



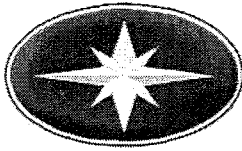
POLARIS
The Way Out.®

2011 *RANGER* RZR XP 900

SERVICE MANUAL

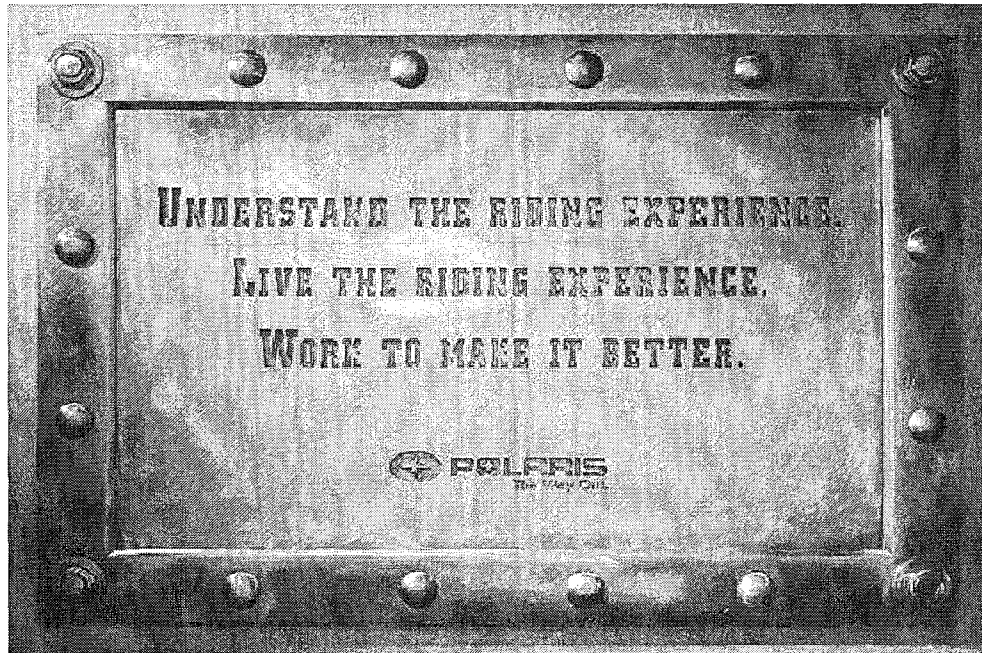
PN 9923144





POLARIS

The Way Out.



2011 *RANGER RZR XP 900* SERVICE MANUAL

FOREWORD

The information printed within this publication includes the latest product information at time of print. The most recent version of this Service Manual is available in electronic format at www.polarisdealers.com.

This Service Manual is designed primarily for use by certified Polaris Master Service Dealer® technicians in a properly equipped shop and should be kept available for reference. All references to left and right side of the vehicle are from the operator's perspective when seated in a normal riding position.

Some procedures outlined in this manual require a sound knowledge of mechanical theory, tool use, and shop procedures in order to perform the work safely and correctly. Technicians should read the text and be familiar with the service procedures before starting any repair. Certain procedures require the use of special tools. Use only the proper tools as specified. If you have any doubt as to your ability to perform any of the procedures outlined in this Service Manual, contact an authorized dealer for service.

We value your input and appreciate any assistance you can provide in helping make these publications more useful. Please provide any feedback you may have regarding this manual. Authorized dealers can submit feedback using 'Ask Polaris'. Click on 'Ask Polaris', and then click on 'Publications Question'.

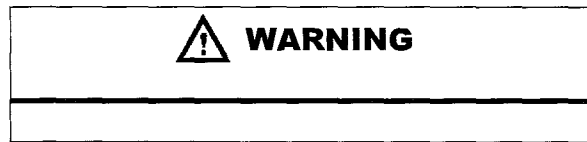
Consumers, please provide your feedback in writing to: Polaris Industries Inc. ATTN: Service Publications Department, 2100 Hwy 55, Medina, MN 55340.

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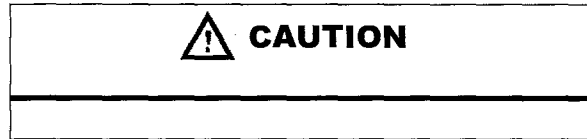
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UNDERSTANDING MANUAL SAFETY LABELS AND DIRECTIONS

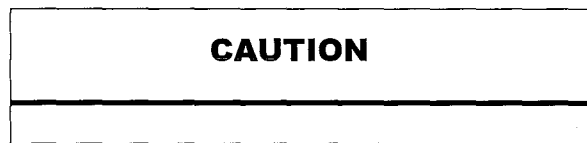
Throughout this manual, important information is brought to your attention by the following symbols:



SAFETY ALERT WARNING indicates a potential hazard that may result in severe injury or death to the operator, bystander or person(s) inspecting or servicing the vehicle.



SAFETY ALERT CAUTION indicates a potential hazard that may result in minor personal injury or damage to the vehicle.



CAUTION indicates special precautions that must be taken to avoid vehicle damage or property damage.

NOTE:

NOTE provides key information by clarifying instructions.

IMPORTANT:

IMPORTANT provides key reminders during disassembly, assembly and inspection of components.

TRADEMARKS

POLARIS ACKNOWLEDGES THE FOLLOWING PRODUCTS MENTIONED IN THIS MANUAL:

Loctite, Registered Trademark of the Loctite Corporation

Nyogel, Trademark of Wm. F. Nye Co.

Fluke, Registered Trademark of John Fluke Mfg. Co.

Mity-Vac, Registered Trademark of Neward Enterprises, Inc.

Torx, Registered Trademark of Textron

Hilliard, Trademark of the Hilliard Corporation

Warn, Trademark of Warn Industries

FOX, Registered Trademark of FOX RACING SHOX

RydeFX, Registered Trademark of ArvinMeritor

Some Polaris factory publications can be downloaded from www.polarisindustries.com, purchased from www.purepolaris.com or by contacting the nearest Polaris dealer.

GENERAL INFORMATION

1

MAINTENANCE

2

ENGINE / COOLING

3

ELECTRONIC FUEL INJECTION

4

BODY / STEERING / SUSPENSION

5

CLUTCHING (PVT)

6

FINAL DRIVE

7

TRANSMISSION

8

BRAKES

9

ELECTRICAL

10

GENERAL INFORMATION

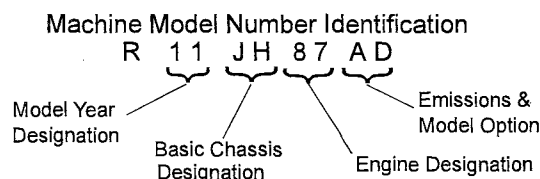
MODEL INFORMATION	1.2
MODEL IDENTIFICATION	1.2
ENGINE DESIGNATION NUMBER	1.2
VIN IDENTIFICATION	1.2
VEHICLE AND ENGINE SERIAL NUMBER LOCATION	1.2
VEHICLE INFORMATION	1.3
PUBLICATION NUMBERS	1.3
REPLACEMENT KEYS	1.3
SPECIAL TOOLS	1.3
GENERAL SPECIFICATIONS	1.4
GENERAL: 2011 <i>RANGER</i> RZR XP 900	1.4
DETAILED: 2011 <i>RANGER</i> RZR XP 900	1.5
MISC. SPECIFICATIONS AND CHARTS	1.6
CONVERSION TABLE	1.6
STANDARD TORQUE SPECIFICATIONS	1.7
SAE TAP / DRILL SIZES	1.8
METRIC TAP / DRILL SIZES	1.8
DECIMAL EQUIVALENTS	1.8
GLOSSARY OF TERMS	1.9

GENERAL INFORMATION

MODEL INFORMATION

Model Identification

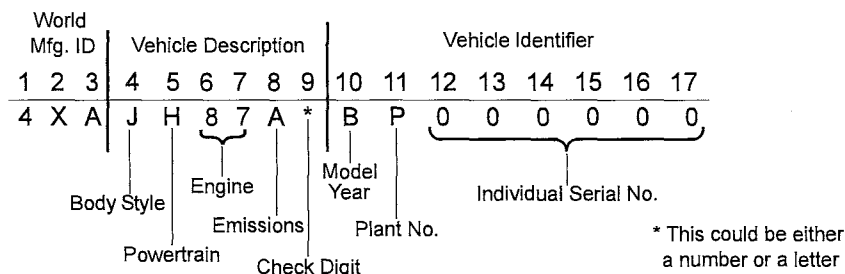
The machine model number must be used with any correspondence regarding warranty or service.



Engine Designation Number

ES087OLE011 4-Stroke DOHC Twin Cylinder, Liquid Cooled, Electric Start

VIN Identification

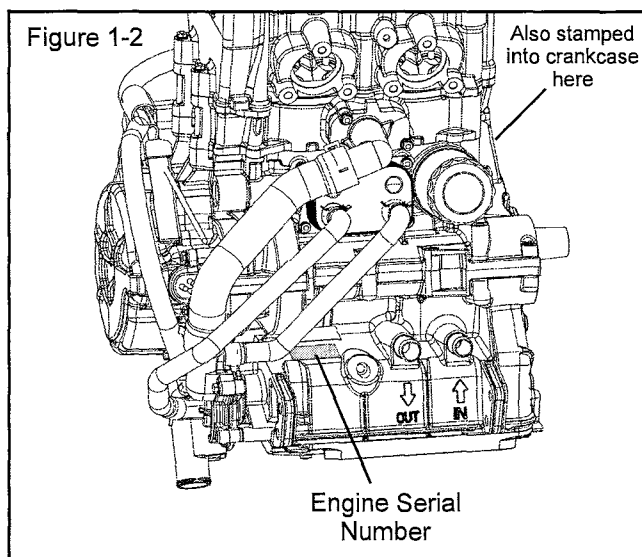
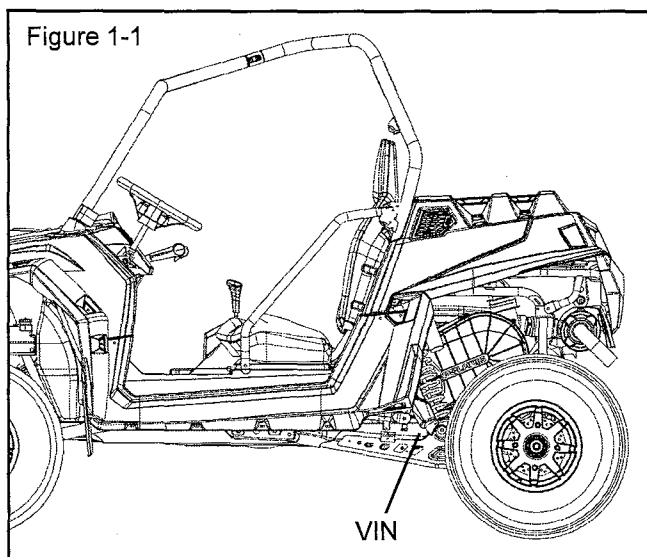


Vehicle and Engine Serial Number Location

Whenever corresponding about a Polaris ORV, refer to the vehicle identification number (VIN) and the engine serial number.

The VIN can be found stamped on a portion of the left rear frame rail, behind the lower shock mounting location (see Figure 1-1).

The engine serial number can be found on a decal applied to the crankcase, on the front side of the engine (see Figure 1-2).



VEHICLE INFORMATION**Publication Numbers**

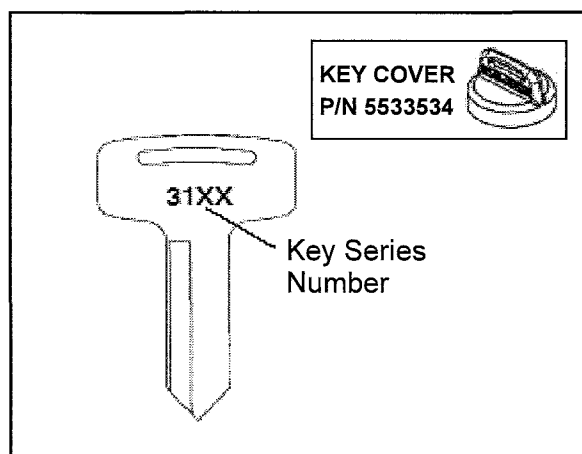
Model	Model No.	Owner's Manual	Parts Manual
2011 <i>RANGER</i> RZR XP 900	R11JH87AA, AD	9922978	9922979

NOTE: When ordering service parts be sure to use the correct parts manual.

NOTE: Polaris factory publications can be found at www.polarisindustries.com or purchased from www.purepolaris.com.

Replacement Keys

Replacement keys can be made from the original key. To identify which series the key is, take the first two digits on the original key and refer to the chart to the right for the proper part number.



Series#	Part Number
20	4010278
21	4010278
22	4010321
23	4010321
27	4010321
28	4010321
31	4110141
32	4110148
67	4010278
68	4010278

SPECIAL TOOLS

Special tools may be required while servicing this vehicle. Some of the tools listed or depicted are mandatory, while other tools may be substituted with a similar tool, if available. Polaris recommends the use of Polaris Special Tools when servicing any Polaris product. Dealers may order special tools through Polaris' official tool supplier, SPX Corporation, by phone at 1-800-328-6657 or on-line at <http://polaris.spx.com/>.

GENERAL INFORMATION

GENERAL SPECIFICATIONS

MODEL: 2011 *RANGER RZR XP 900*

MODEL NUMBER: R11JH87AA, AD

ENGINE NUMBER: 1204098

Category	Dimension / Capacity
Length	108.4 in. / 275 cm
Width	64 in. / 162.5 cm
Height	73 in. / 185 cm
Wheel Base	81.4 in. / 207 cm
Ground Clearance	13 in. / 33 cm
Dry Weight	1190 lbs. / 540 kg
Gross Vehicle Weight	1930 lbs. / 875 kg
Cargo Box Capacity	300 lbs. / 136 kg
Maximum Weight Capacity (Payload)	740 lbs. / 335.6 kg (Includes driver, passenger, cargo and accessories)
Hitch Towing Capacity	This vehicle is not equipped with a hitch for towing loads. Do not use this vehicle for towing. Do not modify the vehicle by adding a hitch.
Hitch Tongue Capacity	



MODEL: 2011 RANGER RZR XP 900

MODEL NUMBER: R11JH87AA, AD

ENGINE NUMBER: 1204098

Engine	
Platform	4-Stroke DOHC Twin Cylinder, Liquid Cooled, Electric Start
Engine Number	1204098 - ES087OLE011
Engine Displacement	875cc
Number of Cylinders	2
Bore & Stroke (mm)	93 x 64.4 mm
Compression Ratio	10.5:1
Engine Idle Speed	1250 ± 100 RPM
Engine Max Operating RPM	8750 RPM
Lubrication	Dry Sump
Oil Requirements	PS-4 Plus Synthetic
Oil Capacity	3.5 qts. / 3.3 liters
Coolant Capacity	4.9 qts. / 4.6 liters
Overheat Warning	Instrument Cluster Indicator
Exhaust System	Dual Headpipe / Single Silencer
Fuel System	
Fuel System Type	Bosch M17 EFI
Fuel Delivery	Electronic Fuel Pump (in tank)
Fuel Pressure	43.5 ± 2 psi (300 ± 14 kPa)
Fuel Filters	See Chapter 4
Fuel Capacity / Requirement	7.25 gal. (27.4 liters) 87 Octane (minimum)
Electrical	
Alternator Max Output	750 Watts @ 3000 RPM
Headlights	2 - Dual Beam LED: Low 27 Watts; High 40 Watts
Tail / Brake	2 - 6 Watts / 2 - 27 Watts
Starting System	Electric Start
Ignition System	Bosch M17 (ECU Controlled)
Spark Plug / Gap	RG4YCX / 0.03 in. (0.75 mm)
Battery	Deka ETX30L / 30 AH 365 CCA / 12 Volt
Instrument Type	Multifunction Instrument Cluster
DC Outlet	Standard 12 Volt
Relays	Chassis / EFI / Fan Fuel Pump / EPS (OPT)
Circuit Breaker	20 Amp: Fan Motor
Fuses (Fuse/Relay Box)	10 Amp: Drive 10 Amp: Fuel Pump 20 Amp: Lights 20 Amp: EFI 20 Amp: Accessory
Fuses (Power Fuse Holder)	30 Amp: EFI 30 Amp: Chassis 30 Amp: EPS (OPT)

Drivetrain	
Transmission Type	Polaris Automatic PVT
Drive Ratio - Front	3.82:1
Drive Ratio - Final	3.53:1
Shift Type	In Line Shift - H / L / N / R / P
Front Gearcase Fluid Type / Capacity	Polaris Demand Drive Plus 6.75 oz. (200 ml)
Transmission Fluid Type / Capacity	Polaris AGL Plus 44 oz. (1300 ml)
Clutching (PVT) Type	Drive: Polaris, Basic, Non-Braking Bearing
	Driven: Team Roller Dampened
Clutching (PVT) Center-to-Center Distance	10.5 in. (26.7 cm)
PVT Drive Belt	3211142
Steering / Suspension	
Front Suspension / Shock	Independent Dual A-arm FOX™ 2.0 Piggyback
Front Travel	13.5 in. / 34.3 cm
Rear Suspension / Shock	Independent Trailing Arm FOX™ 2.0 Piggyback
Rear Travel	14 in. / 35.6 cm
Shock Preload Adjustment Front / Rear	Threaded Spanner Wrench Adjustment
Toe Out	1/8 - 3/16 in. (3.2 - 4.8 mm)
Wheels / Brakes	
Front Wheel Size	12 x 6 / Cast Aluminum
Front Tire Type / Size	ITP "900XCT" / 27 x 9 R12
Rear Wheel Size	12 x 8 / Cast Aluminum
Rear Tire Type / Size	ITP "900XCT" / 27 x 12 R12
Tire Air Pressure	Front: 12 psi (82.7 kPa) Rear: 14 psi (96.5 kPa)
Brake - Front / Rear	Foot Actuated - 4 Wheel Hydraulic Disc
Brake Fluid	DOT 4

CLUTCH CHART

Altitude		Shift Weight	Drive Spring	Driven Spring
Meters (Feet)	0-1500 (0-5000)	25-60 (1322969)	Blue / Yellow (7043766)	Red (3234452)
		26-59 (1322981)		
	1500-3700 (5000 - 12000)	26-56 (1322979)	Blue / Yellow (7043766)	Red (3234452)
		26-55 (1322982)		

GENERAL INFORMATION

MISC. SPECIFICATIONS AND CHARTS

Conversion Table

Unit of Measure	Multiplied by	Converts to
ft. lbs.	x 12	= in. lbs.
in. lbs.	x .0833	= ft. lbs.
ft. lbs.	x 1.356	= Nm
in. lbs.	x .0115	= kg-m
Nm	x .7376	= ft.lbs.
kg-m	x 7.233	= ft. lbs.
kg-m	x 86.796	= in. lbs.
kg-m	x 10	= Nm
in.	x 25.4	=mm
mm	x .03937	= in.
in.	x 2.54	= cm
mile (mi.)	x 1.6	= km
km	x .6214	= mile (mi.)
Ounces (oz)	x 28.35	= Grams (g)
Fluid Ounces (fl. oz.)	x 29.57	= Cubic Centimeters (cc)
Cubic Centimeters (cc)	x .03381	= Fluid Ounces (fl. oz.)
Grams (g)	x 0.035	= Ounces (oz)
lb.	x .454	= kg
kg	x 2.2046	= lb.
Cubic inches (cu in)	x 16.387	= Cubic centimeters (cc)
Cubic centimeters (cc)	x 0.061	= Cubic inches (cu in)
Imperial pints (Imp pt)	x 0.568	= Liters (l)
Liters (l)	x 1.76	= Imperial pints (Imp pt)
Imperial quarts (Imp qt)	x 1.137	= Liters (l)
Liters (l)	x 0.88	= Imperial quarts (Imp qt)
Imperial quarts (Imp qt)	x 1.201	= US quarts (US qt)
US quarts (US qt)	x 0.833	= Imperial quarts (Imp qt)
US quarts (US qt)	x 0.946	= Liters (l)
Liters (l)	x 1.057	= US quarts (US qt)
US gallons (US gal)	x 3.785	=Liters (l)
Liters (l)	x 0.264	= US gallons (US gal)
Pounds - force per square inch (psi)	x 6.895	= Kilopascals (kPa)
Kilopascals (kPa)	x 0.145	= Pounds - force per square inch (psi)
Kilopascals (kPa)	x 0.01	= Kilograms - force per square cm
Kilograms - force per square cm	x 98.1	= Kilopascals (kPa)
$\pi (3.14) \times R^2 \times H$ (height)		= Cylinder Volume

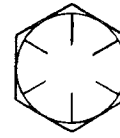
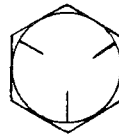
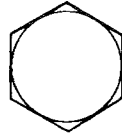
$$^{\circ}\text{C to }^{\circ}\text{F: } \frac{9}{5}(^{\circ}\text{C} + 32) = ^{\circ}\text{F}$$

$$^{\circ}\text{F to }^{\circ}\text{C: } \frac{5}{9}(^{\circ}\text{F} - 32) = ^{\circ}\text{C}$$

Standard Torque Specifications

1

The following torque specifications are to be used only as a general guideline. There are exceptions in the steering, suspension, and engine areas. Always consult the exploded views or each manual section for torque values of fasteners before using standard torque.



Bolt Size	Threads/in	Grade 2	Grade 5	Grade 8
Torque in. lbs. (Nm)				
#10 -	24	27 (3.1)	43 (5.0)	60 (6.9)
#10 -	32	31 (3.6)	49 (5.6)	68 (7.8)
Torque ft. lbs. (Nm)*				
1/4 -	20	5 (7)	8 (11)	12 (16)
1/4 -	28	6 (8)	10 (14)	14 (19)
5/16 -	18	11 (15)	17 (23)	25 (35)
5/16 -	24	12 (16)	19 (26)	29 (40)
3/8 -	16	20 (27)	30 (40)	45 (62)
3/8 -	24	23 (32)	35 (48)	50 (69)
7/16 -	14	30 (40)	50 (69)	70 (97)
7/16 -	20	35 (48)	55 (76)	80 (110)
1/2 -	13	50 (69)	75 (104)	110 (152)
1/2 -	20	55 (76)	90 (124)	120 (166)

Metric

6 x 1.0 72-78 in. lbs.

8 x 1.25 14-18 ft. lbs.

10 x 1.25 26-30 ft. lbs.

*To convert ft. lbs. to Nm multiply foot pounds by 1.382

*To convert Nm to ft. lbs. multiply Nm by .7376.

SPECIFIC TORQUE VALUES OF FASTENERS

Refer to exploded views in the appropriate section.

GENERAL INFORMATION

SAE Tap / Drill Sizes

Thread Size/Drill Size		Thread Size/Drill Size	
#0-80	3/64	1/2-13	27/64
#1-64	53	1/2-20	29/64
#1-72	53	9/16-12	31/64
#2-56	51	9/16-18	33/64
#2-64	50	5/8-11	17/32
#3-48	5/64	5/8-18	37/64
#3-56	45	3/4-10	21/32
#4-40	43	3/4-16	11/16
#4-48	42	7/8-9	49/64
#5-40	38	7/8-14	13/16
#5-44	37	1-8	7/8
#6-32	36	1-12	59/64
#6-40	33	1 1/8-7	63/64
#8-32	29	1 1/8-12	1 3/64
#8-36	29	1 1/4-7	1 7/64
#10-24	24	1 1/4-12	1 11/64
#10-32	21	1 1/2-6	1 11/32
#12-24	17	1 1/2-12	1 27/64
#12-28	4.6mm	1 3/4-5	1 9/16
1/4-20	7	1 3/4-12	1 43/64
1/4-28	3	2-4 1/2	1 25/32
5/16-18	F	2-12	1 59/64
5/16-24	I	2 1/4-4 1/2	2 1/32
3/8-16	O	2 1/2-4	2 1/4
3/8-24	Q	2 3/4-4	2 1/2
7/16-14	U	3-4	2 3/4
7/16-20	25/64		

Metric Tap / Drill Sizes

Tap Size	Drill Size	Decimal Equivalent	Nearest Fraction
3 x .50	#39	0.0995	3/32
3 x .60	3/32	0.0937	3/32
4 x .70	#30	0.1285	1/8
4 x .75	1/8	0.125	1/8
5 x .80	#19	0.166	11/64
5 x .90	#20	0.161	5/32
6 x 1.00	#9	0.196	13/64
7 x 1.00	16/64	0.234	15/64
8 x 1.00	J	0.277	9/32
8 x 1.25	17/64	0.265	17/64
9 x 1.00	5/16	0.3125	5/16
9 x 1.25	5/16	0.3125	5/16
10 x 1.25	11/32	0.3437	11/32
10 x 1.50	R	0.339	11/32
11 x 1.50	3/8	0.375	3/8
12 x 1.50	13/32	0.406	13/32
12 x 1.75	13/32	0.406	13/32

Decimal Equivalents

1/64	.0156	
1/32	.0312	1 mm = .0394"
3/64	.0469	
1/16	.0625	2 mm = .0787"
5/64	.0781	
3/32	.0938	
7/64	.1094	3 mm = .1181"
1/8	.1250	
9/64	.1406	
5/32	.1563	4 mm = .1575"
11/64	.1719	
3/16	.1875	5 mm = .1969"
13/64	.2031	
7/32	.2188	
15/64	.2344	6 mm = .2362"
1/4	.25	
17/64	.2656	7 mm = .2756"
9/32	.2813	
19/64	.2969	
5/16	.3125	8 mm = .3150"
21/64	.3281	
11/32	.3438	9 mm = .3543"
23/64	.3594	
3/8	.375	
25/64	.3906	10 mm = .3937"
13/32	.4063	
27/64	.4219	11 mm = .4331"
7/16	.4375	
29/64	.4531	
15/32	.4688	12 mm = .4724"
31/64	.4844	
1/2	.5	13 mm = .5118
33/64	.5156	
17/32	.5313	
35/64	.5469	14 mm = .5512"
9/16	.5625	
37/64	.5781	15 mm = .5906"
19/32	.5938	
39/64	.6094	
5/8	.625	16 mm = .6299"
41/64	.6406	
21/32	.6563	17 mm = .6693"
43/64	.6719	
11/16	.6875	
45/64	.7031	18 mm = .7087"
23/32	.7188	
47/64	.7344	19 mm = .7480"
3/4	.75	
49/64	.7656	
25/32	.7813	20 mm = .7874"
51/64	.7969	
13/16	.8125	21 mm = .8268"
53/64	.8281	
27/32	.8438	
55/64	.8594	22 mm = .8661"
7/8	.875	
57/64	.8906	23 mm = .9055"
29/32	.9063	
59/64	.9219	
15/16	.9375	24 mm = .9449"
61/64	.9531	
31/32	.9688	25 mm = .9843
63/64	.9844	
1	1.0	

Glossary of Terms

ABDC: After bottom dead center.

ACV: Alternating current voltage.

Alternator: Electrical generator producing voltage alternating current.

ATDC: After top dead center.

BBDC: Before bottom dead center.

BDC: Bottom dead center.

BTDC: Before top dead center.

CC: Cubic centimeters.

Center Distance: Distance between center of crankshaft and center of driven clutch shaft.

Chain Pitch: Distance between chain link pins (No. 35 = 3/8" or 1 cm). Polaris measures chain length in number of pitches.

CI: Cubic inches.

Clutch Buttons: Plastic bushings which aid rotation of the movable sheave in the drive and driven clutch.

Clutch Offset: Drive and driven clutches are offset so that drive belt will stay nearly straight as it moves along the clutch face.

Clutch Weights: Three levers in the drive clutch which relative to their weight, profile and engine RPM cause the drive clutch to close and grip the drive belt.

Crankshaft Run-Out: Run-out or "bend" of crankshaft measured with a dial indicator while crankshaft is supported between centers on V blocks or resting in crankcase. Measure at various points especially at PTO.

DCV: Direct current voltage

CVT: Centrifugal Variable Transmission (Drive Clutch System)

DCV: Direct current voltage.

Dial Bore Gauge: A cylinder measuring instrument which uses a dial indicator. Good for showing taper and out-of-round in the cylinder bore.

Electrical Open: Open circuit. An electrical circuit which isn't complete.

Electrical Short: Short circuit. An electrical circuit which is completed before the current reaches the intended load. (i.e. a bare wire touching the chassis).

End Seals: Rubber seals at each end of the crankshaft.

Engagement RPM: Engine RPM at which the drive clutch engages to make contact with the drive belt.

ft.: Foot/feet.

Foot Pound: Ft. lb. A force of one pound at the end of a lever one foot in length, applied in a rotational direction.

g: Gram. Unit of weight in the metric system.

gal.: Gallon.

ID: Inside diameter.

in.: Inch/inches.

Inch Pound: In. lb. 12 in. lbs. = 1 ft. lb.

kg/cm²: Kilograms per square centimeter.

kg-m: Kilogram meters.

Kilogram/meter: A force of one kilogram at the end of a lever one meter in length, applied in a rotational direction.

l or ltr: Liter.

lbs/in²: Pounds per square inch.

Left or Right Side: Always referred to based on normal operating position of the driver.

m: Meter/meters.

Mag: Magneto.

Magnetic Induction: As a conductor (coil) is moved through a magnetic field, a voltage will be generated in the windings. Mechanical energy is converted to electrical energy in the stator.

mi.: Mile/miles.

mm: Millimeter. Unit of length in the metric system. 1 mm = approximately .040".

Nm: Newton meters.

OD: Outside diameter.

Ohm: The unit of electrical resistance opposing current flow.

oz.: Ounce/ounces.

Piston Clearance: Total distance between piston and cylinder wall.

psi.: Pounds per square inch.

PTO: Power take off.

PVT: Polaris Variable Transmission (Drive Clutch system)

qt.: Quart/quarts.

Regulator: Voltage regulator. Regulates battery charging system output at approx. 14.5 DCV as engine RPM increases.

Reservoir Tank: The fill tank in the liquid cooling system.

Resistance: In the mechanical sense, friction or load. In the electrical sense, ohms, resulting in energy conversion to heat.

RPM: Revolutions per minute.

Seized Piston: Galling of the sides of a piston. Usually there is a transfer of aluminum from the piston onto the cylinder wall.

Possible causes: 1) improper lubrication; 2) excessive temperatures; 3) insufficient piston clearance; 4) stuck piston rings.

Stator Plate: The plate mounted under the flywheel supporting the battery charging coils.

TDC: Top dead center. Piston's most outward travel from crankshaft.

Volt: The unit of measure for electrical pressure of electromotive force. Measured by a voltmeter in parallel with the circuit.

Watt: Unit of electrical power. Watts = amperes x volts.

WOT: Wide open throttle.

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CHAPTER 2

MAINTENANCE

2

PERIODIC MAINTENANCE CHART	2.3
BREAK-IN PERIOD / MAINTENANCE CHART KEY	2.3
PRE-RIDE - 50 HOUR MAINTENANCE INTERVAL	2.4
50 - 500 HOUR MAINTENANCE INTERVAL	2.5
MAINTENANCE QUICK REFERENCE	2.6
MAINTENANCE QUICK REFERENCE, CONTINUED.....	2.7
GREASE LUBRICATION POINTS	2.8
LUBRICANTS / SERVICE PRODUCTS	2.9
GENERAL VEHICLE INSPECTION AND MAINTENANCE.....	2.10
PRE-RIDE / DAILY INSPECTION	2.10
FRAME, NUTS, BOLTS, AND FASTENERS	2.10
SHIFT CABLE INSPECTION / ADJUSTMENT.....	2.10
FUEL SYSTEM AND AIR INTAKE	2.11
FUEL TANK VENT LINE AND FILTER.....	2.11
FUEL PUMP / FUEL FILTERS	2.11
FUEL LINES	2.12
THROTTLE PEDAL INSPECTION	2.12
THROTTLE FREEPLAY ADJUSTMENT	2.13
ENGINE INTAKE PRE-FILTER SERVICE	2.13
AIR FILTER SERVICE	2.14
INTAKE BAFFLE BOX DRAIN INSPECTION.....	2.14
AIR BOX / AIR FILTER EXPLODED VIEW	2.15
ENGINE.....	2.16
ENGINE OIL LEVEL / OIL AND FILTER CHANGE	2.16
ENGINE / OIL TANK BREATHER HOSE INSPECTION	2.18
ENGINE CYLINDER LEAKDOWN TEST	2.18
VALVE CLEARANCE INSPECTION	2.18
EXHAUST - SPARK ARRESTOR.....	2.21
TRANSMISSION AND FRONT GEARCASE.....	2.22
TRANSMISSION LUBRICATION	2.22
FRONT GEARCASE LUBRICATION	2.23
COOLING SYSTEM.....	2.24
COOLANT STRENGTH	2.24
COOLANT LEVEL INSPECTION	2.25
COOLING SYSTEM PRESSURE TEST / HOSES.....	2.25
RADIATOR INSPECTION / CLEANING.....	2.26
COOLANT DRAIN / FILL	2.26
PVT / FINAL DRIVE / WHEEL AND TIRE	2.27
DRIVE CLUTCH / DRIVEN CLUTCH / BELT SERVICE	2.27
PVT INTAKE PRE-FILTER SERVICE	2.27
PVT DRYING	2.27
DRIVE SHAFT BOOT INSPECTION	2.28
WHEEL AND HUB TORQUE TABLE	2.28
WHEEL REMOVAL / INSTALLATION	2.28
TIRE INSPECTION.....	2.29
TIRE PRESSURE.....	2.29
ELECTRICAL AND IGNITION SYSTEM	2.29
BATTERY MAINTENANCE	2.29
BATTERY REMOVAL / INSTALLATION	2.30
BATTERY CHARGING / OFF SEASON STORAGE	2.30
ENGINE / CHASSIS ELECTRICAL GROUND.....	2.30
SPARK PLUG SERVICE	2.31

MAINTENANCE

STEERING	2.32
STEERING INSPECTION	2.32
STEERING WHEEL FREEPLAY	2.32
TIE ROD END / WHEEL HUB INSPECTION	2.32
WHEEL TOE ALIGNMENT INSPECTION	2.33
WHEEL TOE ADJUSTMENT	2.33
SUSPENSION (FOX™)	2.34
SPRING PRELOAD ADJUSTMENT	2.34
SHOCK COMPRESSION ADJUSTMENT	2.35
BRAKE SYSTEM	2.36
BRAKE FLUID INSPECTION	2.36
BRAKE PAD / DISC INSPECTION	2.36
BRAKE HOSE AND FITTING INSPECTION	2.36
MAINTENANCE LOG	2.37

PERIODIC MAINTENANCE CHART

Periodic Maintenance Overview

Inspection, adjustment and lubrication of important components are explained in the periodic maintenance chart.

Inspect, clean, lubricate, adjust and replace parts as necessary. When inspection reveals the need for replacement parts, use genuine Pure Polaris parts available from your Polaris dealer.

NOTE: Service and adjustments are critical. If you're not familiar with safe service and adjustment procedures, have a qualified dealer perform these operations.

Maintenance intervals in the following chart are based upon average riding conditions and an average vehicle speed of approximately 10 miles per hour. Vehicles subjected to severe use must be inspected and serviced more frequently.

Severe Use Definition

- Frequent immersion in mud, water or sand
- Racing or race-style high RPM use
- Prolonged low speed, heavy load operation
- Extended idle
- Short trip cold weather operation

Pay special attention to the oil level. A rise in oil level during cold weather can indicate contaminants collecting in the oil sump or crankcase. Change oil immediately if the oil level begins to rise. Monitor the oil level, and if it continues to rise, discontinue use and determine the cause or see your dealer.

Break-In Period

The break-in period consists of the first 25 hours of operation. Careful treatment of a new engine and drive components will result in more efficient performance and longer life for these components.

- Drive vehicle slowly at first while varying the throttle position. Do not operate at sustained idle.
- Perform regular checks on fluid levels and other areas outlined on the daily pre-ride inspection checklist.
- Change both the engine oil and filter after 25 hours or one month.
- See "Owner's Manual" for additional break-in information.

Maintenance Chart Key

The following symbols denote potential items to be aware of during maintenance:

■ = **CAUTION:** Due to the nature of these adjustments, it is recommended this service be performed by an authorized Polaris dealer.

▶ = **SEVERE USE ITEM:** See information provided above.

E = **Emission Control System Service (California).**

NOTE: Inspection may reveal the need for replacement parts. Always use genuine Polaris parts.



WARNING

Improperly performing the procedures marked ■ could result in component failure and lead to serious injury or death. Have an authorized Polaris dealer perform these services.

MAINTENANCE

Pre-Ride - 50 Hour Maintenance Interval

Item	Maintenance Interval (whichever comes first)			Remarks
	Hours	Calendar	Miles (KM)	
Steering	-	Pre-Ride	-	Inspect or adjust as needed. See Pre-Ride Checklist on Page 2.10.
Front Suspension	-	Pre-Ride	-	
Rear Suspension	-	Pre-Ride	-	
Tires	-	Pre-Ride	-	
Brake Fluid Level	-	Pre-Ride	-	
Brake Pedal Travel	-	Pre-Ride	-	
Brake System	-	Pre-Ride	-	
Wheels / Fasteners	-	Pre-Ride	-	
Frame Fasteners	-	Pre-Ride	-	
E Engine Oil Level	-	Pre-Ride	-	
E Engine Intake Pre-Filter	-	Daily	-	Inspect and clean often
PVT Intake Pre-Filter	-	Daily	-	Inspect and clean often
Coolant Level	-	Daily	-	Check level daily
Head Lights / Tail Lights	-	Daily	-	Check operation
▶ ■ Brake Pad Wear	10 H	Monthly	100 (160)	Inspect periodically
▶ E Engine Oil & Filter Change (Break-In)	25 H	1 M	-	Perform a break-in oil and filter change at 25 hours or one month; perform every 50 hours or 6 months thereafter
▶ E Air Filter	25 H	Monthly	250 (400)	Inspect; replace as needed
Battery	25 H	Monthly	250 (400)	Check terminals; clean; test
▶ Front Gearcase Lubricant (Demand Drive Plus)	25 H	Monthly	250 (400)	Inspect level; add lubricant if needed
▶ Transmission Lubricant (AGL Gearcase Lubricant)	25 H	Monthly	250 (400)	Inspect level; add lubricant if needed
▶ E Engine Breather Filter (if equipped)	25 H	Monthly	250 (400)	Inspect; replace if necessary
▶ General Lubrication	50 H	3 M	500 (800)	Lubricate all fittings, pivots, cables, etc.
■ E Throttle Cable / Throttle Pedal	50 H	6 M	300 (500)	Inspect; adjust; replace if necessary
E Throttle Body Intake Boots	50 H	6 M	300 (500)	Inspect ducts for proper sealing / air leaks
Shift Linkage	50 H	6 M	500 (800)	Inspect; adjust as needed
▶ Front Suspension	50 H	6 M	500 (800)	Lubricate
▶ Rear Suspension	50 H	6 M	500 (800)	Lubricate

▶ Perform these procedures more often for vehicles subjected to severe use.

E Emission Control System Service (California)

■ Have an authorized Polaris dealer perform these services.

50 - 500 Hour Maintenance Interval

Item	Maintenance Interval (whichever comes first)			Remarks
	Hours	Calendar	Miles (KM)	
■ Cooling System	50 H	6 M	500 (800)	Inspect coolant strength seasonally; pressure test system yearly
▶ Engine Oil Change	50 H	6 M	1000 (1600)	Perform a break-in oil change at 25 hours or one month
▶ Engine Oil Filter Change	50 H	6 M	1000 (1600)	Replace oil filter during engine oil change
▶ Front Gearcase Lubricant (Demand Drive Plus)	-	12 M	2500 (4000)	Change lubricant
▶ Transmission Lubricant (AGL Gearcase Lubricant)	-	12 M	2500 (4000)	Change lubricant
■ E Fuel System	100 H	12 M	1000 (1600)	Check for leaks at fill cap, fuel line / rail, and fuel pump.
■ E Spark Plug Inspection	100 H	12 M	1000 (1600)	Inspect; replace as needed; torque to specification
▶ Radiator	100 H	12 M	1000 (1600)	Inspect; clean external surfaces
▶ Cooling Hoses	100 H	12 M	1000 (1600)	Inspect for leaks; pressure test system
▶ Engine Mounts	100 H	12 M	1000 (1600)	Inspect, torque to specification
Exhaust Silencer / Pipe	100 H	12 M	1000 (1600)	Inspect
▶ Wiring	100 H	12 M	1000 (1600)	Inspect for wear, routing, security; apply dielectric grease to connectors subjected to water, mud, etc.
■ Clutches (Drive and Driven)	100 H	12 M	1000 (1600)	Inspect; clean; replace worn parts
■ Drive Belt	100 H	12 M	1000 (1600)	Inspect; replace as needed
■ Front Wheel Bearings	100 H	12 M	1000 (1600)	Inspect; replace as needed
▶ Shocks	100 H	-	-	Visually inspect shock seals
▶ Coolant	-	24 M	-	Replace coolant
■ Brake Fluid	200 H	24 M	2000 (3200)	Change every two years (DOT 4)
Spark Arrestor	200 H	24 M	2000 (3200)	Clean out
■ E Valve Clearance	200 H	-	2000 (3200)	Inspect; adjust as needed
▶ ■ Shocks	200 H	24 M	-	Change shock oil and seals
■ E Spark Plug Replacement	500 H	36 M	5000 (8000)	Replace; torque to specification
■ Toe Adjustment	-			Inspect periodically; adjust when parts are replaced
Headlight Aim	-			Adjust as needed

▶ Perform these procedures more often for vehicles subjected to severe use.

E Emission Control System Service (California)

■ Have an authorized Polaris dealer perform these services.

MAINTENANCE

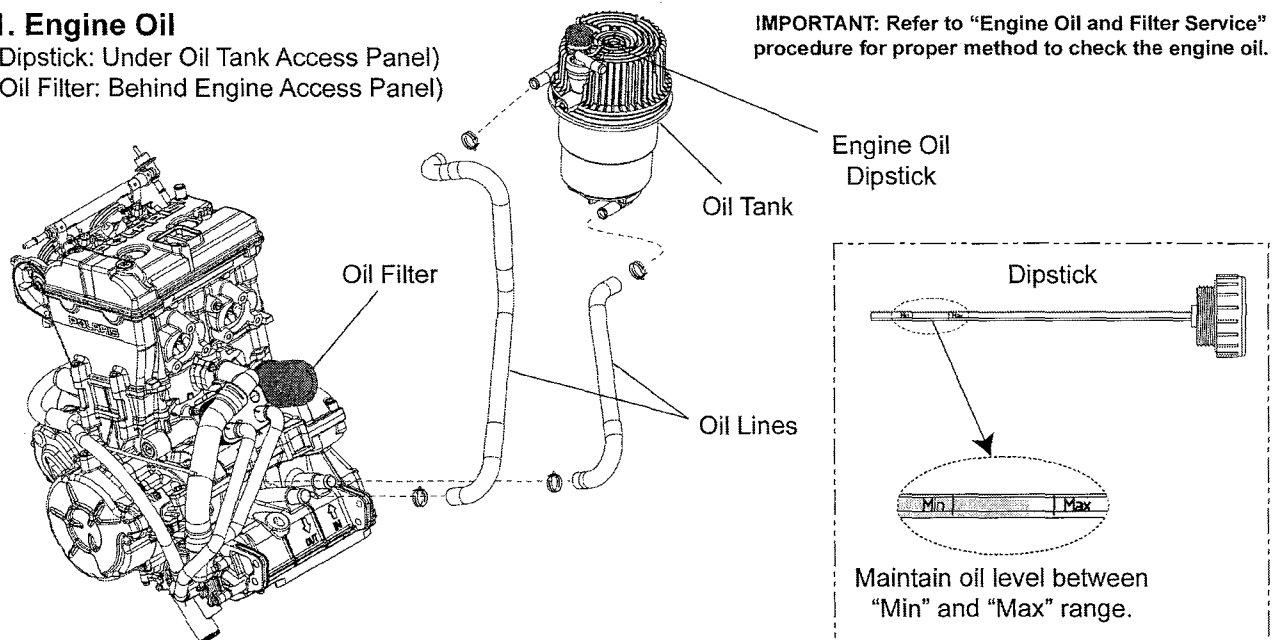
Maintenance Quick Reference

Ill. #	Item	Lube Rec.	Method	Frequency*
1	Engine Oil	Polaris PS-4 Plus Performance Synthetic 4-Cycle Engine Oil	Add oil to proper level on dipstick	Perform a break-in oil and filter change at 25 hrs or one month; perform every 50 hrs thereafter
2	Engine Coolant	Polaris 60/40 Coolant	Maintain coolant level in coolant reservoir bottle.	Check level daily; change coolant every two years

* More often under severe use, such as operated in water or under severe loads.

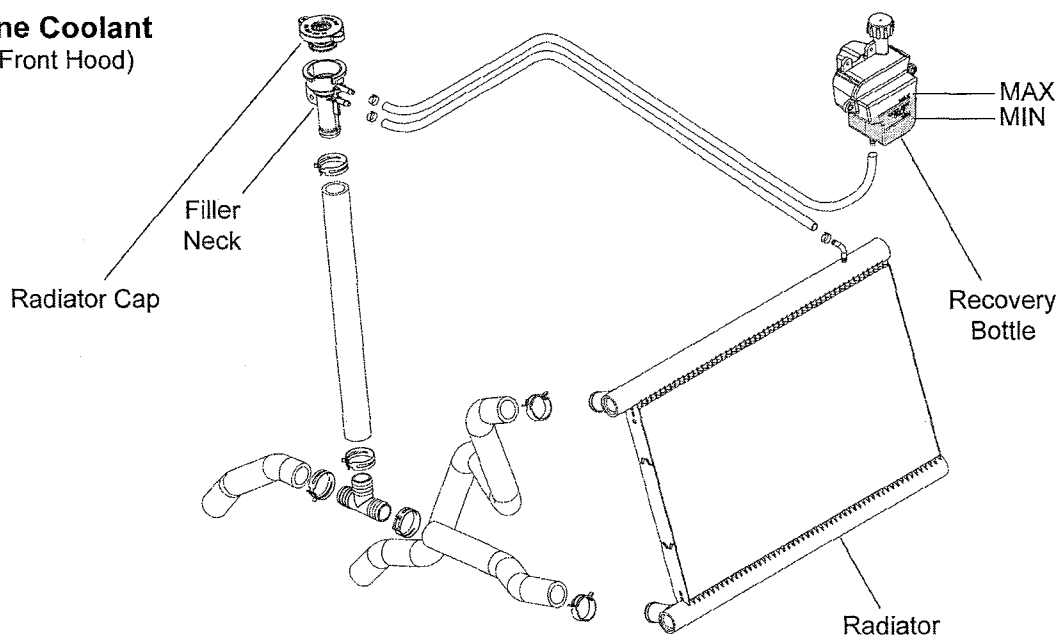
1. Engine Oil

(Dipstick: Under Oil Tank Access Panel)
(Oil Filter: Behind Engine Access Panel)



2. Engine Coolant

(Under Front Hood)



Maintenance Quick Reference, Continued.....

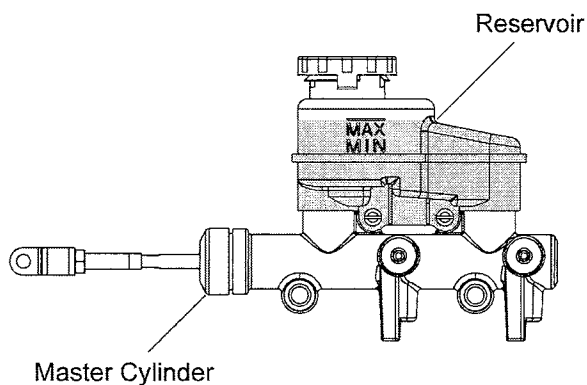
Ill. #	Item	Lube Rec.	Method	Frequency*
3	Brake Fluid	Polaris DOT 4 Brake Fluid	Maintain fluid level between "MAX" and "MIN" lines on the master cylinder reservoir	Check level during pre-ride inspection; change fluid every two years
4	Front Gearcase	Polaris Demand Drive Plus	Add lubricant until it is visible at the fill hole threads	Check level every 25 hours or 250 mi (400 km); Change fluid yearly or every 2500 mi. (4000 km); whichever comes first
5	Transmission	Polaris AGL Plus Gearcase Lubricant	Add lubricant until it is visible at the fill hole threads	

* More often under severe use, such as operated in water or under severe loads.

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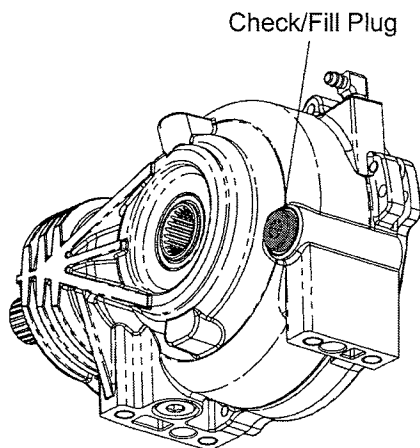
3. Brake Fluid

(Front LH Wheel Well)



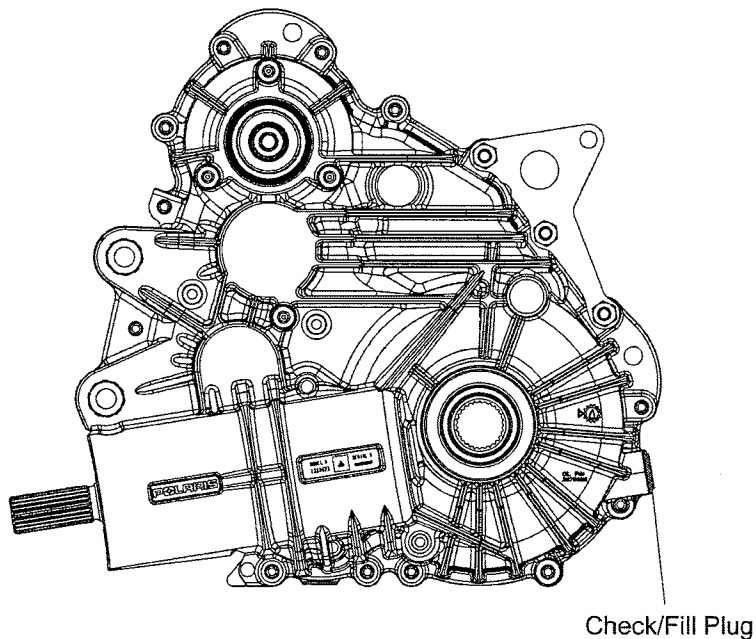
4. Front Gearcase

(Front RH Wheel Well)



5. Transmission

(Rear of Vehicle)

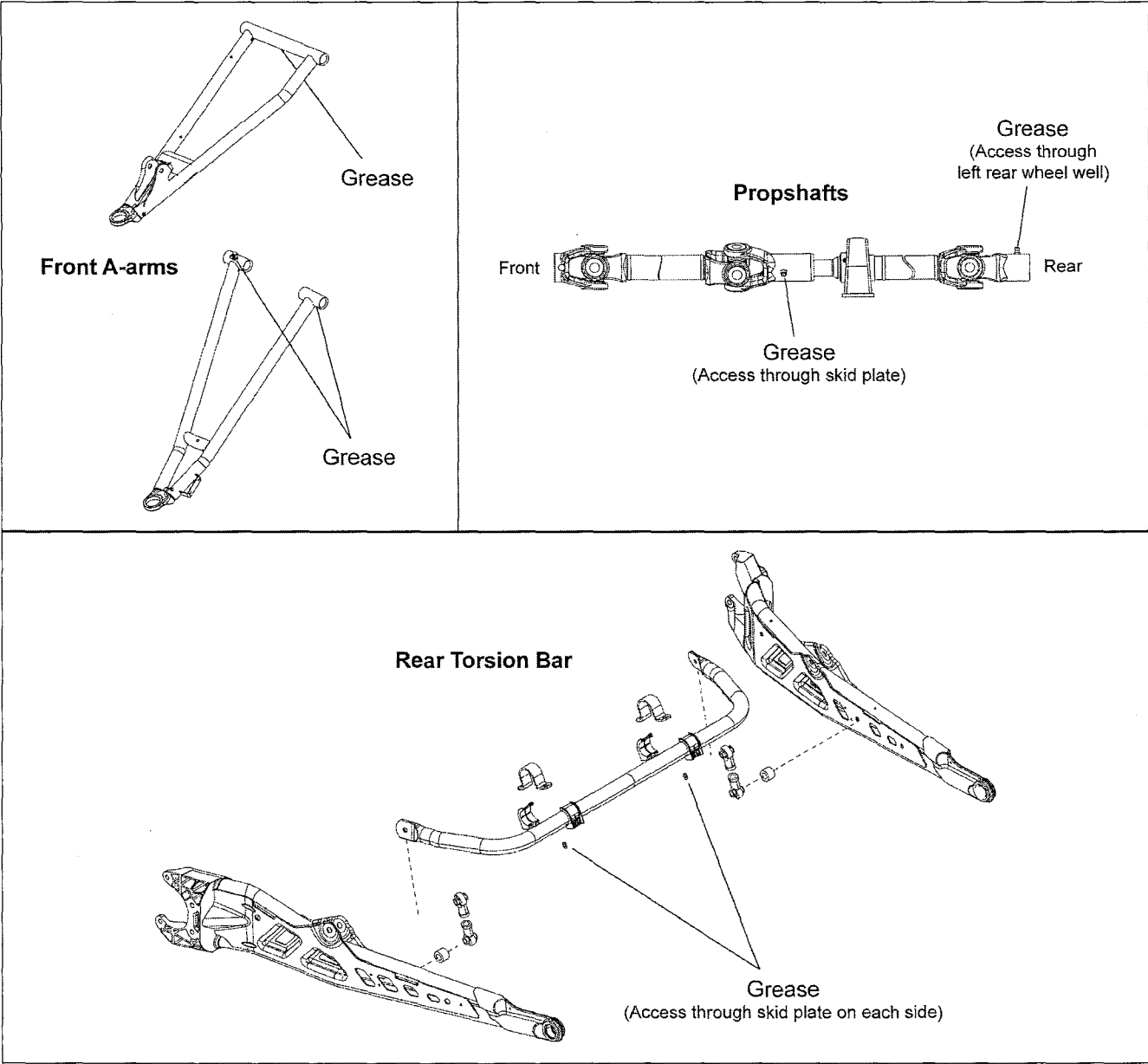


MAINTENANCE

Grease Lubrication Points

There are grease fittings at each front A-arm pivot point, each rear torsion bar bushing and on the front propshaft yokes. Apply grease until all traces of water have been purged out at each of these areas.

Item	Method	Recommended Lube	Frequency
Propshaft Yokes	Grease middle and rear fittings	Polaris Premium U-Joint Grease	Grease fittings every 500 miles (800 km); Grease before long periods of storage, and after thoroughly washing or submerging the vehicle
Front A-arm Pivot Bushings	Grease 3 fittings on each side of the vehicle	Polaris All Season Grease	
Rear Torsion Bar Bushings	Grease 2 fittings through the skid plate access holes on each side of the vehicle	Polaris All Season Grease	



LUBRICANTS / SERVICE PRODUCTS

Polaris Lubricants, Maintenance and Service Products

Part No.	Description
Engine Lubricant	
2870791	Fogging Oil (12 oz. Aerosol)
2876244	PS-4 Plus Synthetic 4-Cycle Engine Oil (Quart)
2876245	PS-4 Plus Synthetic 4-Cycle Engine Oil (Gallon)
Gearcase / Transmission Lubricants	
2878068	AGL Plus Gearcase Lubricant (1 Qt.) (12 Count)
2878069	AGL Plus Gearcase Lubricant (1 Gal.) (4 Count)
2878070	AGL Plus Gearcase Lubricant (2.5 Gal.) (2 Count)
2877922	Demand Drive Plus (Quart)
2877923	Demand Drive Plus (2.5 Gallon)
2870465	Oil Pump for 1 Gallon Jug
Grease / Specialized Lubricants	
2871312	Grease Gun Kit
2871322	Premium All Season Grease (3 oz. cartridge) (24 Count)
2871423	Premium All Season Grease (14 oz. cartridge) (10 Count)
2871460	Starter Drive Grease (12 Count)
2871515	Premium U-Joint Lube (3 oz.) (24 Count)
2871551	Premium U-Joint Lube (14 oz.) (10 Count)
2871329	Dielectric Grease (Nyogel™)
Coolant	
2871323	60/40 Coolant (Gallon) (6 Count)
2871534	60/40 Coolant (Quart) (12 Count)

NOTE: Each item can be purchased separately at your local Polaris dealer.

Part No.	Description
Additives / Sealants / Thread Locking Agents / Misc.	
2871950	Loctite™ Threadlock 242 (6 ml.) (12 count)
2871326	Premium Carbon Clean (12 oz.) (12 count)
2870652	Fuel Stabilizer (16 oz.) (12 count)
2872189	DOT 4 Brake Fluid (12 count)
2871557	Crankcase Sealant, 3-Bond 1215 (5 oz.)

NOTE: The number count indicated by each part number in the table above indicates the number of units that are shipped with each order.

MAINTENANCE

GENERAL VEHICLE INSPECTION AND MAINTENANCE

Pre-Ride / Daily Inspection

Perform the following pre-ride inspection daily, and when servicing the vehicle at each scheduled maintenance.

- Engine Oil - Check for proper level on dipstick located in oil tank (refer to "Engine Oil Level" procedure)
- Tires - check condition and pressures
- Fuel tank - fill to proper level
- All brakes - check operation and fluid level
- Throttle - check for free operation and closing
- Headlights/Taillights/Brakelights - also check operation of all indicator lights, instrument cluster and switches
- Ignition switch - check for proper function
- Wheels - check for tightness of wheel nuts and axle nuts; check to be sure axle nuts are secured by cotter pins
- Engine Intake Pre-Filter - Inspect pre-filter and clean with soapy water and compressed air if necessary
- PVT Intake Pre-Filter - Inspect pre-filter and clean with soapy water and compressed air if necessary
- Steering - check for free operation noting any unusual looseness in any area
- Loose parts - visually inspect vehicle for any damaged or loose nuts, bolts or fasteners
- Engine coolant - check for proper level at the recovery bottle
- Drive Shaft Boots - Inspect inner and outer boots for tears or damage on both front and rear drive shafts
- Check all front and rear suspension components for wear or damage.

Frame, Nuts, Bolts, and Fasteners

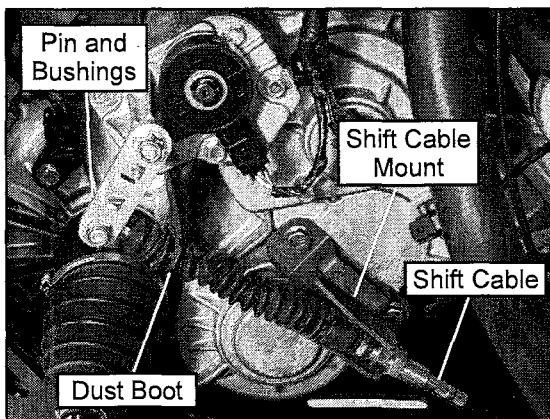
Periodically inspect the torque of all fasteners in accordance with the maintenance schedule. Check that all cotter pins are in place. Refer to specific fastener torques listed in each chapter.

Shift Cable Inspection / Adjustment

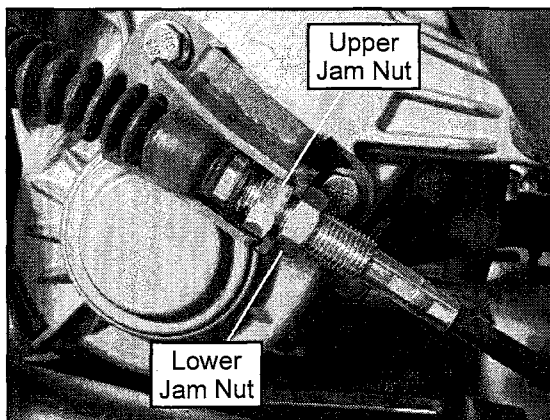
Shift cable adjustment may be necessary if symptoms include:

- No gear position or AWD display on instrument cluster
- Ratcheting noise on deceleration
- Inability to engage into a gear
- Excessive gear clash (noise)
- Gear selector moving out of desired range

1. Locate the shift cable attached to the transmission case in the right rear wheel well area.
2. Inspect shift cable, clevis pin, pivot bushings, and dust boot. Replace if worn or damaged.



3. If adjustment is required, loosen the lower jam nut and pull the cable out of the mount to move the upper jam nut.



4. Adjust the shift cable so there is the same amount of cable travel when shifting slightly past HIGH gear and PARK.
5. Thread the upper or lower jam nut as required to obtain proper cable adjustment.

NOTE: This procedure may require a few attempts to obtain the proper adjustment.

6. Once the proper adjustment is obtained, place the shift cable and upper jam nut into the mount. Tighten the lower jam nut against the mount.
7. Start engine and shift through all gears to ensure the shift cable is properly adjusted. If transmission still ratchets after cable adjustment, the transmission will require service.

FUEL SYSTEM AND AIR INTAKE

Fuel System

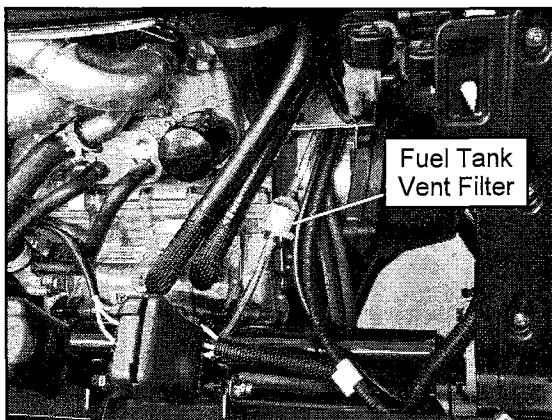
WARNING

Gasoline is extremely flammable and explosive under certain conditions.
Always stop the engine and refuel outdoors or in a well ventilated area.
Do not smoke or allow open flames or sparks in or near the area where refueling is performed or where gasoline is stored.
Do not overfill the tank. Do not fill the tank neck.
If you get gasoline in your eyes or if you swallow gasoline, seek medical attention immediately.
If you spill gasoline on your skin or clothing, immediately wash it off with soap and water and change clothing.
Never start the engine or let it run in an enclosed area. Engine exhaust fumes are poisonous and can result in loss of consciousness or death in a short time.
Never drain the fuel when the engine is hot. Severe burns may result.

Fuel Tank Vent Line and Filter

Symptoms of a restricted fuel tank vent include the following: collapsing fuel tank, engine miss or hesitation, loss of engine performance or high exhaust temperatures.

1. Remove the seats and the engine service panel.
2. Locate and inspect the in-line filter. Note the direction of the arrow on the filter if removed.



3. If there is debris visible in the filter, replace it.

NOTE: Be sure to install the filter in the orientation shown in the previous photo.

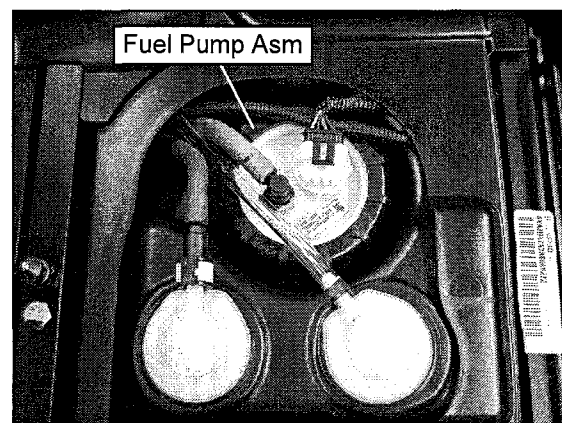
4. Check the fuel tank vent line for signs of wear, deterioration or damage. Replace vent line if necessary.
5. Be sure the vent line is routed properly and secured with cable tie(s).

IMPORTANT: Make sure vent line is not kinked or pinched.

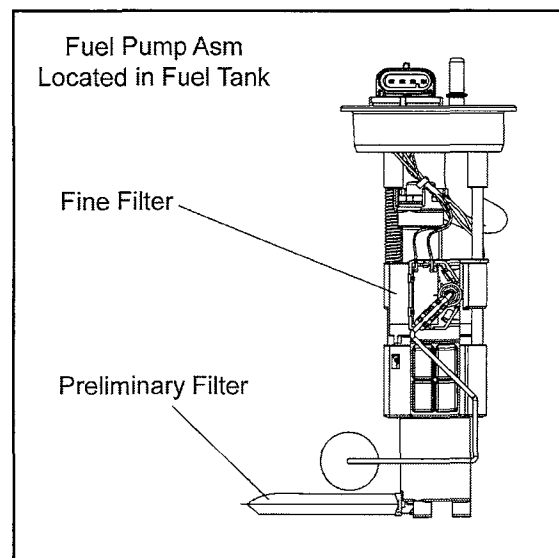
Fuel Pump / Fuel Filters

The fuel pump assembly is located in the fuel tank under the passenger seat.

The RZR XP EFI engine uses a serviceable, high-volume, high-pressure, fuel pump that includes a preliminary filter and an internal fine filter located before the pump regulator.



NOTE: Neither filter is serviceable individually. Must replace the fuel pump as an assembly.

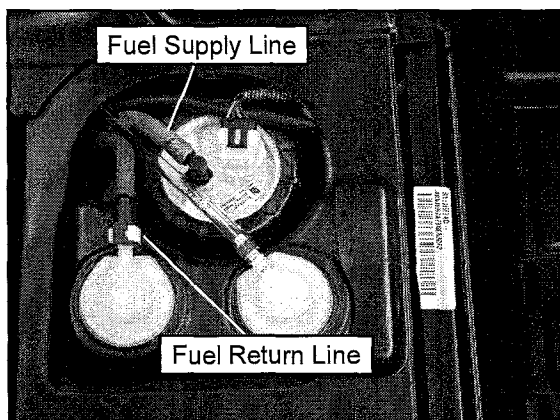


NOTE: Refer to Chapter 4 for fuel pump replacement and all other information related to the EFI System.

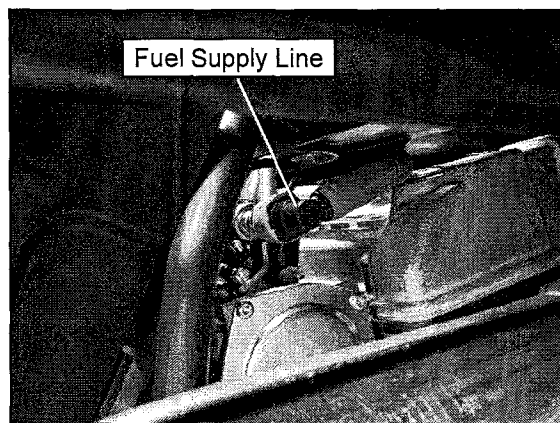
MAINTENANCE

Fuel Lines

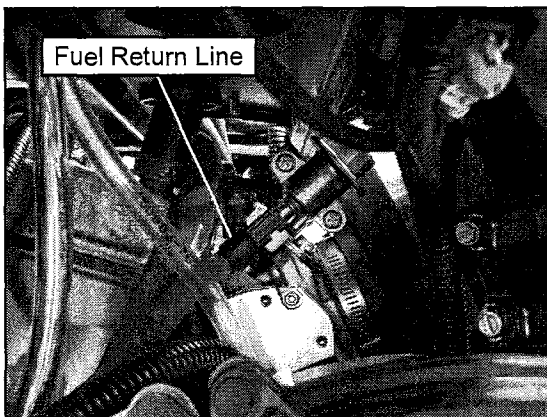
1. Check both quick-connect fuel lines at the fuel tank for signs of wear, deterioration, damage or leakage. Replace line(s) if necessary.



2. Locate the fuel supply fitting through the right rear wheel well on the upper right side of the engine. Check the line and quick-connect fitting for signs of wear, deterioration, damage or leakage. Replace line if necessary.



3. Locate the fuel return fitting through the left rear wheel well on the upper left side of the engine. Check the line and quick-connect fitting for signs of wear, deterioration, damage or leakage. Replace line if necessary.

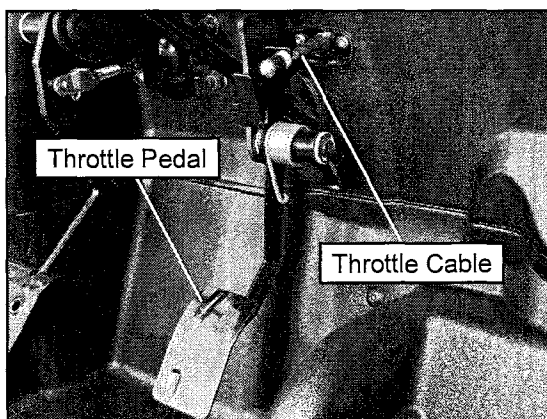


4. Be sure fuel lines are routed and retained properly.

IMPORTANT: Make sure lines are not kinked or pinched.

Throttle Pedal Inspection

If the throttle pedal has excessive play due to cable stretch or cable misadjustment, it will cause a delay in throttle reaction. Also, the throttle may not open fully. If the throttle pedal has no play, the throttle may be hard to control, and the idle speed may be erratic.



Check the throttle pedal play periodically in accordance with the Periodic Maintenance Chart and adjust the freeplay if necessary.

Throttle Freeplay Adjustment

Inspection

1. Place the transmission in PARK.
2. Start the engine, and warm it up thoroughly.
3. Measure the distance the throttle pedal moves before the engine begins to pick up speed. Freeplay should be 1/16" - 1/8" (1.5 - 3 mm).

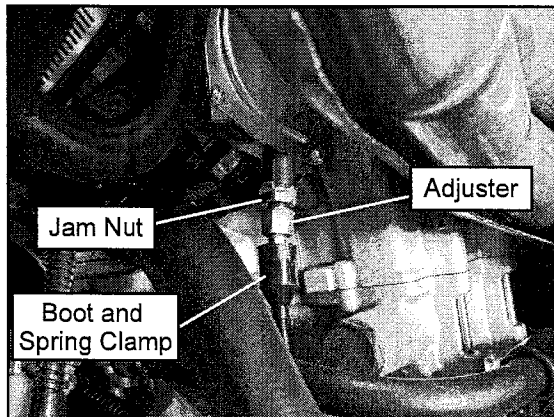
Adjustment

1. Allow the engine and exhaust system to cool before attempting to perform this procedure.

CAUTION

Use caution when performing this procedure. Engine and exhaust components may be hot and may cause severe injury or burns.

2. Locate the throttle freeplay adjustment through the right rear wheel well, behind the exhaust header pipe.
3. Slide back the cable adjuster boot and spring clamp.



4. Using a 14 mm open-end wrench, loosen the adjustment jam nut. Using a 12 mm open-end wrench, move the cable adjuster until 1/16" to 1/8" (1.5 - 3 mm) of freeplay is achieved at the throttle pedal.

NOTE: While adjusting, lightly move the throttle pedal in and out.

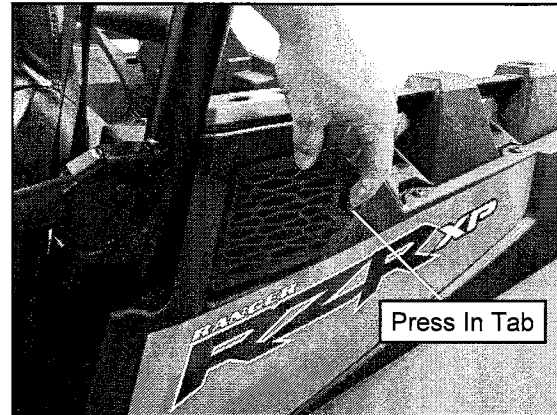
5. Apply Thread Sealant with Teflon® to the adjuster threads.
6. Re-tighten the jam nut after final adjustment is made.
7. Slide the cable adjuster boot over the cable adjuster to its original position and reinstall the spring clamp.

Engine Intake Pre-Filter Service

It is recommended that the engine intake pre-filter be inspected daily. The filter should be inspected using the following procedure:

1. The engine intake pre-filter is located just above the left rear wheel fender.
2. Press in on the intake grill cover tab to access the pre-filter.

2



3. Inspect the pre-filter. If necessary, clean with soapy water and dry with compressed air.

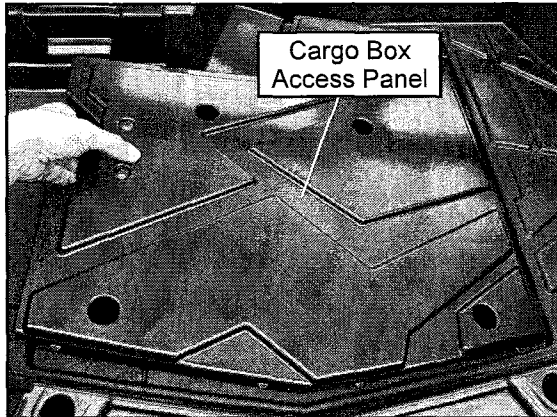


MAINTENANCE

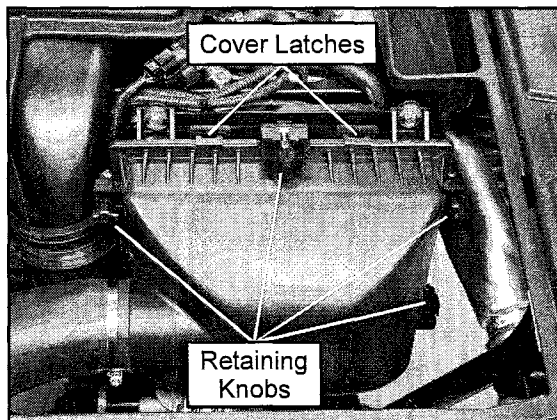
Air Filter Service

Inspect the air filter at the intervals outlined in the Periodic Maintenance Chart. In extremely dusty conditions, air filter replacement will be required more often.

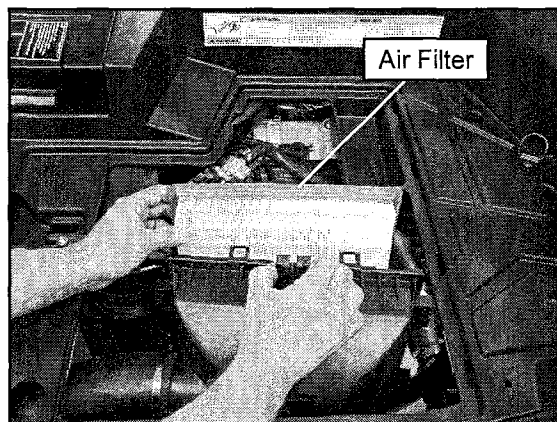
1. Remove the cargo box access panel.



2. Loosen the (5) air box cover retaining knobs and rotate them away from the cover. Release the (2) cover latches.



3. Pull the cover rearward just far enough to remove the air filter. It is not necessary to remove cover from hinges.



4. Inspect the air box for oil or water deposits. Wipe away any deposits with a clean shop towel.

NOTE: If the filter has been soaked with fuel or oil it must be replaced.

5. Inspect the air filter and replace if necessary.

IMPORTANT: DO NOT attempt to clean the air filter.

6. Place the air filter into the air box and reinstall the air box cover.

NOTE: Be sure the lower tabs on the air box cover are properly engaged into the airbox.

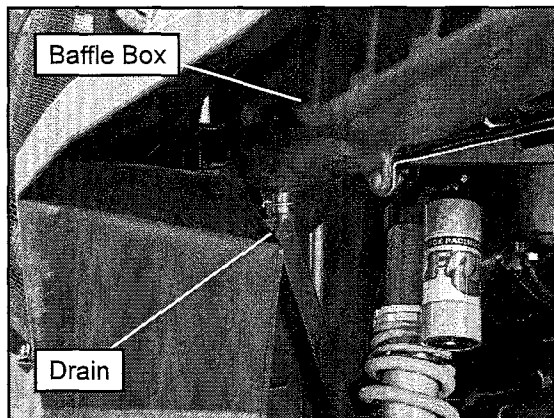
7. Engage the cover latches and tighten the retaining knobs.

8. Reinstall the cargo box access panel.

Intake Baffle Box Drain Inspection

It is recommended that the intake baffle box drain be inspected daily.

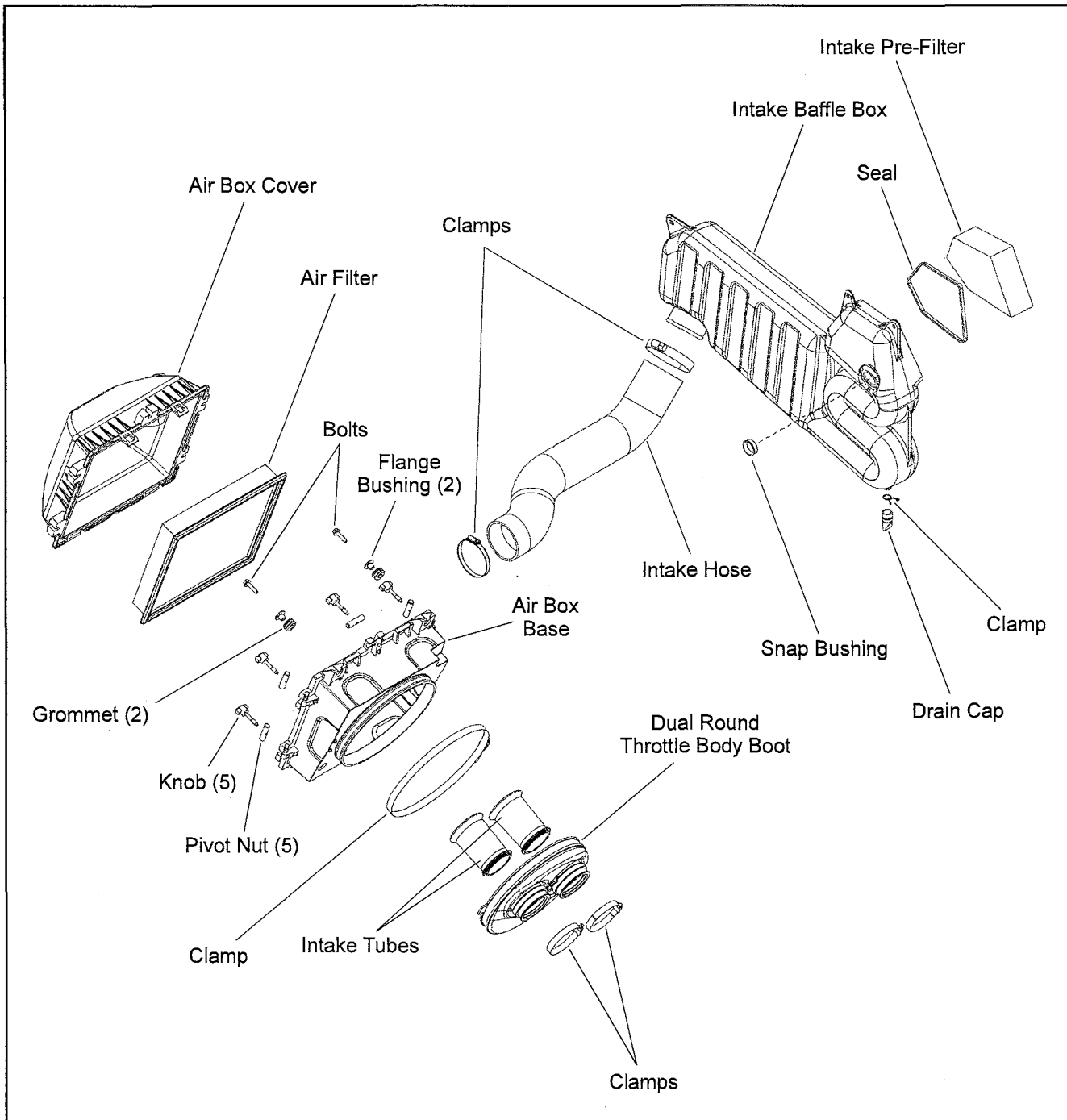
1. Access the intake baffle box drain through the left rear wheel well.



2. Check the drain to ensure it is not plugged with debris so it can drain properly. If needed, remove the drain from the baffle box during inspection.

Air Box / Air Filter Exploded View

2



MAINTENANCE

ENGINE

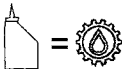
Engine Oil Level

The *RANGER* RZR XP engine has a dry-sump design, meaning the engine oil is contained within a remote oil tank. To check the oil level follow the procedure listed below:

IMPORTANT: Always check the oil level when the engine is cold. If the engine is hot when the oil level is checked, the level will appear to be overfull.

Access the oil tank dipstick through the oil tank access panel located in the left front corner of the cargo box.

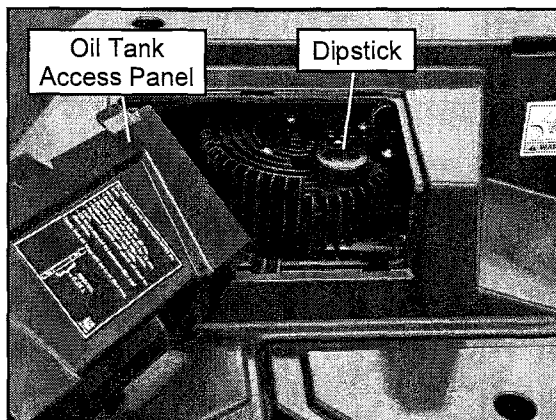
Polaris recommends the use of PS-4 Plus Synthetic 4-Cycle Engine Oil.



Recommended Engine Oil:
PS-4 Plus Synthetic 4-Cycle Engine Oil
(PN 2876244) (Quart)

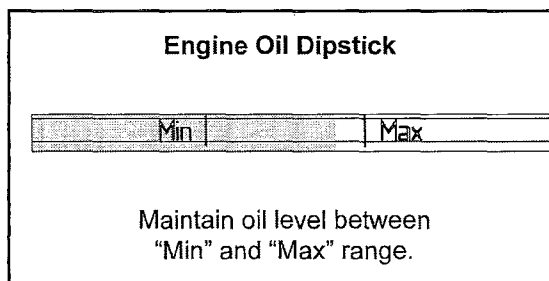
Capacity: 3.5 Quarts (3.3 L)

1. Position vehicle on a level surface and place the transmission in PARK.
2. Start the engine and allow it to idle for 30 seconds.
3. Stop the engine and wait 15 seconds.
4. Remove the oil tank access panel. Remove the dipstick from the oil tank and wipe it dry with a clean cloth.



5. Reinstall the dipstick completely (fully threaded). Remove the dipstick and check the oil level.

6. Add the recommended oil as necessary to bring the level near the "Max" mark on the dipstick. Do not overfill.



7. When finished, reinstall dipstick and oil tank access panel.


Engine Oil and Filter Change

Always change engine oil and filter at the intervals outlined in the Periodic Maintenance Chart. Always change the oil filter whenever changing the engine oil.

The oil tank drain plug is located on the bottom of the oil tank. Access the drain plug through the left rear wheel well.

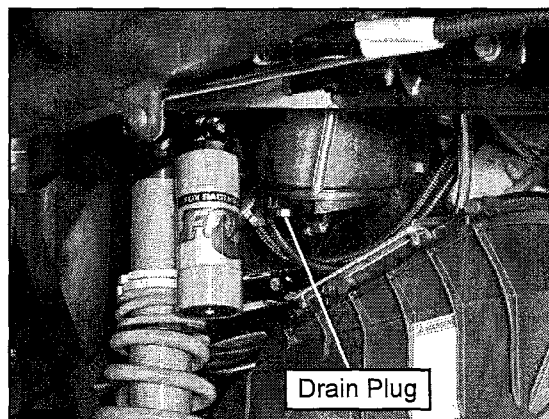
The crankcase drain plug is located on the bottom of the crankcase. Access the drain plug through the skid plate access hole located directly under the crankcase.

1. Position vehicle on a level surface and place the transmission in PARK.
2. Clean area around the oil tank and crankcase drain plugs.

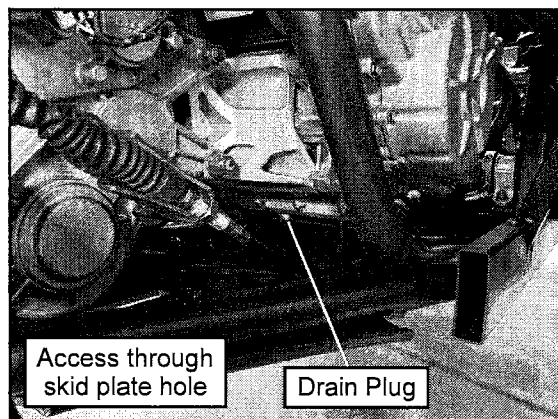
 **CAUTION**

Use caution when performing this procedure. Do not allow hot engine oil to come into contact with skin, as serious burns may result.

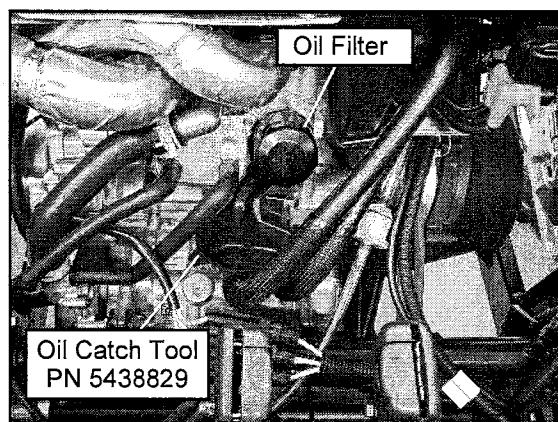
3. Place a drain pan under the oil tank and remove the drain plug. Allow the oil to drain completely.



- Place a drain pan under the engine crankcase and remove the drain plug. Allow the oil to drain completely.



- Remove the seats and engine service panel to access the oil filter.
- Locate the Oil Catch Tool (PN 5438829) in the tool kit. Position the tool below the oil filter to catch the oil when the filter is removed.



- Using Oil Filter Wrench (PU-50105), turn the oil filter counter-clockwise to remove it.

Oil Filter Wrench:
PU-50105: 2.5" (64 mm)

- Using a clean dry cloth, clean the filter sealing surface on the engine crankcase.
- Lubricate the O-ring on the new oil filter with a film of fresh engine oil. Check to make sure the O-ring is in good condition. Install it by hand until the O-ring contacts the sealing surface, then turn an additional 1/2 turn.



Oil Filter Torque:

Turn by hand until filter O-ring contacts sealing surface, then turn an additional 1/2 turn.

- Replace the sealing washer on drain plug.

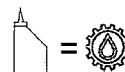
NOTE: The sealing surface on the drain plug should be clean and free of burrs, nicks or scratches.

- Reinstall the oil tank and engine crankcase drain plugs. Torque drain plugs to specification.



Drain Plugs: 12 ft. lbs. (16 Nm)

- Remove the engine oil dipstick (see "Engine Oil Level"). Fill the oil tank with 3.5 quarts (3.3 L) of recommended engine oil.



Recommended Engine Oil:

PS-4 Plus Synthetic 4-Cycle Engine Oil
(PN 2876244) (Quart)

Capacity: 3.5 Quarts (3.3 L)

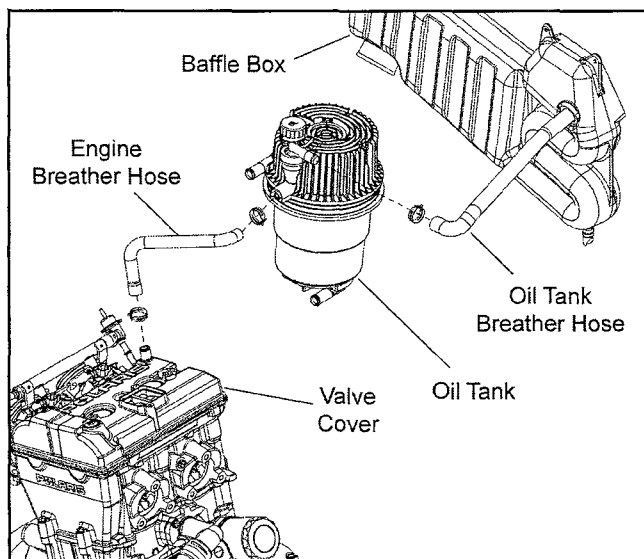
- Verify the transmission is still in PARK.
- Start the engine and allow it to idle for 30 seconds.
- Stop the engine and inspect for leaks. Wait at least 15 seconds before removing the dipstick.
- Remove the dipstick from the oil tank and wipe it dry with a clean cloth.
- Reinstall the dipstick completely (fully threaded). Remove the dipstick and check the oil level.
- Add the recommended oil as necessary to bring the level near the "Max" mark on the dipstick. Do not overfill.
- When finished, reinstall dipstick and oil tank access panel.
- Dispose of used oil and filter properly.

MAINTENANCE

Engine / Oil Tank Breather Hose Inspection

The engine and oil tank are equipped with a breather hose. Inspect the breather hoses for possible kinks or wear. The hoses are form fitted for proper fit.

- **Engine Breather Hose:** Follow the breather hose from the top of the valve cover to the side of the oil tank.
- **Oil Tank Breather Hose:** Follow the breather hose from the top of the oil tank to the side of the air intake baffle box.



NOTE: Make sure hoses are not kinked or pinched.

Engine Cylinder Leakdown Test

A cylinder leak-down test is the best indication of engine condition. Follow tester manufacturer's instructions to perform a cylinder leak-down test. Never use high pressure leakage testers as crankshaft seals may dislodge and leak.

Cylinder Leakage Service Limit: 20%

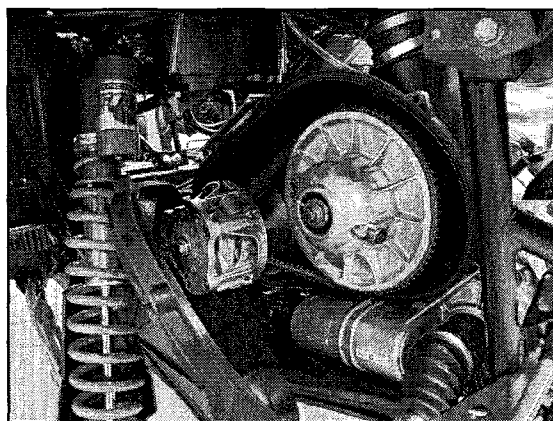
If leakage exceeds service limit, inspect the engine for the cause.

Valve Clearance Inspection

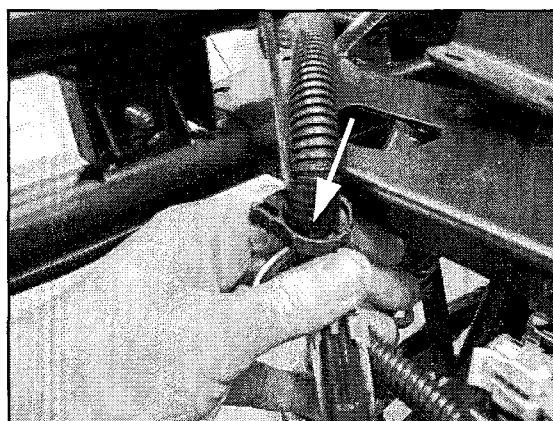
IMPORTANT: Valve clearance inspection should be performed on a cold engine, at room temperature.

1. Remove the seats and engine service panel.
2. Disconnect the negative (-) battery cable.
3. Remove the rear bumper and cargo box as an assembly (see Chapter 5).
4. Remove the (8) screws that retain the outer clutch cover.
5. Maneuver the outer clutch cover for drive clutch access.

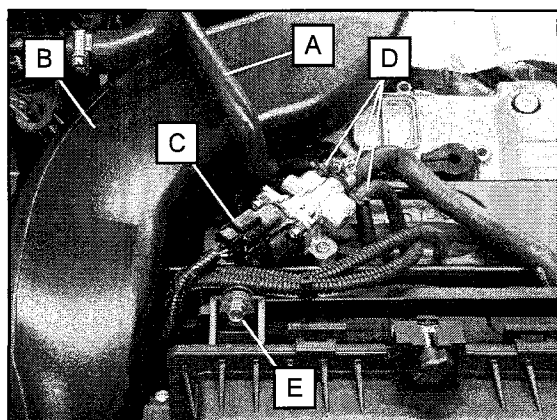
NOTE: Removal of left rear wheel or left rear shock is NOT necessary to perform this procedure.



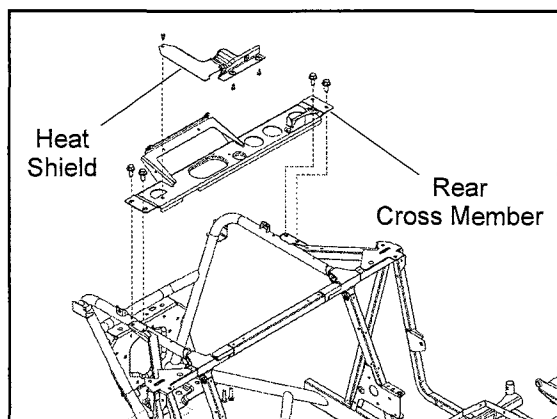
6. Remove the wire harness from the routing clip on the rear cross member.



7. Remove the breather hose (A) from the valve cover, remove the PVT outlet duct (B), remove the harness from the IAC valve (C), remove the (3) hoses (D) from the IAC valve and remove the (2) screws (E) that mount the air box to the upper frame cross member.

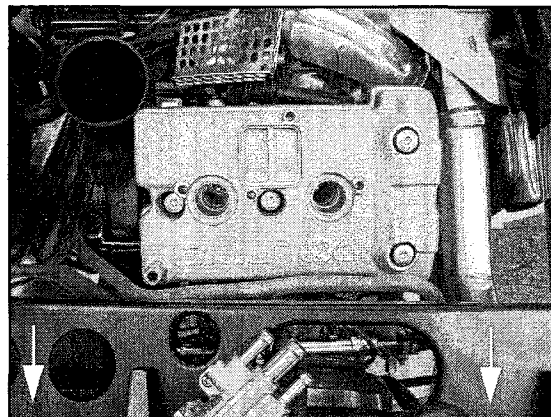


8. Remove the spark plug wires from the engine.
9. Remove the (3) push rivets that retain the heat shield to the frame cross members. Remove the heat shield.

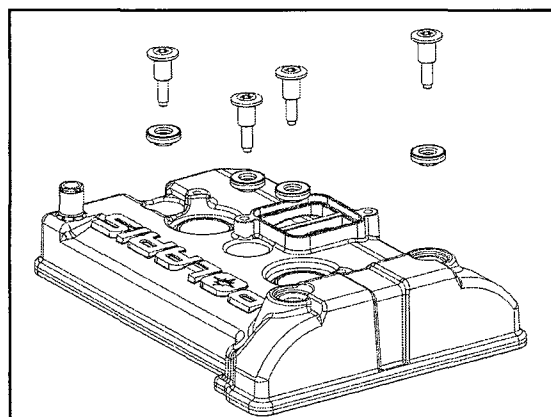


10. Support the oil tank in position prior to removing the rear cross member.

11. Remove the (4) bolts that attach the rear cross member to the vehicle frame. Raise and slide the cross member towards the rear of the vehicle to gain access to valve cover as shown below.

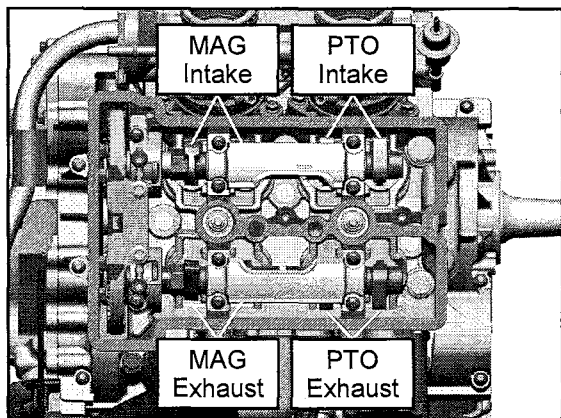


12. Remove the (4) T40 bolts retaining the valve cover.

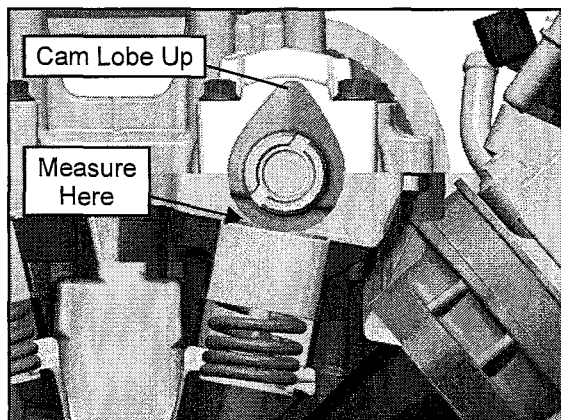


MAINTENANCE

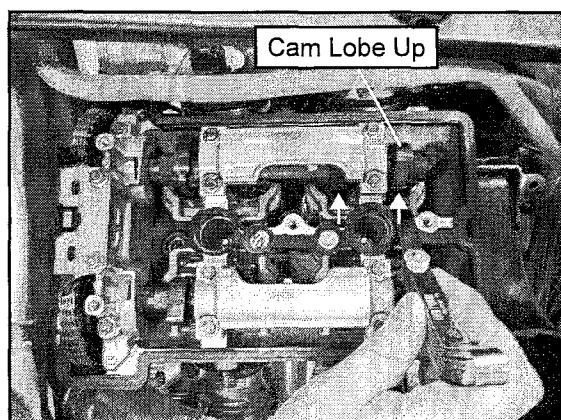
13. The engine will need to be rotated (4) times to inspect all (8) valve clearances. Two valves can be measured at each camshaft lobe position.



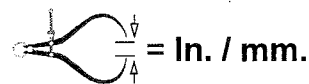
14. Rotate the drive clutch counter-clockwise until the cam lobes above the valves you are inspecting are facing up.



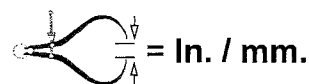
15. Measure the valve clearance using a feeler gauge.



16. If the valve clearance is out of specification, proceed to "Valve Clearance Adjustment" (see Chapter 3).

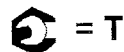


Intake Valve Clearance (cold):
.005-.007 in. (0.125-0.175 mm)



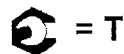
Exhaust Valve Clearance (cold):
.011-.013 in. (0.275-0.325 mm)

17. Repeat steps 14-16 until all (8) valves have been inspected.
18. Inspect the valve cover seal and replace if necessary.
19. Install valve cover and the (4) T40 bolts. Torque bolts to specification.



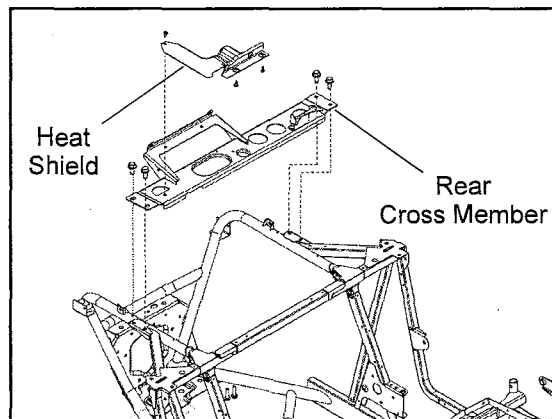
Valve Cover Bolts:
7 ft. lbs. (10 Nm)

20. Slide rear cross member back into position and install the (4) self tapping mounting bolts. Be sure oil tank mounting bracket is correctly supporting the oil tank.



Rear Cross Member Bolts:
17 ft. lbs. (23 Nm)

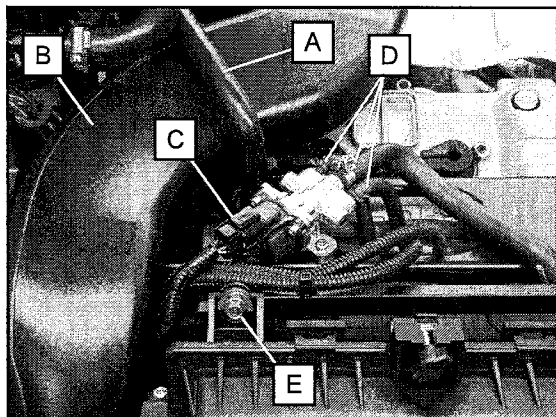
21. Install the heat shield and the (3) push rivets.



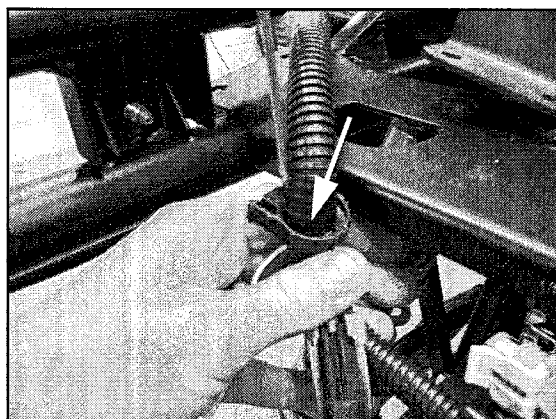
22. Install the spark plug wires. Ensure wires are pushed down all the way so they engage onto the spark plugs.

IMPORTANT: The engine will misfire if the spark plug wires are installed incorrectly. The spark plug wires are marked with PTO and MAG and should be installed to the corresponding cylinder.

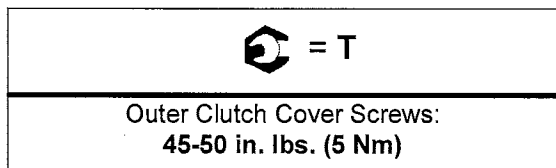
23. Install the breather hose (A) to the valve cover, install the PVT outlet duct (B), install the harness onto the IAC valve (C), install the (3) hoses (D) onto the IAC valve and install the (2) screws (E) that mount the air box to the upper frame cross member.



24. Install the wire harness back into the routing clip on the rear cross member.



25. Install outer clutch cover and (8) retaining screws.



26. Connect the negative (-) battery cable to the battery.
27. Start the engine to ensure proper operation.
28. Reinstall the rear bumper and cargo box assembly (see Chapter 5). Reinstall the engine service panel and seats.

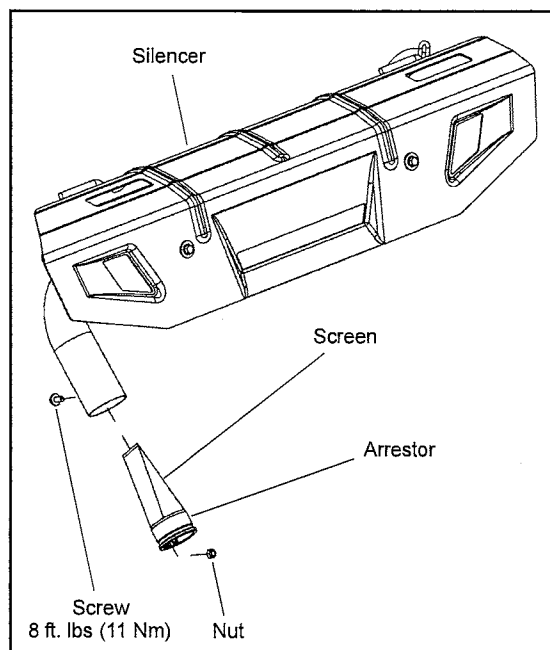
Exhaust - Spark Arrestor

WARNING

Do not clean spark arrestor immediately after the engine has been run, as the exhaust system becomes very hot. Serious burns could result from contact with the exhaust components. Allow components to cool sufficiently before proceeding. Wear eye protection and gloves. Never run the engine in an enclosed area. Exhaust contains poisonous carbon monoxide gas that can cause loss of consciousness or death in a very short time.

Periodically clean spark arrestor to remove accumulated carbon.

1. Remove the retaining screw and nut.
2. Remove the spark arrestor from the end of the silencer.
3. Use a non-synthetic brush to clean the arrestor screen. A synthetic brush may melt if components are warm. If necessary, blow debris from screen with compressed air.
4. Inspect the screen for wear and damage. Replace if needed.
5. Reinstall the arrestor and torque the retaining screw to 8 ft. lbs. (11 Nm).



MAINTENANCE

TRANSMISSION AND FRONT GEARCASE

Specification Chart

Gearcase	Lubricant	Capacity	Fill / Drain Plug Torque
Transmission	AGL Plus Gearcase Lubricant	44 oz. (1300 ml)	10-14 ft. lbs. (14-19 Nm)
Front Gearcase	Demand Drive Plus	6.75 oz. (200 ml)	8-10 ft. lbs. (11-14 Nm)

Transmission Lubrication

NOTE: It is important to follow the transmission maintenance intervals described in the Periodic Maintenance Chart. Regular lubricant level inspections should be performed as well.

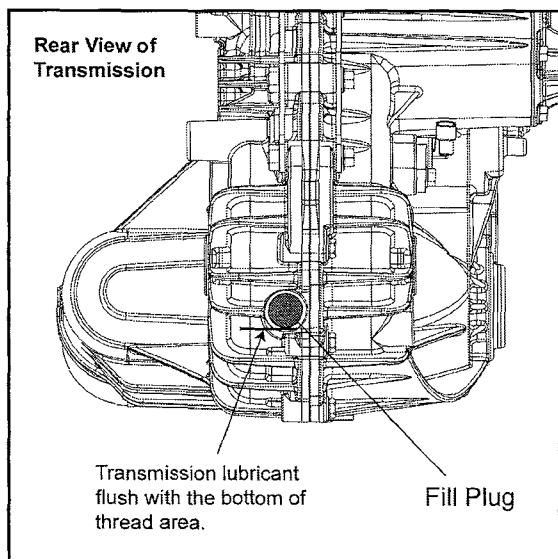
The transmission lubricant level should be checked and changed in accordance with the maintenance schedule.

- Be sure vehicle is positioned on a level surface when checking or changing the lubricant.
- Check vent hose to be sure it is routed properly and unobstructed.

Transmission Lubricant Level Check

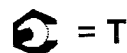
The fill plug is located on the rear portion of the transmission gearcase. Access the fill plug at the rear of the vehicle. Maintain lubricant level even with the bottom of the fill plug hole.

1. Position vehicle on a level surface.
2. Remove the fill plug and check the lubricant level.



3. If lubricant level is not even with the bottom threads, add the recommended lubricant as needed. Do not overfill.

4. Reinstall the fill plug and torque to specification.



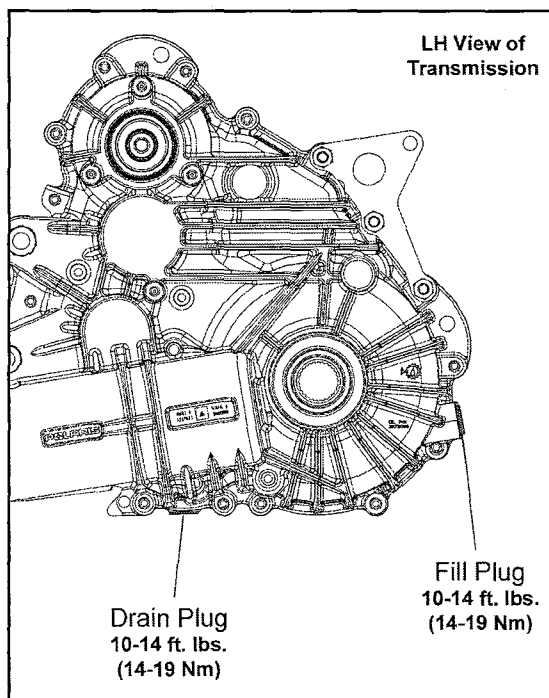
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Fill / Drain Plug Torque:
10-14 ft. lbs. (14-19 Nm)

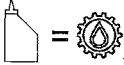
Transmission Lubricant Change

The drain plug is located on the bottom of the transmission gearcase. Access the drain plug through the drain hole in the skid plate.

1. Remove the fill plug (refer to "Transmission Lubricant Level Check").
2. Place a drain pan under the transmission drain plug.
3. Remove drain plug and allow lubricant to drain completely.



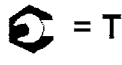
4. Clean the drain plug magnetic surface.
5. Reinstall drain plug with a new O-ring and torque to specification.
6. Add the recommended amount of lubricant through the fill plug hole. Maintain the lubricant level at the bottom of the fill plug hole when filling the transmission. Do not overfill.



Recommended Transmission Lubricant:
 AGL Plus Gearcase Lubricant
 (PN 2878068) (Quart)

Capacity: 44 oz. (1300 ml)

7. Reinstall fill plug with a new O-ring and torque to specification.



Fill / Drain Plug Torque:
10-14 ft. lbs. (14-19 Nm)

8. Check for leaks. Dispose of used lubricant properly.

Front Gearcase Lubrication

NOTE: It is important to follow the front gearcase maintenance intervals described in the Periodic Maintenance Chart. Regular fluid level inspections should be performed as well.

The front gearcase fluid level should be checked and changed in accordance with the maintenance schedule.

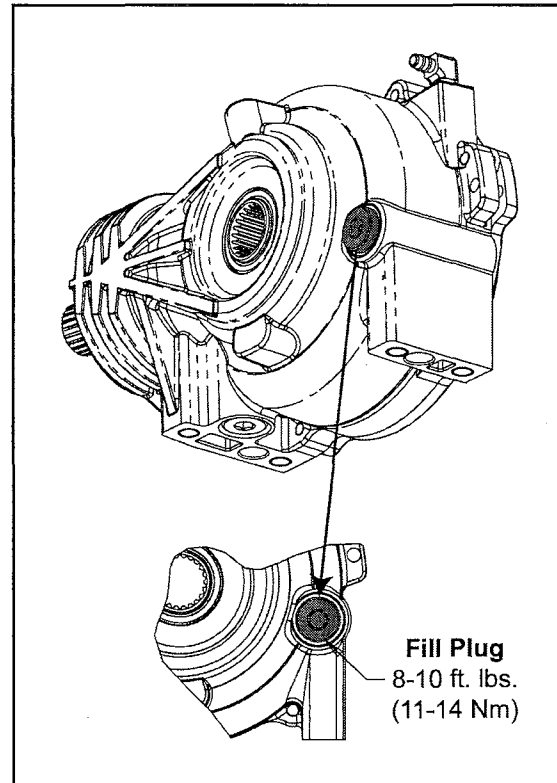
- Be sure vehicle is positioned on a level surface when checking or changing the fluid.
- Check vent hose to be sure it is routed properly and unobstructed.

Front Gearcase Fluid Level Check

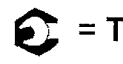
The fill plug is located on the bottom right side of the front gearcase. Access the fill plug through the right front wheel well. Maintain fluid level even with the bottom of the fill plug hole.

1. Position vehicle on a level surface.

2. Remove the fill plug and check the fluid level.



3. If fluid level is not even with the bottom threads, add the recommended fluid as needed. Do not overfill.
4. Reinstall the fill plug and torque to specification.



Fill / Drain Plug Torque:
8-10 ft. lbs. (11-14 Nm)

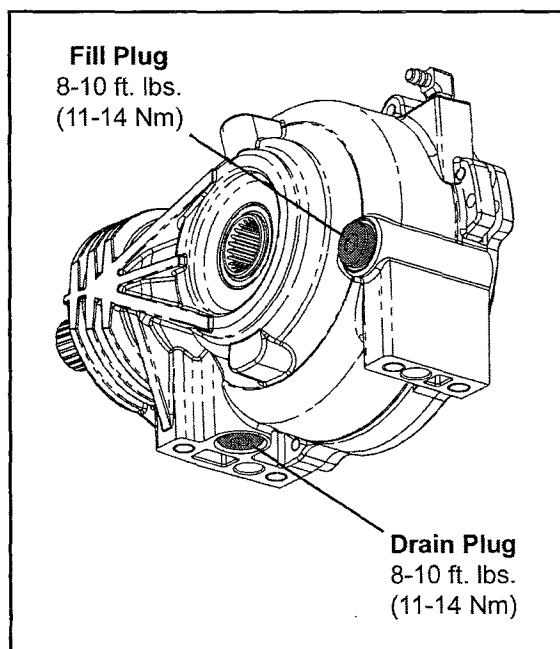
Front Gearcase Fluid Change:

The drain plug is located on the bottom of the front gearcase. Access the drain plug through the access hole in the frame underneath the front gearcase.

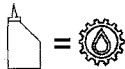
1. Remove the fill plug (refer to "Front Gearcase Fluid Level Check").
2. Place a drain pan under the front gearcase drain plug.

MAINTENANCE

3. Remove the drain plug and allow fluid to drain completely.



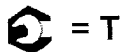
4. Clean the drain plug magnetic surface.
5. Reinstall drain plug with a new O-ring and torque to specification.
6. Add the recommended amount of fluid through the fill hole. Maintain the fluid level even with the bottom threads of the fill plug hole.



Recommended Front Gearcase Fluid:
Polaris Demand Drive Plus
(PN 2877922) (Quart)

Capacity: 6.75 oz. (200 ml)

7. Reinstall fill plug with a new O-ring and torque to specification.



Fill / Drain Plug Torque:
8-10 ft. lbs. (11-14 Nm)

8. Check for leaks. Dispose of used fluid properly.

COOLING SYSTEM

Cooling System Overview

The engine coolant level is controlled, or maintained, by the recovery system. The recovery system components are the recovery bottle, radiator filler neck, radiator pressure cap and connecting hose.

As coolant operating temperature increases, the expanding (heated) excess coolant is forced out of the radiator past the pressure cap and into the recovery bottle. As engine coolant temperature decreases the contracting (cooled) coolant is drawn back up from the tank past the pressure cap and into the radiator.

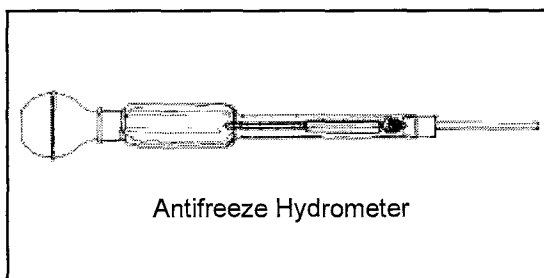
NOTE: Some coolant level drop on new machines is normal as the system is purging itself of trapped air. Observe coolant levels often during the break-in period.

NOTE: Overheating of engine could occur if air is not fully purged from system.

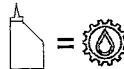
IMPORTANT: Polaris Premium 60/40 Antifreeze is already premixed and ready to use. Do not dilute with water.

Coolant Strength

Test the strength of the coolant using an antifreeze hydrometer.



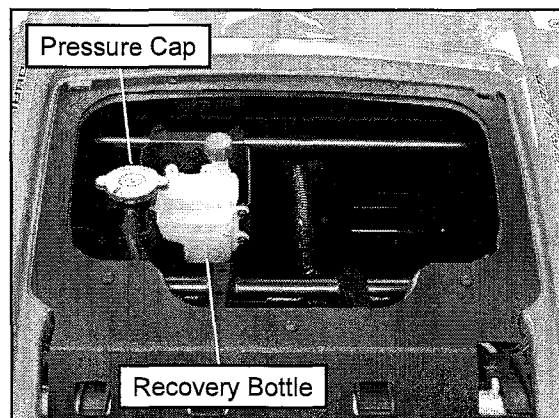
- A 50/50 or 60/40 mixture of antifreeze and distilled water will provide the optimum cooling, corrosion protection, and antifreeze protection.
- Do not use tap water, straight antifreeze, or straight water in the system. Tap water contains minerals and impurities which build up in the system.
- Straight water or antifreeze may cause the system to freeze, corrode, or overheat.



Recommended Coolant:
Polaris Premium Pre-Mixed Antifreeze
(PN 2871534) (Quart)
(PN 2871323) (Gallon)

Coolant Level Inspection

The pressure cap and recovery bottle are located under the front hood of the vehicle. The coolant level must be maintained between the minimum and maximum levels indicated on the recovery bottle.



With the engine at operating temperature, the coolant level should be between the upper and lower marks on the coolant recovery bottle. If not, perform the following procedure:

1. Position the vehicle on a level surface.
2. Remove the front hood.
3. View the coolant level in the recovery bottle.
4. If the coolant level is below the MIN line, inspect the coolant level in the radiator.

NOTE: If overheating is evident, allow system to cool completely and check coolant level in the radiator and inspect for signs of trapped air in system.

WARNING

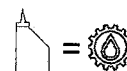
Never remove the pressure cap when the engine is warm or hot. Escaping steam can cause severe burns. The engine must be cool before removing the pressure cap.

5. Remove the pressure cap. Using a funnel, add coolant to the top of the filler neck.
6. Reinstall the pressure cap.

NOTE: Use of a non-standard pressure cap will not allow the recovery system to function properly.

7. Remove recovery bottle cap and add coolant using a funnel.

8. Fill recovery bottle to MAX level with recommended coolant or 50/50 or 60/40 mixture of antifreeze and distilled water as required for freeze protection in your area.



Recommended Coolant:

Polaris Premium Pre-Mixed Antifreeze
(PN 2871534) (Quart)
(PN 2871323) (Gallon)

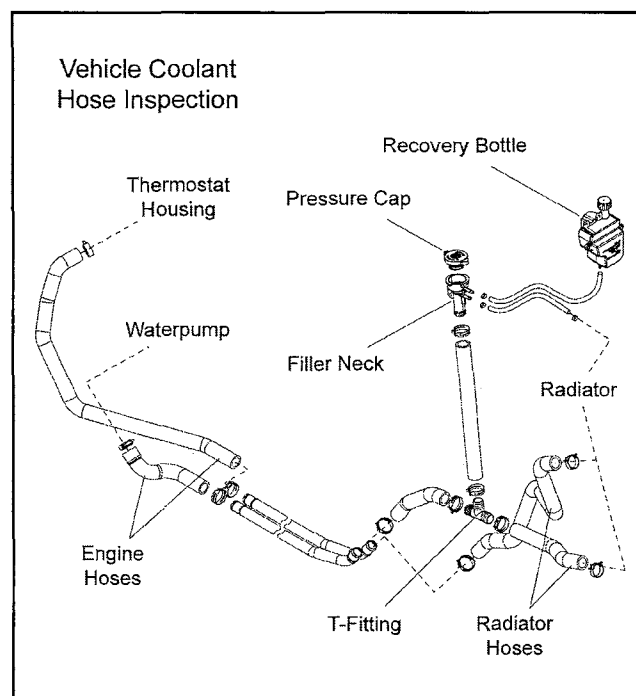
9. Reinstall the recovery bottle cap.
10. If coolant was required, start engine and check for leaks. Make sure radiator fins are clean to prevent overheating.

Cooling System Pressure Test

Refer to cooling system pressure test procedures provided in Chapter 3 "Engine / Cooling".

Cooling System Hoses

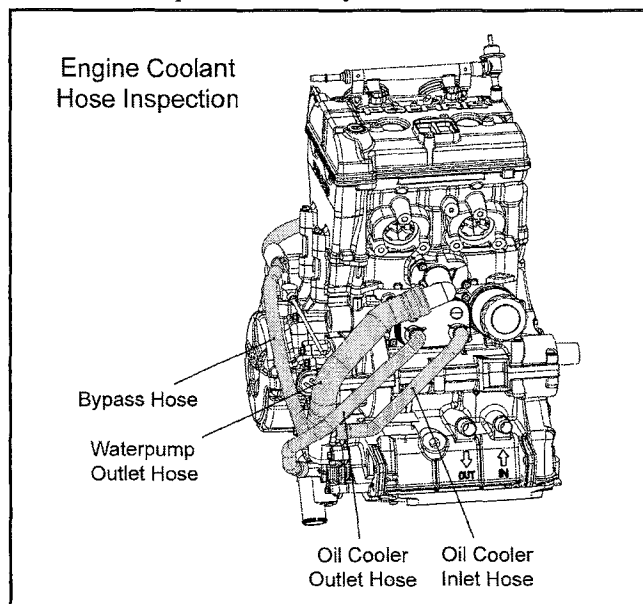
1. Inspect all vehicle hoses for cracks, deterioration, abrasion or leaks. Replace if necessary.



2. Check tightness and condition of all hose spring clamps. Replace if necessary.

MAINTENANCE

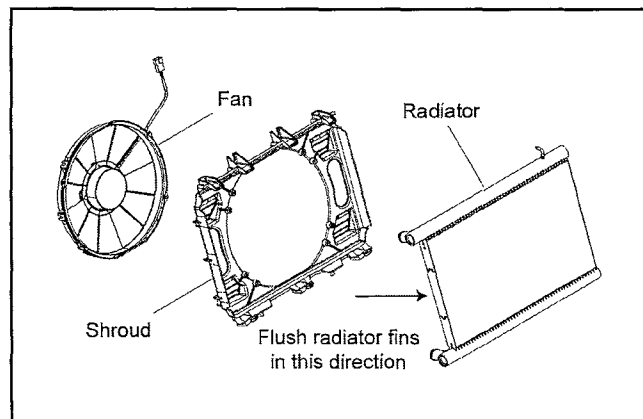
3. Inspect all engine hoses for cracks, deterioration, abrasion or leaks. Replace if necessary.



4. Check tightness and condition of all hose spring clamps. Replace if necessary.

Radiator Inspection / Cleaning

1. Check radiator air passages for restrictions or damage.



2. Carefully straighten any bent radiator fins.
3. Remove any obstructions with compressed air or low pressure water.

CAUTION

Washing the vehicle with a high-pressure washer could damage the radiator fins and impair the radiators effectiveness. Use of a high-pressure washer is not recommended.

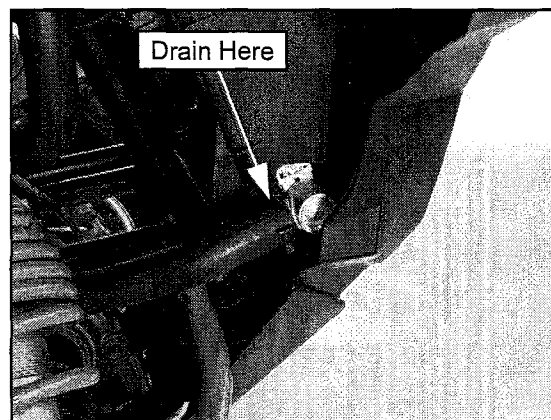
Coolant Drain / Fill

1. Remove the front hood.

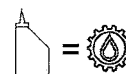
WARNING

Never drain the coolant when the engine and radiator are warm or hot. Hot coolant can cause severe burns. Allow engine and radiator to cool.

2. Slowly remove the pressure cap to relieve any cooling system pressure.
3. Place a suitable drain pan underneath the radiator fitting on the front right side of the vehicle.
4. Drain the coolant from the radiator by removing the lower coolant hose from the radiator as shown.



5. Allow coolant to drain completely. Properly dispose of the used coolant.
6. Reinstall coolant hose and reposition the spring clamp.
7. Remove the pressure cap. Using a funnel, add the recommended coolant to the top of the filler neck and fill the recovery bottle to the MAX level.
8. Refer to "Cooling System Bleeding Procedure" provided in Chapter 3.



Recommended Coolant:
Polaris Premium Pre-Mixed Antifreeze
(PN 2871534) (Quart)
(PN 2871323) (Gallon)

PVT / FINAL DRIVE / WHEEL AND TIRE

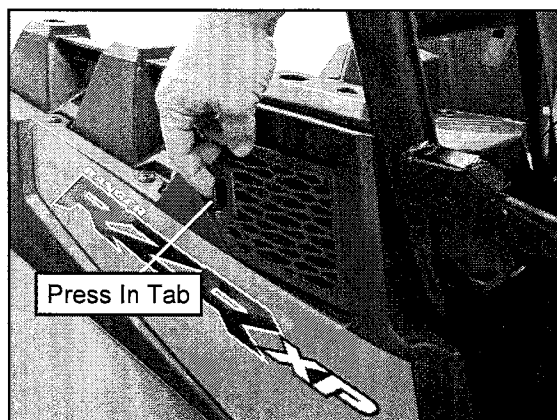
Drive Clutch / Driven Clutch / Belt Service

Refer to Chapter 6 “Clutching (PVT)” for service and removal procedures.

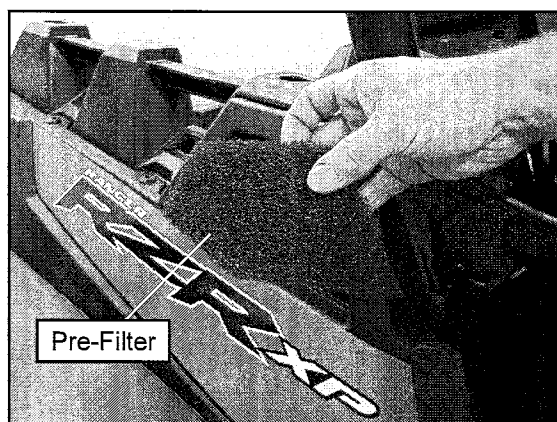
PVT Intake Pre-Filter Service

It is recommended that the PVT intake pre-filter be inspected daily. The filter should be inspected using the following procedure:

1. The PVT intake pre-filter is located just above the right rear wheel fender.
2. Press in on the intake grill cover tab to access the pre-filter.



3. Inspect the pre-filter. If necessary, clean with soapy water and dry with compressed air.



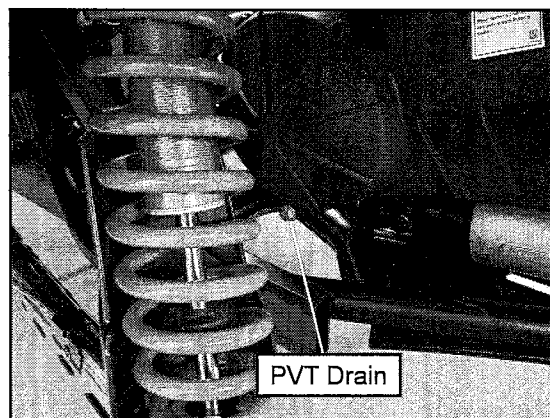
PVT Drying

NOTE: After operating in water, the vehicle's PVT system should be checked immediately. Use the following instructions to dry it out before operating.

The PVT drain plug is located at the bottom of the outer clutch cover. Access the drain plug through the left rear wheel well.

2

1. Using a flat blade screwdriver, remove the PVT drain plug and O-ring from the outer clutch cover.



2. Allow the water to drain out completely.
3. Reinstall the drain plug and O-ring.
4. Place the transmission in PARK, apply the brake and start the engine.
5. Apply varying throttle for 10-15 seconds to expel the moisture and air-dry the belt and clutches.

NOTE: Do not hold the throttle pedal wide open for more than 5 seconds.

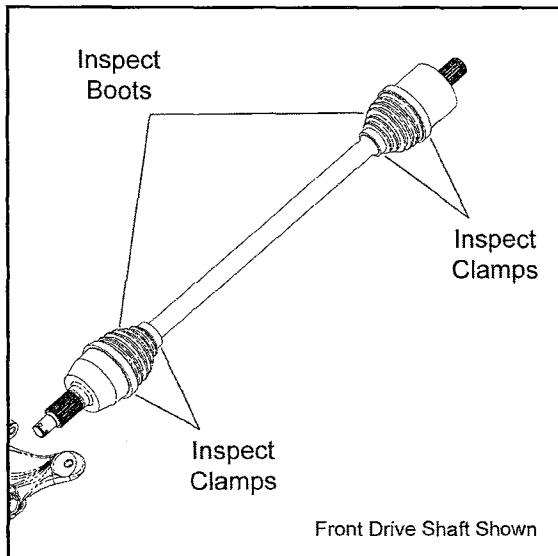
6. Allow the engine RPM to return to idle, then shift the transmission into low gear.
7. Test the PVT system for belt slippage. If the belt slips, repeat the process or remove the outer clutch cover to inspect the PVT system (see Chapter 6 “Clutching (PVT)” for service and removal procedures).

IMPORTANT: If the vehicle has ingested a large amount of water into the PVT system and has not been operated for a period of time, be sure to check the PVT system components for water damage.

MAINTENANCE

Drive Shaft Boot Inspection

Inspect the front and rear drive shaft boots for damage, tears, wear or leaking grease. If the boots exhibit any of these symptoms, they should be replaced. Check to see the boot clamps are properly positioned. Refer to Chapter 7 for drive shaft boot replacement.



Wheel and Hub Torque Table

Item	Specification
Wheel Nuts (Cast Aluminum Wheels)	30 ft. lbs. (41 Nm) + 90° (1/4 turn)
Hub Retaining Nuts (Front and Rear)	80 ft. lbs. (108 Nm)

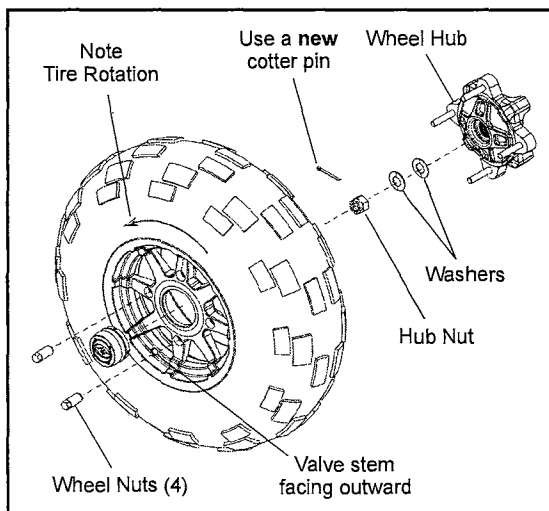
NOTE: Do not lubricate the stud or the lug nut.

Wheel Removal

1. Position the vehicle on a level surface.
2. Place the transmission in PARK and stop the engine.
3. Loosen the wheel nuts slightly. If wheel hub removal is required, remove the wheel cap, cotter pin and loosen the hub nut slightly.
4. Elevate the appropriate side of the vehicle by placing a suitable stand under the frame.
5. Remove the wheel nuts and remove the wheel.

Wheel Installation

1. Verify the transmission is still in PARK.
2. Place the wheel in the correct position on the wheel hub. Be sure the valve stem is toward the outside and rotation arrows on the tire point toward forward rotation.
3. Attach the wheel nuts and finger tighten them.
4. Carefully lower the vehicle to the ground.
5. Torque the wheel nuts and/or hub nut to the proper torque specification (see "Wheel and Hub Torque Table").
6. If hub nut was removed, install a new cotter pin after the hub nut has been tightened. If the holes do not line up, turn the hub nut counter-clockwise until the cotter pin can be installed.



CAUTION

If wheels are improperly installed it could affect vehicle handling and tire wear. On vehicles with tapered wheel nuts, make sure tapered end of nut goes into taper on wheel.

Tire Inspection

- Improper tire inflation may affect vehicle maneuverability.
- When replacing a tire always use original equipment size and type.
- The use of non-standard size or type tires may affect vehicle handling.

WARNING

Operating with worn tires will increase the possibility of the vehicle skidding easily with possible loss of control.

Worn tires can cause an accident.

Always replace tires when the useable tread depth has worn out.

Tire Pressure

Remove the valve stem cap and check tire pressure using the tire pressure gauge included in the vehicle's tool kit.

CAUTION

Maintain proper tire pressure.
Refer to the warning tire pressure decal applied to the vehicle.

Tire Pressure Inspection (Cold)	
Front	Rear
12 psi (82.7 kPa)	14 psi (96.5 kPa)

ELECTRICAL AND IGNITION SYSTEM

Battery Maintenance

Keep battery terminals and connections free of corrosion. If cleaning is necessary, remove the corrosion with a stiff wire brush. Wash with a solution of one tablespoon baking soda and one cup water. Rinse well with tap water and dry off with clean shop towels. Coat the terminals with dielectric grease or petroleum jelly.

2

WARNING

CALIFORNIA PROPOSITION 65 WARNING:

Batteries, battery posts, terminals and related accessories contain lead and lead compounds, and other chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

WASH HANDS AFTER HANDLING.

WARNING

Battery electrolyte is poisonous. It contains sulfuric acid. Serious burns can result from contact with skin, eyes or clothing. Antidote:

External: Flush with water.

Internal: Drink large quantities of water or milk. Follow with milk of magnesia, beaten egg, or vegetable oil. Call physician immediately.

Eyes: Flush with water for 15 minutes and get prompt medical attention.

Batteries produce explosive gases. Keep sparks, flame, cigarettes, etc. away. Ventilate when charging or using in an enclosed space. Always shield eyes when working near batteries.

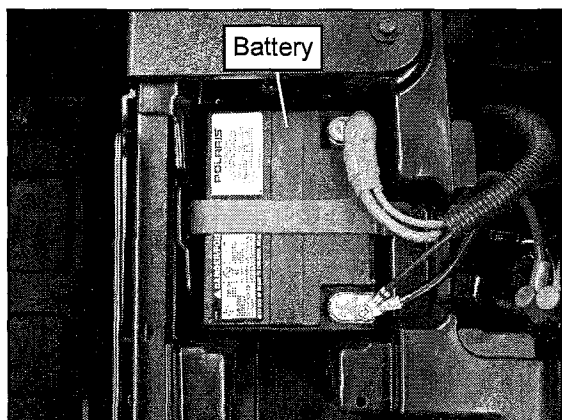
KEEP OUT OF REACH OF CHILDREN.

NOTE: Batteries must be fully charged before use or battery life will be reduced by 10-30% of full potential. Charge battery according to "Charging Procedure" provided in Chapter 10. Do not use the vehicle's stator/alternator to charge a new battery.

MAINTENANCE

Battery Removal

1. Remove the driver's seat to access the battery.

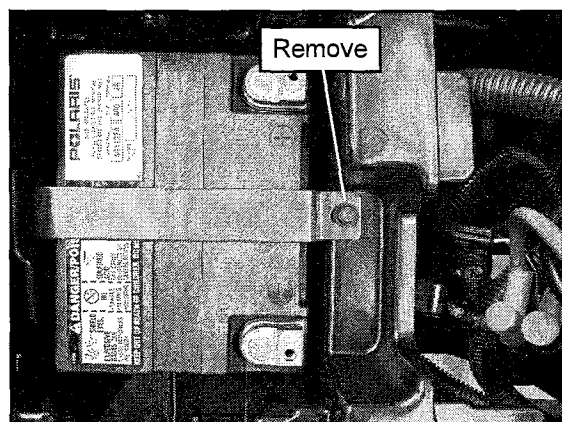


2. Disconnect the black (negative) battery cables.
3. Disconnect the red (positive) battery cables.

CAUTION

To reduce the chance of sparks: Whenever removing the battery, disconnect the black (negative) cable first. When reinstalling the battery, install the black (negative) cable last.

4. Remove the hold-down strap and lift the battery out of the vehicle.

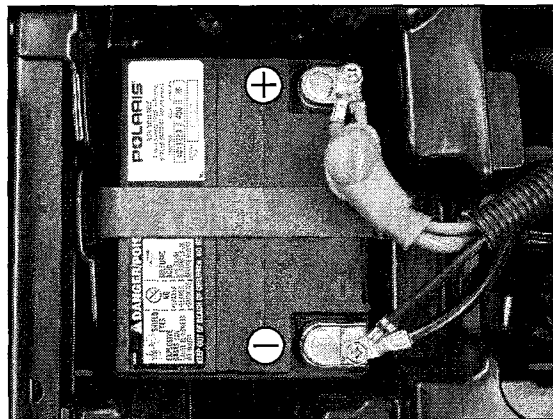


Battery Installation

IMPORTANT: Using a new battery that has not been fully charged can damage the battery and result in a shorter life. It can also hinder vehicle performance. Follow the battery charging procedure in Chapter 10 "Electrical" before installing the battery.

1. Ensure the battery is fully charged.

2. Place the battery in the battery holder and secure with hold-down strap.
3. Coat the terminals with dielectric grease or petroleum jelly.
4. Connect and tighten the red (positive) cables first.
5. Connect and tighten the black (negative) cables last.



6. Verify that cables are properly routed and reinstall the driver's seat.

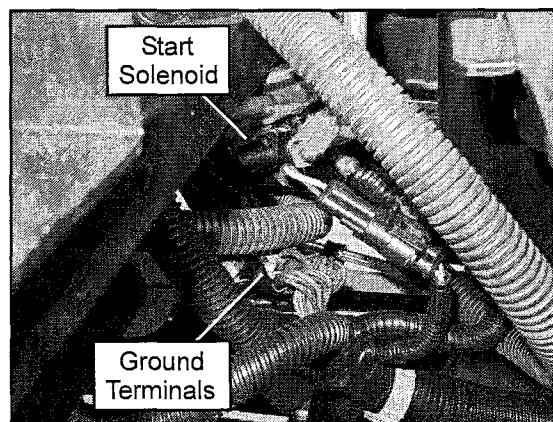
Battery Charging / Off Season Storage

Refer to Chapter 10 "Electrical" for charging and off season storage procedures.

Engine / Chassis Electrical Ground

Inspect the ground cable connections. Remove ground terminals and clean if necessary.

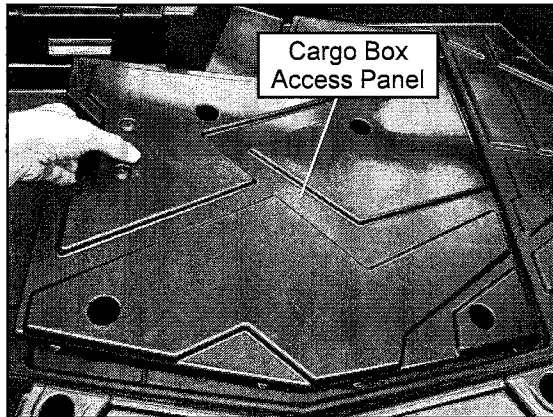
1. Remove the driver's seat and locate the start solenoid behind the battery box.
2. Inspect the ground terminals located below the solenoid. Be sure they are clean and tight.



Spark Plug Service

Inspect and replace the spark plugs at the intervals outlined in the Periodic Maintenance Chart.

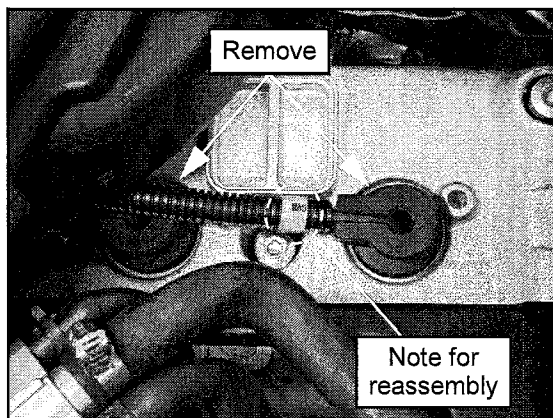
1. Remove the cargo box access panel.



WARNING

A hot engine can cause serious burns. Allow engine to cool or wear protective gloves when removing the spark plugs.

2. Remove both spark plug caps.

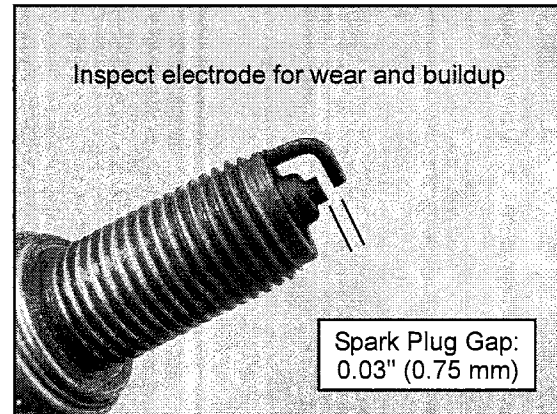


3. Clean out plug wells with compressed air to remove any loose dirt or debris.
4. Rinse plug wells with water and dry with compressed air.

NOTE: Spark plug wells have drain holes built into the cylinder head to allow water to drain out.

5. Remove spark plugs using a 5/8" spark plug socket with an extension.

6. Inspect electrodes for wear and carbon buildup. Look for a sharp outer edge with no rounding or erosion of the electrodes.



7. Clean with electrical contact cleaner or a glass bead spark plug cleaner only. **CAUTION:** A wire brush or coated abrasive should not be used.
8. Measure gap with a wire gauge. Adjust gap if necessary by carefully bending the side electrode.
9. If necessary, replace spark plug with proper type. **CAUTION:** Severe engine damage may occur if the incorrect spark plug is used.

**Recommended Spark Plug:
Champion RG4YCX**

10. Apply anti-seize compound to the spark plug threads.
11. Install spark plugs and torque to specification.



**Spark Plug Torque:
9 ft. lbs. (12 Nm)**

12. Install the plug caps to the appropriate cylinder by referencing the MAG and PTO spark plug wire decals. Ensure wires are pushed down all the way so they engage onto the spark plugs.
13. Reinstall the cargo box access panel.

MAINTENANCE

STEERING

Steering Inspection

The steering components should be checked periodically for loose fasteners, worn tie rod ends, ball joints, and damage. Also check to make sure all cotter pins are in place. If cotter pins are removed, they must be replaced. Always use new cotter pins.

Replace any worn or damaged steering components. Steering should move freely through the entire range of travel without binding. Check routing of all cables, hoses, and wiring to be sure the steering mechanism is not restricted or limited.

NOTE: Whenever steering components are replaced, check front end alignment.

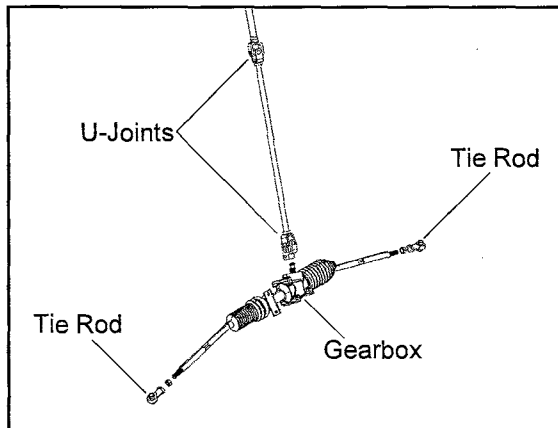
WARNING

Due to the critical nature of the procedures outlined in this chapter, Polaris recommends steering component repair and adjustment be performed by an authorized Polaris MSD certified technician. Use only genuine Polaris replacement parts.

Steering Wheel Freeplay

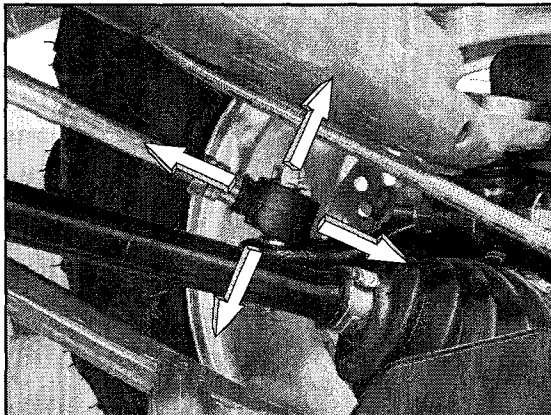
Check the steering wheel for specified freeplay and operation.

1. Position the vehicle on level ground.
2. Lightly turn the steering wheel left and right.
3. There should be 0.8"-1.0" (20-25 mm) of freeplay.
4. If there is excessive freeplay or the steering feels rough, inspect the following components.
 - Tie Rod Ends
 - Steering Shaft U-Joints
 - Steering Gearbox



Tie Rod End / Wheel Hub Inspection

- To check for play in the tie rod end, grasp the steering tie rod, pull in all directions feeling for movement.



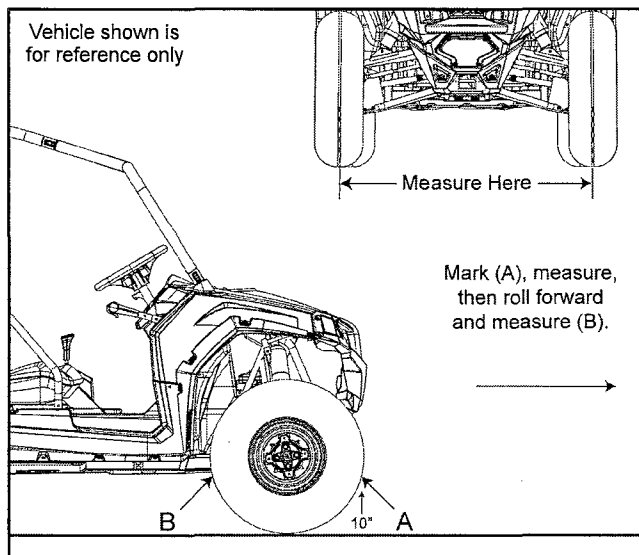
- Replace any worn steering components. Steering should move freely through entire range of travel without binding.
- Elevate front end of machine so front wheels are off the ground. Check for any looseness in front wheel/hub assembly by grasping the tire firmly at top and bottom first, and then at front and rear. Try to move the wheel and hub by pushing inward and pulling outward.



- If abnormal movement is detected, inspect the hub and wheel assembly to determine the cause (loose wheel nuts or loose front hub nut).
- Refer to Chapter 7 "Final Drive" for front hub service procedures.

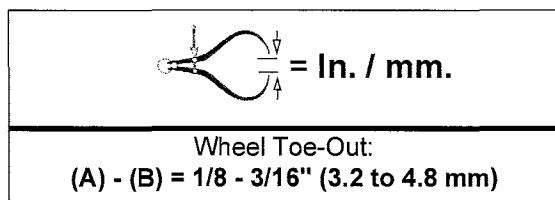
Wheel Toe Alignment Inspection

1. Place machine on a smooth level surface and set steering wheel in a straight ahead position. Secure the steering wheel in this position.
2. Place a chalk mark on the center line of the front tires approximately 10" (25.4 cm) from the floor or as close to the hub/axle center line as possible.



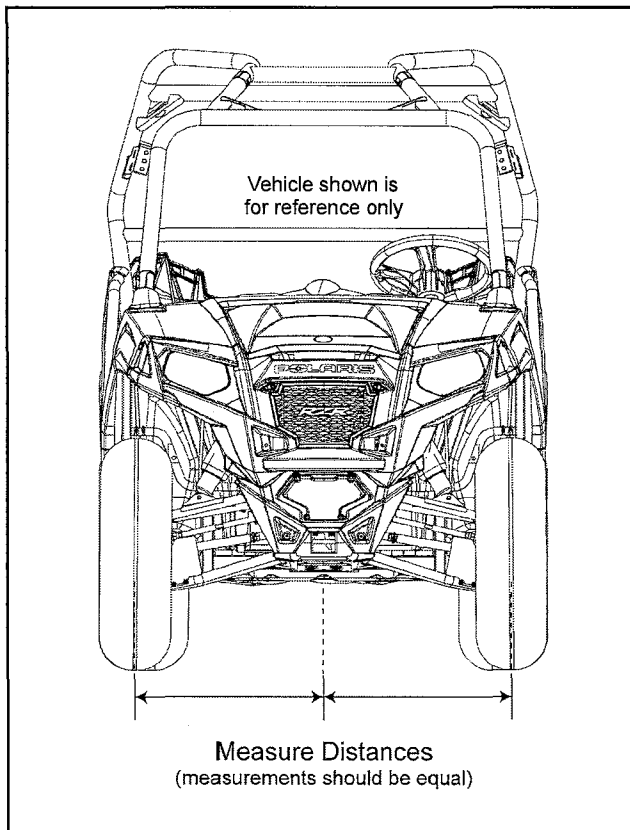
NOTE: It is important the height of both marks be equally positioned to get an accurate measurement.

3. Measure the distance between the marks and record the measurement. Call this measurement "A".
4. Rotate the tires 180° by moving the vehicle forward. Position chalk marks facing rearward, even with the hub/axle center line.
5. Again measure the distance between the marks and record. Call this measurement "B". Subtract measurement "B" from measurement "A". The difference between measurements "A" and "B" is the vehicle toe alignment. The recommended vehicle toe tolerance is 1/8", to 3/16", (3.2 to 4.8 mm) toe out. This means the measurement at the front of the tire (A) is 1/8", to 3/16", (3.2 to 4.8 mm) wider than the measurement at the rear (B).



Wheel Toe Adjustment

If toe alignment is incorrect, measure the distance between vehicle center and each wheel. This will tell you which tie rod needs adjusting.



NOTE: Be sure steering wheel is straight ahead before determining which tie rod needs adjustment.

CAUTION

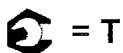
During tie rod adjustment, it is very important that the following precautions be taken when tightening tie rod end jam nuts. If the rod end is positioned incorrectly it will not pivot, and may break.

To adjust toe alignment:

- Hold tie rod end to keep it from rotating.
- Loosen jam nuts at both end of the tie rod.
- Shorten or lengthen the tie rod until alignment is as required to achieve the proper toe setting as specified in "Wheel Toe Alignment".

MAINTENANCE

- **IMPORTANT:** When tightening the tie rod end jam nuts, the rod ends must be held parallel to prevent rod end damage and premature wear. Damage may not be immediately apparent if done incorrectly.
- After alignment is complete, torque jam nuts to specification.



Tie Rod Jam Nut:
12-14 ft. lbs. (16-19 Nm)

SUSPENSION (FOX™)

Spring Preload Adjustment

The front and rear shocks have a spring preload adjustment. Suspension spring preload may be adjusted to suit different riding conditions or vehicle payloads.

WARNING

Uneven adjustment may cause poor handling of the vehicle, which could result in an accident and serious injury or death. Always adjust both the left and right spring preloads equally.

Spring Preload Adjustment - Factory Setting

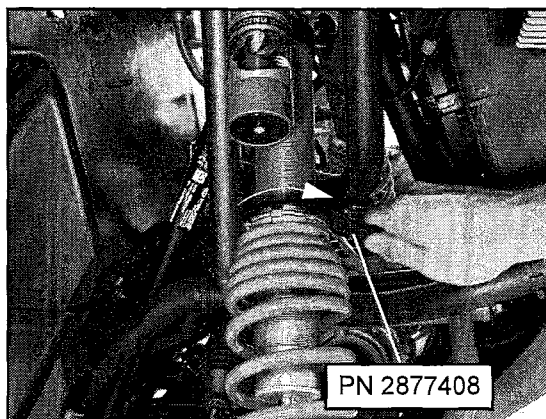
Front	Rear
7.625 in. (19.37 cm)	3.625 in. (9.21 cm)

NOTE: Refer to the shock illustrations within this procedure for spring preload measurement location.

The factory preload setting is appropriate for nearly all riding conditions. Since this vehicle is equipped with full skid plates, adjustment is not necessary.

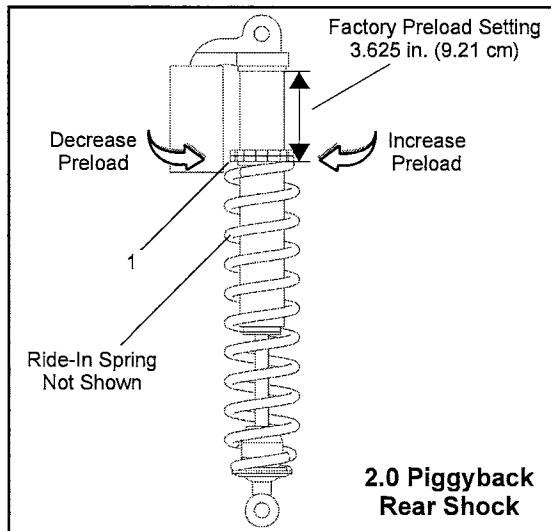
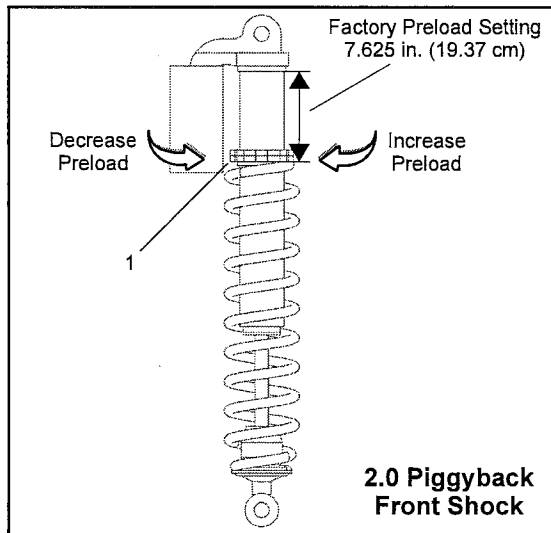
If desired, the spring preload setting may be adjusted to maintain vehicle clearance height when carrying loads.

1. Raise and safely support the front or rear of the vehicle off the ground to allow the suspension to fully extend.
2. Loosen the upper jam nut adjustment ring using the spanner wrench (PN 2877408) included in the vehicle's tool kit.



Shock Spanner Wrench:
(PN 2877408)

- Turn the lower adjustment ring (1) clockwise to increase preload or counter-clockwise to decrease preload.



IMPORTANT: DO NOT increase the spring preload by more than one inch (25.4 mm) over the factory setting.

- Once you have obtained the correct preload, hold the lower adjustment ring while tightening the upper adjustment ring to lock them in place.

IMPORTANT: Always return the spring preload to the factory setting after the load is removed from the vehicle. The increased suspension height will negatively impact vehicle stability when operating without a load.

Shock Compression Adjustment

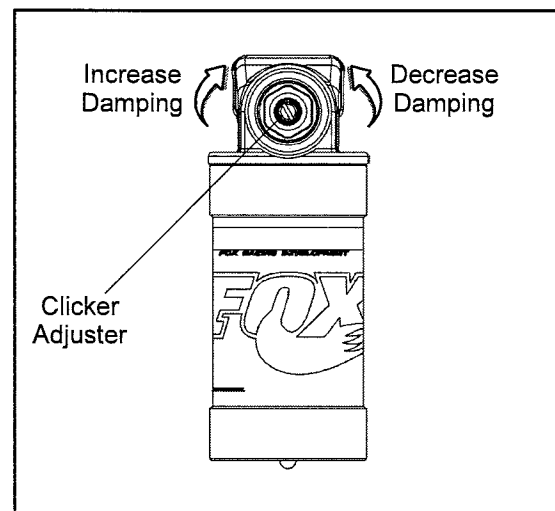
The compression damping adjustment is located on top of the shock 'Piggyback' reservoir of each shock.

Use a flat blade screwdriver to make damping adjustments.

NOTE: When the adjuster screw is turned clockwise until it stops, the damping is in the fully closed position.

Turn the clicker clockwise to increase compression damping. Turn the clicker counter-clockwise to decrease compression damping.

NOTE: The factory setting is 10 clicks from closed. Refer to the "Compression Adjustment Table" below.



Compression Adjustment Table

Setting	Compression Damping
Softest	18 clicks from closed
Factory	10 clicks from closed
Firmer	2 clicks from closed

MAINTENANCE

BRAKE SYSTEM

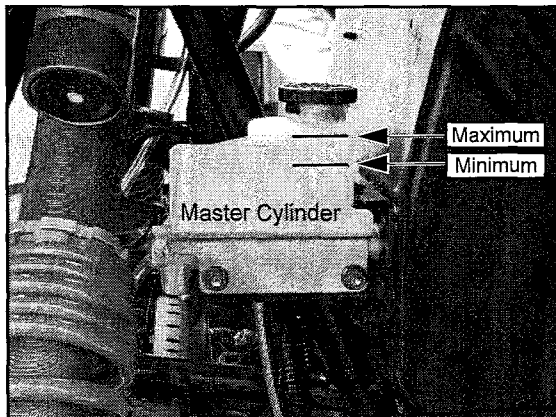
Brake Fluid Inspection

Always check the brake pedal travel and inspect the brake fluid reservoir level before each operation. If the fluid level is low, add DOT 4 brake fluid only.

Brake fluid should be changed every two years. The fluid should also be changed anytime the fluid becomes contaminated, the fluid level is below the minimum level, or if the type and brand of the fluid in the reservoir is unknown.

The brake fluid master cylinder reservoir can be accessed through the left front wheel well.

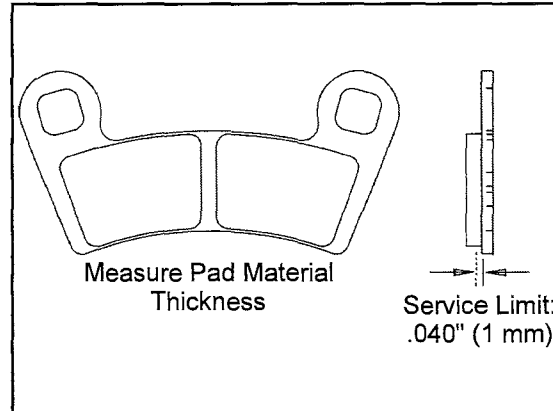
1. Position the vehicle on a level surface.
2. Place the transmission in PARK.
3. View the brake fluid level in the reservoir. The level should be between the MAX and MIN level lines.



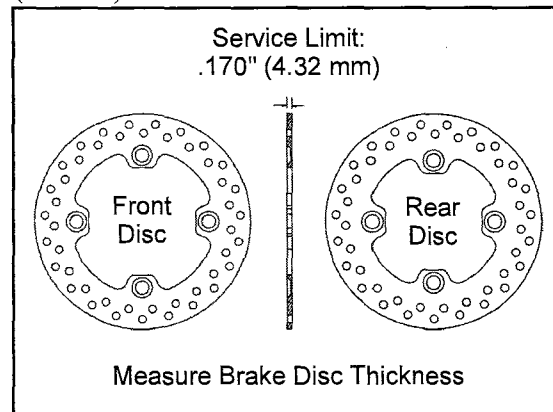
4. If the fluid level is lower than the MIN level line, add brake fluid until it reaches the MAX level line.
5. Install the reservoir cap and apply the brake pedal forcefully for a few seconds and check for fluid leakage around the master cylinder fittings and the brake caliper fittings.

Brake Pad / Disc Inspection

1. Check the brake pads for wear, damage, or looseness.
2. Inspect the brake pad wear surface for excessive wear.
3. Pads should be changed when the friction material is worn to .040" (1 mm).



4. Check surface condition of the brake discs.
5. Measure the thickness of the front and rear brake discs.
6. The disc(s) should be replaced if thickness is less than .170" (4.32 mm).



Brake Hose and Fitting Inspection

Check brake system hoses and fittings for cracks, deterioration, abrasion, and leaks. Tighten any loose fittings and replace any worn or damaged parts.

2

NOTES

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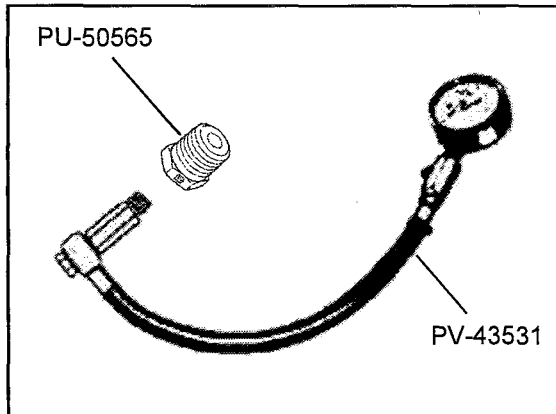
CHAPTER 3**ENGINE / COOLING**

GENERAL INFORMATION	3.3
SPECIAL TOOLS	3.3
ENGINE LUBRICATION SPECIFICATIONS	3.3
OIL PRESSURE TEST	3.4
ENGINE OIL FLOW CHART	3.5
ENGINE SERVICE SPECIFICATIONS	3.6
ENGINE DETAIL - TORQUE VALUES / SEQUENCES / ASSEMBLY NOTES	3.8
ENGINE COOLING SYSTEM	3.13
COOLING SYSTEM SPECIFICATIONS	3.13
COOLING SYSTEM PRESSURE TEST / PRESSURE CAP TEST	3.13
RADIATOR REMOVAL / INSTALLATION	3.14
THERMOSTAT REPLACEMENT	3.15
COOLING SYSTEM EXPLODED VIEW	3.16
COOLING SYSTEM BLEEDING PROCEDURE	3.17
WATER PUMP REMOVAL / INSTALLATION	3.18
WATER PUMP SERVICE	3.20
ENGINE SERVICE	3.22
ACCESSIBLE ENGINE COMPONENTS	3.22
TOP-END SERVICE (ENGINE IN CHASSIS)	3.22
ENGINE REMOVAL	3.22
ENGINE INSTALLATION	3.26
ENGINE MOUNTING AND TORQUE VALUES	3.30
ENGINE BREAK-IN PERIOD / LUBRICATION SPECIFICATIONS	3.30
ENGINE DISASSEMBLY / INSPECTION - TOP END	3.31
VALVE COVER REMOVAL	3.31
CAMSHAFT REMOVAL	3.31
CAMSHAFT SPROCKET INSPECTION	3.33
CAMSHAFT / CAMSHAFT BORE INSPECTION	3.33
CYLINDER HEAD REMOVAL	3.34
CYLINDER HEAD INSPECTION / WARP INSPECTION	3.35
CYLINDER HEAD DISASSEMBLY	3.35
VALVE INSPECTION	3.36
COMBUSTION CHAMBER CLEANING	3.37
VALVE SEAT RECONDITIONING	3.38
ENGINE DISASSEMBLY / INSPECTION - LOWER END	3.40
STATOR COVER REMOVAL / INSPECTION	3.40
WATER PUMP HOUSING REMOVAL	3.41
FLYWHEEL REMOVAL	3.41
STARTER ONE-WAY CLUTCH INSPECTION / DISASSEMBLY	3.42
STARTER ONE-WAY CLUTCH ASSEMBLY	3.43
CRANKCASE DISASSEMBLY / INSPECTION	3.44
BALANCE SHAFT REMOVAL / INSPECTION	3.46
CRANKSHAFT REMOVAL / INSPECTION	3.47
CRANKCASE INSPECTION	3.50
CYLINDER / PISTON REMOVAL	3.51
CYLINDER INSPECTION	3.51
PISTON DISASSEMBLY / INSPECTION	3.52
PISTON RING REMOVAL	3.53
PISTON RING TO GROOVE CLEARANCE INSPECTION	3.54
PISTON RING INSTALLED GAP	3.54
PISTON-TO-CYLINDER CLEARANCE	3.55
CONNECTING ROD INSPECTION	3.55

ENGINE / COOLING

Oil Pressure Test

1. Attach the Oil Pressure Gauge Adapter (PU-50565) to the Oil Pressure Gauge (PV-43531).



Oil Pressure Gauge Adapter: PU-50565
Oil Pressure Gauge: PV-43531

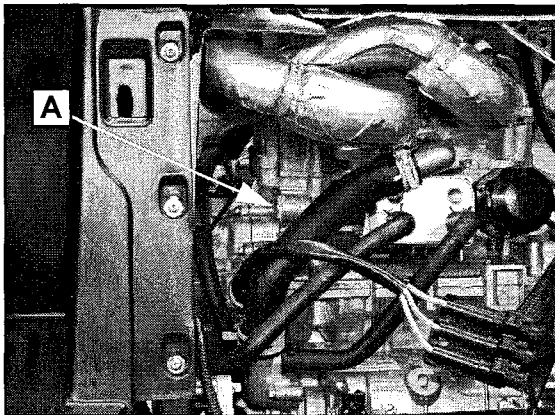
Oil Pressure Specification (Engine Hot):
Minimum @ 1200 RPM: 10 PSI
Minimum @ 7000 RPM: 40 PSI

6. Upon assembly, torque the crankcase gallery plug to specification.



Crankcase Gallery Plug:
11 ft. lbs. (15 Nm)

2. Remove the seats and engine service panel.
3. Clean the area around the main oil gallery plug (A), located in the upper crankcase on the MAG side of the engine.
4. Remove the plug (A) and insert the oil pressure adapter.

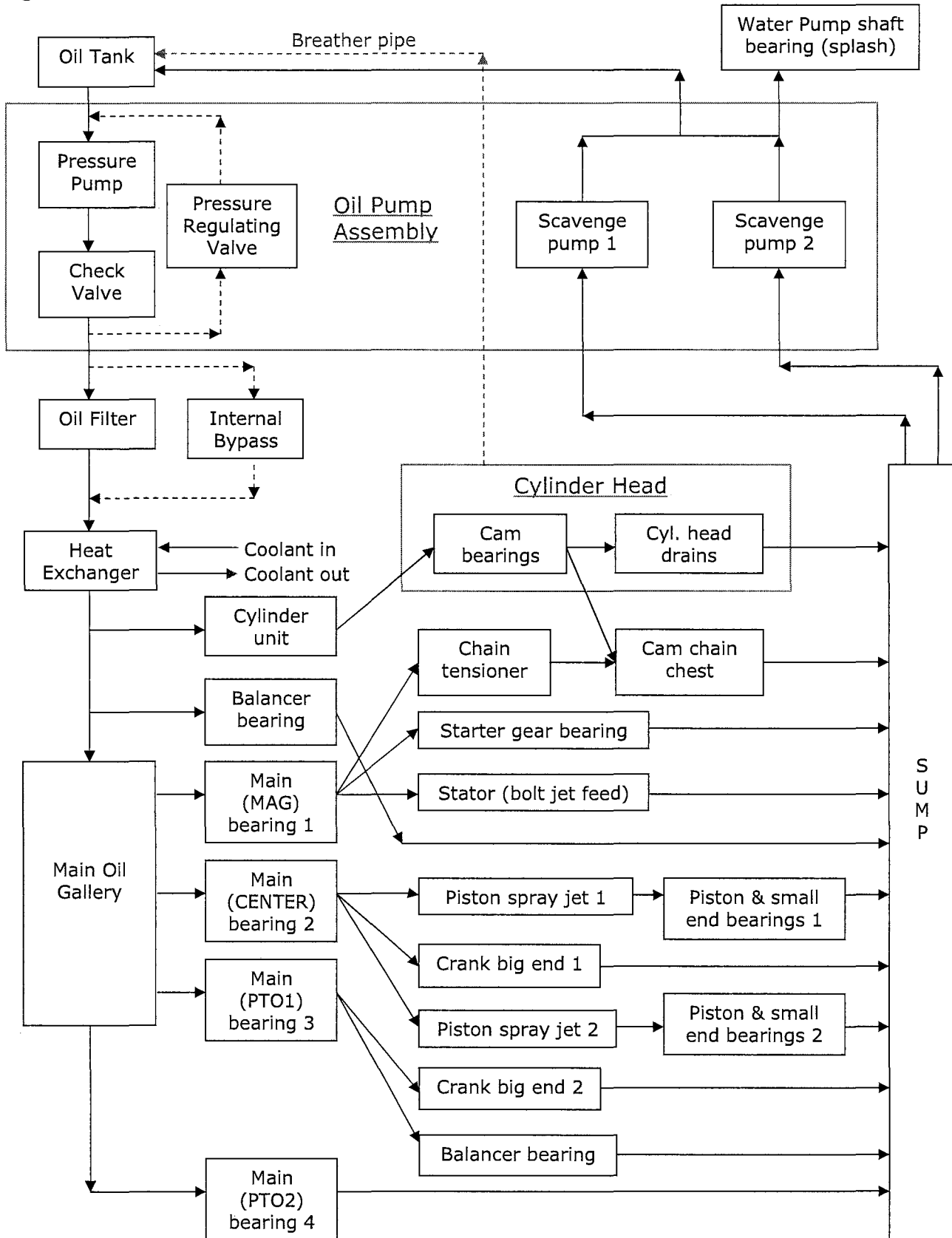


5. Start engine and allow it to reach operating temperature, monitoring gauge indication.

NOTE: Test results are based on the use of the recommended engine oil (Polaris PS-4 Plus) at operating temperature, and may vary considerably if any other oil is used or if engine is not up to temperature.

Engine Oil Flow Chart

3



3.5

ENGINE / COOLING

ENGINE SERVICE SPECIFICATIONS

Engine Specifications - ES087OLE011

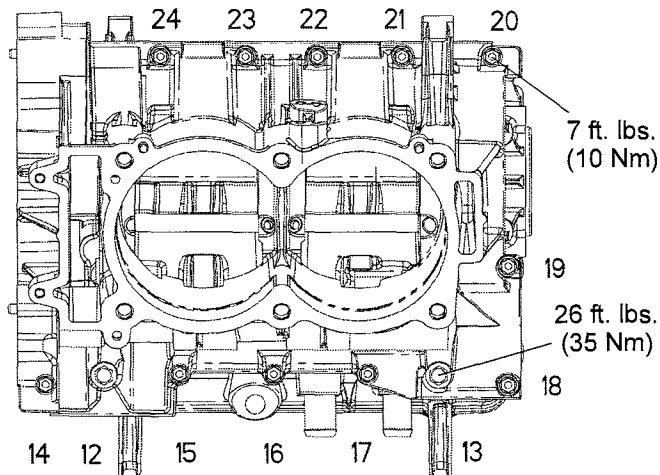
CAMSHAFT / CYLINDER HEAD / CYLINDER (IN. / MM)		
Camshaft	Cam Lobe Height - Intake (Standard)	0.9499" \pm 0.0015" (24.13 \pm 0.04 mm)
	Cam Lobe Height - Intake (Service Limit)	0.9464" (24.04 mm)
	Cam Lobe Height - Exhaust (Standard)	0.9251" \pm 0.0015" (23.50 \pm 0.04 mm)
	Cam Lobe Height - Exhaust (Service Limit)	0.9216" (23.41 mm)
	Camshaft Journal O.D. - All (Standard)	0.9036" - 0.9045" (22.954 - 22.975 mm)
	Camshaft Journal O.D. - All (Service Limit)	0.9033" (22.944 mm)
	Camshaft Journal Bore I.D. - All (Standard)	0.9055" - 0.9063" (23.000 - 23.021 mm)
	Camshaft Journal Bore I.D. - All (Service Limit)	0.9072" (23.044 mm)
	Camshaft Oil Clearance (Standard)	0.0009" - 0.0026" (0.025 - 0.067 mm)
	Camshaft Oil Clearance (Service Limit)	0.0039" (0.1 mm)
	Camshaft End Play (Standard)	0.0049" - 0.0108" (0.125 - 0.275 mm)
	Camshaft End Play (Service Limit)	0.0157" (0.4 mm)
Cylinder Head	Cylinder Head - Surface Warp Limit	0.0039" (0.1 mm)
	Cylinder Head - Standard Height	4.682" \pm 0.0019" (118.93 \pm 0.05 mm)
Valve Seat	Valve Seat - Contacting Width - Intake (Standard)	0.0393" \pm 0.0039" (1.0 \pm 0.10 mm)
	Valve Seat - Contacting Width - Intake (Service Limit)	0.0551" (1.4 mm)
	Valve Seat - Contacting Width - Exhaust (Standard)	0.0590" \pm 0.0039" (1.5 \pm 0.10 mm)
	Valve Seat - Contacting Width - Exhaust (Service Limit)	0.0748" (1.9 mm)
	Valve Seat Angles	30.0° \pm 1.5° / 45.0° \pm 0.5° / 60.0° \pm 1.5°
Valve Guide	Valve Guide Inner Diameter	0.2165" - 0.2171" (5.500 - 5.515 mm)
Valve	Valve Lash (Cold) - Intake	0.005" - 0.007" (0.125 - 0.175 mm)
	Valve Lash (Cold) - Exhaust	0.011" - 0.013" (0.275 - 0.325 mm)
	Valve Stem Diameter - Intake	0.2155" - 0.2161" (5.475 - 5.490 mm)
	Valve Stem Diameter - Exhaust	0.2147" - 0.2153" (5.455 - 5.470 mm)
	Valve Stem Oil Clearance - Intake	0.0003" - 0.0015" (0.010 - 0.040 mm)
	Valve Stem Oil Clearance - Exhaust	0.0011" - 0.0023" (0.030 - 0.060 mm)
	Valve Stem Overall Length - Intake	3.7704" (95.77 mm)
	Valve Stem Overall Length - Exhaust	3.8023" (96.58 mm)
Valve Spring	Valve Spring Free Length (Standard)	1.7263" (43.85 mm)
	Valve Spring Free Length (Service Limit)	1.6830" (42.75 mm)
Cylinder	Cylinder - Surface Warp Limit (mating with cylinder head)	0.002" (0.05 mm)
	Cylinder Bore - Standard	3.6614" \pm 0.0003" (93 mm \pm 0.008 mm)
	Cylinder Out of Round Limit	0.001" (0.025 mm)
	Cylinder Taper Limit	0.001" (0.025 mm)
	Cylinder to Piston Clearance	0.0009" - .0019" (.025 - .050 mm)

PISTON / RINGS / CONNECTING ROD / CRANKSHAFT / BALANCE SHAFT (IN. / MM)			
Piston	Piston - Standard O.D. - Measured 90 degrees to pin, 0.39 in. (10 mm) up from piston skirt. See text.		3.6597 ± .0003" (92.959 ± .008 mm)
	Piston Pin Bore I.D. (Standard)		0.7877" - 0.7881" (20.009 - 20.018 mm)
	Piston Pin Bore I.D. (Service Limit)		0.7893" (20.05 mm)
Piston Pin	Piston Pin O.D. (Standard)		0.7873" - 0.7875" (20.000 - 20.005 mm)
	Piston Pin O.D. (Service Limit)		0.7866" (19.98 mm)
Piston Ring	Installed Gap	Top Ring (Standard)	0.010" - 0.014" (0.25 - 0.35 mm)
		Top Ring (Service Limit)	0.0196" (0.5 mm)
		Second Ring (Standard)	S/N < 00517: 0.014" - 0.020" (0.35 - 0.50 mm)
			S/N > 00516: 0.039" - 0.045" (1.00 - 1.15 mm)
		Second Ring (Service Limit)	S/N < 00517: 0.028" (0.70 mm)
			S/N > 00516: 0.053" (1.35 mm)
	Ring to Groove Clearance	Oil Control Rails (Standard)	0.008" - 0.028" (0.20 - 0.70 mm)
		Oil Control Rails (Service Limit)	0.0354" (0.9 mm)
		Top Ring (Standard)	0.0007" - 0.0023" (0.020 - 0.060 mm)
		Second Ring (Standard)	
		Service Limit	0.0047" (0.12 mm)
Connecting Rod	Connecting Rod Small End I.D. (Standard)		0.7879" - 0.7885" (20.015 - 20.030 mm)
	Connecting Rod Small End I.D. (Service Limit)		0.7897" (20.06 mm)
	1 - Marking	Connecting Rod Big End Bore I.D.	1.7318" - 1.7321" (43.989 - 43.996 mm)
	2 - Marking	Connecting Rod Big End Bore I.D.	1.7321" - 1.7323" (43.996 - 44.003 mm)
	3 - Marking	Connecting Rod Big End Bore I.D.	1.7323" - 1.7326" (44.003 - 44.010 mm)
Crankshaft	B - Marking	Main Journal O.D. (Standard)	1.6144" - 1.6147" (41.006 - 41.014 mm)
	G - Marking	Main Journal O.D. (Standard)	1.6140" - 1.6143" (40.998 - 41.005 mm)
	Y - Marking	Main Journal O.D. (Standard)	1.6137" - 1.6140" (40.990 - 40.997 mm)
	Main Journal O.D. (Service Limit)		1.6129" (40.970 mm)
	B - Marking	Rod Journal O.D. (Standard)	1.6118" - 1.6122" (40.942 - 40.950 mm)
	G - Marking	Rod Journal O.D. (Standard)	1.6115" - 1.6118" (40.934 - 40.941 mm)
	Y - Marking	Rod Journal O.D. (Standard)	1.6112" - 1.6115" (40.926 - 40.933 mm)
	Rod Journal O.D. (Service Limit)		1.6104" (40.906 mm)
	Crankshaft Runout Limit (PTO and MAG)		Less than 0.001" (0.025 mm)
	Auxiliary Sprocket Installed Depth		4.9527" ± 0.0078" (125.8 ± 0.2 mm)
Balance Shaft	A - Marking	Bearing Journal O.D. (Standard)	1.4950" - 1.4953" (37.974 - 37.982 mm)
	B - Marking	Bearing Journal O.D. (Standard)	1.4947" - 1.4950" (37.966 - 37.974 mm)
	Bearing Journal O.D. (Service Limit)		1.4941" (37.951 mm)

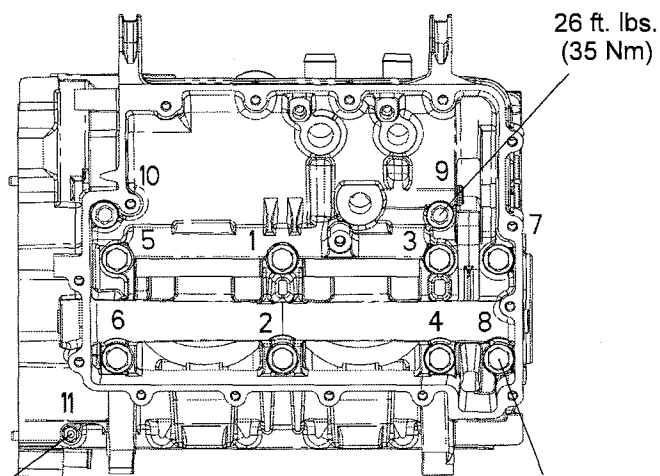
ENGINE / COOLING

ENGINE DETAIL - TORQUE VALUES / SEQUENCES / ASSEMBLY NOTES

Main Engine Components - Torque Specification and Sequence

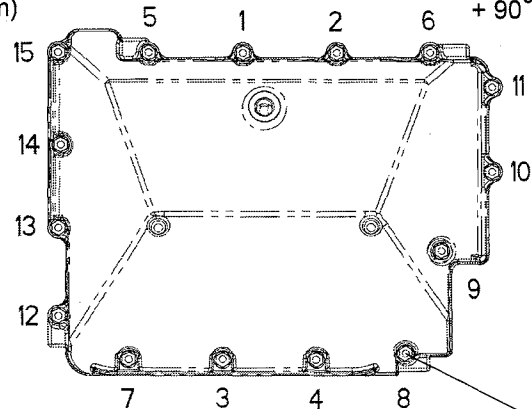


CRANKCASE SPLIT-LINE
TORQUE SEQUENCE



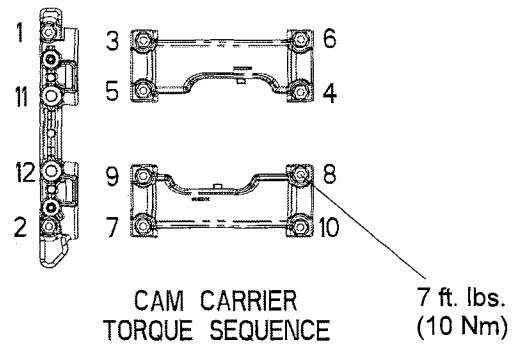
9 ft. lbs.
(12 Nm)

21 ft. lbs. (28 Nm)
+ 90° (1/4 turn)



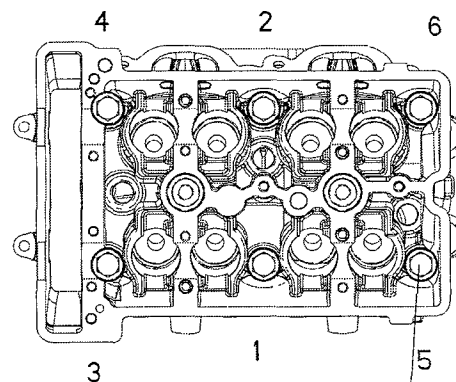
SUMP COVER
TORQUE SEQUENCE

9 ft. lbs.
(12 Nm)



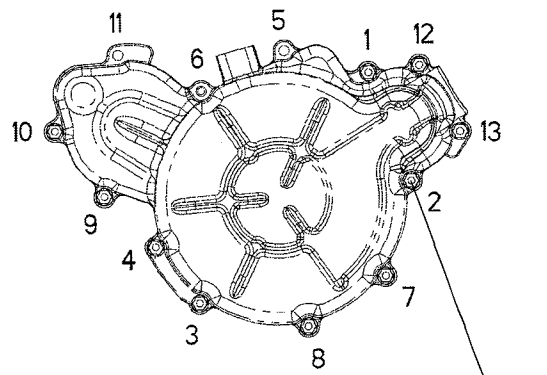
CAM CARRIER
TORQUE SEQUENCE

7 ft. lbs.
(10 Nm)



CYLINDER HEAD
TORQUE SEQUENCE

Step 1: 21 ft. lbs. (28 Nm)
Step 2: 26 ft. lbs. (35 Nm)
Step 3: 180° (1/2 turn)

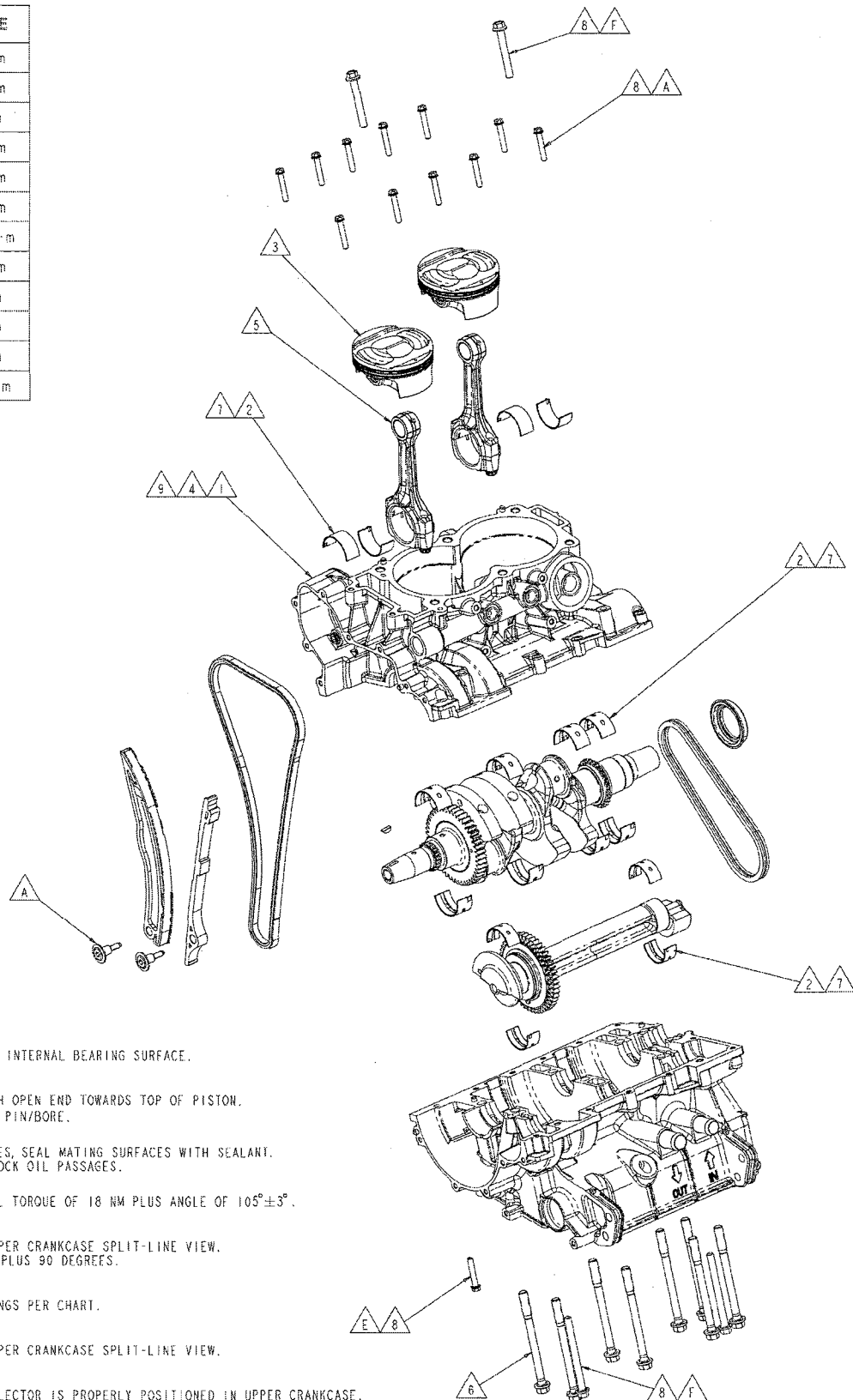


STATOR COVER
TORQUE SEQUENCE

9 ft. lbs.
(12 Nm)

Balance Shaft / Connecting Rods / Crankcase / Crankshaft / Pistons

FASTENER TORQUE TABLE	
A	10.00±1.00 N·m
B	16.00±2.00 N·m
C	8.00±1.00 N·m
D	28.00±3.00 N·m
E	12.00±2.00 N·m
F	35.00±2.00 N·m
G	100.00±10.00 N·m
H	22.50±2.50 N·m
K	40.00±4.00 N·m
L	14.00±2.00 N·m
M	15.00±2.00 N·m
N	120.00±12.00 N·m



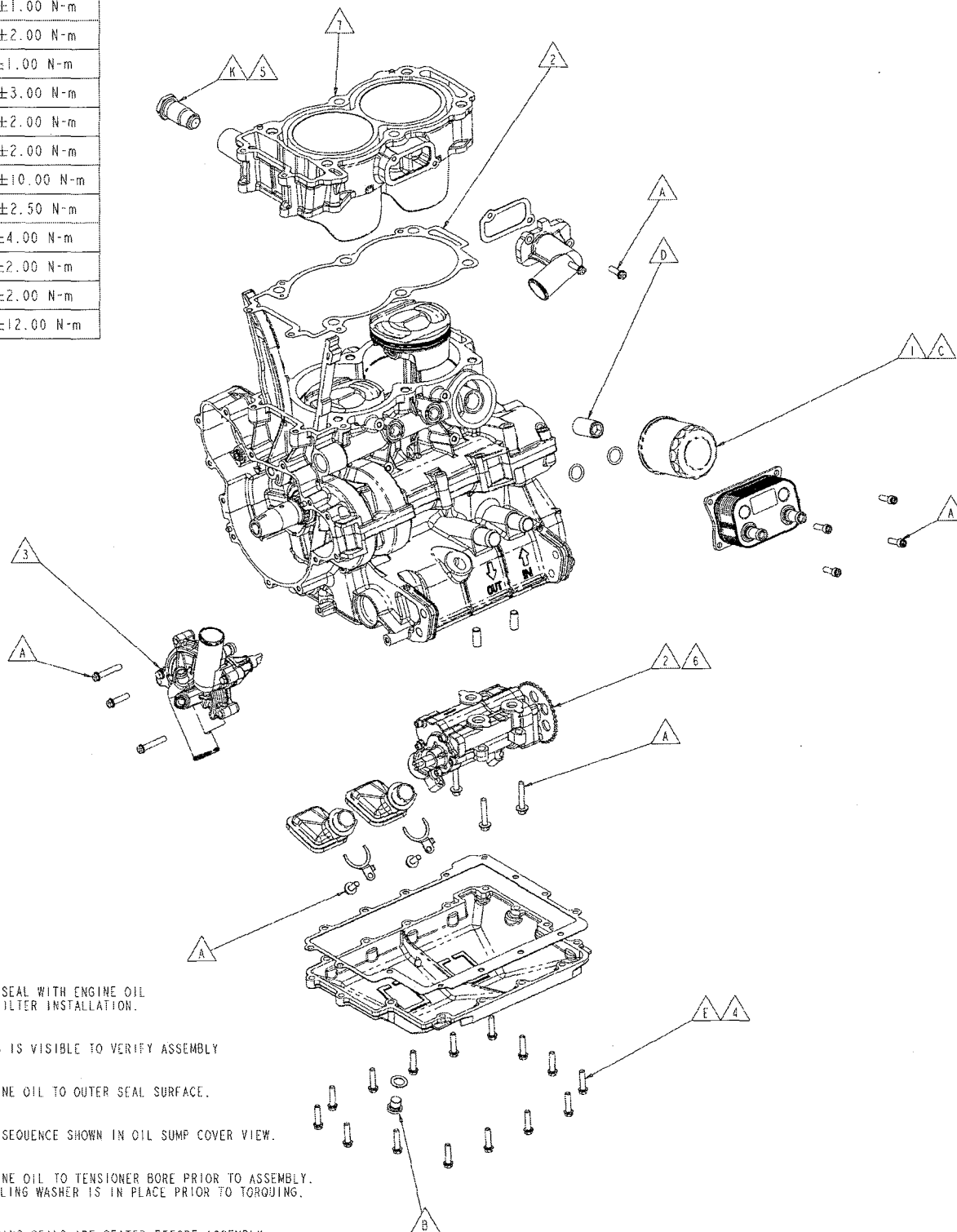
NOTES:

- 2 APPLY ENGINE OIL TO INTERNAL BEARING SURFACE.
- 3 INSTALL CIRCLIP WITH OPEN END TOWARDS TOP OF PISTON.
APPLY OIL TO PISTON PIN/BORE.
- 4 CLEAN MATING SURFACES, SEAL MATING SURFACES WITH SEALANT.
SEALANT MUST NOT BLOCK OIL PASSAGES.
- 5 TIGHTEN WITH INITIAL TORQUE OF 18 NM PLUS ANGLE OF $105^{\circ} \pm 3^{\circ}$.
- 6 TORQUE IN SEQUENCE PER CRANKCASE SPLIT-LINE VIEW.
TORQUE TO 28 ± 3 N·m PLUS 90 DEGREES.
- 7 SELECT PROPER BEARINGS PER CHART.
- 8 TORQUE IN SEQUENCE PER CRANKCASE SPLIT-LINE VIEW.
- 9 INSURE THAT OIL DEFLECTOR IS PROPERLY POSITIONED IN UPPER CRANKCASE.

ENGINE / COOLING

Cylinder / Oil Cooler / Oil Filter / Oil Pump / Oil Sump / Water Pump

FASTENER TORQUE TABLE	
A	10.00±1.00 N·m
B	16.00±2.00 N·m
C	8.00±1.00 N·m
D	28.00±3.00 N·m
E	12.00±2.00 N·m
F	35.00±2.00 N·m
G	100.00±10.00 N·m
H	22.50±2.50 N·m
K	40.00±4.00 N·m
L	14.00±2.00 N·m
M	15.00±2.00 N·m
N	120.00±12.00 N·m



NOTES:

- 1 LUBRICATE SEAL WITH ENGINE OIL PRIOR TO FILTER INSTALLATION.
- 2 INSURE TAB IS VISIBLE TO VERIFY ASSEMBLY
- 3 APPLY ENGINE OIL TO OUTER SEAL SURFACE.
- 4 TORQUE IN SEQUENCE SHOWN IN OIL SUMP COVER VIEW.
- 5 APPLY ENGINE OIL TO TENSIONER BORE PRIOR TO ASSEMBLY. INSURE SEALING WASHER IS IN PLACE PRIOR TO TORQUING.
- 6 INSURE O-RING SEALS ARE SEATED BEFORE ASSEMBLY.
- 7 APPLY ENGINE OIL TO CYLINDER BORES PRIOR TO ASSEMBLY.

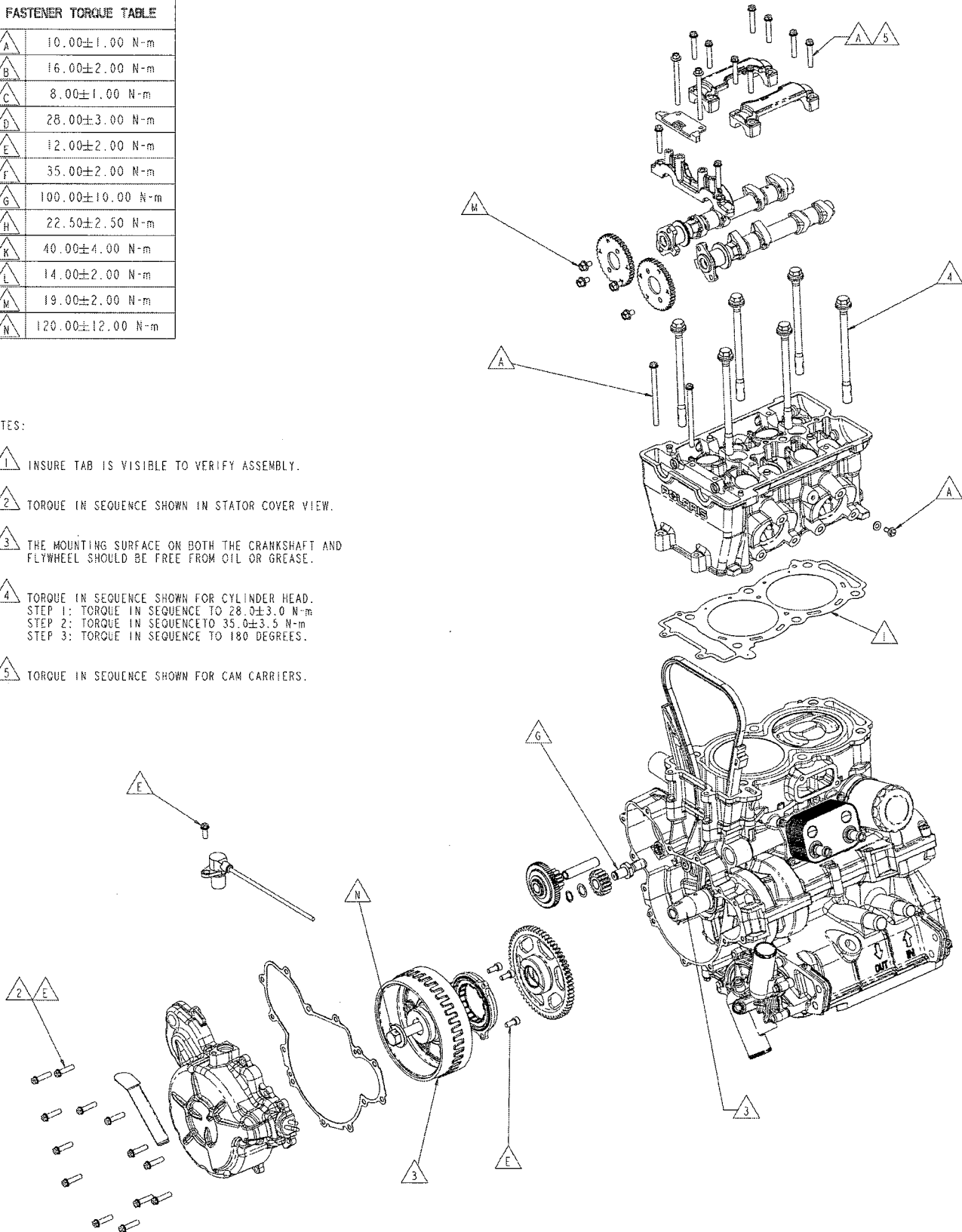
Camshafts / Cylinder Head / Flywheel / Idler Gears / Stator Cover

FASTENER TORQUE TABLE	
A	10.00±1.00 N-m
B	16.00±2.00 N-m
C	8.00±1.00 N-m
D	28.00±3.00 N-m
E	12.00±2.00 N-m
F	35.00±2.00 N-m
G	100.00±10.00 N-m
H	22.50±2.50 N-m
K	40.00±4.00 N-m
L	14.00±2.00 N-m
M	19.00±2.00 N-m
N	120.00±12.00 N-m

NOTES:

- 1 INSURE TAB IS VISIBLE TO VERIFY ASSEMBLY.
- 2 TORQUE IN SEQUENCE SHOWN IN STATOR COVER VIEW.
- 3 THE MOUNTING SURFACE ON BOTH THE CRANKSHAFT AND FLYWHEEL SHOULD BE FREE FROM OIL OR GREASE.
- 4 TORQUE IN SEQUENCE SHOWN FOR CYLINDER HEAD.
STEP 1: TORQUE IN SEQUENCE TO 28.0±3.0 N-m
STEP 2: TORQUE IN SEQUENCE TO 35.0±3.5 N-m
STEP 3: TORQUE IN SEQUENCE TO 180 DEGREES.
- 5 TORQUE IN SEQUENCE SHOWN FOR CAM CARRIERS.

3

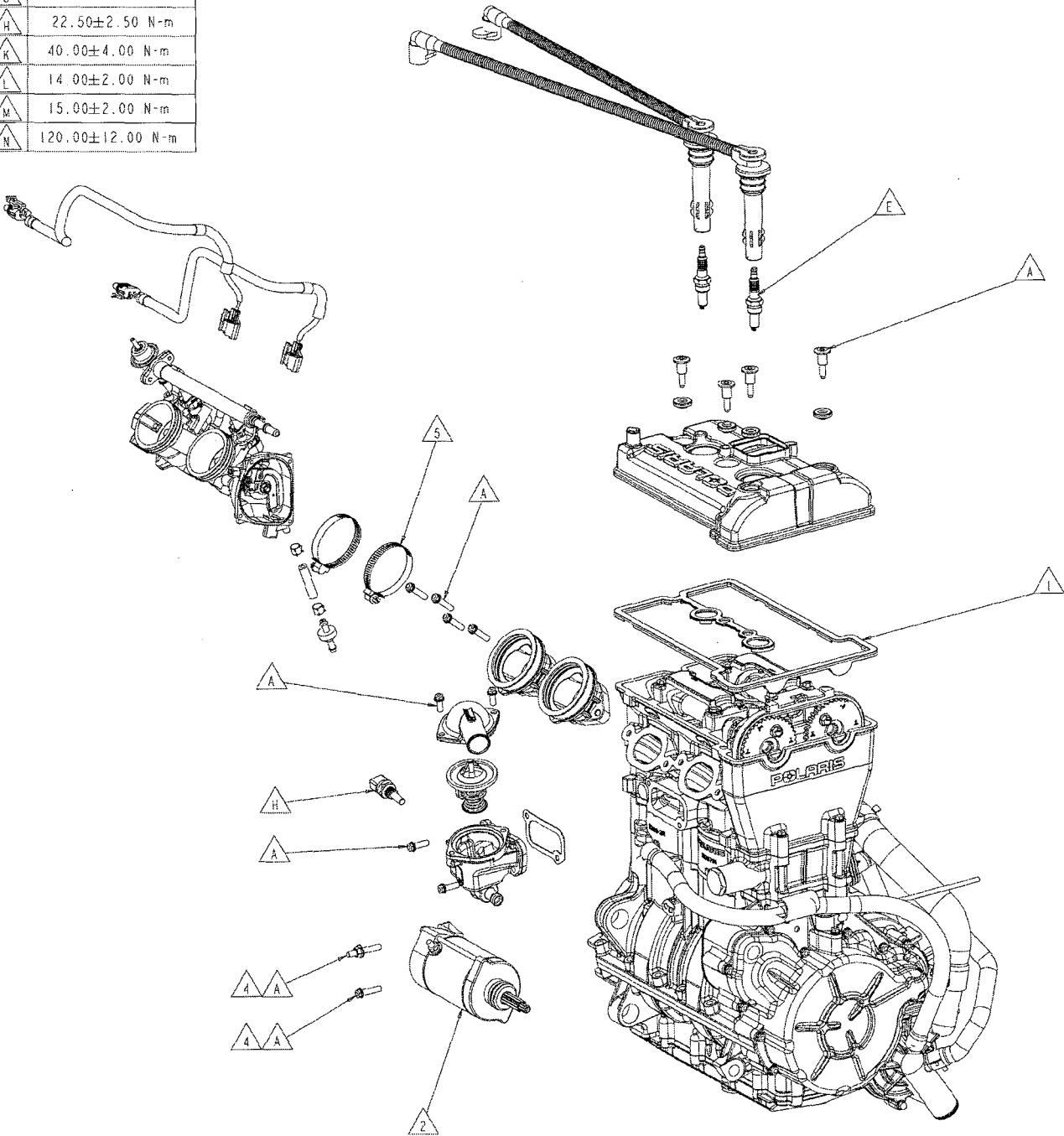


ENGINE / COOLING

Spark Plugs / Starter / Thermostat Housing / Throttle Body / Valve Cover

FASTENER TORQUE TABLE	
A	10.00±1.00 N·m
B	16.00±2.00 N·m
C	8.00±1.00 N·m
D	28.00±3.00 N·m
E	12.00±2.00 N·m
F	35.00±2.00 N·m
G	100.00±10.00 N·m
H	22.50±2.50 N·m
K	40.00±4.00 N·m
L	14.00±2.00 N·m
M	15.00±2.00 N·m
N	120.00±12.00 N·m

- NOTES:
- 1 APPLY SEALANT TO BOTH INSIDE CORNERS OF VALVE COVER GASKET.
 - 2 APPLY STARTER O-RING GREASE TO SEALS.
 - 4 INSERT TOP SCREW FIRST AND HAND TIGHTEN; THEN INSERT LOWER SCREW AND TORQUE; THEN TORQUE TOP SCREW.
 - 5 TORQUE CLAMP SCREW TO 1Nm +/- 0.5.



ENGINE COOLING SYSTEM

Cooling System Specifications

Condition	Coolant Temperature °F (°C)
Room Temperature	68° F (20° C)
Thermostat Open	180° F (82° C)
Fan Off	192° F (89° C)
Fan On	198° F (92° C)
Thermostat Full Open Lift	203° F (95° C)
Engine Temperature Overheat Indicator	233° F (112° C)
Engine Protection Ignition Misfire	236° F (113° C)
Engine Protection Shutdown	257° F (125° C)

Item	Specification
Cooling System Capacity	4.9 qts. (4.6 l)
Pressure Cap Relief	13 PSI

Polaris Premium Antifreeze
2871534 - Quart
2871323 - Gallon

Recommended Coolant

Use only high quality antifreeze/coolant mixed with distilled water in a 50/50 or 60/40 ratio, depending on freeze protection required in your area.

CAUTION: Using tap water in the cooling system will lead to a buildup of deposits which may restrict coolant flow and reduce heat dissipation, resulting in possible engine damage. Polaris Premium 60/40 Antifreeze/Coolant is recommended for use in all cooling systems and comes pre-mixed, ready to use.

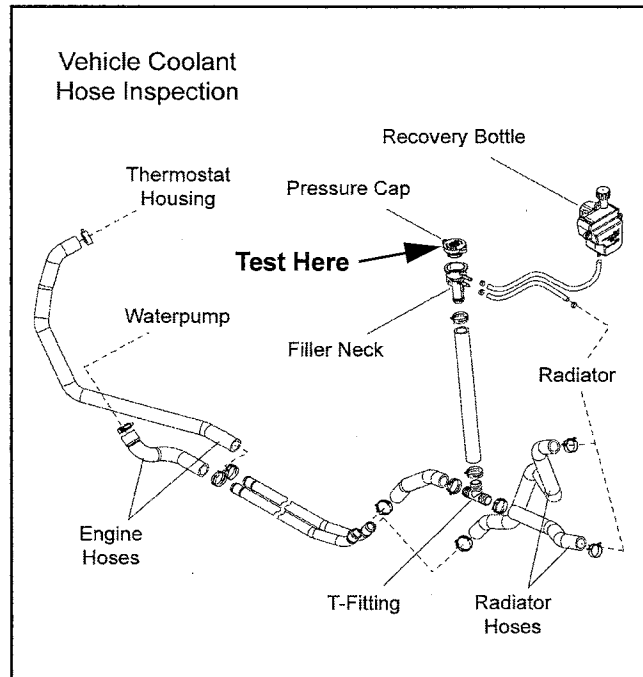
Cooling System Pressure Test

1. Remove the hood from the front cab.

WARNING

Never remove pressure cap when engine is warm or hot. The cooling system is under pressure and serious burns may result. Allow the engine to cool before servicing.

2. Remove pressure cap and pressure test the cooling system using a commercially available pressure tester.



3

3. The system must maintain 10 psi for five minutes or longer. If pressure loss is evident within five minutes, check the filler neck, radiator, hoses, clamps and water pump weep hole for leakage.

Pressure Cap Test

1. Remove the hood from the front cab (see "WARNING" under "Cooling System Pressure Test").
2. Remove pressure cap (A) and test using a pressure cap tester (commercially available).

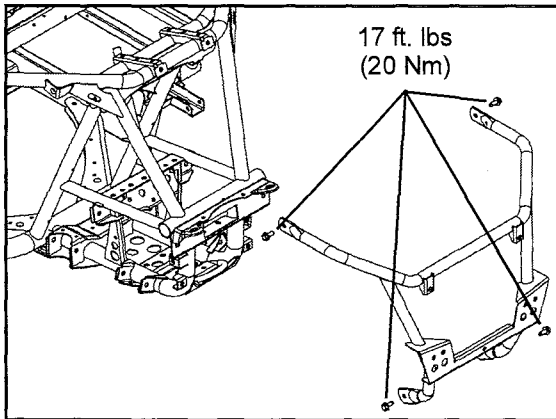


3. The pressure cap relief pressure is 13 psi. Replace cap if it does not meet this specification.

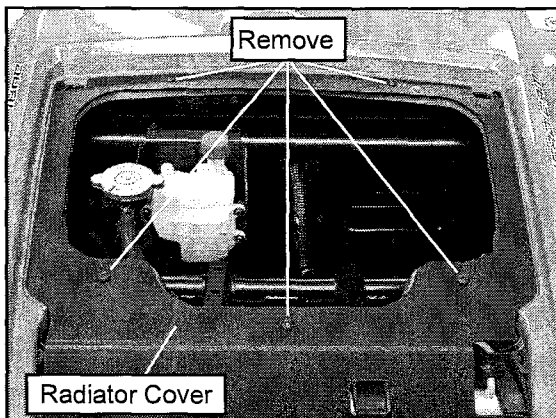
ENGINE / COOLING

Radiator Removal / Installation

1. Remove the hood and front bumper (see Chapter 5).
2. Remove the (4) fasteners that secure the front bumper support to the main frame.



3. Remove the (5) fasteners that secure the upper radiator cover to the front cab. Remove the upper radiator cover.



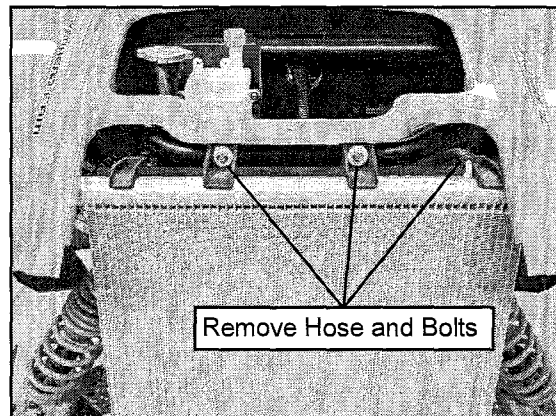
WARNING

The cooling system is under pressure and serious burns may result.
Allow the engine to cool before servicing.

4. Drain radiator by removing lower radiator hose. Be sure to catch and dispose of coolant properly.

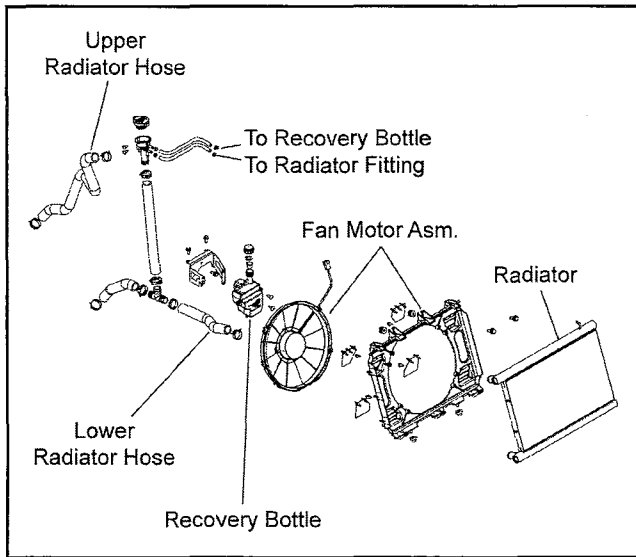


5. Disconnect cooling fan electrical connector.
6. Remove the upper radiator hose from the radiator.
7. Disconnect the small radiator bypass hose and remove the (2) upper radiator support bolts.



8. Lift radiator up to disengage it from its lower mounting points. Tilt top of radiator outward and remove the radiator from the vehicle.
9. Separate the fan motor assembly from the radiator. Inspect fan blades for damage.

- Reverse this procedure for installation. Be sure to properly fill and bleed cooling system as outlined in this chapter.



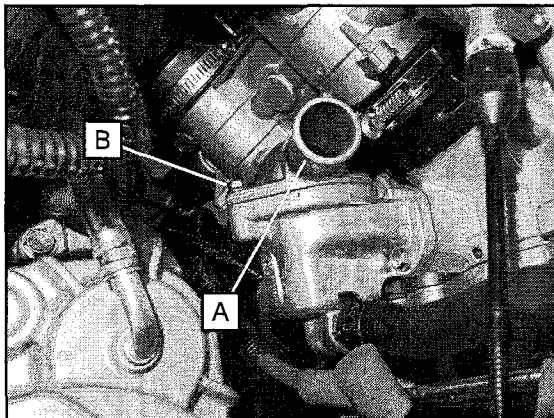
Thermostat Replacement

- Remove the hood from the front cab.

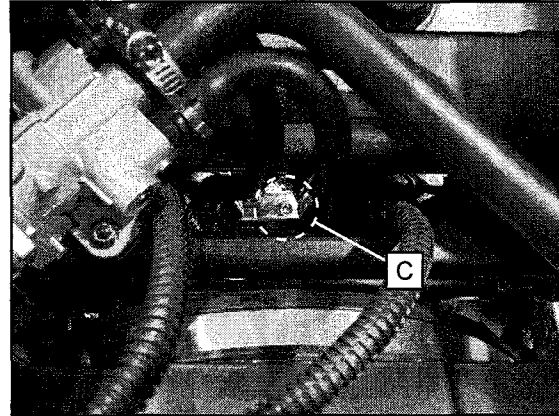
WARNING

The cooling system is under pressure and serious burns may result. Allow the engine to cool before servicing.

- Remove the pressure cap to relieve any system pressure (see "Pressure Cap Test").
- Drain coolant to a level below the thermostat housing.
- Remove upper coolant hose from thermostat housing (A).
- Remove the rear bolt (B) retaining the thermostat cover.



- Remove the cargo box access panel.
- Using an 8 mm swivel socket and long extension, remove the front bolt (C) retaining the thermostat cover.

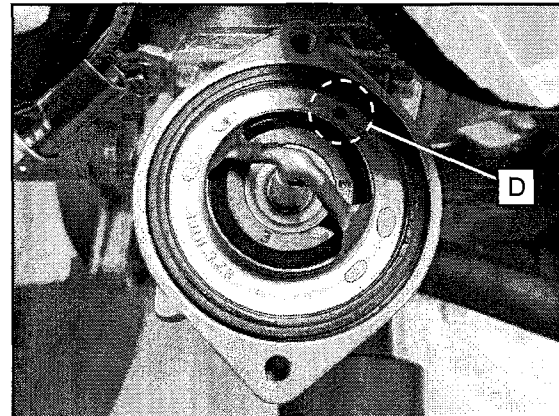


3

- Lift the cover from the housing and remove the thermostat.

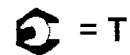
NOTE: Thermostat has a pop-off relief to allow the bypass system to operate until thermostat opens.

- Install a new thermostat with the bleed hole (D) positioned closest to the engine.



NOTE: Image shown above is with engine removed for clarity.

- Reverse this procedure for installation. Torque thermostat cover bolts to specification.

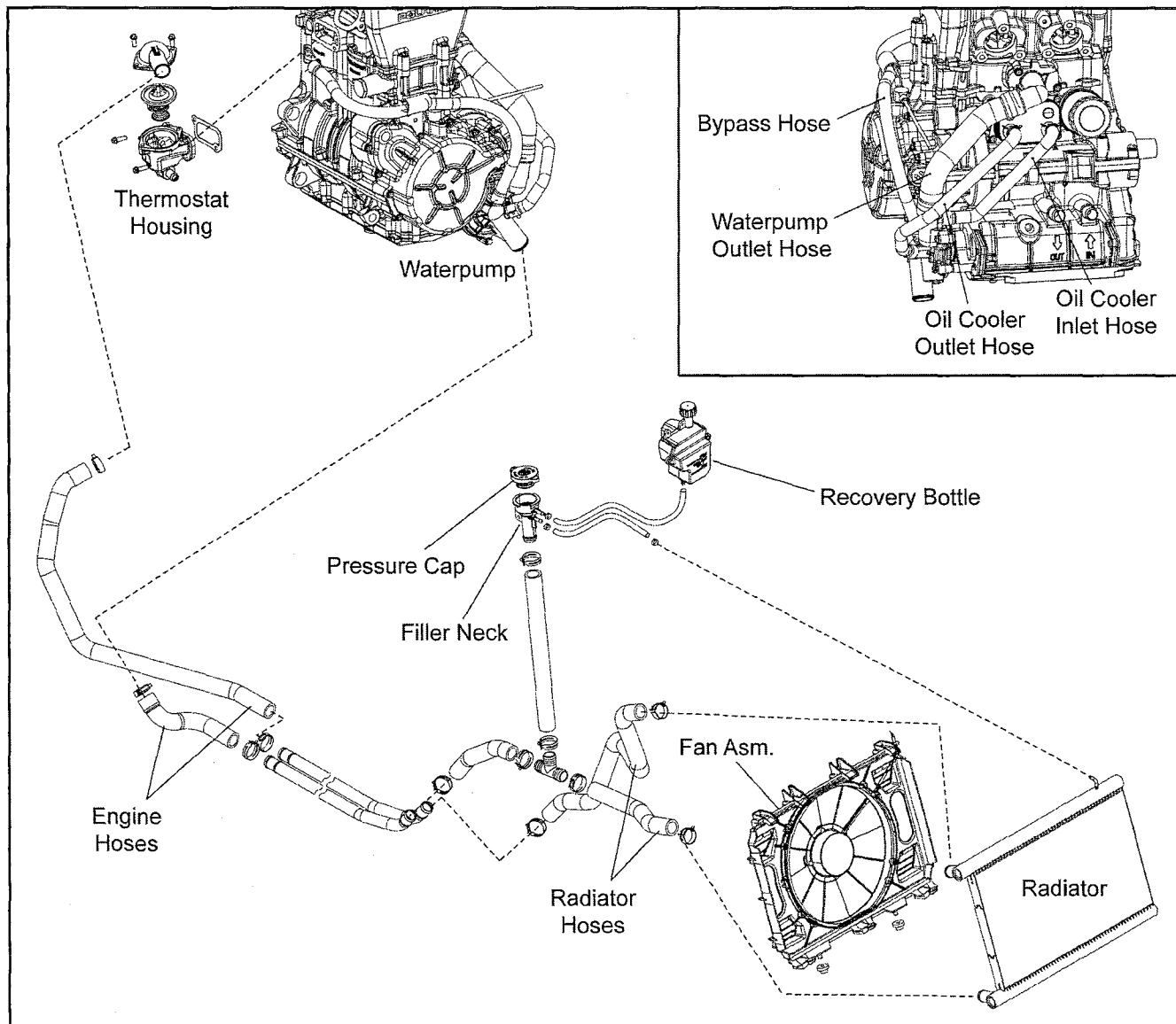


Thermostat Cover Bolts:
89 ± 9 in. lbs. (10 ± 1 Nm)

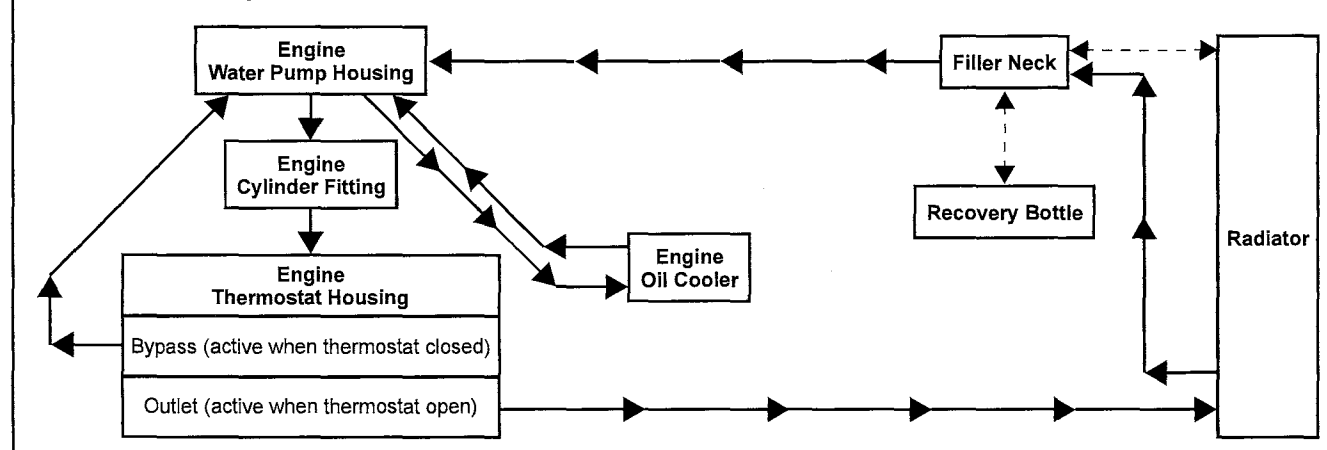
- Be sure to properly fill and bleed cooling system as outlined in this chapter.

ENGINE / COOLING

Cooling System Exploded View



Coolant Flow Diagram



Cooling System Bleeding Procedure

WARNING

Always wear safety glasses and proper shop clothing when performing the procedures in this manual. Failing to do so may lead to possible injury or death.

CAUTION

Use caution when performing these procedures. Coolant may be hot and may cause severe injury or burns.

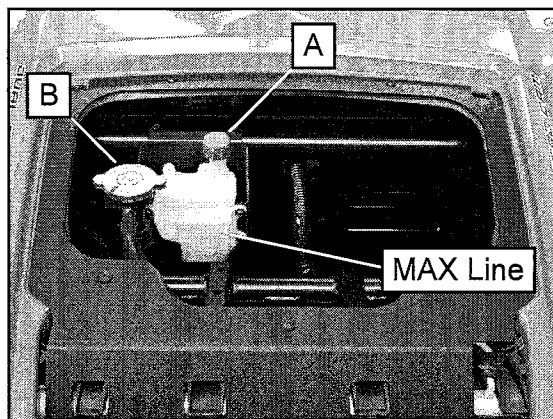
NOTE: If the coolant level is LOW in the radiator, or if there are leaks in the system, the coolant system will not draw coolant from the reservoir tank.

1. Allow engine and cooling system to cool down.

CAUTION

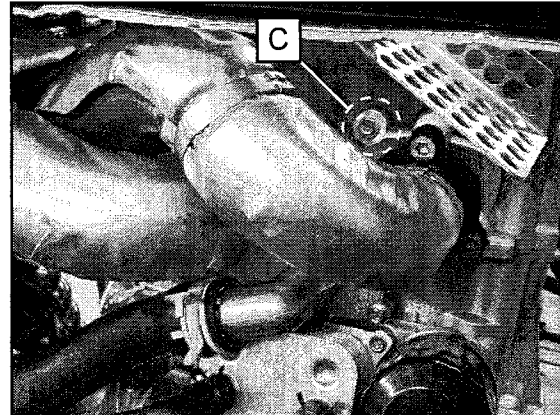
Be sure the engine has cooled and no pressure is built up in the cooling system before removing the pressure cap. The coolant may be hot and could cause severe injury or burns.

2. Remove the hood.
3. Remove the recovery bottle cap (A) and fill the bottle to the MAX line.



4. Remove the pressure cap (B) and add the necessary amount of Polaris Premium Antifreeze to the radiator filler neck.
5. Remove the seats and engine service panel to access the coolant bleed screw.

6. Open the bleed screw (C) to allow any trapped air to escape. Close the bleed screw once a steady stream of coolant begins to drain out.



7. Tighten the bleed screw to specification, top off coolant and properly install the pressure cap.



= T

Coolant Bleed Screw:
89 ± 9 in. lbs. (10 ± 1 Nm)

8. Start the engine and allow it to idle until the coolant fan has cycled two times.
9. Allow engine and cooling system to completely cool down (see CAUTION).
10. Remove the pressure cap. Add the necessary amount of Polaris Premium Antifreeze to the radiator filler neck.
11. Open the bleed screw to allow any trapped air to escape. Close the bleed screw once a steady stream of coolant begins to drain out.
12. Tighten the bleed screw to specification, top off coolant and properly install the pressure cap.



= T

Coolant Bleed Screw:
89 ± 9 in. lbs. (10 ± 1 Nm)

13. Fill the recovery bottle to the MAX line.
14. Reinstall the hood.
15. Reinstall the seats and engine service panel.

ENGINE / COOLING

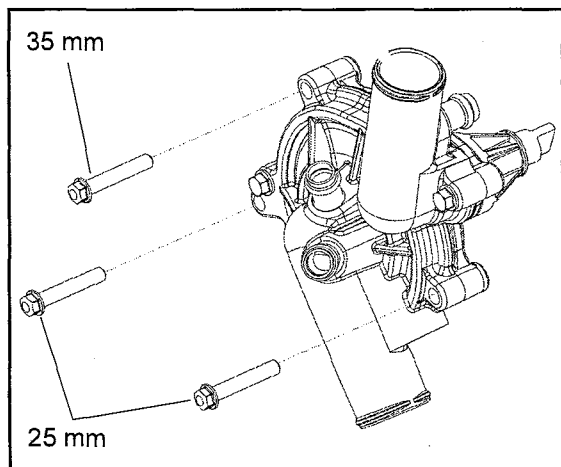
Water Pump Removal

1. Allow engine and cooling system to cool down.

CAUTION

Be sure the engine has cooled and no pressure is built up in the cooling system before removing the pressure cap. The coolant may be hot and could cause severe injury or burns.

2. Remove both seats and the engine service panel.
3. Disconnect the (-) negative battery cable.
4. Remove all debris and thoroughly clean water pump area and RH side of engine block.
5. Remove the hood.
6. Remove the pressure cap from the filler neck.
7. Drain cooling system as outlined in this chapter.
8. Elevate the rear of the vehicle off the ground using a suitable ATV lift and remove the right rear wheel.
9. Remove the right rear shock lower mounting bolt. Discard the nut. Swing and support right rear shock rearward to gain access to water pump area.
10. Remove the (5) coolant hoses that are attached to the water pump. Note location and routing for installation. Be sure to catch and dispose of coolant properly.
11. Remove the (3) bolts holding the water pump to the engine block. Make note of different bolt lengths for installation.



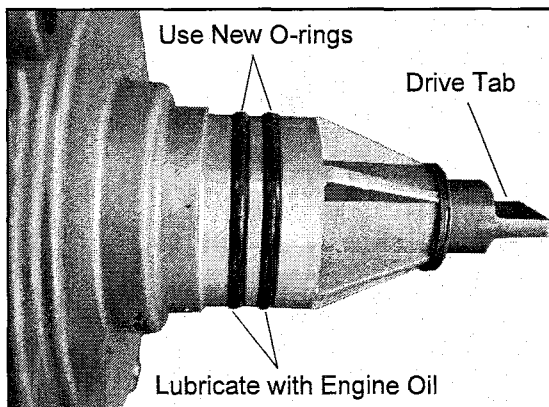
12. Remove water pump from engine by gently twisting and rocking the water pump housing while pulling outward.
13. Maneuver water pump downward and remove it through the access hole in the skid plate.
14. Plug the water pump drive access hole in the engine block with a clean shop towel.

Water Pump Installation

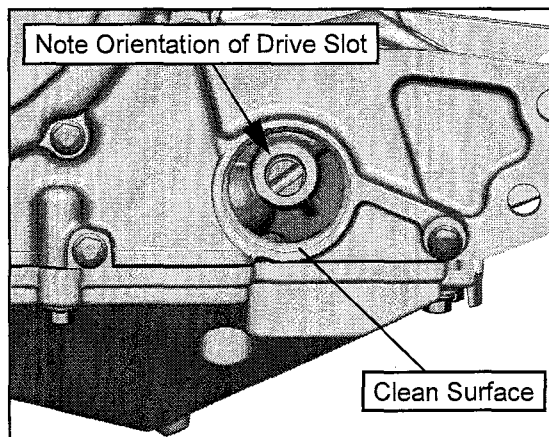
1. Replace the (2) sealing O-rings on the water pump housing.

NOTE: Do not reuse the water pump O-rings. Always use NEW O-rings each time the water pump is removed.

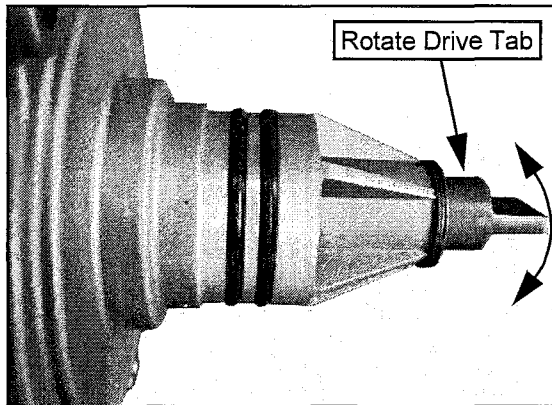
2. Lubricate new O-rings with fresh engine oil.



3. Remove the shop towel from the water pump drive access hole in the engine block.
4. Clean the O-ring sealing surface in the engine block using a clean shop towel.
5. Use a shop light to illuminate the water pump drive access hole in engine crankcase.
6. Note orientation of the water pump drive slot.



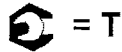
- Rotate water pump drive tab so it matches the angle of the drive slot in the engine.



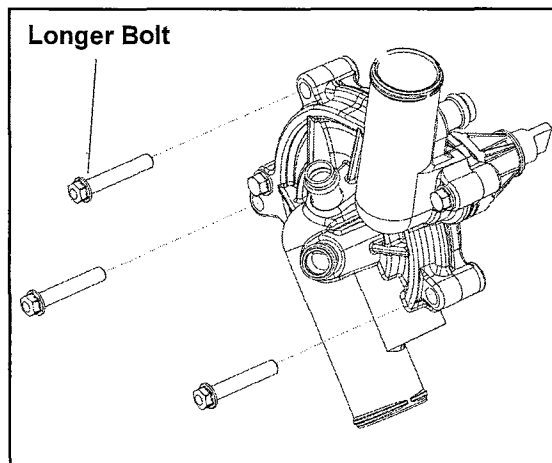
CAUTION

The water pump drive tab and slot must be aligned properly during installation. Severe engine or water pump damage will occur if the tab and slot are not in alignment during water pump installation.

- Maneuver water pump up through the access hole in the skid plate on the RH side of the vehicle.
- Slide water pump into engine crankcase.
- Be sure water pump is fully seated and the drive tab and slot are properly engaged.
- Install the (3) water pump mounting bolts and torque to specification.

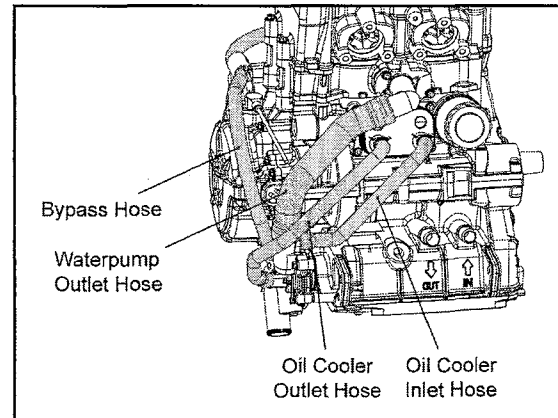


Water Pump Mounting Bolts:
89 ± 1 in. lbs. (10 ± 1 Nm)

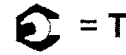


NOTE: The top bolt is longer than the lower bolts.

- Install the (5) coolant hoses that attach to the water pump. Be sure orientation and routing are correct.

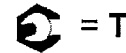


- Install the right rear lower shock bolt and new nut. Torque mounting bolt to specification.



Rear Shock Mounting Bolts:
70 ft. lbs. (95 Nm)

- Install the right rear wheel. Torque wheel nuts to specification.



Wheel Nuts:
30 ft. lbs. (41 Nm) + 90° (1/4 turn)

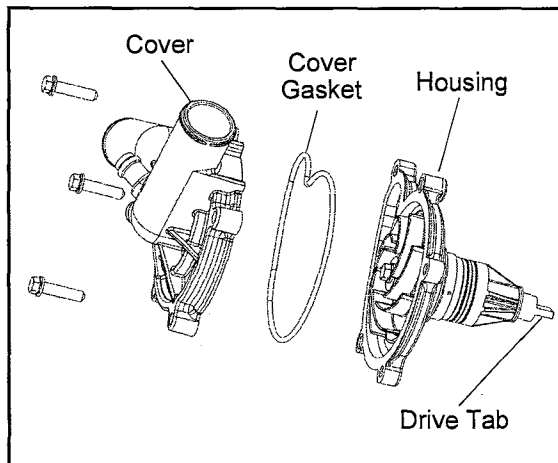
- Connect the (-) negative battery cable.
- Fill and bleed cooling system as outlined in this chapter.
- Install hood, engine service panel and seats (Chapter 5).

ENGINE / COOLING

Water Pump Service

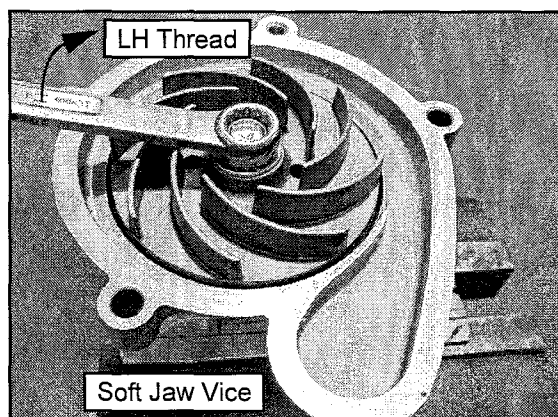
NOTE: The water pump cover gasket can be replaced while the water pump housing is still installed in the engine.

1. Remove water pump assembly as outlined in this chapter.
2. Remove the (3) bolts retaining the water pump cover to the water pump housing. Discard water pump cover gasket.



3. Place the water pump drive tab vertically into a soft jaw vice.
4. Remove the bolt and washer retaining the water pump impeller to the shaft. Inspect impeller veins for damage, replace water pump housing assembly if needed.

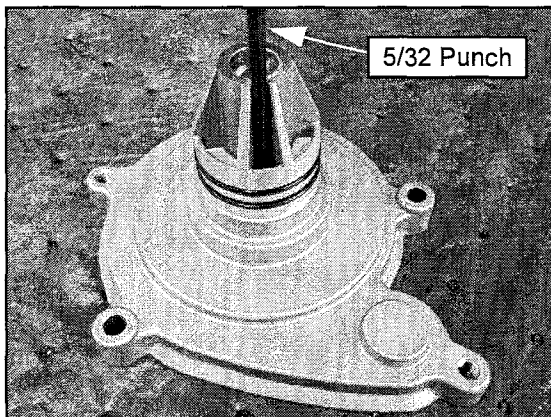
NOTE: The water pump impeller bolt is left hand thread (reverse thread).



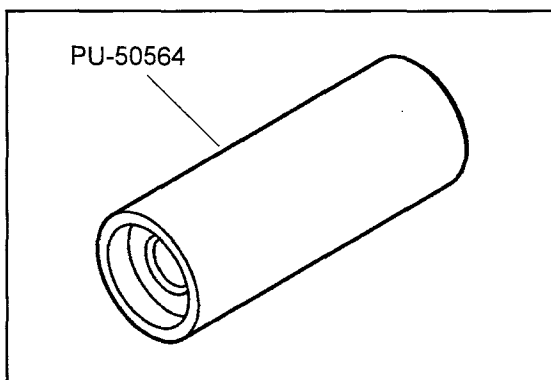
5. Remove impeller from water pump shaft.
6. Using an appropriate arbor press, properly support the water pump housing and press out the water pump shaft from the impeller side.

7. Extract the mechanical seal and the oil seal from the water pump housing.


NOTE: A 5/32 diameter punch will fit in the lubrication slot to aid in the removal of the oil seal. Be sure not to damage the water pump shaft bearing surface.



8. Inspect the water pump shaft bore for excessive wear or damage. Replace water pump housing assembly if necessary.
9. Clean and inspect water pump shaft for excessive wear or damage. Replace water pump housing assembly if necessary, as shaft can not be purchased separately.
10. Thoroughly clean mechanical seal and oil seal bores.
11. Install a NEW oil seal into the water pump housing until fully seated.
12. Fully install the water pump shaft and (2) washers into the housing.
13. Place water pump drive tab vertically into soft jaw vice as previously shown in this procedure.
14. Install a NEW mechanical seal into the water pump housing using special tool PU-50564. Press the new mechanical seal in until it is flush with the water pump housing.

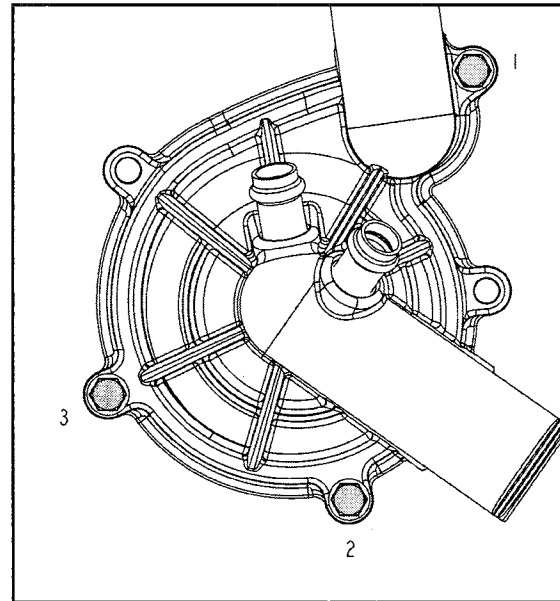
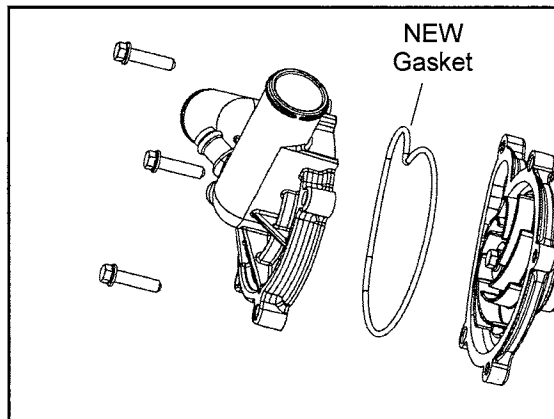



15. Rotate water pump shaft after seal installation to verify free movement.
16. Place impeller onto the water pump shaft.
17. Apply Loctite® 204™ to the threads of the impeller bolt. Install washer and impeller bolt and torque to specification.

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Water Pump Impeller Bolt:
89 ± 18 in. lbs. (10 ± 2 Nm)
(Apply Loctite® 204™ to bolt threads)

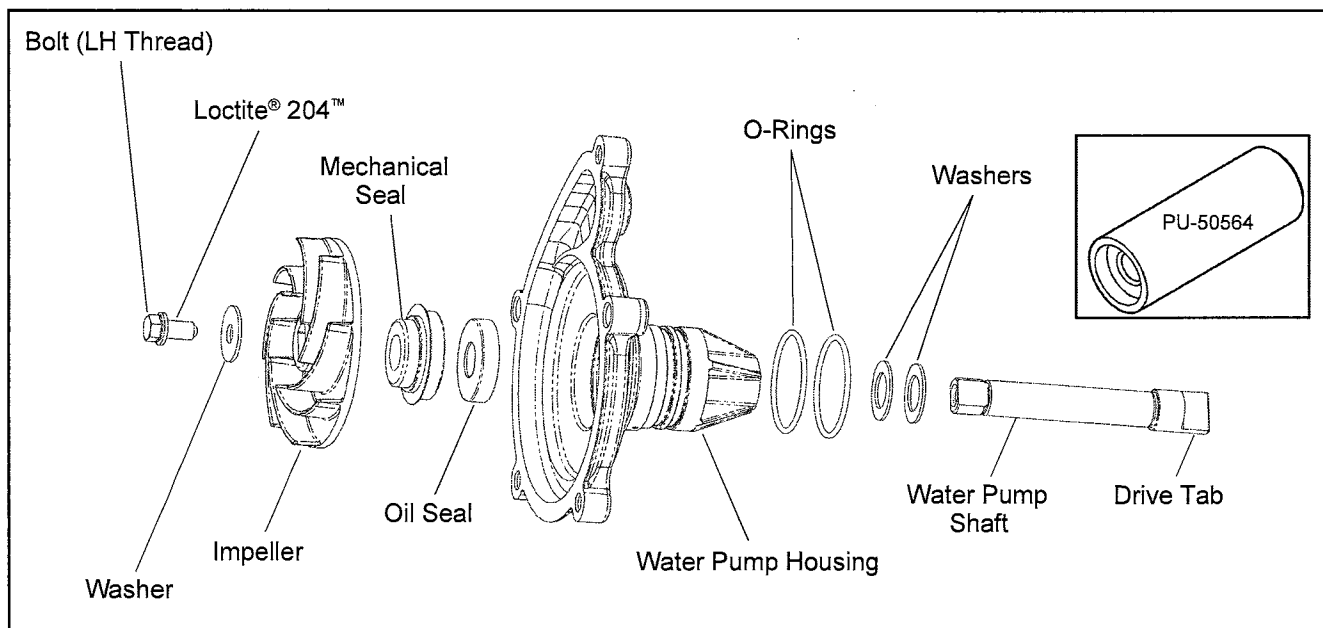
18. Clean water pump cover and housing gasket surfaces.
19. Install a new water pump cover gasket.
20. Install the water pump cover and (3) retaining bolts. Torque bolts in sequence to specification.



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Water Pump Cover Bolts:
89 ± 18 in. lbs. (10 ± 2 Nm)
(Apply Loctite® 204™ to bolt threads)

21. Install (2) new water pump (O-rings) and lubricate them with fresh engine oil.
22. Install water pump assembly into engine as shown in the “Water Pump Installation” procedure.



ENGINE / COOLING

ENGINE SERVICE

Accessible Engine Components

The following components can be serviced or removed with the engine installed:

- Camshaft(s)
- Camshaft Sprocket(s)
- Cylinder Head
- Flywheel
- Oil Cooler
- Starter Motor / Idler Gear Asm
- Stator (Alternator)
- Thermostat
- Valve Cover
- Water Pump

The following components require engine removal for service:

- Camshaft Timing Chain
- Connecting Rod(s)
- Counterbalance Shaft / Bearings
- Crankcase
- Crankshaft / Main Bearings
- Crankshaft Seal (PTO)
- Cylinder
- Oil Pump / Oil Pump Sprocket or Chain
- Piston / Rings

Top-End Service (Engine in Chassis)

Some top-end engine components can be serviced while the engine is mounted in the chassis.

To service the top-end of the engine refer to the "Valve Clearance Inspection" procedure in Chapter 2, which provides detailed steps to access the valve cover.

Engine Removal

IMPORTANT: Some engine repair procedures can be performed without removing the engine assembly from the vehicle. Refer to "Accessible Engine Components" for further information.

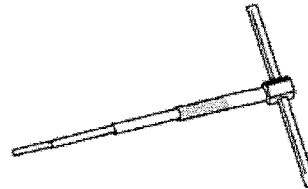
NOTE: The use of an overhead or portable engine hoist is the only recommended method for removing and installing the engine.

NOTE: Have an assistant help guide the engine in and out of the vehicle while using an engine hoist to prevent personal injury or damage to vehicle components.

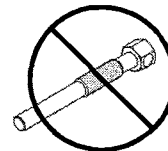
CAUTION

Correct Drive Clutch Puller P/N 2872085

2872085 - Correct Drive Clutch Puller For RZR XP 900

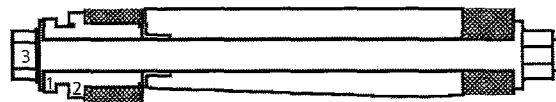


PA-48595 - Incorrect Drive Clutch Puller



CAUTION

THE ENGINE TO TRANSMISSION COUPLER BRACKET REQUIRES A CRITICAL TORQUE PROCEDURE AS OUTLINED IN THIS CHAPTER.



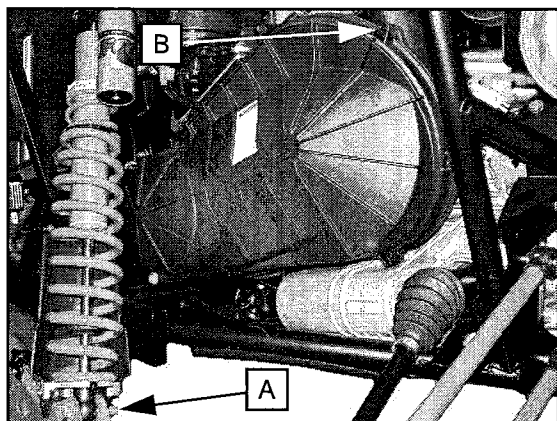
Critical Joint: Failure to follow torque procedure outlined in Service Manual will result in damage to the engine case.

- | | | |
|---------------------------------|-------------------------|----------------------|
| 1. 10 ft-lbs
threaded spacer | 2. 33 ft-lbs
jam nut | 3. 75 ft-lbs
bolt |
|---------------------------------|-------------------------|----------------------|

WARNING

Always wear safety glasses and proper shop clothing when performing the procedures in this Service Manual.
Failing to do so may lead to possible injury.

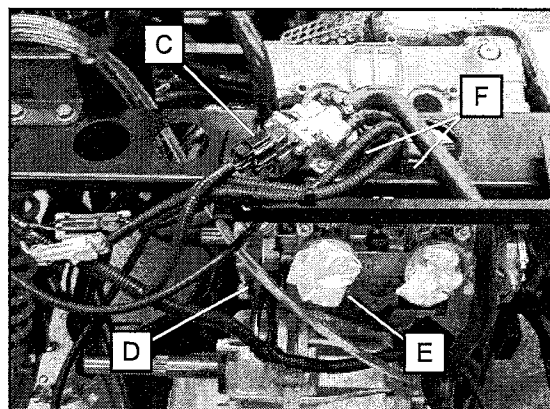
1. If vehicle was recently operated, allow it to cool down before attempting to perform any work.
2. Thoroughly clean the engine and chassis.
3. Drain the engine oil and coolant prior to engine removal (see Chapter 2).
4. Remove the seats, console cover and engine service panel (see Chapter 5).
5. Disconnect the (-) negative battery cable from the battery.
6. Remove the rear bumper and cargo box as an assembly (see Chapter 5).
7. Remove the air box assembly (see Chapter 4 "ECT Sensor Replacement").
8. Elevate the rear of the vehicle off the ground using a suitable lift and remove the left rear wheel.
9. Remove lower mounting bolt (A) from the left rear shock and discard the nut. Install a new nut upon assembly.
10. Remove the outer clutch cover screws (B) and remove the cover from the vehicle.



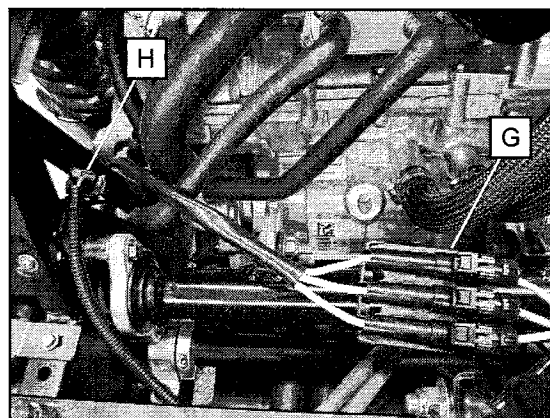
11. Remove the drive belt, drive clutch, driven clutch, inner clutch cover and clutch outlet duct (see Chapter 6).

IMPORTANT: Be sure to use the correct Drive Clutch Puller (PN 2872085) to prevent damage to crankshaft.

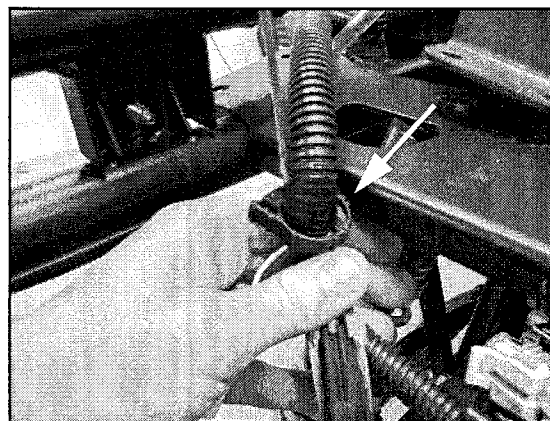
12. Disconnect the IAC valve (C), MAQS (D), ECT sensor (E), fuel injector harness leads (F) and ignition coil harness lead.



13. Disconnect the stator harness (G) and CPS harness (H) connections. Remove the connectors attached to the vehicle frame and engine mount to prevent from damaging them upon engine removal.



14. Remove (+) positive cable from the starter motor.
15. Remove (-) negative cable from the starter mounting bolt.
16. Remove the wire harness from the routing clip on the rear cross member.



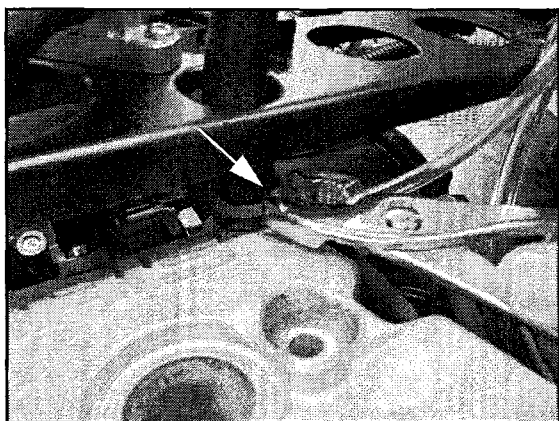
ENGINE / COOLING

17. Disconnect fuel lines and remove throttle body assembly (see Chapter 4). Make note of line routing for installation.

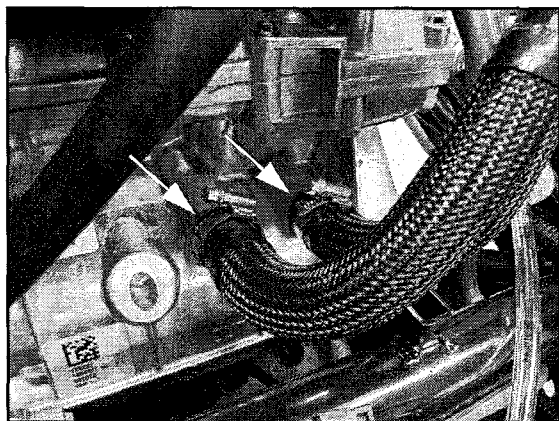
18. Remove spark plug wires from the engine.

IMPORTANT: The spark plug wires are marked with **MAG** and **PTO**. Note during installation procedure.

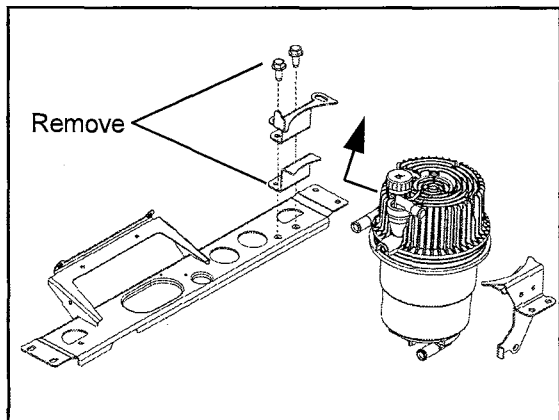
19. Remove the breather hose from the valve cover.



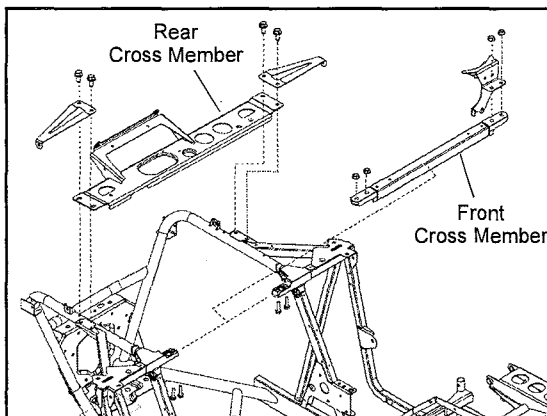
20. Disconnect the oil lines at the engine crankcase. Make note of routing and orientation.



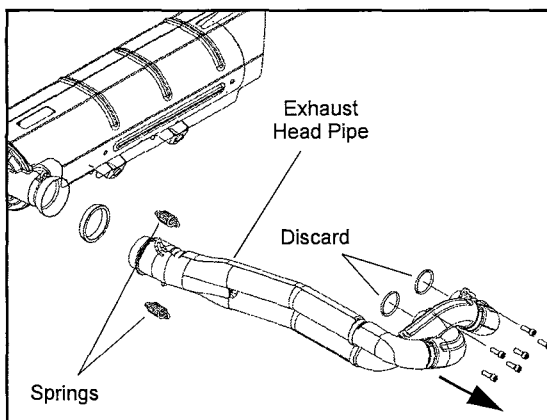
21. Remove the (2) bolts that secure the rear oil tank bracket to the rear cross member. Remove oil tank from the vehicle.



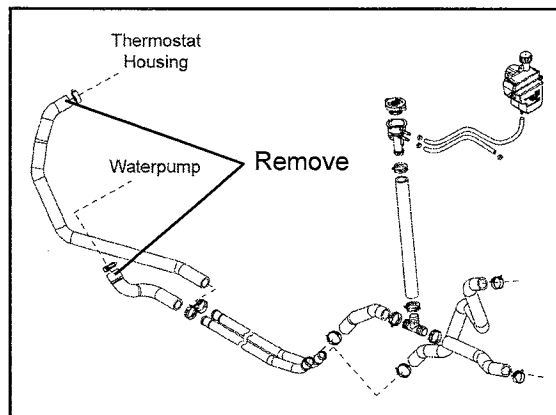
22. Remove the push rivet that attaches the heat shield to the rear cross member. Remove the (8) bolts and (4) nuts that attach the front and rear cross member to the vehicle frame.



23. Remove the (6) fasteners that attach the exhaust head pipe to the engine. Remove the (2) exhaust springs that attach the head pipe to the muffler. Remove exhaust head pipe towards the front of the vehicle. Discard exhaust gaskets.



24. Place a suitable drain pan under the vehicle and remove the (2) coolant hoses from the engine. Dispose of engine coolant properly.



25. Use an overhead or portable engine hoist and suitable engine straps to secure the engine in its current position.

CAUTION

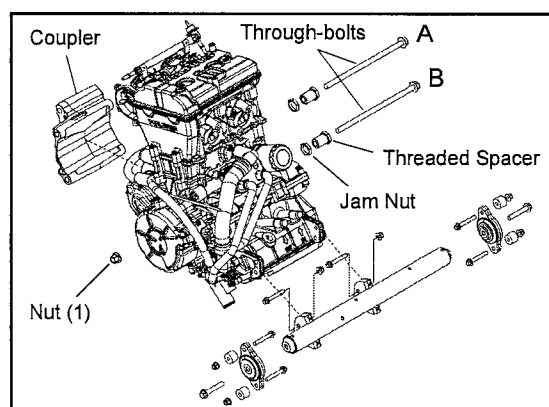
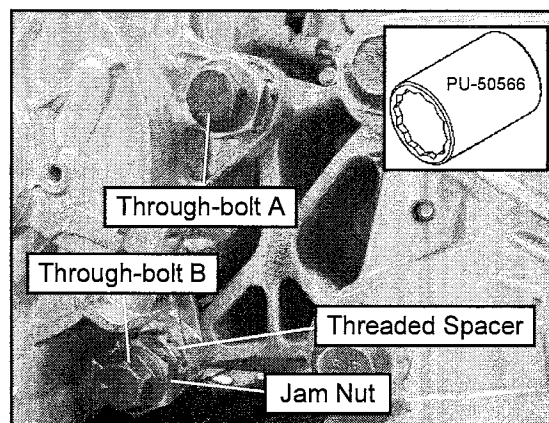
The threaded spacers must not rotate while removing the through-bolts.
Severe engine damage may occur if the threaded spacers are not properly held in position while removing the through-bolts.

NOTE: Through bolt (A) threads into the engine case. Through bolt (B) threads into a nut on the RH side of the engine.

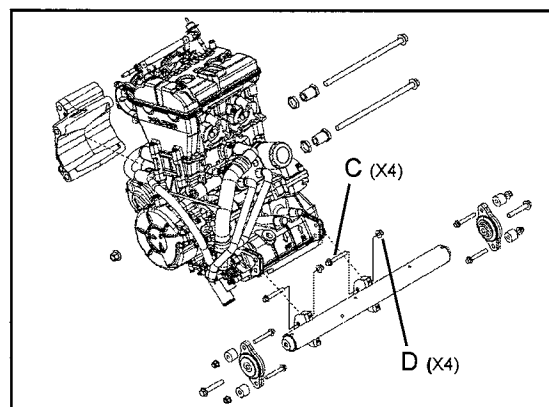
26. **To remove through-bolt (A):** Hold the threaded spacer firmly in position with a 1 1/8" or 28 mm open-end wrench. The threaded spacer must not rotate while removing the through-bolt. Loosen and remove through-bolt (A) from the LH side of the vehicle. Discard the through-bolt.

27. **To remove through-bolt (B):** Hold through-bolt (B) firmly in position with an open ended wrench from the LH side of the engine. From the RH side of the engine, remove the nut that secures through-bolt (B). Be sure that through-bolt (B) does not rotate while removing the nut from the RH side of the engine. Remove the through bolt from the LH side of the vehicle after the nut has been removed. Discard the through-bolt and nut.

28. Using special tool PU-50566, loosen the inner jam nuts and remove the threaded spacers from the engine case.



29. Remove the (4) front engine mounting bolts (C) and nuts (D).

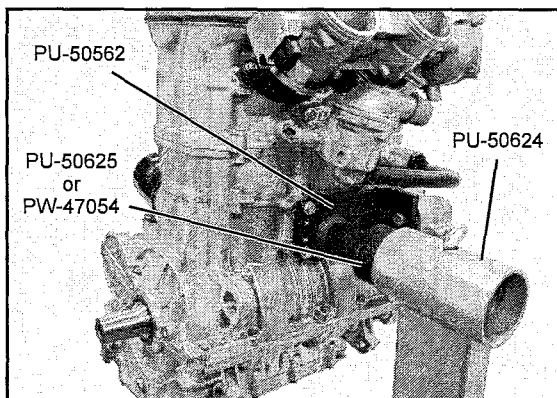


30. With the help of an assistant and the engine hoist, raise the engine vertically out of the vehicle frame.

NOTE: Have an assistant help guide the engine in and out of the vehicle while using an engine hoist to prevent personal injury or damage to vehicle components.

ENGINE / COOLING

31. Remove the starter motor bolts and starter motor from the engine.
32. Install the engine stand adapter (PU-50562) onto the engine where the starter motor was located.
33. Select the proper engine stand sleeve adapter and install it onto the engine stand adapter.
 - Sleeve adapter for a 2" bore engine stand: (PU-50625)
 - Sleeve adapter for a 2.375" bore engine stand: (PW-47054)
34. Place engine onto the engine stand (PU- 50624) for service.

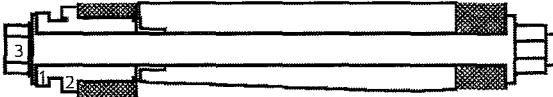


Engine Installation

Use the following procedure to reinstall the engine assembly.

⚠ CAUTION

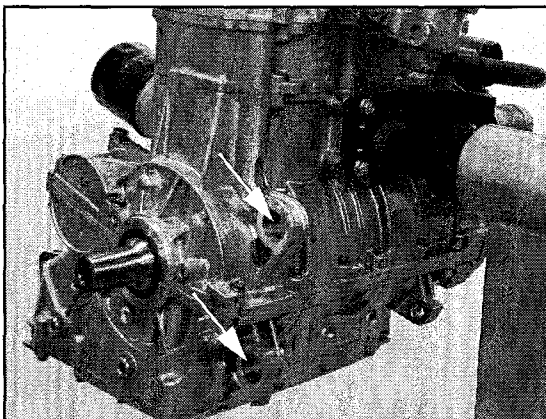
THE ENGINE TO TRANSMISSION COUPLER BRACKET REQUIRES A CRITICAL TORQUE PROCEDURE AS OUTLINED IN THIS CHAPTER.



Critical Joint: Failure to follow torque procedure outlined in Service Manual will result in damage to the engine case.

1. 10 ft-lbs threaded spacer	2. 33 ft-lbs jam nut	3. 75 ft-lbs bolt
---------------------------------	-------------------------	----------------------

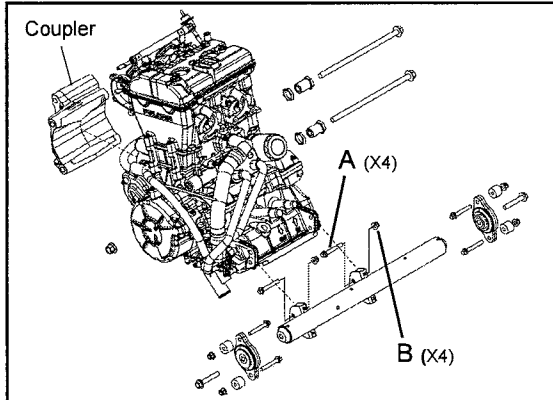
1. Clean all dirt and debris out of the rear engine mount threads.



2. Attach engine with suitable lifting straps to an overhead or portable engine hoist.
3. Remove the engine stand adapter plate and install the starter motor back onto engine.
4. Use the overhead or portable engine hoist and suitable engine straps to lower the engine into the vehicle frame.

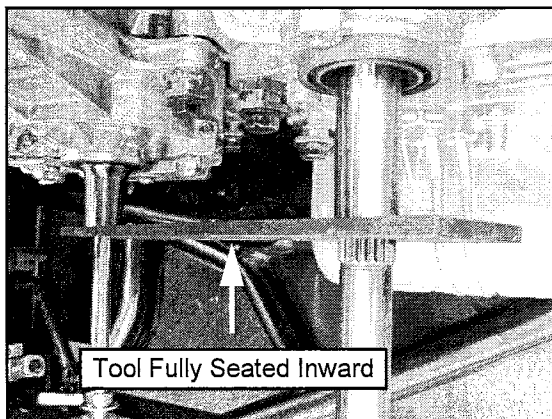
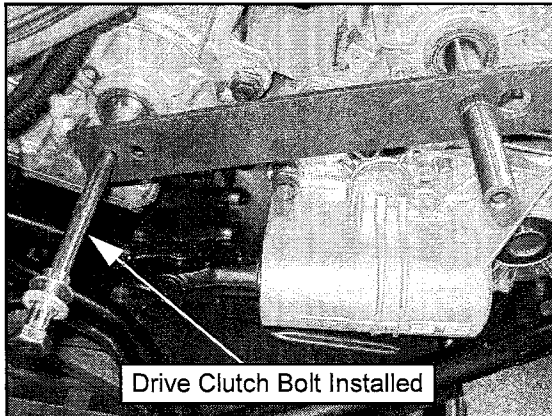
NOTE: Have an assistant help guide the engine in and out of the vehicle while using an engine hoist to prevent personal injury or damage to vehicle components.

- Align both the front and rear engine mounting locations. Install the (4) front engine mounting bolts (A) and nuts (B) by hand.

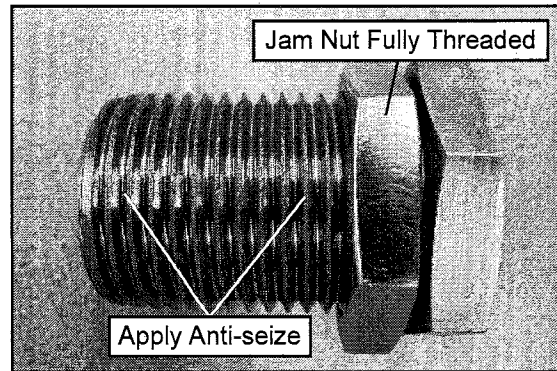


IMPORTANT: DO NOT torque fasteners at this time.

- Align rear engine mounting holes with the transmission coupler mounting holes.
- Install the Clutch Center Distance Tool (PU-50658) onto the crankshaft and transmission input shaft to properly position the clutch center distance. The pictures below show the tool (PU-50658) properly installed.

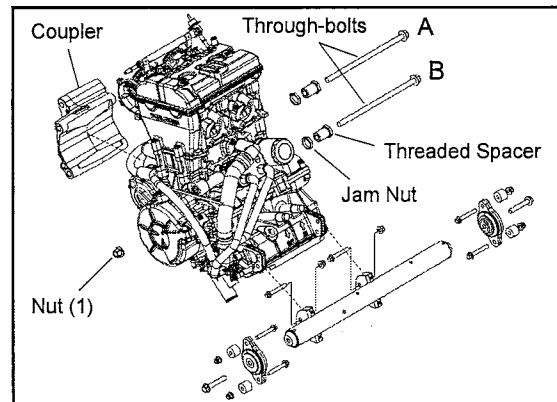


- Apply anti-seize to the threaded spacers and fully thread the inner jam nuts onto the threaded spacers.

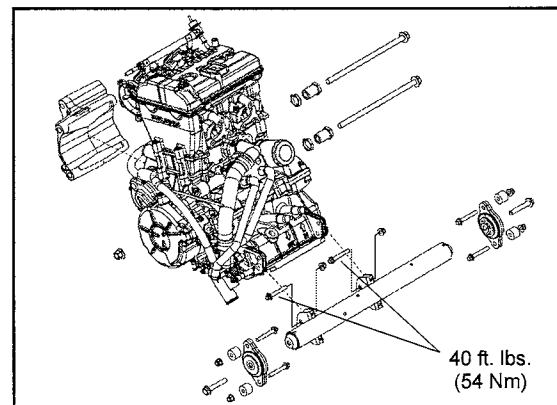


3

- Install threaded spacers into the engine crankcase by hand approximately 3 turns.
- Install new engine through-bolts and nut. Loosely assemble by hand.
- Lightly tighten both threaded spacers by hand. Be sure inner jam nuts are fully threaded onto the threaded spacers.

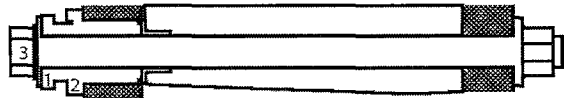


- Torque the (4) front engine mount fasteners to 40 ft. lbs. (54 Nm).



CAUTION

THE ENGINE TO TRANSMISSION COUPLER BRACKET REQUIRES A CRITICAL TORQUE PROCEDURE AS OUTLINED IN THIS CHAPTER.

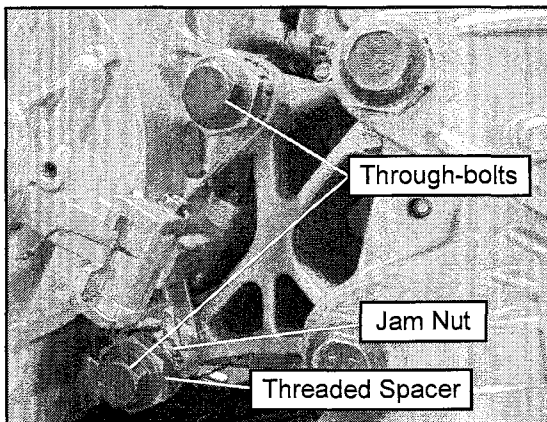
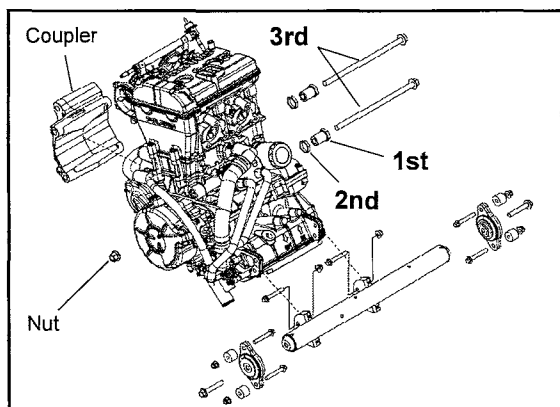
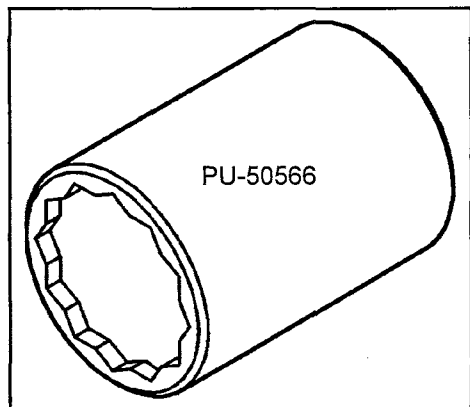


Critical Joint: Failure to follow torque procedure outlined in Service Manual will result in damage to the engine case.

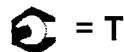
- | | | |
|---------------------------------|-------------------------|----------------------|
| 1. 10 ft-lbs
threaded spacer | 2. 33 ft-lbs
jam nut | 3. 75 ft-lbs
bolt |
|---------------------------------|-------------------------|----------------------|

13. Using special tool PU-50566 and a proper torque wrench, torque the threaded spacer to **10 ft. lbs. (14 Nm)**.
14. Using special tool PU-50566 and a proper torque wrench, torque the inner jam nut to **33 ft. lbs. (45 Nm)**.
15. Torque the (2) new through-bolts and new nut to **75 ft. lbs. (102 Nm)**.

IMPORTANT: Hold the threaded spacer firmly in position while tightening the top through-bolt.

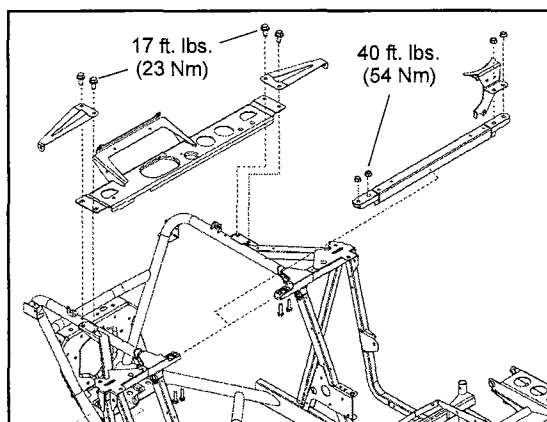


16. Remove the lifting straps and overhead or portable engine hoist.
17. Install the (2) coolant hoses onto the engine.
18. Replace exhaust gaskets (seals). Install exhaust head pipe. Install the (6) fasteners that attach the exhaust head pipe to the engine and torque to specification.

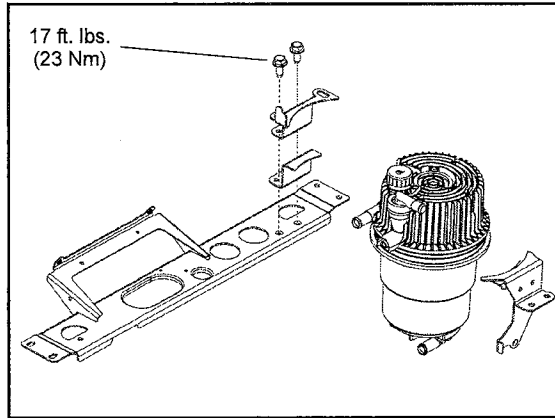


**Exhaust Head Pipe Bolts:
13 ft. lbs. (17.5 Nm)**

19. Install the (2) exhaust springs that attach the head pipe to the muffler.
20. Install both front and rear cross members onto the vehicle frame. Torque fasteners to specifications provided in the illustration below.



21. Install the oil tank and oil tank bracket. Torque fasteners to specification.




22. Connect the oil lines to the engine crankcase and tighten oil hose clamps.
 23. Install the breather hose to the valve cover.
 24. Install the spark plug wires to the appropriate cylinder by referencing the MAG and PTO spark plug wire decals.


IMPORTANT: Ensure plug wires caps are pushed down all the way so they engage onto the spark plugs.

25. Install the throttle body assembly and connect fuel lines as outlined in the EFI Chapter (see Chapter 4).
 26. Secure wire harness in the routing clip on the rear cross member.
 27. Install (+) positive cable to the starter motor.
 28. Install (-) negative cable to the starter motor mounting bolt.
 29. Connect the stator harness and CPS harness. Attach the connectors to the vehicle frame and engine mount.
 30. Properly route and connect the harness leads for the IAC valve, MAQS, ECT sensor, fuel injectors and ignition coil.
 31. Install the air box assembly as outlined in the EFI Chapter (see Chapter 4 "ECT Sensor Replacement").
 32. Install the inner clutch cover, drive clutch, driven clutch, drive belt, outer clutch cover and clutch outlet duct (see Chapter 6).

33. Install the left rear shock lower mounting bolt and new nut. Torque to specification.

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Rear Shock Mounting Bolts: 70 ft. lbs. (95 Nm)

34. Install the left rear wheel and torque wheel nuts to specification.

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Wheel Nuts: 30 ft. lbs. (41 Nm) + 90° (1/4 turn)

3

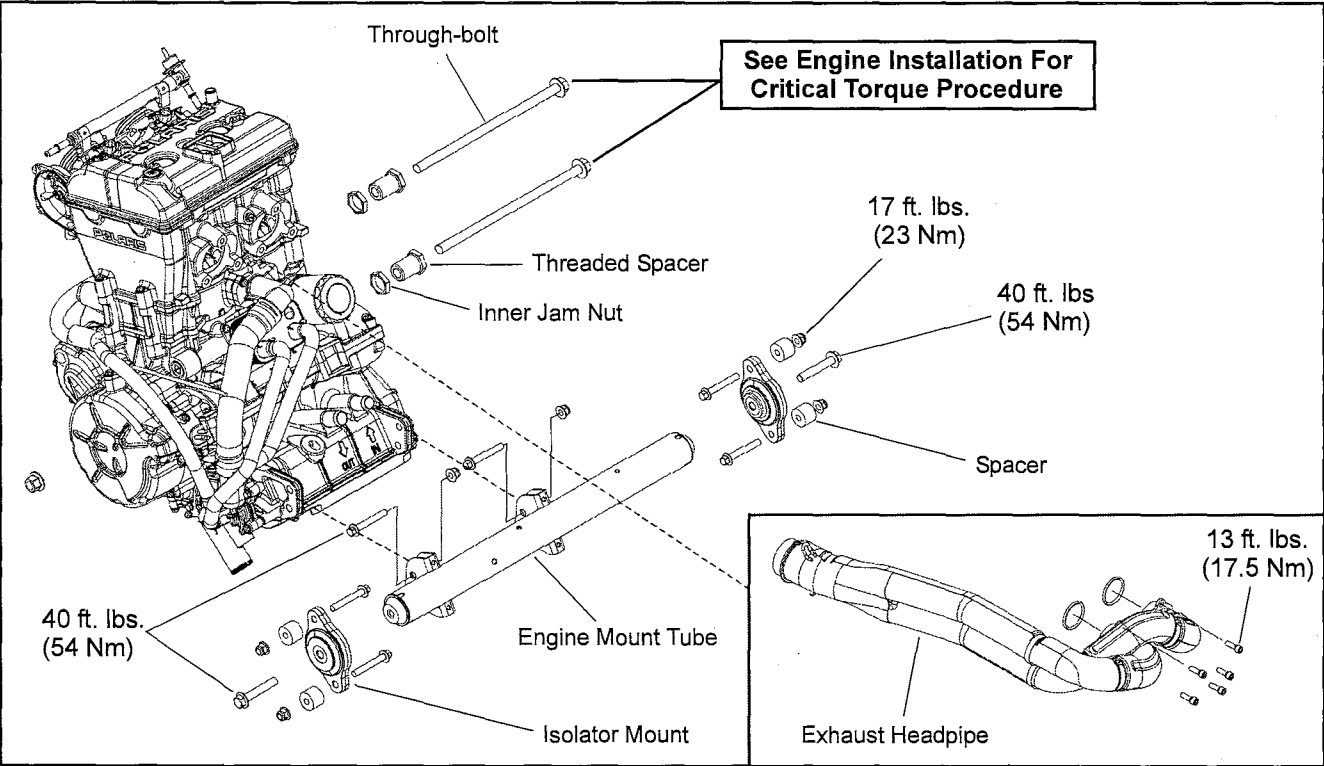
35. Install the rear bumper and cargo box as an assembly (see Chapter 5).

NOTE: Be sure to connect the oil tank vent hose, engine intake hose and clutch air intake hose to the rear cargo box asm upon installation.

36. Connect the (-) negative battery cable.
 37. Remove the pressure cap and fill the cooling system through the filler neck with properly mixed anti-freeze / coolant.
 38. If engine and oil tank were completely drained, add approximately 3.5 quarts (3.3 L) of Polaris PS-4 Plus Synthetic Engine Oil to the oil tank.
 39. Install a new oil filter. Lubricate the seal with engine oil prior to installation (see Chapter 2 "Maintenance").
 40. Follow the "Cooling System Bleeding Procedure" as outlined in this chapter.
 41. Install engine service panel and both seats (see Chapter 5).
 42. Start engine and check for any oil or coolant leaks.
 43. Check the engine oil level (see Chapter 2).
 44. Refer customer to "Engine Break-In Period" upon returning vehicle to customer.

ENGINE / COOLING

Engine Mounting and Torque Values



Engine Break-In Period

The break-in period consists of the first 25 hours of operation, or the time it takes to use 15 gallons (57 liters) of fuel. Careful treatment of a new engine and drive components will result in more efficient performance and longer life for these components.

CAUTION



Use only Polaris PS-4 PLUS Synthetic Engine Oil.
Never substitute or mix oil brands.
Serious engine damage and voiding of warranty can result.

Do not operate at full throttle or high speeds for extended periods during the first three hours of use. Excessive heat can build up and cause damage to close fitted engine parts.

1. Fill fuel tank with unleaded fuel which has a minimum pump octane number of 87 = (R + M)/2.
2. Refer to Chapter 2, "Engine Oil Level". Check oil level indicated on oil tank dipstick. Add oil if necessary.

3. Drive slowly at first to gradually bring engine up to operating temperature.
4. Vary throttle positions. Do not operate at sustained idle or sustained high speed.
5. Perform regular checks on fluid levels, controls and all important bolt torques.
6. Change oil and oil filter after break-in period at 25 hours.

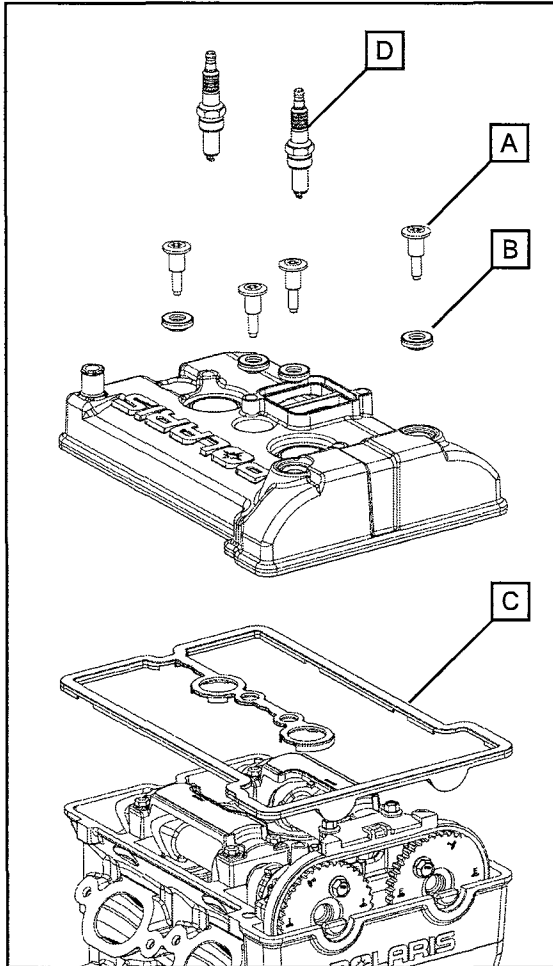
Engine Lubrication Specifications

 = 	
Oil Capacity	Approx. 3.5 Quarts (3.3 L)
Oil Filter Wrench	PU-50105 or 2.5" (64 mm)
Oil Type	Polaris PS-4 Plus Synthetic Engine Oil
Oil Pressure Minimum Specification (using Polaris PS-4 Plus at operating temperature)	10 PSI @ 1200 RPM
	40 PSI @ 7000 RPM

ENGINE DISASSEMBLY / INSPECTION - TOP END**Valve Cover Removal**

NOTE: The valve cover can be removed with the engine installed in the chassis.

1. Remove the (4) valve cover shoulder bolts (A) and isolators (B) using a T40 driver.

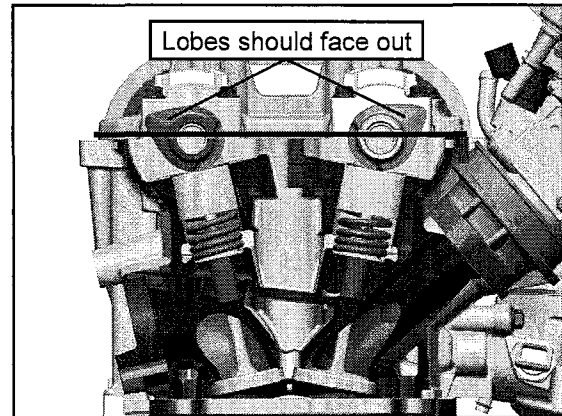


2. Replace isolators (B) and valve cover seal (C) if oil leaks are evident.
3. Remove the spark plugs (D). Stuff spark plug holes with shop towels to prevent anything from falling into the combustion chamber.

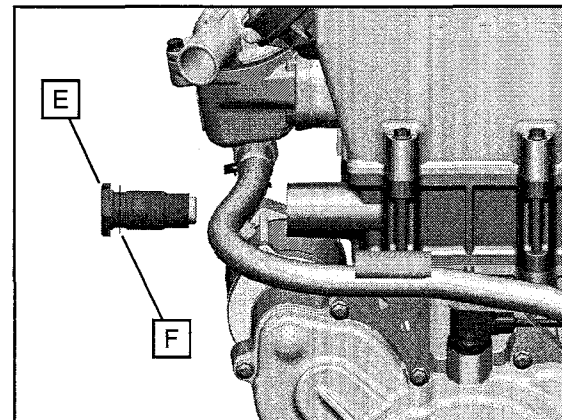
Camshaft Removal

NOTE: The camshafts can be removed with the engine installed in the chassis.

1. Rotate the engine so the PTO cylinder is at Top Dead Center (TDC) to relieve most of the valve spring pressure. The camshaft lobes should face out and the slots on the end of the camshafts should line up.

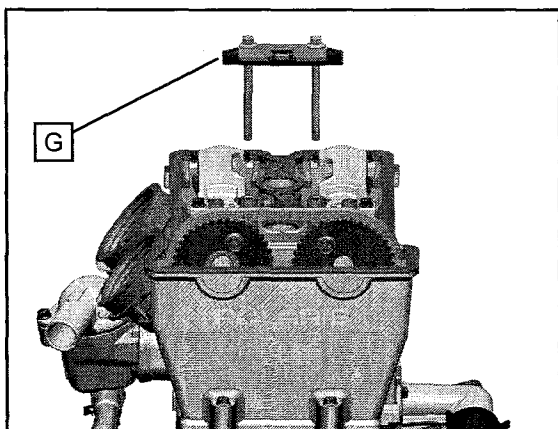


2. Remove the hydraulic cam chain tensioner (E) from the cylinder. Note the sealing washer (F) for reassembly.

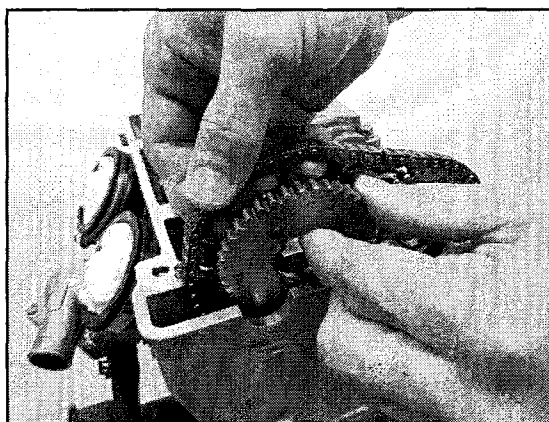


ENGINE / COOLING

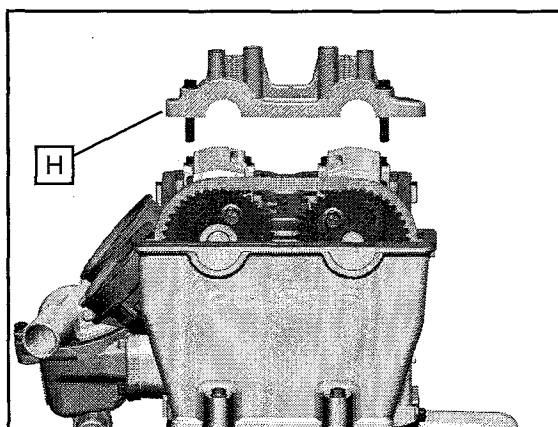
3. Remove the (2) bolts retaining the fixed cam chain guide (G) and remove the assembly from the engine.



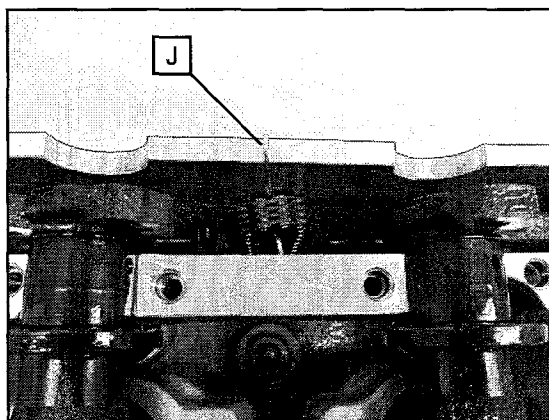
7. Lift the chain and sprockets off the camshafts to allow each sprocket to be removed.



4. Remove the remaining (2) bolts that retain the front camshaft carrier (H) and carefully lift the carrier off the camshafts.

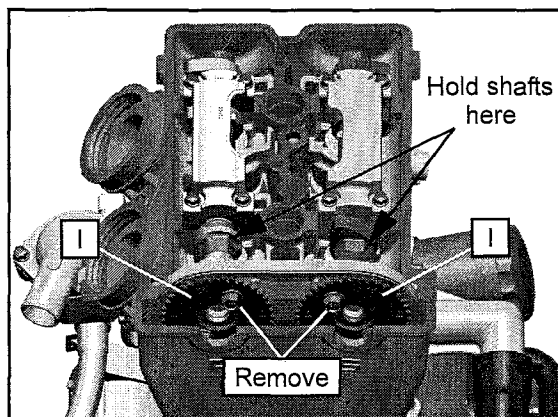


8. Using a paperclip (J) or other tool, hold the cam chain up.

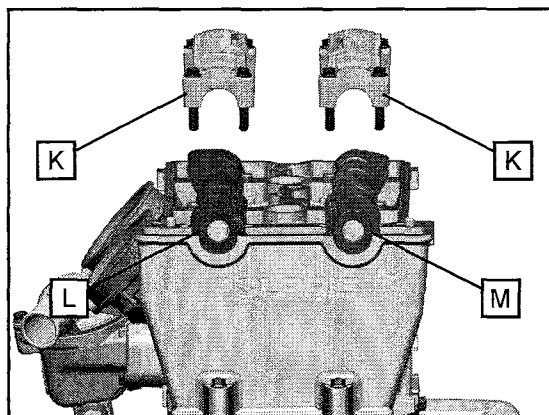


NOTE: The crankcase has a built-in lower guide to prevent the chain from falling off the crankshaft.

5. Hold camshafts with a 13/16" (21mm) open-end wrench, and remove the top bolt from the camshaft sprockets (I).



9. Evenly loosen the (4) bolts retaining each rear camshaft carrier (K) and carefully lift the carriers off the camshafts.



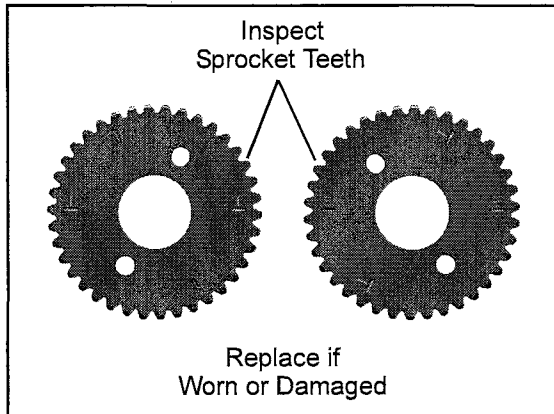
6. Rotate the engine using the flywheel and remove the remaining bolt from each camshaft sprocket (I).

10. Mark the intake (L) and exhaust (M) camshafts to ensure proper assembly.

- Carefully remove the camshafts from the cylinder head.

Camshaft Sprocket Inspection

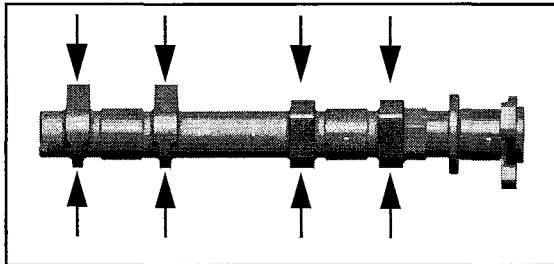
Inspect cam sprocket teeth for wear or damage. Replace timing chain and sprockets if worn or damaged.




Camshaft / Camshaft Bore Inspection

Inspect all main journals and cam lobes as described below and compare to specifications. Replace camshaft(s) or cylinder head if worn beyond service limit or if any surface is pitted or damaged.

- Visually inspect each cam lobe for wear or damage.
- Measure the height of each cam lobe from the base circle to highest point on the lobe using a micrometer. Compare to specification.



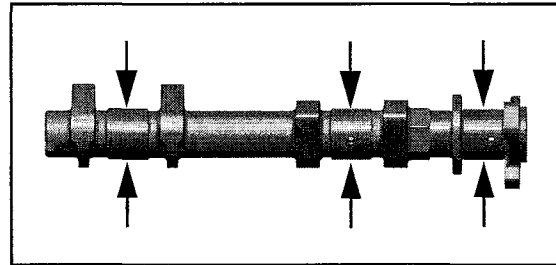
NOTE: Replace camshafts if damaged or if any part is worn past the service limit.

 = In. / mm.

Camshaft Lobe Height:
 Intake: 0.9499" ± .0015" (24.13 ± .040 mm)
 Service Limit: 0.9464" (24.04 mm)


Exhaust: 0.9251" ± .0015" (23.50 ± .040 mm)
 Service Limit: 0.9216" (23.41 mm)

- Visually inspect each camshaft journal for scoring, wear or damage.
- Measure the diameter of the camshaft journals using a micrometer. Compare to specification.



3

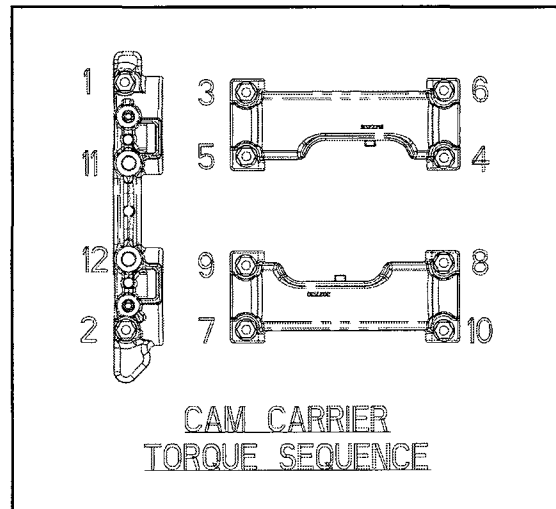
NOTE: Replace camshafts if damaged or if any part is worn past the service limit.


 = In. / mm.

Camshaft Journal O.D.:
 0.9036" - 0.9045" (22.954 - 22.975 mm)

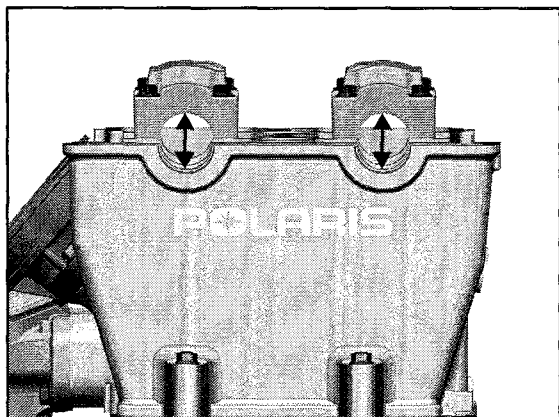
Service Limit: 0.9033" (22.944 mm)

- Temporarily install the camshaft carriers to measure the camshaft bore. Torque bolts in sequence to specification. Replace cylinder head if worn.

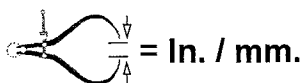


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Camshaft Carrier Bolts:
 89 ± 9 in. lbs. (10 ± 1 Nm)



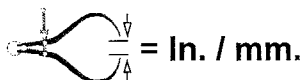
NOTE: Replace cylinder head if camshaft journal bores are damaged or if worn past the service limit.



Camshaft Carrier Bore I.D.:
0.9055" - 0.9063" (23.000 - 23.021 mm)

Service Limit: 0.9072" (23.044 mm)

6. Calculate oil clearance by subtracting camshaft journal O.D.s from camshaft carrier bore I.D.s. Compare to specification.



Calculated Camshaft Oil Clearance:
0.0009" - 0.0026" (.025 - .067 mm)

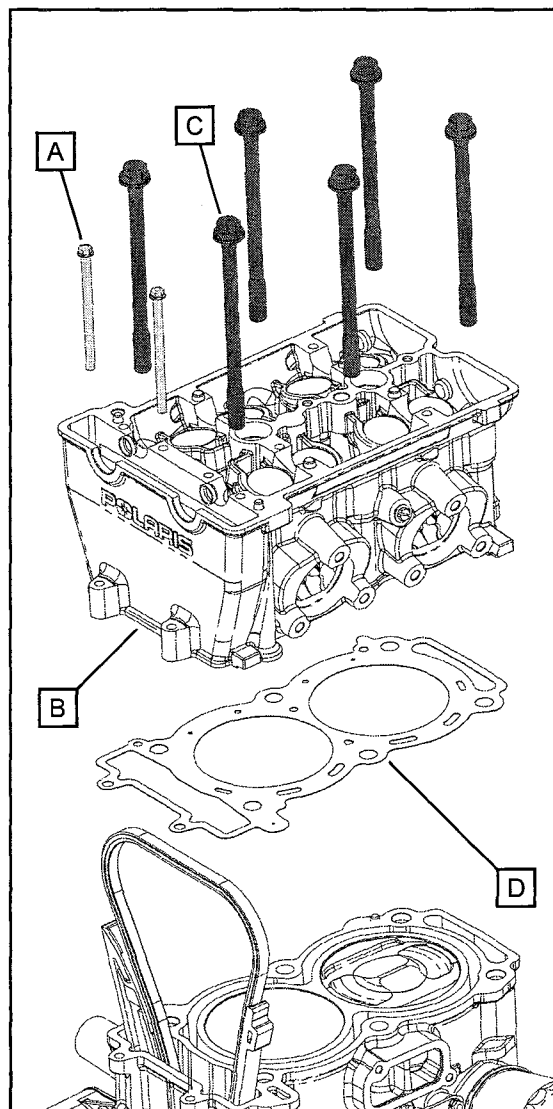
Service Limit: .0039" (.10 mm)

Cylinder Head Removal

NOTE: The cylinder head can be serviced with the engine installed in the chassis.

1. Remove the (2) outer M6 bolts (A) that retain the cylinder head (B) to the cylinder.
2. Loosen the (6) cylinder head bolts (C) evenly 1/8 turn at a time until all are loose.
3. Remove and discard the cylinder head bolts (C).
4. Tap cylinder head lightly with a soft faced hammer until loose.

5. Tap only in reinforced areas or on thick parts of the cylinder head casting.
6. Remove the cylinder head (B) and head gasket (D).



IMPORTANT: Once the cylinder head is removed, nothing retains the cylinder to the engine. **DO NOT** rotate the engine without using the Cylinder Holding & Camshaft Timing Plate (PU-50563). Refer to "Cylinder / Piston Removal".

Cylinder Head Inspection

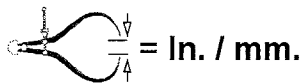
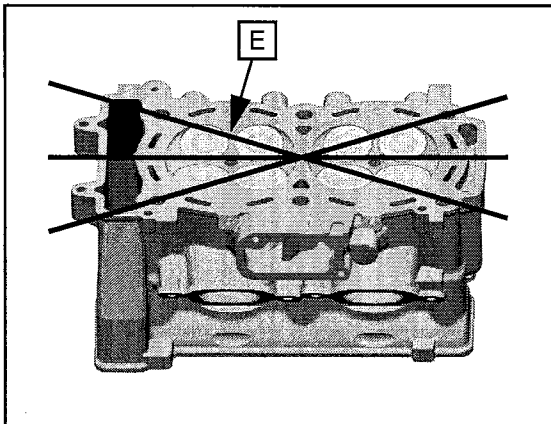
Thoroughly clean cylinder head surface to remove all traces of gasket material and carbon.

CAUTION

Use care not to damage gasket sealing surface. All gasket surfaces must be clean, dry and free of any oil or grease upon assembly. Clean sealing surfaces with rubbing alcohol or electrical contact cleaner. Do not touch sealing surfaces of the new head gasket.

Cylinder Head Warp Inspection

1. Lay a straight edge (E) across the surface of the cylinder head at several different points and measure warp by inserting a feeler gauge between the straight edge and the cylinder head surface. If warp exceeds the service limit, replace the cylinder head.



Cylinder Head Warp Limit:
.004" (0.10 mm)

Cylinder Head Disassembly

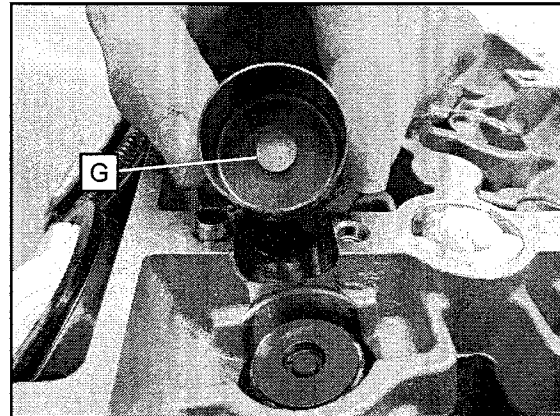
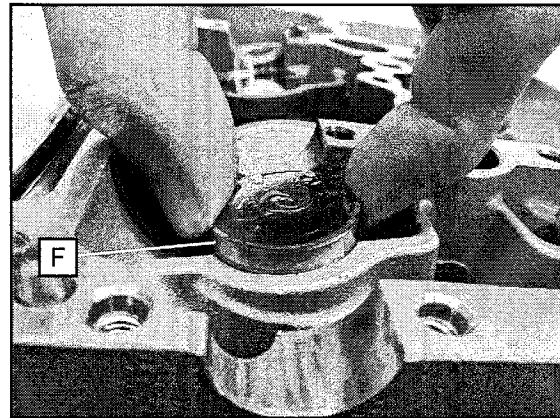
WARNING

Wear eye protection during cylinder head disassembly and reassembly or when working with the valve springs.

IMPORTANT: Keep mated parts together and in order with respect to their location in the cylinder head for assembly purposes. It is important to install cylinder head components back in the same location. Mark each component or place them in an organized rack as you remove them.

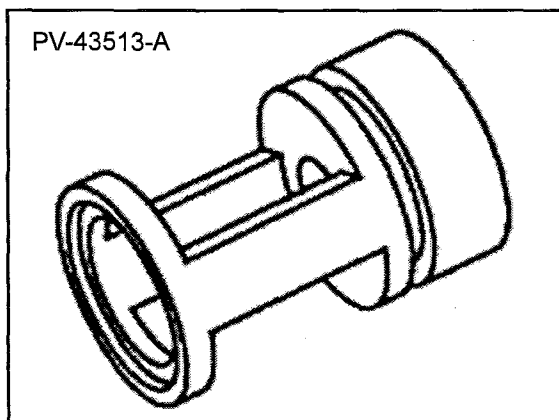
3

1. Remove the valve bucket (F) and adjustment shim (G) from the cylinder head.

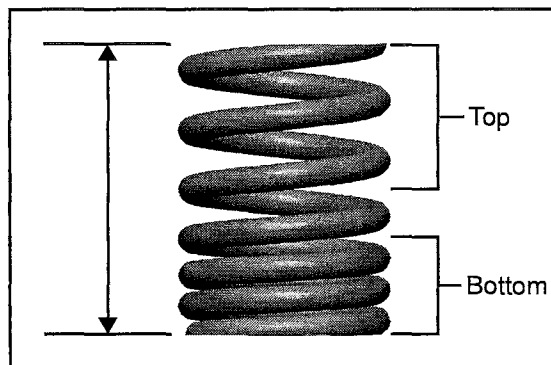


ENGINE / COOLING

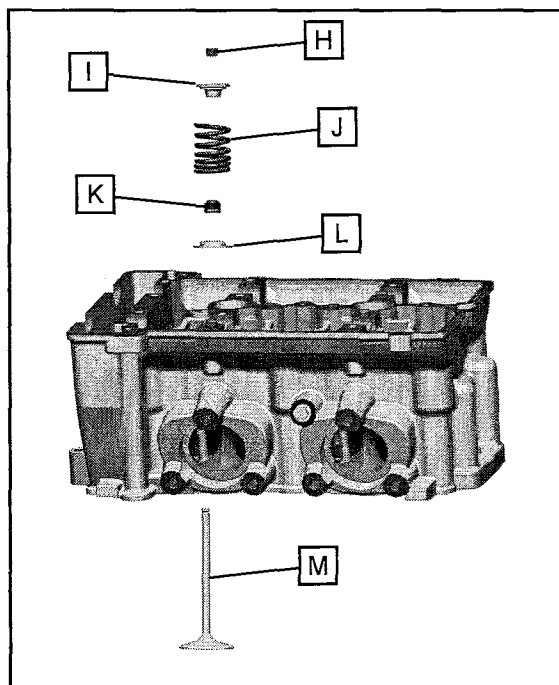
2. Compress the valve spring by hand using valve spring compressor adapter (PV-43513-A).



8. Clean the combustion chamber and head gasket surface.
9. Measure the free length of each valve spring with a Vernier caliper and compare to specification.



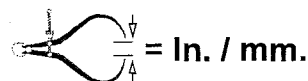
3. Push down on the spring and remove the split keepers (H).



4. Slowly release valve spring pressure and remove the compressor adapter.
5. Remove the valve retainer (I), valve spring (J), valve stem seal (K) and valve spring seat (L). Discard the valve seal.

NOTE: Replace valve seals whenever cylinder head is disassembled. Hardened, cracked or worn seals will cause excessive oil consumption.

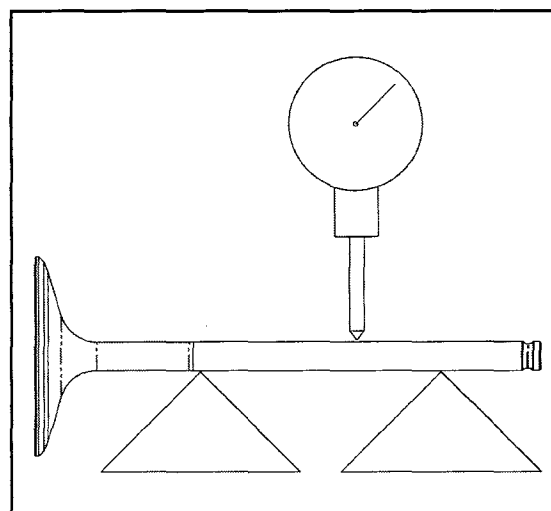
6. Lift up the cylinder head and push the valve (M) out, keeping it in order for reassembly in the same valve guide.
7. Repeat the previous steps to remove the remaining valves.



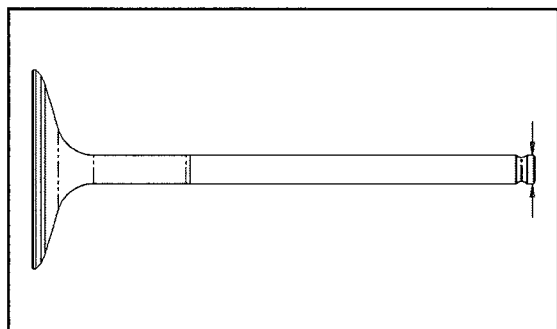
Valve Spring Free Length:
Standard: 1.726" (43.85 mm)
Service Limit: 1.683" (42.75 mm)

Valve Inspection

1. Remove all carbon from valves with a soft wire wheel or brush.
2. Check valve face for runout, pitting, and burnt spots. To check for bent valve stems, mount valve in a drill or use "V" blocks and a dial indicator.



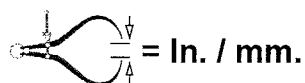
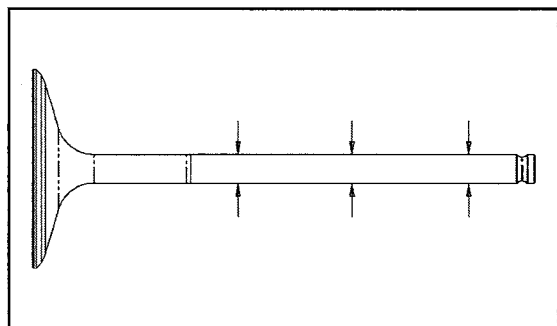
3. Check the end of the valve stem for flaring, pitting, wear or damage.



4. Inspect split keeper groove for wear or flaring in the keeper seat area.

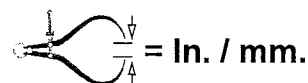
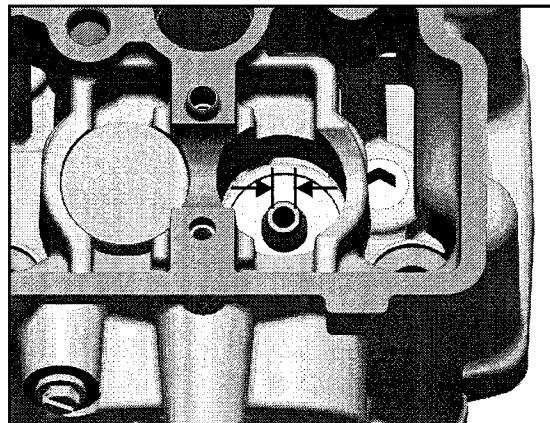
NOTE: The valves can be re-faced or end ground, if necessary. They must be replaced if extensively worn, burnt, bent or damaged.

5. Measure diameter of valve stem with a micrometer in three places, then rotate 90° and measure again (take six measurements total). Compare to specifications.



Valve Stem Diameter:
Intake: 0.2155" - 0.2161" (5.475 - 5.490 mm)
Exhaust: 0.2147" - 0.2153" (5.455 - 5.470 mm)

6. Measure valve guide inside diameter at the top middle and end of the guide using a small hole gauge and a micrometer. Measure in two directions.



Valve Guide I.D.:
0.2165" - 0.2171" (5.500 - 5.515 mm)

7. Be sure to measure each guide and valve combination individually.

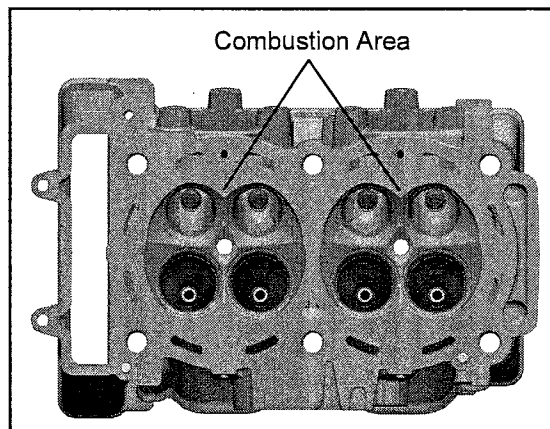
NOTE: The valve guides cannot be replaced.

Combustion Chamber Cleaning

! WARNING

Wear eye protection during combustion chamber cleaning.

1. Clean all accumulated carbon deposits from combustion chambers and valve seat area.



ENGINE / COOLING

NOTE: Carbon Clean Fuel Treatment (2871326) can be used to help remove carbon deposits.

IMPORTANT: Do not use a metal scraper, a coarse wire brush or abrasive cleaners to clean the cylinder head. Damage may result.

2. Visually inspect cylinder head gasket surface and combustion chamber for cracks or damage. Pay close attention to the areas around spark plug and valve seats.

Valve Seat Reconditioning

Valve seat reconditioning should be performed by a technician proficient in cylinder head reconditioning techniques. Reconditioning techniques vary, so follow the instructions provided by the valve reconditioning equipment manufacturer. Do not grind seats more than necessary to provide proper seat surface, width, and contact point on valve face.

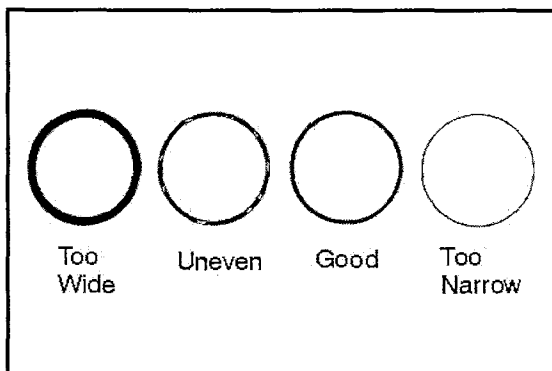
WARNING

Wear eye protection or a face shield during cylinder head disassembly and reassembly.

Valve Seat Inspection

Inspect valve seat in cylinder head for pitting, burnt spots, roughness, and uneven surface. If any of the above conditions exist, the valve seat must be reconditioned. *If the valve seat is cracked the cylinder head must be replaced.*

Valve seat width and point of contact on the valve face is very important for proper sealing. The valve must contact the valve seat over the entire circumference of the seat, and the seat must be the proper width all the way around. If the seat is uneven, compression leakage will result. If the seat is too wide, seat pressure is reduced, causing carbon accumulation and possible compression loss. If the seat is too narrow, heat transfer from valve to seat is reduced. The valve may overheat and warp, resulting in burnt valves.



Renewing Valve Seats

1. Install pilot into valve guide.
2. Apply cutting oil to valve seat and cutter.
3. Place 46° cutter on the pilot and make a light cut.
4. Inspect the cut area of the seat:

* If the contact area is less than 75% of the circumference of the seat, rotate the pilot 180° and make another light cut.

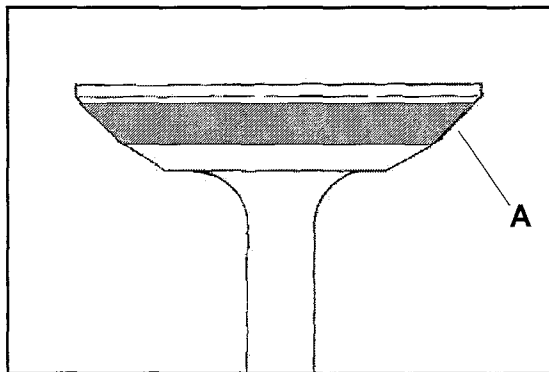
* If the cutter now contacts the uncut portion of the seat, check the pilot. Look for burrs, nicks, or runout. If the pilot is bent it must be replaced.

* If the contact area of the cutter is in the same place, the valve guide is distorted from improper installation.

* If the contact area of the initial cut is greater than 75%, continue to cut the seat until all pits are removed and a new seat surface is evident.

NOTE: Remove only the amount of material necessary to repair the seat surface.

5. To check the contact area of the seat on the valve face, apply a thin coating of Prussian Blue™ paste to the valve seat. If using an interference angle (46°) apply black permanent marker to the entire valve face (A).



6. Insert valve into guide and tap valve lightly into place a few times.
7. Remove valve and check where the Prussian Blue™ indicates seat contact on the valve face. The valve seat should contact the middle of the valve face or slightly above, and must be the proper width.

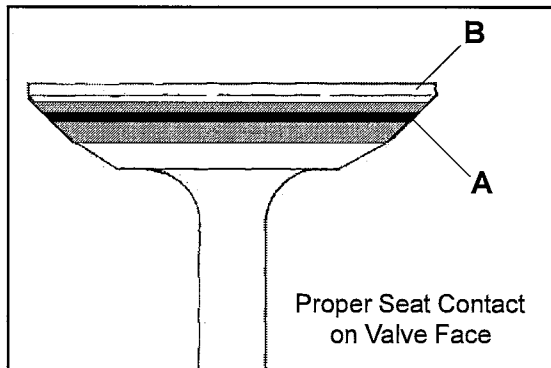
* If the indicated seat contact is at the top edge of the valve face and contacts the margin area (B) it is too high on the valve face. Use the 30° cutter to lower the valve seat.

* If too low, use the 60° cutter to raise the seat. When contact area is centered on the valve face, measure seat width.

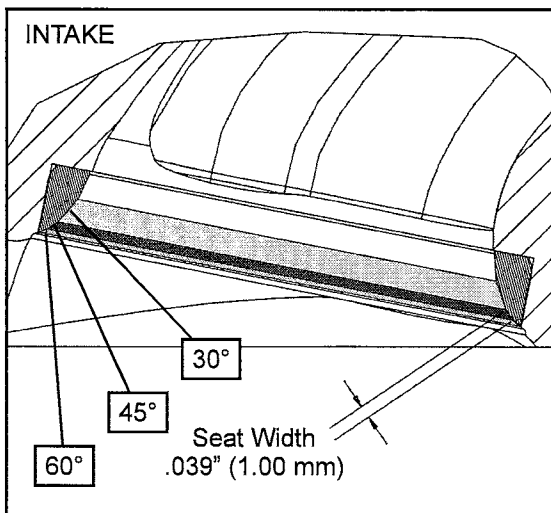
* If the seat is too wide or uneven, use both top and bottom cutters to narrow the seat.

* If the seat is too narrow, widen using the 45° cutter and re-check contact point on the valve face and seat width after each cut.

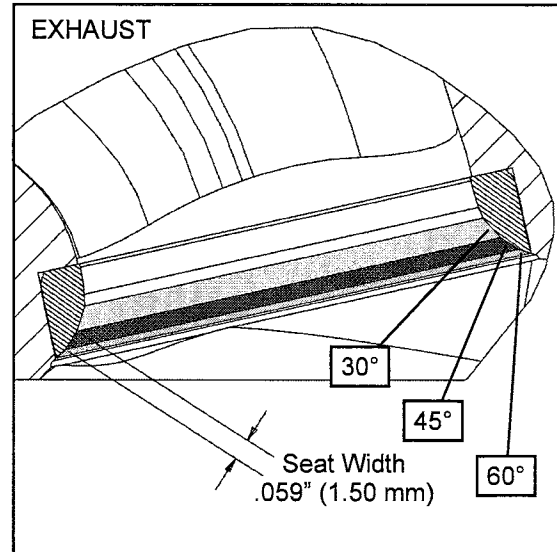
NOTE: When using an interference angle, the seat contact point on the valve will be very narrow, and is a normal condition. Look for an even and continuous contact point all the way around the valve face (A).



Intake Seat Cutter Diameter: 1.567 in. (39.80 mm)



Exhaust Seat Cutter Diameter: 1.364 in. (34.65 mm)



= In. / mm.

Valve Seat Width:	
Intake:	.039" (1.00 mm)
Service Limit:	.055" (1.4 mm)
Exhaust:	.059" (1.50 mm)
Service Limit:	.075" (1.9 mm)

8. Clean all filings from the area with hot soapy water. Rinse and dry with compressed air.

9. Lubricate valve guides with clean engine oil and apply oil or water based lapping compound to the face of the valve.

NOTE: Lapping is not required if an interference angle reconditioning method is used.

10. Insert the valve into its respective guide and lap using a lapping tool or a section of fuel line connected to the valve stem.

11. Rotate the valve rapidly back and forth until the cut sounds smooth. Lift the valve slightly off of the seat, rotate 1/4 turn, and repeat the lapping process. Do this four to five times until the valve is fully seated, and repeat process for the other valve(s).

12. Thoroughly clean cylinder head and valves.

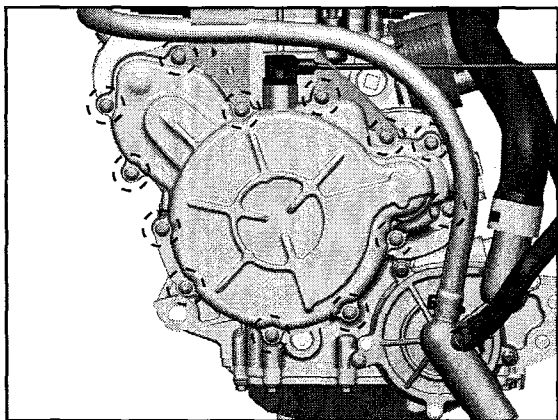
ENGINE / COOLING

ENGINE DISASSEMBLY / INSPECTION - LOWER END

Stator Cover Removal / Inspection

NOTE: The stator cover can be removed with the engine installed in the chassis.

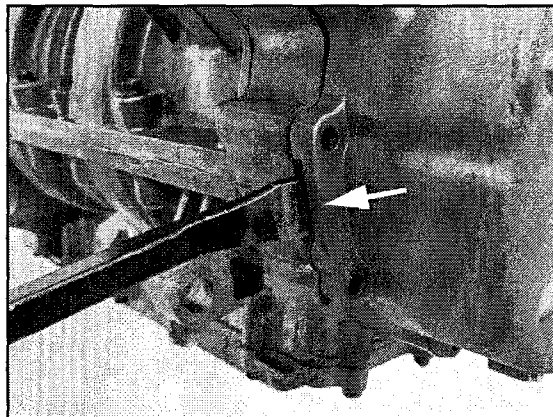
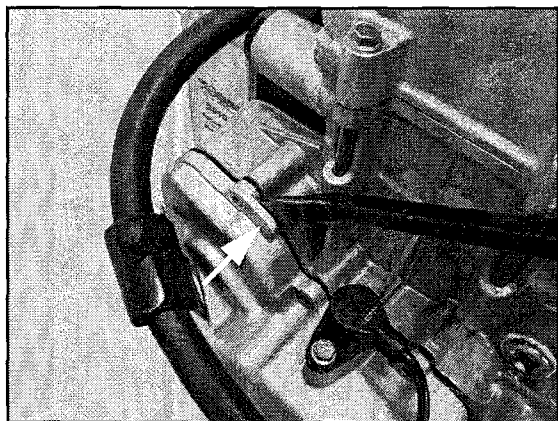
1. Remove the (13) screws retaining the stator cover.



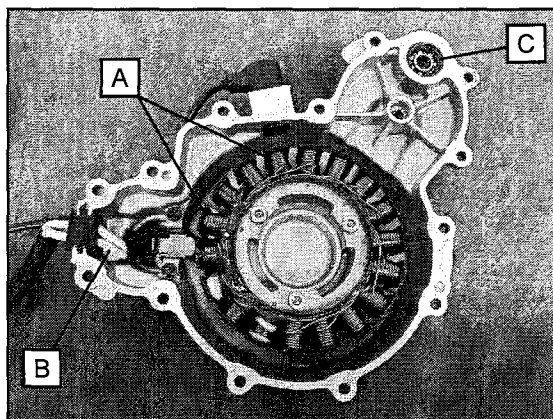
CAUTION

The flywheel contains powerful magnets. Use caution when removing and installing the stator cover. DO NOT place fingers between cover and crankcase at any time during the removal / installation process or injury could result.

2. Carefully pry the stator cover off the engine using the two pry areas as shown below.



3. Inspect the condition of the stator windings (A) and output wires (B). If replacement is required, refer to Chapter 10.

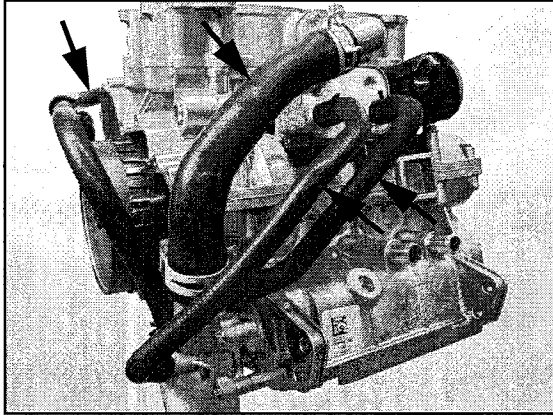


4. Inspect the ball bearing (C) that supports the starter motor shaft.
5. If bearing replacement is required, remove the retaining ring and heat the stator cover around the bearing evenly with a heat gun. Tap cover on a soft work surface to remove the bearing from the housing. A blind bearing puller can also be used. Replace bearing if removed.

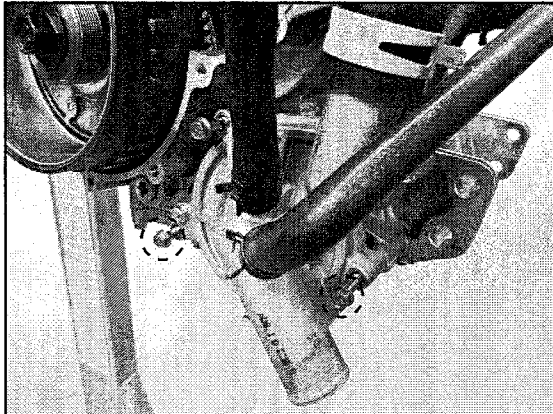
Water Pump Housing Removal

NOTE: The water pump housing can be serviced with the engine installed in the chassis (see **ENGINE COOLING SYSTEM - Water Pump Removal**).

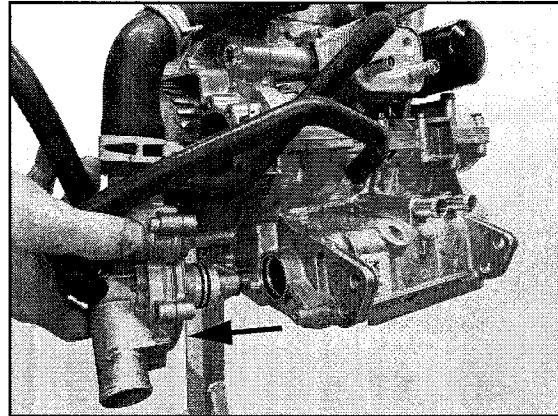
1. Remove the coolant lines from the thermostat housing, cylinder inlet and oil cooler. Leave them all attached to the water pump housing.



2. Remove the (3) long gold colored bolts retaining the water pump housing to the engine.



3. Remove the water pump assembly from the engine by using a twisting motion as you pull out on the housing.



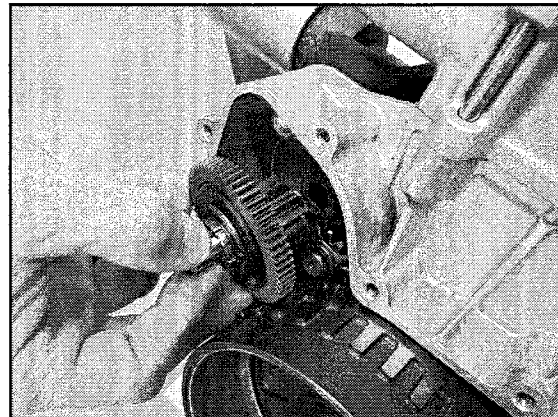
3

4. If water pump service is required (impeller or mechanical seal), refer to "ENGINE COOLING SYSTEM".

Flywheel Removal

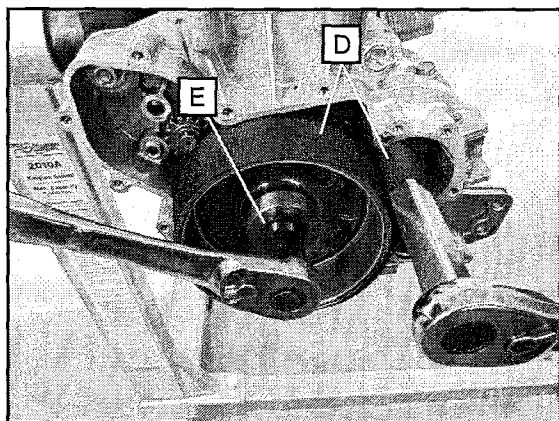
NOTE: The flywheel can be serviced with the engine installed in the chassis.

1. Remove the stator cover assembly.
2. Remove the starter torque limit gear as an assembly.

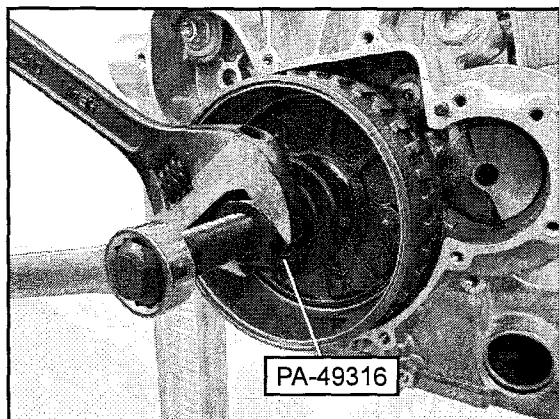


3. Inspect gear teeth for damage. Inspect fit of shaft inside gear and replace gear assembly if clearance is excessive. Inspect the shaft and bearing surfaces in the crankcase and stator cover for excessive wear.

- Using a commercially available strap wrench (D), hold the flywheel and remove the flywheel retaining bolt (E).



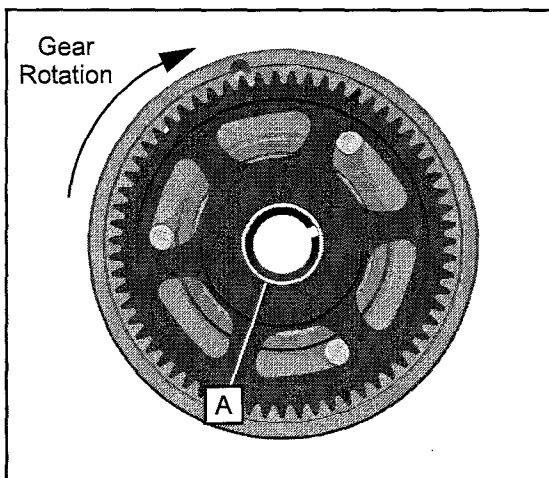
- Fully install Flywheel Puller (PA-49316) on the threads of the flywheel (left hand thread - turn flywheel puller counterclockwise to install).
- Hold puller body and tighten the center bolt to remove the flywheel.



Starter One-Way Clutch Inspection

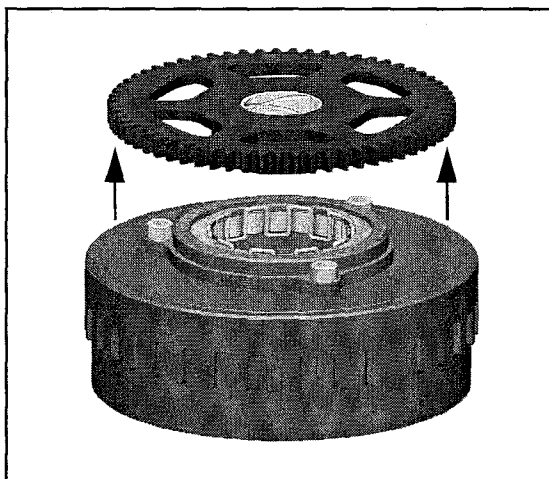
NOTE: The starter one-way clutch can be serviced with the engine installed in the chassis.

- Remove the stator cover and flywheel (see “Stator Cover Removal / Inspection” and “Flywheel Removal”).
- Place flywheel on a work bench with the one-way clutch facing up. Grasp clutch gear and rotate clockwise. It should turn smoothly without binding.
- Rotate one-way gear counterclockwise. The gear should immediately lock in position and not slip.
- Inspect the one-way gear bushing (A) for wear or galling. If service is required, refer to “Starter One-Way Clutch Disassembly”.

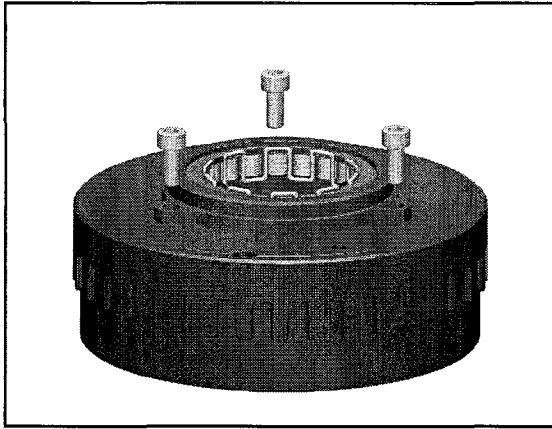


Starter One-Way Clutch Disassembly

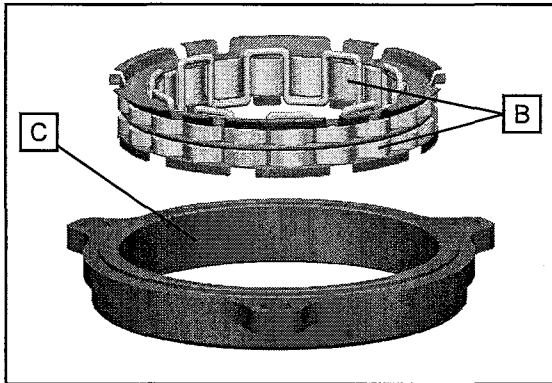
- Lift up to remove starter one-way gear.



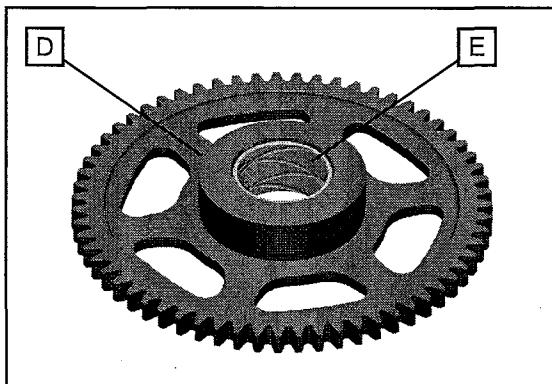
2. Remove the (3) one-way clutch retaining screws.



3. Remove the one-way clutch and inspect both sides of drive rollers (B). Inspect the roller contact surface (C) inside the hub for wear, damage or uneven surface.

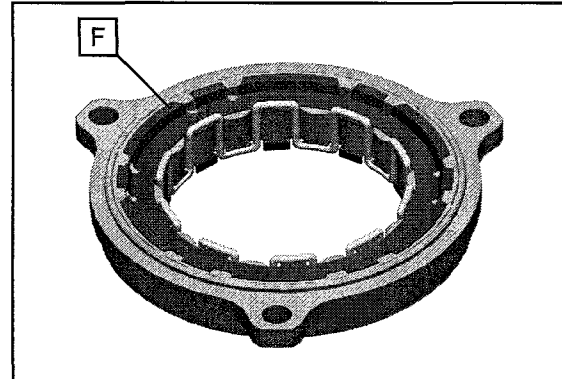


4. Inspect drive surface of starter gear (D) and bushing (E) for wear, damage or uneven surface. If any starter one-way clutch component is worn or damaged, replace the clutch and starter gear as an assembly.



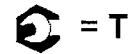
Starter One-Way Clutch Assembly

1. Install one-way clutch in clutch hub with flange of clutch (F) engaged in recess.



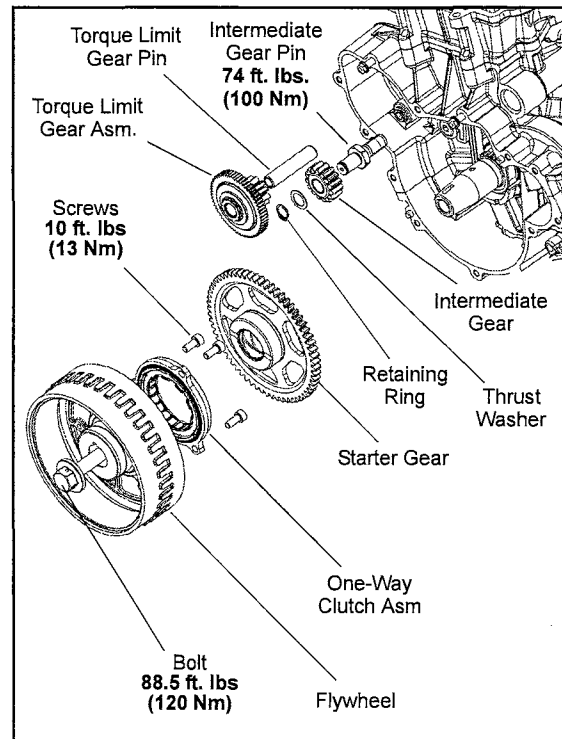
3

2. Clean screw threads in flywheel to remove all oil or grease.
3. Place one-way clutch on flywheel and install the (3) screws. Torque screws to specification.



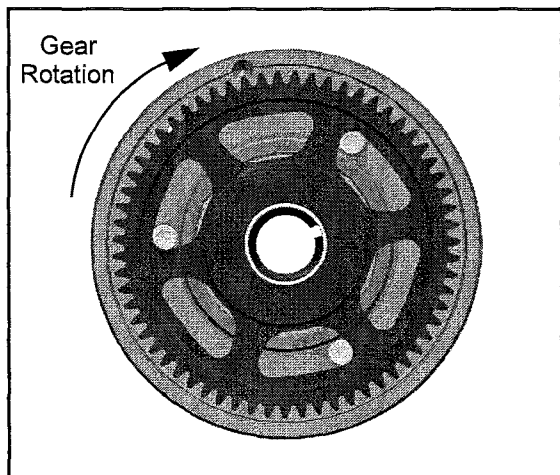
One-Way Clutch Retaining Screws:
106 ± 18 in. lbs. (12 ± 2 Nm)

4. Reassemble starter one-way clutch and gear using the following illustration.

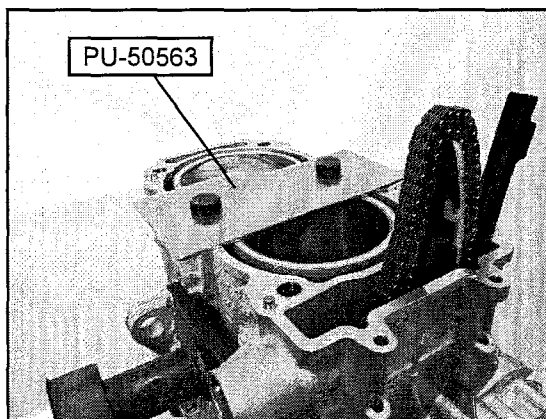


ENGINE / COOLING

5. If starter gear was replaced, replace the intermediate gear and inspect the torque limit gear.
6. After assembly, be sure the starter gear rotates in the clockwise direction only.
3. Locate the Oil Catch Tool (PN 5438829) in the vehicle's tool kit. Position the tool below the oil filter to catch the oil when the filter is removed. Remove the oil filter.

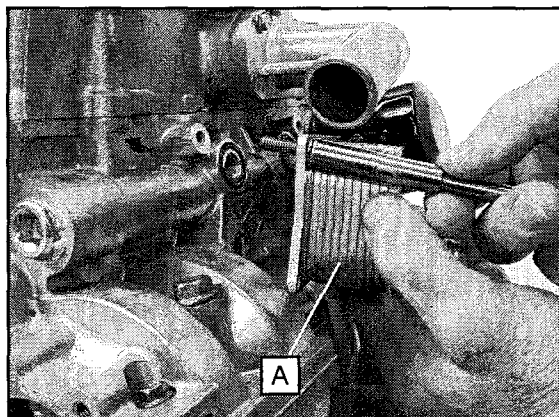


4. Install the Cylinder Holding & Camshaft Timing Plate (PU-50563) onto the cylinder. The cylinder holding tool retains the cylinder and pistons when the engine is rotated.

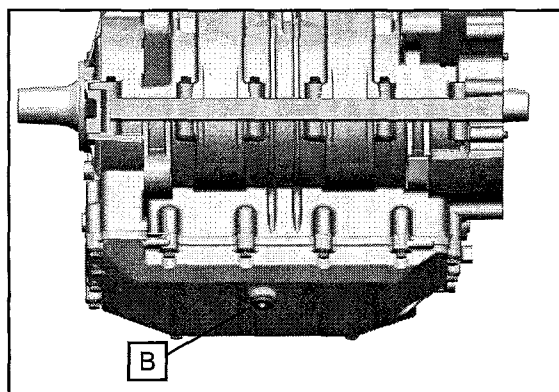


Crankcase Disassembly / Inspection

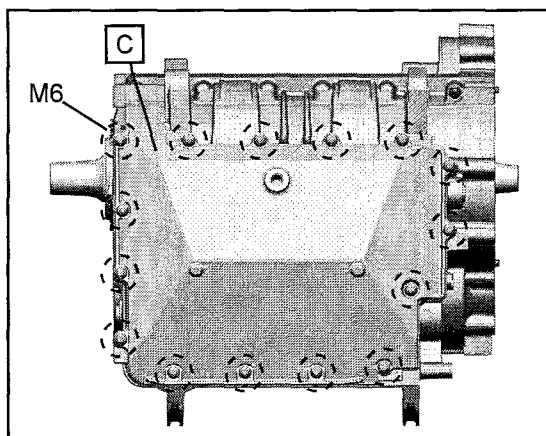
1. Remove the oil cooler (A) from the crankcase.



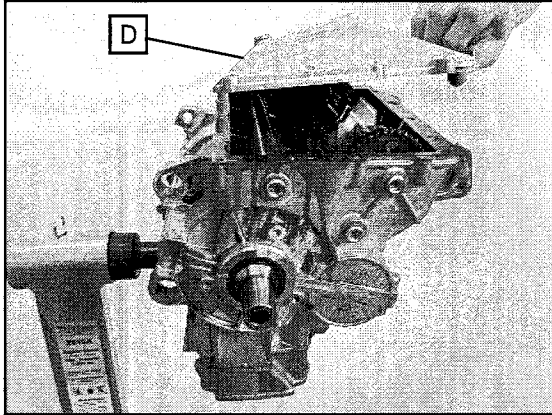
2. Remove the crankcase drain plug (B) to drain any oil remaining in the engine.



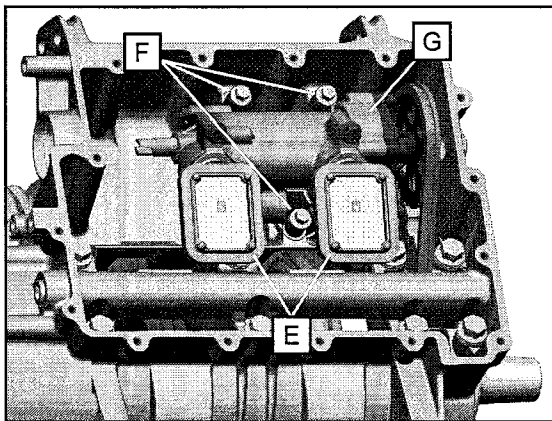
5. Rotate the engine to access the crankcase sump cover.
6. Remove the (15) M6 bolts retaining the sump cover (C) to the crankcase.



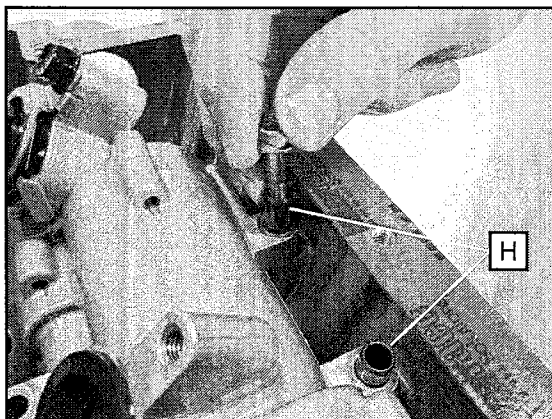
7. Remove the sump cover (D) from the crankcase.



8. Remove and clean oil pump pick-ups (E).
9. Remove the (3) bolts (F) that retain the oil pump (G) to the crankcase.

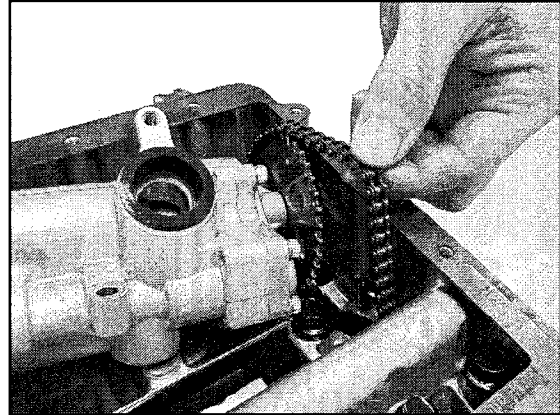


10. Use one of the oil pump retaining bolts or a pen magnet to extract the dowel pins (H) from the oil pump. Doing so allows for oil pump removal without having to remove the pump drive sprocket.

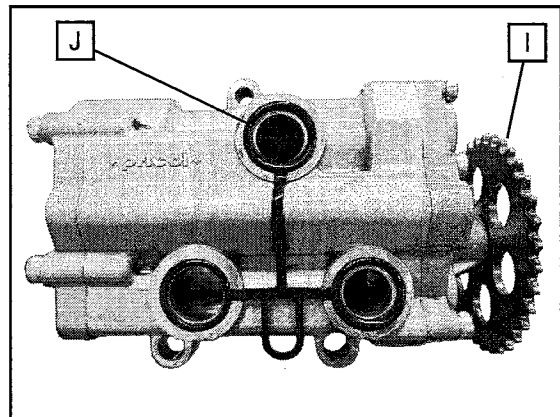


NOTE: If unable to extract the dowel pins from the oil pump, the oil pump sprocket must be removed. Access the sprocket bolt by removing the case plug.

11. Lift the oil pump drive chain and remove the oil pump.

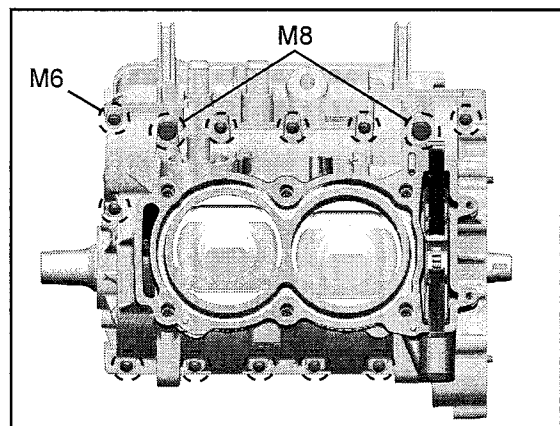


12. Visually inspect the oil pump and drive sprocket (I) for wear or damage. Replace oil pump drive chain and sprocket if worn or damaged. If any part of the oil pump is damaged, the entire assembly must be replaced. Replace the oil pump seal (J) during crankcase assembly.



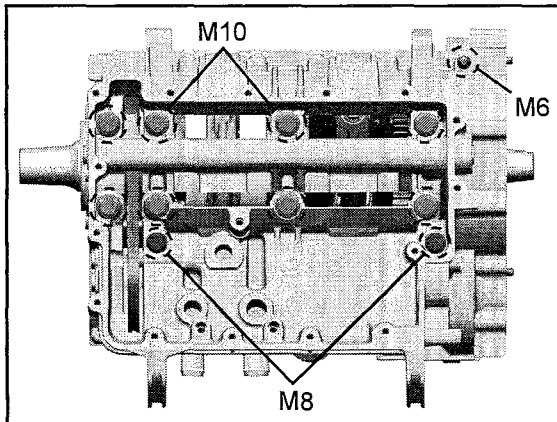
NOTE: Oil pump assembly is non-serviceable

13. Rotate the engine so the cylinder is facing up.
14. Remove the (11) M6 and (2) M8 upper crankcase bolts.

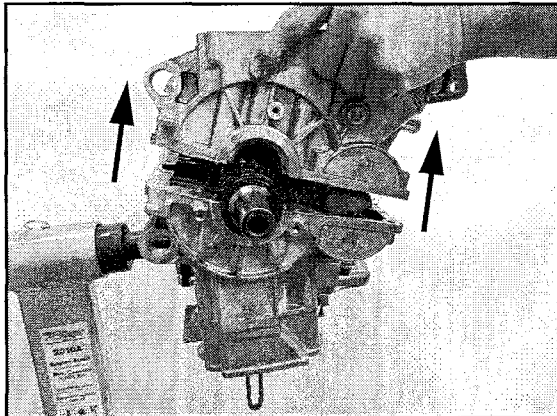


15. Rotate the engine so the cylinder is facing down.

16. Remove the (8) M10, (2) M8 and (1) M6 lower crankcase bolts. Discard the (8) M10 bolts.

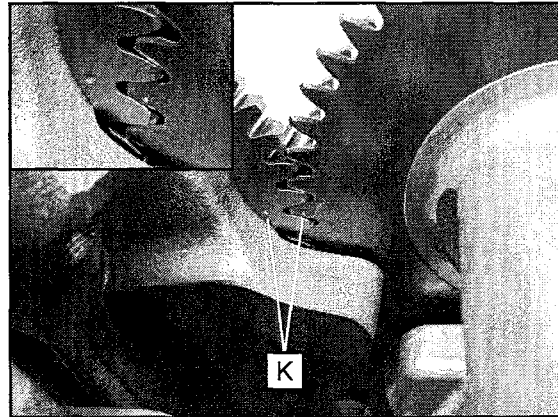


17. Tap on the lower crankcase in reinforced areas with a soft faced hammer to loosen. Carefully lift up and remove the lower crankcase half.

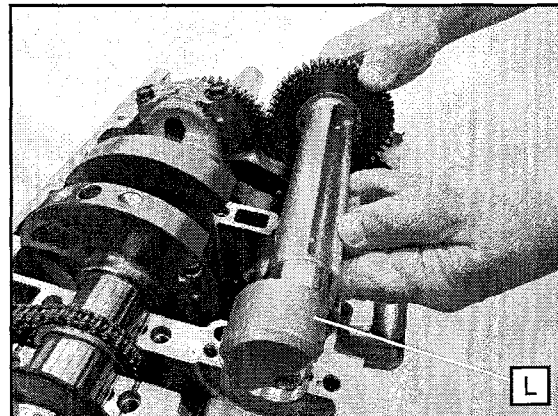


Balance Shaft Removal / Inspection

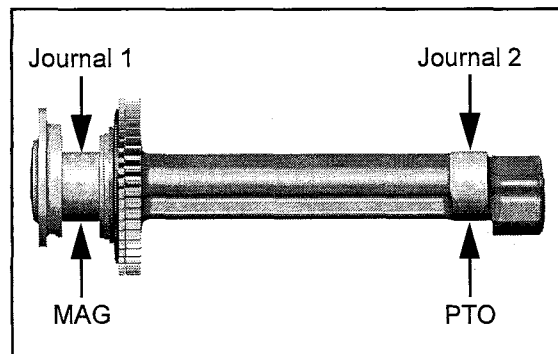
1. Perform "Crankcase Disassembly / Inspection" procedure.
2. Note timing marks (K) on balance shaft and crankshaft drive gears. Shafts must be properly timed upon assembly.



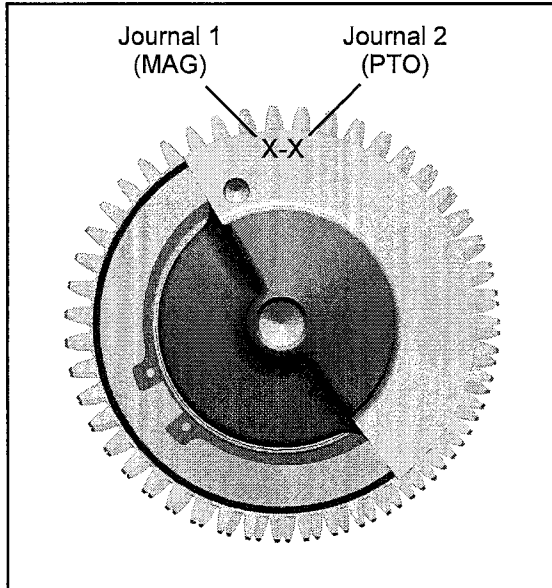
3. Carefully rotate the balance shaft (L) and remove it from the crankcase.



4. Inspect the balance shaft gear teeth for damage.
5. Measure each bearing journal in two locations, 90 degrees apart. Replace balance shaft if either journal is worn below the service limit specification.



- Refer to the two letters stamped onto the MAG end of the balance shaft. The first letter represents Journal 1 (MAG) end. The second letter represents Journal 2 (PTO) end.



- Use the table below to see if the balance shaft bearing journals are within specification. If worn past the service limit, replace the balance shaft assembly.

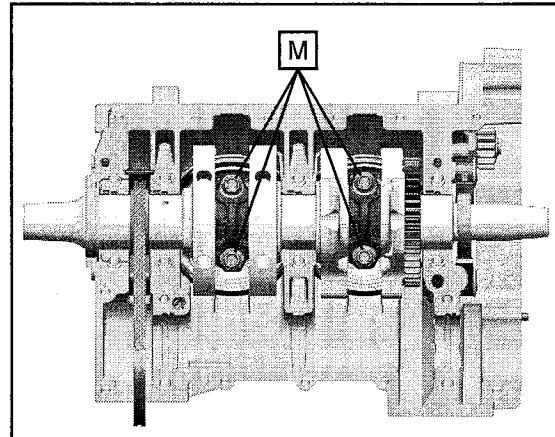
Balance Shaft Bearing Journal Diameters		
	A	B
Standard	1.4950-1.4953 in. (37.974-37.982 mm)	1.4947-1.4950 in. (37.966-37.974 mm)
Service Limit	1.4941 in. (37.951 mm)	

- Whether installing a new balance shaft or re-installing the original, refer to the bearing selection chart provided in the "Balance Shaft Bearing Selection" procedure in this chapter.

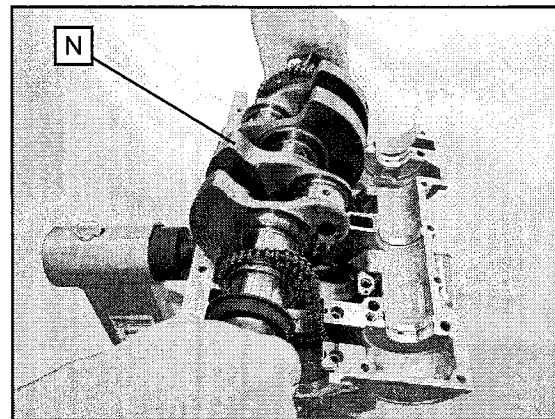
Crankshaft Removal / Inspection

- Perform "Crankcase Disassembly / Inspection" procedure.
- Perform "Balance Shaft Removal / Inspection" procedure.
- For ease of assembly, mark each connecting rod and end cap.

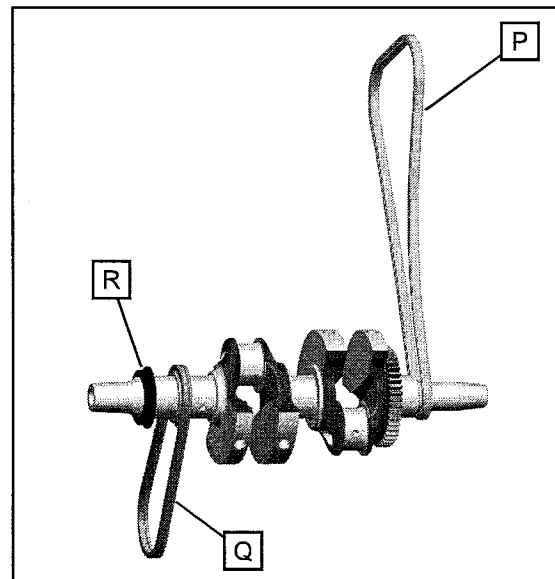
- Loosen, remove and discard the (4) connecting rod bolts (M). Remove the end caps from the crankshaft.



- Carefully lift the crankshaft (N) out of the crankcase.

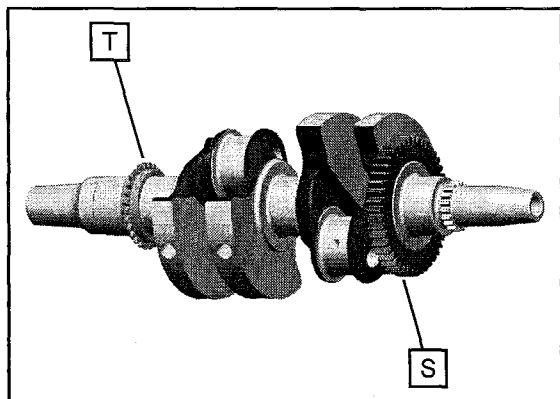


- Remove the cam chain (P), oil pump drive chain (Q) and PTO main seal (R) from the crankshaft.

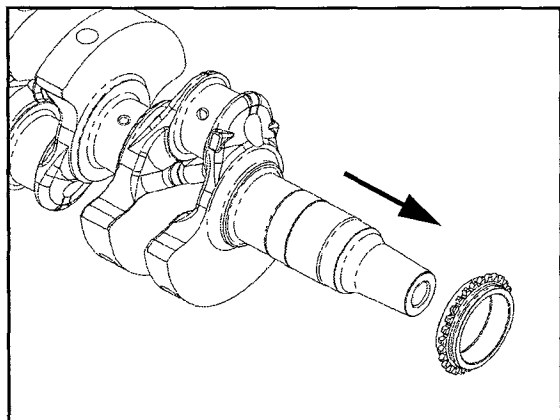


ENGINE / COOLING

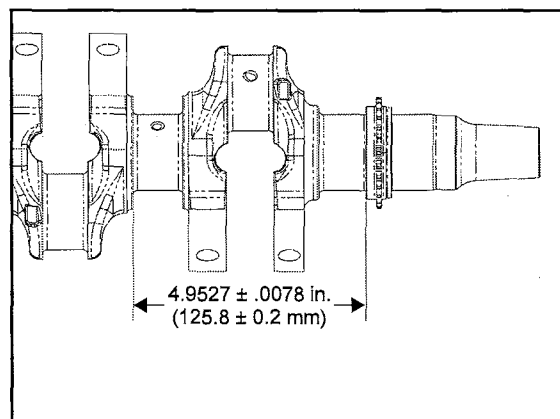
7. Inspect the crankshaft gear (S) and auxiliary sprocket (T) for broken or worn teeth.



8. If the crankshaft gear (S) is damaged, the crankshaft assembly must be replaced.
9. If the auxiliary sprocket (T) is damaged, remove the sprocket with a 3-jaw puller.



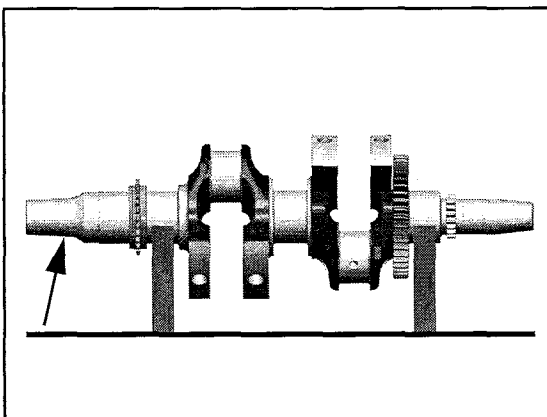
10. Using an arbor press, install new sprocket in any orientation to the depth shown in the following illustration.



$$\text{Diagram of a circle with a vertical line through its center and a horizontal line across its middle, with arrows indicating measurement.} = \text{In. / mm.}$$

Auxiliary Sprocket Installed Depth:
 $4.9527 \pm .0078 \text{ in. (125.8} \pm 0.2 \text{ mm)}$

11. Support crankshaft on V-blocks or on-centers in a crankshaft stand or lathe. Measure crankshaft runout and replace if runout exceeds maximum listed below.

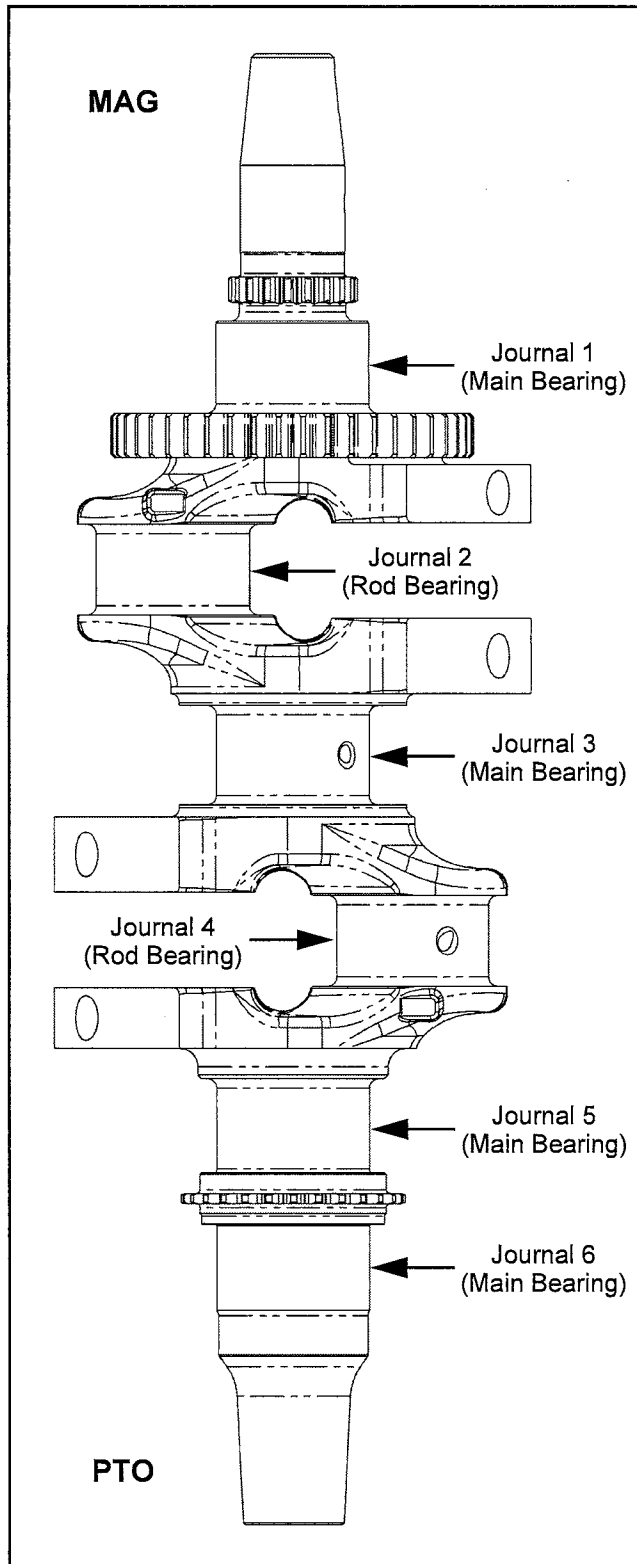


$$\text{Diagram of a circle with a vertical line through its center and a horizontal line across its middle, with arrows indicating measurement.} = \text{In. / mm.}$$

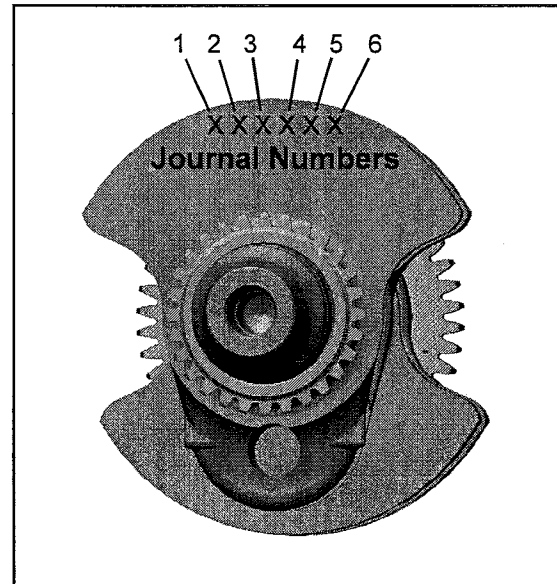
Crankshaft Maximum Runout:
 $.001 \text{ in. (0.025 mm)}$

12. Visually inspect surface of crankshaft main and connecting rod journals. Replace crankshaft if any journal is scratched or pitted.

13. Measure each main journal and connecting rod journal in two locations, 90 degrees apart. Replace crankshaft if any journal is worn below the service limit specification.



14. Refer to the six letters stamped onto the PTO end of the crankshaft.



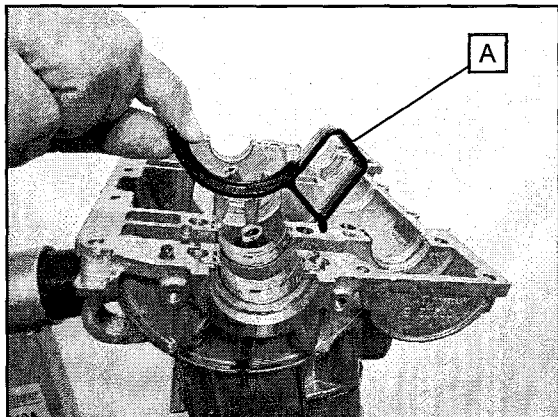
15. Use the table below to see if the crankshaft bearing journals are within specification. If worn past the service limit, replace the crankshaft assembly.

Crankshaft Bearing Journal Diameters		
B		
Main Bearing	Standard	1.6144 - 1.6147 in. (41.006 - 41.014 mm)
	Service Limit	1.6129 in. (40.970 mm)
Conn Rod Bearing	Standard	1.6118 - 1.6122 in. (40.942 - 40.950 mm)
	Service Limit	1.6104 in. (40.906 mm)
G		
Main Bearing	Standard	1.6140 - 1.6143 in. (40.998 - 41.005 mm)
	Service Limit	1.6129 in. (40.970 mm)
Conn Rod Bearing	Standard	1.6115 - 1.6118 in. (40.934 - 40.941 mm)
	Service Limit	1.6104 in. (40.906 mm)
Y		
Main Bearing	Standard	1.6137 - 1.6140 in. (40.990 - 40.997 mm)
	Service Limit	1.6129 in. (40.970 mm)
Conn Rod Bearing	Standard	1.6112 - 1.6115 in. (40.926 - 40.933 mm)
	Service Limit	1.6104 in. (40.906 mm)

16. Whether installing a new crankshaft or re-installing the original, refer to the bearing selection chart provided in the "Crankshaft Main Bearing Selection" and "Connecting Rod Bearing Selection" procedure in this chapter.

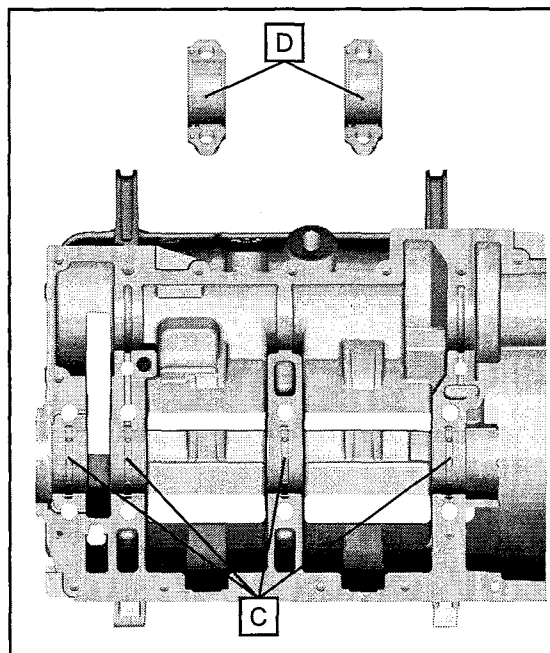
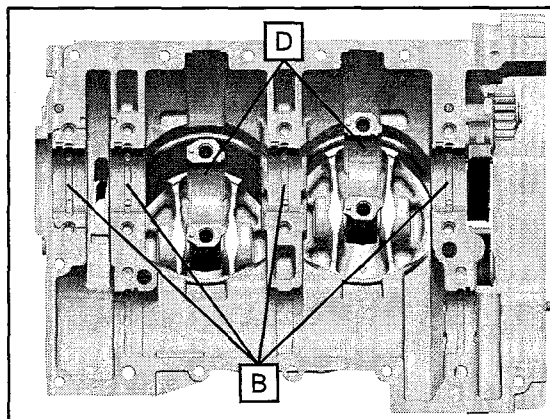
Crankcase Inspection

1. Remove the oil drain diverter (A) from the upper crankcase.



2. Remove all traces of crankcase sealer from the crankcase mating surfaces. Inspect the surfaces closely for nicks, burrs or damage.
3. Be sure alignment pins are in place where used.
4. Be sure oil passages are clean and free of any cleaning solvent (see "Engine Oil Flow Chart").

5. Remove and discard the plain bearings located in the upper crankcase (B), lower crankcase (C) and connecting rods (D). Replace the crankcase assembly if a bearing bore is galled or if bearing inserts have rotated in the case. Refer to bearing selection procedures upon assembly.



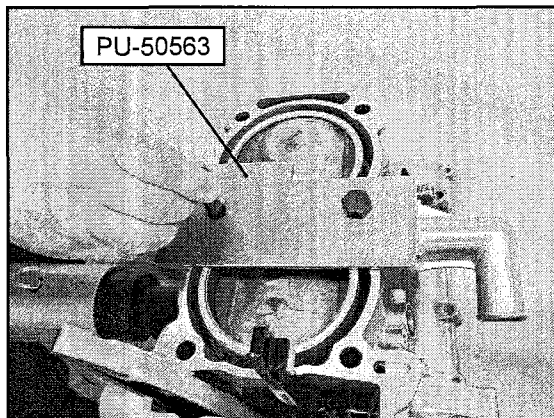
IMPORTANT: Always replace plain bearings when the crankcase or connecting rods have been disassembled. Refer to "Bearing Selection Chart".

Cylinder / Piston Removal

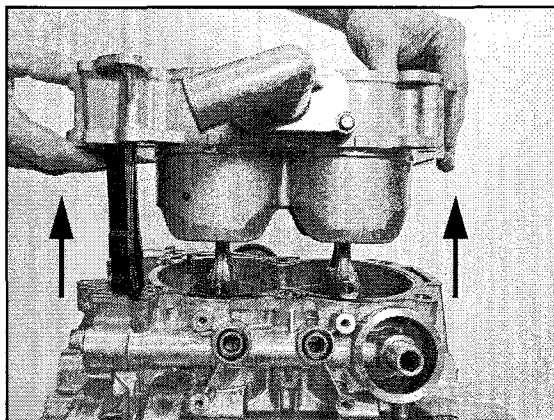
CAUTION

Pistons must be removed from the cylinders with the connecting rods attached.
DO NOT attempt to service the cylinder or pistons without disassembling the crankcase.
Although you can remove the cylinder and pistons without disassembly, you will not be able to reassemble the engine because of the unique cylinder skirt and crankcase design.

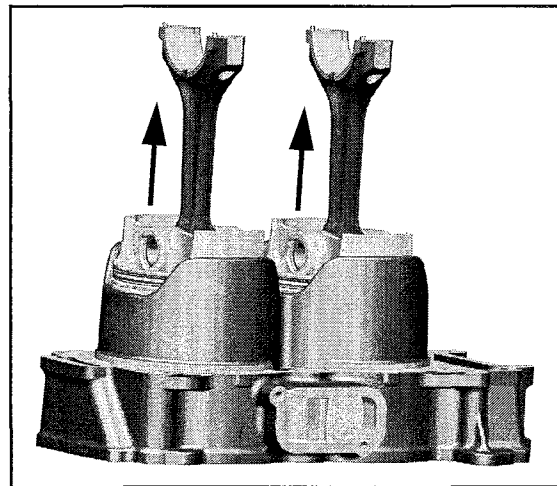
1. Perform "ENGINE DISASSEMBLY / INSPECTION - TOP END" and the "ENGINE DISASSEMBLY / INSPECTION - LOWER END" procedures.
2. Rotate the engine so the cylinder is facing up.
3. Remove the Cylinder Holding & Camshaft Timing Plate (PU-50563) from the cylinder.



4. Carefully lift the cylinder and pistons from the upper crankcase.



5. Remove the piston / connecting rod assemblies from the cylinder.

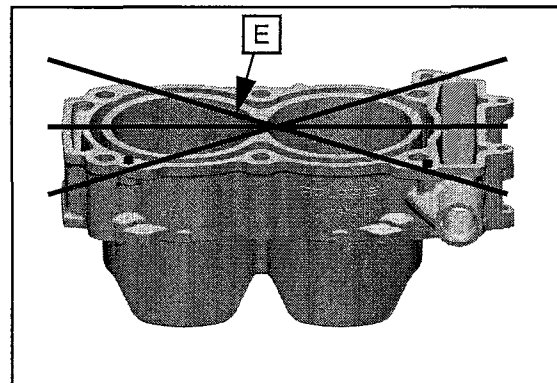


3

NOTE: If the pistons are to be reused, mark the pistons so they are reassembled in the same cylinder bore and direction from which they were removed (MAG / PTO).

Cylinder Inspection

1. Lay a straight edge (E) across the top surface of the cylinder at several different points and measure warp by inserting a feeler gauge between the straight edge and the cylinder surface. If warp exceeds the service limit, replace the cylinder head.



$$\frac{\text{Feeler Gauge Reading}}{\text{Straight Edge Length}} = \text{In. / mm.}$$

Cylinder Warp Limit:
.002" (0.05 mm)

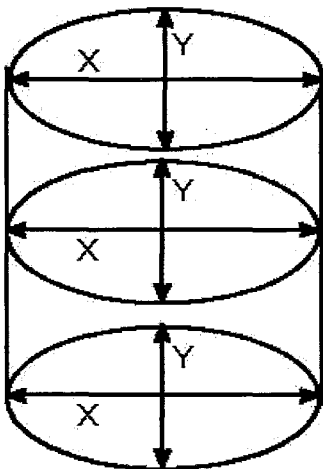
2. Inspect cylinder for wear, scratches, or damage.

ENGINE / COOLING

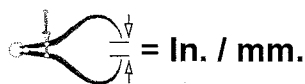
IMPORTANT: DO NOT hone the cylinders or attempt to repair a damaged cylinder by honing.

3. Inspect taper and out of round with a dial bore gauge.
4. Inspect cylinder for taper and out of round with a dial bore gauge. Measure in two different directions (front to back and side to side), on three levels (0.5 in. down from top, the middle, and 0.5 in. up from bottom). Record measurements. If cylinder is tapered or out of round beyond .001", the cylinder must be replaced.

0.59 in. (15 mm) Down From Top

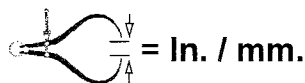


1.54 in. (39.3 mm) Up From Bottom



Cylinder Taper:
Service Limit: .001" (.025 mm)

Cylinder Out of Round:
Service Limit: .001" (.025 mm)

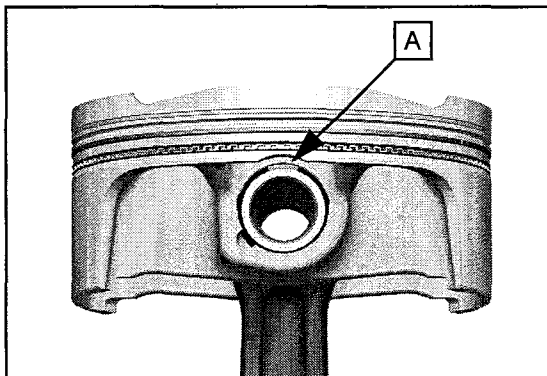


Standard Bore Size:
3.6614" ± .0003" (93 mm ± .008 mm)

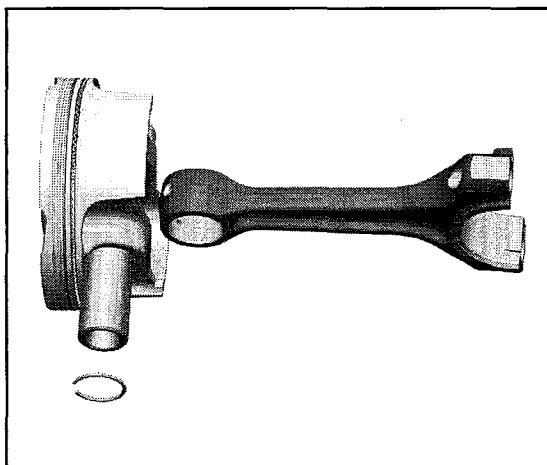
Piston Disassembly / Inspection

NOTE: New pistons are directional (intake vs. exhaust), but can be placed in either cylinder.

1. Note location of the piston circlip gap (A) at the top (12:00 position) or bottom (6:00 position).



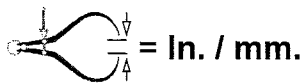
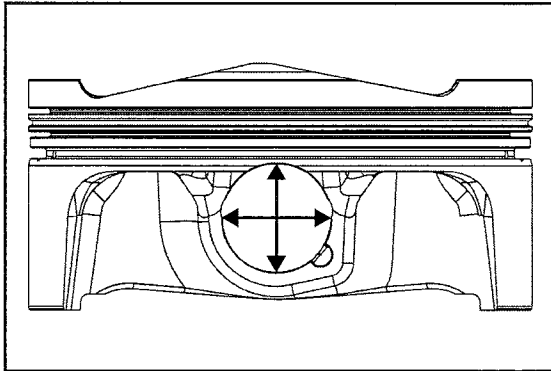
2. Remove piston circlip and push piston pin out of piston. If necessary, heat the crown of the piston slightly with a heat gun if pin cannot be removed by hand. Discard circlips.



CAUTION

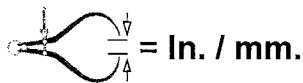
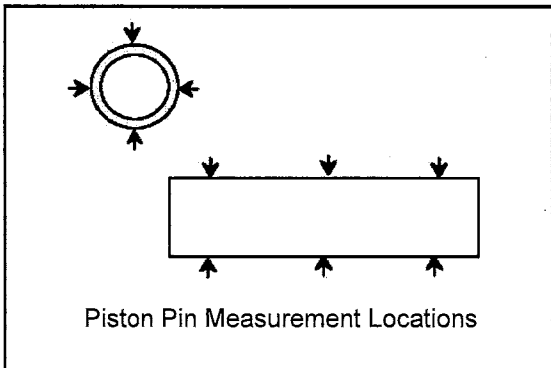
DO NOT apply heat to piston rings or a loss of radial tension could result.

3. Measure piston pin bore I.D. in two directions (90° apart).
Replace piston and piston pin if out of specification.



Piston Pin Bore I.D.:
0.7877" - 0.7881" (20.009 - 20.018 mm)
Service Limit: 0.7893" (20.05 mm)

4. Measure piston pin O.D. in two directions (90° apart) at three locations on the length. Replace piston and piston pin if out of specification.



Piston Pin O.D.:
0.7873" - 0.7875" (20.000 - 20.005 mm)
Service Limit: 0.7866" (19.98 mm)

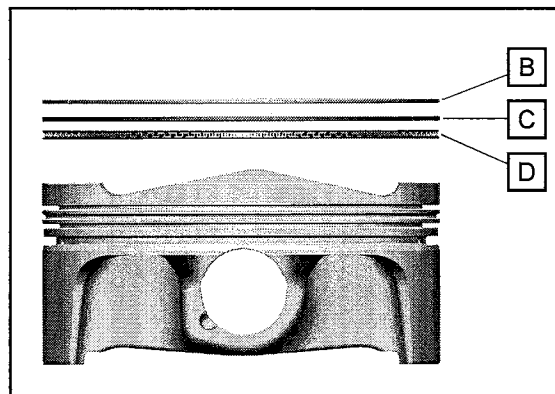
Piston Ring Removal

1. Carefully remove top compression ring (B) by hand or using a ring removal pliers.

CAUTION

DO NOT expand the ring more than necessary to remove it from the piston or the ring may break or lose radial tension.

- **Piston ring pliers:** Carefully expand ring and lift it off the piston.
- **By hand:** Placing both thumbs on the ring ends, spread the ring open and push up on opposite side. Do not scratch ring lands.

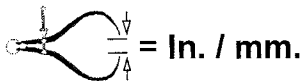
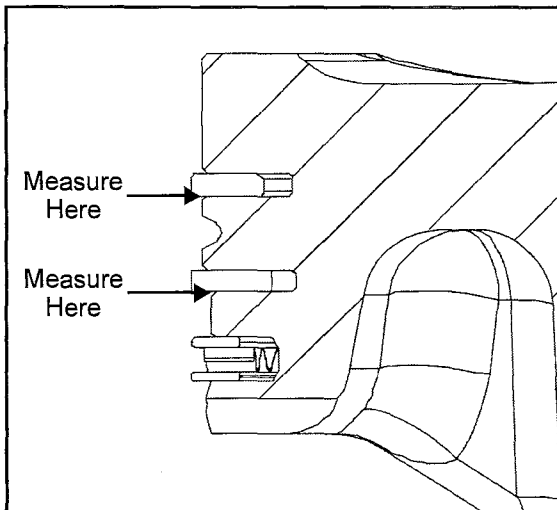


2. Repeat procedure for second compression ring (C).
3. The oil control ring (D) is a three piece design consisting of a top and bottom steel rail and a center expander section. Remove top rail first, then bottom rail, then the expander.

ENGINE / COOLING

Piston Ring to Groove Clearance Inspection

1. Measure piston ring to groove clearance by placing the ring in the ring land and measuring with a thickness (feeler) gauge. Replace piston and rings if ring-to-groove clearance exceeds service limits.



Piston Ring to Groove Clearance:

Top Ring: .0007" - .0023" (.020 - .060 mm)

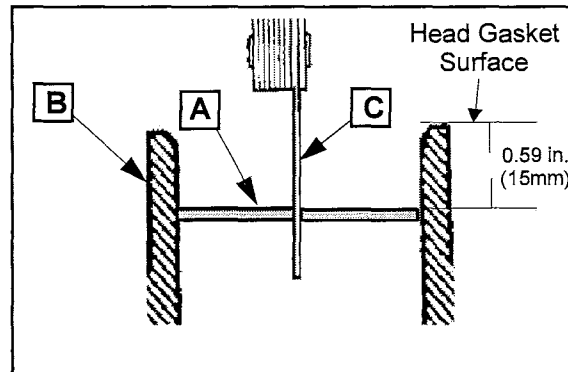
Second Ring: .0007" - .0023" (.020 - .060 mm)

Service Limit: .0047" (.12 mm)

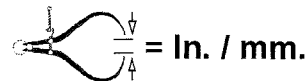
Piston Ring Installed Gap

1. Place each piston ring (A) inside the cylinder (B). Use the piston to push the ring squarely into cylinder, as shown below.
2. Measure installed gap with a feeler gauge (C) at both the top and bottom of the cylinder.

IMPORTANT: A difference between top and bottom end gap measurements is a general indication of cylinder taper (wear). The cylinder should be measured for taper and out of round.



3. If the installed gap measurement exceeds the service limit, replace the rings.



Piston Ring Installed Gap:

Top Ring: .010" - .014" (.25 - .35 mm)
Service Limit: .020" (.50 mm)

Second Ring (S/N 00516 and Prior):
.014" - .020" (.35 - .50 mm)
Service Limit: .028" (.70 mm)

Second Ring (S/N 00517 to Current):
.039" - .045" (1.00 - 1.15 mm)
Service Limit: .053" (1.35 mm)

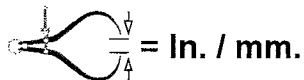
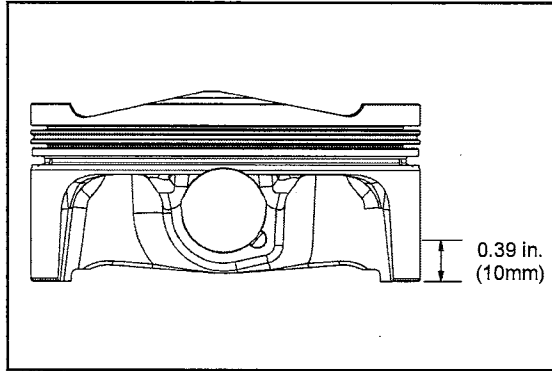
Oil Control Rails: .008" - .028" (.20 - .70 mm)
Service Limit: .035" (.90 mm)

NOTE: Always check piston ring installed gap when installing new rings and/or a new cylinder.

Piston-to-Cylinder Clearance

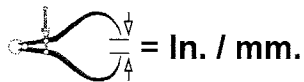
Measure piston outside diameter at a point 10 mm up from the bottom of the piston, at a right angle to piston pin bore.

Subtract measurement from maximum measurement obtained in Step 4 of "Cylinder Inspection" procedure.



Piston O.D. (Standard):

3.6597 ± .0003" (92.959 ± .008 mm)

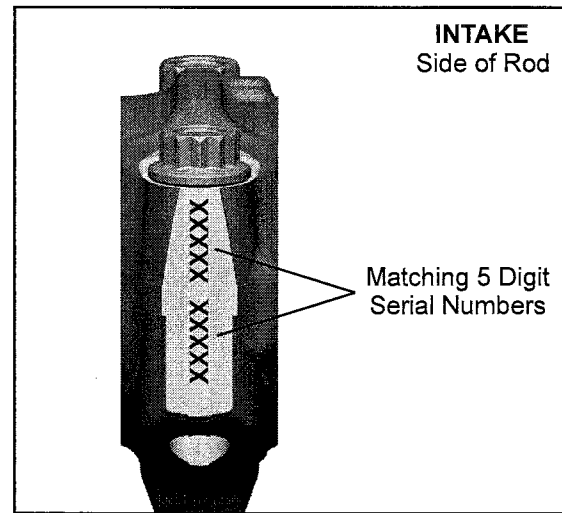


Piston to Cylinder Clearance:

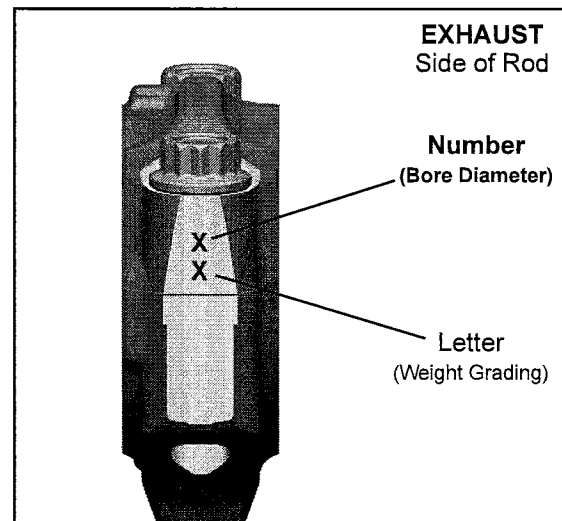
.0009" - .0019" (.025 - .050 mm)

Connecting Rod Inspection

1. The 5 digit numbers stamped onto the intake side of the connecting rod are serial numbers used to match the rod stem with the rod cap.



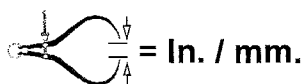
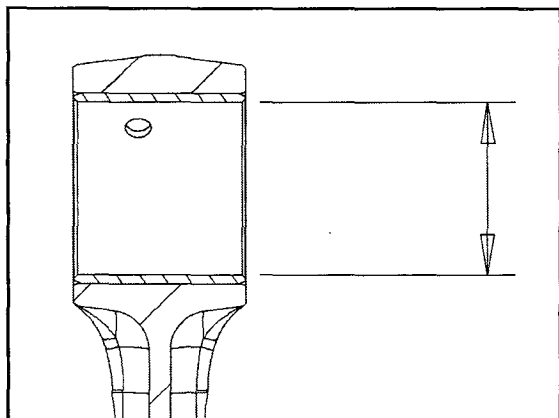
2. The number and letter stamped onto the exhaust side of the connecting rod represent the bore diameter and weight grading of the connecting rod.



3. Inspect the small end and big end of connecting rod (and matching rod cap) for damage, galling of surface or pitting.

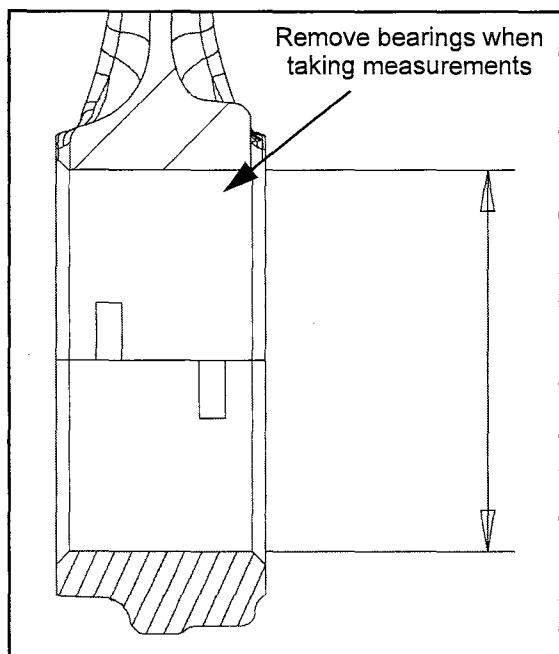
ENGINE / COOLING

4. Measure small end I.D. in two directions as shown. Record measurements and compare to specifications. Replace connecting rod if worn past the service limit specification.

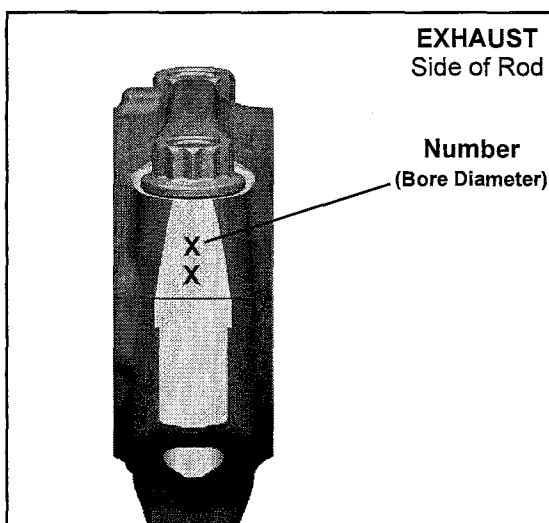


Connecting Rod Small End I.D.:
0.7879" - 0.7885" (20.015 - 20.030 mm)
Service Limit: 0.7897" (20.06 mm)

5. Install matching rod cap on connecting rod (**without bearings**) and install the bolts.
6. Tighten bolts snug, then torque to 13 ft. lbs. (18 Nm).
7. Using a dial bore gauge, measure big end I.D. in two directions shown. Record measurements and compare to specifications.



8. Refer to the number stamped onto the exhaust side of the connecting rod. This number represents the bore diameter.



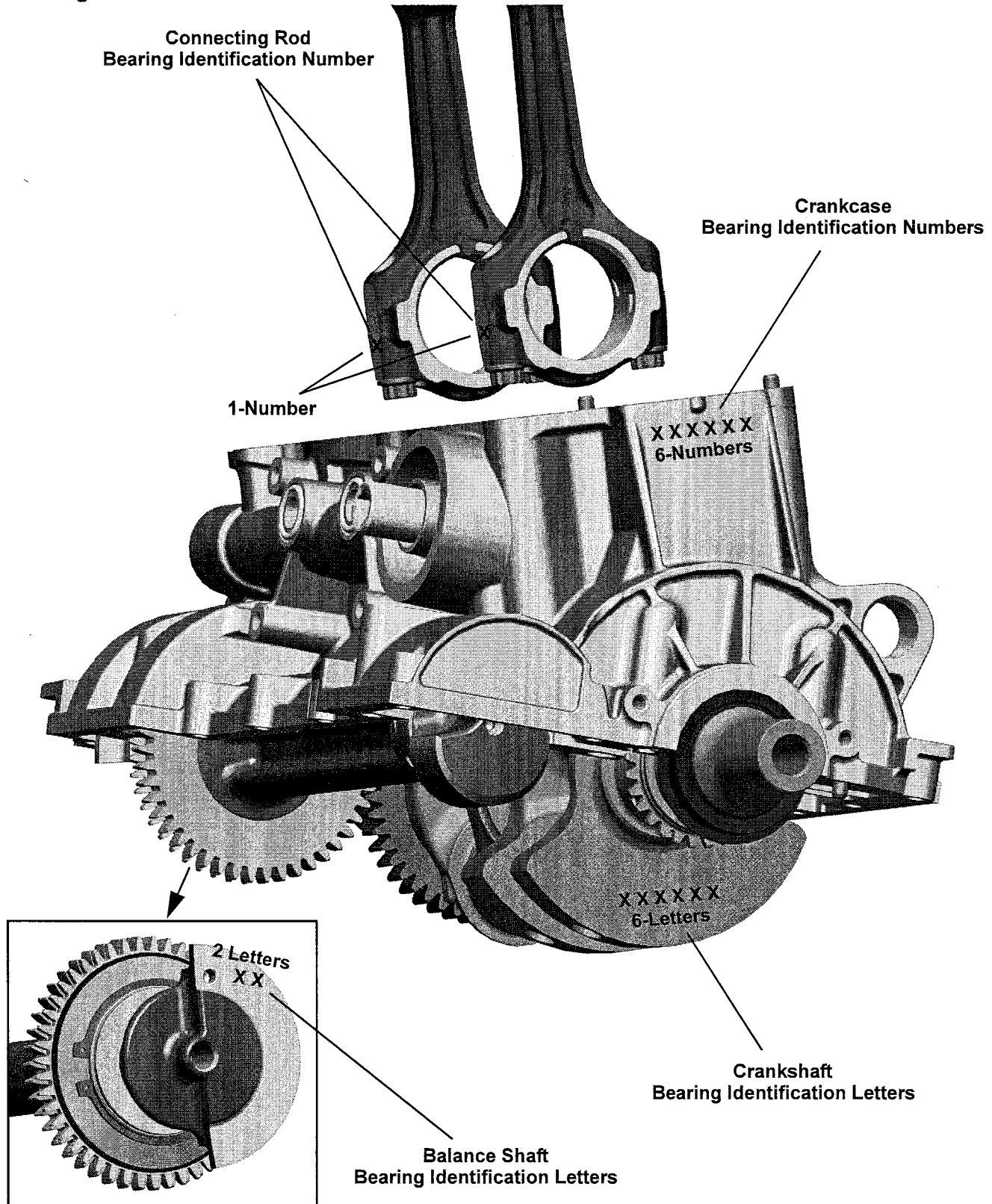
9. The table below lists the big end bore diameter specifications.

Connecting Rod Big End Bore Diameters		
1	2	3
1.7318-1.7321 in. (43.989-43.996 mm)	1.7321-1.7323 in. (43.996-44.003 mm)	1.7323-1.7326 in. (44.003-44.010 mm)

10. Whether using new connecting rods or re-installing the original ones, refer to the bearing selection chart provided in the "Connecting Rod Bearing Selection" procedure in this chapter.

ENGINE ASSEMBLY - LOWER END

Bearing Selection Identification Letters and Numbers

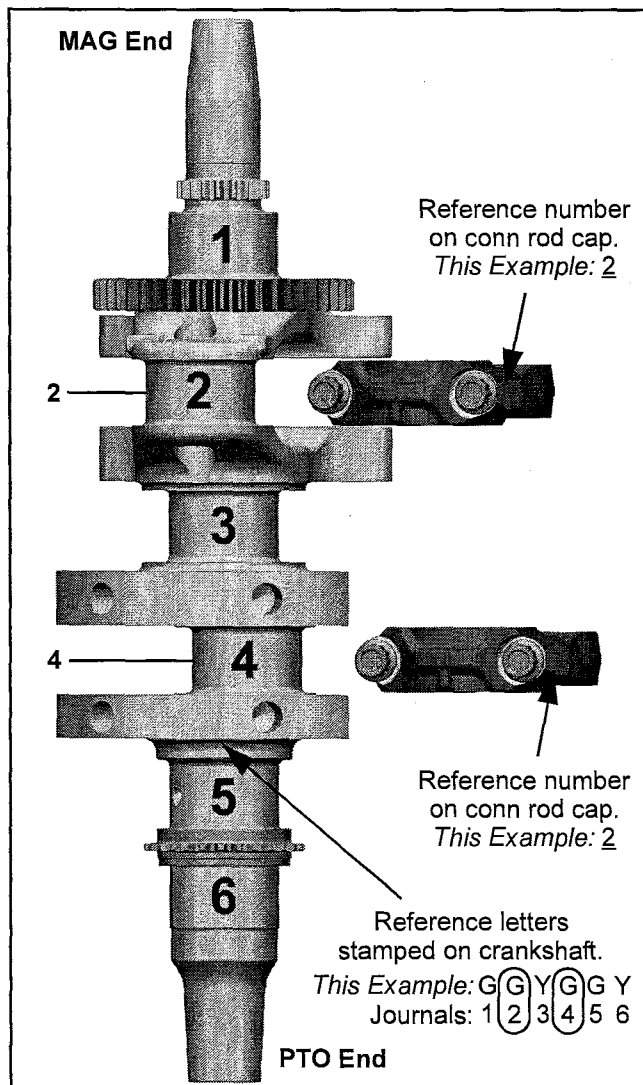


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ENGINE / COOLING

Connecting Rod Bearing Selection

In order to select the proper bearing for the connecting rods, you must reference the number on each connecting rod and match that up with the rod journal letters on the crankshaft.



In this example, you would use the number **2** as the connecting rod code. You would use letters **G** and **G** as the crankshaft codes (crank journals 2 and 4).

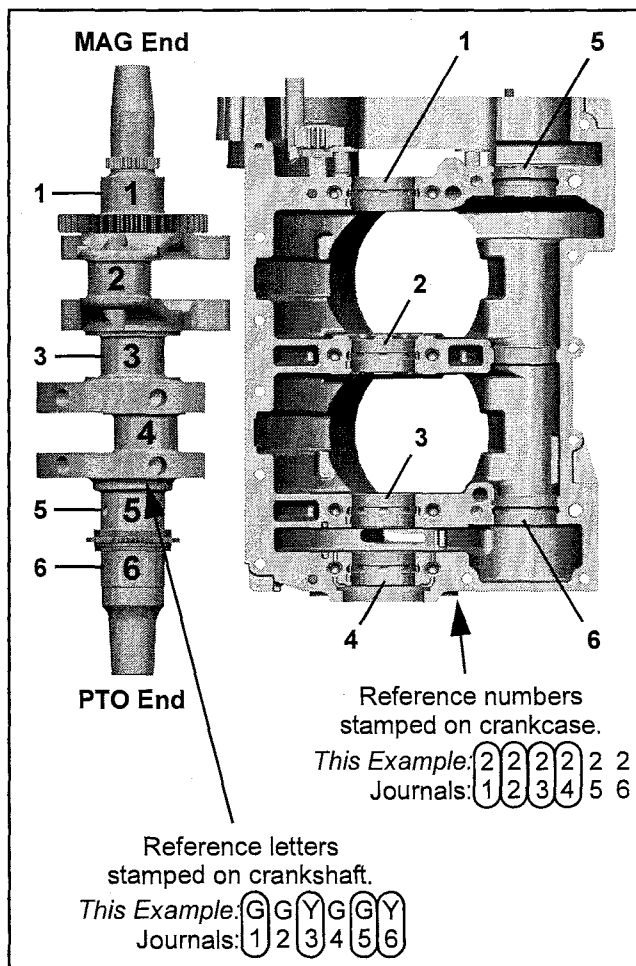
Based off the bearing selection chart, you would use:

Green bearing for each connecting rod

Bearing Selection Chart - Rod Bearings				
Rod	Crankshaft			
	Code	B	G	Y
	1	White	Blue	Green
	2	Blue	Green	Yellow
	3	Green	Yellow	Yellow

Crankshaft Main Bearing Selection

In order to select the proper main bearings for the crankshaft, you must reference the six numbers on the crankcase and match that up with the main journal letters on the crankshaft.



In this example, you would use the number **2** as the crankcase codes (case journals 1, 2, 3, 4). You would use letters **G, Y, G, Y** as the crankshaft codes (crank journals 1, 3, 5 and 6).

Based off the bearing selection chart, you would use:

Green bearing for Main #1

Yellow bearing for Main #2

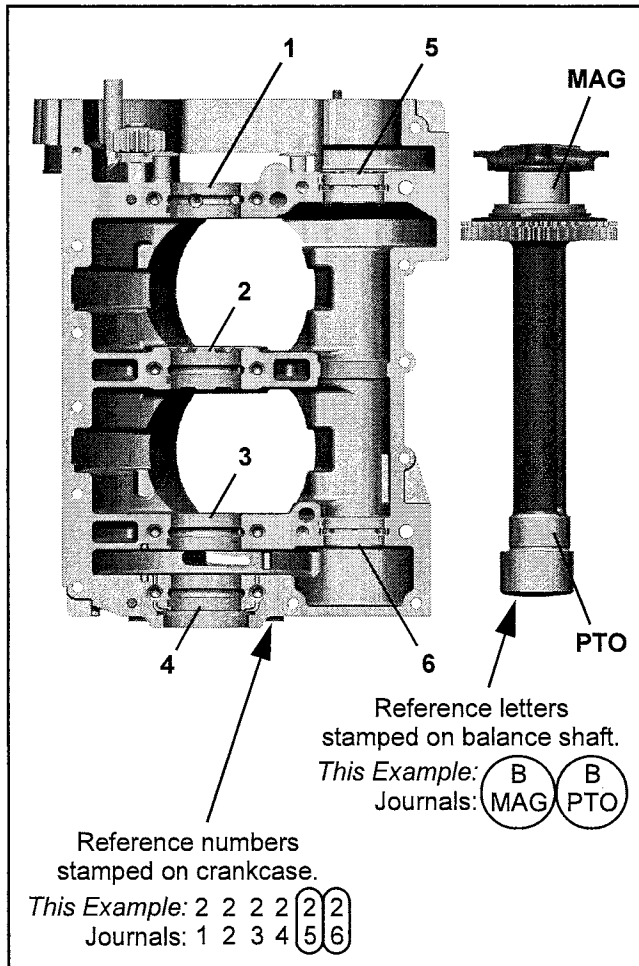
Green bearing for Main #3

Yellow bearing for Main #4

Bearing Selection Chart - Main Bearings				
Case	Crankshaft			
	Code	B	G	Y
	1	White	Blue	Green
	2	Blue	Green	Yellow
	3	Green	Yellow	Red

Balance Shaft Bearing Selection

In order to select the proper balance shaft bearings, you must reference the six numbers on the crankcase and match that up with the MAG and PTO journals on the balance shaft.



In this example, you would use the number 2 as the crankcase codes (case journals 5, 6). You would use letters B, B, as the balance shaft codes (balance shaft journals MAG, PTO).

Based off the bearing selection chart, you would use:

Green bearing for MAG

Green bearing for PTO

Bearing Selection Chart - Balance Shaft Bearings				
Case	Balance Shaft			
	Code	A	B	N/A
	1	White	Blue	N/A
	2	Blue	Green	N/A

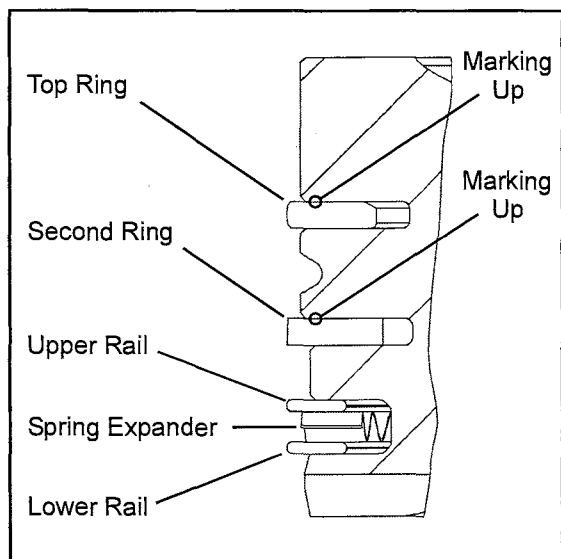
Upper Crankcase Preparation

IMPORTANT: Always replace plain bearings when the crankcase or connecting rods have been disassembled. Refer to bearing selection procedures.

1. Remove all traces of crankcase sealer from the crankcase mating surfaces. Inspect the surfaces closely for nicks, burrs or damage.
2. Clean bolt hole threads to remove any oil or crankcase sealant.
3. Inspect crankcase bearing bores. Replace the crankcase assembly if a bearing bore is galled or if bearing inserts have rotated in the case.
4. Be sure alignment pins are in place where used.
5. Refer to "Oil Flow Chart" at the beginning of this chapter and trace the oil paths through the crankcase and cylinder.
6. Flush all oil passages with solvent and then warm soapy water. Rinse with clear, warm water and dry with compressed air.
7. Be sure passages are clean and dry before assembling the upper crankcase.

Piston Ring Installation

NOTE: Apply clean engine oil to all ring surfaces and ring lands upon installation. Always check piston ring installed gap before rings are installed on piston (see "Piston Ring Installed Gap"). Clean accumulated carbon from piston ring grooves and oil ring lube holes if piston has been in service.

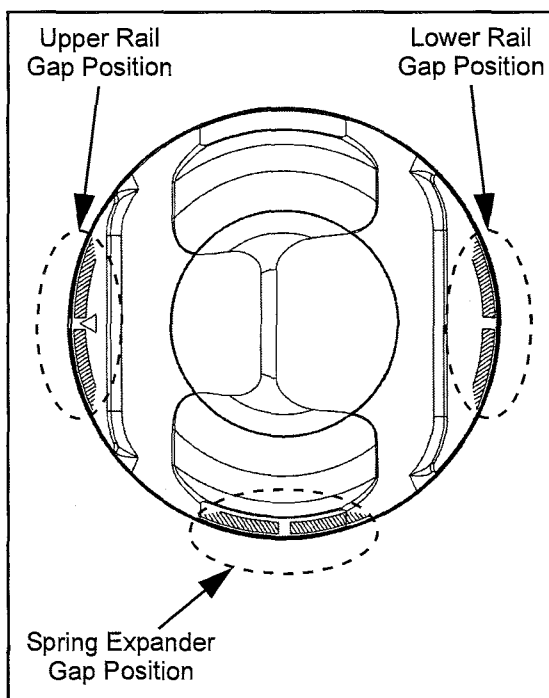


1. Place oil control ring expander in oil ring groove. Rotate expander in groove until butt ends are on PTO side of piston (see illustration below).

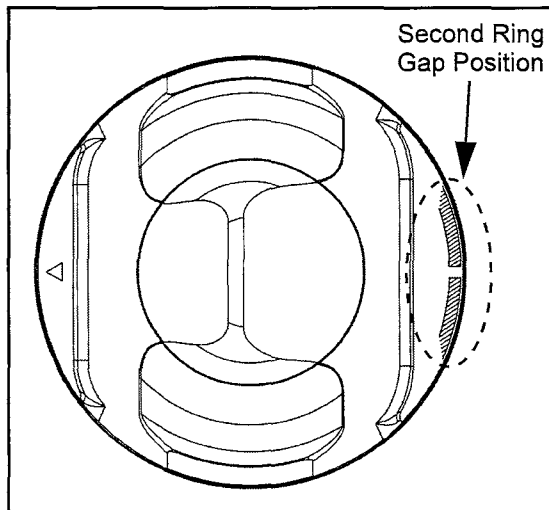
IMPORTANT: Ends must butt squarely together and must not overlap.

2. Install lower rail with end gap positioned on the intake side of piston.

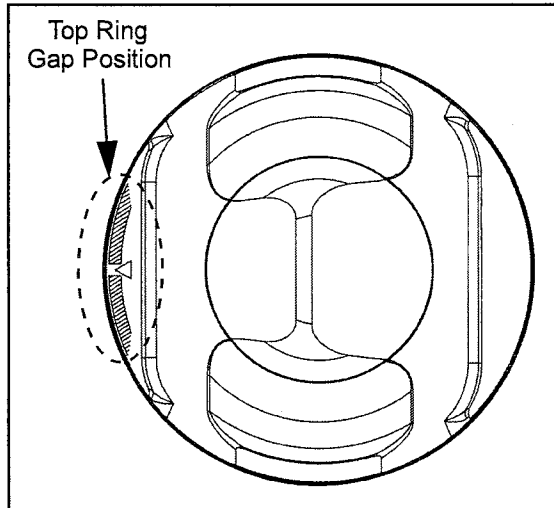
3. Install upper rail with end gap positioned on the exhaust side of piston.



4. Install second ring with marking facing top of piston. Rotate ring to position the end gap toward intake side of piston as shown below.



5. Install top ring with mark facing top of piston. Rotate ring to position the end gap toward exhaust side of piston as shown below.



6. Be sure top and second rings rotate freely in their grooves and do not bind when compressed by hand.

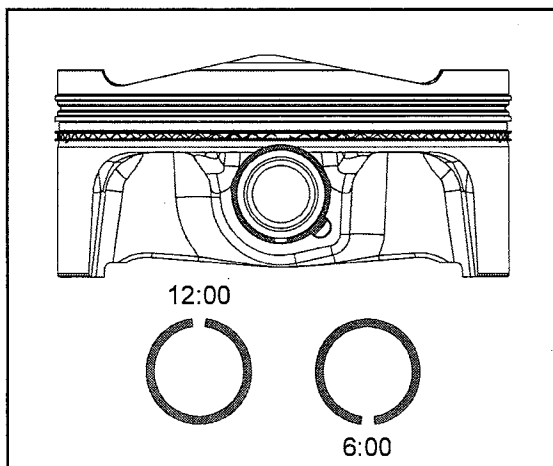
Piston / Connecting Rod Assembly

1. Lubricate connecting rod small end, piston pin bore and piston pin with engine oil.

CAUTION

Do not re-use circlips. Circlips become deformed during the removal process.
Do not compress the new clip more than necessary to prevent loss of radial tension. Severe engine damage may result if circlips are re-used or deformed during installation.

2. Install a new circlip (C) on one side of piston with gap at the top (12:00 position) or bottom (6:00 position).



IMPORTANT: Never re-use a piston pin circlip.

NOTE: If reinstalling the original connecting rods, orientate the rods the same as when removed. If new connecting rods are being installed, they can be installed either way (there is no piston pin offset in the rod), however it is recommended they be installed with rods facing the same direction.

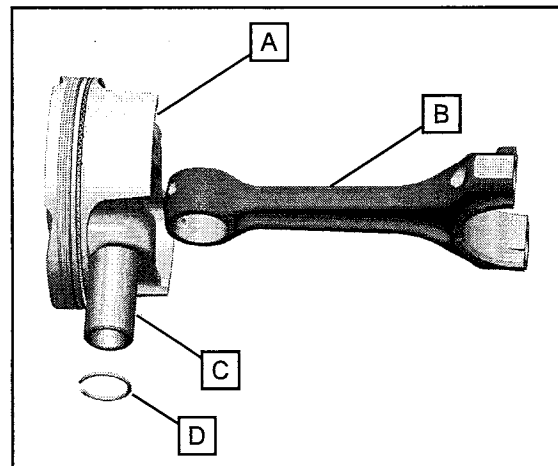
3. Place piston (A) on connecting rod (B). Push piston pin (C) through rod and piston until it seats against the installed circlip.

3

IMPORTANT: Do not tap on pin or cause any sideways force to connecting rod. Warm piston crown with a heat gun if pin cannot be installed by hand, or use a piston pin installation tool.

CAUTION

DO NOT apply heat to piston rings or a loss of radial tension could result.



4. Install the remaining circlip (D) with gap at the top (12:00 position) or bottom (6:00 position). Push the piston pin in both directions to make sure the clips are properly seated in the groove.

ENGINE / COOLING

Cylinder / Piston Installation

CAUTION

Pistons must be installed into the cylinders with the connecting rods attached.

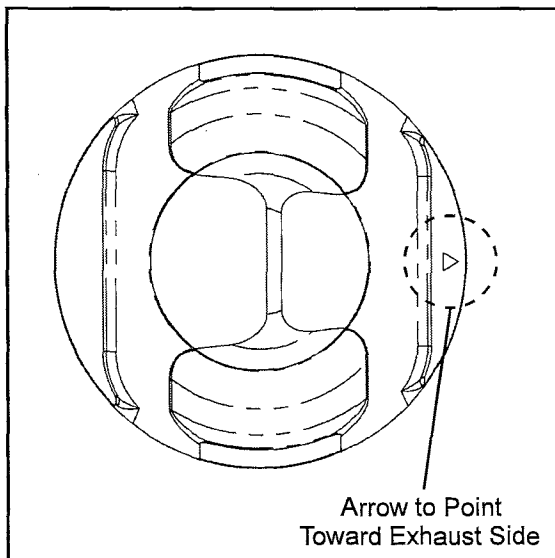
DO NOT attempt to service the cylinder or pistons without disassembling the crankcase.

Although you can remove the cylinder and pistons without disassembly, you will not be able to reassemble the engine because of the unique cylinder skirt and crankcase design.

NOTE: If the pistons are being reused, reassemble in the same cylinder bore and direction from which they were removed (MAG / PTO).

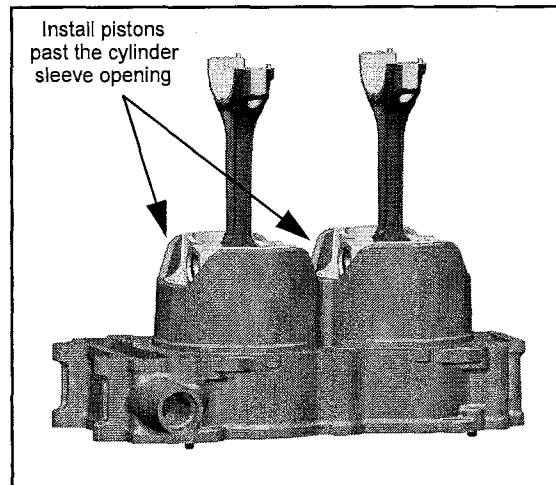
NOTE: New pistons are directional (intake vs. exhaust), but can be placed in either cylinder.

1. Apply clean engine oil to each piston assembly, cylinder bore and bottom tapered portion of each cylinder sleeve.
2. Verify that all ring end gaps are correctly located on each piston (see "Piston Ring Installation").
3. Note the piston orientation mark (arrow) located on top of the piston. Arrow should point toward the exhaust side.



NOTE: Orientation arrow is also located on the bottom side of piston as an additional reference.

4. Carefully compress the piston rings with your fingers and install the piston / connecting rod assemblies into the cylinder from the bottom side.

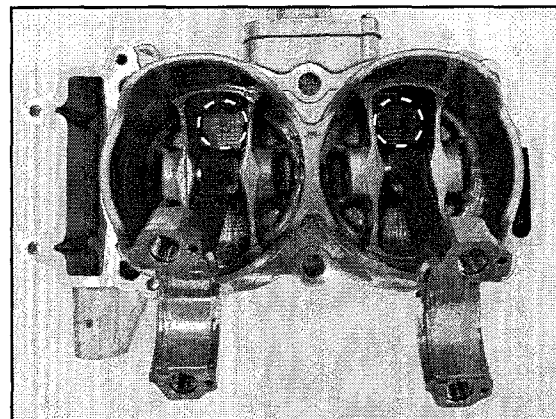


NOTE: Use a slight front to back rocking motion until all rings are captive in cylinder and past the cylinder sleeve opening.

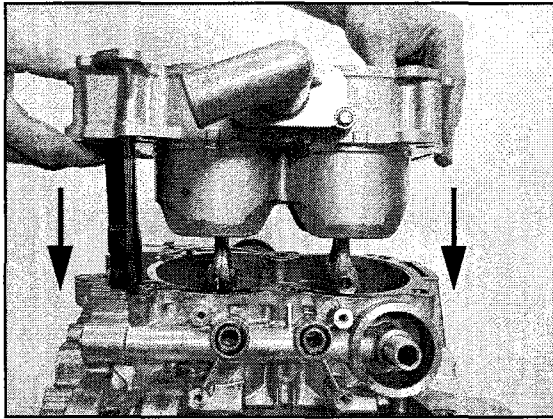
5. Rotate the engine so the crankcase to cylinder mounting surface is facing up.
6. Clean base gasket sealing surface on cylinder and crankcase to remove all oil and grease.

NOTE: Base gasket and surfaces must be DRY and oil free. Use care upon assembly to keep oil away.

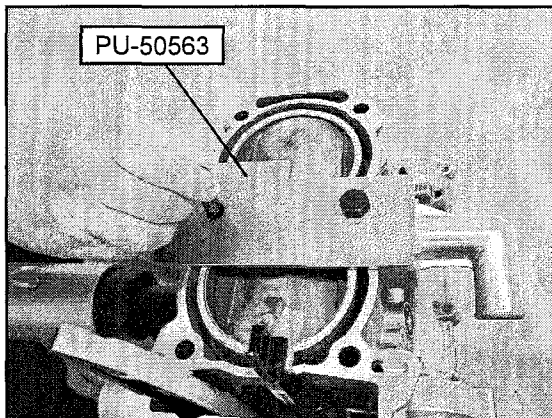
7. Reinstall dowel pins in crankcase if previously removed.
8. Install a new cylinder base gasket.
9. Verify piston orientation (arrow pointing toward exhaust) one last time prior to installation.



10. Carefully place the cylinder and pistons into the upper crankcase.



11. Install the Cylinder Holding & Camshaft Timing Plate (PU-50563) onto the cylinder. The cylinder holding tool retains the cylinder and pistons when the engine is rotated.

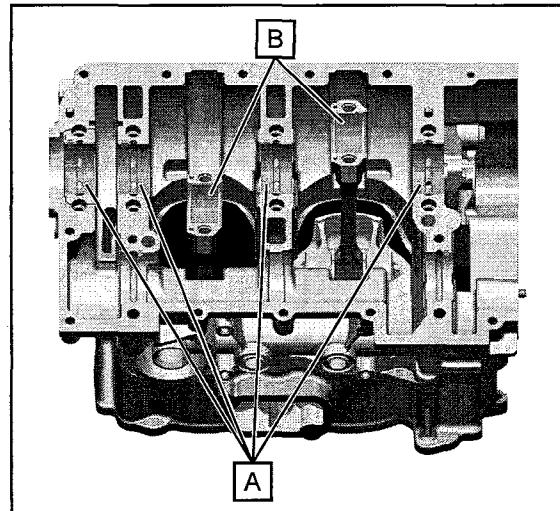


Crankshaft Installation

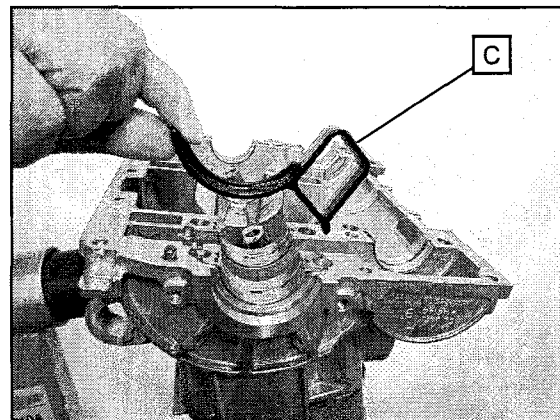
IMPORTANT: Whether installing a new crankshaft or re-installing the original, refer to the bearing selection charts (see "Crankshaft Main Bearing Selection" and "Connecting Rod Bearing Selection" procedures in this chapter).

1. Rotate the engine so the cylinder is facing down.
2. Clean the bearing bore surfaces of upper crankcase (main bearings), connecting rods, and connecting rod caps.
3. Align tab of new main bearing (A) with the slot in main bearing bore of crankcase. Press bearing insert firmly into place. Repeat for all main bearings.
4. Align tab of new connecting rod bearings (B) with the slot in the connecting rod stem and connecting rod end cap. Press bearing insert firmly into place. Repeat for the other connecting rod.

3

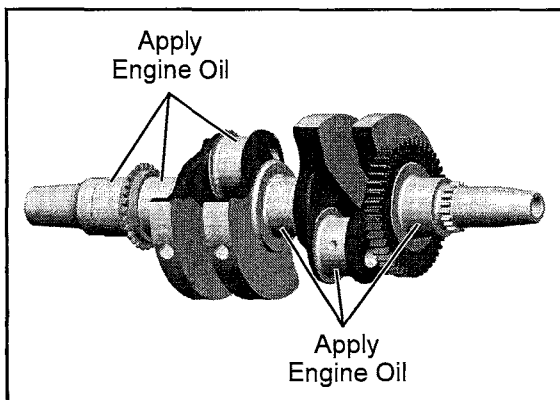


5. Install the oil drain diverter (C) into the upper crankcase.

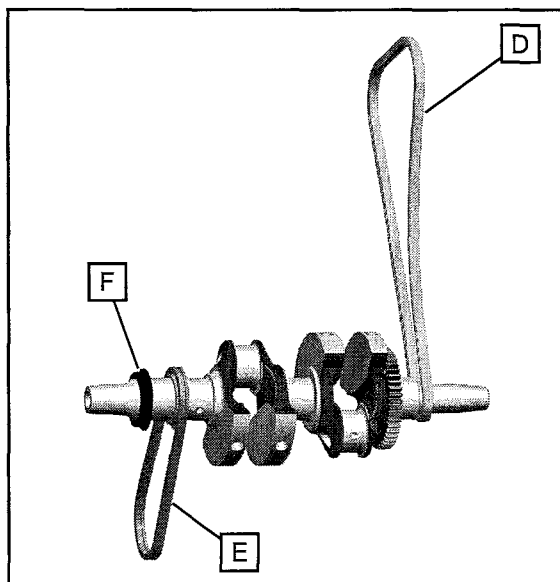


ENGINE / COOLING

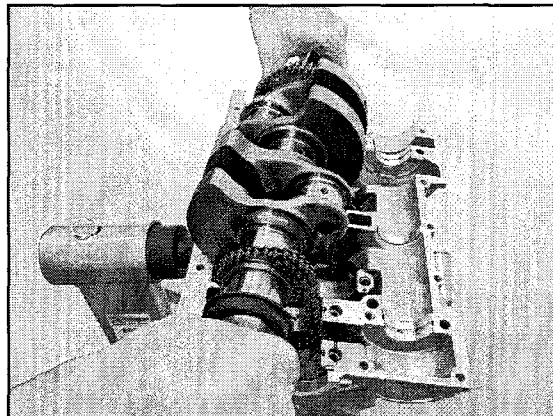
6. Apply Polaris PS-4 Plus engine oil to each main and rod bearing journal of crankshaft.



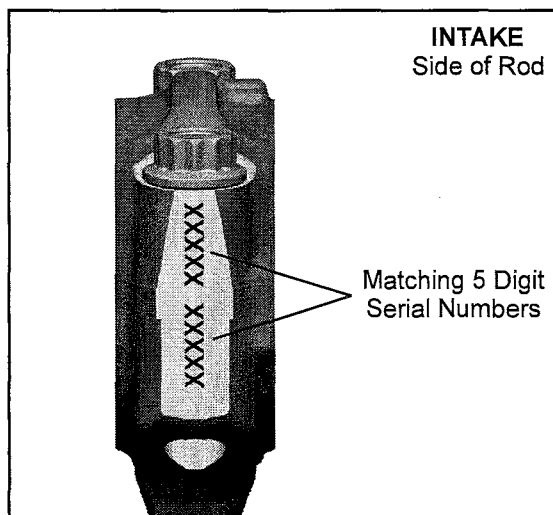
7. Loop cam chain (D) and oil pump drive chain (E) over crankshaft sprockets.
8. Apply Polaris PS-4 Plus engine oil to the new crankshaft oil seal (F) and install the seal on the PTO end of the crankshaft.



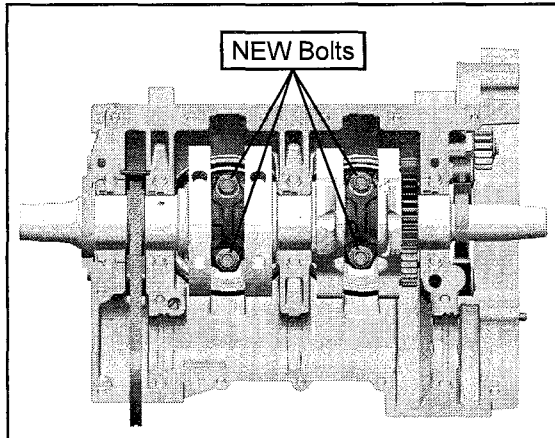
9. Carefully lower the crankshaft into upper crankcase. Guide connecting rods onto the rod journals of crankshaft as necessary.



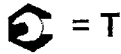
10. Adjust the PTO crankshaft seal so it rests properly in the upper crankcase.
11. Clean bolt hole threads in connecting rod to remove all oil.
12. Install matching rod cap on connecting rod with 5 digit serial number stampings aligned.



13. Install **new bolts** and tighten evenly until snug.



14. Torque connecting rod bolts to specification.



Connecting Rod Bolts:

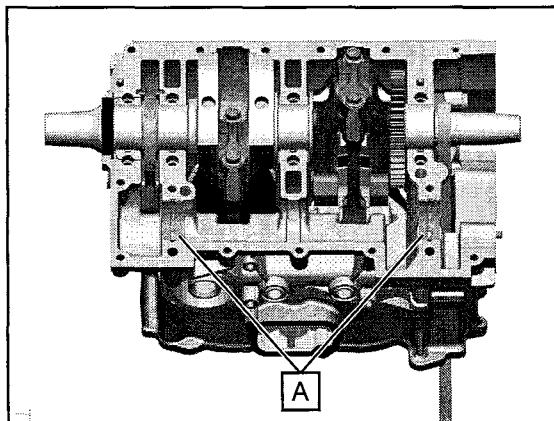
Step 1: Torque to 13 ft. lbs. (18 Nm)

Step 2: Tighten an additional 105° ± 3°

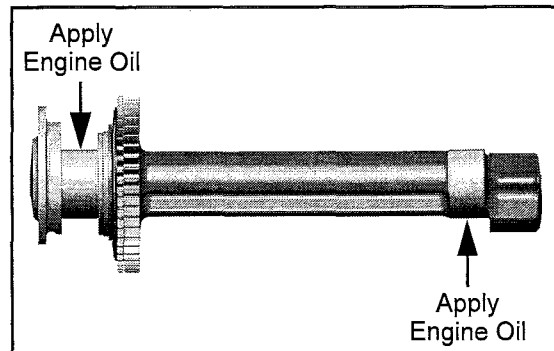
Balance Shaft Installation

IMPORTANT: Whether installing a new balance shaft or re-installing the original, refer to bearing selection chart (see "Balance Shaft Bearing Selection" procedure in this chapter).

1. Clean the upper crankcase balance shaft bearing bore surfaces.
2. Align tab of new balance shaft bearings (A) with the slot in each bearing bore of crankcase. Press bearing insert firmly into place.

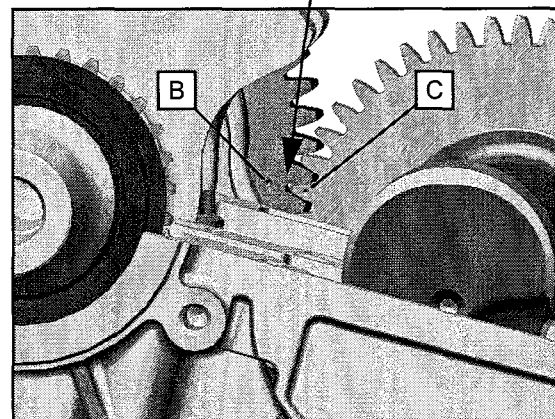
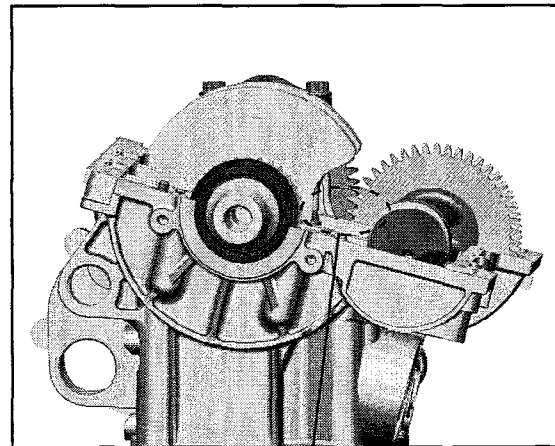


3. Rotate the crankshaft until the alignment dot (B) on the crankshaft MAG end gear is visible.
4. Apply Polaris PS-4 Plus engine oil to both balance shaft journals.



3

5. Install the balance shaft, placing the tooth with the alignment dot (C) in-line with the dot (B) on the crankshaft gear (see reference images below).



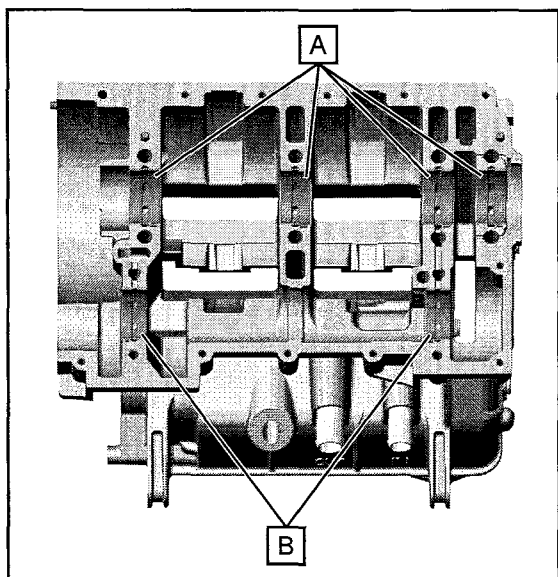
Lower Crankcase Preparation

IMPORTANT: Always replace plain bearings when the crankcase or connecting rods have been disassembled. Refer to bearing selection procedures.

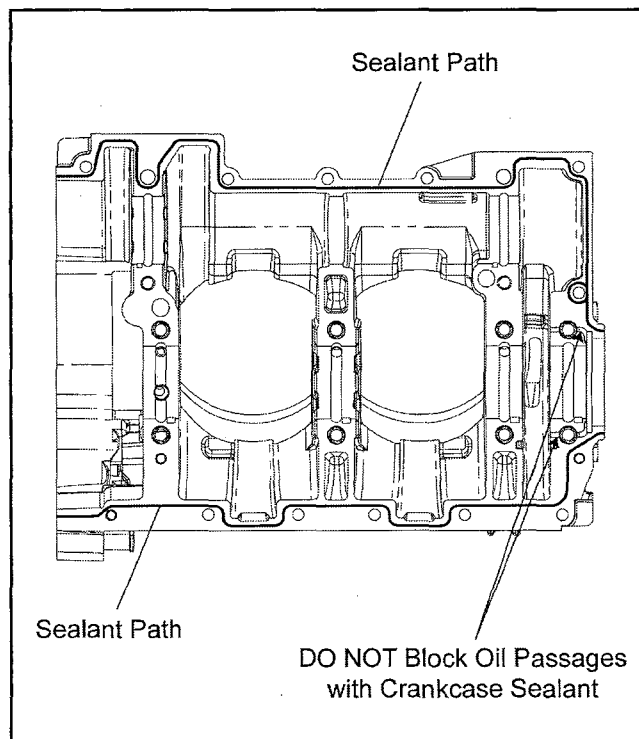
1. Remove all traces of crankcase sealant from the crankcase mating surfaces. Inspect the surfaces closely for nicks, burrs or damage.
2. Clean bolt hole threads to remove any oil or crankcase sealant.
3. Inspect crankcase bearing bores. Replace the crankcase assembly if a bearing bore is galled or if bearing inserts have rotated in the case.
4. Be sure alignment pins are in place where used.
5. Refer to "Oil Flow Chart" at the beginning of this chapter and trace the oil paths through the crankcase and cylinder.
6. Flush all oil passages with solvent and then warm soapy water. Rinse with clear, warm water and dry with compressed air.
7. Be sure passages are clean and dry before assembling the crankcase.

Crankcase Assembly

1. Check to be sure the PTO crankshaft seal is resting properly in the upper crankcase.
2. Align tab of new main bearings (A) and new balance shaft bearings (B) with the slot in each bearing bore of the lower crankcase. Press bearing inserts firmly into place.

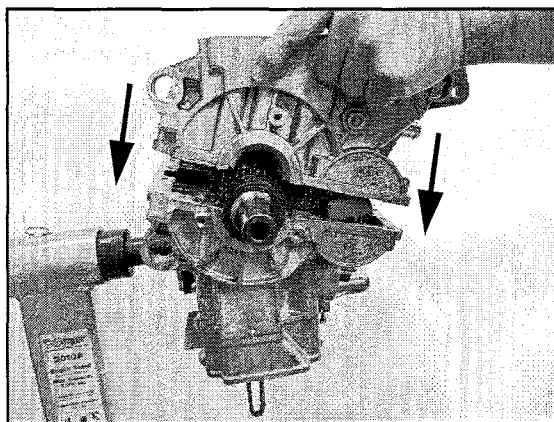


3. Apply Polaris PS-4 Plus engine oil to the new bearings installed in the lower crankcase half.
4. Clean crankcase mating surfaces to remove any oil.
5. Apply a thin, continuous film of Crankcase Sealant (PN 2871557) to the upper crankcase mating surface as shown. Do not allow sealant to dry before assembly.



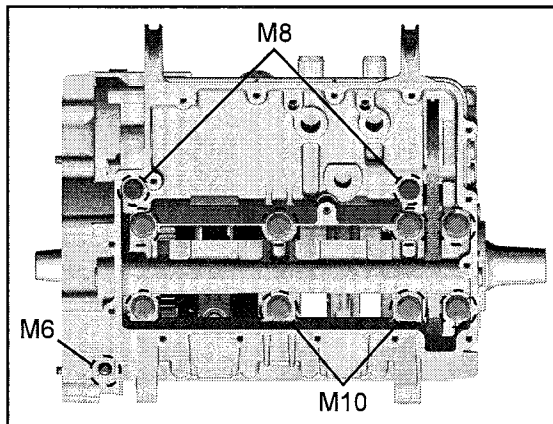
IMPORTANT: DO NOT block oil passages with crankcase sealant.

6. Carefully place lower crankcase on upper case, making sure the oil pump drive chain is fed through the lower crankcase.



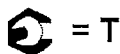
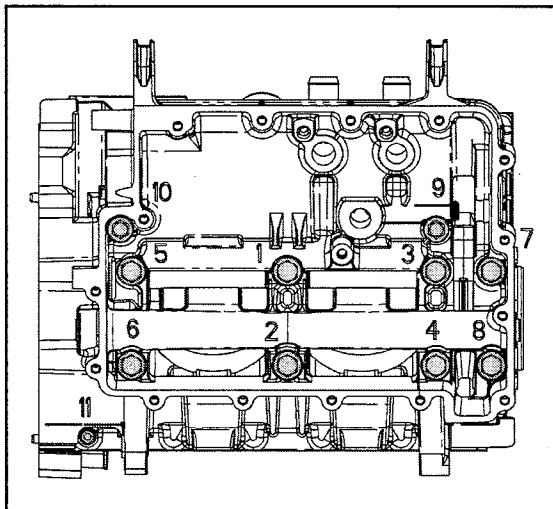
7. Tap lower crankcase with a rubber hammer to seat the case halves together.

8. Inspect crankcase mating surfaces to be sure they are joined properly. Investigate the cause of any gaps.
9. Install the (8) M10, (2) M8 and (1) M6 lower crankcase bolts. Tighten all bolts lightly by hand.



IMPORTANT: Install new M10 lower crankcase bolts.

10. Torque the lower crankcase bolts in sequence to specification. Repeat the sequence to verify final torque.



Lower Crankcase Bolts:

M10 Bolts:

- Step 1: 21 ± 2 ft. lbs. (28 ± 3 Nm)
 Step 2: Tighten an additional 90° (1/4 turn)

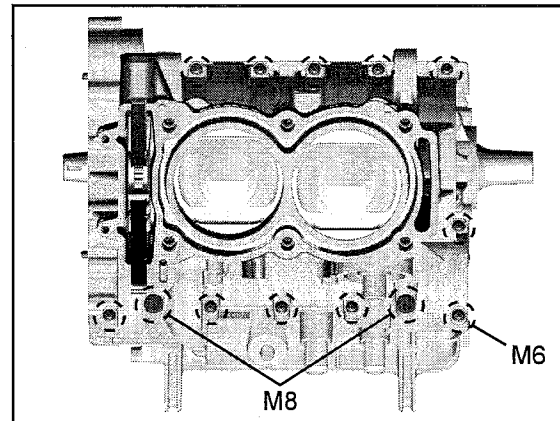
M8 Bolts:

26 ± 1 ft. lbs. (35 ± 2 Nm)

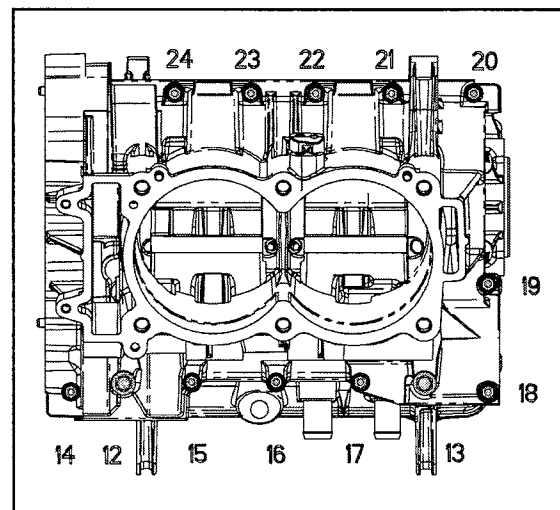
M6 Bolts:

106 ± 18 in. lbs. (12 ± 2 Nm)

11. Rotate the engine so the cylinder is facing up.
12. Install the (11) M6 and (2) M8 upper crankcase bolts. Tighten all bolts lightly by hand.



13. Torque the upper crankcase bolts in sequence to specification (start with #12). Repeat the sequence to verify final torque.



Upper Crankcase Bolts:

M8 Bolts:

26 ± 1 ft. lbs. (35 ± 2 Nm)

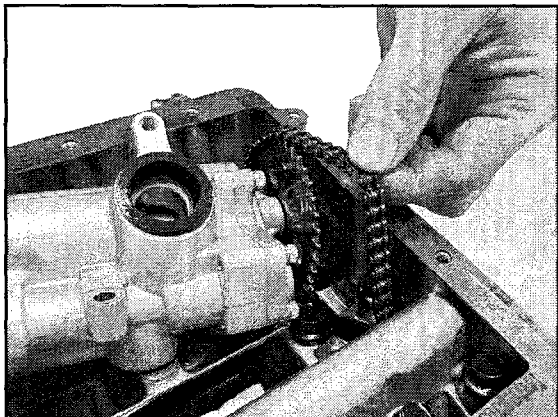
M6 Bolts:

89 ± 9 in. lbs. (10 ± 1 Nm)

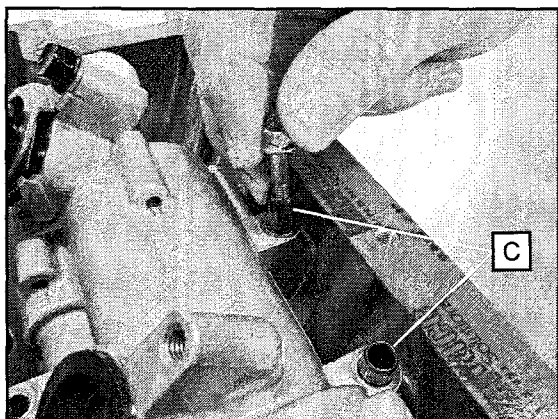
14. Rotate the engine so the cylinder is facing down.
15. Install a new seal on the oil pump.

ENGINE / COOLING

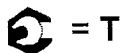
16. Lift the oil pump drive chain and install the oil pump.



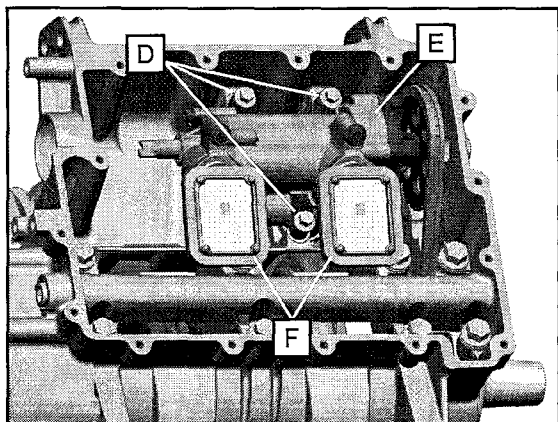
17. Install the dowel pins (C) into the oil pump mounting holes.



18. Install the (3) bolts (D) that retain the oil pump (E) to the crankcase. Torque mounting bolts to specification.



Oil Pump Mounting Bolts:
89 ± 9 in. lbs. (10 ± 1 Nm)



19. Reinstall oil pump pick-ups (F) if previously removed. Torque mounting screws to specification.



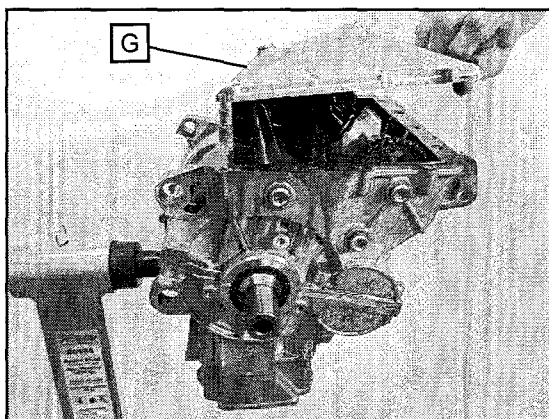
Oil Pump Pick-Up Retaining Screws:
89 ± 9 in. lbs. (10 ± 1 Nm)

20. Clean the gasket sealing surfaces on oil sump cover and crankcase to remove old gasket material and any oil.

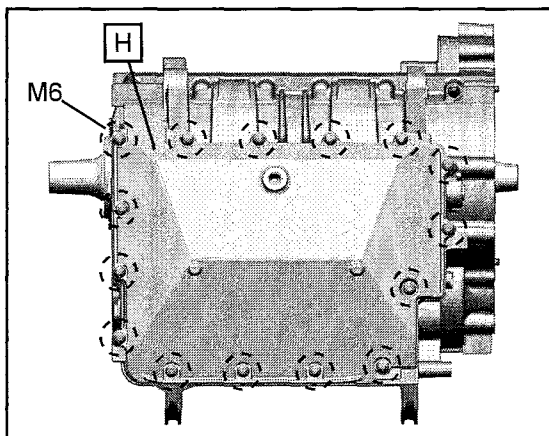
NOTE: Gasket surfaces must be DRY and oil free. Use care upon assembly to keep oil away.

21. Install a new oil sump cover gasket.

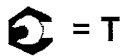
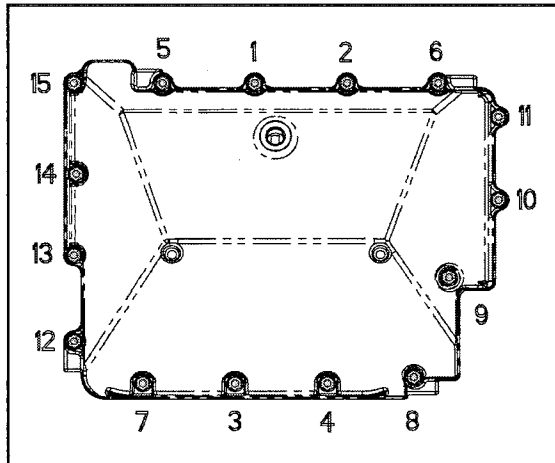
22. Install the oil sump cover (G) onto the crankcase.



23. Install the (15) M6 bolts that retain the oil sump cover (H) to the crankcase.

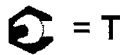


24. Torque the oil sump cover bolts in sequence to specification. Repeat the sequence to verify final torque.



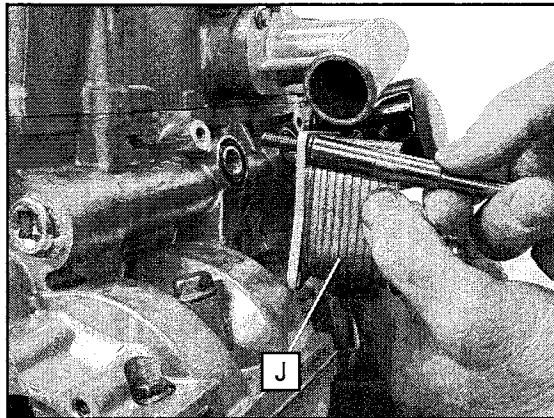
Oil Sump Cover Bolts:
 106 ± 18 in. lbs. (12 ± 2 Nm)

25. Reinstall the crankcase drain plug if previously removed. Torque drain plug to specification.



Crankcase Drain Plug:
 12 ± 1 ft. lbs. (16 ± 2 Nm)

26. Reinstall the oil cooler (J), if previously removed. Use *new O-rings* upon installation.

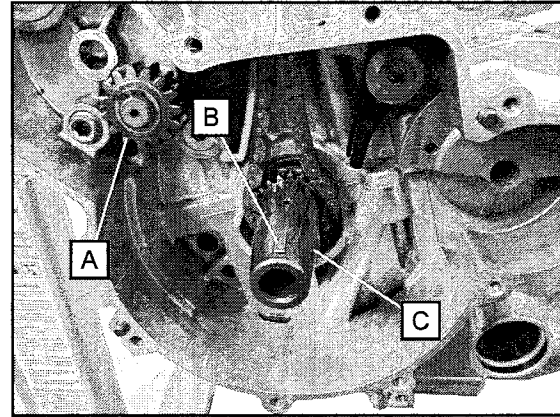


27. Proceed to "Flywheel Installation" and then "Cylinder Head Installation".

NOTE: Install the stator cover after the engine has been timed. You will need to reference the flywheel TDC mark during camshaft installation.

Flywheel Installation

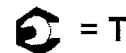
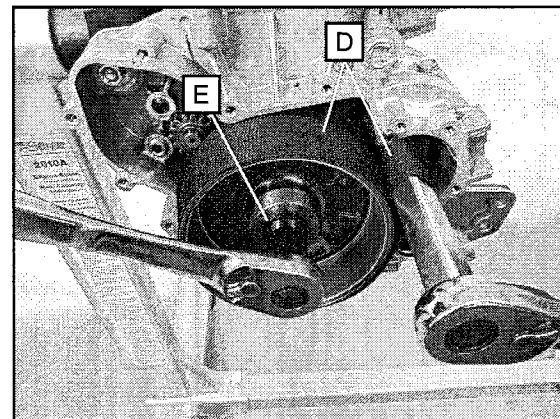
1. If intermediate gear (A) was removed, reinstall with a new retaining ring prior to flywheel installation.
2. If previously removed, reinstall the flywheel key (B).
3. Clean taper of crankshaft (C) to remove all oil or grease.



3

4. Clean flywheel taper to remove all oil or grease.
5. Align flywheel key-way with key and install the flywheel, seating it fully on taper.
6. Install the flywheel retaining bolt. Using a commercially available strap wrench (D), hold the flywheel and torque the flywheel retaining bolt (E) to specification.

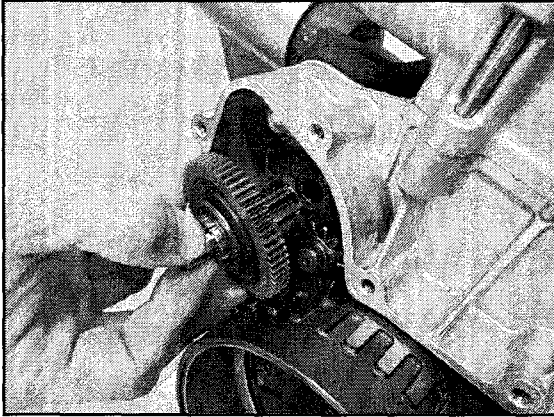
IMPORTANT: If the Cylinder Holding & Camshaft Timing Plate (PU-50563) is installed, remove it before tightening the flywheel.



Flywheel Retaining Bolt:
 88.5 ± 9 ft. lbs. (120 ± 12 Nm)

ENGINE / COOLING

7. Install the starter torque limit gear as an assembly.



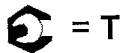
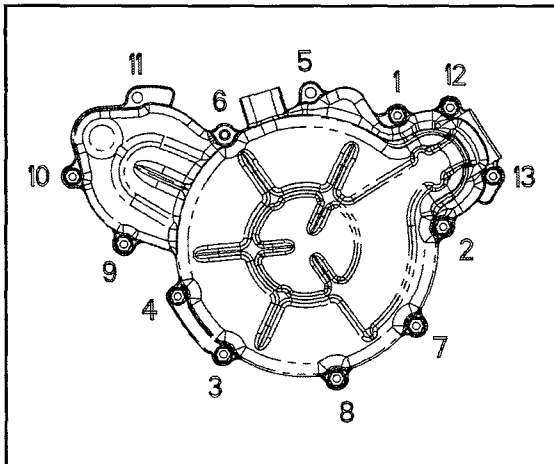
Stator Cover Installation

1. Apply gasket tack adhesive to help hold gasket in place during assembly.
2. Install a new stator cover gasket over alignment pins.

CAUTION

The flywheel contains powerful magnets. Use caution when removing and installing the stator cover. DO NOT place fingers between cover and crankcase at any time during the removal / installation process or injury could result.

3. Install stator cover and (13) screws. Torque screws in sequence to specification.



Stator Cover Screws:
106 ± 18 in. lbs. (12 ± 2 Nm)

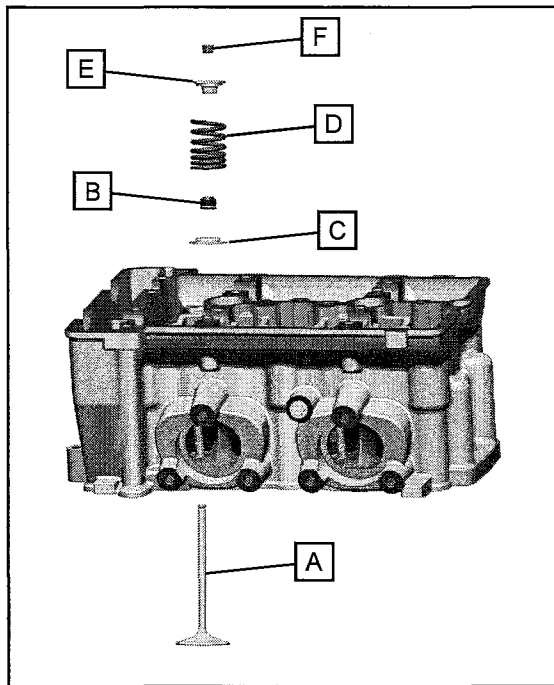
ENGINE ASSEMBLY - TOP END**Cylinder Head Assembly**

NOTE: Assemble the valves one at a time to maintain proper order.

! WARNING

Wear eye protection during cylinder head disassembly and reassembly or when working with the valve springs.

1. Apply engine oil to valve guides and seats.
2. Coat valve stem with Premium Starter Grease (2871460).
3. Install the valve (A) in the cylinder head, through the guide.

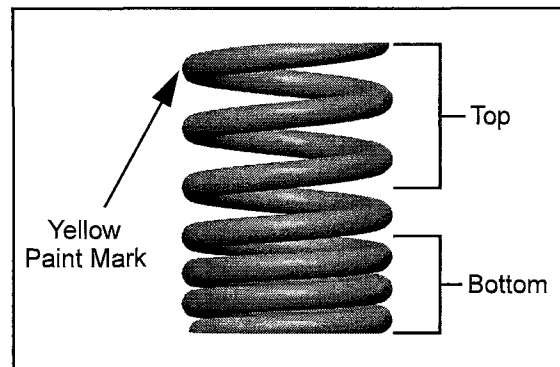


4. Carefully install a new valve seal (B) on the valve guide with a rotating motion. Push firmly until seated in retaining groove and square with the guide

IMPORTANT: Valve seals should be installed **AFTER** the valves are in the head to avoid valve seal damage.

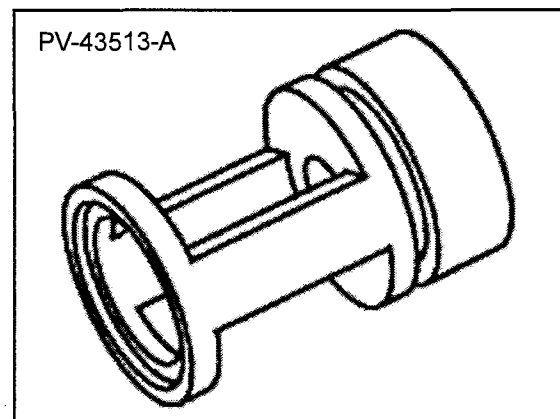
5. Dip the seat (C), valve spring (D) and retainer (E) in clean engine oil.
6. Install the valve spring seat (C).

7. Install the valve spring (D) with tightly spaced coils facing down toward the cylinder head.



NOTE: Valve springs to be installed with yellow paint mark facing up.

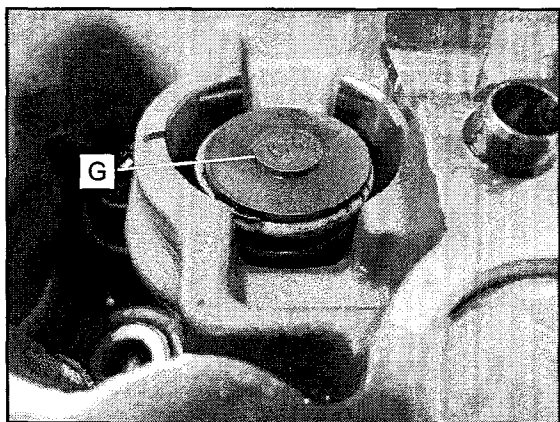
8. Place the valve retainer (E) on the spring.
9. Compress the valve spring by hand using valve spring compressor adapter (PV-43513-A). Compress spring only enough to allow split keeper installation.



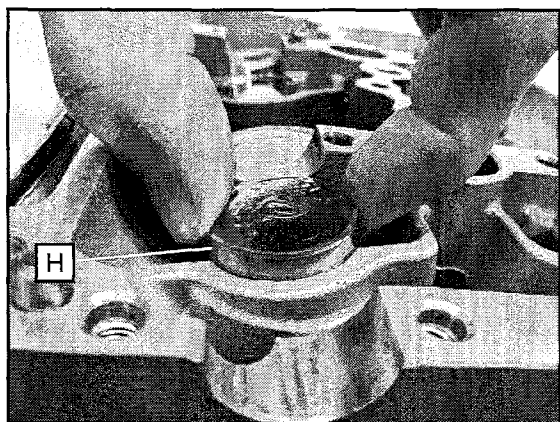
NOTE: To prevent damage to the valve seals, do not compress the valve spring more than necessary to install the keepers.

10. Install split keepers (F) with gap even on both sides.
11. Repeat this procedure for remaining valves.

12. Install the valve adjustment shim (G) and valve bucket (H) for each valve in the order they were removed.



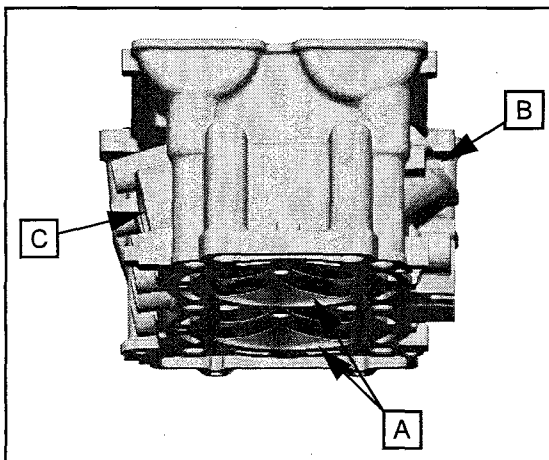
NOTE: Shim 240 is shown for reference only. Refer to "Valve Clearance Adjustment" procedure for proper shim selection.



IMPORTANT: If any valve train components were replaced, refer to "Valve Clearance Adjustment" procedure prior to "Camshaft Installation / Timing" procedure.

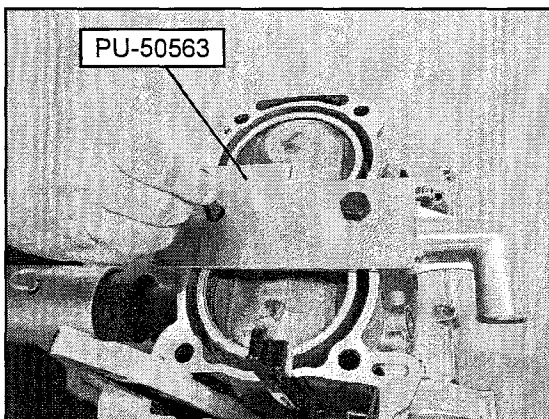
Valve Sealing Test

1. Clean and dry the combustion chamber area (A).
2. Pour a small amount of clean solvent into each intake port (B) and check for leakage around the valves. The valve seats should hold fluid with no seepage.
3. Repeat for exhaust valves by pouring fluid into each exhaust port (C).



Cylinder Head Installation

1. Rotate the engine so the cylinder is facing up.
2. Remove the Cylinder Holding & Camshaft Timing Plate (PU-50563) from the cylinder.

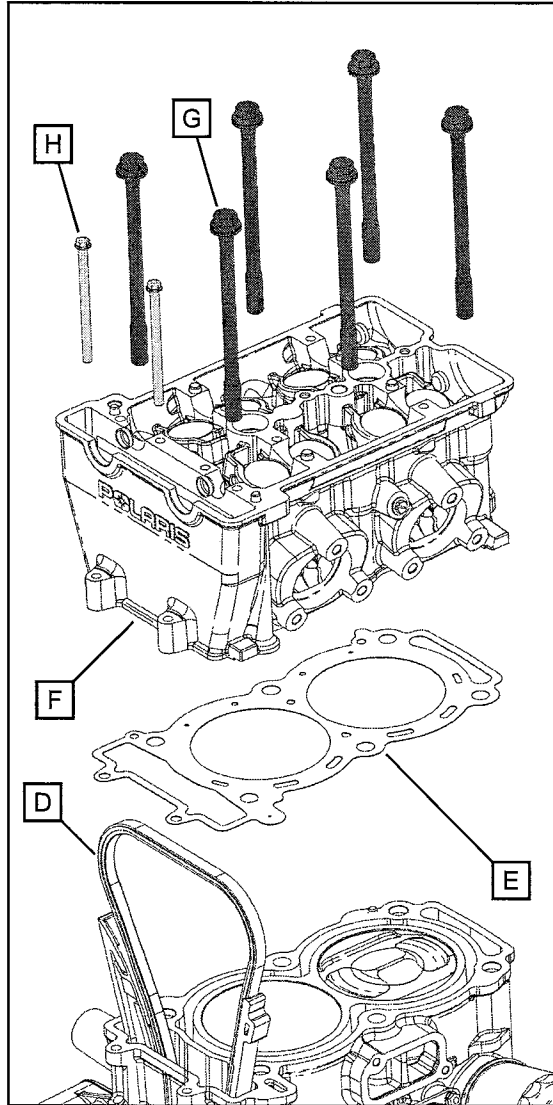


IMPORTANT: Once the cylinder head is removed, nothing retains the cylinder to the engine. **DO NOT** rotate the engine without using the Cylinder Holding & Camshaft Timing Plate (PU-50563).

3. Prepare cylinder head gasket sealing surfaces by cleaning thoroughly to remove all residue. The head gasket must be installed clean and dry, free from oil or grease.

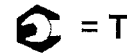
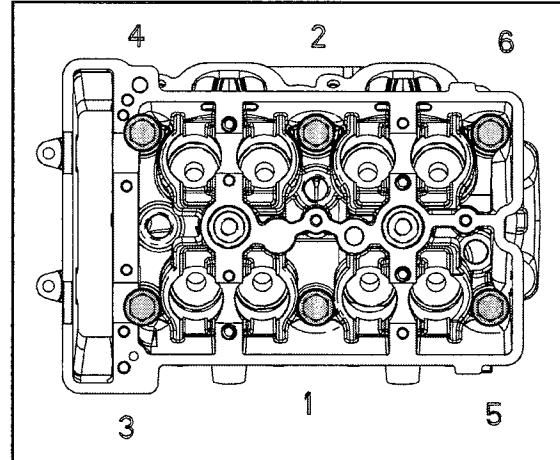
NOTE: Do not touch sealing surfaces of gasket.

4. Guide cam chain (D) through a new head gasket (E) and install the gasket on the cylinder, locating it on the alignment pins.
5. Carefully set the cylinder head (F) in place on alignment pins.
6. Install **new bolts** and finger tighten the (6) cylinder head bolts (G) evenly.
7. Install and finger tighten the (2) outer M6 bolts (H) evenly.



IMPORTANT: Install new cylinder head bolts.

8. Torque cylinder head bolts in sequence to specification.



Cylinder Head Torque Procedure:

Step 1: Torque in Sequence
21 ft. lbs. (28 Nm)

Step 2: Torque in Sequence
26 ft. lbs. (35 Nm)

Step 3: Torque in Sequence
Additional 180° (1/2 turn)

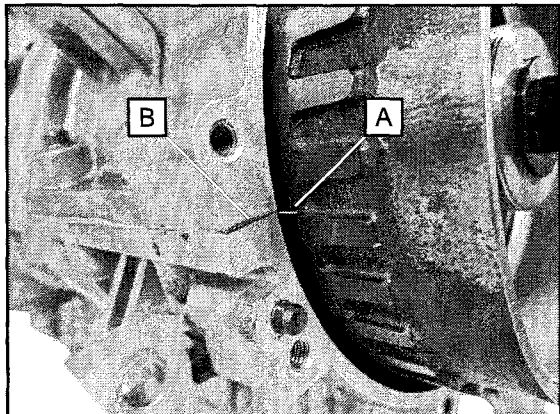
Step 4: Torque Outer M6 Head Bolts
89 ± 9 in. lbs. (10 ± 1 Nm)

ENGINE / COOLING

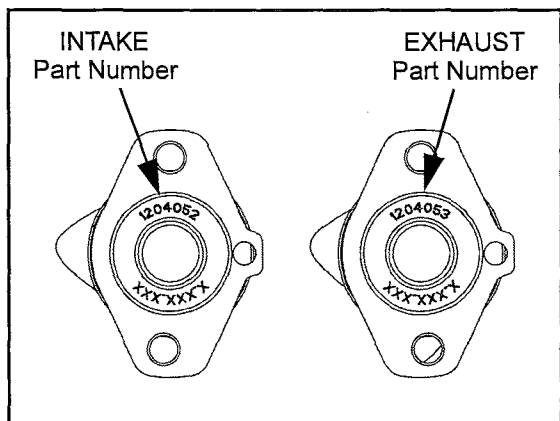
Camshaft Installation / Timing

IMPORTANT: If any valve train components were replaced, refer to "Valve Clearance Adjustment" procedure prior to "Camshaft Installation / Timing".

1. Rotate the engine until the flywheel Top Dead Center (TDC) mark (A) is aligned with crankcase parting line (B). This places the PTO cylinder at TDC for camshaft installation.



2. Reference the intake and exhaust markings made during disassembly. If installing new camshafts or if camshafts were not marked, you can reference the part number stamped on the end of the shafts.

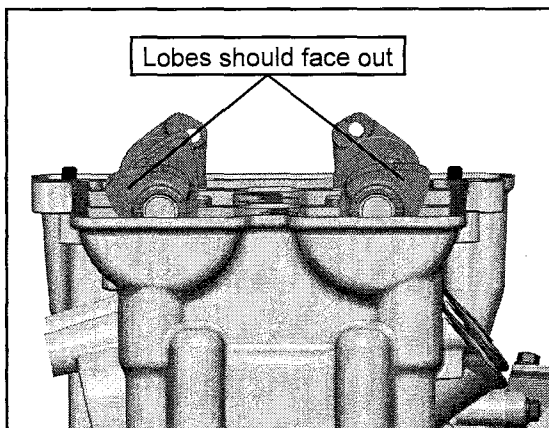


Intake Camshaft - PN 1204052

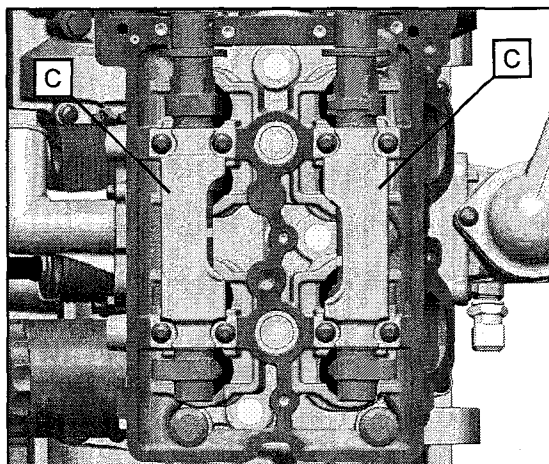
Exhaust Camshaft - PN 1204053

3. Lubricate all camshaft lobes and bearing journal surfaces with Polaris PS-4 Plus engine oil prior to installation.

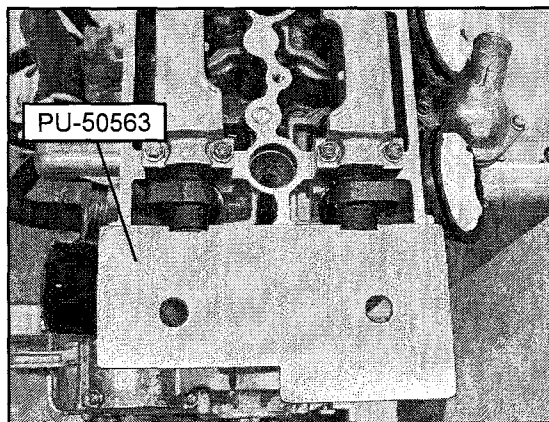
4. Carefully install the camshafts into the cylinder head. The PTO camshaft lobes should face out as shown.



5. Carefully install the rear camshaft carriers onto the camshafts. Carrier openings should face each other when installed properly.
6. Install the (4) bolts that retain each rear camshaft carrier (C) and tighten the bolts evenly until snug.

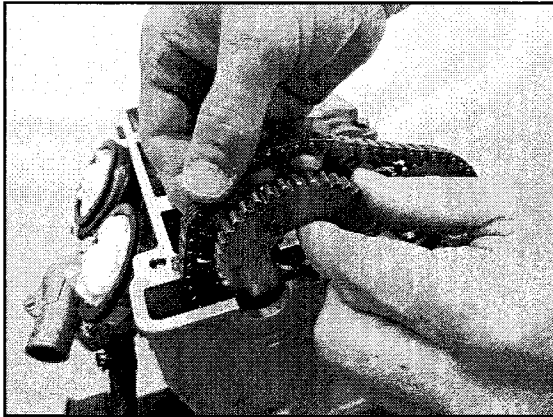


7. Install the Cylinder Holding & Camshaft Timing Plate (PU-50563) into the end of camshafts as shown. Use a 13/16" open-end wrench to rotate camshafts slightly if needed.



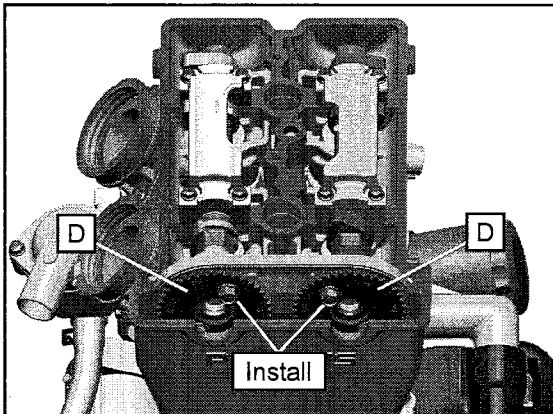
8. Verify TDC mark on flywheel is aligned with crankcase parting line.
9. Pull cam chain upward, making sure it is engaged with the drive sprocket on the crankshaft.
10. While lifting the cam chain up, engage the cam sprockets into the chain with the "I" and "E" marks facing out.
11. Install the sprockets onto the camshafts and align the sprocket marks with the valve cover gasket surface (see sprocket timing illustration).

IMPORTANT: Intake cam sprocket should have "I" marks aligned with gasket surface and the exhaust cam sprocket should have "E" marks aligned with gasket surface.



IMPORTANT: Install the exhaust cam sprocket first (opposite the cam chain tensioner) to ensure proper cam timing.

12. Use **new** camshaft sprocket retaining bolts upon assembly. Apply Loctite® 272™ to bolt threads. Install the top bolt in each camshaft sprocket (D). Do not torque the bolts at this time.

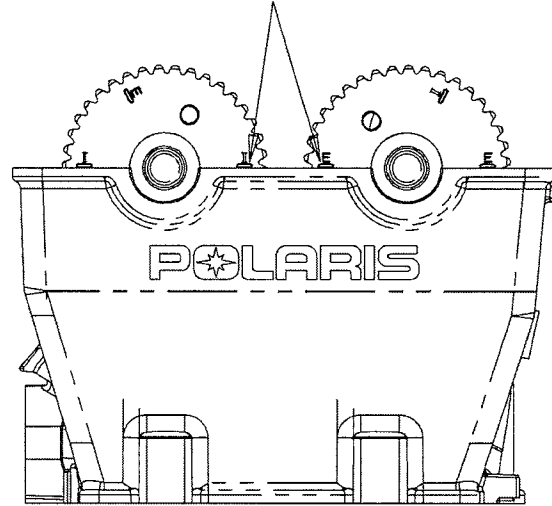


IMPORTANT: Use new sprocket retaining bolts upon assembly with Loctite® 272™ applied to bolt threads.

13. Verify cam timing is correct. Flywheel TDC mark should still be aligned with crankcase parting line and cam sprocket markings should line up as shown below.

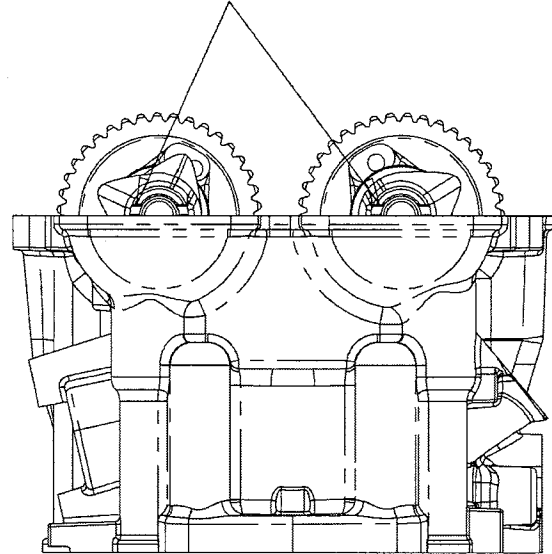
TIMING VIEW FOR SPROCKETS

FOR CORRECT SPROCKET ORIENTATION, INSURE THE "I" FOR INTAKE ON CAM 1204052 AND THE "E" FOR EXHAUST ON CAM 1204053 ARE POSITIONED AS SHOWN. VIEWED FROM MAG SIDE.



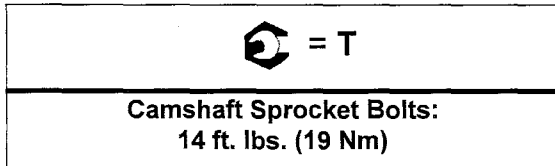
TIMING VIEW FOR CAMSHAFTS

1. ALIGN SLOT OF BOTH CAMS WITH THE TOP DECK OF THE HEAD.
2. POSITION 4MM THICK FLAT BAR THROUGH SLOTS TO LOCK CAMS IN CORRECT POSITION.

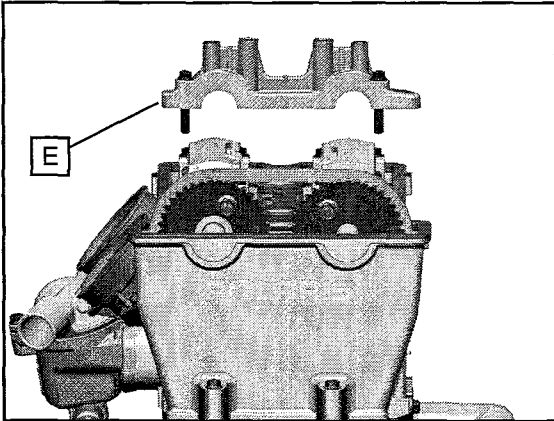


ENGINE / COOLING

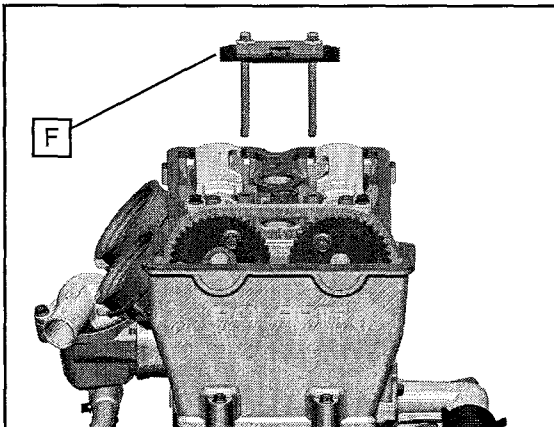
14. If timing marks are not aligned, remove sprockets and correct alignment.
15. Remove the Cylinder Holding & Camshaft Timing Plate (PU-50563) from the end of the camshafts.
16. Rotate the engine using the flywheel and install the remaining bolt in each camshaft sprocket. Torque the sprocket bolts to specification.



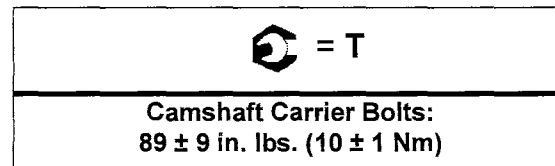
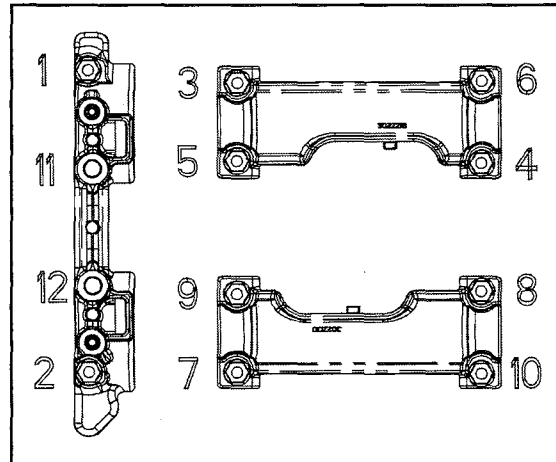
17. Rotate the engine using the flywheel and torque the remaining sprocket bolts to specification.
18. Install the front camshaft carrier (E) and (2) outer retaining bolts.



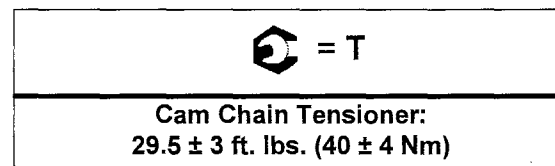
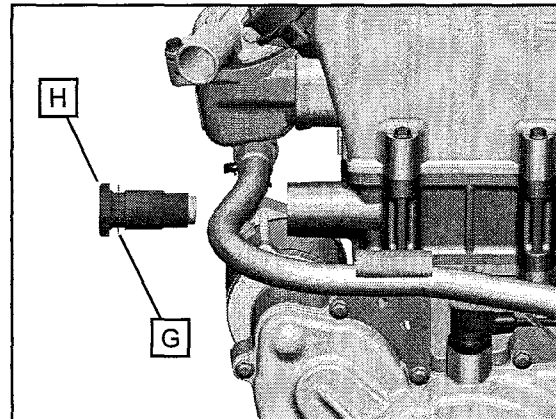
19. Install the fixed cam chain guide (F) and (2) retaining bolts.



20. Torque the camshaft carriers bolts in sequence to specification.

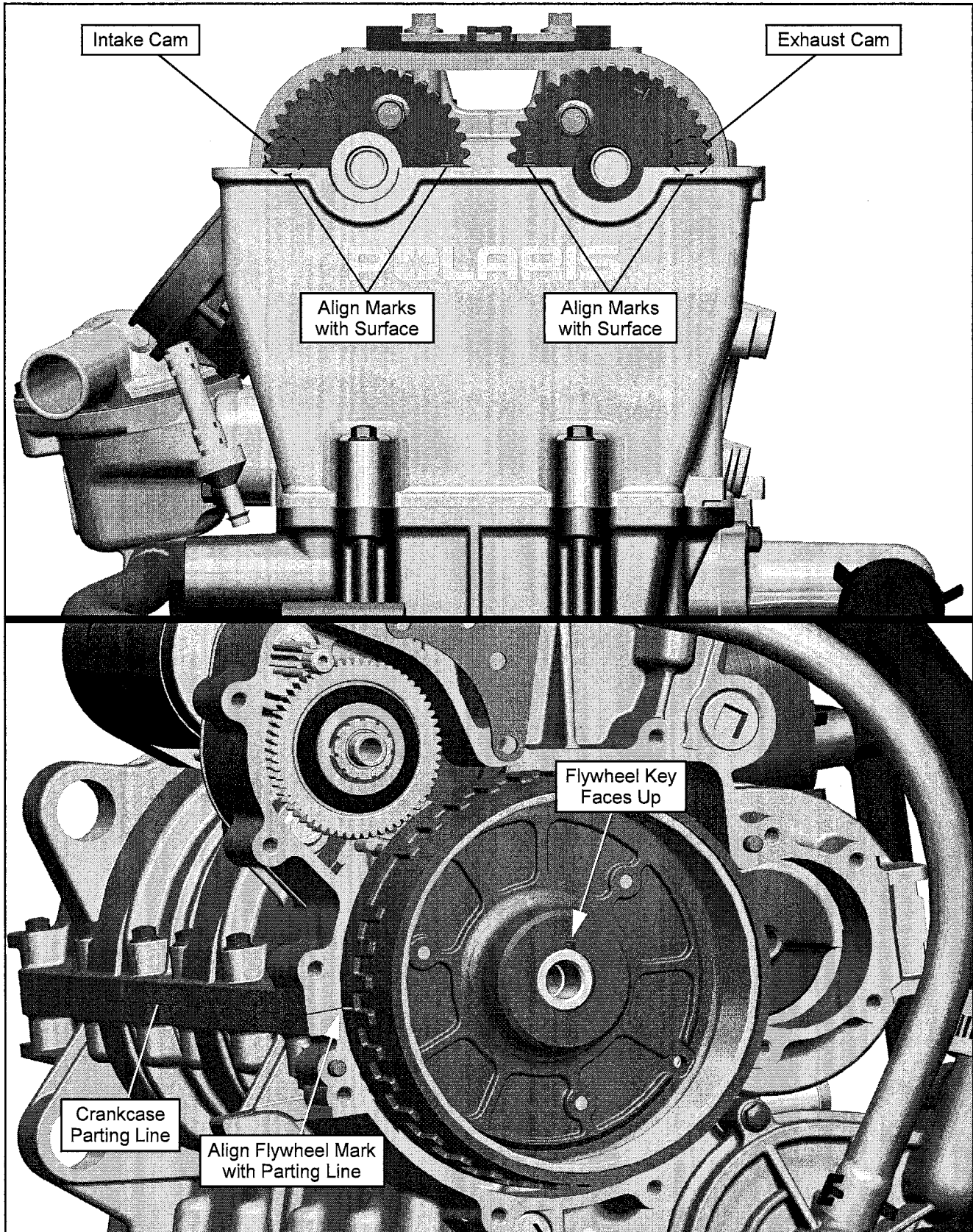


21. Apply Polaris PS-4 Plus engine oil to the cam chain tensioner bore prior to assembly. Insure the sealing washer (G) is in place.
22. Install the hydraulic cam chain tensioner (H) into the cylinder and torque to specification.



23. Rotate crankshaft through two revolutions and verify camshaft timing is correct.

Camshaft Timing - Quick Reference



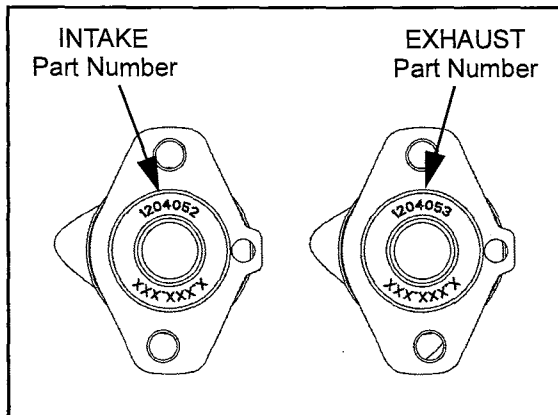
3.77

ENGINE / COOLING

Valve Clearance Adjustment

IMPORTANT: Always inspect valve clearance prior to camshaft installation or final engine assembly.

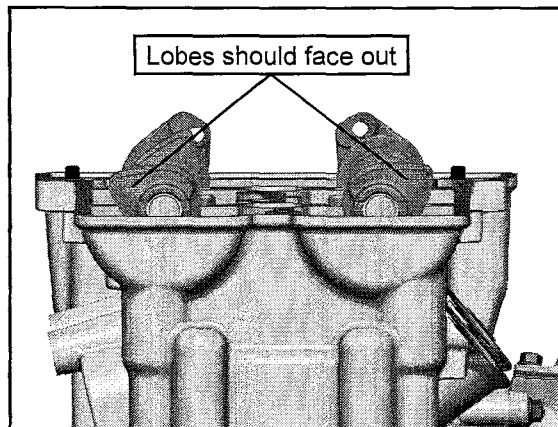
1. Reference the camshaft intake and exhaust markings made during disassembly. If installing new camshafts or if camshafts were not marked, you can reference the part number stamped on the end of the shafts.



Intake Camshaft - PN 1204052

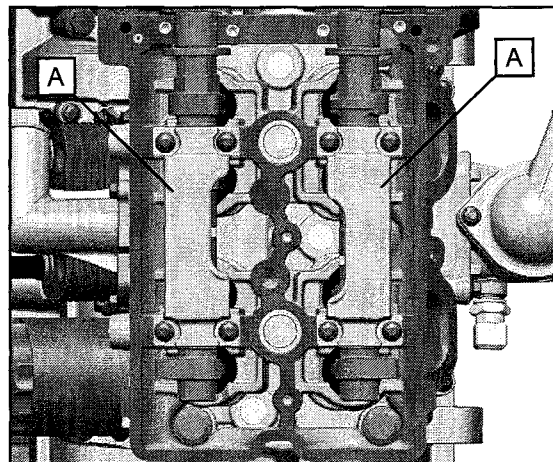
Exhaust Camshaft - PN 1204053

2. Lubricate the camshaft bearing journal surfaces with Polaris PS-4 Plus engine oil prior to installation.
3. Carefully install the camshafts into the cylinder head. The PTO camshaft lobes should face out as shown.



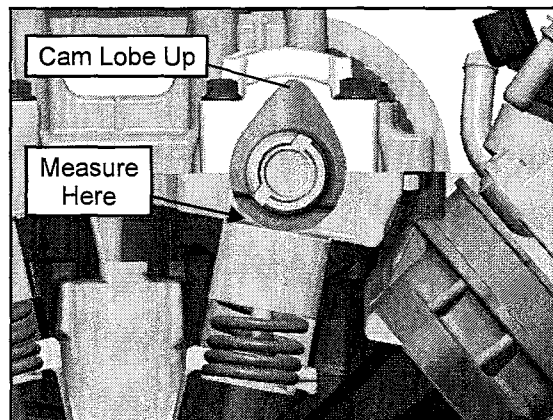
4. Carefully install the rear camshaft carriers onto the camshafts. Carrier openings should face each other when installed properly.

5. Install the (4) bolts that retain each rear camshaft carrier (A) and tighten the bolts evenly to specification.

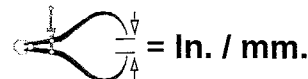


Camshaft Carrier Bolts:
89 ± 9 in. lbs. (10 ± 1 Nm)

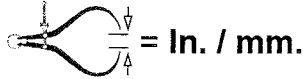
6. Rotate the camshaft until the cam lobes above the valves you are inspecting are facing up.



7. Measure the valve clearance using a thickness (feeler) gauge. Record the measurement if clearance is out of specification.
8. Repeat steps 6 and 7 until all (8) valves have been inspected.



Intake Valve Clearance (cold):
.005-.007 in. (0.125-0.175 mm)

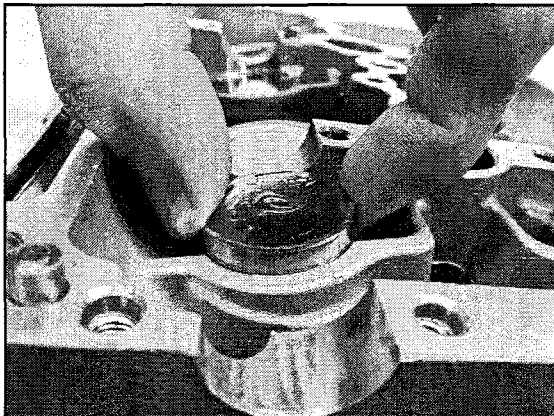


Exhaust Valve Clearance (cold):
.011-.013 in. (0.275-0.325 mm)

9. If any of the valve clearance measurements are out of specification, remove the camshaft carriers and camshafts and proceed with this procedure.

NOTE: If all valve clearance measurements are within specification, remove the camshaft carriers and proceed to "Camshaft Installation / Timing".

10. Remove the valve bucket from a valve that was out of specification.

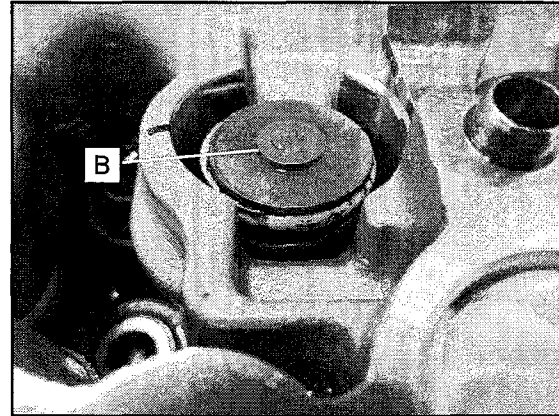


IMPORTANT: Keep mated parts together and in order with respect to their location in the cylinder head for assembly purposes. Mark each component or place them in an organized rack as you remove them.

CAUTION

If performing this procedure with the cylinder head installed on the engine, cover the spark plug holes and the cam chain opening to prevent a valve adjustment shim from falling into the cylinder or crankcase.

11. Record the 3 digit adjustment shim number (B).



NOTE: Shim 240 is shown for reference only.

12. Reference the valve clearance measurement recorded for that valve, along with the 3-digit shim number.
13. Refer to the appropriate shim selection matrix (Intake or Exhaust) on the following pages and select the proper shim.
14. Install the new adjustment shim and valve bucket.

NOTE: Lubricate the outer portion of the valve bucket upon installation.

15. Repeat steps 10-14 until all necessary valves have been adjusted.
16. Reinstall the camshafts and camshaft carriers and tighten the bolts evenly to specification.



Camshaft Carrier Bolts:
89 ± 9 in. lbs. (10 ± 1 Nm)

17. Measure and confirm that valve clearance is now within specification for each valve.
18. If valve clearance is not within specification, repeat this procedure.
19. If all valve clearance measurements are now within specification, remove the camshaft carriers and proceed to "Camshaft Installation / Timing".

ENGINE / COOLING

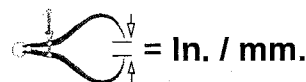
Intake Valve Lash - Shim Selection Matrix

Example:

- Installed shim is 240
- Measured clearance is 0.002 in. (0.06 mm)
- Replace 240 shim with 232 shim

Shim Thickness: Example 240 equals thickness of 2.40 mm

Part Number: 3022173-XXX (Xs represent 3 digits on shim)



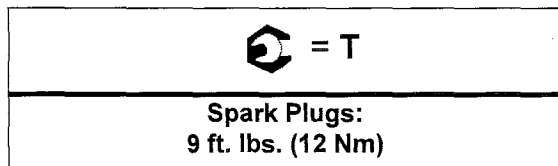
Intake Valve Clearance:
0.005 - 0.007 in. (0.125 - 0.175 mm)

		Existing Valve Lash Shim Marking (3 digits on shim)																																					
		190	192	195	198	200	202	205	208	210	212	215	218	220	222	225	228	230	232	235	238	240	242	245	248	250	252	255	258	260	262	265	268	270	272	275	278	280	
		Correct Valve Lash Shim Marking (3 digits on shim)																																					
Intake Valve Clearance Before Adjusting (mm)	0.000-0.024	178	180	182	185	188	190	192	195	198	200	202	205	208	210	212	215	218	220	222	225	228	230	232	235	238	240	242	245	248	250	252	255	258	260	262	265	268	
	0.025-0.049	180	182	185	188	190	192	195	198	200	202	205	208	210	212	215	218	220	222	225	228	230	232	235	238	240	242	245	248	250	252	255	258	260	262	265	268	270	
	0.050-0.074	182	185	188	190	192	195	198	200	202	205	208	210	212	215	218	220	222	225	228	230	232	235	238	240	242	245	248	250	252	255	258	260	262	265	268	270	272	
	0.075-0.099	185	188	190	192	195	198	200	202	205	208	210	212	215	218	220	222	225	228	230	232	235	238	240	242	245	248	250	252	255	258	260	262	265	268	270	272	275	
	0.100-0.124	188	190	192	195	198	200	202	205	208	210	212	215	218	220	222	225	228	230	232	235	238	240	242	245	248	250	252	255	258	260	262	265	268	270	272	275	278	
	0.125-0.175 (Standard)																																						
	0.176-0.200	192	195	198	200	202	205	208	210	212	215	218	220	222	225	228	230	232	235	238	240	242	245	248	250	252	255	258	260	262	265	268	270	272	275	278	280	282	
	0.201-0.225	195	198	200	202	205	208	210	212	215	218	220	222	225	228	230	232	235	238	240	242	245	248	250	252	255	258	260	262	265	268	270	272	275	278	280	282	285	
	0.226-0.250	198	200	202	205	208	210	212	215	218	220	222	225	228	230	232	235	238	240	242	245	248	250	252	255	258	260	262	265	268	270	272	275	278	280	282	285	288	
	0.251-0.275	200	202	205	208	210	212	215	218	220	222	225	228	230	232	235	238	240	242	245	248	250	252	255	258	260	262	265	268	270	272	275	278	280	282	285	288	290	
	0.276-0.300	202	205	208	210	212	215	218	220	222	225	228	230	232	235	238	240	242	245	248	250	252	255	258	260	262	265	268	270	272	275	278	280	282	285	288	290	292	
	0.301-0.325	205	208	210	212	215	218	220	222	225	228	230	232	235	238	240	242	245	248	250	252	255	258	260	262	265	268	270	272	275	278	280	282	285	288	290	292	295	
	0.326-0.350	208	210	212	215	218	220	222	225	228	230	232	235	238	240	242	245	248	250	252	255	258	260	262	265	268	270	272	275	278	280	282	285	288	290	292	295	298	
	0.351-0.375	210	212	215	218	220	222	225	228	230	232	235	238	240	242	245	248	250	252	255	258	260	262	265	268	270	272	275	278	280	282	285	288	290	292	295	298	300	
	0.376-0.400	212	215	218	220	222	225	228	230	232	235	238	240	242	245	248	250	252	255	258	260	262	265	268	270	272	275	278	280	282	285	288	290	292	295	298	300		
	0.401-0.425	215	218	220	222	225	228	230	232	235	238	240	242	245	248	250	252	255	258	260	262	265	268	270	272	275	278	280	282	285	288	290	292	295	298	300			
	0.426-0.450	218	220	222	225	228	230	232	235	238	240	242	245	248	250	252	255	258	260	262	265	268	270	272	275	278	280	282	285	288	290	292	295	298	300				
	0.451-0.475	220	222	225	228	230	232	235	238	240	242	245	248	250	252	255	258	260	262	265	268	270	272	275	278	280	282	285	288	290	292	295	298	300					
	0.476-0.500	222	225	228	230	232	235	238	240	242	245	248	250	252	255	258	260	262	265	268	270	272	275	278	280	282	285	288	290	292	295	298	300						
	0.501-0.525	225	228	230	232	235	238	240	242	245	248	250	252	255	258	260	262	265	268	270	272	275	278	280	282	285	288	290	292	295	298	300							
	0.526-0.550	228	230	232	235	238	240	242	245	248	250	252	255	258	260	262	265	268	270	272	275	278	280	282	285	288	290	292	295	298	300								
	0.551-0.575	230	232	235	238	240	242	245	248	250	252	255	258	260	262	265	268	270	272	275	278	280	282	285	288	290	292	295	298	300									
	0.576-0.600	232	235	238	240	242	245	248	250	252	255	258	260	262	265	268	270	272	275	278	280	282	285	288	290	292	295	298	300										
	0.601-0.625	235	238	240	242	245	248	250	252	255	258	260	262	265	268	270	272	275	278	280	282	285	288	290	292	295	298	300											
	0.626-0.650	238	240	242	245	248	250	252	255	258	260	262	265	268	270	272	275	278	280	282	285	288	290	292	295	298	300												
	0.651-0.675	240	242	245	248	250	252	255	258	260	262	265	268	270	272	275	278	280	282	285	288	290	292	295	298	300													
	0.676-0.700	242	245	248	250	252	255	258	260	262	265	268	270	272	275	278	280	282	285	288	290	292	295	298	300														
	0.701-0.725	245	248	250	252	255	258	260	262	265	268	270	272	275	278	280	282	285	288	290	292	295	298	300															
0.726-0.750	248	250	252	255	258	260	262	265	268	270	272	275	278	280	282	285	288	290	292	295	298	300																	
0.751-0.775	250	252	255	258	260	262	265	268	270	272	275	278	280	282	285	288	290	292	295	298	300																		
0.776-0.800	252	255	258	260	262	265	268	270	272	275	278	280	282	285	288	290	292	295	298	300																			
0.801-0.825	255	258	260	262	265	268	270	272	275	278	280	282	285	288	290	292	295	298	300																				
0.826-0.850	258	260	262	265	268	270	272	275	278	280	282	285	288	290	292	295	298	300																					
0.851-0.875	260	262	265	268	270	272	275	278	280	282	285	288	290	292	295	298	300																						
0.876-0.900	262	265	268	270	272	275	278	280	282	285	288	290	292	295	298	300																							
0.901-0.925	265	268	270	272	275	278	280	282	285	288	290	292	295	298	300																								
0.926-0.950	268	270	272	275	278	280	282	285	288	290	292	295	298	300																									
0.951-0.975	270	272	275	278	280	282	285	288	290	292	295	298	300																										
0.976-1.000	272	275	278	280	282	285	288	290	292	295	298	300																											
1.001-1.025	275	278	280	282	285	288	290	292	295	298	300																												
1.026-1.050	278	280	282	285	288	290	292	295	298	300																													

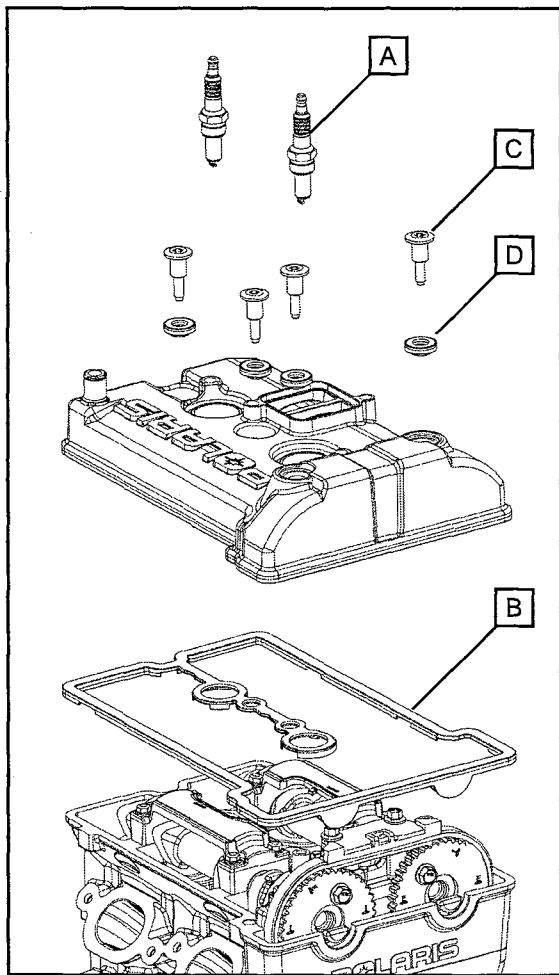
ENGINE / COOLING

Valve Cover Installation

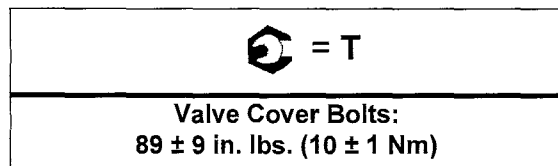
1. Install the spark plugs (A) and torque to specification.



2. Prepare valve cover sealing surfaces by cleaning thoroughly to remove all residue.
3. Install a new valve cover seal (B).
4. Install the (4) valve cover shoulder bolts (C) and isolators (D) using a T40 driver.



5. Torque valve cover bolts to specification.



TROUBLESHOOTING**Engine****Spark Plug Fouling**

- Spark plug cap loose or faulty
- Incorrect spark plug heat range or gap
- PVT system calibrated incorrectly/ components worn or mis-adjusted
- Fuel quality poor (old) or octane too high
- Low compression
- Restricted exhaust
- Weak ignition (loose coil ground, faulty coil, or stator)
- Restricted air filter (main or pre-cleaner) or breather system
- Improperly assembled air intake system
- Restricted engine breather system
- Oil contaminated with fuel

Engine Turns Over But Fails To Start

- No fuel
- Dirt in fuel line or filter
- Fuel will not pass through fuel valve
- Fuel pump inoperative/restricted
- Tank vent plugged or pinched
- Engine flooded
- Low compression (high cylinder leakage)
- No spark (Spark plug fouled) ignition component failure

Engine Does Not Turn Over

- Dead battery
- Starter motor does not turn
- Engine seized, rusted, or mechanical failure

Engine Runs But Will Not Idle

- Restricted fuel supply
- Low compression
- Crankcase breather restricted

Engine Idles But Will Not Accelerate

- Spark plug fouled/weak spark
- Broken throttle cable
- Obstruction in air intake
- Air box removed (reinstall all intake components)
- Incorrect ignition timing
- Restricted exhaust system
- Cam worn excessively

Engine Has Low Power

- Spark plug fouled
- Cylinder, piston, ring, or valve wear or damage (check compression)
- PVT not operating properly
- Restricted exhaust muffler
- Cam worn excessively

Piston Failure - Scoring

- Lack of lubrication
- Dirt entering engine through cracks in air filter or ducts
- Engine oil dirty or contaminated

Excessive Smoke and Carbon Buildup

- Excessive piston-to-cylinder clearance
- Wet sumping
- Worn rings, piston, or cylinder
- Worn valve guides or seals
- Restricted breather
- Air filter dirty or contaminated

Piston Failure - Scoring

- Lack of lubrication
- Dirt entering engine through cracks in air filter or ducts
- Engine oil dirty or contaminated

Excessive Smoke and Carbon Buildup

- Excessive piston-to-cylinder clearance
- Wet sumping due to over-full crankcase
- Worn rings, piston, or cylinder
- Worn valve guides or seals
- Restricted breather
- Air filter dirty or contaminated

Low Compression

- Cylinder head gasket leak
- No valve clearance (cam wear)
- Cylinder or piston worn
- Piston rings worn, leaking, broken, or sticking
- Bent valve or stuck valve
- Valve spring broken or weak
- Valve not seating properly (bent or carbon accumulated on sealing surface)
- Rocker arm sticking

Backfiring

- Fouled spark plug or incorrect plug or plug gap
- Intake system air leaks
- Exhaust system air leaks
- Valve sticking
- Ignition system faulty:
 - Spark plug cap cracked / broken
 - Ignition coil faulty
 - Ignition or kill switch circuit faulty
 - Poor connections in ignition system
 - Ignition timing incorrect
 - Sheared flywheel key

Cooling System

Overheating

- Low coolant level
- Air in cooling system
- Wrong type/mix of coolant
- Faulty pressure cap or system leaks
- Restricted system (mud or debris in radiator fins causing restriction to air flow, passages blocked in radiator, lines, pump, or water jacket, accident damage)
- Lean mixture (vents, fuel pump or fuel valve)
- Fuel pump output weak
- Electrical malfunction
- Water pump failure/ Loose impeller
- Thermistor failure
- Cooling fan inoperative or turning too slowly (perform current draw test)
- Low oil level
- Spark plug incorrect heat range
- Faulty hot light circuit
- Thermostat stuck closed or not opening completely
- Radiator is missing its internal diverter plate not allowing coolant to flow through entire radiator

Temperature Too Low

- Thermostat stuck open

Leak at Water Pump Weep Hole

- Faulty water pump mechanical seal (coolant leak)
- Faulty pump shaft oil seal (oil leak)

CHAPTER 4

ELECTRONIC FUEL INJECTION

GENERAL INFORMATION	4.2
SPECIAL TOOLS	4.2
EFI SERVICE NOTES	4.4
EFI SYSTEM EXPLODED VIEW	4.5
EFI SYSTEM COMPONENT LOCATIONS	4.6
FUEL TANK	4.8
EXPLODED VIEW	4.8
FUEL LINES - QUICK CONNECT FITTINGS	4.9
FUEL TANK REMOVAL	4.10
FUEL TANK INSTALLATION	4.11
ELECTRONIC FUEL INJECTION	4.12
PRINCIPAL COMPONENTS / EFI OPERATION OVERVIEW	4.12
INITIAL PRIMING / STARTING PROCEDURE	4.12
ELECTRONIC CONTROL UNIT (ECU)	4.13
ECU SERVICE / REPLACEMENT	4.13
MANIFOLD AIR QUALITY SENSOR (MAQS)	4.14
MAQS TEST / REPLACEMENT	4.14
CRANKSHAFT POSITION SENSOR (CPS)	4.15
CPS TEST	4.15
CPS REPLACEMENT	4.16
IDLE AIR CONTROL VALVE (IAC)	4.17
IAC TEST / REPLACEMENT	4.17
ENGINE COOLANT TEMPERATURE SENSOR (ECT)	4.18
ECT SENSOR TEST / REPLACEMENT	4.18
DUAL THROTTLE BODY ASSEMBLY	4.20
THROTTLE BODY SERVICE / REMOVAL	4.20
FUEL INJECTORS	4.22
FUEL INJECTOR TROUBLESHOOTING	4.22
FUEL INJECTOR TEST / REPLACEMENT	4.23
FUEL PUMP	4.26
FUEL SENDER TEST	4.26
FUEL PUMP TEST	4.27
FUEL PUMP REPLACEMENT	4.28
IGNITION COIL	4.31
IGNITION COIL / HT LEAD REPLACEMENT	4.31
IGNITION COIL TESTS	4.31
EFI DIAGNOSTICS	4.32
INSTRUMENT CLUSTER TROUBLE CODE DISPLAY	4.32
EFI TROUBLESHOOTING	4.35
DIGITAL WRENCH™ OPERATION	4.36
SPECIAL TOOLS / DIAGNOSTIC SOFTWARE VERSION	4.36
ECU REPLACEMENT	4.36
GUIDED DIAGNOSTIC AVAILABLE	4.36
DIGITAL WRENCH™ COMMUNICATION ERRORS	4.36
DIGITAL WRENCH™ - DIAGNOSTIC CONNECTOR	4.37
DIGITAL WRENCH™ SERIAL NUMBER LOCATION	4.37
DIGITAL WRENCH™ VERSION AND UPDATE ID	4.37
DIGITAL WRENCH™ UPDATES	4.38
DIGITAL WRENCH™ FEATURE MAP	4.39
ENGINE CONTROLLER REPROGRAMMING (REFLASH)	4.40
EFI SYSTEM ELECTRICAL OPERATION	4.44

ELECTRONIC FUEL INJECTION

GENERAL INFORMATION

WARNING

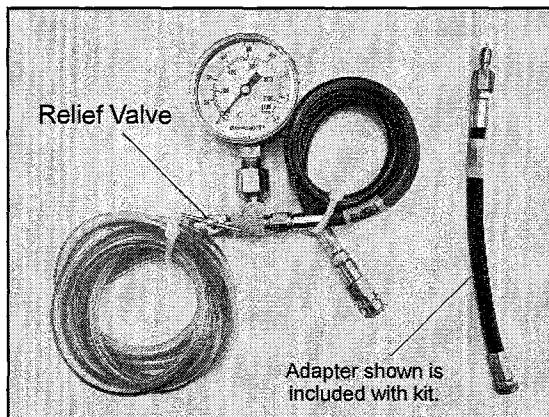
- * Gasoline is extremely flammable and explosive under certain conditions.
- * EFI components are under high pressure.
Verify system pressure has been relieved before disassembly.
- * Never drain the fuel system when the engine is hot.
Severe burns may result.
- * Do not overfill the tank. The tank is at full capacity when the fuel reaches the bottom of the filler neck.
Leave room for expansion of fuel.
- * Never start the engine or let it run in an enclosed area.
Gasoline powered engine exhaust fumes are poisonous and can cause loss of consciousness and death in a short time.
- * Do not smoke or allow open flames or sparks in or near the area where refueling is performed or where gasoline is stored.
- * If you get gasoline in your eyes or if you should swallow gasoline, seek medical attention immediately.
- * If you spill gasoline on your skin or clothing, immediately wash with soap and water and change clothing.
- * Always stop the engine and refuel outdoors or in a well ventilated area.

Special Tools

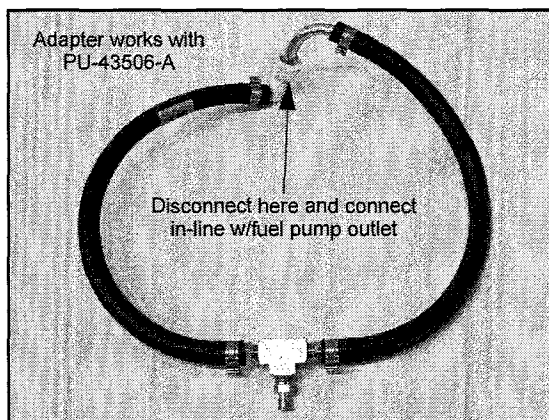
PART NUMBER	TOOL DESCRIPTION	
PU-43506-A	Fuel Pressure Gauge Kit	
PV-48656	Fuel Pressure Gauge Adapter	
PU-47063-A	Digital Wrench™ Diagnostic Software (Includes most recent version of software w/serial number, standard interface cable and SmartLink Module Kit)	
PU-47471	Digital Wrench™ SmartLink Module Kit (PU-47470, PU-47469, PU-47468)	
	PU-47470	Digital Wrench™ PC Interface Cable
	PU-47469	Digital Wrench™ Vehicle Interface Cable
	PU-47468	Digital Wrench™ SmartLink Module

Fuel Pressure Gauge Kit - PU-43506-A

IMPORTANT: The EFI fuel system remains under high pressure, even when the engine is not running. Before attempting to service any part of the fuel system, pressure should be relieved. The Fuel Pressure Gauge Kit has an integrated pressure relief valve that can be used to bleed off pressure once you have completed the fuel pressure test.



Fuel Pressure Gauge Adapter - PV-48656



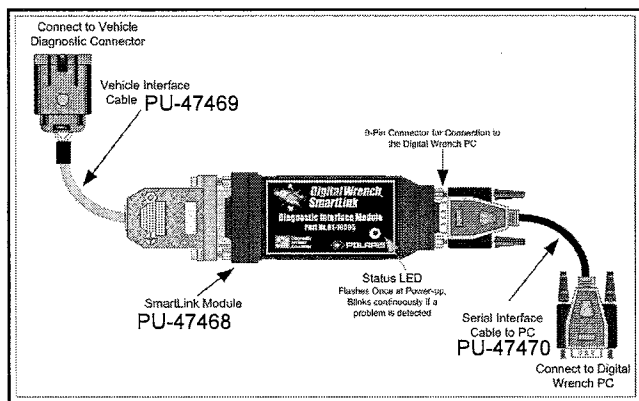
Digital Wrench™ Diagnostic Software - PU-47063-A

This dealer-only software installs on laptop computers equipped with a CD drive and serial port connection, and is designed to replace multiple shop tools often used to test EFI components. It also includes step-by-step diagnostic procedures to aid technician repair and troubleshooting.

IMPORTANT: If the PC you are using is not equipped with a 9-pin serial port, a USB to serial port adapter will be necessary. A USB to serial port adapter can be purchased through DSA at: www.diagsys.com

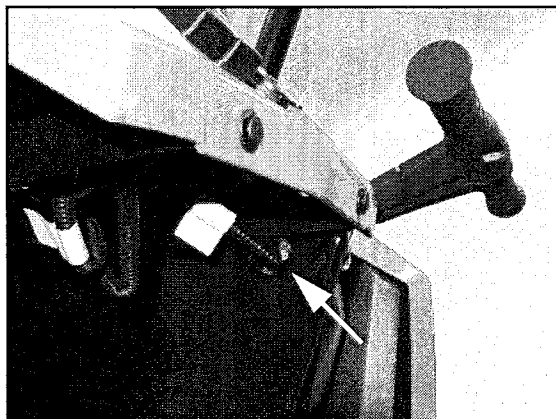
Digital Wrench™ SmartLink Module Kit - PU-47471

This module kit contains the necessary cables and hardware to communicate between the vehicle ECU and the Digital Wrench™ diagnostic software. Polaris dealers can also order the following kit components separately: **SmartLink Module PU-47468**, **Vehicle Interface Cable PU-47469** and **PC Interface Cable PU-47470**. This module kit is used on all 8 pin connector-based Polaris EFI systems. This kit is available to Polaris dealers through our tool supplier SPX at (1-800-328-6657) or <http://polaris.spx.com>



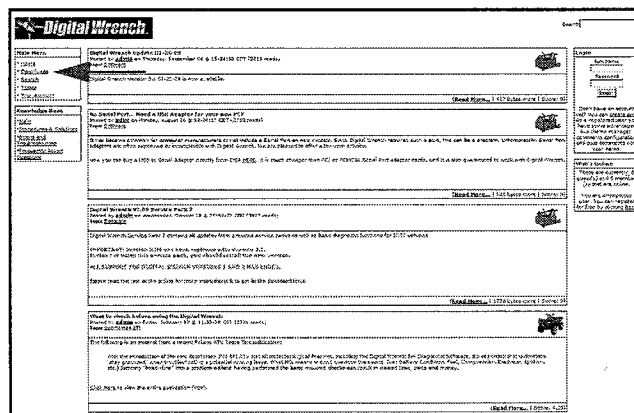
Digital Wrench™ - Diagnostic Connector

Located under the dash connected to a sealed plug.

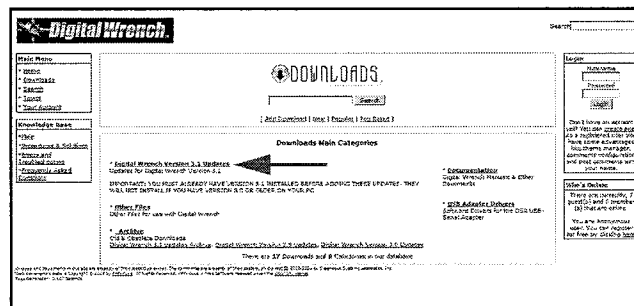


Digital Wrench™ - Download Website

Located at: www.polaris.diagsys.com



Download Digital Wrench™ Updates:



IMPORTANT: For the most recent information on Digital Wrench™ software and update downloads please visit the website: www.polaris.diagsys.com

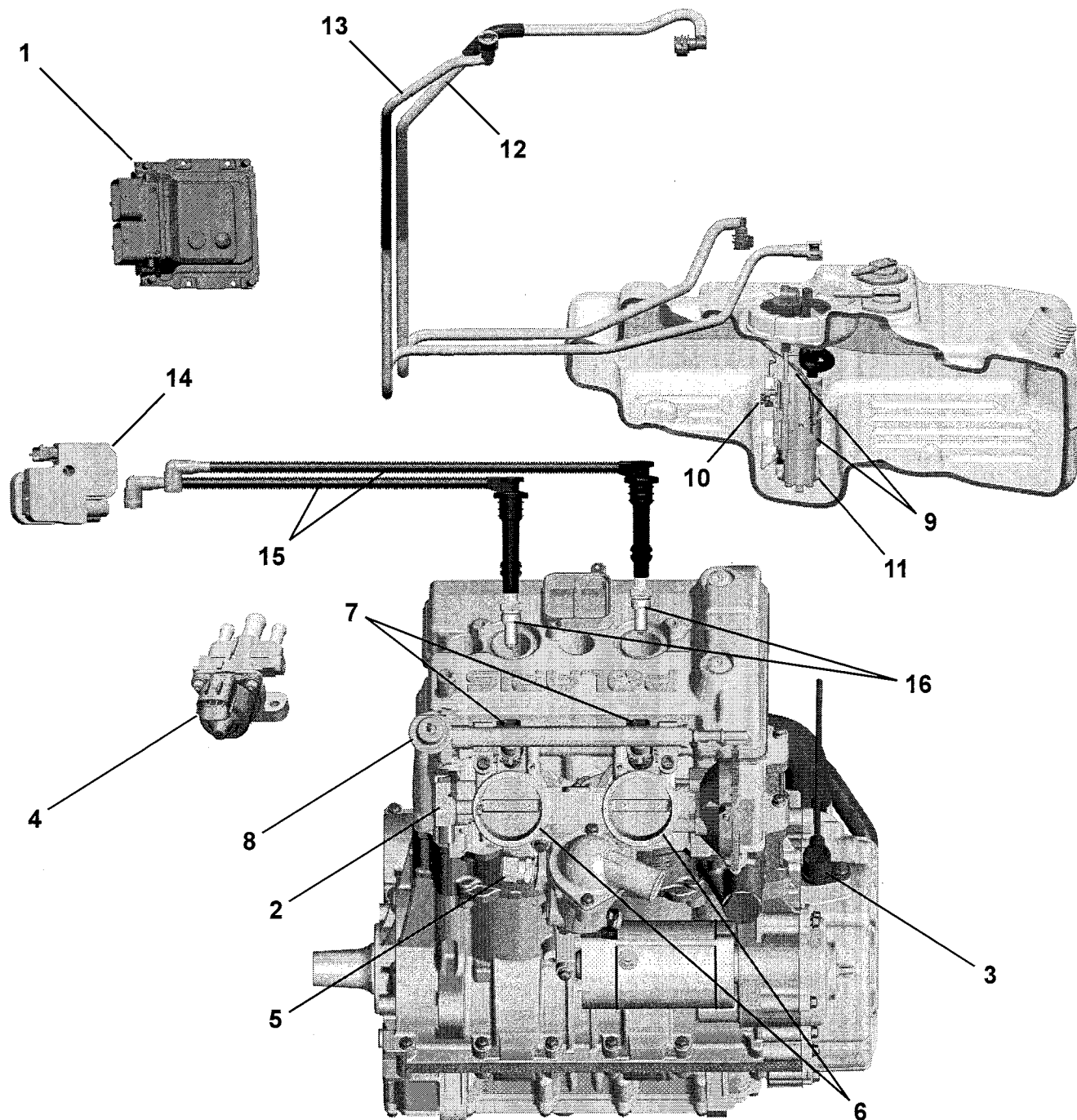
ELECTRONIC FUEL INJECTION

EFI Service Notes

- For more convenient and accurate testing of EFI components, it is recommended dealers utilize the Digital Wrench™ Diagnostic Software (dealer only). Some testing may be done manually using the procedures provided in this chapter.
- **80% of all EFI problems are caused by wiring harness connections.**
- For the purpose of troubleshooting difficult running issues, a known-good ECU from another *RANGER* RZR XP 900 of the same model and year may be used without damaging system or engine components.
- Never attempt to service any fuel system component while engine is running or ignition switch is "on."
- Cleanliness is essential and must be maintained at all times when servicing or working on the EFI system. Dirt, even in small quantities, can cause significant problems.
- Do not use compressed air if the system is open. Cover any parts removed and wrap any open joints with plastic if they will remain open for any length of time. New parts should be removed from their protective packaging just prior to installation.
- Clean any connector before opening to prevent dirt from entering the system.
- Although every precaution has been taken to prevent water intrusion failure, avoid direct water or spray contact with system components.
- Do not disconnect or reconnect the wiring harness connector to the control unit or any individual components with the ignition "on." This can send a damaging voltage spike through the ECU.
- Do not allow the battery cables to touch opposing terminals. When connecting battery cables attach the positive (red) cable to positive (+) battery terminal first, followed by negative (black) cable to negative (-) battery terminal.
- Never start the engine when the cables are loose or poorly connected to the battery terminals.
- Never disconnect battery while engine is running.
- Never use a battery boost-pack to start the engine.
- Do not charge battery with key switch "on."
- Always disconnect negative (-) battery cable lead before charging battery.
- Always unplug ECU from the wire harness before performing any welding on the unit.

EFI System Exploded View

- | | |
|--|--------------------------|
| 1. Electronic Control Unit (ECU) | 9. Fuel Pump / Regulator |
| 2. Manifold Air Quality Sensor (MAQS) | 10. Fuel Level Sender |
| 3. Crankshaft Position Sensor (CPS) | 11. Fuel Filter |
| 4. Idle Air Control Valve (IAC) | 12. Fuel Supply Line |
| 5. Engine Coolant Temperature Sensor (ECT) | 13. Fuel Return Line |
| 6. Dual Throttle Body Assembly | 14. Ignition Coil |
| 7. Fuel Injectors | 15. Spark Plug Wires |
| 8. Fuel Rail / Regulator | 16. Spark Plugs |

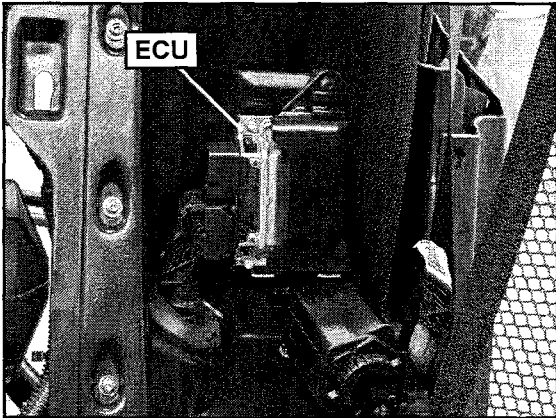


ELECTRONIC FUEL INJECTION

EFI System Component Locations

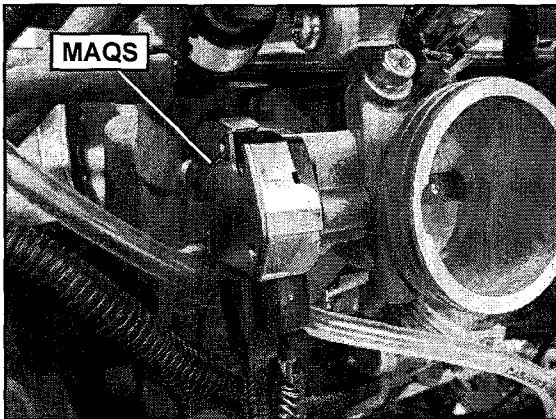
1. Electronic Control Unit (ECU)

- Located behind the driver's seat.



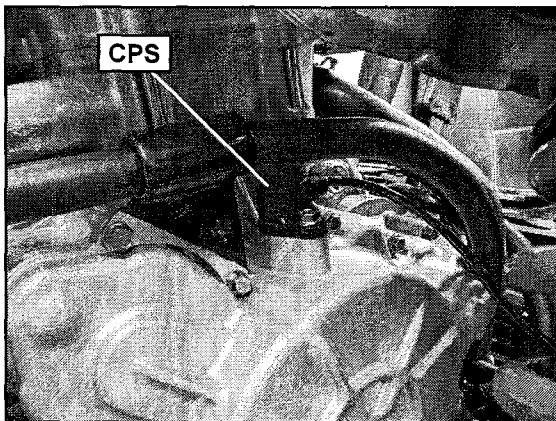
2. Manifold Air Quality Sensor (MAQS)

- Located on the PTO end of the throttle body assembly.



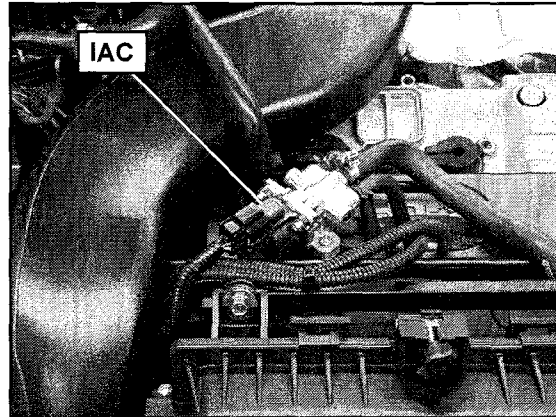
3. Crankshaft Position Sensor (CPS)

- Located on top of the stator cover.



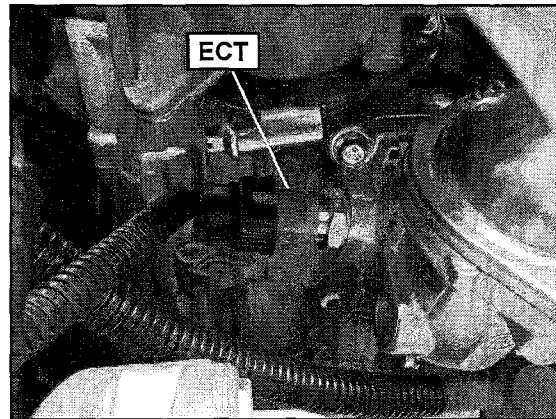
4. Idle Air Control Valve (IAC)

- Located above the engine, underneath the cargo box access panel.



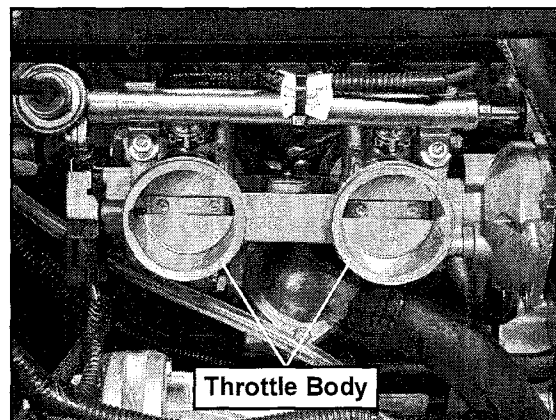
5. Engine Coolant Temperature Sensor (ECT)

- Located on the left side of the thermostat housing. The sensor can be accessed with the air box assembly removed.



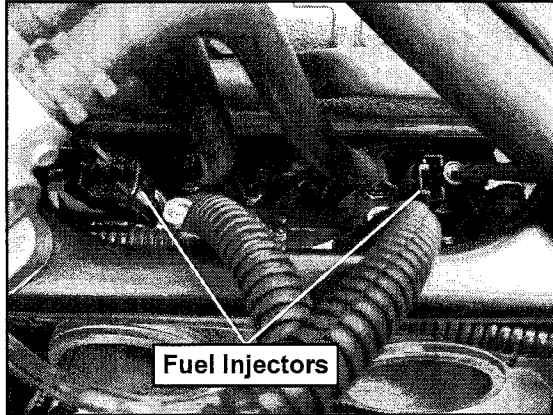
6. Dual Throttle Body Assembly

- Located between the air box assembly and rubber cylinder head adapters.



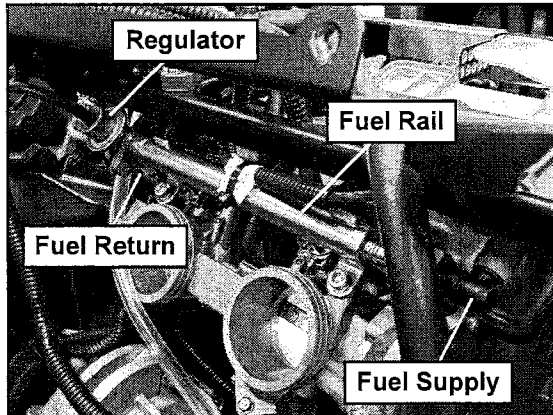
7. Fuel Injectors

- Located on the top of the throttle body in the intake track, retained on top by the fuel rail.



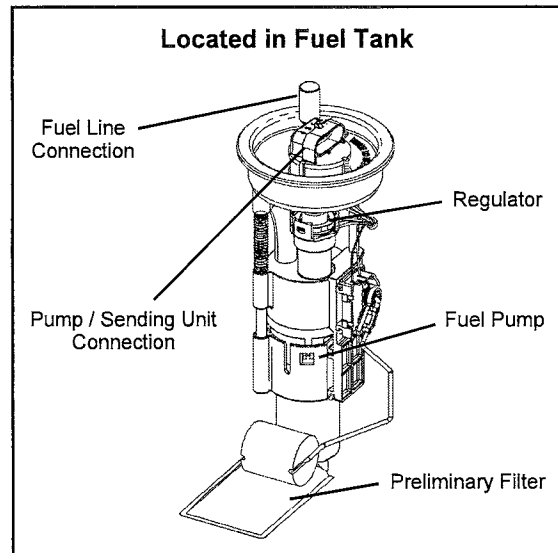
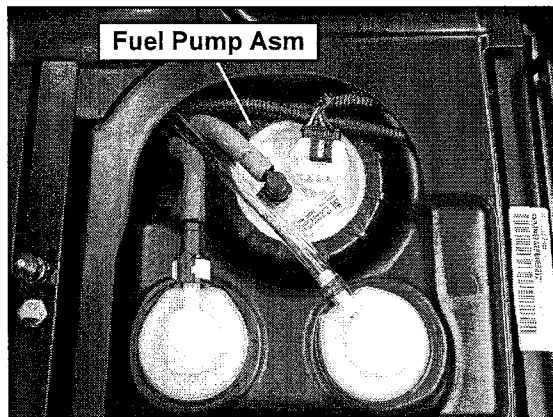
8. Fuel Rail / Regulator

- Located on the throttle body, on top of the fuel injectors.



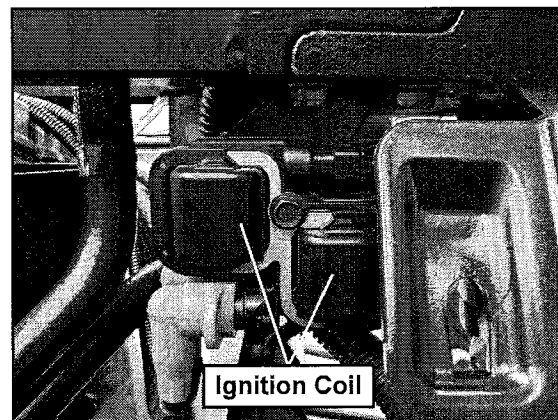
9. Fuel Pump / Regulator / Fuel Gauge Sender Assembly

- Located under the passenger seat.



10. Ignition Coil / High Tension Leads

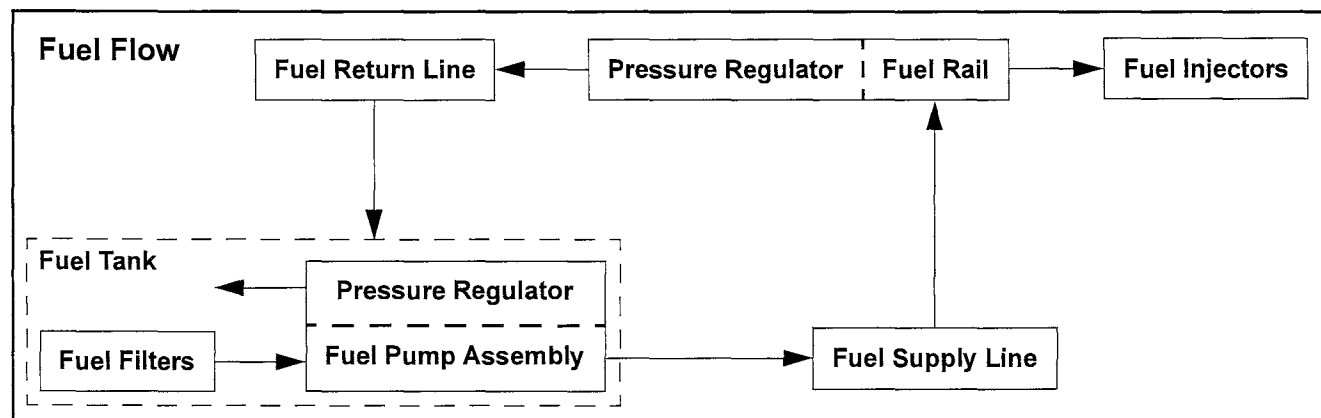
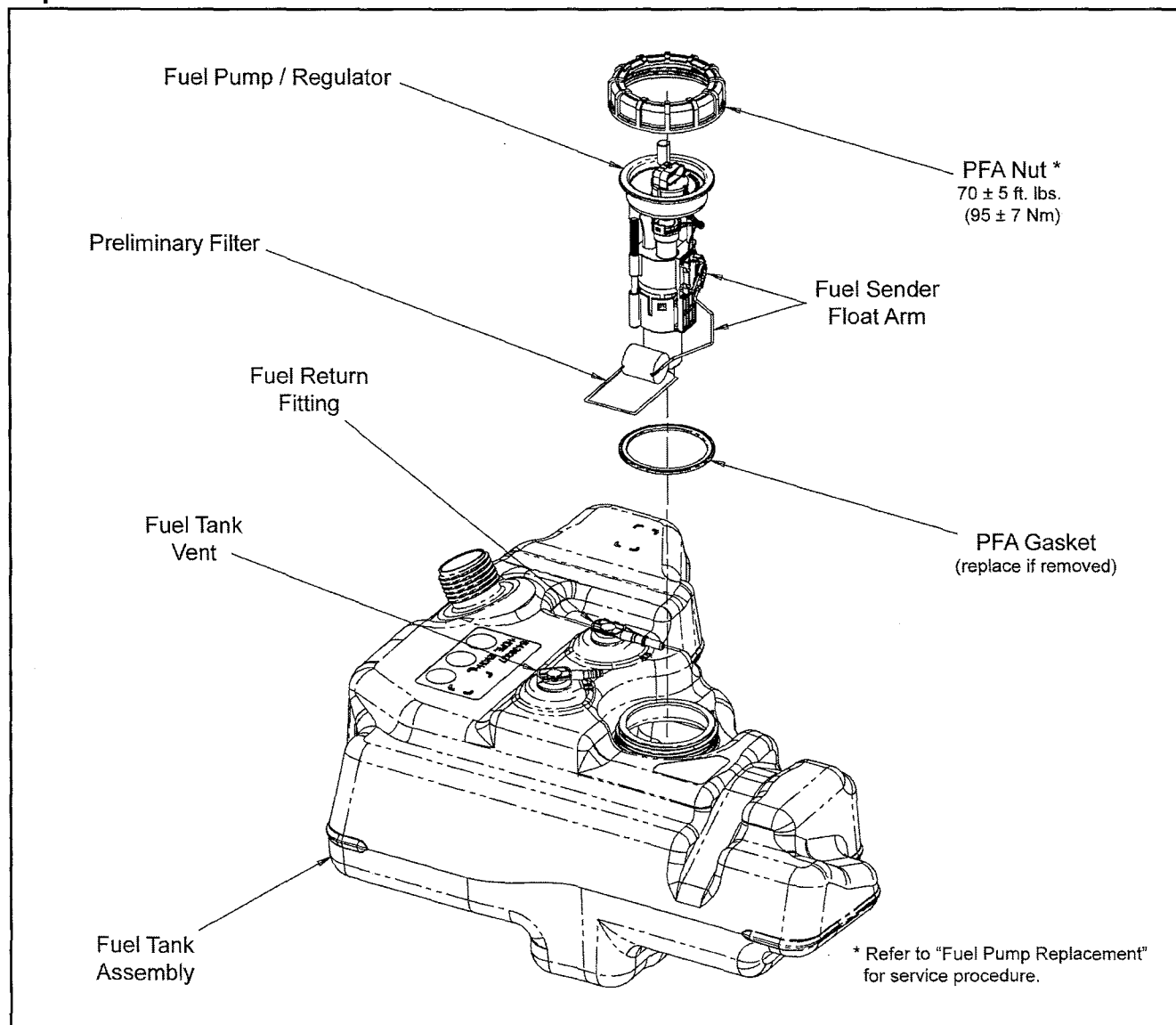
- Located behind the engine service panel on the driver's side of the vehicle.



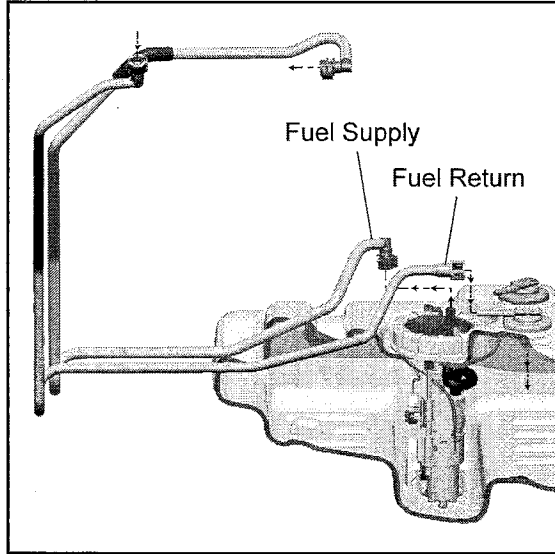
ELECTRONIC FUEL INJECTION

FUEL TANK

Exploded View

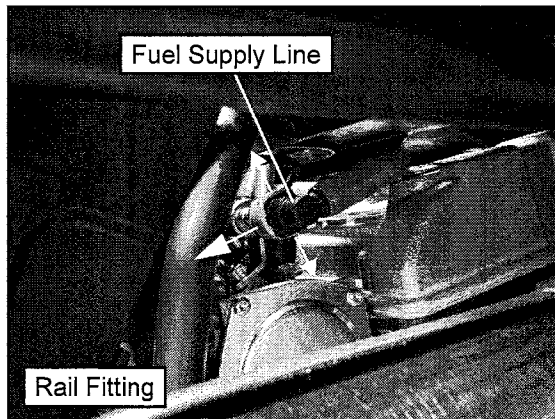
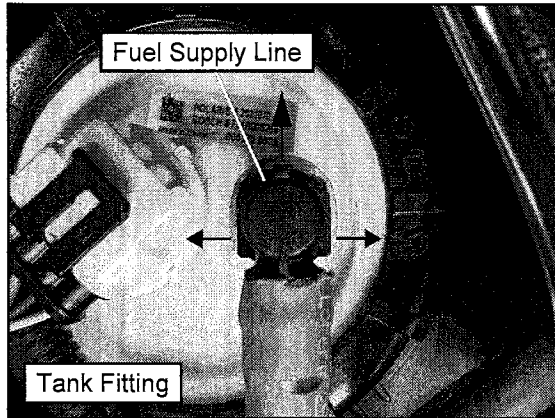


Fuel Lines - Quick Connect Fittings



Fuel Supply Line Removal

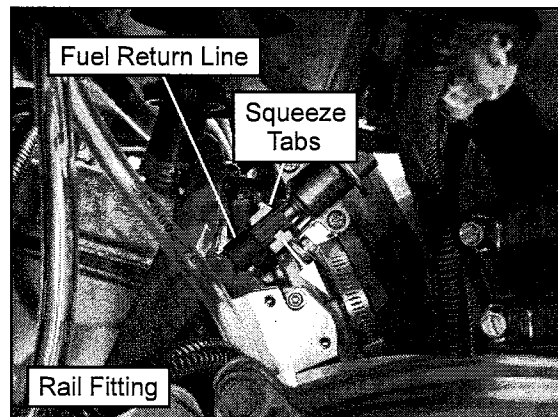
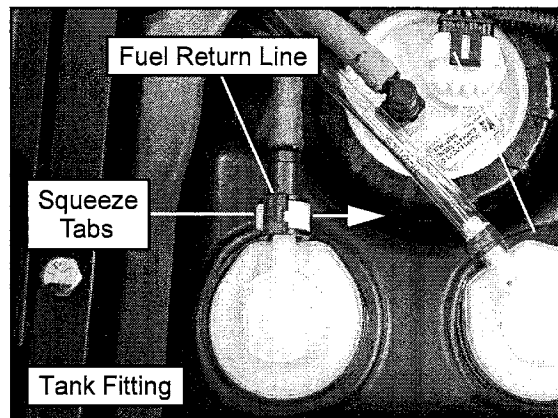
1. Place a shop towel around the fuel line to catch any dripping fuel.
2. If removing either end of supply line, pull open both tabs while moving the green connector out to release the line.



3. Pull on the fuel line for removal.
4. To install the line, verify the connections are clean and free of debris.
5. Place the fuel line back over the fitting and slide the green connector locking mechanism back into place. Verify the connector tabs snap back into place.
6. Be sure fuel line is routed and retained properly.

Fuel Return Line Removal

1. Place a shop towel around the fuel line to catch any dripping fuel.
2. If removing either end of return line, squeeze the connector tabs together and push the white locking slide back to release the line.



3. Pull on the fuel line for removal.
4. To install the line, verify the connections are clean and free of debris.
5. Place the fuel line back over the fitting and slide the white connector locking mechanism back into place. Verify the connector tabs snap back into place.
6. Be sure fuel line is routed and retained properly.

ELECTRONIC FUEL INJECTION

Fuel Tank Removal

IMPORTANT: Syphon as much fuel from the tank as possible before attempting to remove it from the vehicle.

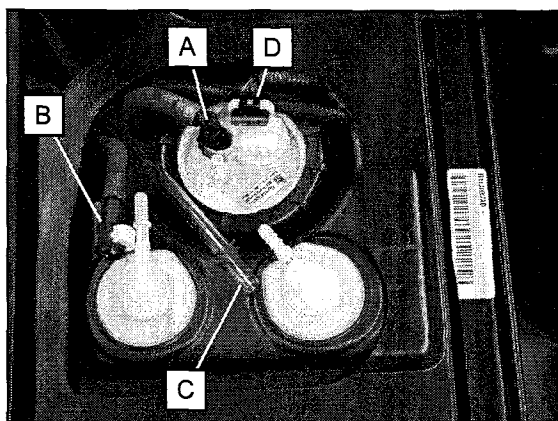
WARNING

Always wear safety goggles when working with high pressure or flammable fluids. Failure to do so could result in serious injury or complications.

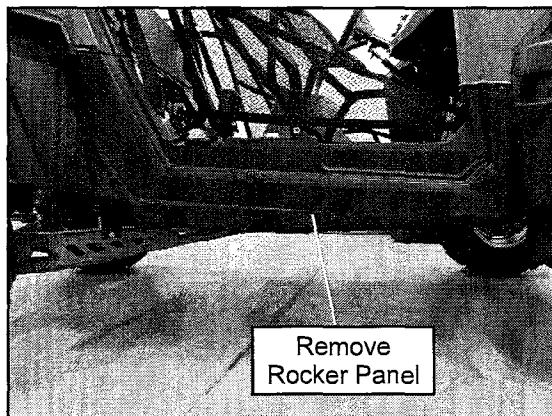
1. Remove the driver and passenger seats along with the engine service panel.
2. Disconnect the negative battery cable from the battery, located under the driver's seat.
3. While holding a shop towel over the fuel line connectors, disconnect the fuel supply line (A) from the pump and the fuel return line (B) from the tank (see "Fuel Lines - Quick Connect Fittings" for specific removal procedures).

NOTE: A small amount of fuel may come out of the fuel lines or pump fitting. Properly drain fuel into a suitable container.

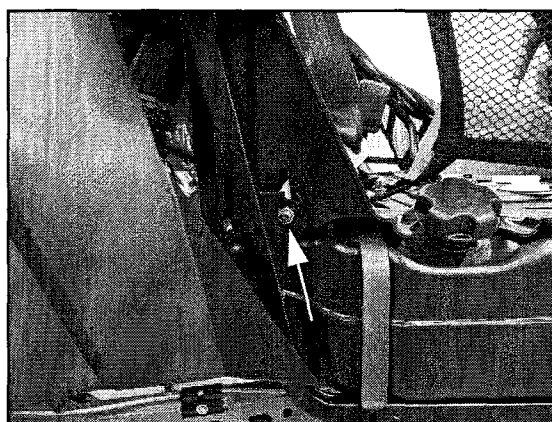
4. Remove the fuel tank vent line (C) from the tank fitting.
5. Disconnect the fuel pump electrical harness (D).



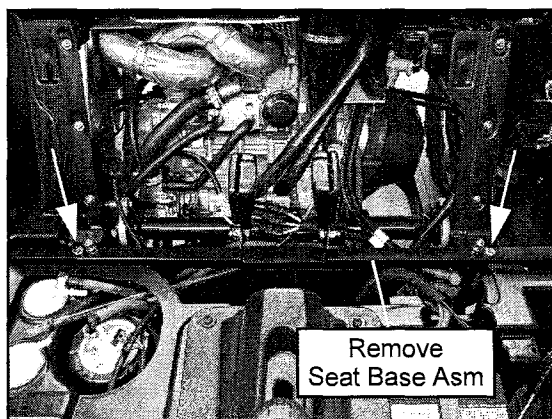
6. Remove the push rivets and Torx screws retaining the right-hand rocker panel using the multi-function pliers and a T27 Torx driver. Remove the rocker panel from the vehicle.



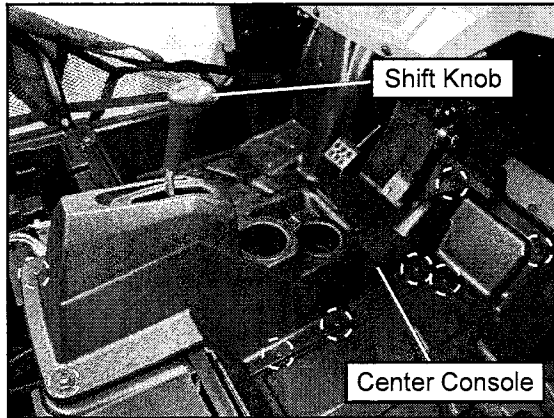
7. Remove the fastener retaining the seat belt mechanism to the frame near the right rear portion of the fuel tank. Once removed, place the mechanism in the rear cargo box to keep it out of the way.



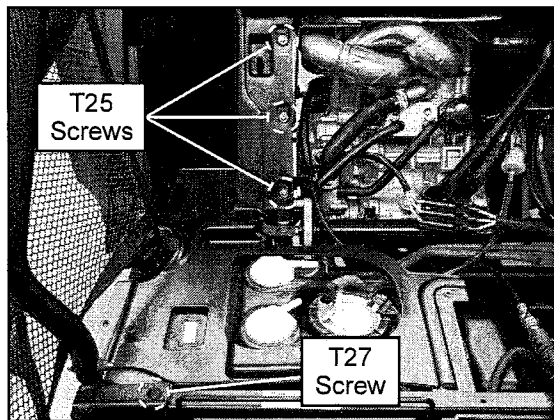
8. Remove the (2) bolts retaining the rear seat base assembly to the frame using a 5/8" socket. Remove the rear seat base assembly from the vehicle.



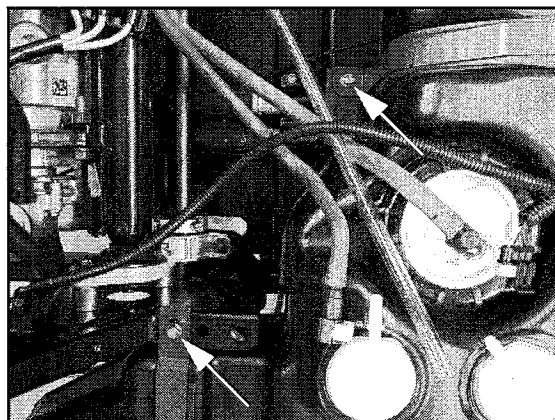
9. Remove the shift knob using a flat blade screwdriver and T25 Torx driver. Remove the screws retaining the center console using a T27 and T30 Torx driver. Remove the console from the vehicle.



10. Remove the Torx screws retaining the right rear fender well using a T25 and T27 Torx driver. Remove the fender well from the vehicle.

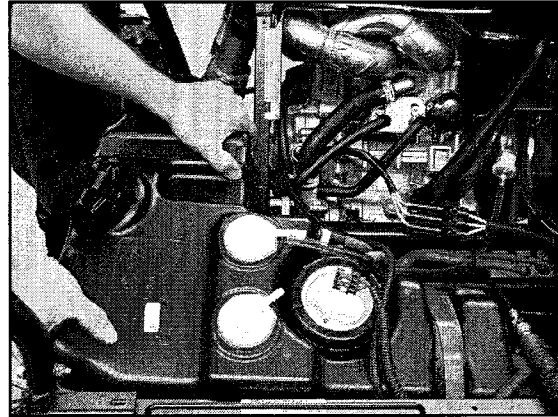


11. Remove the (2) tank bracket fasteners that retain the fuel tank in the chassis using a 3/8" socket. Swing the tank brackets clear of the fuel tank for removal.



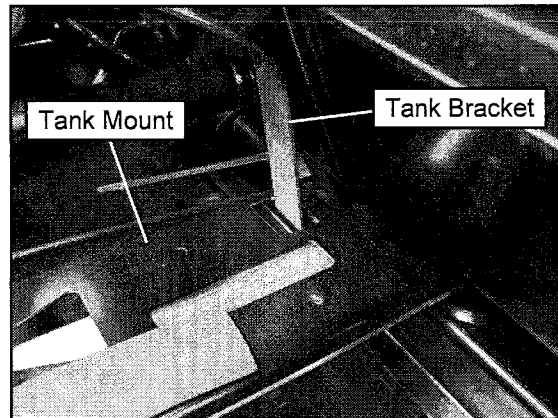
12. Lift the rear of the fuel tank up first.

13. Carefully pull the fuel tank out of the vehicle.



Fuel Tank Installation

1. Carefully reinstall the fuel tank assembly. Install the inner tank bracket with the fuel tank to ensure the bracket is inserted properly into the lower fuel tank mount as shown.



2. Reinstall the (2) fuel tank brackets and fasteners.
3. Reinstall the right rear fender well and secure with screws.
4. Reinstall the center console, shift knob and screws.
5. Reinstall the rear seat base assembly and secure with bolts.
6. Reinstall the seat belt mechanism. Torque bolt to **40 ft. lbs. (54 Nm)**.
7. Reinstall the right-hand rocker panel and all previously removed fasteners.
8. Install the fuel lines, vent line and clamp. Verify the line connections are secure.
9. Reconnect the fuel pump electrical harness.
10. Reconnect the negative battery cable. Test the fuel pump by turning the ignition key on and listening for the pump to activate. Check the fuel line fittings for leaks.
11. Finally, install the engine service panel and both seats.

ELECTRONIC FUEL INJECTION

ELECTRONIC FUEL INJECTION

Principal Components

The Electronic Fuel Injection (EFI) system is a complete engine fuel and ignition management design. This system includes the following principal components:

- Check Engine Light
- Crankshaft Position Sensor (CPS)
- Dual Throttle Body / Intake Adapter
- Engine Control Unit (ECU)
- Engine Coolant Temperature Sensor (ECT)
- Fuel Filter(s)
- Fuel Injectors
- Fuel Pressure Regulators
- Fuel Pump
- Fuel Rail
- Fuel Supply/Return Lines
- Idle Air Control Valve (IAC)
- Ignition Coil
- Manifold Air Quality Sensor (MAQS)
- Wire Harness Assembly

EFI Operation Overview

The EFI system is designed to provide peak engine performance with optimum fuel efficiency and lowest possible emissions. The ignition and injection functions are electronically controlled, monitored and continually corrected during operation to maintain peak performance.

The central component of the system is the Bosch M17 Electronic Control Unit (ECU) which manages system operation, determining the best combination of fuel mixture and ignition timing for the current operating conditions.

An electric fuel pump is used to move fuel from the tank, through the fuel supply line, to the fuel rail. Fuel pressure regulators located in the tank and on the end of the fuel rail, maintain system operating pressure and return excess fuel back into the fuel tank. At the engine, fuel fed through the fuel rail supplies fuel to the injectors, which inject into the intake ports. The ECU controls the amount of fuel by varying the length of time that the injectors are "on." This range can vary depending on fuel requirements. The controlled injection of the fuel occurs every other crankshaft revolution, or once for each 4-stroke cycle. When the intake valve opens, the fuel/air mixture is drawn into the combustion chamber, ignited and burned.

The ECU controls the amount of fuel being injected and the ignition timing by monitoring the primary sensor signals for intake air temperature, manifold absolute pressure (load), engine temperature, engine speed (RPM) and throttle position. These primary signals are compared to the programming in the ECU computer chip, and the ECU adjusts the fuel delivery and ignition timing based on these values.

During operation, the ECU has the ability to re-adjust temporarily; providing compensation for changes in overall engine condition and operating environment, so it will be able to maintain the ideal air/fuel ratio.

During certain operating periods such as cold starts, warm up, acceleration, etc., a richer air / fuel ratio is automatically calculated by the ECU.

Initial Priming / Starting Procedure

NOTE: The injection system must be purged of all air prior to the initial start up, and / or any time the system has been disassembled.

If the EFI system is completely empty of fuel or has been disassembled and repaired:

1. Cycle the key switch from "OFF" to "ON" 6 times, waiting for approximately 3 seconds at each "ON" cycle to allow the fuel pump to cycle and shut down.
2. Once step 1 is completed, turn the key switch to "START" until the engine starts or 5 seconds has passed.
3. If the engine failed to start, repeat step 1 for 2 more cycles and attempt to start the engine.

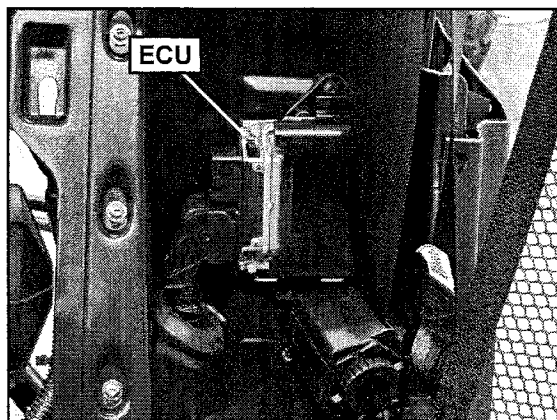
If the engine fails to start, a problem may still exist, and should be diagnosed.

NOTE: Accurate testing of EFI components is recommended utilizing the Digital Wrench™ Diagnostic Software (dealer only).

ELECTRONIC CONTROL UNIT (ECU)

Operation Overview

The ECU is the brain or central processing computer of the entire EFI fuel/ignition management system. During operation, sensors continuously gather data which is relayed through the wiring harness to input circuits within the ECU. Signals to the ECU include: ignition power (on/off), intake air temperature, manifold absolute pressure (load), engine coolant temperature, crankshaft position and engine speed (RPM), throttle position and battery voltage. The ECU compares the input signals to the programmed maps in its memory and determines the appropriate fuel and ignition requirements for the immediate operating conditions. The ECU then sends output signals to set the injector duration and ignition timing.



During operation, the ECU continually performs a diagnostic check of itself, each of the sensors, and system performance. If a fault is detected, the ECU turns on the "Check Engine" light on the instrument cluster and stores the fault code in its fault memory. Depending on the significance or severity of the fault, normal operation may continue, or "Fail-Safe" operation (slowed speed, richer running) may be initiated. A technician can determine the cause of the "Check Engine" light by referencing the "Instrument Cluster Trouble Code Display" and "Diagnostic Trouble Code Table" or by using Digital Wrench™. The ECU requires a minimum of 7.0 volts to operate. The memory in the ECU is operational the moment the battery cables are connected.

To prevent engine over-speed and possible failure, an RPM limiting feature is programmed into the ECU. If the maximum RPM limit is exceeded, the ECU suppresses the injection signals, cutting off the fuel flow and retards the ignition timing. This process repeats itself in rapid succession, limiting operation to the preset maximum.

Maximum RPM Limit: 8750

ECU Service

Never attempt to disassemble the ECU. It is sealed to prevent damage to internal components. Warranty is void if the case is opened or tampered with in any way.

All operating and control functions within the ECU are pre-set. No internal servicing or readjustment may be performed. If a problem is encountered, and you determine the ECU to be faulty, contact the Polaris Service Department for specific handling instructions. Do not replace the ECU without factory authorization.

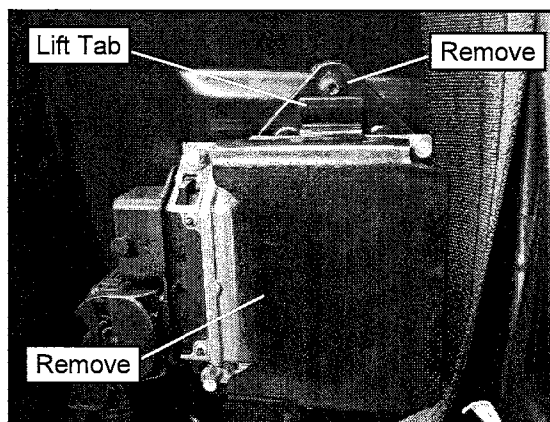
For the purpose of troubleshooting, a known-good ECU from another Polaris *RANGER RZR XP 900* of the same model may be used without system or engine component damage.

ECU Replacement

Although the need for ECU replacement is unlikely, a specific replacement procedure is required to ensure that all essential data contained within the original ECU is transferred to the replacement ECU.

IMPORTANT: Refer to this procedure and carefully follow all instructions provided in Digital Wrench™.

1. Carefully follow the ECU replacement instructions provided in Digital Wrench™ to ensure that all essential data contained within the original ECU is transferred to the replacement ECU.
2. Remove the black plastic cover by lifting up on the tab. Remove the retaining screw that attaches the ECU to the left rear fender well.



ELECTRONIC FUEL INJECTION

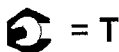
3. With the ignition turned off, disconnect the wire harness from the ECU. Lift the connector locking lever and rotate it up until the connector is free from the ECU.

NOTE: Upon removing the ECU connector, you should hear a “click” when the connector is fully open.



4. To install, reverse the procedure and tighten the mounting screws to specification.

NOTE: Upon installing the ECU connector, you should hear a “click” when the connector is fully closed.

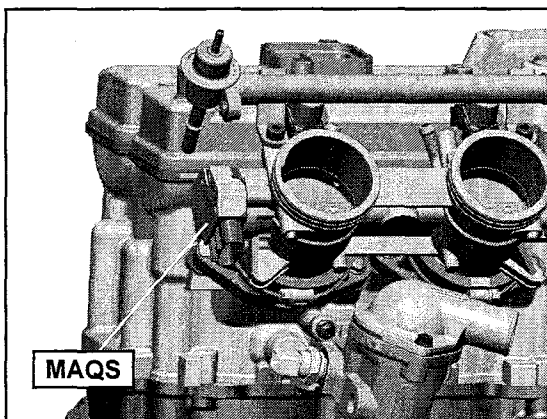


ECU Retaining Screws
10 in. lbs. (1.1 Nm)

MANIFOLD AIR QUALITY SENSOR (MAQS)

Operation Overview

Mounted on the end of the dual throttle body assembly, the MAQS performs three functions in one unit. The MAQS detects intake air temperature, manifold absolute pressure and throttle position.



These sensor signals, comprised of separate intake air temperature, manifold absolute pressure readings and throttle plate position are processed by the ECU and compared to its programming for determining the fuel and ignition requirements during engine operation. The MAQS provides the ECU with engine load data.

MAQS Test / Replacement

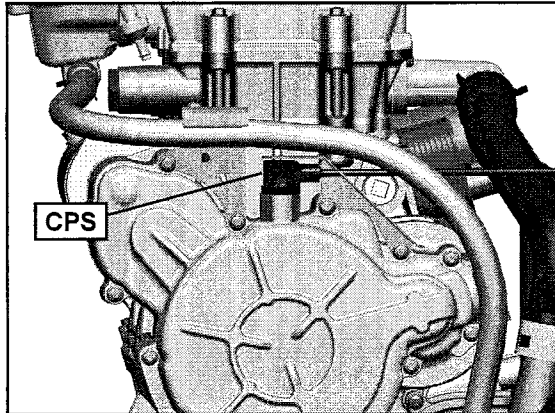
The MAQS is a non-serviceable item and can only be tested using Digital Wrench™. If the sensor is faulty, the dual throttle body assembly must be replaced. Refer to “Throttle Body Removal” procedure.

IMPORTANT: This sensor should only be tested using Digital Wrench™ Diagnostic Software (dealer only).

CRANKSHAFT POSITION SENSOR (CPS)

Operation Overview

Mounted on top of the stator cover, the crankshaft position sensor is essential to engine operation, constantly monitoring the rotational speed (RPM) and position of the crankshaft.



A ferromagnetic 35-tooth encoder ring with a missing tooth is built onto the flywheel. The inductive speed sensor is mounted 1.0 ± 0.26 mm (0.059 ± 0.010 in.) away from the encoder ring. During rotation, an AC pulse is created within the sensor for each passing tooth. The ECU calculates engine speed from the time interval between the consecutive pulses.

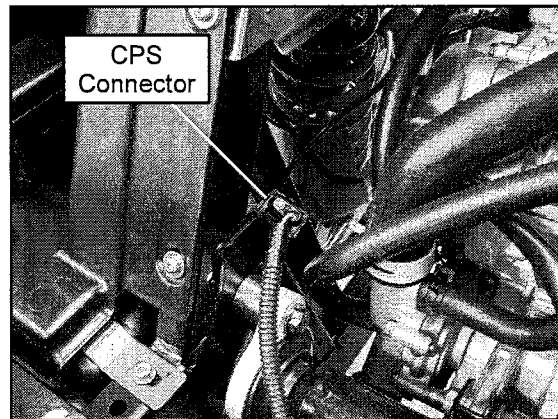
The encoder ring missing tooth creates an “interrupt” input signal, corresponding to specific crankshaft position. This signal serves as a reference for the control of ignition timing by the ECU. Synchronization of the CPS and crankshaft position takes place during the first two revolutions each time the engine is started. This sensor must be properly connected at all times. If the sensor fails or becomes disconnected for any reason, the engine will stop running.

CPS Test

The CPS is a sealed, non-serviceable assembly. If fault code diagnosis indicates a problem with this sensor, test as follows:

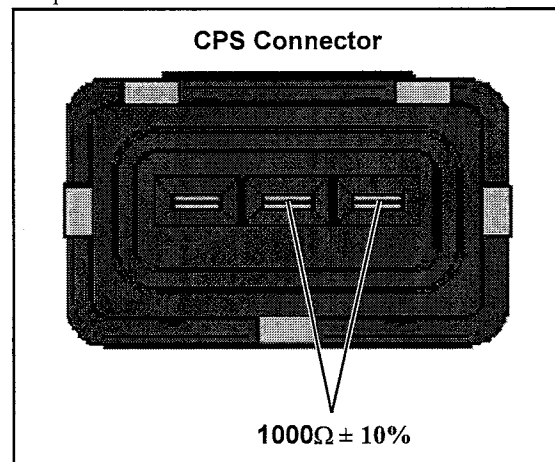
1. Remove the seats and engine service panel to access the CPS harness connector.

2. Disconnect CPS harness connector attached to the right-hand frame support, above the water pump housing.



4

3. Connect an ohmmeter between the CPS pin terminals shown below. A resistance value of $1000\Omega \pm 10\%$ at room temperature should be obtained.



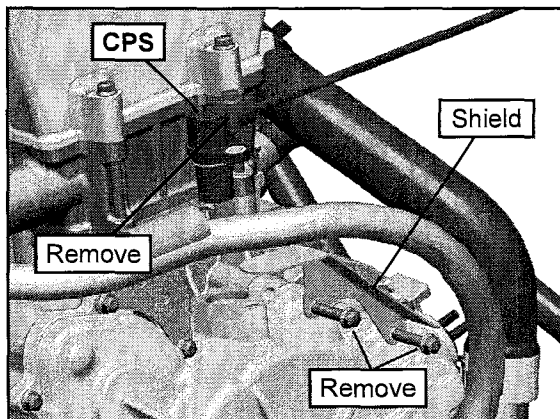
CPS Resistance Specification:
 $1000\Omega \pm 10\%$

4. If the resistance is correct:
 - Test the main harness circuit between the sensor connector terminals and the corresponding pin terminals at the ECU (see wiring diagram).
 - Check the sensor mounting, air gap, flywheel encoder ring for damage or runout, and flywheel key. Follow the “CPS Replacement” procedure to inspect CPS and flywheel encoder ring for damage.
5. If the resistance is incorrect, follow the “CPS Replacement” procedure.

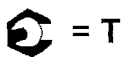
ELECTRONIC FUEL INJECTION

CPS Replacement

1. If not done already; disconnect the CPS harness connector (see "CPS Test").
2. Using an 8mm socket, remove the (2) bolts retaining the CPS heat shield and remove the shield.
3. Using an 8mm socket, remove the CPS retaining bolt and remove the sensor from the stator cover.



4. Install new sensor using a light coating of oil on the O-ring to aid installation.
5. Torque the CPS and heat shield retaining bolts to specification.

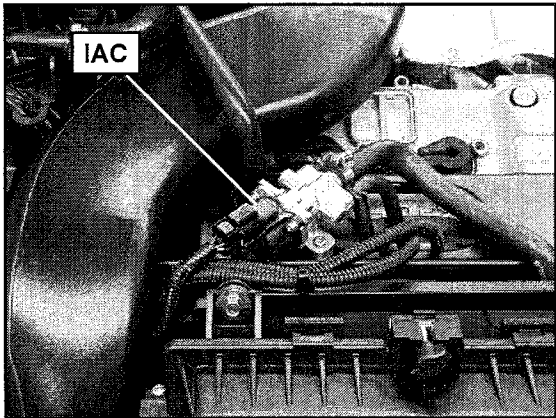


CPS / Stator Cover Retaining Bolt Torque:
106 in. lbs. (12 Nm)

IDLE AIR CONTROL VALVE (IAC)

Operation Overview

The Idle Air Control (IAC) is used to stabilize the idle quality of the engine at cold start-up and after warm-up operations.

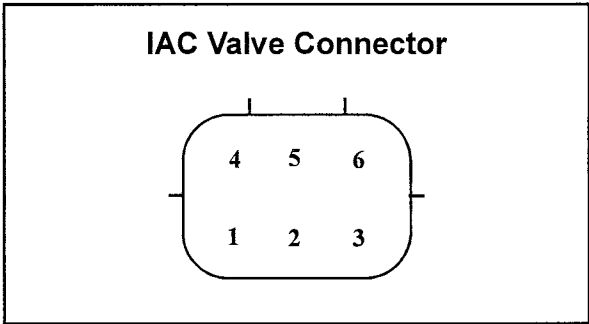


The IAC contains 1 stepper motor which receives varying voltage signal pulses from the ECU. These pulses determine the IAC plunger setting, thereby controlling the amount of air bypassing the closed throttle body plates for idle control. If the IAC is disconnected or inoperative, it will remain at it's last operated position.

IAC Test

The IAC is a non-serviceable item. If it is faulty, it must be replaced. It can be 'bench tested' using the following method:

Set your meter to read Ohms. Check the resistance values at each of the following pin locations of the IAC. If any of the readings are out of specification, replace the IAC.

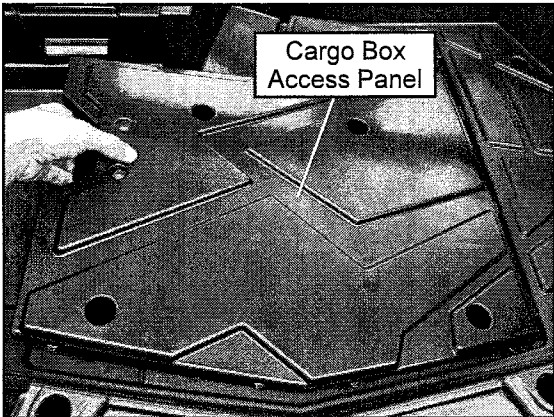


IAC Resistance Readings

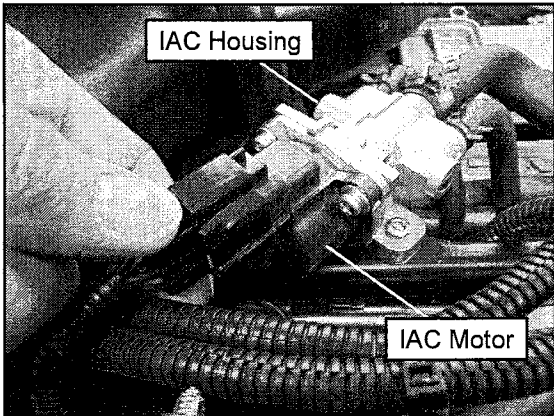
Pins	Resistance	Pins	Resistance
1 - 2	30 Ω ± 1.2 Ω	4 - 5	30 Ω ± 1.2 Ω
2 - 3	30 Ω ± 1.2 Ω	5 - 6	30 Ω ± 1.2 Ω
1 - 3	60 Ω ± 2.4 Ω	4 - 6	60 Ω ± 2.4 Ω

IAC Replacement

1. Remove the cargo box access panel.




2. Locate the IAC valve above the engine and disconnect the vehicle harness from the IAC motor.



3. Remove the (3) Phillips-head mounting screws and remove the IAC motor from the IAC housing.
4. Install the new IAC motor and torque the mounting screws to specification.

NOTE: Make sure not to twist or pinch the IAC lines upon assembly.

 = T
IAC Mounting Screw Torque:
17.7 in. lbs. (2 ± 0.5 Nm)

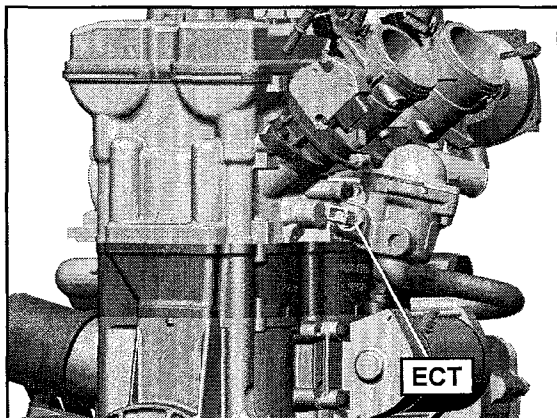
5. Reconnect the vehicle harness to the IAC motor.
6. Reinstall the cargo box access panel.

ELECTRONIC FUEL INJECTION

ENGINE COOLANT TEMPERATURE SENSOR (ECT)

Operation Overview

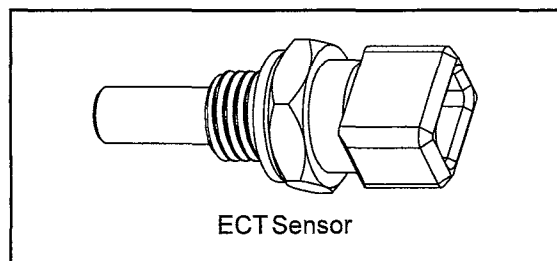
Mounted in the thermostat housing, the engine temperature sensor measures coolant temperature. The engine temperature sensor is a Negative Temperature Coefficient (NTC) type sensor, as the temperature increases the resistance decreases.



Coolant passes through the thermostat housing and by the sensor probe, varying a resistance reading which is relayed to the ECU. This signal is processed by the ECU and compared to its programming for determining the fuel and ignition requirements during operation. The ECU also uses this signal to determine when to activate the cooling fan during operation.

ECT Sensor Test

To quickly rule out other components and wiring related to the ECT, disconnect the harness from the ECT sensor and start the engine. After a few seconds, the fan should turn on and the "Check Engine" indicator should display on the instrument cluster. This indicates all other components are working properly.



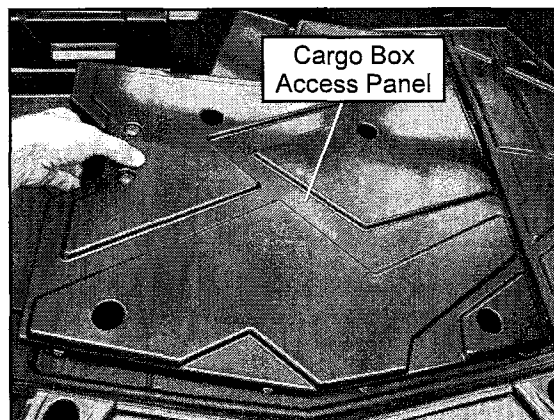
Refer to Chapter 10 for additional ECT sensor information. Polaris dealers can test the sensor by using Digital Wrench™ Diagnostic Software (dealer only).

ECT Sensor Resistance Readings

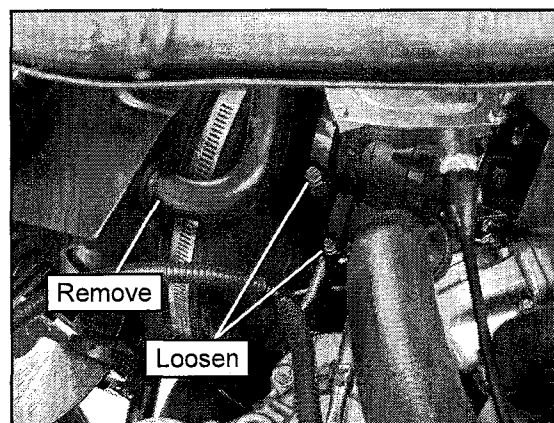
Temperature °F (°C)	Resistance
68 °F (20 °C)	2.5 kΩ ± 6%
86 °F (30 °C)	1.7 kΩ ± 6%
104 °F (40 °C)	1.2 kΩ ± 6%
122 °F (50 °C)	834 Ω ± 6%
140 °F (60 °C)	596 Ω ± 6%
158 °F (70 °C)	435 Ω ± 6%
176 °F (80 °C)	323 Ω ± 6%
194 °F (90 °C)	243 Ω ± 6%
212 °F (100 °C)	186 Ω ± 6%

ECT Sensor Replacement

1. Remove the cargo box access panel.

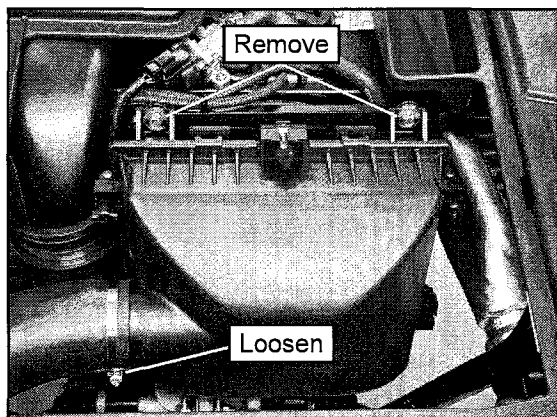


2. Be sure the engine has cooled enough to work on.
3. Remove the breather hose from the air box and loosen the hose clamps retaining the air box to the throttle body assembly.

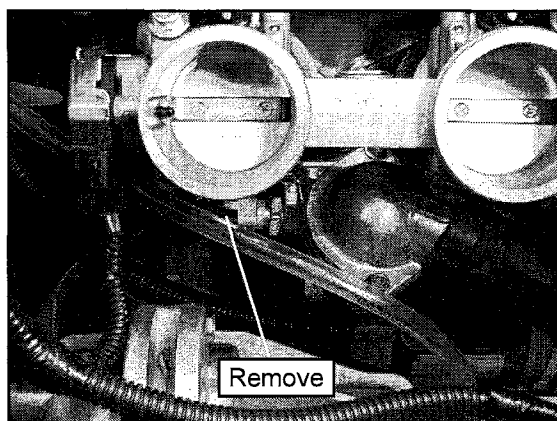


ELECTRONIC FUEL INJECTION

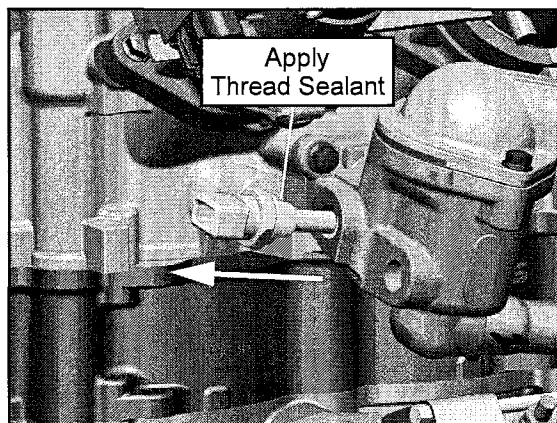
- Remove the (2) screws retaining the air box assembly and loosen the hose clamp retaining the intake hose to the air box. Remove the air box assembly from the vehicle.



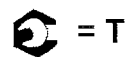
- Disconnect the vehicle harness from the ECT sensor.



- Drain the coolant so the level is below the sensor (see Chapter 2 "Coolant Drain / Fill").
- Using a wrench, remove and replace the sensor, applying a light coating of thread sealant to aid installation.

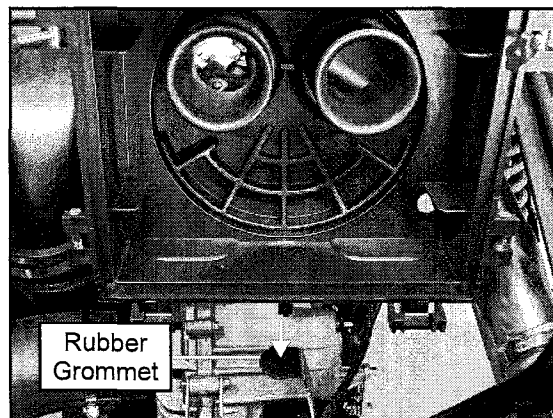


- Torque the new ECT sensor to specification and connect the vehicle harness to the sensor.

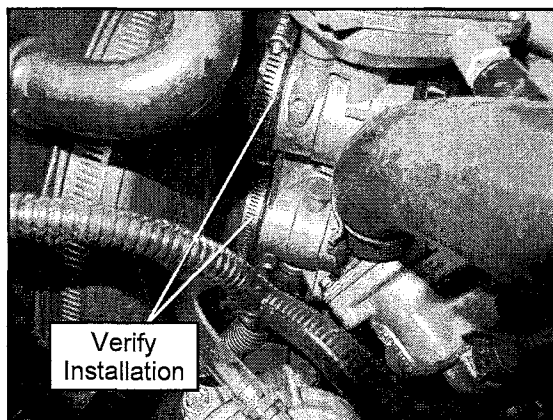


ECT Retaining Bolt Torque:
17 ft. lbs. (23 Nm)

- Reinstall the air box assembly:
 - Be sure the lower air box post is placed properly into the rubber grommet.



- Be sure the air box boots fully seat onto the dual throttle body before tightening the hose clamps.



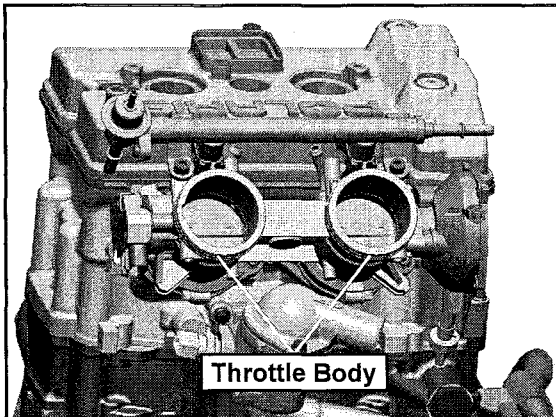
- Reinstall the breather into the air box and tighten the hose clamps retaining the air box to the throttle body assembly.
- Reinstall the (2) screws retaining the air box assembly.
- Position the intake hose onto the air box and tighten the hose clamp.
- Reinstall the cargo box access panel.
- Add the required amount of coolant and bleed the system (see Chapter 3 "Cooling System Bleeding Procedure").

ELECTRONIC FUEL INJECTION

DUAL THROTTLE BODY ASSEMBLY

Operation Overview

Mounted to the cylinder head, the dual throttle body assembly provides the proper air/fuel ratio needed for engine operation.



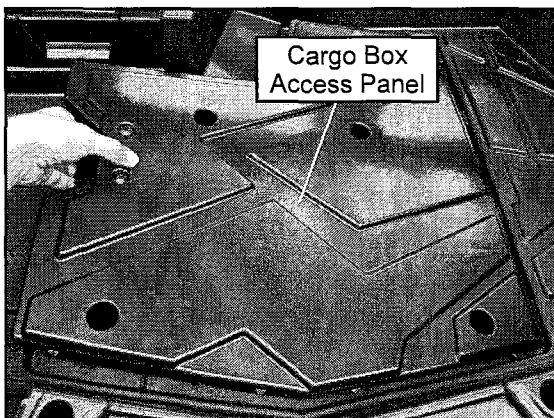
The throttle body assembly also includes the Manifold Air Quality Sensor (MAQS), which provides the ECU with intake air temperature, manifold absolute pressure and throttle position.

Throttle Body Service

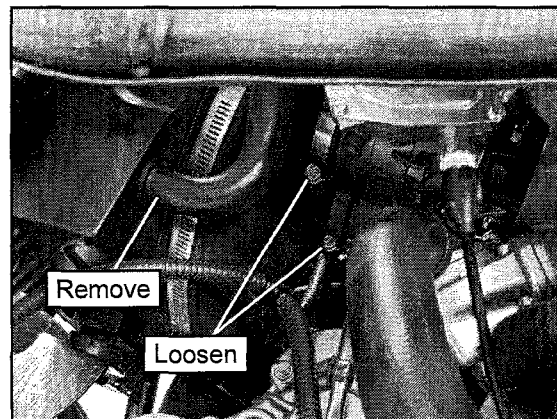
The throttle body assembly is a non-serviceable component. However, the fuel rail and fuel injectors can be serviced separately (see "Fuel Injectors"). The Manifold Air Quality Sensor (MAQS) attached to the end of the throttle body is non-serviceable. If the sensor is faulty, the entire throttle body assembly must be replaced. Refer to "Throttle Body Removal" procedure.

Throttle Body Removal

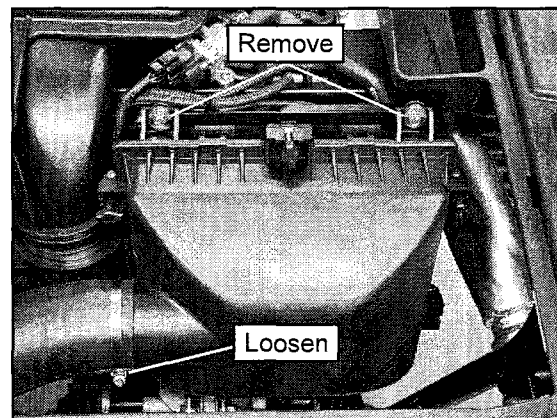
1. Remove the cargo box access panel.



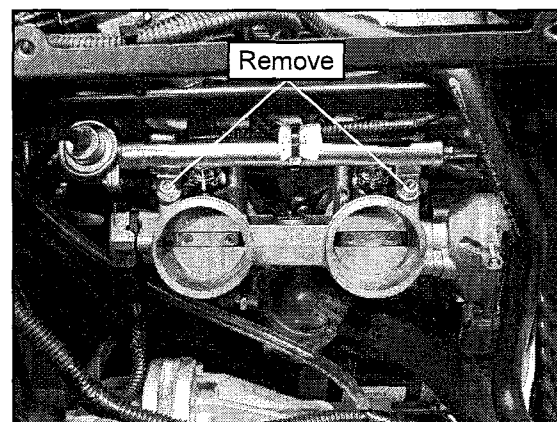
2. Be sure the engine has cooled enough to work on.
3. Remove the breather hose from the air box and loosen the hose clamps retaining the air box to the throttle body assembly.



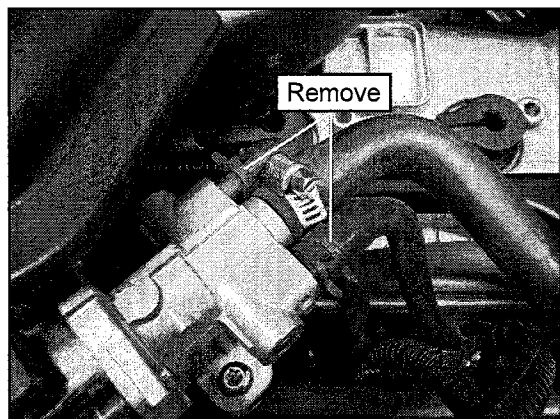
4. Remove the (2) screws retaining the air box assembly and loosen the hose clamp retaining the intake hose to the air box. Remove the air box assembly from the vehicle.



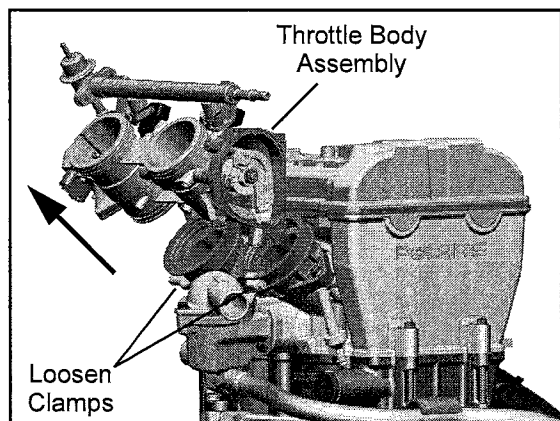
5. Remove the (2) screws that mount the fuel rail to the throttle body using a 5 mm Allen wrench.



6. Remove the (2) IAC valve hoses that are attached to the throttle body.



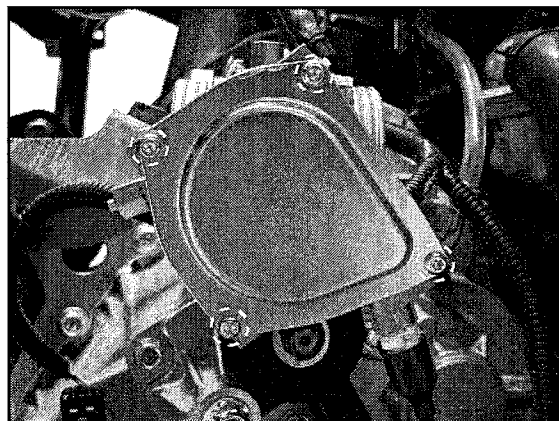
7. Loosen the (2) hose clamps that retain the dual throttle body assembly to the intake adapters. Carefully lift the throttle body assembly out of the intake adapters.



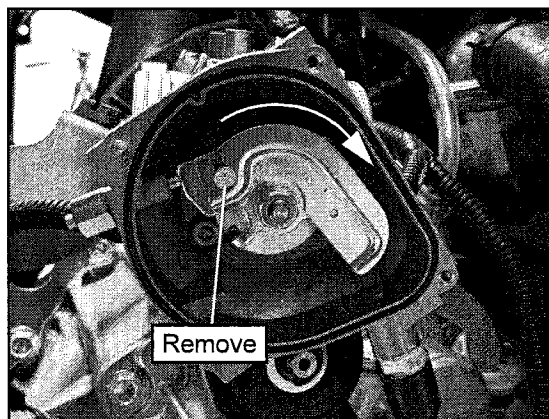
8. Lift the fuel rail and injectors out of the throttle body assembly taking care not to damage the fuel injector ends.

NOTE: It is not necessary to disconnect fuel lines or the injector harnesses to perform this procedure.

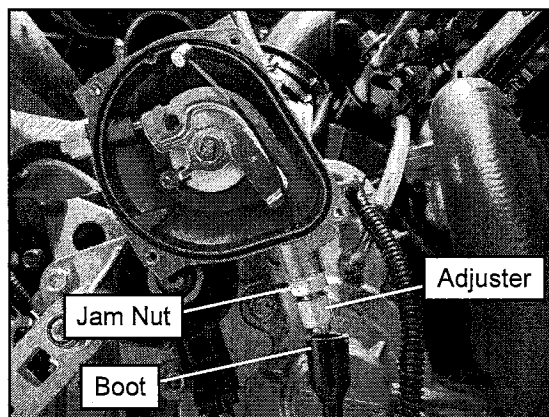
9. Remove the (4) screws retaining the throttle body cover plate using a T20 Torx driver. Remove the cover plate.



10. Rotate the throttle plate arm and remove the throttle cable end to allow for throttle cable removal.



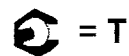
11. Slide back the cable adjuster boot. Using a 14 mm wrench, loosen the jam nut. Using a 12 mm wrench, turn the adjuster in and count the number of turns it takes to fully seat it. Note the number of turns so it can be set the same upon assembly.



12. Unscrew the throttle cable adjuster and jam nut from the throttle body. Remove the throttle body from the vehicle.

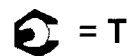
13. Reverse the previous steps to reinstall the throttle body.

14. Upon installation of the throttle cable, refer to Chapter 2 "Throttle Freeplay Adjustment". Torque the throttle body cover screws to specification.



Throttle Body Cover Screws: 18 in. lbs. (2 Nm)

15. Upon installation of the fuel rail and injectors, lightly lubricate injector O-rings to aid installation. Torque the fuel rail mounting screws to specification.



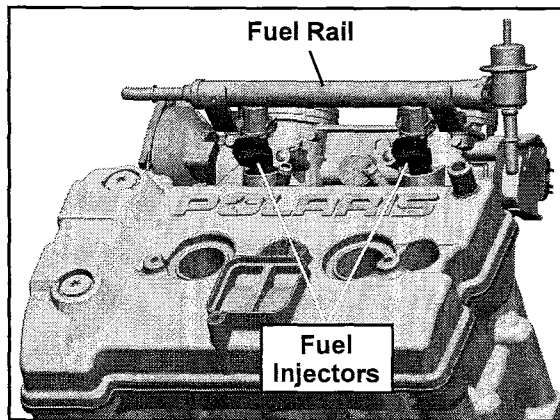
Fuel Rail Mounting Screws: 44 in. lbs. (5 Nm)

ELECTRONIC FUEL INJECTION

FUEL INJECTORS

Operation Overview

The fuel injectors are mounted into the dual throttle body assembly, with the fuel rail retaining them from the top end. O-rings on both ends of the injector prevent external fuel leaks and also insulate the injectors from heat and vibration.



When the key switch is on, the fuel rail is pressurized, and the EFI relay provides voltage to the injectors. During engine operation, the ECU completes the ground circuit, energizing the injectors. The valve needle in each injector is opened electromagnetically, and the pressure in the fuel rail forces fuel down through the inside. The “director plate” at the tip of the injector contains a series of calibrated openings which directs the fuel into the intake port in a cone-shaped spray pattern.

The amount of fuel injected is controlled by the ECU and determined by the length of time the valve needle is held open, also referred to as the “injection duration” or “pulse width”. It may vary in length depending on the speed and load requirements of the engine.

The ECU gathers fuel injection timing information from the Crankshaft Position Sensor (CPS) and the Manifold Air Quality Sensor (MAQS) to allow for sequential fuel injection.

Fuel Injector Troubleshooting

Injector problems typically fall into three general categories—electrical, dirty / clogged, or leakage. An electrical problem usually causes one or both of the injectors to stop functioning. Several methods may be used to check if the injectors are operating.

- With the engine running at idle, feel for operational vibration, indicating that they are opening and closing.
- When temperatures prohibit touching, listen for a buzzing or clicking sound with a screwdriver or mechanic's stethoscope.
- Disconnect the electrical connector from an injector and listen for a change in idle performance (only running on one cylinder) or a change in injector noise or vibration.

NOTE: Do not apply voltage directly to the fuel injector(s). Excessive voltage will burn out the injector(s). Do not ground the injector(s) with the ignition on. Injector(s) will open/turn on if relay is energized.

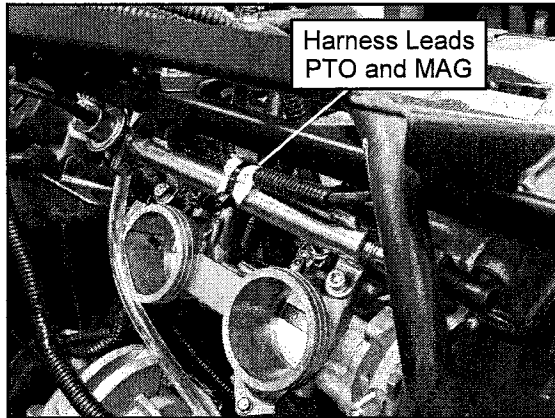
If an injector is not operating, it can indicate either a bad injector, or a wiring/electrical connection problem. Check as follows:

Injector leakage is very unlikely, but in rare instances it can be internal (past the tip of the valve needle), or external (weeping around the injector body). The loss of system pressure from the leakage can cause hot restart problems and longer cranking times.

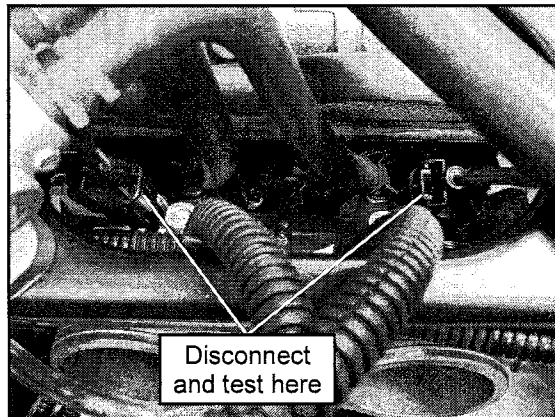
Injector problems due to dirt or clogging are unlikely due to the design of the injectors, the high fuel pressure, the use of filters and the detergent additives in the gasoline. Symptoms that could be caused by dirty/clogged injectors include rough idle, hesitation/stumble during acceleration, or triggering of fault codes related to fuel delivery. Injector clogging is usually caused by a buildup of deposits on the director plate, restricting the flow of fuel, resulting in a poor spray pattern. Some contributing factors to injector clogging include; dirty air filters, higher than normal operating temperatures, short operating intervals and dirty, incorrect, or poor quality fuel. Cleaning of clogged injectors is not recommended; they should be replaced. Additives and higher grades of fuel can be used as a preventative measure if clogging has been a problem.

Fuel Injector Test

IMPORTANT: Take note of PTO and MAG fuel injector harness connectors before disconnecting them. The harness leads are marked with PTO and MAG identifiers.



The fuel injectors are non-serviceable. If diagnosis indicates a problem with either injector, test the resistance of the fuel injector(s) by measuring between the two pin terminals:

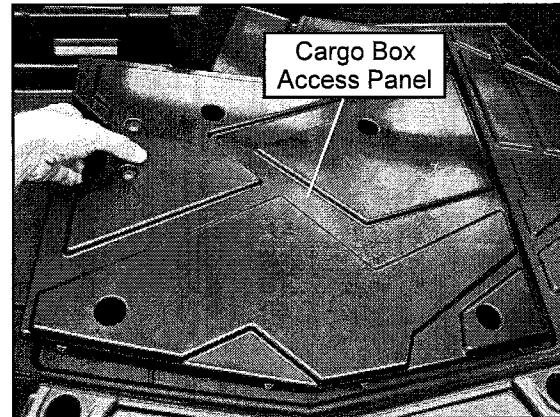


Fuel Injector Resistance Specification:
 $11.4 \Omega - 12.6 \Omega$

IMPORTANT: Be sure to connect the PTO harness lead to the PTO injector and the MAG harness lead to the MAG injector to ensure proper engine operation.

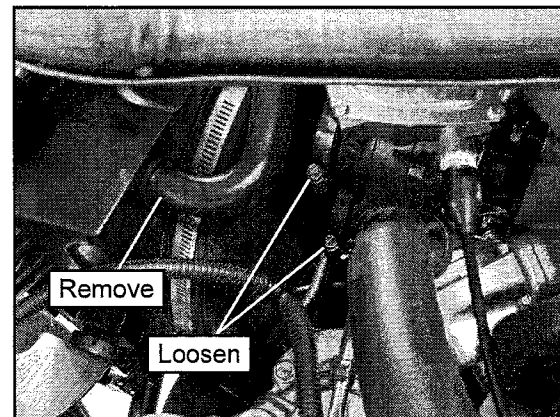
Fuel Injector Replacement

1. Remove the cargo box access panel.

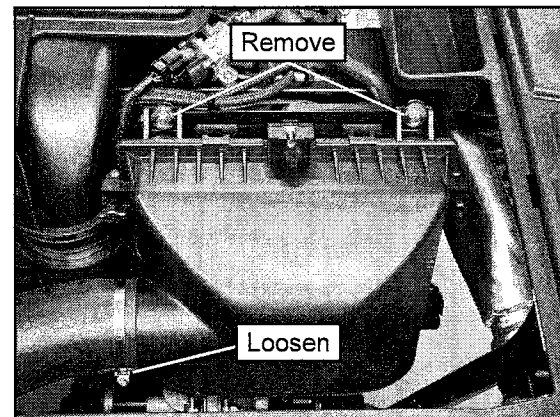


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2. Be sure the engine has cooled enough to work on.
3. Remove the breather hose from the air box and loosen the hose clamps retaining the air box to the throttle body assembly.

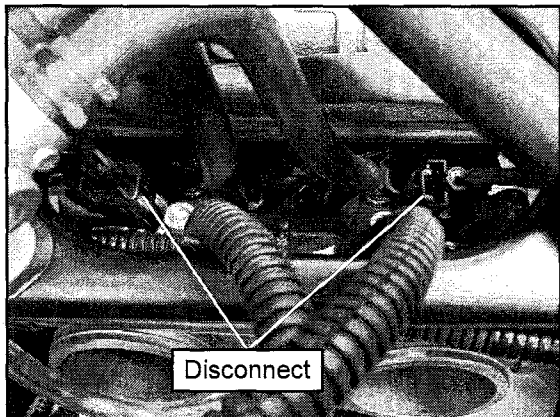


4. Remove the (2) screws retaining the air box assembly and loosen the hose clamp retaining the intake hose to the air box. Remove the air box assembly from the vehicle.

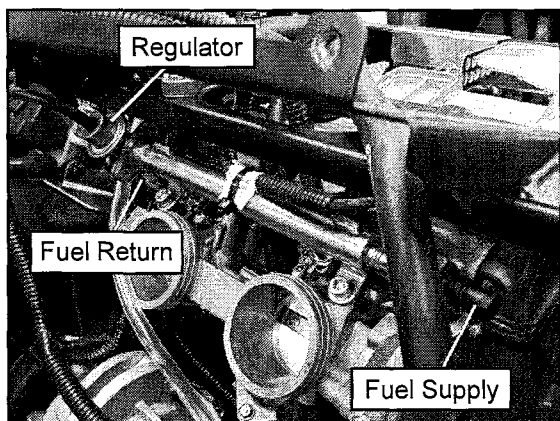


ELECTRONIC FUEL INJECTION

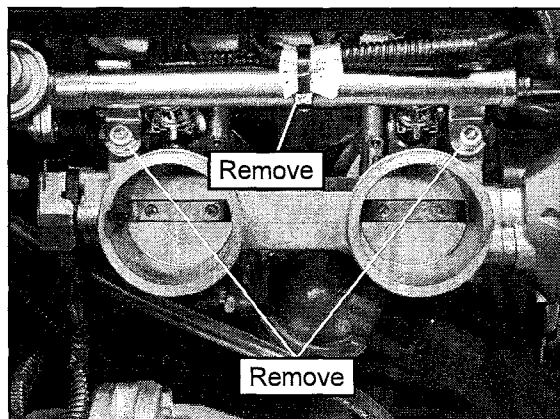
5. Remove the driver's seat and disconnect the negative battery cable.
6. Disconnect the fuel injector harness leads.



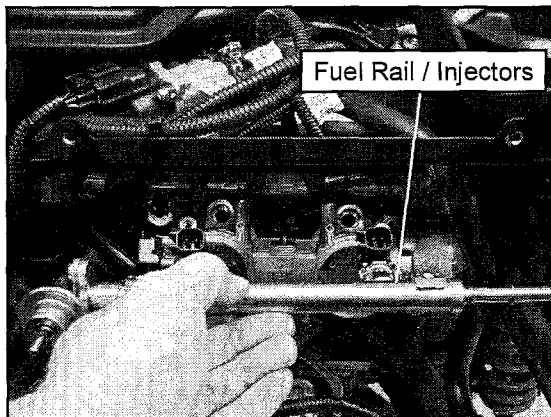
7. Hold a shop towel over the fuel line fittings and remove the fuel return and supply lines from each end of the fuel rail. Remove the vent line from the fuel pressure regulator.



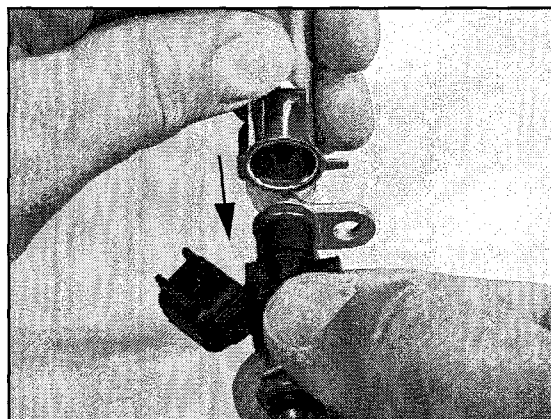
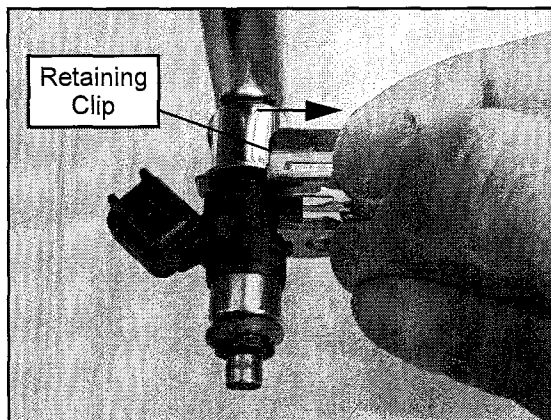
8. Remove the tie strap retaining the injector harness leads to the fuel rail. Remove the (2) screws that mount the fuel rail to the throttle body using a 5 mm Allen wrench.



9. Carefully pull up on the fuel rail and injectors and remove them from the throttle body as an assembly. Take care not to damage the fuel injector ends during removal.

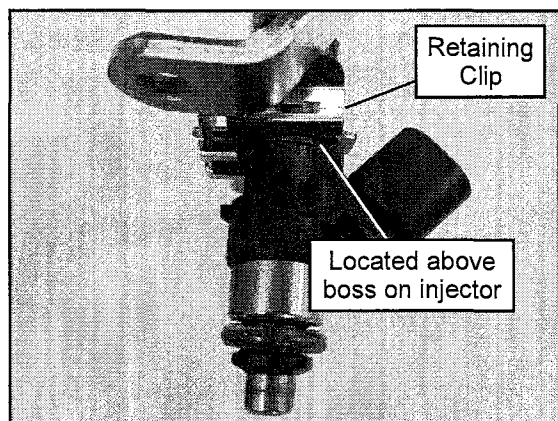


10. Pull out on the fuel injector retaining clip and pull the injector out of the fuel rail. Repeat on the other injector if removal is necessary.



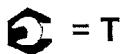
11. Upon installation of the new fuel injectors, lightly lubricate the injector O-rings to aid installation.

12. Install the new injector(s) into the fuel rail and reinstall the retaining clip.



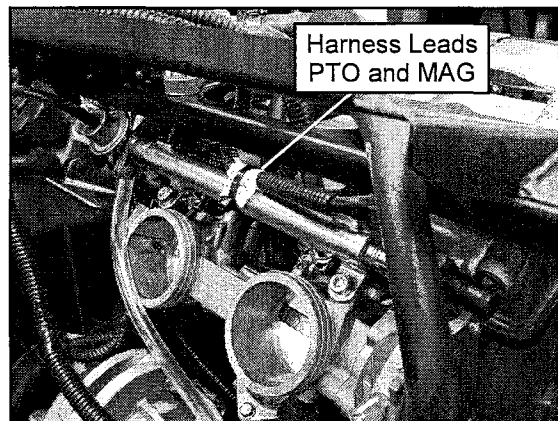
NOTE: Be sure the retaining clip is positioned on the injector and fuel rail as shown above.

13. Thoroughly clean the area around the fuel injector ports on the throttle body.
14. Lightly lubricate the injector O-rings and reinstall the fuel rail / injector assembly into the throttle body.
15. Install the fuel rail mounting screws and torque to specification.



Fuel Rail Mounting Screws: 44 in. lbs. (5 Nm)

16. Reinstall the fuel lines and vent line to the fuel rail.
 17. Connect the harness leads to the fuel injectors.
- IMPORTANT:** Be sure to connect the PTO harness lead to the PTO injector and the MAG harness lead to the MAG injector to ensure proper engine operation.
18. Use a tie strap to retain the harness leads to the fuel rail.

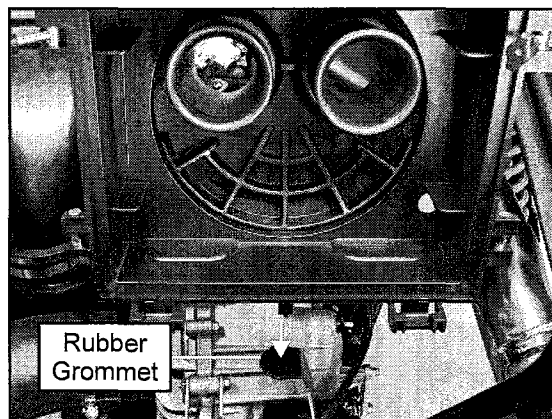


19. Reconnect the negative battery cable and reinstall the driver's seat.

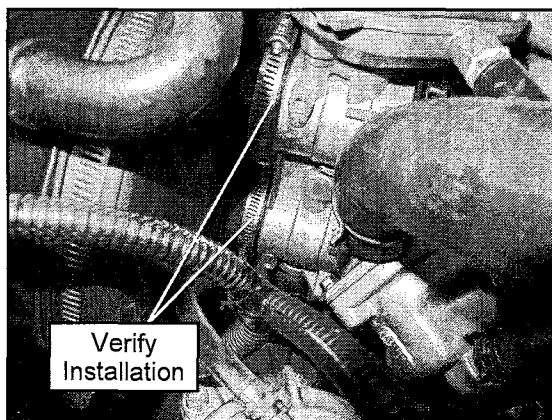
20. Start the engine briefly and inspect the fuel rail and injectors for fuel leaks.

21. Reinstall the air box assembly:

- Be sure the lower air box post is placed properly into the rubber grommet.



- Be sure the air box boots fully seat onto the dual throttle body before tightening the hose clamps.



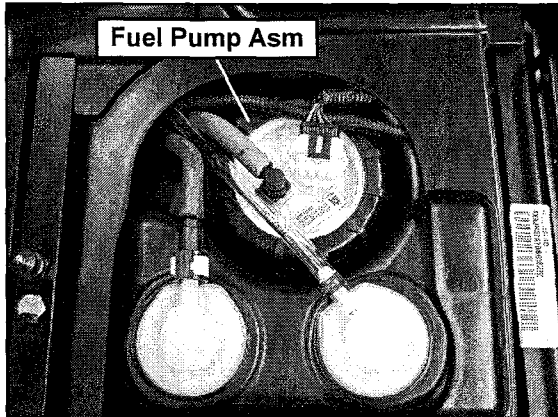
22. Reinstall the breather into the air box and tighten the hose clamps retaining the air box to the throttle body assembly.
23. Reinstall the (2) screws retaining the air box assembly.
24. Position the intake hose onto the air box and tighten the hose clamp.
25. Reinstall the cargo box access panel.

ELECTRONIC FUEL INJECTION

FUEL PUMP

Operation Overview

An electric fuel pump assembly is used to transfer fuel to the EFI system from inside the fuel tank. This assembly includes the fuel pump, fuel filters, regulator and fuel gauge sender. The pump is rated for a minimum output of 25 liters per hour at 43.5 ± 2 psi and has two non-serviceable fuel filters.



The ECU switches off the pump preventing the continued delivery of fuel in these instances:

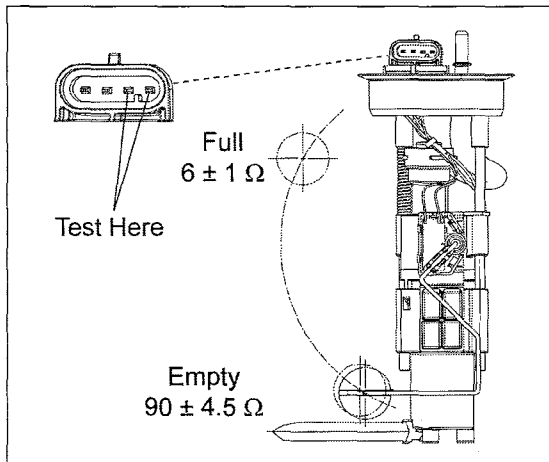
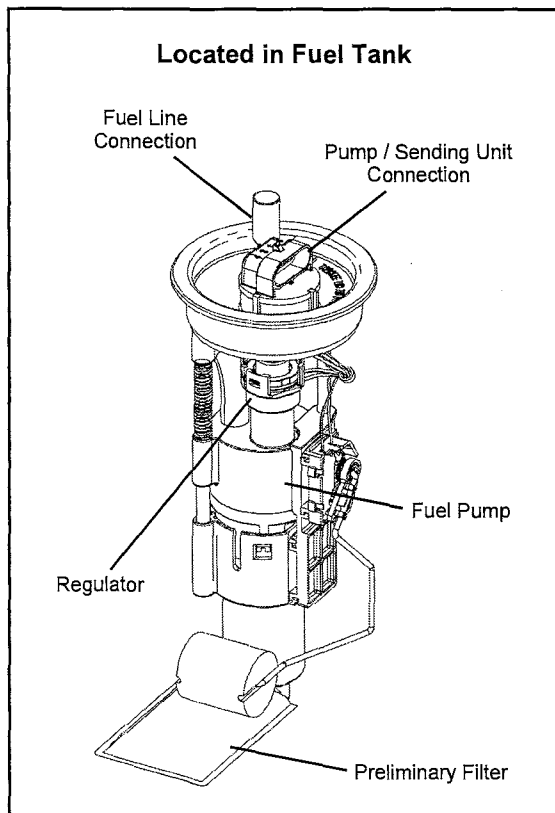
- If the key switch is not promptly turned to the "start" position.
- If the engine fails to start.
- If the engine is stopped with the key switch "on" (as in the case of an accident).

In these situations, the "check engine" light will go on, but will turn off after 4 cranking revolutions if system function is OK. Once the engine is running, the fuel pump remains on.

Fuel Sender Test

If the fuel gauge reading on the instrument cluster is not working, or if the display reading differs in large comparison to the fuel in the tank, perform a resistance test on the fuel sender.

Disconnect the fuel pump / sending unit connection and measure the resistance. If out of specification, replace the fuel pump assembly.



Fuel Sender Resistance Specifications:

Full: $6 \pm 1 \Omega$
Empty: $90 \pm 4.5 \Omega$

When the key switch is turned to "ON", the ECU activates the fuel pump, which pressurizes the system for start-up.

Fuel Pump Test

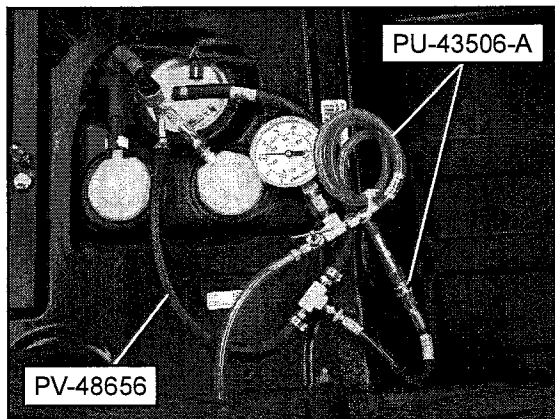
If a fuel delivery problem is suspected, make certain the fuel pump filters are not plugged, that the pump is being activated through the ECU, all electrical connections are properly secured, the fuses are good, and a minimum of 7.0 volts is being supplied. If during starting the battery voltage drops below 7.0 volts, the ECU will fail to operate the system.



WARNING

Fuel is extremely flammable and may cause severe burns, injury, or death. Do not use any device that produces a flame or electrical devices that may spark around fuel or fuel vapors.

1. Remove the passenger seat from the vehicle.
2. Cover the fuel line connection at the fuel tank with a shop towel and disconnect the line from the fuel pump outlet.
3. Install the Fuel Pressure Gauge Adapter (PV-48656) in-line between the fuel pump outlet and fuel line.
4. Connect the hose from the Fuel Pressure Gauge Kit (PU-43506-A) to the test valve on the Fuel Pressure Gauge Adapter (PV-48656). Route the clear hose into a portable gasoline container or the vehicle's fuel tank.

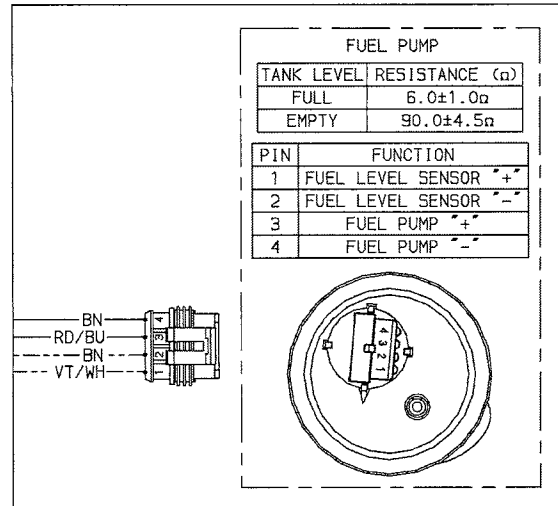


5. Turn on the key switch to activate the pump and check the system pressure on the gauge. If system pressure of 43.5 ± 2 psi is observed, the ignition switch, ECU, fuel pump, and pressure regulator are working properly. Turn the key switch off and depress the valve button on the tester to relieve the system pressure.

Normal Fuel Pressure: 43.5 ± 2 psi.

NOTE: If the fuel pressure is out of specification, replace the fuel pump assembly.

6. If the pump did not activate (Step 5), disconnect the harness connector from the fuel pump. Connect a DC voltmeter across terminals "3" and "4" in the plug on the vehicle fuel pump harness. Turn on the key switch and observe voltage to ensure a minimum of 7 volts is present.



NOTE: If the voltage was below 7 VDC, test the battery, ignition switch, relay(s), wiring harness and ECU.

7. If the reading is between 7 and 14 volts, turn key switch off and connect an ohmmeter between terminals "3" and "4" at the white fuel pump connector to check for continuity within the fuel pump.

NOTE: If there was no continuity between the pump terminals, replace the fuel pump assembly.

8. If voltage at the plug was within the specified range, and there was continuity across the pump terminals, reconnect the plug to the fuel pump, making sure you have a clean connection. Turn on the key switch and listen for the pump to activate.

NOTE: If the pump starts, repeat steps 3, 4 and 5 to verify correct pressure.

9. If the pump still does not operate, check for correct ECU operation by plugging in a known-good ECU of the same model.

NOTE: If the pump still does not operate, replace the fuel pump assembly.

ELECTRONIC FUEL INJECTION

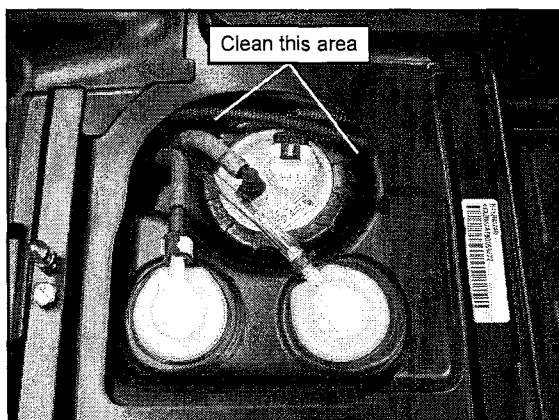
Fuel Pump Replacement

1. Move the vehicle to a well ventilated area. Shift the transmission into Park and turn the ignition key off.
2. Remove the passenger seat to access the fuel pump.

WARNING

Always wear safety goggles when working with high pressure or flammable fluids. Failure to do so could result in serious injury or complications.

3. Be sure the top of the fuel tank is clean. If it requires cleaning, hand wash the top of the tank to ensure no debris will enter the fuel system when the fuel pump is removed.



CAUTION

Failure to clean area around fuel pump may lead to debris entering the fuel tank during service. Excessive debris in fuel tank may cause premature wear of fuel pump and/or clogging of internal fuel filters.

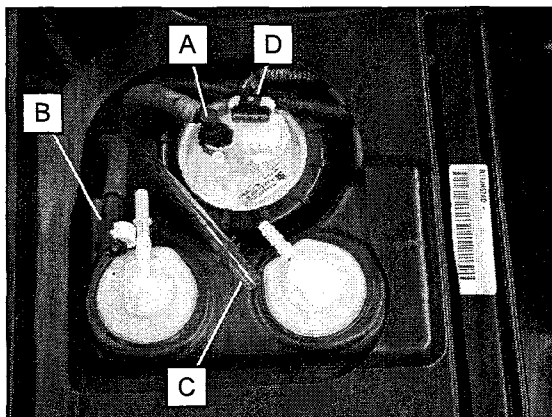
4. Ensure that static has been discharged from you by touching a ground source such as the engine or frame.
5. While holding a shop towel over the fuel line connectors, disconnect the fuel supply line (A) from the pump and the fuel return line (B) from the tank (see "Fuel Lines - Quick Connect Fittings" for specific removal procedures).

CAUTION

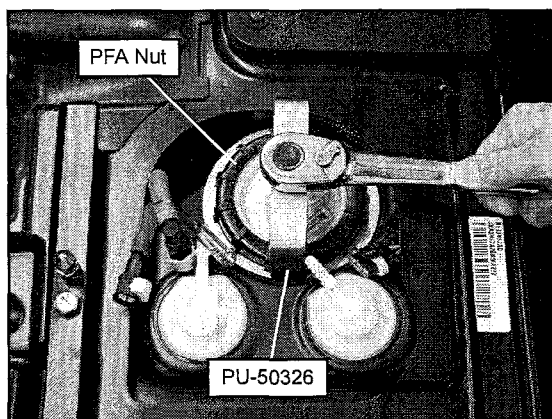
It is possible for pressurized fuel to be present when disconnecting the fuel line. It is recommended to allow the vehicle to sit for a period of one hour after shutting off the engine before servicing the fuel pump. This allows the exhaust to cool and fuel pressure to drop.

NOTE: A small amount of fuel may come out of the fuel lines or pump fitting. Properly drain fuel into a suitable container.

6. Remove the fuel tank vent line (C) from the tank fitting.
7. Disconnect the fuel pump electrical harness (D).

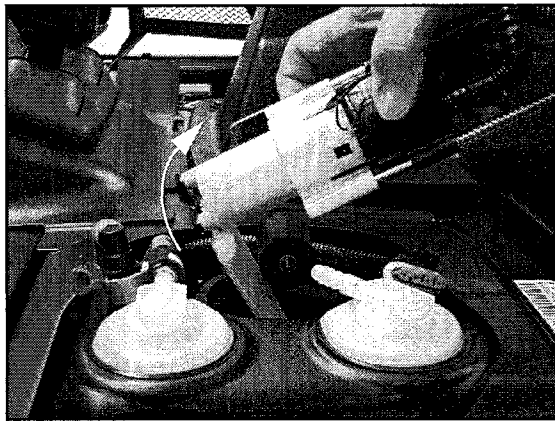
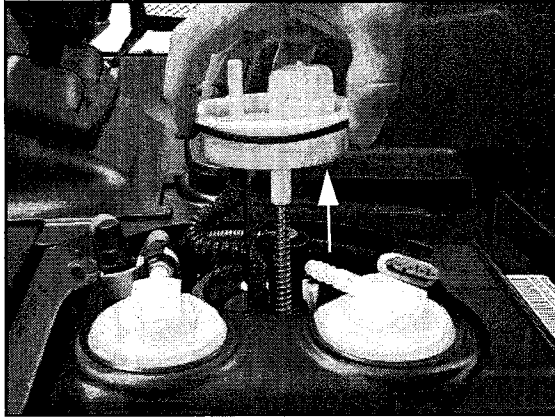


8. Place the Fuel Pump Service Tool (PU-50326) over the fuel pump PFA nut. Using a 1/2" drive ratchet or breaker bar, loosen and remove the PFA nut. Discard the PFA nut.



NOTE: Apply downward force on the fuel pump flange while removing the fuel pump PFA nut.

9. Carefully lift the fuel pump out of the fuel tank. As the fuel pump assembly is being removed, be aware of float arm and pump pre-filter. Hold the float arm to the pump body as you lift and tilt the pump to ensure that the float arm is not bent when removed from the tank.

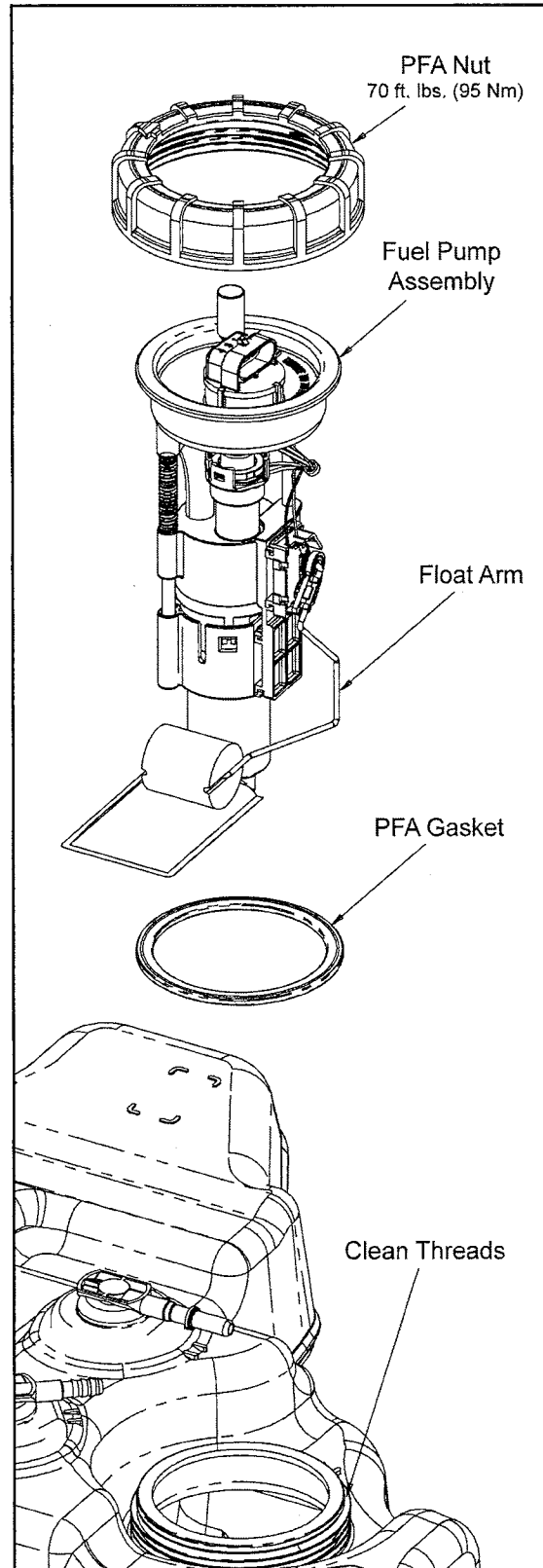


10. Transfer old fuel pump to a suitable container capable of safely holding fuel. The fuel pump will retain some fuel.
11. Inspect the inside of the fuel tank for debris (may require flashlight and mirror). If debris like mud or sand is present, fuel tank should be flushed and cleaned out prior to installation of new fuel pump assembly.

IMPORTANT: It is recommended to remove the fuel tank from the vehicle and rinse it with a small amount of clean fuel. Do not use water or any other chemicals to remove debris.

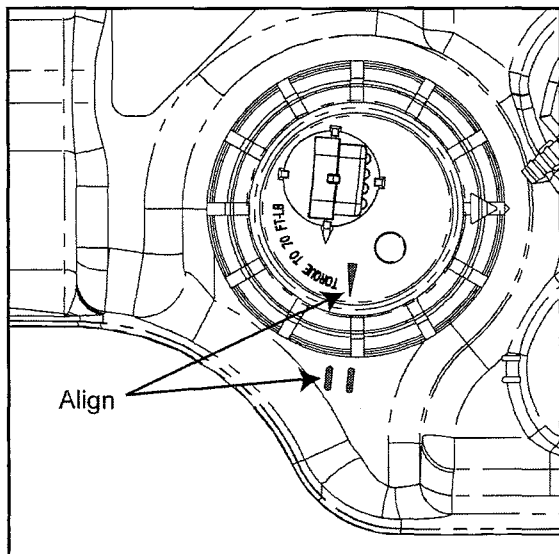
12. Remove new fuel pump assembly, gasket and PFA nut from packaging. Use care not to bend float arm during unpacking. Do not lift or carry fuel pump assembly by the float arm.
13. Use cleaning wipes provided to clean fuel tank surface and threads. Remove all debris, grease and oil. Allow surfaces to dry completely.

14. Install new PFA gasket onto fuel pump assembly using care not to damage gasket or bend float arm.



ELECTRONIC FUEL INJECTION

15. Install fuel pump into fuel tank, hold float arm to the pump body and tilt assembly to ensure float arm does not get caught or bent during installation.
16. Gently push down on fuel pump flange ensuring flange is centered.
17. Roughly align orientation mark on fuel pump between the orientation marks on fuel tank to ensure float arm does not get bent or snagged.

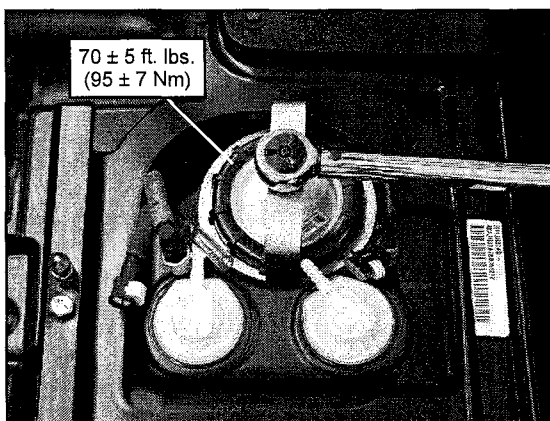


CAUTION

Failure to align the orientation marks may lead to interferences with the fuel level float arm and cause incorrect function.

18. While maintaining downward pressure, thread new PFA nut onto fuel tank and hand tighten. Use care when starting PFA nut, ensuring threads are properly aligned. Verify orientation marks are still aligned between fuel pump and fuel tank.

19. Torque PFA nut to specification using the Fuel Pump Service Tool (PU-50326) and a calibrated torque wrench.



Fuel Pump PFA Nut:
70 ± 5 ft. lbs. (95 ± 7 Nm)

20. Verify alignment of fuel pump and tank orientation marks.
21. Connect the fuel supply line to the pump and the fuel return line to the tank (see "Fuel Lines - Quick Connect Fittings" for specific installation procedures).

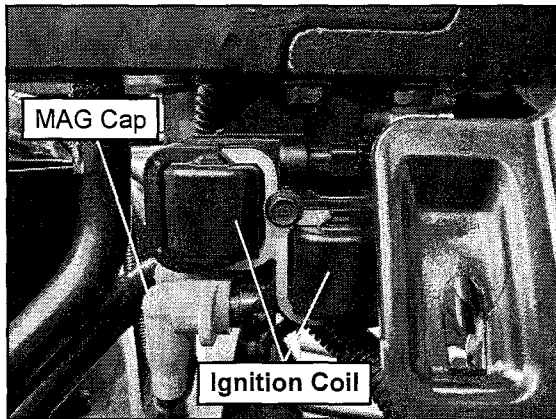
IMPORTANT: Be sure to engage the retainers on each fuel line until each snaps into place. Pull on fuel lines lightly to confirm connection.

22. Install the fuel tank vent line onto the tank fitting.
23. Connect the fuel pump electrical harness.
24. Test the fuel pump by turning on the key and listening for the pump to activate. Cycle the key several times to prime the system.
25. Install the passenger seat.

IGNITION COIL

Operation Overview

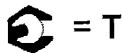
The ignition coil is used to provide high voltage to fire the spark plugs. When the ignition key is on, DC voltage is present in primary side of the ignition coil windings. During engine rotation, an AC pulse is created within the crankshaft position sensor for each passing tooth on the flywheel's encoder ring. The encoder ring missing tooth creates an "interrupt" input signal, corresponding to specific crankshaft position. This signal serves as a reference for the control of ignition timing. The ECU then calculates the time interval between the consecutive pulses, and determines when to trigger the voltage spike that induces the voltage from the primary to the secondary coil windings to fire the spark plugs.



Ignition Coil / HT Lead Replacement

IMPORTANT: The engine will misfire if the spark plug wires are installed incorrectly. The spark plug wires are marked with PTO and MAG from the factory and should be installed to the corresponding cylinder and ignition coil post.

1. Remove the seats and engine service panel to access the ignition coil.
2. Disconnect the ignition coil harness and remove the high tension leads from the coil.
3. Remove the fastener retaining the ignition coil and remove it from the vehicle. If replacing the high tension lead(s), remove the other end of the lead(s) from the spark plug.
4. Install the new ignition coil and/or high tension lead(s).



Ignition Coil Retaining Bolt: 75 in. lbs. (8.5 Nm)

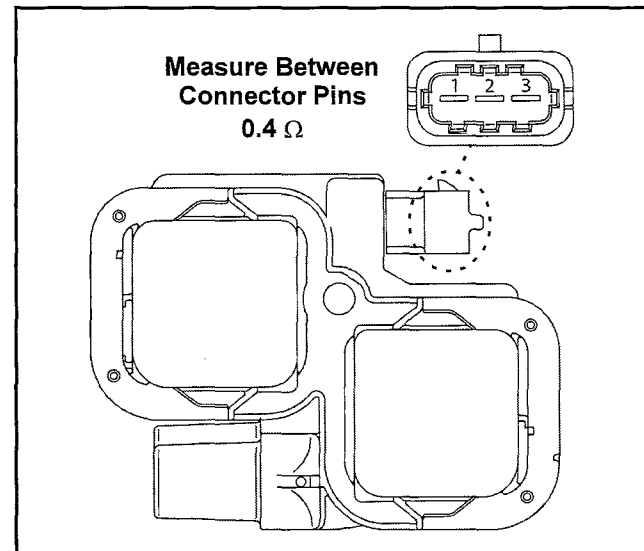
Ignition Coil Tests

The ignition coil can be tested by using an ohm meter. Use the following illustration and specification table to test the ignition coil resistance.

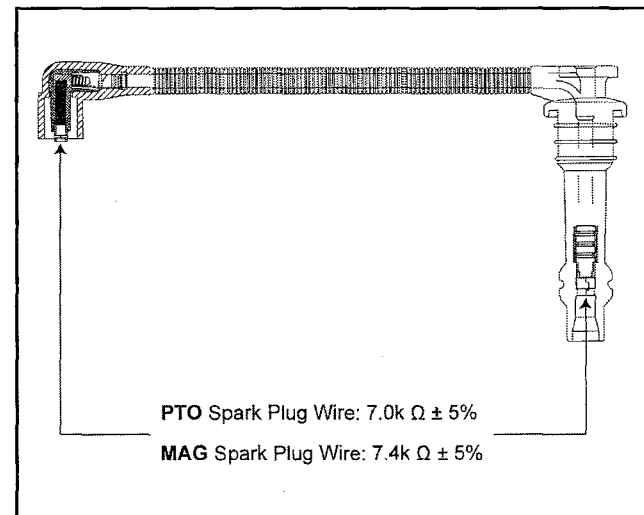
Ignition Coil Resistance Readings

Test	Pin Connection	Resistance
Primary	Between 1 & 2 Between 2 & 3	0.4 Ω
Secondary (PTO)	Between High Tension Lead Caps	7.0k $\Omega \pm 5\%$
Secondary (MAG)	Between High Tension Lead Caps	7.4k $\Omega \pm 5\%$

Primary Test



Secondary Test



ELECTRONIC FUEL INJECTION

EFI DIAGNOSTICS

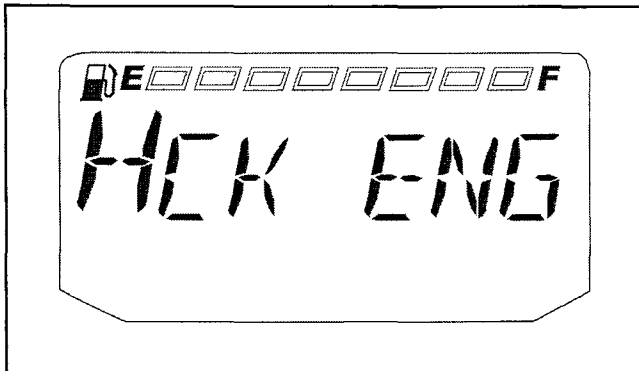
Instrument Cluster Trouble Code Display

NOTE: The diagnostic mode is accessible only when the check engine MIL has been activated.

Use the following procedure to display diagnostic trouble codes that were activated during current ignition cycle causing the MIL to illuminate. Diagnostic trouble codes will remain stored in the gauge (even if MIL turns off) until the key is turned off.

NOTE: If there is a diagnostic problem with the power steering system, the power steering MIL will illuminate and blink in place of the check engine MIL.

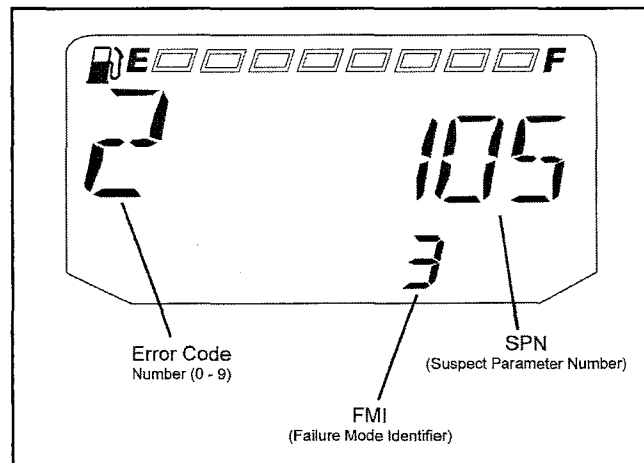
1. If the trouble code(s) are not displayed, use the MODE button to toggle until "CK ENG" displays on the information display area.



2. Press and hold the MODE button to enter the diagnostics code menu.

3. A set of three numbers will appear in the information area.

- The first number (located far left) can range from 0 to 9. This number represents the total number of trouble code present (example: 2 means there are 3 codes present).
- The second number (located top right) can be 2 to 6 digits in length. This number equates to the suspected area of fault (SPN).
- The third number (located bottom right) can be 1 to 2 digits in length. This number equates to the fault mode (FMI).



4. If more than one code exists, press the MODE button to advance to the next trouble code.
5. To exit the diagnostic mode, press and hold the MODE button or turn the ignition key OFF once the codes are recorded.

DIAGNOSTIC TROUBLE CODE TABLE

Component	Condition	SPN	FMI	Digital Wrench™ P-Code
Throttle Position (MAQS)	Voltage Too High	51	3	P0123
	Voltage Too Low		4	P0122
Vehicle Speed Signal	Data Erratic or Intermittent (or missing)	84	2	P0503
	Received Vehicle Speed Has Error		19	C1069
Manifold Absolute Pressure (MAQS)	Voltage Too High	102	3	P0108
	Voltage Too Low		4	P0107
Intake Air Temperature (MAQS)	Voltage Too High	105	3	P0113
	Voltage Too Low		4	P0112
Engine Temperature Sensor (ECT)	Voltage Too High	110	3	P0118
	Voltage Too Low		4	P0117
	Temperature Too High		16	P0217
	Engine Overheat Shutdown		0	P1217

DIAGNOSTIC TROUBLE CODE TABLE

Component	Condition	SPN	FMI	Digital Wrench™ P-Code
System Power (Battery Potential / Power Input)	Voltage Too High	168	3	P0563
			C1063	
	Voltage Too Low		4	P0562
			C1064	
Engine Speed (This is applicable when the EPS module gets the engine speed from the ECM)	Received Engine Speed Has Error	190	19	C1066
Gear Sensor Signal	Voltage Too Low	523	4	P0916
ECU Memory	EEPROM: Read/Write Failure	628	12	C1073
Crankshaft Position Sensor (CPS)	Plausibility Fault	636	2	P0335
Injector 1 (MAG)	Driver Circuit Open / Grounded	651	5	P0261
	Driver Circuit Short to B+		3	P0262
	Driver Circuit Grounded		4	P1262
Injector 2 (PTO)	Driver Circuit Open / Grounded	652	5	P0264
	Driver Circuit Short to B+		3	P0265
	Driver Circuit Grounded		4	P1265
Rear Differential Output (if equipped w/TURF)	Driver Circuit Open / Grounded	746	5	P1691
	Driver Circuit Short to B+		3	P1692
	Driver Circuit Grounded		4	P1693
Fan Relay Driver Circuit	Driver Circuit Open / Grounded	1071	5	P1481
	Driver Circuit Short to B+		3	P1482
	Driver Circuit Grounded		4	P1483
Ignition Coil Primary Driver 1 (MAG)	Driver Circuit Short to B+	1268	3	P1353
Ignition Coil Primary Driver 2 (PTO)	Driver Circuit Short to B+	1269	3	P1354
Fuel Pump Driver Circuit	Driver Circuit Open / Grounded	1347	5	P0230
	Driver Circuit Short to B+		3	P0232
	Driver Circuit Grounded		4	P0231
ECU Output Supply Voltage 1	Voltage Too High	3597	3	P16A2
	Voltage Too Low		4	P16A1
ECU Output Supply Voltage 2	Voltage Too High	3598	3	P16A9
	Voltage Too Low		4	P16A8
All Wheel Drive Control Circuit (AWD)	Driver Circuit Open / Grounded	520207	5	P1836
	Driver Circuit Short to B+		3	P1835
	Driver Circuit Grounded		4	P1834
Steering Over Current Shut Down (if equipped w/EPS)	Current Above Normal or Grounded	520221	6	C1050
Steering Excessive Current Error (if equipped w/EPS)	Current Above Normal or Grounded	520222	6	C1051

ELECTRONIC FUEL INJECTION

DIAGNOSTIC TROUBLE CODE TABLE

Component	Condition	SPN	FMI	Digital Wrench™ P-Code
Steering Torque Partial Failure (if equipped w/EPS)	Condition Exists	520223	31	C1052
Steering Torque Full Failure (if equipped w/EPS)	Condition Exists	520224	31	C1053
EPS Inverter Temperature (if equipped w/EPS)	Greater than 110° C (230° F)	520225	16	C1054
	Greater than 120° C (248° F)		0	C1055
EPS CAN Communications Receive Error (if equipped w/EPS)	No RX Message for 2 Seconds	520226	2	U0100
EPS CAN Communications Transmit Error (if equipped w/EPS)	No TX Message for 2 Seconds	520227	2	U1100
Position Encoder Error (if equipped w/EPS)	Position Encoder Error	520228	11	C1065
EPS Software Error (if equipped w/EPS)	Software Error	520229	12	C1070
IC CAN Communication with EPS (if equipped w/EPS)	EPS Off Line (EPS DM1 not seen)	520230	31	U0131
Idle Air Control Valve (IAC) M17; IAC Stepper Pin 1	Driver Circuit Open / Grounded	520267	5	P1505
	Driver Circuit Short to B+		3	P1509
	Driver Circuit Grounded		4	P1508
Idle Air Control Valve (IAC) M17; IAC Stepper Pin 3	Driver Circuit Open / Grounded	520268	5	P1515
	Driver Circuit Short to B+		3	P1519
	Driver Circuit Grounded		4	P1518
Idle Air Control Valve (IAC) M17; IAC Stepper Pin 4	Driver Circuit Open / Grounded	520269	5	P1525
	Driver Circuit Short to B+		3	P1529
	Driver Circuit Grounded		4	P1528
Idle Air Control Valve (IAC) M17; IAC Stepper Pin 6	Driver Circuit Open / Grounded	520270	5	P1535
	Driver Circuit Short to B+		3	P1539
	Driver Circuit Grounded		4	P1538

EFI Troubleshooting

Fuel Starvation / Lean Mixture

Symptoms: Hard start or no start, bog, backfire, popping through intake / exhaust, hesitation, detonation, low power, spark plug erosion, engine runs hot, surging, high idle, idle speed erratic.

- No fuel in tank
- Restricted tank vent, or routed improperly
- Fuel lines or fuel injectors restricted
- Fuel filter plugged
- Fuel pump inoperative
- Air leak in system
- Intake air leak (throttle shaft, intake ducts, air box cover)

Rich Mixture

Symptoms: Fouls spark plugs, black, sooty exhaust smoke, rough idle, poor fuel economy, engine runs rough/ misses, poor performance, bog, engine loads up, backfire.

- Air intake restricted (inspect intake duct)
- Air filter dirty/plugged
- Poor fuel quality (old fuel)
- Fouled spark plug
- Injector failure

Poor Idle

Symptom: Idle Too High (if > 1400 RPM when warm).

- Throttle stop screw tampering
- Throttle cable sticking, improperly adjusted, routed incorrectly

Symptom: Idle Too Low (if < 1100 RPM when warm).

- Plugged air filter
- Leaking injector (rich condition)
- Belt dragging
- Throttle stop screw tampering

Symptom: Erratic Idle.

- Throttle cable incorrectly adjusted
- Air Leaks, dirty injector
- MAQS damaged (check with Digital Wrench™)
- Tight valves (low compression or high leakdown)
- Ignition timing incorrect
- Belt dragging
- Dirty air filter
- High percentage of cylinder leakdown (worn engine)
- Low compression (worn engine)
- Spark plug(s) fouled
- Spark plug wires loose or worn

ELECTRONIC FUEL INJECTION

DIGITAL WRENCH™ OPERATION

Digital Wrench™ Diagnostic Software Overview

IMPORTANT: Refer to Section 2, 3 and 4 in the Instruction Manual provided in the Digital Wrench™ Diagnostic Kit to install the Polaris Digital Wrench™ diagnostic software on your computer.

The Digital Wrench™ diagnostic software allows the technician to perform the following tests and observations:

- View or clear trouble codes
- Analyze real-time engine data
- Reflash ECU calibration files
- Perform guided diagnostic procedures
- Create customer service account records
- Perform output state control tests (on some models)

Special Tools (also refer to page 4.2)

DIGITAL WRENCH™ DIAGNOSTIC SOFTWARE	PART NUMBER
Digital Wrench™ Diagnostic Kit	PU-47063-A
PU-47063-A (listed above) INCLUDES:	Digital Wrench™ Software: PU-48731
	Standard Interface Cable: PU-47151
	SmartLink Module Kit: PU-47471
Fuel Pressure Gauge Kit	PU-43506-A
Fuel Pressure Gauge Adapter	PV-48656
Fluke 73 Digital Multi-Meter or Fluke 77 DMM	PV-43546 (Fluke 77: PV-43568)
Laptop or Desktop Computer USB/Serial Adapter: Saelig RS-232	Commercially Available (refer to diagnostic software user manual or HELP section for minimum requirements)

Diagnostic Software Version

Always use the most current version of the Digital Wrench™ software to ensure you have the latest updates or enhancements. New reprogramming files and guided diagnostic procedures are added to these updates as they become available. For information on how to determine if you have the latest update available, refer to "Digital Wrench™ Version and Update ID".

ECU Replacement

Although the need for ECU replacement is unlikely, a specific replacement procedure is required to ensure that all essential data contained within the original ECU is transferred to the replacement ECU.

Refer to procedure and carefully follow all instructions provided in Digital Wrench™.

Guided Diagnostic Available

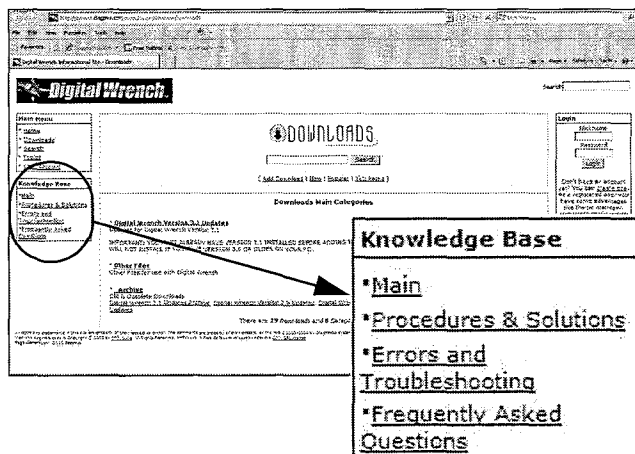
Guided diagnostics are available within Digital Wrench™ for all supported Trouble Codes (that is, any fault that will turn on the 'Check Engine' indicator).

In addition, guided diagnostics are also available for many other electrical sub systems.

Diagnostic procedures are added to subsequent versions of Digital Wrench™ as they become available. Check your release version often and upgrade when available to be sure you are using the most current software available.

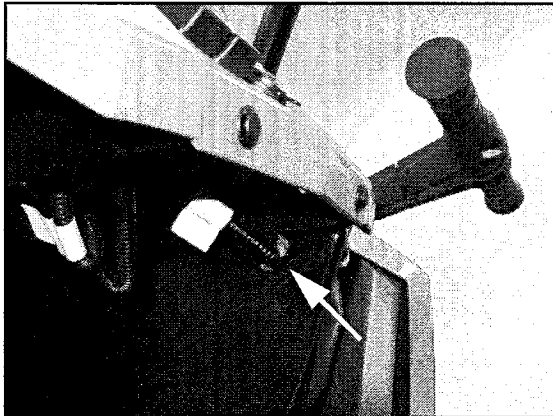
Digital Wrench™ Communication Errors

If you experience problems connecting to a vehicle or any Digital Wrench™ related problem, visit the Digital Wrench™ Knowledge Base for the most current troubleshooting information, FAQs, downloads and software updates at: <http://polaris.diagsys.com/>.



Digital Wrench™ - Diagnostic Connector

Located under the dash connected to a sealed plug.

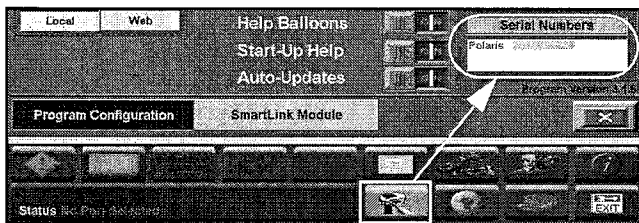


Follow these steps to connect the diagnostic interface cable to the vehicle to allow Digital Wrench™ use:

1. Assemble the SmartLink Module and attach the PC Interface Cable to your laptop (see page 4.3).
2. Remove the protective cap from the Digital Wrench™ connector.
3. Connect the Vehicle Interface Cable to the Digital Wrench™ diagnostic connector.
4. Turn the ignition key to the 'ON' position, select the appropriate vehicle and wait for the status to display 'Connected' in the lower left corner of the screen.
5. Once connected, proceed with using Digital Wrench™.

Digital Wrench™ Serial Number Location

Open the configuration screen by clicking on the wrench icon. The serial number is located on the right side of the screen.

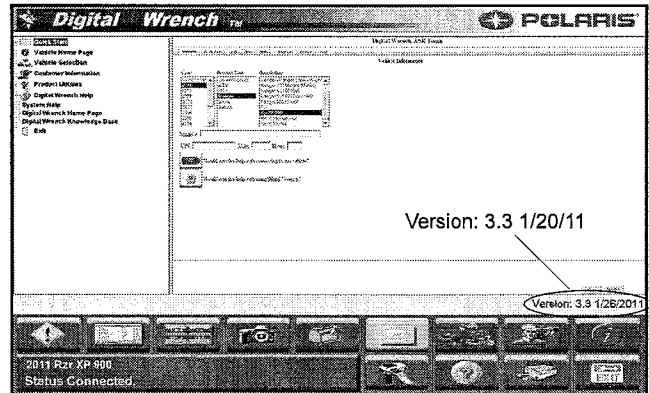


Digital Wrench™ Version and Update ID

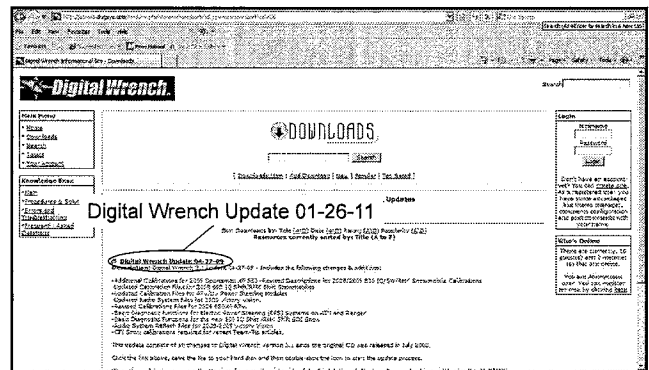
Knowing what Digital Wrench™ version and update is installed will help determine which updates are required.

NOTE: Versions and updates are subject to change.

1. Open the Digital Wrench™ software. Locate the version ID shown on the lower right side of the Digital Wrench™ start-up screen.



2. In this case, the version number is 3.3 with a 1/20/11 update. Proceed to <http://polaris.diaagsys.com> to see if a newer update is available.



3. In this case, a newer update (01-26-11) is available and should be downloaded before using Digital Wrench™ (see "Digital Wrench™ Updates").

IMPORTANT: Always operate with the latest update.

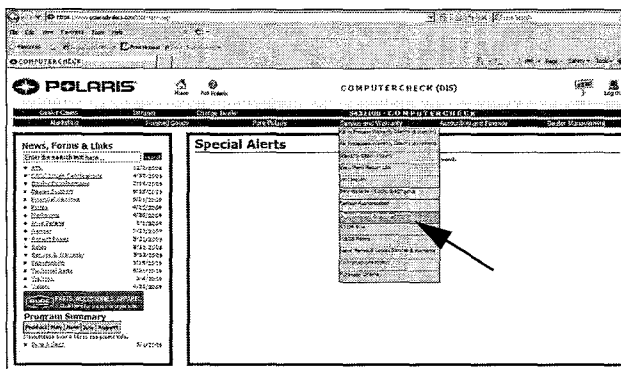
ELECTRONIC FUEL INJECTION

Digital Wrench™ Updates

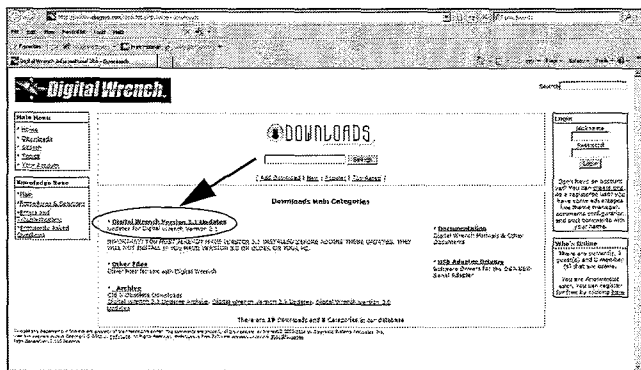
Updates are released for Digital Wrench™ via the Internet at: <http://polaris.diagsys.com>. The Digital Wrench™ website can also be accessed through the dealer website at: www.polarisdealers.com.

NOTE: Only authorized Polaris dealers and distributors can access the dealer website.

1. Log on to www.polarisdealers.com.
2. Locate the “Service and Warranty” drop-down menu.
3. Click on “Digital Wrench Updates”.

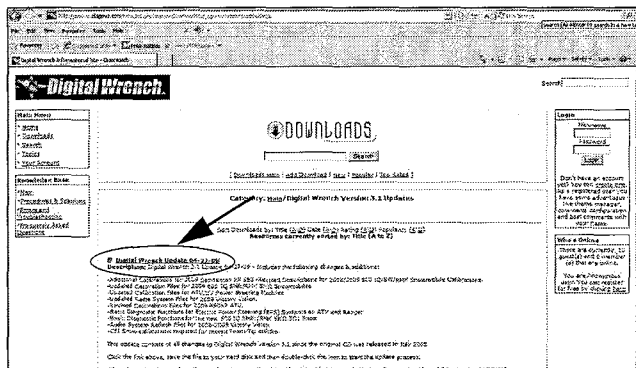


4. The Digital Wrench™ portal website should appear in a new web browser.
5. Click on “Digital Wrench Version 3.3 Updates”.



IMPORTANT: You must already have version 3.3 installed before adding these updates. They will not install if you have version 3.0 or older on your PC.

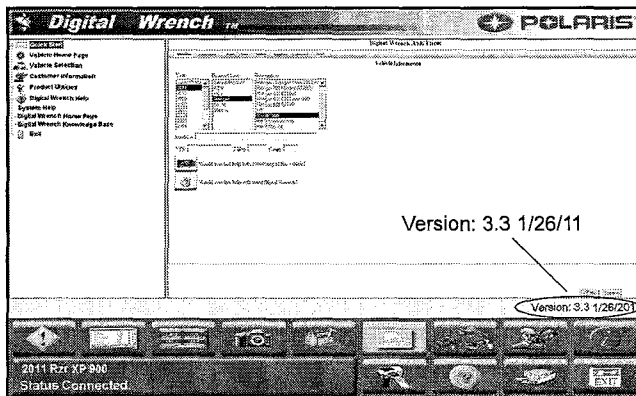
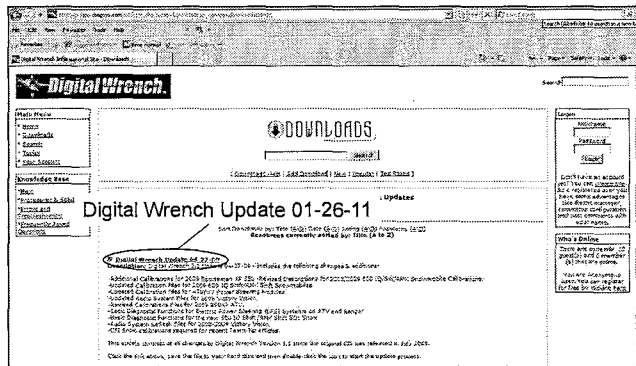
6. If the update file date listed is newer than your current version and update (see “Digital Wrench™ Version and Update ID”), download the file.



7. Click on the link shown above, save the file to your hard disk and then double-click the icon to start the update process.

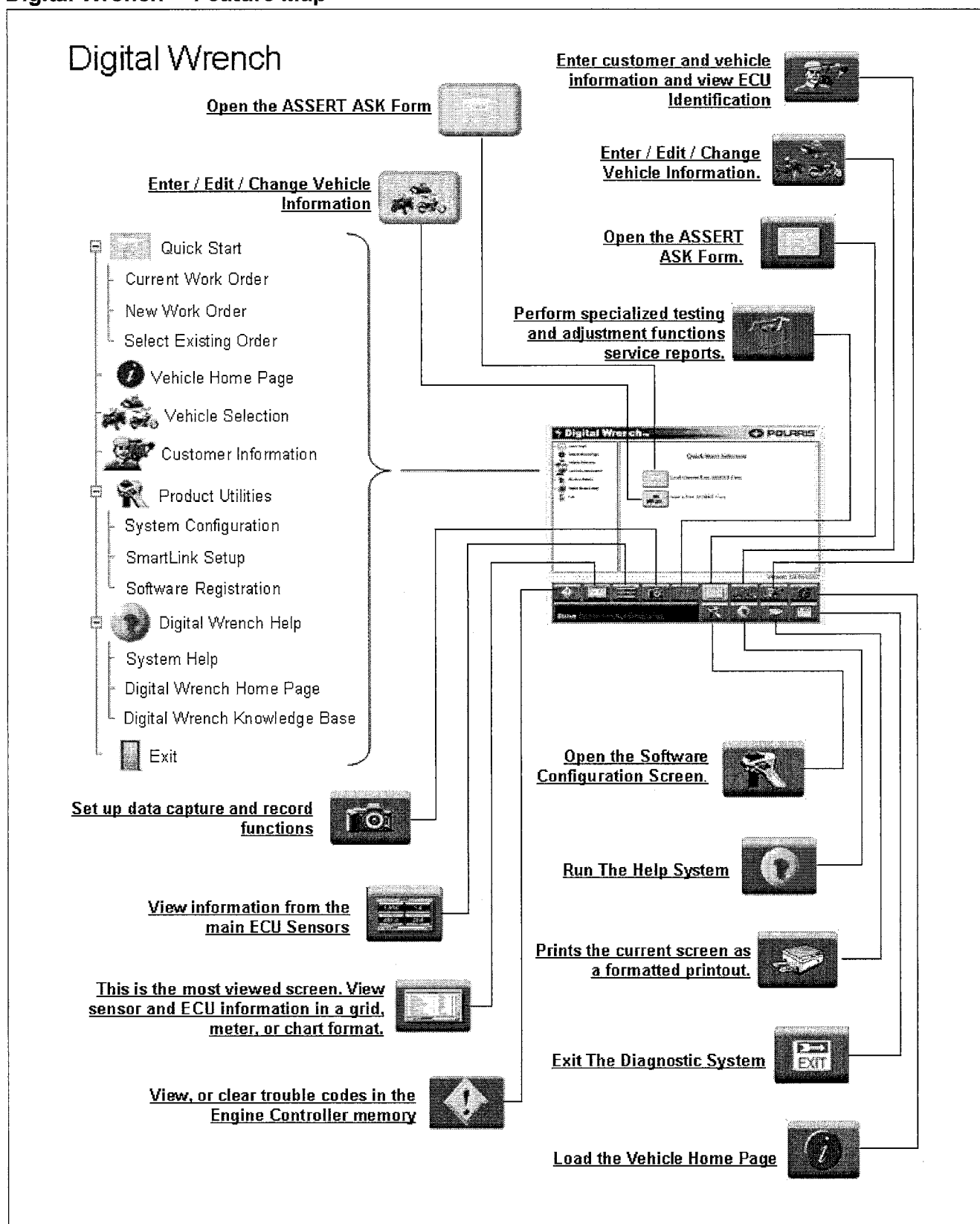
NOTE: Do not “run” or “open” the file from where they are. Select “save” and download them to your PC before running the install.

8. When the update is complete, the version shown on the right side of the Digital Wrench™ start-up screen should match the update you just downloaded.



NOTE: Versions and updates are subject to change.

Digital Wrench™ Feature Map



ELECTRONIC FUEL INJECTION

Engine Controller Reprogramming (Reflash)

Process Overview

The reprogramming feature is in the Special Tests menu on the Digital Wrench™ screen. Start Digital Wrench™ and click on the Special Tests menu icon (red tool box). A technician should be familiar with the process and with computer operation in general before attempting to reprogram an ECU.

The Digital Wrench™ Engine Controller Reprogramming (or “Reflash”) feature allows reprogramming of the ECU fuel and ignition map. To successfully reprogram the ECU, an Authorization Key must be obtained by entering a Request Code in the box provided on the Reflash Authorization site. The Request Code is automatically generated by Digital Wrench™ during the reprogramming process. The Reflash Authorization site is located under the “Service and Warranty” drop down menu on the dealer website at: www.polarisdealers.com.

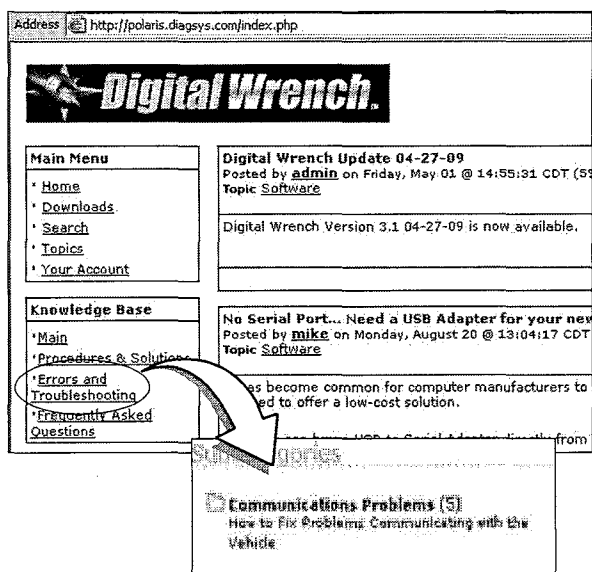
IMPORTANT: Failure to follow the reprogramming instructions completely and correctly can result in an engine that does not run! Replacement ECUs are programmed as “no-start” and require a reflash for them to work.

Reprogramming (Reflash) Tips:

- **BATTERY VOLTAGE:** The majority of problems with reprogramming can be attributed to a low battery. Be sure the battery voltage (no load) is at least 13 volts and at least 12.5 volts with the key ‘ON’. Connect a battery charger if necessary to bring voltage level above minimum. Fully charge the battery before you attempt to reprogram.
- **DEDICATED LAPTOP:** Best results are obtained using a laptop computer that is “dedicated to Digital Wrench™”. A laptop that is used by a variety of people and in several applications around the dealership is more likely to cause a reprogramming problem than one dedicated to Digital Wrench™ diagnostics only.
- **OBTAINING THE LATEST UPDATE:** Reprogramming updates are provided periodically and contain the most recent calibrations (see “Digital Wrench™ Updates”).
- **CLOSE NON-ESSENTIAL PROGRAMS:** Polaris recommends that you DO NOT install non-essential programs on a Service Department laptop. Camera detection software, Virus Scanners, Tool Bars, etc. may clog up memory if running in the background and make it harder for the diagnostic software to operate.

- **KNOW THE PROCESS:** If you are not familiar with the entire reprogramming process, review the HELP section of the diagnostic software before you attempt reprogramming. Click on the ? on the tool bar or press F11. The information in the on-line help is the most current and complete information available. This should be your first step until you are familiar with the process.
- **COMMUNICATION PROBLEMS:** If you have had problems communicating with a vehicle while performing diagnostic functions, do not attempt reprogramming until the cause has been identified and fixed. Check all connections, and be sure battery voltage is as specified.

Proceed to <http://polaris.diagnostics.com> for specific information and FAQs on how to troubleshoot communication problems.



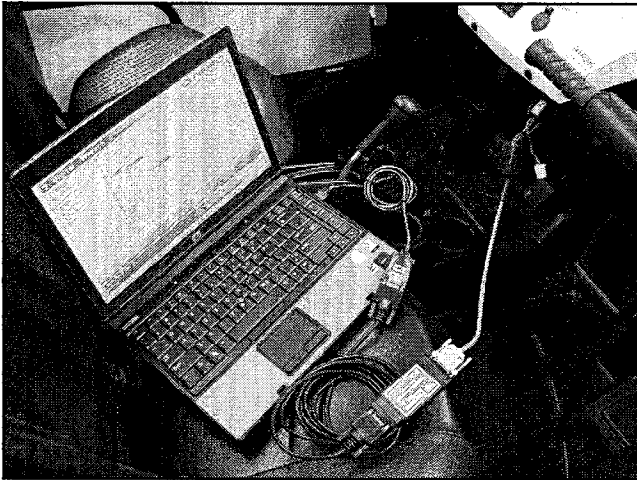
- **DON'T DISTURB THE PC:** While reprogramming is in progress, don't move the mouse and don't touch the keyboard. The process only takes a few minutes, and is best left alone until complete.

Reprogramming (Reflash) Procedure:

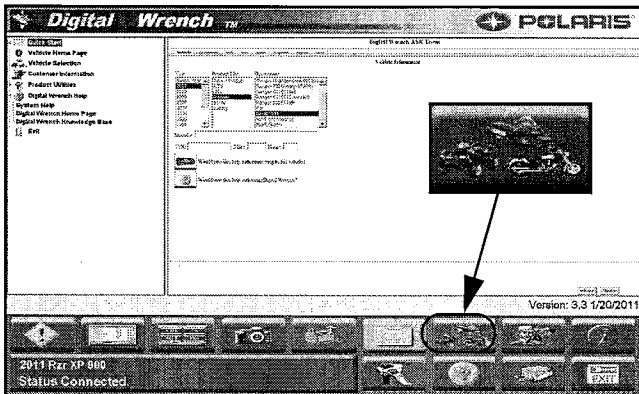
If you are not familiar with the reprogramming process, review the “Reprogramming (Reflash) Tips” before you begin. Follow the on-screen instructions as you progress through the steps. If you encounter a problem, always check the On-Line help for current tips and information.

1. Verify the most current update has been downloaded and loaded into Digital Wrench™. See “Digital Wrench™ Version and Update ID” on page 4.37.

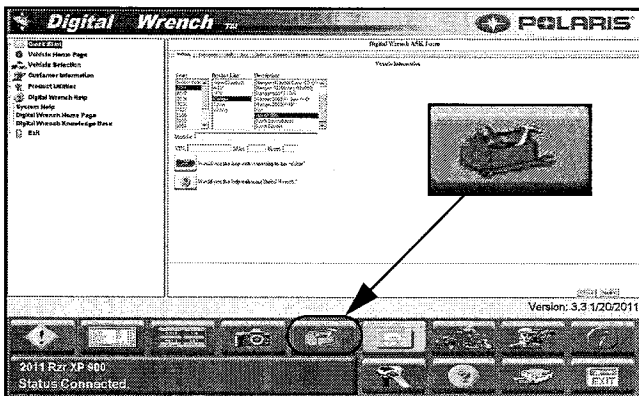
2. Connect the SmartLink Module cables to the PC and vehicle. See "Digital Wrench™ - Diagnostic Connector" on page 4.37.



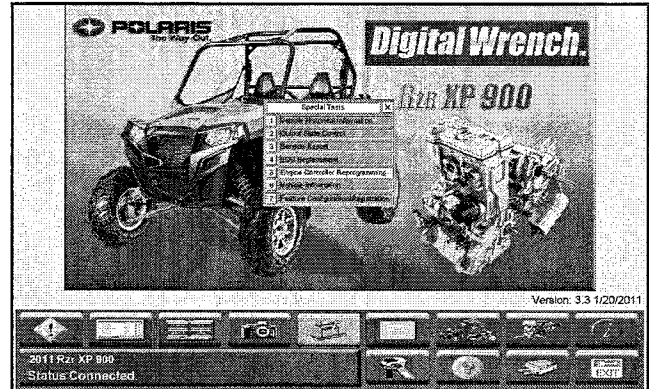
3. Open the Digital Wrench™ program.
4. Select the model year, product line and vehicle description by selecting the "Change Vehicle Type" icon.



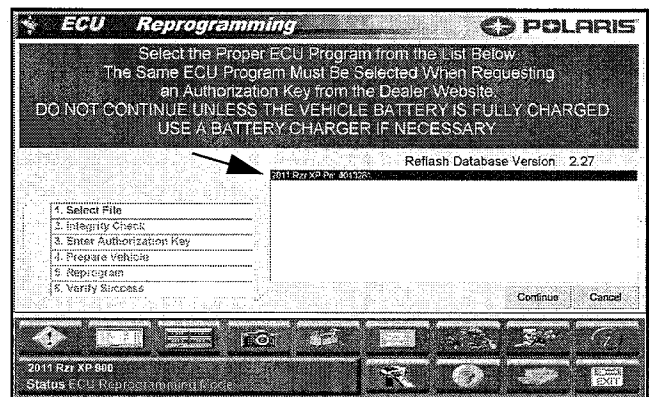
5. Select the "Special Tests" icon.



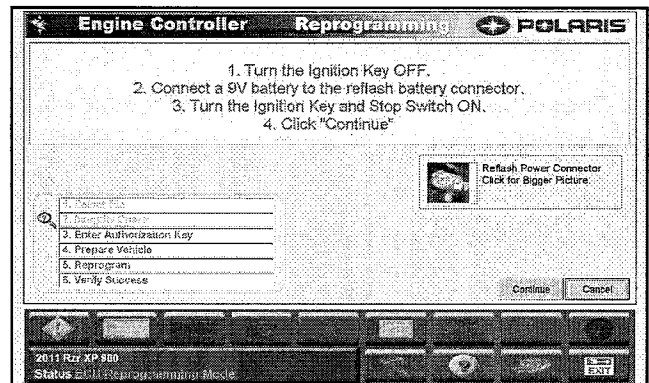
6. Select "Engine Controller Reprogramming".



7. Select the file you want to load into the ECU then click the "Continue" icon to proceed to the Integrity Check.



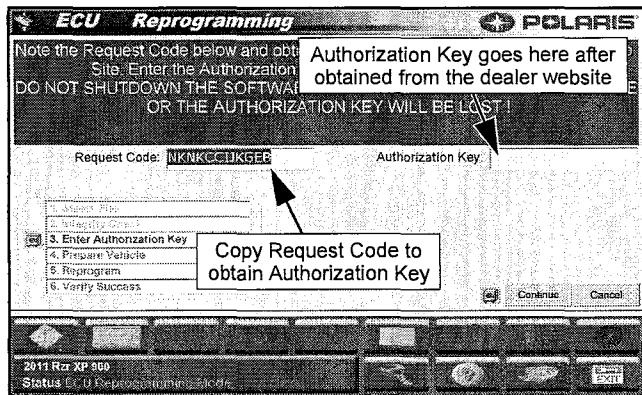
8. Follow the on screen instructions and connect a 9V battery to the reflash battery connector located off the main diagnostic connector. Click the "Continue" icon to obtain a Request Code.



4

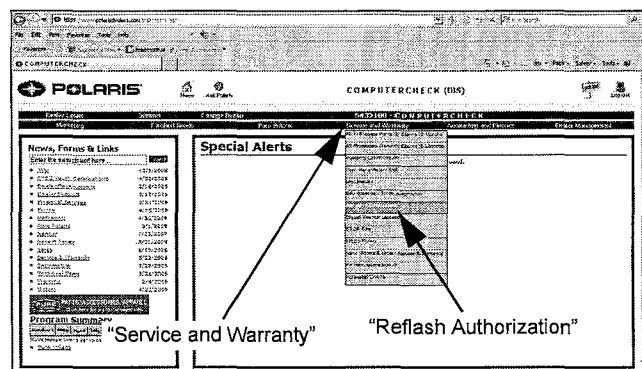
ELECTRONIC FUEL INJECTION

- Copy (CTRL+C) the Request Code that will be required on the dealer website in the next step. DO NOT CLOSE Digital Wrench™ or the Request Code will be invalid. **NOTE: All characters are letters; there are no numbers in a request code.**

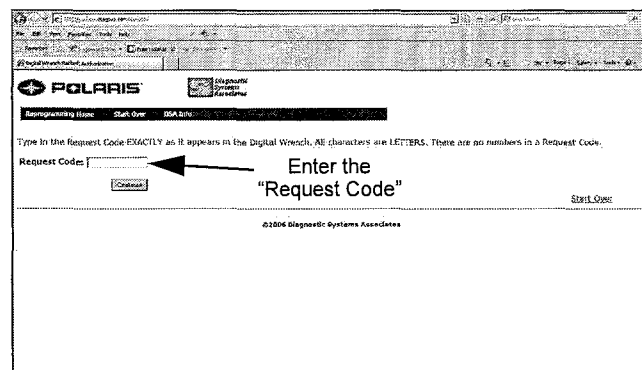


NOTE: Request Codes and Authorization Keys must be entered EXACTLY as they appear on the screen.

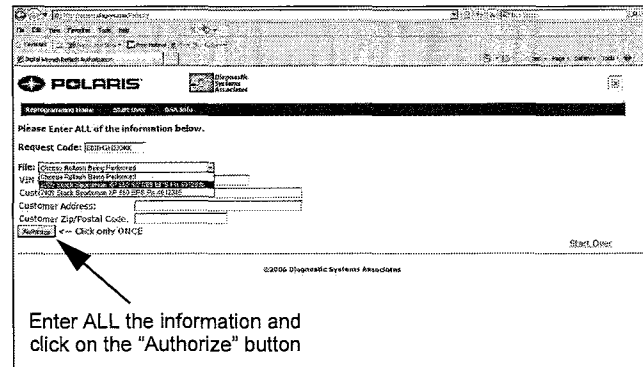
- Go to www.polarisdealers.com and click on "ReFlash Authorization" from the "Service and Warranty" drop-down menu.



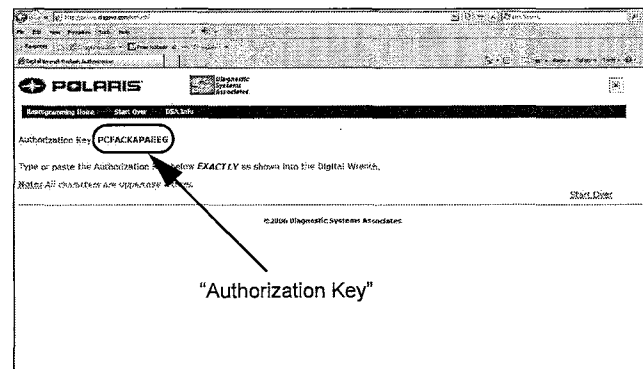
- Enter or paste (CTRL+V) the Request Code into the box.



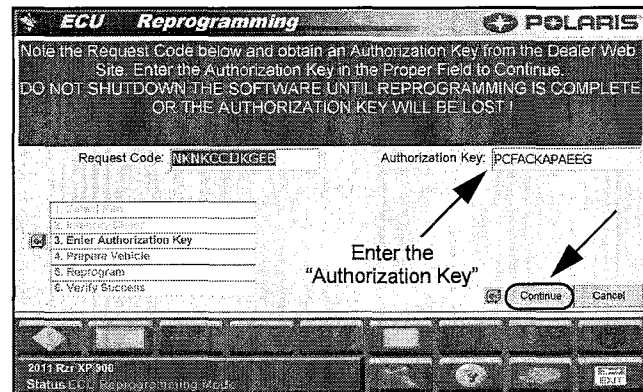
- Select the same file type from the list that you selected previously while in Digital Wrench™. Enter the VIN along with the customer's name and address. When completed, click the Authorize button **once** to proceed.



- An "Authorization Key" will appear in the upper left corner of the screen. Copy (CTRL+C) this key exactly as it appears.



- Enter or paste (CTRL+C) the Authorization Key in the box located on the Digital Wrench™ screen. Click the 'Continue' button and follow instructions provided on the screen to complete the reprogramming procedure.



15. At this point the reflash process will begin. Do not touch the vehicle or PC during the process.

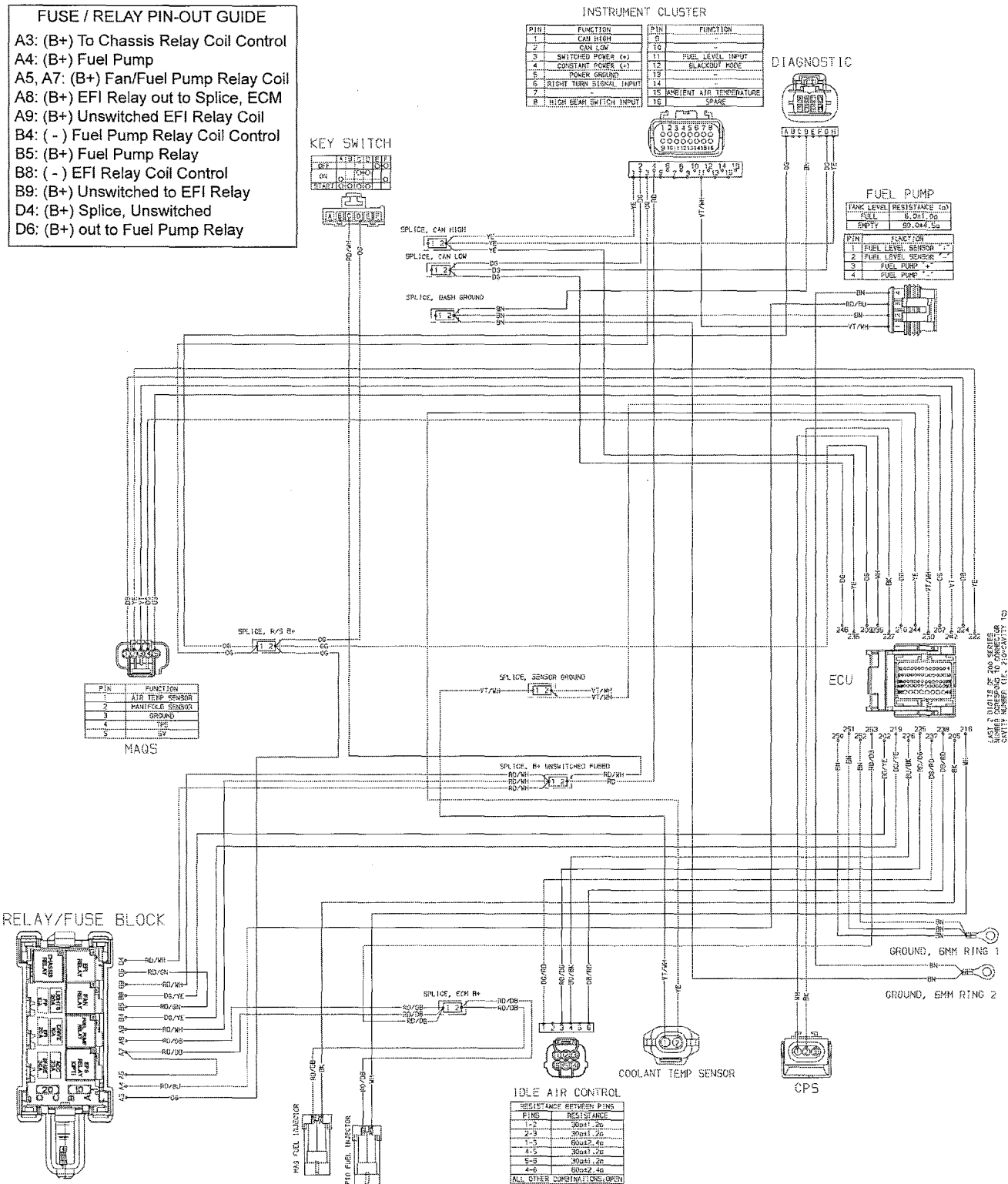


16. Once the ECU reprogramming procedure is complete, click the 'Finish' button on the screen. Verify the reflash was a success by starting the vehicle.

ELECTRONIC FUEL INJECTION

EFI SYSTEM ELECTRICAL OPERATION

Breakout Diagram



CHAPTER 5

BODY / STEERING / SUSPENSION

TORQUE SPECIFICATIONS	5.2
SPECIAL TOOLS	5.2
CAB FRAME	5.3
ASSEMBLY / REMOVAL	5.3
BODY EXPLODED VIEWS	5.4
SIDE SAFETY NETS	5.4
DASH INSTRUMENTS / CONTROLS / GLOVEBOX	5.5
HOOD / FRONT BODY WORK	5.6
FRONT / REAR BUMPER	5.7
SEAT ASSEMBLY / SEAT BELTS / MOUNTING	5.8
FLOOR / ROCKER PANELS	5.9
REAR CARGO BOX / FENDERS	5.10
CHASSIS / MAIN FRAME	5.11
BODY COMPONENT REMOVAL	5.12
SEATS	5.12
ENGINE SERVICE PANEL	5.12
FRONT / REAR BUMPER	5.12
HOOD AND FRONT BODY WORK	5.13
REAR FENDER FLAIR / BOX SIDE REMOVAL	5.14
CARGO BOX ASSEMBLY REMOVAL	5.14
ROCKER PANELS, CONSOLE AND FLOOR	5.15
STEERING ASSEMBLY	5.16
STEERING WHEEL REMOVAL	5.17
STEERING SHAFT REMOVAL	5.17
STEERING SHAFT BEARING REPLACEMENT	5.18
FRONT A-ARMS	5.19
REMOVAL / REPLACEMENT	5.19
BALL JOINT SERVICE	5.20
REMOVAL	5.20
INSTALLATION	5.21
REAR RADIUS RODS	5.22
REMOVAL / INSTALLATION	5.22
REAR TRAILING ARM	5.23
TRAILING ARM REMOVAL / INSTALLATION	5.23
TRAILING ARM SPHERICAL BEARING REPLACEMENT	5.25
REAR SUSPENSION EXPLODED VIEW	5.25
REAR STABILIZER BAR	5.26
REMOVAL / INSTALLATION	5.26
DECAL REPLACEMENT	5.27
SHOCKS / SPRINGS / FASTENERS	5.28
FRONT / REAR SHOCK EXPLODED VIEW	5.28
SHOCK REMOVAL / INSTALLATION / REPLACEMENT	5.28
FOX™ SHOCK EXPLODED VIEWS	5.29
FOX™ 2.0 'PIGGYBACK' SHOCK	5.29
FOX™ SHOCK SERVICE	5.30
GENERAL SERVICE INFORMATION	5.30
FRONT / REAR SHOCK SERVICE INFORMATION	5.30
FOX™ SHOCK REBUILD INFORMATION	5.31
FOX™ SHOCK DISASSEMBLY	5.32
FOX™ SHOCK REBUILD	5.34
FOX™ SHOCK REASSEMBLY	5.35

BODY / STEERING / SUSPENSION

TORQUE SPECIFICATIONS

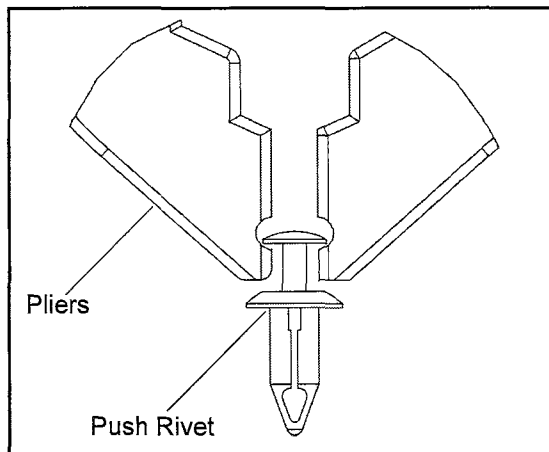
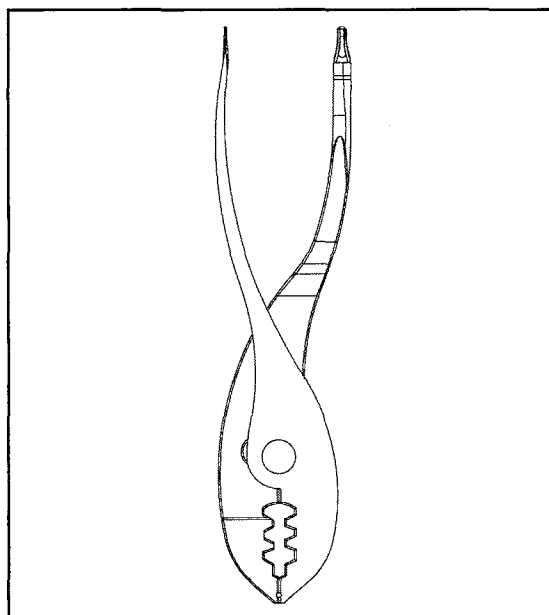
ITEM	TORQUE VALUE
Front LH/RH Upper / Lower A-Arm Bolt	50 ft. lbs. (67.7 Nm)
Outer Tie Rod to Bearing Carrier Housing	42.5 ft. lbs. (58 Nm)
Front Ball Joint Pinch Bolts	23 ft. lbs. (31 Nm)
Front Shock Mounting Bolts	50 ft. lbs. (67.7 Nm)
Rear Shock Mounting Bolts	70 ft. lbs. (95 Nm)
Wheel Hub Castle Nuts	80 ft. lbs. (108 Nm)
Wheel Nuts (Cast Aluminum Rims)	30 ft. lbs. (41 Nm) + 90° (1/4 turn)
Tie Rod End Jam Nut	13 ft. lbs. (18 Nm)
Radius Rod Mounting Bolts	50 ft. lbs. (67.7 Nm)
Trailing Arm to Main Frame Bolt	50 ft. lbs. (67.7 Nm)
Bearing Carrier to Trailing Arm Bolts	50 ft. lbs. (67.7 Nm)
Rear Brake Caliper Mounting Bolts	30 ft. lbs. (40.6 Nm)
Front Brake Caliper Mounting Bolts	31-34 ft. lbs. (42-46 Nm)
Stabilizer Bar Linkage	31-34 ft. lbs. (42-46 Nm)
Stabilizer Bar Bushing Bracket Bolts	17 ft. lbs. (23 Nm)
Stabilizer Bar Locating Clamp Bolts	10 ft. lbs. (13.5 Nm)
Seat Belt to Seat Base	40 ft. lbs. (54 Nm)
Tilt Shock Upper Fastener	7 ft. lbs. (10 Nm)
Tilt Shock Lower Fastener	12 ft. lbs. (16 Nm)
Steering Pivot Tube Fasteners	23 ft. lbs. (31 Nm)
Steering Wheel to Shaft	65 ft. lbs. (88 Nm)
Lower Steering Shaft to Box	30 ft. lbs. (41 Nm)
Steering Gear Box	17 ft. lbs. (23 Nm)

SPECIAL TOOLS

TOOL DESCRIPTION	PART NUMBER
Gas Shock Recharging Kit	2200421
Shock Shaft Seal Protector .625" Diameter	2201640
IFP Tool	PS-45908
Shock Spanner Wrench	2877408
Shock Spring Compressor Tool	2870623
Multi-Function Pliers	2876389

Multi-Function Pliers

Included in the tool kit, the multi-function pliers is designed to remove the plastic push rivets used to fasten body components.



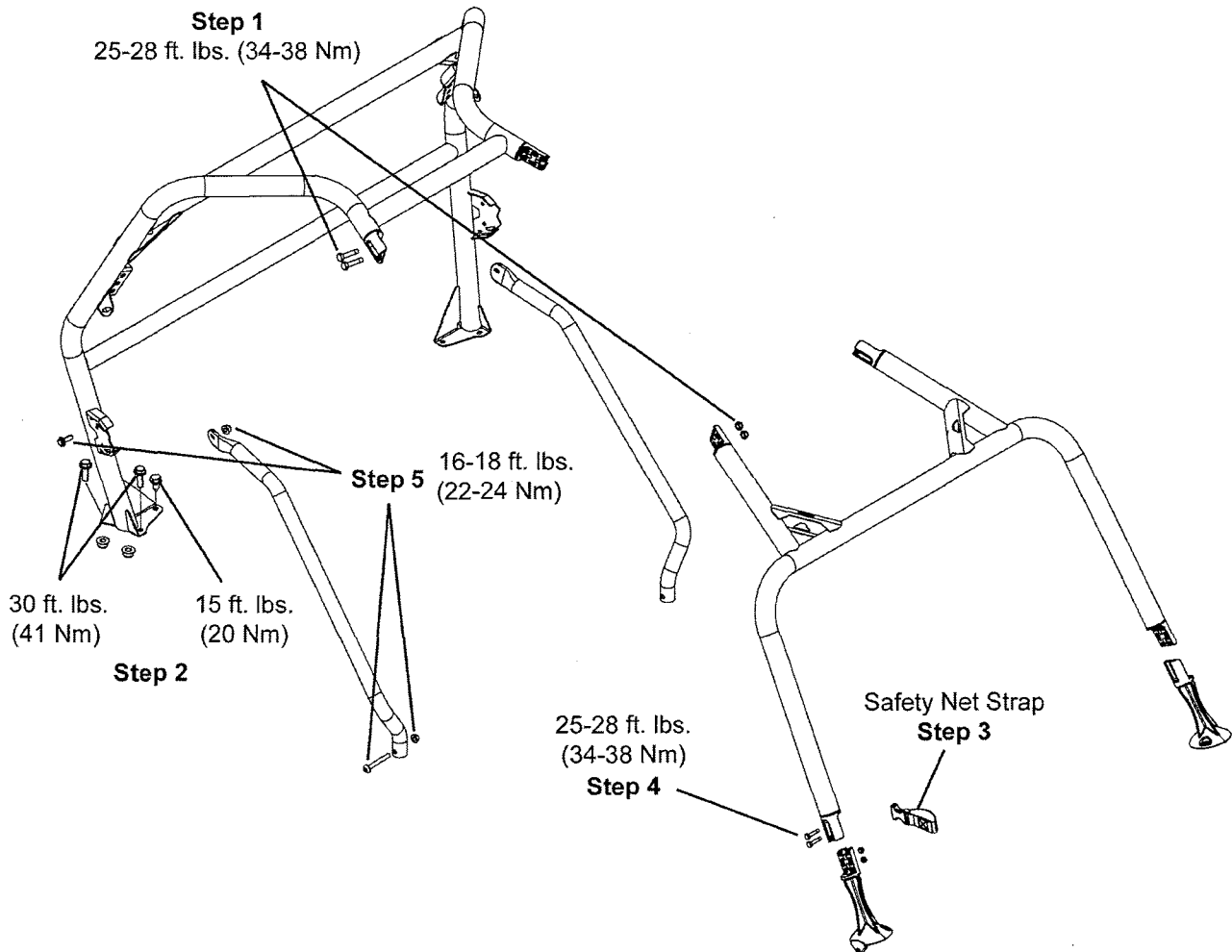
CAB FRAME

Assembly / Removal

NOTE: Finger tighten all components until cab frame is completely assembled on vehicle, then tighten to specifications listed.

1. Assemble the rear cab frame and the front cab frame at the coupler joints and secure with four (3/8-16 x 1 1/4) screws and (3/8-16 Nyloc) nuts. Tighten screws to 25-28 ft. lbs. (34-38 Nm).
2. Place the assembled cab frame onto the vehicle and align the rear mount holes. Fasten the rear cab frame brackets to vehicle with four (M10x1.5x25) bolts and (M10x1.5) nuts. Tighten bolts to 30 ft. lbs. (41 Nm). Fasten the two self-tapping screws to the rear inner portion of the bracket on each side. Tighten screws to 15 ft. lbs. (20 Nm).
3. Place the straps from the safety net over the front coupler posts.
4. Fasten the front of the cab frame to the base brackets and secure with four (3/8-16 x 1 1/4) screws and (3/8-16 Nyloc) nuts. Tighten screws to 25-28 ft. lbs. (34-38 Nm).
5. Attach side bars to cab frame using M8 screws and nuts on top and M8 screws and nuts on the bottom. Tighten to 16-18 ft. lbs. (22-24 Nm).
6. To remove the cab frame, reverse the assembly procedure (steps 1-5).

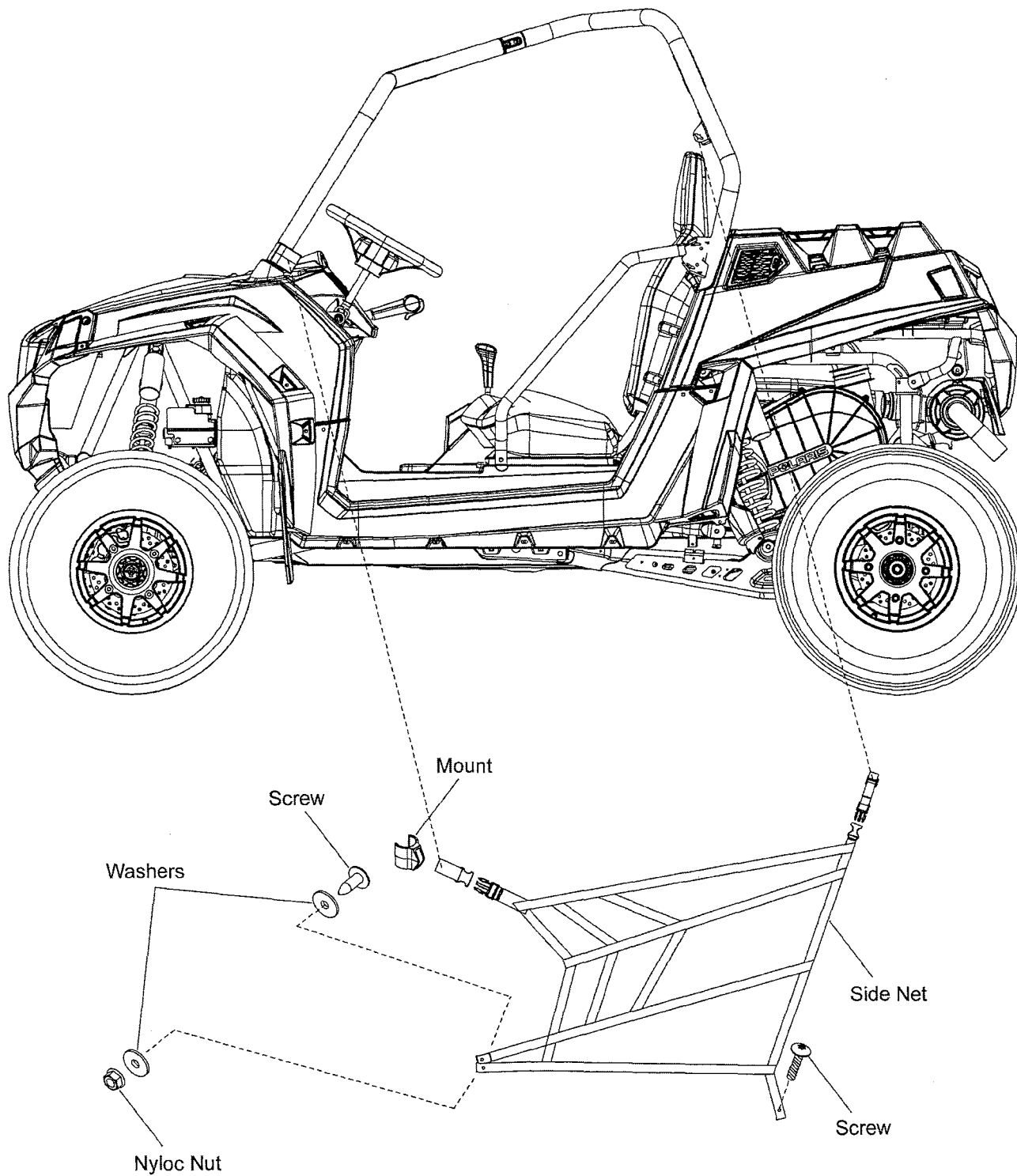
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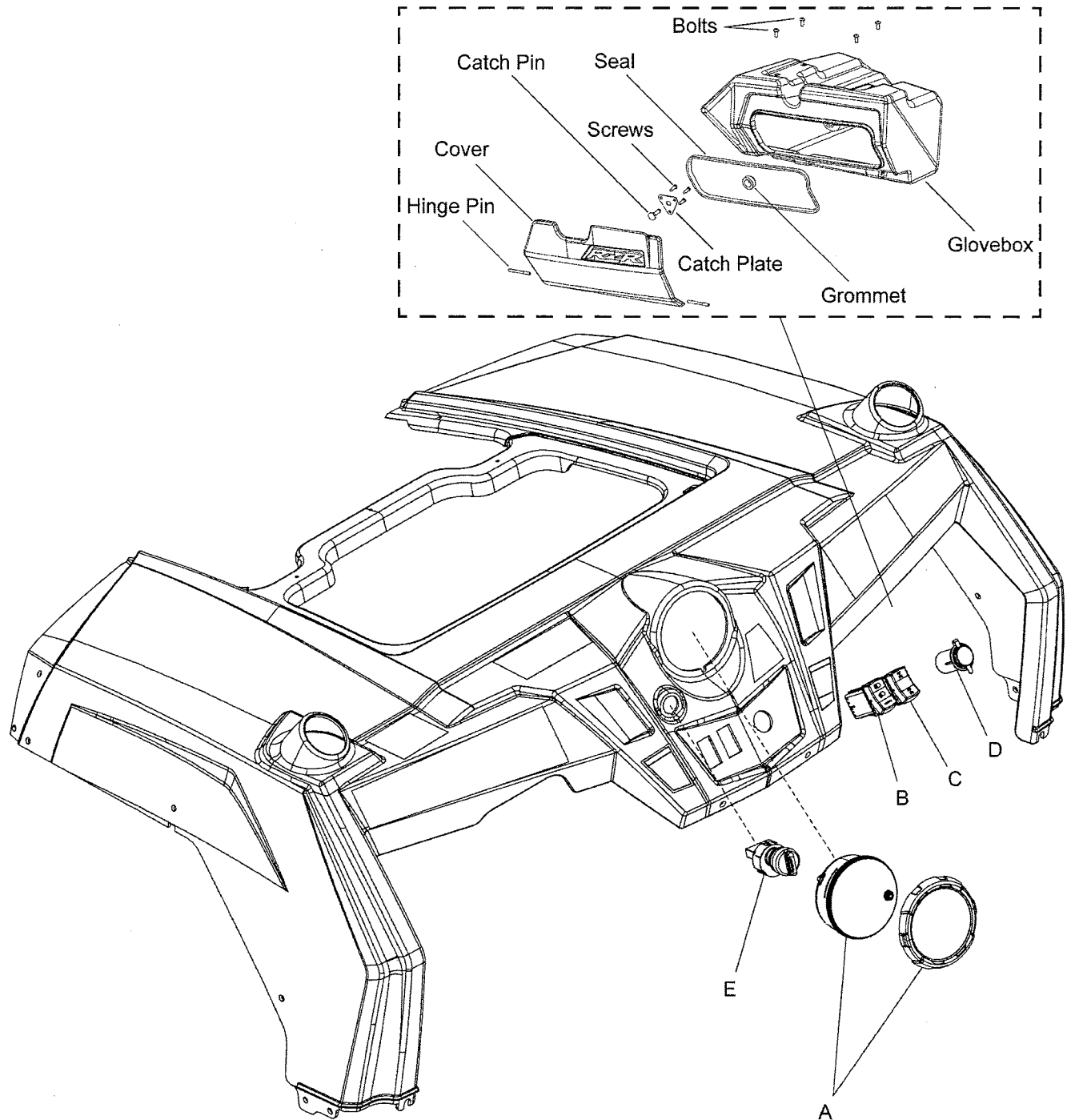
BODY / STEERING / SUSPENSION

BODY EXPLODED VIEWS

Side Safety Nets



Dash Instruments / Controls / Glovebox

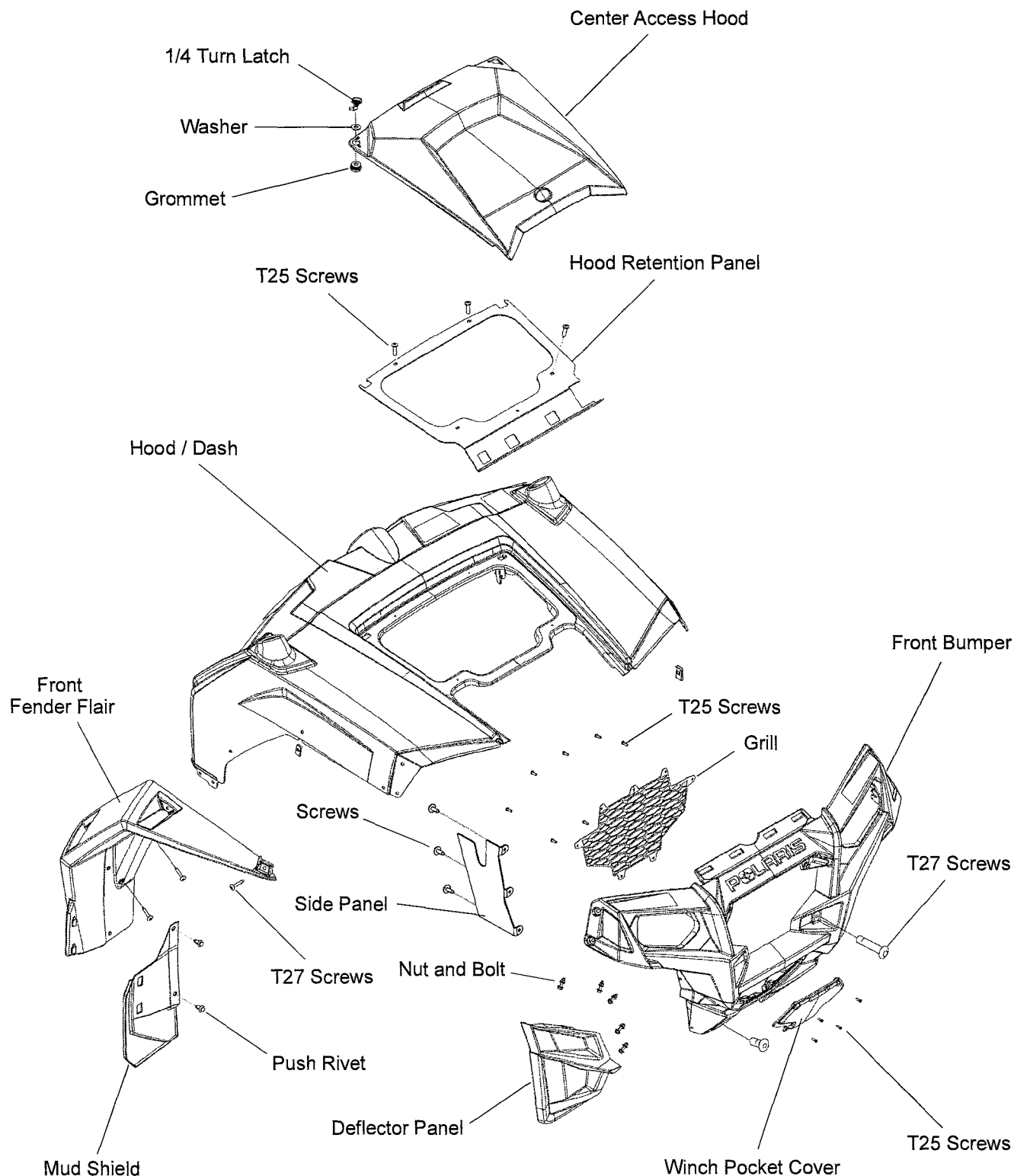


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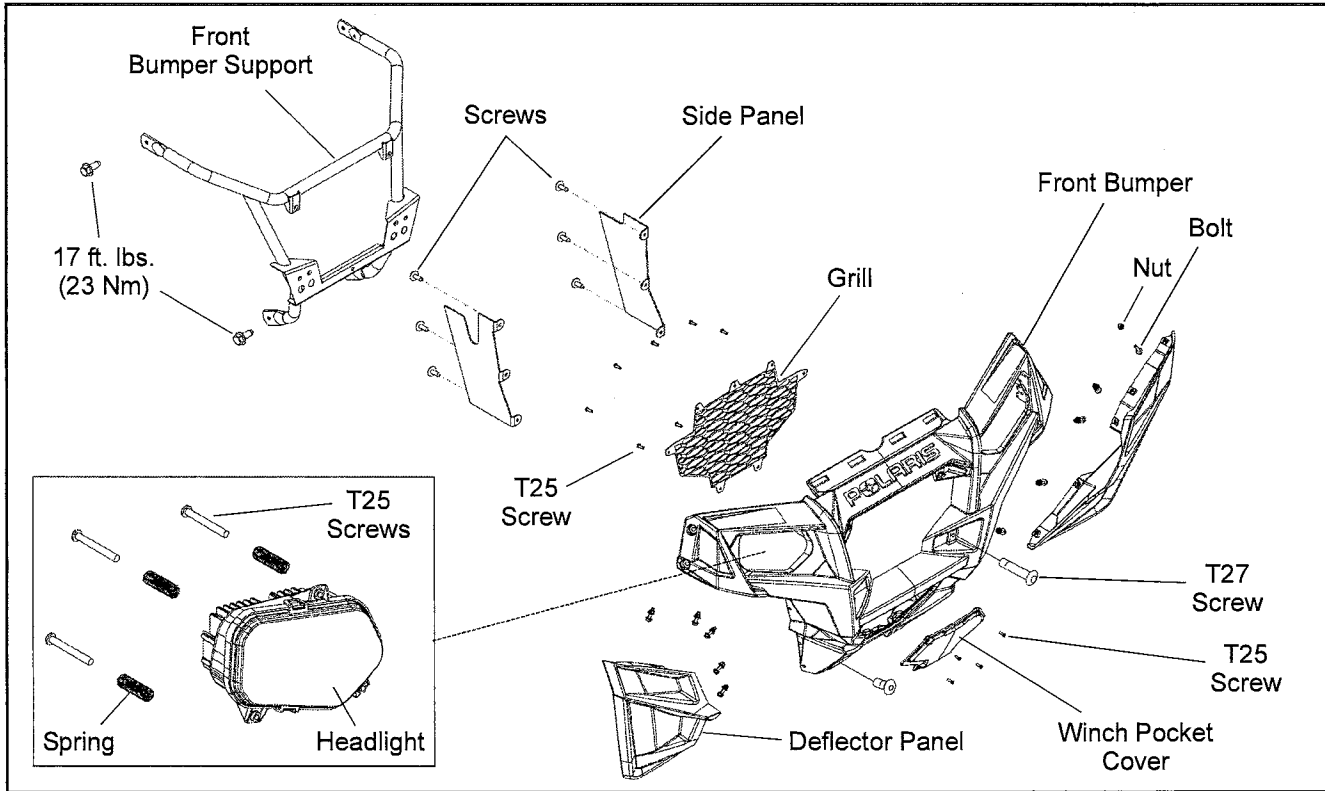
- A. Instrument Cluster / Speedo
- B. Headlight Switch
- C. AWD/2WD Switch
- D. 12 Volt Accessory Receptacle
- E. Key Switch

BODY / STEERING / SUSPENSION

Hood / Front Body Work



Front Bumper



Rear Bumper

