPS sends throttle plate angle position to the ECM.

The IACV, also mounted on the throttle body, is used by the ECM to control idle RPM.



TYPICAL
1. *Throttle body*
2. *Throttle plate*
3. *TPS (Throttle Position Sensor)*
4. *IACV (Inlet Air Control Valve)*

Engine coolant flows through the throttle body to prevent potential freezing of the throttle plate.

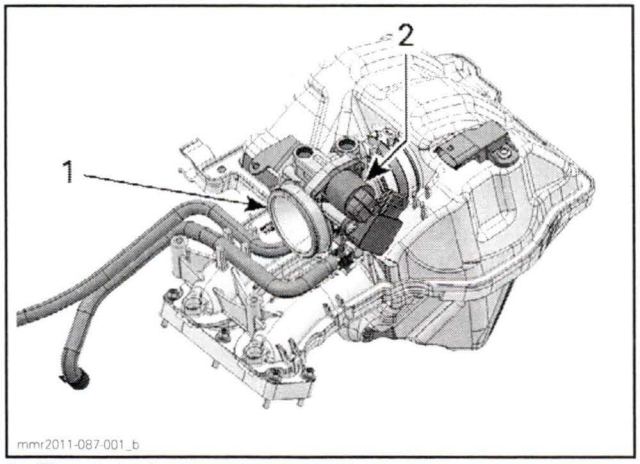


TYPICAL
1. *Throttle body*
2. *Intake manifold*
3. *Coolant-heated lines*

Idle Air Control Valve (IACV)

Since the throttle plate is closed when engine is idling, an idle air control valve (IACV) is used to allow air to bypass the throttle plate through a port in the throttle body.

Idle control is required to satisfy the varying conditions such as air temperature, altitude, engine load, etc.



1. *Throttle body*
2. *IACV (Idle air control valve)*

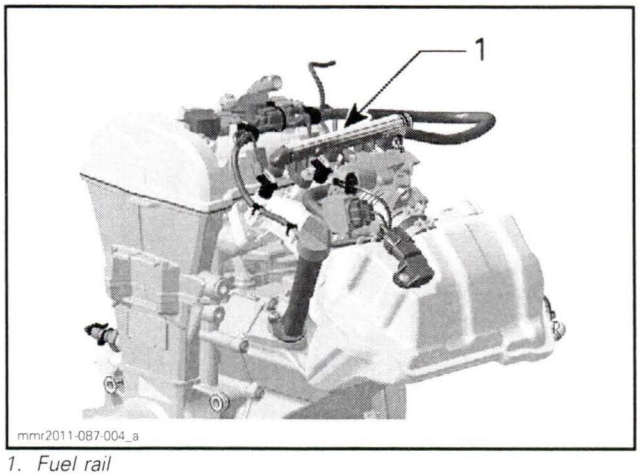
The amount of opening or closing of the IACV is controlled by the ECM. As the IACV opening is increased, more air is bypassed resulting in an increased idle speed.

Fuel System

Fuel Rail

A fuel rail is mounted on the intake manifold. The fuel rail, which is used to secure the injectors to the manifold, also provides to the injectors the fuel pressure that it receives from the fuel pump.

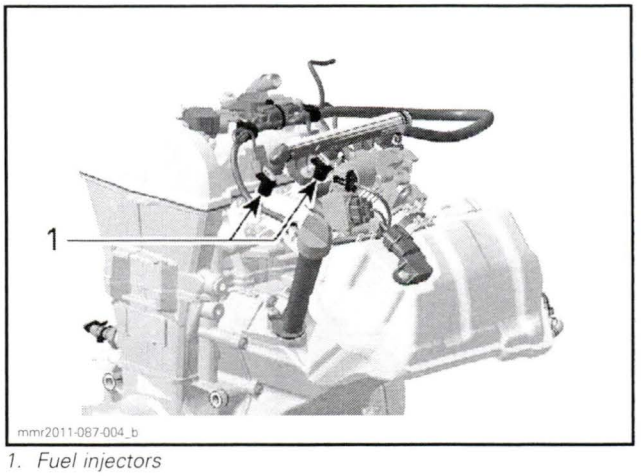
The fuel pressure applied to the fuel rail is regulated by the fuel pressure regulator located in the fuel pump module.



1. *Fuel rail*

Fuel Injectors

Two fuel injectors are used to inject fuel into the intake ports of the cylinder head. One injector is used per cylinder.



1. *Fuel injectors*

Fuel is injected in accordance with injection signals received from the ECM.

Fuel Pump

An electric fuel pump with an integrated pressure regulator and fuel system filters is used. For more details on the fuel pump unit, refer to *FUEL TANK AND FUEL PUMP* subsection.

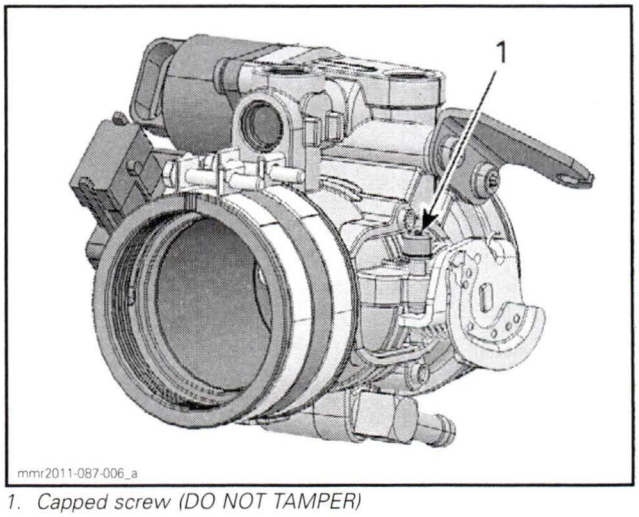
ADJUSTMENT

IDLE SPEED

Idle speed (RPM) is controlled by the EMS (Engine Management System) and is not adjustable.

If idle RPM is not as per specification (see *TECHNICAL SPECIFICATIONS*), perform the *CLOSED THROTTLE RESET (TPS)* as described in this subsection.

NOTICE **Never attempt to adjust the capped idle stop screw, it is calibrated at the factory. If the screw adjustment is changed, the throttle body must be replaced.**

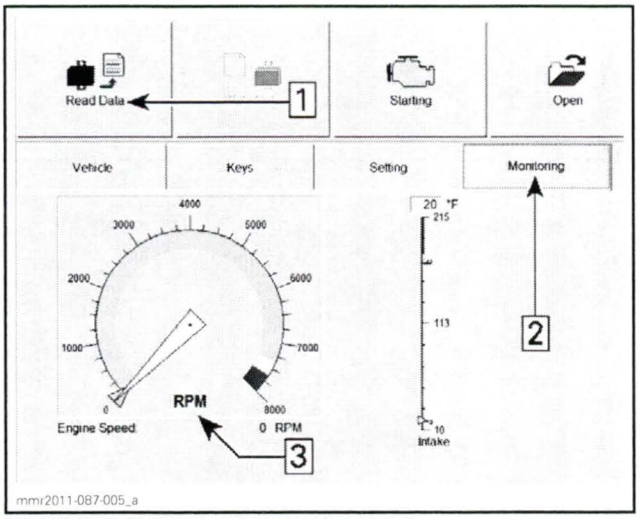


1. *Capped screw (DO NOT TAMPER)*

The vehicle multifunction gauge can provide a readout of the engine's idle RPM.

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

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



VERIFYING ENGINE RPM USING B.U.D.S.
Step 1: Click on the **Read Data** *button*
Step 2: Select the **Monitoring** *page tab*
Step 3: Read the engine **RPM** *indication*

NOTE: The vehicle gauge and B.U.D.S. use the same signal to provide the engine RPM indication.

TROUBLESHOOTING

DIAGNOSTIC TIPS

Engine problems are not necessarily related to the fuel injection system.

It is important to ensure that the engine and propulsion system, fuel delivery and electrical systems are functioning normally.

For diagnostics purposes, use B.U.D.S. software. See *COMMUNICATION TOOLS AND B.U.D.S.* subsection.

After a problem has been solved, be sure to clear the fault(s) recorded in the ECM using the B.U.D.S. software.

⚠ WARNING

Electrical actuators and electronic modules may be powered up as soon as the START/RER button is depressed. Always disconnect the battery prior to disconnecting any electrical or electronic parts.

Never use a battery charger to temporarily substitute the battery as it may cause the ECM to function erratically, or not at all.

Check related-circuit fuse solidity and condition with an ohmmeter. A visual inspection could lead to a false diagnosis.

Poor Idling

If poor idling is experienced, check the following:
- Throttle cable adjustment or routing
- IACV operation, cleanliness, leaking or clogged air passages
- Throttle body cleanliness and idle stop screw
- Engine leaks or other mechanical problem.

Related Electrical Problems

It is important to check the following in the electrical system:
- Battery voltage
- Fuses
- Ground connections
- Wiring and connectors.

Ensure that all electronic components are original BRP recommended components. Any modification to the wiring harness may lead to poor system operation or generate fault codes.

Electrical Connections

Pay particular attention to ensure that terminals and pins are not out of their connectors, corroded, or out of shape.

When probing terminals, pay attention not to deform the terminals as this could cause a loose or intermittent connection that would be difficult to troubleshoot.

NOTE: Do not apply dielectric grease or other lubricants on the ECM connectors.

PROCEDURES

FUEL HOSES AND OETIKER CLAMPS

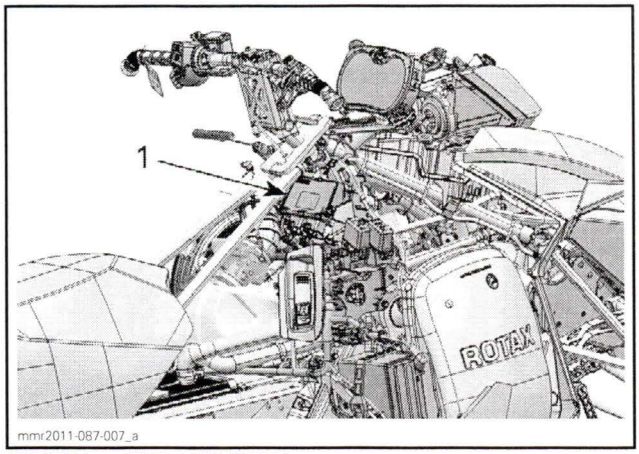
Refer to *FUEL TANK AND FUEL PUMP (600 HO E-TEC AND 600 ACE* subsection.

ENGINE CONTROL MODULE (ECM)

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

ECM Location

The ECM is located above the air intake manifold.

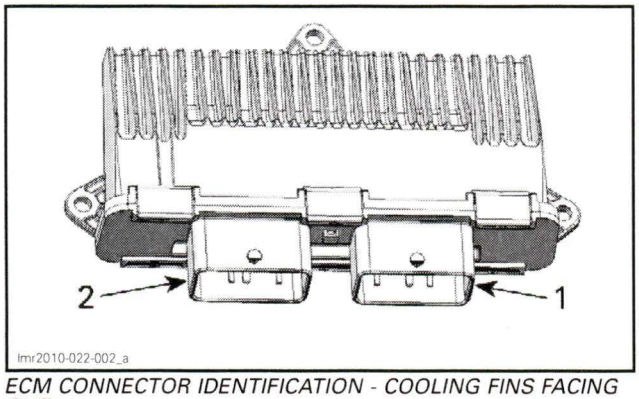


TYPICAL - ECM LOCATION
(FUEL TANK REMOVED FOR CLARITY)
1. ECM

ECM Connector Identification

There are 2 connectors connected to the ECM:

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



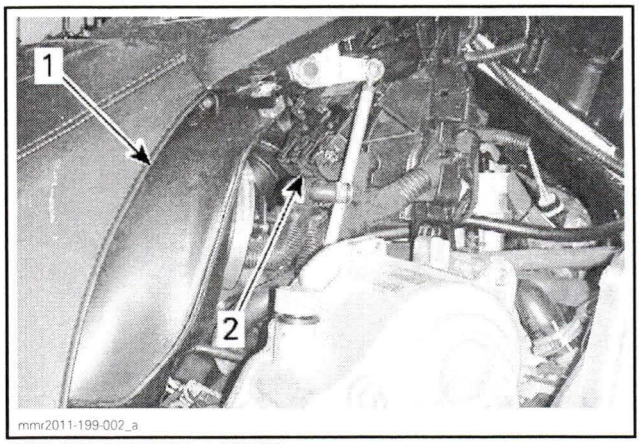
ECM CONNECTOR IDENTIFICATION - COOLING FINS FACING OUT
1. Connector A
2. Connector B

The ECM connectors have 48 pins.

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

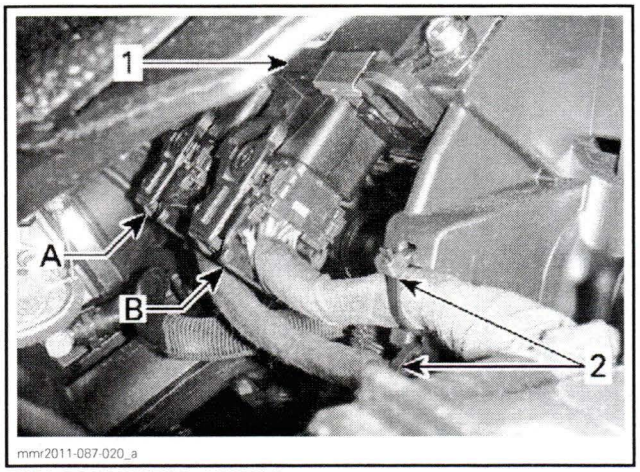
ECM Connector Access

1. Refer to *BODY* subsection and remove the RH side panel.
2. Reach in above the gearbox, between the fuel tank and shift rod.



ECM CONNECTOR ACCESS
1. Fuel tank
2. ECM connectors

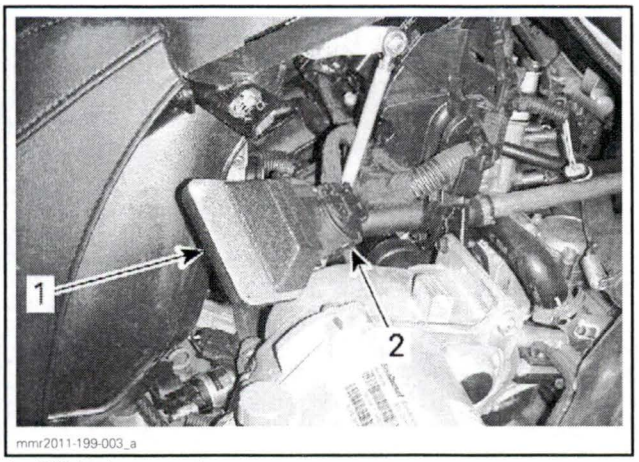
3. Cut the locking tie(s) that secure the ECM connector harnesses to the ECM support.



ECM CONNECTOR ACCESS
1. ECM
2. Harness locking ties
A. ECM-A connector
B. ECM-B connector

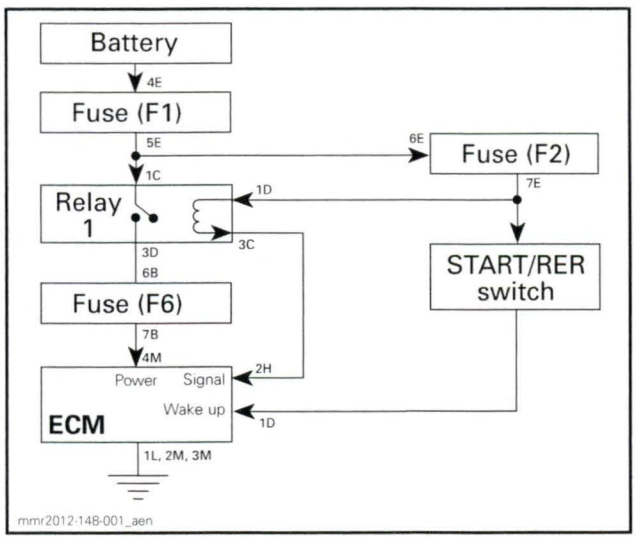
NOTE: The ECM is mounted with the cooling fins facing forward. Therefore, ECM A connector is on the LH side of the vehicle, and ECM B connector is on the RH side.

4. Disconnect the ECM connector(s) and pull them outwards for installation on the ECM adapter tool.



1. ECM adapter tool
2. ECM connector

ECM Power Circuit Diagram



ECM Power Circuit Validation

Briefly press START/RER button.

This should wake up the ECM. The ECM will then activate relay R1 for approximately 12 seconds after which it will turn off all power. If the tether cord (D.E.S.S. key) is installed when the START/RER button is pressed, the power will stay on for approximately 40 seconds.

QUICK INDICATION THAT ECM IS POWERED (ASSUMING THE OBSERVED COMPONENT IS WORKING)
Multifunction gauge comes ON.
Fuel pump turns on for approx. 2 seconds (if tether cord installed).

If ECM does not turn on, check the following:
- Fuse F1, F2 and F6
- Battery voltage. Refer to *CHARGING SYSTEM*
- Relay R1
- START/RER switch. Refer to *STARTING SYSTEM*
- ECM power circuit wires and ground wires.

For testing of fuses and relay R1, refer to *POWER DISTRIBUTION* subsection.

NOTE: When relay 1 is not working, the EMS (engine management system) and the complete vehicle electrical system will not be powered.

ECM Wake Up Circuit Test

1. Disconnect "B" connector from ECM, refer to *ECM CONNECTOR ACCESS* in this subsection.
2. Install ECM connector "B" on the ECM adapter tool.

ECM ADAPTER TOOL (P/N 529 036 166)	

3. Use a multimeter and select Vdc.
4. While pressing START/RER button, read voltage as follows.

ECM ADAPTER	BATTERY	MEASUREMENT
1D	Battery ground	Battery voltage

If voltage is as per specification, refer to *ECM POWER CIRCUIT TEST*.

If voltage is out of specification:
- Test the START/RER switch, refer to *STARTING SYSTEM* subsection.
- If START/RER switch tests good, test wiring and connectors from battery to ECM.

ECM Power Circuit Test

1. Connect ECM connector "B" on the ECM adapter tool.

ECM ADAPTER TOOL (P/N 529 036 166)	

2. Install an appropriate fused jumper wire between the following terminals on the ECM adapter tool.

JUMPER WIRE COORDINATES ON ECM ADAPTER	
2H	2M, 3M or 1L

NOTE: When the jumper is installed, the multifunction gauge should come on.

If the multifunction gauge did not come on, check the following:
- Fuses F1, F2 and F6
- Relay R1
- Wiring between ECM-B contact 2H and fuse F2
- ECM ground circuit, refer to *CONTINUITY TEST OF ECM GROUND CIRCUITS* in this subsection.

For testing of fuses and relay R1, refer to *POWER DISTRIBUTION* subsection.

If gauge came on, carry on with the following step.

3. Use the FLUKE 115 MULTIMETER (P/N 529 035 868) and select Vdc.
4. Check for voltage as follows.

ECM ADAPTER	BATTERY	VOLTAGE
B-4M	Negative post	Battery voltage

If voltage is not measured, check the wiring and connections between ECM and fuse F6.

If all items mentioned in this test and in *ECM WAKE UP CIRCUIT TEST* tested good, try a new ECM.

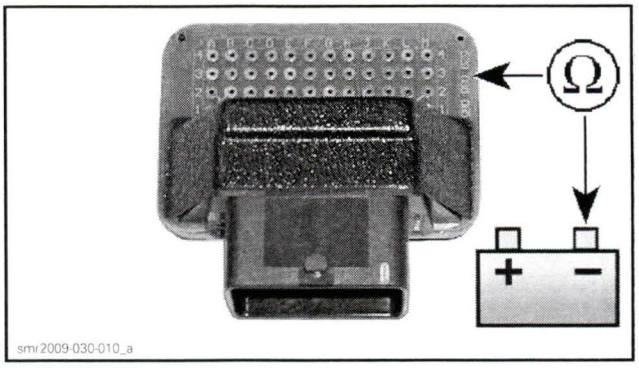
Continuity Test of ECM Ground Circuits

1. Connect ECM connector "B" on the ECM adapter tool.

ECM ADAPTER TOOL (P/N 529 036 166)	

2. Select the FLUKE 115 MULTIMETER (P/N 529 035 868) to Ω and probe adapter terminals as per following table.

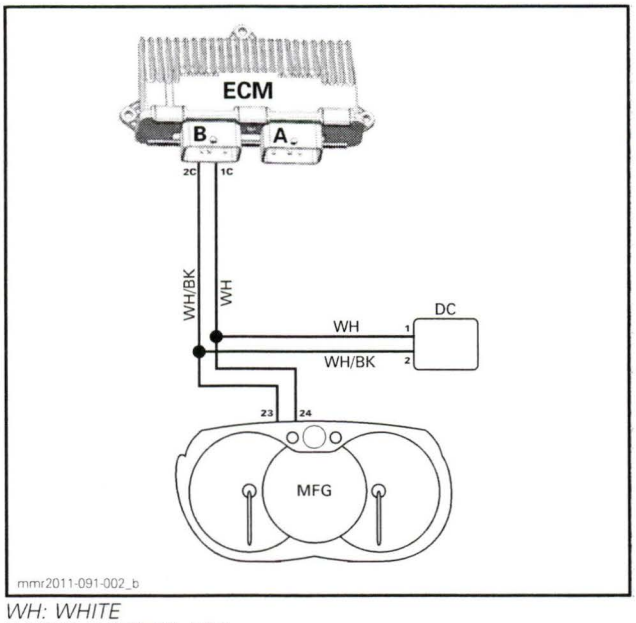
ECM ADAPTER	BATTERY POST	RESISTANCE
Pins 1L, 2M and 3M	Ground	Close to 0 Ω (continuity)



If any measurement is out of specification refer to *POWER DISTRIBUTION* subsection and check the following:
- Wiring and connections
- Engine ground
- Battery ground
- Frame ground.

ECM CAN Line Test

CAN lines link the ECM, multifunction gauge and vehicle diagnostic connector.



WH: WHITE
WH/BK: WHITE/BLACK
MFG (multifunction gauge)
ECM (electronic control module)
DC (diagnostic connector)

Test CAN wire continuity as follows.

1. Disconnect ECM connector "B".
2. Disconnect multifunction gauge connector. Refer to *LIGHTS, GAUGE AND ACCESSORIES* subsection.
3. Check wire resistance as follows.

ECM ADAPTER TOOL (P/N 529 036 166)	

ECM ADAPTER	GAUGE CONNECTOR	MEASUREMENT
Pin 2C	Pin 23	Close to 0 Ω
Pin 1C	Pin 24	

If continuity is out of specification, repair or replace wiring harness between ECM and multifunction gauge.

If continuity is as per specification, carry out the following test.

4. Disconnect vehicle diagnostic connector from its protective cap.
5. Read wire resistance as follows.

DIAGNOSTIC CONNECTOR	GAUGE CONNECTOR	MEASUREMENT
Pin 2	Pin 23	Close to 0 Ω
Pin 1	Pin 24	

If continuity is out of specification, repair or replace wiring harness between diagnostic connector and multifunction gauge.

If continuity is as per specification, CAN lines are functional.

Reconnect connectors and reinstall removed parts.

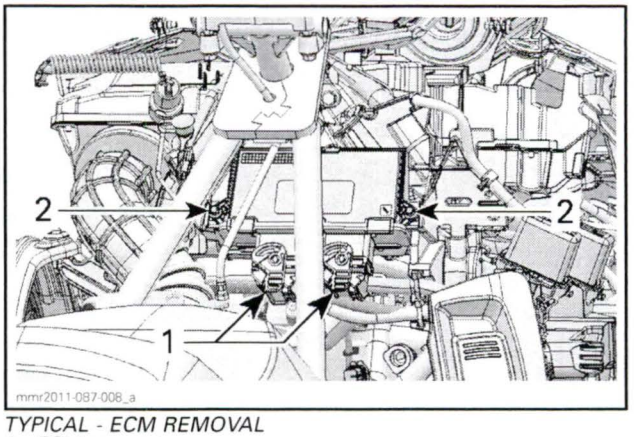
ECM Removal

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

1. Disconnect battery cables.

NOTICE Always disconnect the BLACK negative (–) battery cable first, then disconnect RED positive (+) cable.

2. Refer to *BODY* subsection and remove the LH and RH side panels.
3. Remove the air intake silencer and headlight/gauge module as a unit, refer to *AIR INTAKE SYSTEM* subsection.
4. Disconnect both ECM connectors from ECM.
5. Remove ECM retaining screws and remove the ECM from its support.



TYPICAL - ECM REMOVAL
1. ECM connectors
2. ECM retaining screws

ECM Installation

1. Reverse removal procedure however, pay attention to the following.

ECM INSTALLATION	
TORQUE	2.5 N•m (22 lbf•**in**)

2. Reconnect ECM connectors.
3. Reconnect battery cables.

⚠ WARNING

Always reconnect the RED positive (+) battery cable first, then reconnect BLACK negative (–) cable.

4. If a new ECM is installed, refer to *ECM REPLACEMENT* in this subsection.

ECM Replacement

NOTE: Prior to replacing an ECM, ensure that all the recommendations in the general introduction of this section have been followed and all applicable testing procedures have been carried out.

When the ECM is replaced, data must be entered into the new ECM. Refer to *ECM MANUAL DATA ENTRY FOR ECM REPLACEMENT* further in this subsection.

ECM Manual Data Entry for ECM Replacement

Use one of the following 2 methods to collect the required information. The 1st being the easiest:

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

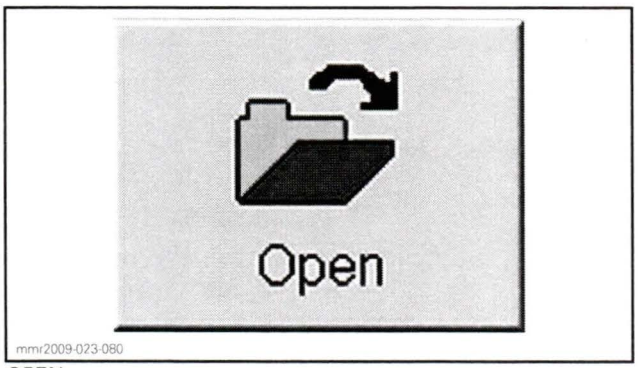
Once the required information has been collected, refer to *ENTERING THE COLLECTED INFORMATION INTO THE ECM.*

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

1. Start B.U.D.S.

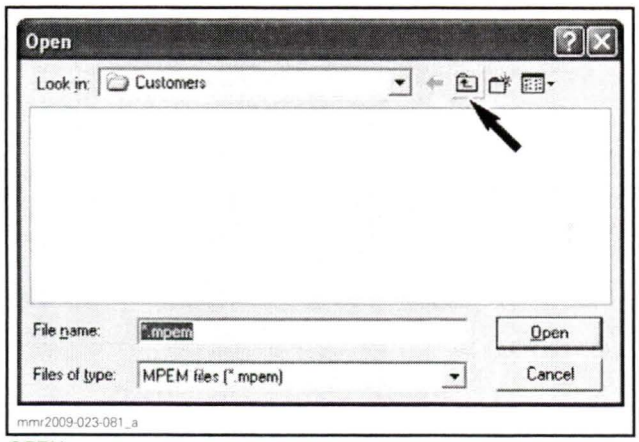
NOTE: It is not necessary to perform any connection. The PC computer can be used alone.

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



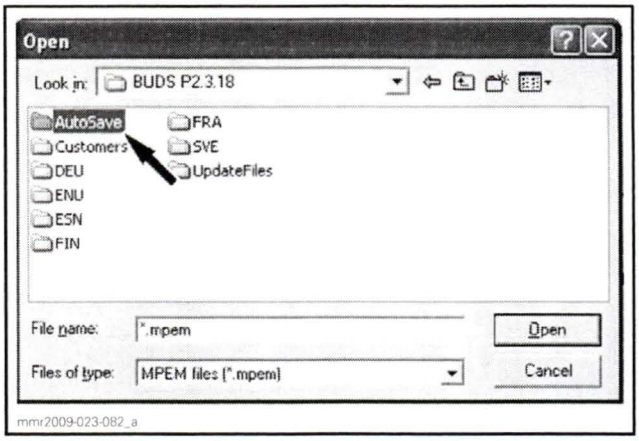
OPEN

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



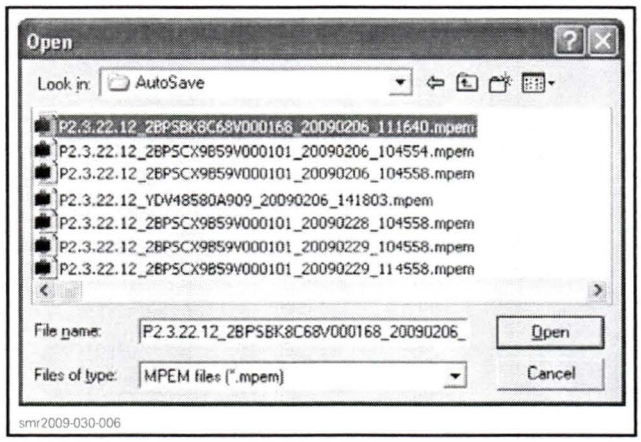
OPEN

Double click on the **AutoSave** folder.



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

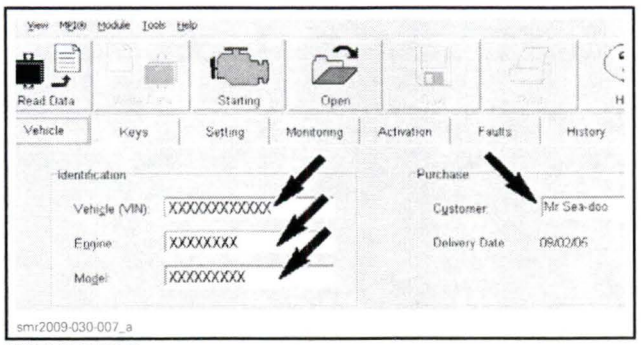
4. Choose the latest file saved for this specific vehicle.



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

NOTE: The file name structure is as follows:
B.U.D.S. version_VIN_date read (yyyymmdd)_hour read (hhmmss).mpem
Example: **P2.3.22.12_2BPSBK8C68V000168_20090206_111640.mpem** Therefore: B.U.D.S. version: P2.3.22.12 VIN: 2BPSBK8C68V000168 Date: 2009 02 06 Hour: 11h 16m 40s

5. Select the **Vehicle** page tab and record (write down) the following information.
   1. Vehicle serial number
   2. Engine serial number (without the leading "M")
   3. Vehicle model number
   4. Customer name.

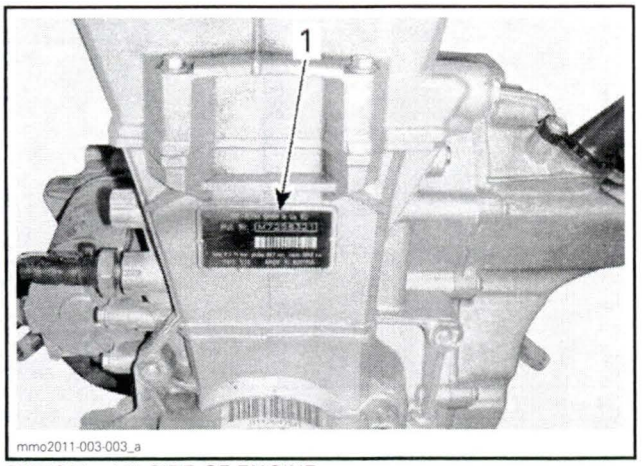


VEHICLE TAB

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

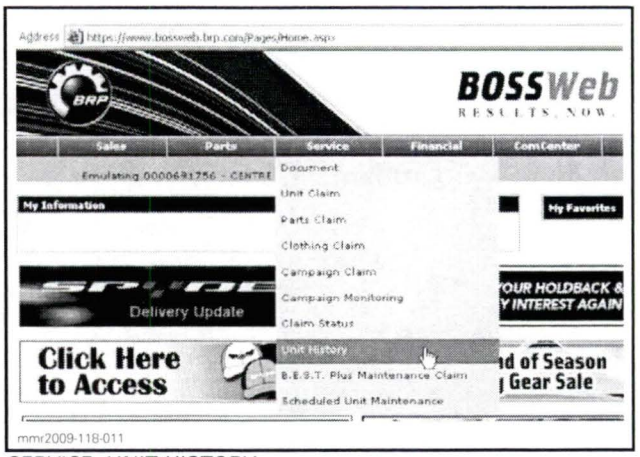
2nd Collecting Method: Collect the Information from the Vehicle and BOSSWeb

1. Record engine serial number.



TYPICAL - LH SIDE OF ENGINE
1. Engine serial number

2. Record the following numbers using BOSSWeb. Look in **Service** menu and choose Unit history.
   1. Vehicle serial number
   2. Vehicle model number
   3. Customer name.

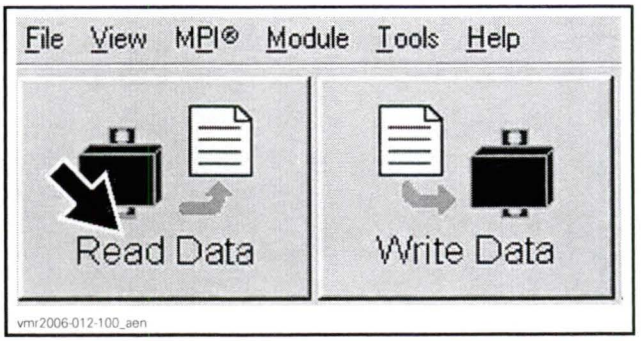


SERVICE, UNIT HISTORY

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

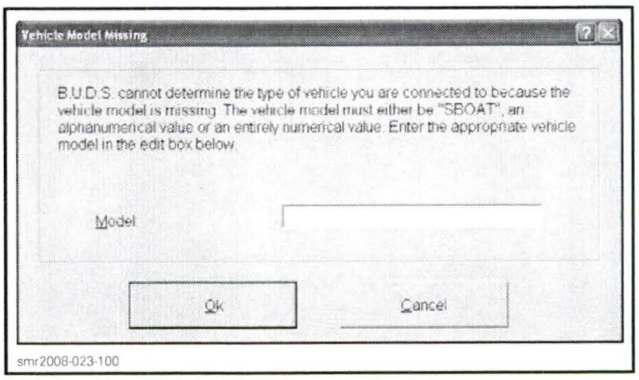
Entering the Collected Information Into the ECM

1. Use the applicable B.U.D.S. version. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. In B.U.D.S., click the **Read Data** button to read the new ECM.



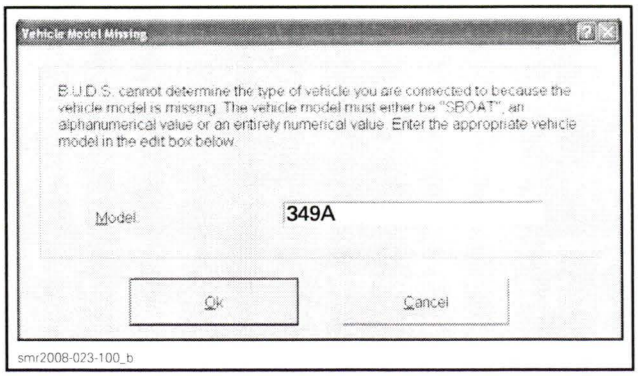
NOTE: A BEEP will sound repeatedly until the tether cord cap (D.E.S.S. key) is programmed into the new ECM.

The following screen window will pop up.

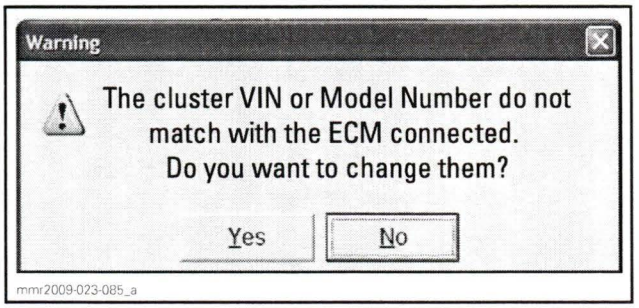


3. Enter the vehicle model number.

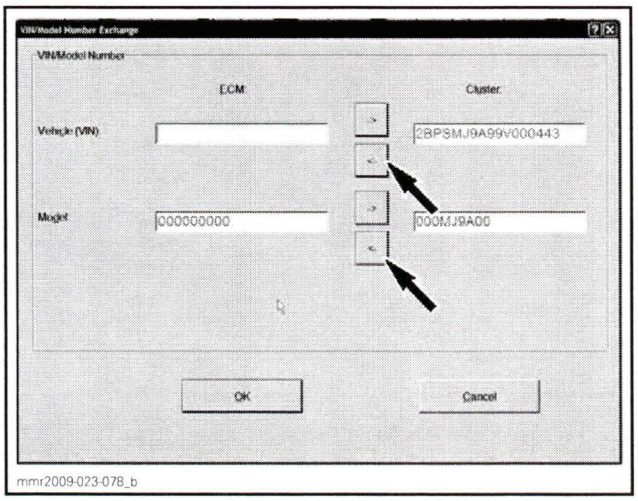
NOTICE Enter only the appropriate product model number as obtained when gathering the information.

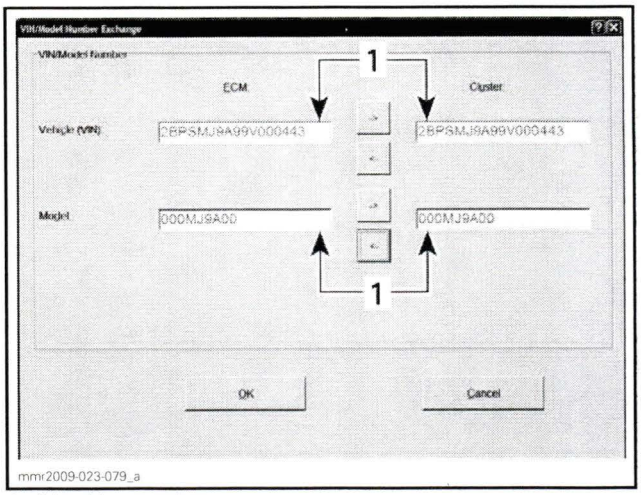


4. Click **Ok** once the required data has been entered.
5. The following message will appear on B.U.D.S. screen.



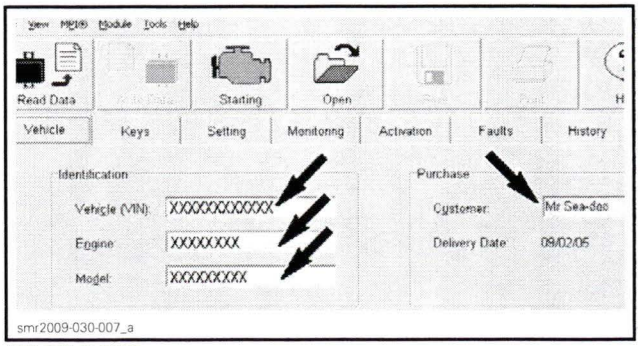
6. Click **Yes** to match ECM and gauge.
7. The serial numbers are purposely missing as seen in B.U.D.S. Click the arrows indicated in the following illustration to transfer the gauge numbers into the ECM.





1. Matching numbers

8. Click the **OK** button to complete the procedure.
9. Select the **Vehicle** page tab and ensure all of the following information you recorded previously is precisely entered in the new ECM.
   1. Vehicle serial number (VIN)
   2. Engine serial number (do not enter the "M" at the beginning of the engine number)
   3. Vehicle model number
   4. Customer name.

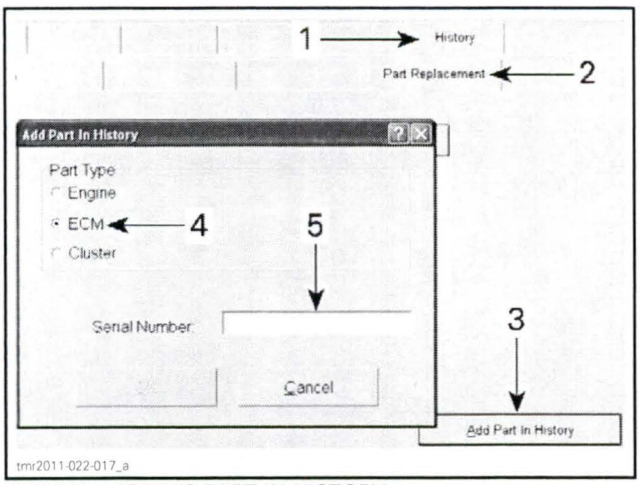


VEHICLE TAB

10. Enter all missing information.

NOTICE Pay particular attention when typing the V.I.N. and model numbers. Once **Write Data** button is pressed, the data cannot be modified.

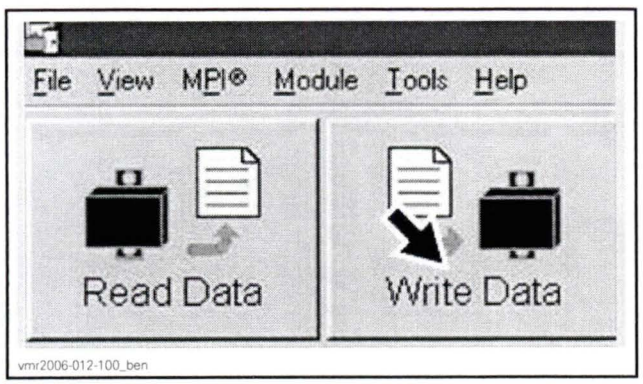
11. Click on the following tabs:
    - **History**
    - **Part Replacement**
    - **Add Part in History**.
12. Enter the **old** ECM serial number in the **Add Part In History** window.



TYPICAL - ADDING PART IN HISTORY
1. History *page tab*
2. Part Replacement *tab*
3. Add part in history *button*
4. ECM *selection*
5. *Add ECM serial number here*

NOTE: The ECM serial number can be found on the ECM sticker that also identifies the part number.

13. Click on the **OK** button.
14. Click on the **Write Data** button.



15. Perform the *CLOSED THROTTLE RESET (TPS)* procedure, refer to *THROTTLE POSITION SENSOR (TPS)* further in this subsection.
16. Program the tether cord cap (D.E.S.S. key(s)) into the new ECM, refer to *DIGITAL ENCODED SECURITY SYSTEM (D.E.S.S.)* subsection.
17. Set the gauge units of display. Refer to *LIGHTS, GAUGE AND ACCESSORIES* subsection.
18. Start the engine and ensure proper operation.

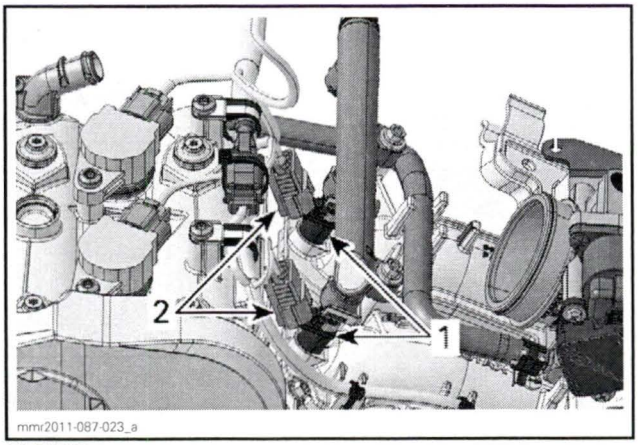
NOTE: If the engine will not idle, or idles very roughly, refer to *IACV AUTO RESET* in this subsection.

19. Reinstall any remaining removed parts.

FUEL INJECTOR

Fuel Injector Access

1. Refer to *BODY* subsection and remove both side body panels.
2. Refer to *AIR INTAKE SYSTEM* subsection and remove the following parts:
   - Air intake silencer and headlight/gauge module (as a unit)
   - Air intake hose from throttle body.

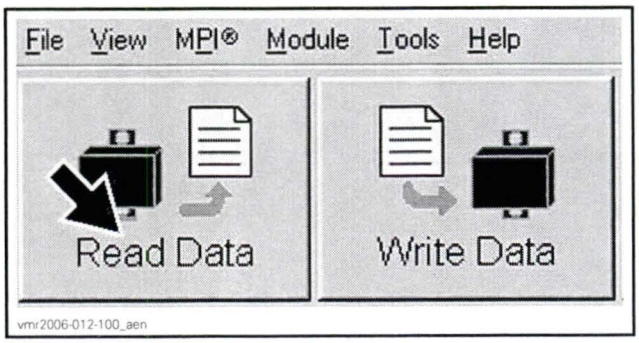


TYPICAL
1. *Fuel Injectors*
2. *Fuel Injector connectors*

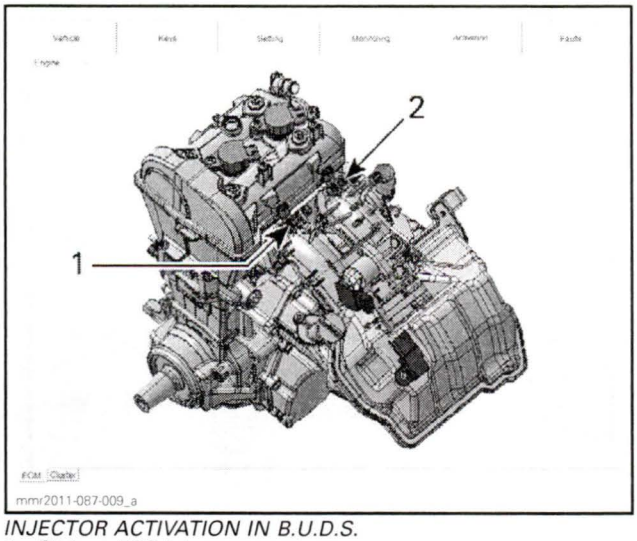
3. If removing injectors, also disconnect the ECM connectors. Refer to *ECM CONNECTOR ACCESS* in this subsection.

Fuel Injector Activation Test Using B.U.D.S.

1. Connect vehicle to the applicable B.U.D.S. version. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. In B.U.D.S., click the **Read Data** button to read the new ECM.



3. On the **Activation** page of B.U.D.S. software, energize the fuel injector to be tested.



INJECTOR ACTIVATION IN B.U.D.S.
1. *Click on PTO injector to activate*
2. *Click on MAG injector to activate*

You should hear the injector functioning.

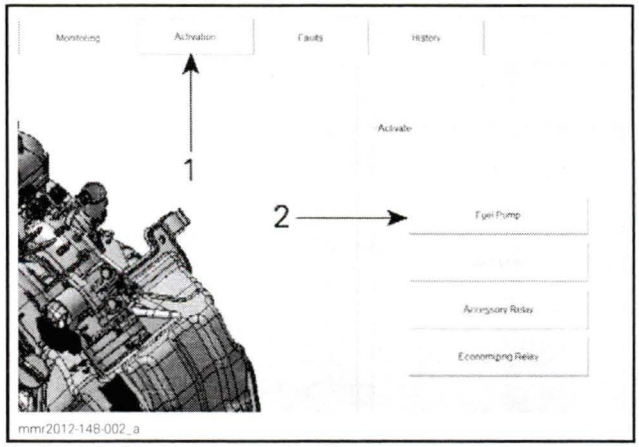
This will validate the injector mechanical and electrical operation.

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

Fuel Injector Balance Test

NOTICE **After fuel injector activation using B.U.D.S., always crank engine in drowned mode to ventilate the engine of fuel.**

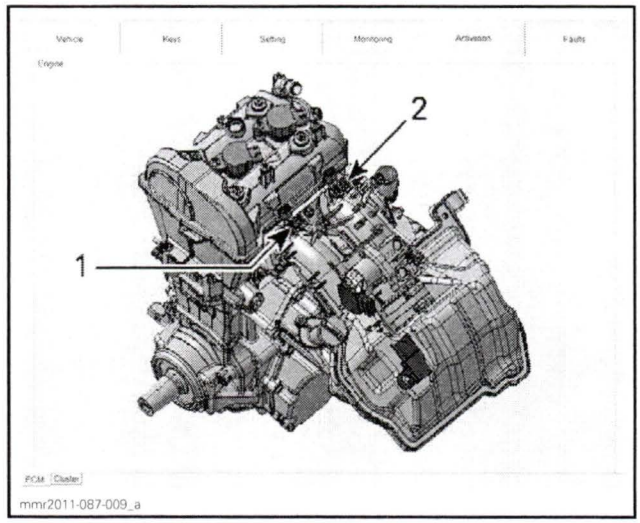
1. Install a fuel pressure gauge as described in *FUEL PUMP PRESSURE TEST* in *FUEL TANK AND FUEL PUMP (600 HO E-TEC AND 600 ACE* subsection.
2. Connect vehicle to the applicable B.U.D.S. software version. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
3. In B.U.D.S., select the following:
   - **Read Data** button
   - **Activation** page tab.
4. In B.U.D.S., click on the **Fuel Pump** button to activate fuel pump.



1. *ECM* **Activation** *page tab*
2. **Fuel Pump** *activation button*

NOTE: Indicated fuel pressure must be within specification. Refer to *FUEL TANK AND FUEL PUMP* subsection. Re-activate fuel pump as necessary.

5. In B.U.D.S., energize fuel injector **no. 1**.



INJECTOR ACTIVATION IN B.U.D.S.
1. *Click on PTO injector to activate*
2. *Click on MAG injector to activate*

6. Record the fuel pressure drop for injector **no. 1**.
7. In B.U.D.S., click on the Fuel Pump button to activate fuel pump.
8. Repeat the procedure for fuel injector **no. 2** and record the pressure drop for each injector.
9. The maximum fuel pressure drop between injectors should not exceed the following specification:

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

If the pressure drop between fuel injectors is greater than the specification, replace the injector with the least pressure drop, then repeat the test.

10. Using the valve on the fuel pressure gauge, release the pressure in the system (if so equipped).
11. Remove fuel pressure gauge and reinstall removed parts.
12. Set emergency engine stop switch to OFF.
13. Crank engine in drowned mode (accelerator held all the way in) to ventilate the engine of the fuel that was injected during the test.

⚠ WARNING

Always crank engine in drowned mode to ventilate all fuel that was injected during the test. Failure to do so may result in severe engine damage and injury.

Fuel Injector Leak Test

Test Setup

1. Ensure there is enough fuel in fuel tank.
2. Ensure fuel pressure from fuel pump is within specification. Refer to *FUEL TANK AND FUEL PUMP (600 HO E-TEC AND 600 ACE)* subsection.

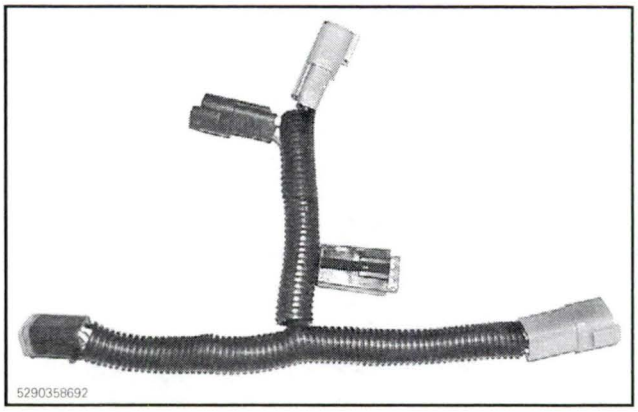
NOTE: Keep the pressure gauge installed for the leak test.

3. Remove tether cord from engine cut-off switch.
4. Set emergency engine stop switch to STOP.

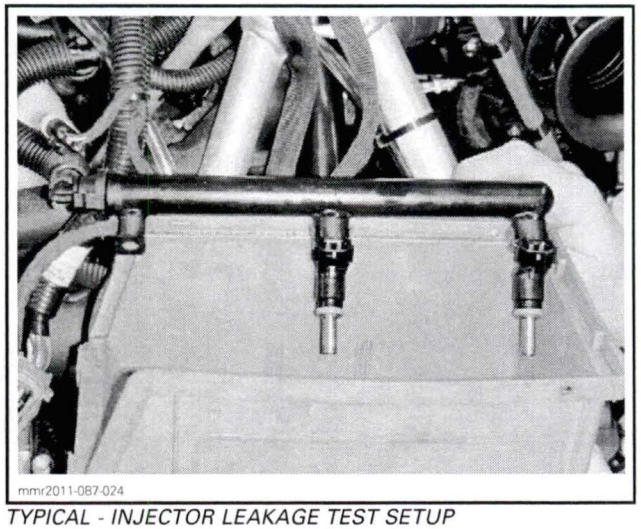
⚠ WARNING

The emergency engine stop switch is set to STOP to prevent any spark in the engine compartment should the engine be cranked. Fuel vapors may ignite in presence of a spark creating a fire hazard.

5. Disconnect the vehicle from B.U.D.S. by disconnecting the T-HARNESS (P/N 529 035 869) from the vehicle diagnostic connector.



6. Wait for vehicle electrical power to shut off; the multifunction gauge will turn off.
7. Remove fuel rail with injectors from engine however, **do not** disconnect fuel pump pressure hose from fuel rail. Refer to *FUEL INJECTORS* in this subsection.
8. Position fuel rail so that an appropriate container may be placed under the injectors to collect any fuel leakage.

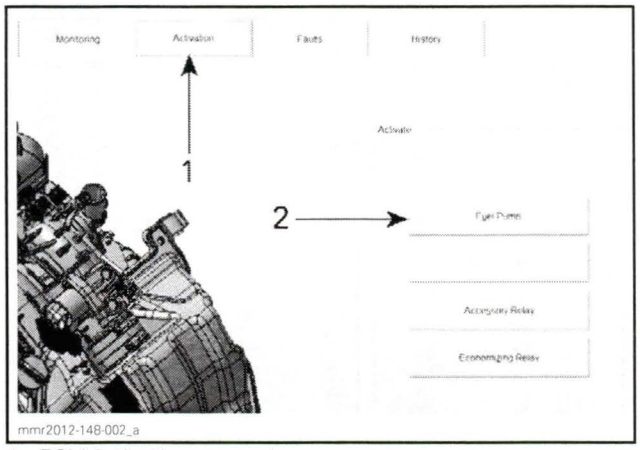


TYPICAL - INJECTOR LEAKAGE TEST SETUP

9. Install tether cord on engine cut-off switch.
10. Connect vehicle to the applicable B.U.D.S. software, refer to *COMMUNICATION TOOLS AND B.U.D.S.*

Leak Test

1. In B.U.D.S., select the following:
   - **Activation** page tab
   - **ECM** page.
2. Click on the **Fuel Pump** button to activate fuel pump for a few seconds.



1. *ECM* **Activation** *page tab*
2. **Fuel Pump** *activation button*

3. Check for fuel leakage from the injector nozzles.
4. Monitor fuel pressure at fuel pressure gauge. If pressure drops below 372 kPa (54 PSI) during the test, re-activate fuel pump as necessary.

FUEL INJECTOR LEAK TEST	
TEST DURATION	SPECIFICATION
2 minutes	1 drop per minute maximum

If test is not within specification, replace the faulty fuel injector.

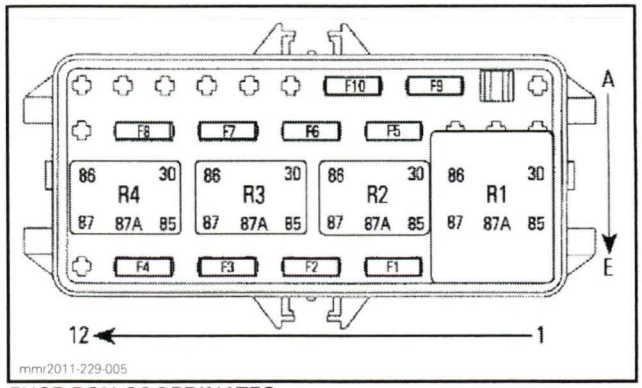
5. Properly reinstall fuel rail. Refer to *FUEL RAIL* in this subsection.
6. Reinstall remaining removed components.

⚠ WARNING

Wipe up any spilled fuel.

Fuel Injector and Circuit Resistance Test

1. Ensure vehicle electrical power is off.
2. Disconnect connector "A" from the ECM, refer to *ECM CONNECTOR ACCESS* in this subsection.
3. Remove cover from the fuse box and locate fuse F5 (HIC fuse).



FUSE BOX COORDINATES

4. Using a FLUKE 115 MULTIMETER (P/N 529 035 868), check resistance value between fuse box and ECM connector terminals as follows.

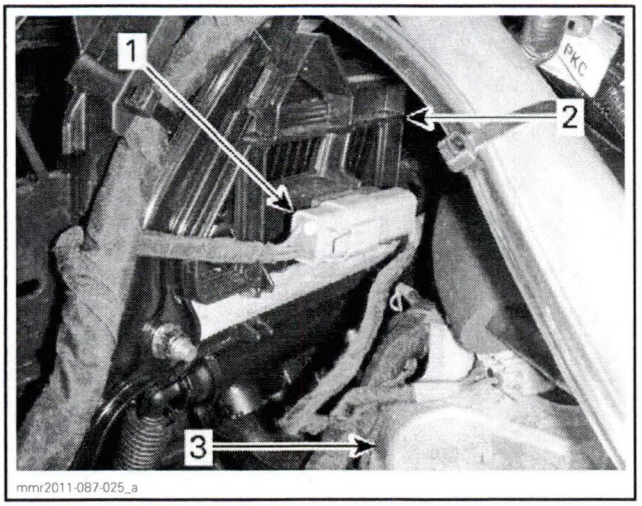
NOTE: It is not necessary to remove the fuse. Refer to *POWER DISTRIBUTION* subsection for fuse box information.

FUEL INJECTOR RESISTANCE TEST AT FUSE BOX			
INJECTOR	**FUSE CONTACT**	**ECM CONNECTOR "A"**	**RESISTANCE @ 20°C (68°F)**
PTO	5B	A-1J	12 ± 0.6 Ω
MAG		A-1K	

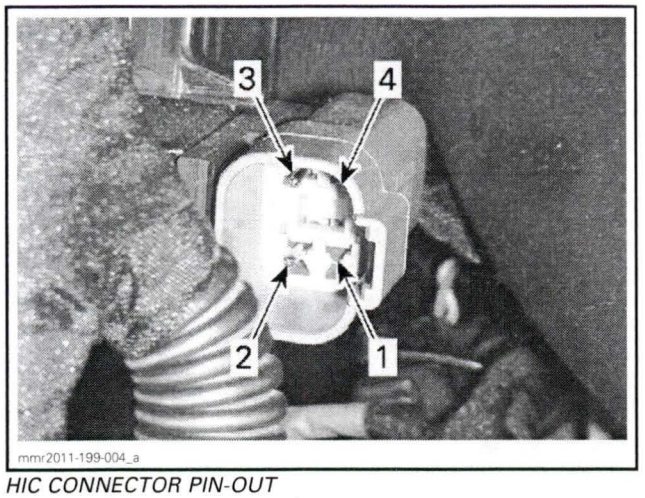
If resistance value obtained is correct, carry out a *FUEL INJECTOR INPUT VOLTAGE TEST.*

If resistance value obtained is incorrect, repeat test at HIC connector located on front side of ECM support.

FUEL INJECTOR RESISTANCE TEST AT HIC CONNECTOR			
INJECTOR	**HIC CONNECTOR**	**ECM CONNECTOR "A"**	**RESISTANCE @ 20°C (68°F)**
PTO	Pin 2	A-1J	12 ± 0.6 Ω
MAG	Pin 3	A-1K	



HIC CONNECTOR LOCATION
1. *HIC connector*
2. *ECM support*
3. *Engine valve cover*



HIC CONNECTOR PIN-OUT

If resistance value obtained is incorrect, carry out a *FUEL INJECTOR RESISTANCE TEST AT COMPONENT.*

Fuel Injector Resistance Test at Component

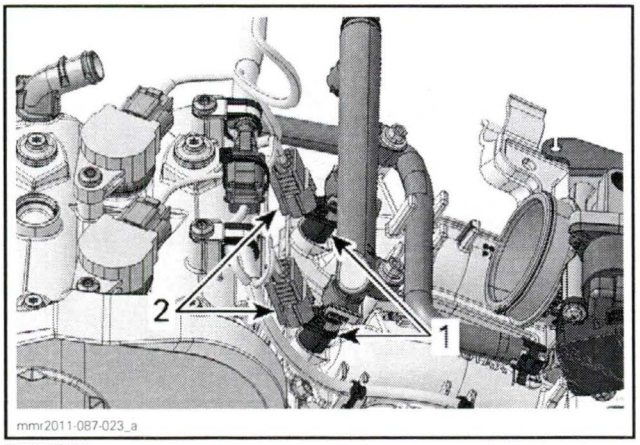
1. Remove injector connector, refer to *FUEL INJECTOR ACCESS* in this subsection.
2. Check resistance value between injector pins as follows.

FUEL INJECTOR RESISTANCE TEST AT INJECTOR		
INJECTOR PIN		RESISTANCE @ 20°C (68°F)
1	2	12 ± 0.6 Ω

If readings are out of specifications, replace injector.

Fuel Injector Input Voltage Test

1. Ensure both ECM connectors are properly connected.
2. Ensure the HIC connector is properly connected.
3. Disconnect the fuel injector connector. Refer to *FUEL INJECTOR ACCESS* in this subsection.



TYPICAL
1. *Fuel Injectors*
2. *Fuel Injector connectors*

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

4. Ensure fuse F5 (HIC fuse) is properly installed.
5. Set emergency engine stop switch to STOP to prevent engine starting.
6. Install tether cord on engine cut-off switch.

NOTE: With tether cord installed on engine cut-off switch, vehicle electrical power will stay on for approximately 20 seconds.

7. Momentarily press the START/RER button to wake up the ECM.

NOTE: It is not necessary to activate the injector since it is continuously powered when the ECM is awake.

8. Use a multimeter and set it to Vdc. Read voltage.

CYLINDER	INJECTOR CONNECTOR WIRE		MEASUREMENT
PTO	VIOLET/ BLUE	Battery ground	Approximately 12 Vdc
MAG	VIOLET/ GREEN		

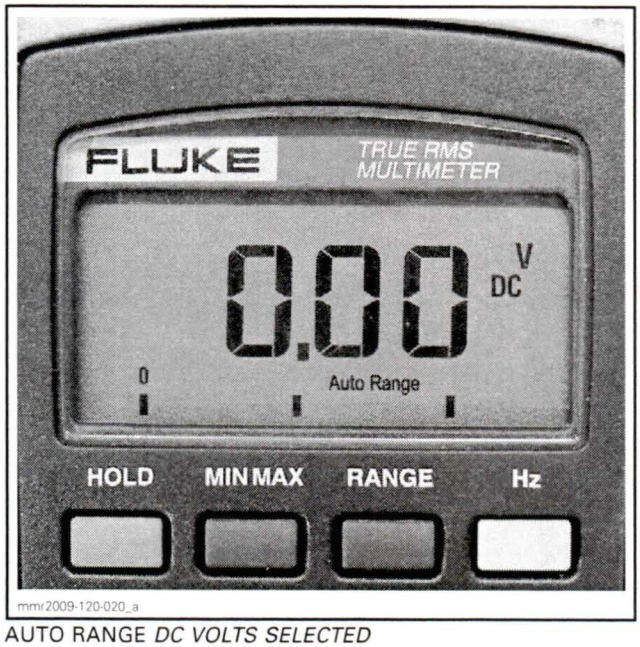
If injector input voltage is good, carry out the following:
- Circuit continuity test between injector and ECM
- *FUEL INJECTOR SIGNAL TEST* further in this subsection.

If injector input voltage is not good, check the following:
- Fuse F5 (HIC fuse)
- Circuit continuity between fuse F5 and injector.

Fuel Injector Signal Test

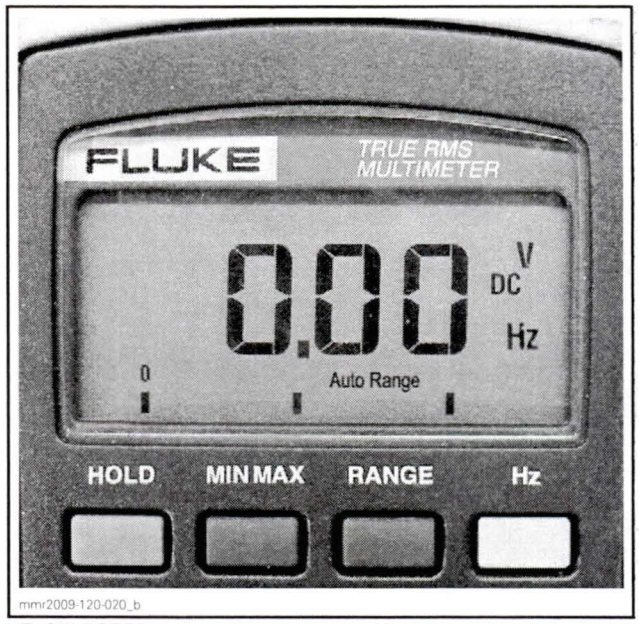
1. Connect vehicle to the applicable B.U.D.S. version. Refer to *COMMUNICATION TOOLS AND B.U.D.S. SOFTWARE.*
2. In B.U.D.S., select the **Activation** page tab.
3. Use the FLUKE 115 MULTIMETER (P/N 529 035 868) and set it to Vdc.

NOTE: Make sure multimeter is in the **Auto Range** mode.



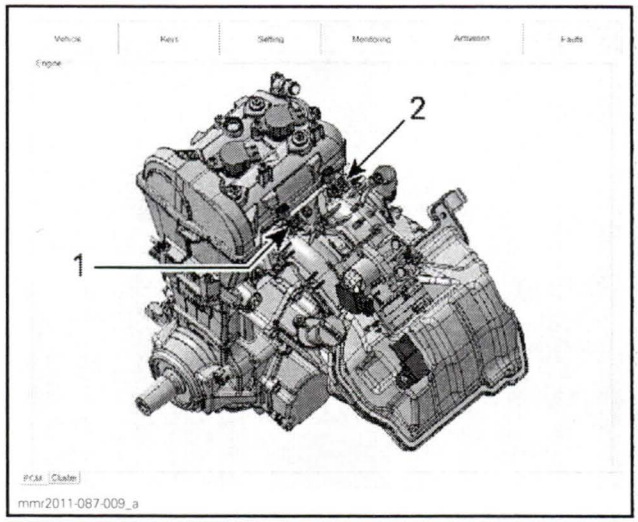
AUTO RANGE *DC VOLTS SELECTED*

4. Press the **Hz** button so that the display shows Hz.



HZ *SELECTED*

5. Connect the multimeter probes as indicated in the following table and using the B.U.D.S. software, activate each injector and read the frequency on the multimeter.



INJECTOR ACTIVATION IN B.U.D.S.
1. *Click on PTO injector to activate*
2. *Click on MAG injector to activate*

NOTE: The multimeter counts the pulses per seconds (Hertz) of current the ECM sends to the injector.

INJECTOR	INJECTOR CONNECTOR CONTACT	BATTERY	MEASUREMENT
PTO	BROWN/ RED wire	Battery ground	Approximately 9 Hz
MAG	BROWN/ BLUE wire		

If reading is good, the control circuit is functional.

If there is no reading, check continuity of control circuit (ECM to injectors).

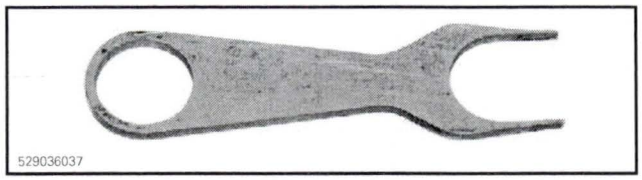
Fuel Injector Removal

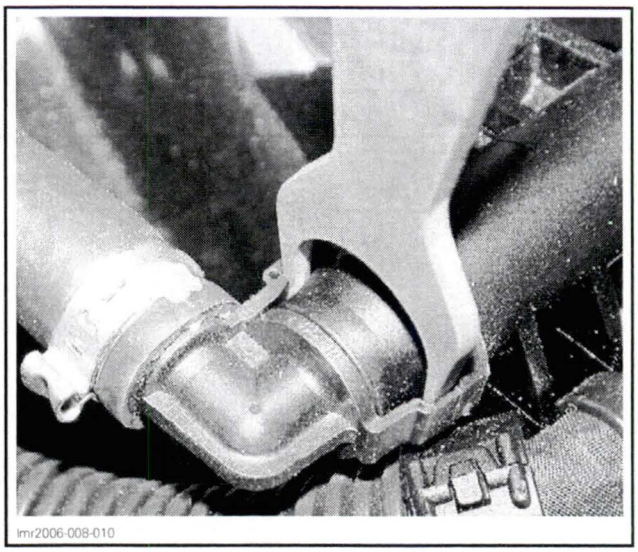
1. Disconnect fuel pump electrical connector, refer to *FUEL TANK AND FUEL PUMP (600 HO E-TEC AND 60 ACE)* subsection.
2. Start engine and let run until it runs out of fuel.
3. Disconnect the battery, refer to *CHARGING SYSTEM* subsection.

⚠ WARNING

When removing or disconnecting the fuel injectors, always remove the tether cord from the engine cut-off switch and disconnect the battery.

4. Remove parts required for access to the fuel rail and fuel injectors, refer to *FUEL INJECTOR ACCESS*.
5. Disconnect the fuel injector electrical connectors.
6. Disconnect the fuel pressure hose from the fuel rail using the FUEL HOSE DISCONNECT TOOL (P/N 529 036 037).

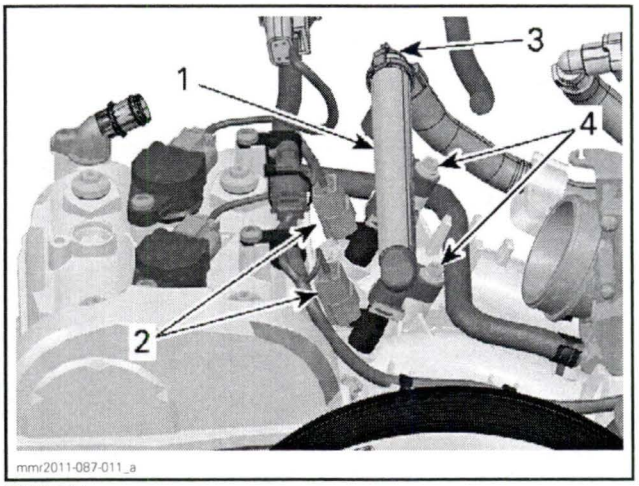




NOTE: It may be necessary to rotate fuel hose fitting to align the tool ends with the openings of the locking mechanism.

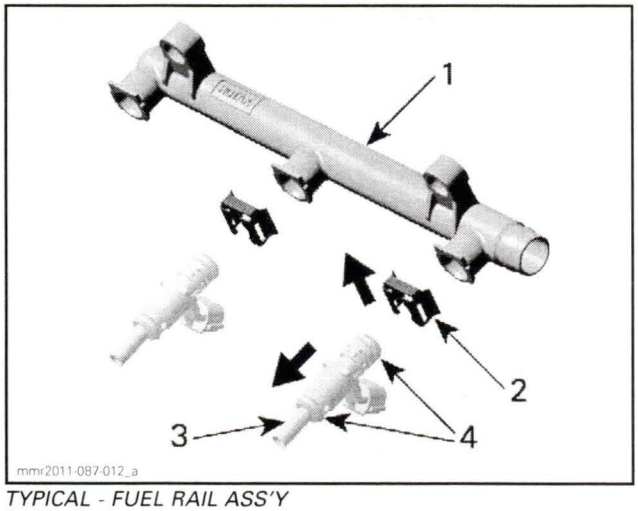
NOTE: Wrap a rag around the hose end to catch any fuel leakage.

7. Remove the fuel rail mounting screws (2).



TYPICAL
1. *Fuel rail*
2. *Injector connectors*
3. *Fuel pressure hose disconnect*
4. *Fuel rail mounting screws*

8. Pull on fuel rail to remove the fuel rail and injectors from the engine.
9. Remove the fuel injector retaining clips (2) from the fuel rail.



TYPICAL - FUEL RAIL ASS'Y
1. *Fuel rail*
2. *Fuel injector retaining clip*
3. *Injector*
4. *Injector O-rings*

10. Pull the fuel injector(s) out of the fuel rail.

Fuel Injector Installation

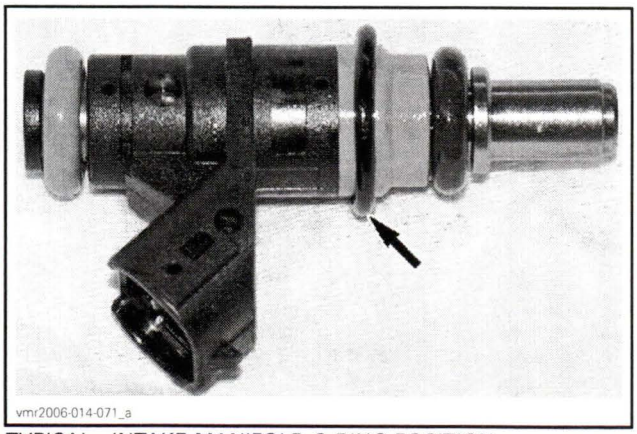
For the installation, reverse the removal procedure however, pay attention to the following details.

NOTICE **If installing the removed injector(s), ensure injector O-rings are in good condition. Replace O-rings as required.**

1. Apply a thin film of engine oil to O-rings to ease insertion in rail.
2. Install fuel injector with your hand. **Do not** use any tool.

FUEL INJECTOR INSTALLATION		
O-RINGS	New	Lubricate with engine oil

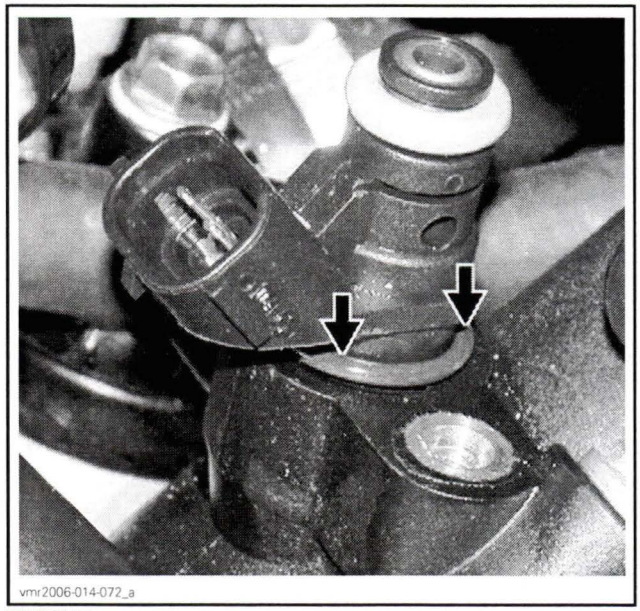
3. Ensure proper positioning of the intake manifold O-ring on injector as in following illustration.



TYPICAL - INTAKE MANIFOLD O-RING POSITION

4. Carefully insert injector in air intake manifold paying attention to the manifold O-ring.

NOTICE **Gently push O-ring in evenly all around while inserting injector. O-ring must be completely inserted and not visible, before completing the insertion of the injector.**

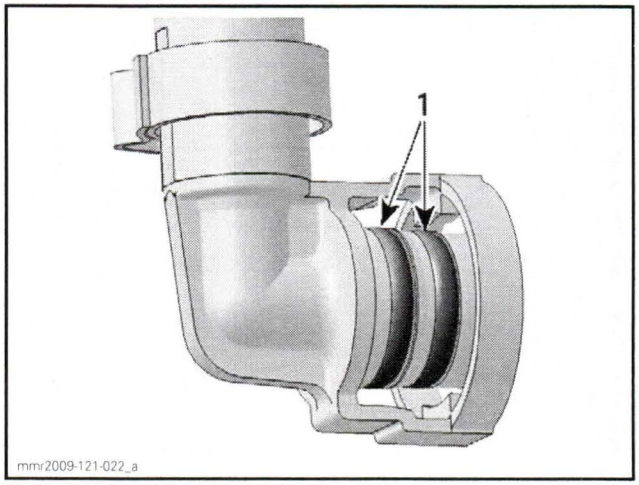


TYPICAL

5. Firmly push injector until it bottoms out.
6. Install fuel rail.

FUEL RAIL RETAINING SCREW TORQUE
11 N•m (97 lbf•**in**)

7. Apply engine oil on O-rings of fuel pressure hose fitting.



FUEL PRESSURE HOSE FITTING
1. *Apply oil on O-rings*

8. Connect fuel pressure hose to fuel rail.

IMPORTANT: Push fuel hose fitting on fuel rail until you hear a "click". Try pulling on fuel hose fitting to ensure it is properly locked.

Pressurize the fuel system and check for fuel leaks. Refer to *FUEL SYSTEM PRESSURIZATION* in *FUEL TANK AND FUEL PUMP* subsection.

⚠ WARNING

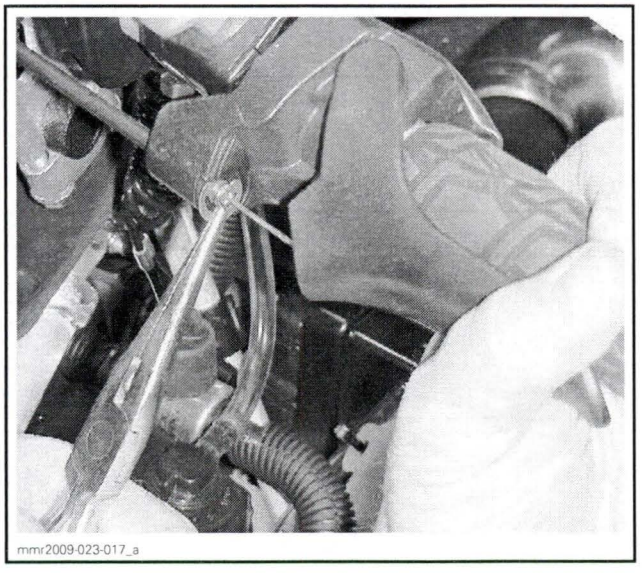
Failure to pressurize the fuel system and checking for fuel leaks may result in severe injury or a life threatening situation should a leak occur.

9. Reinstall all remaining removed parts.

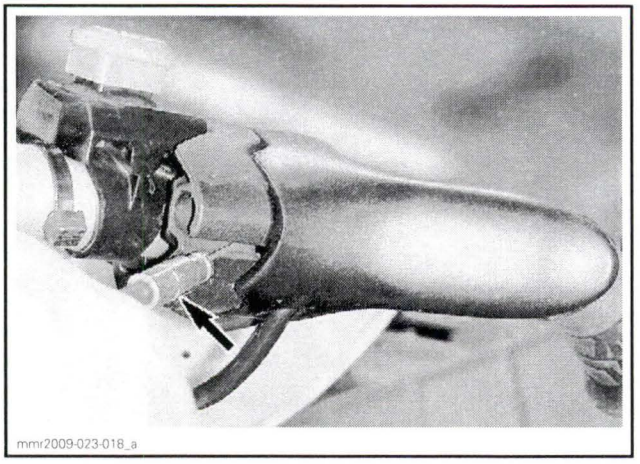
THROTTLE CABLE

Throttle Cable Removal

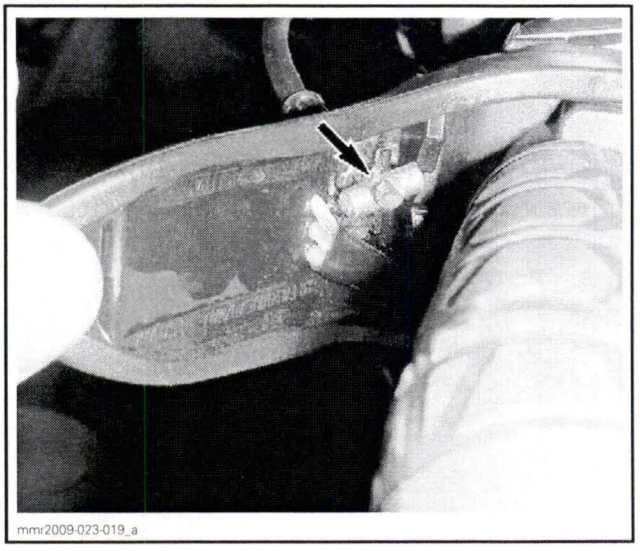
1. Remove handlebar cover.
2. Depress and hold throttle lever.
3. Pull out circlip using long nose pliers. Keep circlip for re-use.



4. Pull throttle cable out of throttle lever housing.



5. Unhook cable barrel end from throttle lever and remove cable from throttle lever.

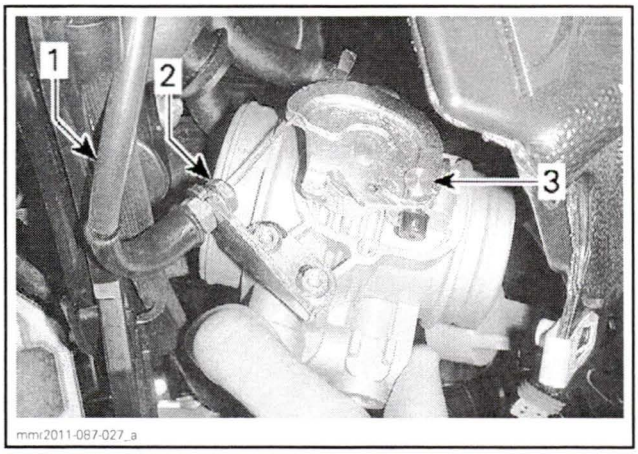


6. Take note of factory throttle cable routing before removal.
7. Refer to *THROTTLE BODY REMOVAL* and remove the throttle body from the intake manifold.

NOTE: DO NOT disconnect the coolant hoses from the throttle body.

8. Pull out and turn throttle body towards you for access to throttle cable attachment. See following illustration.
9. Remove throttle cable retaining nut and pull cable out through the slot in the cable support.
10. Detach throttle cable from the throttle plate actuating cam.

NOTE: Be careful not to drop the throttle cable retainer when removing it from the throttle plate actuating cam.



1. Throttle cable
2. Throttle cable retaining nut
3. Throttle cable retainer

11. Remove throttle cable from vehicle.

Throttle Cable Installation

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

1. Route cable as per factory installation as noted before removal.

NOTICE **Do not alter throttle cable routing. Incorrect cable routing may cause the engine to be difficult to start or to idle erratically.**

2. Ensure cable ends are properly secured in the throttle lever and throttle plate actuating cam.

THROTTLE CABLE RETAINING NUT TORQUE (AT THROTTLE BODY)
4.5 N•m (40 lbf•**in**)

3. Proceed with a *THROTTLE CABLE ADJUSTMENT* as described in this subsection.

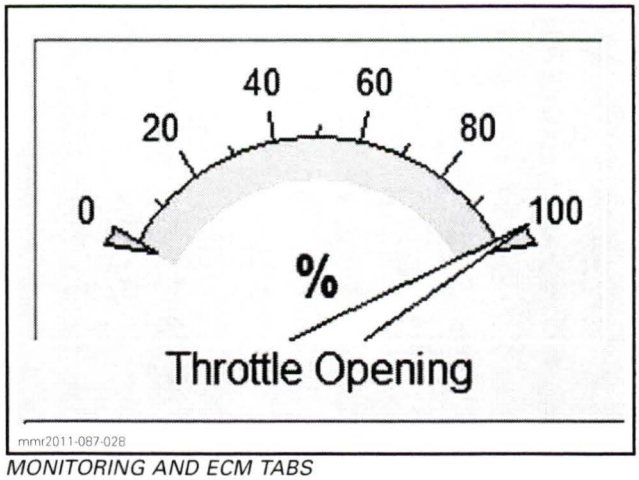
Throttle Cable Adjustment

Wide Open Throttle Adjustment

1. Position handlebar in the straight ahead position.
2. Connect vehicle to the applicable B.U.D.S. software. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
3. In B.U.D.S., select the following:
   - **Monitoring** page tab
   - **ECM** page.
4. Observe the throttle opening in B.U.D.S. while holding throttle lever at wide open throttle (WOT).

The displayed value must be within the following specification.

WIDE OPEN THROTTLE READING IN B.U.D.S.
95 to 100%

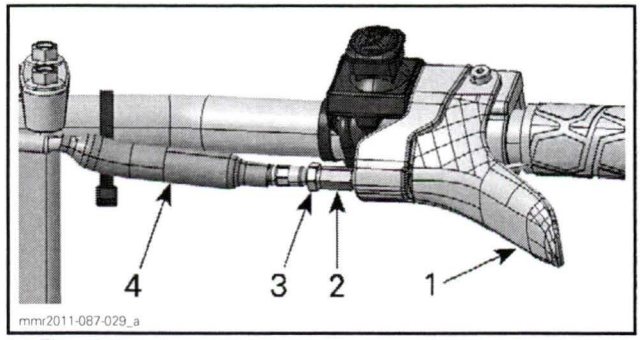


MONITORING AND ECM TABS

NOTE: There will be no performance loss as long as the throttle opening is within the specification.

If reading is not within specification, adjust throttle cable.

5. Pull protector back from throttle cable adjuster.
6. Loosen lock nut on the cable adjuster.



1. Throttle lever
2. Cable adjuster
3. Adjuster lock nut
4. Adjuster protector

7. Set cable adjuster as required to obtain specified throttle opening in B.U.D.S., then tighten lock nut.

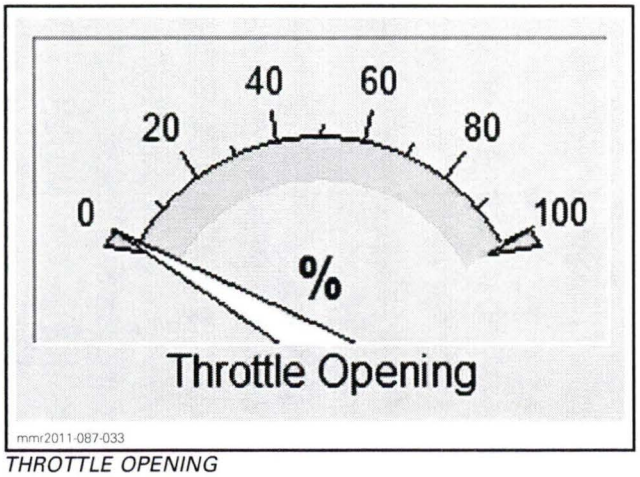
NOTE: If value is below the minimum, tighten throttle cable adjuster. If value is above the maximum value, loosen throttle cable adjuster.

LOCK NUT TORQUE (THROTTLE CABLE ADJUSTER)
2.5 N•m (22 lbf•**in**)

8. Turn handlebar side to side and ensure adjustment is still within the specification in each position while at WOT.
9. Carry out the *IDLE POSITION VERIFICATION.*

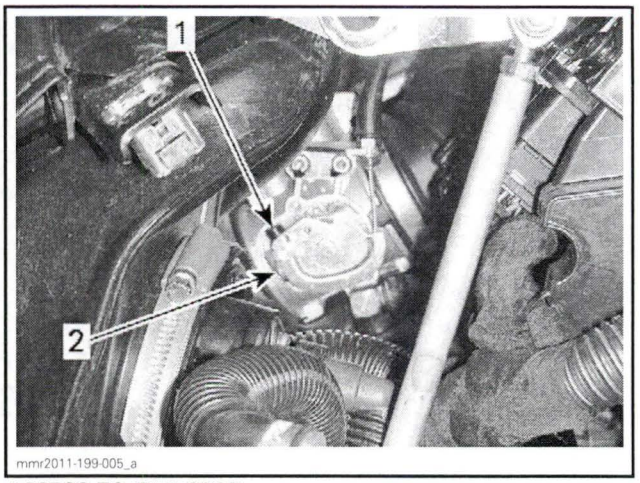
Idle Position Verification

1. Apply and release throttle lever a few times.
2. While throttle is released, ensure the following:
   - Throttle cam idle stop rests against the idle stop screw
   - No tension on throttle cable
   - There is some throttle free-play between throttle lever and housing.
   - The throttle opening indicated in B.U.D.S. is zero (0).

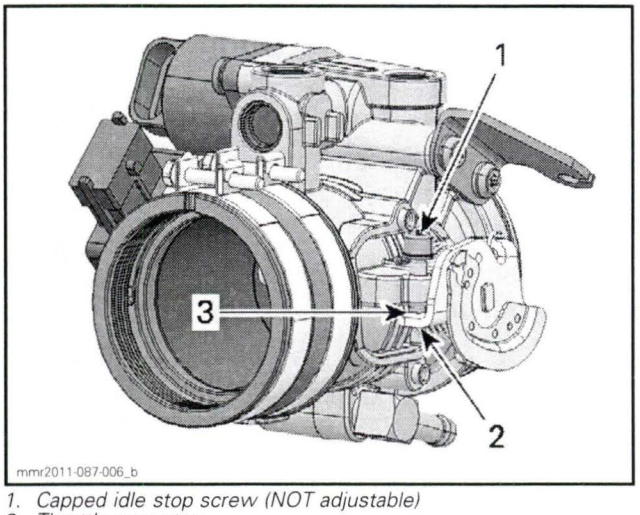


THROTTLE OPENING

NOTE: To see the throttle cam and the idle stop screw contact, look in from the RH side of the vehicle using a flashlight and a mechanics mirror.



ACCESS TO IDLE STOP
1. *Capped idle stop screw (NOT adjustable)*
2. *Look for idle stop screw contact here*



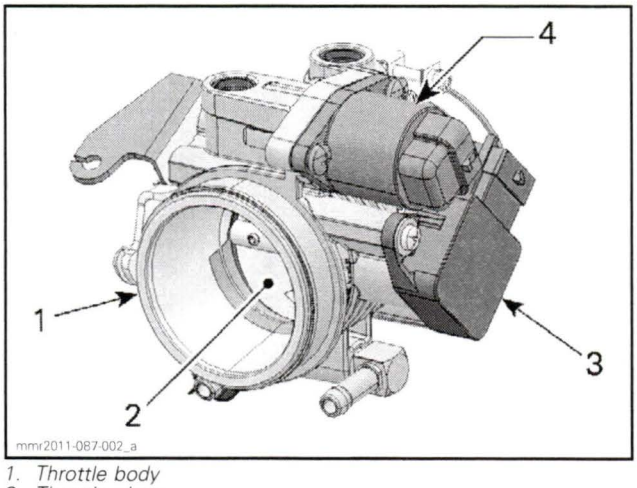
1. *Capped idle stop screw (NOT adjustable)*
2. *Throttle cam stop*
3. *Contact here*

3. If the specified conditions are not met, adjust throttle cable as detailed in *WIDE OPEN THROTTLE ADJUSTMENT.*
4. If all conditions are met except for the throttle opening indication in B.U.D.S., carry out the *CLOSED THROTTLE RESET* procedure as described in this subsection.

NOTICE **If there is no free-play at the idle position, it may cause the engine to be difficult to start, or to idle erratically.**

THROTTLE BODY

Throttle Body Description



1. *Throttle body*
2. *Throttle plate*
3. *Throttle position sensor (TPS) (inside)*
4. *Idle air control valve (IACV)*

Throttle Body Access

1. Refer to *BODY* subsection and remove the LH side body panel.
2. Remove the drive belt guard, refer to *DRIVE SYSTEM AND BRAKE* subsection.
3. If removing, inspecting or cleaning throttle body, refer to *AIR INTAKE SYSTEM* and remove the throttle body hose adapter from air intake silencer.

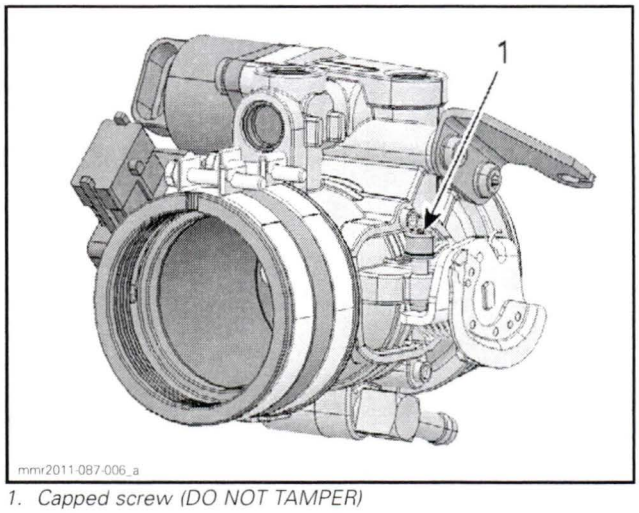
Throttle Body Lubrication

No lubrication is required.

Throttle Body Inspection

1. Remove parts required to access throttle body, refer to *THROTTLE BODY ACCESS*.

NOTICE **Never attempt to adjust the capped idle stop screw. It is calibrated at the factory. If the screw adjustment is changed, the throttle body must be replaced.**



1. *Capped screw (DO NOT TAMPER)*

2. Carry out the following:
   - Inspect throttle body for cleanliness.
   - Ensure throttle plate opens fully and smoothly.
   - Check if throttle body idle stop screw is loose or worn. If so, throttle body must be replaced.
   - Check if TPS (throttle position sensor) is loose).
   - Check for a dirty or loose IACV (idle air control valve).
   - Check for corroded or damaged wiring or connectors on TPS and IACV.

Throttle Body Cleaning

1. Remove parts required to access throttle body, refer to *THROTTLE BODY ACCESS*.
2. Check throttle body cleanliness using a flashlight. Fully open throttle plate and verify:
   - Throttle body bore
   - Throttle plate edge.

   Look for:
   - Dirt
   - Oily surfaces
   - Carbon and salt deposits on throttle plate and the surrounding bore.
3. Clean as necessary.
4. To clean throttle body, remove throttle body from intake manifold without disconnecting the throttle cable and hoses. Refer to *THROTTLE BODY REMOVAL* further in this subsection.
5. Use a throttle body cleaner such as GUNK INTAKE MEDIC or an equivalent.

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

⚠ CAUTION Use the product in a well ventilated area. Refer to product manufacturer's warnings.

6. To avoid getting dirt into engine, spray cleaner on a clean rag then rub rag against throttle plate and bore. A toothbrush may also be used.
7. Gently open throttle plate and hold fully open to clean all surfaces.
8. To remove residual dirt, spray cleaner on throttle plate and and throttle bore.

NOTE: If the engine idle speed is not stable, also remove and clean the IACV. Refer to *IDLE AIR CONTROL VALVE (IACV)* further in this subsection.

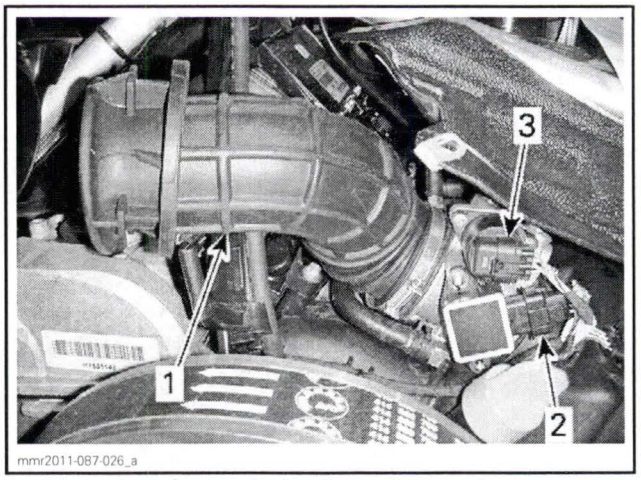
9. Reinstall all removed parts.

Throttle Body Removal

⚠ WARNING

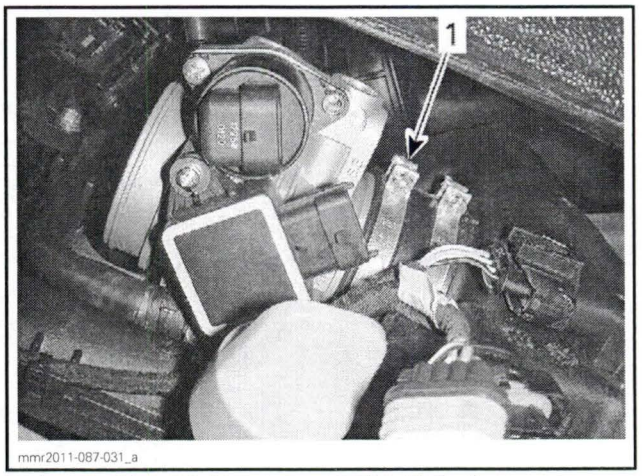
When electrically disconnecting or removing the throttle body from the intake manifold, or the idle air control valve (IACV) from the throttle body, always remove the tether cord from the engine cut-off switch and disconnect the battery.

1. Remove parts required to access throttle body, refer to *THROTTLE BODY ACCESS*.
2. Disconnect TPS connector (throttle position sensor).
3. Disconnect IACV connector (idle air control valve).



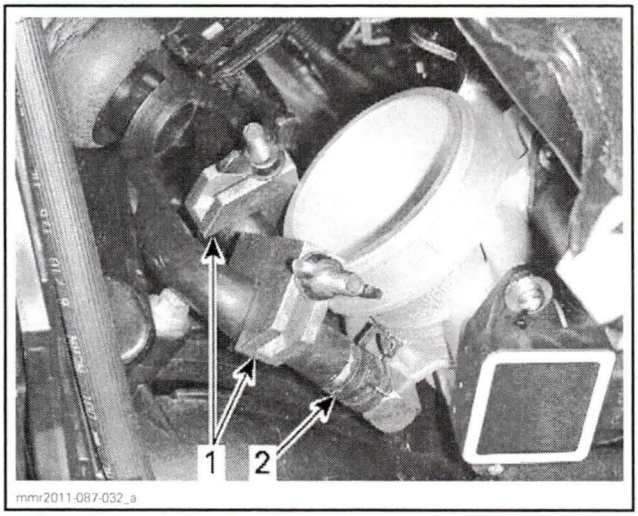
1. Adapter hose from air intake silencer (removed)
2. TPS connector
3. IACV connector

4. Loosen gear clamp and remove throttle body from intake manifold adapter.



1. Loosen this gear clamp to remove throttle body

5. Disconnect throttle cable from throttle body, refer to *THROTTLE CABLE REMOVAL* in this subsection.
6. Install a SMALL HOSE PINCHER (P/N 295 000 076) on each coolant hose connected to throttle body.
7. Disconnect coolant hoses from throttle body.



1. Small hose pinchers on coolant hoses
2. Disconnect hoses here (2)

Throttle Body Installation

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

1. Install throttle cable on throttle body, refer to *THROTTLE CABLE INSTALLATION*.
2. Install throttle body on intake manifold.
3. Install coolant hoses on throttle body; replace clamps as required.
4. Refill and bleed cooling system as required. Refer to *COOLING SYSTEM*.
5. Carry out the *WIDE OPEN THROTTLE ADJUSTMENT* and *IDLE POSITION VERIFICATION* procedures as described in this subsection.

NOTE: If the throttle body was replaced, perform a *CLOSED THROTTLE RESET* and an *IACV AUTO RESET* procedures as described in this subsection.

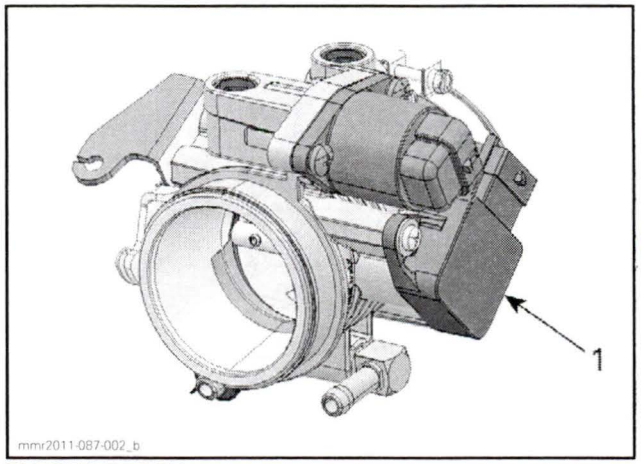
6. Install all remaining removed parts, refer to applicable subsections.
7. Start engine and ensure proper idle and throttle control.

THROTTLE POSITION SENSOR (TPS)

TPS Description

The throttle position sensor (TPS) is a potentiometer that sends a signal to the ECM that is proportional to the throttle plate angle.

The TPS is attached to the side of the throttle body.



THROTTLE BODY
1. Throttle position sensor (TPS)

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

Throttle Position Sensor Access

Open the LH side body panel, refer to *BODY* subsection.

Closed Throttle Reset

General Information

This operation performs a reset of the basic TPS (throttle position sensor) values stored in the ECM when the throttle is closed. This reset is very important as the setting of the TPS will determine the basic parameters for all fuel mapping and several ECM calculations for idle speed control of the engine.

A closed throttle reset must be carried out if the :
- TPS is loosened, removed or replaced
- Throttle body is replaced
- ECM is replaced.

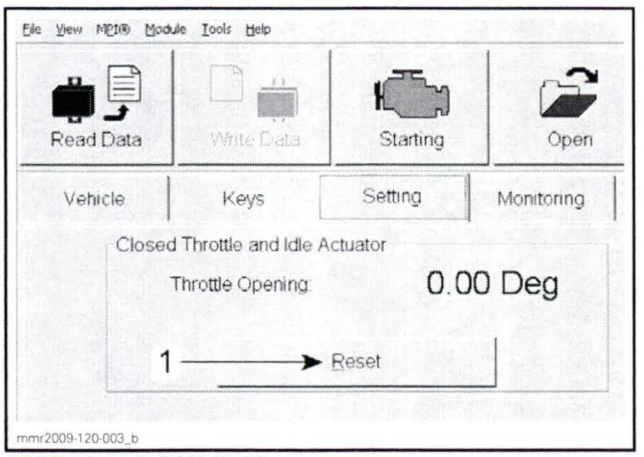
NOTICE **A *CLOSED THROTTLE RESET* must be carried out anytime the TPS has been loosened, removed or replaced. An improperly set TPS may lead to poor engine performance, engine stalls, fault codes and possible engine damage. Emission compliance may also be affected.**

Closed Throttle Reset Procedure

1. Remove the LH and RH side body panels, refer to *BODY* subsection.
2. Connect vehicle to the applicable B.U.D.S. software version, refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
3. Open throttle approximately one quarter travel, then quickly release.

NOTE: Repeat 2 - 3 times to settle throttle plate.

4. Ensure the throttle cam stop rests against the idle stop screw without any tension in the cable. Refer to the *IDLE POSITION VERIFICATION* procedure in this subsection.
5. If the throttle cam stop does not contact the idle stop screw, perform the *WIDE OPEN THROTTLE CABLE ADJUSTMENT* and the *IDLE POSITION VERIFICATION* procedures. Refer to *THROTTLE CABLE ADJUSTMENT* in this subsection.
6. In B.U.D.S., click on the **Reset** button.



SETTING AND ECM TABS
1. Click Reset

A message will be displayed if the operation is successful.

IMPORTANT: If the TPS is not within the allowed range when the **Closed Throttle Reset** is carried out, B.U.D.S. will display a message box and will not accept the setting.

7. If a fault message box is displayed:
   - Follow the instructions in the message box(s).
   - Check throttle cable adjustment.
   - Check for fault codes, refer to *DIAGNOSTIC AND FAULT CODES*.
   - Carry out the service actions.
   - Reset the fault.
   - Repeat the closed throttle reset procedure.

If all of the previous steps have been carried out and the closed throttle reset cannot be carried out successfully, the engine will not start or will not idle properly, carry out the following:

- Exit B.U.D.S.
- Remove the tether cord from engine cut-off switch.
- Wait for the ECM to shut down.
- Perform an *IACV AUTO RESET* procedure as described in this subsection.
- Connect vehicle to the applicable B.U.D.S. software version, refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
- Perform another *CLOSED THROTTLE RESET* procedure.

8. Start engine and make sure it operates normally throughout its full RPM range.

TPS Wear Test

1. Ensure TPS connector is properly connected.
2. With the engine **turned off**, slowly apply throttle and pay attention for smooth operation without physical stops.
3. Connect vehicle to the applicable B.U.D.S. software version. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
4. In B.U.D.S., select the following:
   - **Monitoring** page tab
   - **ECM** page tab.
5. Slowly and regularly apply and release the throttle while observing the **Throttle Opening** indication in B.U.D.S.



MONITORING AND ECM TABS

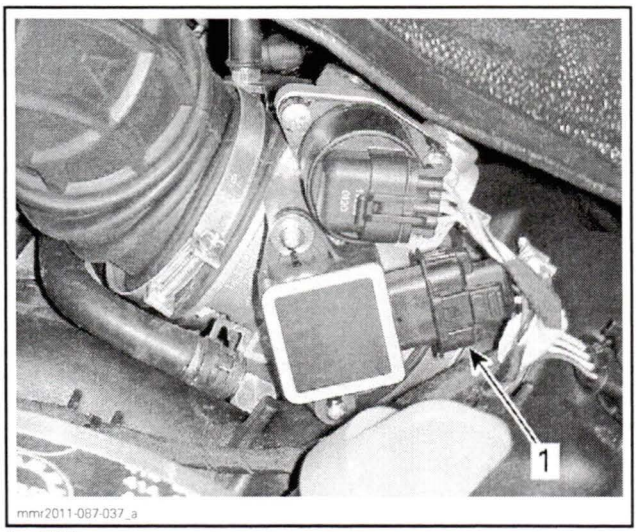
NOTE: The needle should move gradually and regularly as you move the throttle. If the TPS indication is erratic or suddenly drops off, it may indicate a worn TPS that needs to be replaced. An initial slight delay after the throttle is applied and before the needle starts to move is normal.

If the indication does not move as expected, perform the *TPS INPUT VOLTAGE TEST*.

TPS Input Voltage Test

1. Remove parts required to access throttle body, refer to *THROTTLE BODY ACCESS* in this subsection.

2. If connected to B.U.D.S., disconnect the T-HARNESS (P/N 529 035 869) from the vehicle diagnostic connector.
3. Disconnect the TPS connector.



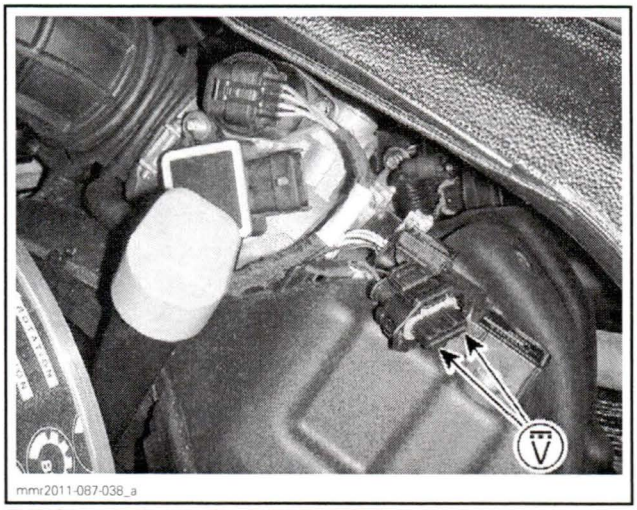
1. TPS connector

4. Install the tether cord on the engine cut-off switch.

NOTE: Installing the tether cord allows electrical power to stay on for approximately 40 seconds.

5. Use the FLUKE 115 MULTIMETER (P/N 529 035 868) and set it to Vdc.
6. Briefly press the START/RER button.
7. Read voltage at TPS harness connector as follows.

TPS HARNESS CONNECTOR		VOLTAGE
Pin 1	Pin 2	3.3 Vdc



TYPICAL - TPS INPUT VOLTAGE TEST

If voltage is good, carry out the *TPS SIGNAL WIRE TEST*.

TPS Signal Wire Test

1. Remove parts required to access the ECM connectors, refer to *ECM CONNECTOR ACCESS* in this subsection.
2. Disconnect the "A" connector from the ECM and install it on the ECM ADAPTER TOOL (P/N 529 036 166).
3. Test for continuity as follows.

TPS HARNESS CONNECTOR	ECM A CONNECTOR	RESISTANCE
Pin 3	Pin 3F	Close to 0 Ω (continuity)

If the TPS signal wire tests good, carry out the *TPS RESISTANCE TEST* before assuming the TPS is at fault.

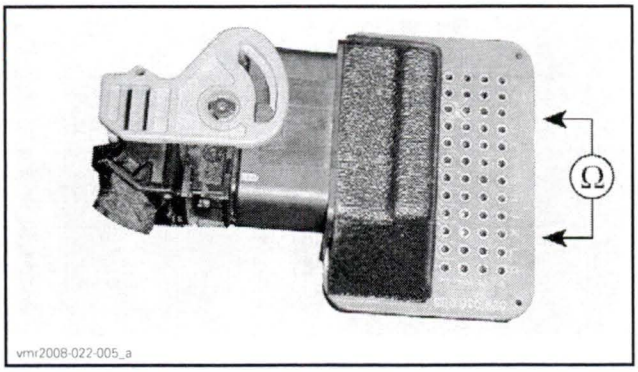
If the TPS signal wire does not test good, repair or replace wiring and connectors.

TPS Resistance Test

1. Remove parts required to fully access the throttle body, refer to *THROTTLE BODY ACCESS* in this subsection.
2. Ensure the TPS connector is properly connected.
3. Ensure ECM connector A is properly installed on the ECM ADAPTER TOOL (P/N 529 036 166).
4. Use the FLUKE 115 MULTIMETER (P/N 529 035 868) and select Ω.
5. Probe circuit as per following table while using your hand to manually move throttle plate.

IMPORTANT: For the WOT measurement, manually open the throttle plate until the throttle cam touches its stopper. Using the throttle lever on the handlebar will not fully open the throttle plate.

ECM ADAPTER		THROTTLE IDLE POSITION	WIDE OPEN THROTTLE POSITION
PIN		RESISTANCE Ω	
3F	4K	2390 - 2810	880 - 1300
4K	2A	1600 - 2400	1600 - 2460
3F	2A	880 - 1300	2390 - 2810

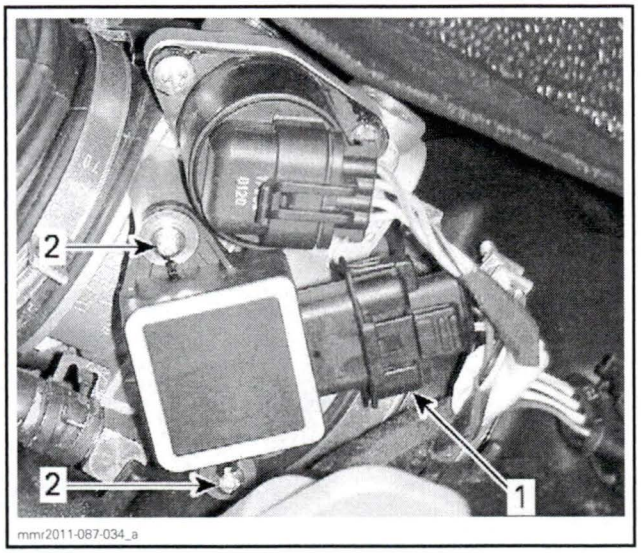


If resistance values are correct, try a new ECM. Refer to *ENGINE CONTROL MODULE (ECM)* in this subsection.

If any resistance value is incorrect, replace the TPS.

TPS Removal

1. Remove parts required to access the LH side of the throttle body, refer to *THROTTLE BODY ACCESS* in this subsection.
2. Disconnect the TPS connector.
3. Remove the TPS retaining screws (2).



1. TPS connector
2. TPS retaining screws

4. Pull the TPS from the throttle body.

TPS Installation

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

TPS INSTALLATION	
O-RING	SERVICE PRODUCT
	APPLY ENGINE OIL ON O-RING
MOUNTING SCREWS	SERVICE PRODUCT
	LOCTITE 243 (BLUE) (P/N 293 800 060)
	TORQUE
	3 N•m (27 lbf•**in**)

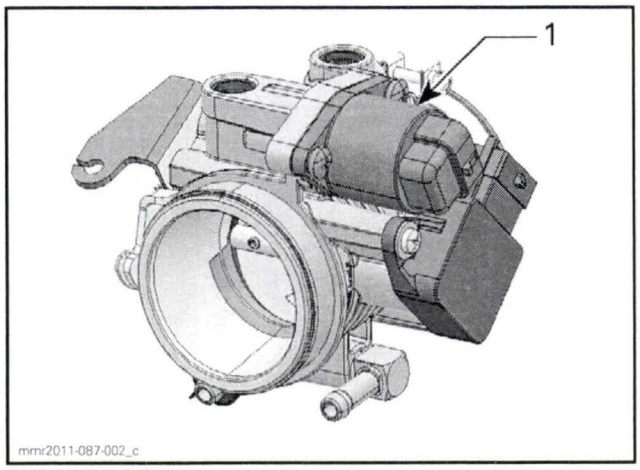
Carry out a *CLOSED THROTTLE RESET* as described in this subsection.

NOTICE **A closed throttle reset must be carried out anytime the TPS has been loosened, removed or replaced. An improperly set TPS may lead to poor engine performance, engine stalls, fault codes and possible engine damage. Emission compliance may also be affected.**

IDLE AIR CONTROL VALVE (IACV)

If the IACV is to be removed, refer to *IACV REMOVAL* in this subsection. Important instructions are given to prevent damaging the IACV.

NOTICE **Do not perform any test on the IACV when it is disassembled, otherwise it will be damaged.**



THROTTLE BODY
1. Idle air control valve (IACV)

IACV Auto Reset

When the engine is shut down, just before the ECM turns off, the IACV will completely close to find its zero position. It will then back out a number of steps and park to this reference position.

If idle speed is not stable or is inaccurate, reset the IACV as follows:

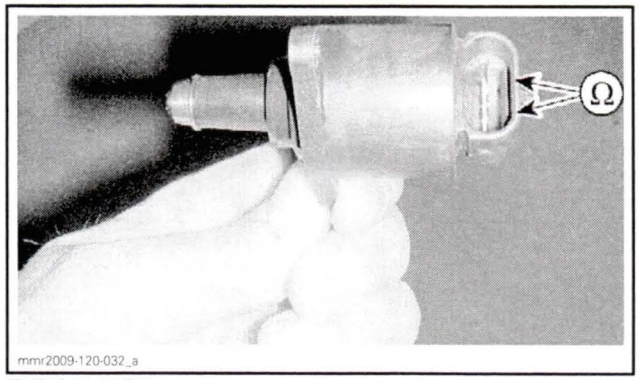
1. Power the ECM by briefly by pressing the START/RER button.
2. Remove the tether cord from engine cut-off switch.
3. Wait until multifunction gauge turns off.
4. Repeat the procedure 2 - 3 times.

IACV Resistance Test (at Component)

NOTE: An idle air control valve with good resistance measurements can still be faulty. A mechanical failure may occur which, may not detectable without measuring the air flow. Replacing the IACV may be necessary as a test.

1. Remove LH side body panel, refer to *BODY* subsection.
2. Disconnect IACV connector.
3. Remove IACV from intake manifold.
4. Check the resistance between pins as follows.

IACV		MEASUREMENT
PIN		RESISTANCE @ 20°C (68°F)
1	4	Approximately 50 Ω
2	3	



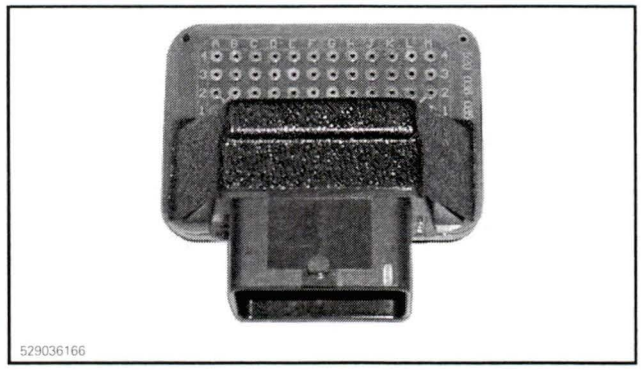
TYPICAL IACV

If the resistance is not as specified, replace the IACV.

If resistance test is good, refer to *IACV RESISTANCE TEST (AT ECM CONNECTOR.*

IACV Resistance Test (at ECM Connector)

1. Reconnect IACV connector.
2. Remove parts required to access ECM connectors, refer to *ECM CONNECTOR ACCESS* in this subsection.
3. Disconnect ECM-A connector and connect it to the ECM ADAPTER TOOL (P/N 529 036 166).



4. Set multimeter to Ω and read resistance as follows.

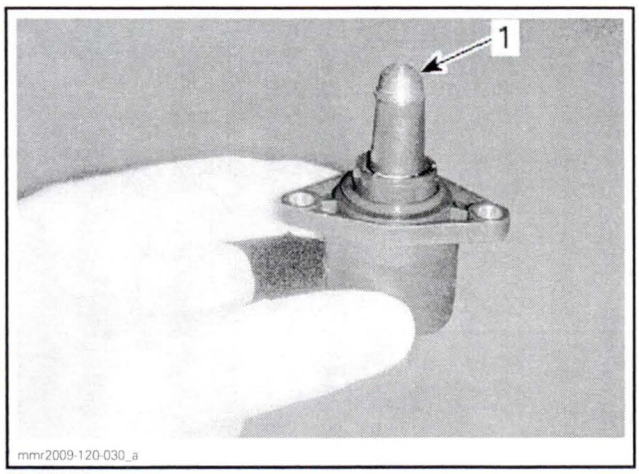
ECM ADAPTER		MEASUREMENT
PIN		RESISTANCE @ 20°C (68°F)
1C	2C	Approximately 50 Ω
2B	4A	

If any resistance test failed, repair/replace wiring/connectors between IACV and ECM.

If resistance tests are good and all valve maintenance and reset procedures have been carried out, check ECM. Refer to *ECM.* in this subsection.

IACV Visual Inspection and Cleaning

1. Refer to *IACV REMOVAL* in this subsection and remove IACV from throttle body. **Important safety instructions** are given.
2. Check the piston and idle air bypass ports in throttle body for dirt or deposits which can cause the piston to stick.



TYPICAL
1. Piston

3. Using a parts cleaner, clean idle bypass port in throttle body of any contamination, then use an air gun to dry it.
4. Install ACV on throttle body.
5. Reconnect the battery.

IACV Removal

NOTICE Do not remove the IACV unless absolutely necessary.

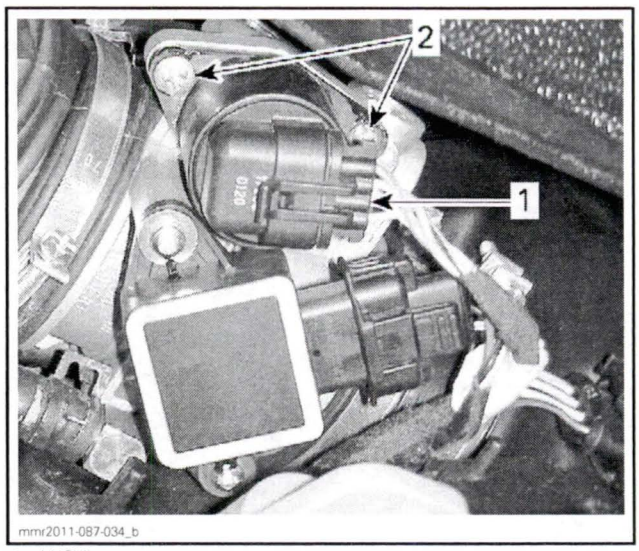
1. Remove tether cord from engine cut-off switch and disconnect the battery.

⚠ WARNING

When electrically disconnecting or removing the throttle body from the intake manifold, or the idle air control valve (IACV) from the throttle body, always remove the tether cord from the engine cut-off switch and disconnect the battery.

NOTICE Do not attempt to operate the piston of the IACV when it is removed from the throttle body. Also do not move the piston by hand. The screw drive is very sensitive and will be damaged.

2. Disconnect IACV connector.
3. Remove IACV retaining screws.

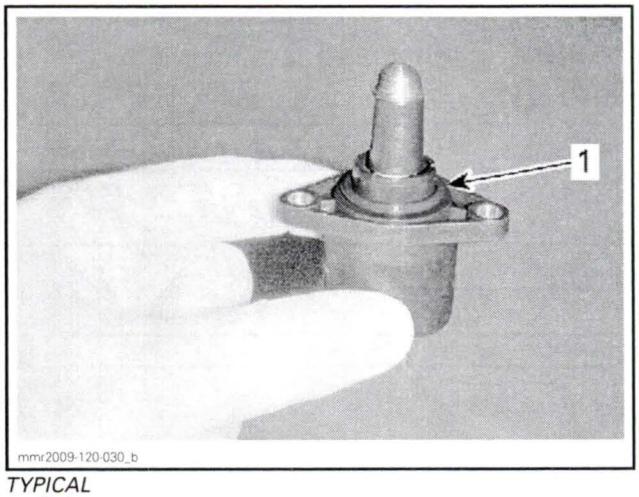


1. IACV connector
2. IACV retaining screws

4. Pull IACV out of throttle body.

IACV Installation

1. Inspect IACV O-ring condition. Replace as necessary.



TYPICAL
1. O-ring

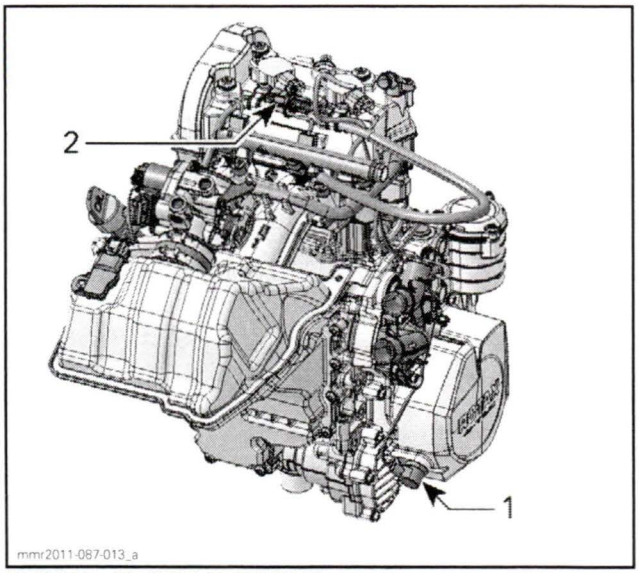
2. Install IACV.

IACV INSTALLATION	
O-RING	SERVICE PRODUCT
	APPLY ENGINE OIL ON O-RING
MOUNTING SCREW	TORQUE
	4.5 N•m (40 lbf•**in**)

3. Carry out an *IACV AUTO RESET*.

CRANKSHAFT POSITION SENSOR (CPS)

CPS and CPS Connector Location



TYPICAL - RH SIDE OF ENGINE
1. *CPS location*
2. *CPS connector location*

NOTE: Take into account that a CPS fault can be triggered by bent or missing encoder wheel teeth. First check fault codes using B.U.D.S., then check the encoder wheel teeth condition if necessary (refer to *MAGNETO SYSTEM*).

CPS Access

1. Remove both side body panels, refer to *BODY* subsection.
2. Remove air intake silencer and headlight/gauge module as a unit, refer to *AIR INTAKE SYSTEM* subsection.
3. Remove muffler, refer to *EXHAUST SYSTEM* subsection.

CPS Resistance Test

1. Remove parts required to access ECM connector, refer to *ECM CONNECTOR ACCESS* in this subsection.
2. Disconnect ECM-A connector, refer to *ECM CONNECTOR ACCESS*.
3. Connect ECM-A connector to the ECM adapter.

ECM ADAPTER TOOL (P/N 529 036 166)	

4. Set the FLUKE 115 MULTIMETER (P/N 529 035 868) to Ω.



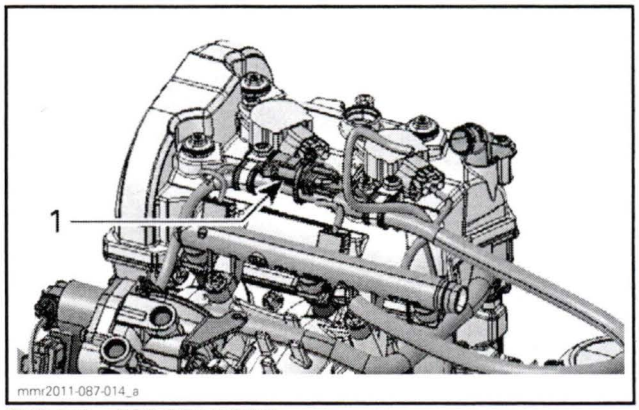
5. Measure the resistance of the sensor as per following table.

ECM A CONNECTOR		RESISTANCE @ 20°C (68°F)
Pin 1-H	Pin 2-K	775 - 950 Ω

If resistance is as specified, test continuity of wiring between ECM-A and CPS connectors.

If resistance value is not as specified, reconnect ECM-A connector to the ECM and carry on with the following steps.

6. Remove air intake silencer and headlight/gauge module, refer to *AIR INTAKE SYSTEM* subsection.
7. Disconnect CPS wiring harness connector.



TYPICAL - TOP OF ENGINE
1. *CPS connector location*

8. Probe CPS connector terminals as per following table.

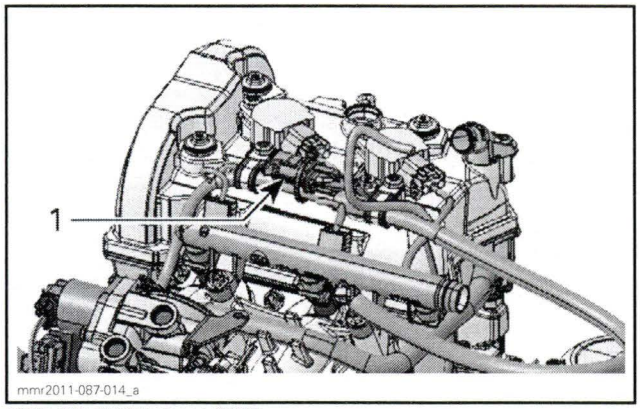
CPS CONNECTOR		MEASUREMENT
PIN		RESISTANCE Ω @ 20°C (68°F)
1	2	775 - 950 Ω

If resistance is not within specifications, replace the CPS.

If resistance tests good, carry out a *CPS OUTPUT VOLTAGE TEST*.

CPS Output Voltage Test

1. Remove fuse F5 (Ignition/Injection fuse), refer to *POWER DISTRIBUTION* subsection.
2. Disconnect the CPS connector.



TOP OF ENGINE LH SIDE
1. CPS connector location

3. Probe CPS connector terminals while cranking engine as per following table.

CPS CONNECTOR		VOLTAGE
Pin 1	Pin 2	1 - 2 Vac min.

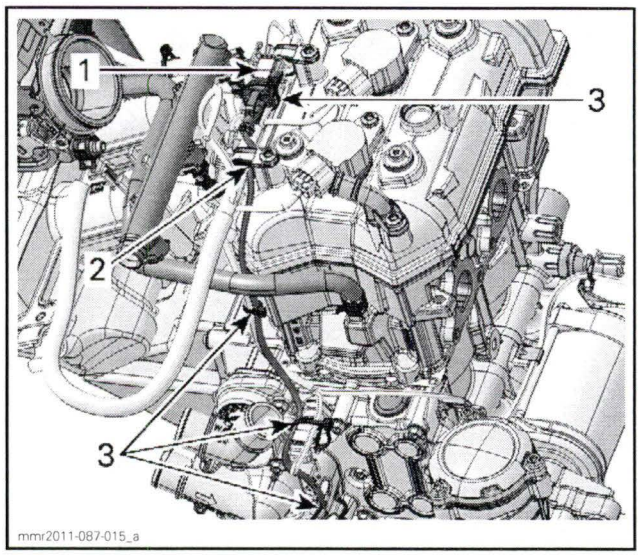
If voltage is out of specification, inspect wiring/connectors. Replace CPS if wiring is good.

If voltage is within specification, the problem may be related to the ECM.

4. Reconnect CPS connector and install all removed parts.

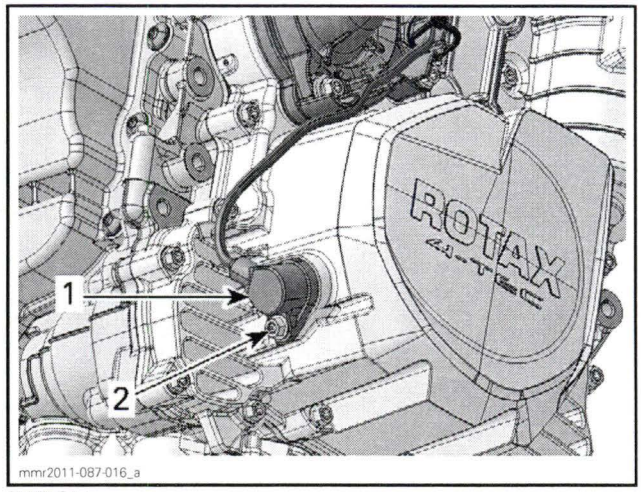
CPS Replacement

1. Remove parts required to access the CPS, refer to *CPS ACCESS* in this subsection.
2. Take note of factory CPS wire harness routing for reinstallation.
3. Remove CPS wire harness retaining clamp on top of engine.
4. Disconnect CPS connector and cut harness locking ties (4).



TYPICAL
1. CPS connector
2. Retaining clamp
3. Locking ties (4)

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



TYPICAL
1. CPS
2. Retaining screw

6. Install new CPS.

CPS INSTALLATION	
O-RING	SERVICE PRODUCT
	Apply engine oil on O-ring
RETAINING SCREW	TORQUE
	10 N•m ± 1 N•m (89 lbf•**in** ± 9 lbf•**in**)

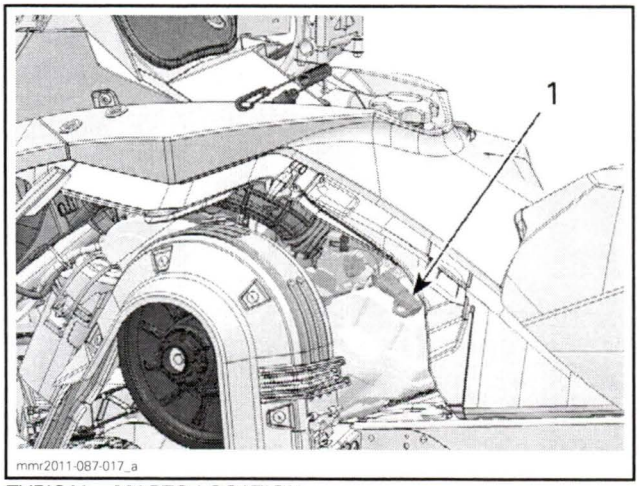
7. Route and secure CPS harness using harness clamp and locking ties as noted prior to removal.

MANIFOLD ABSOLUTE PRESSURE AND TEMPERATURE SENSOR (MAPTS)

NOTE: This sensor is a multifunction device. It measures manifold absolute pressure and intake temperature for air flow calculations.

MAPTS Access

To access the MAPTS, remove the LH side body panel.



TYPICAL - MAPTS LOCATION
1. Manifold air pressure and temperature sensor (MAPTS)

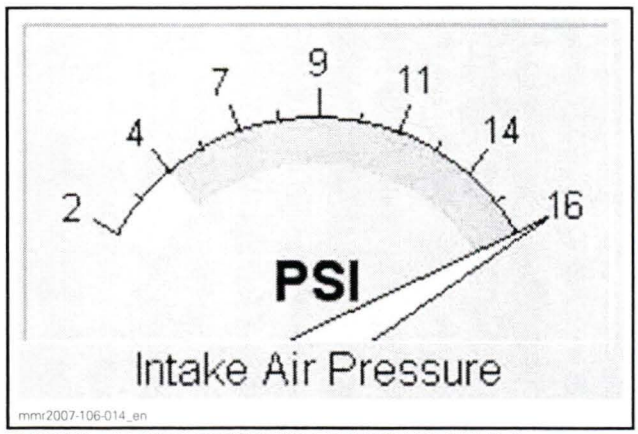
MAPTS Pressure Function

Before the engine is started, when power is applied to the system, the sensor measures the ambient air atmospheric pressure. The ambient pressure is, at that moment, stored in the ECM. Thereafter, once the engine is started, it measures the air pressure in the intake manifold at operating RPMs.

The sensor must be correctly installed on the intake manifold. Otherwise, the MAPTS could generate a fault code for an unexpected sensor range at idle when it reads the atmospheric pressure. If this is the case, remove sensor and check for oil or dirt on its end and if problem persists, check throttle plate condition/position and the wiring harness. Perform the following tests.

MAPTS Quick Test (Pressure Function)

1. Connect vehicle to the applicable B.U.D.S. software version.
2. In B.U.D.S., select the following:
   - **Read Data**
   - **Monitoring** page tab
   - **ECM** page.



TYPICAL - MAPTS PRESSURE READING IN B.U.D.S.

3. Look for and take note of the MAPTS pressure reading while the engine is stopped.

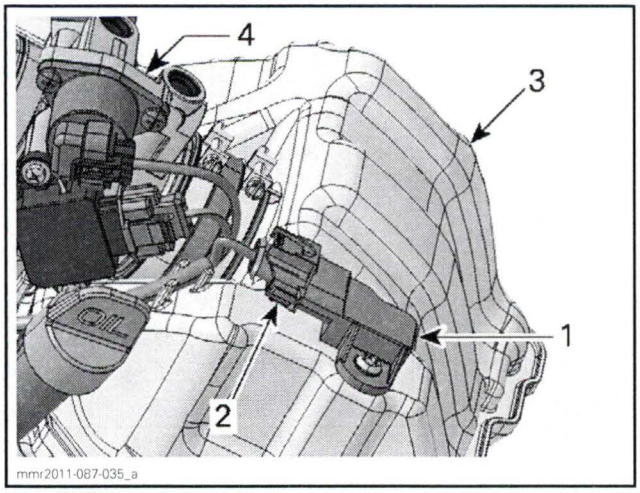
NOTE: The indicated intake air pressure in B.U.D.S. must be within 3.4 kPa (.5 PSI) of local atmospheric pressure when the engine is stopped.

MAPTS PRESSURE FUNCTION QUICK TEST			
RESULT	**SERVICE ACTION**		
NO READING	Circuit continuity test of MAPTS pressure function	MAPTS input voltage test	Repair or replace wiring
VALUE IS OUT OF RANGE	Replace MAPTS		

4. Perform the same test with a new MAPTS and compare both readings.

MAPTS Input Voltage Test

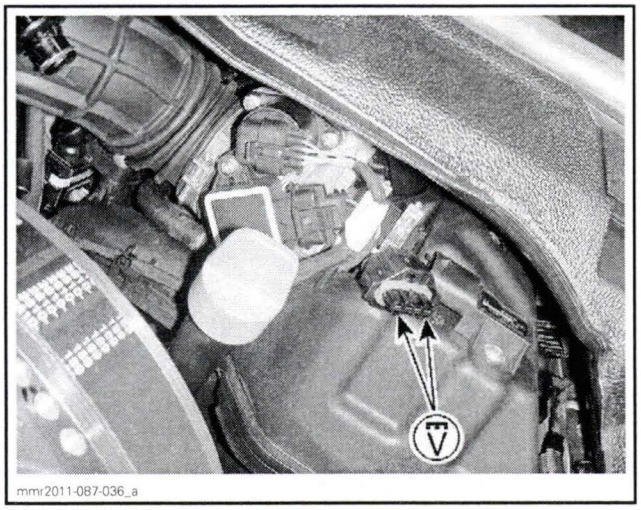
1. Remove parts required to access the MAPTS, refer to *MAPTS ACCESS*.
2. Remove electrical connector from MAPTS.



1. *MAPTS*
2. *MAPTS connector to remove*
3. *Air intake*
4. *Throttle body*

3. Briefly push START/RER button.
4. Using a FLUKE 115 MULTIMETER (P/N 529 035 868) set to Vdc, measure for MAPTS input voltage as per following table.

MAPTS CONNECTOR		MEASUREMENT
PIN		VOLTAGE
1	3	5 Vdc



If voltage test is good, replace the MAPTS.

If voltage test is not good, carry out the *MAPTS CIRCUIT CONTINUITY TEST (PRESSURE FUNCTION).*

MAPTS Circuit Continuity Test (Pressure Function)

1. Remove parts required to access ECM connectors, refer to *ECM CONNECTOR ACCESS* in this subsection.
2. Disconnect the ECM-A connector from the ECM and connect it to the ECM adapter tool.

ECM ADAPTER TOOL (P/N 529 036 166)	

3. Using a FLUKE 115 MULTIMETER (P/N 529 035 868) set to Ω, check continuity of the following circuits.



MAPTS CIRCUIT CONTINUITY TEST (PRESSURE FUNCTION)		
ECM-A	MAPTS CONNECTOR	RESISTANCE VALUE
Pin 4B	Pin 3	Close to 0 Ω
Pin 4G	Pin 4	
Pin 2H	Pin 1	

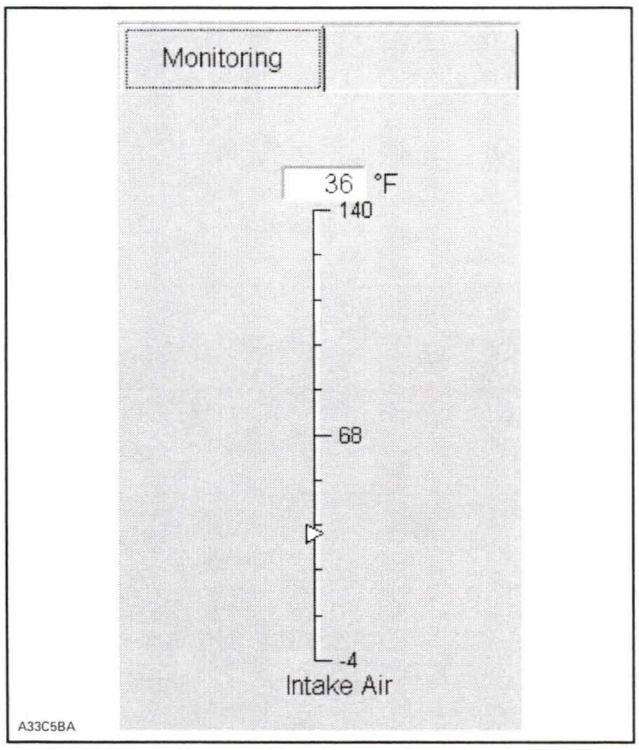
If resistance is not within specification, repair or replace the wiring harness between ECM connector and the MAPTS.

MAPTS Temperature Function

The MAPTS also monitors the temperature of the air in the intake manifold.

MAPTS Quick Test (Temperature Function)

1. Connect vehicle to the applicable B.U.D.S. software version.
2. In B.U.D.S., select the following:
   - **Read Data**
   - **Monitoring** page tab
   - **ECM** page.
3. Look for the **Intake Air** temperature reading while the engine is stopped.



TYPICAL - MONITORING PAGE TAB, ECM

NOTE: If the complete vehicle is at room temperature, B.U.D.S. should display the ambient air temperature at the intake manifold.

4. Perform the same test with a new MAPTS and compare both readings.

If the engine's MAPTS temperature reading is significantly different than the new MAPTS, replace it.

NOTE: Both sensors must feel same ambient air temperature.

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

MAPTS Resistance Test (Temperature Function)

1. Disconnect the MAPTS connector.
2. Using the FLUKE 115 MULTIMETER (P/N 529 035 868) set to Ω, test MAPTS resistance at the sensor as per following tables.

MAPTS		MEASUREMENT
PIN		Refer to MAPTS *TEMPERATURE SENSOR TABLE*
1	2	

MAPTS TEMPERATURE SENSOR TABLE		
TEMPERATURE		RESISTANCE (OHMS)
°C	°F	MAPTS
- 40	- 40	—
- 30	- 22	28000
- 20	- 4	15000
0	32	5500
20	68	2500
40	104	1200
60	140	600
80	176	320
100	212	180
130	266	90

If resistance is not within specification, replace the MAPTS.

If resistance tests good, **reconnect** the MAPTS and proceed with the following steps.

3. Disconnect the ECM-A connector.
4. Install ECM-A connector on the ECM adapter tool.

ECM ADAPTER TOOL (P/N 529 036 166)	

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

ECM CONNECTOR		MEASUREMENT
PIN		Refer to *MAPTS TEMPERATURE SENSOR TABLE*
A-2H	A-3H	

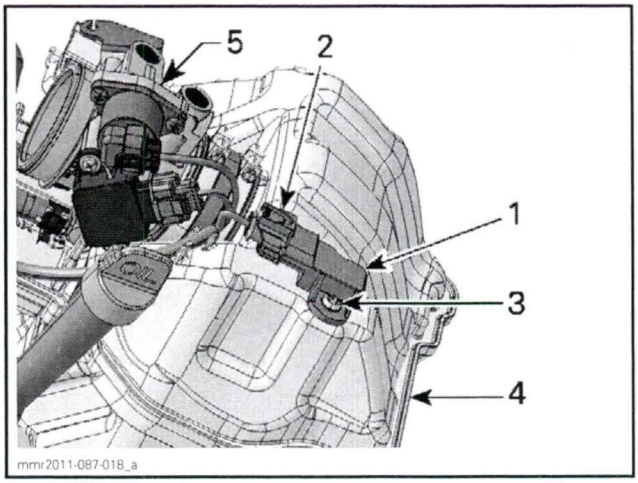
MAPTS TEMPERATURE SENSOR TEST RESULTS			
RESULT	SERVICE ACTION		
NO READING	Circuit continuity test of MAPTS temperature function	MAPTS input voltage test	Repair or replace wiring
INCORRECT RESISTANCE VALUE	Replace MAPTS		
CORRECT RESISTANCE VALUE	Try a new ECM		

MAPTS Circuit Continuity Test (Temperature Function)

MAPTS CIRCUIT CONTINUITY TEST (TEMPERATURE FUNCTION)		
ECM-A	MAPTS CONNECTOR	RESISTANCE VALUE
Pin 2H	Pin 1	Close to 0 Ω
Pin 3H	Pin 2	

Repair or replace wiring as required.

MAPTS Replacement



mmr2011-087-018_a

1. *MAPTS*
2. *MAPTS connector*
3. *Retaining screw*
4. *Intake manifold*
5. *Throttle body*

1. Disconnect MAPTS connector and remove the MAPTS from the intake manifold.
2. Install new MAPTS as per following table.

RETAINING SCREW TORQUE
6 N•m ± 0.7 N•m (53 lbf•**in** ± 6 lbf•**in**)

COOLANT TEMPERATURE SENSOR (CTS)

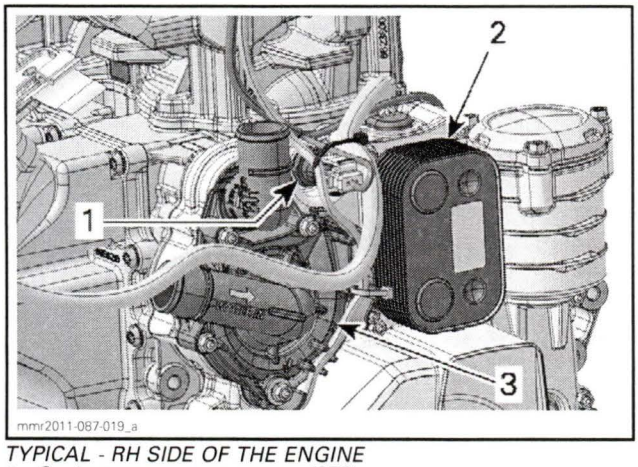
Overheat Warning

The CTS will cause the engine overheat warning to come on when the coolant temperature is above 110°C (230°F).

CTS Access

The CTS is located on the RH side of the engine, between the water pump and oil cooler.

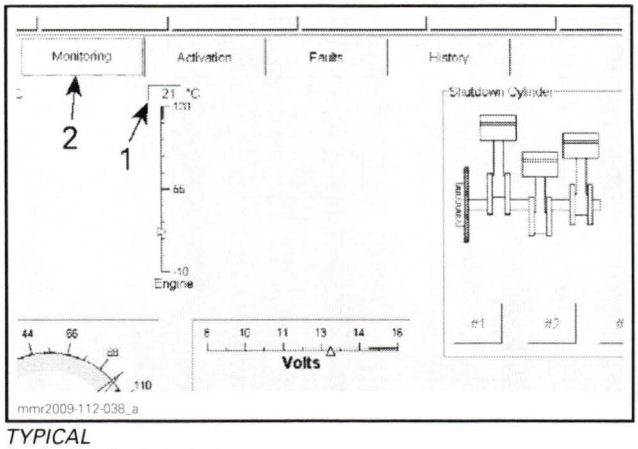
To access the CTS, remove the RH side body panel.



TYPICAL - RH SIDE OF THE ENGINE
1. *Coolant temperature sensor (CTS)*
2. *Oil cooler*
3. *Water pump*

CTS Quick Test

1. Connect the vehicle to the applicable B.U.D.S. software.
2. In B.U.D.S., select the following:
   - **Read Data** button
   - **Monitoring** page tab
   - **ECM** page.
3. Look for the engine temperature indication.



TYPICAL
1. *Engine temperature*
2. *Monitoring tab*

The engine temperature gauge in B.U.D.S. should provide an indication of the actual engine coolant temperature. Otherwise, perform the *CTS RESISTANCE TEST*.

CTS Resistance Test

1. Disconnect the CTS connector.
2. Test the resistance of the sensor as per following tables.

CTS SENSOR		MEASUREMENT
PIN		Refer to CTS *TEMPERATURE SENSOR TABLE*
1	2	

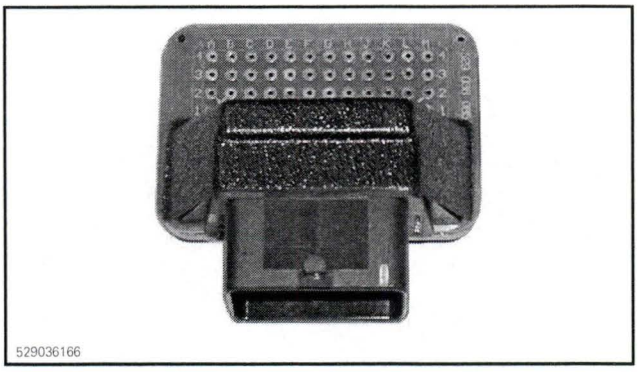
CTS TEMPERATURE SENSOR TABLE				
TEMPERATURE		RESISTANCE (OHMS)		
°C	°F	NOMINAL	LOW	HIGH
- 30	- 22	12600	11800	13400
- 20	- 4	11400	11000	11800
- 10	14	9500	8000	11,000
0	32	5900	4900	6900
10	50	3800	3100	4500
20	68	2500	2200	2800
30	86	1700	1500	1900
40	104	1200	1080	1320
50	122	840	750	930
60	140	630	510	750
70	158	440	370	510
80	176	325	280	370
90	194	245	210	280
100	212	195	160	210
110	230	145	125	160
120	248	115	100	125

NOTE: To test sensor at various temperatures, remove sensor and use a heat gun, ice and a thermometer.

If resistance is out of specification, replace the CTS.

If resistance test is good, proceed with the following steps.

3. Reconnect the CTS connector.
4. Remove parts required to access ECM connectors, refer to *ECM CONNECTOR ACCESS* in this subsection.
5. Disconnect the ECM-A connector.
6. Install ECM-A connector on ECM ADAPTER TOOL (P/N 529 036 166).



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

ECM "A" CONNECTOR		MEASUREMENT
PIN		Refer to CTS *TEMPERATURE SENSOR TABLE*
1A	2J	

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

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

CTS Replacement

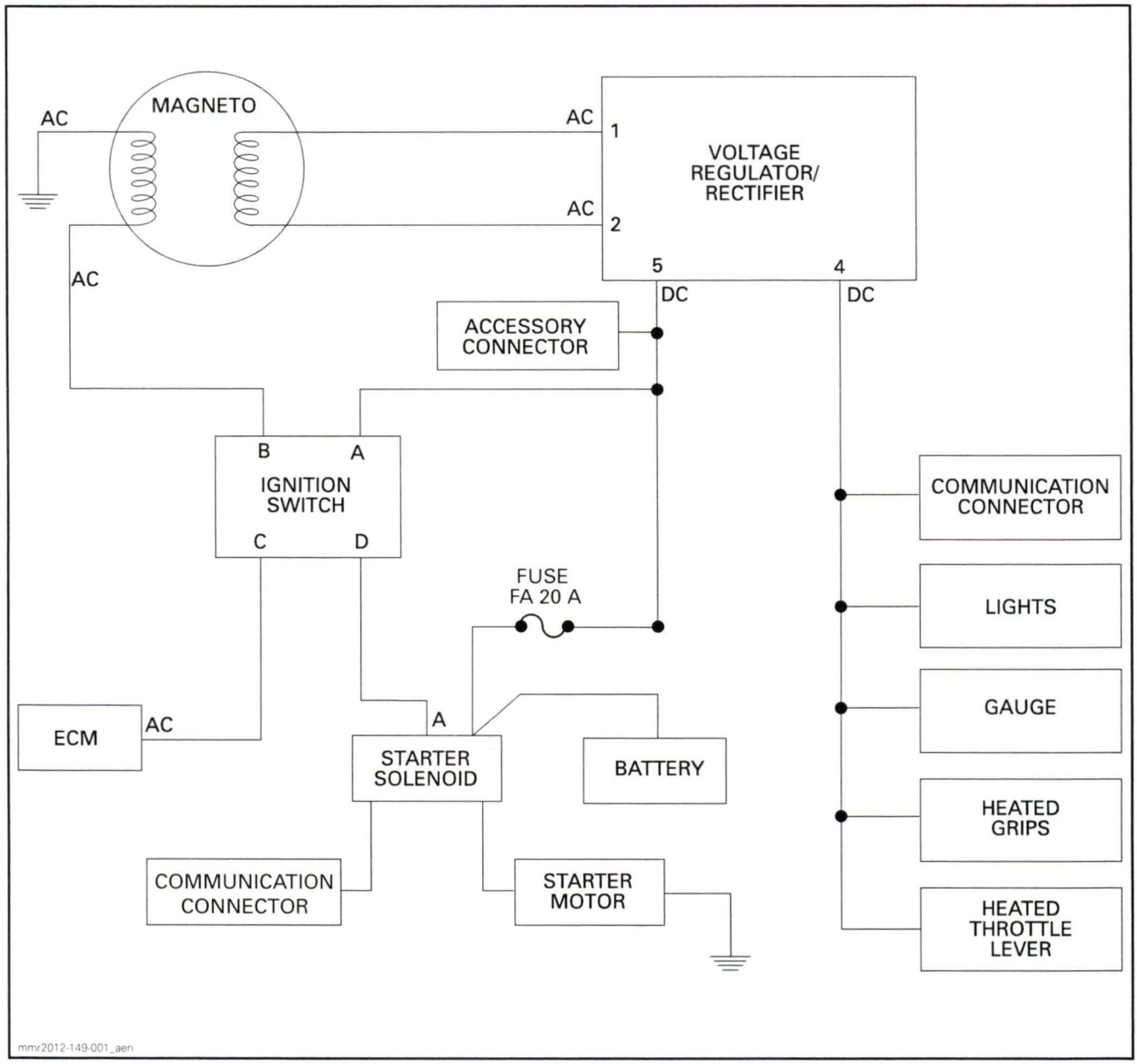
1. Disconnect CTS connector.
2. Remove CTS from engine.
3. Install new CTS and torque as specified.

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

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

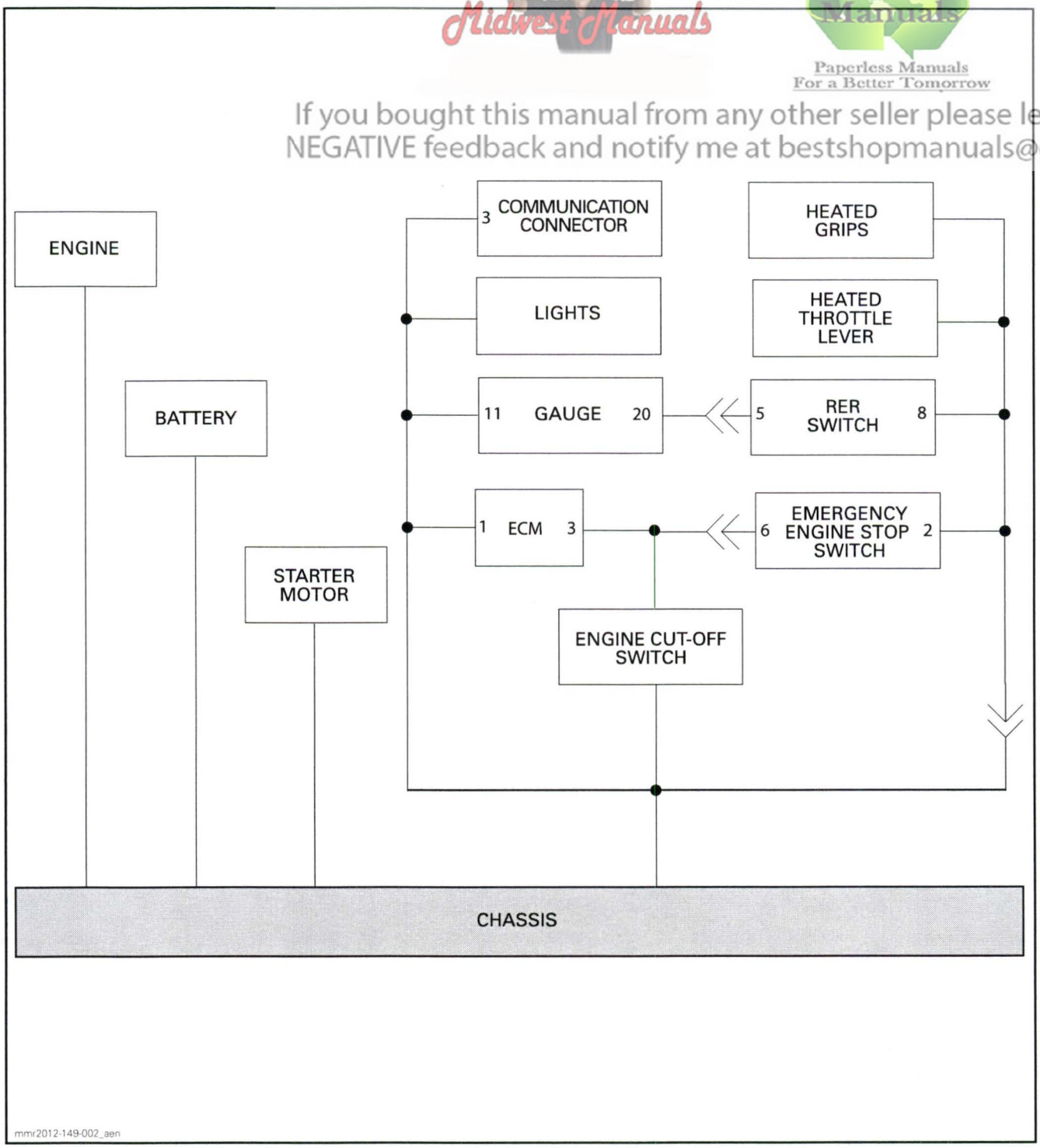
POWER DISTRIBUTION AND GROUNDS (550F)

POWER DISTRIBUTION



GROUND DISTRIBUTION

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NEGATIVE feedback and notify me at bestshopmanuals@gmail.com



GENERAL

It is highly recommended to disconnect the battery when replacing any electric or electronic component.

⚠ WARNING

Always disconnect battery exactly in the specified order, BLACK (-) cable first, RED (+) cable last. Always reconnect BLACK (-) cable last. Do not place tools on battery.

SYSTEM OVERVIEW

The electrical power is provided by the magneto which is composed of windings in 2 separate circuits:

- The ignition winding
- A set of charging/lighting windings.

The ignition winding directly provides AC to the ECM.

The charging/lighting windings, connected in series, bring AC to the voltage regulator/rectifier.

The regulator/rectifier has 2 different DC outputs:

- A circuit supplies DC voltage to the lights, gauge, accessories and communication connector.
- Another circuit supplies DC voltage to the optional accessories connector and is used to charge the battery.

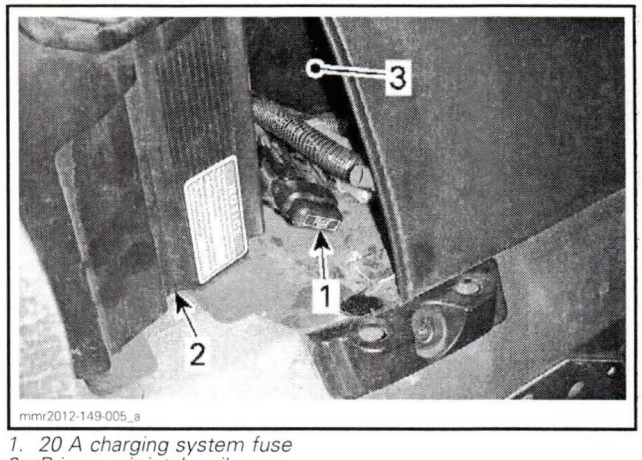
The battery cannot supply power through the regulator/rectifier, an internal diode isolates the battery circuit from the other circuits.

NOTE: On electric start models, there is an optional accessory connector that must be used to connect a sensitive electronic device such as a cellular phone or GPS. Do not connect a sensitive electronic device to a manual start vehicle.

Charging Fuse

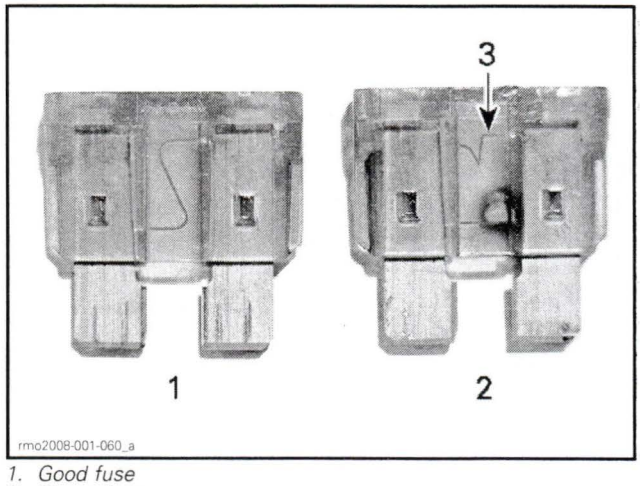
Charging Fuse Location

There is one fuse: 20 A charging system fuse, located on left side of vehicle, between fuel tank and primary air intake silencer.



1. 20 A charging system fuse
2. Primary air intake silencer
3. Fuel tank

Fuse Inspection



1. Good fuse
2. Blown fuse
3. Melted filament

A visual inspection of a fuse may not be conclusive.

Two metal contacts are visible on top of the fuse. They can be used for testing the fuse using a test lamp, fuse tester or a multimeter. They can also be used for testing the circuit the fuse protects without removing the fuse.

However, when testing a fuse using an ohmmeter, the fuse must always be removed from the fuse box.

NOTE: A good fuse will show system voltage on both sides. Voltage read on one side only indicates a blown fuse.

Fuse Replacement

⚠ WARNING

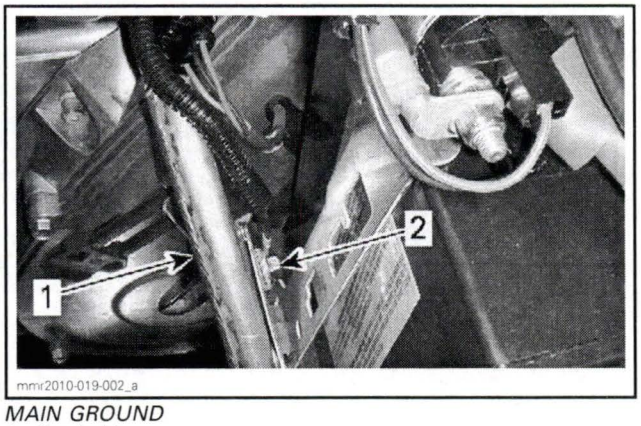
When replacing a fuse, do not use a higher rated fuse than recommended. Use of a higher rated fuse can lead to severe component or circuit damage, an overheat condition, and possibly and electrical fire. If fuse has burnt out, the source of the malfunction should be identified and corrected before applying power to the vehicle.

Grounds

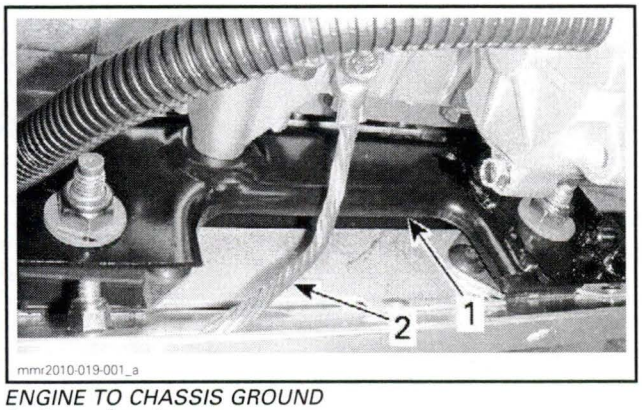
Grounds Location

There are 3 grounds on electric start models.

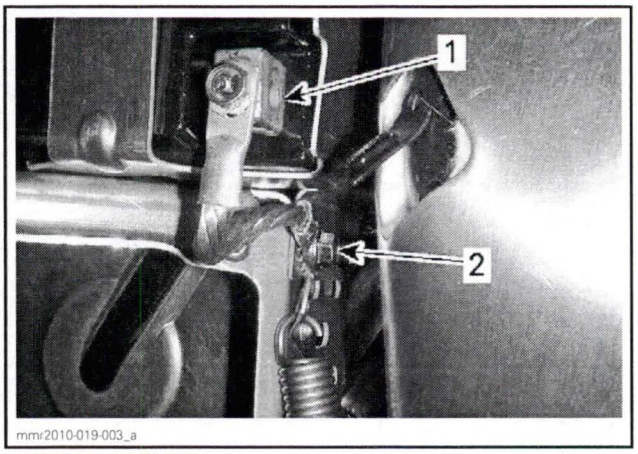
- **Main ground** (Lights, gauge, accessories, ECM, voltage regulator/rectifier and communication connector), located on the RH toe hold.
- **Engine to chassis ground**, located at front of the engine.
- **Battery ground**, located on the RH toe hold.



MAIN GROUND
1. *Toe hold*
2. *Ground terminal*



ENGINE TO CHASSIS GROUND
1. *Front of engine support*
2. *Ground wire*

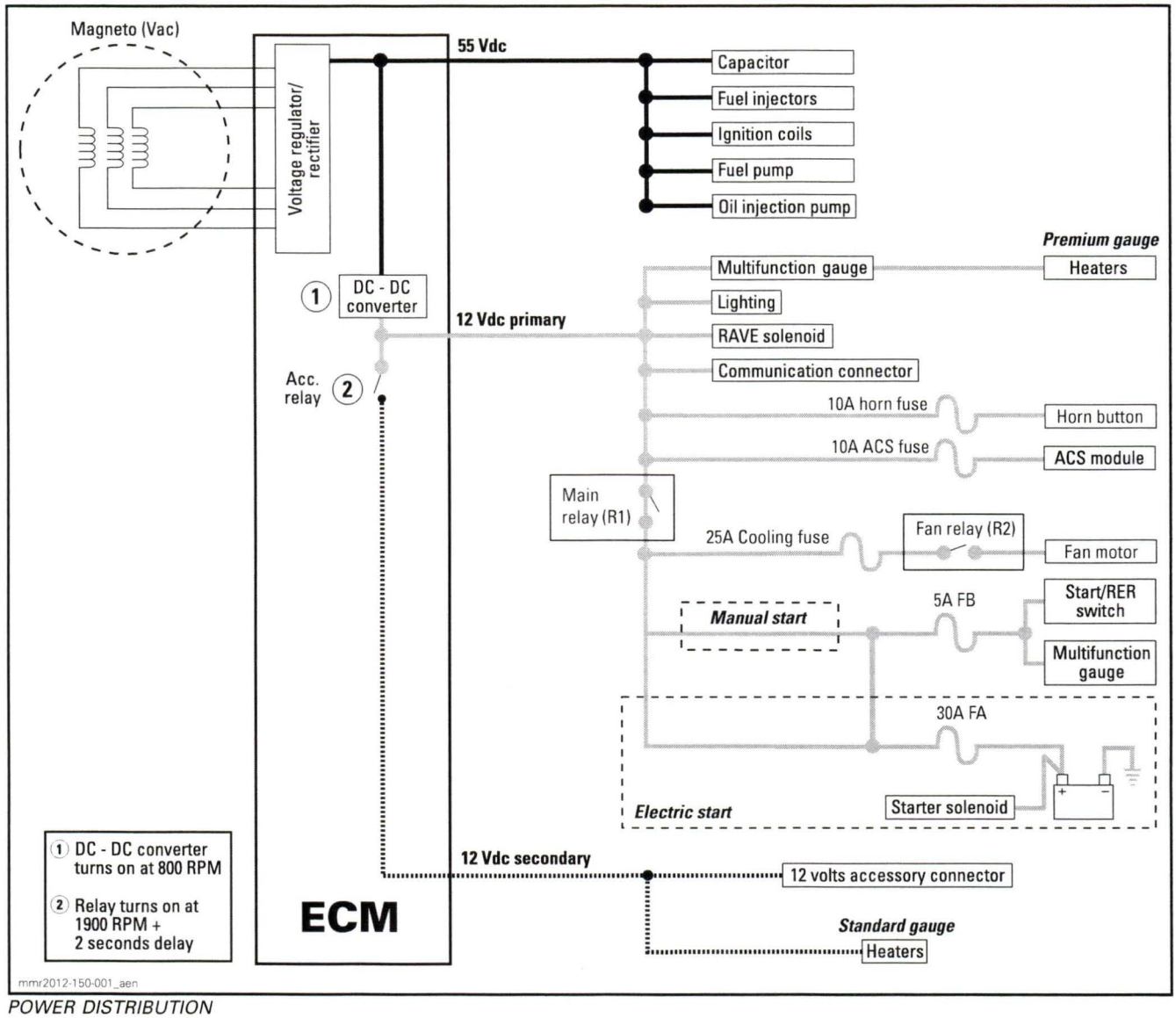


BATTERY GROUND
1. *Battery terminal*
2. *Ground terminal*

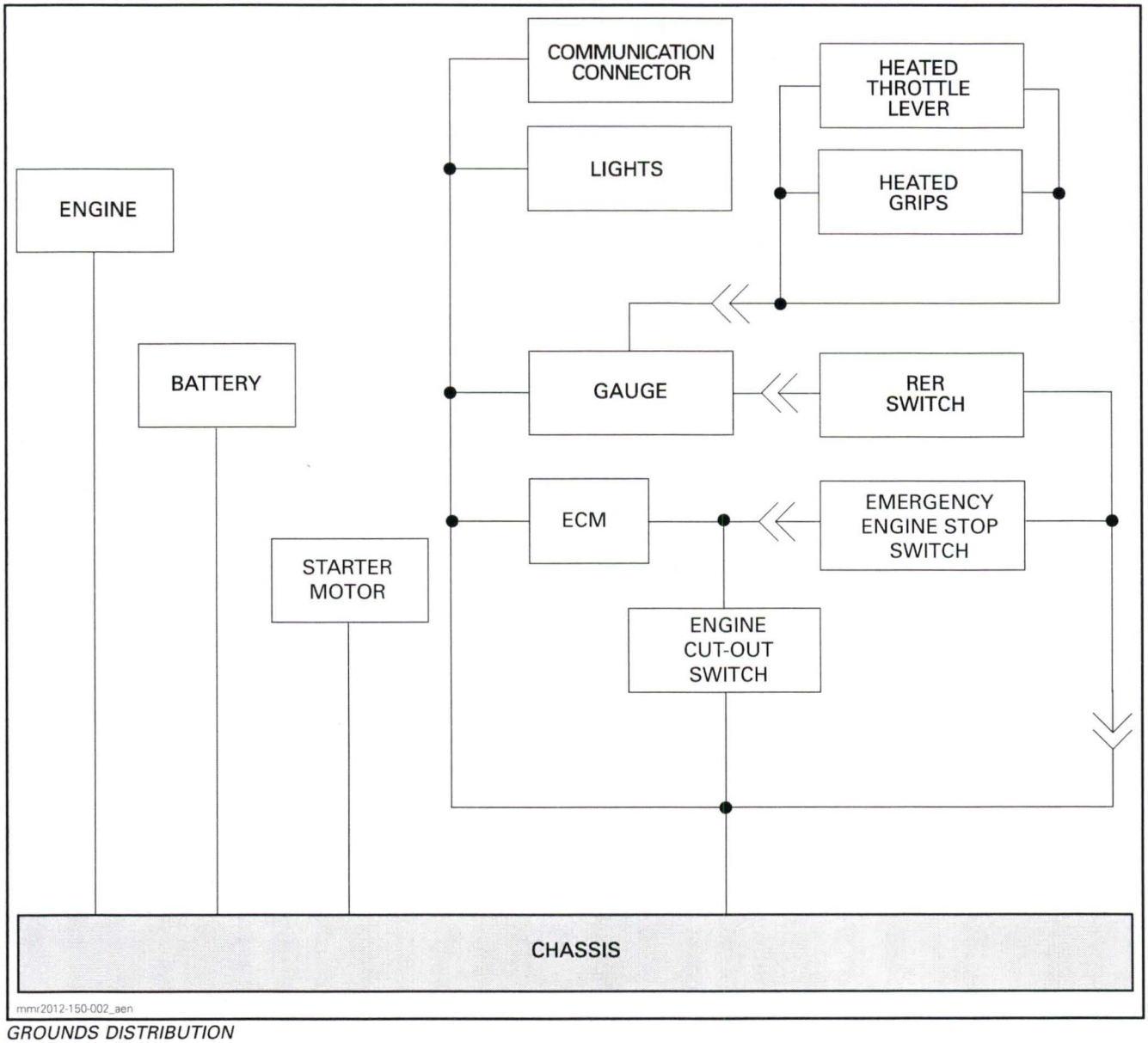
POWER DISTRIBUTION AND GROUNDS (600 HO E-TEC)

GENERAL

OVERVIEW



POWER DISTRIBUTION



GROUNDS DISTRIBUTION

The magneto stator is wired with 3 independent windings that works in phase. Each winding is separately wound, they are not connected, so 6 wires go to the ECM.

The vehicle requires the highest possible voltage at low RPM (to properly supply the fuel pump, injectors and ignition coils) and the highest possible current at higher RPM (to properly supply the RAVE valves, gauge, lights, heaters and other accessories). To achieve this, the stator windings are connected in series at low RPM to meet the voltage requirements and then connected in parallel at higher RPM to meet the current requirements. This series-parallel switch is done in the ECM.

The series to parallel switching occurs at approximately 1500 RPM.

At high RPM if the magneto power is greater than the loads, the ECM will shunt the stator windings to regulate its power as necessary.

The voltage regulator/rectifier is part of the ECM.

The ECM receives the energy produced by the magneto, rectifies the alternating current (AC) to direct current (DC) and regulates the voltage as per the following chart.

MODEL	VOLTAGE
600 HO E-TEC	55 Vdc

SYSTEM VOLTAGE (55 VDC)

Since the available power is low when cranking, the ECM first supplies 55 Vdc to the components that mandatory need voltage for the starting and the basic operation of the engine:

- ECM (internally powered to a lower voltage)
- Fuel pump
- Fuel injectors
- Ignition coils
- Electronic oil injection pump.

A large capacitor is used to stabilize the 55 Vdc system to provide a constant power to the injectors.

The capacitor is attached to the oil tank.

SYSTEM VOLTAGE (12 VDC)

A DC-DC converter, in the ECM, steps down the 55 DC voltage to 12 Vdc when the engine reaches 800 RPM.

The 12 Vdc voltage is then divided in a primary and a secondary system.

Below 2000 RPM, the total available current is limited to reduce the load on the system voltage. Above 2000 RPM, the 12 Vdc system have a maximum of 25 A available. In all running conditions, the system voltage must be kept at 55 Vdc.

Primary Voltage (12 Vdc)

Since the available power is not at its maximum at the early stage of engine starting, the ECM supplies 12 Vdc to the components that are critical for the engine and vehicle when engine reaches 800 RPM.

- RAVE solenoid
- Lighting system
- Multifunction gauge.

When the conditions indicated in the chart are met, the charging system relay (R1) closes and battery charging can take place.

MODEL	CHARGING RELAY ACTIVATION
600 HO E-TEC	1900 RPM

Secondary Voltage (12 Vdc)

When the conditions indicated in the chart are met, the accessory relay inside the ECM closes and power is delivered to the vehicle accessories (handle grip/lever heaters, 12 V power outlet and other accessories).

MODEL	ACCESSORY RELAY ACTIVATION
600 HO E-TEC	1900 RPM

POWER DISTRIBUTION SUMMARY

ENGINE OPERATION	VOLTAGE DELIVERED	COMPONENT SUPPLIED
Any engine speed	55 Vdc	– ECM (internally powered) – Fuel pump – Fuel injectors – Ignition coils – Electronic oil injection pump
When engine reaches 800 RPM	12 Vdc	– RAVE solenoid – Lighting system – Multifunction gauge – Handle grip/lever heaters (premium gauge)
1900 RPM	12 Vdc	– Battery charging
1900 RPM	12 Vdc	– Handle grip/lever heaters (standard gauge) – 12 V power outlet – Other accessories

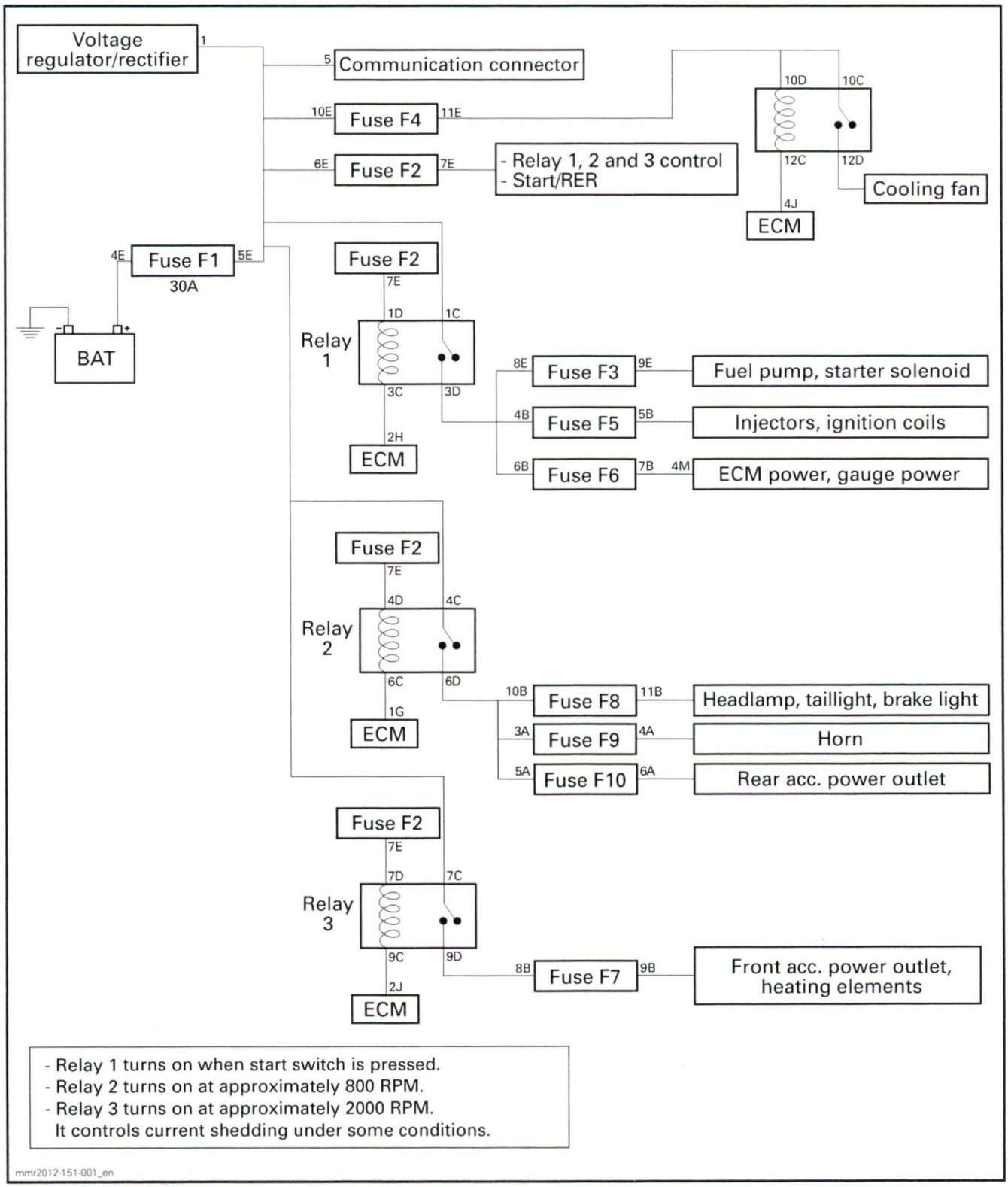
POWER DISTRIBUTION AND GROUNDS (600 ACE)

SERVICE TOOLS

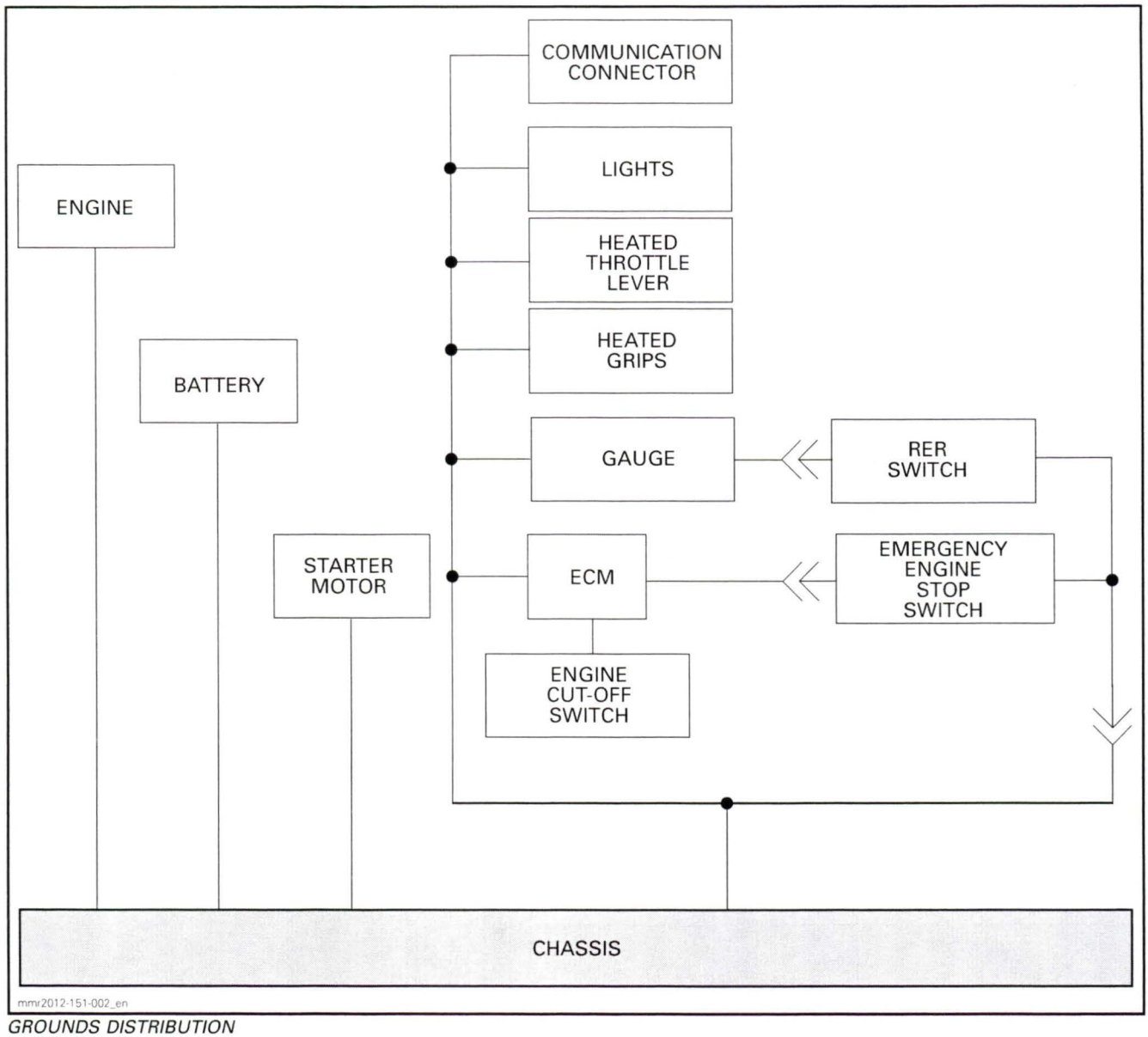
Description	Part Number	Page
ECM ADAPTER TOOL	529 036 166	573
FLUKE 115 MULTIMETER	529 035 868	572–573

GENERAL

OVERVIEW



POWER DISTRIBUTION



GROUNDS DISTRIBUTION

All the electrical system is powered by DC current supplied by a 12 V battery. The battery charge is maintained by the charging system.

Electrical system is protected by fuses located in one fuse box.

The system uses 3 relays that control different electrical components.

Relay 1 Activation

When the START/RER button is briefly pressed or held, it wakes up the ECM that in turn, powers the relay 1 and its contacts close to deliver power.

The relay supplies the following components:
- ECM power (B 4M)
- Fuel pump
- Starter solenoid
- Injectors
- Ignition coils
- Gauge.

Relay 2 Activation

When engine reaches approximately 800 RPM, the ECM activates the relay 2 and its contacts close to deliver power.

The relay supplies the following components:
- Lights
- Horn
- Rear power outlet.

Relay 3 Activation

When engine runs, the ECM activates the relay 3 and its contacts close to deliver power.

The relay supplies the following components:
- Thumb heater
- Front grip heaters
- Front power outlet.

The following actions will be taken by the ECM to preserve electrical power for the most important functions.

CONDITION	ECM CORRECTIVE ACTION
If battery voltage is lower than 12 V for 10 seconds	Relay 3 is disabled.
If battery voltage is lower than 11.5 V	Engine speed is increased to idle speed.
If battery voltage is lower than 11 V	Low battery pilot lamp turns on.

Automatic Power Cut-Off

The ECM features an automatic power cut-off that will completely turn off the ECM (after engine was running) and thus cutting all power to components. All the vehicle electrical loads will be turned off (except the clock in the multifunction gauge). This feature prevents the battery from discharging if the tether cord cap is left on engine cut-off switch when the engine is not running.

The cut-off time is as follows.

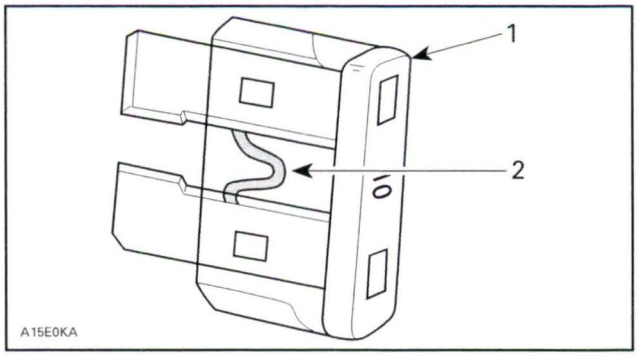
ACTION	POWER CUT-OFF TIME
Removing tether cord cap	Approximately 15 seconds
Setting emergency engine stop switch to STOP (tether cord cap connected)	Approximately 20 seconds

NOTE: The ECM will remain off until the START/RER button is pressed.

FUSES

Fuse Inspection

Check if filament is melted. Replace as necessary.



1. Fuse
2. Check if melted

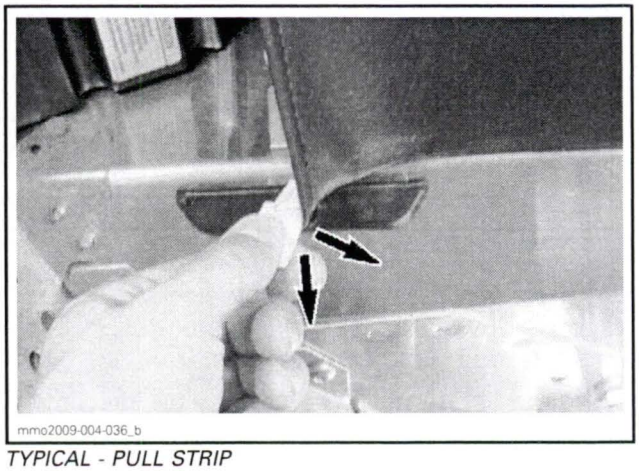
⚠ WARNING

Do not use a higher rated fuse as this can cause severe damage to electric components and/or a fire. If fuse has burnt out, the cause of the malfunction should be determined and corrected before restarting.

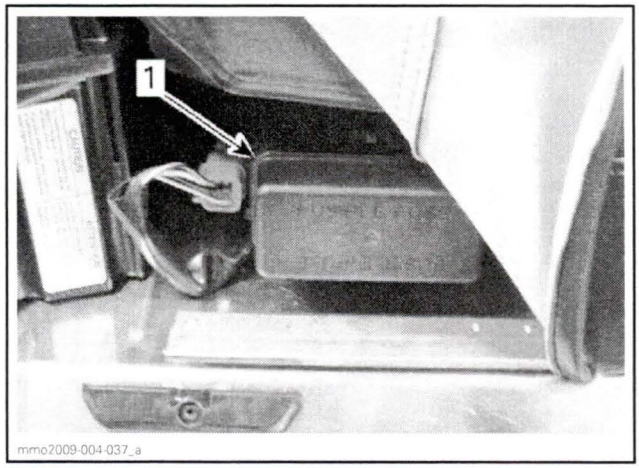
Fuse Box Location

The fuse box is located behind the front seat upholstery at the LH front lower portion of seat.

To access the fuse box, carefully pull seat upholstery out of the aluminum extrusion by pulling the plastic strip downwards and sideways at the same time.



TYPICAL - PULL STRIP

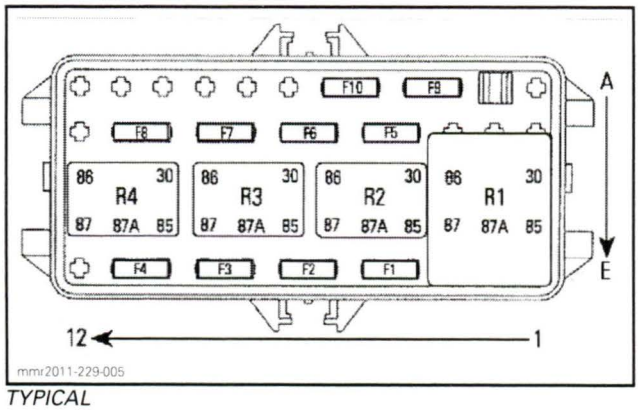


1. Fuse box

Refer to the decal inside the fuse box cover for fuse identification.

Close upholstery by pushing the strip back in the aluminum extrusion when finished.

Fuse box contacts are identified with letters to identify rows and numbers to identify columns. The combined letter and number identify the coordinate of a contact that is used in the procedures.

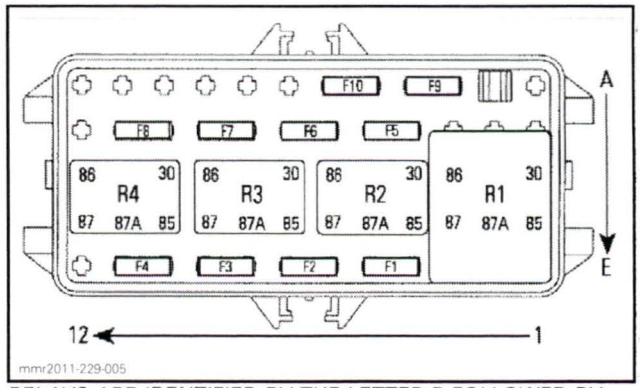


TYPICAL

RELAYS

Relay Location

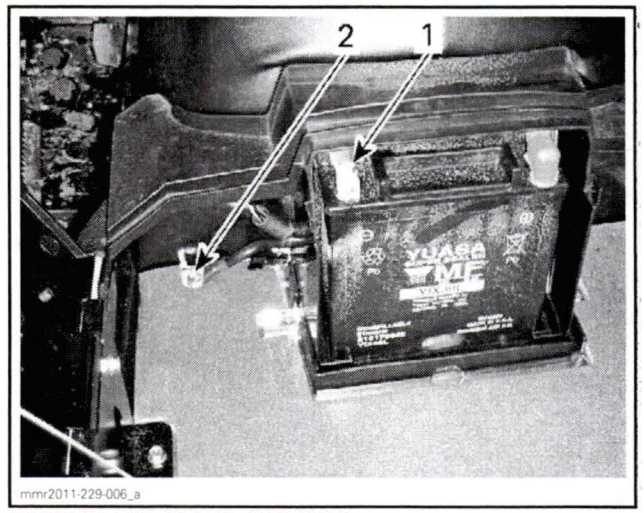
Relays are in the fuse box.



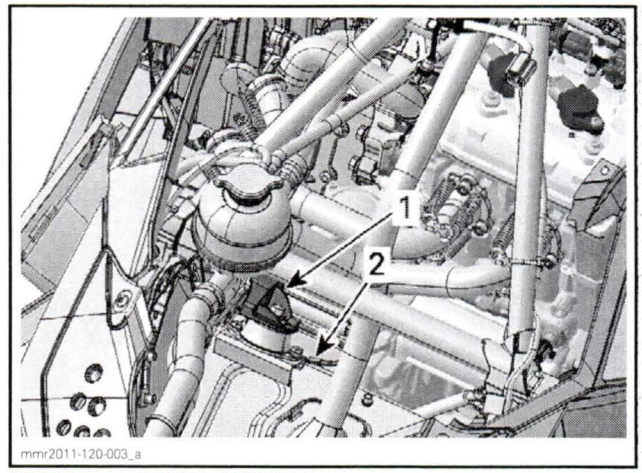
RELAYS ARE IDENTIFIED BY THE LETTER R FOLLOWED BY A DIGIT

GROUNDS

Ground Location



BATTERY AND FRAME GROUNDS
1. *Battery ground*
2. *Frame ground*



TYPICAL — ENGINE GROUND
1. *Engine mount*
2. *Ground*

PROCEDURES

RELAYS

Relay Input Voltage Test

Remove relay from fuse box.

Measure voltage between fuse box terminals and ground.

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

RELAY 1 (R1)		
PROBES		VOLTAGE
Winding input: Fuse box pin 1 D	Battery ground	Battery voltage
Contact input: Fuse box pin 1 C	Battery ground	

RELAY 2 (R2)		
PROBES		VOLTAGE
Winding input: Fuse box pin 4 D	Battery ground	Battery voltage
Contact input: Fuse box pin 4 C	Battery ground	

RELAY 3 (R3)		
PROBES		VOLTAGE
Winding input: Fuse box pin 7 D	Battery ground	Battery voltage
Contact input: Fuse box pin 7 C	Battery ground	

If input voltages are good, check the following:
- Relay, refer to *RELAY CONTINUITY TEST* in this subsection.
- ECM ground signal. Refer to *RELAY 1 (R1) GROUND SIGNAL TEST* or *RELAY 2 (R2) GROUND SIGNAL TEST* or *RELAY 3 (R3) GROUND SIGNAL TEST*.
- ECM ground signal wire, refer to *GROUND WIRE CONTINUITY TEST (R1, R2 AND R3)* in this subsection.
- Accessory supply wire for an open circuit.

If input voltages are not good, check for an open circuit on the applicable relay winding supply wire.

Relay 1 (R1) Ground Signal Test

1. Remove relays 1 and 2.
2. Temporarily install relay 2 into relay 1 location.
3. Check if functions related to relay 1 work.

If functions work, replace relay 1 by a new one and install in its original location.

If functions do not work, reinstall relay 2 into its original location then perform *GROUND SIGNAL WIRE CONTINUITY TEST* for relay 1.

Relay 2 (R2) Ground Signal Test

1. Remove relay 2.
2. Start engine.
3. Measure voltage as follows to confirm ground signal:

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

RELAY 2 (R2)		
PROBES		VOLTAGE
Fuse box pin 6 C	Battery positive terminal (+)	Approximately battery voltage

If test fails, perform *GROUND SIGNAL WIRE CONTINUITY TEST*.

Relay 3 (R3) Ground Signal Test

1. Remove relay 3.
2. Start engine.
3. Measure voltage as follows to confirm ground signal:

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

RELAY 3 (R3)		
PROBES		VOLTAGE
Fuse box pin 9 C	Battery positive terminal (+)	Approximately battery voltage

If test fails, perform *GROUND SIGNAL WIRE CONTINUITY TEST*.

Ground Wire Continuity Test (R1, R2 and R3)

1. Disconnect ECM connector B and install it on the recommended adapter. Refer to *ELECTRONIC FUEL INJECTION* subsection.

2. Remove applicable relay.
3. Measure resistance as per the following table.

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

RELAY 1 (R1)		
PROBES		RESISTANCE
Fuse box pin 3 C	ECM pin B 2H	Close to 0 Ω

RELAY 2 (R2)		
PROBES		RESISTANCE
Fuse box pin 6 C	ECM pin B 1G	Close to 0 Ω

RELAY 3 (R3)		
PROBES		RESISTANCE
Fuse box pin 9 C	ECM pin B 2J	Close to 0 Ω

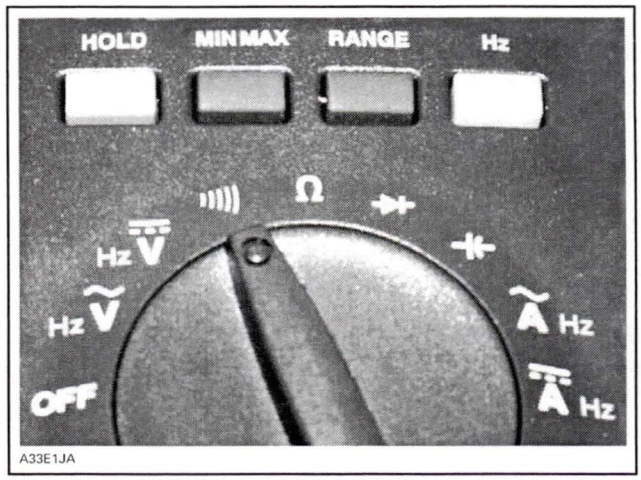
Relay Test

Relay Substitution Test

1. Remove the suspected relay.
2. Remove another relay from fuse box.
3. Replace it by the suspected relay.
4. Check if the relay related functions work.
   - 4.1 If the functions work, the suspected relay is good.
   - 4.2 If the functions do not work, the suspected relay is bad. Replace by a new one.
5. Reinstall the removed relays.

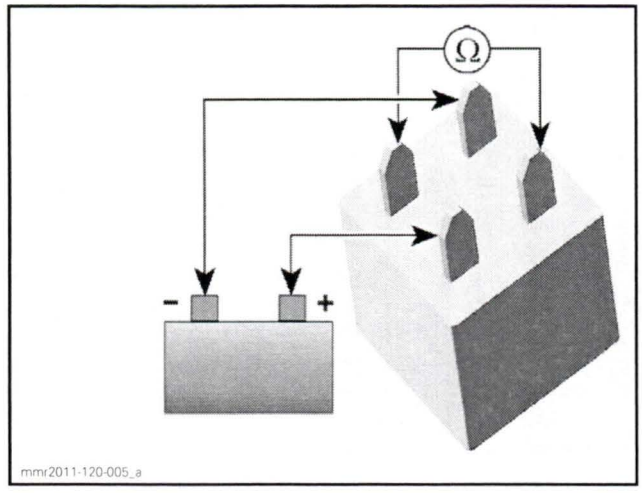
Relay Continuity Test

1. Remove relay to be tested from fuse box.
2. Set multimeter to the beeper position.



A33E1JA

3. Connect a jumper from the positive post of a 12 V battery to terminals 85 and 86 of relay then place the multimeter probe on terminal 30 and the other probe on the terminal 87.



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The audible signal should be continuous. If not, replace the relay.

IGNITION SYSTEM (550F)

SERVICE TOOLS

Description	Part Number	Page
DIGITAL INDUCTION TACHOMETER	529 014 500	578
FLUKE 115 MULTIMETER	529 035 868	580–581, 583–584
TDC DIAL INDICATOR	295 000 143	576
TDC DIAL INDICATOR	414 104 700	576

SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 767 (ANTISEIZE LUBRICANT)	293 800 070	580

GENERAL

SYSTEM DESCRIPTION

A CDI ignition system is used.

The ignition coil is integrated in the ECM.

The ECM is powered by the magneto stator (ignition winding) through the ignition switch.

The ECM controls ignition using the trigger coil signals.

INSPECTION

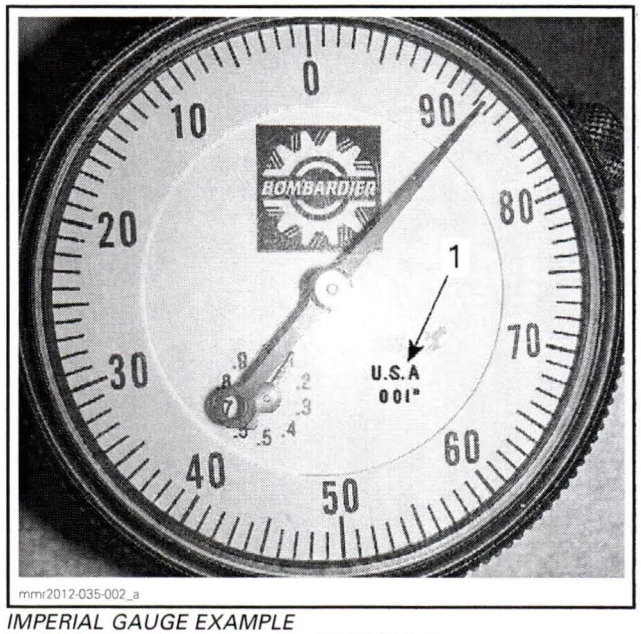
IGNITION TIMING

Ignition timing has been set at the factory and should remain correctly adjusted as every component is fixed and non adjustable.

Understanding the TDC Gauge

Dial gauges can be either in imperial or metric units. It is crucial to identify gauge units and graduation.

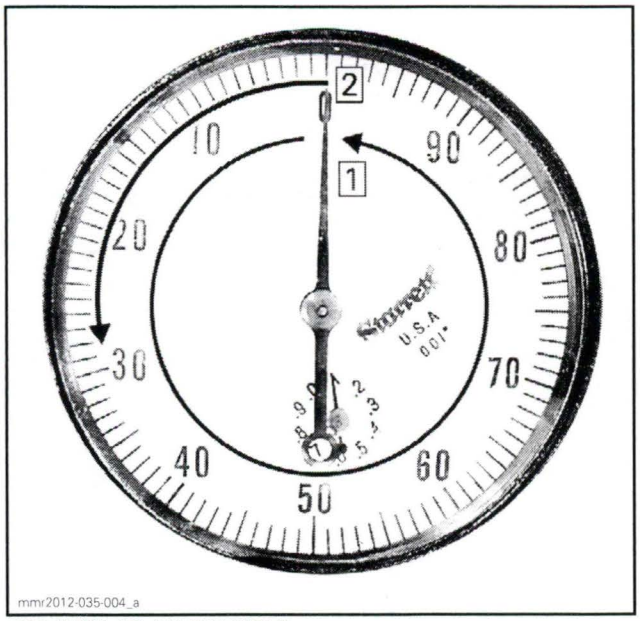
Imperial Dial Gauge



IMPERIAL GAUGE EXAMPLE
1. 001" means its graduated each 1/1000 inch

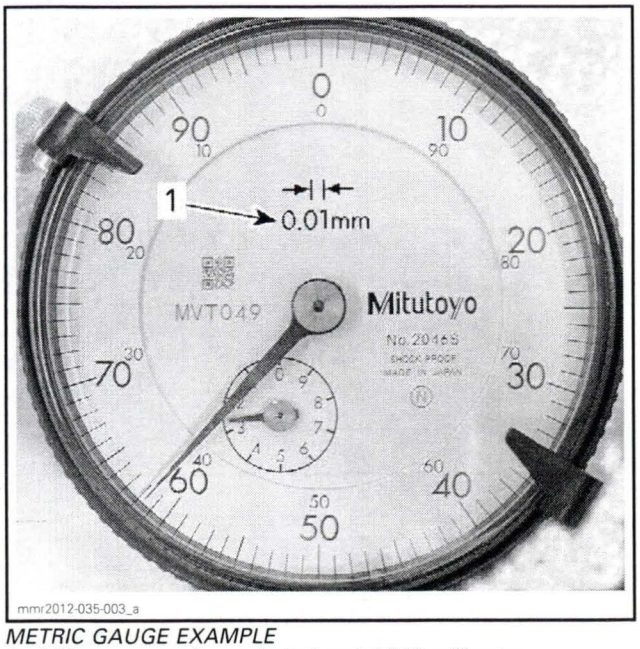
TYPICAL IMPERIAL DIAL GAUGE		
GRADUATION	MEASURE PER NEEDLE TURN	MEASURE EXAMPLE: .128 INCH
1/1000 inch (.001) per graduation line	1 turn = .100 inch	1 complete turn + 28 graduation lines

NOTE: The small dial indicates the number of turns the long needle traveled around the main dial.



.128 INCH AS AN EXAMPLE
Step 1: 1 complete turn
Step 2: 28 lines

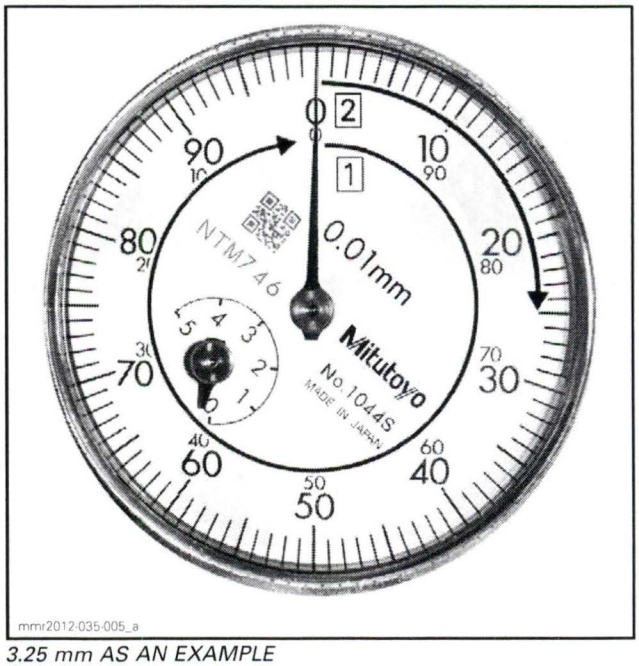
Metric Dial Gauge



METRIC GAUGE EXAMPLE
1. 0.01mm means its graduated each 1/100 millimeter

IMPERIAL DIAL GAUGE EXAMPLE		
GRADUATION	MEASURE PER NEEDLE TURN	MEASURE EXAMPLE: 3.25 mm
1/100 millimeter (.01) per graduation line	1 turn = 1 millimeter	3 complete turns + 25 graduation lines

NOTE: The small dial indicates the number of turns the long needle traveled around the main dial.



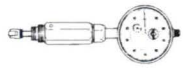
3.25 mm AS AN EXAMPLE
Step 1: Complete turns (3 X)
Step 2: 25 lines

TDC Gauge Installation

⚠ WARNING

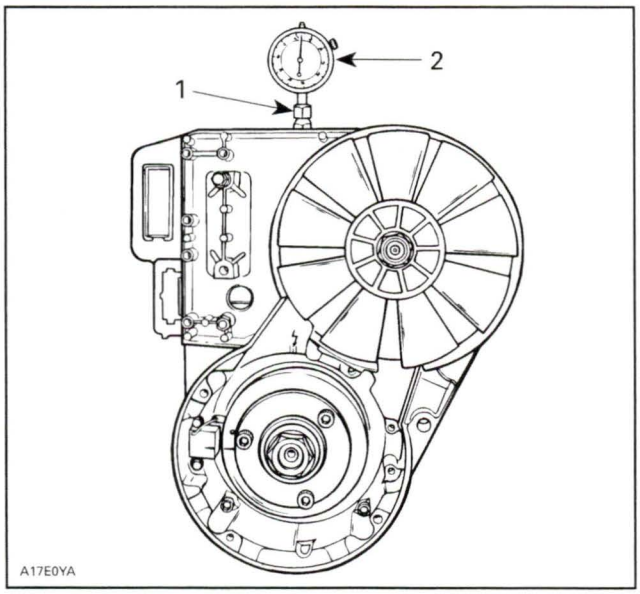
Ensure tether cord cap is removed from engine cut-off switch and emergency engine stop switch is in the STOP position.

Two TDC gauges can be used:

TDC GAUGES	
TDC DIAL INDICATOR (P/N 295 000 143) **(short reach)**	
TDC DIAL INDICATOR (P/N 414 104 700) **(long reach)**	

1. Remove secondary air intake silencer and headlight/gauge module as a unit. Refer to *AIR INTAKE SYSTEM* subsection.
2. Clean the area around the spark plugs.
3. Remove spark plugs.
4. Assemble the gauge to the adaptor and tighten the roller lock nut. Do not tighten the adaptor lock nut.
5. Screw the adaptor into the spark plug hole and tighten to prevent movement in the plug hole.

6. Position the magneto flywheel at approximately TDC.



TYPICAL — INSTALLATION OF TDC GAUGE
1. Adaptor lock nut
2. Gauge on MAG side cylinder

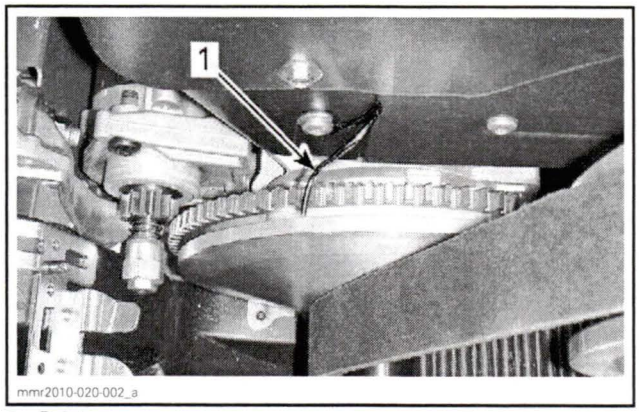
7. Position the dial face toward the PTO side. Move the gauge down until the needle just begins to move, then move down a further approximately 6 mm (1/4 in). Tighten adaptor lock nut by hand.

Locating Piston TDC

NOTE: Normal engine rotation as seen from the PTO side is counterclockwise.

1. Craft a pointer using a strong metal wire such as a clothes hanger and attach it to the engine.

NOTE: The pointer has to be securely attached and strong enough to prevent it from moving.



1. Pointer

2. With a firm hold on the drive pulley, slowly rotate the drive pulley counterclockwise while observing the TDC gauge needle.

NOTE: Note that the needle stops moving only as the piston is changing direction at the top of its stroke.

3. Rotate the dial face so the "0" is in line with the needle when it stops moving.
4. Resume rotating the engine (counterclockwise) until the gauge needle has rotated approximately 1/4 turn past TDC.
5. Then, slowly rotate the engine in a clockwise direction until the needle stops moving.

NOTE: The needle should stop on the "0". If not, reset the dial "0" to the needle.

6. Again, slowly rotate the drive pulley back and forth across TDC to confirm the needle always stops exactly at "0" before changing direction. "0" now indicates exact TDC.
7. Lock the dial face with the dial lock screw.

NOTE: If a difference in "0" setting the dial in each direction of rotation is easily noticeable, make sure dial gauge is installed correctly. If gauge is correct, the engine components may suffer from excessive wear.

Scribing the Timing Mark

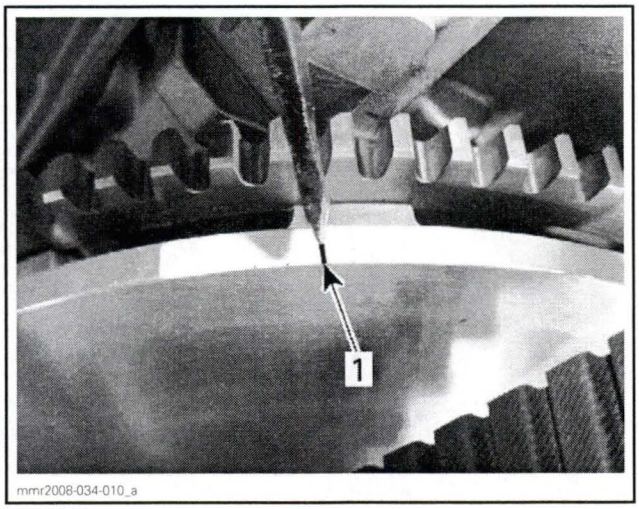
IMPORTANT: Be sure to understand how the TDC gauge functions. Refer to *UNDERSTANDING THE TDC GAUGE* in this subsection.

1. From the "0" (TDC), rotate the drive pulley clockwise (reverse engine rotation) until the dial needle rotates past the required BTDC measurement (see table that follows).
2. Carefully rotate engine counterclockwise (forward engine rotation) until the needle precisely indicates the measurement specified in the following table.

NOTE: Final setting must always be made counterclockwise (in the normal engine rotation).

IGNITION TIMING BTDC		
ENGINE	MEASUREMENT BTDC	DEGREE SETTING BTDC
550F	2.77 mm (.109 in)	22°

3. With the TDC gauge indicating specified timing, use a permanent marker to draw a line on the drive pulley fixed sheave directly in line with pointer.



TYPICAL
1. *Timing mark in line with pointer*

4. Repeat procedure to ascertain the mark is exactly in line with the pointer.
5. Remove the TDC gauge and dial indicator adapter.
6. Reinstall the spark plugs. Refer to *SPARK PLUG INSTALLATION* in this subsection.
7. Check ignition timing as per *CHECKING IGNITION TIMING* procedure in this subsection.

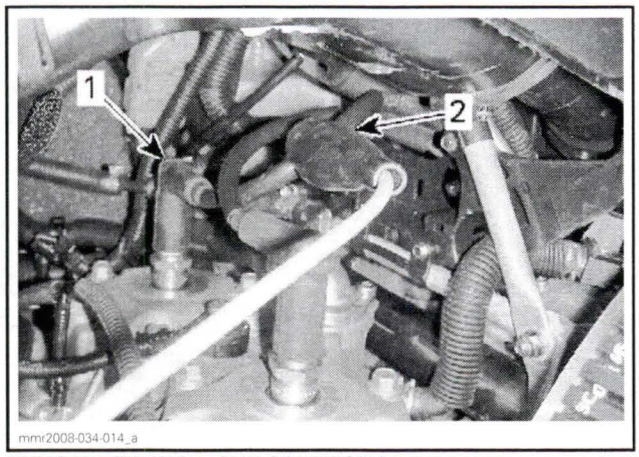
Checking Ignition Timing

⚠ WARNING

Do not allow anyone in front of or behind the vehicle while engine is running. Keep clear of track and do not wear loose clothing which can get caught in moving parts.

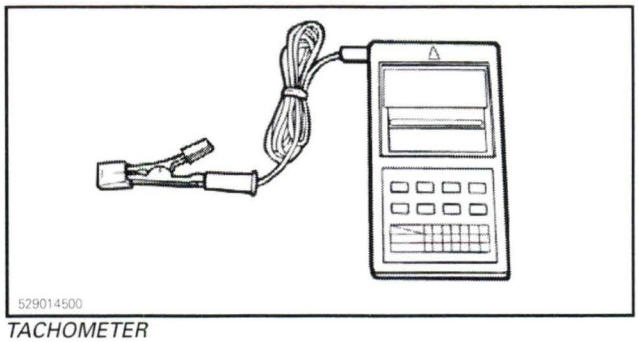
1. Place ski tips against a wall, raise rear of vehicle on a stand, so that track does not contact the ground.
2. Attach the timing light pick-up clamp to the **MAG** spark plug cable.

NOTE: Be careful to route timing light cable away from drive belt and pulleys.



TYPICAL - TIMING LIGHT CONNECTION
1. *MAG spark plug*
2. *Timing light connected to MAG plug cable*

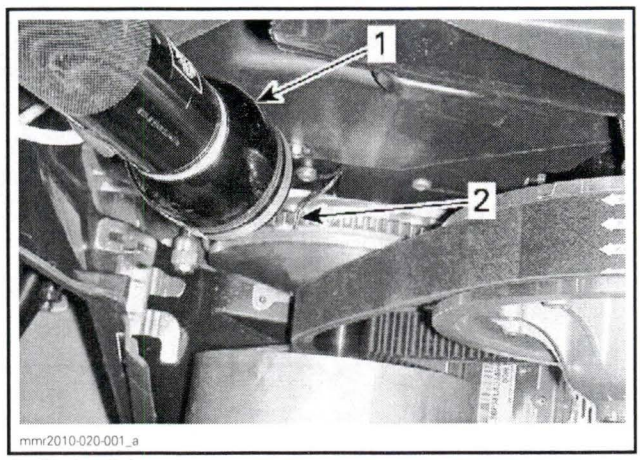
3. Connect the DIGITAL INDUCTION TACHOMETER (P/N 529 014 500) to a spark plug cable.



TACHOMETER

NOTICE **Before starting engine, check cable routing of test equipment to ensure it cannot come into contact with rotating parts or with the exhaust manifold.**

4. Start engine and point timing light on timing mark/pointer.
5. Throttle engine to specified speed for a brief instant.



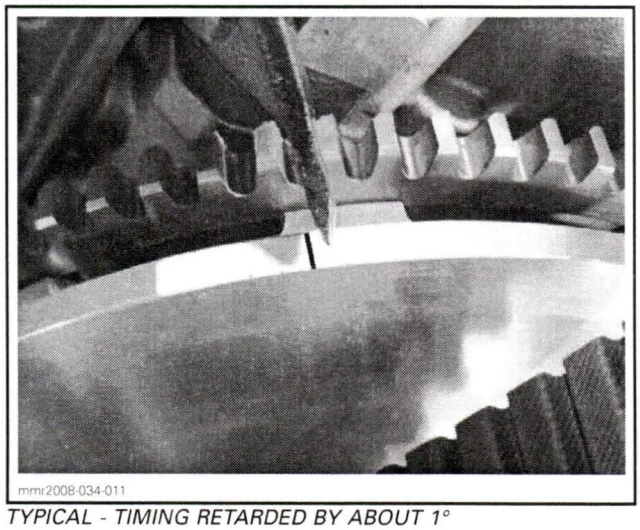
1. *Timing light*
2. *Pointer*

MODEL	ENGINE SPEED (HOT OR COLD)
550F	3500 RPM +/- 500

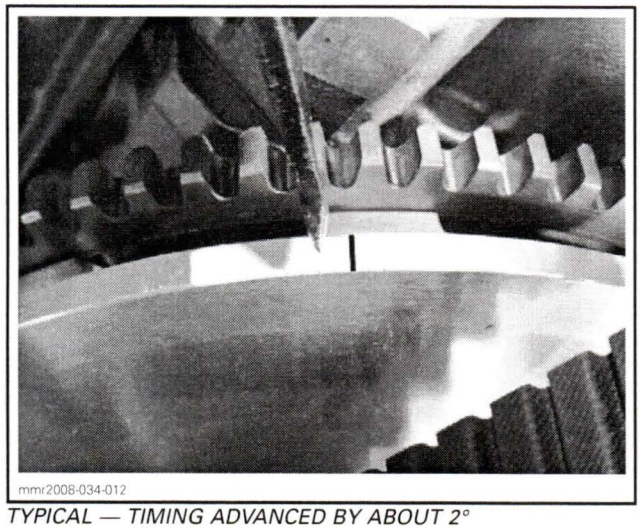
6. Ensure timing mark is aligned with the pointer end within the specified tolerance.

MODEL	TOLERANCE
550F	± 1°

If marks are aligned, no adjustment is required.



TYPICAL - TIMING RETARDED BY ABOUT 1°



TYPICAL — TIMING ADVANCED BY ABOUT 2°

If marks are misaligned by more than one degree, carry out a crankshaft alignment verification, refer to *ENGINE MEASUREMENT* subsection.

If crankshaft alignment is correct, substitute trigger coil or ECM, then check timing again.

TROUBLESHOOTING

IGNITION SYSTEM TESTING

In the case of ignition problems, check the following in the prescribed order until the problem can be solved:

1. Spark plugs
2. Spark plug cables
3. Wiring harness/electrical connectors
4. Emergency engine stop switch
5. Engine cut-off switch
6. Ignition switch
7. Trigger coil(s)
8. Stator (ignition winding)
9. ECM (Engine Control Module).

Check spark using the original spark plugs.

If there is no spark, try new spark plugs.

If there is no spark with new spark plugs, make sure connectors at ECM are securely installed.

PROCEDURES

SPARK PLUG

Spark Plug Removal

1. Remove LH side panel, refer to *BODY* subsection.
2. Remove air outlet duct, refer to *AXIAL FAN* subsection.
3. Disconnect spark plug wire by twisting and lifting up on cap.
4. Unscrew spark plug 1 turn.
5. Clean spark plug and cylinder head with pressurized air, then completely remove spark plug.

⚠ CAUTION Whenever using compressed air, always wear protective eye wear.

Spark Plug Installation

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

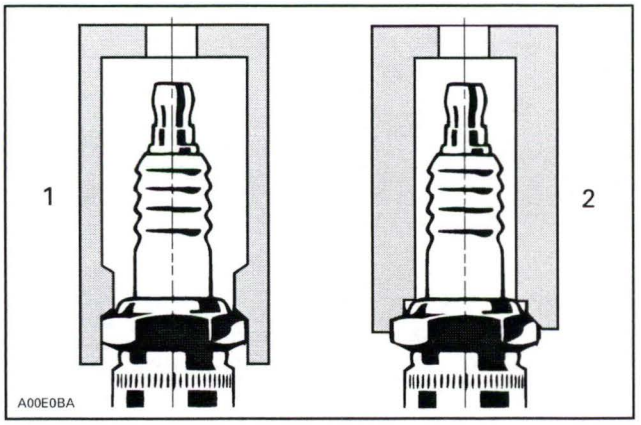
Prior to installation make sure that contact surfaces of the cylinder head and spark plug are free of grime.

Using a feeler gauge, measure spark plug gap.

NOTE: Replace spark plug if gap is out of specification.

Apply LOCTITE 767 (ANTISEIZE LUBRICANT) (P/N 293 800 070) to the spark plug threads to prevent possible seizure.

Hand screw spark plug into cylinder head and tighten to specification.



TYPICAL
1. *Proper socket*
2. *Improper socket*

ENGINE	SPARK PLUG	TORQUE N•M (LBF•FT)
550F	NGK	27 N•m (20 lbf•ft)

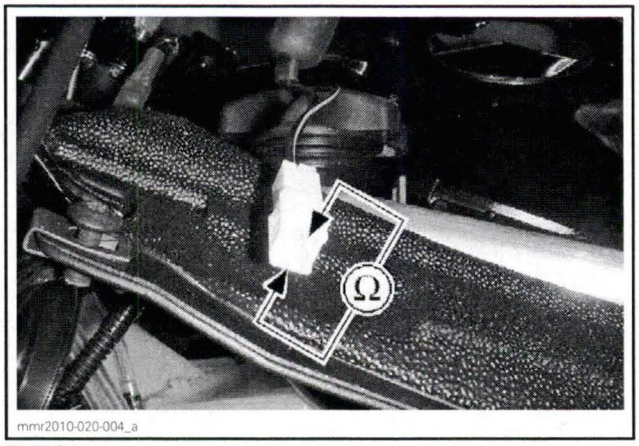
ENGINE CUT-OFF SWITCH

Engine Cut-Off Switch Continuity Test

1. Refer to *BODY* subsection and lift LH side of the console for access to engine cut-off switch connector.
2. Disconnect engine cut-off switch connector.

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

3. Measure resistance as per following table.



TYPICAL

ENGINE CUT-OFF SWITCH CONTINUITY TEST			
SWITCH POSITION	TEST PROBES		RESISTANCE
Tether cap installed	Switch connector (TS) Pin 1	Switch connector (TS) Pin 2	Infinite (OL)
Tether cap removed	Switch connector (TS) Pin 1	Switch connector (TS) Pin 2	Close to 0 Ω (continuity)

RESULT	SERVICE ACTION
Resistance as specified	– Check wiring and connectors (engine cut-off switch). – Test emergency engine stop switch.
Resistance NOT as specified	– Replace switch.

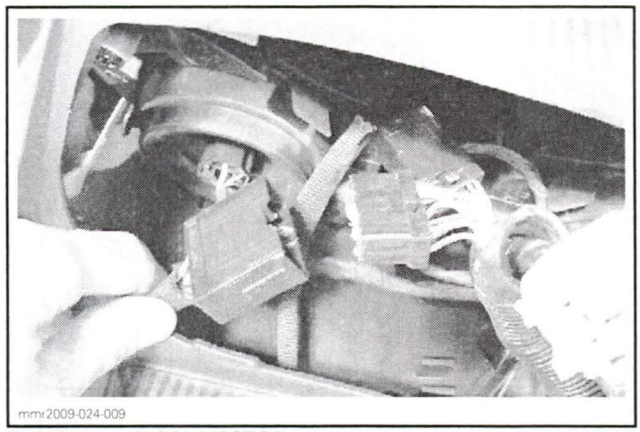
EMERGENCY ENGINE STOP SWITCH

Emergency Engine Stop Switch Continuity Test

1. Remove gauge, refer to *LIGHTS, GAUGE AND ACCESSORIES* subsection.

NOTE: It is not necessary to disconnect gauge.

2. Disconnect the 13 pin steering harness connector (HG).


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TYPICAL - HG CONNECTOR

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

3. Measure resistance as per following table.

EMERGENCY ENGINE STOP SWITCH CONTINUITY TEST			
SWITCH POSITION	TEST PROBES		RESISTANCE
RUN	HG connector Pin 6	HG connector Pin 2	Infinite (OL)
STOP			Close to 0 Ω (continuity)

RESULT	SERVICE ACTION
Resistance as specified	– Check wiring and connectors to ECM. – Check wiring and connectors to ground.
Resistance NOT as specified	– Repeat test at switch. – Test continuity of wiring between switch and HG connector. – Replace switch.

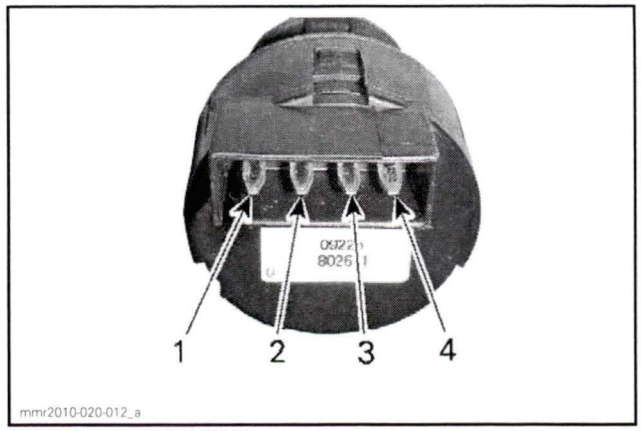
IGNITION SWITCH

Ignition Switch Continuity Test

1. Remove gauge, refer to *LIGHTS, GAUGE AND ACCESSORIES* subsection.
2. Remove ignition switch from headlight/gauge module.
3. Disconnect ignition switch connector.

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

4. Measure continuity through ignition switch as per following table.



IGNITION SWITCH PINS
1. *Pin D*
2. *Pin C*
3. *Pin B*
4. *Pin A*

SWITCH POSITION	TEST PROBES		RESISTANCE
OFF	Pin B	Pin C	Infinite (OL)
	Pin A	Pin D	
ON	Pin B	Pin C	Close to 0 Ω
	Pin A	Pin D	Infinite (OL)
START	Pin B	Pin C	Close to 0 Ω (continuity)
	Pin A	Pin D	

RESULT	SERVICE ACTION
Resistance as specified	Check the following: – *IGNITION SWITCH INPUT VOLTAGE TEST.*
Resistance NOT as specified	– Replace ignition switch.

Ignition Switch Input Voltage Test

Measure for battery power at ignition switch harness connector as per following table.

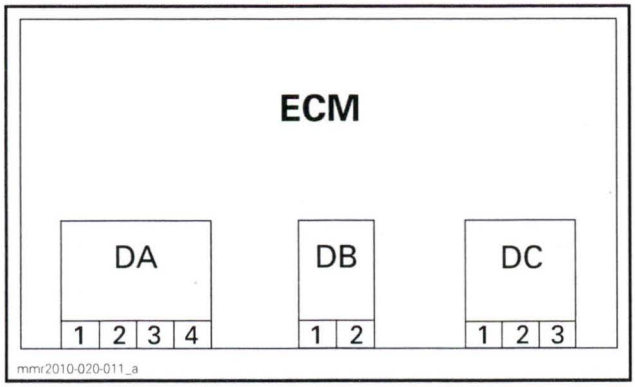
IGNITION SWITCH INPUT VOLTAGE TEST		
PROBES		VOLTAGE
Ignition switch connector Pin A	Chassis ground	Battery voltage

RESULT	SERVICE ACTION
NO voltage	– Test charging fuse, refer to *POWER DISTRIBUTION AND GROUNDS.* – Check continuity of wiring to charging fuse.
Low battery voltage	– Test battery voltage, refer to *CHARGING SYSTEM (550F).* – Check system connections from battery to ignition switch.
Battery voltage measured	Check the following: – *STARTER SOLENOID CONTROL CIRCUIT TEST AT IGNITION SWITCH.* – *MAGNETO STATOR (IGNITION WINDING),* refer to *MAGNETO SYSTEM (550)* subsection. – *ECM IGNITION CIRCUIT TEST AT IGNITION SWITCH.*

ECM

NOTE: Due to the internal circuitry design, primary circuit is impossible to test.

ECM Connectors Identification



CONNECTOR DA
1. *RER switch signal (to ground through gauge and RER switch)*
2. *Beeper output (to gauge)*
3. *RER trigger coil*
4. *RER trigger coil*

CONNECTOR DB
1. *Forward trigger coil*
2. *Forward trigger coil*

CONNECTOR DC
1. *ECM ground*
2. *ECM input voltage (from ignition switch)*
3. *Engine stop switches (to ground through cut-off and emergency switches)*

ECM Ignition Circuit Test at Ignition Switch

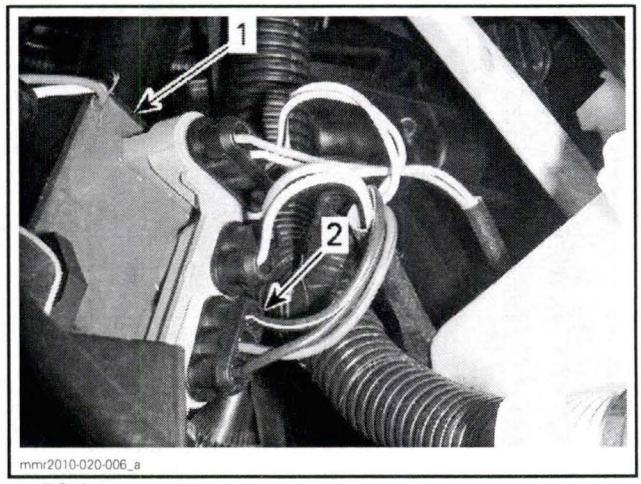
1. Disconnect the ECM 3 pin connector (DC).
2. Check for circuit continuity as follows.

ECM CIRCUIT TEST AT IGNITION SWITCH		
TEST PROBES		RESISTANCE
Ignition switch connector (Pin C)	ECM-DC connector (Pin 2)	Close to 0 Ω (Continuity)

RESULT	SERVICE ACTION
Resistance as specified	– Refer to *ECM INPUT VOLTAGE TEST.*
Resistance NOT as specified	– Check continuity between ignition switch connector (pin C) and ECM-DC connector (pin 2). – Repair or replace wiring and connectors.

ECM Input Voltage Test

1. Refer to *BODY* subsection and remove LH side panel.
2. Refer to *AIR INTAKE SYSTEM* subsection and remove primary intake silencer.
3. Disconnect the 3 pin (DC) connector.

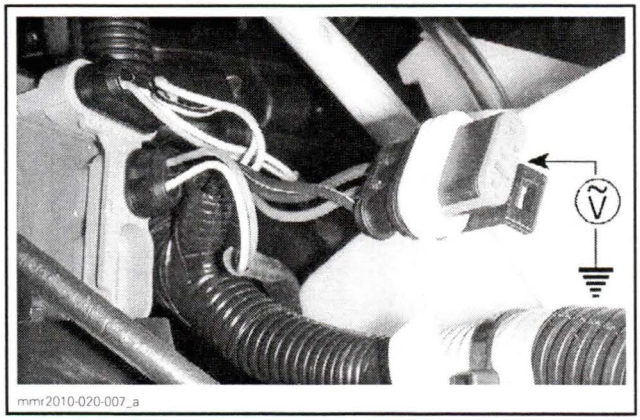


1. ECM
2. 3 pin (DC) connector

4. Turn ignition switch (key) to ON.

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

5. Measure for voltage as per following table.



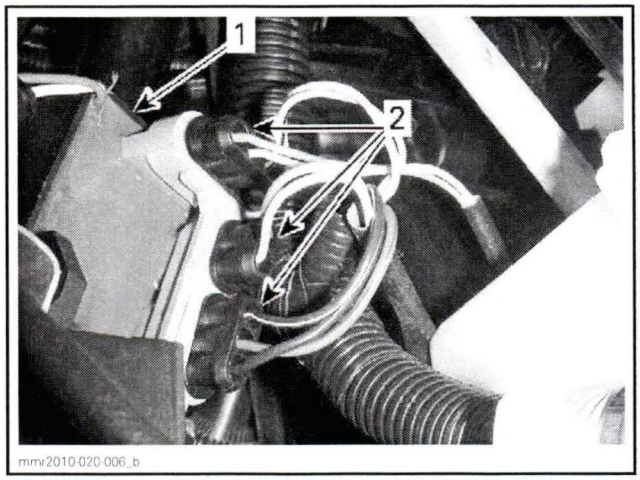
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TEST PROBES		VOLTAGE
Pin 2 of ECM 3-pin connector (DC)	Chassis ground	Battery voltage

RESULT	SERVICE ACTION
Voltage as specified	– Refer to *IGNITION COIL RESISTANCE TEST (SECONDARY CIRCUIT).*
Voltage NOT as specified	– Test ignition switch contacts between pins B and C, refer to *IGNITION SWITCH CONTINUITY TEST* in this subsection. – Check continuity between ECM-DC (pin 2) and Ignition switch. – Repair/replace wiring and connectors.

ECM Removal and Installation

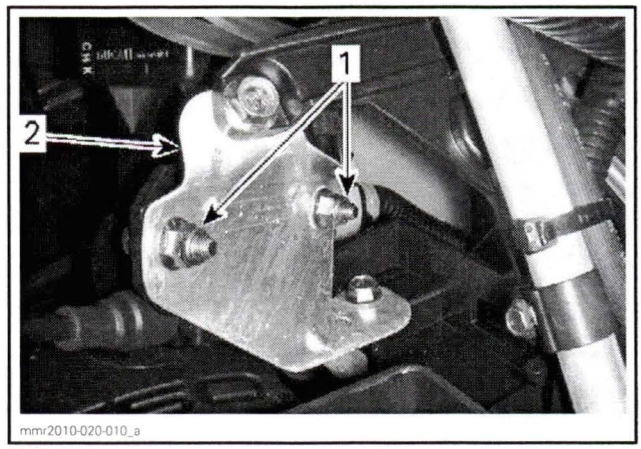
1. Remove primary intake silencer, refer to *AIR INTAKE SYSTEM* subsection.
2. Remove the air outlet duct, refer to *AXIAL FAN* subsection.
3. Disconnect all three ECM connectors and both spark plugs cables.



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TYPICAL
1. ECM
2. ECM connectors

4. Remove ECM from its bracket by removing the retaining nuts.



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TYPICAL
1. ECM retraining nuts
2. ECM bracket

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

TIGHTENING TORQUE	
ECM retaining nuts	3.5 N•m (31 lbf•**in**)

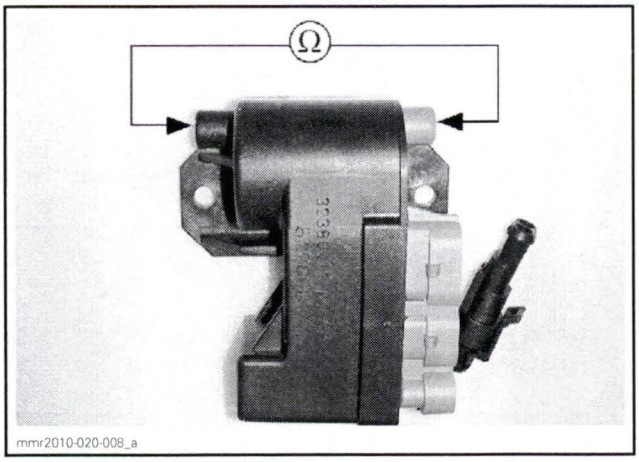
IGNITION COIL

Ignition Coil Resistance Test (Secondary Circuit)

1. Remove ECM, see procedure in this subsection.
2. Note the spark plug cable positions on the ECM (cables are not the same length).
3. Unscrew and remove spark plug cables from ECM.

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

4. Measure resistance as per following table.

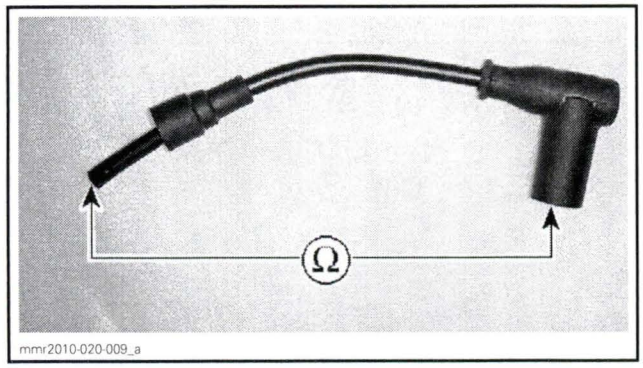


TEST PROBES		RESISTANCE @20°C (68°F)
PTO spark plug cable pin	MAG spark plug cable pin	900 to 1100 Ω

RESULT	SERVICE ACTION
Resistance as specified	– Refer to *SPARK PLUG CAP AND CABLE RESISTANCE TEST.*
Resistance NOT as specified	– Replace ignition coil.

Spark Plug Cap and Cable Resistance Test

1. Measure cable and cap resistance as per following table.



TEST PROBES		RESISTANCE @ 20°C (68°F)
Cable (ECM end)	Spark plug cap	4000 to 6000 Ω

RESULT	SERVICE ACTION
Resistance as specified	– Test trigger coils, refer to *MAGNETO SYSTEM.*
Resistance NOT as specified	– Replace ignition coil.

IGNITION SYSTEM (600 HO E-TEC)

SERVICE TOOLS

Description	Part Number	Page
12 V BATTERY SUPPLY CABLE	529 035 997	597
DIAL INDICATOR ADAPTER	529 036 132	587–588
FLUKE 115 MULTIMETER	529 035 868	595
IGNITION TIMING TOOL	529 036 129	587
T-HARNESS	529 035 869	597
TDC DIAL INDICATOR	295 000 143	587
TDC DIAL INDICATOR	414 104 700	587

SERVICE PRODUCTS

Description	Part Number	Page
DIELECTRIC GREASE	293 550 004	594

GENERAL

⚠ WARNING

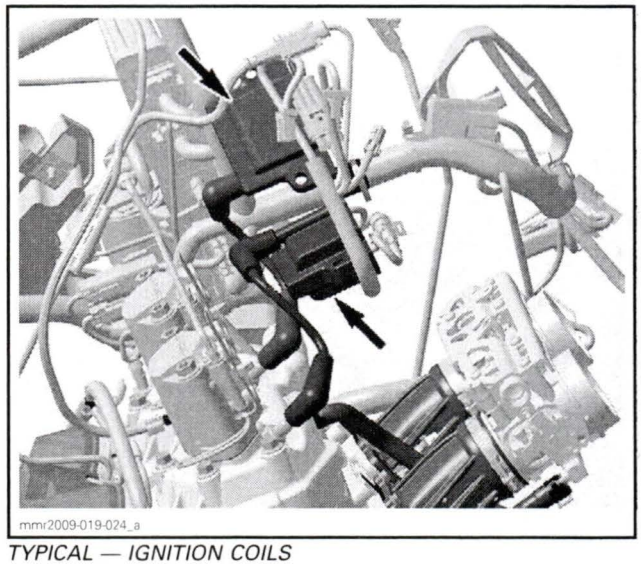
Always electrically disconnect both fuel injectors prior to testing for ignition spark. Otherwise, fuel vapors may ignite in the presence of a spark creating a fire hazard.

SYSTEM DESCRIPTION

This ignition system is an inductive type specifically designed for the E-TEC engine with a rapid rise time to prevent spark plug fouling. It provides a quick spark similar to a CDI system but with a longer duration.

The ignition system is fully managed by the ECM which controls the ignition system parameters such as spark timing, dwell time, and firing order.

The system uses two separate ignition coils which induce voltage to a high level in their secondary winding to produce a spark at each spark plug independently.



TYPICAL — IGNITION COILS

The ignition coils receive power from the 55 Vdc system. Their operating voltage varies from 20 to 55 Vdc.

Ignition System Basic Operation

A 3-wire connector is connected to the primary winding of each coil.

The ignition coils are powered by the 55 Vdc system voltage through the WHITE/RED wire. The BLACK wire is connected to a ground circuit.

Each ignition coil uses an active circuitry to energize the primary winding when it receive a pulse from the ECM via the following wires.

CYLINDER	WIRE COLOR
PTO	ORANGE/GREEN
MAG	ORANGE/BLUE

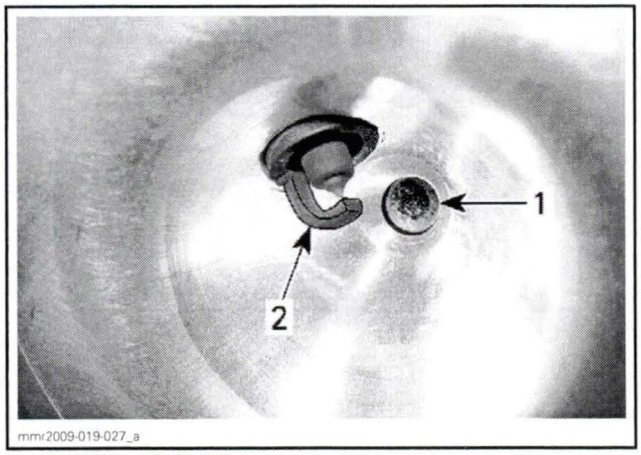
The dwell time has an amplitude of approximately 10 volts. At the end of the dwell time, the power is released from the primary winding which induces a current that produces a high voltage in the secondary winding. This high voltage is then fed to the spark plug.

A resistive core spark plug cable is used to prevent the RFI (Radio Frequency Interference). There is no resistor in the spark plug cap.

Spark Plugs

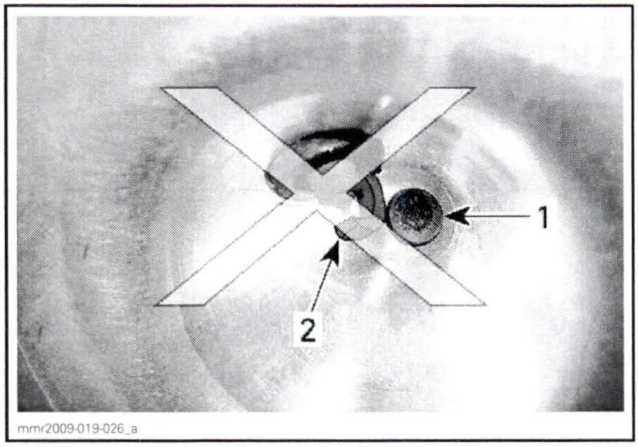
The OEM spark plug used in the E-TEC engine is specially indexed for optimum engine operation and efficiency.

The threads on the spark plug and in the cylinder head are indexed so that when the plug is installed, the open end of the negative electrode will be facing the injection spray, within ± 90°.This ensures the negative electrode does not deviate the injection spray and ensures proper ignition.



CORRECTLY INDEXED
1. *Injector nozzle*
2. *Ground electrode*

NOTE: Using an incorrectly indexed spark plug will result in poor idle and increased emissions.



INCORRECTLY INDEXED
1. *Injector nozzle*
2. *Ground electrode*

If using a non OEM spark plug, a specific installation procedure must be followed. Refer to *SPARK PLUG INSTALLATION* in this subsection.

Ignition Timing

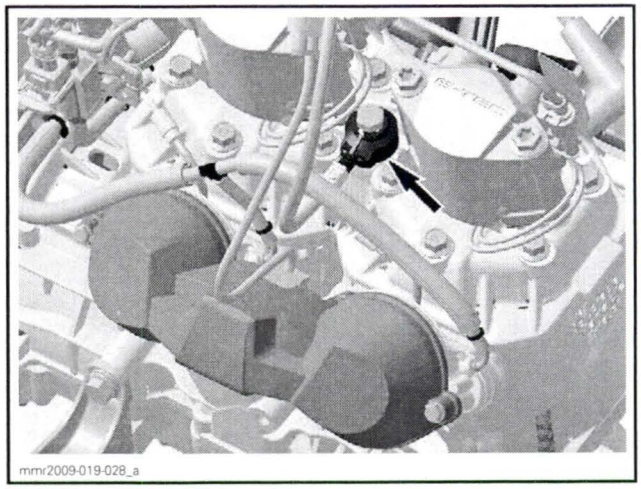
The crankshaft position sensor (CPS), the air pressure sensor (APS) and the throttle position sensor (TPS) are the primary sensors used to control the ignition timing.

The ECM is programmed with data (ignition mappings). Using engine operating parameters provided by the sensors, the ECM controls the ignition timing for optimum engine operation under all operating conditions.

Ignition timing can be adjusted using B.U.D.S., refer to *ADJUSTMENT* in this subsection.

Knock Detection

A knock sensor is mounted on top of the cylinder head. It detects specific vibrations that would be typically generated by engine detonation.



TYPICAL

If detonation occurs, the ECM temporarily retards the ignition and increases the fuel injected (it goes into a specific operating mode) until detonation stops.

ADJUSTMENT

IGNITION TIMING

Normally, ignition timing adjustments should not be required. It has been set at the factory and should remain correctly adjusted as every component is fixed and non adjustable.

The only time the ignition timing may require adjustment is when replacing the crankshaft, the magneto flywheel, a CPS or the ECM.

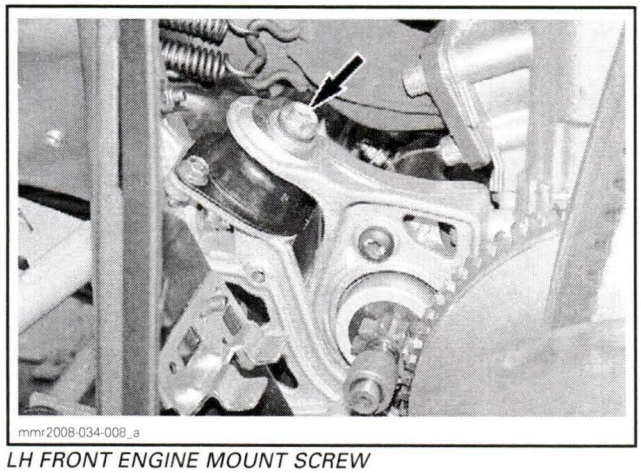
If the ignition timing is found incorrect, first check for proper crankshaft alignment. This might be an indication of a twisted crankshaft. Refer to *ENGINE MEASUREMENT* subsection.

Ignition Timing Tool Installation

⚠ WARNING

Ensure the tether cord is removed from the engine cut-off switch and emergency engine stop switch is in the STOP position.

1. Remove the LH front engine mounting screw.



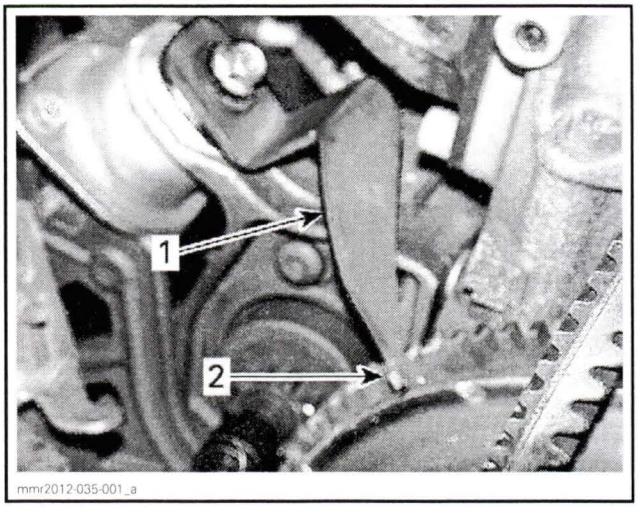
LH FRONT ENGINE MOUNT SCREW

NOTE: Note position of washers for installation.

2. Install the appropriate ignition timing tool on the LH front engine mount.

REQUIRED TOOL	
IGNITION TIMING TOOL (P/N 529 036 129)	

TIGHTENING TORQUE	
Engine mount screw	25 N•m (18 lbf•ft)



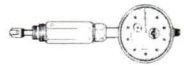
1. Ignition timing tool
2. Pointer

TDC Gauge Installation

⚠ WARNING

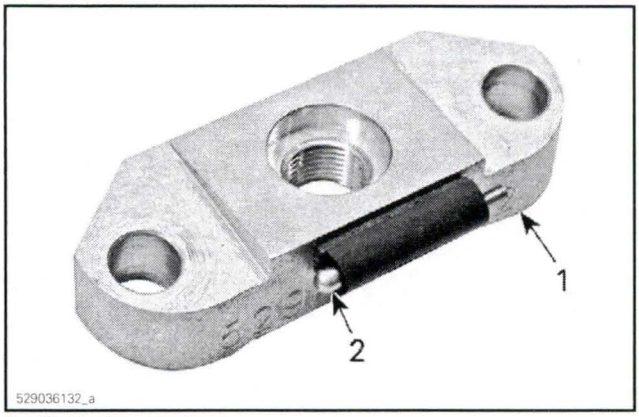
Ensure tether cord is removed from engine cut-off switch and emergency engine stop switch is in the STOP position.

Two TDC gauges can be used:

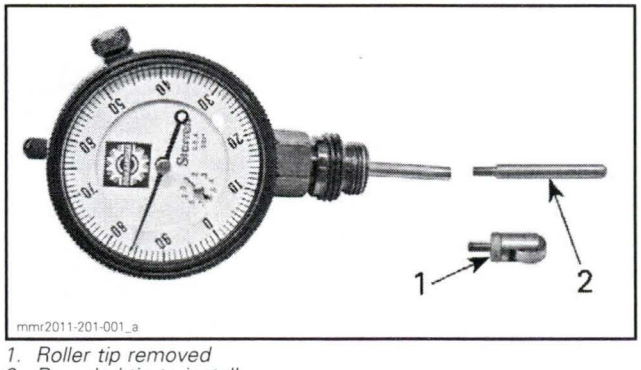
TDC GAUGES	
TDC DIAL INDICATOR (P/N 295 000 143) **(short reach)**	
TDC DIAL INDICATOR (P/N 414 104 700) **(long reach)**	

Short Reach Gauge Preparation (Preferred Gauge)

1. Remove the roller tip from the gauge.
2. Use the rounded tip from the DIAL INDICATOR ADAPTER (P/N 529 036 132).



1. Dial indicator adaptor
2. Rounded tip



1. Roller tip removed
2. Rounded tip to install

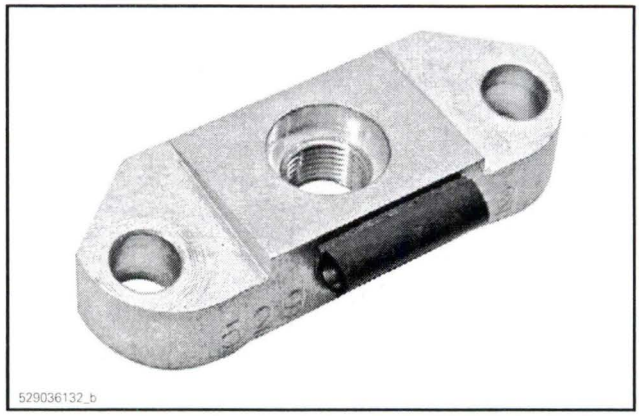
3. Install the rounded tip on the gauge.

Long Reach Gauge Preparation

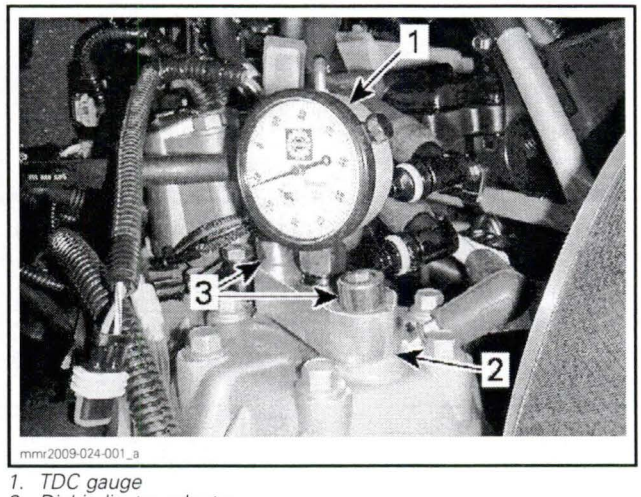
1. Loosen and lift the console, headlight/gauge module and secondary air intake silencer to provide clearance for the long reach gauge.
2. Replace the roller tip by the rounded tip as described in the *SHORT REACH GAUGE PREPARATION*.

Gauge Installation (both Gauges)

1. Remove the PTO injector, refer to *E-TEC DIRECT FUEL INJECTION* subsection.
2. Install the DIAL INDICATOR ADAPTER (P/N 529 036 132) over the PTO injector hole.



3. Use two screws M10 x 1.5 x 35 to secure the adaptor.
4. Carefully insert the TDC gauge through the dial indicator adapter hole.



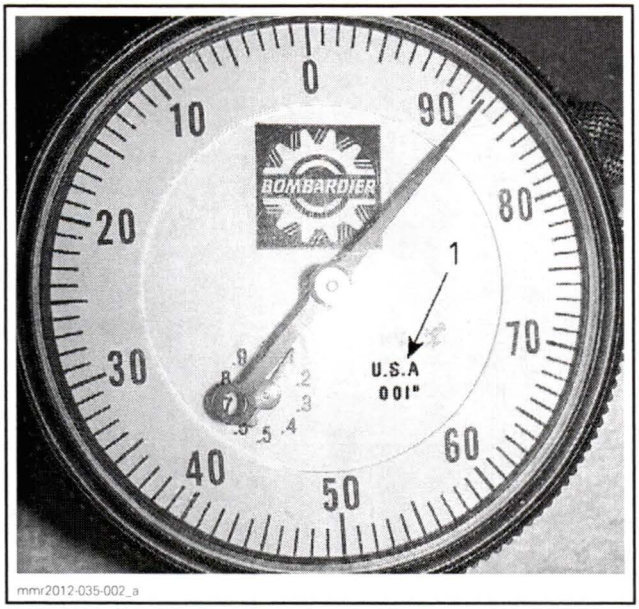
1. TDC gauge
2. Dial indicator adaptor
3. Screws

5. Screw the gauge into the adapter plate with the dial face towards the PTO and tighten it sufficiently to prevent movement.

Understanding the TDC Gauge

Dial gauges can be either in imperial or metric units. It is crucial to identify gauge units and graduation.

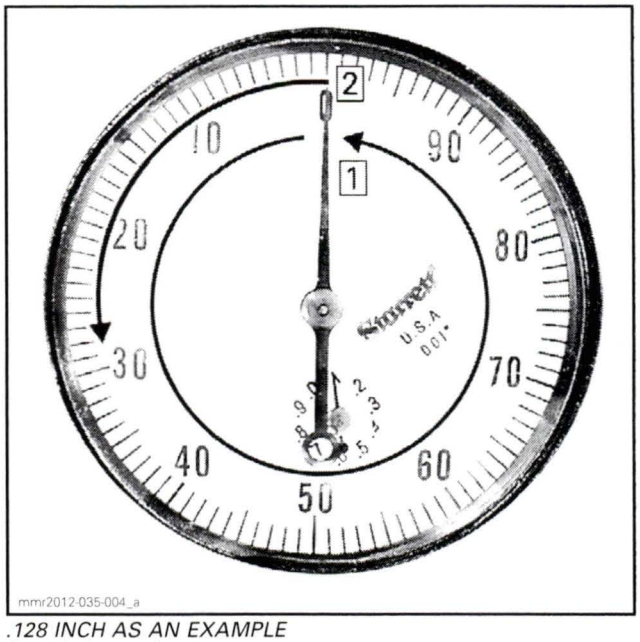
Imperial Dial Gauge



IMPERIAL GAUGE EXAMPLE
1. 001" means its graduated each 1/1000 inch

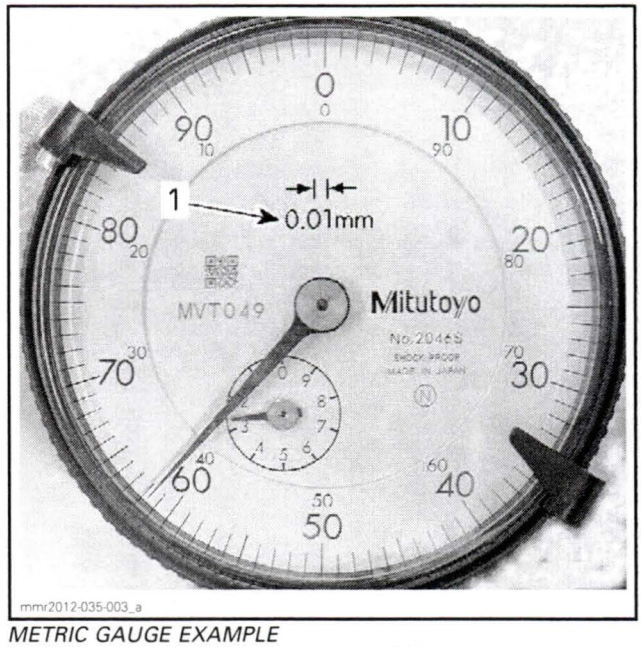
TYPICAL IMPERIAL DIAL GAUGE		
GRADUATION	MEASURE PER NEEDLE TURN	MEASURE EXAMPLE: .128 INCH
1/1000 inch (.001) per graduation line	1 turn = .100 inch	1 complete turn + 28 graduation lines

NOTE: The small dial indicates the number of turns the long needle traveled around the main dial.



.128 INCH AS AN EXAMPLE
Step 1: 1 complete turn
Step 2: 28 lines

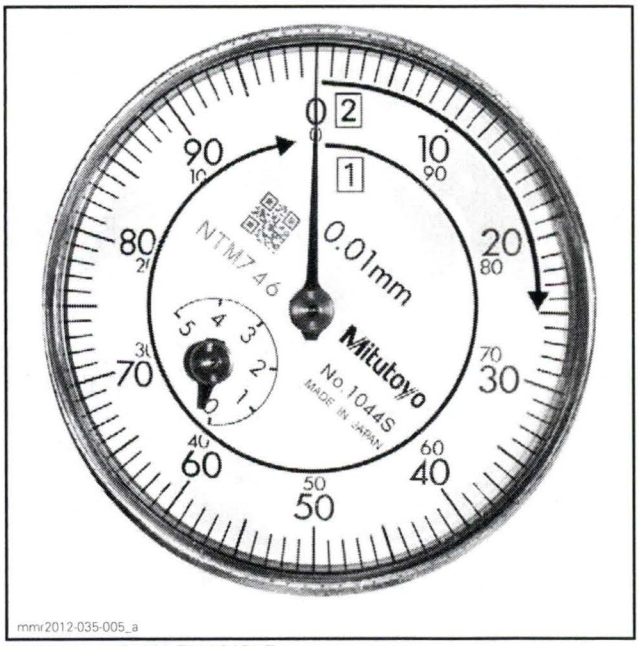
Metric Dial Gauge



METRIC GAUGE EXAMPLE
1. 0.01mm means its graduated each 1/100 millimeter

IMPERIAL DIAL GAUGE EXAMPLE		
GRADUATION	MEASURE PER NEEDLE TURN	MEASURE EXAMPLE: 3.25 mm
1/100 millimeter (.01) per graduation line	1 turn = 1 millimeter	3 complete turns + 25 graduation lines

NOTE: The small dial indicates the number of turns the long needle traveled around the main dial.



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3.25 mm AS AN EXAMPLE
Step 1: Complete turns (3 X)
Step 2: 25 lines

Locating Piston TDC

NOTE: Normal engine rotation as seen from the PTO side is counterclockwise.

1. With a firm hold on the drive pulley, slowly rotate the drive pulley counterclockwise while observing the TDC gauge needle.

NOTE: Rotate pulley until the gauge needle starts reversing its movement. This indicates the piston is changing direction at the top of its stroke.

2. Rotate the dial face so the "0" is in line with the needle when it stops moving (top of piston stroke).
3. Resume rotating the engine counterclockwise until the gauge needle has rotated approximately 1/4 turn past TDC.
4. Then, slowly rotate the engine in a clockwise direction until the needle stops moving.

NOTE: The needle should stop on the "0". If not, reset the dial "0" to the needle.

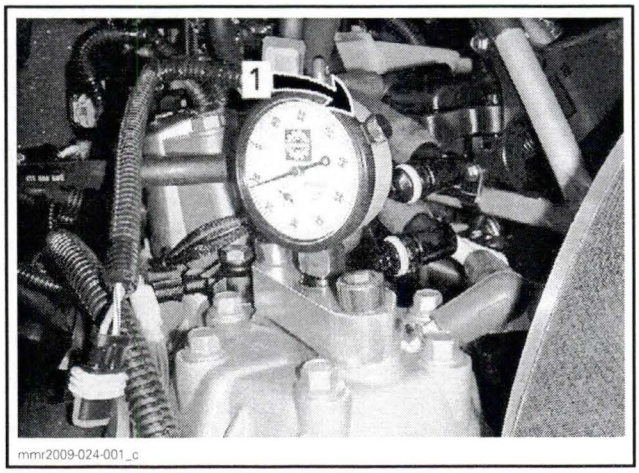
5. Again, slowly rotate the drive pulley back and forth across TDC and confirm the needle always stops exactly at "0" before changing direction. "0" now indicates exact TDC.
6. Lock the dial face with the dial lock screw.

NOTE: If a difference in "0" setting the dial in each direction of rotation is easily noticeable, the engine components may suffer from excessive wear. The engine may require further inspection and maintenance.

Scribing the Timing Mark

IMPORTANT: Be sure to understand how the TDC gauge functions. Refer to *UNDERSTANDING THE TDC GAUGE* in this subsection.

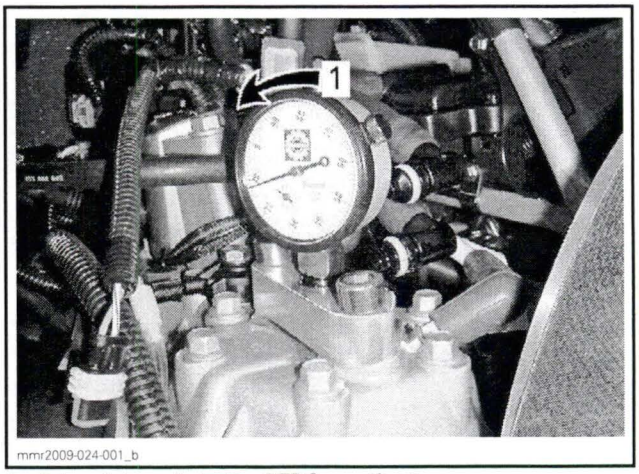
1. From the "0" (TDC), rotate the drive pulley clockwise (reverse engine rotation) until the dial needle rotates past the BTDC specification (see table below).



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1. Pass the BTDC specification

2. Then carefully rotate engine forwards until the needle points precisely to the measurement specified in the following table.



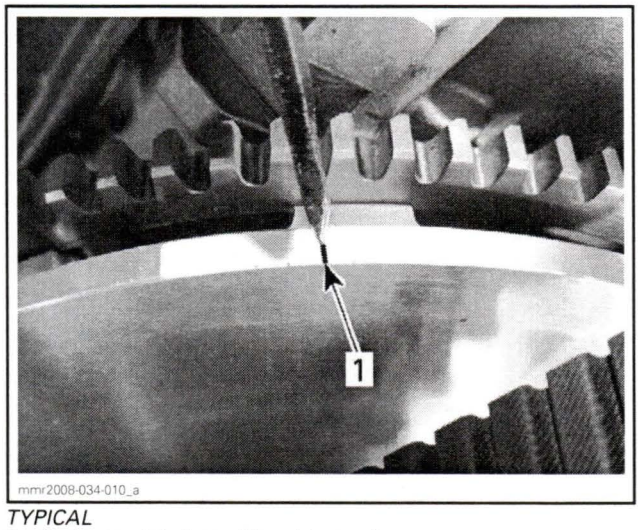
mmr2009-024-001_b

1. Bring dial needle to the BTDC specification

NOTE: Final setting must always be made counterclockwise (normal engine rotation).

IGNITION TIMING BTDC		
ENGINE	BTDC SPECIFICATION	DEGREE SETTING BTDC
600 HO E-TEC	5.39 mm (.212 in)	28°

3. With the TDC gauge indicating specified timing, use a permanent marker to draw a line on the drive pulley fixed sheave directly in line with pointer end.



TYPICAL
1. Timing mark in line with pointer end

4. Repeat the procedure to ascertain the mark is exactly in line with the pointer.
5. Remove the TDC gauge and dial indicator adapter.
6. Reinstall the fuel injector. Refer to *E-TEC DIRECT FUEL INJECTION* subsection.
7. Check ignition timing as per applicable procedure in this subsection.

Checking Ignition Timing

The ignition timing can be checked with either the engine hot or cold at the specified RPM.

ENGINE SPEED FOR IGNITION TIMING CHECK	
MODEL	ENGINE RPM
600 HO E-TEC	2500 to 4000 (1)
(1) In this range, the spark advance does not change during the procedure.	

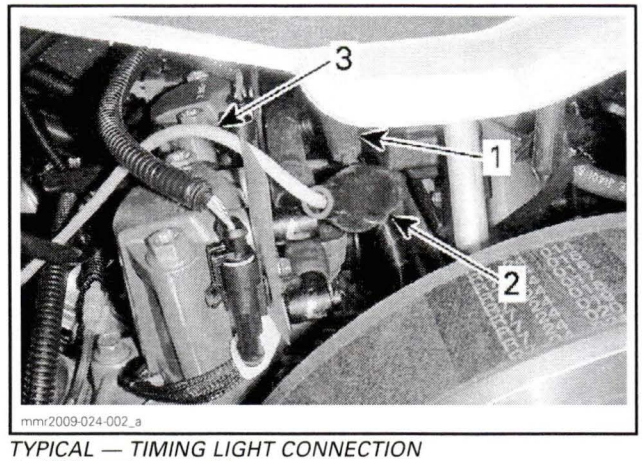
To check the ignition timing proceed as follows:

⚠ WARNING

Do not allow anyone in front of or behind the vehicle while engine is running. Keep clear of track and do not wear loose clothing which can get caught in moving parts.

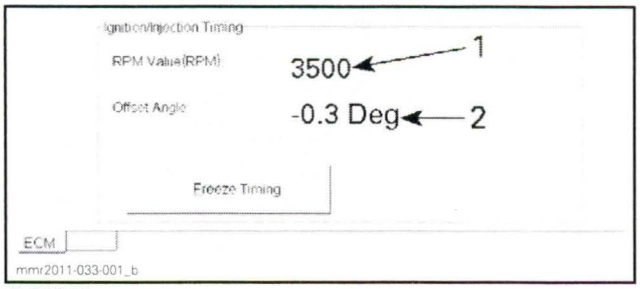
1. Place ski tips against a wall, raise rear of vehicle on a stand, so that track does not contact the ground.
2. Connect the timing light pick-up to the **PTO** spark plug cable.

NOTE: Be careful to route timing light cable away from drive belt and pulleys.



TYPICAL — TIMING LIGHT CONNECTION
1. PTO spark plug cable
2. Timing light connection to PTO plug cable
3. Timing light wire routing

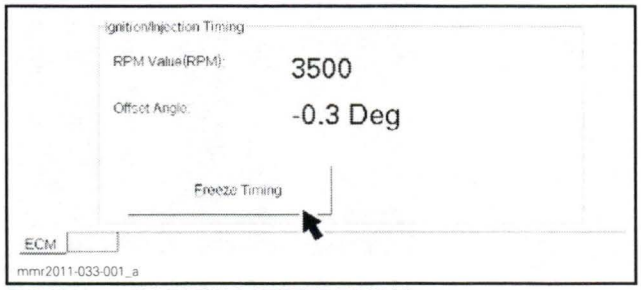
3. Connect vehicle to the latest applicable B.U.D.S. version. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
4. Start engine and let idle.
5. In B.U.D.S., select:
   - **Read Data** button
   - **Setting** page tab
   - **ECM** page.
6. In the bottom left hand corner of the page, read the **RPM Value** and **Offset Angle** in the **Ignition/Injection Timing** field.



TYPICAL
1. *RPM Value*
2. *Timing Offset Angle*

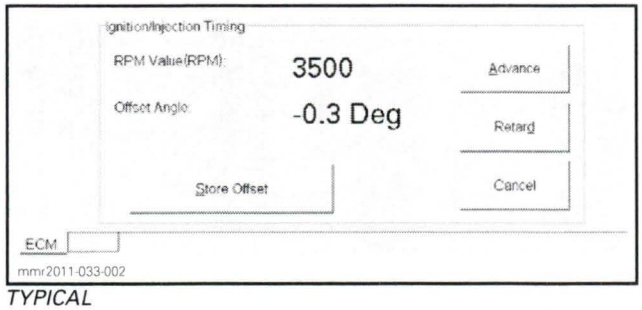
7. In the **Ignition/Injection Timing** field, select **Freeze timing**.

NOTE: Selecting **Freeze timing** will freeze the timing to the proper advance. Timing will be frozen on the PTO cylinder only for RPM stability. RPM will be limited to 4000 RPM.



TYPICAL — SELECTING FREEZE TIMING

Note how the available buttons in the **Ignition/Injection Timing** field have changed.



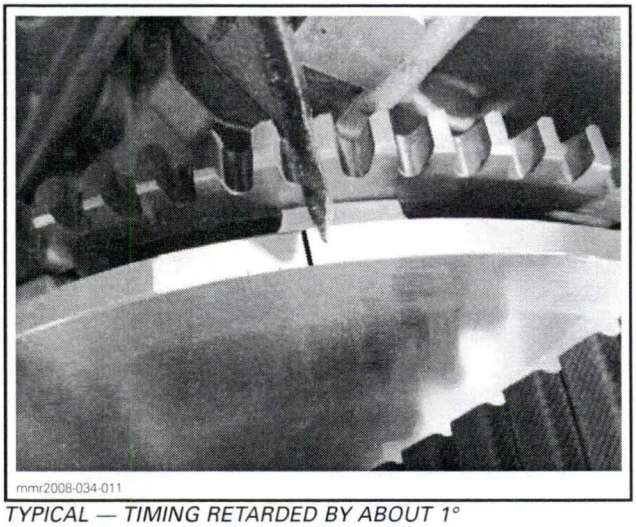
TYPICAL

8. Point the timing light on the timing mark and increase engine to the specified engine speed for a brief instant.
9. The timing mark must be aligned with the pointer end within the specified tolerance.

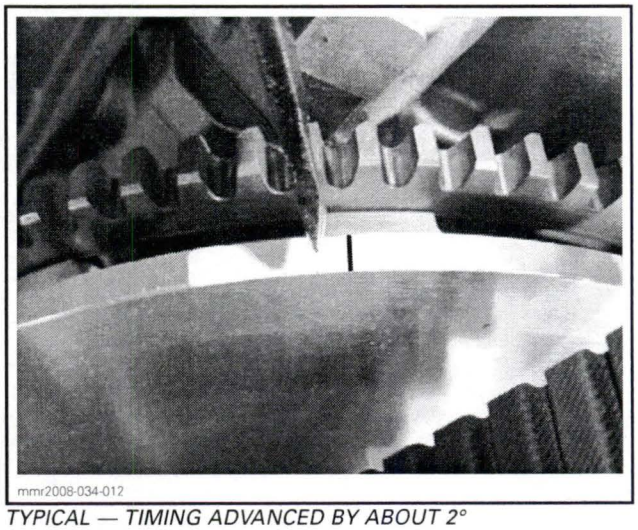
MODEL	TOLERANCE
600 HO E-TEC	± 0.5°

If timing mark and pointer are aligned, no adjustment is required.

If they are not aligned, note if timing is retarded or advanced, see following illustrations. Then, adjust timing as described in *ADJUSTING TIMING (E-TEC)* further in this subsection.



TYPICAL — TIMING RETARDED BY ABOUT 1°



TYPICAL — TIMING ADVANCED BY ABOUT 2°

Adjusting Timing

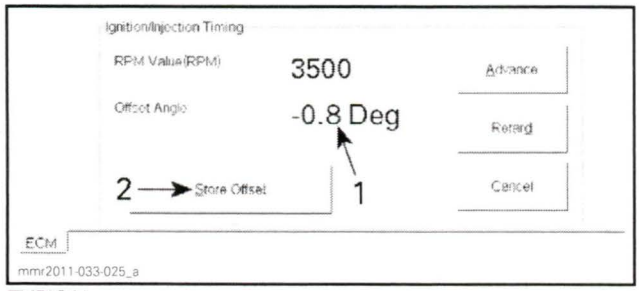
1. In the **Ignition/Injection Timing** field on the **Setting** page, select **Advance** or **Retard** to change the ignition timing. Select **Cancel** to erase the last change.



TYPICAL
1. *Advance timing button*
2. *Retard timing button*
3. *Cancel timing change*

NOTE: Timing will be changed in 0.5° increments.

2. Adjust the timing using the appropriate button until the timing mark is in line with the pointer within 0.5°. Then select **Store Offset** to store the ignition timing correction.



TYPICAL
1. *Timing angle changed in 0.5° increments*
2. *Store Offset button*

3. Shut down engine.
4. Restart engine and select **Read Data** in B.U.D.S.
5. Recheck timing to ensure ignition timing adjustment was properly stored in the ECM.
6. Increase engine RPM past 4000 RPM to ascertain the **Freeze Timing** function is no longer active.

NOTE: The **Freeze Timing** function automatically disengages when the **Store Offset** is selected or when engine is stopped.

7. Remove all tools.

TROUBLESHOOTING

IGNITION SYSTEM TESTING SEQUENCE

NOTE: It is good practice to check for fault codes using the B.U.D.S. software as a first troubleshooting step. Refer to the *DIAGNOSTIC AND FAULT CODES* subsection.

In the case of ignition problems, check the following in the prescribed order until the problem can be solved:

1. Spark plugs
2. Spark plug cables
3. Wiring harness/electrical connectors
4. Emergency engine stop switch
5. Ignition cut-off switch
6. Ignition coil(s)
7. CPS
8. ECM (Engine Control Module).

If the engine idles roughly or shows signs of increased emissions, the spark plugs may be incorrectly indexed. Refer to *SPARK PLUG INSTALLATION* in this subsection.

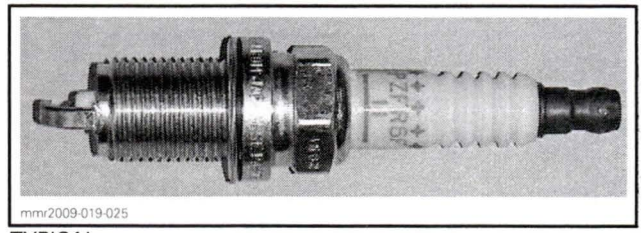
PROCEDURES

SPARK PLUGS

Spark Plug Application

A platinum NGK spark plug is used, one per cylinder.

MODEL	NGK SPARK PLUG NUMBER
600 HO E-TEC	PZFR6F



TYPICAL

Spark Testing

NOTE: Use ONLY an approved inductive spark plug tester or a new spark plug to test for ignition spark. In-line (series connected) spark testers must not be used. Radio frequency interference (RFI) generated by the arcing current may cause erratic behavior in the ECM.

⚠ WARNING

Always electrically disconnect both fuel injectors prior to testing for ignition spark. Otherwise, fuel vapors may ignite in presence of a spark, creating a fire hazard.

1. Install the inductive spark tester (or a new spark plug) on the spark plug cable.

⚠ WARNING

Do not remove spark plugs installed on engine.

2. Bring the new spark plug into contact with the engine.
3. Press START/RER button to crank engine.
4. If no spark is produced, refer to *IGNITION SYSTEM TESTING SEQUENCE* in this subsection.
5. If a spark is produced, install new spark plugs in the engine and repeat the test to assure the new spark plugs are in good condition and functioning correctly.

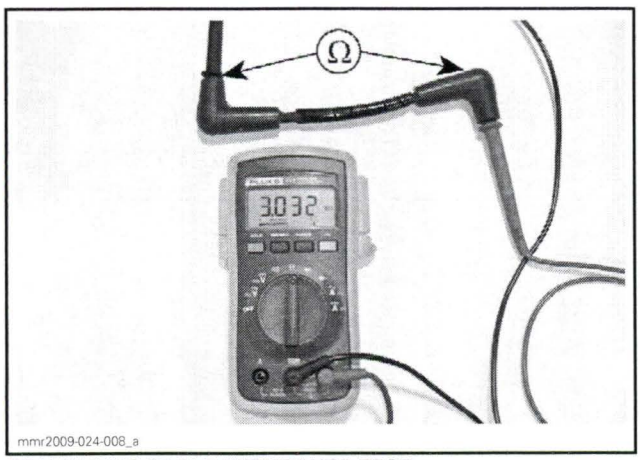
SPARK PLUG CABLES

Spark Plug Cable Resistance Test

If the spark plug cables are in good condition, carry out the following resistance test.

1. Remove each spark plug cable from its ignition coil and spark plug.
2. Set multimeter to Ω.
3. Insert a probe in each cable end and measure the resistance.

SPARK PLUG CABLE RESISTANCE
1283 – 4083 Ω



SPARK PLUG CABLE RESISTANCE TEST

If resistance is not as specified, replace spark plug cable.

NOTE: Apply DIELECTRIC GREASE (P/N 293 550 004) on contact in spark plug cap before reinstalling cable.

NOTICE Do not interchange spark plug cables. The lower LH coil must be matched to the PTO spark plug.

EMERGENCY ENGINE STOP SWITCH

Emergency Engine Stop Switch Operation

The emergency engine stop switch provides a ground signal to the ECM when STOP is selected.

The ground signal is applied to ECM connector J1A pin 9, through the emergency engine stop switch (STOP position).

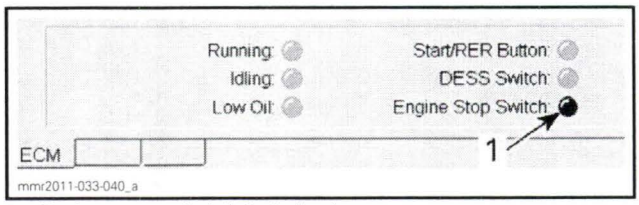
Emergency Engine Stop Switch Troubleshooting

Engine Will Not Start, No Spark

If the engine will not start and you do not have ignition spark at the plugs, the emergency engine stop switch or its wiring to the ECM may be shorted to ground.

Provide power to the electrical system using the T-harness and connect as described in *COMMUNICATION TOOLS AND B.U.D.S.* subsection.

1. In B.U.D.S., select:
   - **Monitoring** tab
   - **ECM** page.
2. In B.U.D.S., look for the engine stop switch indicator light at the bottom of the page as you toggle the emergency engine stop switch between STOP and RUN positions.



1. Engine stop switch light indication

EMERGENCY ENGINE STOP SWITCH NORMAL RESULT	
STOP position (down)	B.U.D.S. indicators light ON
RUN position (UP)	B.U.D.S. indicators light OFF

3. If results are not as specified, carry out an *EMERGENCY ENGINE STOP SWITCH CONTINUITY TEST* as per procedures in this subsection.

Engine Will Not Stop

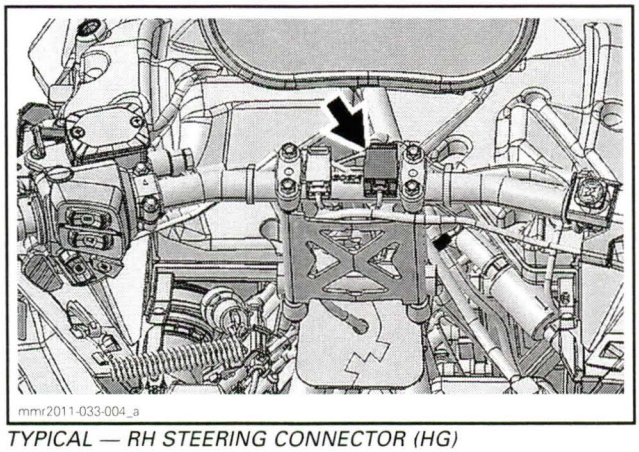
The emergency engine stop switch and wiring may be open-circuit (no ground available).

Carry out an *EMERGENCY ENGINE STOP SWITCH CONTINUITY TEST* as per procedures in this subsection.

Emergency Engine Stop Switch Continuity Test

To test the emergency engine stop switch, carry out the following steps.

1. Disconnect the RH steering connector (HG) under the steering cover.



TYPICAL — RH STEERING CONNECTOR (HG)

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

2. Measure the resistance through the switch and its wiring as follows.

EMERGENCY ENGINE STOP SWITCH CONTINUITY TEST			
SWITCH POSITION	**TEST PROBES**		**RESISTANCE**
RUN	Black wire	Yellow/ Black wire	Infinite (OL)
STOP			0 to 0.5 Ω

If readings are not as specified in table, replace switch or repair wiring/connector.

If readings are as specified, check the circuit wiring.

ENGINE CUT-OFF SWITCH

Engine Cut-off Switch Continuity Test

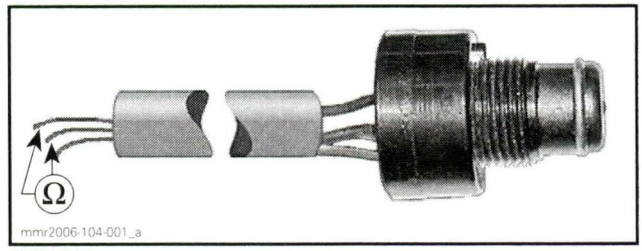
REQUIRED TOOL	
FLUKE 115 MULTIMETER (P/N 529 035 868)	

Tether Cord Cap Removed from Switch

Set multimeter to Ω.

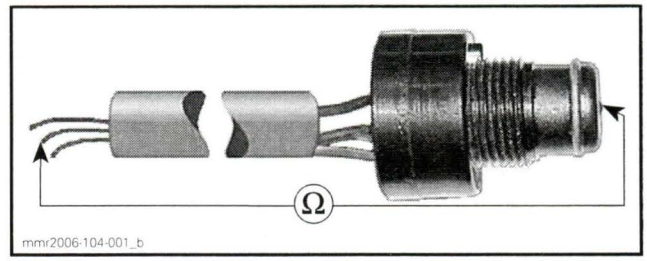
Connect test probes to engine cut-off switch and its connector as per tables and measure resistance.

ENGINE CUT-OFF SWITCH		RESISTANCE Ω @ 20°C (68°F)
WIRE		
GREEN/BLACK	WHITE/BLACK	Open circuit



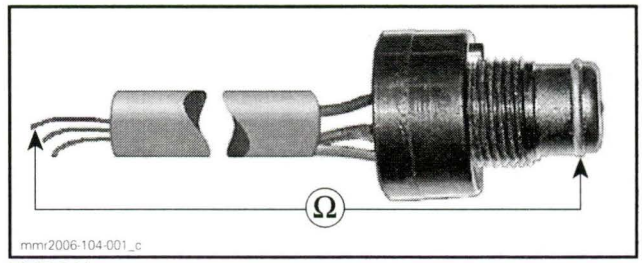
TYPICAL

ENGINE CUT-OFF SWITCH		RESISTANCE Ω @ 20°C (68°F)
WIRE		
WHITE/GRAY	Switch terminal	Close to 0 Ω



TYPICAL

ENGINE CUT-OFF SWITCH		RESISTANCE Ω @ 20°C (68°F)
WIRE		
GREEN/BLACK	Switch ring	Close to 0 Ω

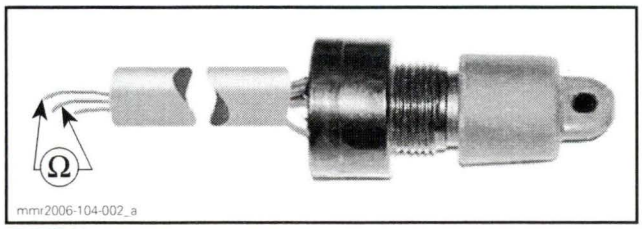


TYPICAL

Tether Cord Cap on Switch

Connect test probes to engine cut-off switch connector as per table and measure resistance.

ENGINE CUT-OFF SWITCH		RESISTANCE Ω @ 20°C (68°F)
WIRE		
GREEN/BLACK	WHITE/BLACK	Close to 0 Ω



TYPICAL

If any resistance test fails, replace engine cut-off switch.

If readings are as specified, check the circuit wiring.

IGNITION COILS

Ignition Coil Testing Sequence

NOTE: A resistance test of the ignition coil primary and secondary windings cannot be carried out due to internal circuits.

Before replacing an ignition coil, carry out the following in this order:

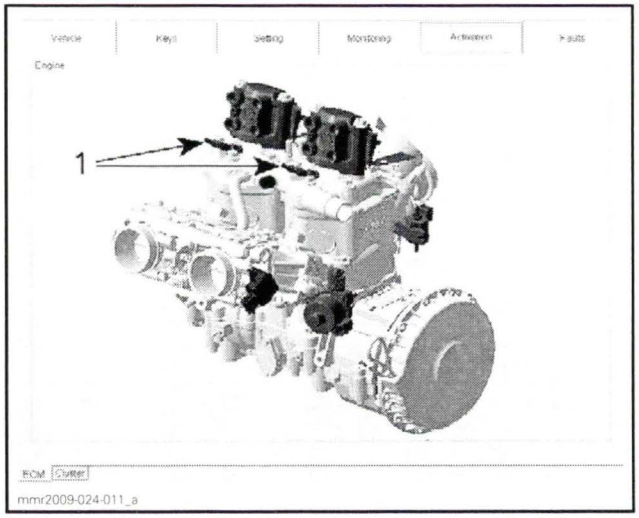
- Ignition coil test with B.U.D.S.
- Ignition coil input voltage test
- Ignition control signal test with B.U.D.S.
- Ignition coil control circuit test
- Ignition coil ground circuit test
- Spark plug cable test
- Spark plug replacement.

Ignition Coil Test with B.U.D.S.

NOTE: The battery must be fully charged. The test with B.U.D.S. will fail if the battery voltage is less than 11 Vdc.

NOTE: The ECM energizes and sends a trigger signal to each ignition coil individually. It can detect if each ignition coil is connected, display a trouble code in the multifunction display, and a CHECK ENGINE upon engine starting.

1. Connect the vehicle to the latest applicable B.U.D.S. version, refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. In B.U.D.S., select:.
   - **Read Data** button
   - **Activation** page tab
   - **ECM** page.
3. Energize each ignition coil separately.



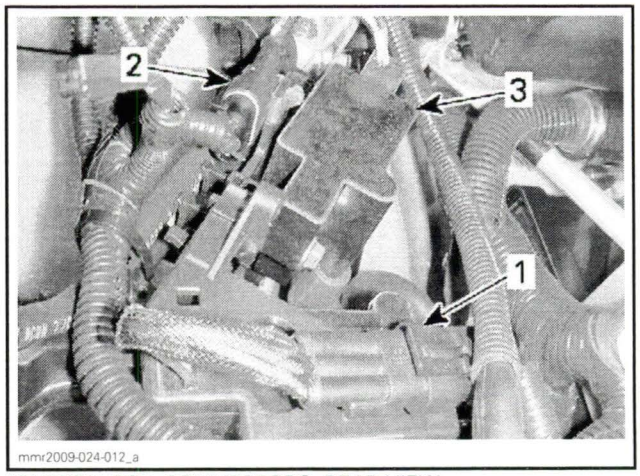
1. Activate here

You should hear the spark occurring. If in doubt, use an inductive spark tester.

If there is no spark, carry out an *IGNITION COIL INPUT VOLTAGE TEST.*

Ignition Coil Input Voltage Test

1. Remove parts required for access to the ignition coil connectors.
2. Disconnect the connector from each ignition coil.

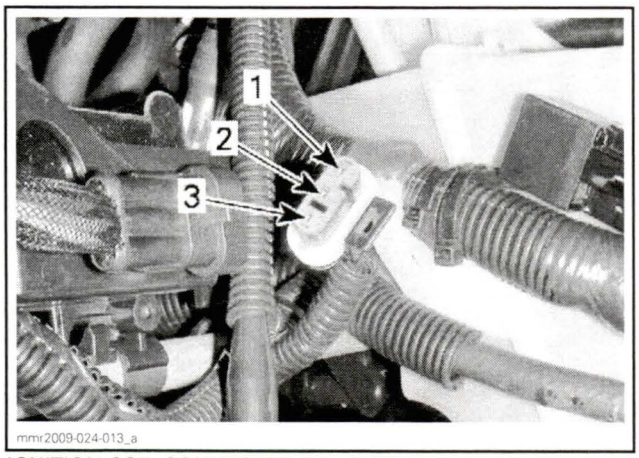


IGNITION COIL CONNECTORS, REAR VIEW
1. PTO coil connector
2. MAG coil connector
3. MAG ignition coil

3. Install the following tools to supply 12 Vdc to the primary 12 Vdc circuits and to the 55/60 Vdc circuits for this test. Refer to *LIGHTS, GAUGE AND ACCESSORIES* subsection for proper connections.

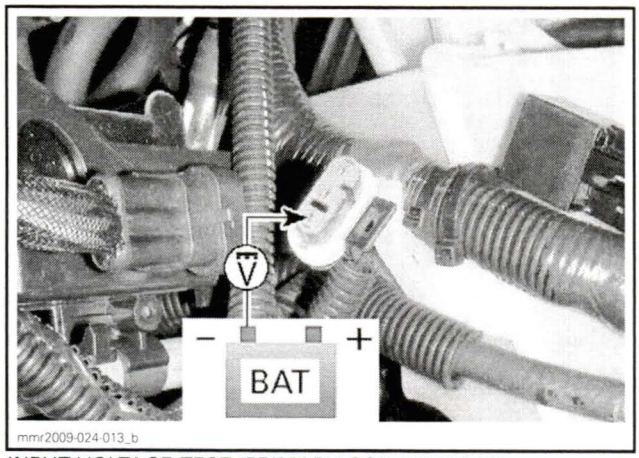
REQUIRED TOOLS	
T-HARNESS (P/N 529 035 869)	
12 V BATTERY SUPPLY CABLE (P/N 529 035 997)	

4. Set multimeter to Vdc and measure supply battery voltage.
5. Check ignition coil input voltage as follows.



IGNITION COIL CONNECTOR PIN-OUT

IGNITION COIL WIRE		VOLTAGE (VDC)
WH/RD	Battery ground	Battery voltage minus 0.7 Vdc



INPUT VOLTAGE TEST (PRIMARY COIL WINDING)

If voltage is NOT as specified, carry out the following:

- Check continuity of wire between WH/RD wire of ignition coil and pin 13 of the ECM J2 connector.
- Test for supply battery voltage at pins 15 and 16 of ECM J2 connector.
- Test continuity of all ECM ground circuits, refer to *E-TEC DIRECT INJECTION* subsection.
- Repair or replace wiring as required.

If battery voltage is read at coil input, carry out the following:

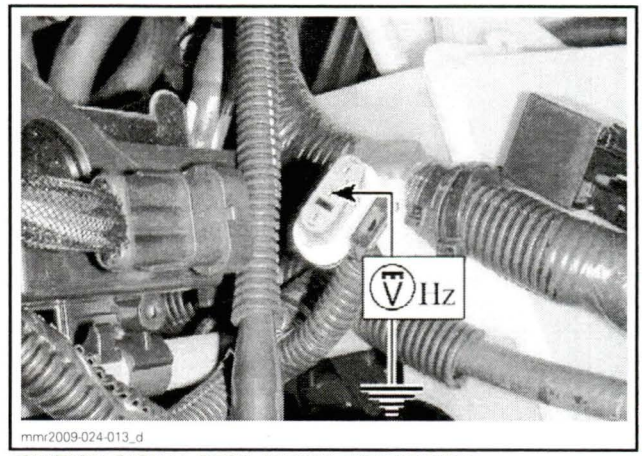
- Ignition control signal test with B.U.D.S.
- Spark plug cable resistance test
- Continuity test of ignition coil control circuit
- Continuity test of coil ground circuit, BK wire to chassis ground
- Replace coil
- Replace ECM.

Ignition Coil Control Signal Test with B.U.D.S.

1. Disconnect the affected ignition coil connector.
2. Set multimeter to Vdc, then select the frequency function (Hz), and manually set the scale to 6 Hz.

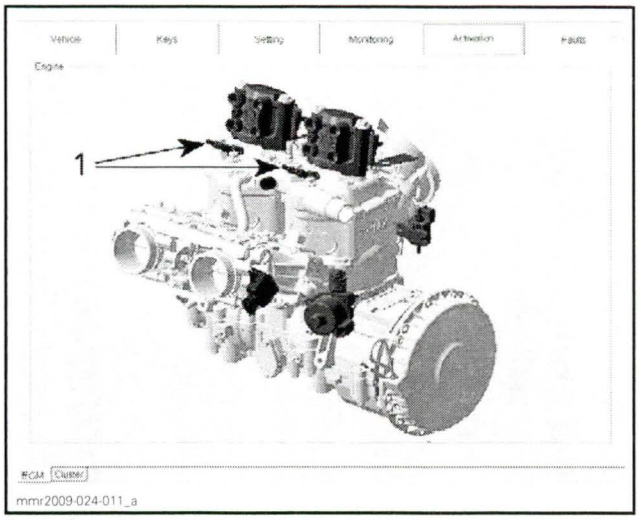
NOTE: If the meter is left in automatic range mode, you will not obtain a reading as the ignition control signal is too fast and far too short a period of time for the meter to adjust and take the reading. The meter must be in a low manual Hz range.

3. Set multimeter to a low manual Hz range.
4. Select the MAX. function on the multimeter to record the maximum reading detected.
5. Install an alligator clip adapter to the BLACK (–) probe, and a thin rigid back probe to the RED multimeter probe.



IGNITION SIGNAL TEST AT COIL CONNECTOR

6. Insert the RED probe in OR/GN wire (PTO) and OR/BU wire (MAG) of the coil connector, and clip the BLACK probe to engine ground.
7. In B.U.D.S., energize the affected ignition coil separately.



1. Activate here

METER SELECTION	TEST PROBES		READING
Vdc Hz manual range	Coil wire	Engine	Approximately 2 Hz
	PTO: Orange/ Green	Ground	
	MAG: Orange/ Blue	Ground	

Frequency of ignition signal should be consistentl.

If signal is not present, refer to *IGNITION COIL CONTROL CIRCUIT.*

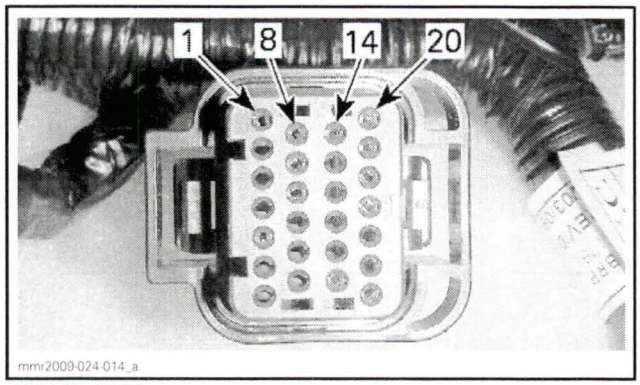
If the ignition coil control signal test was good, test the following before installing a new coil.

- Ignition coil ground circuit test
- Spark plug cable resistance test
- Spark plugs.

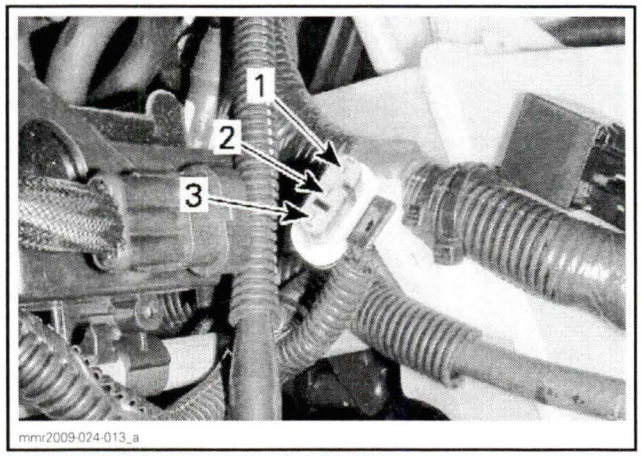
Ignition Coil Control Circuit Test

1. Disconnect connector J1B from ECM.
2. Test for continuity of the circuit between ECM connector and ignition coil connector as follows.

CONNECTOR PIN			
CYLINDER	ECM J1B	IGNITION COIL WIRE	RESISTANCE
PTO	19	Orange/Green	Close to 0 Ω (continuity)
MAG	26	Orange/Blue	



J1B PIN-OUT



IGNITION COIL CONNECTOR PIN-OUT

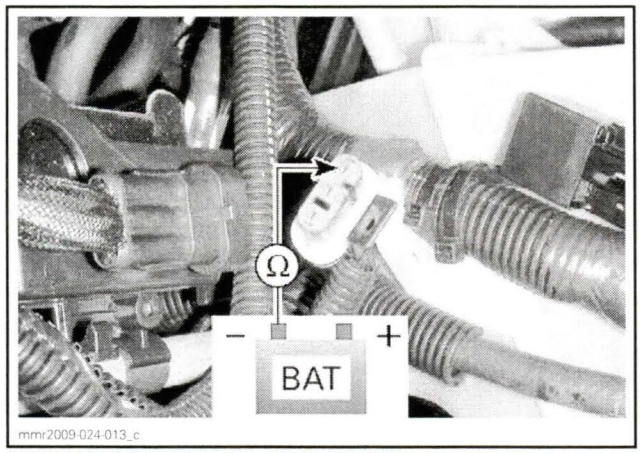
If wiring harness is defective, repair the connector or replace the wiring harness between ECM connector and the ignition coil.

If wiring harness tested good, refer to *IGNITION COIL GROUND CIRCUIT TEST.*

Ignition Coil Ground Circuit Test

1. Disconnect the input connector from both coils.
2. Test for continuity of the coil ground circuit as follows.

CYLINDER	IGNITION COIL CONNECTOR		RESISTANCE
PTO	Black	Chassis ground	Close to 0 Ω (continuity)
MAG			



IGNITION COIL GROUND CIRCUIT TEST (PIN 1)

If wiring harness is defective, repair or replace the wiring and connectors.

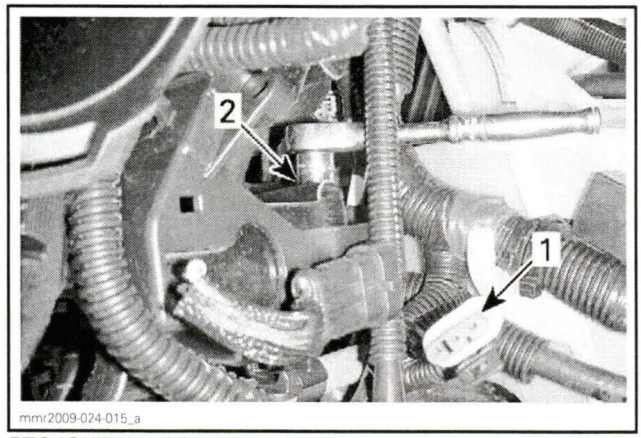
If the ground circuit tested good, replace the ignition coil.

Ignition Coil Removal

1. Remove parts required for access to the ignition coil connectors.
2. Note position of spark plug cables and remove them from the spark plugs.

PTO Coil Removal

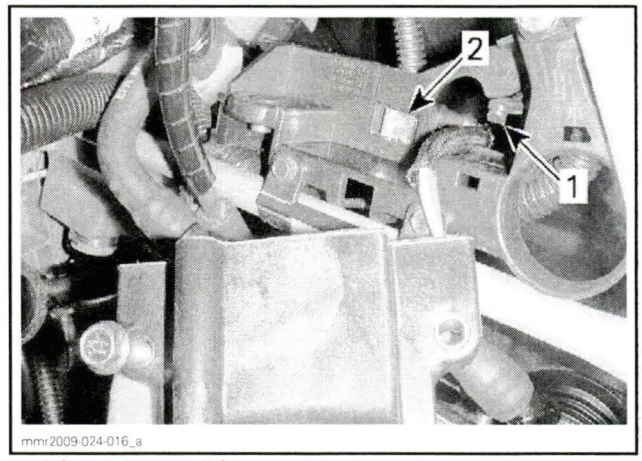
1. Disconnect the ignition coil connector.
2. Remove the coil retaining screw.



PTO IGNITION COIL (REAR VIEW)
1. Disconnect coil connector
2. Remove coil retaining screw

NOTE: PTO coil connector is mounted to the support with a retaining clip. Coil must be off support to access clip for removal.

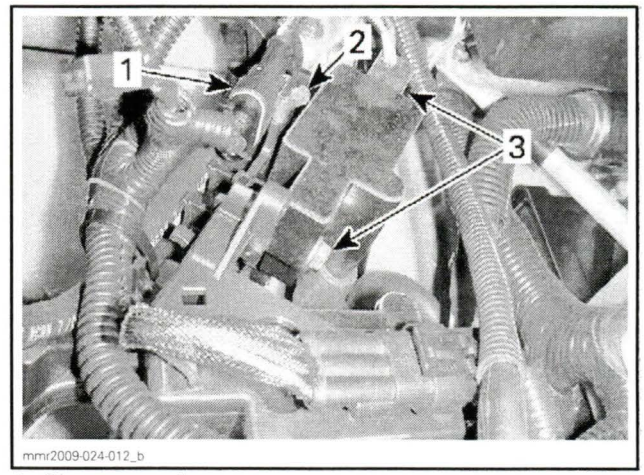
3. Using a screwdriver, lift the retaining tab out of the second coil mounting hole to release coil from support. Do not pull coil away from support.
4. Using a small screwdriver, remove spring clip retaining coil connector to support and pull connector through support opening.



1. Lift to release coil from support
2. Remove connector retaining clip from support

MAG Coil Removal

1. Disconnect the ignition coil connector.
2. Using a small screwdriver, remove connector retaining clip from support.
3. Remove the two coil retaining screws.

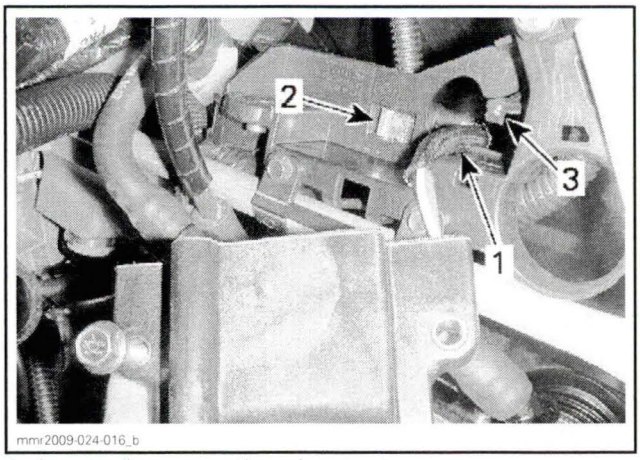


1. Disconnect coil connector
2. Remove connector retaining clip
3. Remove two mounting screws

Ignition Coil Installation

Reverse the removal procedures but pay attention to the following:

1. On the PTO coil, insert the coil connector through the coil support and install its retaining clip on the support before installing the coil.
2. Insert the PTO coil under the coil support retaining tab and slide it onto the support until the tab drops into the coil mounting hole.



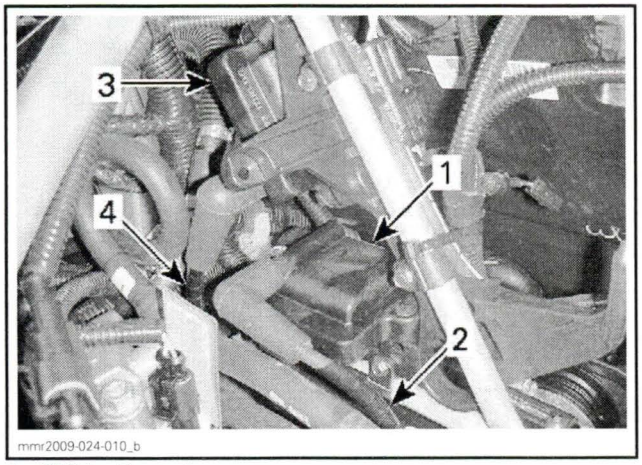
1. Insert coil connector through support
2. Install connector retaining clip
3. Lift tab and insert coil

3. Install the coil retaining screw(s) (both coils).

TIGHTENING TORQUE	
Ignition coil retaining screws	10 N•m (89 lbf•**in**)

4. Reconnect the primary winding connectors and the spark plug cables.

NOTE: Pay attention to the position of the spark plug cables when connecting them. Lower coil connects to the PTO spark plug. Apply dielectric grease, refer to *SPARK PLUG CABLE* in this subsection.



1. PTO ignition coil
2. Cable To PTO spark plug
3. MAG ignition coil
4. To MAG spark plug

⚠ WARNING

Always reconnect ignition coil cables to the same spark plugs they were disconnected from. Otherwise, severe backfire may occur with possible damage to exhaust system components.

IGNITION SYSTEM (600 ACE)

SERVICE TOOLS

Description	Part Number	Page
ECM ADAPTER TOOL	529 036 166	603, 606
FLUKE 115 MULTIMETER	529 035 868	602, 605

GENERAL

Cables and locking ties removed during a procedure must be reinstalled as per factory standards.

NOTICE **Never force a multimeter probe into an electrical terminal.**

SYSTEM DESCRIPTION

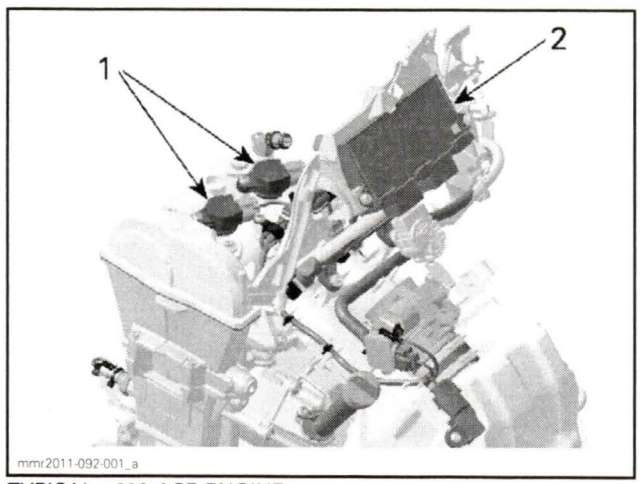
The ignition system is a digital inductive type (IDI) system.

Ignition system parameters such as ignition timing, spark duration, and firing order, are controlled by the ECM in order to meet engine operational requirements.

Direct ignition coils (stick coils) are used for each cylinder.

When a ground signal is provided by the ECM to an ignition coil primary winding, a high voltage is induced in the ignition coil secondary winding that is used to produce a spark at the spark plug electrode.

Cylinder 1 is on the PTO side of the engine.



TYPICAL - 600 ACE ENGINE
1. Ignition coils
2. ECM

Ignition Timing

Ignition timing is not adjustable.

The ECM is programmed with data (ignition mappings), used along with data received from a variety of sensors to establish optimum ignition timing under all engine operating conditions.

The firing of each spark plug is independent of the other(s).

TROUBLESHOOTING

DIAGNOSTIC TIPS

No Spark when Cranking Engine with both Spark Plugs Removed and Grounded on Cylinder Head

At least one spark plug must be installed in a cylinder. Otherwise, there will be no spark at any spark plug.

IGNITION SYSTEM TESTING

The ECM controls the ignition system.

If a fault is detected by the ECM, the check engine light will turn on.

A check engine message will be displayed in the gauge digital display and a beep code will be emitted. Refer to *DIAGNOSTIC AND FAULT CODES* subsection for details.

The ECM can detect a problem on the primary winding or circuit of the ignition coils.

The secondary winding of the ignition coils is not monitored by the ECM.

Other sensors in relation with the ignition system are also monitored by the ECM.

Ignition System Testing Sequence

Check for fault codes using B.U.D.S. software as a first troubleshooting step. Refer to *DIAGNOSTIC AND FAULT CODES* subsection.

Check the following fuse(s):

IGNITION/INJECTOR FUSE (HIC)
Fuse 5

If a fuse is burnt, test for a short circuit or faulty component on that fuse circuit before replacing the fuse. Refer to *POWER DISTRIBUTION AND GROUNDS* subsection.

Check ignition spark, refer to *IGNITION COIL QUICK TEST USING B.U.D.S.* in this subsection.

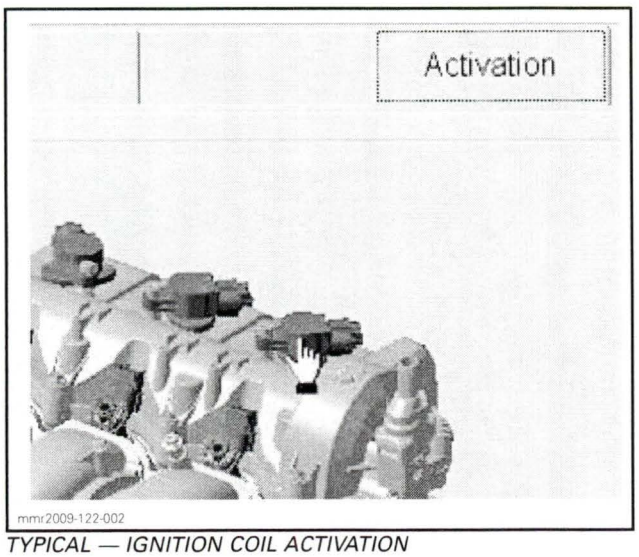
PROCEDURES

IGNITION COILS

Ignition Coil Quick Test using B.U.D.S.

This test confirms the working condition of the ignition circuit and ignition coil for the cylinder tested.

1. Remove ignition coil, refer to *IGNITION COIL REMOVAL* in this subsection.
2. Install a spark tester on the ignition coil.
3. Connect to the latest applicable B.U.D.S. version, refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
4. In B.U.D.S., select;
   - **Read Data**
   - **Activation**page tab
5. Energize the **ignition** coil by selecting it on the engine illustration.



TYPICAL — IGNITION COIL ACTIVATION

If there is no spark, carry out the following tests.

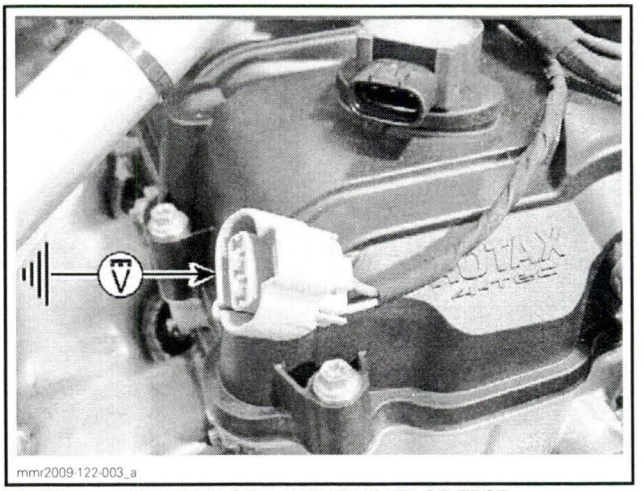
Ignition Coil Input Voltage Test

1. Disconnect the ignition coil connector.
2. Install tether cord cap on engine cut-off switch.
3. Set emergency engine stop switch to RUN.
4. Briefly press on START/RER switch to wake up ECM.
5. Measure voltage as per following table.

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

NOTE: Test is valid only if ECM is active (gauge will be on).

IGNITION COIL INPUT VOLTAGE TEST		
TEST PROBES		VOLTAGE
PTO coil VIOLET/BLUE wire	Battery ground	Battery voltage
MAG coil VIOLET/GREEN wire		



TYPICAL — IGNITION COIL INPUT VOLTAGE TEST

TEST RESULT	SERVICE ACTION
Battery voltage **is** read	Refer to *IGNITION COIL CIRCUIT CONTINUITY TEST*
Battery voltage **NOT** read	Refer to *IGNITION COIL CIRCUIT CONTINUITY TEST*

6. Remove tether cord cap from engine cut-off switch.

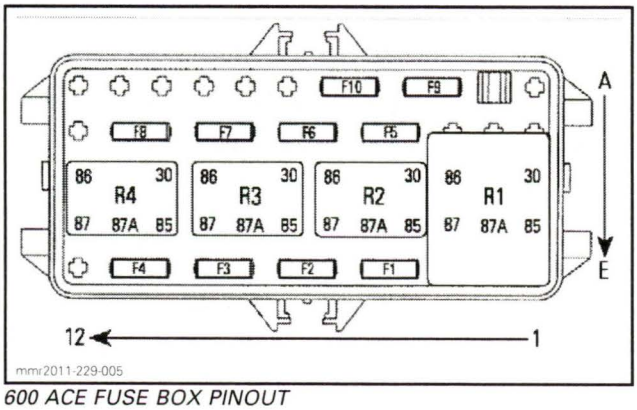
Ignition Coil Circuit Continuity Test

Power Input Wire (Ignition Coil)

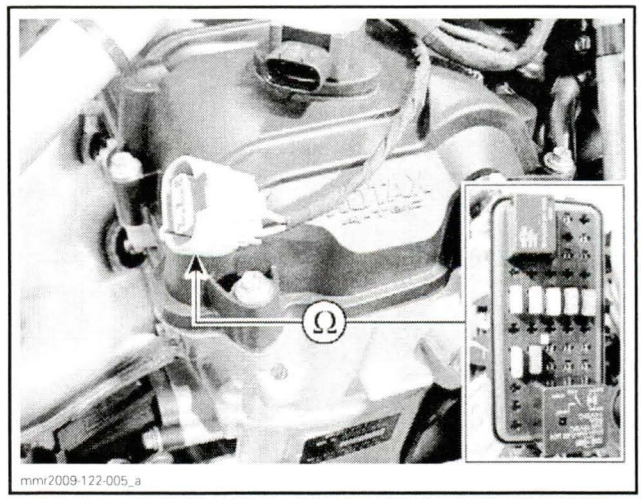
1. Ensure that tether cord cap is removed from engine cut-off switch.
2. Ensure emergency engine stop switch is set to STOP.
3. Locate the applicable ignition/injector fuse (F5) in the fuse box. Refer to *POWER DISTRIBUTION AND GROUNDS* subsection.
4. Disconnect ignition coil connector.
5. Remove applicable fuse.
6. Test for continuity of circuit as per following table.

NOTE: Probe the metallic part on top of the fuse.

POWER INPUT WIRE CONTINUITY TEST (IGNITION COIL) FUSE BOX			
IGNITION COIL	**IGNITION COIL CONNECTOR WIRE**	**FUSE BOX CONTACT**	**RESISTANCE**
PTO	VIOLET/ BLUE	5B (fuse 5)	Close to 0 Ω (continuity)
MAG	VIOLET/ GREEN		



600 ACE FUSE BOX PINOUT



TYPICAL — POWER INPUT WIRE CONTINUITY TEST (IGNITION COIL)

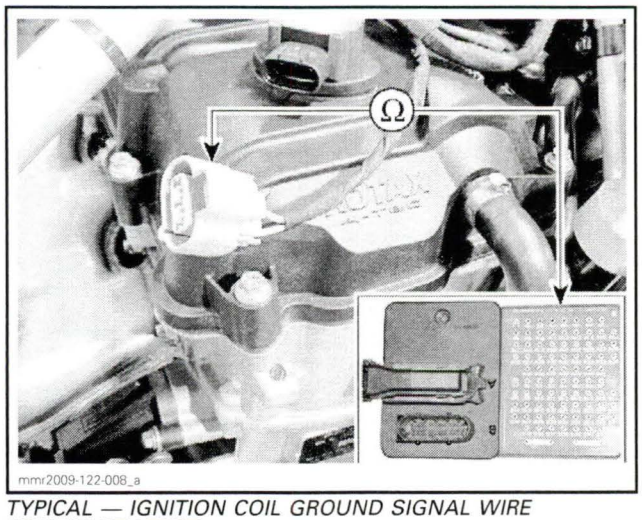
If continuity is not measured as specified, test the engine and vehicle harnesses.

Ground Signal Wire (Ignition Coil)

1. Disconnect ECM connector A. Refer to *ELECTRONIC FUEL INJECTION* subsection.
2. Disconnect ignition coil connector.
3. Test for continuity of ignition coil ground signal circuit as per following table.

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

POWER INPUT WIRE CONTINUITY TEST (IGNITION COIL) FUSE BOX			
IGNITION COIL	**IGNITION COIL CONNECTOR WIRE**	**ECM PIN**	**RESISTANCE**
PTO	BROWN/ BLACK	M1	Close to 0 Ω (continuity)
MAG	BROWN/ ORANGE	M2	



TYPICAL — IGNITION COIL GROUND SIGNAL WIRE CONTINUITY TEST

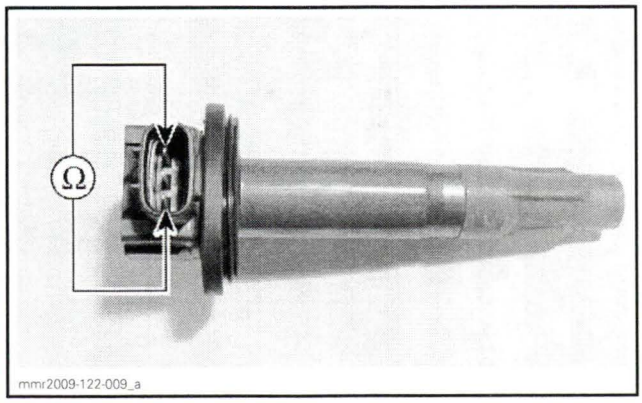
If continuity is not measured as specified, repair the connector or replace the engine wiring harness.

Ignition Coil Resistance Test

An ignition coil with a good resistance measurement can still be faulty. Current leakage can occur at high voltage levels which is not detectable with an ohmmeter. Replacing the ignition coil may be necessary as a test.

Primary Winding

1. Remove ignition coil. Refer to *IGNITION COIL REMOVAL* in this subsection.
2. Set the multimeter to Ω and measure primary winding resistance as specified.



MODEL	CIRCUIT	PIN	RESISTANCE @ 20°C (68°F)
600 ACE	Primary	1 and 3	0.8 - 0.97 Ω

If resistance is not within specification, replace ignition coil.

Secondary Winding

The secondary winding on this type of ignition coil cannot be tested.

Ignition Coil Removal

1. Disconnect ignition coil connector.
2. Remove ignition coil retaining screw.

NOTICE **Do not pry on ignition coil with a tool.**

3. Remove ignition coil from spark plug by rotating coil side to side as you pull up.

NOTE: For cylinder 2, turn steering column to ease ignition coil removal.

Ignition Coil Installation

1. Align the retaining screw hole of the ignition coil with the threaded hole on the valve cover.
2. Install the ignition coil on the spark plug and push it all the way down until it rests on the valve cover.
3. Install the retaining screw an tighten to 11 N•m (97 lbf•**in**).
4. Connect ignition coil connector.

SPARK PLUGS

Spark Plug Application

ENGINE	SPARK PLUG
600 ACE	CR7EB

EMERGENCY ENGINE STOP SWITCH

Emergency Engine Stop Switch Operation

The emergency engine stop switch provides a ground signal to the ECM when STOP is selected.

The ground signal is applied to the ECM connector as per following table.

MODEL	ECM PIN
600 ACE	B-4C

Emergency Engine Stop Switch Continuity Test

Remove gauge.

Check switch continuity as per following table.

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

EMERGENCY ENGINE STOP SWITCH CONTINUITY TEST			
SWITCH POSITION	**TEST PROBES**		**RESISTANCE**
RUN	BK wire	YE/BK wire	Infinite (OL)
STOP			Close to 0 Ω

If readings are not as specified in table, check wiring and connections going to switch. If good, replace switch.

ENGINE CUT-OFF SWITCH

Engine Cut-Off Switch Continuity Test

Disconnect engine cut-off switch connector.

Carry out the following continuity tests.

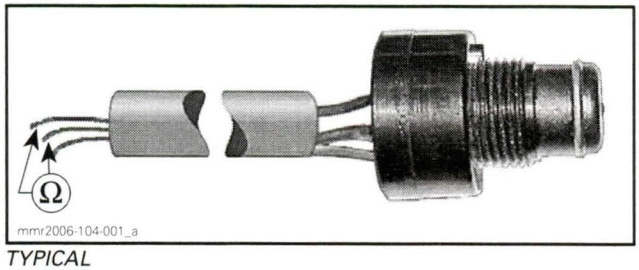
REQUIRED TOOL	
FLUKE 115 MULTIMETER (P/N 529 035 868)	

Tether Cord Cap Removed from Engine Cut-Off Switch

Set multimeter to Ω.

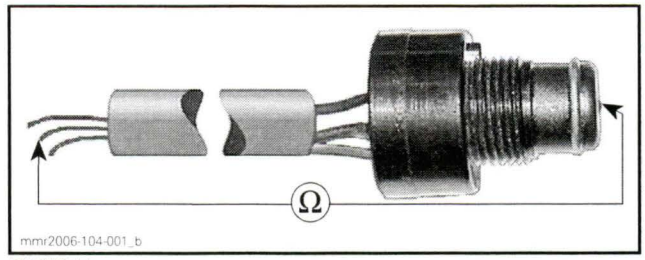
Connect test probes to engine cut-off switch and its connector as per tables and measure resistance.

ENGINE CUT-OFF SWITCH		
PROBE WIRES		RESISTANCE Ω @ 20°C (68°F)
GREEN/BLACK	WHITE/BLACK	Open circuit



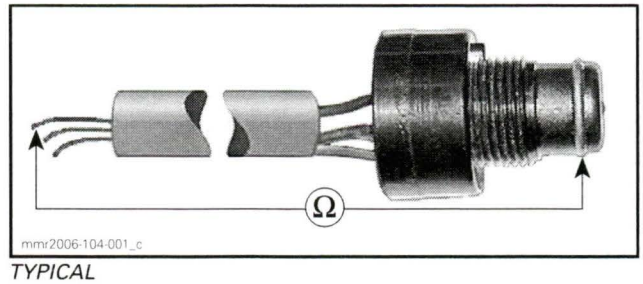
TYPICAL

ENGINE CUT-OFF SWITCH		
PROBE		RESISTANCE Ω @ 20°C (68°F)
WHITE/ GRAY	Switch center contact	Close to 0 Ω



TYPICAL

ENGINE CUT-OFF SWITCH		
PROBE		RESISTANCE Ω @ 20°C (68°F)
GREEN/BLACK	Switch ring	Close to 0 Ω

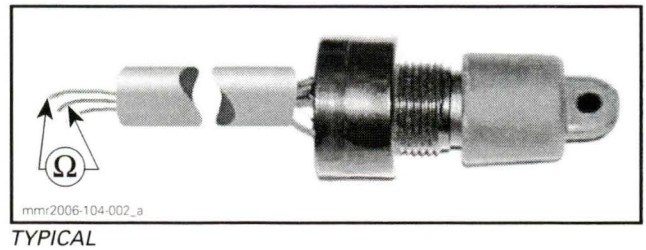


TYPICAL

Tether Cord Cap on Engine Cut-Off Switch

Connect test probes to engine cut-off switch connector as per table and measure resistance.

ENGINE CUT-OFF SWITCH		
PROBE WIRES		RESISTANCE Ω @ 20°C (68°F)
GREEN/BLACK	WHITE/BLACK	Close to 0 Ω



TYPICAL

If any resistance test fails, replace engine cut-off switch.

Engine Cut-Off Switch Vehicle Harness Continuity Test

Disconnect engine cut-off switch connector.

Disconnect ECM connector B. Refer to *ELECTRONIC FUEL INJECTION* subsection.

Check wire continuity between engine cut-off switch connector of main wiring harness and ECM as follows.

MODEL	TOOL	TOOL VIEW
600 ACE	ECM ADAPTER TOOL (P/N 529 036 166)	

ENGINE CUT-OFF SWITCH CONNECTOR (MAIN WIRING HARNESS SIDE)	**ECM ADAPTER**	**RESISTANCE Ω @ 20°C (68°F)**
WIRE	PIN	
WHITE/GRAY (3)	B-2B	Close to 0 Ω
WHITE/BLACK (1)	B-4E	
GREEN/BLACK (2)	B-2F	

If any continuity test failed, repair or replace wiring connectors/terminals.

If the problem persists and all tests have been performed, check the ECM. Refer to *(ENGINE CONTROL MODULE ECM)* in the *ELECTRONIC FUEL INJECTION (EFI)* subsection.

CHARGING SYSTEM (550F)

SERVICE TOOLS

Description	Part Number	Page
FLUKE 115 MULTIMETER	529 035 868	608, 610

SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
NAPA ULTRA PRO BATTERY LOAD TESTER	95260	610

SERVICE PRODUCTS

Description	Part Number	Page
DIELECTRIC GREASE	293 550 004	612

GENERAL

SYSTEM DESCRIPTION

Magneto

A 340 watts magneto provides the primary source of electrical energy. It transforms a magnetic field into an alternating current (AC).

The magneto provides two AC outputs:
- To the ECM (via ignition switch)
- To the voltage regulator.

Voltage Regulator

The AC current sent to the voltage regulator/rectifier is rectified and regulated to between 13.4 and 15 volts DC. for primary power to the vehicle electrical system, and to charge the battery on electric start models.

The voltage regulator/rectifier provides two DC outputs:
- Primary power for the vehicle electrical systems
- Battery charging, accessory and horn power.

Battery

A battery is used to power the:
- Starter
- Starter solenoid through the ignition switch (start contact)
- Horn
- Front and rear accessory power outlets.

The regulator provides a pulsated unfiltered DC current that is not suitable for powering electronic equipment.

The power outlets are connected directly to the battery. They can be used to power electrical or electronic equipment even if the engine is not running.

INSPECTION

VOLTAGE REGULATOR/ RECTIFIER

DC Voltage Output Test (Vehicle Electrical Systems)

Proceed as follows:

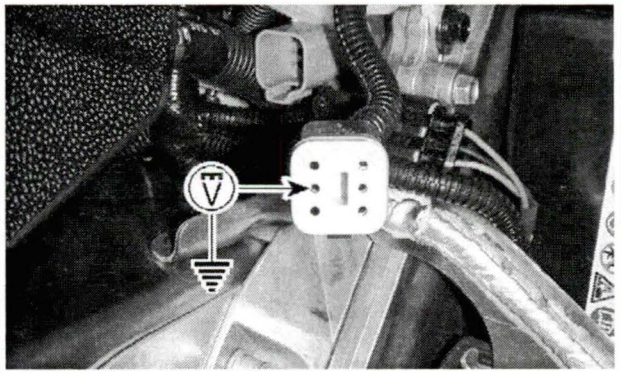
1. Raise vehicle and ensure the track is off the ground and can turn freely.

⚠ WARNING

Ensure vehicle track is completely raised off ground. If track should come into contact with ground when engine is at 5000 RPM, equipment damage and severe injury may result.

2. Disconnect the communication diagnostic connector.
3. Start engine and read voltage as follows.

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



mmr2010-021-003_a

DC VOLTAGE OUTPUT TEST (VEHICLE ELECTRICAL SYSTEMS)			
TEST ENGINE SPEED	TEST PROBES		VOLTAGE
5000 RPM	Pin 5 (diagnostic connector)	Chassis ground	14.5 Vdc ± 0.5

If no voltage is detected, check ground (wires and connectors) between voltage regulator/rectifier and frame.

If voltage is above specification, replace voltage regulator/rectifier.

If voltage is below specification, check stator and wiring/connections.

If the stator and associated wiring/connectors test good, try a new voltage regulator/rectifier.

DC Voltage Output Test (Charging and Accessory Systems)

Proceed as follows:

1. Raise vehicle and ensure the track is off the ground and can turn freely.

⚠ WARNING

Ensure vehicle track is completely raised off ground. If track should come into contact with ground when engine is at 5000 RPM, equipment damage and severe injury may result.

2. Remove RED rubber boot protector from positive battery post.
3. Connect multimeter to battery posts.
4. Start engine and read voltage as follows.

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



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DC VOLTAGE OUTPUT TEST (CHARGING AND ACCESSORY SYSTEMS)			
TEST ENGINE SPEED	TEST PROBES		VOLTAGE
5000 RPM	Battery (+)	Battery (-)	14.5 Vdc ± 0.5

If no voltage is detected, check ground (wires and connectors) between voltage regulator/rectifier and frame.

If voltage is above specification, replace voltage regulator/rectifier.

If voltage is below specification, check stator and wiring/connections. Refer to *MAGNETO SYSTEM (550)* subsection for stator testing procedure.

If the stator and associated wiring/connectors test good, try a new voltage regulator/rectifier.

TROUBLESHOOTING

TROUBLESHOOTING GUIDELINES

Weak or Discharged Battery

If the battery is weak or discharged, check the following items:

– 20 A charging fuse (F1)

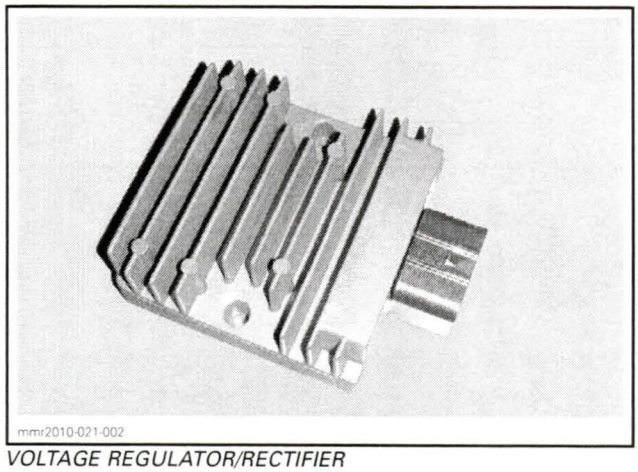
- Charging system voltage, see *DC VOLTAGE OUTPUT TEST (CHARGING SYSTEM)* in this subsection
- Stator, see *MAGNETO SYSTEM (550)* subsection
- Battery
- Wiring and connections.

PROCEDURES

VOLTAGE REGULATOR/ RECTIFIER

Voltage Regulator/rectifier Continuity Test

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

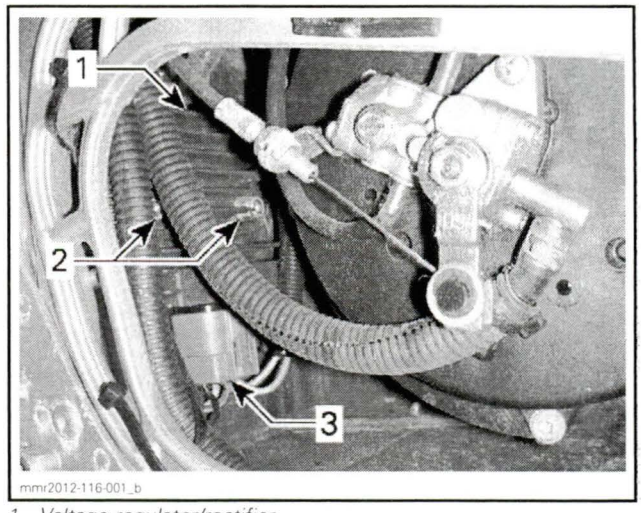


VOLTAGE REGULATOR/RECTIFIER

Voltage Regulator/Rectifier Removal

The voltage regulator/rectifier is located behind the chaincase, aft of the engine.

1. Disconnect the battery. See *BATTERY* in this subsection.
2. Remove the muffler. Refer to *EXHAUST SYSTEM (550F)* subsection.
3. Remove both screws securing the voltage regulator/rectifier to frame.
4. Disconnect the connector from the voltage regulator/rectifier to complete the removal procedure.



1. Voltage regulator/rectifier
2. Screws
3. Connector

Voltage Regulator/Rectifier Installation

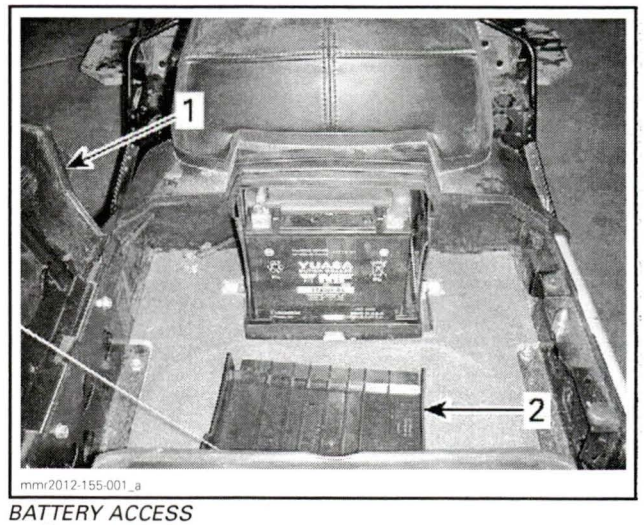
The installation is the reverse of the removal procedure. However, pay attention to the following.

TIGHTENING TORQUE	
Voltage regulator/rectifier retaining screws	5 N•m (44 lbf•**in**)

BATTERY (YTX20L-BS)

Battery Location

The battery is located in the storage compartment under the passenger seat.



BATTERY ACCESS
1. Passenger seat open
2. Battery cover removed

Battery Technical Information

A sealed valve regulated lead acid (VRLA) battery is used. It is a non-spillable, maintenance reduced type (no electrolyte level to be checked and readjusted). No ventilation tube is attached to the battery.

Battery Voltage Test (No Load Applied)

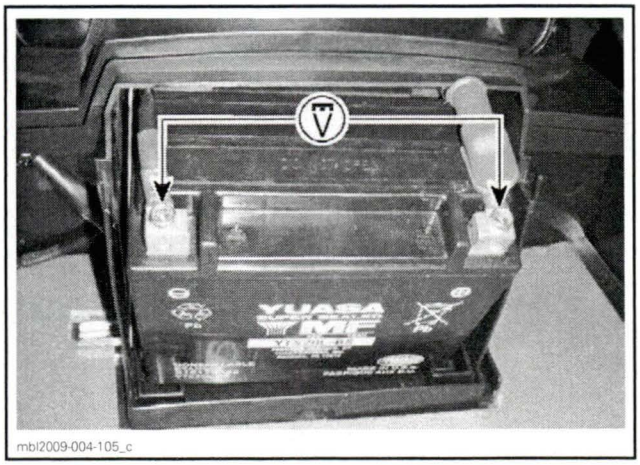
NOTE: An unloaded voltmeter test, with a high impedance multimeter, is carried out on a battery without discharging current. It is the simplest and most commonly used. However, be aware that a voltage test can indicate that the battery is in good condition even though the battery does not have enough power to crank the engine.

A voltage reading provides an instant indication of the state of charge of the battery, not of its current storage capacity. A battery load test gives a more accurate indication of the battery condition.

If the battery has just received a charge, allow it to rest for 1 - 2 hours before taking a voltage reading.

Set multimeter to Vdc and connect to battery terminals. Always respect battery polarity.

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



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BATTERY VOLTAGE TEST (NO LOAD APPLIED)	
RESULT	SERVICE ACTION
12.8 V and above	Battery full charge (no action required)
12.7 V and below	Recharge battery

If battery requires recharging, refer to *BATTERY CHARGING* in this subsection.

Battery Load Test (Engine Cranking)

Battery must be fully charged, refer to *BATTERY VOLTAGE TEST (NO LOAD APPLIED)*.

1. Place the emergency engine stop switch in OFF position.
2. Set multimeter to Vdc and connect it to the battery.
3. Measure battery voltage at rest.
4. With the multimeter still connected, crank engine while reading multimeter.

Assuming the starting system is in good condition, a battery voltage that drops below 10 Vdc indicates a worn or defective battery.

NOTE: Before replacing the battery, make sure the charging system is in good condition.

BATTERY LOAD TEST (WITH ENGINE CRANKING)	
Battery voltage	10 Vdc minimum

Battery Load Test (Using a Battery Load Tester)

This is the best test to determine the battery condition. Use a load testing device such as the NAPA ULTRA PRO BATTERY LOAD TESTER (P/N 95260). It has a 500 Amp carbon pile adjustable load.

Battery must be fully charged.

1. If the battery has just been recharged, allow battery to rest for at least one hour.
2. Follow battery load tester instructions.
3. Apply a load of 150 amperes. At 5 seconds into the test, check battery voltage.

BATTERY LOAD TEST (USING LOAD TESTER)	
TIME TO MEASURE INTO TEST	VOLTAGE
5 seconds	Minimum 10 Vdc

If battery voltage has dropped below 10 Vdc, battery storage capacity has decreased appreciably and battery should be replaced.

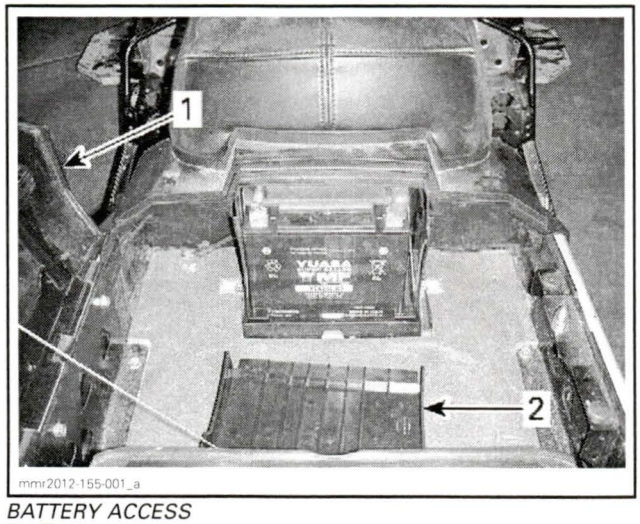
NOTE: Note, before replacing the battery, make sure the charging system is in good condition.

Battery Removal

⚠ WARNING

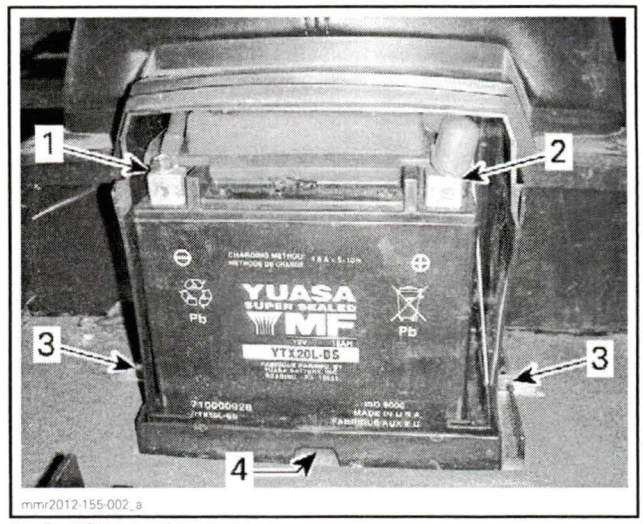
The BLACK (–) battery cable must always be disconnected first and reconnected last. Never charge or boost a battery while installed in vehicle.

1. Open passenger seat to access rear storage compartment.
2. Remove battery cover.



BATTERY ACCESS
1. *Passenger seat open*
2. *Battery cover removed*

3. Disconnect BLACK (–) cable terminal from the negative battery post.
4. Slide the RED rubber protector off the positive (+) cable terminal and disconnect it from the battery post.
5. Remove the battery retaining bolts.



1. *BLACK (–) cable terminal*
2. *Positive (+) cable terminal*
3. *Battery retaining bolts*
4. *Lift battery support here*

6. Lift back end of battery support to remove it and the battery from the vehicle.
7. Remove retaining strip.
8. Remove battery from support.

NOTICE Should any electrolyte spillage occur, immediately wash off with a solution of baking soda and water to prevent damage to vehicle components.

Battery Cleaning

Clean the battery, battery casing, cables and battery posts using a solution of baking soda and water.

Remove corrosion from battery cable terminals and battery posts using a firm wire brush. Battery top should be cleaned with a soft brush and any grease-cutting soap or baking soda solution.

Battery Inspection

Visually inspect battery casing for cracks, leaks or other possible damage.

Discoloration, warping or raised top, indicates that the battery has overheated or been overcharged.

If the casing is damaged, replace battery and thoroughly clean battery tray and surrounding area with a water and baking soda solution.

⚠ WARNING

Should the battery casing be damaged, wear a suitable pair of nonabsorbent gloves when removing the battery by hand.

Inspect the battery posts for security of mounting.

Battery Storage

NOTICE A discharged battery will freeze and may damage its casing. A damaged casing will allow electrolyte spillage that may damage surrounding parts.

1. Disconnect and remove battery from the vehicle.
2. Clean battery terminals and cable connections using a wire brush. Apply a light coat of DIELECTRIC GREASE (P/N 293 550 004) or petroleum jelly on terminals.
3. Clean battery casing using a solution of baking soda and water. Rinse battery with clear water and dry thoroughly using a clean cloth.

NOTE: The battery must always be stored in fully a charged state.

4. Charge the battery every month if stored at a temperature **below** 15°C (59°F).
5. Charge the battery every two week if stored at a temperature **above** 15°C (59°F).

New Battery Activation

Refer to the instructions provided with the battery.

Battery Charging

⚠ WARNING

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

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

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

Carry out a *BATTERY UNLOADED VOLTMETER TEST* as described in this subsection, then proceed as described here.

An automatic charger is the fastest and most convenient way for error-proof charging.

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

Battery Voltage Below 12.8 V and Above 11.5 V

STANDARD CHARGING (RECOMMENDED)		
BATTERY TYPE	TIME	CHARGE
YTX20L-BS	4 - 9 hours	2 A

QUICK CHARGING		
BATTERY TYPE	TIME	CHARGE
YTX20L-BS	50 minutes	10 A

Battery Voltage Below 11.5 V

A battery with a voltage below 11.5 V requires a special procedure to recharge. In charging an over discharged battery, its internal resistance may be too high to charge at a normal charging rate.

Set charger to the 10 A charging rate and monitor charging current for approximately 30 minutes. If there is no change in charging current or battery becomes abnormally hot, the battery is most likely at the end of its service life and should be replaced.

Battery Installation

Reinstall battery and secure retaining strip properly.

Connect **RED (+) cable FIRST** to positive battery terminal.

Connect **BLACK (–) cable LAST**.

⚠ WARNING

Battery BLACK (–) cable must always be disconnected first and reconnected last.

TIGHTENING TORQUES	
Battery retaining screws	10 N•m (89 lbf•**in**)
Battery terminal screws	3 N•m (27 lbf•**in**)

Apply DIELECTRIC GREASE (P/N 293 550 004) on battery posts and connectors.

Cover the RED (+) cable terminal with the protective rubber boot.

CHARGING SYSTEM (600 HO E-TEC)

SERVICE TOOLS

Description	Part Number	Page
FLUKE 115 MULTIMETER	529 035 868	618–619

SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
FLUKE RIGID BACK PROBES	TP88	618–619
NAPA ULTRA PRO BATTERY LOAD TESTER	95260	623

SERVICE PRODUCTS

Description	Part Number	Page
DIELECTRIC GREASE	293 550 004	624–625

GENERAL

⚠ WARNING

Unless otherwise specified, always disconnect the magneto connector and ensure spark plugs are installed in the engine before carrying out electrical system checks. Should the engine be made to rotate with the magneto connected, a spark may occur resulting in electrical shock, a fire, or an explosion.

SYSTEM DESCRIPTION

Magneto

A magneto provides the primary source of electrical energy. It transforms a magnetic field into an alternating current (AC).

The magneto is comprised of a 3 winding, single phase wound stator that has a capacity of 1200 watts.

AC current is rectified and regulated by a voltage regulator/rectifier circuit, and a DC to DC converter, both integrated within the ECM.

The charging system provides 3 outputs to the vehicle electrical system, one 55 Vdc and two 12 Vdc outputs.

Battery

A battery is installed as a secondary power source. It is primarily used for energizing the starter. It provides power to instantly power the ECM when the START/RER button is pressed.

NOTE: Never use a battery charger to temporarily substitute the battery as it may cause the ECM (engine control module) to function erratically or not at all.

TROUBLESHOOTING

NOTE: It is good practice to check for fault codes using B.U.D.S. software as a first troubleshooting step. Refer to *DIAGNOSTIC AND FAULT CODES* subsection.

TROUBLESHOOTING GUIDELINES

Weak or Discharged Battery

If the battery is weak or discharged, check the following items:

- Battery charging fuse (F1)
- Battery RUN relay (R1)
- Charging system voltage, see *PRIMARY 12 VDC CIRCUIT TEST WITH B.U.D.S.* in this section
- Battery
- Wiring and connections.

NOTE: If there is no primary 12 Vdc circuit output voltage, the lights, horn and gauge will not function.

Low or No Charging System Voltage (Engine May Not Start)

The engine cannot start without having a minimum voltage to the 55 V power circuit. If the engine does not start, see *VOLTAGE REGULATOR/RECTIFIER* in this section and carry out the 55 Vdc voltage output test with B.U.D.S.

If voltage is not as specified, check the following items in the recommended order until you find the fault:

- Stator (refer to *MAGNETO* subsection)
- Capacitor (see procedure in this section).

NOTE: The 55 Vdc may be unstable or unobtainable if the capacitor is faulty, not connected, or incorrectly connected.

If the above mentioned checks were good, isolate each of the following components by disconnecting them individually, and repeating the voltage test after each one.

- Each injector
- Each ignition coil
- Fuel pump
- Oil injection pump.

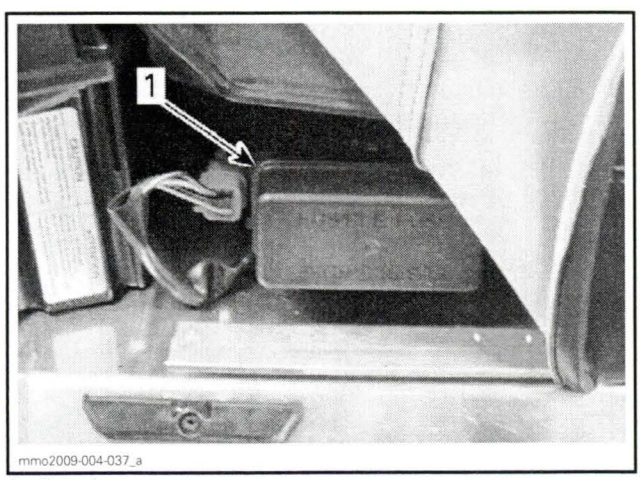
NOTE: When the 55 Vdc tests good after a component is disconnected, replace that component and repeat the test.

PROCEDURES

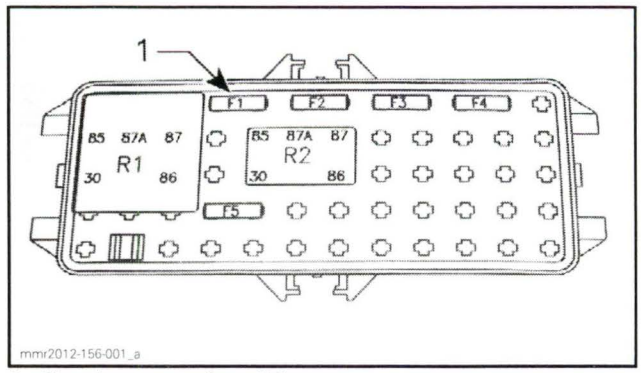
BATTERY CHARGING FUSE

Fuse Location

The battery charging fuse (F1) is located in the fuse box.



1. Fuse box



1. Charging system fuse (F1)

Fuse Information

The voltage regulator could be the culprit of a blown battery charging fuse.

To check for this, carry out the *PRIMARY 12 VDC CIRCUIT TEST WITH B.U.D.S.* in this section. Also check for an applicable fault code, refer to *DIAGNOSTIC AND FAULT CODES*.

BATTERY CHARGING RELAY (R1)

The RUN relay (R1), completes the charging circuit between the voltage regulator output and the battery. It receives its ground control signal from the ECM.

The ECM provides the ground to activate the relay at approximately the following engine speed:

MODEL	CHARGING RELAY ACTIVATION
600 HO E-TEC	1900 RPM

Battery Charging Relay Location

The battery charging relay is located in fuse box.

VOLTAGE REGULATOR/ RECTIFIER

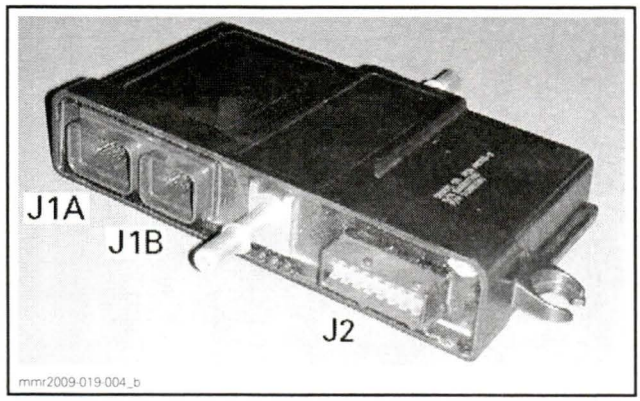
Description

The voltage regulator/rectifier is integrated within the ECM. It receives three single phase alternating current (AC) inputs from the magneto which it rectifies and regulates to 55 Vdc.

On a single pull start with the engine between 250 and 500 RPM, the magneto, combined with an ingenious series/parallel switching capability of the voltage regulator/rectifier, is capable of producing 55 Vdc.

55 Vdc Output Path

ECM CONNECTOR	TO
J2 (pins 12 and 13)	Capacitor Fuel Injectors Ignition coils Fuel pump Oil injection pump J2 (pin 12) (ECM internal protection)



Continuity Test (Voltage Regulator/Rectifier)

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

55 Vdc Voltage Output Test with B.U.D.S. (Voltage Regulator/Rectifier)

1. Lift and safely support vehicle so that the track is off the ground and can turn freely.

⚠ WARNING

Ensure vehicle track is completely off ground. If the track should come into contact with the ground when the engine is at 5000 RPM, equipment damage and severe injury may result.

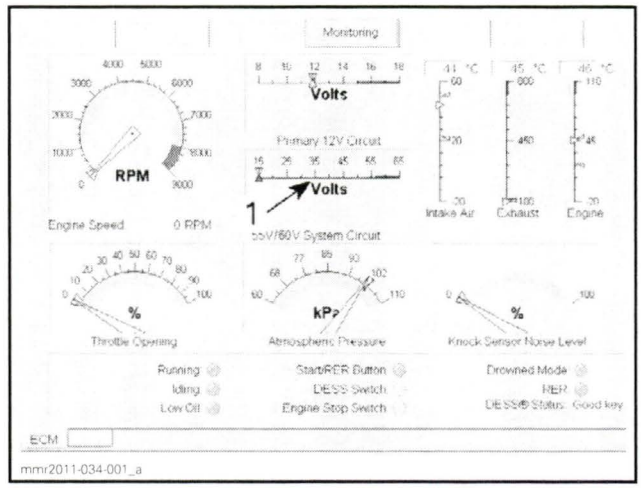
2. Make proper connections and use the applicable B.U.D.S. version. Refer to *COMMUNICATION TOOLS/B.U.D.S.* subsection.

Procedure when Engine Cannot be Started

NOTE: Pressing the START/RER button momentarily will power the ECM to allow B.U.D.S. to read the ECM prior to engine cranking for the test.

1. In B.U.D.S., select:
   - **Read Data** button
   - **Monitoring** page tab
   - **ECM** page.
2. Crank the engine over by pressing and holding the START/RER button for a few seconds.
3. Read the voltage on the **55 V System Circuit** meter in B.U.D.S. as the engine is being cranked.

NOTICE **Do not hold the START/RER button more than 10 seconds. A rest period should be observed between the cranking cycles to let the starter cool down. Holding the START/RER button for extended periods could overheat and permanently damage the starter.**



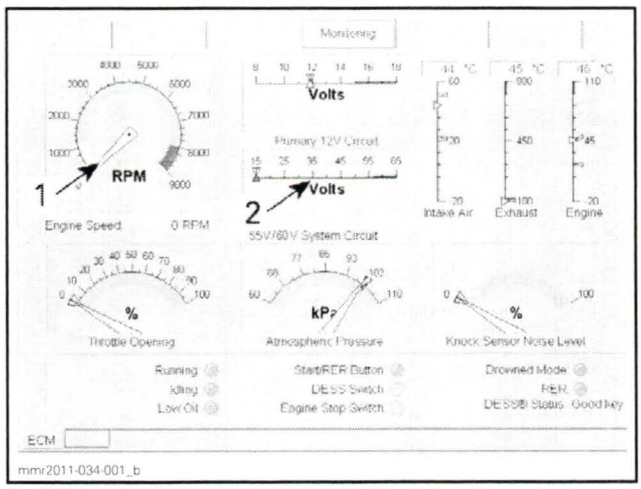
1. 55 V system circuit

55 VDC VOLTAGE OUTPUT TEST		
MODEL	TEST ENGINE SPEED	VOLTAGE
600 HO E-TEC	Engine cranking	At least 30 Vdc

Procedure with Engine Running

1. Make proper connections and use the applicable B.U.D.S. software version. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. Start engine.
3. In B.U.D.S., select:
   - **Read Data** button
   - **Monitoring** page tab
   - **ECM** page.
4. Read the voltage on the **55 V System Circuit** meter in B.U.D.S.

55 VDC VOLTAGE OUTPUT TEST (ENGINE RUNNING)		
MODEL	TEST ENGINE SPEED	VOLTAGE
600 HO E-TEC	Any RPM from idle and above	55 Vdc ± 2



1. RPM indication
2. 55 V system circuit indication

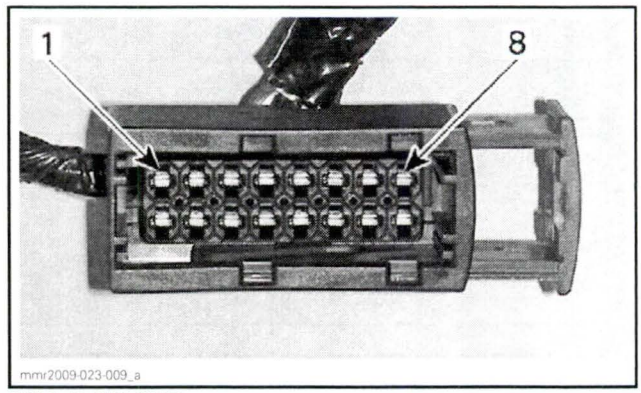
If voltage is not within specification, refer to *TROUBLESHOOTING* in this subsection and carry out the required tests.

Also carry out the *VOLTAGE REGULATOR/RECTIFIER GROUND CIRCUIT TEST.*

Ground Circuit Test (Voltage Regulator/Rectifier)

1. Disconnect the ECM J2 connector.
2. Test ground circuit continuity as follows.

VOLTAGE REGULATOR/RECTIFIER GROUND CIRCUIT TEST	
ECM J2 CONNECTOR	Chassis ground
Pin 5	
Pin 7	
Pin 8	



ECM J2 PIN-OUT

DC-DC CONVERTER

Description

The DC-DC converter is integrated within the ECM. It receives 55 Vdc from the voltage regulator/rectifier which, it steps down to 12 Vdc. This 12 Vdc power is then split into two separate circuits, a primary and a secondary 12 Vdc output.

Primary 12 Vdc Output

From approximately 800 RPM and 50/55 V from the voltage regulator, the primary 12 Vdc output provides power to the following:

- Multifunction gauge
- 3D RAVE valve solenoid
- Lighting system.

NOTICE The 12 Vdc primary circuit is not to be used to power accessory loads. All accessories are to be powered from the secondary 12 Vdc circuit.

Secondary 12 Vdc Output

The secondary 12 Vdc output provides power to the accessories when the engine reaches the following conditions.

MODEL	SECONDARY 12 VDC ACTIVATION
600 HO E-TEC	1900 RPM + 2 second delay

NOTE: Should the 12 Vdc outputs fail, the engine will still run on the 55 Vdc supply voltage.

12 Vdc Output Voltage Tests (DC-DC Converter)

The primary 12 volts is supplied through ECM connector J2 pins 15 and 16.

The secondary 12 volts is supplied through ECM connector J2 pins 6 and 14.

ECM connector J2 is not easily accessible. To carry out 12 Vdc output tests, carry out the following procedures.

Primary 12 Vdc Circuit Test with B.U.D.S.

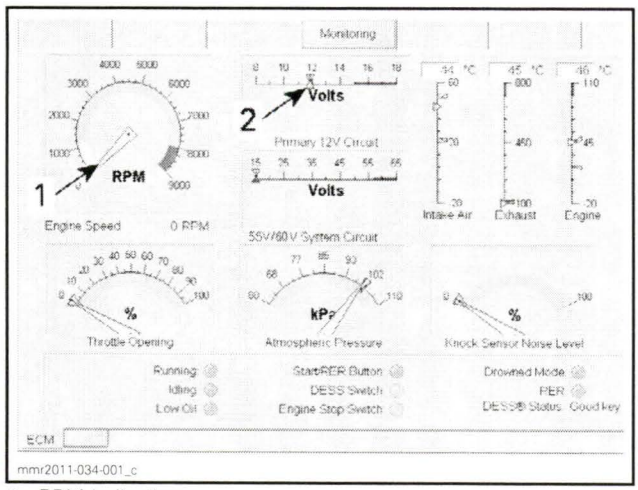
1. Make proper connections and use the applicable B.U.D.S. version. Refer to *COMMUNICATION TOOLS/B.U.D.S.* subsection.
2. Lift and safely support vehicle so that the track is off the ground and can turn freely.

⚠ WARNING

Ensure vehicle track is completely off ground. If the track should come into contact with the ground when the engine is at 5000 RPM, equipment damage and severe injury may result.

3. Start engine.
4. In B.U.D.S., select:
   - **Read Data** button
   - **Monitoring** page tab
   - **ECM** page.
5. Read the primary 12 Vdc system voltage on the **Primary 12V Circuit** meter in B.U.D.S.

PRIMARY 12 VDC CIRCUIT TEST WITH B.U.D.S.		
ENGINE	TEST ENGINE SPEED	VOLTAGE
600 HO E-TEC	Any RPM above 1100 RPM	14.75 ± 0.5 Vdc



1. RPM indication
2. Primary 12 V circuit indication (battery)

If voltage is above specification, replace ECM.

If voltage is below specification, check the 55 Vdc. Refer to *VOLTAGE REGULATOR/RECTIFIER.*

Also carry out the *VOLTAGE REGULATOR/RECTIFIER GROUND CIRCUIT TEST* in this subsection.

Install all removed parts and connectors.

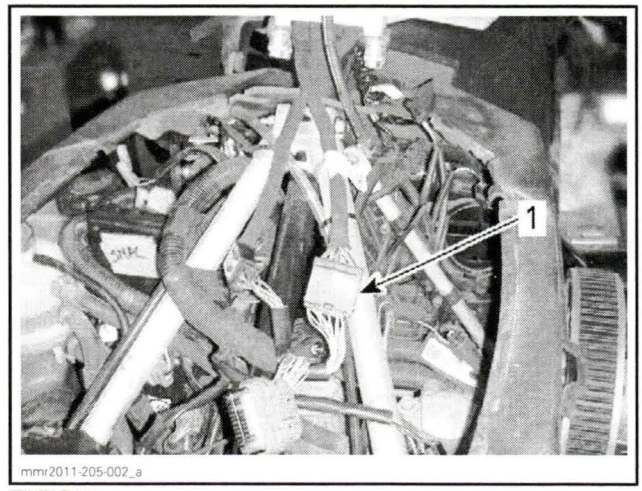
Secondary 12 Vdc Circuit Test

The secondary 12 Vdc system is not monitored in B.U.D.S.

To test the secondary 12 Vdc system, carry out the following procedure.

1. Remove multifunction gauge to access the HG connector.

NOTE: Do not disconnect gauge or the HG connector.



TYPICAL
1. HG-pin connector

2. Lift and safely support vehicle so that the track is off the ground and can turn freely.

⚠ WARNING

Ensure vehicle track is completely off ground. If the track should come into contact with the ground when the engine is at 5000 RPM, equipment damage and severe injury may result.

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

3. Start the engine.
4. Accelerate the engine above 1900 RPM and hold for at least 2 seconds.
5. To measure the secondary 12 Vdc, back-probe the HG connector as follows.

ENGINE SPEED	BACK-PROBE 10-PIN CONNECTOR		VOLTAGE
	RED TEST PROBE	BLACK TEST PROBE	
Over 1900 RPM + 2 sec.	YL/RD (Pin 9)	Chassis ground	14.75 ± 0.5 Vdc
		BK (Pin 4)	

If the secondary 12 Vdc voltage is as specified to chassis ground, but not present when measuring between YELLOW/RED and BLACK wires, test continuity of BLACK wire to ground.

If voltage cannot be measured, test continuity of YELLOW/RED wire from the HG connector to pins 6 and 14 of ECM J2 connector.

If the YELLOW/RED wire continuity is good and other voltages from ECM tested good, ECM may not output secondary 12 Vdc.

Carry out the *VOLTAGE REGULATOR/RECTIFIER GROUND CIRCUIT TEST*. If the ground circuit tests good, the ECM will need to be replaced.

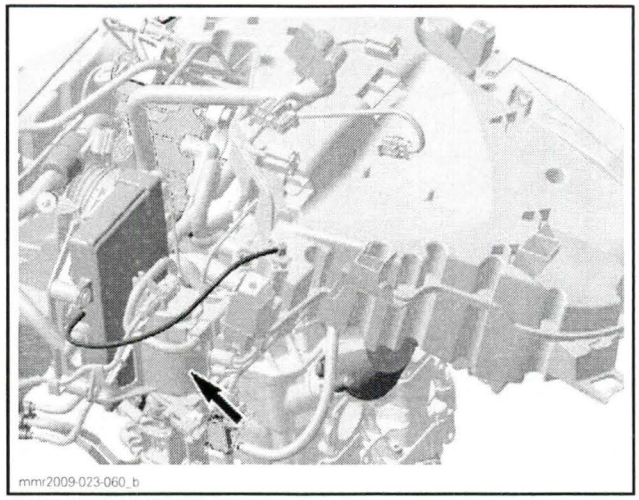
NOTE: Before replacing ECM, all ECM grounds, power output circuits, and input circuits from the magneto must be tested.

Repair or replace as applicable.

CAPACITOR

The engine fuel injectors, which require a stable 55 Vdc for their operation, are particularly sensitive to voltage variations. A capacitor is connected to the 55 Vdc electrical system to stabilize the system voltage.

The capacitor is located on the RH side of the vehicle, just ahead of the ECM.



CAPACITOR LOCATION

Quick Troubleshooting

A faulty capacitor will lead to the following symptoms:

- Unstable, low, or no system voltage (55 V).
- Engine will not start
- Engine hard to start
- Poor idling
- Engine misfiring.

NOTE: A defective capacitor is likely to give off a burn like odor.

Discharging Capacitor

⚠ WARNING

The capacitor remains charged approximately 10 seconds after engine is stopped. A high energy could suddenly be discharged if capacitor terminals were shorted. Always discharge capacitor before servicing.

To properly discharge capacitor, leave it connected for at least 10 seconds after engine has been stopped, or after engine was last cranked before carrying out any maintenance procedure on the capacitor or 55 volt electrical system.

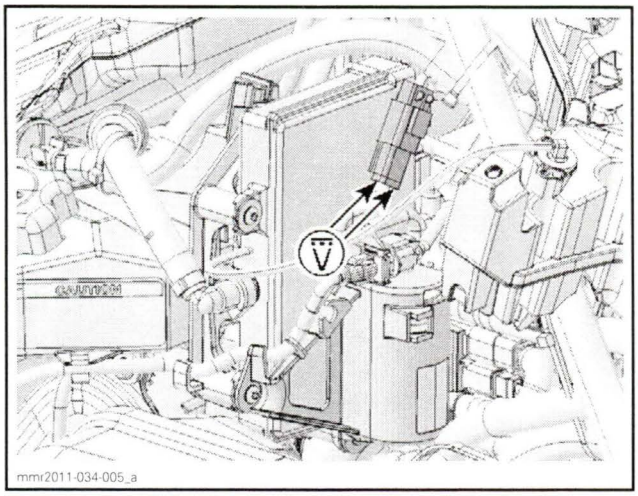
Capacitor Charge Hold Test

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

1. Set multimeter to Vdc.

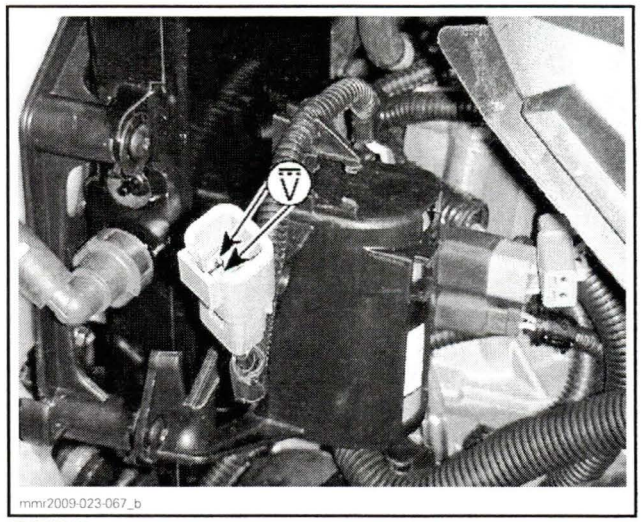
NOTE: Ensure to use the multimeter RED probe with the WHITE/RED wire (Pin 2).

2. Back-probe capacitor connector to measure the capacitor charge voltage.



TYPICAL — VOLTAGE MEASUREMENT AT CAPACITOR CONNECTOR

3. Start engine to charge capacitor.
4. Stop engine.
5. Read and note capacitor charge voltage.
6. Disconnect capacitor connector.
7. Wait 5 minutes.
8. Read capacitor charge voltage again.



TYPICAL

CAPACITOR CHARGE HOLD TEST
Capacitor Vdc must be within 1 Vdc of battery Vdc after 5 minutes

If voltage is out of specification, replace capacitor.

If in doubt, proceed with the following residual voltage test.

Capacitor Residual Voltage Test

⚠ WARNING

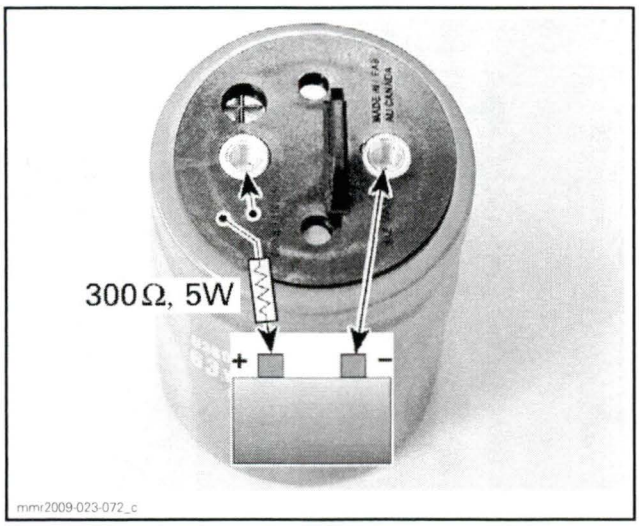
Disconnect the magneto connector. Should the engine be made to rotate with magneto connected, a spark may occur resulting in electrical shock, a fire or an explosion.

1. Disconnect magneto connector.
2. Remove capacitor from vehicle and carry out the following test on a non metallic workbench.
3. Connect the following items to the capacitor, see following illustration.
   - A switch
   - Resistor (300 Ω/5 W)
   - 12 V battery (fully charged).

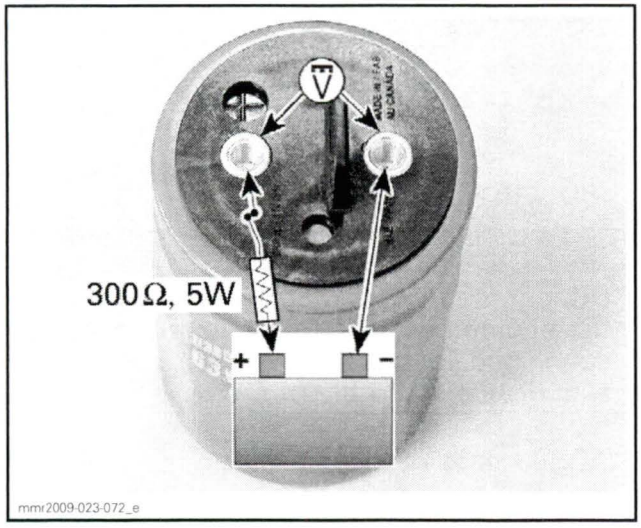
NOTICE **Ensure the test switch is in the OFF position when connecting the battery to the capacitor to prevent sparking or electrical shock.**

⚠ WARNING

Be sure to connect the battery POSITIVE post to the capacitor POSITIVE terminal.



4. Turn switch to **ON** and read capacitor voltage. Wait until voltage reaches 12 V to ensure the capacitor is fully charged.

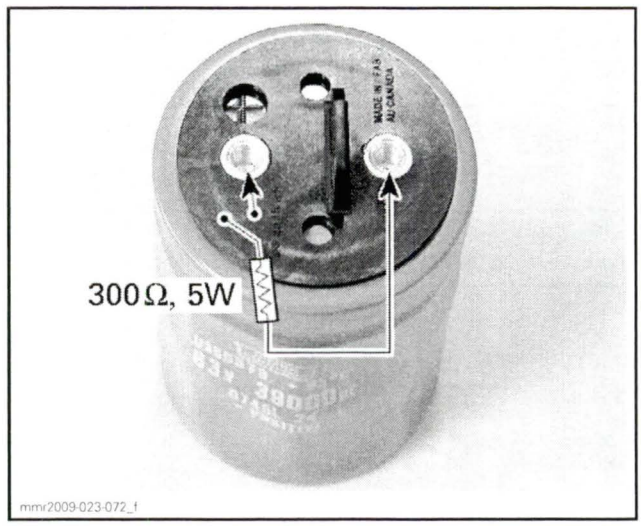


5. Turn test switch to **OFF**.

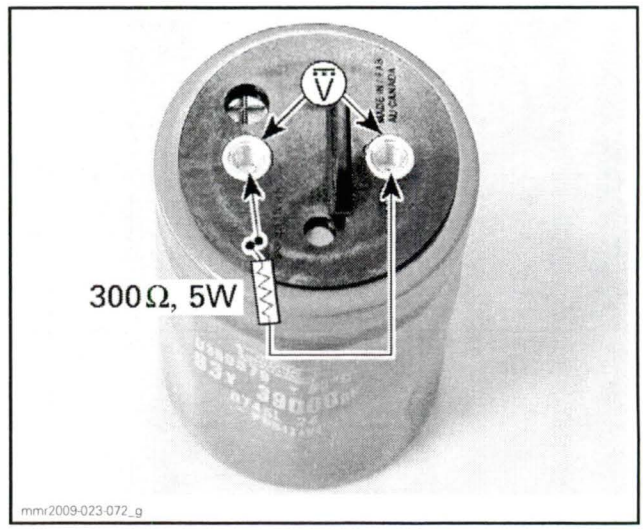
NOTE: Carry out the following steps within the following minute to ensure the capacitor does not begin to discharge before the test.

6. Remove battery from circuit and connect the resistor and switch across capacitor terminals.

NOTICE **Ensure test switch is in the OFF position during the circuit configuration change.**



7. Turn test switch to the **ON** position for 12 seconds ± 1 second to slowly discharge capacitor.
8. Read capacitor voltage.



CAPACITOR RESIDUAL VOLTAGE
Must be above 2.6 Vdc

If voltage is out of specification, replace capacitor.

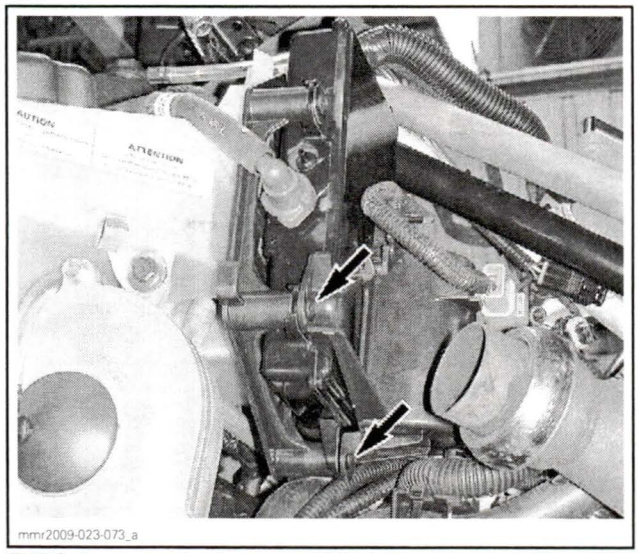
Capacitor Removal

⚠ WARNING

Disconnect the magneto connector. Should the engine be made to rotate with magneto connected, a spark may occur resulting in electrical shock, a fire or an explosion.

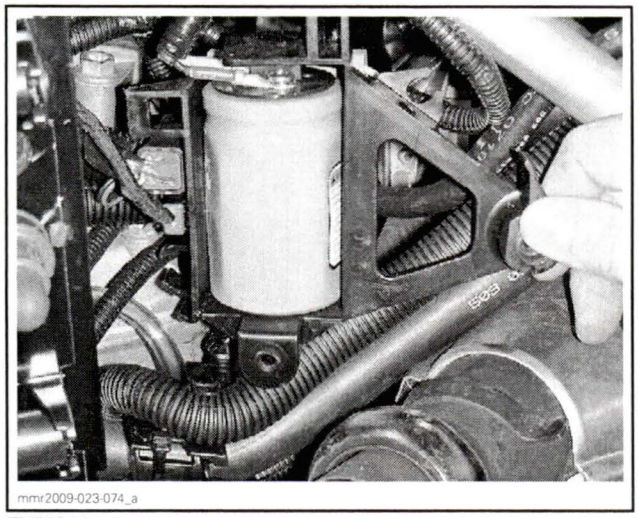
1. Ensure capacitor remained connected for at least 10 seconds after engine shut down, or after engine was last cranked. This ensures capacitor is fully discharged.

2. Remove retaining screws from capacitor support cover.



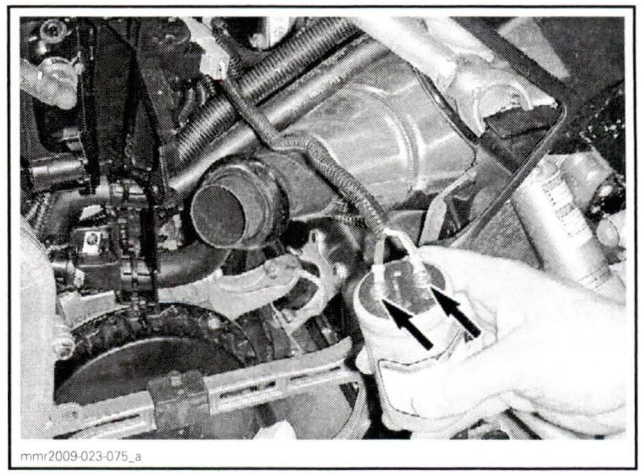
TYPICAL

3. Pull capacitor support cover open.



TYPICAL

4. Pull capacitor out of support and remove terminal screws.

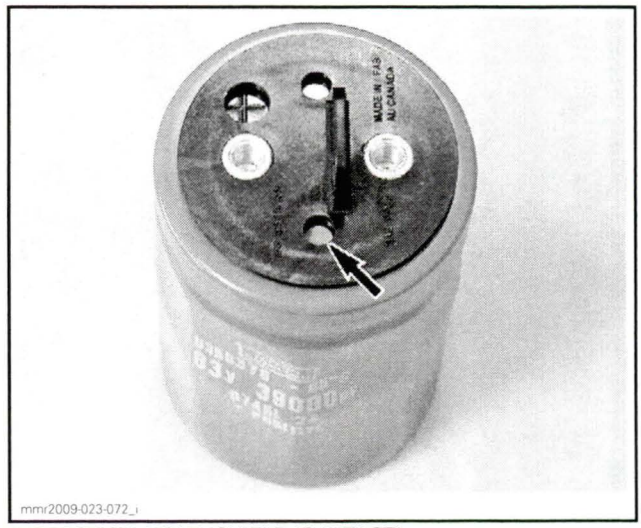


TYPICAL

⚠ WARNING

Do not remove plastic protector from top of capacitor unless the capacitor is to be replaced. The cover prevents the two capacitor contacts from being easily shorted together which may cause a spark, possibly resulting in a fire.

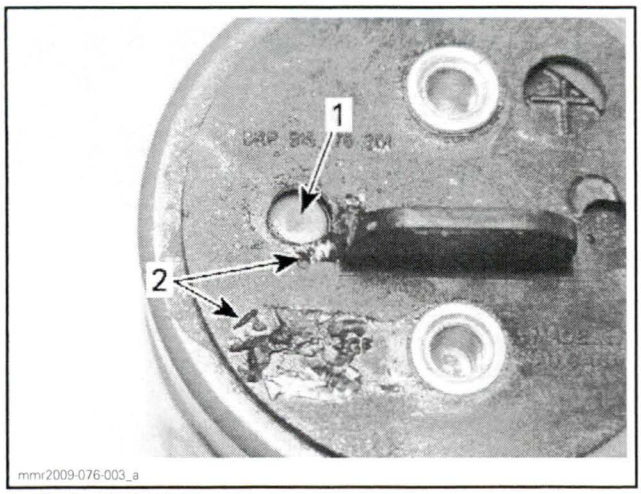
5. Check inspection hole on top of capacitor.



INSPECTION HOLE (SHIELD IS INTACT)

If the top shield is open (pierced), replace capacitor.

NOTE: The following illustration shows a perforated shield with capacitor fluid leakage. This capacitor was connected in reverse polarity.

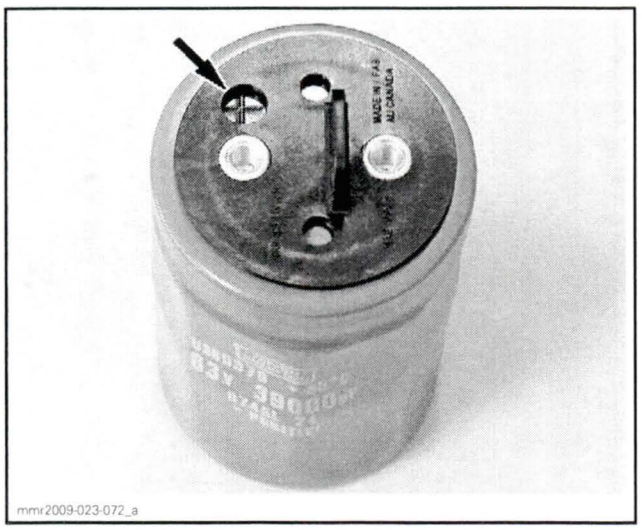


1. Perforated shield
2. Capacitor fluid leakage

Capacitor Installation

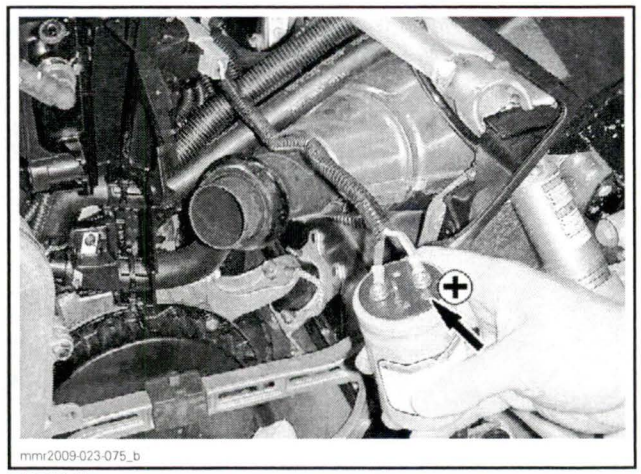
1. If capacitor was replaced, install a plastic protector cap on new capacitor.

NOTE: When reinstalling plastic protector, ensure the + sign on top of capacitor is visible through the hole in protector. If + sign is not visible, pull off protector, rotate it one half turn, then reinstall it.



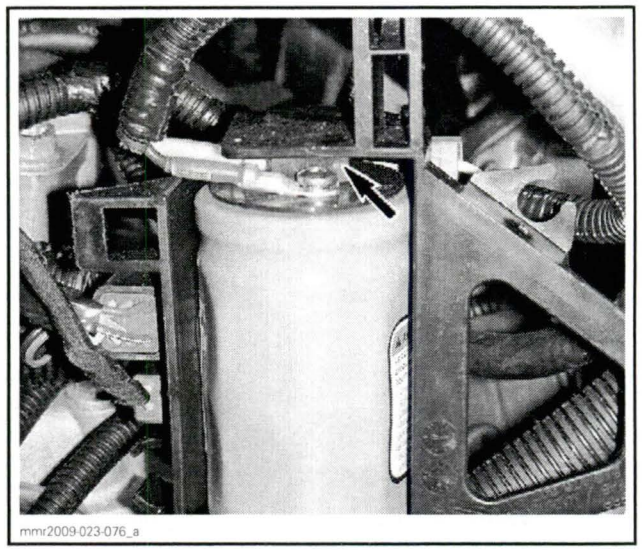
2. Connect wire terminals to capacitor. Ensure to connect the YELLOW/RED wire to the + terminal on capacitor. Position wires so as to route them away of the + sign.

NOTICE **Improper polarity could destroy the capacitor while in operation.**



TYPICAL

3. Insert capacitor in its support ensuring it bottoms out completely.



4. Complete assembly of remaining parts in the reverse order of removal.

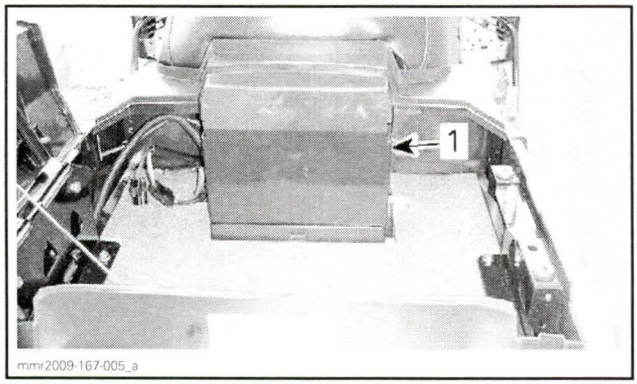
BATTERY

Battery Technical Information

The battery type used is a sealed valve regulated lead acid (VRLA) battery. It is a non-spillable, maintenance reduced type (no electrolyte level to be checked and readjusted). No ventilation tube is attached to the battery.

Battery Location

Battery is located in the rear storage compartment.



1. Battery cover



1. Battery

Battery Testing

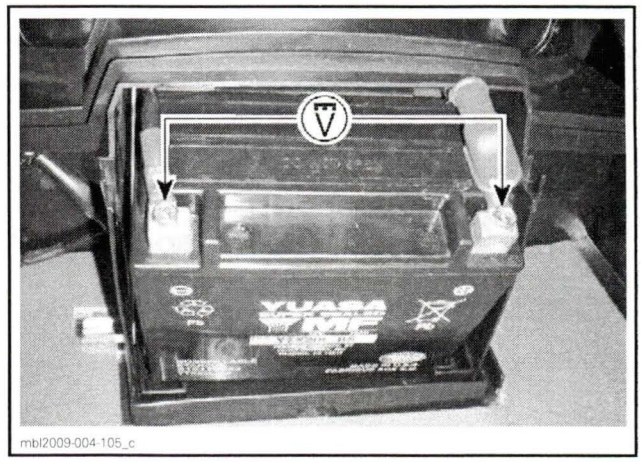
NOTE: The most accurate test to determine battery condition is the *BATTERY TESTING (LOAD APPLIED) USING A LOAD TESTER.*

Battery Voltage Test (No Load Applied)

NOTE: An unloaded voltmeter test is carried out on a battery without discharging current. It is the simplest and most commonly used. However, be aware that a voltage test can indicate that the battery is in good condition even though the battery does not have enough power to crank the engine. A voltage reading provides an instant indication of the state of charge of the battery, not of its current storage capacity. A battery load test gives a more accurate indication of the battery condition.

If the battery has just received a charge, allow it to rest for 1 - 2 hours before taking a voltage reading.

Set multimeter to Vdc and connect to battery terminals. Always respect polarity.



Batteries with a voltage above 12.8 V do not need to be charged.

Batteries with a voltage of 12.8 V and below need to be charged. Refer to *BATTERY CHARGING* in this subsection.

Battery Voltage Test (Load Applied)

This is the best test used to determine the battery condition.

Using a load testing device such as the NAPA ULTRA PRO BATTERY LOAD TESTER (P/N 95260), test the storage capacity of the battery. It has a 500 A carbon pile adjustable load.

The battery should be fully charged before testing.

If battery has just been recharged, allow battery to rest for at least one hour.

Follow battery load tester instructions.

If battery voltage has dropped below 10 Vdc (or voltage indicated on battery temperature compensation chart), battery storage capacity has decreased appreciably and should be replaced.

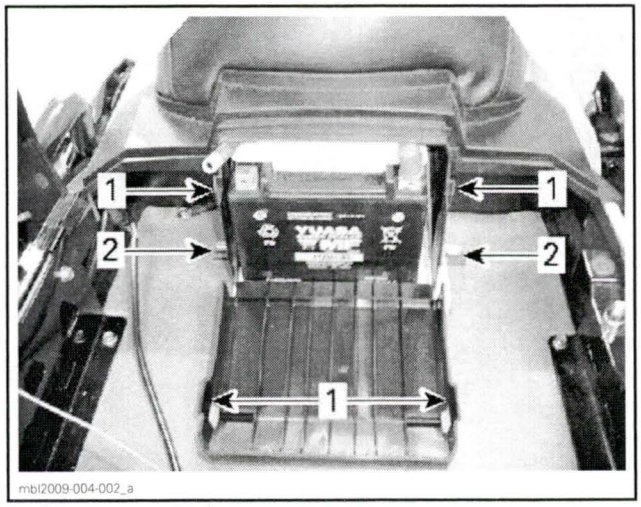
Battery Removal

⚠ WARNING

The BLACK (-) battery cable must always be disconnected first and reconnected last. Never charge or boost a battery while installed on vehicle.

1. Open storage compartment cover.
2. Remove battery cover.
3. Disconnect BLACK (-) cable terminal from the negative battery post.
4. Slide the RED rubber protector off the (+) cable terminal and disconnect it from the battery post.

5. Remove 2 screws securing metal support and remove support.



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1. Battery cover latches
2. Screws from metal support

6. Remove battery.

NOTICE **Should any electrolyte spillage occur, immediately wash off with a solution of baking soda and water to prevent damage to vehicle components.**

Battery Cleaning

Clean the battery, battery casing, cables and battery posts using a solution of baking soda and water.

Remove corrosion from battery cable terminals and battery posts using a firm wire brush. Battery top should be cleaned with a soft brush and any grease-cutting soap or baking soda solution.

Battery Inspection

Visually inspect battery casing for cracks, leaks or other possible damage.

Discoloration, warping or raised top, indicates that the battery has overheated or been overcharged.

If the casing is damaged, replace battery and thoroughly clean battery tray and surrounding area with a water and baking soda solution.

⚠ WARNING

Should the battery casing be damaged, wear a suitable pair of non-absorbent gloves when removing the battery by hand.

Inspect the battery posts for security of mounting.

Battery Storage

NOTICE **A discharged battery will freeze and may damage its casing. A damaged casing will allow electrolyte spillage that may damage surrounding parts.**

1. Disconnect and remove battery from the vehicle.
2. Clean battery terminals and cable connections using a wire brush. Apply a light coat of DIELECTRIC GREASE (P/N 293 550 004) or petroleum jelly on terminals.
3. Clean battery casing using a solution of baking soda and water. Rinse battery with clear water and dry thoroughly using a clean cloth.

NOTE: The battery must always be stored in fully a charged state.

4. Charge the battery every month if stored at a temperature **below** 15°C (59°F).
5. Charge the battery every two week if stored at a temperature **above** 15°C (59°F).

NEW Battery Activation

Refer to the instructions provided with the battery.

Battery Charging

⚠ WARNING

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

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

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

Carry out a battery *BATTERY VOLTAGE TEST (NO LOAD APPLIED)* as described in this subsection, then proceed as described here.

An automatic charger is the fastest and most convenient way for error-proof charging.

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

Battery Voltage Below 12.8 V and Above 11.5 V

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

QUICK CHARGING	
TIME	CHARGE
50 minutes	10 A

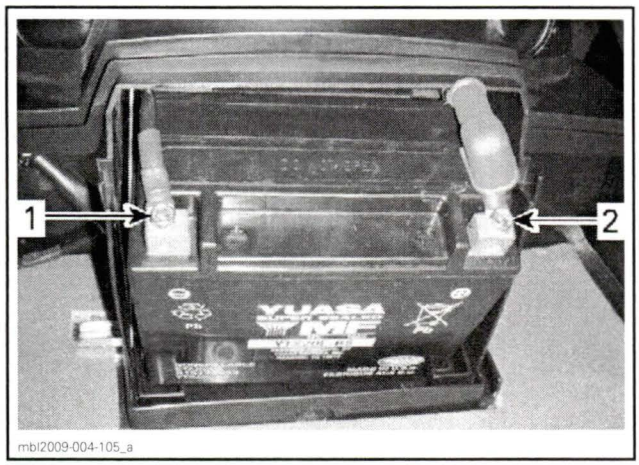
Battery Voltage Below 11.5 V

A battery with a voltage below 11.5 V requires a special procedure to recharge. In charging an over discharged battery, its internal resistance may be too high to charge at a normal charging rate.

Set charger to the 10 A charging rate and monitor charging current for approximately 30 minutes. If there is no change in charging current or battery becomes abnormally hot, the battery is most likely at the end of its service life and should be replaced.

Battery Installation

1. Connect RED (+) cable to battery positive post.
2. Connect BLACK (-) cable to battery negative post.



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1. BLACK (-) cable
2. RED (+) cable

TIGHTENING TORQUES	
Battery retaining screws	10 N•m (89 lbf•**in**)
Battery terminal screws	3 N•m (27 lbf•**in**)

3. Apply DIELECTRIC GREASE (P/N 293 550 004) on battery posts.
4. Cover the RED (+) connection with the red rubber boot.
5. Close battery cover.

CHARGING SYSTEM (600 ACE)

SERVICE TOOLS

Description	Part Number	Page
FLUKE 115 MULTIMETER	529 035 868	628–632

SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
EXTECH AMMETER	380941	628
FLUKE RIGID BACK PROBES	TP88	630–631
NAPA ULTRA PRO BATTERY LOAD TESTER	95260	633

SERVICE PRODUCTS

Description	Part Number	Page
DIELECTRIC GREASE	293 550 004	634–635

GENERAL

SYSTEM DESCRIPTION

Magneto

A magneto provides the primary source of electrical energy. It transforms a magnetic field into an alternating current (AC).

The magneto is comprised of a 3 phase delta wound stator.

AC current is rectified to DC current and regulated by a voltage regulator to between 14 - 15 volts DC for primary power to the vehicle electrical system, and to charge the battery.

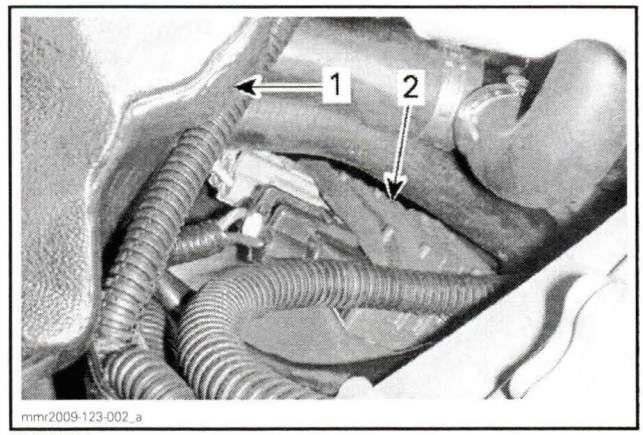
Voltage Regulator

The voltage regulator has two connectors.

- An AC input connector coming from the magneto stator (YELLOW wires).
- A DC output connector that holds the supply wire (WHITE/RED) and the ground wire (BLACK).

The voltage regulator DC output supplies all the vehicle's needs in current when the engine is running, and also charges the battery through the battery charging fuse (main).

The voltage regulator is located on the RH side of the tunnel, in front of the fuel tank.



TYPICAL
1. Fuel tank
2. Voltage regulator

Battery

A battery is installed as a power source. It is primarily used for energizing the ECM, gauge and starter.

The battery also helps to provide a stable DC system voltage to ensure the ECM or other sensitive equipment connected to the system operates normally.

NOTE: Never use a battery charger to temporarily substitute the battery as it may cause the ECM (engine control module) to function erratically or not at all.

INSPECTION

CHARGING SYSTEM OUTPUT

DC Voltage Output Test

NOTE: The charging system can have an adequate voltage output while being unable to provide enough current for the vehicle needs. If in doubt, perform the *DC CURRENT OUTPUT TEST*.

1. Lift and support rear of vehicle. Ensure the track is off the ground and can turn freely.

⚠ WARNING

Make sure vehicle track is completely off the ground. If the track should come into contact with the ground when the engine is at high RPM, equipment damage and severe injury may result.

2. Remove RED rubber boot protector from positive battery post.

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

3. Connect multimeter to battery posts.
4. Start engine and read voltage as follows.

DC VOLTAGE OUTPUT TEST				
MAGNETO	TEST ENGINE SPEED	TEST PROBES		VOLTAGE (VDC)
600 ACE 650 W	4000 RPM	Battery (+)	Battery (-)	14 - 15



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If voltage is above specification, replace voltage regulator.

If voltage is below specification, check the following:

- Check stator wires (YELLOW) and terminals at voltage regulator for damage.
- Test stator, refer to *MAGNETO AND STARTER* subsection.
- Perform wiring tests. Refer to *VOLTAGE REGULATOR* in this subsection.

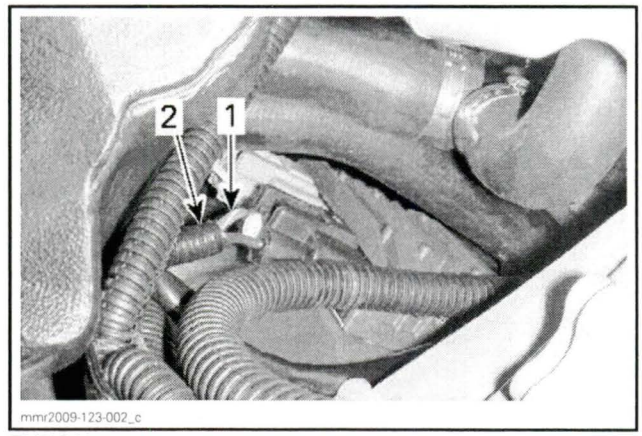
DC Current Output Test

1. Move fuel tank back, refer to *FUEL TANK AND FUEL PUMP* subsection.
2. Lift and support rear of vehicle. Ensure the track is off the ground and can turn freely.

⚠ WARNING

Make sure vehicle track is completely off ground. If track should come into contact with ground when engine is at high RPM, equipment damage and severe injury may result.

3. If necessary, carefully open the protective sheath covering the wires enough to allow ammeter clamp installation.
4. Measure current using an inductive ammeter such as the EXTECH AMMETER (P/N 380941).
   4.1 Install ammeter clamp over the WHITE/RED wire, near the voltage regulator.



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TYPICAL
1. Protective sheath
2. WHITE/RED wire

   4.2 Start engine.
   4.3 Set the handlebar grip and throttle lever heaters to the highest intensity.
   4.4 Set the headlights to high beam.

4.5 Rev engine to 4000 RPM and read ammeter.

DC CURRENT OUTPUT TEST	
TEST ENGINE SPEED	MINIMUM CURRENT
4000 RPM	25 A

If current reading is significantly below specification, do the following:
- Check battery connections.
- Check stator wires (YELLOW) and terminals at voltage regulator for damage.
- Test stator, refer to *MAGNETO AND STARTER* subsection.
- Perform wiring tests. Refer to *VOLTAGE REGULATOR* in this subsection.

TROUBLESHOOTING

NOTE: It is good practice to check for fault codes using B.U.D.S. software as a first troubleshooting step. Refer to *DIAGNOSTIC AND FAULT CODES* subsection.

DIAGNOSTIC TIPS

Weak or Discharged Battery

If the battery is weak or discharged, check the following:
- Check battery. Refer to *BATTERY* in this subsection.
- Check items in *LOW OR NO CHARGING SYSTEM VOLTAGE*.
- Check charging current output, refer to *INSPECTION* in this subsection.

Low or No Charging System Voltage

If charging system voltage is low, the engine may become unstable, or stall.

Test the following items:
- Charging system voltage, refer to *INSPECTION* in this subsection
- Test stator, refer to *MAGNETO AND STARTER* subsection
- Wiring and connections, refer to *VOLTAGE REGULATOR* in this subsection.

Engine Stalls

- Check battery charging fuse (main).

Battery Charging Fuse (Main) Continuously Burns

A defective voltage regulator, loose connection, damaged wires or terminals can cause the fuse to blow.

1. Disconnect voltage regulator connectors and inspect wires and terminals for damage. Do not reconnect voltage regulator connectors.
2. Install a new charging fuse.
3. Start and rev engine.
4. Stop engine.

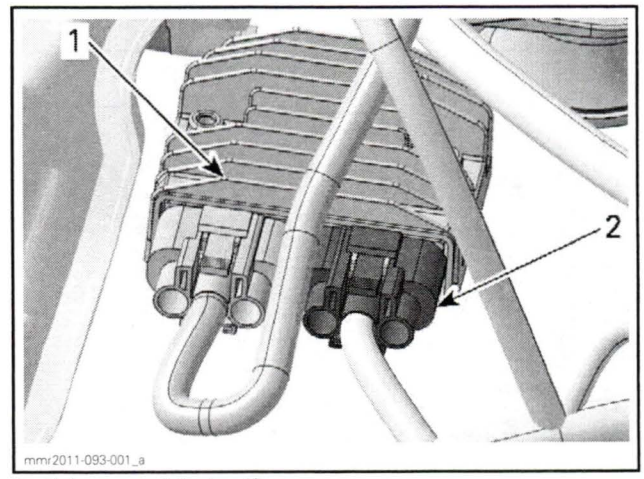
- If fuse does not burn, replace voltage regulator.
- If fuse still burns, the problem is in the wiring harness.

PROCEDURES

VOLTAGE REGULATOR

Voltage Regulator Wiring Continuity Test

1. Disconnect battery.
2. Disconnect regulator DC connector.



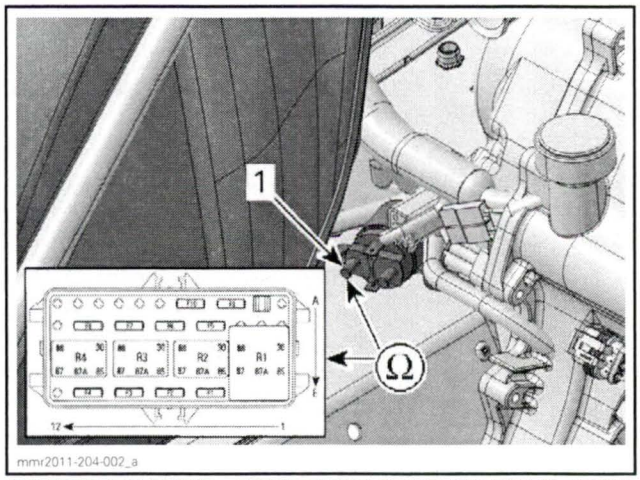
1. *Voltage regulator/rectifier*
2. *DC connector*

3. Remove the battery charging fuse (main), refer to *POWER DISTRIBUTION AND GROUNDS (600 ACE)* subsection.

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

4. Measure resistance as follows:

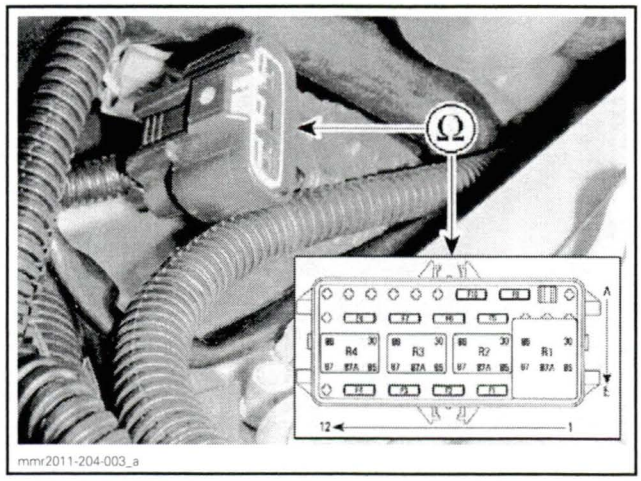
TEST PROBES		RESISTANCE
Charge wire (RED)	Fuse box, terminal 4E	Close to 0 Ω



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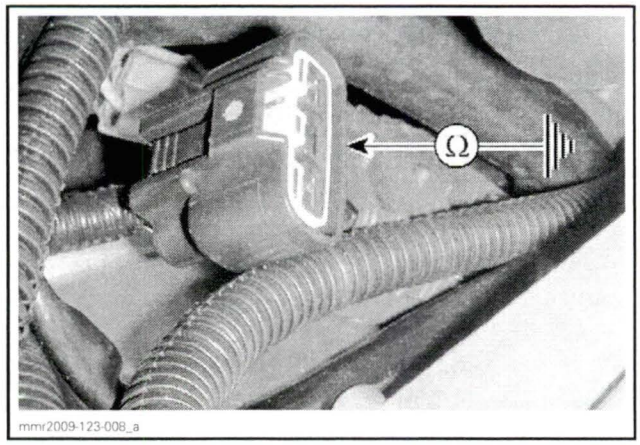
STARTER SOLENOID - SOME PARTS REMOVED FOR CLARITY
1. Charge wire connected here

TEST PROBES		RESISTANCE
Regulator DC connector pin 1 (WHITE/RED wire)	Fuse box, terminal 5E	Close to 0 Ω



mmr2011-204-003_a

TEST PROBES		RESISTANCE
Regulator DC connector pin 3 (BLACK wire)	Chassis ground	Close to 0 Ω



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If a high resistance is read, check wire for corrosion or damage.

Reconnect voltage regulator connector.

Voltage Regulator Wiring Voltage Drop Test

In some cases, even if the continuity tests good, a parasitic resistance may affect the circuit. In these cases, a voltage drop test is more accurate.

Supply Wire Voltage Drop Test

1. Move fuel tank back, refer to *FUEL TANK AND FUEL PUMP* subsection.

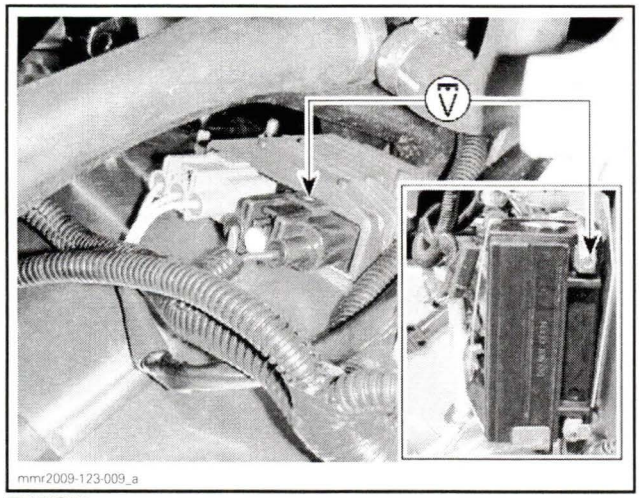
NOTE: Ensure the DC connector is connected to the voltage regulator.

2. Start engine and rev it above 2000 RPM.
3. Set the handlebar grip and throttle lever heaters to the highest intensity.
4. Set the headlights to high beam.

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

5. Back probe the at voltage regulator DC connector to measure for voltage between the following points.

REGULATOR DC CONNECTOR	BATTERY	VOLTAGE DROP
Pin 1 (WHITE/RED wire)	Positive post (+)	Maximum 1 volt



TYPICAL

6. Stop engine.

If reading is above specification, check battery connections, terminals at regulator DC connector, WHITE/RED wire and fuse holder for corrosion or damage.

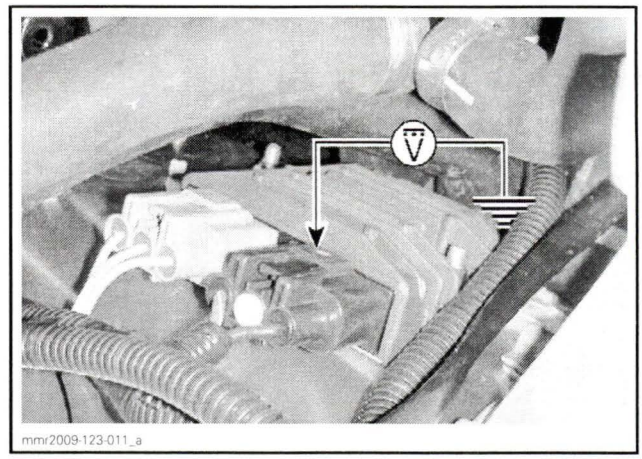
Ground Circuit Voltage Drop Test

1. Start engine and rev it above 2000 RPM.
2. Set the handlebar grip and throttle lever heaters to the highest intensity.
3. Set headlights to high beam.

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

4. Back probe the voltage regulator DC connector to measure voltage between the following points.

REGULATOR DC CONNECTOR	CHARGING SYSTEM FUSE HOLDER (FA)	VOLTAGE DROP
Pin 3 (BLACK wire)	Chassis ground	Maximum 1 volt



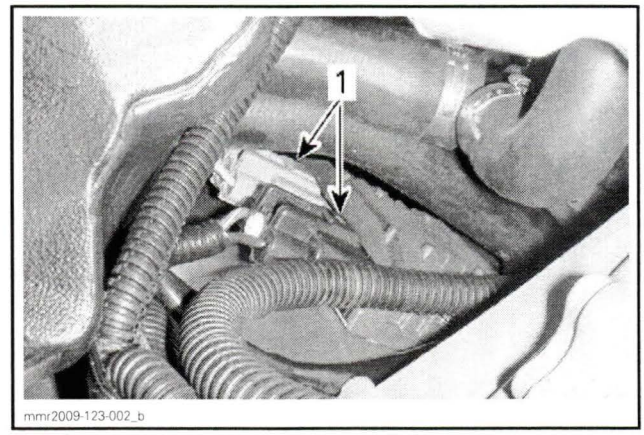
TYPICAL

5. Stop engine.

If reading is above specification, check battery connections, terminal at regulator DC connector, battery ground, engine ground, chassis ground and BLACK wire for corrosion or damage.

Voltage Regulator Removal

1. Disconnect battery.
2. Move fuel tank back, refer to *FUEL TANK/FUEL PUMP* subsection.
3. Disconnect the voltage regulator connectors.



TYPICAL
1. Voltage regulator connectors

4. Remove both elastic nuts retaining the regulator to the tunnel.
5. Lift regulator up to free it from the LH mounting stud.
6. Pivot regulator counterclockwise, then free it from the RH mounting stud.

Voltage Regulator Installation

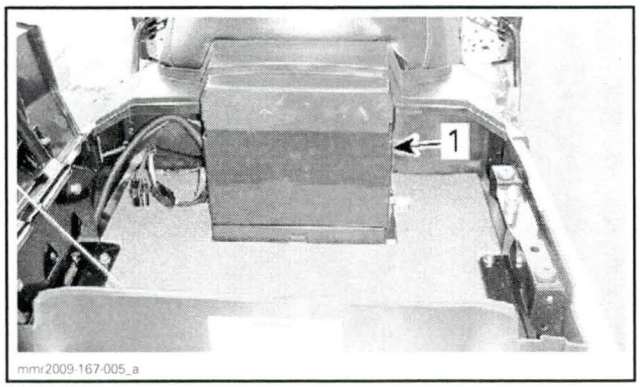
Installation is the reverse order of removal procedure.

Torque voltage regulator screws to 5 N•m (44 lbf•**in**).

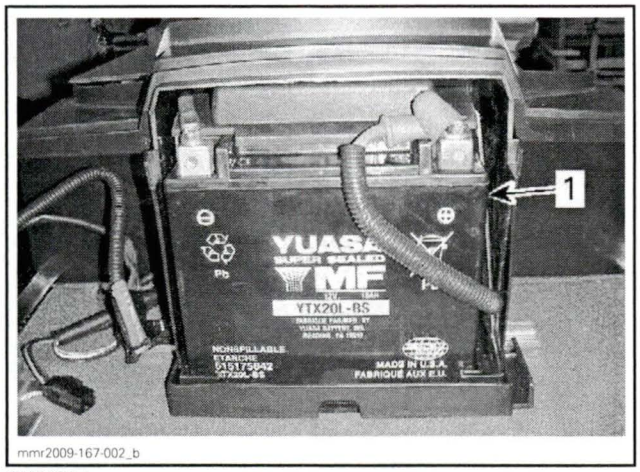
BATTERY

Battery Location

Battery is located in the rear storage compartment.



TYPICAL
1. Battery cover



TYPICAL
1. Battery

Battery Technical Information

The battery type used is a sealed valve regulated lead acid (VRLA). It a non-spillable, maintenance reduced type (no electrolyte level to be checked and readjusted). No ventilation tube is attached to the battery.

Battery Testing

NOTE: The most accurate test to determine battery condition is the *BATTERY VOLTAGE TEST (LOAD APPLIED) USING A LOAD TESTER.*

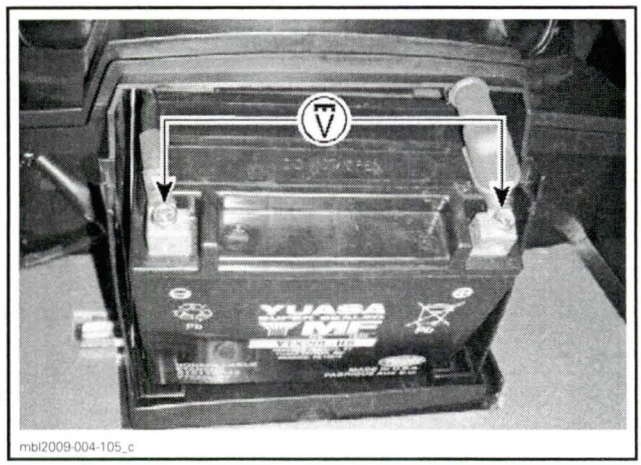
Battery Voltage Test (No Load Applied)

NOTE: An unloaded voltmeter test is carried out on a battery without discharging current. It is the simplest and most commonly used. However, be aware that a voltage test can indicate that the battery is in good condition even though the battery does not have enough power to crank the engine. A voltage reading provides an instant indication of the state of charge of the battery, not of its current storage capacity. A battery load test gives a more accurate indication of the battery condition.

If the battery has just received a charge, allow it to rest for 1 - 2 hours before taking a voltage reading.

Set multimeter to Vdc and connect to battery terminals. Always respect polarity.

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



BATTERY VOLTAGE TEST (NO LOAD APPLIED)	
RESULT	SERVICE ACTION
12.8 V and above	Battery full charge (no action required)
12.7 V and below	Recharge battery

If battery requires recharging, refer to *BATTERY CHARGING* in this subsection.

Battery Voltage Test (Load Applied Quick Test)

The battery must be fully charged before testing.

1. Disconnect the regulator DC connector.
2. Set the multimeter to Vdc.
3. Start engine and rev it above 2000 RPM.

4. Set the heated grips and throttle lever to the highest intensity and the headlights to high beam.
5. Measure voltage on the battery terminals.

BATTERY VOLTAGE TEST (LOAD APPLIED QUICK TEST)	
Battery voltage	10 Vdc minimum

If battery voltage reading is below 10 Vdc, storage capacity has decreased appreciably and battery should be replaced.

NOTE: Before replacing the battery, make sure the charging system is in good condition.

Battery Voltage Test (Load Applied Using a Load Tester)

This is the best test used to determine the battery condition.

Using a load testing device such as the NAPA ULTRA PRO BATTERY LOAD TESTER (P/N 95260), test the storage capacity of the battery. It has a 500 Amp carbon pile adjustable load.

The battery must be fully charged before testing.

If battery has just been recharged, allow battery to rest for at least one hour.

Follow battery load tester instructions.

Apply a load of 150 amperes. At 5 seconds into the test, check battery voltage.

BATTERY VOLTAGE TEST (LOAD APPLIED USING A LOAD TESTER)	
TIME TO MEASURE INTO TEST	VOLTAGE
5 seconds	Minimum 10 Vdc

If battery voltage has dropped below 10 Vdc (or voltage indicated on battery temperature compensation chart), battery storage capacity has decreased appreciably and should be replaced.

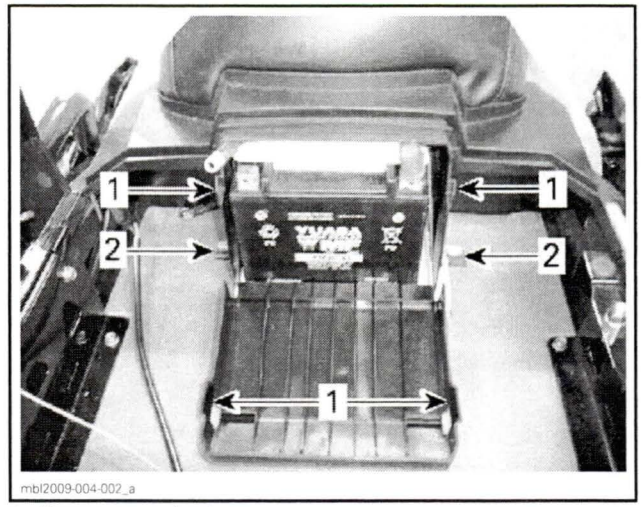
NOTE: Note, before replacing the battery, make sure the charging system is in good condition.

Battery Removal

⚠ WARNING

The BLACK (–) battery cable must always be disconnected first and reconnected last. Never charge or boost a battery while installed on vehicle.

1. Open storage compartment.
2. Remove battery cover.
3. Disconnect BLACK (–) cable terminal from the negative battery post.
4. Slide the RED rubber protector off the (+) cable terminal and disconnect it from the battery post.
5. Remove 2 screws securing metal battery support.



1. Battery cover latches
2. Screws from metal support

6. Lift back end of battery support to remove it and the battery from the vehicle.
7. Remove battery.

NOTICE Should any electrolyte spillage occur, immediately wash off with a solution of baking soda and water to prevent damage to vehicle components.

Battery Cleaning

Clean the battery, battery casing, cables and battery posts using a solution of baking soda and water.

Remove corrosion from battery cable terminals and battery posts using a firm wire brush. Battery top should be cleaned with a soft brush and any grease-cutting soap or baking soda solution.

Battery Inspection

Visually inspect battery casing for cracks, leaks or other possible damage.

Discoloration, warping or raised top, indicates that the battery has overheated or been overcharged.

If the casing is damaged, replace battery and thoroughly clean battery tray and surrounding area with a water and baking soda solution.

⚠ WARNING

Should the battery casing be damaged, wear a suitable pair of non-absorbent gloves when removing the battery by hand.

Inspect the battery posts for security of mounting.

Battery Storage

NOTICE **A discharged battery will freeze when exposed to temperature below 0°C (32°F) and may damage its casing. A damaged casing will allow electrolyte spillage that may damage surrounding parts.**

1. Disconnect and remove battery from the vehicle.
2. Clean battery terminals and cable connections using a wire brush. Apply a light coat of DIELECTRIC GREASE (P/N 293 550 004) or petroleum jelly on terminals.
3. Clean battery casing using a solution of baking soda and water. Rinse battery with clear water and dry thoroughly using a clean cloth.

NOTE: The battery must always be stored in fully charged condition.

4. Charge the battery every month if stored at a temperature **below** 15°C (59°F).
5. Charge the battery every two weeks if stored at a temperature **above** 15°C (59°F).

New Battery Activation

Refer to the instructions provided with the battery.

Battery Charging

⚠ WARNING

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

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

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

Carry out a battery *BATTERY VOLTAGE TEST (NO LOAD APPLIED)* as described in this subsection, then proceed as described here.

An automatic charger is the fastest and most convenient way for error-proof charging.

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

Battery Voltage Below 12.8 V and Above 11.5 V

STANDARD BATTERY CHARGING (RECOMMENDED)	
TIME	CHARGE
5 - 10 hours	2 A

QUICK BATTERY CHARGING	
TIME	CHARGE
50 minutes	10 A

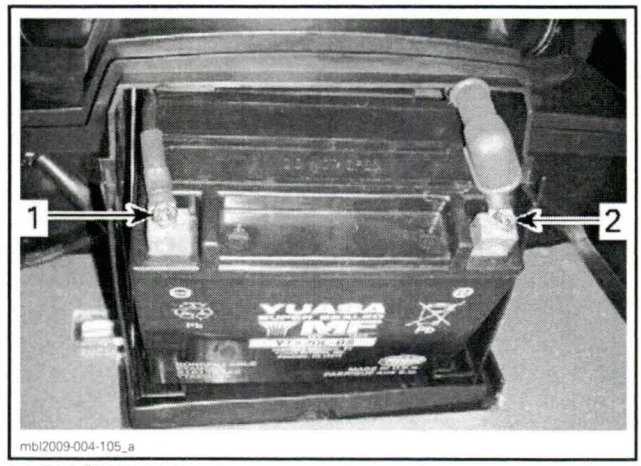
Battery Voltage Below 11.5 V

A battery with a voltage below 11.5 V requires a special procedure to recharge. In charging an over discharged battery, its internal resistance may be too high to charge at a normal charging rate.

Set charger to the 10 A charging rate and monitor charging current for approximately 30 minutes. If there is no change in charging current or battery becomes abnormally hot, the battery is most likely at the end of its service life and should be replaced.

Battery Installation

1. Connect RED (+) cable to battery positive post.
2. Connect BLACK (-) cable to battery negative post.



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1. BLACK (-) cable
2. RED (+) cable

TIGHTENING TORQUES	
Battery retaining screws	10 N•m (89 lbf•**in**)
Battery terminal screws	3 N•m (27 lbf•**in**)

3. Apply DIELECTRIC GREASE (P/N 293 550 004) on battery posts.
4. Cover the RED (+) connection with the red rubber boot.
5. Close battery cover.

STARTING SYSTEM (550F)

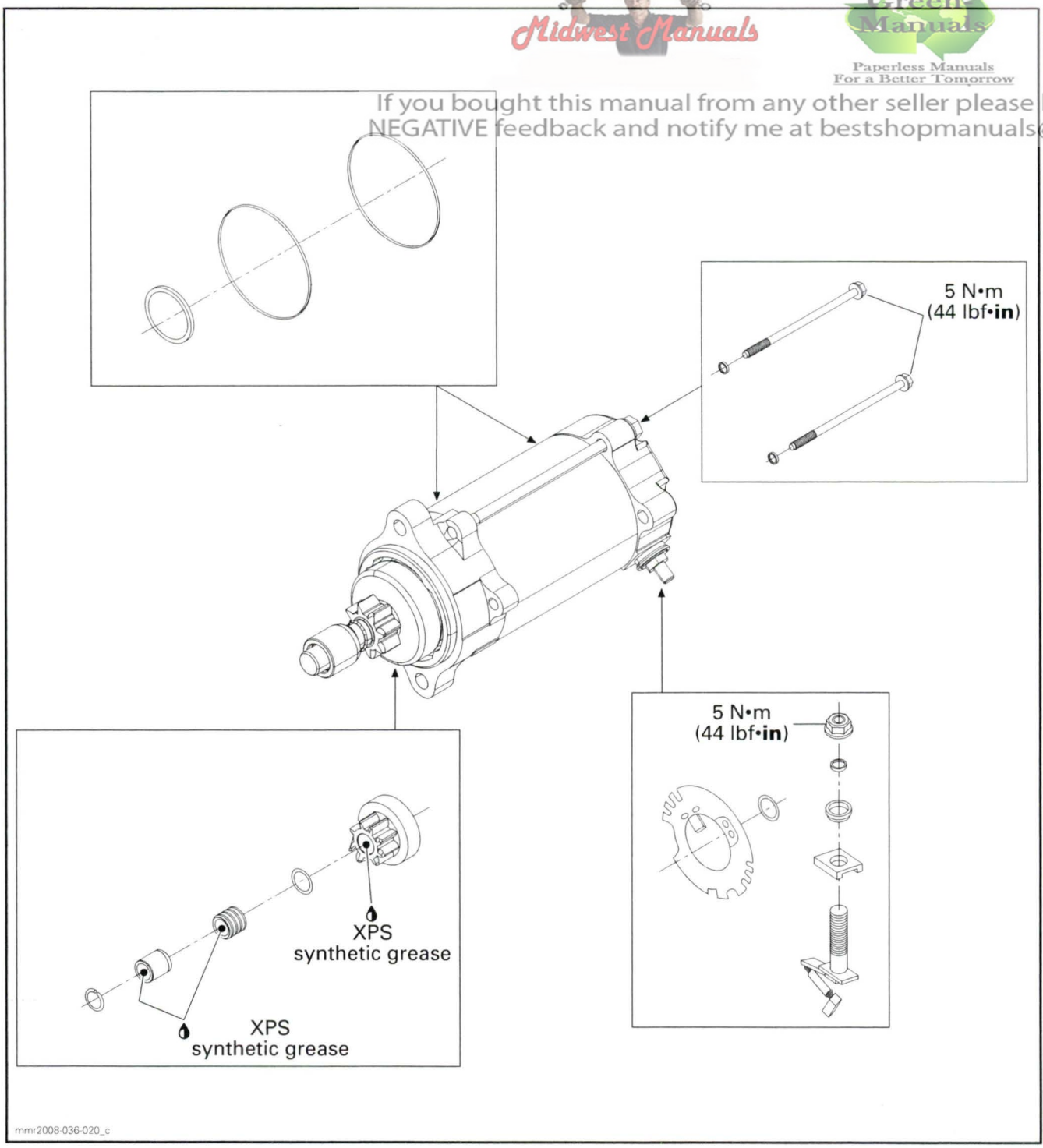
SERVICE TOOLS

Description	Part Number	Page
FLUKE 115 MULTIMETER	529 035 868	639

SERVICE PRODUCTS

Description	Part Number	Page
XPS SYNTHETIC GREASE	293 550 010	642–643

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GENERAL

BASIC STARTING SYSTEM OPERATION

Conditions for Engine Starting

The following conditions must be met to allow engine starting:

- Emergency engine stop switch to RUN.
- Tether cord cap installed on engine cut-off switch.
- Ignition key turned clockwise to START position to engage starter.

NOTE: The starter will crank the engine even with the emergency engine stop switch set to STOP and the tether cord cap removed, however, the engine will not start.

TROUBLESHOOTING

TROUBLESHOOTING TIPS

If the starter does not crank the engine, first ensure the problem is not related to an engine mechanical component.

Try to pull start the engine using the rewind starter.

If the engine can be started, test starting system as per *STARTING SYSTEM TESTING SEQUENCE*.

If the engine does not start or cannot be rotated, the problem is not related to the starting system.

STARTING SYSTEM TESTING SEQUENCE

Test starting system in the following order:

- 20 A charging fuse (F1), refer to *POWER DISTRIBUTION AND GROUNDS (550F)* subsection
- Battery connections, load test and voltage test, refer to *CHARGING SYSTEM (550F)*
- Starter, refer to *STARTER QUICK TEST*
- Starter solenoid, refer to *STARTER SOLENOID QUICK TEST*
- Ignition switch, refer to *IGNITION SYSTEM* subsection
- Wiring and connectors.

PROCEDURES

ELECTRIC STARTER

Starter Quick Test

1. Set the emergency engine stop switch to STOP and remove tether cord cap to prevent engine from starting.
2. Connect one end of a battery booster cable to the positive (+) battery post.
3. Momentarily touch the other end of the booster cable to the starter cable terminal on the starter solenoid.

⚠ WARNING

A spark will be generated when making the final contact of the booster cable to power the starter directly. If there is a fuel or acid smell (fuel system or battery leak), or visible evidence of a leak, do not carry out this procedure as the spark generated may ignite the fuel or acid vapors.

NOTE: This procedure will bypass the starter solenoid and supply current from the battery directly to the starter through its power input cable.

If the starter does rotate, carry out a *STARTER INPUT VOLTAGE TEST*.

If the starter rotated, carry out a *STARTER SOLENOID QUICK TEST*.

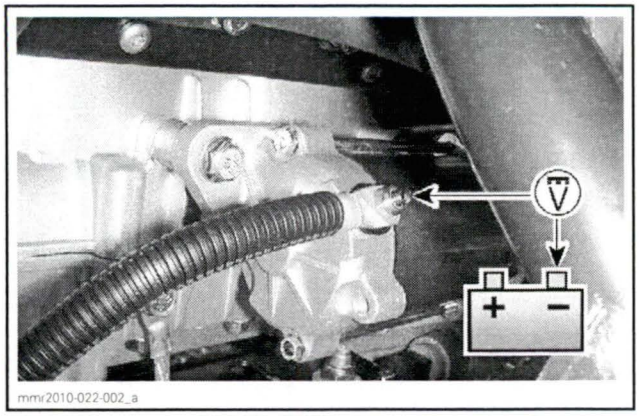
Starter Input Voltage Test

1. Set emergency engine stop switch to STOP.
2. Remove tether cord cap from engine cut-off switch.
3. Set multimeter to Vdc.

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

4. Measure voltage at starter terminal while cranking engine.

NOTE: Battery voltage will drop and fluctuate with starter cranking load.



STARTER INPUT VOLTAGE TEST

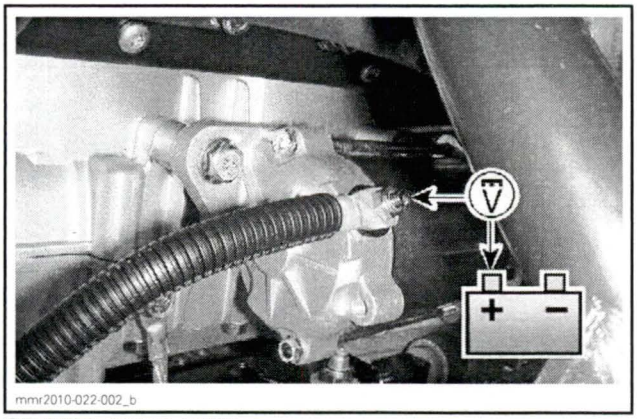
STARTER INPUT VOLTAGE TEST		
PROBES		SPECIFICATION (WHILE CRANKING)
Negative battery post	Starter terminal	Close to battery voltage

RESULT	SERVICE ACTION
No voltage	– Check 20 A charging fuse – Check starter solenoid – Check ignition switch – Check wiring and connectors
Voltage is low	– Carry out a *STARTER CABLE TEST*
Voltage is good	– Carry out a *STARTER GROUND CIRCUIT TEST*

Starter Cable Test

This test confirms if there is parasitic resistance in the cable, solenoid or connections by measuring the voltage drop across the components.

1. Set multimeter to Vdc.
2. Connect multimeter probes to the starter terminal and battery positive post.



STARTER CABLE TEST

3. Turn ignition key to start and read multimeter **while cranking** engine.

STARTER CABLE TEST		
PROBES		SPECIFICATION (WHILE CRANKING)
Battery positive post	Starter terminal	1 Vdc maximum

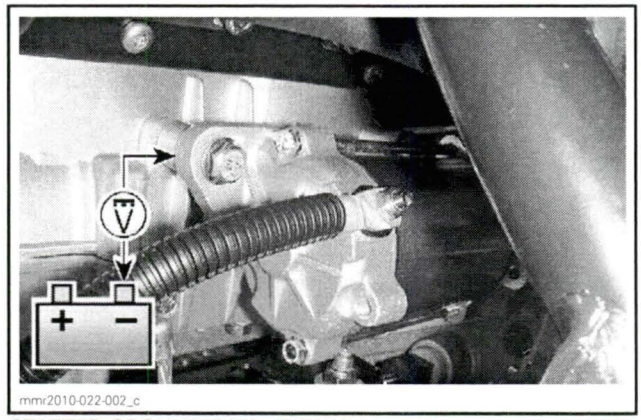
RESULT	SERVICE ACTION
Measured voltage within specification	– Carry out a *STARTER GROUND CIRCUIT TEST*
Measured voltage exceeds specification	Test the following using same method: – Battery positive post and starter solenoid post – Between both starter solenoid posts – Starter solenoid post and terminal on starter

Replace cable or solenoid if necessary.

Starter Ground Circuit Test

This test confirms if there is parasitic resistance between starter and engine by measuring the voltage drop across the components.

1. Set multimeter to Vdc.
2. Connect multimeter probes to the starter housing and battery negative post.



STARTER GROUND CIRCUIT TEST

3. Carry out a start and read multimeter **while cranking**.

STARTER GROUND CIRCUIT TEST		
PROBES		SPECIFICATION (WHILE CRANKING)
Starter housing	Battery negative post	0.8 Vdc maximum

RESULT	SERVICE ACTION
Measured voltage within specification	– Repair or replace starter
Measured voltage exceeds specification	– Check engine to chassis ground – Check battery ground

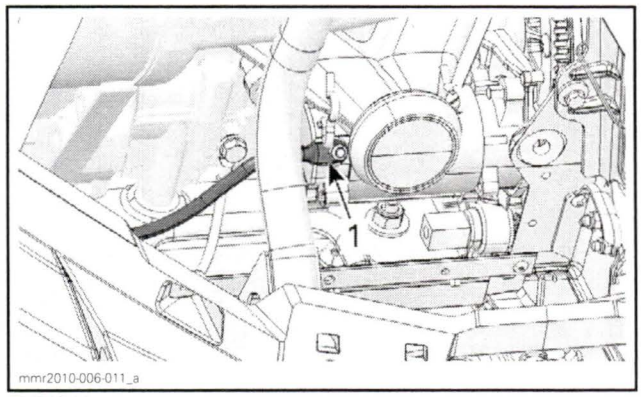
Starter Removal

1. Refer to *BODY* subsection and remove the following:
   - Hood
   - LH upper and lower side panels.
2. Refer to *EXHAUST SYSTEM* subsection and remove the tuned pipe.
3. Disconnect BLACK (-) cable from battery.
4. Disconnect RED (+) cable from battery.

⚠ WARNING

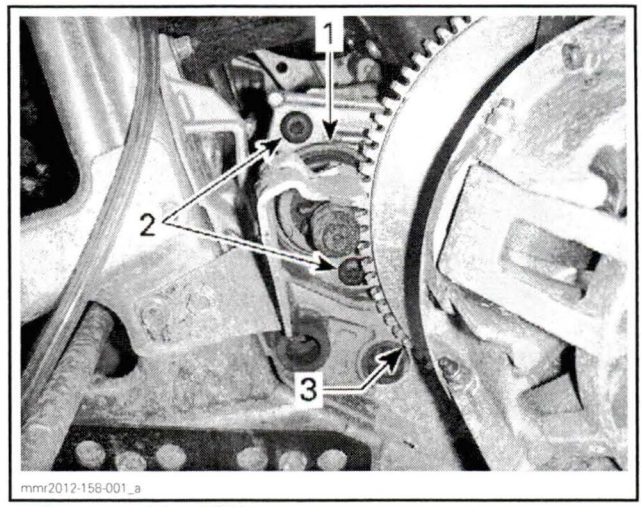
Always disconnect BLACK (-) cable first and reconnect last.

5. Remove drive belt guard.
6. Disconnect RED power cable from starter.



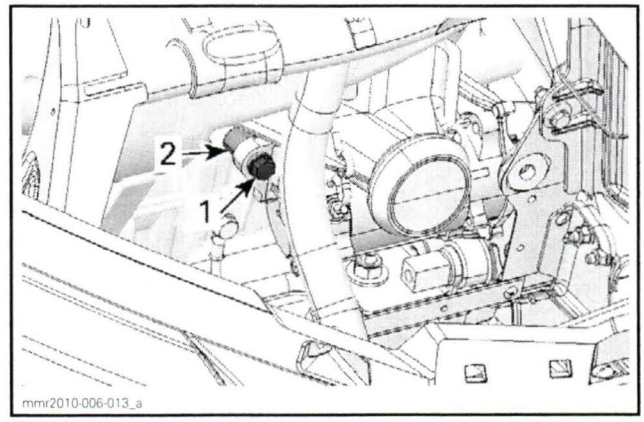
TYPICAL
1. Starter cable

7. Remove and discard both TORX screws securing starter to starter support.



1. Starter retaining TORX screws
2. Starter
3. Drive pulley starter ring gear

8. Remove and discard retaining screw on the RH side of starter. Keep washer and starter spacer for reuse.

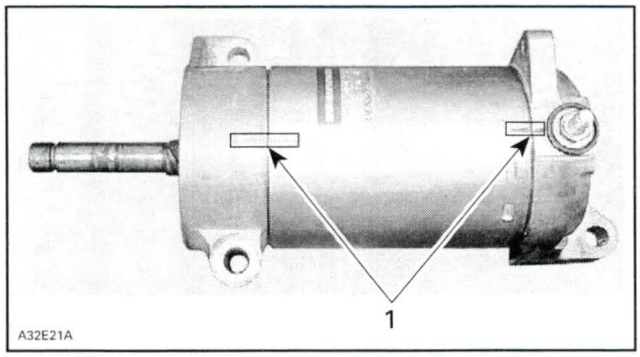


TYPICAL
1. RH side starter retaining screw
2. Starter spacer

9. Remove starter from vehicle.

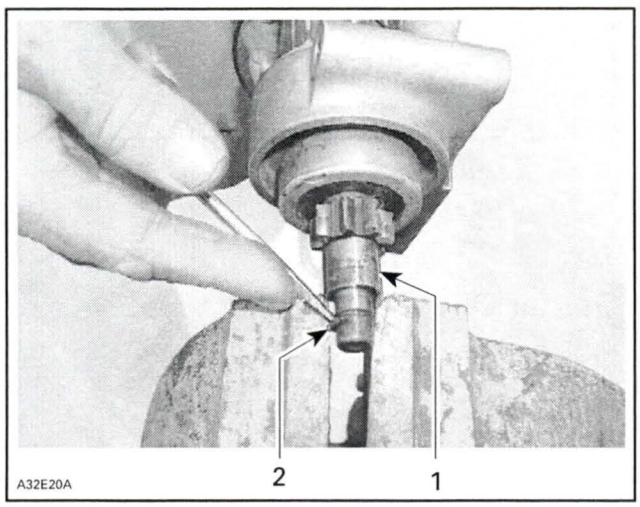
Starter Disassembly

1. Before disassembling, trace index marks on the starter housing and covers for parts alignment at reassembly.



TYPICAL
1. Alignment index marks for reassembly

2. Remove starter through bolts.
3. Separate end cap from starter housing.
4. Withdraw armature from starter housing.
5. If necessary, remove brush holder from end cap.
6. Check for radial play between the armature shaft and end cap bearing. Replace starter if radial play is detected.
7. If parts are in good condition, coat them with XPS SYNTHETIC GREASE (P/N 293 550 010) before reinstalling them.
8. Push back the collar near the starter gear/clutch assembly using a screwdriver.
9. Remove snap ring, collar, and spring.



1. Collar
2. Snap ring

10. Turn starter clutch clockwise to remove it from the armature assembly.
11. Pull yoke from armature.

Starter Cleaning

NOTICE **Yoke, drive unit (clutch assembly) and end cap must not be immersed in cleaning solvent.**

1. Clean brushes and holders with a clean cloth impregnated with solvent. Brushes must be dried thoroughly with a clean cloth.
2. Blow brush holders clean using compressed air.

⚠ WARNING

Always wear safety glasses when using compressed air.

3. Remove dirt, oil or grease from commutator using a clean cloth soaked in suitable solvent. Dry well using a clean and dry cloth.
4. Clean engine ring gear teeth and drive unit (clutch).

NOTE: Bushings or bearings must not be cleaned with grease dissolving agents.

5. Immerse all metal components in cleaning solution. Dry using a clean and dry cloth.

Starter Inspection

Brush Holder

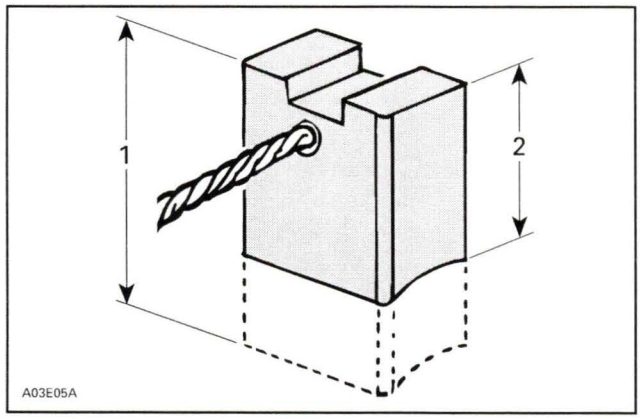
1. Check the brush holder for insulation using growler test probes.
2. Place one test probe on the insulated brush holder and the other test probe on the brush holder plate.

If the growler lamp turns on, the brush holder has to be repaired or replaced.

Brush Length

Measure brush length as illustrated. If less than the specified value, replace them.

MODEL	LENGTH	
	NEW	WEAR LIMIT
All	10 mm (.4 in)	6 mm (.24 in)

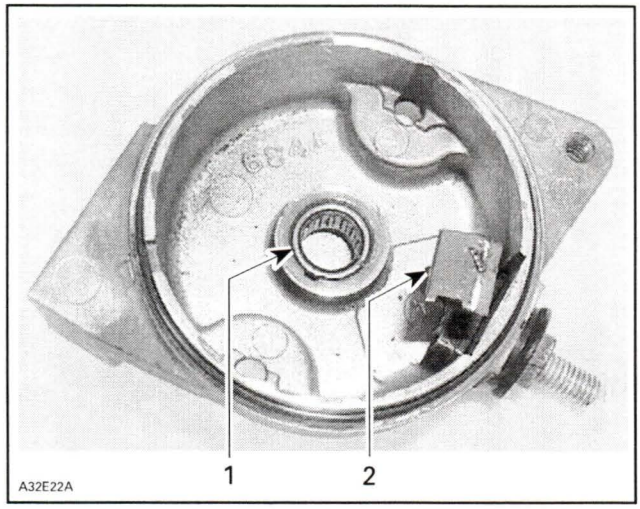


TYPICAL
1. New
2. Wear limit

End Cap

Check the mica insulation of the positive brush.

Check the roller bearing (or bushing) condition. Replace, if necessary.



1. Roller bearing
2. Positive brush

Overrunning Clutch

The pinion of the overrunning clutch should turn smoothly in a clockwise direction, and should not slip in a counterclockwise direction. If defective, replace clutch assembly.

Check the pinion teeth for wear and damage. If defective, replace.

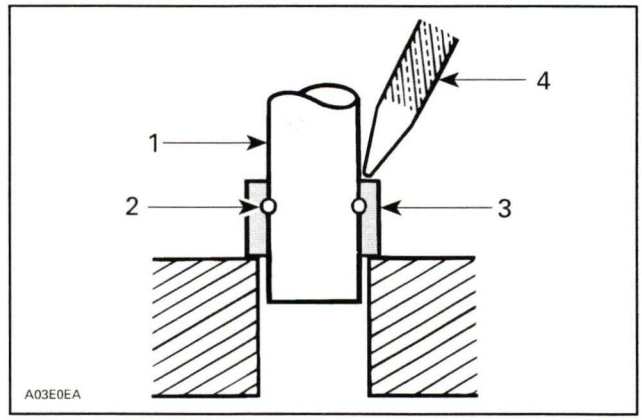
Starter Assembly

Reverse the order of disassembly to reassemble starter. However, pay attention to the following operations.

Prior to assembling, coat sliding surfaces on armature shaft splines, overrunning clutch and bushing with XPS SYNTHETIC GREASE (P/N 293 550 010).

After placing collar on armature shaft, install a new snap ring on the armature shaft and ensure that it is properly secured.

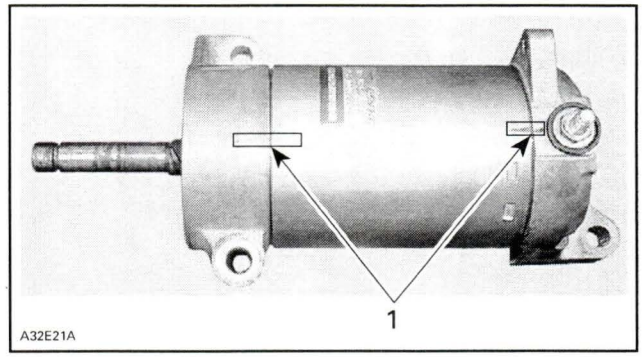
Slide collar over snap ring and secure in place by punching it at two or three places.



1. Armature shaft
2. Snap ring
3. Collar
4. Punch

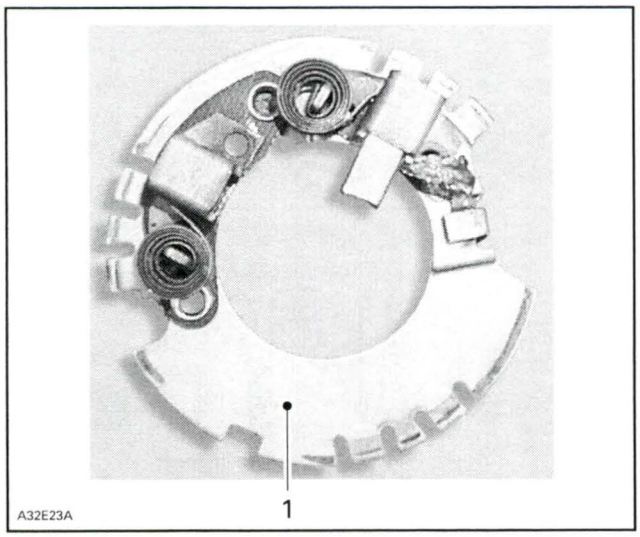
Starter Housing, Yoke and End Cap

1. Align previously traced index marks on housing, yoke and end cap.



TYPICAL
1. Aligned index marks

2. Open brushes and slide over commutator.
3. Align end cap locating notch with yoke locating protrusion and properly sit brush holder into cap.



1. Brush holder

NOTE: To ease end cap installation, retain brush holder with a small screwdriver while installing armature assembly.

NOTICE Place two end caps on a flat surface before tightening the through bolts. Ensure end cap fits perfectly on yoke.

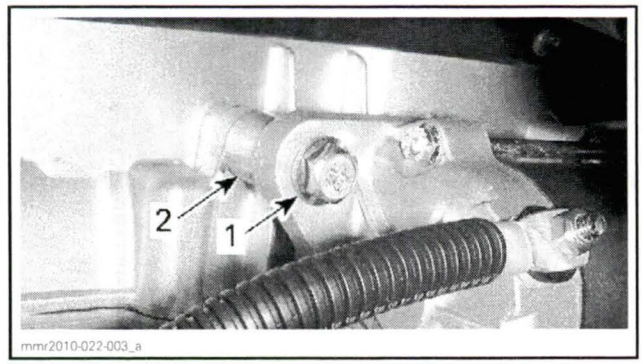
4. Torque starter through bolts as per exploded view.

Starter Installation

Install removed parts in the reverse order of removal, however, pay attention to the following.

- Ensure starter and engine mating surfaces are free of grime. Serious trouble may arise if starter is not properly aligned.
- For ease of installation, install the **three new starter mounting screws** loosely before torquing.
- Torque starter mounting Torx screws first, then the hexagonal screw.
- Connect the RED wire to the large terminal on the starter. Tighten nut to specification.

NOTICE Be sure to install the starter spacer between engine and starter, and the washer under the screw head when installing the mounting screw on the RH side of the starter.



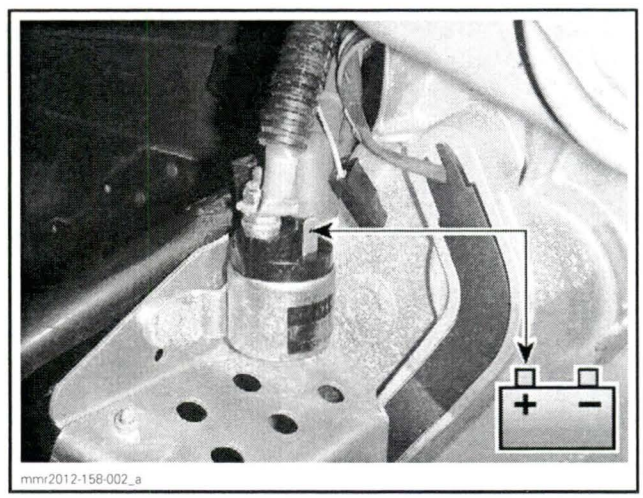
1. Washer under screw head
2. Starter spacer between starter and engine

TIGHTENING TORQUE	
Starter mounting screws	28 N•m (21 lbf•ft)
Cable terminal on starter	7 N•m (62 lbf•**in**)

STARTER SOLENOID

Solenoid Quick Test

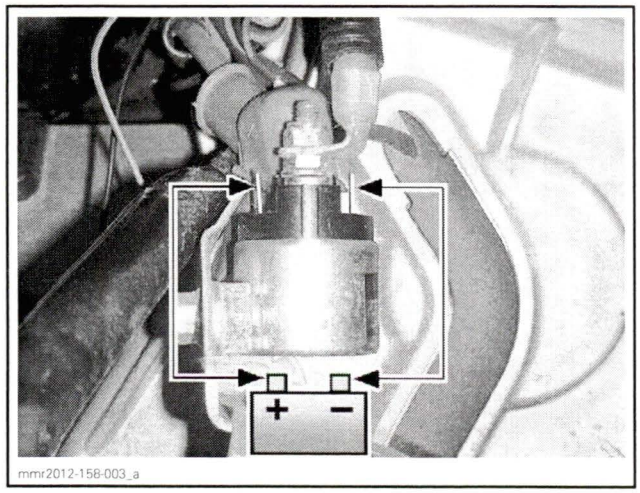
1. Test battery voltage, it should be approximately 12.8 Vdc for a fully charged battery.
2. Disconnect the small positive connector (RED/GREEN wire) from the starter solenoid.
3. Install a jumper wire (with insulated clips) on the positive solenoid terminal and momentary touch the positive battery post with the other clip of jumper.



If starter engages, check ignition switch, wires and connectors for an open circuit. Refer to *IGNITION SYSTEM* subsection.

If the starter does not engage, do the following.

4. Secure the jumper to the positive battery post.
5. Disconnect the negative connector (BLACK wire) from the starter solenoid and install a jumper on the negative solenoid terminal.



6. Momentary touch the negative battery post with the jumper free clip.

If the starter engages, check grounds for an open circuit.

If the starter does not engage, replace the solenoid.

Starter Solenoid Control Winding Test

Disconnect the 2 small connectors from the starter solenoid.

Measure for continuity through the control winding.

STARTER SOLENOID CONTROL WINDING TEST AT STARTER SOLENOID	
RESISTANCE @ 20°C (69°F)	Approximately 7.5 Ω

RESULT	SERVICE ACTION
Resistance as specified	– Refer to *STARTER SOLENOID CIRCUIT TEST AT IGNITION SWITCH*
Resistance NOT as specified	– Replace starter solenoid

Starter Solenoid Control Circuit Test (at Ignition Switch)

Ensure small starter solenoid connectors are properly installed.

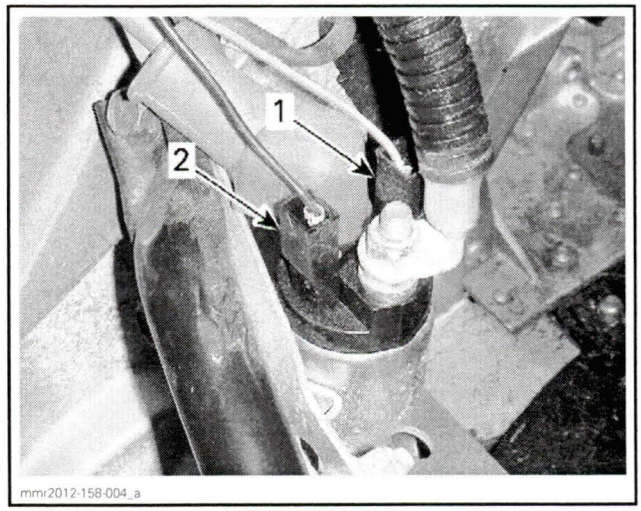
Read the resistance through the starter solenoid from the ignition switch harness connector as follows.

STARTER SOLENOID CIRCUIT TEST AT IGNITION SWITCH		
TEST PROBES		RESISTANCE @ 20°C (69°F)
Ignition switch connector Pin D	Chassis ground	Approximately 7.5 Ω

RESULT	SERVICE ACTION
Resistance as specified	– The starter solenoid control circuit is good
Resistance NOT as specified	– Check continuity from ignition switch connector (pin D) to starter solenoid – Check continuity from starter solenoid winding to ground

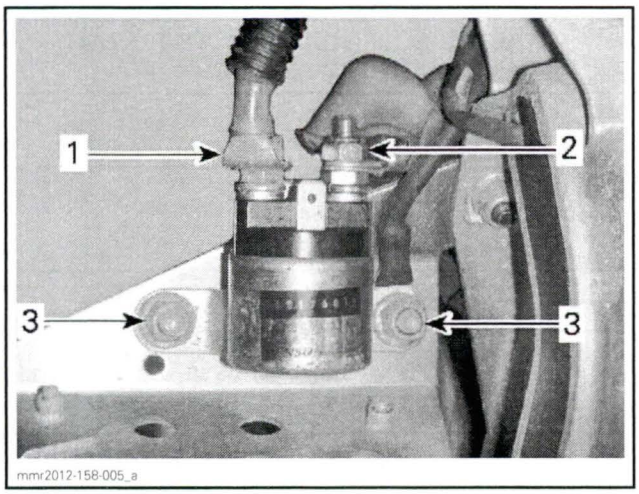
Solenoid Replacement

1. Disconnect BLACK (–) cable terminal from the negative battery post.
2. Disconnect both small connectors from solenoid.



1. Positive connector (RED/GREEN wire)
2. Negative connector (BLACK wire)

3. Remove nuts securing cable terminals on solenoid posts.
4. Remove solenoid retaining nuts.



1. Starter cable terminal nut
2. Battery cable terminal nut
3. Solenoid mounting nuts

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

Install solenoid using **NEW** self-locking nuts.

Tighten solenoid power cables as specified.

TIGHTENING TORQUE	
Solenoid power cable terminals	4 N•m (35 lbf•**in**)

STARTING SYSTEM (600 HO E-TEC)

SERVICE TOOLS

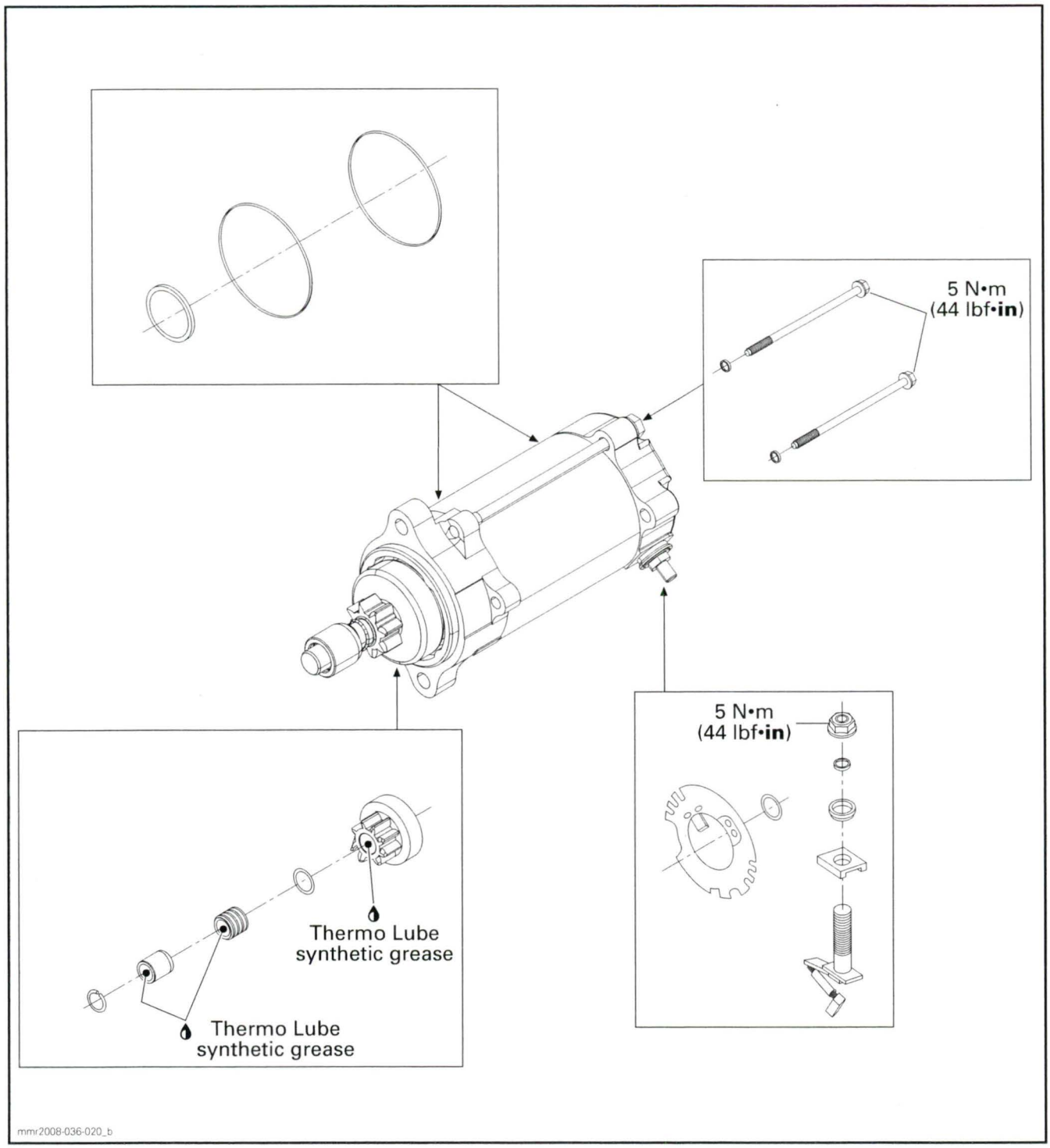
Description	Part Number	Page
FLUKE 115 MULTIMETER	529 035 868	654–657

SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
FLUKE RIGID BACK PROBES	TP88	657

SERVICE PRODUCTS

Description	Part Number	Page
XPS SYNTHETIC GREASE	293 550 010	651–652


5 N•m
(44 lbf•in)
5 N•m
(44 lbf•in)
Thermo Lube
synthetic grease
Thermo Lube
synthetic grease
mmr2008-036-020_b

GENERAL

BASIC STARTING SYSTEM OPERATION

When the START/RER button is pressed, a 12 Vdc signal is sent to the ECM, which completes the starter solenoid circuit by providing a ground. The battery then supplies current to the starter through the starter solenoid to crank the engine.

Conditions for Engine Cranking

- Emergency engine stop switch set to RUN
- Tether cord cap installed
- START/RER button depressed.

TROUBLESHOOTING

TROUBLESHOOTING TIPS

NOTE: It is good practice to check for fault codes using B.U.D.S. software as a first troubleshooting step. Refer to *DIAGNOSTIC AND FAULT CODES* subsection.

In case of starter malfunction, first ensure the problem is not related to an engine mechanical component by doing the following.

1. Set engine stop switch to STOP.
2. Ensure tether cord cap is **not installed** on the engine cut-off switch.
3. Manually rotate the engine using the drive pulley.

⚠ WARNING

When manually rotating engine, the emergency engine stop switch MUST BE set to STOP and tether cord cap MUST NOT be installed or severe injury may occur.

If the engine can be rotated, test starting system as per *STARTING SYSTEM TESTING SEQUENCE.*

If the engine cannot be rotated, check engine.

STARTING SYSTEM TESTING SEQUENCE

Test starting system in the following order:

- 30 A battery charging fuse (F1)
- 5 A START/RER fuse (F2)
- Battery connections and voltage test, refer to *CHARGING SYSTEM* subsection
- Starter. Refer to *STARTER QUICK TEST*
- Starter solenoid. Refer to *STARTER SOLENOID QUICK TEST*
- Start switch. Refer to *START/RER SWITCH USING B.U.D.S.*
- Diode test (through GN/RD wire of starter solenoid and ECM connector J1B, pin 10).

PROCEDURES

START/RER FUSE

NOTE: When a burnt fuse is found, always identify the cause before replacing it.

Fuse Inspection

The ECM power circuit used for the starting system first passes through the 30 A battery charging fuse (F1).

Then it passes through a 5 A START/RER fuse (F2), to the starting system circuits.

If the starter does not crank the engine, test each fuse condition and replace it if necessary.

If fuses are good, refer to *STARTER SOLENOID QUICK TEST* in this subsection.

ELECTRIC STARTER

Starter Quick Test

1. Set emergency engine stop switch to STOP and remove tether cord cap from engine cut-off switch to prevent engine from starting.

⚠ WARNING

Do not touch spark plug or cables when cranking engine. High voltage can cause a powerful electrical shock if you touch them.

2. Connect one end of a battery booster cable to the positive (+) battery post.
3. Momentarily touch the other end of the booster cable to the starter cable terminal on the starter solenoid.

⚠ WARNING

A spark will be generated when making the final contact of the booster cables to power the starter directly. If there is a fuel or acid smell (fuel system or battery leak), or visible evidence of a leak, do not carry out this procedure as the spark generated may ignite the fuel or acid vapors, possibly resulting in a fire or explosion.

NOTE: This procedure will bypass the starter solenoid and supply current from the battery directly to the starter through its power input cable.

If the starter does not turn, check for the following:

- Starter power cable/connections
- Starter.

If the starter rotated, carry out a *STARTER SOLENOID QUICK TEST* in this subsection.

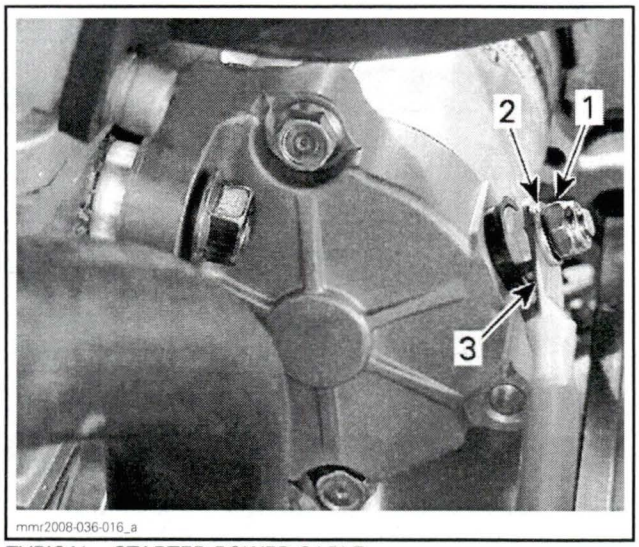
Starter Removal

1. Refer to *BODY* subsection and remove:
   - Hood
   - LH lower side panel.
2. Disconnect BLACK (-) cable from battery.
3. Disconnect RED (+) cable from battery.

⚠ WARNING

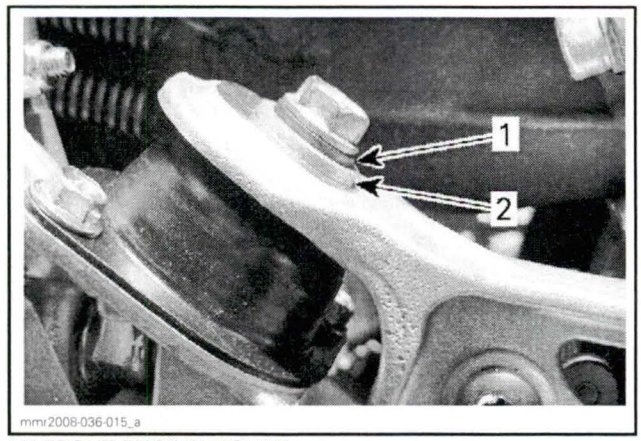
Always disconnect BLACK (-) cable first and reconnect last.

4. Remove tool kit holder and drive belt guard.
5. Remove drive belt and drive pulley, refer to *ENGINE DRIVE SYSTEM* subsection.
6. Remove muffler and tuned pipe, refer to *EXHAUST SYSTEM* subsection.
7. Disconnect RED power cable from starter.



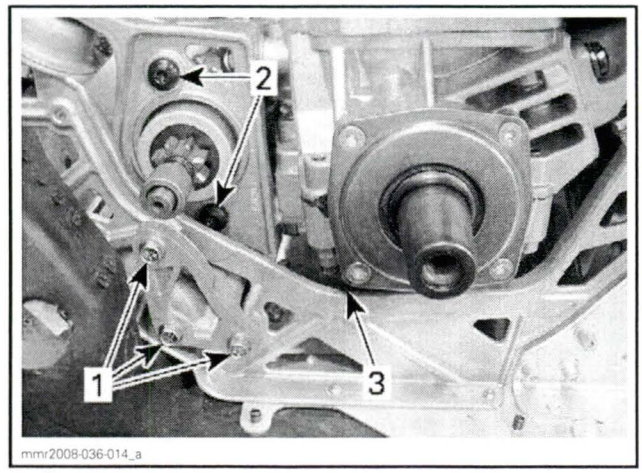
TYPICAL - STARTER POWER CABLE
1. *Elastic nut*
2. *Washer*
3. *Power cable*

8. Remove the LH front and rear engine mounting hex screws (PTO side). Discard the screws.



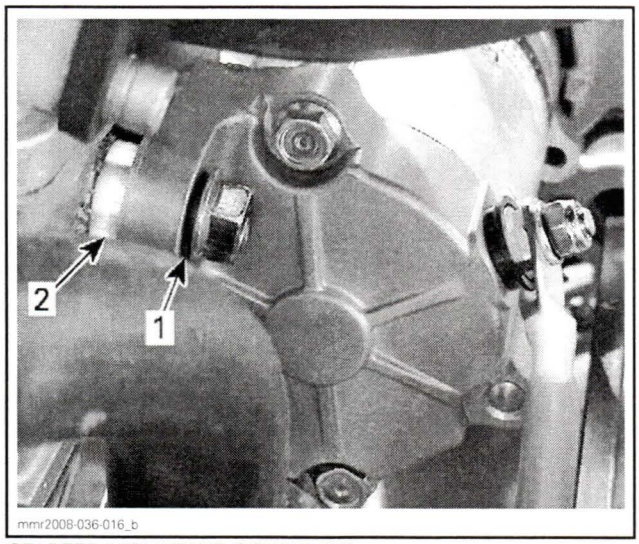
LH FRONT ENGINE MOUNT
1. *Conical washer*
2. *Flat washer*

9. Remove and discard the three bolts retaining the engine torque stopper support.



1. *Screws, torque stopper support*
2. *Starter screws*
3. *Pry bar position*

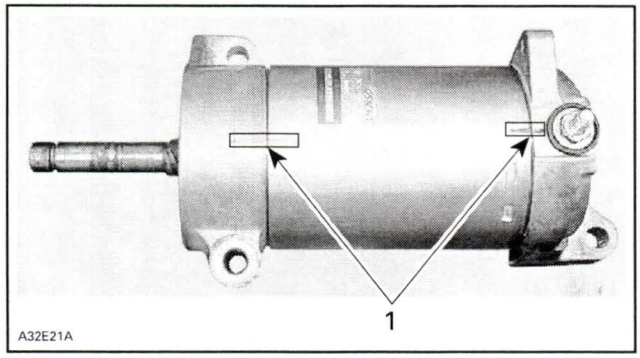
10. Insert a pry bar over the LH frame member and gently raise the engine just enough to access the lower mounting torx screw on the starter.
11. Remove and discard the lower mounting screw from the starter.
12. Remove pry bar.
13. Remove and discard the upper mounting torx screw from the starter.
14. Remove and discard the RH starter mounting screw from the front of the engine.



STARTER MOUNTING SCREW, RH
1. *Washer under screw head*
2. *Washer spacer between starter and engine*

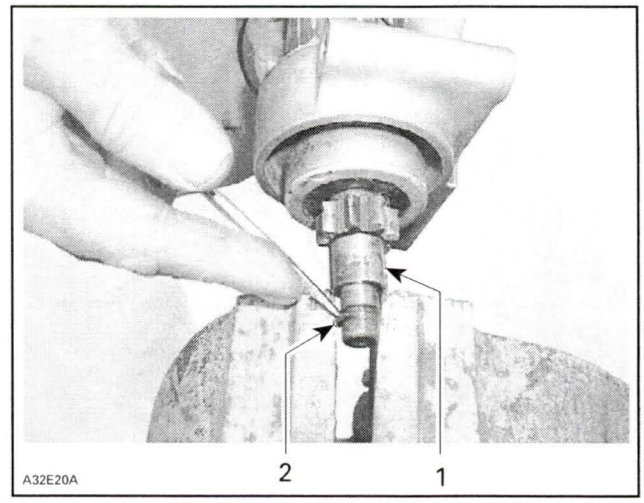
Starter Disassembly

1. Before disassembling, trace index marks on the starter housing and covers for parts alignment at reassembly.



TYPICAL
1. *Alignment index marks for reassembly*

2. Remove starter through bolts.
3. Separate end cap from starter housing.
4. Withdraw armature from starter housing.
5. If necessary, remove brush holder from end cap.
6. Check for radial play between the armature shaft and end cap bearing. Replace starter if radial play is detected.
7. If parts are in good condition, coat them with XPS SYNTHETIC GREASE (P/N 293 550 010) before reinstalling them.
8. Push back the collar near the starter gear/clutch assembly using a screwdriver.
9. Remove snap ring, collar, and spring.



1. *Collar*
2. *Snap ring*

10. Turn starter clutch clockwise to remove it from the armature assembly.
11. Pull yoke from armature.

Starter Cleaning

NOTICE **Yoke, drive unit (clutch assembly) and end cap must not be immersed in cleaning solvent.**

1. Clean brushes and holders with a clean cloth impregnated with solvent. Brushes must be dried thoroughly with a clean cloth.
2. Blow brush holders clean using compressed air.

⚠ WARNING

Always wear safety glasses when using compressed air.

3. Remove dirt, oil or grease from commutator using a clean cloth soaked in suitable solvent. Dry well using a clean and dry cloth.
4. Clean engine ring gear teeth and drive unit (clutch).

NOTE: Bushings or bearings must not be cleaned with grease dissolving agents.

5. Immerse all metal components in cleaning solution. Dry using a clean and dry cloth.

Starter Inspection

Brush Holder

1. Check the brush holder for insulation using growler test probes.

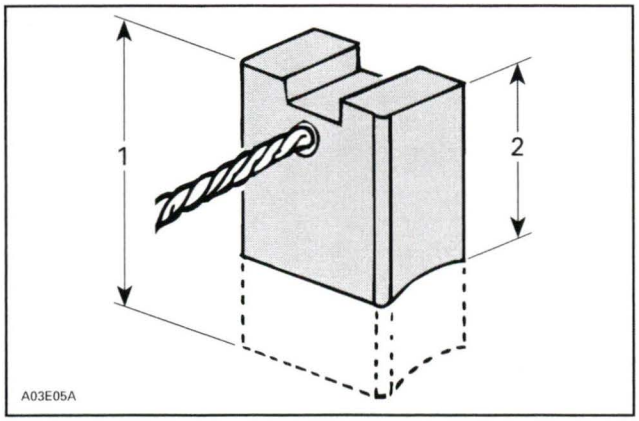
2. Place one test probe on the insulated brush holder and the other test probe on the brush holder plate.

If the growler lamp turns on, the brush holder has to be repaired or replaced.

Brush Length

Measure brush length as illustrated. If less than the specified value, replace them.

MODEL	LENGTH	
	NEW	WEAR LIMIT
All	10 mm (.4 in)	6 mm (.24 in)

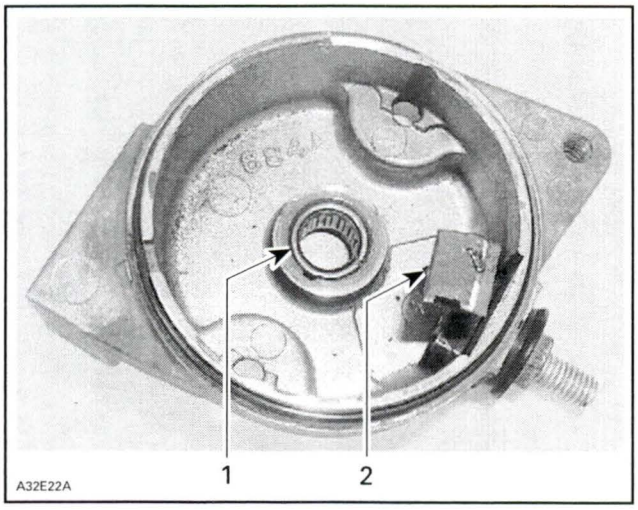


TYPICAL
1. New
2. Wear limit

End Cap

Check the mica insulation of the positive brush.

Check the roller bearing (or bushing) condition. Replace, if necessary.



1. Roller bearing
2. Positive brush

Overrunning Clutch

The pinion of the overrunning clutch should turn smoothly in a clockwise direction, and should not slip in a counterclockwise direction. If defective, replace clutch assembly.

Check the pinion teeth for wear and damage. If defective, replace.

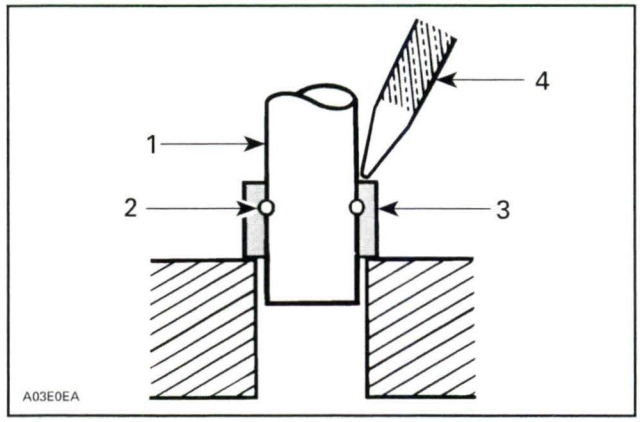
Starter Assembly

Reverse the order of disassembly to reassemble starter. However, pay attention to the following operations.

Prior to assembling, coat sliding surfaces on armature shaft splines, overrunning clutch and bushing with XPS SYNTHETIC GREASE (P/N 293 550 010).

After placing collar on armature shaft, install a new snap ring on the armature shaft and ensure that it is properly secured.

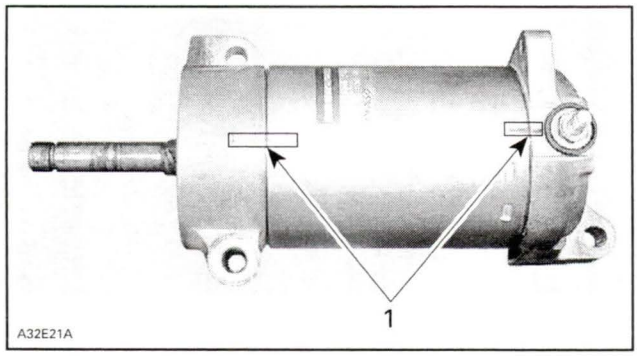
Slide collar over snap ring and secure in place by punching it at two or three places.



1. Armature shaft
2. Snap ring
3. Collar
4. Punch

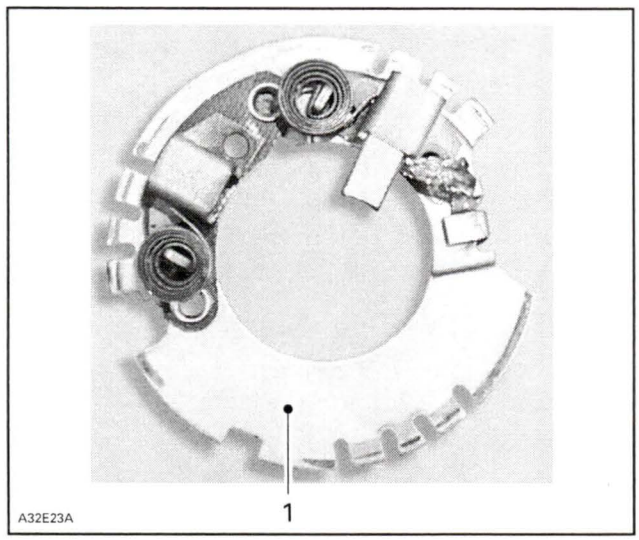
Starter Housing, Yoke and End Cap

1. Align previously traced index marks on housing, yoke and end cap.



TYPICAL
1. Aligned index marks

2. Open brushes and slide over commutator.
3. Align end cap locating notch with yoke locating protrusion and properly sit brush holder into cap.



1. Brush holder

NOTE: To ease end cap installation, retain brush holder with a small screwdriver while installing armature assembly.

NOTICE **Place two end caps on a flat surface before tightening the through bolts. Ensure end cap fits perfectly on yoke.**

4. Torque starter through bolts as per exploded view.

Starter Installation

Install removed parts in the reverse order of removal, however, pay attention to the following.

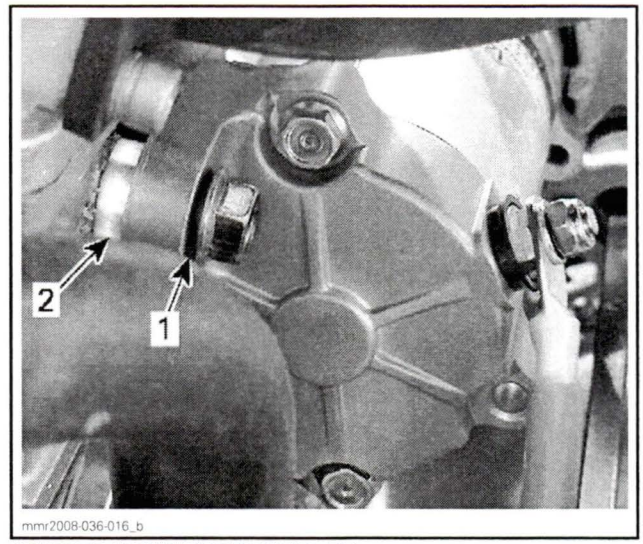
Ensure starter and engine mating surfaces are free of grime. Serious trouble may arise if starter is not properly aligned.

Replace all scotch grip screws.

For ease of installation, install the three new starter mounting screws loosely before torquing.

Install the washer and spacer as shown.

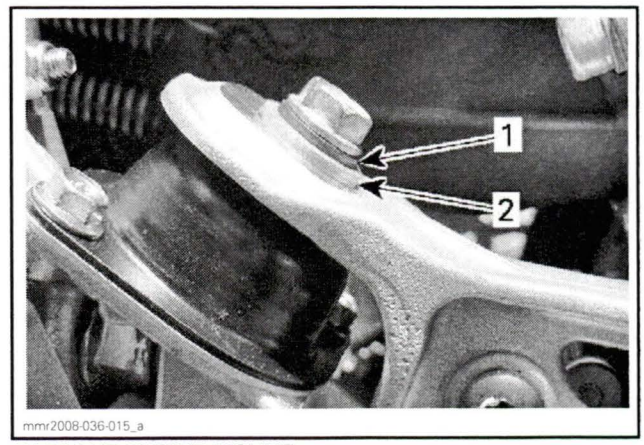
NOTICE **Be sure to install the washer and spacer as shown when installing the mounting screw on the RH side of the starter.**



STARTER MOUNTING SCREW, RH
1. Washer under screw head
2. Washer spacer between starter and engine

Torque the two starter mounting Torx screws first, then the hex screw to 28 N•m (21 lbf•ft).

Install the torque stopper support and two new engine mounting bolts, refer to *ENGINE REMOVAL AND INSTALLATION* subsection. Install washers under front mount bolt head as shown.



LH FRONT ENGINE MOUNT
1. Conical washer
2. Flat washer

Connect the RED wire to the large terminal on the starter.

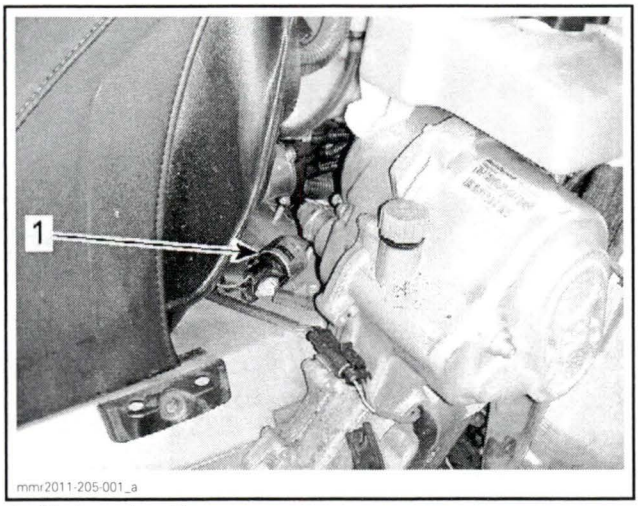
Install the drive belt, refer to *DRIVE SYSTEM AND BRAKE* subsection.

Install the muffler and tune pipe, refer to *EXHAUST SYSTEM* subsection.

Reconnect the positive (+) RED battery cable, then the negative (-) BLACK cable.

STARTER SOLENOID

The starter solenoid is located on RH side of vehicle, between gearbox and fuel tank.



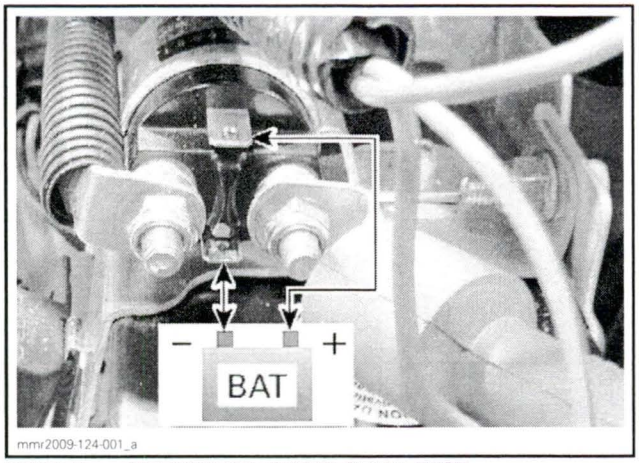
1. Starter solenoid

NOTE: In the following tests, a typical view is used.

Solenoid Quick Test

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

1. Test battery voltage, it should be approximately 12.8 Vdc and above for a fully charged battery.
2. Disconnect both small connectors from the solenoid coil.
3. Install a jumper wire (with insulated clips) between the positive solenoid terminal and the positive battery terminal.
4. Install a jumper wire on the negative solenoid terminal and momentarily touch the other end to battery ground.



TYPICAL — STARTER SOLENOID QUICK TEST

NOTICE **The two small solenoid coil terminals are close to each other. When installing the two jumper wires, ensure the ends of the jumper wires are insulated and cannot come into contact with each other or a short circuit will occur.**

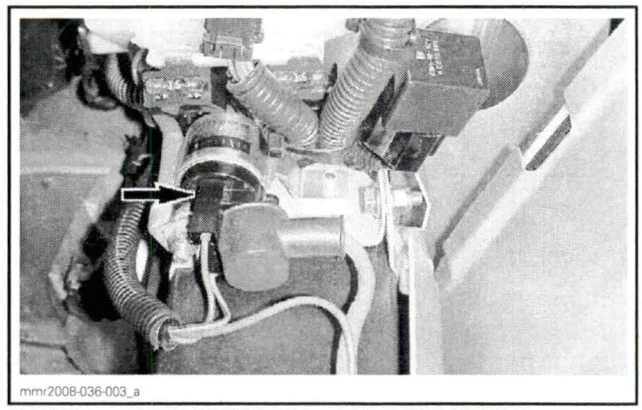
If the starter engages, refer to *INPUT VOLTAGE TEST (STARTER SOLENOID).*

If the starter did not engage, refer to *STARTER SOLENOID STATIC TEST,* or try a known good solenoid.

Input Voltage Test (Starter Solenoid)

1. Ensure both small connectors are properly connected to the starter solenoid.
2. Set engine stop switch to RUN.
3. Press and hold the START/RER button as you back-probe the solenoid coil 12 Vdc input connector.

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



TYPICAL — BACK-PROBE COIL 12 VDC INPUT WIRE

4. Measure the solenoid input voltage as per following table.

MODEL	PROBE		VOLTAGE
600 HO E-TEC	GREEN/RED	Battery ground	Battery voltage
	ORANGE/BLACK		

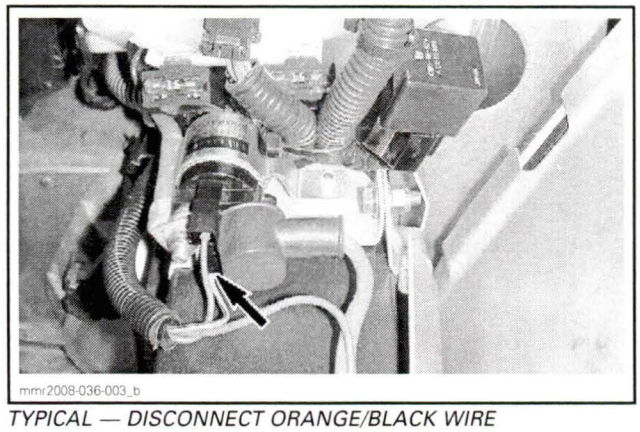
If voltage is **not** as specified, test for solenoid power wire continuity.

NOTE: If battery voltage is read on the GREEN/RED wire but is not read on the ORANGE/BLACK, the solenoid coil is open. Replace the starter solenoid.

If the input voltage to the solenoid control winding is as specified, refer to *SOLENOID GROUND SIGNAL TEST*.

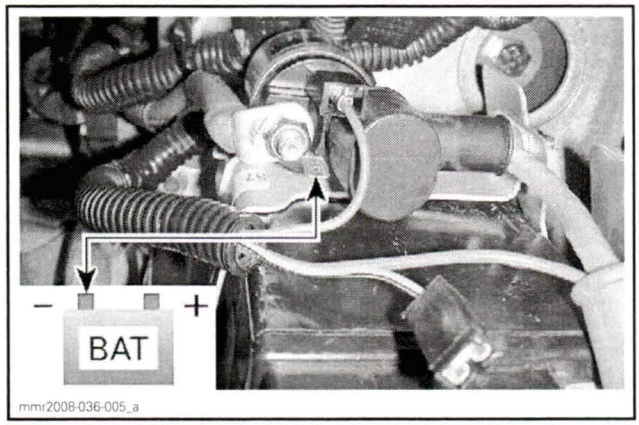
Solenoid Ground Signal Test

1. Disconnect the small ORANGE/BLACK wire from the solenoid negative terminal (ground signal).



TYPICAL — DISCONNECT ORANGE/BLACK WIRE

2. Connect a jumper wire between solenoid negative terminal and battery ground.



TYPICAL — JUMPER NEGATIVE TO SOLENOID TERMINAL

3. Press START/RER button.

If solenoid does not function and starter solenoid input voltage test was good, carry out the following:

- *SOLENOID STATIC TEST*
- *SOLENOID DYNAMIC TEST.*

If solenoid functions normally, ECM may not be providing a ground signal, or the ground signal wire from ECM to starter solenoid may be open circuit.

Carry out the following:

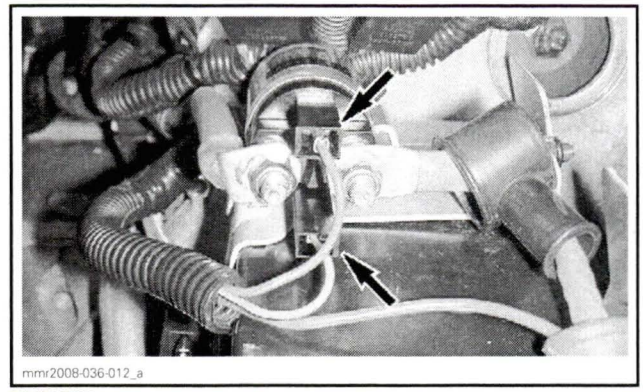
- *SOLENOID WIRING CONTINUITY TEST*
- *VEHICLE HARNESS CONTINUITY.*

Repair or replace wiring/connectors.

NOTE: If ground signal wire tested good, and all other previous test were good, try a **NEW** ECM.

Solenoid Static Test

1. Disconnect the small terminals from the starter solenoid.

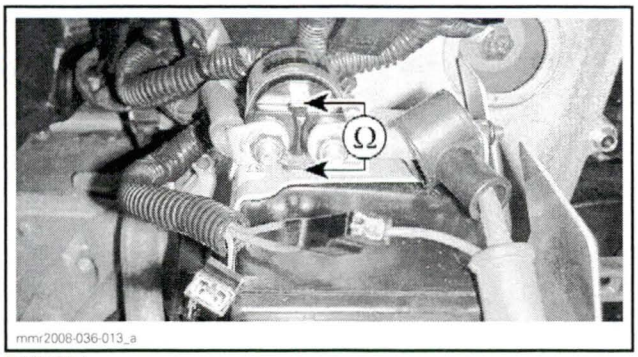


TYPICAL

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

2. Test coil winding resistance as follows.

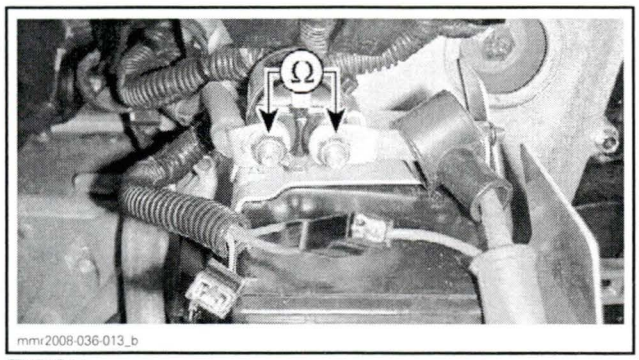
SOLENOID CONNECTOR		MEASUREMENT
TERMINAL		RESISTANCE @ 20°C (68°F)
A	B	Approximately 7.5 Ω



TYPICAL

3. Disconnect battery ground cable.
4. Check for a stuck solenoid plunger by measuring the resistance through the solenoid main contacts as follows.

SOLENOID CONNECTOR		MEASUREMENT
Battery post	Starter post	Open circuit



TYPICAL

If a reading other than an open circuit is measured, replace solenoid.

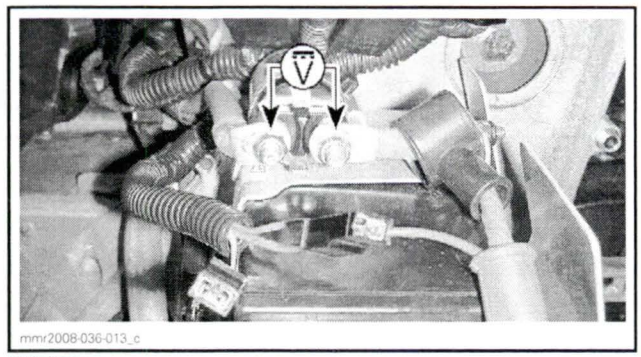
Solenoid Dynamic Test

1. Reconnect battery ground cable and solenoid connectors.
2. Disconnect the ignition coil(s) primary winding connector(s) to prevent engine from starting.

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

3. Press START/RER button and hold. While engine is cranking, measure the voltage drop across the solenoid main contacts as follows.

SOLENOID CONNECTOR		VOLTAGE
Post coming from battery	Post going to starter	0.2 Vdc max.



TYPICAL

4. Reconnect ignition coil connector(s).

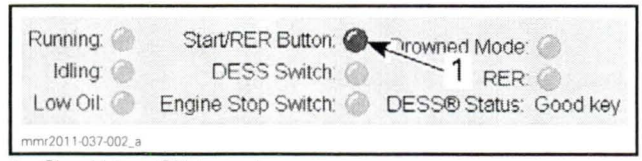
If voltage is out of specification, replace solenoid.

If solenoid tests good, refer to *ELECTRIC STARTER*.

START/RER SWITCH

START/RER Switch Test Using B.U.D.S.

1. Connect the vehicle to the applicable B.U.D.S. software available from BOSSWeb. Refer to *COMMUNICATION TOOLS/B.U.D.S. SOFTWARE* for proper connection instructions.
2. In B.U.D.S., select the **Read Data** button.
3. Select the **Monitoring** tab.
4. At the bottom LH corner of the **Monitoring** page, select the **ECM** tab.
5. Set engine stop switch to RUN and install D.E.S.S. cap on engine cut-off switch.
6. Press the **START/RER Button** and look for the **START/RER Button** LED in the bottom field. It should come ON (turn GREEN).



1. Should turn ON (green)

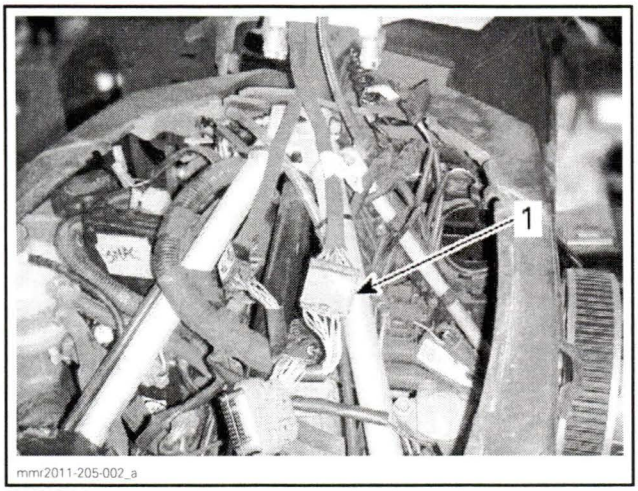
If the **START/RER Button** LED comes on in B.U.D.S., the starting system is functional on the input side (START/RER button, ECM and circuit wiring to ECM). Test the output side of the starting system.

If the LED does not come on, refer to *START/RER SWITCH INPUT VOLTAGE TEST*.

START/RER Switch Input Voltage Test

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

1. Measure voltage at battery terminals. It should be approximately 12.8 Vdc for a fully charged battery.
2. Remove but do not disconnect multifunction gauge.
3. Disconnect the main steering connector (HG).



TYPICAL
1. HG connector

4. Measure START/RER switch input voltage at the HG connector (vehicle harness side) as per following table.

START/RER SWITCH INPUT VOLTAGE TEST		
PROBE		VOLTAGE
GRAY/RED	Battery ground	Battery voltage

If battery voltage is measured, refer to *CONTINUITY TEST START/RER SWITCH.*

If battery voltage is not measured, test the following in the recommended order:
- 30 A battery charging fuse (F1)
- 5 A START/RER fuse (F2)
- START/RER Switch Power Circuit Continuity.

START/RER Switch Continuity Test

1. Set multimeter to Ω selection.
2. Measure start switch continuity as per following table.

CONTINUITY TEST START/RER SWITCH (SB CONNECTOR)			
SWITCH POSITION	3-PIN (SB) CONNECTOR		RESISTANCE
Released	BEIGE	BLACK	Continuity (close to 0 Ω)
	BEIGE	RED	High value or infinite (OL)
Pressed and held	BEIGE	BLACK	High value or infinite (OL)
	BEIGE	RED	Continuity (close to 0 Ω)

If continuity test failed, replace START/RER switch.

If continuity test of steering harness was good, test vehicle harness continuity.

STARTING SYSTEM (600 ACE)

SERVICE TOOLS

Description	Part Number	Page
ECM ADAPTER TOOL	529 036 166	661, 663
FLUKE 115 MULTIMETER	529 035 868	660–663

SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
FLUKE RIGID BACK PROBES	TP88	660–661, 663

GENERAL

BASIC STARTING SYSTEM OPERATION

When the START/RER button is pressed, a 12 Vdc signal is sent to the ECM, which completes the starter solenoid circuit by providing a ground. The battery then supplies current to the starter through the starter solenoid to crank the engine.

Conditions for Engine Cranking

- Emergency engine stop switch to RUN
- Tether cord cap installed
- Pressing START/RER button.

TROUBLESHOOTING

DIAGNOSTIC TIPS

Check for fault codes using B.U.D.S. software as a first troubleshooting step. Refer to *DIAGNOSTIC AND FAULT CODES*.

NOTE: Some tests require fuse removal which may lead to a fault code occurrence. Clear fault codes ias needed.

Starter Does Not Turn

1. Check battery charging fuse (main).
2. Check starter relay/fuel pump fuse.
3. Ensure the terminals are properly secured to the battery posts.

Carry out the following procedure to check if engine can be rotated.

1. Set emergency engine stop switch to STOP.
2. Make sure tether cord is **not installed**.
3. Manually rotate the engine using the drive pulley.

⚠ WARNING

When manually rotating engine, the emergency engine stop switch MUST BE set to STOP and tether cord cap MUST NOT be installed or severe injury may occur.

If the engine can be rotated, test starting system as per *STARTING SYSTEM TESTING SEQUENCE*.

If the engine cannot be rotated, check engine.

Starter Turns Slowly

Check the following:

- Condition of battery and connections. Refer to *CHARGING SYSTEM* subsection.
- Starter operation. Refer to *MAGNETO AND STARTER* subsection.
- Starter solenoid contacts. Refer to *SOLENOID VOLTAGE DROP TEST* in this subsection.

STARTING SYSTEM TESTING SEQUENCE

Test starting system in the following order:

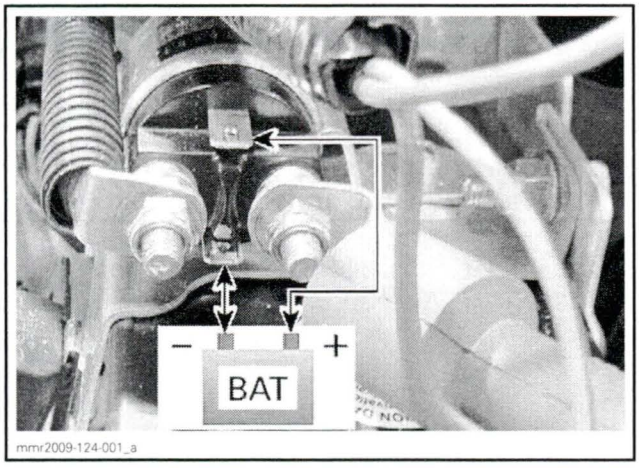
- Fuse F2 and F3 (in fuse box).
- Battery charging fuse (F1, in fuse box). A blown main fuse cuts the current flow to the entire electrical system.
- Condition of battery and connections, refer to *CHARGING SYSTEM* subsection.
- Starter. Refer to *MAGNETO AND STARTER* subsection.
- Starter solenoid. Refer to *SOLENOID QUICK TEST* in this subsection.
- Ignition/start switch. Refer to *START/RER SWITCH TEST USING B.U.D.S.*

PROCEDURES

STARTER SOLENOID

Solenoid Quick Test

1. Remove tether cord cap from engine cut-off switch.
2. Disconnect both small connectors from the starter solenoid.
3. Install a jumper wire (with insulated clips) between the positive solenoid terminal and the positive battery terminal.
4. Install a jumper wire on the battery negative terminal and momentarily touch the negative solenoid terminal.



NOTICE **The two small solenoid coil terminals are close to each other. When installing the jumper wires, ensure the ends of the jumper wires are insulated and cannot come into contact with each other or a short circuit will occur.**

If the starter engages, test solenoid input voltage. Refer to *INPUT VOLTAGE TEST (STARTER SOLENOID).*

If the starter does not engage, refer to *STARTER SOLENOID STATIC TESTS*, or try a known good solenoid.

Input Voltage Test (Starter Solenoid)

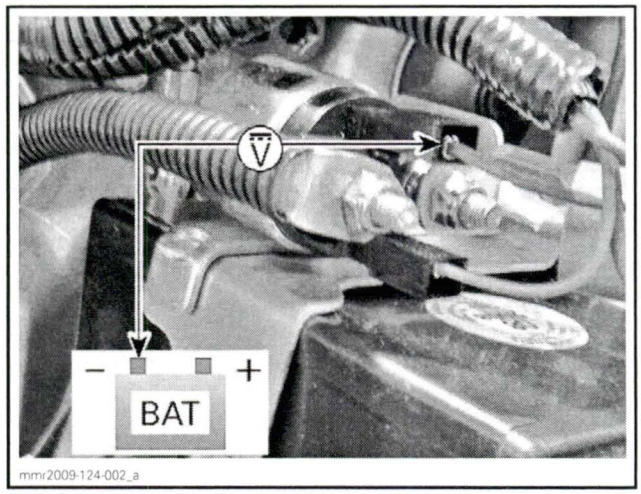
1. Install tether cord cap on engine cut-off switch.
2. Set emergency engine stop switch to RUN.

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

3. Quickly press on START/RER button to wake up the ECM.
4. Back probe the solenoid input terminal and measure voltage as per following table.

TEST PROBES		VOLTAGE
600 ACE: GREEN/BLUE wire	Battery ground	Battery voltage

NOTE: Test is valid only if the ECM is powered (gauge will turn on).



TYPICAL

If voltage is not as specified, repair open circuit.

If the solenoid input voltage is as specified, refer to *SOLENOID GROUND SIGNAL TEST.*

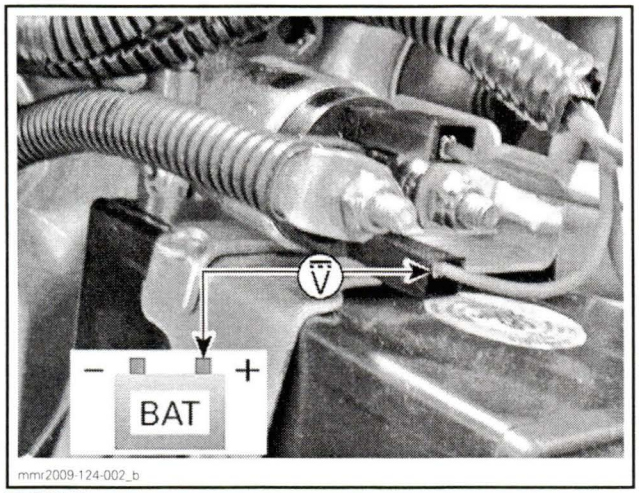
Solenoid Ground Signal Test (Starter Solenoid)

1. Carry out steps 1 to 4 of *INPUT VOLTAGE TEST (STARTER SOLENOID).*

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

2. Back probe solenoid negative terminal (ORANGE/BLACK wire) and measure voltage as per following table.

TEST PROBES		VOLTAGE
OR/BK	Battery positive terminal	Battery voltage



TYPICAL

If voltage is not as specified, carry out *GROUND WIRE CONTINUITY TEST*.

If voltage is as specified, carry out *START/RER SWITCH TESTS*.

Ground Wire Continuity Test (Starter Solenoid)

1. Disconnect battery negative terminal.
2. Disconnect ECM connector B, refer to *ELECTRONIC FUEL INJECTION* subsection.
3. Install ECM connector on the ECM adapter tool.

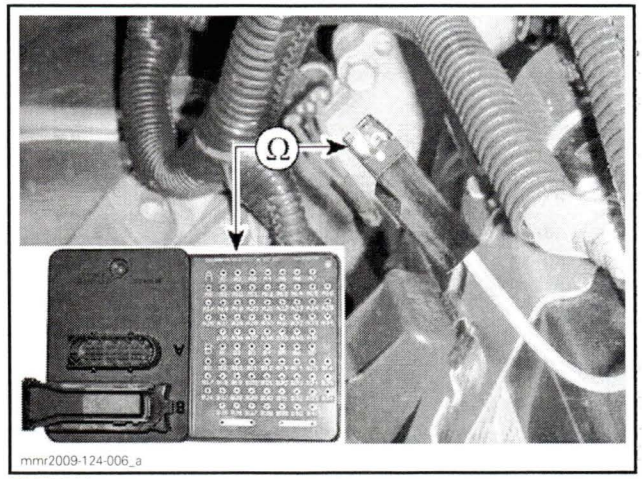
MODEL	TOOL	TOOL VIEW
600 ACE	ECM ADAPTER TOOL (P/N 529 036 166)	

4. Disconnect ground signal wire (ORANGE/BLACK) from starter solenoid.

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

5. Measure wire continuity as follows:

600 ACE MODELS		
TEST PROBES		RESISTANCE
Ground wire (OR/BK)	ECM connector B pin 4L	Close to 0 Ω



TYPICAL

If resistance is not as specified, repair open circuit

If resistance is as specified, test ECM grounds, refer to *ECM* in *ELECTRONIC FUEL INJECTION* subsection. If ECM grounds are good, try a new ECM.

Solenoid Static Tests

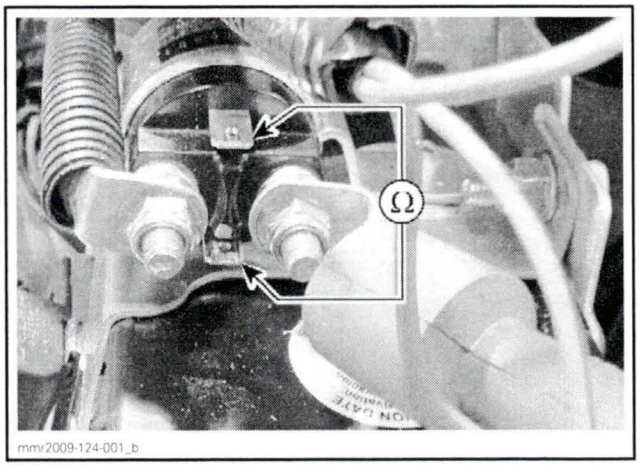
Solenoid Winding Resistance Verification

1. Disconnect the small terminals from the starter solenoid.

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

2. Test coil winding resistance as follows.

TEST PROBES		MEASUREMENT
SOLENOID COIL TERMINALS		RESISTANCE @ 20°C (68°F)
A	B	Approximately 7.5 Ω



mmr2009-124-001_b
TYPICAL

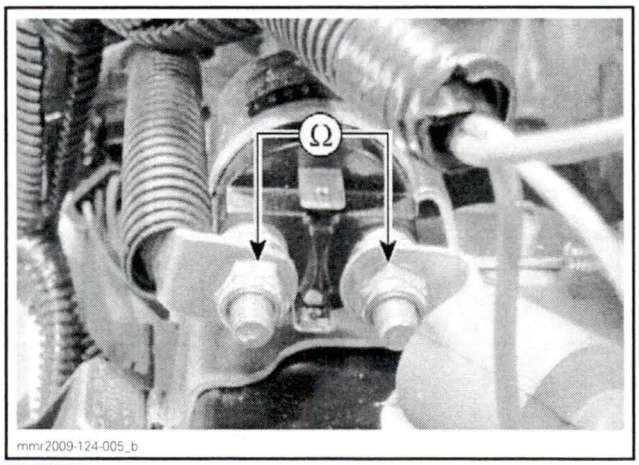
If resistance is not as specified, replace solenoid.

If resistance is as specified, carry out the *SOLENOID PLUNGER VERIFICATION.*

Solenoid Plunger Verification

1. Disconnect battery ground cable.
2. Check for a stuck solenoid plunger by measuring the resistance through the solenoid main contacts as follows.

SOLENOID CONNECTOR		MEASUREMENT
Battery post	Starter post	Open circuit



mmr2009-124-005_b
TYPICAL

If a reading other than an open circuit is measured, replace solenoid.

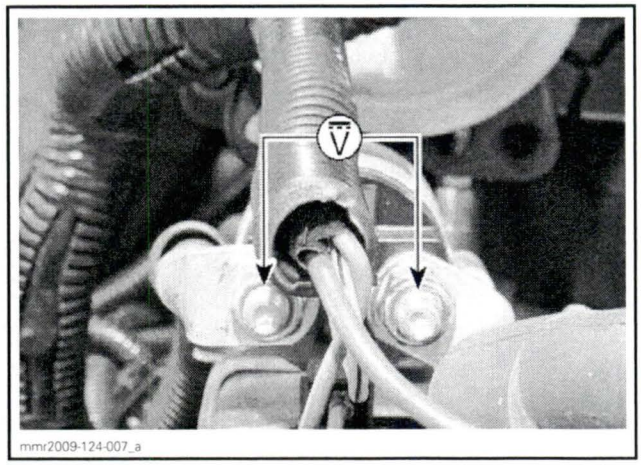
If an open circuit is measured, carry out the *SOLENOID VOLTAGE DROP TEST.*

Solenoid Voltage Drop Test

1. Fully squeeze and hold throttle lever (to enter engine drown mode) to prevent engine from starting.
2. Press START/RER button and hold. While engine is cranking, measure the voltage drop across the solenoid main contacts as follows.

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

SOLENOID CONNECTOR		VOLTAGE
Post coming from battery	Post going to starter	0.2 Vdc max.



mmr2009-124-007_a
TYPICAL

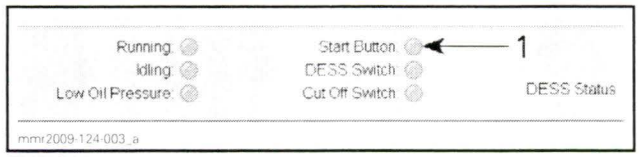
If voltage is out of specification, replace solenoid.

If solenoid tests good, test START/RER switch. Refer to *START/RER SWITCH.*

START/RER SWITCH

START/RER Switch Test Using B.U.D.S.

1. Connect vehicle to applicable B.U.D.S. version available from BOSSWeb. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. In B.U.D.S., select:
   - **Read Data** button
   - **Monitoring** page tab
   - **ECM** page.
3. Set emergency engine stop switch to RUN.
4. Install tether cord cap on engine cut-off switch.
5. As you press the START/RER button, look for the **START Button** LED in the bottom section. It should come ON (turn GREEN).



TYPICAL
1. Should turn ON (GREEN)

If the **START Button** LED turns green, the ECM receives the START/RER signal. This confirms that:

- The voltage input reaches the START/RER switch.
- The START switch is good.
- The signal wiring is good.

Therefore, the tests are completed.

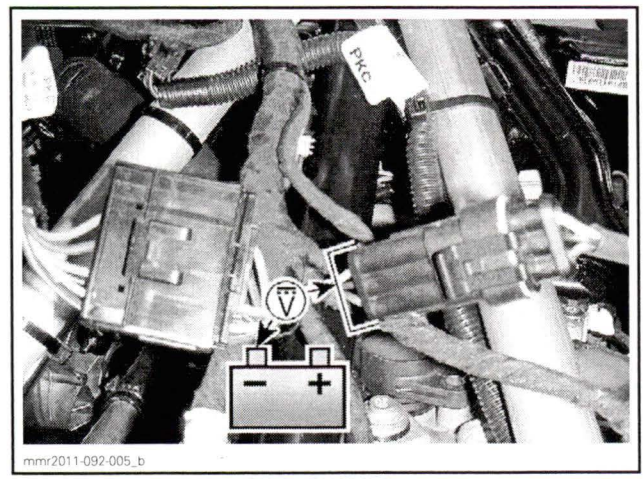
If the START/RER LED does **not** turn green refer to *START/RER INPUT VOLTAGE TEST.*

START/RER Switch Input Voltage Test

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

Back probe switch input wire as per following table.

INPUT VOLTAGE (SWITCH CONNECTOR)		
TEST PROBES		VOLTAGE
RD/BN	Battery ground	Battery voltage



TYPICAL — 600 ACE MODEL SHOWN

If voltage is as specified, refer to *START/RER SWITCH OUTPUT TEST.*

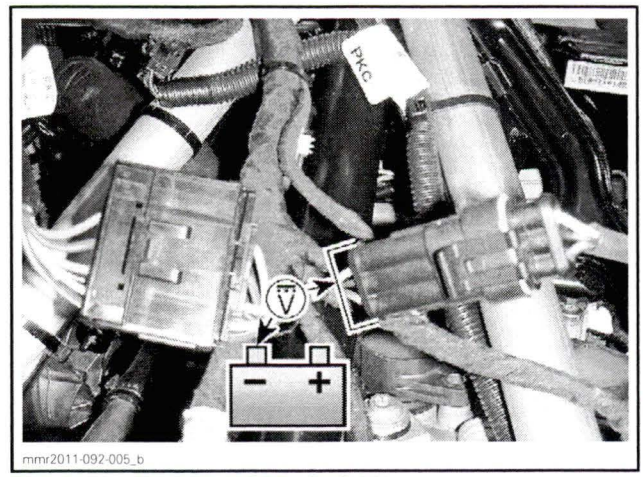
If voltage is not as specified, repair open circuit.

START/RER Switch Output Voltage Test

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

Press and hold START/RER button while back probing switch output (signal) wire as per following table.

SWITCH OUTPUT VOLTAGE (SWITCH CONNECTOR)		
TEST PROBES		VOLTAGE
LIGHT BROWN	Battery ground	Battery voltage



TYPICAL — 600 ACE MODEL SHOWN

If voltage is as specified, refer to *START/RER SIGNAL WIRE CONTINUITY TEST.*

If voltage is not as specified, replace switch.

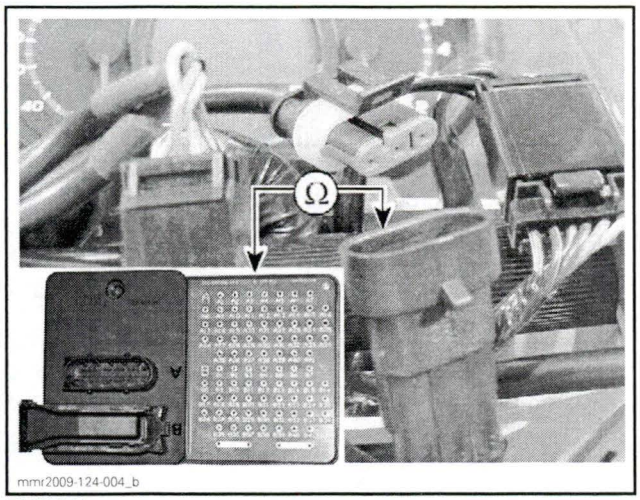
START/RER Signal Wire Continuity Test

1. Disconnect battery negative terminal.
2. Disconnect ECM connector B, refer to *ELECTRONIC FUEL INJECTION* subsection.
3. Install connector on the ECM adapter tool.

MODEL	TOOL	TOOL VIEW
600 ACE	ECM ADAPTER TOOL (P/N 529 036 166)	

4. Disconnect switch connector.
5. Measure resistance as per following table.

600 ACE MODELS		
TEST PROBES		RESISTANCE
Switch connector, LIGHT BROWN wire	ECM connector B pin 1D	Close to 0 Ω



TYPICAL —

If resistance is as specified and switch input and output are good, carry out the *START/RER SWITCH GROUND TEST.*

If resistance is not as specified, repair open circuit.

START/RER Switch Ground Test

1. Set multimeter to Vdc.
2. Disconnect switch connector.
3. Measure voltage as per following table.

TEST PROBES		VOLTAGE
Switch connector, BK wire	Battery positive terminal	Battery voltage

If voltage is not as specified, repair open circuit.

If voltage is as specified, test ECM grounds. Refer to *ECM* in *ELECTRONIC FUEL INJECTION* subsection. If ECM grounds are good, try a new ECM.

DIGITALLY ENCODED SECURITY SYSTEM (D.E.S.S.)

GENERAL

SYSTEM DESCRIPTION

The following components are specially designed for this system: ECM, D.E.S.S. key (inside tether cord cap) and engine cut-off switch.

This system allows the engine to reach pulley engagement speed only if a D.E.S.S. key is installed on engine cut-off switch and the key is recognized as valid by the ECM.

The D.E.S.S. key contains a magnet and a ROM chip.

- The magnet closes the reed switch inside the engine cut-off switch. It is the equivalent of a rotary mechanical ignition switch.
- The ROM chip owns a unique digital code. It is the equivalent of the tooth-pattern cut on a conventional ignition key.

The D.E.S.S. system is quite flexible. Up to 8 D.E.S.S. keys may be programmed in the memory of the ECM using the B.U.D.S. software. The keys can also be erased individually.

NOTE: If desired, a D.E.S.S. key can be used on another vehicle equipped with the D.E.S.S. It only needs to be programmed on that vehicle.

D.E.S.S. Beeper Codes

When a tether cord cap is installed on the engine cut-off switch and the ECM wakes up, it identifies the D.E.S.S. key. The D.E.S.S. signals will be issued according to the key recognition. See table.

D.E.S.S. SIGNAL		DESCRIPTION	COMMENT
BEEPER	DISPLAYED MESSAGE (1)		
2 shorts beeps	SKI-DOO	Welcome message, good key	– Working D.E.S.S. key – Vehicle can be driven – It allows engine to rev above 3000 RPM
2 short beeps repeating slowly	CHECK KEY	Unable to read key (bad connection)	– Make sure the tether cord cap contacts are free of dirt, snow or ice – Reinstall tether cap and restart engine – Vehicle can not be driven
Short beeps repeating rapidly	BAD KEY	Invalid key or key not programmed	– Use the proper key for this vehicle or have the key programmed – Vehicle can not be driven
(1) Only available on premium gauge			

PROCEDURES

D.E.S.S. KEY

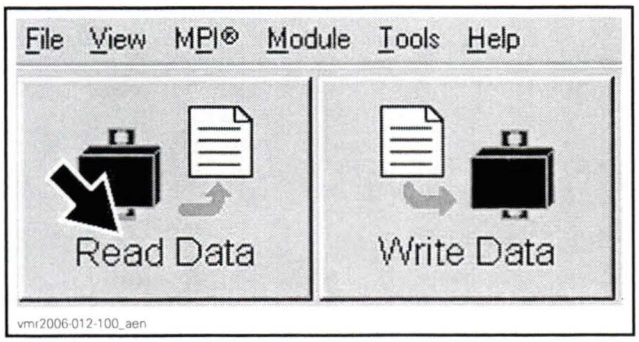
D.E.S.S. Key Programming

Use the latest applicable B.U.D.S. version available on BOSSWeb.

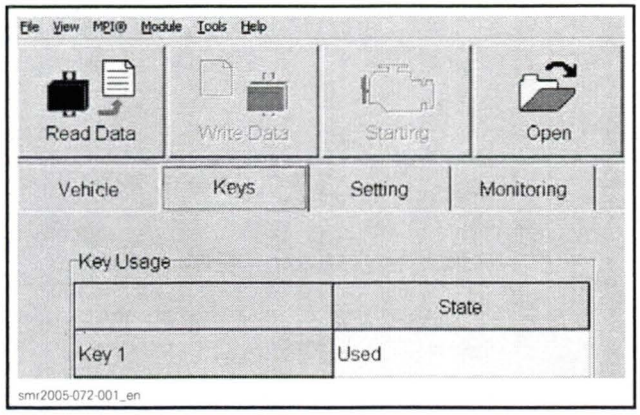
Carry out the proper connections to use B.U.D.S. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.

Start B.U.D.S. and logon.

Read the ECM by clicking the **Read Data** button.

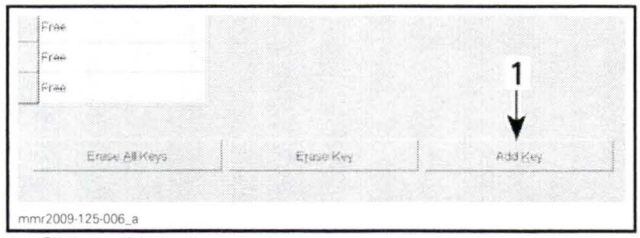


Click on **Keys** tab.



Adding a Key

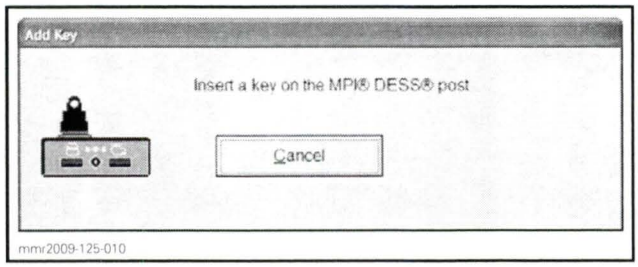
1. Install the **NEW** tether cord cap (D.E.S.S. key) (**to be programmed**) on engine cut-off switch.
2. Click on **Add Key** button at bottom of screen.



1. Click on this button

3. Strictly follow all instructions displayed by B.U.D.S. according to model.

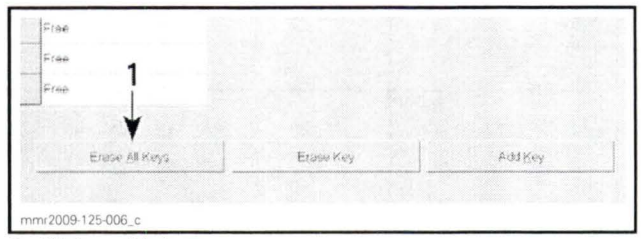
NOTE: If the following window pops up, rock the tether cord cap on the engine cut-off switch to make a good contact until window disappears.



4. A new window will confirm the new key has been saved in the PC computer.
5. When done, write the changes to the ECM. Refer to *WRITING CHANGES IN ECM* in this subsection.
6. To program any other key, restart the complete *ADDING A KEY* procedure from step 1.
7. Ensure the newly programmed key(s) work on the vehicle.

Erasing all Keys

1. Click on **Erase All Keys** button at bottom of screen.

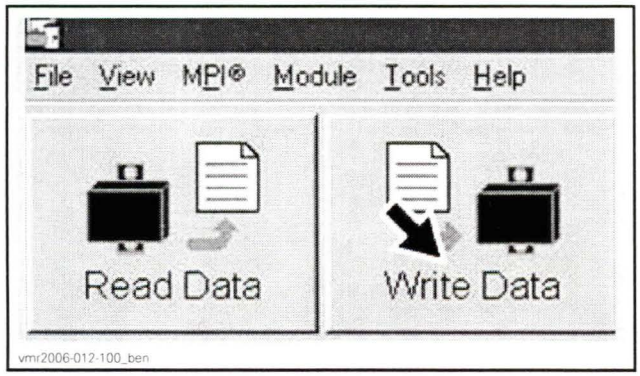


1. Click on this button

2. When done, program at least a new key in the ECM.
3. Write the changes to the ECM. Refer to *WRITING CHANGES IN ECM* in this subsection.
4. Ensure the erased keys do not work anymore on the vehicle (if possible) and ensure the newly added key(s) work.

Writing Changes in ECM

Save the changes in the ECM by clicking the **Write Data** button.



BEEPER

The beeper is integrated in the multifunction gauge and cannot be replaced alone.

If the beeper does not sound when starting engine, check the beeper operation. Refer to *LIGHTS, GAUGE AND ACCESSORIES.*

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LIGHTS, GAUGE AND ACCESSORIES

SERVICE TOOLS

Description	Part Number	Page
12 V BATTERY SUPPLY CABLE	529 035 997	670–671
FLUKE 115 MULTIMETER	529 035 868	674–675, 677, 679, 681, 684, 687–689, 693
T-HARNESS	529 035 869	670–672, 679

SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
FLUKE RIGID BACK PROBES	TP88	684
MULTILOCK - TERMINAL EXTRACTION TOOL	755430-2	690

SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 5900	293 800 066	686

GENERAL

NOTE: It is a good practice to check for fault codes using B.U.D.S. software as a first troubleshooting step. Refer to *DIAGNOSTIC AND FAULT CODES* subsection.

When troubleshooting, always refer to applicable *POWER DISTRIBUTION* subsection and wiring diagram for circuit details.

⚠ WARNING

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

550F Models

The battery provides power directly to the:
- Horn
- Power outlets.

The voltage regulator/rectifier provides power to the following thru a DC output:
- Gauge
- Beeper
- Lighting system
- Heated grips and thumb warmer.

600 HO E-TEC Models

All vehicle lights are powered from the primary 12 Vdc circuit. This circuit is powered from and controlled by the ECM when the engine reaches 800 RPM.

There are no relays or fuses outside the ECM to test or replace for the lights circuits. Refer to *CHARGING SYSTEM* for more information on testing the primary 12 Vdc circuits.

⚠ CAUTION The battery fuse (F1) should always be removed before carrying out any maintenance on the vehicle to prevent any unexpected electrical activation. Removal of this fuse isolates the battery from the vehicle electrical system, except for the starter relay input terminal.

NOTICE The 12 Vdc primary circuit is not to be used to power accessory loads. All accessories are to be powered from the secondary 12 Vdc circuit.

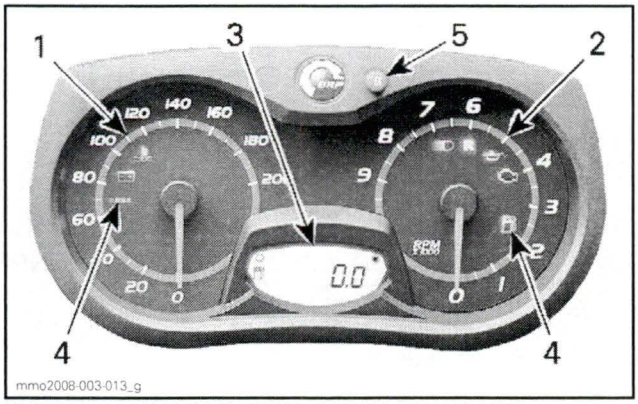
600 ACE Models

The ECM controls electrical power thru relays to the following:
- Gauge
- Beeper
- Lighting system
- Heated grips and thumb warmer.

SYSTEM DESCRIPTION (GAUGE)

An **analog/digital gauge (standard gauge)** is used to provide all indications in a single unit.

The gauge can be set to indicate in metric or imperial units.

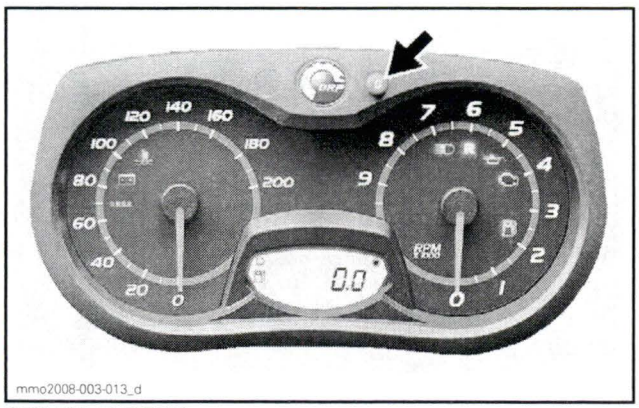


TYPICAL — ANALOG/DIGITAL GAUGE (STANDARD)
1. *Speedometer*
2. *Tachometer (RPM)*
3. *Gauge Digital Display*
4. *Gauge Pilot Lamps*
5. *Gauge SET "S" button (except 550F)*

Set Button Functions

NOTE: The 550F models do not have any gauge button.

The gauge is equipped with a SET button only.



SET "S" BUTTON

The button is used to toggle through the different functions and settings of the indicator.

TROUBLESHOOTING

GAUGE, LIGHTING, AND ACCESSORY SYSTEM TESTING (550F)

Troubleshooting Chart

SYMPTOM	CONDITION	SERVICE ACTION
No horn or accessory outlet power	Engine OFF	– Check charging fuse – Check battery – Check wiring and connectors – Check affected component.
	Engine running	– Check affected component – Check wiring and connectors to affected component.
No gauge, beeper, lighting, or heaters	Engine OFF	– Normal condition.
	Engine running	– Check affected component – Check wiring and connectors to affected component – Check voltage regulator/rectifier unit DC output, refer to *CHARGING SYSTEM* subsection.

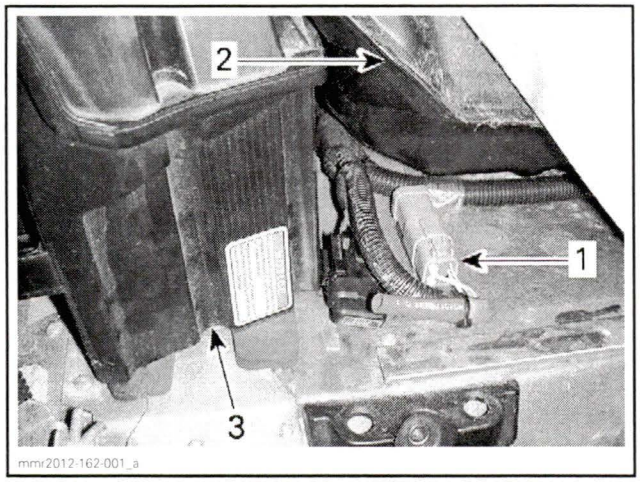
NOTE: Check voltage regulator FIRST if none of the components are functioning.

Gauge, Lighting and Heater Power Supply for Testing

The vehicle electrical system can be powered for testing without starting the engine.

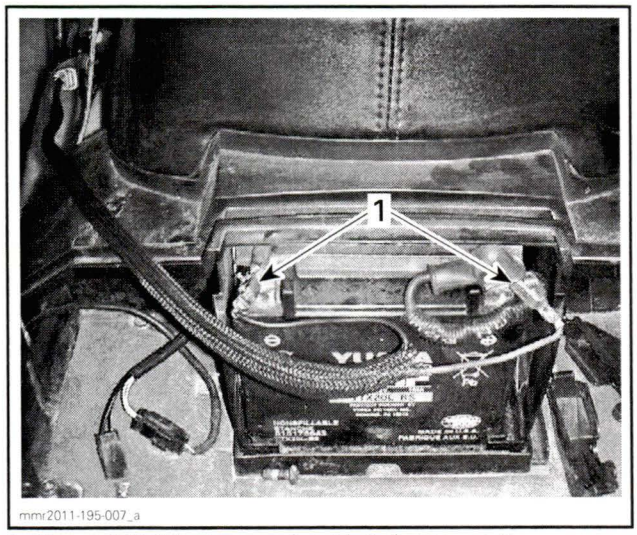
REQUIRED TOOLS	
T-HARNESS (P/N 529 035 869)	
12 V BATTERY SUPPLY CABLE (P/N 529 035 997)	

1. Remove the communication connector from the protective cap on the LH side of the vehicle.



TYPICAL - COMMUNICATION CONNECTOR LOCATION LH SIDE
1. *Communication connector (stowed)*
2. *LH front corner of fuel tank*
3. *Primary air intake silencer*

2. Connect the T-HARNESS (P/N 529 035 869) to the communication connector.
3. Connect the 12 V BATTERY SUPPLY CABLE (P/N 529 035 997) to the T-harness.
4. Connect the battery supply cable clamps to the vehicle battery.



1. *Connect 12 V battery supply cable to battery posts*

NOTICE Always use the proper supply harness and cables. Make sure to respect polarity when connecting cable clips to battery. Match RED cables together.

GAUGE, LIGHTING AND ACCESSORY SYSTEM TESTING (600 HO E-TEC)

Gauge, Lighting and Accessory Power Supply for Testing

To provide power to specific circuits for testing, refer to the following procedures.

How to Energize Gauge and Lighting System for Testing

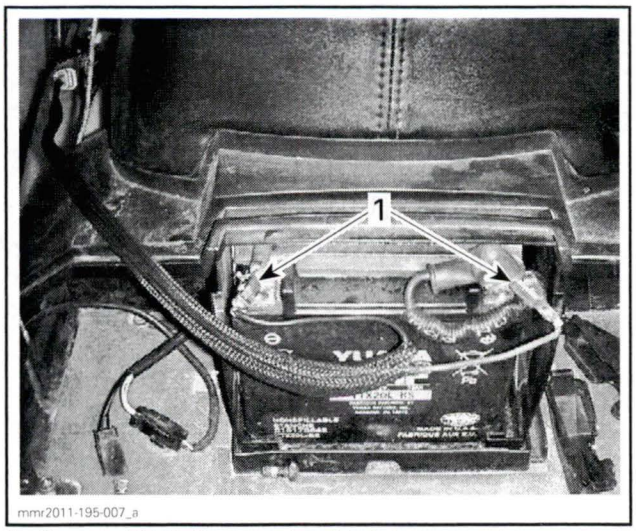
REQUIRED TOOLS	
T-HARNESS (P/N 529 035 869)	
12 V BATTERY SUPPLY CABLE (P/N 529 035 997)	

1. Connect the T-HARNESS (P/N 529 035 869) to the communication connector.



1. *Diagnostic connector*
2. *T-harness*

2. Connect the 12 V BATTERY SUPPLY CABLE (P/N 529 035 997) to the T-harness.
3. Connect the battery supply cable clamps to the vehicle battery.



1. Connect 12 V battery supply cable to battery posts

NOTICE Always use the proper supply harness and cables. Make sure to respect polarity when connecting cable clips to battery. Match RED cables together.

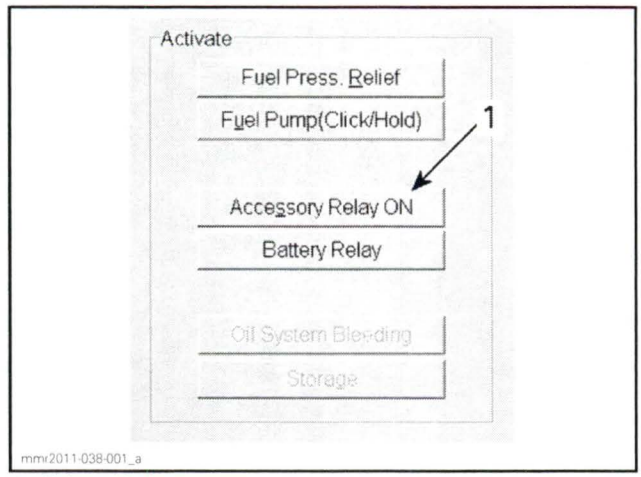
How to Energize Heaters for Testing

Start engine and accelerate it slightly above 2000 RPM for at least 2 seconds.

⚠ CAUTION Do not accelerate engine to drive pulley engagement speed. If engine is to be accelerated above drive pulley engagement speed, lift and safely support rear of vehicle so the track cannot make contact with the ground. Do not allow anyone to stand behind track while it is rotating.

How to Energize Accessory Accessory Power Outlets for Testing

1. Connect vehicle to latest applicable B.U.D.S. version using the MPI-2 interface. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. In B.U.D.S., select the following:
   - **Read Data** button
   - **Activation** page tab
   - **Cluster** page tab.
3. In the Activate field, select the **Accessory Relay** button.



1. Select this button

NOTE: The accessory relay is internal to the ECM.

GAUGE, LIGHTING AND ACCESSORY SYSTEM TESTING (600 ACE)

Gauge, Lighting and Accessory Troubleshooting

For instructions on how to energize the applicable relay, refer to *GAUGE, LIGHTING AND ACCESSORY POWER SUPPLY FOR TESTING* in this subsection.

SYSTEM TO TEST	CONDITIONS REQUIRED
– Gauge	– Energize R1 (RUN relay)
– Tail light and brake light – Headlights – Rear power outlet – Heaters	– Energize R2 (LOAD relay)
– Front power outlet – Heaters	– Energize R3 (LOAD relay)

Gauge, Lighting and Accessory Power Supply for Testing

The power distribution relays can all be activated by starting the engine, or can be activated without starting engine using the following procedures.

How to Energize R1 for Testing

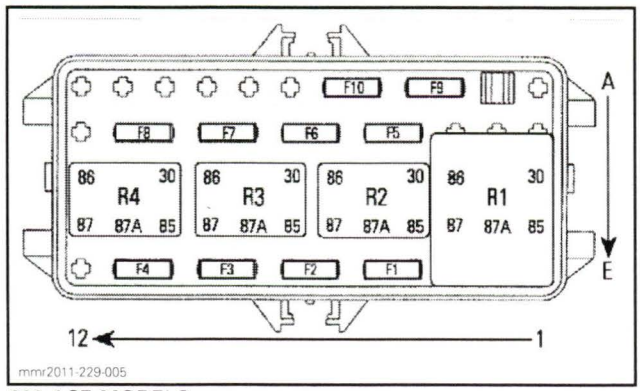
To energize relay 1 (R1) for testing, install the T-HARNESS (P/N 529 035 869) on the diagnostic connector. Refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection for proper connection.

Briefly press the Start button to wake up the ECM.

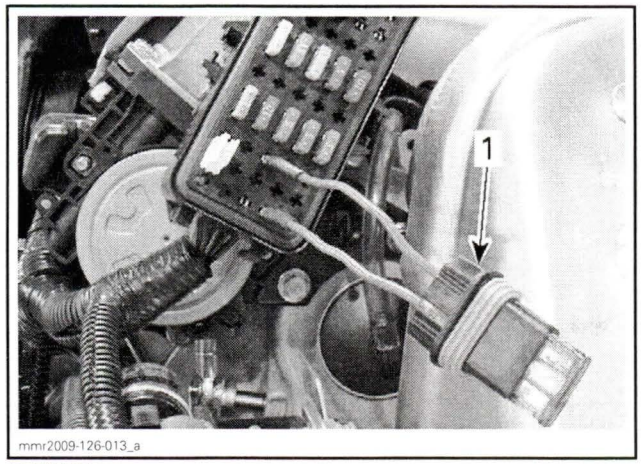
How to Energize R2 or R3 for Testing

To test the components supplied by relay 2 (R2) or relay 3 (R3), replace relay by a suitable fused jumper between fuse box pins as per table.

MODEL	RELAY	PIN TO JUMP
600 ACE	R2	4C and 6D
	R3	7C and 9D



600 ACE MODELS



TYPICAL
1. Fused jumper

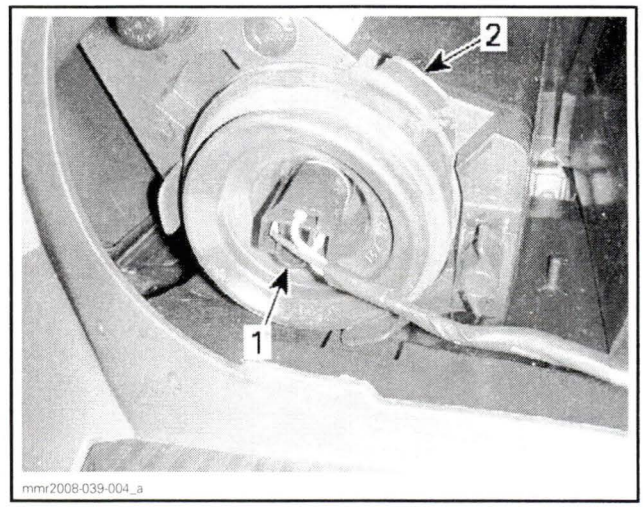
PROCEDURES

HEADLIGHTS

Headlight Bulb Removal

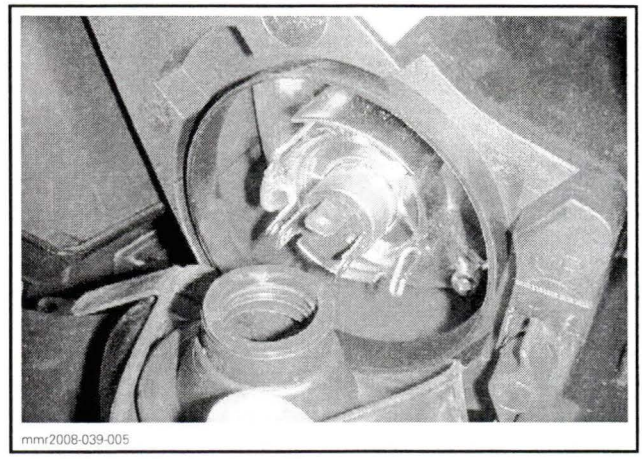
If a headlight bulb is burnt, proceed as follows.

1. Remove multifunction gauge to gain access to headlight bulbs, see procedure in this section.
2. Remove bulb connector.
3. Remove top and center portion of rubber boot from headlight.

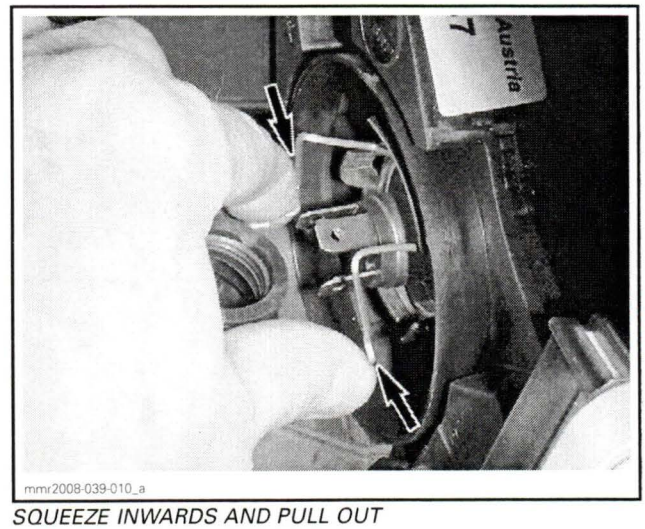


1. Remove headlight connector
2. Remove rubber boot

NOTE: It is not necessary to fully remove rubber boot.

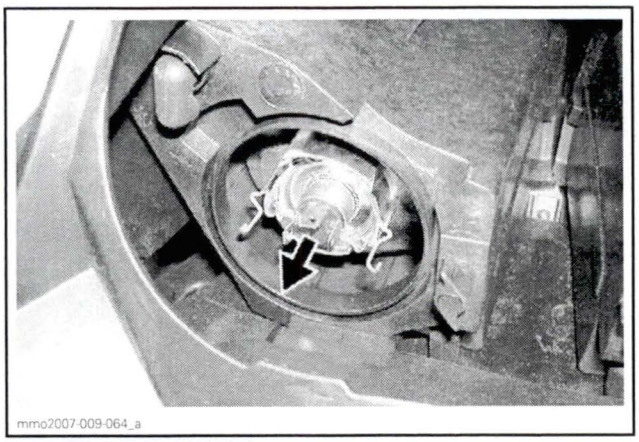


4. Press both sides of the bulb holder (spring clip) inwards at the same time, and pull it out to release it from the bulb support.



SQUEEZE INWARDS AND PULL OUT

5. Pull bulb from headlight.



PULL TO REMOVE BULB

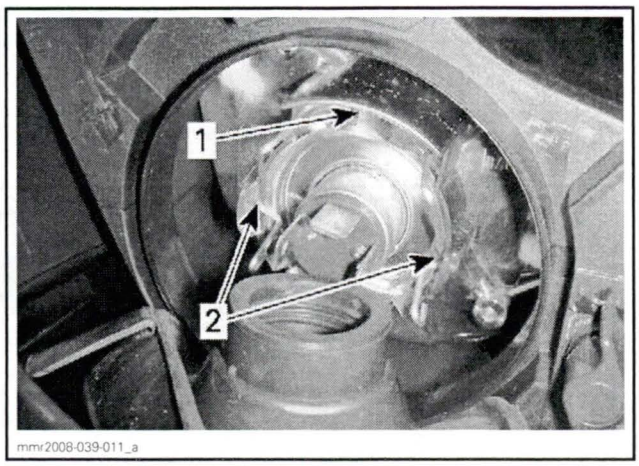
Headlight Bulb Installation

NOTICE **Never touch glass portion of a halogen bulb with bare fingers, it shortens its operating life. If glass is touched, clean it with isopropyl alcohol which will not leave a film on the bulb.**

1. Insert bulb in headlight.

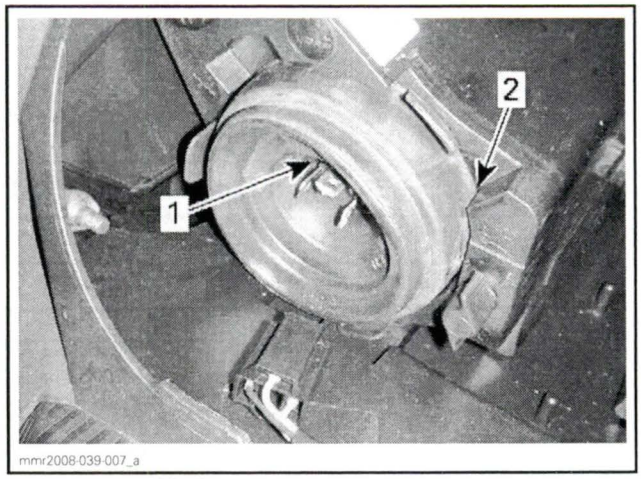
NOTE: Widest alignment tab on bulb should be at top of headlight.

2. Insert top of bulb holder (spring clip) as you squeeze the two sides inwards. Release bulb holder so that it locks in the grooves on either side of headlight.



1. Wide bulb tab
2. Bulb holder locked

3. Install rubber boot. Ensure cover is properly inserted in groove provided in the headlight, and around the base of the bulb.



1. Insert around bulb
2. Insert in groove provided

4. Install light connector.
5. Always test light operation after bulb replacement.
6. Install gauge, see procedure in this section.

Headlight Input Voltage Test

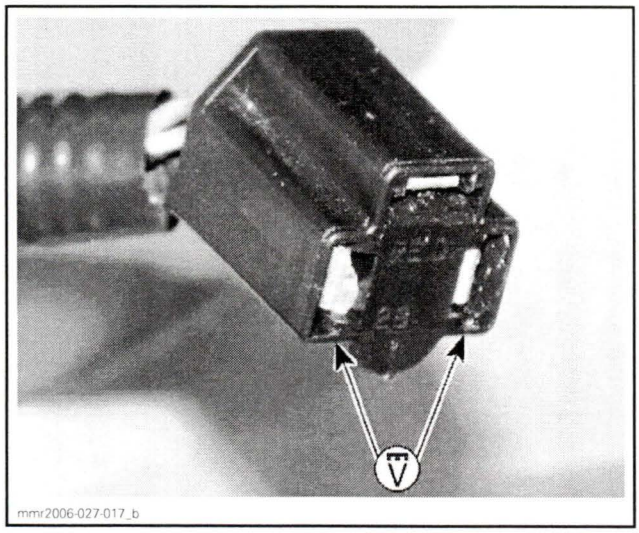
If headlight(s) does not function with a known good bulb, proceed as follows.

1. Remove gauge, see procedure in this subsection.
2. Disconnect headlight connector(s).
3. Provide power to the electrical system for testing. Refer to applicable *GAUGE, LIGHTING AND ACCESSORY POWER SUPPLY FOR TESTING* in the *TROUBLESHOOTING* topic at the beginning of this subsection.

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

4. Read voltage at headlight connector as follows:

HEADLIGHT INPUT VOLTAGE TEST			
SWITCH POSITION	WIRE COLOR (HEADLIGHT CONNECTOR)		VOLTAGE
LO BEAM	GY/BK	BK	Battery voltage
		Chassis ground	
HI BEAM	GY	BK	
		Chassis ground	



If voltage is not as specified to chassis ground and black wire, carry out the following:

- Check applicable fuse (600 ACE ONLY). Refer to applicable *POWER DISTRIBUTION* subsection.
- Test supply circuit.
- Test headlights dimmer switch. Refer to *HEADLIGHT DIMMER SWITCH CONTINUITY TEST* in this subsection.

If voltage is not as specified to black wire only, test ground circuit.

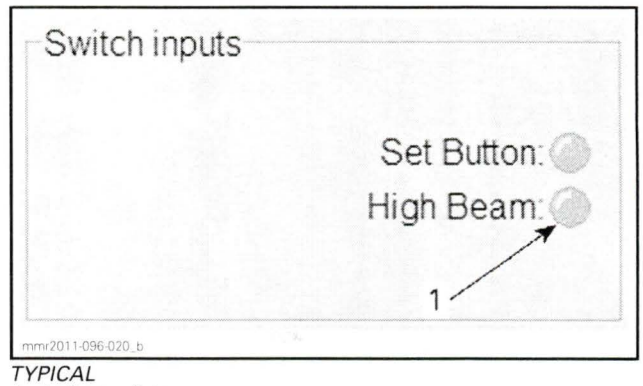
Headlight Dimmer Switch Test with B.U.D.S.

Connect vehicle to applicable B.U.D.S. version, refer to *COMMUNICATION TOOLS AND .U.D.S.* subsection.

In B.U.D.S., select;

- **Read Data** button
- **Monitoring** page tab
- **Cluster** page tab.

Set vehicle dimmer switch to High Beam and look for applicable indicator light in the **Switch inputs** field to come ON.



TYPICAL
1. Indicator light

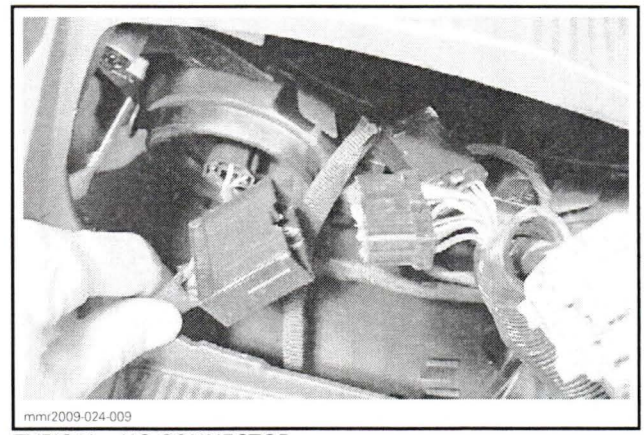
If the indicator light comes ON in B.U.D.S., the dimmer switch is functioning correctly.

If the indicator light does not come ON, proceed with the *HEADLIGHT DIMMER SWITCH CONTINUITY TEST.*

Headlight Dimmer Switch Continuity Test

Remove gauge, refer to *GAUGE* in this subsection.

Disconnect the main steering connector (HG).



TYPICAL - HG CONNECTOR

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

Test switch circuits as per table.

HEADLIGHT DIMMER SWITCH CONTINUITY TEST (MULTIFUNCTION SWITCH)			
SWITCH POSITION	WIRE		RESISTANCE
HIGH	RD/OR Pin 11	GY Pin 12	Close to 0 Ω
		GY/VI Pin 10	Infinite (OL)
LOW	RD/OR Pin 11	GY Pin 12	
		GY/VI Pin 10	Close to 0 Ω

If tests were good, switch is functioning properly.

If any test failed, check wiring and connections going to switch.

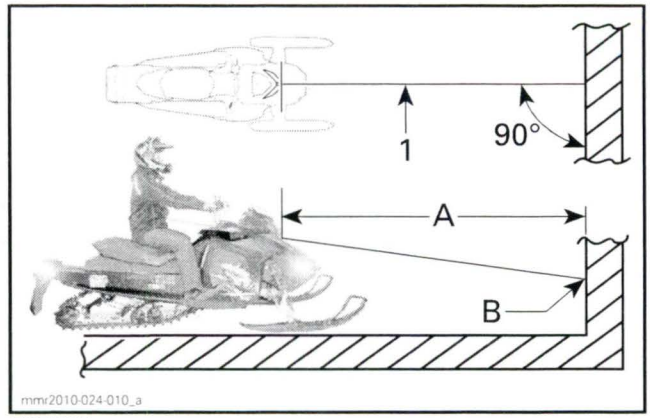
– If test of wiring and connections was good, replace switch.

Headlight Beam Aiming

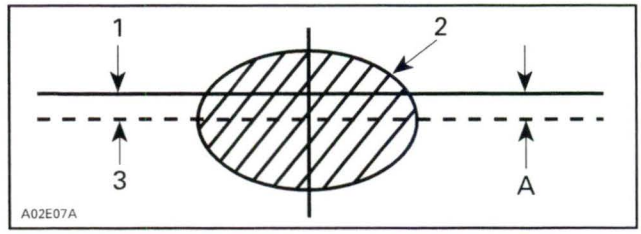
Beam aiming is correct when the center of the high beam is 25 mm (1 in) below the headlight horizontal center line, scribed on a test surface 381 cm (12.5 ft) away.

1. Place the vehicle on a flat surface perpendicular to test surface (wall or screen) and 381 cm (12.5 ft) away from it.
2. Ask rider to sit on vehicle, or apply equivalent weight on the vehicle.
3. On the vehicle, measure the distance from the center of headlight to the ground. Scribe a line at this height on the test surface (wall or screen).
4. Select **high** beam.

NOTE: Light beam center should be 25 mm (1 in) below scribed line.



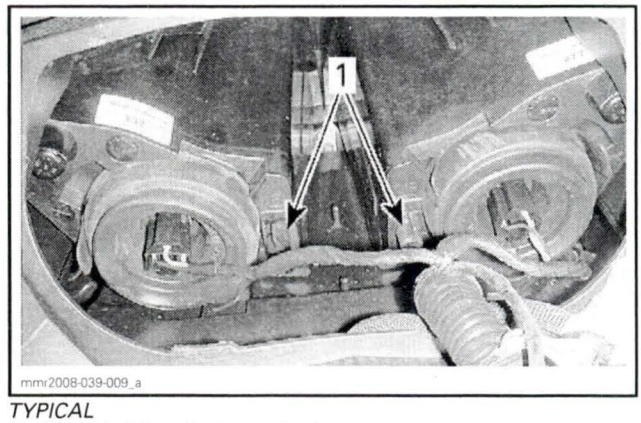
TYPICAL
1. Headlight center line
A. 381 cm (12.5 ft)
B. 25 mm (1 in) below center line



1. Headlight horizontal
2. Light beam (high beam) (projected on the wall)
3. Light beam center
A. 25 mm (1 in)

Beam Aiming Adjustment

1. Remove multifunction gauge.
2. Turn knob on headlight to adjust beam height.

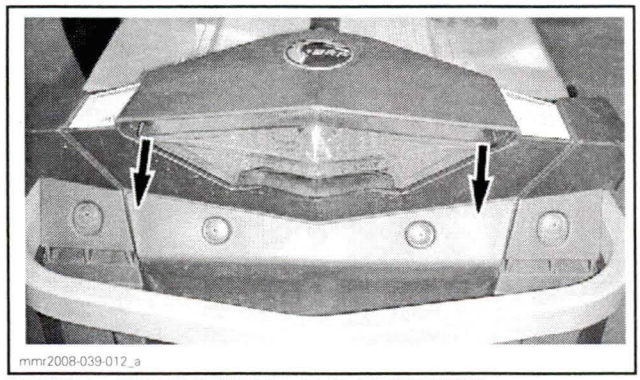


TYPICAL
1. Beam height adjustment knobs

TAILLIGHT AND BRAKE LIGHT

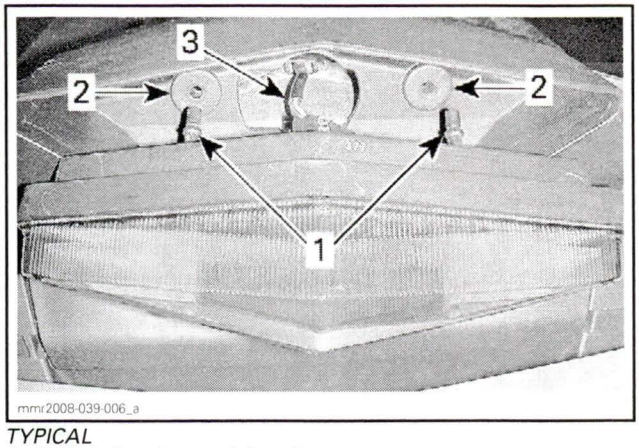
Taillight Bulb Replacement

Remove taillight housing by carefully pulling on lens at both ends.



TYPICAL - CAREFULLY PULL OUT AT CORNERS

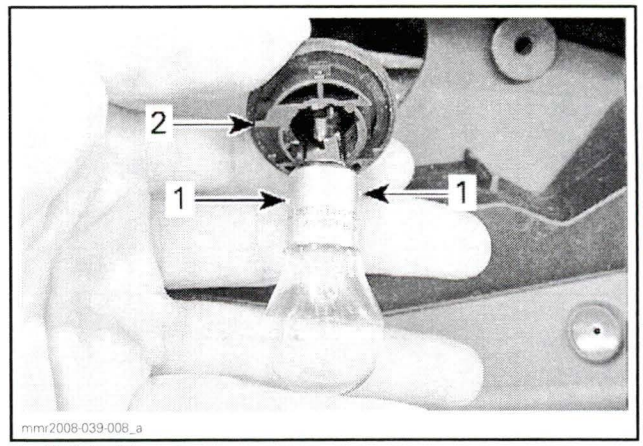
NOTICE Taillight housing is held in place by two plastic pins inserted in rubber grommets. If housing is forced too far sideways when removing, the lens mounting pins may break and housing will have to be replaced. Do not pull housing out too far to avoid damaging wiring.



TYPICAL
1. *Taillight housing retaining pins*
2. *Retaining grommets*
3. *Light wire harness*

1. Rotate bulb socket counterclockwise to remove it from taillight housing.
2. Push in and rotate bulb counterclockwise to remove it from its socket.
3. Install the new bulb by pushing it in the socket and turning it clockwise.

NOTE: Note position of bulb locking pins on its base, and bulb holder alignment key to lens.



1. *Bulb locking pins*
2. *Bulb holder alignment key*

Taillight Input Voltage Test

If taillight does not function with a known good bulb, proceed as follows.

1. Access taillight connector as explained *TAILLIGHT BULB REPLACEMENT*.
2. Disconnect taillight connector.
3. Provide power to the electrical system for testing. Refer to applicable *GAUGE LIGHTING AND ACCESSORY POWER SUPPLY FOR TESTING* in the *TROUBLESHOOTING* topic at the beginning of this subsection.

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

4. Read voltage at taillight connector as follows:

TAILLIGHT INPUT VOLTAGE TEST		
PROBES		VOLTAGE
YE/RD wire (Pin 2)	BK wire (Pin 3)	Battery voltage

Reading should be battery voltage. If no voltage is read, check ground and supply circuits independently. Repair open circuit as needed.

Brake Light Input Voltage Test

1. If brake light does not function with a known good bulb, carry out steps 1 to 4 of *TAILLIGHT INPUT VOLTAGE TEST.*
2. Apply parking brake.
3. Read voltage at taillight connector as follows:

BRAKE LIGHT INPUT VOLTAGE TEST		
PROBES		VOLTAGE
WH wire (Pin 1)	BK wire (Pin 3)	Battery voltage

Reading should be battery voltage. If no voltage is read, check ground and supply circuits independently. Repair open circuit if needed. To check brake light switch, refer to *BRAKE* subsection.

Taillight Holder Replacement

If the taillight lens is broken, see the *TAILLIGHT BULB REPLACEMENT* procedure in this section.

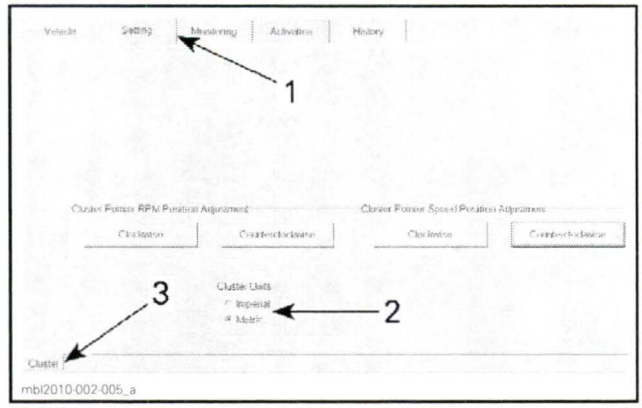
The taillight holder is part of the snow guard. If it needs to be replaced, refer to *BODY* subsection.

If the light bulb socket or wiring need to be replaced, you will have to lift up the rear of the fuel tank to access and disconnect the harness connector, refer to *FUEL TANK AND FUEL PUMP* section.

GAUGE

Changing Gauge Units of Measurement

1. Connect vehicle to applicable B.U.D.S., refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. In B.U.D.S., select:
   - **Read Data** button
   - **Setting** page tab
   - **Cluster** page tab.
3. Select **Imperial** or **Metric** in the **Cluster Units** field.



TYPICAL
1. *Setting page tab*
2. *Cluster Units field*
3. *Cluster page tab*

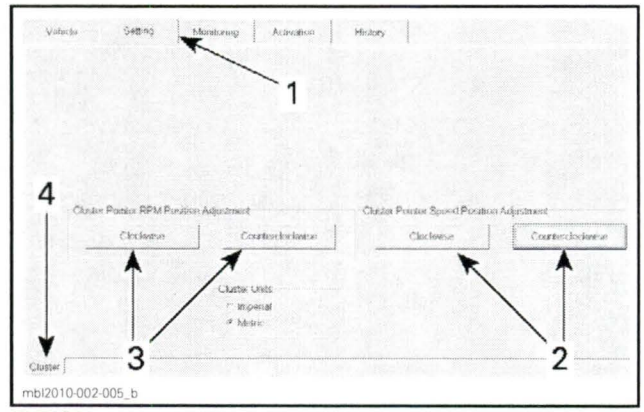
NOTE: Speedometer, odometer and trip meter will have their units (kilometer or miles) changed together.

Speedometer and Tachometer Pointer Adjustment

1. Connect vehicle to applicable B.U.D.S., refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. In B.U.D.S., select the:
   - **Read Data** button
   - **Setting** page tab
   - **Cluster** page tab.

NOTE: Be sure to look at the gauge straight on to prevent parallax error.

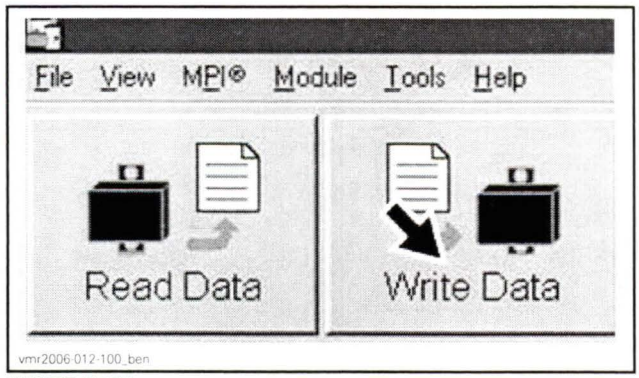
3. Click on **Clockwise** or **Counterclockwise** button to align gauge pointer with the zero (0).



TYPICAL
1. *Setting tab*
2. *Speedometer pointer buttons*
3. *Tachometer pointer buttons*
4. *Cluster tab*

NOTE: Because of the fine tuning of the pointer, the button must be pressed several times before perceiving pointer movement.

4. In B.U.D.S., click on **Write Data** button to save the new setting in the gauge.



WRITE DATA

Gauge Self-Test

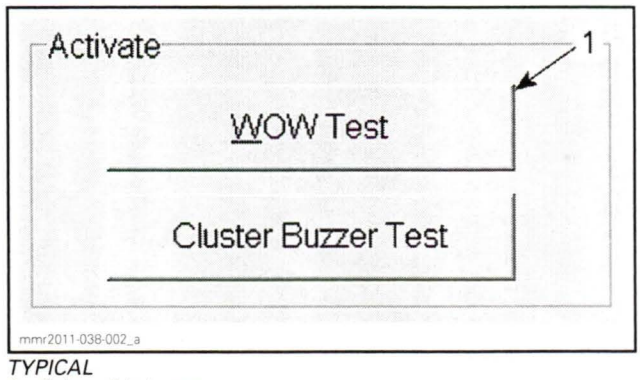
On **ECM wake-up**, the gauge will perform a self-test. All indications should come ON and gauge pointers will cycle once. You will have a few seconds to ensure the indications (**LEDs** and **LCDs**) are functioning correctly.

NOTE: This test only validates the gauge operation of the **LEDs**, **LCDs** in the gauge digital display and the pointers. It does not test the actual circuit functions related to each indication.

If the self test does not take place, proceed with the *GAUGE POWER INPUT TEST*.

Gauge Test With B.U.D.S.

1. Connect vehicle to applicable B.U.D.S., refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. In B.U.D.S., select the:
   - **Read Data** button
   - **Activation** page tab
   - **Cluster** page tab.
3. Select **WOW Test** in the **Activate** field.



TYPICAL
1. Select this button

Gauge Power Input Test (Main 12 Vdc)

If the gauge does not come on when the engine is started, carry out the following test.

1. Check fuse/relay as applicable. Refer to applicable *POWER DISTRIBUTION AND GROUNDS* subsection.
2. Remove the gauge.
3. Disconnect the gauge connector.
4. Press on start button or install the T-harness on the diagnostic connector.

REQUIRED TOOLS	
T-HARNESS (P/N 529 035 869)	
FLUKE 115 MULTIMETER (P/N 529 035 868)	

5. Measure voltage as per following table.

GAUGE POWER INPUT TEST		
PROBES		VOLTAGE
Gauge connector (Pin 8)	Battery ground	Battery voltage

6. If battery voltage is measured, carry out the gauge *GROUND CIRCUIT CONTINUITY TEST*.
7. If no voltage was read, test wiring continuity.

Gauge Ground Circuit Continuity Test

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

1. Measure gauge ground wire for continuity as per following table.

GAUGE GROUND CIRCUIT CONTINUITY TEST		
PROBES		RESISTANCE
Gauge connector pin 11 (BK)	Battery ground	Close to 0 Ω

If ground circuit test failed, check vehicle ground.

If gauge power input test and ground circuit continuity tests are good, replace gauge.

Beeper Test

550F and 600 ACE Models

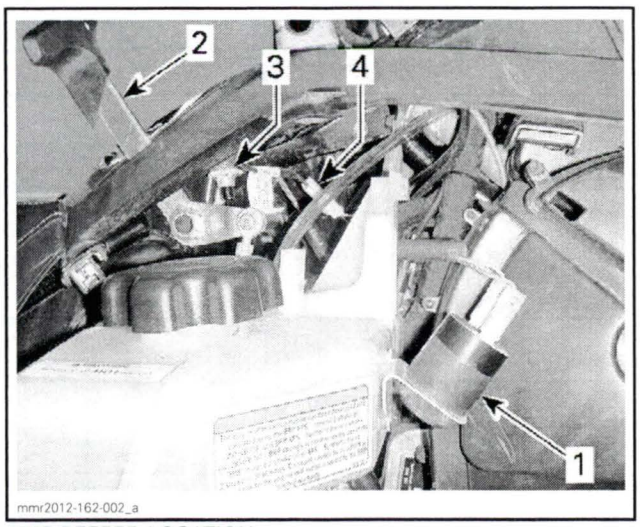
1. Start engine.

2. Set shift lever to reverse.

You should hear the beeper.

If you do not hear the beeper:
- Test reverse switch
- Test wiring and connectors

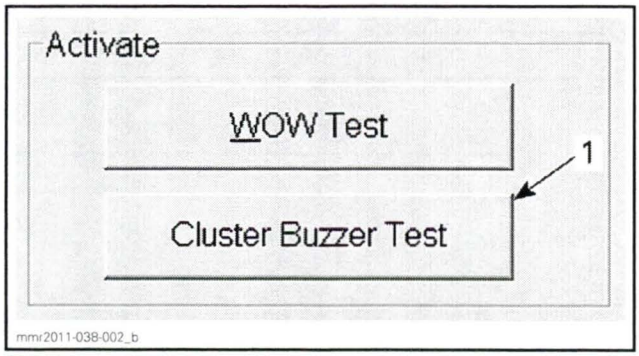
If all else tested good:
- Replace beeper (550F)
- Replace gauge (600 ACE)



550F BEEPER LOCATION
1. *Beeper*
2. *Reverse lever*
3. *Reverse switch*
4. *Reverse switch connector*

600 HO E-TEC Models

1. Connect vehicle to applicable B.U.D.S. version, refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. In B.U.D.S., select the:
   - **Read Data** button
   - **Activation** page tab
   - **Cluster** page tab.
3. Select **Cluster Buzzer Test** in the **Activate** field.



TYPICAL
1. *Select this button*

You should hear a few beeps.

If you do not hear the beeper:
- Test reverse switch
- Test wiring and connectors

If all else tested good, replace gauge.

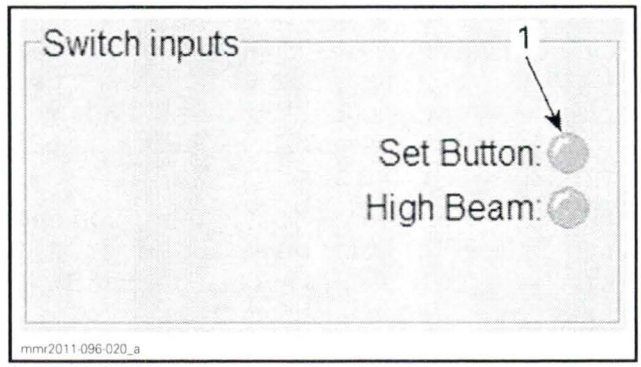
Gauge Button Test with B.U.D.S.

NOTE: 550F models do not have a gauge button.

Using the B.U.D.S. software, select the **Monitoring** page tab.

On the bottom of the page, choose the **Cluster** page tab.

Press on the gauge "S" button and look for applicable indicator light in the **Switch inputs** field to turn green.



1. *Indicator light*

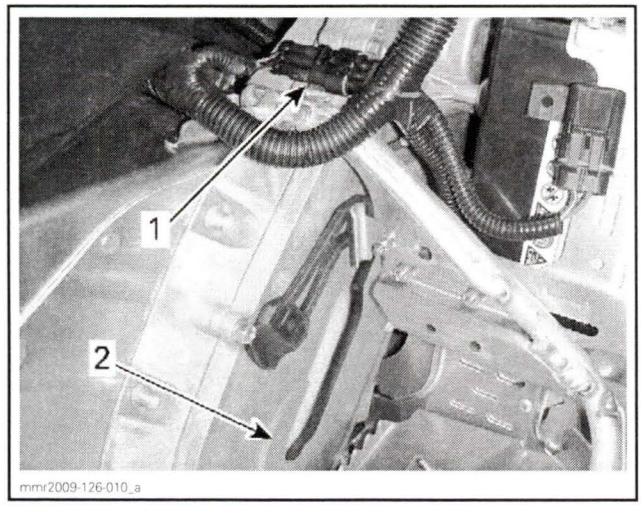
If the indicator light comes ON in B.U.D.S., the gauge button is functioning correctly.

If the indicator light does not come ON, check button. If in good condition, replace gauge.

Gauge Speedometer Function Test

First ensure the gauge pointer is not stuck. Refer to *GAUGE TEST WITH B.U.D.S.* in this subsection.

1. Disconnect speed sensor connector.



TYPICAL
1. *Speed sensor connector*
2. *Speed sensor (inside cover)*

2. Provide power to the electrical system for testing. Refer to applicable *GAUGE, LIGHTING AND ACCESSORY POWER SUPPLY FOR TESTING* in the *TROUBLESHOOTING* topic at the beginning of this subsection.

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

3. Set multimeter to Vdc.
4. Probe connector on vehicle harness side as per applicable table.

550F Models

GAUGE VOLTAGE TEST		
SPEED SENSOR CONNECTOR (MAIN HARNESS SIDE)		VOLTAGE
RD/BK	BU/BK	Close to battery voltage
WH/GN	BU/BK	Close to battery voltage

600 E-TEC Models

GAUGE VOLTAGE TEST		
SPEED SENSOR CONNECTOR (MAIN HARNESS SIDE)		VOLTAGE
RD/BK	BK	Close to battery voltage
WH/GN	BK	Close to battery voltage

600 ACE Models

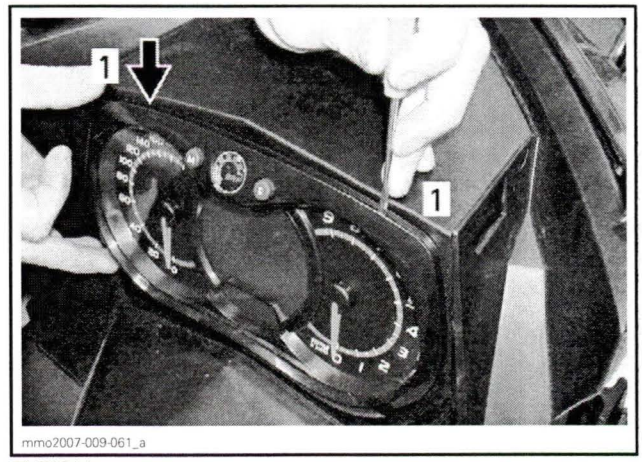
GAUGE VOLTAGE TEST		
SPEED SENSOR CONNECTOR (MAIN HARNESS SIDE)		VOLTAGE
VI/BK	RD/BK	Close to battery voltage
WH/GN	RD/BK	Close to battery voltage

If test succeeded, gauge is good, proceed with *SPEED SENSOR SIGNAL TEST.*

If test failed, check wiring harness going to gauge. If wiring harness is good, replace gauge.

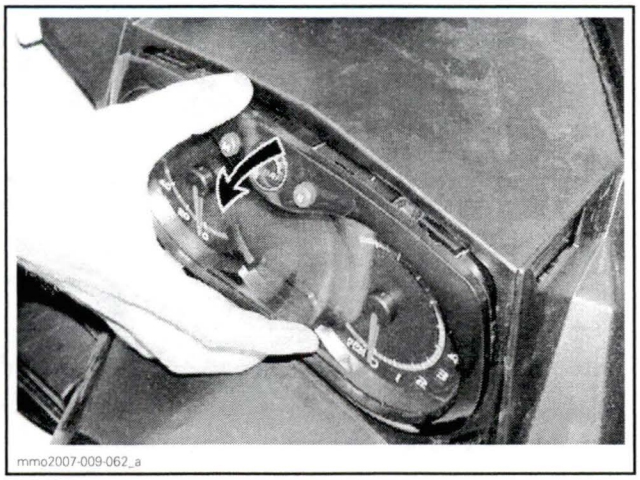
Gauge Removal

1. Insert a small screwdriver in one of the rectangular slots at top of gauge.
2. As you gently press down on the screwdriver to release multifunction gauge locking tab, pull out and hold gauge in position.
3. Insert screwdriver in second hole and press to release other tab.



TYPICAL
1. *Locking tabs*

4. Gently pull multifunction gauge from headlight/gauge module.


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TYPICAL

5. Press on connector locking tab and pull connector off gauge.
6. Store gauge in a secure area to prevent it from being damaged.

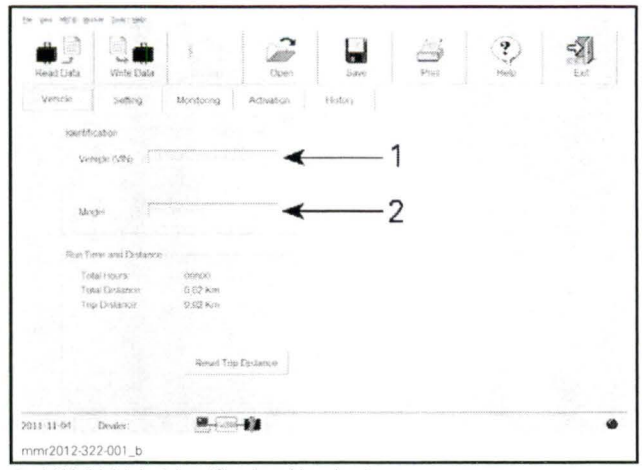
Gauge Installation

1. Carefully align and install gauge connector, pressing it in until connector lock engages.
2. Insert bottom of gauge in gauge holder.
3. Press top of gauge in holder until you feel locking tabs engage in holder.
4. Start engine and test gauge functions.

NOTE: If a new gauge is installed, refer to *GAUGE TO ECM MATCHING*.

New Gauge Set-Up (550F Only)

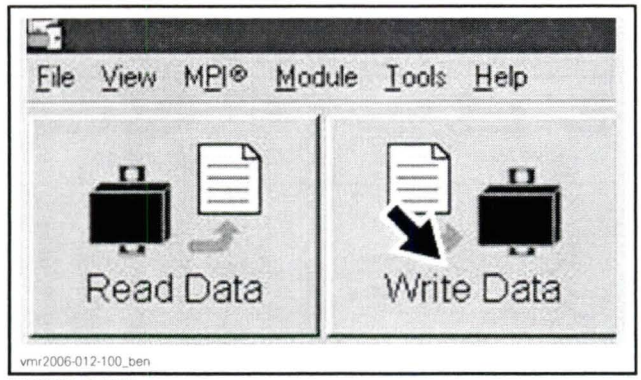
1. Connect vehicle to applicable B.U.D.S. version, refer to *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. In B.U.D.S., click on the:
   - **Read Data** button
   - **Vehicle** page tab.
3. Enter the VIN and model in the appropriate boxes.



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1. *VIN (Vehicle Identification Number)*
2. *Model number*

4. Set the desired units, refer to *CHANGING GAUGE UNITS OF MEASUREMENT* in this subsection.
5. Click on **Write Data** to save the new setting in the gauge.



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WRITE DATA

Gauge to ECM Matching (600 E-TEC and 600 ACE Only)

NOTE: If the gauge is replaced, the VIN (Vehicle Identification Number) and the vehicle model number must be entered in the gauge memory so they match those stored in the vehicle ECM.

600 E-TEC Models

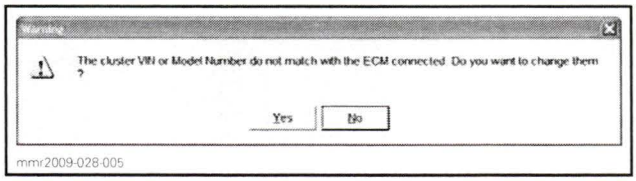
If the identification numbers stored in the gauge do not match those stored in the ECM, the new gauge will operate partially. The LCD display will remain blank and the D.E.S.S. LED will be turned ON.

600 ACE Models

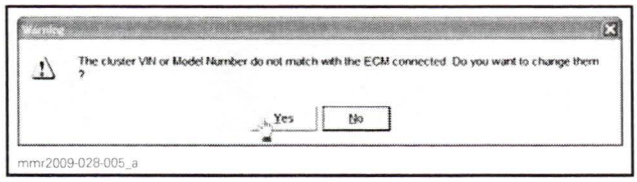
If the identification numbers stored in the gauge do not match those stored in the ECM, the gauge will operate normally however the ECM will send a message to B.U.D.S. through the diagnostic connector.

All Models

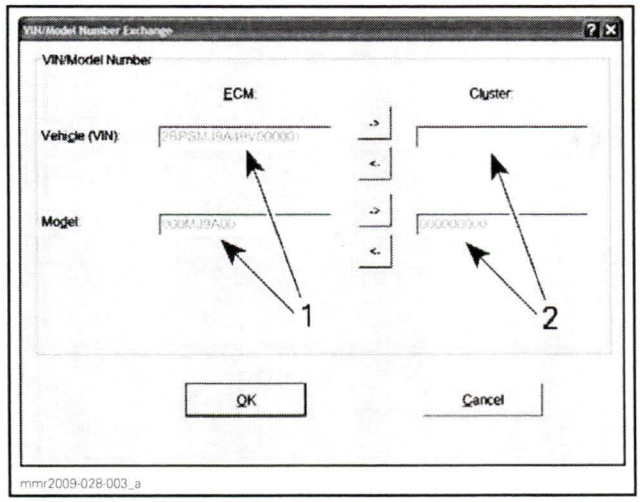
1. To write the VIN number and model number into the gauge, connect vehicle to latest applicable B.U.D.S. version. Refer to the *COMMUNICATION TOOLS AND B.U.D.S.* subsection.
2. Follow the instructions in the referenced subsection and in the software.
3. Once connected and activated, select the **Read Data** button. You will see a message similar to the following illustration.



4. Select **Yes** in the displayed window.

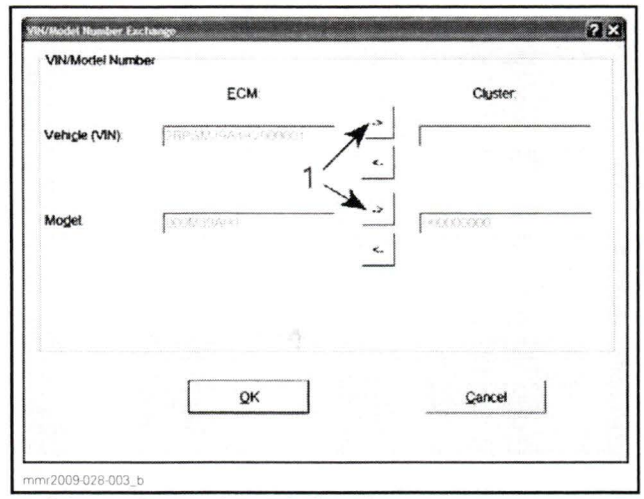


The following window illustrates that the VIN number or model number in the ECM and cluster are not the same.



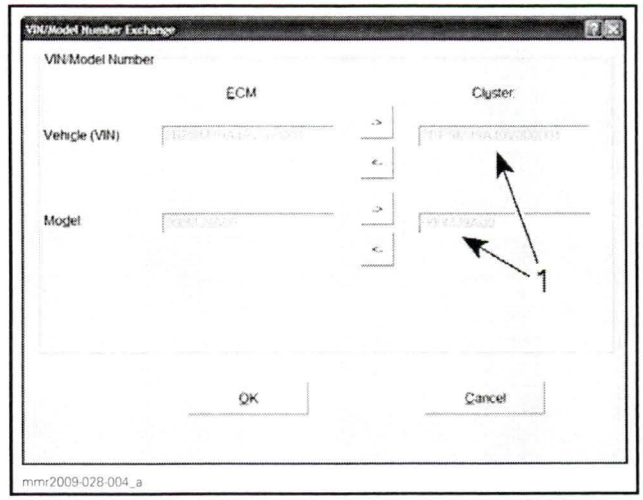
1. *Numbers stored in ECM*
2. *No numbers stored in new cluster*

5. Select each of the arrows indicated in the following illustration to copy the VIN and model numbers from the ECM to the cluster.



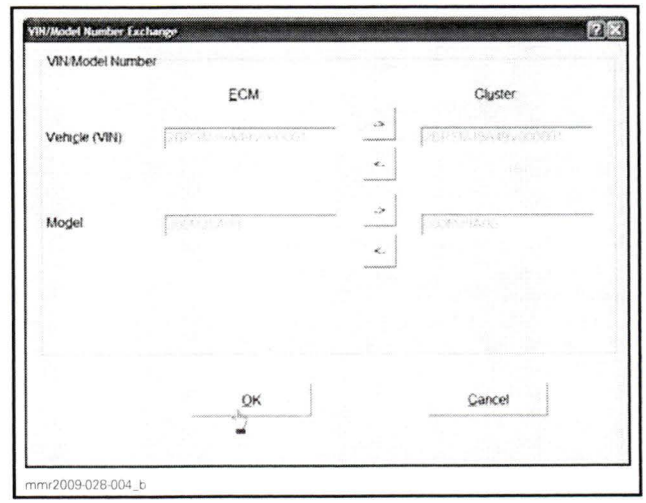
1. *Select each arrow button indicated*

Note how the numbers in the **Cluster** field now match those in the **ECM** field.



1. *Numbers in Cluster field now match those in the ECM field*

6. Select **OK** to continue.



7. Once the gauge has been matched to the ECM, you will need to:
   - Set the units of measurement (see procedure in this section)
   - Enter customer information.
8. Ensure the gauge functions properly and that all settings and indications are within parameters.
9. Shut down vehicle and disconnect the communication tools.

SPEED SENSOR

Speed Sensor Location

The speed sensor is mounted in the gearbox cover.

Speed Sensor Signal Test

First proceed with the *GAUGE SPEEDOMETER FUNCTION TEST* in this subsection.

1. Lift and support rear of vehicle.

⚠ CAUTION **Use proper lifting techniques, notably using your leg force. Do not attempt to lift the vehicle if it is above your limits.**

2. Ensure speed sensor connector is properly connected.
3. Provide power to the electrical system for testing. Refer to applicable *GAUGE, LIGHTING AND ACCESSORY POWER SUPPLY FOR TESTING* in the *TROUBLESHOOTING* topic at the beginning of this subsection.
4. Rotate driven pulley so that tracks rotates slowly.
5. Back-probe connector pins or equivalent, between wires as per table.

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

NOTICE **Be careful not to damage connector seals when back probing.**

550F Models

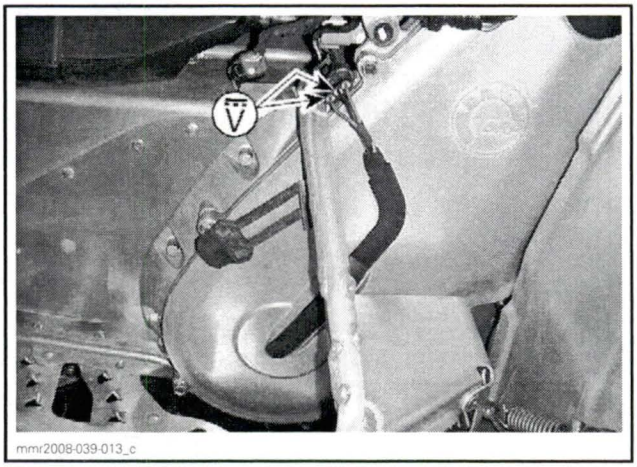
SPEED SENSOR SIGNAL TEST			
ROTATE DRIVEN PULLEY	SPEED SENSOR CONNECTOR (SENSOR SIDE)		VOLTAGE
	WH/GN (Pin 3)	BU/BK (Pin 2)	Alternating voltage within 0 and 12 Vdc

600 HO E-TEC Models

SPEED SENSOR SIGNAL TEST			
ROTATE DRIVEN PULLEY	SPEED SENSOR CONNECTOR (SENSOR SIDE)		VOLTAGE
	WH/GN (Pin 3)	BK (Pin 2)	Alternating voltage within 0 and 12 Vdc

600 ACE Models

SPEED SENSOR SIGNAL TEST			
ROTATE DRIVEN PULLEY	SPEED SENSOR CONNECTOR (SENSOR SIDE)		VOLTAGE
	WH/GN (Pin 3)	RD/BK (Pin 2)	Alternating voltage within 0 and 12 Vdc



TYPICAL — SENSOR SIGNAL VOLTAGE TEST

The signal voltage should alternate as per specification.

If test failed, replace the speed sensor.

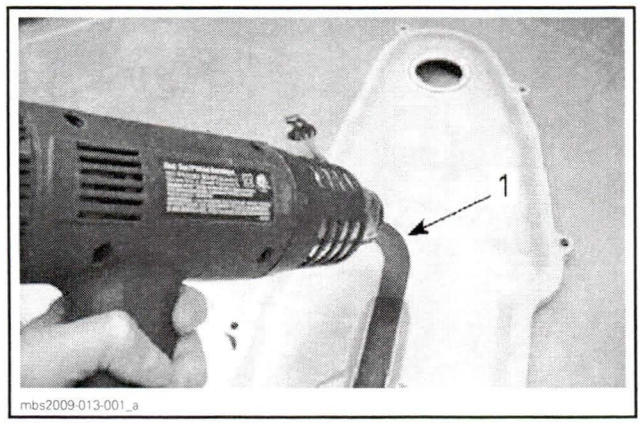
Speed Sensor Replacement

The sensor can be replaced with the gearbox cover as an assembly. In such a case, refer to *CHAINCASE* subsection.

To replace sensor only, proceed as follows.

Speed Sensor Removal

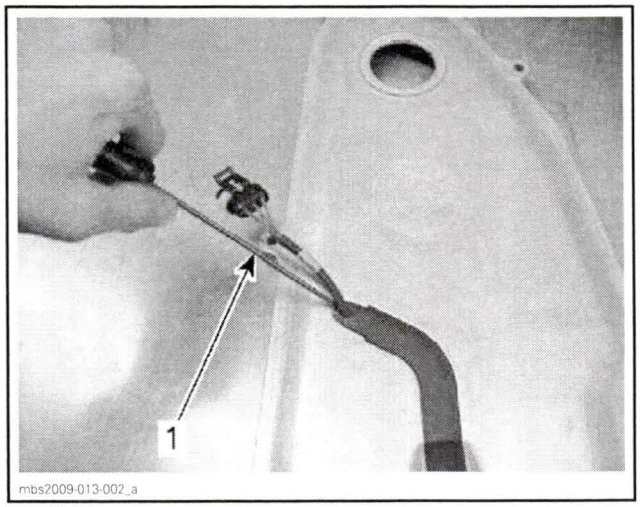
1. Remove gearbox cover, refer to *GEARBOX* subsection.
2. Using a heat gun, heat the speed sensor at plastic sheath end.



TYPICAL
1. Plastic sheath end

NOTE: Plastic sheath color will slightly change, which tells it is adequately heated.

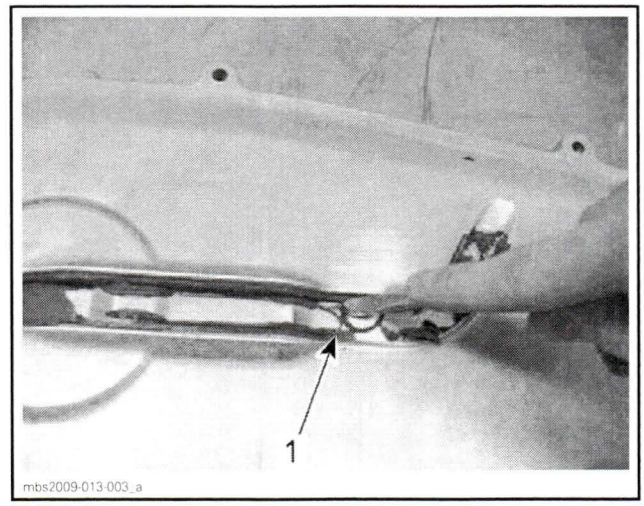
3. Use a flat screwdriver to pry out the end of the plastic sheath from gearbox cover.



TYPICAL
1. Prying out plastic sheath

NOTICE **Use care when prying out the plastic sheath not to damage the gearbox cover.**

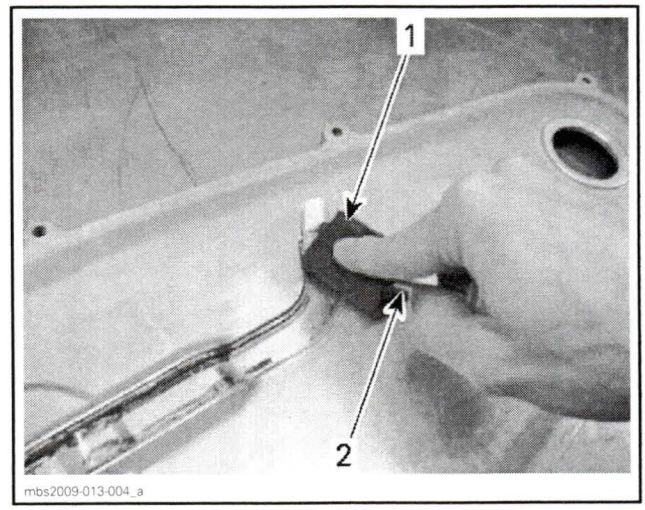
4. Heat the next section of the plastic sheath.
5. Pry out the heated section using the flat screwdriver.
6. Repeat steps 4 and 5 until the plastic sheath is completely removed.
7. Use the flat screwdriver to remove the remaining sealant from the gearbox cover.



TYPICAL
1. Remaining sealant

NOTICE **Do not apply excessive pressure when removing the remaining sealant not to damage the gearbox cover.**

8. Rub the sealant using a scouring pad.



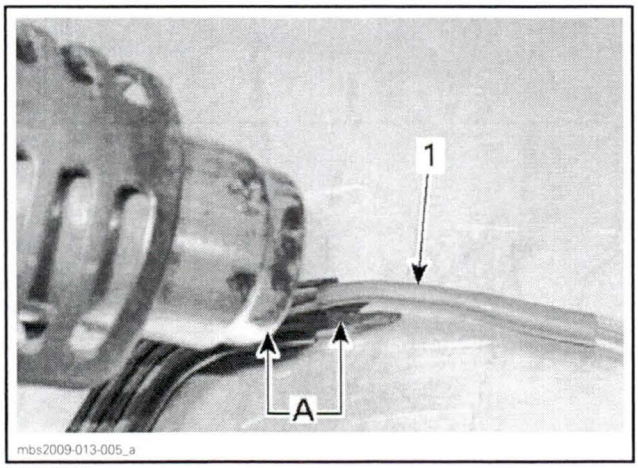
TYPICAL
1. Scouring pad
2. Flat screwdriver

Speed Sensor Installation

1. Thoroughly clean the surface where the speed sensor is to be stuck.

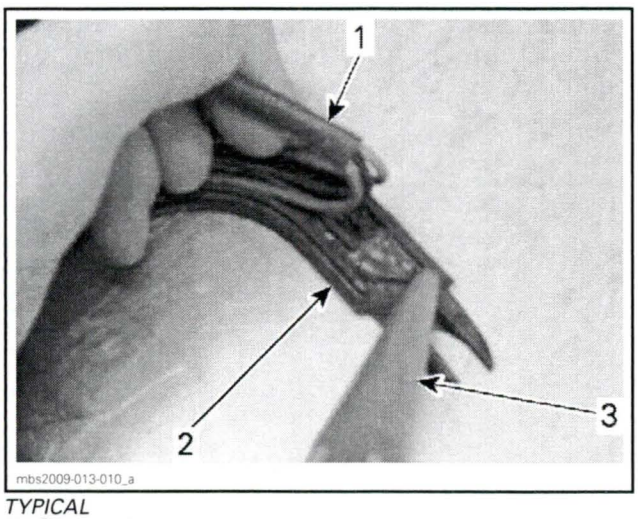
NOTE: Make sure surface is clean and free of grease.

2. Slide the shrink tubing into sensor plastic housing. The end of tubing must be inside sensor plastic housing about 15 mm (19/32 in).



TYPICAL
1. Shrink tubing
A. 15 mm (19/32 in)

3. Apply LOCTITE 5900 (P/N 293 800 066) under the sensor wires, between the end of the guide grooves and the plastic sheath extremity.

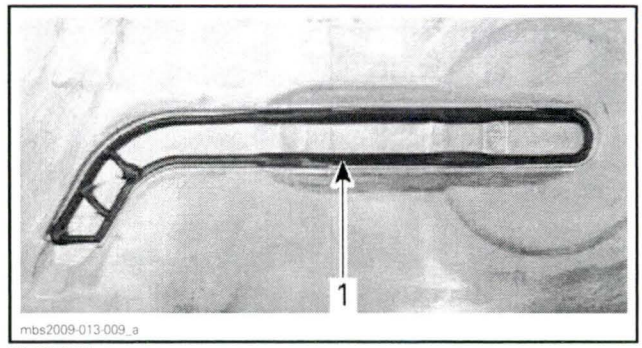


TYPICAL
1. Sensor wires
2. Plastic sheath extremity
3. Loctite 5900 (P/N 293 800 066) bottle tip

NOTE: The assembly must be watertight.

4. Apply LOCTITE 5900 (P/N 293 800 066) all around the plastic sheath location on the gearbox cover.

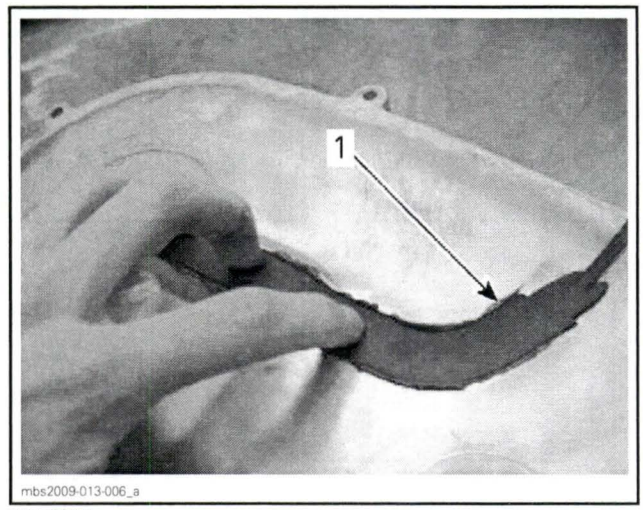
Follow the pattern shown on the next picture.



TYPICAL
1. Loctite 5900 (P/N 293 800 066)

NOTE: Make sure the plastic sheath circumference is well covered.

5. Place the plastic sheath in position and firmly push in order to evacuate all the surplus sealant. Keep pressure for at least 1 minute.

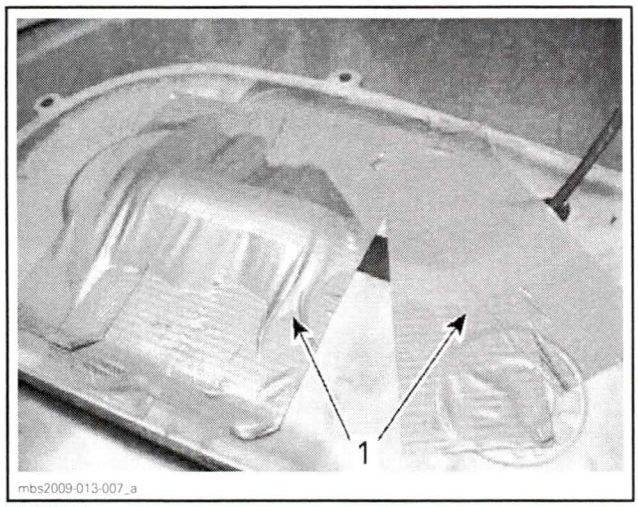


TYPICAL
1. Surplus sealant

6. Wipe off all the sealant surplus around the plastic sheath.
7. Once cleaned up, inspect all the circumference for sealant lacks.

NOTE: Sealant must be visible all around.

8. Place some adhesive tape on the sensor to maintain a pressure on the sensor for at least 24 hours.



TYPICAL
1. Adhesive tape

NOTE: Wait for at least 1 hour before exposing vehicle to cold temperature.

9. Reinstall gearbox cover, refer to *GEARBOX* subsection.

FUEL LEVEL SENSOR

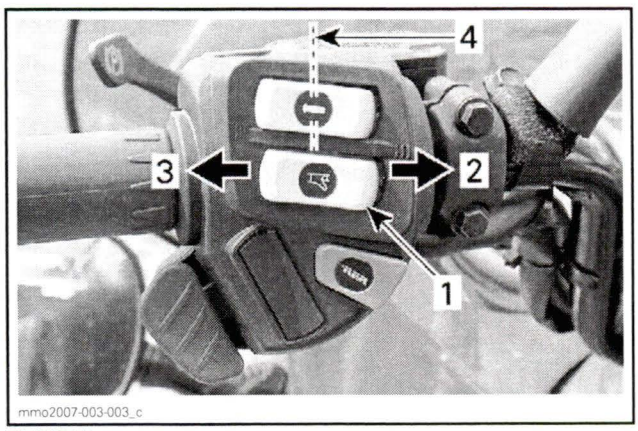
Refer to *FUEL TANK AND FUEL PUMP* for sensor test.

HEATED THROTTLE LEVER

System Description

The throttle lever heater is controlled by a toggle switch on the LH multifunction switch.

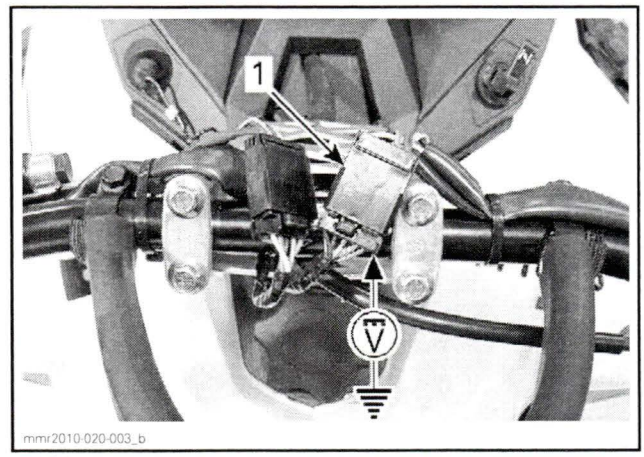
The switch allows you to select **High**, center (**Off**), and **Low** heat settings. The switch button will remain in the selected position until another selection is made.



TYPICAL
1. Throttle lever heat switch
2. High
3. Low
4. Heat OFF (center position)

Throttle Lever Heating Element Input Voltage Test

1. Remove steering cover.
2. Set the FLUKE 115 MULTIMETER (P/N 529 035 868) to Vdc.
3. Apply electrical power to the accessories for testing. Refer to *TROUBLESHOOTING* in this subsection for procedure.
4. Back-probe steering connector (GD) and measure voltage as per following table.



1. GD connector

SWITCH POSITION	TEST PROBES		VOLTAGE
LOW	GD connector pin 2 (BR/YL wire)	Chassis ground	Battery voltage
HIGH	GD connector pin 1 (BR wire)	Chassis ground	

If voltage is as specified, carry out *THROTTLE LEVER HEATING ELEMENT TEST* in this subsection.

If voltage is not as specified, carry out *THROTTLE LEVER HEAT SWITCH TEST* in this subsection

Throttle Lever Heat Switch Test

1. Remove gauge, see procedure in this subsection.
2. Disconnect the 13 pin steering connector (HG).
3. Remove the steering cover.
4. Disconnect the RH upper steering connector (GD).

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

5. Test throttle lever switch and circuits as per following table.

THROTTLE LEVER SWITCH TEST			
INTENSITY	HG	GD	RESISTANCE
HIGH	OR/RD (Pin 9)	BN (Pin 1)	Close to 0 Ω
		BN/VI (Pin 2)	Infinite (OL)
LOW	OR/RD (Pin 9)	BN (Pin 1)	Infinite (OL)
		BN/VI (Pin 2)	Close to 0 Ω

If continuity test is as per specification, proceed with *THROTTLE LEVER HEATING ELEMENT TEST* in this section.

If continuity test is out of specification, check switch circuit. If good, replace switch.

Throttle Lever Heating Element Test

1. Carry out a resistance check of the heating elements as per applicable table.

THROTTLE LEVER HEATER TEST (550F)			
INTENSITY	GD		RESISTANCE @ 20°C (68°F)
LOW	BR/YL (Pin 2)	YL/BK (Pin 3)	5.7 to 18.5 Ω
HIGH	BR (Pin 1)		1.7 to 4.2 Ω

THROTTLE LEVER HEATER TEST 600 HO E-TEC AND 600ACE			
INTENSITY	GD		RESISTANCE @ 20°C (68°F)
LOW	OR/WH (Pin 2)	BK (Pin 3)	5.7 to 18.5 Ω
HIGH	OR (Pin 1)		1.7 to 4.2 Ω

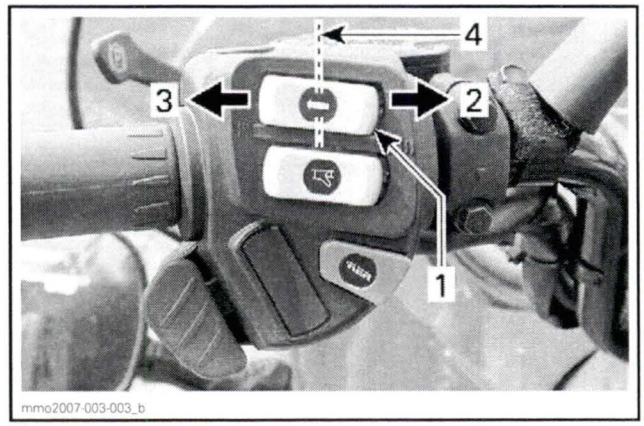
2. If readings are out of specifications, replace throttle lever.
3. If heating element readings are within specifications, check ground circuit.
4. Reconnect connectors.

HEATED HANDLEBAR GRIPS

System Description

the grip heater is controlled by a toggle switch on the LH multifunction switch.

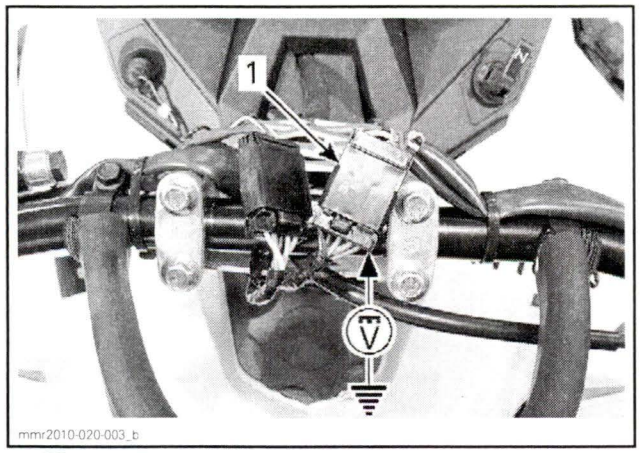
The switch allows you to select **High**, center (**Off**), and **Low** heat settings. The switch button will remain in the selected position until another selection is made.



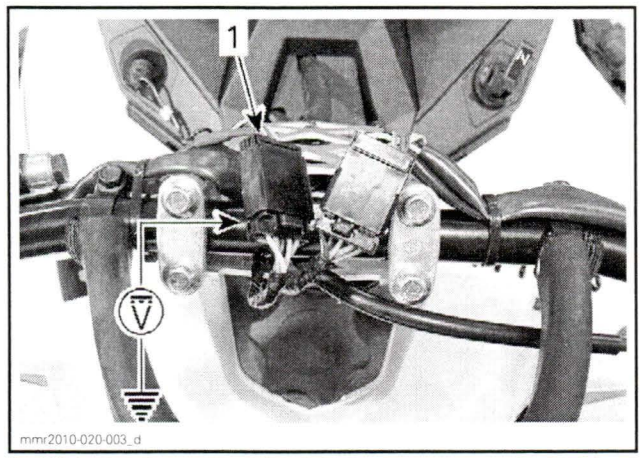
TYPICAL
1. *Grip heat control switch*
2. *High*
3. *Low*
4. *Heat OFF (center position)*

Grip Heating Element Input Voltage Test

1. Remove steering cover.
2. Set the FLUKE 115 MULTIMETER (P/N 529 035 868) to Vdc.
3. Apply electrical power to the accessories for testing. Refer to *TROUBLESHOOTING* in this subsection for procedure.
4. Back probe steering connector GD or GG depending on what side of the handlebar the heated grip is inoperative and measure voltage as per following table.



1. GD connector



1. GG connector

NOTE: Use GD connector to test RH heating element and GG to test on LH side.

SWITCH POSITION	TEST PROBES GG CONNECTOR		VOLTAGE
LOW	Pin 2 (OR/VI wire)	Chassis ground	Battery voltage
HIGH	Pin 1 (OR wire)	Chassis ground	

SWITCH POSITION	TEST PROBES GD CONNECTOR		VOLTAGE
LOW	Pin 5 (OR/VI wire)	Chassis ground	Battery voltage
HIGH	Pin 6 (OR wire)	Chassis ground	

If voltage is as specified, carry out *GRIP HEATING ELEMENT TEST* in this subsection.

If voltage is not as specified, carry out *HANDLEBAR GRIP HEAT SWITCH TEST* in this subsection.

Handlebar Grip Heat Switch Test

1. Remove gauge, see procedure in this subsection.
2. Disconnect the 13 pin steering connector (HG).
3. Remove the steering cover.
4. Disconnect the LH upper steering connector (GG).

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

5. Test handlebar grip switch and circuits as per table.

HANDLEBAR GRIP SWITCH TEST LH HEATER			
INTENSITY	HG	GG	RESISTANCE
HIGH	RD/YL (Pin 9)	OR (Pin 1)	Close to 0 Ω
		OR/VI (Pin 2)	Infinite (OL)
LOW	RD/YL (Pin 9)	OR (Pin 1)	Infinite (OL)
		OR/VI (Pin 2)	Close to 0 Ω

If continuity test is as per specification, proceed with *HANDLEBAR GRIP HEATING ELEMENT TEST* in this section.

If continuity test is out of specification, check switch circuit. If good, replace switch.

Grip Heating Element Test

If you cannot feel the temperature increase of a hand grip heating element, carry out the following.

1. Remove gauge, see procedure in this subsection.
2. Disconnect the 13 pin steering connector (HG).
3. Remove the steering cover.
4. Disconnect the LH upper steering connector (GG).
5. Disconnect the RH upper steering connector (GD).
6. Set the FLUKE 115 MULTIMETER (P/N 529 035 868) to Ω.
7. Test heating elements on either side as per following specifications.

HANDLEBAR GRIP HEATING ELEMENT TEST			
INTENSITY	HEATER WIRE		RESISTANCE @ 20°C (68°F)
LOW	OR/VI	BK	17 to 21 Ω
HIGH	OR	BK	8.5 to 10.5 Ω

8. If readings are out of specifications, replace applicable handle grip heating element.

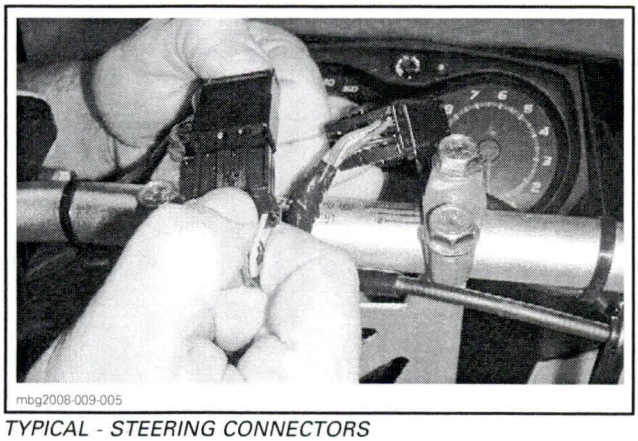
If heating element readings are within specifications, check the heater element ground circuit.

9. Reconnect connectors.

Grip Heater Element Removal

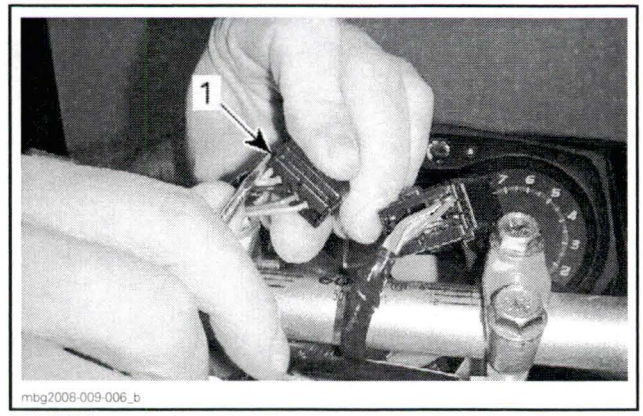
NOTICE **Heater wire routing may vary significantly due to different type handlebars and vehicles. Its highly important to take note of exact positioning of grip heaters, locking ties, and wire routing before removing them from the handle bars. Failure to properly route wires may lead to equipment damage or failure.**

1. Remove the following items as applicable, refer to *STEERING SYSTEM* section for details.
   - Steering cover
   - Rubber hand grip
   - Multifunction switch cover.
2. Disconnect the LH or RH steering connectors under the steering cover.



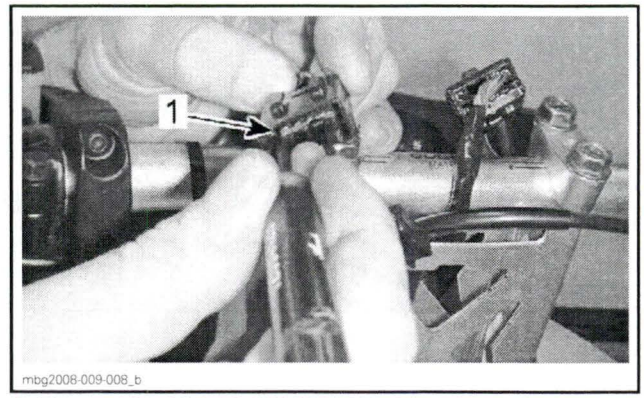
TYPICAL - STEERING CONNECTORS

3. Open the cover on the back of the connector housing using a small screwdriver or a suitable tool.



TYPICAL
1. Connector housing cover locks (one each side)

4. Using an appropriate tool such as the MULTILOCK - TERMINAL EXTRACTION TOOL (P/N 755430-2), unlock the heater wire terminals and push them out of the connector housing.



TYPICAL - UNLOCKING CONNECTOR PIN (FRONT SIDE)
1. Pin removal tool inserted above pin

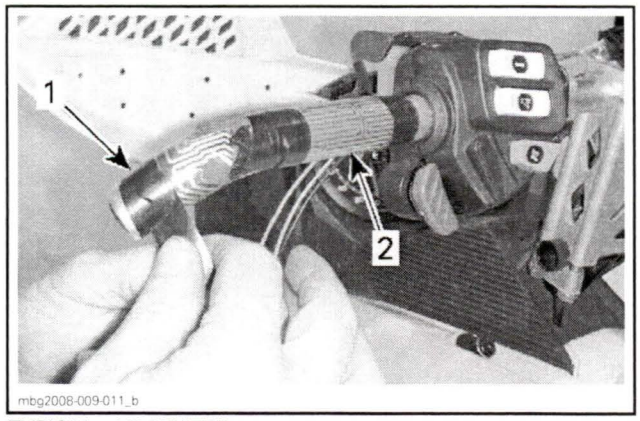
NOTE: Terminals are unlocked and pushed out from the front (pin side) of the connector housing.

HEATER TERMINALS (HANDLEBAR CONNECTOR)	
HIGH	OR
LOW	OR/VI
GROUND	BK

NOTICE **Be sure to take note of exact positioning of grip heaters, locking ties, and wire routing before removing them from the handlebar.**

5. Cut locking ties securing heater wires to handlebar.
6. Pull wires from harness protective sheath, multifunction switch housing or throttle lever housing.

7. Cut and remove BLACK electrical tape from heater element and remove heater from cork insulator.

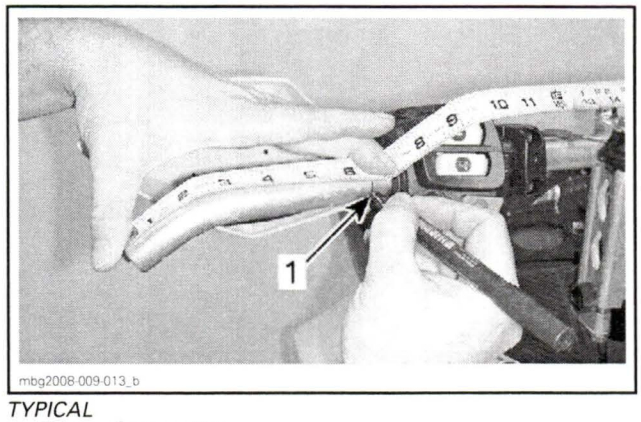


TYPICAL - LH HEATER
1. *Electrical tape*
2. *Heater element*

8. If damaged, remove cork insulator from handle bar and clean all adhesive residue from the handlebar.

Grip Heater Element Installation

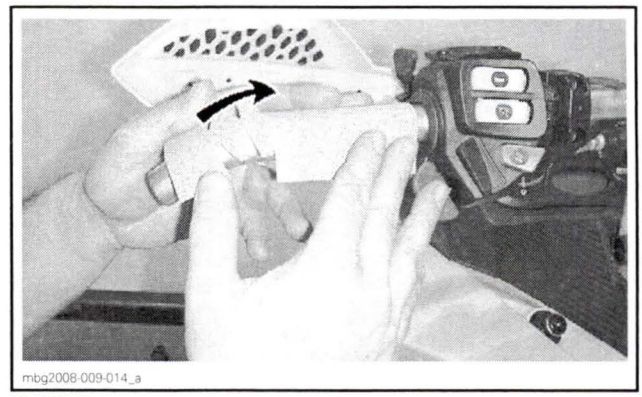
1. Measure specified distance from the end of the handlebar, and across the top of the bend in the bar (if applicable). Trace a reference line with a marker at that point on the handle bar as shown.



TYPICAL
1. *Trace reference line*

HANDLEBAR TYPE	REFERENCE LINE DISTANCE
STEEL	135 mm (5.3 in)

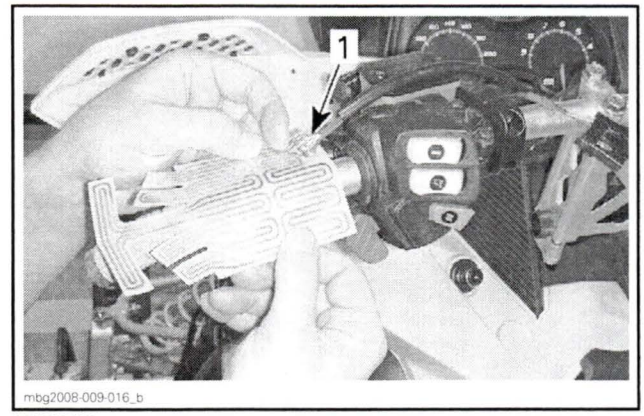
2. Align the edge of the cork insulator with the reference line centered with the handlebar folding axis as illustrated. The ends should meet to form the joint under the handlebar.



TYPICAL

3. Apply firm pressure to cork insulator to assure proper adherence to handlebar.
4. Install the film heater element on the cork insulator and center of handlebar folding axis as per following table.

HANDLEBAR TYPE	HEATER ALIGNMENT
STEEL	At 2.5 mm (3/32 in) from the inside edge of insulator

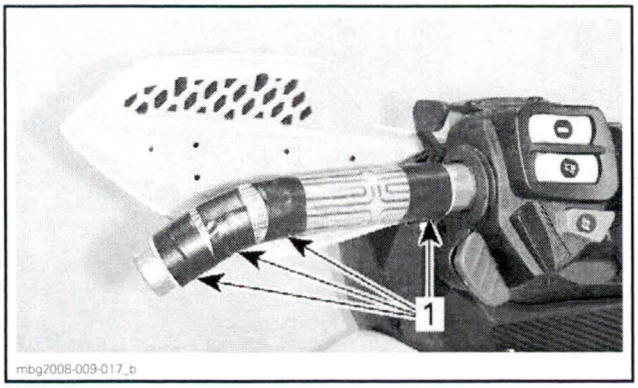


TYPICAL
1. *Heater wire position (LH front, RH rear)*

5. Apply firm pressure to heater to assure proper adherence to cork insulator.

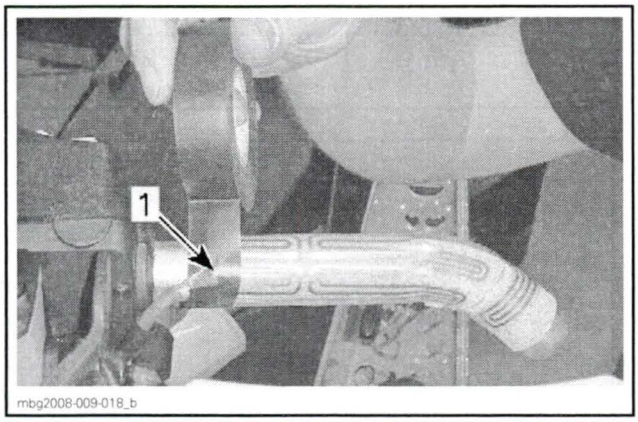
NOTE: The same heater element is used for both the LH and RH sides. Therefore, the electrical wiring will be in front of the handlebar on the LH side, and behind the handlebar (towards driver) on the RH side.

6. On steel handlebar, apply tape at the outside and inside ends (two locations). The tape must cover the edges of the heater element and welds to prevent snagging and damage to the element during rubber grip installation.



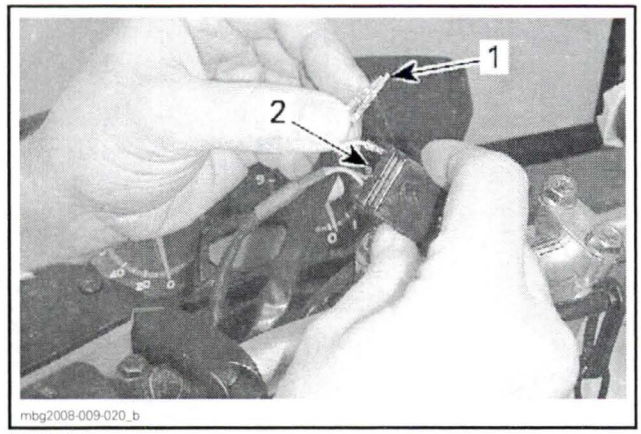
TYPICAL
1. Electrical tape application

NOTE: It is highly important to apply tape so that it fully secures the electrical wire connections and covers welds. This will ease installation of the rubber hand grip and prevent undue stress to the connections.



TYPICAL - IMPORTANT
1. Tape application over wire connections

7. Install rubber hand grip, refer to *STEERING SYSTEM* section for detail.
8. Route wiring as noted during the removal procedure.
9. Insert wire terminals in steering connector housing.

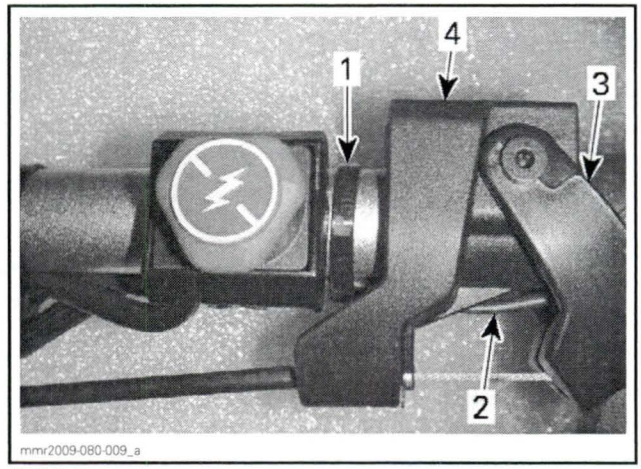


TYPICAL
1. Heater wire terminals
2. Insertion through back of connector

10. Install locking ties to secure the heater wire tightly against the handlebar.

⚠ WARNING

To ensure RH heater wires does not prevent smooth operation of throttle lever, it must be passed straight through the housing without any slack, and secured with a locking tie immediately after the lever housing.



TYPICAL
1. Locking tie
2. Heater wire straight through throttle lever housing
3. Throttle lever
4. Lever housing

NOTICE **Ensure LH heater wires are properly routed through multifunction switch housing to prevent them from being pinched when installing housing cover. Pinched or damaged wires may result in a short circuit.**

11. Provide power to the electrical system for testing. Refer to applicable *GAUGE, LIGHTING AND ACCESSORY POWER SUPPLY FOR TESTING* in the *TROUBLESHOOTING* topic at the beginning of this subsection.
12. Using the hand grip heat switch, turn on the hand grip heaters and ensure they function correctly.

PASSENGER HEATED GRIPS

Passenger Grip Voltage Input Test

1. Refer to *BODY* and remove passenger seat.
2. Locate the tail light connector.
3. Provide power to the electrical system for testing. Refer to applicable *GAUGE, LIGHTING AND ACCESSORY POWER SUPPLY FOR TESTING* in the *TROUBLESHOOTING* topic at the beginning of this subsection.

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

4. Back probe connector and read voltage as follows:

PASSENGER GRIP VOLTAGE INPUT TEST			
SWITCH POSITION	PROBES		VOLTAGE
LOW	OR/VI	BK	Battery voltage
HIGH	OR		

Reading should be battery voltage. If no voltage is read, check switch, ground and supply circuits independently. Repair open circuit or replace switch as needed.

PASSENGER GRIP CONTINUITY TEST — HEATED GRIP SWITCH			
SWITCH POSITION	WIRE		RESISTANCE
LOW	YE/RD	OR/VI	Close to 0 Ω
OFF	YE/RD	OR/VI	Infinite (OL)
OFF	YE/RD	OR	Infinite (OL)
HIGH	YE/RD	OR	Close to 0 Ω

Passenger Grip Heating Element Test

1. Test heating element as per following specifications.

PASSENGER GRIP HEATING ELEMENT TEST			
INTENSITY	HEATER WIRE		RESISTANCE @ 20°C (68°F)
LOW	OR/VI	BK	17 to 21 Ω
HIGH	OR		8.5 to 10.5 Ω

If heating element readings are not within specifications, replace heating element.

If heating element readings are within specifications, carry out *PASSENGER GRIPS VOLTAGE INPUT TEST.*

12-VOLT POWER OUTLET

12-Volt Power Outlet Test

First try another accessory, if it does not function, test outlet as follows:

1. Disconnect power outlet connector.
2. Provide power to the electrical system for testing. Refer to applicable *LIGHTS, GAUGE AND ACCESSORY SYSTEM TESTING* in the *TROUBLESHOOTING* topic at the beginning of this subsection.

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

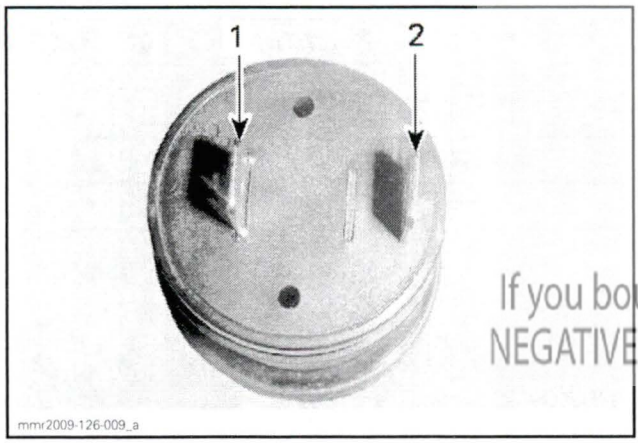
3. Measure the voltage as follows.

FRONT 12-VOLT POWER OUTLET TEST		
WIRES		VOLTAGE
YE/RD	BK	Battery voltage

12-Volt Power Outlet Installation

1. Connect both connectors.

NOTE: Respect polarities. The negative terminal is located closest to the power outlet edge.



1. *Positive terminal*
2. *Negative terminal (closer to the edge)*

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DRIVE BELT

SERVICE TOOLS

Description	Part Number	Page
DRIVEN PULLEY OPENING TOOL	529 017 200	696

GENERAL

To determine which drive belt must be used with your snowmobile, refer to proper *PARTS CATALOG*.

PROCEDURES

DRIVE BELT GUARD

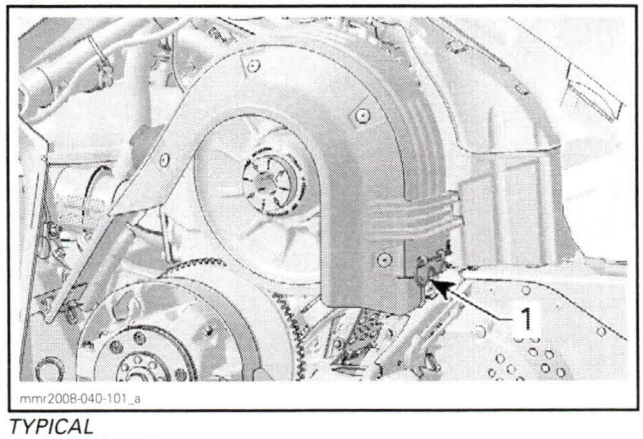
Drive Belt Guard Removal

⚠ WARNING

NEVER operate the snowmobile without the drive belt guard securely installed.

Open the LH side panel.

Remove retaining pin.



TYPICAL
1. Retaining pin

Lift rear portion of guard then release from front tabs by pivoting the guard outwards.

Drive Belt Guard Installation

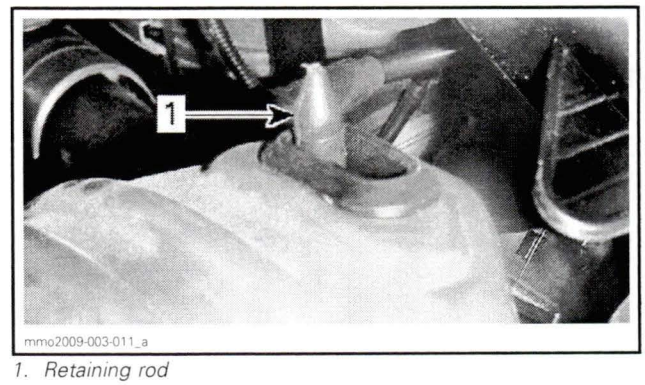
Place the front LH slot of the guard over the longest tab.

Pivot the guard inward to engage the shortest tab in the RH slot.



1. Tabs

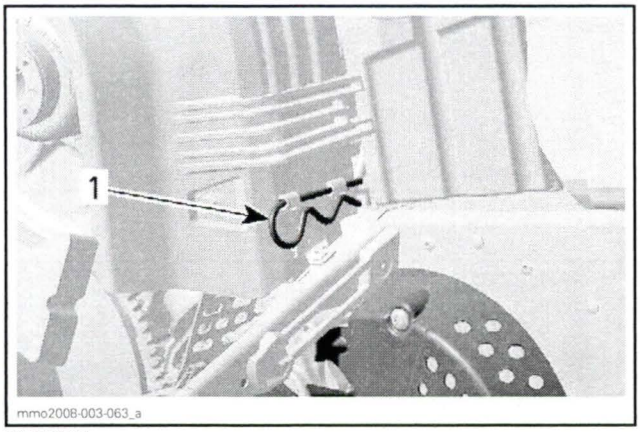
Position the grommet over the retaining rod. It may be necessary to slightly lift the console to make room.



1. Retaining rod

Position rear portion of the drive belt guard over the retainer and secure it using the retaining pin.

NOTE: The drive belt guard is purposely made slightly oversize to maintain tension on its pins and retainers preventing undue noise and vibration. It is important that this tension be maintained when reinstalling.



TYPICAL
1. Retaining pin

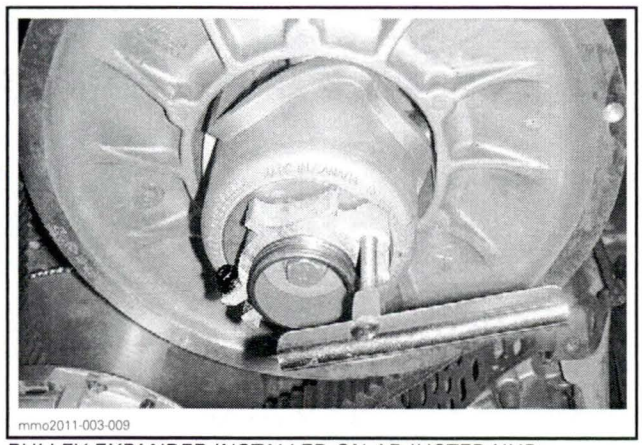
DRIVE BELT

Drive Belt Removal

1. Remove the drive belt guard.
2. Open the driven pulley by screwing the driven pulley opening tool in the threaded hole on the adjuster hub.

REQUIRED TOOL	
DRIVEN PULLEY OPENING TOOL (P/N 529 017 200)	

NOTE: A pulley expander is also provided in the vehicle tool box.



PULLEY EXPANDER INSTALLED ON ADJUSTER HUB

3. To remove belt, slip the belt over the top of driven pulley, then over the drive pulley.

Drive Belt Inspection

Inspect belt for:
- Cracks
- Fraying
- Abnormal wear (uneven wear, wear on one side, missing cogs, cracked fabric).

If abnormal wear is noted, probable cause could be:
- Pulley misalignment
- Excessive RPM with frozen track
- Fast starts without warm-up period
- Scratched or rusty sheave
- Oil on belt
- Distorted spare belt.

Check drive belt width. Replace the drive belt if its width is under minimum recommended specification.

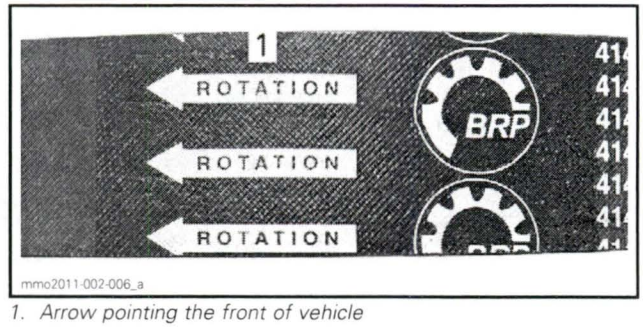
ENGINE	MINIMUM WIDTH (WEAR LIMIT)
550F and 600 ACE	32.1 mm (1.264 in)
600 HO E-TEC	36.1 mm (1.421 in)

Drive Belt Installation

1. Make sure the driven pulley is opened.
2. Set the drive belt inside drive pulley, then slip the top of drive belt over the driven pulley.

NOTICE Do not force or use tools to pry the drive belt into place, as this could cut or break the cords in the belt.

NOTE: The maximum drive belt life span is obtained when the arrow on the drive belt is directed toward the front of the vehicle. This will ensure that correct direction of rotation is respected.



1. Arrow pointing the front of vehicle

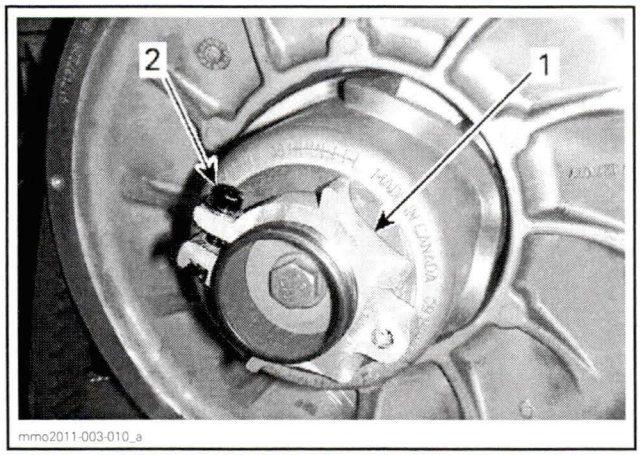
3. Unscrew and remove the driven pulley opening tool from the pulley.
4. Rotate the driven pulley several times to properly set the drive belt between the sheaves.
5. Adjust the drive belt height. Refer to *DRIVE BELT HEIGHT ADJUSTMENT* and follow steps 3 to 5.

Drive Belt Height Adjustment

The drive belt height must be checked every time a new drive belt is installed.

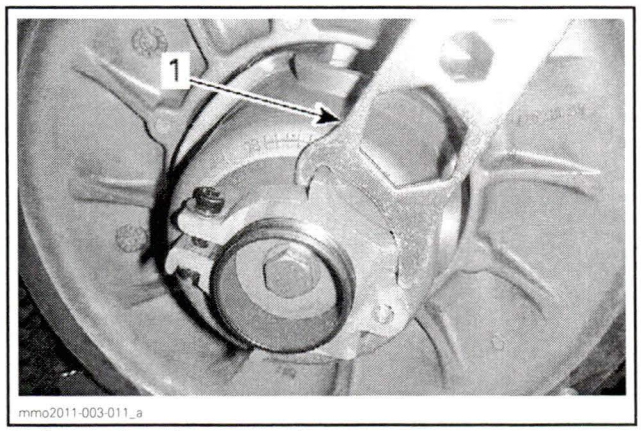
To adjust the drive belt height, proceed as follows:

1. Remove tether cord cap from engine cut-off switch.
2. Remove drive belt guard.
3. Loosen the clamping screw.



1. Adjuster hub
2. Clamping screw

4. Using the suspension adjustment tool provided in the tool kit, turn the ring 1/4 turn at a time then rotate the driven pulley to properly set the drive belt between the pulley sheaves.



1. Suspension adjustment tool

NOTE: The adjustment ring has **left hand treads**.

Repeat step 4 until the external surface of drive belt is even with the driven pulley edge.

NOTE: Turning the ring counterclockwise lowers the drive belt in the pulley. Turning the ring clockwise raises the drive belt in the pulley.

5. Firmly tighten the clamping screw. If possible, tighten to specified torque using a torque wrench.

TIGHTENING TORQUE	
Clamping screw	5.5 N•m ± 0.5 N•m (49 lbf•**in** ± 4 lbf•**in**)

6. Install drive belt guard.
7. Install side panel.

NOTE: This setting is correct as a preliminary adjustment for most models. In some cases, when starting the engine, the vehicle could creep, indicating that the drive belt is too tight.

If the vehicle creeps, lower the drive belt height from the preliminary setting. Repeat procedure until creeping stops.

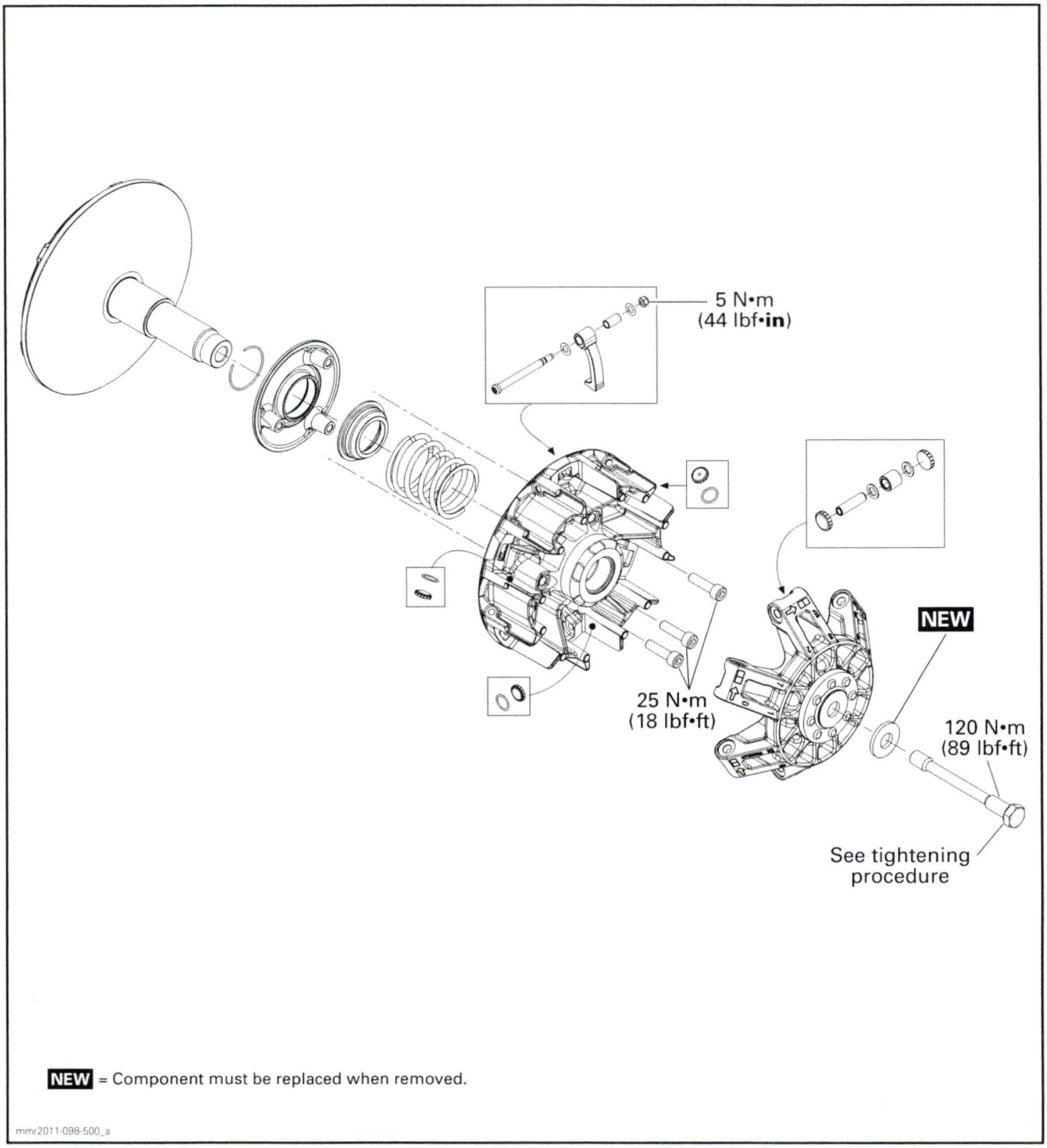
DRIVE PULLEY (eDRIVE)

SERVICE TOOLS

Description	Part Number	Page
CLUTCH HOLDER	529 036 235	701
DRIVE PULLEY PULLER	529 000 064	701
PULLEY SPRING COMPRESSOR TOOL	529 036 012	703

SERVICE PRODUCTS

Description	Part Number	Page
PULLEY FLANGE CLEANER	413 711 809	704



NEW = Component must be replaced when removed.

mmr2011-098-500_a

GENERAL

This drive pulley is lubrication free. Never lubricate any components.

Some drive pulley calibration components (spring, ramps) can be changed to adapt to different altitudes. Refer to appropriate Service Bulletin.

⚠ WARNING

Any drive pulley repairs must be performed by an authorized Ski-Doo dealer. Subcomponent installation and assembly tolerances require strict adherence to procedures detailed.

⚠ WARNING

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

NOTICE This pulley has metric threads. Do not use a puller with ANS or IS type threads. Always tighten puller by hand to ensure that the drive pulley has the same type of threads (metric vs ANS or IS) prior to fully tightening.

TROUBLESHOOTING

ERRATIC DRIVE PULLEY PERFORMANCE

1. Damaged slider shoe O-ring.
   - *Install new O-rings, refer to DRIVE PULLEY ASSEMBLY.*
2. Missing slider shoe O-ring.
   - *Install new O-rings, refer to DRIVE PULLEY ASSEMBLY.*
3. Excessive wear on slider shoes.
   - *Inspect slider shoes, refer to DRIVE PULLEY INSPECTION.*

PROCEDURES

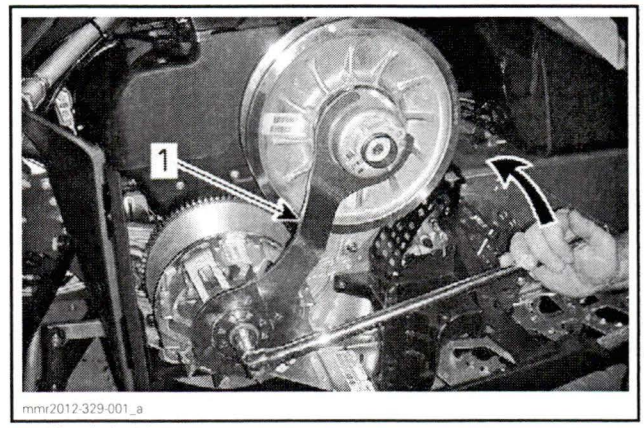
DRIVE PULLEY

Drive Pulley Removal

1. Remove drive belt. Refer to *DRIVE BELT* subsection.
2. Remove the drive pulley from engine.

REQUIRED TOOLS	
CLUTCH HOLDER (P/N 529 036 235)	
DRIVE PULLEY PULLER (P/N 529 000 064)	

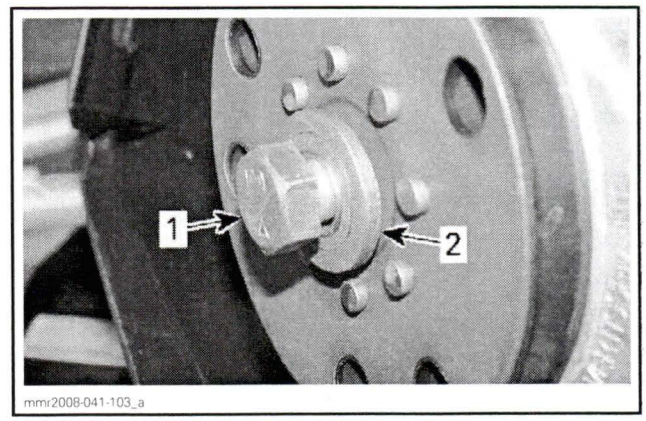
2.1 Using the clutch holder, hold the drive pulley in place.



1. Clutch holder

2.2 Remove the drive pulley screw. Discard the conical spring washer.

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



TYPICAL
1. Drive pulley retaining screw
2. Conical spring washer

2.3 Using the drive pulley puller, remove the drive pulley from crankshaft end.

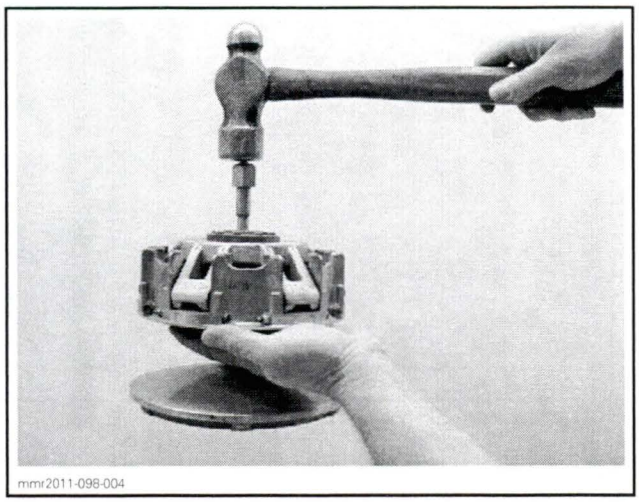
NOTICE Always use the specified tool to avoid damaging crankshaft.

Drive Pulley Disassembly

Fixed Sheave Removal

Separate fixed sheave from sliding sheave as follows:

- Screw puller into fixed sheave shaft (about 13 mm (1/2 in).
- Hold drive pulley in your hand by the sliding sheave as illustrated.
- Tap on puller head to disengage fixed sheave.

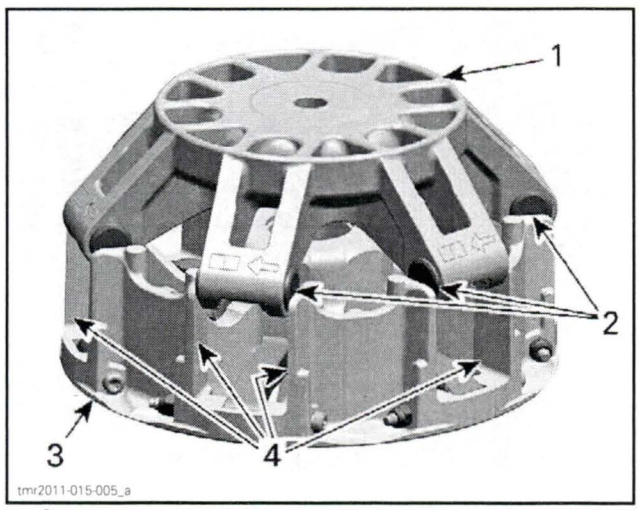


NOTE: If necessary, use a heat gun to slightly heat the governor cup to ease disassembly.

NOTICE Never use any type of torch to heat governor cup.

Governor Cup Removal

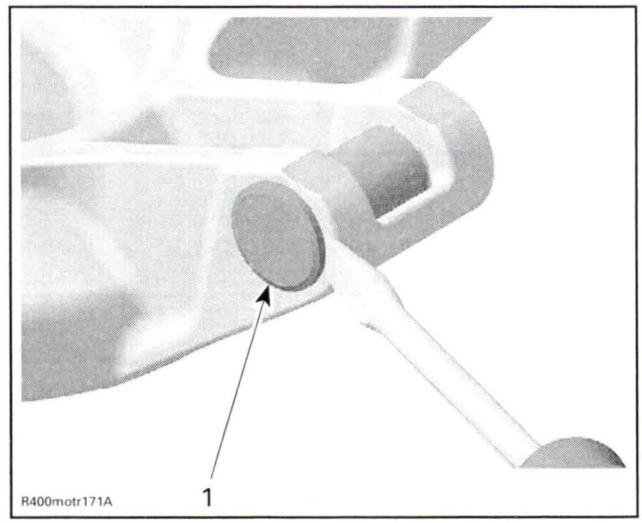
Carefully pull up on governor cup until the slider shoes are at their highest position in the guides.



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

Slider Shoes and Roller Removal

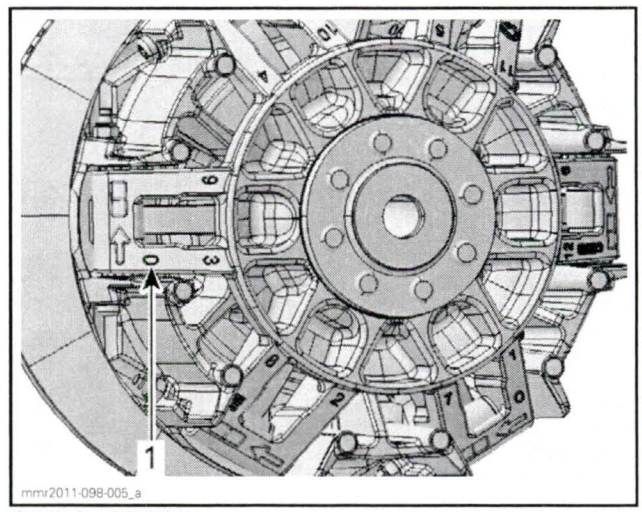
1. Remove slider shoes from governor cup using a flat screwdriver.



1. Slider shoe

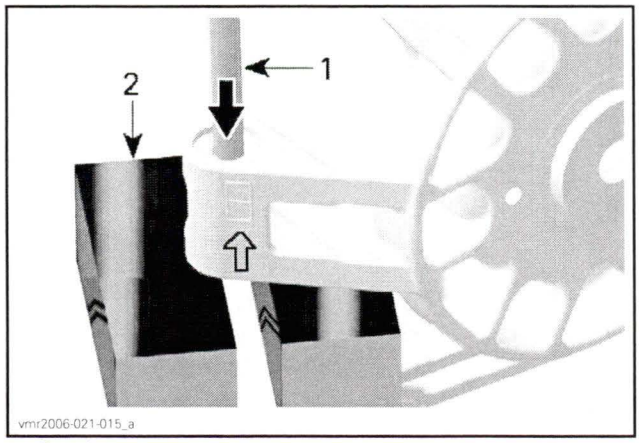
2. Remove O-ring from slider shoes.

NOTE: The O-rings are positioned on the slider shoes identified by an O on the governor cup (total of 3 slider shoes with O-rings).

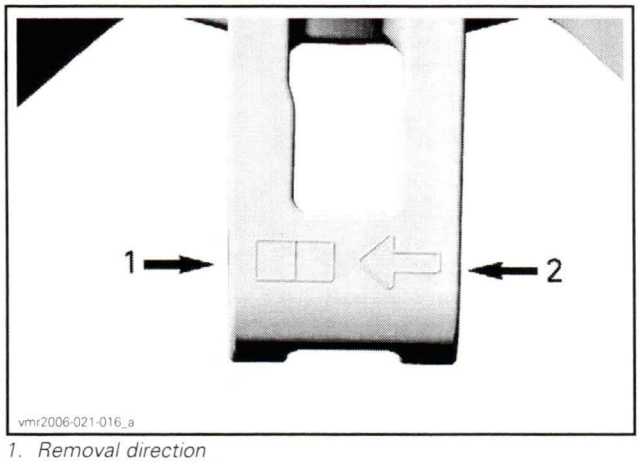


O-RING POSITION
1. O on governor cup

3. Place governor cup **on** a vice using protection plates.
4. Remove bearing sleeve using a punch by pushing it towards the opposite direction of the arrow.



1. *Punch*
2. *Vice*

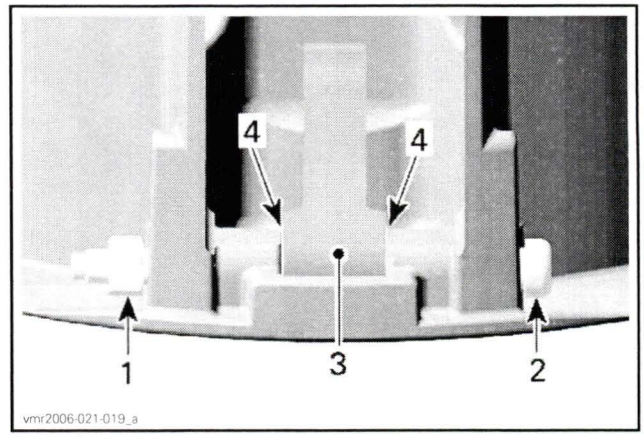


1. *Removal direction*
2. *Assembly direction*

NOTICE Do not clamp governor cup **in** the vice to avoid damaging it.

Centrifugal Lever Removal

1. Unscrew lock nut and remove centrifugal lever pivot bolt.
2. Remove centrifugal lever and both thrust washers.



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

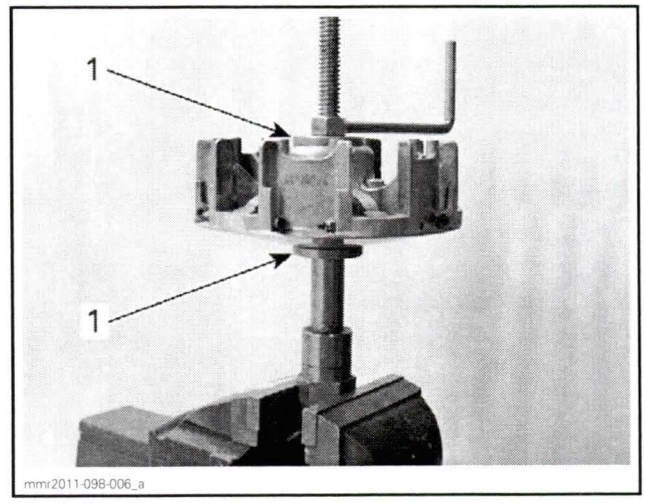
Spring Cover Removal

⚠ WARNING

The spring cover is under high clutch spring preload. Never attempt to remove the spring cover without the recommended tool.

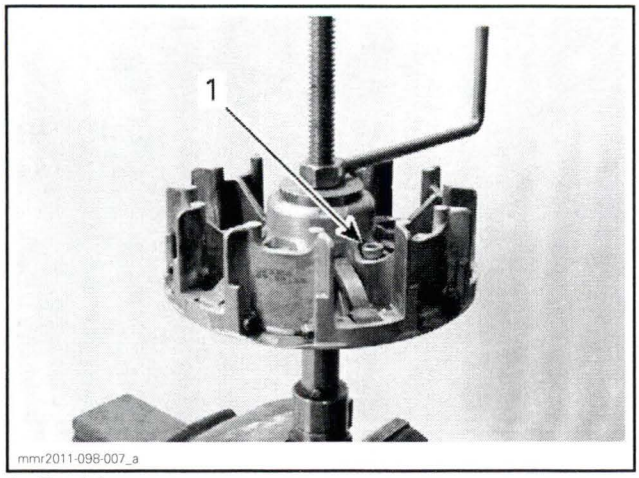
REQUIRED TOOL	
PULLEY SPRING COMPRESSOR TOOL (P/N 529 036 012)	

1. Install tool in a vice with the sliding sheave between the washers.



1. *Washers*

2. Remove retaining screws from spring cover.



1. Retaining screw

3. Unscrew tool to disengage spring cover from sliding sheave.

Drive Pulley Cleaning

NOTICE Always use the specified cleaning solvent and abrasive type to avoid damaging components.

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

Clean the following components using a paper towel with PULLEY FLANGE CLEANER (P/N 413 711 809).

- Crankshaft tapered end
- Crankshaft threads
- Fixed sheave shaft
- Inside the fixed sheave taper
- Drive pulley screw threads.

NOTICE Avoid contact between cleaner and crankshaft seal.

If additional cleaning is required on tapered surfaces, use a medium or coarse steel wool or a no. 600 sand paper.

Reclean tapered surfaces with paper towel and PULLEY FLANGE CLEANER (P/N 413 711 809).

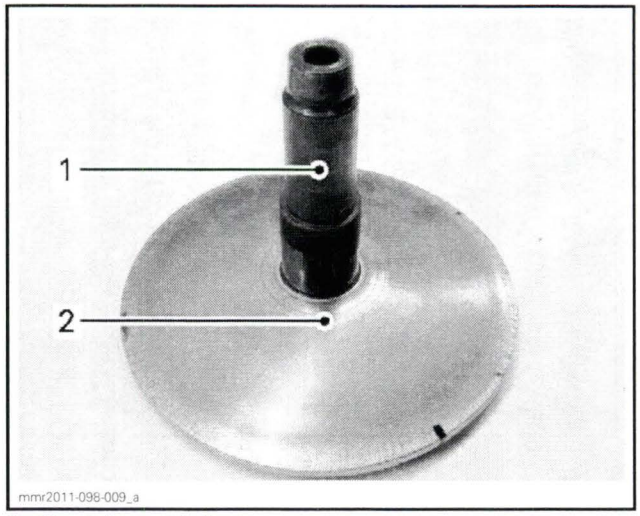
NOTICE Tapered surfaces must be free of any foreign particles.

Drive Pulley Inspection

NOTE: Unless otherwise noted, during inspection, replace any component found defective or out of specifications.

Fixed Sheave Inspection

Check fixed sheave shaft and surface for scratches or other damage.



1. Fixed sheave shaft
2. Fixed sheave surface

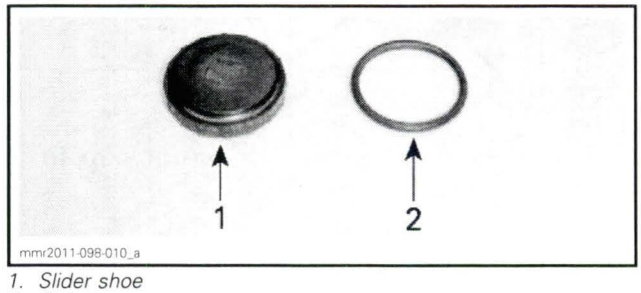
Governor Cup Inspection

Check governor cup for cracks or other visible damage.

Slider Shoes and Roller Inspection

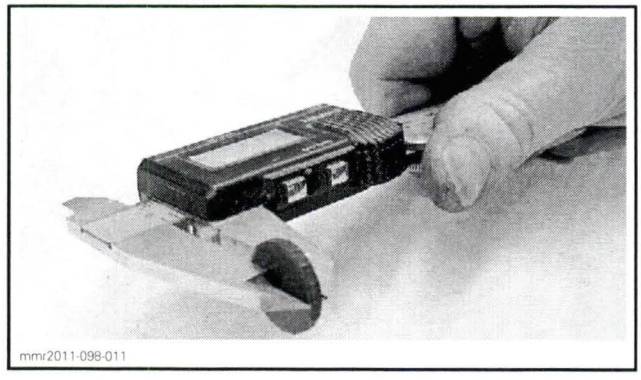
Check if O-rings of slider shoes are cracked, cut or crushed.

Check slider shoes for visible wear.



1. Slider shoe
2. O-ring

Measure the thickness of the slider shoes.



NOTE: Take measurement at the center of slider shoe.

SLIDER SHOE SERVICE LIMIT	
With O-ring	3.70 mm (.146 in)
Without O-ring	3.80 mm (.15 in)

Check each roller for roundness of external diameter.

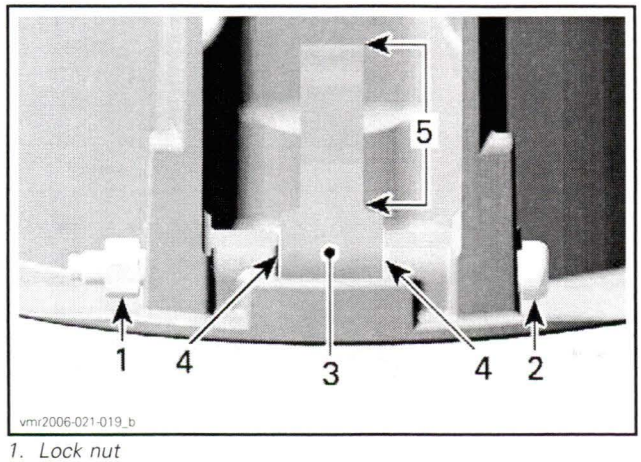
Check if rollers move freely.

NOTICE Whenever replacing rollers and slider shoes, always replace all rollers and slider shoes at the same time.

Centrifugal Lever Inspection

Check contact surfaces of centrifugal lever for visible wear.

If major wear is visible, replace the following:
- Centrifugal levers
- Thrust washers
- Centrifugal lever pivot bolts
- Centrifugal lever pivot lock nuts.

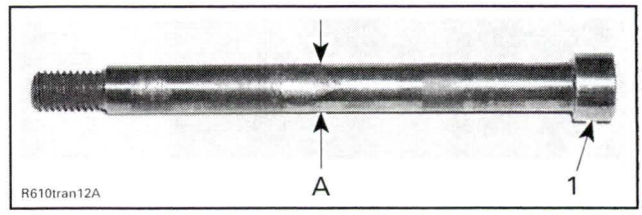


1. *Lock nut*
2. *Centrifugal lever pivot bolt*
3. *Centrifugal lever*
4. *Thrust washers*
5. *Contact surface to the roller*

⚠ WARNING

Whenever replacing centrifugal levers, always replace all levers at the same time. Otherwise, drive pulley imbalance will occur.

Measure diameter of centrifugal lever pivot bolt.

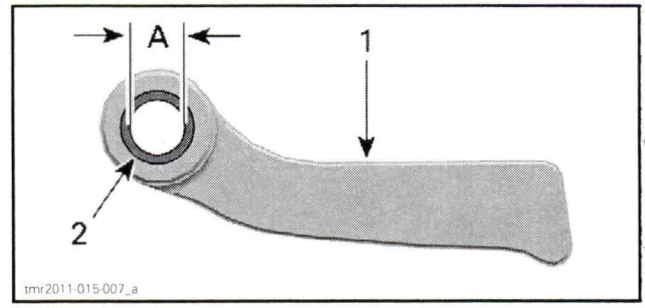


1. *Centrifugal lever pivot bolt*

A. Measure diameter here

CENTRIFUGAL LEVER PIVOT BOLT	
SPECIFICATION	**DIAMETER**
NOMINAL	6.063 mm to 6.091 mm (.239 in to .24 in)
SERVICE LIMIT	6.00 mm (.236 in)

Measure diameter of centrifugal lever bushing.



1. *Centrifugal lever*
2. *Bushing*

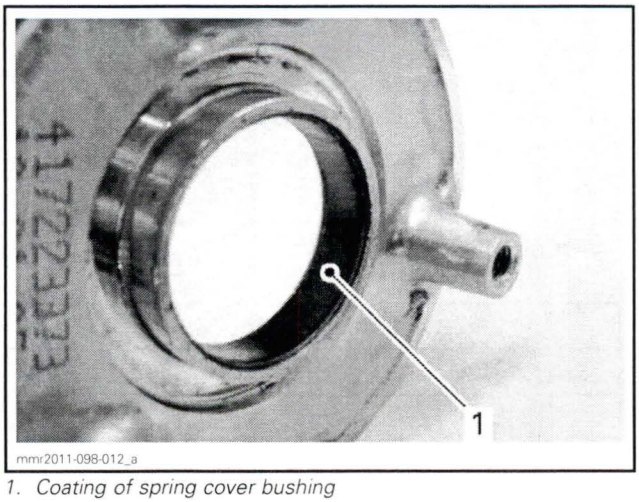
A. Bushing inner diameter

CENTRIFUGAL LEVER BUSHING	
SPECIFICATION	**INNER DIAMETER**
NOMINAL	6.00 mm to 6.12 mm (.236 in to .241 in)
SERVICE LIMIT	6.200 mm (.244 in)

Spring Cover Inspection

Check spring cover for cracks or wear.

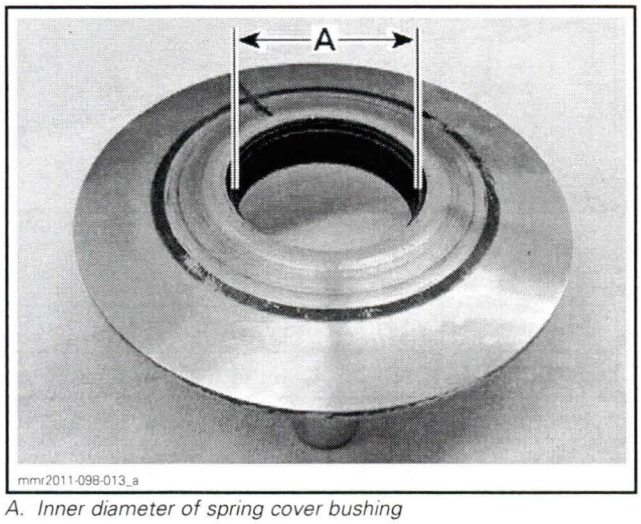
Check coating of spring cover bushing for wear.



1. Coating of spring cover bushing

Using a bore gauge, measure the inner diameter of spring cover bushing.

NOTE: Measuring point must be at least 6 mm (1/4 in) from bushing edge.



A. Inner diameter of spring cover bushing

SPRING COVER BUSHING	
SPECIFICATION	**INNER DIAMETER**
SERVICE LIMIT	38.37 mm (1.511 in)

If bushing is out of specification, replace spring cover.

Spring Inspection

Check spring free length.

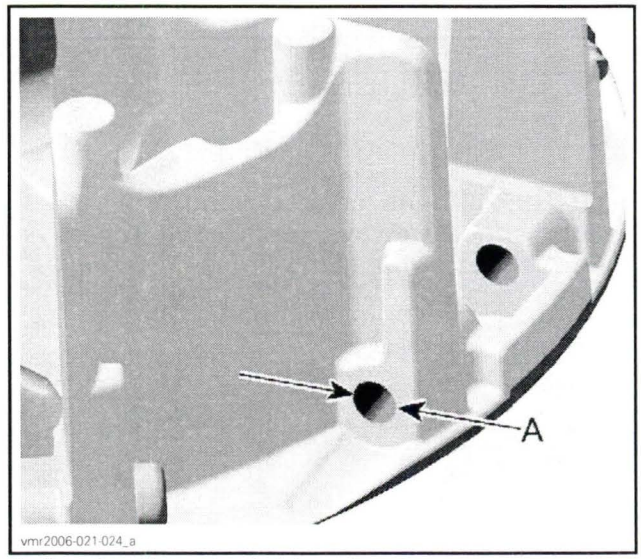
SPRING FREE LENGTH	
COLOR CODE	FREE LENGTH
RED/WHITE	115.0 mm (4.528 in)

Sliding Sheave Inspection

Check sliding sheave for cracks or other damage.

Check sliding contact surface for excessive wear.

Measure centrifugal lever pivot bolt bores.



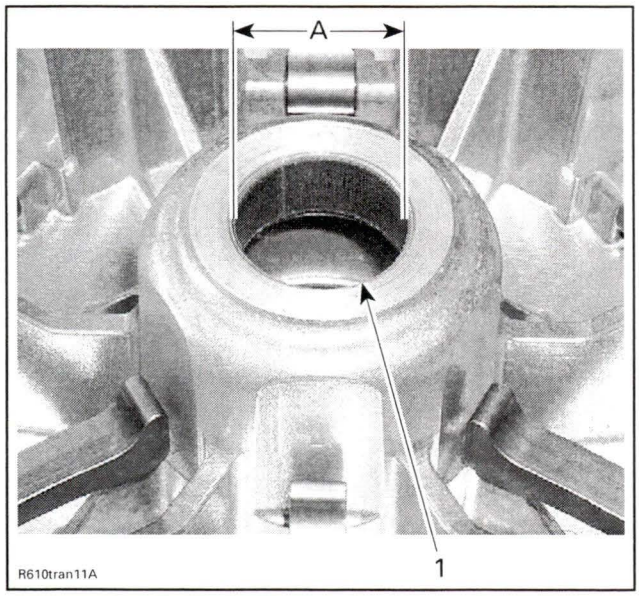
A. Centrifugal lever pivot bolt bore diameter

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

Check coating of sliding sheave bushing for wear.

Measure bushing diameter of sliding sheave.

NOTE: Use a dial bore gauge to measure bushing diameter. Measuring point must be at least 5 mm (1/4 in) from bushing edge.



TYPICAL
1. Sliding sheave bushing
A. Inner diameter of bushing

SLIDING SHEAVE BUSHING	
SPECIFICATION	**INNER DIAMETER**
NOMINAL	32.01 mm to 32.13 mm (1.26 in to 1.265 in)
SERVICE LIMIT	33.22 mm (1.308 in)

If bushing is out of specification, replace sliding sheave.

Drive Pulley Assembly

Spring Cover Installation

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

Tighten spring cover retaining screws to specification.

TIGHTENING TORQUE	
Spring cover retaining screws	25 N•m (18 lbf•ft)

Centrifugal Lever Installation

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

Install centrifugal levers with both thrust washers.

NOTICE **Centrifugal levers must move easily after installation.**

Tighten centrifugal lever pivot nuts to specification.

TIGHTENING TORQUE	
Centrifugal lever pivot nut	5 N•m (44 lbf•**in**)

Slider Shoes and Roller Installation

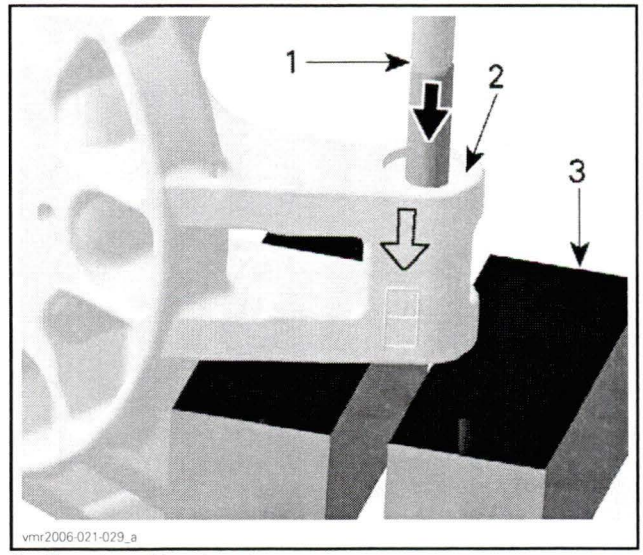
The installation is the reverse of removal procedure, however pay attention to the following.

Ensure that rollers move easily after installation.

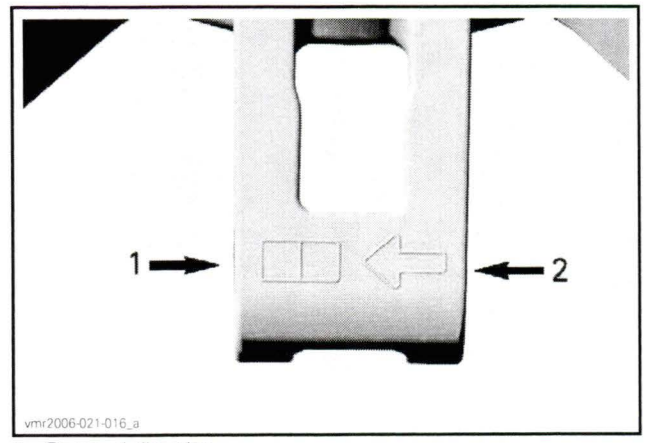
Install bearing sleeve by pushing it towards the same direction as the arrow.

Ensure the bearing sleeve is aligned with the contact surface of the slider shoes (no protrusion).

NOTICE **Do not clamp governor cup in the vice to avoid to damaging it.**

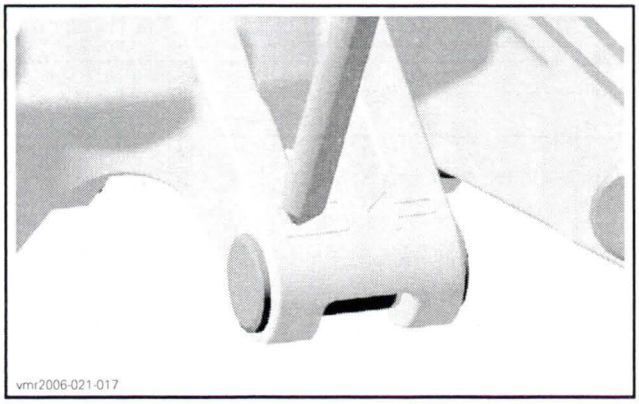


1. Top edge of bearing sleeve
2. Contact surface of slider shoes
3. Vice

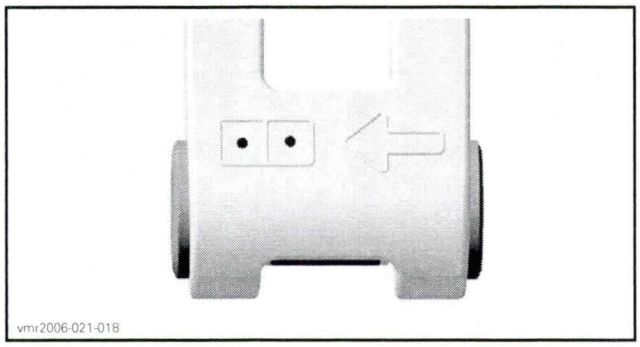


1. Removal direction
2. Assembly direction

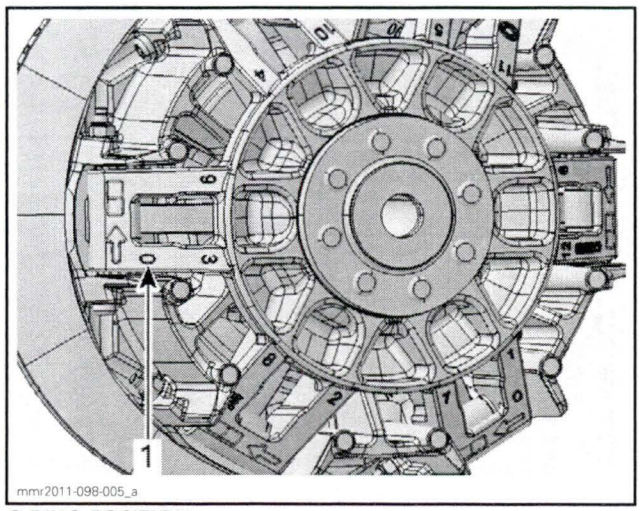
Carefully mark governor cup box using a punch.



NOTE: Never install a governor cup with two marks.



Install O-rings on slider shoes identified by an O on the governor cup. (total of 3 slider shoes with O-rings).



O-RING POSITION
1. O on governor cup

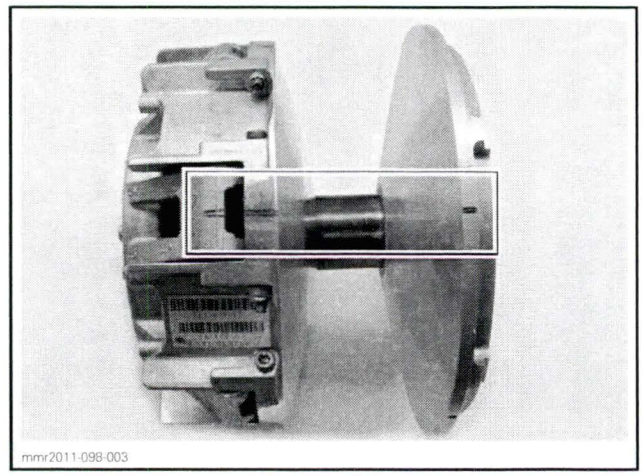
Governor Cup Installation

The installation is the reverse of removal procedure.

Fixed Sheave Assembly

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

Align fixed sheave, sliding sheave and governor cup together using the index marks (index marks have been traced at the factory).



Drive Pulley Installation

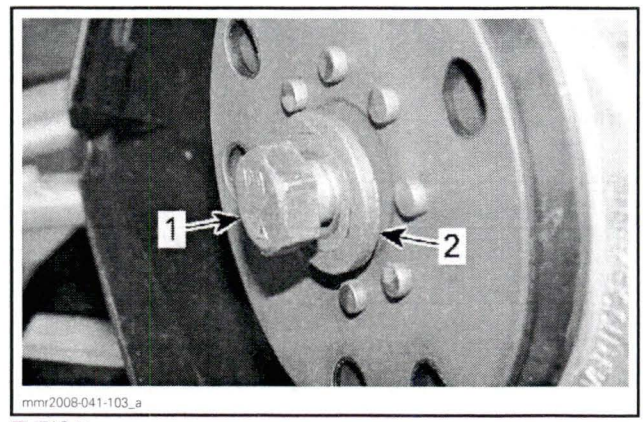
For installation, reverse the removal procedure. However, pay attention to the following.

Clean mounting surfaces as described in *DRIVE PULLEY CLEANING* above.

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

Install NEW conical spring washer with its concave side towards drive pulley.

NOTICE Always use BRP genuine parts for conical spring washer and screw.



TYPICAL
1. Drive pulley screw
2. Conical spring washer

1. Tighten drive pulley retaining screw to specification.

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

DRIVE PULLEY FIRST TORQUE
120 N•m (89 lbf•ft)

2. Lift rear of vehicle and support it safely.

⚠ WARNING

Ensure the track is free of particles which could be thrown out while track is rotating. Keep hands, tools, feet and clothing clear of track. Ensure nobody is standing near the vehicle.

3. Start engine.
4. Release parking brake.
5. Accelerate vehicle at low speed (maximum 32 km/h (20 MPH)).
6. Apply brake.
7. Repeat the above sequence 5 times.
8. Stop engine.
9. Lower vehicle back on ground.
10. Retighten drive pulley retaining screw to specification.

DRIVE PULLEY FINAL TORQUE
120 N•m (89 lbf•ft)

⚠ WARNING

After 10 hours of operation, the torque of the drive pulley retaining screw must be checked.

DRIVE PULLEY (TRA III)

SERVICE TOOLS

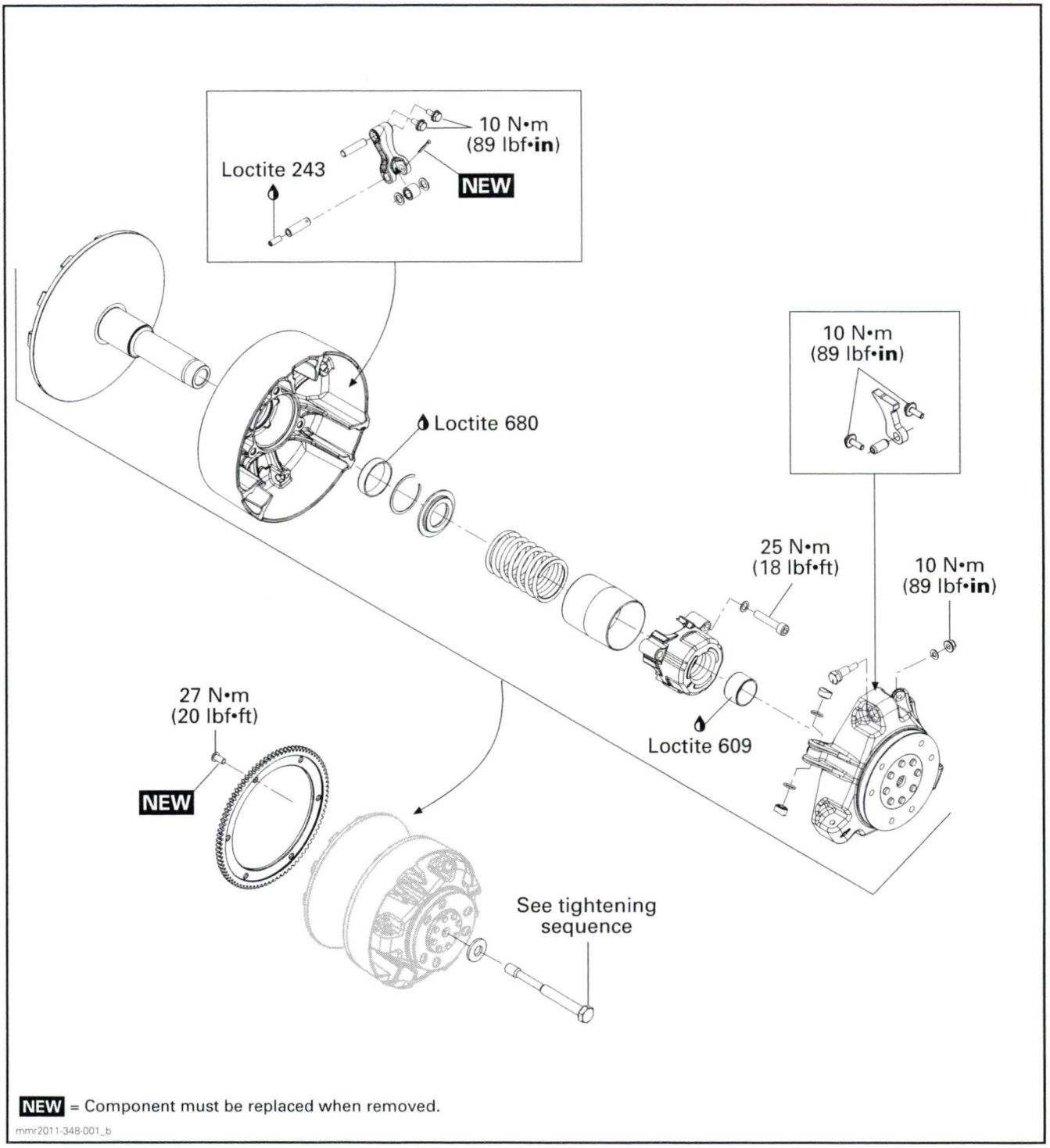
Description	Part Number	Page
BUSHING PULLER/INSTALLER	529 031 200	717
BUSHING REMOVER/INSTALLER	529 035 931	717, 719
DRIVE PULLEY HOLDER	529 035 674	713, 723
DRIVE PULLEY PULLER	529 000 064	713
PULLEY SPRING COMPRESSOR TOOL	529 036 012	715, 717, 719, 721
SLIDER SHOE FORK	529 005 500	714, 720

SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
TEMPILSTIK INDICATOR STICK	TS212F	716

SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 243 (BLUE)	293 800 060	722
LOCTITE 680	293 800 118	719
PULLEY FLANGE CLEANER	413 711 809	717–718



NEW = Component must be replaced when removed.

mmr2011-348-001_b

GENERAL

TRA™ drive pulley stands for **Total Range Adjustable** drive pulley.

These are lubrication free drive pulleys. Do not lubricate any component.

Some drive pulley components (return spring, ramp) can be changed to improve vehicle performance in high altitude regions. A Service Bulletin provides information about calibration according to altitude.

NOTICE Such modifications should only be performed by experienced mechanics since they can greatly affect vehicle performance. Verify spring specifications before installation. Do not only refer to the spring color code.

⚠ WARNING

Any drive pulley repairs must be performed by an authorized Ski-Doo dealer. Subcomponent installation and assembly tolerances require strict adherence to procedures detailed.

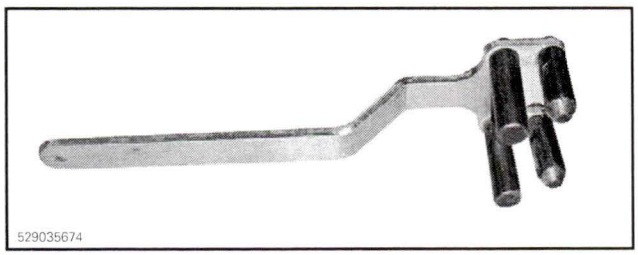
PROCEDURES

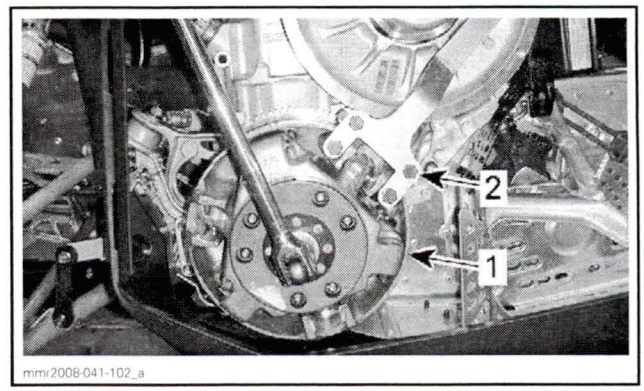
DRIVE PULLEY

Drive Pulley Removal

Remove drive belt. Refer to *DRIVE BELT* subsection.

Secure drive pulley with the DRIVE PULLEY HOLDER (P/N 529 035 674). Install it over a sliding sheave tower.

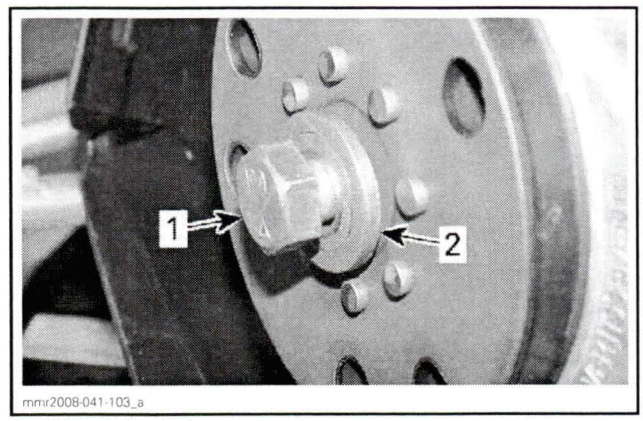




TYPICAL
1. *Drive pulley*
2. *Drive pulley holder*

Remove the drive pulley bolt and its conical spring washer.

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

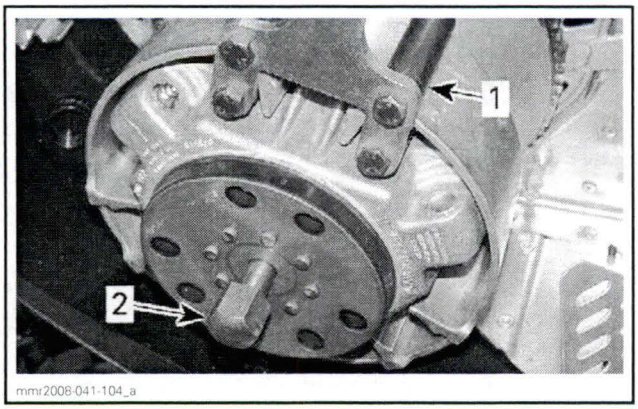


1. *Drive pulley bolt*
2. *Conical spring washer*

To remove drive pulley from engine, use the following tools:

REQUIRED TOOLS	
DRIVE PULLEY HOLDER (P/N 529 035 674)	
DRIVE PULLEY PULLER (P/N 529 000 064)	

To remove the drive pulley, hold drive pulley and tighten the puller.



1. Drive pulley holder
2. Drive pulley puller

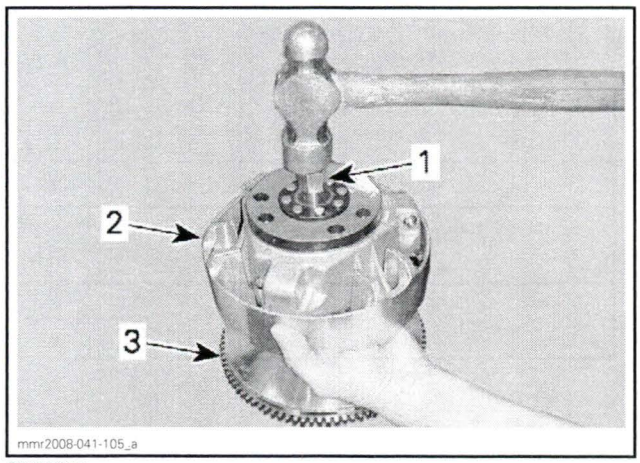
NOTICE These pulleys have metric threads. Do not use a puller with ANS (American National Standard) or IS (International Standard) type threads. Always tighten puller by hand to ensure that the drive pulley has the same type of threads (metric vs ANS or IS)) prior to fully tightening.

Drive Pulley Disassembly

To separate fixed sheave from sliding sheave, screw puller into fixed sheave shaft about 13 mm (1/2 in).

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

NOTICE NEVER tap on governor cup.



TYPICAL
1. Puller screwed 13 mm (1/2 in) in fixed sheave
2. Sliding sheave
3. Fixed sheave

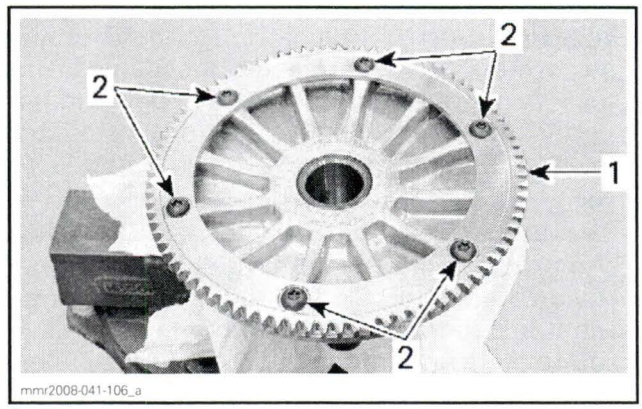
NOTE: No component marking is required before disassembly, this drive pulley features factory apposed index marks as reference.

If separation of the fixed sheave from the sliding sheave is hard, use a heat gun to slightly heat the governor cup to expand its taper.

NOTICE Never use any type of torch to heat governor cup.

Ring Gear Removal

To remove the ring gear, use a heat gun to break the threadlocker on ring gear screws. Discard the ring gear screws.

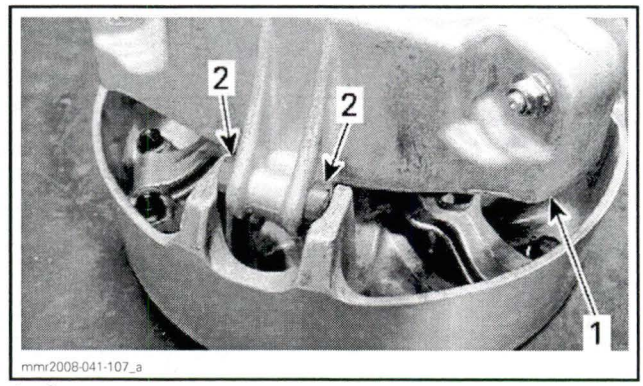


1. Ring gear
2. Ring gear screws

NOTICE If a tool other than a heat gun is used, do not exceed 150°C (302°F).

Slider Shoes and Governor Cup Removal

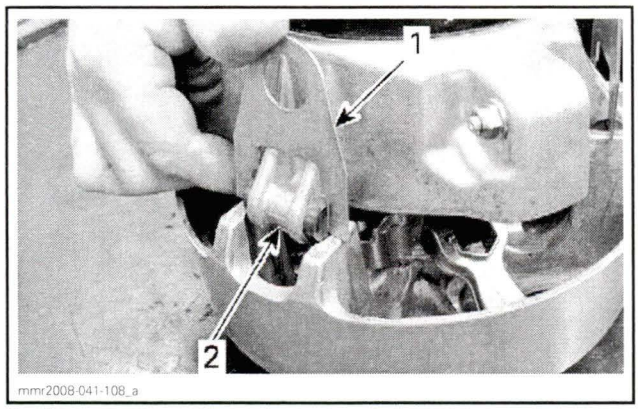
Carefully lift governor cup until slider shoes are at their highest position in the guides.



1. Governor cup
2. Slider shoes

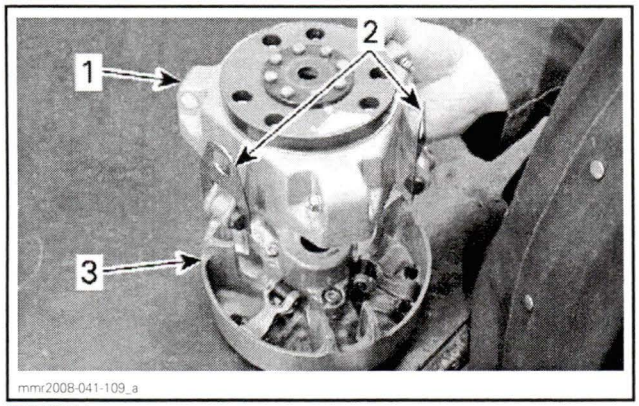
Hold slider shoes in place using the following tool.

REQUIRED TOOL	
SLIDER SHOE FORK (P/N 529 005 500)	



1. Governor cup
2. Slider shoe forks

When all slider shoes are held with the forks, remove the governor cup.



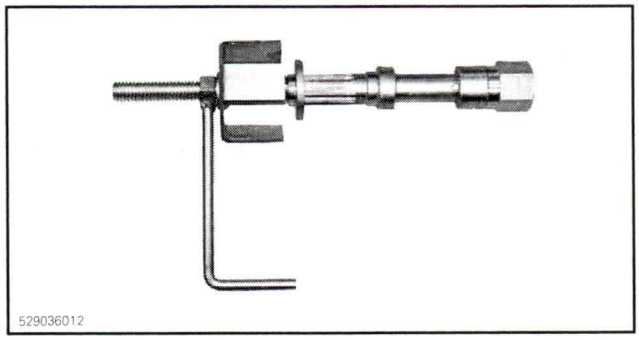
TYPICAL
1. Governor cup
2. Slider shoe forks
3. Sliding sheave

Spring Cover Removal

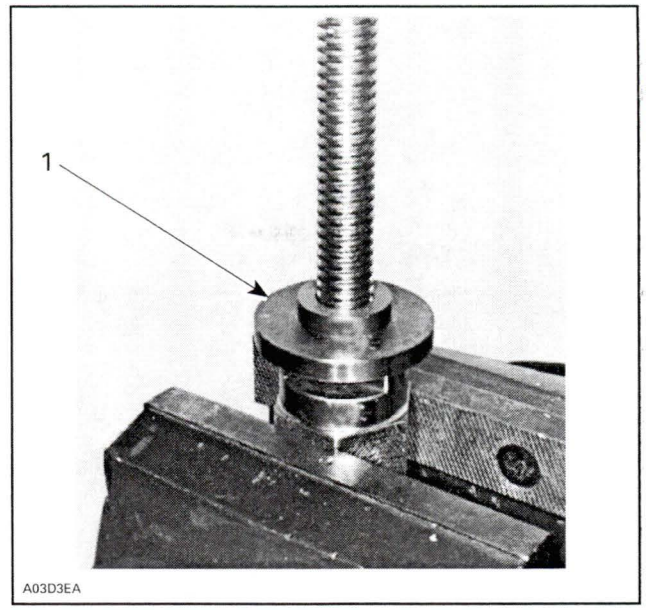
To remove the spring cover, always use the PULLEY SPRING COMPRESSOR TOOL (P/N 529 036 012).

⚠ WARNING

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



Install support guide of spring compressor in a vice.

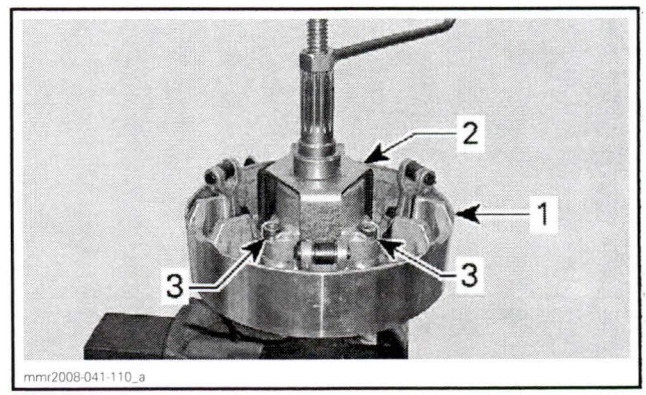


1. Support guide

NOTE: The support guide will prevent bushing damages.

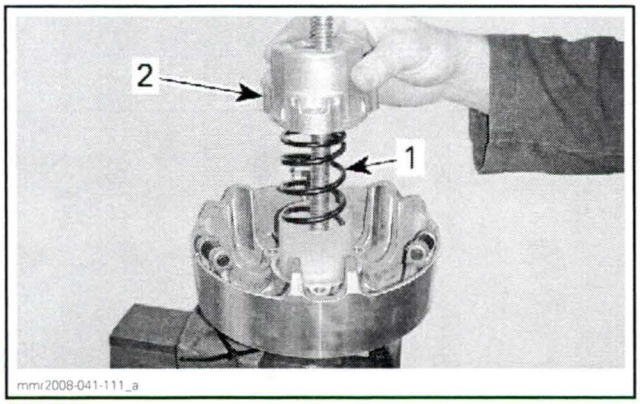
Install sliding sheave then the support cup over spring cover.

Remove 3 Allen screws retaining spring cover then unscrew compressor.



TYPICAL
1. Sliding sheave
2. Support cup
3. Spring cover screws

Remove spring cover, spring and spring seat.



TYPICAL
1. *Spring*
2. *Spring cover*

Hollow Threaded Pin Set Screw Removal

Position a propane torch ± 25.4 mm (1 in) from the end of the pin (on the opposite side of the cotter pin).

Heat during 10 to 15 seconds or until the end of the pin reaches 100°C (212°F) and stop heating.

NOTE: Probe the end of the pin with a temperature indicator stick such as the TEMPILSTIK INDICATOR STICK (P/N TS212F), which will liquefy when pin reaches the correct temperature.

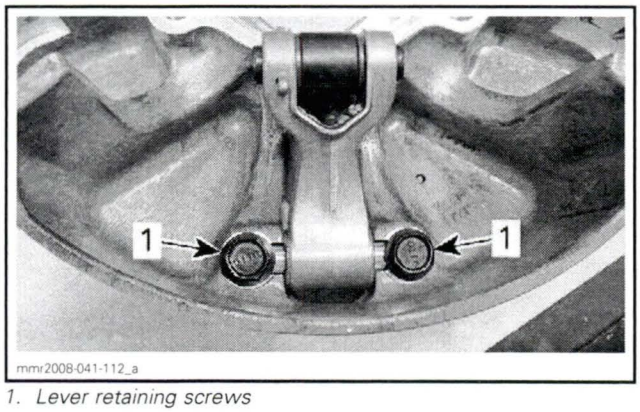
NOTICE Make sure not to exceed 100°C (212°F). Exceeding this temperature will cause severe pulley damages.

Wait approximately 30 seconds and remove the set screw.

NOTE: If the set screw cannot be removed, heat the pin end again during 5 seconds and try again to remove set screw. Make sure not to exceed 100°C (212°F).

Lever, Roller and Pin Removal

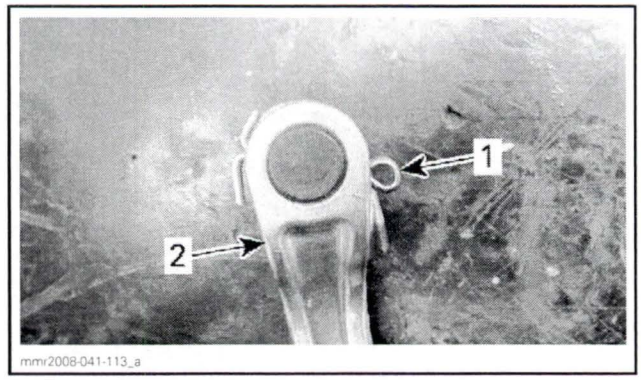
Remove lever retaining screws.



1. *Lever retaining screws*

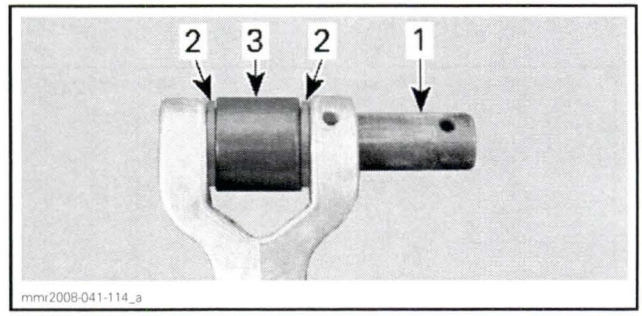
Pull lever to remove it from sliding sheave.

Remove and discard the cotter pin.



1. *Cotter pin*
2. *Lever*

Remove pin, thrust washers and roller.

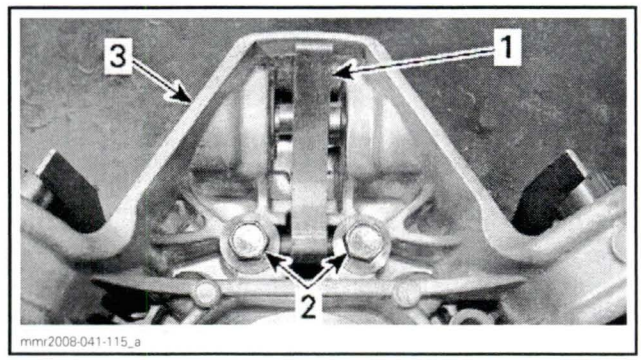


1. *Pin*
2. *Thrust washers*
3. *Roller*

Ramp Removal

Turn the governor cup up side down.

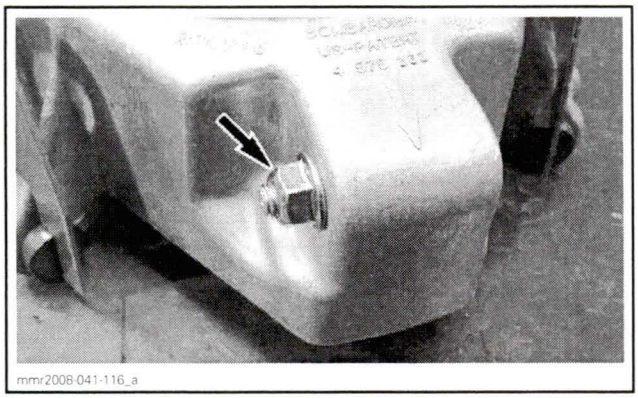
Remove screws retaining ramp to governor cup.



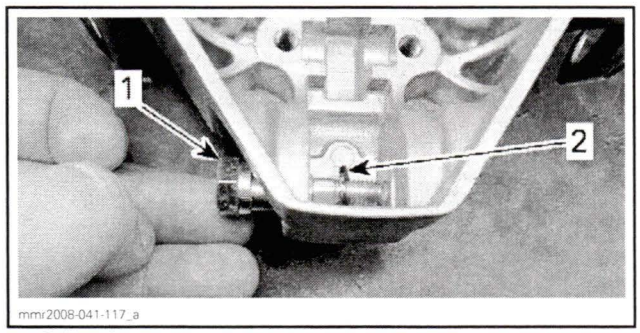
1. *Ramp*
2. *Ramp screws*
3. *Governor cup*

Calibration Screw Removal

Unscrew the nut securing the calibration screw.


mmr2008-041-116_a

Remove calibration screw and its washer.



mmr2008-041-117_a

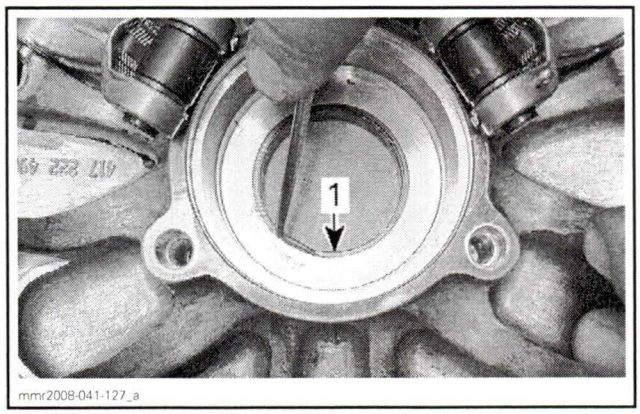
1. Calibration screw
2. Washer

Sliding Sheave Bushing Removal

NOTE: In case of worn out bushing, it is advisable to replace whole sliding sheave assembly as replacing just the bushing may reduce drive pulley performance.

If bushing is out of specifications, remove it as follows:

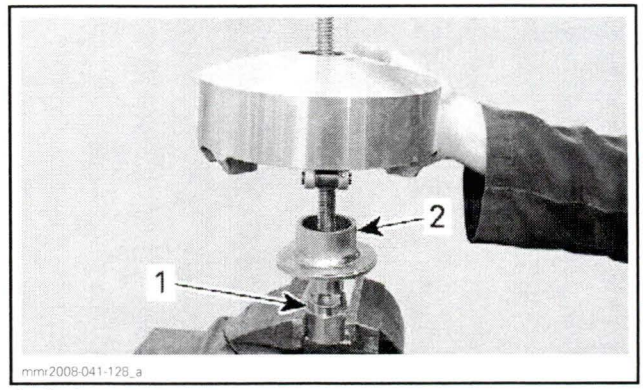
1. Remove circlip from sliding sheave.



mmr2008-041-127_a

1. Circlip

2. Secure the PULLEY SPRING COMPRESSOR TOOL (P/N 529 036 012) in a vice.
3. Mount the BUSHING PULLER/INSTALLER (P/N 529 031 200) and the sliding sheave assembly on it.

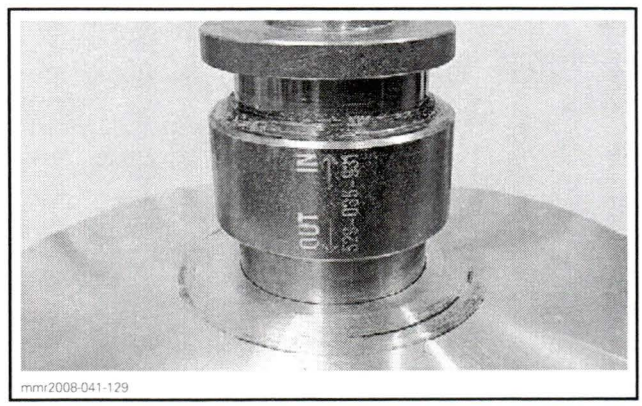


mmr2008-041-128_a

1. Spring compressor
2. Bushing remover/installer

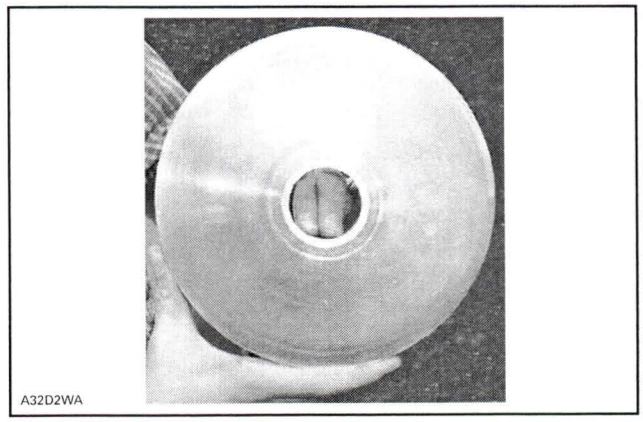
4. Use the BUSHING REMOVER/INSTALLER (P/N 529 035 931) to press out old bushing.

NOTE: Make sure to use the tool as marked; to remove the bushing press using the side marked "OUT", as shown below in the picture.



mmr2008-041-129

5. Use a soft sand paper to clean sliding sheave bushing mounting surface.


A32D2WA

6. Clean sliding sheave bushing mounting surface with PULLEY FLANGE CLEANER (P/N 413 711 809).
7. Clean the circlip groove.

Drive Pulley Cleaning

Parts must be at room temperature before cleaning.

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

Using a paper towel with PULLEY FLANGE CLEANER (P/N 413 711 809), clean the following components.

- Crankshaft tapered end
- Taper inside fixed sheave of drive pulley
- Crankshaft threads
- Retaining screw threads.

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

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

NOTICE **Do not use any other type of abrasive.**

Reclean mounting surfaces with paper towel and cleaning solvent.

Wipe off the mounting surfaces with a clean, dry paper towel.

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

Drive Pulley Inspection

NOTE: During inspection, replace any component if found defective or out of specifications.

Fixed Sheave and Governor Cup

Inspect fixed sheave for marks or scratches.

Inspect fixed sheave and governor cup splines.

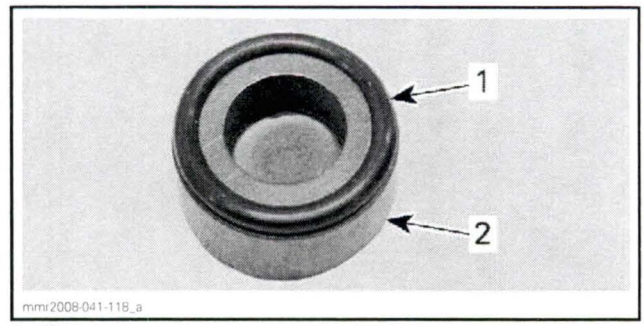
Check free-play between governor cup and fixed sheave.

NOTE: Maximum free play is measured at calibration screw radius.

MAXIMUM FREE PLAY	
Between fixed sheave and governor cup splines	0.5 mm (.02 in)

Slider Shoes

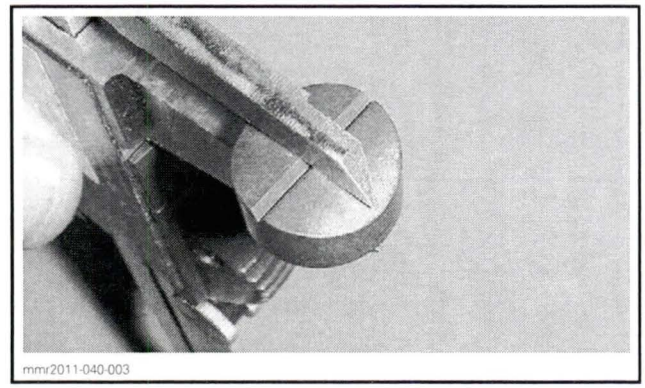
Check if slider shoe O-rings are cracked, cut or crushed.



1. O-ring
2. Slider shoe

Measure the thickness of slider shoes. Take measurement at the center of slider shoe, perpendicularly with the groove.

SLIDER SHOE THICKNESS	
SERVICE LIMIT	7.45 mm (19/64 in)

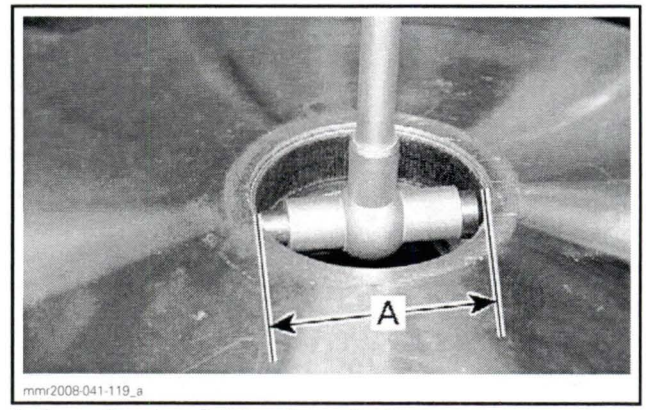


Sliding Sheave

Inspect pulley sheave for marks or scratches.

Visually inspect coating of bushings.

Using a bore gauge, measure the inner diameter of sliding sheave bushing. Measuring point must be at least 6 mm (1/4 in) from bushing edge.



A. Inner diameter of sliding sheave bushing

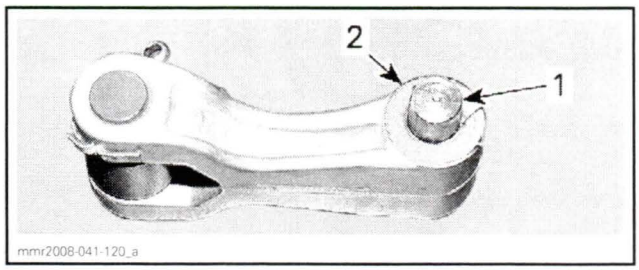
SLIDING SHEAVE BUSHING (inner bushing)	
SERVICE LIMIT	40.3 mm (1.587 in)

Lever, Roller and Pin

Check levers for cracks, distortion or other damages.

Check lever pivot for wear.

Check lever flanged bushing for wear.



1. Lever pivot
2. Lever flanged bushing

Check rollers for roundness of external diameter.

Check thrust washers for thickness wear.

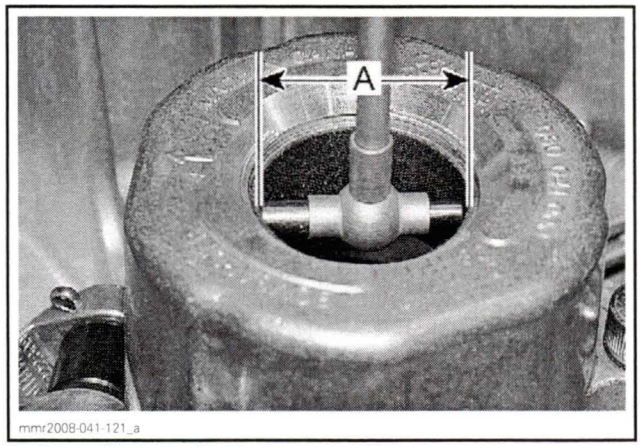
Check roller pins for wear.

Spring Cover

Check spring cover for cracks or wear.

Visually inspect the coating of spring cover bushing for wear.

Using a bore gauge, measure the inner diameter of spring cover bushing. Measuring point must be at least 5 mm (1/4 in) from bushing edge.



A. Inner diameter of spring cover bushing

SPRING COVER BUSHING (inner bushing)	
SERVICE LIMIT	30.4 mm (1.197 in)

Replace the spring cover if the inner diameter of bushing is out of specification.

Spring

Check spring color code and free length. Replace if necessary.

DRIVE PULLEY SPRING	
COLOR CODE	FREE LENGTH
YELLOW/RED	121.1 mm (4.768 in)

Drive Pulley Assembly

Sliding Sheave Bushing Installation

Secure the sliding sheave in a vice using the following tool.

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

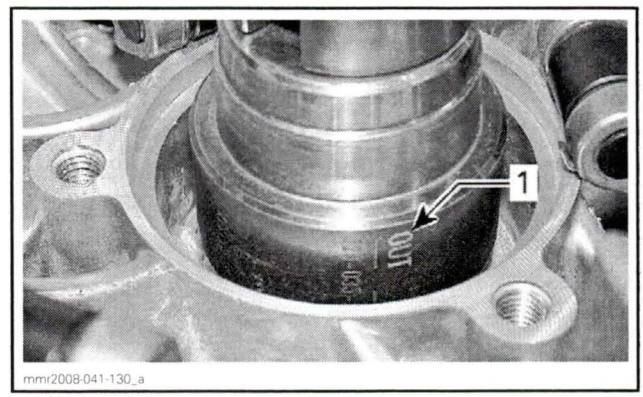
Apply LOCTITE 680 (P/N 293 800 118) on the outside of bushing face.

Insert the bushing from inner side of sliding sheave.

Press in the new bushing.

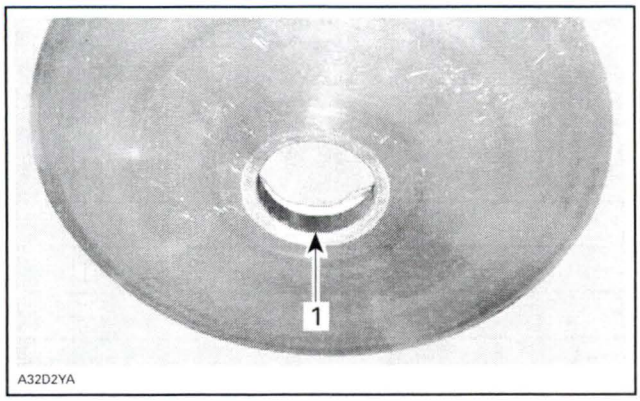
REQUIRED TOOL	
BUSHING REMOVER/INSTALLER (P/N 529 035 931)	

NOTE: Press in the bushing with the side marked "IN".



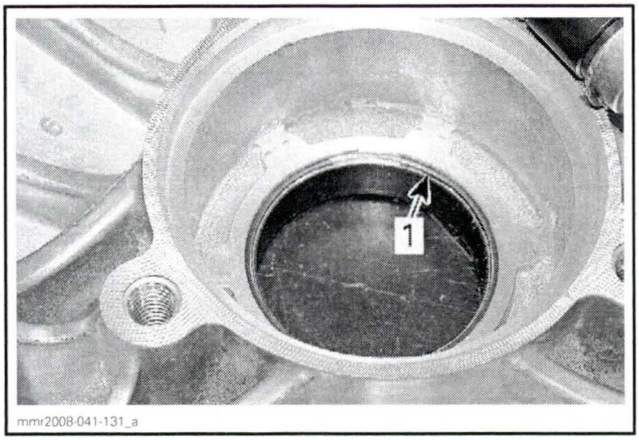
1. Mark "OUT" toward outside

NOTE: Make sure that the bushing is well seated on the sliding sheave.



1. Bushing

Install the circlip.



1. Circlip

NOTICE Make sure that the circlip is properly position in its groove.

Ring Gear Installation

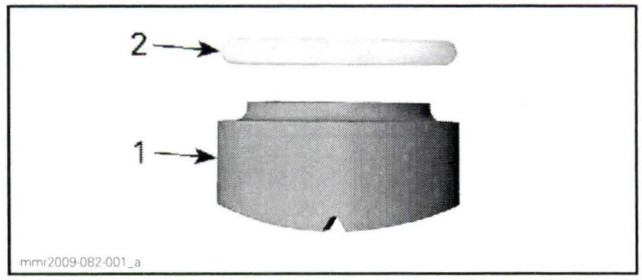
Clean ring gear and the inner threads of fixed sheave.

Install **NEW** ring gear screws and torque them in accordance with the following chart.

TIGHTENING TORQUE	
Ring gear screw	27 N•m (20 lbf•ft)

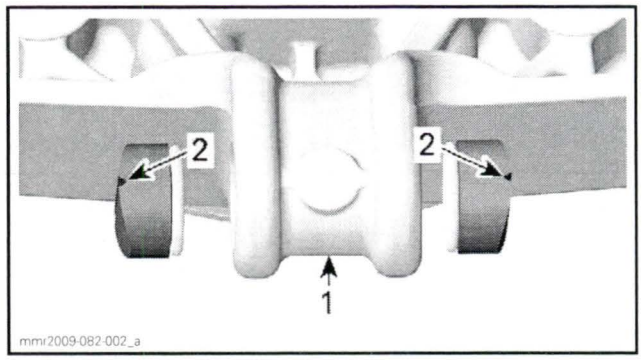
Sliding Sheave, Slider Shoes and Governor Cup Installation

Install an O-ring on each slider shoes.



1. Slider shoe
2. O-ring

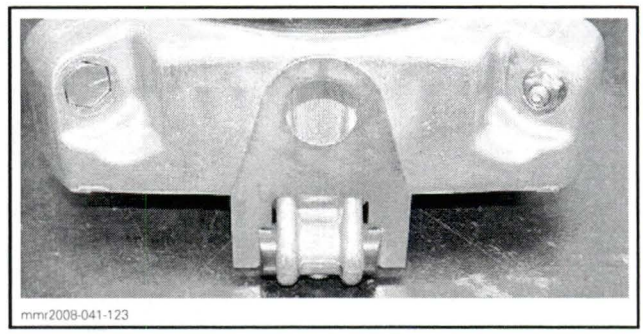
Insert slider shoes into governor cup so that groove in each slider shoe is vertical to properly slide in guides.



1. Governor cup
2. Slider shoe grooves

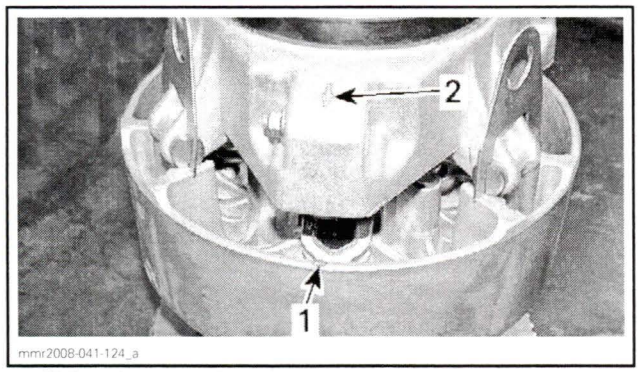
Install slider shoes on governor cup and hold them using the following tool.

REQUIRED TOOL	
SLIDER SHOE FORK (P/N 529 005 500)	



Carefully slide governor cup into sliding sheave.

NOTE: Make sure to align governor cup arrow with sliding sheave mark.



1. *Sliding sheave mark*
2. *Governor cup arrow*

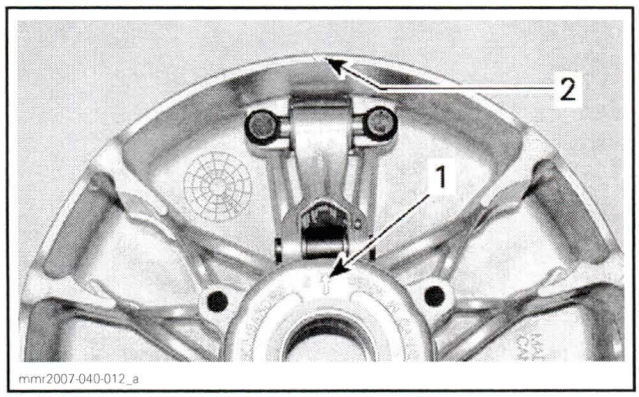
Remove forks and push governor cup.

Spring Cover Installation

Secure the sliding sheave in a vice and compress spring cover using the following tool.

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

Align spring cover arrow with sliding sheave mark.



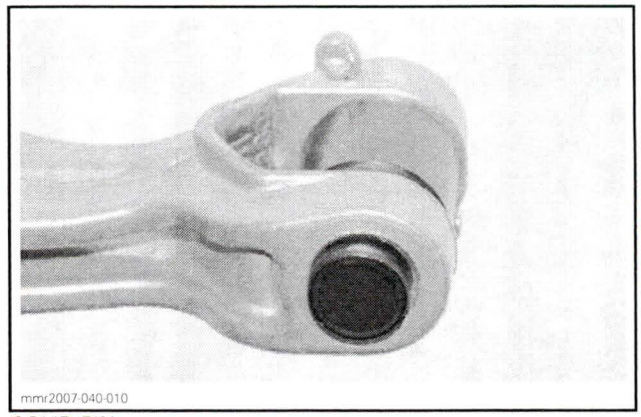
TYPICAL
1. *Spring cover arrow*
2. *Sliding sheave mark*

Tighten spring cover screws to specification.

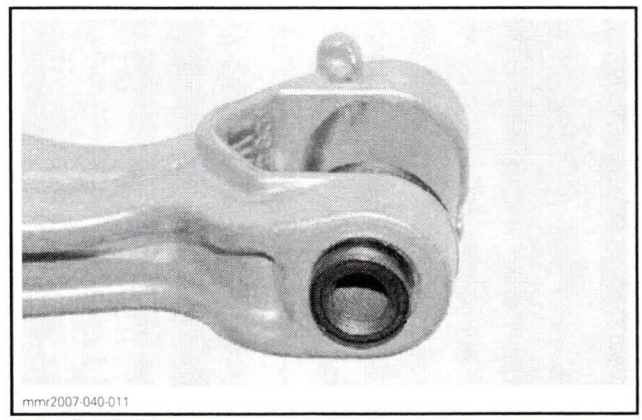
TIGHTENING TORQUE	
Spring cover screws	25 N•m (18 lbf•ft)

Lever, Roller and Pin Installation

Always use the same type of pin as originally installed when servicing. Refer to *TECHNICAL SPECIFICATIONS*.



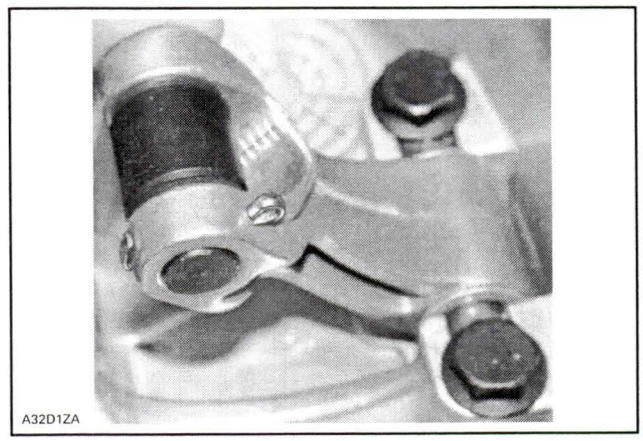
SOLID PIN



HOLLOW PIN

NOTE: Different types have different weights for calibration purpose. Refer to *HIGH ALTITUDE BULLETIN*.

While installing lever make sure that the curved sides of the levers are outwards as shown.

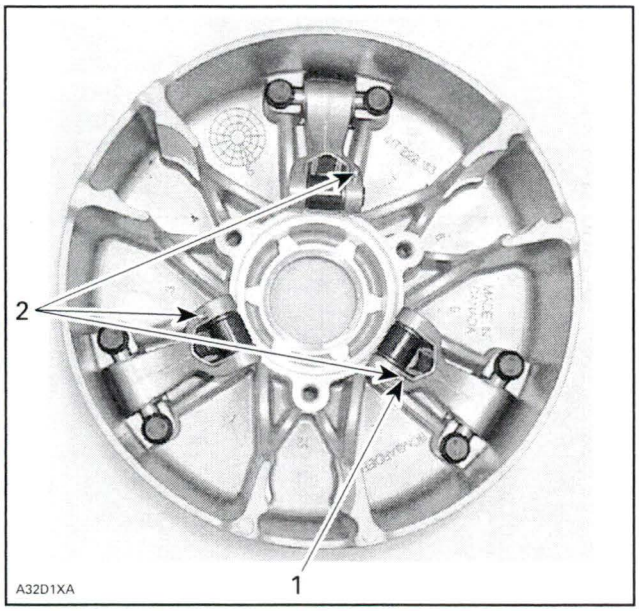


Always install lever assemblies so cotter pin heads are oriented on top when lever is set at the bottom of sliding sheave.

Bend cotter pin ends to sit perfectly against lever.

⚠ WARNING

Whenever replacing centrifugal levers, always replace all 3 at the same time. Otherwise, drive pulley unbalance will occur because of levers difference.



1. Cotter pin head on top
2. All on the same side

Torque lever screws to specification.

TIGHTENING TORQUE	
Lever screws	10 N•m (89 lbf•**in**)

NOTICE **Levers and rollers must move easily after installation.**

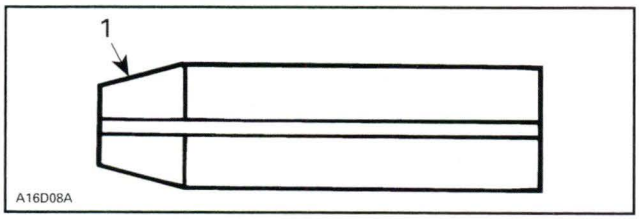
Hollow Threaded Pin Set Screw installation

Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on set screw.

Tighten the set screw completely inside the hollow threaded pin.

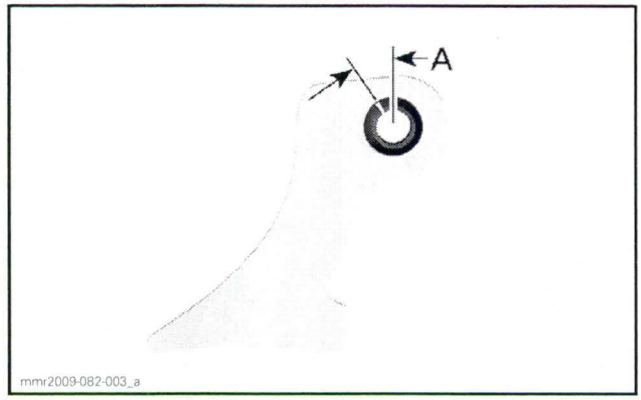
Ramp Installation

Insert dowel tube from chamfered side.



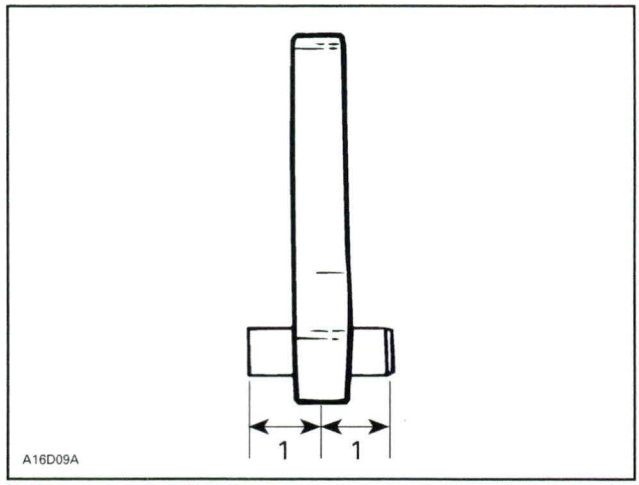
1. Chamfered side

Position dowel tube split at the angle "A".



MODEL	ANGLE "A"
All	45 ± 3°

Make sure ramp is centered on dowel tube.



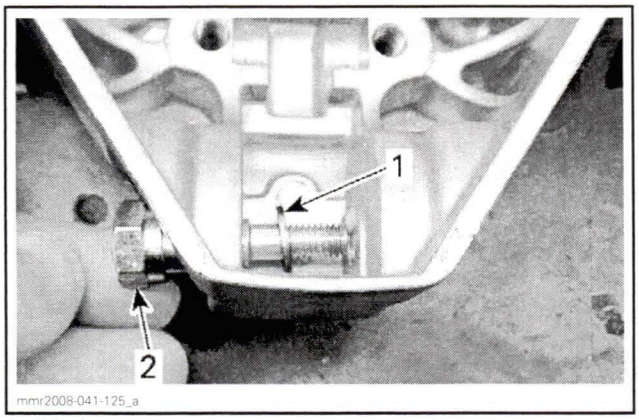
1. Equal distance

Torque ramp screws to specification.

TIGHTENING TORQUE	
Ramp screws	10 N•m (89 lbf•**in**)

Calibration Screw Installation

When installing calibration screw, make sure to install washer as shown.



1. Washer
2. Calibration screw

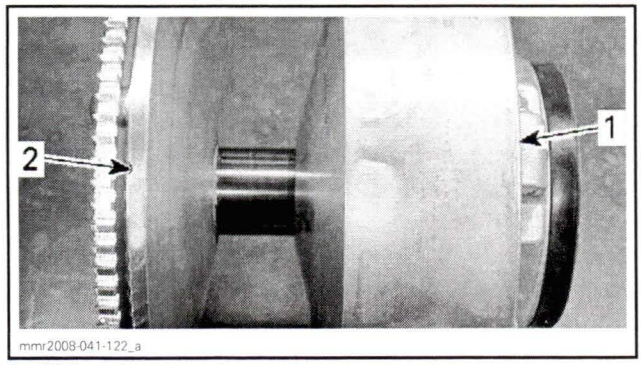
NOTE: Refer to *DRIVE PULLEY ADJUSTMENT*, further in this section, to install the calibration screws in original setting.

Torque locking nut to specification.

TIGHTENING TORQUE	
Calibration screw nuts	10 N•m (89 lbf•**in**)

Sliding Sheave and Fixed Sheave Assembly

To assemble the sliding sheave on the fixed sheave, align sliding sheave mark with the dot at the back of fixed sheave.



1. Sliding sheave mark
2. Fixed sheave dot

NOTE: Push sliding sheave until governor cup splines are engaged on fixed sheave splines.

Drive Pulley Installation

Clean mounting surfaces as described in *DRIVE PULLEY CLEANING* above.

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

Install drive pulley on crankshaft extension.

Install a **NEW** conical spring washer with its concave side towards drive pulley then install drive pulley bolt.

NOTICE Always use BRP genuine parts for conical spring washer and bolt.

Install the drive pulley bolt.

NOTICE Make sure to use the proper bolt length to avoid damaging the crankshaft.

DRIVE PULLEY BOLT LENGTH
152.5 mm (6.004 in)

Hold drive pulley and torque drive pulley bolt.

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

REQUIRED TOOL	
DRIVE PULLEY HOLDER (P/N 529 035 674)	

DRIVE PULLEY FIRST TORQUE	
All engines	120 N•m (89 lbf•ft)

Before starting engine, perform drive pulley adjustment, see further in this section.

Install drive belt and guard.

Raise the rear of the vehicle and support it with a mechanical stand.

⚠ WARNING

Ensure that the track is free of particles which could be thrown out while track is rotating. Keep hands, tools, feet and clothing clear of track. Ensure nobody is standing near the vehicle.

Accelerate the vehicle at low speed (maximum 32 km/h (20 MPH) and apply the brake, repeat 5 times.

Re-torque drive pulley bolt.

DRIVE PULLEY FINAL TORQUE	
All engines	120 N•m (89 lbf•ft)

⚠ WARNING

After 10 hours of operation the transmission system of the vehicle must be inspected to ensure drive pulley bolt is properly torqued.

Drive Pulley Adjustment

The drive pulley is factory calibrated to transmit maximum engine power at a predefined RPM. Factors such as ambient temperature, altitude or surface condition may vary this critical engine RPM thus affecting snowmobile efficiency.

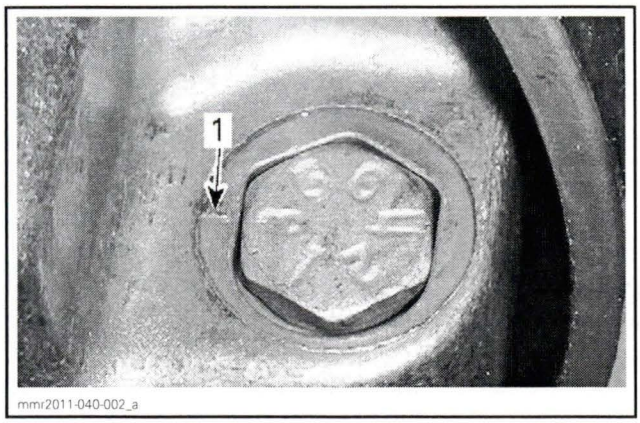
This adjustable drive pulley allows setting maximum engine RPM in the vehicle to maintain maximum power. Refer to *ENGINE MANAGEMENT SYSTEM* for engine RPM adjustment.

Calibration screws should be adjusted so that actual maximum engine RPM in vehicle matches the maximum horsepower RPM given in *TECHNICAL SPECIFICATIONS*.

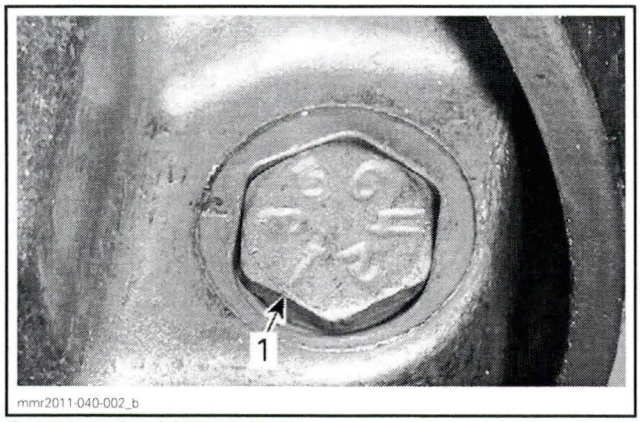
NOTE: The adjustment has an effect on high RPM only.

To adjust, modify ramp end position by turning calibration screws.

Governor cup has a notch while calibration screw head has 6 positions numbered 1 to 6.



GOVERNOR CUP
1. Notch



CALIBRATION SCREW HEAD
1. Position 1

See the following table for original setting.

CALIBRATION SCREW FACTORY SETTING
2

Each number modifies maximum engine RPM by about 200 RPM.

Lower numbers decrease engine RPM in steps of 200 RPM and higher numbers increase it in steps of 200 RPM.

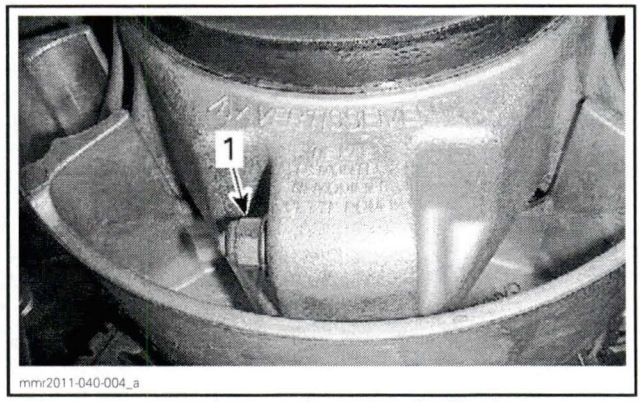
Example:

Calibration screw is set at position 3 and is changed to position 5. So maximum engine RPM is increased by about 400 RPM.

To Adjust:

Just loosen locking nut enough to pull calibration screw **partially** out. Do not completely remove the locking nut.

NOTICE Do not completely remove calibration screw otherwise its inside washer will fall off.



1. Loosen just enough to permit rotating of calibration screw

Adjust to desired position.

NOTICE Always adjust all 3 calibration screws and make sure they are all set at the same number.

Torque locking nuts to specification.

TIGHTENING TORQUE	
Calibration screw nuts	10 N•m (89 lbf•**in**)

DRIVEN PULLEY AND COUNTERSHAFT (550F AND 600 ACE)

SERVICE TOOLS

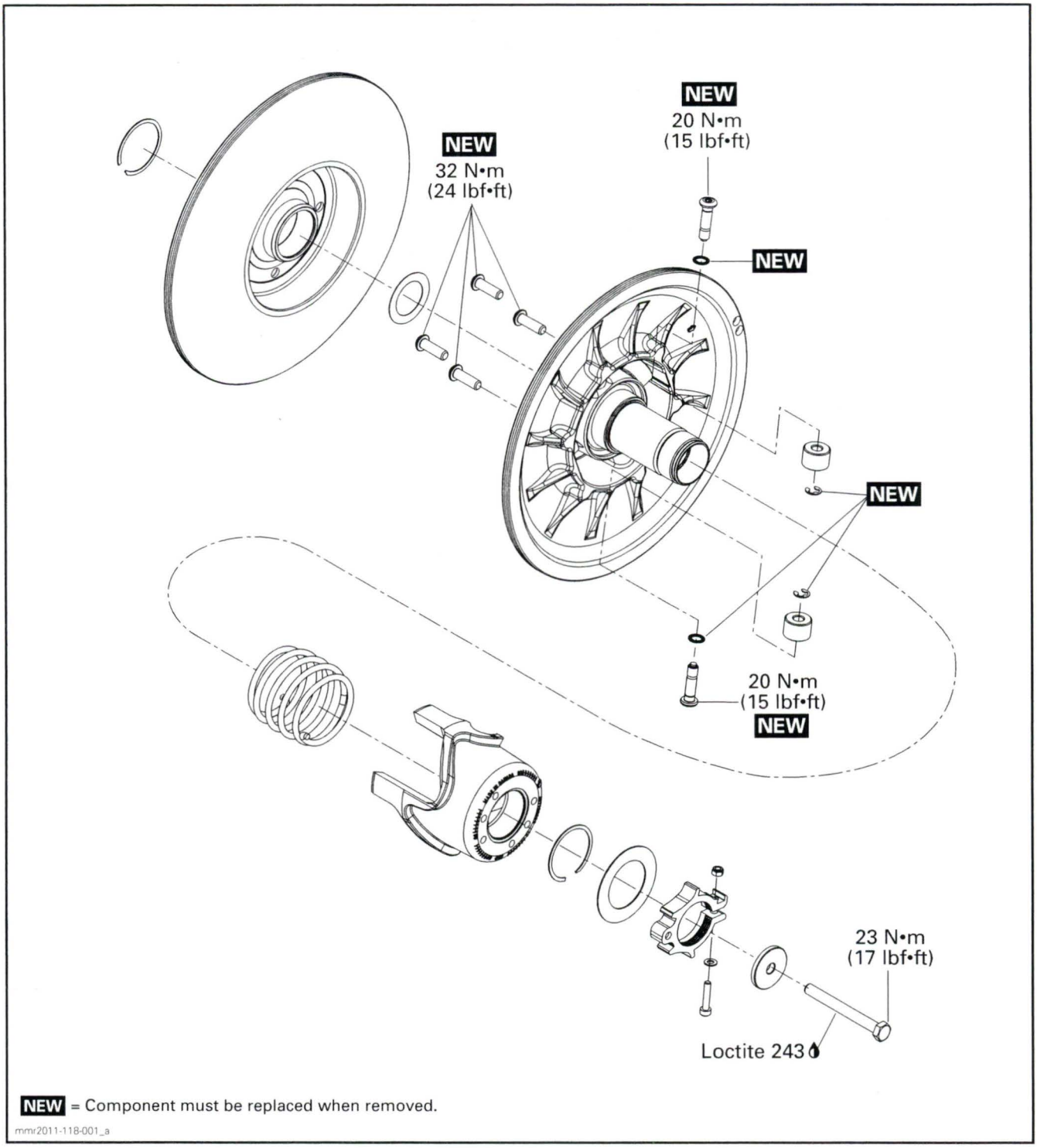
Description	Part Number	Page
ALIGNMENT BAR	529 036 157	728
DRIVEN PULLEY SPRING COMPRESSOR	529 036 182	731
ENGINE LIFTING TOOL	529 036 217	737
PRELOAD TESTER	529 036 164	729

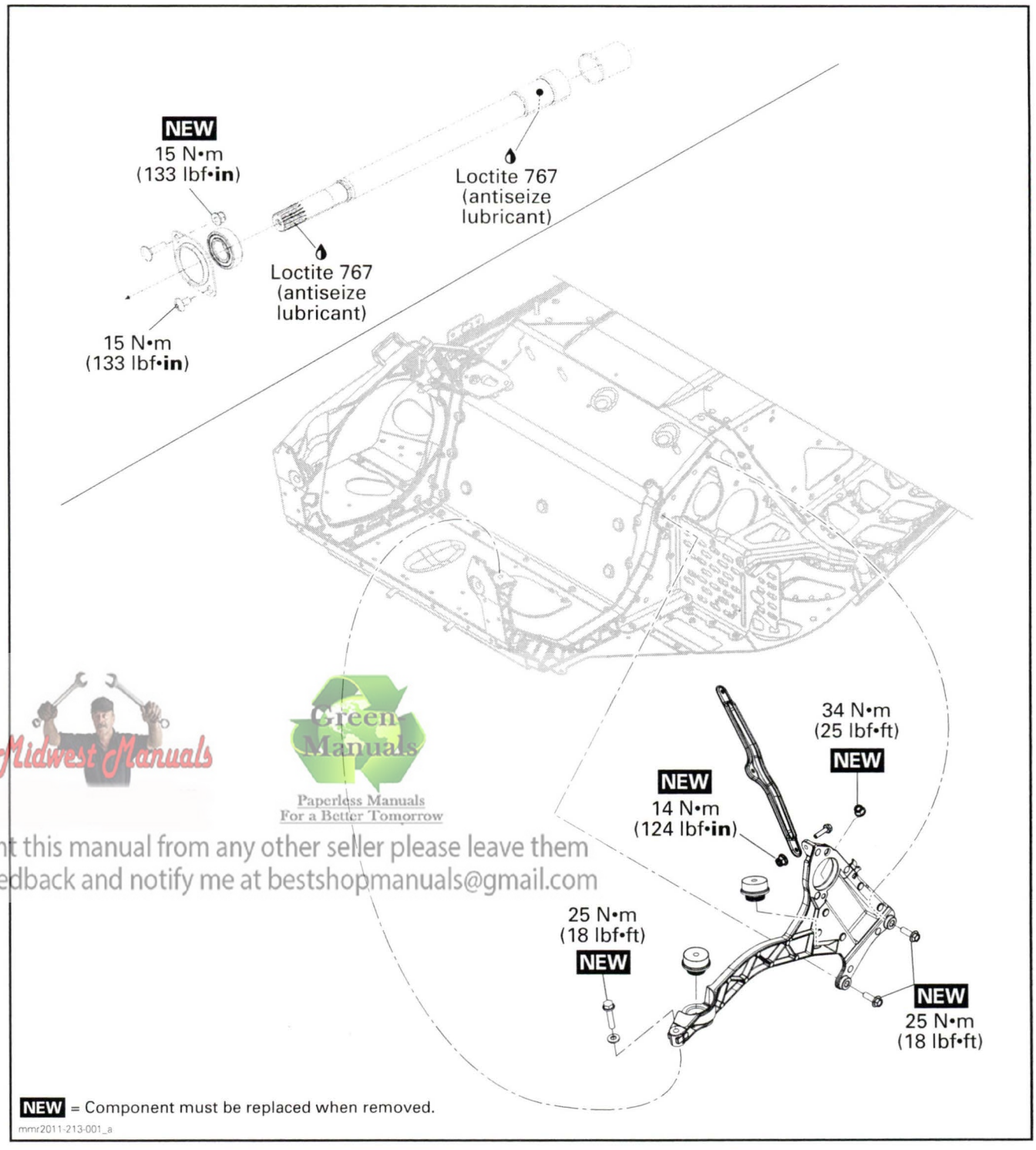
SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
ROTOR CLIP® APPLICATOR	A-150	734

SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 243 (BLUE)	293 800 060	735
LOCTITE 609	413 703 100	736
LOCTITE 767 (ANTISEIZE LUBRICANT)	293 800 070	734, 736
PULLEY FLANGE CLEANER	413 711 809	736


NEW
20 N•m
(15 lbf•ft)
NEW
32 N•m
(24 lbf•ft)
NEW
NEW
20 N•m
(15 lbf•ft)
NEW
23 N•m
(17 lbf•ft)
Loctite 243
NEW = Component must be replaced when removed.
mmr2011-118-001_a



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Green Manuals
Paperless Manuals
For a Better Tomorrow
If you bought this manual from any other seller please leave them
NEGATIVE feedback and notify me at bestshopmanuals@gmail.com

GENERAL

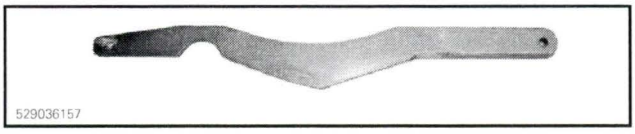
⚠ WARNING

Never start engine when the pulley guard is removed.

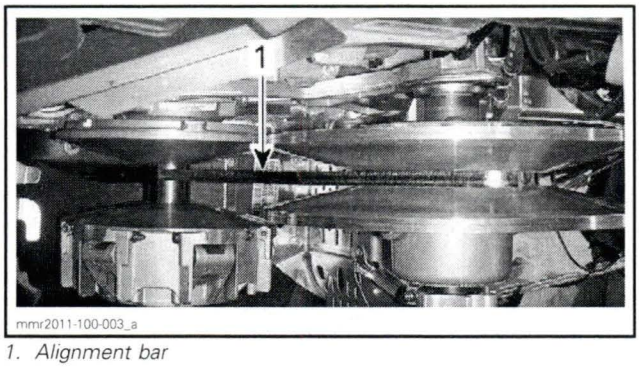
ADJUSTMENT

DRIVEN PULLEY ALIGNMENT

1. Remove drive belt, refer to *DRIVE BELT* subsection.
2. Completely open driven pulley.
3. Insert ALIGNMENT BAR (P/N 529 036 157) between the pulley sheaves. The half moon recess must match the drive pulley fixed sheave shaft.

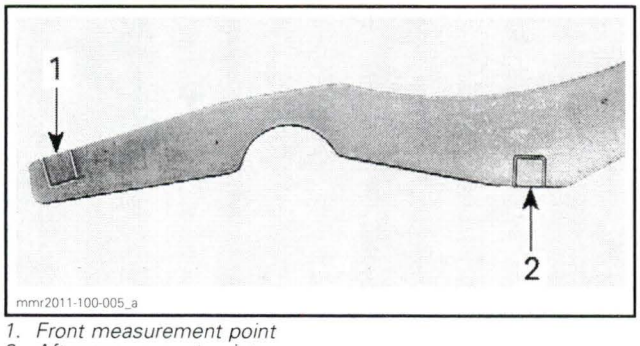


4. Close the driven pulley on the alignment bar. Make sure it stays against the pulley bottom.



1. Alignment bar

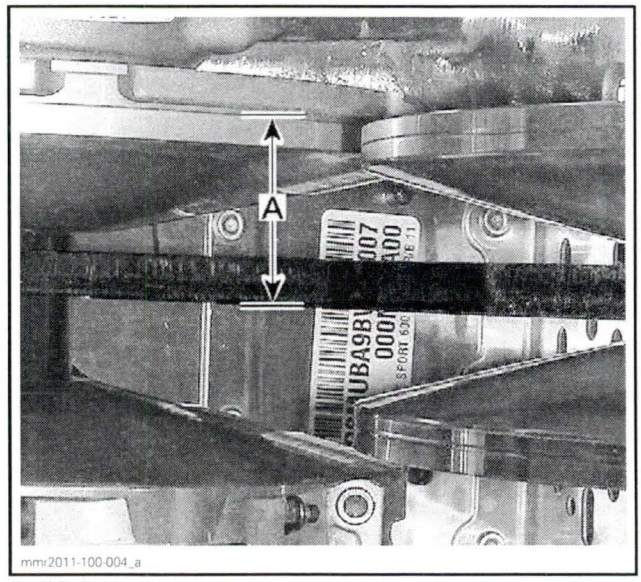
5. Locate the measurement points on the alignment bar.



1. Front measurement point
2. Aft measurement point

6. Measure "X" distance as per the following illustration.

NOTE: Always measure "X" distance from the farther alignment bar side to the fixed sheave inner edge (including alignment bar thickness).

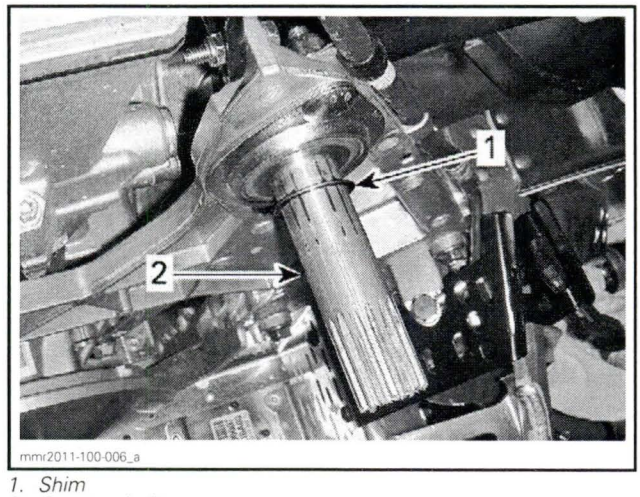


A. "X" distance

7. Compare the result to the specification.

"X" DISTANCE SPECIFICATION	
Minimum	36.7 mm (1.445 in)
Maximum	37.7 mm (1.484 in)

8. If an alignment is necessary:
   - 8.1 Remove driven pulley, see *DRIVEN PULLEY REMOVAL* in this subsection.
   - 8.2 Add or remove shim(s) to obtain the specified alignment.



1. Shim
2. Countershaft

   - 8.3 Refer to the following table to use the proper shim thickness.

SHIM THICKNESS	
(P/N 504 112 000)	0.42 mm ± 0.05 mm (.017 in ± .002 in)
(P/N 417 300 265)	1.02 mm ± 0.10 mm (.04 in ± .004 in)

NOTICE Total shim thickness must not exceed 3 mm (.118 in).

9. Install drive belt, refer to *DRIVE BELT INSTALLATION* in *DRIVE BELT* subsection.

PROCEDURES

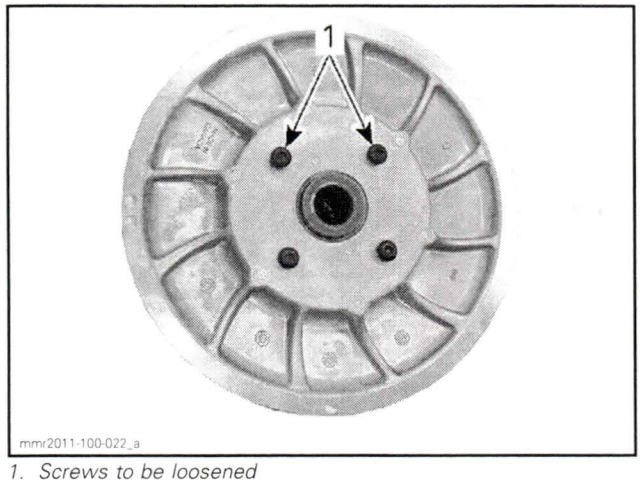
DRIVEN PULLEY

Driven Pulley Spring Preload Verification

1. Remove driven pulley, see procedure in this subsection.
2. Loosen 2 cam screws without removing them.

NOTE: Heat the cam screws to ease loosening.

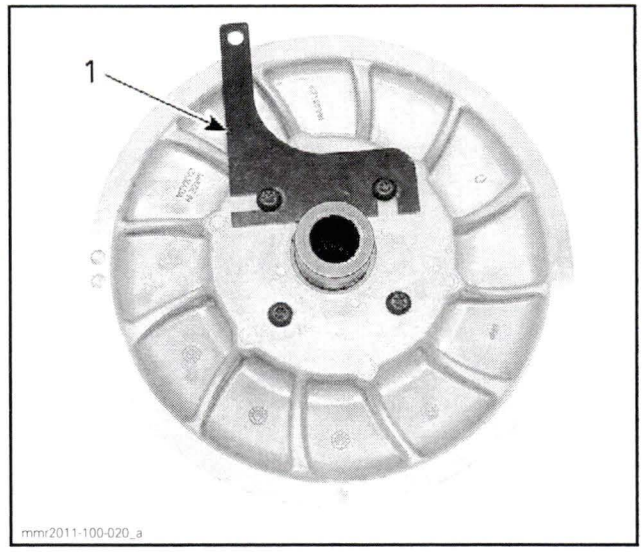
NOTICE If screws are completely removed, they must be replaced.



1. Screws to be loosened

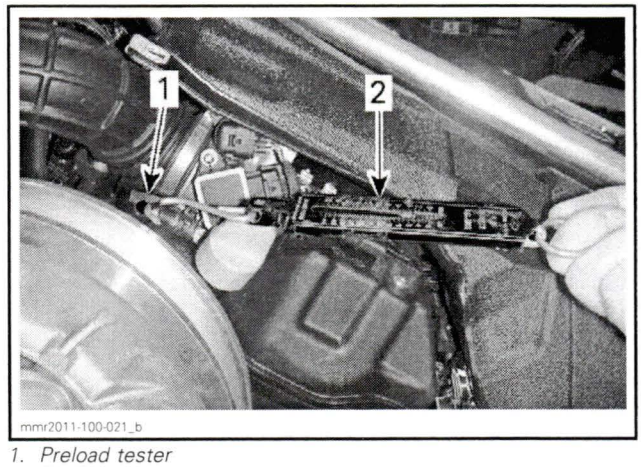
3. Install the specified service tool.

REQUIRED TOOL	
PRELOAD TESTER (P/N 529 036 164)	



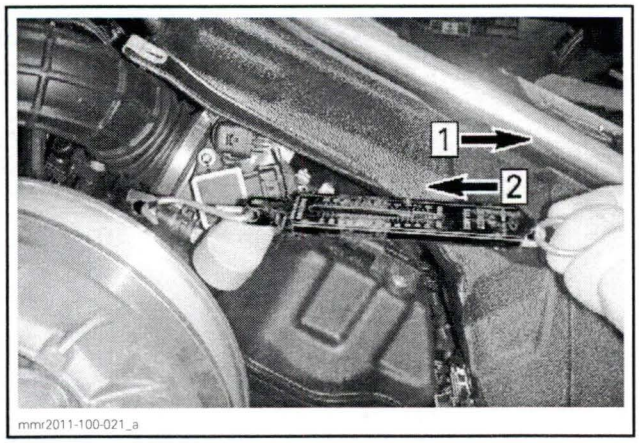
1. Preload tester

4. Install driven pulley.
5. Hook a fish scale to the preload tester.



1. Preload tester
2. Fish scale

6. Pull the preload tester using the fish scale, then read the torsion force as follows:
   - 6.1 Take a 1st measurement when sliding sheave begins to turn.
   - 6.2 Hold fish scale in this position.
   - 6.3 Slowly release tension and take a 2nd measurement when sliding sheave begins to return.



Step 1: 1st measurement
Step 2: 2nd measurement

7. Calculate the average of the two readings.

$$\frac{1^{ST}\ \text{MEASUREMENT (WHEN OPENING)} + 2^{ND}\ \text{MEASUREMENT (WHEN CLOSING)}}{2} = \text{SPRING PRELOAD}$$

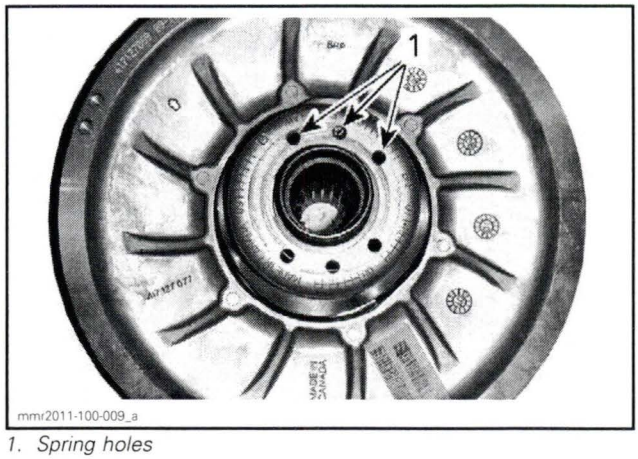
Example:

$$\frac{6.8\ \text{KG (15 LB) (WHEN OPENING)} + 6.4\ \text{KG (14 LB) (WHEN CLOSING)}}{2} = 6.6\ \text{KG (15 LB) ACTUAL SPRING PRELOAD}$$

8. Compare the result to the specifications.

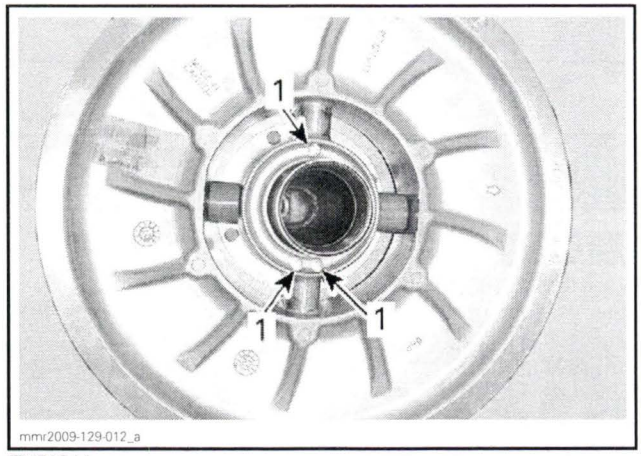
SPRING PRELOAD SPECIFICATION	
Minimum	6.4 kg (14 lb)
Maximum	7.0 kg (15 lb)

If spring preload is out of specification, move the spring hook in another cam hole to increase or decrease preload.



1. Spring holes

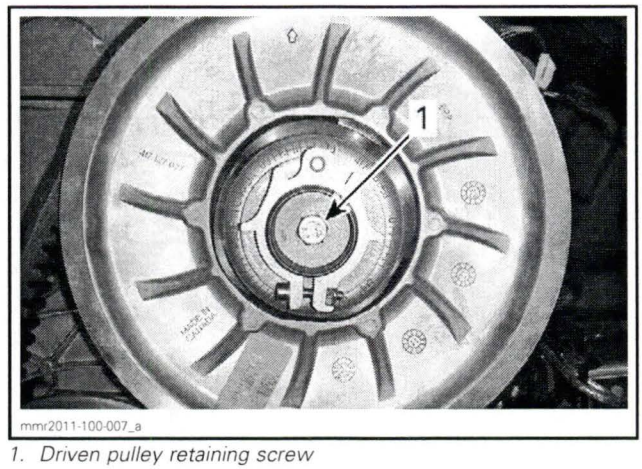
If correct spring preload is unattainable, use the fixed sheave holes.



TYPICAL
1. Fixed sheave holes

Driven Pulley Removal

1. Apply parking brake.
2. Remove drive belt, refer to *DRIVE BELT* subsection.
3. Remove driven pulley retaining screw and shouldered washer.



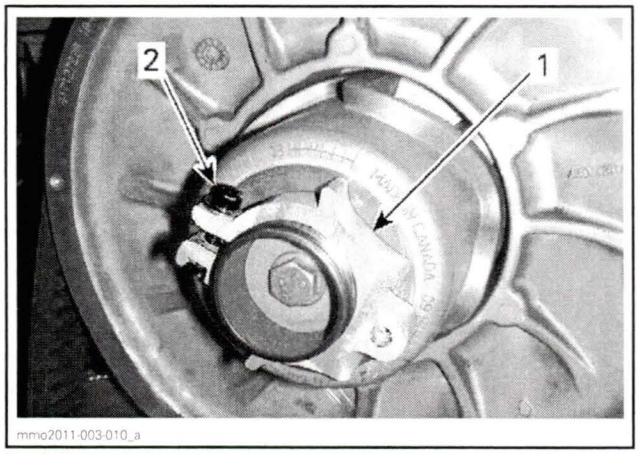
1. Driven pulley retaining screw

4. Remove driven pulley from countershaft.

Driven Pulley Disassembly

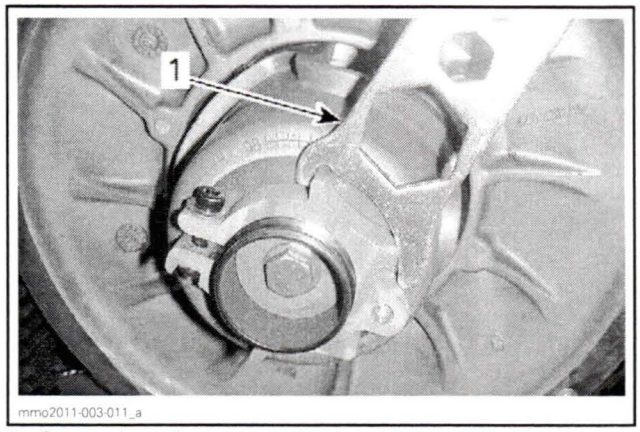
Cam and Spring Removal

1. Loosen the adjuster ring clamping screw.



1. *Adjuster hub*
2. *Clamping screw*

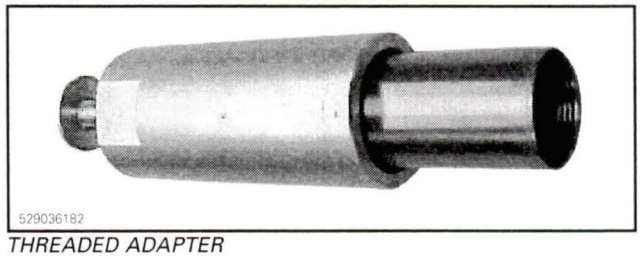
2. Unscrew the adjuster hub **clockwise**, using the suspension adjustment tool.



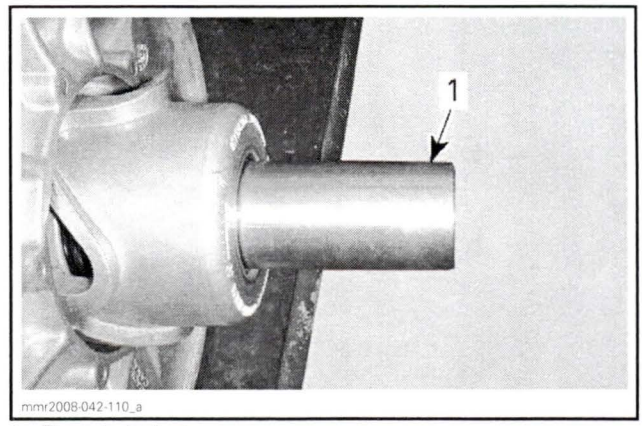
1. *Suspension adjustment tool*

NOTE: When reaching the end of the threads, slightly spread the adjuster ring to remove it from the pulley.

3. Install the threaded adapter of the DRIVEN PULLEY SPRING COMPRESSOR (P/N 529 036 182) on the driven pulley.

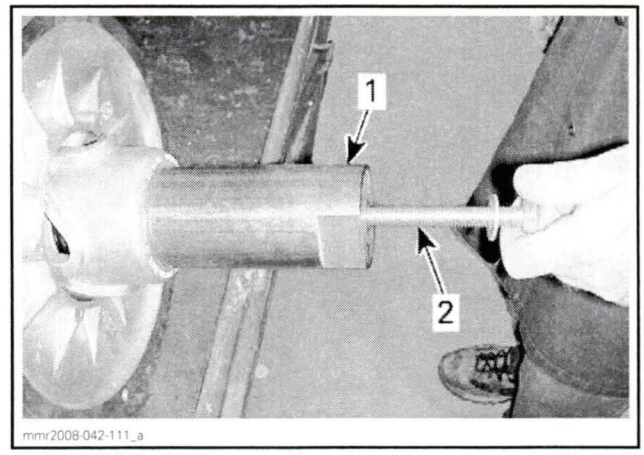


THREADED ADAPTER



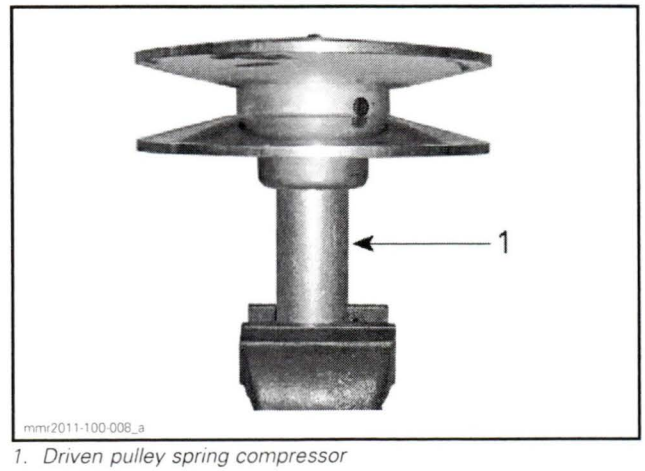
1. *Threaded adapter*

4. Install the external sleeve over the threaded adapter and secure sleeve with the tool screw.



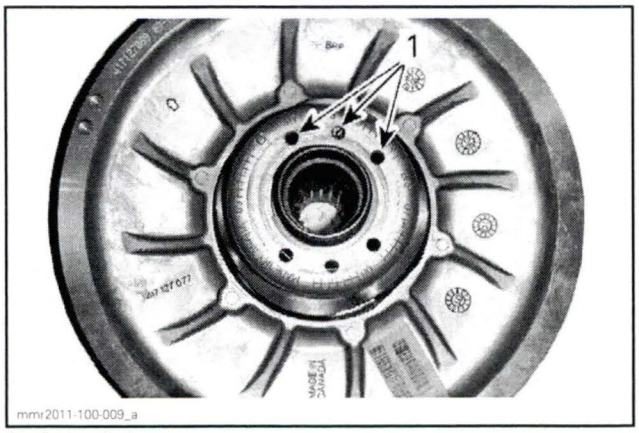
1. *External sleeve*
2. *Driven pulley spring compressor screw*

5. Tighten the tool screw to compress the cam.
6. Install the tool in a vice.



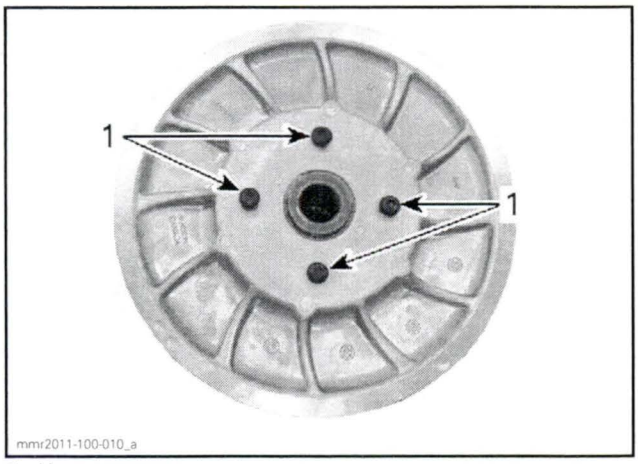
1. *Driven pulley spring compressor*

7. Note in which hole the spring hook is inserted in the cam.



1. Spring holes

8. Using a heat gun, heat cam screws to break the thread locker.

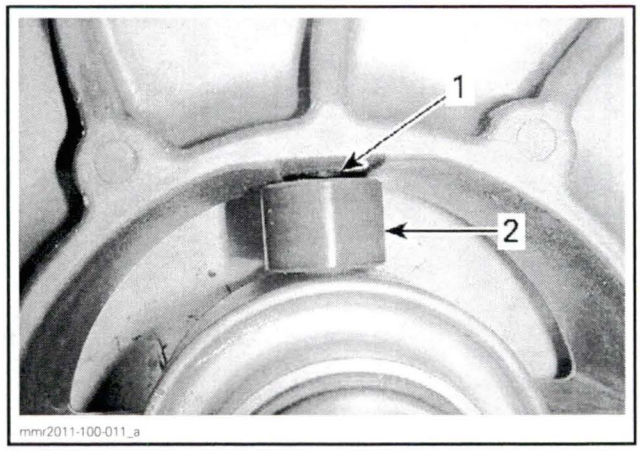


1. Heat cam screws

9. Remove and discard cam screws.
10. Remove the sliding sheave.
11. Unscrew the tool screw completely.
12. Note in which hole the spring hook is inserted to the fixed sheave.
13. Remove cam and spring.
14. Remove the tool threaded adapter.

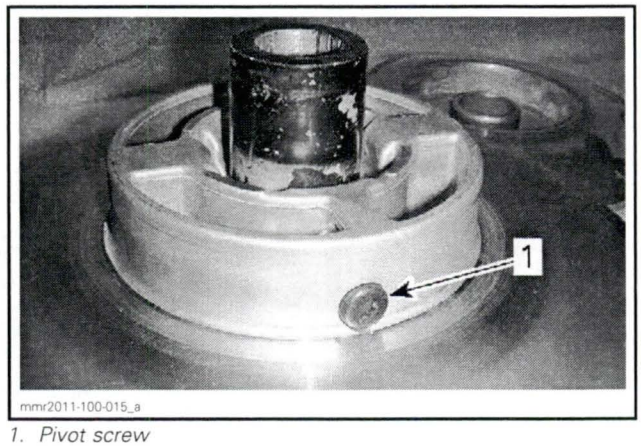
Driven Pulley Rollers Removal

1. Remove and discard the E-clips.



1. E-clip
2. Roller

2. Remove and **discard** pivot screws.



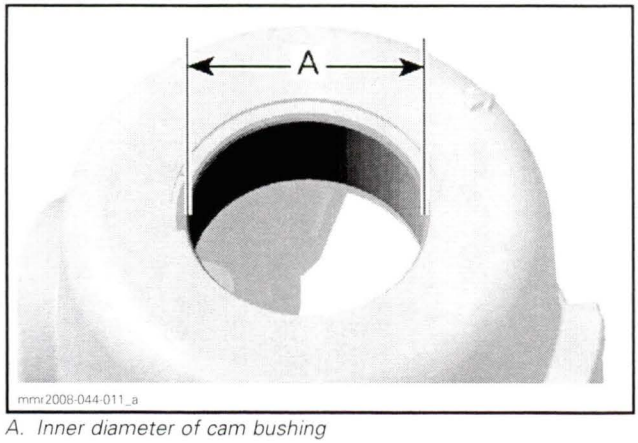
1. Pivot screw

3. Remove rollers.

Driven Pulley Inspection

Cam and Spring

1. Verify contact surfaces of cam for visible damage. Ensure circlip properly locks the inner bushing. Replace part if necessary.
2. Using a dial bore gauge, measure the inner diameter of cam bushing. Measuring point must be at least 6 mm (1/4 in) from bushing edge.



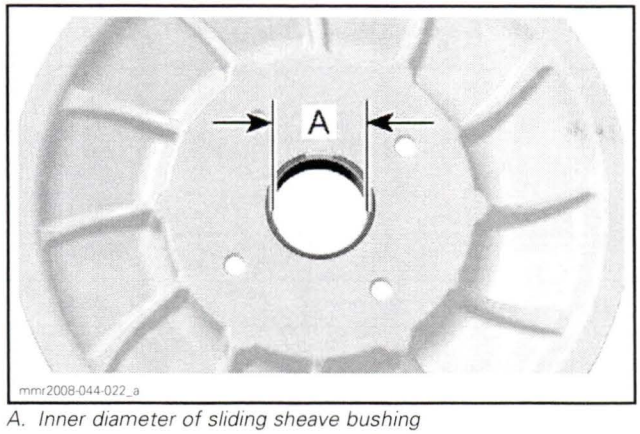
A. Inner diameter of cam bushing

BUSHING	SERVICE LIMIT
Cam bushing	41.5 mm (1.634 in)

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

Sliding Sheave

1. Inspect pulley sheave for marks or scratches.
2. Ensure circlip properly locks the inner bushing. Replace part if necessary.
3. Using a dial bore gauge, measure the inner diameter of sliding sheave bushing. Measuring point must be at least 6 mm (1/4 in) from bushing edge.



A. Inner diameter of sliding sheave bushing

BUSHING	SERVICE LIMIT
Sliding sheave bushing	41.5 mm (1.634 in)

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

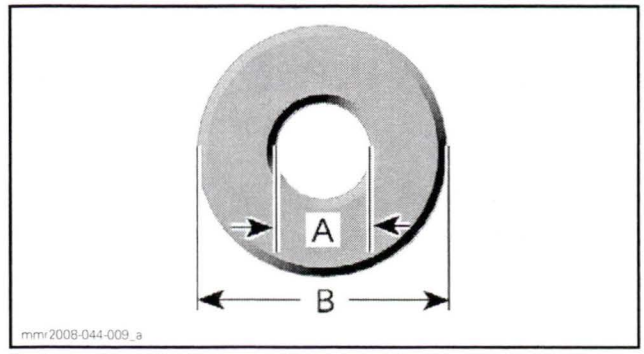
Fixed Sheave

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

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

Driven Pulley Rollers

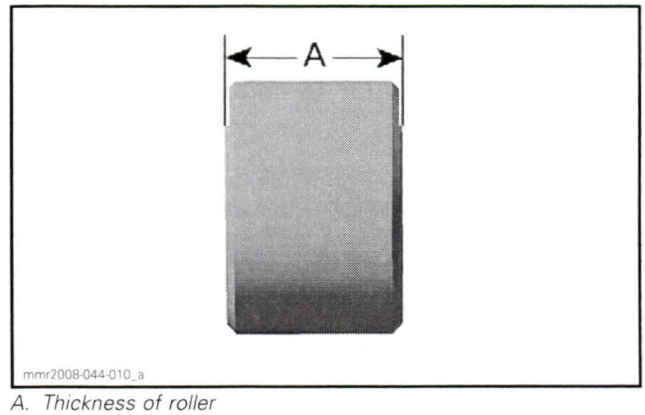
1. Check the rollers for flat spots, cracks or other visible damage. Replace if necessary (as a set).
2. Measure inner and outer diameter of rollers.



A. Inner diameter
B. Outer diameter

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

3. Measure the roller thickness.



A. Thickness of roller

ROLLER THICKNESS	
SERVICE LIMIT	14.75 mm (.581 in)

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

Driven Pulley Assembly

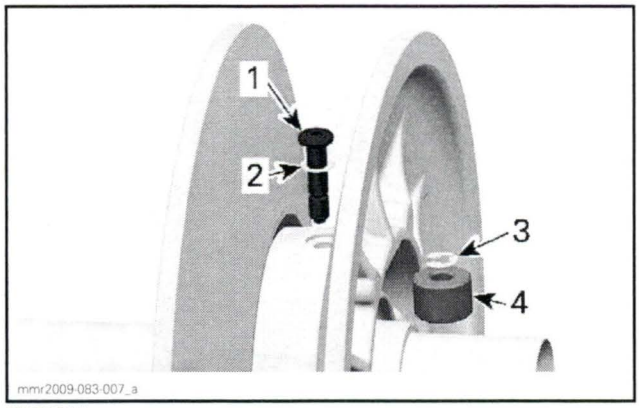
Driven Pulley Rollers Installation

1. Using a screw tap, clean pivot screw threaded holes into fixed sheave.

2. Install rollers into fixed sheave using **NEW** pivot screws with ribbed lock washers.

NOTICE **Always use new pivot screws with pre-applied threadlocker.**

3. Tighten pivot screws to the specified torque.

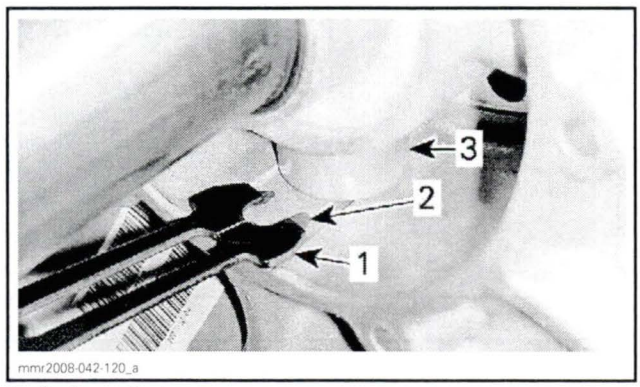


TYPICAL
1. *Pivot screw*
2. *Ribbed lock washer*
3. *E-clip*
4. *Roller*

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

4. Using a ROTOR CLIP® APPLICATOR (P/N A-150), install **NEW** E-clips to lock pivot screws.

NOTE: To purchase an applicator, contact Rotor Clip Company at **www.rotorclip.com**.

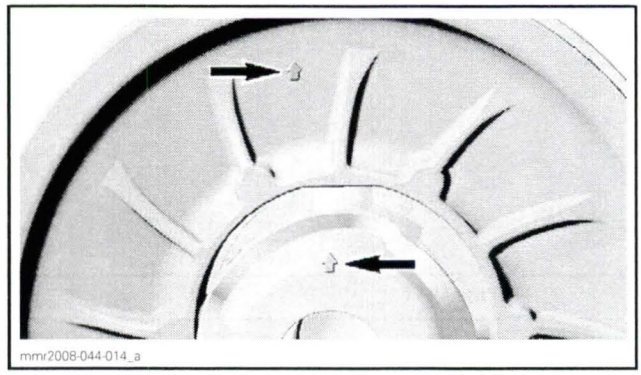


1. *E-clip applicator*
2. *E-clip*
3. *Roller*

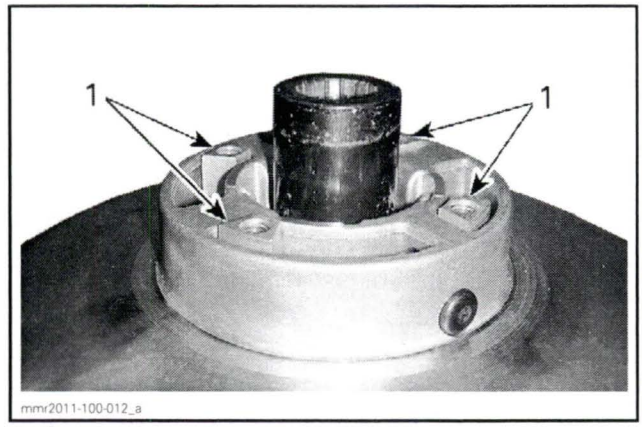
Cam and Spring Installation

1. Install the spring compressor threaded adapter on the fixed sheave.
2. Slide the cam over the tool threaded adapter.
3. Turn cam against the spring and align its arrow with the arrow on the fixed sheave.

NOTE: At the end of cam installation, the arrow on the cam should have moved clockwise (approximately 30°).



4. Compress spring until cam mounting holes exceed the fixed sheave.



1. *Cam mounting holes*

5. Install the sliding sheave on the cam using 4 **NEW** screws.
6. Tighten cam screws to the specified torque.

TIGHTENING TORQUE	
Cam screws	32 N•m (24 lbf•ft)

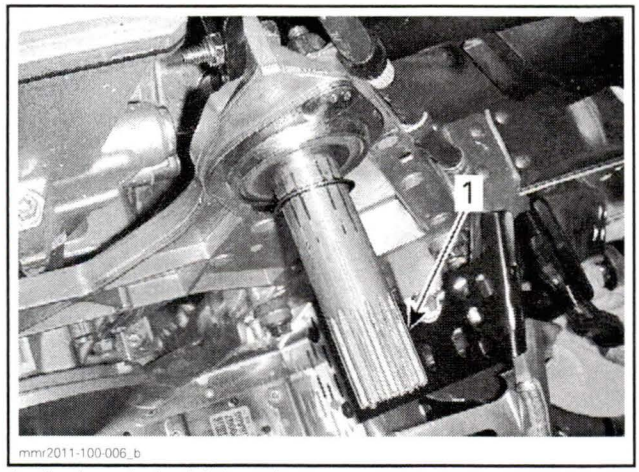
7. Remove the tool.

Driven Pulley Installation

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

Apply LOCTITE 767 (ANTISEIZE LUBRICANT) (P/N 293 800 070) on countershaft splines.

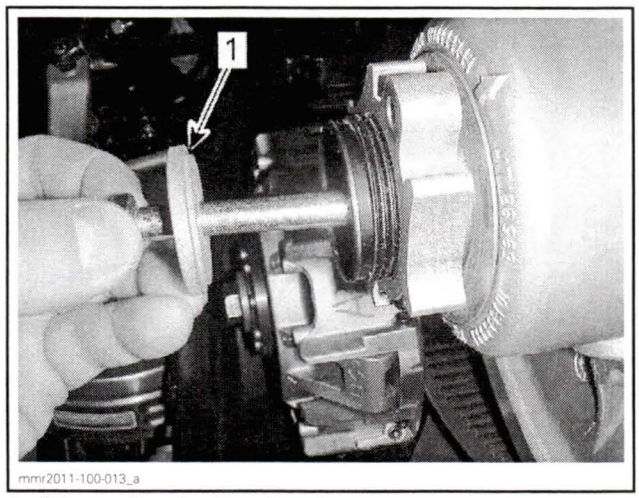
Rotor Clip® is a trademark of Rotor Clip Company, Inc.



1. Apply antiseize lubricant here

Check pulley alignment, refer to *DRIVEN PULLEY ALIGNMENT* in this subsection.

Install driven pulley shouldered washer as per illustration.



1. Driven pulley shouldered washer

Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on driven pulley retaining screw threads.

Tighten driven pulley retaining screw to the specified torque.

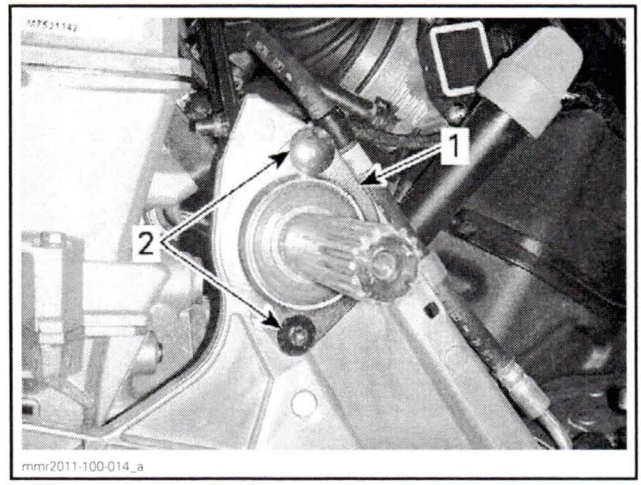
TIGHTENING TORQUE	
Driven pulley retaining screw	23 N•m (17 lbf•ft)

NOTICE **Driven pulley alignment must always be checked whenever pulleys have been removed, disassembled or replaced.**

COUNTERSHAFT

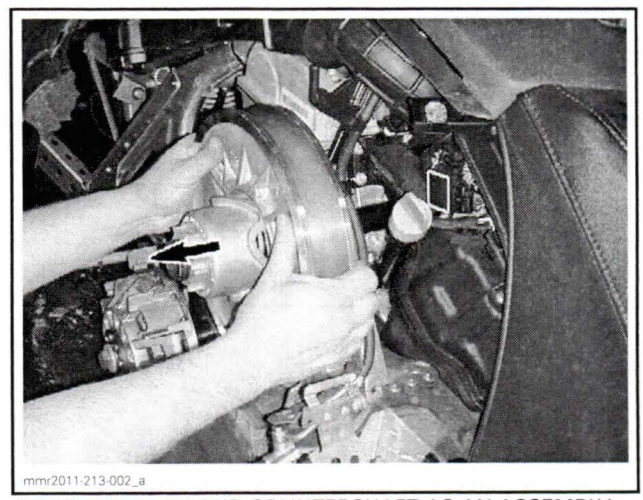
Countershaft Removal

1. Remove side panels, refer to *BODY* subsection.
2. Remove driven pulley, see *DRIVEN PULLEY REMOVAL* in this subsection.
3. Remove countershaft bearing flange as follows:
   3.1 Remove retaining fasteners.



1. Countershaft bearing flange
2. Retaining fasteners

   3.2 Be careful not to loose the brake hose retainer.
   3.3 Remove countershaft bearing flange from support.
4. Install drive pulley.
5. Firmly grab the drive pulley and pull the assembly out.



REMOVE PULLEY AND COUNTERSHAFT AS AN ASSEMBLY

6. Remove pulley from countershaft.

Countershaft Inspection

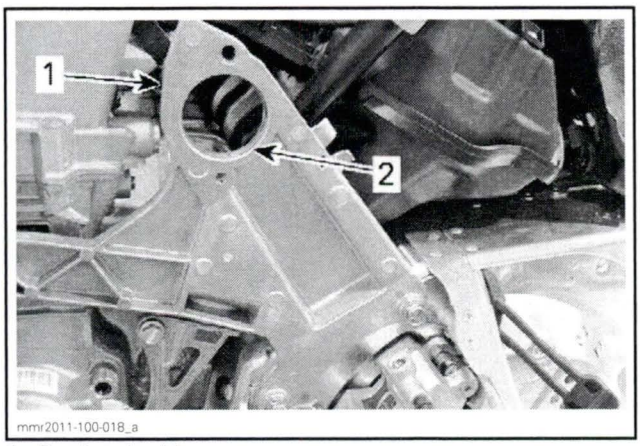
Replace countershaft if one of the following problem is detected:

- Bent, twisted or otherwise damaged countershaft.
- Defective splines and threads at the end of countershaft.

Countershaft Installation

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

Remove any rust on bearing shoulder of countershaft bearing support using sand paper (600-grit or 1000-grit) or steel wool.



1. Bearing shoulder
2. Countershaft bearing support

Apply LOCTITE 767 (ANTISEIZE LUBRICANT) (P/N 293 800 070):

- Bearing shoulder
- Countershaft internal splines (gearbox end).

Ensure countershaft bearing is installed properly into the countershaft bearing support.

Secure the brake hose using the upper flange retaining bolt.

Tighten countershaft bearing flange bolts to the specified torque.

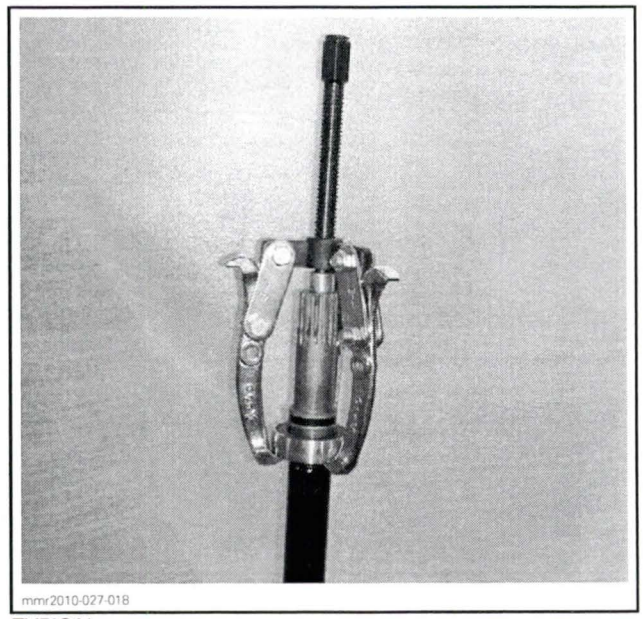
TIGHTENING TORQUE	
Countershaft bearing fasteners	25 N•m (18 lbf•ft)

Install driven pulley. Refer to *DRIVEN PULLEY INSTALLATION* in this subsection.

COUNTERSHAFT BEARING

Countershaft Bearing Removal

1. Proceed with *COUNTERSHAFT REMOVAL*, see procedure in this subsection.
2. Install an appropriate puller on the countershaft bearing.

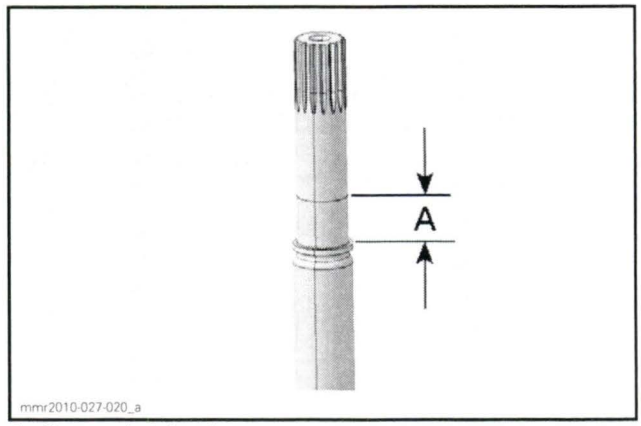


TYPICAL

3. Tighten puller to extract the bearing.
4. Discard the bearing.

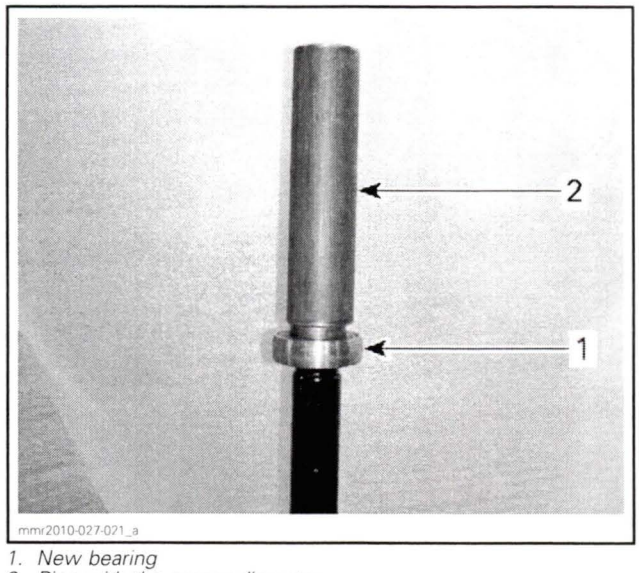
Countershaft Bearing Installation

1. Clean residues on countershaft bearing area using PULLEY FLANGE CLEANER (P/N 413 711 809).



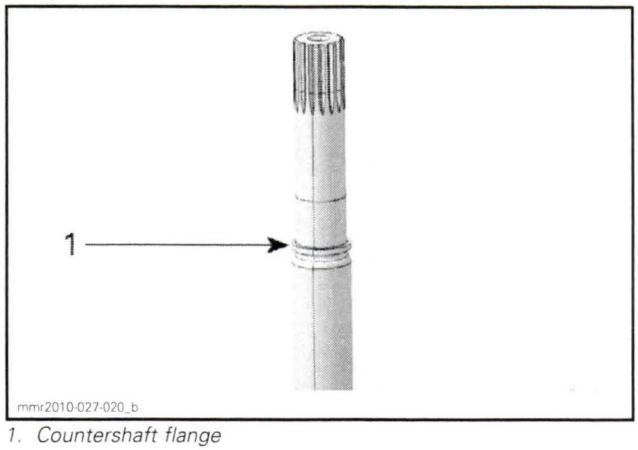
A. Countershaft bearing area

2. Apply LOCTITE 609 (P/N 413 703 100) on countershaft bearing area.
3. Install a **NEW** bearing on countershaft using a press and a pipe with the proper diameter.



1. New bearing
2. Pipe with the proper diameter

4. Press bearing until it is properly seated on countershaft flange.



1. Countershaft flange

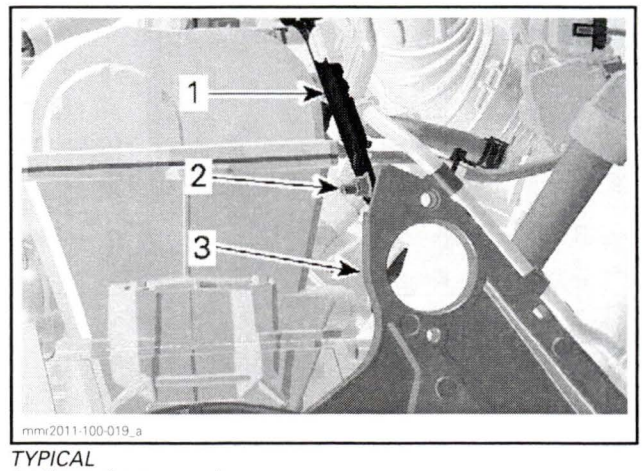
5. Clean the surplus of Loctite with a rag to avoid having Loctite on sliding sheave bushing.

NOTICE **Always use a press, never tap on countershaft bearing installer with an hammer to avoid damaging bearing and countershaft. Always apply force on the inner race of the bearing.**

COUNTERSHAFT BEARING SUPPORT

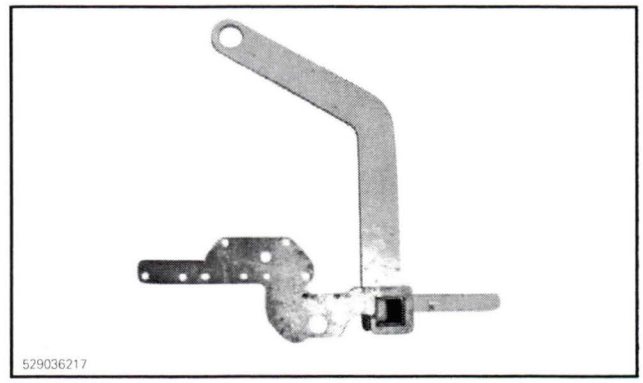
Countershaft Bearing Support Removal

1. Remove countershaft, see *COUNTERSHAFT REMOVAL* in this subsection.
2. Remove the bolt attaching the upper frame member to the countershaft bearing support.

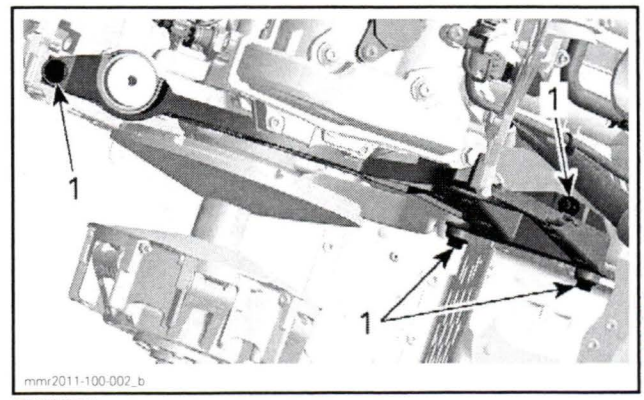


TYPICAL
1. Upper frame member
2. Bolt
3. Countershaft bearing support

3. Install the ENGINE LIFTING TOOL (P/N 529 036 217) in order to support the LH side of the engine. Refer to *ENGINE REMOVAL AND INSTALLATION*.



4. Remove the bolts securing the engine to the LH rubber mounts.
5. Remove the countershaft bearing support retaining fasteners.

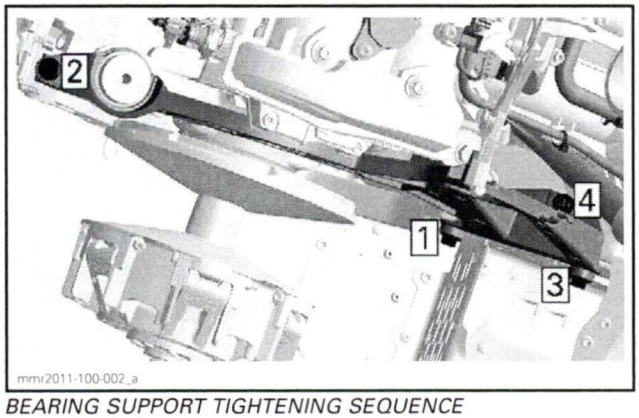


TYPICAL
1. Countershaft bearing support retaining fasteners

6. Remove the countershaft bearing support.

Countershaft Bearing Support Installation

1. Thread the fasteners retaining the bearing support to the chassis and both engine rubber mounts screws without tightening yet.
2. Tighten the retaining fasteners to the specified torque following the illustrated sequence.



BEARING SUPPORT TIGHTENING SEQUENCE

COUNTERSHAFT BEARING SUPPORT FASTENERS TIGHTENING TORQUE	
Bearing support to side of tunnel screws	25 N•m (18 lbf•ft)
Front of bearing support retaining screw	25 N•m (18 lbf•ft)
Bearing support to top of tunnel nut	34 N•m (25 lbf•ft)

3. Tighten the rear engine rubber mount screw to the specified torque.

TIGHTENING TORQUE	
Rear rubber mount screw	25 N•m (18 lbf•ft)

4. Tighten the front engine rubber mount screw to the specified torque.

TIGHTENING TORQUE	
Front rubber mount bolt	25 N•m (18 lbf•ft)

5. Install the upper frame member to the bearing support and tighten bolt to the specified torque.

TIGHTENING TORQUE	
Bearing support to upper frame member bolt	14 N•m (124 lbf•**in**)

6. Install all other removed parts.

DRIVEN PULLEY AND COUNTERSHAFT (600 HO E-TEC)

SERVICE TOOLS

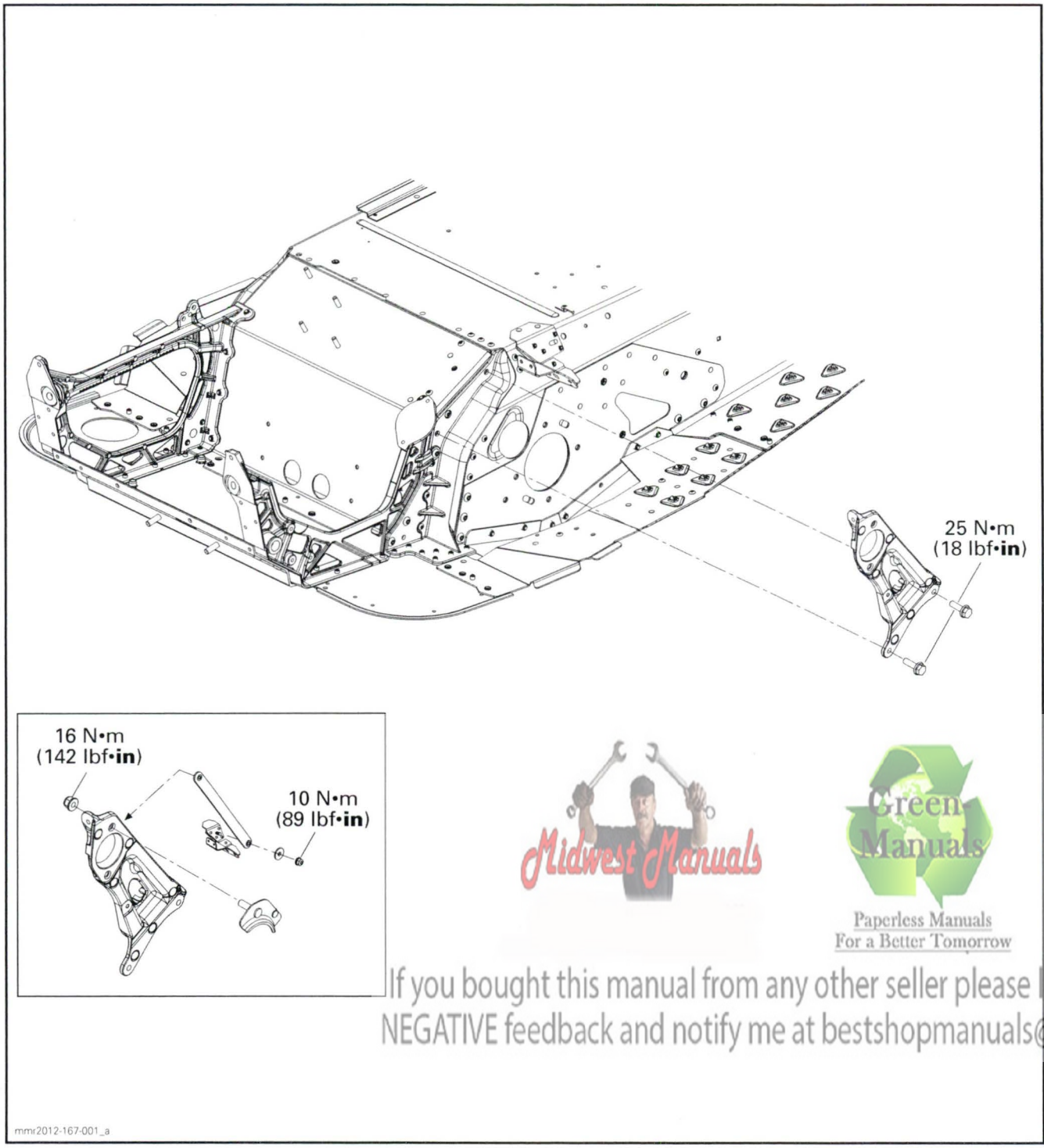
Description	Part Number	Page
COUNTERSHAFT BEARING INSTALLER	529 036 066	750
COUNTERSHAFT BEARING REMOVER	529 036 065	749
COUNTERSHAFT RETAINING TOOL	529 036 165	747
COUNTERSHAFT SUPPORT	529 036 067	750
DRIVEN PULLEY SPRING COMPRESSOR	529 036 064	749
DRIVEN PULLEY SPRING COMPRESSOR	529 036 182	743
PRELOAD TESTER	529 036 164	747

SERVICE TOOLS – OTHER SUPPLIER

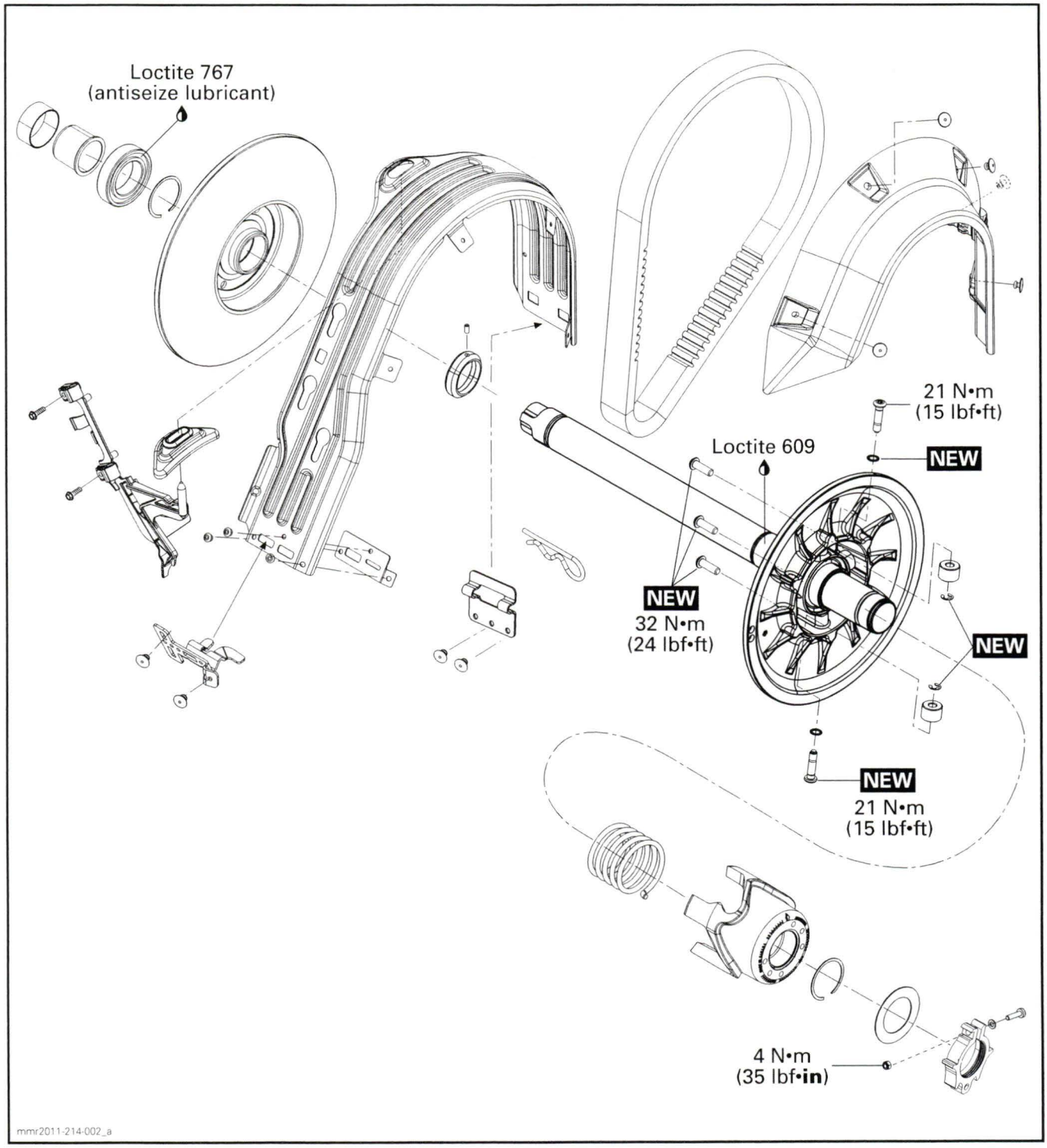
Description	Part Number	Page
ROTOR CLIP® APPLICATOR	A-150	746

SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 609	413 703 100	750
LOCTITE 767 (ANTISEIZE LUBRICANT)	293 800 070	749
PULLEY FLANGE CLEANER	413 711 809	745, 750



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Green Manuals
Paperless Manuals
For a Better Tomorrow
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Loctite 767
(antiseize lubricant)
21 N•m
(15 lbf•ft)
Loctite 609
NEW
NEW
32 N•m
(24 lbf•ft)
NEW
NEW
21 N•m
(15 lbf•ft)
4 N•m
(35 lbf•in)
mmr2011-214-002_a

GENERAL

⚠ WARNING

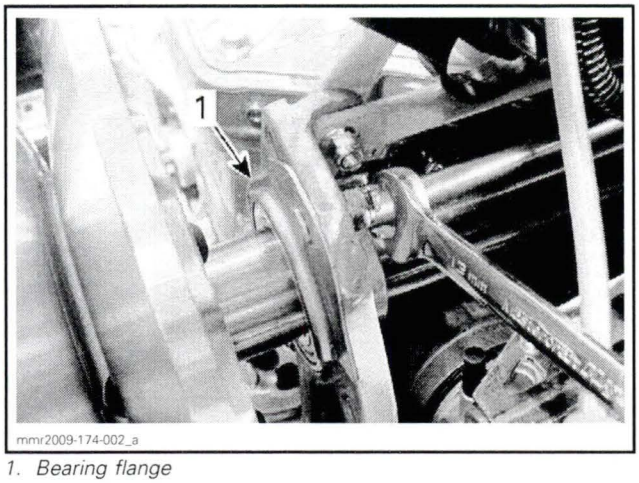
Never start engine when the pulley guard is removed.

PROCEDURES

DRIVEN PULLEY

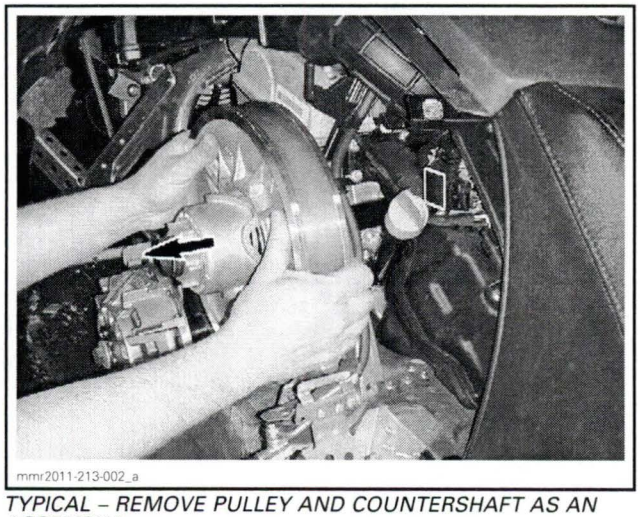
Driven Pulley Removal

1. Remove drive belt. Refer to *DRIVE BELT* subsection.
2. Set gearbox to *NEUTRAL*.
3. Remove bearing flange from countershaft bearing support.



1. Bearing flange

4. Firmly grab the drive pulley and pull the assembly out.

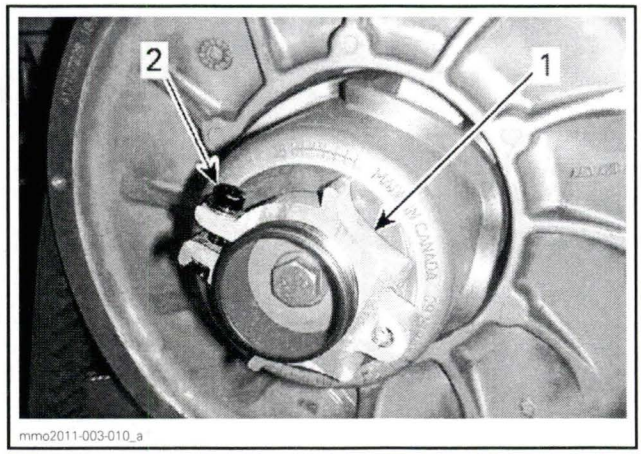


TYPICAL – REMOVE PULLEY AND COUNTERSHAFT AS AN ASSEMBLY

Driven Pulley Disassembly

Cam and Spring Removal

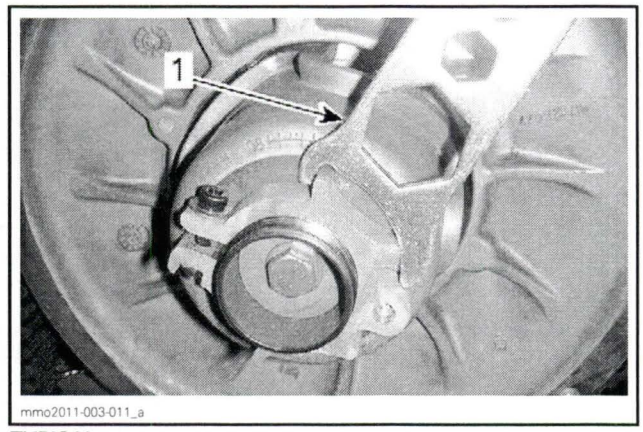
1. Loosen the adjuster ring clamping screw.



TYPICAL
1. Adjuster hub
2. Clamping screw

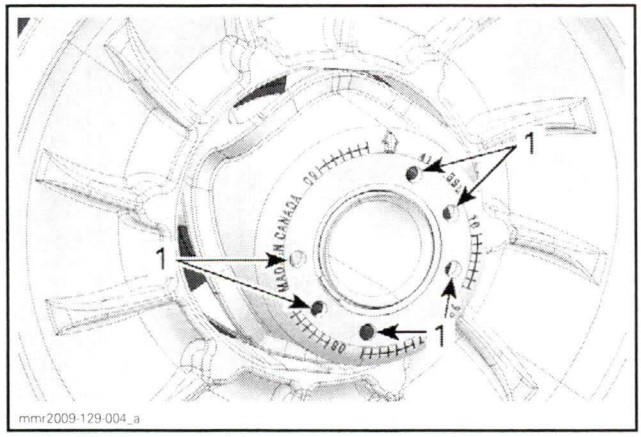
2. Unscrew the adjuster hub **clockwise**, using the suspension adjustment tool.

NOTE: When reaching the end of the threads, slightly spread the adjuster ring to remove it from the pulley.



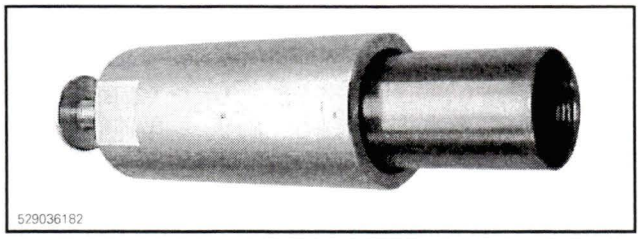
TYPICAL
1. Suspension adjustment tool

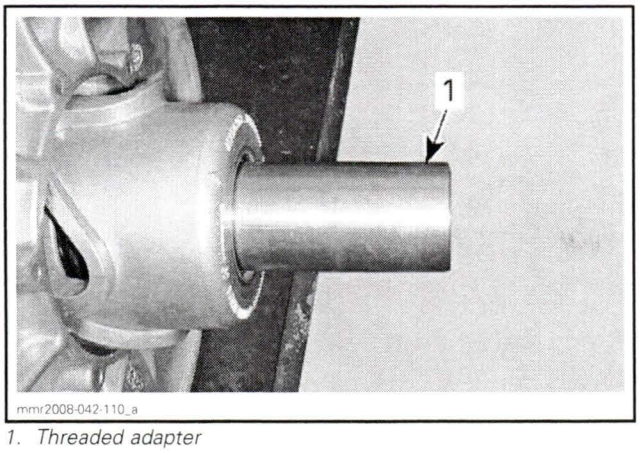
3. Remember spring position for reinstallation.



1. Available spring positions

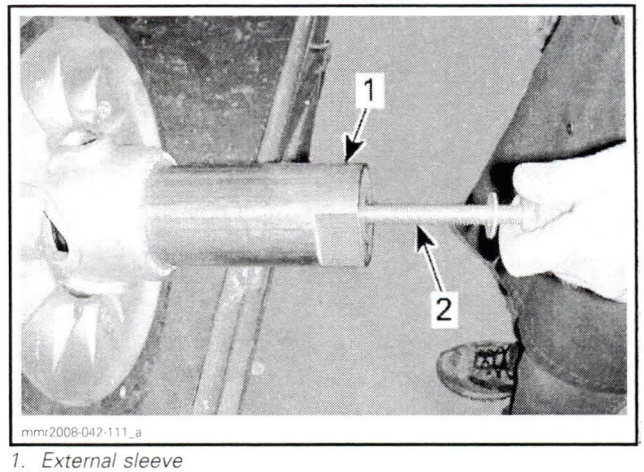
4. Install the threaded adapter of the DRIVEN PULLEY SPRING COMPRESSOR (P/N 529 036 182) on the driven pulley.





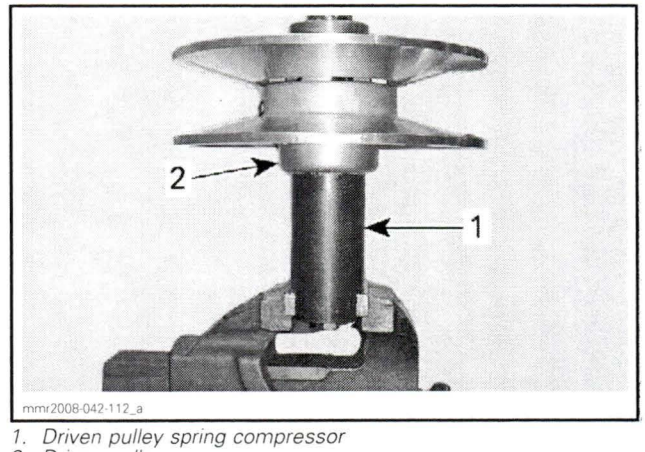
1. Threaded adapter

5. Install the external sleeve over the threaded adapter.
6. Thread spring compressor screw in the threaded adapter.



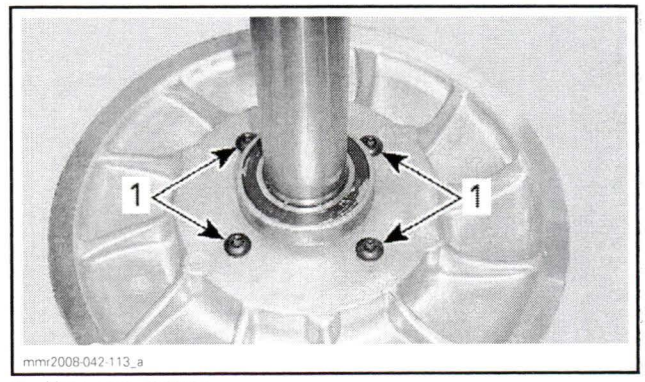
1. External sleeve
2. Driven spring compressor screw

7. Tighten the driven spring compressor screw to compress the cam.
8. Install the driven pulley spring compressor in a vice.



1. Driven pulley spring compressor
2. Driven pulley

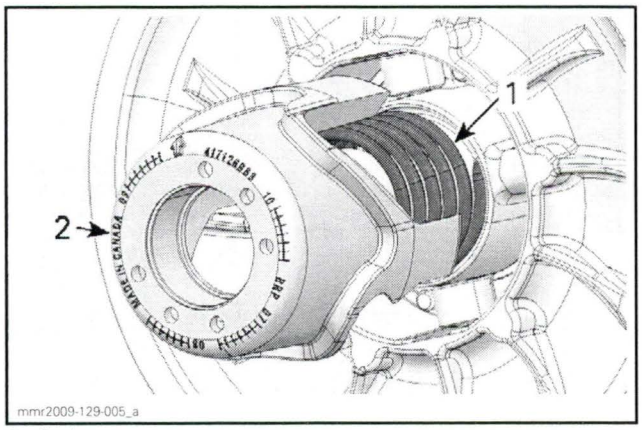
9. Using a heat gun, heat cam screws to break the thread locker.



1. Heat cam screws

10. Remove and discard the cam screws.
11. Unscrew the spring compressor screw completely.

12. Retain cam and spring in position.
13. Hold spring against the fixed sheave and remove cam.
14. Note in which hole the spring hook is inserted to the fixed sheave.



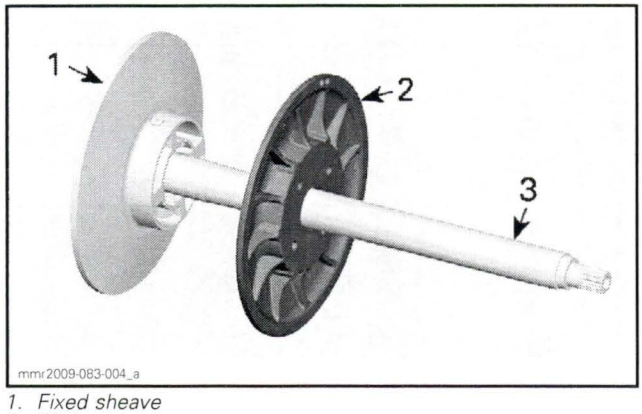
mmr2009-129-005_a

1. Spring
2. Cam

15. Remove cam and spring.
16. Remove the tool threaded adapter.

Sliding Sheave Removal

1. Remove the cam and spring. See procedure in this subsection.
2. Remove the *COUNTERSHAFT BEARING*, see procedure in this subsection.
3. Remove sliding sheave.



mmr2009-083-004_a

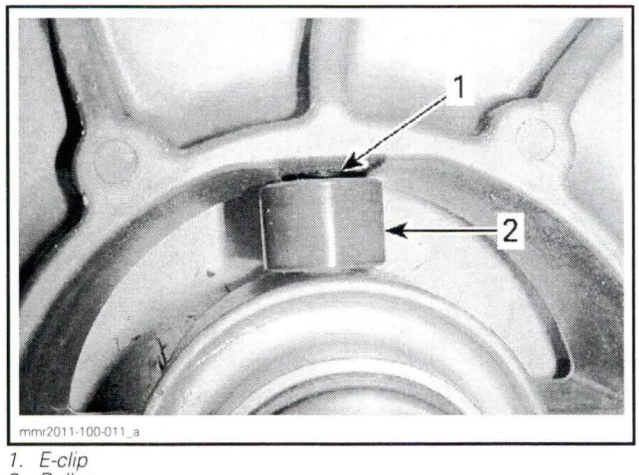
1. Fixed sheave
2. Sliding sheave
3. Countershaft

Fixed Sheave Removal

The fixed sheave and countershaft are sold as an assembly. They are not available separately.

Driven Pulley Rollers Removal

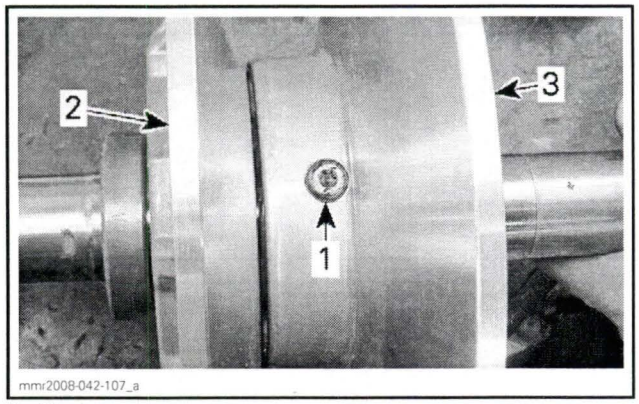
1. Move sliding and fixed sheaves apart.
2. Remove and discard the E-clips.



mmr2011-100-011_a

1. E-clip
2. Roller

3. Remove and **discard** pivot screws.



mmr2008-042-107_a

1. Pivot screw
2. Sliding sheave
3. Fixed sheave

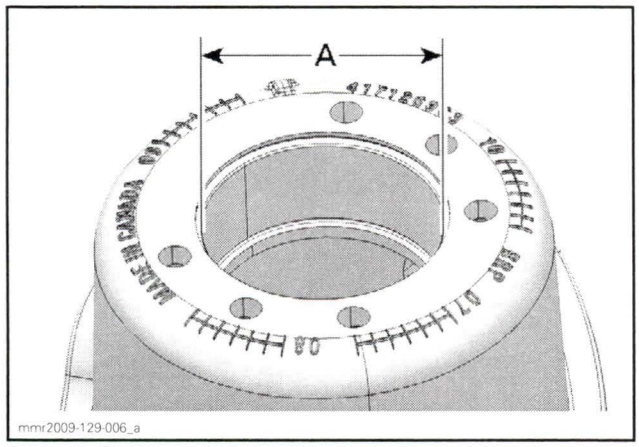
4. Remove rollers.

Driven Pulley Inspection

Cam and Spring

Verify contact surfaces of cam for visible damage. Replace cam if necessary.

Using a dial bore gauge, measure the inner diameter of cam bushing. Measuring point must be at least 6 mm (1/4 in) from bushing edge.



A. Inner diameter of cam bushing

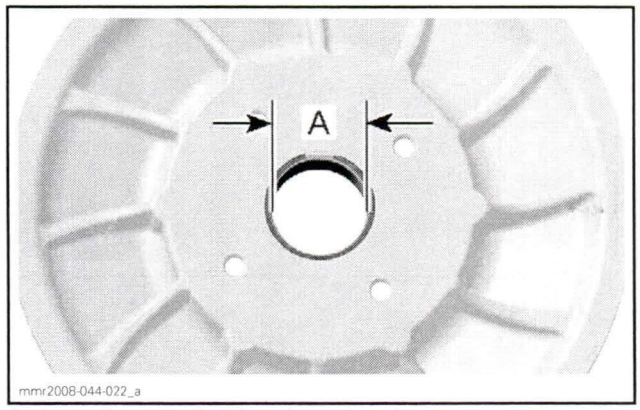
BUSHING	SERVICE LIMIT
Cam bushing	41.5 mm (1.634 in)

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

Sliding Sheave

Inspect pulley sheave for marks or scratches.

Using a dial bore gauge, measure the inner diameter of sliding sheave bushing. Measuring point must be at least 6 mm (1/4 in) from bushing edge.



A. Inner diameter of sliding sheave bushing

BUSHING	SERVICE LIMIT
Sliding sheave bushing	41.5 mm (1.634 in)

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

Fixed Sheave

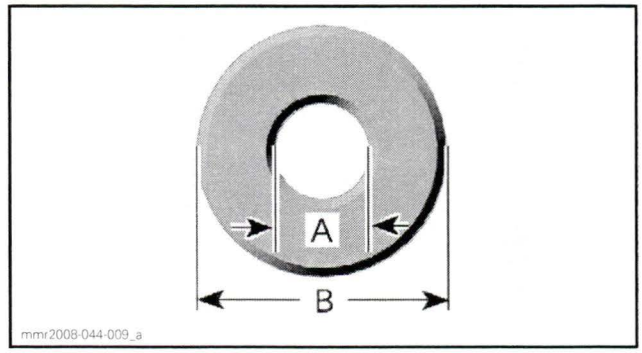
Replace fixed sheave and countershaft if one of the following problem is detected:

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

Driven Pulley Rollers

Check the rollers for flat spots, cracks or other visible damages. Replace if necessary.

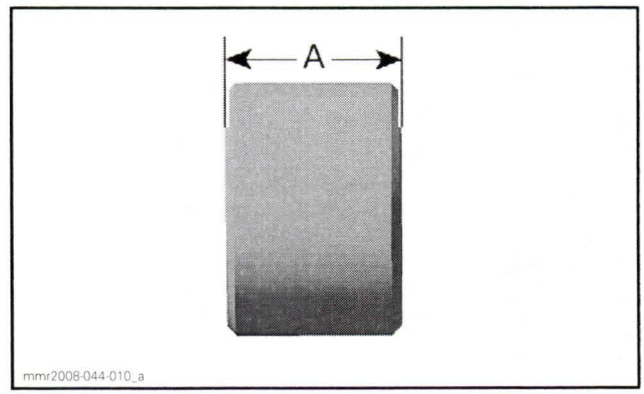
Measure inner and outer diameter of rollers.



A. Inner diameter
B. Outer diameter

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

Measure the roller thickness.



A. Thickness of roller

ROLLER THICKNESS	
SERVICE LIMIT	14.75 mm (.581 in)

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

Driven Pulley Cleaning

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

Clean residues of adhesive product on sliding sheave bushing area.

Cam and Spring

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

NOTE: During break-in period, teflon from bushing moves to cam or countershaft surface. A teflon over teflon running condition occurs, leading to low friction. Do not remove this deposit.

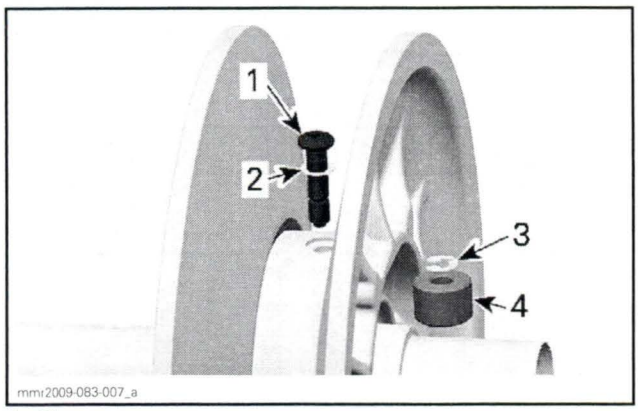
Driven Pulley Assembly

Driven Pulley Rollers Installation

1. Using a screw tap, clean pivot screw threaded holes into fixed sheave.
2. Install rollers into fixed sheave using **NEW** pivot screws with ribbed lock washers.

NOTICE Always use new pivot screws with pre-applied threadlocker.

3. Tighten pivot screws to the specified torque.

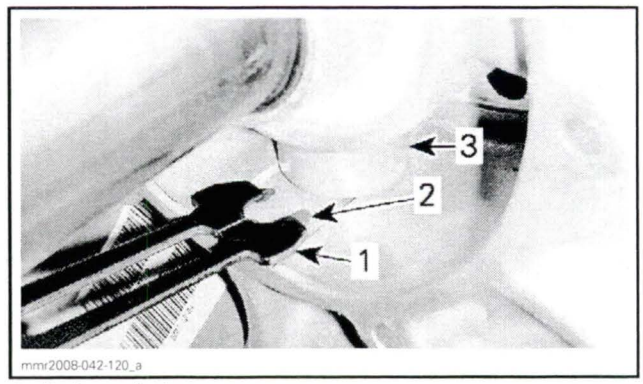


1. Pivot screw
2. Ribbed lock washer
3. E-clip
4. Roller

PIVOT SCREWS TIGHTENING TORQUE
21 N•m (15 lbf•ft)

4. Using a ROTOR CLIP® APPLICATOR (P/N A-150), install **NEW** E-clips to lock pivot screws.

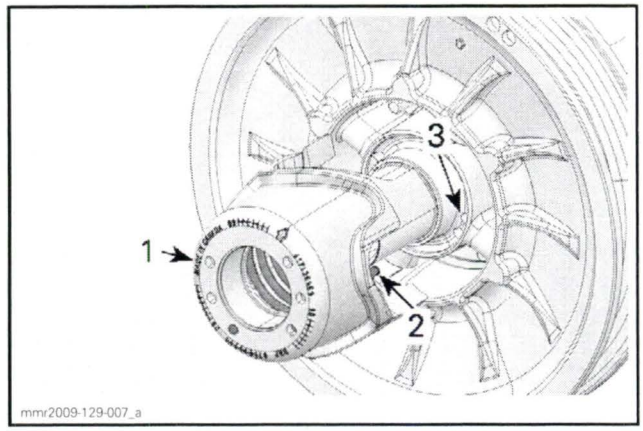
NOTE: To purchase an applicator, contact Rotor Clip Company at **www.rotorclip.com**.



1. E-clip applicator
2. E-clip
3. Roller

Cam and Spring Installation

1. Insert one end of the spring into the appropriate cam locating hole (previously noted during removal).
2. Install cam and spring. Enter the other end of the spring in the fixed sheave locating hole previously noted during removal.

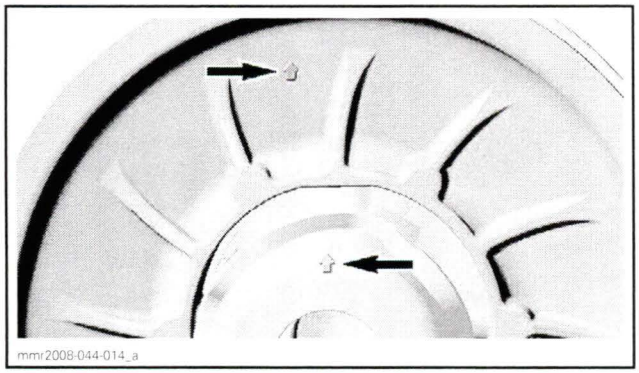


1. Cam
2. End of spring
3. Fixed sheave locating holes

3. Push and turn the cam to align its arrow with the arrow on fixed sheave.

At the end of the cam installation, the arrow on the cam should be move clockwise (± 30°).

Rotor Clip® is a trademark of Rotor Clip Company, Inc.



4. Install the driven spring compressor sleeve and tighten the driven spring compressor screw until cam is completely pressed against sliding sheave.
5. Check the *SPRING TORSIONAL PRELOAD*, see procedure in this subsection.
6. When preload is within specification, install 4 **NEW** cam screws.
7. Tighten cam screws to the specified torque.

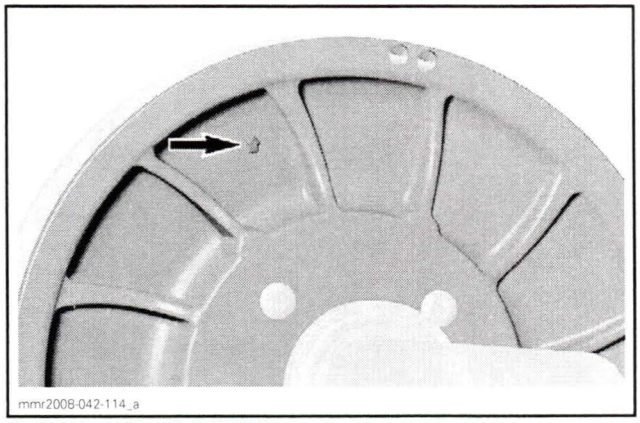
CAM SCREWS TIGHTENING TORQUE
32 N•m (24 lbf•ft)

8. Remove the driven spring compressor.

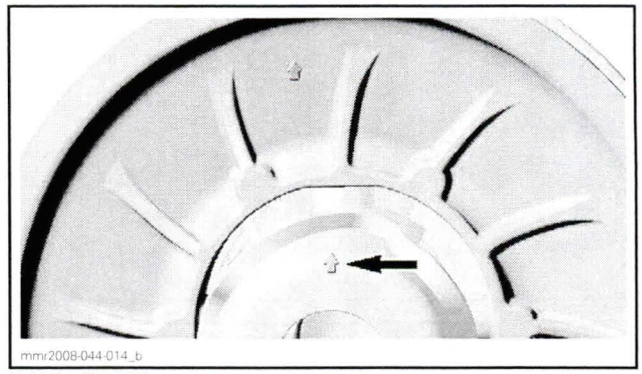
Sliding Sheave Installation

The assembly of sliding sheave is the reverse of the disassembly. However, pay attention to the following.

When installing sliding sheave, make sure to align its arrow with the arrow on cam.



SLIDING SHEAVE ARROW

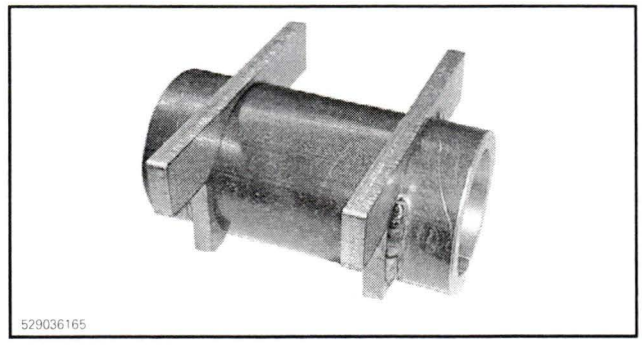


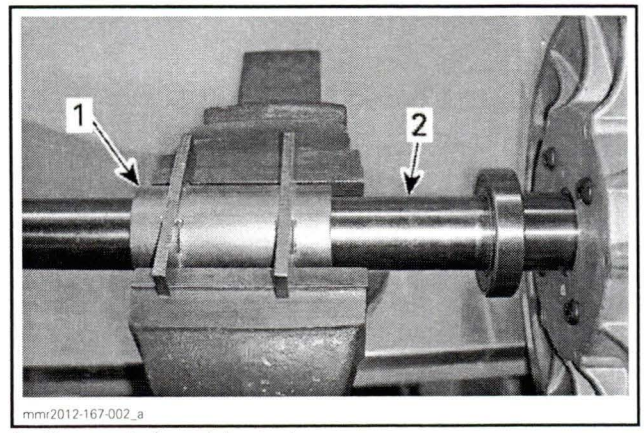
CAM ARROW

Spring Torsional Preload

NOTE: It is usual to experience spring setting during break-in period of a new spring. The factory spring preload is slightly higher (about 1 kg (2 lb)) to compensate for spring setting. Specifications in *TECHNICAL SPECIFICATIONS* are applicable after break-in period (about 10 hours of use).

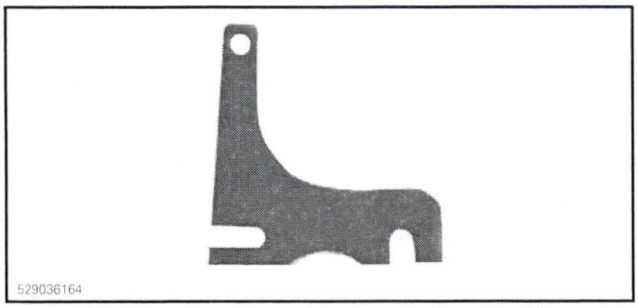
1. Secure the countershaft in a vise using the COUNTERSHAFT RETAINING TOOL (P/N 529 036 165).

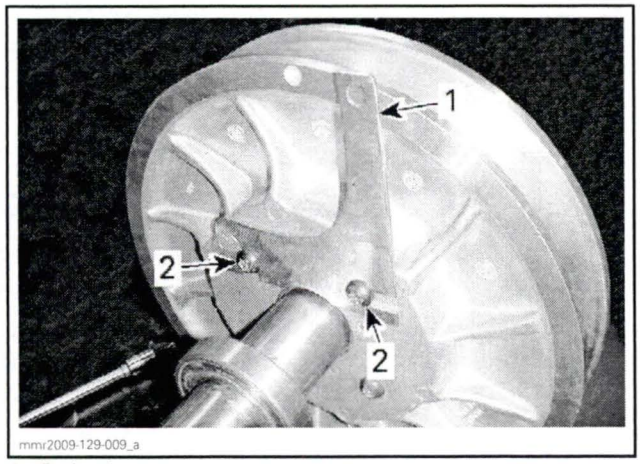




1. *Countershaft retaining tool*
2. *Countershaft*

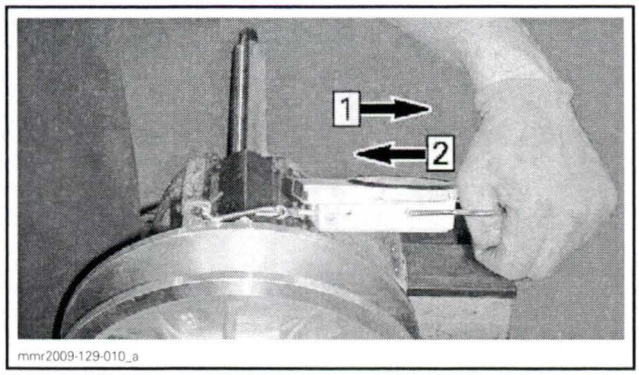
2. Install the PRELOAD TESTER (P/N 529 036 164) using old cam screws.





1. Preload tester
2. Cam screws

3. Hook a fish scale to the preload tester.
4. Pull the preload tester using the fish scale perpendicularly with pulley axle.
   - 4.1 Take a 1st measurement when sliding sheave begins to turn.
   - 4.2 Hold fish scale in this position.
   - 4.3 Slowly release tension and take a 2nd measurement when sliding sheave begins to return.



Step 1: 1st measurement
Step 2: 2nd measurement

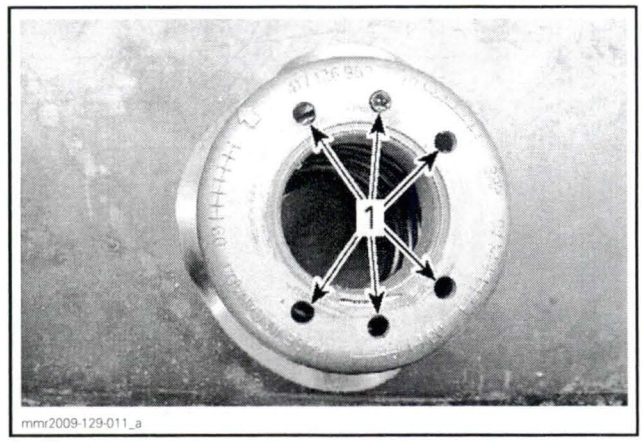
SPRING PRELOAD IS THE AVERAGE MEASUREMENT BETWEEN THESE 2:

$$\frac{\text{1st measurement (when opening)} + \text{2nd measurement (when closing)}}{2} = \text{Spring preload}$$

EXAMPLE:

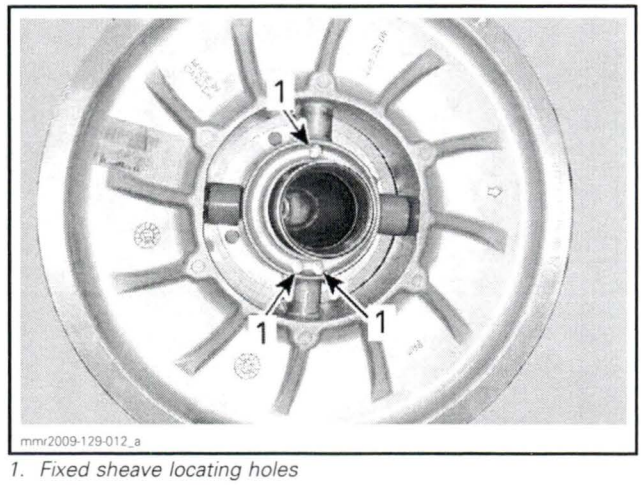
$$\frac{\text{8.2 kg (18 lb) (when opening)} + \text{6.5 kg (14 lb) (when closing)}}{2} = \text{7.3 kg (16 lb) Actual spring preload}$$

To adjust spring preload, relocate spring end in the cam, moving it clockwise to increase the preload and counterclockwise to decrease it. Always recheck torsional preload after an adjustment.



1. Cam locating holes

If spring preload cannot be adjusted, try to relocate the other end of spring in fixed sheave.

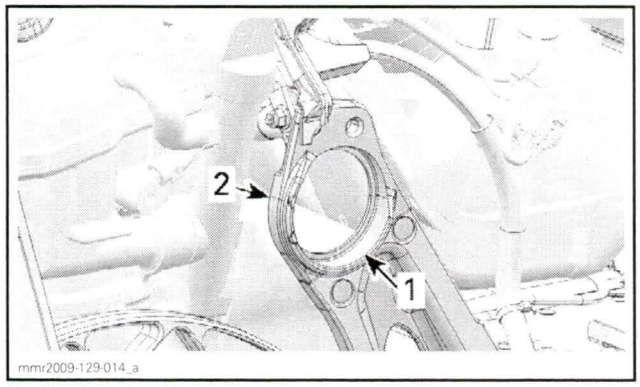


1. Fixed sheave locating holes

5. Finalize driven pulley assembly.

Driven Pulley Installation

1. Using sand paper (600-grit or 1000-grit) or steel wool, remove any rust on bearing shoulder of countershaft bearing support.

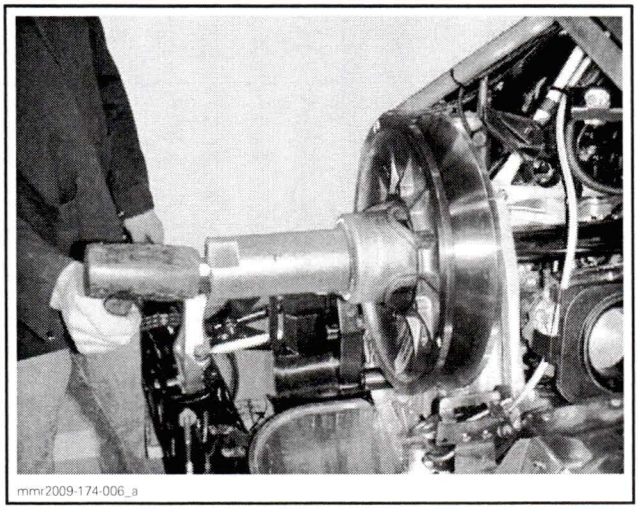


1. Bearing shoulder
2. Countershaft bearing support

2. Apply a thin layer of LOCTITE 767 (ANTISEIZE LUBRICANT) (P/N 293 800 070) on bearing shoulder.

Apply LOCTITE 767 (ANTISEIZE LUBRICANT) (P/N 293 800 070):
- Bearing shoulder
- Countershaft internal splines (gearbox end).

3. Install DRIVEN PULLEY SPRING COMPRESSOR (P/N 529 036 064) on the driven pulley.
4. Position countershaft on gearbox input shaft.
5. Properly insert countershaft through countershaft bearing support using a plastic hammer.



6. On LH side, install the bearing flange on countershaft bearing support.
7. Tighten nut bearing flange to the specified torque.

BEARING FLANGE NUT TIGHTENING TORQUE
16 N•m (142 lbf•**in**)

8. Remove driven pulley spring compressor.
9. Install the adjuster ring on the countershaft end and adjust drive belt. Refer to *DRIVE BELT* subsection.
10. Install all other removed parts.

COUNTERSHAFT

The countershaft and the fixed sheave are sold as an assembly. They are not available separately.

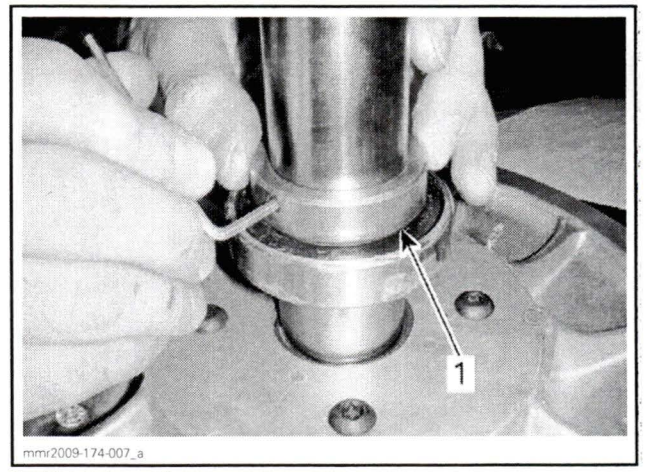
Countershaft Removal and Installation

Refer to *DRIVEN PULLEY* in this subsection.

COUNTERSHAFT BEARING

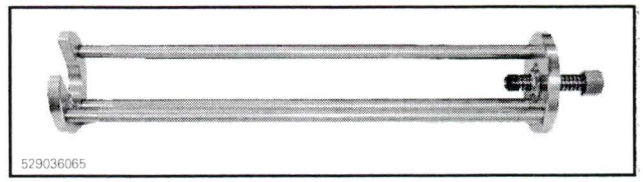
Countershaft Bearing Removal

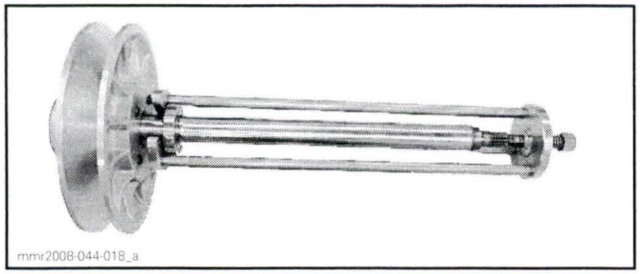
1. Remove *DRIVEN PULLEY*, see procedure in this subsection.
2. Remove bearing retaining collar from countershaft.



1. Retaining collar

3. Install the COUNTERSHAFT BEARING REMOVER (P/N 529 036 065) on countershaft.

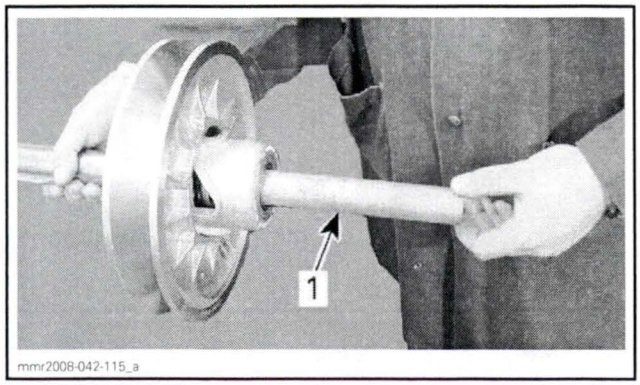




4. Tighten the screw at the end of tool to extract the bearing. Discard the bearing.

Countershaft Bearing Installation

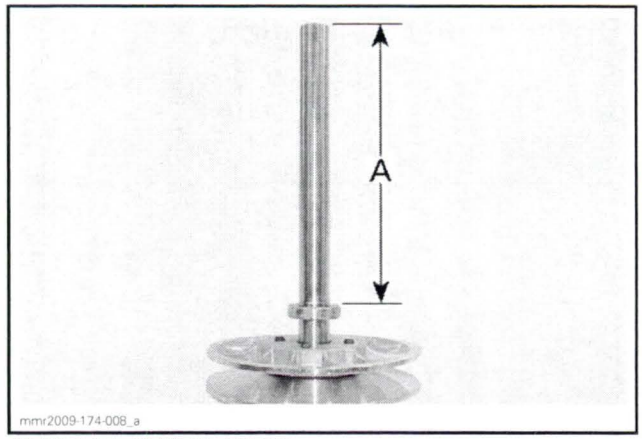
1. Remove the adjustment ring on the cam.
2. Insert the COUNTERSHAFT SUPPORT (P/N 529 036 067) into the countershaft.



1. Countershaft support

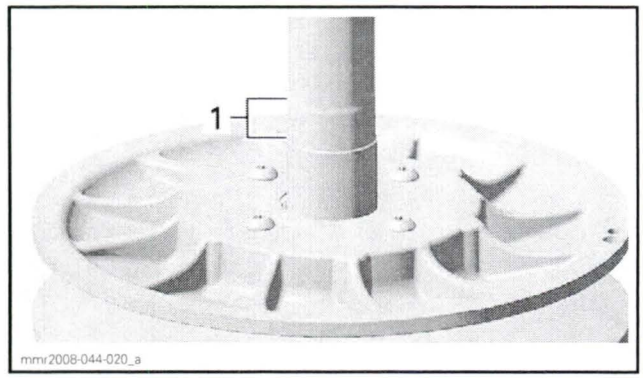
NOTICE **The countershaft support is mandatory to avoid damaging the countershaft and the cam during bearing installation.**

3. Using PULLEY FLANGE CLEANER (P/N 413 711 809), clean residues on countershaft bearing surface.
4. Check countershaft bearing surface for wear.
5. Mark countershaft at 362 mm ± 0.3 mm (14.252 in ± .012 in) from the gearbox end.



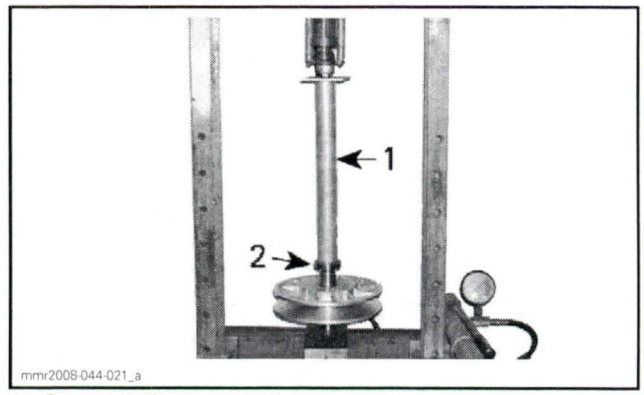
BEARING LOCATION MARK
A. 362 mm ± 0.3 mm (14.252 in ± .012 in)

6. Apply LOCTITE 609 (P/N 413 703 100) on countershaft bearing surface.



1. Apply Loctite 609 in this region

7. Install a **NEW** bearing on countershaft using a press and the COUNTERSHAFT BEARING INSTALLER (P/N 529 036 066).



1. Countershaft bearing installer
2. NEW bearing

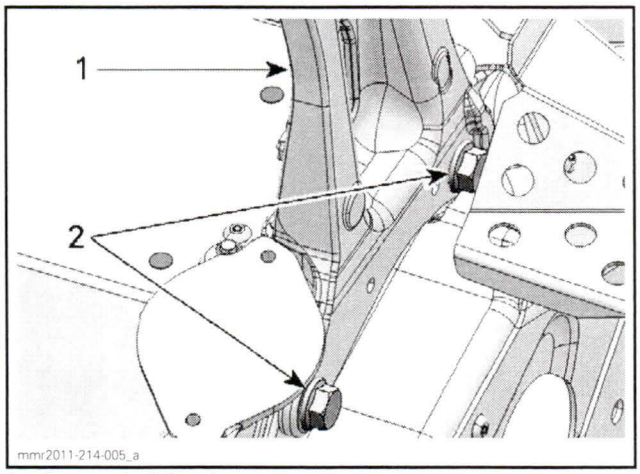
NOTICE **Always use a press, never tap on countershaft bearing installer with an hammer to avoid damaging bearing and countershaft.**

8. Clean the surplus of Loctite with a rag to avoid having Loctite on sliding sheave bushing.

COUNTERSHAFT BEARING SUPPORT

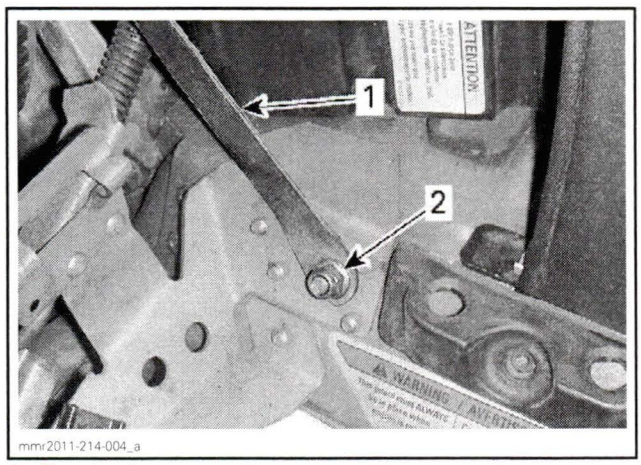
Countershaft Bearing Support Removal

1. Remove *DRIVEN PULLEY*, see procedure in this subsection.
2. Remove screws securing the bottom of countershaft bearing support to the frame.



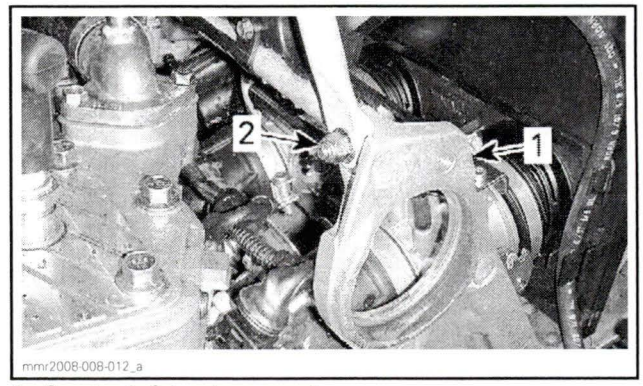
1. Countershaft bearing support
2. Screws

3. Loosen the rear bracket lower retaining nut, then move bracket aside.



1. Rear bracket
2. Lower retaining nut

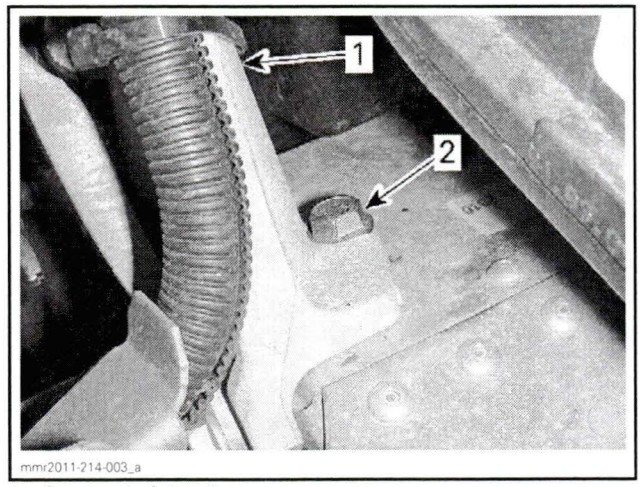
4. Remove the bolt retaining the top of countershaft bearing support to the frame members.



1. Countershaft bearing support
2. Bolt

5. Remove the primary air intake silencer.
6. Loosen the lower nut located behind the countershaft bearing support.

NOTE: For an easier access to the bolt, slightly move throttle body upwards.



1. Countershaft bearing support
2. Lower nut

7. Remove the countershaft bearing support.

Countershaft Bearing Support Installation

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

Tighten the bolt securing the top of bearing support to the frame members loosely last.

Tighten fasteners to the specified torque.

COUNTERSHAFT BEARING SUPPORT FASTENERS TIGHTENING TORQUE	
Top of bearing support to frame members	14 N•m (124 lbf•**in**)
Bearing support to frame screws	25 N•m (18 lbf•ft)
Bearing support lower rear nut	34 N•m (25 lbf•ft)
Bearing flange nut	16 N•m (142 lbf•**in**)
Bottom of rear bracket nut	10 N•m (89 lbf•**in**)

1. Install all other removed parts.

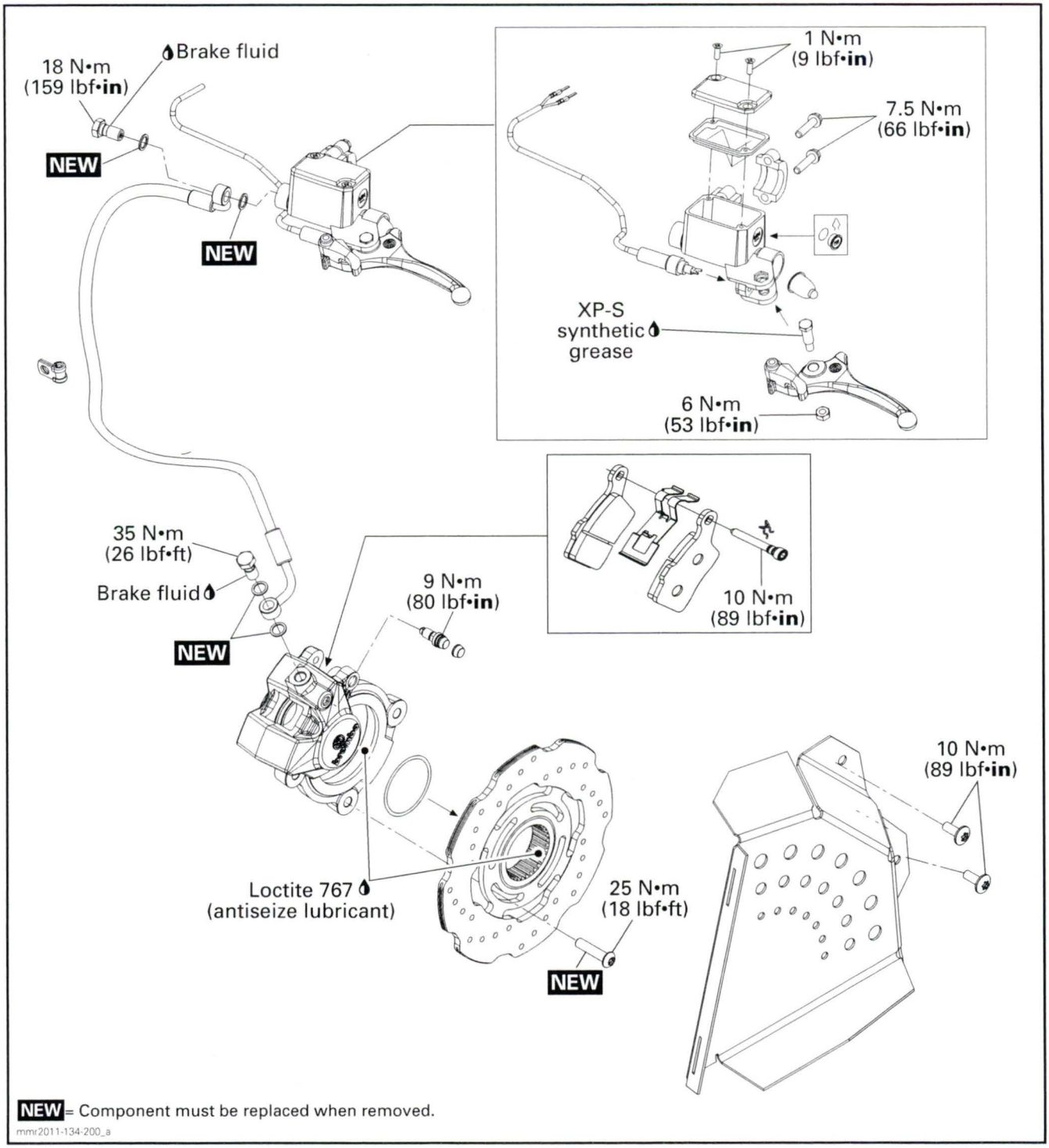
BRAKE

SERVICE TOOLS

Description	Part Number	Page
CALIPER PULLER	529 036 145	758
FLUKE 115 MULTIMETER	529 035 868	762
PROTECTIVE CAP	529 036 150	758

SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 767 (ANTISEIZE LUBRICANT)	293 800 070	758
XPS SYNTHETIC GREASE	293 550 010	761


18 N•m
(159 lbf•in)
Brake fluid
NEW
NEW
1 N•m
(9 lbf•in)
7.5 N•m
(66 lbf•in)
XP-S
synthetic
grease
6 N•m
(53 lbf•in)
35 N•m
(26 lbf•ft)
Brake fluid
NEW
9 N•m
(80 lbf•in)
10 N•m
(89 lbf•in)
Loctite 767
(antiseize lubricant)
25 N•m
(18 lbf•ft)
NEW
10 N•m
(89 lbf•in)
NEW = Component must be replaced when removed.
mmr2011-134-200_a

GENERAL

⚠ WARNING

Never apply anything to brake fittings. The use of thread sealant or Teflon tape could cause brake system failure. Severe injury or death can occur.

⚠ WARNING

A contaminated brake disc or pad reduces braking efficiency. Discard contaminated pads and clean contaminated disc with a high quality brake degreasing agent.

NOTICE Avoid spilling brake fluid on plastic, rubber or painted parts. Protect these parts with a rag when servicing brake system.

⚠ WARNING

To avoid serious damage to the brake system, use only DOT 4 brake fluid from a sealed container. Do not use brake fluid taken from old or already opened containers, nor mix different fluids for topping off.

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

PROCEDURES

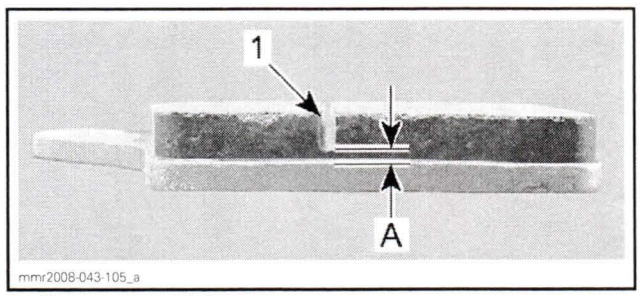
BRAKE PADS

Brake Pad Inspection

1. Measure brake pad lining thickness.

BRAKE PAD THICKNESS	
SERVICE LIMIT	1 mm (1/32 in)

NOTICE Brake pads must always be replaced in pairs.

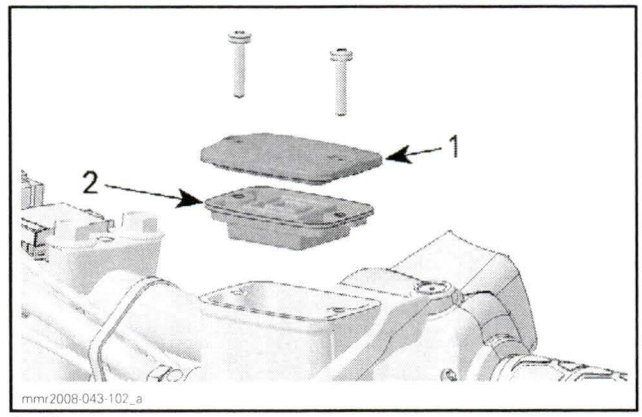


1. Groove on pad lining
A. Brake pad minimum thickness 1 mm (1/32 in)

2. Inspect brake disc at the same time.

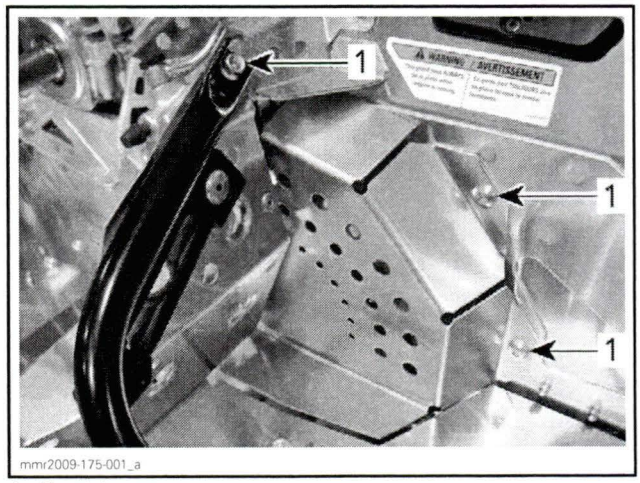
Brake Pad Replacement

1. Place the vehicle on a level surface.
2. Cover the plastic parts under and near master cylinder in the event that brake fluid would be spilled.
3. Remove reservoir cover with its diaphragm.

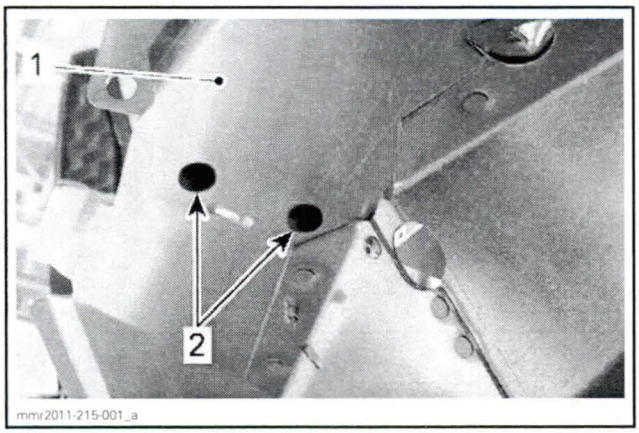


1. Reservoir cover
2. Diaphragm

4. Remove the brake disc protective cover by unscrewing the retaining screws.

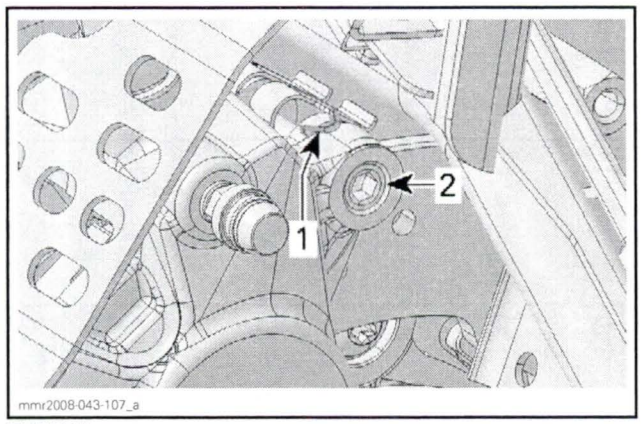


1. Retaining screws



1. Underside of foot board
2. Retaining screw

5. Remove the clip securing pad pin.
6. Unscrew and remove the pad pin.

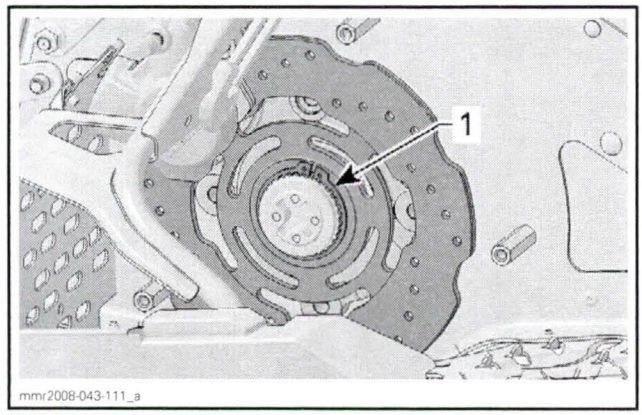


TYPICAL
1. Clip
2. Brake pad pin

7. Using a flat screwdriver, retract pistons into their bores.

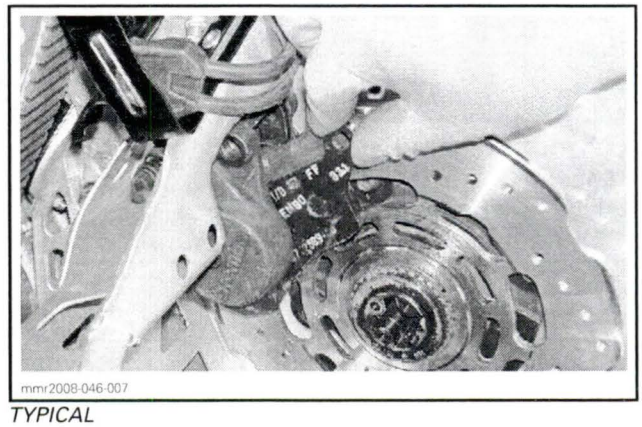
NOTICE **Pay attention to avoid scratching brake disc.**

8. Remove the circlip securing brake disc to drive shaft.



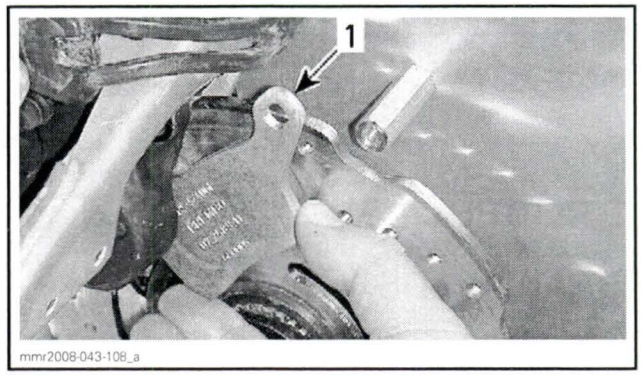
TYPICAL
1. Brake disc circlip

9. Remove brake pads.
   9.1 Remove the external pad first.
   9.2 Pull the brake disc and remove the internal pad.



TYPICAL

10. At this time, check brake disc condition. Refer to *BRAKE DISC INSPECTION* further in this subsection.
11. Install **NEW** brake pads with tabs upward.

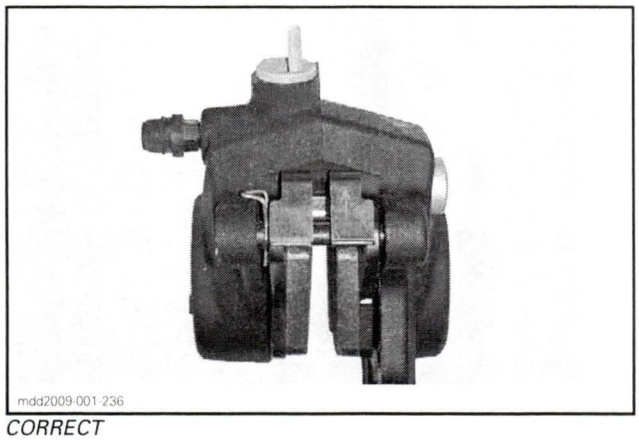


TYPICAL
1. Brake pad tab

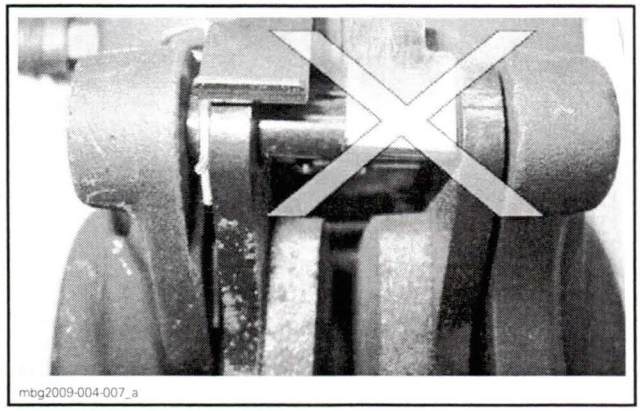
12. Install brake pad pin.
13. Tighten pin to specified torque.

TIGHTENING TORQUE	
Brake pad pin	10 N•m (89 lbf•**in**)

14. Install clip on brake pad pin. If the clip seems loose, replace it with a new one.
15. Make sure spring ends on brake pads pins are correctly installed as per the following pictures.



CORRECT



INCORRECT (ON RIGHT SIDE)

16. Operate the brake lever several times to bring the brake pads into contact with the brake disc.
17. Check brake fluid level in master cylinder and refill if necessary.
18. Install the diaphragm and the reservoir cover.
19. Install the protective cover of the brake disc.
20. Ride the vehicle a few minutes to make sure the repair is successful.

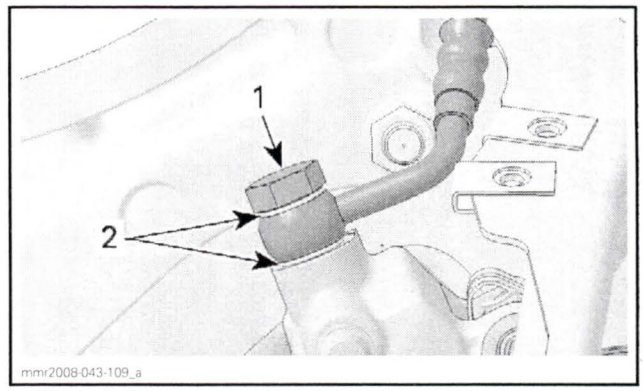
CALIPER

Caliper Removal

1. Open LH side panels.
2. Remove drive belt guard support. Refer to *DRIVE BELT* subsection.

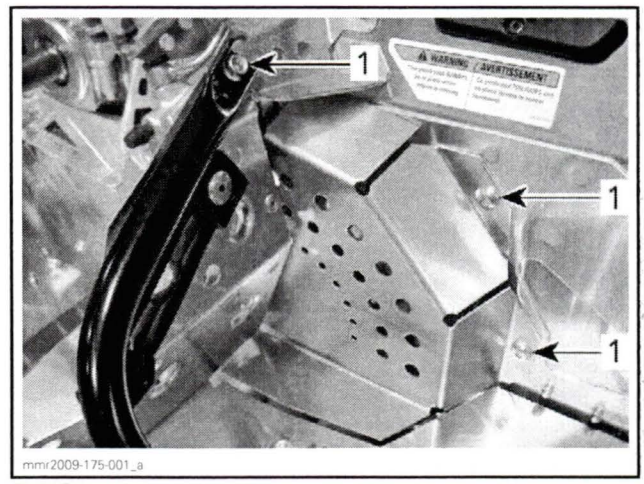
NOTE: If the caliper is not replaced, omit steps 3 and 4 concerning the brake system draining and brake hose removal.

3. Drain the brake system, refer to *BRAKE FLUID REPLACEMENT* in *PERIODIC MAINTENANCE PROCEDURES* subsection.
4. Remove the Banjo fitting and discard the sealing washers.

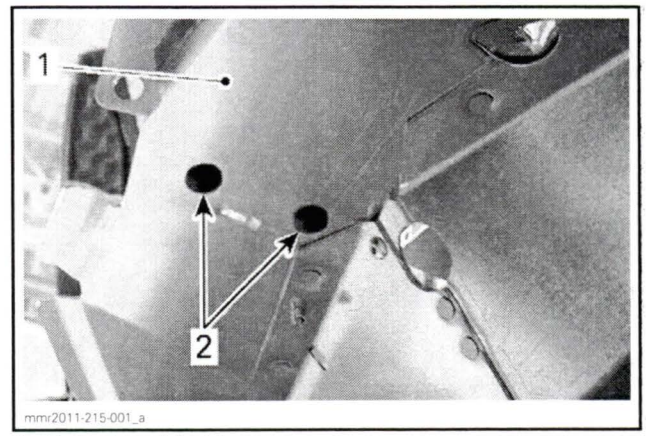


1. Banjo fitting
2. Sealing washers

5. Remove the protective cover from over the brake disc.

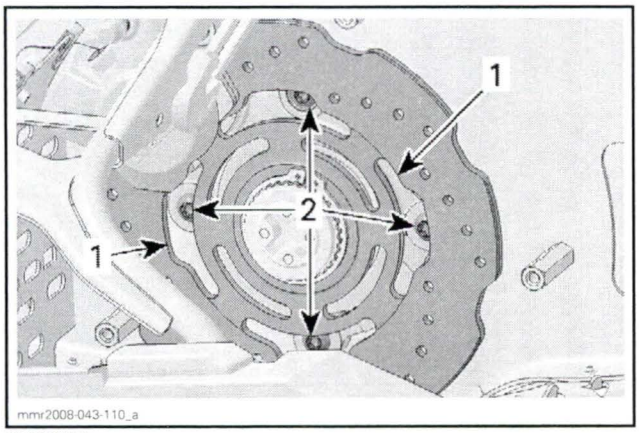


TYPICAL
1. Screws



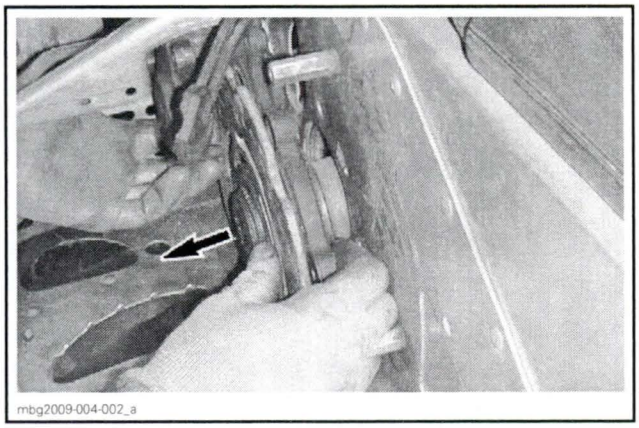
1. Underside of foot board
2. Retaining screws

6. Lift rear of vehicle and release track tension completely. Refer to *TRACK* subsection.
7. Turn driven pulley to align brake disc slots with caliper bracket screws.
8. Remove caliper screws (4) behind brake disc.



TYPICAL
1. *Brake disc slots*
2. *Caliper screws behind brake disc*

9. Pull the drive axle assembly (brake disc, caliper and bearing) from LH side.



PULL

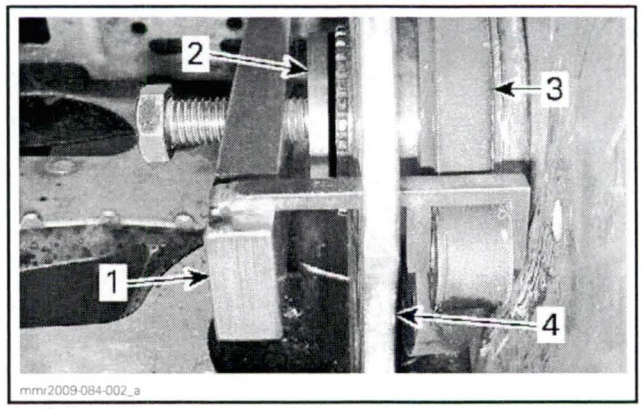
10. Remove *BRAKE PADS*, see procedure in this subsection.
11. Separate caliper from drive axle bearing.

REQUIRED TOOL	
CALIPER PULLER (P/N 529 036 145)	
PROTECTIVE CAP (P/N 529 036 150)	

11.1 Install the caliper puller on the brake caliper through the brake disc slots.

NOTE: Make sure puller tabs are correctly engaged on caliper.

11.2 Install the protective cap between caliper puller bolt and plastic cap.



1. *Caliper puller*
2. *Protective cap*
3. *Caliper bracket*
4. *Brake disc*

11.3 Tighten caliper puller bolt.

NOTICE **Never use an impact tool to operate caliper puller. The caliper or the puller could break.**

12. When the brake disc is disengaged from the drive shaft splines, remove it.
13. Remove caliper.

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

Caliper Inspection

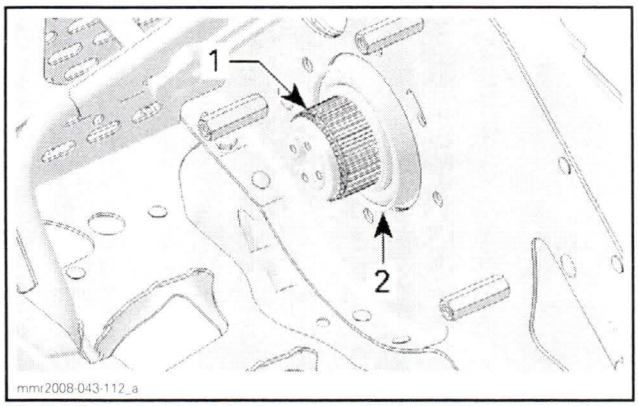
Check pistons for:
- Rust
- Scratches
- Leaks.

Check caliper bracket for:
- Cracks
- Rust on bearing shoulder (clean with a steel wood).

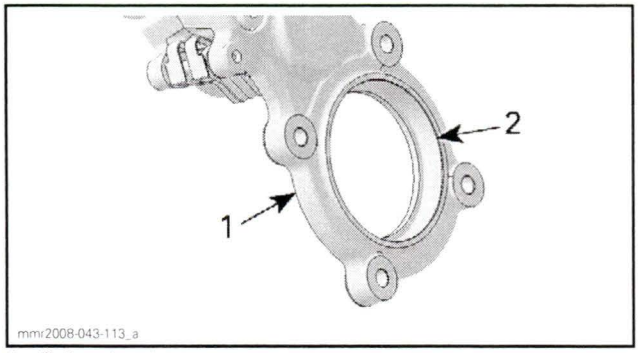
Replace caliper if required.

Caliper Installation

1. Using your fingers or a small piece of wood, push both pistons into their bores.
2. Clean brake caliper bearing shoulder with fine steel wool.
3. Apply LOCTITE 767 (ANTISEIZE LUBRICANT) (P/N 293 800 070) on drive shaft splines and on caliper bracket bearing shoulder.

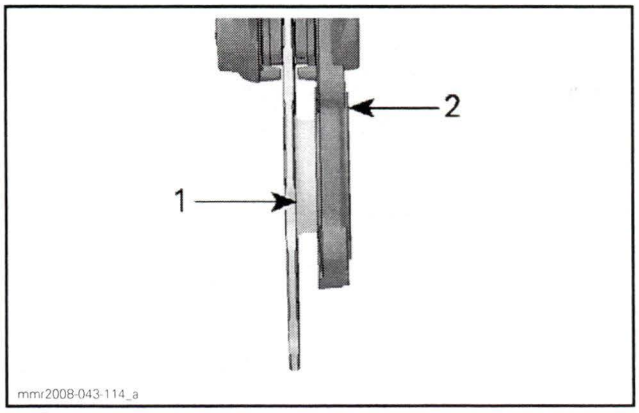


TYPICAL
1. *Drive shaft splines*
2. *Drive shaft bearing*



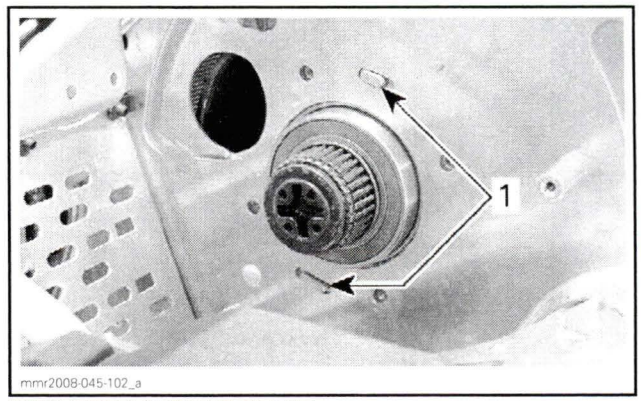
1. *Caliper bracket*
2. *Bearing shoulder*

4. Insert brake disc in the caliper. The brake disc collar must be inserted in the caliper bracket.



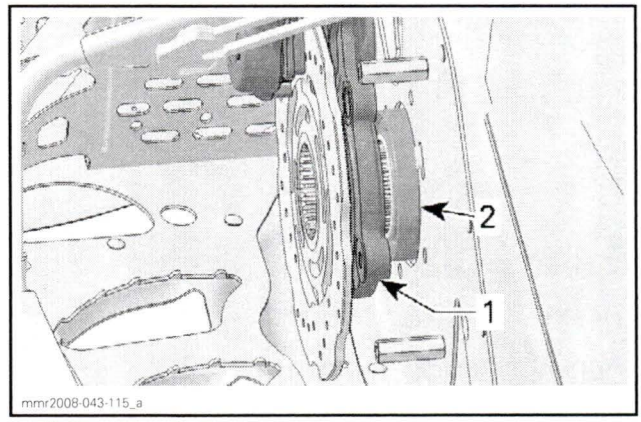
1. *Brake disc collar*
2. *Caliper bracket*

5. Ensure drive shaft bearing flange is properly locked in the frame. Tabs must be properly inserted in frame slots.



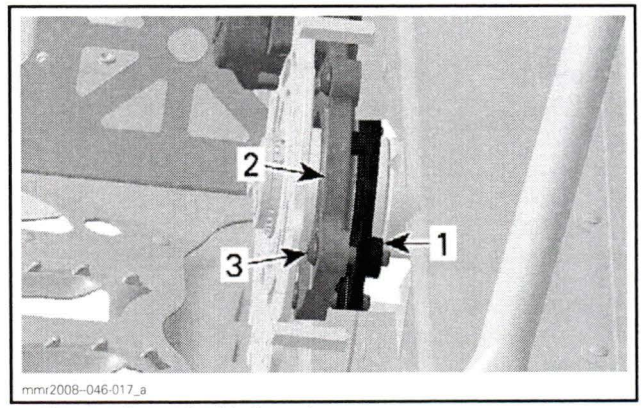
VIEW FROM OUTSIDE FRAME
1. *Bearing flange locking tabs*

6. Align brake disc splines with drive shaft splines and push the disc onto the shaft.
7. Push the caliper bracket over the drive shaft bearing.



1. *Caliper bracket*
2. *Drive shaft bearing*

8. Align caliper bracket holes with bearing flange holes and install caliper retaining screws.



1. *Bearing flange (inside frame)*
2. *Caliper bracket*
3. *Caliper screws*

9. HAND TORQUE each caliper bracket screw evenly in a criss-cross pattern until bracket is correctly positioned against frame.

NOTICE Never use an air tool to tighten caliper screws. The caliper bracket could crack.

TIGHTENING TORQUE	
Caliper retaining screw	25 N•m (18 lbf•ft)

10. Install *BRAKE PADS*, see procedure in this subsection.
11. Install the brake disc circlip.
12. Apply brake fluid on Banjo fitting threads.
13. Install the Banjo fitting with two **NEW** sealing washers.
14. Torque Banjo fitting as specified.

TIGHTENING TORQUE	
Banjo fitting	35 N•m (26 lbf•ft)

15. Fill and bleed the brake system. Refer to *BRAKE FLUID REPLACEMENT* in *PERIODIC MAINTENANCE PROCEDURES* subsection.
16. Install all other removed parts.
17. Check the operation of the brake carefully before riding the snowmobile.

BRAKE DISC

Brake Disc Inspection

Prior Brake Disc Removal

1. Remove the protective cover from over the brake disc.
2. Check for scoring, cracking or bending, replace as required.
3. Measure brake disc thickness. If the brake disc is out of specification, replace it with a new one.

NOTICE Brake disc should never be machined.

BRAKE DISC THICKNESS	
Minimum thickness	5.5 mm (.217 in)

After Brake Disc Removal

Check brake disc splines and drive shaft splines for wear or other damages. Replace defective parts.

Brake Disc Removal and Installation

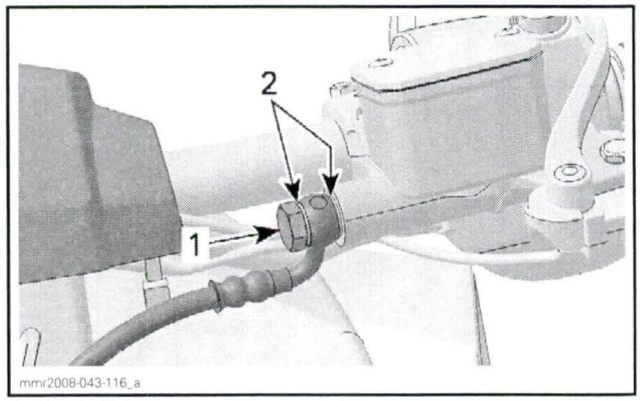
Use the same procedure as for the caliper.

MASTER CYLINDER

Master Cylinder Removal

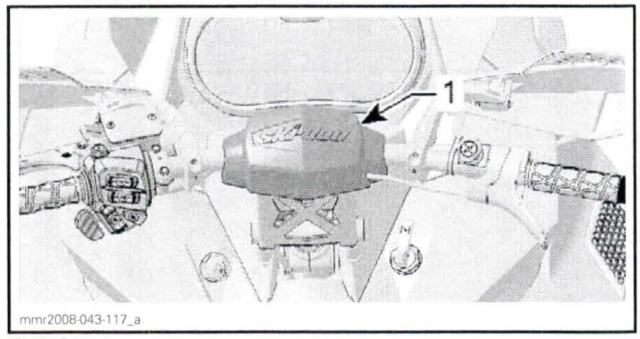
NOTE: If the master cylinder is not replaced, omit the next steps concerning the brake system draining and brake hose removal.

1. Drain the brake system, refer to *BRAKE FLUID REPLACEMENT* in *PERIODIC MAINTENANCE PROCEDURES* subsection.
2. Remove the Banjo fitting and discard the sealing washers.



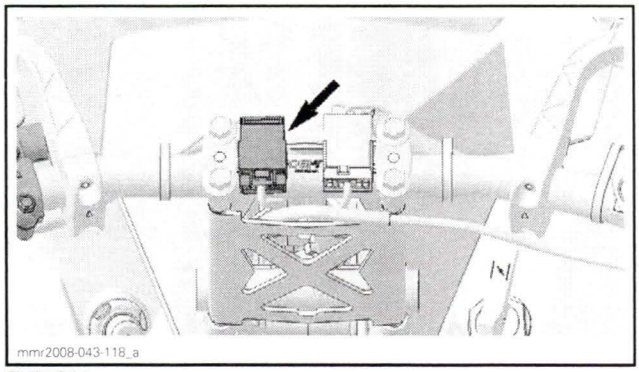
1. Banjo fitting
2. Sealing washers

3. Remove steering pad.



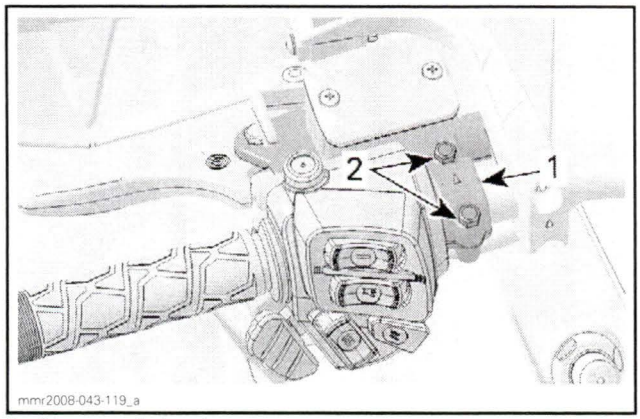
TYPICAL
1. Steering pad

4. Disconnect the LH steering connector atop the handlebar and remove the two brake light switch wires from the connector.



TYPICAL

5. Cut locking tie securing brake light switch wiring to handlebar.
6. Remove screws and clamp securing master cylinder to handlebar.



1. *Master cylinder clamp*
2. *Master cylinder clamp screws*

7. Remove master cylinder.

NOTICE **Do not let master cylinder hang by the hose and do not stretch or twist the hose.**

Master Cylinder Inspection

Discard all remaining fluid inside master cylinder reservoir.

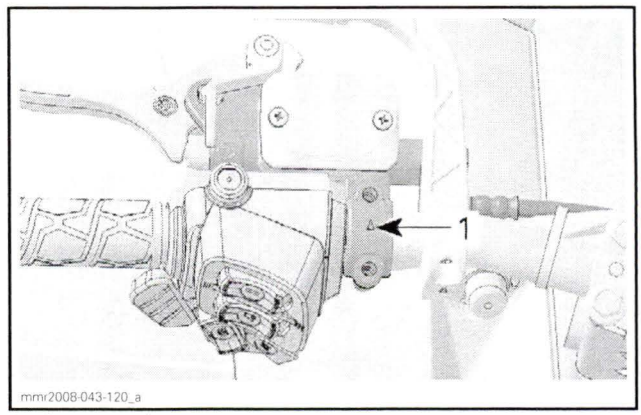
Check the seal of the reservoir cap. If brittle, hard or damaged, replace it.

If the reservoir is damaged or leaking, replace master cylinder.

Check the brake lever. If bent, cracked or otherwise damaged, replace it as required.

Master Cylinder Installation

1. Place the master cylinder on the handlebar.
2. Install master cylinder clamp with its arrow pointing toward the front of vehicle.



1. *Arrow on clamp*

3. Install master cylinder clamp screws finger tight.
4. With the handlebar in a straight ahead position, position the reservoir parallel to the ground.
5. Tighten brake lever clamp screws as specified.

TIGHTENING TORQUE	
Brake lever clamp screws	10 N•m (89 lbf•**in**)

6. Install the Banjo fitting with two **NEW** sealing washers.
7. Torque Banjo fitting as specified.

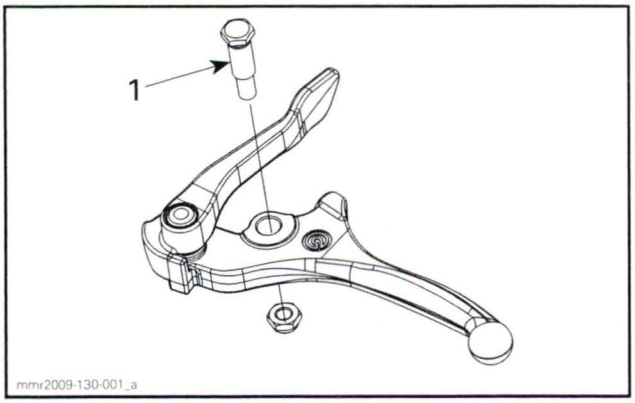
TIGHTENING TORQUE	
Banjo fitting	18 N•m (159 lbf•**in**)

8. Fill and bleed the brake system. Refer to *BRAKE FLUID REPLACEMENT* in the *PERIODIC MAINTENANCE PROCEDURES* subsection.
9. Insert the brake light switch wires in the LH steering connector and reconnect the steering connector.
10. Install steering cover.

BRAKE LEVER

Brake Lever Replacement

Lubricate brake lever pivot screw using XPS SYNTHETIC GREASE (P/N 293 550 010).



1. Lubricate brake lever pivot

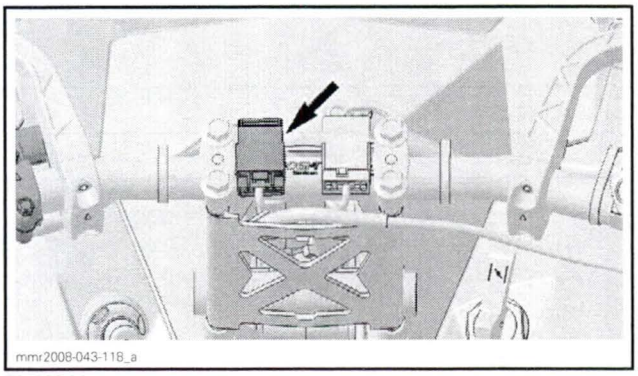
Torque brake lever retaining nut as specified.

TIGHTENING TORQUE	
Brake lever nut	6 N•m (53 lbf•**in**)

BRAKE LIGHT SWITCH

Brake Light Switch Continuity Test

1. Remove steering cover.
2. Disconnect LH steering connector.



TYPICAL

3. Test for continuity through brake switch as per the following table.

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

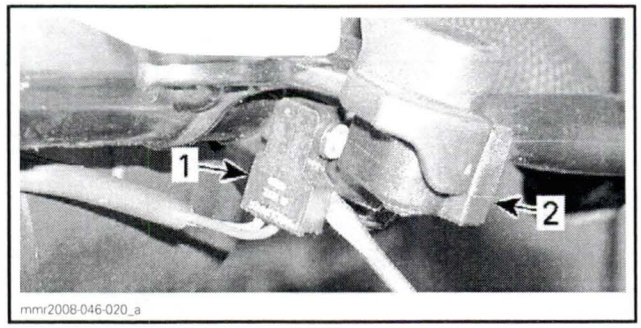
BRAKE LEVER POSITION	TEST PROBES	RESISTANCE
Released	GY and BR wires	Open (OL)
Pull in		

If readings are not as specified, replace switch.

If readings are as specified, check fuse, wiring and connectors going to switch. Repair or replace defective part(s). Refer to *LIGHTS, GAUGE AND ACCESSORIES* subsection.

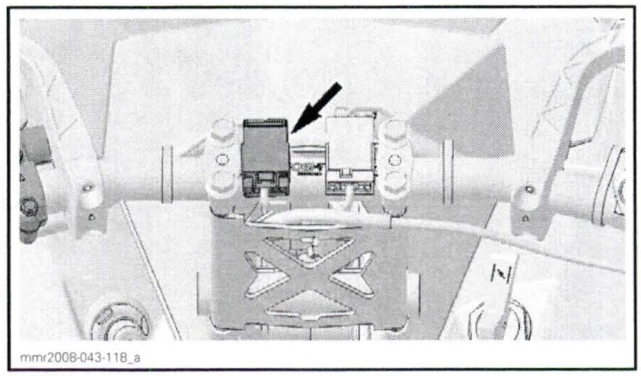
Brake Light Switch Removal

1. Slip a small screwdriver between brake light switch and brake lever and separate them.



1. Brake light switch
2. Brake lever

2. Remove the steering cover and disconnect the LH steering connector.



TYPICAL

3. Cut all locking ties securing switch wires.
4. Remove switch wires from connector.

NOTE: Observe and note wire location for reinstallation.

Brake Light Switch Installation

1. Squeeze brake lever.
2. Insert both tabs on switch in the brake lever body.
3. Insert switch wires in the steering connector as noted prior to removal.
4. Connect the steering connector.
5. Check for proper switch operation.
6. Install new locking ties and the steering cover.

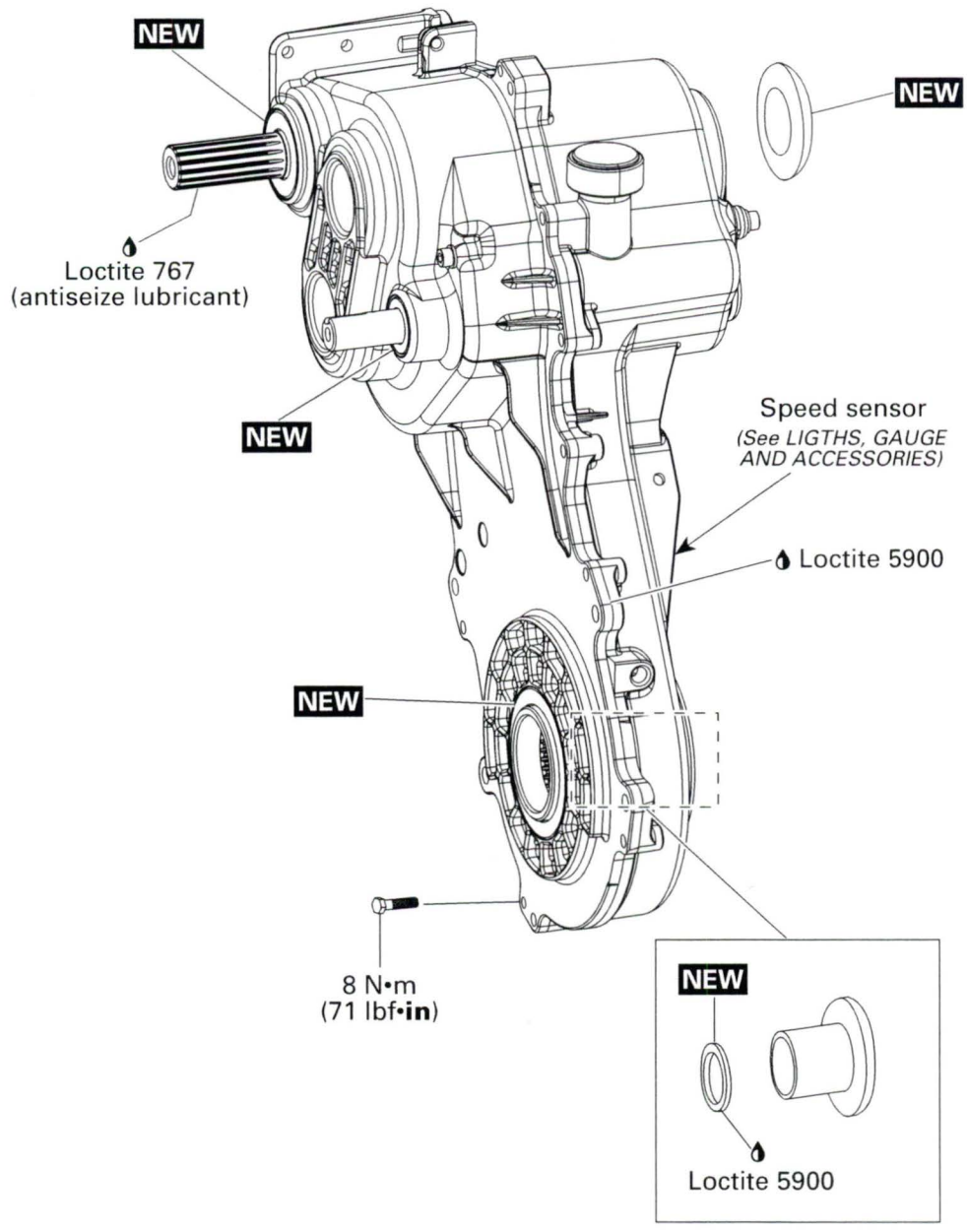
GEARBOX

SERVICE TOOLS

Description	Part Number	Page
FLUKE 115 MULTIMETER	529 035 868	767

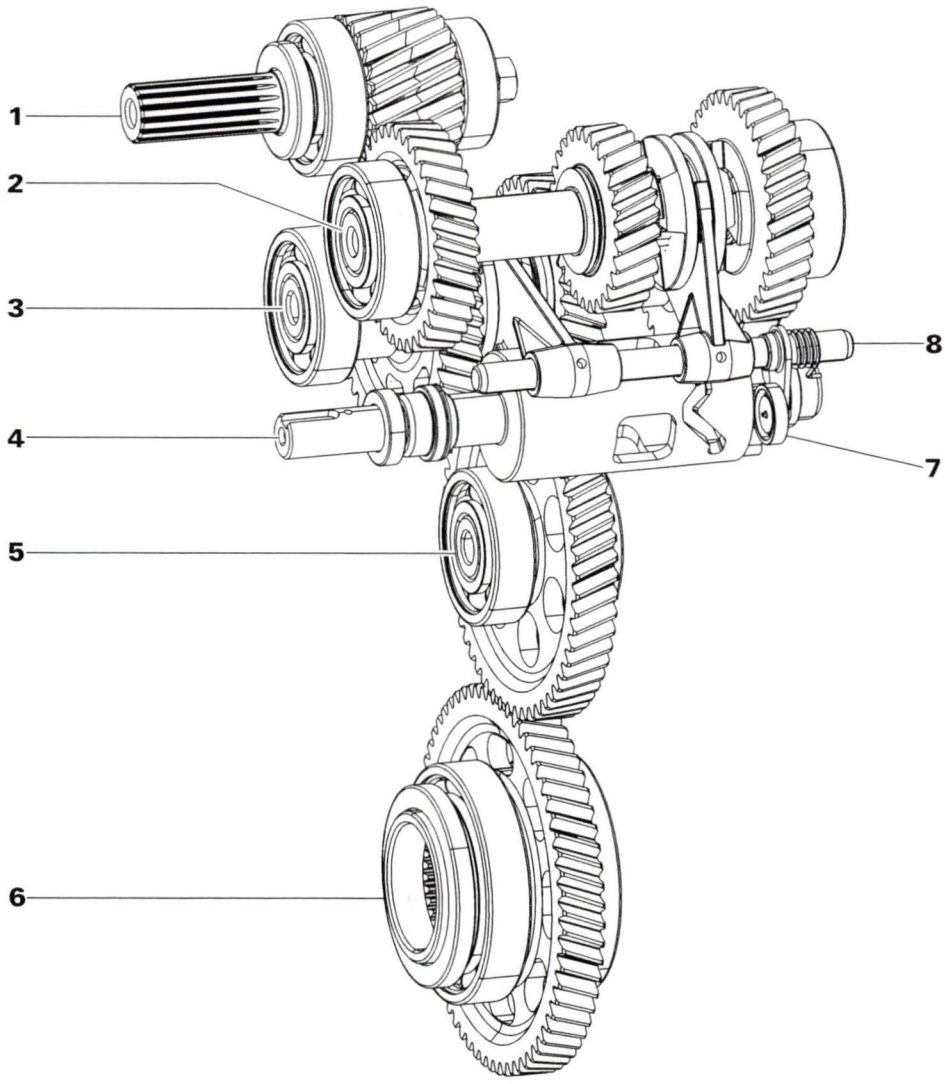
SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 5900	293 800 066	772
LOCTITE 767 (ANTISEIZE LUBRICANT)	293 800 070	772–773
LOCTITE CHISEL (GASKET REMOVER)	413 708 500	770
PULLEY FLANGE CLEANER	413 711 809	772



NEW = Component must be replaced when removed.

mmr2009-176-100_c



mmr2009-176-101_a

1. *Input shaft*
2. *Main shaft*
3. *Reverse shaft*
4. *Shift drum*
5. *Middle gear*
6. *Lower gear*
7. *Index lever*
8. *Shift fork shaft*

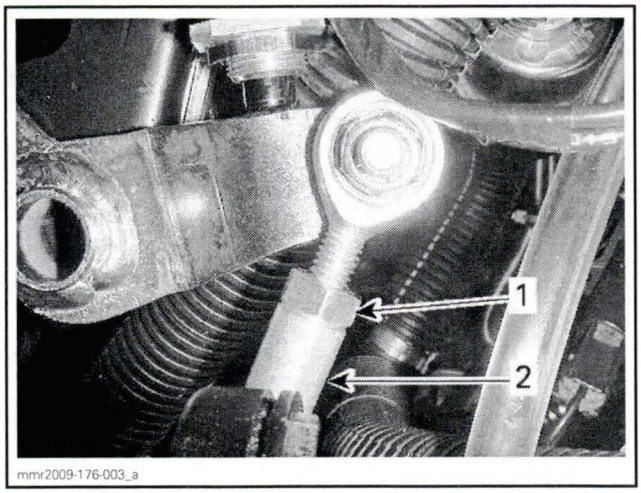
ADJUSTMENT

GEARSHIFT LEVER

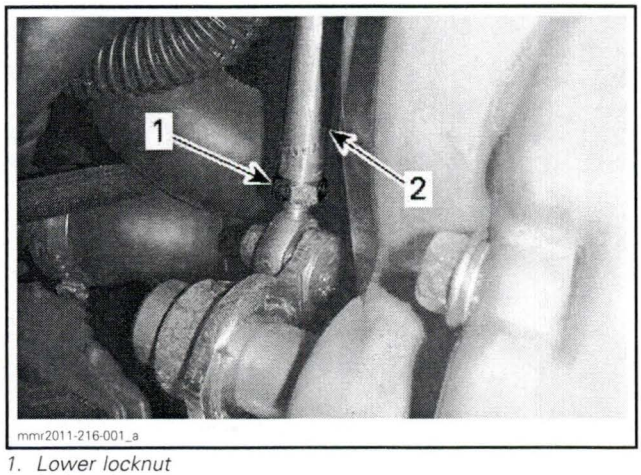
Gearshift Lever Adjustment

1. Refer to *BODY* and remove RH side panels.
2. Loosen both gearshift link rod locknuts and unscrew a few turns.

NOTE: The upper locknut has LH threads.

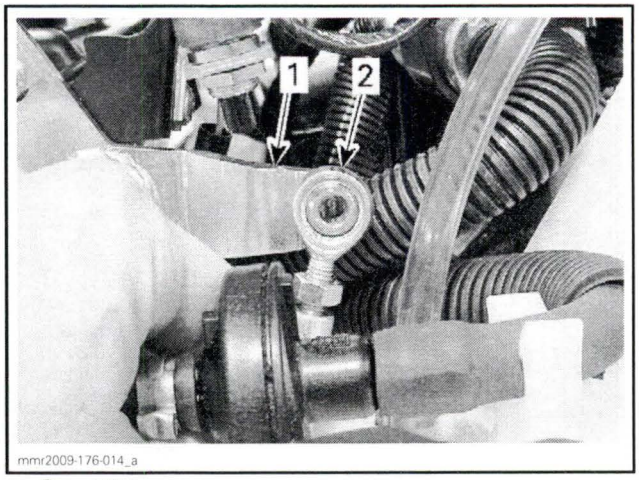


1. Upper locknut
2. Link rod



1. Lower locknut
2. Link rod

3. Detach gearshift linkage from gearshift lever.
4. Place gearshift lever to neutral.
5. Shift gearbox to neutral by moving shift drum lever.
6. Turn gearshift link rod in order to align the link rod bolt hole with the gearshift lever hole.



1. Gearshift lever
2. Link rod

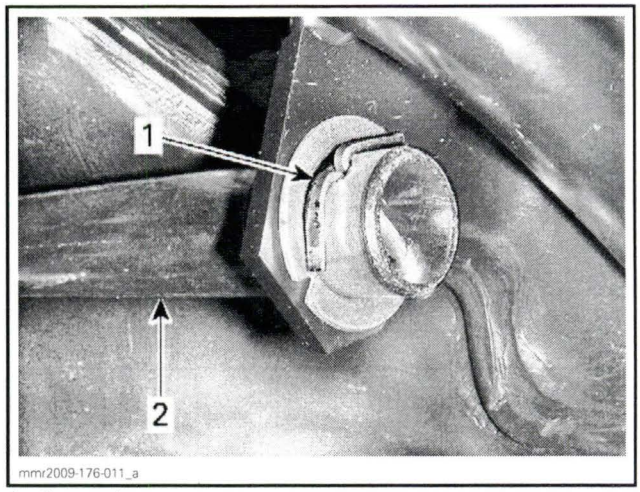
7. Reinstall link rod to gearshift lever.
8. Tighten the link rod locknuts without turning the link rod.

PROCEDURES

GEARSHIFT LEVER

Gearshift Lever Removal

1. Remove gearshift lever knob screw, then remove knob. Be prepared to catch the spring as the knob comes off the lever.
2. Refer to *BODY* and remove console.
3. Remove and discard cotter pin on the LH side of gearshift lever shaft.



1. Cotter pin
2. Gearshift lever shaft

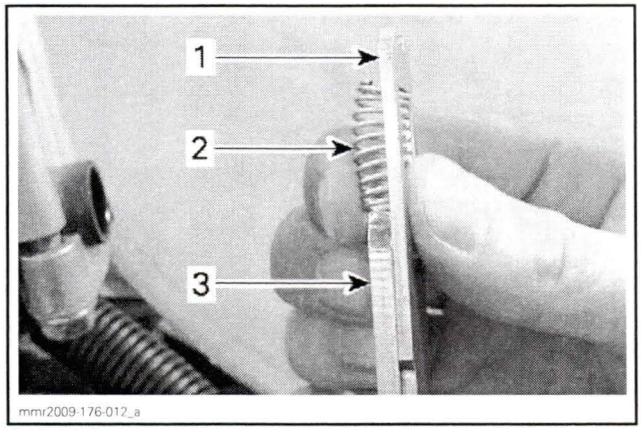
4. Pull gearshift lever assembly out.

Gearshift Lever Installation

Installation of the lever is the reverse of removal.

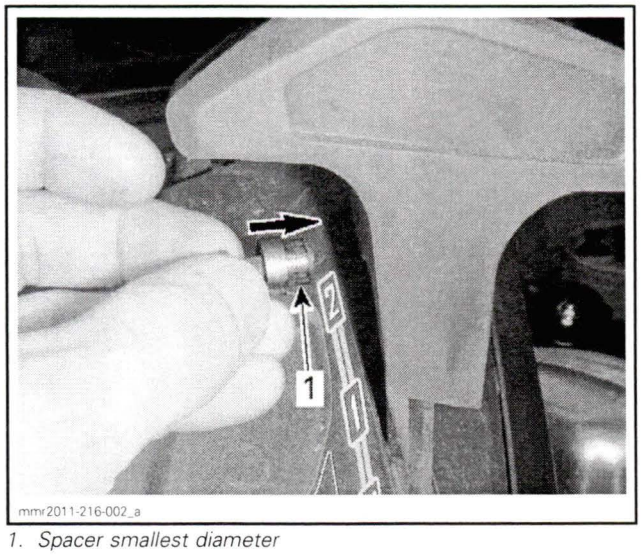
To instal knob, proceed as follows:

1. Shift gearbox to a forward gear.
2. Install spring in the slot between the lock lever and the shift lever, then hold it in position.



1. Lock lever
2. Spring
3. Shift lever

3. Slide knob over the levers.
4. Install spacer with the smallest diameter towards the knob.



1. Spacer smallest diameter

5. Secure knob with the screw.

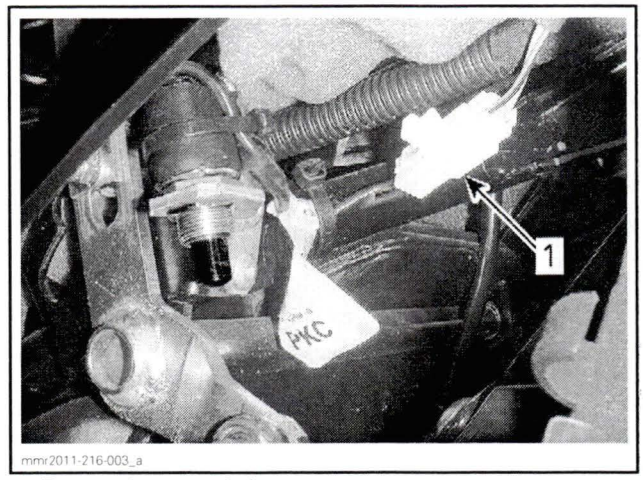
NOTE: Make sure the spacer engages in the shift lever slot and that the knob moves freely downwards.

REVERSE BEEPER SWITCH

The reverse switch activates the beeper (integrated in gauge) for reverse operation by switching the ECM beeper circuit to ground.

Reverse Beeper Switch Testing

1. Remove RH upper side panel.
2. Disconnect reverse beeper switch connector.



1. Reverse beeper switch connector

3. Probe the terminals on the switch harness and measure resistance as follows:

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

TEST PROBES	SWITCH POSITION	RESISTANCE
Switch terminals	Button in	Close to 0 Ω
	Button out	Infinite (open)

If resistance is as specified, check switch adjustment.

If resistance is not as specified, replace switch.

Reverse Beeper Switch Circuit Testing

550F Models

1. Check the continuity between reverse beeper switch and ground.
2. Check the continuity between reverse beeper switch and gauge (pin 8).

Repair wiring or connector if necessary.

600 ACE and 600 HO E-TEC Models

1. Check the continuity between reverse beeper switch and ground.
2. Check the continuity between reverse beeper switch and ECM. Use the following table to identify ECM pin.

REVERSE BEEPER ECM PIN IDENTIFICATION	
ENGINE	ECM PIN
600 ACE	B connector Pin 3H
600 HO E-TEC	J1A connector Pin 31

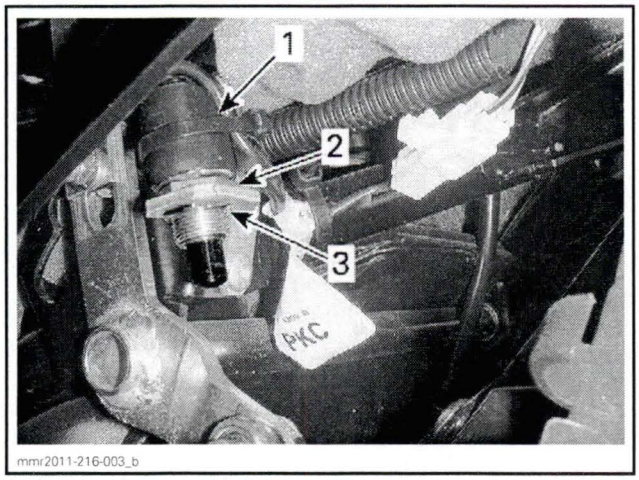
Repair wiring or connectors if necessary.

Reverse Beeper Switch Replacement

1. Refer to *BODY* and remove RH upper side panel.
2. Disconnect reverse beeper switch connector.
3. Remove the lower reverse beeper switch nut.
4. Remove reverse beeper switch.
5. Pass the **NEW** switch through holder with the upper nut installed.
6. Loosely install the other nut and adjust reverse beeper switch. Refer to *REVERSE BEEPER SWITCH ADJUSTMENT*.

Reverse Beeper Switch Adjustment

1. Refer to *BODY* and remove RH upper side panel.
2. Loosen both switch nuts.



mmr2011-216-003_b

1. Reverse beeper switch
2. Upper nut
3. Lower nut

3. Adjust switch height so that switch button goes in when gearbox is shifted in reverse without being forced into it.
4. Tighten nuts.
5. Check switch operation.

GEARBOX

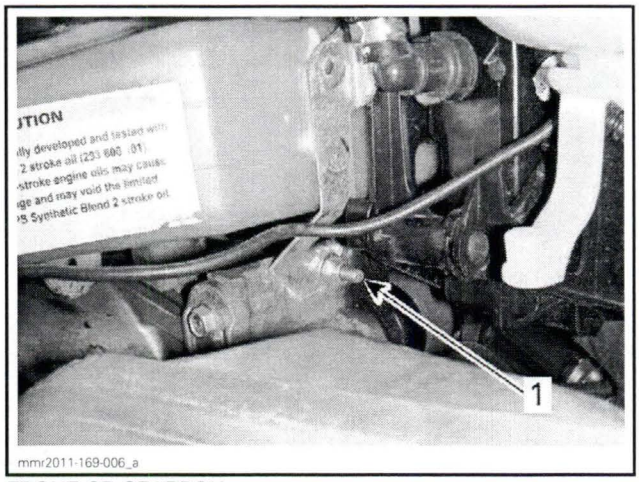
Gearbox Removal

NOTE: If gearbox is to be opened, drain oil, refer to *MAINTENANCE PROCEDURES* subsection.

1. Remove driven pulley and countershaft, refer to *DRIVE SYSTEM AND BRAKE* section.
2. Remove muffler, refer to *EXHAUST SYSTEM* subsection.
3. Completely release track tension.

600 HO E-TEC Models

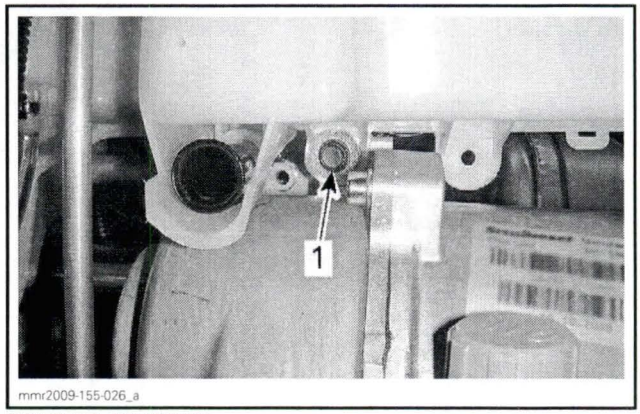
4. Remove bolt securing coolant tank support to gearbox.



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FRONT OF GEARBOX
1. Coolant tank support bolt

5. Remove screw securing oil tank to gearbox.



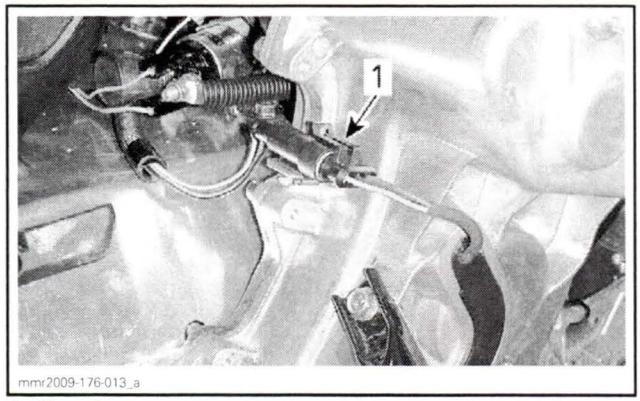
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REAR OF GEARBOX
1. Oil tank retaining screw

All Models

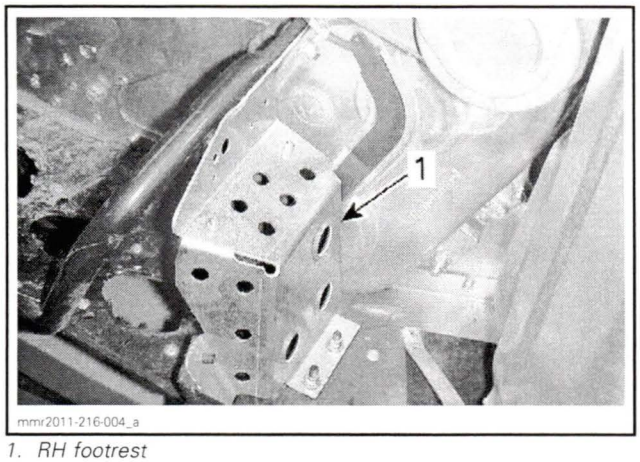
6. Remove gearshift link rod.
7. Remove the bolt retaining the frame member to the top of gearbox.

8. Disconnect the speed sensor connector and detach from gearbox casing.



1. Speed sensor connector

9. Remove the RH footrest.



1. RH footrest

10. Remove all four nuts retaining gearbox to the chassis.
11. Carefully pull gearbox outwards to free it from the chassis, then from the drive axle splines.

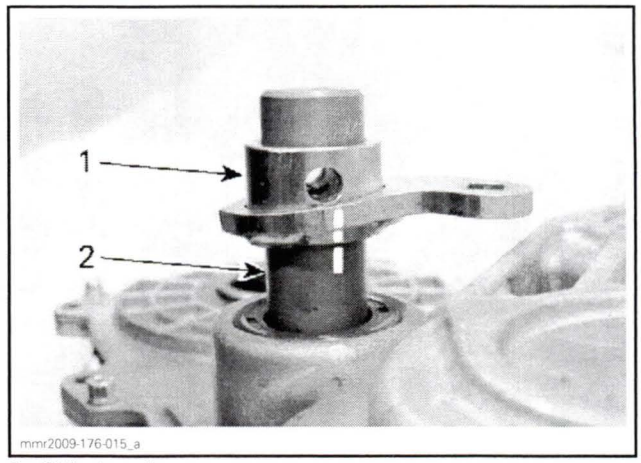
Gearbox Disassembly

Casing Separation

1. Remove all 10 screws securing the gearbox casing halves together.

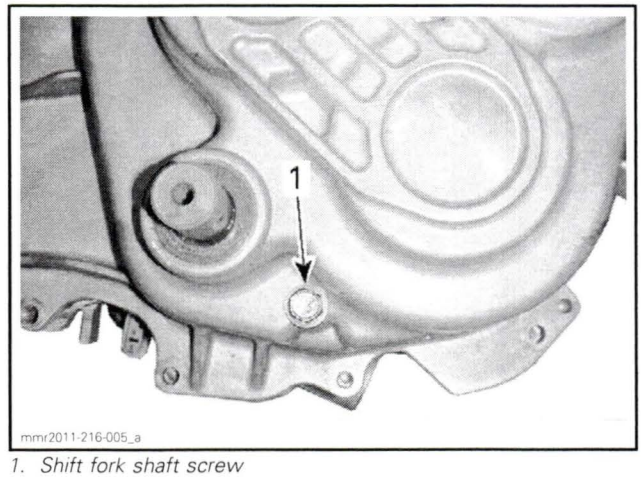
NOTE: There is one screw installed on the outer (RH) side casing half.

2. Mark shift drum lever position on shift drum shaft.



1. Shift drum lever
2. Shift drum shaft

3. Remove shift drum lever spring pin, then shift drum lever using a suitable puller.
4. Remove the shift fork shaft retaining screw from the inner (LH) casing half.

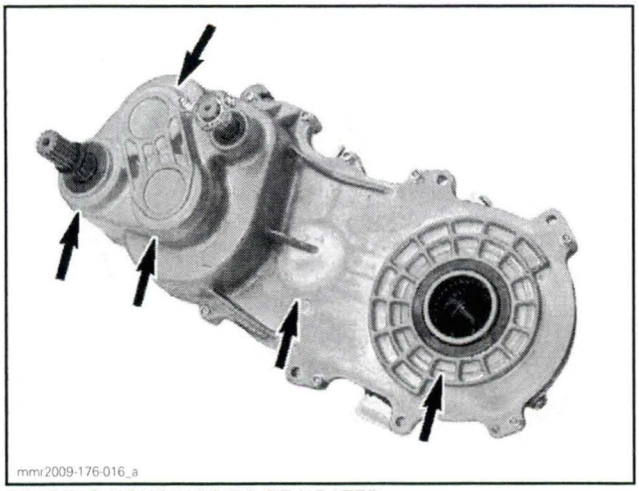


1. Shift fork shaft screw

5. Heat every bearing housing of the inner (LH) casing half and the dowel pins area equally to approximately 150°C (302°F).

NOTE: While heating, apply an upwards motion from time to time.

NOTICE **Never pry between the mating surfaces or force casing. Be very careful when splitting casing to avoid breakage or warpage.**



BEARING HOUSINGS TO BE HEATED

6. Separate casing.

NOTE: If there is a shim on the reverse shaft bearing, keep it for reassembly.

Input Shaft, Middle and Lower Gear Removal

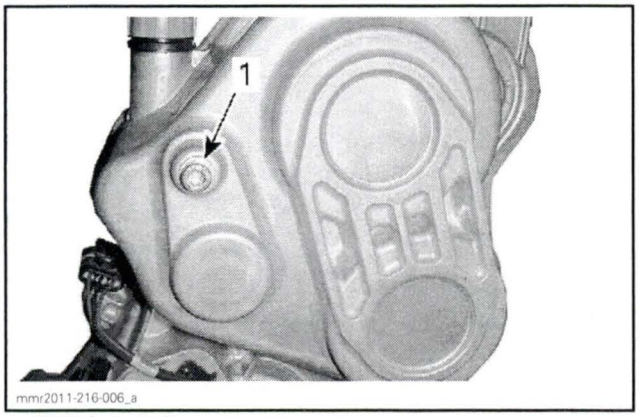
Heat the applicable bearing housing on the outer (RH) casing half to approximately 150°C (302°F).

While heating, pull on shaft or gear from time to time until shaft or gear comes out.

Main and Reverse Shaft Removal

NOTE: Gears, shafts and bearings are replaced as an assembly.

1. Remove shift fork shaft retaining screw from the exterior of casing.



1. Shift fork shaft screw

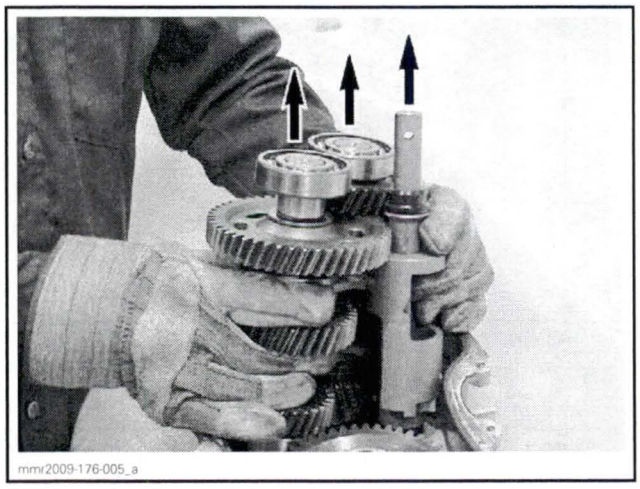
2. Heat both bearing housings on the outer (RH) casing to approximately 150°C (302°F) to free bearings from the casing.

NOTE: While heating, pull on shafts from time to time.

3. Free both bearings.

4. Grab both shafts, shift drum and shift forks and extract as an assembly.

NOTE: Pull on shift fork shaft from time to time during this procedure to ease parts removal.



Gearbox Cleaning and Inspection

1. Clean parts in clean solvent, then dry with compressed air.
2. Check bearings and gear teeth condition for wear, signs of overheating or other damage.
3. Remove all sealant residue from casing mating surfaces using LOCTITE CHISEL (GASKET REMOVER) (P/N 413 708 500) and a brass brush. Wipe with a clean hand towel.
4. Remove and discard oil seals and rubber plug.
5. Clean casing in clean solvent, then dry with compressed air.

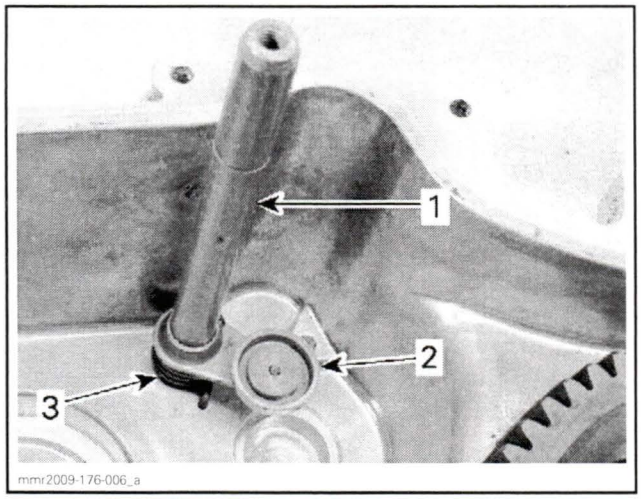
NOTICE To avoid damage to casing mating surfaces, do not use a steel brush or scraper.

6. Check casing for cracks, scored mating surfaces or other damage.

Gearbox Assembly

Gearing and Shift Mechanism Installation

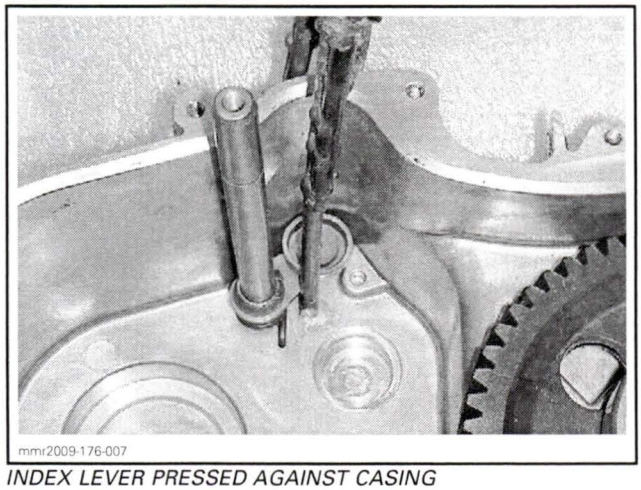
1. Install index lever spring, index lever and shift fork shaft in the outer (RH) casing half.



1. Shift fork shaft
2. Index lever
3. Index lever spring

2. Press index lever against the casing.

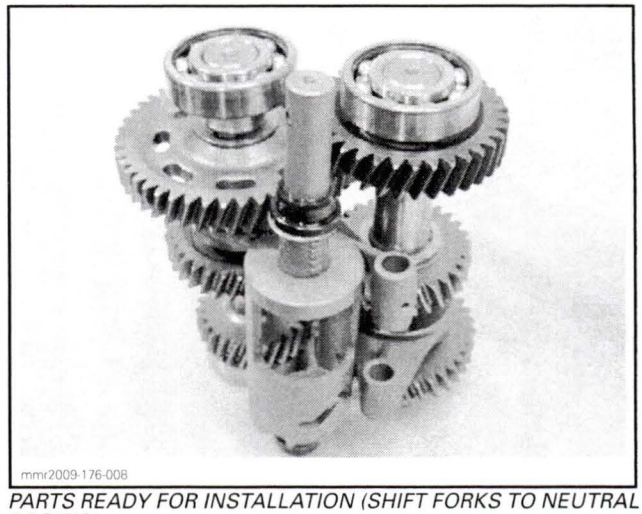
NOTE: For this purpose, use a pair of locking pliers with jaws of at least 10 cm (4 in).



INDEX LEVER PRESSED AGAINST CASING

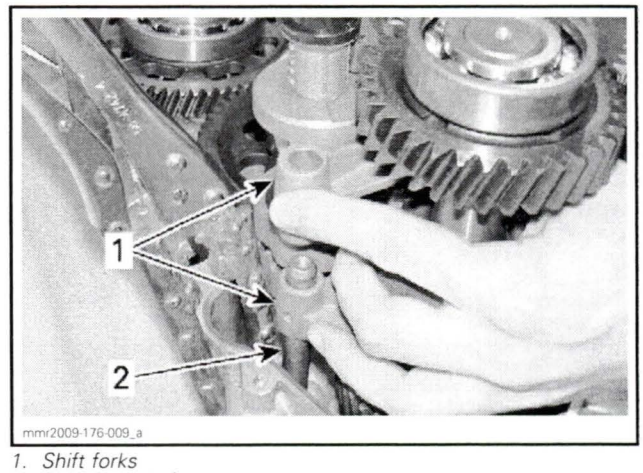
3. Assemble the following parts on a workbench as shown.
   - Main shaft
   - Reverse shaft
   - Shift drum
   - Shift forks.

NOTE: Set the shift forks to neutral (fork pins inserted in straight grooves of the shift drum).



PARTS READY FOR INSTALLATION (SHIFT FORKS TO NEUTRAL POSITION)

4. Heat the bearing housings equally from the exterior of the casing to approximately 150°C (302°F).
5. Carefully put the assembled parts in the casing.
   5.1 Pass the shift forks bores over the shift fork shaft.
   5.2 Align both bearings and shift drum in their bores.



1. Shift forks
2. Shift fork shaft

6. Align the input shaft bearing in its bore.
7. Completely insert all bearings in their bores.

NOTE: If necessary, continue heating until complete insertion.

During this procedure, make sure that:
- Shift drum bushing remains aligned with the casing bore.
- Shift fork pins are properly inserted into the shift drum grooves.
- Shift forks are properly inserted into the sliding sleeve grooves.

8. Once bearings and shift drum are bottomed in their casing bores, remove the pliers.
9. Install the input, middle gear and lower gear following the method used to install the main and reverse shafts (steps 4 and 6).
10. Rotate gearing to be sure there is no binding or gear interference.
11. Lubricate gearing and shift mechanism with recommended oil.

Closing Casing

1. Clean the casing mating surfaces with PULLEY FLANGE CLEANER (P/N 413 711 809) or equivalent.
2. If applicable, put the shim on the reverse shaft bearing.
3. Put a thin regular bead of LOCTITE 5900 (P/N 293 800 066) on the outer (RH) casing half.
4. Heat all five bearing housings of the inner (LH) casing half equally to approximately 150°C (302°F).
5. Carefully lower the inner casing half until it contacts the other half. Heat more if necessary.

NOTE: It may be necessary to gently strike the dowel pins area with a soft faced hammer.

6. Install and hand tighten the casing screws.

NOTICE Never tighten screws if there is a gap between casing halves. Make sure mating surfaces are brought into contact before tightening screws.

7. Tighten casing screws to specification in a crossed pattern starting from the middle of the casing.

TIGHTENING TORQUE	
Casing screws	8 N•m (71 lbf•**in**)

8. Install both shift fork shaft retaining screws with their washers and tighten to specification.

TIGHTENING TORQUE	
Shift fork shaft retaining screws	8 N•m (71 lbf•**in**)

9. Install shift drum lever.
10. Confirm gearbox operation by rotating the input shaft in all gear ranges.
11. Install **NEW** seals.

Gearbox Installation

1. Install drain plug.

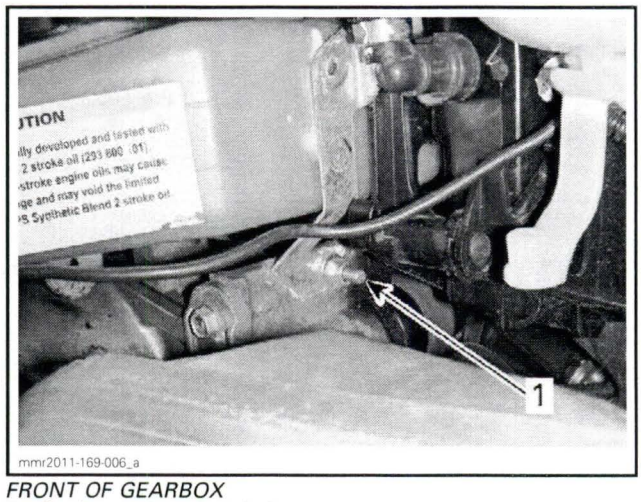
TIGHTENING TORQUE	
Drain plug	10 N•m (89 lbf•**in**)

2. Apply LOCTITE 767 (ANTISEIZE LUBRICANT) (P/N 293 800 070) to the drive axle splines.
3. Insert the drive axle splines into lower gear splines.
4. Protect the gearbox area on chassis to prevent scratches.
5. Pry gearbox upwards and tilt to reach the proper angle.
6. Insert the round shaped part of the gearbox casing into the chassis bore.
7. Align the gearbox casing mounting holes with the studs on the chassis.
8. Install **NEW** retaining nuts.
9. Tighten nuts to specification in a crossed pattern.

TIGHTENING TORQUE		
Gearbox casing mounting nuts	First step	Hand torque
	Second step	27 N•m (20 lbf•ft)

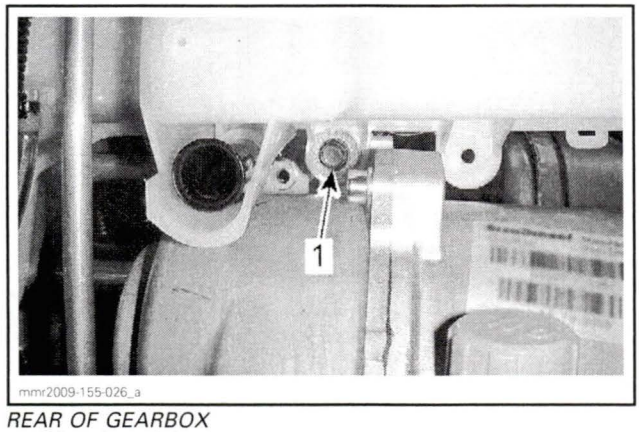
600 HO E-TEC Models

10. Install the coolant tank support retaining bolt.



FRONT OF GEARBOX
1. Coolant tank support bolt

11. Install the oil tank retaining screw.



REAR OF GEARBOX
1. Oil tank retaining screw

All Models

12. Install the bolt retaining the frame member to the top of gearbox.
13. Install and adjust gearshift link rod. Refer to *GEARSHIFT LEVER ADJUSTMENT* in this subsection.
14. Connect speed sensor and attach connector to gearbox.
15. Install driven pulley and countershaft, refer to *DRIVE SYSTEM AND BRAKE* section.
16. Apply LOCTITE 767 (ANTISEIZE LUBRICANT) (P/N 293 800 070) to the input shaft splines.
17. Install muffler, refer to *EXHAUST SYSTEM* subsection.
18. Install RH footrest.
19. Fill gearbox with recommended oil, refer to *MAINTENANCE PROCEDURES* subsection.
20. Adjust track tension, refer to *PERIODIC MAINTENANCE PROCEDURES*.

DRIVE AXLE

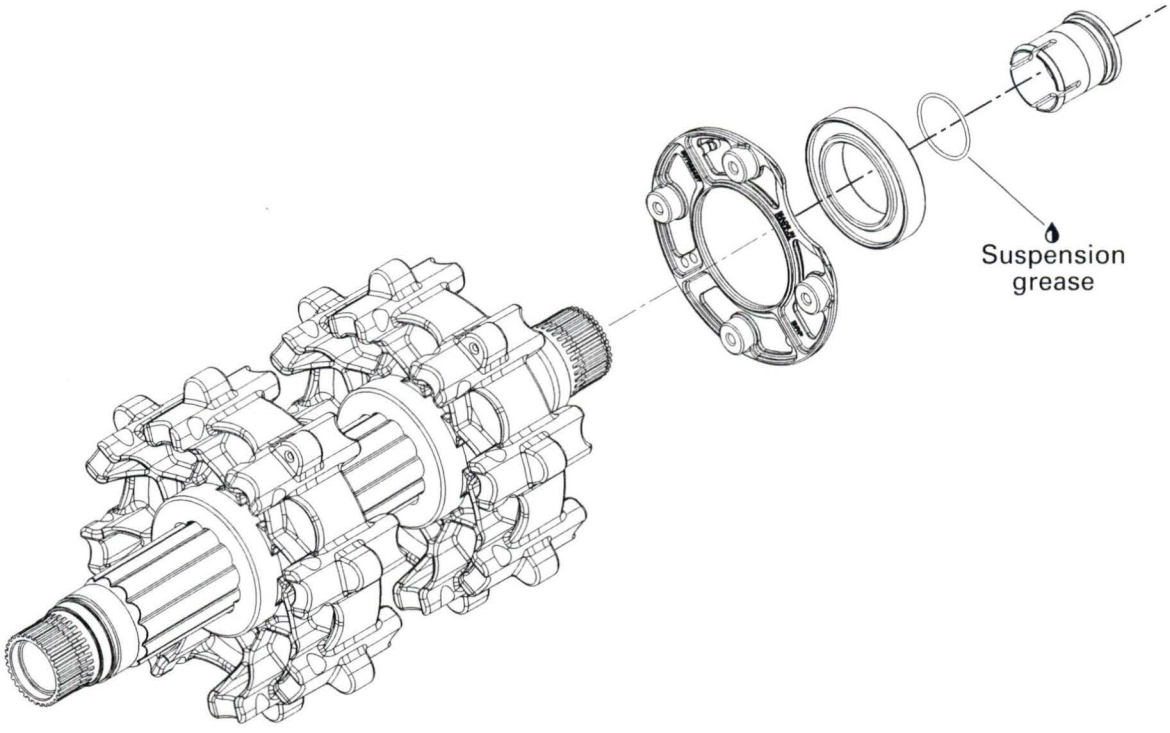
SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
SNAP-ON 3-JAW PULLER	CG273	777

SERVICE PRODUCTS

Description	Part Number	Page
SUSPENSION GREASE	293 550 033	778

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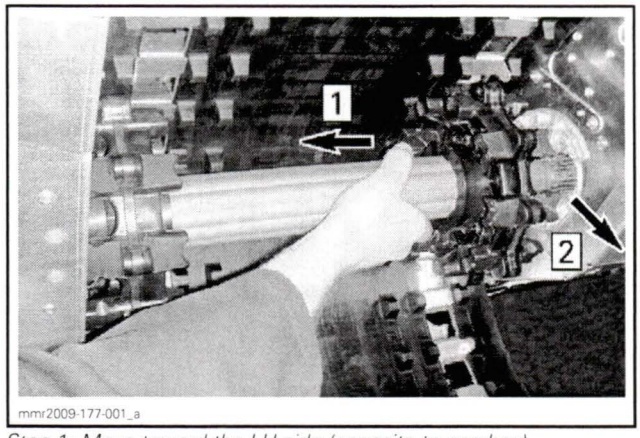
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PROCEDURES

DRIVE AXLE

Drive Axle Removal

1. Remove the rear suspension. Refer to *REAR SUSPENSION* subsection.
2. Remove the brake caliper. Refer to *BRAKE* subsection.
3. From underneath of vehicle, turn the LH bearing flange counterclockwise to unlock it from frame.
4. Release drive axle sprockets from track.
5. Move drive axle toward the LH side to release it from gearbox.
6. Move drive axle downwards to remove its RH side out of frame.



Step 1: Move toward the LH side (opposite to gearbox)
Step 2: Move downwards

NOTE: The drive axle may be very tight between tunnel sides. Ensure to completely move axle toward the LH side (opposite to gearbox) to provide enough clearance to release it from the frame.

Drive Axle Inspection

Check if bearing turns smoothly and freely. Replace if necessary.

Check if bearing seals are damaged. Replace if necessary.

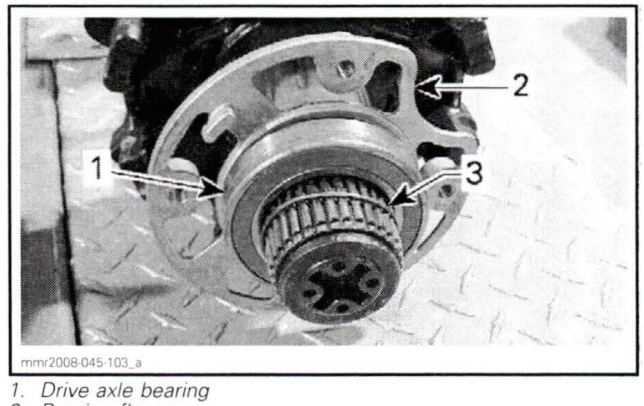
Check if the bearing flange is cracked, bent or otherwise damaged. Replace if necessary.

Replace drive axle if one of the following situations is detected:

- Cracked, worn or damaged drive axle
- Worn or damaged drive axle splines
- Worn or damaged sprockets
- Worn bearing journal.

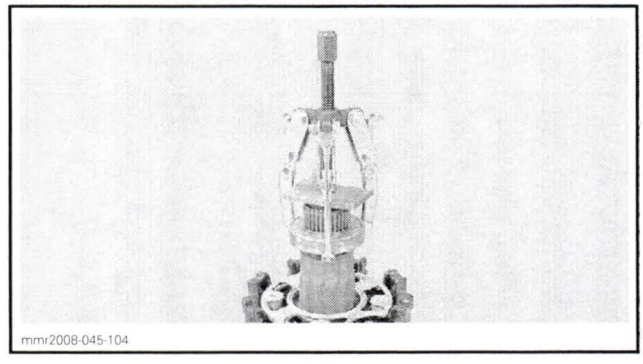
Drive Axle Bearing Removal

1. Remove drive axle from vehicle. Refer to *DRIVE AXLE REMOVAL* in this subsection.
2. Remove O-ring.



1. Drive axle bearing
2. Bearing flange
3. O-ring

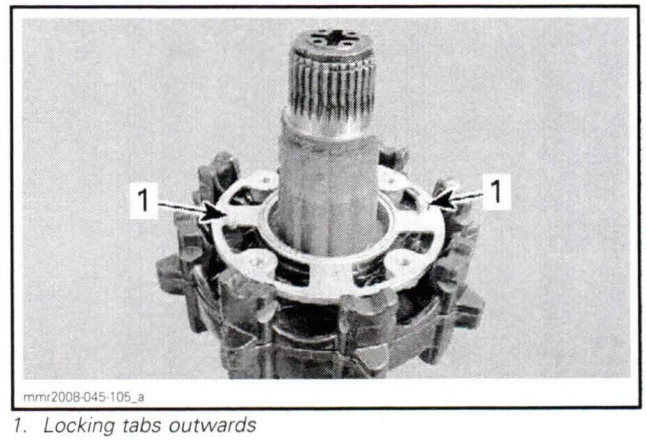
3. Using a 3 legs jaw puller such as the SNAP-ON 3-JAW PULLER (P/N CG273), remove the drive axle bearing.



4. Remove the bearing flange.

Drive Axle Bearing Installation

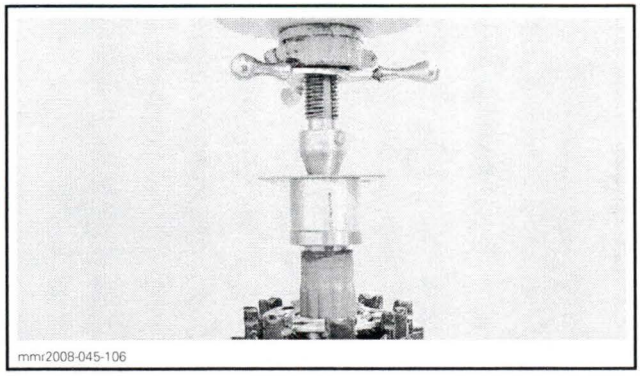
1. Install bearing flange on drive axle with locking tabs outwards.



1. Locking tabs outwards

2. Using a press and a suitable pipe, push the bearing onto drive axle.

NOTICE **Always push the bearing by inner race.**

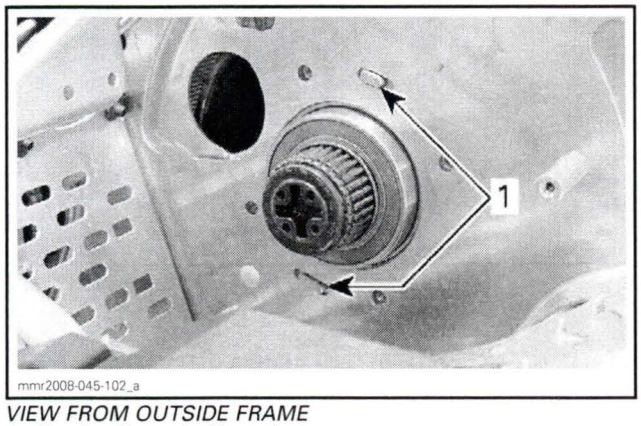

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Drive Axle Installation

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

Install drive axle and lock the bearing flange on frame.

NOTICE **Locking tabs must be properly inserted and locked into frame slots.**



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VIEW FROM OUTSIDE FRAME
1. Bearing flange locking tabs

1. Install the caliper and the disc brake. Refer to *BRAKE* subsection for the specific procedure.
2. Install all other removed parts. Refer to appropriate subsections.

MAGNETIC CAP

Magnetic Cap Removal

For the LH side cap, remove the protective cover of the brake disc. Refer to *BRAKE* subsection.

1. Using 2 screwdrivers or pliers, pry or pull the magnetic cap out of drive axle end.
2. Discard the magnetic cap.

Magnetic Cap Installation

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

Apply SUSPENSION GREASE (P/N 293 550 033) on O-ring.

TRACK

SERVICE TOOLS

Description	Part Number	Page
TRACK CLEAT INSTALLER	529 036 044	779

PROCEDURES

TRACK

Track Inspection

1. Visually inspect track for:
   - Cuts and abnormal wear
   - Broken rods
   - Broken or missing track cleats
   - Perforations in the track
   - Tears in the track (particularly around traction product holes)
   - Lugs that are broken or torn off, exposing portion of rods
   - Delamination of the rubber
   - Missing track guide(s).

If track is damaged or rods are broken, replace track.

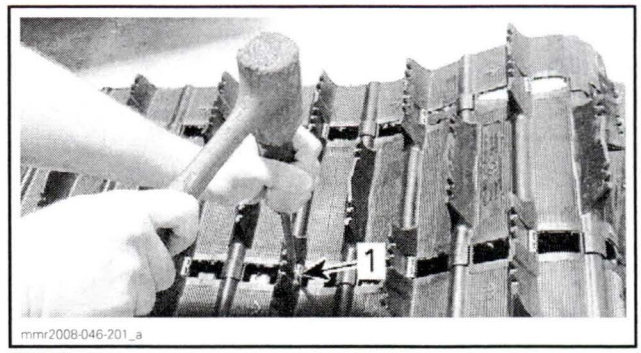
For damaged or missing cleats, replace by NEW ones.

⚠ WARNING

Do not operate a snowmobile with a cut, torn or damaged track.

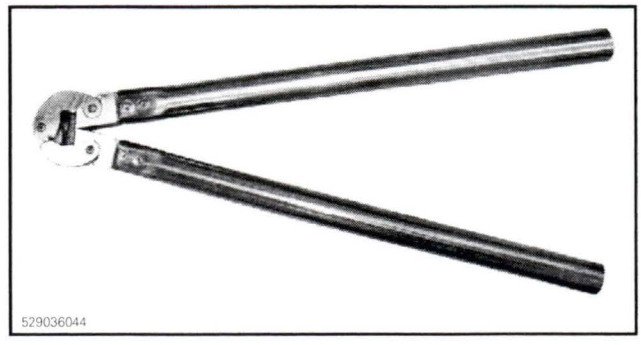
Track Cleat Replacement

1. Raise rear of vehicle off the ground.
2. Lift snow guard.
3. Rotate track to expose a cleat to be replaced.
4. Remove cleat from track using plastic hammer and a big screwdriver.

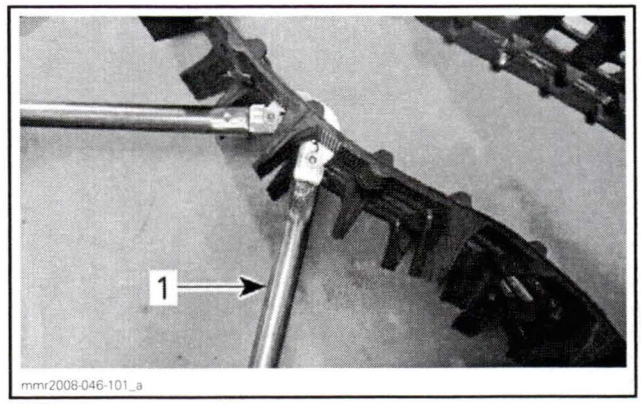


TYPICAL
1. Cleat

5. Place NEW cleat in position on the track.
6. Secure cleat using the TRACK CLEAT INSTALLER (P/N 529 036 044).



7. Bend cleat and push tabs into rubber.



TYPICAL
1. Narrow-cleat installer

8. Reopen narrow-cleat installer.
9. Position cleat tabs on open end of tool.
10. Squeeze tabs until they are indented in rubber.

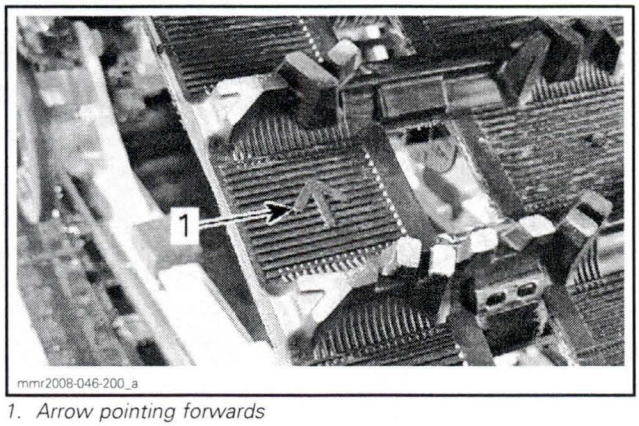
Track Removal

1. Remove rear suspension from vehicle. Refer to *REAR SUSPENSION* subsection.
2. Remove drive axle from vehicle. Refer to *DRIVE AXLE* subsection.
3. Remove track from vehicle.

Track Installation

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

Respect rotation direction indicated by an arrow on track thread.



1. Arrow pointing forwards

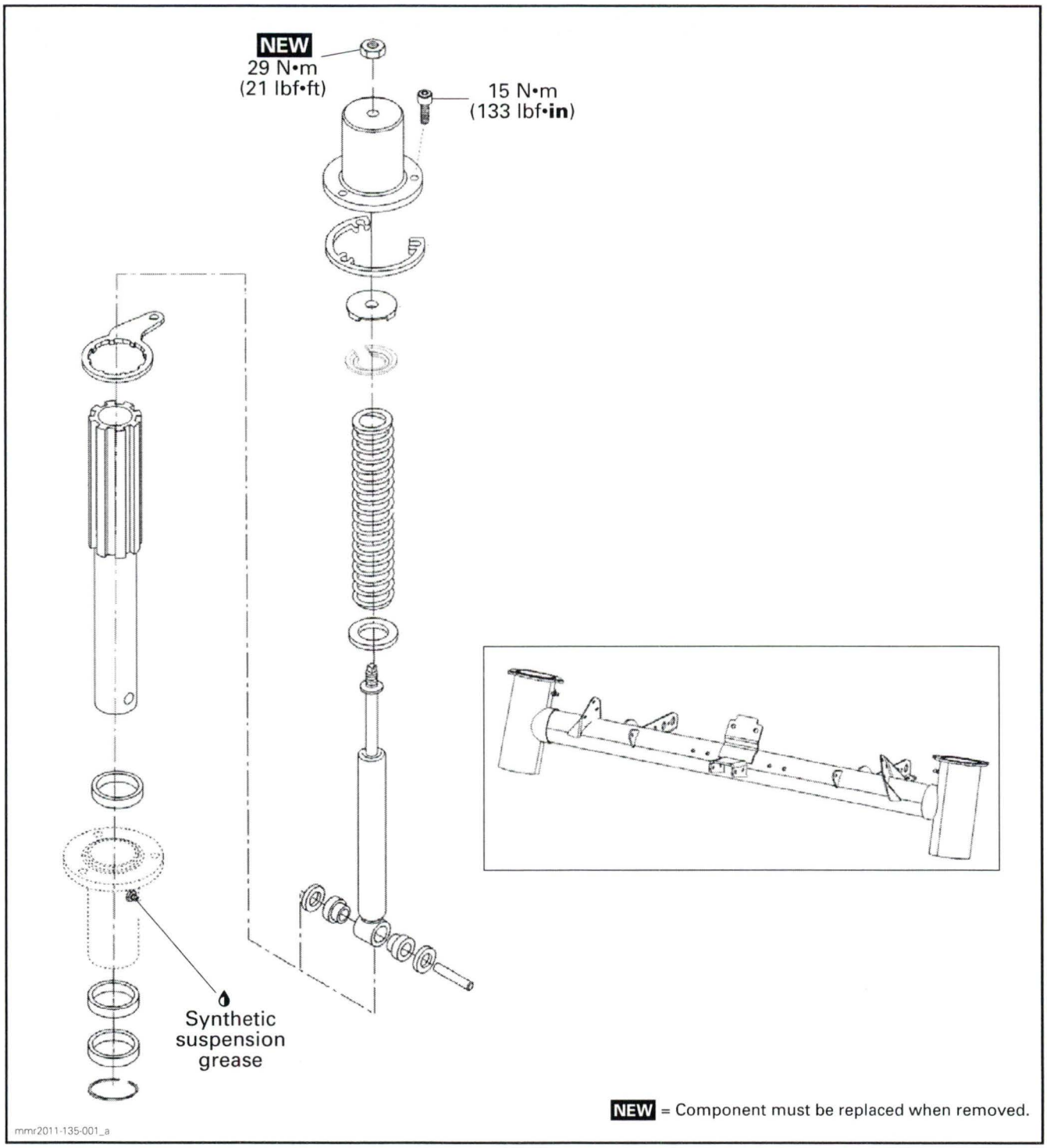
FRONT SUSPENSION (XU-LTS)

SERVICE TOOLS

Description	Part Number	Page
SPRING COMPRESSOR	529 036 184	785

SERVICE PRODUCTS

Description	Part Number	Page
SUSPENSION GREASE	293 550 033	786


NEW
29 N•m
(21 lbf•ft)
15 N•m
(133 lbf•in)
Synthetic
suspension
grease
NEW = Component must be replaced when removed.
mmr2011-135-001_a

GENERAL

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

⚠ CAUTION To avoid potential burns, never touch exhaust system components immediately after the engine has been running. Let engine and exhaust system cool down before performing any servicing.

INSPECTION

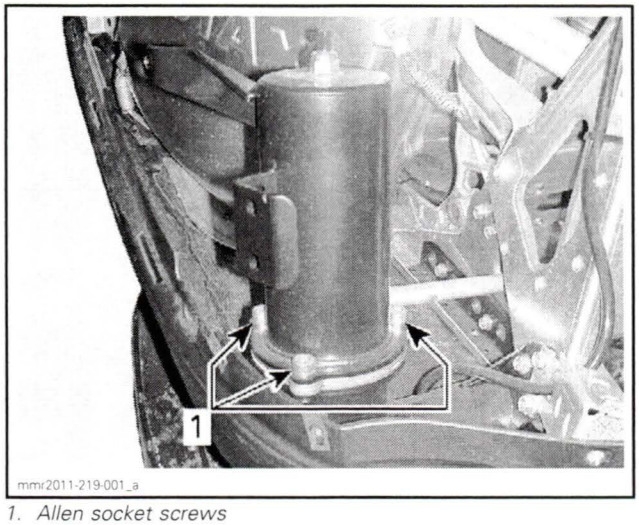
Check for loose, bent, worn out, rusted or otherwise damaged components. Replace the faulty components.

PROCEDURES

SHOCK ABSORBER COVERS

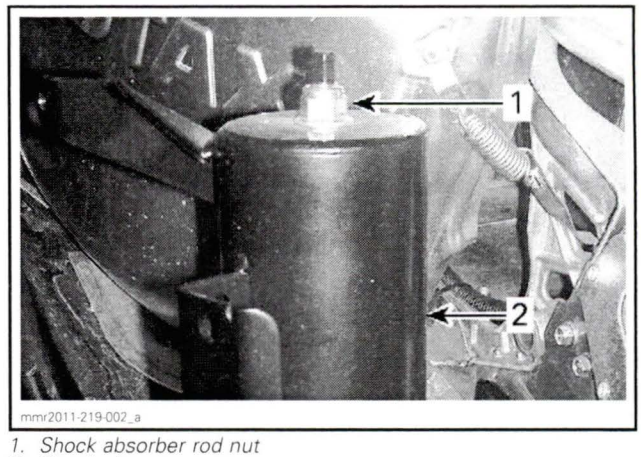
Shock Absorber Cover Removal

1. Refer to *BODY* subsection and remove the following parts:
   - Upper and lower side panels
   - Hood
   - Upper front bottom pans.
2. Lift the front of vehicle until skis are off the ground.
3. Place the front portion of frame on a wooden box to support it securely.
4. Remove the three Allen socket screws retaining the shock absorber cover.



1. Allen socket screws

5. Remove the shock absorber rod nut on the top of the cover.

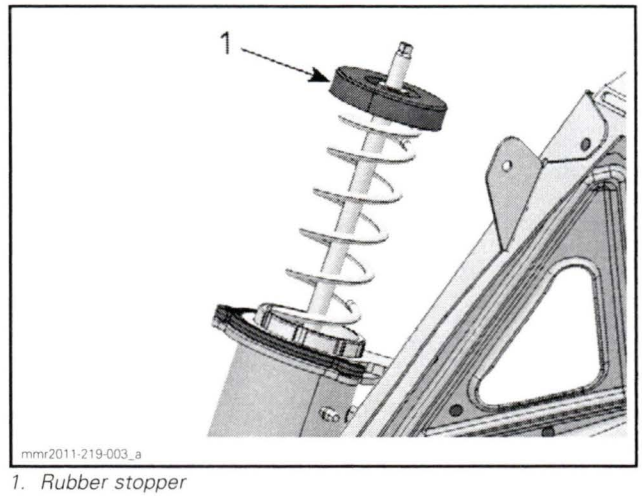


1. Shock absorber rod nut
2. Shock absorber cover

6. Remove shock absorber cover from vehicle.

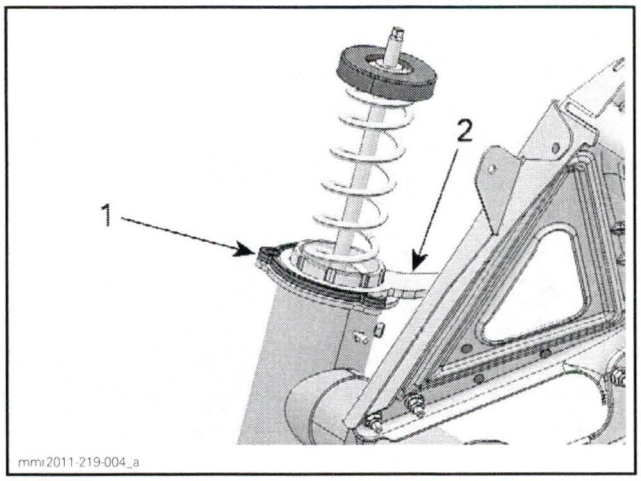
Shock Absorber Cover Installation

1. Make sure the rubber stopper on the top of the shock absorber is in place.



1. Rubber stopper

2. Check that half spacer and steering arm are properly installed on the LTS module post.



1. Half spacer
2. RH steering arm

3. Install all screws loosely, then tighten as specified.

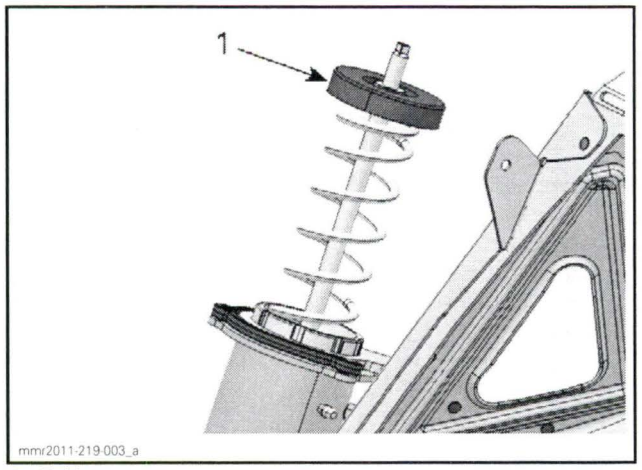
TIGHTENING TORQUE	
Cover retaining screws	15 N•m (133 lbf•**in**)
Rod nut	29 N•m (21 lbf•ft)

4. Install all other removed parts.

SHOCK ABSORBERS

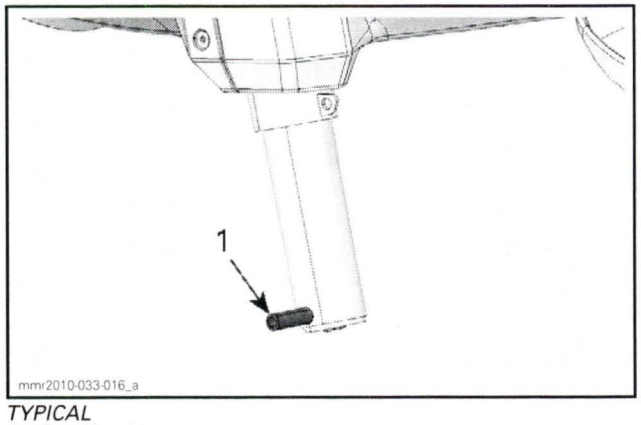
Shock Absorber Removal

1. Lift the front of vehicle until skis are off the ground.
2. Place the front portion of frame on a wooden box to support it securely.
3. Remove the ski. Refer to *STEERING SYSTEM* subsection.
4. Remove the *SHOCK ABSORBER COVER*. See procedure in this subsection.
5. Remove the rubber stopper on the top of shock absorber.



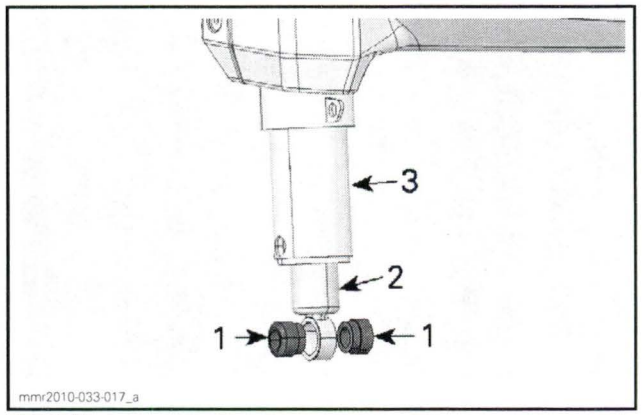
1. Rubber stopper

6. At the bottom of the ski leg, remove the steel bushing retaining the bottom of the shock absorber.



TYPICAL
1. Steel bushing

7. Lift up ski leg and remove both lower bushing from the shock absorber.



TYPICAL
1. Shock absorber lower bushings
2. Shock absorber
3. Ski leg

8. Pull shock absorber out through top of ski leg to remove it.

Shock Absorber Inspection

Remove spring from shock absorber.

Inspect shock as per following:

1. Extend and compress the piston at least 5 complete strokes with its rod upward and examine shock for leaks.
2. Ensure shock moves smoothly and with uniform resistance over its entire stroke.

NOTE: For the first 5 complete strokes, it could be normal to note uneven resistance.

3. Check the following conditions that will denote a defective shock:
   - A skip or a hang back when reversing stroke at mid travel.
   - Seizing or binding condition except at extreme end of either stroke.
   - Oil leakage.
   - A gurgling noise, after completing one full compression and extension strokes.
4. If suspecting a shock is freezing, place it in a freezer (temperature below 0°C (32°F)) for 4 hours.
5. Push down on rod and note its resistance. If shock is frozen it will be much more difficult to compress than one in normal condition.
6. Replace if any faults are present.

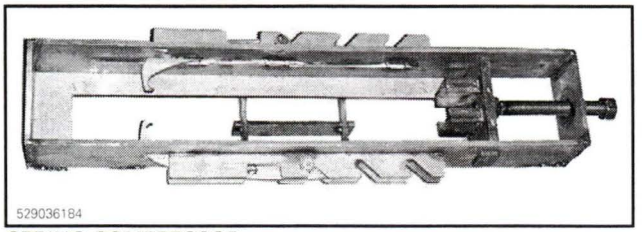
Shock Absorber Installation

For installation, reverse the removal procedure.

SPRINGS

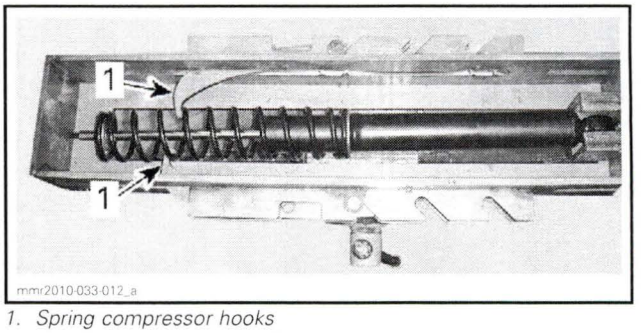
Spring Removal

1. Secure the SPRING COMPRESSOR (P/N 529 036 184) in a vise.



SPRING COMPRESSOR

2. Position the shock absorber in the tool and install the spring compressor hooks.

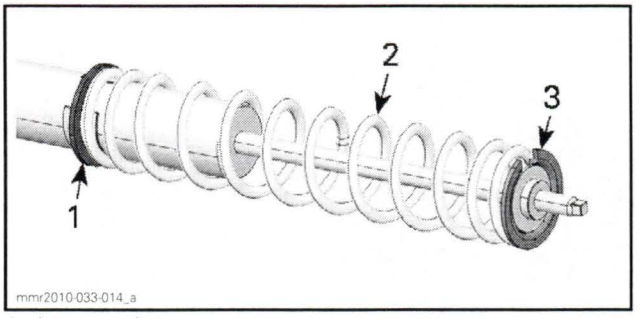


1. Spring compressor hooks

3. Tighten the spring compressor tool screw until the spring is sufficiently compressed to remove spring stopper.
4. Release the spring compressor tool screw.
5. Remove spring from shock absorber.

Spring Installation

Position the large washer and the spring on the shock, and secure them with the spring stopper.



1. Large washer
2. Spring
3. Spring stopper

SKI LEGS

Ski Leg Inspection

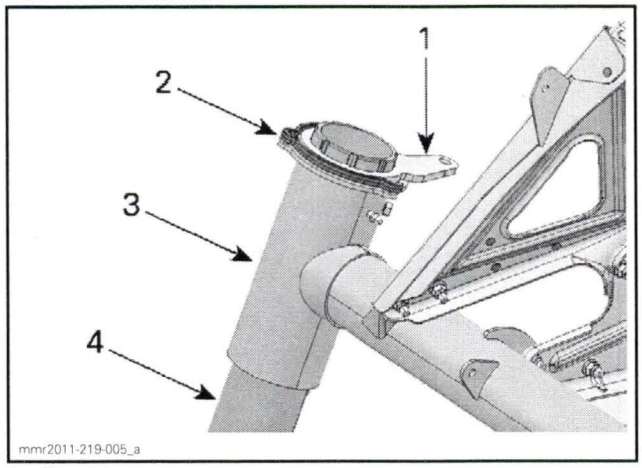
1. Remove the ski and the steel bushing that secures the shock to the bottom of the ski leg.
2. Lift the ski leg to check its freedom of movement.



3. Check the ski leg for straightness and for a scored or scratched surface. Replace as required.
4. When the shock absorber cover is removed, check the splines on ski leg and steering arm interlock for abnormal free play. Replace as necessary.

Ski Leg Removal

1. Remove the *SHOCK ABSORBER*, see procedure in this subsection.
2. Disconnect the tie-rod end from the steering arm, refer to *STEERING SYSTEM* subsection.
3. Remove the half spacer and the steering arm from the ski leg.

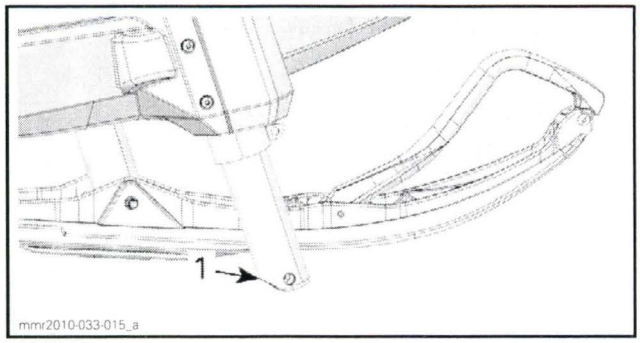


1. *Steering arm*
2. *Half spacer*
3. *LTS*
4. *Ski leg*

4. Pull the ski leg out through the top of the LTS.

Ski Leg Installation

1. Apply a thin layer of SUSPENSION GREASE (P/N 293 550 033) on ski leg splines.
2. Insert the ski leg into the LTS module tube. Make sure to place the angular end of the ski leg rearward.



TYPICAL
1. *Angular end of ski leg*

3. Reinstall all removed parts.
4. Lubricate the suspension. Refer to *PERIODIC MAINTENANCE PROCEDURE* subsection.

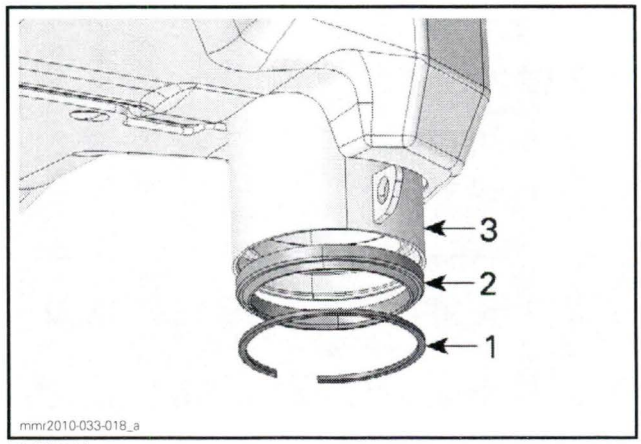
NOTE: When a ski leg is changed, perform a steering alignment. Refer to *STEERING SYSTEM* subsection.

SEALS

Seal Replacement

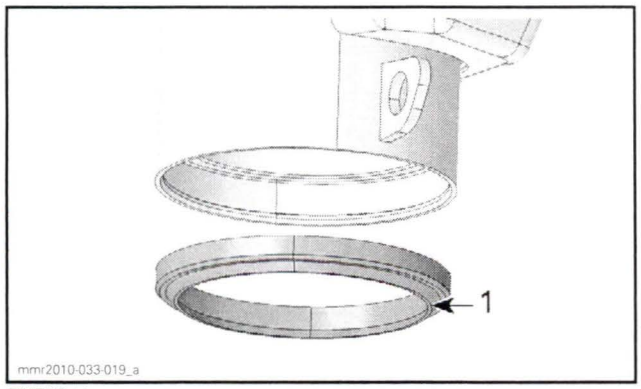
The seals are located at the bottom ends of each LTS module tube.

1. Remove *SKI LEG*, see procedure in this subsection.
2. Remove the circlip at the bottom of the LTS module tube.
3. Remove and discard the seal.



TYPICAL
1. *Circlip*
2. *Seal*
3. *LTS module tube*

4. Clean seal location inside LTS module tube. Make sure all grease is removed before inserting the new seal.
5. Install the new seal with the lips outward.



TYPICAL
1. Seal

6. Reinstall the circlip.

NOTE: Replace the circlip with a new one if loose.

7. Reinstall all removed parts.
8. Lubricate the suspension. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

REAR SUSPENSION (SC-5U)

SERVICE TOOLS

Description	Part Number	Page
SHOCK ABSORBER SUPPORTS	529 036 186	797

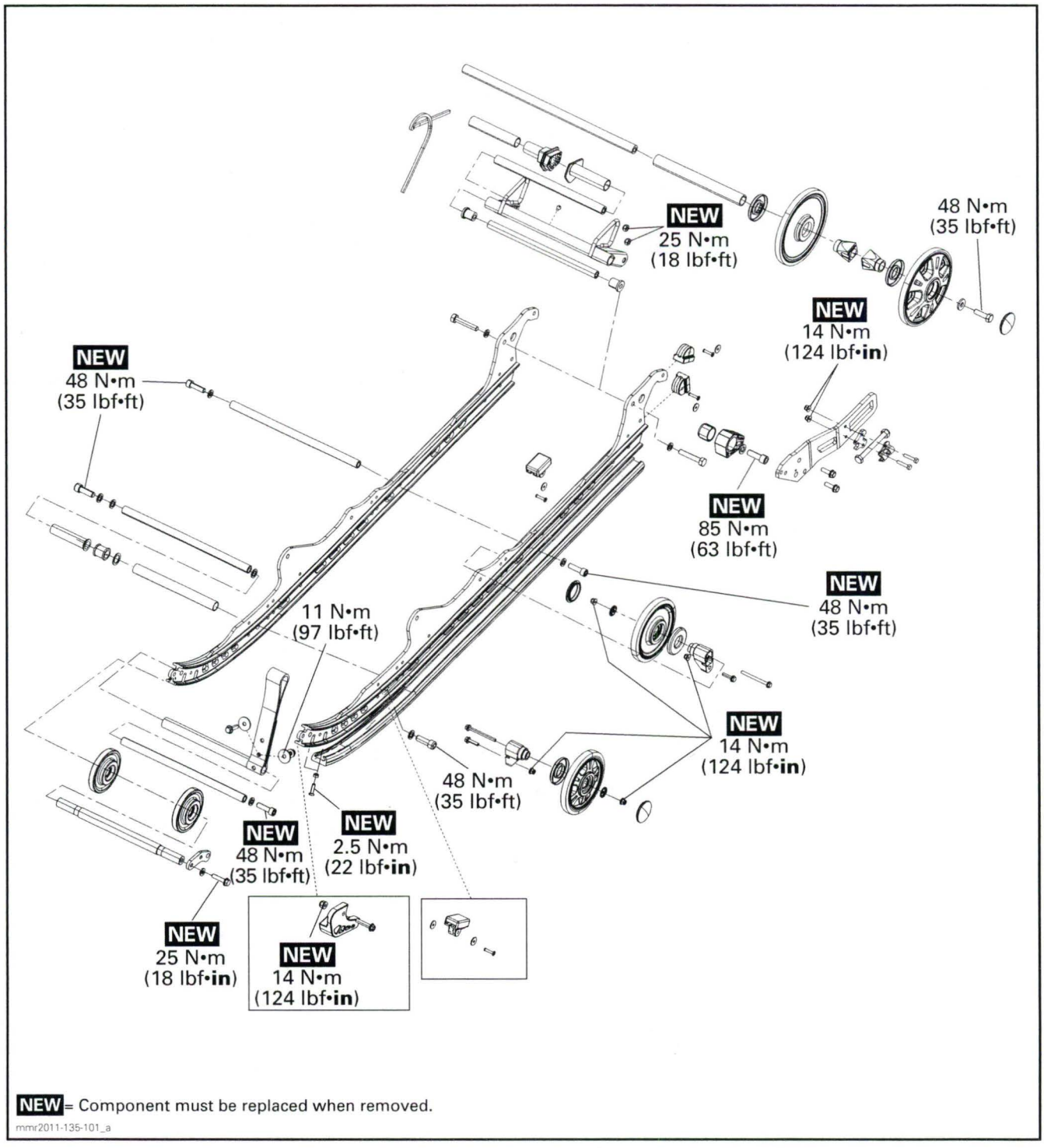
SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
BENCH SCALE SUCH AS SALTER BRECKNELL	PS 400	797

SERVICE PRODUCTS

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

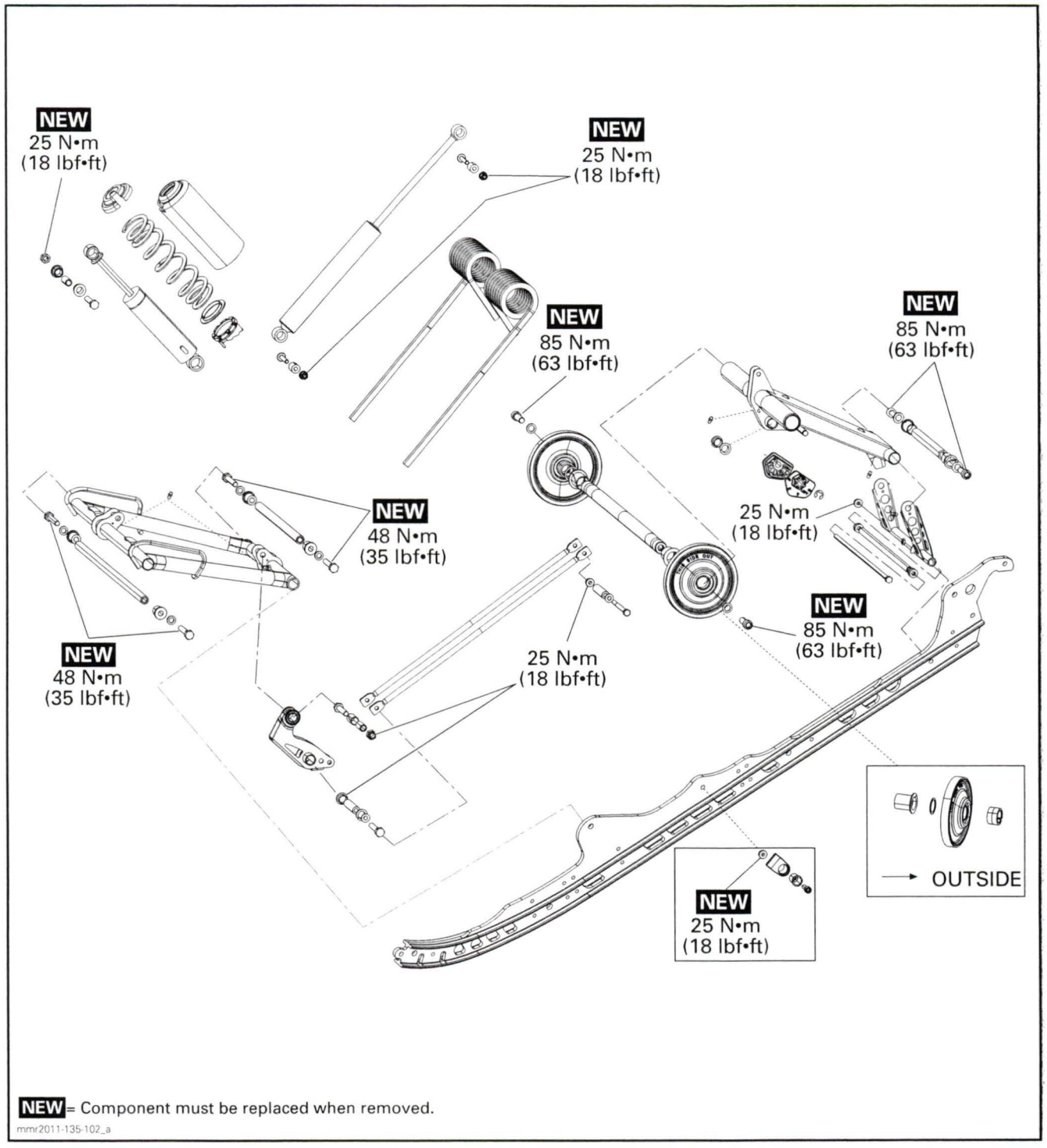
RAILS AND IDLERS WHEELS



NEW = Component must be replaced when removed.

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ARMS AND SHOCK ABSORBERS



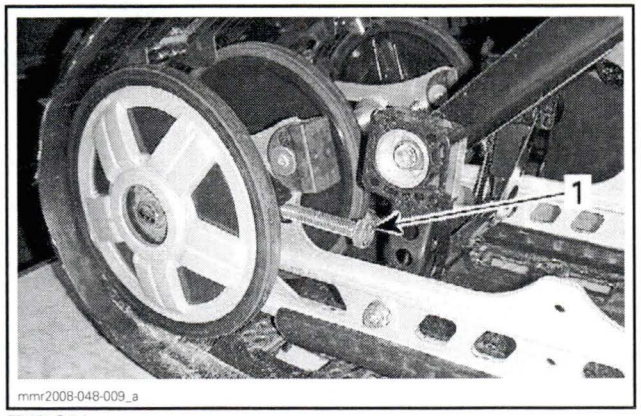
PROCEDURES

NOTE: Many parts can be changed with rear suspension in place. When specified, refer to *SUSPENSION ASSEMBLY* to remove rear suspension from the vehicle.

SUSPENSION ASSEMBLY

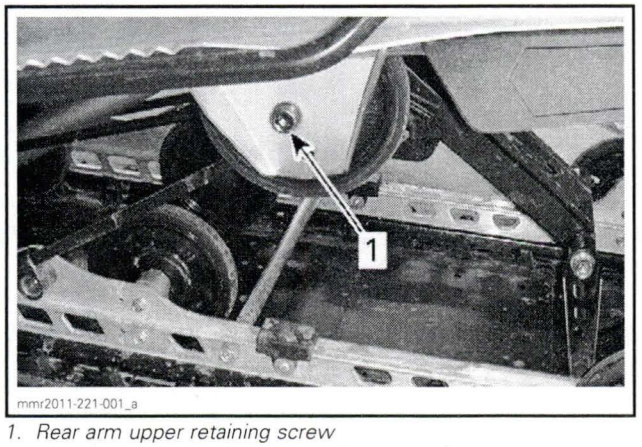
Suspension Assembly Removal

1. Lift rear of vehicle and support it off the ground.
2. Completely loosen track tension by unscrewing both adjustment screws.



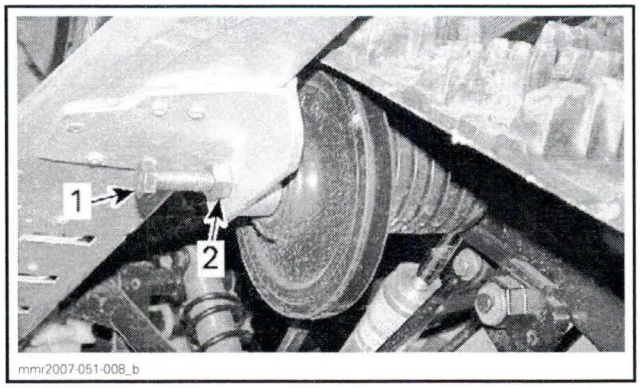
TYPICAL
1. RH adjustment screw

3. Remove and discard rear arm upper screws. Use the following procedure to remove screws easily.
   3.1 Unscrew one screw securing the rear arm to frame.



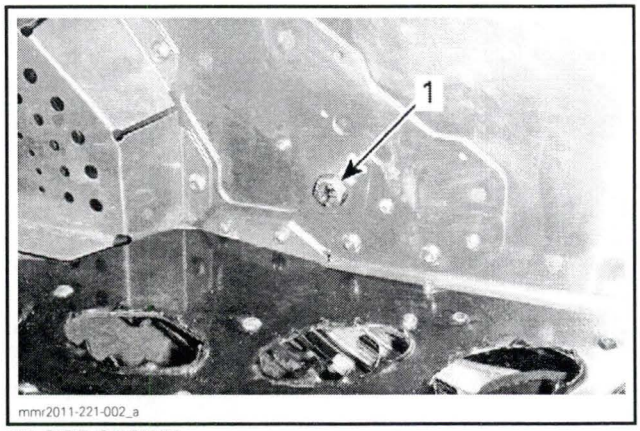
1. Rear arm upper retaining screw

   3.2 Replace the screw with a longer one and a nut.
   3.3 Screw in the longer screw by approximately 7 turns.
   3.4 Hold the longer screw and tighten locking nut.



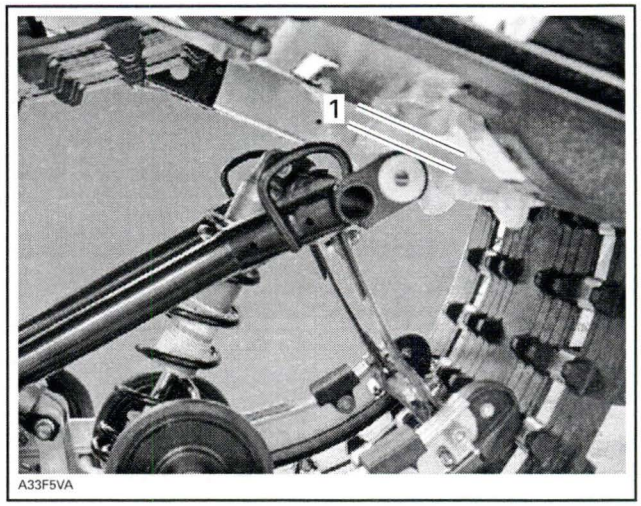
TYPICAL
1. Longer screw
2. Locking nut

   3.5 Unscrew the screw on the other side then unlock nut and remove the longer screw.
4. Remove and discard both screws retaining front arm to the tunnel.



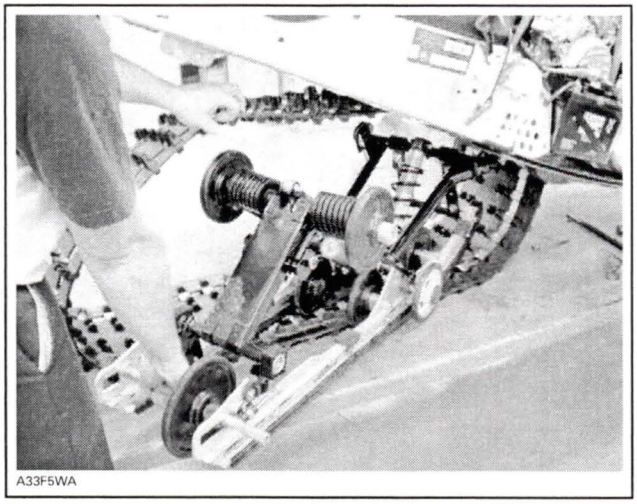
LH SIDE SHOWN
1. Front arm upper retaining screw

5. Lift rear of vehicle until the front arm clears the tunnel.



TYPICAL
1. Enough clearance

6. Remove suspension assembly from the vehicle.



TYPICAL — REMOVE SUSPENSION

Suspension Assembly Installation

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

Inspect track thoroughly before reinstalling suspension. Refer to *TRACK* subsection.

Install suspension into track with front portion first.

Install **NEW** front arm upper screws.

Install **NEW** rear arm upper screws.

Tighten screws to specified torque.

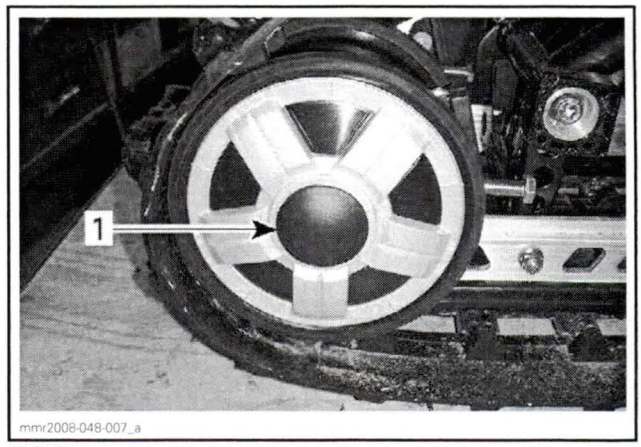
TIGHTENING TORQUE	
Front arm upper screws	48 N•m (35 lbf•ft)
Rear arm upper screws	85 N•m (63 lbf•ft)

Adjust track tension, refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

REAR AXLE

Rear Axle Removal

1. Lift rear of vehicle and support it off the ground.
2. Remove rear idler wheel caps.



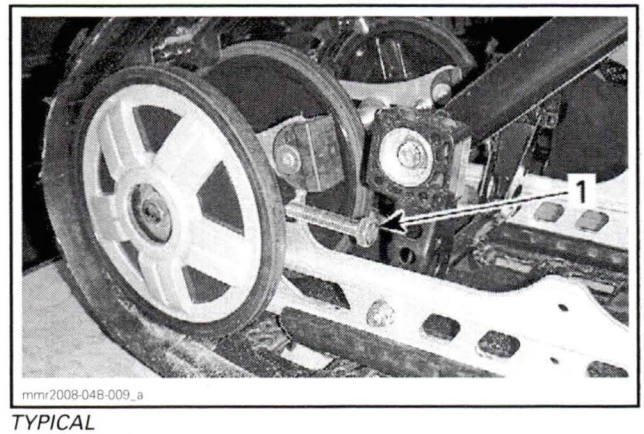
TYPICAL
1. RH rear idler wheel cap

3. Loosen rear axle screws (one each side).



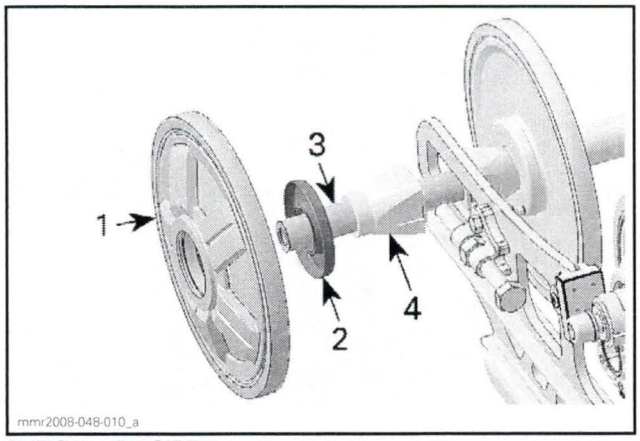
TYPICAL
1. RH rear axle screw

4. Completely loosen track tension by unscrewing both adjustment screws.



TYPICAL
1. RH adjustment screw

5. Remove both rear axle screws.
6. Remove rear idler wheels, seals and wheel spacers.



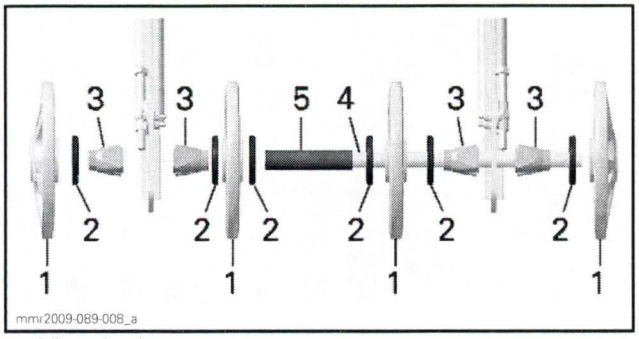
TYPICAL - RH SIDE
1. *Rear idler wheel*
2. *Seal*
3. *Rear axle*
4. *Wheel spacer*

7. Pull out the rear axle.

Rear Axle Installation

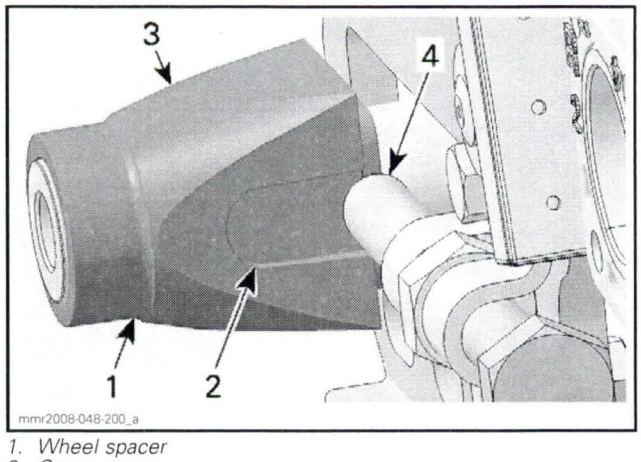
Installation is the reverse of removal procedure. However, pay attention to the following.

Make sure to position all parts correctly.



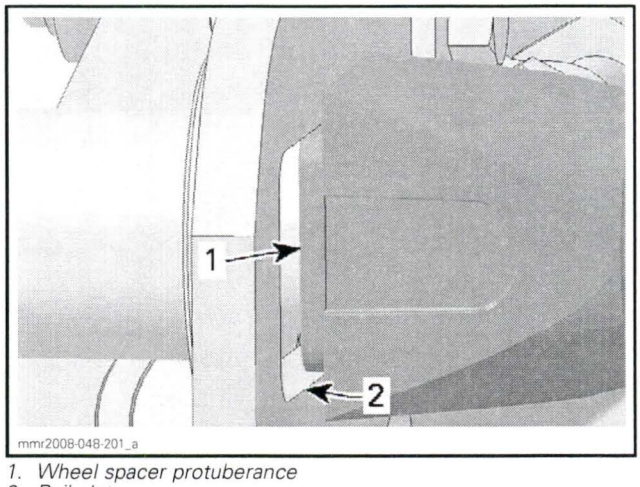
1. *Idler wheels*
2. *Seals*
3. *Wheel spacers*
4. *Rear axle*
5. *Rear axle spacer*

Position wheel spacers with a flat side up and a groove in front of tensioner screw.



1. *Wheel spacer*
2. *Groove*
3. *Flat side*
4. *Tensioner screw*

When tightening rear axle, make sure each wheel spacer protuberance is engaged into rail slot.



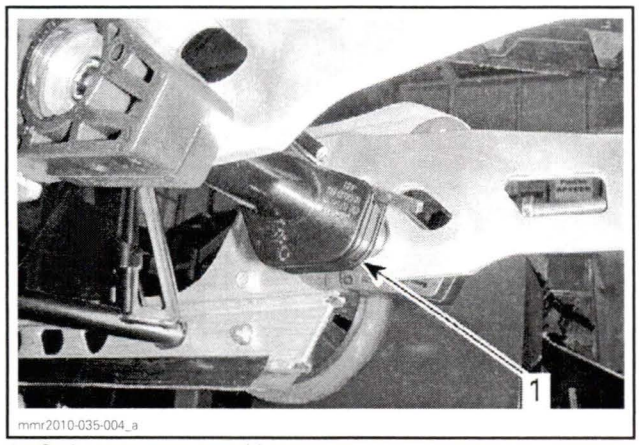
1. *Wheel spacer protuberance*
2. *Rail slot*

Adjust track tension. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

REAR EXTENSION

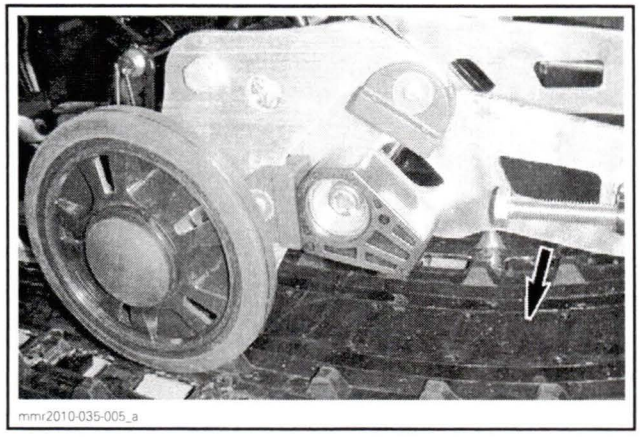
Rear Extension Removal

1. Proceed with *REAR AXLE REMOVAL*. See procedure in this subsection.
2. Unload the spring cam of rear extension by placing it to position 1.

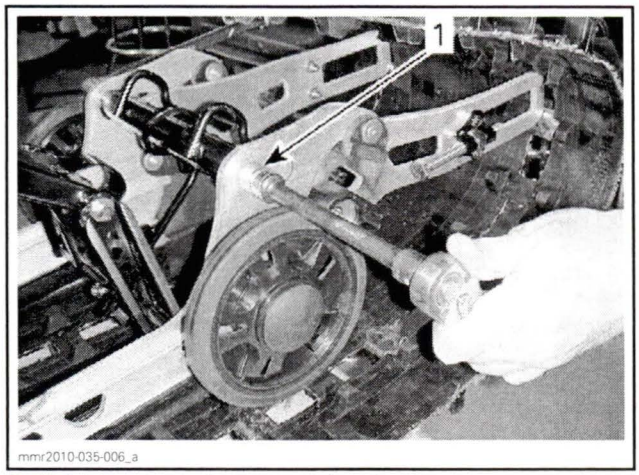


1. Spring cam set to position 1

3. Ensure that rear extension is positioned fully downwards (against lower stopper).

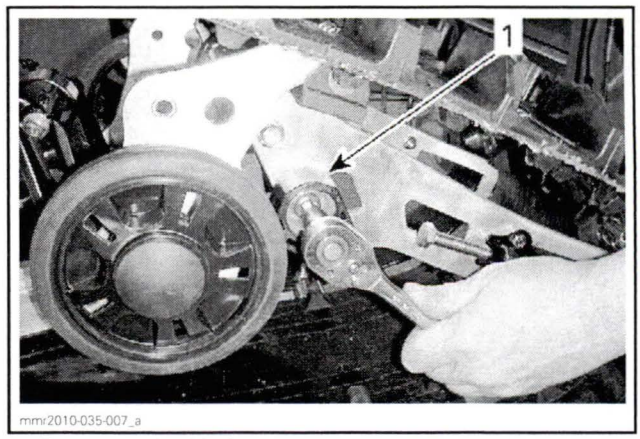


4. Remove retaining screws and washers from rear extension pivot.



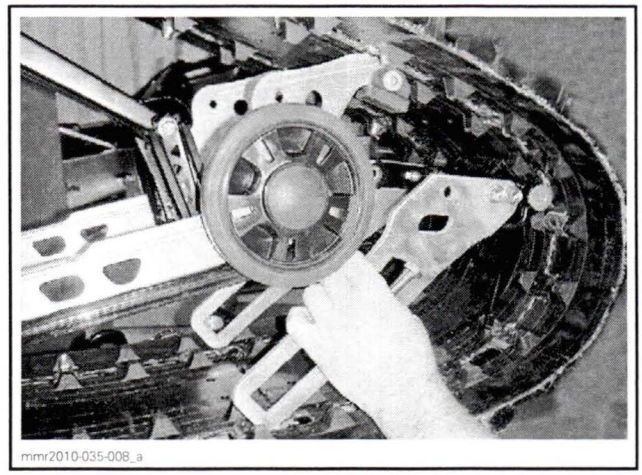
1. Retaining screw of rear extension pivot

5. Remove retaining screws and washers from rear extension block.
6. Remove rear extension blocks and spacer.



1. Rear extension block

7. Rotate rear extension downwards then remove it from rear suspension.



Rear Extension Installation

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

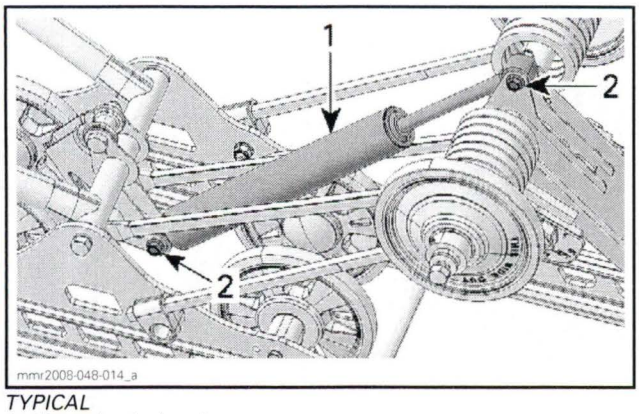
Lubricate rear extension pivot. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

SHOCK ABSORBERS

Rear Shock Absorber Removal

NOTE: If necessary, to ease shock removal, unfasten stopper straps to release shock pressure.

1. Lift rear of vehicle and support it off the ground.
2. Remove bolts and nuts from shock.

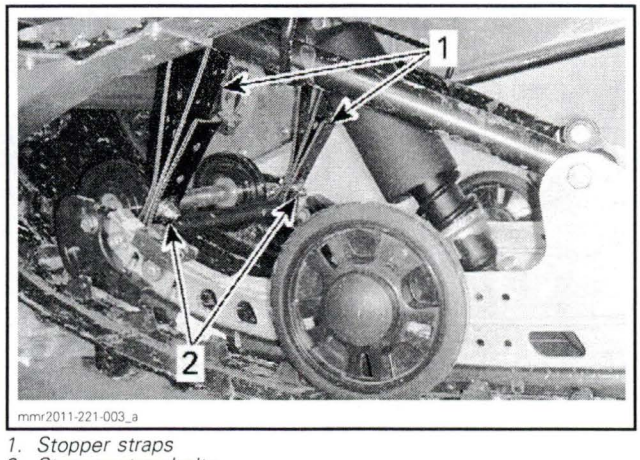


TYPICAL
1. *Rear shock absorber*
2. *Remove bolts and washers*

3. Remove rear shock absorber from the vehicle.

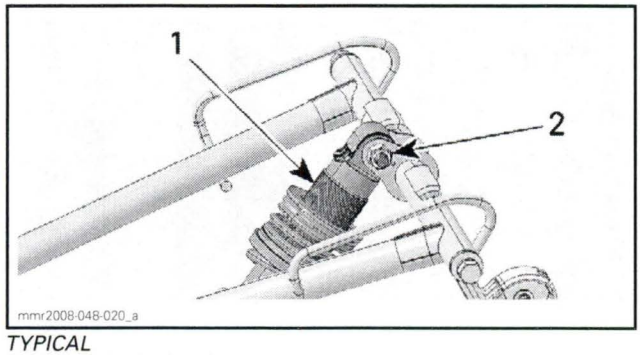
Center Shock Absorber Removal

1. Lift the rear of vehicle and support it off the ground.
2. Unfasten stopper straps.



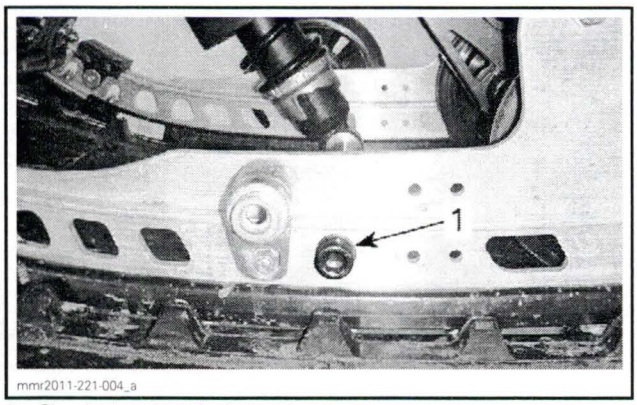
1. *Stopper straps*
2. *Stopper strap bolts*

3. Remove upper shock absorber bolt.



TYPICAL
1. *Front shock absorber*
2. *Remove bolt*

4. Remove the front idler wheels.
5. Remove and discard shock absorber shaft screws (one on each side).



1. *Shock absorber shaft screw*

6. Remove center shock absorber from the vehicle.
7. Remove bushings and shock shaft from shock absorber.

Shock Absorber Inspection

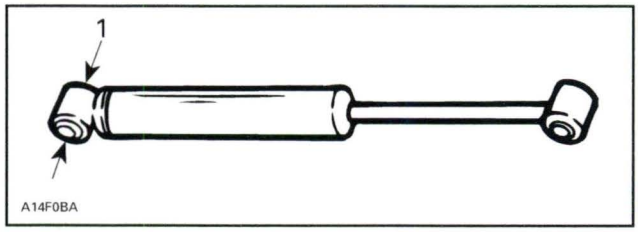
NOTE: All types of shock absorbers are covered in this topic, refer to *TECHNICAL SPECIFICATIONS* to identify the shock absorber relating to the vehicle model.

NOTE: Unless otherwise noted, shock absorber must be at normal room temperature (21°C ± 2°C (70°F ± 36°F)) during inspection.

MC Hydraulic Shock

1. Perform a visual inspection of the shock:
   - The shock must be exempt of any dent or scratch, especially on the rod.
   - Small dent on the shock body may not affect any performance or reliability of this shock.
   - Any defect on the rod, as small as it is, can lead to seal failure and oil leak.
   - If such defect (on rod) is detected, the shock must be replaced, and this will not be cover under warranty.
2. Secure the shock body end in a vise, clamping on eyelet, with its rod upward.

NOTICE **Do not clamp directly on shock body.**



1. *Shock body eyelet*

3. Examine shock for leaks. Extend and compress the piston at least 5 complete strokes with its rod upward.
4. Check that shock moves smoothly and with uniform resistance over its entire stroke.

NOTE: For the first 5 complete strokes, it could be normal to note uneven resistance.

5. Check the following conditions that will denote a defective shock:
   - A skip or a hang back when reversing stroke at mid travel.
   - Seizing or binding condition except at extreme end of either stroke.
   - Oil leakage.
   - A gurgling noise, after completing one full compression and extension strokes.
6. If suspecting a shock is freezing, place shock in a freezer (temperature below 0°C (32°F)) for 4 hours.
7. Push down on rod and note its resistance. If shock is frozen it will be much more difficult to compress than one in normal condition.
8. If any faults are present, replace shock.

All HPG™ Shock (Including KYB PRO Series)

1. Perform a visual inspection of the shock:
   - The shock must be exempt of any dent or scratch, especially on the rod.
   - Any defect on the rod, as small as it is, can lead to seal failure and oil leak.
   - If such defect is detected, the shock must be replaced and this will not be covered under warranty.
2. Completely push down shock rod into the body and check result as per table.

HPG SHOCK	RESULT
All except 551 mm (21-11/16 in) rear shock	The rod should completely get in the shock body
551 mm (21-11/16 in) rear shock	The stroke must be at least 138 mm (5-7/16 in)

NOTE: For the **HPG Variable Rate Shock**, it should be stiff for approximately the first 25 mm (1 in), then softer for about 50 mm (2 in), and stiffer again. This stiff/soft/stiff phenomenon shows the normal operation of VR shock.

3. Release shock from completely collapsed position and check result as per table.

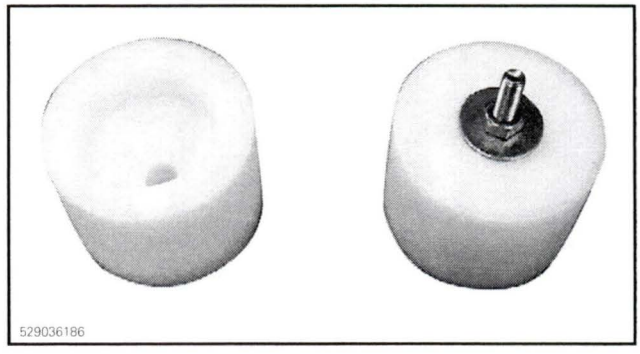
HPG SHOCK EXCEPT VARIABLE RATE
– The shock should extend unassisted. – The rod must come out at a steady speed.

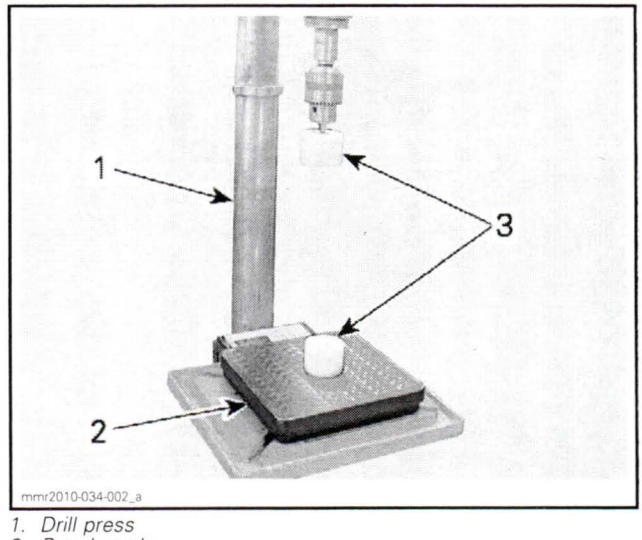
HPG VARIABLE RATE SHOCK
– The shock should extend unassisted. – Rod must come out slowly first, than faster and finally slow again for the last 25 mm (1 in).

4. Proceed with *SHOCK ABSORBER COMPRESSION TEST*. See procedure in this subsection.
5. If any faults are present, replace shock.

Shock Absorber Compression Test

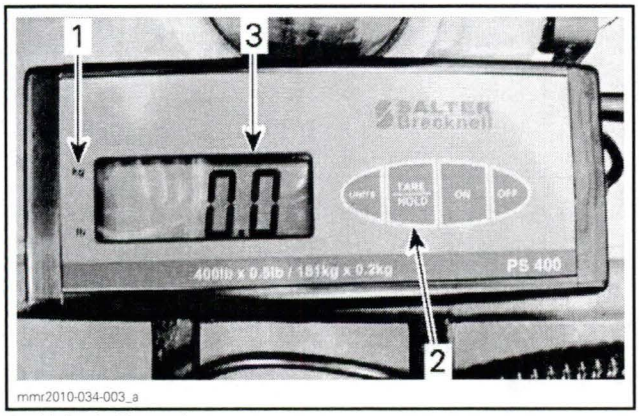
1. Ensure shock absorber is at normal room temperature (21°C ± 2°C (70°F ± 36°F)).
2. Remove spring from shock absorber (if applicable).
3. Place a BENCH SCALE SUCH AS SALTER BRECKNELL (P/N PS 400) (or an equivalent) on a suitable drill press.
4. Install SHOCK ABSORBER SUPPORTS (P/N 529 036 186) onto drill press.





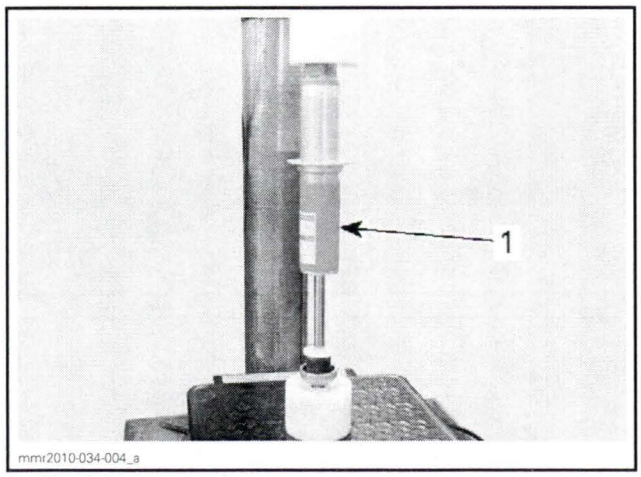
1. *Drill press*
2. *Bench scale*
3. *Shock absorber supports*

5. Set bench scale units to **kg** (or lb).
6. Press **TARE** to reset digits (must indicate (0) zero).



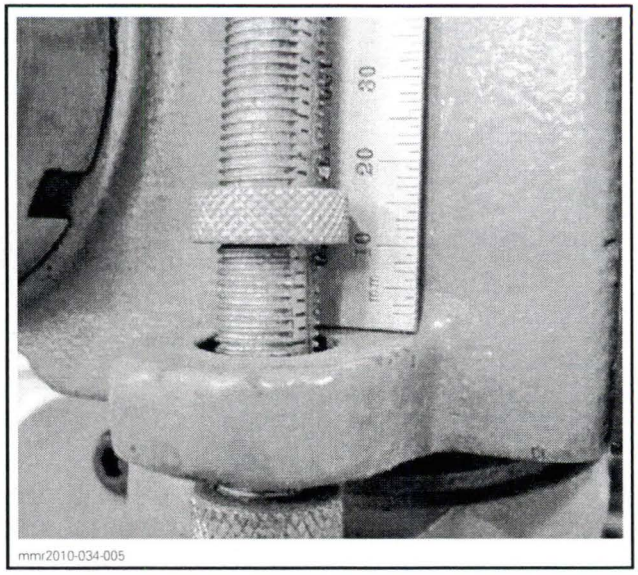
1. Units indicator lamp
2. TARE button
3. Digits

7. Install shock absorber into support with shock body upwards.
8. Adjust drill press table height in order to set the upper shock support flush with the shock body end.
9. Ensure shock absorber is aligned with drill press axis.

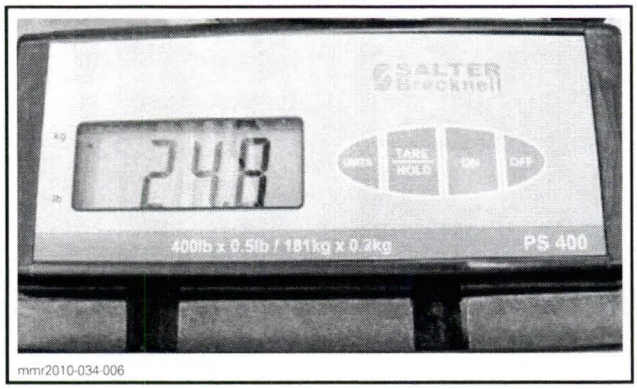


1. Shock body upwards

10. Set the drill press displacement to 10 mm (.394 in) using locking nut.



11. Compress shock absorber by 10 mm (.394 in) and hold it in position.
12. Read load recorded on the bench scale.



13. Load reading must be as per the following table.

MODEL	ROD DIAMETER	SERVICE RANGE
All HPG VR/Plus/Plus R	12.5 mm (1/2 in)	24 kgf ± 4 kgf (53 lbf ± 9 lbf)
All HPG KYB PRO	16 mm (5/8 in)	39 kgf ± 5 kgf (86 lbf ± 11 lbf)

Rear Shock Absorber Installation

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

Make sure upper and lower shock absorber bushings are properly installed.

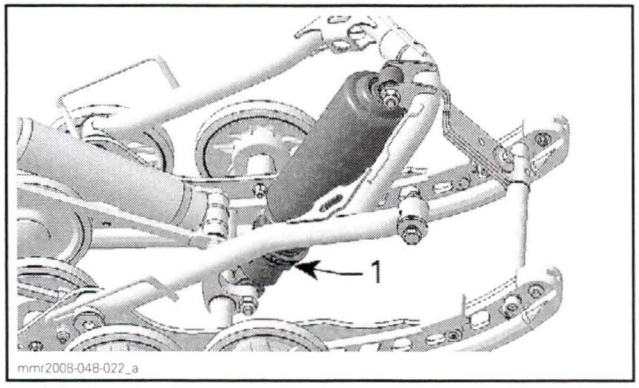
Install **NEW** shock absorber retaining nuts and tighten to specified torque.

REAR SHOCK ABSORBER FASTENERS TIGHTENING TORQUE
25 N•m (18 lbf•ft)

Center Shock Absorber Installation

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

Position the adjustment cam downwards.

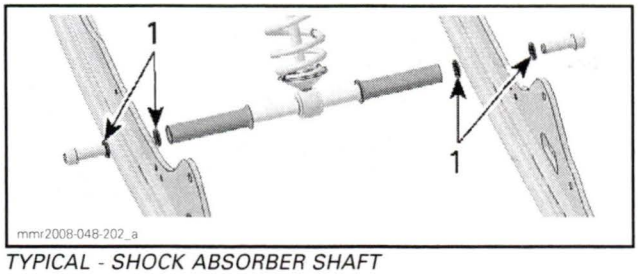


1. Adjustment cam

Torque shock absorber upper nut to specification.

TIGHTENING TORQUE	
Shock absorber upper nut	25 N•m (18 lbf•ft)

Position washers as shown.



TYPICAL - SHOCK ABSORBER SHAFT
1. Washers location

Install **NEW** socket screws.

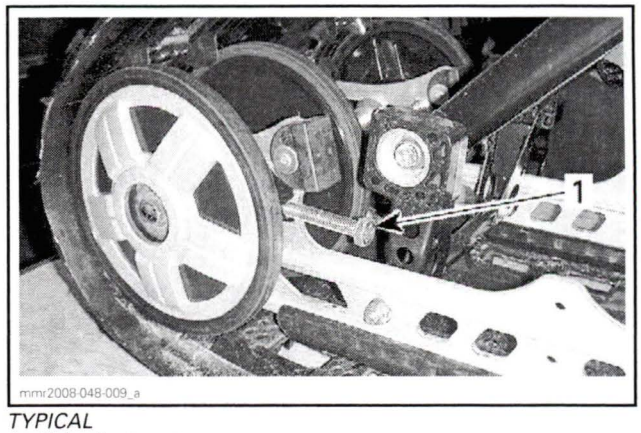
Torque socket screws to specification.

TIGHTENING TORQUE	
Shock absorber socket screws	48 N•m (35 lbf•ft)

REAR SPRINGS

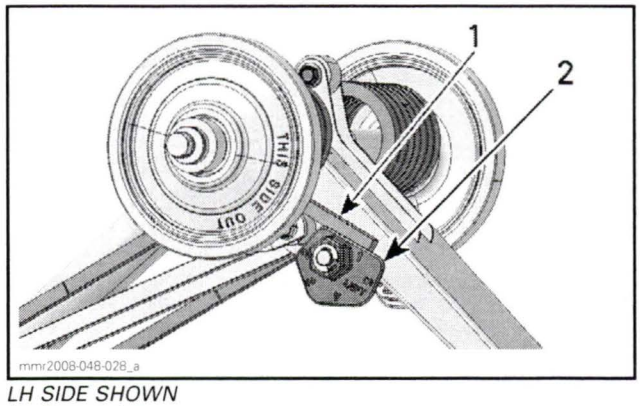
Rear Spring Removal

1. Lift rear of vehicle and support it off the ground.
2. Completely loosen track tension by unscrewing both adjustment screws.



TYPICAL
1. RH adjustment screw

3. Decrease springs preload by turning cams accordingly.

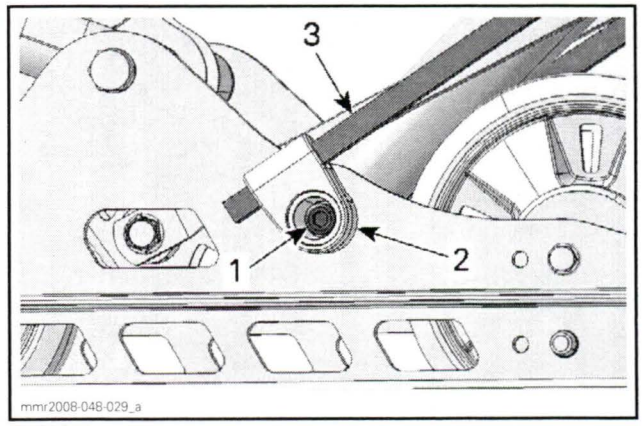


LH SIDE SHOWN
1. Rear spring
2. Cam

4. Firmly hold the spring support and unscrew its retaining bolt (one on each side).

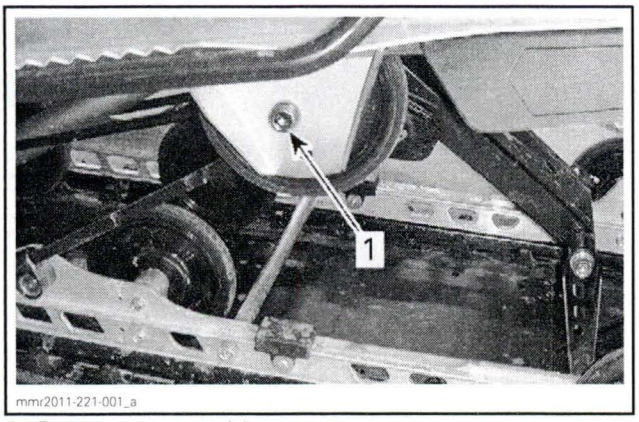
⚠ WARNING

Firmly hold the spring support, they are spring loaded.



TYPICAL
1. Spring support bolt
2. Spring support
3. Spring

5. Remove rear arm upper screws and washers.



1. Rear arm upper retaining screw

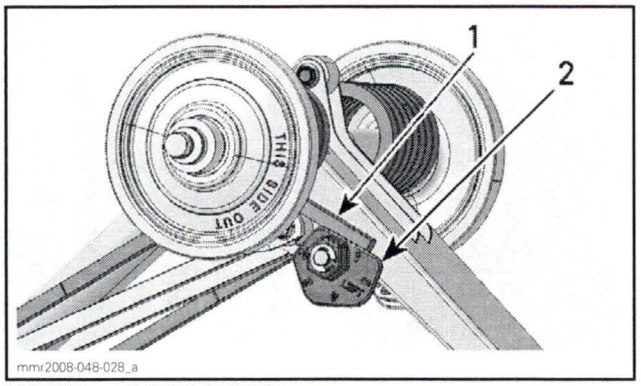
6. Remove upper idler wheels.
7. Remove springs.

Rear Spring Installation

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

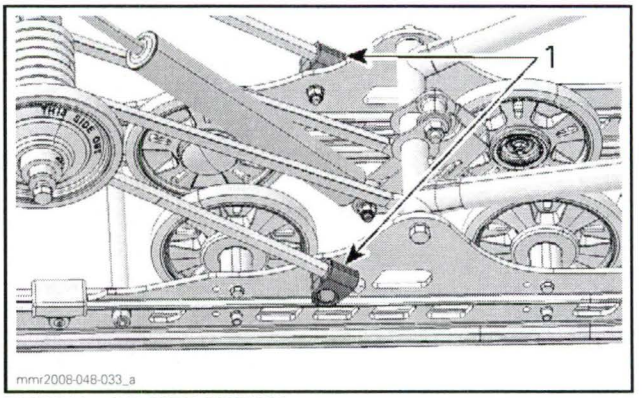
Respect THIS SIDE OUT inscription on top idler wheels.

Make sure that spring end is in cam adjuster.



TYPICAL - LH SIDE SHOWN
1. Spring end
2. Cam

Install spring supports upwards.



TYPICAL - RH SIDE SHOWN
1. Spring supports upwards

Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on set screw of the locking rings.

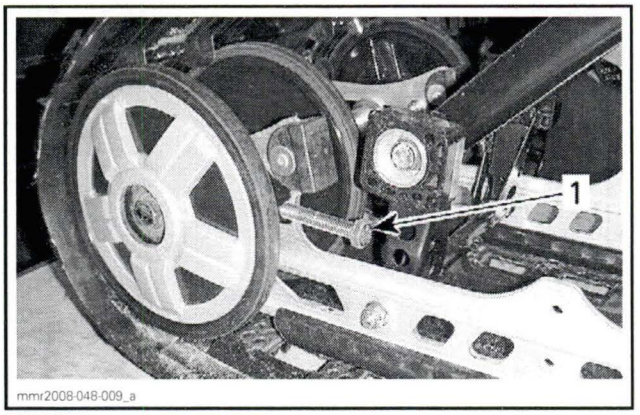
Torque rear arm upper screws to specification.

TIGHTENING TORQUE	
Rear arm upper screws	85 N•m (63 lbf•ft)

SLIDER SHOES

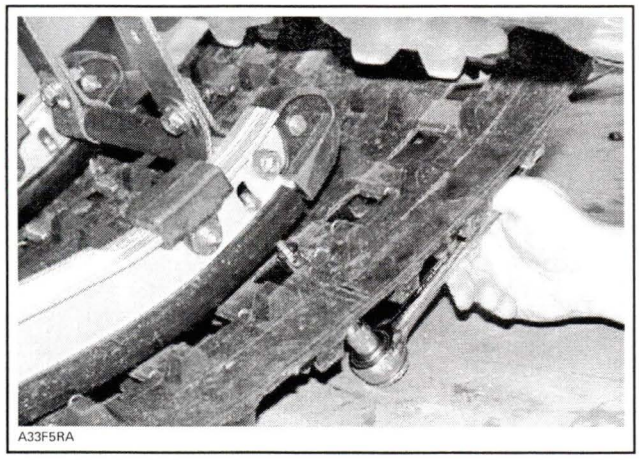
Slider Shoe Removal

1. Lift rear of vehicle and support it off the ground.
2. Completely loosen track tension by unscrewing both adjustment screws.



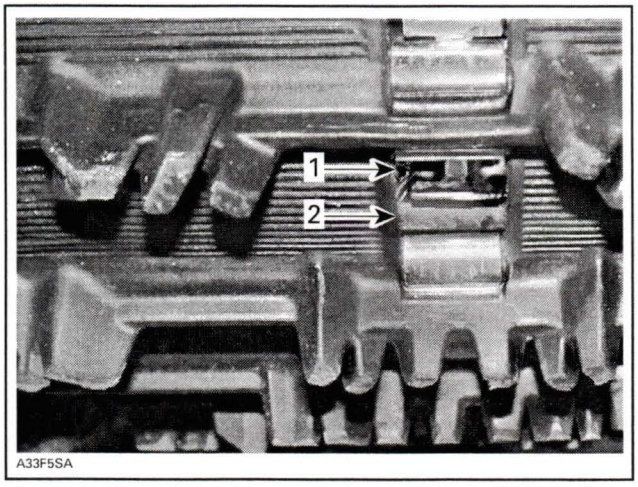
TYPICAL
1. RH adjustment screw

3. Remove nut and screw on each rail.


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REMOVE NUT AND SCREW ON EACH RAIL

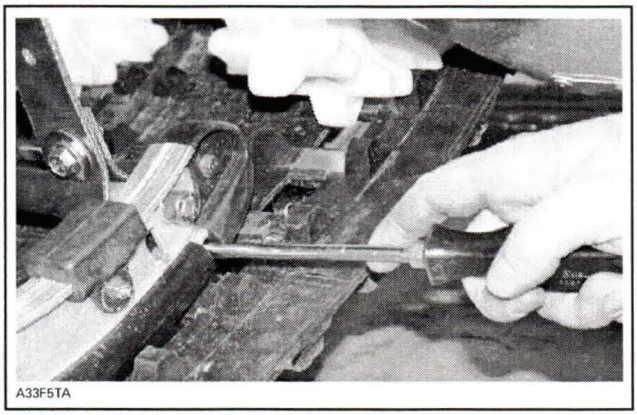
4. At the rear of vehicle, align a track window with slider shoe.



A33F5SA

TYPICAL
1. *Track window*
2. *Slider shoe*

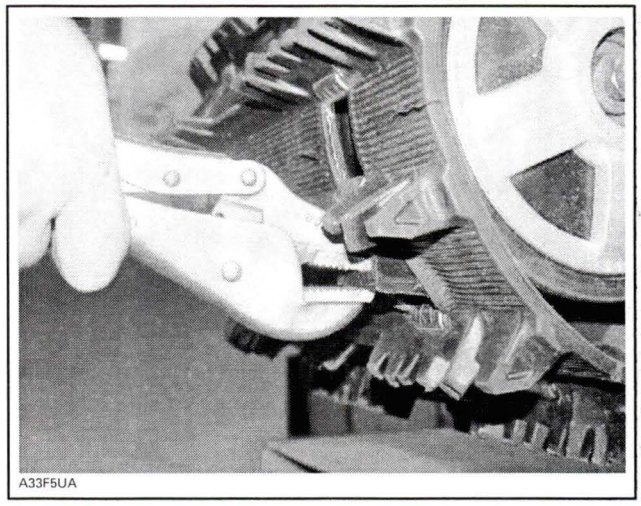
5. Using a pry bar or a screwdriver, push slider shoe rearward until it comes in contact with track.


A33F5TA

PUSH ON SLIDER SHOE

6. Using locking pliers, pull slider shoe through track window to remove.

NOTE: If necessary, lubricate track window to facilitate slider shoe removal.


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PULL ON SLIDER SHOE TO REMOVE

Slider Shoe Installation

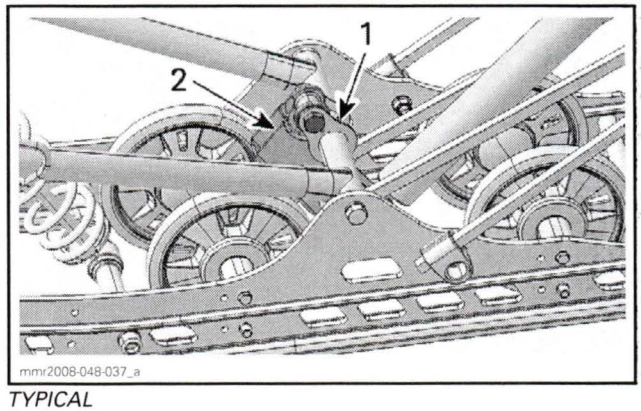
Installation is reverse of removal procedure. However, pay attention to the following.

Make sure to insert slider shoe end with hole first.

FRONT ARM

Front Arm Removal

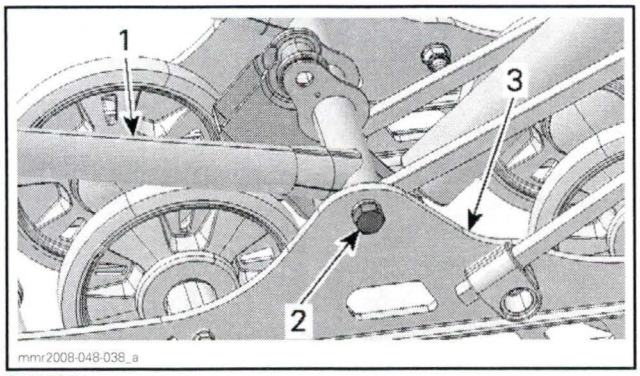
1. Proceed with *SUSPENSION ASSEMBLY REMOVAL*. See procedure in this subsection.
2. Remove bolt securing rocker to front arm.



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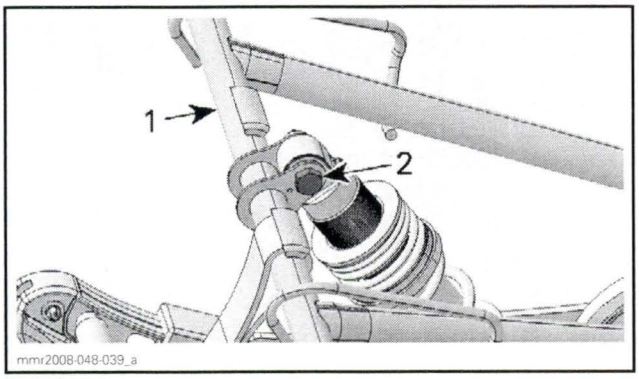
TYPICAL
1. *Front arm*
2. *Rocker*

3. Remove the front arm lower screws and washers.



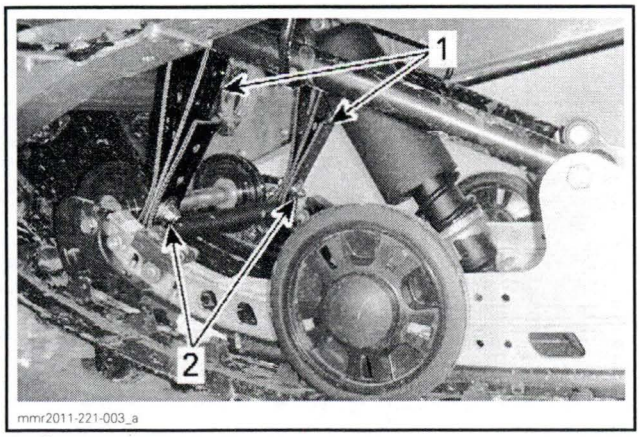
TYPICAL
1. *Front arm*
2. *Lower screw*
3. *LH rail*

4. Remove the shock absorber upper bolt.



TYPICAL
1. *Front arm*
2. *Shock absorber upper bolt*

5. Unfasten stopper straps.



1. *Stopper straps*
2. *Stopper strap bolts*

6. Remove front arm from suspension assembly.

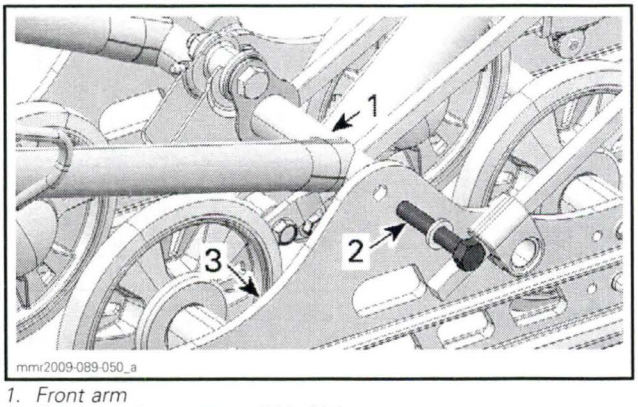
Front Arm Installation

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

Install **NEW** front arm lower screws.

Torque front arm lower screws to specification.

TIGHTENING TORQUE	
Front arm lower screws	48 N•m (35 lbf•ft)



1. *Front arm*
2. *Front arm lower screw (LH side)*
3. *Rail*

Torque nut securing rocker on front arm to specification.

TIGHTENING TORQUE	
Nut securing rocker on front arm	25 N•m (18 lbf•ft)

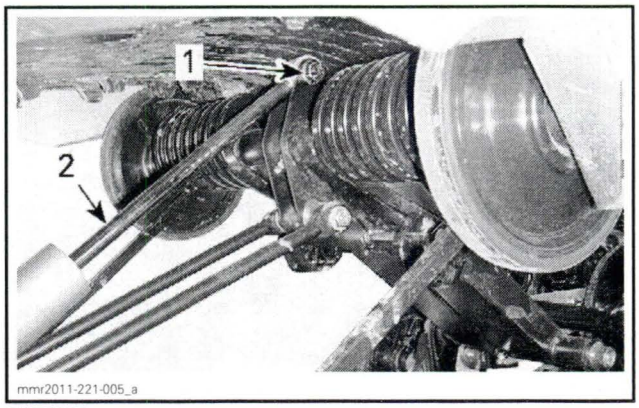
Lubricate front arm pivot. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

REAR ARM

Rear Arm Removal

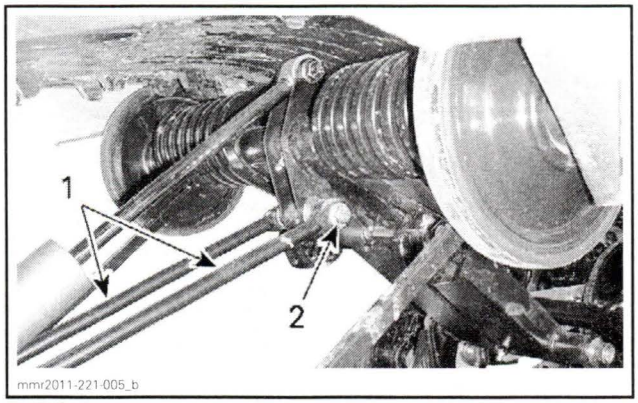
1. Proceed with *REAR SPRING REMOVAL*. See procedure in this subsection.
2. Remove the rear shock absorber upper bolt and nut.

NOTE: To ease some parts removal, lower the vehicle just enough to apply a slight load on the rear suspension.



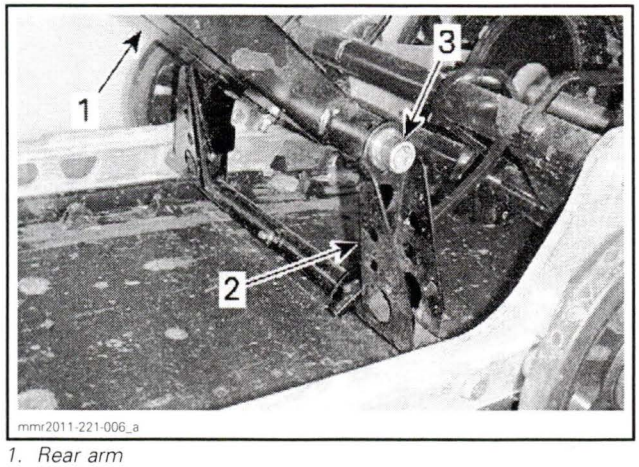
TYPICAL
1. *Rear shock absorber upper bolt*
2. *Rear shock absorber*

3. Remove throttle rods from the rear arm.



TYPICAL
1. *Throttle rods*
2. *Throttle rods upper bolt*

4. Remove screws and washers holding rear arm to pivot arm.



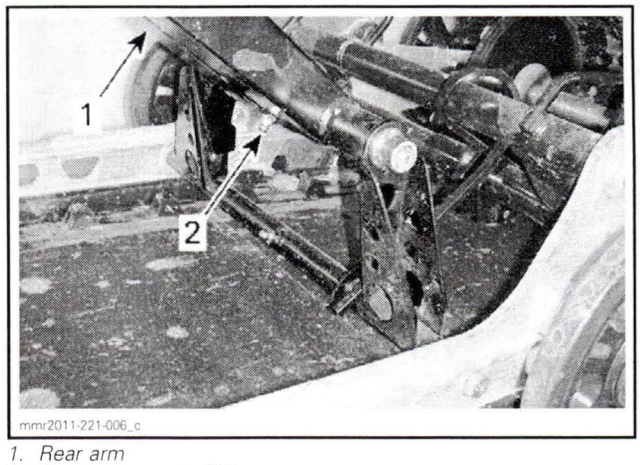
1. *Rear arm*
2. *Pivot arm*
3. *Rear arm to pivot arm screws*

5. Remove rear arm from vehicle.
6. Remove adjustment cams from the rear arm.

Rear Arm Installation

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

Place rear arm with grease fitting towards front.



1. *Rear arm*
2. *Rear arm grease fitting*

Install **NEW** rear arm screws, throttle rod and shock absorber nuts.

Torque rear arm nuts and screws to specification.

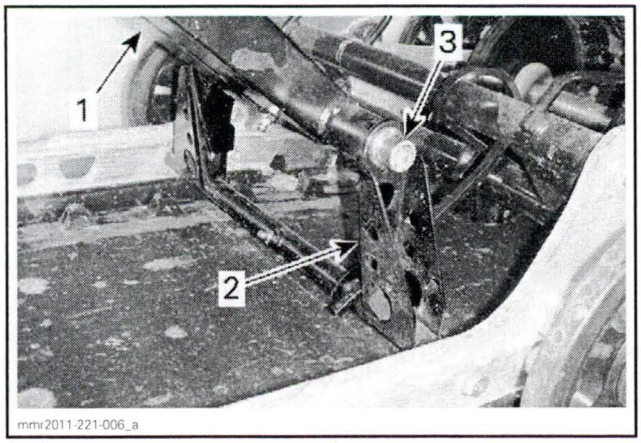
TIGHTENING TORQUE	
Rear shock absorber upper nut	25 N•m (18 lbf•ft)
Throttle rods upper nut	25 N•m (18 lbf•ft)
Rear arm upper screws	85 N•m (63 lbf•ft)
Rear arm to pivot arm screws	85 N•m (63 lbf•ft)

Lubricate rear arm. Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

PIVOT ARM

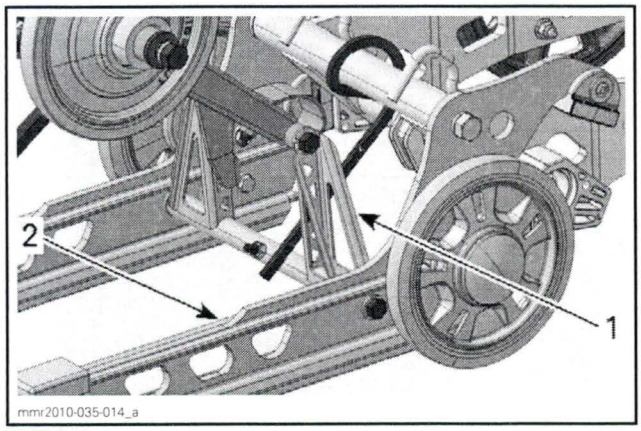
Pivot Arm Removal

1. Lift rear of vehicle and support it off the ground.
2. Completely loosen track tension by unscrewing both adjustment screws.
3. Remove rear arm to pivot arm screws.



1. *Rear arm*
2. *Pivot arm*
3. *Rear arm to pivot arm screw*

4. Remove bolt and washers holding pivot arm to rails.



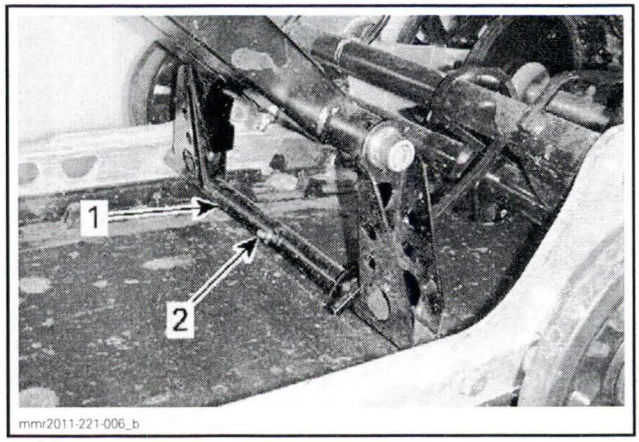
TYPICAL
1. *Pivot arm*
2. *Rail*

5. Carefully remove pivot arm from rear arm.

Pivot Arm Installation

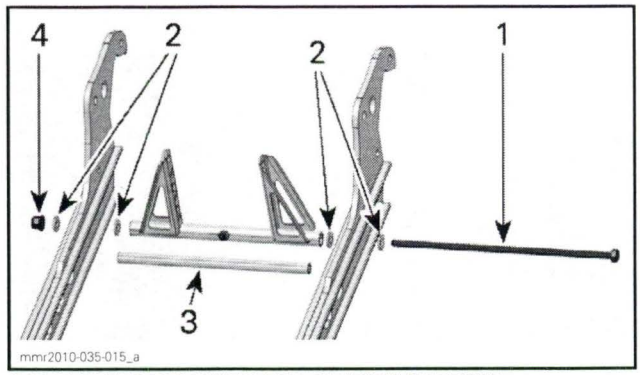
The installation is the reverse of the removal procedure. However, pay attention to the following.

Place pivot arm with grease fitting towards front.



1. *Pivot arm*
2. *Pivot arm grease fitting*

Assemble pivot arm lower fasteners as per following illustrations.



SOME PARTS REMOVED FOR CLARITY PURPOSE
1. *Pivot arm lower bolt*
2. *Washers*
3. *Axle*
4. *Pivot arm lower nut*

TIGHTENING TORQUE	
Pivot arm lower nut	25 N•m (18 lbf•ft)
Pivot arm upper screws	85 N•m (63 lbf•ft)

Lubricate pivot arm. Refer to *PERIODIC MAINTENANCE PROCEDURE* subsection.

IDLER WHEELS AND SUPPORTS

Idler Wheels Removal and Installation

Refer to the exploded views at the beginning of this subsection for parts layout and fasteners tightening torque.

STOPPER STRAPS

Stopper Strap Removal and Installation

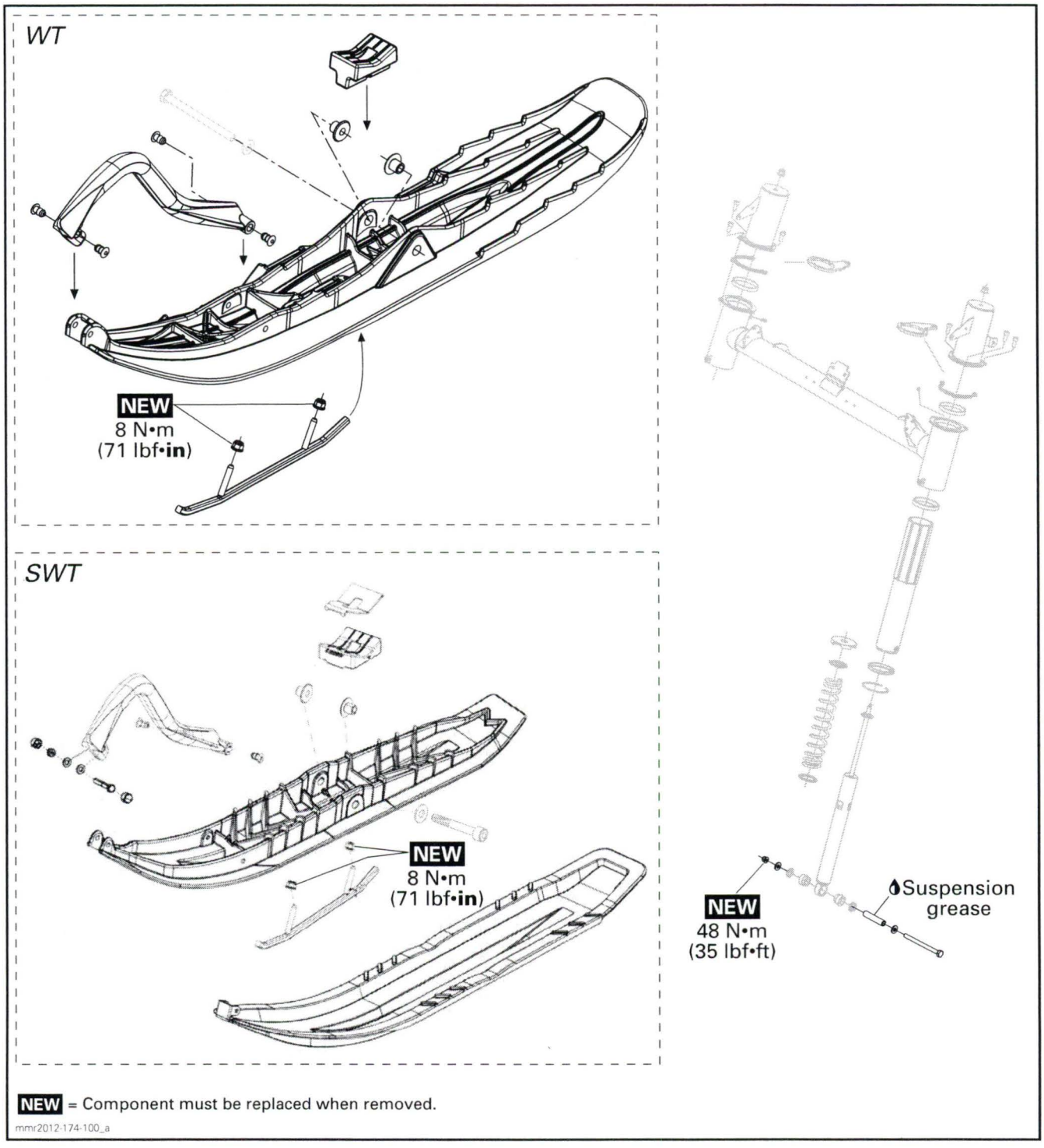
Refer to the exploded view for stopper straps configuration and tightening torque.

STEERING SYSTEM

SERVICE PRODUCTS

Description	Part Number	Page
SUSPENSION GREASE	293 550 033	817

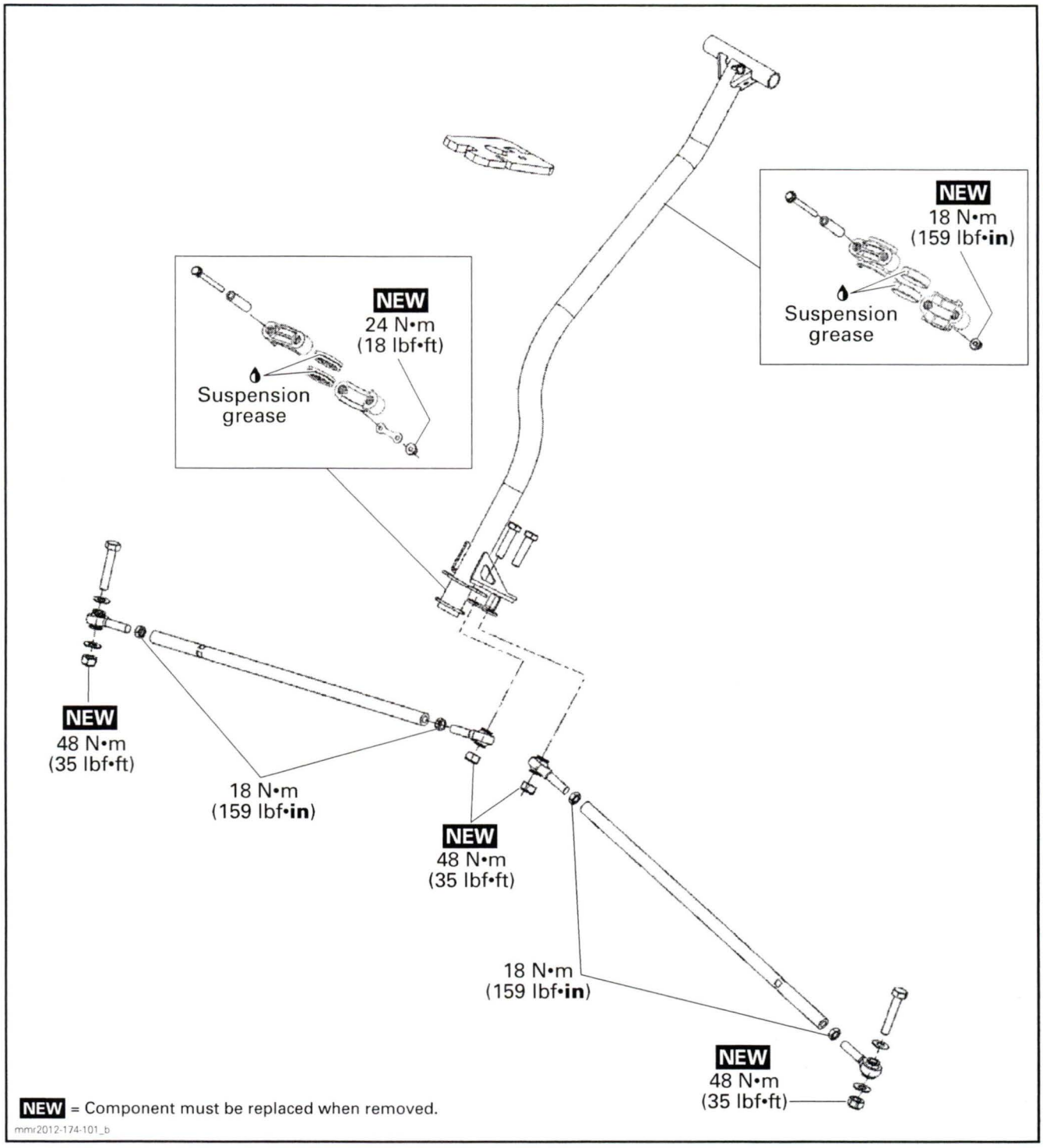
SKIS



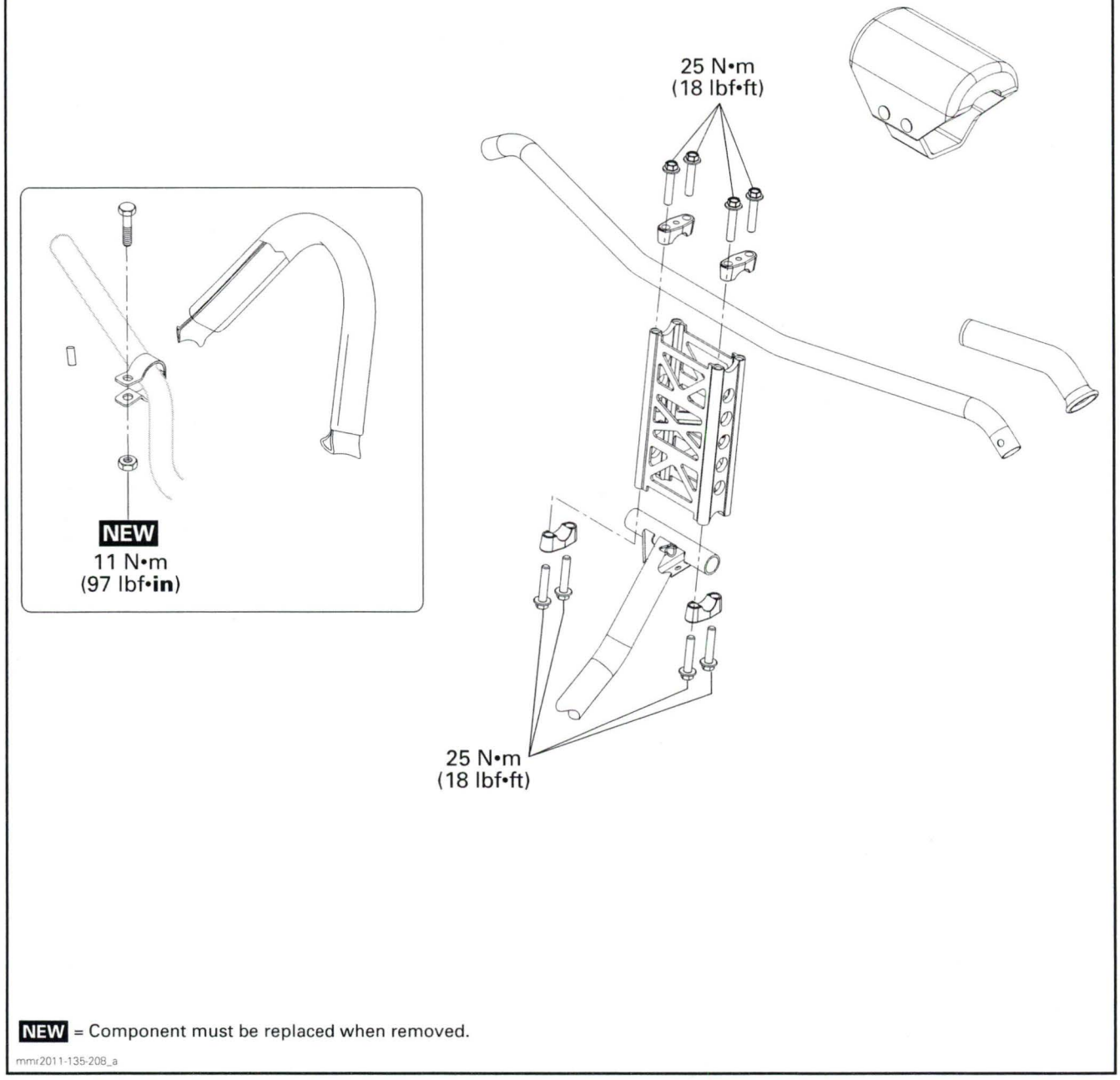
NEW = Component must be replaced when removed.

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STEERING COLUMN AND TIE-RODS



HANDLEBAR



NEW = Component must be replaced when removed.

mmr2011-135-208_a

GENERAL

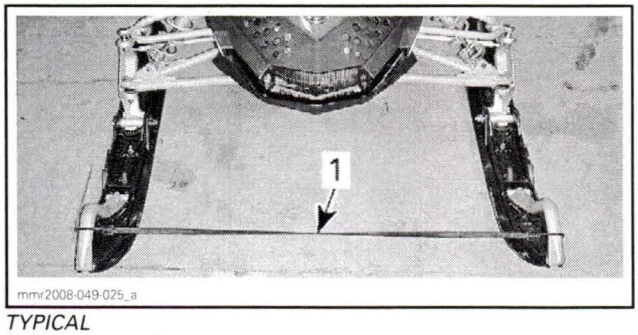
When removing or replacing a part of the steering mechanism, perform the steering alignment, refer to *STEERING ALIGNMENT* in this subsection.

ADJUSTMENT

STEERING ALIGNMENT

Ski alignment is performed by adjusting the length of left and right tie-rods.

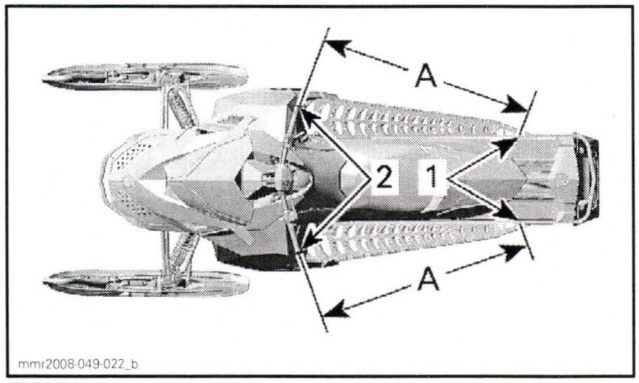
1. Leave the vehicle on the ground on its own weight.
2. Attach ski handles together with a bungee cord.



TYPICAL
1. Bungee cord

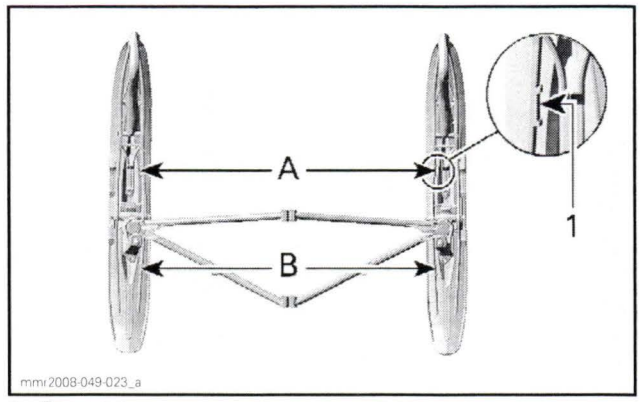
3. Position handlebar so that it is straight ahead position by measuring from the extremities of the grips to the rear most edge of the tunnel, as shown.

NOTE: The reference point must be the same to each side.



TYPICAL
1. Same fixed reference point
2. Handlebar end
A. Equal distance on each side

4. Verify if skis are in straight-ahead position by placing a straight edge against adjusted track and measuring distance between front and rear ski recesses and straight edge.
5. When skis are in straight ahead position, adjust the toe-out.
6. Measure the distance between front and rear ski recesses.
7. Use the following illustration and this equation to determine the perfect steering adjustment.

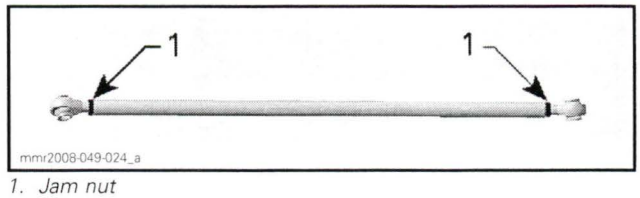


1. Recesses
A – B = 5 mm (.197 in)

STEERING ALIGNMENT	
Toe-out	5 mm (.197 in)

8. If adjustment is needed, loosen tie-rod jam nuts then turn tie-rods to change their length.
9. Tighten jam nuts as specified.

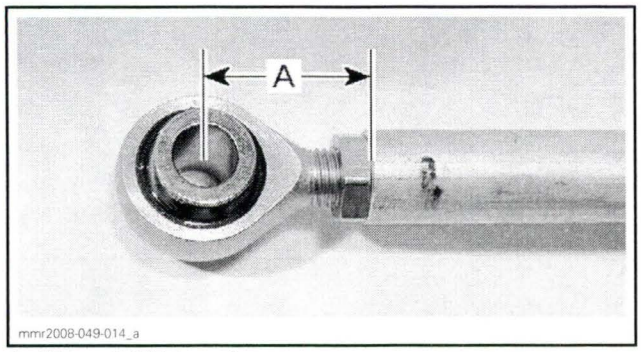
JAM NUT TORQUE, TIE-ROD END
18 N•m (159 lbf•**in**)



1. Jam nut

⚠ WARNING

The maximum tie-rod end length not engaged in the tie rod must not exceed 32 mm (1.26 in) to ensure proper thread engagement.



A. 32 mm (1.26 in) **maximum**

PROCEDURES

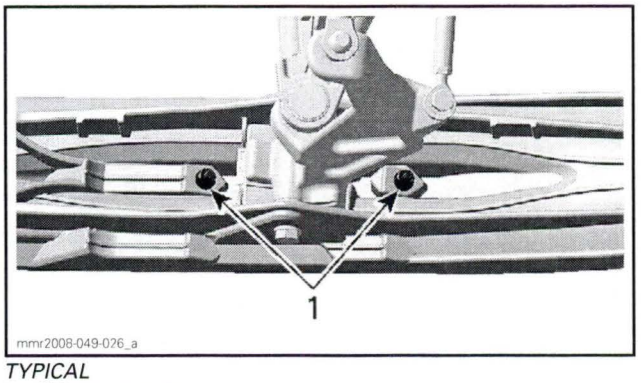
SKI RUNNERS

Ski Runner Inspection

Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

Ski Runner Removal

1. Lift the front of vehicle and support it off ground.
2. Unscrew the ski runner nuts then remove ski runners.



TYPICAL
1. Ski runner nuts

Ski Runner Installation

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

Torque ski runner nuts to 8 N•m (71 lbf•**in**).

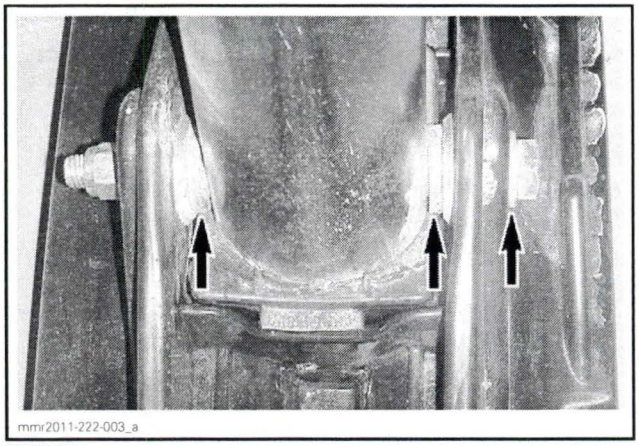
SKIS

Ski Inspection

Refer to *PERIODIC MAINTENANCE PROCEDURES* subsection.

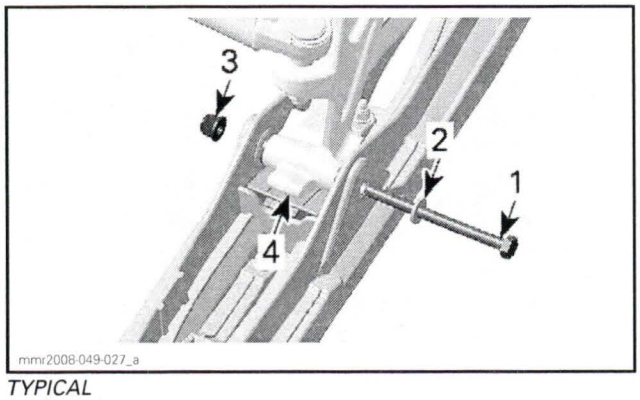
Ski Removal

1. Lift front of vehicle and support it off the ground.
2. Observe and note position and size of washer and spacers for reinstallation.



TYPICAL

3. Unscrew nut then pull ski bolt out.

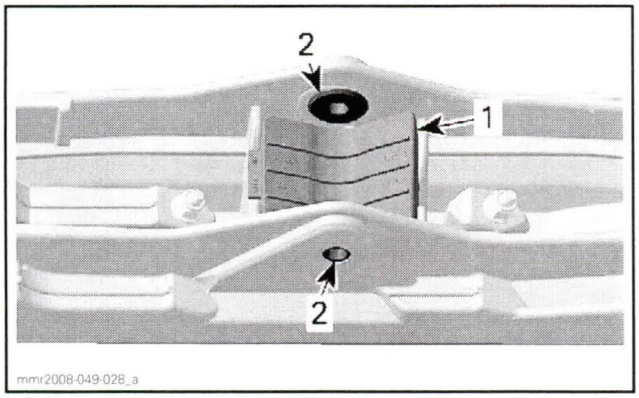


TYPICAL
1. Ski bolt
2. Washer
3. Nut
4. Ski leg

4. Remove ski from vehicle.

Ski Installation

1. Make sure bushings are installed in ski holes.
2. Install the ski stopper. Position indicator towards the front and make sure the bump in the ski is in the groove of the ski stopper.



TYPICAL
1. *Ski stopper*
2. *Bushings*

3. Install ski bolt and tighten as specified.

SKI BOLT TORQUE
48 N•m (35 lbf•ft)

NOTE: Be sure to install washer and spacers as noted prior to removal.

SKI HANDLES

Ski Handle Removal

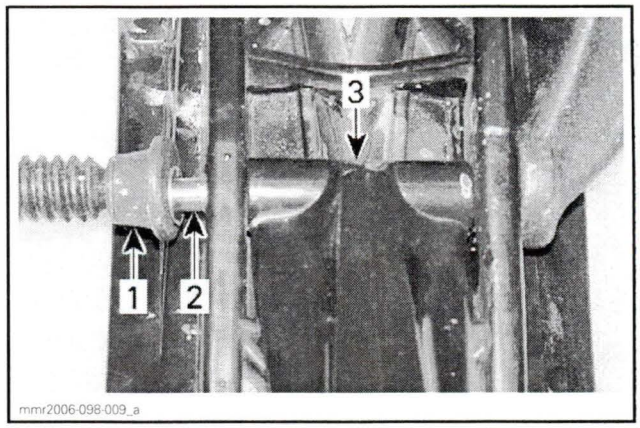
1. Remove ski from vehicle.
2. Using a 9 mm (3/8 in) drill bit, remove ski handle rivets.

NOTE: Drill only the rivet head. Do not try to drill all the way through the rivet. Angle the drill bit to reduce the chance of spinning the rivet in the ski.

3. Remove handle from ski.
4. Place handle in hot water for 10 minutes then using a punch, drive the rivet shank out of the handle.

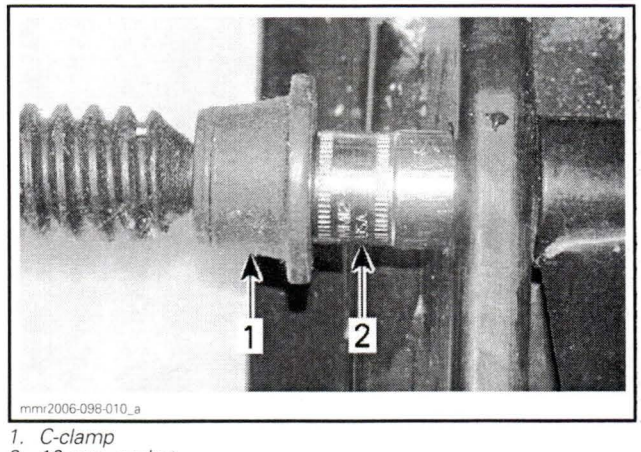
Ski Handle Installation

1. To install rivets, use a C-clamp and a short 10 mm socket.
2. Place a rivet in position and insert it into the ski and ski handle. Repeat the procedure for the other side.



1. *C-clamp*
2. *Rivet*
3. *Handle*

3. When both rivets are installed, use the short 10 mm socket to push rivet heads against the ski.



1. *C-clamp*
2. *10 mm socket*

SKI LEGS

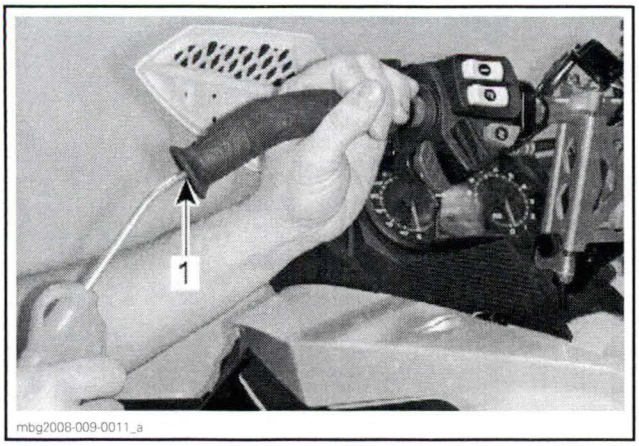
To replace a ski leg, refer to *FRONT SUSPENSION* subsection.

HANDLEBAR GRIPS

NOTE: To verify or replace heating elements, refer to *LIGHTS, GAUGE AND ACCESSORIES* subsection.

Handlebar Grip Removal

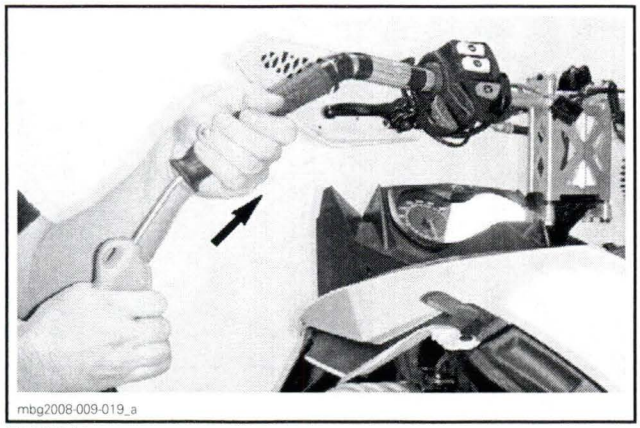
Remove grips by pulling while using compressed air to inflate or loosen the fit between the grip and handlebar as illustrated.



TYPICAL
1. Blow air in the grip hole

Handlebar Grip Installation

Insert the handlebar grip on handlebar while blowing compressed air to inflate or loosen the fit between grip and handlebar.



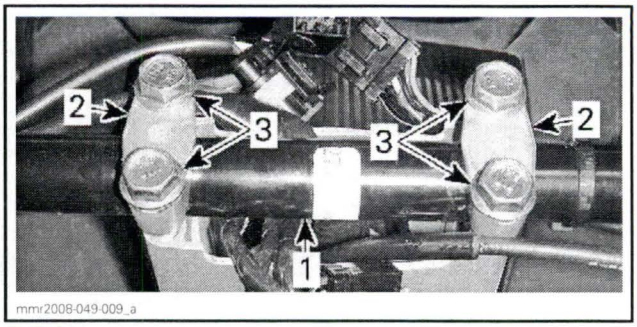
TYPICAL

HANDLEBAR

Handlebar Removal

NOTE: If the handlebar must be changed, remove all components (handle grip, throttle lever housing, etc.) before removing it from vehicle.

1. Remove steering cover.
2. Disconnect all electrical connectors.
3. Remove handlebar retaining clamp screws.



TYPICAL
1. Handlebar
2. Retaining clamps
3. Screws

4. Remove handlebar from handlebar extension.

Handlebar Inspection

1. Inspect the handlebar for:
   - Damages
   - Cracks
   - Bending.
2. Replace if any of these problems is detected.

⚠ WARNING

Do not try to repair a defective handlebar.

3. Check handlebar clamps for cracks or distortion, replace if necessary.

Handlebar Installation

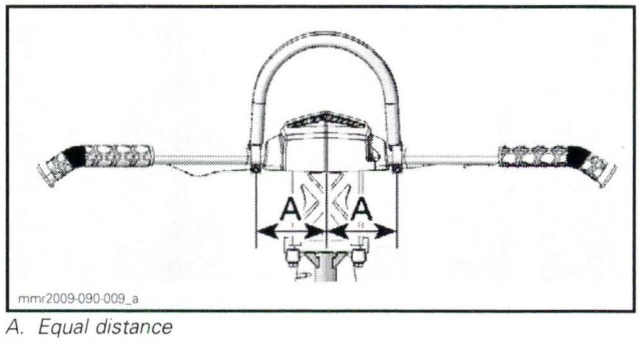
The installation is the reverse of the removal procedure. However, pay attention to the following.

HANDLEBAR CLAMP SCREW TORQUE
25 N•m (18 lbf•ft)

Turn handlebar completely from side to side making sure it does not exert unwanted tension on handlebar wires.

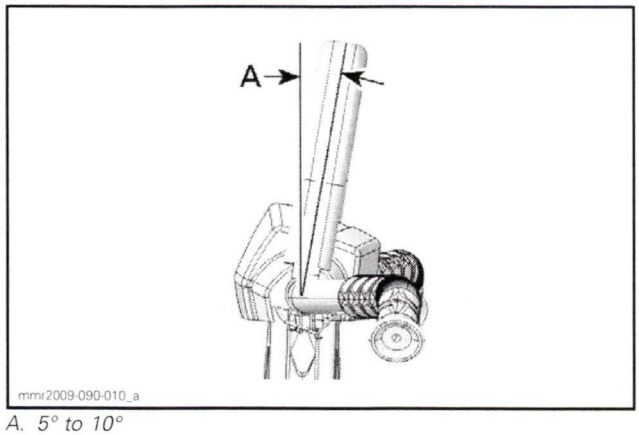
Handlebar Strap (If Equipped)

1. Ensure to position strap symmetrically each side of handlebar retaining clamps.



A. Equal distance

2. Tilt strap 5° to 10° towards driver relative to handlebar extension.



A. 5° to 10°

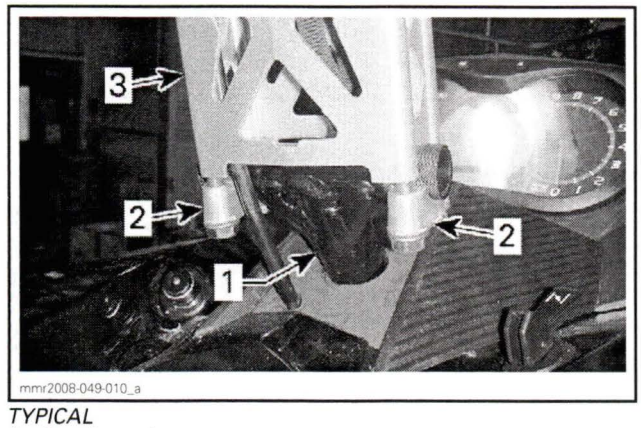
Make sure the strap clamps and bolts do not interfere with cables or wires.

STRAP RETAINING SCREW TORQUE
11 N•m (97 lbf•**in**)

HANDLEBAR EXTENSION (FIXED)

Handlebar Extension Removal

1. Proceed with *HANDLEBAR REMOVAL*, see procedure in this subsection.
2. Remove secondary air intake silencer and headlight gauge module as a unit, refer to *AIR INTAKE SYSTEM* subsection.
3. Disconnect the multifunction switch harness connectors.
4. Remove screws retaining the extension to steering column.



TYPICAL
1. *Steering column*
2. *Handlebar extension clamps*
3. *Handlebar extension*

5. Remove handlebar extension from vehicle.

Handlebar Extension Inspection

Check handlebar extension for:
- Cracks
- Deformation
- Other damages.

Replace if any of these problems is detected.

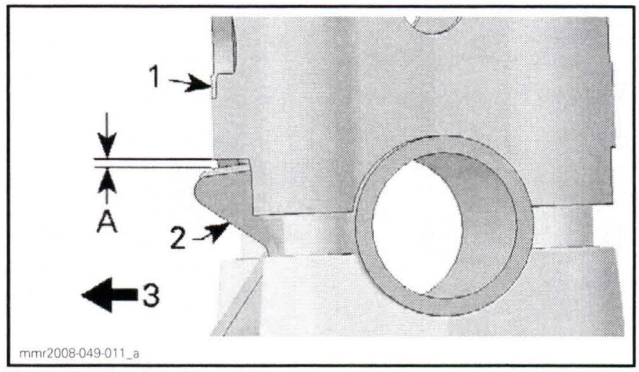
⚠ WARNING

Do not try to repair a defective handlebar extension.

Handlebar Extension Installation

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

When installing handlebar extension, ensure to leave a gap between handlebar extension and stop block on steering column.



1. *Bottom of handlebar extension*
2. *Steering column stop block*
3. *Front of vehicle*

A. 1 mm (.039 in) minimum

Torque handlebar extension retaining screws.

HANDLEBAR EXTENSION SCREW TORQUE
25 N•m (18 lbf•ft)

⚠ WARNING

The handlebar and it's components must not make contact with any other parts (windshield, fuel tank cap, etc.) when steering is turned.

TIE-RODS

NOTE: The same procedure is applied on RH and LH side.

Tie-Rod Inspection

Check tie-rod ends for looseness. If play is excessive, replace tie-rod.

Check if the tie-rod is bent, cracked or otherwise damaged. Replace if necessary.

Tie-Rod Access

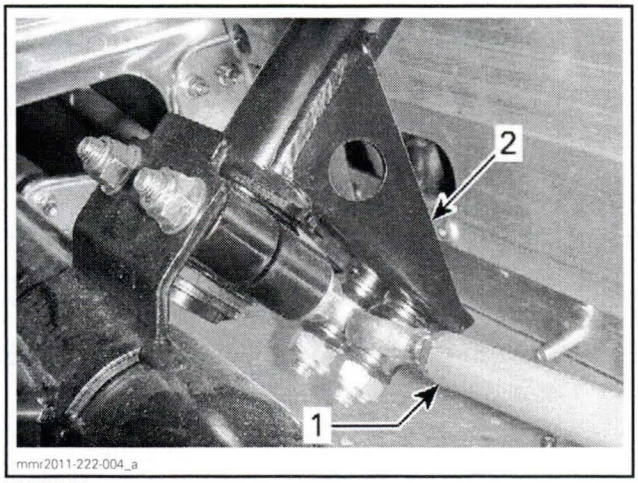
1. Refer to *BODY* subsection and remove:
   - Side panels
   - Hood.

All Except 600 ACE

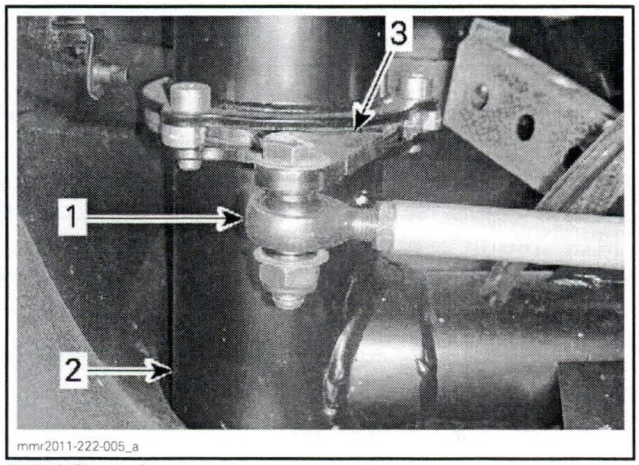
2. Remove tuned pipe. Refer to *EXHAUST SYSTEM* subsection.

Tie-Rod Removal

1. Remove the tie-rod ends from the steering column and ski leg.



TYPICAL
1. *Tie-rod*
2. *Steering column*



TYPICAL
1. *Tie-rod end*
2. *LTS*
3. *Steering arm*

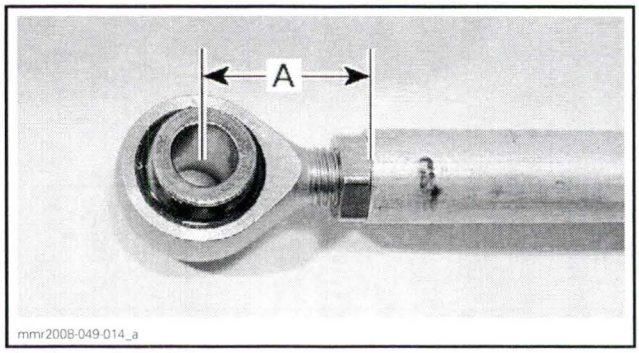
2. Remove tie-rod from vehicle.

Tie-Rod Installation

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

1. Adjust the tie-rod ends to their nominal length without tightening the jam nuts.

NOMINAL LENGTH ADJUSTMENT, TIE-ROD END
30 mm (1.181 in)

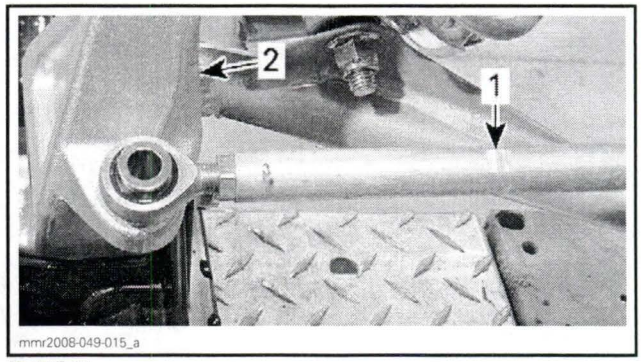


A. 30 mm (1.181 in)

⚠ WARNING

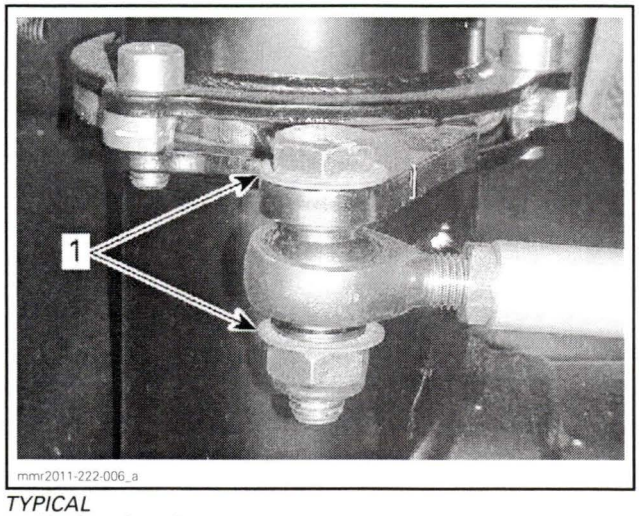
The maximum tie-rod end length must not exceed 32 mm (1.26 in) to ensure sufficient thread engagement in tie-rod.

2. Install tie-rod with the grooved end on the ski leg side.



TYPICAL
1. *Tie-rod groove*
2. *Ski leg*

3. On ski leg side, install hardened washers as illustrated.



TYPICAL
1. *Hardened washers*

4. Install nuts retaining tie-rod ends and tighten them as specified.

RETAINING NUT TORQUE, TIE-ROD END
48 N•m (35 lbf•ft)

5. Perform a *STEERING ALIGNMENT*, see procedure in this subsection.

STEERING COLUMN

Steering Column Removal

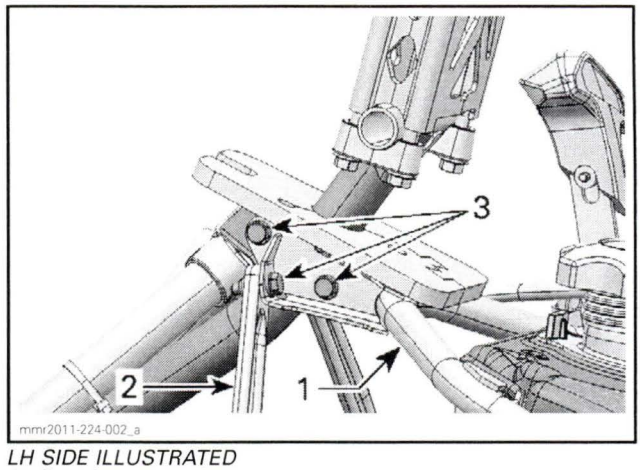
1. Refer to *BODY* subsection to remove the following parts:
   - Side panels
   - Hood
   - Console.
2. Remove secondary air intake silencer and headlight/gauge module as a unit, refer to *AIR INTAKE SYSTEM* subsection.

All Except 600 ACE

3. Remove tuned pipe. Refer to *EXHAUST SYSTEM* subsection.

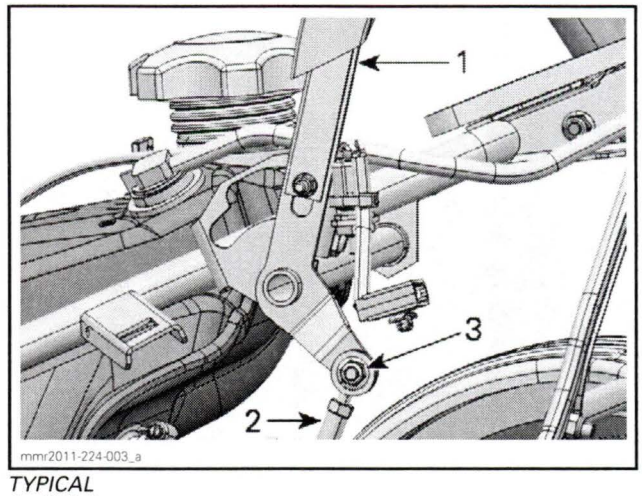
All Models

4. Remove *HANDLEBAR EXTENSION* from steering column, see procedure in this subsection.
5. Remove bolts and nuts securing upper steering column support.
6. Remove bolts and nuts securing side frame members to rear frame member at upper steering column support.



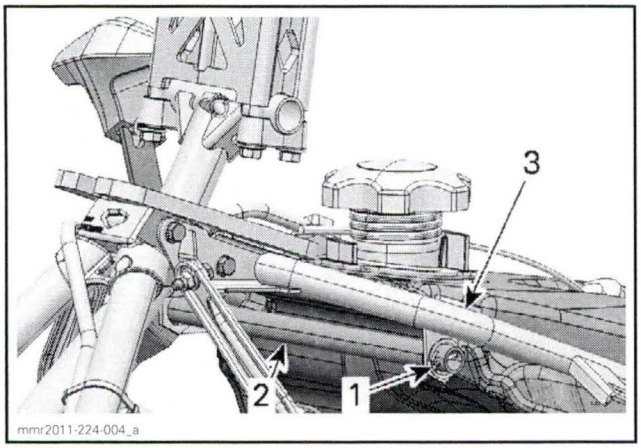
LH SIDE ILLUSTRATED
1. *Rear frame member*
2. *Side frame member*
3. *Bolts to remove*

7. Disconnect the shift rod from the shift lever.



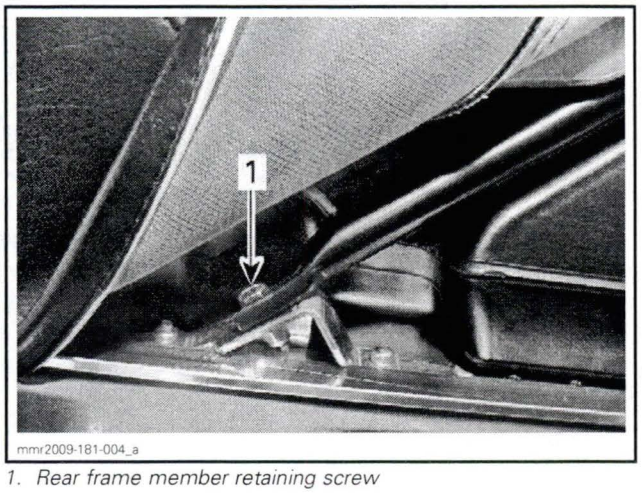
TYPICAL
1. *Shift lever*
2. *Shift rod*
3. *Remove this bolt and nut*

8. Remove the cotter pin that retains the shift lever shaft to the rear frame member and remove the shift lever.



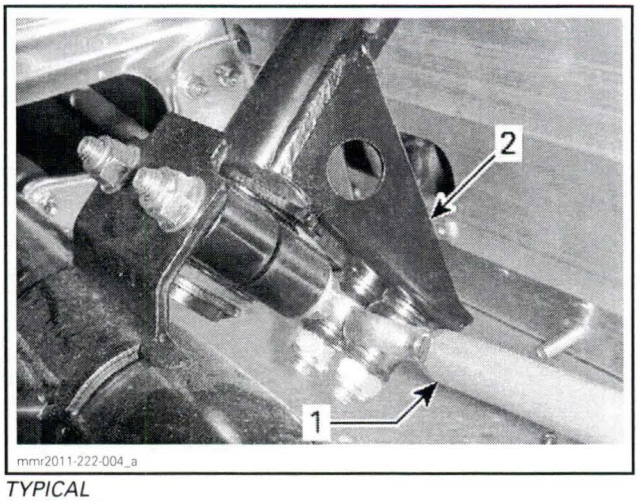
TYPICAL
1. *Cotter pin to remove*
2. *Shift lever shaft*
3. *Rear frame member*

9. Remove steering pad covering upper steering support halves.
10. Remove screw retaining the rear frame members (one each side) to the tunnel.



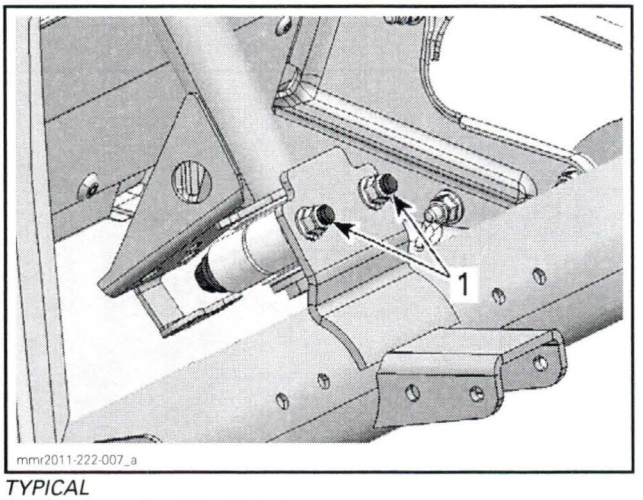
1. *Rear frame member retaining screw*

11. Remove tie-rod ends from steering column.



TYPICAL
1. *Tie-rod*
2. *Steering column*

12. Remove screws securing the steering column lower support.



TYPICAL
1. *Steering column support screws*

13. Remove lower steering support halves.
14. Pull steering column from top.
15. Remove the upper steering column support halves as you pull up on the steering column.

NOTE: Move the rear frame member aside as you remove the steering column. Be wary of upper and lower steering dampers.

Steering Column Inspection

Check if steering column is:
- Cracked
- Bent
- Twisted
- Otherwise damaged.

Replace steering column if necessary.

⚠ WARNING

Do not try to repair a defective steering column.

Steering Column Installation

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

Apply SUSPENSION GREASE (P/N 293 550 033) on vibration dampers in steering column supports before installing upper and lower supports.

Replace all elastic nuts with **NEW** ones.

Ensure proper operation of steering and shift lever.

MOUNTING BOLT TORQUE	
UPPER STEERING COLUMN SUPPORT	18 N•m (159 lbf•**in**)
SIDE FRAME MEMBER	17 N•m (150 lbf•**in**)
AFT REAR FRAME MEMBER	14 N•m (124 lbf•**in**)
LOWER STEERING COLUMN SUPPORT	24 N•m (18 lbf•ft)
TIE-ROD END TO STEERING	48 N•m (35 lbf•ft)

BODY

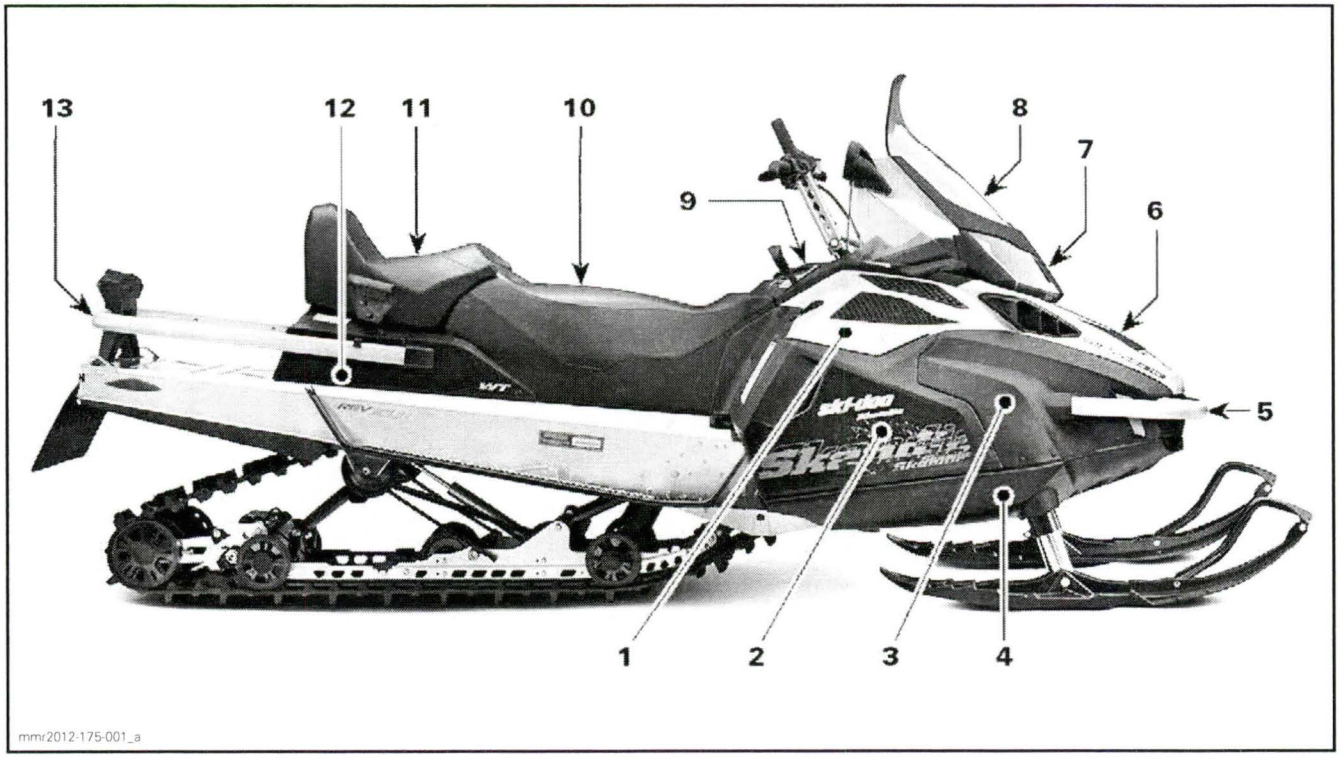
SERVICE TOOLS

Description	Part Number	Page
SUPERTANIUM DRILL BIT 3/16"	529 031 800	826

SERVICE PRODUCTS

Description	Part Number	Page
LOCTITE 243 (BLUE)	293 800 060	830

BODY PARTS NOMENCLATURE



1. *Upper side panel*
2. *Lower side panel*
3. *Upper front bottom pan*
4. *Lower front bottom pan*
5. *Front bumper*
6. *Hood*
7. *Headlight/gauge module*
8. *Windshield*
9. *Console*
10. *Operator seat*
11. *Passenger seat*
12. *Storage compartment*
13. *Rear bumper*

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GENERAL

VEHICLE CLEANING

Seat Cleaning

It is recommended to clean the seat with a solution of warm soapy water, using a soft clean cloth.

NOTICE **Avoid use of harsh detergents such as strong soaps, de-greasing solvents, abrasive cleaners, paint thinners, etc. that may cause damage to the seat cover.**

Plastic Cleaning

Clean the vehicle thoroughly, removing all dirt and grease accumulation.

Use a soft clean cloth and either soapy water or isopropyl alcohol to clean the vehicle.

To remove grease, oil or glue use isopropyl alcohol.

NOTICE **Do not apply isopropyl alcohol or acetone directly on decals.**

NOTICE **The following products must not be applied on the plastic components used on the vehicles:**

- Gasoline
- Brake fluid
- Kerosene
- Diesel fuel
- Lighter fluid
- Varsol
- Naphtha
- Acetone
- Strong detergents
- Abrasive cleaners
- Waxes containing an abrasive or a cleaning agent in their formula.

Apply only non abrasive wax on the glossy finish.

BODY PARTS REPAIR

The very first step before repairing plastic materials is to find out exactly which type of material is involved.

PARTS	MATERIAL
Side panels	Polypropylene (PP)
Console	Polypropylene (PP)
Headlight/gauge module	Polypropylene (PP)
Hood	Surlyn
Front bottom pan	Polypropylene (PP)
Storage compartment	Polyethylene (PE)

NOTICE **Some repair products are not compatible with certain plastics.**

⚠ WARNING

Polycarbonate windshields must never be repaired by welding or otherwise.

The following company provides a complete line of products to repair plastic materials:

CREST INDUSTRIES, INC.
Trenton, MI 48183
Phone: 734 479-4141
Toll Free: 1 800 822-4100
Fax: 734 479-4040
E-Mail: info@crestauto.com
Web Site: www.crestauto.com

PROCEDURES

DECALS

Decal Replacement

1. To remove a decal; heat old decal with a heat gun and peel off slowly.
2. Using isopropyl alcohol, clean the surface and dry thoroughly.
3. Apply liquid soap to new decal and carefully position the decal. Using a sponge or a squeegee, remove the air bubbles and surplus water working from the center toward the edges. Allow to air dry.

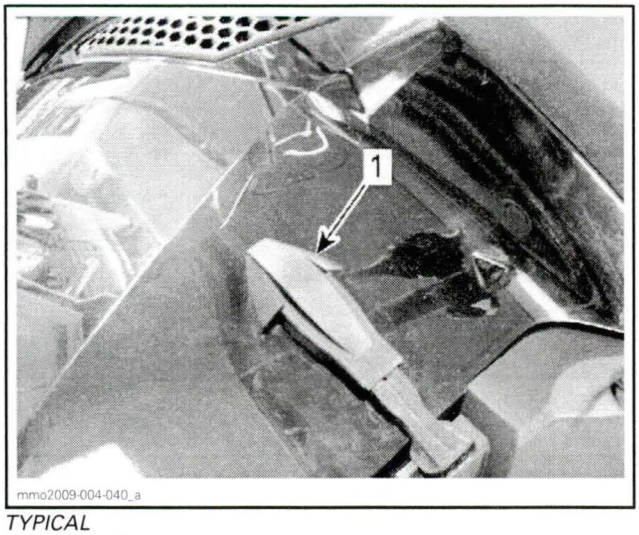
NOTICE **Do not apply isopropyl alcohol or solvent directly on decals. Use only in a well ventilated area.**

UPPER SIDE PANELS

NOTE: The same procedure applies for RH or LH side.

Upper Side Panel Removal

1. Unhook the rubber tie.

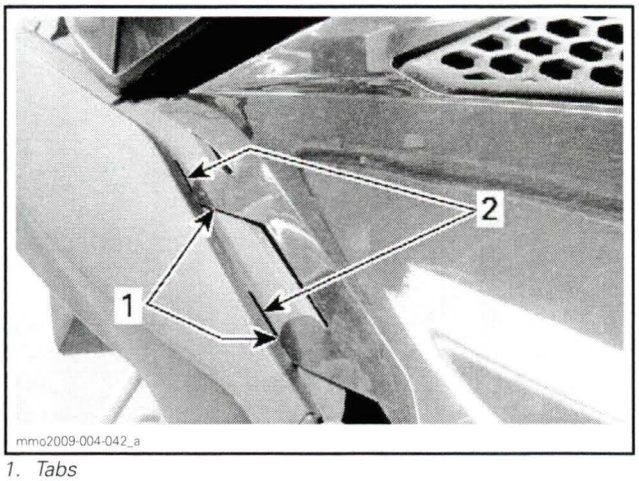


TYPICAL
1. Rubber tie

2. Lift the rear portion of panel to free the plastic tab from the console.
3. Slide panel back.

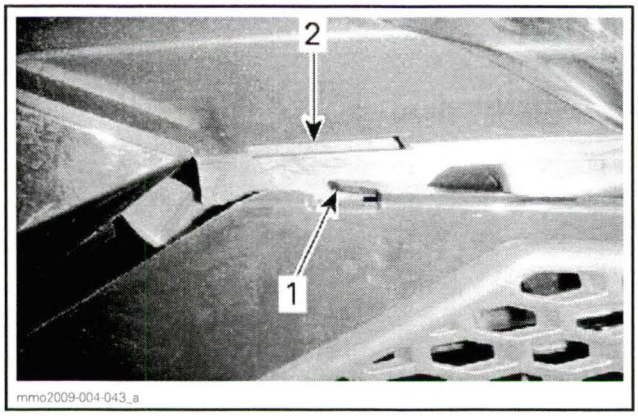
Upper Side Panel Installation

1. Insert front lower tabs into the upper bottom pan slots.



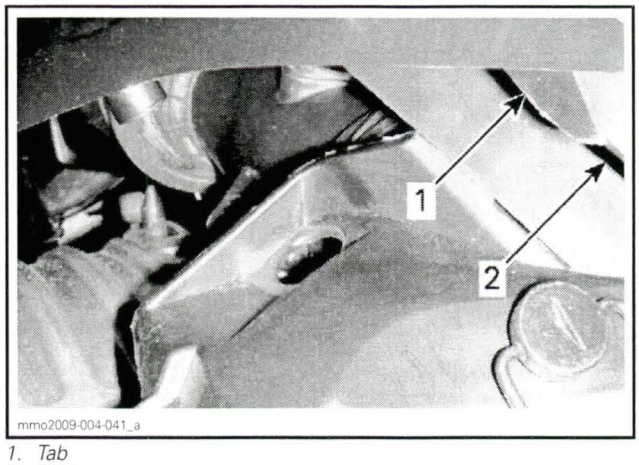
1. Tabs
2. Slots

2. Insert the top center tabs into the console.



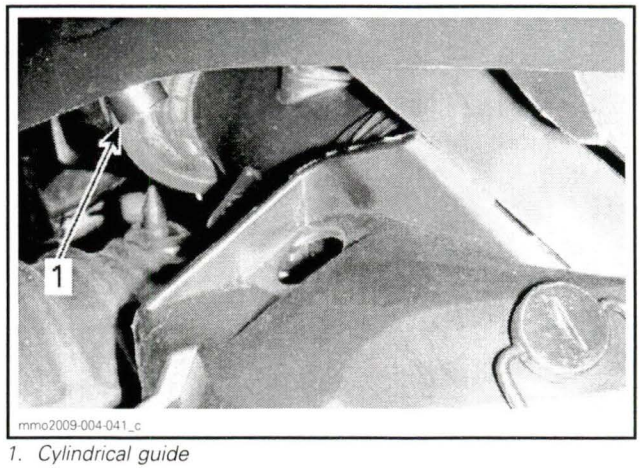
1. Tab
2. Slot

3. Insert the rear tab into the console.



1. Tab
2. Slot

4. Align and insert both cylindrical guides into the round holes on the lower side panel.



1. Cylindrical guide

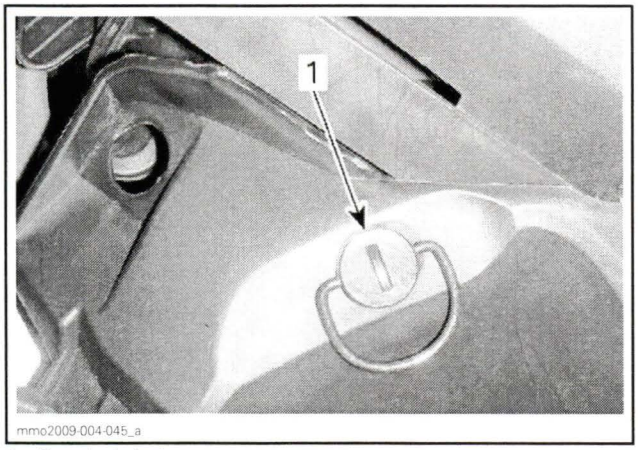
5. Hook rubber tie.

LOWER SIDE PANELS

NOTE: The same procedure applies for RH or LH side.

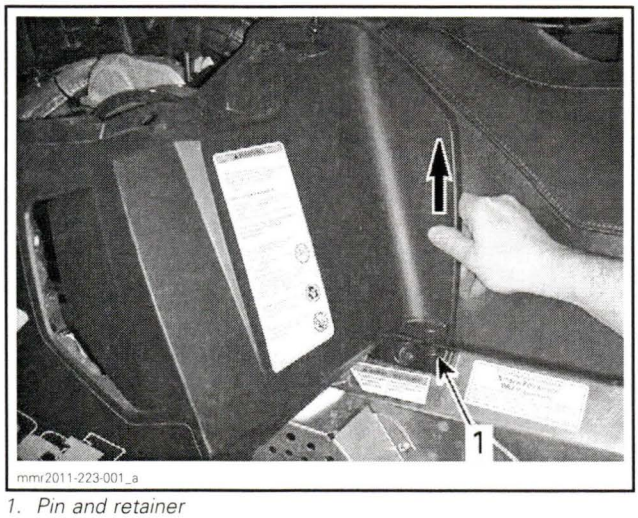
Lower Side Panel Removal

1. Remove *UPPER SIDE PANEL*.
2. At the aft top corner of the panel, turn the cam-lock fastener 1/4 turn counterclockwise to unlock.



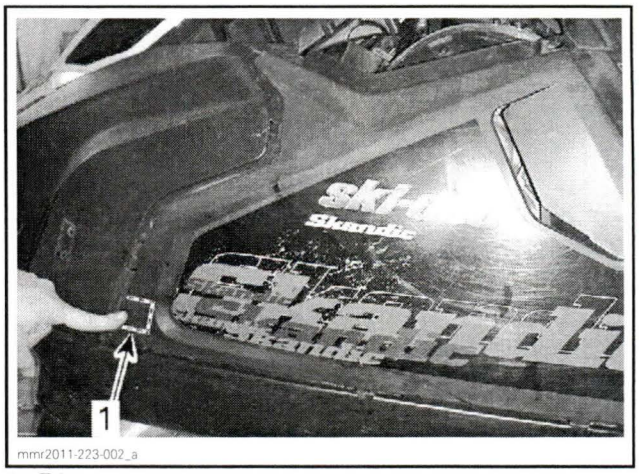
1. Cam-lock fastener

3. Slightly lift the lower aft corner of the panel to free the retaining pin from its retainer.

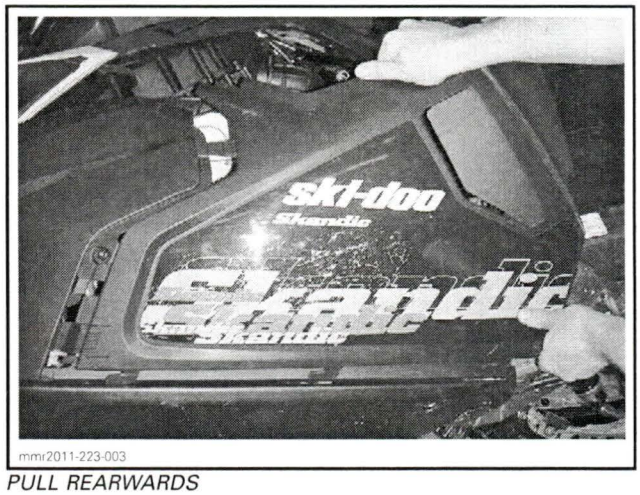


1. Pin and retainer

4. Press on the tab in the lower front corner of the panel to release it, then pull the panel back and upwards slightly to remove it.



1. Tab

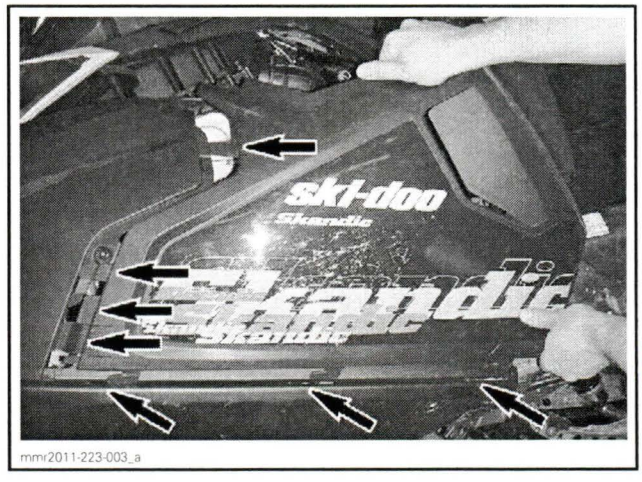


PULL REARWARDS

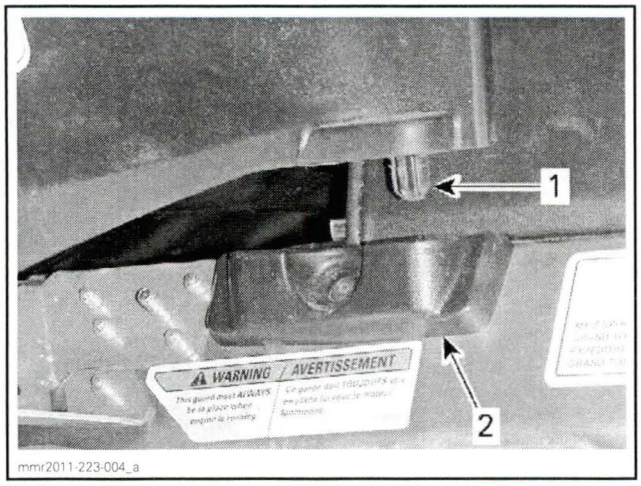
Lower Side Panel Installation

Reverse the removal procedure however, pay attention to the following.

As you install the panel on the bottom pan, ensure all the retaining tabs are properly engaged.



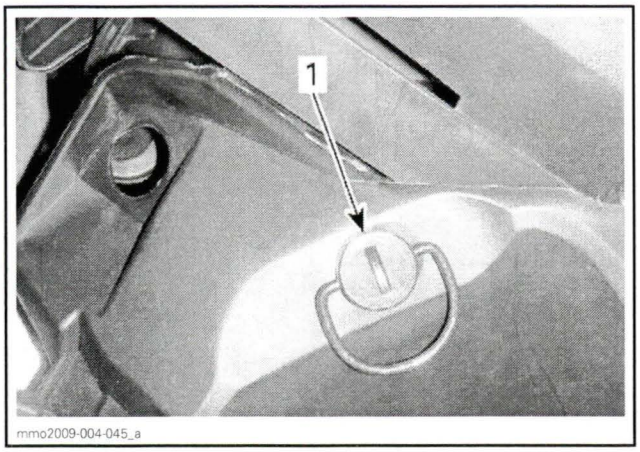
Insert the lower rear pin into its retainer.



mmr2011-223-004_a

1. Pin
2. Retainer

Lock the cam-lock fastener by turning it 1/4 turn clockwise.



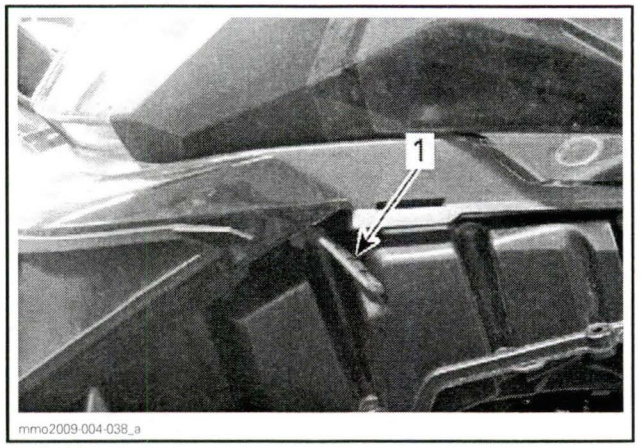
mmo2009-004-045_a

1. Cam-lock fastener

HOOD

Hood Removal

1. Remove *UPPER SIDE PANELS*, see procedure in this subsection.
2. Unhook the rubber ties on both sides.



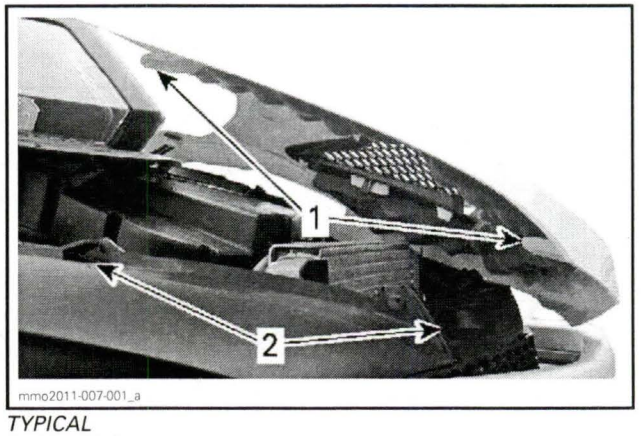
mmo2009-004-038_a

1. Rubber tie

3. Slide hood towards front to free the tabs from their slots.

Hood Installation

1. Engage the tabs located at front and center of the hood into the bottom pan slots.



mmo2011-007-001_a

TYPICAL
1. Hood tabs
2. Bottom pan slots

2. Slide hood towards headlights until it stops.
3. Hook the rubber ties.

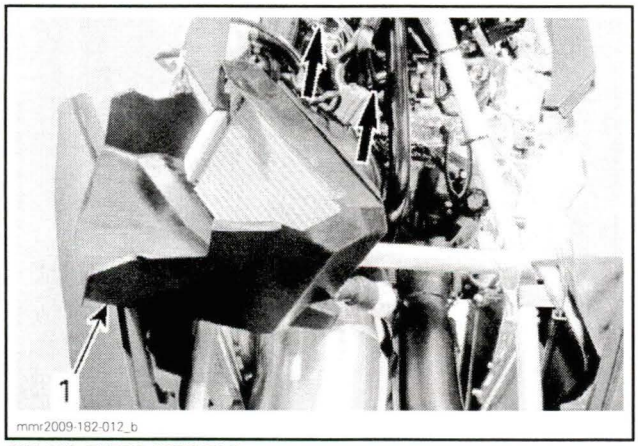
FRONT BUMPER

Front Bumper Removal

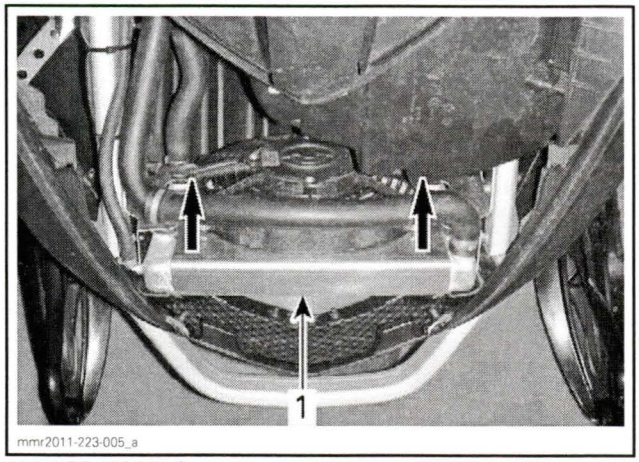
1. Remove *HOOD*, see procedure in this subsection.

All Models Except 550F

2. Remove the *SECONDARY AIR INTAKE SILENCER*.
3. Detach front radiator from frame and move it rearward. Refer to *COOLING SYSTEM* subsection.



600 HO E-TEC MODELS
1. Radiator



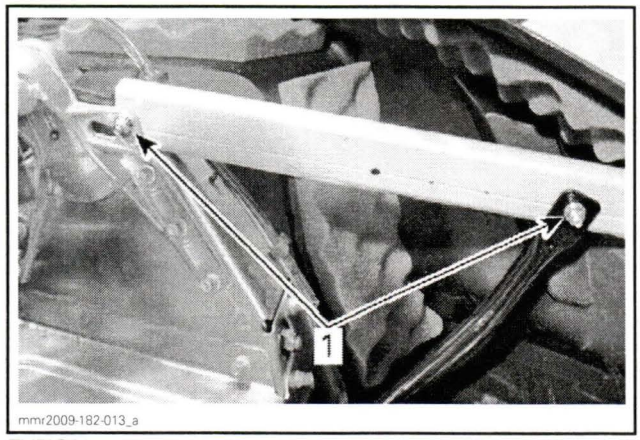
600 ACE MODELS
1. Radiator

550F Models

4. Remove RH *LOWER SIDE PANEL*, see procedure in this subsection.

All Models

5. Remove front bumper retaining bolts and nuts.



TYPICAL
1. Retaining nuts

6. Remove front bumper from vehicle by moving it forward.

Front Bumper Installation

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

Torque front bumper nuts to 10 N•m (89 lbf•**in**).

FRONT BOTTOM PAN

The front bottom pan is a four-piece design.

PARTS	FASTENING METHOD
Upper front bottom pan (RH and LH)	Fastened using Torx screws
Lower front bottom pan (RH and LH)	Riveted to the chassis

Front Bottom Pan Removal

1. Remove *SIDE PANELS*, see procedure in this subsection.
2. Remove *HOOD*, see procedure in this subsection.

All Models Except 550F

3. Remove the *SECONDARY AIR INTAKE SILENCER*.
4. Detach front radiator from frame and move it rearward. Refer to *COOLING SYSTEM* subsection.

600 HO E-TEC Models

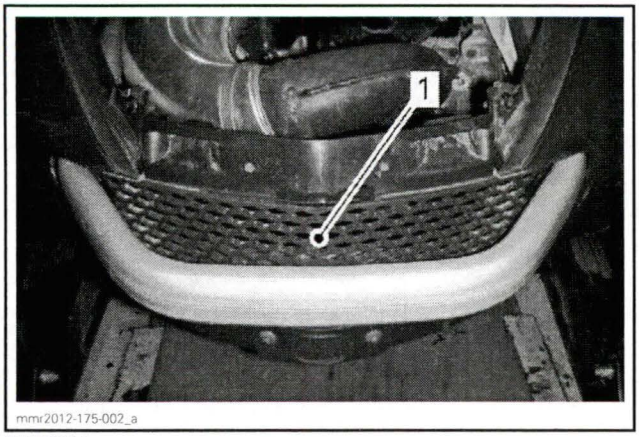
5. Remove tuned pipe. Refer to *EXHAUST SYSTEM* subsection.

600 ACE

6. Remove exhaust pipe. Refer to *EXHAUST SYSTEM* subsection.

All Models

7. Remove bottom pan grille.



TYPICAL
1. Bottom pan grille

8. Remove Torx screws securing upper front bottom pans, then remove them from the vehicle.
9. Hoist front of vehicle.
10. Remove both skis. Refer to *STEERING SYSTEM* subsection.
11. Using an angle drill and a SUPERTANIUM DRILL BIT 3/16" (P/N 529 031 800), remove all rivets retaining lower front bottom pans.

NOTE: Refer to *FRAME* for proper procedure when drilling rivets retaining plastic.

12. Remove lower front bottom pans.

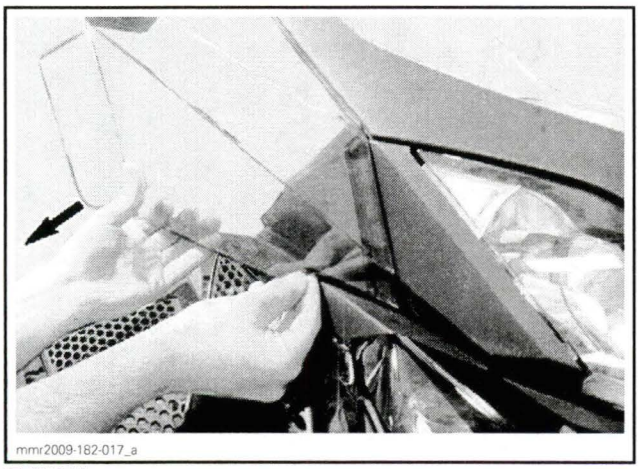
Front Bottom Pan Installation

The installation is the reverse of removal procedure.

WINDSHIELD

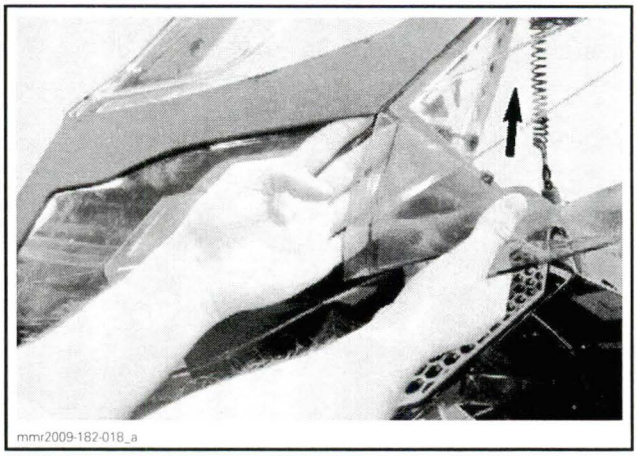
Windshield Removal

1. Detach windshield sides by pulling them toward the outside.



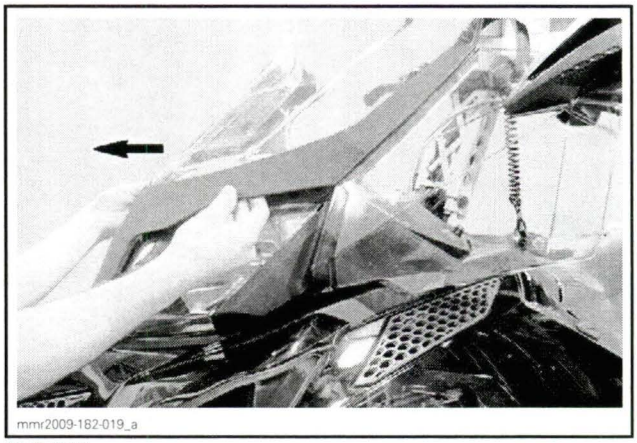
TYPICAL

2. Push windshield upwards.



TYPICAL

3. Remove windshield from vehicle by pulling it toward the front.



TYPICAL

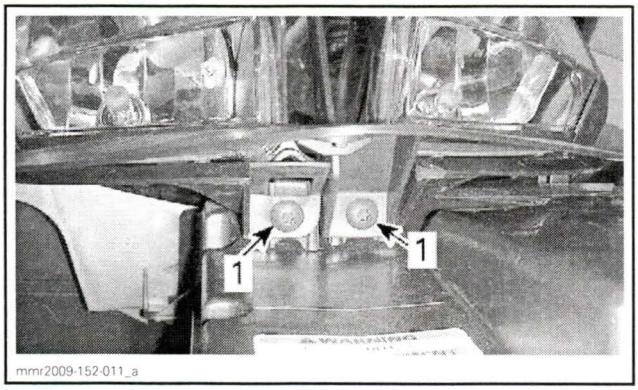
Windshield Installation

The installation is the reverse of removal procedure.

HEADLIGHT/GAUGE MODULE

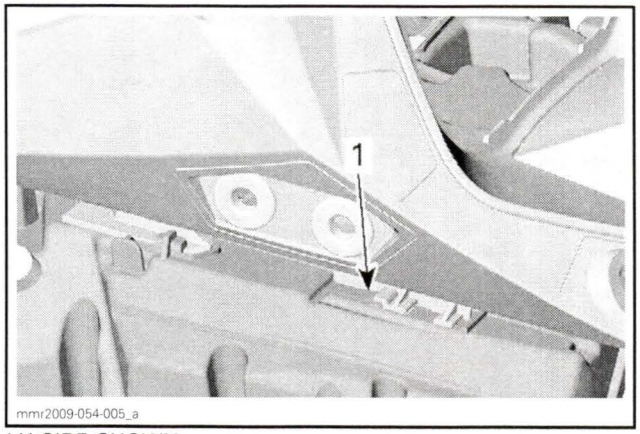
Headlight/Gauge Module Removal

1. Remove the secondary air intake silencer and headlight/gauge module as a unit, refer to *AIR INTAKE SYSTEM* subsection.
2. Remove both screws securing front of headlight/gauge module to secondary air intake silencer.

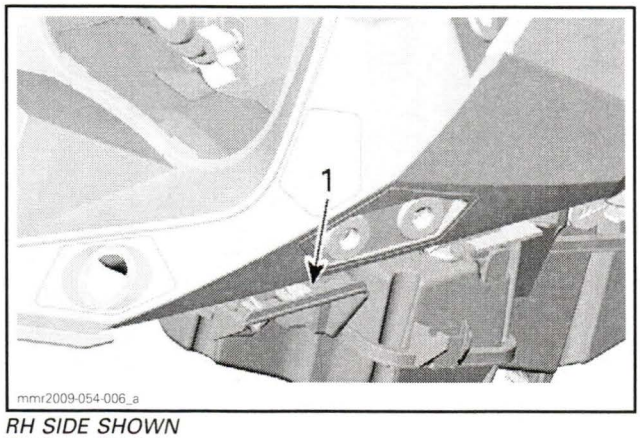


1. Front retaining screws

3. On LH and RH sides of headlight/gauge module, press and hold the tabs securing headlight/gauge module to secondary air intake silencer.



LH SIDE SHOWN
1. Press this tab



RH SIDE SHOWN
1. Press this tab

4. Slide the headlight/gauge module then lift its rear portion to separate it from secondary air intake silencer.

Headlight/Gauge Module Installation

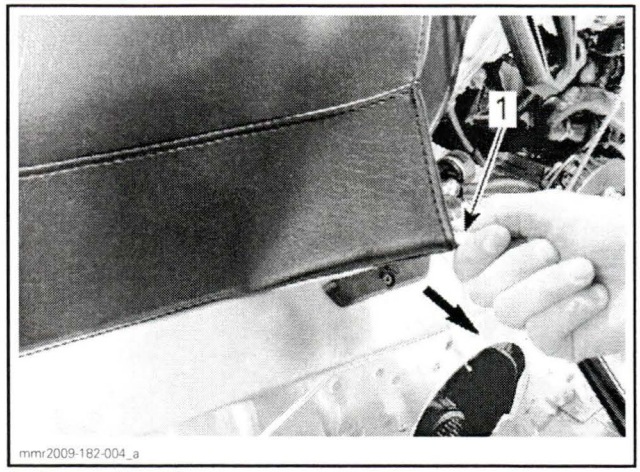
The installation is the reverse of the removal procedure. However, pay attention to the following.

Check headlight beam aiming, refer to *LIGHTS, GAUGE AND ACCESSORIES* subsection.

CONSOLE

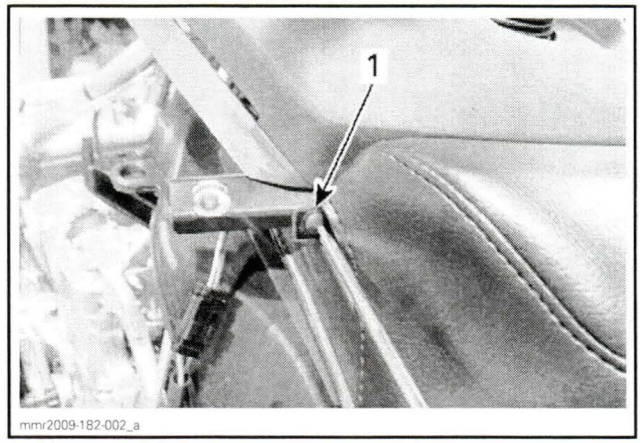
Console Removal

1. Detach the front part of seat cover from tunnel as follows:
   1.1 Pull lower side strip downward.
   1.2 Pull lower side strip toward the outside.



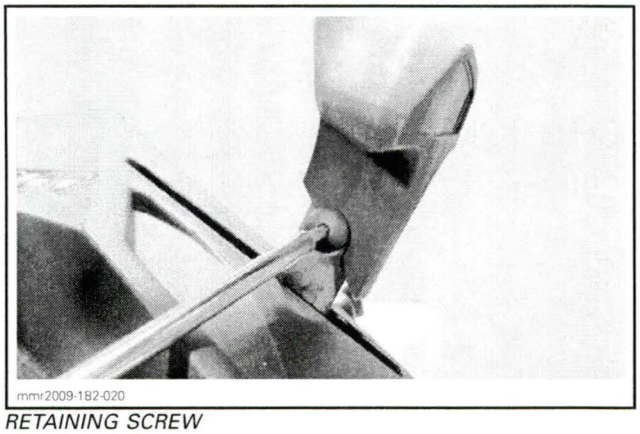
1. Lower side strip

2. Remove upper retaining screws from operator seat.



1. Upper retaining screw

3. Remove shift lever knob by unscrewing retaining screw.



RETAINING SCREW

4. Remove fuel tank cap.
5. Remove console from vehicle.
6. Install fuel tank cap.

Console Installation

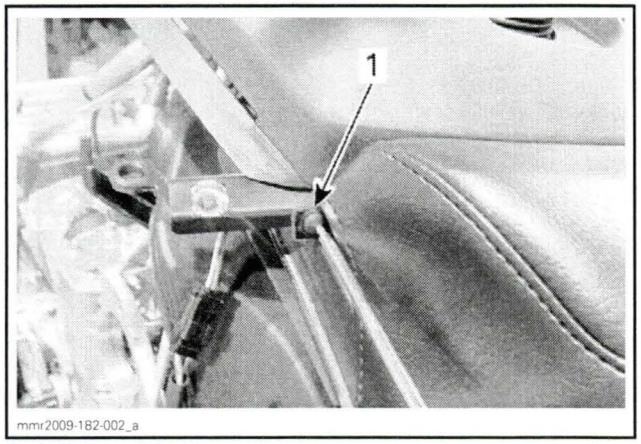
The installation is the reverse of removal procedure, however pay attention to the following.

Torque shift lever knob screw to 4 N•m (35 lbf•**in**).

OPERATOR SEAT

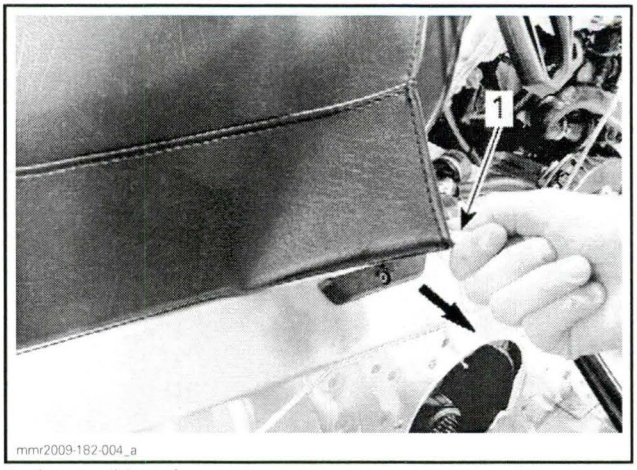
Operator Seat Removal

1. Remove *PASSENGER SEAT*, see procedure in this subsection.
2. Remove *STORAGE COMPARTMENT*, see procedure in this subsection.
3. Remove upper retaining screws.



1. Upper retaining screw

4. Detach seat cover from tunnel as follows:
   4.1 Pull lower side strip downward.
   4.2 Pull lower side strip toward the outside.



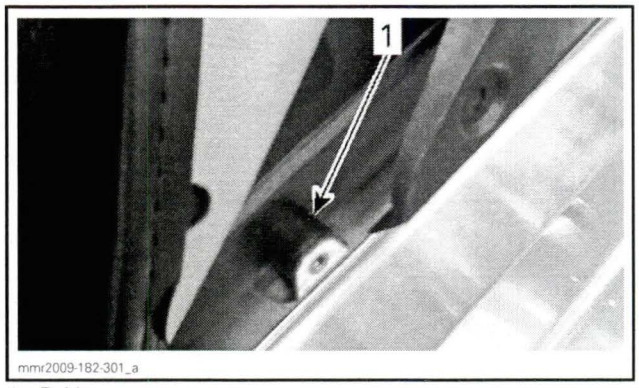
1. Lower side strip

5. Remove seat cover and foam from vehicle.

Operator Seat Installation

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

Properly install rubber spacers before tightening the side retaining screws for the storage compartment.



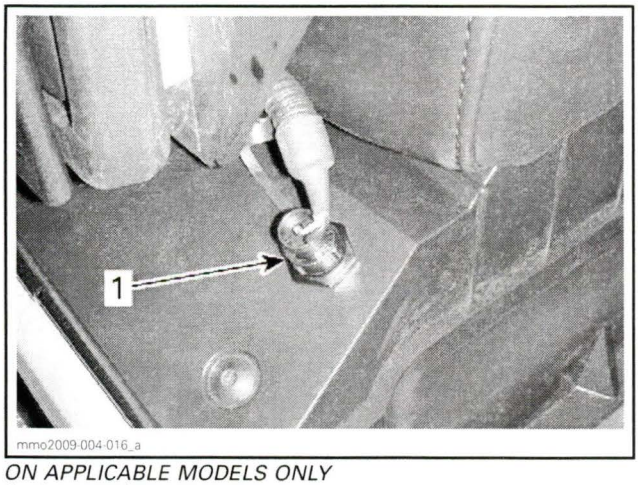
1. Rubber spacer

PASSENGER SEAT

Passenger Seat Removal

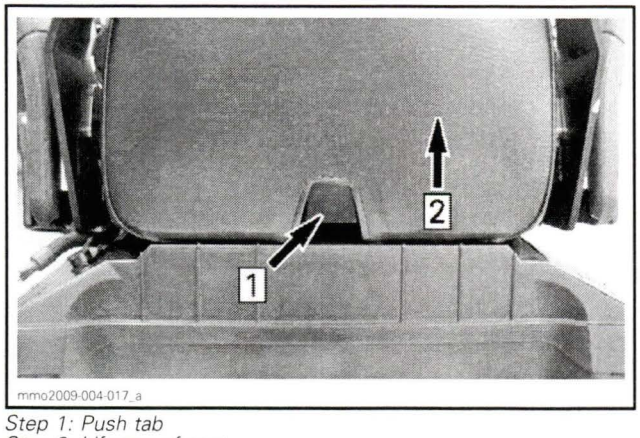
1. On applicable models:
   - Disconnect the accessories connector by turning the plastic housing counterclockwise.
   - Install the rubber plug on the connector.

NOTE: The connector is located on the LH side of the storage compartment.



ON APPLICABLE MODELS ONLY
1. Accessories connector

2. Push the latch tab in and lift-up the rear of seat.

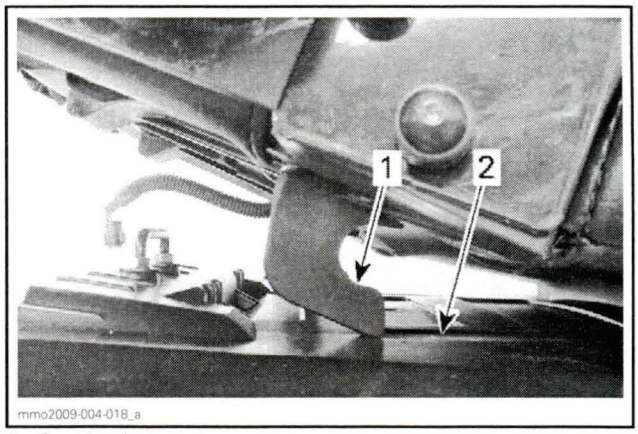


Step 1: Push tab
Step 2: Lift rear of seat

3. Slide seat rearward and set aside.

Passenger Seat Installation

1. Place the passenger seat facing forward on the storage compartment lid.
2. Slightly incline the passenger seat towards front and engage both seat hooks in the storage compartment lid slots.



1. Seat hook
2. Slot

3. Push the passenger seat towards the operator seat and firmly push the rear portion down to lock the passenger seat in position.

NOTE: A distinctive snap will be felt. Double check that the seat is secure by giving it a tug to confirm proper latching.

⚠ WARNING

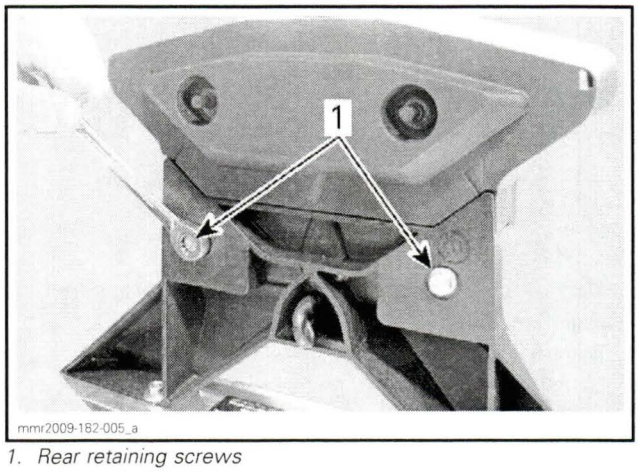
Make sure seat is securely latched before riding.

4. On applicable models, connect the accessories connector.

REAR BUMPER

Rear Bumper Removal

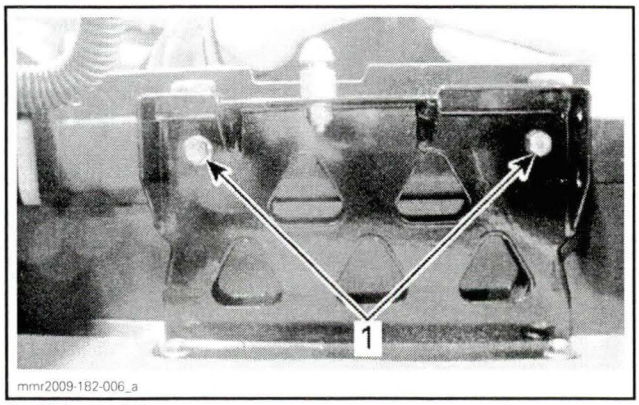
1. Remove *PASSENGER SEAT*, see procedure in this subsection.
2. Remove rear retaining screws from taillight support.



1. Rear retaining screws

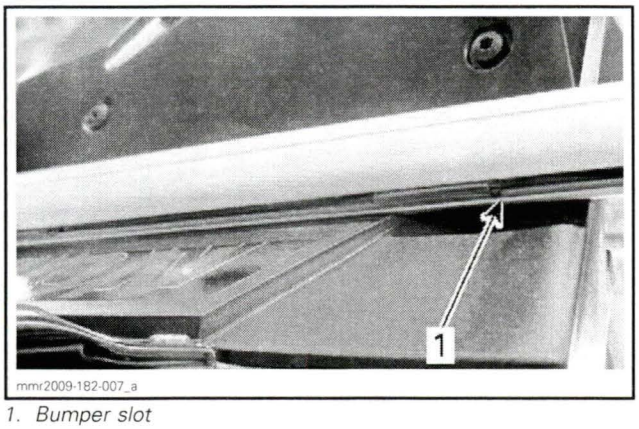
3. Open storage compartment.

4. Remove side retaining screws from storage compartment support.



1. Side retaining screws

5. From underneath bumper, remove taillight harness from bumper slot.



1. Bumper slot

6. Remove rear bumper from vehicle.

Rear Bumper Installation

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

Apply LOCTITE 243 (BLUE) (P/N 293 800 060) on bumper screws threads before reinstallation.

Torque bumper screws to 10 N•m (89 lbf•**in**).

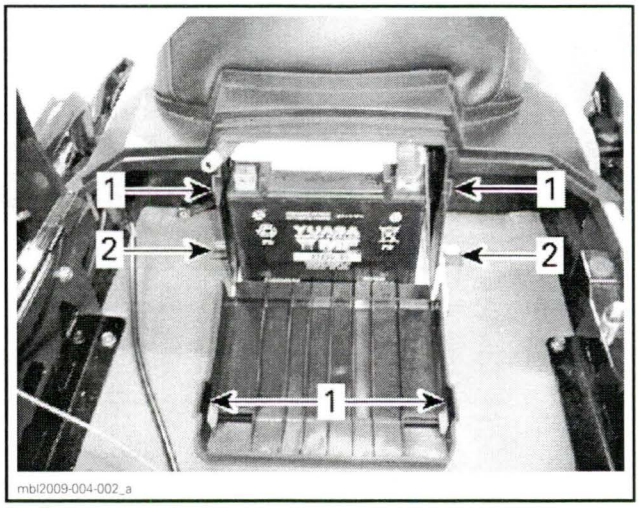
STORAGE COMPARTMENT

Storage Compartment Removal

⚠ WARNING

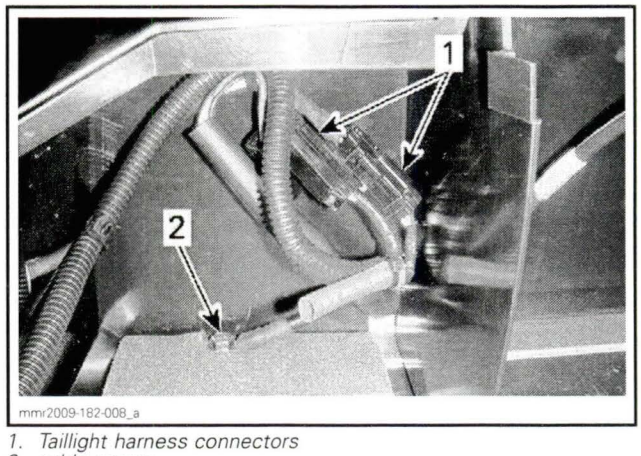
Battery BLACK negative (-) cable must always be disconnected first and connected last.

1. Remove *REAR BUMPER*, see procedure in this subsection.
2. Open battery cover.
3. Disconnect BLACK negative (-) cable from battery.
4. Disconnect RED positive (+) cable from battery.
5. Remove screws securing metal support.



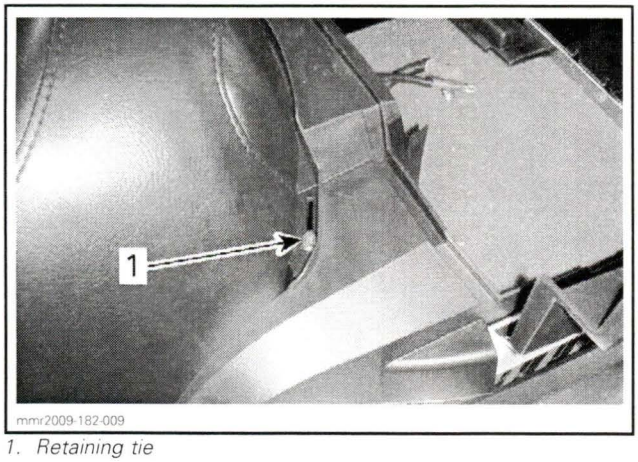
1. Battery cover latches
2. Screws from metal support

6. Remove metal support and battery from vehicle.
7. Disconnect taillight harness connectors.
8. Remove screw securing BLACK negative (-) cable on frame.



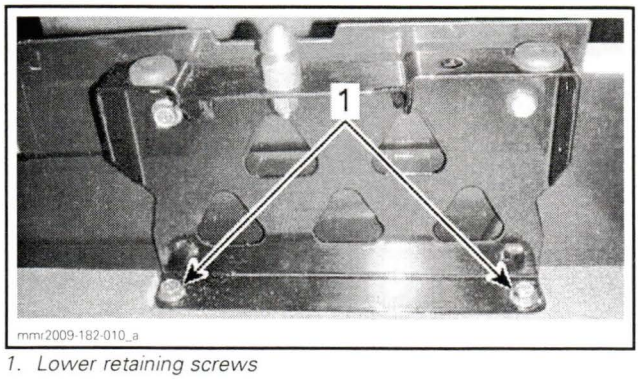
1. Taillight harness connectors
2. cable screw

9. Remove retaining tie that holds taillight harness.



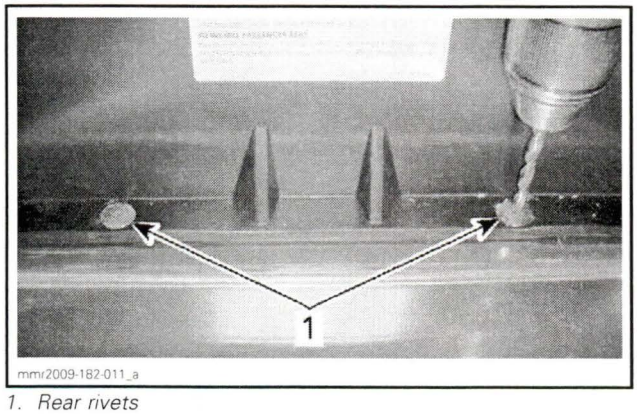
1. Retaining tie

10. Remove lower retaining screws from storage compartment support.



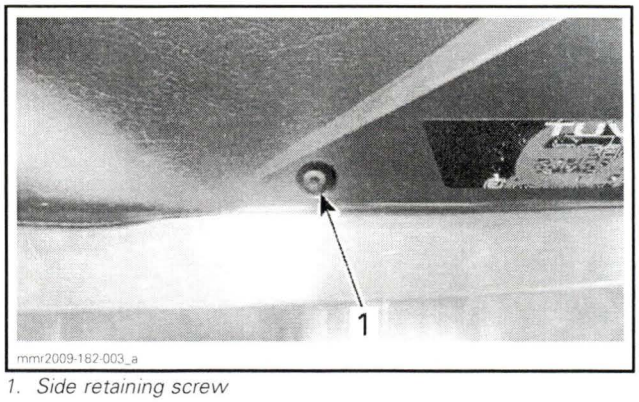
1. Lower retaining screws

11. Remove rear rivets by drilling them.



1. Rear rivets

12. Remove side retaining screws.



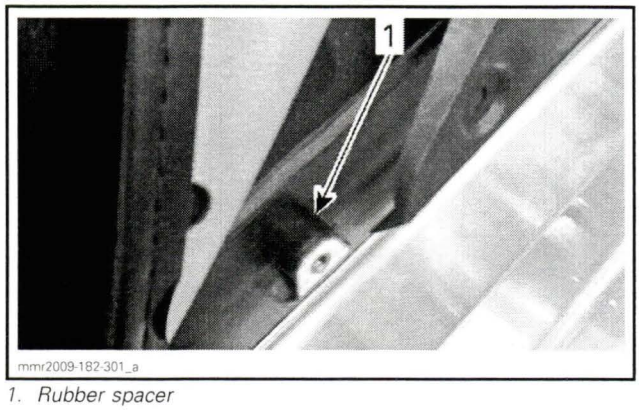
1. Side retaining screw

13. Remove storage compartment from vehicle.

Storage Compartment Installation

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

Properly install rubber spacers before tightening side retaining screws.



1. Rubber spacer

Torque side retaining screws to 3 N•m (27 lbf•**in**).

FRAME

SERVICE TOOLS

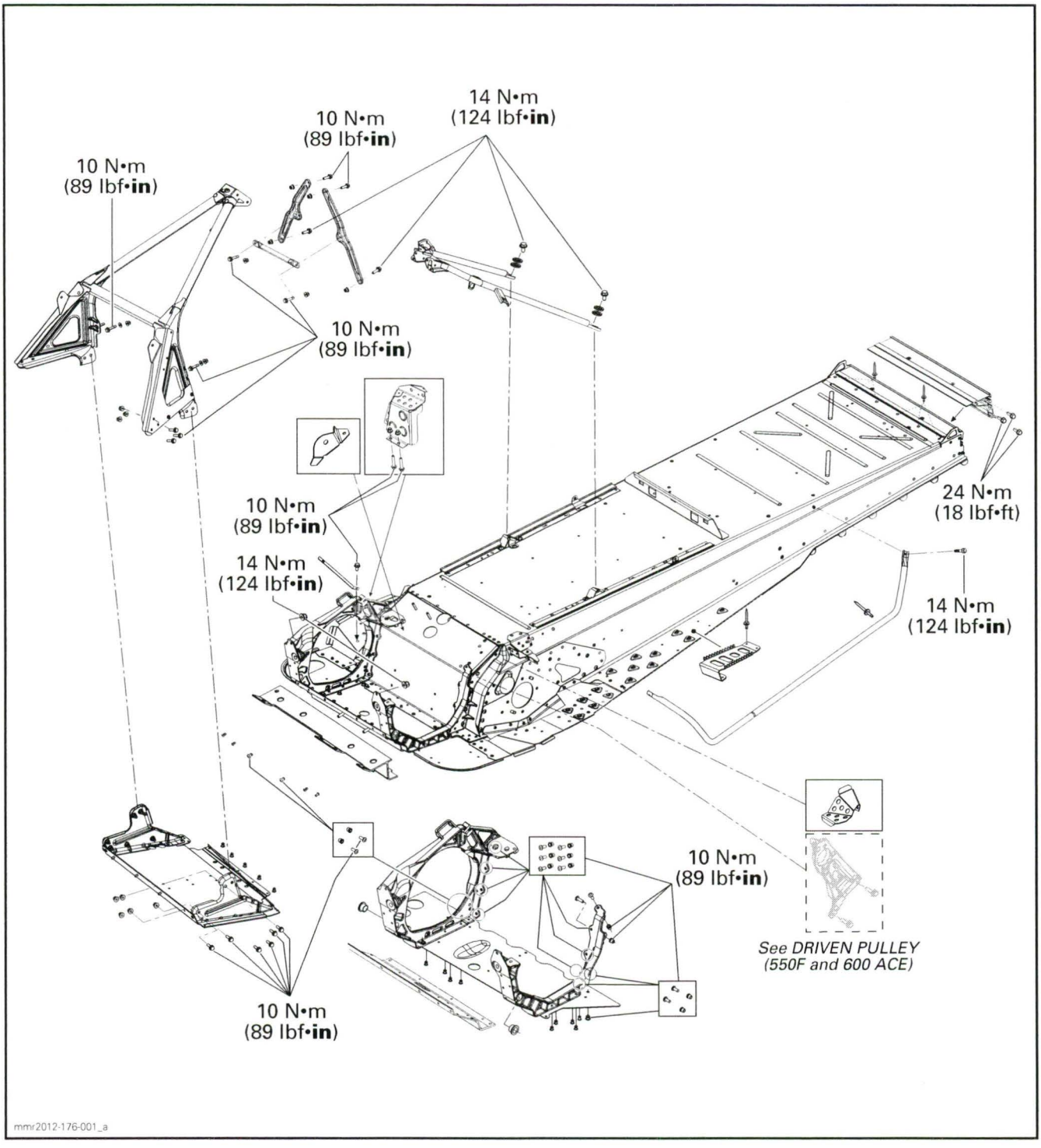
Description	Part Number	Page
SUPERTANIUM DRILL BIT 3/16"	529 031 800	837

SERVICE PRODUCTS

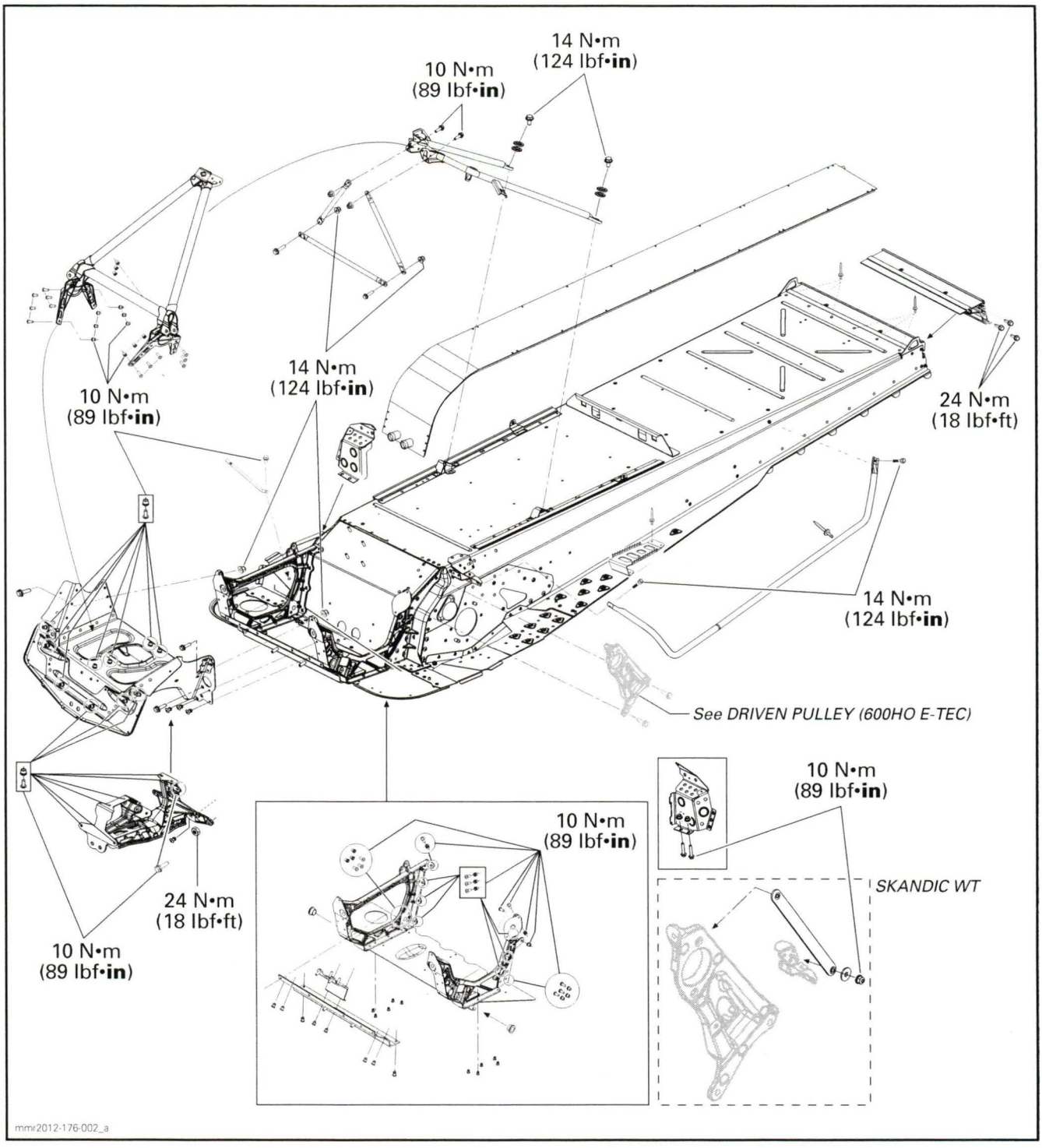
Description	Part Number	Page
XPS SYNTHETIC CHAINCASE OIL	413 803 300	837

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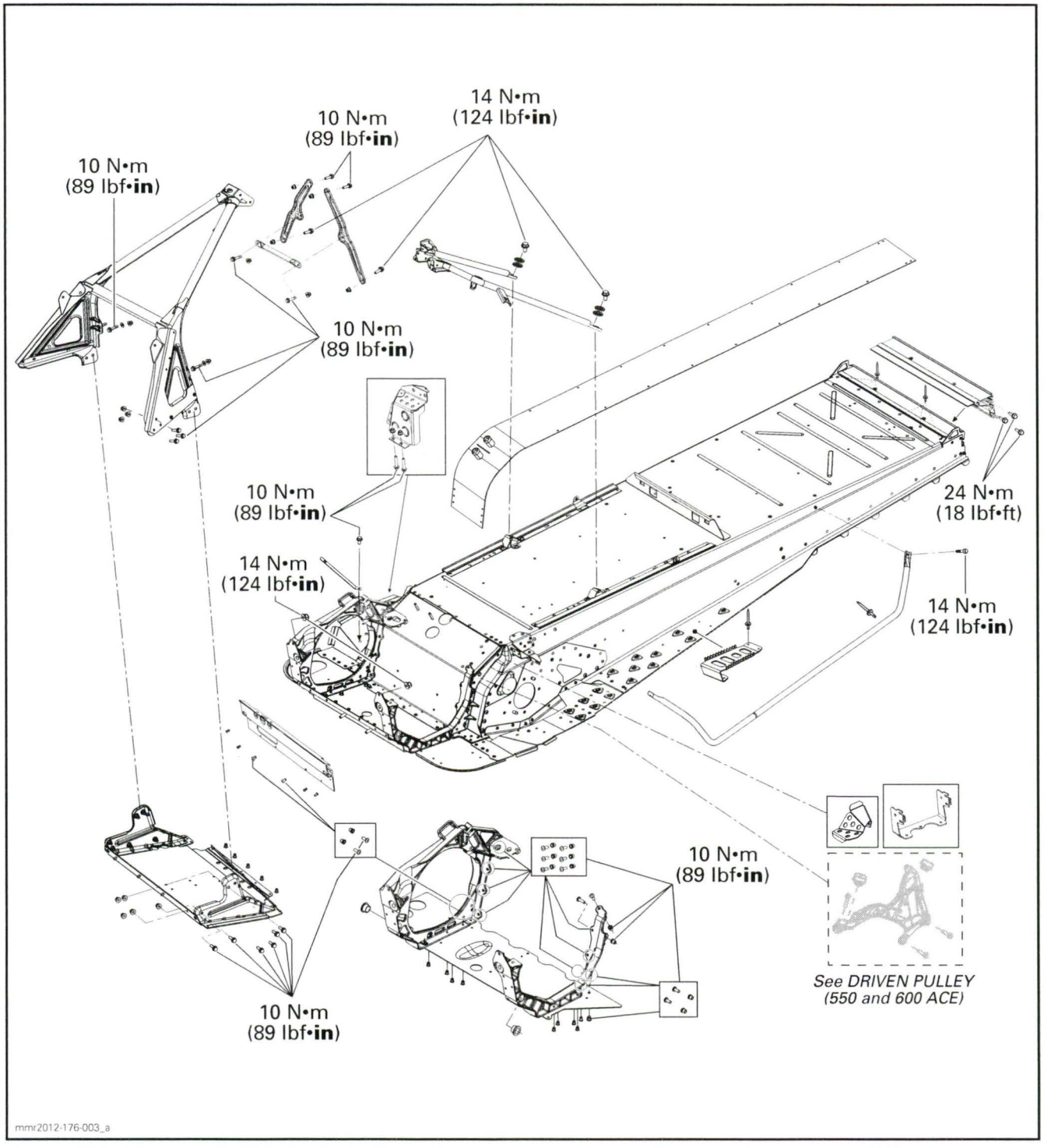
Skandic WT 550F



Skandic WT/Skandic SWT 600 HO E-TEC



Skandic WT/ Skandic SWT 600 ACE



PROCEDURES

RIVETS

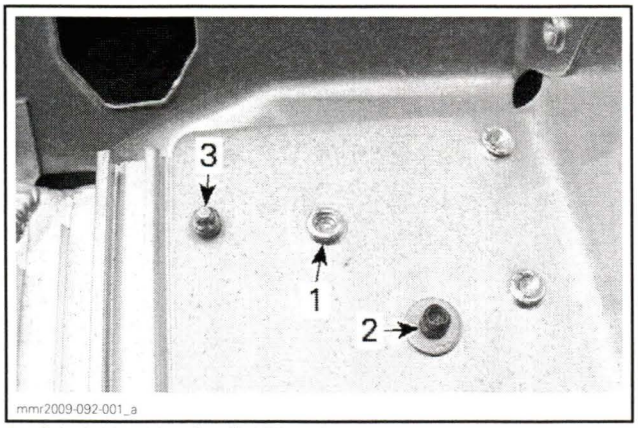
For proper drilling instructions and to prevent premature wear, follow the procedures as detailed.

NOTICE When removing rivets, be careful not to enlarge or deform the rivet holes in the frame.

Self-Percing Rivet Removal

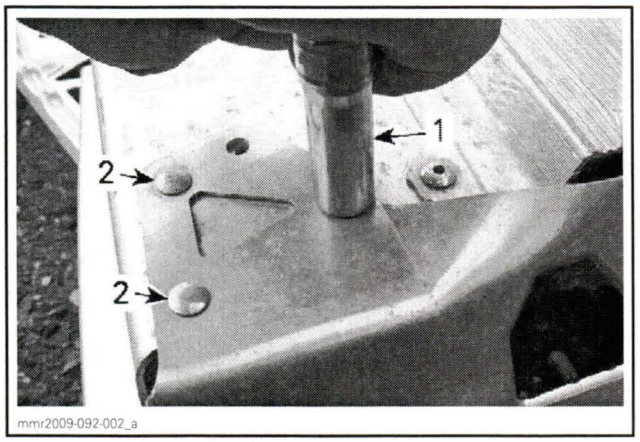
Recommended Method

1. Using a grinding disk, grind the rivet end.



1. Grind this side of self-drilling rivet
2. Pop rivet
3. STAVEX rivet

2. Support the frame around the rivet head with a socket on the opposite side to avoid warpage.



1. 11 mm socket over a rivet head
2. Rivet heads

3. Drive out remaining rivet using a punch.

Alternative Method

1. Use a SUPERTANIUM DRILL BIT 3/16" (P/N 529 031 800) and a variable speed drill.
2. Partially drill **rivet end — not the rivet head.**

NOTICE High speed drilling will cause excessive heat which may destroy the cutting edge of the bit; therefore, avoid using pneumatic drills.

NOTE: To increase bit life, use XPS SYNTHETIC CHAINCASE OIL (P/N 413 803 300) as a cutting oil.

3. Cut rivet using a chisel.
4. Remove riveted part.
5. Drive out remaining rivet head using a punch.

Pop Rivet Removal

1. Use a SUPERTANIUM DRILL BIT 3/16" (P/N 529 031 800), and a variable speed drill.
2. Drill **rivet head** sufficiently to cut through rivet head.

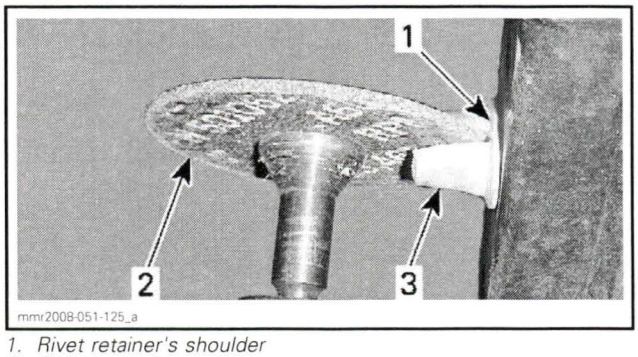
NOTICE Drill only sufficiently to cut rivet head. Do not drill into frame material, or part secured using the rivet. When rivet is used to secure a plastic part, use pliers to avoid rotation of rivet with drill bit and heating or melting of the plastic part.

3. Using a small punch, drive out the remaining rivet end.

HUCK Rivet Removal

Recommended Method

1. Using a cut-off tool, cut the rivet retainer without touching the retainer's shoulder.



1. Rivet retainer's shoulder
2. Cutter wheel
3. Rivet retainer

NOTE: Apply a thin layer of grease on cutter wheel to increase its durability.

2. Break the rivet retainer's shoulder using a chisel.
3. Use a small punch to drive out the rivet stem.

Alternative Method

1. Measure outside diameter of rivet stem and select appropriate drill bit.

2. Drill the **rivet stem — not the rivet head** using a variable speed drill until rivet retainer is freed.

NOTE: When possible, use an angle grinder to grind rivet head or use an air hammer to cut the rivet retainer.

FRAME

Frame Cleaning

Clean frame and tunnel with appropriate cleaners and rinse with high pressure hose.

NOTE: For bare aluminum frames use only aluminum cleaner and follow instructions on container.

NOTICE Never direct high-pressure water jet towards decals. They will peel off.

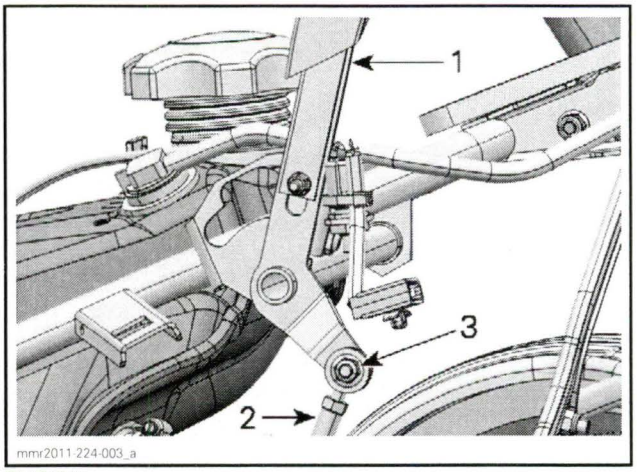
Frame Welding

Repairs using a welding technique should not be carried out on aluminum frame parts unless it is specified on a BRP *BULLETIN*.

REAR FRAME MEMBER

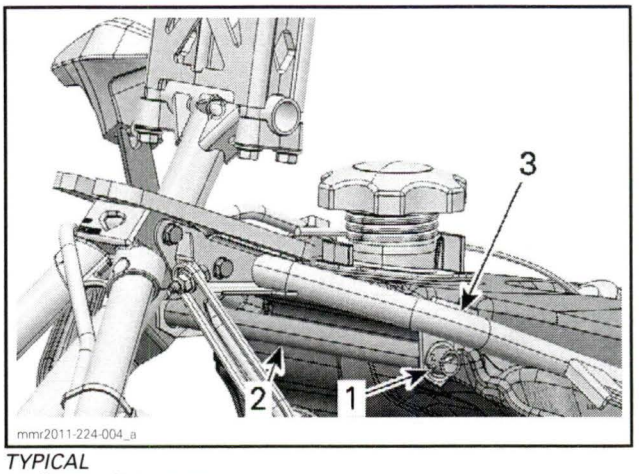
Rear Frame Member Removal

1. Refer to *BODY* subsection and remove the following:
   - Seat(s)
   - LH and RH side panels
   - Hood.
2. Refer to *AIR INTAKE SYSTEM* subsection and remove the headlight/gauge module and air intake silencer as a unit.
3. Remove console panel, refer to *BODY* subsection.
4. Disconnect the shift rod from the shift lever.



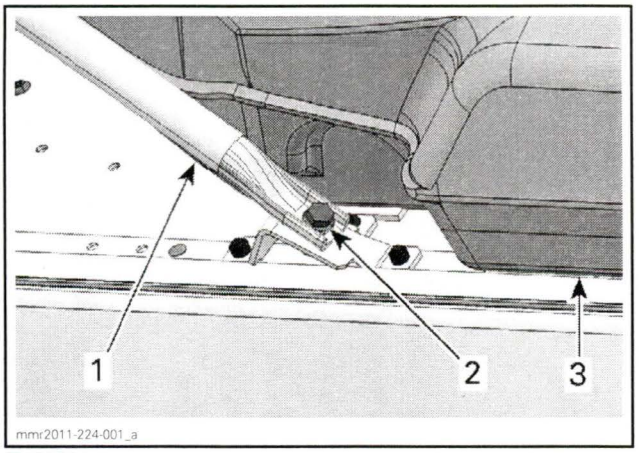
TYPICAL
1. *Shift lever*
2. *Shift rod*
3. *Remove this bolt and nut*

5. Remove the cotter pin that retains the shift lever shaft to the rear frame member and remove the shift lever.



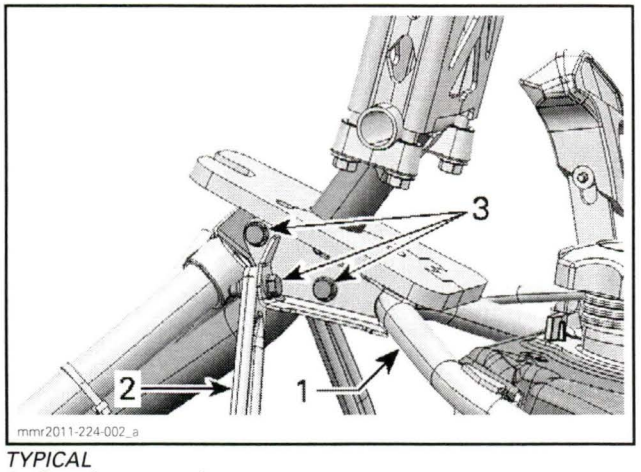
TYPICAL
1. *Cotter pin to remove*
2. *Shift lever shaft*
3. *Rear frame member*

6. Remove bolt and washer securing rear frame member (one each side).



TYPICAL
1. *Rear frame member*
2. *Bolt and washer to remove (each side)*
3. *Fuel tank*

7. Remove bolts securing:
   - Front and rear frame members to the upper steering column support
   - Side frame members to rear frame member.



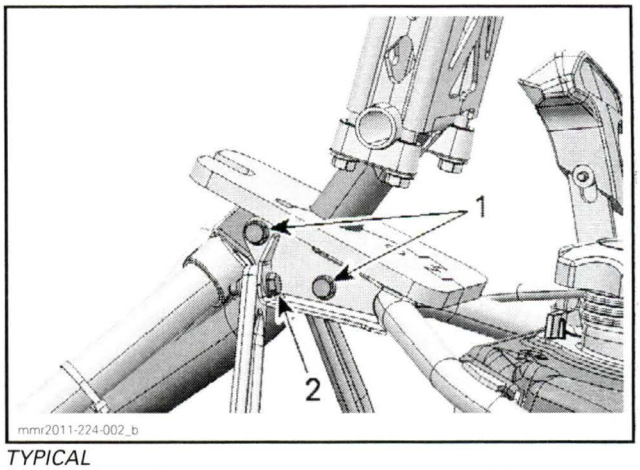
TYPICAL
1. *Rear frame member*
2. *LH side frame member*
3. *Bolts to remove*

8. Remove rear frame member.

Rear Frame Member Installation

Installation is the reverse of the removal procedure.

NOTE: Install all bolts and nuts before tightening them.



TYPICAL
1. *Mounting bolts, upper steering column support (2)*
2. *Side frame member mounting bolt (1 each side)*

TIGHTENING TORQUE	
Upper steering column support screws	18 N•m (159 lbf•**in**)
Side frame member screws	14 N•m (124 lbf•**in**)
Aft rear frame member screws	

FRONT FRAME MEMBER

Front Frame Member Removal

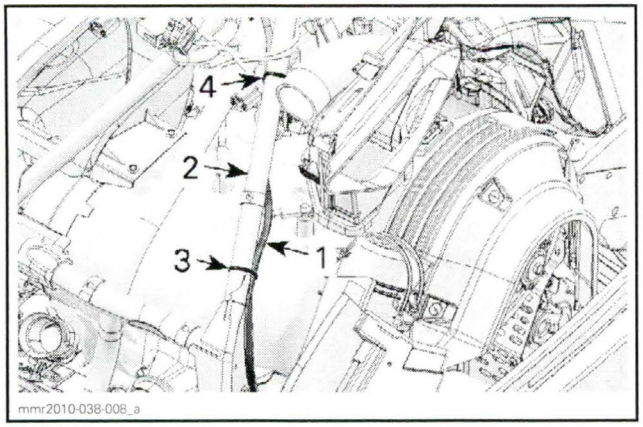
1. Refer to *BODY* subsection and remove the following parts.
   - Hood
   - Upper side panels (both sides)
   - Console.
2. Refer to *AIR INTAKE SYSTEM* subsection and remove the secondary air intake silencer and headlight/gauge module as a unit.

600 HO E-TEC Models

3. Refer to *EXHAUST SYSTEM* subsection and remove the tuned pipe.
4. Refer to *COOLING SYSTEM* subsection and remove the air cooled radiator.

All Models

5. Cut locking ties securing the fuel tank vent hose to the front frame member.

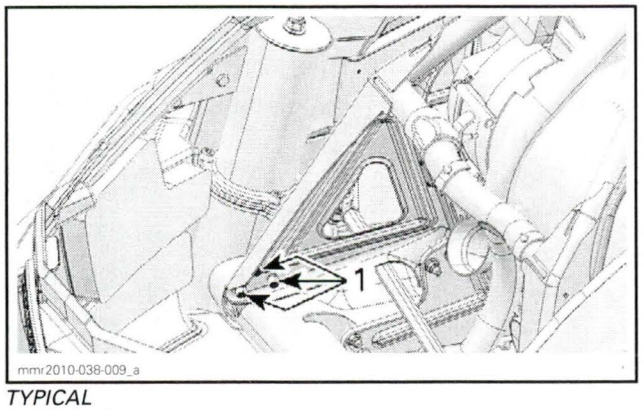


TYPICAL
1. *Fuel tank vent hose*
2. *Front frame member*
3. *Locking tie*
4. *Locking tie*

6. Place a wooden block of sufficient height under the engine module to support the weight of the engine and front suspension module.

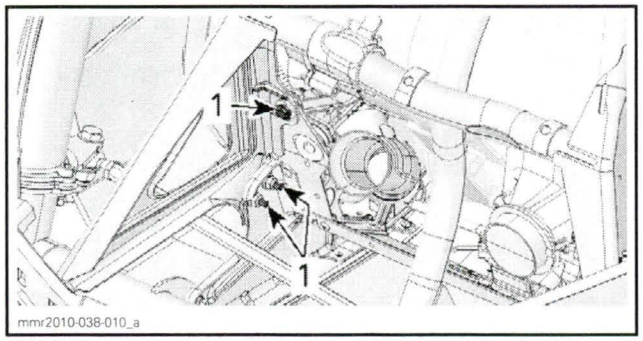
NOTE: The skis should not be lifted off the ground.

7. Remove bolts (3 on each side) securing the front frame member to the LTS module.



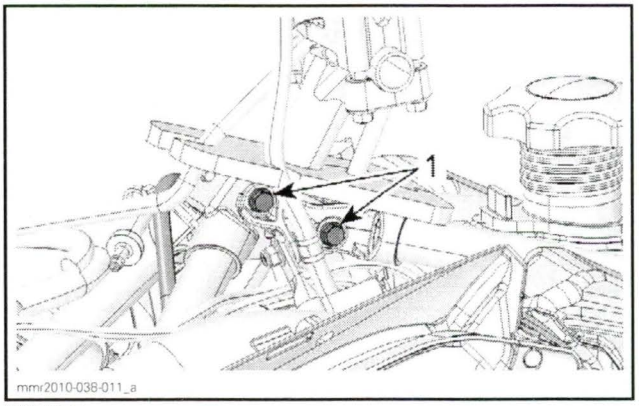
TYPICAL
1. *Huck rivets*

8. Remove bolts (3 on each side) retaining the front frame member to the front cross member and engine member.



TYPICAL
1. *Retaining bolts to remove*

9. Remove bolts securing front frame member and rear frame member at the steering column support.



TYPICAL
1. *Upper retaining bolts to remove*

10. Remove the front frame member from vehicle.

Front Frame Member Installation

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

600 HO E-TEC Models

1. Refer to *COOLING SYSTEM* subsection and install the air cooled radiator as specified.

All Models

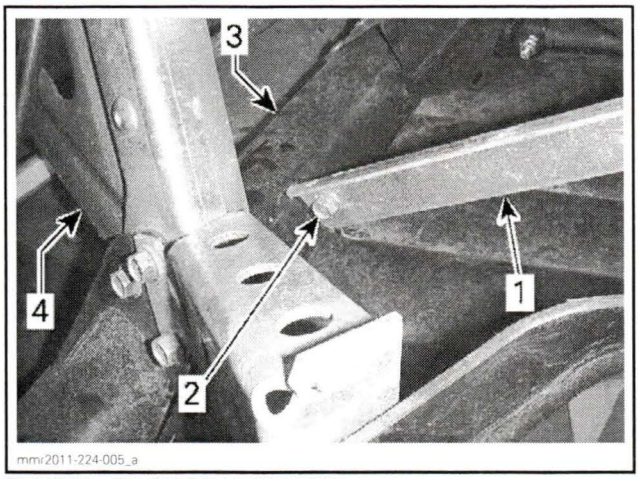
2. Secure the fuel tank vent hose to the front frame member using new locking ties.
3. Install all body parts as specified in the *BODY* subsection.

FRONT SUSPENSION MODULE

Front Suspension Module Removal

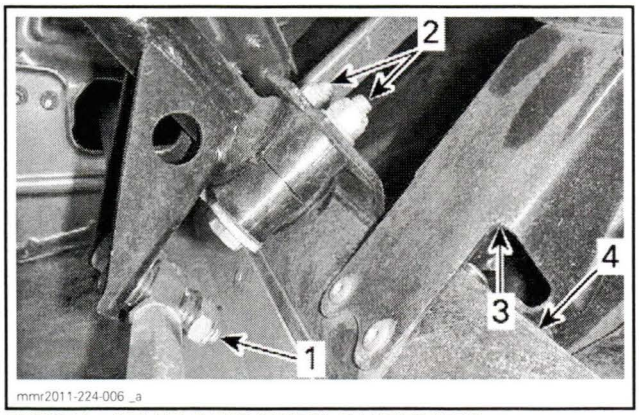
1. Refer to *BODY* subsection and remove the following:
   - Hood
   - Upper and lower side panels.
2. Refer to *INTAKE SYSTEM* subsection and remove the secondary air intake silencer and headlight/gauge module as a unit.
3. Remove the muffler and exhaust pipe(s), or tuned pipe as applicable. Refer to *EXHAUST SYSTEM* subsection.
4. Refer to *BODY* subsection and remove the upper and lower front bottom pans.
5. With the skis hoisted off the ground, place a wooden box under the engine module to support it securely and disconnect the hoist.

6. Disconnect the lower front bumper braces from the LTS.



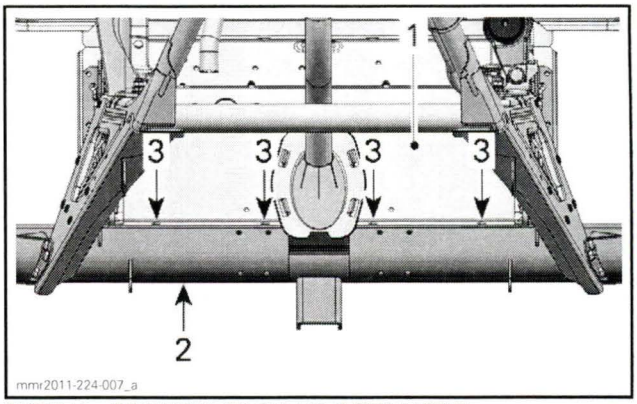
TYPICAL - RH SIDE ILLUSTRATED
1. *Lower front bumper brace*
2. *Bolt to remove*
3. *LTS center tube*
4. *RH front frame member*

7. Completely remove both tie rods.
8. Remove lower steering mounting bolts.



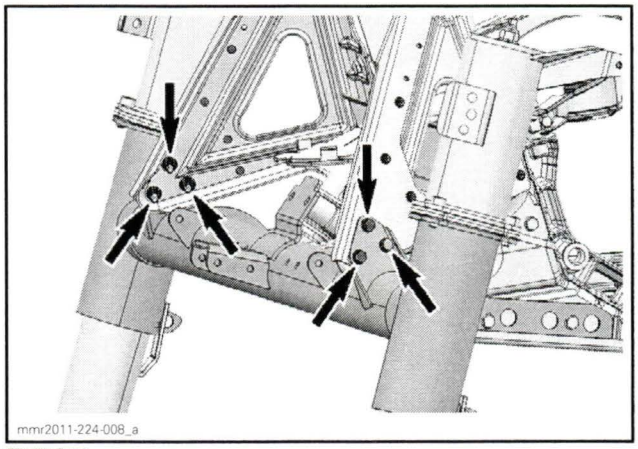
TYPICAL - 600 HO E-TEC MODEL ILLUSTRATED
1. *Inner tie-rod end bolt*
2. *Lower steering mounting bolts*
3. *Tuned pipe mount*
4. *LTS center tube*

9. Remove rivets that secure the aluminum front bottom plate to the LTS using the appropriate procedure explained in the beginning of this subsection.



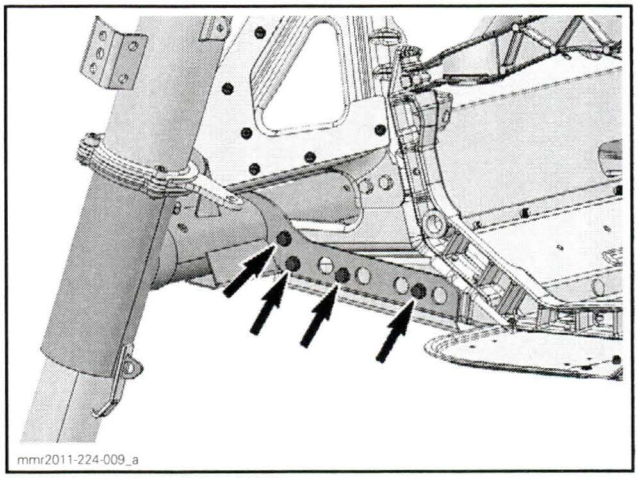
TYPICAL - TOP VIEW OF 600 HO E-TEC MODEL
1. *Front bottom plate*
2. *LTS center tube*
3. *Rivets to remove*

10. Remove the bolts (3 each side) that secure the LTS to the lower portion of the front frame member.



TYPICAL

11. Remove the bolts (4 each side) that secure the LTS to sides of the front bottom plate reenforcements.



TYPICAL - LEFT SIDE VIEW

12. Pull LTS from the front bottom plate.

Front Suspension Module Installation

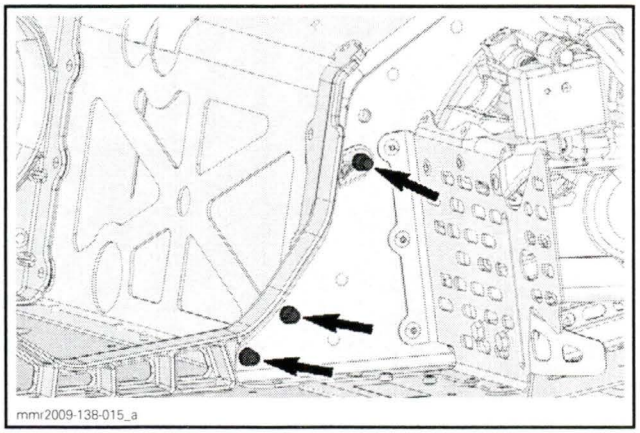
The installation is the reverse of the removal procedure. However, pay attention to the following.

1. Replace all removed elastic nuts with new ones.
2. Reinstall all removed parts by using the applicable installation procedure.

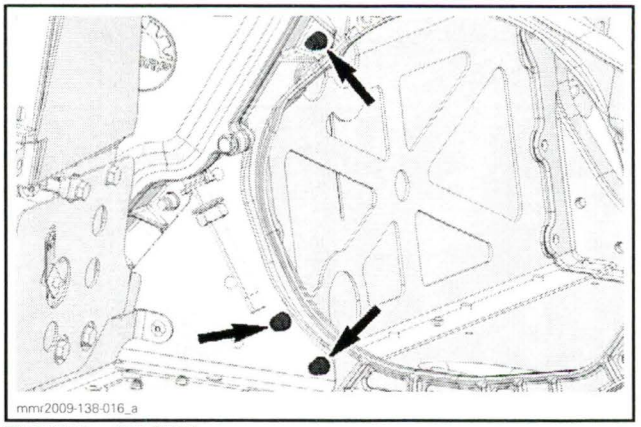
ENGINE MODULE

Engine Module Removal

1. Refer to *ENGINE REMOVAL AND INSTALLATION* subsection and remove the following:
   - Engine
   - RH rear engine mount.
2. Remove track, refer to *TRACK* subsection.
3. Remove the *FRONT SUSPENSION MODULE*, see procedure in this subsection.
4. From underneath tunnel, remove HUCK rivets securing LH and RH frame members, refer to *HUCK RIVET REMOVAL* procedure at the beginning of this subsection.
5. Remove rivets that secure the engine module to the frame as applicable to model.
6. Remove rivets located on both sides of frame.

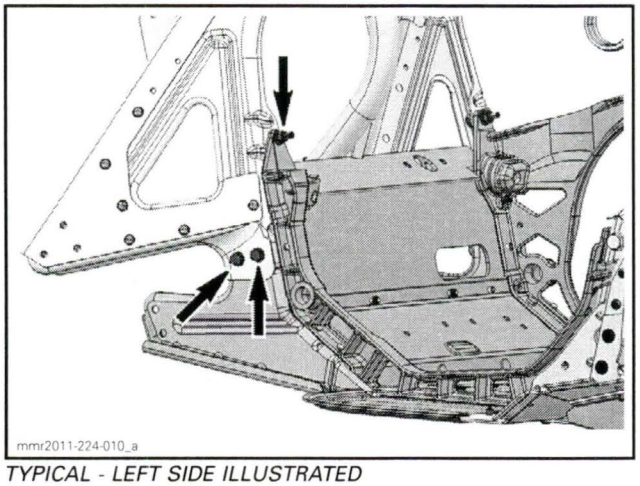


TYPICAL - LH SIDE



TYPICAL - RH SIDE

7. Remove bolts (3 each side) that secure front frame member to engine module.



TYPICAL - LEFT SIDE ILLUSTRATED

8. Remove the engine module.

Engine Module Installation

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

1. Replace rivets that secured the engine module to the frame with the following parts.

NEW FASTENERS	
Hexagonal flanged bolt M6 x 20	(P/N 207 662 044)
Hexagonal flanged elastic stop nut M6	(P/N 233 261 414)
TORQUE	
10 N•m (89 lbf•**in**)	

NOTE: Unless otherwise stated, install bolt heads toward outside of the vehicle.

2. Reinstall all removed parts by using the applicable installation procedure.

SKANDIC WT (550F)

ENGINE			
Engine type			552, Fan cooled (axial fan), cylinder reed porting
Number of cylinders			2
Bore		Standard	76.01 mm (2.993 in)
		1st oversize	76.26 mm (3.002 in)
		2nd oversize	76.51 mm (3.012 in)
Stroke			61.00 mm (2.402 in)
Displacement			553.40 cm^3 (33.77 in^3)
Compression ratio			9.66 ± 0.54
Maximum power engine speed			6800 ± 100 RPM
Combustion chamber volume			30.98 to 33.58 cc
Piston ring type		1st	Semi-trapezoidal
		2nd	Rectangular
Ring end gap		New	0.400 mm to 0.55 mm (.016 in to .022 in)
		Wear limit	1.0 mm (.039 in)
Ring/piston groove clearance		New	0.037 mm to 0.077 mm (.0015 in to .003 in)
		Wear limit	0.200 mm (.0079 in)
Piston/cylinder wall clearance		New	0.157 mm ± 0.026 mm (.0062 in ± .001 in)
		Wear limit	0.200 mm (.0079 in)
Piston skirt wear		Wear limit	0.150 mm (.006 in)
Cylinder head warpage		Wear limit	0.150 mm (.006 in)
Cylinder taper		New (max.)	0.050 mm (.002 in)
		Wear limit	0.100 mm (.0039 in)
Cylinder out of round		New (max.)	0.010 mm (.0004 in)
		Wear limit	0.080 mm (.0031 in)
Maximum crankshaft end play		New (max.)	0.300 mm (.0118 in)
Crankshaft deflection	Maximum	PTO	0.060 mm (.0024 in)
		Center	0.080 mm (.0031 in)
		MAG	0.030 mm (.0012 in)
Connecting rod big end axial play		New	0.170 mm to 0.530 mm (.0067 in to .0209 in)
		Wear limit	1.200 mm (.0472 in)
AXIAL FAN			
Axial fan belt adjustment		Drive belt deflection	9.5 mm ± 1.5 mm (.374 in ± .059 in)
		Force	5.0 kgf (11 lbf)
LUBRICATION SYSTEM			
Injection oil		Type	XPS MINERAL INJECTION OIL (P/N 413 802 900)
		Quantity	3.7 L (125 U.S. oz)

FUEL SYSTEM		
Carburetor type		VM30
Main jet	MAG	190
	PTO	200
Needle jet		P-8
Pilot jet		35
Jet needle identification		6BFY46
Jet needle clip position	MAG	3
	PTO	4
Slide valve cut-away		2.5
Idle throttle valve height		1.6 mm ± 0.1 mm (.063 in ± .004 in)
Float level		23.9 mm ± 1 mm (.941 in ± .039 in)
Air screw adjustment	MAG	1.25 (reference only)
	PTO	1.00 (reference only)
Idle speed		1650 ± 200 RPM
Gas type		Unleaded
Minimum octane rating	Inside North America ((R+M)/2)	87
	Outside North America (RON)	92
Fuel tank capacity		40 L (10.57 U.S. gal.)
ELECTRICAL SYSTEM		
Magneto generator output		340 W @ 6000 RPM
Ignition type		CDI
Spark plug	Make and type	NGK BR9ECS[2]
	Gap	0.45 mm ± 0.05 mm (.018 in ± .002 in)
Ignition timing BTDC		2.77 mm ± 0.05 mm (.109 in ± .002 in) @ 3500 RPM
Trigger coils		160 to 180 Ω
Magneto stator windings	Ignition	6.3 to 7.7 Ω
	Charging/lighting	0.145 to 0.175 Ω
Ignition coil (integrated in ECM)	Primary	N.A.
	Secondary	900 to 1100 Ω (without spark plug wires)
Battery (if applicable)		12 V, 18 A•h
Headlamp		60/55 W (H4)
Taillight and stoplight		5/21 W
Fuse	Starter solenoid	30 A (if applicable)

DRIVE SYSTEM		
Chaincase oil	Type	XPS SYNTHETIC CHAINCASE OIL (P/N 413 803 300)
	Quantity	700 ml (24 U.S. oz)
Gear ratio	1st	3.86 : 1
	2nd	2.30 : 1
	R	4.06 : 1
Drive pulley type		eDrive
Drive pulley calibration	Clutch engagement	2600 ± 100 RPM
	Spring color	Red/Yellow
	Spring free length	90.4 mm (3.56 in)
	Pin	N/A
	Ramp	700
	Screw position	N/A
Driven pulley	Type	QRS-NTC
	Spring color	White/White
	Cam angle	47° - 44°
Pulley distance	Z	21.10 mm (.831 in)
Offset	X	39.4 mm ± 0.50 mm (1.551 in ± .02 in)
Drive belt	Part number	(P/N 414 860 700)
	Width	35.30 mm (1.39 in)
	Wear limit	32.9 mm (1.295 in)
Drive belt adjustment	Deflection	32 mm ± 0.5 mm (1.26 in ± .02 in)
	Force	11.3 kg (24.9 lb)
Track	Width	508 mm (20 in)
	Length	3923 mm (154 in)
	Profile height	38.1 mm (1.5 in)
Track adjustment	Deflection	40 mm to 50 mm (1.575 in to 1.969 in)
	Force[1]	7.3 kgf (16 lbf)
BRAKE SYSTEM		
Brake pad thickness	Service limit	1 mm (.039 in)
Brake fluid	Type	DOT 4
	Quantity	65 ml (2.2 U.S. oz)
FRONT SUSPENSION		
Suspension type		XU-LTS
Suspension maximum travel		150 mm (6 in)
Shock absorber type		Motion control
REAR SUSPENSION		
Suspension type		SC-5 U
Suspension maximum travel		340 mm (13.4 in)
Shock absorber type	Center	Motion control
	Rear	HPG
Stroke limiter standard position		3

STEERING SYSTEM	
Ski type	Pilot DS
Toe-out	5 mm (.197 in)
Camber	0°
WEIGHT AND DIMENSIONS	
Dry weight	269 kg (593 lb)
Length	324 cm (128 in)
Width	107.6 cm (42.4 in)
Height	133 cm (52.4 in)
Ski stance (carbide to carbide, not adjustable)	90 cm (35.4 in)
Ski width	165 mm (6.5 in)
N.A.: Not Available	

(1) Measure gap between slider shoe and bottom inside track when exerting a downward pull to the track.

(2) **Notice** Do not attempt to adjust gap on this spark plug.

SKANDIC WT/SWT (600 HO E-TEC)

ENGINE			
Engine type			Rotax 593 E-TEC, liquid cooled w/Reed valve, 3D-RAVE
Number of cylinder			2
Bore			72 mm (2.835 in)
Stroke			73 mm (2.874 in)
Displacement			594.4 cm^3 (36.27 in^3)
Compression ratio			12.25 : 1
Maximum power engine speed			8100 ± 100 RPM
3D RAVE spring	Compression spring	Color	Red
		Wire diameter	0.8 mm (.031 in)
		Minimum free length	45 mm (1.772 in)
	Valve springs	Color	Red
		Wire diameter	0.7 mm (.0276 in)
		Minimum free length	35 mm (1.378 in)
Piston ring type			Semi-trapezoidal
Ring end gap		New	0.4 mm to 0.55 mm (.016 in to .022 in)
		Wear limit	1 mm (.039 in)
Ring/piston groove clearance		New	0.05 mm to 0.1 mm (.002 in to .0039 in)
		Wear limit	0.2 mm (.0079 in)
Piston/cylinder wall clearance		New	0.108 mm to 0.152 mm (.0043 in to .006 in)
		Wear limit	0.2 mm (.0079 in)
Piston projection		Minimum	0.9 mm to 1.1 mm (.035 in to .043 in)
		Maximum	1.1 mm (.043 in)
Piston skirt wear		Wear limit	0.15 mm (.006 in)
Cylinder head warpage		Wear limit	0.5 mm (.0197 in)
Cylinder taper		New (max.)	0.05 mm (.002 in)
		Wear limit	0.1 mm (.0039 in)
Cylinder out of round		New (max.)	0.012 mm (.0005 in)
		Wear limit	0.08 mm (.0031 in)
Crankshaft end play		New	MIN.: 0.10 mm (.0039 in) MAX.: 0.30 mm (.0118 in)
Crankshaft deflection		MAX.	MAG: 0.06 mm (.0024 in) CENTER: 0.08 mm (.0031 in) PTO: 0.06 mm (.0024 in)
Connecting rod big end axial play		New	0.28 mm to 0.68 mm (.011 in to .0268 in)
		Wear limit	1.2 mm (.0472 in)

COOLING SYSTEM			
Coolant		Type	Ethyl glycol and distilled water (50%/50%). Use BRP premix coolant (P/N 219 700 362) or coolant specifically formulated for aluminum engines
		Quantity	5 L (1.32 U.S. gal.)
Thermostat opening temperature			37°C (99°F)
Radiator cap opening pressure			90 kPa (13 PSI)
LUBRICATION SYSTEM			
Oil injection pump type			Electronic oil injection pump
Injection oil		Type	XPS synthetic blend 2-stroke oil (P/N 293 600 100)
		Quantity	2.9 L (98 U.S. oz)
FUEL SYSTEM			
Fuel delivery			E-TEC direct injection
Throttle body			Dell'Orto 46 mm
Fuel pump			In-tank electrical fuel pump
Idle speed (not adjustable)			1200 ± 200 RPM
Fuel	Type		Premium unleaded gasoline
	Octane rating	Inside North America ((R+M)/2)	Recommended: 91 Accepted: 87
		Outside North America (RON)	Recommended: 95 Accepted: 92
Fuel tank capacity			45 L (11.9 U.S. gal.)
ELECTRICAL SYSTEM			
Magneto generator output			1200 W
Voltage regulator output			2 x 12V and 1 x 55V
Ignition type			Inductive
Spark plug		Make and type	NGK PZFR6F[2] (engine and spark plug threads are indexed)
		Gap	Not adjustable 0.7 mm to 0.8 mm (.028 in to .031 in)
Ignition timing BTDC @ 3500 ± 500 RPM			28°
			5.38 mm (.212 in)
Crankshaft position sensor (CPS)			190 to 290 Ω
Stator			0.63 ± 0.03 Ω
Battery			12 V, 18 A•h
Headlamp			2 x 60/55 W (H4)
Taillight and stoplight			P 21/5 W
Fuses		F1: Battery	30 A
		F2: Relay 2, start button, gauge	5 A
		F3: Horn (optional)	10 A
		F4: Relay 2 power (cooling fan)	15 A
Relays		Relay 1	Fuse 3, fuse 5, gauge and lighting system
		Relay 2	Cooling fan relay

DRIVE SYSTEM				
Gearbox oil		Type		XPS synthetic chaincase oil (P/N 413 803 300)
		Quantity		700 ml (24 U.S. oz)
Gear ratio		1st		3.86 : 1
		2nd		2.30 : 1
		R		4.06 : 1
Drive pulley type				TRA III
Drive pulley calibration		Clutch engagement		3000 ± 100 RPM
		Spring color		Yellow/Red
		Spring free length		121.1 mm (4.77 in)
		Pin		Solid (long)
		Ramp		600
		Screw position		2
Driven pulley type		Type		QRS-NTC
		Spring color		White/White
		Spring preload	New	8.3 kg ± 0.7 kg (18.3 lb ± 1.5 lb)
			After break-in	7.5 kg ± 0.7 kg (16.5 lb ± 1.5 lb)
		Cam angle		40°
Pulley distance		Z		21 mm (.827 in) (not adjustable)
Offset		X		36.4 mm ± 1.8 mm (1.433 in ± .071 in) (not adjustable)
Drive belt		Width		38.5 mm (1.516 in)
		Wear limit		36.1 mm (1.421 in)
Track	Width	WT		508 mm (20 in)
		SWT		600 mm (24 in)
	Length	WT		3923 mm (154 in)
		SWT		3968 mm (156 in)
	Profile height	WT		38.1 mm (1.5 in)
		SWT		31.8 mm (1.25 in)
Track adjustment		Deflection		40 mm to 50 mm (1.575 in to 1.969 in)
		Force[1]		7.3 kg (16 lb)
BRAKE SYSTEM				
Brake lining minimum thickness				1 mm (.039 in)
Brake disk minimum thickness				4.5 mm (.177 in)
Brake fluid		Type		DOT 4
		Quantity		65 ml (2.2 U.S. oz)

SUSPENSION		
FRONT		
Suspension type		XU-LTS
Suspension maximum travel		150 mm (6 in)
Shock absorber type		Motion control
REAR		
Suspension type		SC-5U
Suspension maximum travel		340 mm (13.4 in)
Shock absorber type	Center	Motion control
	Rear	HPG
STEERING SYSTEM		
Ski type		Pilot DS (SWT with liner)
Toe-out		5 mm (.197 in)
Camber		0°
WEIGHT AND DIMENSIONS		
Dry weight	WT	285 kg (628 lb)
	SWT	303 kg (668 lb)
Length		3 240 mm (127.6 in)
Width		1076 mm (42.4 in)
Height		1 330 mm (52.4 in)
Ski stance (carbide to carbide, not adjustable)		900 mm (35.4 in)
Ski width		165 mm (6.5 in)
Liner width (SWT)		226.06 mm (8.9 in)
MATERIAL		
Frame		Aluminum
Bottom pans, headlight/gauge module and side panels		Polypropylene
Hood and console		Surlyn

(1) Measure gap between slider shoe and bottom inside track when exerting a downward pull to the track.

(2) **Notice** Do not attempt to adjust gap on this spark plug.

SKANDIC WT/SWT (600 ACE)

ENGINE			
Engine type			ROTAX® 600 ACE 4-stroke, Double Over Head Camshaft (DOHC), dry sump, liquid cooled
Number of cylinders			2
Number of valves			8 valves (self adjusting hydraulic valve lifters)
Bore			74 mm (2.91 in)
Stroke			69.7 mm (2.74 in)
Displacement			599.54 cm^3 (36.59 in^3)
Compression ratio			12.0 : 1
Decompressor type			N.A.
Maximum HP RPM			7250 (± 100) RPM
Intake valve opening			3° BTDC
Intake valve closing			37° ABDC
Exhaust valve opening			44° BBDC
Exhaust valve closing			6° ATDC
Valve stem diameter	Intake	New	4.958 mm to 4.972 mm (.1952 in to .1957 in)
		Service limit	4.94 mm (.1945 in)
	Exhaust	New	4.956 mm to 4.970 mm (.1951 in to .1957 in)
		Service limit	4.94 mm (.194 in)
Valve guide diameter		New	5.0 mm to 5.012 mm (.1969 in to .1973 in)
		Service limit	5.05 mm (.1988 in)
Valve spring free length		New	31.35 mm (1.2343 in)
		Service limit	29.50 mm (1.1614 in)
Valve seat contact width	Intake	New	1.05 mm to 1.35 mm (.0413 in to .0531 in)
		Service limit	1.7 mm (.0669 in)
	Exhaust	New	1.25 mm to 1.45 mm (.0492 in to .0571 in)
		Service limit	1.8 mm (.0709 in)
Piston measurement		New	73.95 mm to 73.966 mm (2.9114 in to 2.912 in)
		Service limit	73.92 mm (2.91 in)
Piston/cylinder wall clearance		New	0.037 mm to 0.067 mm (.0015 in to .0026 in)
		Service limit	0.08 mm (.0031 in)
Piston ring type		1st	Upper compression ring, rectangular
		2nd	Lower compression ring, tapered face
		3rd	Oil scraper ring
Ring end gap	Rectangular	New	0.20 mm to 0.35 mm (.0079 in to .0138 in)
		Service limit	1.2 mm (.0472 in)
	Taper-face	New	0.30 mm to 0.50 mm (.0118 in to .0197 in)
		Service limit	1.2 mm (.0472 in)
	Oil scraper ring	New	0.20 mm to 0.70 mm (.0079 in to .0276 in)
		Service limit	1.2 mm (.0472 in)

ENGINE (cont'd)			
Ring/piston groove clearance	Rectangular	New	0.030 mm to 0.066 mm (.0012 in to .0026 in)
		Service limit	0.12 mm (.0047 in)
	Taper-face	New	0.020 mm to 0.056 mm (.0008 in to .0022 in)
		Service limit	0.12 mm (.0047 in)
	Oil scraper ring	New	0.010 mm to 0.040 mm (.0004 in to .0016 in)
		Service limit	0.15 mm (.0059 in)
Cylinder bore		New	74.003 mm to 74.017 mm (2.9135 in to 2.9141 in)
Cylinder taper		Maximum New	0.030 mm (.0012 in)
		Service limit	0.05 mm (.002 in)
Cylinder out of round		Maximum New	0.008 mm (.0003 in)
		Service limit	0.03 mm (.0012 in)
Camshaft bearing journal diameter	PTO	New	25.947 mm to 25.960 mm (1.0215 in to 1.022 in)
		Service limit	25.92 mm (1.0205 in)
	MAG/Center	New	22.947 mm to 22.960 mm (.9034 in to .9039 in)
		Service limit	22.92 mm (.9024 in)
Camshaft holder bore diameter	PTO	New	26.00 mm to 26.021 mm (1.0236 in to 1.0244 in)
		Service limit	26.05 mm (1.0256 in)
	MAG/Center	New	23.00 mm to 23.021 mm (.9055 in to .9063 in)
		Service limit	23.05 mm (.9075 in)
Camshaft lobe height	Intake	New	38.70 mm to 38.90 mm (1.5236 in to 1.5315 in)
		Service limit	38.68 mm (1.5228 in)
	Exhaust	New	39.40 mm to 39.60 mm (1.5512 in to 1.5591 in)
		Service limit	39.38 mm (1.5504 in)
Crankshaft bearing journal diameter		New	35.990 mm to 36.006 mm (1.4169 in to 1.4176 in)
		Service limit	35.960 mm (1.4157 in)
Crankshaft radial play		Service limit	0.07 mm (.003 in)
Crankshaft axial play		New	0.120 mm - 0.392 mm (.0047 in - .0154 in)
		Service limit	0.450 mm (.0177 in)
Crankshaft pin diameter		New	35.979 mm to 35.995 mm (1.416 in to 1.417 in)
		Service limit	35.969 mm (1.416 in)
Crankshaft deflection	MAG	Maximum	0.050 mm (.002 in)
	Center	Maximum	0.050 mm (.002 in)
	PTO	Maximum	0.050 mm (.002 in)
Crankshaft plain bearing inside diameter		Service limit	36.08 mm (1.4205 in)
Connecting rod big end diameter		Service limit	36.06 mm (1.4197 in)
Connecting rod big end radial play		Service limit	0.08 mm (.0031 in)
Connecting rod big end axial play		New	0.100 mm to 0.352 mm (.0039 in to .0139 in)
		Service limit	0.450 mm (.0177 in)
Connecting rod small end diameter		New	17.010 mm to 17.020 mm (.6697 in to .6701 in)
		Service limit	17.060 mm (.6717 in)
Piston pin diameter		New	16.996 mm to 17.000 mm (.6691 in to .6693 in)
		Service limit	16.986 mm (.6687 in)
Connecting rod small end radial play		Service limit	0.04 mm (.0016 in)

COOLING SYSTEM			
Coolant	Type		Ethyl glycol and distilled water (50%/50%). Use BRP premixed coolant (P/N 219 700 362) or coolant specifically formulated for aluminum engines
	Quantity		5.0 L (1.32 U.S. gal.)
Thermostat opening temperature			75°C (167°F)
Radiator cap opening pressure			110 kPa (16 PSI)
LUBRICATION SYSTEM			
Lubrication	Type		Dry sump. Replaceable oil filter
	Oil filter		BRP Rotax paper type, replaceable
	Engine oil pressure	Minimum	60 kPa (8.7 PSI) @ 1400 RPM
			400 kPa (58 PSI) @ 4000 RPM
	Engine oil	Capacity (oil change with filter)	2.2 L (2.32 qt (U.S. liq.))
		Recommended	XPS Synthetic 4-Stroke oil (All climate) (P/N 293 600 112) or a SAE 0W 40 API service SM synthetic oil
FUEL SYSTEM			
Throttle body type			Dell'Orto 46mm heated
Idle speed	Normal idle		1450 ± 200 RPM
	Fast idle		2100 ± 100 RPM
Gasoline type			Unleaded
Minimum octane rating	Inside North America ((R+M)/2)		87
	Outside North America (RON)		92
Fuel tank capacity			45 L (12 U.S. gal.)
ELECTRICAL SYSTEM			
Magneto generator output			650 W @ 6000 RPM @ 14 V
Magneto stator resistance (between any pair of yellow wires)			0.1 to 1 Ohm @ 20°C (68°F)
Ignition type			IDI (Inductive Digital Ignition)
Spark plug	Make and type		NGK MR7BI-8
	Gap		.70 mm to 0.80 mm (.028 in to .031 in)
Ignition timing			Not adjustable
Battery			12 volt 18 A.h. YTX20HL-BS
Headlamp LOW/HI beam			2 X 55/60 W (H4)
Taillight and stoplight			2 X P 5/21 W
Fuses	F 1: Fuse 2, fuse 4, relay 1, relay 2, relay 3, voltage regulator, communication connector		30 A
	F 2: Relay coils (R1, R2, R3, R4), start button, gauge		5 A
	F 3: Fuel pump, starter solenoid		10 A
	F 4: Fan relay (R4)		15 A
	F 5: Fuel injectors, ignition coils		10 A
	F 6: Gauge, ECM, gauge		10 A
	F 7: 12-volt power outlet, heated grips, heated throttle lever		10 A
	F 8: Lights		20 A
	F 9: Horn (optional)		5 A
	F 10: Rear 12-volt power outlet (optional)		5 A

ELECTRICAL SYSTEM (cont'd)			
Relays	Relay 1		Fuse 3, fuse 5, fuse 6
	Relay 2		Fuse 8, fuse 9, fuse 10
	Relay 3		Fuse 7
	Relay 4		Cooling fan
DRIVE SYSTEM			
Gearbox oil	Type		XPS synthetic chaincase oil (P/N 413 803 300)
	Quantity		700 ml (23.67 U.S. oz)
Gear ratio	1st		3.86 : 1
	2nd		2.3 : 1
	R		4.06 : 1
Drive pulley	Type		eDrive
	Clutch engagement		2200 ± 100 RPM
	Spring color		Red/White
	Spring length		114.7 mm (4.5 in)
	Pin		N.A.
	Ramp		716
	Screw position		N.A.
Driven pulley	Type		QRS-NTC
	Spring preload (New)		7.0 kgf ± 0.7 kgf (15.4 lbf ± 1.5 lbf)
	Spring preload (After break-in)		6.4 kgf ± 0.7 kgf (14.1 lbf ± 1.5 lbf)
	Spring color		Pink/Pink
	Cam angle		37°/45°
Pulley distance		Z	21.40 mm (.843 in)
Pulley offset		X	37.2 mm ± 0.5 mm (1.465 in ± .02 in)
Drive belt	Width		36.3 mm (1.43 in)
	Wear limit		33.9 mm (1.33 in)
Track	Width	WT	508 mm (20 in)
		SWT	600 mm (24 in)
	Length	WT	3923 mm (154 in)
		SWT	3968 mm (156 in)
	Profile height	WT	38.1 mm (1.5 in)
		SWT	31.8 mm (1.252 in)
Track adjustment	Deflection		40 mm to 50 mm (1.575 in to 1.969 in)
	Force[1]		7.3 kgf (16 lbf)
BRAKE SYSTEM			
Brake lining minimum thickness			1 mm (.039 in)
Brake disk minimum thickness			4.5 mm (.177 in)
Brake fluid	Type		DOT 4
	Quantity		65 ml (2.2 U.S. oz)
FRONT SUSPENSION			
Suspension type			XU-LTS
Suspension maximum travel			150 mm (6 in)
Shock absorber type			Motion control

REAR SUSPENSION		
Suspension type		SC-5U
Suspension maximum travel		34 cm (13.4 in)
Shock absorber type	Center	Motion control
	Rear	HPG
Stroke limiter standard position		3
STEERING SYSTEM		
Ski type		Pilot DS (SWT with liner)
Toe-out		5 mm (.197 in)
Camber		0°
WEIGHT AND DIMENSIONS		
Dry weight	WT	269 kg (594 lb)
	SWT	302 kg (666 lb)
Length		3240 mm (127.5 in)
Width		1076 mm (42.4 in)
Height		133 cm (52.3 in)
Ski stance (carbide to carbide)		900 mm (35.4 in)
Ski width		165 mm (6.5 in)
Liner width (SWT)		226.06 mm (8.9 in)

(1) Measure gap between slider shoe and bottom inside track when exerting a downward pull to the track.

WIRING DIAGRAM INFORMATION

GENERAL

WIRING DIAGRAM LOCATION

Wiring diagrams are found in the *WIRING DIAGRAM BOOKLET* (P/N 219 100 601).

WIRE COLOR CODES

Wire insulation color may be of a single color, or composed of two colors (half one color and half the other color).

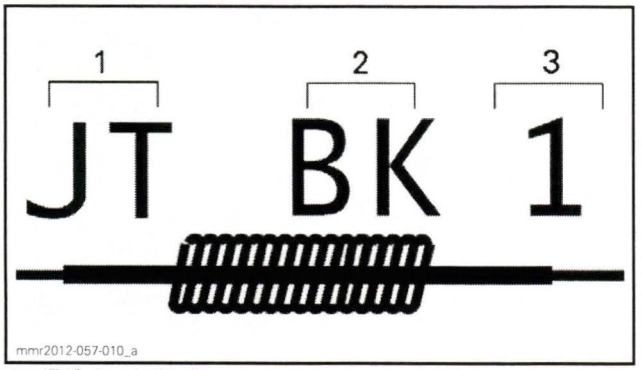
Example:

- RD is a RED wire (single color)
- YE/BK is a YELLOW and BLACK wire.

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

SPLICES IN WIRING HARNESS

Splices in wiring harness are indicated on the wiring diagram as follows.



1. *JT: Splice indication*
2. *Spliced wire color*
3. *Splice number on the wire*

CONNECTOR INFORMATION

SERVICE TOOLS

Description	Part Number	Page
CRIMPING TOOL (HEAVY GAUGE WIRE)	529 035 730	868
CRIMPING TOOL (KOSTAL)	529 035 909	867
ECM ADAPTER TOOL	529 036 166	866
ECM TERMINAL REMOVER 2.25	529 036 175	866
ECM TERMINAL REMOVER 3.36	529 036 174	866
KOSTAL DIE	529 035 906	867

SERVICE TOOLS – OTHER SUPPLIER

Description	Part Number	Page
AMP EXTRACTION TERMINAL TOOL	726503-1	863
AMP EXTRACTION TERMINAL TOOL	755430-2	861–862
SNAP ON TERMINAL TOOL	TT600-5	859, 861
SNAP-ON SCREWDRIVER	TT600-5	859
TOOL	AMP-755430-2	862

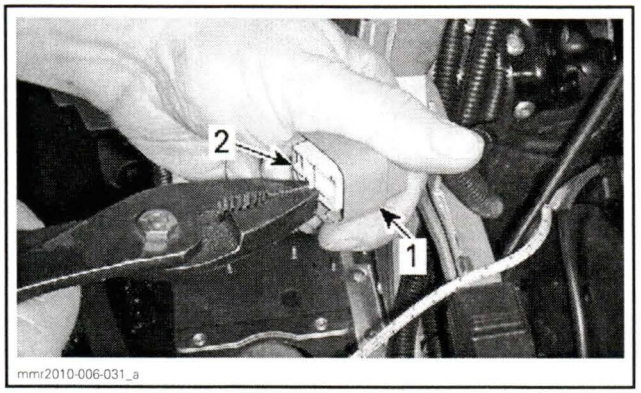
GENERAL

SUMITOMO CONNECTOR

Connector Disassembly

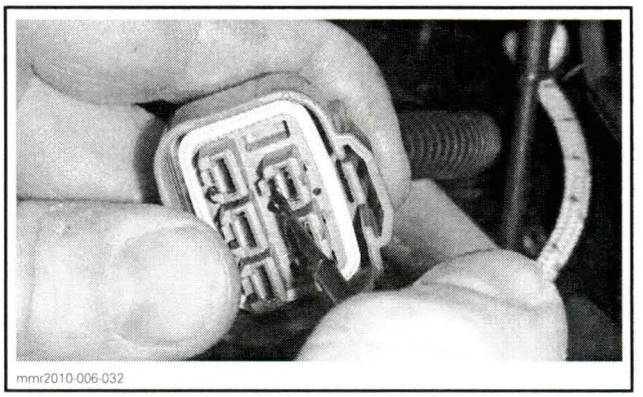
5-Pin Magneto Connector (550F Models)

Remove the blue lock.



1. Voltage regulator/rectifier connector
2. Connector lock

Using a small screwdriver or a terminal tool such as the SNAP ON TERMINAL TOOL (P/N TT600-5), lift the terminal lock.



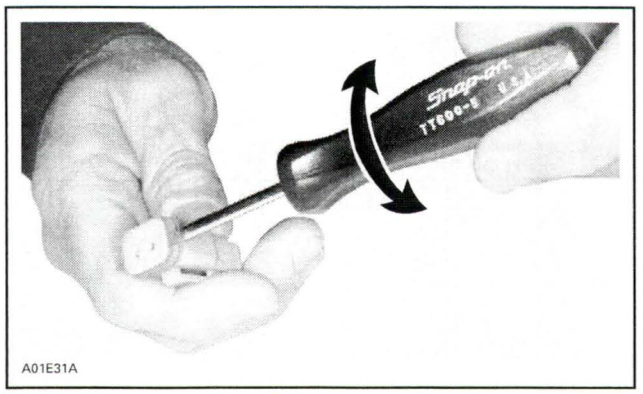
Extract the wire from the connector.

DEUTSCH CONNECTOR

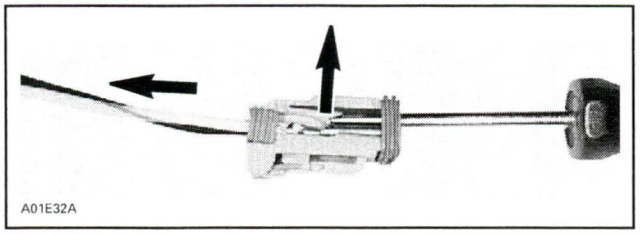
Connector Disassembly

Male Housing

Insert SNAP-ON SCREWDRIVER (P/N TT600-5) under lock and twist to lift it.



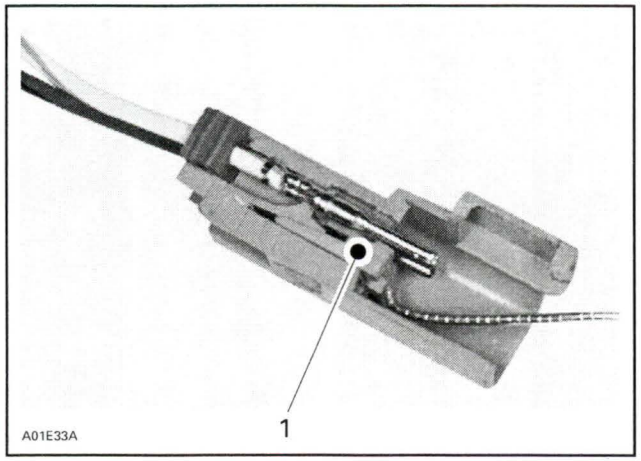
Pry tab to free connector then pull wire out of housing.



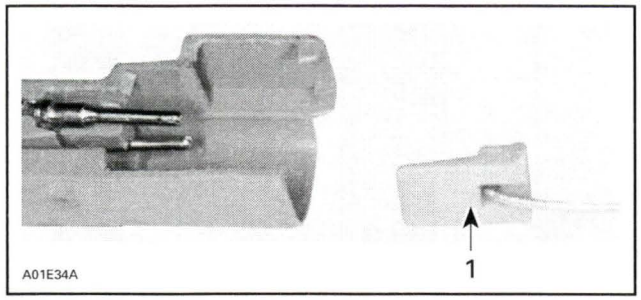
FEMALE CONNECTOR HOUSING — CUT-AWAY

Female Housing

Using a small hook, pull out the lock.

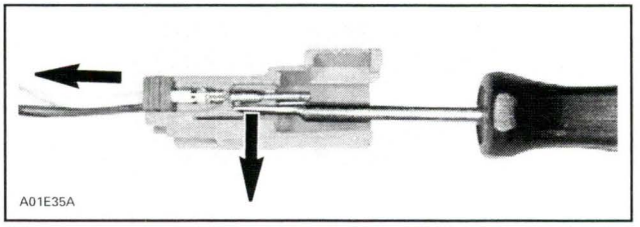


1. Lock



1. Lock

Pry tab to free connector then pull wire out of housing.

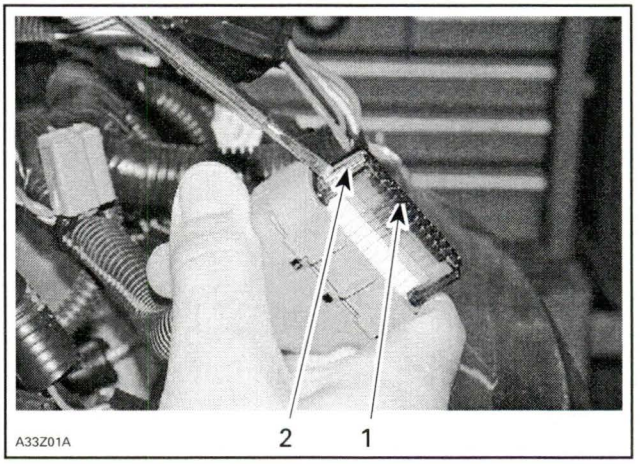


FEMALE HOUSING — CUT-AWAY

PACKARD CONNECTOR (GAUGE)

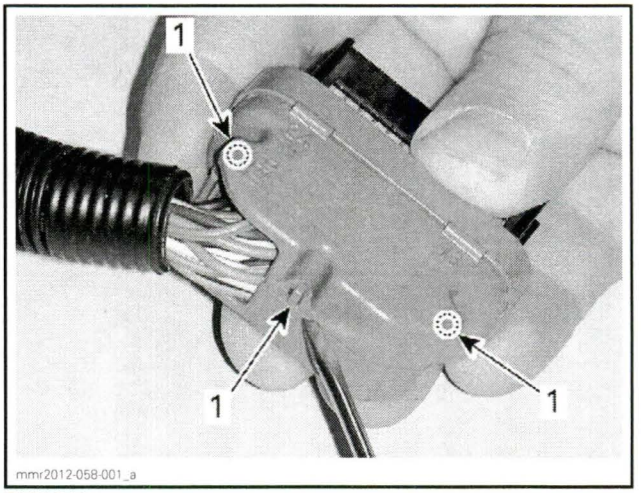
Connector Disassembly

Push on both tabs to remove retainer.



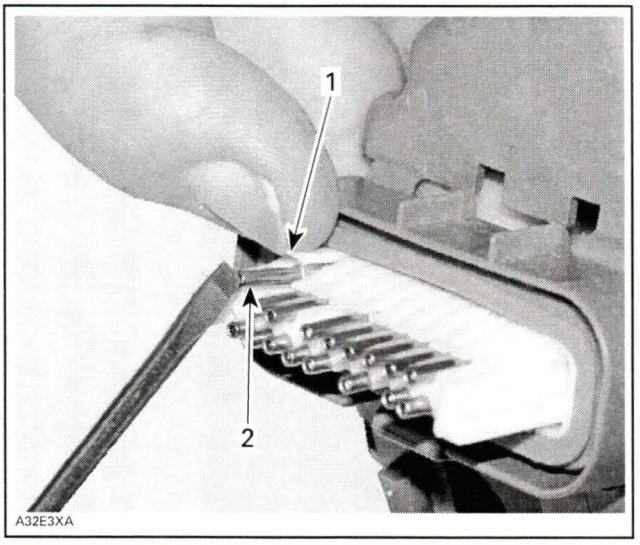
TYPICAL
1. Retainer
2. Tab (one on each side)

Open connector housing by lifting 3 retaining tabs.



TYPICAL
1. Tabs (2 are hidden from view)

Lift the top plastic lock of the female terminal to be removed and hold in position. Lift the female terminal to unlock from the housing and push out of housing.



1. Lift and hold plastic lock
2. Lift to unlock and push out

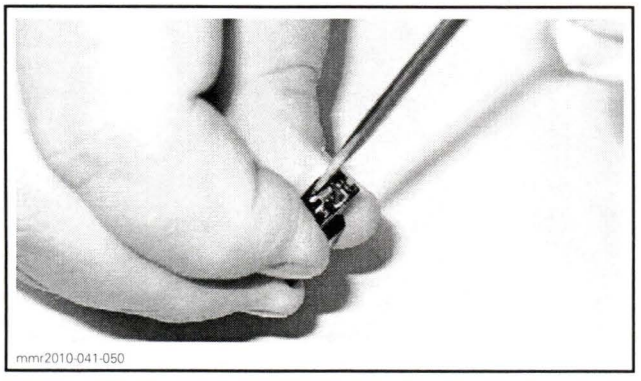
AMP SINGLE-PIN CONNECTOR

Single-Pin Connector Disassembly

Unplug the connector.

NOTICE **Always unplug connector by pulling on housing not on wires.**

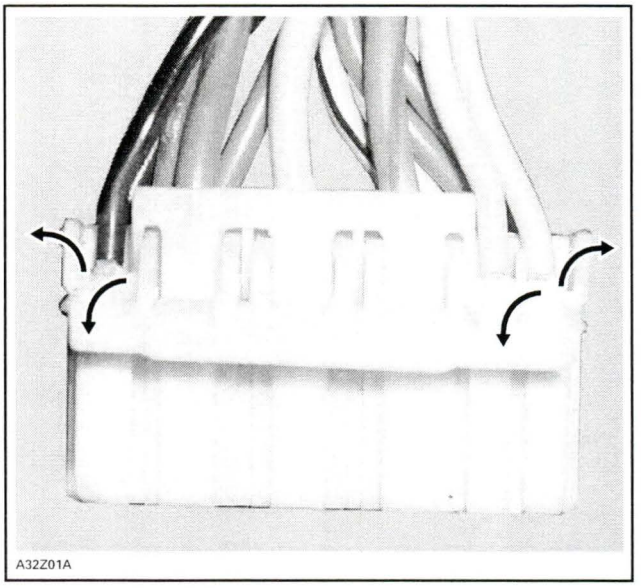
Insert a small screwdriver or a terminal tool such as the SNAP ON TERMINAL TOOL (P/N TT600-5) in access opening then pull housing toward wire side.



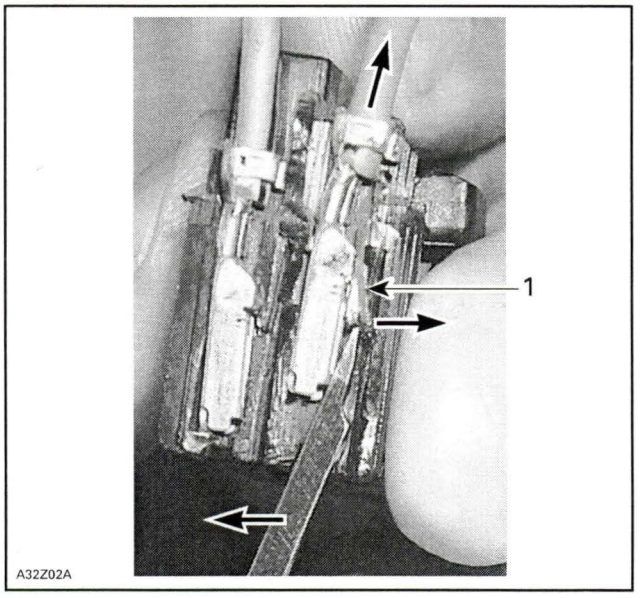
AMP MULTILOCK CONNECTORS

Multilock Connector Disassembly

Male Housing



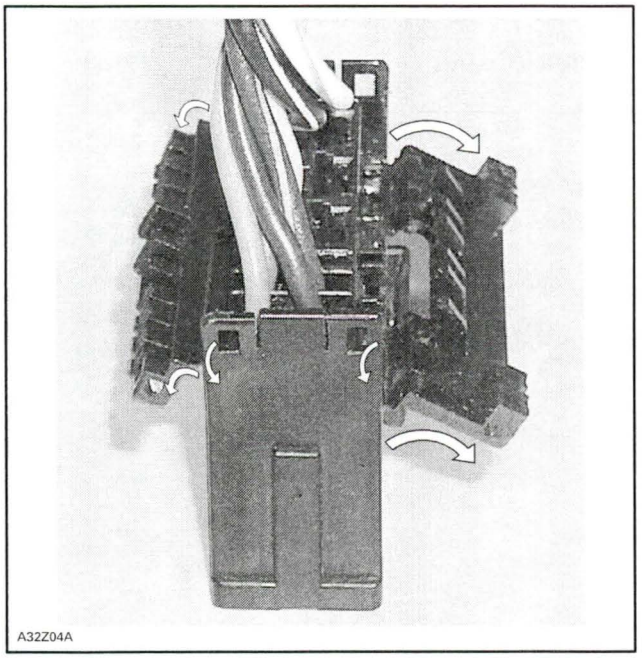
Insert AMP EXTRACTION TERMINAL TOOL (P/N 755430-2) under lock and twist to lift it.



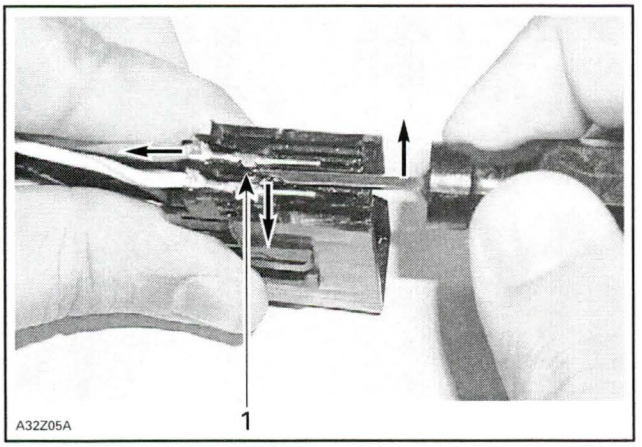
MALE HOUSING — CUT-AWAY
1. Lock

Female terminals can be removed from housing with sharp head pin.

Female Housing



InsertAMP EXTRACTION TERMINAL TOOL (P/N 755430-2) under lock and twist to lift it.



FEMALE HOUSING — CUT-AWAY
1. Lock

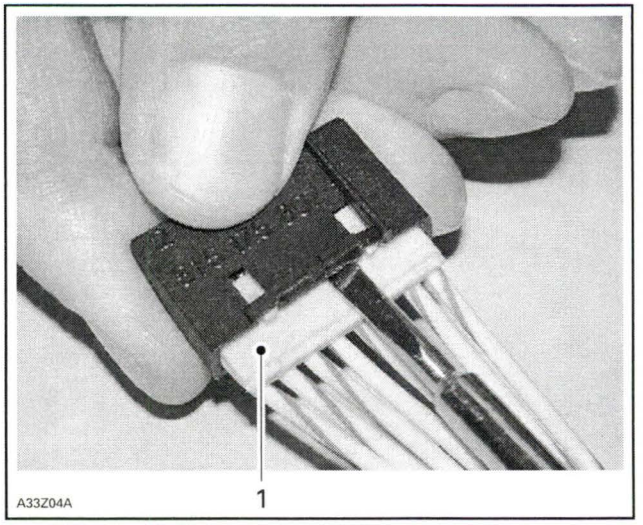
Terminal Crimping

Refer to *TERMINAL CRIMPING (AMP 8-CIRCUIT AND MULTILOCK)* further in this subsection.

AMP CONNECTOR (8-CIRCUIT)

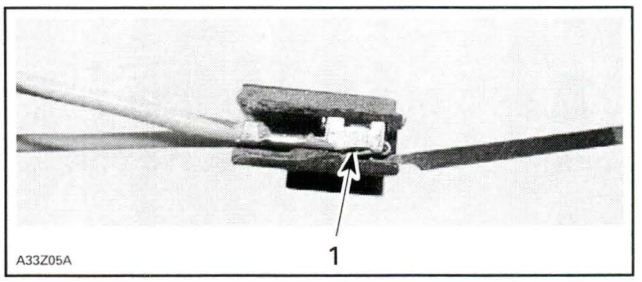
Connector Disassembly

Pry housing to release lock.



1. Lock

Insert TOOL (P/N AMP-755430-2) under tab and pry it to free connector. Pull on the female terminal wire to remove female terminal from housing.



AMP 8-CIRCUIT CONNECTOR — CUT-AWAY
1. Tab

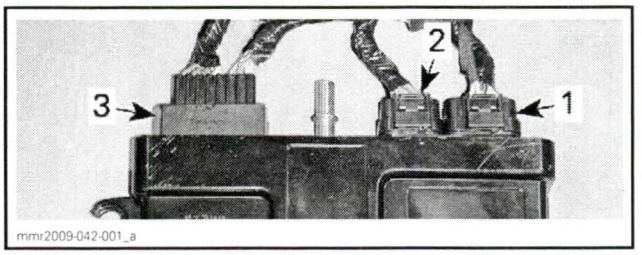
Terminal Crimping

Refer to *TERMINAL CRIMPING (AMP 8-CIRCUIT AND MULTILOCK)* further in this subsection.

AMP CONNECTOR

ECM Connector (600 HO E-TEC Models)

Connector Identification

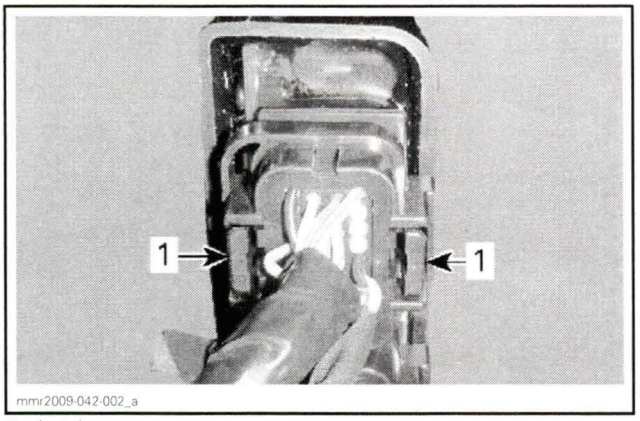


1. J1A connector
2. J1B connector
3. J2 connector

Connector Removal

J1A and J1B Connectors

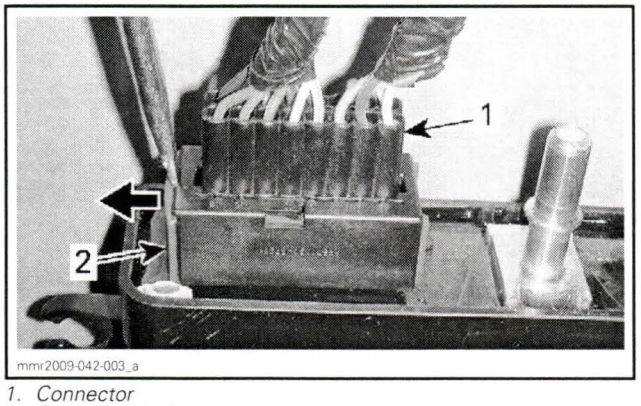
Depress both latches and pull connector housing.



1. Latches

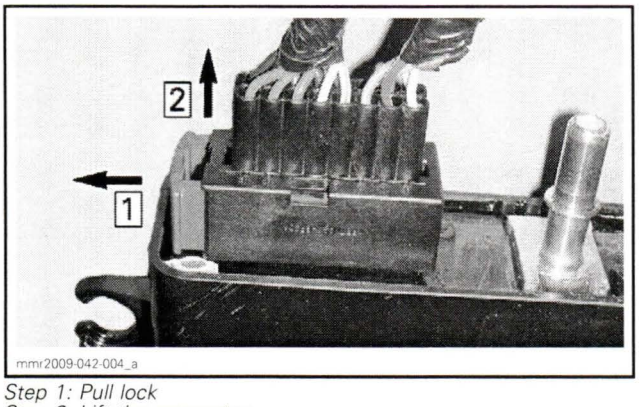
J2 Connector

Using a small screwdriver, open the connector lock.



1. Connector
2. Connector lock

Pull the lock approximately 20 mm (3/4 in)to remove the connector.

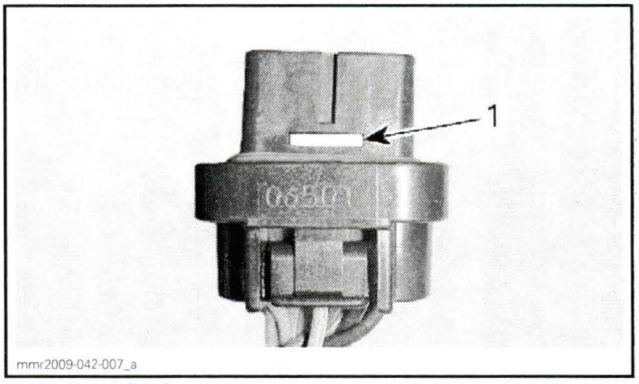


Step 1: Pull lock
Step 2: Lift the connector

Connector Disassembly

J1A and J1B Connectors

Push the lock mechanism to open it.

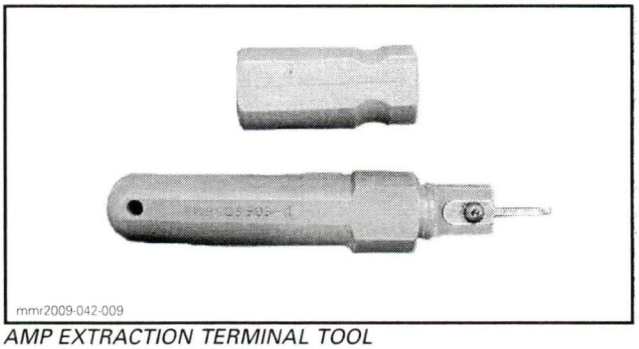


1. Lock mechanism

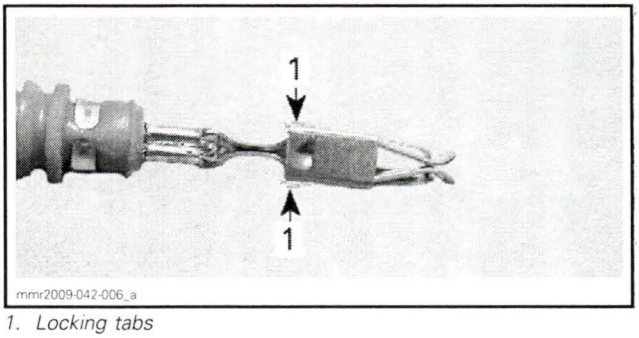
Pull on wire to extract terminal from connector housing.

J2 Connector

Using the AMP EXTRACTION TERMINAL TOOL (P/N 726503-1), release both locking tabs of connector. Pull terminal from housing.



AMP EXTRACTION TERMINAL TOOL



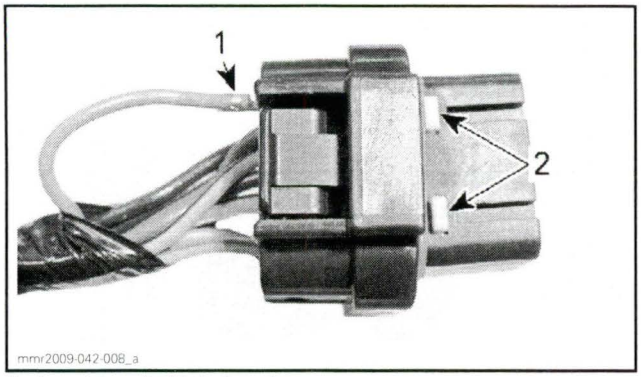
1. Locking tabs

Connector Assembly

J1A and J1B Connectors

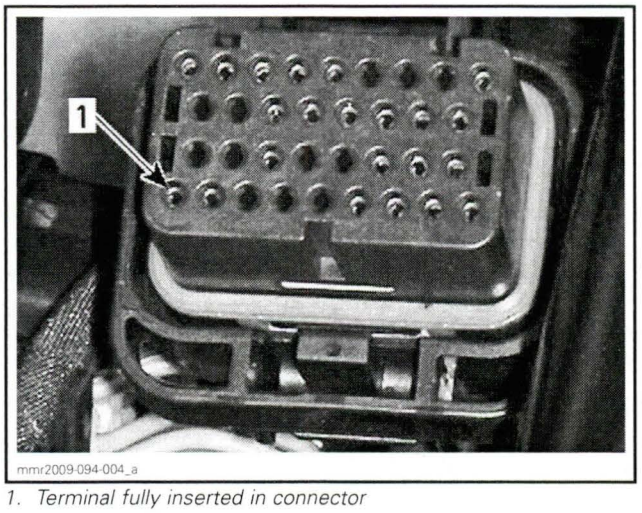
Push terminal through seal until it is seated in connector housing.

Close the lock mechanism.



1. Insert terminal into housing
2. Push here to close the lock mechanism

NOTE: If the locking mechanism does engage, it is likely due to an improperly inserted terminal. Look at the end of connector to see if a terminal is partially out. If, so push the corresponding wire fully into connector then lock mechanism.



1. Terminal fully inserted in connector

J2 Connector

Align terminal with connector housing and push terminal with seal into connector housing until seated.

Terminal Crimping

Refer to *TERMINAL CRIMPING (AMP 8-CIRCUIT AND MULTILOCK)* further in this subsection for procedure.

MOLEX CONNECTOR

ECM Connector (600 ACE Models)

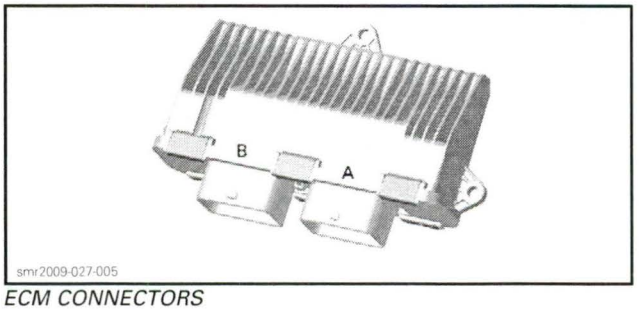
Molex Connector Application

The Molex connector is used on the ECM.

There are 2 MOLEX connectors on the ECM.

The engine wiring harness connector is connected to ECM connector "A". The vehicle wiring harness connector is connected to ECM connector "B".

Each ECM connector has 48 pins.

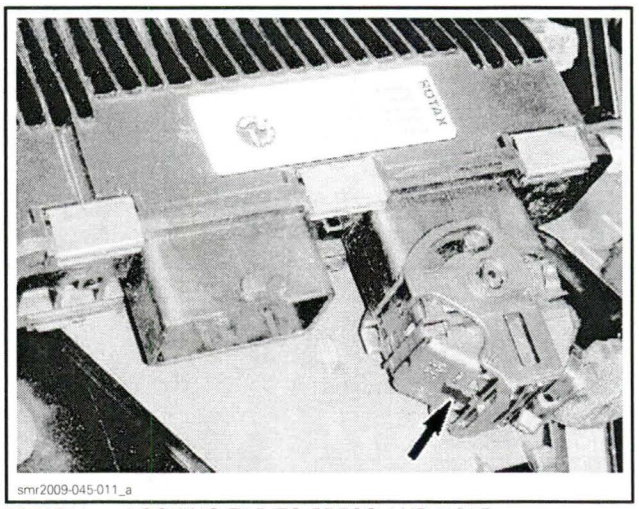


ECM CONNECTORS

Do not apply any product to the pins in the ECM connector.

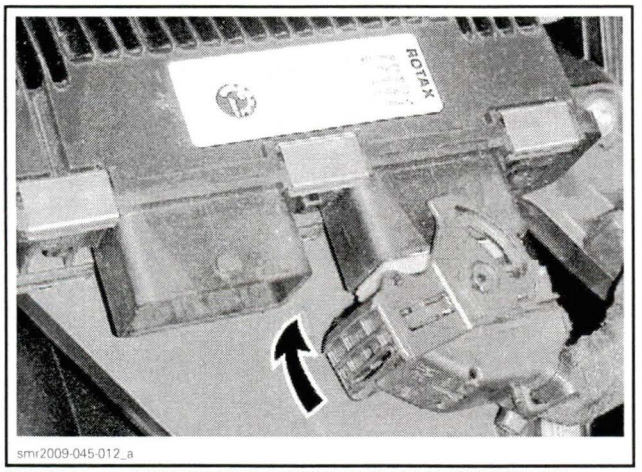
Connector Removal

1. To access the ECM, refer to *ELECTRONIC FUEL INJECTION (600 ACE)* subsection.
2. Press and hold the locking tab on the connector to be disconnected.



TYPICAL — LOCKING TAB TO PRESS AND HOLD

3. As you hold the locking tab, rotate the connector locking cam until it stops.



TYPICAL — CONNECTOR LOCKING CAM ROTATION TO RELEASE

4. Pull connector off ECM.



TYPICAL

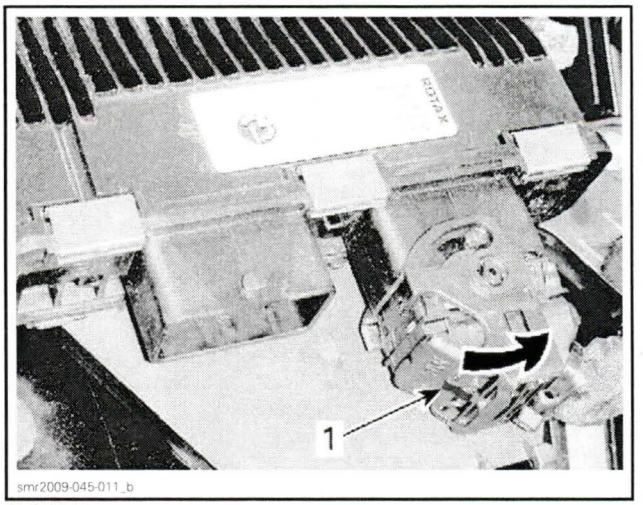
Connector Installation

1. Fully open connector locking cam.



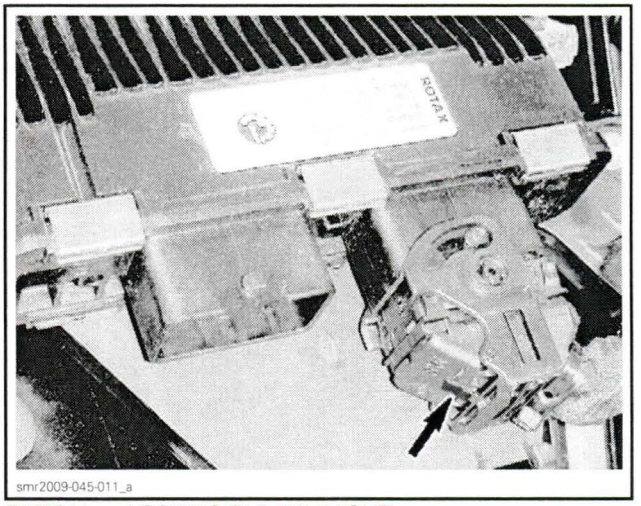
TYPICAL — CONNECTOR LOCKING CAM IN RELEASE POSITION

2. Insert connector on ECM.
3. As you push the connector onto the ECM, rotate the connector locking cam until it snaps locked.



TYPICAL
1. Locked here

4. Ensure the locking tab is fully out.



TYPICAL — LOCKING TAB FULLY OUT

Connector Inspection

Before replacing an ECM, always check electrical connections.

1. Ensure connector locking mechanism is functioning properly.
2. Ensure all wire terminals (pins) are properly locked in the connector.
3. Ensure they are very tight, make good contact with the pins in the ECM.
4. Ensure the pins in the harness connector and the ECM connector are clean, shiny and corrosion-free.

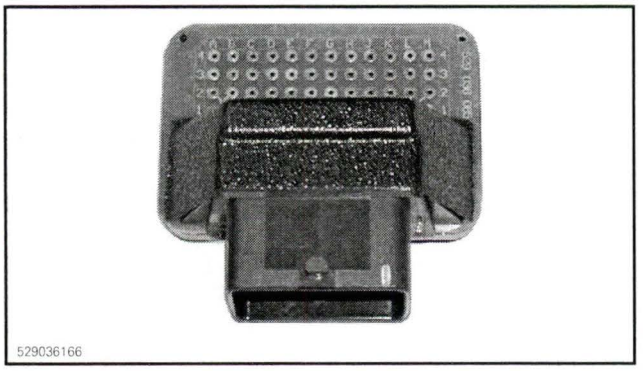
5. Check wiring harness for signs of scoring.

NOTE: A "defective ECM module" could possibly be repaired simply by disconnecting and reconnecting it.

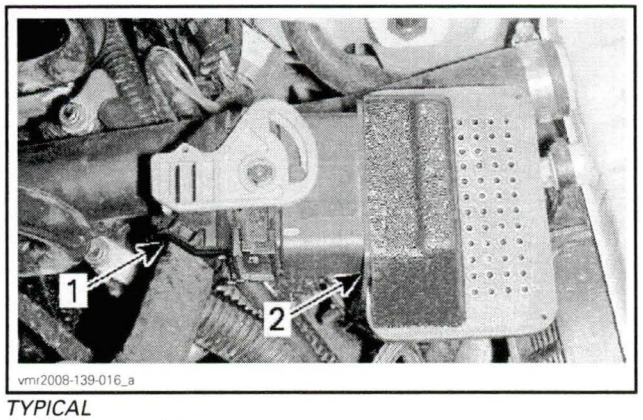
NOTICE **Do not apply any lubricant, liquid, spray or any grease inside the ECM connector.**

Connector Probing

The most recommended and safest method to probe the MOLEX (ECM) connector terminals is to use the ECM ADAPTER TOOL (P/N 529 036 166). This tool will prevent deforming or enlarging of the terminals, which would lead to bad ECM terminal contact creating intermittent or permanent problems.



1. Disconnect the ECM connector to be probed, and reconnect it on the ECM adapter.
2. Probe wire terminals of the circuit to be tested directly in the adapter holes.



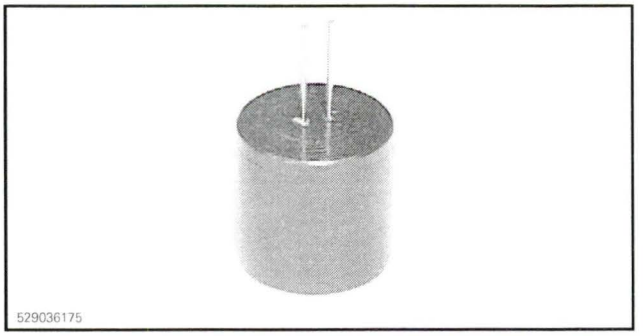
TYPICAL
1. ECM connector
2. ECM adapter

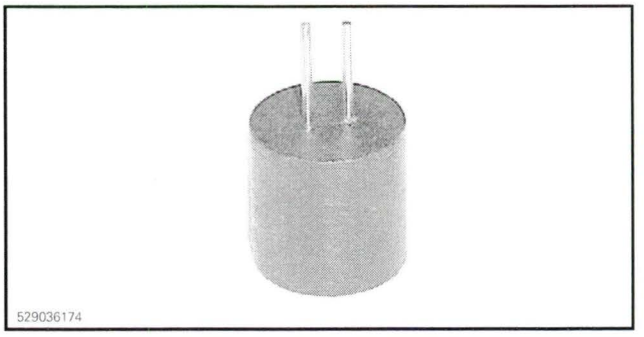
NOTICE **Never probe directly on the ECM harness connector. This could change the shape or enlarge the terminals and create intermittent or permanent contact problems.**

Connector Terminal Removal (Harness Connector)

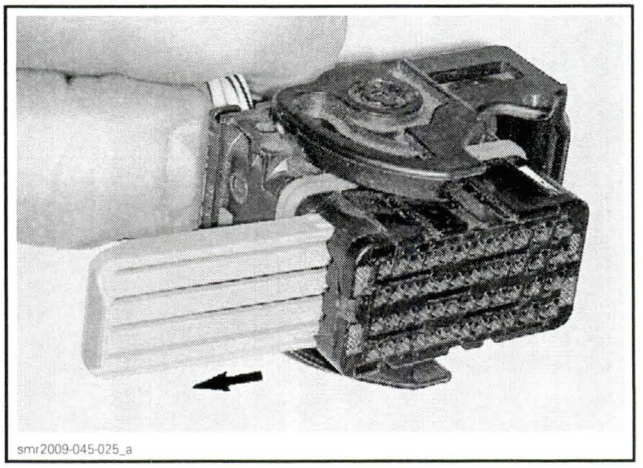
To remove a signal terminal from the ECM harness connector, use the ECM TERMINAL REMOVER 2.25 (P/N 529 036 175).

To remove a power terminal, use the ECM TERMINAL REMOVER 3.36 (P/N 529 036 174).

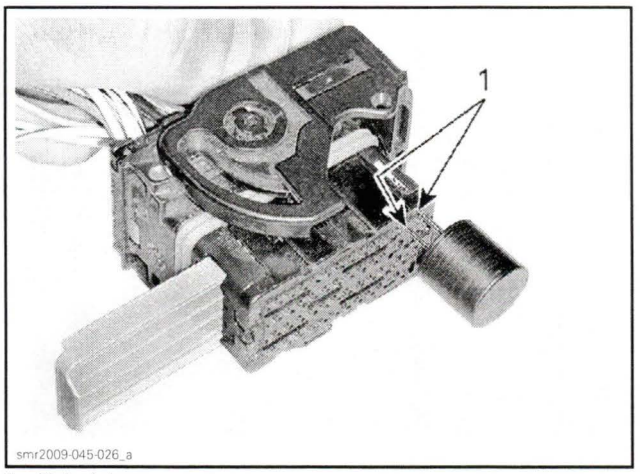




1. Remove rear protector from connector.
2. Pull out the connector lock.

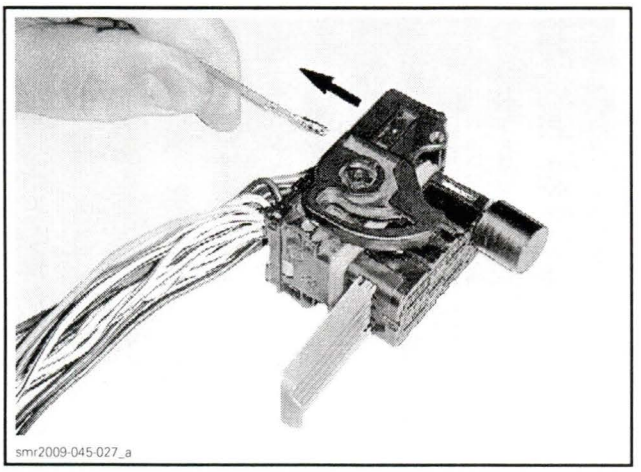


3. Insert tool to unlock terminal.



1. Unlock here

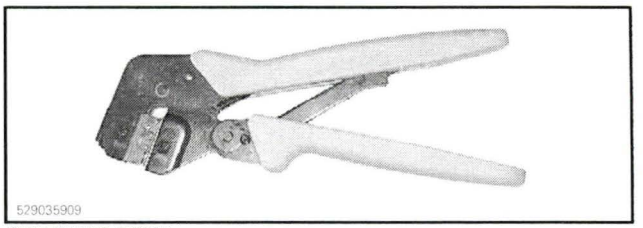
4. Gently pull on the wire to extract the terminal out the back of the connector.



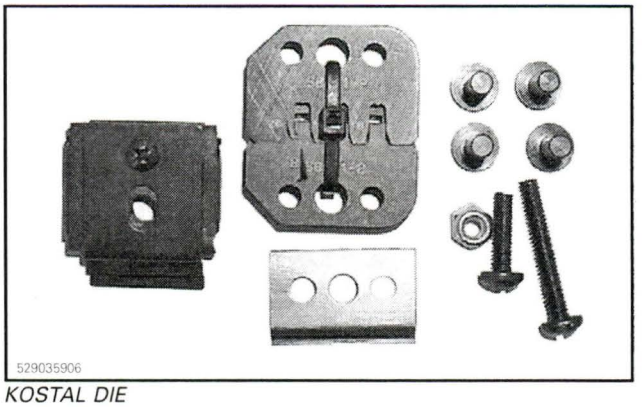
NOTICE Before installing wire terminals in the connector, ensure all terminals are properly crimped on wires. After installation of wire terminals in the connectors, ensure they are properly locked by gently pulling on them as if to extract them.

TERMINAL CRIMPING (AMP 8-CIRCUIT AND MULTILOCK)

To crimp a new connector terminal, use the CRIMPING TOOL (KOSTAL) (P/N 529 035 909) and the KOSTAL DIE (P/N 529 035 906).



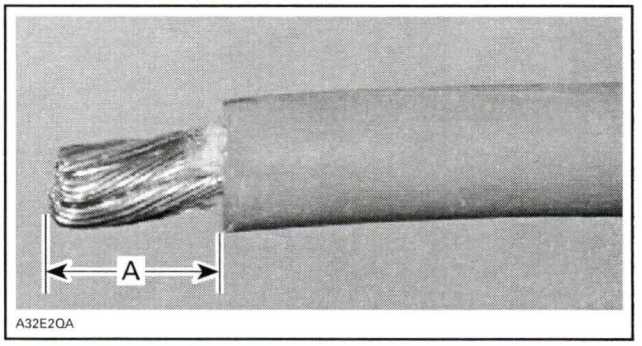
CRIMPING TOOL



KOSTAL DIE

To properly crimp the terminal on the wire, strictly follow this procedure.

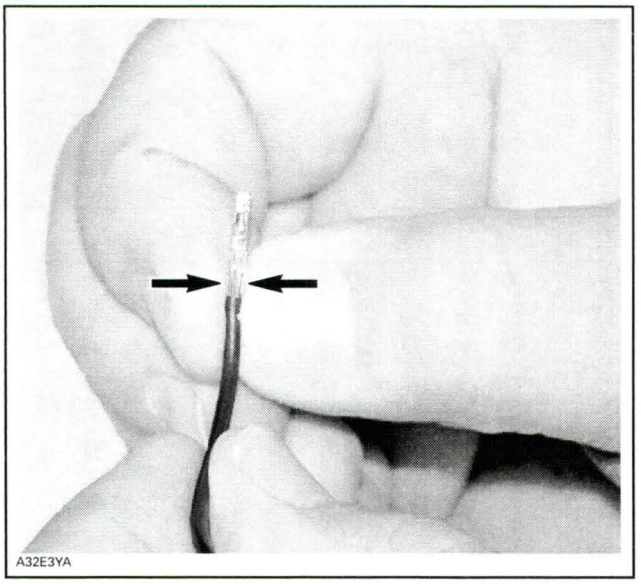
Strip the wire to a maximum of 3 mm (1/8 in).



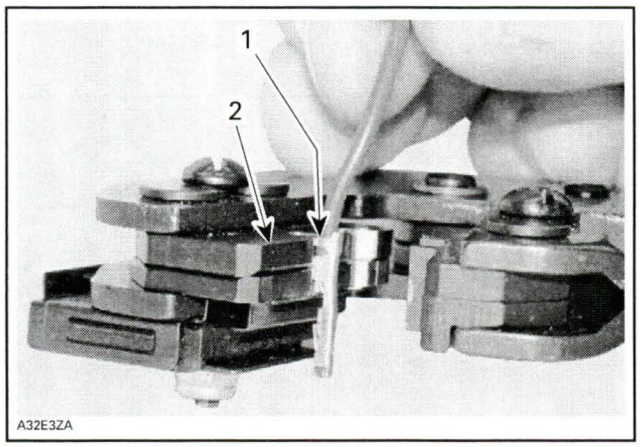
TYPICAL
A. 3 mm (1/8 in) maximum

Position wire in terminal.

Squeeze the terminal tabs with your fingers to temporarily retain terminal in place.


A32E3YA

Insert terminal with wire in crimping pliers and position it so the top of the terminal tabs are flush with the pliers edge, or a little bit lower as shown.



A32E3ZA

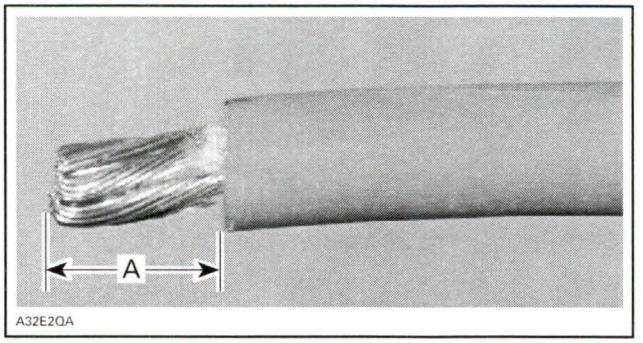
1. Top of terminal tabs
2. Align tabs with pliers edge

Crimp terminal. Ensure all wire strands are in the terminal. If not, the loose strands may cause strange problems in the electrical system.

BATTERY CABLE TERMINAL

Terminal Installation

Carefully strip the wire approximately to 10 mm (1/2 in) in length, using a wire stripping tool or sharp blade/knife.

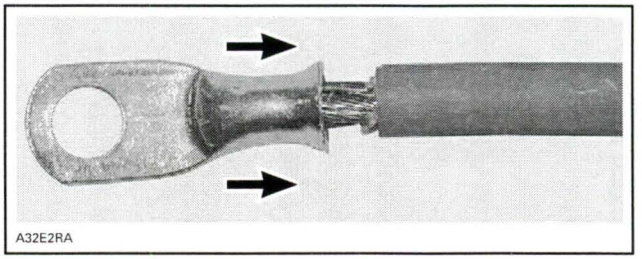


A32E2QA

A. 10 mm (1/2 in)

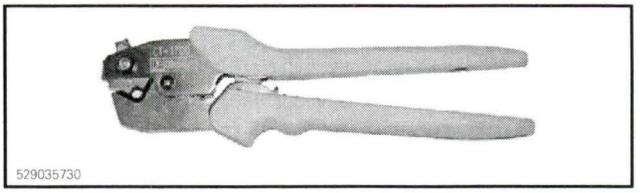
NOTE: Make sure not to cut wire strands while stripping the wire.

Install the appropriate terminal on the wire according to the requirement. Refer to appropriate *PARTS CATALOG*.

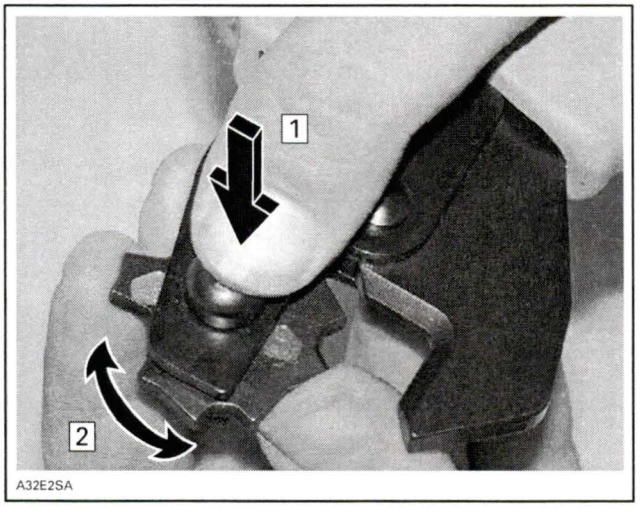

A32E2RA

INSTALLATION OF TERMINAL

Follow the instructions provided with the CRIMPING TOOL (HEAVY GAUGE WIRE) (P/N 529 035 730) to select the proper position of the tool.

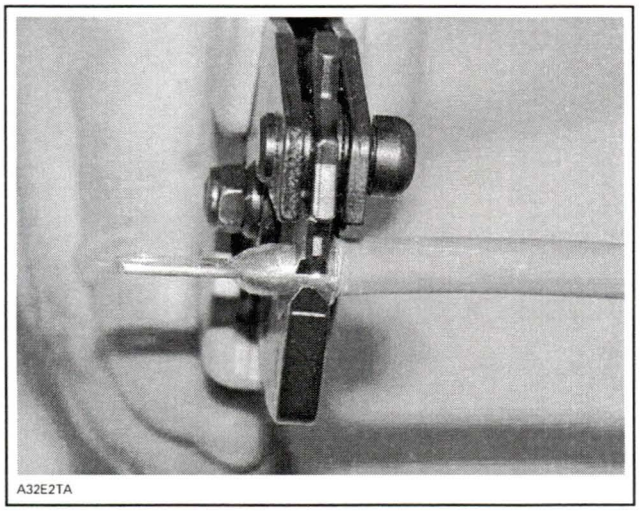

529035730

NOTE: Different wires require different crimp pliers settings, so make sure to follow the instruction supplied with the tool.

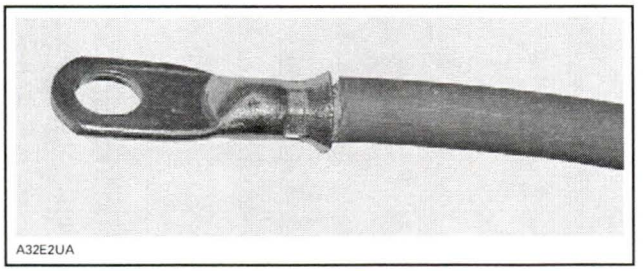


POSITIONING THE CRIMP PLIERS
Step 1: Press
Step 2: Rotate

After positioning the crimp pliers, crimp the terminal already installed on wire.



CRIMPING OF WIRE



PROPERLY CRIMPED WIRE

To verify, if the wire is properly crimped, apply some pulling force on wire and the terminal at the same time from both directions.

NOTICE Never solder the wire to the terminal. Soldering can change the property of the wire and it can become brittle and break.

Install the protective heat shrink rubber tube on the terminal. Heat the heat shrink rubber tube using the heat gun so that it grasps the wire and the terminal.

NOTICE Make sure that the protective heat shrink rubber tube has been properly installed and no part of wire is exposed.

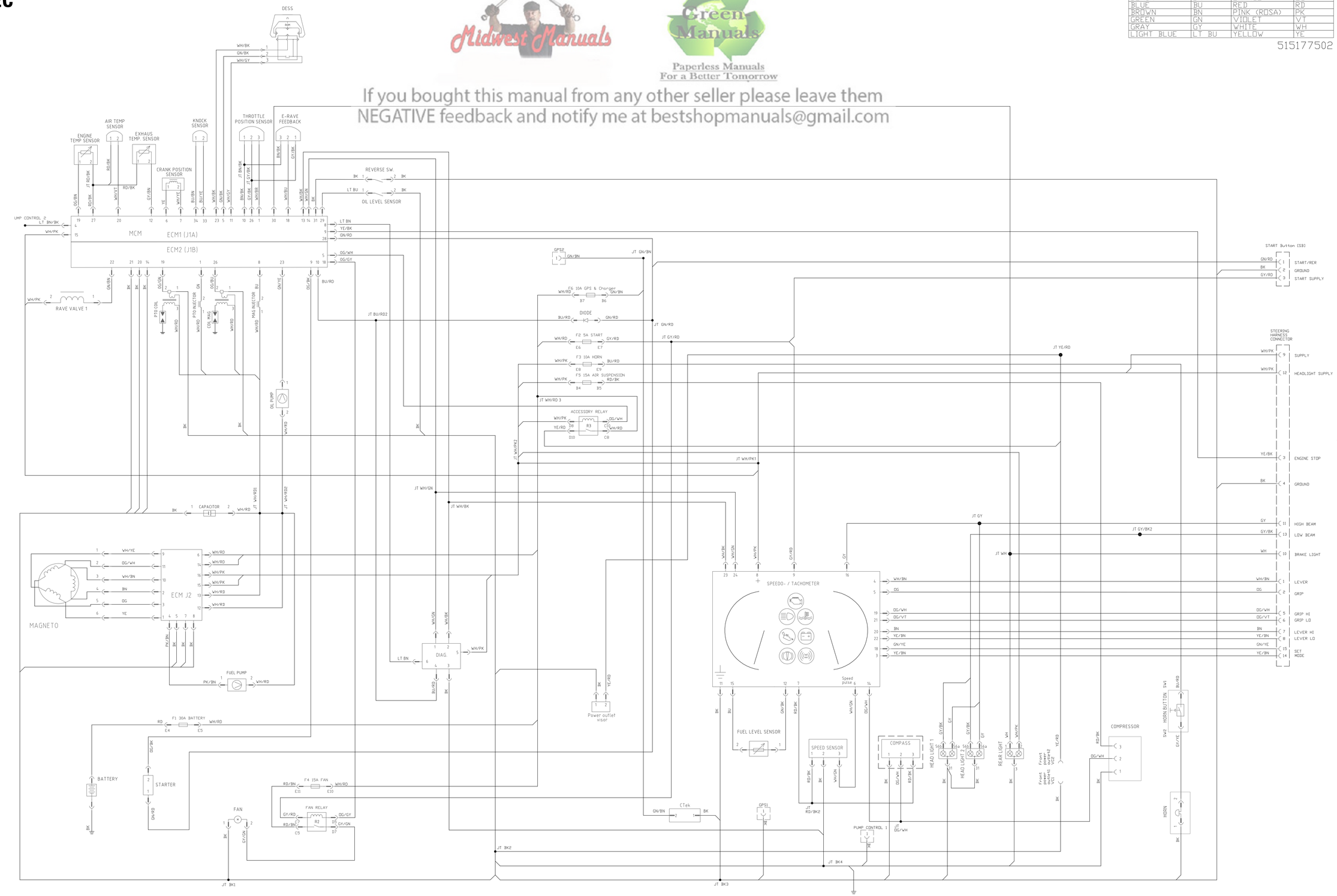
600 HO E-TEC

Skandic WT
Skandic SWT

COLOUR	CODE	COLOUR	CODE
BEIGE	BE	LIGHT BROWN	LT BN
BLACK	BK	ORANGE	OG
BLUE	BU	RED	RD
BROWN	BN	PINK (ROSA)	PK
GREEN	GN	VIOLET	VT
GRAY	GY	WHITE	WH
LIGHT BLUE	LT BU	YELLOW	YE

515177502

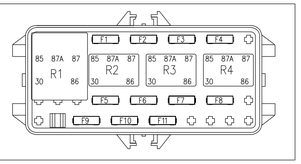
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Skandic SWT 600 ACE

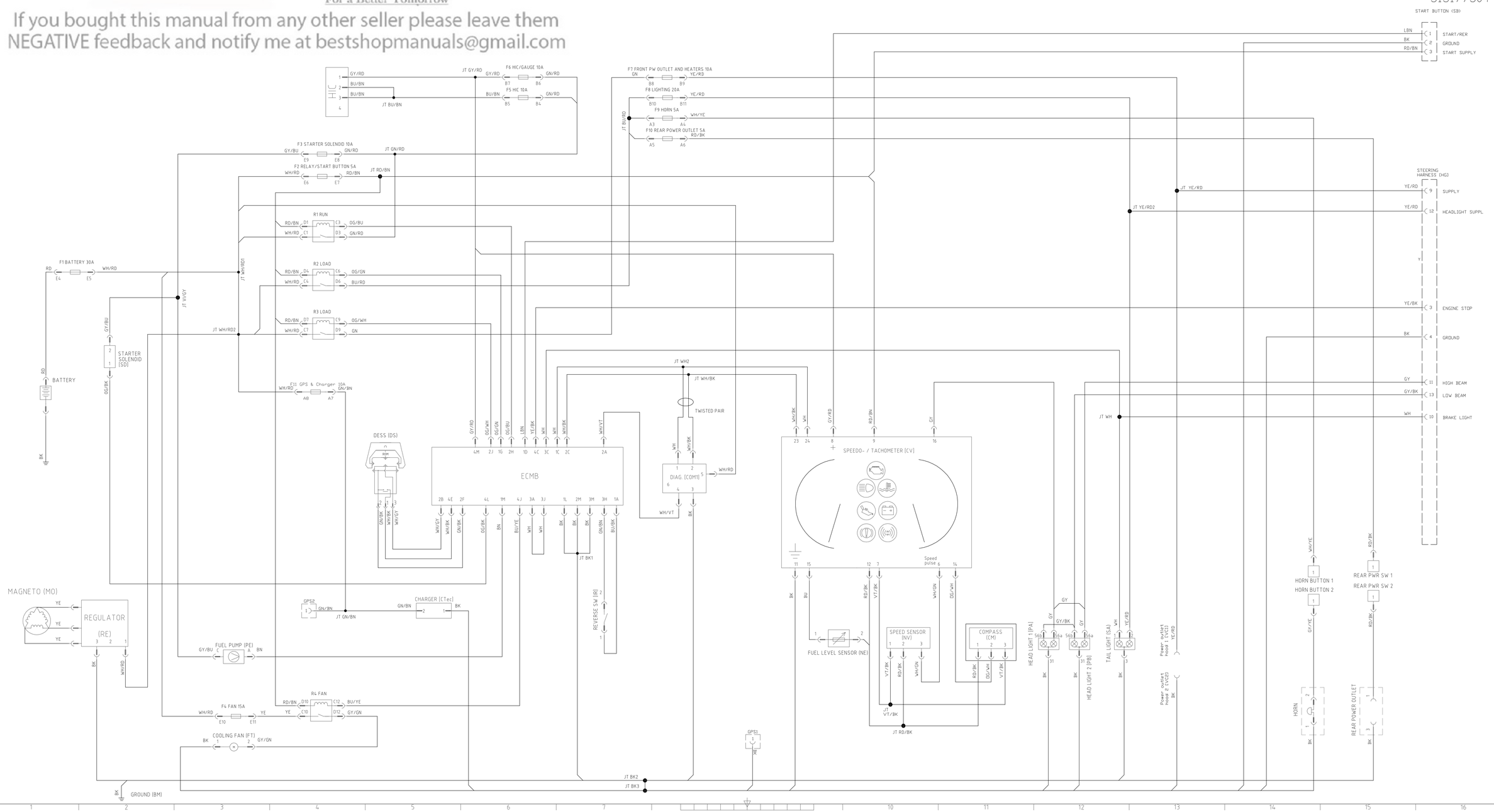
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R1 RUN RELAY
R2 LOAD RELAY
R3 LOAD RELAY
R4 FAN RELAY
F1 BATTERY 30A
F2 RELAY/START BUTTON 5A
F3 STARTER SOLENOID 10A
F4 FAN 15A
F5 HIC 10A
F6 HIC/GAUGE 10A
F7 FRONT PW OUTLET AND HEATERS 10A
F8 LIGHTING 20A
F9 HORN 5A
F10 REAR POWER OUTLET 5A
F11 GPS & CHARGER 10A



COLOR	CODE
BLACK	BK
BLUE	BU,BL
GREEN	GN
ORANGE	OG, OR
PINK, ROSA	PK, RS
WHITE	WH
RED	RD
YELLOW	YE, YL
GRAY	GY, GR
BROWN	BN, BR
VIOLET	VT, VI
DARK BLUE	DBU, DBL
DARK GREEN	DGN
LIGHT BROWN	LBN, LBR, BE
LIGHT GREEN	LGN
LIGHT BLUE	LBU, LBL

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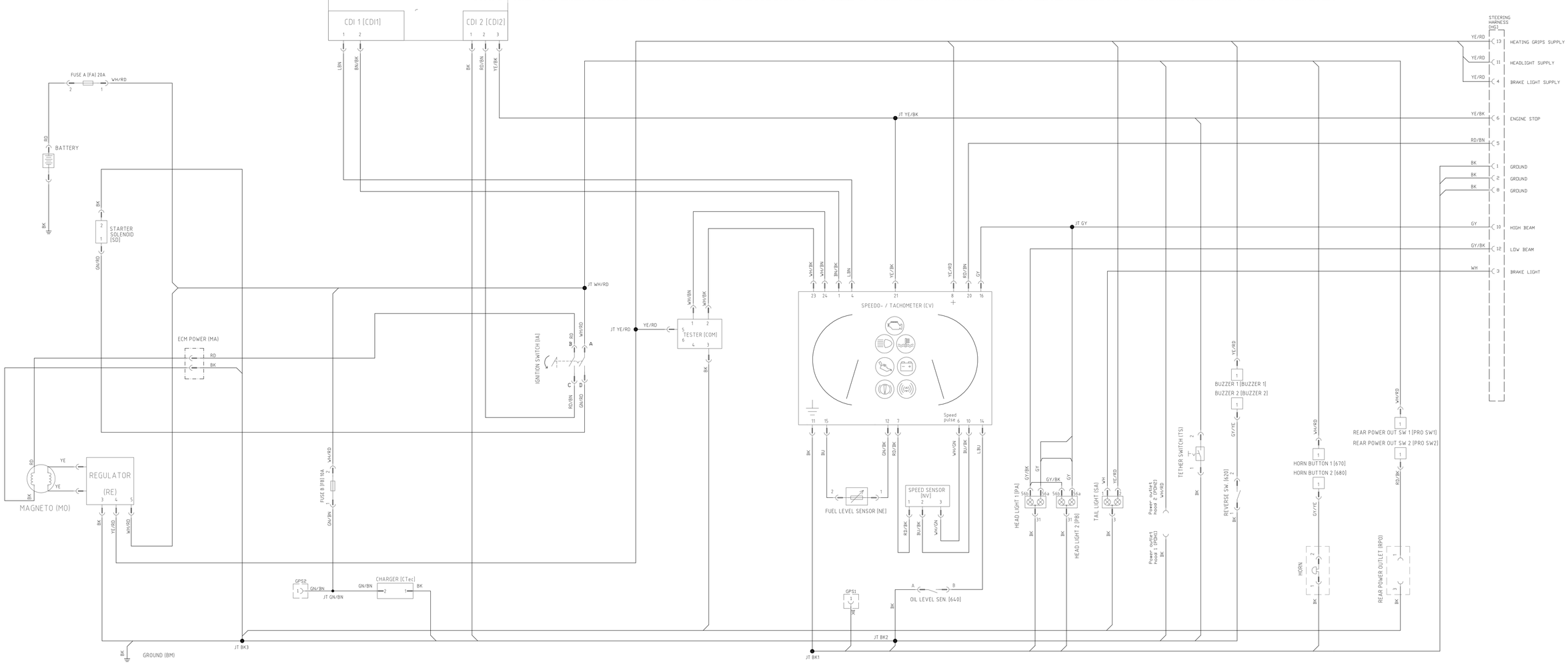


Skandic WT 550F

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COLOR	CODE
BLACK	BK
BLUE	BU,BL
GREEN	GN
ORANGE	OG, OR
PINK, ROSA	PK, RS
WHITE	WH
RED	RD
YELLOW	YE, YL
GRAY	GY, GR
BROWN	BN, BR
VIOLET	VT, VI
DARK BLUE	DBU, DBL
DARK GREEN	DGN
LIGHT BROWN	LBN, LBR, BE
LIGHT GREEN	LGN
LIGHT BLUE	LBU, LBL

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NOTES



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