TORO

LCE/Residential Products

Side By Side Off Road Utility Vehicle

500 EFI & 700 EFI

Service Manual

FOREWORD

This Toro Service Manual contains service, maintenance, and troubleshooting information for the 2015 Toro UTV500/ UTV700. The complete manual is designed to aid service personnel in service-oriented applications.

This manual is divided into sections. Each section covers a specific vehicle component or system and, in addition to the standard service procedures, includes disassembling, inspecting, and assembling instructions. When using this manual as a guide, the technician should use discretion as to how much disassembly is needed to correct any given condition.

This service manual is designed primarily for use by a Toro USD (Unlisted Service Dealer). The procedures found in this manual are of varying difficulty, and certain service procedures in this manual require one or more special tools to be completed. The technician should use sound judgement when determining which procedures can be completed based on their skill level and access to appropriate special tools.

All Toro publications and decals display the words Warning, Caution, Note, and At This Point to emphasize important information. The symbol ⚠ **WARNING** identifies personal safety-related information. Be sure to follow the directive because it deals with the possibility of serious personal injury or even death. A **CAUTION** identifies unsafe practices which may result in vehicle-related damage. Follow the directive because it deals with the possibility of damaging part or parts of the vehicle. The symbol ■ **NOTE:** identifies supplementary information worthy of particular attention. The symbol ☞ **AT THIS POINT** directs the technician to certain and specific procedures to promote efficiency and to improve clarity.

At the time of publication, all information, photographs, and illustrations were technically correct. Some photographs used in this manual are used for clarity purposes only and are not designed to depict actual conditions. Because Toro-Exmark constantly refines and improves its products, no retroactive obligation is incurred.

All materials and specifications are subject to change without notice.

Keep this manual accessible in the shop area for reference.

Product Service and
Warranty Department
Toro

April 2015

Table of Contents

General Information

■**NOTE: Some photographs and illustrations used in this manual are used for clarity purposes only and are not designed to depict actual conditions.**

General Specifications

MISCELLANY		
Tire Size	(front) (rear)	26 x 10R-14 26 x 12R-14
Tire Inflation Pressure		1.12 kg/cm² (16 psi) - 500 1.41 kg/cm² (20 psi) - 700
Spark Plug Type		NGK CR7E - 500 NGK CPR8E - 700
Spark Plug Gap		0.7-0.8 mm (0.028-0.031 in.) -500 0.5-0.6 mm (0.019-0.024 in.) - 700
Gas Tank Capacity		31 L (8.2 U.S. gal.)
Coolant Capacity		2.9 L (3.0 U.S. qt)
Front Differential Capacity		275 ml (9.3 fl oz)*
Rear Drive Capacity		250 ml (8.5 fl oz)*
Engine Oil Capacity (approx)	(500) (700)	3.3 L (3.5 U.S. qt) - Overhaul 2.8 L (3.0 U.S. qt) - Change 2.5 L (2.6 U.S. qt) - Overhaul 1.9 L (2.0 U.S. qt) - Change
Gasoline (recommended)		87 Octane Regular Unleaded
Engine Oil (recommended)		Toro ACX All Weather Synthetic
Front Differential/Rear Drive Lubricant (One inch below plug threads)		SAE Approved 80W-90 Hypoid
Belt Width (minimum)		28.5 mm (1.12 in.) - 500 35.0 mm (1.38 in.) - 700
Brake Fluid		DOT 4
Taillight/Brakelight		12V/8W/27W
Headlight		12V/27W (4)
ELECTRICAL SYSTEM		
Ignition Timing		10° BTDC @ 1500 RPM
Spark Plug Cap		5000 ohms
Ignition Coil Resistance	(primary) (secondary)	Less than 5.0 ohms - 500 Less than 1 ohm - 700 12k-19k ohms - 500 1.8M ohms - 700
Ignition Coil Primary Voltage		Battery Voltage
Stator Coil Resistance	(CKP Sensor) (AC generator)	104-156 ohms Less than 1 ohm
AC Generator Output (no load)		60 AC volts @ 5000 RPM
Crankshaft Position Sensor AC Voltage		2.5 volts or more - 500 2.0 volts or more - 700

Specifications subject to change without notice.

CYLINDER, PISTON, AND RINGS (500)		
Piston Skirt/Cylinder Clearance		0.025-0.055 mm
Piston Diameter 8 mm from Skirt End		88.96-88.98 mm
Piston Ring Free End Gap (max)	(1st) (2nd)	11.6 mm 10.1 mm
Bore x Stroke		89.0 x 71.2 mm
Cylinder Trueness	(max)	0.01 mm
Piston Ring End Gap - Installed	(min)	0.15 mm
Piston Ring to Groove Clearance (max) (1st/2nd)		0.06 mm
Piston Ring Groove Width	(1st) (2nd) (oil)	1.01-1.03 mm 1.21-1.23 mm 2.01-2.03 mm
Piston Ring Thickness	(1st) (2nd)	0.97-.99 mm 1.17-1.19 mm
Piston Pin Bore	(max)	20.008 mm
Piston Pin	(min)	19.994 mm
CYLINDER, PISTON, AND RINGS (700)		
Piston Skirt/Cylinder Clearance (min)		0.06 mm
Cylinder Bore		101.992-102.008 mm
Piston Diameter 15 mm from Skirt End		101.930-101.949 mm
Piston Ring Free End Gap	(1st/2nd)	12.5 mm
Bore x Stroke		102 x 85 mm
Cylinder Trueness (max)		0.01 mm
Piston Ring End Gap - Installed (min)		0.38 mm
Piston Ring to Groove Clearance (max) (1st/2nd)		0.03 mm
Piston Ring Groove Width	(1st/2nd) (oil)	1.202-1.204 mm 2.01-2.03 mm
Piston Ring Thickness	(1st/2nd)	1.970-1.990 mm
Piston Pin Bore (max)		23.0 mm
Piston Pin Outside Diameter (min)		22.99 mm
VALVES AND GUIDES (500)		
Valve Face Diameter	(intake) (exhaust)	35.0 mm 30.5 mm
Valve/Tappet Clearance (cold engine)	(intake) (exhaust)	0.10 mm 0.17 mm
Valve Guide/Stem Clearance (max)	(intake) (exhaust)	0.10 mm 0.30 mm
Valve Guide Inside Diameter		5.000-5.012 mm
Valve Seat Angle	(intake/exhaust)	45°
Valve Spring Free Length	(min)	44.73 mm
Valve Spring Tension @ 35.2 mm		17.23 kg (37.98 lb)
VALVES AND GUIDES (700)		
Valve Face Diameter	(intake) (exhaust)	31.6 mm 27.9 mm
Valve/Tappet Clearance (cold engine)	(intake) (exhaust)	0.1016 mm 0.1524 mm
Valve Guide/Stem Clearance		0.013 mm
Valve Guide Inside Diameter		5.000-5.012 mm
Valve Head Thickness	(min)	2.3 mm
Valve Seat Angle		45° +15'/+30'
Valve Spring Free Length	(min)	38.7 mm
Valve Spring Tension @ 31.5 mm		19.0 kg (42 lb)

CRANKSHAFT (500)		
Connecting Rod (small end)	(max)	20.021 mm
Connecting Rod (big end side-to-side) (max)		0.7 mm
Connecting Rod (big end width)		21.95-22.00 mm
Connecting Rod (small end deflection) (max)		3.0 mm
Crankshaft (web-to-web)		60.9 mm
Crankshaft Runout	(max)	0.03 mm
CRANKSHAFT 700)		
Connecting Rod (small end inside (max) (diameter)		23.021 mm
Connecting Rod (big end side-to-side)(min)		0.6 mm
Connecting Rod @ 150 mm (small end deflection)	(max)	0.3 mm
Crankshaft (web-to-web)	(min)	71 mm
Crankshaft Runout	(max)	0.03 mm
CAMSHAFT AND CYLINDER HEAD (500)		
Cam Lobe Height (min)	(intake) (exhaust)	34.71 mm 34.48 mm
Camshaft Journal Holder(right & center) Inside Diameter	(left)	22.01-22.04 mm 17.51-17.54 mm
Camshaft Journal Outside(right & center) Diameter	(left)	17.466-17.480 mm 21.966- 21.980 mm
Camshaft Runout	(max)	0.03 mm
Cylinder Head/Cover Distortion	(max)	0.05 mm
CAMSHAFT AND CYLINDER HEAD (700)		
Cam Lobe Height	(min)	33.53 mm
Camshaft Journal Oil Clearance	(max)	0.04 mm
Camshaft Runout	(max)	0.05 mm
Cylinder Head/Cover Distortion	(max)	0.05 mm

Torque Specifications

■NOTE: Torque specifications have the following tolerances:

Torque (ft-lb)	Tolerance
0-15	±20%
16-39	±15%
40+	±10%

EXHAUST COMPONENTS			
Part	Part Bolted To	Torque ft-lb	N-m
Exhaust Pipe	Cylinder Head	20	27
Spark Arrester	Muffler	50 in.-lb	5
O2 Sensor	Exhaust Pipe	19	26
BRAKE COMPONENTS			
Brake Disc**	Hub	15	20
Brake Hose	Caliper	20	27
Brake Hose	Master Cylinder	20	27
Master Cylinder	Frame	25	34
Caliper****	Knuckle	20	27
Rear Driveline ****	Rear Differential	12	16
ELECTRICAL COMPONENTS			
Coil*	Frame	8	11

DRIVE TRAIN COMPONENTS			
Part	Part Bolted To	Torque ft-lb	N-m
Rear Differential/Gear Case	Frame	38	48
Front Engine Mounting Bracket	Frame	45	61
Rear Engine Mounting Bracket	Frame	45	61
Engine Mounting Through-Bolt	Frame	40	54
Front Differential	Frame/Differential Bracket	38	52
Rear Output Flange	Rear Driven Flange	40	54
Input Shaft Assembly	Gear Case Housing	23	31
Pinion Housing	Differential Housing	23	31
Secondary Shaft Bearing Housing	Crankcase	28	38
Rear Cradle	Frame	25	34
Driveshaft (Front/Rear)	Engine	20	27
Shift Cable Bracket	Engine	8	11
Front Input Drive Flange	Front Drive Yoke Flange	20	27
Differential Housing Cover***	Differential Housing	23	31
Thrust Button**	Gear Case Cover	8	11
Drive Bevel Gear Nut***	Shaft	87	118
Lock Collar	Differential Housing	125	170
Hub Nut	Front/Rear Shaft/Axle (min)	200	272
Oil Drain Plug	Front Differential - Rear Drive	45 in.-lb	5
Oil Fill Plug	Front Differential - Rear Drive	16	22
Oil Drain Plug	Engine	16	22
Wheel (Aluminum)	Hub	80	108
Wheel (Steel)	Hub	40	54
STEERING COMPONENTS			
Steering Wheel**	Steering Wheel Shaft	25	34
Steering Wheel Shaft***	Intermediate Shaft (Upper)	31	42
Intermediate Shaft (Lower)***	Steering Pinion Shaft	36	49
Rack and Pinion Assembly	Frame	35	48
Tie Rod	Rack	37	50
Tie Rod End**	Knuckle	30	41
Jam Nut	Tie Rod End	10	14
Intermediate Shaft Coupler	Intermediate Shaft	31	42
Steering Shaft Housing (6 mm)	Frame	8	11
Steering Shaft Housing (8 mm)	Frame	20	27
CHASSIS/ROPS ASSEMBLY			
Shift Axle Support	Frame	48 in.-lb	5
Front/Rear ROPS Tube	Arm Rest/Steering Support	35	48
Top ROPS Support	Front/Rear ROPS Tubes	35	48
Rear ROPS Tube	Lower ROPS Support	35	48
Shift Cable	Shift Arm Stud	8	34
Shift Cable Mounting/Adjuster	Shift Cable	20	27
Cargo Box Hinge	Cargo Box Frame	20	27
Side Panel/Spacer	Cargo Box Frame	25	34
Tilt Pivot Bushing	Cargo Box Frame	15	20
Latch Striker	Cargo Box Liner	60 in.-lb	7
SUSPENSION COMPONENTS			
A-Arm	Frame	35	48
Knuckle	Ball Joint	35	48
Shock Absorber	Frame/Upper A-Arm	35	48
Shock Absorber (Front)	Lower A-Arm	20	27
Shock Absorber (Rear)	Lower A-Arm	35	48
Knuckle	A-Arm	35	48
Sway Bar Bracket (Rear)	Frame	35	48

* w/Blue Loctite #243 ** w/Red Loctite #271
*** w/Green Loctite #270 **** w/"Patch-Lock"

ENGINE/TRANSMISSION (500)			
Part	Part Bolted To	Torque	
		ft-lb	N-m
Clutch Shoe**	Crankshaft	147	199
Clutch Cover/Housing Assembly	Crankcase	8	11
Crankcase Half (6 mm)	Crankcase Half	10	13.5
Crankcase Half (8 mm)	Crankcase Half	21	28
Cylinder Nut	Crankcase Half	8	11
Cylinder Head (Cap Screw)	Crankcase	28	38
Cylinder Head Nut	Cylinder	20	27
Cylinder Head Cover	Cylinder Head	8	11
Oil Pump Drive Gear**	Crankshaft	63	86
Driven Pulley Nut**	Driveshaft	147	199
Ground Wire	Engine	8	11
Rotor/Flywheel Nut	Crankshaft	107	146
Cam Sprocket**	Camshaft	11	15
Valve Adjuster Jam Nut	Valve Adjuster	7	9.5
Starter Motor**	Crankcase	8	11
Oil Fitting	Engine	8	11
Starter One-Way Clutch**	Rotor/Flywheel	26	35
Oil Pump**	Crankcase	8	11
Movable Drive Face Nut**	Clutch Shaft	147	199
Output Shaft Flange Nut	Output Shaft	59	80
Cam Chain Tensioner Guide	Cylinder	11	15
Valve Inspection Cover	Cylinder Head Cover	8	11
Cam Chain Tensioner	Cylinder	10	13.5
Magneto Cover	Crankcase	8	11
Water Pump Cover/Housing	Magneto Cover	8	11
Water Pump Drive Gear	Crankshaft	28	38
Air Filter	Frame	12	16
Oil Strainer Cap	Crankcase	10	13.5
V-belt Cover	Crankcase	8	11

ENGINE/TRANSMISSION (700)			
Part	Part Bolted To	Torque	
		ft-lb	N-m
Clutch Shoe**	Crankshaft	221	300
Clutch Cover/Housing Assembly	Crankcase	8	11
Crankcase Half (6 mm)	Crankcase Half	10	13.5
Crankcase Half (8 mm)	Crankcase Half	20	27
Cylinder Head (Cap Screw)	Crankcase	40	54
Cylinder Head Nut (6 mm)	Cylinder	8	11
Cylinder Head Nut (8 mm)	Cylinder	18	24
Valve Cover	Cylinder Head	8	11
Driven Pulley Nut	Driveshaft	162	220
Movable Drive Face Nut**	Driveshaft	165	224
Ground Wire	Engine	8	11
Magneto Cover	Crankcase	8	11
Crankshaft Spacer	Crankshaft	28	38
Oil Pump**	Crankcase	8	11
Oil Pump Drive Gear**	Crank Balancer Shaft	62	84
Output Shaft Flange Nut**	Output Shaft	62	84
One-Way Clutch**	Rotor/Flywheel	26	35
Outer Magneto Cover	Side Cover	8	11
Magneto Rotor Nut**	Crankshaft	105	143
Cam Sprocket**	Camshaft	11	15
Speed Sensor Housing	Crankcase	8	11
V-Belt Cover	Crankcase	8	11
Output Yoke Nut**	Secondary Driven Output Shaft	74	100
Output Shaft Flange Yoke/ Nut**	Output Shaft	59	80
Secondary Shaft Bearing Housing	Crankcase Half	28	38
Stator Coil*	Magneto Cover	13	18
Intake Manifold Boot Clamp	Intake Boot	30 in.-lb	3.4
Water Pump	Engine	8	11
Oil Strainer Cap	Crankcase	10	13.5
Air Filter	Frame	12	16
Shift Cam Plate**	Camshaft	8	11
Crankshaft Bushing	Crankshaft	25	34

Torque Conversions (ft-lb/N-m)

ft-lb	N-m	ft-lb	N-m	ft-lb	N-m	ft-lb	N-m
1	1.4	26	35.4	51	69.4	76	103.4
2	2.7	27	36.7	52	70.7	77	104.7
3	4.1	28	38.1	53	72.1	78	106.1
4	5.4	29	39.4	54	73.4	79	107.4
5	6.8	30	40.8	55	74.8	80	108.8
6	8.2	31	42.2	56	76.2	81	110.2
7	9.5	32	43.5	57	77.5	82	111.5
8	10.9	33	44.9	58	78.9	83	112.9
9	12.2	34	46.2	59	80.2	84	114.2
10	13.6	35	47.6	60	81.6	85	115.6
11	15	36	49	61	83	86	117
12	16.3	37	50.3	62	84.3	87	118.3
13	17.7	38	51.7	63	85.7	88	119.7
14	19	39	53	64	87	89	121
15	20.4	40	54.4	65	88.4	90	122.4
16	21.8	41	55.8	66	89.8	91	123.8
17	23.1	42	57.1	67	91.1	92	125.1
18	24.5	43	58.5	68	92.5	93	126.5
19	25.8	44	59.8	69	93.8	94	127.8
20	27.2	45	61.2	70	95.2	95	129.2
21	28.6	46	62.6	71	96.6	96	130.6
22	29.9	47	63.9	72	97.9	97	131.9
23	31.3	48	65.3	73	99.3	98	133.3
24	32.6	49	66.6	74	100.6	99	134.6
25	34	50	68	75	102	100	136

Gasoline - Oil - Lubricant

RECOMMENDED GASOLINE

The recommended gasoline to use in this vehicle is 87 minimum octane regular unleaded. In many areas, oxygenates are added to the gasoline. Oxygenated gasolines containing up to 10% ethanol or 5% methane are acceptable gasolines.

When using ethanol blended gasoline, it is not necessary to add a gasoline antifreeze since ethanol will prevent the accumulation of moisture in the fuel system.

CAUTION

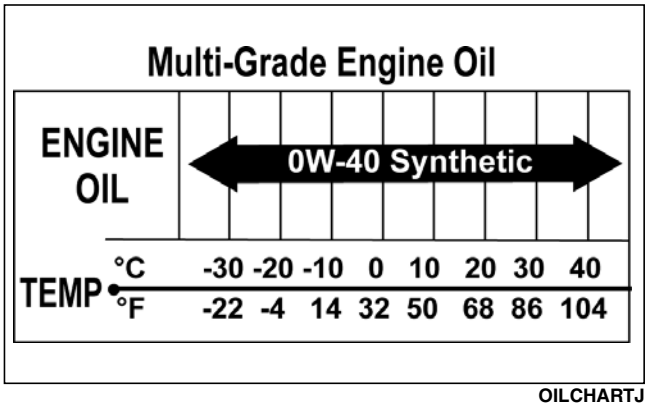
Do not use white gas. Only recommended gasoline additives should be used.

RECOMMENDED ENGINE/ TRANSMISSION OIL

CAUTION

Any oil used in place of the recommended oil could cause serious engine damage. Do not use oils which contain graphite or molybdenum additives. These oils can adversely affect clutch operation. Also, not recommended are racing, vegetable, non-detergent, and castor-based oils.

The recommended oil to use is Toro 0W-40 All Weather synthetic engine oil, which has been specifically formulated for use in this engine. Although Toro 0W-40 All Weather synthetic engine oil is the only oil recommended for use in this engine, use of any API certified SM 0W-40 synthetic oil is acceptable.



OILCHARTJ

RECOMMENDED FRONT DIFFERENTIAL/REAR DRIVE LUBRICANT

■NOTE: Toro recommends the use of genuine Toro lubricants.

The recommended front differential/rear drive lubricant is SAE approved 80W-90 hypoid. This lubricant meets all of the lubrication requirements of this vehicle.

CAUTION

Any lubricant used in place of the recommended lubricant could cause serious front differential/rear drive damage.

FILLING GAS TANK

⚠ WARNING

Always fill the gas tank in a well-ventilated area. Never add fuel to the gas tank near any open flames or with the engine running. DO NOT SMOKE while filling the gas tank.

Since gasoline expands as its temperature rises, the gas tank must be filled to its specified capacity only. Expansion room must be maintained in the tank particularly if the tank is filled with cold gasoline and then moved to a warm area.

⚠ WARNING

Do not overflow gasoline when filling the gas tank. A fire hazard could materialize. Always allow the engine to cool before filling the gas tank.

Tighten the gas tank cap securely after filling the tank.

⚠ WARNING

Do not over-fill the gas tank.

Genuine Parts

When replacement of parts is necessary, use only genuine Toro parts. They are precision-made to ensure high quality and correct fit. Refer to the appropriate Illustrated Parts Manual for the correct part number, quantity, and description.

Special Tools

A number of special tools must be available to the technician when performing service procedures in this manual. Refer to the current Special Tools Catalog for the appropriate tool description.

Description	p/n
Crankcase Separator/Crankshaft Remover	132-3161
Gear Case Seal Installer Tool	132-3162
Magneto Rotor Remover Set	132-3164
Valve Clearance Adjuster	132-3165
Driven Clutch Holder	132-3166
Clutch Cover Seal Installation Tool	132-3167
Slide Hammer 6 mm Adapter	132-3168
Spanner Wrench	132-3188
Fuel Pressure Tester Kit	132-3198
CVT Pulley Holder	132-3180

■NOTE: Special tools are available from the Toro Service Department.

Preparation For Storage

CAUTION

Prior to storing the vehicle, it must be properly serviced to prevent rusting and component deterioration.

1. Clean the seat cushions with a damp cloth and allow to dry.
2. Clean the vehicle thoroughly by washing dirt, oil, grass, and other foreign matter from the entire vehicle. Allow the vehicle to dry thoroughly. DO NOT get water into any part of the engine or air intake.
3. Either drain the gas tank or add a fuel stabilizer to the gas in the gas tank.
4. Clean the interior of the air filter housing.
5. Plug the hole in the exhaust system with a clean cloth.
6. Apply light oil to the upper steering shaft bushing and plungers of the shock absorbers.
7. Tighten all nuts, bolts, cap screws, and screws. Make sure rivets holding components together are tight. Replace all loose rivets. Care must be taken that all calibrated nuts, cap screws, and bolts are tightened to specifications.
8. Fill the cooling system to the bottom of the stand pipe in the radiator neck with properly mixed coolant.
9. Disconnect the battery cables (negative cable first); then remove the battery, clean the battery posts and cables, and store in a clean, dry area.

■NOTE: For storage, use a battery maintainer or make sure the battery is fully charged (see Battery section in this manual).

10. Store the vehicle indoors in a level position.

CAUTION

Avoid storing outside in direct sunlight and avoid using a plastic cover as moisture will collect on the vehicle causing rusting.

Preparation After Storage

Taking this vehicle out of storage and correctly preparing it will assure many miles and hours of trouble-free riding. Toro recommends the following procedure.

1. Clean the vehicle thoroughly.
2. Clean the engine. Remove the cloth from the exhaust system.
3. Check all control wires and cables for signs of wear or fraying. Replace if necessary.
4. Change the engine/transmission oil and filter.
5. Check the coolant level and add properly mixed coolant as necessary.
6. Charge the battery; then install. Connect the battery cables making sure to connect the positive cable first.

CAUTION

Before installing the battery, make sure the ignition switch is in the OFF position.

7. Check the entire brake systems (fluid level, pads, etc.), all controls, headlights, taillight, brakelight, and headlight aim; adjust or replace if necessary.
8. Check the tire pressure. Inflate to recommended pressure as necessary.
9. Tighten all nuts, bolts, cap screws, and screws making sure all calibrated nuts, cap screws, and bolts are tightened to specifications.
10. Make sure the steering moves freely and does not bind.
11. Check the spark plug. Clean or replace as necessary.

Periodic Maintenance

This section has been organized into sub-sections which show common maintenance procedures for the Toro ROV.

Periodic Maintenance Chart

A = Adjust I = Inspect C = Clean R = Replace T = Tighten L = Lubricate

Item	Initial Service After Break-In (First Month or 100 Miles)	Every Day	Every Month or Every 100 Miles	Every 3 Months or Every 300 Miles	Every 6 Months or Every 500 Miles	Every Year or Every 1500 Miles	As Needed
Battery	I		I				C
Fuses				I			R
Air Filter	I			I*			R
Valve/Tappet Clearance	I				I		A
Engine Compression						I	
Spark Plug	I			I	I		R (4000 Mi or 18 Mo)
Muffler/Spark Arrester					C		R
Gas Hoses	I	I					R (2 Yrs)
Throttle Cable Ends/Accelerator Pedal Pivot	I	I			C-L		A-R
Engine-Transmission Oil Level		I					A
Engine-Transmission Oil/Filter	R			R*/R**/R***			R
Front Differential - Rear Drive Lubricant	I		I				R (4 Yrs)
Tires/Air Pressure	I	I					R
Steering Components	I	I		I			R
V-Belt	I				I		R
Suspension (Ball joint boots, drive axle boots front and rear, tie rods, differential and rear drive bellows)	I	I					R
Nuts/Bolts/Cap Screws	T		T				A
Ignition Timing						I	
Headlight/Taillight-Brakelight	I	I					R
Switches	I	I					R
Shift Lever					I		A-L
Gauges/Indicators	I	I					R
Frame/Welds	I		I		I		
Electrical Connections					I		C
Complete Brake System (Hydraulic)	I	I					
Brake Pads	I			I*			R
Brake Fluid	I			I			R (2 Yrs)
Brake Hoses	I			I			R (4 Yrs)
Coolant/Cooling System	I		I				R (2 Yrs)
Wheel Lug Nuts	T			T			

* Service/Inspect more frequently when operating in adverse conditions. ** When using an API certified SM 0W-40 oil.

*** When using Toro 0W-40 All Weather synthetic oil, oil change interval can be increased to every 1600 km (1,000) miles or every year.

Lubrication Points

It is advisable to lubricate certain components periodically to ensure free movement. Apply light oil to the components using the following list as reference.

A. Accelerator Pedal Pivot/Cable Ends

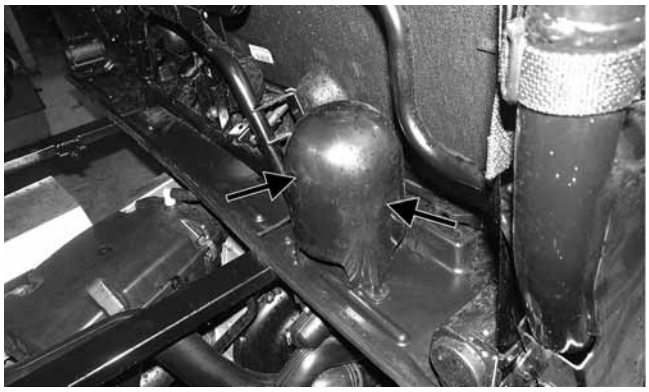
B. Brake Pedal Pivot

C. Shift Cable

Air Inlet Pre-Filter

This vehicle is equipped with a foam pre-filter to filter dirt from the inlet air prior to reaching the main air filter.

1. Raise the cargo box; then gently squeeze the pre-filter cover and lift it up to expose the pre-filter.



HDX237A

2. Loosen the clamp securing the pre-filter.

HDX235

2. Remove the pre-filter assembly and wash thoroughly in warm, soapy water; then rinse and dry.
3. Install and secure with the clamp. Tighten securely; then with the pre-filter cover installed, lower the cargo box.

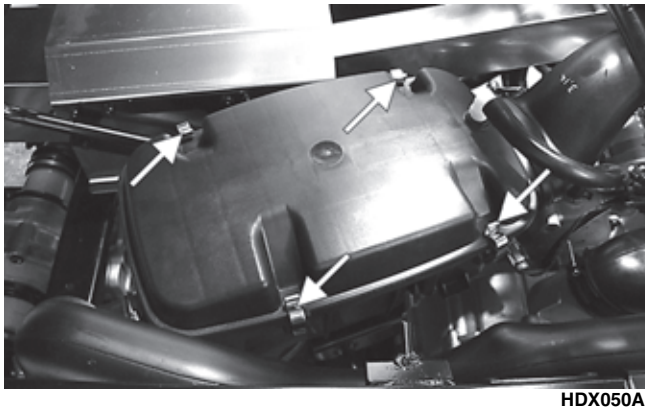
Air Filter

CAUTION

Failure to inspect the air filter frequently if the vehicle is used in dusty, wet, or muddy conditions can damage the engine.

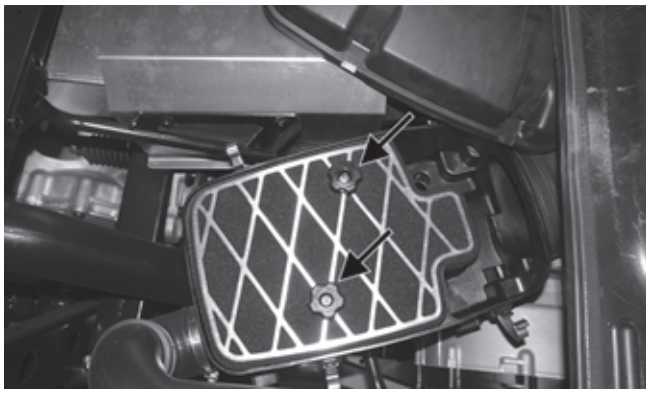
■NOTE: To access the air filter, raise the cargo box.

1. Remove dirt and debris from around the filter housing.
2. Unsnap the four spring-clip fasteners and remove the air filter cover.



HDX050A

3. Remove the two knobs securing the filter; then remove the metal hold-down and filter.



HDX226A

4. Fill a wash pan larger than the element with a soapy water; then dip the element in the soapy water and wash it.
5. Squeeze the element by pressing it between the palms of both hands to remove excess soapy water. Do no twist or ring the element or it will tear.
6. Dry the element.
7. Put the element in a plastic bag; then pour in air filter oil and work the oil into the element.

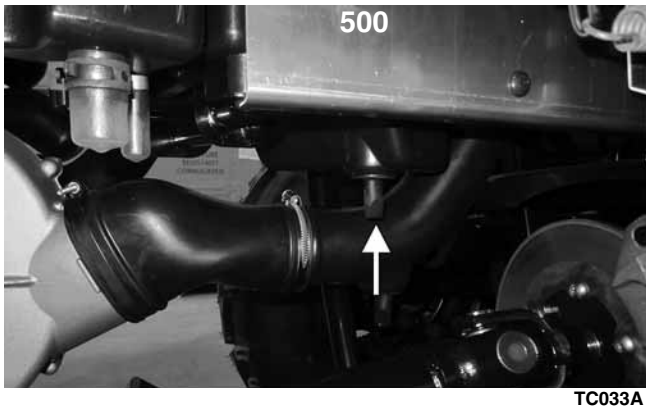
8. Squeeze the element to remove excess oil.

CAUTION

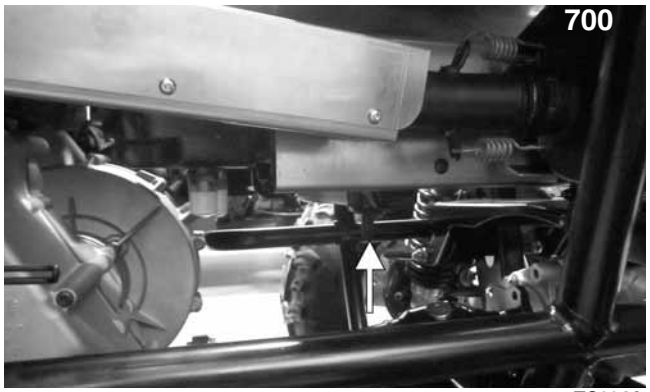
A torn air filter can cause damage to the engine. Dirt and dust may get inside the engine if the element is torn. Carefully examine the element for tears before and after cleaning it. Replace the element with a new one if it is torn.

9. Clean any dirt or debris from inside the filter housing.
10. Install the air filter and metal hold-down, secure with the two knobs tightened to 16 N-m (12 ft-lb), and install the cover. Secure with the four clips.
11. Lower the cargo box.

AIR FILTER HOUSING DRAINS



TC033A



TC034A

Inspect and squeeze the "duck bill" drain beneath the main housing for debris and for proper sealing.

Remove the tube drain and clean out any water, oil, or debris. Reinstall and secure with the clamp.

Valve/Tappet Clearance

■NOTE: The engine must be cold for this procedure.

■NOTE: The seat, seat back, seat base, and spark plug must be removed for this procedure.

1. Remove the spark plug and timing inspection plug; then remove the tappet covers (for more detailed information, see the Engine/Transmission section - Servicing Top-Side Components).
2. Rotate the crankshaft to the TDC position on the compression stroke.

■NOTE: At this point, the rocker arms and adjuster screws must not have pressure on them.

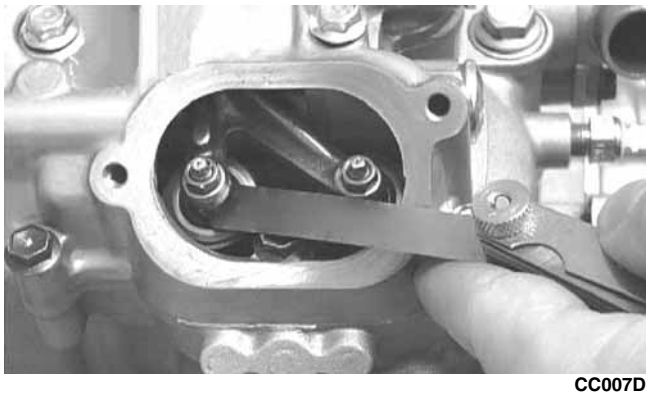
Feeler Gauge Procedure

Using a feeler gauge, check each valve/tappet clearance. If clearance is not within specifications, loosen the jam nut and rotate the tappet adjuster screw until the clearance is within specifications. Tighten each jam nut to 7 ft-lb after completing the adjustment.

CAUTION

The feeler gauge must be positioned at the same angle as the valve and valve adjuster for an accurate measurement of clearance. Failure to measure the valve clearance accurately could cause valve component damage.

VALVE/TAPPET CLEARANCE	
Intake	0.1016 mm (0.004 in.)
Exhaust	0.1524 mm (0.006 in.)



CC007D

Valve Adjuster Procedure

A. Place the Valve Clearance Adjuster onto the jam nut securing the tappet adjuster screw; then rotate the valve adjuster dial clockwise until the end is seated in the tappet adjuster screw.

B. While holding the valve adjuster dial in place, use the valve adjuster handle and loosen the jam nut; then rotate the tappet adjuster screw clockwise until friction is felt.

C. Align the valve adjuster handle with one of the marks on the valve adjuster dial.

D. While holding the valve adjuster handle in place, rotate the valve adjuster dial counterclockwise until proper valve/tappet clearance is attained.

■NOTE: Refer to the specifications in Feeler Gauge Procedure sub-section for the proper valve/tappet clearance.

■NOTE: Rotating the valve adjuster dial counterclockwise will open the valve/tappet clearance by 0.05 mm (0.002 in.) per mark.

E. While holding the adjuster dial at the proper clearance setting, tighten the jam nut securely with the valve adjuster handle.

3. Install the spark plug; then install the timing inspection plug.
4. Place the two tappet covers with O-rings into position. Tighten the cap screws to 8 ft-lb.

Testing Engine Compression

■NOTE: The engine should be warm (operating temperature) and the battery fully charged for an accurate compression test. The throttle must be in the wide-open throttle (WOT) position. In the event the engine cannot be run, cold values are included.

■NOTE: The seat, seat back, and seat base must be removed for this procedure.

1. Remove the high tension lead from the spark plug.
2. Using compressed air, blow any debris from around the spark plug.

⚠ WARNING

Always wear safety glasses when using compressed air.

3. Remove the spark plug; then attach the high tension lead to the plug and ground the plug on the cylinder head well away from the spark plug hole.
4. Attach a suitable compression tester.
5. While holding the throttle in the full-open position, crank the engine over with the electric starter until the gauge stops climbing (five to 10 compression strokes).

PSI Hot (WOT)	PSI Cold (WOT)
125-145	100-140

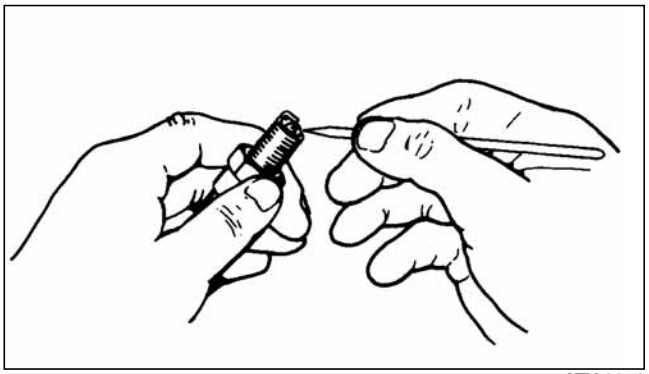
6. If compression is abnormally low, inspect the following items.
   A. Starter cranks engine over.
   B. Gauge is functioning properly.
   C. Throttle in the full-open position.
   D. Valve/tappet clearance correct.
   E. Engine warmed up.
   F. Intake obstructed.

■NOTE: To service top-side components, see the Engine/Transmission section.

7. Pour approximately 30 ml (1 fl oz) of oil into the spark plug hole, reattach the gauge, and retest compression.
8. If compression is now evident, service the piston rings (see the appropriate Engine/Transmission - Top Side Components).

Spark Plug

A light brown insulator indicates that the plug is correct. A white or dark insulator indicates that the engine may need to be serviced. To maintain a hot, strong spark, keep the plug free of carbon.

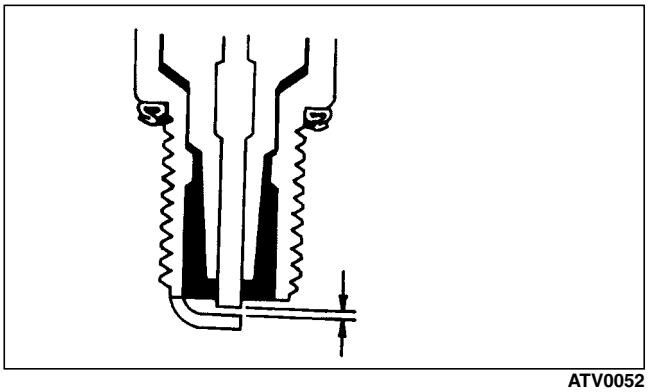


ATV-0051

CAUTION

Before removing the spark plug, be sure to clean the area around the spark plug. Dirt could enter engine when removing or installing the spark plug.

Adjust the gap to 0.5-0.6 mm (0.019-0.024 in.).



ATV0052

A new spark plug should be tightened 1/2 turn once the washer contacts the cylinder head. A used spark plug should be tightened 1/8 - 1/4 turn once the washer contacts the cylinder head.

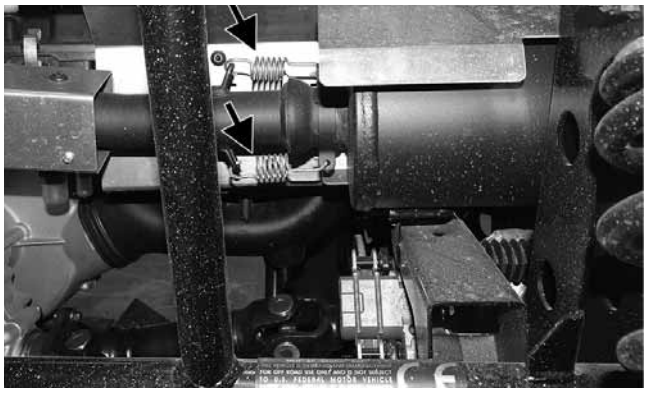
Muffler/Spark Arrester

Clean the spark arrester using the following procedure.

⚠ WARNING

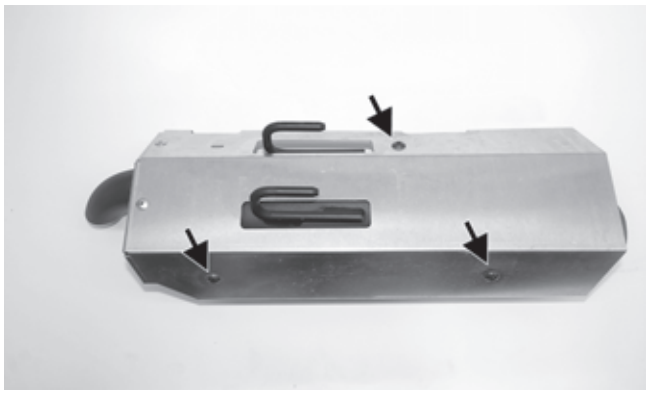
Wait until the muffler cools to avoid burns.

1. Open the cargo box and remove the two springs securing the muffler to the exhaust pipe.



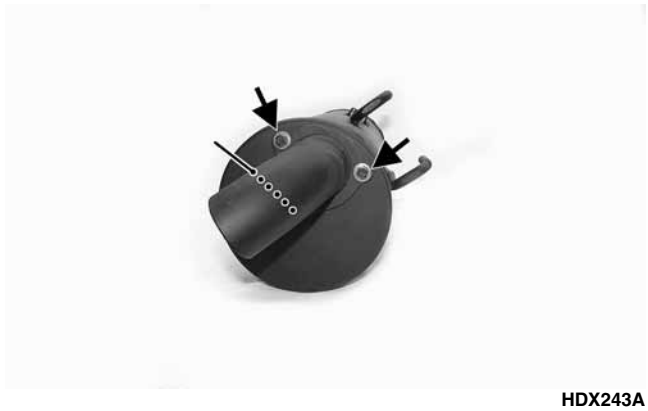
HDX238A

2. Remove the muffler by pulling it rearward out of the vehicle.
3. Remove the heat shield.



HDX241A

4. Remove the three cap screws securing the exhaust pipe/spark arrester assembly to the muffler.



HDX243A

5. Using a wire brush, clean the carbon deposits from the screen taking care not to damage the screen.

HDX242

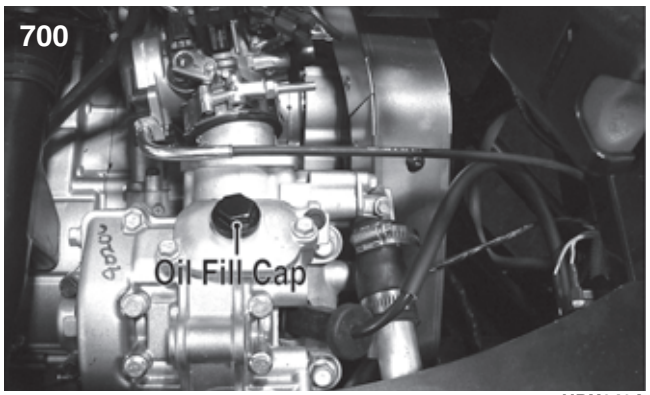
■**NOTE: If the screen or gasket is damaged in any way, it must be replaced.**

6. Install the exhaust pipe/spark arrester assembly and secure with the three cap screws. Tighten to 6.8 N-m (60 in.-lb).
7. Install the heat shield and tighten the fasteners to 8.1 N-m (72 in.-lb).
8. Install the muffler and secure it to the exhaust pipe with the two springs.

Engine/Transmission Oil - Filter

Change the engine oil and oil filter at the scheduled intervals. The engine should always be warm when the oil is changed so the oil will drain easily and completely.

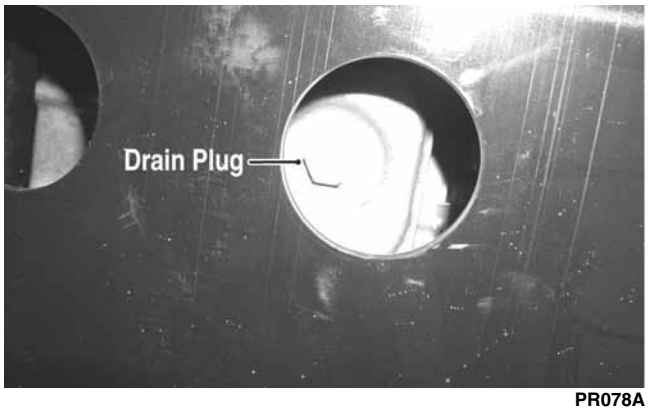
1. Park the vehicle on level ground.
2. Remove the seat; then remove the backrest and seat base.
3. Loosen the oil fill cap using a 27 mm socket (700) or oil level stick (500). Be careful not to allow contaminants to enter the opening.



HDX042A

HDX234A

4. Remove the drain plug from the bottom of the engine and drain the oil into a drain pan.



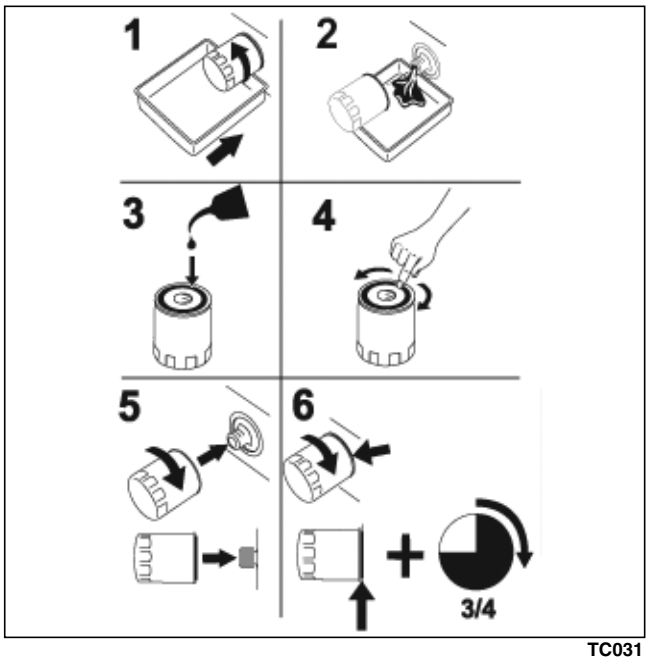
PR078A

5. Use an appropriate oil filter wrench to remove the old oil filter and dispose of properly. Do not re-use oil filter.

■NOTE: To access the filter, remove the seat, seat back, and seat base (see Seats in General Information).

■NOTE: Clean up any excess oil after removing the filter.

6. Apply oil to the new filter O-ring and check to make sure it is positioned correctly; then install the new oil filter. Tighten 3/4 turn after contact with the sealing flange.



TC031

7. Install the engine drain plug and tighten to 22 N-m (16 ft-lb). Pour the recommended oil in the fill hole (700) or oil level stick opening (500). Install the oil fill cap (700) or the oil level stick (500).

8. Start the engine (while the vehicle is outside on level ground) and allow it to idle for a few minutes.

9. Turn the engine off and wait approximately one minute. Check the oil level. The engine oil level must be within the operating range but not exceeding the upper mark.

GZ461A

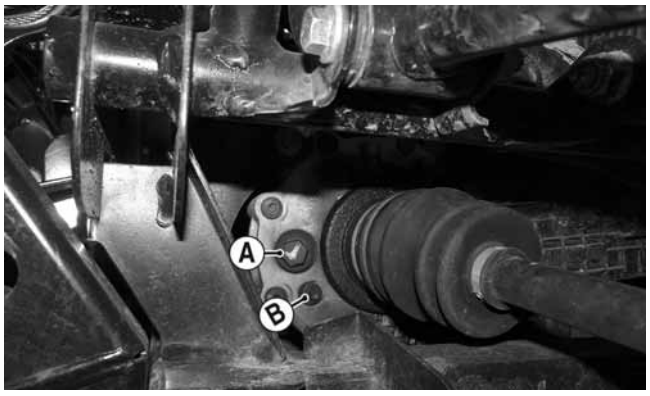
10. Inspect the area around the drain plug and oil filter for leaks.

11. Install the seat base, seat, and backrest.

Front Differential - Rear Drive Lubricant

To check lubricant, use the following procedure.

1. Remove the level plug (B); the lubricant should be level with the bottom threads.



HDX221A

2. If low, remove the fill plug (A) and add the appropriate lubricant until it appears at the bottom of the level plug threads.

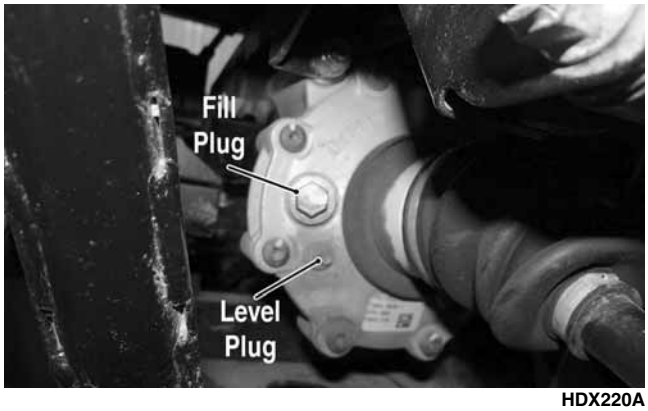
To change the lubricant, use the following procedure.

1. Place the vehicle on level ground.

2. Remove the front differential and rear drive fill plugs.

3. Drain the lubricant into a drain pan by removing the drain plug from the front differential and rear drive.

HDX255



HDX220A

4. After all the lubricant has been drained, install the drain plugs and tighten to 5 N-m (45 in.-lb).
5. Pour SAE approved 80W-90 hypoid lubricant into each fill hole until it flows out of the hole.
6. Install the fill plugs and tighten to 22 N-m (16 ft-lb).

■NOTE: If the lubricant is contaminated with water, inspect the drain plug, fill plug, and/or bladder.

Driveshaft/Coupling

The following drive system components should be inspected periodically to ensure proper operation.

A. Spline lateral movement (slop).

B. Coupling cracked, damaged, or worn.

C. Universal joints worn or missing bearings.

Nuts/Bolts/Cap Screws

Tighten all nuts, bolts, and cap screws. Make sure rivets holding components together are tight. Replace all loose rivets. Care must be taken that all calibrated nuts, bolts, and cap screws are tightened to specifications.

Headlight/Taillight-Brakelight

HEADLIGHT

■NOTE: The bulb portion of the headlight is fragile. HANDLE WITH CARE. When replacing the headlight bulb, do not touch the glass portion of the bulb. If the glass is touched, it must be cleaned with a dry cloth before installing. Skin oil residue on the bulb will shorten the life of the bulb.

⚠ WARNING

Do not attempt to remove the bulb when it is hot. Severe burns may result.

To replace the headlight bulb, use the following procedure.

1. Remove the wiring harness connector from the back of the headlight.
2. Grasp the bulb housing, turn it counterclockwise, and remove the housing. Remove the bulb.
3. Install the new bulb into the housing; then install the housing and rotate it completely clockwise.
4. Install the wiring harness connector.

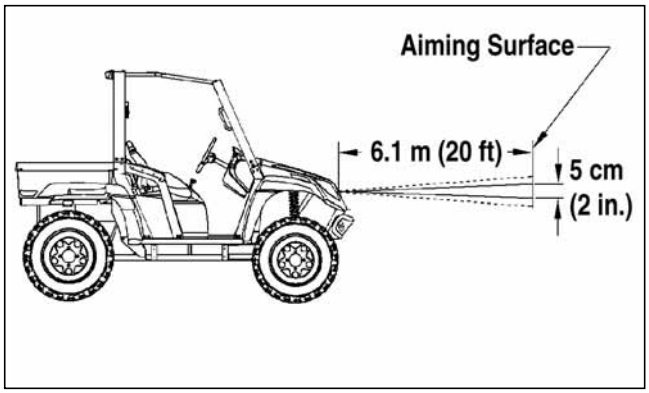
To replace the taillight/brakelight bulb, use the following procedure.

1. Remove the mounting screws securing the taillight/brakelight assembly to the rear ROPS tube.
2. Rotate the socket counterclockwise and remove it from the housing.
3. To remove the bulb from the socket, pull it straight out of the socket.
4. To install the bulb, push it straight into the socket.
5. Insert the socket into the housing and rotate it clockwise.
6. Position the taillight/brakelight assembly on the rear ROPS tube; then tighten the mounting screws securely.

CHECKING/ADJUSTING HEADLIGHT AIM

The headlights can be adjusted vertically. The center of the HIGH beam light zone is to be used for aiming.

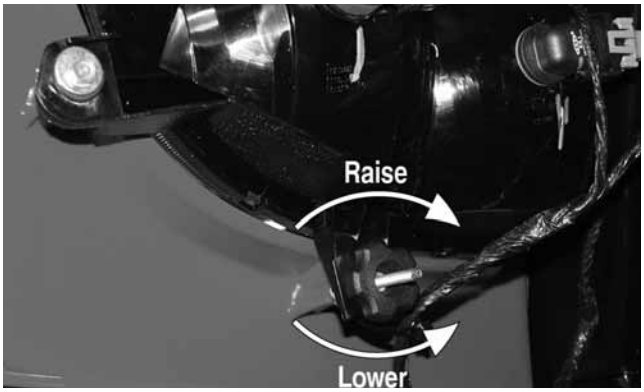
1. Position the vehicle on a level floor so the headlights are approximately 6.1 m (20 ft) from an aiming surface (wall or similar aiming surface).



0740-647

■ **NOTE: There should be an average operating load on the vehicle when adjusting the headlight aim.**

2. Measure the distance from the floor to the mid-point of each headlight.
3. Using the measurements obtained in step 2, make horizontal marks on the aiming surface.
4. Make vertical marks which intersect the horizontal marks on the aiming surface directly in front of the headlights.
5. Switch on the lights. Make sure the HIGH beam is on. DO NOT USE LOW BEAM.
6. Observe each headlight beam aim. Proper aim is when the HIGH beam is centered on the vertical mark 5 cm (2 in.) below the horizontal mark on the aiming surface.
7. Turn the adjuster nut clockwise to raise the beam and counterclockwise to lower the beam.



TC004A

Shift Lever

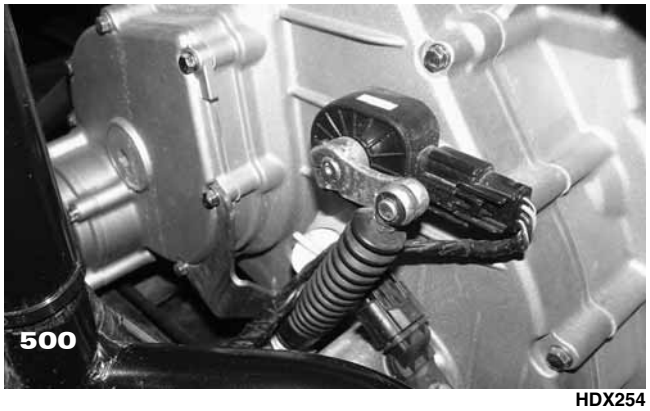
CHECKING SHIFT CABLE ADJUSTMENT

1. Turn the ignition switch on; then with the shift lever in the neutral position, look for the (N) indication on the LCD. Shift into high range and look for the (H) indication, low range for the (L) indication, and reverse for the (R) indication.
2. Shift the transmission into park and observe that the (P) illuminates on the LCD gauge.

ADJUSTING SHIFT CABLE

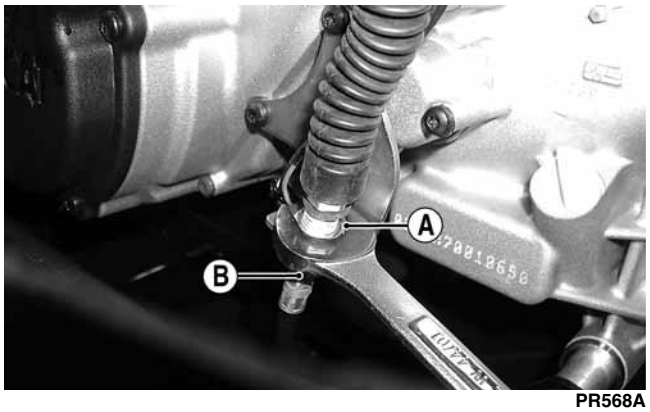
1. Place the transmission in park; then tilt the cargo box.
2. Make sure the shift lever is in park; then remove the E-clip securing the cable end to the shift arm stud.

HDX251



HDX254

3. Loosen nuts (A) and (B) and adjust the cable housing to align the shift cable end to the shift arm stud.



PR568A

4. Install the E-clip; then tighten the nuts (A) and (B) to 8 ft-lb.
5. Check each gear shift position for proper gear selection and make sure the proper icon illuminates on the LCD.

Hydraulic Brake System

■NOTE: This ROV is equipped with hydraulic brakes at all four wheels.

CHECKING/BLEEDING

The hydraulic brake system has been filled and bled at the factory.

1. With the master cylinder in a level position, check the fluid level in the reservoir. If the level in the reservoir is not above the MIN, add DOT 4 brake fluid.

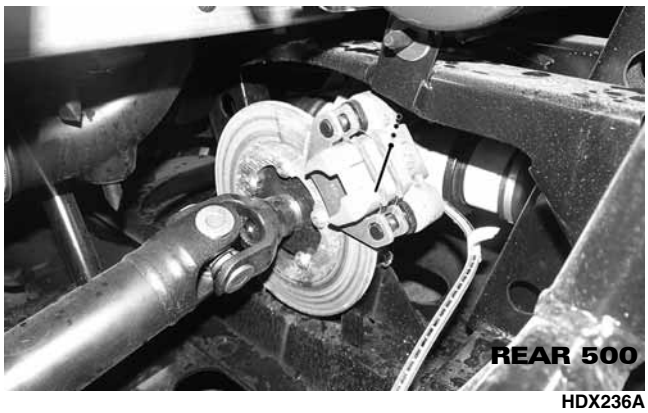
PR095

2. Depress the brake pedal several times to check for a firm brake. If the brake is not firm, the system must be bled. To bleed the brake system, use the following procedure.

   A. Remove the cover and fill the reservoir with DOT 4 Brake Fluid; then install and secure the cover.

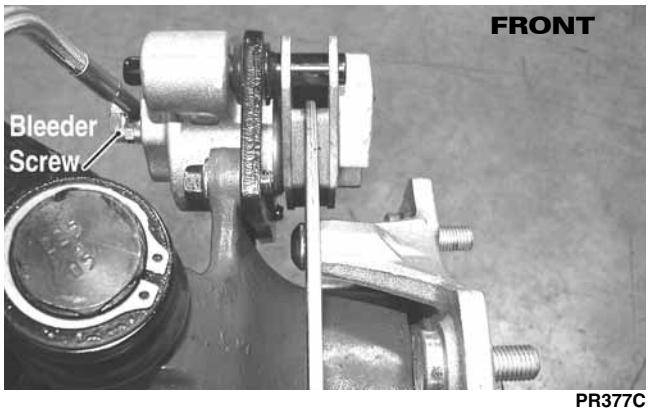
   B. Slowly depress the brake pedal several times.

   C. Remove the protective cap, install one end of a clear hose onto the RIGHT REAR (700) or REAR DRIVELINE (500) bleeder screw, and direct the other end into a container; then while holding slight pressure on the brake pedal, open the bleeder screw and watch for air bubbles. Close the bleeder screw before releasing the brake pedal. Repeat this procedure until no air bubbles are present. Repeat B and C for the rear left.



HDX236A

AF637D



PR377C

■NOTE: During the bleeding procedure, watch the reservoir very closely to make sure there is always a sufficient amount of brake fluid. When the level falls below MIN, refill the reservoir before the bleeding procedure is continued. Failure to maintain a sufficient amount of fluid in the reservoir will result in air in the system.

   D. At this point, perform steps B and C on the REAR LEFT bleeder screw (700 only); then move to the FRONT RIGHT bleeder screw and follow the same procedure. Finally, complete the procedure on the FRONT LEFT bleeder screw.

   E. Repeat steps B and C until the brake pedal is firm.

3. Carefully check the entire hydraulic brake system to ensure all hose connections are tight, the bleed screws are tight, the protective caps are installed, and no leakage is present.

CAUTION

This hydraulic brake system is designed to use DOT 4 brake fluid only. If brake fluid must be added, care must be taken as brake fluid is very corrosive to painted surfaces.

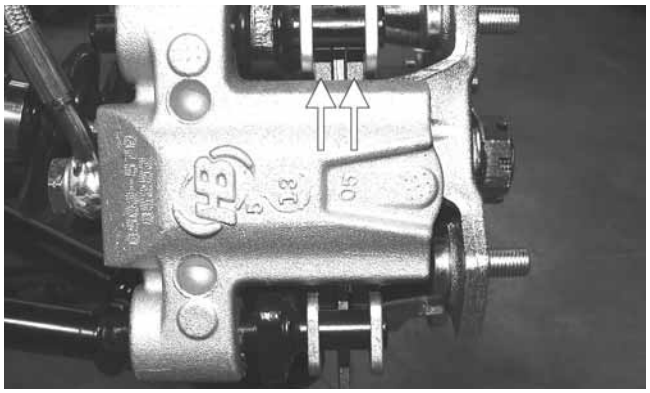
INSPECTING HOSES

Carefully inspect the hydraulic brake hoses for cracks or other damage. If found, the brake hoses must be replaced.

CHECKING/REPLACING PADS

The clearance between the brake pads and brake discs is adjusted automatically as the brake pads wear. The only maintenance that is required is replacement of the brake pads when they show excessive wear. Check the thickness of each of the brake pads as follows.

1. Remove the wheel corresponding to the brake being checked.
2. Measure the thickness of each brake pad.



PR376A

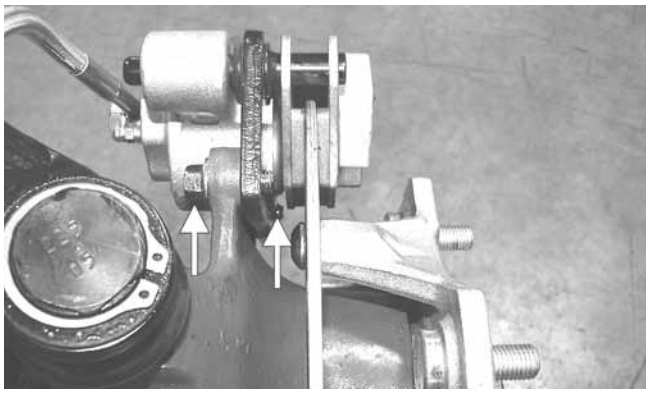
3. If thickness of either brake pad is less than 1.0 mm (0.039 in.), the brake pads must be replaced.

■NOTE: The brake pads should be replaced as a set.

4. To replace the brake pads, use the following procedure.
   A. Remove the cap screws securing the caliper holder to the knuckle; then remove the pads from the caliper.

PR237

   B. Install the new brake pads.
   C. Secure the caliper holder to the knuckle with new "patch-lock" cap screws. Tighten to 20 ft-lb.



PR377B

5. Install the wheel; then using a crisscross pattern, tighten the wheel nuts in 27 N-m (20 ft-lb) increments to the final torque shown in the table below.

Steel Wheel	54 N-m (40 ft-lb)
Aluminum Wheel (Black Nuts)	80 N-m (60 ft-lb)
Aluminum Wheel (Chrome Nuts)	108 N-m (80 ft-lb)

PR941A

CAUTION

Using an impact wrench could result in incorrect torque which could damage the wheel or hub studs.

6. Burnish the brake pads.

BRAKE DISC

Using a micrometer, measure the thickness of the brake disc in the contact surface. If thickness is 0.125 in. or less, the disc must be replaced. To replace the brake disc, see Drive System – Hub.

Burnishing Brake Pads

Brake pads must be burnished to achieve full braking effectiveness. Braking distance will be extended until brake pads are properly burnished. To properly burnish the brake pads, use the following procedure.

⚠ WARNING

Failure to properly burnish the brake pads could lead to premature brake pad wear or brake loss. Brake loss can result in severe injury.

1. Choose an area large enough to safely accelerate the vehicle to 30 mph and to brake to a stop.
2. Accelerate to 30 mph; then depress the brake pedal to decelerate to 0-5 mph.
3. Repeat procedure 20 times until brake pads are burnished.

Checking/Replacing V-Belt

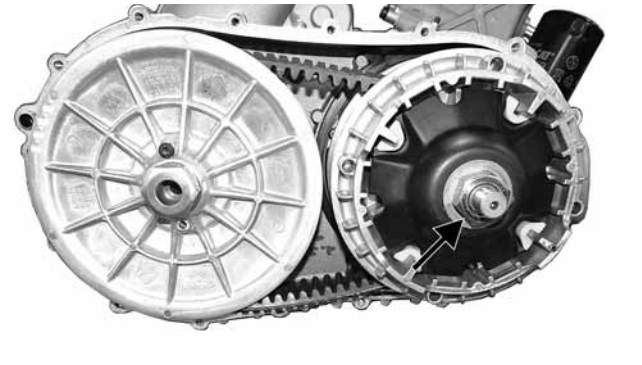
REMOVING

1. Remove the seat, seat back, and seat base; then remove the floor and gas tank.
2. Remove the cap screws securing the CVT cover noting the location of the different-lengthed cap screws for installing purposes; then using a rubber mallet, gently tap on the cover tabs to loosen the cover. Remove the cover.

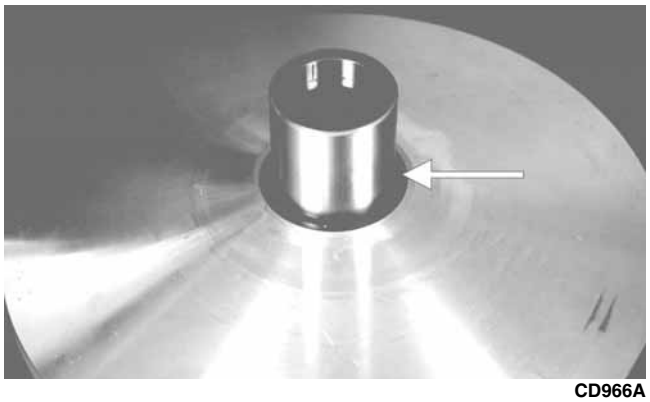
CF363

3. Remove the nut securing the movable drive face; then remove the face. Account for the spacer.

■NOTE: Keep the drive face plate in contact with the drive face when removing or installing the drive face to prevent the rollers from falling out.



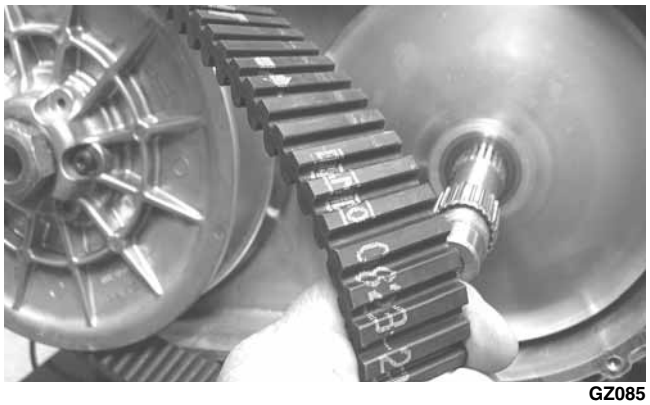
CF364A



CD966A

4. Install one of the CVT cover cap screws into the driven pulley fixed face; then turn the cap screw clockwise to spread the pulley faces. Remove the V-belt.

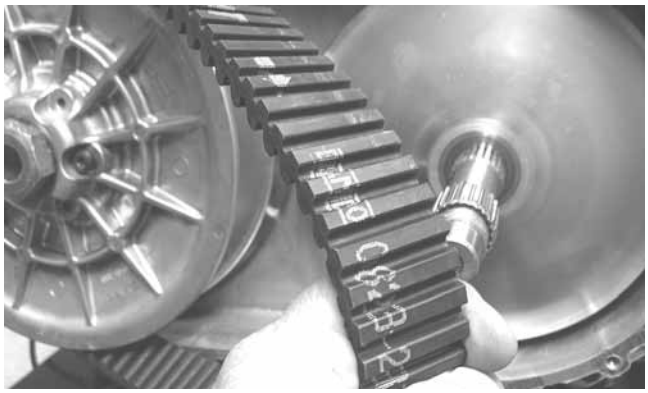
GZ076



GZ085

INSTALLING

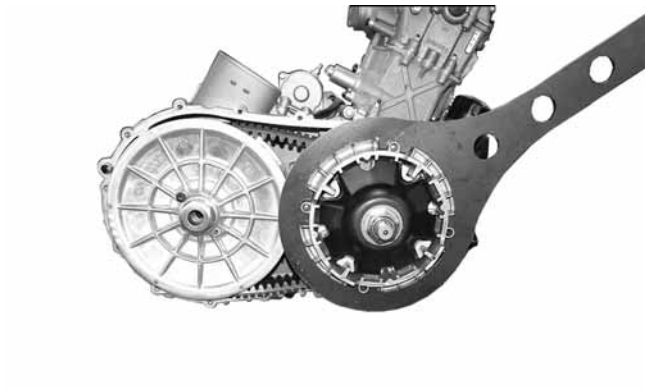
1. Place the V-belt into position on the driven pulley and over the front shaft.



GZ085

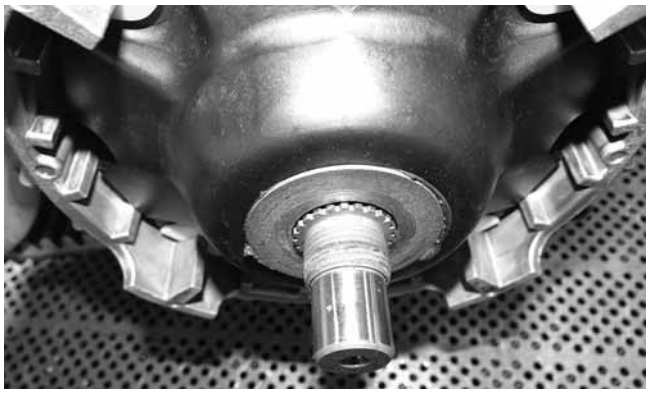
■**NOTE: The arrows on the V-belt should point in direction of engine rotation (forward).**

2. Pinch the V-belt together near its center and slide the spacer and movable drive face onto the front shaft. Secure the drive face with a new nut. Using an appropriate spanner wrench, tighten the nut to 147 ft-lb (500) or 165 ft-lb (700).



CF366

CAUTION
Make sure the movable drive face plate is fully engaged onto the splines of the clutch shaft before tightening the nut or false torque readings may occur. This will cause the assembly to loosen damaging the shaft and clutch face plate.



CF379

■**NOTE: At this point, the CVT cover cap screw can be removed.**

3. With the vehicle in neutral, rotate the V-belt and clutches counterclockwise until the V-belt is flush with the top of the driven pulley.

4. Place the CVT cover gasket into position; then install the cover and secure with the cap screws making sure the different-lengthed cap screws are in their proper location. Tighten the cap screws to 8 ft-lb.

CF363

5. Install the gas tank and floor; then install the seat back, seat base, and seat.

Steering/Frame/Controls

The following steering components should be inspected periodically to ensure safe and proper operation.

A. Steering wheel secure.

B. Steering has equal and complete full-left and full-right capability.

C. Steering assembly mounting bolts tight.

D. Ball joints not worn, cracked, or damaged.

E. Tie rods not bent or cracked.

F. Knuckles not worn, cracked, or damaged.

G. Cotter pins not damaged or missing.

The frame and welds should be checked periodically for damage, bends, cracks, deterioration, broken components, and missing components.

Steering Wheel

REMOVING

1. Remove the steering wheel cover; then match mark the steering shaft and steering wheel.

■NOTE: Any time steering components are disassembled, all connecting components should be marked for proper alignment during assembling.

2. Remove the lock clip from the steering shaft; then remove the nut securing the steering wheel and remove the steering wheel.

INSPECTING

1. Inspect the steering wheel for cracks, missing padding, or broken spokes.
2. Inspect the splines for wear.
3. Check that the steering wheel is not bent.

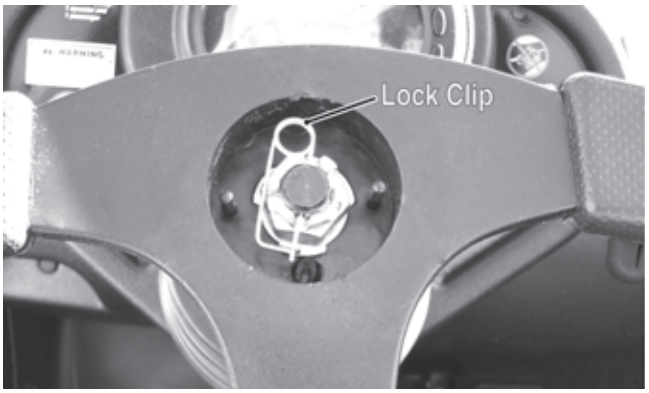
INSTALLING

1. Install the steering wheel aligning the two match marks; then apply a drop of red Loctite #271 to the threads of the nut and secure the steering wheel. Tighten to 25 ft-lb.

■NOTE: If a new steering wheel is being installed, mark the wheel as close as possible to the old wheel mark; then check for proper positioning with the front wheels straight forward.

2. Install the lock clip on the steering shaft.

■NOTE: If the hole in the steering shaft does not align with the slots in the castle nut, tighten the nut slightly until the next slot aligns with the hole.



HDX131A

Tie Rods

REMOVING

1. Remove the steering rack assembly (see Steering Assembly in this section).
2. Support the steering rack assembly in a suitable holding fixture or bench vise; then cut the securing band and slide the boot toward the outer tie rod end.
3. Using a punch or chisel, bend the lock washer away from the flats on the tie rod joint.

PR780

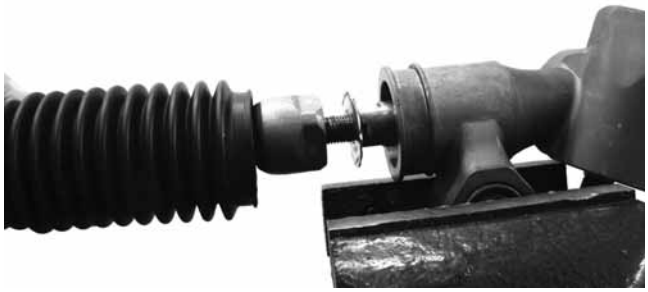
4. Using an appropriate crow-foot and backing wrench, remove the tie rod assembly.

■NOTE: Tie rods come as a complete assembly. No further disassembly is required.

5. Remove and discard the lock washer.

INSTALLING

1. Remove the tie rod end and lock nut from the tie rod; then install the tie rod boot onto the tie rod.
2. Install the tie rod lock nut and tie rod end.
3. Coat the tie rod joint threads with red Loctite #271; then with a new lock washer, thread the tie rod into the rack.

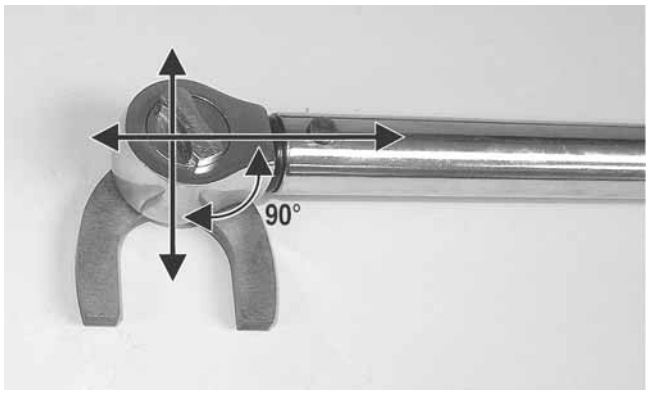


PR784

4. While holding the rack shaft with a wrench, tighten the tie rod joint to 37 ft-lb using an appropriate crow-foot.

PR781

■NOTE: Always attach the crow-foot to the torque wrench with the open end 90° to the torque wrench handle to ensure accurate torque application.



PR528A

5. Install the boot onto the rack and secure with the nylon tie.
6. Center the rack in the steering rack assembly and align the white paint line on the pinion with the mark on the rack housing.

PR785A

Steering Assembly

REMOVING

1. Remove the right front wheel.
2. Remove the cotter pins and nuts securing the tie rod ends to the knuckles; then remove the tie rod ends from the knuckles.

PR301

3. Remove the cap screws securing the steering rack assembly to the rack bracket and remove from the left side.

INSPECTING

1. Inspect the tie rod ends for damaged threads, torn boots, or excessive wear.
2. Inspect the tie rods for bends or deformation.
3. Inspect the rack and pinion-to-tie rod boots for tears or deterioration.

PR785

4. Check boot clamps for security.
5. Check that the steering assembly operates smoothly with no binding from full-left to full-right position.
6. Inspect for grease seepage from the steering assembly.

■NOTE: The steering assembly (rack and pinion) is not repairable and must be replaced as an assembly; however, the tie rods and boots are replaceable.

INSTALLING

1. From the left side, install the steering assembly (rack and pinion) to the frame assembly and secure with two cap screws. Tighten to 35 ft-lb.
2. Place the tie rod ends into the knuckles and secure with the castle nuts (coated with red Loctite #271). Tighten to 30 ft-lb; then install new cotter pins.

■NOTE: If the slots in the castle nut are not aligned with the hole in the tie rod end, tighten until the cotter pin can be installed.

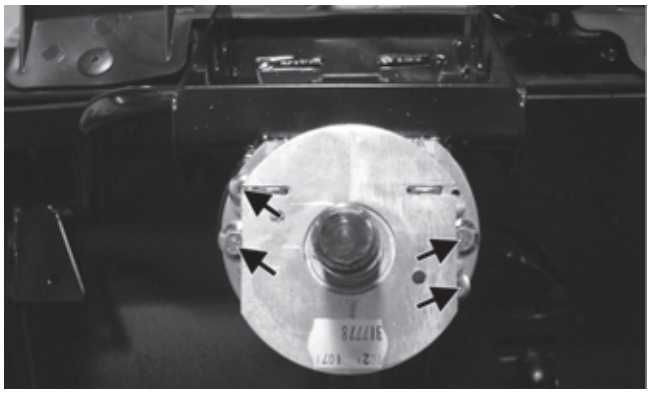
3. Install the wheel; then using a crisscross pattern, tighten the wheel nuts in 27 N-m (20 ft-lb) increments to the final torque shown in the table below.

Steel Wheel	54 N-m (40 ft-lb)
Aluminum Wheel (Black Nuts)	80 N-m (60 ft-lb)
Aluminum Wheel (Chrome Nuts)	108 N-m (80 ft-lb)

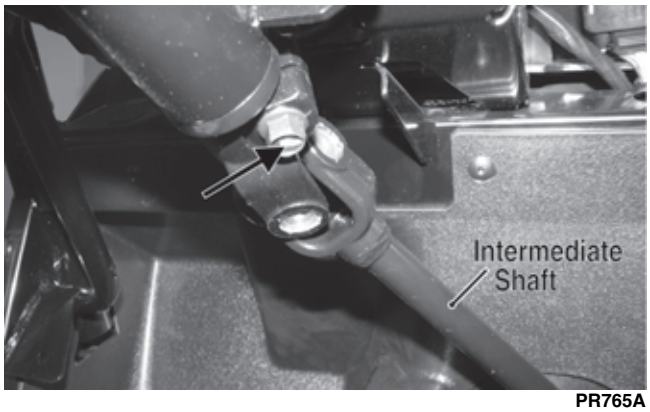
Upper Steering Shaft

REMOVING

1. Remove the dashboard (see Dashboard in this section).
2. Remove the four cap screws and nuts securing the steering shaft housing to the steering support; then remove the cap screw securing the intermediate shaft yoke to the steering shaft.



PR764A



PR765A

3. Remove the steering shaft housing and shaft from the steering support and intermediate shaft.

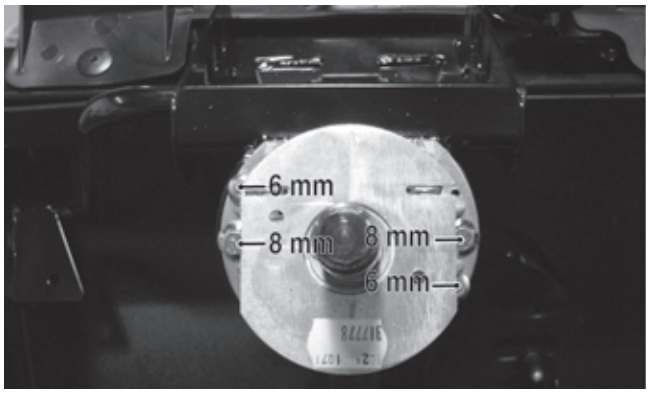
■NOTE: Any time steering components are disassembled, all connecting components should be marked for proper alignment during assembling.

INSPECTING

1. Inspect the steering wheel shaft for excessive wear.
2. Check for worn splines, cracks, or damaged threads.
3. Roll the steering wheel shaft on a flat surface to check for bends.
4. Inspect the nylon bushings in the steering shaft housing for cracking or excessive wear.

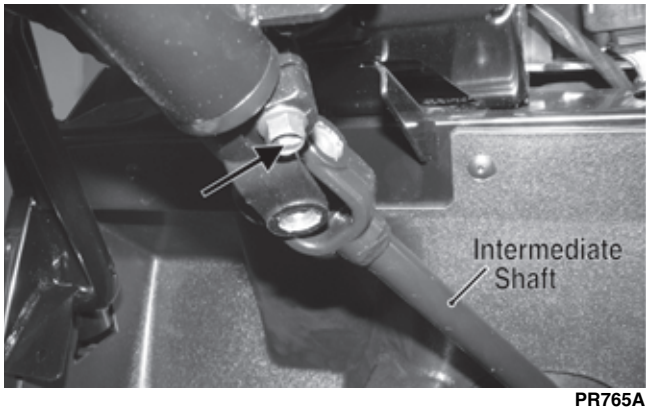
INSTALLING

1. Install the steering shaft housing with steering shaft and connect the steering shaft and intermediate shaft first; then slide the housing into place on the steering support.
2. Secure the steering shaft housing to the frame with four cap screws and nuts. Tighten the 6 mm nuts to 8 ft-lb and the 8 mm nuts to 20 ft-lb.



PR764B

3. Install the cap screw in the intermediate shaft coupler and tighten to 31 ft-lb.



PR765A

Intermediate Steering Shaft Assembly

☞ AT THIS POINT
Before beginning this procedure, the upper steering shaft must be removed.

REMOVING

With the upper steering shaft removed, remove the cap screw from the intermediate shaft coupler and remove the shaft from the vehicle.

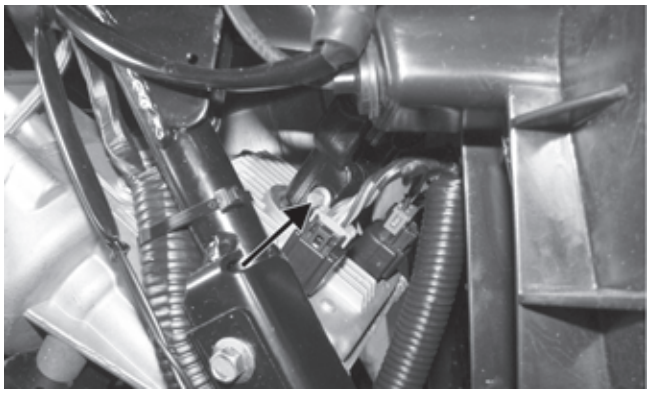
INSPECTING

■NOTE: The lower steering shaft assembly is not repairable or rebuildable. If any damage or excessive wear is detected, the assembly must be replaced.

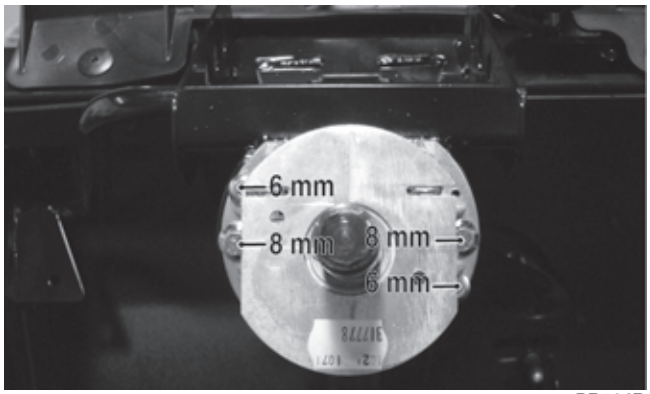
1. Inspect the joints for excessive wear or looseness.
2. Inspect welds.

INSTALLING

1. Place the steering shaft assembly into position through the opening in the splash panel; then align the slot in the intermediate steering shaft coupler to the index (flattened) spline on the input shaft and install. Install but do not tighten the cap screw.

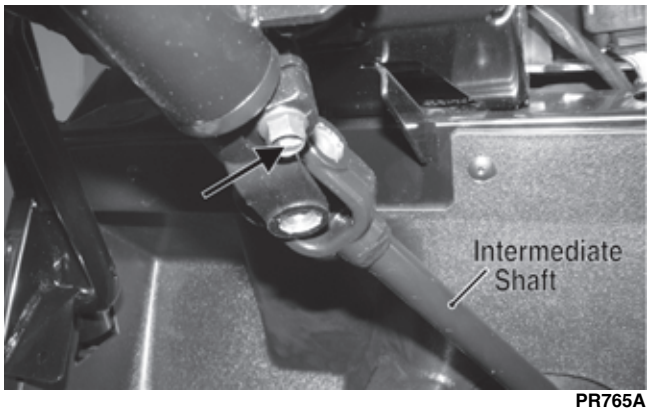

PR759B

2. Install the steering shaft housing with steering shaft connecting the steering shaft and intermediate shaft first; then slide the housing into place on the steering support.
3. Secure the steering shaft housing to the frame with four cap screws and nuts. Tighten the 6 mm nuts to 8 ft-lb and the 8 mm nuts to 20 ft-lb.



PR764B

4. Install the cap screw in the intermediate shaft coupler and tighten to 31 ft-lb; then tighten the cap screw (from step 1) to 11 ft-lb.



PR765A

5. Install the dash and connect the two electrical connectors. Secure with sheet metal screws and tighten securely. Do not over-tighten.
6. Install the steering housing boot; then install the boot support and secure with two machine screws.
7. Install the steering wheel; then apply a drop of red Loctite #271 to the threads of the castle nut. Secure the steering wheel and tighten to 25 ft-lb. Install the lock clip and cover.

Steering Knuckles

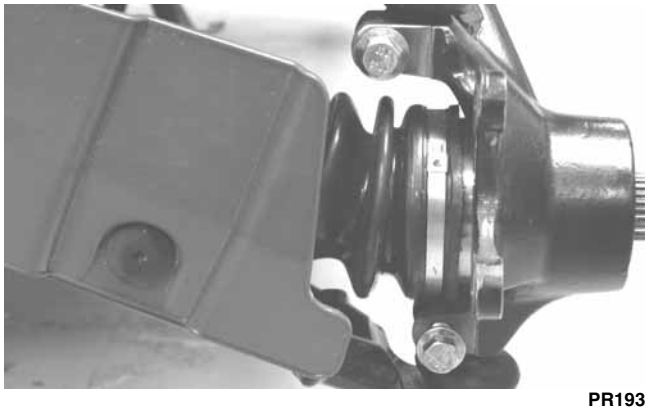
REMOVING AND DISASSEMBLING

1. Secure the vehicle on a support stand to elevate the wheel; then remove the wheel.

⚠ WARNING

Make sure the vehicle is solidly supported on the support stand to avoid injury.

2. Remove the cotter pin from the axle.
3. Remove the nut securing the hub.
4. Remove the brake caliper.
5. Remove the hub assembly.
6. Remove the cotter pin from the tie rod end and remove the tie rod end from the knuckle.
7. Remove the two cap screws securing the ball joints in the knuckle.



PR193

8. Tap the ball joint end out of the knuckle; then remove the knuckle.
9. Remove the snap ring securing the bearing in the knuckle; then press the bearing out of the knuckle.

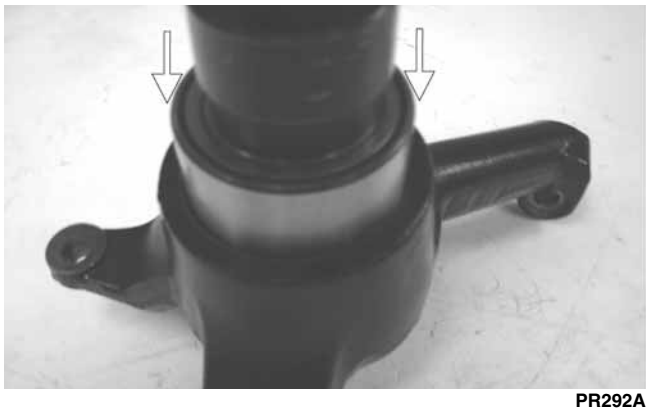
PR289

CLEANING AND INSPECTING

1. Clean all knuckle components.
2. Inspect the bearing for pits, scoring, rusting, or premature wear.
3. Inspect the knuckle for cracks, breaks, or galling of the bearing surface.

ASSEMBLING AND INSTALLING

1. Using a suitable press and driver, press the bearing into the knuckle until firmly seated; then install the snap ring.



PR292A

PR289

2. Install the knuckle to the upper and lower ball joints and secure with the two cap screws. Tighten to 35 ft-lb.

PR202

PR203

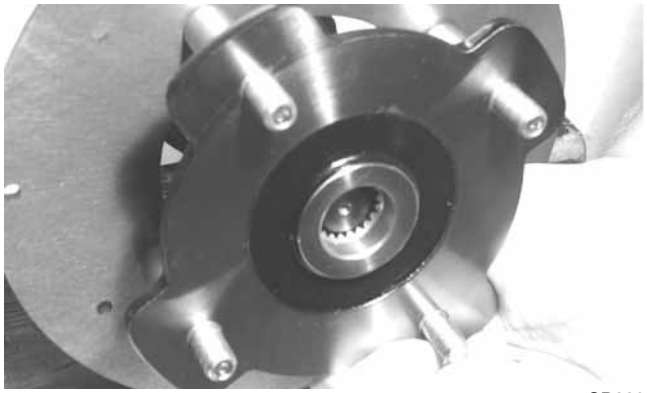
3. Install the tie rod end and secure with the nut (coated with red Loctite #271). Tighten to 30 ft-lb; then install a new cotter pin and spread the pin.

■NOTE: During assembling, new cotter pins should be installed.

4. Apply a small amount of grease to the hub splines.

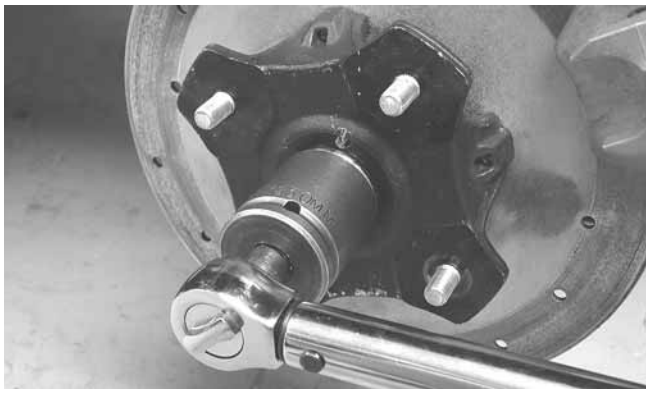
PR290A

5. Install the hub assembly onto the splines of the shaft.



CD009

6. Secure the hub assembly with the nut. Tighten to 200 ft-lb.



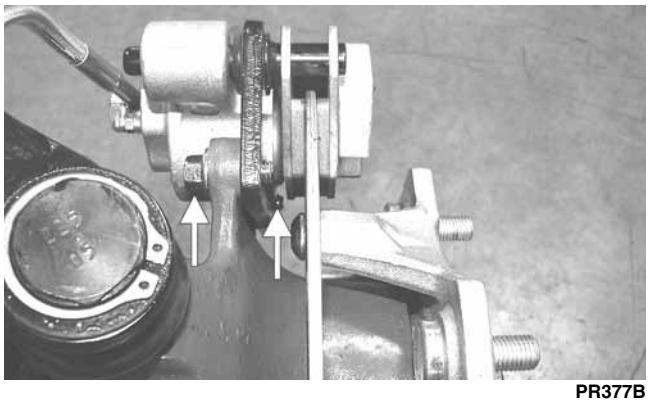
PR256

7. Install a new cotter pin and secure by spreading as shown.

PR260

■NOTE: If the hole in the axle shaft does not align with the slots in the castle nut, tighten the nut until the hole and slots align.

8. Secure the brake caliper to the knuckle with the two new “patch-lock” cap screws. Tighten to 20 ft-lb.



PR377B

9. Install the wheel; then using a crisscross pattern, tighten the wheel nuts in 27 N-m (20 ft-lb) increments to the final torque shown in the table below.

Steel Wheel	54 N-m (40 ft-lb)
Aluminum Wheel (Black Nuts)	80 N-m (60 ft-lb)
Aluminum Wheel (Chrome Nuts)	108 N-m (80 ft-lb)

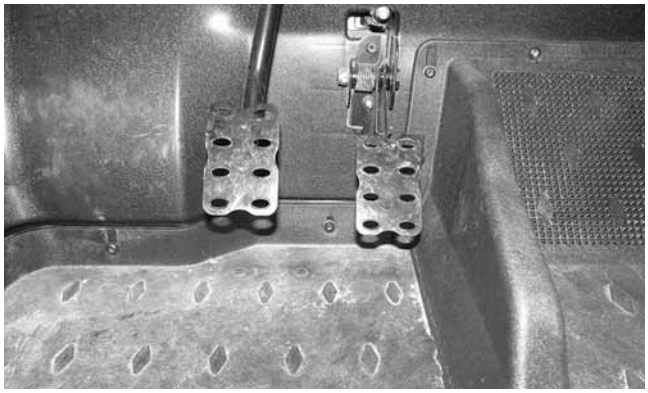
10. Remove the vehicle from the support stand.

Accelerator Pedal

REMOVING

Dislodge the throttle cable holding grommet from the actuator arm; then remove two torx-head screws and nuts securing the accelerator pedal assembly to the splash panel and remove the accelerator pedal.

PR709



HDX256

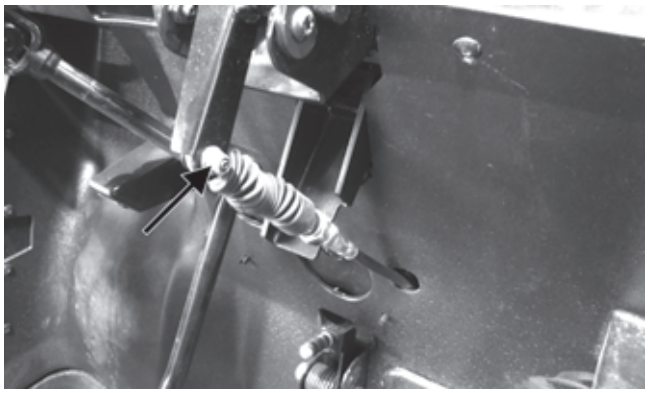
INSTALLING

Align the mounting holes with the holes in the splash panel and secure with the two torx-head screws and nuts; then snap the throttle cable holding grommet into the actuator arm.

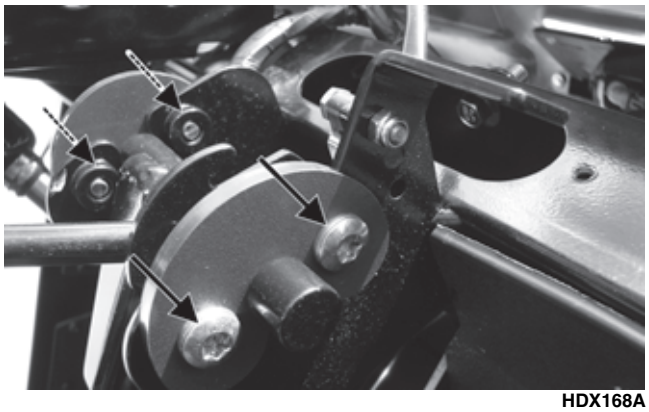
Shift Lever

REMOVING

1. Remove the dashboard (see Dashboard in this section).
2. Remove the nut securing the shift cable to the shift arm; then remove the four cap screws securing the shift axle supports to the frame and remove the shift lever.



HDX166A



HDX168A

INSTALLING

1. Install the shift axle supports onto the shift lever; then secure the axle supports to the frame with four cap screws and tighten to 48 in.-lb.

HDX168

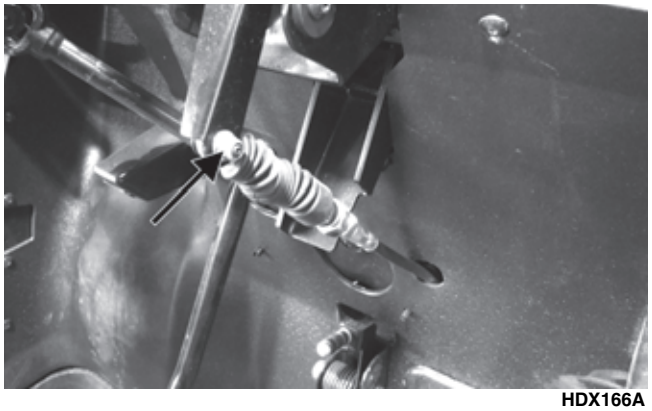
2. Secure the shift cable end to the shift arm stud with the cap screw and nut. Tighten to 8 ft-lb.

Shift Cable

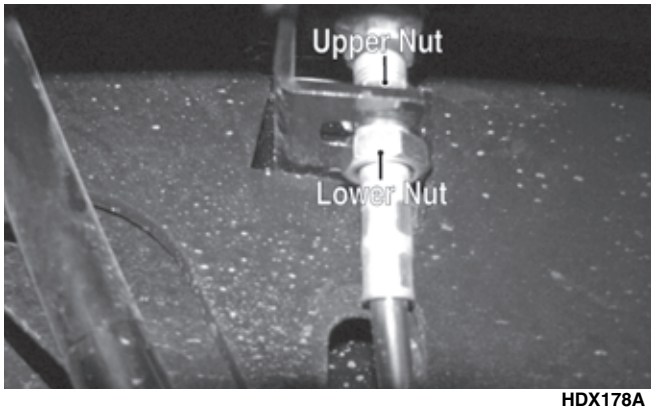
REMOVING

1. Remove the dashboard (see Dashboard in this section).

2. Remove the nut securing the shift cable to the shift arm stud; then loosen the upper adjuster nut on the shift cable and remove the shift cable from the shifter assembly.

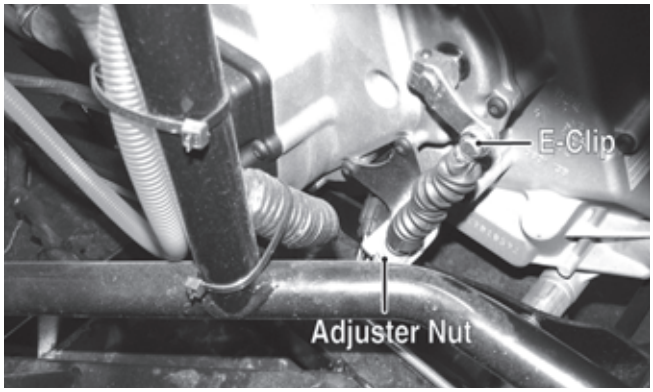


HDX166A



HDX178A

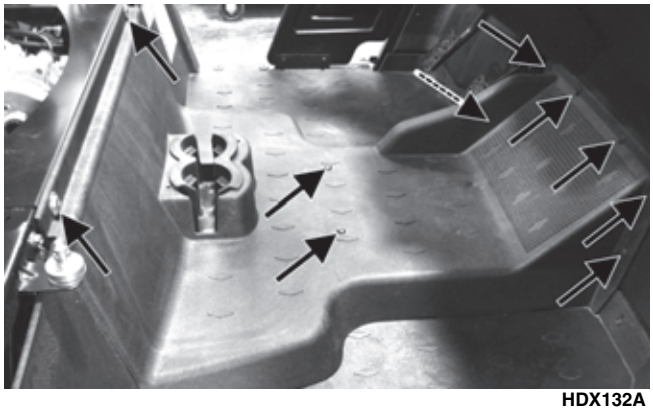
3. Tilt the cargo box back and remove the E-clip from the shift arm on the transmission; then loosen the adjuster nut on the shift cable housing and remove the shift cable from the transmission.



HDX137B

4. Remove the center floorboard and remove all nylon ties securing the cable housing to the frame; then remove the shift cable.

■NOTE: If the cable is being replaced, connect the new cable to the end of the cable being removed and pull the new cable into place.



HDX132A

INSTALLING

1. Route the cable into position making sure there are no kinks or sharp bends.
2. Install the cable housing onto the transmission holder; then connect the cable end to the shift arm and secure with the E-clip.
3. Install the shift cable into the shift cable support; then connect the shift cable end to the shifter and secure with a cap screw and nut. Tighten to 8 ft-lb.
4. Adjust the shift cable (see Periodic Maintenance - Shift Lever).
5. Install nylon ties on the shift cable where removed; then install the center floorboard and tighten the machine screws securely.
6. Install the dashboard (see Dashboard in this section).
7. Shift the transmission through all positions making sure the gear position icons indicate the appropriate gears selected and that the Park Indicator illuminates only when fully in Park (see Periodic Maintenance - Shift Lever).

LCD Gauge

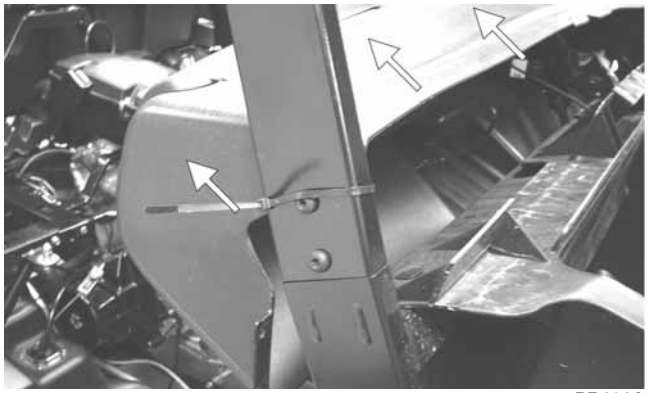
REPLACING

1. Remove the steering wheel; then remove the steering wheel boot.
2. Remove the two machine screws securing the steering wheel boot support to the steering support assembly. Remove the boot support.

PR762A

3. Remove the six screws securing the dash panel to the frame; then remove the shifter handle and shift lever boot.

4. Slide the dash panel to the rear sufficiently to access the components.



PR181A

5. Remove the nuts securing the gauge assembly to the dash; then unplug the multi-pin connector and remove the gauge from the vehicle.

PR284A

6. Place the new gauge into the dash panel opening; then place the gauge holder over the mounting screws and secure with the nuts.

7. Plug the multi-pin connector into the gauge; then turn the ignition switch to the ON position and check gauge functions.

8. Slide the dash into position and secure with the six screws.

9. Install the shifter handle; then install the shift lever boot.

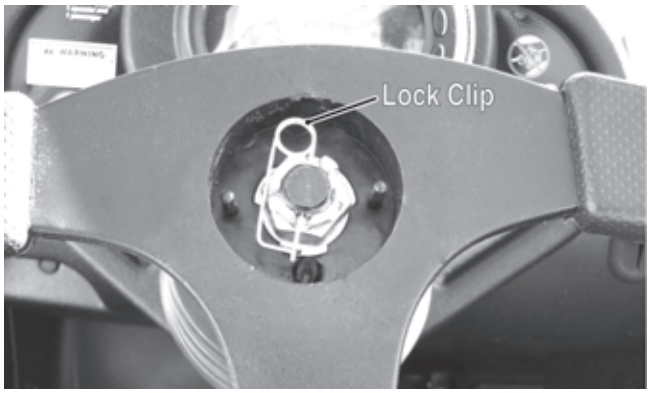
10. Install the steering wheel boot support.

PR762A

11. Install the steering boot onto the boot support.

12. Install the steering wheel; then with a drop of red Loctite #271 on the threads of the steering shaft, install the nut and tighten to 25 ft-lb.

13. Install the lock clip and steering wheel cover.



HDX131A

Checking/Adjusting Front Wheel Alignment

■NOTE: All measurements and adjustments must be made with the vehicle unloaded.

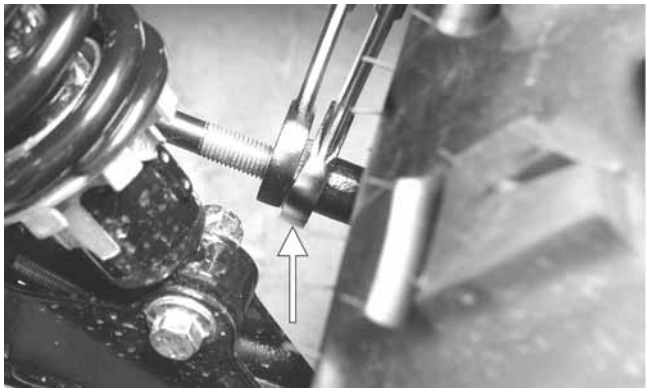
Mark the center-line of the front tires at the front and rear of the tire; then using a tape measure, measure and record the distance between the marks at the front and rear. The front measurement should be 6-12 mm (1/4-1/2 in.) greater than the rear measurement (toe-out).

PR087A

To adjust the wheel alignment, use the following procedure.

1. Center the steering wheel; then using an open-end wrench to hold the tie rod ends, loosen the right-side and left-side jam nuts.

TC044



PR085A

CAUTION

Always use a wrench to hold the tie rod ends when loosening or tightening the jam nuts or damage to the boots could occur.

2. Turn the left-side and right-side tie rods in equal increments to achieve the proper toe-out; then tighten the jam nuts securely.

PR086

Front Bumper Assembly

REMOVING

Remove four cap screws and nuts. Account for four lock washers and eight flat washers.

CLEANING AND INSPECTING

1. Clean all bumper components with hot, soapy water.
2. Inspect all welds for cracking or bending.

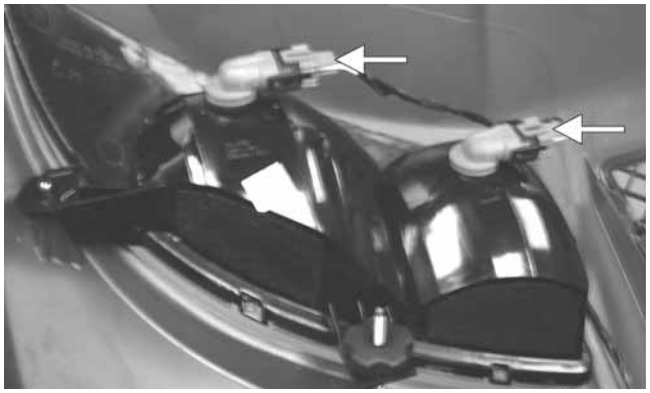
INSTALLING

Place the bumper assembly into position on the frame; then secure with the four cap screws and nuts making sure the flat washers and lock washers are properly positioned. Tighten securely.

Hood

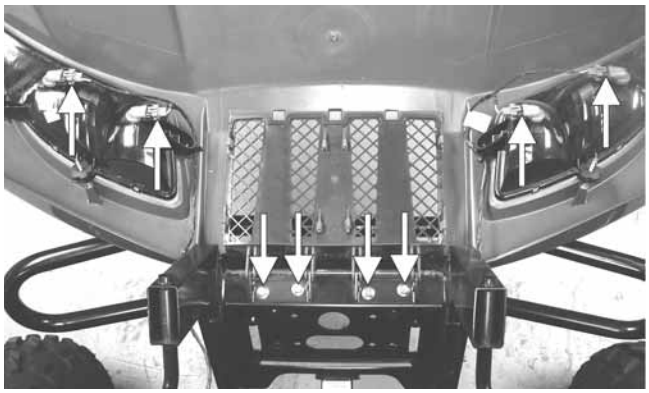
REMOVING

1. Open the hood; then disconnect the four headlight connectors and remove two nylon ties.



PR328A

2. Loosen but do not remove the four cap screws and flange nuts securing the hood hinge to the frame; then lower the hood.



PR332A

3. Finish removing the cap screws and flange nuts (from step 2); then remove the hood assembly.

CLEANING AND INSPECTING

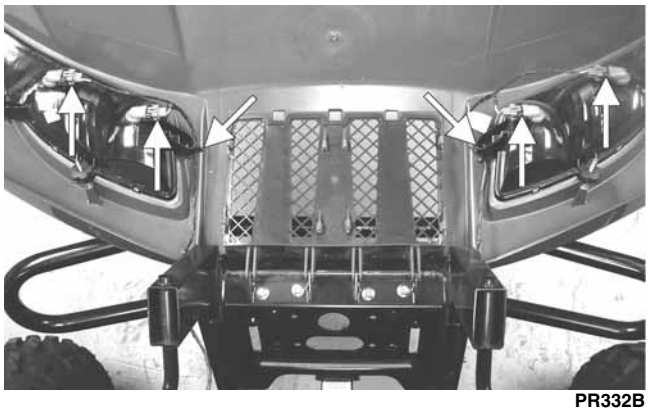
1. Clean all hood components with soap and water.
2. Inspect the hood for cracks and/or loose fasteners.
3. Inspect for any missing decals.

INSTALLING

1. Place the hood into position on the vehicle; then install the two outside cap screws and flange nuts. Finger-tighten only at this time.
2. Open the hood; then install the remaining two cap screws and flange nuts. Tighten all four securely.

PR332

3. Connect the four headlight connectors; then secure the wires with two new nylon ties.

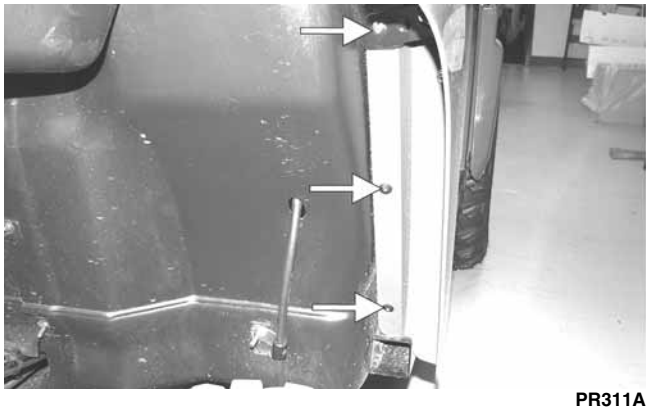


PR332B

Fenders

REMOVING

Remove three torx-head screws securing each fender to the frame. Account for a stiffener bracket on the front fenders.



PR311A

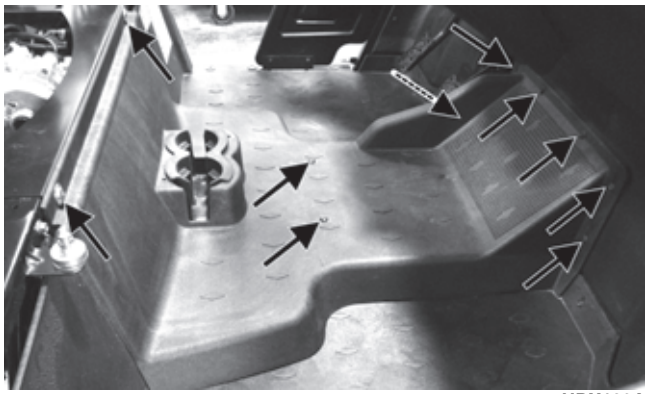
INSTALLING

Place the appropriate fender into position and secure with existing hardware.

Floor

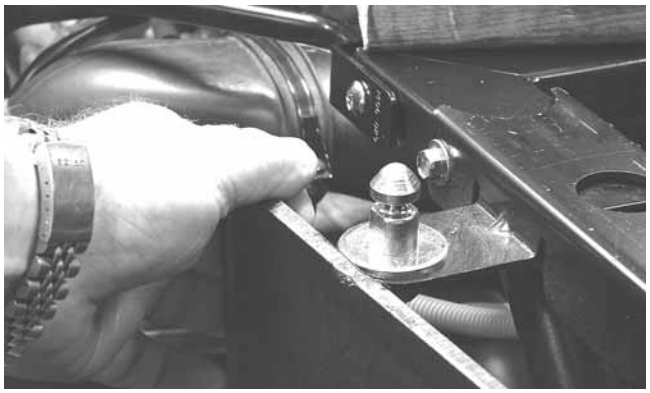
REMOVING

1. Remove the seat, seat back, and seat base.
2. Remove the self-tapping screws securing the side foot restraints.
3. Remove the center floorboard.



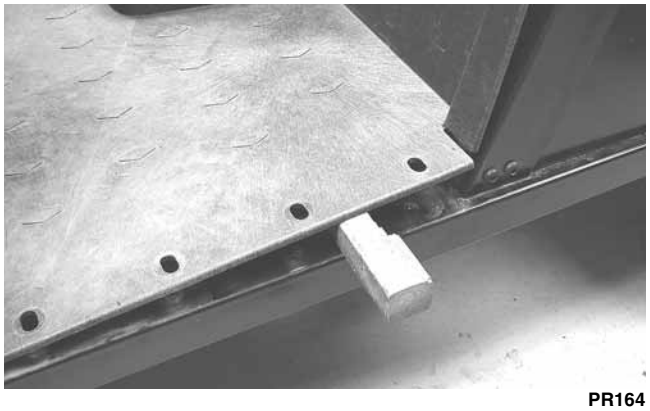
HDX132A

4. While pulling forward on the upper-rear of the floor, lift the rear part of the floor above the seat locating stud.



PR163

■**NOTE: To aid in removing, insert a small wood block to hold in position.**



PR164

5. From the opposite side of the vehicle, repeat step 3; then lift the rear of the floor up and lift the floor out of the vehicle.

CLEANING AND INSPECTING

1. Clean the floor with soap and water.
2. Inspect the floor for cracks or holes.

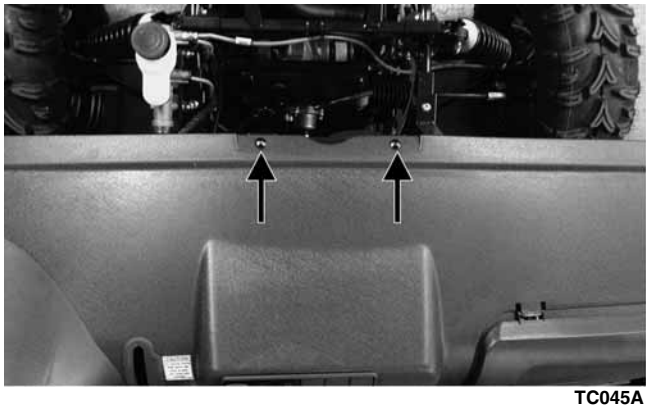
INSTALLING

1. Place the front of the floor into position in the vehicle first; then lower the rear and push past the seat locating studs.
2. Secure the floor with the cap screws and self-tappings screws.
3. Install the center floorboard; then install the seat base, seat back, and seat.

Dashboard

REMOVING

1. Remove the steering wheel and steering shaft boot.
2. Remove two machine screws securing the steering shaft boot support to the steering support and remove the boot support.



TC045A

3. Remove the six sheet metal and three machine screws securing the dash assembly to the frame; then remove the shift lever grip and locking nut.
4. Disconnect the gauge plug, dash harness, and park/seat belt indicator light connector and remove the dash assembly.
5. Slide the dash assembly rearward and off the steering shaft and shift lever assemblies.

INSTALLING

1. Place the dash into position and connect the park/seat belt indicator light, dash harness, and gauge connector.
2. Secure the dash with the six sheet metal and three machine screws. Do not over-tighten.
3. Install the steering shaft boot support and secure with machine screws; then install the steering shaft boot and steering wheel. Apply a drop of red Loctite #271 to the steering shaft; then tighten the steering wheel nut to 25 ft-lb and install the lock clip.
4. Install the steering wheel cover.
5. Check shifter/shift cable adjustment (see Periodic Maintenance - Shift Lever).

Belly Panel

REMOVING

1. Remove the body screws securing the belly panel to the underside of the frame.
2. Remove the belly panel.

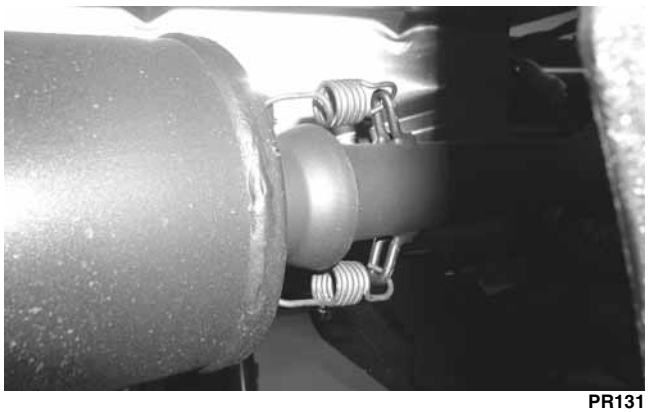
INSTALLING

1. Place the belly panel into position on the underside of the frame.
2. Install the body screws. Tighten securely.

Exhaust System

REMOVING MUFFLER

1. Remove the two exhaust springs at the muffler/exhaust pipe juncture.



PR131

2. Slide the muffler assembly clear of the holder pins.

INSPECTING MUFFLER

1. Inspect muffler externally for cracks, holes, and dents.
2. Inspect the muffler internally by shaking the muffler back and forth and listening for rattles or loose debris inside the muffler.

■NOTE: For additional details on cleaning the muffler/spark arrester, see the Periodic Maintenance.

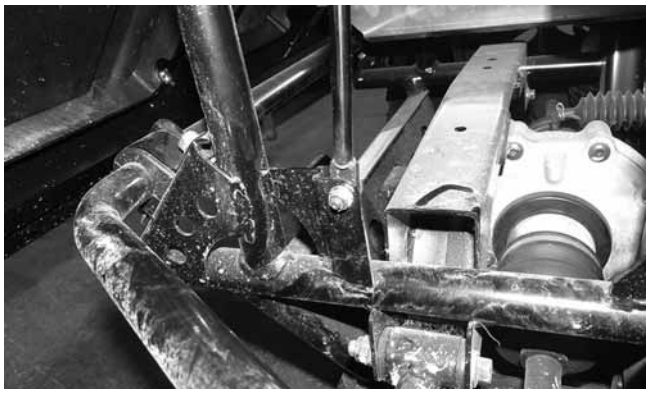
INSTALLING MUFFLER

1. Place the muffler onto the holder pins and slide into position.
2. Secure the muffler to the exhaust pipe with the two exhaust springs.

Cargo Box

REMOVING

1. Raise the cargo box; then remove the cap screw and nut securing the lower lift support to the frame. Account for the washer. The cargo box will tilt fully rearward.



HDX257

2. Loosen but do not remove the four shoulder cap screws securing the pivot housings to the cargo box.

PR335

3. Lower the cargo box; then remove the four cap screws (from step 2).
4. With the help of an assistant or an adequate lift, remove the cargo box from the vehicle. Account for four pivot housings.

CLEANING AND INSPECTING

1. Clean all cargo box components with soap and water.
2. Inspect the cargo box for cracks, tears, and loose hardware.
3. Inspect the welds of the cargo box frame for cracking or bending.
4. Inspect the cargo box gate latches for smooth operation.

INSTALLING

1. With the help of an assistant or an adequate lift, set the cargo box into position on the frame; then position the two upper pivot housings between the cargo box and frame. Lightly grease the pivot housings.
2. Align the holes in the upper pivot housings with the holes in the cargo box; then install the lower pivot housings and secure with the four shoulder cap screws. Tighten to 20 ft-lb.
3. Raise the cargo box; then connect the lift support to the frame, install the cap screw and nut, and tighten the nut securely.
4. Lower the cargo box and lock into position.

Taillight Assembly

REMOVING

1. Remove the cap screws and lock nuts securing the taillight assembly to the ROPS tube.
2. Disconnect the wire connector; then remove the socket assembly and remove the bulb.

INSPECTING

1. Inspect wiring harness, three-prong connector, lens, base, cap screws, and socket for damage.
2. Inspect all wires for corroding, pinching, and cracking.
3. Inspect the bulb for wattage, voltage, and proper operation.

INSTALLING

1. Install the new bulb in the socket and place the socket assembly into the taillight housing. Twist clockwise to lock.
2. Connect the wire connector; then install on the ROPS tube and secure with two cap screws and lock nuts. Tighten securely.

Seat

REMOVING/INSTALLING

1. To remove the seat, raise the front of the seat and slide it forward.
2. To install the seat, slide the rear of the seat into the seat retainers and push down firmly on the front of seat.

■NOTE: To remove the seat base and seat back, first remove the four screws securing the seat back and set the seat back aside. Remove the screws securing the seat base and set the seat base aside.

Troubleshooting

Problem: Handling too heavy or stiff	
Condition	**Remedy**
1. **Front wheel alignment** incorrect	1. Adjust alignment
2. **Steering shaft** binding	2. Lubricate/replace steering shaft
3. **Tire inflation pressure** incorrect	3. Adjust pressure
4. **Tie rod ends** seizing	4. Replace tie rod ends
5. **U-joints** seized	5. Replace U-joints
Problem: Steering oscillation	
Condition	**Remedy**
1. **Tires** inflated unequally	1. Adjust pressure
2. **Wheel(s)** bent	2. Replace wheel(s)
3. **Wheel hub studs** loose - missing	3. Tighten - replace wheel studs
4. **Wheel hub bearing** worn - damaged	4. Replace bearing
5. **Tie rod ends** worn - loose	5. Replace - tighten tie rod ends
6. **Tires** defective - incorrect	6. Replace tires
7. **A-arm bushings** damaged	7. Replace bushings
8. **Bolts - nuts (frame)** loose	8. Tighten bolts - nuts
Problem: Steering pulling to one side	
Condition	**Remedy**
1. **Tires** inflated unequally	1. Adjust pressure
2. **Front wheel alignment** incorrect	2. Adjust alignment
3. **Wheel hub bearings** worn - broken	3. Replace bearings
4. **Frame** distorted	4. Repair - replace frame
5. **Shock absorber** defective	5. Replace shock absorber
Problem: Steering impaired	
Condition	**Remedy**
1. **Tire pressure** too high	1. Adjust pressure
2. **Steering linkage** worn	2. Replace linkage
3. **Cap screws (suspension system)** loose	3. Tighten cap screws
Problem: Tire wear rapid or uneven	
Condition	**Remedy**
1. **Wheel hub bearings** worn - loose	1. Replace bearings
2. **Front wheel alignment** incorrect	2. Adjust alignment
Problem: Steering noise	
Condition	**Remedy**
1. **Caps screws - nuts** loose	1. Tighten cap screws - nuts
2. **Wheel hub bearings** broken - damaged	2. Replace bearings
3. **Lubrication** inadequate	3. Lubricate appropriate components
Problem: Rear wheel oscillation	
Condition	**Remedy**
1. **Rear wheel hub bearings** worn - loose	1. Replace bearings
2. **Tires** defective - incorrect	2. Replace tires
3. **Wheel rim** distorted	3. Replace rim
4. **Wheel hub cap screws** loose	4. Tighten cap screws
5. **Rear suspension arm-related bushing** worn	5. Replace bushing
6. **Rear shock absorber** damaged	6. Replace shock absorber
7. **Rear suspension arm nut** loose	7. Tighten nut

Engine/Transmission

This section has been organized into sub-sections which show a progression for the complete servicing of the Toro ROV engine/transmission.

To service the center crankcase halves, the engine/transmission must be removed from the frame. To service topside, left-side, and right-side components, the engine/transmission does not have to be removed from the frame.

■NOTE: Toro recommends the use of new gaskets, lock nuts, and seals and lubricating all internal components when servicing the engine/ transmission.

■NOTE: A new ROV and an overhauled ROV engine require a "break-in" period. The first 10 hours (or 200 miles) are most critical to the life of this ROV. Proper operation during this break-in period will help assure maximum life and performance from the ROV. Instruct the customer to follow the proper break-in procedure as described in the Operators Manual.

Troubleshooting

Problem: Engine will not start or is hard to start (Compression too low)	
Condition	**Remedy**
1. **Valve clearance** out of adjustment	1. Adjust clearance
2. **Valve guides** worn	2. Replace guides
3. **Valves** mistimed	3. Retime engine
4. **Piston rings** worn - broken	4. Replace rings
5. **Cylinder bore** worn	5. Replace cylinder
6. **Starter motor** cranks too slowly - does not turn	6. See Electrical System
Problem: Engine will not start or is hard to start (No spark)	
Condition	**Remedy**
1. **Spark plug** fouled	1. Clean - replace plug
2. **Spark plug** wet	2. Clean - dry plug
3. **Magneto** defective	3. Replace stator coil
4. **ECM** defective	4. Replace ECM
5. **Ignition coil** defective	5. Replace ignition coil
6. **High-tension lead** open - shorted	6. Replace high tension lead
Problem: Engine will not start or is hard to start (No fuel reaching the fuel injector)	
Condition	**Remedy**
1. **Gas tank vent hose** obstructed	1. Clean vent hose
2. **Fuel hose** obstructed	2. Clean - replace hose
3. **Fuel screens** obstructed	3. Clean - replace inlet screen
4. **Fuel pump** defective	4. Replace fuel pump
Problem: Engine stalls easily	
Condition	**Remedy**
1. **Spark plug** fouled	1. Clean - replace plug
2. **Magneto** defective	2. Replace stator coil
3. **ECM** defective	3. Replace ECM
4. **Fuel injector** obstructed	4. Replace fuel injector
5. **Valve clearance** out of adjustment	5. Adjust clearance
Problem: Engine noisy (Excessive valve chatter)	
Condition	**Remedy**
1. **Valve clearance** excessive	1. Adjust clearance
2. **Valve spring(s)** weak - broken	2. Replace spring(s)
3. **Rocker arm** - **rocker arm shaft** worn	3. Replace arm - shaft
4. **Camshaft** worn	4. Replace camshaft
Problem: Engine noisy (Noise seems to come from piston)	
Condition	**Remedy**
1. **Piston - cylinder** worn	1. Replace cylinder - service piston
2. **Combustion chamber carbon** buildup	2. Clean cylinder head and piston
3. **Piston pin - piston pin bore** worn	3. Replace - service pin - bore
4. **Piston rings - ring groove(s)** worn	4. Replace rings - piston
Problem: Engine noisy (Noise seems to come from timing chain)	
Condition	**Remedy**
1. **Chain** stretched	1. Replace chain
2. **Sprockets** worn	2. Replace sprockets
3. **Tension adjuster** malfunctioning	3. Repair - replace adjuster
Problem: Engine noisy (Noise seems to come from crankshaft)	
Condition	**Remedy**
1. **Main bearing** worn - burned	1. Replace bearing
2. **Lower rod-end bearing** worn - burned	2. Replace crankshaft assembly
3. **Connecting rod side clearance** too large	3. Replace crankshaft assembly
4. **Centrifugal clutch** loose	4. Tighten - replace clutch
5. **Rotor/flywheel** loose	5. Tighten - replace flywheel - crankshaft
Problem: Engine noisy (Noise seems to come from transmission)	
Condition	**Remedy**
1. **Gears** worn - chipped	1. Replace gears
2. **Splines** worn	2. Replace shaft(s) - gears
3. **Primary gears** worn - chipped	3. Replace gears
4. **Bearings** worn	4. Replace bearings
5. **Bushing** worn	5. Replace bushing

Problem: Engine noisy (Noise seems to come from secondary bevel gear and final driven shaft)	
Condition	**Remedy**
1. **Drive - driven bevel gears** damaged - worn	1. Replace gears
2. **Backlash** excessive	2. Adjust backlash
3. **Tooth contact** improper	3. Adjust contact
4. **Bearing** damaged	4. Replace bearing
5. **Gears** worn - chipped	5. Replace gears
6. **Splines** worn	6. Replace shaft(s) - gears
7. **Final driven shaft thrust clearance** too large	7. Replace thrust washer(s)
Problem: Engine idles poorly	
Condition	**Remedy**
1. **Valve clearance** out of adjustment	1. Adjust clearance
2. **Valve seating** poor	2. Replace - service seats - valves
3. **Valve guides** defective	3. Replace guides
4. **Rocker arms - arm shaft** worn	4. Replace arms - shafts
5. **Magneto** defective	5. Replace stator coil
6. **ECM** defective	6. Replace ECM
7. **Spark plug** fouled - **gap** too wide	7. Adjust gap - replace plug
8. **Ignition coil** defective	8. Replace ignition coil
9. **Fuel injector** obstructed	9. Replace fuel injector
Problem: Engine runs poorly at high speed	
Condition	**Remedy**
1. **High RPM "cut out"** against RPM limiter	1. Shift into higher gear - decrease speed
2. **Valve springs** weak	2. Replace springs
3. **Valve timing** out of adjustment	3. Adjust timing
4. **Cams - rocker arms** worn	4. Replace cams - arms
5. **Spark plug gap** too narrow	5. Adjust gap
6. **Ignition coil** defective	6. Replace ignition oil
7. **Air cleaner element** obstructed	7. Clean element
8. **Fuel hose** obstructed	8. Clean - prime hose
Problem: Exhaust smoke dirty or heavy	
Condition	**Remedy**
1. **Engine oil** overfilled - contaminated	1. Drain excess oil - change oil
2. **Piston rings - cylinder** worn	2. Replace cylinder - service rings
3. **Valve guides** worn	3. Replace guides
4. **Cylinder wall** scored - scuffed	4. Replace cylinder
5. **Valve stems** worn	5. Replace valves
6. **Stem seals** defective	6. Replace seals
Problem: Engine lacks power	
Condition	**Remedy**
1. **Valve clearance** incorrect	1. Adjust clearance
2. **Valve springs** weak	2. Replace springs
3. **Valve timing** out of adjustment	3. Time camshaft
4. **Piston ring(s) - cylinder** worn	4. Replace cylinder - service rings
5. **Valve seating** poor	5. Repair seats
6. **Spark plug** fouled	6. Clean - replace plug
7. **Rocker arms - shafts** worn	7. Replace arms - shafts
8. **Spark plug gap** incorrect	8. Adjust gap - replace plug
9. **Fuel injector** obstructed	9. Replace fuel injector
10. **Air cleaner element** obstructed	10. Clean element
11. **Engine oil** overfilled - contaminated	11. Drain excess oil - change oil
12. **Intake manifold** leaking air	12. Tighten - replace manifold
13. **Cam chain** worn	13. Replace cam chain - sprockets
Problem: Engine overheats	
Condition	**Remedy**
1. **Carbon deposit (piston crown)** excessive	1. Clean piston
2. **Oil** low	2. Add oil
3. **Octane** low - **gasoline** poor	3. Drain - replace gasoline
4. **Oil pump** defective	4. Replace pump
5. **Oil circuit** obstructed	5. Clean circuit
6. **Intake manifold** leaking air	6. Tighten - replace manifold
7. **Coolant level** low	7. Fill - examine system for leaks
8. **Fan** malfunctioning	8. Check fan fuse/fan relay - replace fan
9. **Fan relay** malfunctioning	9. Replace fan relay
10. **Thermostat** stuck - closed	10. Replace thermostat
11. **Radiator hoses - cap** damaged - obstructed	11. Clear obstruction - replace hoses

Removing Engine/ Transmission

Many service procedures can be performed without removing the engine/transmission from the frame. Closely observe the note introducing each sub-section for this important information.

☞ AT THIS POINT

If the technician's objective is to service/replace right-side cover oil seals, front output joint oil seal, rear output joint oil seal, and/or the oil strainer (from beneath the engine/transmission), the engine/transmission does not have to be removed from the frame.

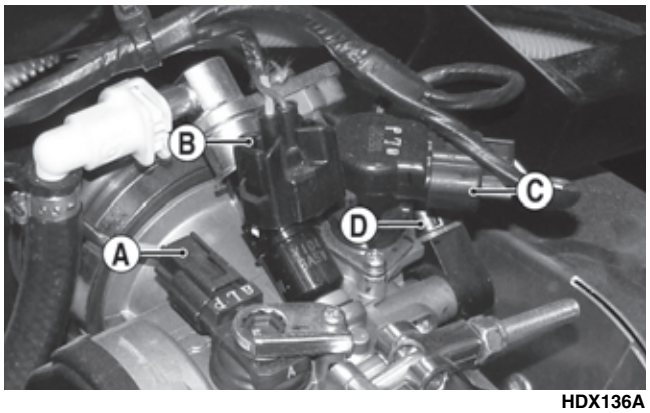
Support the vehicle on a suitable lift or jack stands allowing room to perform work from the underside.

■NOTE: Locate the jack stands to allow removing of the center belly panel.

⚠ WARNING

Make sure the vehicle is solidly supported on the support stands to avoid injury.

1. Remove the seat, seat back, and seat base; then disconnect negative battery cable.
2. Remove the center skid plate; then drain the oil and coolant.
3. Remove the center floorboard.
4. Marking all nylon tie locations for installing purposes, from the right side disconnect the MAP sensor connector (A), fuel injector connector (B), ISC connector (C), and TPS connector (D).



HDX136A

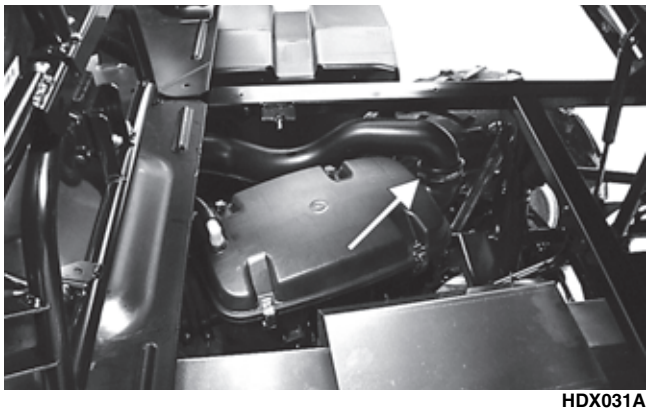
5. Wrap the gasline hose connector with a shop cloth; then remove the gasline hose connector from the fuel rail.

⚠ WARNING

Gasoline may be under pressure. Place an absorbant towel around the connector to absorb any gasoline spray when disconnected.

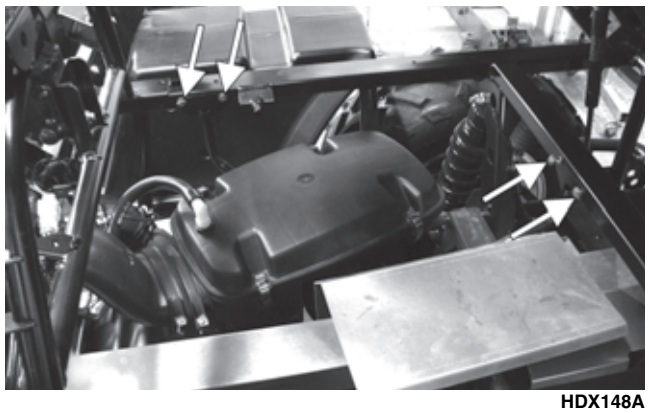
HDX138A

6. Loosen the clamp securing the air filter intake tube to the air filter; then remove the mounting screw and remove the intake tube.



HDX031A

7. Remove four sheet metal screws securing the air filter mounting bracket to the frame; then loosen the air inlet boot clamp and disconnect the IAT sensor connector and remove the air filter assembly.



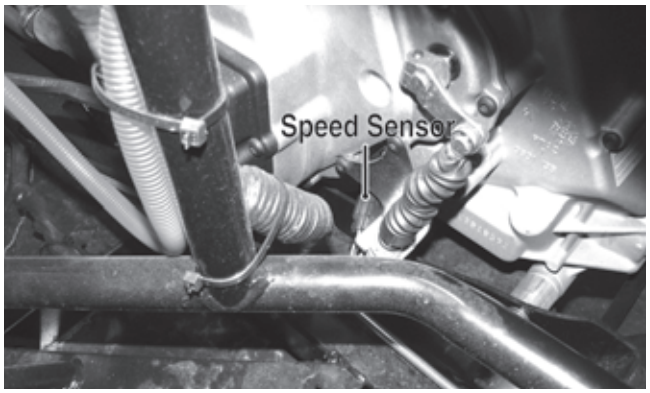
HDX148A

HDX144A

8. Loosen the clamp securing the throttle body to the intake manifold boot; then remove the throttle body and set aside.

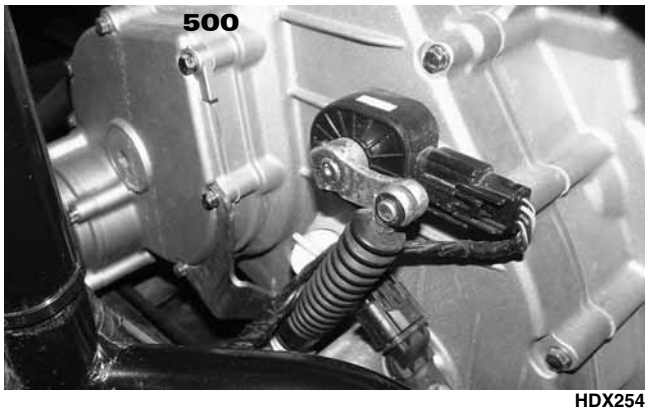
9. From the left side, disconnect the ECT sensor connector, speed sensor connector, and spark plug cap.

HDX135A

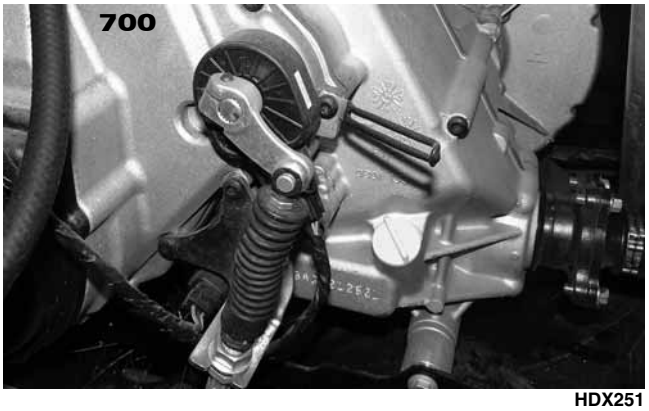


HDX137A

10. Remove the cap screws securing the shift cable bracket to the engine case. Remove the cap screw from the shift arm and disconnect the gear position switch connector. Slide the gear position switch off the engine.



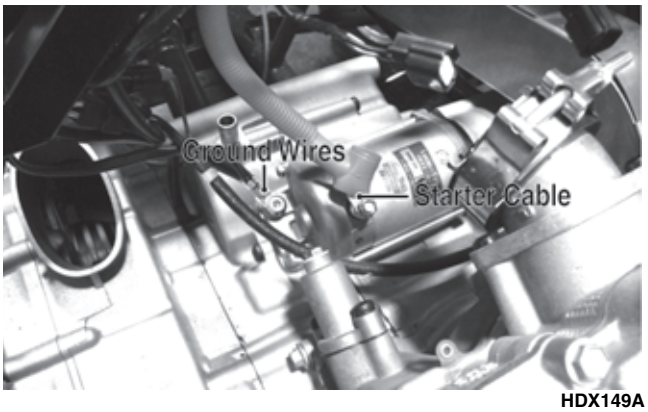
HDX254



HDX251

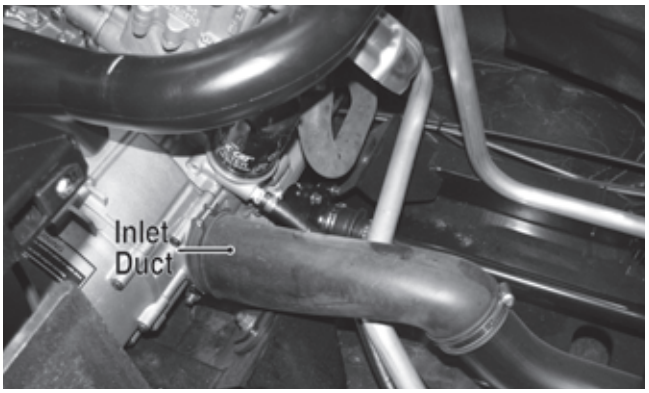
■NOTE: On the 500, shifting the transmission into park will aid in accessing the shift arm cap screw.

11. Disconnect the starter cable from the starter; then remove the cap screw securing the engine/harness ground wires to the engine case.

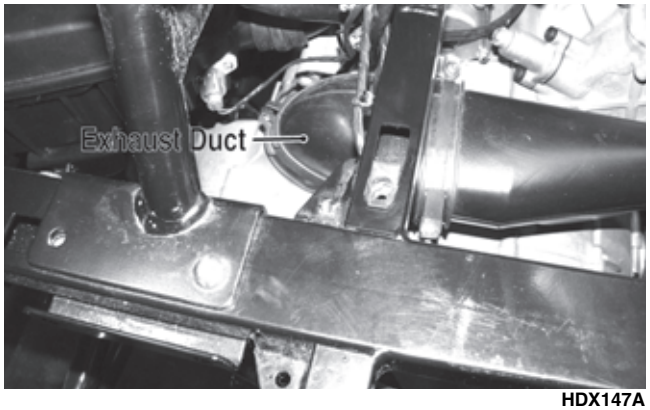


HDX149A

12. Remove the CVT inlet and exhaust ducts from the V-belt housing.

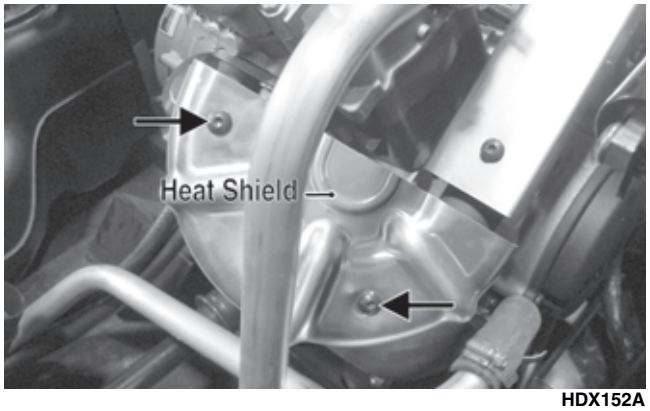


HDX146A

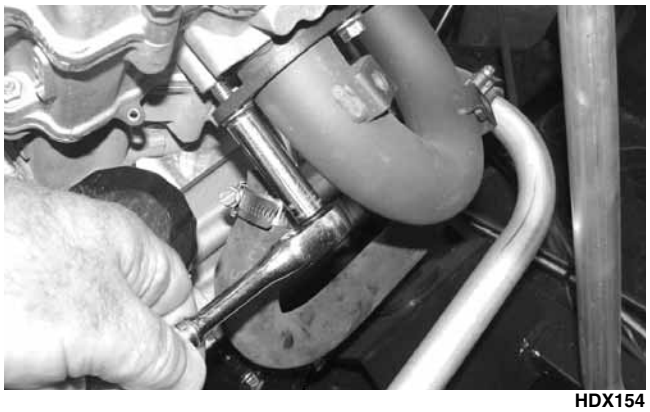


HDX147A

13. Remove the forward heat shield from the exhaust pipe; then remove the cap screws securing the exhaust pipe to the cylinder head.

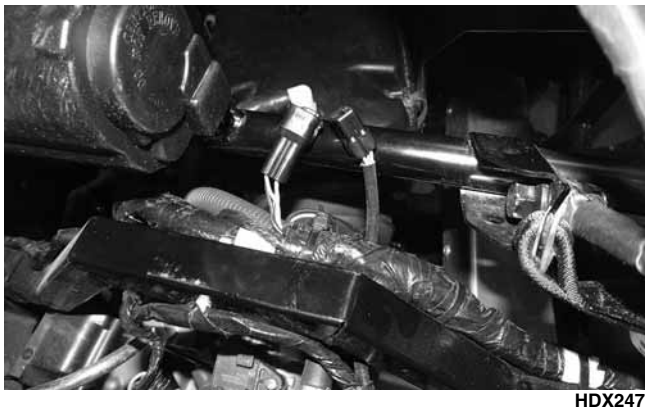


HDX152A



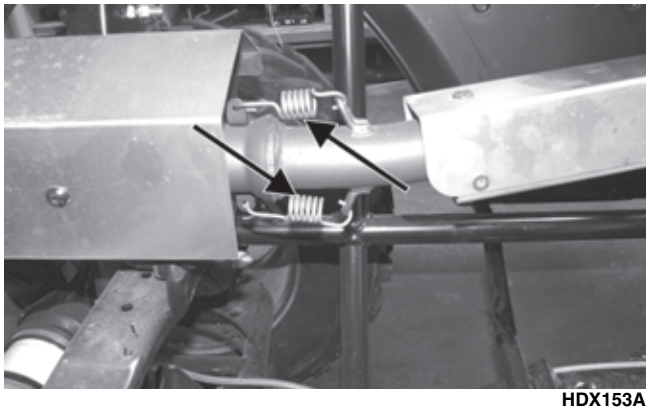
HDX154

14. Disconnect the O2 sensor; then remove the O2 sensor.



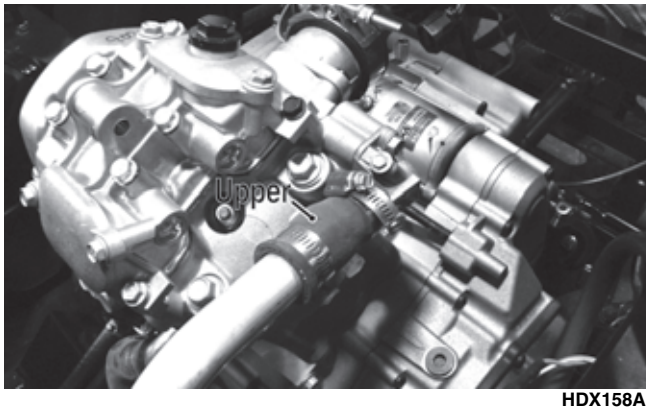
HDX247

15. Remove the two exhaust springs at the muffler; then remove the exhaust pipe. Account for a grafoil seal in the cylinder head and a grafoil seal at the muffler.

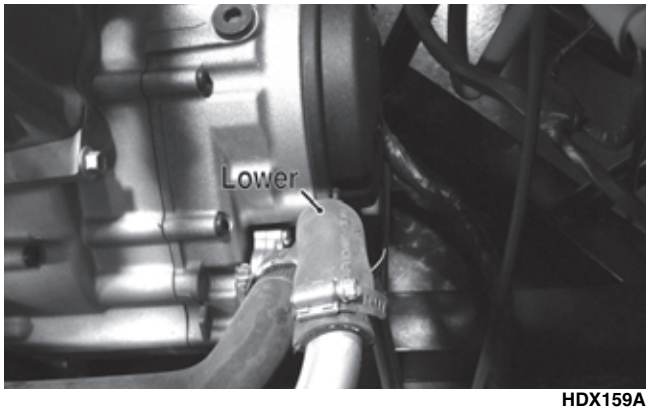


HDX153A

16. Remove the cap screws securing the driveshafts to the front and rear engine flanges; then disconnect the upper and lower coolant hoses.



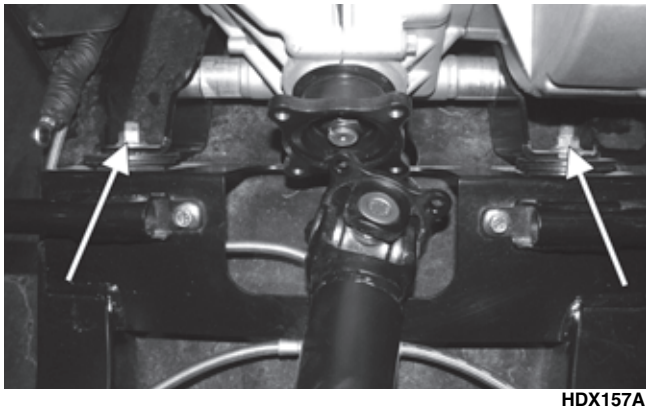
HDX158A



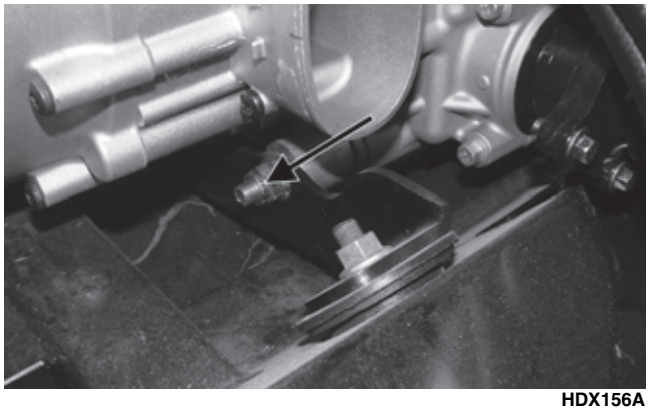
HDX159A

17. Disconnect the oil cooler lines and plug them to prevent oil spillage.

18. Remove the nuts from the rear engine mounts; then remove the front through-bolt.



HDX157A



HDX156A

19. Attach a suitable lifting sling and with a suitable engine hoist, lift the engine from the vehicle.

Servicing Engine (500)

Top-Side Components

■NOTE: For efficiency, it is preferable to remove and disassemble only those components which need to be addressed and to service only those components. The technician should use discretion and sound judgment.

☞ AT THIS POINT
To service any one specific component, only limited disassembly of components may be necessary. Note the AT THIS POINT information in each sub-section.

■NOTE: The engine/transmission does not need to be removed from the frame for this procedure.

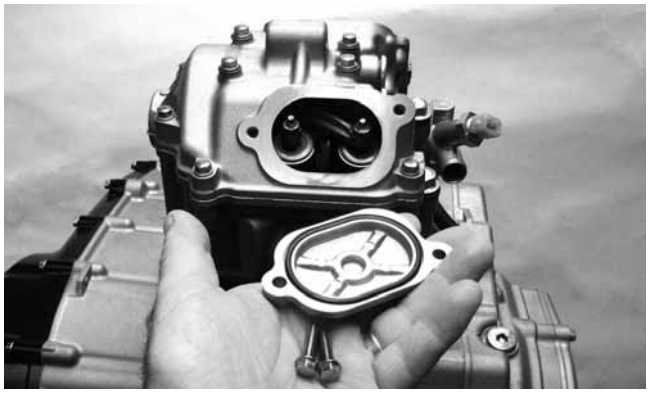
Removing Top-Side Components

A. Cylinder Head Cover/ Rocker Arms
B. Cylinder Head/Camshaft

■NOTE: Remove the spark plug, timing inspection plug, and outer magneto cover; then using an appropriate wrench, rotate the crankshaft to top-dead-center of the compression stroke.

■NOTE: Toro recommends the use of new gaskets, lock nuts, and seals and lubricating all internal components when servicing the engine/transmission.

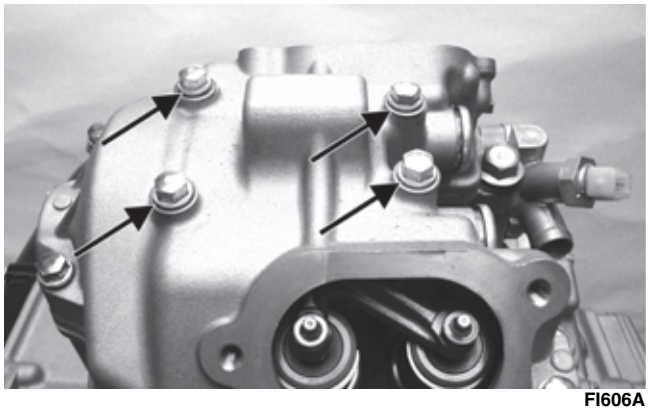
1. Remove the cap screws securing the two tappet covers. Remove the two tappet covers. Account for the O-rings.



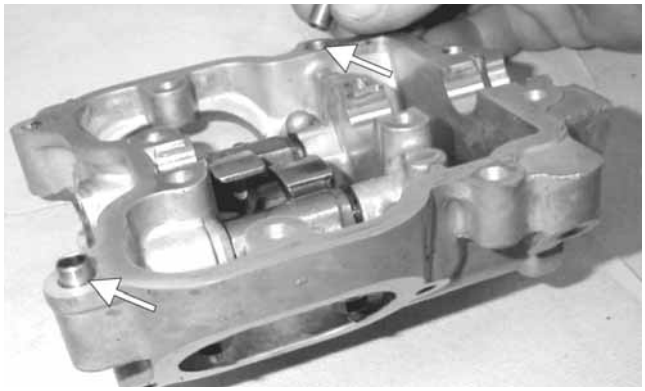
FI603

■NOTE: Keep the mounting hardware with the covers for assembly purposes.

2. Remove the cylinder head cover cap screws. Note the rubber washers on the four top-side cap screws; remove the cylinder head cover. Note the orientation of the cylinder head plug and remove it. Note the location of the two alignment pins.

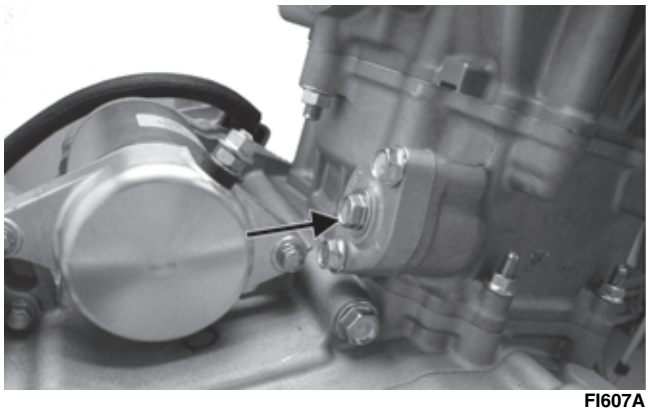


FI606A

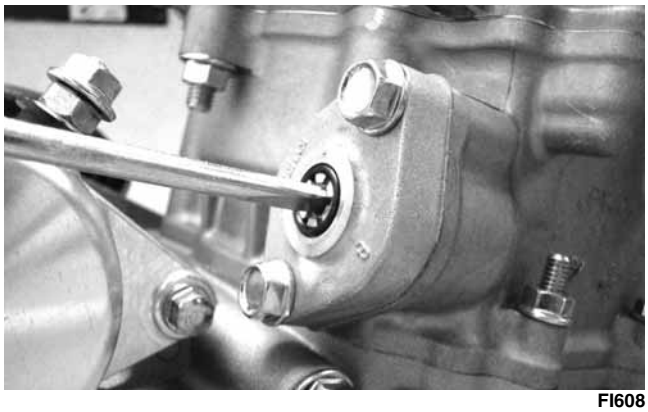


MD1354A

3. Remove the cap screw from the tension adjuster; then using a flat-blade screwdriver, relax the cam chain tension by rotating the adjuster screw clockwise until it locks.



FI607A

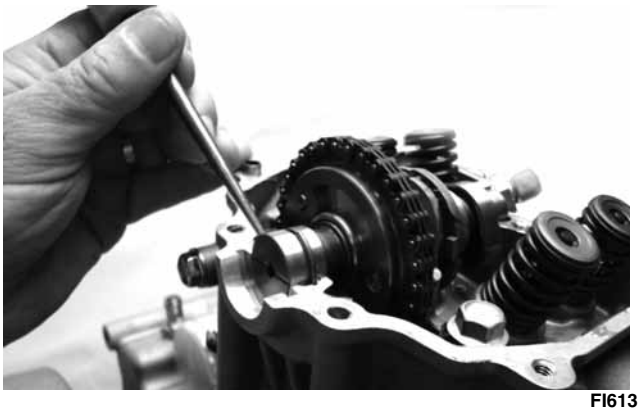


FI608

4. Bend the washer tabs and remove the two cap screws securing the sprocket to the camshaft.

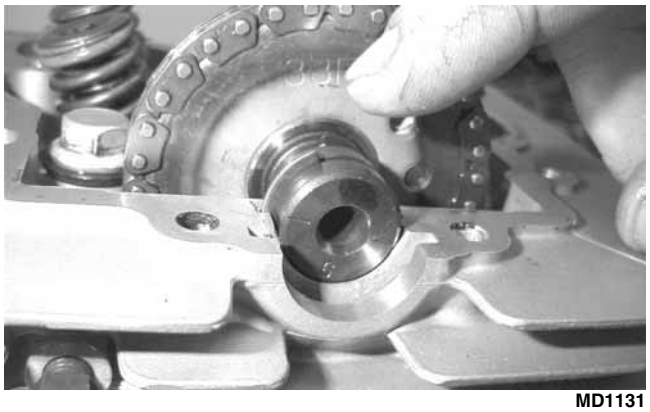
FI612

5. Using an awl, rotate the C-ring in its groove until it is out of the cylinder head; then remove the C-ring.



FI613

■NOTE: Care should be taken not to drop the C-ring down into the crankcase.

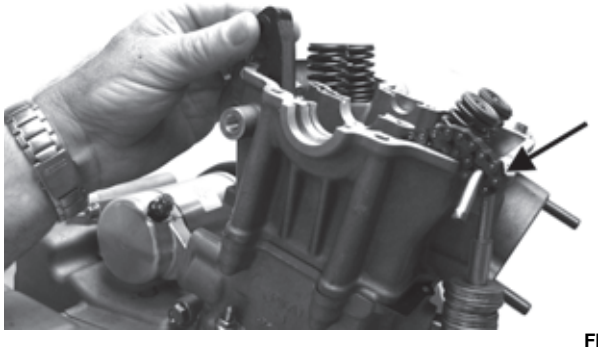


MD1131

6. Noting the timing marks for installing purposes, drop the sprocket off the camshaft. While holding the cam chain, slide the sprocket and camshaft out of the cylinder head. Account for an alignment pin.

■NOTE: Loop the chain over the cylinder and secure it to keep it from falling into the crankcase.

FI620

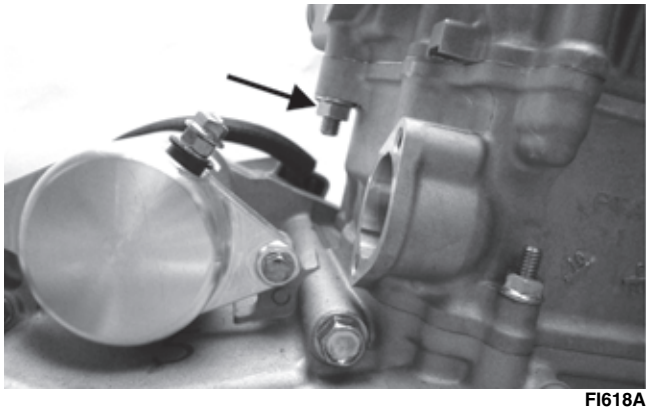


FI617A

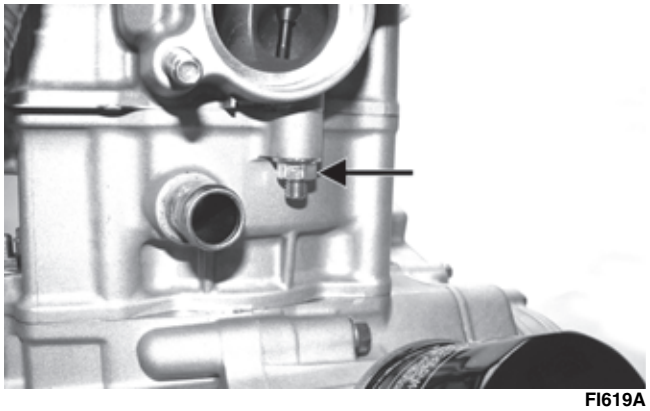
7. Remove the cam chain tensioner pivot bolt and remove the chain tensioner; then remove the two nuts securing the cylinder head to the cylinder.

FI616

FI617



FI618A

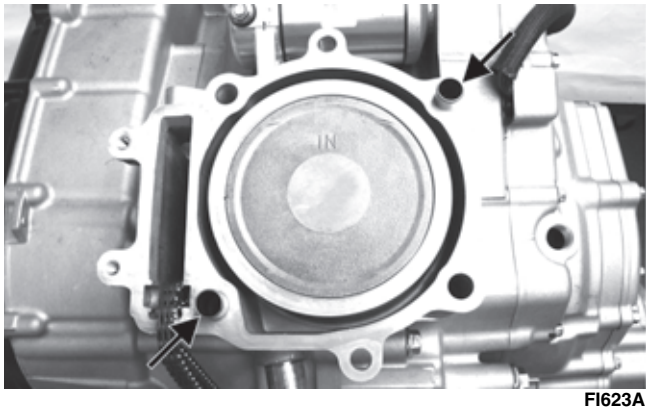


FI619A

8. Remove the four cylinder head cap screws and washers. Note that the two cap screws on the right side of the cylinder head nearest the cam sprocket are longer than the two cap screws on the left (spark plug) side.

CD211

9. Remove the cylinder head from the cylinder, remove the gasket, and account for two alignment pins.



FI623A

☞ AT THIS POINT
To service valves and cylinder head, see Servicing Top-Side Components sub-section.

10. Remove the cam chain guide.

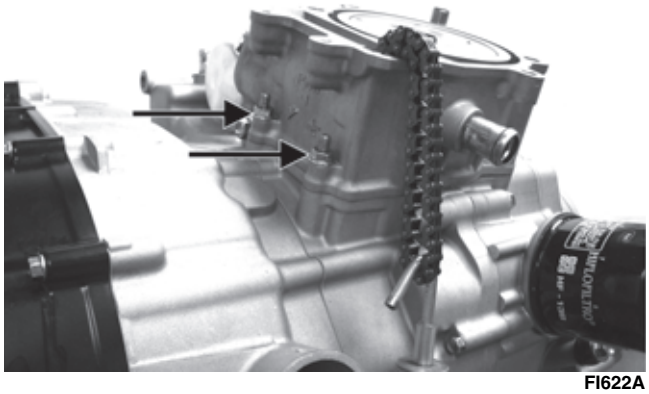
☞ AT THIS POINT
To inspect cam chain guide, see Servicing Top-Side Components sub-section.

FI621

C. Cylinder
D. Piston

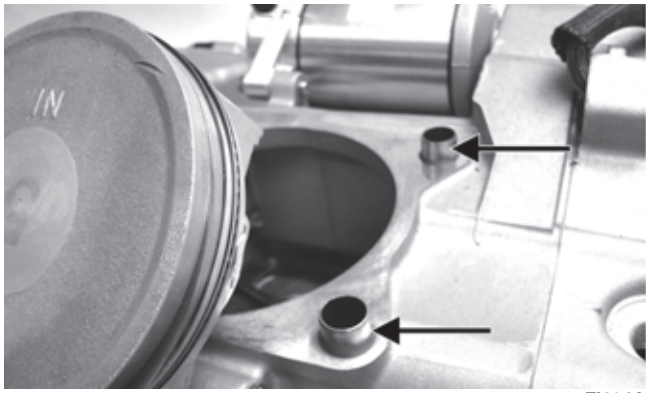
■NOTE: Steps 1-10 in the preceding sub-section must precede this procedure.

11. Remove the two nuts securing the right side of the cylinder to the right-side crankcase half.



FI622A

12. Lift the cylinder off the crankcase taking care not to allow the piston to drop against the crankcase. Account for the gasket and two alignment pins.



FI624A

☞ AT THIS POINT
To service cylinder, see Servicing Top-Side Components sub-section.

CAUTION
When removing the cylinder, be sure to support the piston to prevent damage to the crankcase and piston.

13. Using an awl, remove one piston-pin circlip. Take care not to drop it into the crankcase.

FI625

14. Using a suitable piston pin puller, remove the piston pin. Account for the opposite-side circlip. Remove the piston.

■NOTE: It is advisable to remove the opposite-side circlip prior to using the puller.

MD1219

■**NOTE: Support the connecting rod with rubber bands to avoid damaging the rod or install a connecting rod holder.**

CAUTION

Do not allow the connecting rod to go down inside the crankcase. If the rod is down inside the crankcase and the crankshaft is rotated, severe damage will result.

☞AT THIS POINT

To service piston, see Servicing Top-Side Components sub-section.

☞AT THIS POINT

To service center crankcase components only, proceed to Removing Left-Side Components.

Servicing Top-Side Components

VALVE ASSEMBLY

When servicing valve assembly, inspect valve seats, valve stems, valve faces, and valve stem ends for pits, burn marks, or other signs of abnormal wear.

■**NOTE: Whenever a valve is out of tolerance, it must be replaced.**

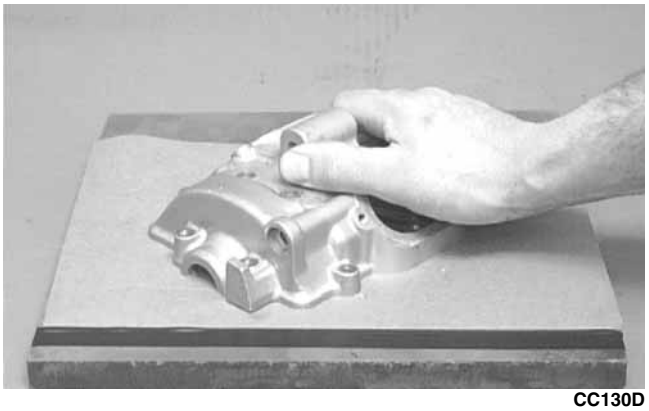
Cleaning/Inspecting Cylinder Head Cover

■**NOTE: If the cylinder head cover cannot be trued, the cylinder head assembly must be replaced.**

1. Wash the cylinder head cover in parts-cleaning solvent.
2. Place the cylinder head cover on a surface plate covered with #400 grit wet-or-dry sandpaper. Using light pressure, move the cylinder head cover in a figure eight motion. Inspect the sealing surface for any indication of high spots. A high spot can be noted by a bright metallic finish. Correct any high spots before assembly by continuing to move the cylinder head cover in a figure eight motion until a uniform bright metallic finish is attained.

CAUTION

Do not remove an excessive amount of the sealing surface or damage to the camshaft will result. Always check camshaft clearance when resurfacing the cylinder head cover.



CC130D

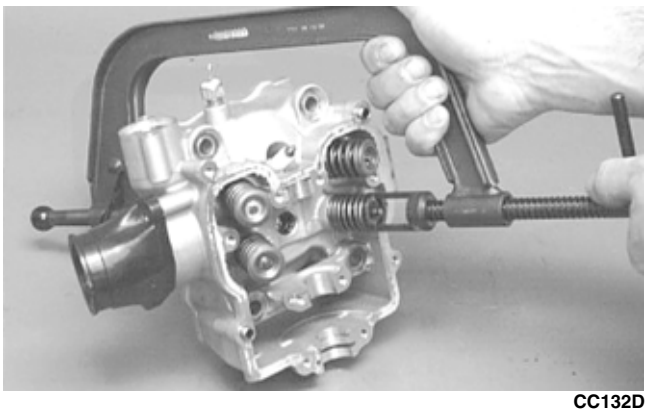
CAUTION

Water or parts-cleaning solvent must be used in conjunction with the wet-or-dry sandpaper or damage to the sealing surface may result.

Removing Valves

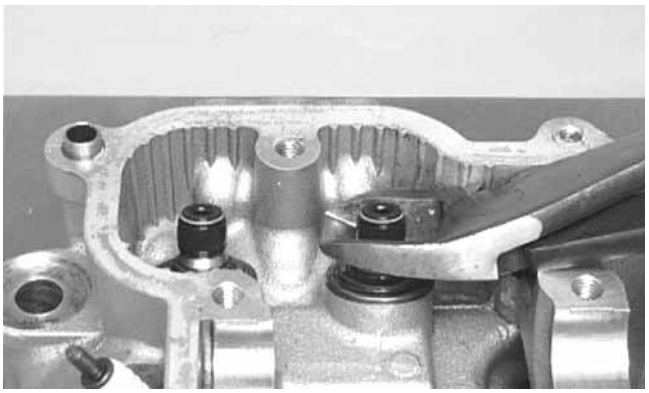
■**NOTE: Index all valves, springs, and cotters to their original position when removing. When installing, all valve components should be installed in their original position.**

1. Using a valve spring compressor, compress the valve springs and remove the valve keepers. Account for an upper spring retainer.

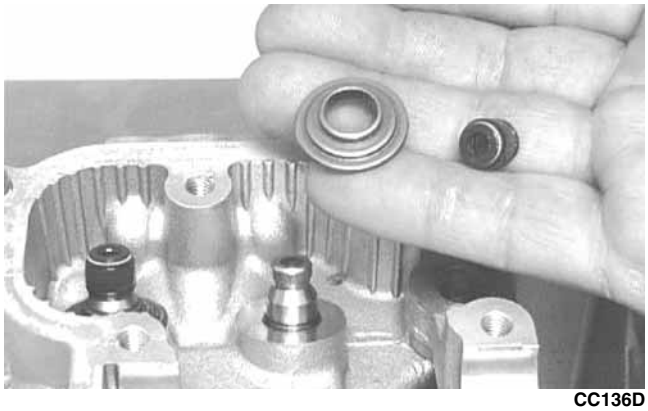


CC132D

2. Remove the valve seal and the lower remaining spring seat. Discard the valve seal.



CC134D



CC136D

■**NOTE: The valve seals must be replaced.**

3. Remove the valve springs; then invert the cylinder head and remove the valves.

Measuring Valve Guide (Bore)

1. Insert a snap gauge 1/2 way down into each valve guide bore; then remove the gauge and measure it with a micrometer.
2. Acceptable inside diameter range must be within specifications.
3. If a valve guide is out of tolerance, the cylinder head must be replaced.

Servicing Valves/Valve Guides/Valve Seats

If valves, valve guides, or valve seats require servicing or replacement, Toro recommends that the components be taken to a qualified machine shop for servicing.

CAUTION

If valves are discolored or pitted or if the seating surface is worn, the valve must be replaced. Do not attempt to grind the valves or severe engine damage may occur.

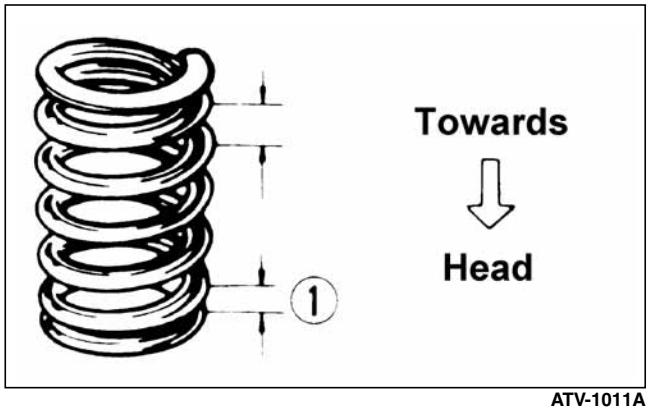
Installing Valves

1. Apply grease to the inside surface of the valve seals; then place a lower spring seat and valve guide seal over each valve guide.

CC144D

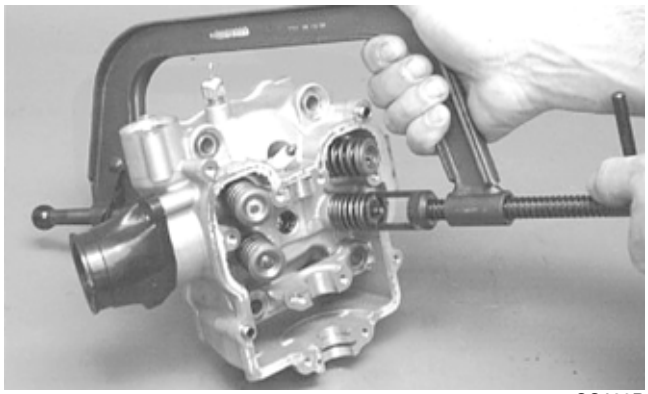
2. Insert each valve into its original valve location.
3. Install the valve springs with the painted end of the spring facing away from the cylinder head.

■**NOTE: If the paint is not visible, install the ends of the springs with the closest wound coils toward the head.**



ATV-1011A

4. Place a spring retainer over the valve springs; then using the valve spring compressor, compress the valve springs and install the valve keepers.



CC132D

PISTON ASSEMBLY

■**NOTE: Whenever a piston, rings, or pin are out of tolerance, they must be replaced.**

Inspecting Piston

1. Inspect the piston for cracks in the piston pin, boss, top, and skirt areas.
2. Inspect the piston for seizure marks or scuffing. If piston is scored or galled, replace it with a new one.
3. Inspect the perimeter of each piston for signs of "blowby" indicated by dark discoloration. "Blowby" is caused by worn piston rings, excessive carbon in ring grooves, or an out-of-round cylinder.

Removing Piston Rings

1. Starting with the top ring, slide one end of the ring out of the ring-groove.

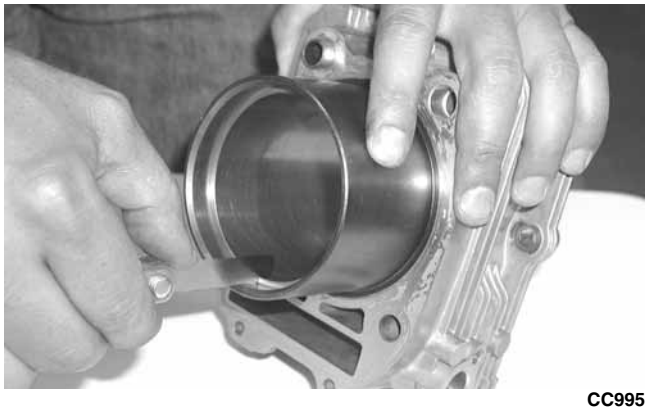
CC400D

2. Remove each ring by working it toward the top of the piston while rotating it out of the groove.

■NOTE: When installing new rings, install as a complete set only.

Measuring Piston-Ring End Gap (Installed)

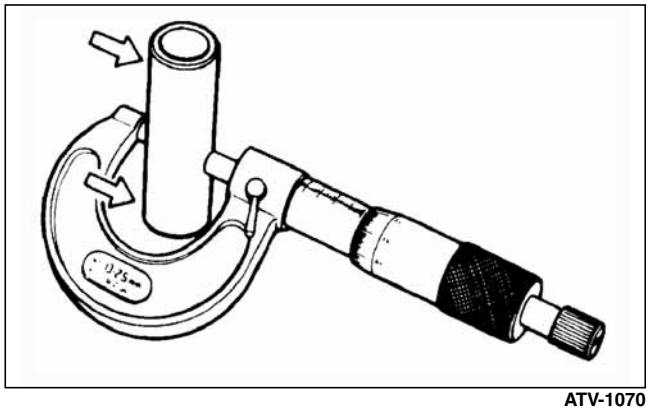
1. Place each piston ring in the wear portion of the cylinder. Use the piston to position each ring squarely in the cylinder.
2. Using a feeler gauge, measure each piston-ring end gap. Acceptable ring end gap must not exceed specifications.



CC995

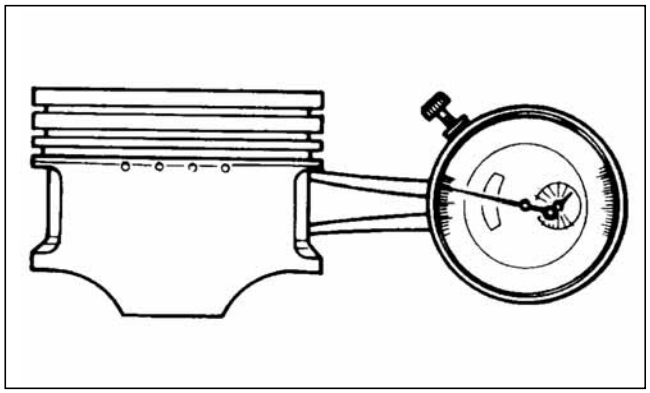
Measuring Piston Pin, Connecting Rod Small End, and Piston-Pin Bore

1. Measure the piston pin outside diameter at each end and in the center. If measurement does not meet specifications, the piston pin must be replaced.



ATV-1070

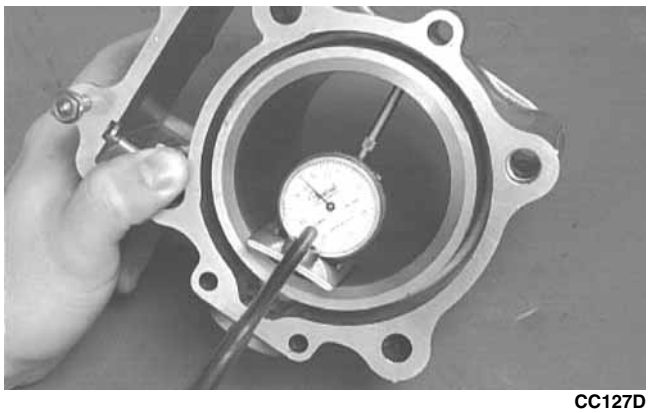
2. Inspect and measure the connecting rod small end inside diameter. If the measurement exceeds specifications, the connecting rod must be replaced (see Center Crankcase Components in this section).
3. Insert an inside dial indicator into the piston-pin bore. Take two measurements to ensure accuracy. The diameter must not exceed specifications. If the diameter exceeds specifications, the piston must be replaced.



ATV-1069

Measuring Piston Skirt/ Cylinder Clearance

1. Measure the cylinder front to back in six places.



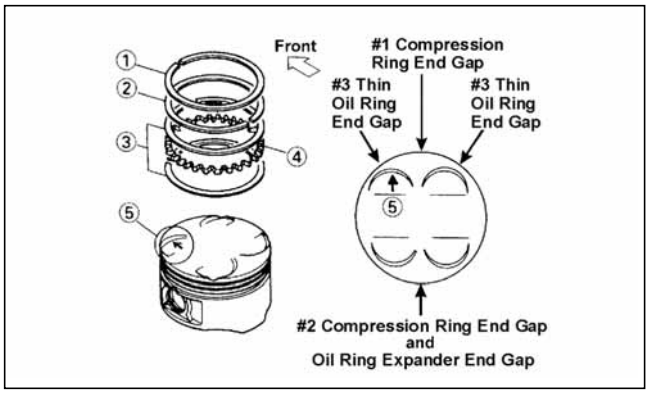
CC127D

2. Measure the corresponding piston diameter at a point 8 mm (0.3 in.) above the piston skirt at a right angle to the piston-pin bore. Subtract this measurement from the measurement in step 1. The difference (clearance) must be within specifications.

Installing Piston Rings

1. Install ring expander (4) in the bottom groove of the piston; then install the thin oil rings (3) over the expander making sure the expander ends do not overlap. Stagger the end gaps of the upper and lower thin oil rings according to the illustration.

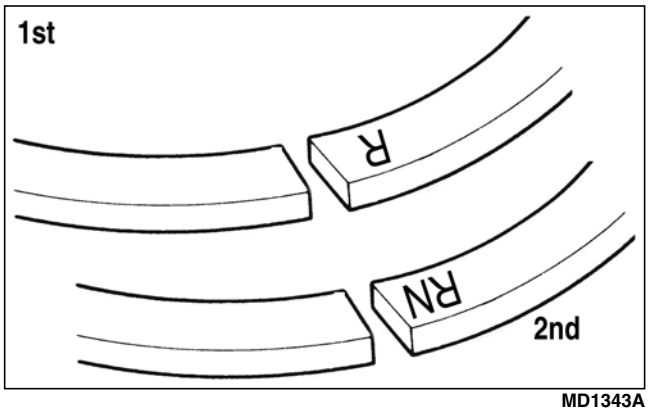
■NOTE: Note the direction of the exhaust side of the piston (5) for correct ring end gap orientation.



ATV-1085B

2. Install the compression rings (1 and 2) so the letter(s) on the top surface of each ring faces the dome of the piston. Rotate the rings until the ring end gaps are on directly opposite sides of the piston according to the illustration.

■NOTE: The chrome (silver) ring should be installed in the top position.



MD1343A

CAUTION

Incorrect installation of the piston rings will result in engine damage.

CYLINDER/CYLINDER HEAD ASSEMBLY

■NOTE: If the cylinder/cylinder head assembly cannot be trued, they must be replaced.

Cleaning/Inspecting Cylinder Head

CAUTION

The cylinder head studs must be removed for this procedure.

1. Using a non-metallic carbon removal tool, remove any carbon buildup from the combustion chamber being careful not to nick, scrape, or damage the combustion chamber or the sealing surface.
2. Inspect the spark plug hole for any damaged threads. Repair damaged threads using a “heli-coil” insert.
3. Place the cylinder head on the surface plate covered with #400 grit wet-or-dry sandpaper. Using light pressure, move the cylinder head in a figure eight motion. Inspect the sealing surface for any indication of high spots. A high spot can be noted by a bright metallic finish. Correct any high spots before assembly by continuing to move the cylinder head in a figure eight motion until a uniform bright metallic finish is attained.

CAUTION

Water or parts-cleaning solvent must be used in conjunction with the wet-or-dry sandpaper or damage to the sealing surface may result.

Measuring Cylinder Head Distortion

1. Remove any carbon buildup in the combustion chamber.
2. Lay a straightedge across the cylinder head; then using a feeler gauge, check the distortion factor between the head and the straightedge.
3. Maximum distortion must not exceed specifications.

CC141D

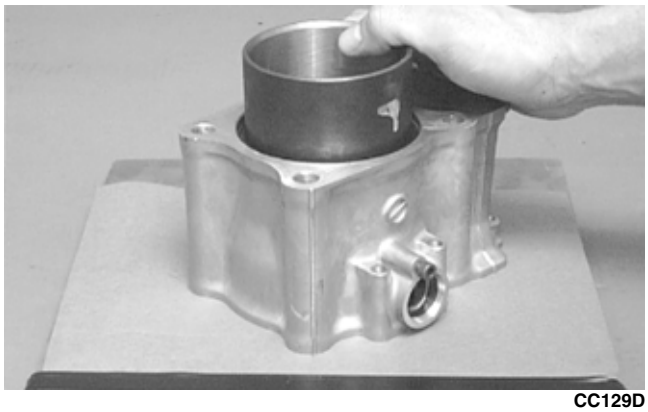
Cleaning/Inspecting Cylinder

1. Wash the cylinder in parts-cleaning solvent.
2. Inspect the cylinder for pitting, scoring, scuffing, warpage, and corrosion. If marks are found, repair the surface using a cylinder hone (see Honing Cylinder in this sub-section).

3. Place the cylinder on the surface plate covered with #400 grit wet-or-dry sandpaper. Using light pressure, move the cylinder in a figure eight motion. Inspect the sealing surface for any indication of high spots. A high spot can be noted by a bright metallic finish. Correct any high spots before assembly by continuing to move the cylinder in a figure eight motion until a uniform bright metallic finish is attained.

CAUTION

Water or parts-cleaning solvent must be used in conjunction with the wet-or-dry sandpaper or damage to the sealing surface may result.



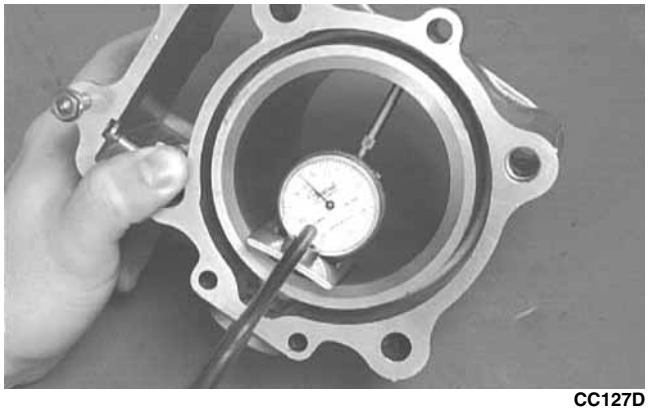
CC129D

Inspecting Cam Chain Guide

1. Inspect cam chain guide for cuts, tears, breaks, or chips.
2. If the chain guide is damaged, it must be replaced.

Honing Cylinder

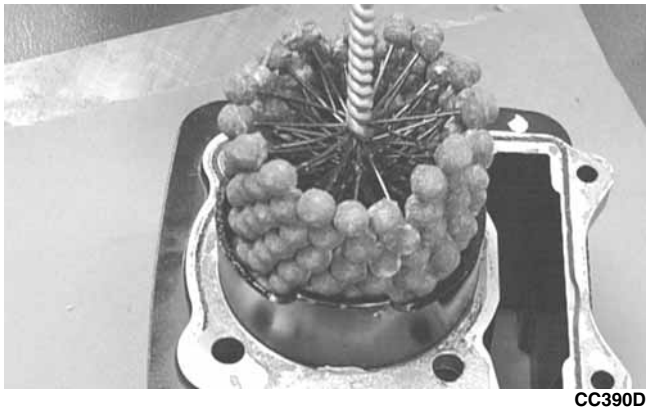
1. Using a slide gauge and a dial indicator or a snap gauge, measure the cylinder bore diameter in three locations from top to bottom and again from top to bottom at 90° from the first measurements for a total of six measurements. The trueness (out-of-roundness) is the difference between the highest and lowest reading. Maximum trueness (out-of-roundness) must not exceed specifications.



CC127D

2. Wash the cylinder in parts-cleaning solvent.
3. Inspect the cylinder for pitting, scoring, scuffing, and corrosion. If marks are found, repair the surface using a #320 grit ball hone.

■NOTE: To produce the proper 60° cross-hatch pattern, use a low RPM drill (600 RPM) at the rate of 30 strokes per minute. If honing oil is not available, use a lightweight petroleum-based oil. Thoroughly clean cylinder after honing using soap and hot water. Dry with compressed air; then immediately apply oil to the cylinder bore. If the bore is severely damaged or gouged, replace the cylinder.



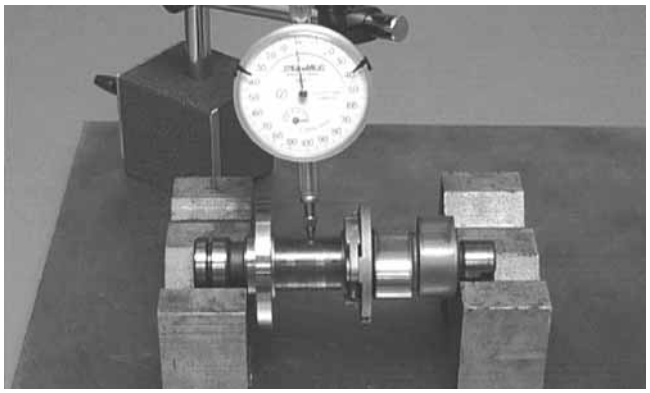
CC390D

4. If any measurement exceeds the limit, the cylinder must be replaced.

Measuring Camshaft Runout

■NOTE: If the camshaft is out of tolerance, it must be replaced.

1. Place the camshaft on a set of V blocks; then position the dial indicator contact point against the shaft and zero the indicator.

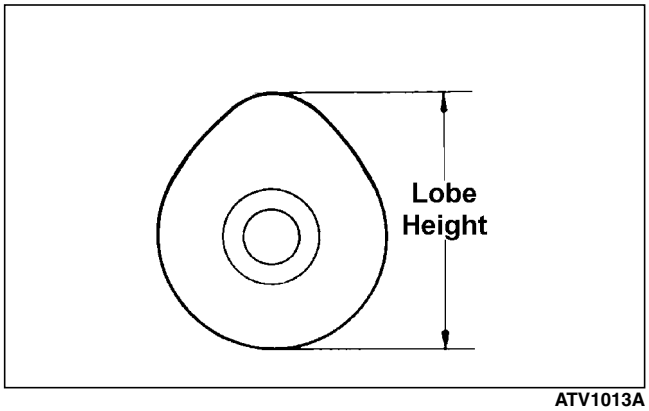


CC283D

2. Rotate the camshaft and note runout; maximum tolerance must not exceed specifications.

Measuring Camshaft Lobe Height

1. Using a calipers, measure each cam lobe height.



ATV1013A

2. The lobe heights must be greater than minimum specifications.

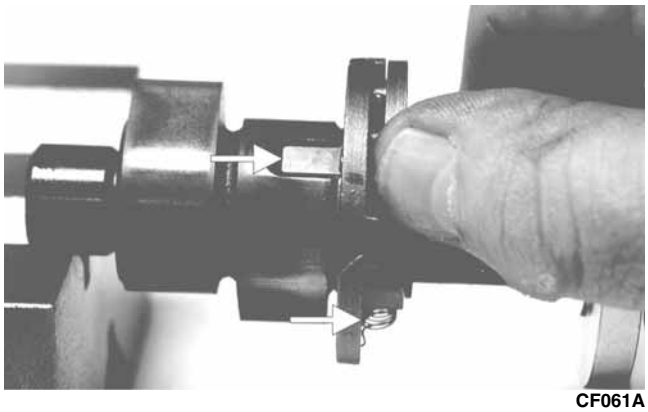
Inspecting Camshaft Bearing Journal

1. Inspect the bearing journal for scoring, seizure marks, or pitting.
2. If excessive scoring, seizure marks, or pitting is found, the cylinder head assembly must be replaced.

■NOTE: If the journals are worn, replace the camshaft.

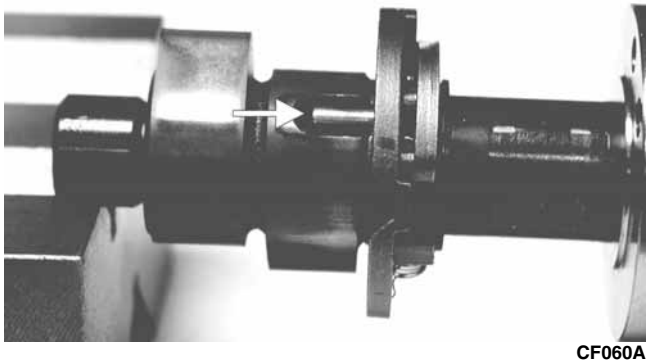
Inspecting Camshaft Spring/Drive Pin

1. Inspect the spring and unloader pin for damage.



CF061A

■NOTE: With the weight extended, the unloader pin should be flat-side out; with the weight retracted, the unloader pin should be round-side out.



CF060A

2. If damaged, the camshaft must be replaced.

Installing Top-Side Components

A. Piston
B. Cylinder

1. Lubricate the piston pin, connecting rod, and piston pin bore with motor oil; then install the piston on the connecting rod making sure there is a circlip on each side.

FI626

■NOTE: The piston should be installed so the IN points towards the intake side.

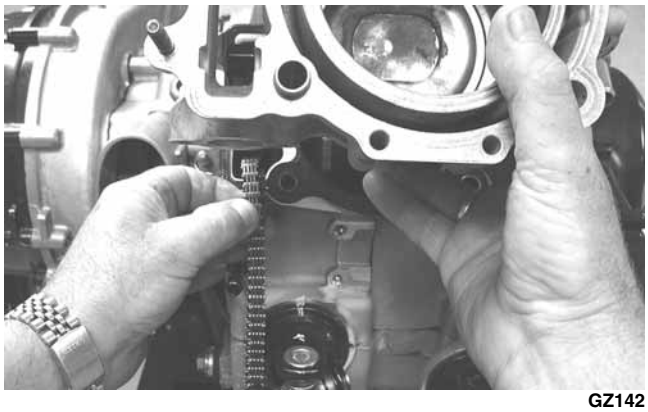
2. Place the two alignment pins into position. Place a new cylinder gasket into position; then place a piston holder (or suitable substitute) beneath the piston skirt and square the piston in respect to the crankcase.

MD1344

3. Lubricate the inside wall of the cylinder; then using a ring compressor or the fingers, compress the rings and slide the cylinder over the piston. Route the cam chain up through the cylinder cam chain housing; then remove the piston holder and seat the cylinder firmly on the crankcase.

CAUTION

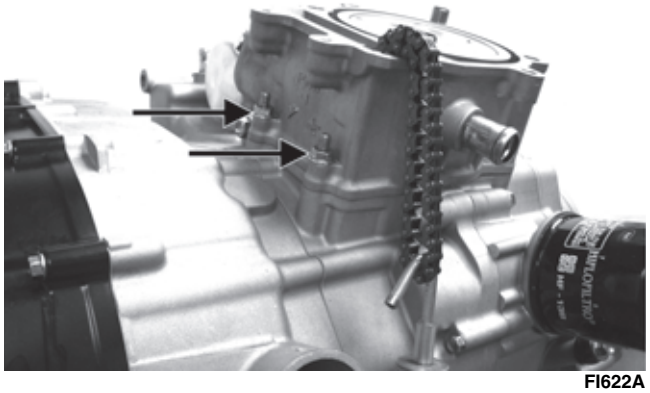
The cylinder should slide on easily. Do not force the cylinder or damage to the piston, rings, cylinder, or crankshaft assembly may occur.



GZ142

4. Loosely install the two nuts securing the cylinder to the right-side crankcase half.

■NOTE: The two cylinder-to-crankcase nuts will be tightened in step 9.



FI622A

C. Cylinder Head/Camshaft
D. Cylinder Head Cover/Rocker Arms

■NOTE: Steps 1-4 in the preceding sub-section must precede this procedure.

5. While keeping tension on the cam chain, place the front cam chain guide into the cylinder.

CAUTION

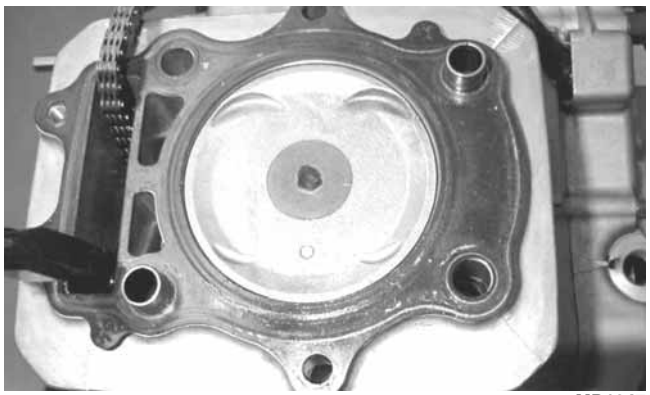
Care should be taken that the bottom of the chain guide is secured in the crankcase boss.

FI621

6. Place a new gasket into position on the cylinder. Place the alignment pins into position; then place the head assembly into position on the cylinder making sure the cam chain is routed through the chain cavity.

CAUTION

Keep tension on the cam chain to avoid damaging the crankcase boss.



MD1347

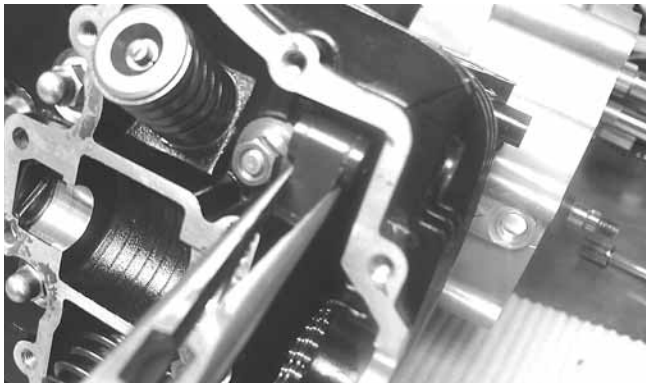
7. Install the four cylinder head cap screws with washers. Note that the two cap screws on the right side of the cylinder head nearest the cam sprocket are longer than the two cap screws on the left (spark plug) side. Tighten only until snug.

8. Install the two lower nuts securing the cylinder head to the cylinder, one in front and one in rear.

9. In a crisscross pattern, tighten the four cylinder head cap screws (from step 7) to 28 ft-lb. Tighten the two lower cylinder head nuts (from step 8) to 20 ft-lb and the cylinder-to-crankcase nuts (from step 4) to 8 ft-lb.

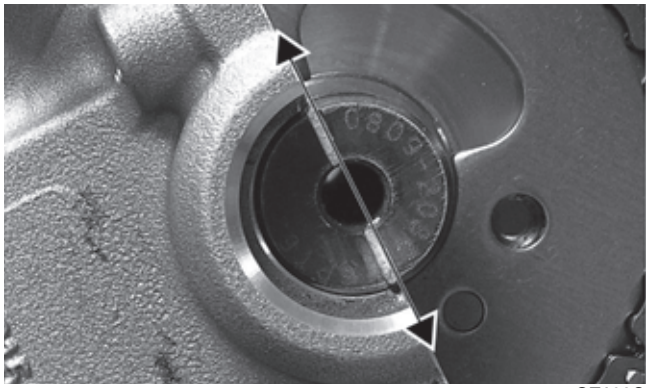
10. With the timing inspection plug removed and the cam chain held tight, rotate the crankshaft until the piston is at top-dead-center.

11. While holding the cam chain to the front, install the rear cam chain tensioner guide into the cylinder head. Install the pivot cap screw and washer. Tighten to 11 ft-lb.



CD383

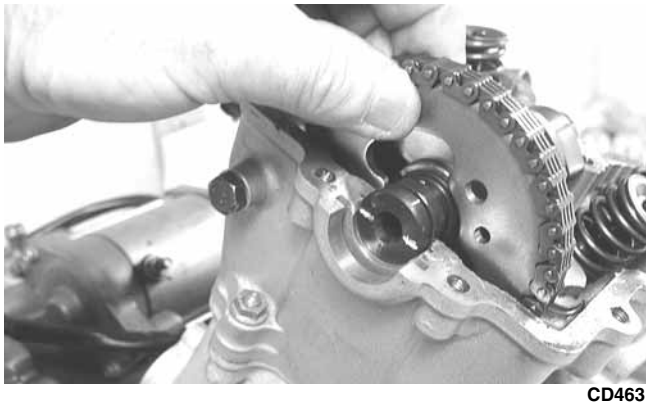
12. With the alignment pin installed in the camshaft and the cam lobes directed down (toward the piston), place the camshaft in position and verify that the timing mark on the magneto is visible through the inspection plug and that the timing marks on the camshaft sprocket are parallel with the valve cover mating surface.



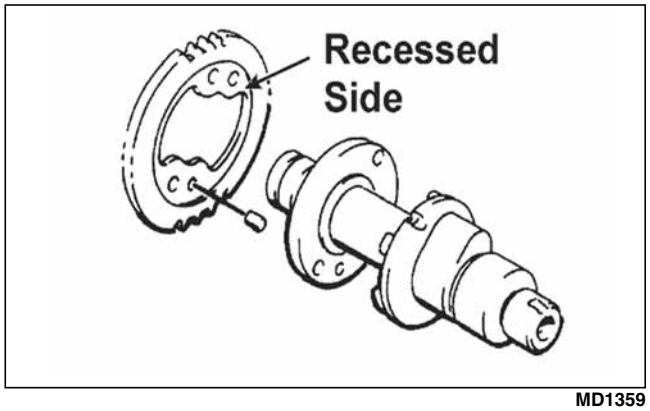
GZ190C

■NOTE: When the camshaft assembly is seated, make sure the alignment pin in the camshaft aligns with the smallest hole in the sprocket.

13. With the alignment pin installed in the camshaft, loosely place the cam sprocket (with the recessed side facing the camshaft lobes) onto the camshaft and place it into position with the cam chain over the sprocket.



CD463



MD1359

14. Place the C-ring into position in its groove in the cylinder head.

FI615

■NOTE: At this point, oil the camshaft bearings, cam lobes, and the three seating journals on the cylinder head.

■NOTE: Note the position of the alignment marks on the end of the camshaft. They must be parallel with the valve cover mating surface. If rotating the camshaft and sprocket is necessary for alignment, do not allow the crankshaft to rotate and be sure the cam lobes end up in the down position.

15. When the camshaft assembly is seated, ensure the following.

    A. Piston still at top-dead-center.

    B. Camshaft lobes directed down (toward the piston).

    C. Camshaft alignment marks parallel to the valve cover mating surface.

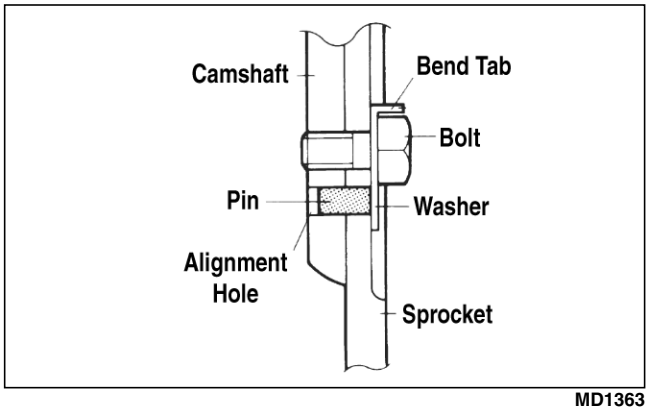
    D. Recessed side of the sprocket directed toward the cam lobes.

    E. Camshaft alignment pin and sprocket alignment hole (smallest) are aligned.

CAUTION

If any of the above factors are not as stated, go back to step 13 and carefully proceed.

16. Place the tab washer onto the sprocket making sure it covers the pin in the alignment hole.

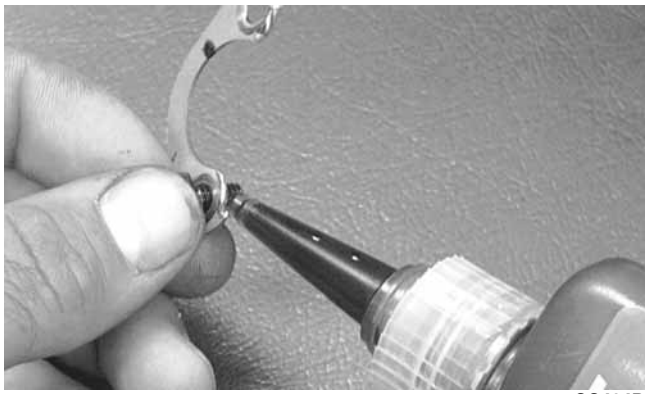


MD1363

CAUTION

Care must be taken that the tab washer is installed correctly to cover the alignment hole on the sprocket. If the alignment pin falls out, severe engine damage will result.

17. Apply red Loctite #271 to the first cap screw securing the sprocket and tab washer to the camshaft; then install the cap screw and tab washer. Tighten cap screw only until snug.



CC404D

FI612

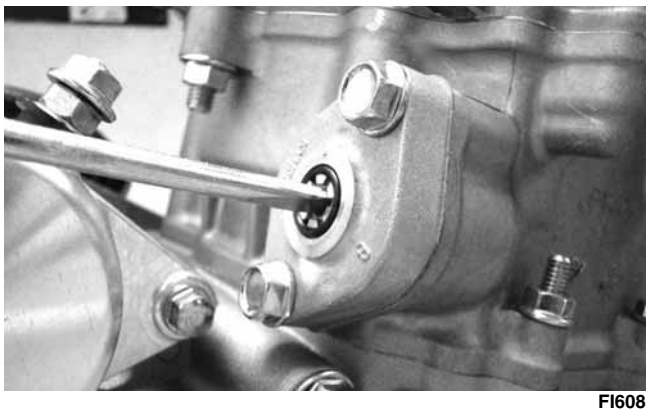
18. Rotate the crankshaft until the second cap screw securing the sprocket to the camshaft can be installed; then install the cap screw (threads coated with red Loctite #271). Tighten to 11 ft-lb; then bend the tab to secure the cap screw.

19. Rotate the crankshaft until the first cap screw (from step 17) securing the sprocket to the camshaft can be addressed; then tighten to 11 ft-lb. Bend the tab to secure the cap screw.

20. Install the cylinder head plug with the cupped end facing the camshaft and the opening directed downwards.

21. Place the cam chain tensioner assembly and gasket into the cylinder. Tighten to 10 ft-lb.

22. Using a flat-blade screwdriver, turn the tensioner screw counterclockwise to apply tension to the cam chain; then install the cap screw plug and washer and tighten securely.



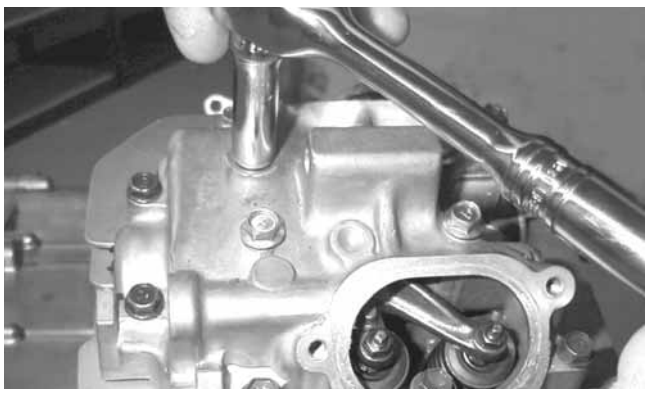
FI608

23. Loosen the adjuster screw jam nuts; then loosen the adjuster screws on the rocker arms in the valve cover.

24. Apply a thin coat of Three Bond Sealant to the mating surface of the valve cover; then place the valve cover into position. Note that the two alignment pins are properly positioned.

■NOTE: At this point, the rocker arms and adjuster screws must not have pressure on them.

25. Install the four top-side cap screws with rubber washers; then install the remaining cap screws. Tighten only until snug.



MD1261

26. In a crisscross pattern starting from the center and working outward, tighten the cap screws (from step 25) to 8 ft-lb.

27. Adjust valve/tappet clearance (see Periodic Maintenance).

28. Place the two tappet covers with O-rings into position; then install and tighten the cap screws to 9 ft-lb.

FI602

29. Install the spark plug and tighten securely; then install the timing inspection plug.

Left-Side Components

■NOTE: For efficiency, it is preferable to remove and disassemble only those components which need to be addressed and to service only those components. The technician should use discretion and sound judgment.

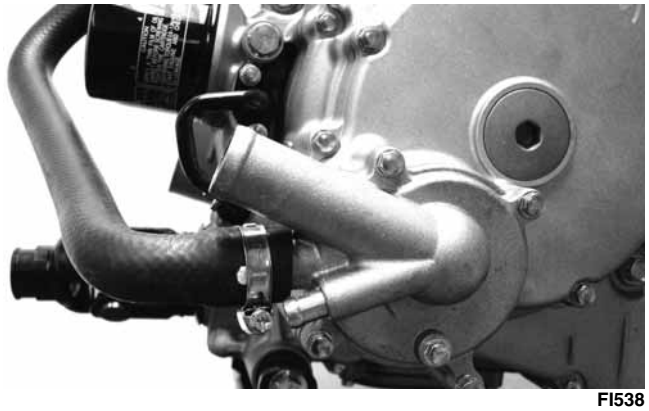
☞ AT THIS POINT
To service any one specific component, only limited disassembly of components may be necessary. Note the AT THIS POINT information in each sub-section.

■NOTE: The engine/transmission does not need to be removed from the frame for this procedure.

Removing Left-Side Components

A. Water Pump
B. Speed Sensor
C. Magneto Cover/ Stator Assembly

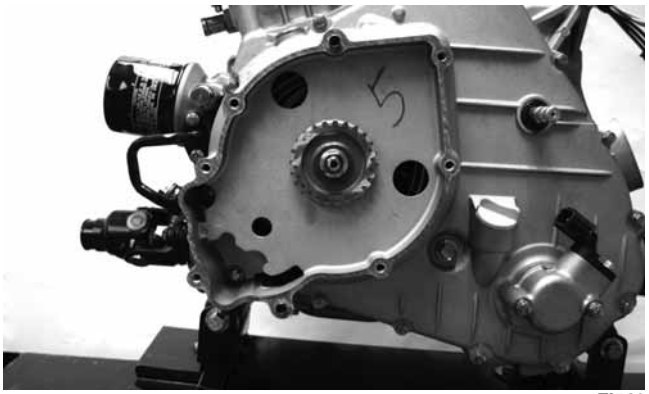
1. Remove the coolant hose connecting the water pump to the cylinder; then remove the water pump cover.



FI538

2. Remove the water pump housing assembly noting the location of the longer cap screw. Account for a gasket and two alignment pins.

FI539

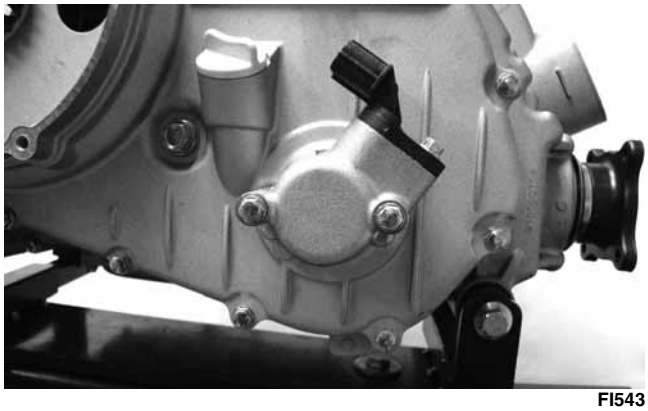


FI541

3. Remove two cap screws and the oil bolt securing the oil pressure relief line to the engine. Account for two crush washers and an O-ring.

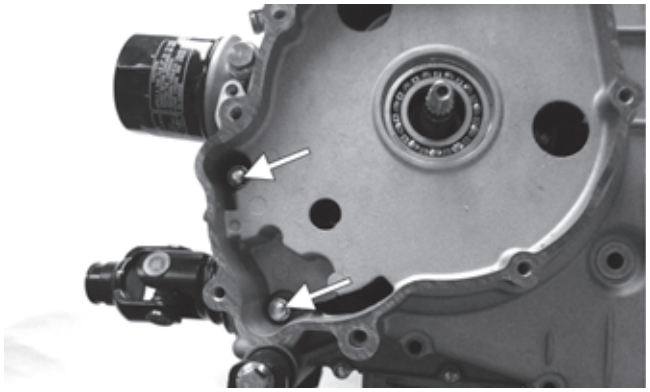
FI544

4. Remove the water pump drive gear; then remove the speed sensor housing assembly. Account for two alignment pins, a gasket, and two seal washers.



FI543

5. Remove the cap screws securing the magneto cover to the crankcase. Note the location of the two internal cap screws and the two longer cap screws.



FI596A

6. Remove the magneto cover and account for two alignment pins and the gasket.

D. Rotor/Flywheel
E. Starter Clutch/Gear
F. Starter Motor

■NOTE: Steps 1-6 in the preceding sub-section must precede this procedure.

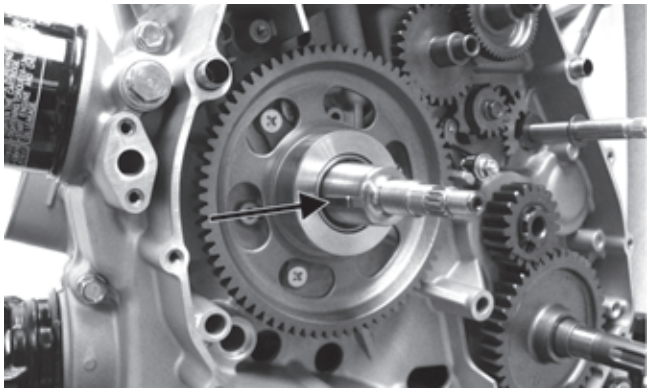
7. Remove the nut securing the rotor/flywheel on the crankshaft and install the crankshaft protector.

FI549

8. Using the Magneto Rotor Remover Set, break the rotor/flywheel loose from the crankshaft; then remove the puller and crankshaft protector and remove the rotor/flywheel.

FI550

9. Remove the flywheel key from the crankshaft; then remove the starter clutch gear.



FI551A

10. Remove starter idler gears and their respective shafts; then remove the starter motor. Account for an O-ring on the starter drive housing.

FI555

G. Shift Shaft
H. Drive Gear

■NOTE: Steps 1-10 in the preceding sub-sections must precede this procedure.

11. Remove the shift shaft noting a washer on each end; then remove the cap screw securing the gear shift cam plate and remove the plate from the shaft.

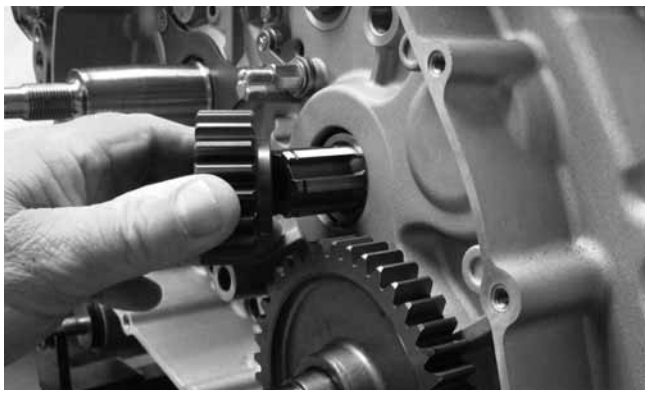
FI559

12. Remove the shift detent cam arm and spring.

FI560

13. Remove the snap ring securing the output drive gear to the output shaft and remove the gear noting that the hub flange is directed toward the crankcase.

FI564



FI566

Servicing Left-Side Components

INSPECTING STARTER CLUTCH/ GEAR

1. Place the starter clutch gear onto the rotor/flywheel and attempt to rotate the starter clutch gear clockwise. It should lock up to the rotor/flywheel. Rotate the gear counterclockwise and it should turn freely. If it moves or locks up both ways, the starter clutch must be replaced.
2. Inspect the starter clutch gear for chipped or missing teeth or discoloration/scoring of the clutch surface. Inspect the bearing for loose, worn, or discolored rollers. If bearing is damaged, it must be replaced.

FI569

3. Inspect the one-way bearing for chipped surfaces, missing rollers, or discoloration. If any of the above conditions exist, replace the starter clutch assembly.

FI572

REPLACING STARTER CLUTCH ASSEMBLY

1. Remove the cap screws securing the starter clutch assembly to the flywheel; then remove from the flywheel.

FI570

2. Thoroughly clean the rotor/flywheel; then install the new clutch and secure with the cap screws after applying a drop of red Loctite #271 to the threads. Tighten to 26 ft-lb using a crisscross pattern. Make sure the one-way bearing is installed with the notches directed away from the rotor/flywheel.

FI576A

FI578

REPLACING STARTER GEAR BEARING

1. Support the starter clutch gear in a press making sure to support the hub around the entire circumference; then using a suitable bearing driver, press the bearing from the gear.

FI583

2. Thoroughly clean the gear hub; then apply a drop of green Loctite #620 to the bearing outer race and press into the gear hub until even with the lower chamfer radius.

FI580

INSPECTING STATOR/MAGNETO COVER ASSEMBLY

1. Inspect the stator for burned or discolored wiring, broken or missing hold-down clips, or loose cap screws.
2. Inspect the bearings in the magneto housing for discoloration, roughness when rotated, and secure fit in bearing bores.
3. Inspect the oil pressure relief valve for evidence of metal chips or contamination. Do not disassemble the valve.

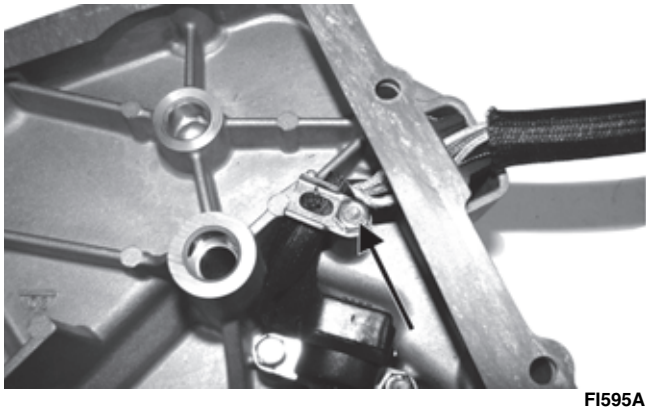
FI588

REPLACING STATOR COIL/ CRANKSHAFT POSITION SENSOR

1. Remove the three cap screws securing the stator coil, two cap screws securing the crankshaft position sensor, and one cap screw from the harness hold-down.
2. Lift the rubber grommet out of the housing; then remove the stator coil/crankshaft position sensor. Account for and note the position of the harness hold-down under the crankshaft position sensor.

FI590

3. Install the new stator coil assembly and secure with three cap screws (threads coated with blue Loctite #243). Tighten to 13 ft-lb.
4. Place the stator wire harness hold-down into position; then install the crankshaft position sensor and secure with two cap screws. Tighten securely.
5. Install the upper cable hold-down and secure with a cap screw. Tighten securely.



FI595A

REPLACING MAGNETO COVER BEARINGS

1. Using a suitable press and proper support, press the bearing from the housing as indicated (one from outside and one from inside).

FI593

FI594

2. Clean the bearing bores in the housing and inspect closely for cracks or shiny areas indicating bearing movement. Replace the housing if any of the above are evident.
3. With a drop of red Loctite #271 around the bearing bore, press a new bearing into the magneto cover until the bearing is firmly seated in the bearing bore.

Installing Left-Side Components

A. Starter Clutch/Gear
B. Rotor/Flywheel

1. If removed, place the crankshaft bearing retainer into position. Apply red Loctite #271 to the three cap screws. Install and tighten the three cap screws securely.

MD1122

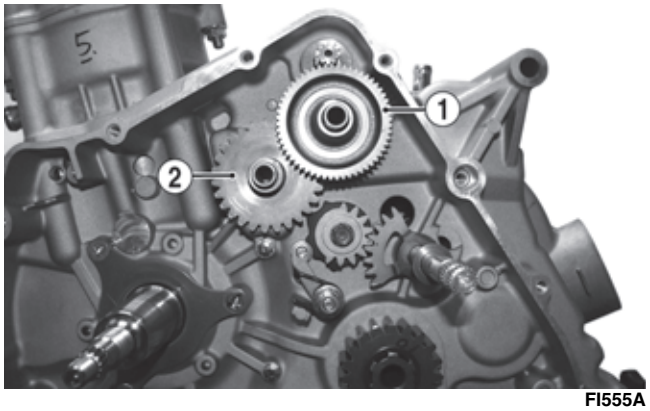
2. Install the starter motor and tighten the two cap screws to 8 ft-lb.
3. Install the shift detent cam making sure the washer is installed.

MD1086

4. Install the shift detent cam arm and spring.
5. Install the gear shift shaft assembly and washer making sure to align the alignment marks.

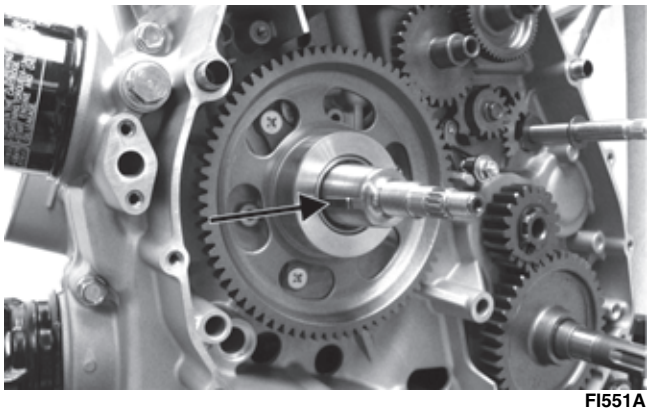
FI559

6. Install starter idler gears (1) and (2).



FI555A

7. Install the starter clutch gear onto the crankshaft; then install the rotor/flywheel key in the crankshaft.



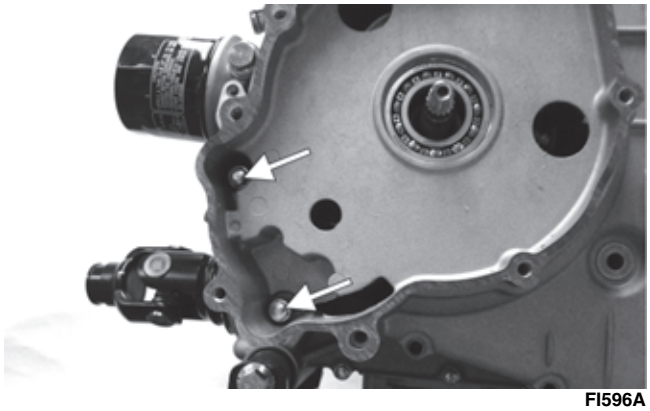
FI551A

8. Install the rotor/flywheel and secure with the nut. Tighten to 107 ft-lb.

C. Magneto Cover
D. Water Pump

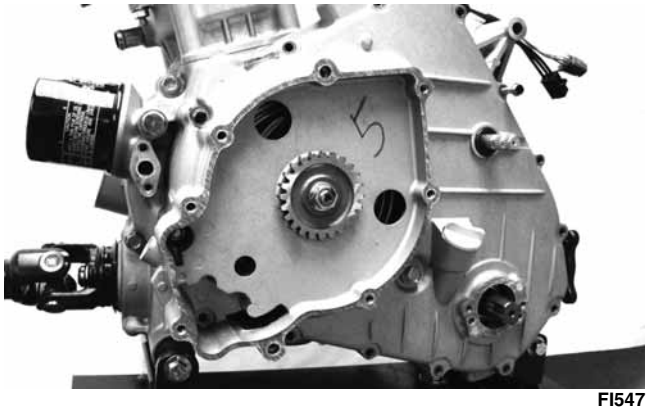
■NOTE: Steps 1-8 in the preceding sub-section must precede this procedure.

9. Install two alignment pins and place the magneto cover gasket into position. Install the magneto cover. Noting the different-lengthed 6 mm cap screws and the location of the two internal cap screws, tighten the cap screws in a crisscross pattern to 8 ft-lb.



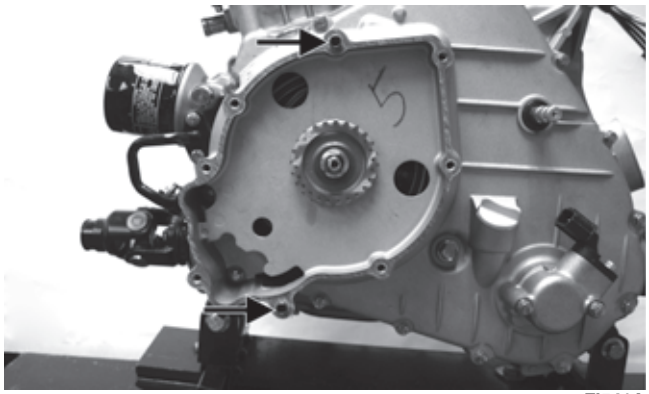
FI596A

10. Install the water pump drive gear and secure with the nut. Tighten to 28 ft-lb.

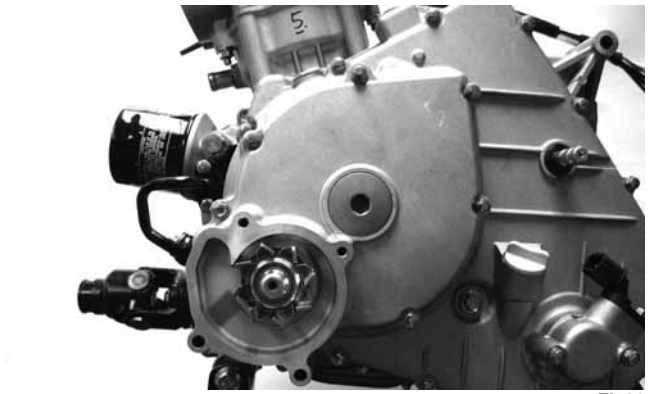


FI547

11. Install two alignment pins and a gasket on the magneto cover; then install the water pump housing assembly. Tighten the cap screws to 8 ft-lb.

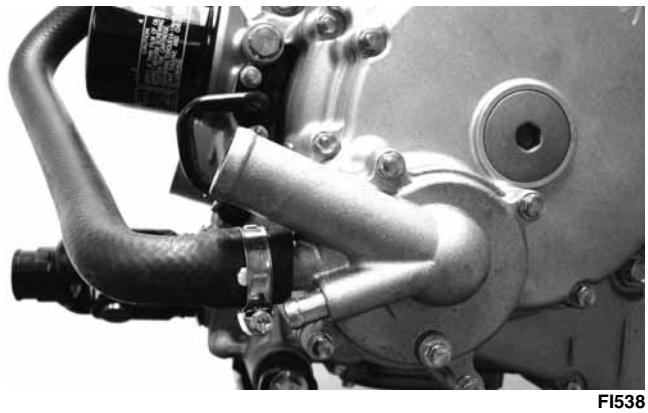


FI541A



FI539

12. Install the water pump cover with a new O-ring and secure with the four cap screws. Tighten to 8 ft-lb.



FI538

13. Connect the coolant hoses to the water pump and secure with the hose clamps. Tighten securely.

Right-Side Components

☞ AT THIS POINT
To service center crankcase components only, proceed to Removing Right-Side Components.

■NOTE: For efficiency, it is preferable to remove and disassemble only those components which need to be addressed and to service only those components. The technician should use discretion and sound judgment.

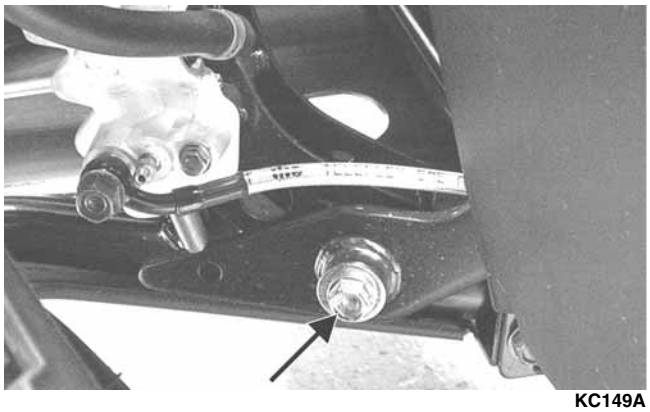
☞ AT THIS POINT
To service any one specific component, only limited disassembly of components may be necessary. Note the AT THIS POINT information in each sub-section.

■NOTE: The engine/transmission does not have to be removed from the frame for this procedure.

Removing Right-Side Components

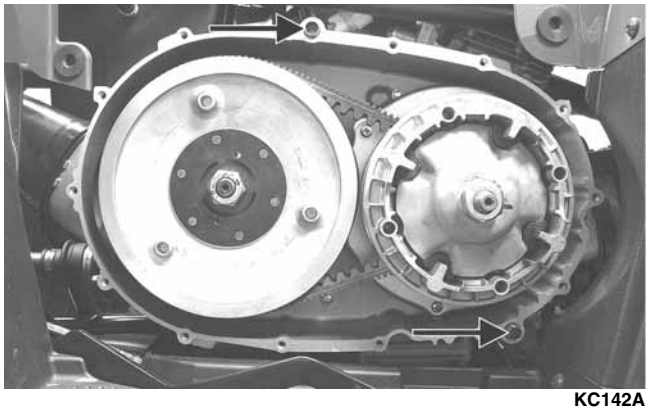
A. V-Belt Cover
B. Driven Pulley
C. Clutch Cover

1. If the engine is still in the frame, remove the cap screw securing the brake pedal to the pedal axle. Account for a flat washer.



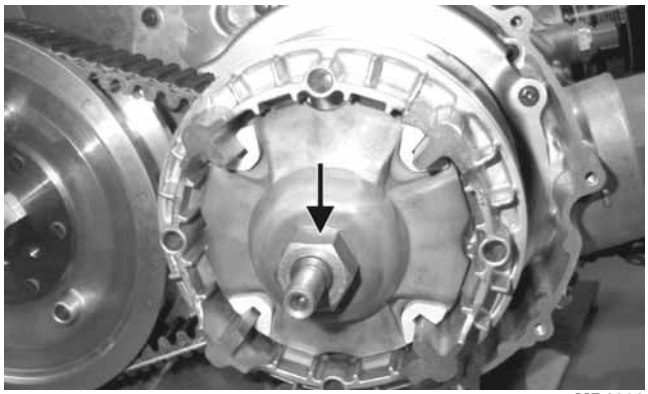
KC149A

2. Remove the cap screws securing the V-belt cover to the clutch cover; then slide the brake pedal outward and remove the V-belt cover. Account for two alignment pins and a gasket.



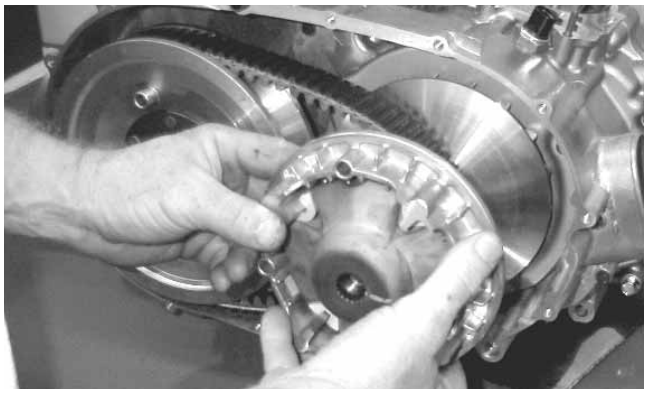
KC142A

3. Mark the movable drive face and the fixed drive face for installing purposes; then remove the nut holding the movable drive face onto the crankshaft.

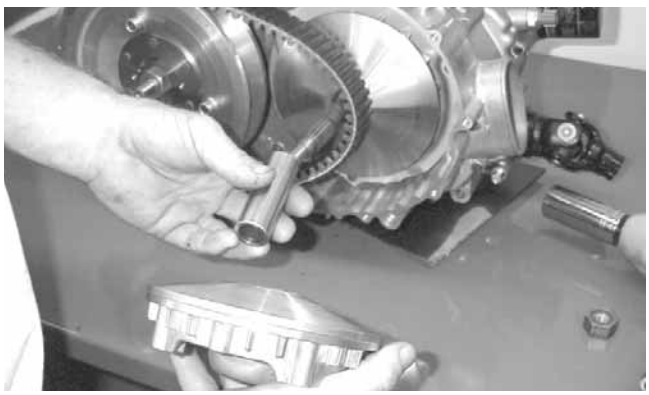


MD1033

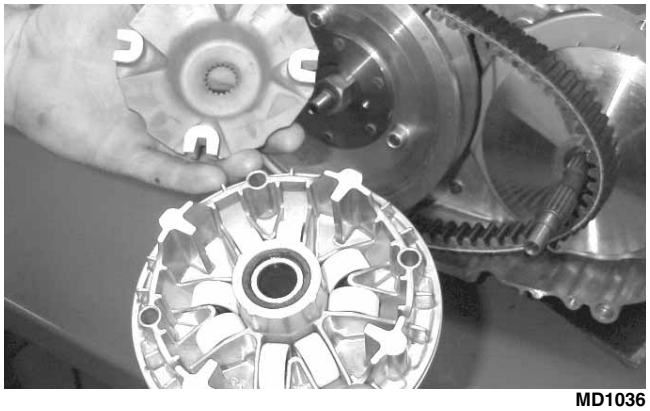
4. Remove the movable drive face and spacer. Account for the movable drive face rollers and outer drive face cover.



MD1035

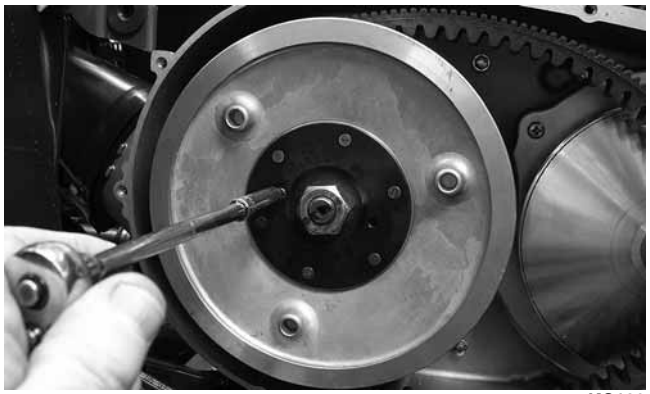


MD1034



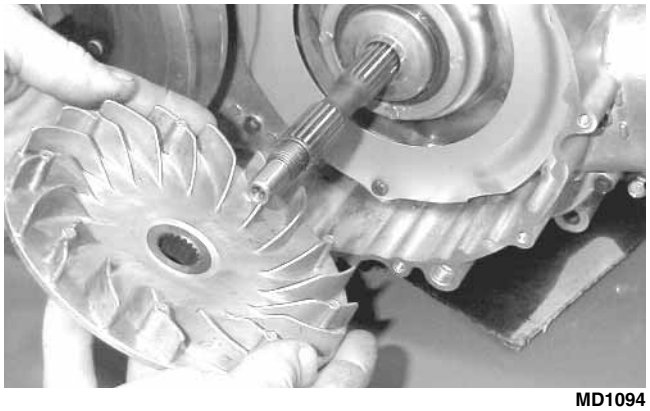
MD1036

5. Using a 6 mm cap screw threaded into the fixed driven face, spread the driven pulley by turning the cap screw clockwise; then remove the V-belt.



KC132

6. Remove the fixed drive face.

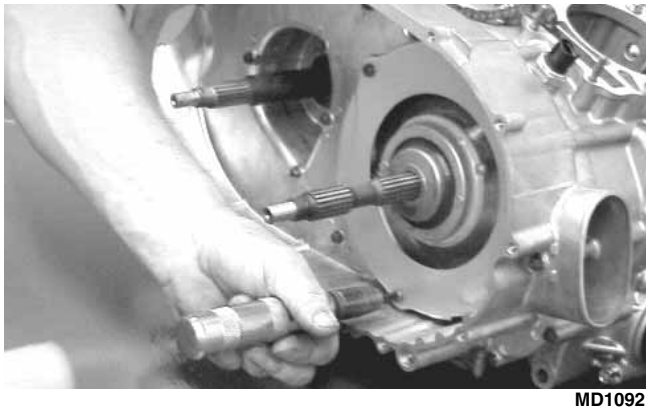


MD1094

7. Remove the nut holding the driven pulley assembly; then remove the driven pulley assembly.

MD1068

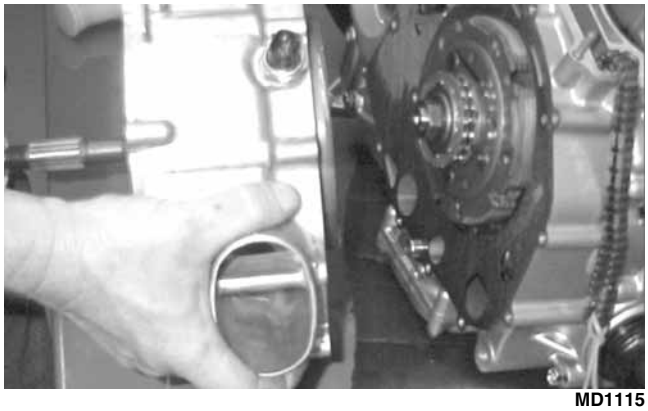
8. Using an impact screwdriver, remove the three Phillips-head cap screws holding the air intake plate. Remove the air intake plate.



MD1092

9. Remove the cap screws holding the clutch cover onto the right-side crankcase half. Note the positions of the different-lengthed cap screws for installing purposes.

10. Using a rubber mallet, loosen the clutch cover; then pull it away from the right-side crankcase half. Account for two alignment pins and gasket.



MD1115

D. Centrifugal Clutch Assembly
E. Oil Pump Drive Gear
F. Oil Pump Driven Gear

■NOTE: Steps 1-10 in the preceding sub-section must precede this procedure.

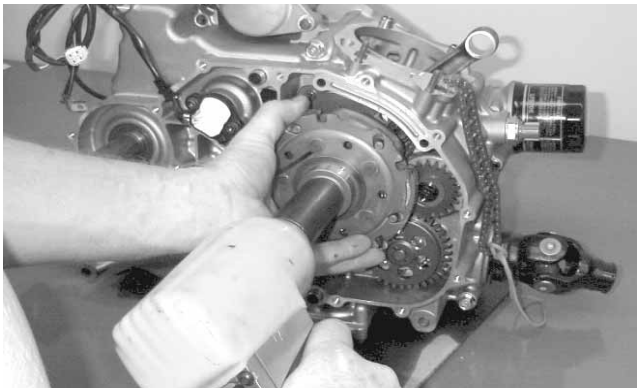
11. Remove the one-way clutch noting the direction of the green dot or the word OUTSIDE for installing purposes.

MD1286

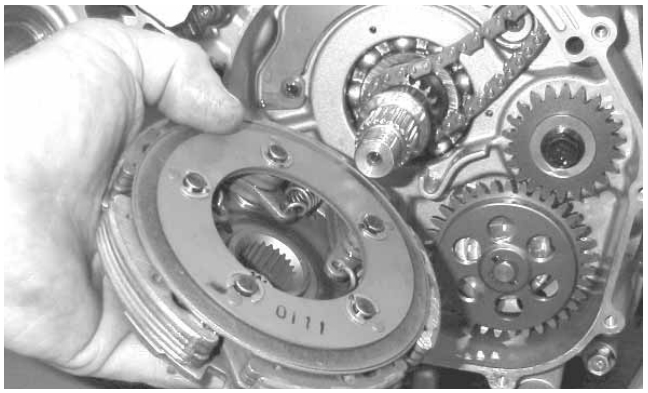
12. Remove the left-hand threaded nut holding the centrifugal clutch assembly.

CAUTION

Care must be taken when removing the nut; it has "left-hand" threads.



MD1014

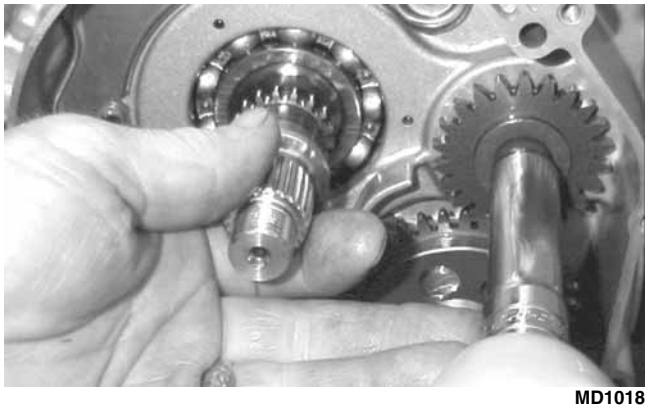


MD1016

13. Remove the cam chain.

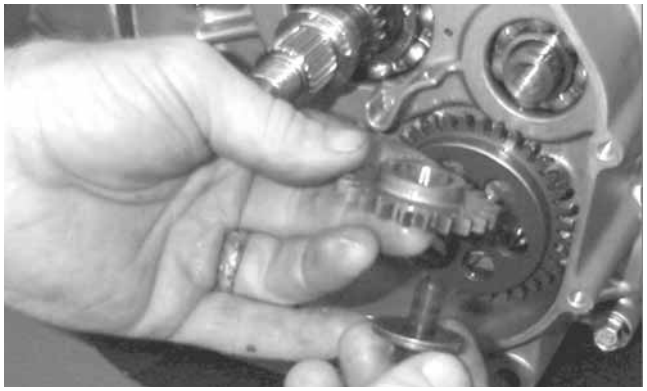
FI630

14. Remove the oil pump drive gear cap screw.



MD1018

15. Remove oil pump drive gear. Account for the pin.



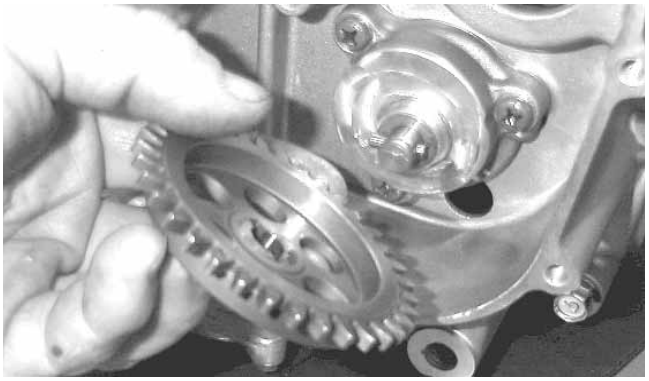
MD1017

16. Remove the snap ring holding the oil pump driven gear.

MD1019

■NOTE: Always use a new snap ring when installing the oil pump driven gear.

17. Remove oil pump driven gear. Account for the drive pin and thrust washer.



MD1020

☞AT THIS POINT

To service clutch components, see Servicing Right-Side Components sub-section.

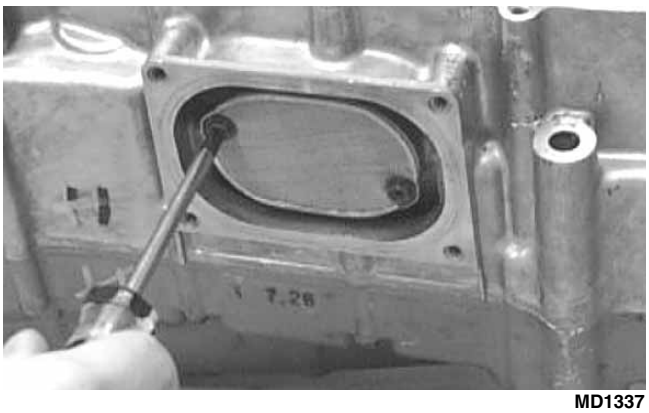
G. Oil Pump/Oil Strainer

■NOTE: Steps 1-17 in the preceding sub-sections must precede this procedure.

18. Remove three cap screws holding the oil pump and remove the oil pump. Account for two alignment pins.

MD1060

19. Remove the four cap screws securing the oil strainer cap; then remove the Phillips-head screws securing the oil strainer. Account for the O-ring.



MD1337

MD1208

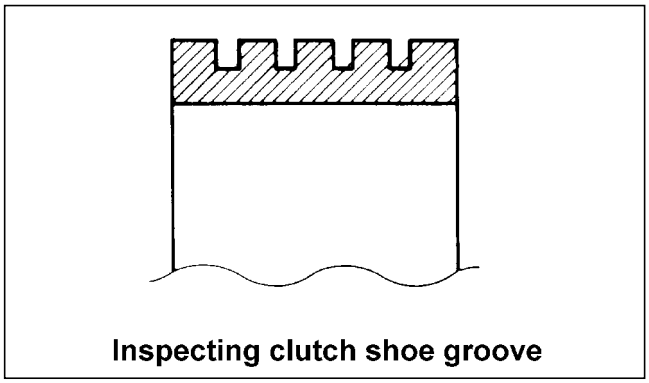
☞ AT THIS POINT

To service center crankcase components only, proceed to Separating Crankcase Halves.

Servicing Right-Side Components

INSPECTING CENTRIFUGAL CLUTCH SHOE

Inspect the clutch shoe for uneven wear, chips, cracks, or discoloration. If wear is present, replace the clutch assembly.



Inspecting clutch shoe groove

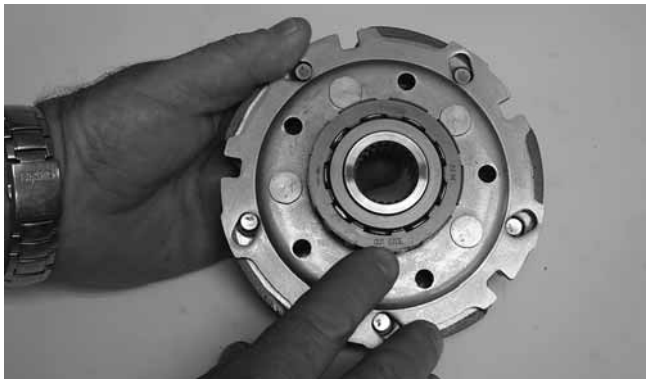
ATV1014

INSPECTING CENTRIFUGAL CLUTCH HOUSING

1. Inspect the clutch housing for burns, marks, scuffs, cracks, scratches, or uneven wear.
2. If the housing is damaged in any way, the housing must be replaced.

INSPECTING PRIMARY ONE-WAY DRIVE

1. Place the one-way clutch onto the clutch shoe assembly with the green dot or the word "OUTSIDE" directed away from the clutch shoe.



KC330

2. Place the clutch housing onto the clutch shoe/one-way clutch.

■NOTE: It will be necessary to rotate the clutch housing counterclockwise to properly seat the one-way clutch.

KC331A

3. Check that the clutch shoe can only be rotated counterclockwise in respect to the clutch housing. If the clutch shoe locks up or turns in both directions, the one-way clutch must be replaced.

KC332A

INSPECTING OIL PUMP

1. Inspect the pump for damage.
2. It is inadvisable to remove the screw securing the pump halves. If the oil pump is damaged, it must be replaced.

■NOTE: The oil pump is a non-serviceable component and must be replaced as a complete assembly.

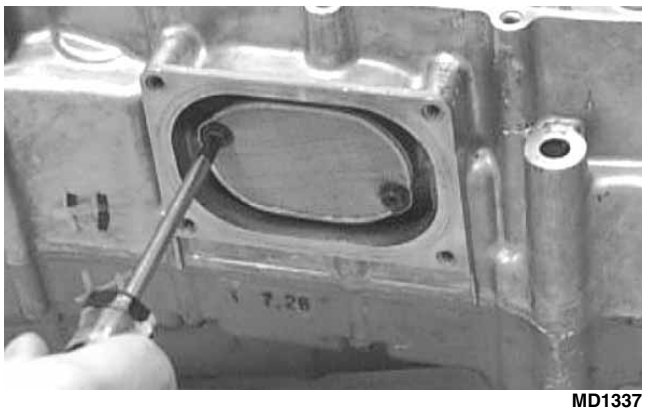
DRIVEN PULLEY ASSEMBLY

■NOTE: The driven pulley assembly is a non-serviceable component and must be replaced as a complete assembly.

Installing Right-Side Components

A. Oil Strainer/Oil Pump

1. Place the oil strainer into position beneath the crankcase. Tighten the Phillips-head screws securely.



MD1337

2. Place the strainer cap into position on the crankcase making sure the O-ring is properly installed and secure with the four cap screws. Tighten the cap screws to 10 ft-lb; then install the oil drain plug and tighten to 16 ft-lb.

MD1208

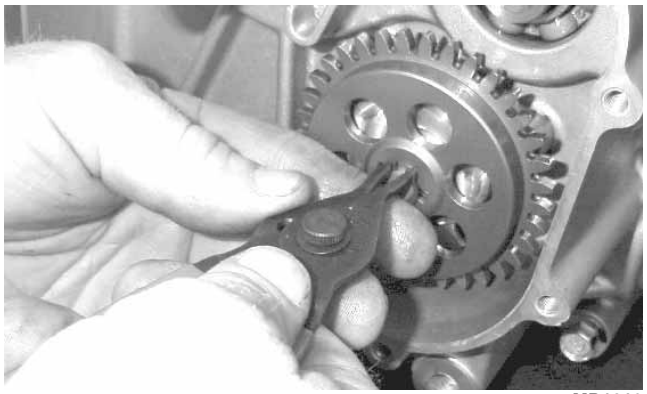
3. Place two alignment pins and the oil pump into position on the crankcase and secure with the Phillips-head screws coated with red Loctite #271. Tighten to 8 ft-lb.

MD1060

4. Place the thrust washer and drive pin into position on the oil pump shaft, install the oil pump driven gear making sure the recessed side of the gear is directed inward, and secure with a new snap ring.

■NOTE: Always use a new snap ring when installing the oil pump driven gear.

MD1020



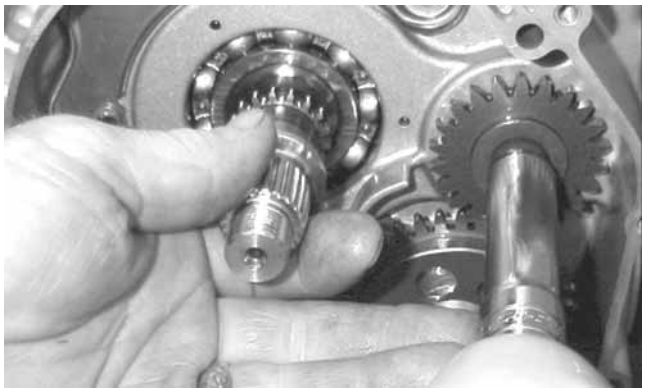
MD1019

5. Install the cam chain.

■NOTE: Keep tension on the cam chain to avoid damaging the crankcase boss.

6. Place the pin into position, install the oil pump drive gear, and tighten the cap screw (coated with red Loctite #271) to 63 ft-lb.

MD1017



MD1018

7. Install the clutch shoe assembly on the crankshaft; then install the flange nut (left-hand thread) (coated with red Loctite #271). Tighten to 147 ft-lb.

■NOTE: The flat side of the flange nut should be directed towards the clutch shoe.

CAUTION
Care must be taken when installing the flange nut; it has "left-hand" threads.

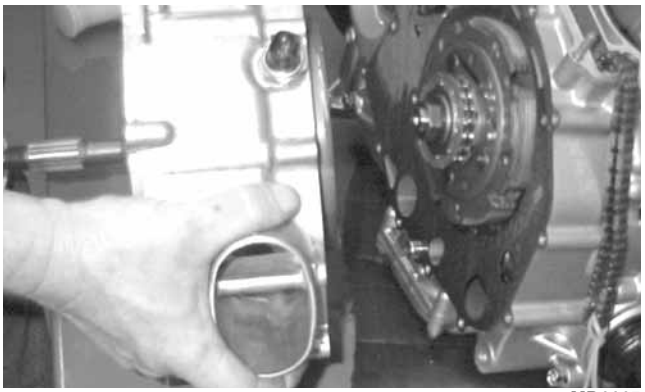
8. Install the one-way clutch making sure that the green dot or the word OUTSIDE is directed away from the crankcase.

MD1286

B. Clutch Cover
C. Fixed Drive Face
D. Movable Drive Face

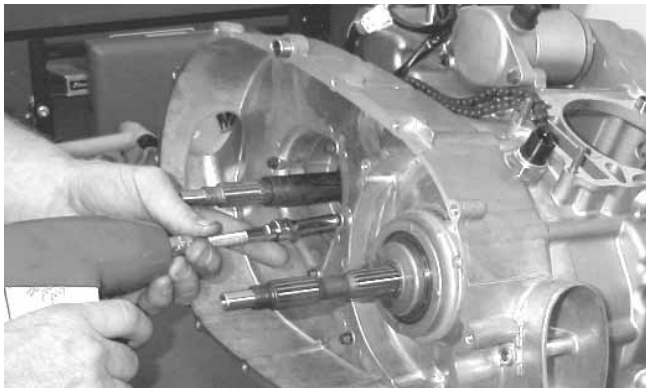
■NOTE: Steps 1-8 in the preceding sub-section must precede this procedure.

9. Install two alignment pins and place the clutch cover gasket into position. Install the clutch cover.



MD1115

10. Tighten the clutch cover cap screws to 8 ft-lb.



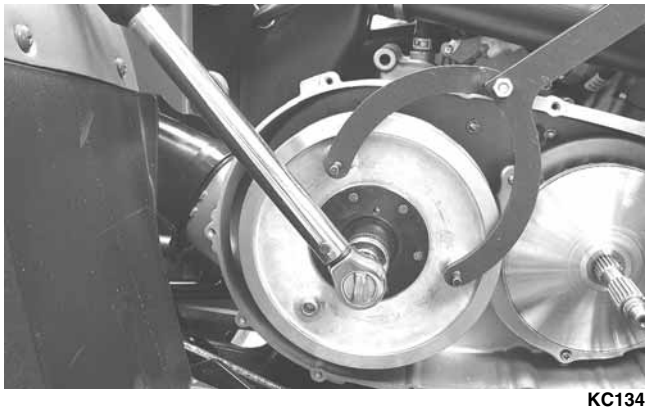
MD1117

11. Install the air intake plate. Apply red Loctite #271 to the threads of the three Phillips-head cap screws; then install and tighten securely.

MD1342

12. Place the driven pulley assembly into position and secure with the nut (threads coated with red Loctite #271). Tighten to 147 ft-lb.

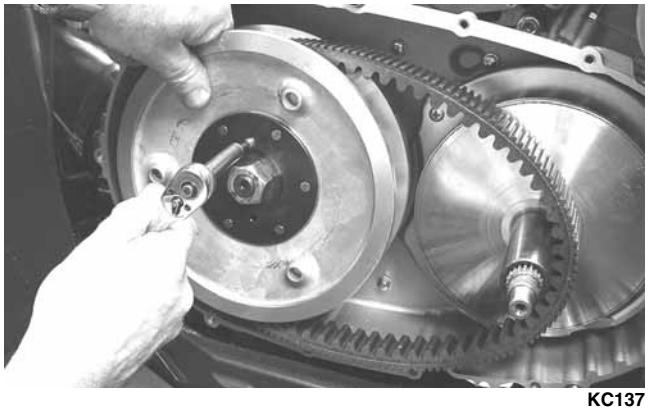
MD1068



KC134

13. Slide the fixed drive face assembly onto the front shaft.

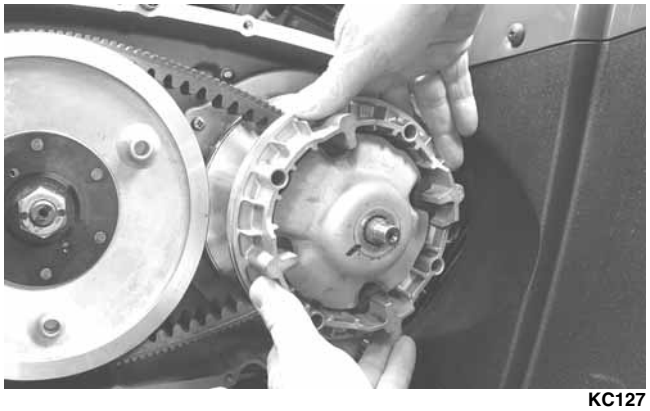
14. Spread the faces of the driven pulley by threading a V-belt cover cap screw into the fixed driven face and tightening until the faces open sufficiently to allow the V-belt to drop into the pulley approximately 3/4 in.



KC137

■NOTE: The arrows on the V-belt should point in direction of engine rotation.

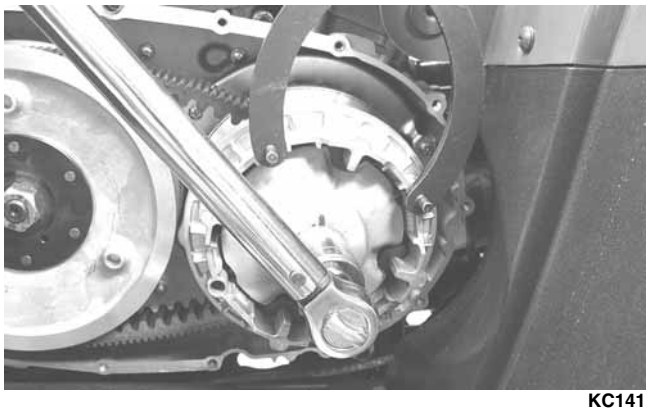
15. Making sure the movable drive face rollers are in position, pinch the V-belt together near its center and slide the spacer and movable drive face onto the shaft.



KC127

16. Coat the threads of the nut with red Loctite #271; then making sure the splines of the clutch shaft protrude through the cover plate, secure with the nut and tighten to 147 ft-lb.

KC138

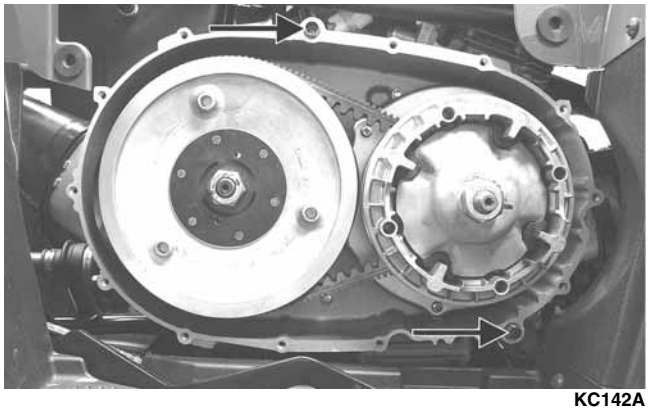


KC141

■NOTE: At this point, the cap screw can be removed from the driven pulley face.

17. Rotate the V-belt and drive/driven assemblies until the V-belt is flush with the top of the driven pulley.

18. Install two alignment pins and place a new V-belt cover gasket into position on the clutch cover. In a crisscross pattern, tighten cap screws to 8 ft-lb.



KC142A

19. If removed, install the brake pedal and tighten to 25 ft-lb.

Center Crankcase Components

■NOTE: This procedure cannot be done with the engine/transmission in the frame. Complete Removing procedures for Top-Side, Left-Side, and Right-Side must precede this procedure.

■NOTE: For efficiency, it is preferable to remove and disassemble only those components which need to be addressed and to service only those components. The technician should use discretion and sound judgment.

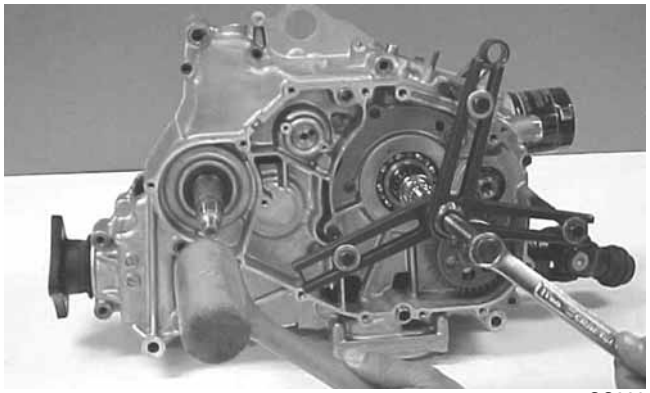
Separating Crankcase Halves

1. Remove the left-side and right-side cap screws securing the crankcase halves noting the position of the different-sized cap screws for joining purposes.

MD1006

MD1012

2. Using Crankcase Separator/Crankshaft Remover and tapping lightly with a rubber mallet, separate the crankcase halves. Account for two alignment pins.



CC869

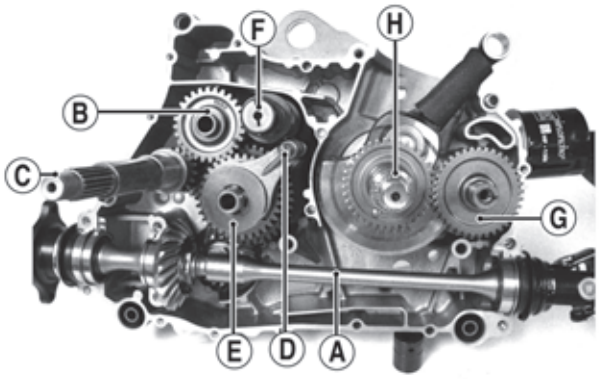
■NOTE: To keep the shaft/gear assemblies intact for identification, tap the shafts toward the left-side crankcase half when separating the halves.

MD1313

Disassembling Crankcase Half

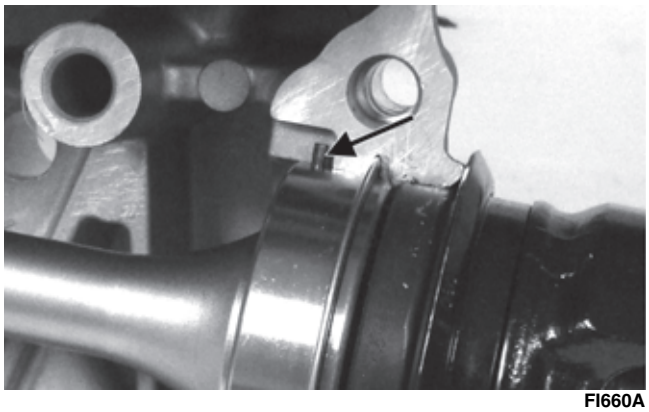
■NOTE: To aid in installing, it is recommended that the assemblies be kept together and in order.

■NOTE: For steps 1-6, refer to illustration FI639A.

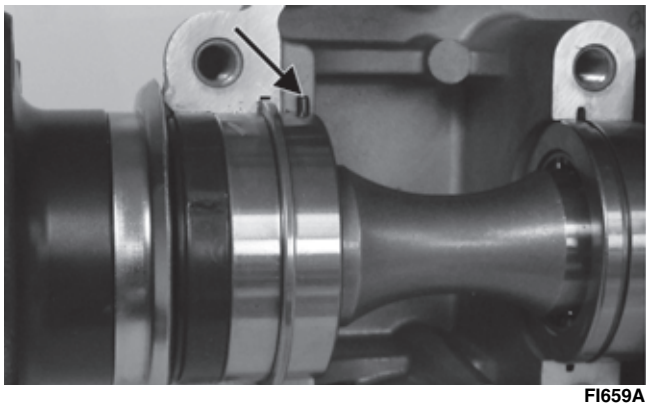


FI639A

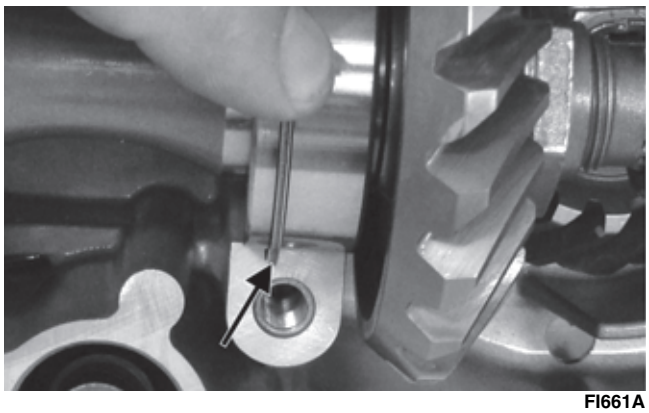
1. Remove the secondary driven shaft assembly (A) noting the location of the front and rear bearing locating pins and the center bearing locating ring.



FI660A

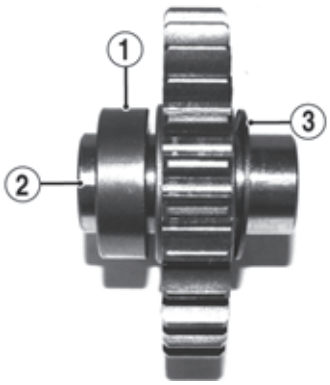


FI659A



FI661A

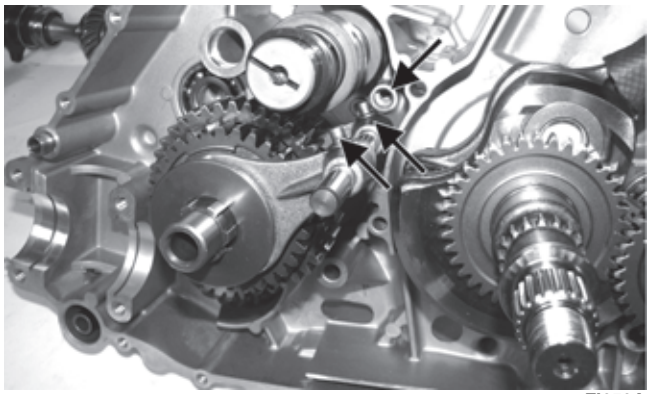
2. Remove the reverse idler assembly (B). Account for and note the location of the inner bushing (1), idler shaft (2), and outer washer (3).



FI641A

3. Remove the driveshaft (C); then pull the shift fork locating shaft (D) out of the crankcase locating boss and allow the shift forks to disengage from the gear shift shaft (F).

FI646

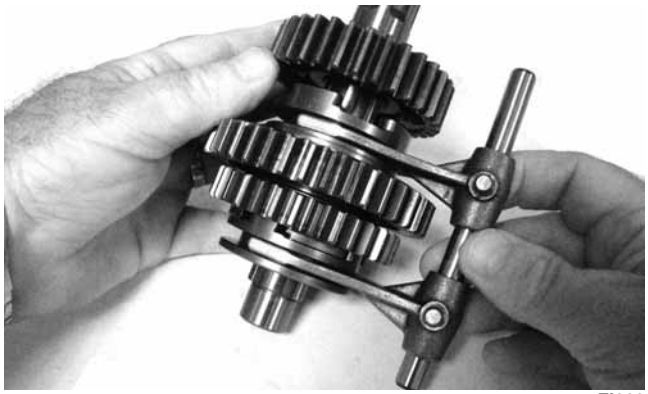


FI653A

4. Remove the gear shift shaft (F) noting the inner and outer washers.

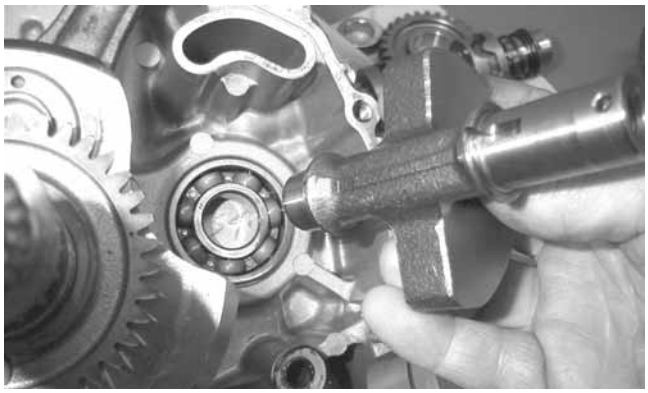
FI650A

5. Remove the countershaft assembly (E) along with the shift fork assembly.



FI662

6. Remove the crank balancer driven gear (G) and account for a key; then remove the crankshaft balancer shaft.



MD1024

7. Using Crankcase Separator/Crankshaft Remover with the appropriate crankshaft protector, remove the crankshaft.

MD1330

CAUTION

Do not remove the remaining output shaft assembly unless absolutely necessary. If the shaft is removed, the shaft nut must be replaced with a new one and the shaft must be re-shimmed.

8. Remove the secondary drive gear/secondary driven gear retaining nut. From inside the crankcase using a rubber mallet, drive out the output shaft assembly. Account for the output shaft, a shim, a washer, and the nut.

☞AT THIS POINT

To service crankshaft assembly, see Servicing Center Crankcase Components sub-section.

Servicing Center Crankcase Components

SECONDARY GEARS

■NOTE: When checking and correcting secondary gear backlash and tooth contact, the universal joint must be secured to the front shaft or false measurements will occur.

Checking Backlash

■NOTE: The rear shaft and bevel gear must be removed for this procedure. Also, always start with the original shims on the rear shaft.

1. Place the left-side crankcase cover onto the left-side crankcase half to prevent runout of the secondary transmission output shaft.
2. Install the secondary driven output shaft assembly onto the crankcase.
3. Mount the indicator tip of the dial indicator on the secondary driven bevel gear (centered on the gear tooth).
4. While rocking the driven bevel gear back and forth, note the maximum backlash reading on the gauge.
5. Acceptable backlash range is 0.05-0.33 mm (0.002-0.013 in.).

Correcting Backlash

■NOTE: If backlash measurement is within the acceptable range, no correction is necessary.

1. If backlash measurement is less than specified, remove an existing shim, measure it, and install a new thinner shim.
2. If backlash measurement is more than specified, remove an existing shim, measure it, and install a thicker shim.

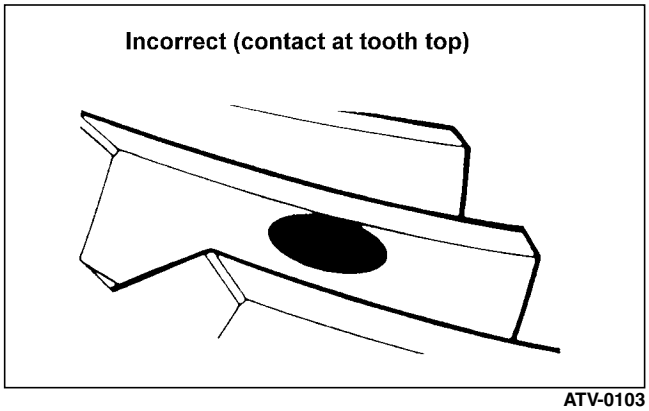
■NOTE: Continue to remove, measure, and install until backlash measurement is within tolerance. Note the following chart.

Backlash Measurement	Shim Correction
Under 0.05 mm (0.002 in.)	Decrease Shim Thickness
At 0.05-0.33 mm (0.002-0.013 in.)	No Correction Required
Over 0.33 mm (0.013 in.)	Increase Shim Thickness

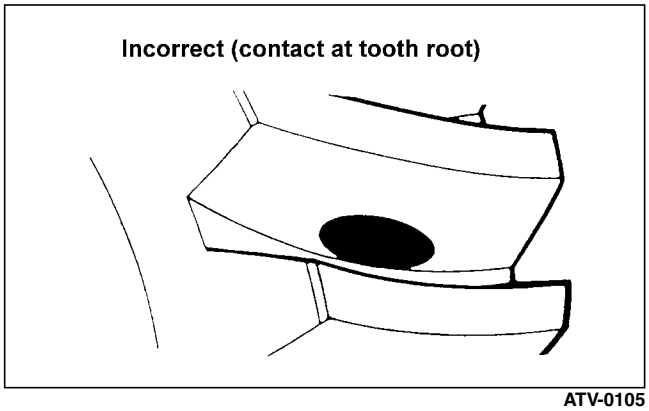
Checking Tooth Contact

■NOTE: After correcting backlash of the secondary driven bevel gear, it is necessary to check tooth contact.

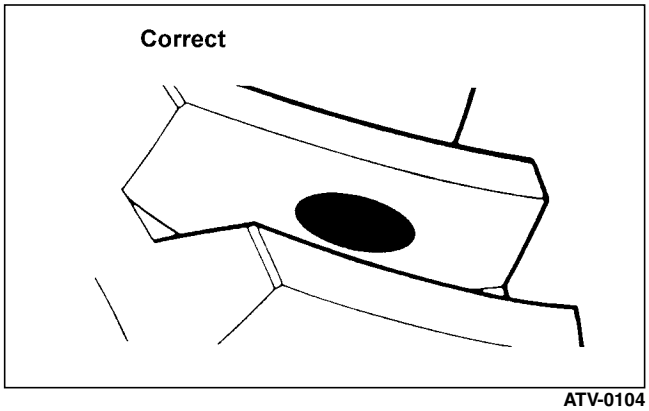
1. Remove the secondary driven output shaft assembly from the left-side crankcase half.
2. Clean the secondary driven bevel gear teeth of old oil and grease residue.
3. Apply a thin, even coat of a machinist-layout dye to several teeth of the gear.
4. Install the secondary driven output shaft assembly.
5. Rotate the secondary driven bevel gear several revolutions in both directions.
6. Examine the tooth contact pattern in the dye and compare the pattern to the illustrations.



ATV-0103



ATV-0105



ATV-0104

Correcting Tooth Contact

■NOTE: If tooth contact pattern is comparable to the correct pattern illustration, no correction is necessary.

If tooth contact pattern is comparable to an incorrect pattern, correct tooth contact according to the following chart.

Tooth Contact	Shim Correction
Contacts at Top	Decrease Shim Thickness
Contacts at Root	Increase Shim Thickness

■NOTE: To correct tooth contact, steps 1 and 2 (with NOTE) of "Correcting Backlash" must be followed and the above "Tooth Contact/Shim Correction" chart must be consulted.

CAUTION

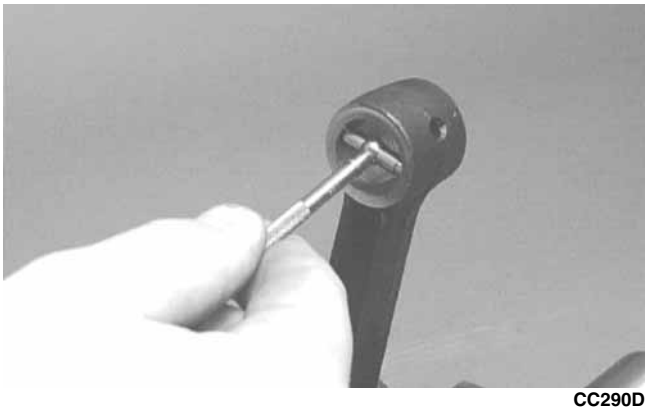
After correcting tooth contact, backlash must again be checked and corrected (if necessary). Continue the correcting backlash/correcting tooth contact procedures until they are both within tolerance values.

CRANKSHAFT ASSEMBLY

■NOTE: The crankshaft and connecting rod is a non-serviceable assembly. If any component is out of specification, the assembly must be replaced.

Measuring Connecting Rod (Small End Inside Diameter)

1. Insert a snap gauge into the upper connecting rod small end bore; then remove the gauge and measure it with micrometer.



CC290D

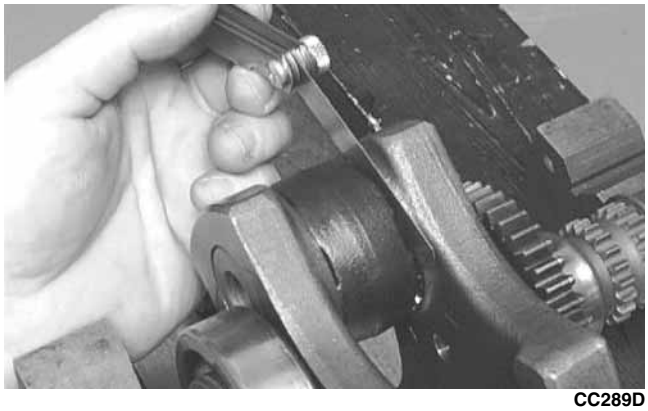
2. Maximum diameter must not exceed specifications.

Measuring Connecting Rod (Small End Deflection)

1. Place the crankshaft on a set of V-blocks and mount a dial indicator and base on the surface plate. Position the indicator contact point against the center of the connecting rod small end journal.
2. Zero the indicator and push the small end of the connecting rod away from the dial indicator.
3. Maximum deflection must not exceed specifications.

Measuring Connecting Rod (Big End Side-to-Side)

1. Push the lower end of the connecting rod to one side of the crankshaft journal.
2. Using a feeler gauge, measure the gap between the connecting rod and crankshaft journal.

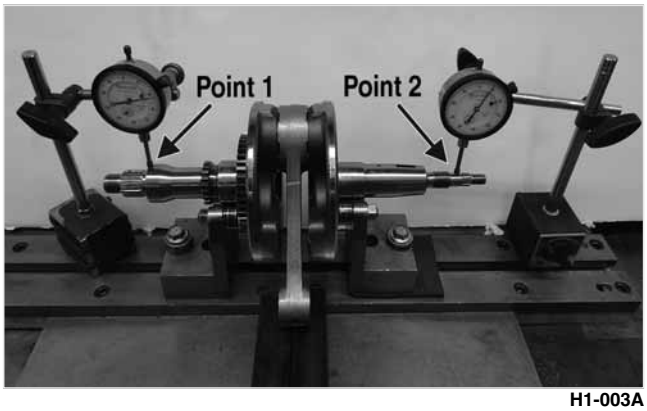


CC289D

3. Acceptable gap range must be within specifications.

Measuring Crankshaft (Runout)

1. Place the crankshaft on a set of V blocks.
2. Mount a dial indicator and base on the surface plate. Position the indicator contact at point 1 of the crankshaft.



H1-003A

3. Zero the indicator and rotate the crankshaft slowly.

CAUTION

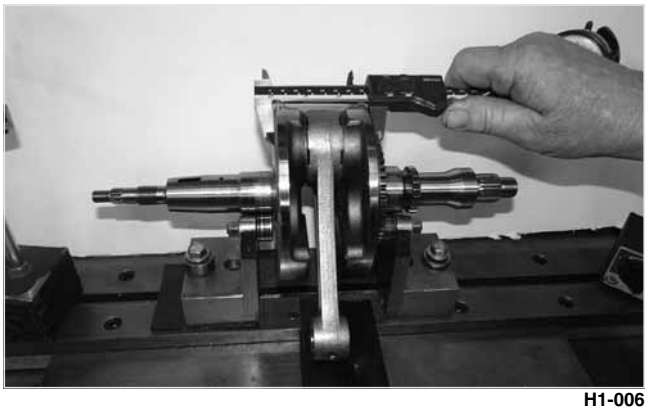
Care should be taken to support the connecting rod when rotating the crankshaft.

4. Maximum runout must not exceed specifications.

■NOTE: Proceed to check runout on the other end of the crankshaft by positioning the indicator contact at point 2 and following steps 3-4.

Measuring Crankshaft (Web-to-Web)

1. Using a calipers, measure the distance from the outside edge of one web to the outside edge of the other web.



H1-006

2. Acceptable width range must be within specifications.

COUNTERSHAFT

CAUTION

When disassembling the countershaft, care must be taken to note the direction each major component (dog, gear) faces. If a major component is installed facing the wrong direction, transmission damage may occur and/or the transmission will malfunction. In either case, complete disassembly and assembly will be required.

Disassembling

1. Remove the reverse driven gear dog; then remove the circlip securing the reverse driven gear.

FI663

FI664

2. Remove the splined washer; then remove the reverse driven gear along with the bearing and bushing.

FI665

3. Remove the low driven gear washer; then remove the low driven gear along with the bearing and bushing.

FI666

FI667

4. Remove the splined washer; then remove the circlip securing the high-low sliding dog. Remove the sliding dog.

FI668

FI669

5. Remove the circlip securing the high driven gear; then remove a washer, the high driven gear along with the bearing and bushing, and remove the high driven washer.

FI670

FI671

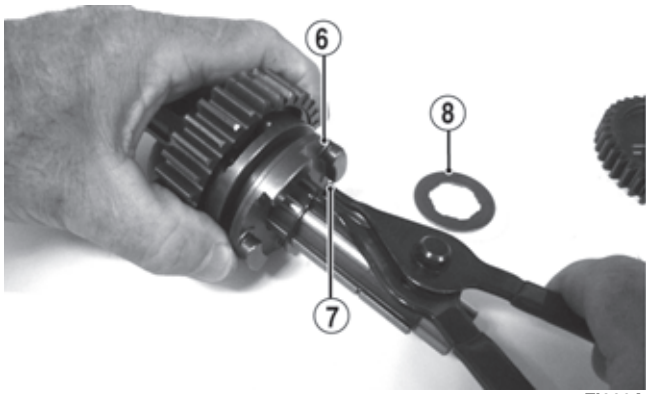
ASSEMBLING

1. With the high driven washer (1) on the countershaft, install the high driven gear bushing (3), bearings (2), and gear (4) on the countershaft; then install the washers (5) and secure with the snap-ring.

FI671A

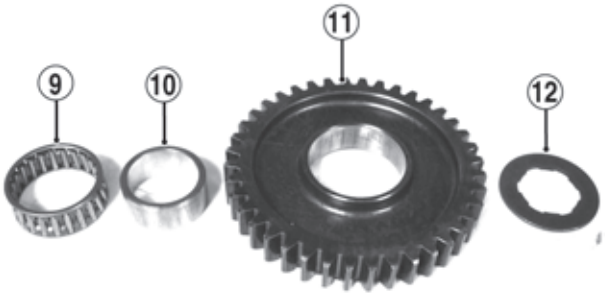
FI670

2. Install the high/low shift dog (6) on the countershaft and secure with snap-ring (7); then install the splined washer (8).



FI668A

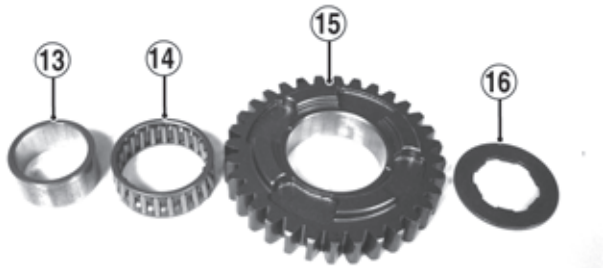
3. Install the low driven bushing (10), bearing (9), and gear (11) on the countershaft; then install splined washer (12).



FI667A

FI666

4. Place the reverse driven bushing (13) onto the shaft; then install the bearing (14), gear (15), and splined washer (16). Secure with a snap-ring.

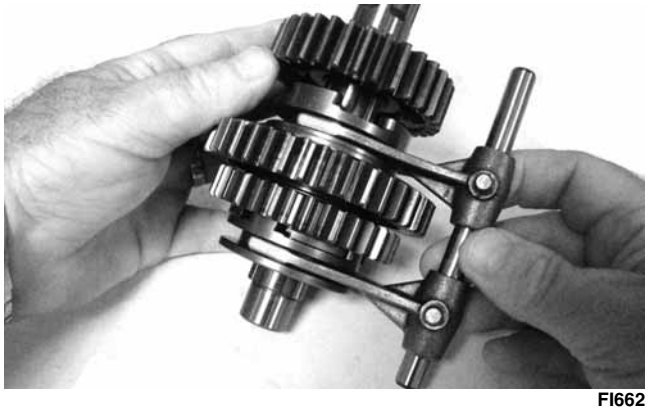


FI665A

FI664

5. Install the reverse dog on the shaft; then place the shift forks and shift shaft into position.

FI663



FI662

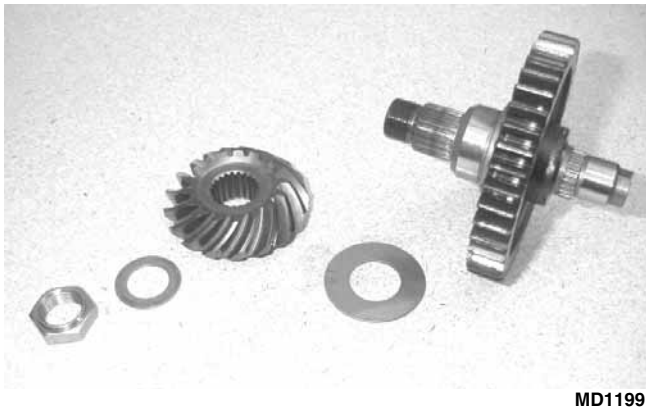
■**NOTE: The countershaft assembly is now ready to be installed.**

Assembling Crankcase Half

■**NOTE: For ease of assembly, install components on the right-side crankcase half.**

■**NOTE: If the output shaft was removed, make sure that the proper shim is installed.**

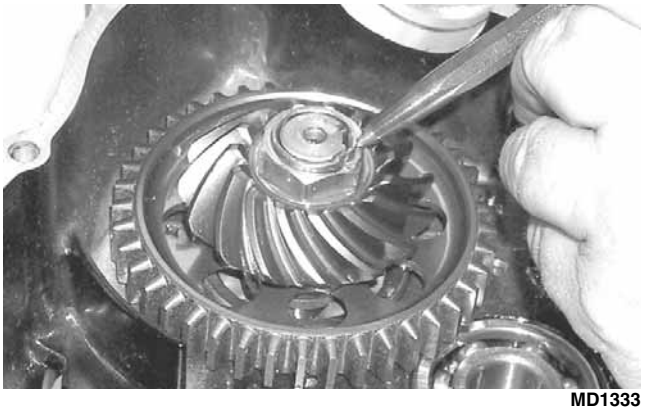
1. Install the output shaft into the crankcase making sure the two gears, shim, washer, and nut are in the correct order.



MD1199

MD1079

2. Install and tighten the output shaft flange nut to 59 ft-lb. Using a punch, peen the nut.



MD1333

3. Apply a liberal amount of oil to the crankshaft bearing. Using a propane torch, heat the bearing until the oil begins to smoke; then slide the crankshaft assembly into place.

MD1334

■**NOTE: If heating the bearing is not possible, the crankshaft can be installed using a crankshaft installer.**

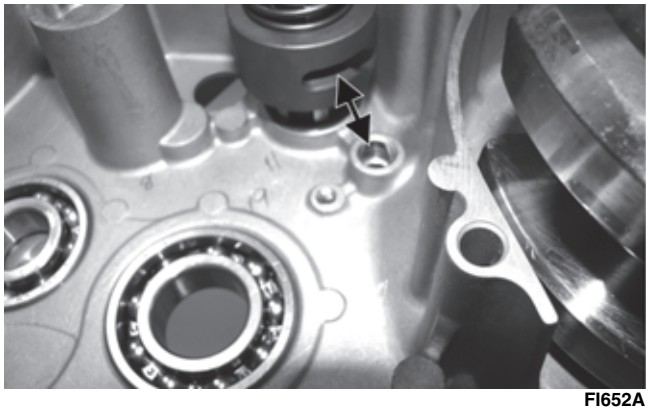
4. Rotate the crankshaft so the counterweight is toward the rear of the engine. Install the crank balancer shaft.

MD1024

5. Install the key in the crank balancer shaft; then install the gear and aligning the timing marks, slide the gear into place.

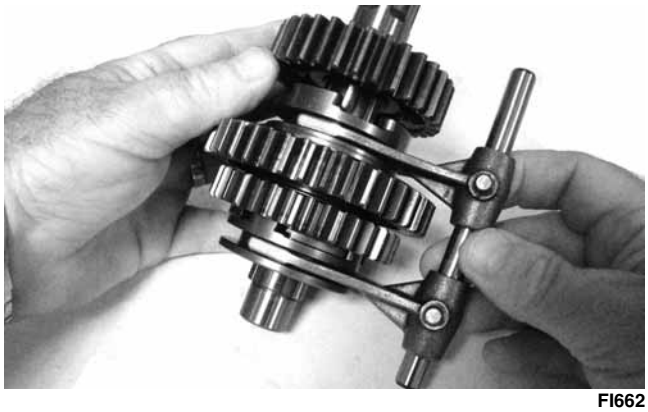
FI658

6. Align the shift cam fork slots with the shift fork shaft locating boss and with a washer on each end, install in the crankcase.



FI652A

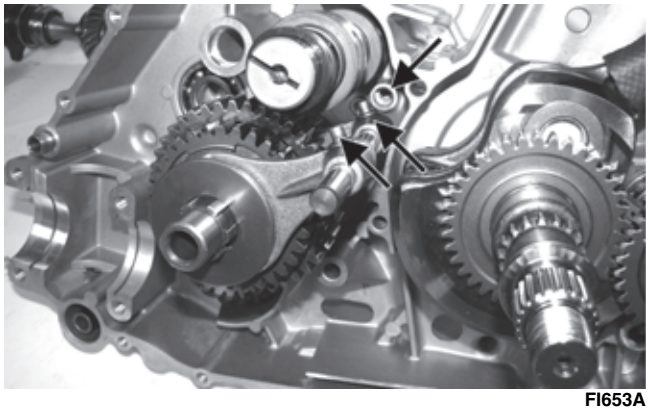
7. Place the shift forks into position on the assembled countershaft and install into the crankshaft as an assembly.



FI662

FI653

8. Align the shift forks to allow engagement with the shift cam; then engage the shift forks and slide the shift fork shaft into the locating boss in the crankcase.



FI653A

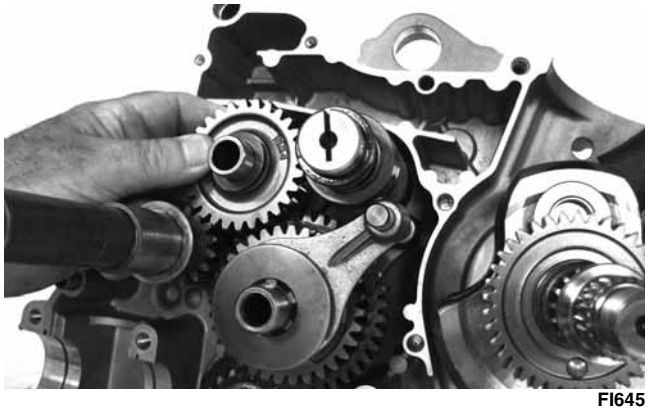
FI655A

9. Install the input driveshaft.

FI646

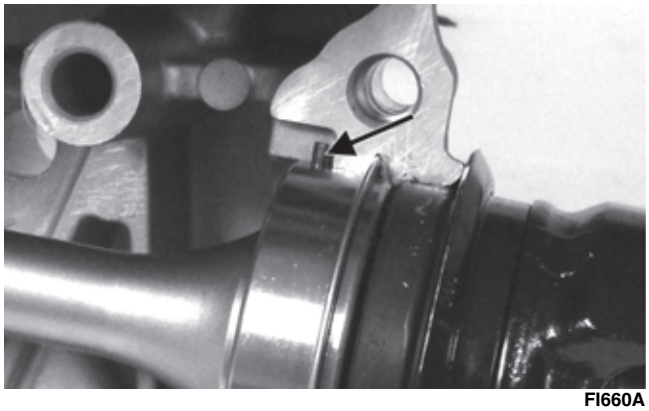
10. Install the spacer (1), shaft (2), reverse idler gear, and washer (3).

FI641A

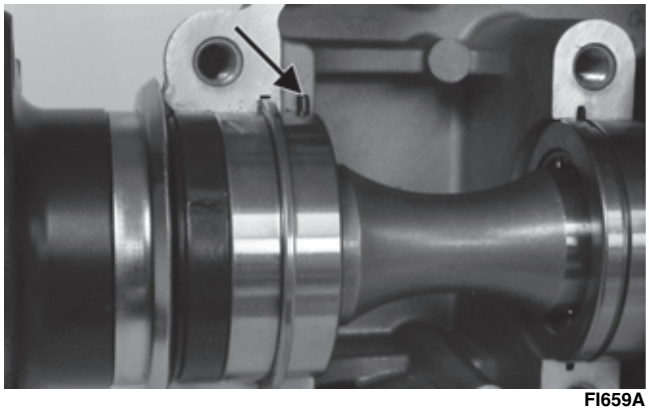


FI645

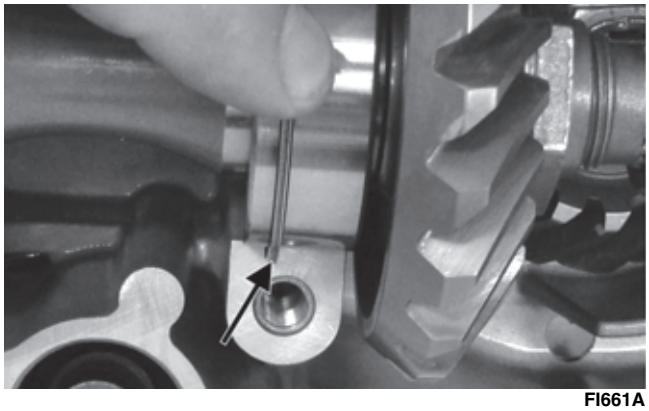
11. Install the secondary output driveshaft assembly into the crankcase half making sure the front and rear bearing alignment pins are seated in the recesses; then install the center carrier bearing alignment C-ring.



FI660A



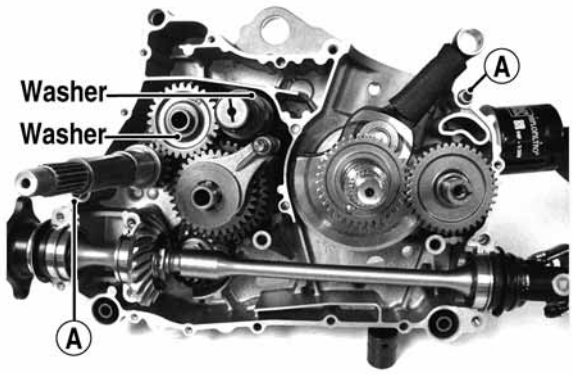
FI659A



FI661A

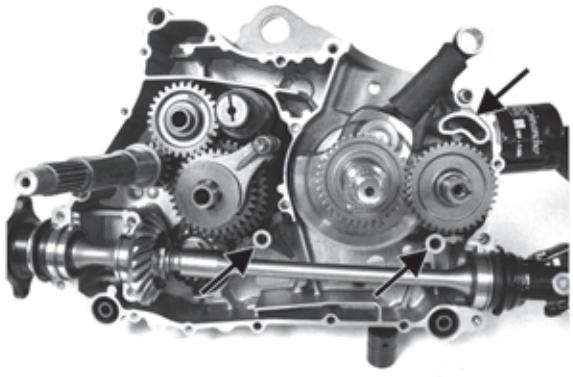
Joining Crankcase Halves

1. Verify that the two alignment pins (A) are in place and that both case halves are clean and grease free. Apply Loctite #5900 or suitable substitute sealant to the mating surfaces. Place the right-side half onto the left-side half.



FI639B

■NOTE: Be sure to apply silicone to the inside radius of all cap screw locations and the entire surface of the internal cap screw bosses.



FI639D

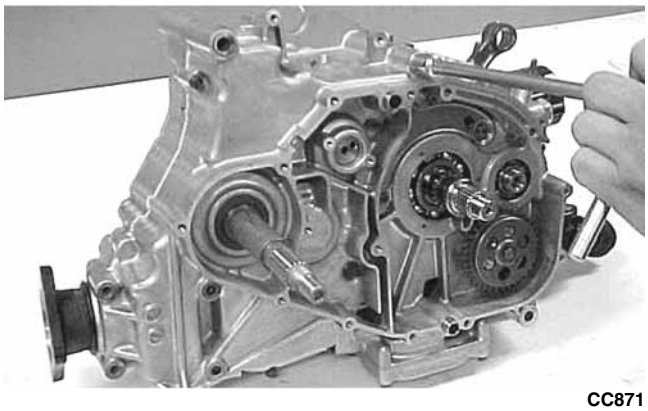
2. Using a plastic mallet, lightly tap the case halves together until cap screws can be installed.
3. From the right side, install the crankcase cap screws noting the location of the different-sized cap screws; then tighten only until snug.

■NOTE: Rotate the shafts back and forth to ensure no binding or sticking occurs while tightening the cap screws.

MD1008

4. From the left side, install the remaining crankcase cap screws; then tighten only until snug.

■NOTE: Rotate the shafts back and forth to ensure no binding or sticking occurs while tightening the cap screws.



CC871

5. In a crisscross pattern, tighten the 8 mm cap screws until the halves are correctly joined; then tighten to 21 ft-lb.

■NOTE: Rotate the shafts back and forth to ensure no binding or sticking occurs.

6. In a crisscross pattern, tighten the 6 mm cap screws to 10 ft-lb.

■NOTE: Rotate the shafts back and forth to ensure no binding or sticking occurs.

☞AT THIS POINT
After completing center crankcase components, proceed to Installing Right-Side Components, to Installing Left-Side Components, and to Installing Top-Side Components.

Servicing Engine (700)

Top-Side Components

■NOTE: For efficiency, it is preferable to remove and disassemble only those components which need to be addressed and to service only those components. The technician should use discretion and sound judgment.

☞AT THIS POINT
To service any one specific component, only limited disassembly of components may be necessary. Note the AT THIS POINT information in each sub-section.

■NOTE: The engine/transmission does not have to removed from the frame for this procedure.

Removing Top-Side Components

A. Valve Cover/Rocker Arms
B. Cylinder Head/Camshaft

■NOTE: Remove the spark plug and timing inspection plug; then using a socket and ratchet, rotate the crankshaft to top-dead-center of the compression stroke.

1. Remove the two tappet covers.

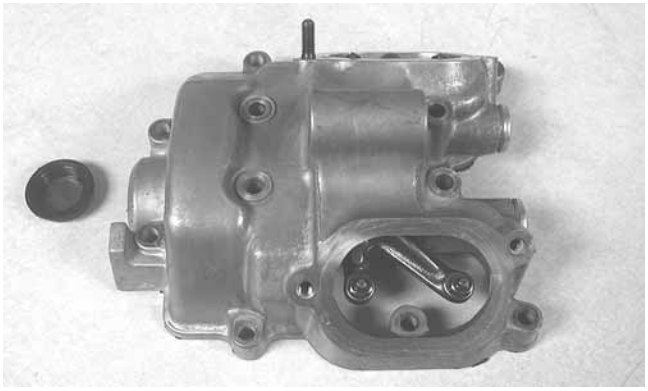
CC001D

■**NOTE: Keep the mounting hardware with the covers for assembly purposes or thread them back into the head to keep them separated.**

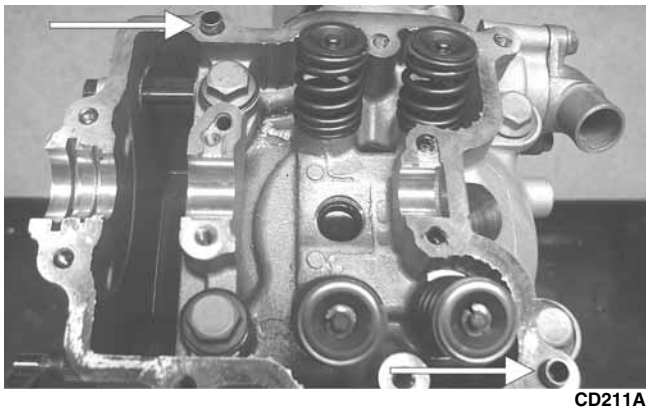
2. Remove the twelve cap screws securing the valve cover to the head.
3. Remove all cap screws except the two top-side cap screws next to the spark plug. These will keep the alignment pins in place. Note the two rubber washers on the remaining cap screws.

H1-013A

4. Remove the valve cover. Account for and note the orientation of the cylinder head plug. Note the location of the two alignment pins.



CD206



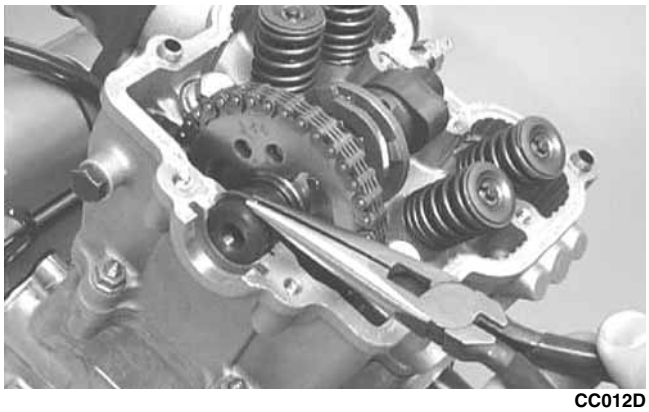
CD211A

5. Loosen the cap screw on the end of the tensioner; then remove the two cap screws securing the tensioner adjuster assembly and remove the assembly. Account for a gasket.

CC009D

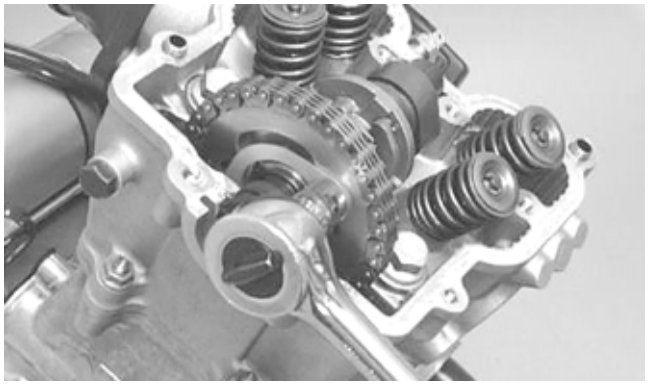
6. Using an awl, rotate the C-ring in its groove until it is out of the cylinder head; then remove the C-ring.

■**NOTE: Care should be taken not to drop the C-ring down into the crankcase.**



CC012D

7. Bend the washer tabs down and remove the two cap screws securing the sprocket to the camshaft; then drop the sprocket off the camshaft.



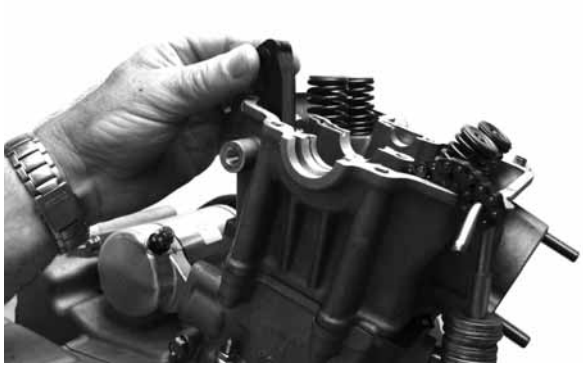
CC013D

8. While holding the chain, slide the sprocket and camshaft out of the cylinder head.

■NOTE: Loop the chain over the cylinder and secure it to keep it from falling into the crankcase.

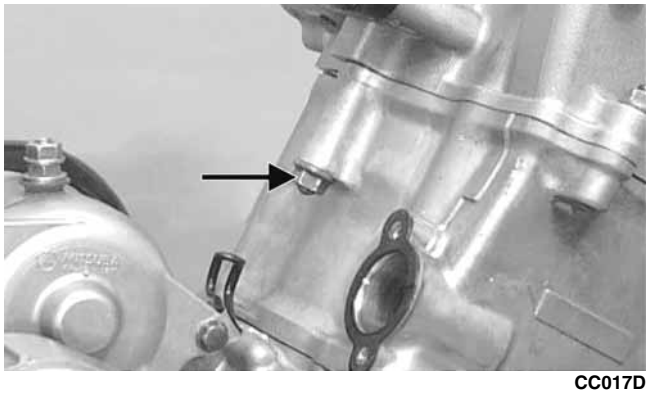
FI620

9. Remove the cap screw securing the chain tensioner (account for a washer); then remove the tensioner.

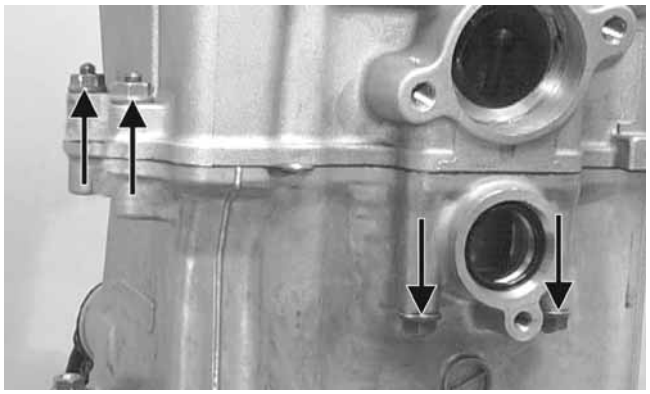


FI617

10. Remove the five nuts securing the cylinder head to the cylinder.



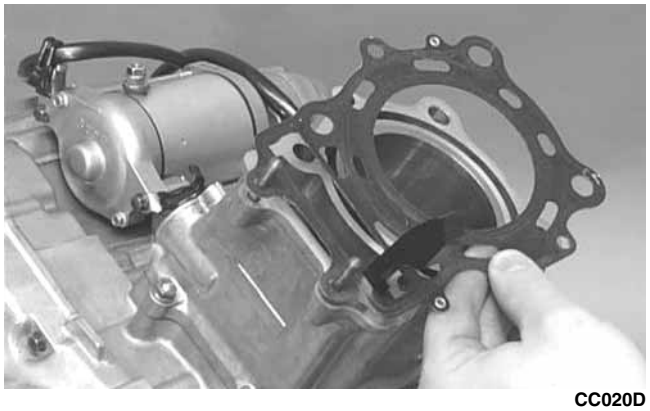
CC017D



CC018D

11. Remove the four cylinder head bolts.

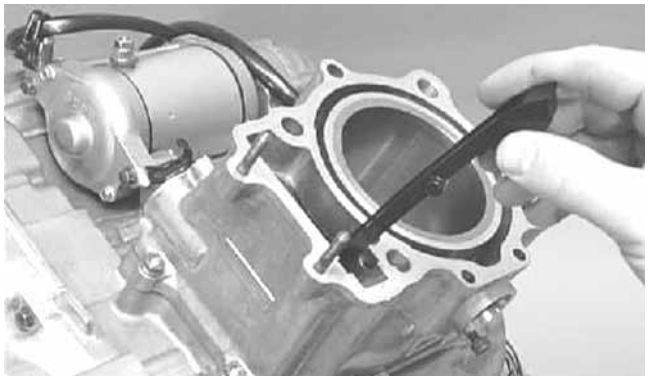
12. Remove the cylinder head from the cylinder, remove the gasket, and account for two alignment pins; then remove the cam chain guide.



CC020D

☞ AT THIS POINT
To service valves and cylinder head, see Servicing Top-Side Components sub-section.

☞ AT THIS POINT
To inspect cam chain guide, see Servicing Top-Side Components sub-section.

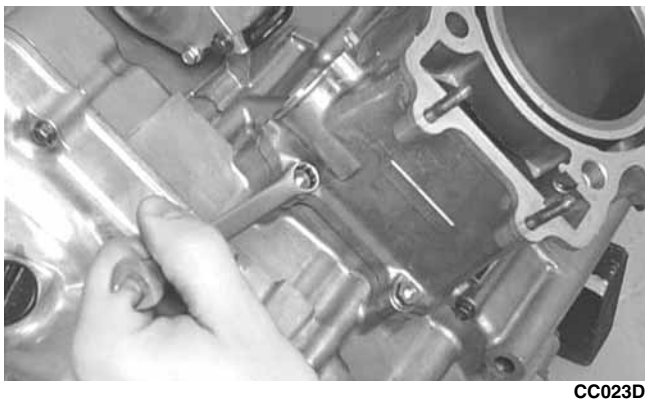


CC022D

C. Cylinder
D. Piston

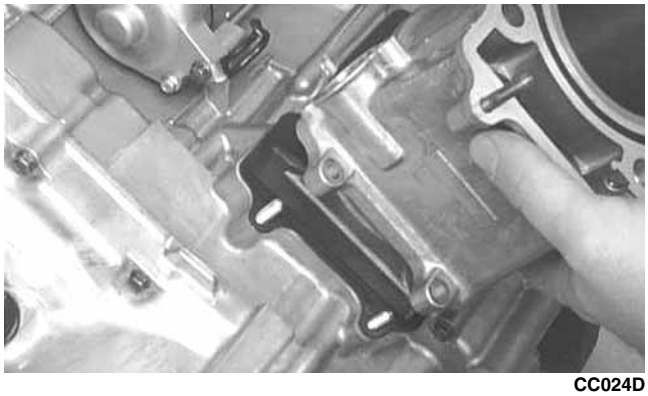
■NOTE: Steps 1-12 in the preceding sub-section must precede this procedure.

13. Loosen the clamp securing the coolant hose to the union; then detach the hose.
14. Remove the two nuts securing the cylinder to the crankcase.

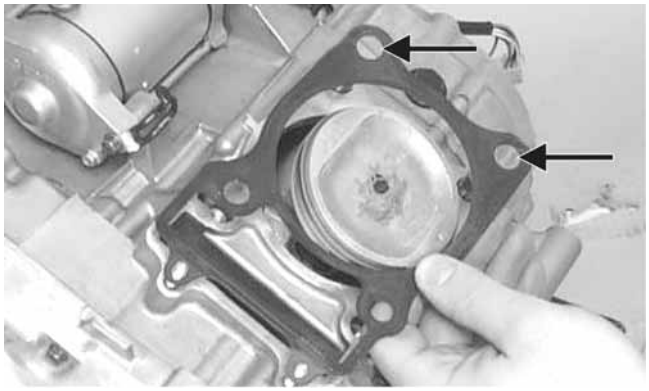


CC023D

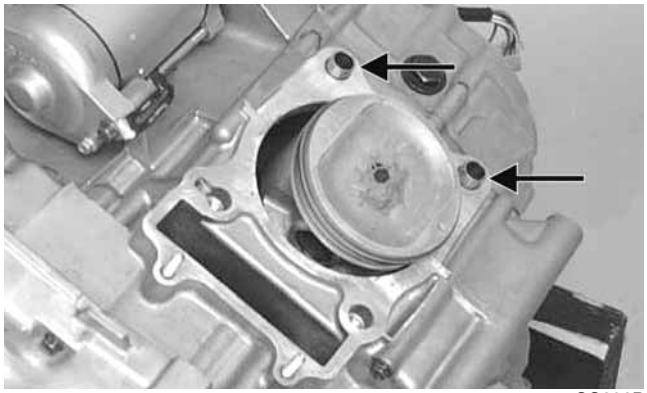
15. Lift the cylinder off the crankcase taking care not to allow the piston to drop against the crankcase. Account for the gasket and two alignment pins.



CC024D



CC025D



CC026D

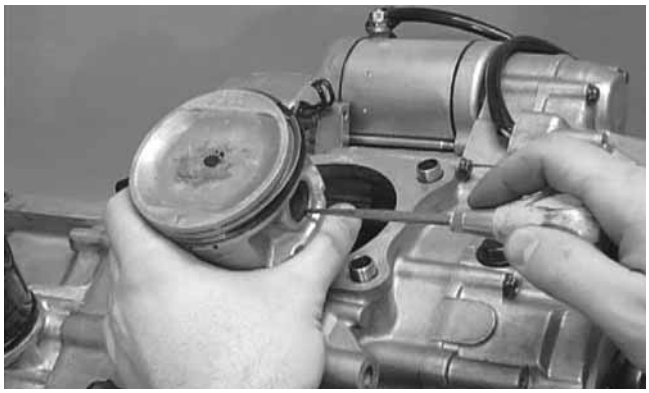
☞AT THIS POINT

To service cylinder, see Servicing Top-Side Components sub-section.

CAUTION

When removing the cylinder, be sure to support the piston to prevent damage to the crankcase and piston.

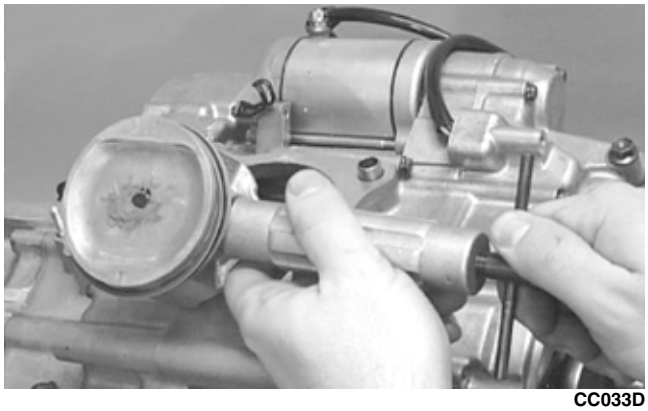
16. Using an awl, remove one piston-pin circlip.



CC032D

17. Using a suitable piston pin puller, remove the piston pin. Account for the opposite-side circlip. Remove the piston.

■NOTE: It is advisable to remove the opposite-side circlip prior to using the puller.



CC033D

■**NOTE: Support the connecting rod with rubber bands to avoid damaging the rod or install the Connecting Rod Holder.**

CAUTION

Do not allow the connecting rod to go down inside the crankcase. If the rod is down inside the crankcase and the crankshaft is rotated, severe damage will result.

■**NOTE: If the existing rings will not be replaced with new rings, note the location of each ring for proper installation. When replacing with new rings, replace as a complete set only. If the piston rings must be removed, remove them in this sequence.**

A. Starting with the top ring, slide one end of the ring out of the ring-groove.

B. Remove each ring by working it toward the dome of the piston while rotating it out of the groove.

☞AT THIS POINT

To service piston, see Servicing Top-Side Components sub-section.

☞AT THIS POINT

To service center crankcase components only, proceed to Removing Left-Side Components.

Servicing Top-Side Components

VALVE ASSEMBLY

When servicing valve assembly, inspect valve seats, valve stems, valve faces, and valve stem ends for pits, burn marks, or other signs of abnormal wear.

■**NOTE: Whenever a valve is out of tolerance, it must be replaced.**

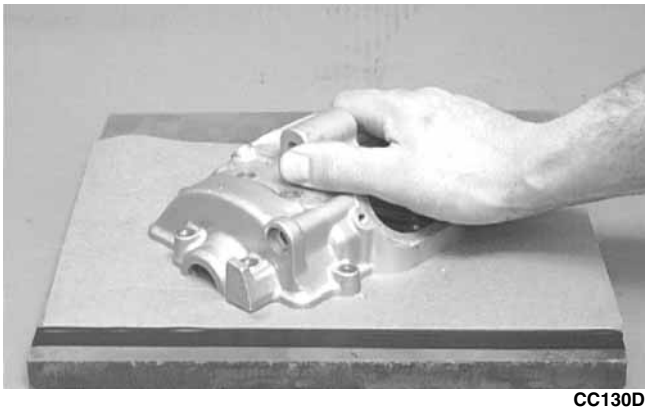
Cleaning/Inspecting Valve Cover

■**NOTE: If the valve cover cannot be trued, the cylinder head assembly must be replaced.**

1. Wash the valve cover in parts-cleaning solvent.
2. Place the valve cover on a surface plate covered with #400 grit wet-or-dry sandpaper. Using light pressure, move the valve cover in a figure eight motion. Inspect the sealing surface for any indication of high spots. A high spot can be noted by a bright metallic finish. Correct any high spots before assembly by continuing to move the valve cover in a figure eight motion until a uniform bright metallic finish is attained.

CAUTION

Do not remove an excessive amount of the sealing surface or damage to the camshaft will result. Always check camshaft clearance when resurfacing the valve cover.



CC130D

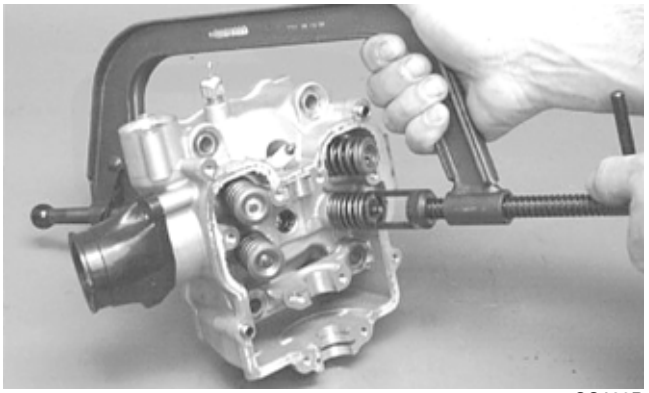
CAUTION

Water or parts-cleaning solvent must be used in conjunction with the wet-or-dry sandpaper or damage to the sealing surface may result.

Removing Valves

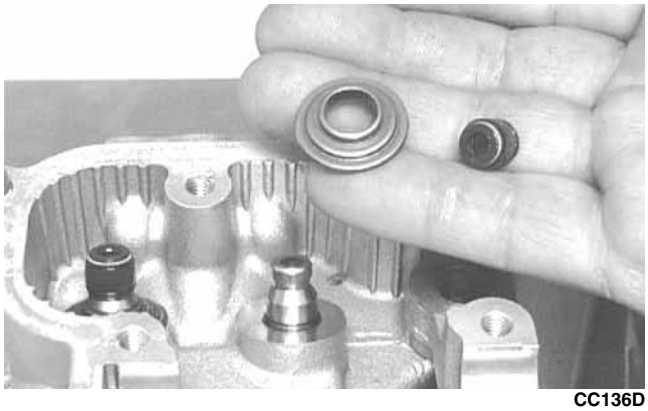
■**NOTE: Index all valves, springs, and cotters to their original position when removing. When installing, all valve components should be installed in their original position.**

1. Using a valve spring compressor, compress the valve springs and remove the valve cotters. Account for an upper spring retainer.



CC132D

2. Remove the valve seal and the lower remaining spring seat. Discard the valve seal.



CC136D

■**NOTE: The valve seals must be replaced.**

3. Remove the valve springs; then invert the cylinder head and remove the valves.

Measuring Valve Guide (Bore)

1. Insert a snap gauge 1/2 way down into each valve guide bore; then remove the gauge and measure it with a micrometer.
2. Acceptable inside diameter range must be within specifications.
3. If a valve guide is out of tolerance, it must be replaced.

Servicing Valves/Valve Guides/Valve Seats

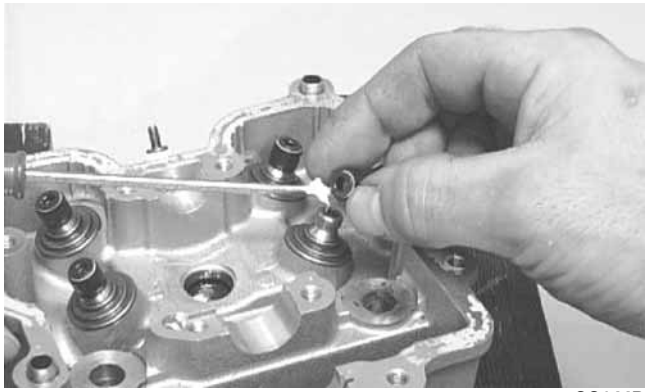
If valves, valve guides, or valve seats require servicing or replacement, Toro recommends that the components be taken to a qualified machine shop for servicing.

CAUTION

If valves are discolored or pitted or if the seating surface is worn, the valve must be replaced. Do not attempt to grind the valves or severe engine damage may occur.

Installing Valves

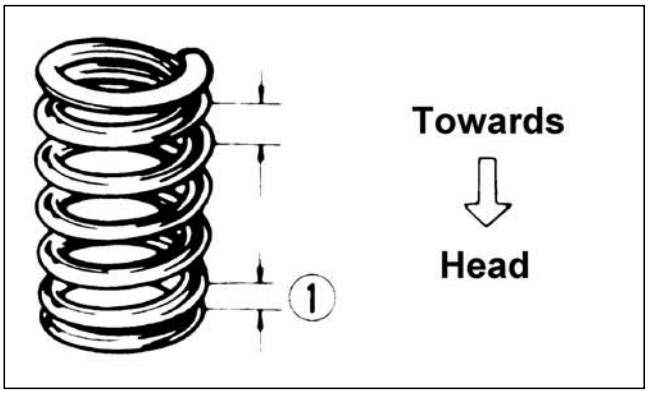
1. Apply grease to the inside surface of the valve seals; then place a lower spring seat and valve guide seal over each valve guide.



CC144D

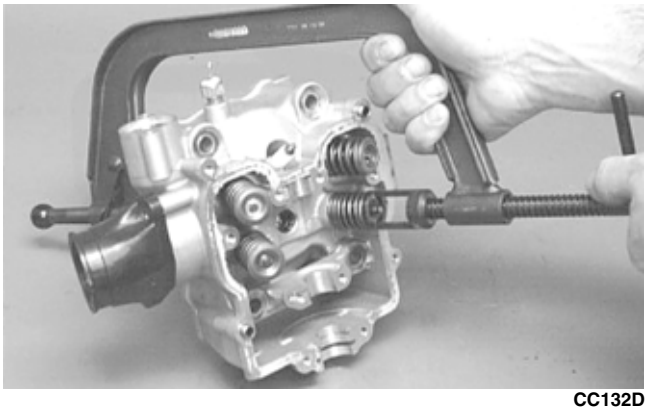
2. Insert each valve into its original location.
3. Install the valve springs with the painted end of the spring facing away from the cylinder head.

■**NOTE: If the paint is not visible, install the ends of the springs with the closest wound coils toward the head.**



ATV-1011A

4. Place a spring retainer over the valve springs; then using the valve spring compressor, compress the valve springs and install the valve cotters.



CC132D

PISTON ASSEMBLY

■**NOTE: Whenever a piston, rings, or pin are out of tolerance, they must be replaced.**

Inspecting Piston

1. Inspect the piston for cracks in the piston pin, dome, and skirt areas.
2. Inspect the piston for seizure marks or scuffing. Repair with #400 grit wet-or-dry sandpaper and water or honing oil.

■**NOTE: If scuffing or seizure marks are too deep to correct with the sandpaper, replace the piston.**

3. Inspect the perimeter of each piston for signs of excessive “blowby.” Excessive “blowby” indicates worn piston rings or an out-of-round cylinder.

Removing Piston Rings

1. Starting with the top ring, slide one end of the ring out of the ring-groove.

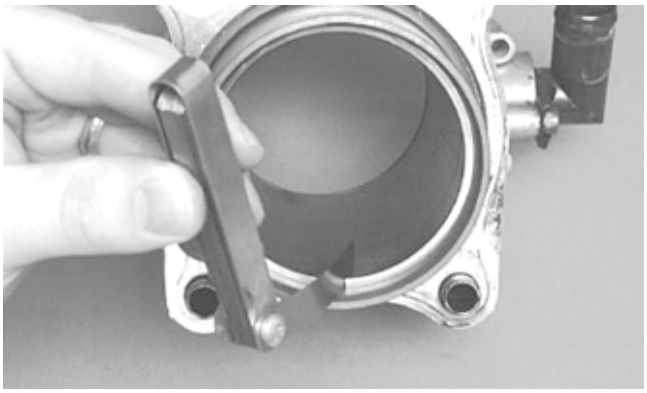
CC400D

2. Remove each ring by working it toward the dome of the piston while rotating it out of the groove.

■NOTE: If the existing rings will not be replaced with new ones, note the location of each ring for proper installation. When installing new rings, install as a complete set only.

Measuring Piston-Ring End Gap (Installed)

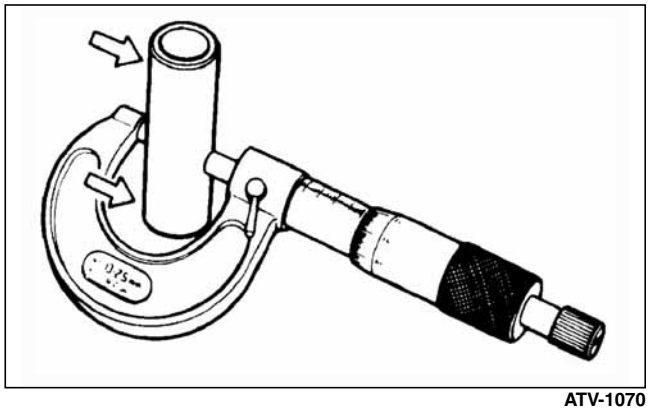
1. Place each compression ring in the wear portion of the cylinder. Use the piston to position each ring squarely in the cylinder.
2. Using a feeler gauge, measure each piston-ring end gap. Acceptable ring end gap must not exceed specifications.



CC280D

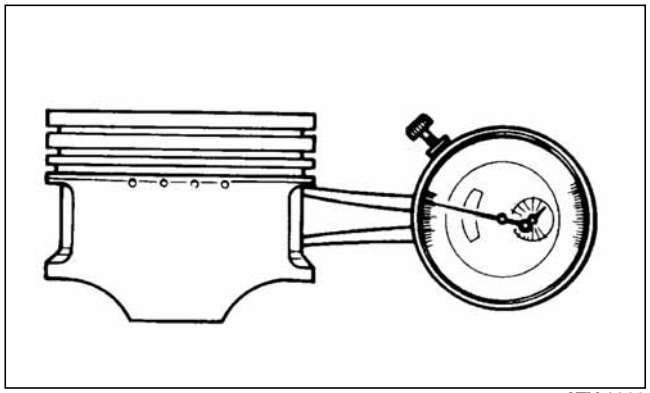
Measuring Piston Pin (Outside Diameter) and Piston-Pin Bore

1. Measure the piston pin outside diameter at each end and in the center. If measurement is not within specifications, the piston pin must be replaced.



ATV-1070

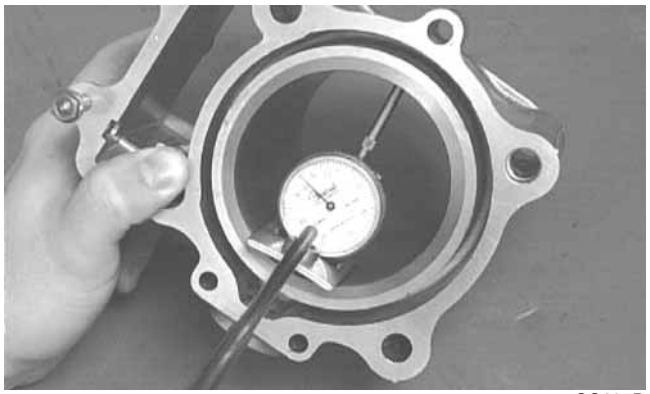
2. Insert an inside dial indicator into the piston-pin bore. The diameter must not exceed specifications. Take two measurements to ensure accuracy.



ATV-1069

Measuring Piston Skirt/Cylinder Clearance

1. Measure the cylinder front to back in six places.

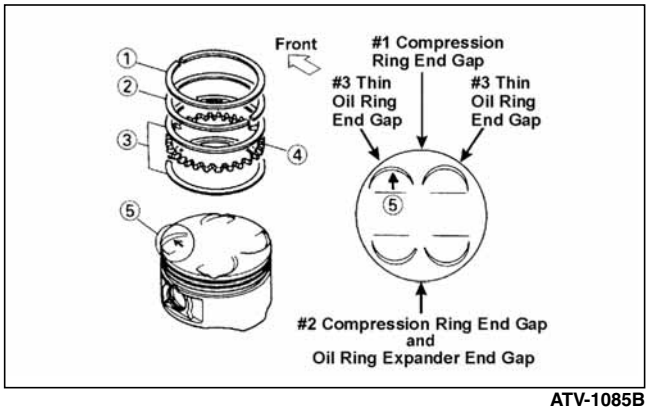


CC127D

2. Measure the corresponding piston diameter at the recommended point above the piston skirt at a right angle to the piston-pin bore. Subtract this measurement from the measurement in step 1. The difference (clearance) must not exceed specifications.

Installing Piston Rings

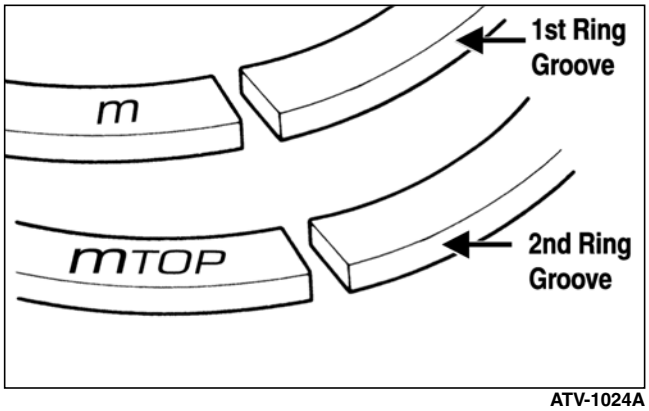
1. Install ring expander (4) in the bottom groove of the piston; then install the thin oil rings (3) over the expander making sure the expander ends do not overlap. Stagger the end gaps of the upper and lower thin oil rings according to the illustration.



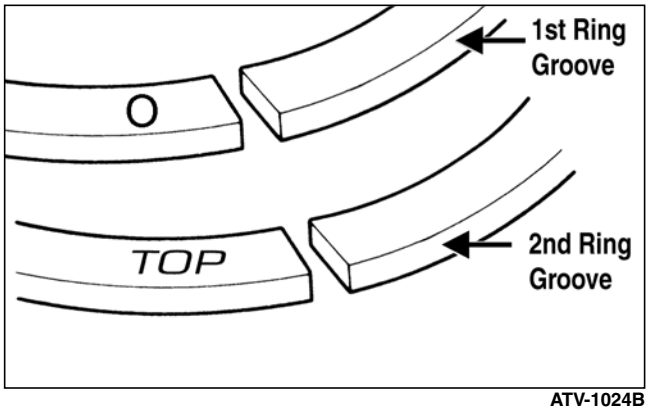
ATV-1085B

■NOTE: Note the direction of the exhaust side of the piston (5) for correct ring end gap orientation.

2. The ring with the orientation mark (MTOP or TOP) should be installed in the second (middle) groove and the ring with the orientation mark (M or O) should be installed in the first (top) groove.



ATV-1024A



ATV-1024B

CAUTION

Incorrect installation of the piston rings will result in engine damage.

CYLINDER/CYLINDER HEAD ASSEMBLY

■NOTE: If the cylinder/cylinder head cannot be trued, they must be replaced as an assembly.

Cleaning/Inspecting Cylinder Head

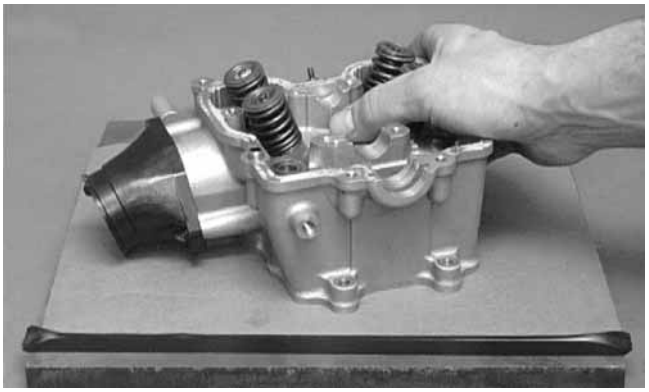
CAUTION

The cylinder head studs must be removed for this procedure.

1. Using a non-metallic carbon removal tool, remove any carbon buildup from the combustion chamber being careful not to nick, scrape, or damage the combustion chamber or the sealing surface.
2. Inspect the spark plug hole for any damaged threads. Repair damaged threads using a “heli-coil” insert.
3. Place the cylinder head on a surface plate covered with #400 grit wet-or-dry sandpaper. Using light pressure, move the cylinder head in a figure eight motion. Inspect the sealing surface for any indication of high spots. A high spot can be noted by a bright metallic finish. Correct any high spots before assembly by continuing to move the cylinder head in a figure eight motion until a uniform bright metallic finish is attained.

CAUTION

Water or parts-cleaning solvent must be used in conjunction with the wet-or-dry sandpaper or damage to the sealing surface may result.



CC128D

Measuring Cylinder Head Distortion

1. Remove any carbon buildup in the combustion chamber.
2. Lay a straightedge across the cylinder head; then using a feeler gauge, check the distortion factor between the head and the straightedge.
3. Maximum distortion must not exceed specifications.

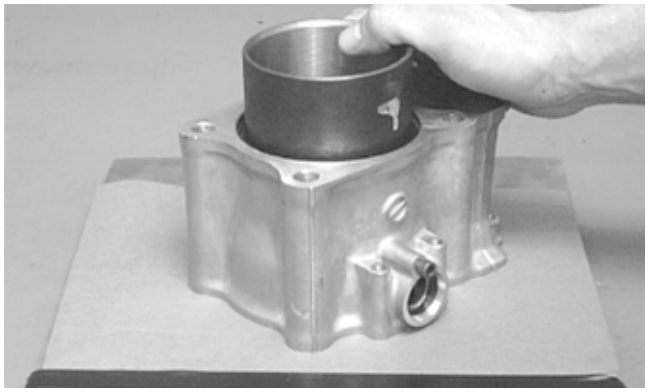
CC141D

Cleaning/Inspecting Cylinder

1. Wash the cylinder in parts-cleaning solvent.
2. Inspect the cylinder for pitting, scoring, scuffing, warpage, and corrosion. If marks are found, repair the surface using a cylinder hone (see Inspecting Cylinder in this sub-section).
3. Place the cylinder on the surface plate covered with #400 grit wet-or-dry sandpaper. Using light pressure, move the cylinder in a figure eight motion. Inspect the sealing surface for any indication of high spots. A high spot can be noted by a bright metallic finish. Correct any high spots before assembly by continuing to move the cylinder in a figure eight motion until a uniform bright metallic finish is attained.

CAUTION

Water or parts-cleaning solvent must be used in conjunction with the wet-or-dry sandpaper or damage to the sealing surface may result.



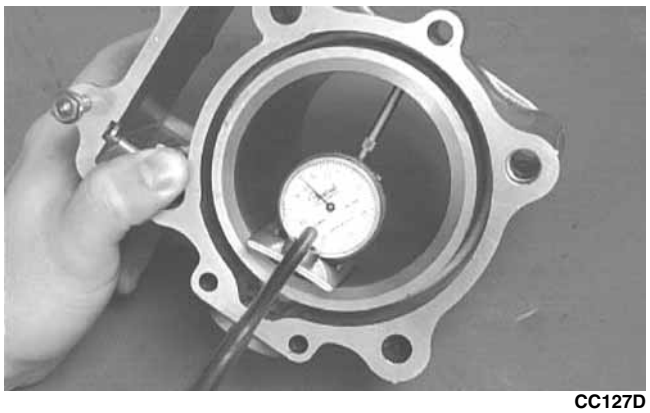
CC129D

Inspecting Cam Chain Guide

1. Inspect cam chain guide for cuts, tears, breaks, or chips.
2. If the chain guide is damaged, it must be replaced.

Inspecting Cylinder

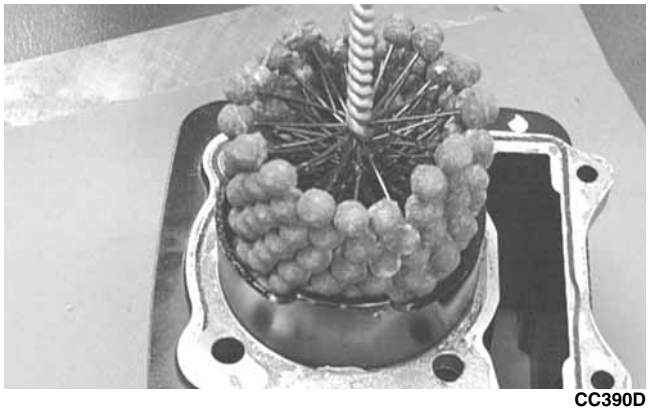
1. Using a slide gauge and a dial indicator or a snap gauge, measure the cylinder bore diameter in three locations from top to bottom and again from top to bottom at 90° from the first measurements for a total of six measurements. The trueness (out-of-roundness) is the difference between the highest and lowest reading. Maximum trueness (out-of-roundness) must not exceed specifications.



CC127D

2. Wash the cylinder in parts-cleaning solvent.
3. Inspect the cylinder for pitting, scoring, scuffing, and corrosion. If marks are found, repair the surface using a #320 grit ball hone.

■NOTE: To produce the proper 60° cross-hatch pattern, use a low RPM drill (600 RPM) at the rate of 30 strokes per minute. If honing oil is not available, use a lightweight petroleum-based oil. Thoroughly clean cylinder after honing using soap and hot water. Dry with compressed air; then immediately apply oil to the cylinder bore. If the bore is severely damaged or gouged, replace the cylinder.



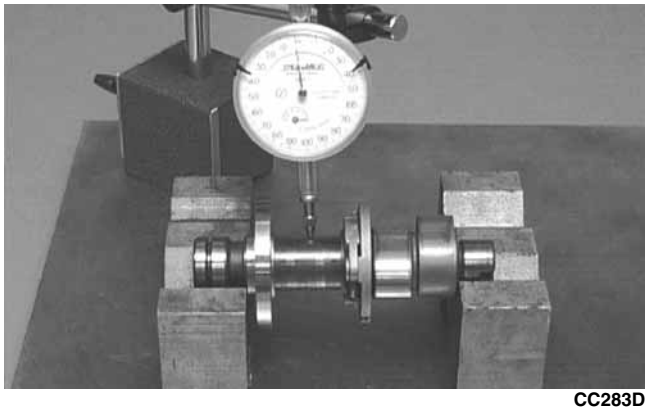
CC390D

4. If any measurement exceeds the limit, replace the cylinder and piston.

Measuring Camshaft Runout

■NOTE: If the camshaft is out of tolerance, it must be replaced.

1. Place the camshaft on a set of V blocks; then position the dial indicator contact point against the shaft and zero the indicator.

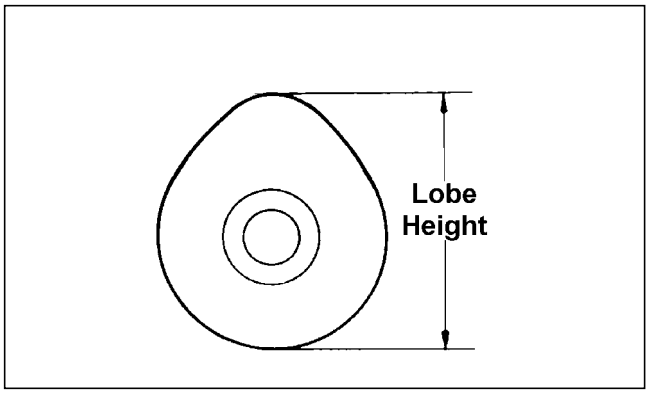


CC283D

2. Rotate the camshaft and note runout; maximum runout must not exceed specifications.

Measuring Camshaft Lobe Height

1. Using a calipers, measure each cam lobe height.



ATV1013A

2. The lobe heights must be greater than minimum specifications.

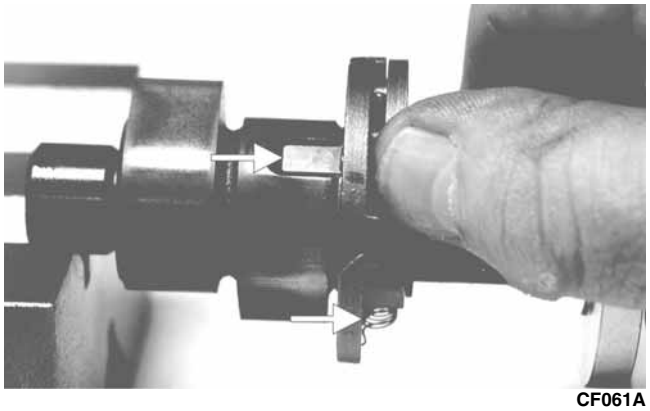
Inspecting Camshaft Bearing Journal

1. Inspect the bearing journal for scoring, seizure marks, or pitting.
2. If excessive scoring, seizure marks, or pitting is

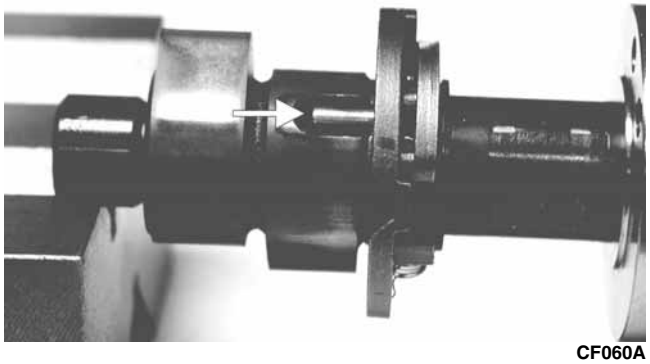
■NOTE: If the journals are worn, replace the camshaft.

Inspecting Camshaft Spring/Drive Pin

1. Inspect the spring and drive pin for damage.



CF061A



CF060A

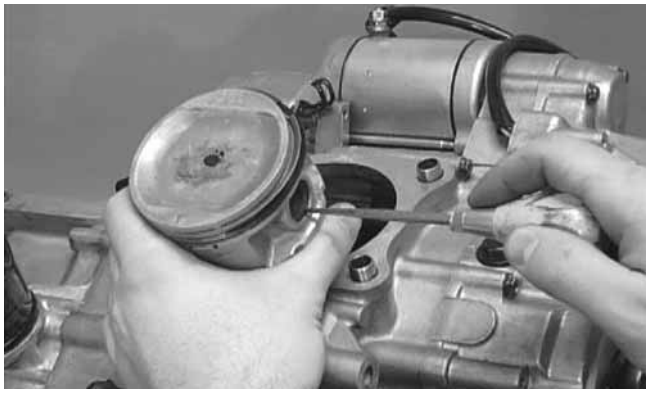
2. If damaged, the camshaft must be replaced.

Installing Top-Side Components

A. Piston
B. Cylinder

1. Install the piston on the connecting rod making sure the circlip on each side is fully seated in the piston.

■NOTE: The piston should be installed so the arrow points toward the exhaust.



CC032D

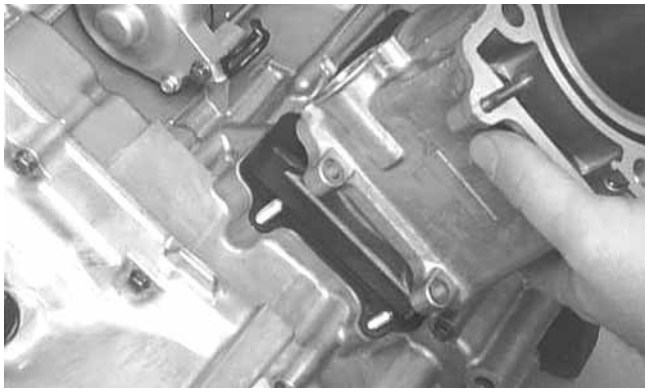
2. Place the two alignment pins into position. Place the cylinder gasket into position; then place a piston holder (or suitable substitute) beneath the piston skirt and square the piston in respect to the crankcase.

CF083

3. Lubricate the inside wall of the cylinder; then using a ring compressor or the fingers, compress the rings and slide the cylinder over the piston. Route the cam chain up through the cylinder cam chain housing; then remove the piston holder and seat the cylinder firmly on the crankcase.

CAUTION

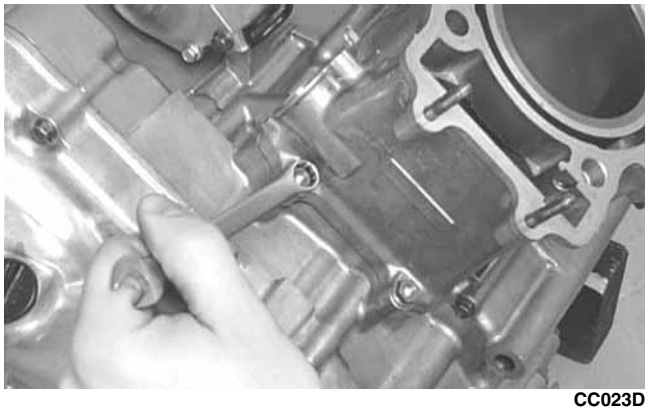
The cylinder should slide on easily. Do not force the cylinder or damage to the piston, rings, cylinder, or crankshaft assembly may occur.



CC024D

4. Loosely install the two nuts which secure the cylinder to the crankcase.

■NOTE: The two cylinder-to-crankcase nuts will be tightened in step 11.



CC023D

5. Install the coolant hose onto the crankcase union and tighten the clamp.

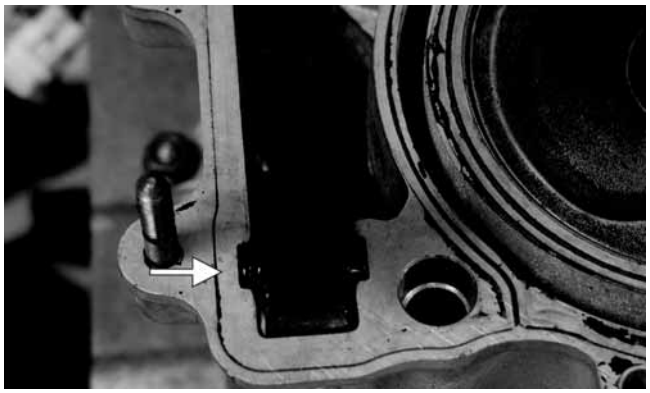
C. Cylinder Head
D. Valve Cover

■NOTE: Steps 1-5 in the preceding sub-section must precede this procedure.

6. Place the chain guide into the cylinder.

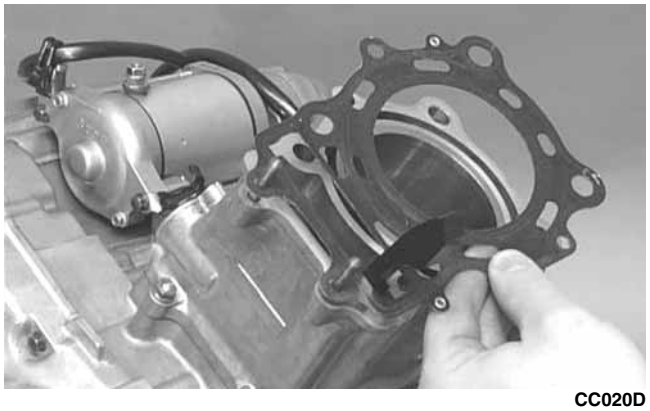
CAUTION

Care should be taken that the bottom of the chain guide is secured in the crankcase boss.

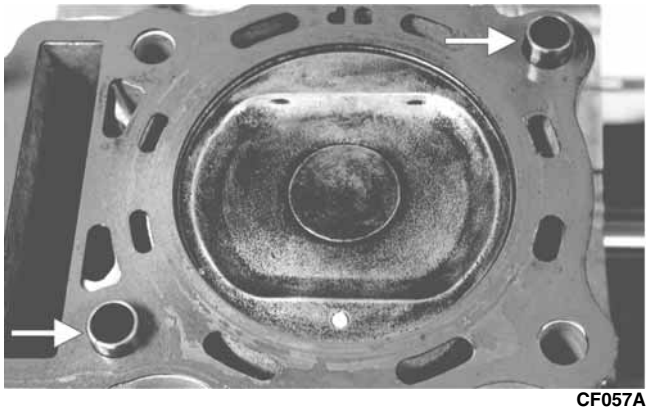


CF058A

7. Place a new head gasket into position on the cylinder. Place the alignment pins into position; then place the head assembly into position on the cylinder.

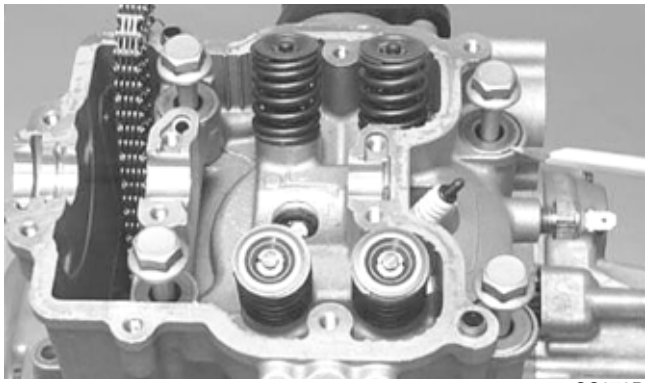


CC020D



CF057A

8. Install the four cylinder head cap screws and washers. Tighten only until snug.



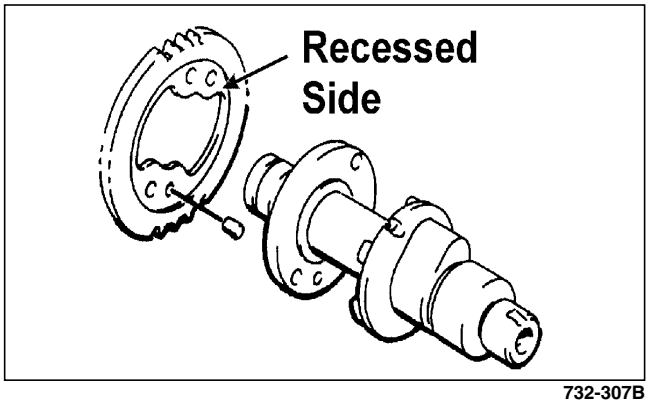
CC272D

9. Loosely install the five cylinder head nuts.
10. Using a crisscross pattern, tighten the four cap screws (from step 8) initially to 20 ft-lb; then in 10 ft-lb increments, tighten to a final torque of 40 ft-lb.
11. Tighten the 8 mm nuts from step 9 to 18 ft-lb and the 6 mm nuts to 8 ft-lb; then tighten the two cylinder-to-crankcase nuts (from step 4) securely.
12. With the timing inspection plug removed and the chain held tight, rotate the crankshaft until the piston is at top-dead-center.
13. Install the rear cam chain tensioner guide into the cylinder head. Install the pivot cap screw and washer.

CD461

■NOTE: At this point, oil the camshaft journals, cam lobes, and the three seating surfaces on the cylinder.

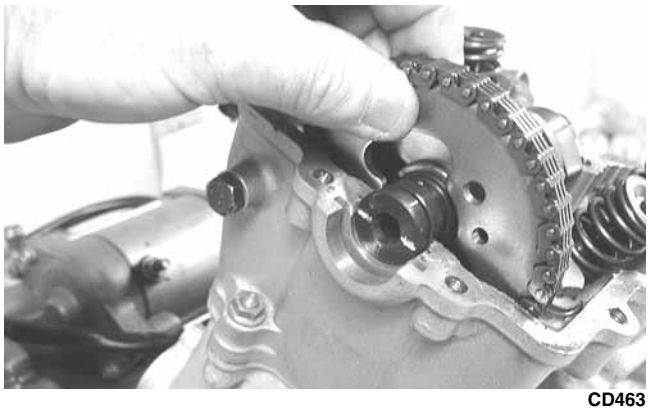
14. With the alignment pin installed in the camshaft, loosely place the cam sprocket (with the recessed side facing the cam shaft lobes) onto the camshaft. At this point, do not "seat" the sprocket onto the shaft.



732-307B

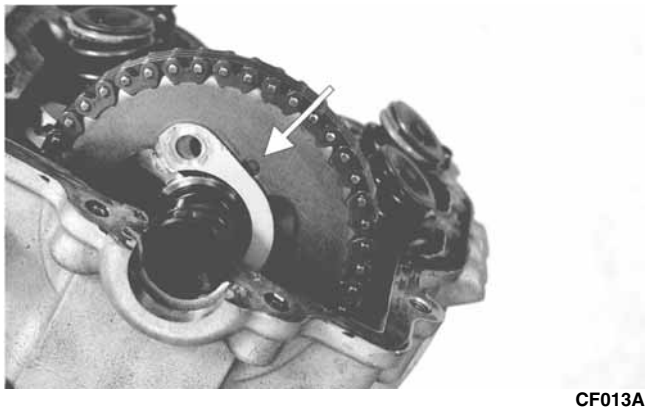
15. With the cam lobes directed down (toward the piston), maneuver the camshaft/sprocket assembly through the chain and towards its seating position; then loop the chain over the sprocket.

■NOTE: Note the position of the alignment marks on the end of the camshaft. They must be parallel with the valve cover mating surface. If rotating the camshaft and sprocket is necessary for alignment, do not allow the crankshaft to rotate and be sure the cam lobes end up in the down position.



CD463

16. Seat the cam sprocket onto the camshaft making sure the alignment pin in the camshaft aligns with the smallest hole in the sprocket; then place the camshaft/sprocket assembly onto the cylinder ensuring the following.



CF013A

A. Piston still at top-dead-center.

B. Camshaft lobes directed down (toward the piston).

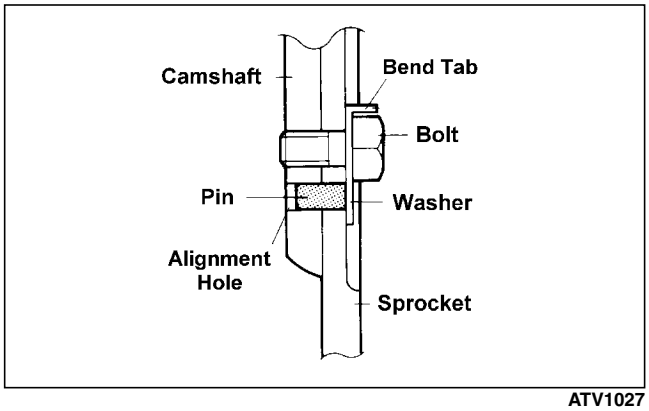
C. Camshaft alignment marks parallel to the valve cover mating surface.

D. Recessed side of the sprocket directed toward the cam lobes.

E. Camshaft alignment pin and sprocket alignment hole (smallest) are aligned.

CAUTION
If any of the above factors are not as stated, go back to step 12 and carefully proceed.

17. Place the tab-washer onto the sprocket making sure it covers the pin in the alignment hole.

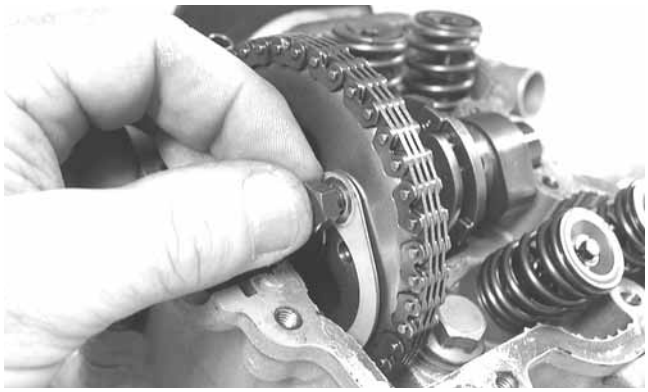


ATV1027

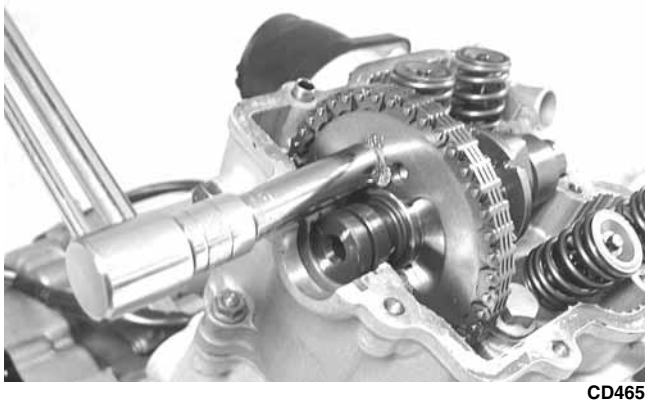
CAUTION

Care must be taken that the tab-washer is installed correctly to cover the alignment hole on the sprocket. If the alignment pin falls out, severe engine damage will result.

18. Install the first cap screw (threads coated with red Loctite #271) securing the sprocket and tab-washer to the camshaft. Tighten only until snug.


CD464

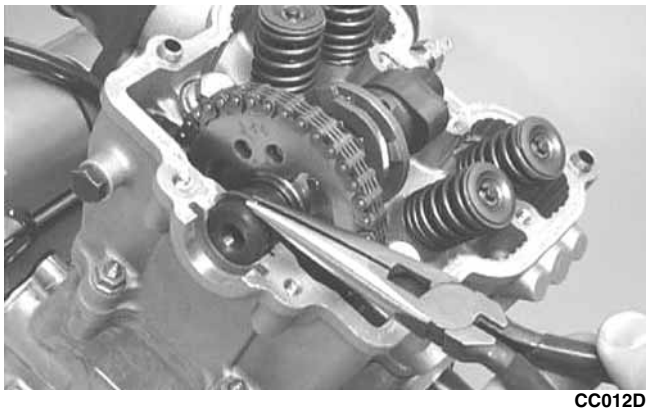
19. Rotate the crankshaft until the second cap screw securing the sprocket to the camshaft can be installed; then install the cap screw (threads coated with red Loctite #271) and tighten to 11 ft-lb. Bend the tab to secure the cap screw.


CD465

20. Rotate the crankshaft until the first cap screw (from step 18) can be accessed; then tighten to 11 ft-lb. Bend the tab to secure the cap screw.


CD466

21. Place the C-ring into position in its groove in the cylinder head.


CC012D

22. Install the cylinder head plug in the cylinder head with the open end facing downward and toward the inside.

CAUTION

The open end of the plug must be positioned downward.

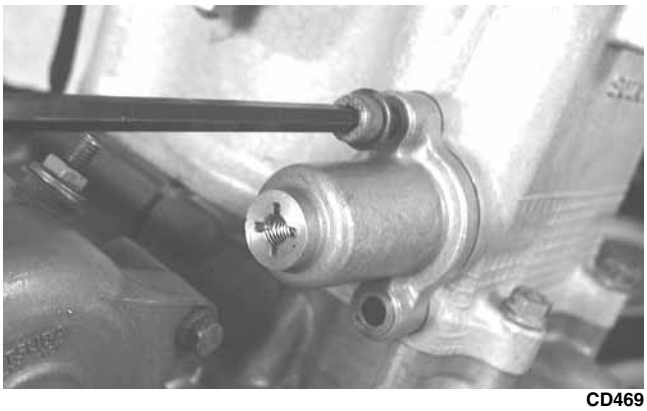

CD468

23. Remove the cap screw from the end of the chain tensioner; then using a flat-blade screwdriver, rotate the adjuster screw inside the tensioner clockwise until the screw bottoms.

CD501

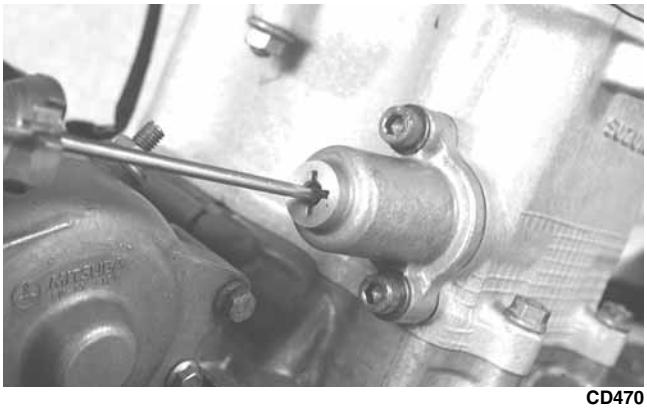
■**NOTE: The adjuster shaft will be drawn into the tensioner as the adjuster screw is rotated clockwise. The adjuster shaft tension will be released in step 25.**

24. Place the chain tensioner adjuster assembly and gasket into position on the cylinder and secure with the two cap screws.



CD469

25. Using a flat-blade screwdriver, rotate the adjuster screw inside the tensioner counterclockwise until all tension is released; then install the cap screw into the end of the chain tensioner.



CD470

CD471

26. Loosen the four adjuster screw jam nuts; then loosen the four adjuster screws on the rocker arms in the valve cover.

CC005D

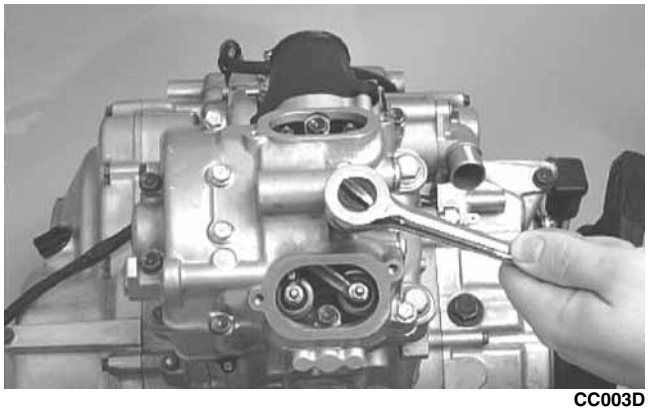
27. Apply a thin coat of Three Bond Sealant to the mating surfaces of the cylinder head and valve cover.

CC275D

28. Place the valve cover into position.

■**NOTE: At this point, the rocker arms and adjuster screws must not have pressure on them.**

29. Install the four top side cap screws with rubber washers; then install the remaining cap screws. Tighten only until snug.



CC003D

30. In a crisscross pattern starting from the center and working outward, tighten the cap screws (from step 29) to 8.5 ft-lb.
31. Adjust valve/tappet clearance (see Periodic Maintenance).
32. Place the two tappet covers into position making sure the proper cap screws are with the proper cover. Tighten to 9 ft-lb.

CC001D

33. If removed, install the spark plug. Tighten securely.

Left-Side Components

■NOTE: For efficiency, it is preferable to remove and disassemble only those components which need to be addressed and to service only those components. The technician should use discretion and sound judgment.

☞AT THIS POINT
To service any one specific component, only limited disassembly of components may be necessary. Note the AT THIS POINT information in each sub-section.

■NOTE: The engine/transmission does not have to be removed from the frame for this procedure.

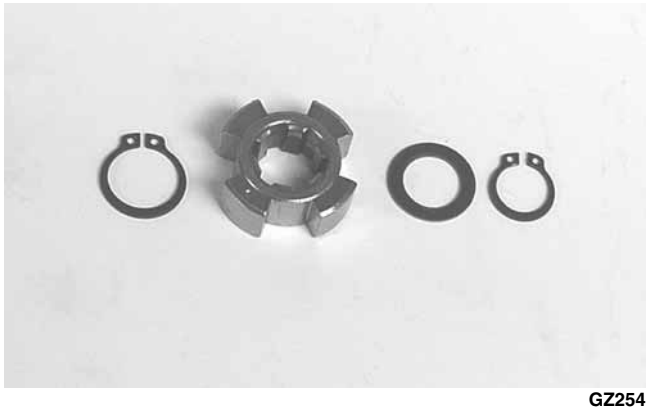
Removing Left-Side Components

A. Outer Magneto Cover
B. Water Pump
C. Cover
D. Rotor/Flywheel

1. Remove the four cap screws securing the outer magneto cover to the left-side cover; then remove the outer magneto cover.
2. Remove the flange nut securing the bushing to the crankshaft; then remove the bushing. Account for the O-ring inside the spacer.
3. Remove the cap screws securing the speed sensor housing to the crankcase and remove the housing assembly; then remove the snap ring securing the speed sensor trigger to the shaft and remove the trigger. Account for the gasket.

■NOTE: It may be necessary to use a small two-jaw puller to remove the trigger.

CD920



GZ254

4. Loosen the clamps securing the coolant hose to the water pump; then remove the crossover tube from the cylinder head. Account for an O-ring.
5. Remove the two cap screws securing the water pump to the engine; then remove the water pump.
6. Remove the cap screws securing the left-side cover to the crankcase noting the location of the different-sized cap screws for installing purposes.

7. Using an appropriate side case puller, remove the side cover. Account for a gasket and two alignment pins.

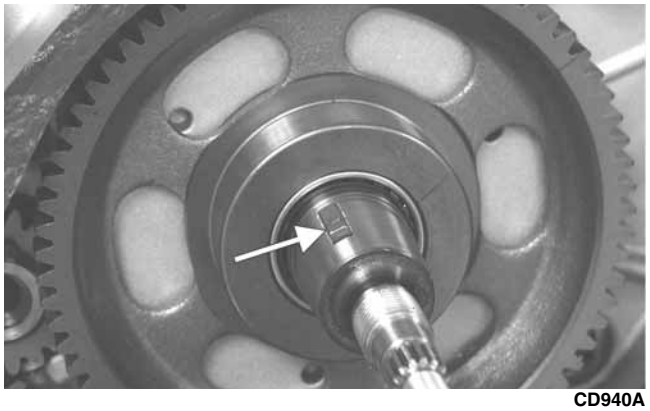
8. Remove the nut securing the magneto rotor to the crankshaft; then install the magneto rotor puller adapter.

■NOTE: The puller has left-hand threads.

9. Using Magneto Rotor Remover Set and the appropriate crankshaft protector, remove the rotor/flywheel assembly from the crankshaft. Account for the key; then remove the starter clutch gear assembly and washer.

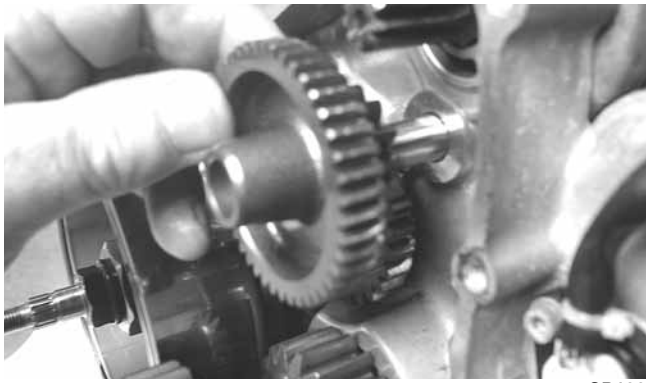
PR441

CD939A

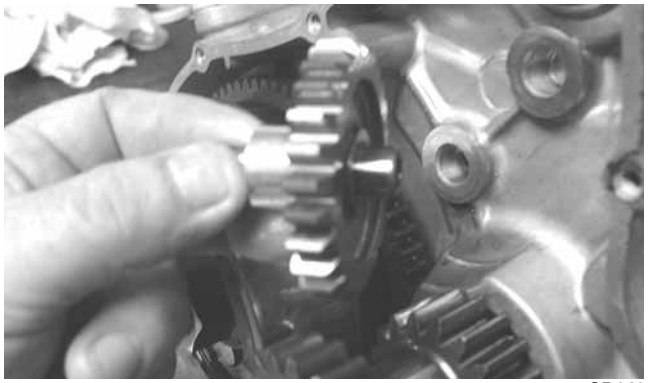


CD940A

10. Remove the two starter gears from the crankcase noting the direction of the beveled side of the gears for installing purposes; then remove the two starter gear shafts.



CD136

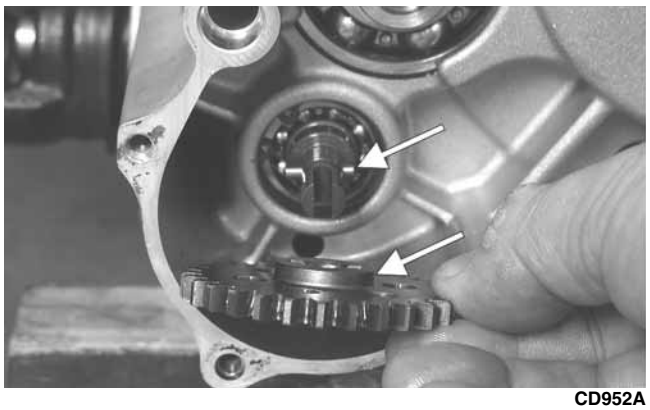


CD140

11. Remove the snap ring securing the water pump drive gear; then remove the gear noting the direction of the sides of the gear for installing purposes. Account for the drive gear alignment pin.

CD944

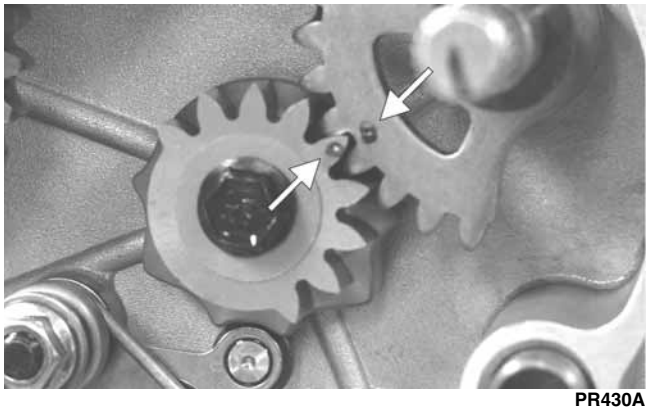
12. Remove the snap ring securing the water pump driven gear; then remove the gear noting the direction of the sides of the gear for installing purposes. Account for the driven gear alignment pin.



CD952A

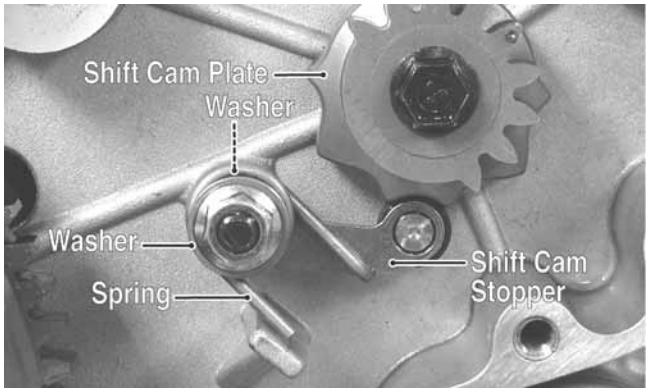
■**NOTE: There is an oil passage beneath the driven gear/drive gear assembly. This passage should be plugged prior to removing the driven gear and drive gear. Failure to do so could result in the loss of an alignment pin into the crankcase.**

13. Remove the shift shaft noting the timing marks for assembling purposes. Account for two washers.



PR430A

14. Remove the gear shift cam plate and account for a washer; then remove the cam stopper and cam stopper spring. Account for two washers.



PR434A

Servicing Left-Side Components

INSPECTING STARTER CLUTCH/ GEAR

1. Place the starter clutch gear onto the rotor/flywheel and attempt to rotate the starter clutch gear clockwise. It should lock up to the rotor/flywheel. Rotate the gear counterclockwise and it should turn freely. If it moves or locks up both ways, the starter clutch must be replaced.
2. Inspect the starter clutch gear for chipped or missing teeth or discoloration/scoring of the clutch surface. Inspect the bearing for loose, worn, or discolored rollers. If bearing is damaged, it must be replaced.

FI569

3. Inspect the one-way bearing for chipped surfaces, missing rollers, or discoloration. If any of the above conditions exist, replace the starter clutch assembly.

FI572

REPLACING STARTER CLUTCH ASSEMBLY

1. Remove the cap screws securing the starter clutch assembly to the flywheel; then remove from the flywheel.

FI570

2. Thoroughly clean the rotor/flywheel; then install the new clutch and secure with the cap screws after applying a drop of red Loctite #271 to the threads. Tighten to 26 ft-lb using a crisscross pattern. Make sure the one-way bearing is installed with the notches directed away from the rotor/flywheel.

FI576A

FI578

REPLACING STARTER GEAR BEARING

1. Support the starter clutch gear in a press making sure to support the hub around the entire circumference; then using a suitable bearing driver, press the bearing from the gear.

FI583

2. Thoroughly clean the gear hub; then apply a drop of green Loctite #620 to the bearing outer race and press into the gear hub until even with the lower chamfer radius.

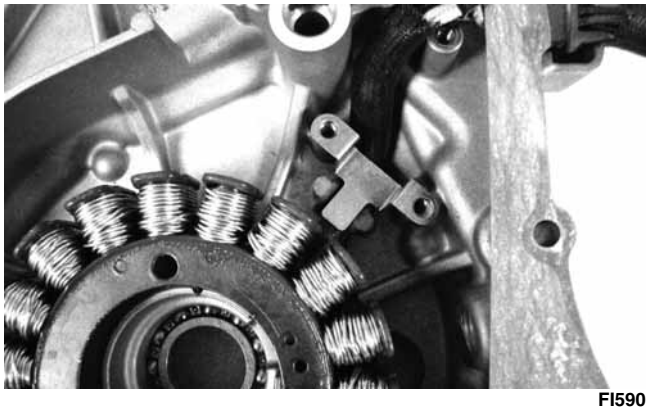
FI580

INSPECTING STATOR COIL/ MAGNETO COVER ASSEMBLY

1. Inspect the stator coil for burned or discolored wiring, broken or missing hold-down clips, or loose cap screws.
2. Inspect the bearings in the magneto housing for discoloration, roughness when rotated, and secure fit in bearing bores.

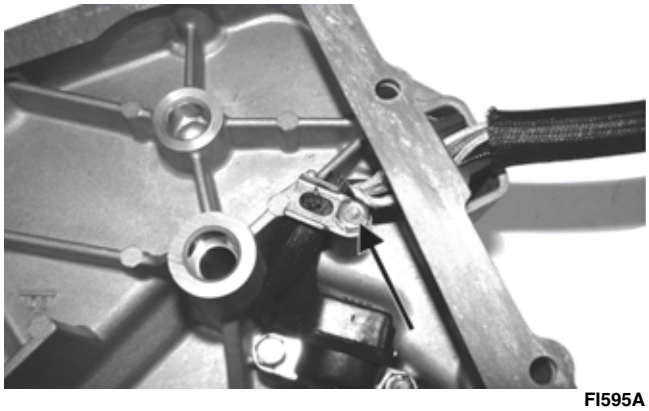
REPLACING STATOR COIL/ CRANKSHAFT POSITION SENSOR

1. Remove the three cap screws securing the stator coil, two cap screws securing the crankshaft position sensor, and one cap screw from the harness hold-down.
2. Lift the rubber grommet out of the housing; then remove the stator coil/crankshaft position sensor. Account for and note the position of the harness hold-down under the crankshaft position sensor.



FI590

3. Install the new stator coil assembly and secure with three new “patch-lock” cap screws. Tighten to 13 ft-lb.
4. Place the stator wire harness hold-down into position; then install the crankshaft position sensor and secure with two cap screws. Tighten securely.
5. Install the upper cable hold-down and secure with a cap screw. Tighten securely.

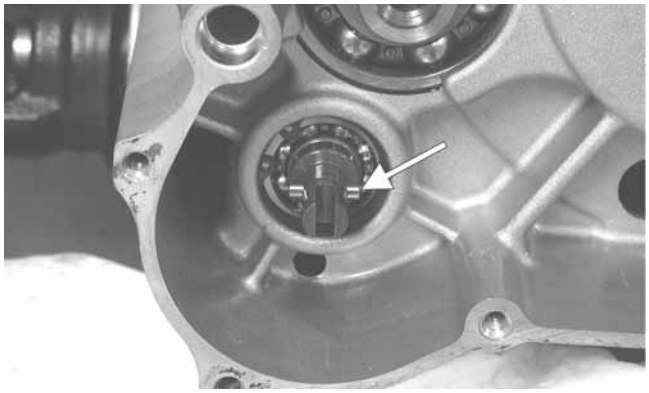


FI595A

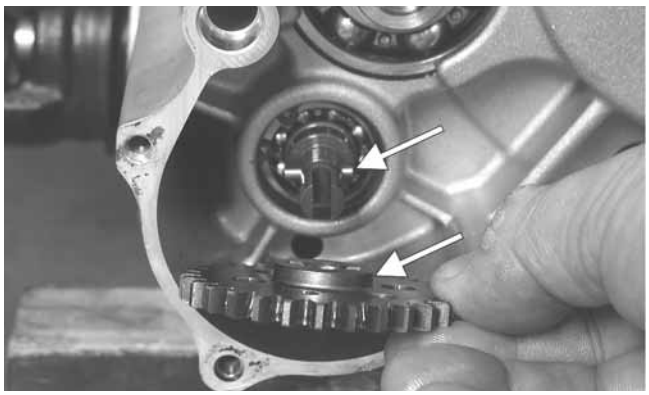
Installing Left-Side Components

■NOTE: Plug the oil passage in the crankcase housing prior to installing the drive gear/driven gear assembly to prevent loss of an alignment pin.

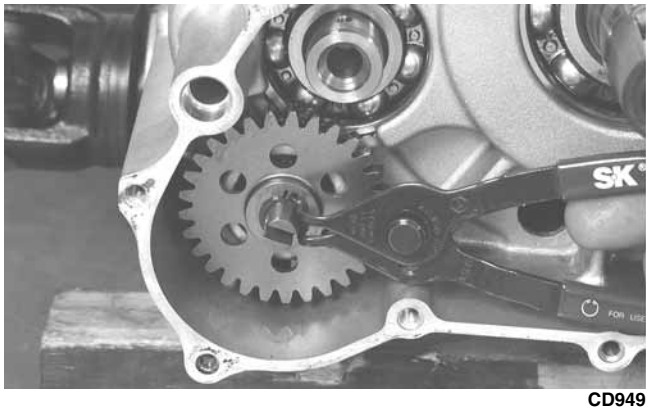
1. Install the water pump driven gear alignment pin and the driven gear (with the beveled side of the gear facing outward as noted in removing); then secure with the snap ring.



CD950A



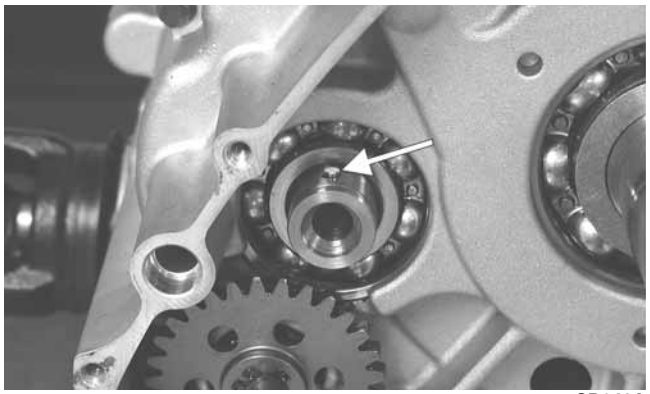
CD952A



CD949

■NOTE: The sharp side of the snap ring should be facing outward.

2. Install the water pump drive gear drive pin and the drive gear (with the flat side of the gear facing outward as noted in removing); then secure with the snap ring.



CD946A

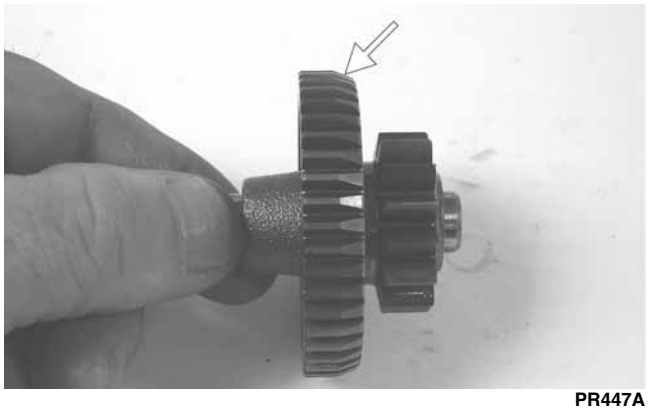
CD944

■NOTE: The sharp side of the snap ring should be facing outward.

■NOTE: Once the gears are secured, remove the oil passage plug from the crankcase.

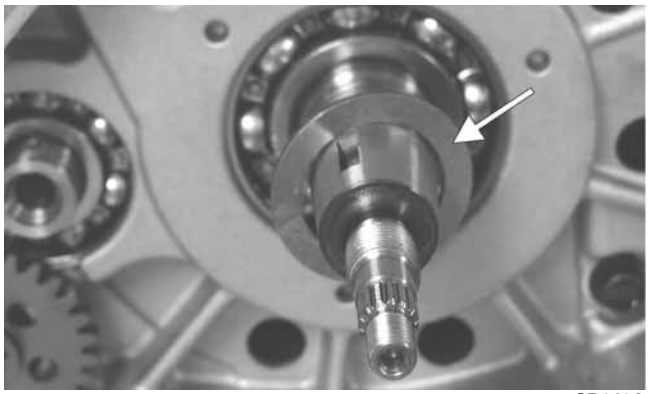
3. Install the two starter gear shafts; then install the two starter gears (with the beveled side of the intermediate gear facing inward as noted in removing).

CD139

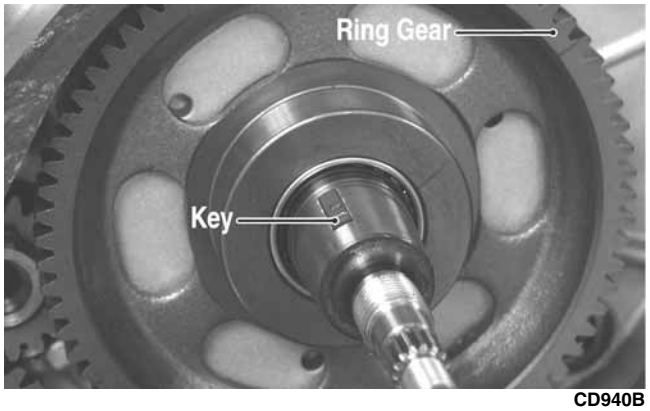


PR447A

4. In order on the crankshaft, install a washer, ring gear, key, and the magneto rotor. Secure with the nut (coated with red Loctite #271). Tighten to 105 ft-lb.

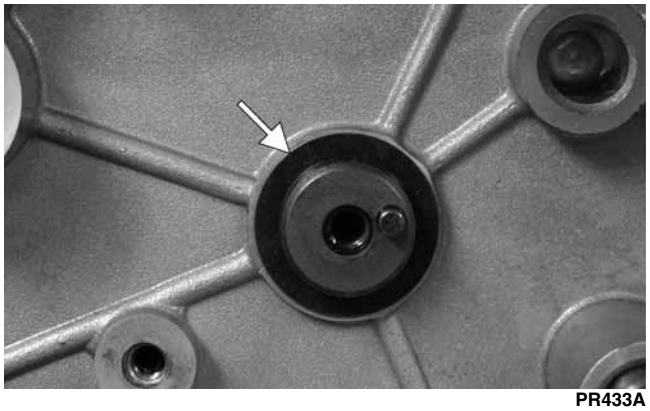


CD948A



CD940B

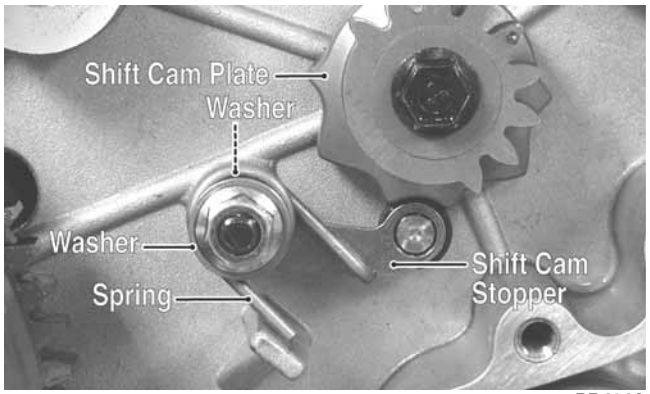
5. Install the thrust washer and shift cam plate onto the shift cam shaft; then coat the cap screw threads with red Loctite #271 and tighten to 8 ft-lb.



PR433A

CD934

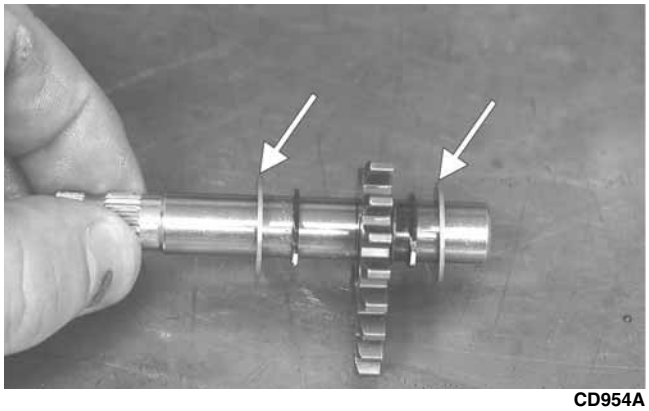
6. Install the shift cam stopper, spring, and two washers (thick washer closest to the nut); then coat the threads on the mounting stud with red Loctite #271 and install the nut. Tighten to 8 ft-lb.



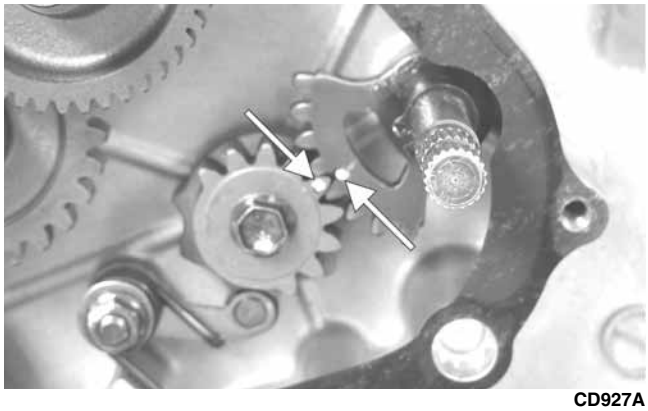
PR434A

■NOTE: Rotate the shift cam plate to ensure it ratchets with no binding.

7. Install the shift shaft with two washers making sure to align the timing mark on the shift shaft with the mark on the shift cam plate.

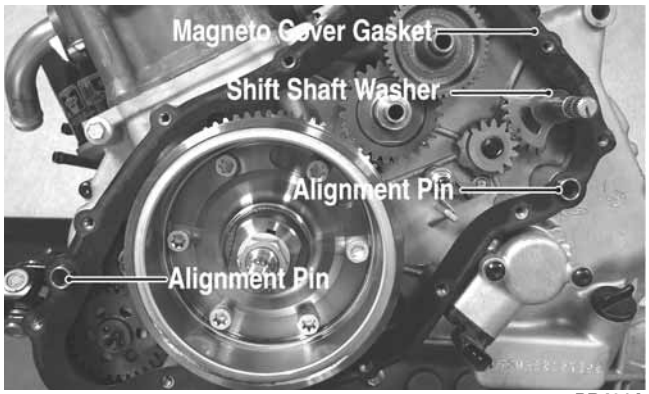


CD954A



CD927A

8. Lubricate the magneto cover gasket with fresh engine oil; then place it into position on the two alignment pins. Make sure the outer shift shaft washer is in place.



PR431A

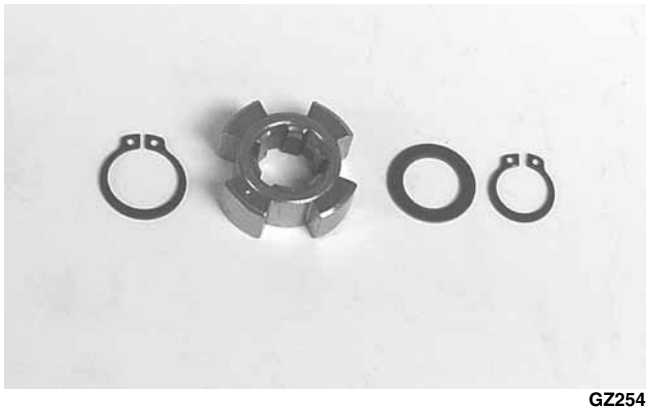
9. Install the magneto cover and secure with the cap screws. Tighten only until snug.

10. Place the bushing into position on the crankshaft making sure a new, lubricated O-ring is inside the bushing. Tighten the flange nut to 25 ft-lb.

11. Using a crisscross pattern, tighten the cap screws (from step 9) to 8 ft-lb.

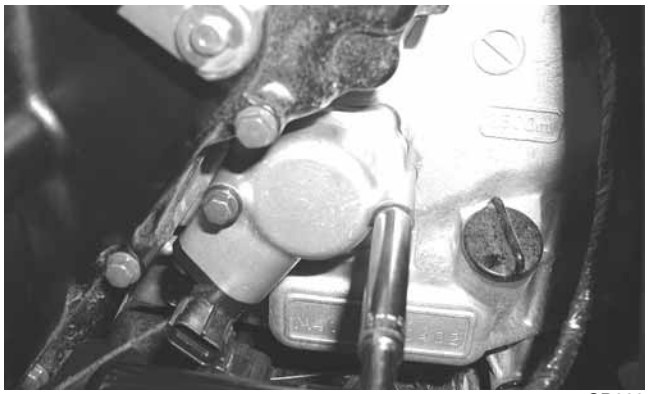
12. Clean the countershaft and trigger splines thoroughly and install the inner snap ring onto the shaft; then apply green Loctite #620 to the trigger and countershaft splines and install the trigger. Secure with a flat washer and outer snap ring.

GZ253



GZ254

13. Using a new gasket, install the speed sensor housing onto the crankcase and secure with two cap screws. Tighten to 8 ft-lb.



CD069

14. Place the water pump into position and secure with two cap screws. Tighten to 8 ft-lb.

■NOTE: Ensure the slotted water pump shaft is aligned with the groove in the counter balancer shaft.

15. Install the crossover tube on the water pump and cylinder head making sure the O-ring is properly positioned.

16. Place the outer magneto cover into position on the left-side cover; then tighten four cap screws to 6 ft-lb.

Right-Side Components

■**NOTE: For efficiency, it is preferable to remove and disassemble only those components which need to be addressed and to service only those components. The technician should use discretion and sound judgment.**

☞ AT THIS POINT
To service any one specific component, only limited disassembly of components may be necessary. Note the AT THIS POINT information in each sub-section.

■**NOTE: The engine/transmission does not have to be removed from the frame for this procedure.**

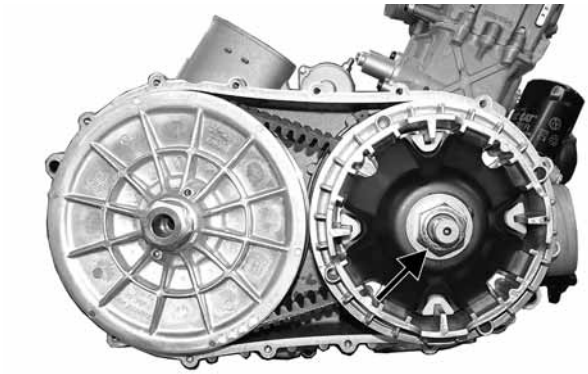
Removing Right-Side Components

A. V-Belt Cover
B. Driven Pulley
C. Clutch Cover
D. Oil Pump

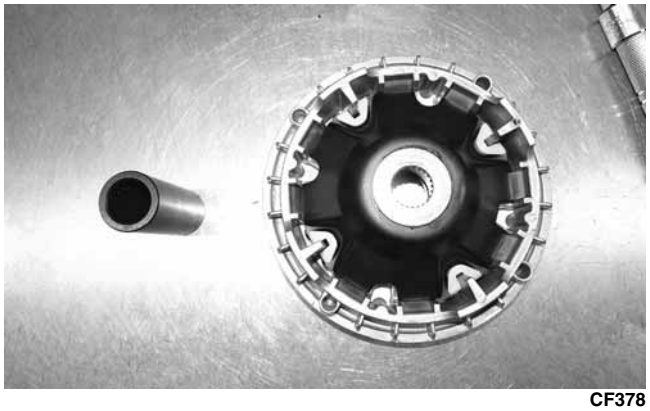
1. Remove the cap screws securing the V-belt cover noting the location of the different-lengthed cap screws for installing purposes; then using a rubber mallet, gently tap on the cover tabs to loosen the cover. Account for two alignment pins and a gasket.

CF363

2. Remove and discard the nut securing the movable drive face; then remove the face. Account for a spacer.



CF373A

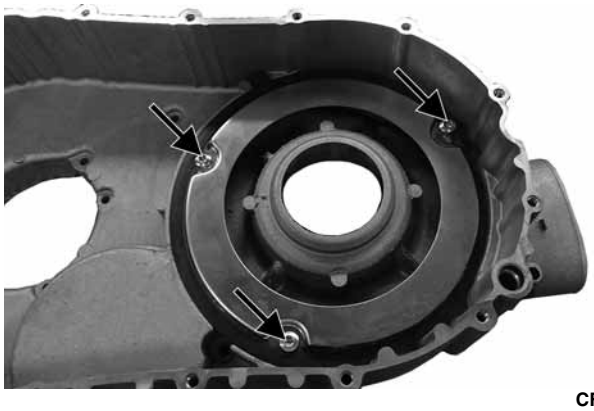


CF378

3. Remove the V-belt.
4. Remove the nut securing the fixed driven assembly; then remove the assembly.

PR388

5. Remove the fixed drive face.
6. Remove and discard the cap screws securing the windage plate.



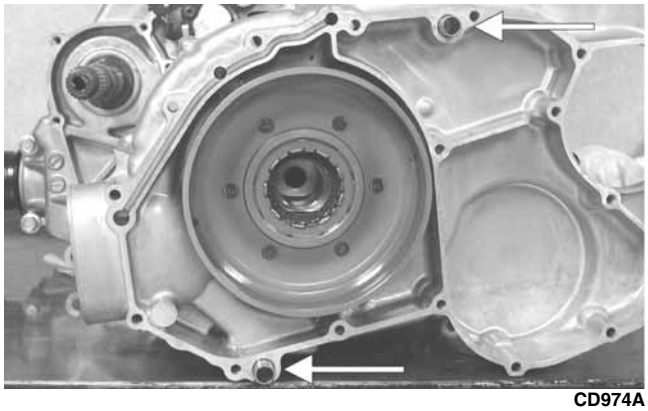
CF632A

7. Remove the cap screws securing the clutch cover. Note the location of the different-lengthed cap screws for installing purposes. Using a rubber mallet, carefully remove the cover. Account for two alignment pins.

CD973A

CAUTION

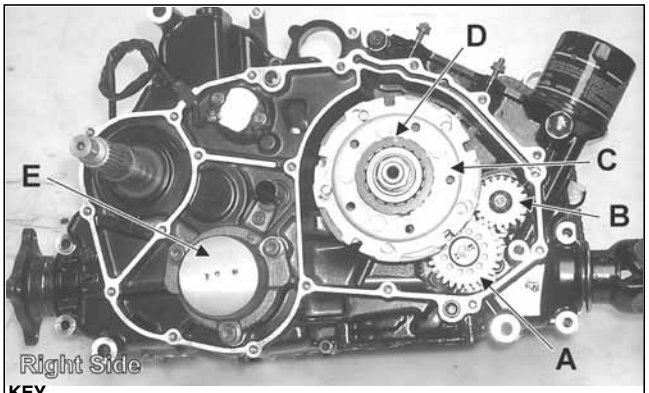
Care must be taken when removing the cover so the cover gasket is not damaged.



CD974A

■NOTE: For steps 8-14, refer to illustration CC829B.

■NOTE: To aid in installing, it is recommended that the assemblies are kept together and IN ORDER.



KEY

- A. Oil Pump Driven Gear
- B. Oil Pump Drive Gear
- C. Clutch Shoe Assembly
- D. One-Way Clutch
- E. Final Drive Carrier Bearing Housing

CC829B

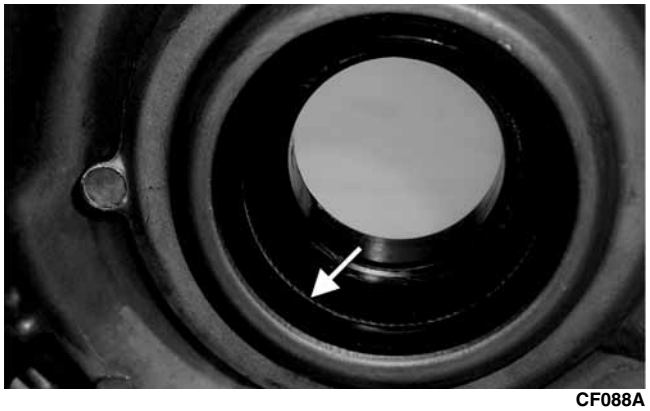
8. Remove the one-way clutch (D) from the clutch housing. Note the location of the green alignment dot (or the word OUTSIDE) for installing purposes.

9. Using a hydraulic press, remove the clutch housing assembly from the clutch cover. Account for the left fixed drive spacer and an O-ring inside the fixed drive spacer.

CF085

CC596

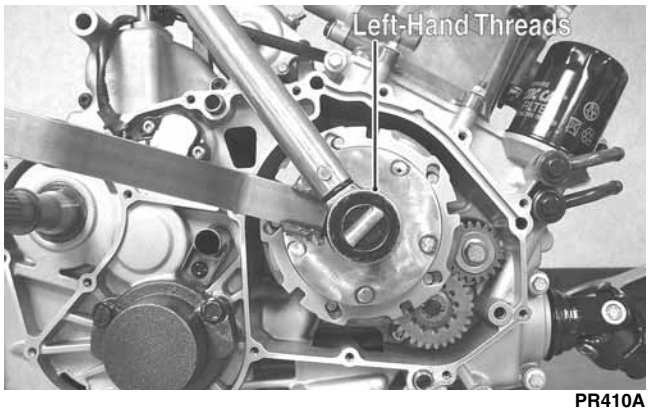
■NOTE: Account for and inspect the clutch housing seal.



CF088A

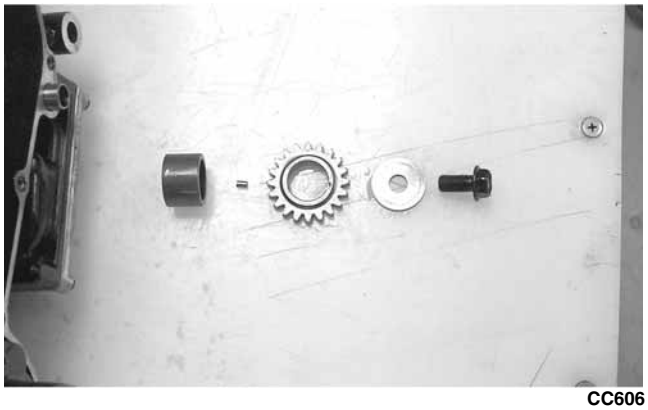
10. Remove the two cap screws securing the gear position switch; then remove the switch.

11. Remove the nut (left-hand threads) securing the clutch shoe assembly (C).

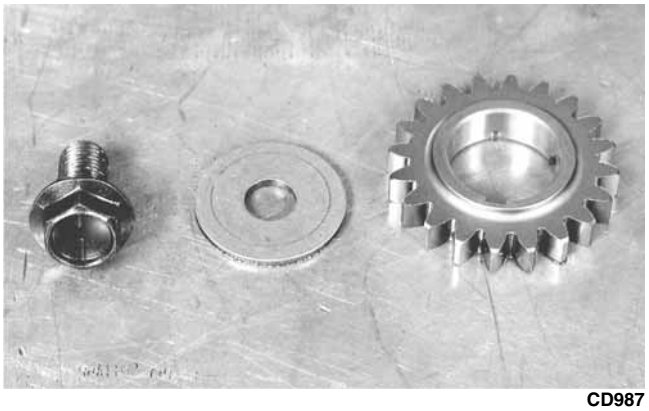


PR410A

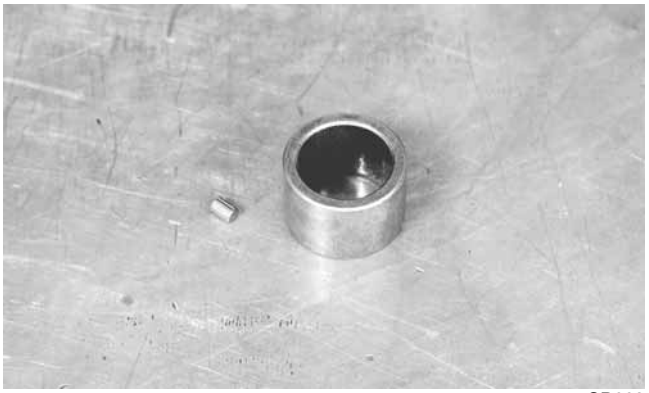
12. Remove the cap screw securing the oil pump drive gear (B). Account for a cap screw, washer, pin, and spacer.



CC606



CD987



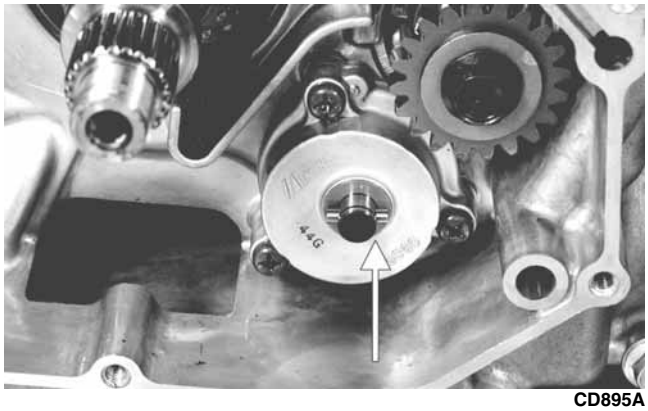
CD993

13. Using an impact wrench, remove the cap screws securing the final drive carrier bearing housing (E); then remove the housing and account for two alignment pins.

CD999

14. Remove the snap ring securing the oil pump driven gear (A); then remove the gear noting the direction of the sides of the gear for installing purposes. Account for a pin and a washer.

CD984



CD895A

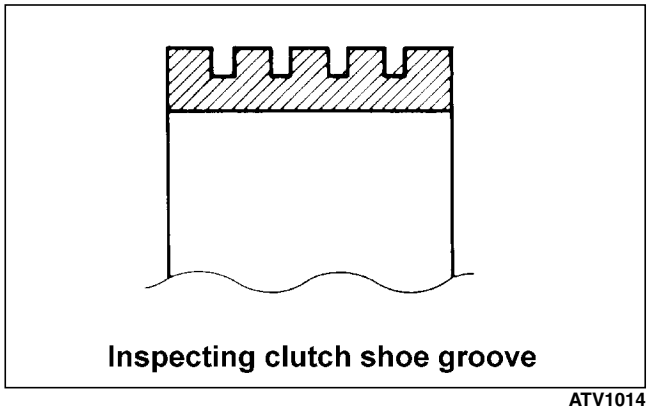
15. Using an impact driver, remove the three torx-head screws securing the oil pump; then remove the pump.

CD988

Servicing Right-Side Components

INSPECTING CENTRIFUGAL CLUTCH SHOE

1. Inspect the clutch shoes for uneven wear, chips, cracks, or discoloration. If any shoe is damaged, replace the complete set.
2. Inspect the clutch shoes for wear or damage. If any shoe is worn to the bottom of the groove, replace the clutch assembly.



Inspecting clutch shoe groove

ATV1014

INSPECTING CLUTCH HOUSING

1. Inspect the clutch housing for burns, grooving, cracks, or uneven wear.
2. If the housing is damaged in any way, the housing must be replaced.

INSPECTING PRIMARY ONE-WAY DRIVE

1. Insert the drive into the clutch housing.
2. Rotate the inner race by hand and verify the inner race rotates only one direction.
3. If the inner race is locked in place or rotates both directions, the drive assembly must be replaced.

INSPECTING OIL PUMP

1. Inspect the pump for damage.
2. It is inadvisable to remove the screw securing the pump halves. If the oil pump is damaged, it must be replaced.

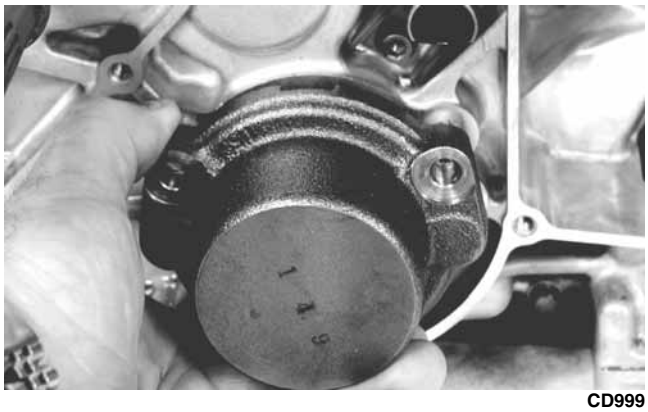
CC446D

DRIVEN PULLEY ASSEMBLY

■NOTE: The driven pulley is a non-serviceable component. If the pulley faces, cam ramps, or sheave bushing are worn or loose, the pulley must be replaced as an assembly. Do not disassemble the driven pulley.

Installing Right-Side Components

1. Install the secondary shaft bearing housing making sure the two alignment pins are properly positioned. Tighten the new "patch-lock" cap screws to 28 ft-lb.

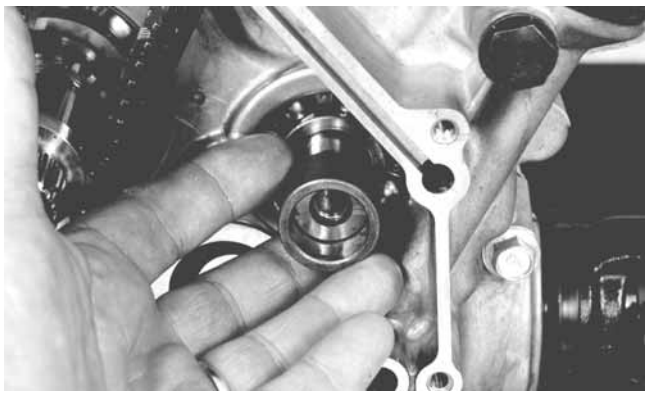


CD999

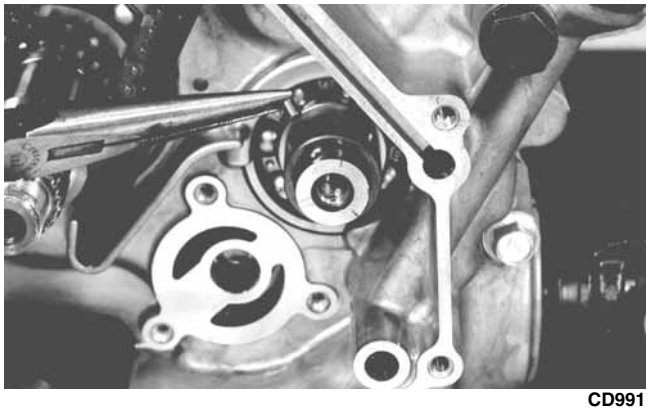
2. Install the oil pump; then tighten the screws (coated with red Loctite #271) to 8 ft-lb.

CD988

3. Install the oil pump drive gear spacer onto the crank balancer shaft. Grease the pin and insert it into the shaft; then install the drive gear making sure the raised side of the gear is facing toward the inside. Secure the gear with the cap screw (threads coated with red Loctite #271) and the washer. Tighten the cap screw to 62 ft-lb.

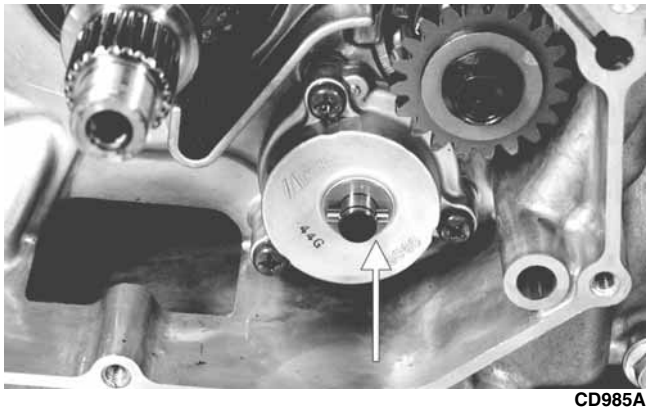


CD992



CD991

4. Grease the driven gear pin and insert it into the shaft. Install the washer; then install the driven gear noting the direction on the sides of the gear from removing). Secure with a snap ring.

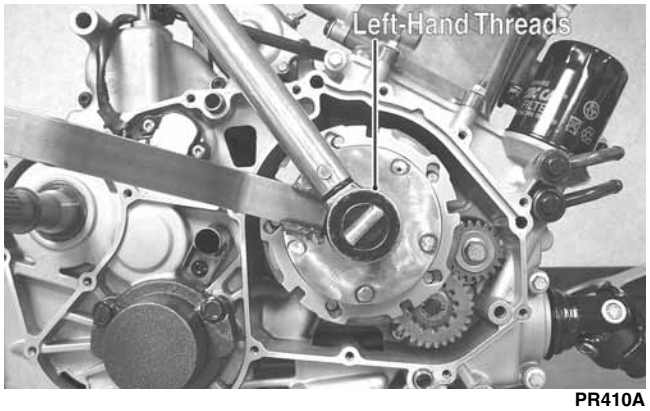


CD985A

CD984

■NOTE: When installed correctly, the sides of the drive and driven gears will be flush with each other.

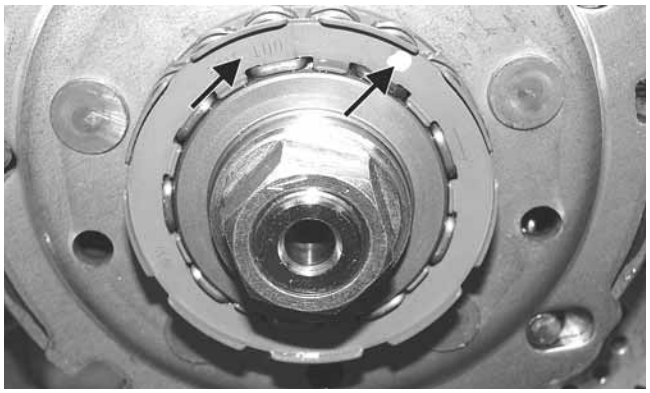
5. Install the clutch shoe assembly and secure with the flange nut (threads coated with red Loctite #271). Tighten to 221 ft-lb.



PR410A

6. Install the clutch cover alignment pins into the crankcase, apply oil to the cover gasket, and install the gasket onto the crankcase.

7. Install the one-way clutch onto the clutch shoe assembly.

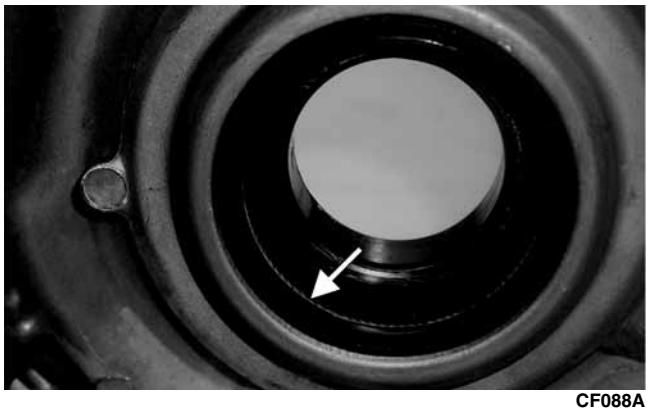


PR399A

CAUTION

When installed correctly, the green alignment dot (or the word OUTSIDE) on the one-way clutch is visible.

8. Lightly grease the clutch housing seal; then insert the left fixed-drive spacer.



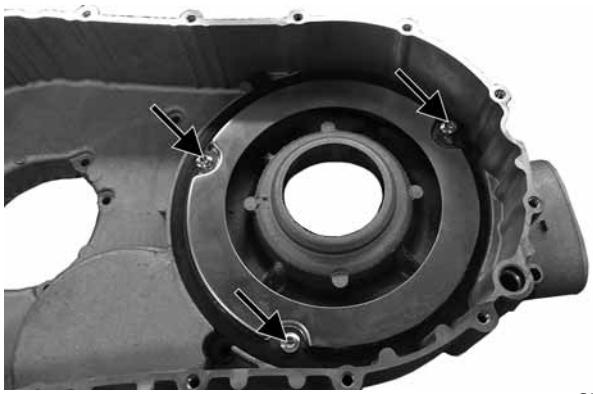
CF088A

CF085A

9. Apply grease to the outer edges of the clutch housing; then from inside the clutch cover, install the clutch housing into the cover using a rubber mallet.

10. Place the clutch cover/housing assembly into position on the crankcase; then secure with the cap screws making sure the different-lengthed cap screws are in their proper location. Tighten to 8 ft-lb.

11. Install the windage plate and secure with new "patch-lock" cap screws. Tighten to 7 ft-lb.



CF632A

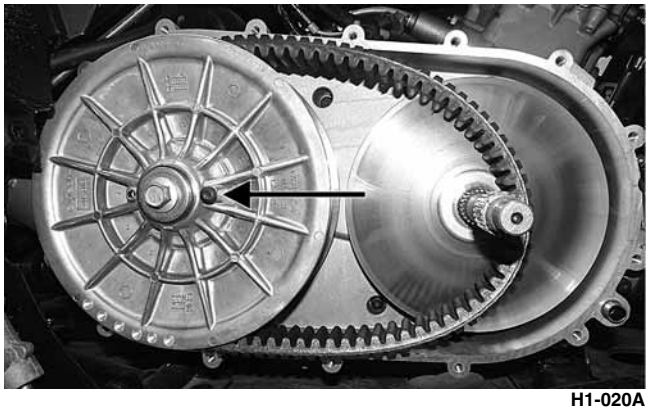
12. Place the driven pulley assembly into position and secure with the nut. Tighten to 162 ft-lb.

CF262

13. Slide the fixed drive face onto the clutch shaft.

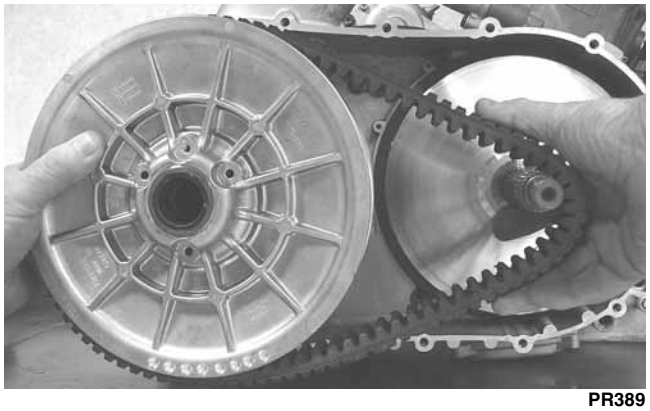
14. Spread the faces of the driven pulley by threading a cap screw into one of the bosses of the driven fixed face; then tighten the cap screw until the V-belt drops into the driven pulley 1/2 to 3/4 inch.

CF270A



H1-020A

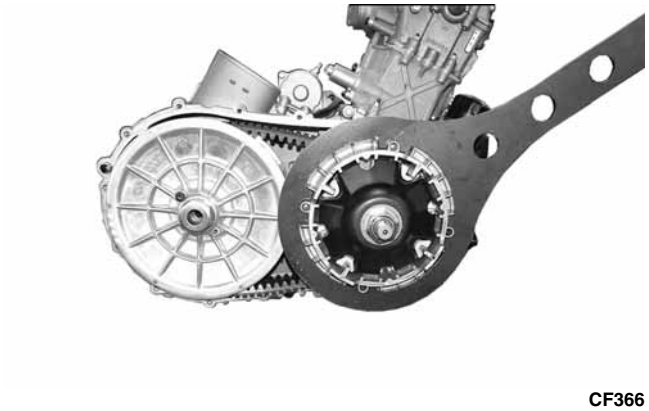
15. Place the V-belt into position on the driven pulley and over the front shaft.



PR389

■NOTE: The arrows on the V-belt should point in the direction of rotation.

16. Pinch the V-belt together near its center and slide the spacer and movable drive face onto the driveshaft. Using an appropriate spanner wrench, secure the drive face with a new nut and tighten the nut to 165 ft-lb.



CF366

CAUTION

Make sure the movable drive face plate is fully engaged onto the splines of the clutch shaft before tightening the nut or false torque readings may occur. This will cause the assembly to loosen damaging the shaft and clutch face plate.

CF379

■NOTE: At this point, the cap screw can be removed from between the driven pulley faces.

17. With the vehicle in neutral, rotate the V-belt and clutches counterclockwise until the V-belt is flush with the top of the driven pulley.

18. Place the V-belt cover gasket into position; then install the cover and secure with the cap screws making sure the different-lengthed cap screws are in their proper location. Tighten the cap screws to 8 ft-lb.

CF363

Center Crankcase Components

■**NOTE: This procedure cannot be done with the engine/transmission in the frame. Complete Removing procedures for Top-Side, Left-Side, and Right-Side must precede this procedure.**

■**NOTE: For efficiency, it is preferable to remove and disassemble only those components which need to be addressed and to service only those components. The technician should use discretion and sound judgment.**

Separating Crankcase Halves

1. Remove the right-side cap screws securing the crankcase halves. Note the location of the different-lengthed cap screws.
2. Remove the left-side cap screws securing the crankcase halves. Note the location of the different-lengthed cap screws.
3. Using the Crankcase Separator/Crankshaft Remover and tapping lightly with a rubber mallet, separate the crankcase halves. Account for two alignment pins.

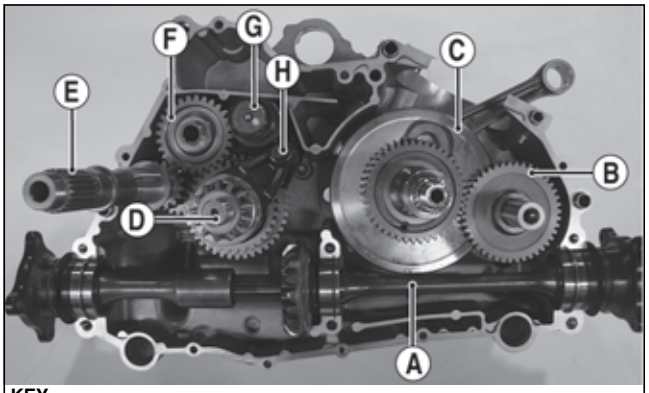
■**NOTE: To keep the shaft/gear assemblies intact for identification, tap the shafts toward the left-side crankcase half when separating the halves.**

PR786

Disassembling Crankcase Half

■**NOTE: For steps 1-7, refer to illustration PR787A.**

■**NOTE: To aid in installing, it is recommended that the assemblies are kept together and IN ORDER.**

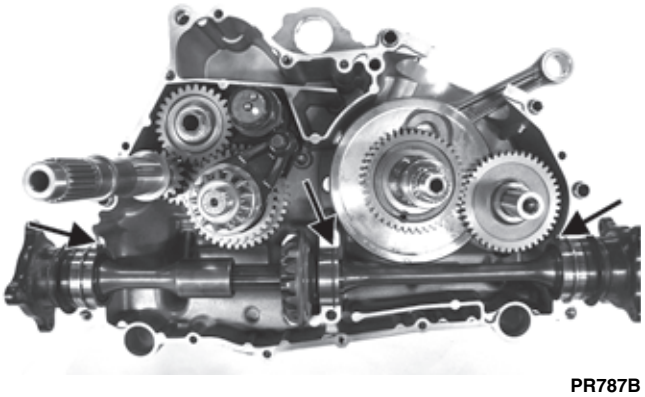


KEY

- **A. Secondary Driven Shaft Assembly**
- **B. Crank Balancer Assembly**
- **C. Crankshaft**
- **D. Countershaft Assembly**
- **E. Driveshaft**
- **F. Reverse Idler Gear Assembly**
- **G. Gear Shift Shaft**
- **H. Shift Shaft with 2 Forks**

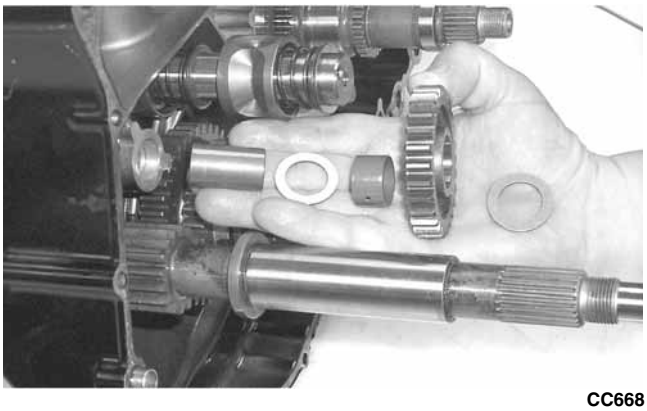
PR787A

1. Remove the secondary driven shaft assembly (A) noting the location of the bearing locating pins. Account for the bearing C-ring.



PR787B

2. Remove the reverse idler gear assembly (F). Account for all washers, shaft, bushing, and the gear.



CC668

3. Remove the shift shaft (H); then remove the two forks taking note of the direction of the tabs on the forks for assembling purposes.
4. Remove the gear shift shaft (G) noting the location of the two holes on the end of the shaft. Account for a spacer and a washer.

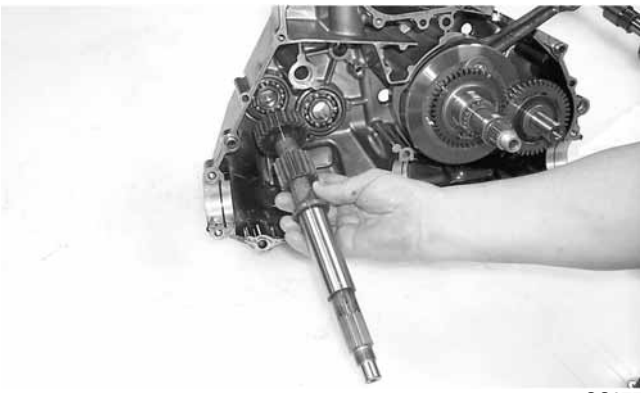
DE677A

5. Remove the countershaft assembly (D). Account for a washer on each end of the countershaft.

CC674

■NOTE: Do not disassemble the countershaft assembly unless necessary. If necessary, see Servicing Center Crankcase Components sub-section.

6. Using a rubber mallet, tap on the crankcase to remove the driveshaft.



CC675

7. Note the timing marks on the crank balancer assembly (B) gear and crankshaft (C) gear for assembling purposes; then slide the crank balancer gear off the crank balancer. Account for the key in the keyway.

CD826

8. Remove the crank balancer.

■NOTE: There is a flat spot on the crank balancer bearing flange to allow clearance past the crankshaft.

CD832B

9. Remove the snap ring securing the water pump driven gear shaft.

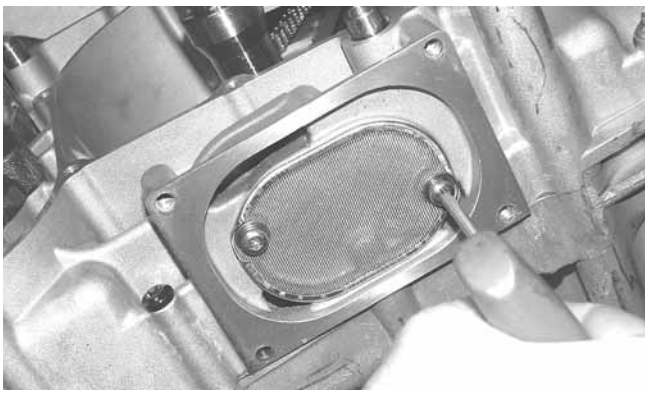
10. Using a hydraulic press, remove the crankshaft assembly.

■NOTE: Use a protective end cap to prevent damage to the crankshaft threads.

11. Remove the cap screws securing the oil strainer cap; then remove the cap.

12. Remove the two cap screws securing the oil strainer; then remove the strainer.

■NOTE: Thoroughly clean any sealant from the oil strainer cap.



PR406

CAUTION

Unless the secondary drive gear, bevel gear, or bearings require service, do not remove the secondary drive assembly from the case. If removed, bevel gear backlash will have to be adjusted requiring re-shimming of the drive bevel gear shaft.

13. To remove the secondary drive/bevel gear, remove the secondary drive bearing housing; then remove the nut securing the drive/bevel gear shaft in the bearing and using a plastic mallet, drive the shaft out of the bearing. Account for shim/shims.

■NOTE: Shims should be measured and kept for a starting point in adjusting backlash.

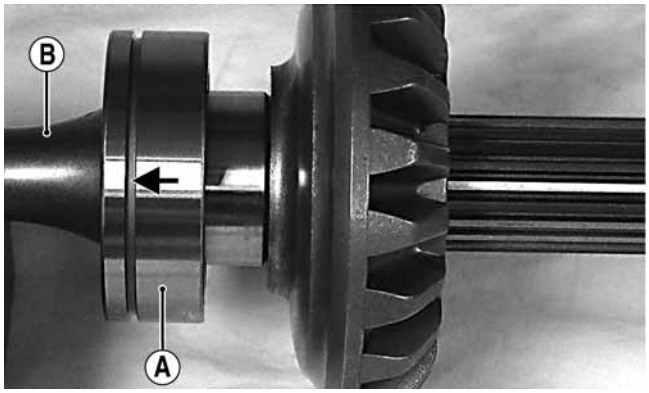
Servicing Center Crankcase Components

SECONDARY OUTPUT DRIVE GEARS

Initial Set-Up

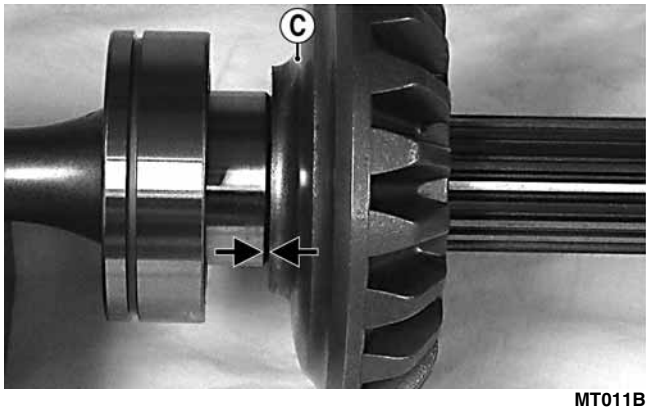
■NOTE: If the secondary output driven shaft is replaced or disassembled, the initial set-up must be performed to establish correct gear tooth contact. If only the secondary output drive shaft or secondary output driven gear is replaced, proceed to Correcting Backlash in this sub-section.

1. Install a new bearing (A) onto the secondary driven shaft (B) making sure the bearing locating groove is directed away from the driven gear splines.



MT011A

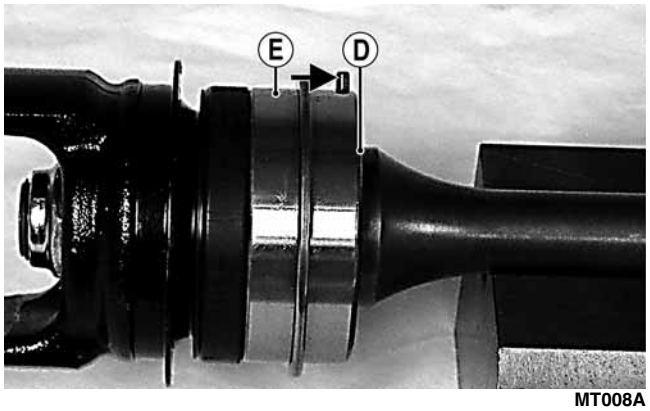
2. Using a suitable press, install the driven gear (C) on the shaft until the gear firmly seats on the shoulder of the shaft.



MT011B

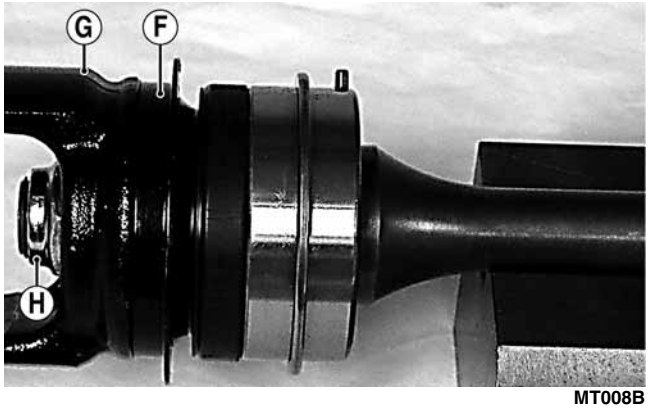
3. If installing the existing shaft, start with the shims removed during disassembly or if installing a new shaft, start with approximately 1.0 mm shims at point (D); then install the output drive shaft bearing (E) making sure the locating pin is directed toward the center of the shaft.

MT012



MT008A

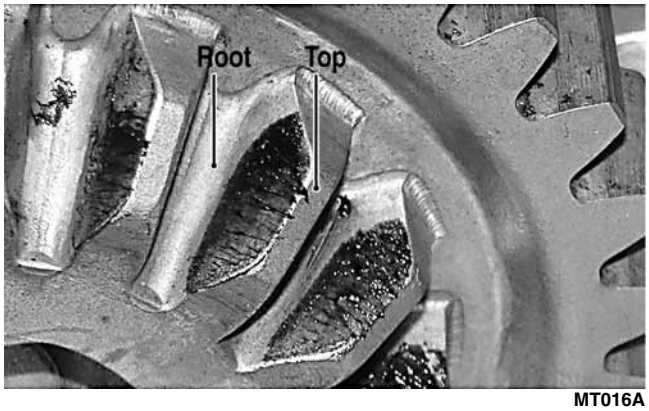
4. Install a new seal (F), output yoke (G), and nut (H) and tighten to 74 ft-lb.



MT008B

■NOTE: Do not use a new lock nut at this time as this procedure may have to be repeated.

5. Place the assembled shaft into the left crankshaft case; then lightly coat the gear teeth with machinist's lay-out dye. Rotate the shafts through several rotations in both directions. Gear contact should extend from the root to the top of the gear teeth.



MT016A

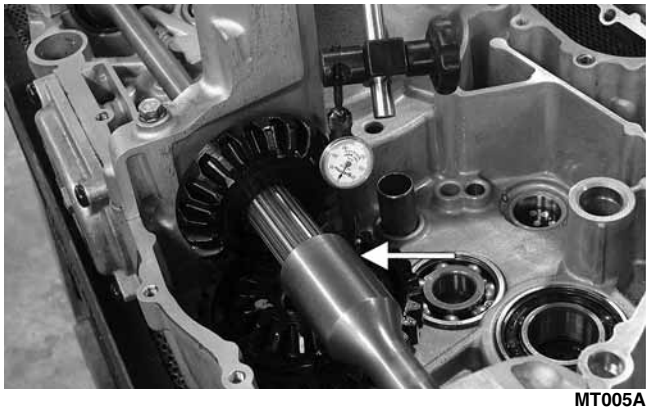
6. To adjust tooth contact, use the following chart to correctly shim the driven shaft.

Tooth Contact	Shim Correction
Contact at Top	Increase Shim Thickness
Contact at Root	Decrease Shim Thickness

7. After correct tooth contact is established, proceed to Checking Backlash in this sub-section.

Checking Backlash

1. If removed, install the secondary drive/bevel gear shaft into the crankcase; then tighten the nut to 59 ft-lb.
2. Install the secondary drive bearing support; then install the secondary driven output shaft into the crankcase.
3. Mount the dial indicator so the tip is contacting a tooth on the secondary drive bevel gear.
4. While rocking the drive bevel gear back and forth, note the maximum backlash reading on the gauge.


MT005A

5. Acceptable backlash range is 0.127-0.381 mm (0.005-0.015 in.).

Correcting Backlash

■NOTE: If backlash measurement is within the acceptable range, no correction is necessary.

1. If backlash measurement is less than specified, remove an existing shim, measure it, and install a new thinner shim.
2. If backlash measurement is more than specified, remove an existing shim, measure it, and install a thicker shim.

■NOTE: Continue to remove, measure, and install until backlash measurement is within tolerance. Note the following chart.

Backlash Measurement	Shim Correction
Under 0.127 mm (0.005 in.)	Decrease Shim Thickness
At 0.127-0.381 mm (0.005-0.015 in.)	No Correction Required
Over 0.381 mm (0.015 in.)	Increase Shim Thickness

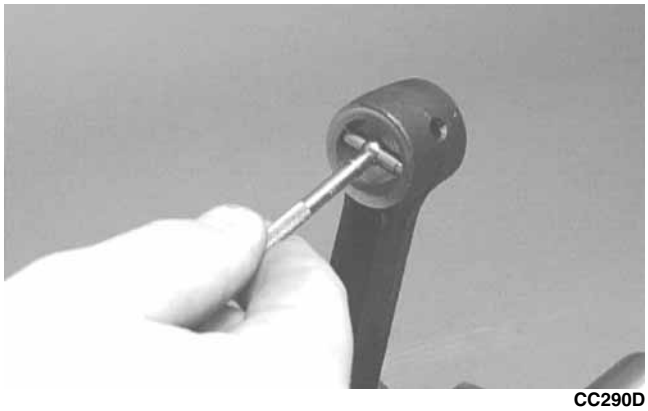
After backlash and tooth contact are within specifications, apply red Loctite #271 to the driveshaft threads and driven output shaft threads; then using new nuts, tighten the output shaft nut to 59 ft-lb and the output yoke nut to 74 ft-lb.

CRANKSHAFT ASSEMBLY

■NOTE: The crankshaft and connecting rod is a non-serviceable assembly. If any component is out of specification, the assembly must be replaced.

Measuring Connecting Rod (Small End Inside Diameter)

1. Insert a snap gauge into the upper connecting rod small end bore; then remove the gauge and measure it with micrometer.



CC290D

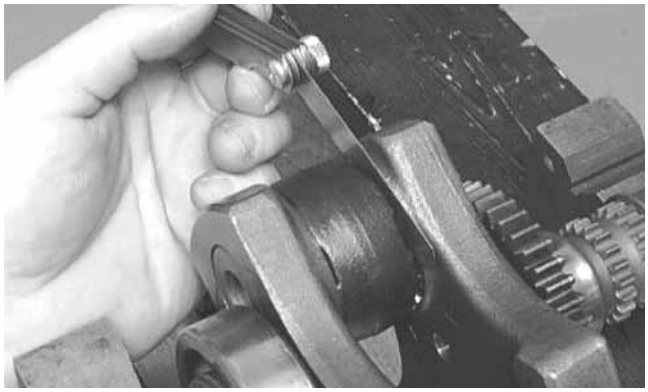
2. Maximum diameter must not exceed specifications.

Measuring Connecting Rod (Small End Deflection)

1. Place the crankshaft on a set of V blocks and mount a dial indicator and base on the surface plate. Position the indicator contact point against the center of the connecting rod small end journal.
2. Zero the indicator and push the small end of the connecting rod away from the dial indicator.
3. Maximum deflection must not exceed specifications.

Measuring Connecting Rod (Big End Side-to-Side)

1. Push the lower end of the connecting rod to one side of the crankshaft journal.
2. Using a feeler gauge, measure the gap between the connecting rod and crankshaft journal.

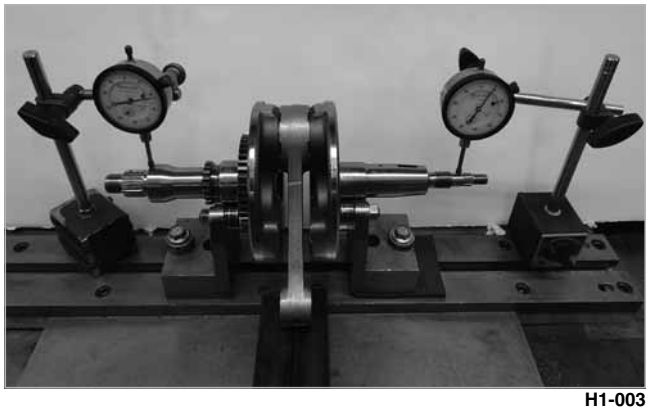


CC289D

3. Acceptable gap range must not exceed specifications.

Measuring Crankshaft (Runout)

1. Place the crankshaft on a set of V blocks.
2. Mount a dial indicator and base on the surface plate. Position the indicator contact at point 1 of the crankshaft.



H1-003

3. Zero the indicator and rotate the crankshaft slowly.

CAUTION

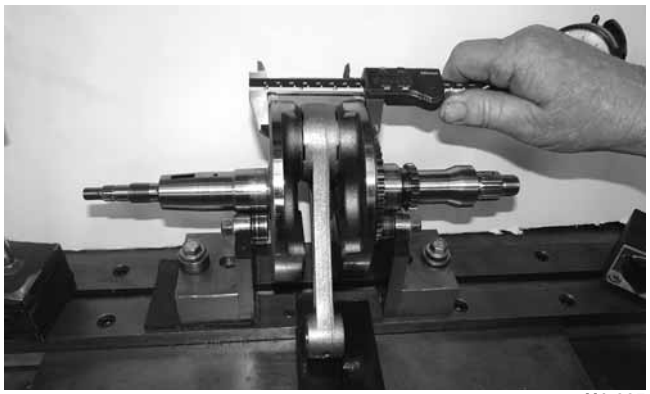
Care should be taken to support the connecting rod when rotating the crankshaft.

4. Maximum runout must not exceed specifications.

■NOTE: Proceed to check runout on the other end of the crankshaft by positioning the indicator contact at point 2 and following steps 3-4.

Measuring Crankshaft (Web-to-Web)

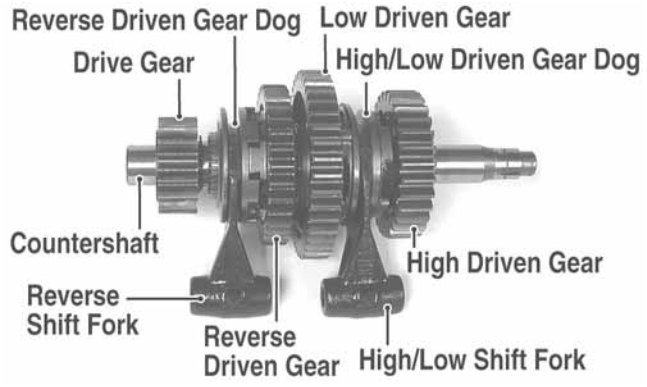
1. Using a calipers, measure the distance from the outside edge of one web to the outside edge of the other web.



H1-005

2. Acceptable width range must not exceed specifications.

COUNTERSHAFT



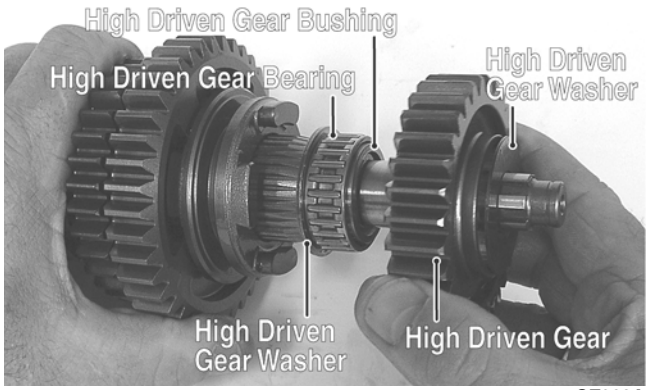
GZ281A

CAUTION

When disassembling the countershaft, care must be taken to note the direction each major component (dog, gear) faces. If a major component is installed facing the wrong direction, transmission damage may occur and/or the transmission will malfunction. In either case, complete disassembly and assembly will be required.

Disassembling

1. Remove the shift forks noting the positions for assembling; then remove the high driven gear outer washer, high driven gear, high driven gear bearing, high driven gear bushing, and high driven gear inner washer.



GZ283A

2. Remove the drive gear; then remove the snap ring securing the reverse driven gear dog and bushing to the countershaft.

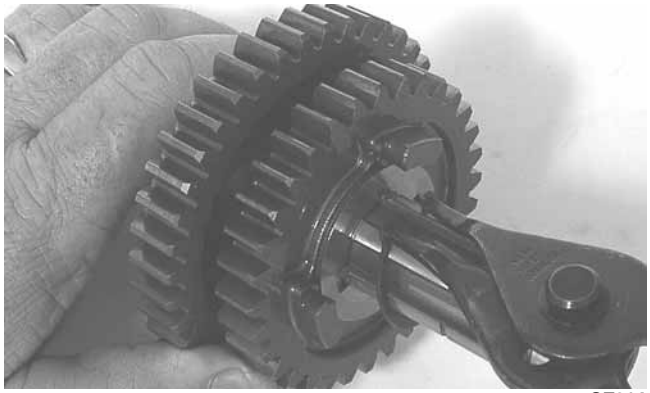
GZ296

GZ312

3. Remove the reverse driven gear dog.

GZ313A

4. Remove the snap ring securing the reverse driven gear and washer; then remove the washer and gear.

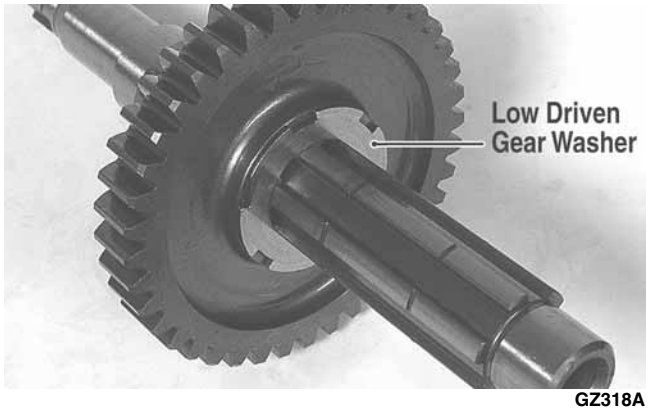


GZ314

5. Remove the reverse driven washer; then remove the low driven gear locking washer.

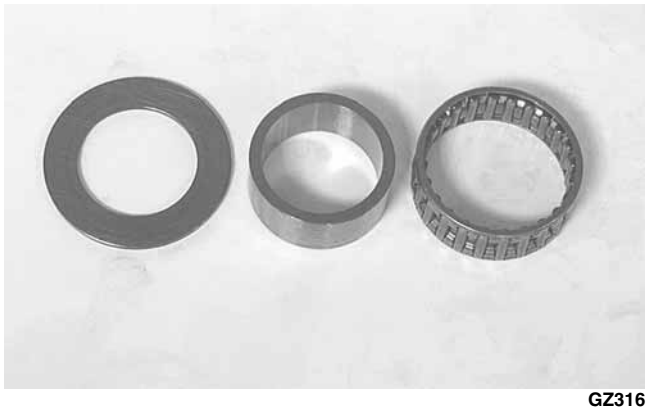
GZ320

GZ319



GZ318A

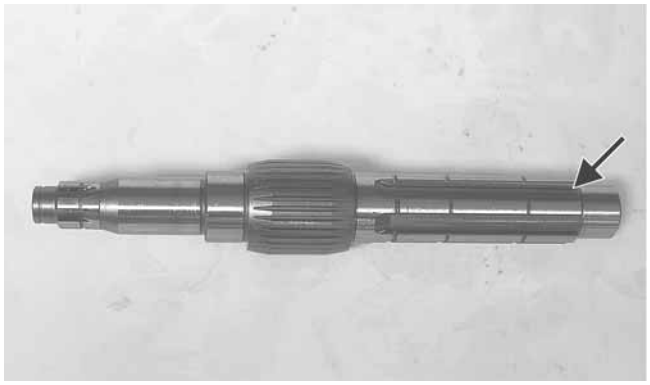
6. Remove the low driven gear. Account for a bearing, bushing, and thrust washer.



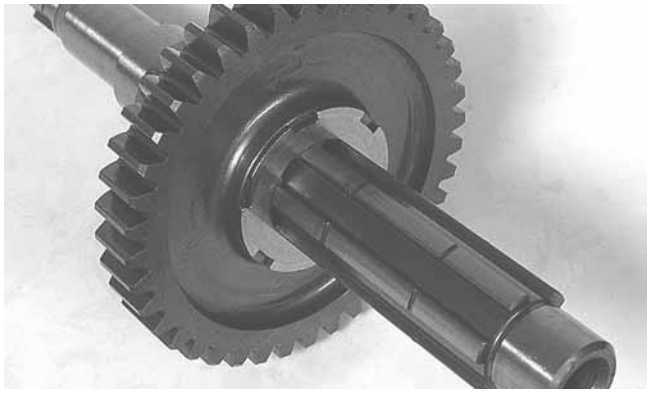
GZ316

Assembling

1. From the drive gear end, install a thrust washer, bushing, and bearing; then install the low driven gear and washer.

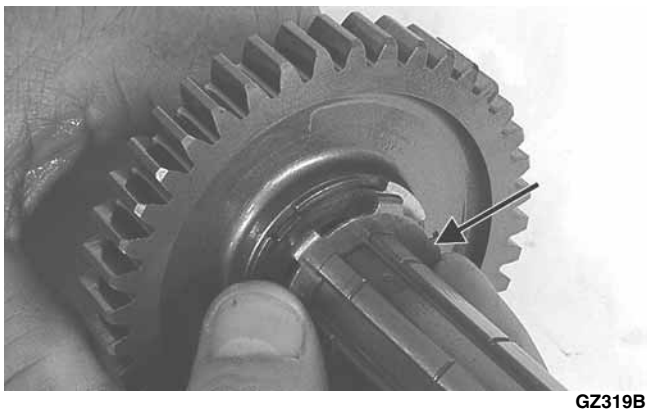


GZ317A

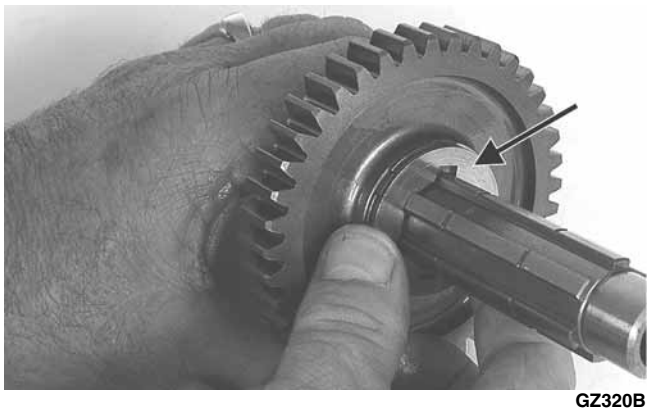


GZ318

2. Install the low driven gear locking washer; then install the inner reverse driven gear washer.

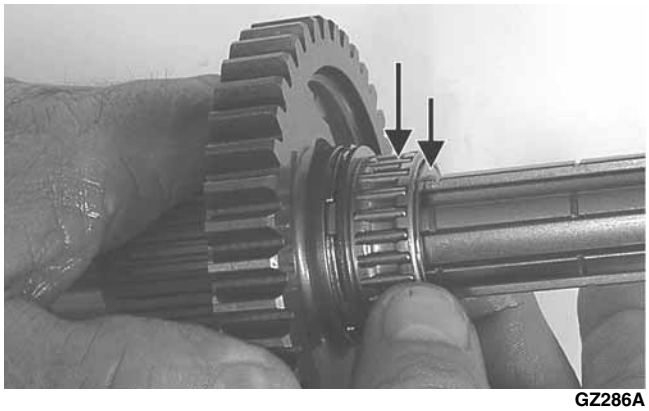


GZ319B



GZ320B

3. Install the reverse driven bushing and bearing; then install the reverse driven gear.



GZ286A

GZ287

4. Install the outer reverse driven washer; then secure the reverse driven gear assembly with a snap ring.

GZ288A

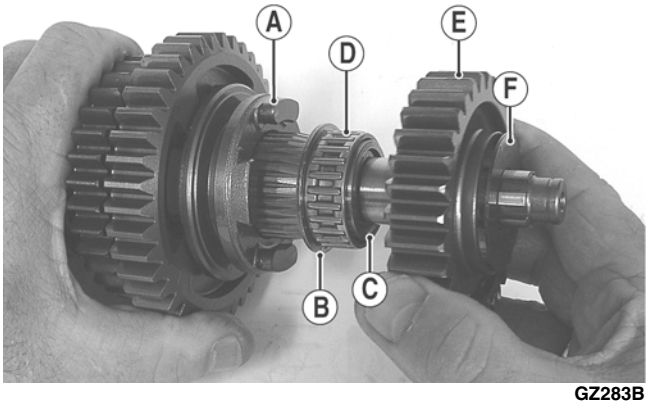
GZ314

5. Install the reverse driven gear dog onto the countershaft and secure with a snap ring.

GZ313A

GZ312

6. From the opposite end of the countershaft, install the high/low driven gear dog (A), thrust washer (B), bushing (C), bearing (D), high/low driven gear (E), and spacer washer (F).



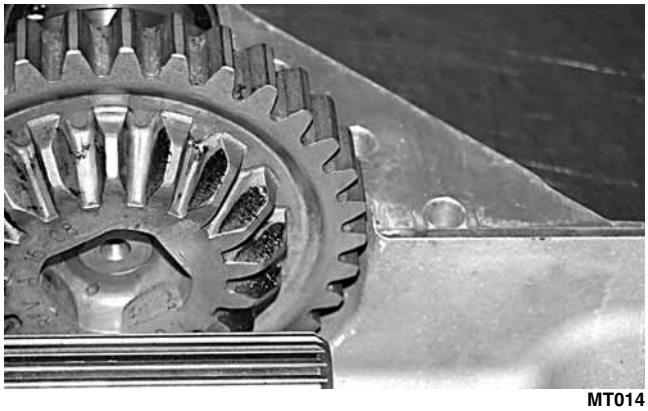
GZ283B

7. Install the two drive gear washers and the shift forks. The countershaft is now ready for installation.

■NOTE: When installing the countershaft assembly, account for the washer on each end of the shaft.

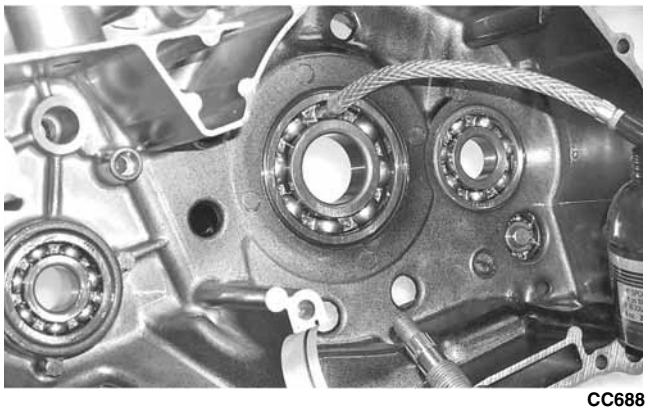
Assembling Crankcase Half

1. Install the secondary drive gear assembly into the crankcase.

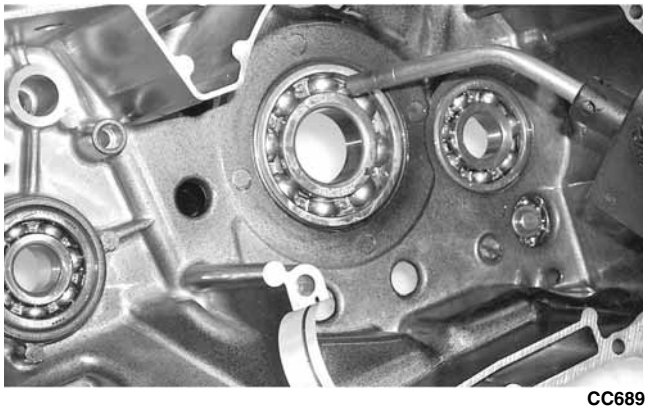


MT014

2. Apply a liberal amount of engine oil to the crankshaft bearing. Using a propane torch, heat the bearing until the oil begins to smoke; then slide the crankshaft assembly into place.



CC688



CC689

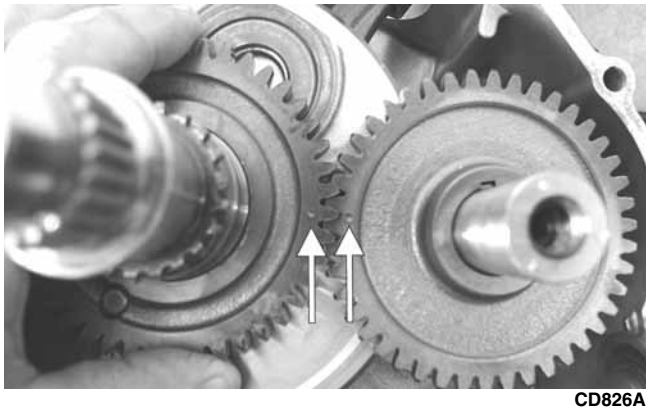
■NOTE: If heating the bearing is not possible, the crankshaft can be installed using a crankshaft installing tool.

3. Install the crank balancer.

CD832B

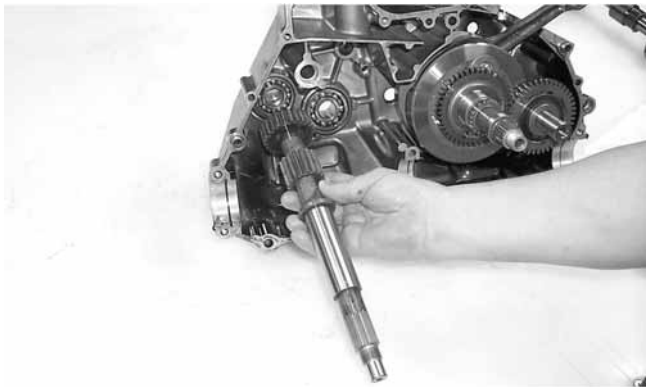
■NOTE: It will be necessary to rotate the crank balancer until the counterweight is facing away from the crankshaft; then rotate the crankshaft clockwise into the journal area to allow the crank balancer to be fully seated.

4. Place the key into the crank balancer keyway; then install the crank balancer gear making sure the alignment dots on the crank balancer gear and the crankshaft gear align.



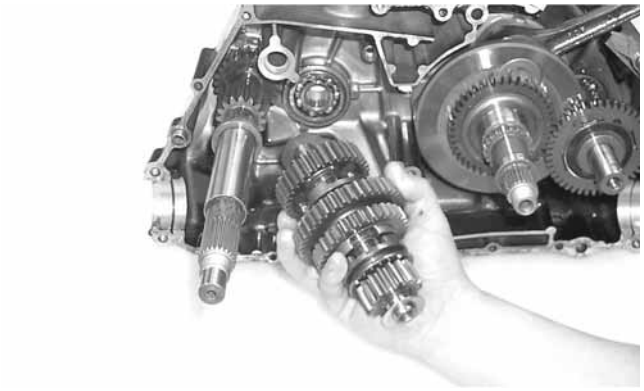
CD826A

5. Install the driveshaft.



CC675

6. Place a washer on each end of the countershaft assembly; then install the assembly.



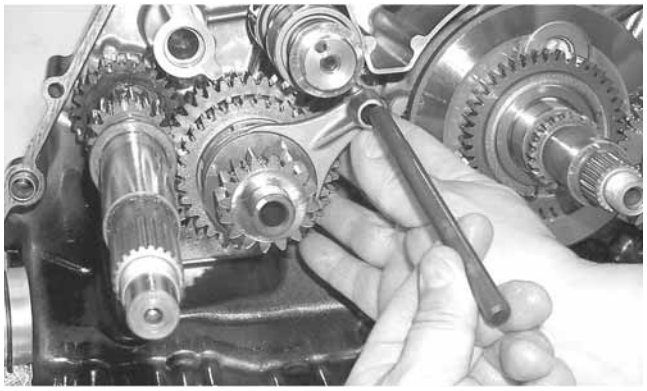
CC674

7. Place a washer on the end of the gear shift shaft; then install the shaft assembly making sure the two holes on the end of the shaft are positioned vertically. Install the spacer on the shift shaft.

DE677A

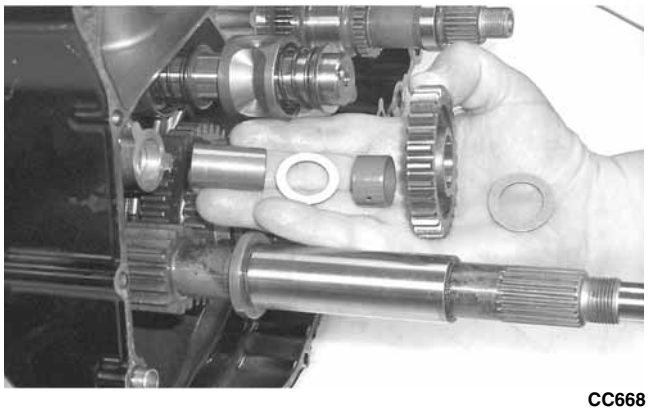
8. Insert the two shift forks into the sliding dogs noting the direction of the tabs from disassembling; then install the shift fork shaft.

■NOTE: Make sure the shift fork tabs face upward and that they are properly seated into the shift cams.



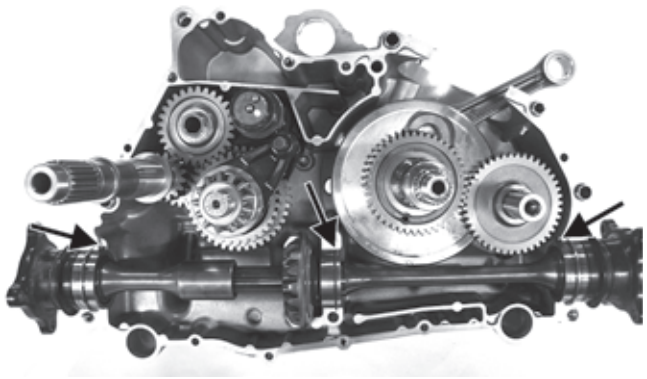
CC669

9. Install the reverse idler gear assembly noting the positioning of the two washers, gear, bushing, and shaft.



CC668

10. Install the front and rear secondary driven shaft assemblies into the left side of the crankcase making sure the bearing locating pins are toward the top of the crankcase and the bearing C-ring is fully seated in the crankcase.



PR787B

11. Place the oil strainer into position; then secure with the two screws.

12. Place the oil strainer cap into position making sure silicone sealant is applied; then secure the cap with cap screws. Tighten to 10 ft-lb.

Joining Crankcase Halves

1. Apply High-Temp Sealant to the left-side mating surface smoothing out any build-up or bumps.

2. Lightly oil all bearings and grease all shafts in the right-side crankcase.

3. Using a plastic mallet, lightly tap the case halves together until cap screws can be installed.

4. From the right side, install the 8 mm cap screws; then tighten only until snug.

■NOTE: Rotate the shafts back and forth to ensure no binding or sticking occurs.

5. From the left side, install the remaining 8 mm cap screws (two inside the case); then tighten only until snug.

■NOTE: Rotate the shafts back and forth to ensure no binding or sticking occurs.

6. From the left side, install the case half 6 mm cap screws; then tighten only until snug.

■NOTE: Rotate the shafts back and forth to ensure no binding or sticking occurs.

7. From the right side, install the 6 mm cap screws; then tighten only until snug.

■NOTE: Rotate the shafts back and forth to ensure no binding or sticking occurs.

8. In a crisscross/case-to-case pattern, tighten the 8 mm cap screws (from steps 4-5) until the halves are correctly joined; then tighten to 20 ft-lb.

■NOTE: Rotate the shafts back and forth to ensure no binding or sticking occurs.

9. In a crisscross/case-to-case pattern, tighten the 6 mm cap screws (from steps 6-7) to 10 ft-lb.

■NOTE: Rotate the shafts back and forth to ensure no binding or sticking occurs.

☞ AT THIS POINT

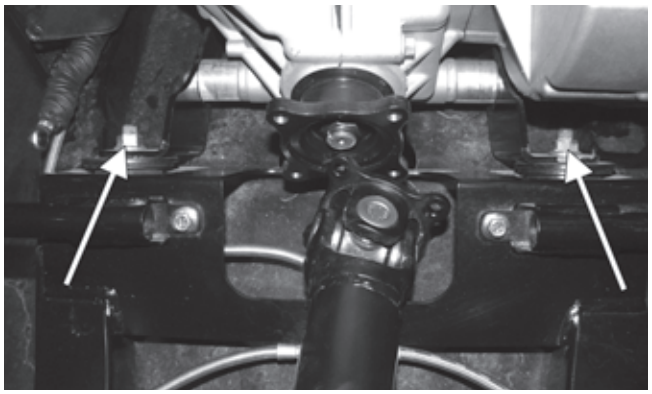
After completing center crankcase components, proceed to Installing Right-Side Components, to Installing Left-Side Components, and to Installing Top-Side Components.

Installing Engine/ Transmission

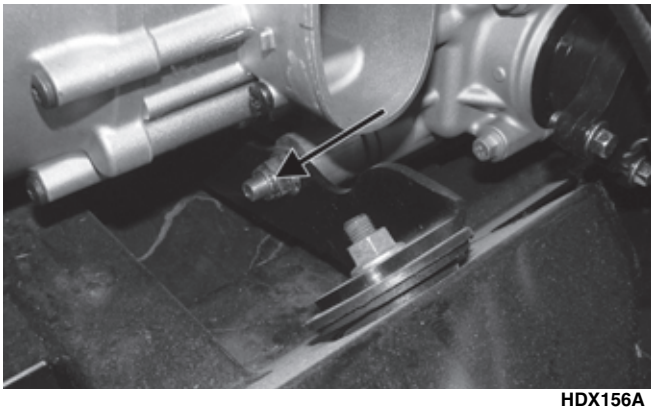
■NOTE: Toro recommends new gaskets and O-rings be installed whenever servicing the vehicle.

1. Using a suitable lifting sling and engine hoist, lower the engine into the vehicle engaging the slotted rear engine mount brackets with the engine mounts; then install the front through-bolt.

2. Tighten the flange nuts on the rear cradle to 25 ft-lb; then tighten the nut on the front through-bolt to 40 ft-lb.



HDX157A

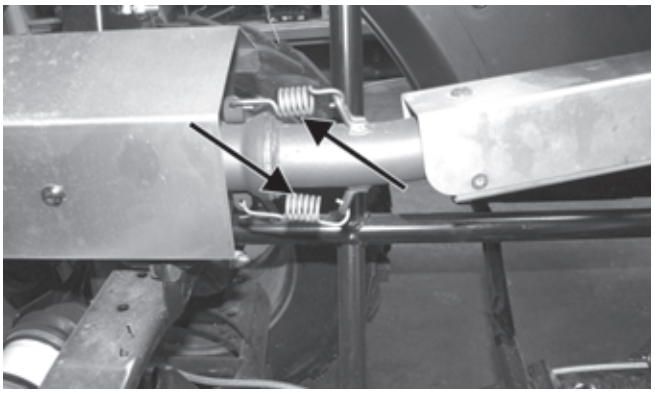


HDX156A

3. Remove the plugs from the oil cooler lines and connect to the appropriate fittings. Secure with hose clamps and tighten securely.

4. Secure the front and rear driveshafts to the engine flanges with the cap screws and tighten to 20 ft-lb; then connect the upper and lower coolant hoses and tighten the clamps securely.

5. Place a new grafoil seal in the cylinder head and a new grafoil seal on the muffler end of the exhaust pipe and install the exhaust pipe. Secure with two exhaust springs and two cap screws tightened to 20 ft-lb.

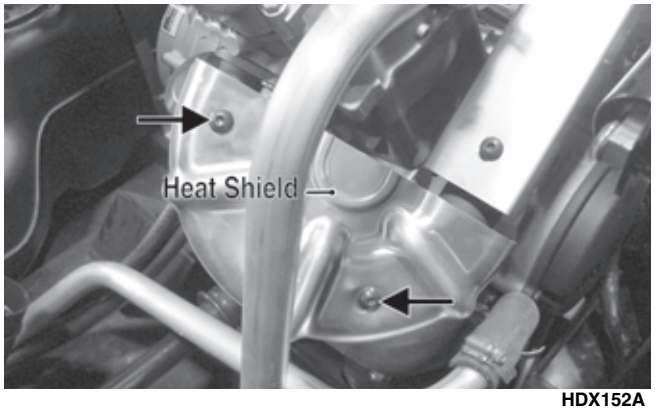


HDX153A

HDX154

6. Install the O2 sensor and tighten the sensor to 19 ft-lb. Connect the harness to the sensor.

7. Install the forward exhaust pipe heat shield and secure with the machine screws. Tighten securely.

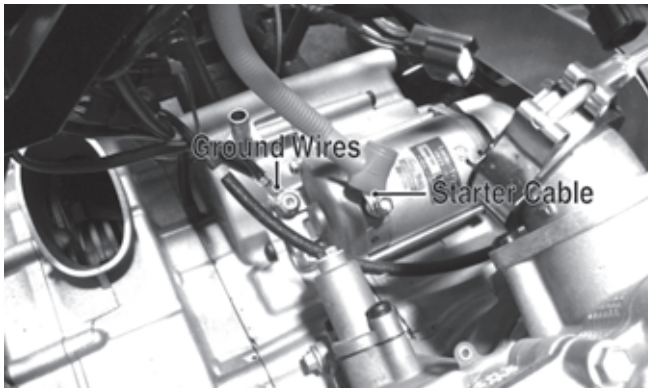


HDX152A

8. Install the CVT cooling ducts on the V-bolt housing and secure with clamps. Tighten securely. Install an appropriate nylon tie to secure the exhaust duct.

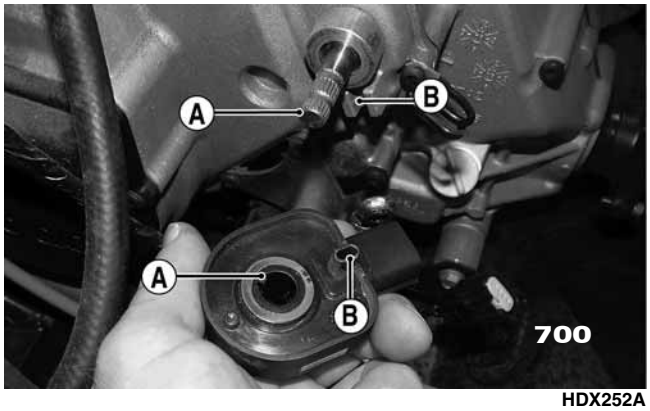
HDX135A

9. Install the starter cable to the starter motor, secure with the nut, and tighten securely; then secure the engine/harness ground wires to the engine with a cap screw and tighten to 8 ft-lb.

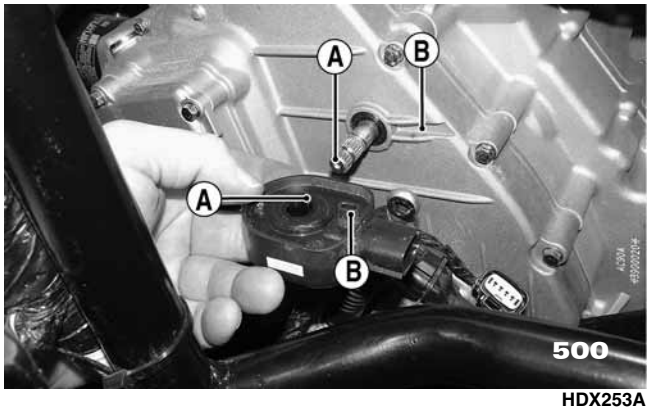


HDX149A

10. Properly position the gear position switch on the engine (A to A and B to B); then secure the shift cable bracket to the engine case and tighten the engine case screws to 8 ft-lb. Connect the gear position switch connector.



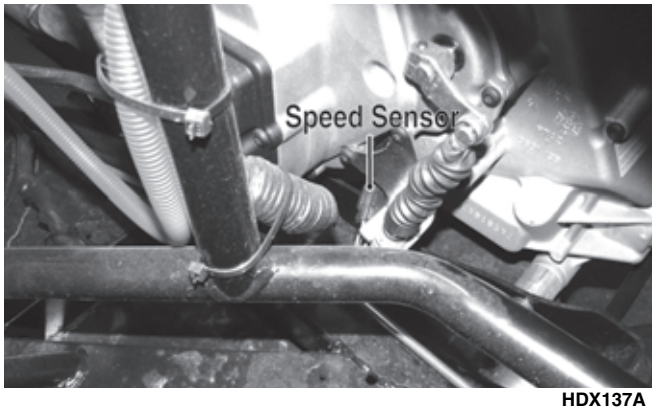
HDX252A



HDX253A

11. On the left side, connect the ECT sensor connector, speed sensor connector, and spark plug cap.

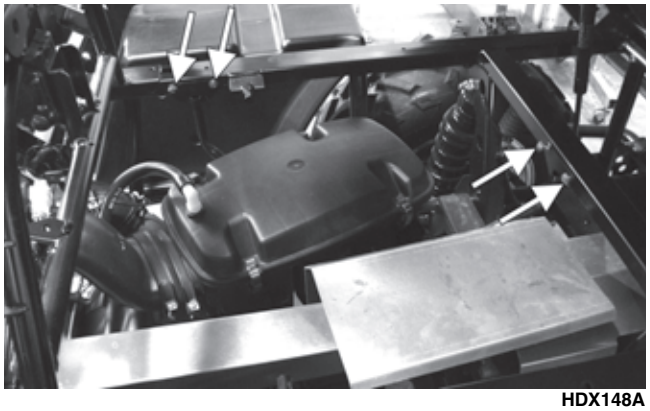
HDX135A



HDX137A

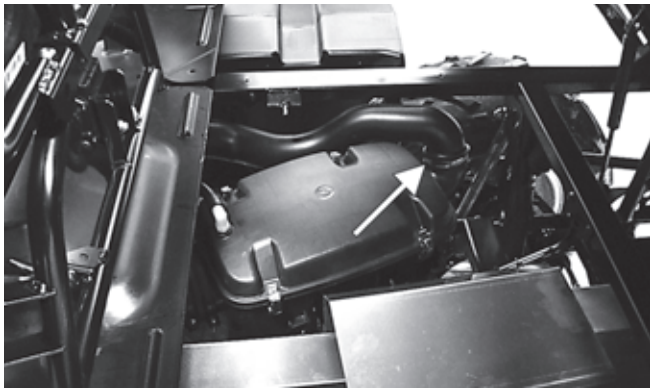
12. Install the throttle body into the intake manifold boot and secure with the clamp. Tighten to 30 in.-lb.

13. Install the air filter assembly and secure to the frame with four sheet metal screws; then secure the intake boot with the clamp and tighten securely.



HDX148A

14. Connect the IAT sensor connector to the IAT sensor and the crankcase breather tube to the crankcase; then install the air filter intake tube and secure with a clamp and sheet metal screw.

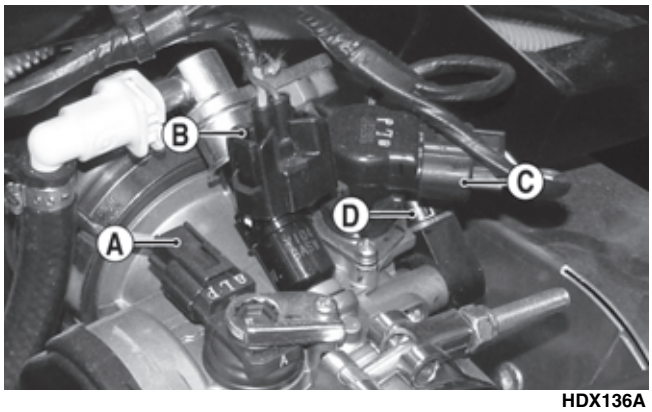


HDX031A

15. Connect the gasline hose to the throttle body making sure the gasline hose connector fully engages and locks onto the fuel rail.

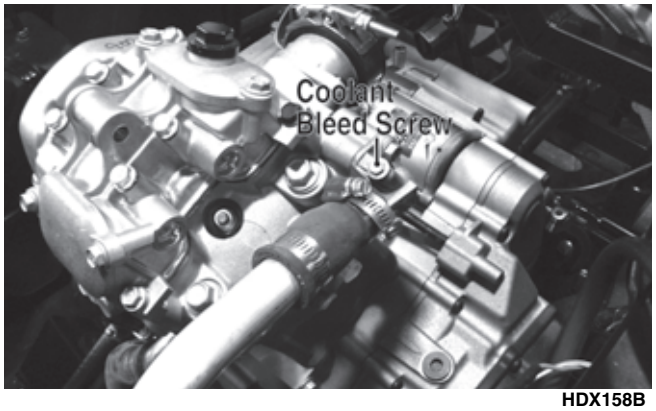
HDX138B

16. Connect the MAP sensor connector (A), fuel injector connector (B), ISC connector (C), and TPS connector (D); then install new nylon ties as noted during removing.



HDX136A

17. Pour the recommended amount of oil and coolant into the engine and radiator; then loosen the coolant bleed screw to allow trapped air to escape. When clear coolant flows, tighten the bleed screw.



HDX158B

18. Connect the negative battery cable to the battery.

19. Install the center skid plate, center floorboard, and seat base; then install the seat back and seat.

20. Start the engine and check for leaks allowing to warm up for several minutes; then shut the engine off and check engine oil and coolant levels.

Fuel/Lubrication/Cooling

TROUBLESHOOTING

1. Verify that the electric fuel pump is operating by listening for a “whirring” sound for approximately three seconds after the ignition switch is turned to the ON position. If no sound can be heard, see Fuel Pump/Fuel Level Sensor in Electrical System.
2. Check for a flashing EFI icon on the LCD. If EFI is flashing, see EFI Diagnostic System in Electrical System.
3. Check the air filter housing and air filter for contamination. Clean or replace as necessary (see Periodic Maintenance).

Throttle Body

⚠ WARNING

Whenever the gasline hoses are removed (other than for pressure testing), the battery must be disconnected to prevent inadvertent activation of the electronic fuel pump.

⚠ WARNING

Whenever any maintenance or inspection is performed on the fuel system during which there may be fuel leakage, there should be no welding, smoking, open flames, etc., in the area.

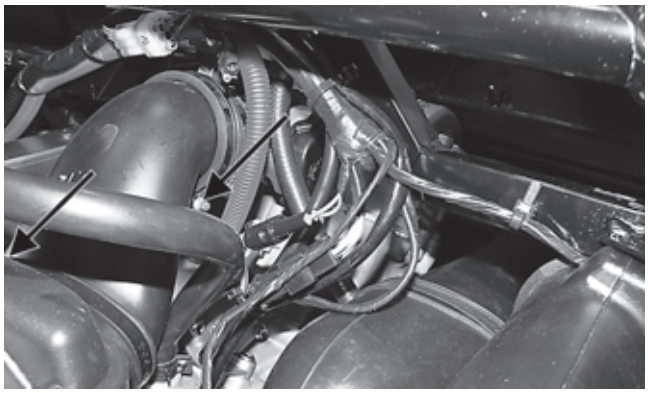
REMOVING

1. Turn the ignition switch to the OFF position; then remove the ignition switch key.

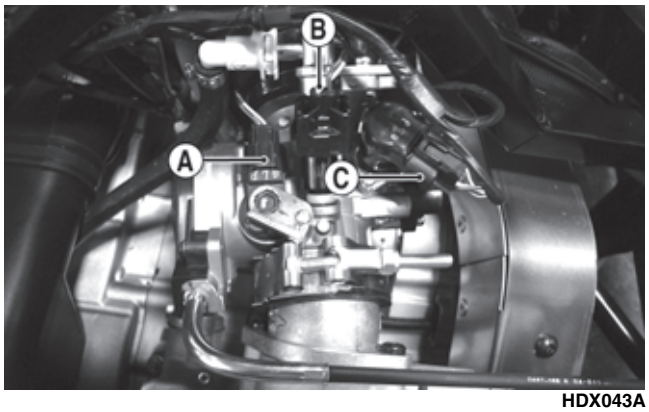
⚠ WARNING

Do not turn the ignition switch to the ON position with the hoses removed. Gasoline will be pumped by the electric fuel pump causing a safety hazard.

2. Remove the seat, seat back, and seat base; then disconnect the battery.
3. Remove the air inlet boot between the air filter and throttle body; then disconnect the MAP sensor connector (A), fuel injector connector (B), and ISC connector (C).

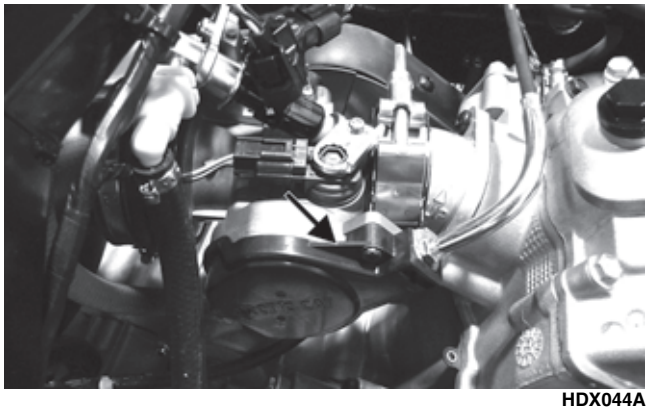


HDX048A



HDX043A

4. Remove the screw from the throttle arm cover and remove the cover; then loosen the jam nut and disconnect the throttle cable.

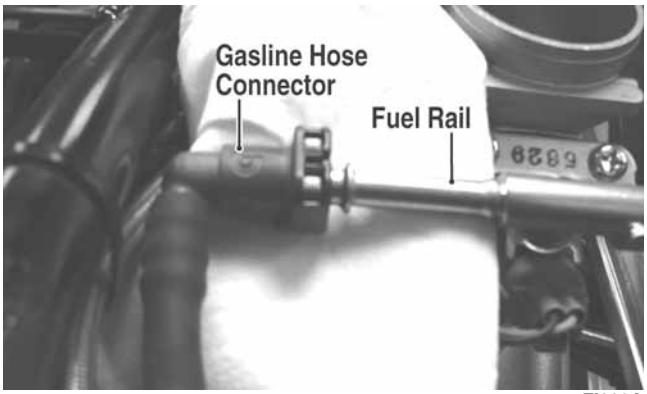


HDX044A

5. Slowly disconnect the gasline hose connector from the fuel rail.

⚠ WARNING

Gasoline may be under pressure. Place an absorbant towel under the connector to absorb any gasoline spray when disconnecting.



FI092A

6. Loosen the clamp securing the throttle body to the intake manifold boot and remove the throttle body assembly.
7. Use tape to cover and seal the intake opening.

CAUTION

Any objects or liquid entering the intake opening will fall into the engine causing severe damage if the engine is turned over or started.

INSTALLING

1. Install the throttle body into the intake manifold boot and secure with the clamp. Tighten to 30 in.-lb.
2. Connect the throttle cable to the throttle body; then connect the gasline hose.
3. Connect the electrical connectors to the throttle body components.
4. Install the air filter boot and secure with the existing hardware.
5. Install the seat base, seat back, and seat.

■NOTE: If the throttle body, ECM, TPS, or ISC are replaced, the EFI system must be synchronized. Use the following procedure.

1. With the key off, depress accelerator pedal to Wide Open Throttle (WOT).
2. Place the ignition key in the ON position and wait for 10 seconds.
3. Release the accelerator pedal, and wait an additional 10 seconds.
4. Turn the key to the OFF position and allow the gauge to shut off.

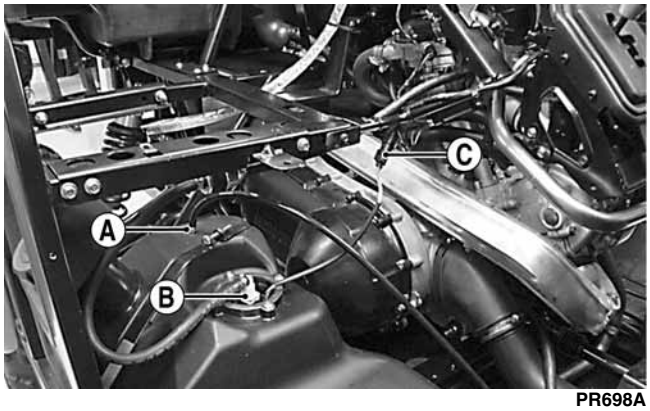
Gas Tank

⚠ WARNING

Whenever any maintenance or inspection is made on the fuel system during which there may be fuel leakage, there should be no welding, smoking, open flames, etc., in the area.

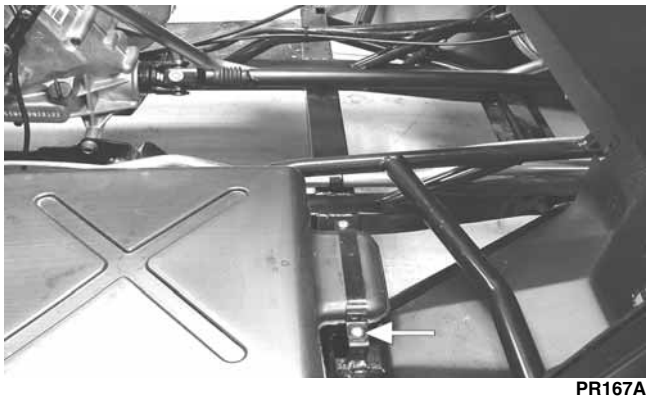
REMOVING

1. Remove the seat, seat back, and seat base; then remove the floorboard.
2. Disconnect the vent hose (A), gasline hose (B), and fuel pump/fuel level sensor connector (C); then cap the vent fitting and gas hose fitting.



PR698A

3. Remove the outer cap screw securing the front tank hold-down; then swing the hold-down to the left.

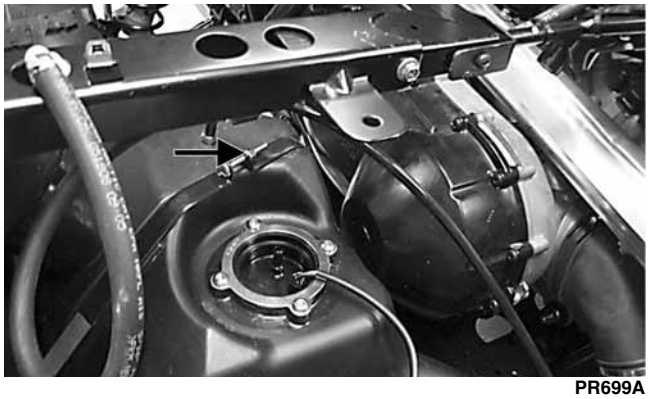

PR167A


PR170

4. Remove four press-nuts securing the gas cap filler panel; then remove the gas cap and panel. Install the gas cap.

PR168

5. Remove the joining cap screw and nut from the rear gas tank hold-down strap; then remove the inside hold-down strap.



PR699A

6. Lift and slide the tank forward raising the front of the tank first; then turn the tank and lift out the right side.

CLEANING AND INSPECTING

1. Clean all gas tank components with parts-cleaning solvent.
2. Inspect all hoses for cracks or leaks.
3. Inspect gas tank cap and tank for leaks, holes, and damaged threads.
4. Inspect the fuel level sensor for proper operation (see Electric Fuel Pump/Fuel Level Sensor in this section).

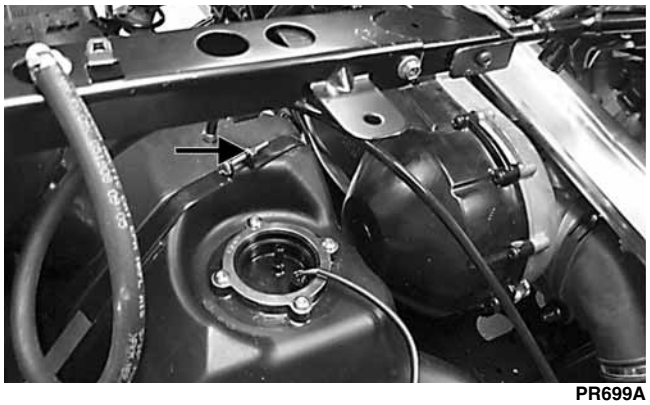
INSTALLING

⚠ WARNING

Whenever any maintenance or inspection is made on the fuel system during which there may be fuel leakage, there should be no welding, smoking, open flames, etc., in the area.

1. Place the gas tank into position in the vehicle; then install the inside rear hold-down strap.

PR173

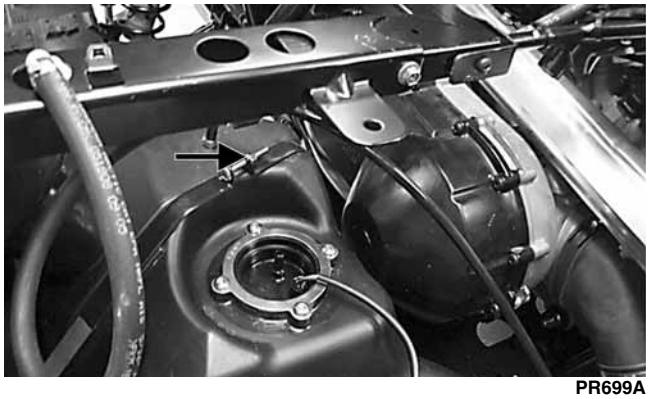


PR699A

2. Swing the front hold-down to the right into position and install the cap screw and nut. Do not tighten at this time.

PR171

3. Install the rear hold-down strap joining cap screw and nut. Do not tighten at this time.

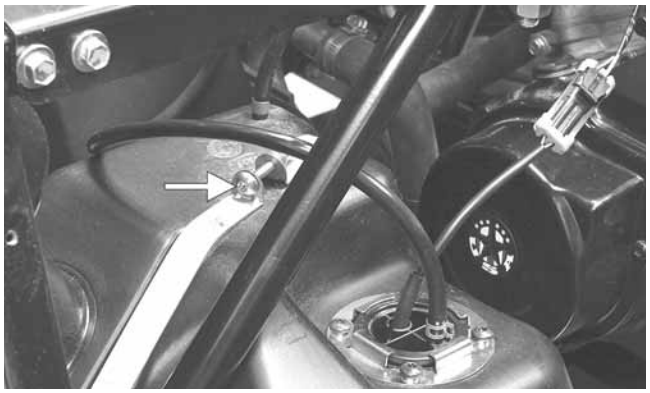


PR699A

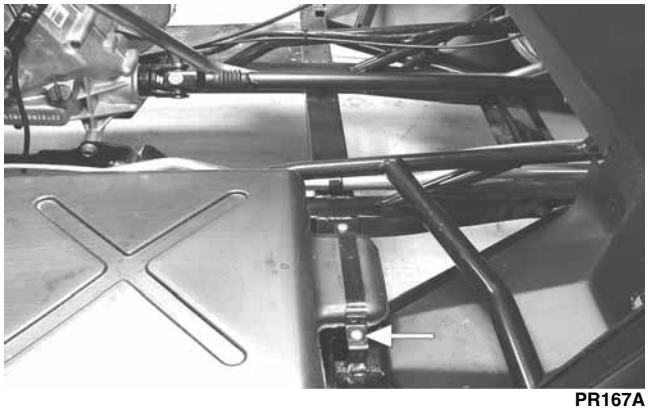
4. Place the gas cap filler panel into position; then if necessary, position the gas tank so the filler panel and filler neck are not binding or rubbing.

PR176

5. Secure the filler panel with four press-nuts; then tighten the hardware securing the hold-down straps (from steps 2-3) securely.

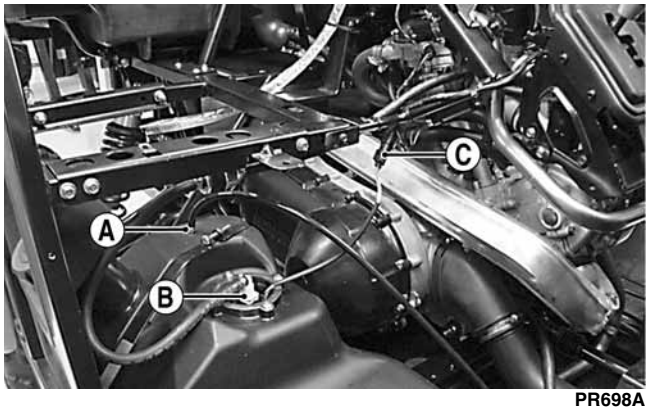


PR166A



PR167A

6. Connect the vent hose (A) and gasline hose (B) to the proper fittings; then connect the fuel pump/fuel level sensor connector (C) to the main harness.



PR698A

7. Position the floorboard into the vehicle and secure with the appropriate hardware; then install the seat base, seat back, and seat.

Gas/Vent Hoses

Replace the gas hose every two years. Damage from aging may not always be visible. Do not bend or obstruct the routing of the vent hoses. Make certain the vent hoses are securely connected and the opposite ends are always open.

Oil Filter/Oil Pump

■NOTE: Whenever internal engine components wear excessively or break and whenever oil is contaminated, the oil pump should be replaced.

TESTING OIL PUMP PRESSURE

■NOTE: The engine must be warmed up to operating temperature (cooling fan cycling) for this test.

1. Remove the seat, seat back, and seat base.
2. Using a suitable "T" fitting, connect a suitable oil pressure test kit to the oil fitting and hose. Tighten all clamps securely.

■NOTE: Some oil seepage may occur when installing the oil pressure gauge. Wipe up oil residue with a cloth.

3. Block the wheels, place the transmission in neutral, and start the engine. Allow the engine to warm up to operating temperature (with cooling fan cycling).
4. With the engine running at 3000 RPM, the pressure gauge must show 0.7-1.4 kg/cm^2 (10-20 psi).
5. Remove the test kit from the vehicle and install the oil hose. Tighten the clamps securely.
6. Install the seat base, seat back, and seat.

■NOTE: If the oil pressure is lower than specified, check for an oil leak, damaged oil seal, or defective oil pump.

■NOTE: If the oil pressure is higher than specified, check for too heavy engine oil weight (see General Information - Gasoline - Oil Lubricant), clogged oil passage, clogged oil filter, or improper installation of the oil filter.

REMOVING/DISASSEMBLING

1. Remove the oil pump from the engine (see Right-Side Components in the Engine/Transmission section).

2. Remove the Phillips-head screw on the back side of the pump and separate the pump housing and cover. Note the position of the inner and outer rotors and alignment pin for assembly.
3. Remove oil pump components.

CLEANING AND INSPECTING

1. Clean all oil-pump components.
2. Inspect the rotors for scoring and gouges.
3. Inspect the alignment pin, driveshaft, and driven sprocket for damage.
4. Inspect the pump housing and cover for cracks or damage.

ASSEMBLING/INSTALLING

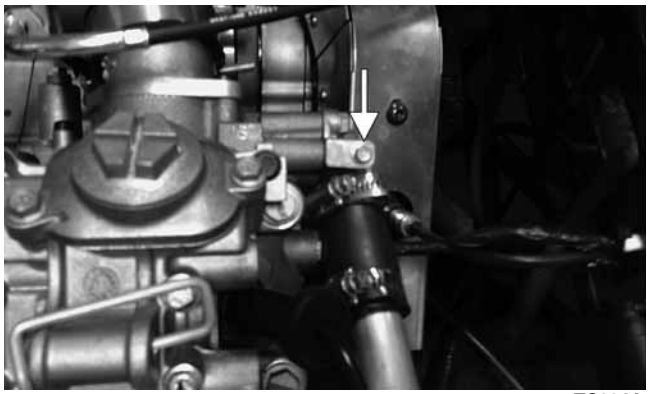
1. Place the rotors into the pump housing making sure the alignment pin is in the groove of the rotor.
2. Place the cover onto the pump housing.
3. Secure the pump cover with the Phillips-head screw coated with red Loctite #271. Tighten to 8 ft-lb.
4. Install the oil pump into the engine (see Right-Side Components in the Engine/Transmission section).

Liquid Cooling System

When filling the cooling system, use a coolant/water mixture which will satisfy the coldest anticipated weather conditions of the area in accordance with the coolant manufacturer's recommendations.

■NOTE: Use a good quality, biodegradable glycol-based, automotive-type antifreeze.

While the cooling system is being filled, air pockets may develop; therefore, remove the bleed plug on the coolant pipe at the front of the engine allowing trapped air to escape.



TC024A

When pure coolant (no air) flows from the bleed hole, install the bleed plug, tighten securely, and then fill the cooling system to the bottom of the stand pipe in the radiator neck. After operating the vehicle for the initial 5-10 minutes, stop the engine, allow the engine to cool down, and check the coolant level. Add coolant as necessary.

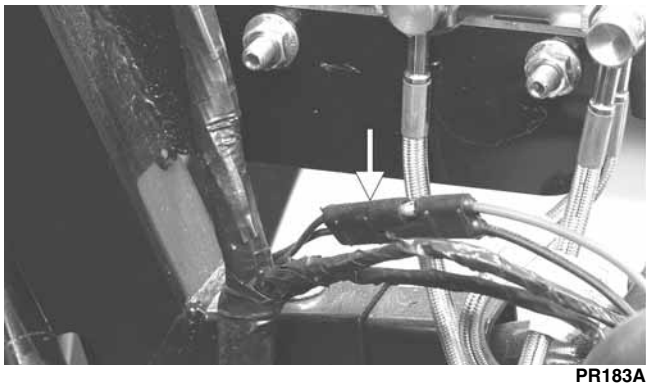
⚠ WARNING

Never check the coolant level when the engine is hot or the cooling system is under pressure.

Radiator

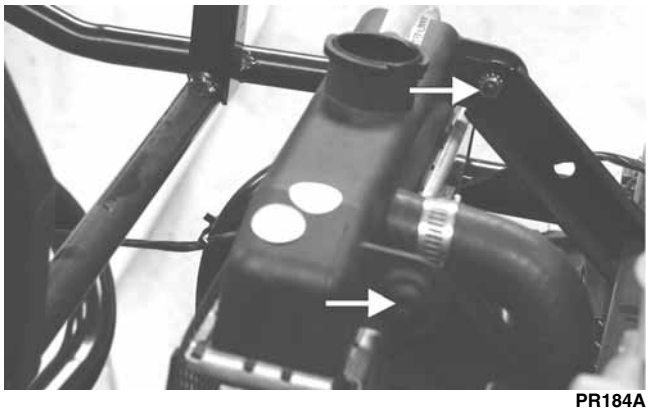
REMOVING

1. Drain the coolant into a suitable container; then disconnect the cooling fan wire connector from the main harness.



PR183A

2. Remove the two shoulder bolts and nuts securing the radiator to the frame; then disconnect the upper and lower coolant hoses.



PR184A

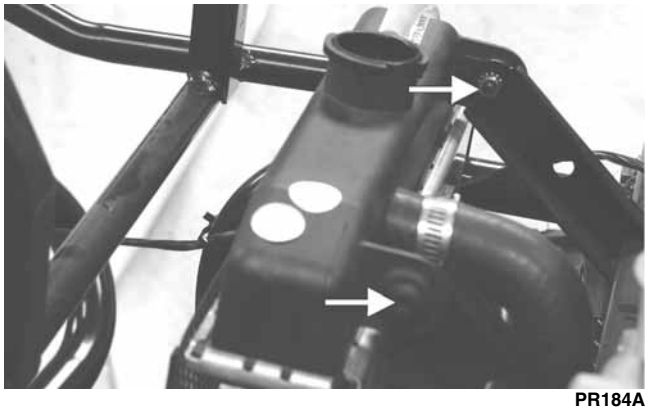
3. Lift the radiator assembly from the vehicle. Account for two upper and two lower rubber mounting grommets.

CLEANING AND INSPECTING

1. Flush the radiator with water to remove any contaminants.
2. Inspect the radiator for leaks and damage.
3. Inspect all hoses for cracks and deterioration.
4. Inspect all fasteners and grommets for damage or wear.

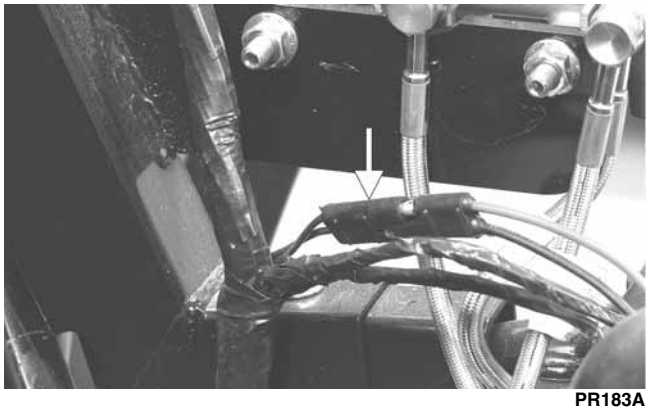
INSTALLING

1. Place the radiator into position making sure the grommets are correctly installed; then secure to the mounts with the two shoulder bolts and nuts. Tighten securely.



PR184A

2. Connect the upper and lower coolant hoses to the radiator and secure with the appropriate hose clamps; then connect the cooling fan wire connector to the main harness.



PR183A

3. Open the high-point bleed screw on the thermostat housing to allow trapped air to escape. Tighten securely after filling.
4. Pour the recommended coolant into the radiator and secure the radiator cap.
5. Start the engine and warm up to operating temperature; then verify the coolant level is at the bottom of the stand pipe in the radiator neck. Add coolant as necessary.

Thermostat

REMOVING

1. Drain approximately one quart of coolant from the cooling system.
2. Remove the two cap screws securing the thermostat housing to the cylinder head. Account for a thermostat with seal.

INSPECTING

1. Inspect the thermostat for corrosion, wear, or spring damage.
2. Using the following procedure, inspect the thermostat for proper operation.
   A. Suspend the thermostat in a container filled with water.
   B. Heat the water and monitor the temperature with a thermometer.
   C. The thermostat should start to open at 71.0-86.0° C (160-187° F).
   D. If the thermostat does not open, it must be replaced.
3. Inspect all coolant hoses, connections, and clamps for deterioration, cracks, and wear.

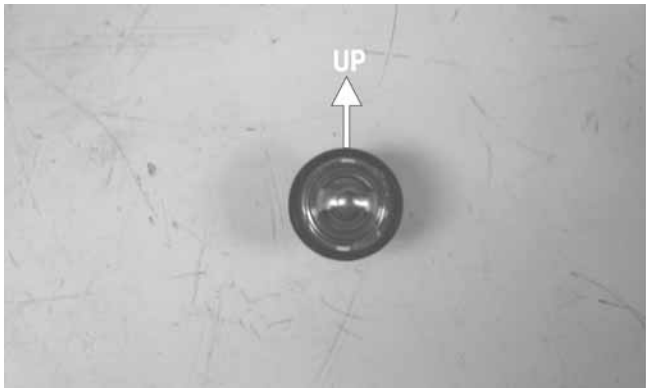
■NOTE: All coolant hoses and clamps should be replaced every four years or 4000 miles.

INSTALLING

1. Place the thermostat with seal into the thermostat housing; then secure the thermostat housing to the cylinder head with the two cap screws.

CAUTION

When installing the thermostat, make sure the bleed holes are straight up and down or air will remain trapped causing engine damage due to overheating.



PR281A

2. Fill the cooling system with the recommended amount of antifreeze. Check for leakage.

Fan

REMOVING

1. Remove the radiator.
2. Remove the fan assembly from the radiator.

INSTALLING

1. Position the fan assembly on the radiator; then secure with existing hardware.

■**NOTE: The fan wiring must be in the upper-right position.**

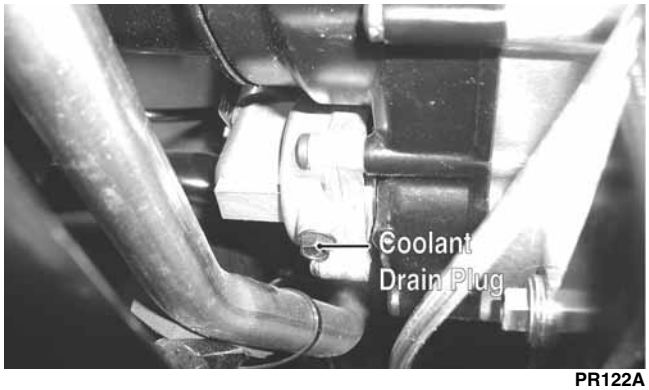
2. Install the radiator.

Water Pump

■ **NOTE: The water pump is not a serviceable component. If the pump is defective or if the mechanical seal is leaking (coolant dripping from the discharge hole), the water pump must be replaced.**

REMOVING

1. Remove the radiator cap; then remove the water pump coolant drain plug and drain the coolant.

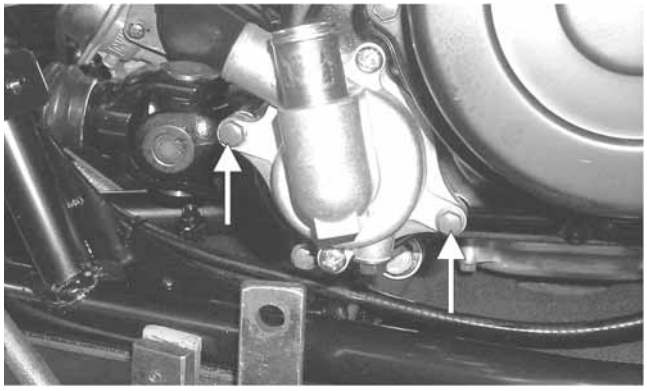


PR122A

2. Drain the oil from the engine/transmission.
3. Remove the seat and seat base.
4. Loosen the coolant hose clamps and slide the clamps away from the hose ends.

PR132

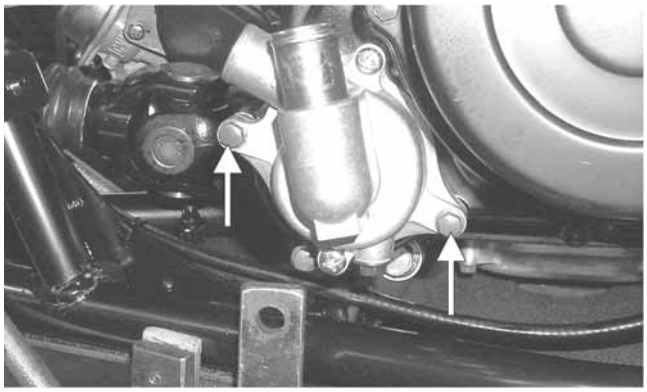
5. Remove the two cap screws securing the water pump to the engine; then remove the water pump.



CC786A

INSTALLING

1. Secure the water pump to the engine with the two cap screws tightened to 8 ft-lb.



CC786A

2. Connect the two coolant hoses to the water pump and secure with the clamps; then install the water pump coolant drain plug.
3. Fill the engine/transmission with the proper amount of recommended oil.
4. Open the coolant bleed screw and fill the cooling system with the proper amount of recommended coolant. Close the bleed screw and tighten when no more air is present.

HDX158B

■**NOTE: While the cooling system is being filled, air pockets may develop; therefore, run the engine for five minutes after the initial fill, shut the engine off, and then fill the cooling system.**

5. Check the entire cooling system for leakage.

CAUTION
After operating the vehicle for the initial 5-10 minutes, stop the engine, allow the engine to cool down, and check the coolant level. Add coolant as necessary.

6. Install the seat base and seat.

Troubleshooting

Problem: Starting impaired	
Condition	**Remedy**
1. **Gas** contaminated	1. Drain gas tank and fill with clean gas
Problem: Idling or low speed impaired	
Condition	**Remedy**
1. **TPS** out of adjustment	1. Adjust TPS
Problem: Medium or high speed impaired	
Condition	**Remedy**
1. **High RPM "cut out"** against RPM limiter	1. Decrease RPM speed

Electrical System

The electrical connections should be checked periodically for proper function.

TESTING ELECTRICAL COMPONENTS

All electrical tests should be made using the CATT II or a suitable multimeter. The CATT II can return data for certain components which are identified at the beginning of their respective sub-section. If any other type of meter is used, readings may vary due to internal circuitry. When troubleshooting a specific component, always verify first that the fuse(s) are good, that the LED(s) are good, that the connections are clean and tight, that the battery is fully charged, and that all appropriate switches are activated.

■NOTE: For absolute accuracy, all tests should be made at room temperature of 68° F.

■NOTE: Certain components and sensors can be checked by using the EFI diagnostic system (see EFI Diagnostic System in this section for more information).

Battery

CATT II
Cat Advanced Tech Tool

Component data can be retrieved using the CATT II. Utilize the Sensor Data screen.

■NOTE: Preliminary checks may be performed on this component using the diagnostic mode on the LCD gauge (see EFI Diagnostic System in this section)

The battery is located under the seat.

After being in service, batteries require regular cleaning and recharging in order to deliver peak performance and maximum service life. The following procedures are recommended for cleaning and maintaining sealed batteries. Always read and follow instructions provided with battery chargers and battery products.

■NOTE: Refer to all warnings and cautions provided with the battery or battery maintainer/charger.

Loss of battery charge may be caused by ambient temperature, ignition OFF current draw, corroded terminals, self discharge, frequent start/stops, and short engine run times. Frequent winch usage, snowplowing, extended low RPM operation, short trips, and high amperage accessory usage are also reasons for battery discharge.

Charging/Maintenance Charging

⚠ WARNING

Any time service is performed on a battery, the following must be observed: keep sparks, open flame, cigarettes, or any other flame away. Always wear safety glasses. Protect skin and clothing when handling a battery. When servicing battery in enclosed space, keep the area well-ventilated. Make sure battery venting is not obstructed.

■NOTE: When charging a battery in the vehicle, be sure the ignition switch is in the OFF position.

1. Clean the battery terminals with a solution of baking soda and water.

■NOTE: The sealing strip should NOT be removed and NO fluid should be added.

2. Be sure the charger and battery are in a well-ventilated area. Be sure the charger is unplugged from the 110-volt electrical outlet.
3. Connect the red terminal lead from the charger to the positive terminal of the battery; then connect the black terminal lead of the charger to the negative terminal of the battery.
4. Plug the battery charger into a 110-volt electrical outlet.
5. Trickle charge the battery at 3 amps for 5-10 hours. If the battery becomes hot to the touch, stop charging. Resume after it has cooled.
6. Once the battery has reached full charge, unplug the charger from the 110-volt electrical outlet.

■ NOTE: If, after charging, the battery does not perform to operator expectations, bring the battery to an authorized Toro ROV dealer for further troubleshooting.

Accessory Receptacle/ Connector

■NOTE: This test procedure is for either the receptacles or the connectors.

VOLTAGE

1. Turn the ignition switch to the ON position; then set the meter selector to the DC Voltage position.
2. Connect the red tester lead to the red/white wire or the positive connector; then connect the black tester lead to ground.
3. The meter must show battery voltage.

■NOTE: If the meter shows no battery voltage, troubleshoot the battery, fuse, receptacle, connector, or the main wiring harness.

Brakelight Switch

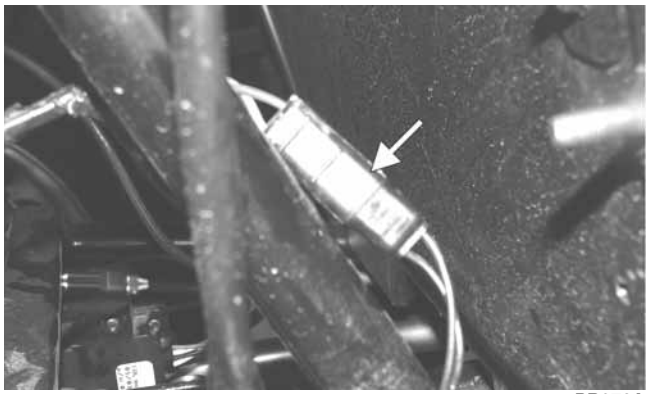
Component data can be retrieved using the CATT II. Utilize the Sensor Data screen.

The switch connector is the two-prong black connector below the master cylinder.

■NOTE: The ignition switch must be in the ON position.

VOLTAGE (Wiring Harness Connector)

1. Set the meter selector to the DC Voltage position.
2. Connect the red tester lead to the orange wire; then connect the black tester lead to battery ground.



PR276A

3. The meter must show battery voltage.

■NOTE: If the meter shows no battery voltage, troubleshoot the battery, fuse, switch, or the main wiring harness.

■NOTE: If the meter shows battery voltage, the main wiring harness is good; proceed to test the switch/component, the connector, and the switch wiring harness for resistance.

RESISTANCE (Switch Connector)

CAUTION

Always disconnect the battery when performing resistance tests to avoid damaging the multimeter.

■NOTE: The brake pedal must be depressed for this test.

1. Set the meter selector to the OHMS position.
2. Connect the red tester lead to one black wire; then connect the black tester lead to the other black wire.

AR621D

3. When the lever is depressed, the meter must show less than 1 ohm.

■NOTE: If the meter shows more than 1 ohm of resistance, replace the switch.

Engine Coolant Temperature (ECT) Sensor

Component data can be retrieved using the CATT II. Utilize the Sensor Data screen.

■NOTE: Preliminary checks may be performed on this component using the diagnostic mode on the LCD gauge (see EFI Diagnostic System in this section).

1. Connect the meter leads (selector in OHMS position) to the sensor terminals.
2. Suspend the sensor and a thermometer in a container of cooking oil; then heat the oil.

■NOTE: Neither the sensor nor the thermometer should be allowed to touch the bottom of the container or inaccurate readings will occur. Use wire holders to suspend the sensor and thermometer.

⚠ WARNING

Wear insulated gloves and safety glasses. Heated oil can cause severe burns.

3. If the readings are not as indicated, the sensor must be replaced.

MODEL	OIL TEMPERATURE	OHMS
500	20 °C (68 °F)	2.45k
	50 °C (122 °F)	800
	80 °C (176 °F)	318
	110 °C (212 °F)	142
700	40 °C (104 °F)	1136
	100 °C (212 °F)	155

4. Install the sensor and tighten securely; then connect the leads.

Fan Motor

This component can be tested using the CATT II. Utilize the Test screen.

■NOTE: Preliminary checks may be performed on this component using the diagnostic mode on the LCD gauge (see EFI Diagnostic System in this section).

■NOTE: To determine if the fan motor is good, connect the red wire from the fan connector to the positive side of a 12 volt battery; then connect the black wire from the fan connector to the negative side. The fan should operate.

⚠ WARNING

Care should be taken to keep clear of the fan blades.

■NOTE: Fan motor resistance checks are not recommended. Resistance values change with the motor commutator position.

Power Distribution Module (PDM)

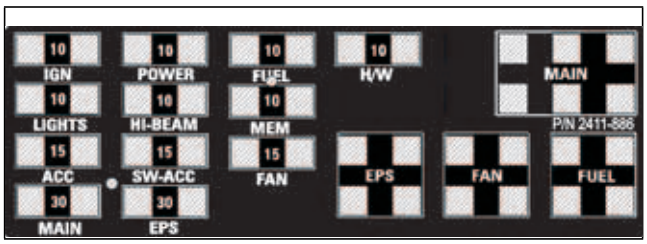
■NOTE: The module and wiring harness are not a serviceable component and must be replaced as an assembly.

If there is any type of electrical system failure, always check the fuses first.

■NOTE: The fuses are located in a power distribution module under the operator's seat.

1. Remove all fuses from the power distribution module.

■NOTE: To remove a fuse, compress the locking tabs on either side of the fuse case and lift out.



2411-886

CAUTION

Always replace a blown fuse with a fuse of the same type and rating.

■NOTE: Make sure the fuses are returned to their proper position according to amperage. Refer to the amperage listed under each fuse on the power distribution module.

2. Set the meter selector to the DC Voltage position.
3. Connect the black tester lead to battery ground.
4. Using the red tester lead, contact each end of the fuse holder connector terminals individually.
5. The meter must show battery voltage from one side of the connector terminal ends.

■NOTE: Battery voltage will be indicated from only one side of the fuse holder connector terminal; the other side will show no voltage.

■NOTE: When testing the HI fuse holder, the headlight OFF/HI/LO switch must be in the HI position; when testing the LIGHTS fuse holder, the headlight dimmer switch can be in either the HI or the LO position.

■NOTE: If the meter shows no battery voltage, troubleshoot the battery, switches, power distribution module, or the main wiring harness.

RELAYS

The 4-pin relays are identical plug-in type located on the power distribution module. Relay function can be checked by switching relay positions. The 4-pin relays are interchangeable.

Ignition Coil

The ignition coil is mounted on the fuel pump mounting plate adjacent to the fuel pump.

VOLTAGE (Primary Side)

See Primary Coil in this sub-section.

RESISTANCE

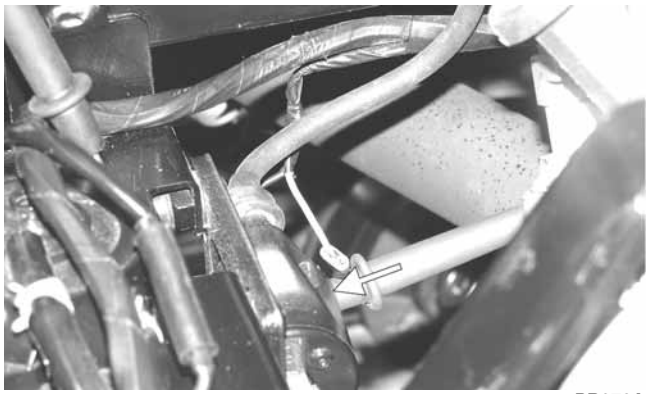
CAUTION

Always disconnect the battery when performing resistance tests to avoid damaging the multimeter.

■NOTE: For these tests, the meter selector should be set to the OHMS position.

Primary Winding

1. Connect the red tester lead to the terminal (with the wire removed); then connect the black tester lead to battery ground.



PR278A

2. The meter reading must be less than 1 ohm.

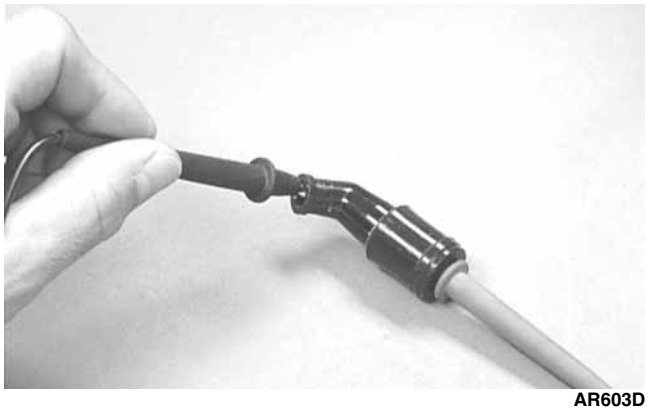
Secondary Winding

1. Connect the red tester lead to the high tension lead (with the plug cap removed); then connect the black tester lead to either primary terminal.
2. The meter reading must be within specification.

■NOTE: If the meter does not show as specified, replace ignition coil.

Spark Plug Cap

1. Connect the red tester lead to one end of the cap; then connect the black tester lead to the other end of the cap.



AR603D

2. The meter must show 4000-6000 ohms.

■NOTE: If the meter does not show as specified, replace the spark plug cap.

VOLTAGE

Primary Coil

1. Set the meter selector to the DC Voltage position; then disconnect the two wires from the coil.

■NOTE: The coil is located to the right of the engine and may be accessed from behind the right-side seat with the cargo box raised.

2. Connect the red tester lead to the orange wire and the black tester lead to the blue/white wire.
3. Turn the ignition switch to the ON position. The meter must show battery voltage.

EFI Sensors/Components

CRANKSHAFT POSITION (CKP) SENSOR

Resistance

1. Set the meter selector to the OHMS position.
2. Connect the red tester lead to the brown wire; then connect the black tester lead to the white wire. The meter reading must be 104-156 ohms.

AC Voltage

■NOTE: The battery must be at full charge for these tests.

1. Set the meter selector to the AC Voltage position.
2. Connect the red tester lead to the brown wire; then connect the black tester lead to the white wire.
3. Crank the engine over using the electric starter.
4. The meter reading must be 2.0 volts or more.

OXYGEN (O2) SENSOR

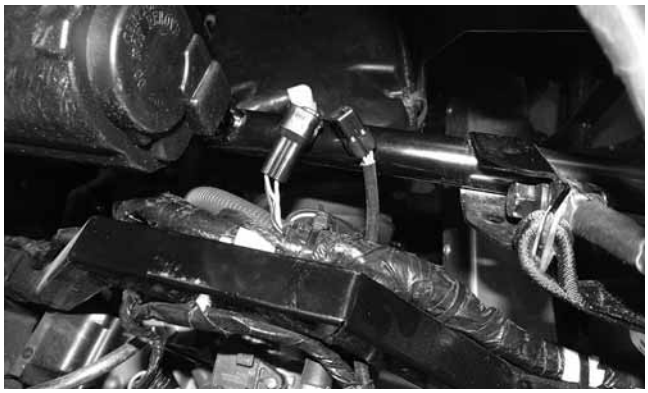
CATT II
Cat Advanced Tech Tool

Component data can be retrieved using the CATT II. Utilize the Sensor Data screen.

The Oxygen Sensor (O2 Sensor) is located in the exhaust pipe.

■NOTE: When testing the resistance of the sensor's heater, the engine/exhaust pipe must be at room temperature (65-75° F) or inaccurate readings will occur.

1. Open the cargo box; then remove the seat, air filter cover, and air filter.
2. Remove the backrest and seat base.
3. Disconnect the sensor.



HDX 247

■NOTE: For this test, the meter must be in OHMS position.

4. On the sensor side of connector, connect the black (negative) test lead to one white wire pin; then connect the red (positive) test lead to the other white wire pin. Readings should be between 6.7 and 10.1 ohms.

■NOTE: If the meter does not read as specified, replace the sensor.

MANIFOLD ABSOLUTE PRESSURE/ INLET AIR TEMPERATURE (MAP/IAT) SENSOR

CATT II
Cat Advanced Tech Tool

Component data can be retrieved using the CATT II. Utilize the Sensor Data screen.

■NOTE: Preliminary checks may be performed on this component using the diagnostic mode on the LCD gauge (see EFI Diagnostic System in this section).

■NOTE: The ambient temperature of the engine and in the intake and exhaust system must be at room temperature (approximately 68° F) when performing this test or an incorrect reading will occur.

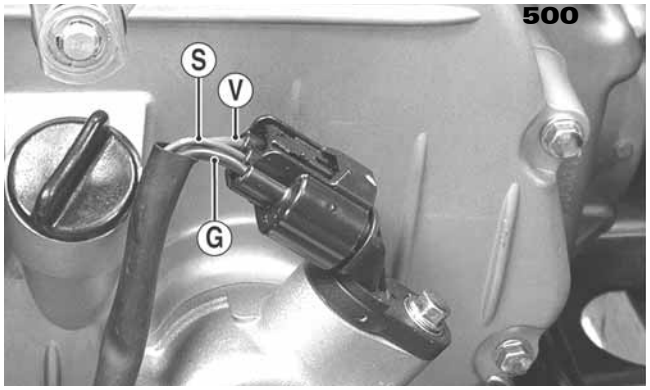
1. Disconnect the MAP/IAT connector from the sensor located on top of the throttle body.
2. Select DC Voltage on the tester and turn the ignition switch to the ON position.
3. Connect the black tester lead to the black/pink wire and the red tester lead to the orange/blue wire. The meter should read 4.5-5.5 DC volts. If the meter does not read as specified, check the ECM connector or wiring.
4. Connect the MAP/IAT to the harness; then using needle adapters, connect the red tester lead to the brown/white wire and the black tester lead to the black/pink wire. With the engine running at idle speed, the meter should read approximately 2.5 DC volts (MAP sensor signal).
5. Connect the red tester lead to the green/red wire. With the engine at idle and at room temperature (approximately 60° F), the meter should read approximately 2.9 DC volts.

■NOTE: If the meter does not read as specified, replace the sensor.

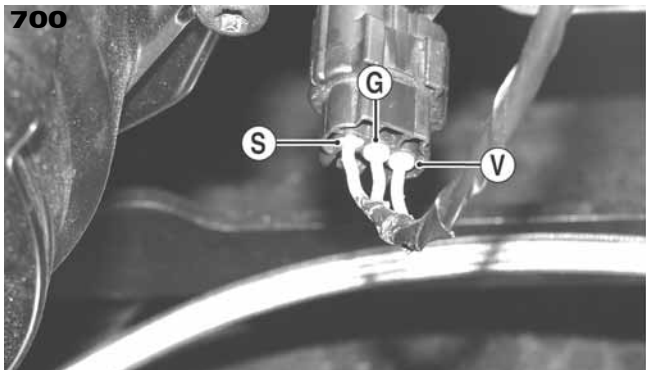
Speed Sensor

■NOTE: Prior to testing the speed sensor, inspect the three-wire connector on the speed sensor for contamination, broken pins, and/or corrosion.

1. Set the meter selector to the DC Voltage position.
2. With appropriate needle adapters on the meter leads, connect the red tester lead to the voltage lead (V); then connect the black tester lead to the ground lead (G).



KC248A



PR279A

3. Turn the ignition switch to the ON position.
4. The meter must show greater than 5 volts (500) or approximately 6 volts (700).
5. Leave the black tester lead connected; then connect the red tester lead to the signal lead pin (S).
6. Slowly move the vehicle forward or backward; the meter must show 0 and approximately 6 volts alternately.

To replace a speed sensor, use the following procedure.

1. Disconnect the three-wire connector from the speed sensor; then remove the cap screw securing the sensor to the sensor housing.
2. Remove the sensor from the sensor housing accounting for an O-ring.

3. Install the new speed sensor into the housing with new O-ring lightly coated with multi-purpose grease; then secure the sensor with the cap screw (threads coated with blue Loctite #242). Tighten securely.

CD071

RPM Limiter

Component data can be retrieved using the CATT II. Utilize the Sensor Data screen.

■NOTE: The ROV is equipped with an ECM that cuts fuel spray and spark when maximum RPM is approached. When the RPM limiter is activated, it could be misinterpreted as a high-speed misfire.

Gear	Park	Neutral	Reverse	High/Low	Fail-Safe Mode	Incorrect ECU/ Gauge (P0630)	Warranty Registration (U1001)
2WD	2250	6500	4000	7650 (500) 7250 (700)	4000	6650	4500
4WD							
4WD Lock							
2WD Override			4500 (500) 5000 (700)				
4WD Override			7000				
Differential-Lock Override							

Ignition Switch

To access the ignition switch, dash switches, front accessory connectors, and front switched accessory connector, the dash must be unfastened and slid to the rear.

VOLTAGE

■NOTE: Perform this test on the harness connector.

1. Set the meter selector to the DC Voltage position.
2. Connect the red meter lead to the red wire; then connect the black meter lead to battery ground.
3. Meter must show battery voltage.

■NOTE: If the meter shows no battery voltage, troubleshoot the main 30 amp fuse, the battery, or the main wiring harness.

4. Connect the red meter lead to the red/black wire; then with the black lead grounded, turn the ignition switch to the ON position. The meter must show battery voltage.
5. Connect the red meter lead to the yellow/green wire; then with the black lead grounded, turn the ignition switch to the START position. The starter should engage and the meter must show battery voltage.

■NOTE: When the starter is engaged, battery voltage will be approximately 10.5 DC volts.

Headlight Switch

VOLTAGE

1. Connect the red meter lead to the gray wire; then connect the black meter lead to the black wire.
2. Turn the ignition switch to the ON position. The meter must show battery voltage.

■NOTE: If the meter does not show battery voltage, troubleshoot the LIGHTS fuse on the power distribution module, the ignition switch, or the main harness.

3. Connect the red meter lead to the yellow wire; then select the high beam position on the headlight switch. The meter must show battery voltage.
4. Connect the red meter lead to either of the two white wires; then select the low beam position on the headlight switch. The meter must show battery voltage.

■NOTE: The battery voltage will show lower in steps 3 and 4 due to electrical loading of the headlights.

Drive Select Switch

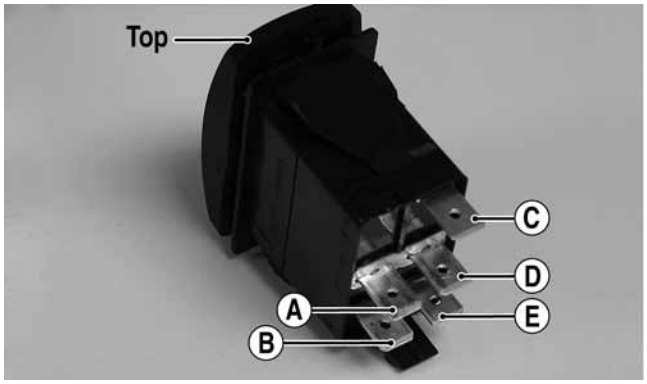
Component data can be retrieved using the CATT II. Utilize the Sensor Data screen.

RESISTANCE

1. Remove the switch assembly from the dash; then disconnect the harness from the switch.

■NOTE: The switch can be removed from the dash using a thin, flat pry bar or suitable putty knife. It is not necessary to remove the dash to remove the switch.

2. Using an ohmmeter, the following readings must be observed.



PR566A

2WD	4WD	DIFFERENTIAL LOCK
A to D <1 ohm	A to D <1 ohm	A to D <1 ohm
C to E <1 ohm	C to E <1 ohm	C to E <1 ohm
A to B Open	A to B <1 ohm	A to B <1 ohm
A to C Open	A to C Open	A to C <1 ohm
A to E Open	A to B <1 ohm	A to C <1 ohm

VOLTAGE

■NOTE: Voltage tests must be made with the switch and the actuator connected. The meter can be connected at the actuator connector using a break-out harness or needle adapters.

1. Connect the black tester lead to the black wire; then turn the ignition switch to the ON position.
2. Select the DC Volts position on the tester and observe the meter readings for each of the three switch positions.

WIRE COLOR	2WD	4WD	DIFFERENTIAL LOCK
Black to Orange	12.0 DC Volts	12.0 DC Volts	12.0 DC Volts
Black to White/ Green	11.5 DC Volts	0 DC Volts	0 DC Volts
Black to White/ Red	11.5 DC Volts	11.5 DC Volts	0 DC Volts

■NOTE: If the meter does not show voltages according to the chart, make sure the front drive actuator is plugged in; then troubleshoot the switch, ignition fuses, battery connections, or wiring harness.

Reverse Override Switch

VOLTAGE

■NOTE: To perform the following tests, the ignition switch must be in the ON position and the transmission shifted into reverse gear.

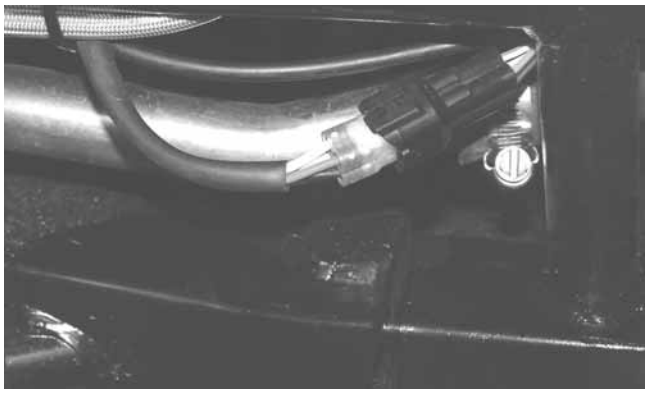
1. Connect the red meter lead to the black/blue wire and the black meter lead to a suitable ground; then select 2WD on the drive select switch. The meter must show approximately 1.5 DC volts.
2. Depress the reverse override switch. The meter showing should not change from step 1.
3. Select 4WD on the drive select switch. The meter must show approximately 5 DC volts.
4. Depress the reverse override switch. The meter must show approximately 1.5 DC volts.
5. Connect the red meter lead to the red/yellow wire. The meter must show approximately 1.5 DC volts. Depress the reverse override switch. The meter must show approximately 1.5 DC volts.
6. Connect the red meter lead to the red/green wire. The meter should show 0 DC volts.
7. Depress the reverse override switch. The meter must show approximately 5 DC volts.

Front Drive Actuator

■NOTE: With the engine stopped and the ignition switch in the ON position, a momentary "whirring" sound must be noticeable each time the drive select switch is moved to 2WD and 4WD. Test the switch, 30 amp fuse, and wiring connections prior to testing the actuator.

VOLTAGE

1. Locate the 4-wire connector for the front drive selector actuator on the frame to the right of the differential; then connect the red meter lead to the orange wire using needle adapters.



PR293

2. Connect the black lead to the black wire using needle adapters; then select 2WD on the drive select switch.

PR295

■NOTE: The black tester lead can remain connected to the black wire for the remaining tests.

3. Turn the ignition switch to the ON position. The meter must show battery voltage.

■NOTE: If battery voltage is not shown, troubleshoot the 10 amp ignition (IGN) fuse on the power distribution module, the ignition switch, or the main wiring harness.

4. Connect the red meter lead to the white/red wire. The meter must show battery voltage.
5. Select 4WD on the drive select switch. The meter must show 0 DC volts.
6. Connect the red meter lead to the white/orange wire. The meter must show battery voltage.
7. Engage the differential lock. The meter must show 0 DC volts.

■NOTE: If the meter does not show 0 DC volts, rock the vehicle to help engage the differential lock; then troubleshoot the differential lock switch.

Stator Coil

VOLTAGE (AC Generator - Regulated Output)

1. Set the meter selector to the DC Voltage position.
2. Connect the red tester lead to the positive battery post; then connect the black tester lead to the negative battery post.
3. With the vehicle in neutral and the engine running as shown in the chart (with the headlights on), the meter must show 14-15.5 DC volts.

MODEL	RPM
500	3000
700	5000

CAUTION

Do not run the engine at high RPM for more than 10 seconds.

■NOTE: If voltage is lower than specified, test AC Generator - No Load.

VOLTAGE (AC Generator - No Load)

The connector is the black three-pin one on the right side below the ignition coil.

HDX150A

■NOTE: Test the connector coming from the engine.

1. Set the meter selector to the AC Voltage position.
2. Test between the three yellow wires for a total of three tests.
3. With the engine running at a constant 5000 RPM, all wire tests must be within specification

CAUTION

Do not run the engine at high RPM for more than 10 seconds.

■NOTE: If both stator coil tests failed, check all connections, etc., and test again. If no voltage is present, replace the stator coil assembly.

RESISTANCE (AC Generator)

CAUTION

Always disconnect the battery when performing resistance tests to avoid damaging the multimeter.

1. Set the meter selector to OHMS position.
2. Test between the three yellow wires for a total of three tests.
3. The meter reading must be within specification.

Starter Motor

■NOTE: The starter motor is not a serviceable component. If the starter is defective, it must be replaced.

REMOVING

1. Disconnect the battery.

CAUTION

Always disconnect the negative battery cable from the battery first; then disconnect the positive cable.

2. Remove the nut securing the positive cable to the starter; then remove the cable from the starter.
3. Remove the two cap screws securing the starter with ground wires to the crankcase; then remove the starter. Account for the wiring forms and an O-ring.

INSTALLING

1. Apply a small amount of grease to the O-ring seal on the starter; then install the starter into the crankcase. Secure with two machine screws and wiring forms.
2. Secure the positive cable to the starter with the nut.
3. Connect the battery.

TESTING VOLTAGE

Perform this test on the starter positive terminal. To access the terminal, slide the boot away.

■NOTE: The ignition switch must be in the ON position, and the shift lever in the NEUTRAL position.

1. Set the meter selector to the DC Voltage position.
2. Connect the red tester lead to the starter terminal; then connect the black tester lead to ground.
3. With the starter button depressed, the meter must show battery voltage and the starter should operate.

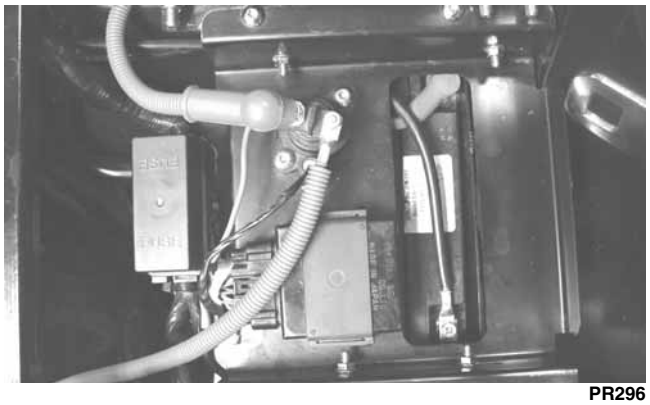
AR607D

■NOTE: If the meter showed battery voltage but the starter did not operate or operated slowly, inspect battery voltage (at the battery), starter condition, and/or ground connections.

■NOTE: If the meter showed no battery voltage, inspect the main fuse, ground connections, starter lead, battery voltage (at the battery), starter relay, or the neutral start relay.

Starter Relay

1. Remove the seat base and battery cover; then using the multimeter set to the DC Voltage position, check the relay as follows.
2. Connect the red tester lead to the positive battery terminal; then connect the black tester lead to the starter cable connection on the starter relay. The meter must show battery voltage.



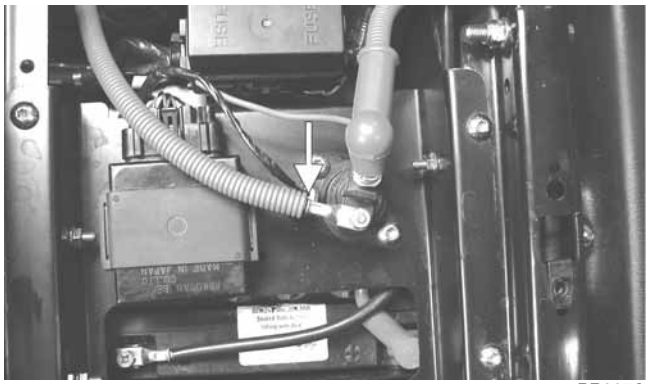
PR296

■NOTE: Make sure the ignition switch is in the ON position, transmission in neutral, and parking brake set.

3. Depress the starter button while observing the multimeter. The multimeter should drop to 0 volts and a "click" should be heard from the relay.

■NOTE: If a "click" is heard and more than one volt is indicated by the multimeter, replace the starter relay. If no "click" is heard and the multimeter continues to indicate battery voltage, proceed to step 4.

4. Disconnect the two-wire plug from the starter relay; then connect the red tester lead to the green wire and the black tester lead to the black wire.



PR297A

5. Depress the starter button and observe the multimeter.

■NOTE: If battery voltage is indicated, replace the starter relay.

Electronic Control Module (ECM)

The ECM is located beneath the seat near the battery.

■NOTE: The ECM is not a serviceable component. If the unit is defective, it must be replaced.

The ECM is rarely the cause for electrical problems; however, if the ECM is suspected, substitute another ECM to verify the suspected one is defective.

This EFI system has a built-in feature that will only allow an ECM of the same part number to be used in this model. Do not attempt to substitute an ECM from a different model as the system will not allow it to start.

Error codes can be cleared by following the procedures located in the EFI Diagnostic System sub-section in this section.

■NOTE: If the throttle body, ECM, TPS, or ISC are replaced, the EFI system must be synchronized. Use the following procedure.

1. With the key off, depress accelerator pedal to Wide Open Throttle (WOT).
2. Place the ignition key in the ON position and wait for 10 seconds.
3. Release the accelerator pedal, and wait an additional 10 seconds.
4. Turn the key to the OFF position and allow the gauge to shut off.

Fuel Pump/Fuel Level Sensor

Component data can be retrieved using the CATT II. Utilize the Sensor Data screen.

■NOTE: Preliminary checks may be performed on this component using the diagnostic mode on the LCD gauge (see EFI Diagnostic System in the Electrical System section).

The electric fuel pump and fuel level sensor are not serviceable components. If either component fails, it must be replaced.

TESTING

⚠ WARNING

Whenever any maintenance or inspection is made on the fuel system during which there may be fuel leakage, there should be no welding, smoking, open flames, etc., in the area.

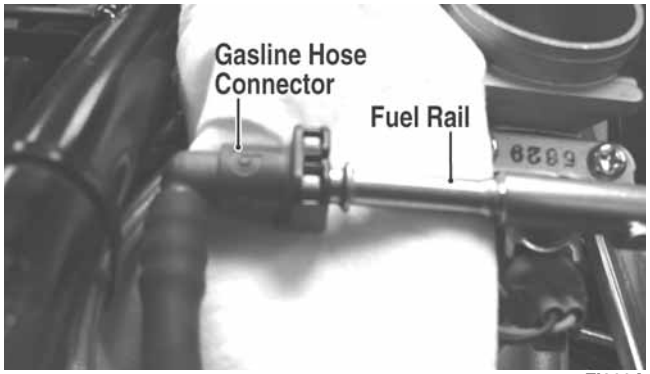
☞ AT THIS POINT

Prior to removing the electric fuel pump, the following check should be performed to determine that removal is necessary.

1. Turn the ignition switch ON and listen for a momentary "whirring" sound of the pump building pressure. If the sound is heard (10 seconds), no electrical checks are necessary. Turn the ignition switch OFF.
2. Disconnect the gasline hose from the fuel rail; then install a suitable pressure gauge.

⚠ WARNING

Gasoline may be under pressure. Place an absorbant towel under the connector to absorb any gasoline spray when disconnecting.



FI092A

3. Turn the ignition switch to the ON position. The fuel pressure should build until the pump shuts off. Pressure should read 3.0 kg/cm^2 (43 psi).

XR172

■NOTE: The fuel pump will cycle 5-10 seconds after the ignition key is turned on.

4. If the pump is producing fuel pressure that is out of specification, check all electrical connectors and verify the pump is getting proper voltage (battery voltage).
5. Connect a multimeter to the power supply leads with the red tester lead to the red wire and the black tester lead to the black wire; then turn the ignition switch to the ON position. The meter should read battery voltage.

■NOTE: Low voltage will produce a low fuel pressure reading.

6. If normal battery voltage is present and the ground wire has been checked for continuity to chassis, replace the fuel pump. If no voltage is present, determine if the fuel pump fuse, relay, wiring, tilt sensor, or ECM is causing no voltage.

■NOTE: If the gauge is flashing FUEL OFF, the tilt sensor system has intentionally deactivated the fuel system.

REMOVING

1. Remove the key from the ignition switch.

⚠ WARNING

Always ensure that power cannot be inadvertently applied to the ignition/ECM when working on the fuel system. If the ignition switch is turned on, the electric fuel pump will start and gas could be rapidly pumped and spilled resulting in fire and severe injury.

2. Remove the seat, seat back, and seat base; then disconnect the negative battery cable.
3. Disconnect the electrical plug from the main harness; then disconnect the gasline hose from the fuel pump.
4. Mark the fuel pump mounting and gas tank for installing purposes; then remove the screws securing the fuel pump to the gas tank and remove the fuel pump.

CAUTION

Take care not to damage the float or float arm or replacement of the entire assembly will be necessary.

5. Using duct tape or other suitable means, cover the fuel pump opening.

INSPECTING

☞ AT THIS POINT

If the pump has failed earlier test and must be replaced, proceed to INSTALLING.

1. Inspect the fuel screen and blow clean with low pressure compressed air.
2. Move the float lever and check for free movement. The float assembly should return to the lower position without force. If not, replace the fuel level sensor assembly.
3. Test the fuel level sensor by connecting a multimeter to the fuel level sensor leads; then select OHMS. The multimeter should show 5 ohms at full fuel position and 95 ohms at empty fuel position.

■NOTE: If readings are erratic, clean the resistor wiper and resistor with clean alcohol and retest. If still not correct, replace the fuel level sensor.

INSTALLING

1. Place the fuel pump assembly into the gas tank with a new gasket aligning the match marks; then secure with the four screws. Tighten securely.

■NOTE: It is important to install the fuel pump with the correct orientation to ensure adequate float lever clearance.

2. Connect the gasline hose to the fuel pump pipe and secure with the hose clamp; then connect the electrical plug to the main harness.
3. Connect the negative battery cable; then turn the ignition switch to the ON position and verify that no gas leaks are present, the pump runs for 2-3 seconds, and the gas gauge reading is normal.
4. Start the engine to verify proper engine operation; then shut off the engine and install the seat base, seat back, and seat.

Regulator/Rectifier

The regulator/rectifier is located under the seat next to the battery. Try to verify all other charging system components before the regulator/rectifier is replaced.

TESTING VOLTAGE

1. Start engine and warm up to normal operating temperatures; then connect a multimeter (set at the DC Voltage position) to the battery as follows.
2. Connect the red tester lead to the positive battery post and the black tester lead to the negative battery post.
3. Slowly increase RPM. The voltage should increase with the engine RPM to a maximum of 15.5 DC volts.

■NOTE: If voltage rises above 15.5 DC volts, the regulator is faulty or a battery connection is loose or corroded. Clean and tighten battery connections or replace the regulator/rectifier. If voltage does not rise, replace the regulator/rectifier.

Headlights

The connectors are the four 2-prong ones secured to the headlight bulbs (two on each side).

VOLTAGE

■NOTE: The low beams are the outside bulbs (black and white wires) and the high beams are the inside bulbs (yellow and black wires). Always connect the black tester lead to the black wires. The ignition switch must be in the ON position.

1. Set the meter selector to the DC Voltage position.
2. Set the light switch to the correct position for the affected light; then connect the black tester lead to the black wire using needle adapters.
3. Connect the red tester lead to the yellow wire (high beam) or white wire (low beam) using needle adapters. The meter must show battery voltage.

■NOTE: If battery voltage is not shown in any test, inspect the LIGHTS fuse on the power distribution module, headlight switch, ignition switch, switch connectors, or wiring harness.

Taillight-Brakelight

VOLTAGE (Taillight)

■NOTE: Perform this test at the socket end of the taillight-brakelight harness (pigtail). The ignition switch must be in the ON position and either high beam or low beam selected on the light switch.

1. Set the meter selector to the DC Voltage position.
2. Connect the black tester lead to the black wire; then connect the red tester lead to the white wire. The meter should show battery voltage.
3. With the ignition key in the LIGHTS position, the meter must show battery voltage.

■NOTE: If battery voltage is not shown and the headlights are illuminated, inspect the three-wire connector in the left-rear canopy tube at the juncture of the canopy tube and lower frame. If battery voltage is shown on the meter, replace the bulb.

VOLTAGE (Brakelight)

■NOTE: Perform this test at the socket end of the taillight-brakelight harness (pigtail). The ignition switch must be in the ON position.

1. Set the meter selector to the DC Voltage position.
2. Connect the red tester lead to the red/blue wire; then connect the black tester lead to the black wire.
3. With the brake applied, the meter must show battery voltage.

■NOTE: If the meter shows no voltage, inspect the 10 amp ignition (IGN) fuse, brakelight switch, wiring harness, or connectors.

Ignition Timing

The ignition timing cannot be adjusted; however, verifying ignition timing can aid in troubleshooting other components. To verify ignition timing, use the following procedure.

■NOTE: To check ignition timing, the seat, seat back, and seat base must be removed.

1. Attach a suitable timing light to the spark plug high tension lead; then remove the timing inspection plug from the left-side crankcase cover.
2. Start the engine and using the RPM function on the speedometer/tachometer, run at 1500 RPM; ignition timing should be 10° BTDC.
3. Install the timing inspection plug.

If ignition timing cannot be verified, the rotor may be damaged, the key may be sheared, the trigger coil bracket may be bent or damaged, or the ECM may be faulty.

Tilt Sensor

⚠ WARNING

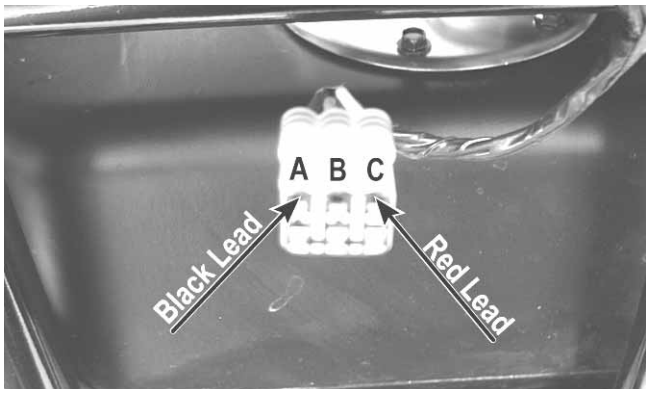
Incorrect installation of the tilt sensor could cause sudden loss of engine power which could result in loss of vehicle control resulting in injury or death.

CAUTION

Do not drop the tilt sensor as shock can damage the internal mechanism.

SUPPLY VOLTAGE

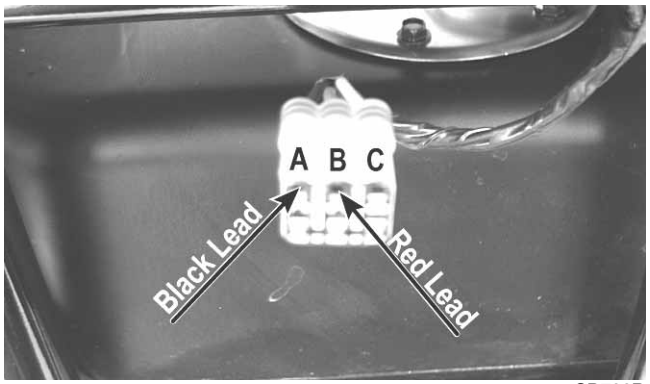
1. Disconnect the three-wire connector from the sensor; then select DC Voltage on the multimeter and connect the red tester lead to the orange wire (C) and the black tester lead to the black wire (A).



CD706A

2. Turn the ignition switch to the ON position. The multimeter should read battery voltage. If battery voltage is not indicated, check the 30-amp fuse in the PDM or the 10-amp ignition fuse, wiring harness, or the ignition switch.

3. Remove the red tester lead and connect to the pin B. The multimeter should read approximately 2.5 DC volts (700) or 0.5 DC volts (500). If the specified voltage is not indicated, check wire connections at the ECM or substitute another ECM to verify the test.



CD706B

OUTPUT VOLTAGE

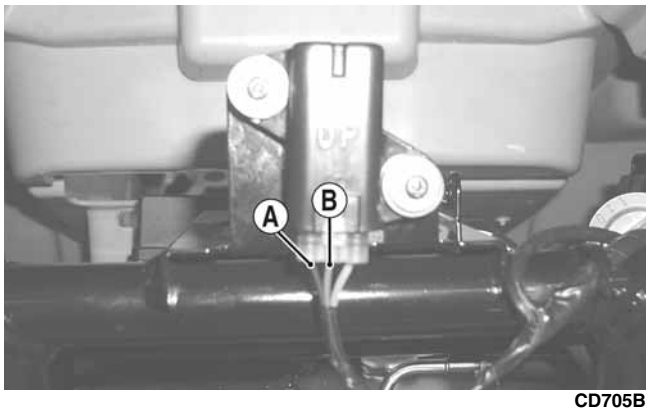
■NOTE: Needle adapters will be required on the multimeter leads as the following tests are made with the sensor connected.

1. Connect the three-wire plug to the sensor; then remove the right-side mounting screw securing the sensor to the rear frame.


CD707

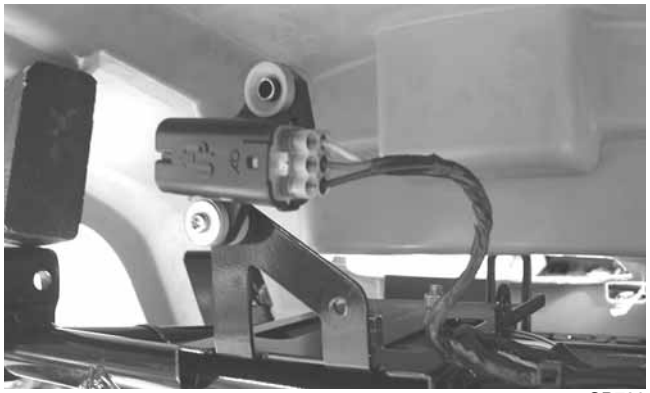
2. Install the needle adapters to the multimeter leads; then select DC Voltage on the multimeter.

3. Connect the red tester lead to the blue/brown wire (B) and the black tester lead to the black/yellow wire (A); then turn the ignition switch ON and observe the meter. The meter should read 0.8-3.0 DC volts (700) or 0.3-1.5 DC volts (500).

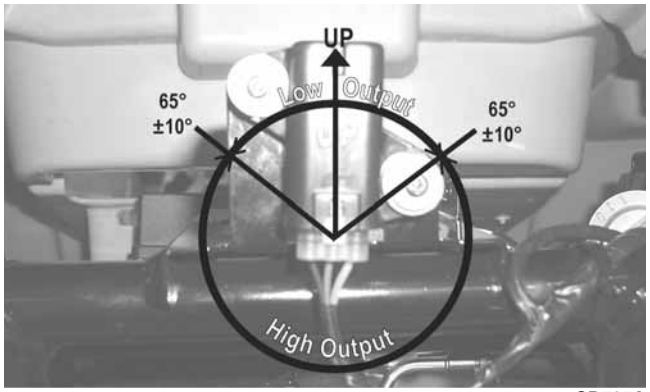


CD705B

4. Tilt the sensor 60° or more to the left and right observing the meter. The meter should read 4.0-8.0 DC volts (700) or 3.0-7.0 DC volts (500) after approximately one second in the tilted position. If the meter readings are not as specified, the tilt sensor is defective.


CD709

■NOTE: When replacing the sensor after testing, make sure the arrow marking is directed up.



CD705A

Throttle Position Sensor (TPS)

Component data can be retrieved using the CATT II. Utilize the Sensor Data screen.

■NOTE: Preliminary checks may be performed on this component using the diagnostic mode on the LCD gauge (see EFI Diagnostic System in this section).

TESTING

1. Remove the left-side engine cover; then disconnect the three-wire TPS connector plug.

■NOTE: Prior to testing the TPS, inspect the three-wire plug connector on the main harness and the three-pin plug on the TPS for contamination, broken pins, and/or corrosion.

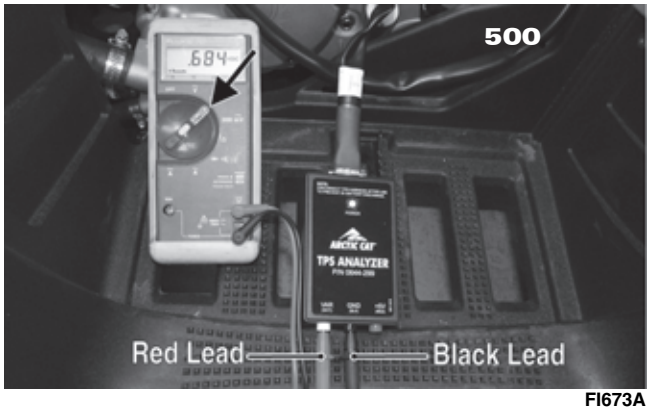
■NOTE: If the vehicle is in warranty, removing or adjusting the TPS will void warranty. If the TPS is tested out of specification, the throttle body must be replaced. If the vehicle is out of warranty, the TPS may be adjusted.

2. Connect the TPS Multi-Analyzer Harness connector #8 to the TPS; then connect the harness to the TPS Analyzer Tool.

FI672

3. Using a multimeter, connect the tester to the analyzer as shown in the table below; then select the DC Voltage position. With the vehicle off and throttle at idle, the gauge should read as shown and at Wide-Open Throttle it should read up to as shown.

Model	Tester Lead	Analyzer Socket	Idle (DC Volts)	WOT (DC Volts)
500	Black	GND	0.66-0.70	3.88
	Red	VAR		
700	Black	VAR	0.58-0.62	3.70
	Red	+5V		



FI673A

FI676A

■NOTE: If the throttle body, ECM, TPS, or ISC are replaced, the EFI system must be synchronized. Use the following procedure.

1. With the key off, depress accelerator pedal to Wide Open Throttle (WOT).
2. Place the ignition key in the ON position and wait for 10 seconds.
3. Release the accelerator pedal, and wait an additional 10 seconds.
4. Turn the key to the OFF position and allow the gauge to shut off.

EFI Diagnostic System

DIGITAL GAUGE

The digital gauge can be used as a diagnostic tool for many of the DTC's displayed. To place the gauge into the diagnostic mode, use the following procedure.

1. Turn the ignition switch ON.
2. Depress and hold both Mode and Set buttons together for approximately 10 seconds after which the letters "dIAg" will appear on the LCD momentarily followed by COOL.

EFI002A

■**NOTE: The display on the gauge will display in SAE (speedometer in MPH mode) or Metric (speedometer in km/h mode), For example to read temperature in degrees Celsius, select km/h mode on the gauge or to read Fahrenheit, select MPH mode.**

3. Cycle the display by depressing either the Set or Mode button to step to the desired function.

EFI004

■**NOTE: The gauge can be utilized dynamically (engine running/vehicle moving) or statically (engine/vehicle stopped).**

Examples of Static checks: Battery voltage, fuel gauge/sensor, and TPS (0% @ closed throttle, 95-100% @ WOT).

EFI007

Examples of Dynamic checks: Battery charging, coolant temperature including fans ON/OFF (see below), MAP/IAT, tachometer, and speedometer signal.

EFI003

***Fan Schedule: Fan ON @ 185 degrees F, OFF @ 175 degrees F.**

***High Temperature REV Limiter 5000 RPM @ 230 degrees F.**

***Thermostat opens @ approximately 180 degrees F noted by a 2-5 degree drop momentarily.**

Coolant (COOL) Diagnostic Mode

EFI 003

Display: Engine coolant temperature as measured by the ECT sensor.

DTC: P0116, P0117, P0118, P0119

Usage: Monitor coolant temperature to verify the following.

1. ECT sensor signal
2. High Temperature indicator (on @ 230 degrees F).
3. Thermostat opening @ approximately 180 degrees F, indicated by a momentary drop or pause in the rising temperature reading.
4. Fan ON @ 185 degrees F, OFF @ 175 degrees F.

   A. fan motor

   B. fan relay

   C. fan fuse

   D. wiring connections
5. High Temperature Rev Limiter 5000 RPM @ 230 degrees F.

Fuel Sensor (FUEL) Diagnostic Mode

EFI010

Display: Fuel level signal from the fuel level sensor (measured in ohms).

DTC: C1400, C1401, C1402

Usage: Check output of the fuel level sensor

1. Full fuel is indicated by a reading of 86-100 ohms
2. Empty is indicated by a reading of 0-5 ohms

*** 110-500 ohms, suspect the fuel level sensor or wiring**
*** 0-100 ohms but no fuel gauge indication, suspect the fuel gauge**

Tachometer (tACH) Diagnostic Mode

EFI009

Display: Engine RPM

DTC: P0336, P0337, P0339

Usage: Verify engine speed signal from the following.

1. CKP (crankshaft position) sensor to ECM
2. ECM (CAN) signal to gauge (tachometer)

Speed (SPd) Diagnostic Mode

EFI008

Display: vehicle speed signal.

DTC: P0500

Usage: verify speedometer sensor signal from the following.

1. Speed sensor to ECM.
2. ECM (CAN) signal to gauge (speedometer/odometer).

TPS (tPS) Diagnostic Mode

EFI007

Display: % of TPS (0% closed, 95-100% WOT).

DTC: P0121, P0122, P0123

Usage: Verify TPS signal and adjust throttle cable.

MAP (bArO) Diagnostic Mode

EFI006

Display: MAP in millibars (1013 millibar = 29.92 in. mercury).

DTC: P0107, P0108

Usage: Verify barometric pressure signal correct.

■NOTE: Local barometric pressure is given in in./Hg (Inches of Mercury). 34 millibars are equal to 1 inch of mercury. Example: (Gauge reading in the BARO mode = 974 millibars, thus 974/34 = 28.64 in./Hg). Second example: (Local barometer reading is 29.87 in./Hg, therefore 29.87 X 34 = 1015 millibars) The gauge should be reading very close to 1015.

Inlet Air Temperature (Air) Diagnostic Mode

EFI005

Display: Inlet air temperature in Fahrenheit or Celsius.

DTC: P0112, P0113, P0114

Usage: Verify correct output of IAT sensor.

■NOTE: After engine has been running, IAT readings will be higher than outside air temperature due to engine and engine compartment heat as well as intake manifold heating.

Battery (bAtt) Diagnostic Mode

EFI004

Display: System DC voltage.

DTC: P0562, P0563, P2531, P2532

Usage: Verify system voltage under following conditions.

1. Battery voltage with engine and accessories off (>12.2 VDC for fully charged).
2. Battery voltage with engine running (charging = 13.8 VDC or greater).
3. Battery voltage with electrical accessories operating, engine idling (13.5 VDC or greater).
4. Battery voltage starter cranking (10.5-11.5 VDC).

DIAGNOSTIC TROUBLE CODES (DTC)

If an EFI or related chassis component fails or an out-of-tolerance signal is detected by the ECM, a diagnostic trouble code (DTC) will be generated in the ECM and displayed on the LCD. The DTC will be displayed alternately with a wrench icon or malfunction indicator light (MIL). The DTC will continue to flash, until the malfunction is corrected and the code cleared.

Code List

■NOTE: Each of the following numerical codes will have a one-letter prefix of C, P, or U. A "C" prefix denotes a chassis malfunction, a "P" prefix denotes a power train malfunction, and a "U" prefix denotes a loss of communication with the gauge.

■NOTE: Normal malfunction codes are cleared from the LCD when the component is replaced or the malfunction is corrected; however, intermittent codes must be cleared as noted in the code chart.

Code	Fault Description	Possible Cause	Fault Recovery Method
C0063	Tilt Sensor Circuit High	Sensor or interconnect harness shorted to battery power	Correct condition*
C0064	Tilt Sensor Circuit Low/SG/Open	Sensor or interconnect harness open or shorted to chassis ground	Correct condition*
P0030	O2 Heater Intermittent/Open	Heater or interconnect harness intermittent or open	Correct condition*
P0031	O2 Heater Low/SG	Heater or interconnect harness shorted to chassis ground	Correct condition*
P0032	O2 Heater High/SP	Heater or interconnect harness shorted to battery power	Correct condition*
P0107	MAP Sensor Circuit Low/SG/Open	Sensor or interconnect harness shorted to chassis ground	Correct condition*
P0108	MAP Sensor Circuit High/SP	Sensor or interconnect harness shorted to battery power	Correct condition*
P0112	IAT Sensor Circuit Low/SG	Sensor or interconnect harness shorted to chassis ground	Correct condition*
P0113	IAT Sensor Circuit High/Open	Sensor or interconnect harness open or shorted to battery power	Correct condition*
P0114	IAT Sensor Circuit Intermittent	Sensor or interconnect harness intermittent	Correct condition*
P0116	ECT Sensor Circuit Range/Performance	Sensor producing an out-of-range voltage	Correct condition*
P0117	ECT Sensor Circuit Low/SG	Sensor or interconnect harness shorted to chassis ground	Correct condition*
P0118	ECT Sensor Circuit High/Open/SP	Sensor or interconnect harness open or shorted to battery power	Correct condition*
P0119	ECT Sensor Circuit Intermittent	Sensor or interconnect harness intermittent	Correct condition*
P0121	TPS Range/Performance	Sensor producing an out-of-range voltage	Correct condition*
P0122	TPS Circuit Low/SG	Sensor or interconnect harness shorted to chassis ground	Correct condition*
P0123	TPS Circuit High	Sensor or interconnect harness open or shorted to battery power	Correct condition*
P0130	O2 Sensor Intermittent/Open	Sensor or interconnect harness intermittent or open	Correct condition*
P0131	O2 Sensor Low/SG or Air-Leak	Sensor or interconnect harness shorted to chassis ground or an air-leak exists	Correct condition*

Code	Fault Description	Possible Cause	Fault Recovery Method
P0132	O2 Sensor High/SP	Sensor or interconnect harness shorted to battery power	Correct condition*
P0171	O2 Feedback Below Minimum Correction	Low fuel rail pressure, dirty fuel filter, or dirty injectors	Correct condition*
P0172	O2 Feedback Exceeds Maximum Correction	Excessive fuel rail pressure, MAP or temp sensors out-of-spec	Correct condition*
P0219	Engine Over-Speed Condition	Engine speed (RPM) has exceeded the ECM over-speed setpoint/ limit	Reduce engine speed
P0231	Fuel Pump Relay Circuit Low/SG/Open	Relay has been removed or interconnect harness shorted to chassis ground	Correct condition*
P0232	Fuel Pump Relay Circuit High	Relay or interconnect harness shorted to battery power	Correct condition*
P0233	Fuel Pump Relay Circuit	Relay circuit erratic or intermittent	Correct condition*
P0261	Cylinder Fuel injector Circuit Low/SG	Injector or interconnect harness shorted to chassis ground	Correct condition**
P0262	Cylinder Fuel injector Circuit High	Injector or interconnect harness shorted to battery power	Correct condition**
P0263	Cylinder Fuel injector Balance/Open	Injector has been disconnected or interconnect harness open	Correct condition**
P0336	Crankshaft Angle Sensor Synchronization	Sensor or interconnect harness intermittent	Correct condition**
P0337	Crankshaft Angle Sensor Circuit/SG	Sensor or interconnect harness shorted to chassis ground	Correct condition**
P0339	Crankshaft Angle Sensor Intermittent/Erratic	Sensor or interconnect harness intermittent	Correct condition**
P0340	Camshaft Angle Sensor Synchronization	Sensor or interconnect harness intermittent	Correct condition**
P0341	Camshaft Angle Sensor Circuit/SG	Sensor or interconnect harness shorted to chassis ground	Correct condition**
P0342	Camshaft Angle Sensor Intermittent/Erratic	Sensor or interconnect harness intermittent	Correct condition**
P0480	Fan Relay Control Circuit	Relay erratic or intermittent	Correct condition*
P0484	Fan Relay Control Circuit High	Relay or interconnect harness shorted to battery power	Correct condition*
P0485	Fan Relay Control Circuit Low/SG/Open	Primary fan fuse has blown, the primary fan relay has been removed or interconnect harness shorted to chassis ground	Correct condition*
P0500	Vehicle Speed-Sensor	Sensor circuit signal intermittent or missing	Correct condition*, start and drive the vehicle*
P0508	IAC System Circuit Low/SG	IAC interconnect harness shorted to chassis ground	Correct condition*
P0509	IAC System Circuit High/Open	IAC disconnected or the interconnect harness shorted to battery power	Correct condition*
P0520	Engine Oil Sensor/Switch	Sensor or interconnect harness erratic or intermittent	Correct condition*
P0562	System Voltage Low	Battery charge condition low or the regulator/rectifier output low	Correct condition*
P0563	System Voltage High	Battery cable connections are loose or the regulator/rectifier output high	Correct condition*
P0601	ECU Memory Check-Sum Error	Reflash the ECM with the current software version	Correct ECM software issue*
P0615	Starter Relay Circuit	Start switch/button, starter relay, gear switch or interconnect harness erratic or intermittent	Correct condition*
P0616	Starter Relay Circuit Low	Start switch/button, starter relay or interconnect harness intermittent or shorted to chassis ground	Correct condition*
P0617	Starter Relay Circuit High	Start switch/button, starter relay or interconnect harness intermittent or shorted to battery power	Correct condition*
P0630	VIN Not Programmed or Incompatible	Verify the LCD gauge and ECM part numbers are correct for the vehicle model number and VIN	Correct gauge and ECM VIN compatibility issue*
P0642	Sensor Power Circuit Low	One or more of the sensors defective or shorted to chassis ground	Correct condition*
P0643	Sensor Power Circuit High	One or more of the sensors defective or shorted to battery power	Correct condition*
P2300	Ignition Coil Primary Circuit Low/SG/Open	Coil or interconnect harness open or shorted to chassis ground	Correct condition**
P2301	Ignition Coil Primary Circuit High	Coil or interconnect harness shorted to battery power	Correct condition**
P2531	Ignition Switch Circuit Low	Battery charge condition low or the regulator/rectifier output low	Correct condition*
P2532	Ignition Switch Circuit High	Battery cable connections are loose or the regulator/rectifier output high	Correct condition*
U0155	LCD Gauge to EFI ECM CAN Communication Lost	Gauge CAN circuit or interconnect harness intermittent or has failed	Correct condition*
U1000	Vehicle Not Registered or Invalid PIN Entered	An invalid registration PIN has been entered	Enter the correct registration PIN*
U1001	Vehicle Not Registered and Vehicle Limits Enabled	An invalid registration PIN has been entered	Enter the correct registration PIN*
FUEL OFF	Tilt Sensor Activation Code	Sensor has been activated	Restore the vehicle chassis to an upright position*

High: A high voltage condition has been detected

Low: A low voltage condition has been detected

Intermittent: An intermittent circuit condition has been detected

Open: An open circuit condition has been detected

* After correcting the condition, cycle the key switch On-Off-On

**After correcting the condition, cycle the key switch On-Off-On, start the engine, then cycle the key switch On-Off-On.

Troubleshooting

Problem: Spark absent or weak	
Condition	**Remedy**
1. **Ignition coil** defective	1. Replace ignition coil
2. **Spark plug(s)** defective	2. Replace plug(s)
3. **CKP sensor** defective	3. Replace CKP sensor
4. **ECM** defective	4. Replace ECM
Problem: Spark plug fouled with carbon	
Condition	**Remedy**
1. **Gasoline** incorrect	1. Change to correct gasoline
2. **Air cleaner element** dirty	2. Clean element
3. **Spark plug(s)** incorrect (too cold)	3. Replace plug(s)
4. **Valve seals** cracked - missing	4. Replace seals
5. **Oil rings** worn - broken	5. Replace rings
Problem: Spark plug electrodes overheat or burn	
Condition	**Remedy**
1. **Spark plug(s)** incorrect (too hot)	1. Replace plug(s)
2. **Engine** overheats	2. Service cooling system
3. **Spark plug(s)** loose	3. Tighten plug(s)
Problem: Battery does not charge	
Condition	**Remedy**
1. **Lead wires/connections** shorted - loose - open	1. Repair - replace - tighten lead wires
2. **Stator coils** shorted - grounded - open	2. Replace stator coils
3. **Regulator/rectifier** shorted	3. Replace regulator/rectifier
Problem: Battery charges, but charging rate is below the specification	
Condition	**Remedy**
1. **Lead wires** shorted - open - loose (at terminals)	1. Repair - tighten lead wires
2. **Stator coils** grounded - open	2. Replace stator coils
3. **Regulator/rectifier** defective	3. Replace regulator/rectifier
4. **Cell plates (battery)** defective	4. Replace battery
Problem: Magneto overcharges	
Condition	**Remedy**
1. **Battery** short circuited	1. Replace battery
2. **Regulator/rectifier** defective	2. Replace regulator/rectifier
3. **Regulator/rectifier** poorly grounded	3. Clean - tighten ground connection
Problem: Charging unstable	
Condition	**Remedy**
1. **Lead wire** intermittently shorting	1. Replace lead wire
2. **Magneto** internally shorted	2. Replace stator coil
3. **Regulator/rectifier** defective	3. Replace regulator/rectifier
Problem: Starter does not engage	
Condition	**Remedy**
1. **Battery charge** low	1. Recharge - replace battery
2. **Switch contacts** defective	2. Replace switch
3. **Starter motor brushes** not seating	3. Replace starter
4. **Starter relay** defective	4. Replace relay
5. **Wiring connections** loose - disconnected	5. Connect - tighten - repair connections
6. **Start-in-gear/neutral relay** defective	6. Replace relay
Problem: Battery "sulfation" (Acidic white powdery substance or spots on surfaces of cell plates)	
Condition	**Remedy**
1. **Charging rate** too low - too high	1. Replace battery
2. **Battery** discharged	2. Charge battery
Problem: Battery discharges too rapidly	
Condition	**Remedy**
1. **Charging system (charging operation)** not set properly	1. Check AC generator - regulator/rectifier - circuit connections
2. **Cell plates** overcharged - damaged	2. Replace battery - correct charging system
3. **Battery** short-circuited	3. Replace battery
4. **Electrical load** too high	4. Reduce load
Problem: Battery polarity reversed	
Condition	**Remedy**
1. **Battery** incorrectly connected	1. Reverse connections - replace battery

Drive System

GENERAL INFORMATION

All gear cases are tagged beneath a cover bolt. This tag is marked with a production date code, sequence code, and a ratio code. All gear cases are 4.0:1 ratio.

The die-cast aluminum housings have been assembled with thread-rolling screws (trilobular). When assembling with these screws, start the screws carefully into the housing; then use the following torque values.

Size	New Housing	Reassembled Housing
M6 (Torx T-30 Recess)	9 ft-lb	8 ft-lb
M8 (Torx T-40 Recess)	28 ft-lb	23 ft-lb

■NOTE: Never reuse a lock nut. Once a lock nut has been removed, it must be replaced with a new lock nut.

Front Drive Actuator

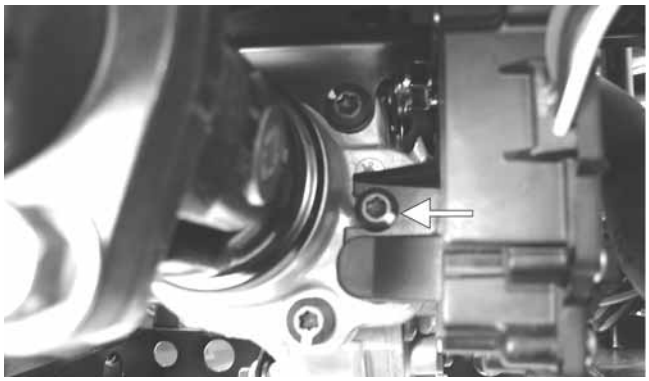
■NOTE: The actuator is not a serviceable component. If it is defective, it must be replaced.

■NOTE: The actuator will operate only when the ignition switch is in the ON position.

The front drive actuator is located on the right side of the front drive input housing. With the engine stopped and the ignition switch in the ON position, a momentary "whirring" sound can be heard each time the drive select switch is shifted. If no sound is heard, see the Electrical System section. If the actuator runs constantly or makes squealing or grinding sounds, the actuator must be replaced.

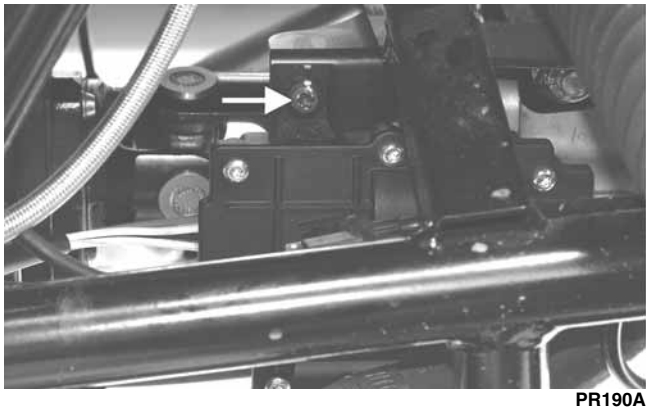
REMOVING

1. Select LOCK on the drive select switch; then disconnect the connector on the actuator harness.
2. Using a T-30 torx wrench, remove the mounting cap screw from the driveshaft side of the actuator.



PR189A

3. Remove the mounting cap screw from above the actuator on the suspension side.



PR190A

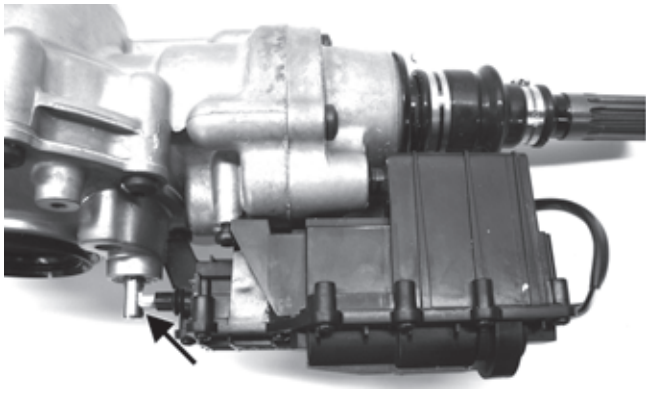
4. Loosen but do not remove the mounting cap screw at the front of the actuator; then slide the actuator to the rear enough to clear the slotted mounting tab and the selector shaft. Remove from the right side.

AG928

INSTALLING

1. Lubricate the O-rings on the actuator; then ensure all mounting surfaces are clean and free of debris.
2. Align the actuator with the selector shaft and slide it forward onto the shaft taking care to engage the cap screw in the slot of the front mounting tab.

■NOTE: Make sure to properly align the differential lock actuator lever with the hole in the differential lock plunger.

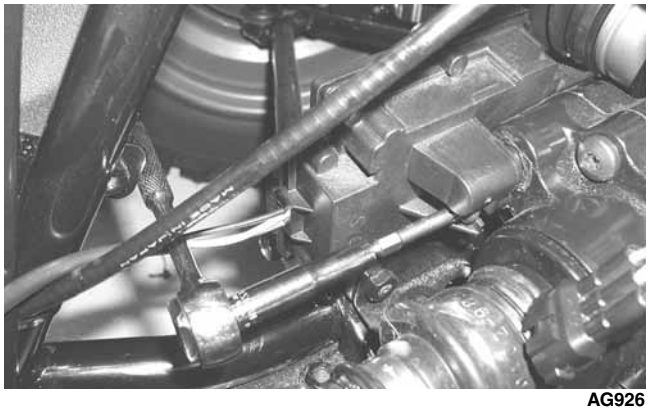


GC002A

3. While holding the actuator firmly forward, tighten the front cap screw to hold the actuator in place; then install but do not tighten the two remaining cap screws.

GC001

4. Loosen the front cap screw; then tighten the cap screw on the driveshaft side.



AG926

■NOTE: It is important to tighten this cap screw while the others are loose to ensure proper seating of the actuator.

5. Tighten the remaining cap screws; then connect the electrical plug to the main harness.
6. Turn the ignition switch to the ON position and check the operation by shifting the select switch several times.
7. Secure the wiring harness to the frame with a nylon cable tie.

Front Differential

REMOVING

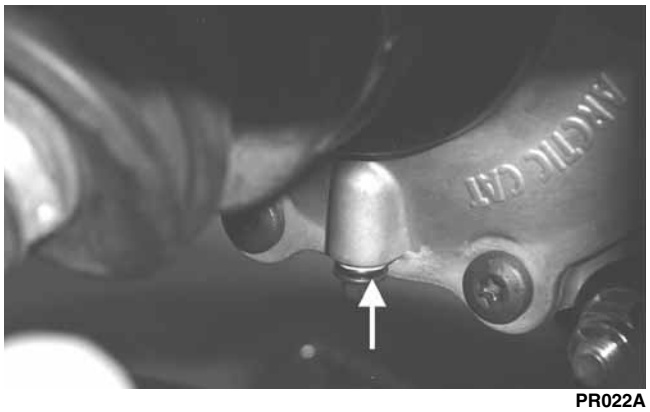
1. Remove the belly panel; then place the vehicle on jack stands adjusted high enough to allow working from the underside of the vehicle.

■NOTE: The jack stands should be placed under the main frame to avoid contact with front suspension components.

⚠ WARNING

Make sure the vehicle is solidly supported on the jack stands to avoid injury.

2. Remove the drain plug and drain the gear lubricant into a drain pan; then install the plug and tighten to 45 in.-lb.

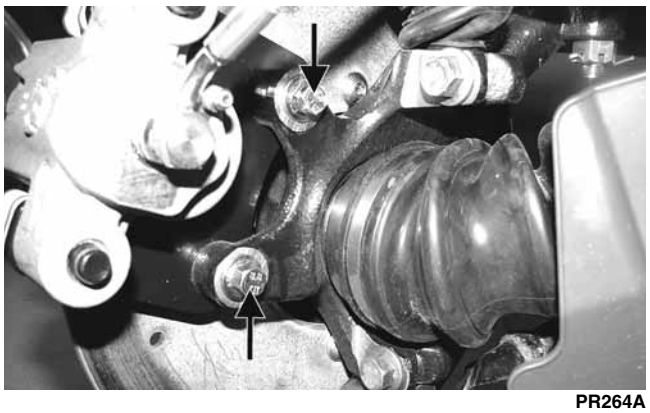


PR022A

3. Remove the front wheels.
4. Place the transmission in park; then turn the ignition switch to the ON position and select LOCK on the drive select switch. Turn the ignition switch to the OFF position.
5. Remove the cotter pin securing the axle nut; then remove the nut.

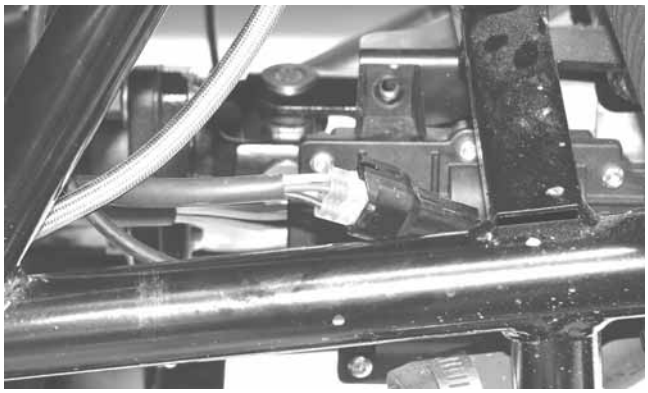
■NOTE: It is not necessary to remove the brake hoses from the calipers for this procedure.

6. Remove the two brake calipers. Account for the four cap screws; then remove the hubs.



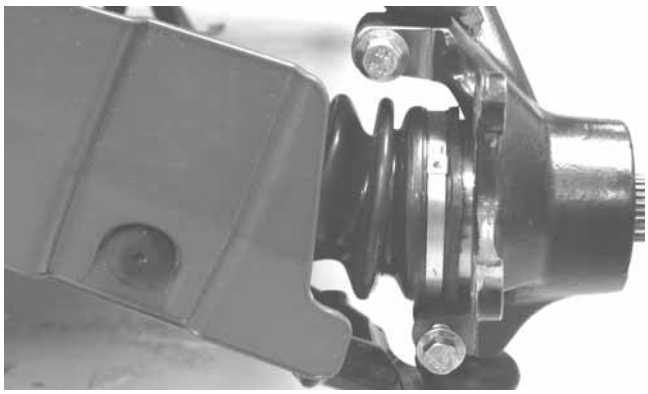
PR264A

7. Disconnect the front drive actuator connector from the main harness.



PR191

8. Remove the lower and upper ball joint cap screws taking care not to strip the threads on the ball joint shaft; then using a rubber mallet, tap the end of the axle and free it from the knuckle assembly.



PR193

9. Pull the steering knuckle away from the axle.

PR222

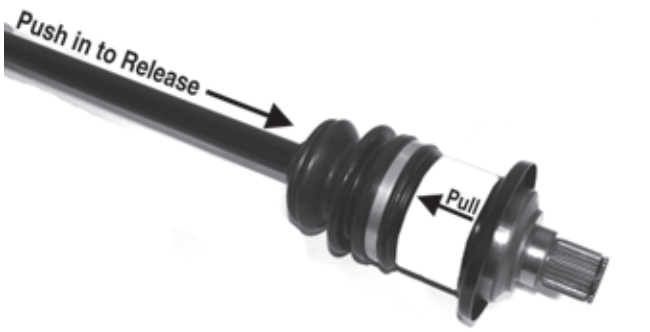
10. Support the axle to prevent it from dropping or hanging.

CAUTION

The axle must be supported. If the axle is allowed to drop or hang, damage to the inner CV joint may occur.

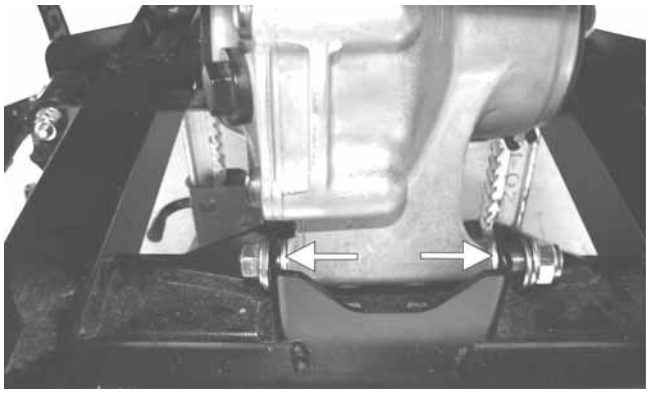
11. Remove the lower shock cap screws. Account for the lock nuts; then move the shocks and upper A-arm up and secure them with a strap.

12. Push the axle shaft toward the differential to release the "plunge" coupler; then remove the axle from the differential. Repeat for the opposite side.



PR729C

13. Remove the lower differential mounting cap screw. Account for a lock nut and four washers. Note the position of the washers for assembling.



PR205A

14. Remove the upper differential mounting cap screw. Account for a lock nut and two washers.

CD016

15. Free the differential assembly from the frame mountings; then lower the differential through the frame.

Disassembling Input Shaft

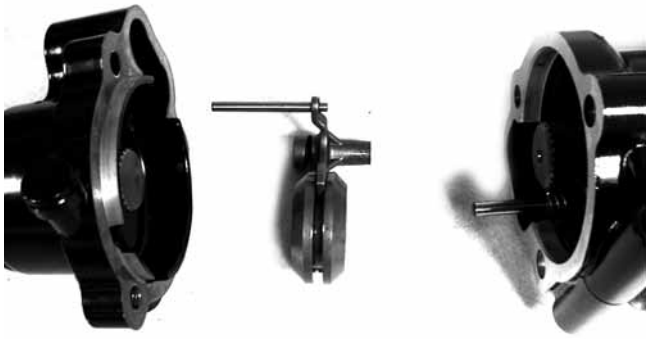
■NOTE: This procedure can be performed on a rear gear case.

1. Using a T-40 torx wrench, remove the cap screws securing the pinion housing.

GC004A

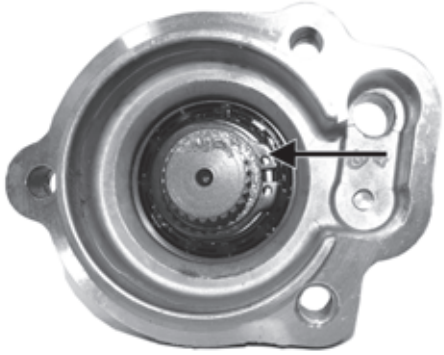
2. Using a rubber mallet, remove the housing. Account for a gasket. Remove the fork, collar, and spring. Note the location of all the components for assembling purposes.

GC015



CD106

3. Remove the snap rings from the input shaft; then remove the input shaft from the pinion housing.



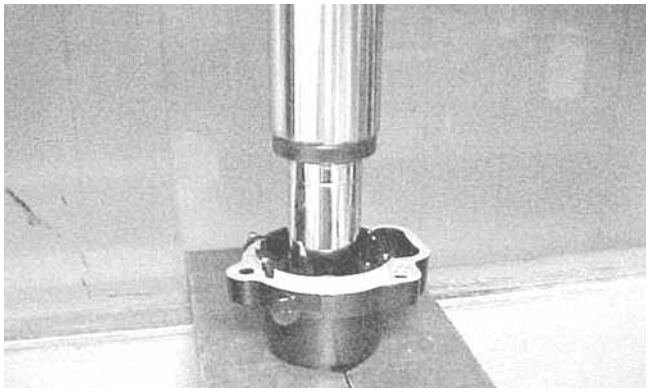
GC009A

4. Using a seal removal tool, remove the input shaft seal. Account for a spacer.

GC010

5. Remove the snap ring securing the input shaft bearing; then place the pinion housing in a press and remove the bearing.

GC011



AF984

KX219

Assembling Input Shaft

1. Place the pinion housing in a press and install the input shaft bearing. Secure the bearing with the existing snap ring making sure the sharp edge of the snap ring faces to the outside.

GC012

GC011

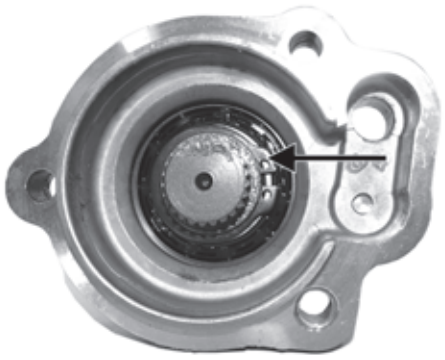
2. Install the input shaft seal making sure it is fully seated in the edge of the housing.

GC014

3. Lubricate the input shaft with High-Performance #2 Molybdenum Disulphide Grease packing the boot ribs and splines; then assemble allowing excess grease to freely escape. Slight pressure on the boot will be present during assembly. Secure with new clamps.

■NOTE: Any time drive splines are separated, clean all splines with parts-cleaning solvent and dry with compressed air; then lubricate with recommended grease.

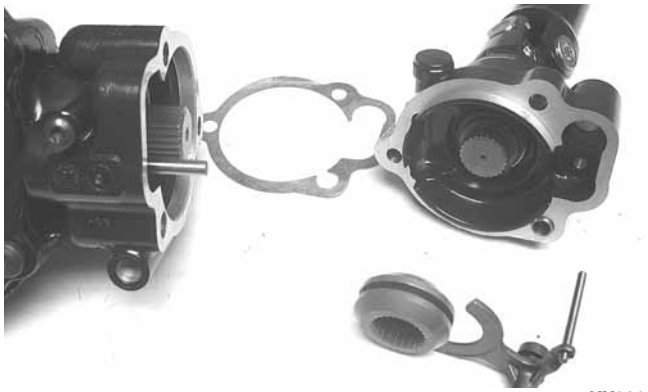
4. Install the input shaft into the pinion housing; then secure the bearing with a circlip.



GC009A

5. Place the pinion housing with new gasket onto the differential housing; then secure with existing cap screws. Tighten to 23 ft-lb.

■NOTE: If a new differential housing is being installed, tighten the cap screws to 28 ft-lb.



KX209

GZ004A

Disassembling Differential Assembly

■NOTE: This procedure can be performed on a rear gear case.

1. Using a T-40 torx wrench, remove the cap screws securing the pinion housing. Account for the coupler, fork, and spring (differential only).

GC015

2. Using a T-40 torx wrench, remove the cap screws securing the differential cover. Account for and make note of the ID tag location for assembling purposes.

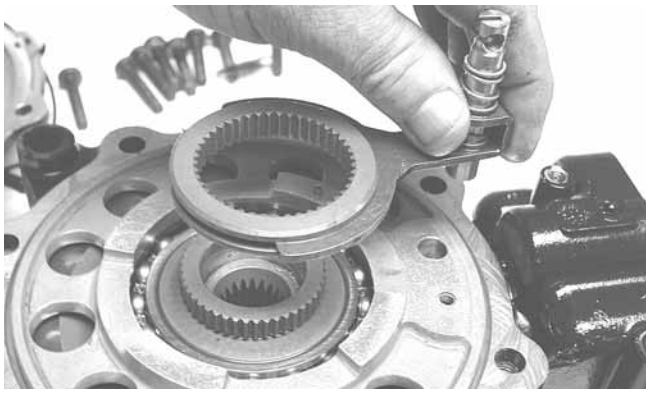
GC003

3. Using a plastic mallet, tap lightly to remove the differential cover. Account for an O-ring.

KX174

■NOTE: If the cover is difficult to remove, pry on the cover in more than one recessed location.

4. Remove the splined coupler, shifter fork, pin, and spring of the differential lock assembly and set aside. Note position of parts for assembling purposes.



KX175

5. Remove the left differential bearing flange assembly and account for a shim. Mark the shim as left-side.

KX177

KX178

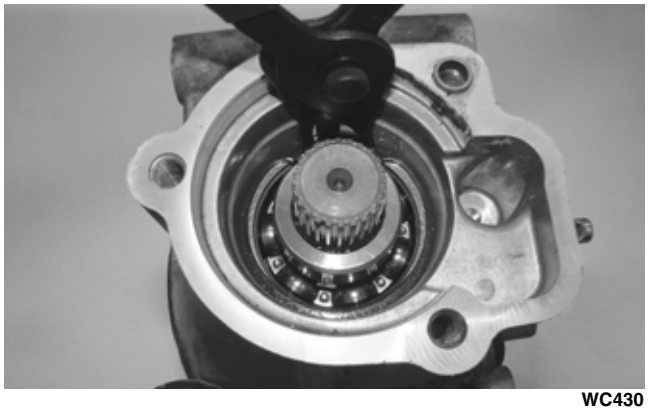
6. Place the differential with the open side down; then lift the housing off the spider assembly. Account for shim(s) and mark as right-side.

KX179

KX181

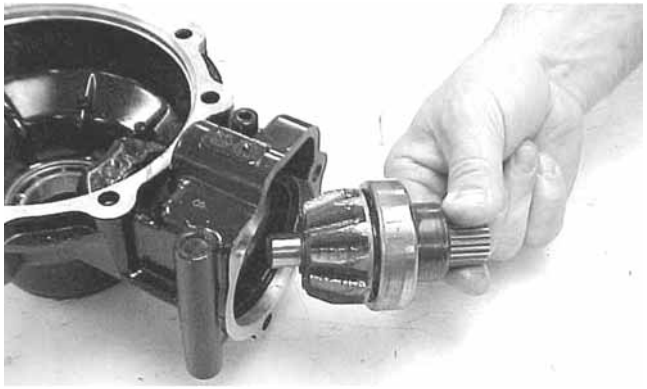
Disassembling Pinion Gear

1. Remove the internal snap ring securing the pinion bearing in the housing.



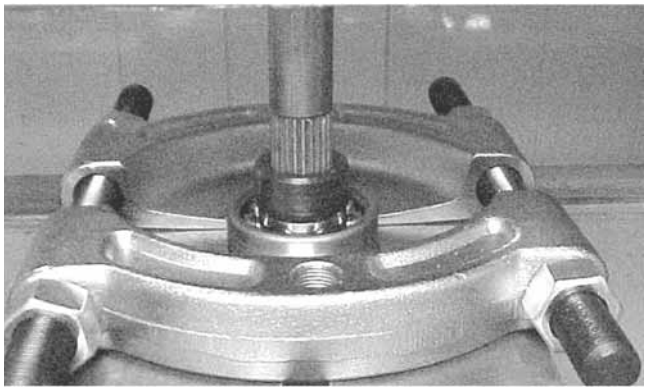
WC430

2. Using a suitable pinion gear/shaft removal tool and a hammer, remove the pinion gear from the gear case housing.



CC878

3. Secure the pinion gear in a bearing puller; then remove the pinion bearing using a press. Account for a collar and a bearing.

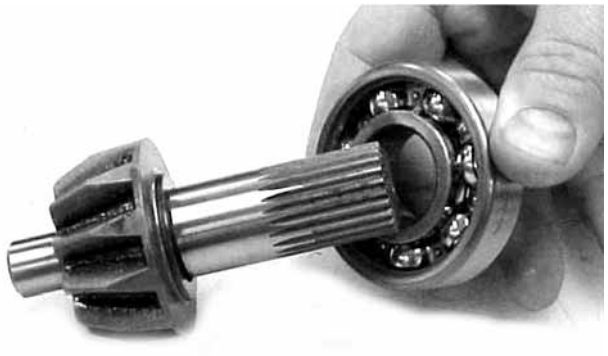


CC879

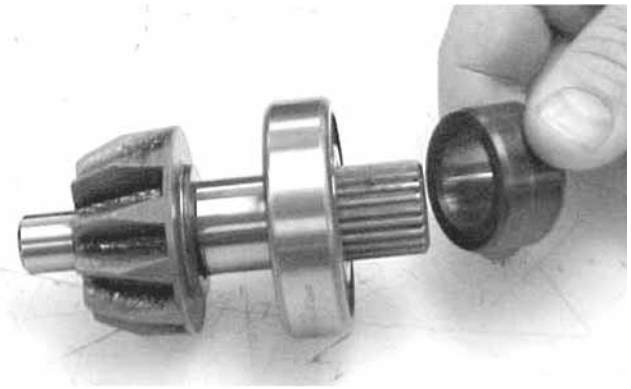
4. Remove any reusable parts from the gear case housing; then discard the housing and lock collar.

Assembling Pinion Gear

1. Install the bearing onto the pinion shaft. Install the pinion shaft collar.

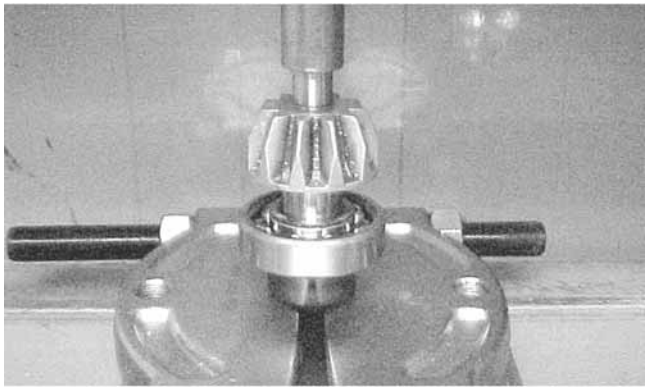


CC882



CC883

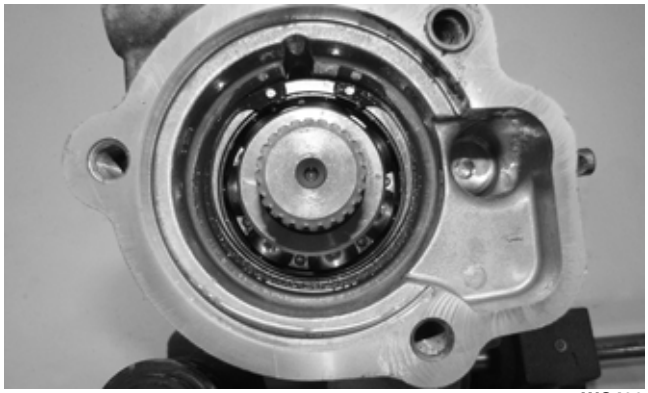
2. Place the pinion assembly in a bearing puller; then install the bearing using a press.



CC884

3. Using a propane torch, heat the gear case housing to approximately 200° F; then install the pinion assembly.

4. Install the internal snap ring with the sharp side directed away from the bearing.



WC429

Shimming Procedure/Shim Selection

Case-Side Shims (Backlash)		
p/n	mm	in.
0402-405	1.3	0.051
0402-406	1.4	0.055
0402-407	1.5	0.059
0402-408	1.6	0.063
0402-409	1.7	0.067

Cover-Side Shims (Ring Gear End-Play)		
p/n	mm	in.
1402-074	1.3	0.051
1402-075	1.4	0.055
1402-076	1.5	0.059
1402-077	1.6	0.063
1402-078	1.7	0.067

It is very important to adjust bevel gears for the proper running tolerances. Gear life and gear noise are greatly affected by these tolerances; therefore, it is very important to properly adjust any gear set prior to final assembly.

The following procedure can be used on both front differential or rear drive gear case.

■NOTE: All bearings must be installed in the gear case and the pinion properly installed before proceeding.

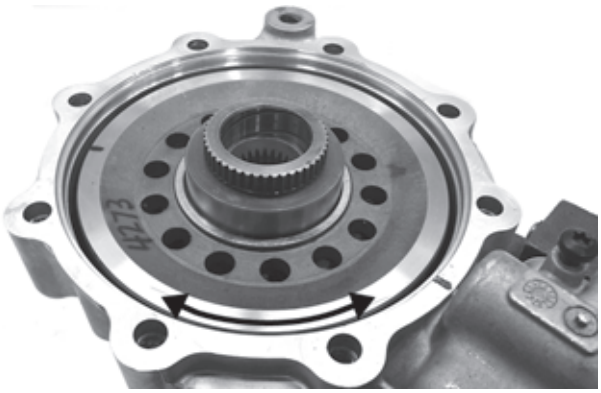
Backlash

■NOTE: Always set backlash prior to any other shimming.

1. Install the existing shim or a 0.051-0.055-in. shim on the gear case side of the ring gear assembly.

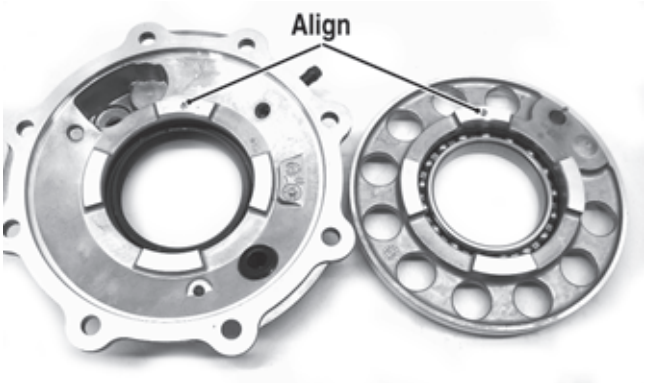
GC031A

2. Install the ring gear with shim in the gear case; then while holding the pinion stationary, rock the ring gear forward and back to determine if any backlash exists. If no backlash exists, install a thicker shim and recheck.



GC036A

3. Install the bearing flange onto the gear case cover making sure the alignment/locating pin engages the locating hole in the cover; then make sure the bearing flange is completely seated in the cover.



GC032A

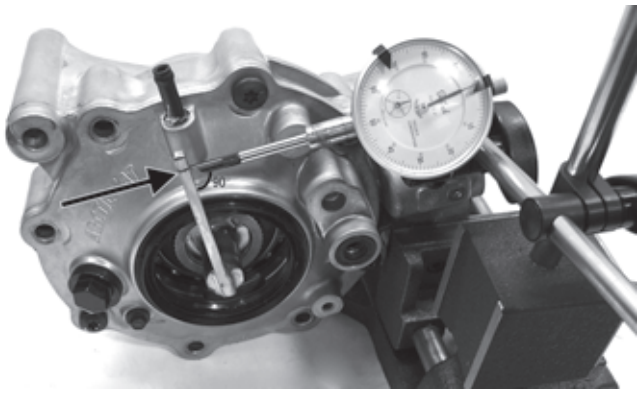
GC033A

4. Install the existing shim or a 0.063 in. shim on the cover side of the ring gear; then place the assembled gear case cover onto the gear case and secure with three cap screws. Tighten evenly using a crisscross pattern.

GC036B

5. Place an appropriate backlash measuring tool into the splines of the ring gear and install a dial indicator making sure it contacts the gauge at a 90° angle and on the index mark.

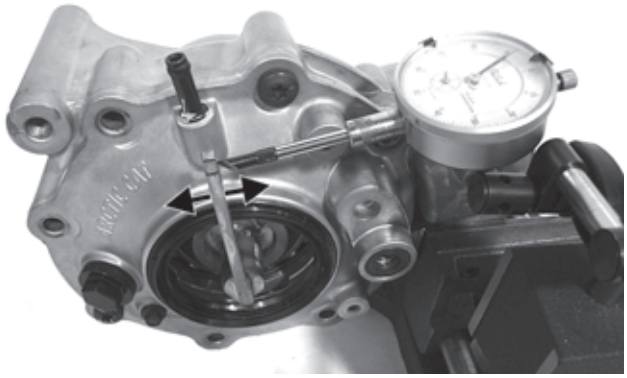
GC040



GC039A

6. Zero the dial indicator; then while holding the pinion stationary, rock the ring gear assembly forward and back and record the backlash. Backlash must be 0.011-0.015 in. If backlash is within specifications, proceed to Ring Gear End-Play. If backlash is not within specifications, increase shim thickness to increase backlash or decrease shim thickness to decrease backlash.

■NOTE: Higher backlash settings usually result in quieter gear operation.



GC037A

Ring Gear End-Play

After correcting backlash, ring gear end-play can be adjusted. To adjust end-play, use the following procedure.

1. Secure the gear case in a holding fixture with the cover side up; then install a dial indicator contacting the ring gear axle flange.

GC035

2. Zero the dial indicator; then push the ring gear toward the dial indicator and release. End-play should be 0.004-0.008 in.

3. To increase end-play, decrease the shim thickness. To decrease end-play, increase the shim thickness.

■NOTE: Once proper backlash and end play are established, the gear case can be assembled.

Assembling Differential Assembly

1. With the pinion gear and new bearings installed, place the selected (backlash) shim on the gear case side of the ring gear with the chamfered side toward the ring gear; then install into gear case/differential housing.

GC031A

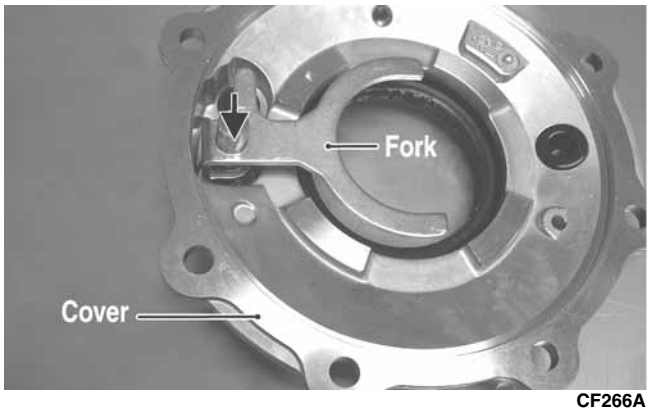
GC020

2. Place the selected (end-play) shim, chamfered side toward the gear, onto the cover side of the ring gear.

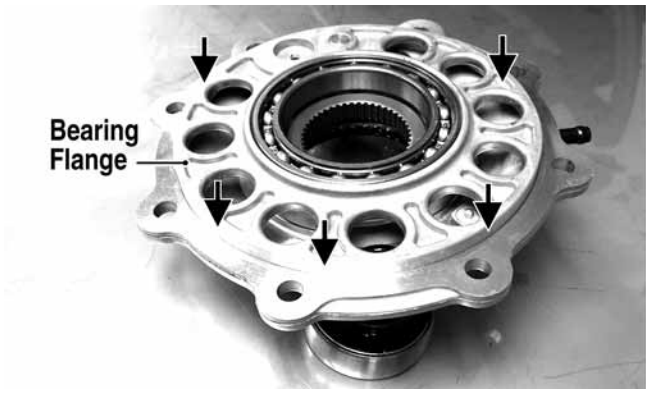
GC036B

■NOTE: The spider and ring gear assembly must be replaced as a complete unit.

3. Assemble the fork and sliding collar into the cover assembly; then install the left bearing flange/bearing assembly and seat firmly into the cover.



CF266A



CF267A

4. Apply a liberal coat of grease to the O-ring; then install it on the assembled cover assembly making sure to seat the O-ring completely down around the circumference of the bearing flange.

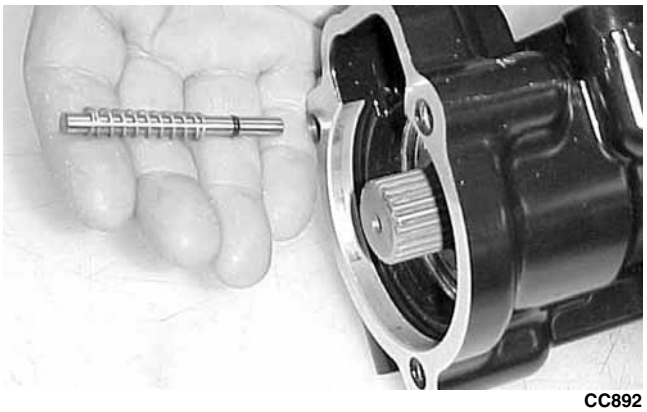
CF275A

5. Making sure the O-ring is properly positioned on the differential housing cover assembly, install the cover with existing cap screws (coated with green Loctite #270). Account for the ID tag. Tighten the cap screws evenly to 23 ft-lb.

■NOTE: Grease can be applied to the O-ring for ease of assembling.

■NOTE: If a new housing is being installed, tighten the cap screws to 28 ft-lb.

6. Install the shift fork shaft w/spring into the housing making sure the shaft O-ring is positioned to the inside.



CC892

7. Install the shift fork assembly making sure the fork leg is facing upward. Apply a small amount of oil to the gasket; then install the gasket.

CC893

8. Place the input shaft assembly onto the gear case housing; then secure with the existing cap screws. Tighten to 23 ft-lb.

■NOTE: If a new housing is being installed, tighten the cap screws to 28 ft-lb.

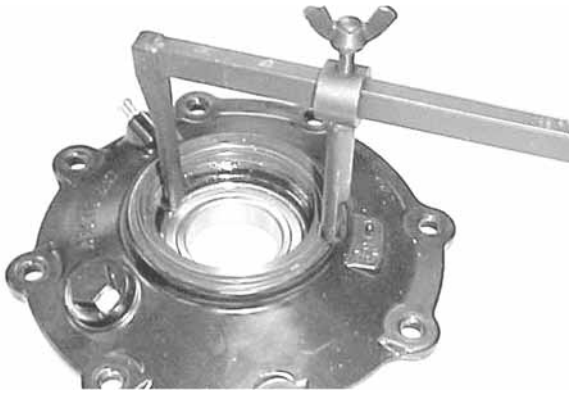
CD103

CD110

Removing/Installing Axle Seal

■NOTE: This procedure can be performed on a rear gear case.

1. Remove the seal using a seal removal tool.



CC899

■NOTE: Prior to installing the seal, apply High-Performance #2 Molybdenum Disulphide grease to the seal outside diameter.

2. Using Gear Case Seal Installer Tool, evenly press the seal into the cover bore until properly seated.

CF278

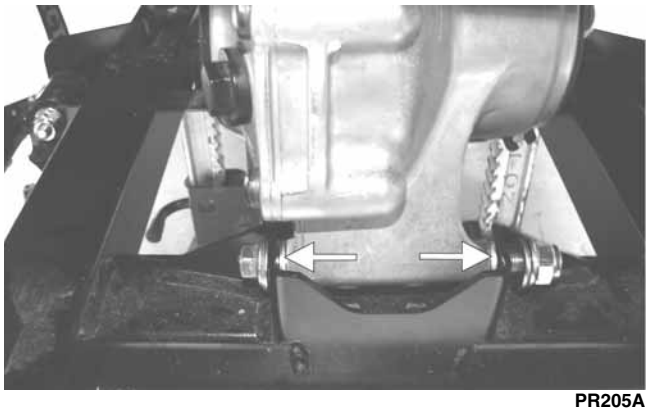
CAUTION

Make sure the tool is free of nicks or sharp edges or damage to the seal may occur.

3. Repeat steps 1-2 for the opposite side.

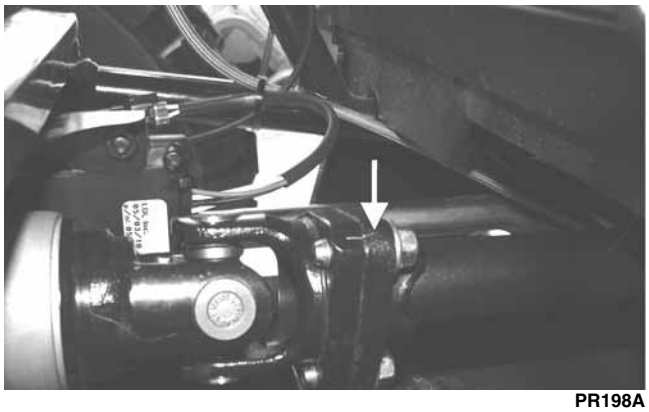
INSTALLING DIFFERENTIAL

1. Place the differential assembly into position in the frame; then install the top mounting cap screw, two washers, and lock nut. Do not tighten at this time.
2. Install the lower differential mounting cap screw, washers, and lock nut. Note the correct location for the washers.



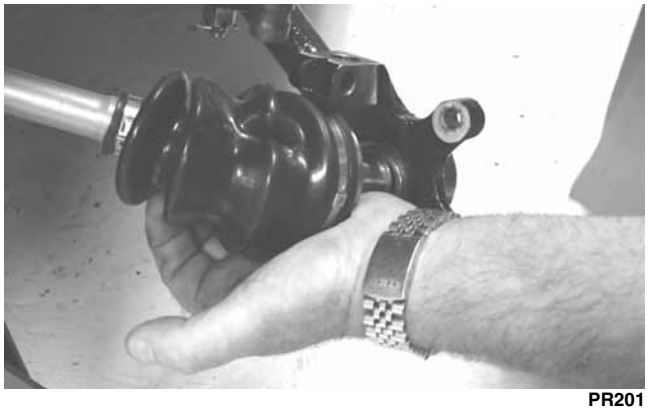
PR205A

3. Tighten the nuts to 38 ft-lb.
4. Pour 275 ml (9.3 fl oz) of SAE 80W-90 hypoid lubricant into the differential and install the fill plug. Tighten to 16 ft-lb.
5. Align the scribed match marks on the front input drive flange and the front drive yoke flange; then secure with the cap screws tightened to 20 ft-lb.

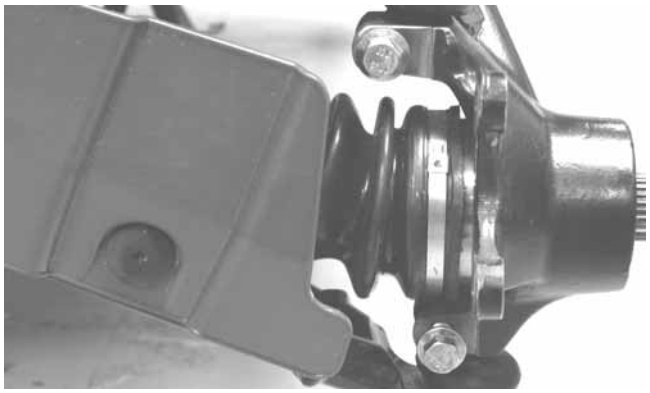


PR198A

6. Install the front axles.
7. Install the knuckle assemblies onto the axles and ball joints; then secure with four cap screws taking care not to damage the threads when installing. Tighten to 35 ft-lb.

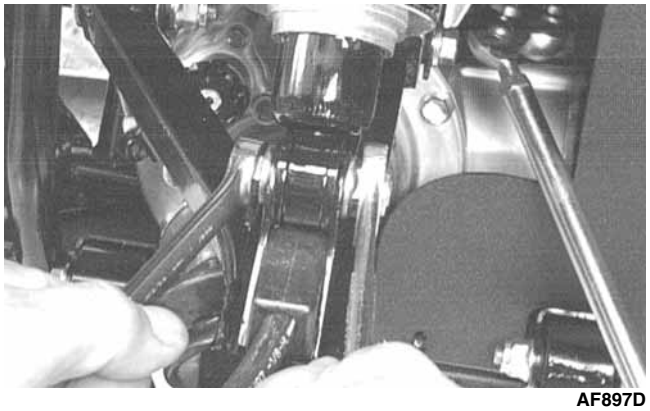


PR201



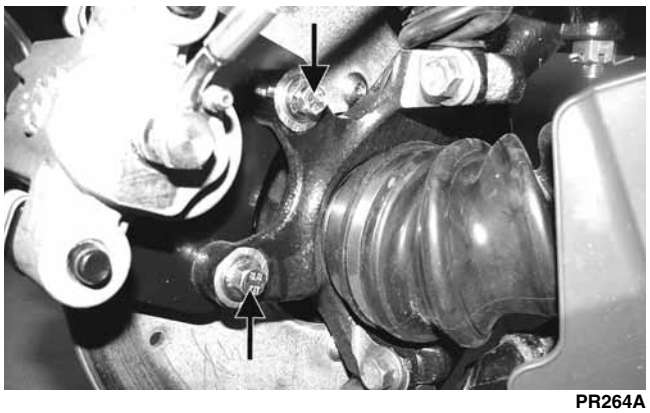
PR193

8. Secure the lower shock eyelets with cap screws and lock nuts. Tighten to 20 ft-lb.



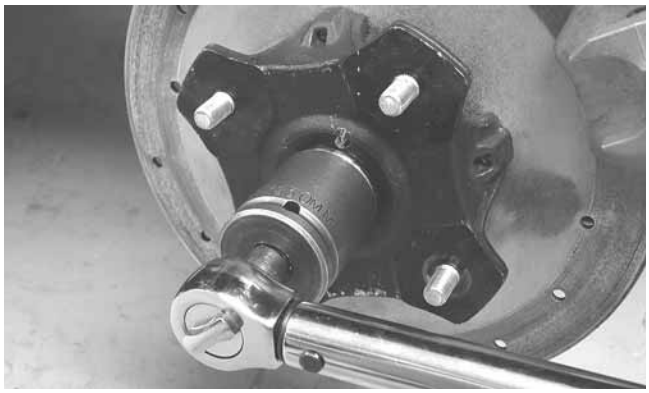
AF897D

9. Install the brake calipers. Secure with new "patch-lock" cap screws tightened to 20 ft-lb.



PR264A

10. Connect the front drive actuator connector to the main harness; then secure the wires to the frame with nylon ties.
11. Apply a light coat of multi-purpose grease to the hub splines; then install the hubs and nuts. Tighten to 200 ft-lb; then install new cotter pins.



PR256

12. Install the wheels; then using a crisscross pattern, tighten the wheel nuts in 27 N-m (20 ft-lb) increments to the final torque shown in the table below.

Steel Wheel	54 N-m (40 ft-lb)
Aluminum Wheel (Black Nuts)	80 N-m (60 ft-lb)
Aluminum Wheel (Chrome Nuts)	108 N-m (80 ft-lb)

13. Remove the vehicle from the support stand.
14. Install the belly panel.

Drive Axles

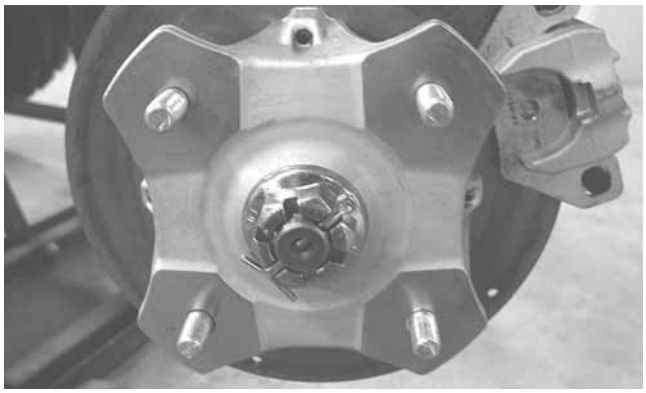
REMOVING REAR DRIVE AXLE

1. Secure the vehicle on a support stand to elevate the wheels.

⚠ WARNING

Make sure the vehicle is solidly supported on the support stand to avoid injury.

2. Place the transmission in park; then remove the wheels.
3. Remove the cotter pins securing the axle nuts; then remove the nuts.



KX041

4. Slide the hub out of the knuckle and set aside.

PR221

5. Remove the cap screw and lock nut securing the knuckle to the upper A-arm. Discard the lock nut.

PR220A

6. While holding the drive axle stationary, pull the top of the knuckle out and down until it is free of the drive axle.

PR218

7. Place a drain pan under the vehicle to contain any oil leakage; then pushing the axle shaft in, pull the axle assembly from the gear case.

PR729C

REMOVING FRONT DRIVE AXLE

■NOTE: For removing a front drive axel, see Front Differential in this section.

CLEANING AND INSPECTING AXLES

■NOTE: Always clean and inspect the drive axle components to determine if any service or replacement is necessary.

1. Using a clean towel, wipe away any oil or grease from the axle components.

CD019

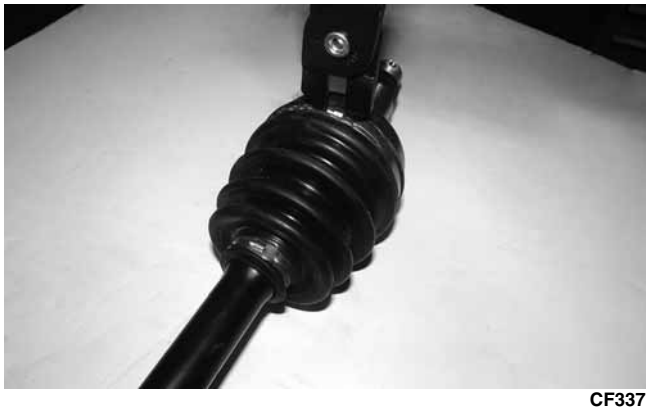
2. Inspect boots for any tears, cracks, or deterioration.

■NOTE: If a boot is damaged in any way, it must be replaced with a boot kit.

DISASSEMBLING AXLES

■NOTE: Only the boots are serviceable on the axles; if any other component is worn or damaged, the axle must be replaced.

1. Using CV Boot Clamp Tool, remove and retain both clamps for assembly purposes.



CF337

2. Place the white-striped end of the CV joint into a vise.

CF335

3. To disengage the axle from the CV joint, sharply pull back on the axle; then slide the boot off of the axle.

CF334

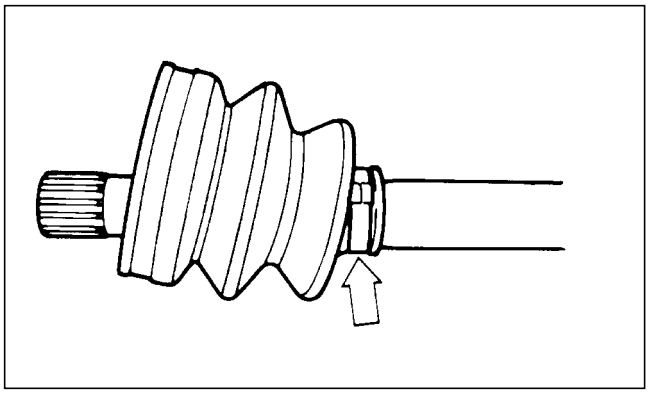
■NOTE: Steps 1-3 can be used to replace the outboard boot.

ASSEMBLING AXLES

1. Install the inner boot with the small clamp making sure the ends of the clamp are positioned correctly.

■NOTE: The boot is positioned correctly when the small end of the boot seats down into the recessed groove.

2. Using the boot clamp tool, secure the small clamp of the inner boot.



ATV-1048

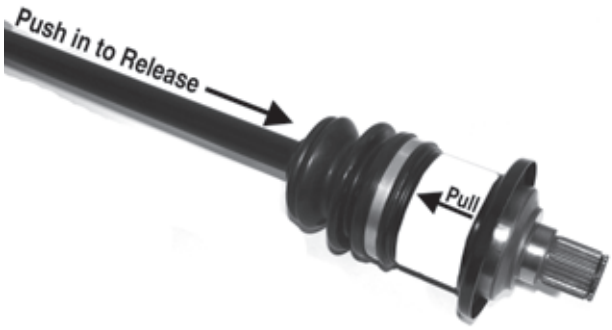
3. Apply 80 grams (2/3 of contents) of grease from the pack into the bearing housing.

■NOTE: Steps 1-3 can be used to replace the outboard boot.

■NOTE: In the outboard boot, use the final 40 grams (1/3 of contents) of grease from the pack in the bearing housing.

INSTALLING REAR DRIVE AXLE

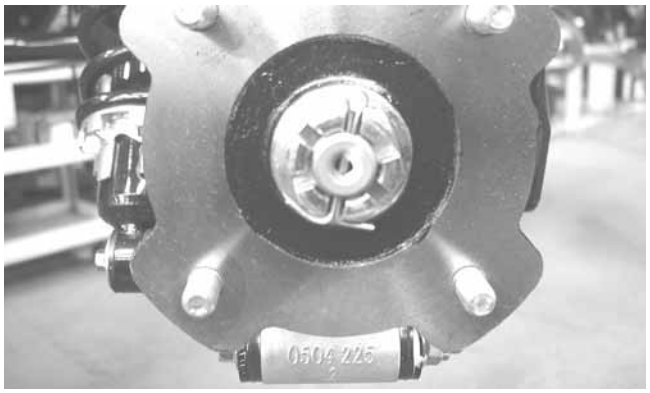
1. Push the axle shaft into the CV coupler to release the lock ring; then slide the drive axle into place in the gear case.



PR729C

■NOTE: To ensure proper axle seating, give it a light pull; the axle should remain "clipped" in place.

2. Swing the knuckle up and onto the drive axle; then place the knuckle into place in the upper A-arm. Secure the knuckle to the A-arm with a cap screw and a new lock nut. Tighten to 35 ft-lb.
3. Place the hub into position on the axle followed by a hex nut. Tighten the hex nut finger-tight at this time.
4. Tighten the hub hex nut (from step 3) to 200 ft-lb; then install and spread a new cotter pin making sure each side of the pin is flush to the hub nut.



CD027

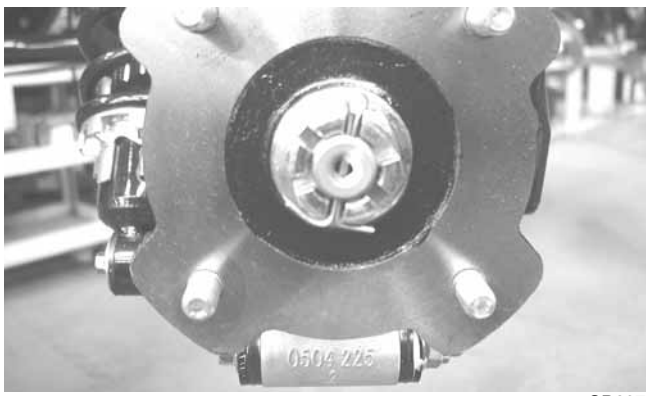
5. Install the wheel; then using a crisscross pattern, tighten the wheel nuts in 27 N-m (20 ft-lb) increments to the final torque shown in the table below.

Steel Wheel	54 N-m (40 ft-lb)
Aluminum Wheel (Black Nuts)	80 N-m (60 ft-lb)
Aluminum Wheel (Chrome Nuts)	108 N-m (80 ft-lb)

6. Remove the vehicle from the support stand and release the parking brake.

INSTALLING FRONT DRIVE AXLE

1. Push the axle shaft into the CV coupler to release the lock ring; then position the drive axle in the gear case and steering knuckle; then insert the ball joints into the steering knuckles. Secure with cap screws tightened to 35 ft-lb.
2. Secure the lower shock eyelet to the A-arm with a cap screw and a new lock nut. Tighten to 20 ft-lb.
3. Slide the hub w/brake disc into position in the steering knuckle followed by a hex nut. Finger-tighten at this time.
4. Install the brake caliper on the steering knuckle using new "patch-lock" cap screws. Tighten to 20 ft-lb.
5. Place the transmission in park; then turn the ignition switch to the ON position, select LOCK on the drive select switch. Turn the ignition switch to the OFF position.
6. Tighten the hex nut (from step 3) to 200 ft-lb; then install and spread a new cotter pin making sure each side of the pin is flush to the hub nut.

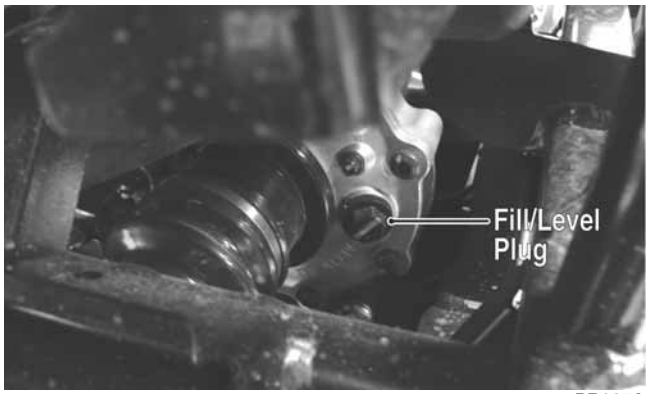


CD027

7. Install the wheel; then using a crisscross pattern, tighten the wheel nuts in 27 N-m (20 ft-lb) increments to the final torque shown in the table below.

Steel Wheel	54 N-m (40 ft-lb)
Aluminum Wheel (Black Nuts)	80 N-m (60 ft-lb)
Aluminum Wheel (Chrome Nuts)	108 N-m (80 ft-lb)

8. Remove the vehicle from the support stand.
9. Check the front differential lubricant level and add lubricant as necessary.



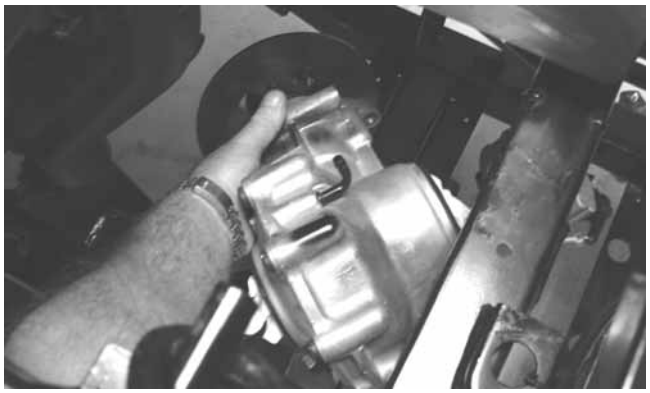
PR065A

Rear Gear Case

REMOVING

■NOTE: Release the cargo box latch and allow the cargo box to tilt back; then remove the cargo box lift support by removing the cap screw and nut securing the lower lift support to the frame. The cargo box will tilt fully rearward.

1. Drain the lubricant from the rear gear case; then remove both rear drive axles.
2. Remove the driveline brake caliper; then cut the rearmost propeller shaft boot clamp and slide the boot forward.
3. Remove the boot clamps on the rear driveline boot.
4. Remove the two cap screws and lock nuts securing the rear gear case to the frame; then remove the gear case through the upper left-side of the frame and lift out the top.


PR207

☞AT THIS POINT

For servicing the input shaft, pinion gear, needle bearing, ring gear, and axle seal, see Front Differential in this section.

RING GEAR/THRUST BUTTON

Removing

1. Remove the cap screws securing the gear case cover to the gear case; then remove the ring gear.
2. Remove the thrust button from the gear case cover (left-hand threads). Account for a shim.

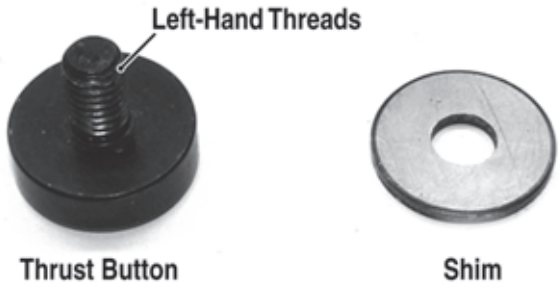
Inspecting

1. Inspect the ring gear for excessive wear, missing or chipped teeth, or discoloration.
2. Inspect the thrust button for excessive wear or discoloration.
3. Inspect the bearings for discoloration, roughness, or excessive wear.

Installing/Shimming

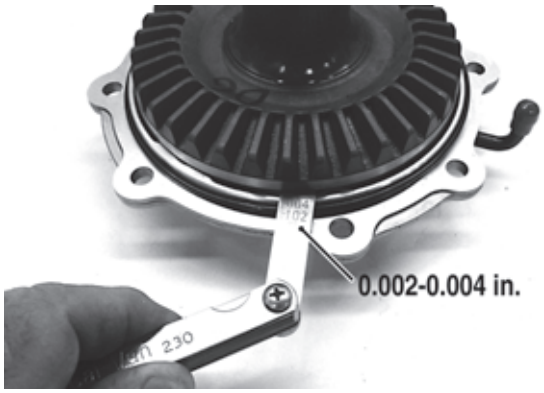
■NOTE: Ring gear clearance must be adjusted prior to selecting shim for the thrust button.

1. Install the thrust button with shim into the gear case cover and tighten securely (left-hand threads).



GC057A

2. Place the ring gear with selected shim into the cover and measure the ring gear to thrust button clearance with a thickness gauge. Clearance should be 0.002-0.004 in.



GC058A

3. If clearance is as specified, remove the ring gear and thrust button; then place a drop of red Loctite #271 on the threads and tighten to 8 ft-lb (left-hand threads).

4. If clearance is not as specified, repeat steps 1 and 2 using thicker shim (clearance too great) or thinner shim (clearance too small) until correct specification is reached.

REAR DRIVE INPUT SHAFT/ HOUSING

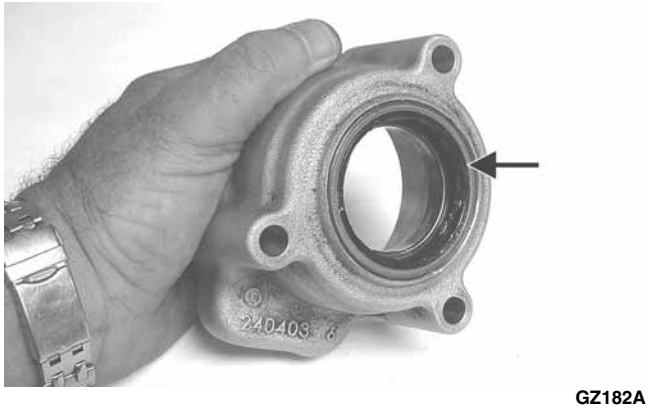
Removing/Disassembling

1. Remove the cap screws securing the rear drive input shaft/housing to the rear gear case; then remove the input housing assembly.

GZ183

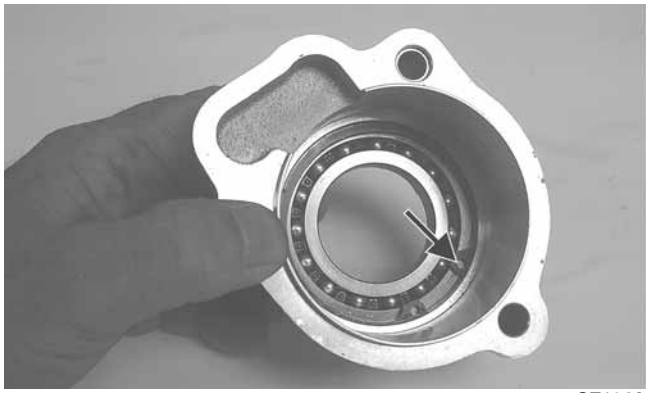
2. Remove the input shaft from the input housing; then remove the oil seal.

GZ180



GZ182A

3. Remove the snap ring retaining the input bearing and using an appropriate bearing driver, press the bearing from the housing.



GZ184A

Cleaning and Inspecting

1. Wash all parts in parts cleaning solvent and dry with compressed air.

⚠ WARNING

Always wear safety glasses when working with compressed air.

2. Clean all gasket material and sealant from mating surfaces.

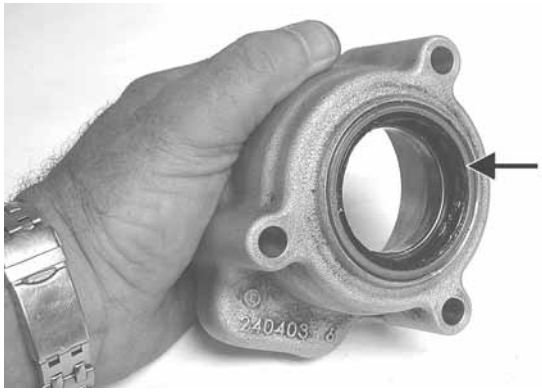
3. Inspect bearings, shafts, and housing for excessive wear, cracks, or discoloration.

Assembling/Installing

1. Install a new bearing into the input housing and secure with the snap ring (flat side directed away from bearing).

GZ184

2. Using a suitable seal driver, install a new oil seal into the front of the input housing until the seal is flush with the housing.



GZ182A

3. Apply grease to the lips of the oil seal; then install the input shaft into the input bearing and housing.

GZ179A

4. Using a new gasket, install the assembled rear drive input shaft/housing onto the rear drive gear case and secure with the three cap screws. Tighten to 23 ft-lb.

☞AT THIS POINT

For servicing the input shaft, pinion gear, needle bearing, and axle seal, see Front Differential in this section.

INSTALLING

1. Slide the gear case into position down through the upper-left side of the frame; then align the driveline splines to the differential input coupler and engage the driveshaft and differential.
2. Pack the driveline boot with the appropriate grease; then secure with the boot clamps using CV Boot Clamp Tool.
3. Secure the differential to the frame with two through-bolts and secure with lock nuts and flat washers. Tighten to 38 ft-lb.
4. Install the rear drive axles.
5. Install the brake caliper and tighten the new "patch-lock" cap screws to 20 ft-lb.
6. Fill the gear case with the appropriate lubricant.

Hub

REMOVING

1. Secure the vehicle on a support stand to elevate the wheel; then remove the wheel.

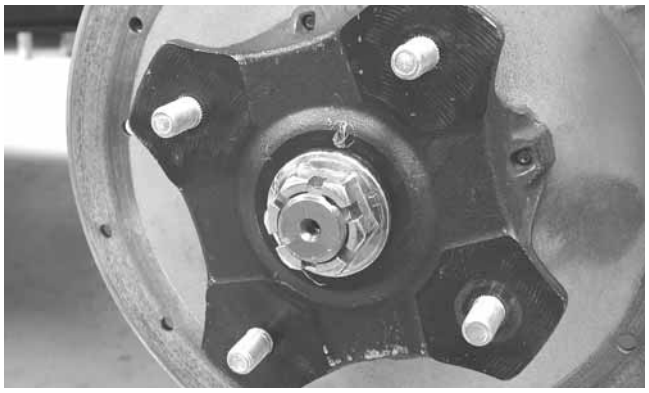
■NOTE: Removing or tightening of the hub nuts requires the axles be locked. To lock the rear axle, place the transmission in park. To lock the front axle, turn the ignition switch to ON and select LOCK on the drive select switch; then place the transmission in park and turn the ignition switch to OFF.

⚠ WARNING

Make sure the vehicle is solidly supported on the support stand to avoid injury.

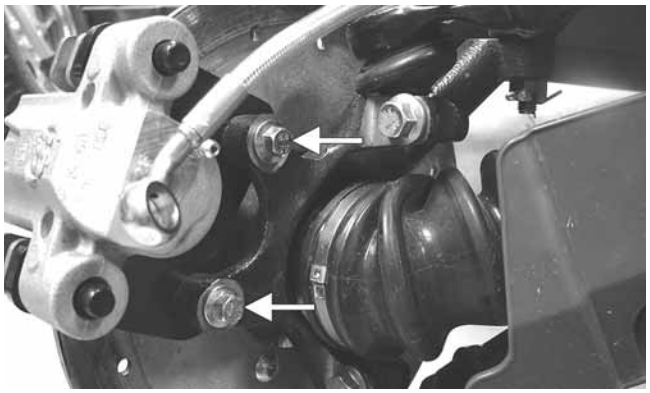
2. Remove the cotter pin from the axle.

■NOTE: During assembly, new cotter pins should be installed.



PR257

3. Remove the hub nut securing the hub.
4. Remove the brake caliper (front only).



PR243A

5. Remove the hub assembly.
6. Remove the four cap screws securing the brake disc.

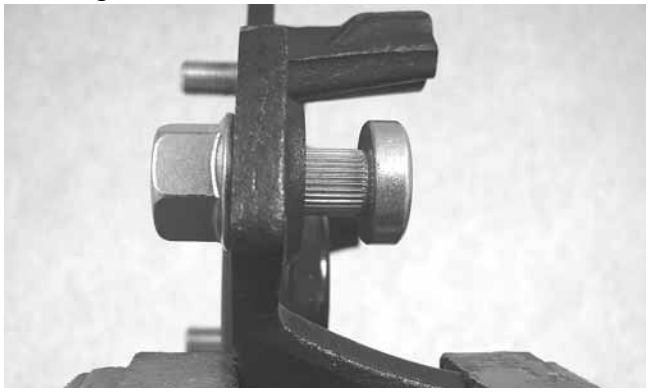
PR254A

CLEANING AND INSPECTING

1. Clean all hub components.
2. Inspect all threads for stripping or damage.
3. Inspect the brake disc (if applicable) for cracks or warping.
4. Inspect the hub for pits, cracks, loose studs, or spline wear.

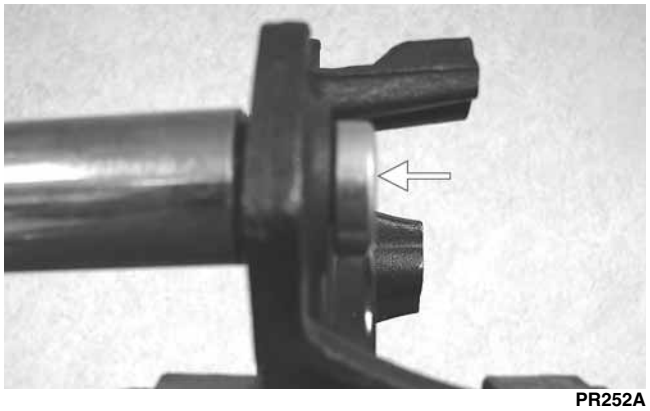
REPLACING WHEEL STUDS

1. Secure the hub in a suitable holding fixture and remove the brake disc (if applicable).
2. Drive the damaged stud out of the hub; then place the new stud into the hub and thread on an appropriate flange nut.



PR250

3. Using a socket and ratchet handle, tighten the nut until the stud is fully drawn into the hub.



PR252A

INSTALLING

1. Secure the brake disc (if applicable) to the hub with the four cap screws coated with red Loctite #271. Tighten to 15 ft-lb.
2. Apply grease to the splines in the hub.

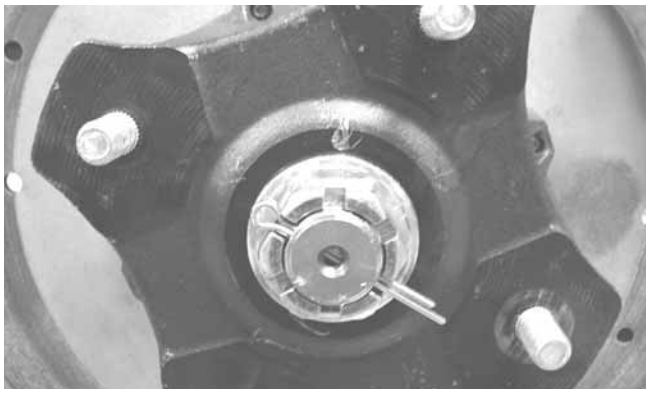
PR254B

3. Install the hub assembly onto the axle; then place the transmission in park.

PR221

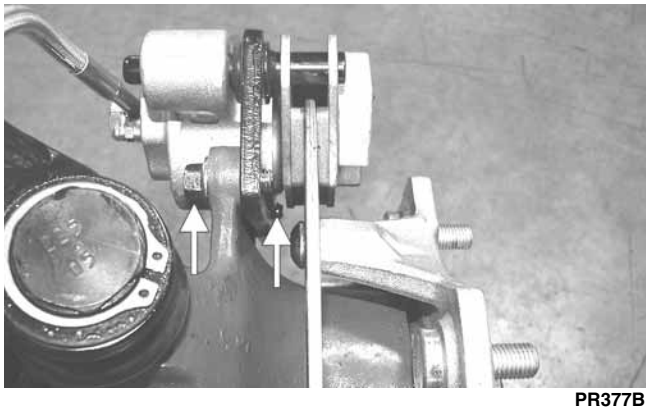
4. Secure the hub assembly with the nut. Tighten to 200 ft-lb; then secure with a new cotter pin.

■NOTE: If the cotter pin cannot be inserted due to misalignment of the hole in the axle and the slots in the nut, tighten the nut until properly aligned.



PR258

5. Secure the brake calipers to the knuckle with two new “patch-lock” cap screws tightened to 20 ft-lb.



PR377B

6. Install the wheel; then using a crisscross pattern, tighten the wheel nuts in 27 N-m (20 ft-lb) increments to the final torque shown in the table below.

Steel Wheel	54 N-m (40 ft-lb)
Aluminum Wheel (Black Nuts)	80 N-m (60 ft-lb)
Aluminum Wheel (Chrome Nuts)	108 N-m (80 ft-lb)

7. Remove the vehicle from the support stand.

Hydraulic Brake Caliper

⚠ WARNING

Toro recommends only authorized Toro ROV dealers perform hydraulic brake service. Failure to properly repair brake systems can result in loss of control causing severe injury or death.

REMOVING/DISASSEMBLING

1. Secure the vehicle on a support stand to elevate the wheel; then remove the wheel.

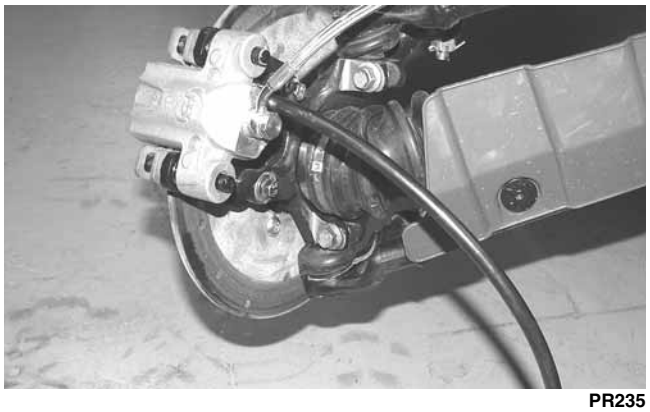
⚠ WARNING

Make sure the vehicle is solidly supported on the support stand to avoid injury.

⚠ WARNING

Never let brake fluid contact the eyes. Damage to the eyes will occur. Always wear appropriate protective safety goggles and latex gloves when handling brake fluid.

2. Drain the brake fluid from the caliper, hose, and master cylinder through the bleed screw by pumping the brake pedal.



PR235

CAUTION

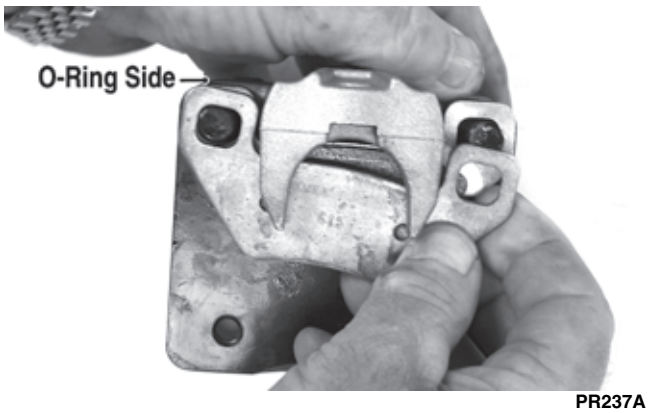
Brake fluid is highly corrosive. Do not spill brake fluid on any surface of the vehicle and do not reuse brake fluid.

■NOTE: Whenever brake components are removed, disassembled, or repaired where brake fluid is exposed to air, drain all fluid and replace with new DOT 4 brake fluid from an unopened container. Brake fluid readily absorbs moisture from the air significantly lowering the boiling point. This increases the chance of vapor lock reducing braking power and increasing stopping distance.

3. Remove the brake hose from the caliper and close the bleed screw; then remove the caliper.

4. Compress the caliper holder against the caliper (opposite the O-ring side) and remove the outer brake pad; then remove the inner brake pad.

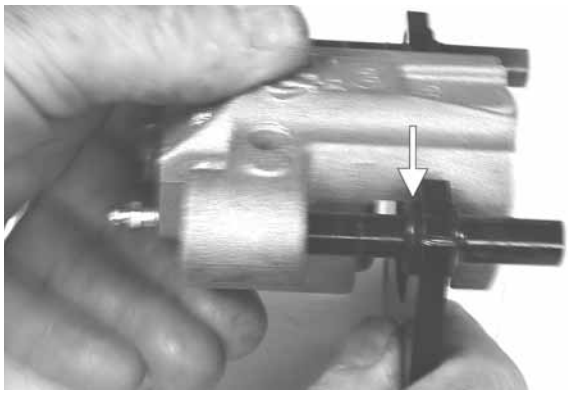
■NOTE: If brake pads are to be returned to service, do not allow brake fluid to contaminate them.



PR237A

PR238

5. Remove the caliper holder from the caliper and discard the O-ring.



PR239B

■NOTE: The O-ring is used for shipping purposes and provides no function in operation.

6. Cover the piston end of the housing with a shop towel; then keeping fingers clear of piston travel, apply compressed air to the fluid port to blow the piston free of the housing. Account for two seal rings in the housing.

PR713A

PR715

⚠ WARNING

Make sure to hold the towel firmly in place or the piston could be ejected from the housing causing injury.

7. Using an appropriate seal removal tool, carefully remove the seals from the brake caliper housing; then remove four O-rings from the brake caliper housing noting the location of the different sized O-rings. Discard all seals, O-rings, and crush washers.

CLEANING AND INSPECTING

1. Clean all caliper components (except the brake pads) with DOT 4 brake fluid. Do not wipe dry.
2. Inspect the brake pads for damage and excessive wear.

■NOTE: For measuring brake pads, see the Periodic Maintenance - Hydraulic Brake System.

3. Inspect the brake caliper housings for scoring in the piston bores, chipped seal ring grooves, or signs of corrosion or discoloration.
4. Inspect the piston surface for scoring, discoloration, or evidence of binding or galling.
5. Inspect the caliper holder for wear or bending.

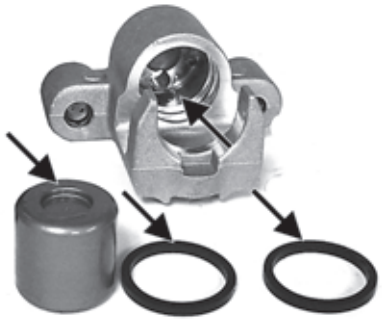
ASSEMBLING/INSTALLING

1. Install new seals into the brake caliper housing and apply a liberal amount of DOT 4 brake fluid to the cylinder bore of the housing, seals, and brake piston.

CAUTION

Make sure the seals are properly in place and did not twist or roll during installation.

PR715



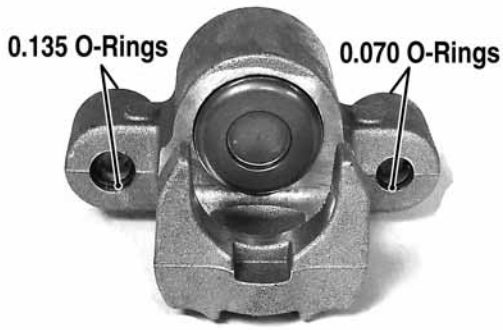
PR717A

2. Press the piston into the caliper housing using hand pressure only. Completely seat the piston; then wipe off any excessive brake fluid.

PR711A

PR712

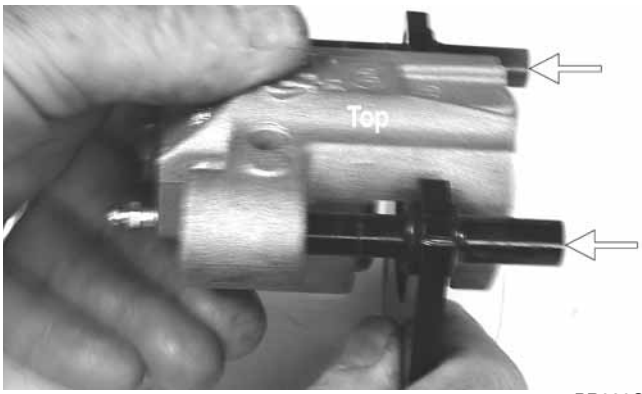
3. Apply high-temperature silicone grease (supplied with the O-ring kit) to the inside of the caliper holder bores and O-rings; then install the four O-rings into the caliper.



PR719C

4. Install the caliper onto the caliper holder making sure the caliper and holder are correctly oriented.

■NOTE: It is very important to apply silicone grease to the O-rings and caliper bores prior to assembly.



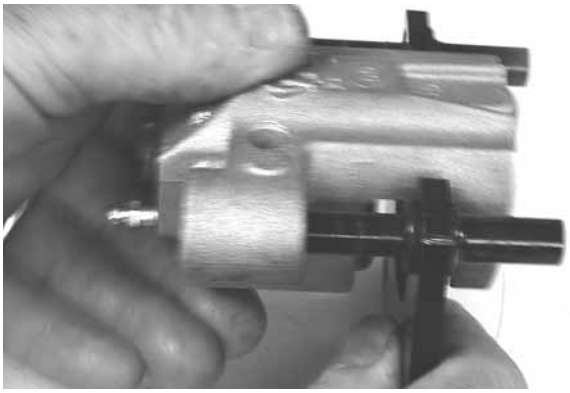
PR239C

5. Making sure brake fluid does not contact the brake pads, compress the caliper holder toward the caliper and install the inner brake pad; then install the outer pad.

CAUTION

If brake pads become contaminated with brake fluid, they must be thoroughly cleaned with brake cleaning solvent or replaced with new pads. Failure to do so will result in reduced braking and premature brake pad failure.

PR238



PR239

6. Place the brake caliper assembly into position and secure with new "patch-lock" cap screws. Tighten the caliper to 20 ft-lb.

7. Place a new crush washer on each side of the brake hose fitting and install it on the caliper. Tighten to 20 ft-lb.

8. Fill the reservoir; then bleed the brake system (see Periodic Maintenance - Hydraulic Brake System).

⚠ WARNING

Never use brake fluid from an open container or reuse brake fluid. Moisture-contaminated brake fluid could cause vapor build-up (expansion) during hard braking resulting in greatly increased stopping distance or loss of control leading to injury or death.

9. Install the wheel; then using a crisscross pattern, tighten the wheel nuts in 27 N-m (20 ft-lb) increments to the final torque shown in the table below.

Steel Wheel	54 N-m (40 ft-lb)
Aluminum Wheel (Black Nuts)	80 N-m (60 ft-lb)
Aluminum Wheel (Chrome Nuts)	108 N-m (80 ft-lb)

10. Remove the vehicle from the support stand and verify brake operation.

MASTER CYLINDER ASSEMBLY

■NOTE: The master cylinder is a non-serviceable component; it must be replaced as an assembly.

Removing

1. Slide a piece of flexible tubing over one of the wheel bleeder valves and direct the other end into a container. Remove the reservoir cover; then open the bleeder valve. Allow the brake fluid to drain until the reservoir is empty.

AF637D

2. Remove the cotter pin and pivot pin from the yoke; then remove two cap screws and flange nuts securing the master cylinder assembly to the frame.

PR338

PR336

3. Remove the oil bolt securing the banjo-fittings to the master cylinder; then remove the master cylinder. Discard the three crush washers.

CAUTION

Brake fluid is highly corrosive. Do not spill brake fluid on any surface of the vehicle.

Inspecting

1. Inspect the master cylinder push rod and clevis for wear, bending, or elongation of clevis holes.
2. Inspect the push rod boot for tears or deterioration.
3. Inspect the reservoir for cracks and leakage.
4. Inspect the brake hose for cracks and deterioration and the condition of the banjo-fittings.

Installing

1. Place the master cylinder into position; then using three new crush washers, secure the two banjo-fittings to the master cylinder. Tighten to 20 ft-lb.
2. Secure the master cylinder assembly to the frame with two cap screws and two flange nuts. Tighten to 25 ft-lb.
3. Install the pivot pin and secure with a new cotter pin.
4. Fill the master cylinder and bleed the brake system (see Hydraulic Brake System in Periodic Maintenance).

Universal Joints

REMOVING

■NOTE: The universal joints can be accessed by removing the belly panel. To remove the belly panel, see the Steering/Frame/Controls section.

1. Support the vehicle on suitable jack stands elevated high enough to allow working from the underside of the vehicle.
2. To aid in installing, match mark drive-line components prior to removing.

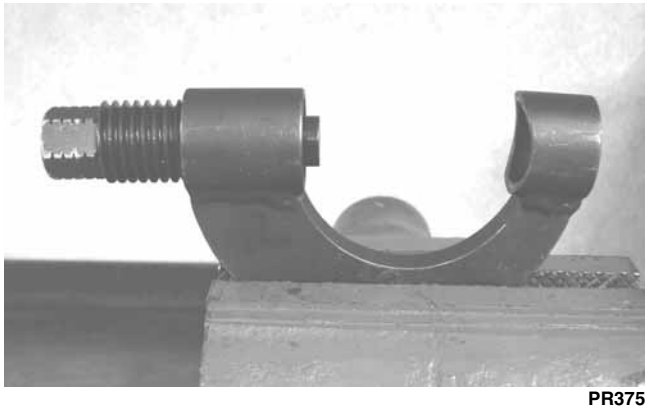
3. Remove the cap screws securing the driveshaft flange to the output flange; then remove the driveshaft.

HDX157

4. Install a U-joint separator tool on the universal joint fixed yoke; then remove the bearing cup retainers.
5. Using a suitable socket and ratchet handle, rotate the jackscrew to push the bearing cup out of the yoke; then remove the tool and the bearing cup.

PR359

6. Install the separator tool on the opposite side of the yoke to push the second bearing cup from the yoke; then remove the tool and separate the universal joint.
7. Secure the separator tool in a vise and repeat steps 4-6 to remove the bearing cups from the movable yoke.



PR375

INSPECTING

1. Inspect the yoke bores for damage or signs of bearing cup looseness. If bearing cups are loose, the yoke must be replaced.

PR367B

2. Verify the yoke legs are parallel.

PR367A

3. Check splines and flanges for excessive wear, thread damage, or warpage.

PR367C

INSTALLING

1. Remove the bearing cups from the universal joint; then insert the joint into the yoke and install one bearing cup on the joint.

CAUTION
Care must be taken when installing bearing cups that the needle bearings stay in place or severe damage to the universal joint will occur.

PR368

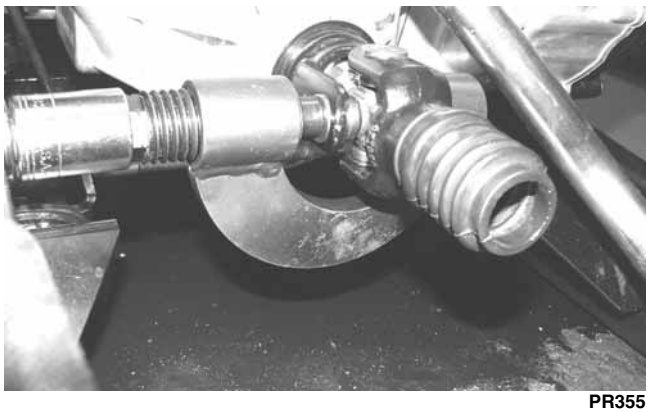
2. Secure a U-joint separator tool in a vise; then place the yoke, joint, and bearing cup into position and press the cup into the yoke.

PR374

3. Install the retainer in the bearing cup; then remove the yoke from the separator tool.

■NOTE: Repeat steps 2-3 for the opposite-side bearing cup.

4. Remove the separator tool from the vise and install the universal joint, bearing cups, and movable yoke into the fixed yoke using the same procedure as steps 2-3 except the vise cannot be used.



PR355

5. Check that the universal joint can be flexed freely without binding; then apply multi-purpose grease to the splines and install the driveshaft noting the match marks made prior to removing.

Troubleshooting Drive System

Problem: Power not transmitted from engine to wheels	
Condition	**Remedy**
1. **Rear axle shaft serration** worn - broken	1. Replace shaft
Problem: Power not transmitted from engine to either front wheel	
Condition	**Remedy**
1. **Secondary drive - driven gear teeth** broken	1. Replace gear(s)
2. **Propeller shaft serration** worn - broken	2. Replace shaft
3. **Coupling** damaged	3. Replace coupling
4. **Coupling joint serration** worn - damaged	4. Replace joint
5. **Front drive - driven bevel gears** broken - damaged	5. Replace gear(s)
6. **Front differential gears/pinions** broken - damaged	6. Replace gears - pinions
7. **Front drive actuator** not operating	7. Replace fuse - drive select switch - front drive actuator

Troubleshooting Brake System

Problem: Braking poor	
Condition	**Remedy**
1. **Pad** worn 2. **Brake fluid** leaking 3. **Master cylinder/brake cylinder seal** worn	1. Replace pads 2. Repair - replace hydraulic system 3. Replace seal(s)
Problem: Brake pedal travel excessive	
Condition	**Remedy**
1. **Brake fluid** low 2. **Piston seal - cup** worn	1. Add fluid to proper level 2. Replace seal - cup
Problem: Brake fluid leaking	
Condition	**Remedy**
1. **Connection fittings** loose 2. **Hose** cracked 3. **Piston seal** worn	1. Tighten fittings 2. Replace hose 3. Replace seal
Problem: Brake pedal spongy	
Condition	**Remedy**
1. **Air** trapped in hydraulic system 2. **Brake fluid** low	1. Bleed hydraulic system 2. Add brake fluid and bleed hydraulic brake system

Suspension

The following suspension system components should be inspected periodically to ensure proper operation.

A. Shock absorber rods bent, pitted, or damaged.

B. Rubber damper cracked, broken, or missing.

C. Shock absorber body damaged, punctured, or leaking.

D. Shock absorber eyelets broken, bent, or cracked.

E. Shock absorber eyelet bushings worn, deteriorated, cracked, or missing.

F. Shock absorber spring broken or sagging.

G. Sway bar mountings tight and bushings secure.

Shock Absorbers

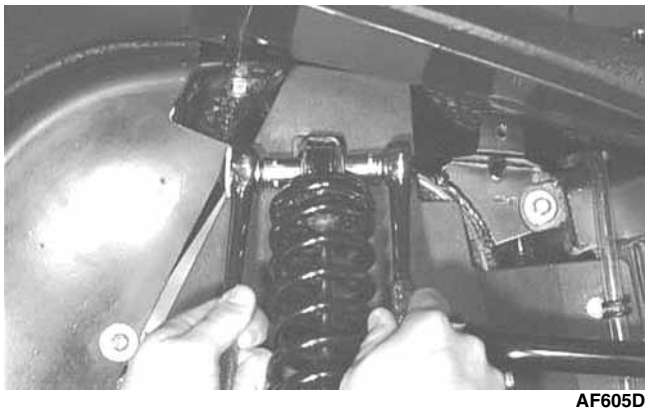
REMOVING

1. Secure the vehicle on a support stand to elevate the wheels and to release load on the suspension.

⚠ WARNING

Make sure the vehicle is solidly supported on the support stand to avoid injury.

2. Remove the cap screws and nuts securing each shock absorber. Account for any bushings and sleeves and discard the nuts.



AF605D

3. Using a suitable spring compression stand, compress the spring, remove the retainer, and remove the spring.

⚠ WARNING

Shock absorber springs are under high compression loads. Do not attempt to remove springs without an adequate spring compressor. Sever injury could result.

CF341

CLEANING AND INSPECTING

1. Clean all shock absorber components in parts-cleaning solvent.

2. Inspect each shock rod for nicks, pits, rust, bends, and oily residue.

3. Inspect all springs, spring retainers, shock rods, sleeves, bushings, shock bodies, and eyelets for cracks, leaks, and bends.

INSTALLING

1. Place the shock absorber spring over the shock absorber, compress the spring, and install the retainer.

2. Place bushings and sleeves (where appropriate) into shock eyelet; then install shocks with two cap screws and new lock nuts. Tighten new lock nuts to 35 ft-lb.

3. Remove the vehicle from the support stand.

Front A-Arms

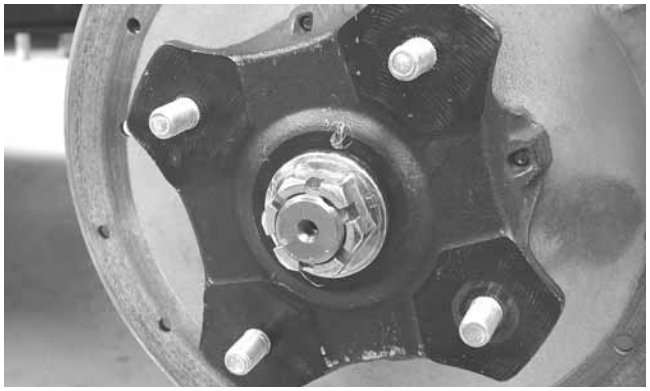
REMOVING

1. Secure the vehicle on a support stand to elevate the front wheels; then remove the wheels.

⚠ WARNING

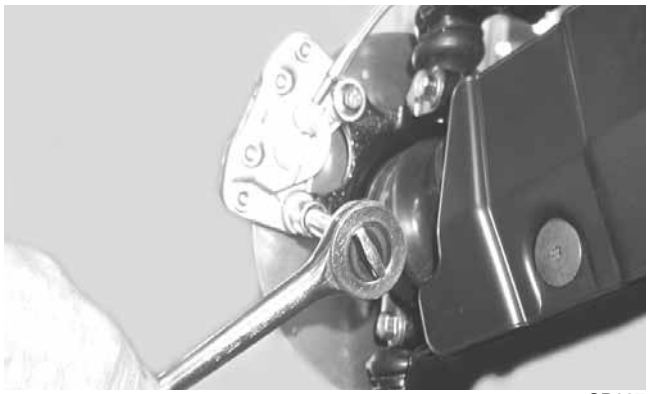
Make sure the vehicle is solidly supported on the support stand to avoid injury.

2. Remove the cotter pin from the nut. Discard the cotter pin.



PR257

3. Remove the nut securing the hub.
4. Remove the brake caliper. Account for two cap screws.

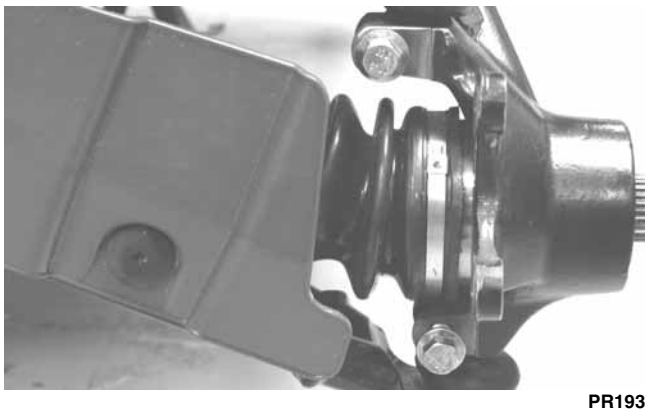


CD007

5. Remove the hub assembly.
6. Remove the cotter pin and slotted nut securing the tie rod end to the knuckle; then remove the tie rod end from the knuckle.
7. Remove the cap screws securing the ball joints to the knuckle.

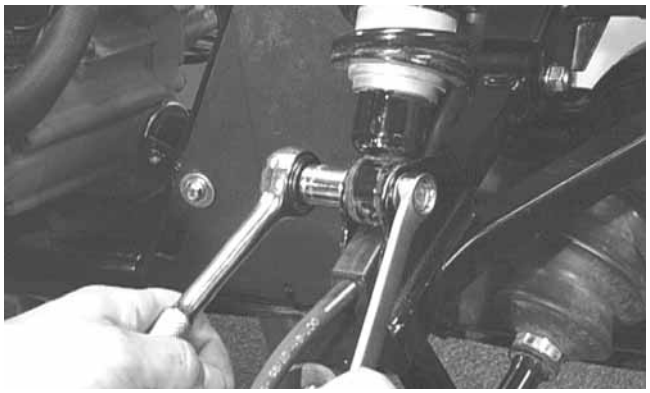
CAUTION

Support the knuckle when removing the cap screws or damage to the threads will occur.



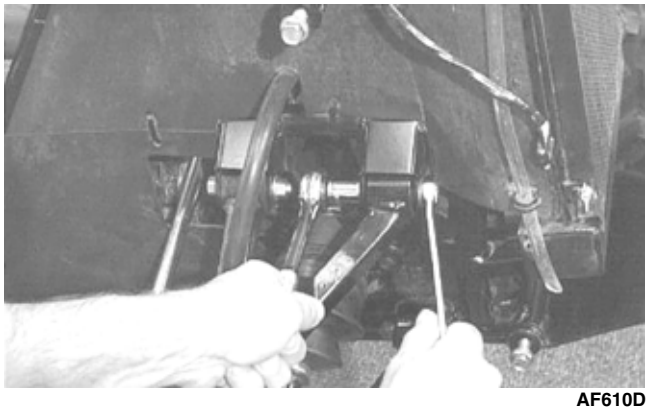
PR193

8. Tap the ball joints out of the knuckle; then remove the knuckle.
9. Remove the lower shock absorber eyelet from the upper A-arm.



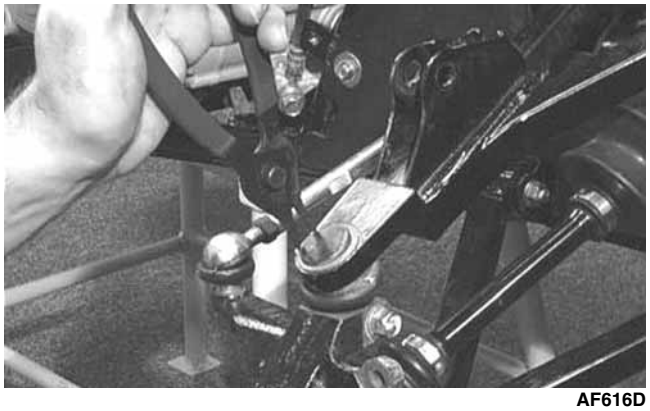
AF626D

10. Remove the cap screws securing the A-arms to the frame.



AF610D

11. Remove the snap ring from the ball joint; then remove the ball joint from the A-arm.



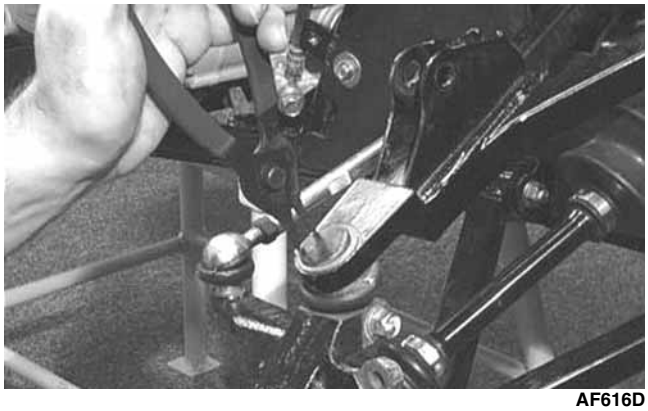
AF616D

CLEANING AND INSPECTING

1. Clean all A-arm components in parts-cleaning solvent.
2. Clean the ball joint mounting hole of all residual Loctite, grease, oil, or dirt for installing purposes.
3. Inspect the A-arm for bends, cracks, and worn bushings.
4. Inspect the ball joint mounting holes for cracks or damage.
5. Inspect the frame mounts for signs of damage, wear, or weldment damage.

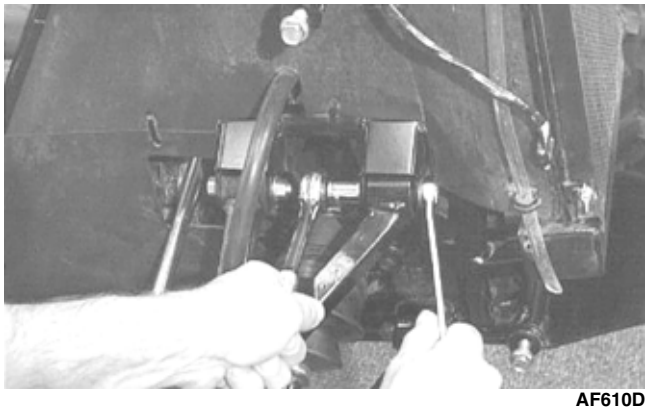
INSTALLING

1. Apply Loctite Primer "T" to the A-arm socket; then apply green Loctite #609 to the entire outside diameter of the ball joint. Install the ball joint into the A-arm and secure with the snap ring.



AF616D

2. Install the A-arm assemblies into the frame mounts and secure with the cap screws. Only finger-tighten at this time.



AF610D

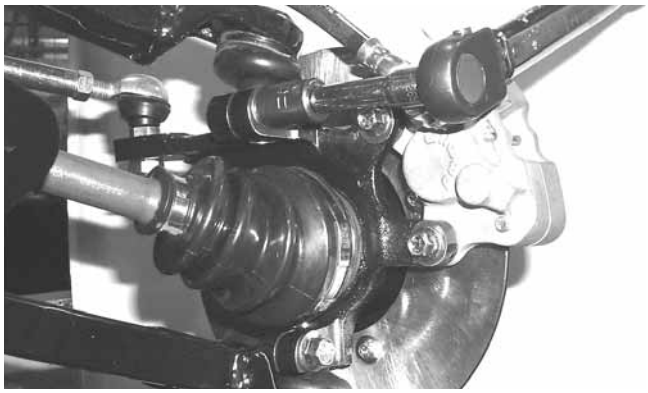
3. Route the brake hose through the upper A-arm shock absorber mount.

AF627D

4. Secure the lower eyelet of the shock absorber to the lower A-arm. Tighten nut to 20 ft-lb.

5. Secure the A-arm assemblies to the frame mounts (from step 2). Tighten the cap screws to 35 ft-lb.

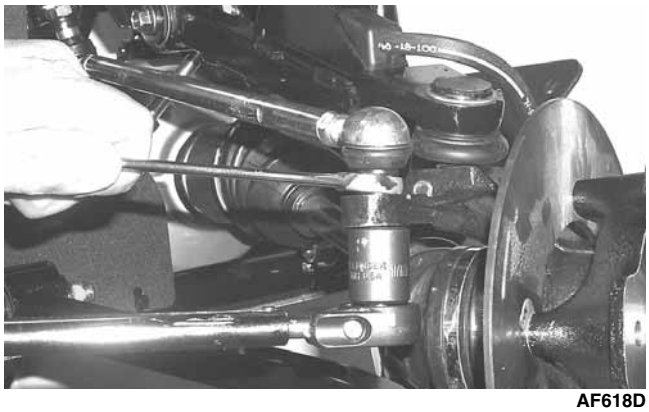
6. Install the knuckle assembly onto the ball joints and secure with cap screws. Tighten to 35 ft-lb.



AF628D

7. Install the tie rod end and secure with the nut (coated with red Loctite #271). Tighten to 30 ft-lb; then install a new cotter pin and spread the pin to secure the nut.

■NOTE: During assembly, new cotter pins should be installed.



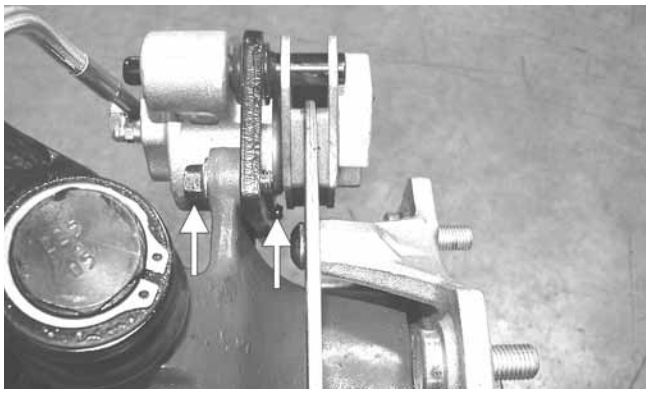
AF618D

8. Apply grease to the hub and drive axle splines; then install the hub assembly onto the drive axle.

PR290A

9. Secure the hub assembly with the nut. Tighten only until snug.

10. Secure the brake caliper holder to the knuckle with two new "patch-lock" cap screws. Tighten to 20 ft-lb.



PR377B

11. Secure the hub nut (from step 9) to the shaft/axle. Tighten to 200 ft-lb.
12. Install a new cotter pin and spread the pin to secure the nut.

■NOTE: If the cotter pin cannot be inserted due to misalignment of the hole in the axle and the slots in the nut, tighten the nut until properly aligned.

PR260

13. Install the wheel; then using a crisscross pattern, tighten the wheel nuts in 27 N-m (20 ft-lb) increments to the final torque shown in the table below.

Steel Wheel	54 N-m (40 ft-lb)
Aluminum Wheel (Black Nuts)	80 N-m (60 ft-lb)
Aluminum Wheel (Chrome Nuts)	108 N-m (80 ft-lb)

14. Remove the vehicle from the support stand.

Rear A-Arms

REMOVING

1. Secure the vehicle on a support stand to elevate the wheels.

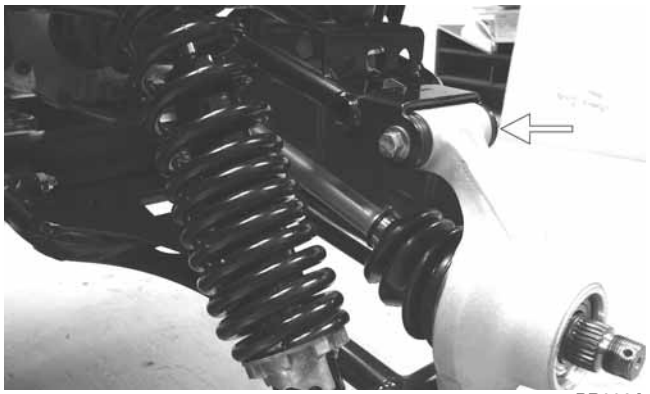
⚠ WARNING

Make sure the vehicle is solidly supported on the support stand to avoid injury.

2. Place the transmission in park.
3. Remove the wheel.
4. Remove the cotter pin securing the hex nut; then remove the hex nut.
5. Remove the cap screws and lock nut securing the shock absorber to the frame and lower A-arm; then remove the shock absorber.
6. Remove the cap screws securing the boot guard to the lower A-arm.

AF934

7. Slide the axle out of the knuckle and set aside.
8. Remove the cap screws and lock nuts securing the knuckle to the A-arms. Discard the lock nuts.



PR220A

■NOTE: Never reuse a lock nut. Once a lock nut has been removed, it must be replaced with a new lock nut.

9. Remove the cap screws and lock nuts securing the A-arms to the frame; then remove the A-arms.

CLEANING AND INSPECTING

1. Clean all A-arm components in parts-cleaning solvent.
2. Inspect the A-arm for bends, cracks, and worn bushings.
3. Inspect the frame mounts for signs of damage, wear, or weldment damage.

INSTALLING

1. Install the A-arm assemblies into the frame mounts and secure with the cap screws and new lock nuts. Finger-tighten only at this time.

2. Slide the knuckle onto the drive axle and into position on the A-arms; then secure the knuckle to the A-arms with cap screws and new lock nuts. Tighten to 35 ft-lb.
3. Tighten the hardware securing the A-arms to the frame mounts (from step 1) to 35 ft-lb.
4. Apply grease on the drive axle splines; then install the hub assembly onto the drive axle.

PR221

5. Secure the hub assembly with the nut. Tighten to 200 ft-lb.
6. Install a new cotter pin and spread the pin to secure the nut.

■NOTE: If the cotter pin cannot be inserted due to misalignment of the hole in the axle and the slots in the nut, tighten the nut until properly aligned.

PR196

7. Secure the shock absorber to the frame with a cap screw and new lock nut. Tighten to 35 ft-lb.
8. Secure the shock absorber to the lower A-arm with a cap screw and new lock nut. Tighten to 35 ft-lb.
9. Secure the boot guard to the lower A-arm with the two cap screws. Tighten securely.
10. Install the wheel; then using a crisscross pattern, tighten the wheel nuts in 27 N-m (20 ft-lb) increments to the final torque shown in the table below.

Steel Wheel	54 N-m (40 ft-lb)
Aluminum Wheel (Black Nuts)	80 N-m (60 ft-lb)
Aluminum Wheel (Chrome Nuts)	108 N-m (80 ft-lb)

11. Remove the vehicle from the support stand.

Wheels and Tires

TIRE SIZE

⚠ WARNING

Use only Toro approved tires when replacing tires. Failure to do so could result in unstable vehicle operation.

This vehicle is equipped with low-pressure tubeless tires of the size and type listed in the General Information section. Do not under any circumstances substitute tires of a different type or size.

⚠ WARNING

Always use the size and type of tires specified. Always maintain proper tire inflation pressure.

⚠ WARNING

Do not mix tire tread patterns. Use the same pattern type on front and rear. Failure to heed warning could cause poor handling qualities of the vehicle and could cause excessive drive train damage not covered by warranty.

TIRE INFLATION PRESSURE

Front and rear tire inflation pressure should be 1.41 kg/cm² (20 psi).

REMOVING

1. Secure the vehicle on a support stand to elevate the wheels.

⚠ WARNING

Make sure the vehicle is solidly supported on the support stand to avoid injury.

2. Remove the nuts securing the wheels; then remove the wheels.

CLEANING AND INSPECTING

1. Clean the wheels and hubs with parts-cleaning solvent.
2. Clean the tires with soap and water.
3. Inspect each wheel for cracks, dents, or bends.
4. Inspect each tire for cuts, wear, missing lugs, and leaks.

INSTALLING

Install each wheel on its hub; then using a crisscross pattern, tighten the wheel nuts in 27 N-m (20 ft-lb) increments to the final torque shown in the table below.

Steel Wheel	54 N-m (40 ft-lb)
Aluminum Wheel (Black Nuts)	80 N-m (60 ft-lb)
Aluminum Wheel (Chrome Nuts)	108 N-m (80 ft-lb)

CHECKING/INFLATING

1. Using an air pressure gauge, measure the air pressure in each tire. Adjust the air pressure as necessary to meet the recommended inflation pressure.
2. Inspect the tires for damage, wear, or punctures.

⚠ WARNING

Do not operate the vehicle if tire damage exists.

■NOTE: If repair is needed, follow the instructions found on the tire repair kit or remove the wheel and have it repaired professionally.

■NOTE: Be sure all tires are the specified size and have identical tread pattern.

Troubleshooting

Problem: Suspension too soft	
Condition	**Remedy**
1. **Spring preload** incorrect 2. **Spring(s)** weak 3. **Shock absorber** damaged 4. **Rear shock absorbers** too soft	1. Adjust preload 2. Replace spring(s) 3. Replace shock absorber 4. Check and adjust air pressure in shocks
Problem: Suspension too stiff	
Condition	**Remedy**
1. **Spring preload** incorrect 2. **A-arm-related bushings** worn	1. Adjust preload 2. Replace bushing
Problem: Suspension noisy	
Condition	**Remedy**
1. **Cap screws (suspension system)** loose 2. **A-arm-related bushings** worn	1. Tighten cap screws 2. Replace bushings
Problem: Vehicle pulling or steering erratic	
Condition	**Remedy**
1. **Vehicle steering** is erratic on dry, level surface 2. **Vehicle** pulls left or right on dry, level surface	1. Check front wheel alignment and adjust if necessary (see the Steering/Frame/Controls - Checking/Adjusting Front Wheel Alignment) 2. Check air pressure in tires and adjust to specifications

Printed in U.S.A. **p/n 492-9346**