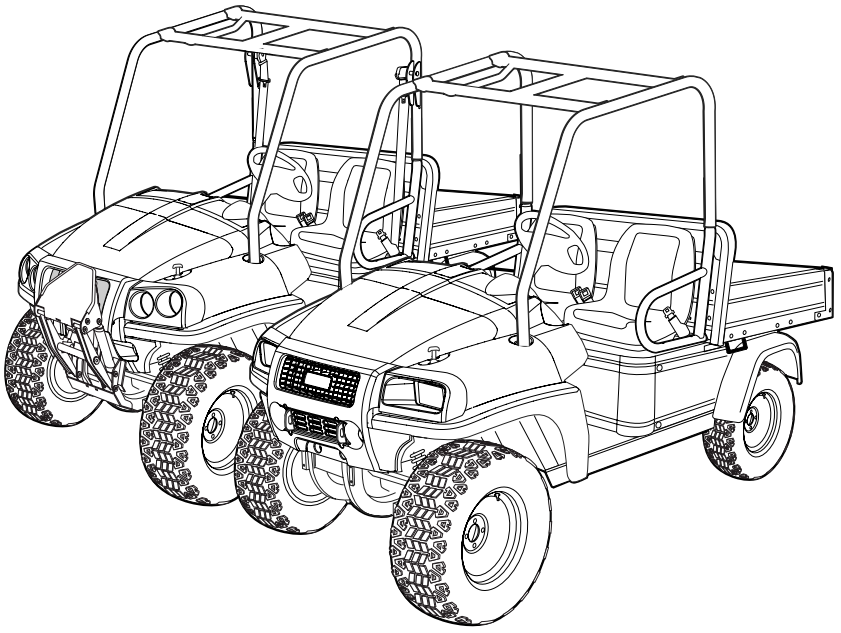
2007 Carryall 295/295SE and XRT 1550/1550SE Maintenance and Service Manual



Gasoline, Diesel and IntelliTach, and Homologated Vehicles

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FOREWORD

Club Car vehicles are designed and built to provide the ultimate in performance efficiency; however, proper maintenance and repair are essential for achieving maximum service life and continued safe and reliable operation.

This manual provides detailed information for the maintenance and repair of Carryall 295, Carryall 295 SE, XRT 1550, XRT 1550 SE and IntelliTach vehicles, and should be thoroughly reviewed prior to servicing the vehicles. The procedures provided must be properly implemented, and the DANGER, WARNING, and CAUTION statements must be heeded.

This manual was written for the trained technician who already possesses knowledge and skills in electrical and mechanical repair. If the technician does not have such knowledge and skills, attempted service or repairs to the vehicle may render the vehicle unsafe. For this reason, Club Car advises that all repairs and/or service be performed by an authorized Club Car distributor/dealer representative or by a Club Car factory-trained technician.

It is the policy of Club Car, Inc. to assist its distributors and dealers in continually updating their service knowledge and facilities so they can provide prompt and efficient service for vehicle owners. Regional technical representatives, vehicle service seminars, periodic service bulletins, maintenance and service manuals, and other service publications also represent Club Car's continuing commitment to customer support.

This manual covers all aspects of typical vehicle service; however, unique situations sometimes occur when servicing a vehicle. If it appears that a service question is not answered in this manual, you may write to us at: Club Car, Inc.; P.O. Box 204658; Augusta, GA 30917; Attention: Technical Services, or contact a Club Car Technical Service Representative at (706) 863-3000, ext. 3580.

This manual effective June 19, 2006.

⚠ WARNING

- **Read Section 1 – Safety before attempting any service on this vehicle.**
- **Before servicing vehicle, read complete section(s) and any referenced information that may be relevant to the service or repair to be performed.**

NOTE: *This manual represents the most current information at the time of publication. Club Car, Inc., is continually working to further improve its vehicles and other products. These improvements may affect servicing procedures. Any modification and/or significant change in specifications or procedures will be forwarded to all Club Car dealers and will, when applicable, appear in future editions of this manual.*

Damage to a vehicle or component thereof not resulting from a defect or that occurs due to unreasonable or unintended use, overloading, abuse, or neglect (including failure to provide reasonable or necessary maintenance as instructed in the vehicle owner's manual), accident or alteration, including increasing vehicle speed beyond factory specifications or modifications that affect the stability of the vehicle or the operation thereof, will void the warranty.

Club Car, Inc., reserves the right to change specifications and designs at any time without notice and without incurring any obligation or liability whatsoever.

There are no warranties expressed or implied in this manual. See the limited warranty found in the vehicle owner's manual or write to Club Car, Inc., P.O. Box 204658, Augusta, GA 30917-4658 USA, Attention: Warranty Department.

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SECTION 1 – SAFETY

To ensure the safety of those servicing these vehicles, and to protect the vehicles from damage resulting from improper service or maintenance, the procedures in this manual must be followed. It is important to note that throughout this manual there are statements contained within headings labeled DANGER, WARNING, CAUTION, or NOTE. These special statements relate to specific safety issues, and must be read, understood, and heeded before proceeding.

⚠ DANGER

- **A DANGER indicates an immediate hazard that will result in severe personal injury or death.**

⚠ WARNING

- **A WARNING indicates an immediate hazard that could result in severe personal injury or death.**

⚠ CAUTION

- **A CAUTION with the safety alert symbol indicates a hazard or unsafe practice that could result in minor personal injury.**

CAUTION

- **A CAUTION without the safety alert symbol indicates a potentially hazardous situation that could result in property damage.**

GENERAL WARNING

The following safety statements must be heeded whenever the vehicle is being operated, repaired, or serviced. Service technicians should become familiar with these safety statements, which can be found throughout this manual. Also, other specific safety statements appear throughout this manual and on the vehicle.

⚠ DANGER

- **Battery – Explosive gases! Do not smoke. Keep sparks and flames away from the vehicle and service area. Ventilate when charging or operating vehicle in an enclosed area. Wear a full face shield and rubber gloves when working on or near batteries.**
- **Battery – Poison! Contains acid! Causes severe burns. Avoid contact with skin, eyes, or clothing. Antidotes:**
  - **External: Flush with water. Call a physician immediately.**
  - **Internal: Drink large quantities of milk or water. Follow with milk of magnesia or vegetable oil. Call a physician immediately.**
  - **Eyes: Flush with water for 15 minutes. Call a physician immediately.**
- **Gasoline/Diesel – Flammable! Explosive! Do not smoke. Keep sparks and flames away from the vehicle and service area. Service only in a well-ventilated area.**
- **Do not operate engine in an enclosed area without proper ventilation. The engine produces carbon monoxide, which is an odorless, deadly poison.**

⚠ WARNING

- **Follow the procedures exactly as stated in this manual, and heed all DANGER, WARNING, and CAUTION statements in this manual as well as those on the vehicle.**
- **Only trained technicians should service or repair the vehicle. Anyone doing even simple repairs or service should have knowledge and experience in electrical and mechanical repair. The appropriate instructions must be used when performing maintenance, service, or accessory installation.**
- **Prior to servicing the vehicle or leaving the vehicle unattended, turn the key switch OFF, remove the key, and place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels when servicing the vehicle.**
- **To avoid unintentionally starting the vehicle:**
- **Disconnect battery cables, negative (–) cable first (Figure 1-2, Page 1-3).**
- **Gasoline vehicles only: Disconnect the spark plug wires from the spark plugs.**
- **Frame ground – Do not allow tools or other metal objects to contact frame when disconnecting battery cables or other electrical wiring. Do not allow a positive wire to touch the vehicle frame, engine, or any other metal component.**
- **Wear safety glasses or approved eye protection when servicing the vehicle. Wear a full face shield and rubber gloves when working on or near batteries.**
- **Do not wear loose clothing or jewelry such as rings, watches, chains, etc., when servicing the vehicle.**
- **Moving parts! Do not attempt to service the vehicle while it is running.**
- **Hot! Do not attempt to service hot engine or exhaust system. Failure to heed this warning could result in severe burns.**
- **Use insulated tools when working near batteries or electrical connections. Use extreme caution to avoid shorting of components or wiring.**
- **Check the vehicle owner's manual for proper location of all vehicle safety and operation decals and make sure they are in place and are easy to read.**
- **Any modification or change to the vehicle that affects the stability or handling of the vehicle, or increases maximum vehicle speed beyond factory specifications, could result in severe personal injury or death.**
- **The diameter of all tires on the vehicle must be equal, otherwise the all-wheel drive system will not operate as intended and could result in severe personal injury or death. Never install tires of different diameters on the vehicle.**
- **Lift only one end of the vehicle at a time. Use a suitable lifting device (chain hoist or hydraulic floor jack) with 1000 lb. (454 kg) minimum lifting capacity. Do not use lifting device to hold vehicle in raised position. Use approved jack stands of proper weight capacity to support the vehicle and chock the wheels that remain on the floor. When not performing a test or service procedure that requires movement of the wheels, lock the brakes.**
- **When servicing the vehicle with part of the vehicle on jack stands, do not operate the engine with the Forward/Reverse handle in either the FORWARD or REVERSE position. The all-wheel drive system will engage any wheel(s) with traction. See Figure 1-1, Page 1-3.**

Figure 1-1 All-Wheel Drive Warning

- **If wires are removed or replaced, make sure wiring and wire harness are properly routed and secured. Failure to properly route and secure wiring could result in vehicle malfunction, property damage, personal injury, or death.**
- **For vehicles with cargo beds, remove all cargo before raising the bed or servicing the vehicle. If the vehicle is equipped with a prop rod, ensure that it is securely engaged while bed is raised. Do not close bed until all persons are clear of cargo bed area. Keep hands clear of all crush areas. Do not drop cargo bed; lower gently and keep entire body clear. Failure to heed this warning could result in severe personal injury or death.**
- **Improper use of the vehicle or failure to properly maintain it could result in decreased vehicle performance, severe personal injury, or death.**
- **Do not leave children unattended on vehicle.**

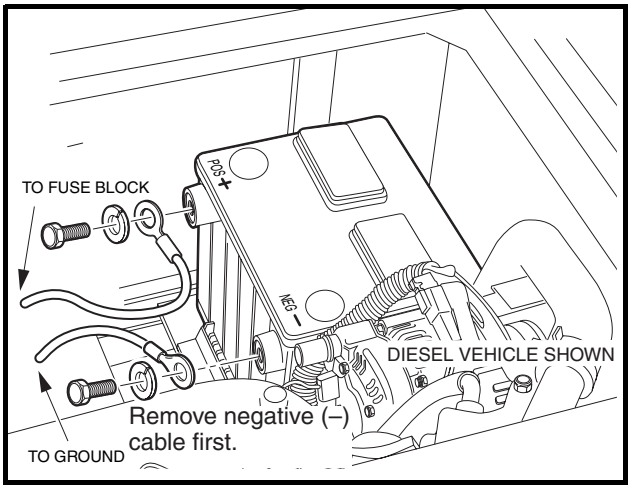


Figure 1-2 Battery

SECTION 2A – VEHICLE SPECIFICATIONS: HONDA GAS & KUBOTA DIESEL POWERED

295/295 SE AND 1550/1550 SE SPECIFICATIONS

SPECIFICATIONS	Carryall 295 & XRT 1550	Carryall 295 & XRT 1550	Carryall 295 SE & XRT 1550 SE	Carryall 295 SE & XRT 1550 SE
POWER SOURCE	**Gasoline**	**Diesel**	**Gasoline**	**Diesel**
Engine: 4-cycle OHV, 614 cc, 20.0 maximum HP @3600 rpm (per SAE J 1940/1349), twin-cylinder, air-cooled, with pressure lubrication system	•		•	
Engine: 4-cycle OHV, 719 cc, 20.0 maximum HP @3600 rpm (per SAE J 1940/1349), three-cylinder, liquid-cooled, with pressure lubrication system		•		•
Fuel system: Side-draft carburetor with float bowl, fixed jets, fuel filters, and impulse fuel pump	•		•	
Fuel system: Mechanical injection, fuel water separator, fuel filters, and electric fuel pump		•		•
Governor: (Honda Engine) Automatic ground-speed sensing, internally geared in transmission	•		•	
Governor: internal to engine, mechanical, centrifugal ball		•		•
Ignition: Transistorized magneto	•		•	
Ignition: Compression		•		•
Transmission: Forward and reverse with neutral (4.98:1 forward, 7.79:1 reverse)	•	•	•	•
Electrical system: 12 volt, 500 cca at 0 °F (-17.8 °C), 650 at 32 °F (0 °C). 105-minute reserve capacity and 35-amp charging capacity	•	•	•	•
Torque converter: Automatic, variable-speed, dry type	•	•	•	•
STEERING/SUSPENSION/BRAKES				
Suspension: **Front:** Independent double A-arms with coil-over shock absorbers **Rear:** Swing arms with coil-over shock absorbers	•	•	•	•
Steering: Self-adjusting rack and pinion, Ackerman	•	•	•	•
Brakes: Hydraulic brake system – brake pads and discs on each wheel with separate foot-operated park brake	•	•	•	•
BODY/CHASSIS				
Frame/Chassis: Box tube aluminum	•	•	•	•
Side and rear body: Plastic	•	•	•	•
Cargo bed: Powder-coated steel or aluminum	•	•	•	•
Front body: Geloy XTWM206	•	•	•	•
Tires: **All Terrain:** 25 x 10.5 – 12 front and rear; tubeless, 4-ply rated load range **Mud:** 25 x 11 – 12 front and rear; tubeless, 4-ply rated load range	•	•	•	•
DIMENSIONS/WEIGHT				
NOTE: Items marked with an asterisk (*) indicate approximate values.				
***Overall length** (box bed configuration, without brushguard):	122 in. (309.9 cm)		154 in. (391.2 cm)	
Overall width: without mirror with mirror	58.5 in. (148.5 cm) 63.6 in. (161.5 cm)			
***Overall height** (with ROPS): with mud tires with all-terrain tires	82.3 in. (209 cm)		80.3 in. (203.8 cm)	
Specifications continued on next page...				

SPECIFICATIONS	Carryall 295 & XRT 1550	Carryall 295 & XRT 1550	Carryall 295 SE & XRT 1550 SE	Carryall 295 SE & XRT 1550 SE
DIMENSIONS/WEIGHT, CONTINUED	**Gasoline**	**Diesel**	**Gasoline**	**Diesel**
Wheelbase	81.5 in. (207 cm)		114 in. (289.5 cm)	
Ground clearance: under differential	8.2 in. (20.8 cm)			
Front and rear wheel tread	48.8 in. (124 cm)			
***Weight:** 2-passenger gasoline with electric bed lift, mud tires, and without brush guard 2-passenger diesel with electric bed lift, mud tires, and brush guard 4-passenger gasoline with all-terrain tires 4-passenger diesel with all-terrain tires	1450 lb. (657.6 kg)	1597 lb. (724.2 kg)	1630 lb. (739.2 kg)	1734 lb. (786.4 kg)
Forward speed	25 mph (40 km/h)			
Governed RPM	3825			
Turning Radius	138 in. (350.5 cm)		204 in. (518.2 cm)	
Load bed height	34 in. (86.4 cm)			
Load bed size (box bed inside dimensions)	48.0 x 49.8 x 10.9 in. (122 x 127 x 28 cm) (15.3 cubic feet)			
Maximum payload capacity (level surface only)	800 lb. (363 kg) High capacity option: 1050 lb. (476 kg)		800 lb. (363 kg)	
Vehicle rated capacity (payload, driver, and passenger; level surface only)	1200 lb. (544 kg) High capacity option: 1450 lb (658 kg)		1600 lb. (725.5 kg)	
Maximum gross vehicle weight (fully loaded vehicle, including accessories)	2750 lb. (1247 kg) High capacity option: 3012 lb. (1366 kg)		3350 lb. (1519.1 kg)	
Standard seating capacity	2		4	
LIQUID CAPACITIES				
Engine (Honda) crankcase with filter: SAE 10W-30, API classification SJ	1 qt. and 25 oz (1.7 L)		1 qt.and 25 oz. (1.7 L)	
Engine crankcase with filter: SAE 10W-30, API classification CF		3 qt. (2.8 L)		3 qt. (2.8 L)
Front differential: Mobil 424, Exxon Hydraul 560, or Esso Hydraul 56 lubricant	5 oz. (150 mL)			
Rear differential: Mobil 424, Exxon Hydraul 560, or Esso Hydraul 56 lubricant	20 oz. (600 mL)			
Transmission: Mobil 424, Exxon Hydraul 560, or Esso Hydraul 56 lubricant	20 oz. (600 mL)			
Engine coolant: mixture of 55% propylene glycol and 45% water	n/a	2 gal. (7.8 L)	n/a	2.25 gal. (8.5 L)
Brake fluid: DOT 5 (silicone) brake fluid	8 oz. (240 ml)		17.9 oz. (530 ml)	
Fuel tank: unleaded gasoline	6.5 gallons (24.6 L)		6.5 gallons (24.6 L)	
Fuel tank: diesel grade no.2 with cetane rating of 45 or higher		6.5 gallons (24.6 L)		6.5 gallons (24.6 L)
TIRE PRESSURE				
All-terrain tread and mud tires	20 - 22 psi (1.38 - 1.52 Bars)			

INTELLITACH SPECIFICATIONS

SPECIFICATIONS	Carryall 295 & XRT 1550 IntelliTach
POWER SOURCE	**Diesel**
Engine: 4-cycle OHV, 719 cc, 20.0 maximum HP @3600 rpm (per SAE J 1940/1349), three-cylinder, liquid-cooled, with pressure lubrication system	•
Fuel system: Mechanical injection, fuel water separator, fuel filters, and electric fuel pump	•
Governor: internal to engine, mechanical, centrifugal ball	•
Ignition: Compression	•
Transmission: Forward and reverse with neutral (5.39:1 forward, 7.79:1 reverse)	•
Electrical system: 12 volt, 500 cca at 0 °F (-17.8 °C), 650 at 32 °F (0 °C). 105-minute reserve capacity and 60-amp charging capacity	•
Torque converter: Automatic, variable-speed, dry type	•
STEERING/SUSPENSION/BRAKES	
Suspension: **Front:** Independent double A-arms with coil-over shock absorbers **Rear:** Swing arms with coil-over shock absorbers	•
Steering: Self-adjusting rack and pinion, Ackerman	•
Brakes: Hydraulic brake system – brake pads and discs on each wheel with separate foot-operated park brake	•
BODY/CHASSIS	
Frame/Chassis: Box tube aluminum	•
Side and rear body: Plastic	•
Cargo bed: Powder-coated steel	•
Front body: Geloy XTWM206	•
Tires: **All Terrain:** 25 x 10.5 – 12 front and rear; tubeless, 4-ply rated load range **Mud:** 25 x 11 – 12 front and rear; tubeless, 4-ply rated load range	•
DIMENSIONS/WEIGHT	
Overall length with cylinders “stored” and no attachment arm or interface with attachment arm and interface and both cylinder fully retracted with both cylinders in position for maximum overall vehicle length	 121 in. (307 cm) 136 in. (345 cm) 155 in. (394 cm)
Overall width:	57.8 in. (147 cm)
Overall height (with ROPS)	78.75 in. (200 cm)
Wheelbase	82 in. (208.3 cm)
Ground clearance: under differential under floorboard	 7.3 in. (18.5cm) 11.1 in. (28 cm)
Front wheel tread	48.25 in. (122.5 cm)
Rear wheel tread	48.63 in. (123.5 cm)
Weight (with all-terrain tires)	1800 lb. (815 kg)
Forward speed	25 mph (40 kph)
Governed RPM	3825
Turning radius (per SAE J 695)	23 ft-10 in.
Load bed height	32.5 in. (83 cm)
DIMENSIONS/WEIGHT continued on next page...	

SPECIFICATIONS	Carryall 295 & XRT 1550 IntelliTach
DIMENSIONS/WEIGHT, CONTINUED	
Load bed size (box bed inside dimensions)	48.0 x 49.8 x 10.9 in. (122 x 127 x28 cm) (15.3 cubic feet)
Maximum payload capacity (level surface only)	800 lb. (363 kg)
Vehicle rated capacity (payload, driver, and passenger; level surface only)	1200 lb. (544 kg)
Maximum attachment arm load (includes attachment weight plus attachment load)	500 lb. (227 kg)
Maximum gross vehicle weight (fully loaded vehicle, including accessories)	3200 lb. (1451 kg)
Standard seating capacity	2
LIQUID CAPACITIES	
Engine crankcase with filter: SAE 10W-30, API classification CF	3 qt. (2.8 L)
Front differential: Mobil 424, Exxon Hydraul 560, or Esso Hydraul 56 lubricant	5 oz. (150 mL)
Rear differential: Mobil 424, Exxon Hydraul 560, or Esso Hydraul 56 lubricant	20 oz. (600 mL)
Transmission: Mobil 424, Exxon Hydraul 560, or Esso Hydraul 56 lubricant	20 oz. (600 mL)
Engine coolant: mixture of 55% propylene glycol and 45% water	2 gal. (7.8 L)
Brake fluid: DOT 5 (silicone) brake fluid	8 oz. (240 mL)
Fuel tank: diesel grade no.2 with cetane rating of 45 or higher	6.5 gallons (24.6 L)
Hydraulic fluid: ExxonMobil DTE15M (is compatible with Bobcat Hydraulic Fluid)	1.3 gallons (5.0 L)
TIRE PRESSURE	
All-terrain tread and mud tires	20-22 psi (1.38 - 1.52 Bars)

SECTION 2B – VEHICLE SPECIFICATIONS: KAWASAKI GAS & KUBOTA DIESEL POWERED

295/295 SE AND 1550/1550 SE SPECIFICATIONS

SPECIFICATIONS	Carryall 295 & XRT 1550	Carryall 295 & XRT 1550	Carryall 295 SE & XRT 1550 SE	Carryall 295 SE & XRT 1550 SE
POWER SOURCE	**Gasoline**	**Diesel**	**Gasoline**	**Diesel**
Engine: (Kawasaki) 4-cycle OHV, 675 cc, 23.0 maximum HP @3600 rpm (per SAE J 1940/1349), twin-cylinder, air-cooled, with pressure lubrication system	•		•	
Engine: 4-cycle OHV, 719 cc, 20.0 maximum HP @3600 rpm (per SAE J 1940/1349), three-cylinder, liquid-cooled, with pressure lubrication system		•		•
Fuel system: Side-draft carburetor with float bowl, fixed jets, fuel filters, and impulse fuel pump	•		•	
Fuel system: Mechanical injection, fuel water separator, fuel filters, and electric fuel pump		•		•
Governor (Kawasaki engine): internal to engine, centrifugal ball	•		•	
Governor: internal to engine, mechanical, centrifugal ball		•		•
Ignition: Transistorized magneto	•		•	
Ignition: Compression		•		•
Transmission: Forward and reverse with neutral (5.39:1 forward, 7.79:1 reverse)	•	•	•	•
Electrical system: 12 volt, 500 cca at 0 °F (-17.8 °C), 650 at 32 °F (0 °C). 105-minute reserve capacity and 35-amp charging capacity	•	•	•	•
Torque converter: Automatic, variable-speed, dry type	•	•	•	•
STEERING/SUSPENSION/BRAKES				
Suspension: **Front:** Independent double A-arms with coil-over shock absorbers **Rear:** Swing arms with coil-over shock absorbers	•	•	•	•
Steering: Self-adjusting rack and pinion, Ackerman	•	•	•	•
Brakes: Hydraulic brake system – brake pads and discs on each wheel with separate foot-operated park brake	•	•	•	•
BODY/CHASSIS				
Frame/Chassis: Box tube aluminum	•	•	•	•
Side and rear body: Plastic	•	•	•	•
Cargo bed: Powder-coated steel or aluminum	•	•	•	•
Front body: Geloy XTWM206	•	•	•	•
Tires: **All Terrain:** 25 x 10.5 – 12 front and rear; tubeless, 4-ply rated load range **Mud:** 25 x 11 – 12 front and rear; tubeless, 4-ply rated load range	•	•	•	•
DIMENSIONS/WEIGHT				
NOTE: Items marked with an asterisk (*) indicate approximate values.				
***Overall length** (box bed configuration, without brushguard):	122 in. (309.9 cm)		154 in. (391.2 cm)	
Overall width: without mirror with mirror	58.5 in. (148.5 cm) 63.6 in. (161.5 cm)			
***Overall height** (with ROPS): with mud tires with all-terrain tires	82.3 in. (209 cm)		80.3 in. (203.8 cm)	

Specifications continued on next page...

SPECIFICATIONS	Carryall 295 & XRT 1550	Carryall 295 & XRT 1550	Carryall 295 SE & XRT 1550 SE	Carryall 295 SE & XRT 1550 SE
DIMENSIONS/WEIGHT, CONTINUED	**Gasoline**	**Diesel**	**Gasoline**	**Diesel**
Wheelbase	81.5 in. (207 cm)		114 in. (289.5 cm)	
Ground clearance: under differential	8.2 in. (20.8 cm)			
Front and rear wheel tread	48.8 in. (124 cm)			
***Weight:** 2-passenger gasoline with electric bed lift, mud tires, and without brush guard 2-passenger diesel with electric bed lift, mud tires, and brush guard 4-passenger gasoline with all-terrain tires 4-passenger diesel with all-terrain tires	1450 lb. (657.6 kg)	1597 lb. (724.2 kg)	1630 lb. (739.2 kg)	1734 lb. (786.4 kg)
Forward speed	25 mph (40 km/h)			
Governed RPM	3825			
Turning Radius	138 in. (350.5 cm)		204 in. (518.2 cm)	
Load bed height	34 in. (86.4 cm)			
Load bed size (box bed inside dimensions)	48.0 x 49.8 x 10.9 in. (122 x 127 x 28 cm) (15.3 cubic feet)			
Maximum payload capacity (level surface only)	800 lb. (363 kg) High capacity option: 1050 lb. (476 kg)		800 lb. (363 kg)	
Vehicle rated capacity (payload, driver, and passenger; level surface only)	1200 lb. (544 kg) High capacity option: 1450 lb (658 kg)		1600 lb. (725.5 kg)	
Maximum gross vehicle weight (fully loaded vehicle, including accessories)	2750 lb. (1247 kg) High capacity option: 3012 lb. (1366 kg)		3350 lb. (1519.1 kg)	
Standard seating capacity	2		4	
LIQUID CAPACITIES				
Engine (Kawasaki) crankcase with filter: SAE 10W-30, API classification SJ	1 qt. and 19 oz. (1.5 L)		1 qt.and 19 oz. (1.5 L)	
Engine crankcase with filter: SAE 10W-30, API classification CF		3 qt. (2.8 L)		3 qt. (2.8 L)
Front differential: Mobil 424, Exxon Hydraul 560, or Esso Hydraul 56 lubricant	5 oz. (150 mL)			
Rear differential: Mobil 424, Exxon Hydraul 560, or Esso Hydraul 56 lubricant	20 oz. (600 mL)			
Transmission: Mobil 424, Exxon Hydraul 560, or Esso Hydraul 56 lubricant	20 oz. (600 mL)			
Engine coolant: mixture of 55% propylene glycol and 45% water	n/a	2 gal. (7.8 L)	n/a	2.25 gal. (8.5 L)
Brake fluid: DOT 5 (silicone) brake fluid	8 oz. (240 ml)		17.9 oz. (530 ml)	
Fuel tank: unleaded gasoline	6.5 gallons (24.6 L)		6.5 gallons (24.6 L)	
Fuel tank: diesel grade no.2 with cetane rating of 45 or higher		6.5 gallons (24.6 L)		6.5 gallons (24.6 L)
TIRE PRESSURE				
All-terrain tread and mud tires	20 - 22 psi (1.38 - 1.52 Bars)			

295 HOMOLOGATED SPECIFICATIONS

SPECIFICATIONS	Carryall 295 Homologated	
POWER SOURCE	**Diesel**	
Engine: Three-cylinder, liquid-cooled, with pressure lubrication system	•	
Fuel system: Mechanical injection, fuel water separator, fuel filters, and electric fuel pump	•	
Governor: internal to engine, mechanical, centrifugal ball	•	
Ignition: Compression	•	
Transmission: Forward and reverse with neutral (4.98:1 forward, 7.79:1 reverse)	•	
Electrical system: 12 volt, 500 cca at 0 °F (-17.8 °C), 650 at 32 °F (0 °C). 105-minute reserve capacity and 35-amp charging capacity	•	
Torque converter: Automatic, variable-speed, dry type	•	
STEERING/SUSPENSION/BRAKES		
Steering: Self-adjusting rack and pinion, Ackerman	•	
Suspension: **Front:** Independent double A-arms with coil-over shock absorbers **Rear:** Swing arms with coil-over shock absorbers	•	
Brakes: Hydraulic brake system – brake pads and discs on each wheel with separate foot-operated park brake	•	
BODY/CHASSIS		
Frame/Chassis: Box tube aluminum	•	
Side and rear body: All aluminum	•	
Cargo bed: Powder-coated steel or aluminum	•	
Front body: ABS/DR acrylic cap	•	
Tires: **All Terrain:** 25 x 10.5 – 12 front, and rear; tubeless, 4-ply rated load range **Mud:** 25 x 11.0 – 12 front and rear; tubeless, 4-ply rated load range	•	
DIMENSIONS/CAPACITIES		
Overall length (box bed configuration)	124.6 in. (317 cm)	
Overall width without mirror with mirror	 58.9 in. (149.7 cm) 66.1 in. (167.8 cm)	
Overall height (with ROPS)	82.2 in. (208.9 cm))	
Wheelbase	81.7 in. (207.5 cm)	
Ground clearance: under differential	 8.27 in. (21.0 cm)	
Front wheel tread	48.2 in. (122.5 cm)	
Rear wheel tread	48.2 in. (122.5 cm)	
Forward speed	25 mph (40 km/h)	
Governed RPM	3825	
Maximum payload capacity (level surface only)	**Standard option:** 706 lb. (320 kg)	**High capacity option:** 961 lb. (436 kg)
Vehicle rated capacity (payload, driver, and passenger; level surface only)	2756 lb. (1250 kg)	3016 lb (1368 kg)
NOISE AND VIBRATION SPECIFICATIONS		
Drive-by noise level to operator	84.4 dBA	
Drive-by noise level to environment	79.9 dBA	
Specifications continued on next page...		

SPECIFICATIONS	Carryall 295 Homologated
Vibration at driver's seat	1.1-1.24 m/sec^2
CLIMATIC EXTREMES	
Operating temperature range	-20 to 40 °C (-4 to 104 °F)
LIQUID CAPACITIES	
Engine crankcase with filter: SAE 10W-30, API classification CF	3 qt. (2.8 L)
Front differential: Mobil 424, Exxon Hydraul 560, or Esso Hydraul 56 lubricant	5 oz. (150 mL)
Rear differential: Mobil 424, Exxon Hydraul 560, or Esso Hydraul 56 lubricant	20 oz. (600 mL)
Transmission: Mobil 424, Exxon Hydraul 560, or Esso Hydraul 56 lubricant	20 oz. (600 mL)
Engine coolant: mixture of 55% propylene glycol and 45% water	2 gal. (7.8 L)
Brake fluid: DOT 5 (silicone) brake fluid	8 oz. (240 ml)
Fuel tank: diesel grade no.2 with cetane rating of 45 or higher	6.5 gallons (24.6 L)
TIRE PRESSURE	
All-terrain tread and mud tires	20 - 22 psi (1.38 - 1.52 Bars)

VEHICLE MASS		Standard option	High capacity option
Unladen vehicle mass (full tank)	Front axle: Rear axle: Total:	862 lb. (391 kg) 1023 lb. (464 kg) 1885 lb. (855 kg)	864 lb. (392 kg) 1025 lb. (465 kg) 1889 lb. (857 kg)
Running order weight with driver (unladen vehicle mass plus driver)	Front axle: Rear axle: Total:	939 lb. (426 kg) 1111 lb. (504 kg) 2050 lb. (930 kg)	941 lb. (427 kg) 1113 lb. (505 kg) 2055 lb. (932 kg)
Running order weight with driver and passenger (unladen vehicle mass plus driver and passenger)	Front axle: Rear axle: Total:	1016 lb. (461 kg) 1199 lb. (544 kg) 2216 lb. (1005 kg)	1019 lb. (462 kg) 1202 lb. (545 kg) 2220 lb. (1007 kg)
Gross vehicle weight limit (GVWR Max): fully loaded vehicle, accessories included		2756 lb. (1250 kg)	3016 lb. (1368 kg)

INTELLITACH SPECIFICATIONS

SPECIFICATIONS	Carryall 295 & XRT 1550 IntelliTach
POWER SOURCE	**Diesel**
Engine: 4-cycle OHV, 719 cc, 20.0 maximum HP @3600 rpm (per SAE J 1940/1349), three-cylinder, liquid-cooled, with pressure lubrication system	•
Fuel system: Mechanical injection, fuel water separator, fuel filters, and electric fuel pump	•
Governor: internal to engine, mechanical, centrifugal ball	•
Ignition: Compression	•
Transmission: Forward and reverse with neutral (5.39:1 forward, 7.79:1 reverse)	•
Electrical system: 12 volt, 500 cca at 0 °F (-17.8 °C), 650 at 32 °F (0 °C). 105-minute reserve capacity and 60-amp charging capacity	•
Torque converter: Automatic, variable-speed, dry type	•
STEERING/SUSPENSION/BRAKES	
Suspension: **Front:** Independent double A-arms with coil-over shock absorbers **Rear:** Swing arms with coil-over shock absorbers	•
Steering: Self-adjusting rack and pinion, Ackerman	•
Brakes: Hydraulic brake system – brake pads and discs on each wheel with separate foot-operated park brake	•
BODY/CHASSIS	
Frame/Chassis: Box tube aluminum	•
Side and rear body: Plastic	•
Cargo bed: Powder-coated steel	•
Front body: Geloy XTWM206	•
Tires: **All Terrain:** 25 x 10.5 – 12 front and rear; tubeless, 4-ply rated load range **Mud:** 25 x 11 – 12 front and rear; tubeless, 4-ply rated load range	•
DIMENSIONS/WEIGHT	
Overall length with cylinders “stored” and no attachment arm or interface with attachment arm and interface and both cylinder fully retracted with both cylinders in position for maximum overall vehicle length	 121 in. (307 cm) 136 in. (345 cm) 155 in. (394 cm)
Overall width:	57.8 in. (147 cm)
Overall height (with ROPS)	78.75 in. (200 cm)
Wheelbase	82 in. (208.3 cm)
Ground clearance: under differential under floorboard	 7.3 in. (18.5cm) 11.1 in. (28 cm)
Front wheel tread	48.25 in. (122.5 cm)
Rear wheel tread	48.63 in. (123.5 cm)
Weight (with all-terrain tires)	1800 lb. (815 kg)
Forward speed	25 mph (40 kph)
Governed RPM	3825
Turning radius (per SAE J 695)	23 ft-10 in.
Load bed height	32.5 in. (83 cm)
DIMENSIONS/WEIGHT continued on next page...	

SPECIFICATIONS	Carryall 295 & XRT 1550 IntelliTach
DIMENSIONS/WEIGHT, CONTINUED	
Load bed size (box bed inside dimensions)	48.0 x 49.8 x 10.9 in. (122 x 127 x28 cm) (15.3 cubic feet)
Maximum payload capacity (level surface only)	800 lb. (363 kg)
Vehicle rated capacity (payload, driver, and passenger; level surface only)	1200 lb. (544 kg)
Maximum attachment arm load (includes attachment weight plus attachment load)	500 lb. (227 kg)
Maximum gross vehicle weight (fully loaded vehicle, including accessories)	3200 lb. (1451 kg)
Standard seating capacity	2
LIQUID CAPACITIES	
Engine crankcase with filter: SAE 10W-30, API classification CF	3 qt. (2.8 L)
Front differential: Mobil 424, Exxon Hydraul 560, or Esso Hydraul 56 lubricant	5 oz. (150 mL)
Rear differential: Mobil 424, Exxon Hydraul 560, or Esso Hydraul 56 lubricant	20 oz. (600 mL)
Transmission: Mobil 424, Exxon Hydraul 560, or Esso Hydraul 56 lubricant	20 oz. (600 mL)
Engine coolant: mixture of 55% propylene glycol and 45% water	2 gal. (7.8 L)
Brake fluid: DOT 5 (silicone) brake fluid	8 oz. (240 mL)
Fuel tank: diesel grade no.2 with cetane rating of 45 or higher	6.5 gallons (24.6 L)
Hydraulic fluid: ExxonMobil DTE15M (is compatible with Bobcat Hydraulic Fluid)	1.3 gallons (5.0 L)
TIRE PRESSURE	
All-terrain tread and mud tires	20-22 psi (1.38 - 1.52 Bars)

SECTION 3 – GENERAL INFORMATION

⚠ DANGER

- **See General Warning, Section 1, Page 1-1.**

⚠ WARNING

- **See General Warning, Section 1, Page 1-1.**

GENERAL INFORMATION

Refer to the owner's manual provided with the vehicle for information on the following topics:

- Safety Decal Identification
- Controls and Indicators
- Driving Instructions
- Towing with the Vehicle
- Transporting on a Trailer
- Engine Oil and Filter Change
- Accessory Equipment
- Subsequent Owner Registration
- Warranties

MODEL IDENTIFICATION

The serial number of each vehicle is printed on a bar code decal mounted on the frame beneath the instrument panel, behind and between the brake and park brake pedals **(Figure 3-1, Page 3-2)**. There is also a second serial number decal mounted on the upper body frame rail. The decal is viewable by tilting the passenger seat forward. **See following NOTE.**

NOTE: *Have the vehicle serial number available when ordering parts or making inquiries.*

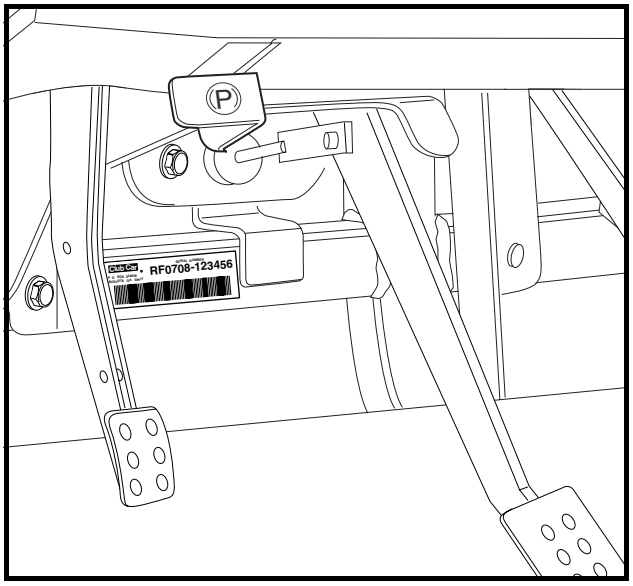


Figure 3-1 Serial Number Decal

STORAGE

See General Warning, Section 1, Page 1-1.

⚠ DANGER

- **Do not attempt to drain fuel when the engine is hot or while it is running.**
- **Clean up any spilled fuel before operating the vehicle.**
- **Store fuel in an approved fuel container only. Store in a well-ventilated area away from sparks, open flames, heaters, or heat sources.**
- **Keep fuel out of the reach of children.**
- **Do not siphon fuel from the vehicle.**

⚠ WARNING

- **Turn the key switch to the OFF position, remove the key, and leave the Forward/Reverse handle in the NEUTRAL position during storage. This is to prevent unintentionally starting the vehicle or a fire hazard.**
- **Gasoline vehicles only: Turn fuel shut-off valve to the closed (OFF) position (Figure 3-5, Page 3-5).**
- **Do not attempt to charge frozen batteries or batteries with bulged cases. Discard the battery. Frozen batteries can explode.**

⚠ CAUTION

- **Batteries in a low state of charge will freeze at low temperatures.**

PREPARING THE VEHICLE FOR EXTENDED STORAGE

1. Unload the vehicle so that the tires are supporting only the weight of the vehicle.
2. Store the vehicle in a cool, dry place. This will minimize battery self-discharge. If the battery appears to be weak, have it charged by a trained technician. Use an automotive-type 12-volt battery charger rated at 10 amps or less. Check electrolyte level after charging and add distilled water if necessary.
3. Make sure the key switch is in the OFF position and the Forward/Reverse handle is in the NEUTRAL position. Chock the wheels.

Gasoline vehicles:

4. Prepare the fuel tank.
   - 4.1. Fill the fuel tank with fresh fuel.
   - 4.2. Following manufacturer's directions, add a commercially available fuel stabilizer (such as Sta-Bil®). Run the engine in a well-ventilated area to allow treated fuel to replace untreated fuel in the carburetor.
   - 4.3. Disconnect the fuel vent line from the fuel tank vent nipple **(Figure 3-2, Page 3-4)**.
   - 4.4. Plug the fuel tank vent nipple so that it is air tight. The manufacturer recommends using a slip-on vinyl cap.
5. Remove both spark plugs and pour 1/2 ounce (14.2 mL) of SAE 10 weight oil through each of the two spark plug holes. Rotate the engine crankshaft by hand several times, then install both spark plugs.

Diesel vehicles:

NOTE: *If biodiesel fuel is used,* ***See Fueling Instructions on page 10a-16.***

6. Prepare the fuel tank.
   - 6.1. Fill the fuel tank with fresh fuel.
   - 6.2. Disconnect the fuel vent line from the fuel tank vent nipple **(Figure 3-3, Page 3-4)**.
   - 6.3. Plug the fuel tank vent nipple so that it is air tight. The manufacturer recommends using a slip-on vinyl cap.

All vehicles:

7. Disconnect the battery cables, negative (–) cable first. **See WARNING "To avoid unintentionally starting..." in Section 1 – Safety on page 1-2.**
8. Change engine oil. **See Engine Oil and Filter Change on page 10a-8.**
9. Batteries should be clean and free of corrosion. Wash tops and terminals of batteries with a solution of baking soda and water (1 cup (237 mL) baking soda per 1 gallon (3.8 L) of water). Rinse solution off batteries. Do not allow this solution to enter the batteries. Be sure terminals are tight. Let the terminals dry and then coat them with Battery Terminal Protector Spray (CCI P/N 1014305).
10. Adjust the tires to the recommended tire pressure. **See Section 8 – Wheels and Tires.**
11. Perform semiannual periodic lubrication. **See Periodic Lubrication Schedule on page 10a-4.**
12. Thoroughly clean the front body, rear body, seats, cargo bed, engine compartment, and underside of vehicle.
13. Do not engage the park brake. Chock the wheels to prevent the vehicle from rolling.

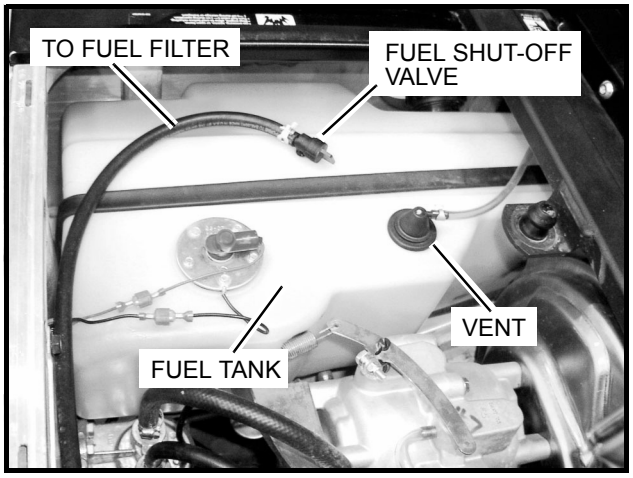


Figure 3-2 Fuel Tank – Gasoline Vehicles

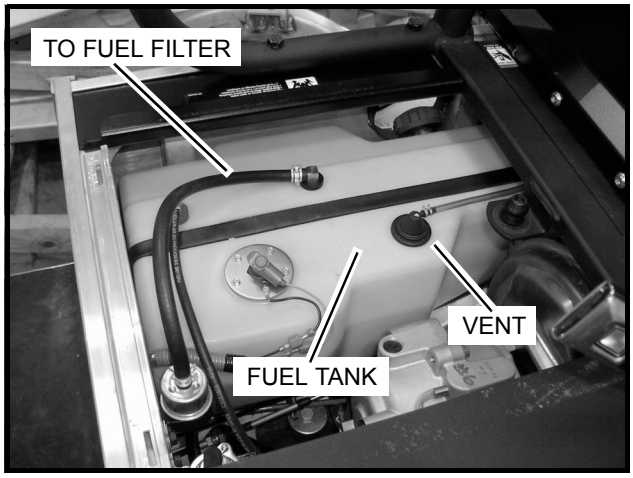


Figure 3-3 Fuel Tank – Diesel Vehicles

RETURNING THE STORED VEHICLE TO SERVICE

1. Make sure the key switch is in the OFF position and the Forward/Reverse handle is in the NEUTRAL position. Chock the wheels.
2. Restore the fuel system to operation **(Figure 3-2, Page 3-4 or Figure 3-3, Page 3-4)**.
   2.1. Remove the plug from the fuel tank vent.
   2.2. Connect the vent tube to the fuel tank vent.
3. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
4. **Gasoline vehicles only:** Completely open the fuel shut-off valve **(Figure 3-4, Page 3-5)**. Ensure that the valve is fully open. A partially closed fuel shut-off valve combined with the use of the choke can result in a fouled spark plug and engine failure **(Figure 3-6, Page 3-5)**.
5. Place the Forward/Reverse handle in the NEUTRAL position. Crank the engine until fuel is pumped into the carburetor (gasoline vehicles) and the fuel lines and the engine starts. Turn the engine off. **See following NOTE.**

NOTE: *Due to the oil added to the engine in preparation for storage, the engine may smoke excessively for a short time when it is run for the first time after storage.*

6. Perform the Pre-Operation and Daily Safety Checklist. **See the Pre-Operation and Daily Safety Checklist in the vehicle owner's manual.**

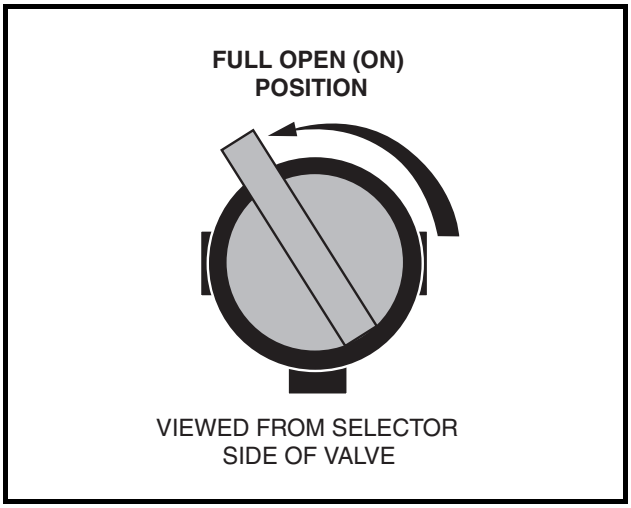


Figure 3-4 Fuel Shut-Off Valve – Open Position

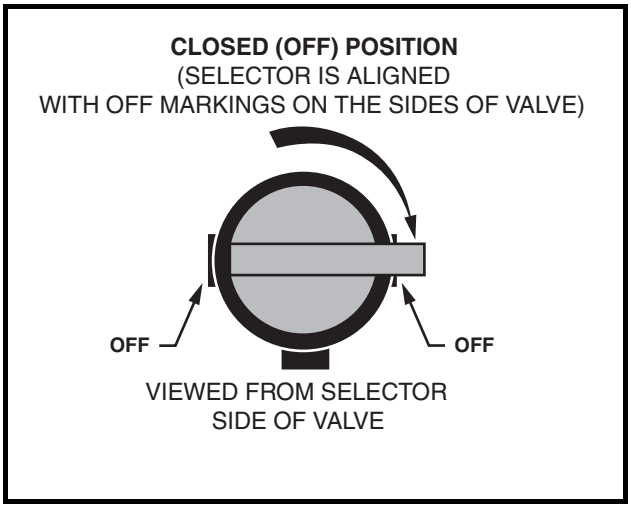


Figure 3-5 Fuel Shut-Off Valve – Closed Position

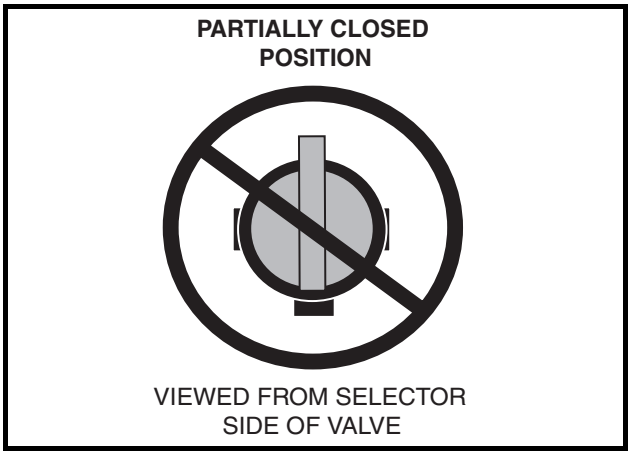


Figure 3-6 Fuel Shut-Off Valve – Partially Closed Position

USING A BOOSTER BATTERY (JUMP STARTING)

⚠ WARNING

- **Wear safety glasses or approved eye protection when servicing the vehicle. Wear a full face shield and rubber gloves when working on or near batteries.**
- **When jumping from a booster battery make final connection (negative) at engine frame.**
- **Do not jump start or charge a frozen or damaged battery. Unplug charger before connecting or disconnecting cables to the battery. Never lean over battery while boosting, testing, or charging.**

If it is necessary to use a booster battery to start the engine, BE CAREFUL!

1. Turn the key switch to the OFF position. Place the Forward/Reverse handle in the NEUTRAL position, engage the park brake, and chock the wheels.

2. Ensure the booster battery is 12-volt. **See following NOTE.**

NOTE: *A starting battery is recommended but a deep cycle battery can be used if necessary.*

3. Access the engine compartment by raising the cargo bed. **See WARNING "For vehicles with cargo beds..." in General Warning, Section 1, Page 1-1.**
4. Locate the vehicle battery on the driver side of the vehicle under the cargo bed **(Figure 3-7, Page 3-6)**.
5. Connect the end of the first cable (1) to the positive (+) terminal of the booster battery. Connect the other end of the same cable (2) to the positive terminal of the vehicle battery. **See DANGER "Battery – Explosive gases!..." in General Warning, Section 1, Page 1-1.**
6. Connect the end of the second cable (3) to the negative (–) terminal of the booster battery. Connect the other end of the same cable (4) to the battery frame ground.
7. Sit in the driver seat and start the engine.
8. After the engine has started, remove the frame ground (–) cable (4) first. Remove the cable from the positive terminal (2). Then remove the cables from the booster battery. **See following CAUTION.**

CAUTION

- **Damage to the alternator can result if the following actions occur:**
  - **Engine is operated with battery cables disconnected.**
  - **Booster cables are connected incorrectly.**

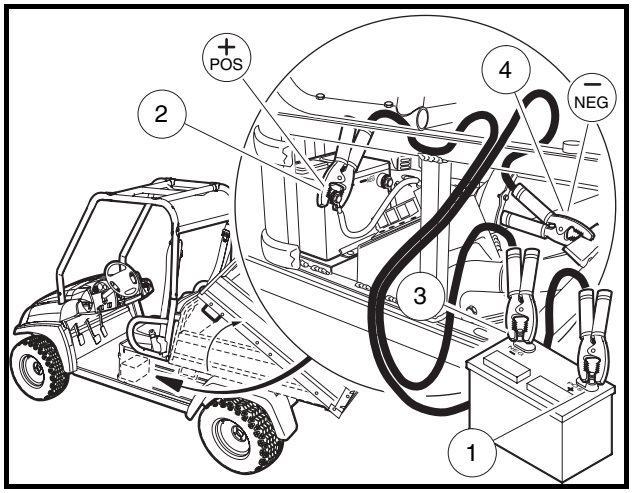


Figure 3-7 Jump Starting

SECTION 4 – BODY AND TRIM

⚠ DANGER

- **See General Warning, Section 1, Page 1-1.**

⚠ WARNING

- **See General Warning, Section 1, Page 1-1.**

CLEANING THE VEHICLE

See General Warning, Section 1, Page 1-1.

CAUTION

- **Do not use detergents or cleaning solvents that contain ammonia, aromatic solvents, or alkali materials on body panels or seats.**
- **Do not allow battery acid to drip on body panels. Battery acid will cause permanent damage. Wash spilled battery acid from body panels immediately.**

Each vehicle is equipped with a Geloy XTW front body, a polypropylene rear body, and an aluminum frame. The cargo beds are either powder-coated steel or aluminum.

The manufacturer does not recommend any type of pressure washing or steam cleaning. Such a process will expose electrical components to moisture. Moisture entering electrical components can result in water damage and subsequent component failure. Normal residential water pressure is adequate for exterior cleaning.

For regular front body cleaning, use automotive cleaning solutions with a sponge or soft cloth. The Geloy XTW body panel material is the same material used in various automotive applications. Automotive cleaning/polishing products are available at automotive specialty and hardware stores.

To remove oxidation or discoloration from aluminum, use a commercially available aluminum cleaner paste and fine grade (No. 00) steel wool. Battery acid, fertilizers, tars, asphalt, creosote, paint, or chewing gum should be removed immediately to prevent possible stains.

SEAT CLEANING

Clean seats regularly using the following guidelines: **See following CAUTION.**

Light Soiling – A solution of 10% liquid dish soap and warm water applied with a soft, damp cloth is recommended. A soft bristle brush may be used if necessary. Wipe off any residue with a water dampened cloth. **See following NOTE.**

NOTE: *Dispose of waste water properly.*

Difficult Stains – Dampen a soft, white cloth with a solution of 10% household bleach (sodium hypochlorite) and 90% water. Rub gently to remove stain, then rinse with a water dampened cloth to remove bleach concentration.

For More Difficult Stains – Perform previous procedure using full-strength bleach, or allow bleach to puddle on affected area for approximately 30 minutes. Rinse with a water dampened cloth to remove any remaining bleach concentration. **See following CAUTION.**

Seat Cleaning, Continued:

CAUTION

- **To prevent damage to the vehicle when removing difficult stains or heavy soiling, remove the seat from the vehicle first.**

FRONT BODY REPAIR

See General Warning, Section 1, Page 1-1.

LIGHT SCRATCHES

1. Clean entire area to be repaired with clean, clear water.
2. Using 1200 grit sandpaper, water-sand entire area of scratch until original scratch is no longer visible, either with finishing sander or wet sanding block. Be sure that sandpaper is centered on sanding pad. Continue to flush with water while sanding, to increase sandpaper life and keep the sanded surface cool. Wipe repaired area dry and visually inspect to be sure that the originial scratch has completely disappeared.
3. Repeat step 2 using 1500 grit sandpaper until all 1200 grit scratches are removed paying close attention to edges.
4. Install a wool cutting pad (3M #5711 or equivalent) on buffer and spread approx 1/2 tsp. (2ml) of compound (3M #05955 or equivalent). Buff slowly and steadily over small area so as not to heat surface as this may cause warping or melting of plastic. Buff sanded area until all sanding scratches have disappeared. Use as much buffing compound as necessary to achieve this step. If at any time original scratches can be seen, repeat steps 2 and 3 as needed. When all 1500 grit scratches have disappeared, there will be a dull luster over entire area.
5. Install a foam polishing pad (3M #5725 or equivalent) on buffer and repeat step 4 using approx 1/2 tsp. (2 ml) buffing compound (3M #5933 or equivalent). Buff compound off until scratches have disappeared. It may be necessary to apply additional compound to achieve this. The result will be an almost-finished product with a very high luster and very few buffer swirls.
6. Using a clean foam polishing pad (3M #5725 or equivalent) and finish glaze (3M #05937 or equivalent), apply a slightly smaller amount of material than in steps 4 and 5 and buff to desired gloss.
7. Wipe clean with soft, clean cloth. Any dirt on cloth can mar surface.

ABRASIONS AND HAZE

Abrasions and haze can be greatly minimized by performing steps 5 through 7 above.

LARGE SCRATCHES AND ABRASIONS

Touch-up is not recommended. Replace the entire body part or have it repaired by a professional paint and body repair shop with experience repairing bodies.

FRONT BODY COMPONENTS

See General Warning, Section 1, Page 1-1.

INSTRUMENT PANEL REMOVAL

1. Make sure the key switch is OFF and the Forward/Reverse handle is in the NEUTRAL position. Remove the key. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Remove the steering wheel. **See Steering Wheel Removal, Section 7, Page 7-1.**
4. Remove the knob from the Forward/Reverse shift handle by unscrewing knob counterclockwise.
5. Loosen and remove the three Torx® screws from the instrument panel. (Two screws are located behind the cup holders and one screw is located inside the glovebox.)
6. Loosen and remove the two hex bolts securing the outside lower ends of the instrument panel (these two bolts also help secure the top portion of the front fenders).
7. Loosen and remove the hex bolt, washer and nut securing the top potion of the instrument panel located above the steering wheel (under the black removable plastic cap). Use a screwdriver or other flat-bladed tool to carefully remove plastic cap to gain access to the bolt head. Gain access to the rear nut and washer by raising hood and reaching up inside rear of instrument panel.
8. Loosen and remove the hex bolt securing the top potion of the instrument panel located inside the glove-box.
9. Pull the top of the instrument panel towards the rear of the vehicle to access the rear of panel.
10. Disconnect the wiring from components mounted on the instrument panel.
11. **Honda Powered Gasoline vehicles:** Remove the choke cable from the engine choke lever. **See Choke Cable Removal, Section 13b, Page 13b-25.**
12. **Kawasaki Powered Gasoline vehicles:** Remove the choke cable from the engine choke lever. **See Choke Cable Removal, Section 13a, Page 13a-20.**
13. Remove instrument panel from vehicle.

INSTRUMENT PANEL INSTALLATION

1. Position the instrument panel on the vehicle.
2. Connect the wiring to the electrical components mounted on the instrument panel. **See Wiring Diagram on page 11a-6 (Kawasaki gasoline vehicles), 11b-6 (Honda gasoline vehicles), or 11c-6 (diesel vehicles).**
3. **Honda Powered Gasoline vehicles:** Connect the choke cable to the engine choke lever. **See Choke Cable Installation, Section 13b, Page 13b-26.**
4. **Kawasaki Powered Gasoline vehicles:** Connect the choke cable to the engine choke lever. **See Choke Cable Installation, Section 13a, Page 13a-21.**
5. Secure the top portion of the instrument panel using the hex bolt through the hole located inside the glovebox and closest to the passenger side of the vehicle.
6. Secure the top portion of the instrument panel using the hex bolt, washer and nut through the hole located above the steering wheel. Gain access to the rear nut and washer by raising hood and reaching up inside rear of instrument panel. Snap the black plastic cap in place over the exposed hex bolt head.

7. Secure the outside lower ends of the instrument panel using the two hex bolts (these two bolts also help secure the top portion of the front fenders).
8. Secure the outside ends and center of the instrument panel with the three Torx® screws. (Two screws are used in the holes behind the cup holders and one screw is used in the hole located inside the glovebox, closer to the center of the instrument panel.)
9. Install the knob for the Forward/Reverse shift handle by screwing the knob onto the shaft clockwise.
10. Install the steering wheel. **See Steering Wheel Installation, Section 7, Page 7-2.**
11. Reconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
12. Unchock wheels.

FRONT FASCIA REMOVAL

1. Remove both side cowl panels (fenders). **See Side Cowl Panel (Fender) Removal on page 4-5.**
2. Remove the four Torx® screws and the three hex head screws that secure the front fascia to the frame.
3. Disconnect the lighting wire harness from each light at connectors.
4. Separate the front fascia from front fenders and remove from vehicle.

FRONT FASCIA INSTALLATION

1. Position the fascia on the vehicle taking care to fit it to the front fenders securely.
2. Connect the lighting wire harness to each light at connectors.
3. Secure the front fascia to the frame using four Torx® screws and the three hex head screws.
4. Reinstall both side cowl panels (fenders). **See Side Cowl Panel (Fender) Installation on page 4-5.**

HOOD REMOVAL

1. Unlatch, raise and securely prop open hood.
2. Remove the four Torx® screws that secure the hood to the hood hinge.
3. Separate the hood and the hood hinge and remove hood from vehicle.
4. Retain hardware.

HOOD INSTALLATION

1. Position the hood on the hood hinge.
2. Secure the hood to the hood hinge using the four Torx® screws.
3. Lower hood and latch securely.

CENTER COWL PANEL REMOVAL

1. Remove hood. **See Hood Removal on page 4-4.**
2. The center cowl panel is held in place by four exposed Tuflok plastic locking fasteners and four metal body trim clips that are hidden from view on the top, underside of the panel. Carefully remove the four Tuflok plastic locking screws by using a size P2 Phillips head screwdriver. The outer portion of the Tuflok fastener may be left in the panel at this time.

3. Grab inside front corner of outboard end of the center cowl panel and firmly pull up to disengage one of the outboard body trim clips. Repeat for other side.
4. Lift up firmly on the front edge of the center cowl panel to disengage the two center body trim clips.
5. Rotate front edge upward and lift off the entire center cowl panel to disengage the Tuflok fasteners and the rear tabs of the panel out of the slots in the instrument panel structural support.

CENTER COWL PANEL INSTALLATION

1. Position the center cowl panel to the vehicle, making sure that the rear tabs of the panel engage the slots in the instrument panel structural support. Make sure that the tabs on the ends of the center cowl panel engage the slots in the tops of the side cowl panels.
2. Position and secure the center cowl panel to the instrument panel structural support by pressing down firmly and directly over the four metal body trim clips on the underside of the panel.
3. Install four Tuflok plastic locking fasteners along the trailing edge of the center cowl panel to secure the panel to the instrument panel structural support.
4. Replace, lower and secure hood. **See Hood Installation on page 4-4.**

SIDE COWL PANEL (FENDER) REMOVAL

1. Remove Roll-over Protective Structure (ROPS). **See ROPS Removal on page 4-7.**
2. Remove hood. **See Hood Removal on page 4-4.**
3. Remove center cowl panel. **See Center Cowl Panel Removal on page 4-4.**
4. Disengage the three tabs securing the top of the side cowl panel from the three slots in the under-hood, inner structure of the fender flare.
5. Reach under the side of the fender flare and use thumb pressure on the three lower side-retaining tabs while pulling upward on the front outboard edge of the side cowl panel to disengage the three lower side-retaining tabs from the fender flare.
6. Lift up on the front of the side cowl panel enough to disengage the rear side tab from the slot in the front side of the instrument panel.
7. Twist the front outside edge of the side cowl panel up, out and away from the centerline of the vehicle. This will disengage the fender from the ROPS cowl support and the fender-retaining notch in the instrument panel structural support.
8. Remove side cowl panel from vehicle.

SIDE COWL PANEL (FENDER) INSTALLATION

1. Position the side cowl panel to the vehicle.
2. Insert the top rear, inside corner down and into the space between the ROPS cowl support and the fender-retaining notch in the instrument panel structural support. Ensure that the top rear, inside corner of the side cowl panel is engaged in the fender-retaining notch in the instrument panel structural support and that the ROPS cowl support passes through the ROPS cowl support clearance hole in the side cowl panel.
3. Rotate the side cowl panel down and over the ROPS cowl support until it is down and in place.
4. Grip the front leading edge of the side cowl panel and twist it towards the center of the vehicle and guide the rear side tab of the side cowl panel into the slot in the front, side of the instrument panel.

5. Engage and secure the three lower side-retaining tabs into the receiving slots on the top of the fender flares.
6. Pass the rubber hood latch through the hole in the top of the side cowl panel.
7. Engage and secure the three top retaining tabs of the side cowl panel into the three slots in the under-hood, inner structure of the fender flare.
8. Reinstall center cowl panel. **See Center Cowl Panel Installation on page 4-5.**
9. Replace, lower and secure hood. **See Hood Installation on page 4-4.**
10. Reinstall Roll-over Protective Structure (ROPS). **See ROPS Installation on page 4-8.**

FRONT FENDER FLARE REMOVAL

1. Remove hood. **See Hood Removal on page 4-4.**
2. Remove center cowl panel. **See Center Cowl Panel Removal on page 4-4.**
3. Remove side cowl panel (fender). **See Side Cowl Panel (Fender) Removal on page 4-5.**
4. Remove front fascia. **See Front Fascia Removal on page 4-4.**
5. Pull back the floor mat, and remove the three hex-head screws securing the front fender flare to the floor-board and the lower, outboard end of the instrument panel.
6. Remove the three hex-head screws securing the front fender flare to the frame, and remove front fender flare.

FRONT FENDER FLARE INSTALLATION

1. Position the front fender flare to the vehicle, and secure the flare to the upper frame support using the three hex-head screws. Tighten hardware to 55 in-lb (6.2 N·m).
2. Secure the fender flare to the front floorboard using three hex-head screws. Make sure that the floor mat is captured underneath the fender flare.
3. Tighten the hardware at the floorboard to 55 in-lb (6.2 N·m).
4. Reinstall front fascia. **See Front Fascia Installation on page 4-4.**
5. Reinstall side cowl panel (fender). **See Side Cowl Panel (Fender) Installation on page 4-5.**
6. Reinstall center cowl panel. **See Center Cowl Panel Installation on page 4-5.**
7. Replace, lower and secure hood. **See Hood Installation on page 4-4.**

ROLL-OVER PROTECTIVE STRUCTURE (ROPS)

See General Warning, Section 1, Page 1-1.

The vehicle is equipped with a certified Roll-over Protective Structure. **See following WARNING.**

⚠ WARNING

- **Do not modify the ROPS or operate the vehicle with the ROPS removed. Doing so will void the certification and could result in property damage, personal injury, or death.**
- **Do not operate the vehicle if the ROPS is damaged. If the ROPS is damaged, replace the structure. Do not attempt repair.**

ROPS REMOVAL

NOTE: *Follow steps 1 through 3 for 2-passenger vehicles and steps 1 through 8 for 4-passenger vehicles. ROPS removal will be easier with the aid of an assistant and a rubber mallet.*

1. Remove the upper four bolts (1) and four flanged nuts (2) that secure the top structure (3) to the two side supports (4), and remove the top structure **(Figure 4-1, Page 4-7)**.

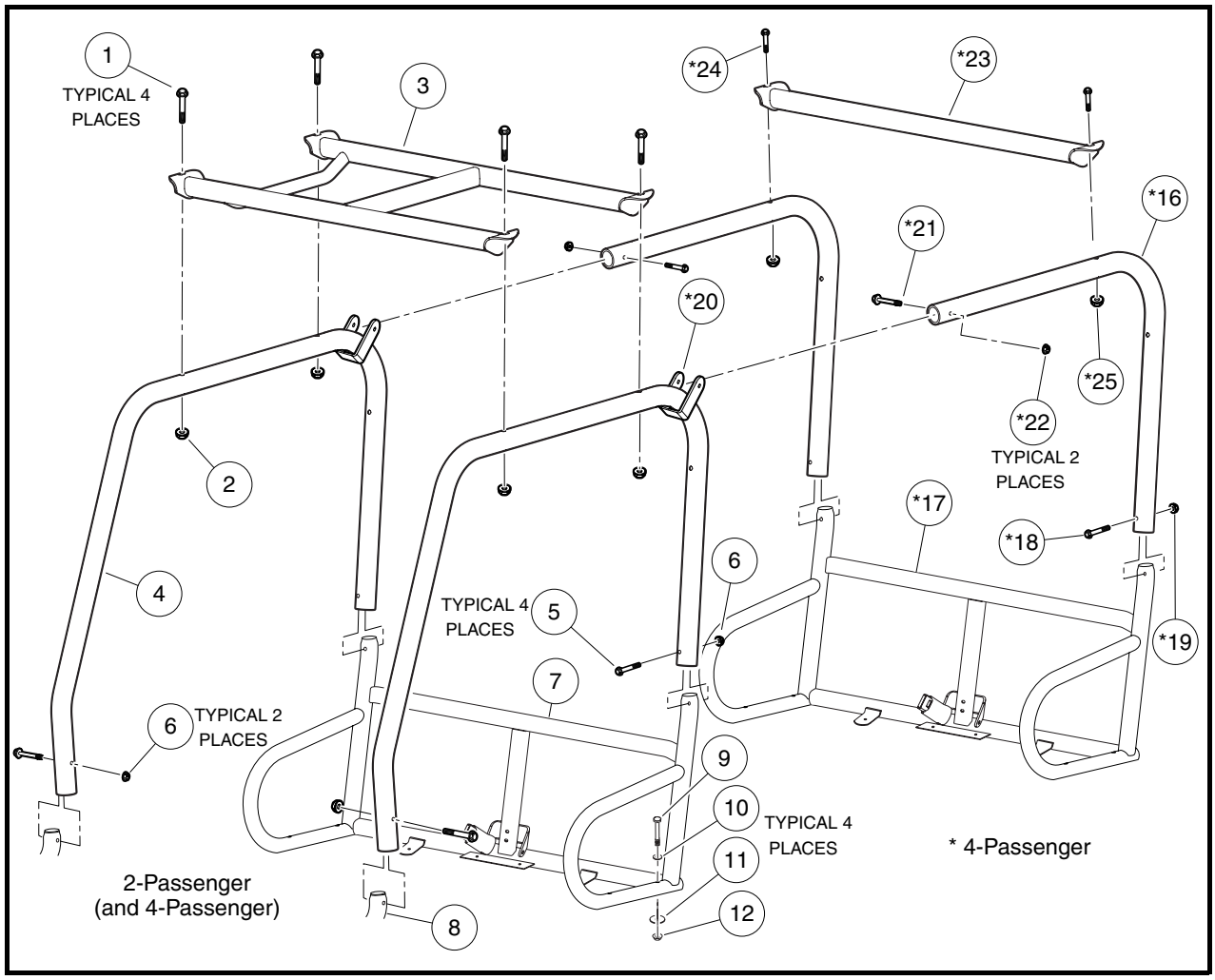


Figure 4-1 Roll-Over Protective Structure (ROPS)

2. Remove the the four bolts (5) and four flanged nuts (6) that secure the two side supports (4) to the seat support (7) and the front cowl supports (8).
3. 2 passenger vehicles: Remove the two side supports (4). **See following NOTE.**

NOTE: *It may facilitate removal to use a rubber mallet to disengage the rear-most tube of the side support first. Finally, disengage the front end of the tube by simultaniously twisting side to side and lifting.*

4. Remove the two hex-head bolts (24) and two flanged lock nuts (25) securing the top brace (23). Remove top brace from vehicle.

5. Remove the hex-head bolts (18) and flanged lock nuts (19) securing the rear support tubes (16) to the rear seat support (17).
6. Remove the hex-head bolts (21) and flanged lock nuts (22) securing the rear support tubes (16) to the tube brackets (20) and to the forward side support tubes (4).
7. Remove the tube brackets (20) and rear support tubes (16) from the vehicle.
8. Remove the forward side supports (4).

ROPS INSTALLATION

NOTE: *Follow steps 1 through 3 for 2-passenger vehicles and steps 1 through 8 for 4-passenger vehicles. ROPS installation will be easier with the aid of an assistant.*

1. Position the side support tubes (4) to the seat support (7) and front cowl supports (8) and secure with hex-head bolts (5), and flanged lock nuts (6). Do not tighten hardware at this time. **See following NOTE**.

NOTE: *Make sure the front cowl support bolt heads are oriented to outside of the ROPS and the seat support bolt heads are oriented to the inside of the ROPS.*

It may be necessary to tap the side support tubes (4) with a rubber mallet in order for them to align properly with the front and rear support tubes.

2. Position the top structure (3) to the top of the side support tubes (4) and secure with hex-head bolts (1), and flanged lock nuts (2). Do not tighten hardware at this time. **See following NOTE**.

NOTE: *Orient the top structure (3) so the grab handle is on the passenger side and the warning decal is visible to the driver.*

3. Tighten all hardware to 33 ft-lb (45 N·m). **See following WARNING and NOTE.**

NOTE: *If any ROPS joints remain loose, apply additional torque up to 40 ft-lb (54 N·m).*

⚠ WARNING

- **Exceeding the maximum torque value could result in damage to the ROPS tubing and stripped threads on the hardware.**
- **Ensure that the ROPS is properly installed before operating the vehicle.**

4. Position the two rear support tubes (16) loosely to the rear seat support (17). Do not install hardware at this time.
5. Secure the rear support tubes (16) to the forward side support tubes (4) with tube brackets (20), using hex-head bolts (21) and flanged lock nuts (22). Do not tighten hardware at this time. **See following NOTE**.

NOTE: *Make sure bolt heads are oriented to the inside of the ROPS.*

6. Lower the two rear support tubes (16) fully into position on the rear seat support (17) and secure with hex-head bolts (18) and flanged lock nuts (19). Do not tighten hardware at this time. **See following NOTE**.

NOTE: *It may be necessary to tap the side support tubes (4) with a rubber mallet in order for them to align properly with the front and rear support tubes.*

7. Position the top brace (23) to the top of the rear side supports (16) and secure with hex-head bolts (24) and flanged lock nuts (25).
8. Tighten all hardware to 33 ft-lb (45 N·m). **See following WARNING and NOTE.**

NOTE: *If any ROPS joints remain loose, apply additional torque up to 40 ft-lb (54 N·m).*

⚠ WARNING

- **Exceeding the maximum torque value could result in damage to the ROPS tubing and stripped threads on the hardware.**
- **Ensure that the ROPS is properly installed before operating the vehicle.**

SEAT

See General Warning, Section 1, Page 1-1.

SEAT REMOVAL

1. Bucket seats
   1.1. Lift the seat back up and forward to raise it.
   1.2. Remove the seat by lifting the front edge hinges from the vehicle frame hinge slots.
2. Bench seat
   2.1. Lift the seat bottom up and forward to raise it.
   2.2. Remove the seat by lifting the front edge hinges from the vehicle frame hinge slots.

SEAT ADJUSTMENT

1. Stationary driver and passenger bucket seats
   1.1. Remove the seat from the vehicle.
   1.2. Remove the four bolts and washers from the bottom of the seat mounting plate.
   1.3. Align the mounting plate holes with the holes in the seat to achieve the desired seat position.
   1.4. Install the washers and bolts, and tighten the hardware to 80 in-lb (9.0 N·m).
   1.5. Install the seat. **See following WARNING.**

⚠ WARNING

- **Ensure that the seat hinges and latch are securely engaged before operating vehicle.**

2. Track-mounted driver seat
   2.1. Sit in seat, grasp seat adjustment handle under seat bottom and slide seat to desired position. **See preceding WARNING.**

SEAT INSTALLATION

1. Align the hinges on the underside of the seat front edge with the hinge slots on the frame.
2. Bucket seats
   2.1. Push back and down on the seat back to secure the seat latch to the frame. **See preceding WARN-**

ING.

3. Bench seat

   3.1. Hold center seatbelt buckles up and out of the way. Lower rear of seat to frame.

SEAT SUPPORT REMOVAL

1. Remove the bolts (9), washers (10 and 11), and flanged locknuts (12) from the seat support (7) and engine cover plate **(Figure 4-1, Page 4-7)**.
2. Remove the seat support.

SEAT SUPPORT INSTALLATION

1. Install the seat support (7) **(Figure 4-1, Page 4-7)**.
2. Secure the seat support to the seat side plates with bolts (9), washers (10 and 11), and flanged locknuts (12). Tighten the hardware to 37 ft-lb (50 N·m).

SAFETY BELTS

See General Warning, Section 1, Page 1-1.

⚠ CAUTION

- **Be careful not to damage the safety belt webbing or hardware.**
- **Inspect the safety belt system periodically. Check for cuts, fraying, and loose parts. Replace damaged parts immediately. Do not disassemble or modify the system.**
- **Keep safety belts clean and dry. If cleaning is necessary, use a solution of mild soap and lukewarm water. Do not use bleach, dye, or abrasive cleaners as they may severely weaken the safety belts.**
- **Do not insert coins, clips, etc. into the safety belt buckle. Foreign objects may interfere with the buckle locking mechanism.**
- **If the safety belt does not function normally, contact your dealer/distributor or trained technician immediately. Do not occupy the seat until the safety belt is repaired.**

SAFETY BELT REMOVAL

1. Remove the bolt from the base of the coiled safety belt assembly (outside location) **(Figure 4-2, Page 4-11)**.
2. Remove the coiled safety belt assembly.
3. Remove the bolt from the safety belt buckle assembly (center location) **(Figure 4-3, Page 4-11)**.

4. Remove the safety belt buckle assembly.

Figure 4-2 Coiled Seat Belt Assembly

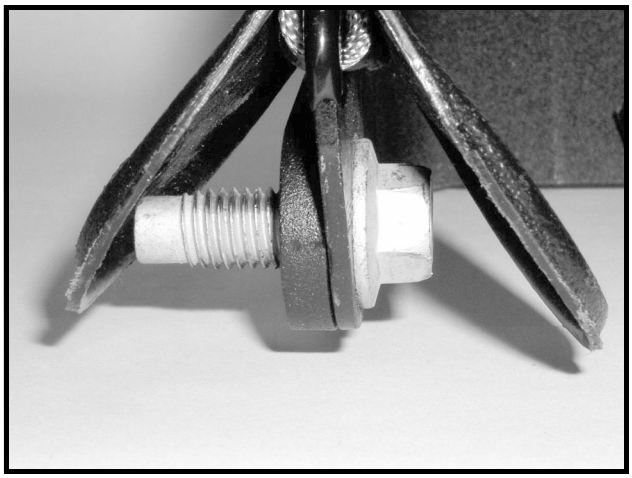


Figure 4-3 Center Seat Belt Fastener

SAFETY BELT INSTALLATION

1. Install the center safety belt buckle assembly to the seat belt bracket with a new thread-forming bolt. Orient the assembly with the buckle end pointed up slightly, and tighten the hardware to 55 ft-lb (75 N·m).
2. Install the coiled safety belt assembly on the outside of the ROPS seat support with a new thread-forming bolt. Orient the assembly with the tang end pointed up slightly, and tighten the hardware to 55 ft-lb (75 N·m).

CARGO BED – ELECTRIC LIFT

See General Warning, Section 1, Page 1-1.

TESTING THE BED LIFT MOTOR

Gasoline Vehicles: See Test Procedure 29, Section 11a, Page 11a-39.

Diesel Vehicles: See Test Procedure 34, Section 11c, Page 11c-51.

BED LIFT MOTOR REMOVAL

1. Make sure the key switch is OFF and the Forward/Reverse handle is in the NEUTRAL position. Remove the key. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. With the bed in the down position, working from under the vehicle, disconnect the two wires from the connectors at the electric bed lift motor.
4. Remove the locknut, bolt, sleeve, spacers and washers from the rod end of the bed lift motor and bed frame.
5. Remove the locknut, bolt, sleeve, spacers and washers from the base of the bed lift motor and vehicle frame and remove the bed lift motor.

BED LIFT MOTOR INSTALLATION

NOTE: *If replacing the actuator, adjust the length of dimension between the base rod hole and the rod end hole using the prior actuator as a guide. The rod end of the actuator can be turned clockwise to shorten and counterclockwise to lengthen the dimension.*

1. Make sure the key switch is OFF and the Forward/Reverse handle is in the NEUTRAL position. Remove the key. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. With the bed in the down position, working from under the vehicle, mount the base of the bed lift motor to the frame bracket.
   3.1. Slide the metal sleeve into the bed lift motor base rod with two spacer washers on each side.
   3.2. Slide a lockwasher onto the bolt and up against the bolt head.
   3.3. Fit the base between the frame bracket.
   3.4. Slide the bolt through the frame bracket and actuator base.
   3.5. Attach a lockwasher and nylon locknut finger tight.

NOTE: *Do not tighten the lose mounting hardware until the rod end has been secured.*

4. Attach the rod end of the bed lift motor to the bed frame bracket.
   4.1. Repeat steps 3.1 through 3.4 for the rod end of the bed lift motor.
   4.2. Attach a lockwasher and nylon locknut and tighten to 23 ft-lb (31 N·m).
5. Tighten the locknut on the bed lift motor base to 30 ft-lb (41 N·m).
6. Attach the two electric wire connectors, red to red and yellow to yellow.

CARGO BED REMOVAL

NOTE: *Cargo bed removal will be easier with the aid of an assistant.*

1. Remove the electric actuator. **See Bed Lift Motor Removal on page 4-11.**
2. With the bed in a down position, working from under the rear of the vehicle, remove the two nylon locknuts from the cargo bed hinge and bolts.
3. Apply slight upward pressure on the rear of the bed to relieve pressure from the hinges. Remove the hinge bolts.
4. With the help from an additional person, or an overhead lift hoist, remove the bed from the vehicle.

CARGO BED INSTALLATION

NOTE: *Cargo bed installation will be easier with the aid of an assistant.*

1. With the help from an additional person, or an overhead lift hoist, place the bed onto the vehicle frame and align the bed hinge brackets with the frame brackets.
2. Start the bolts into both hinges with the bolt heads to the outside. Use an alignment tool if necessary.
3. Use a small hammer, and lightly tap the bolts through the hinges.
4. Install a nylon locknut on each bolt, and tighten the hardware to 15 ft-lb (21 N·m).
5. Install the electric actuator. **See Bed Lift Motor Installation on page 4-12.**

CARGO BED – MANUAL LIFT

See General Warning, Section 1, Page 1-1.

CARGO BED REMOVAL

NOTE: *Cargo bed removal and installation will be easier with the aid of an assistant.*

1. Raise the bed and ensure that the prop rod is securely engaged.
2. Hold the bed securely, and remove the cotter pin (3) and flat washer (4) from the top end of the prop rod where the prop rod is attached to the bed **(Figure 4-4, Page 4-14)**.
3. Remove the prop rod (17) from the bed, and place the prop rod between the prop rod track (2) and the rear body panel. Lower the bed onto the vehicle frame.
4. Remove the two nylon locknuts (8) from the cargo bed hinge and bolts (9).
5. Apply slight upward pressure on the rear of the bed to relieve pressure from the hinges. Remove the hinge bolts (9).
6. Raise the rear edge of the bed approximately 6 inches (15.2 cm), and pull the bed assembly toward the rear of the vehicle approximately 3 inches (7.6 cm) to release bed latch (10) from the latch plate (11). Lift the bed from the vehicle.

CARGO BED INSTALLATION

NOTE: *Cargo bed removal and installation will be easier with the aid of an assistant.*

1. Place the front edge of the bed onto the vehicle frame, and align the latches (10) with the latch plates (11) **(Figure 4-4, Page 4-14)**.
2. Lower the rear edge of the bed onto the vehicle, and align the bed hinge brackets (14) with the frame hinge brackets (15).
3. Start the bolts (9) into both hinges. Use an alignment tool if necessary.
4. Use a small hammer, and lightly tap the bolts through the hinges.
5. Install a nylon locknut (8) on each bolt (9), and tighten the hardware to 15 ft-lb (21 N·m).
6. Lift the bed from the bed latch and, with the prop rod in a slot notch, place the prop rod (17) in the bed mounting hole. Install a flat washer (4) and a new cotter pin (3) onto the prop rod.

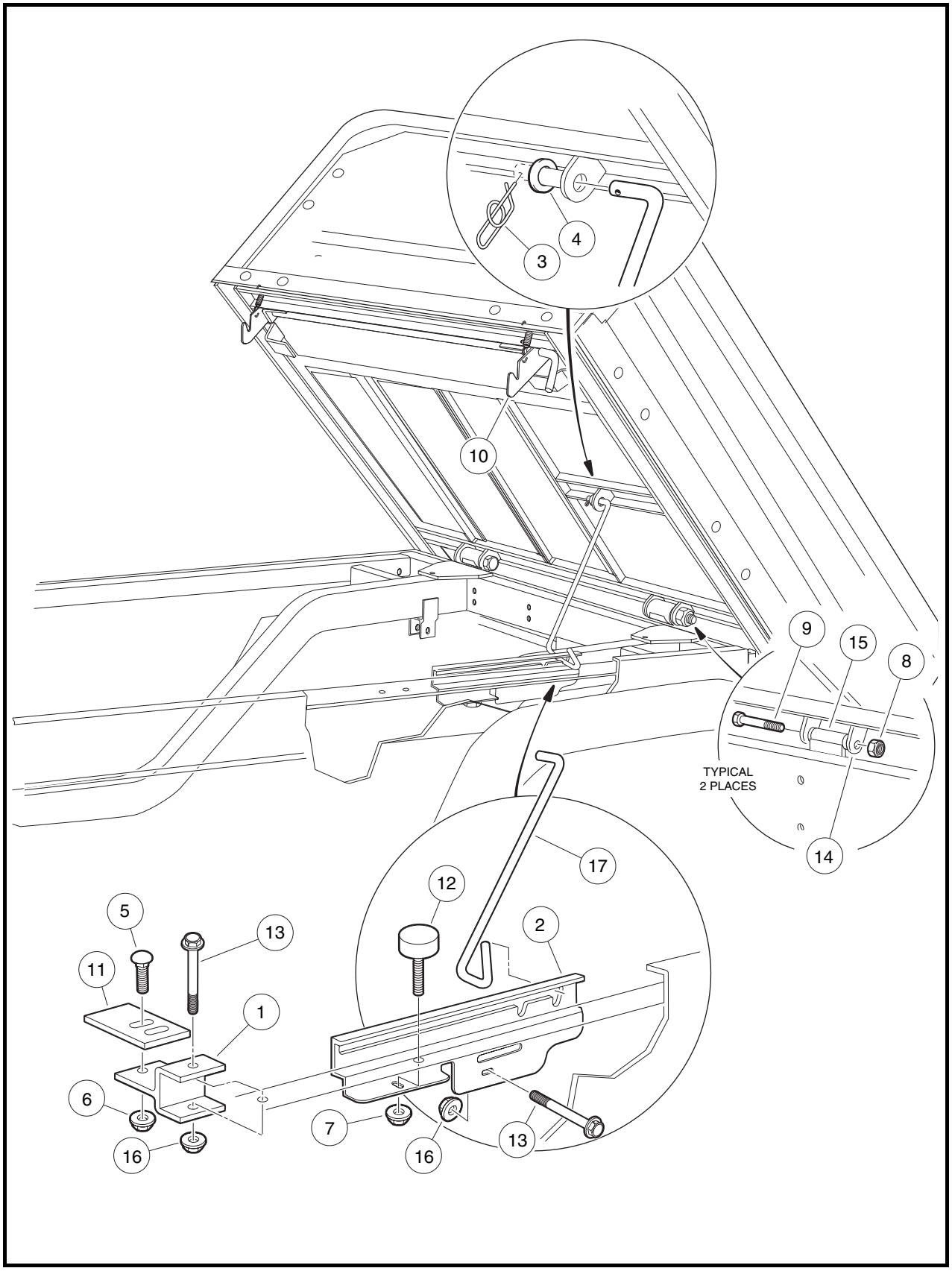


Figure 4-4 Cargo Bed

REAR FENDER

See General Warning, Section 1, Page 1-1.

REAR FENDER REMOVAL

1. Lift bed.
2. Carefully remove the three Tuflok plastic fasteners securing the top of the fender to the rear frame.
   2.1. Using a size P2 Phillips head screwdriver, back out the Tuflok screws at least 1/2 inch (1.25 cm).
   2.2. Grasp the screw head and carefully work the fasteners out to free the top of the fender from the frame.
3. Remove the two Phillips head screws and washers retaining the fender to the side of rear frame.
4. Remove the fender.
5. Repeat steps 1 through 4 to remove the remaining rear fender if necessary.

REAR FENDER INSTALLATION

1. Lift bed.
2. Put fender in place.
3. Install the three Tuflok plastic fasteners to secure the top of the fender to the frame.
4. Install the two Phillips head screws and washers to secure the side of the fender to the frame.
5. Repeat steps 1 through 5 to install the remaining fender if necessary.

FLOOR MAT

See General Warning, Section 1, Page 1-1.

FLOOR MAT REMOVAL

1. Remove the two hex screws securing the lower portion of each front fender.
2. Roll back the top edge of the floor mat and slide the rear edge out from under the molded front kick panel and side panels.
3. Remove the floor mat from vehicle.

FLOOR MAT INSTALLATION

1. Slide the rear edge of the floor mat under the molded front kick panel and side panels.
2. Roll out and tuck the front edge of the mat under the dash and behind the lower portion of the fenders.
3. Install the two hex screws securing the lower portion of each front fender.

SECTION 5 – ACCELERATOR AND BRAKE PEDAL ASSEMBLIES

⚠ DANGER

- **See General Warning, Section 1, Page 1-1.**

⚠ WARNING

- **See General Warning, Section 1, Page 1-1.**

ACCELERATOR PEDAL

See General Warning, Section 1, Page 1-1.

ACCELERATOR PEDAL REMOVAL

1. Turn the key switch OFF, and place the Forward/Reverse handle in the NEUTRAL position. Remove the key. Chock the rear wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Disconnect the cable strain relief from the pedal bracket.
4. Disconnect the Z-shaped end (1) of the accelerator cable from the pedal **(Figure 5-1, Page 5-1).**

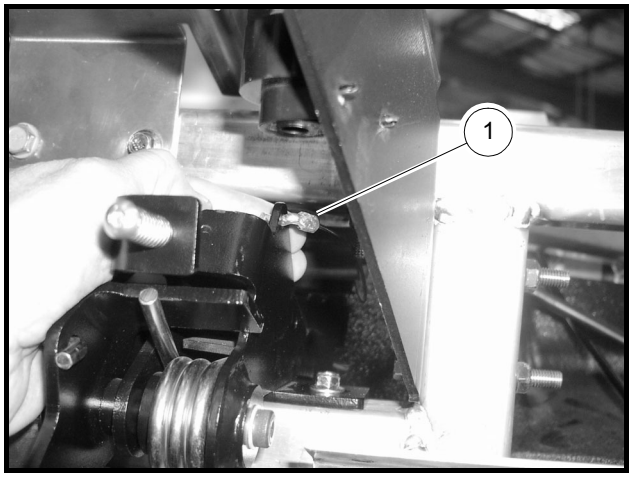


Figure 5-1 Z-Shaped Cable End – Gasoline Vehicles

5. Remove the pedal assembly bolts and locknuts that secure the pedal assembly to the frame.
6. Slide out and twist the pedal to remove the pedal assembly from the frame.
7. Inspect the pedal bushings for wear and replace pedal assembly if worn.
8. Inspect the pedal and return spring hub bushings for excessive side-to-side movement. Replace the pedal assembly if either or both show signs of excessive wear.

ACCELERATOR PEDAL INSTALLATION

1. Twist the accelerator pedal assembly to return the pedal assembly into the frame location.
2. Position pedal between the frame members.
3. Secure the pedal assembly to the upper and lower frame member with bolts and locknuts.
4. Tighten hardware to 15 ft-lb (20.3 N·m).
5. Attach accelerator cable Z-shaped end to hole in pedal.
6. Adjust the accelerator pedal. **See Accelerator Pedal and RPM Adjustment on page 5-2.**

ACCELERATOR PEDAL AND RPM ADJUSTMENT

1. Turn the key switch OFF, and place the Forward/Reverse handle in the NEUTRAL position. Chock the front and rear wheels.
2. Adjust the ground speed set screw to 3/4 inches (19 mm) as shown **(Figure 5-3, Page 5-2)**.

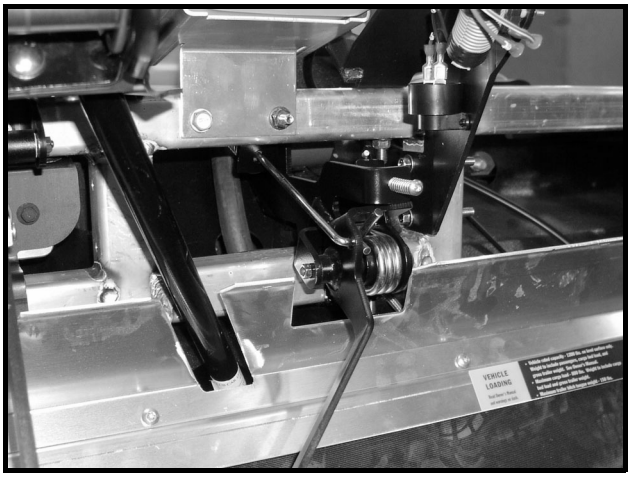


Figure 5-2 Accelerator Pedal Assembly

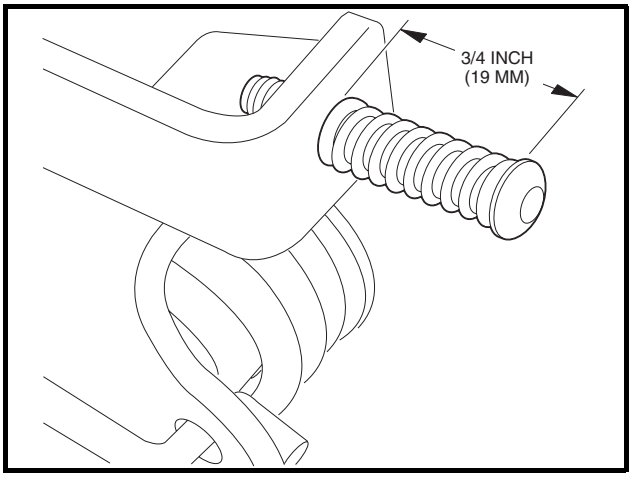


Figure 5-3 Ground Speed Set Screw Adjustment

3. Turn the key switch to start the engine. **See following DANGER.**

⚠ DANGER

- **The engine produces carbon monoxide, which is an odorless, deadly poison. Do not operate the engine in an enclosed area without proper ventilation.**

4. Press the accelerator pedal and allow the engine to achieve full, steady level RPM. **See following NOTE.**

NOTE: *This process should only take a few seconds.*

5. Measure the engine RPM with a tachometer approved for this engine (CCI P/N AM 10753).
6. Release the accelerator pedal, turn the key switch to the OFF position, and remove the key.
7. Adjust the ground speed set screw against the spring to achieve proper RPM.
   7.1. Turn the ground speed set screw clockwise (tightening the spring) to decrease the RPM.
   7.2. Turn the ground speed set screw counterclockwise (loosening the spring) to increase the RPM. **See following NOTE.**

NOTE: *Use 1/4-turn adjustments, and check the RPM setting after each adjustment.*

8. Adjust the screw until the RPM range is 3800–3850.
9. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

BRAKE PEDAL

See General Warning, Section 1, Page 1-1.

BRAKE PEDAL REMOVAL

1. Turn the key switch OFF, and place the Forward/Reverse handle in NEUTRAL. Remove the key, and chock the rear wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Remove the rue pin and the clevis pin. Separate the clevis from the brake pedal **(Figure 5-4, Page 5-3)**.
4. Remove the allen-head shoulder bolt and locknut from the pedal and frame brackets.
5. Remove the brake pedal.
6. Inspect the brake pedal bushing for wear and replace if necessary.

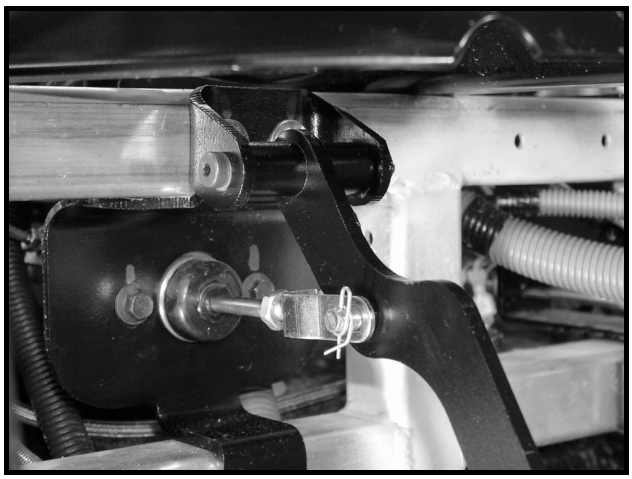


Figure 5-4 Clevis and Rue Pin

BRAKE PEDAL INSTALLATION

1. Position the brake pedal between the frame brackets.
2. Install the allen-head shoulder bolt and locknut. Tighten the hardware to 4.8 ft-lb (6.5 N·m).
3. Install the master cylinder rod and threaded clevis pin assembly.
4. Install the clevis pin and the rue pin.
5. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

BRAKE PEDAL ADJUSTMENT

1. Loosen the master cylinder rod and clevis jam nut **(Figure 5-4, Page 5-3)**.
2. Rotate the master cylinder rod to extend or retract the clevis and brake pedal to the desired position.
3. Tighten the jam nut to 14 ft-lb (19 N·m).
4. Perform all brake system inspections to ensure that the hydraulic brake system and the park brake system are adjusted and operating correctly before the vehicle is returned to service. **See Brake System Inspection, Section 6, Page 6-1.**

PARK BRAKE PEDAL

See General Warning, Section 1, Page 1-1.

PARK BRAKE PEDAL ASSEMBLY REMOVAL

1. Turn the key switch OFF, and place the Forward/Reverse handle in NEUTRAL. Remove the key, and chock the rear wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Remove the driver side cup holder to access the E-clip and washer securing the cable end to the park brake pedal assembly.
4. Remove the E-clip, washer and cable end from the pedal bracket stud.
5. Remove the three bolts and locknuts that secure both the park brake pedal assembly and the pulley mounting plate to the front part of the vehicle frame.
6. Remove the park brake pedal assembly from the vehicle.

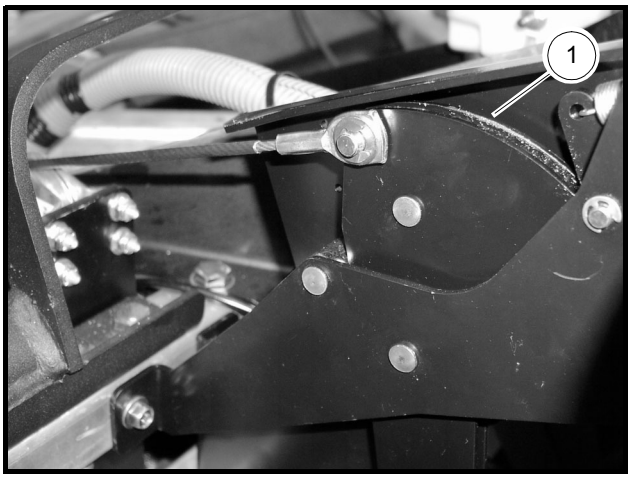


Figure 5-5 Park Brake Cable End

PARK BRAKE PEDAL ASSEMBLY INSTALLATION

1. If installing used assembly, use a small, stiff brush to remove all dirt and debris from the ratchet teeth (1) **(Figure 5-5, Page 5-4)**.
2. Secure the pulley mounting plate and park brake pedal assembly with three bolts and locknuts. Tighten the hardware to 15 ft-lb (20 N·m).

3. Install the cable end on the pedal bracket stud and secure with washer and E-clip.
4. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
5. Adjust the brake cable equalizer. **See Park Brake Cable Adjustment on page 6-25.**

SECTION 6 – HYDRAULIC AND PARK BRAKE SYSTEMS

⚠ DANGER

- **See General Warning, Section 1, Page 1-1.**

⚠ WARNING

- **See General Warning, Section 1, Page 1-1.**

⚠ CAUTION

- **Worn or damaged brake discs cannot be machined to refinish them. Replace as necessary.**

BRAKE SYSTEM INSPECTION

See General Warning, Section 1, Page 1-1.

The hydraulic brake system and park brake system should be inspected immediately after any service to either of the brake systems.

Brake Pedal Inspection

- When the brakes are applied during vehicle operation, the vehicle should come to a smooth, straight stop. If the vehicle swerves or fails to stop, have the brake system checked and adjusted as required.
- Apply and release the brake pedal several times. If noise or binding occurs, the brake pedal or hydraulic brake system may require service. Pedal movement should be smooth, and when the pedal is released, it should return quickly and quietly.
- Move the brake pedal from side to side to check for worn parts. Excessive side movement indicates loose or worn pedal mounting parts. If worn parts are found, replace the worn parts, then adjust the brake pedal. **See Brake Pedal Adjustment, Section 5, Page 5-4.**
- Apply heavy pressure to the pedal and check for sponginess and excessive pedal travel. The pedal should be firm and the back of the pedal should be a minimum of 1.25 inches (3.2 cm) from floorboard. Brake adjustment must be maintained so the brake pedal cannot be pressed to the floorboard under any circumstance. If the brake pedal feels “spongy,” perform the brake bleeding procedure. **See Bleeding the Hydraulic Brake System on page 6-22.**
- Hold the brake pedal down with medium foot pressure (25 to 35 lb.) for 15 seconds. The pedal should not continue dropping when pressed with a steady amount of pressure. If the pedal goes to the floor, inspect the hydraulic system for leaks and repair any worn or damaged components. After repair, bleed the hydraulic brake system. **See Bleeding the Hydraulic Brake System on page 6-22.**

Master Cylinder Inspection

- Inspect the exterior of the master cylinder. Replace any leaking components and bleed the hydraulic brake system. **See Bleeding the Hydraulic Brake System on page 6-22.**
- Check the brake fluid level. **See Brake Fluid on page 10b-7.**

- Remove the reservoir cap and inspect the brake fluid. If the brake fluid is contaminated, purge the brake fluid and refill the hydraulic system. **See Master Cylinder and Reservoir on page 6-20.**
- Check the vent holes in the reservoir cap and clean or replace as necessary.
- Check the diaphragm inside the reservoir cap and replace if damaged.

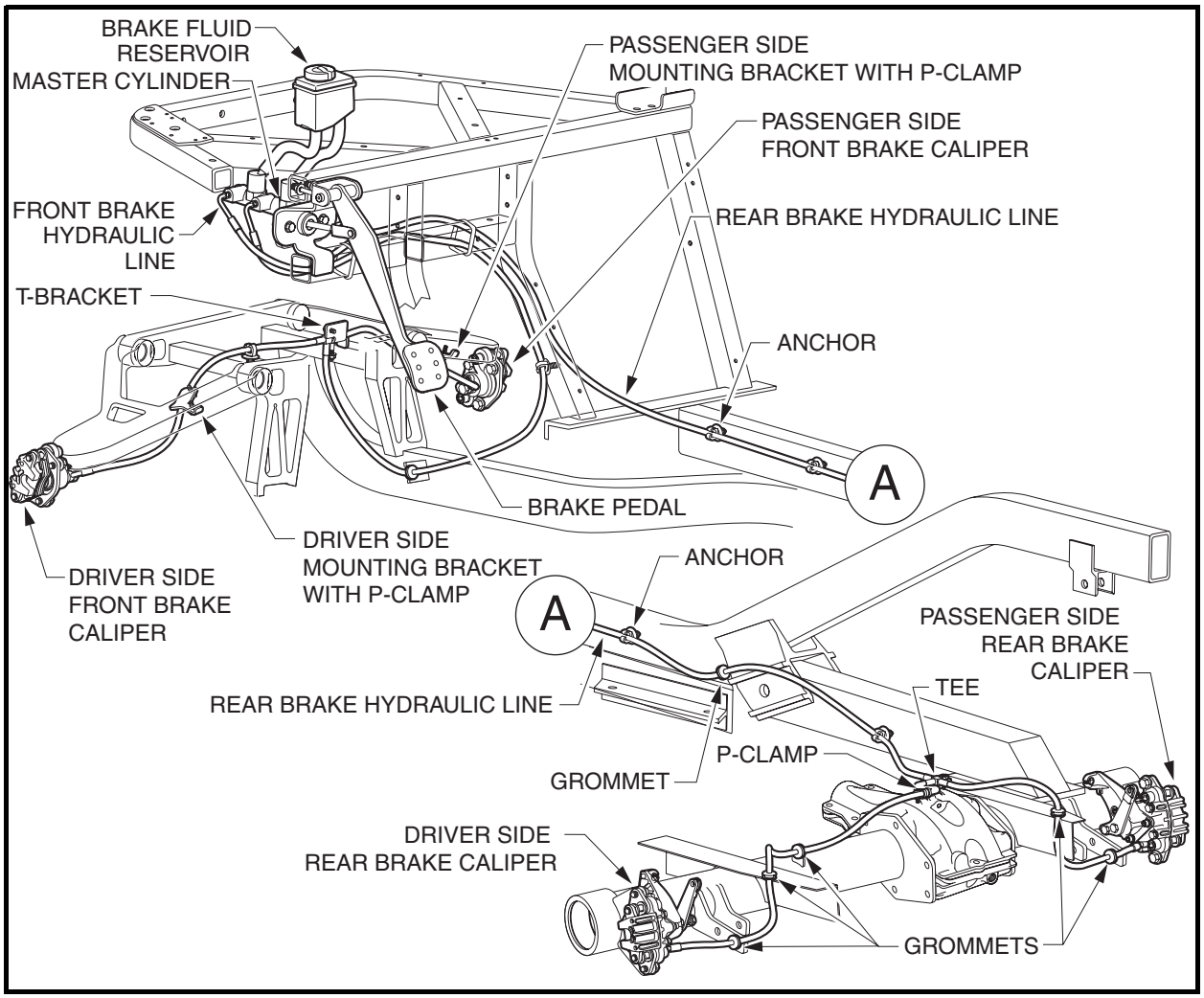


Figure 6-1 Hydraulic Disc Brake System

Brake Line Inspection

- Inspect the brake lines and fittings for leakage. They must be flexible and free of leaks, cuts, cracks or bulges. Replace as needed. **See Hydraulic Line Replacement on page 6-17.**
- Turn the steering wheel all the way from left to right and back again. Contact between the brake hoses and any other components, especially the wheels or half-shafts, will damage the brake hoses.
- Check the back side of each brake caliper assembly for signs of brake fluid leakage. If there is evidence of leakage, determine the cause and repair or replace as needed. **See Brake Pads and Caliper on page 6-5. Also See Hydraulic Line Replacement on page 6-17.**

Park Brake Inspection

- Apply moderate pressure to the park brake pedal. When latched, the park brake should lock the wheels and hold the vehicle stationary on an incline of 20% or less. If not, adjust the park brake. **See Park Brake Cable Adjustment on page 6-25.**
- Check the park brake cables, equalizer, and linkage for damage. The cables should not come in contact with either of the rear wheels or tires.

Brake Disc and Pad Inspection

- Inspect each brake disc. They should not be warped or have excessive scores or heat checks. Each disc should be at least 0.150 inches (3.8 mm) at the thinnest point.
- Inspect each brake caliper assembly. They should not hold the brake pads tightly against the disc when not in use.
- Inspect the brake pads for wear. The pads should not be glazed or soiled with grease or brake fluid. There should be at least 0.020 inches (0.5 mm) of brake pad material at the thinnest point. **See following WARNING.**

⚠ WARNING

- **Use only approved replacement brake pads designed for your vehicle.**
- **Use only DOT 5 brake fluid.**
- **Do not pump brake pedal without fluid in the reservoir or master cylinder.**

BRAKE SYSTEM TROUBLESHOOTING

The procedures used in making the checks provided in the following troubleshooting guide can be found in the referenced sections of this maintenance and service manual.

TROUBLESHOOTING GUIDE

SYMPTOM	POSSIBLE CAUSES	CORRECTIVE ACTION
Low pedal – pedal may go to the floor	Excessive clearance between the disc and brake pads	**See Front Brake Pad Removal on page 6-6. See Rear Brake Pad Removal on page 6-8.**
	Leak in the hydraulic system	Check the master cylinder, brake lines and hoses for leaks. Replace all damaged parts and bleed brake system.
	Air in the hydraulic system	**See Bleeding the Hydraulic Brake System on page 6-22.**
	Weak (bulging) brake line	Replace the worn hose. **See Hydraulic Line Replacement on page 6-17.**
	Improperly adjusted master cylinder push rod	**See Brake Pedal Adjustment, Section 5, Page 5-4.**
Troubleshooting Guide continued on next page...		

TROUBLESHOOTING GUIDE

SYMPTOM	POSSIBLE CAUSES	CORRECTIVE ACTION
Springy or spongy brake pedal – brake pedal has soft, springy, or spongy feel when pressed	Cracked or thin disc	Replace brake discs. **See Brake Disc and Hub on page 6-10.**
	Poor quality brake fluid or water in fluid	Purge hydraulic fluid and fill with approved DOT 5 (silicone) brake fluid. **See Purging the Hydraulic System on page 6-24.**
	Weak (bulging) brake hoses that expand under pressure	Check the master cylinder, brake lines, and hoses for leaks or bulges. Replace all damaged parts.
	Air in the hydraulic system	**See Bleeding the Hydraulic Brake System on page 6-22.**
Hard pedal – excessive pedal pressure is required to stop the vehicle	Grease or brake fluid on the brake discs or pads	Replace the hub or axle seal and replace the brake pads. **See Brake Disc and Hub on page 6-10.**
	Glazed brake pads	Replace the brake pads. **See Brake Pads and Caliper on page 6-5.**
	Damaged or distorted brake pads	Replace the brake pads. **See Brake Pads and Caliper on page 6-5.**
	Clogged hydraulic lines	Replace brake lines as required. **See Hydraulic Line Replacement on page 6-17.**
	Frozen master cylinder piston or bent rod	Replace master cylinder. **See Master Cylinder and Reservoir on page 6-20.**
Over-aggressive braking	Incorrect or distorted brake pads	Replace the brake pads. **See Brake Pads and Caliper on page 6-5.**
Vehicle pulls to one side	Incorrect or distorted brake pads	Replace the brake pads. **See Brake Pads and Caliper on page 6-5.**
	Grease or brake fluid on the brake pads	Replace hub, axle seal, or caliper, and replace the brake pads. **See Brake Disc and Hub on page 6-10.**
	Scored or warped brake disc	Replace the brake disc. **See Brake Disc and Hub on page 6-10.**
	Water on the brakes	Apply the brakes several times to dry the brake pads and disc.
	Sticking caliper piston	Replace the caliper. **See Brake Pads and Caliper on page 6-5.**
	Faulty suspension parts or alignment	**See Section 7 – Steering and Front Suspension, or Section 9 – Rear Suspension.**
Pulsating brake pedal	Warped or worn brake discs	Replace the brake discs. **See Brake Disc and Hub on page 6-10.**
	Bent wheel	Replace the wheel.
	Worn or damaged wheel bearings	Replace bearings. **See Section 7 – Steering and Front Suspension.**
Decreasing brake pedal travel	Sticking caliper piston	Replace the caliper. **See Brake Pads and Caliper on page 6-5.**
Noise and chatter – clicking or scraping sound upon brake application	Bent, damaged, or incorrect brake pads	Replace the brake pads **See Brake Pads and Caliper on page 6-5.**

Troubleshooting Guide continued on next page...

TROUBLESHOOTING GUIDE

SYMPTOM	POSSIBLE CAUSES	CORRECTIVE ACTION
Noise and chatter – clicking or scraping sound upon brake application, continued	Worn brake pads	Replace the brake pads. **See Brake Disc and Hub on page 6-10.**
	Foreign material embedded in brake pads	Replace the brake pads. **See Brake Disc and Hub on page 6-10.**
	Brake discs are cracked or scored	Replace the brake discs. **See Brake Disc and Hub on page 6-10.**
All brakes drag	Binding brake pedal	Replace bushings and adjust. Also replace any bent or damaged components. **See Section 5 – Accelerator and Brake Pedal Assemblies.**
	Soft or swollen rubber parts caused by incorrect or contaminated brake fluid	Replace master cylinder. **See Master Cylinder and Reservoir on page 6-20.**
Rear brakes drag	Binding park brake cables	Adjust or replace cables.
	Improper brake adjustment	**See Park Brake Adjustment on page 6-25.** Also **See Park Brake Wheel Cables on page 6-26.**
One brake drags	Improper park brake adjustment	**See Park Brake System on page 6-25.**
	Sticking caliper pistons	Replace the caliper. **See Brake Pads and Caliper on page 6-5.**
	Bent or distorted brake pads	Replace the brake pads. **See Brake Pads and Caliper on page 6-5.**
	Worn front or rear wheel bearings	Adjust or replace front wheel bearings. **See Brake Disc and Hub on page 6-10.**
	Damaged hydraulic line	Replace brake lines as required. **See Hydraulic Line Replacement on page 6-17.**

BRAKE PADS AND CALIPER

See General Warning, Section 1, Page 1-1.

FRONT BRAKE PAD AND CALIPER REMOVAL

⚠ WARNING

- **If at any point in this procedure the hydraulic system is opened, the brakes must be bled after the correct reinstallation of the brake components. Failure to bleed the brakes could result in decreased braking performance due to air being trapped in the hydraulic system. Use only DOT 5 brake fluid. See Bleeding the Hydraulic Brake System on page 6-22.**
- **Prior to servicing hydraulic brakes, thoroughly clean the vehicle, paying particular attention to areas immediately surrounding hydraulic connections, to prevent dirt or debris from entering system.**

⚠ CAUTION

- **Do not pump the brake pedal without brake fluid in the master cylinder and reservoir.**
- **Worn or damaged brake discs cannot be machined to refinish them. Replace as necessary.**

1. Chock the rear wheels, set the park brake, loosen the front wheel lug nuts, and lift the front of the vehicle with a chain hoist or floor jack. **See WARNING "Lift only one end..." in General Warning, Section 1, Page 1-2**.
2. Place jack stands under each end of the floorboard crossmember and lower onto stands **(Figure 6-2, Page 6-6)**.
3. Remove the lug nuts and front wheel.

Figure 6-2 Front Jack Stand Placement

Front Brake Pad Removal

1. Remove the two socket-head slide-pin bolts securing the top and bottom of the two brake pads **(Figure 6-3, Page 6-7)**.
2. Remove the brake pads.

Front Brake Caliper Removal

1. Remove the banjo bolt and copper washers holding the brake line to the caliper body **(Figure 6-4, Page 6-7)**. **See following NOTE.**

NOTE: *Place a clean, tray-type container below the caliper and brake line assembly to catch brake fluid when the brake line and caliper body are separated.*

2. Place a plastic bag over the hose fitting to prevent dirt and debris from entering the hydraulic brake system.
3. Remove and discard the two hex-head bolts that secure the caliper assembly to the upright and remove the caliper and, if equipped, its two shim washers (one per bolt).
4. Repeat steps 1 through 3 for the opposite front wheel if necessary.

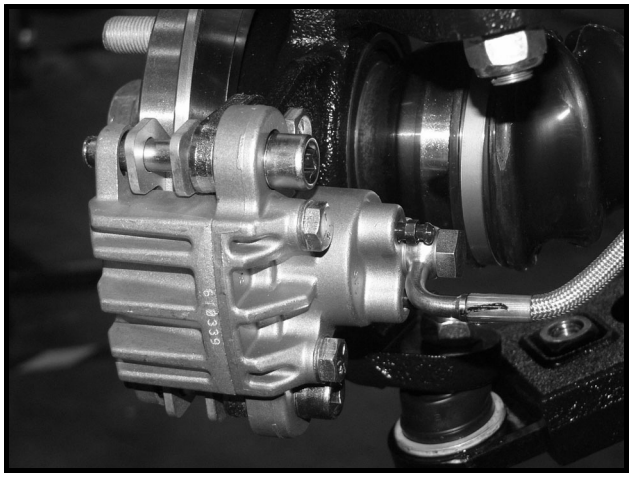


Figure 6-3 Front Brake Pad and Caliper

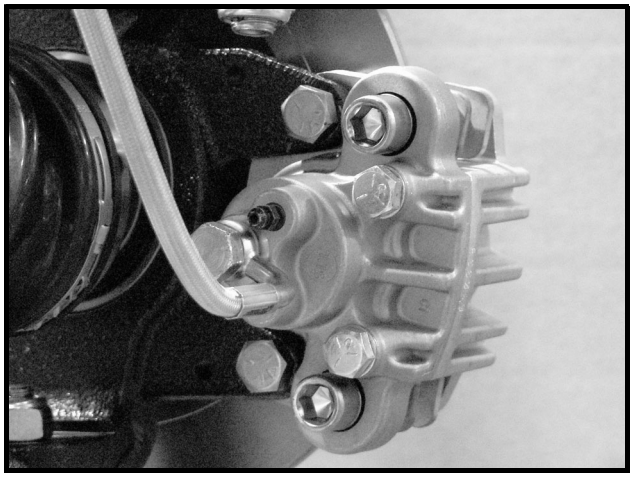


Figure 6-4 Front Brake Line and Banjo Bolt

FRONT BRAKE PAD AND CALIPER INSTALLATION

⚠ WARNING

- **If at any point in this procedure the hydraulic system is opened, the brakes must be bled after the correct reinstallation of the brake components. Failure to bleed the brakes could result in decreased braking performance due to air being trapped in the hydraulic system. Use only DOT 5 brake fluid. See Bleeding the Hydraulic Brake System on page 6-22.**

Front Brake Caliper Installation

1. Install caliper and, if equipped, insert one shim washer between the caliper and upright at each mounting point. Secure with two new lock-patch bolts tightened to 36 ft-lb (49 N·m).
2. Secure the brake line to the caliper with a new banjo bolt and new copper washers. Tighten to 13 ft-lb (18 N·m). **See following CAUTION.**

⚠ CAUTION

- **The banjo bolts are metric. Use only metric thread replacements.**

3. Bleed the brake line at the top bleed port on the caliper body. Tighten the port fitting to 27 in-lb (3 N·m). **See following NOTE.**

NOTE: *Front wheel calipers for this vehicle are equipped with two bleed ports. These calipers can be used on either the left or right side. Always bleed the top port.*

Individual bleeding of the hydraulic ports at the caliper requires an assistant to press the brake pedal or operate special brake bleeding equipment.

4. Repeat steps 1 through 3 for the opposite front wheel if necessary.

Front Brake Pad Installation

1. Install the brake pads and install the socket-head slide-pin bolts through top and bottom holes of pads. Tighten the hardware to 32 ft-lb (43 N·m).
2. Install the tire and wheel. Finger-tighten the lug nuts.
3. Lower the vehicle and use a crisscross pattern to tighten the lug nuts to 85 ft-lb 115 N·m).

4. Repeat steps 1 through 3 for the opposite front wheel.
5. Inspect the brake system. **See Brake System Inspection on page 6-1.**
6. Burnish the new pads before initial vehicle operation. On a flat, open surface, accelerate the vehicle to moderate speed, then apply the brakes under modest, steady pressure. Repeat this procedure for eight to twelve times.

REAR BRAKE PAD AND CALIPER REMOVAL

⚠ WARNING

- **If at any point in this procedure the hydraulic system is opened, the brakes must be bled after the correct reinstallation of the brake components. Failure to bleed the brakes could result in decreased braking performance due to air being trapped in the hydraulic system. Use only DOT 5 brake fluid. See Bleeding the Hydraulic Brake System on page 6-22.**
- **Prior to servicing hydraulic brakes, thoroughly clean the vehicle, paying particular attention to areas immediately surrounding hydraulic connections, to prevent dirt or debris from entering system.**

1. Chock the front wheels, release the park brake, loosen the rear wheel lug nuts, and lift the rear of the vehicle with a chain hoist or floor jack. **See WARNING "Lift only one end..." in General Warning, Section 1, Page 1-2**.
2. Place jack stands under the rear axle and lower onto stands.
3. Remove lug nuts and rear wheel.

Rear Brake Pad Removal

1. Remove the two socket-head slide-pin bolts securing the top and bottom of the two brake pads.
2. Remove the brake pads.

Rear Brake Caliper Removal

1. Remove the banjo bolt and copper washers that secure the brake line to the caliper body **(Figure 6-6, Page 6-9)**. **See following NOTE.**

NOTE: *Place a clean, tray-type container below the caliper and brake line assembly to catch brake fluid when the brake line and caliper body are separated.*

2. Place a plastic bag over the hose fitting to prevent dirt and debris from entering the hydraulic brake system.
3. Remove and discard the two hex-head bolts that secure the caliper assembly to the axle tube and remove the caliper **(Figure 6-5, Page 6-9)**.
4. Repeat steps 1 through 3 for the opposite rear wheel if necessary.

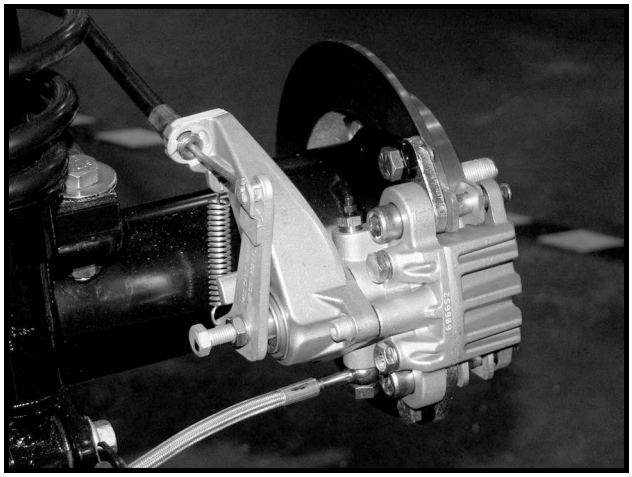


Figure 6-5 Rear Brake Pad and Caliper

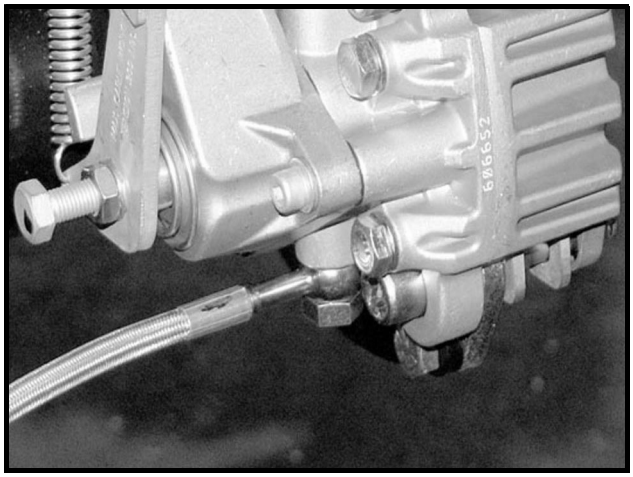


Figure 6-6 Rear Brake Line and Banjo Bolt

REAR BRAKE PAD AND CALIPER INSTALLATION

⚠ WARNING

- **If at any point in this procedure the hydraulic system is opened, the brakes must be bled after the correct reinstallation of the brake components. Failure to bleed the brakes could result in decreased braking performance due to air being trapped in the hydraulic system. Use only DOT 5 brake fluid. See Bleeding the Hydraulic Brake System on page 6-22.**

Rear Brake Caliper Installation

1. Secure the caliper body to the axle tube with two new lock-patch bolts tightened to 36 ft-lb (49 N·m).
2. Secure the brake line to the caliper with a new banjo bolt and new copper washers. Tighten the hardware to 13 ft-lb (18 N·m). **See following NOTE and CAUTION.**

NOTE: *Position the brake line so it is perpendicular to the caliper assembly and pointing directly toward the base bracket on the shock absorber.*

CAUTION

- **The banjo bolts are metric. Use only metric thread replacements.**

3. Bleed the brake line at the bleed port on the caliper body. **See following NOTE.**

NOTE: *Individual bleeding of the hydraulic ports at the caliper requires an assistant to press the brake pedal.*

4. Repeat steps 1 through 3 for the opposite rear wheel if necessary.

Rear Brake Pad Installation

1. Install the brake pads and install the socket-head slide-pin bolts through the top and bottom holes of the pads. Tighten the hardware to 32 ft-lb (43 N·m). **See following NOTE.**

NOTE: *It may be necessary to loosen the park brake adjuster arm on the caliper.*

2. Install the tire and wheel and finger-tighten the lug nuts.
3. Lower the vehicle and use a crisscross pattern to tighten the lug nuts to 85 ft-lb (115 N·m).
4. Repeat steps 1 through 3 for the opposite rear wheel if necessary.
5. Inspect the brake system. **See Brake System Inspection on page 6-1.**
6. Burnish the new pads before initial vehicle operation. On a flat, open surface, accelerate the vehicle to moderate speed, then apply the brakes under modest, steady pressure. Repeat this procedure for eight to twelve times.
7. Adjust the parking brake. **See Park Brake Adjustment on page 6-25.**

BRAKE DISC AND HUB

See General Warning, Section 1, Page 1-1.

FRONT WHEEL DISC AND HUB REMOVAL

⚠ WARNING

- **If at any point in this procedure the hydraulic system is opened, the brakes must be bled after the correct reinstallation of the brake components. Failure to bleed the brakes could result in decreased braking performance due to air being trapped in the hydraulic system. Use only DOT 5 brake fluid. See Bleeding the Hydraulic Brake System on page 6-22.**

⚠ CAUTION

- **Worn or damaged brake discs cannot be machined to refinish them. Replace as necessary.**

1. Chock the rear wheels, set the park brake, loosen the front wheel lug nuts, and lift the front of the vehicle with a chain hoist or floor jack. **See WARNING "Lift only one end..." in General Warning, Section 1, Page 1-1**.
2. Place jack stands under the front frame beam and lower onto stand **(Figure 6-2, Page 6-6)**.
3. Remove the lug nuts and front wheel.
4. Remove the axle spindle nut and washer **(Figure 6-7, Page 6-11)**. **See following NOTE.**

NOTE: *A new spindle nut will be required during assembly.*

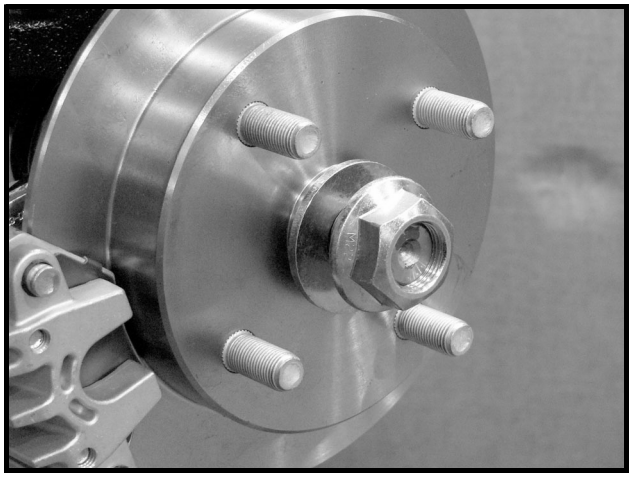


Figure 6-7 Axle Spindle Nut and Washer

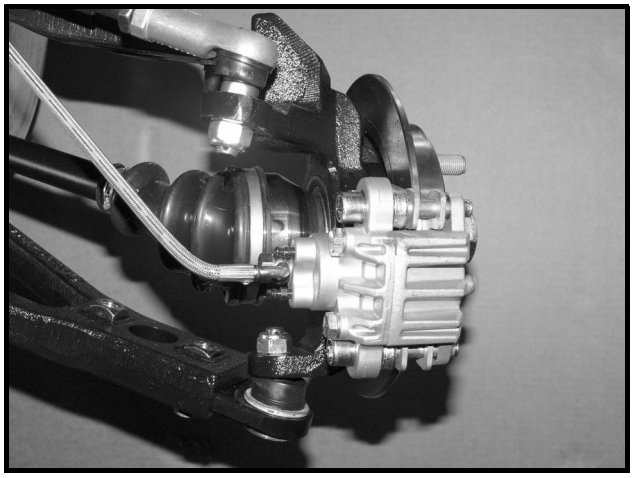


Figure 6-8 Brake Caliper and Upright

5. Remove and discard the two hex-head bolts that secure the caliper assembly to the upright **(Figure 6-8, Page 6-11)**. **See following CAUTION.**

CAUTION

- **Wrap a plastic wire tie around the caliper body to a place on the frame so that it does not hang suspended by the hydraulic brake hose.**

6. Remove the outer tie rod end from the upright.
7. Remove the lower ball joint from the upright **(Figure 6-9, Page 6-11)**.

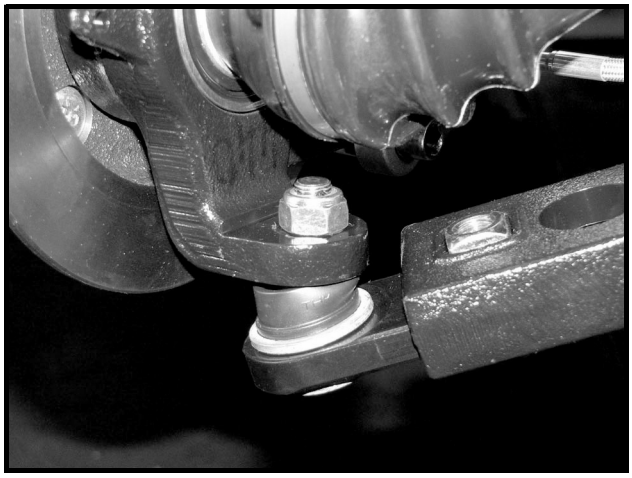


Figure 6-9 Lower Ball Joint and Upright

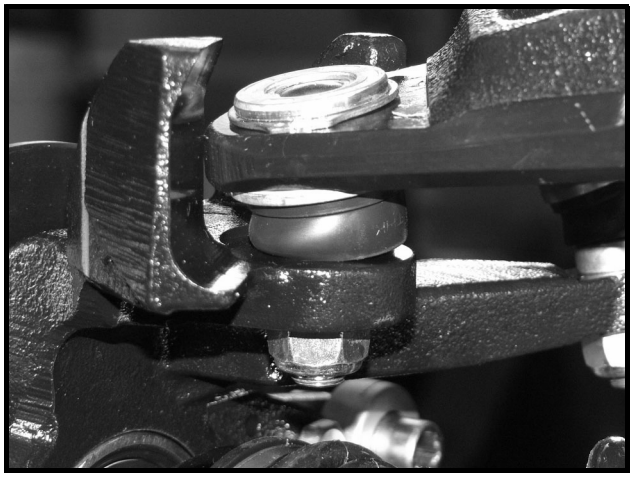


Figure 6-10 Upper Ball Joint and Upright

8. Remove the upper ball joint from the upright **(Figure 6-10, Page 6-11)**. **See following NOTE and CAUTION.**

NOTE: *It may be necessary to use a ball joint removal tool to separate the ball joint stud from the upright.*

CAUTION

- **Take care when separating the ball joint stud from the upright so as not to tear or puncture the rubber seal around the ball socket. If damaged, the ball joint with rubber boot must be replaced.**

9. Remove the wheel hub, disc, and bearing assembly from the splined spindle and CV joint half shaft.
10. Remove the wheel hub and disc from the bearing and upright. **See following CAUTION and NOTE.**

CAUTION

- **The wheel disc and hub are one piece and the splined shaft of the hub is press-fit into the wheel bearing. Removing the wheel hub and disc splined shaft will destroy the wheel bearing and will require a new wheel bearing during assembly.**

NOTE: *Removing the wheel disc and hub from the bearing will require the use of a hydraulic press.*

10.1. Place 2 x 2-inch, or larger, steel blocks (1) onto the platen bars of a hydraulic press **(Figure 6-11, Page 6-12)**.
10.2. Position the disc (6) and upright (5) between the blocks.
10.3. Place a 2 x 1/4-inch flat steel bar (2) under each arm of the upright (5) on the steel blocks (1).
10.4. Position a shim block (3) under each of the two flat steel bars (2) directly under each arm location.
10.5. Place a heavy cloth (4) under the disc to protect the surface when it is released from the bearing.
10.6. Use a rod or bar (8) slightly smaller than the inside diameter of the inner bearing race (7) and press the disc and hub shaft from the bearing. **See following NOTE.**

NOTE: *Bearings will be damaged when the hub and disc are removed. Replace the bearings during reassembly.*

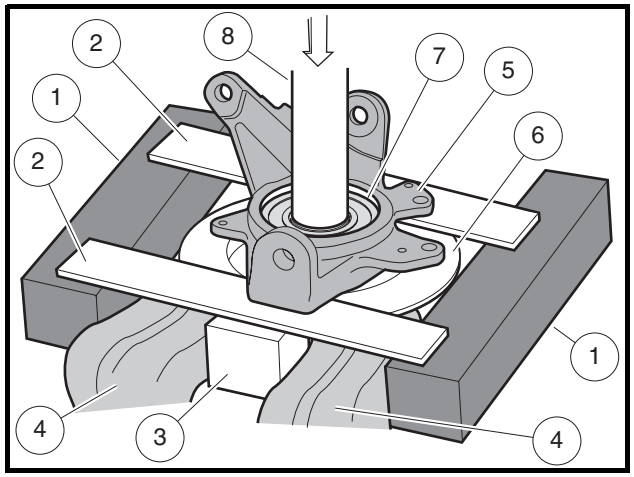


Figure 6-11 Position Steel Blocks and Upright on Press

11. Press the bearing out of the upright.
11.1. Position the upright (5) with the two ball joint arms down on one steel block (1) and the drag link arm down on a second steel block (1) **(Figure 6-12, Page 6-13)**.

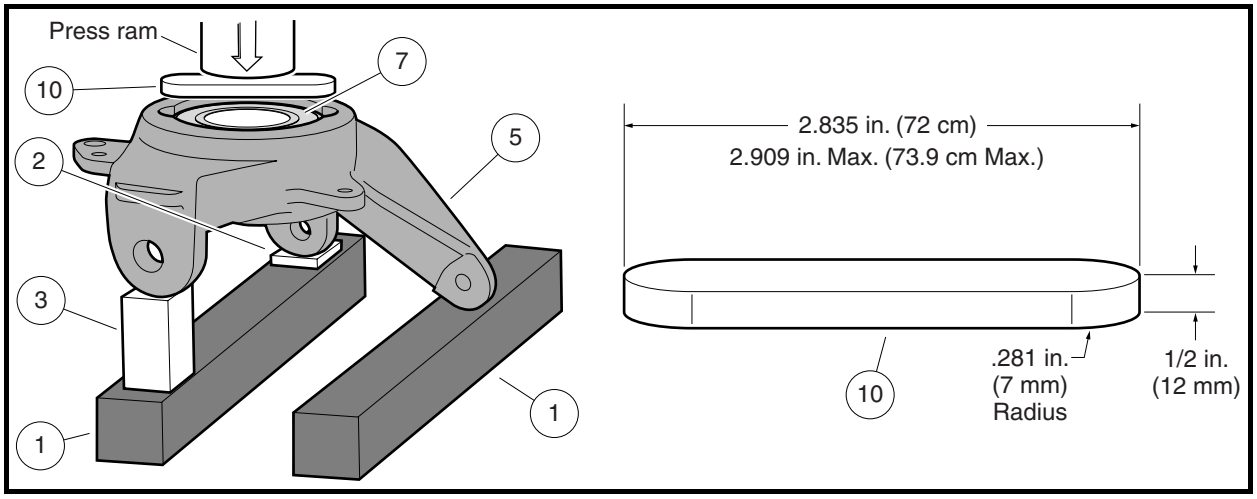


Figure 6-12 Bearing Removal

11.2. Shim the ball joint arms (2 and 3) with steel blocks to provide a level surface for bearing removal (block 2 height is 9/16" and block 3 height is 1-11/16").

11.3. Make special bar (10), that fits inside cutouts of the bearing cavity opening (7), to rest on the outer race of the bearing. Press out bearing.

12. Install a new bearing on the disc and hub.

12.1. Position the upright on 2 x 2-inch, or larger, steel blocks (1) as shown **(Figure 6-13, Page 6-13)**.

12.2. Position a new bearing (7) into the bearing cavity of the upright.

12.3. Use a bar or rod (8) slightly smaller than the outside diameter of the bearing, but large enough to engage the outside bearing race, to press the bearing into the bearing cavity until it bottoms out. **See following CAUTION.**

CAUTION

- **Press against the entire bearing surface.**
- **Bearing must seat completely in cavity. There should be no gap between the bearing and the lip of the upright. The bearing should be flush with the non-lip side of the upright.**

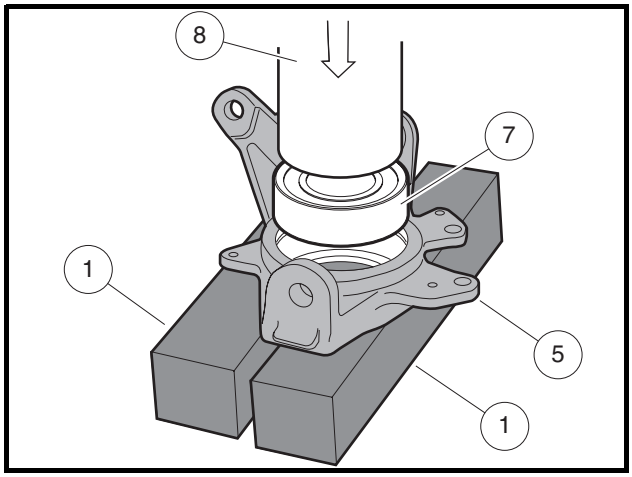


Figure 6-13 Position Upright for New Bearing

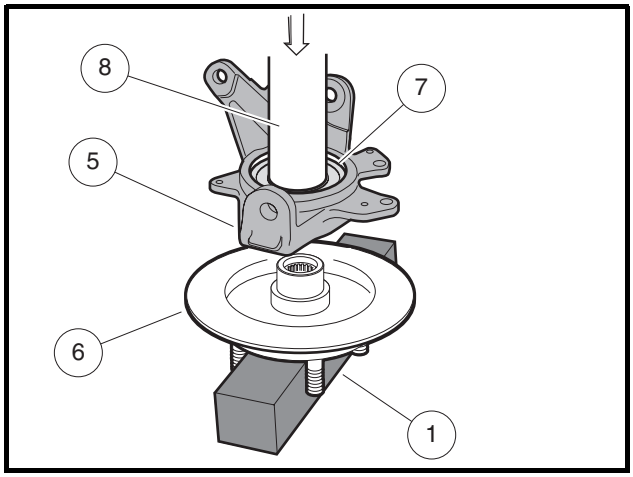


Figure 6-14 Press Disc and Hub into Bearing

13. Press the shaft on the disc and hub into the bearing **(Figure 6-14, Page 6-13)**.
    13.1. Position the disc and hub (6) onto a 2 x 2-inch, or larger, steel block as shown **(Figure 6-14, Page 6-13)**. **See following CAUTION.**

CAUTION

- **Do not press against the lug bolts. Press only against the center of the hub.**

    13.2. Apply anti-seize compound to the hub and disc shaft.
    13.3. Position the upright (5) and bearing (7) onto the shaft of the disc and hub as level as possible.
    13.4. Use a rod or bar (8) larger than the inner race diameter of the bearing (7) and press the bearing onto the disc and hub shaft until it bottoms out against the shoulder of the disc and hub shaft.
14. The disc and hub shaft should be approximately 3/32 inch (2.38 mm) below the bearing inner race surface **(Figure 6-15, Page 6-14)**.

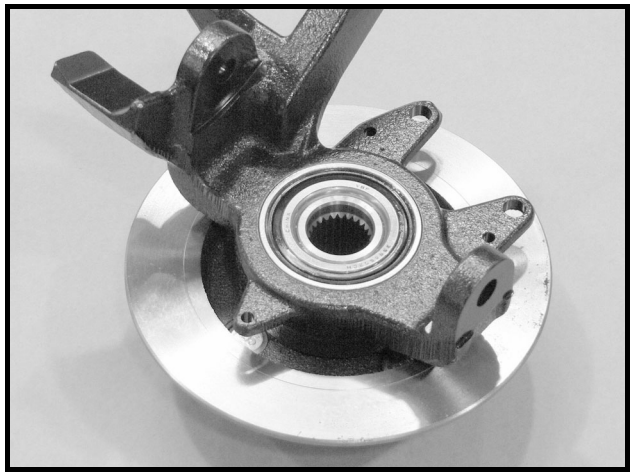


Figure 6-15 Upright, Bearing and Shaft Assembly

FRONT WHEEL DISC AND HUB INSTALLATION

⚠ WARNING

- **If at any point in this procedure the hydraulic system is opened, the brakes must be bled after the correct reinstallation of the brake components. Failure to bleed the brakes could result in decreased braking performance due to air being trapped in the hydraulic system. Use only DOT 5 brake fluid. See Bleeding the Hydraulic Brake System on page 6-22.**

1. Inspect the ball joint boots for damage. Replace the ball joint and boot assemblies if necessary.
2. Apply anti-seize compound to the half-shaft and CV joint spindle spline area.
3. Slip the upright, wheel, and bearing assembly onto the CV joint spindle. **See following CAUTION.**

CAUTION

- **Do not allow anti-seize compound to contact the brake disc or pads.**

4. Apply anti-seize compound to the upper and lower ball joint studs.

5. Secure the upright, wheel, and bearing assembly to the upper ball joint. Use a new nylon locknut and tighten the hardware to 18 ft-lb (24 N·m).
6. Secure the upright, wheel, and bearing assembly to the lower ball joint. Use a new nylon locknut and tighten the hardware to 18 ft-lb (24 N·m).
7. Secure the outer tie rod end to the upright arm. Use a new nylon locknut and tighten the hardware to 70 ft-lb (95 N·m).
8. Inspect the brake pads for wear and replace if necessary. **See Brake Disc and Pad Inspection on page 6-3. See Front Brake Pad Removal on page 6-6.**

NOTE: *If brake pads are replaced on one side, replace the opposite side also.*

9. Install the brake caliper on the upright. **See Front Brake Caliper Installation on page 6-7.**
10. Install the hardened washer and new flanged spindle nut. Tighten, but do not torque the hardware to its finished value.
11. Install the tire and wheel and finger-tighten the lug nuts.
12. Remove the jack stand. With the tires on the ground, use a crisscross pattern to tighten the lug nuts to 85 ft-lb (115 N·m).
13. Tighten the flanged spindle nut to 150 ft-lb (203 N·m).
14. Inspect the brake systems. **See Brake System Inspection on page 6-1.**

REAR WHEEL DISC REMOVAL

⚠ WARNING

- **If at any point in this procedure the hydraulic system is opened, the brakes must be bled after the correct reinstallation of the brake components. Failure to bleed the brakes could result in decreased braking performance due to air being trapped in the hydraulic system. Use only DOT 5 brake fluid. See Bleeding the Hydraulic Brake System on page 6-22.**

1. Chock the front wheels, release the park brake, and loosen the rear wheel lug nuts.
2. Remove the rubber dust cap.
3. Remove and discard the cotter pin.
4. Loosen and discard the castle nut on the axle spindle.
5. Lift the rear of the vehicle with a chain hoist or floor jack. **See WARNING "Lift only one end..." in General Warning, Section 1, Page 1-2.**
6. Place jack stands under the frame and lower it onto the stands **(Figure 6-16, Page 6-16)**.
7. Remove the lug nuts and wheel.
8. Remove the rear caliper from the axle tube. Secure the rear caliper to the respective swing arm assembly with wire ties to remove pressure from the fittings and brake line.
9. Slide the splined wheel disc and hub from the axle spindle **(Figure 6-17, Page 6-16)**. **See following NOTE.**

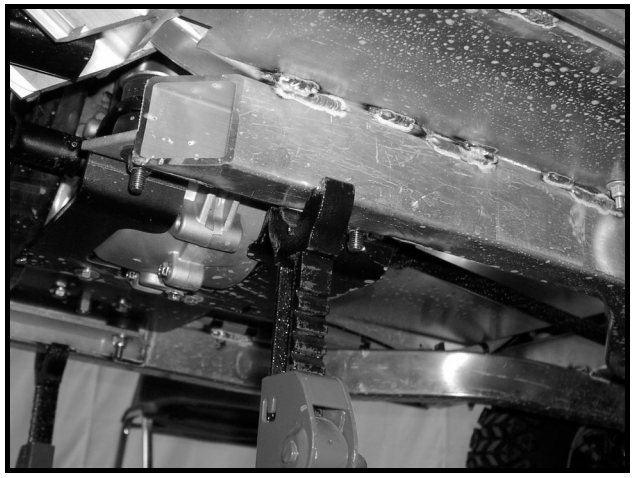


Figure 6-16 Rear Axle Stand

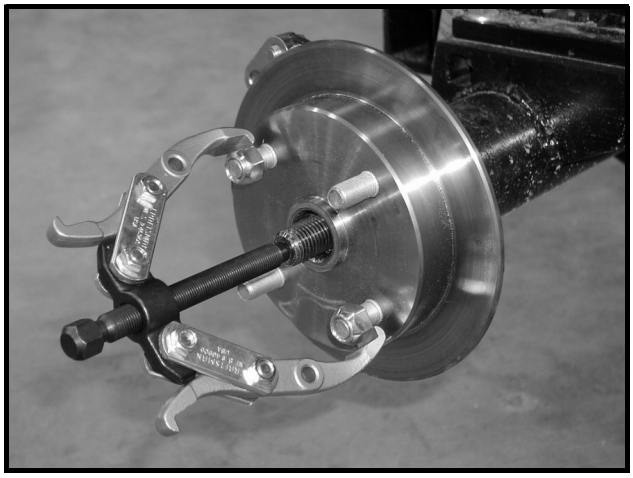


Figure 6-17 Rear Wheel Disc and Hub

NOTE: *If the wheel hub does not slide easily from the axle spindle, use a two or four-jaw wheel puller to remove the wheel hub.*

10. Repeat steps 2 through 9 for the opposite rear wheel if necessary.

REAR WHEEL DISC INSTALLATION

⚠ WARNING

- **If at any point in this procedure the hydraulic system is opened, the brakes must be bled after the correct reinstallation of the brake components. Failure to bleed the brakes could result in decreased braking performance due to air being trapped in the hydraulic system. Use only DOT 5 brake fluid. See Bleeding the Hydraulic Brake System on page 6-22.**

1. Clean the spline and threaded portion of the axle.
2. Apply anti-seize compound to both the axle and wheel hub splined area. **See following CAUTION.**

CAUTION

- **Do not allow anti-seize compound to contact the brake disc or pads.**

3. Apply a light coat of lubrication grease to the outside surface of the splined hub.
4. Slide the wheel hub onto the splined portion of the axle end. **See following NOTE.**

NOTE: *Ensure the splined hub is positioned to slide into the bearing and seal assembly.*

5. Install the large flat washer onto the threaded portion of the axle.
6. Install a new axle nut and advance the nut to the large flat washer.
7. Install the rear caliper. **See Rear Brake Caliper Installation on page 6-9. See following NOTE.**

NOTE: *It may be necessary to loosen the park brake adjuster arm on the caliper.*

8. Install the rubber dust cap.
9. Install the tire and wheel and loosely attach the lug nuts.

10. Raise the vehicle, remove the jack stands, and lower the vehicle.
11. Tighten the axle nut to 80 ft-lb (108 N·m). Position the locking cap and attach a new cotter pin.
12. Tighten the lug nuts to 85 ft-lb (115 N·m).
13. Repeat steps 1 through 12 for the opposite rear wheel if necessary.

HYDRAULIC LINE REPLACEMENT

See General Warning, Section 1, Page 1-1.

⚠ WARNING

- **To perform any of the following procedures, the hydraulic system must be opened. As a result, the brakes must be bled after the correct reinstallation of the brake components. Failure to bleed the brakes could result in decreased braking performance due to air being trapped in the hydraulic system. Use only DOT 5 brake fluid. See Bleeding the Hydraulic Brake System on page 6-22.**
- **Prior to servicing hydraulic brakes, thoroughly clean the vehicle, paying particular attention to areas immediately surrounding hydraulic connections, to prevent dirt or debris from entering system.**

NOTE: *The brake lines are provided as assemblies without separating unions other than those at the wheels and master cylinder.*

FRONT BRAKE LINE REMOVAL

1. Chock the rear wheels and set the park brake.
2. Raise hood.
3. Use a flare-nut wrench to remove the front brake line at the master cylinder. **See following NOTE.**

NOTE: *Place a plastic bag around the master cylinder to catch brake fluid before the brake line is removed. Wrap the bag around the master cylinder to prevent debris from entering the brake line port.*

4. Remove the front brake lines, banjo bolts and copper washers at each front wheel caliper assembly.

NOTE: *Place a pan under each caliper assembly to collect brake fluid.*

Place a plastic bag around each caliper to prevent debris from entering the brake line ports. Do not allow brake fluid to contact the brake pads and disc.

5. Remove the two brake line support brackets, T-bracket and P-clamp from the frame.
6. Slide the front brake lines toward the front of the vehicle, away from the master cylinder.

FRONT BRAKE LINE INSTALLATION

1. Feed the new front brake line under the front of the vehicle and up to the master cylinder.
2. Carefully insert the flared end of the brake line end into the master cylinder and tighten the hardware to 132 in-lb (15 N·m).

3. Install the T-bracket on the frame and tighten the hardware to 50 in-lb (5.6 N·m) **(Figure 6-18, Page 6-18)**. Install the P-clamp on the frame and tighten the hardware to 85 in-lb (9.6 N·m).
4. Install the two support brackets and tighten the hardware to 50 in-lb (5.6 N·m) **(Figure 6-19, Page 6-18)**.
5. Secure the hydraulic lines to the frame above the steering column shaft with wire ties.

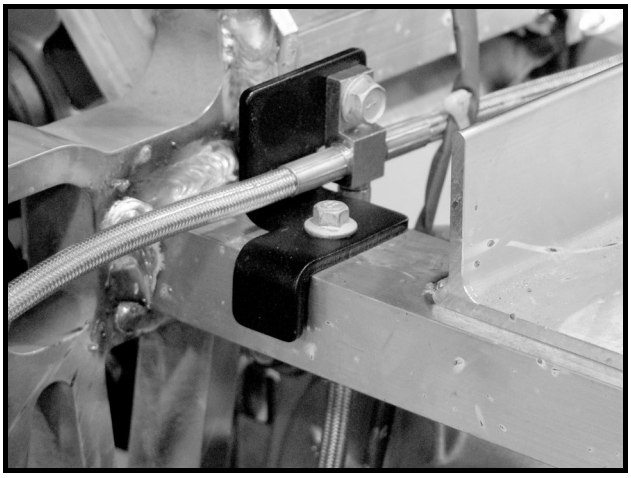


Figure 6-18 Front Brake Line T-Bracket

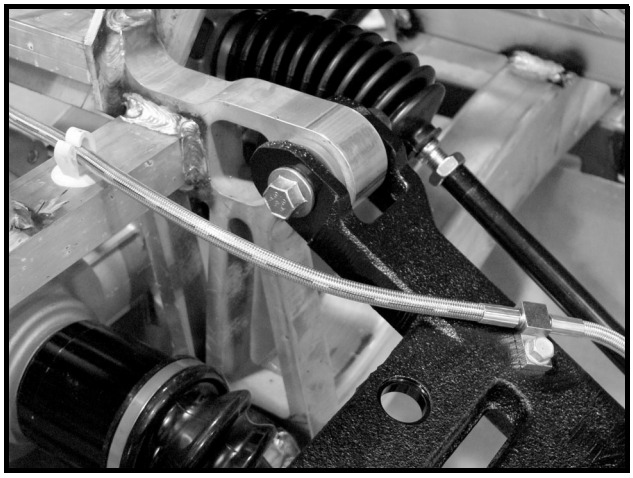


Figure 6-19 Front Brake Line Support Brackets

6. Install brake lines, new banjo bolts, and new copper washers on each front wheel caliper. Position the lines between the nearest top bleeder port and the wheel upright. Tighten the hardware to 13 ft-lb (18 N·m). **See following CAUTION.**

⚠ CAUTION

- **Ensure that the hydraulic lines cannot contact any portion of the half-shafts or CV boot.**
- **The banjo bolts are metric. Use only metric thread replacements.**

7. Fill the reservoir of the master cylinder and bleed the hydraulic system. **See Bleeding the Hydraulic Brake System on page 6-22.**
8. Inspect the brake system. **See Brake System Inspection on page 6-1. See following WARNING.**

⚠ WARNING

- **Use the top bleeding port on each caliper to bleed that respective front wheel.**

9. Close hood.

REAR BRAKE LINE REMOVAL

1. Chock the front wheels and set the park brake.
2. Remove the top screw caps and screws from the dashboard and front body.
3. Open hood.
4. Use a flare-nut wrench to remove the rear brake line at the master cylinder. **See following NOTE.**

NOTE: *Place a plastic bag around the master cylinder to catch brake fluid before the brake line is removed. Wrap the bag around the master cylinder to prevent debris from entering the brake line port.*

5. Remove the brake lines, banjo bolts and copper washers from each rear caliper assembly. **See following NOTE.**

NOTE: *Place a pan under each rear caliper assembly to collect the brake fluid.*

Place a plastic bag around each caliper to prevent debris from entering the brake line ports. Do not allow brake fluid to contact the brake pads and disc.

6. Remove each brake line from the grommet and clamp locations.
7. Remove the T-bracket from the passenger side on the rear receiver hitch frame.
8. Remove the brake line from the clamp locations under the vehicle frame and floorboard.
9. Remove the brake lines that are toward the rear of the vehicle on the passenger side. **See following NOTE.**

NOTE: *Tie a heavy nylon string to the flare-nut end of the brake line before removal. Allow the string to travel with the brake line until it clears the rear of the vehicle. During replacement, tie the flare-nut end of the new brake line to the nylon string and use it to pull the new brake line into position and to the master cylinder.*

REAR BRAKE LINE INSTALLATION

1. Feed a new brake line from the rear of the vehicle and position it in line with the frame clamps and up to the master cylinder. **See following NOTE.**

NOTE: *If a heavy nylon string was used to remove the previous rear brake line, tie the string to the flare-nut end of the new brake line. Use the string to pull the new brake line into position and to the master cylinder.*

2. Carefully install the flared end of the brake line into the master cylinder and tighten to 11 in-lb (15 N·m).
3. Secure the brake lines to the clamp and grommet locations.
4. Secure the brake lines, banjo bolts, and new copper washers to each rear wheel caliper. Tighten the hardware to 13 ft-lb (18 N·m). **See following NOTE.**

NOTE: *Position the brake line perpendicular to the caliper assembly and pointing directly toward the base bracket on the shock absorber.* ***See following CAUTION.***

CAUTION

- **The banjo bolts are metric. Use only metric thread replacements.**

5. Fill the reservoir of the master cylinder and bleed the hydraulic system. **See Bleeding the Hydraulic Brake System on page 6-22.**
6. Perform all of the brake system inspections. **See Brake System Inspection on page 6-1.**

MASTER CYLINDER AND RESERVOIR

See General Warning, Section 1, Page 1-1.

⚠ WARNING

- **To perform this procedure, the hydraulic system must be opened. As a result, the brakes must be bled after the correct reinstallation of the brake components. Failure to bleed the brakes could result in decreased braking performance due to air being trapped in the hydraulic system. Use only DOT 5 brake fluid. See Bleeding the Hydraulic Brake System on page 6-22.**

FILLING THE HYDRAULIC SYSTEM

The brake fluid reservoir is accessible by opening the hood. Do not allow the brake fluid level to fall below the MIN line. Use only DOT 5 brake fluid.

RESERVOIR REMOVAL

1. Chock the wheels and set the park brake.
2. Open hood.
3. Remove the hoses at the master cylinder. **See following NOTE.**

NOTE: *Provide a clean container for the brake fluid to drain into. After both hose ends are in a container, remove the reservoir cap to allow fluid to drain freely from reservoir container.*

4. Remove the hoses at the reservoir.

NOTE: *If hoses are cracked or show signs of aged deterioration, replace them with approved hoses designed to handle brake fluid specified for this vehicle.*

5. Remove the bolt and washer that secure the reservoir container to the dash support structure and remove the container.

RESERVOIR INSTALLATION

1. Secure the reservoir container to the dash support structure with bolt and washer and tighten the hardware to 20 in-lb (2.2 N·m).
2. Install the hoses on the barbed fittings of the reservoir container.
3. Install the remaining loose hose ends on the barbed ports of the master cylinder. **See following NOTE.**

NOTE: *The front port on the master cylinder should be attached to the driver side port on the reservoir.*

Do not allow these hoses to develop kinks or be routed in such a way as to restrict gravity fluid flow.

4. Fill the reservoir with brake fluid specified for this vehicle and bleed the hydraulic brake system. **See Bleeding the Hydraulic Brake System on page 6-22.**
5. Inspect the brake system. **See Brake System Inspection on page 6-1.**

MASTER CYLINDER REMOVAL

⚠ WARNING

- **To perform this procedure, the hydraulic system must be opened. As a result, the brakes must be bled after the correct reinstallation of the brake components. Failure to bleed the brakes could result in decreased braking performance due to air being trapped in the hydraulic system. Use only DOT 5 brake fluid. See Bleeding the Hydraulic Brake System on page 6-22.**

1. Chock the wheels and set the park brake.
2. Open hood.
3. Remove the hoses from the master cylinder. **See following NOTE.**

NOTE: *Use a clean container to collect the brake fluid. After both hose ends have been placed in a container, remove the reservoir cap and allow fluid to drain freely from the reservoir container.*

If hoses are cracked or show signs of deterioration, replace them with approved hoses designed to handle the brake fluid specified for this vehicle.

4. Use a flare-nut wrench to remove the front and rear brake lines from the master cylinder. **See following NOTE.**

NOTE: *Use a clean container to collect the brake fluid.*

5. Remove the rue pin and clevis pin from the brake pedal and push rod clevis **(Figure 6-20, Page 6-21)**.

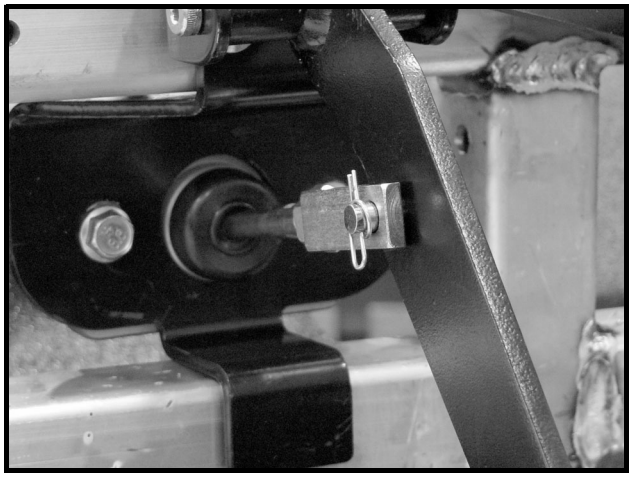


Figure 6-20 Master Cylinder Rod and Brake Pedal

6. Remove the two bolts and locknuts that secure the master cylinder to the frame.
7. Remove the master cylinder from the vehicle.

MASTER CYLINDER INSTALLATION

1. Secure the master cylinder to the master cylinder bracket with two bolts and locknuts. Tighten the hardware to 16 ft-lb (22 N·m).

2. Loosen the jam nut on the push rod clevis and secure the clevis to the brake pedal with a clevis pin and rue pin **(Figure 6-20, Page 6-21)**.
3. Carefully secure the front and rear brake line flare fittings to the master cylinder. Finger-tighten the hardware.
4. Use a flare-nut wrench to tighten the brake line fittings to 11 ft-lb (15 N·m).
5. Secure the reservoir hoses to the master cylinder barbed connectors. **See following NOTE.**

NOTE: *The front port on the master cylinder should be attached to the driver side port on the reservoir.*

Do not allow these hoses to develop kinks or to be routed in such a way as to restrict gravity fluid flow.

6. Fill the reservoir with brake fluid specified for this vehicle and bleed the hydraulic brake system. **See Bleeding the Hydraulic Brake System on page 6-22.**
7. Adjust the brake pedal stroke with the clevis and master cylinder push rod threaded connection. Tighten the jam nut to 14 ft-lb (19 N·m). **See Brake Pedal Adjustment, Section 5, Page 5-4.**
8. Inspect the brake system. **See Brake System Inspection on page 6-1.**

BLEEDING THE HYDRAULIC BRAKE SYSTEM

See General Warning, Section 1, Page 1-1.

⚠ WARNING

- **Do not bleed the brakes in the same manner as a DOT 3 system. Failure to bleed the brakes as instructed in this manual will result in decreased braking performance due to air being trapped in the hydraulic system.**
- **Use only DOT 5 brake fluid to fill the master cylinder. NEVER mix DOT 3, DOT 4, or DOT 5.1 with DOT 5 as it IS NOT compatible.**

The hydraulic system must be free of air. Air enters the hydraulic system whenever the system is opened and will result in a “spongy” brake pedal.

The master cylinder controls two separate hydraulic sub-systems. The front two wheels are connected to the front portion of the master cylinder and the rear wheels to the rear portion. One or both sub-systems may require bleeding, depending on where the hydraulic system was opened.

Pressure or vacuum bleeding, with preference given to the pressure bleeding method, is the recommended way to remove air from a brake system filled with DOT 5 silicone brake fluid. If a pressure or vacuum brake bleeding tool is not available, manually bleeding the system can be accomplished when done carefully.

BLEEDING BRAKES ON A DOT 5 FLUID FILLED SYSTEM

1. Remove all cargo from the cargo bed in preparation for lifting the vehicle. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL.
2. Check the brake pedal and master cylinder push rod for proper adjustment before the brake system is bled. **See Brake Pedal Adjustment, Section 5, Page 5-4.**
3. Remove the cap from the master cylinder reservoir and top off the master cylinder with fresh DOT 5 silicone brake fluid. **NEVER** mix DOT 3, DOT 4, or DOT 5.1 with DOT 5 as it **IS NOT** compatible.

4. Place, but do not tighten, the cap on the master cylinder reservoir.
5. **Vacuum Bleeding:**
   5.1. Chock the front or rear wheels and loosen the lug nuts. Release the park brake and lift the front or rear of the vehicle with a chain hoist or floor jack. **See WARNING "Lift only one end..." in General Warning on page 1-1.**
   5.2. Place jack stands under the outer front frame, or under the rear axle tubes, and lower onto stands **(Figure 6-2, Page 6-6)**.
   5.3. Connect the vacuum-type brake bleeder (CCI P/N S0010702).
      5.3.1. **Front Brakes Only:** Connect the two hose fittings from a vacuum type brake bleeder to the top brake bleeder valves on the back of each of the front caliper assemblies.
      5.3.2. **Rear Brakes Only:** Connect the two hose fittings from a vacuum type brake bleeder to the brake bleeder valves on the back of each of the rear caliper assemblies.
   5.4. Connect an air hose to the vacuum brake bleeder. The air pressure must be regulated at 12 to 15 psi (0.827 to 1.034 Bars).
   5.5. Press the handle on the brake bleeder to start the vacuum.
   5.6. With the vacuum running, open each of the top brake bleeder valves 1/4 turn on the front wheel calipers.
   5.7. Monitor the fluid as it flows through the tubes of the vacuum bleeder tool. Continue to run the vacuum until there are no air bubbles in the lines. **See following NOTE.**

NOTE: *Do not allow the brake fluid in the master cylinder reservoir to fall below the MIN level mark at any time during the brake bleeding procedure.*

   5.8. With the vacuum still running, tighten the two top front brake bleeder valves to 25 in-lb (3 N·m).
   5.9. Allow the handle on the brake bleeder tool to open and turn the vacuum system off.
6. **Manual Bleeding:**

   Manually bleeding brakes is not done by rapidly applying extreme pressure on the vehicle's master cylinder. It's simply a function of gently moving fluid through the system to displace the air and contaminants that have accumulated.

   It is important to have the vehicle sitting level and safely supported on jack stands before the manual bleeding procedure is performed. **See following WARNING.**

⚠ WARNING

- **Do not bleed brakes with only one end of the vehicle raised. To place vehicle on four jack stands, lift only one end of the vehicle at a time. Use a suitable lifting device (chain hoist or hydraulic floor jack) with 1000 lb. (454 kg) minimum lifting capacity. Do not use the lifting device to hold vehicle in the raised position. Use approved jack stands of proper weight capacity to support the vehicle.**

The following procedure will enable correct bleeding:

6.1. Chock the front or rear wheels and loosen the lug nuts. Release the park brake and lift the front of the vehicle with a chain hoist or floor jack. **See preceeding WARNING.** Place jack stands under the outer front frame and lower onto stands **(Figure 6-2, Page 6-6)**.

6.2. Position jack under rear differential and lift rear of vehicle. Ensure the vehicle is not pulled off the front jack stands while lifting the rear. **See following WARNING.** Once vehicle is level, place jack stands under the rear axle tubes and lower onto stands.

⚠ WARNING

- **To prevent possible injury from pulling the vehicle off the front jack stands while lifting the rear, perform the following:**
  - **Position floor jack wheels in the direction the jack will roll as the rear of the vehicle rises.**
  - **Ensure the wheels of the jack are able to roll freely without obstruction.**

6.3. Start at the brake caliper farthest away from the master cylinder. Attach a clear plastic hose to the caliper's bleeder valve and place the other end into a clear container (a clean plastic 16 oz. soda bottle works fine) filled with enough brake fluid to cover the end of the hose. This prevents air from being drawn into the caliper during the bleeding process.

6.4. Have an assistant **SLOWLY** depress and release the brake pedal repeatedly until resistance is encountered when pushing the pedal. **DO NOT VIGOROUSLY PUMP** the brake pedal! Pumping the pedal can aerate the brake fluid in the master cylinder and brake lines.

6.5. When resistance is felt at the pedal, have the assistant apply gentle downward pressure on the pedal and hold while slowly opening the bleeder valve, then close the valve fully as the brake pedal reaches the end of its travel. Continue this process until air bubbles no longer come out of the hose that is submerged into the fluid in the bottle. Gently tap the caliper and the master cylinder with a plastic-tipped hammer and repeat the bleeding sequence. This will dislodge air bubbles that tend to accumulate, allowing for a more complete bleeding process.

6.6. Ensure that no brake fluid gets on the brake rotors or pads. If fluid gets on the brake rotors, they should be cleaned with brake cleaner. If fluid gets on the pads, they should be replaced as brake fluid can reduce the brake pad's effectiveness or even break down the friction material.

6.7. Check the master cylinder fluid level and add fluid if necessary. Always pour fluid into the master cylinder slowly to avoid creating air bubbles in the reservoir. **See following NOTE.**

NOTE: *Do not allow the brake fluid in the master cylinder reservoir to fall below the MIN level mark at any time during the brake bleeding procedure.*

6.8. Once the caliper is bled, tighten the bleeder valve to 25 in-lb (3 N·m), wipe the area of any residual fluid with a clean rag and have the assistant press on the brake pedal to ensure there are no leaks. Normal pedal pressure should be used.

6.9. Repeat this process at each brake caliper, starting at the next caliper farthest from the master cylinder.

7. After bleeding, fill the master cylinder reservoir to the MAX level with DOT 5 brake fluid.
8. Tighten the cap on the master cylinder reservoir.
9. Properly label and dispose of the used brake fluid.
10. Inspect the brake system. **See Brake System Inspection on page 6-1.**
11. Before a test drive, pump the brake pedal 3 or 4 times. Carefully drive the vehicle and test the function of the brakes. Check the fluid level to ensure no loss of fluid.

PURGING THE HYDRAULIC SYSTEM

In some cases it may be necessary to completely drain the front, rear, or entire hydraulic brake system of brake fluid. To completely purge the hydraulic system, perform the following procedure.

1. Perform steps 2 through 6.5 of **Bleeding the Hydraulic Brake System, Section 6, Page 6-22**.
2. Draw 1 qt. (0.9464 L) of the brake fluid into the vacuum-type brake bleeder tool.
3. With the vacuum running, tighten the two top bleeder valves.

4. Allow the handle on the brake bleeder tool to open, turning the vacuum system off.
5. Repeat steps 1 through 4 for the two remaining wheels.

PARK BRAKE SYSTEM

See General Warning, Section 1, Page 1-1.

PARK BRAKE ADJUSTMENT

NOTE: *The hydraulic portion of the brake system has an automatically adjusting brake pad system. The park brake system does not and requires regular adjustment depending on use.*

1. Chock the wheels, release the park brake, and place the Forward/Reverse handle in the NEUTRAL position.
2. Loosen, but do not remove the jam nut on the caliper park brake lever.
3. Thread in and finger-tighten the adjustment bolt.
4. Tighten the jam nut on the caliper lever to hold the adjustment bolt in place.
5. Repeat steps 2 through 4 for the opposite park brake assembly.
6. Inspect the brake system to ensure that both the hydraulic brake system and the park brake system are adjusted and operating correctly before the vehicle is returned to service. **See Brake System Inspection on page 6-1.**

PARK BRAKE CABLE ADJUSTMENT

⚠ CAUTION

- **Perform the following procedure only on a level surface. To avoid injury or property damage, ensure that the path of the vehicle is clear before the vehicle is pushed.**

NOTE: *Adjust rear brake calipers and park brake before adjusting park brake cable.*

1. Chock the wheels, release the park brake, and place the Forward/Reverse handle in the NEUTRAL position.
2. With the park brake released, tighten the conical nut until significant resistance is observed in the park brake cable **(Figure 6-22, Page 6-26)**.
3. With the vehicle on flat ground and the Forward/Reverse handle in the NEUTRAL position, push the park brake pedal seven clicks.
4. Push the vehicle by hand. If the wheels move easily when the vehicle is pushed, continue tightening the conical nut until the vehicle resists rolling easy and firm resistance is achieved.
5. Release the park brake pedal and push it again to seven clicks. The vehicle should not be movable with one person pushing.
6. Tighten the equalizer jam nut against the conical nut and tighten to 55 in-lb (6.3 N·m).
7. Inspect the brake system to ensure that both the hydraulic brake system and the park brake system are adjusted and operating correctly before the vehicle is returned to service. **See Brake System Inspection on page 6-1.**

PARK BRAKE WHEEL CABLES

Right Rear Cable Removal

1. Chock the rear wheels and release the park brake.
2. Remove the hex-head bolt and P-clamp securing the cable to the air cleaner mounting bracket.
3. Cut the nylon wire tie securing the cable to the frame.
4. Remove the C-clip from the right rear cable sheath adjacent to the caliper.
5. Slide the cable forward to release the sheath ferrule from the caliper bracket.
6. Move the cable up and toward the rear of the vehicle and remove the cable from the caliper arm **(Figure 6-21, Page 6-26)**.
7. Disconnect the threaded end of the cable from the frame bracket and remove the cable **(Figure 6-22, Page 6-26)**.

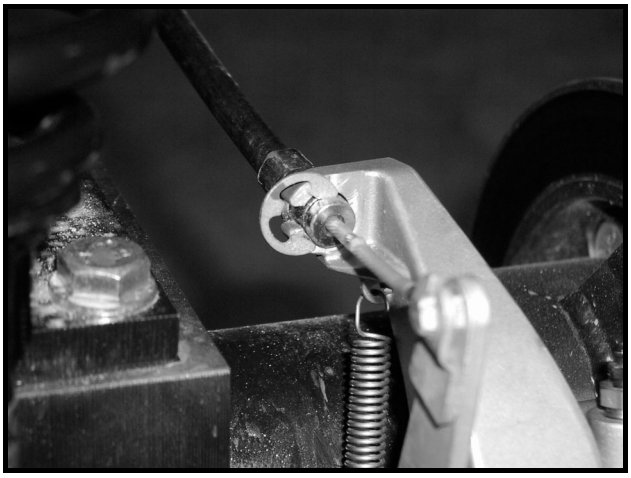


Figure 6-21 Park Brake Cable Attachment

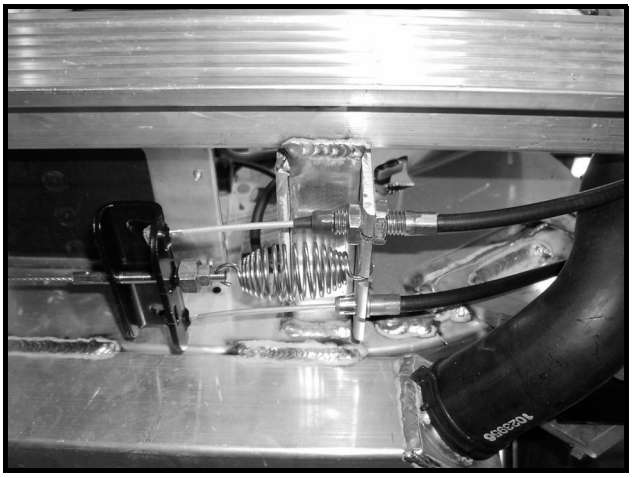


Figure 6-22 Park Brake Frame Bracket

Left Rear Cable Removal

1. Chock the rear wheels and release the park brake.
2. Remove the P-clamp and nylon wire tie securing the cable to the frame.
3. Remove the C-clip from the right rear cable sheath adjacent to the caliper.
4. Slide the cable forward to release the sheath ferrule from the caliper bracket.
5. Move the cable up and toward the rear of the vehicle to remove the cable end from the caliper arm **(Figure 6-21, Page 6-26)**
6. Squeeze the ferrule tines together on the cable end at the frame bracket and remove the cable from the vehicle **(Figure 6-22, Page 6-26)**.

Right Rear Cable Installation

1. Install the caliper end of the cable into the brake caliper arm **(Figure 6-21, Page 6-26)**.
2. Slide the sheath ferrule through the hole in the caliper mounting bracket.
3. Install a C-clip to hold the cable ferrule in place.
4. Route the cable up and across the air filter box and secure the P-clamp and cable to the top bolt on the filter mounting bracket **(Figure 6-23, Page 6-27)**.

5. Route the cable end to the outside of the air intake hose.
6. Secure the cable to the frame bracket at the outside hole **(Figure 6-22, Page 6-26)**.
7. Insert the threaded end of the cable through the frame bracket. Use the nuts to adjust the cable end. Both cables should be equal in length. Tighten the nuts to 40 ft-lb (54 N·m).
8. Secure the cable to the frame with a nylon wire tie.
9. Secure cable end to the equalizer bracket.

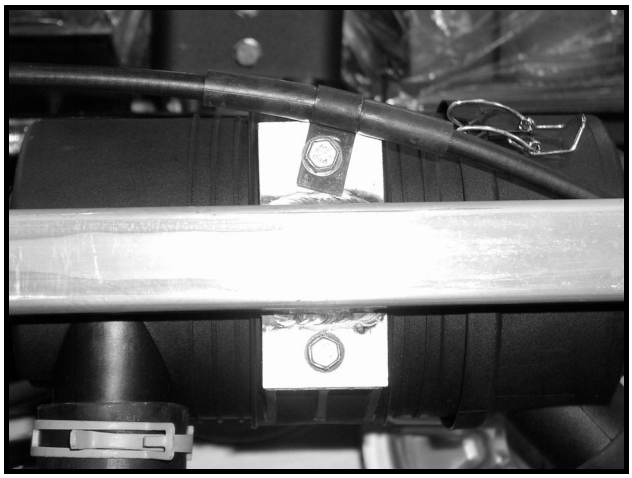


Figure 6-23 Air Filter and Park Brake Cable Clamp

Left Rear Cable Installation

1. Install the caliper end of the cable into the brake caliper arm **(Figure 6-21, Page 6-26)**.
2. Slide the sheath ferrule through the hole in the caliper mounting bracket.
3. Install a C-clip to hold the cable ferrule in place.
4. Route the cable to the inside of the air intake hose.
5. Secure the cable with a P-clamp and nylon wire tie to the frame.
6. Secure the cable end to the equalizer bracket. **See Park Brake Equalizer Installation on page 6-28.**

FRONT PARK BRAKE CABLE REMOVAL

1. Chock the rear wheels and release the park brake.
2. Remove the spring from the driver side equalizer adjustment rod **(Figure 6-24, Page 6-28)**.
3. Remove the nuts from the threaded adjustment rod on the cable end.
4. Release the tines securing the cable ferrule to the frame bracket.
5. Reach under the driver side instrument panel, remove the cotter pin and disconnect the front park brake cable end from the lower-most park brake bell crank **(Figure 6-25, Page 6-28)**.
6. Turn the steering wheel fully to the right to allow access in the wheel well area behind the driver side front wheel.
7. Reach under the driver side wheel well area behind the front wheel and remove the outboard hex-head bolt securing the plastic splash panel.

8. Hold the plastic splash panel forward to access and release the tines securing the cable ferrule to the frame bracket.
9. Remove the front park brake cable from the vehicle.

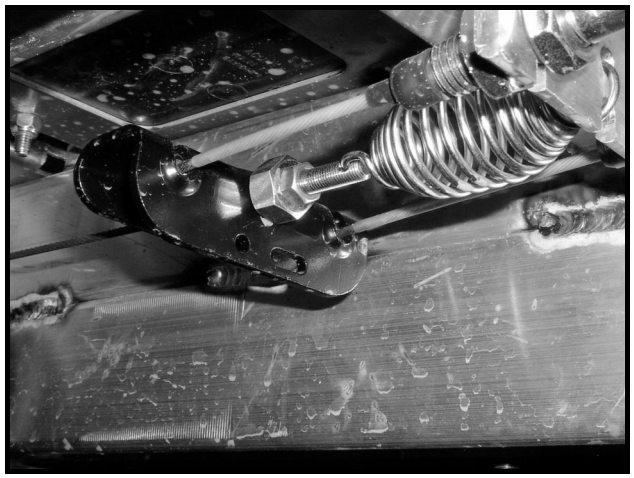


Figure 6-24 Park Brake Equalizer

Figure 6-25 Park Brake Cable Attachment

FRONT PARK BRAKE CABLE INSTALLATION

1. Position the front park brake cable to the vehicle.
2. Hold the plastic splash panel forward to access and route the cable end up to the lower-most park brake bell crank and secure the cable ferrule to the frame bracket.
3. Reach under the driver side instrument panel and use a cotter pin to secure the front park brake cable end to the lower-most park brake bell crank **(Figure 6-25, Page 6-28)**.
4. Secure the rear cable ferrule to the rear frame bracket nearest the park brake equalizer.
5. Insert the threaded adjustment rod through the equalizer bracket **(Figure 6-24, Page 6-28)**.
6. Install the conical nut with the cone oriented toward the equalizer and then install a jam nut onto the threaded portion of the cable end. Advance both nuts a few turns.
7. Secure the spring from the end of the adjustment rod to the brake cable frame bracket.
8. Adjust the brake cable equalizer. **See Park Brake Cable Adjustment on page 6-25.**
9. Inspect all of the brake systems to ensure that both the hydraulic brake system and the park brake system are adjusted and operating correctly before the vehicle is returned to service. **See Brake System Inspection on page 6-1.**

PARK BRAKE EQUALIZER REMOVAL

1. Chock the wheels and release the park brake.
2. Remove the spring from the driver side equalizer adjustment rod **(Figure 6-24, Page 6-28)**.
3. Remove the nuts from the threaded adjustment rod on the cable end.
4. Remove the rear park brake cables from the equalizer and remove the equalizer.

PARK BRAKE EQUALIZER INSTALLATION

1. Secure the equalizer to the ends of the rear park brake cables **(Figure 6-24, Page 6-28)**.

2. Insert the threaded adjustment rod through the equalizer bracket.
3. Secure the conical nut to the cable with the cone oriented toward the equalizer. Tighten the nut until the cable is drawn snugly through the equalizer bracket.
4. Thread the jam nut onto the threaded portion of the equalizer rod so that it is beyond the spring retaining hole.
5. Secure the extension spring to the end of the threaded end of the cable and the vehicle frame.
6. Adjust the brake cable equalizer. **See Park Brake Cable Adjustment on page 6-25.**

SECTION 7 – STEERING AND FRONT SUSPENSION

⚠ DANGER

- **See General Warning, Section 1, Page 1-1.**

⚠ WARNING

- **See General Warning, Section 1, Page 1-1.**

STEERING WHEEL

See General Warning, Section 1, Page 1-1.

STEERING WHEEL REMOVAL

1. Turn the key switch OFF, and place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning on page 1-2.**
3. **Gasoline vehicles:** Disconnect the spark plug wires.
4. Rotate steering wheel to a straight ahead position.

NOTE: *Do not turn steering again until wheel has been installed.*

5. Gently pry the center cap from the steering wheel center.

NOTE: *Pry from the bottom edge of the cap.*

6. Loosen and remove the steering wheel retaining bolt (18) **(Figure 7-1, Page 7-2)**.
7. Remove the steering wheel. **See following NOTE.**

NOTE: *The steering wheel has a tapered hex fitting. A steering wheel puller (CCI P/N 102061201) may be required to remove the steering wheel.*

7.1. Place the puller anvil (4) through the top opening of the steering wheel.

7.2. Insert the anvil feet through the two slots in the base plate (marked "B") (5).

7.3. Rotate the anvil screw (6) clockwise until the base plate contacts the bottom of the steering wheel at the steering column **(Figure 7-2, Page 7-2)**.

7.4. Use a 1/2-inch drive air impact wrench to tighten the anvil screw (6) until the steering wheel releases from the steering shaft.

7.5. Remove the steering wheel from the steering column.

Steering Wheel Removal, Continued:

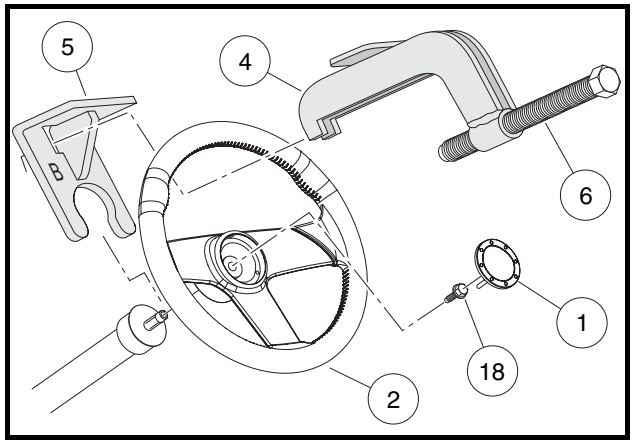


Figure 7-1 Steering Wheel Puller

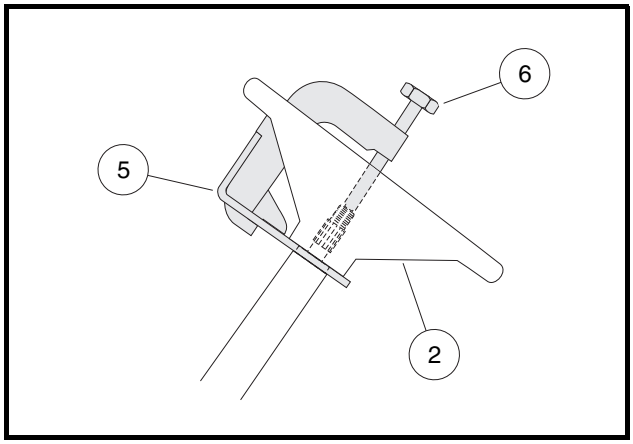


Figure 7-2 Steering Wheel Puller

STEERING WHEEL INSTALLATION

1. Install the steering wheel on the hex portion of the steering shaft. Align the hex fitting of the wheel with the steering column shaft **(Figure 7-1, Page 7-2)**.
2. Install the steering wheel retaining bolt, and tighten the bolt to 13 ft-lb (17.6 N·m).
3. Install the steering wheel center cap by aligning the two pins on the cap with the two holes in the wheel.
4. **Gasoline vehicles:** Connect the spark plug wire.
5. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

STEERING COLUMN

See General Warning, Section 1, Page 1-1.

STEERING COLUMN REMOVAL

1. Turn the key switch OFF, and place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Remove the steering wheel. **See Steering Wheel Removal on page 7-1.**
4. Remove the instrument panel. **See Instrument Panel Removal, Section 4, Page 4-3.**
5. Raise the hood. **See Front Fascia Removal, Section 4, Page 4-4.**
6. Loosen the top bolt from the steering column shaft at the universal joint **(Figure 7-4, Page 7-3)**.
7. Remove the bottom bolt from the rack and pinion shaft at the universal joint.
8. Remove the three nuts from the steering column mount bolts.

NOTE: *Bolts are pressed into the steering column mount bracket.*

9. Remove the steering column, and pull the shaft up through the hole in the splash guard.

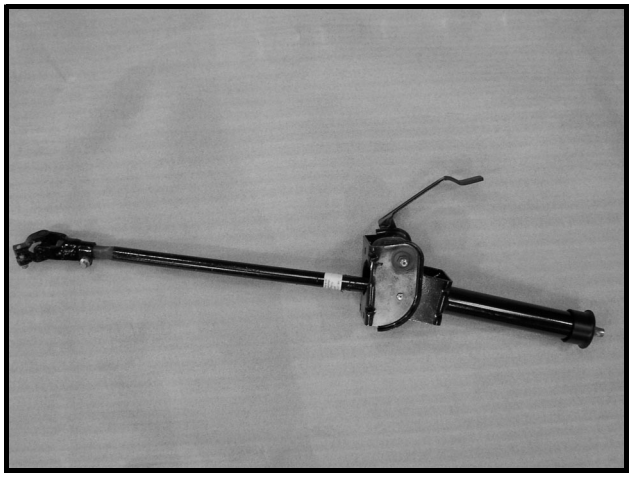


Figure 7-3 Steering Column Assembly

Figure 7-4 Steering Universal Joint

STEERING COLUMN INSTALLATION

1. Slide the steering column through the frame opening and down through the hole in the splash guard.
2. Position the steering column against the dash mounting plate, and install new locknuts. Tighten the hardware to 22 ft-lb (30 N·m).
3. Align the flat portion of the shaft with the bolt side of the universal joint. **See following NOTES.**

NOTE: *The end of the pinion is designed to fit only one way. Align the universal joint coupling with the pinion.*

4. Install the universal joint coupling bolt at the pinion shaft, and tighten the hardware to 18 ft-lb (24 N·m).

NOTE: *Be sure to tighten the bolt at the universal joint on the rack and pinion shaft first.*

5. Tighten the steering column coupling bolt to 18 ft-lb (24 N·m).
6. Install the instrument panel. **See Instrument Panel Installation, Section 4, Page 4-3.**
7. Lower and secure the hood.
8. Install the steering wheel. **See Steering Wheel Installation on page 7-2.**
9. **Gasoline vehicles:** Connect the spark plug.
10. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

RACK AND PINION

See General Warning, Section 1, Page 1-1.

RACK AND PINION REMOVAL

1. Chock the rear wheels, set the park brake, loosen the front wheel lug nuts, and lift the front of the vehicle with a chain hoist or floor jack. **See WARNING "Lift only one end..." in General Warning, Section 1, Page 1-2**.
2. Place jack stands under the outer front frame beams, and lower the vehicle onto the stands. **See Figure 6-2, Section 6, Page 6-6.**

Rack and Pinion Removal, Continued:

3. Remove the front wheels.
4. Remove the outer drag link ball joints from the upright assemblies and inspect for excessive wear and seal damage **(Figure 7-5, Page 7-4)**.

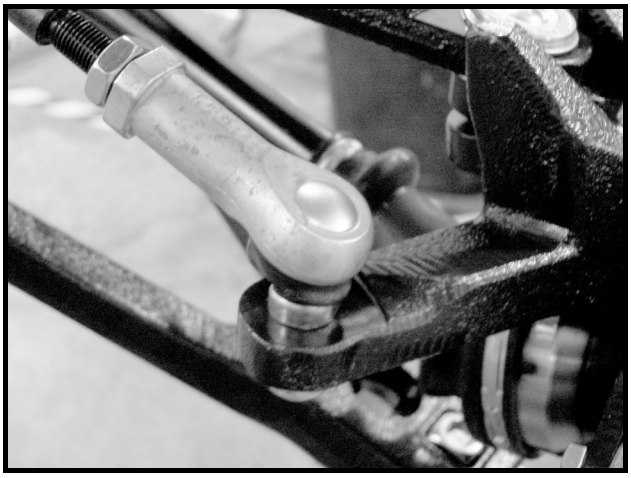


Figure 7-5 Drag Link Ball Joint

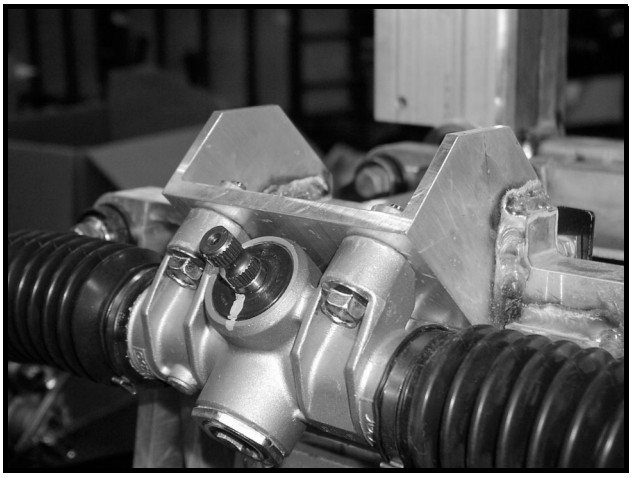


Figure 7-6 Rack and Pinion Bolts

5. Loosen the bolts on the steering universal joint that secure the steering column shaft and the rack and pinion shaft.
6. Remove the rack and pinion spline bolt, and slide the universal joint up on the steering column shaft away from the rack and pinion splined shaft.
7. Remove the four bolts from the rack and pinion steering assembly mounting bracket. Remove the rack and pinion assembly and the tie-rod assembly **(Figure 7-6, Page 7-4)**.

RACK AND PINION INSTALLATION

1. Apply a light coat of anti-seize lubricant to the splined portion of the pinion shaft to minimize corrosion.
2. Position the rack and pinion base next to the mounting bracket, and install the four bolts. Tighten the hardware to 23 ft-lb (31 N·m) **(Figure 7-6, Page 7-4)**.
3. Slide the universal joint down over the pinion. Align the flat-way on the pinion with the bolt path on the universal joint.
4. Install the universal bolt on the pinion shaft and tighten to 18 ft-lb (24 N·m).
5. Tighten the universal joint bolt on the steering column to 18 ft-lb (24 N·m).
6. Install both outer drag link ball joints, and advance the bolt approximately 6 threads. Do not tighten the jam nuts. Jam nuts will be tightened during alignment.
7. Install the outer drag link ball joints on each upright, and tighten the hardware to 70 ft-lb (95 N·m) **(Figure 7-5, Page 7-4)**.
8. Align the front wheels, and adjust the toe-in and camber. **See Wheel Alignment on page 7-11.**
9. Adjust the outer drag link jam nuts, and tighten the hardware to 21 ft-lb (28.4 N·m).
10. Adjust the inner drag link jam nuts, and tighten the hardware to 21 ft-lb (28.4 N·m).
11. Remove the vehicle jack stands, and lower the vehicle to the ground.

RACK AND PINION DISASSEMBLY

1. Remove the rack and pinion and drag link assembly. **See Rack and Pinion Removal on page 7-3.**
2. Remove the two outer ball joints from the drag links **(Figure 7-7, Page 7-5)**.
3. Remove both drag links (19) **(Figure 7-8, Page 7-5)**.

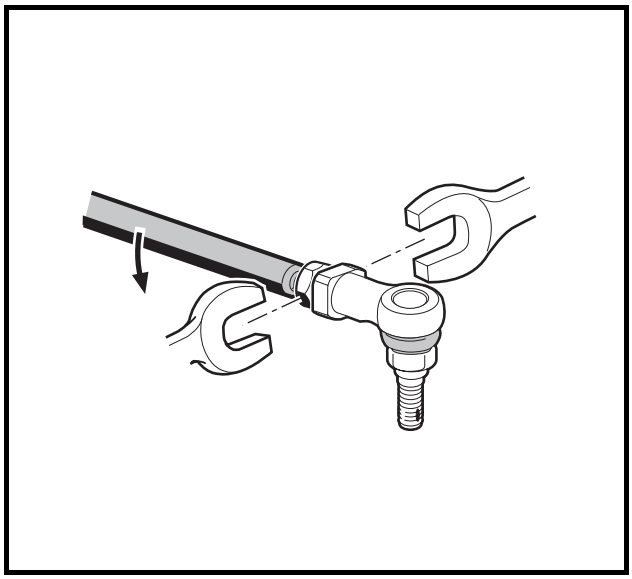


Figure 7-7 Drag Link Ball Joint

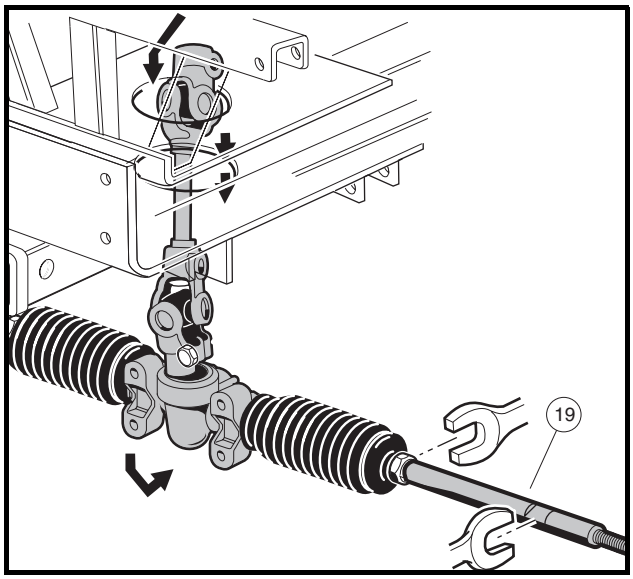


Figure 7-8 Drag Link

4. Remove both bellows clamps (metal clamps or plastic wire ties) **(Figure 7-9, Page 7-5)**. **See following NOTE.**

NOTE: *If the dust seal bellows are secured with a metal clamp, remove the clamp. Do not reuse the clamp when the rack and pinion is reassembled. Use a plastic wire tie to secure the dust seal bellows.*

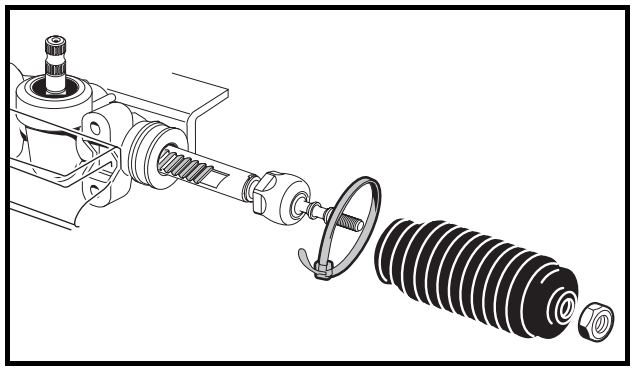


Figure 7-9 Dust Bellows Clamp

5. Remove the two hex nuts from the inner ball-joint ends, and remove both of the dust seal bellows.
6. Remove the rack screw nut (8), rack guide screw (7), rack guide pressure spring (6), and the rack guide (5) **(Figure 7-16, Page 7-8)**.
7. Remove the dust seal **(Figure 7-10, Page 7-6).**
8. Remove the snap ring (4) **(Figure 7-11, Page 7-6)**.

Rack and Pinion Disassembly, Continued:

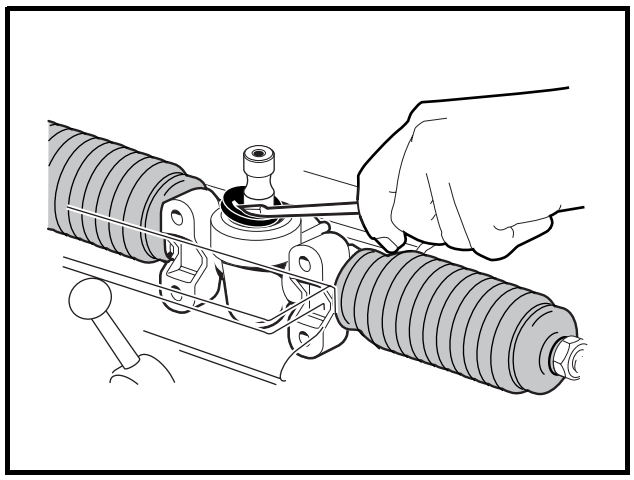


Figure 7-10 Remove Dust Seal

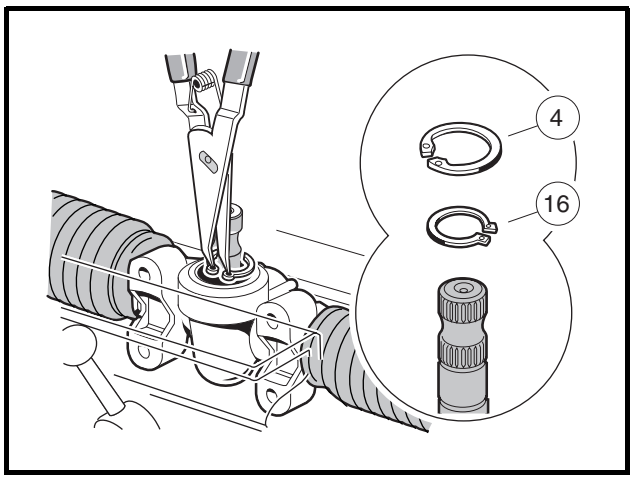


Figure 7-11 Remove Pinion Snap Ring

9. Install the universal joint on the pinion, and place a fork or a large open-end wrench under the universal joint **(Figure 7-12, Page 7-6)**. Gently pry the pinion from the housing.
10. Remove the U-joint from the pinion.
11. If the pinion ball bearing has been damaged, remove the C-type stop ring (16) **(Figure 7-11, Page 7-6),** and use a press to remove the bearing **(Figure 7-13, Page 7-6)**.

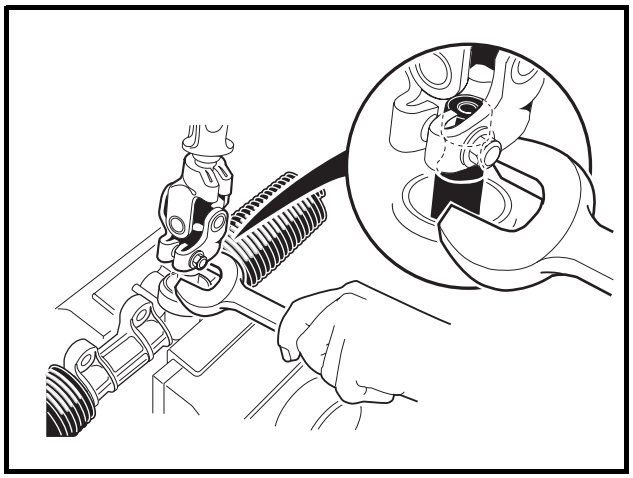


Figure 7-12 Remove Pinion from Housing

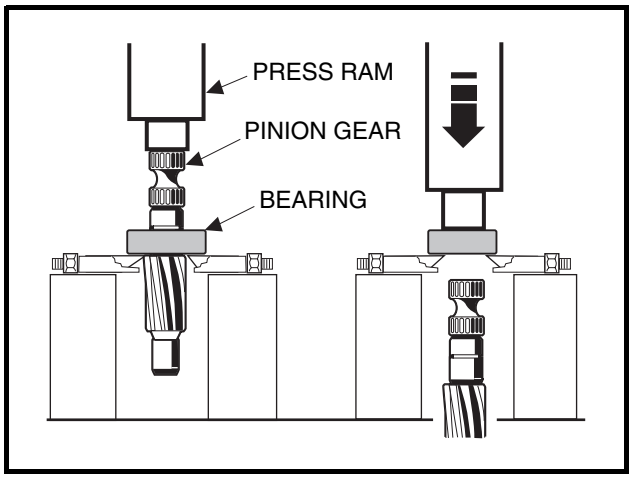


Figure 7-13 Remove Pinion Gear

12. Inspect the bushing (17) and needle bearing (14) for excessive wear. If wear is excessive, replace the complete rack and pinion steering assembly **(Figure 7-16, Page 7-8)**.
13. Inspect the inner ball joints for wear **(Figure 7-16, Page 7-8)**. If either is excessively worn, replace both ball joints.

    13.1. Secure the rack and housing assembly in a vise **(Figure 7-14, Page 7-7)**. **See following CAUTION.**

CAUTION

- **Use wood blocks between the rack and the jaws of the vise to protect the rack from damage.**

13.2. Tap the flange out of the notch in the rack **(Figure 7-15, Page 7-7)**.

13.3. Remove the ball joint from the rack.

14. Remove the rack (2) from the housing (1) **(Figure 7-16, Page 7-8)**.

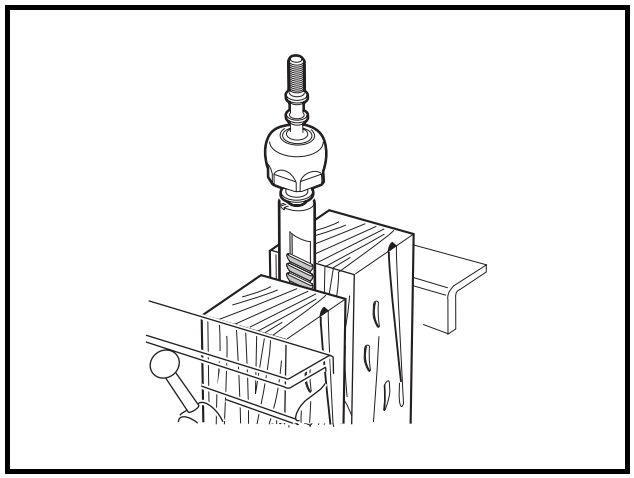


Figure 7-14 Secure Racks

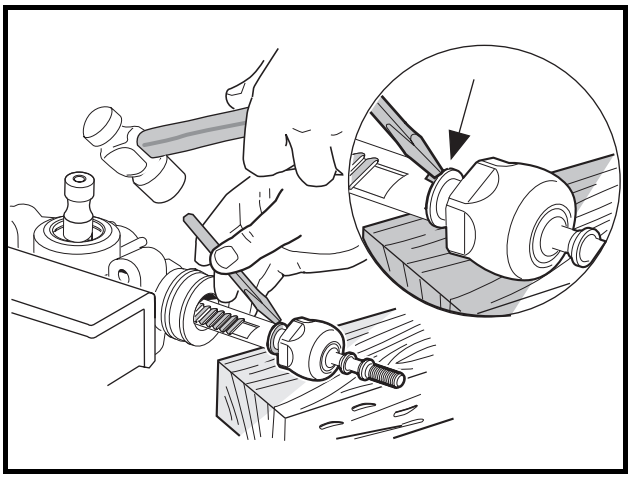


Figure 7-15 Remove Inner Ball Joints

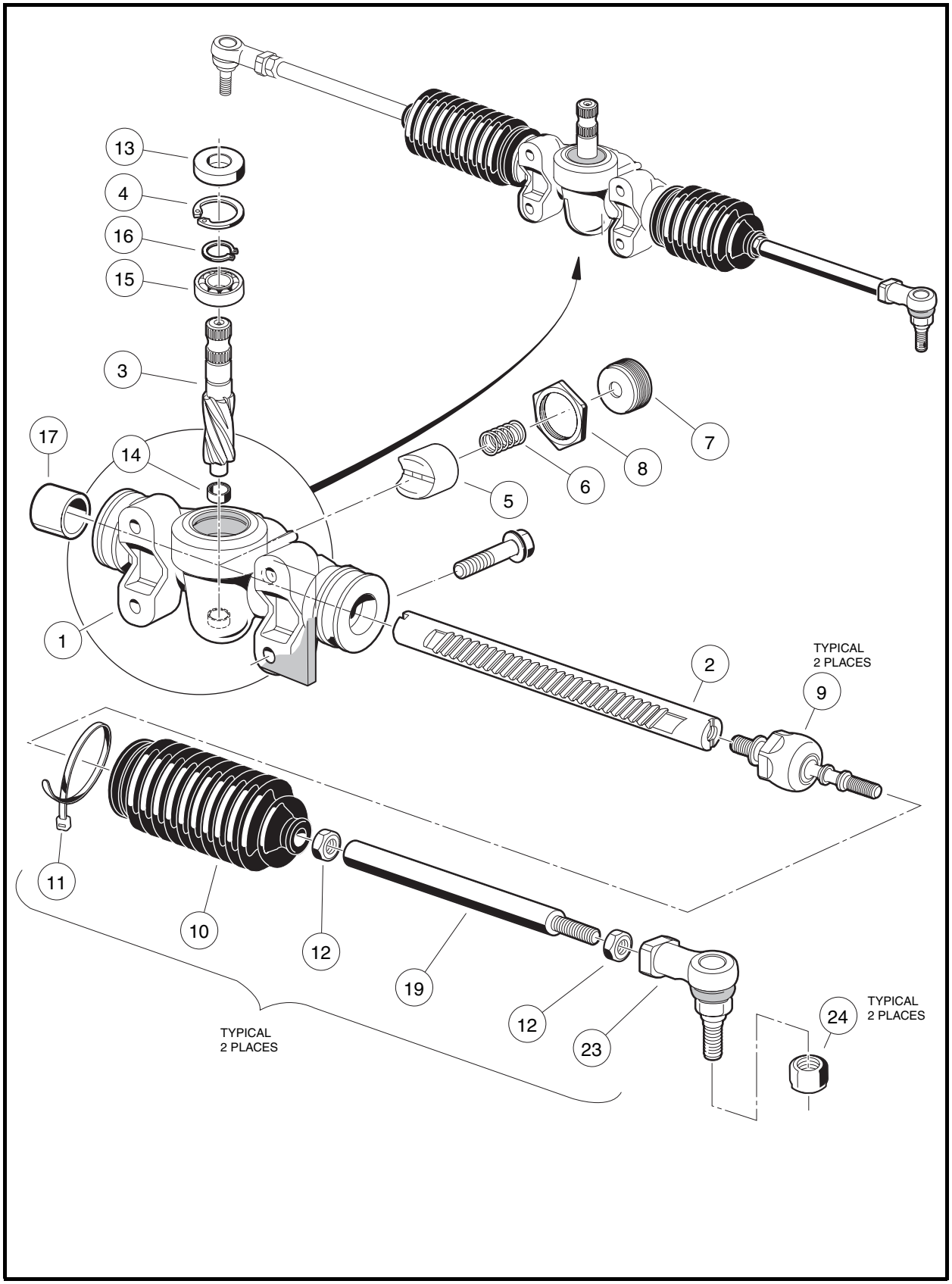


Figure 7-16 Steering Gear Assembly

RACK AND PINION ASSEMBLY

1. Apply a liberal amount of EP grease to the teeth of the rack (2), then slide the rack through the bushing (17) and housing (1) **(Figure 7-16, Page 7-8)**.

CAUTION

- **In step 2, do not press against the outer race of the bearing.**

2. If the pinion bearing (15) was removed, grease a new bearing before installation. Press the new bearing onto the pinion shaft, and exert all pressure on the inner race. Then install the C-type stop ring (16). **See preceding CAUTION.**
3. Install the pinion (3) and bearing (15) assembly into the housing (1). Ensure the gear teeth in the rack (2) will mesh with the gear teeth on the pinion. It may be necessary to rotate the rack slightly and lightly tap the pinion-bearing assembly with a rubber mallet. **See following CAUTION.**

CAUTION

- **Do not force the pinion-bearing assembly into the housing. The gear teeth or the small bearing could be damaged.**

4. Install the snap ring (4).
5. Use a socket to apply pressure evenly, and press in a new dust seal **(Figure 7-17, Page 7-9)**.

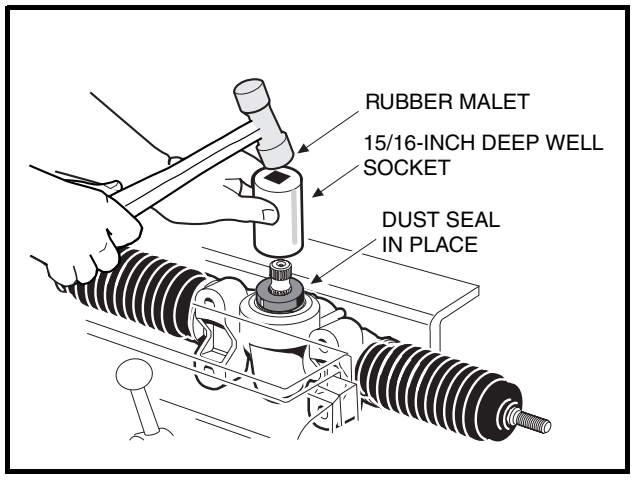


Figure 7-17 Press In Dust Seal

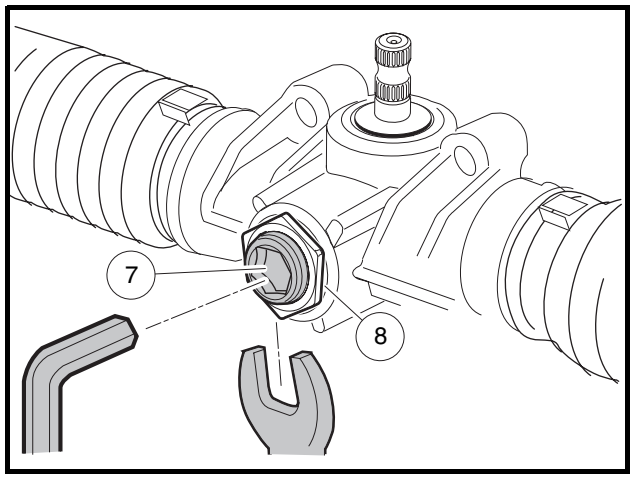


Figure 7-18 Rack and Pinion Adjustment

6. Apply a small amount of grease to the rack guide (5) where it contacts the rack (2) **(Figure 7-16, Page 7-8)**.
7. Install the ball joints (9) onto the rack (2). Secure the rack in a vise with wood blocks between the rack and the jaws of the vise to protect the rack from damage, and tighten the ball joints to 60 ft-lb (81 N·m) **(Figure 7-20, Page 7-10)**.
8. Tap a flange into the notch on the rack.
9. Place a few drops of Loctite 222 on the threads of the screw (7) **(Figure 7-18, Page 7-9)**.

Rack and Pinion Assembly, Continued:

10. Install the rack guide (5), pressure spring (6), and screw (7). Thread-in the screw until it bottoms out, and then unscrew it 1/4 turn **(Figure 7-16, Page 7-8)**.

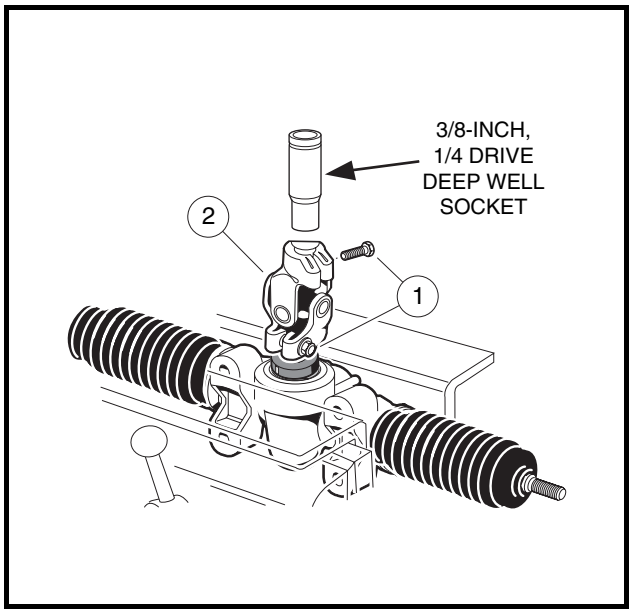


Figure 7-19 Adjust Rack and Pinion Resistance

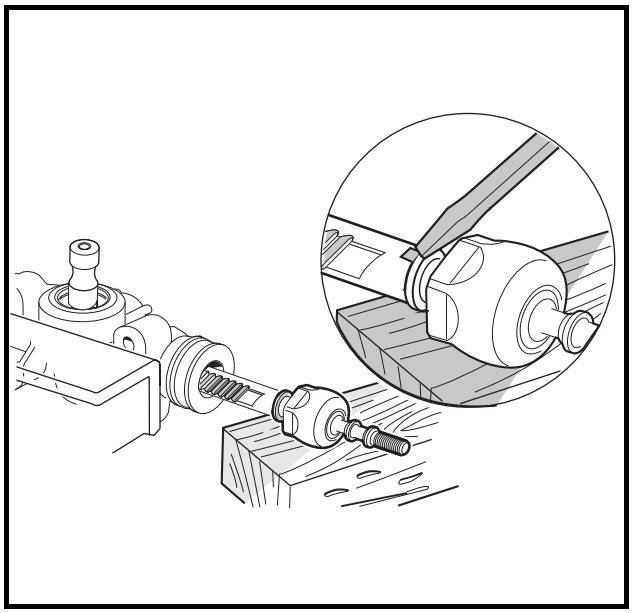


Figure 7-20 Install Inner Ball Joint

11. Insert a 3/8-inch, 1/4-drive deep-well socket into the steering column end of the universal joint (2), and tighten the bolts (1) to 15 ft-lb (20.3 N·m) **(Figure 7-19, Page 7-10)**.

12. Connect a torque wrench to the 3/8-inch deep-well socket, and measure the resistance of the rack and pinion. Rotational resistance should measure 7 to 15 in-lb (0.8 to 1.7 N·m).

13. If the measured resistance is not 7 to 15 in-lb (0.8 to 1.7 N·m), adjust the screw (7) until the setting is correct. Tighten the nut (8) to 28 ft-lb (38 N·m) **(Figure 7-18, Page 7-9)**. **See following NOTE.**

NOTE: *When the nut (8) is tightened, make sure the screw (7) adjustment does not change* ***(Figure 7-18, Page 7-9)****.*

14. Install the two dust seal bellows (10) **(Figure 7-9, Page 7-5)**.

15. Secure the bellows with new bellows clamps or wire ties.

16. Apply a light coat of anti-seize lubricating compound to the inner ball joint threads to minimize corrosion.

17. Loosely install and advance the two nuts and drag links to the inner ball joint **(Figure 7-8, Page 7-5)**. Nuts will be tightened during the toe-in adjustment procedure. **See Toe-in Measurement on page 7-11.**

18. Apply a light coat of anti-seize lubricating compound to the drag link threads.

19. Loosely install the two nuts and drag link ball joints. Advance the ball joints and nuts onto the drag link ends **(Figure 7-7, Page 7-5)**. Nuts will be tightened during the toe-in adjustment procedure. **See Toe-in Measurement on page 7-11.**

20. Install the rack and pinion assembly. **See Rack and Pinion Installation on page 7-4.**

FRONT SUSPENSION

See General Warning, Section 1, Page 1-1.

WHEEL ALIGNMENT

Wheel alignment consists of adjusting the toe-in and camber of the front wheels. **See Toe-in Measurement on page 7-11. Also See Camber Measurement on page 7-12.** Always adjust the toe-in first, and then adjust the camber. **See following NOTE.**

NOTE: *Before any front suspension adjustments are made, inspect components for wear or damage and repair or replace as necessary.*

Toe-in Measurement

1. On a level surface, roll the vehicle forward, then stop. Make sure the front wheels are pointed straight ahead. **See following NOTE.**

NOTE: *Do not turn the steering wheel again during this procedure.*

2. Mark each front tire at the center of the tread face that is facing the rear of the vehicle. The marks should be at the same height as the center of each hub. Measure the distance between the marks.
3. Roll the vehicle forward one-half wheel revolution until the marks appear on the forward facing surfaces of the tires at the same height as the center of each hub. Measure the distance between the marks **(Figure 7-21, Page 7-11)**. **See following NOTE.**

NOTE: *The front measurement must be less than the rear measurement.*

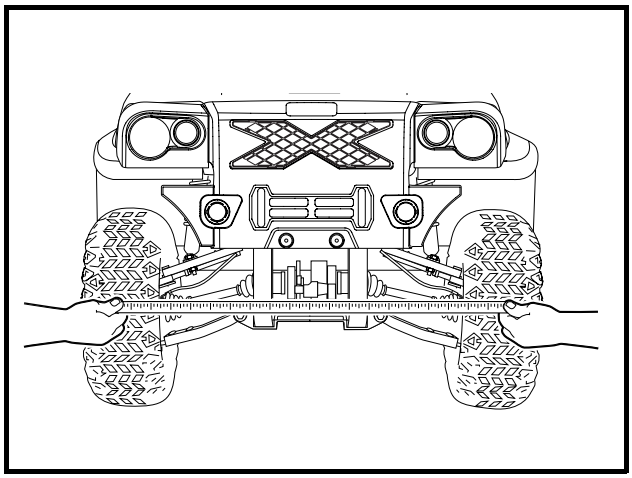


Figure 7-21 Measure Toe-in

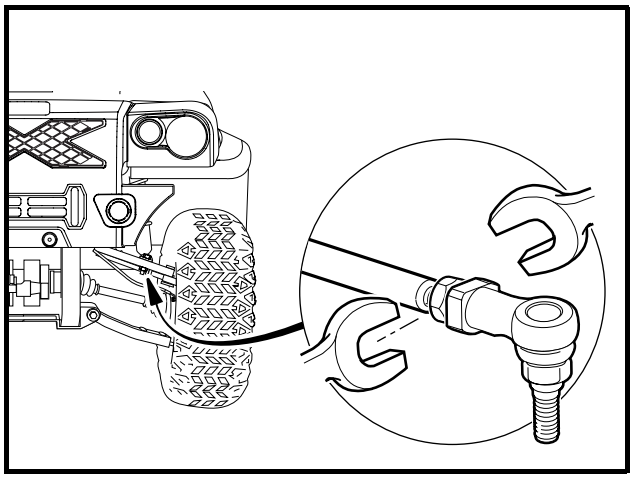


Figure 7-22 Adjust Toe-in

4. Subtract the front face tire measurement from the rear face tire measurement. Proper toe-in is 7/32-inch (5.3 mm) ± 7/32-inch (5.3 mm).

Toe-in Adjustment

1. Loosen the jam nuts on both ends of each drag link **(Figure 7-22, Page 7-11)**.
2. Rotate both of the drag links equally. To increase the toe-in, rotate both drag links counterclockwise. To decrease the toe-in, rotate both drag links clockwise. Maintain an equal distance from the ball joint to the end of the threads on each drag link **(Figure 7-23, Page 7-12)**.
3. Tighten the jam nuts to 21 ft-lb (28 N·m).

4. Check the toe-in, and repeat the adjustment procedure if necessary.
5. After the toe-in adjustment is complete, the steering wheel should be at the center of its travel. If not, remove and correct the position so it is as close to center as possible. **See Steering Wheel Installation on page 7-2.**

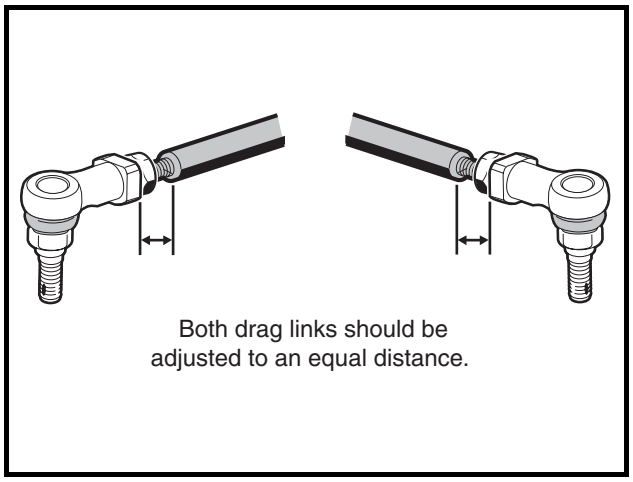


Figure 7-23 Adjust Both Drag Links

Camber Measurement

1. On a level, hard, and smooth surface roll the vehicle forward, then stop. Make sure the front wheels are pointed straight ahead. **See following NOTE.**

NOTE: *Do not turn the steering wheel again during this procedure.*

2. Use a large carpenter's square and position it a few inches (cm) away from the center of one wheel **(Figure 7-24, Page 7-13)**.
3. Measure distance (A) between the edge of the square and a top location on the inside bead of the wheel rim. Record that measurement. **See following NOTE.**

NOTE: *Do not measure against the wheel rim edge or tire sidewall. Both of these can have variations in their surfaces that will result in inaccurate dimensions.*

4. Measure distance (B) in the same method as distance (A), using the same reference on a bottom location on the inside bead of the wheel. Record that measurement. **See following NOTE.**

NOTE: *If dimension (A) is greater that dimension (B), the camber is negative. A positive camber dimension is desirable, with dimension (A) being less than dimension (B).*

5. The camber for this vehicle should be from zero to 0.275 inch (7.0 mm) maximum. **See following NOTE.**

NOTE: *A good average dimension for this specification is 5/32-inch (4 mm) camber on each wheel.*

Camber Adjustment

1. Locate the bolts that secure the flat camber adjustment bar in position at the underside of the lower A-arm. Loosen the bolts just enough to allow the bar to move with some resistance **(Figure 7-25, Page 7-13)**.

2. Insert the cam tool (CCI P/N 102447101) into the adjustment slot on the lower A-arm assembly.
3. Rotate the cam tool to adjust the bar until the desired dimension is achieved and the camber position is positive.
4. Tighten the camber adjustment bar bolts to 53 ft-lb (72 N·m).
5. Check the measurement on the camber, and repeat steps 1 through 4 if necessary.
6. Repeat steps 1 through 5 for the remaining front wheel.

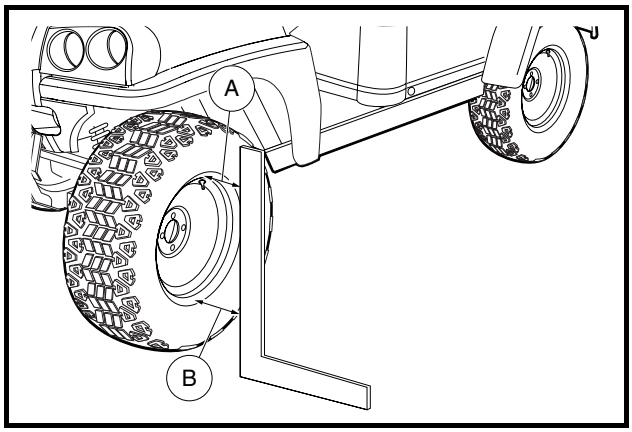


Figure 7-24 Measure Camber

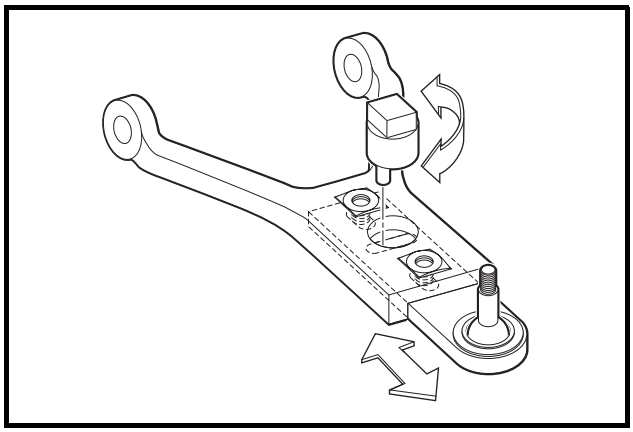


Figure 7-25 Adjust Camber

FRONT SUSPENSION COMPONENTS

See General Warning, Section 1, Page 1-1.

STEERING UPRIGHT REMOVAL

1. Chock the rear wheels, set the park brake, loosen the front wheel lug nuts, and lift the front of the vehicle with a chain hoist or floor jack. **See WARNING "Lift only one end..." in General Warning, Section 1, Page 1-2**.
2. Loosen the front wheel spindle nut.
3. Place jack stands under the outer front frame beams, and lower the vehicle onto the stands. **See Figure 6-2, Section 6, Page 6-6.**
4. Remove the front tire and wheel.
5. Remove the front brake caliper. **See Front Brake Pad and Caliper Removal, Section 6, Page 6-5.**
6. Rest the brake caliper on the A-arm. Ensure that there is no strain on the brake hose. **See following WARNING.**

⚠ WARNING

- **Strain on the brake hose or the brake hose fittings can result in damage to the line or fittings and cause a leak in the hydraulic system, diminished brake performance, or brake failure.**

Steering Upright Removal, Continued:

7. Remove the drag link ball joint from the upright assembly **(Figure 7-26, Page 7-14)**.

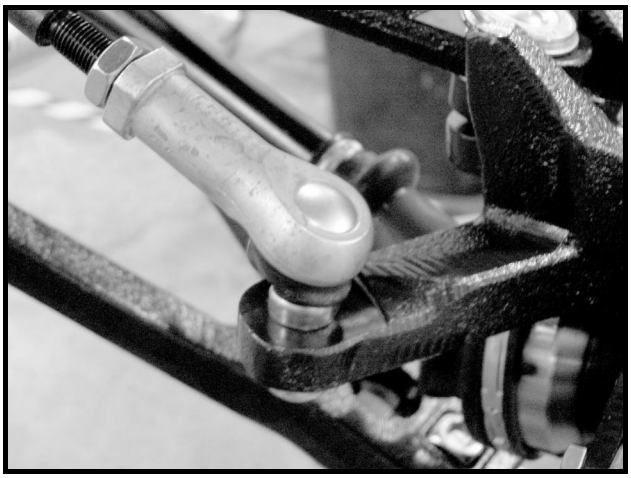


Figure 7-26 Drag Link Ball Joint

8. Remove the axle spindle locknut that secures the wheel hub, disc, and upright.
9. Remove the lower and upper ball joint locknut.
10. Swing the lower A-arm down, and separate the brake rotor and upright from the half-shaft and the upper ball joint.

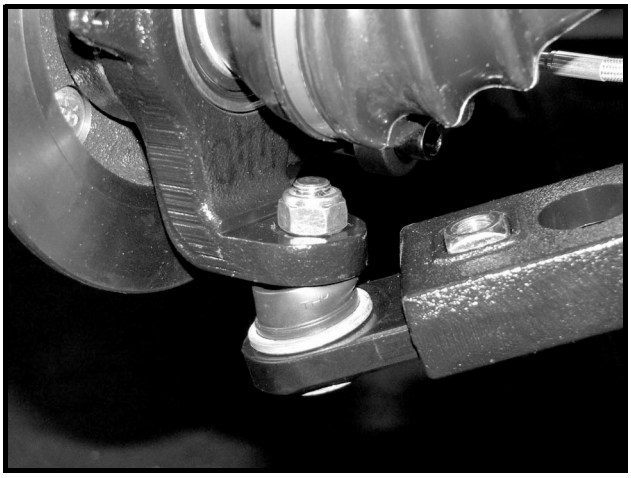


Figure 7-27 Lower Ball Joint

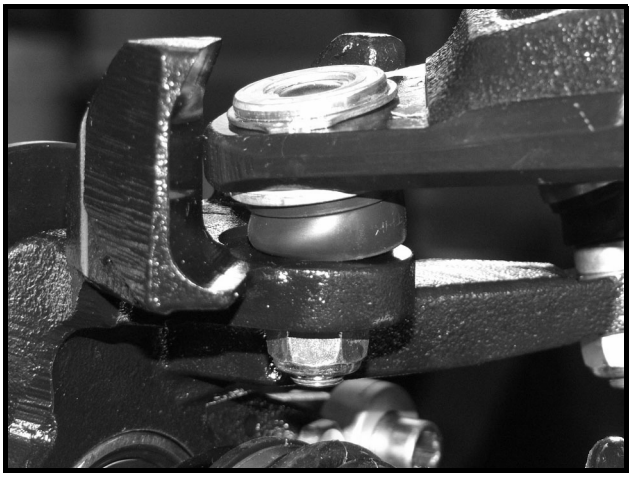


Figure 7-28 Upper Ball Joint

11. Repeat steps 5 through 10 for the remaining front wheel if necessary.

UPPER A-ARM REMOVAL

1. Chock the rear wheels, set the park brake, loosen the front wheel lug nuts, and lift the front of the vehicle with a chain hoist or floor jack. **See WARNING "Lift only one end..." in General Warning, Section 1, Page 1-2**.

2. Place jack stands under each end of the floorboard crossmember and lower the vehicle onto the stands **(Figure 7-34, Page 7-18)**.
3. Remove the front tire and wheel.
4. Remove the brake line bracket from the A-arm.
5. Remove the shock absorber.
   5.1. Remove the bolt from the bottom mount of the shock absorber, and remove the shock absorber from the A-arm .**See following NOTE.**

NOTE: *It may be necessary to place a floor jack under the A-arm assembly and raise it slightly to relieve pressure from the bottom shock absorber bolt.*

6. Remove the nut from the ball joint **(Figure 7-28, Page 7-14)**.
7. Remove the front and rear bolts, washers, and flanged locknuts from the A-arm and frame.
8. Remove the A-arm from the frame and bushings.

Figure 7-29 Upper Front A-Arm Attachment

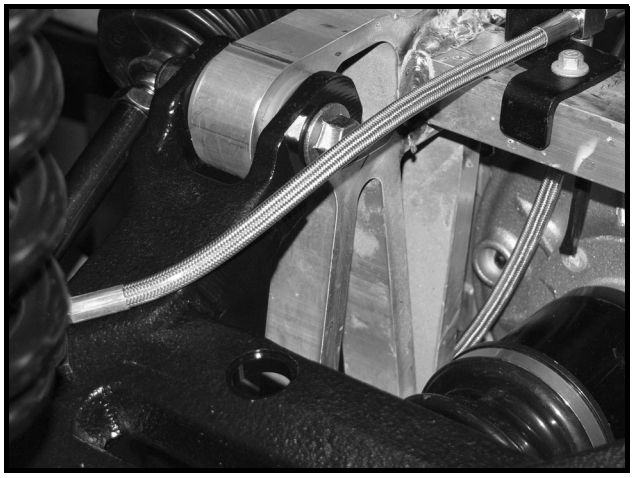


Figure 7-30 Upper Rear A-Arm Attachment

Upper Ball Joint Removal

1. Inspect the ball joint. Replace the ball joint if it is worn, loose, or the rubber boot has been damaged.
   1.1. Remove the C-clip from the top of the ball joint.
   1.2. Push or drive-out the ball joint on the threaded shaft side. **See following NOTE.**

NOTE: *The ball joint is press-fit and secured with 641 Loctite and requires approximately 250 lb. (113.4kg) of force to press it from the casting.*

2. Repeat step 1 for the remaining side if necessary.

Upper Ball Joint Installation

1. Apply a 1/8 inch (3.2 mm) wide bead of Loctite 641 all the way around the face of the ball joint. Once the Loctite is applied, slide the ball joint into the upper control arm. Make sure the ball joint is seated up to the shoulder, and wipe off any excess Loctite.
2. Install the C-clip. Verify that the C-clip is seated in the groove of the ball joint.
3. Allow the Loctite to set up for at least 20 minutes before assembling the front suspension. **See following NOTE.**

NOTE: *The Loctite 641 will set in 20 minutes, thus allowing the vehicle to be driven, and will be completely cured in 24 hours.*

Figure 7-31 Ball Joint C-Clip

UPPER A-ARM INSTALLATION

1. Install a new ball joint if necessary. **See Upper Ball Joint Installation on page 7-15.**
2. Install new A-arm frame bushings. **See following NOTE.**

NOTE: *The urethane bushings fit tightly. It may be necessary to press them into place. Use the assembly bolts and large flat washers to draw the bushings together in the frame brackets.*

3. Slide the A-arm over the frame bushings, and locate the bolt alignment.
4. Install new bolts, washers, and new flanged locknuts in both the front and rear frame attachments. Tighten the hardware to 40 ft-lb (54 N·m).
5. Secure the brake line bracket to the A-arm, and tighten the hardware to 11 ft-lb (15 N·m).
6. Repeat steps 1 through 5 for the remaining side if necessary.
7. Align the front wheels, and adjust the toe-in and the camber. **See Wheel Alignment on page 7-11.**

LOWER A-ARM REMOVAL

1. Chock the rear wheels, set the park brake, loosen the front wheel lug nuts, and lift the front of the vehicle with a chain hoist or floor jack. **See WARNING "Lift only one end..." in General Warning, Section 1, Page 1-2**.
2. Place jack stands under each end of the floorboard crossmember and lower the vehicle onto the stands **(Figure 7-34, Page 7-18)**.
3. Remove the front tire and wheel.
4. Remove lower ball joint nut and separate lower ball joint from upright.
5. Remove the bolt, washer, and flanged locknut from the lower A-arm and frame.
6. Remove the A-arm from the frame and the bushings.

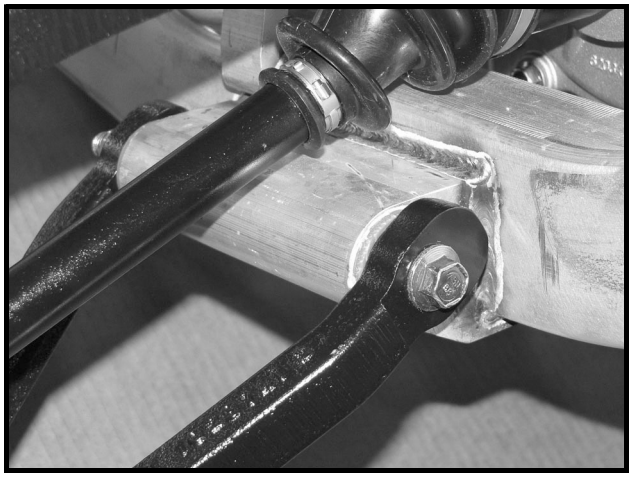


Figure 7-32 Lower A-Arm Attachment

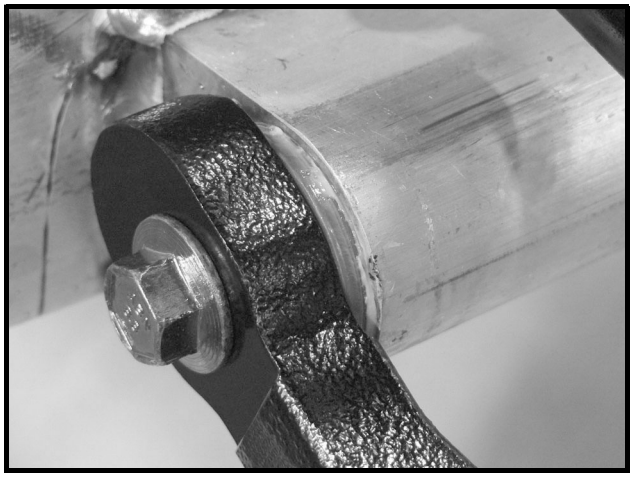


Figure 7-33 A-Arm Frame Bushings

Lower Ball Joint Removal

1. Inspect the ball joint. Replace the ball joint if it is worn, loose, or if the rubber boot is damaged.
   1.1. Remove the C-clip from the ball joint.
   1.2. Push or drive-out the ball joint on the threaded shaft side. **See following NOTE.**

NOTE: *The ball joint is press-fit and secured with 641 Loctite and requires approximately 250 lb. (113.4kg) of force to press it from the casting.*

Do not loosen, adjust, or remove the adjustable plate that secures the lower ball joint unless it must be replaced. If the adjustment plate is replaced, loosened, or moved, the camber adjustment must be re-aligned.

2. Repeat step 1 for the remaining side if necessary.

Lower Ball Joint Installation

1. Apply a 1/8 inch (3.2 mm) wide bead of Loctite 641 all the way around the face of the ball joint. Once the Loctite is applied, slide the ball joint into the lower control arm slide adjuster. Make sure the ball joint is seated up to the shoulder, and wipe off any excess Loctite.
2. Install the C-clip. Verify that the C-clip is seated in the groove of the ball joint.
3. Allow the Loctite to set up for at least 20 minutes before assembling the front suspension. **See following NOTE.**

NOTE: *The Loctite 641 will set in 20 minutes, thus allowing the vehicle to be driven, and will be completely cured in 24 hours.*

4. Repeat steps 1 through 3 for the remaining side if necessary.

LOWER A-ARM INSTALLATION

1. Install a new ball joint if necessary. **See Lower Ball Joint Installation on page 7-17.**
2. Install new A-arm frame bushings **(Figure 7-33, Page 7-17)**. **See following NOTE.**

NOTE: *The urethane bushings fit tightly. It may be necessary to press them into place. Use the assembly bolts and large flat washers to draw the bushings together in the frame brackets.*

3. Slide the A-arm over the frame bushings, and locate the bolt alignment.

4. Install a new bolt, washer, and new flanged locknut. Tighten the hardware to 110 ft-lb (148 N·m), applying torque to the bolt side.
5. Repeat steps 1 through 4 for the remaining side if necessary.
6. Align the front wheels, and adjust the toe-in and the camber. **See Wheel Alignment on page 7-11.**

FRONT COIL-OVER SHOCK ABSORBER REMOVAL

The vehicles are equipped with front coil-over shock absorbers.

1. Chock the rear wheels, and set the park brake. Loosen the lug nuts on both front wheels, and lift the front of the vehicle with a chain hoist or floor jack. **See WARNING "Lift only one end..." in General Warning, Section 1, Page 1-2.**
2. Place jack stands under each end of the floorboard crossmember and lower the vehicle onto the stands **(Figure 7-34, Page 7-18)**.
3. Remove the lug nuts, and remove the tires and wheels.
4. Place a floor jack under the lower A-arm at the lower ball joint, and raise the jack just enough to allow the A-arm assembly to rest on the jack.
5. Remove the flange-head bolt. Separate the bottom of the shock absorber from the top A-arm assembly **(Figure 7-35, Page 7-19)**.
6. Remove the bolt and flanged locknut from the top of the shock mount. Remove the shock absorber.
7. Repeat steps 3 through 6 for the remaining shock absorber.

Figure 7-34 Jack Stand Placement

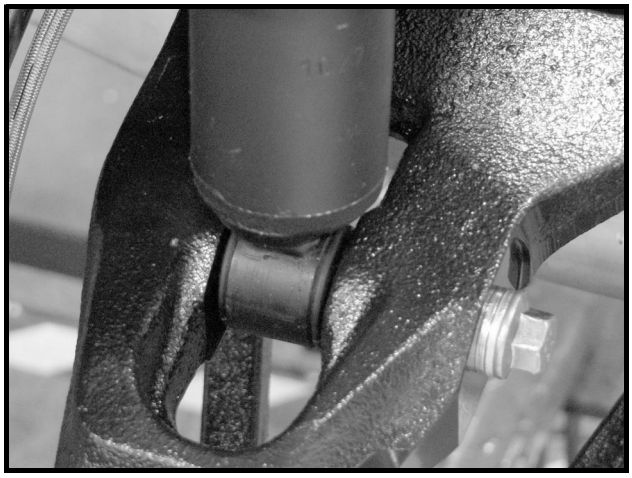


Figure 7-35 Front Shock Bottom Mount

Figure 7-36 Front Shock Top Mount

FRONT COIL-OVER SHOCK ABSORBER INSTALLATION

The vehicles are equipped with coil-over shock absorbers. **See following NOTE.**

NOTE: *When front shock absorbers are installed, ensure both front shock absorbers have identical part numbers.*

1. Install the top of the shock mount on the vehicle frame with a bolt and flange-head locknut. Tighten the hardware to 62 ft-lb (84 N·m) **(Figure 7-36, Page 7-19)**.
2. Install the bottom of the shock mount on the upper A-arm with a new flange-head bolt. Tighten the hardware to 62 ft-lb (84 N·m) **(Figure 7-35, Page 7-19)**.
3. Remove the floor jack.
4. Install the front tire and wheel. Finger-tighten the lug nuts.
5. Raise the vehicle, and remove the jack stands.
6. Tighten the lug nuts to 87 ft-lb (118 N·m).
7. Repeat steps 1 through 6 for the remaining shock absorber.

STEERING UPRIGHT INSTALLATION

1. Slide the upright and wheel hub assembly onto the splined half shaft spindle. **See following NOTE.**

NOTE: *Apply a small amount of anti-seize compound to the splined front spindle before it is installed.*

2. Loosely secure a large flat washer and new locknut to the spindle.
3. Install the lower ball joint onto the upright lower tab **(Figure 7-27, Page 7-14)**.
4. Install a new locknut, and tighten the hardware to 18 ft-lb (24 N·m).
5. Install the upper ball joint on the upright upper tab **(Figure 7-28, Page 7-14)**.
6. Install a new locknut, and tighten the hardware to 18 ft-lb (24 N·m).
7. Install the drag link ball joint on the tab **(Figure 7-26, Page 7-14)**.
8. Secure the top end of the shock absorber to the frame with a new flanged bolt and a new locknut. Tighten the bolt to 73 ft-lb (99 N·m).
9. Secure the bottom end of the shock absorber to the A-arm with new flanged bolt. Tighten the hardware to 85 ft-lb (115 N·m).

10. Install the caliper assembly on the upright with new lock-patch hex head bolts, and tighten the hardware to 36 ft-lb (49 N·m). **See Front Brake Pad and Caliper Installation, Section 6, Page 6-7.**
11. Install the tire and wheel, and finger-tighten the lug nuts.
12. Lower the vehicle.
13. Tighten the lug nuts to 85 ft-lb (115 N·m).
14. Tighten the spindle nut and washer to 150 ft-lb (203 N·m).
15. Align the front wheels, and adjust the toe-in and the camber. **See Wheel Alignment on page 7-11.**

SECTION 8 – WHEELS AND TIRES

⚠ DANGER

- **See General Warning, Section 1, Page 1-1.**

⚠ WARNING

- **See General Warning, Section 1, Page 1-1.**

GENERAL INFORMATION

These vehicles are equipped with either all-terrain or mud tires. The same size tire is used for the front and rear. **See Section 2b – Vehicle Specifications: Kawasaki Gas & Kubota Diesel Powered. See following WARNING.**

⚠ WARNING

- **The diameter of all tires on the vehicle must be equal, otherwise the all-wheel drive system will not operate as intended and could result in severe personal injury or death. Never install tires of different diameters on the vehicle.**

The mud tread design is directional and the tires are mounted on the wheels with regard to which side of the vehicle they will be used on. The arrow molded on the sidewall indicates designed rotation when vehicle is moving forward **(Figure 8-1, Page 8-1)**.

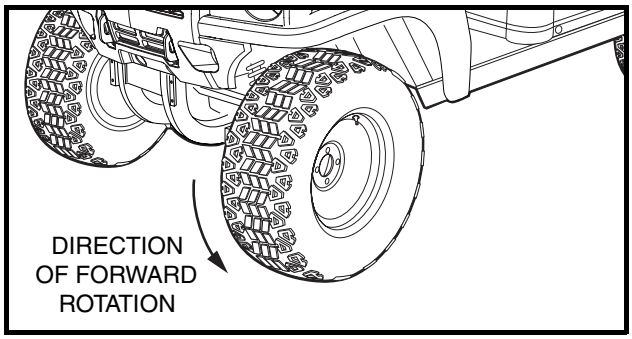


Figure 8-1 Tire Rotation

The wheels for this vehicle are designed for very rough terrain. They are not interchangeable with any other similar wheel designs used on other utility vehicles offered by this manufacturer.

- Keep tires properly inflated as follows:

All-terrain tread	20 - 22 psi (1.38 - 1.52 Bars)
Mud tread	20 - 22 psi (1.38 - 1.52 Bars)

- Keep lug nuts properly tightened to 85 ft-lb (115 N·m).
- Keep the front end properly aligned and adjusted.
- Inspect the brake hoses at all four wheels. The hoses should not come in contact with any component.

- Check the park brake cables. The cables should not come in contact with the tires or wheels.

NOTE: *Small holes in the tire can be plugged with a standard automotive tubeless tire repair kit available at auto supply stores.*

Tires must be removed and installed from the valve stem side of the rim.

WHEELS

See General Warning, Section 1, Page 1-1.

WHEEL REMOVAL

1. Loosen the lug nuts on the wheel to be removed.
2. Raise the end of the vehicle from which the wheel is to be removed and support vehicle with jack stands. Make sure the wheels are off the ground. **See WARNING "When servicing the vehicle with part of the vehicle on jack stands..." and "Lift only one end of the vehicle..." in General Warning, Section 1, Page 1-1.**
3. Remove the lug nuts and remove the wheel.

WHEEL INSTALLATION

1. Install the wheel(s) and use a crisscross pattern to tighten the lug nuts until they are snug. **See following NOTE.**

NOTE: *Mud tires are directional. For optimum performance on muddy terrain, install all four tires as shown* ***(Figure 8-1, Page 8-1)****.*

2. Lower the vehicle and use a crisscross pattern to finish tightening the lug nuts to 85 ft-lb (115 N·m).
3. Inspect the brake hoses at the front wheels. When the steering wheel is turned all the way from left to right and back again, the hoses should not come in contact with any component, especially the wheels or tires.
4. Check the park brake cables. The cables should not come in contact with either of the rear wheels or tires.

TIRES

See General Warning, Section 1, Page 1-1.

TIRE REMOVAL

NOTE: *Tires must be removed and installed from the valve stem side of the rim.*

1. Remove the tire and wheel assembly from the vehicle. **See Wheel Removal on page 8-2.**
2. Remove the valve cap and valve core and allow air to escape from the tire.
3. Use a tire machine to remove the tire from the wheel.

TIRE INSTALLATION

1. Use a tire machine to install the new tire on the wheel. **See following NOTE.**

NOTE: *When installing mud tires, determine which side of the vehicle they will be used on. The arrow molded on the sidewall indicates designed rotation when vehicle is moving forward* ***(Figure 8-1, Page 8-1)****.*

2. Install the valve core.
3. On sidewall of tire, locate the maximum pressure allowed to seat the bead of the tire and inflate to seat tire on wheel. Do not exceed pressure noted on sidewall. **See following DANGER.**

⚠ DANGER

- **Over pressurizing the tire can cause the tire to explode or come off wheel.**
- **Do not exceed maximum pressure noted on sidewall of tire.**

4. Adjust the air pressure in the tire to the recommended pressure and immerse the wheel and tire assembly in water to make sure there are no leaks. **See General Information on page 8-1.**
5. Install the valve cap.
6. Install the wheel. **See Wheel Installation on page 8-2.**

SECTION 9 – REAR SUSPENSION

⚠ DANGER

- **See General Warning, Section 1, Page 1-1.**

⚠ WARNING

- **See General Warning, Section 1, Page 1-1.**

REAR COIL-OVER SHOCK ABSORBER

See General Warning, Section 1, Page 1-1.

The vehicles are equipped with rear coil-over shock absorbers. Standard models are equipped with rear shock absorbers and coil-over springs designed for standard-duty service. Heavy-duty rear shock absorbers and coil-over springs are available as an option for heavy-duty service. Unlike the front shock absorbers and coil-over springs, the rear standard-duty and heavy-duty shock absorbers are designed differently. **See following NOTE.**

NOTE: *The standard-duty and heavy-duty rear shock absorber bodies look identical, but they are different in design internally.*

The part number for standard-duty rear shock absorbers is different than the part number for heavy-duty rear shock absorbers. Ensure that the correct rear shock absorbers and coil-over springs are used for the vehicle's load service option when the rear shock absorbers are removed and replaced.

Rear Shock Absorber Removal

1. Chock the front wheels, and loosen both rear wheel lug nuts. Lift the rear of the vehicle with a chain hoist or floor jack. **See WARNING "Lift only one end..." in General Warning, Section 1, Page 1-2.**
2. Place jack stands under the rear portion of the frame tubes, and lower the vehicle onto the stands **(Figure 9-1, Page 9-2)**.
3. Remove the lug nuts from the wheels, and remove the tires and wheels.
4. Position the floor jack under the center of the hitch frame, and raise the jack arm until the pad touches the hitch frame.
5. Remove the hydraulic line rubber grommet from the brake line bracket **(Figure 9-2, Page 9-2)**.
6. Remove the bottom bolt, flat washer, and flanged locknut.
7. Remove the top bolt, flat washer, and flanged locknut.
8. Remove the coil-over shock absorber. **See following NOTE.**

NOTE: *Note the adjustment position of the coil-over spring. New coil-over shock absorbers should be adjusted to the same position coil spring location as the previous shock absorbers.*

Use the adjustment position of the existing shock absorbers as a reference.

9. Repeat steps 5 through 8 for the remaining shock absorber.

Rear Shock Absorber Removal, Continued:

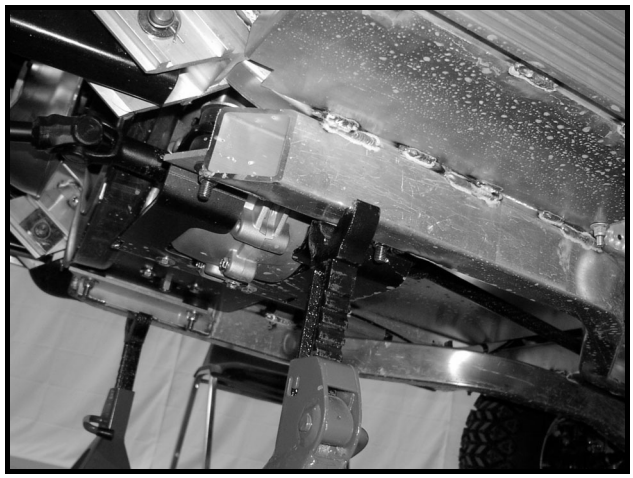


Figure 9-1 Locate Rear Jack Stands

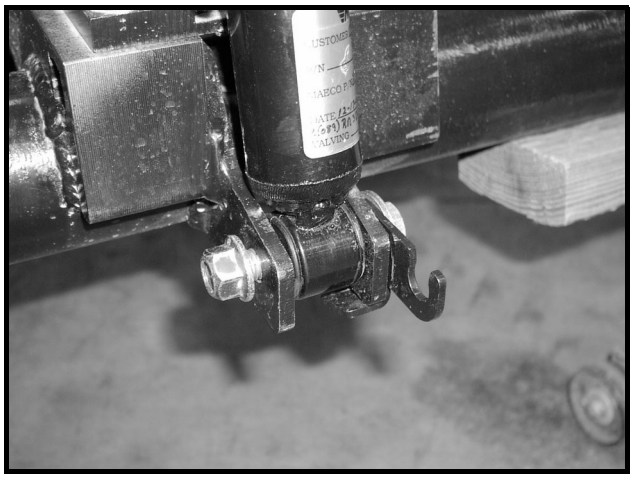


Figure 9-2 Remove Lower Driver-Side Shock Bolt

Rear Shock Absorber Installation

Ensure that the adjustment position of the coil spring on the new shock absorber is the same as the previous shock absorber. Use the adjustment position on the coil spring from the previous shock absorbers as a reference. **See following NOTE.**

NOTE: *When shock absorbers are installed, ensure both shock absorbers have identical part numbers.*

1. Install the top bolt, flat washer, and a new locknut. Tighten the hardware to 73 ft-lb (99 N·m).
2. Secure the bottom of the shock mount to the driver side axle frame bracket with a bolt, flat washer, rubber grommet bracket, and a new locknut. Tighten the hardware to 73 ft-lb (99 N·m).
3. Install the hydraulic line rubber grommet in the shock bracket.
4. Install the rear tire and wheel. Finger-tighten the lug nuts.
5. Repeat steps 1 through 4 for the remaining rear coil spring and shock.
6. Raise the vehicle, and remove the jack stands.
7. Lower the floor jack from the hitch frame.
8. Tighten the lug nuts on both wheels to 85 ft-lb (115 N·m).

SWING ARMS

See General Warning, Section 1, Page 1-1.

SWING ARM REMOVAL

1. Remove the rear axle. **See Rear Axle Removal, Section 14, Page 14-8.**
2. Remove the rue pin, locknut and washer from the swing arm pivot bolt **(Figure 9-3, Page 9-3)**.
3. Remove the swing arm bolt and grease fitting **(Figure 9-4, Page 9-3)**. **See following NOTE.**

NOTE: *Do not hammer against the threaded end of the swing arm bolt.*

4. Remove the swing arm.

Figure 9-3 Swing Arm Bolt, Nut and Rue Pin

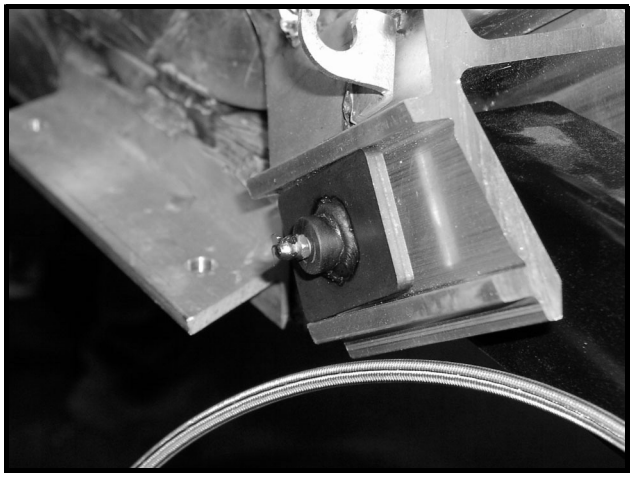


Figure 9-4 Swing Arm Bolt Grease Fitting

5. Remove the urethane bushings and teflon impregnated steel sleeves from the swing arms.
6. Remove the urethane bushings from the swing arm brackets on the frame.

SWING ARM INSTALLATION

1. Replace the urethane bushings in the swing arm brackets on the frame.
2. Install new teflon impregnated steel sleeves into new swing arm urethane bushings.
3. Install the urethane bushings and teflon impregnated sleeves (as an assembly) into the swing arms.

NOTE: *The urethane bushings fit tight. Use a heavy soap compound, light grease, or STP oil treatment on the outside surface of the urethane bushings to reduce friction during installation.*

4. Position the swing arm between the frame brackets and bracket bushings with the axle pad face down. Slide the swing arm pivot bolt into place with the grease pin to the inside of the vehicle frame **(Figure 9-4, Page 9-3)**. **See following NOTE and CAUTION**.

NOTE: *It may be necessary to tap the bolt into place. If so, remove the grease fitting before tapping or hammering the bolt end.*

CAUTION

- **Do not hammer or drive against the grease fitting.**

5. Install the washer and locknut on the pivot bolt and tighten to 14 ft-lb (18 N·m) **(Figure 9-3, Page 9-3)**.
6. Attach a new rue pin to the pivot bolt.
7. Install the rear axle. **See Rear Axle Installation, Section 14, Page 14-10.**

SECTION 10A – PERIODIC MAINTENANCE: HONDA GASOLINE & KUBOTA DIESEL POWERED VEHICLES

⚠ DANGER

- **See General Warning, Section 1, Page 1-1.**

⚠ WARNING

- **See General Warning, Section 1, Page 1-1.**

PERIODIC SERVICE SCHEDULE

See General Warning, Section 1, Page 1-1.

⚠ WARNING

- **Service, repairs, and adjustments must be made per instructions in this maintenance and service manual.**

NOTE: *If the vehicle is constantly subjected to heavy use or severe operating conditions, the preventive maintenance procedures should be performed more often than recommended in the Periodic Service and Lubrication Schedule.*

Both the Periodic Service Schedule and the Periodic Lubrication Schedule must be followed to keep the vehicle in optimum operating condition.

PERIODIC SERVICE SCHEDULE

REGULAR INTERVAL	SERVICE	
Daily service by owner or trained technician	Engine	Check engine oil level; add if necessary. **See Engine Oil Level Check on page 10a-8.**
		Diesel vehicles: Check engine coolant; add if necessary. **See Engine Coolant Level Check on page 10a-16.**
		Clean debris from radiator.
	Fuel filters	**Diesel vehicles:** Drain water from fuel filter. **See Draining Water from Fuel Filter on page 10a-17.**
	Brakes	Check brake fluid; add if necessary. Check brake pedal for proper operation. **See Performance Inspection in the vehicle owner's manual.**
	Hydraulic System (IntelliTach vehicle only)	Check hydraulic fluid; add if necessary.

Periodic Service Schedule continued on next page...

PERIODIC SERVICE SCHEDULE

REGULAR INTERVAL	SERVICE	
Monthly service by owner or trained technician	Engine	Check engine circulating air passage; visually inspect unshrouded area around engine exhaust for grass and debris and clean if necessary. **Diesel vehicles:** Check for grass and debris around the radiator.
	Tires	Check air pressure and adjust if necessary. **See Section 8 – Wheels and Tires.**
	Transmission and differentials	Check lubricant levels. Add if necessary. **See Lubrication Level Check for Front Differential, Transmission, and Rear Differential on page 10a-13.**
	General vehicle	Wash engine compartment and underside of vehicle. Do not wash engine when hot.
First adjustment after 20 hours, additional every 100 hours of operation	Engine (Honda)	Adjust valve clearance. **See Honda GX620 Service Manual (CCI P/N 102615401).**
Semiannual service by trained technician only (or every 50 hours of operation, whichever comes first)	Battery	Clean terminals and wash dirt from casing; check electrolyte level. Add distilled water if necessary. **See Battery on page 12b-15 (gasoline vehicles) or Battery on page 12c-21 (diesel vehicles).**
	Front wheel alignment and toe-in	Check and adjust if necessary. **See Wheel Alignment on page 7-11.**
	Electrical wiring and connections	Check for tightness and damage.
	Brake system	Inspect master cylinder, brake lines, and hoses for damage or leakage.
		Check park brake cables for damage; replace if necessary.
		Check brake pads and discs; replace if necessary. **For brake wear-in procedure**, **see Hydraulic Brakes in the Pre-Operation and Daily Safety Checklist in the Owner's Manual.** See also Section 6 – Hydraulic and Park Brake Systems

Periodic Service Schedule continued on next page...

PERIODIC SERVICE SCHEDULE

REGULAR INTERVAL	SERVICE	
Annual service by trained technician only (or every 100 hours of operation, whichever comes first)	Engine	Check for leaks around gaskets, fill plugs, etc.
		Gasoline vehicles: Inspect, clean, and gap spark plug; replace if necessary. See authorized dealer or trained technician for service.
		Diesel vehicles: Check the v-belt for proper tension or damage. Adjust or replace if necessary.
		Diesel vehicles: Change engine coolant. **See Engine Coolant Change on page 15-1.**
	Radiator	**Diesel vehicles:** Check clamps for tightness; check hoses for cracks. Replace if necessary.
	Engine air intake system	Replace air filter element. **See Air Filter Replacement on page 13b-24 (gasoline vehicles) or page 13c-23 (diesel vehicles).**
		Check clamps for tightness; check hose for cracks.
	General vehicle	Check for loose hardware and tighten if necessary.
	Fuel filters	Replace. Dispose of used filters properly.

⚠ WARNING

- **If any problems are found during scheduled inspection or service, do not operate the vehicle until repairs are made. Failure to make necessary repairs could result in fire, property damage, severe personal injury, or death.**

PERIODIC LUBRICATION SCHEDULE

PERIODIC LUBRICATION SCHEDULE

REGULAR INTERVAL	SERVICE	LUBRICATION POINTS	RECOMMENDED LUBRICANT
Gasoline vehicle: First change 20 hours – Diesel vehicle: First change 50 hours – additional change for both every 100 hours of operation or annually, whichever comes first.	Change engine oil and oil filter	1	**Gasoline (Honda engine) vehicles:** 1 qt.and 25 oz. (1.7 L) with filter **Diesel vehicles:** 3 qt. (2.8 L) with filter **See Oil Viscosity on page 10a-12.**
Monthly by owner or trained technician	Driveshaft	2	Chassis Lube (EP NLGI Grade 2)
Semiannually by owner or trained technician (or every 50 hours of operation, whichever comes first)	Check/add brake fluid	3	Use only DOT 5 (silicone) brake fluid
	Rear suspension (2 fittings)	4	Chassis Lube (EP NLGI Grade 2)
	Attachment Arm and Inteface (8 fittings) – IntelliTach vehicle only	5	Chassis Lube (EP NLGI Grade 2)
First change 50 hours – additional change every 100 hours of operation or annually, whichever comes first	Change front differential lubricant	6	5 oz. (150 mL) Mobil 424, Exxon Hydraul 560, or Esso Hydraul 56 lubricant
First change 50 hours – additional change every 300 hours of operation or annually, whichever comes first	Change rear differential lubricant	7	20 oz. (600 mL) Mobil 424, Exxon Hydraul 560, or Esso Hydraul 56 lubricant
	Change transmission lubricant	8	20 oz. (600 mL) Mobil 424, Exxon Hydraul 560, or Esso Hydraul 56 lubricant

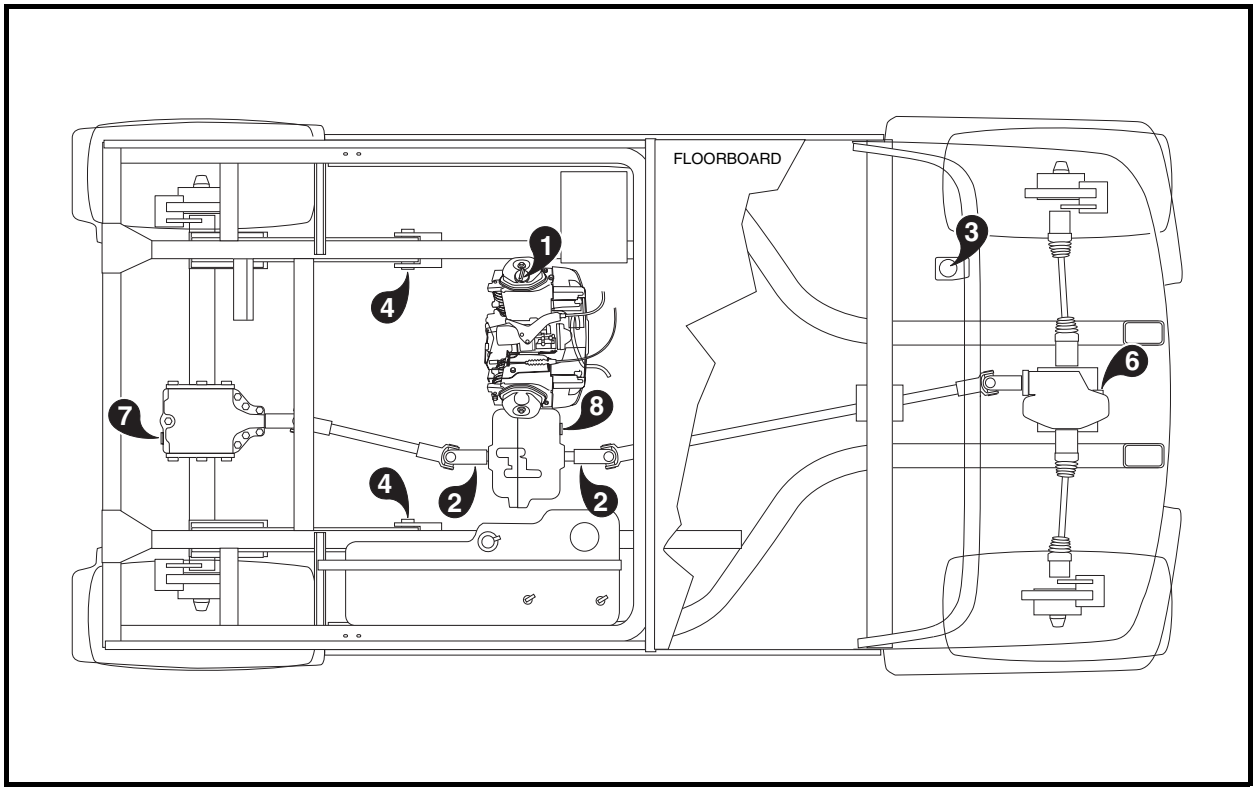


Figure 10a-1 Lubrication Points – Gasoline Vehicles

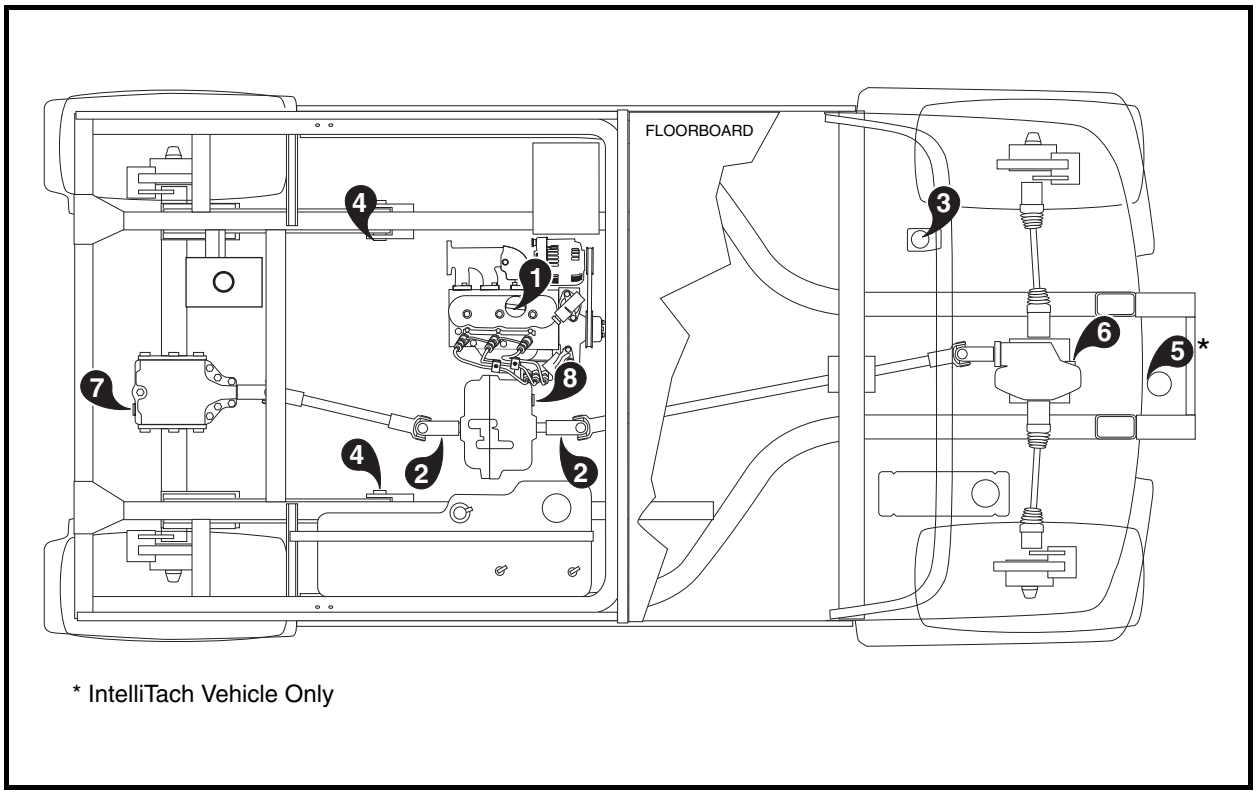


Figure 10a-2 Lubrication Points – Diesel Vehicles

LUBRICATING THE ATTACHMENT ARM AND INTERFACE

Description

Always use a good quality, lithium-based, multi-purpose grease. Apply lubricant until extra grease shows.

Grease the 8 grease fittings every 50 hours of operation, 2 times a year (whichever occurs first) or whenever the attachment arm and interface are removed and reinstalled on the vehicle.

Lubricate the following locations as shown **(Figure 10a-3)**:

1. Attachment Interface Cylinder (both ends).
2. Attachment Arm Pivot - vehicle side (both sides).
3. Attachment Arm Cylinder (both ends).
4. Attachment Arm Pivot - interface side (both sides).

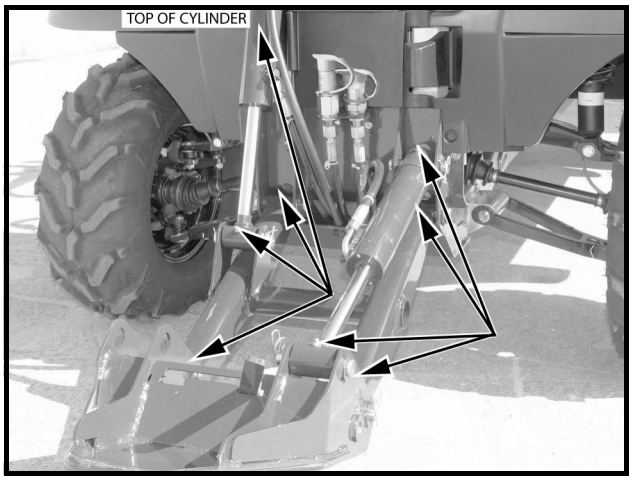


Figure 10a-3 Lubricate Grease Zerks located on Cylinder and Attachment Arm Ends

BRAKE FLUID RESERVOIR

See General Warning, Section 1, Page 1-1.

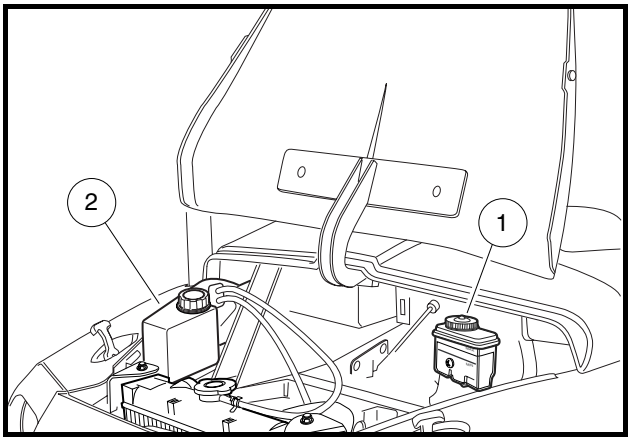


Figure 10a-4 Brake Fluid and Engine Coolant Access

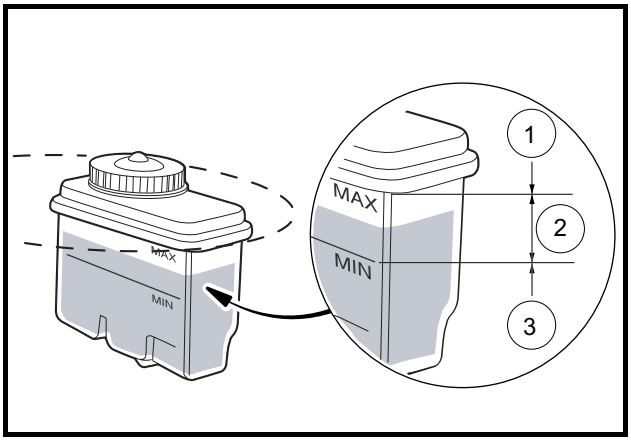


Figure 10a-5 Brake Fluid Reservoir

The brake fluid reservoir (1) is located under the hood **(Figure 10a-4, Page 10a-7)**. Raise the hood to check the brake fluid level.

When checking the brake fluid, also inspect the following:

- The presence of brake fluid on the exterior surface of the master cylinder indicates a leak.
- The brake fluid reservoir diaphragm (located in the cap) should not have holes or other damage.

BRAKE FLUID

Brake fluid level should be within 1/4-inch (6 mm) from the top of the reservoir **(Figure 10a-5, Page 10a-7)**. (Numbered sections indicate: 1 - Full Level, 2 - Safe Level and 3 - Low Level). Also, brake fluid should be clean with no residue in the bottom of the reservoir or other evidence of contamination.

⚠ CAUTION

- **Use only DOT 5 (silicone) brake fluid. Use of any other type brake fluid is not recommended.**

ENGINE OIL

See General Warning, Section 1, Page 1-1.

Even though the low oil warning light on the instrument panel should illuminate if the oil pressure becomes low, the engine oil level should be checked daily. The vehicle should be on a level surface when the oil is checked. Do not overfill with oil.

OIL PRESSURE – GASOLINE ENGINE

The gasoline engine has an oil filter that is mounted on a bracket next to the back side of the front panel. Inlet and outlet oil-carrying hoses enable oil circulation to and from the engine. **See following NOTE.**

NOTE: *The normal oil pressure value stated in the Honda engine manual is 28 psi at idle; however, the remote filter design causes oil pressure to be 18 psi, which is normal for this type of oil circulation design.*

ENGINE OIL LEVEL CHECK

1. Remove the oil level dipstick from the oil filler tube and wipe oil from the dipstick **(Figure 10a-6, Page 10a-8 or Figure 10a-7, Page 10a-8)**. **See following CAUTION.**

⚠ CAUTION

- **Do not remove dipstick while engine is running.**

2. Check oil level by fully inserting the dipstick into the tube and immediately removing it.
3. If the oil level is at or below the low level mark on the dipstick gauge, add oil until the level is between low and full levels (safe level). **See following CAUTION.**

CAUTION

- **Do not fill oil above the full level mark. Doing so will result in decreased engine performance or damage to the engine.**

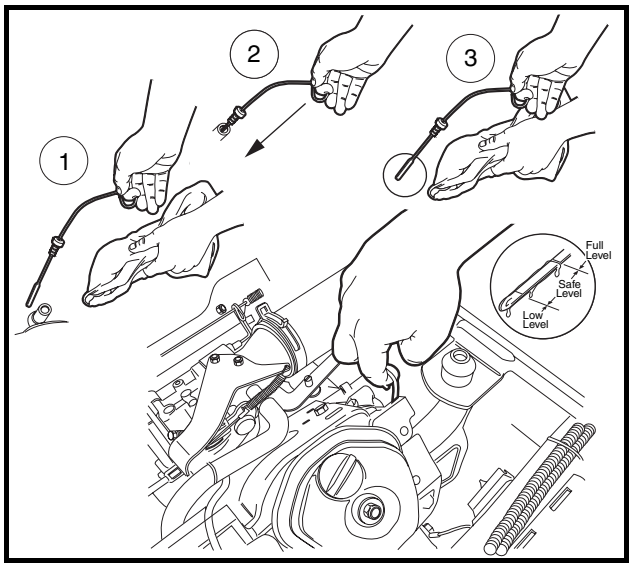


Figure 10a-6 Engine Oil Level Check – Gasoline Vehicles

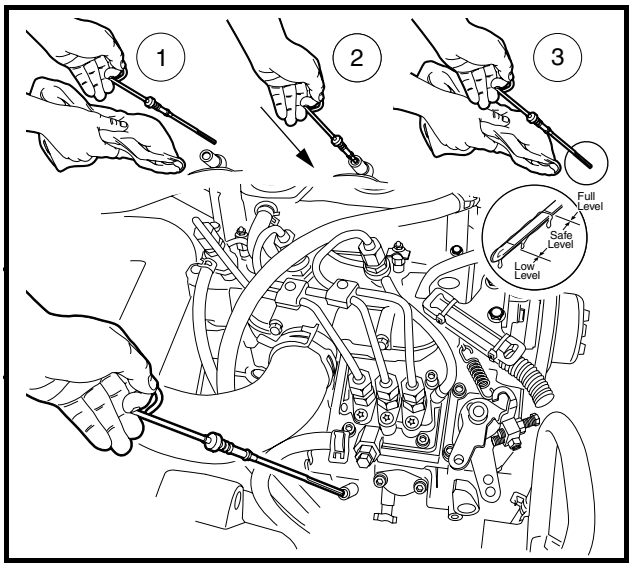


Figure 10a-7 Engine Oil Level Check – Diesel Vehicles

ENGINE OIL AND FILTER CHANGE

Engine oil and oil filter should be changed after the first 20 hours of operation (gasoline) or 50 hours of operation (diesel). After that, they should be changed every 100 hours of operation or annually, whichever comes first.

Engine Oil Draining

1. Turn the key switch to the OFF position and remove the key. Place the Forward/Reverse handle in the NEUTRAL position. Chock the front wheels.

2. Disconnect the battery cables, negative (–) cable first. **See WARNING "To avoid unintentionally starting..." in Section 1 – Safety on page 1-2.**
3. Remove the oil filler cap to allow the oil to drain properly.
4. Position a pan designed for oil changes under the drain plug (1) **(Figure 10a-8, Page 10a-9 or Figure 10a-10, Page 10a-10)**.
5. From the underside of the vehicle, use a 14 mm socket or wrench to remove the drain plug (1). Turn the plug counterclockwise and drain the engine oil into the pan. **See following WARNING.**

⚠ WARNING

- **Do not attempt to change engine oil when the engine is hot or even warm. Hot engine oil can cause skin burns.**
- **Wear safety glasses or approved eye protection when servicing the vehicle. Wear rubber gloves when handling oil drain plug, oil filter, and oil drain pan.**

6. Clean the oil drain plug threads with solvent to remove oil and oil residue. Make sure that the compression washer remains on the drain plug. Inspect the compression washer and replace if necessary.
7. Use a 14 mm socket or wrench to replace the oil drain plug. Turn the plug clockwise and tighten to 29 ft-lb (40 N·m) for gasoline vehicles, 31 ft-lb (42 N·m) for diesel vehicles.

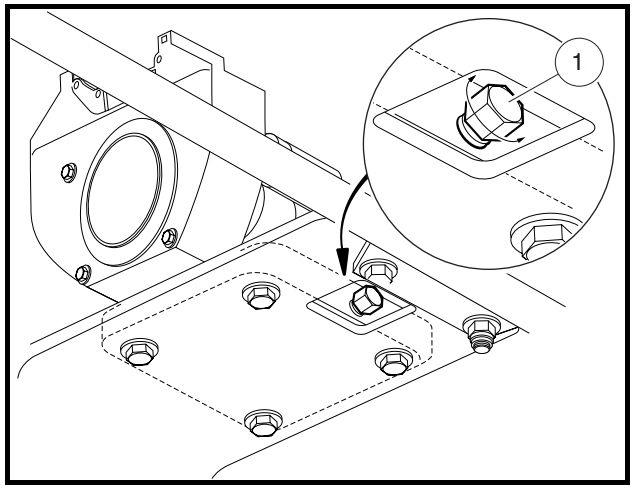


Figure 10a-8 Engine Oil Drain Plug and Pan – Gasoline Vehicles

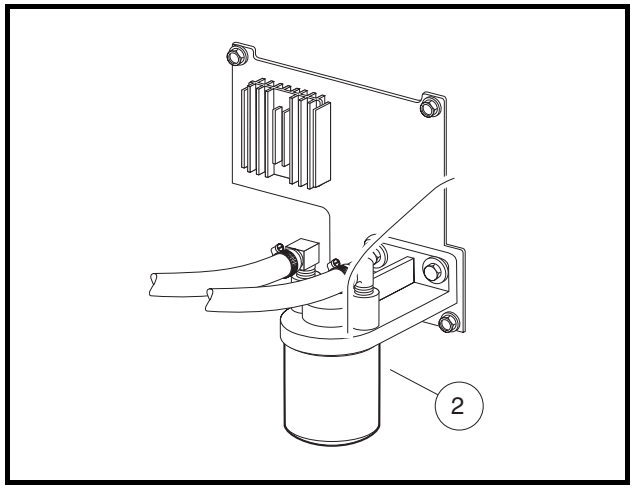


Figure 10a-9 Replace Engine Oil Filter – Gasoline Vehicles

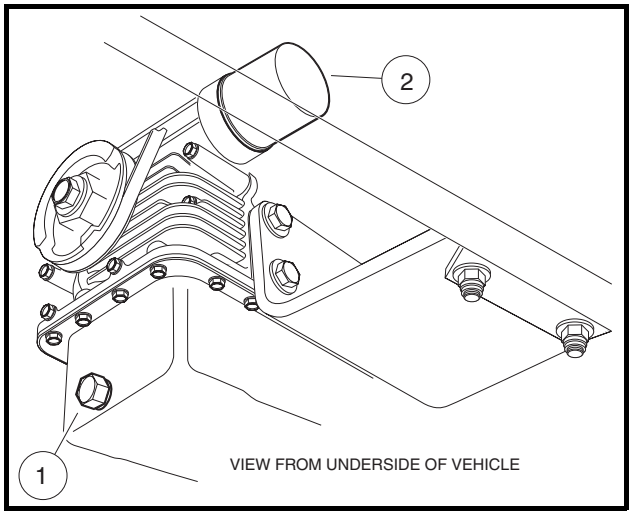


Figure 10a-10 Engine Oil Drain Plug and Oil Filter – Diesel Vehicles

Engine Oil Filter Change

1. Drain the engine oil. **See Engine Oil Draining on page 10a-8.**
2. Place the oil drain pan under the engine oil filter (2) **(Figure 10a-9, Page 10a-9 or Figure 10a-10, Page 10a-10)**.
3. Remove the engine oil filter. Turn it counterclockwise and drain the residual oil in the filter port and filter into the oil drain pan. **See following NOTE.**

NOTE: *An oil drip guard (1) can be used to prevent excess oil from dripping onto the engine base plate. Use an empty quart (one liter) container and cut the bottom off at an angle, then slide the open area of the container up and under the oil filter (2) before removal. Position the port of the plastic container so oil will be directed into the oil pan (3) **(Figure 10a-11, Page 10a-11)**. A drip guard can be made by folding a piece of cardboard, thin metal, or plastic under the oil filter, forming a channel to direct the filter port oil into the drain pan.*

Dispose of used oil according to the environmental laws and regulations for your area.

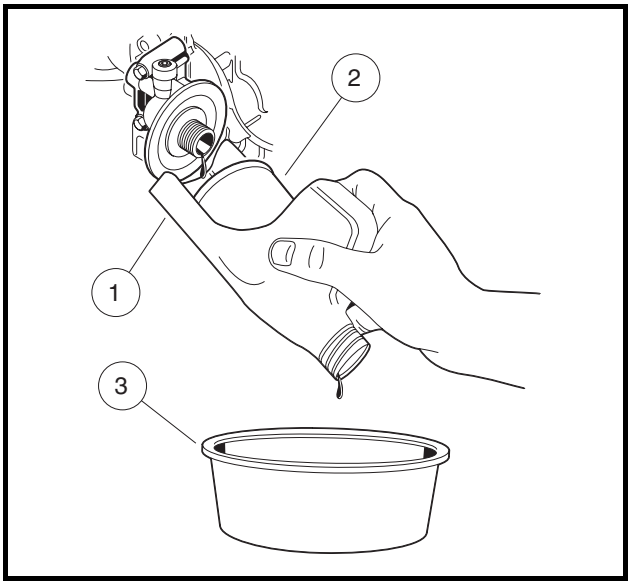


Figure 10a-11 Remove Engine Oil Filter

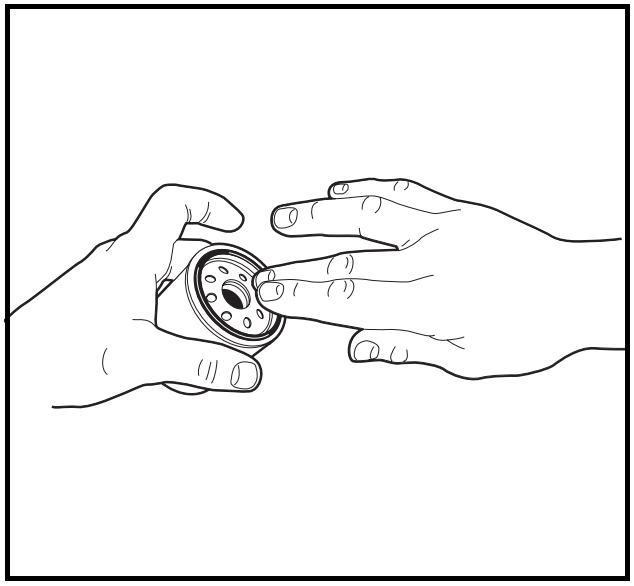


Figure 10a-12 Coat Rubber Seal

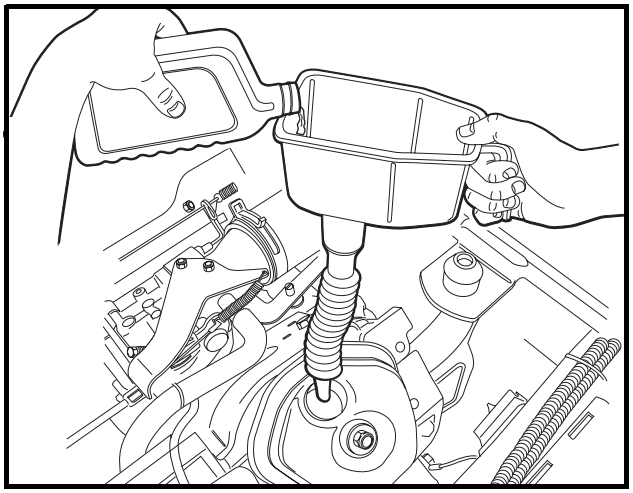


Figure 10a-13 Add Engine Oil – Gasoline Vehicles

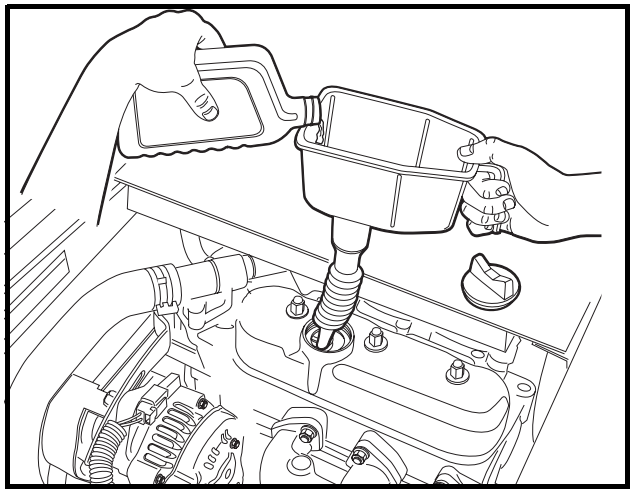


Figure 10a-14 Add Engine Oil – Diesel Vehicles

4. Use a clean, lint-free rag to wipe the oil filter port flange surface clean where the oil filter gasket seats.
5. To help seal the new oil filter to the oil port flange, apply a light coat of white lithium NLGI Number 2 grease (Dow Corning® BR2-Plus or equivalent) or new engine oil to the rubber seal around the outside surface of the filter before attaching it to the oil filter port **(Figure 10a-12, Page 10a-11)**. Install the new oil filter (gas: CCI P/N 1016467, diesel: CCI P/N 102703301) onto the engine oil filter port. **See following NOTE.**

NOTE: *Use only OEM oil filters designed for your engine.*

6. Tighten the oil filter by hand 2/3 turn after gasket contact. Do not use a band wrench or channel lock pliers.

Engine Oil Filling

1. Add engine oil; use a funnel or pour spout to direct the oil into the opening **(Figure 10a-13, Page 10a-11 or Figure 10a-14, Page 10a-11)**. With filter change, the engine requires 1 qt. and 25 oz (1.7 L) of oil per change for gasoline vehicles and 3 qt. (2.8 L) for diesel vehicles. Refer to oil viscosity guidelines for selection of oil grade **(Figure 10a-15, Page 10a-12 or Figure 10a-16, Page 10a-12**). **See following CAUTION.**

CAUTION

- **Do not exceed recommended oil capacity. Doing so will decrease engine performance or result in damage to the engine.**

2. Connect the battery cables, positive (+) cable first, and tighten terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
3. With the Forward/Reverse handle in the NEUTRAL position, start and run the engine for a few minutes. Observe both the drain plug and the oil filter from under the vehicle and watch for oil leaks. If a leak is detected, check the tightness of the oil filter and drain plug. Tighten, repair, and/or replace components as necessary. **See following NOTE.**

NOTE: *Wait five minutes after turning off the engine before removing the dipstick.*

4. Remove the dipstick and check the engine oil as a final step. Replace the dipstick.

OIL VISCOSITY

Choose the viscosity according to the temperature as shown in the appropriate oil viscosity chart **(Figure 10a-15, Page 10a-12 or Figure 10a-16, Page 10a-12)**. **See following NOTE.**

NOTE: *Use engine oil with API classification SJ for gasoline engines and CF for diesel engines.*

Using multi-grade oils (5W-20, 10W-30, and 10W-40) will increase oil consumption. If multi-grade oil is used, check the oil level more frequently.

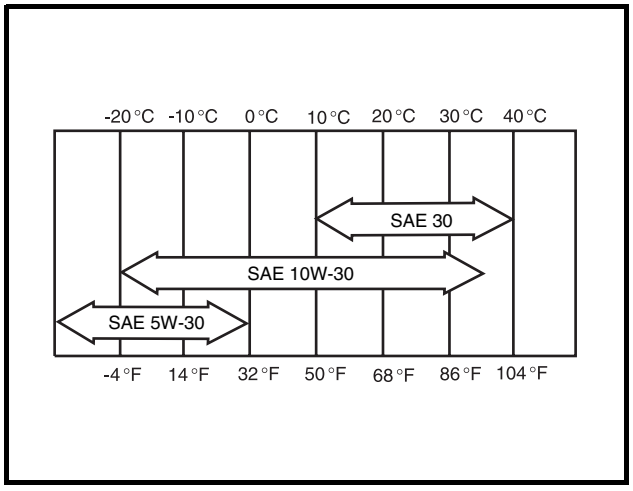


Figure 10a-15 Oil Viscosity Chart – Gasoline

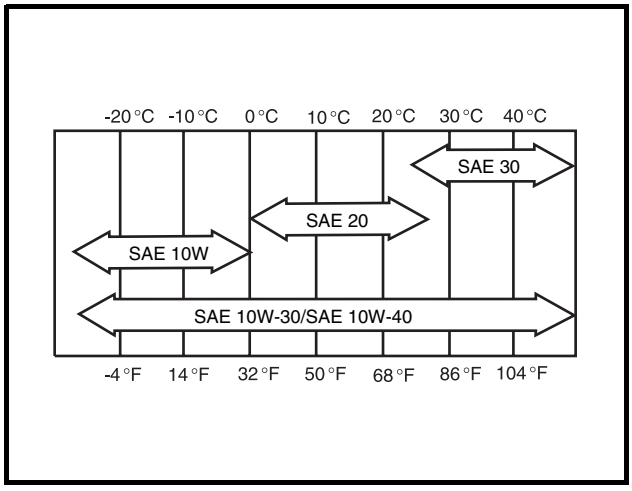


Figure 10a-16 Oil Viscosity Chart – Diesel

GEARCASE LUBRICATION

NOTE: *Dispose of used oil according to the environmental laws and regulations for your area.*

LUBRICATION LEVEL CHECK FOR FRONT DIFFERENTIAL, TRANSMISSION, AND REAR DIFFERENTIAL

Each gearcase component is equipped with two oil port plugs (1 and 2) **(Figure 10a-17, Figure 10a-18, and Figure 10a-19)**. When the vehicle is on a level surface, use the level indicator hole (upper plug) (1) as a lubricant level indicator. Lubricant level should be even with the bottom of level indicator hole (1).

LUBRICATION CHANGE FOR FRONT DIFFERENTIAL, TRANSMISSION, AND REAR DIFFERENTIAL

Use the lower plug (2) for drainage **(Figure 10a-17, Figure 10a-18, and Figure 10a-19)**. Remove both plugs to allow the lubricant to drain faster. **See preceding NOTE.**

Metal particles may be discovered in the fluid or on the magnetic drain plug when changing the differential or transmission fluid. These particles are normal and expected for the first few fluid changes. This is a result of the gears being "net forged", meaning the gears are forged to a shape very close to the final gear size but the teeth are not finish machined prior to assembly. The "finish machining" occurs when the gears make contact under load during vehicle operation. The magnetic drain plug is included in the design to collect the metal particles generated from the gear break in process. This is an established process and is not detrimental to gear service life.

Front differential:

Clean and install the drain plug (2) and washer before filling the front differential with new lubricant **(Figure 10a-17, Page 10a-14)**. Tighten the drain plug to 108 in-lb (12 N·m). Use a funnel when filling the front differential through the lubricant level indicator hole (1). **See Periodic Lubrication Schedule on page 10a-4.** Tighten the level indicator plug to 120 in-lb (14 N·m).

Transmission:

Clean and install the drain plug (2) before filling the transmission with new lubricant **(Figure 10a-18, Page 10a-14)**. Tighten the drain plug to 96 in-lb (11 N·m). Remove the fill plug on the top of the transmission case and use a funnel when filling with lubricant. **See Periodic Lubrication Schedule on page 10a-4.** Apply Loctite 567 to the threads of the fill plug and tighten to 21 ft-lb (28 N·m).

Check the level of lubricant at the level indicator plug (1). Apply Loctite 567 to the threads of the level indicator plug and tighten to 21 ft-lb (28 N·m).

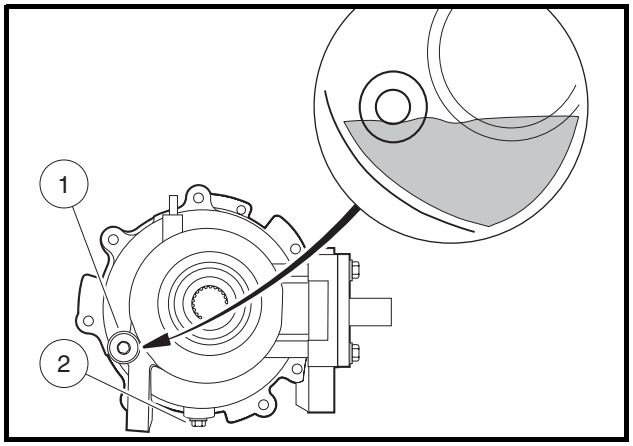


Figure 10a-17 Front Differential Lubrication Level

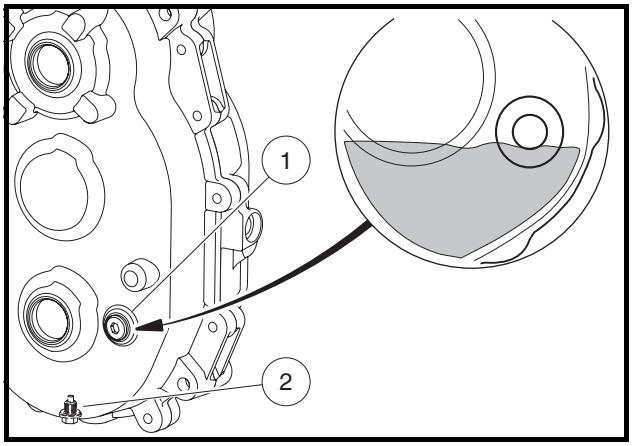


Figure 10a-18 Transmission Lubrication Level

Rear differential:

Clean and install the drain plug (2) and washer before filling the rear differential with new lubricant **(Figure 10a-19, Page 10a-14)**. Tighten the drain plug to 96 in-lb (10.8 N·m). Use a funnel when filling the differential through the lubricant level indicator hole (1). **See Periodic Lubrication Schedule on page 10a-4.** Apply Loctite 567 to the threads of the level indicator plug and tighten to 21 ft-lb (28 N·m).

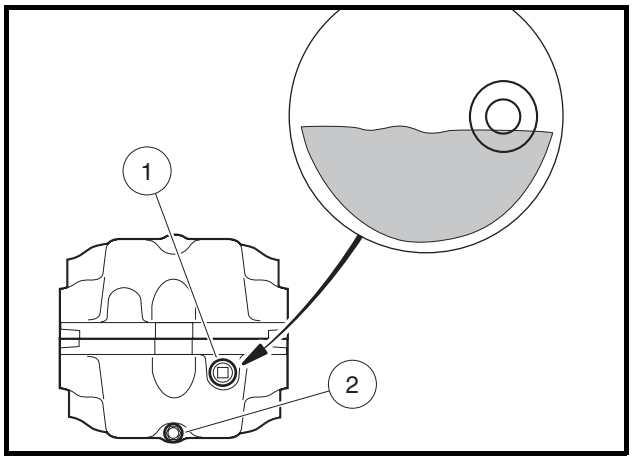


Figure 10a-19 Rear Differential Lubrication Level

HYDRAULIC SYSTEM – INTELLITACH VEHICLE

⚠ WARNING

- **Diesel fuel or hydraulic fluid under pressure can penetrate skin or eyes, causing serious injury or death. Fluid leaks under pressure may not be visible. Use a piece of cardboard or wood to find leaks. Do not use your bare hand. Wear safety goggles. If fluid enters skin or eyes, get immediate medical attention from a physician familiar with this injury.**

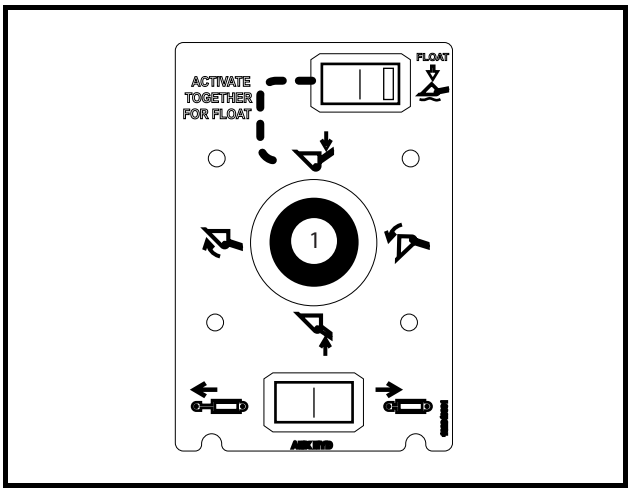


Figure 10a-20 Joystick

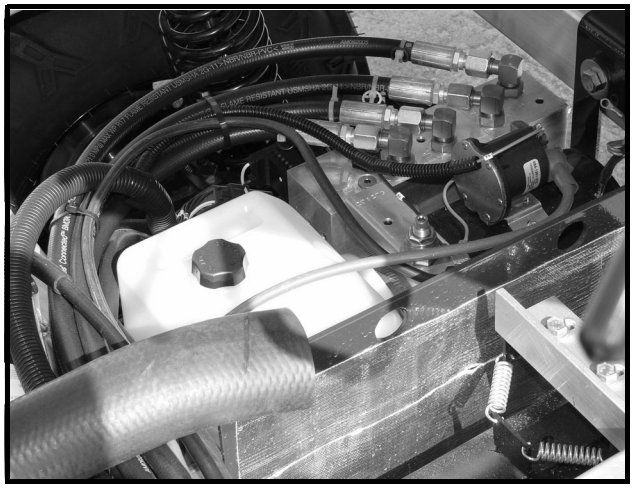


Figure 10a-21 Hydraulic Fluid Tank, Pump and Control Valves

Inspect the hydraulic fluid level daily.

Use only recommended fluid in the hydraulic system. **See IntelliTach Specifications, Section 2a, Page 2a-3.**

1. Lift the cargo box.
2. Turn the start key to the ON position but DO NOT start the engine.
3. Press the joystick ON/OFF switch to ON.
4. Move the joystick (1) back and raise the attachment arm fully **(Figure 10a-20, Page 10a-15)**.
5. Move the joystick (1) to the right and tilt the attachment interface fully in.
6. Press the auxiliary hydraulic rocker switch (2) so that the cylinders are retracted. (If equipped with auxiliary hydraulics).
7. Turn the key to the OFF position.
8. The hydraulic oil level must be between the Maximum Fluid Level and the Minimum Fluid Level lines on the hydraulic tank **(Figure 10a-21)**.
9. If hydraulic oil must be added, thoroughly clean the area around the fill cap. Remove the fill cap and add hydraulic fluid until it is between the Maximum Fluid Level and the Minimum Fluid Level lines.

ENGINE COOLANT – DIESEL VEHICLES

See General Warning, Section 1, Page 1-1.

ENGINE COOLANT LEVEL CHECK

The coolant reserve tank (2) is located under the hood on the passenger side **(Figure 10a-4, Page 10a-7)**. Raise the hood to check the coolant level before every operation.

Check the coolant level of the reserve tank (2). If the coolant is at or below the LOW mark, add pre-mixed coolant until level reaches the FULL mark. If a leak is detected, have it checked by a trained technician. **See following WARNING.**

⚠ WARNING

- **Coolant reservoir and radiator are pressurized. Remove caps slowly to relieve pressure.**
- **Hot! Coolant system is pressurized. Do not remove radiator cap while engine is hot.**

NOTE: *Use a mixture of 45% water and 55% propylene glycol with anti-corrosion additives.*

FUELING INSTRUCTIONS

See General Warning, Section 1, Page 1-1.

⚠ DANGER

- **Turn key switch to the OFF position before fueling.**
- **Never pour fuel into the fuel tank when the engine is hot or while it is running.**
- **To avoid electric arc caused by static electricity, the fuel storage/pumping device must be grounded. If the pump is not grounded, the vehicle must be grounded to the pump before and during the fueling operation.**
- **To avoid the possibility of fire, clean up any spilled fuel before operating the vehicle.**

1. Remove the fuel cap and fill the tank with fuel. Gasoline vehicles have a black fuel cap; diesel vehicles have a green fuel cap. **See preceding DANGER and following NOTE.**

NOTE: ***Gasoline vehicles:*** *Use unleaded gasoline only. Whenever possible, avoid using oxygenated fuels and fuels that are blended with alcohol.*

Diesel vehicles*: Use only diesel fuel grade no. 2 with a cetane rating of 45 or higher.*

2. Replace the fuel cap. Ensure that the cap is tightened securely.
3. Clean any spilled fuel from the cap or around the fuel cap area.

Biodiesel Fuel (Diesel Vehicles Only)

Biodiesel has unique qualities that should be considered before it is used in the Kubota D722 diesel engine. During cold weather, plugged fuel lines, plugged fuel systems, hard starting, and other unknown failures can result from use of this fuel.

Biodiesel is an excellent medium for microbial growth and contamination. Microbial contamination can cause corrosion of the fuel system and prematurely plugged fuel filters. **See following NOTE.**

NOTE: *Use of biodiesel may result in premature failure of fuel system components. Kubota has documented problems such as plugged fuel filters and deteriorated fuel lines during testing of biodiesel.*

Biodiesel can damage painted surfaces. Be sure to remove all spilled fuel immediately to help prevent damage to painted surfaces.

If biodiesel will be used in the Kubota D722 engine, be sure that it meets the following requirements:

- The fuel blend should contain no more than 5% biodiesel by volume.
- The petroleum portion of the fuel blend must meet ASTM standard D975 and the biodiesel portion of the fuel blend must meet ASTM standard D6751.
- For Europe, the fuel blend must meet the EN590 standard. **See following CAUTION.**

CAUTION

- **Never use any fuel that does not meet specifications or fuel in which the contents cannot be identified. Using blends higher than 5% biodiesel content can affect engine life and cause deterioration of hoses, tubelines, injectors, injector pump and seals.**
- **For more information on these fuel standards, please contact your nearest Kubota dealer.**

If biodiesel is used, be sure to apply the following guidelines:

- Ensure the fuel tank is as full as possible at all times to prevent moisture from collecting.
- Ensure that the fuel tank cap is securely tightened to prevent water from entering the fuel tank.
- Drain all water from the fuel filter daily before operating vehicle. **See Draining Water from Fuel Filter.**
- Check the engine oil level daily before the engine is started. **See Engine Oil Level Check on page 10a-8.**
- Before vehicle storage, run the engine with conventional diesel fuel for at least 30 minutes to flush the biodiesel from the engine. **See Preparing the Vehicle for Extended Storage, Section 3, Page 3-3. See following NOTE.**

NOTE: *Biodiesel does not have long-term stability and must not be left in engines longer than three months. This fuel type attracts moisture and may contain higher water content than conventional diesel fuel.*

- Fuel system maintenance, cleaning, and fuel line replacement are required more frequently for engines that are operated with biodiesel.

DRAINING WATER FROM FUEL FILTER

Diesel Vehicles Only

Water should be drained from the fuel filter daily. The fuel filter is mounted on a plate by the lower seat support panel **(Figure 10a-22, Page 10a-18)**.

1. Position a pan under the fuel filter.
2. Lift the passenger-side seat.
3. Locate the valve (1) on the underside of the filter. Turn the valve clockwise until water begins to stream from the filter.
4. Drain the water until it changes color (to fuel). **See following WARNING.**

⚠ WARNING

- **Clean up spilled fuel. Keep sparks and flames away from the vehicle and service area. Failure to heed this warning could result in an explosion or fire, resulting in severe personal injury or death.**

5. Close the valve by rotating it counterclockwise until the valve is firmly sealed.
6. To resupply the filter with fuel, turn the key switch to the ON position for 10 seconds. **See following NOTE.**

NOTE: *Dispose of water according to the environmental laws and regulations for your area.*

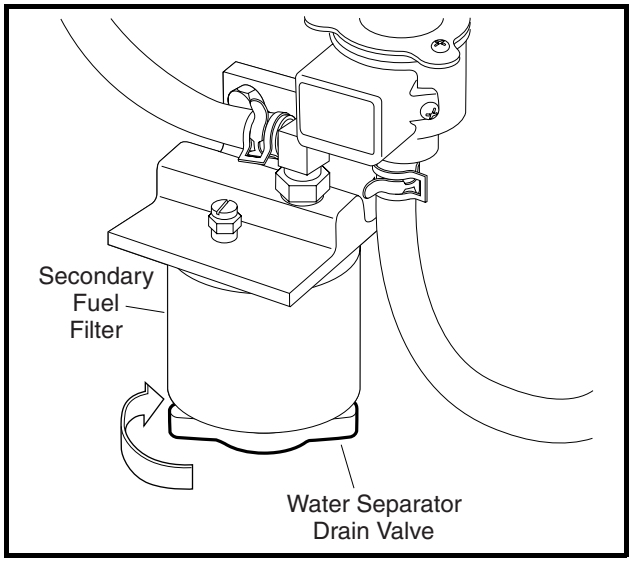


Figure 10a-22 Fuel Filter

BATTERY

For periodic battery maintenance, see Battery on page 12b-15 (gasoline vehicles) or page 12c-21 (diesel vehicles).

SECTION 10B – PERIODIC MAINTENANCE: KAWASAKI GASOLINE & KUBOTA DIESEL POWERED VEHICLES

⚠ DANGER

- **See General Warning, Section 1, Page 1-1.**

⚠ WARNING

- **See General Warning, Section 1, Page 1-1.**

PERIODIC SERVICE SCHEDULE

See General Warning, Section 1, Page 1-1.

⚠ WARNING

- **Service, repairs, and adjustments must be made per instructions in this maintenance and service manual.**

NOTE: *If the vehicle is constantly subjected to heavy use or severe operating conditions, the preventive maintenance procedures should be performed more often than recommended in the Periodic Service and Lubrication Schedule.*

Both the Periodic Service Schedule and the Periodic Lubrication Schedule must be followed to keep the vehicle in optimum operating condition.

PERIODIC SERVICE SCHEDULE

REGULAR INTERVAL	SERVICE	
Daily service by owner or trained technician	Engine	Check engine oil level; add if necessary. **See Engine Oil Level Check on page 10b-8.**
		Diesel vehicles: Check engine coolant; add if necessary. **See Engine Coolant Level Check on page 10b-16.**
		Clean debris from radiator.
	Fuel filters	**Diesel vehicles:** Drain water from fuel filter. **See Draining Water from Fuel Filter on page 10b-17.**
	Brakes	Check brake fluid; add if necessary. Check brake pedal for proper operation. **See Performance Inspection in the vehicle owner's manual.**
	Hydraulic System (IntelliTach vehicle only)	Check hydraulic fluid; add if necessary.
Monthly service by owner or trained technician	Engine	Check engine circulating air passage; visually inspect unshrouded area around engine exhaust for grass and debris and clean if necessary. **Diesel vehicles:** Check for grass and debris around the radiator.
	Tires	Check air pressure and adjust if necessary. **See Section 8 – Wheels and Tires.**
	Transmission and differentials	Check lubricant levels. Add if necessary. **See Lubrication Level Check for Front Differential, Transmission, and Rear Differential on page 10b-13.**
	General vehicle	Wash engine compartment and underside of vehicle. Do not wash engine when hot.
Semiannual service by trained technician only (or every 50 hours of operation, whichever comes first)	Battery	Clean terminals and wash dirt from casing; check electrolyte level. Add distilled water if necessary. **See Battery on page 12a-17 (gasoline vehicles) or Battery on page 12c-21 (diesel vehicles).**
	Front wheel alignment and toe-in	Check and adjust if necessary. **See Wheel Alignment on page 7-11.**
	Electrical wiring and connections	Check for tightness and damage.
	Brake system	Inspect master cylinder, brake lines, and hoses for damage or leakage.
		Check park brake cables for damage; replace if necessary.
		Check brake pads and discs; replace if necessary. **For brake wear-in procedure**, **see Hydraulic Brakes in the Pre-Operation and Daily Safety Checklist in the Owner's Manual.** See also Section 6 – Hydraulic and Park Brake Systems

Periodic Service Schedule continued on next page...

PERIODIC SERVICE SCHEDULE

REGULAR INTERVAL	SERVICE	
Annual service by trained technician only (or every 100 hours of operation, whichever comes first)	Engine	Check for leaks around gaskets, fill plugs, etc.
		Gasoline vehicles: Adjust valve clearance. **See Kawasaki FH680D Service Manual.**
		Gasoline vehicles: Inspect, clean, and gap spark plug; replace if necessary. See authorized dealer or trained technician for service. **See Spark Plugs on page 10b-12.**
		Diesel vehicles: Check the v-belt for proper tension or damage. Adjust or replace if necessary.
		Diesel vehicles: Change engine coolant. **See Engine Coolant Change on page 15-1.**
	Radiator	**Diesel vehicles:** Check clamps for tightness; check hoses for cracks. Replace if necessary.
	Engine air intake system	Replace air filter element. **See Air Filter Replacement on page 13a-23 (gasoline vehicles) or page 13c-23 (diesel vehicles).**
		Check clamps for tightness; check hose for cracks.
	General vehicle	Check for loose hardware and tighten if necessary.
	Fuel filters	Replace. Dispose of used filters properly.

⚠ WARNING

- **If any problems are found during scheduled inspection or service, do not operate vehicle until repairs are made. Failure to make necessary repairs could result in fire, property damage, severe personal injury, or death.**

PERIODIC LUBRICATION SCHEDULE

PERIODIC LUBRICATION SCHEDULE

REGULAR INTERVAL	SERVICE	LUBRICATION POINTS	RECOMMENDED LUBRICANT
Gasoline vehicle: Kawasaki engine- First change 10 hours Diesel vehicle: First change 50 hours Additional change for all engines every 100 hours of operation or annually, whichever comes first.	Change engine oil and oil filter	1	**Gasoline (Kawasaki engine) vehicles:** 1 qt. and 19 oz (1.5L) with filter **Diesel vehicles:** 3 qt. (2.8 L) with filter **See Oil Viscosity on page 11.**
Monthly by owner or trained technician	Driveshaft	2	Chassis Lube (EP NLGI Grade 2)
Semiannually by owner or trained technician (or every 50 hours of operation, whichever comes first)	Check/add brake fluid	3	Use only DOT 5 (silicone) brake fluid
	Rear suspension (2 fittings)	4	Chassis Lube (EP NLGI Grade 2)
	Attachment Arm and Inteface (8 fittings) – IntelliTach vehicle only	5	Chassis Lube (EP NLGI Grade 2)
First change 50 hours – additional change every 100 hours of operation or annually, whichever comes first	Change front differential lubricant	6	5 oz. (150 mL) Mobil 424, Exxon Hydraul 560, or Esso Hydraul 56 lubricant
First change 50 hours – additional change every 300 hours of operation or annually, whichever comes first	Change rear differential lubricant	7	20 oz. (600 mL) Mobil 424, Exxon Hydraul 560, or Esso Hydraul 56 lubricant
	Change transmission lubricant	8	20 oz. (600 mL) Mobil 424, Exxon Hydraul 560, or Esso Hydraul 56 lubricant

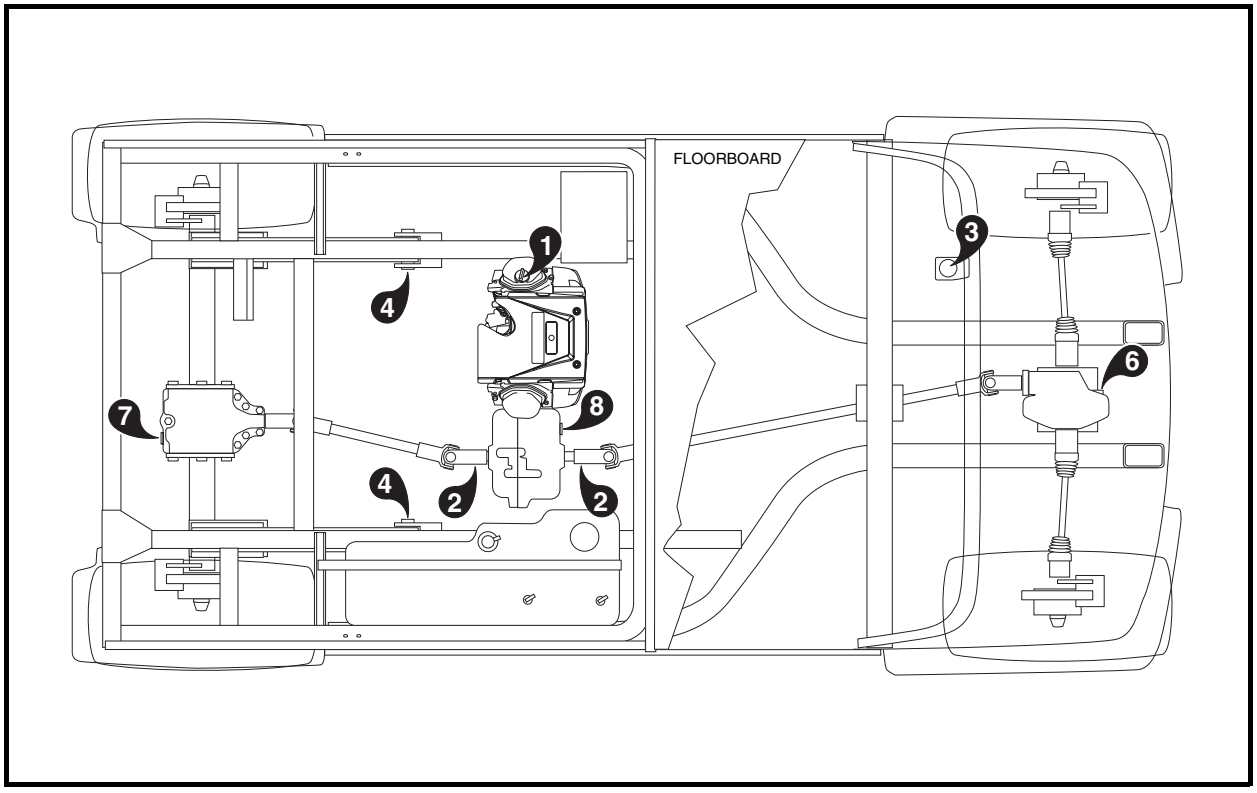


Figure 10b-1 Lubrication Points – Gasoline Vehicles

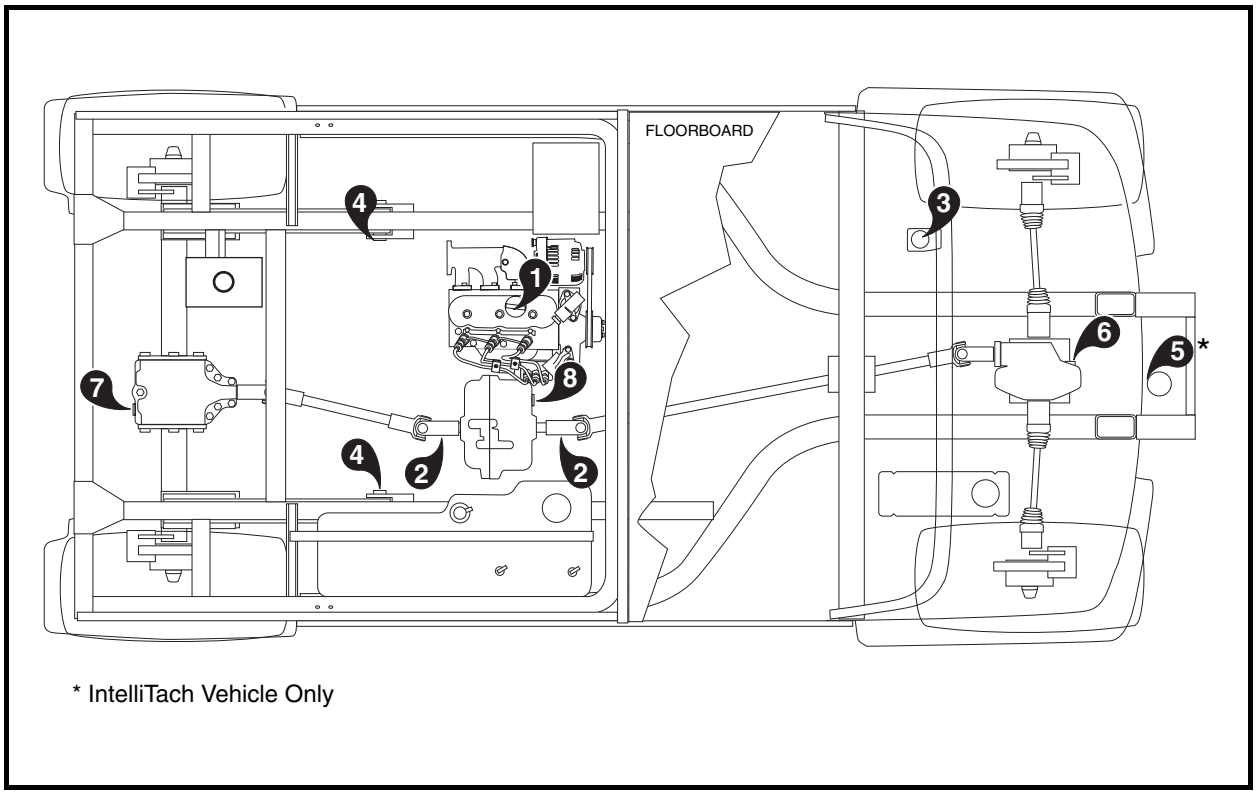


Figure 10b-2 Lubrication Points – Diesel Vehicles

LUBRICATING THE ATTACHMENT ARM AND INTERFACE

Description

Always use a good quality, lithium-based, multi-purpose grease. Apply lubricant until extra grease shows.

Grease the 8 grease fittings every 50 hours of operation, 2 times a year (whichever occurs first) or whenever the attachment arm and interface are removed and reinstalled on the vehicle.

Lubricate the following locations as shown **(Figure 10b-3)**:

1. Attachment Interface Cylinder (both ends).
2. Attachment Arm Pivot - vehicle side (both sides).
3. Attachment Arm Cylinder (both ends).
4. Attachment Arm Pivot - interface side (both sides).

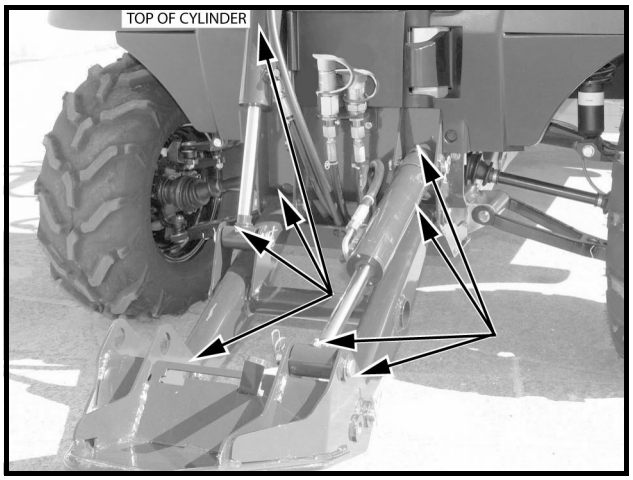


Figure 10b-3 Lubricate Grease Zerks located on Cylinder and Attachment Arm Ends

BRAKE FLUID RESERVOIR

See General Warning, Section 1, Page 1-1.

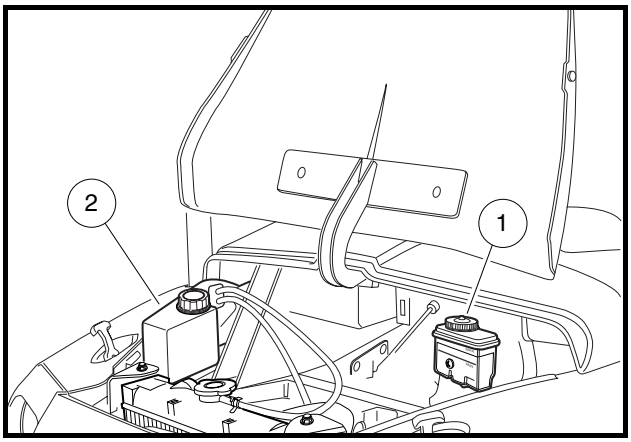


Figure 10b-4 Brake Fluid and Engine Coolant Access

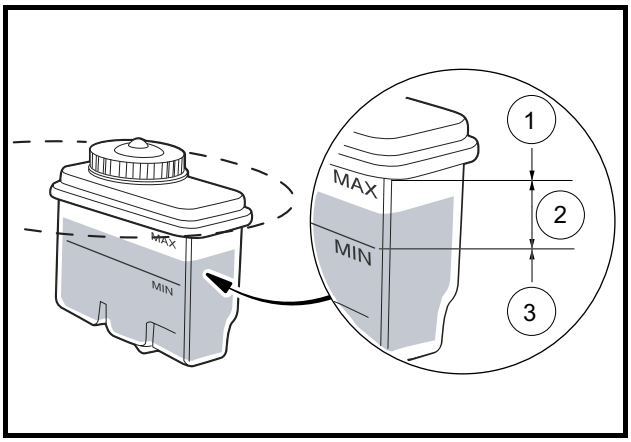


Figure 10b-5 Brake Fluid Reservoir

The brake fluid reservoir (1) is located under the hood **(Figure 10b-4, Page 10b-7)**. Raise the hood to check the brake fluid level.

When checking the brake fluid, also inspect the following:

- The presence of brake fluid on the exterior surface of the master cylinder indicates a leak.
- The brake fluid reservoir diaphragm (located in the cap) should not have holes or other damage.

BRAKE FLUID

Brake fluid level should be within 1/4-inch (6 mm) from the top of the reservoir **(Figure 10b-5, Page 10b-7)**. (Numbered sections indicate: 1 - Full Level, 2 - Safe Level and 3 - Low Level). Also, brake fluid should be clean with no residue in the bottom of the reservoir or other evidence of contamination.

⚠ CAUTION

- **Use only DOT 5 (silicone) brake fluid. Use of any other type brake fluid is not recommended.**

ENGINE OIL

See General Warning, Section 1, Page 1-1.

Even though the low oil warning lamp on the instrument panel should illuminate if the oil pressure becomes low, the engine oil level should be checked daily. The vehicle should be on a level surface when the oil is checked. Do not overfill with oil.

OIL PRESSURE – GASOLINE ENGINE

The Kawasaki gasoline engine has an oil filter that is mounted on a bracket between and in front of the engine and transmission. Inlet and outlet oil-carrying hoses enable oil circulation to and from the engine. **See following NOTE.**

NOTE: *The normal oil pressure value stated in the Kawasaki engine manual is 35-45 psi at idle; however, the remote filter design causes oil pressure to be 18 psi, which is normal for this type of oil circulation design.*

ENGINE OIL LEVEL CHECK

1. Remove the oil level dipstick from the oil filler tube and wipe oil from the dipstick **(Figure 10b-6, Page 10b-8 or Figure 10b-6, Page 10b-8)**. **See following CAUTION.**

⚠ CAUTION

- **Do not remove dipstick while engine is running.**

2. Check oil level by fully inserting the dipstick into the tube and immediately removing it.
3. If the oil level is at or below the low level mark on the dipstick gauge, add oil until the level is between low and full levels (safe level). **See following CAUTION.**

CAUTION

- **Do not fill oil above the full level mark. Doing so will result in decreased engine performance or damage to the engine.**

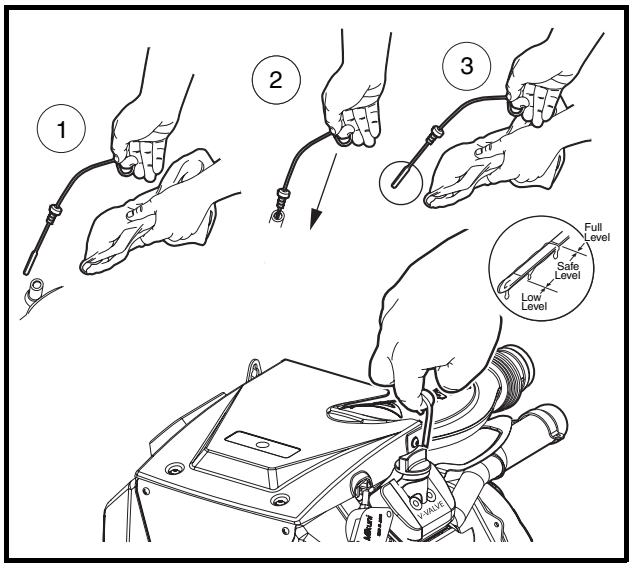


Figure 10b-6 Engine Oil Level Check – Kawasaki Powered Gasoline Vehicles

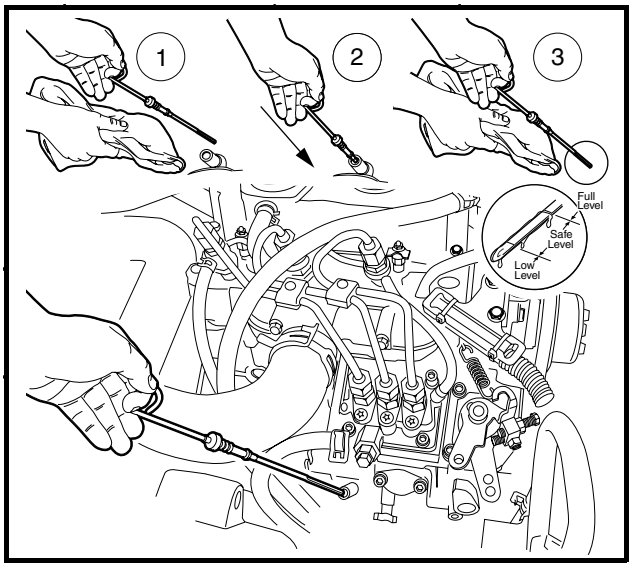


Figure 10b-7 Engine Oil Level Check – Diesel Vehicles

ENGINE OIL AND FILTER CHANGE

Engine oil and oil filter should be changed:

- Kawasaki gasoline engine after the first 10 hours of operation.
- Kubota diesel engine after the first 50 hours of operation.

After that, the oil should be changed every 100 hours of operation or annually, whichever comes first.

Engine Oil Draining

1. Turn the key switch to the OFF position and remove the key. Place the Forward/Reverse handle in the NEUTRAL position. Chock the front wheels.
2. Disconnect the battery cables, negative (–) cable first. **See WARNING "To avoid unintentionally starting..." in Section 1 – Safety on page 1-2.**
3. Remove the oil filler cap to allow the oil to drain properly.
4. Position a pan designed for oil changes under the drain plug (1) **(Figure 10b-8, Page 10b-9 or Figure 10b-10, Page 10b-10)**.
5. From the underside of the vehicle, use a 14 mm socket or wrench to remove the drain plug (1). Turn the plug counterclockwise and drain the engine oil into the pan. **See following WARNING.**

⚠ WARNING

- **Do not attempt to change engine oil when the engine is hot or even warm. Hot engine oil can cause skin burns.**
- **Wear safety glasses or approved eye protection when servicing the vehicle. Wear rubber gloves when handling oil drain plug, oil filter, and oil drain pan.**

6. Clean the oil drain plug threads with solvent to remove oil and oil residue. Make sure that the compression washer or sealing o-ring remains on the drain plug. Inspect the compression washer or the sealing o-ring and replace if necessary.
7. Use a 14 mm socket or wrench to replace the oil drain plug. Turn the plug clockwise and tighten to 61 in-lb (6.9 N·m) for Kawasaki powered gas vehicles, or 31 ft-lb (42 N·m) for diesel vehicles.

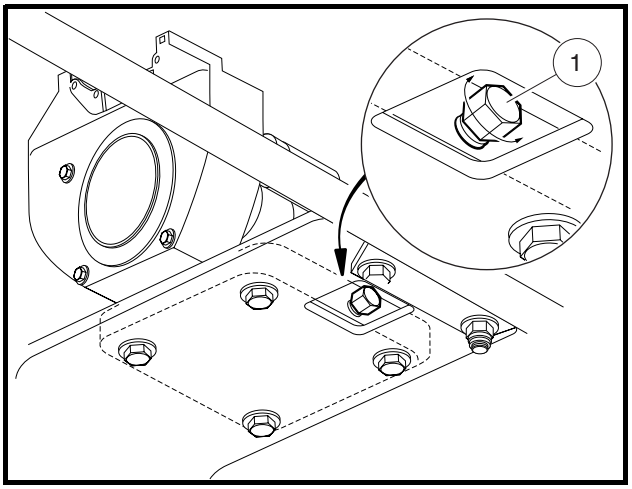


Figure 10b-8 Engine Oil Drain Plug and Pan – Gasoline Vehicles

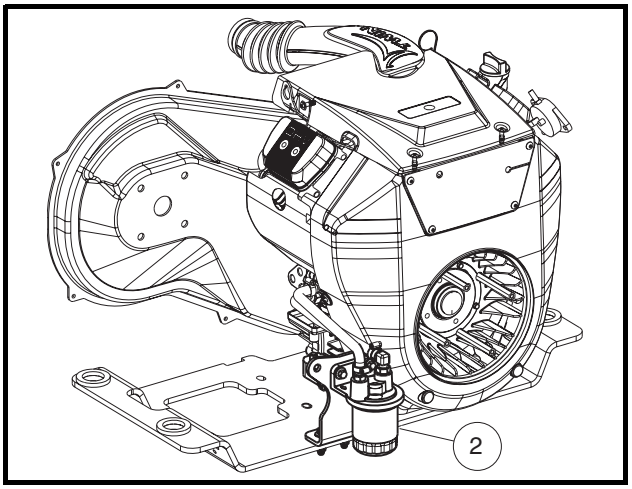


Figure 10b-9 Replace Engine Oil Filter – Kawasaki Powered Gasoline Vehicles

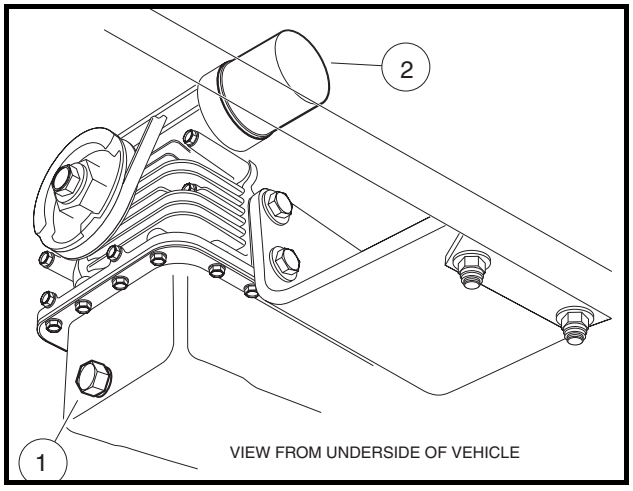


Figure 10b-10 Engine Oil Drain Plug and Oil Filter – Diesel Vehicles

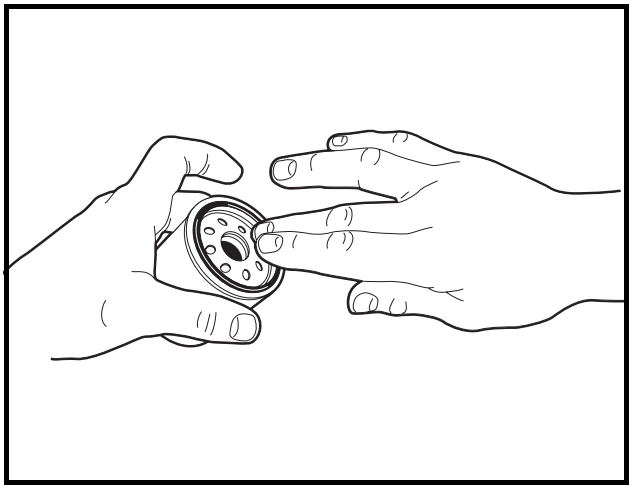


Figure 10b-11 Coat Rubber Seal

Engine Oil Filter Change

1. Drain the engine oil. **See Engine Oil Draining on page 10b-9.**
2. Place the oil drain pan under the engine oil filter (2) **(Figure 10b-9, Page 10b-9**, **or Figure 10b-10, Page 10b-10)**.
3. Remove the engine oil filter. Turn it counterclockwise and drain the residual oil in the filter port and filter into the oil drain pan. **See following NOTE.**

NOTE: *Dispose of used oil according to the environmental laws and regulations for your area.*

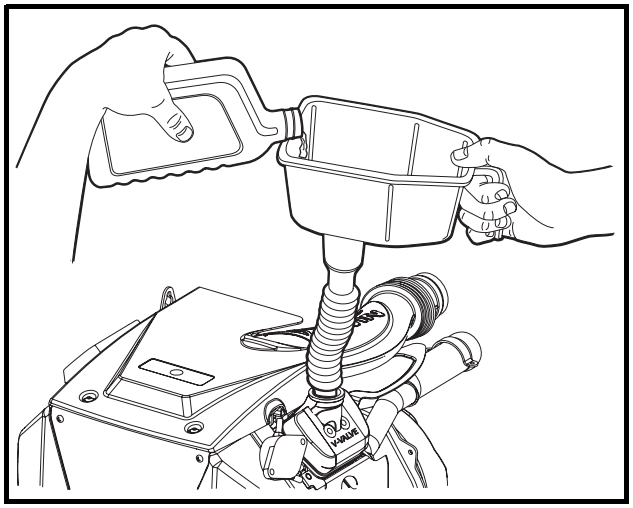


Figure 10b-12 Add Engine Oil – Kawasaki Powered Gasoline Vehicles

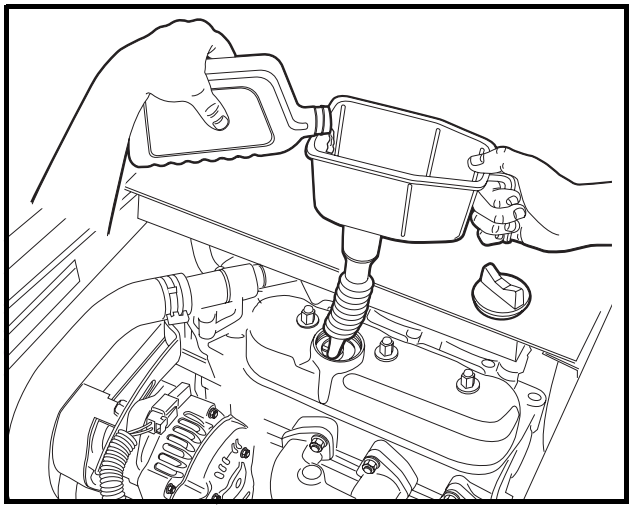


Figure 10b-13 Add Engine Oil – Diesel Vehicles

4. Use a clean, lint-free rag to wipe the oil filter port flange surface clean where the oil filter gasket seats.

5. To help seal the new oil filter to the oil port flange, apply a light coat of white lithium NLGI Number 2 grease (Dow Corning® BR2-Plus or equivalent) or new engine oil to the rubber seal around the outside surface of the filter before attaching it to the oil filter port **(Figure 10b-11, Page 10b-10)**. Install the new oil filter (gas Kawasaki: CCI P/N 1016467, diesel: CCI P/N 102703301) onto the engine oil filter port. **See following NOTE.**

NOTE: *Use only OEM oil filters designed for your engine.*

6. Tighten the oil filter by hand 2/3 turn after gasket contact. Do not use a band wrench or channel lock pliers.

Engine Oil Filling

1. Add engine oil; use a funnel or pour spout to direct the oil into the opening **(Figure 10b-12, Page 10b-10 or Figure 10b-13, Page 10b-10)**. With filter change, the engine requires:

   - Kawasaki gasoline engines: 1 qt. and 19 oz. (1.5 L) of oil per change.
   - Kubota diesel engines: 3 qt. (2.8 L) of oil per change.

2. Refer to oil viscosity guidelines for selection of oil grade **(Figure 10b-14, Page 10b-12 or Figure 10b-15, Page 10b-12**). **See following CAUTION.**

CAUTION

- **Do not exceed recommended oil capacity. Doing so will decrease engine performance or result in damage to the engine.**

3. Connect the battery cables, positive (+) cable first, and tighten terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

4. With the Forward/Reverse handle in the NEUTRAL position, start and run the engine for a few minutes. Observe both the drain plug and the oil filter from under the vehicle and watch for oil leaks. If a leak is detected, check the tightness of the oil filter and drain plug. Tighten, repair, and/or replace components as necessary. **See following NOTE.**

NOTE: *Wait five minutes after turning off the engine before removing the dipstick.*

5. Remove the dipstick and check the engine oil as a final step. Replace the dipstick.

OIL VISCOSITY

Choose the viscosity according to the temperature as shown in the appropriate oil viscosity chart **(Figure 10b-14, Page 10b-12 or Figure 10b-15, Page 10b-12)**. **See following NOTE.**

NOTE: *Use engine oil with API classification SJ for gasoline engines and CF for diesel engines.*

Using multi-grade oils (5W-20, 10W-30, and 10W-40) will increase oil consumption. If multi-grade oil is used, check the oil level more frequently.

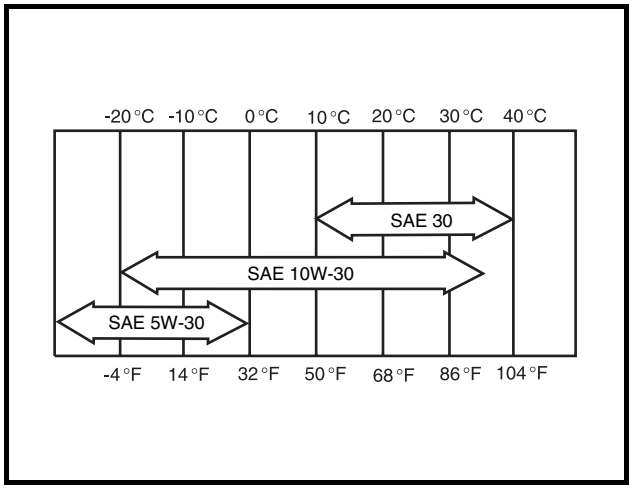


Figure 10b-14 Oil Viscosity Chart – Gasoline

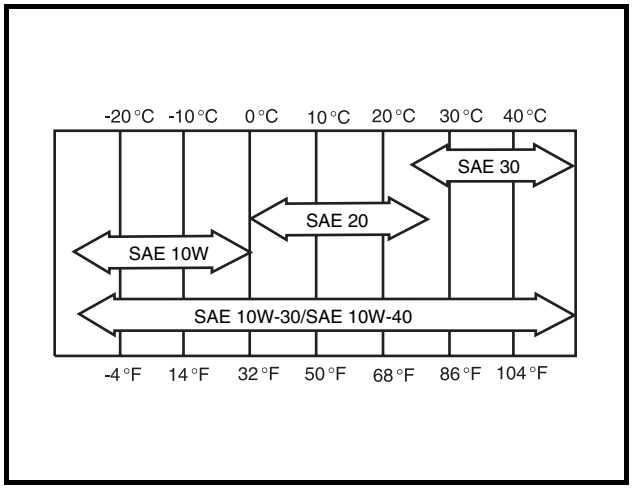


Figure 10b-15 Oil Viscosity Chart – Diesel

SPARK PLUGS

SPARK PLUG CLEANING AND INSPECTION

1. Carefully pull the plug wire from the spark plug and remove the spark plug.
2. If the plug is oily or has carbon built up on it, clean the plug using a high flash-point solvent and a wire brush or other suitable tool.
3. If the spark plug electrodes are corroded or damaged, or if the insulator is cracked, replace the plug with an OEM replacement.

- **Spark Plug Type: NGK BPR2ES**

SPARK PLUG GAP INSPECTION

1. Measure the gap with a wire-type thickness gauge.
2. If the gap is incorrect, carefully bend the side electrode with a suitable tool to obtain the correct gap.

- **Spark Plug Gap: 0.030 in. (0.75 mm)**

GEARCASE LUBRICATION

NOTE: *Dispose of used oil according to the environmental laws and regulations for your area.*

LUBRICATION LEVEL CHECK FOR FRONT DIFFERENTIAL, TRANSMISSION, AND REAR DIFFERENTIAL

Each gearcase component is equipped with two oil port plugs (1 and 2) **(Figure 10b-16, Figure 10b-17, and Figure 10b-18)**. When the vehicle is on a level surface, use the level indicator hole (upper plug) (1) as a lubricant level indicator. Lubricant level should be even with the bottom of level indicator hole (1).

LUBRICATION CHANGE FOR FRONT DIFFERENTIAL, TRANSMISSION, AND REAR DIFFERENTIAL

Use the lower plug (2) for drainage **(Figure 10b-16, Figure 10b-17, and Figure 10b-18)**. Remove both plugs to allow the lubricant to drain faster. **See preceding NOTE.**

Metal particles may be discovered in the fluid or on the magnetic drain plug when changing the differential or transmission fluid. These particles are normal and expected for the first few fluid changes. This is a result of the gears being "net forged", meaning the gears are forged to a shape very close to the final gear size but the teeth are not finish machined prior to assembly. The "finish machining" occurs when the gears make contact under load during vehicle operation. The magnetic drain plug is included in the design to collect the metal particles generated from the gear break in process. This is an established process and is not detrimental to gear service life.

Front differential:

Clean and install the drain plug (2) and washer before filling the front differential with new lubricant **(Figure 10b-16, Page 10b-14)**. Tighten the drain plug to 108 in-lb (12 N·m). Use a funnel when filling the front differential through the lubricant level indicator hole (1). **See Periodic Lubrication Schedule on page 10b-4.** Tighten the level indicator plug to 120 in-lb (14 N·m).

Transmission:

Clean and install the drain plug (2) before filling the transmission with new lubricant **(Figure 10b-17, Page 10b-14)**. Tighten the drain plug to 96 in-lb (11 N·m). Remove the fill plug on the top of the transmission case and use a funnel when filling with lubricant. **See Periodic Lubrication Schedule on page 10b-4.** Apply Loctite 567 to the threads of the fill plug and tighten to 21 ft-lb (28 N·m).

Check the level of lubricant at the level indicator plug (1). Apply Loctite 567 to the threads of the level indicator plug and tighten to 21 ft-lb (28 N·m).

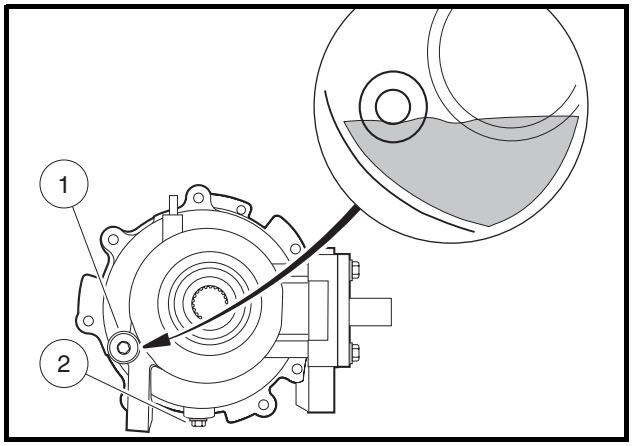


Figure 10b-16 Front Differential Lubrication Level

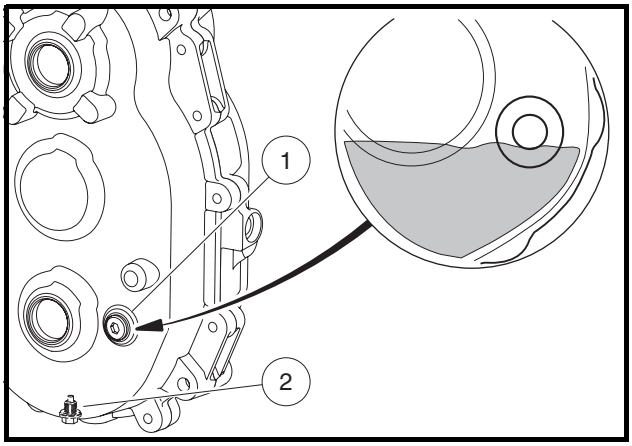


Figure 10b-17 Transmission Lubrication Level

Rear differential:

Clean and install the drain plug (2) and washer before filling the rear differential with new lubricant **(Figure 10b-18, Page 10b-14)**. Tighten the drain plug to 96 in-lb (10.8 N·m). Use a funnel when filling the differential through the lubricant level indicator hole (1). **See Periodic Lubrication Schedule on page 10b-4.** Apply Loctite 567 to the threads of the level indicator plug and tighten to 21 ft-lb (28 N·m).

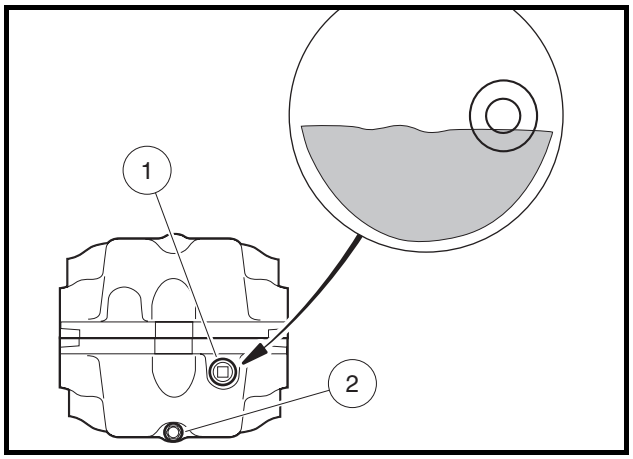


Figure 10b-18 Rear Differential Lubrication Level

HYDRAULIC SYSTEM – INTELLITACH VEHICLE

⚠ WARNING

- **Diesel fuel or hydraulic fluid under pressure can penetrate skin or eyes, causing serious injury or death. Fluid leaks under pressure may not be visible. Use a piece of cardboard or wood to find leaks. Do not use your bare hand. Wear safety goggles. If fluid enters skin or eyes, get immediate medical attention from a physician familiar with this injury.**

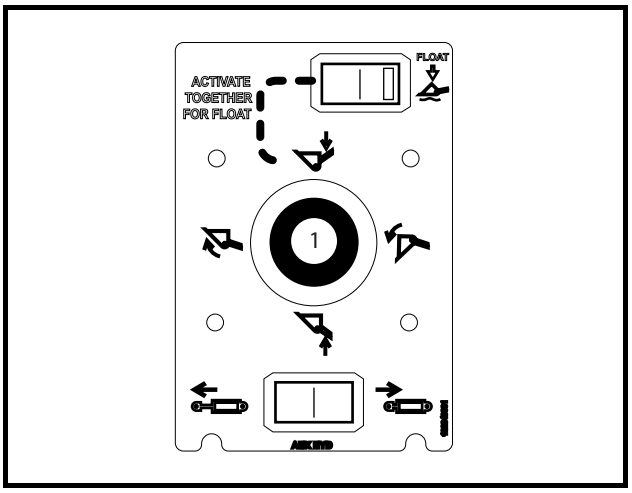


Figure 10b-19 Joystick

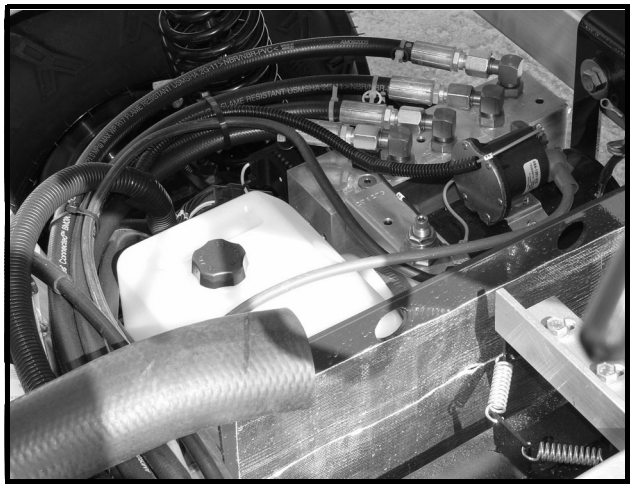


Figure 10b-20 Hydraulic Fluid Tank, Pump and Control Valves

Inspect the hydraulic fluid level daily.

Use only recommended fluid in the hydraulic system. **See IntelliTach Specifications, Section 2b, Page 2b-5.**

1. Lift the cargo box.
2. Turn the start key to the ON position but DO NOT start the engine.
3. Press the joystick ON/OFF switch to ON.
4. Move the joystick (1) back and raise the attachment arm fully **(Figure 10b-19, Page 10b-15)**.
5. Move the joystick (1) to the right and tilt the attachment interface fully in.
6. Press the auxiliary hydraulic rocker switch (2) so that the cylinders are retracted. (If equipped with auxiliary hydraulics).
7. Turn the key to the OFF position.
8. The hydraulic oil level must be between the Maximum Fluid Level and the Minimum Fluid Level lines on the hydraulic tank **(Figure 10b-20)**.
9. If hydraulic oil must be added, thoroughly clean the area around the fill cap. Remove the fill cap and add hydraulic fluid until it is between the Maximum Fluid Level and the Minimum Fluid Level lines.

ENGINE COOLANT – DIESEL VEHICLES

See General Warning, Section 1, Page 1-1.

ENGINE COOLANT LEVEL CHECK

The coolant reserve tank (2) is located under the hood on the passenger side **(Figure 10b-4, Page 10b-7)**. Raise the hood to check the coolant level before every operation.

Check the coolant level of the reserve tank (2). If the coolant is at or below the LOW mark, add pre-mixed coolant until level reaches the FULL mark. If a leak is detected, have it checked by a trained technician. **See following WARNING.**

⚠ WARNING

- **Coolant reservoir and radiator are pressurized. Remove caps slowly to relieve pressure.**
- **Hot! Coolant system is pressurized. Do not remove radiator cap while engine is hot.**

NOTE: *Use a mixture of 45% water and 55% propylene glycol with anti-corrosion additives.*

FUELING INSTRUCTIONS

See General Warning, Section 1, Page 1-1.

⚠ DANGER

- **Turn key switch to the OFF position before fueling.**
- **Never pour fuel into the fuel tank when the engine is hot or while it is running.**
- **To avoid electric arc caused by static electricity, the fuel storage/pumping device must be grounded. If the pump is not grounded, the vehicle must be grounded to the pump before and during the fueling operation.**
- **To avoid the possibility of fire, clean up any spilled fuel before operating the vehicle.**

1. Remove the fuel cap and fill the tank with fuel. Gasoline vehicles have a black fuel cap; diesel vehicles have a green fuel cap. **See preceding DANGER and following NOTE.**

NOTE: ***Gasoline vehicles:*** *Use unleaded gasoline only. Whenever possible, avoid using oxygenated fuels and fuels that are blended with alcohol.*

Diesel vehicles*: Use only diesel fuel grade no. 2 with a cetane rating of 45 or higher.*

2. Replace the fuel cap. Ensure that the cap is tightened securely.
3. Clean any spilled fuel from the cap or around the fuel cap area.

Biodiesel Fuel (Diesel Vehicles Only)

Biodiesel has unique qualities that should be considered before it is used in the Kubota D722 diesel engine. During cold weather, plugged fuel lines, plugged fuel systems, hard starting, and other unknown failures can result from use of this fuel.

Biodiesel is an excellent medium for microbial growth and contamination. Microbial contamination can cause corrosion of the fuel system and prematurely plugged fuel filters. **See following NOTE.**

NOTE: *Use of biodiesel may result in premature failure of fuel system components. Kubota has documented problems such as plugged fuel filters and deteriorated fuel lines during testing of biodiesel.*

Biodiesel can damage painted surfaces. Be sure to remove all spilled fuel immediately to help prevent damage to painted surfaces.

If biodiesel will be used in the Kubota D722 engine, be sure that it meets the following requirements:

- The fuel blend should contain no more than 5% biodiesel by volume.
- The petroleum portion of the fuel blend must meet ASTM standard D975 and the biodiesel portion of the fuel blend must meet ASTM standard D6751.
- For Europe, the fuel blend must meet the EN590 standard. **See following CAUTION.**

CAUTION

- **Never use any fuel that does not meet specifications or fuel in which the contents cannot be identified. Using blends higher than 5% biodiesel content can affect engine life and cause deterioration of hoses, tubelines, injectors, injector pump and seals.**
- **For more information on these fuel standards, please contact your nearest Kubota dealer.**

If biodiesel is used, be sure to apply the following guidelines:

- Ensure the fuel tank is as full as possible at all times to prevent moisture from collecting.
- Ensure that the fuel tank cap is securely tightened to prevent water from entering the fuel tank.
- Drain all water from the fuel filter daily before operating vehicle. **See Draining Water from Fuel Filter.**
- Check the engine oil level daily before the engine is started. **See Engine Oil Level Check on page 10b-8.**
- Before vehicle storage, run the engine with conventional diesel fuel for at least 30 minutes to flush the biodiesel from the engine. **See Preparing the Vehicle for Extended Storage, Section 3, Page 3-3. See following NOTE.**

NOTE: *Biodiesel does not have long-term stability and must not be left in engines longer than three months. This fuel type attracts moisture and may contain higher water content than conventional diesel fuel.*

- Fuel system maintenance, cleaning, and fuel line replacement are required more frequently for engines that are operated with biodiesel.

DRAINING WATER FROM FUEL FILTER

Diesel Vehicles Only

Water should be drained from the fuel filter daily. The fuel filter is mounted on a plate by the lower seat support panel **(Figure 10b-21, Page 10b-18)**.

1. Position a pan under the fuel filter.
2. Lift the passenger-side seat.
3. Locate the valve (1) on the underside of the filter. Turn the valve clockwise until water begins to stream from the filter.
4. Drain the water until it changes color (to fuel). **See following WARNING.**

⚠ WARNING

- **Clean up spilled fuel. Keep sparks and flames away from the vehicle and service area. Failure to heed this warning could result in an explosion or fire, resulting in severe personal injury or death.**

5. Close the valve by rotating it counterclockwise until the valve is firmly sealed.
6. To resupply the filter with fuel, turn the key switch to the ON position for 10 seconds. **See following NOTE.**

NOTE: *Dispose of water according to the environmental laws and regulations for your area.*

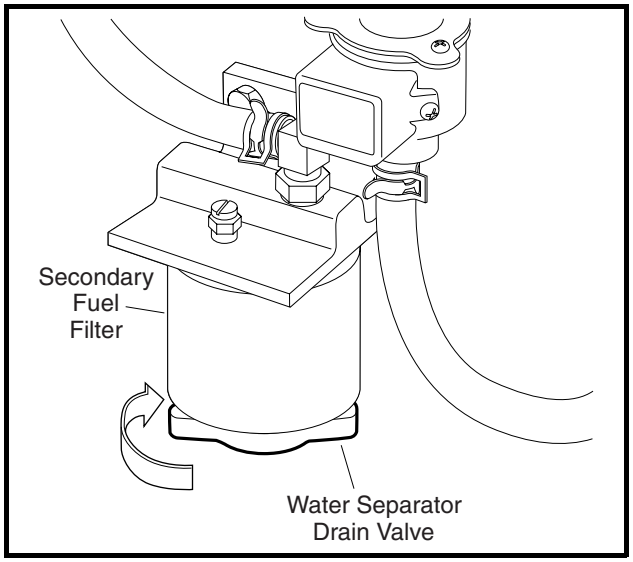


Figure 10b-21 Fuel Filter

BATTERY

For periodic battery maintenance, see Battery on page 12a-17 (gasoline vehicles) or page 12c-21 (diesel vehicles).

SECTION 11A – TROUBLESHOOTING AND ELECTRICAL SYSTEM: KAWASAKI POWERED GASOLINE VEHICLES

⚠ DANGER

- **See General Warning, Section 1, Page 1-1.**

⚠ WARNING

- **See General Warning, Section 1, Page 1-1.**

TROUBLESHOOTING GUIDE

The following troubleshooting guide will be helpful in identifying operating difficulties should they occur. The guide includes the symptom, probable cause(s) and suggested checks.

TROUBLESHOOTING GUIDE

SYMPTOM	POSSIBLE CAUSES	REFER TO
Engine does not start easily.	Spark plug is partially fouled or in poor condition	Spark Plugs on page 10b-12
	Spark plug wire is damaged or loose	See the Kawasaki FH680D engine manual (CCI P/N 103351201).
	Intermittent ignition coil failure	See the Kawasaki FH680D engine manual (CCI P/N 103351201).
	Low cylinder compression	See the Kawasaki FH680D engine manual (CCI P/N 103351201).
	Water or dirt in the fuel system and/or carburetor; dirty or clogged fuel filter	Fuel System on page 13a-9
	Carburetor improperly adjusted	See the Kawasaki FH680D engine manual (CCI P/N 103351201).
	Starter failure	See the Kawasaki FH680D engine manual (CCI P/N 103351201).
	Carburetor solenoid failure	Test Procedure 21 – Carburetor Solenoid Circuit on page 11a-30
	Diode 3 failed open	Test Procedure 8C – Diode 3 on wire 45 and 39 on page 11a-21
	Diode 5 failed open	Test Procedure 8E – Diode 5 on wire 131 and 129 on page 11a-22

Troubleshooting Guide continued on next page...

TROUBLESHOOTING GUIDE

SYMPTOM	POSSIBLE CAUSES	REFER TO
Engine starts but does not run smoothly.	Spark plug is fouled or in poor condition	Spark Plugs on page 10b-12
	Spark plug wire is damaged or loose	See the Kawasaki FH680D engine manual (CCI P/N 103351201).
	Intermittent ignition coil failure	Test Procedure 15 – Ignition Spark on page 11a-26, Test Procedure 16 – Engine Kill Wire on page 11a-27, and Test Procedure 17 – Grounded Kill Wire on page 11a-28
	Water or dirt in the fuel system and/or carburetor; dirty or clogged fuel filter	Fuel System on page 13a-9
	Fuel pump malfunction; fuel pressure to carburetor too low	Fuel System on page 13a-9
Engine turns but fails to start.	Fuel tank is empty	Fuel System on page 13a-9
	Fuel line or filters clogged	Fuel System on page 13a-9
	Fouled spark plug	Spark Plugs on page 10b-12
	Spark plug wire damaged or loose	Section 13a – Kawasaki Gasoline Engine, Muffler, Fuel System, and Clutches
	Engine flooded with fuel as result of excess choking	See owner's manual, Controls and Indicators. See Choke.
	Fuel pump malfunction or failure	Fuel System on page 13a-9
	Ignition coil failure	Test Procedure 15 – Ignition Spark on page 11a-26, Test Procedure 16 – Engine Kill Wire on page 11a-27, and Test Procedure 17 – Grounded Kill Wire on page 11a-28
	Kill circuit grounded	Test Procedure 17 – Grounded Kill Wire on page 11a-28
	Carburetor solenoid failure	Test Procedure 21 – Carburetor Solenoid Circuit on page 11a-30
	Improper idle governor adjustment	Fuel System on page 13a-9
Engine overheats.	Fan screen is partially blocked or plugged	See the Kawasaki FH680D engine manual (CCI P/N 103351201).
	Governor is improperly adjusted	Fuel System on page 13a-9
	Carburetor is too lean; check main jet size	See the Kawasaki FH680D engine manual (CCI P/N 103351201).
Engine pre-ignites.	Excessive carbon deposits on piston head or in combustion chamber	See the Kawasaki FH680D engine manual (CCI P/N 103351201).
	Spark plug heat range is incorrect	Spark Plugs on page 10b-12
	Unsuitable or contaminated fuel	Fuel System on page 13a-9

Troubleshooting Guide continued on next page...

TROUBLESHOOTING GUIDE

SYMPTOM	POSSIBLE CAUSES	REFER TO
Loss of engine power.	Exhaust valve is restricted with carbon deposit	See the Kawasaki FH680D engine manual (CCI P/N 103351201).
	Muffler or exhaust pipe restricted with carbon or other substance	Exhaust System on page 13a-6
	Ignition coil failure	Test Procedure 15 – Ignition Spark on page 11a-26
	Air filter is dirty or clogged	**Air Filter Replacement on page 13a-23**
	Governor is improperly adjusted	Fuel System on page 13a-9
	Throttle linkage out of adjustment	Engine Control Linkages on page 13a-18
	Low cylinder compression	See the Kawasaki FH680D engine manual (CCI P/N 103351201).
	Spark plug failed	Spark Plugs on page 10b-12
	Restricted fuel flow	Fuel System on page 13a-9
	Clutches are not backshifting properly	Clutches on page 13a-27
Spark plug fouls repeatedly.	Incorrect plug	Spark Plugs on page 10b-12
	Unsuitable fuel, or incorrect (rich) fuel mixture	Fuel System on page 13a-9
	Spark plug wire is damaged	See the Kawasaki FH680D engine manual (CCI P/N 103351201).
	Dirt entering combustion chamber	Fuel System on page 13a-9
	Ignition coil failed	See the Kawasaki FH680D engine manual (CCI P/N 103351201).
	Rings are heavily worn, low cylinder pressure	See the Kawasaki FH680D engine manual (CCI P/N 103351201).
Carburetor floods.	Inlet valve or seat is leaking, dirty, worn, or damaged	See the Kawasaki FH680D engine manual (CCI P/N 103351201).
	Float is damaged and filled with gasoline	See the Kawasaki FH680D engine manual (CCI P/N 103351201).
	Carburetor vent is clogged	See the Kawasaki FH680D engine manual (CCI P/N 103351201).
	Float needle valve not functioning properly	See the Kawasaki FH680D engine manual (CCI P/N 103351201).
Starter fails to operate.	Starter control circuit is not operating	Test Procedure 5 – Starter Control Circuit on page 11a-14
	Start relay failure	Test Procedure 6 – Start Relay on page 11a-15
	Fuse is blown	Test Procedure 2 – Fuse on page 11a-12
	Battery is dead	Test Procedure 1 – Battery on page 11a-9
	Charge coil failed	Test Procedure 13 – Charge Coil on page 11a-25

Troubleshooting Guide continued on next page...

TROUBLESHOOTING GUIDE

SYMPTOM	POSSIBLE CAUSES	REFER TO
Starter fails to operate, continued.	Loose or broken wire in charge coil circuit	Test Procedure 13 – Charge Coil on page 11a-25
	Voltage Regulator failure	Test Procedure 14 – Voltage Regulator on page 11a-26
	Starter solenoid or starter motor failure	Test Procedure 5 – Starter Control Circuit on page 11a-14
	Key switch failure	Test Procedure 4 – Key Switch (Starter Circuit) on page 11a-13
	Cylinder and/or crankcase flooded with fuel	See the Kawasaki FH680D engine manual (CCI P/N 103351201).
	Neutral switch failure (failed open)	Test Procedure 9 – Neutral Switch (Transmission) on page 11a-22
	Transmission shifter linkage is binding or is out of adjustment	Forward/Reverse Shifter Cable Adjustment on page 14-17
Charge coil does not charge battery.	Loose or broken wire in charge coil circuit	Test Procedure 13 – Charge Coil on page 11a-25
	Charge coil is shorted (failed closed)	Test Procedure 13 – Charge Coil on page 11a-25
	25-amp fuse is blown	Test Procedure 2 – Fuse on page 11a-12
	Voltage Regulator failure	Test Procedure 14 – Voltage Regulator on page 11a-26
	Battery failure	Test Procedure 1 – Battery on page 11a-9
Transmission does not engage or disengage smoothly.	Transmission shifter linkage is binding or is out of adjustment	Forward/Reverse Shifter Cable Adjustment on page 14-17
	Idle RPM Setting is set too high	Fuel System on page 13a-9
	Insufficient (low) level of lubricant or wrong type of lubricant in transmission	Gearcase Lubrication on page 10b-13
	Internal gears are damaged or worn	See the Engines and Drivetrain Components manual (CCI P/N 102396501).
Excessive vehicle vibration.	Engine mounting nuts or bolts are loose	Section 13a – Kawasaki Gasoline Engine, Muffler, Fuel System, and Clutches
	Misaligned muffler mounting clamp	Exhaust System on page 13a-6
	Damaged drive belt	Clutches on page 13a-27
	Damaged drive clutch	Clutches on page 13a-27
	Damaged driven clutch	Clutches on page 13a-27
	RPM setting is incorrect	Engine RPM Adjustment on page 13a-22
Torque converter does not shift smoothly.	Drive belt is worn, cracked, glazed, or frayed	Drive Belt Removal on page 13a-28
	Drive clutch malfunction	Drive Clutch Cleaning and Inspection on page 13a-30
	Driven clutch malfunction	Drive Clutch Cleaning and Inspection on page 13a-30
	Governor is sticking	Section 13a – Kawasaki Gasoline Engine, Muffler, Fuel System, and Clutches

Troubleshooting Guide continued on next page...

TROUBLESHOOTING GUIDE

SYMPTOM	POSSIBLE CAUSES	REFER TO
Engine won't stop running.	Kill circuit wire is disconnected from the ignition coil	Test Procedure 16 – Engine Kill Wire on page 11a-27
	Key switch failure	Test Procedure 18 – Key Switch (Engine Kill Circuit) on page 11a-28
Low oil warning light stays on.	Oil level sensor failure	See the Kawasaki FH680D engine manual (CCI P/N 103351201).
	Shorted wire harness wire(s)	Test Procedure 22 – Low Oil Warning Light Circuit on page 11a-31
Hour meter does not function.	Failed low oil warning light or oil pressure sensor	Test Procedure 22 – Low Oil Warning Light Circuit on page 11a-31
	Oil pressure switch failed closed	See the Kawasaki FH680D engine manual (CCI P/N 103351201).
	Failed hour meter	Test Procedure 26 – Hour Meter on page 11a-36
Hour meter adds increments with key switch ON and engine not running.	Oil pressure switch failed open	See the Kawasaki FH680D engine manual (CCI P/N 103351201).
Front differential does not engage front wheels.	Failed front drive gearcase engagement coil	Test Procedure 12 – Front Drive Gearcase Coil on page 11a-25
	Failed front differential switch	Test Procedure 11 – Front Differential Limit Switch on page 11a-24
	Front differential switch wires disconnected	Test Procedure 11 – Front Differential Limit Switch on page 11a-24
	Front differential switch wired incorrectly	Test Procedure 11 – Front Differential Limit Switch on page 11a-24
	Neutral switch failure (failed closed)	Test Procedure 9 – Neutral Switch (Transmission) on page 11a-22
	Failed front gearcase	See the Engines and Drivetrain Components manual (CCI P/N 102396501).
10-amp fuse blows repeatedly.	Diode 1 failed closed	Test Procedure 8A – Diode 1 on wire 32 and 35 on page 11a-19
25-amp fuse blows repeatedly.	Diode 4 failed closed	Test Procedure 8D – Diode 4 on wire 130 and 122 on page 11a-21
Starter motor engages when key switch is in the ON position.	Diode 3 failed closed	Test Procedure 8C – Diode 3 on wire 45 and 39 on page 11a-21
Bed lift does not function	Bed lift motor failed	Test Procedure 29 – Bed Lift Motor on page 11a-39
	Bed lift switch failed	Test Procedure 30 – Bed Lift Switch on page 11a-40
	Bed lift circuit breaker failed	Test Procedure 31 – Bed Lift Circuit Breaker on page 11a-41

WIRING DIAGRAM

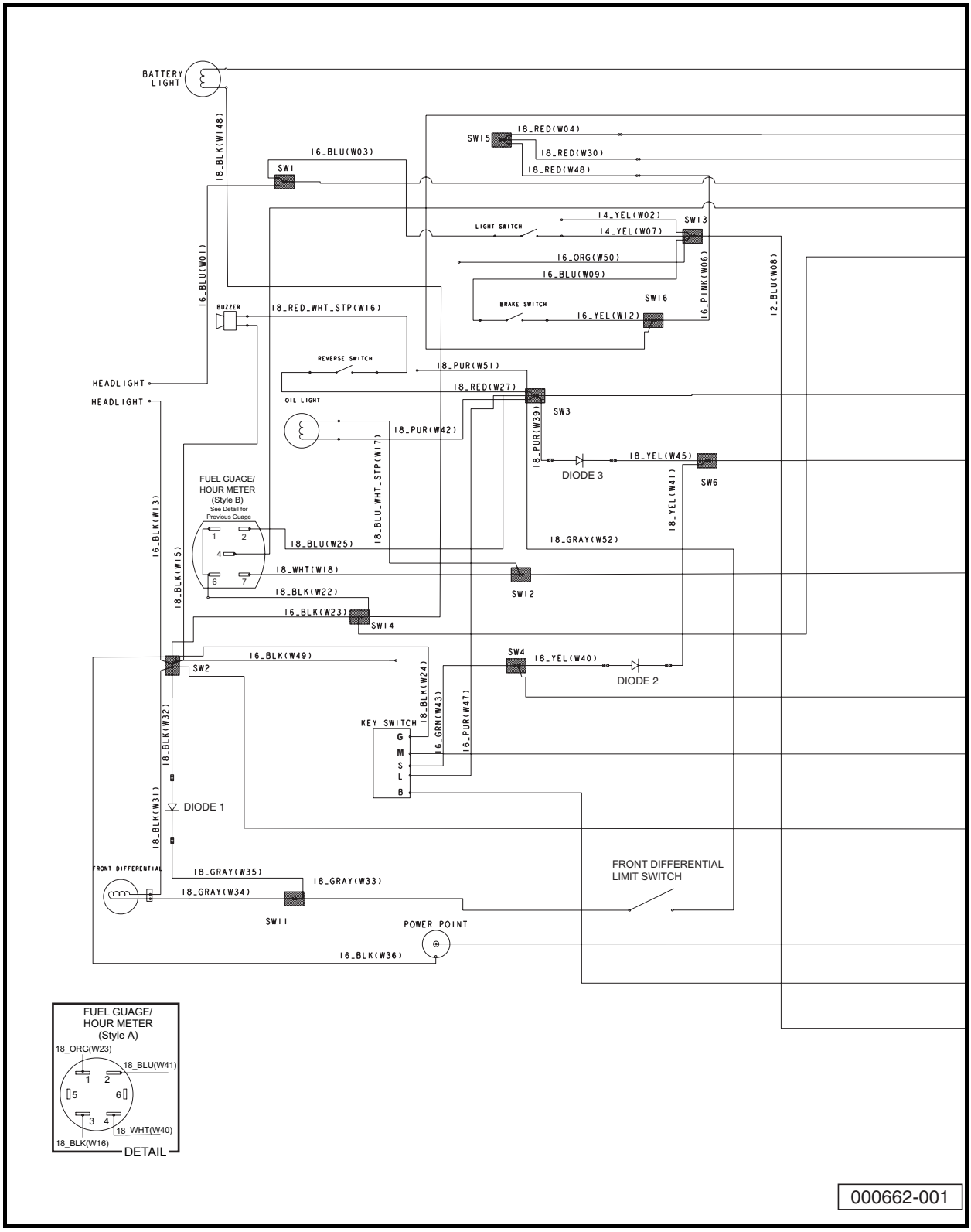


Figure 11a-1 Wiring Diagram – Kawasaki Powered Gasoline Carryall 295 and XRT 1550 Vehicles (Front)

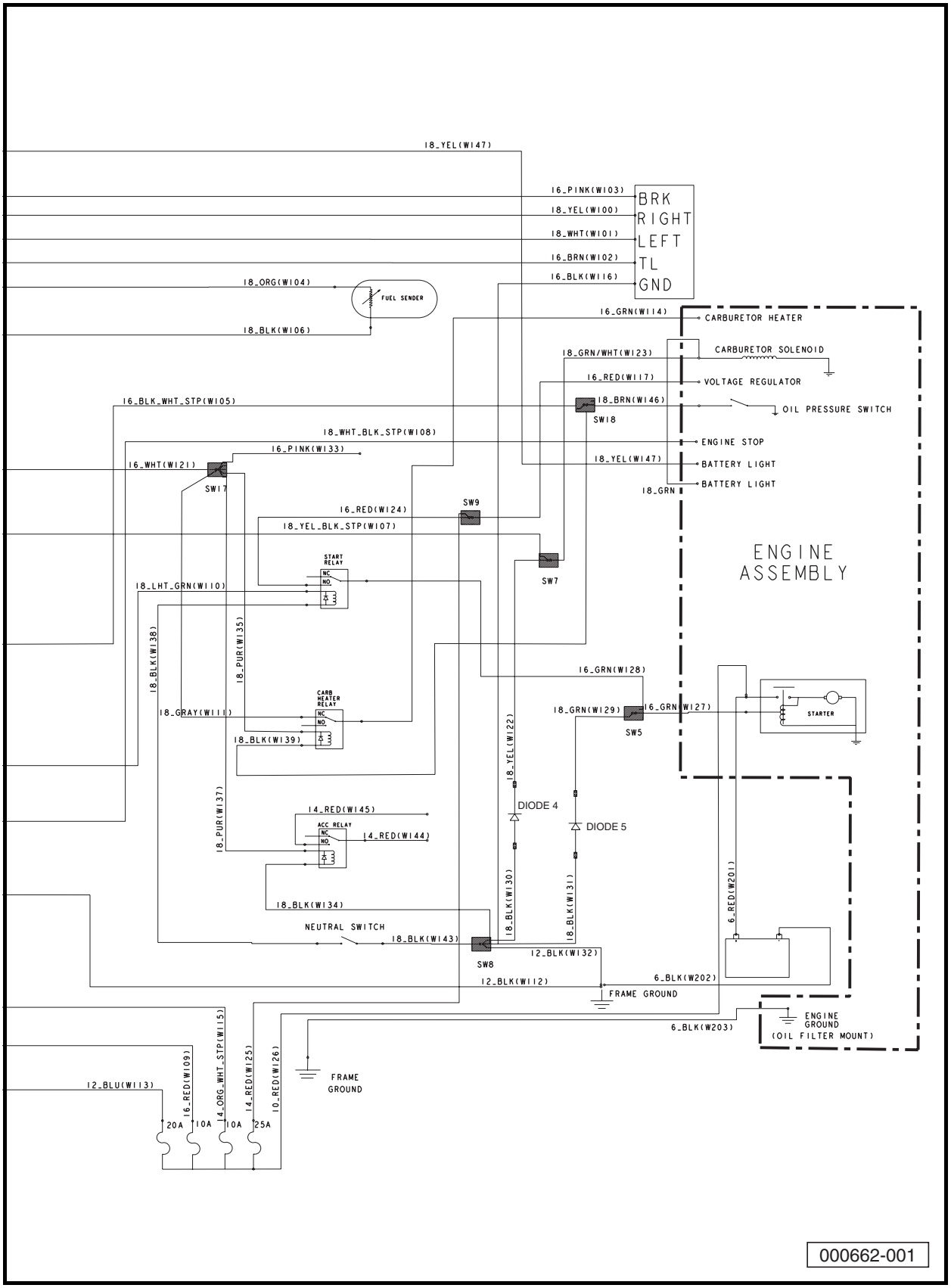


Figure 11a-2 Wiring Diagram – Kawasaki Powered Gasoline Carryall 295 and XRT 1550 Vehicles (Rear)

TEST PROCEDURES

INDEX OF TEST PROCEDURES

TEST PROCEDURE 1 – BATTERY

See General Warning, Section 1, Page 1-1.

⚠ DANGER

- **Due to the danger of an exploding battery, wear a full face shield and rubber gloves when working around a battery.**
- **Battery – Explosive gases! Do not smoke. Keep sparks and flames away from the vehicle and service area. Ventilate when charging or using in an enclosed space. Wear a full face shield and rubber gloves when working on or near batteries. For added protection, cover top of the battery when servicing the vehicle.**
- **Battery – Poison! Contains acid! Causes severe burns! Avoid contact with skin, eyes, or clothing.**
  - **External: Flush with water. Call a physician immediately.**
  - **Internal: Drink large quantities of milk or water. Follow with milk of magnesia or vegetable oil. Call a physician immediately.**
  - **Eyes: Flush with water for 15 minutes. Call a physician immediately.**

NOTE: *The battery must be properly maintained and fully charged in order to perform the following test procedures. Battery maintenance procedures, including watering information and allowable mineral content, can be found in Section 12a of this manual.* ***See Battery, Section 12a, Page 12a-17.***

Test Procedure 1A – Hydrometer Test

A hydrometer (CCI P/N 1011478) measures the specific gravity of battery electrolyte. The higher the specific gravity, the higher the state of charge of the battery. A fully charged battery should read between 1.250 and 1.280 at 80 °F (27 °C). Never add acid to the battery to obtain a higher specific gravity **(Figure 11a-3, Page 11a-10)**. **See following CAUTION.**

CAUTION

- **Do not allow battery acid from battery caps or hydrometer to drip onto the vehicle body. Battery acid will cause permanent damage. Wash off immediately.**

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Check for loose or corroded battery terminal connections. Clean, tighten and replace connections as necessary.
3. Be sure that the battery has sufficient water to cover the plates by approximately 1/2-inch (13 mm) and is fully charged before the test. If water must be added, recharge the battery before performing the hydrometer test **(Figure 11a-4, Page 11a-10)**.
4. Remove the vent cap.
5. Use a battery thermometer (CCI P/N 1011767) to record the electrolyte temperature of a center cell.
6. Squeeze the rubber bulb of the hydrometer and insert it into the cell. Slowly release the bulb, drawing electrolyte up into the glass tube of the hydrometer.
7. Ensure the float rises off the bottom. Adjust the electrolyte level so that the float rides free of the bottom but does not strike the bottom of the rubber bulb. Remove the hydrometer from the cell and release pressure from the bulb.

8. Hold the hydrometer vertically and ensure that the float does not contact the sides of the glass tube. Hold the hydrometer at eye level and read the scale at the level of electrolyte **(Figure 11a-3, Page 11a-10)**.
9. Record the reading.
10. Return the electrolyte to the cell from which it was taken. Replace vent cap.
11. Repeat steps 4 through 10 on all cells.

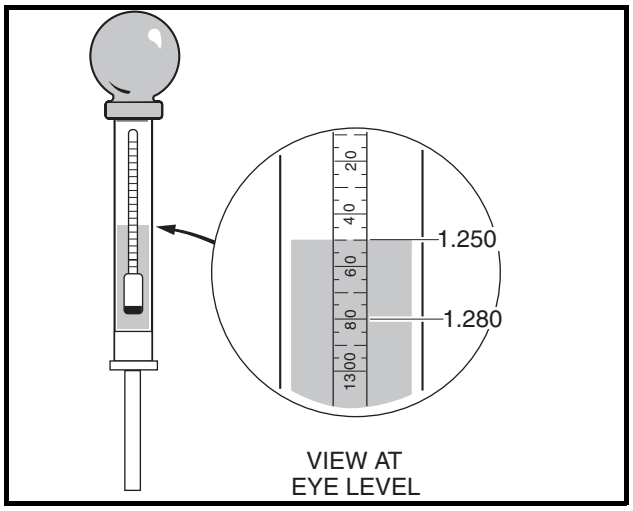


Figure 11a-3 Hydrometer Test

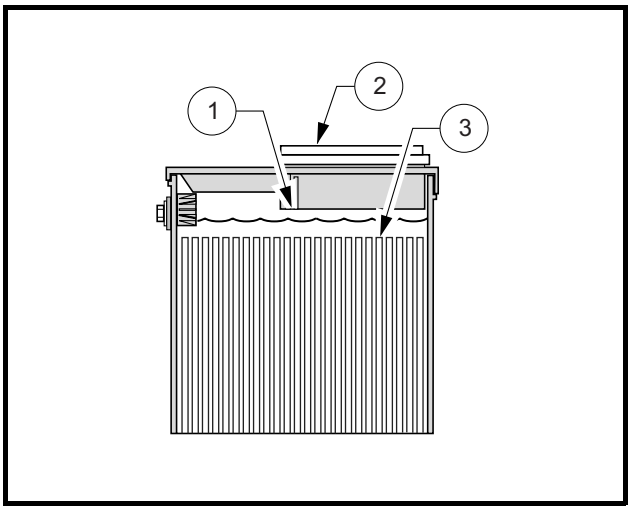


Figure 11a-4 Battery Electrolyte Level

1. Level Indicator 2. Cap 3. Plates
Electrolyte level at least 1/2 inch (13 MM) above plates or to level indicator.

Hydrometer Calibration

Most hydrometers are calibrated to read correctly at 80 °F (27 °C). The readings obtained as described above must be corrected for temperature. For each 10 °F (5.6 °C) above 80 °F (27 °C), add 0.004 to the reading. For each 10 °F (5.6 °C) below 80 °F (27 °C), subtract 0.004 from the reading.

Interpreting the Results of the Hydrometer Test

Use the following table to determine the approximate state of charge:

SPECIFIC GRAVITY (TEMPERATURE CORRECTED)	APPROXIMATE STATE OF CHARGE
1.250-1.280	100%
1.220-1.240	75%
1.190-1.210	50%
1.160-1.180	25%

If the difference between the cells is 0.020 or more, the low cell should be suspected of poor performance. It may require a catch-up charge or it may be a weak cell. When the variations between cells reach 0.050 or more, the battery should be replaced.

Test Procedure 1B – Voltage Test

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Check for loose or corroded battery terminal connections. Clean, tighten and replace connections as necessary.
3. Set the multimeter to the 20 VDC setting.
4. Measure the voltage across the battery terminals. If the reading is less than 12.4 volts, or if the lowest specific gravity reading from the hydrometer test is less than 1.225, recharge the battery. If battery voltage is greater than 12.4 volts and specific gravity is greater than 1.225, the problem is not with the battery. If the battery does not reach 12.4 volts, or if the specific gravity of a cell is still less than 1.225 after charging, replace the battery. **See following NOTE.**

NOTE: *A fully charged battery that is in good condition should have a specific gravity of at least 1.225 in all cells and the difference in the specific gravity of any two cells should be less than 50 points. Open-circuit voltage, the battery voltage with no electrical load, should be at least 12.4 volts.*

Test Procedure 1C – Load Test

NOTE: *Ensure that the battery is fully charged before performing the following test procedure.*

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Check for loose or corroded battery terminal connections. Clean, tighten and replace connections as necessary.
3. Connect a 160-ampere load tester to the battery posts. **See following NOTE.**

NOTE: *If a load tester is not available, a load can be placed on the battery by removing the spark plug wires and activating the starter motor. If this method is used, the voltage must be read when the starter motor is turning.* ***See following CAUTION.***

CAUTION

- **Activating the starter for more than a few seconds could result in damage to the starter motor, the starter, and/or the flywheel gears.**

4. Turn the load tester switch to the ON position.
5. Read the battery voltage after the load tester has been turned ON for 15 seconds. The minimum acceptable battery voltage for proper engine starting is approximately 9.6 VDC.
6. If the battery voltage is acceptable, or if the electrical problem continues after the battery has been replaced, test the electrical circuits.
7. If the voltage reading exceeds 9.6 volts at 70 °F (21 °C) (electrolyte temperature), check the starter. **See the Kawasaki FH680D engine manual (CCI P/N 103351201). See also the following NOTE.**

NOTE: *Record the voltage reading at 70 °F (21 °C). At lower electrolyte temperatures, the voltage reading will be lower.*

8. If the reading is less than 9.6 volts at 70 °F (21 °C) (electrolyte temperature), check the battery electrolyte in each cell. **See Test Procedure 1A – Hydrometer Test on page 11a-9.**

TEST PROCEDURE 2 – FUSE

See General Warning, Section 1, Page 1-1.

The fuse block is located on the electrical component mounting plate **(Figure 11a-5, Page 11a-12)**.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Remove the electrical component cover.
4. Ensure the wires are connected correctly and are tight. If they are not, rewire or tighten as necessary.
5. Remove the fuse to be tested from the fuse block.
6. Connect the probes of a multimeter set to 200 ohms to the fuse terminals. The reading should be continuity. If there is no continuity, determine and repair the cause of the fuse failure. Replace the fuse with a properly rated new one. **See following WARNING.**

⚠ WARNING

- **If a fuse is blown, determine the cause of the failure and make necessary repairs before installing a new fuse. Use the appropriately rated fuse; if a fuse with a higher amp rating is used, damage to the vehicle electrical system may occur.**

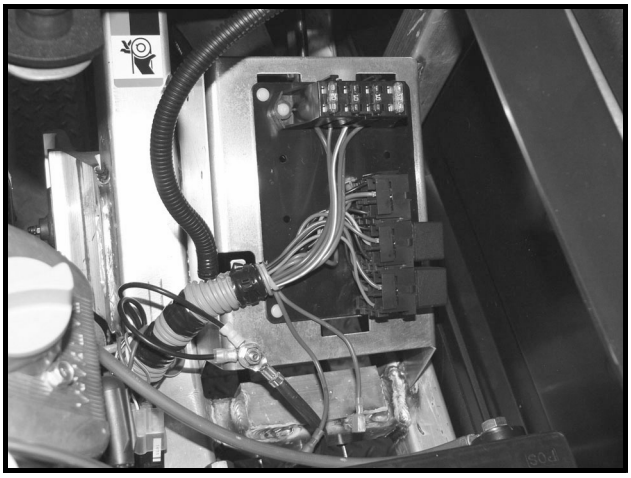


Figure 11a-5 Electrical Component Mounting Plate

TEST PROCEDURE 3 – GROUND CABLES

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Check the frame ground for corrosion, loose connections, and/or damaged terminals **(Figure 11a-6, Page 11a-13)**. Repair or replace as required.

4. Check the negative (–) battery terminal, 6-gauge black wire (w202), and the two 12-gauge black wires (w112 and w132) for damage. Repair or replace as required.
5. Check the engine ground wire (w203), located on the remote oil filter bracket, for corrosion, loose connections, and/or damage **(Figure 11a-7, Page 11a-13)**. Repair or replace as required.
6. Set the multimeter to 200 ohms.
7. Check for continuity between the 6-gauge wire (w202) terminal, disconnected from the negative (–) battery terminal, and the frame.
8. Check for continuity between the 6-gauge wire (w203) terminal, disconnected from the frame, and the engine.
9. The readings obtained in the previous steps should indicate continuity. If any of the readings are incorrect, clean and tighten wire connections. If the connections are good and the reading is incorrect, repair or replace the wire.

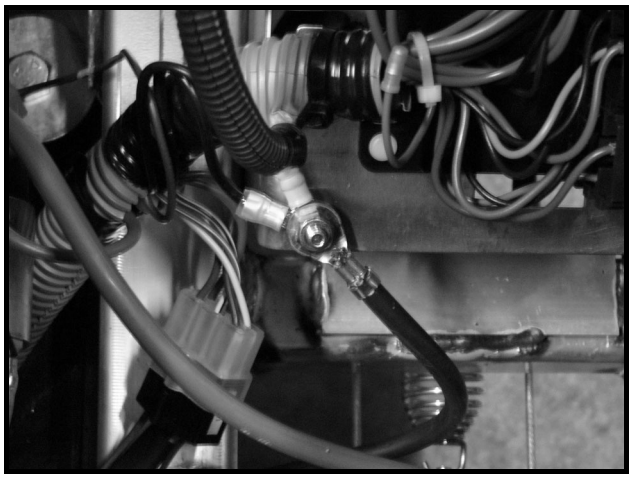


Figure 11a-6 Frame Ground

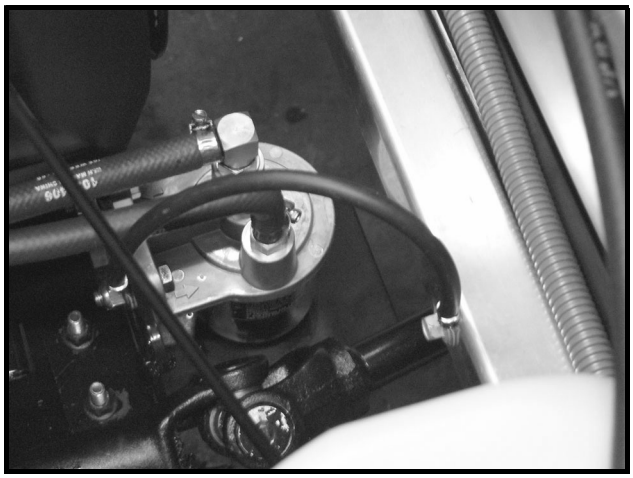


Figure 11a-7 Engine Ground to Frame

TEST PROCEDURE 4 – KEY SWITCH (STARTER CIRCUIT)

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Ensure that the key switch connector is connected correctly and is tight. If it is not, repair or replace as necessary.
4. Remove the key switch. **See Key Switch Removal, Section 12a, Page 12a-7.**
5. Set the multimeter to 200 ohms.
6. Turn the key switch ON. Place the red (+) probe of the multimeter on the (B) terminal and the black (–) probe on the (L) terminal of the key switch. The reading should indicate continuity. If the reading does not indicate continuity, replace the key switch **(Figure 11a-8, Page 11a-14)**. **See Key Switch Removal, Section 12a, Page 12a-7.**

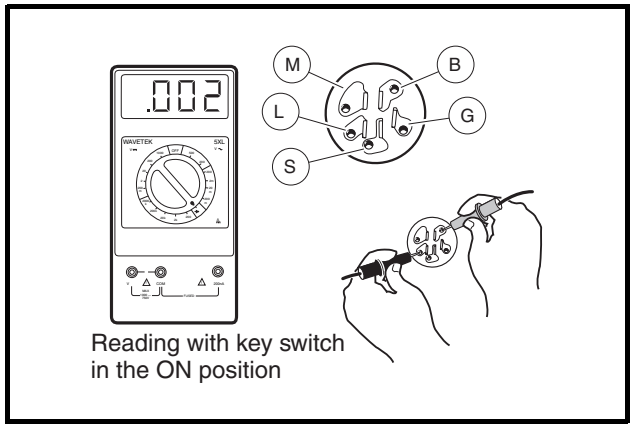


Figure 11a-8 Key Switch Test – Accessory Terminal

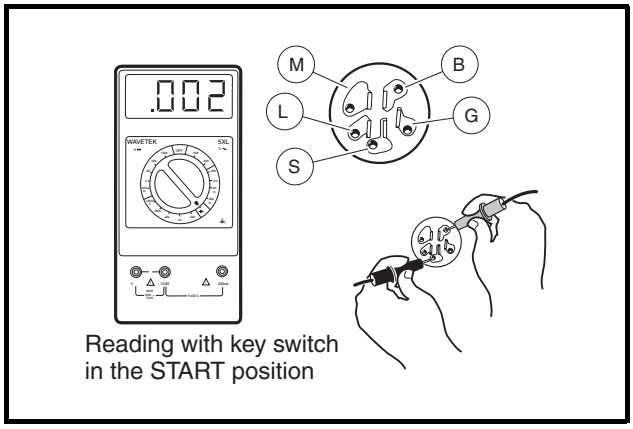


Figure 11a-9 Key Switch Test – Starter Circuit

7. With the key switch still in the ON position, place the red (+) probe of the multimeter on the (B) terminal and the black (–) probe on the (S) terminal of the key switch. The reading should indicate no continuity. If the reading indicates continuity, replace the key switch. **See Key Switch Removal, Section 12a, Page 12a-7.** If the reading does not indicate continuity, leave the probes connected and proceed to step 8.
8. Turn and hold the key switch in the START position. The reading should indicate continuity. If the reading does not indicate continuity, replace the key switch **(Figure 11a-9, Page 11a-14)**. Place the red (+) probe of the multimeter on the (B) terminal and the black (–) probe on the (L) terminal of the key switch, the reading should not indicate continuity. If either reading is not correct, replace the key switch. **See Key Switch Removal, Section 12a, Page 12a-7.**

TEST PROCEDURE 5 – STARTER CONTROL CIRCUIT

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the 16-gauge green wire (w127) from the starter solenoid coil to prevent the vehicle from unintentionally starting **(Figure 11a-10, Page 11a-15)**. **See following WARNING.**

⚠ WARNING

- **Failure to disconnect the wire from the solenoid coil could result in an unexpected engine start when performing this test.**

3. Set the multimeter to 20 VDC.
4. Place the probes to measure the voltage between the 16-gauge green wire (w127) terminal and the frame ground.
5. Monitor the multimeter. The reading should indicate 0 volts with the key in the OFF and ON positions. The reading should indicate approximately 12 VDC when the key is in the START position.

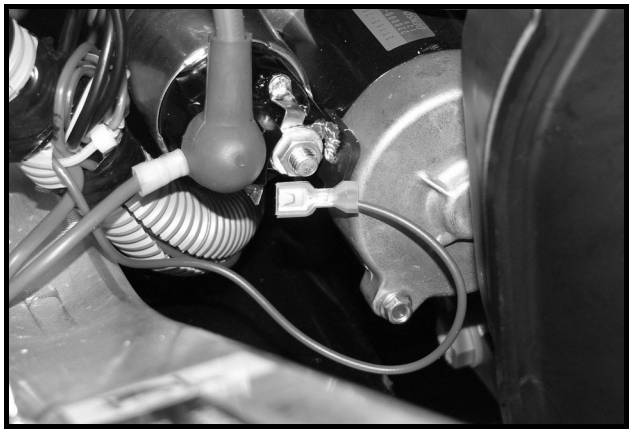


Figure 11a-10 Solenoid Coil Wire (w127) Removed

6. If the readings differ from those described in step 5, perform the following test procedures:
   - Check the battery. **See Test Procedure 1 – Battery on page 11a-9.**
   - Check the 25-amp fuse at the fuse block. **See Test Procedure 2 – Fuse on page 11a-12.**
   - Check the start relay. **See Test Procedure 6 – Start Relay on page 11a-15.**
   - Check diode 5. **See Test Procedure 8E – Diode 5 on wire 131 and 129 on page 11a-22.**
   - Check the neutral switch on the transmission housing. **See Test Procedure 9 – Neutral Switch (Transmission) on page 11a-22.**
   - Check for continuity of the wire harness on wires 127, 129, 128, 124, and 125. **See Wiring Diagram on page 11a-6.**
7. If none of the previous steps resolves the problem, the starter solenoid and/or starter motor has failed. **See the Kawasaki FH680D engine manual (CCI P/N 103351201).**

TEST PROCEDURE 6 – START RELAY

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the 16-gauge green wire (w127) from the starter solenoid coil to prevent the vehicle from unintentionally starting **(Figure 11a-10, Page 11a-15)**. **See following WARNING.**

⚠ WARNING

- **Failure to disconnect the wire from the solenoid coil could result in an unexpected engine start when performing this test.**

3. Set the multimeter to 20 VDC.
4. Place the probes to measure the voltage between the 16-gauge light green start relay wire (w110) terminal and the frame ground **(Figure 11a-11, Page 11a-16)**.
5. Monitor the multimeter. The reading should indicate 0 volts with the key in the OFF and ON positions. The reading should indicate approximately 12 VDC when the key is in the START position and the relay should click. **See following NOTE.**

NOTE: *The carburetor heater and accessory relays (if equipped with accessory relay) may be removed to isolate the sound of the start relay click.*

6. If the reading is 12 VDC and the relay does not click when the key switch is turned to the START position, replace the relay.
7. If the reading is 12 VDC and the relay clicks when the key is in the START position, check the relay contacts.
   7.1. Set the multimeter to 200 ohms.
   7.2. Check for continuity between the 16-gauge red wire (w124) and the 16-gauge green wire (w128) start relay terminals **(Figure 11a-12, Page 11a-16)**.
   7.3. Monitor the multimeter. The multimeter should not indicate continuity with the key in the OFF or ON positions. The multimeter should indicate continuity when the key is in the START position.
   7.4. If the multimeter does not indicate continuity while the key is in the START position and the relay clicks, the contacts have failed. Replace the relay.

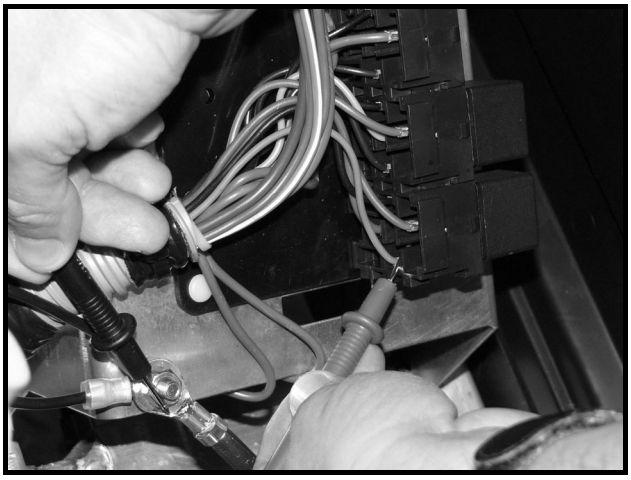


Figure 11a-11 Start Relay Coil Circuit Test

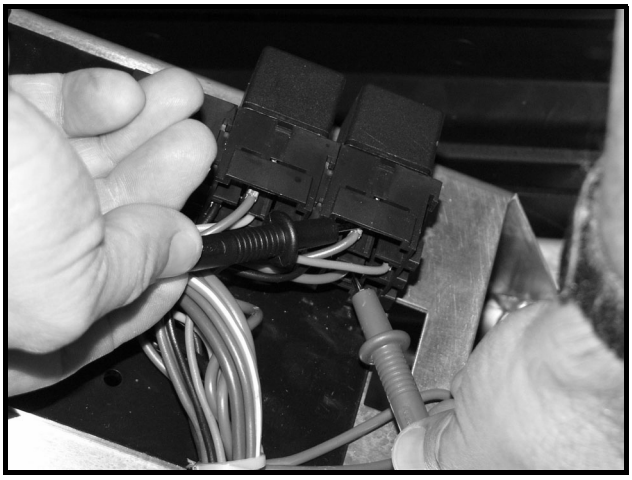


Figure 11a-12 Start Relay Contact Test

8. If the reading obtained in step 5 is not 12 VDC with the key in the START position, perform the following test procedures:

- Check battery. **See Test Procedure 1 – Battery on page 11a-9.**
- Check the 10-amp fuse (on w109). **See Test Procedure 2 – Fuse on page 11a-12.**
- Check the key switch. **See Test Procedure 4 – Key Switch (Starter Circuit) on page 11a-13.**
- Check the neutral switch on the transmission housing. **See Test Procedure 9 – Neutral Switch (Transmission) on page 11a-22.**
- Check for continuity of the wire harness on wires w138, w110, and w43. **See Wiring Diagram on page 11a-6.**

TEST PROCEDURE 7 – CARBURETOR HEATER RELAY

See General Warning, Section 1, Page 1-1.

NOTE: *Keep the battery connected during this test procedure.*

The carburetor heater relay is activated by the oil pressure switch to ensure the carburetor heater is only used while the engine is running.

1. Turn the key switch OFF. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Set the multimeter to 20 VDC.

3. Place the probes to measure the voltage between the 18-gauge purple relay wire (w135) terminal and the frame ground **(Figure 11a-13, Page 11a-17)**.
4. Monitor the multimeter. The reading should indicate 0 volts with the key off. The reading should indicate approximately 12 VDC with the key on.
5. If the reading is 12 VDC and the relay does not click when the engine starts, replace the relay.

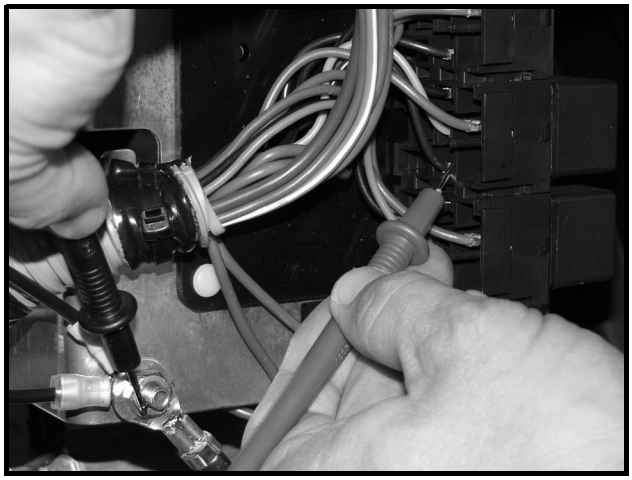


Figure 11a-13 Carburetor Heater Relay Coil Circuit Test

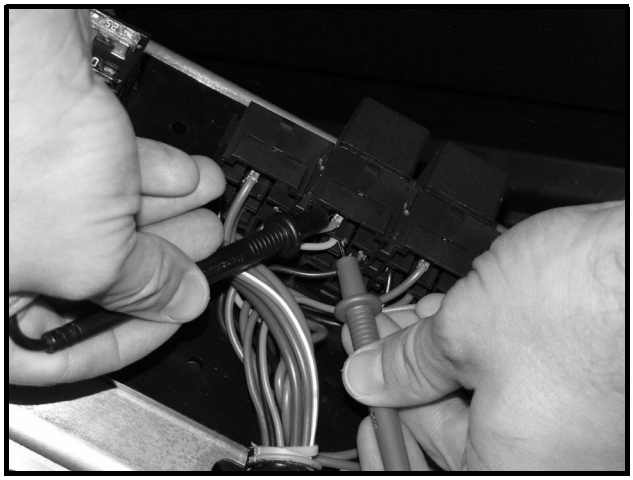


Figure 11a-14 Carburetor Heater Relay Contact Test

6. If the reading is 12 VDC and the relay clicks when the engine starts, check the relay contacts.
   6.1. Set the multimeter to 200 ohms.
   6.2. Check for continuity between the 18-gauge gray wire (w111) and the 16-gauge green wire (w114) relay terminals **(Figure 11a-14, Page 11a-17)**.
   6.3. Monitor the multimeter. The multimeter should NOT indicate continuity with the key in the ON position and the engine off. The multimeter should indicate continuity when the engine starts.
   6.4. If the multimeter indicates continuity while the key is in the ON position and the engine is off, the contacts have failed closed. Replace the relay.
7. If the reading obtained in step 5 is not 12 VDC when the engine starts, perform the following test procedures:

- Check the battery. **See Test Procedure 1 – Battery on page 11a-9.**
- Check the oil pressure switch. **See the Kawasaki FH680D engine manual (CCI P/N 103351201).**
- Check the 10-amp fuse (on w109). **See Test Procedure 2 – Fuse on page 11a-12.**
- Check the key switch. **See Test Procedure 4 – Key Switch (Starter Circuit) on page 11a-13.**
- Check the neutral switch on the transmission housing. **See Test Procedure 9 – Neutral Switch (Transmission) on page 11a-22.**
- Check for continuity of the wire harness on wires w139, w135, and w47. **See Wiring Diagram on page 11a-6.**

TEST PROCEDURE 8 – WIRE HARNESS DIODES

See General Warning, Section 1, Page 1-1.

A diode is designed to conduct current in one direction only. Depending on the application, diodes are used in the vehicle to control electrical system logic, or to help protect relay and switch contacts from excessive arcing. **See following NOTE.**

NOTE: *If a diode conducts current in both directions, the diode has failed closed. If a diode will not conduct current in either direction, the diode has failed open* ***(Figure 11a-15, Page 11a-18)****.*

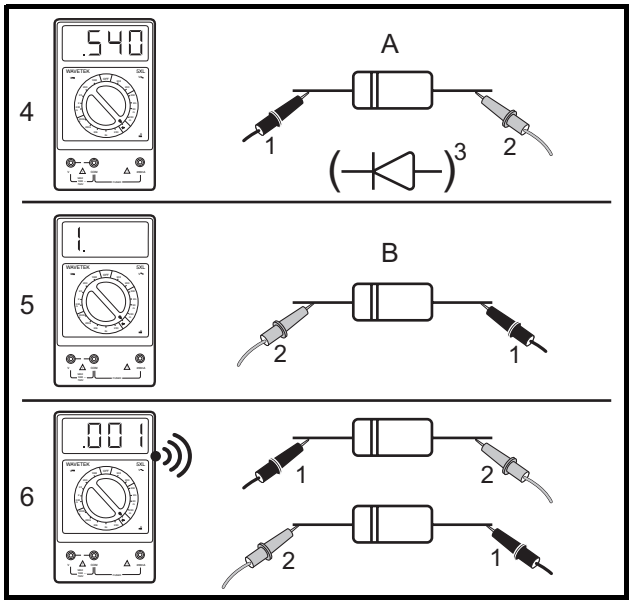


Figure 11a-15 Basic Diode Information

1. VOM Black Lead 2. VOM Red Lead 3. Wiring Diagram Symbol with Diode Stripe Orientation 4. Good Diode (Probe Scenario A) - Conducts Current and Shows Continuity 5. Good Diode (Probe Scenario B) - No Continuity 6. Bad Diode - Meter Beeps In Either Direction (Probe Scenarios A and B)

The wire harness is equipped with several in-line diodes. The following table describes each diode's function in the electrical system, the location in the wire harness, and the symptom(s) of a diode failure.

DIODE TROUBLESHOOTING GUIDE

DIODE	IN-LINE WIRE LOCATION (WIRES)	FUNCTION	FAILURE CONDITION	SYMPTOM/COMMENT
Diode 1	w32 and w35	Front differential coil flyback diode	Open	Will contribute to the premature failure of the limit switch.
			Closed	The 10-amp fuse (on w109) will blow repeatedly, with the key ON & pedal depressed, until the diode has been replaced.
Diode 2	w40 and w41	Blocking diode for carburetor solenoid control (powers carburetor solenoid when key switch is in the START position)	Open	Difficult starting or not start at all
			Closed	Starter will be activated when key switch is in the ON position.
Diode 3	w45 and w39	Carburetor solenoid control (powers carburetor solenoid when key switch is in the ON position)	Open	Difficult starting and engine will shut off shortly after key switch is moved from the START to ON position.
			Closed	Oil light may illuminate when key is in START position until oil pressure rises. Hour meter will be powered when key switch is in the START position.
Diode 4	w130 and w122	Carburetor solenoid coil flyback diode	Open	Will contribute to the premature failure of the key switch contacts.
			Closed	The 10-amp fuse (on w109) will blow repeatedly, when key is in ON position, until the diode has been replaced.
Diode 5	w131 and w129	Starter solenoid coil flyback diode	Open	Will contribute to the premature failure of the start relay contacts.
			Closed	The 25-amp fuse (on w125) will blow repeatedly, when key is in START position, until the diode has been replaced.

Test Procedure 8A – Diode 1 on wire 32 and 35

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Disconnect the two-pin connector between the front gearcase and the wire harness.
4. Set the multimeter to the diode test function (→|←).
5. Connect the black (–) probe of the multimeter to the frame (ground).
6. Connect the red (+) probe of the multimeter to the 18-gauge gray wire (w34) on the two-pin connector (wire harness side).
7. The reading should indicate an over limit (no continuity). If the diode conducts current (shows continuity, e.g. beeps) with the meter probes connected as described, the diode has failed and must be replaced. **See Wire Harness Diode Removal, Section 12a, Page 12a-16.**

8. Reverse the multimeter probes and note the reading. The multimeter should indicate approximately 540 mV, however, a range of 400-700 mV is acceptable.
9. If the readings obtained in the previous steps are incorrect, replace the diode. **See Wire Harness Diode Removal, Section 12a, Page 12a-16.**

Test Procedure 8B – Diode 2 on wire 40 and 41

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Remove the start relay from the multi-pin connector located on the electrical component mounting plate.
4. Disconnect the bullet connector in the carburetor solenoid green wire **(Figure 11a-16, Page 11a-20)**.
5. Set the multimeter to the diode test function (→|←).
6. Connect the black (–) probe of the multimeter to the 18-gauge light-green wire (w110) at the start relay multi-pin connector.
7. Connect the red (+) probe of the multimeter to the female side of the carburetor solenoid bullet connector.
8. The reading should indicate an over limit (no continuity). If the diode conducts current (shows continuity) with the meter probes connected as described, the diode has failed and must be replaced. **See Wire Harness Diode Removal, Section 12a, Page 12a-16.**
9. Reverse the multimeter probes and note the reading. The multimeter should indicate approximately 540 mV, however, a range of 400-700 mV is acceptable.
10. If the readings obtained in the previous steps are incorrect, replace the diode. **See Wire Harness Diode Removal, Section 12a, Page 12a-16.**

Figure 11a-16 Carburetor Solenoid Bullet Connector

Test Procedure 8C – Diode 3 on wire 45 and 39

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Raise the hood and disconnect the multi-pin connector from the key switch.
4. Disconnect the bullet connector in the carburetor solenoid green wire **(Figure 11a-16, Page 11a-20)**.
5. Disconnect the 18-gauge purple wire (w42) from the oil light.
6. Disconnect the 18-gauge blue wire (w25) from the fuel gauge/hour meter.
7. Remove the starter relay, carburetor heater relay and, if equipped, the accessory relay from the multi-pin connector located on the electrical component mounting plate.
8. Set the multimeter to the diode test function (→|←).
9. Connect the black (–) probe of the multimeter to the 18-gauge purple wire (w47) at the key switch multi-pin connector.
10. Connect the red (+) probe of the multimeter to the female side of the carburetor solenoid bullet connector.
11. The reading should indicate an over limit (no continuity). If the diode conducts current (shows continuity) with the meter probes connected as described, the diode has failed and must be replaced. **See Wire Harness Diode Removal, Section 12a, Page 12a-16.**
12. Reverse the multimeter probes and note the reading. The multimeter should indicate approximately 540 mV, however, a range of 400-700 mV is acceptable.
13. If the readings obtained in the previous steps are incorrect, replace the diode. **See Wire Harness Diode Removal, Section 12a, Page 12a-16.**

Test Procedure 8D – Diode 4 on wire 130 and 122

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Raise the hood and disconnect the multi-pin connector from the key switch.
4. Disconnect the bullet connector in the carburetor solenoid green wire **(Figure 11a-16, Page 11a-20)**.
5. Set the multimeter to the diode test function (→|←).
6. Connect the black (–) probe of the multimeter to the frame (ground).
7. Connect the red (+) probe of the multimeter to the female side of the carburetor solenoid bullet connector.
8. The reading should indicate an over limit (no continuity). If the diode conducts current (shows continuity) with the meter probes connected as described, the diode has failed and must be replaced. **See Wire Harness Diode Removal, Section 12a, Page 12a-16.**

9. Reverse the multimeter probes and note the reading. The multimeter should indicate approximately 540 mV, however, a range of 400-700 mV is acceptable.
10. If the readings obtained in the previous steps are incorrect, replace the diode. **See Wire Harness Diode Removal, Section 12a, Page 12a-16.**

Test Procedure 8E – Diode 5 on wire 131 and 129

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Raise the hood and disconnect the multi-pin connector from the key switch.
4. Disconnect the six wire engine harness connector located near the starter **(Figure 11a-23, Page 11a-27)**.
5. Disconnect the 16-gauge green wire (w127) from the starter solenoid coil **(Figure 11a-10, Page 11a-15)**.
6. Set the multimeter to the diode test function (→|←).
7. Connect the black (–) probe of the multimeter to the frame (ground).
8. Connect the red (+) probe of the multimeter to the 16-gauge green wire (w127) at the spade connector.
9. The reading should indicate an over limit (no continuity). If the diode conducts current (shows continuity) with the meter probes connected as described, the diode has failed and must be replaced. **See Wire Harness Diode Removal, Section 12a, Page 12a-16.**
10. Reverse the multimeter probes and note the reading. The multimeter should indicate approximately 540 mV, however, a range of 400-700 mV is acceptable.
11. If the readings obtained in the previous steps are incorrect, replace the diode. **See Wire Harness Diode Removal, Section 12a, Page 12a-16.**

TEST PROCEDURE 9 – NEUTRAL SWITCH (TRANSMISSION)

See General Warning, Section 1, Page 1-1.

The neutral switch is located on the transmission housing.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Disconnect the two-pin connector between the neutral switch and the wire harness (w138 and w143) **(Figure 11a-17, Page 11a-23)**.
4. Check for continuity on the switch contacts with the Forward/Reverse handle in the FORWARD position **(Figure 11a-18, Page 11a-23)**. The multimeter should indicate no continuity.

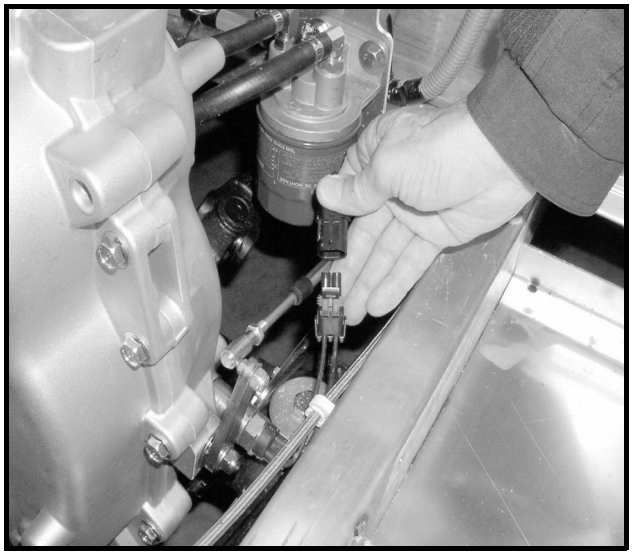


Figure 11a-17 Neutral Switch Two-Pin Connector

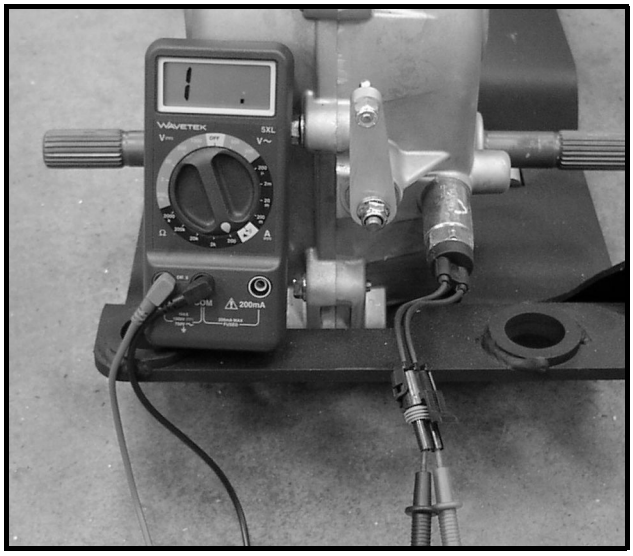


Figure 11a-18 Neutral Switch – Forward Position

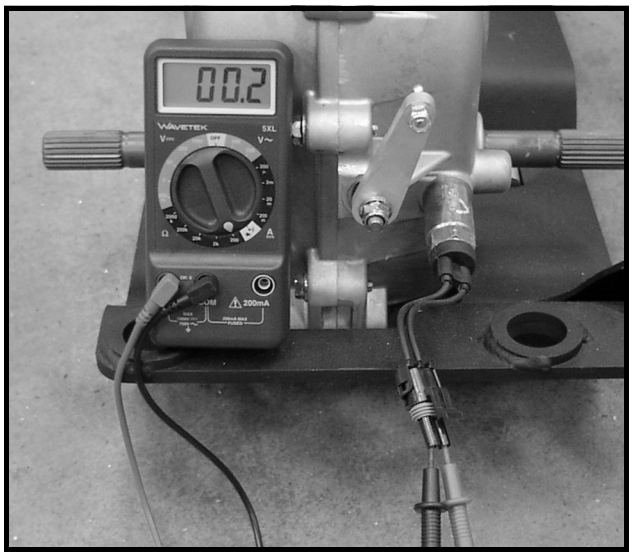


Figure 11a-19 Neutral Switch – Neutral Position

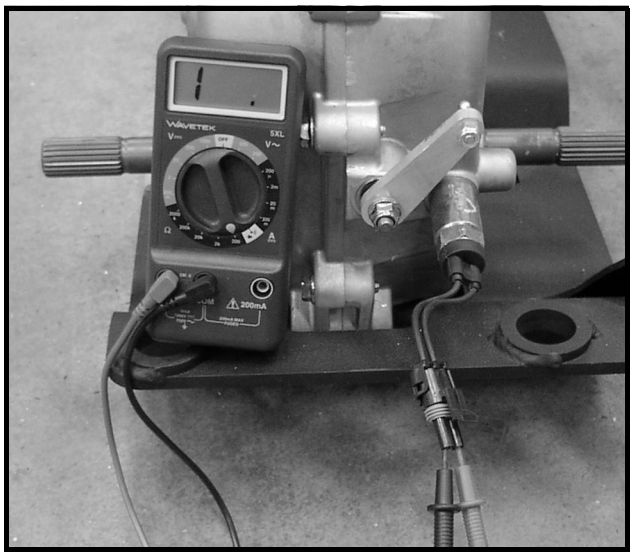


Figure 11a-20 Neutral Switch – Reverse Position

5. Check for continuity on the switch contacts with the Forward/Reverse handle in the NEUTRAL position **(Figure 11a-19, Page 11a-23)**. The multimeter should indicate continuity.
6. Check for continuity on the switch contacts with the Forward/Reverse handle in the REVERSE position **(Figure 11a-20, Page 11a-23)**. The multimeter should indicate no continuity.
7. If any of the continuity readings are incorrect, replace the neutral switch. **See Neutral Switch Removal on page 12a-2.**

TEST PROCEDURE 10 – WIRE CONTINUITY

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. To test a wire for continuity, disconnect either end from the electrical component to which it is attached.
4. Set the multimeter to 200 ohms and place the red (+) probe on the terminal at one end of the wire. Place the black (–) probe on the other terminal end of the wire. The reading should indicate continuity. If the reading is incorrect, repair or replace the wire. **See following NOTE.**

NOTE: *When checking continuity of wires in the wire harness, observe the polarity of diodes. Testing continuity of certain wires will require the appropriate diode test procedure.* ***See Test Procedure 8 – Wire Harness Diodes on page 11a-18.***

TEST PROCEDURE 11 – FRONT DIFFERENTIAL LIMIT SWITCH

See General Warning, Section 1, Page 1-1.

NOTE: *Keep the battery connected during this test procedure.*

The front differential limit switch is located under the hood where the accelerator pedal mounts to the chassis.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Check for proper wiring and tight connections at the front differential limit switch **(Figure 11a-21, Page 11a-24)**.

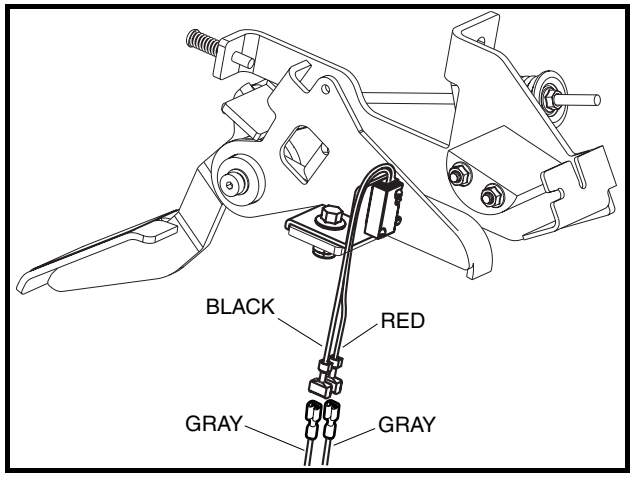


Figure 11a-21 Front Differential Switch

3. Move the accelerator pedal and listen for an audible click from the switch. If there is no click, check the limit switch for proper alignment and switch arm movement.
4. Place the red (+) probe of the multimeter on one terminal and the black (–) probe on the other terminal of the switch. With the accelerator pedal fully released, the reading should be no continuity.

5. Apply the accelerator pedal to activate the switch. The multimeter should indicate continuity when the switch lever is activated. If either reading is incorrect, replace the switch. **See Front Differential Limit Switch Removal on page 12a-13.**

TEST PROCEDURE 12 – FRONT DRIVE GEARCASE COIL

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Disconnect the two-pin connector between the wire harness and the front drive gearcase located under the hood.
4. Set the multimeter to 200 ohms.
5. Measure the resistance between the two wires at the two-pin connector (front drive gearcase side).
6. The resistance should be 24.7 to 27.3 ohms.
7. If the resistance is not within the stated range, replace the large output cover sub-assembly. **See the Engines and Drivetrain Components manual (CCI P/N 102396501).**

TEST PROCEDURE 13 – CHARGE COIL

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Disconnect the 3-pin connector from the voltage regulator.
4. Measure the resistance of the charge coil on the two white wires of the multi-pin connector **(Figure 11a-22, Page 11a-26)**. The resistance should be .01 - .1 ohm.
5. If the resistance is high, or the multimeter indicates an over limit (no continuity), the coil has failed. **See the Kawasaki FH680D engine manual (CCI P/N 103351201).**

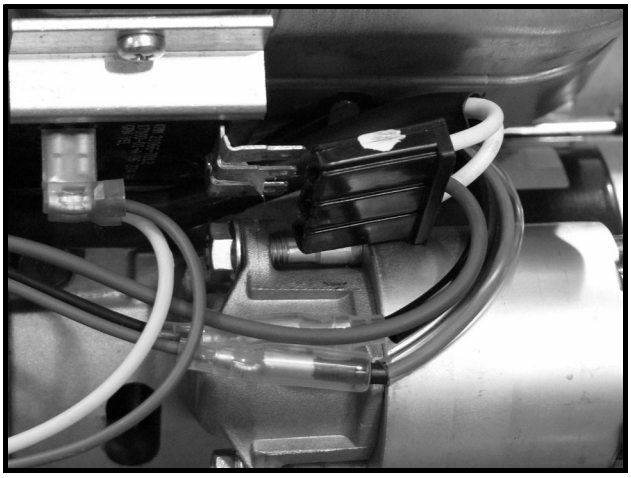


Figure 11a-22 Charge Coil Test (At Voltage Regulator Multi-Pin Connector)

TEST PROCEDURE 14 – VOLTAGE REGULATOR

See General Warning, Section 1, Page 1-1.

NOTE: *Keep the battery connected during this test procedure.*

1. Turn the key switch OFF. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Ensure that the wires are connected correctly and are tight. If they are not, rewire or tighten as necessary.
3. Check the engine RPM setting to ensure that it is adjusted correctly. **See Engine RPM Adjustment, Section 13a, Page 13a-22.**
4. With the battery in good condition and fully charged, run the engine for several minutes to bring the voltage regulator to operating temperature.
5. Set the multimeter for 20 VDC.
6. With the engine running at full-governed RPM, measure the battery voltage at the battery posts. If the reading is between 14.0 and 15.0 volts, the regulator is good. If the reading is lower than 14.0 volts but rising steadily, check the battery condition. **See Test Procedure 1 – Battery on page 11a-9.**
7. If the reading is less than 14.0 volts and not rising, check the charge coil. **See Test Procedure 13 – Charge Coil on page 11a-25.** Also check for a loose connection at the voltage regulator 3-pin connector and check the continuity of each wire in the voltage regulator 3-pin connector.
8. If the reading is more than 15.0 volts and continues to rise, replace voltage regulator. **See Voltage Regulator Removal on page 12a-4.**

TEST PROCEDURE 15 – IGNITION SPARK

See General Warning, Section 1, Page 1-1.

NOTE: *Keep the battery connected during this test procedure.*

1. Turn the key switch OFF. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Remove the spark plug wire from one of the spark plugs.
3. Use an ignition spark gap test tool (Thexton 404 or equivalent) to check for correct spark.

4. Adjust tester probes to approximately 18,000 volts (18 Kv), setting (SE – Small Engine Setting on the Thexton 404 tool). Connect tester to spark plug wire and connect alligator clip to a solid engine ground.
5. If there is a strong blue spark between the probes of the spark gap tester, stop the engine and perform the test on the remaining spark plug.
6. There should be a strong blue spark between the probes of the spark gap tester when both spark plug circuits are tested. If there is no spark on either of the ignition circuits, or if either of the sparks is a faint yellow or red color, test the ignition circuit components. **See the Kawasaki FH680D engine manual (CCI P/N 103351201).**
7. If the spark gap tester tool indicates a strong blue spark, it is possible the spark plug has failed internally. Install a new spark plug set to the proper gap setting and test the engine for proper operation. **See Spark Plugs, Section 10b, Page 10b-12.**

TEST PROCEDURE 16 – ENGINE KILL WIRE

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Disconnect the six wire engine harness connector located near the starter **(Figure 11a-23, Page 11a-27)**.
4. Connect the red (+) probe of the multimeter to the white/black wire terminal of the six wire connector and connect the black (–) probe to the vehicle frame (ground). The multimeter should indicate continuity with the key switch in the OFF position.
5. With the Forward/Reverse handle in the NEUTRAL position, insert the key and turn the key switch to the ON position. Note the multimeter reading. Turn the key and hold it in the START position. Note the multimeter reading.
6. There should be no continuity when the key switch is in the ON or START position. If continuity is indicated, check for worn insulation on the white/black wire that grounds the wire to the frame. **See Test Procedure 17 – Grounded Kill Wire on page 11a-28.** Also check the key switch for proper operation. **See Test Procedure 18 – Key Switch (Engine Kill Circuit) on page 11a-28.**

Figure 11a-23 Engine Harness Connector

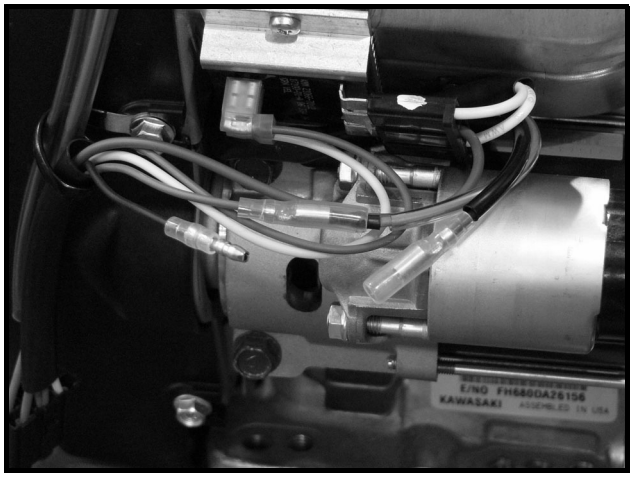


Figure 11a-24 Engine Kill Wire

TEST PROCEDURE 17 – GROUNDED KILL WIRE

See General Warning, Section 1, Page 1-1.

NOTE: *Keep the battery connected during this test procedure.*

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the engine kill black wire of engine harness at the bullet connector located near the starter **(Figure 11a-24, Page 11a-27)**. **See following NOTE.**

NOTE: *Disconnecting the engine kill wire removes the engine ignition circuit from the vehicle start/stop circuit.*

3. Turn the key switch to the START position and release it after the engine starts. If the engine starts and continues to idle, check the kill wire for grounding. **See Test Procedure 16 – Engine Kill Wire on page 11a-27. See following WARNING.**

⚠ WARNING

- **When the black engine kill wire is disconnected, the engine will not stop running immediately after the key switch is turned to the OFF position. It will be necessary to pull and hold the choke handle until the engine stops running.**

4. Also check the key switch for proper operation. **See Test Procedure 18 – Key Switch (Engine Kill Circuit) on page 11a-28. See preceding WARNING.**
5. If the engine does not run, connect the black wire at the bullet connector located near the starter and proceed to Test Procedure 15 – Ignition Spark on page 11a-26.

TEST PROCEDURE 18 – KEY SWITCH (ENGINE KILL CIRCUIT)

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Raise the hood.
4. Remove the connector from the key switch.
5. Place the red (+) probe on the (M) terminal and the black (–) probe on the (G) terminal. With the key switch OFF, the reading should indicate continuity. With the key switch turned ON, the reading should indicate no continuity. If either reading is incorrect, replace the key switch **(Figure 11a-25, Page 11a-29)**.
6. Reconnect the key switch to the wire harness. Ensure that the connector is connected correctly and is tight. If it is not, repair or replace as necessary.

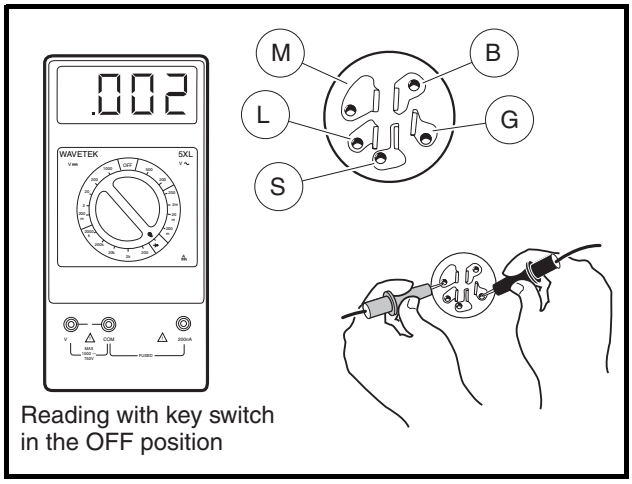


Figure 11a-25 Key Switch Test – Engine Kill Circuit

TEST PROCEDURE 19 – REVERSE WARNING BUZZER LIMIT SWITCH (IF EQUIPPED)

See General Warning, Section 1, Page 1-1.

NOTE: *Keep the battery connected during this test procedure.*

The reverse warning buzzer limit switch is located on the Forward/Reverse handle under the hood.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Check for proper wiring and tight connections at the reverse warning buzzer and the reverse warning buzzer limit switch **(Figure 11a-26, Page 11a-29)**.

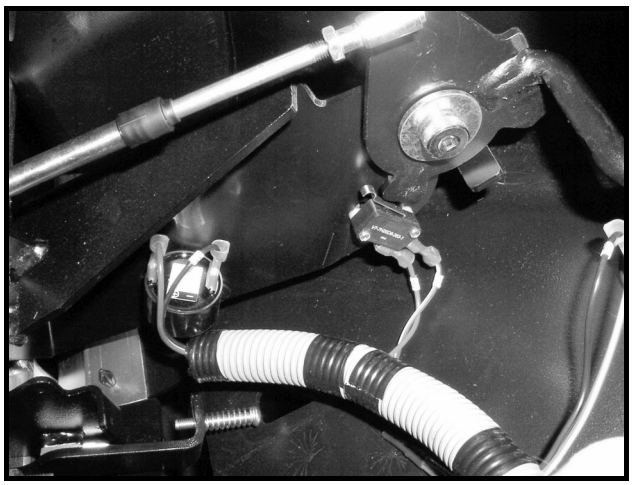


Figure 11a-26 Reverse Warning Buzzer and Limit Switch

3. Move the Forward/Reverse handle to REVERSE and listen for an audible click from the limit switch. If there is no click, check the switch for proper alignment and switch arm movement.

4. If the switch is being activated but the buzzer does not function, place the red (+) probe of the multimeter on one terminal and the black (–) probe on the other terminal of the limit switch. With the Forward/Reverse handle in the NEUTRAL or FORWARD position, the reading should be no continuity.
5. Place the Forward/Reverse handle in the REVERSE position to activate the limit switch. The multimeter should indicate continuity when the limit switch lever is activated. If either reading is incorrect, replace the limit switch **(Figure 11a-26, Page 11a-29)**.

TEST PROCEDURE 20 – REVERSE WARNING BUZZER (IF EQUIPPED)

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Check for proper wiring and tight connections. Use a multimeter and check for continuity through each wire that connects to the reverse warning buzzer individually. **See Wiring Diagram, Section 11a, Page 11a-6.** If the buzzer does not function when properly wired, replace the buzzer. **See Reverse Warning Buzzer Removal, Section 12a, Page 12a-11.**

TEST PROCEDURE 21 – CARBURETOR SOLENOID CIRCUIT

See General Warning, Section 1, Page 1-1.

NOTE: *Keep the battery connected while performing this test procedure.*

1. Check the carburetor solenoid coil circuit.
   1.1. Turn the key switch OFF. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
   1.2. Disconnect the green wire of engine harness at the bullet connector located near the starter **(Figure 11a-27, Page 11a-31)**.
   1.3. Disconnect the 16-gauge green wire (w127) from the starter solenoid coil to prevent the vehicle from unintentionally starting **(Figure 11a-10, Page 11a-15)**. **See following WARNING.**

⚠ WARNING

- **Failure to disconnect the wire from the solenoid coil could result in an unexpected engine start when performing this test.**

   1.4. Set the multimeter to 20 VDC.
   1.5. Place the probes to measure the voltage between the female side of the carburetor solenoid bullet connector green/white wire (w123) and the frame ground.
   1.6. Monitor the multimeter. The reading should indicate 0 volts with the key in the OFF position. The reading should indicate approximately 12 VDC when the key is in the ON and START positions; if the multimeter does indicate 12 VDC, proceed to step 2. If the reading does not indicate approximately 12VDC with the key in the ON and START positions, check the following items:

- Key switch (starter circuit). **See Test Procedure 4 – Key Switch (Starter Circuit) on page 11a-13.**
- Diode 2. **See Test Procedure 8B – Diode 2 on wire 40 and 41 on page 11a-20.**
- Diode 3. **See Test Procedure 8C – Diode 3 on wire 45 and 39 on page 11a-21.**
- Diode 4. **See Test Procedure 8D – Diode 4 on wire 130 and 122 on page 11a-21.**

2. Check the carburetor solenoid coil.

2.1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.

2.2. Disconnect the battery as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**

2.3. Set the multimeter to 200 ohms.

2.4. Measure the resistance between the male side of the carburetor solenoid bullet connector and the engine (ground) **(Figure 11a-27, Page 11a-31)**. The resistance should be approximately 30 ohms.

2.5. If the resistance reading is incorrect, replace the solenoid coil. **See the Kawasaki FH680D engine manual (CCI P/N 103351201).**

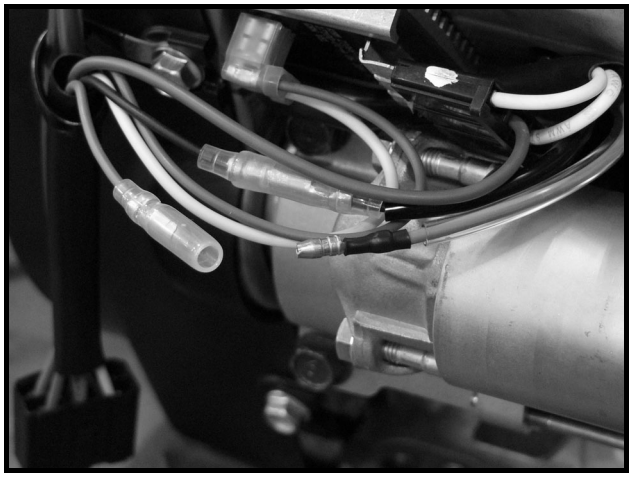


Figure 11a-27 Carburetor Solenoid Bullet Connector

TEST PROCEDURE 22 – LOW OIL WARNING LIGHT CIRCUIT

See General Warning, Section 1, Page 1-1.

If the low oil warning light stays on, test the oil pressure switch. **See the Kawasaki FH680D engine manual (CCI P/N 103351201).** If the low oil warning light does not illuminate and the vehicle is low on oil, proceed to step 1. **See following NOTE.**

NOTE: *The low oil warning light should illuminate when the key switch is turned to the ON position. After the engine has been started, the low oil warning light should remain illuminated until the oil pressure switch has been activated.*

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Raise the hood.
3. Ensure that the wires on the oil warning light are connected correctly and are tight. If they are not, rewire or tighten as necessary.
4. Disconnect the 18-gauge blue/white wire (w17) from the low oil warning light terminal.
5. Leave the 18-gauge purple wire (w42) connected to the low oil warning light.
6. Place a jumper wire on the terminal of the low oil warning light where the blue/white wire (w17) was removed.
7. Touch the frame (ground) with the remaining end of the jumper wire.
8. Turn the key switch to the ON position. The low oil warning light should illuminate.

9. If the low oil warning light does not illuminate when the key switch is in the ON position, check the 18-gauge purple wire (w42) for continuity between the terminal at the low oil warning light and the 18-gauge purple wire (w47) at the key switch. Also check the continuity between the terminal on the 18-gauge blue/white wire (w17) and the terminal on the engine 6-pin connector brown wire (w146).
10. If there is continuity between the 18-gauge purple wire (w42) at the low oil warning light and the 18-gauge purple wire (w47) at the key switch, replace the low oil warning light. **See Warning Light Removal, Section 12a, Page 12a-5.**
11. If the problem is not corrected by performing the previous steps, test the oil pressure switch. **See the Kawasaki FH680D engine manual (CCI P/N 103351201).**

TEST PROCEDURE 23 – 12-VOLT ACCESSORY RECEPTACLE

See General Warning, Section 1, Page 1-1.

NOTE: *Keep the battery connected during this test procedure.*

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Set the multimeter to 20 VDC.
3. Measure the voltage between the center contact and the outer contact of the accessory receptacle. The voltage should be approximately 12 VDC.
4. If the voltage is not approximately 12 VDC, check the 10-amp fuse on the orange/white wire (w115) located on the electrical component mounting plate. **See Test Procedure 2 – Fuse on page 11a-12.**
5. If the fuse is good, check the continuity of the wires connected to the accessory receptacle.
6. If the wire continuity is good, replace the accessory receptacle.

TEST PROCEDURE 24 – FUEL LEVEL SENDING UNIT

See General Warning, Section 1, Page 1-1.

⚠ WARNING

- **To avoid the possibility of fire or explosion, make sure the fuel tank cap is securely in place while performing this test procedure.**

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Disconnect the orange wire from the center post of the fuel level sending unit.
4. With a multimeter set to 2k ohms, place the red (+) probe on the center post of the sending unit. Place the black (–) probe on the ground connection of the sending unit **(Figure 11a-28, Page 11a-33)**.

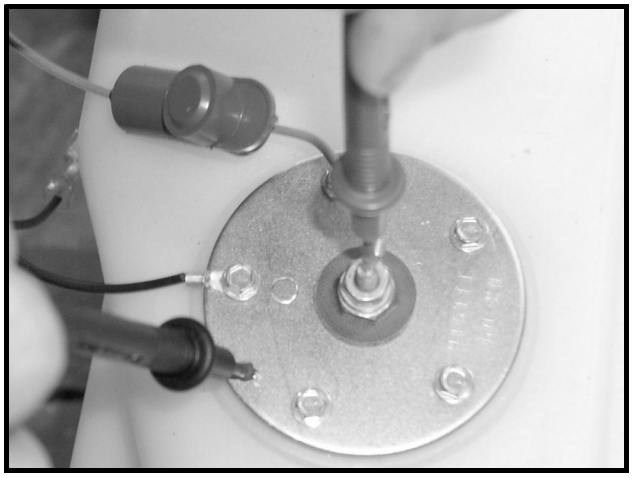


Figure 11a-28 Fuel Level Sending Unit Test

5. The following resistance readings (in ohms) should be indicated, depending on the position of the float inside the fuel tank. The resistance reading will vary according to the exact position of the float. The following table may be used as a guideline to determine if the fuel level sending unit is operating correctly. Make sure the float is at the surface of the fuel in the tank.

FLOAT POSITION	RESISTANCE READING	FUEL GAUGE READINGS
Lower position (tank empty)	240 ± 20 ohms	Empty
Center position (tank half full)	120 ± 20 ohms	Half full
Upper position (tank full)	60 ± 20 ohms	Full

6. If the readings are within the specifications listed in the preceding table, the fuel level sending unit is working properly. If the readings are incorrect, the fuel level sending unit has failed and the fuel tank must be replaced. **See Fuel Tank Removal, Section 13a, Page 13a-14.**
7. If the readings are correct and the fuel gauge does not function correctly, leave the battery disconnected and check the continuity of the following:
   - Orange wire (w104) from the fuel level sending unit to the fuel gauge/hour meter.
   - Blue wire (w25) and purple wire (w47) from the fuel gauge/hour meter to the key switch.
   - Black ground wires at the fuel level sending unit (w106) and at the fuel gauge/hour meter (w22). **See Fuel Gauge/Hour Meter Removal, Section 12a, Page 12a-6.**
8. If the readings are correct according to the position of the float, but the reading on the fuel gauge/hour meter is incorrect, test the fuel gauge/hour meter. **See Test Procedure 25 – Fuel Gauge on page 11a-34.**

TEST PROCEDURE 25 – FUEL GAUGE

See General Warning, Section 1, Page 1-1.

Two fuel gauges were used for model year 2007 **(Figure 11a-29, Page 11a-34 and Figure 11a-30, Page 11a-34)**. The terminal configuration on the back of the gauge easily denotes the type. Follow the appropriate procedure. The early 2007 gauge has the orange wire connected to terminal 1 whereas late 2007 has it connected to terminal 4 in the center of the gauge. In addition, the early 2007 gauge has one terminal (3) to ground it whereas the late 2007 has two ground terminals (1 and 6) with a black jumper wire connecting them. **See following NOTE.**

NOTE: *Keep the battery connected during this test procedure.*

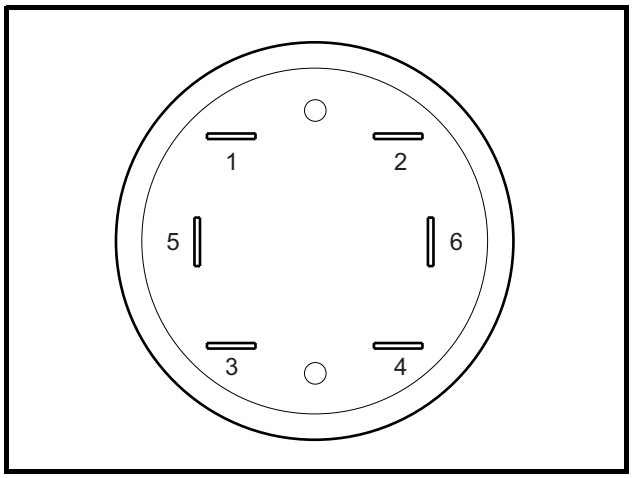


Figure 11a-29 Fuel Gauge/Hour Meter – Early 2007

1. Orange 2. Blue 3. Black 4. White 5. Not used 6. Not used

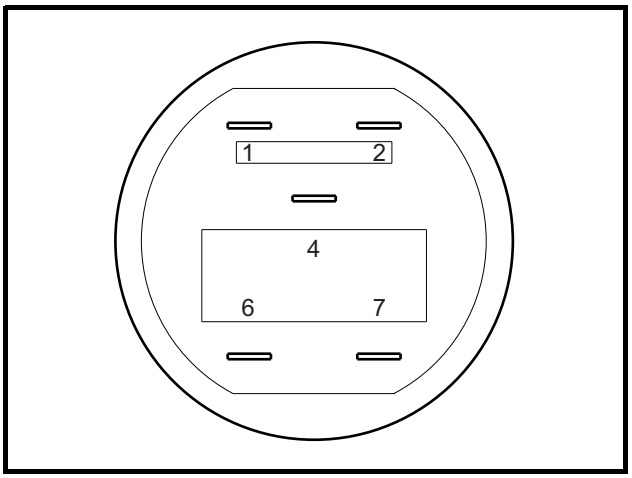


Figure 11a-30 Fuel Gauge/Hour Meter – Late 2007

1. Black(Jumper Wire From 6 2. Blue 4. Orange 6. Black 7. White

Test Procedure 25A – Fuel Gauge (Early 2007)

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Raise the hood.
3. Disconnect the orange wire (w104) from the fuel gauge/hour meter.
4. Set a multimeter to 20 volts DC and place the red (+) probe on the positive (+) post of the battery. Place the black (–) probe on the negative (–) post of the battery. Record the voltage reading.
5. Set a multimeter to 20 volts DC and place the red (+) probe on the (2) terminal of the fuel gauge/hour meter where the blue wire (w25) is connected. Place the black (–) probe on the (3) terminal of the fuel gauge/hour meter with the black wire (w22) **(Figure 11a-31, Page 11a-35)**.
6. Turn the key switch ON. The voltage reading should be the same as the battery voltage reading recorded earlier. If not, check the continuity of the blue and black wires **(Figure 11a-31, Page 11a-35)**.
7. The orange wire should remain disconnected for this step. Place the black probe of the multimeter on the (3) terminal of the fuel gauge/hour meter and place the red (+) probe on the (1) terminal of the fuel gauge/hour meter **(Figure 11a-32, Page 11a-35)**. The voltage reading should be approximately 1.81 volts. If the reading is incorrect, replace the fuel gauge/hour meter.

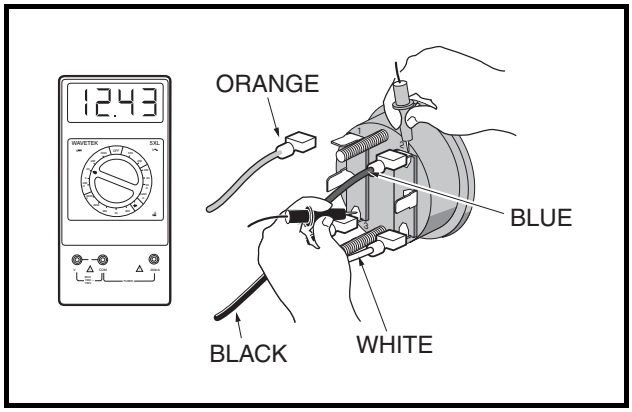


Figure 11a-31 Fuel Gauge Voltage Test - Terminal 2

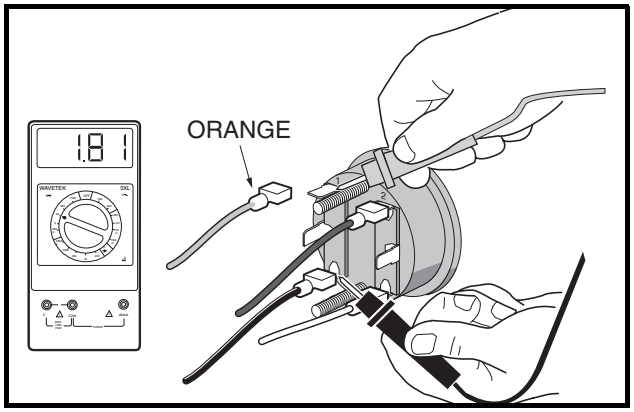


Figure 11a-32 Fuel Gauge Voltage Test - Terminal 1

Test Procedure 25B – Fuel Gauge (Late 2007)

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Raise the hood.
3. Disconnect the orange wire (w104) from the fuel gauge/hour meter.
4. Set a multimeter to 20 volts DC and place the red (+) probe on the positive (+) post of the battery. Place the black (–) probe on the negative (–) post of the battery. Record the voltage reading.
5. Set a multimeter to 20 volts DC and place the red (+) probe on the (2) terminal of the fuel gauge/hour meter where the blue wire (w25) is connected. Place the black (–) probe on the (1) terminal of the fuel gauge/hour meter with the black wire (w22) **(Figure 11a-33, Page 11a-35)**.
6. Turn the key switch ON. The voltage reading should be the same as the battery voltage reading recorded earlier. If not, check the continuity of the blue and black wires **(Figure 11a-33, Page 11a-35)**.
7. The orange wire should remain disconnected for this step. Place the black probe of the multimeter on the (1) terminal of the fuel gauge/hour meter and place the red (+) probe on the (4) terminal of the fuel gauge/hour meter **(Figure 11a-34, Page 11a-35)**. The voltage reading should be approximately 4.94 volts. If the reading is incorrect, replace the fuel gauge/hour meter.

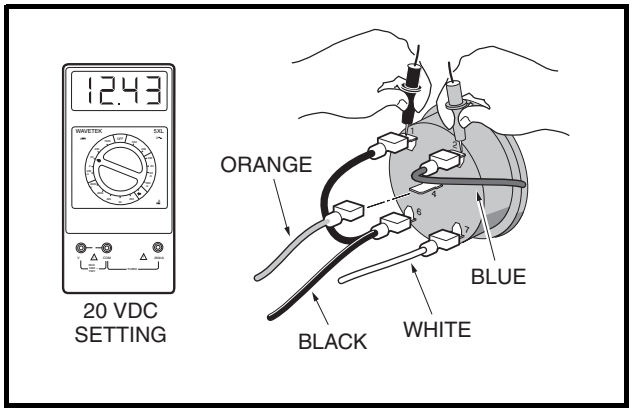


Figure 11a-33 Fuel Gauge Voltage Test - Terminal 2

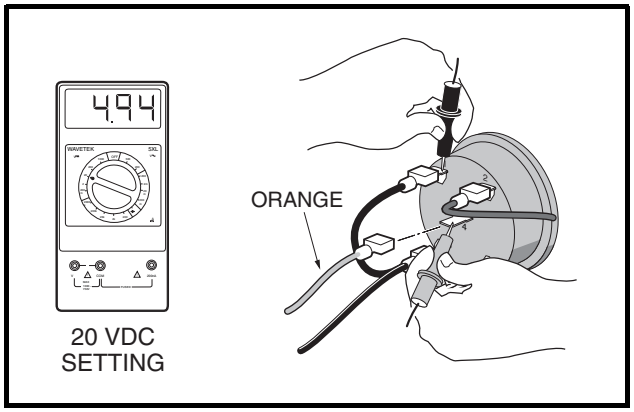


Figure 11a-34 Fuel Gauge Voltage Test - Terminal 4

TEST PROCEDURE 26 – HOUR METER

See General Warning, Section 1, Page 1-1.

Two hour meters were used for model year 2007 **(Figure 11a-29, Page 11a-34 and Figure 11a-30, Page 11a-34)**. The display and the terminal configuration on the back of the meter easily denotes the type. Follow the appropriate procedure. The display on the early 2007 meter only appears when the key switch is ON whereas the display on the late 2007 meter is always on. The early 2007 meter has the orange wire connected to terminal 1 whereas late 2007 has it connected to terminal 4 in the center of the meter. In addition, the early 2007 meter has one terminal (3) to ground it whereas the late 2007 has two ground terminals (1 and 6) with a black jumper wire connecting them. **See following NOTE.**

NOTE: *Keep the battery connected during this test procedure.*

Test Procedure 26A – Hour Meter (Early 2007)

1. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Turn the key switch ON to verify the display appears.
3. Start the engine and let it idle. **See following DANGER.**

⚠ DANGER

- **Do not operate vehicle in an enclosed area without proper ventilation. The engine produces carbon monoxide, which is an odorless, deadly poison.**

4. With engine idling, the "hour glass" icon should flash slowly. If not, check the low oil warning light and the oil pressure switch. **See following NOTE. See also Test Procedure 22 – Low Oil Warning Light Circuit on page 11a-31.**

NOTE: *The hour meter is designed to record actual engine running time and will not start adding increments until the engine is running and the oil pressure switch has opened.*

5. If the hour meter still does not function after the low oil warning light, oil pressure switch, and all of the appropriate wires have been checked for continuity, replace the fuel gauge/hour meter.

Test Procedure 26B – Hour Meter (Late 2007)

1. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. With the key switch OFF, check the hour meter display. It is powered by an internal battery and should always be on, even with the engine off and the key removed.
3. Start the engine and let it idle. **See following DANGER.**

⚠ DANGER

- **Do not operate vehicle in an enclosed area without proper ventilation. The engine produces carbon monoxide, which is an odorless, deadly poison.**

4. With engine idling, the "hour glass" icon should flash. If not, check the low oil warning light and the oil pressure switch. **See following NOTE. See also Test Procedure 22 – Low Oil Warning Light Circuit on page 11a-31.**

NOTE: *The hour meter is designed to record actual engine running time and will not start adding increments until the engine is running and the oil pressure switch has opened.*

5. If the hour meter still does not function after the low oil warning light, oil pressure switch, and all of the appropriate wires have been checked for continuity, replace the fuel gauge/hour meter.

TEST PROCEDURE 27 – LIGHT SWITCH

See General Warning, Section 1, Page 1-1.

NOTE: *The headlight circuit is protected by the 20-amp fuse. Check the fuse before this procedure is performed.* ***See Test Procedure 2 – Fuse on page 11a-12.***

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Remove the light switch from the instrument panel. **See Light Switch Removal, Section 12a, Page 12a-10.**
3. Use a multimeter set to 20 volts DC and place alligator clips on the multimeter probes. Connect the red (+) probe to the light switch terminal where the blue wire (w03) is connected **(Figure 11a-35, Page 11a-37)**.

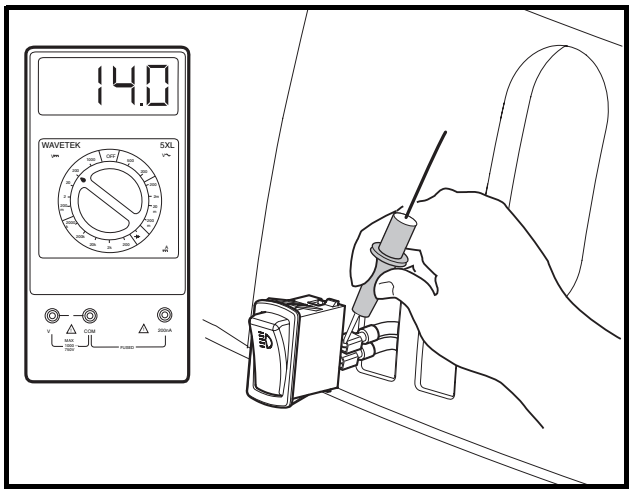


Figure 11a-35 Light Switch Test

4. Connect the black (–) probe of the multimeter to the negative (–) post of the battery.
5. With the light switch in the OFF position, the reading should indicate 0 volts. With the light in the ON position, the reading should indicate between 11 and 12.5 volts. If the there is no voltage reading, check the continuity of the 10-gauge red wire (w126) from the fuse block to the starter solenoid. Check the continuity of the 14-gauge yellow wire (w07) and the 14-gauge blue wire (w113) from the light switch to the fuse block. Check the fuse. **See Test Procedure 2 – Fuse on page 11a-12.** If the wires and fuse show continuity and the readings are still incorrect, replace the switch. **See Light Switch Removal, Section 12a, Page 12a-10.**

TEST PROCEDURE 28 – VOLTAGE AT HEADLIGHT SOCKET

See General Warning, Section 1, Page 1-1.

NOTE: *Keep the battery connected during this test procedure.*

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Inspect the wires at the light bulb socket. Make sure the wires are securely fastened to the contacts inside the socket and that wires are oriented correctly - black to black and blue to blue.
3. Remove the wire harness from the headlight bulb **(Figure 11a-36, Page 11a-38)**.
4. Use a multimeter set to 20 volts DC and place the black (–) probe into the black wire terminal of the wire harness. Place the red (+) probe into the blue wire terminal.
5. Pull the light switch to the ON position. If the multimeter indicates approximately 12 volts, replace the headlight bulb.

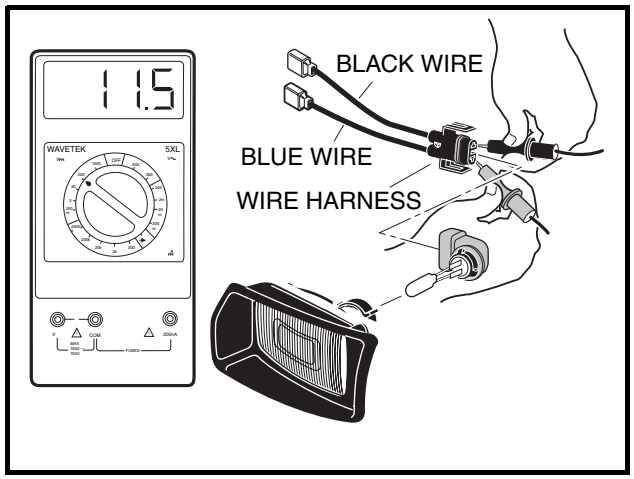


Figure 11a-36 Voltage Measurement at Headlight Socket

6. If there is no voltage reading at the wire harness, check the continuity of the 16-gauge blue wires (w01 and w03) from the headlight to the light switch.
   6.1. Set the multimeter to 20 VDC.
   6.2. Use an alligator clip to attach the black (–) probe onto the negative (–) battery terminal and place the red (+) probe into the blue wire terminal (w01) of the wire harness. If the multimeter reading is approximately 12 volts, the blue wire has continuity.
7. Check the continuity of the 16-gauge black wire (w13) from the headlight to the frame ground.
   7.1. Set the multimeter to 20 VDC.
   7.2. Place the black (–) probe of multimeter into the black wire terminal (w13) of the wire harness and use an alligator clip to attach the red (+) probe onto the positive (+) battery terminal. If the multimeter reading is approximately 12 volts, the black wire has continuity.
8. Check the continuity of the headlight jumper harness wires.
9. If the readings are correct in all of the previous steps, replace the headlight bulb.

Figure 11a-37 Bed Lift Motor Wires

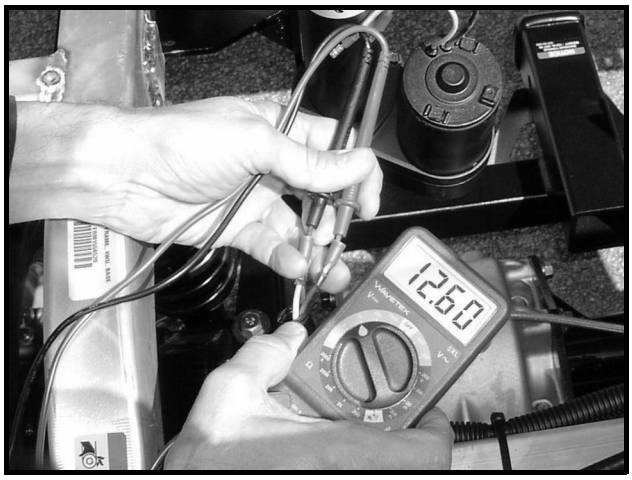


Figure 11a-38 Bed Lift Motor Voltage Reading with Switch in UP position

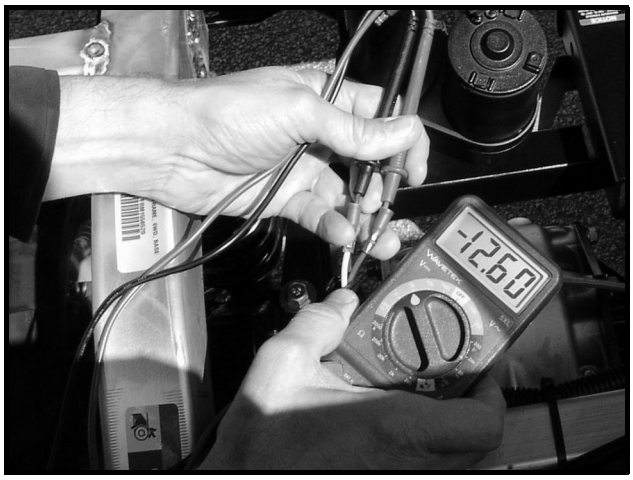


Figure 11a-39 Bed Lift Motor Voltage Reading with Switch in DOWN position

TEST PROCEDURE 29 – BED LIFT MOTOR

NOTE: *Keep the battery connected during this test procedure.*

Ensure that the battery is fully-charged before performing this test procedure.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the red and yellow wires from the bed lift motor **(Figure 11a-37, Page 11a-39)**.
3. Set a multimeter for 20 VDC.
4. Place the red probe in the bullet connector on the red wire (wire harness side) and place the black probe in the bullet connector on the black wire (wire harness side) **(Figure 11a-38, Page 11a-39)**.
5. Have an assistant press the bed lift switch on the instrument panel in the UP position and monitor the multimeter:

- A reading of approximately + (positive) 12 VDC indicates that the bed lift harness and switch are wired correctly. Proceed to step 6.

- A reading of approximately – (negative) 12 VDC indicates that the bed lift harness or switch are wired incorrectly. Check the wiring of the bed lift harness and bed lift switch. **See Wiring Diagram on page 11a-6.**
- A reading of approximately 0 VDC indicates a failed bed lift switch, failed bed lift circuit breaker, a poor connection in the bed lift wire harness, or a broken wire.

6. Place the red probe in the bullet connector on the red wire (wire harness side) and place the black probe in the bullet connector on the black wire (wire harness side) **(Figure 11a-39, Page 11a-39)**.
7. Have an assistant press the bed lift switch on the instrument panel in the DOWN position and monitor the multimeter:
   - A reading of approximately – (negative) 12 VDC indicates that the bed lift harness and switch are wired correctly. Proceed to step 8.
   - A reading of approximately + (positive) 12 VDC indicates that the bed lift harness or switch are wired incorrectly. Check the wiring of the bed lift harness and bed lift switch. **See Wiring Diagram on page 11a-6.**
   - A reading of approximately 0 VDC indicates a failed bed lift switch, failed bed lift circuit breaker, a poor connection in the bed lift wire harness, or a broken wire.
8. If the bed lift motor does not function and the readings obtained in the previous steps are correct, the bed lift motor has failed and must be replaced. **See Bed Lift Motor Removal, Section 4, Page 4-11.**

TEST PROCEDURE 30 – BED LIFT SWITCH

1. Remove the bed lift switch. **See Bed Lift Switch Removal, Section 12a, Page 12a-9.**
2. Check continuity between the terminals **(Figure 11a-40, Page 11a-40)** of the switch and compare the readings with the Bed Lift Switch Continuity Table. If continuity readings do not match the table, replace the switch. **See Bed Lift Switch Installation, Section 12a, Page 12a-9.**

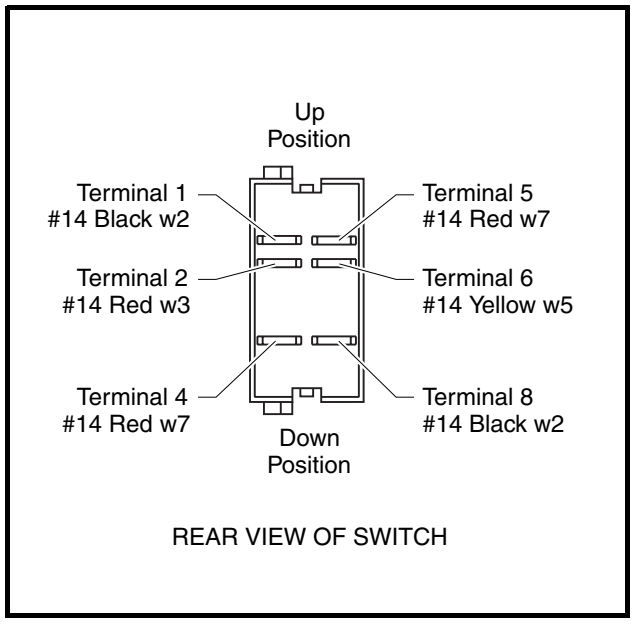


Figure 11a-40 Bed Lift Switch Terminals

BED LIFT SWITCH CONTINUITY						
Between Terminals	**1**	**2**	**4**	**5**	**6**	**8**
1		Cont. when pushed DOWN				
2	Cont. when pushed DOWN		Cont. when pushed UP			
4		Cont. when pushed UP				
5					Cont. when pushed DOWN	
6				Cont. when pushed DOWN		Cont. when pushed UP
8					Cont. when pushed UP	

TEST PROCEDURE 31 – BED LIFT CIRCUIT BREAKER

1. Remove the bed lift circuit breaker. **See Bed Lift Circuit Breaker Removal, Section 12a, Page 12a-9.**
2. Place the red probe of the multimeter on the circuit breaker terminals. If the multimeter does not indicate continuity, replace the circuit breaker. **See Bed Lift Circuit Breaker Installation, Section 12a, Page 12a-9.**

SECTION 11B – TROUBLESHOOTING AND ELECTRICAL SYSTEM: HONDA POWERED GASOLINE VEHICLES

⚠ DANGER

- **See General Warning, Section 1, Page 1-1.**

⚠ WARNING

- **See General Warning, Section 1, Page 1-1.**

TROUBLESHOOTING GUIDE

The following troubleshooting guide will be helpful in identifying operating difficulties should they occur. The guide includes the symptom, probable cause(s) and suggested checks.

TROUBLESHOOTING GUIDE

SYMPTOM	POSSIBLE CAUSES	REFER TO
Engine does not start easily.	Spark plug is partially fouled or in poor condition	See the Honda GX620 engine manual (CCI P/N 102615401).
	Spark plug wire is damaged or loose	See the Honda GX620 engine manual (CCI P/N 102615401).
	Intermittent ignition coil failure	See the Honda GX620 engine manual (CCI P/N 102615401).
	Low cylinder compression	See the Honda GX620 engine manual (CCI P/N 102615401).
	Water or dirt in the fuel system and/or carburetor; dirty or clogged fuel filter	Fuel System, Section 13b, Page 13b-7
	Carburetor improperly adjusted	See the Honda GX620 engine manual (CCI P/N 102615401).
	Starter failure	See the Honda GX620 engine manual (CCI P/N 102615401).
	Carburetor solenoid failure	Test Procedure 21 – Carburetor Solenoid Circuit on page 11b-31
	Diode 2 failed open	Test Procedure 9B – Diode 2 on wire 40 on page 11b-20
	Diode 3 failed open	Test Procedure 9C – Diode 3 on wire 45 on page 11b-21

Troubleshooting Guide continued on next page...

TROUBLESHOOTING GUIDE

SYMPTOM	POSSIBLE CAUSES	REFER TO
Engine starts but does not run smoothly.	Spark plug is fouled or in poor condition	See the Honda GX620 engine manual (CCI P/N 102615401).
	Spark plug wire is damaged or loose	See the Honda GX620 engine manual (CCI P/N 102615401).
	Intermittent ignition coil failure	Test Procedure 15 – Ignition Spark on page 11b-27, Test Procedure 16 – Engine Kill Wire on page 11b-28, and Test Procedure 17 – Grounded Kill Wire on page 11b-28
	Water or dirt in the fuel system and/or carburetor; dirty or clogged fuel filter	Fuel System on page 13b-7
	Fuel pump malfunction; fuel pressure to carburetor too low	Fuel System on page 13b-7
Engine turns but fails to start.	Fuel tank is empty	Fuel System on page 13b-7
	Fuel line or filters clogged	Fuel System on page 13b-7
	Fouled spark plug	Section 13b – Honda Gasoline Engine, Muffler, Fuel System, and Clutches
	Spark plug wire damaged or loose	Section 13b – Honda Gasoline Engine, Muffler, Fuel System, and Clutches
	Engine flooded with fuel as result of excess choking	See owner's manual, Controls and Indicators. See Choke.
	Fuel pump malfunction or failure	Fuel System on page 13b-7
	Ignition coil failure	Test Procedure 15 – Ignition Spark on page 11b-27, Test Procedure 16 – Engine Kill Wire on page 11b-28, and Test Procedure 17 – Grounded Kill Wire on page 11b-28
	Kill circuit grounded	Test Procedure 17 – Grounded Kill Wire on page 11b-28
	Carburetor solenoid failure	Test Procedure 21 – Carburetor Solenoid Circuit on page 11b-31
	Improper idle governor adjustment	Fuel System on page 13b-7
Engine overheats.	Fan screen is partially blocked or plugged	See the Honda GX620 engine manual (CCI P/N 102615401).
	Governor is improperly adjusted	Fuel System on page 13b-7
	Carburetor is too lean; check main jet size	See the Honda GX620 engine manual (CCI P/N 102615401).
Engine pre-ignites.	Excessive carbon deposits on piston head or in combustion chamber	See the Honda GX620 engine manual (CCI P/N 102615401).
	Spark plug heat range is incorrect	See the Honda GX620 engine manual (CCI P/N 102615401).
	Unsuitable or contaminated fuel	Fuel System on page 13b-7

Troubleshooting Guide continued on next page...

TROUBLESHOOTING GUIDE

SYMPTOM	POSSIBLE CAUSES	REFER TO
Loss of engine power.	Exhaust valve is restricted with carbon deposit	See the Honda GX620 engine manual (CCI P/N 102615401).
	Muffler or exhaust pipe restricted with carbon or other substance	Exhaust System on page 13b-5
	Ignition coil failure	Test Procedure 15 – Ignition Spark on page 11b-27
	Air filter is dirty or clogged	Air Filter Replacement on page 13b-24
	Governor is improperly adjusted	Fuel System on page 13b-7
	Throttle linkage out of adjustment	Engine Control Linkages on page 13b-16
	Low cylinder compression	See the Honda GX620 engine manual (CCI P/N 102615401).
	Spark plug failed	See the Honda GX620 engine manual (CCI P/N 102615401).
	Restricted fuel flow	Fuel System on page 13b-7
	Clutches are not backshifting properly	Clutches on page 13b-29
Spark plug fouls repeatedly.	Incorrect plug	See the Honda GX620 engine manual (CCI P/N 102615401).
	Unsuitable fuel, or incorrect (rich) fuel mixture	Fuel System on page 13b-7
	Spark plug wire is damaged	See the Honda GX620 engine manual (CCI P/N 102615401).
	Dirt entering combustion chamber	Fuel System on page 13b-7
	Ignition coil failed	See the Honda GX620 engine manual (CCI P/N 102615401).
	Rings are heavily worn, low cylinder pressure	See the Honda GX620 engine manual (CCI P/N 102615401).
Carburetor floods.	Inlet valve or seat is leaking, dirty, worn, or damaged	See the Honda GX620 engine manual (CCI P/N 102615401).
	Float is damaged and filled with gasoline	See the Honda GX620 engine manual (CCI P/N 102615401).
	Carburetor vent is clogged	See the Honda GX620 engine manual (CCI P/N 102615401).
	Float needle valve not functioning properly	See the Honda GX620 engine manual (CCI P/N 102615401).
Starter fails to operate.	Starter control circuit is not operating	Test Procedure 6 – Starter Control Circuit on page 11b-15
	Start relay failure	Test Procedure 7 – Start Relay on page 11b-16
	Fuse is blown	Test Procedure 2 – Fuse on page 11b-12
	Battery is dead	Test Procedure 1 – Battery on page 11b-9
	Charge coil failed	Test Procedure 13 – Charge Coil on page 11b-26

Troubleshooting Guide continued on next page...

TROUBLESHOOTING GUIDE

SYMPTOM	POSSIBLE CAUSES	REFER TO
Starter fails to operate, continued.	Loose or broken wire in charge coil circuit	Test Procedure 13 – Charge Coil on page 11b-26
	Voltage Regulator failure	Test Procedure 14 – Voltage Regulator on page 11b-27
	Starter solenoid or starter motor failure	Test Procedure 6 – Starter Control Circuit on page 11b-15
	Key switch failure	Test Procedure 4 – Key Switch (Starter Circuit) on page 11b-13
	Cylinder and/or crankcase flooded with fuel	See the Honda GX620 engine manual (CCI P/N 102615401).
	Neutral switch failure (failed open)	Test Procedure 10 – Neutral Switch (Transmission) on page 11b-24
	Transmission shifter linkage is binding or is out of adjustment	Forward/Reverse Shifter Cable Adjustment on page 14-17
	Diode 5 failed open	Test Procedure 9E – Diode 5 on wire 141 on page 11b-22
Charge coil does not charge battery.	Loose or broken wire in charge coil circuit	Test Procedure 13 – Charge Coil on page 11b-26
	Charge coil is shorted (failed closed)	Test Procedure 13 – Charge Coil on page 11b-26
	25-amp fuse is blown	Test Procedure 2 – Fuse on page 11b-12
	Voltage Regulator failure	Test Procedure 14 – Voltage Regulator on page 11b-27
	Battery failure	Test Procedure 1 – Battery on page 11b-9
Transmission does not engage or disengage smoothly.	Transmission shifter linkage is binding or is out of adjustment	Forward/Reverse Shifter Cable Adjustment on page 14-17
	Idle RPM Setting is set too high	Fuel System on page 13b-7
	Insufficient (low) level of lubricant or wrong type of lubricant in transmission	Gearcase Lubrication on page 10a-13
	Internal gears are damaged or worn	See the Engines and Drivetrain Components manual (CCI P/N 102396501).
Excessive vehicle vibration.	Engine mounting nuts or bolts are loose	Section 13b – Honda Gasoline Engine, Muffler, Fuel System, and Clutches
	Misaligned muffler mounting clamp	Exhaust System on page 13b-5
	Damaged drive belt	Clutches on page 13b-29
	Damaged drive clutch	Clutches on page 13b-29
	Damaged driven clutch	Clutches on page 13b-29
	RPM setting is incorrect	Engine RPM Adjustment on page 13b-23
Torque converter does not shift smoothly.	Drive belt is worn, cracked, glazed, or frayed	Drive Belt Removal on page 13b-31
	Drive clutch malfunction	Drive Clutch Cleaning and Inspection on page 13b-32

Troubleshooting Guide continued on next page...

TROUBLESHOOTING GUIDE

SYMPTOM	POSSIBLE CAUSES	REFER TO
Torque converter does not shift smoothly (continued).	Driven clutch malfunction	Drive Clutch Cleaning and Inspection on page 13b-32
	Governor is sticking	See the Engines and Drivetrain Components manual (CCI P/N 102396501).
Engine won't stop running.	Kill circuit wire is disconnected from the ignition coil	Test Procedure 16 – Engine Kill Wire on page 11b-28
	Key switch failure	Test Procedure 18 – Key Switch (Engine Kill Circuit) on page 11b-29
Low oil warning light stays on.	Oil level sensor failure	See the Honda GX620 engine manual (CCI P/N 102615401).
	Shorted wire harness wire(s)	Test Procedure 22 – Low Oil Warning Light Circuit on page 11b-32
Hour meter does not function.	Failed low oil warning light or oil pressure sensor	Test Procedure 22 – Low Oil Warning Light Circuit on page 11b-32
	Oil pressure switch failed closed	See the Honda GX620 engine manual (CCI P/N 102615401).
	Failed hour meter	Test Procedure 26 – Hour Meter on page 11b-35
Hour meter adds increments with key switch ON and engine not running.	Oil pressure switch failed open	See the Honda GX620 engine manual (CCI P/N 102615401).
Front differential does not engage front wheels.	Failed front drive gearcase engagement coil	Test Procedure 12 – Front Drive Gearcase Coil on page 11b-25
	Failed differential relay	Test Procedure 8 – Differential Relay on page 11b-17
	Neutral switch failure (failed closed)	Test Procedure 10 – Neutral Switch (Transmission) on page 11b-24
	Failed front gearcase	See the Engines and Drivetrain Components manual (CCI P/N 102396501).
10-amp fuse blows repeatedly.	Diode 1 failed closed	Test Procedure 9A – Diode 1 on wire 32 on page 11b-19
	Diode 6 failed closed	Test Procedure 9F – Diode 6 on wire 130 on page 11b-23
25-amp fuse blows repeatedly.	Diode 7 failed closed	Test Procedure 9G – Diode 7 on wire 129 on page 11b-23
Starter motor engages when key switch is in the ON position.	Diode 2 failed closed	Test Procedure 9B – Diode 2 on wire 40 on page 11b-20
Engine can be started while Forward/ Reverse handle is in the FOWARD or REVERSE position.	Diode 4 failed closed	Test Procedure 9D – Diode 4 on wire 140 on page 11b-21
Bed lift does not function	Bed lift motor failed	Test Procedure 29 – Bed Lift Motor on page 11b-38
	Bed lift switch failed	Test Procedure 30 – Bed Lift Switch on page 11b-39
	Bed lift circuit breaker failed	Test Procedure 31 – Bed Lift Circuit Breaker on page 11b-40

WIRING DIAGRAM

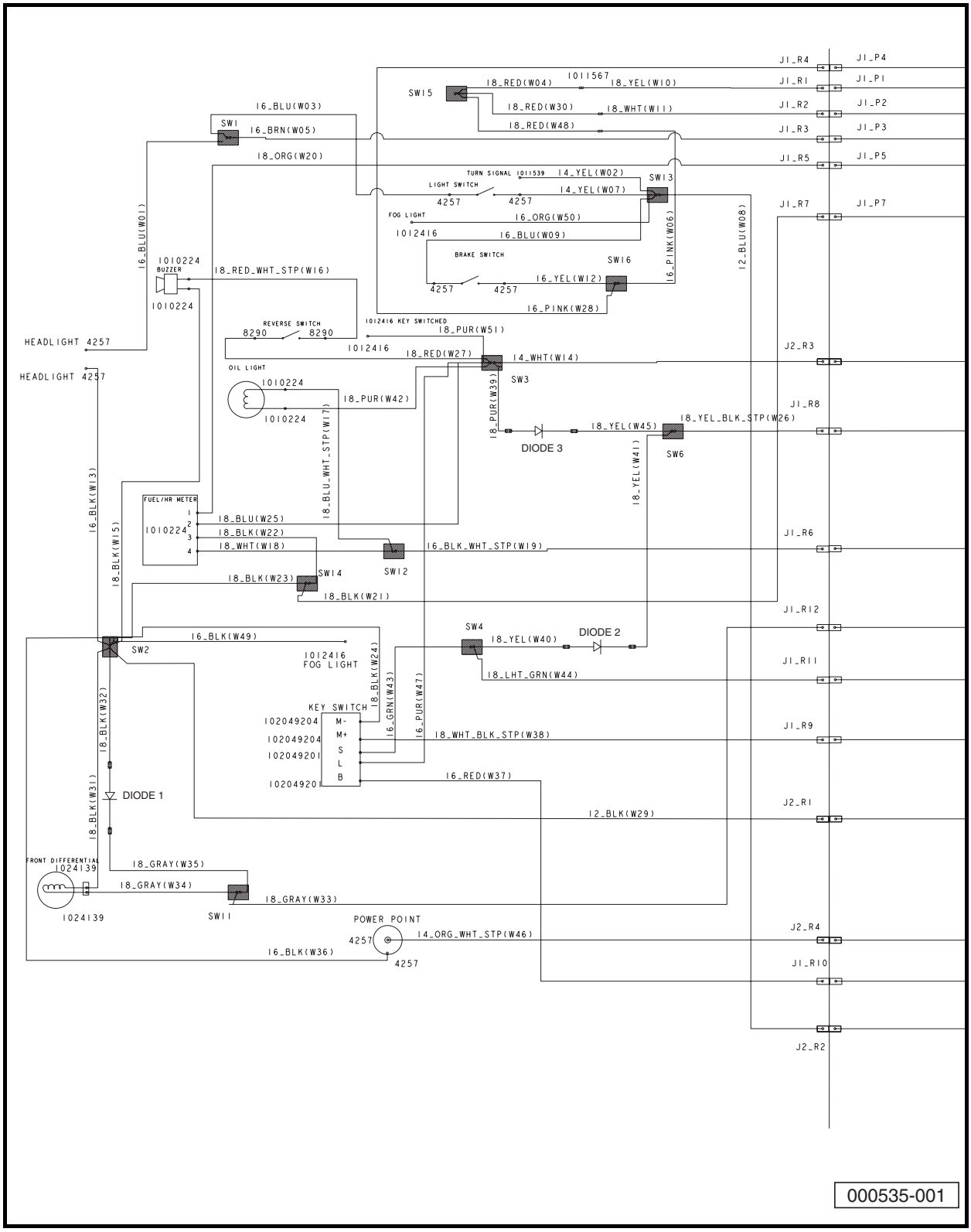


Figure 11b-1 Wiring Diagram – Honda Powered Gasoline Carryall 295 and XRT 1550 Vehicles (Front)

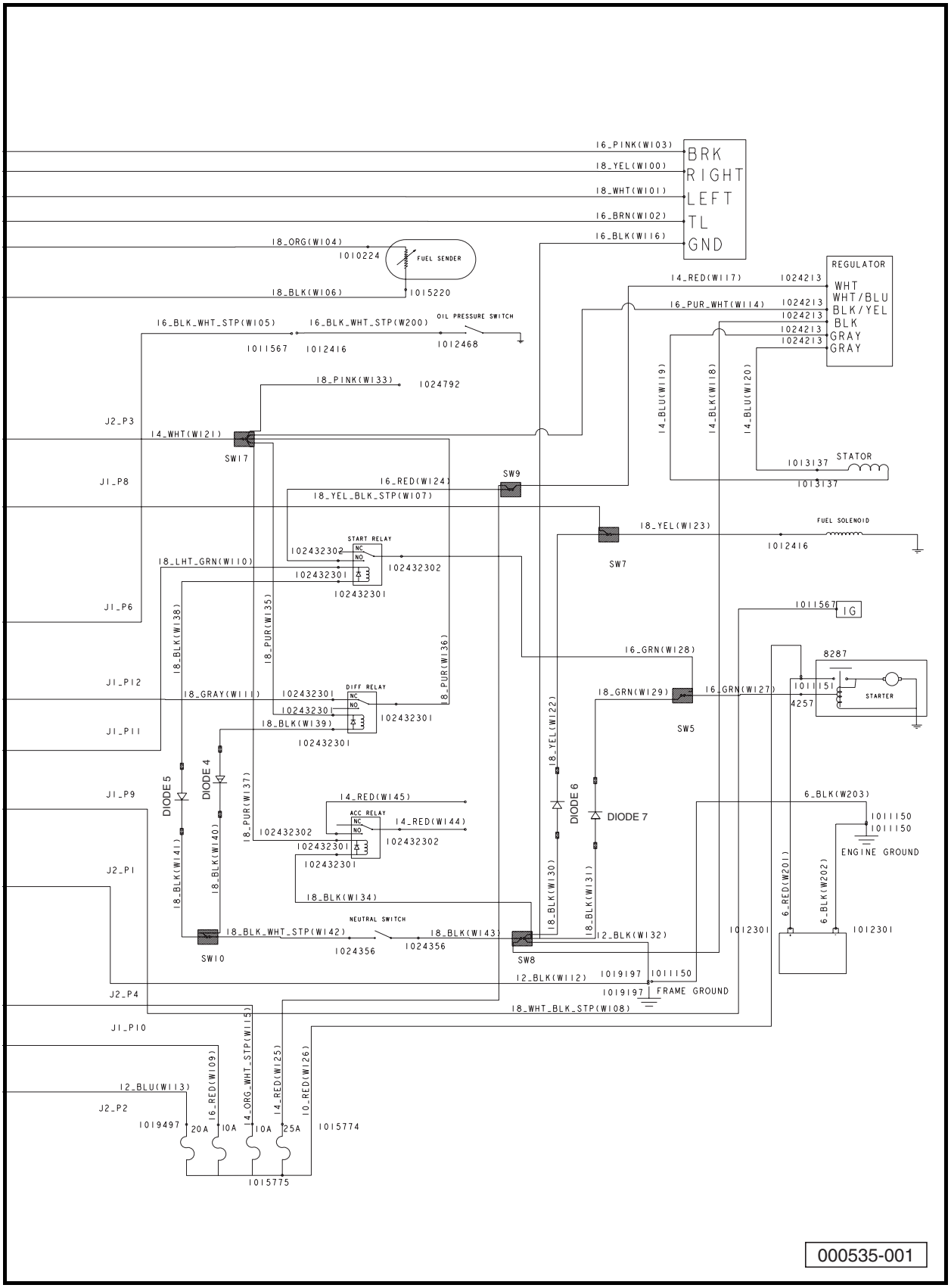


Figure 11b-2 Wiring Diagram – Honda Powered Gasoline Carryall 295 and XRT 1550 Vehicles (Rear)

TEST PROCEDURES

INDEX OF TEST PROCEDURES

TEST PROCEDURE 1 – BATTERY

See General Warning, Section 1, Page 1-1.

⚠ DANGER

- **Due to the danger of an exploding battery, wear a full face shield and rubber gloves when working around a battery.**
- **Battery – Explosive gases! Do not smoke. Keep sparks and flames away from the vehicle and service area. Ventilate when charging or using in an enclosed space. Wear a full face shield and rubber gloves when working on or near batteries. For added protection, cover top of the battery when servicing the vehicle.**
- **Battery – Poison! Contains acid! Causes severe burns! Avoid contact with skin, eyes, or clothing.**
  - **External: Flush with water. Call a physician immediately.**
  - **Internal: Drink large quantities of milk or water. Follow with milk of magnesia or vegetable oil. Call a physician immediately.**
  - **Eyes: Flush with water for 15 minutes. Call a physician immediately.**

NOTE: *The battery must be properly maintained and fully charged in order to perform the following test procedures. Battery maintenance procedures, including watering information and allowable mineral content, can be found in Section 12b of this manual.* ***See Battery, Section 12b, Page 12b-15.***

Test Procedure 1A – Hydrometer Test

A hydrometer (CCI P/N 1011478) measures the specific gravity of battery electrolyte. The higher the specific gravity, the higher the state of charge of the battery. A fully charged battery should read between 1.250 and 1.280 at 80 °F (27 °C). Never add acid to the battery to obtain a higher specific gravity **(Figure 11b-3, Page 11b-10)**. **See following CAUTION.**

CAUTION

- **Do not allow battery acid from battery caps or hydrometer to drip onto the vehicle body. Battery acid will cause permanent damage. Wash off immediately.**

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Check for loose or corroded battery terminal connections. Clean, tighten and replace connections as necessary.
3. Be sure that the battery has sufficient water to cover the plates by approximately 1/2-inch (13 mm) and is fully charged before the test. If water must be added, recharge the battery before performing the hydrometer test **(Figure 11b-4, Page 11b-10)**.
4. Remove the vent cap.
5. Use a battery thermometer (CCI P/N 1011767) to record the electrolyte temperature of a center cell.
6. Squeeze the rubber bulb of the hydrometer and insert it into the cell. Slowly release the bulb, drawing electrolyte up into the glass tube of the hydrometer.
7. Ensure the float rises off the bottom. Adjust the electrolyte level so that the float rides free of the bottom but does not strike the bottom of the rubber bulb. Remove the hydrometer from the cell and release pressure from the bulb.

8. Hold the hydrometer vertically and ensure that the float does not contact the sides of the glass tube. Hold the hydrometer at eye level and read the scale at the level of electrolyte **(Figure 11b-3, Page 11b-10)**.
9. Record the reading.
10. Return the electrolyte to the cell from which it was taken. Replace vent cap.
11. Repeat steps 4 through 10 on all cells.

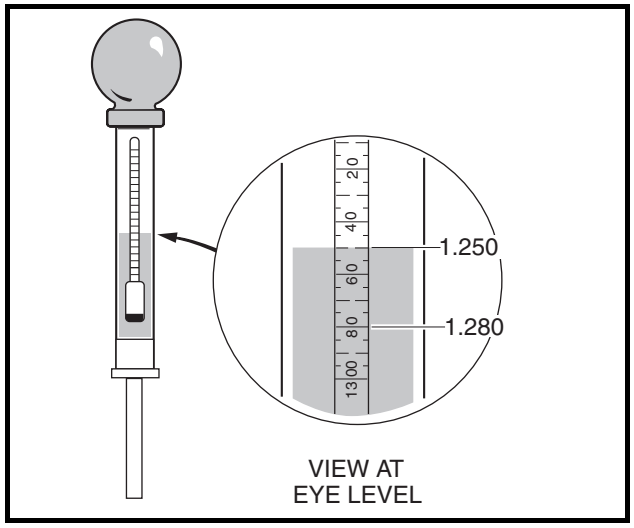


Figure 11b-3 Hydrometer Test

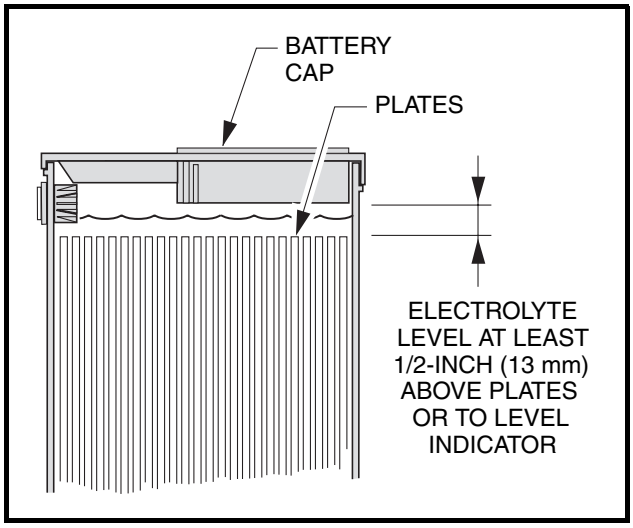


Figure 11b-4 Battery Electrolyte Level

Hydrometer Calibration

Most hydrometers are calibrated to read correctly at 80 °F (27 °C). The readings obtained as described above must be corrected for temperature. For each 10 °F (5.6 °C) above 80 °F (27 °C), add 0.004 to the reading. For each 10 °F (5.6 °C) below 80 °F (27 °C), subtract 0.004 from the reading.

Interpreting the Results of the Hydrometer Test

Use the following table to determine the approximate state of charge:

SPECIFIC GRAVITY (TEMPERATURE CORRECTED)	APPROXIMATE STATE OF CHARGE
1.250-1.280	100%
1.220-1.240	75%
1.190-1.210	50%
1.160-1.180	25%

If the difference between the cells is 0.020 or more, the low cell should be suspected of poor performance. It may require a catch-up charge or it may be a weak cell. When the variations between cells reach 0.050 or more, the battery should be replaced.

Test Procedure 1B – Voltage Test

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Check for loose or corroded battery terminal connections. Clean, tighten and replace connections as necessary.
3. Set the multimeter to the 20 VDC setting.
4. Measure the voltage across the battery terminals. If the reading is less than 12.4 volts, or if the lowest specific gravity reading from the hydrometer test is less than 1.225, recharge the battery. If battery voltage is greater than 12.4 volts and specific gravity is greater than 1.225, the problem is not with the battery. If the battery does not reach 12.4 volts, or if the specific gravity of a cell is still less than 1.225 after charging, replace the battery. **See following NOTE.**

NOTE: *A fully charged battery that is in good condition should have a specific gravity of at least 1.225 in all cells and the difference in the specific gravity of any two cells should be less than 50 points. Open-circuit voltage, the battery voltage with no electrical load, should be at least 12.4 volts.*

Test Procedure 1C – Load Test

NOTE: *Ensure that the battery is fully charged before performing the following test procedure.*

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Check for loose or corroded battery terminal connections. Clean, tighten and replace connections as necessary.
3. Connect a 160-ampere load tester to the battery posts. **See following NOTE.**

NOTE: *If a load tester is not available, a load can be placed on the battery by removing the spark plug wires and activating the starter motor. If this method is used, the voltage must be read when the starter motor is turning.* ***See following CAUTION.***

CAUTION

- **Activating the starter for more than a few seconds could result in damage to the starter motor, the starter, and/or the flywheel gears.**

4. Turn the load tester switch to the ON position.
5. Read the battery voltage after the load tester has been turned ON for 15 seconds. The minimum acceptable battery voltage for proper engine starting is approximately 9.6 VDC.
6. If the battery voltage is acceptable, or if the electrical problem continues after the battery has been replaced, test the electrical circuits.
7. If the voltage reading exceeds 9.6 volts at 70 °F (21 °C) (electrolyte temperature), check the starter. **See the Honda GX620 engine manual (CCI P/N 102615401). See also the following NOTE.**

NOTE: *Record the voltage reading at 70 °F (21 °C). At lower electrolyte temperatures, the voltage reading will be lower.*

8. If the reading is less than 9.6 volts at 70 °F (21 °C) (electrolyte temperature), check the battery electrolyte in each cell. **See Test Procedure 1A – Hydrometer Test on page 11b-9.**

TEST PROCEDURE 2 – FUSE

See General Warning, Section 1, Page 1-1.

The fuse block is located on the electrical component mounting plate **(Figure 11b-5, Page 11b-12)**.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Remove the electrical component cover.
4. Ensure the wires are connected correctly and are tight. If they are not, rewire or tighten as necessary.
5. Remove the fuse to be tested from the fuse block.
6. Connect the probes of a multimeter set to 200 ohms to the fuse terminals. The reading should be continuity. If there is no continuity, determine and repair the cause of the fuse failure. Replace the fuse with a properly rated new one. **See following WARNING.**

⚠ WARNING

- **If a fuse is blown, determine the cause of the failure and make necessary repairs before installing a new fuse. Use the appropriately rated fuse; if a fuse with a higher amp rating is used, damage to the vehicle electrical system may occur.**

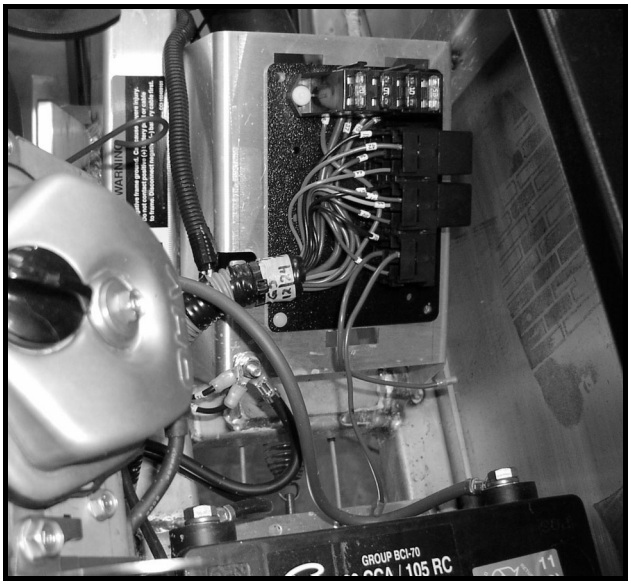


Figure 11b-5 Electrical Component Mounting Plate

TEST PROCEDURE 3 – GROUND CABLES

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**

3. Check the frame ground connection for loose connections and damaged terminals **(Figure 11b-6, Page 11b-13)**. Repair or replace as required.
4. Check the negative (–) battery terminal and 6-gauge black wire (w202) for damage. Repair or replace as required.
5. Check the engine ground for a loose connection and damaged terminals where the two 6-gauge black wires (w202 and w203) are connected to the engine block (under the starter) **(Figure 11b-7, Page 11b-13)**. Repair or replace as required.
6. Set the multimeter to 200 ohms.
7. Check for continuity between the 6-gauge wire (w202) terminal, disconnected from the negative (–) battery terminal, and the frame.
8. Check for continuity between the 6-gauge wire (w202) terminal, disconnected from the negative (–) battery terminal, and the engine.
9. The readings obtained in the previous steps should indicate continuity. If any of the readings are incorrect, clean and tighten wire connections. If the connections are good and the reading is incorrect, repair or replace the wire.

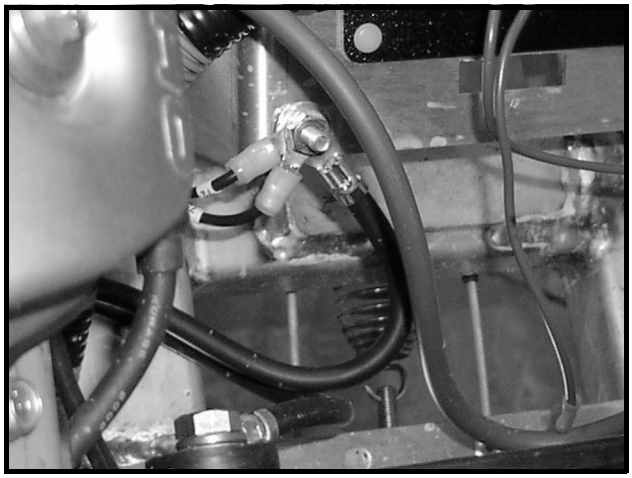


Figure 11b-6 Frame Ground

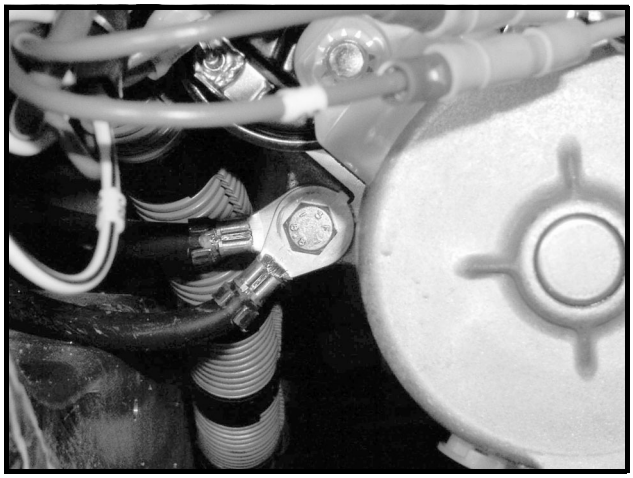


Figure 11b-7 Engine Ground (Under Starter)

TEST PROCEDURE 4 – KEY SWITCH (STARTER CIRCUIT)

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Ensure that the key switch connector is connected correctly and is tight. If it is not, repair or replace as necessary.
4. Remove the key switch. **See Key Switch Removal, Section 12b, Page 12b-6.**
5. Set the multimeter to 200 ohms.

6. Turn the key switch ON. Place the red (+) probe of the multimeter on the (B) terminal and the black (–) probe on the (L) terminal of the key switch. The reading should indicate continuity. If the reading does not indicate continuity, replace the key switch **(Figure 11b-8, Page 11b-14)**. **See Key Switch Removal, Section 12b, Page 12b-6.**

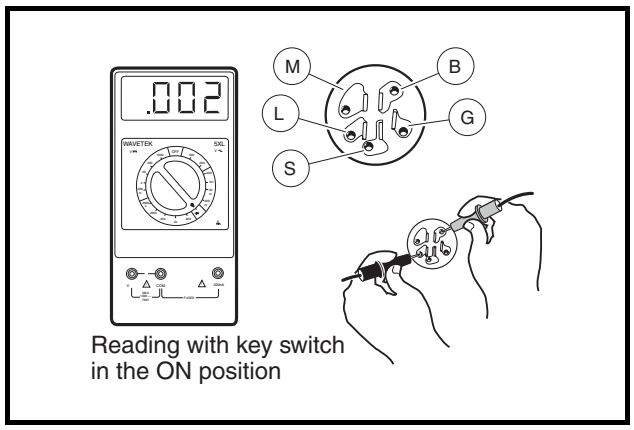


Figure 11b-8 Key Switch Test – Accessory Terminal

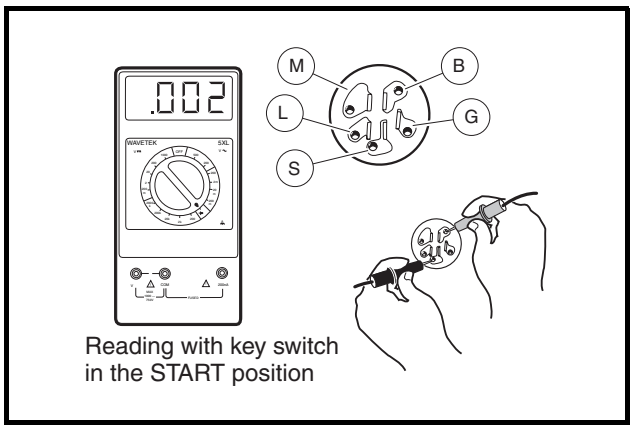


Figure 11b-9 Key Switch Test – Starter Circuit

7. With the key switch still in the ON position, place the red (+) probe of the multimeter on the (B) terminal and the black (–) probe on the (S) terminal of the key switch. The reading should indicate no continuity. If the reading indicates continuity, replace the key switch. **See Key Switch Removal, Section 12b, Page 12b-6.** If the reading does not indicate continuity, leave the probes connected and proceed to step 8.

8. Turn and hold the key switch in the START position. The reading should indicate continuity. If the reading does not indicate continuity, replace the key switch **(Figure 11b-9, Page 11b-14)**. Place the red (+) probe of the multimeter on the (B) terminal and the black (–) probe on the (L) terminal of the key switch, the reading should indicate continuity. If either reading does not indicate continuity, replace the key switch. **See Key Switch Removal, Section 12b, Page 12b-6.**

TEST PROCEDURE 5 – KEY SWITCH (ACCESSORY TERMINAL)

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.

2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**

3. Ensure that the key switch connector is connected correctly and is tight. If it is not, repair or replace as necessary.

4. Remove the key switch. **See Key Switch Removal, Section 12b, Page 12b-6.**

5. Turn the key switch to the ON position. With the multimeter set to 200 ohms, place the red (+) probe on the (B) terminal and the black (–) probe on the (L) terminal of the key switch **(Figure 11b-8, Page 11b-14)**. The reading should indicate continuity. If the reading does not indicate continuity, replace the key switch. **See Key Switch Removal, Section 12b, Page 12b-6.**

TEST PROCEDURE 6 – STARTER CONTROL CIRCUIT

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the 16-gauge green wire (w127) from the starter solenoid coil to prevent the vehicle from unintentionally starting **(Figure 11b-10, Page 11b-15)**. **See following WARNING.**

⚠ WARNING

- **Failure to disconnect the wire from the solenoid coil could result in an unexpected engine start when performing this test.**

3. Set the multimeter to 20 VDC.
4. Place the probes to measure the voltage between the 16-gauge green wire (w127) terminal and the frame ground **(Figure 11b-11, Page 11b-15)**.
5. Monitor the multimeter. The reading should indicate 0 volts with the key in the OFF and ON positions. The reading should indicate approximately 12 VDC when the key is in the START position.

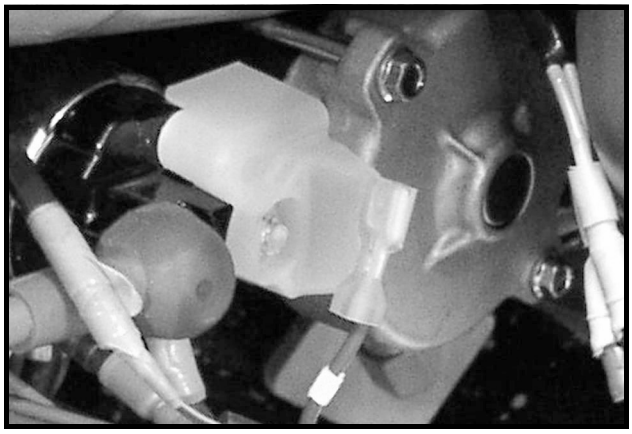


Figure 11b-10 Solenoid Coil Wire (w127) Removed

Figure 11b-11 Starter Circuit Test

6. If the readings differ from those described in step 5, perform the following test procedures:
   - Check the battery. **See Test Procedure 1 – Battery on page 11b-9.**
   - Check the 25-amp fuse at the fuse block. **See Test Procedure 2 – Fuse on page 11b-12.**
   - Check the start relay. **See Test Procedure 7 – Start Relay on page 11b-16.**
   - Check diode 7. **See Test Procedure 9G – Diode 7 on wire 129 on page 11b-23.**
   - Check the neutral switch on the transmission housing. **See Test Procedure 10 – Neutral Switch (Transmission) on page 11b-24.**
   - Check for continuity of the wire harness on wires 127, 129, 128, 124, and 125. **See Wiring Diagram on page 11b-6.**
7. If none of the previous steps resolves the problem, the starter solenoid and/or starter motor has failed. **See the Honda GX620 engine manual (CCI P/N 102615401).**

TEST PROCEDURE 7 – START RELAY

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the 16-gauge green wire (w127) from the starter solenoid coil to prevent the vehicle from unintentionally starting **(Figure 11b-10, Page 11b-15)**. **See following WARNING.**

⚠ WARNING

- **Failure to disconnect the wire from the solenoid coil could result in an unexpected engine start when performing this test.**

3. Set the multimeter to 20 VDC.
4. Place the probes to measure the voltage between the 16-gauge green start relay wire (w110) terminal and the frame ground **(Figure 11b-12, Page 11b-16)**.
5. Monitor the multimeter. The reading should indicate 0 volts with the key in the OFF and ON positions. The reading should indicate approximately 12 VDC when the key is in the START position and the relay should click. **See following NOTE.**

NOTE: *The differential and accessory relays may be removed to isolate the sound of the start relay click.*

6. If the reading is 12 VDC and the relay does not click when the key switch is turned to the START position, replace the relay.
7. If the reading is 12 VDC and the relay clicks when the key is in the START position, check the relay contacts.
   7.1. Set the multimeter to 200 ohms.
   7.2. Check for continuity between the 16-gauge red wire (w124) and the 16-gauge green wire (w128) relay terminals **(Figure 11b-13, Page 11b-16)**.
   7.3. Monitor the multimeter. The multimeter should not indicate continuity with the key in the OFF or ON positions. The multimeter should indicate continuity when the key is in the START position.
   7.4. If the multimeter does not indicate continuity while the key is in the START position and the relay clicks, the contacts have failed. Replace the relay.

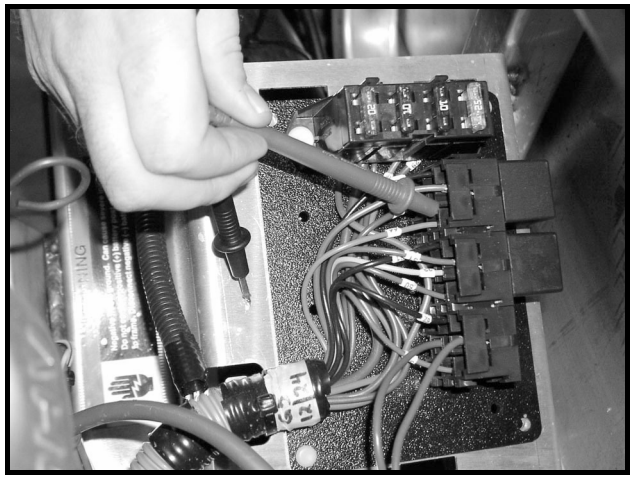


Figure 11b-12 Start Relay Coil Circuit Test

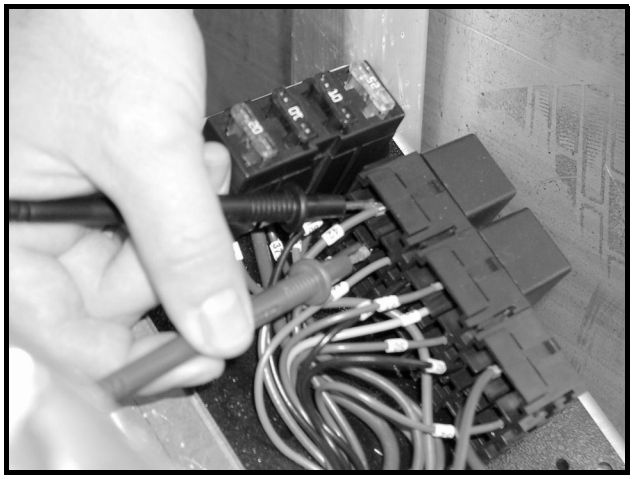


Figure 11b-13 Start Relay Contact Test

8. If the reading obtained in step 5 is not 12 VDC with the key in the START position, perform the following test procedures:
   - Check battery. **See Test Procedure 1 – Battery on page 11b-9.**
   - Check the 10-amp fuse (on w109). **See Test Procedure 2 – Fuse on page 11b-12.**
   - Check the key switch. **See Test Procedure 4 – Key Switch (Starter Circuit) on page 11b-13.**
   - Check diode 5. **See Test Procedure 9E – Diode 5 on wire 141 on page 11b-22.**
   - Check the neutral switch on the transmission housing. **See Test Procedure 10 – Neutral Switch (Transmission) on page 11b-24.**
   - Check for continuity of the wire harness on wires w141, w138, w110, and w43. **See Wiring Diagram on page 11b-6.**

TEST PROCEDURE 8 – DIFFERENTIAL RELAY

See General Warning, Section 1, Page 1-1.

The differential relay activates the front differential when the key is in the ON position and the Forward/Reverse handle is in the FORWARD or REVERSE position.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the 16-gauge green wire (w127) from the starter solenoid coil to prevent the vehicle from unintentionally starting **(Figure 11b-10, Page 11b-15)**. **See following WARNING.**

⚠ WARNING

- **Failure to disconnect the wire from the solenoid coil could result in an unexpected engine start when performing this test.**

3. Set the multimeter to 20 VDC.
4. Place the probes to measure the voltage between the 18-gauge purple differential relay wire (w135) terminal and the frame ground.

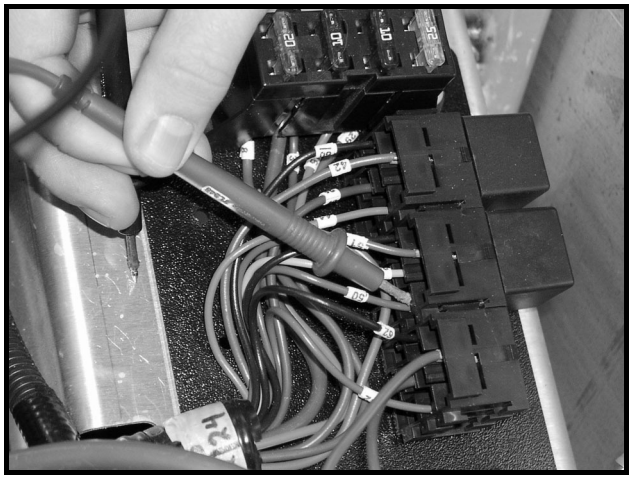


Figure 11b-14 Differential Relay Coil Circuit Test

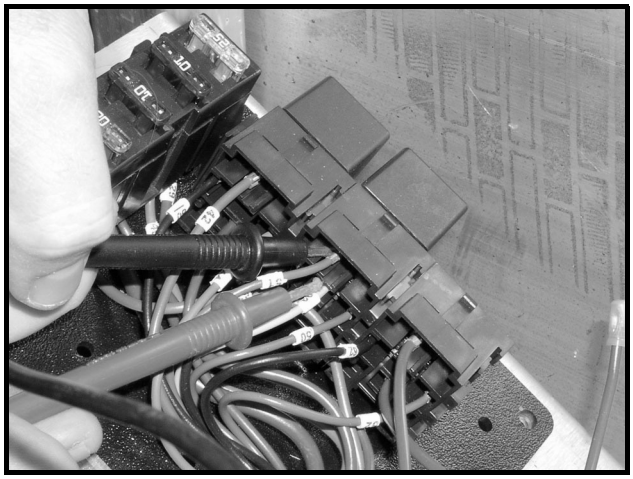


Figure 11b-15 Differential Relay Contact Test

5. Monitor the multimeter. The reading should indicate 0 volts with the key in the OFF position and the Forward/Reverse handle in the NEUTRAL position. The reading should indicate approximately 12 VDC when the key is in the ON position and the differential relay should click. **See following NOTE.**

NOTE: *The start and accessory relays may be removed to isolate the sound of the differential relay click.*

6. If the reading is 12 VDC and the relay does not click with the key switch in the ON position and the Forward/Reverse handle in the NEUTRAL position, replace the relay.
7. If the reading is 12 VDC and the relay clicks when the key is in the ON position, check the relay contacts.
   7.1. Set the multimeter to 200 ohms.
   7.2. Check for continuity between the 18-gauge gray wire (w111) and the 18-gauge purple wire (w136) relay terminals.
   7.3. Monitor the multimeter. The multimeter should indicate continuity with the key in the OFF position. The multimeter should NOT indicate continuity when the key is in the ON position.
   7.4. If the multimeter indicates continuity while the key is in the ON position and the relay clicks, the contacts have failed closed. Replace the relay.
8. If the reading obtained in step 5 is not 12 VDC with the key in the ON position, perform the following test procedures:

- Check the battery. **See Test Procedure 1 – Battery on page 11b-9.**
- Check the 10-amp fuse (on w109). **See Test Procedure 2 – Fuse on page 11b-12.**
- Check the key switch. **See Test Procedure 4 – Key Switch (Starter Circuit) on page 11b-13.**
- Check diode 4. **See Test Procedure 9D – Diode 4 on wire 140 on page 11b-21.**
- Check the neutral switch on the transmission housing. **See Test Procedure 10 – Neutral Switch (Transmission) on page 11b-24.**
- Check for continuity of the wire harness on wires w140, w139, w135, and w47. **See Wiring Diagram on page 11b-6.**

TEST PROCEDURE 9 – WIRE HARNESS DIODES

See General Warning, Section 1, Page 1-1.

A diode is designed to conduct current in one direction only. Depending on the application, diodes are used in the vehicle to control electrical system logic, or to help protect relay and switch contacts from excessive arcing. **See following NOTE.**

NOTE: *If a diode conducts current in both directions, the diode has failed closed. If a diode will not conduct current in either direction, the diode has failed open.*

The wire harness is equipped with several in-line diodes. The following table describes each diode's function in the electrical system, the location in the wire harness, and the symptom(s) of a diode failure.

DIODE TROUBLESHOOTING GUIDE

DIODE	IN-LINE WIRE LOCATION (WIRES)	FUNCTION	FAILURE CONDITION	SYMPTOM/COMMENT
Diode 1	w32 and w35	Differential solenoid coil flyback diode	Open	Will contribute to the premature failure of the differential relay contacts.
			Closed	The 10-amp fuse (on w109) will blow repeatedly until the diode has been replaced.
Diode 2	w40 and w41	Carburetor solenoid control (powers carburetor solenoid when key switch is in the START position)	Open	Difficult starting
			Closed	Starter will be activated when key switch is in the ON position.
Diode 3	w45 and w123	Carburetor solenoid control (powers carburetor solenoid when key switch is in the ON position)	Open	Difficult starting and engine will shut off shortly after key switch is moved from the START to ON position.
			Closed	Oil light may illuminate when key is in ON position until oil pressure rises. Hour meter will be powered when key switch is in the START position.
Diode 4	w140 and w139	Differential relay coil isolation diode	Open	Differential solenoid is energized all of the time, even when Forward/ Reverse handle is in the NEUTRAL position.
			Closed	May allow the vehicle to be started when Forward/Reverse handle is in FORWARD or REVERSE positions.
Diode 5	w141 and w138	Start relay coil isolation diode	Open	Vehicle will not start. Start relay will not be energized when key switch is in the START position.
			Closed	Loss of start relay coil isolation.
Diode 6	w130 and w122	Carburetor solenoid coil flyback diode	Open	Will contribute to the premature failure of the key switch contacts.
			Closed	The 10-amp fuse (on w109) will blow repeatedly until the diode has been replaced.
Diode 7	w129 and w131	Starter solenoid coil flyback diode	Open	Will contribute to the premature failure of the start relay contacts.
			Closed	The 25-amp fuse (on w29) will blow repeatedly until the diode has been replaced.

Test Procedure 9A – Diode 1 on wire 32

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**

3. Disconnect the two-pin connector between the front gearcase and the wire harness.
4. Set the multimeter to the diode test function (→|←).
5. Connect the black (–) probe of the multimeter to the frame (ground).
6. Connect the red (+) probe of the multimeter to the 18-gauge gray wire (w34) on the two-pin connector (wire harness side).
7. The reading should indicate an over limit (no continuity). If the diode conducts current (shows continuity) with the meter probes connected as described, the diode has failed and must be replaced. **See Wire Harness Diode Removal, Section 12b, Page 12b-14.**
8. Reverse the multimeter probes and note the reading. The multimeter should indicate approximately 540 mV, however, a range of 400-700 mV is acceptable.
9. If the readings obtained in the previous steps are incorrect, replace the diode. **See Wire Harness Diode Removal, Section 12b, Page 12b-14.**

Test Procedure 9B – Diode 2 on wire 40

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Remove the start relay from the multi-pin connector located on the electrical component mounting plate.

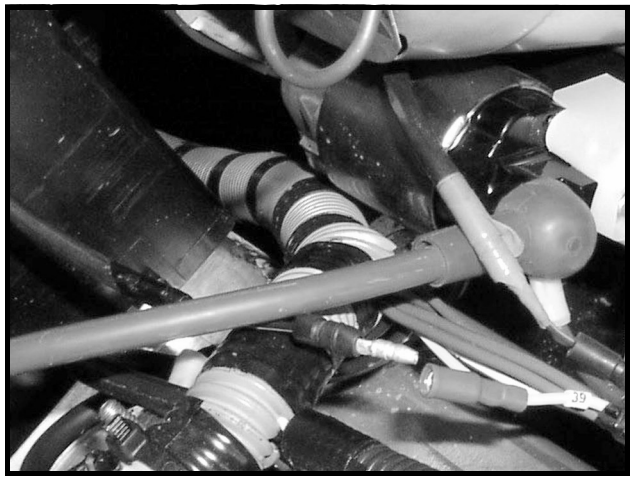


Figure 11b-16 Carburetor Coil Bullet Connector

4. Disconnect the 18-gauge yellow wire (w123) from the carburetor solenoid bullet connector **(Figure 11b-16, Page 11b-20)**.
5. Set the multimeter to the diode test function (→|←).
6. Connect the black (–) probe of the multimeter to the 18-gauge light-green wire (w110) at the start relay multi-pin connector.
7. Connect the red (+) probe of the multimeter to the 18-gauge yellow wire (w123) at the bullet connector (wire harness side).

8. The reading should indicate an over limit (no continuity). If the diode conducts current (shows continuity) with the meter probes connected as described, the diode has failed and must be replaced. **See Wire Harness Diode Removal, Section 12b, Page 12b-14.**
9. Reverse the multimeter probes and note the reading. The multimeter should indicate approximately 540 mV, however, a range of 400-700 mV is acceptable.
10. If the readings obtained in the previous steps are incorrect, replace the diode. **See Wire Harness Diode Removal, Section 12b, Page 12b-14.**

Test Procedure 9C – Diode 3 on wire 45

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Raise the hood and disconnect the multi-pin connector from the key switch.
4. Disconnect the 18-gauge purple wire (w42) from the oil light.
5. Disconnect the 18-gauge blue wire (w25) from the fuel gauge/hour meter.
6. Remove the differential relay and the accessory relay from the multi-pin connector located on the electrical component mounting plate.
7. Set the multimeter to the diode test function (→|←).
8. Connect the black (–) probe of the multimeter to the 18-gauge purple wire (w47) at the key switch multi-pin connector.
9. Connect the red (+) probe of the multimeter to the 18-gauge yellow wire (w123) at the bullet connector (wire harness side).
10. The reading should indicate an over limit (no continuity). If the diode conducts current (shows continuity) with the meter probes connected as described, the diode has failed and must be replaced. **See Wire Harness Diode Removal, Section 12b, Page 12b-14.**
11. Reverse the multimeter probes and note the reading. The multimeter should indicate approximately 540 mV, however, a range of 400-700 mV is acceptable.
12. If the readings obtained in the previous steps are incorrect, replace the diode. **See Wire Harness Diode Removal, Section 12b, Page 12b-14.**

Test Procedure 9D – Diode 4 on wire 140

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Remove the start relay, differential relay, and accessory relay from the multi-pin connector located on the electrical component mounting plate.

4. Disconnect the two-pin connector between the neutral switch and the wire harness **(Figure 11b-17, Page 11b-22)**.

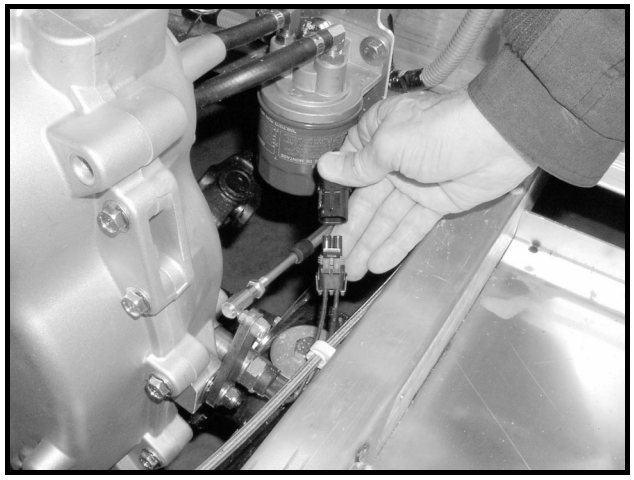


Figure 11b-17 Neutral Switch Two-Pin Connector

5. Set the multimeter to the diode test function (→|←).
6. Connect the black (–) probe of the multimeter to the 18-gauge black/white wire (w142) at the neutral switch two-pin connector.
7. Connect the red (+) probe of the multimeter to the 18-gauge black wire (w139) on the multi-pin differential relay connector located on the electrical component mounting plate.
8. The reading should indicate an over limit (no continuity). If the diode conducts current (shows continuity) with the meter probes connected as described, the diode has failed and must be replaced. **See Wire Harness Diode Removal, Section 12b, Page 12b-14.**
9. Reverse the multimeter probes and note the reading. The multimeter should indicate approximately 540 mV, however, a range of 400-700 mV is acceptable.
10. If the readings obtained in the previous steps are incorrect, replace the diode. **See Wire Harness Diode Removal, Section 12b, Page 12b-14.**

Test Procedure 9E – Diode 5 on wire 141

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Remove the start relay, differential relay, and accessory relay from the multi-pin connector located on the electrical component mounting plate.
4. Disconnect the two-pin connector between the neutral switch and the wire harness **(Figure 11b-17, Page 11b-22)**.
5. Set the multimeter to the diode test function (→|←).

6. Connect the black (–) probe of the multimeter to the 18-gauge black/white wire (w142) at the neutral switch two-pin connector.
7. Connect the red (+) probe of the multimeter to the 18-gauge black wire (w138) on the multi-pin start relay connector located on the electrical component mounting plate.
8. The reading should indicate an over limit (no continuity). If the diode conducts current (shows continuity) with the meter probes connected as described, the diode has failed and must be replaced. **See Wire Harness Diode Removal, Section 12b, Page 12b-14.**
9. Reverse the multimeter probes and note the reading. The multimeter should indicate approximately 540 mV, however, a range of 400-700 mV is acceptable.
10. If the readings obtained in the previous steps are incorrect, replace the diode. **See Wire Harness Diode Removal, Section 12b, Page 12b-14.**

Test Procedure 9F – Diode 6 on wire 130

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Raise the hood and disconnect the multi-pin connector from the key switch.
4. Disconnect the multi-pin connector between the voltage regulator and the wire harness.
5. Set the multimeter to the diode test function (→|←).
6. Connect the black (–) probe of the multimeter to the frame (ground).
7. Connect the red (+) probe of the multimeter to the 18-gauge yellow wire (w123) at the bullet connector (wire harness side).
8. The reading should indicate an over limit (no continuity). If the diode conducts current (shows continuity) with the meter probes connected as described, the diode has failed and must be replaced. **See Wire Harness Diode Removal, Section 12b, Page 12b-14.**
9. Reverse the multimeter probes and note the reading. The multimeter should indicate approximately 540 mV, however, a range of 400-700 mV is acceptable.
10. If the readings obtained in the previous steps are incorrect, replace the diode. **See Wire Harness Diode Removal, Section 12b, Page 12b-14.**

Test Procedure 9G – Diode 7 on wire 129

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Raise the hood and disconnect the multi-pin connector from the key switch.
4. Disconnect the multi-pin connector between the voltage regulator and the wire harness.
5. Disconnect the 16-gauge green wire (w127) from the starter solenoid coil **(Figure 11b-10, Page 11b-15)**.

6. Set the multimeter to the diode test function (→|←).
7. Connect the black (–) probe of the multimeter to the frame (ground).
8. Connect the red (+) probe of the multimeter to the 16-gauge green wire (w127) at the bullet connector.
9. The reading should indicate an over limit (no continuity). If the diode conducts current (shows continuity) with the meter probes connected as described, the diode has failed and must be replaced. **See Wire Harness Diode Removal, Section 12b, Page 12b-14.**
10. Reverse the multimeter probes and note the reading. The multimeter should indicate approximately 540 mV, however, a range of 400-700 mV is acceptable.
11. If the readings obtained in the previous steps are incorrect, replace the diode. **See Wire Harness Diode Removal, Section 12b, Page 12b-14.**

TEST PROCEDURE 10 – NEUTRAL SWITCH (TRANSMISSION)

See General Warning, Section 1, Page 1-1.

The neutral switch is located on the transmission housing.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Disconnect the two-pin connector between the neutral switch and the wire harness (w142 and w143) **(Figure 11b-17, Page 11b-22)**.
4. Check for continuity on the switch contacts with the Forward/Reverse handle in the FORWARD position **(Figure 11b-18, Page 11b-24)**. The multimeter should indicate no continuity.

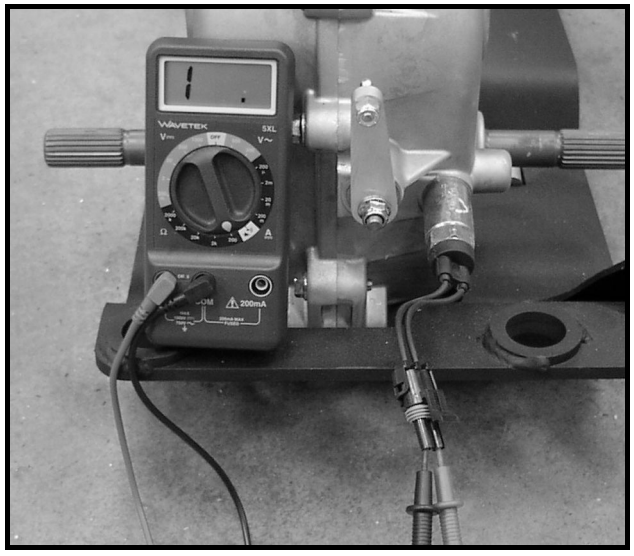


Figure 11b-18 Neutral Switch – Forward Position

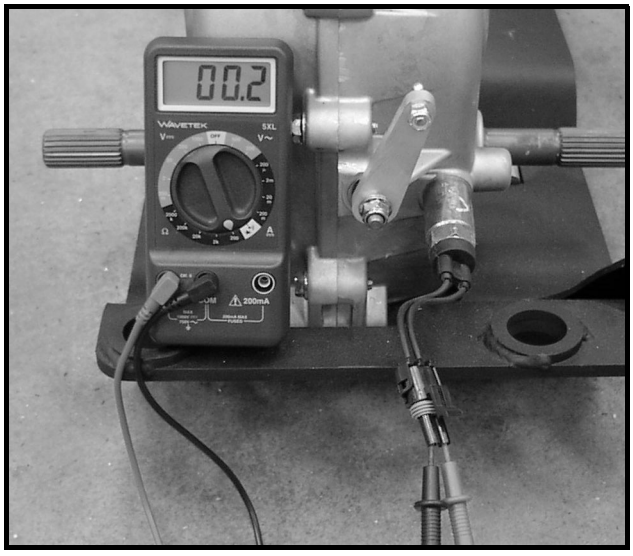


Figure 11b-19 Neutral Switch – Neutral Position

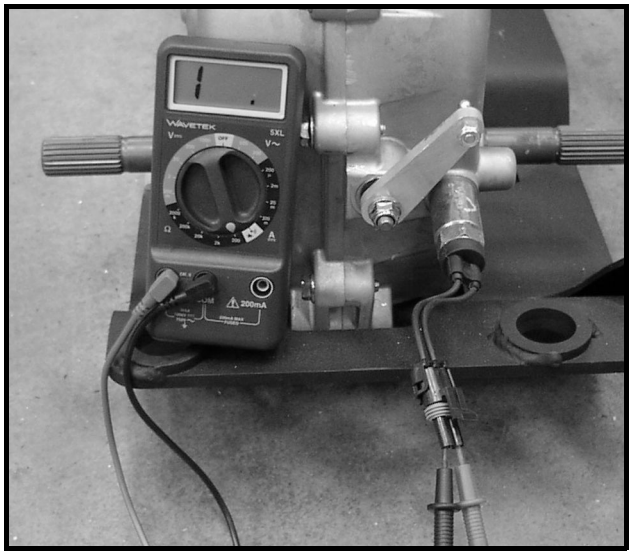


Figure 11b-20 Neutral Switch – Reverse Position

5. Check for continuity on the switch contacts with the Forward/Reverse handle in the NEUTRAL position **(Figure 11b-19, Page 11b-24)**. The multimeter should indicate continuity.
6. Check for continuity on the switch contacts with the Forward/Reverse handle in the REVERSE position **(Figure 11b-20, Page 11b-25)**. The multimeter should indicate no continuity.
7. If any of the continuity readings are incorrect, replace the neutral switch. **See Neutral Switch Removal on page 12b-2.**

TEST PROCEDURE 11 – WIRE CONTINUITY

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. To test a wire for continuity, disconnect either end from the electrical component to which it is attached.
4. Set the multimeter to 200 ohms and place the red (+) probe on the terminal at one end of the wire. Place the black (–) probe on the other terminal end of the wire. The reading should indicate continuity. If the reading is incorrect, repair or replace the wire. **See following NOTE.**

NOTE: *When checking continuity of wires in the wire harness, observe the polarity of diodes. Testing continuity of certain wires will require the appropriate diode test procedure.* ***See Test Procedure 9 – Wire Harness Diodes on page 11b-18.***

TEST PROCEDURE 12 – FRONT DRIVE GEARCASE COIL

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**

3. Disconnect the two-pin connector between the wire harness and the front drive gearcase located under the front floorboard.
4. Set the multimeter to 200 ohms.
5. Measure the resistance between the two wires at the two-pin connector (front drive gearcase side).
6. The resistance should be 24.7 to 27.3 ohms.
7. If the resistance is not within the stated range, replace the large output cover sub-assembly. **See the Engines and Drivetrain Components manual (CCI P/N 102396501).**

TEST PROCEDURE 13 – CHARGE COIL

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Disconnect the multi-pin connector between the voltage regulator and the wire harness.
4. Measure the resistance of the charge coil on the two blue wires at the voltage regulator multi-pin connector (harness side) **(Figure 11b-21, Page 11b-26)**. The resistance should be small (less than 1 ohm).
5. If the resistance is high, or the multimeter indicates an over limit (no continuity), check the resistance at the two bullet connectors (engine side) close to the starter **(Figure 11b-22, Page 11b-26)**.
6. If the resistance reading at the bullet connectors is less than 1 ohm, check for wire harness continuity on the blue wires (w120 and w119) between the bullet connectors and the voltage regulator multi-pin connector. Also check for loose connections at the bullet connectors and the voltage regulator multi-pin connector.
7. If the resistance is high, or the multimeter indicates an over limit (no continuity), the coil has failed. **See the Honda GX620 engine manual (CCI P/N 102615401).**

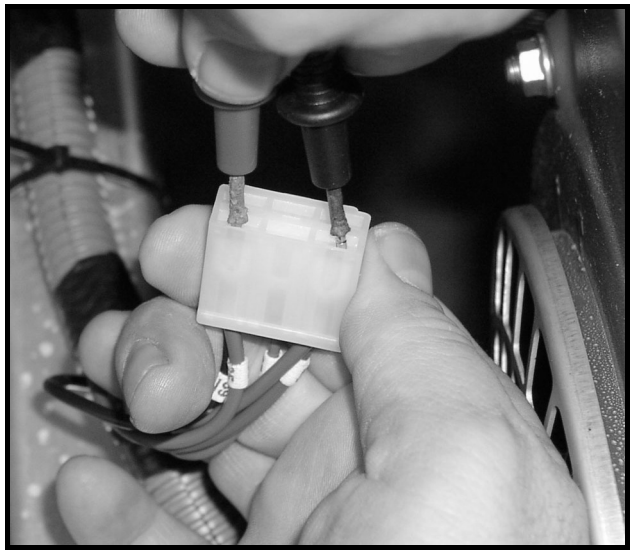


Figure 11b-21 Charge Coil Test (At Voltage Regulator Multi-Pin Connector)

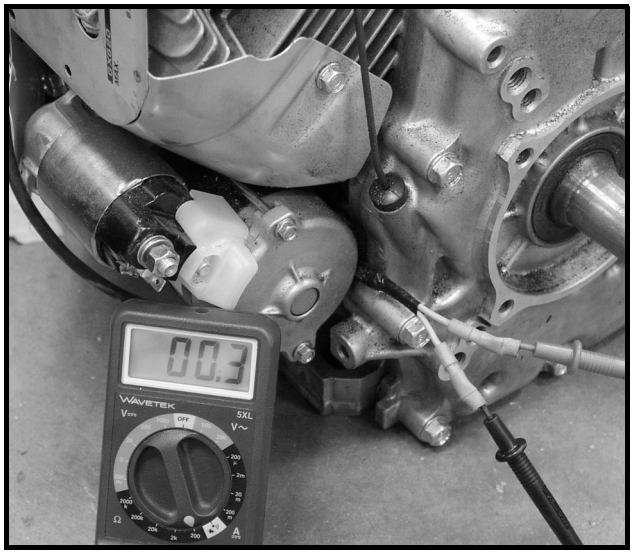


Figure 11b-22 Charge Coil Test (At Bullet Connectors)

TEST PROCEDURE 14 – VOLTAGE REGULATOR

See General Warning, Section 1, Page 1-1.

NOTE: *Keep the battery connected during this test procedure.*

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Ensure that the wires are connected correctly and are tight. If they are not, rewire or tighten as necessary.
3. Check the engine RPM setting to ensure that it is adjusted correctly. **See Engine RPM Adjustment, Section 13b, Page 13b-23.**
4. With the battery in good condition and fully charged, run the engine for several minutes to bring the voltage regulator to operating temperature.
5. Set the multimeter for 20 VDC.
6. With the engine running at full-governed RPM, measure the battery voltage at the battery posts. If the reading is between 14.0 and 15.0 volts, the regulator is good. If the reading is lower than 14.0 volts but rising steadily, check the battery condition. **See Test Procedure 1 – Battery on page 11b-9.**
7. If the reading is less than 14.0 volts and not rising, check the charge coil. **See Test Procedure 13 – Charge Coil on page 11b-26.** Also check for a loose connection at the voltage regulator multi-pin connector and check the continuity of each wire in the voltage regulator multi-pin connector.
8. If the reading is more than 15.0 volts and continues to rise, replace voltage regulator. **See Voltage Regulator Removal, Section 12b, Page 12b-3.**

TEST PROCEDURE 15 – IGNITION SPARK

See General Warning, Section 1, Page 1-1.

NOTE: *Keep the battery connected during this test procedure.*

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Remove the spark plug wire from one of the spark plugs.
3. Use an ignition spark gap test tool (Thexton 404 or equivalent) to check for correct spark.
4. Adjust the tester probes to approximately 18,000 volts (18 Kv), setting (SE – Small Engine Setting on the Thexton 404 tool). Connect the tester to the spark plug wire and connect the alligator clip to a solid engine ground.
5. If there is a strong blue spark between the probes of the spark gap tester, stop the engine and perform the test on the remaining spark plug.
6. There should be a strong blue spark between the probes of the spark gap tester when both spark plug circuits are tested. If there is no spark on either of the ignition circuits, or if either of the sparks is a faint yellow or red color, test the ignition circuit components. **See the Honda GX620 engine manual (CCI P/N 102615401).**
7. If the spark gap tester tool indicates a strong blue spark, it is possible the spark plug has failed internally. Install a new spark plug set to the proper gap setting and test the engine for proper operation. **See the Honda GX620 engine manual (CCI P/N 102615401).**

TEST PROCEDURE 16 – ENGINE KILL WIRE

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Disconnect white/black wire bullet connector located near the starter **(Figure 11b-23, Page 11b-28)**.
4. Connect the red (+) probe of the multimeter to the male bullet terminal on the white/black wire and connect the black (–) probe to the vehicle frame (ground). The multimeter should indicate continuity with the key switch in the OFF position.
5. With the Forward/Reverse handle in the NEUTRAL position, insert the key and turn the key switch to the ON position. Note the multimeter reading. Turn the key and hold it in the START position. Note the multimeter reading.
6. There should be no continuity when the key switch is in the ON or START position. If continuity is indicated, check for worn insulation on the white/black wire that grounds the wire to the frame. **See Test Procedure 17 – Grounded Kill Wire on page 11b-28.** Also check the key switch for proper operation. **See Test Procedure 18 – Key Switch (Engine Kill Circuit) on page 11b-29.**

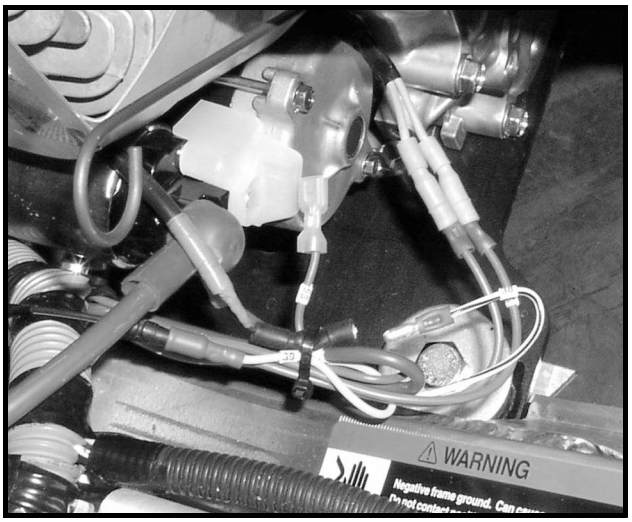


Figure 11b-23 Engine Kill Wire

TEST PROCEDURE 17 – GROUNDED KILL WIRE

See General Warning, Section 1, Page 1-1.

NOTE: *Keep the battery connected during this test procedure.*

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the engine kill white/black wire (w108) at the bullet connector located near the starter **(Figure 11b-23, Page 11b-28)**. **See following NOTE.**

NOTE: *Disconnecting the engine kill wire removes the engine ignition circuit from the vehicle start/stop circuit.*

3. Turn the key switch to the START position and release it after the engine starts. If the engine starts and continues to idle, check the kill wire for grounding. **See Test Procedure 16 – Engine Kill Wire on page 11b-28. See following WARNING.**

⚠ WARNING

- **When the white/black engine kill wire is disconnected, the engine will not stop running immediately after the key switch is turned to the OFF position. It will be necessary to pull and hold the choke handle until the engine stops running.**

4. Also check the key switch for proper operation. **See Test Procedure 18 – Key Switch (Engine Kill Circuit) on page 11b-29. See preceding WARNING.**
5. If the engine does not run, connect the white/black wire at the bullet connector located near the starter and proceed to Test Procedure 15 – Ignition Spark on page 11b-27.

TEST PROCEDURE 18 – KEY SWITCH (ENGINE KILL CIRCUIT)

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Raise the hood.
4. Remove the connector from the key switch.
5. Place the red (+) probe on the (M) terminal and the black (–) probe on the (G) terminal. With the key switch OFF, the reading should indicate continuity. With the key switch turned ON, the reading should indicate no continuity. If either reading is incorrect, replace the key switch **(Figure 11b-24, Page 11b-29)**.
6. Reconnect the key switch to the wire harness. Ensure that the connector is connected correctly and is tight. If it is not, repair or replace as necessary.

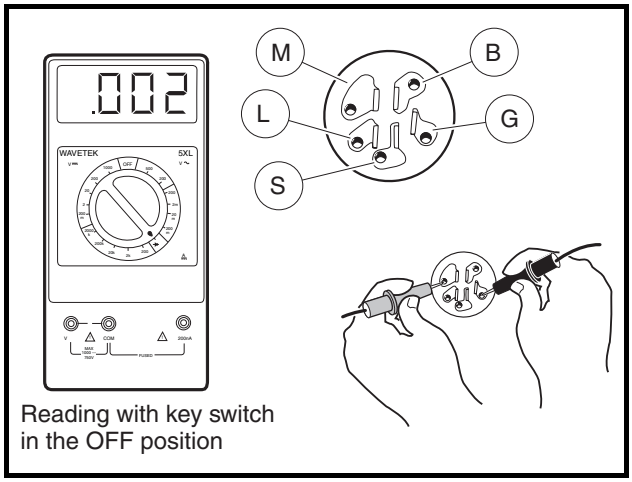


Figure 11b-24 Key Switch Test – Engine Kill Circuit

TEST PROCEDURE 19 – REVERSE WARNING BUZZER LIMIT SWITCH

See General Warning, Section 1, Page 1-1.

NOTE: *Keep the battery connected during this test procedure.*

The reverse warning buzzer limit switch is located on the Forward/Reverse handle under the hood.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Check for proper wiring and tight connections at the reverse warning buzzer and the reverse warning buzzer limit switch **(Figure 11b-25, Page 11b-30)**.

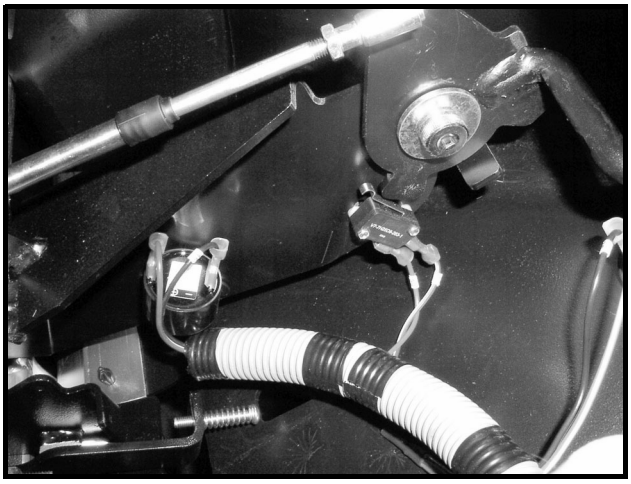


Figure 11b-25 Reverse Warning Buzzer and Limit Switch

3. Move the Forward/Reverse handle to REVERSE and listen for an audible click from the limit switch. If there is no click, check the switch for proper alignment and switch arm movement.
4. If the switch is being activated but the buzzer does not function, place the red (+) probe of the multimeter on one terminal and the black (–) probe on the other terminal of the limit switch. With the lever fully released, the reading should be no continuity.
5. Place the Forward/Reverse handle in the REVERSE position to activate the limit switch. The multimeter should indicate continuity when the limit switch lever is activated. If either reading is incorrect, replace the limit switch **(Figure 11b-25, Page 11b-30)**.

TEST PROCEDURE 20 – REVERSE WARNING BUZZER

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Check for proper wiring and tight connections. Use a multimeter and check for continuity through each wire that connects to the reverse warning buzzer individually. **See Wiring Diagram, Section 11b, Page 11b-6.** If the buzzer does not function when properly wired, replace the buzzer. **See Reverse Warning Buzzer Removal, Section 12b, Page 12b-10.**

TEST PROCEDURE 21 – CARBURETOR SOLENOID CIRCUIT

See General Warning, Section 1, Page 1-1.

NOTE: *Keep the battery connected while performing this test procedure.*

1. Check the carburetor solenoid coil circuit.

   1.1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.

   1.2. Disconnect the 18-gauge yellow wire (w123) from the carburetor solenoid bullet connector **(Figure 11b-16, Page 11b-20)**.

   1.3. Disconnect the 16-gauge green wire (w127) from the starter solenoid coil to prevent the vehicle from unintentionally starting **(Figure 11b-10, Page 11b-15)**. **See following WARNING.**

⚠ WARNING

- **Failure to disconnect the wire from the solenoid coil could result in an unexpected engine start when performing this test.**

   1.4. Set the multimeter to 20 VDC.

   1.5. Place the probes to measure the voltage between the 18-gauge yellow wire (w123) terminal (wire harness side) and the frame ground.

   1.6. Monitor the multimeter. The reading should indicate 0 volts with the key in the OFF position. The reading should indicate approximately 12 VDC when the key is in the ON and START positions; if the multimeter does indicate 12 VDC, proceed to step 2. If the reading does not indicate approximately 12VDC with the key in the ON and START positions, check the following items:

- Key switch (starter circuit). **See Test Procedure 4 – Key Switch (Starter Circuit) on page 11b-13.**
- Diode 2. **See Test Procedure 9B – Diode 2 on wire 40 on page 11b-20.**
- Diode 3. **See Test Procedure 9C – Diode 3 on wire 45 on page 11b-21.**
- Diode 6. **See Test Procedure 9F – Diode 6 on wire 130 on page 11b-23.**

2. Check the carburetor solenoid coil.

   2.1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.

   2.2. Disconnect the battery as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**

   2.3. Set the multimeter to 200 ohms.

   2.4. Measure the resistance between the carburetor solenoid coil wire and the frame or engine (ground) **(Figure 11b-26, Page 11b-32)** The resistance should be approximately 37.5 ohms.

   2.5. If the resistance reading is incorrect, replace the solenoid coil. **See the Honda GX620 engine manual (CCI P/N 102615401).**

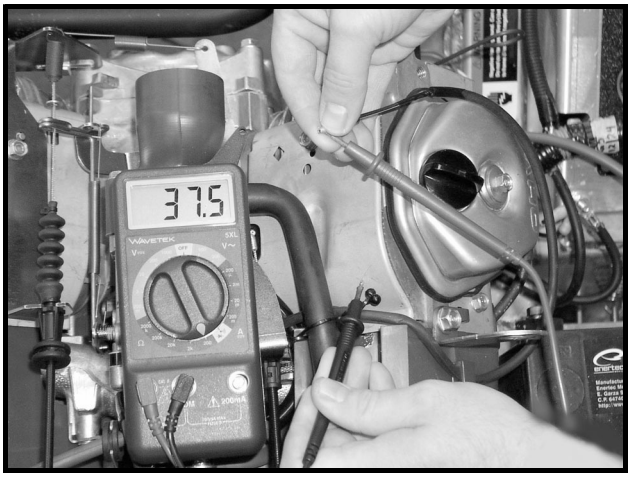


Figure 11b-26 Carburetor Solenoid Coil Resistance

TEST PROCEDURE 22 – LOW OIL WARNING LIGHT CIRCUIT

See General Warning, Section 1, Page 1-1.

If the low oil warning light stays on, test the oil pressure switch. **See the Honda GX620 engine manual (CCI P/N 102615401).** If the low oil warning light does not illuminate and the vehicle is low on oil, proceed to step 1. **See following NOTE.**

NOTE: *The low oil warning light should illuminate when the key switch is turned to the ON position. After the engine has been started, the low oil warning light should remain illuminated until the oil pressure switch has been activated.*

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Raise the hood.
3. Ensure that the wires are connected correctly and are tight. If they are not, rewire or tighten as necessary.
4. Disconnect the 18-gauge blue/white wire (w17) from the low oil warning light terminal.
5. Leave the 18-gauge purple wire (w42) connected to the low oil warning light.
6. Place a jumper wire on the terminal of the low oil warning light where the black/white wire was removed.
7. Touch the frame (ground) with the remaining end of the jumper wire.
8. Turn the key switch to the ON position. The low oil warning light should illuminate.
9. If the low oil warning light does not illuminate when the key switch is in the ON position, check the 18-gauge purple wire (w42) for continuity between the terminal at the low oil warning light and the 18-gauge purple wire (w47) at the key switch. Also check the continuity between the terminal on the 18-gauge black/white wire (w17) and the terminal on the oil pressure switch 16-gauge black/white wire (w200).
10. If there is continuity between the 18-gauge purple wire (w42) at the low oil warning light and the 18-gauge purple wire (w47) at the key switch, replace the low oil warning light. **See Warning Light Removal, Section 12b, Page 12b-4.**
11. If the problem is not corrected by performing the previous steps, test the oil pressure switch. **See the Honda GX620 engine manual (CCI P/N 102615401).**

TEST PROCEDURE 23 – 12-VOLT ACCESSORY RECEPTACLE

See General Warning, Section 1, Page 1-1.

NOTE: *Keep the battery connected during this test procedure.*

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Set the multimeter to 20 VDC.
3. Measure the voltage between the center contact and the outer contact of the accessory receptacle. The voltage should be approximately 12 VDC.
4. If the voltage is not approximately 12 VDC, check the 10-amp fuse on wire 115 (w115) located on the electrical component mounting plate. **See Test Procedure 2 – Fuse on page 11b-12.**
5. If the fuse is good, check the continuity of the wires connected to the accessory receptacle.

TEST PROCEDURE 24 – FUEL LEVEL SENDING UNIT

See General Warning, Section 1, Page 1-1.

⚠ WARNING

- **To avoid the possibility of fire or explosion, make sure the fuel tank cap is securely in place while performing this test procedure.**

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Disconnect the orange wire from the center post of the fuel level sending unit.
4. With a multimeter set to 2k ohms, place the red (+) probe on the center post of the sending unit. Place the black (–) probe on the ground connection of the sending unit **(Figure 11b-27, Page 11b-33)**.

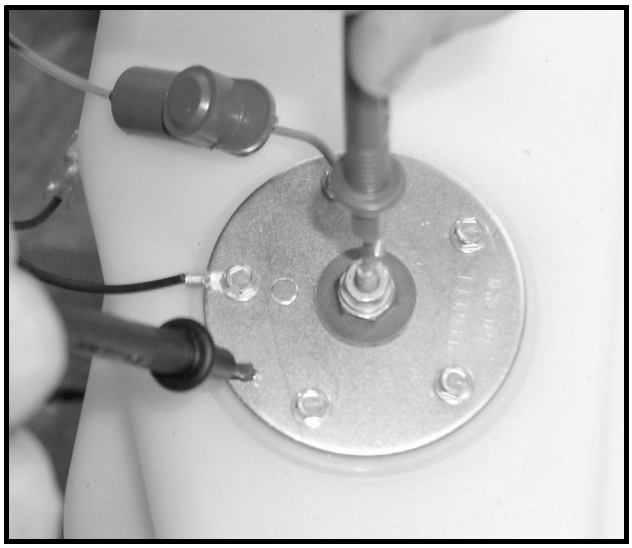


Figure 11b-27 Fuel Level Sending Unit Test

5. The following resistance readings (in ohms) should be indicated, depending on the position of the float inside the fuel tank. The resistance reading will vary according to the exact position of the float. The following table may be used as a guideline to determine if the fuel level sending unit is operating correctly. Make sure the float is at the surface of the fuel in the tank.

FLOAT POSITION	RESISTANCE READING	FUEL GAUGE READINGS
Lower position (tank empty)	240 ± 20 ohms	Empty
Center position (tank half full)	120 ± 20 ohms	Half full
Upper position (tank full)	60 ± 20 ohms	Full

6. If the readings are within the specifications listed in the preceding table, the fuel level sending unit is working properly. If the readings are incorrect, the fuel level sending unit has failed and the fuel tank must be replaced. **See Fuel Tank Removal, Section 13b, Page 13b-12.**
7. If the readings are correct and the fuel gauge does not function correctly, leave the battery disconnected and check the continuity of the following:
   - Orange wire from the fuel level sending unit to the fuel gauge/hour meter.
   - Blue wire (w25) from the fuel gauge/hour meter to the key switch.
   - Black ground wires at the fuel level sending unit and at the fuel gauge/hour meter. **See Fuel Gauge/ Hour Meter Removal, Section 12b, Page 12b-6.**
8. If the readings are correct according to the position of the float, but the reading on the fuel gauge/hour meter is incorrect, test the fuel gauge/hour meter. **See Test Procedure 25 – Fuel Gauge on page 11b-34.**

TEST PROCEDURE 25 – FUEL GAUGE

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Raise the hood.
3. Disconnect the orange wire from the fuel gauge/hour meter.
4. Set a multimeter to 20 volts DC and place the red (+) probe on the positive (+) post of the battery. Place the black (–) probe on the negative (–) post of the battery. Record the voltage reading.
5. Set a multimeter to 20 volts DC and place the red (+) probe on the (2) terminal of the fuel gauge/hour meter where the blue wire is connected. Place the black (–) probe on the (3) terminal of the fuel gauge/ hour meter with the black wire **(Figure 11b-28, Page 11b-35)**.
6. Turn the key switch ON. The voltage reading should be the same as the battery voltage reading recorded earlier. If not, check the continuity of the blue and black wires **(Figure 11b-28, Page 11b-35)**.

7. The orange wire should remain disconnected for this step. Place the black probe of the multimeter on the (3) terminal of the fuel gauge/hour meter and place the red (+) probe on the (1) terminal of the fuel gauge/hour meter **(Figure 11b-29, Page 11b-35)**. The voltage reading should be the same as the full battery voltage reading obtained in step 4. If the reading is incorrect, replace the fuel gauge/hour meter.

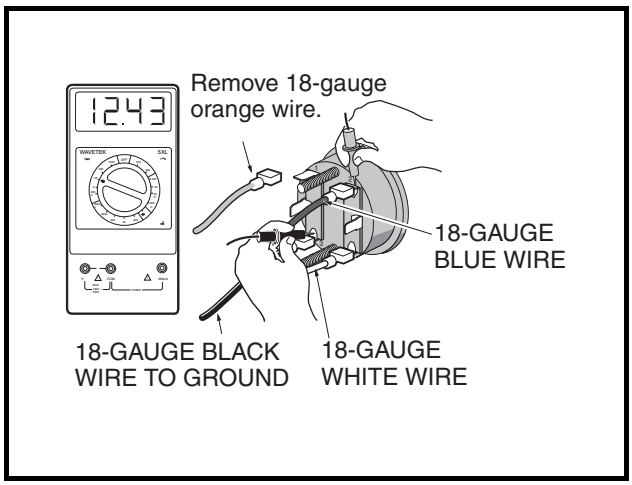


Figure 11b-28 Fuel Gauge Voltage Test - Terminal 2

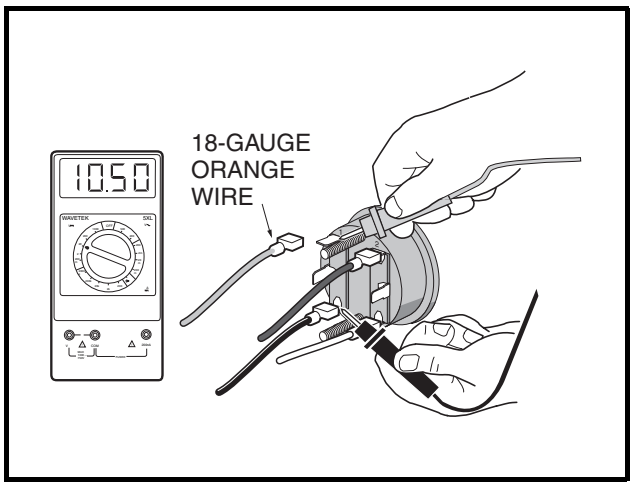


Figure 11b-29 Fuel Gauge Voltage Test - Terminal 1

TEST PROCEDURE 26 – HOUR METER

See General Warning, Section 1, Page 1-1.

NOTE: *Keep the battery connected during this test procedure.*

1. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Turn the key switch ON and record the current hour meter reading.
3. Turn the key switch to the START position and hold it until the engine is running smoothly. Release the key and it will return to the ON position. The engine should idle.
4. Allow the engine to idle for at least 6 minutes (the meter records in 6-minute increments). **See following DANGER.**

⚠ DANGER

- **Do not operate vehicle in an enclosed area without proper ventilation. The engine produces carbon monoxide, which is an odorless, deadly poison.**

5. If the reading does not change after six minutes, check the low oil warning light and the oil pressure switch. **See following NOTE. See also Test Procedure 22 – Low Oil Warning Light Circuit on page 11b-32.**

NOTE: *The hour meter is designed to record actual engine running time and will not start adding increments until the oil pressure switch has opened.*

6. If the hour meter still does not function after the low oil warning light, oil pressure switch, and all of the appropriate wires have been checked for continuity, replace the fuel gauge/hour meter.

TEST PROCEDURE 27 – LIGHT SWITCH

See General Warning, Section 1, Page 1-1.

NOTE: *The headlight circuit is protected by the 20-amp fuse. Check the fuse before this procedure is performed.* ***See Test Procedure 2 – Fuse on page 11b-12.***

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Remove the light switch from the instrument panel. **See Light Switch Removal, Section 12b, Page 12b-9.**
3. Use a multimeter set to 20 volts DC and place alligator clips on the multimeter probes. Connect the red (+) probe to the light switch terminal where the blue wire (w03) is connected **(Figure 11b-30, Page 11b-36)**.

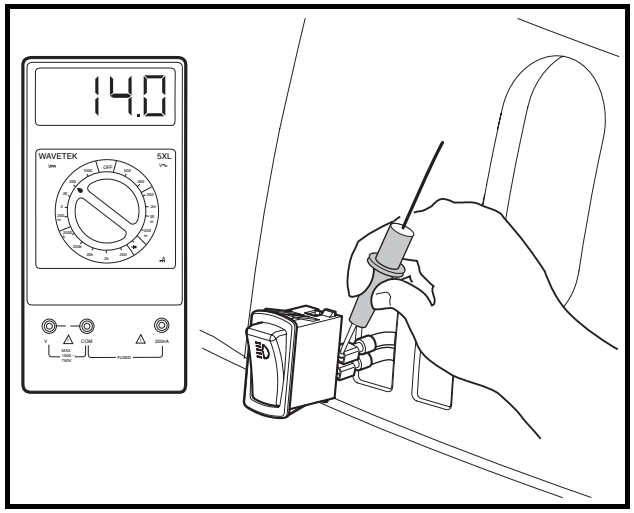


Figure 11b-30 Light Switch Test

4. Connect the black (–) probe of the multimeter to the negative (–) post of the battery.
5. With the light switch in the OFF position, the reading should indicate 0 volts. With the light in the ON position, the reading should indicate between 11 and 12.5 volts. If the there is no voltage reading, check the continuity of the 10-gauge red wire from the fuse block to the starter solenoid. Check the continuity of the 14-gauge yellow wire and the 14-gauge blue wire from the light switch to the fuse block. Check the fuse. **See Test Procedure 2 – Fuse on page 11b-12.** If the wires and fuse show continuity and the readings are still incorrect, replace the switch. **See Light Switch Removal, Section 12b, Page 12b-9.**

TEST PROCEDURE 28 – VOLTAGE AT HEADLIGHT SOCKET

See General Warning, Section 1, Page 1-1.

NOTE: *Keep the battery connected during this test procedure.*

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Inspect the wires at the light bulb socket. Make sure the wires are securely fastened to the contacts inside the socket.

3. Remove the wire harness from the headlight bulb **(Figure 11b-31, Page 11b-37)**.
4. Use a multimeter set to 20 volts DC and place the black (–) probe into the black wire terminal of the wire harness. Place the red (+) probe into the blue wire terminal.
5. Pull the light switch to the ON position. If the multimeter indicates approximately 12 volts, replace the headlight bulb.

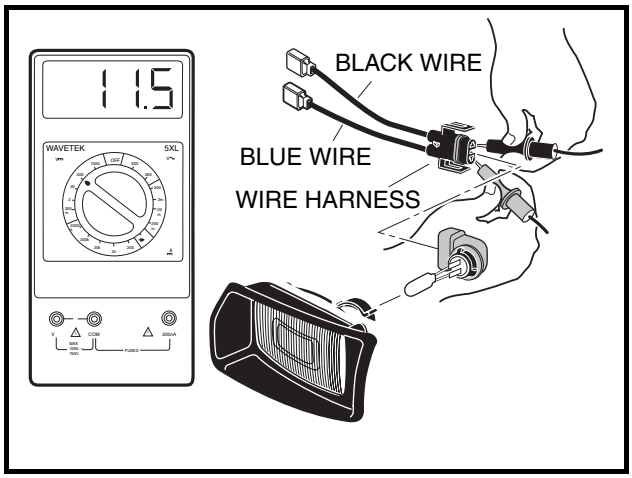


Figure 11b-31 Voltage Measurement at Headlight Socket

6. If there is no voltage reading at the wire harness, check the continuity of the 16-gauge blue wire from the headlight to the light switch.
   6.1. Set the multimeter to 20 VDC.
   6.2. Use an alligator clip to attach the black (–) probe onto the negative (–) battery terminal and place the red (+) probe into the blue wire terminal of the wire harness. If the multimeter reading is approximately 12 volts, the blue wire has continuity.
7. Check the continuity of the 16-gauge black wire from the headlight to the ground terminal.
   7.1. Set the multimeter to 20 VDC.
   7.2. Place the black (–) probe of multimeter into the black wire terminal of the wire harness and use an alligator clip to attach the red (+) probe onto the positive (+) battery terminal. If the multimeter reading is approximately 12 volts, the black wire has continuity.
8. If the readings are correct in all of the previous steps, replace the headlight bulb.

Figure 11b-32 Bed Lift Motor Wires

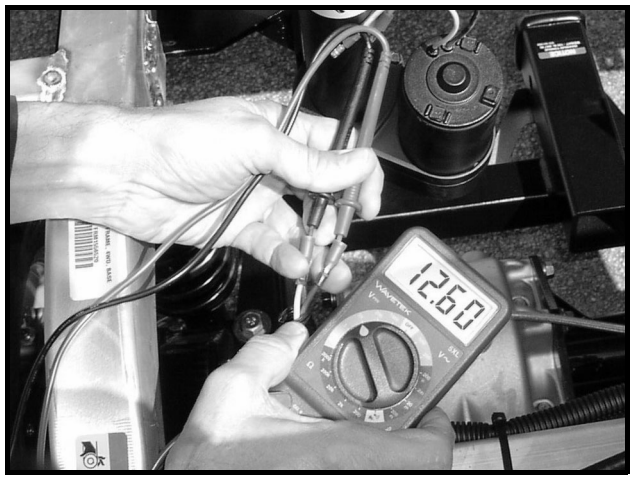


Figure 11b-33 Bed Lift Motor Voltage Reading with Switch in UP position

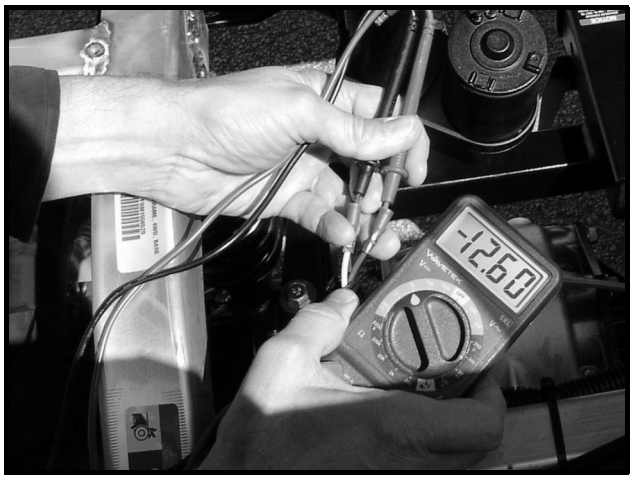


Figure 11b-34 Bed Lift Motor Voltage Reading with Switch in DOWN position

TEST PROCEDURE 29 – BED LIFT MOTOR

NOTE: *Keep the battery connected during this test procedure.*

Ensure that the battery is fully-charged before performing this test procedure.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the red and yellow wires from the bed lift motor **(Figure 11b-32, Page 11b-38)**.
3. Set a multimeter for 20 VDC.
4. Place the red probe in the bullet connector on the red wire (wire harness side) and place the black probe in the bullet connector on the black wire (wire harness side) **(Figure 11b-33, Page 11b-38)**.
5. Have an assistant press the bed lift switch on the instrument panel in the UP position and monitor the multimeter:

- A reading of approximately + (positive) 12 VDC indicates that the bed lift harness and switch are wired correctly. Proceed to step 6.

- A reading of approximately – (negative) 12 VDC indicates that the bed lift harness or switch are wired incorrectly. Check the wiring of the bed lift harness and bed lift switch. **See Wiring Diagram on page 11b-6.**
- A reading of approximately 0 VDC indicates a failed bed lift switch, failed bed lift circuit breaker, a poor connection in the bed lift wire harness, or a broken wire.

6. Place the red probe in the bullet connector on the red wire (wire harness side) and place the black probe in the bullet connector on the black wire (wire harness side) **(Figure 11b-34, Page 11b-38)**.
7. Have an assistant press the bed lift switch on the instrument panel in the DOWN position and monitor the multimeter:
   - A reading of approximately – (negative) 12 VDC indicates that the bed lift harness and switch are wired correctly. Proceed to step 8.
   - A reading of approximately + (positive) 12 VDC indicates that the bed lift harness or switch are wired incorrectly. Check the wiring of the bed lift harness and bed lift switch. **See Wiring Diagram on page 11b-6.**
   - A reading of approximately 0 VDC indicates a failed bed lift switch, failed bed lift circuit breaker, a poor connection in the bed lift wire harness, or a broken wire.
8. If the bed lift motor does not function and the readings obtained in the previous steps are correct, the bed lift motor has failed and must be replaced. **See Bed Lift Motor Removal, Section 4, Page 4-11.**

TEST PROCEDURE 30 – BED LIFT SWITCH

1. Remove the bed lift switch. **See Bed Lift Switch Removal, Section 12b, Page 12b-8.**
2. Check continuity between the terminals **(Figure 11b-35, Page 11b-39)** of the switch and compare the readings with the Bed Lift Switch Continuity Table. If continuity readings do not match the table, replace the switch. **See Bed Lift Switch Installation, Section 12b, Page 12b-8.**

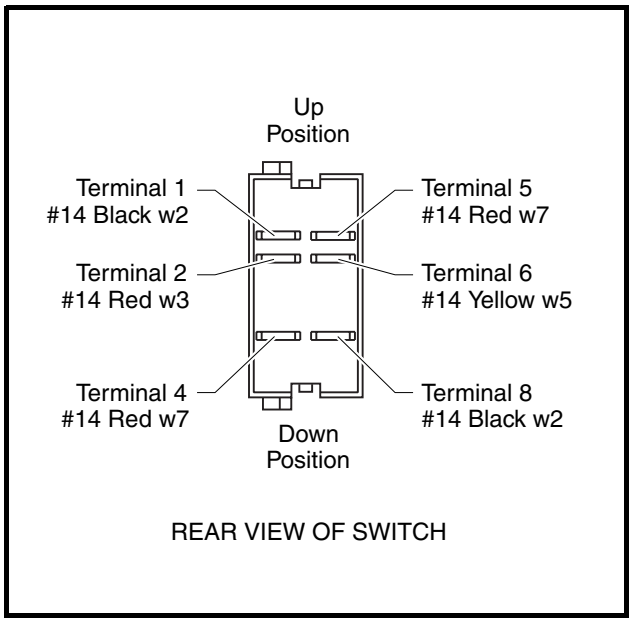


Figure 11b-35 Bed Lift Switch Terminals

BED LIFT SWITCH CONTINUITY						
Between Terminals	**1**	**2**	**4**	**5**	**6**	**8**
1		Cont. when pushed DOWN				
2	Cont. when pushed DOWN		Cont. when pushed UP			
4		Cont. when pushed UP				
5					Cont. when pushed DOWN	
6				Cont. when pushed DOWN		Cont. when pushed UP
8					Cont. when pushed UP	

TEST PROCEDURE 31 – BED LIFT CIRCUIT BREAKER

1. Remove the bed lift circuit breaker. **See Bed Lift Circuit Breaker Removal, Section 12b, Page 12b-8.**
2. Place the red probe of the multimeter on the circuit breaker terminals. If the multimeter does not indicate continuity, replace the circuit breaker. **See Bed Lift Circuit Breaker Installation, Section 12b, Page 12b-8.**

SECTION 11C – TROUBLESHOOTING AND ELECTRICAL SYSTEM: DIESEL VEHICLES

⚠ DANGER

- **See General Warning, Section 1, Page 1-1.**

⚠ WARNING

- **See General Warning, Section 1, Page 1-1.**

TROUBLESHOOTING GUIDE

The following troubleshooting guide will be helpful in identifying operating difficulties should they occur. The guide includes the symptom, probable cause(s) and suggested checks.

TROUBLESHOOTING GUIDE

SYMPTOM	POSSIBLE CAUSES	REFER TO
Engine does not start (starter motor functions).	Fuel tank is empty	Fuel System on page 13c-8
	Fuel with low cetane number	Use specified fuel. See owner's manual.
	Excessively high viscosity fuel or engine oil	Use specified fuel and engine oil. See owner's manual.
	Water in fuel system	Replace fuel and fuel filter.
	Air in fuel system	See the Kubota D722 diesel engine manual (CCI P/N 102615501).
	Fuel filter clogged	Replace fuel filter. See Fuel Filter Replacement on page 13c-9.
	Fuel line or pipe(s) clogged	Clean or replace fuel line and/or pipe(s). See Fuel System on page 13c-8.
	Injection nozzle clogged	See the Kubota D722 diesel engine manual (CCI P/N 102615501).
	Injection pump failed	
	Fuel pump failure	Test Procedure 26 – Fuel Pump Circuit on page 11c-43
	Fuel leak caused by loose injection pipe retaining nut	Tighten nut. See the Kubota D722 diesel engine manual (CCI P/N 102615501).
	Incorrect injection timing	See the Kubota D722 diesel engine manual (CCI P/N 102615501).
	Excessive valve clearance	
	Improper valve seat alignment, valve spring broken, or valve seized	
	Improper valve timing	
	Piston ring worn	
	Cylinder compression leak	

Troubleshooting Guide continued on next page...

TROUBLESHOOTING GUIDE

SYMPTOM	POSSIBLE CAUSES	REFER TO
Engine does not start (starter motor functions), continued.	Fuel cam shaft worn	See the Kubota D722 diesel engine manual (CCI P/N 102615501).
	Seizure of crankshaft, camshaft, piston, or bearing	
	Fuel solenoid failure	Test Procedure 24 – Fuel Solenoid Pull Coil Circuit on page 11c-42 and Test Procedure 25 – Fuel Solenoid Hold Coil Circuit on page 11c-42
	Improper idle governor adjustment	Idle RPM Adjustment on page 13c-20
Engine does not start (starter motor does not function).	Battery is discharged	Test Procedure 1 – Battery on page 11c-13
	Key switch failed	Test Procedure 4 – Key Switch (Starter Circuit) on page 11c-18
	Failed starter and/or starter solenoid	Test Procedure 7 – Starter Control Circuit on page 11c-20
	Start relay failure	Test Procedure 8 – Start Relay on page 11c-21
	Loose or improper wiring	Check for proper wiring and tighten any loose connections. See Wiring Diagram on page 11c-6.
	Diode 4 failed open	Test Procedure 13D – Diode 4 on wire 141 on page 11c-32
	One or both 30-amp fuses blown	Test Procedure 2 – Fuse on page 11c-16
	Neutral switch failure (failed open)	Test Procedure 14 – Neutral Switch (Transmission) on page 11c-35
	Transmission shifter linkage is binding or is out of adjustment	Forward/Reverse Shifter Cable Adjustment on page 14-17
	Diode 1, 2, 5, or 6 failed closed	Test Procedure 13 – Wire Harness Diodes on page 11c-28
Engine does not run smoothly.	Incorrect nozzle opening pressure	See the Kubota D722 diesel engine manual (CCI P/N 102615501).
	Injection nozzle clogged	
	Failed injection pump	
	Fuel overflow pipe clogged	
	Fuel leak caused by loose injection pipe retaining nut	
	Fuel pump failure	Test Procedure 26 – Fuel Pump Circuit on page 11c-43
	Air filter is dirty or clogged	Air Filter Replacement on page 13c-23
	Fuel filter clogged or dirty	Fuel System on page 13c-8
	Water or dirt in the fuel system	
Loss of engine power.	Muffler or exhaust pipe restricted with carbon or other substance	Exhaust System on page 13c-5
	Air filter is dirty or clogged	Air Filter Replacement on page 13c-23
	Throttle linkage out of adjustment	Engine Control Linkages on page 13c-19
	Restricted fuel flow	Fuel System on page 13c-8

Troubleshooting Guide continued on next page...

TROUBLESHOOTING GUIDE

SYMPTOM	POSSIBLE CAUSES	REFER TO
Loss of engine power, continued.	Clutches are not backshifting properly	Clutches on page 13c-27
	Low cylinder compression	See the Kubota D722 diesel engine manual (CCI P/N 102615501).
	Incorrect injection timing	
	Seized engine parts	
	Uneven fuel injection	
	Poor injection nozzle performance	
Low oil warning light stays on.	Oil level is low	Add engine oil. See owner's manual.
	Oil level sensor failure	See the Kubota D722 diesel engine manual (CCI P/N 102615501).
	Low oil warning circuit malfunction	Test Procedure 27 – Low Oil Warning Light Circuit on page 11c-44
High oil pressure.	Improper engine oil	See the Kubota D722 diesel engine manual (CCI P/N 102615501).
	Relief valve failed	
Low oil pressure.	Oil level is low	Add engine oil. See owner's manual.
	Oil strainer clogged	See the Kubota D722 diesel engine manual (CCI P/N 102615501).
	Oil filter clogged	
	Relief valve clogged with dirt	
	Relief valve spring is weak or broken	
	Excessive clearance or crankshaft bearing	
	Excessive clearance of rocker arm boss	
	Oil passage clogged	
	Oil pump failure	
	Improper engine oil	Drain engine oil and refill with specified engine oil. See owner's manual.
Engine overheats.	Oil level is low	Add engine oil. See owner's manual.
	Failed radiator fan or radiator fan circuit	Test Procedure 12 – Fan Motor on page 11c-27
	Thermostat switch failure	Test Procedure 11 – Thermostat Switch on page 11c-25
	Fan relay failure	Test Procedure 10 – Fan Relay on page 11c-23
	Low engine coolant level	Add coolant. See owner's manual.
	Radiator fins clogged with dust	Clean radiator fins.
	Internal radiator corrosion	Clean or replace radiator. See Section 15 – Radiator and Coolant System (Diesel)
	Coolant lines corroded	Clean or replace coolant lines. See Section 15 – Radiator and Coolant System (Diesel)
	Failed radiator cap	Replace radiator cap.

Troubleshooting Guide continued on next page...

TROUBLESHOOTING GUIDE

SYMPTOM	POSSIBLE CAUSES	REFER TO
Engine overheats, continued.	Failed radiator hose	Replace radiator hose. See Section 15 – Radiator and Coolant System (Diesel)
	Failed thermostat	See the Kubota D722 diesel engine manual (CCI P/N 102615501).
	Failed water pump	
	Vehicle is overloaded	Do not overload vehicle. See owner's manual.
Excessive engine oil consumption.	Oil ring worn	See the Kubota D722 diesel engine manual (CCI P/N 102615501).
	Piston ring groove worn	
	Valve stem and/or guide worn	
	Crankshaft bearing and crank pin bearing worn	
Fuel mixed into engine lubricant oil.	Worn injection pump plunger	See the Kubota D722 diesel engine manual (CCI P/N 102615501).
Water mixed into engine lubricant oil.	Failed head gasket	See the Kubota D722 diesel engine manual (CCI P/N 102615501).
	Crank case or cylinder head failed	
White or blue exhaust gas is observed.	Excessive engine oil	Drain engine oil and refill with specified engine oil. See owner's manual.
	Piston ring worn	See the Kubota D722 diesel engine manual (CCI P/N 102615501).
	Incorrect injection timing	
	Cylinder compression leak	
Black or dark gray exhaust gas is observed.	Vehicle is overloaded	Do not overload vehicle. See owner's manual.
	Low-grade fuel	Drain fuel and refill with specified fuel. See owner's manual.
	Fuel filter clogged	Replace fuel filter. See Fuel Filter Replacement on page 13c-9
	Air cleaner clogged	Replace air filter. See Air Filter Replacement on page 13c-23
Excessive vehicle vibration.	Engine mounting nuts or bolts are loose	Section 13c – Diesel Engine, Muffler, Fuel System, and Clutches
	Misaligned muffler mounting clamp	Exhaust System on page 13c-5
	Damaged drive belt	Clutches on page 13c-27
	Damaged drive clutch	Clutches on page 13c-27
	Damaged driven clutch	Clutches on page 13c-27
	RPM setting is incorrect	Engine RPM Adjustment on page 13c-20
Transmission does not engage or disengage smoothly.	Transmission shifter linkage is binding or is out of adjustment	Forward/Reverse Shifter Cable Adjustment on page 14-17
	Idle RPM setting is set too high	Idle RPM Adjustment on page 13c-20
	Insufficient (low) level of lubricant or wrong type of lubricant in transmission	Gearcase Lubrication on page 10b-13
	Internal gears are damaged or worn	See the Engines and Drivetrain Components manual (CCI P/N 102396501).

Troubleshooting Guide continued on next page...

TROUBLESHOOTING GUIDE

SYMPTOM	POSSIBLE CAUSES	REFER TO
Front differential does not engage front wheels.	Failed front drive gearcase engagement coil	Test Procedure 17 – Front Drive Gearcase Coil on page 11c-37
	Failed differential relay (early 2007) or differential limit switch (late 2007)	Test Procedure 9 – Differential Relay on page 11c-22 or Test Procedure 16 – Front Differential Limit Switch on page 11c-36
	Neutral switch failure (failed closed)	Test Procedure 14 – Neutral Switch (Transmission) on page 11c-35
	Failed front gearcase	See the Engines and Drivetrain Components manual (CCI P/N 102396501).
Torque converter does not shift smoothly.	Drive belt is worn, cracked, glazed, or frayed	Drive Belt Removal on page 13c-28
	Drive clutch malfunction	Drive Clutch Cleaning and Inspection on page 13c-29
	Driven clutch malfunction	Driven Clutch on page 13c-33
Battery discharged.	Loose alternator belt	See Alternator and V-belt Installation on page 12c-15
	Loose electrical connection(s)	Check for proper wiring and tighten any loose connections. See Wiring Diagram on page 11c-6.
	Failed alternator	Test Procedure 18 – Alternator on page 11c-37
	Failed battery	Test Procedure 1 – Battery on page 11c-13
	60-amp fusible link failed	Test Procedure 19 – 60-Amp Fusible Link on page 11c-38
Engine can be started while Forward/ Reverse handle is in the FOWARD or REVERSE position.	Diode 3 failed closed	Test Procedure 13C – Diode 3 on wire 144 on page 11c-31
Hour meter adds increments with key switch ON and engine not running.	Oil pressure switch failed open	See the Kubota D722 diesel engine manual (CCI P/N 102615501).
Hour meter does not function.	Failed low oil warning light or oil pressure sensor	Test Procedure 27 – Low Oil Warning Light Circuit on page 11c-44
	Oil pressure switch failed closed	See the Kubota D722 diesel engine manual (CCI P/N 102615501).
	Failed hour meter	Test Procedure 31 – Hour Meter on page 11c-48
30-amp fuse (on w125) blows repeatedly.	Diode 1 or diode 5 in wire harness failed	Test Procedure 13A – Diode 1 on wire 32 on page 11c-30 and Test Procedure 13E – Diode 5 on wire 123 on page 11c-33
30-amp fuse (on w109) blows repeatedly.	Diode 2 or diode 6 in wire harness failed	Test Procedure 13B – Diode 2 on wire 40 on page 11c-31 and Test Procedure 13F – Diode 6 on wire 129 on page 11c-34
Bed lift does not function	Bed lift motor failed	Test Procedure 34 – Bed Lift Motor on page 11c-51
	Bed lift switch failed	Test Procedure 35 – Bed Lift Switch on page 11c-52
	Bed lift circuit breaker failed	Test Procedure 36 – Bed Lift Circuit Breaker on page 11c-53

WIRING DIAGRAM

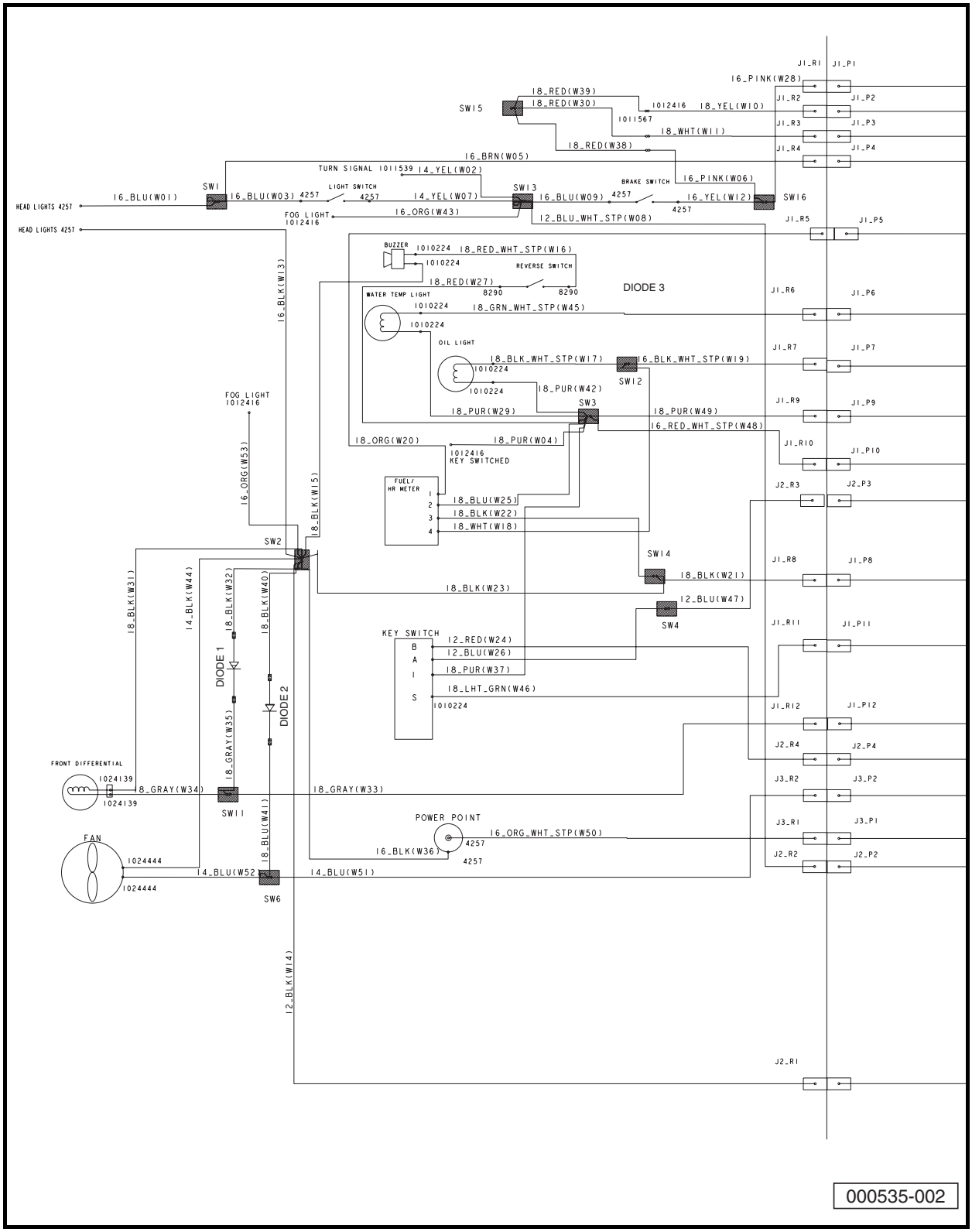


Figure 11c-1 Wiring Diagram (2 Piece Harness) for Diesel Carryall 295 and XRT 1550 Vehicles (Front)

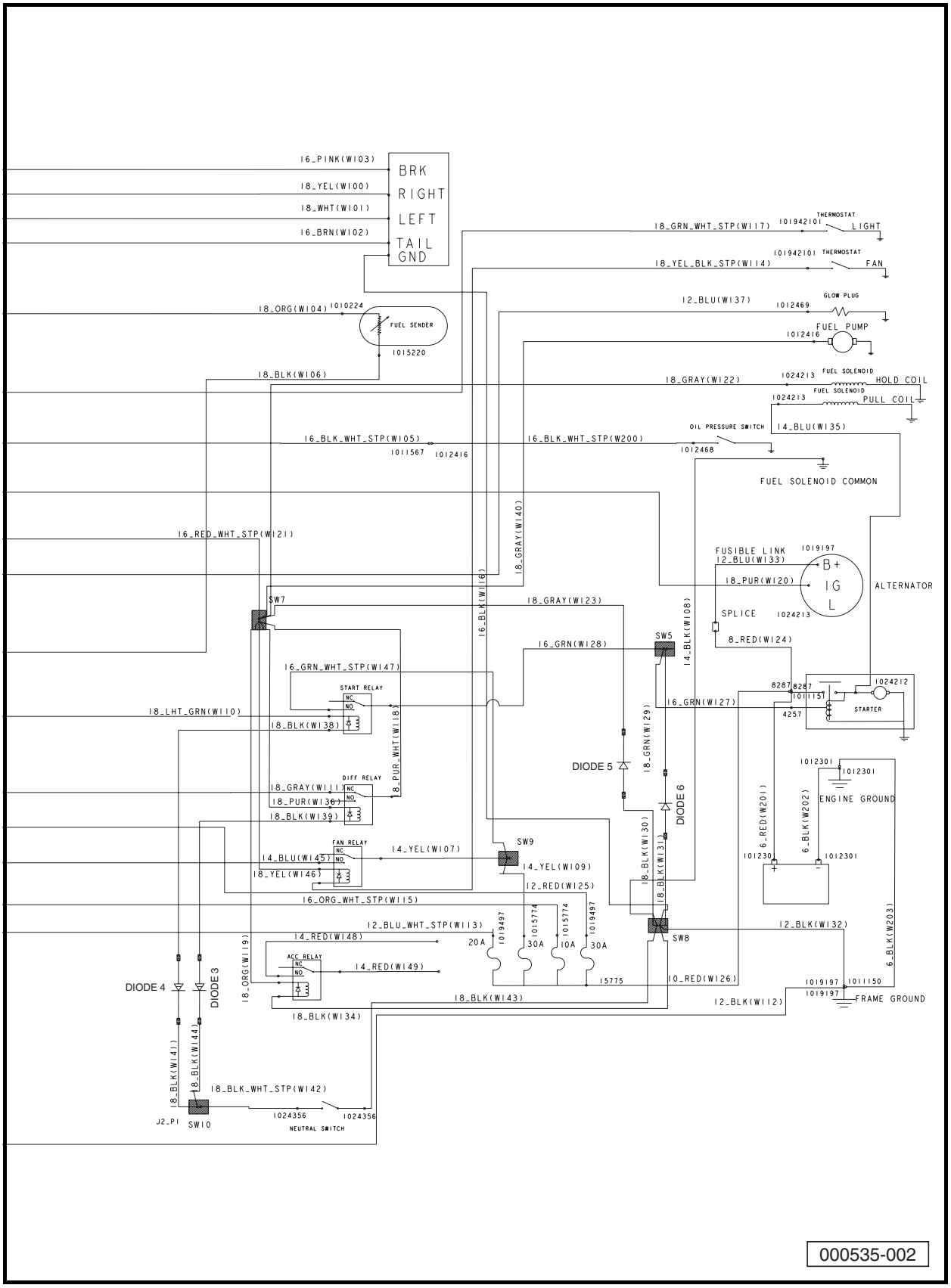


Figure 11c-2 Wiring Diagram (2 Piece Harness) for Diesel Carryall 295 and XRT 1550 Vehicles (Rear)

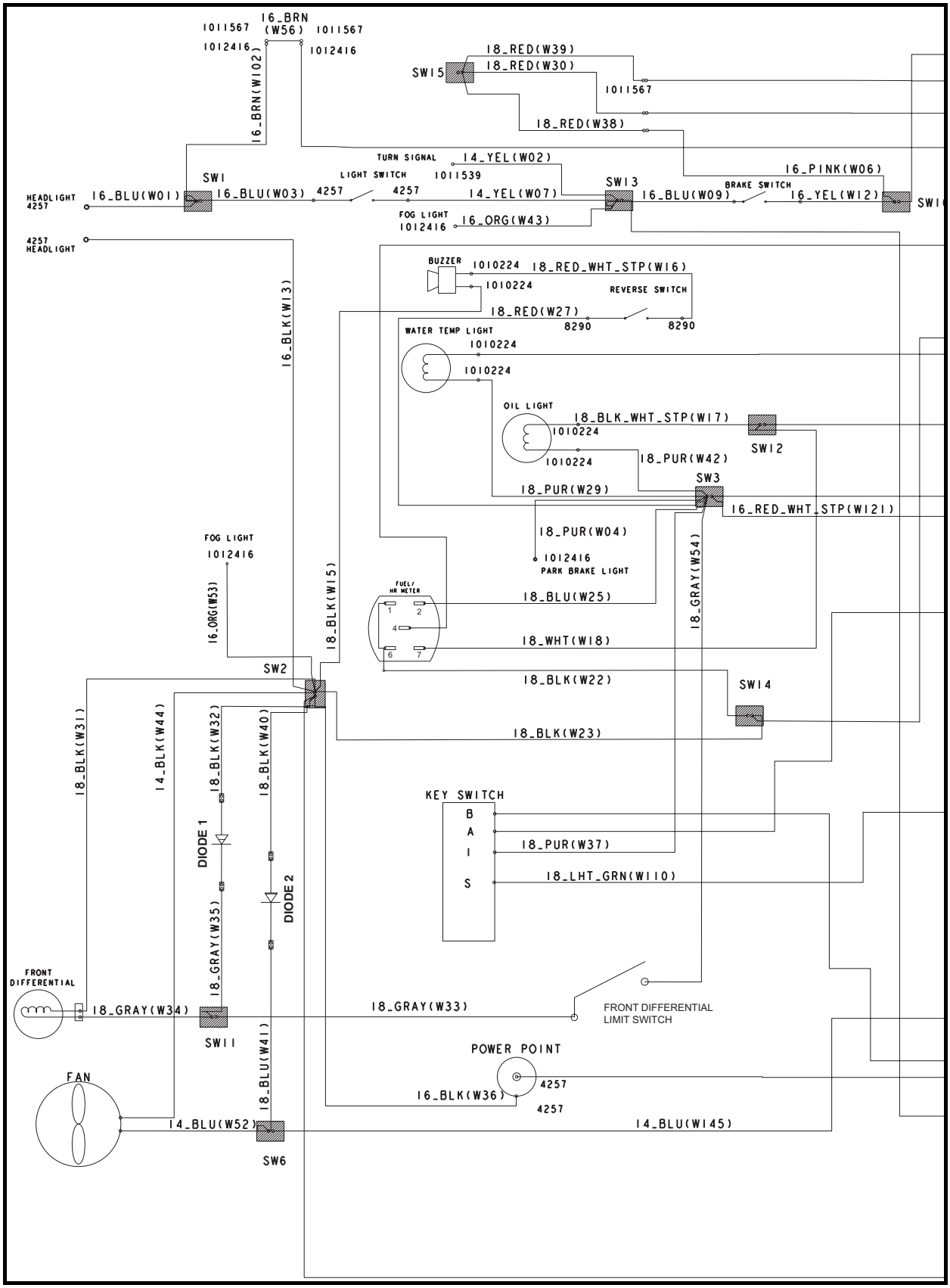


Figure 11c-3 Wiring Diagram (1 Piece Harness) for Diesel Carryall 295 and XRT 1550 Vehicles (Front)

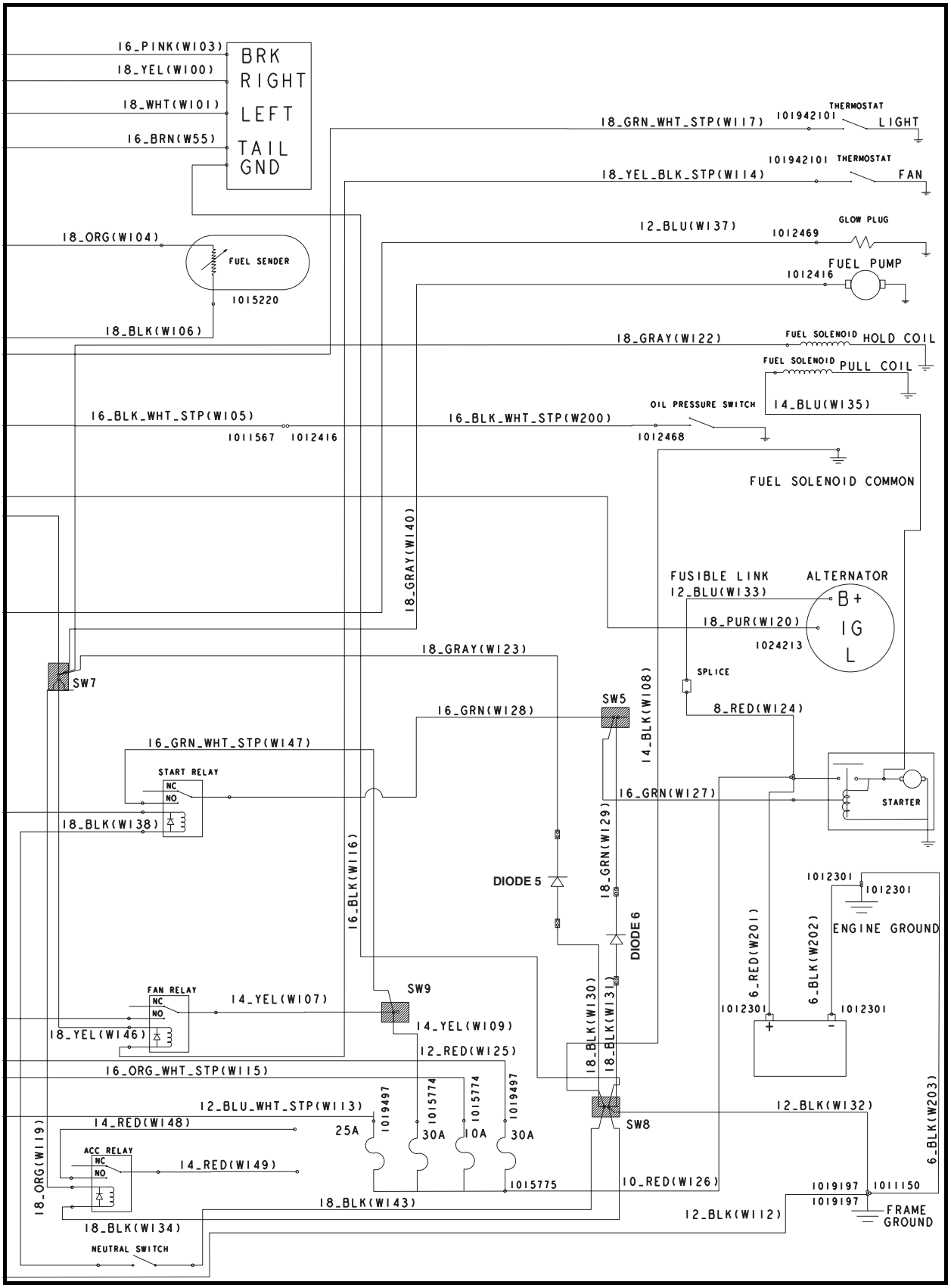


Figure 11c-4 Wiring Diagram (1 Piece Harness) for Diesel Carryall 295 and XRT 1550 Vehicles (Rear)

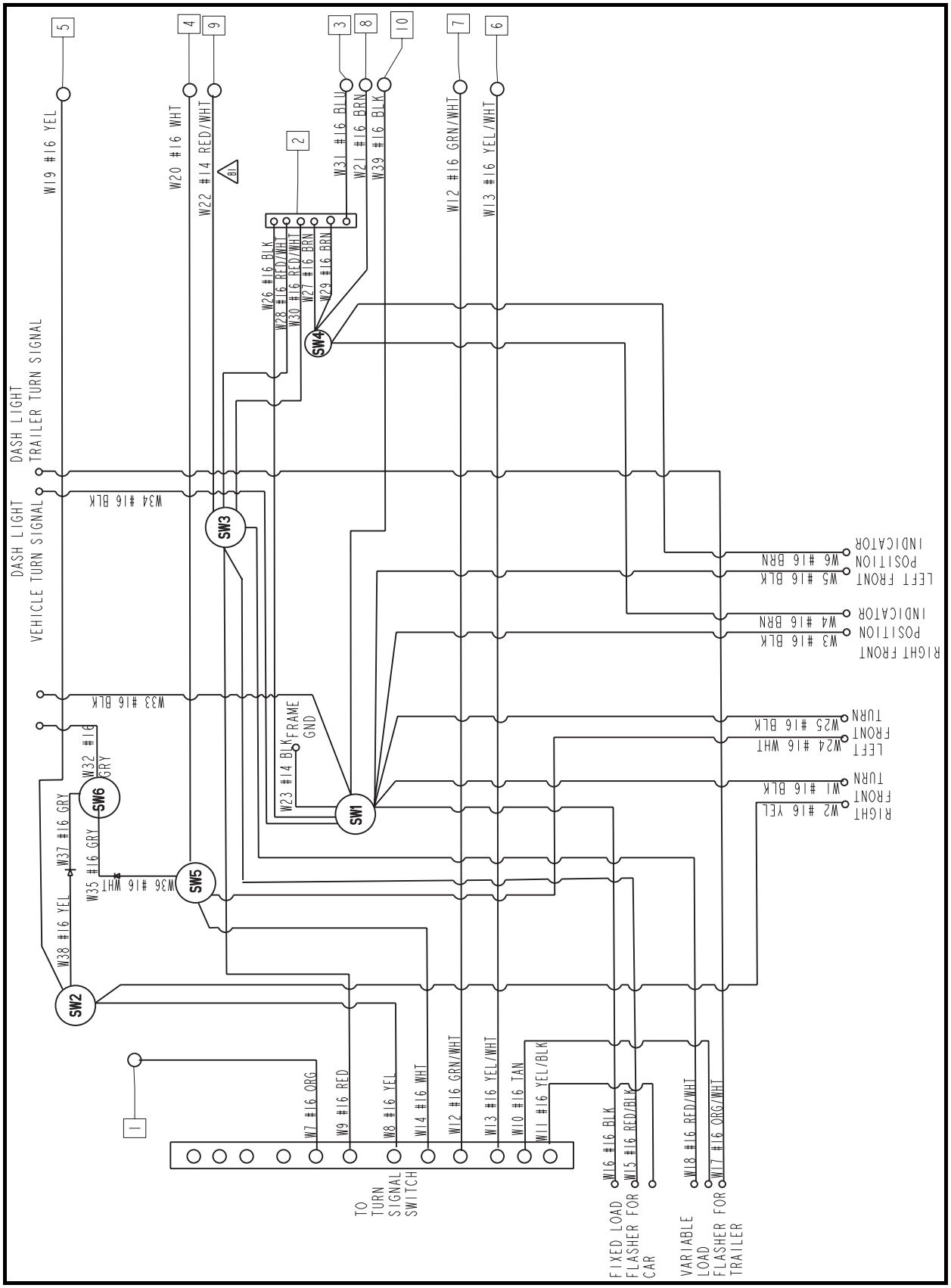


Figure 11c-5 Main Light Wiring Diagram – Carryall 295 Homologated Vehicle

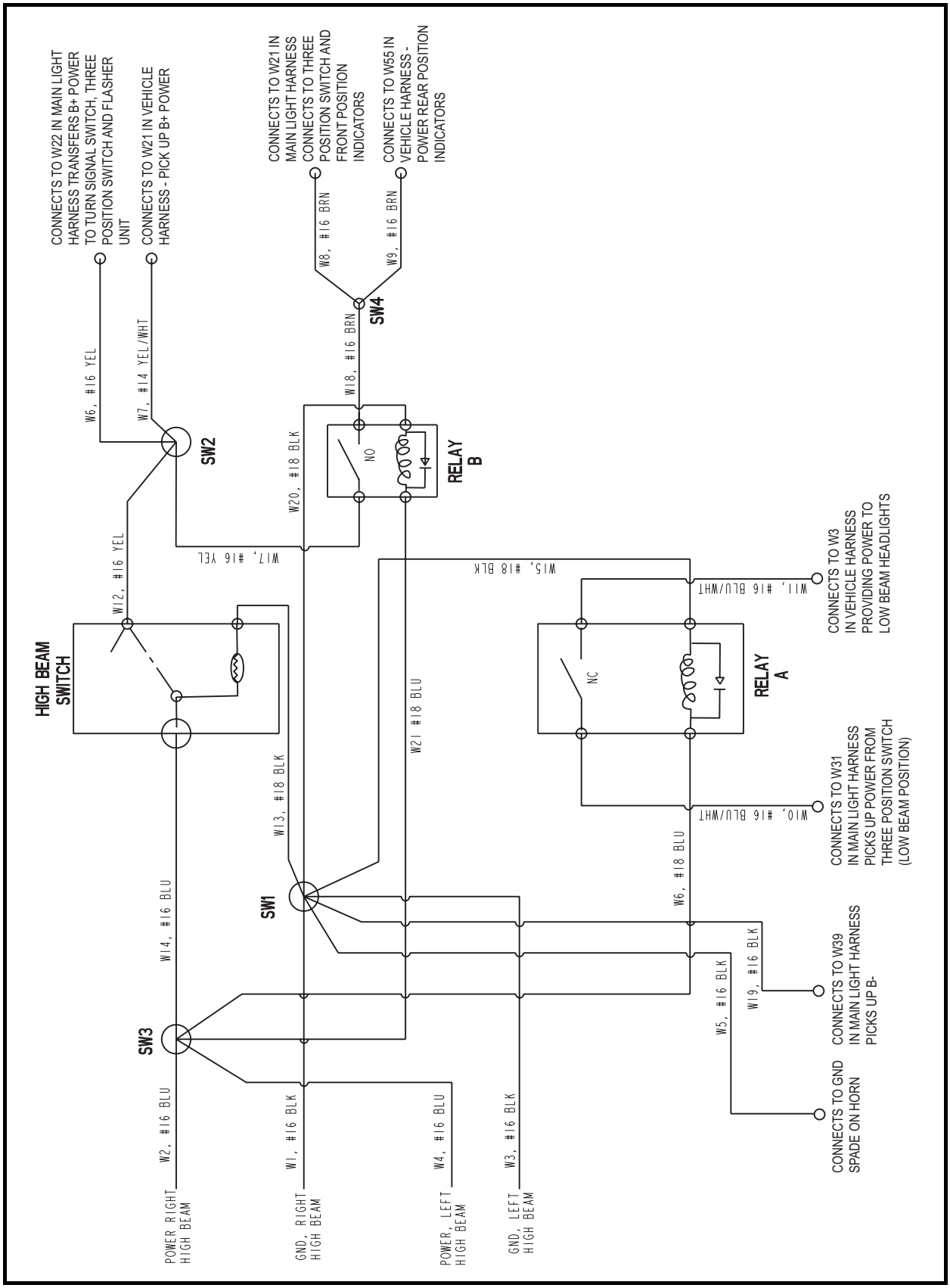


Figure 11c-6 High Beam Wiring Diagram – Carryall 295 Homologated Vehicle

TEST PROCEDURES

INDEX OF TEST PROCEDURES

TEST PROCEDURE 1 – BATTERY

See General Warning, Section 1, Page 1-1.

⚠ DANGER

- **Due to the danger of an exploding battery, wear a full face shield and rubber gloves when working around a battery.**
- **Battery – Explosive gases! Do not smoke. Keep sparks and flames away from the vehicle and service area. Ventilate when charging or using in an enclosed space. Wear a full face shield and rubber gloves when working on or near batteries. For added protection, cover top of the battery when servicing the vehicle.**
- **Battery – Poison! Contains acid! Causes severe burns! Avoid contact with skin, eyes, or clothing.**
  - **External: Flush with water. Call a physician immediately.**
  - **Internal: Drink large quantities of milk or water. Follow with milk of magnesia or vegetable oil. Call a physician immediately.**
  - **Eyes: Flush with water for 15 minutes. Call a physician immediately.**

NOTE: *The battery must be properly maintained and fully charged in order to perform the following test procedures. Battery maintenance procedures, including watering information and allowable mineral content, can be found in Section 12c of this manual.* ***See Battery, Section 12c, Page 12c-21.***

Test Procedure 1A – Hydrometer Test

A hydrometer (CCI P/N 1011478) measures the specific gravity of battery electrolyte. The higher the specific gravity, the higher the state of charge of the battery. A fully charged battery should read between 1.250 and 1.280 at 80 °F (27 °C). Never add acid to the battery to obtain a higher specific gravity **(Figure 11c-7, Page 11c-14)**. **See following CAUTION.**

CAUTION

- **Do not allow battery acid from battery caps or hydrometer to drip onto the vehicle body. Battery acid will cause permanent damage. Wash off immediately.**

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Check for loose or corroded battery terminal connections. Clean, tighten and replace connections as necessary.
3. Be sure that the battery has sufficient water to cover the plates by approximately 1/2-inch (13 mm) and is fully charged before the test. If water must be added, recharge the battery before performing the hydrometer test **(Figure 11c-8, Page 11c-14)**.
4. Remove the vent cap.
5. Use a battery thermometer (CCI P/N 1011767), to record the electrolyte temperature of a center cell.
6. Squeeze the rubber bulb of the hydrometer and insert it into the cell. Slowly release the bulb, drawing electrolyte up into the glass tube of the hydrometer.
7. Ensure the float rises off the bottom. Adjust the electrolyte level so that the float rides free of the bottom but does not strike the bottom of the rubber bulb. Remove the hydrometer from the cell and release pressure from the bulb.

8. Hold the hydrometer vertically and ensure that the float does not contact the sides of the glass tube. Hold the hydrometer at eye level and read the scale at the level of electrolyte **(Figure 11c-7, Page 11c-14)**.
9. Record the reading.
10. Return the electrolyte to the cell from which it was taken. Replace vent cap.
11. Repeat steps 4 through 10 on all cells.

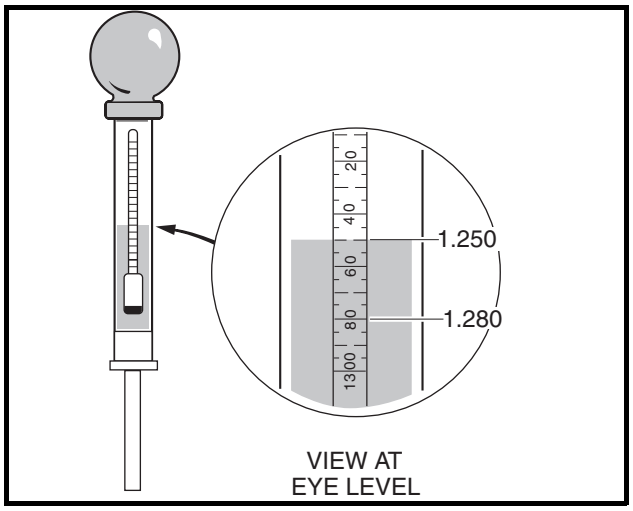


Figure 11c-7 Hydrometer Test

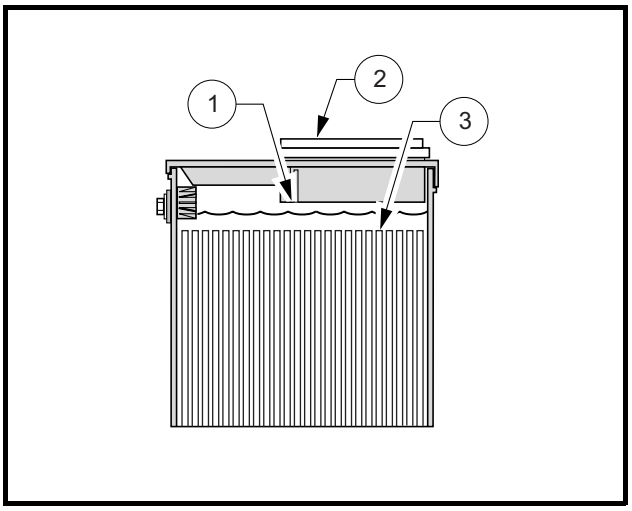


Figure 11c-8 Battery Electrolyte Level

1. Level Indicator 2. Cap 3. Plates
Electrolyte level at least 1/2 inch (13 MM) above plates or to level indicator.

Hydrometer Calibration

Most hydrometers are calibrated to read correctly at 80 °F (27 °C). The readings obtained as described above must be corrected for temperature. For each 10 °F (5.6 °C) above 80 °F (27 °C), add 0.004 to the reading. For each 10 °F (5.6 °C) below 80 °F (27 °C), subtract 0.004 from the reading.

Interpreting the Results of the Hydrometer Test

Use the following table to determine the approximate state of charge:

SPECIFIC GRAVITY (TEMPERATURE CORRECTED)	APPROXIMATE STATE OF CHARGE
1.250-1.280	100%
1.220-1.240	75%
1.190-1.210	50%
1.160-1.180	25%

If the difference between the cells is 0.020 or more, the low cell should be suspected of poor performance. It may require a catch-up charge or it may be a weak cell. When the variations between cells reach 0.050 or more, the battery should be replaced.

Test Procedure 1B – Voltage Test

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Check for loose or corroded battery terminal connections. Clean, tighten and replace connections as necessary.
3. Set the multimeter to the 20 VDC setting.
4. Measure the voltage across the battery terminals. If the reading is less than 12.4 volts, or if the lowest specific gravity reading from the hydrometer test is less than 1.225, recharge the battery. If battery voltage is greater than 12.4 volts and specific gravity is greater than 1.225, the problem is not with the battery. If the battery does not reach 12.4 volts, or if the specific gravity of a cell is still less than 1.225 after charging, replace the battery. **See following NOTE.**

NOTE: *A fully charged battery that is in good condition should have a specific gravity of at least 1.225 in all cells and the difference in the specific gravity of any two cells should be less than 50 points. Open-circuit voltage, the battery voltage with no electrical load, should be at least 12.4 volts.*

Test Procedure 1C – Load Test

NOTE: *Ensure that the battery is fully charged before performing the following test procedure.*

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Check for loose or corroded battery terminal connections. Clean, tighten and replace connections as necessary.
3. Connect a 160-ampere load tester to the battery posts. **See following NOTE.**

NOTE: *If a load tester is not available, a load can be placed on the battery by removing the fuel shut-off solenoid wires and activating the starter motor. If this method is used, the voltage must be read when the starter motor is turning.* ***See following CAUTION.***

CAUTION

- **Activating the starter for more than a few seconds could result in damage to the starter motor, the starter, and/or the flywheel gears.**

4. Turn the load tester switch to the ON position.
5. Read the battery voltage after the load tester has been turned ON for 15 seconds. The minimum acceptable battery voltage for proper engine starting is approximately 9.6 VDC.
6. If the battery voltage is acceptable, or if the electrical problem continues after the battery has been replaced, test the electrical circuits.
7. If the voltage reading exceeds 9.6 volts at 70 °F (21 °C) (electrolyte temperature), check the starter. **See the Kubota D722 diesel engine manual (CCI P/N 102615501). See also the following NOTE.**

NOTE: *Record the voltage reading at 70 °F (21 °C). At lower electrolyte temperatures, the voltage reading will be lower.*

8. If the reading is less than 9.6 volts at 70 °F (21 °C) (electrolyte temperature), check the battery electrolyte in each cell. **See Test Procedure 1A – Hydrometer Test on page 11c-13.**

TEST PROCEDURE 2 – FUSE

See General Warning, Section 1, Page 1-1.

The fuse block is located on the electrical component mounting plate **(Figure 11c-9, Page 11c-16)**.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Remove the electrical component cover.
4. Ensure the wires are connected correctly and are tight. If they are not, rewire or tighten as necessary.
5. Remove the fuse to be tested from the fuse block.
6. Connect the probes of a multimeter set to 200 ohms to the fuse terminals. The reading should be continuity. If there is no continuity, determine and repair the cause of the fuse failure. Replace the fuse with a properly rated new one. **See following WARNING.**

⚠ WARNING

- **If a fuse is blown, determine the cause of the failure and make necessary repairs before installing a new fuse. Use the appropriately rated fuse; if a fuse with a higher amp rating is used, damage to the vehicle electrical system may occur.**

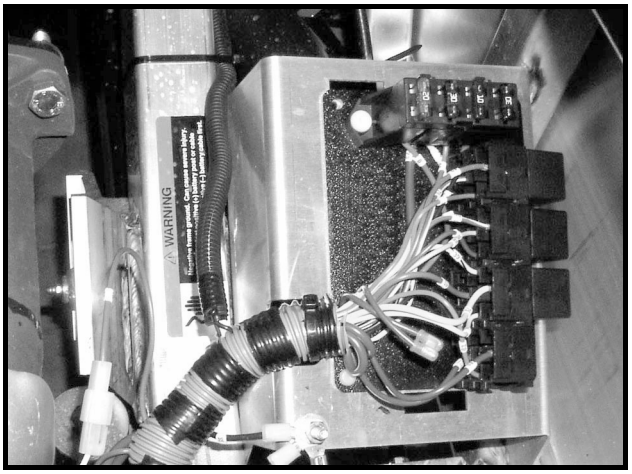


Figure 11c-9 Electrical Component Mounting Plate

TEST PROCEDURE 3 – GROUND CABLES

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Check the frame ground connection for loose connections and damaged terminals **(Figure 11c-10, Page 11c-17)**. Repair or replace as required.
4. Check the negative (–) battery terminal and 6-gauge black wire (w202) for damage. Repair or replace as required.
5. Check the engine ground for a loose connection, damaged terminals and an excess of paint on the engine block (under the starter) where the two 6-gauge black wires (w202 and w203) are connected **(Figure 11c-11, Page 11c-17)**. Repair or replace as required.
6. Set the multimeter to 200 ohms.
7. Check for continuity between the 6-gauge wire (w202) terminal, disconnected from the negative (–) battery terminal, and the frame.
8. Check for continuity between the 6-gauge wire (w203) terminal, disconnected from the negative (–) battery terminal, and the engine.
9. The readings obtained in the previous steps should indicate continuity. If any of the readings are incorrect, clean and tighten wire connections. If the connections are good and the reading is incorrect, repair or replace the wire.

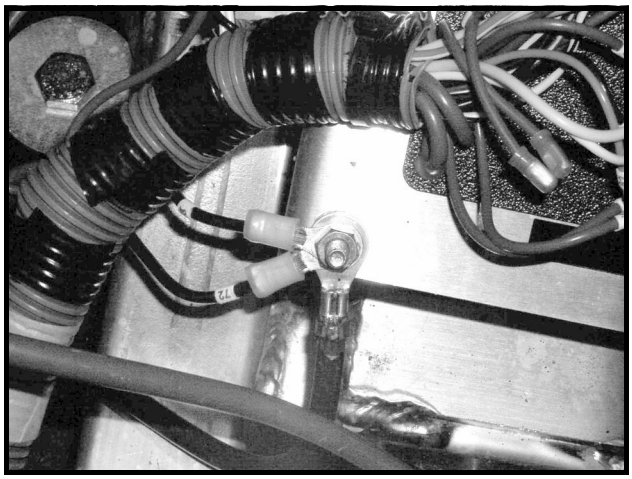


Figure 11c-10 Frame Ground

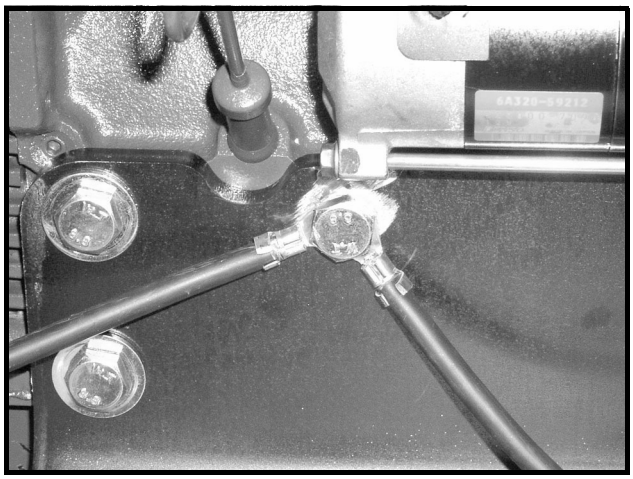


Figure 11c-11 Engine Ground (Under Starter)

TEST PROCEDURE 4 – KEY SWITCH (STARTER CIRCUIT)

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Remove the key switch. **See Key Switch Removal, Section 12c, Page 12c-7.**
4. Ensure that the key switch connector is connected correctly and is tight. If it is not, repair or replace as necessary.
5. Set the multimeter to 200 ohms.
6. Check the BATT and ST terminals.
   6.1. Use alligator clips to connect the multimeter probes between the BATT and ST terminals. With the key in the START position, the multimeter should indicate continuity **(Figure 11c-12, Page 11c-18)**. If the multimeter does not indicate continuity, the key switch has failed and should be replaced. **See Key Switch Removal, Section 12c, Page 12c-7.**
   6.2. If the multimeter indicates continuity between the BATT and ST terminals with the key in any position other than START, the key switch has failed and should be replaced. **See Key Switch Removal, Section 12c, Page 12c-7.**

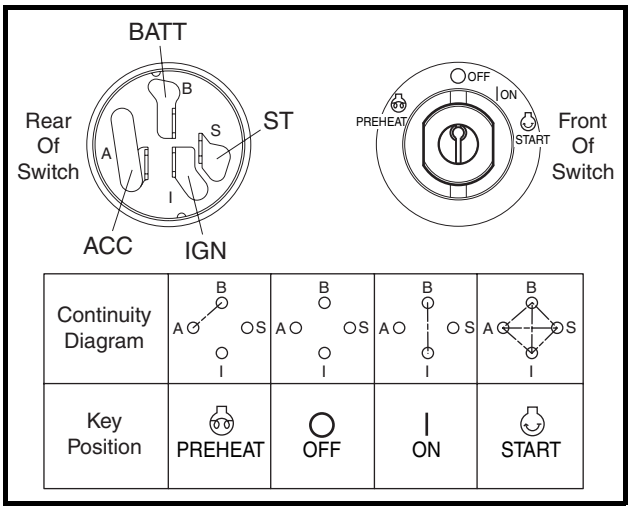


Figure 11c-12 Key Switch Terminals and Continuity Diagram

7. Check the BATT and IGN terminals.
   7.1. Use alligator clips to connect the multimeter probes between the BATT and IGN terminals. With the key in the START position, the multimeter should indicate continuity **(Figure 11c-12, Page 11c-18)**. If the multimeter does not indicate continuity, the key switch has failed and should be replaced. **See Key Switch Removal, Section 12c, Page 12c-7.**
   7.2. If the multimeter indicates continuity between the BATT and IGN terminals with the key in any position other than the START or the ON position, the key switch has failed and should be replaced. **See Key Switch Removal, Section 12c, Page 12c-7.**
8. Check the BATT and ACC key switch terminals.
   8.1. Use alligator clips to connect the multimeter probes between the BATT and ACC terminals. With the

key switch in the START position, the multimeter should indicate continuity **(Figure 11c-12, Page 11c-18)**. If the multimeter does not indicate continuity, the key switch has failed and should be replaced. **See Key Switch Removal, Section 12c, Page 12c-7.**

8.2. If the multimeter indicates continuity between the BATT and ACC terminals with the key in any position other than START, the key switch has failed and should be replaced. **See Key Switch Removal, Section 12c, Page 12c-7.**

TEST PROCEDURE 5 – KEY SWITCH (ON POSITION)

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Ensure that the key switch connector is connected correctly and is tight. If it is not, repair or replace as necessary.
4. Remove the key switch. **See Key Switch Removal, Section 12c, Page 12c-7.**
5. Set the multimeter to 200 ohms.
6. Check the BATT and IGN terminals.
   6.1. Use alligator clips to connect the multimeter probes between the BATT and IGN terminals. With the key switch in the ON position, the multimeter should indicate continuity **(Figure 11c-12, Page 11c-18)**. If the multimeter does not indicate continuity, the key switch has failed and should be replaced. **See Key Switch Removal, Section 12c, Page 12c-7.**
   6.2. If the multimeter indicates continuity between the BATT and IGN terminals with the key in any position other than START or ON, the key switch has failed and should be replaced. **See Key Switch Removal, Section 12c, Page 12c-7.**

TEST PROCEDURE 6 – KEY SWITCH (GLOW PLUG CIRCUIT)

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Ensure that the key switch connector is connected correctly and is tight. If it is not, repair or replace as necessary.
4. Remove the key switch. **See Key Switch Removal, Section 12c, Page 12c-7.**
5. Set the multimeter to 200 ohms.
6. Check the BATT and ACC terminals.
   6.1. Use alligator clips to connect the multimeter probes between the BATT and ACC terminals. With the key in the PREHEAT position, the multimeter should indicate continuity **(Figure 11c-12, Page 11c-18)**. If the multimeter does not indicate continuity, the key switch has failed and should be replaced. **See Key Switch Removal, Section 12c, Page 12c-7.**
   6.2. If the multimeter indicates continuity between the BATT and ACC terminals with the key in any position other than PREHEAT, the key switch has failed and should be replaced. **See Key Switch Removal, Section 12c, Page 12c-7.**

TEST PROCEDURE 7 – STARTER CONTROL CIRCUIT

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the 16-gauge green wire (w127) from the starter solenoid coil to prevent the vehicle from unintentionally starting **(Figure 11c-13, Page 11c-20)**. **See following WARNING.**

⚠ WARNING

- **Failure to disconnect the wire from the solenoid coil could result in an unexpected engine start when performing this test.**

3. Set the multimeter to 20 VDC.
4. Place the probes to measure the voltage between the 16-gauge green wire (w127) terminal and the frame ground **(Figure 11c-14, Page 11c-20)**.
5. Monitor the multimeter. The reading should indicate 0 volts with the key in the OFF and ON positions. The reading should indicate approximately 12 VDC when the key is in the START position.

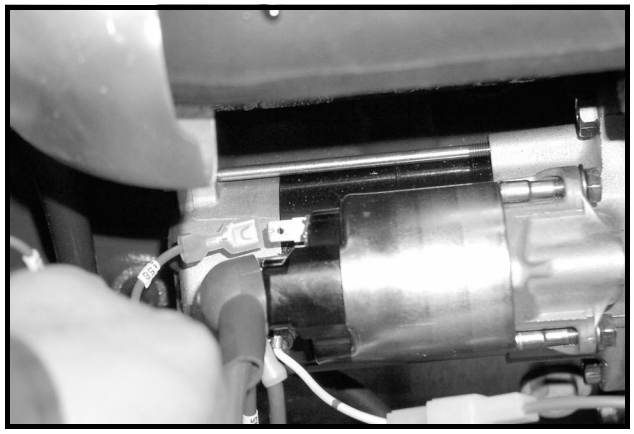


Figure 11c-13 Solenoid Coil Wire (w127) Removed

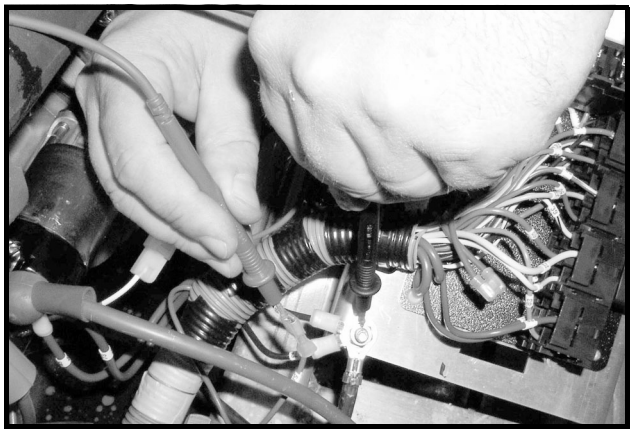


Figure 11c-14 Starter Circuit Test

6. If the readings differ from those described in step 5, perform the following test procedures:
   - Check the battery. **See Test Procedure 1 – Battery on page 11c-13.**
   - Check the 30-amp fuse on w109 at the fuse block. **See Test Procedure 2 – Fuse on page 11c-16.**
   - Check the start relay. **See Test Procedure 8 – Start Relay on page 11c-21.**
   - Check diode 6. **See Test Procedure 13E – Diode 5 on wire 123 on page 11c-33.**
   - Check the neutral switch on the transmission housing. **See Test Procedure 14 – Neutral Switch (Transmission) on page 11c-35.**
   - Check for continuity of the wire harness on wires 127, 128, 147, and 109. **See Wiring Diagram on page 11c-6.**
7. If none of the previous steps resolves the problem, the starter solenoid and/or starter motor has failed. **See the Kubota D722 diesel engine manual (CCI P/N 102615501).**

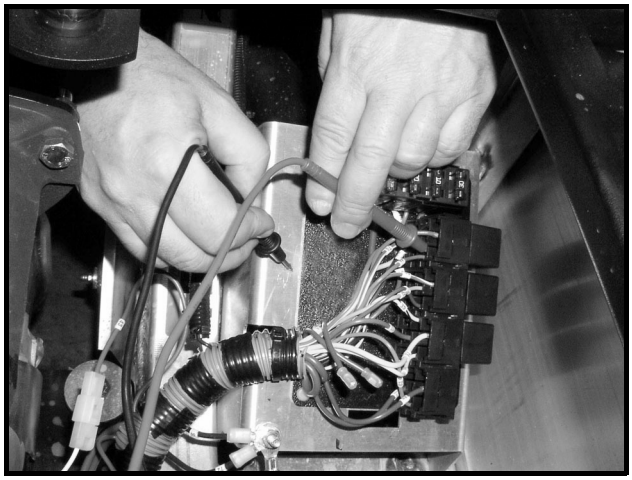


Figure 11c-15 Start Relay Coil Circuit Test

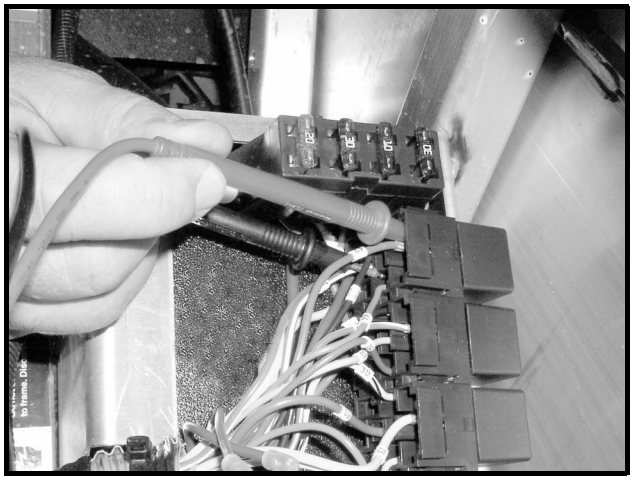


Figure 11c-16 Start Relay Contact Test

TEST PROCEDURE 8 – START RELAY

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the 16-gauge green wire (w127) from the starter solenoid coil to prevent the vehicle from unintentionally starting **(Figure 11c-13, Page 11c-20)**. **See following WARNING.**

⚠ WARNING

- **Failure to disconnect the wire from the solenoid coil could result in an unexpected engine start when performing this test.**

3. Set the multimeter to 20 VDC.
4. Place the probes to measure the voltage between the 16-gauge light green start relay wire (w110) terminal and the frame ground **(Figure 11c-15, Page 11c-21)**.
5. Monitor the multimeter. The reading should indicate 0 volts with the key in the OFF and ON positions. The reading should indicate approximately 12 VDC when the key is in the START position and the relay should click. **See following NOTE.**

NOTE: *The differential (if equipped), fan, and accessory relays may be removed to isolate the sound of the start relay click.*

6. If the reading is 12 VDC and the relay does not click when the key switch is turned to the START position, replace the relay.
7. If the reading is 12 VDC and the relay clicks when the key is in the START position, check the relay contacts.
   7.1. Set the multimeter to 200 ohms.
   7.2. Check for continuity between the 16-gauge green/white wire (w147) and the 16-gauge green wire (w128) relay terminals **(Figure 11c-16, Page 11c-21)**.
   7.3. Monitor the multimeter. The multimeter should not indicate continuity with the key in the OFF or ON positions. The multimeter should indicate continuity when the key is in the START position.
   7.4. If the multimeter does not indicate continuity while the key is in the START position and the relay

clicks, the contacts have failed. Replace the relay.

8. If the reading obtained in step 5 is not 12 VDC with the key in the START position, perform the following test procedures:
   - Check battery. **See Test Procedure 1 – Battery on page 11c-13.**
   - Check the 30-amp fuse (on w125). **See Test Procedure 2 – Fuse on page 11c-16.**
   - Check the key switch. **See Test Procedure 4 – Key Switch (Starter Circuit) on page 11c-18.**
   - Check diode 4. **See Test Procedure 13D – Diode 4 on wire 141 on page 11c-32.**
   - Check the neutral switch on the transmission housing. **See Test Procedure 14 – Neutral Switch (Transmission) on page 11c-35.**
   - Check for continuity of the wire harness on wires w141, w138, w110, and w125. **See Wiring Diagram on page 11c-6.**

TEST PROCEDURE 9 – DIFFERENTIAL RELAY

The differential relay is only used on early 2007 vehicles equipped with the two-piece wire harness.

See General Warning, Section 1, Page 1-1.

The differential relay activates the front differential when the key is in the ON position and the Forward/Reverse handle is in the Forward or Reverse position.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the 16-gauge green wire (w127) from the starter solenoid coil to prevent the vehicle from unintentionally starting **(Figure 11c-13, Page 11c-20)**. **See following WARNING.**

⚠ WARNING

- **Failure to disconnect the wire from the solenoid coil could result in an unexpected engine start when performing this test.**

3. Set the multimeter to 20 VDC.
4. Place the probes to measure the voltage between the 18-gauge purple differential relay wire (w136) terminal and the frame ground **(Figure 11c-17, Page 11c-22)**.

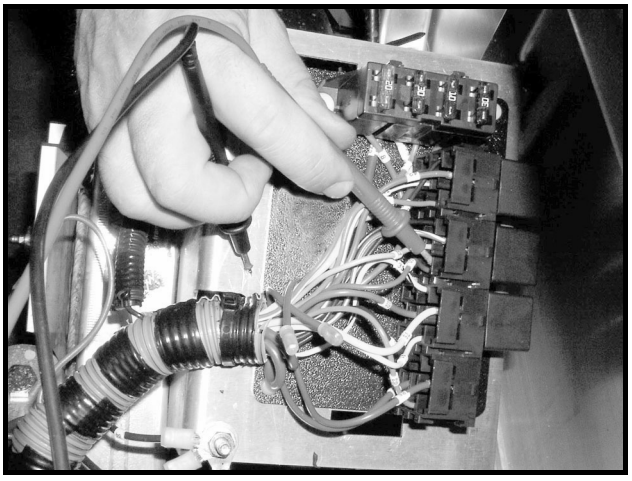


Figure 11c-17 Differential Relay Coil Circuit Test

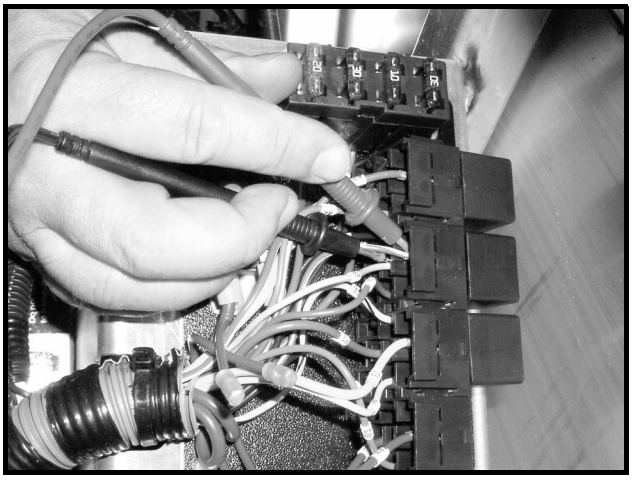


Figure 11c-18 Differential Relay Contact Test

5. Monitor the multimeter. The reading should indicate 0 volts with the key in the OFF position and the Forward/Reverse handle in the NEUTRAL position. The reading should indicate approximately 12 VDC when the key is in the ON position and the differential relay should click. **See following NOTE.**

NOTE: *The start, fan, and accessory relays may be removed to isolate the sound of the differential relay click.*

6. If the reading is 12 VDC and the relay does not click with the key switch in the ON position and the Forward/Reverse handle in the NEUTRAL position, replace the relay.
7. If the reading is 12 VDC and the relay clicks when the key is in the ON position, check the relay contacts.
   7.1. Set the multimeter to 200 ohms.
   7.2. Check for continuity between the 18-gauge gray wire (w111) and the 18-gauge purple/white wire (w118) relay terminals **(Figure 11c-18, Page 11c-22)**.
   7.3. Monitor the multimeter. The multimeter should indicate continuity with the key in the OFF position. The multimeter should NOT indicate continuity when the key is in the ON position.
   7.4. If the multimeter indicates continuity while the key is in the ON position and the relay clicks, the contacts have failed closed. Replace the relay.
8. If the reading obtained in step 5 is not 12 VDC with the key in the ON position, perform the following test procedures:

- Check the battery. **See Test Procedure 1 – Battery on page 11c-13.**
- Check the 30-amp fuse (on w125). **See Test Procedure 2 – Fuse on page 11c-16.**
- Check the key switch. **See Test Procedure 4 – Key Switch (Starter Circuit) on page 11c-18.**
- Check diode 3. **See Test Procedure 13C – Diode 3 on wire 144 on page 11c-31.**
- Check the neutral switch on the transmission housing. **See Test Procedure 14 – Neutral Switch (Transmission) on page 11c-35.**
- Check for continuity of the wire harness on wires w144, w142, w139, w136, w121, w48 and w37. **See Wiring Diagram on page 11c-6.**

TEST PROCEDURE 10 – FAN RELAY

See General Warning, Section 1, Page 1-1.

The fan relay closes the fan thermostat switch and activates the radiator fan when the engine coolant reaches a temperature range of 187 °F to 198 °F (86 °C to 92 °C).

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the 16-gauge green wire (w127) from the starter solenoid coil to prevent the vehicle from unintentionally starting **(Figure 11c-13, Page 11c-20)**. **See following WARNING.**

⚠ WARNING

- **Failure to disconnect the wire from the solenoid coil could result in an unexpected engine start when performing this test.**

3. Check power to the relay.
   3.1. Set the multimeter to 20 VDC and place the probes to measure the voltage between the 18-gauge yellow fan relay wire (w146) terminal and the frame ground **(Figure 11c-19, Page 11c-24)**.
   3.2. Monitor the multimeter. The reading should indicate 0 volts with the key in the OFF position. If not, check for a short or incorrect wiring between the yellow fan relay wire (w146) terminal and the key

switch.

3.3. The reading should indicate approximately 12 VDC with key in the ON position. If so, proceed to step 4. If not, perform the following test procedures:

- Check battery. **See Test Procedure 1 – Battery on page 11c-13.**
- Check the 30-amp fuse (on w125). **See Test Procedure 2 – Fuse on page 11c-16.**
- Check the key switch. **See Test Procedure 5 – Key Switch (ON Position) on page 11c-19.**
- Check diode 2. **See Test Procedure 13B – Diode 2 on wire 40 on page 11c-31.**
- Check for continuity of the wire harness on wires w114, w146, w121, w48, w37, w24, and w125. **See Wiring Diagram on page 11c-6.**
- Check the engine coolant thermostat switch. **See Test Procedure 11 – Thermostat Switch on page 11c-25.**

4. If the reading is 12 VDC with key in the ON position, check relay function.

4.1. At the relay, place the meter probes to check continuity between the 14-gauge yellow wire (w107) and the 14-gauge blue wire (w145) relay terminals **(Figure 11c-20, Page 11c-24)** when the relay is activated.

4.2. At the relay, ground the yellow/black fan relay wire (w114) to the frame with a jumper wire.

4.3. Turn the key switch ON. The relay should click, the fan should run and the meter should indicate continuity. **See following NOTE.** If not, replace the relay.

NOTE: *The start, differential (if equipped), and accessory relays may be removed temporarily to isolate the sound of the fan relay click.*

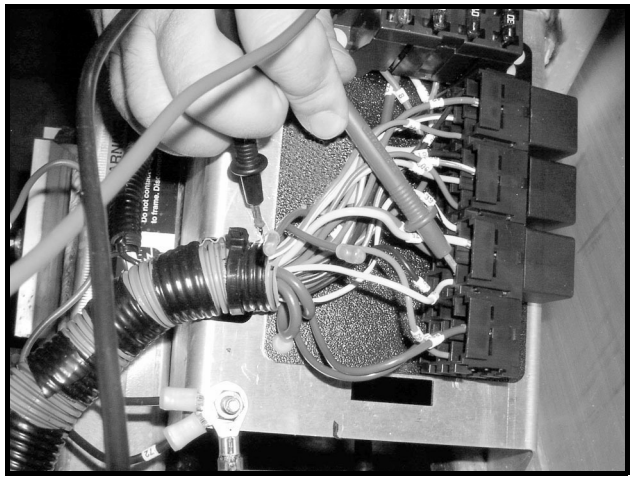


Figure 11c-19 Check Power To Fan Relay

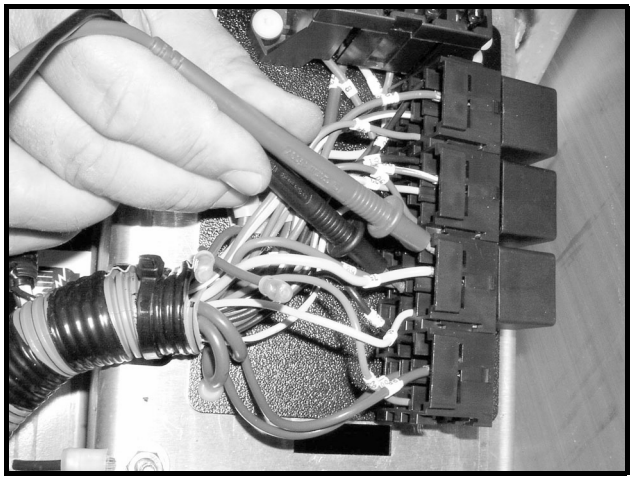


Figure 11c-20 Fan Relay Contact Test

5. If the fan runs constantly, even with the key switch OFF, remove the relay. If fan stops, the relay contacts have failed closed and the relay must be replaced.

TEST PROCEDURE 11 – THERMOSTAT SWITCH

See General Warning, Section 1, Page 1-1.

The thermostat switch houses two independent switches. Each switch closes the circuit between the thermostat housing (effectively frame ground) and the appropriate wire of the thermostat switch (white or black).

THERMOSTAT SWITCH

WIRE COLOR	FUNCTION	CONTACT OPERATION:	
		CLOSE ON RISE	OPEN
White	Radiator Fan	187 °F to 198 °F (86 °C to 92 °C)	165 °F (74 °C)
Black	Temperature Warning Light	216 °F to 226 °F (102 °C to 108 °C)	185 °F (85 °C)

The fan relay closes the fan thermostat switch and activates the radiator fan when the engine coolant reaches a temperature range of 187 °F to 198 °F (86 °C to 92 °C).

The engine coolant thermostat switch closes and provides a ground to the coolant temperature warning light when the engine block reaches a temperature range of 216 °F to 226 °F (102 °C to 108 °C). **See following NOTE.**

NOTE: *Keep the battery connected during this test procedure.*

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Drain coolant from engine. **See Engine Coolant Change, Section 15, Page 15-1. See following WARNING.**

⚠ WARNING

- **Hot! Coolant system is pressurized. Do not remove thermostat switch while engine is hot.**

3. Disconnect the two-pin connector between the thermostat switch and the wire harness **(Figure 11c-21, Page 11c-26)**.
4. Test for failed switches in closed condition.
   - 4.1. Set a multimeter to 200 ohms.
   - 4.2. Use an alligator clip to connect the black (–) probe of the multimeter to the frame (ground).
   - 4.3. Use an alligator clip to connect the red (+) probe of the multimeter to the white wire terminal.
   - 4.4. The multimeter should indicate an over limit (no continuity) at room temperature. If the multimeter indicates continuity at room temperature, replace the thermostat switch. **See Thermostat Switch Removal, Section 12c, Page 12c-17.**
   - 4.5. Leave the black (–) probe of the multimeter connected to the frame (ground). Use an alligator clip to connect the red (+) probe of the multimeter to the black wire terminal.
   - 4.6. The multimeter should indicate an over limit (no continuity) at room temperature. If the multimeter indicates continuity at room temperature, replace the thermostat switch. **See Thermostat Switch Removal, Section 12c, Page 12c-17.**

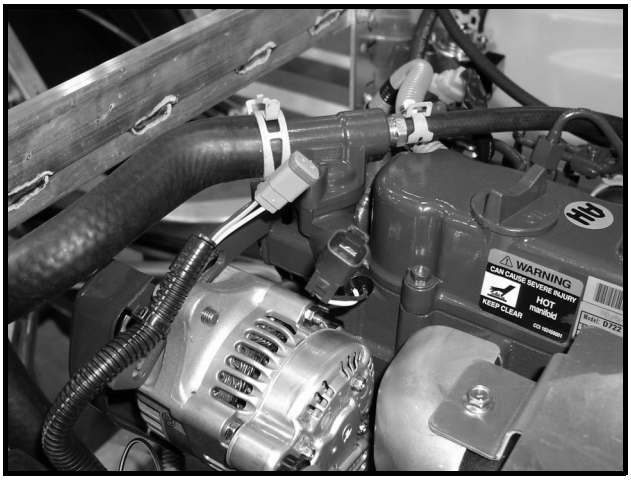


Figure 11c-21 Thermostat Switch

5. Unscrew the thermostat switch from the engine block. **See preceding WARNING.**

6. Test the fan control thermostat switch.

   6.1. Place the thermostat switch in a kitchen pot as shown **(Figure 11c-22, Page 11c-27)**.

   6.2. Set a multimeter to 200 ohms.

   6.3. Use an alligator clip to connect the black (–) probe to the thermostat switch housing.

   6.4. Use an alligator clip to connect the red (+) probe to the white wire terminal.

   6.5. The multimeter should indicate an over limit (no continuity) at room temperature. If the multimeter indicates continuity at room temperature, replace the thermostat switch. **See Thermostat Switch Removal, Section 12c, Page 12c-17.**

   6.6. Fill the kitchen pot with water so that approximately half of the thermostat housing is submerged as shown **(Figure 11c-22, Page 11c-27)**.

   6.7. Place the kitchen pot on a stove and bring the water to a boil. **See following WARNING.**

⚠ WARNING

- **Hot! Do not touch hot surfaces or boiling water. Contact with hot surfaces or boiling water will result in severe burns. Allow hot surfaces to cool adequately before touching them.**

   6.8. The multimeter should indicate continuity between the housing and the white wire when the thermostat switch is submerged in boiling water. If the multimeter does not indicate continuity, the thermostat switch has failed and must be replaced. Discard the failed thermostat switch and install a new one. **See Thermostat Switch Installation, Section 12c, Page 12c-18.**

   6.9. Turn off the stove. **See following WARNING.**

⚠ WARNING

- **Allow surfaces to cool adequately before touching them.**

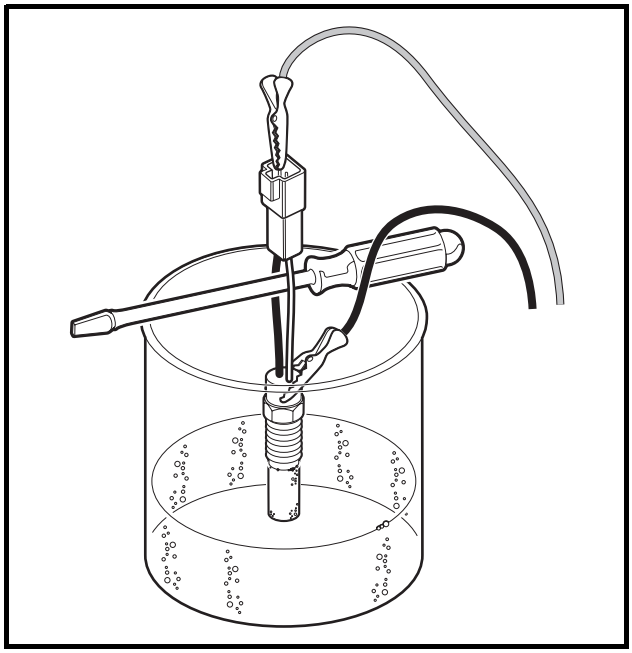


Figure 11c-22 Fan Thermostat Switch Test Setup

TEST PROCEDURE 12 – FAN MOTOR

See General Warning, Section 1, Page 1-1.

The fan relay closes the fan thermostat switch and activates the radiator fan when the engine coolant reaches a temperature range of 187 °F to 198 °F (86 °C to 92 °C).

Test Procedure 12A – Fan Motor

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the two-pin connector from the thermostat switch **(Figure 11c-24, Page 11c-28)** and install a jumper wire between the frame and the 18-gauge yellow/black wire in the connector.
3. With the Forward/Reverse handle still in the NEUTRAL position, turn the key switch to the ON position. The fan motor should run. If not, perform Test Procedure 12B – Voltage to Fan Motor on page 11c-27

Test Procedure 12B – Voltage to Fan Motor

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Raise the hood.
3. Disconnect the two-pin connector from the fan motor **(Figure 11c-23, Page 11c-28)**.
4. Disconnect the two-pin connector from the thermostat switch **(Figure 11c-24, Page 11c-28)**.
5. Place a jumper wire between the frame and the 18-gauge yellow/black wire at the two-pin connector disconnected from the thermostat switch.
6. Set a multimeter to measure 20 VDC.
7. Place the multimeter probes into each terminal of the two-pin connector disconnected from the fan motor (wire harness side).

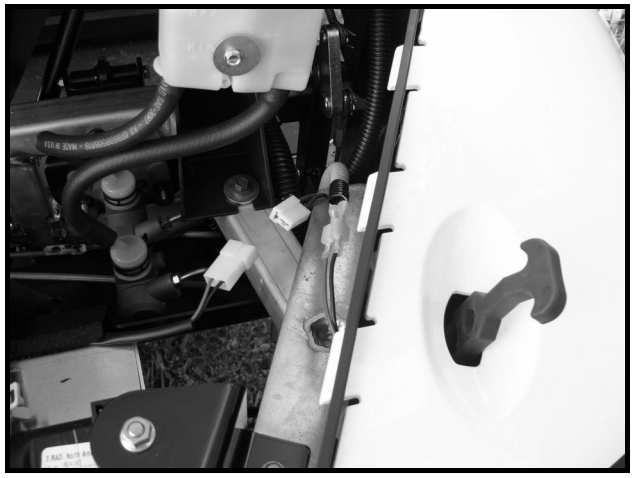


Figure 11c-23 Fan Motor Connector

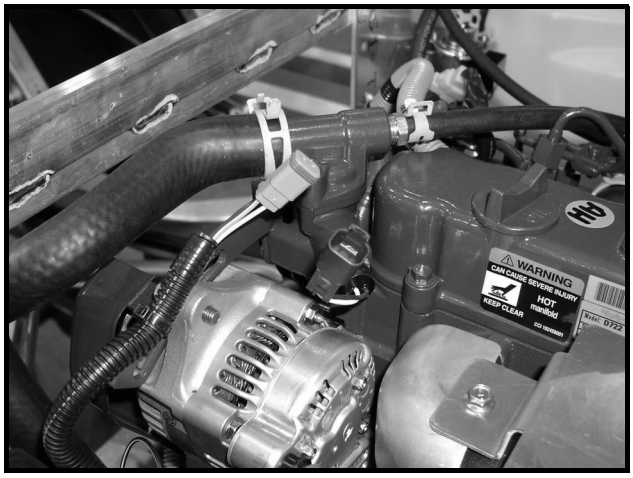


Figure 11c-24 Thermostat Switch Connector

8. Connect the battery cables, positive (+) cable first.
9. Leave the Forward/Reverse handle in the NEUTRAL position.
10. Monitor the multimeter while turning the key switch to the ON position. The multimeter should indicate 0 (zero) VDC with the key in the OFF position and approximately 12 VDC with the key switch in the ON position.
11. If the voltage reading is approximately 12 VDC with the key switch in the OFF position, check the fan relay for proper wiring and function. **See Test Procedure 10 – Fan Relay on page 11c-23.**
12. If the voltage reading is not approximately 12 VDC with the key switch in the ON position, check the following:
    - Diode 2 for failure in closed condition. **See Test Procedure 13B – Diode 2 on wire 40 on page 11c-31.**
    - Fan relay for proper wiring and function. **See Test Procedure 10 – Fan Relay on page 11c-23.**
    - Both 30-amp fuses (on wires w109 and w125). **See Test Procedure 2 – Fuse on page 11c-16.**
    - Key switch. **See Test Procedure 5 – Key Switch (ON Position) on page 11c-19.**
    - Connections and wire continuity for wires w112, w44, w52, w51, w107, w109, w114, w146, w125, w24, and w48.

TEST PROCEDURE 13 – WIRE HARNESS DIODES

See General Warning, Section 1, Page 1-1.

A diode is designed to conduct current in one direction only. Depending on the application, diodes are used in the vehicle to control electrical system logic, or to help protect relay and switch contacts from excessive arcing. **See following NOTE.**

NOTE: *If a diode conducts current in both directions, the diode has failed closed. If a diode will not conduct current in either direction, the diode has failed open* ***(Figure 11c-25, Page 11c-29)****.*

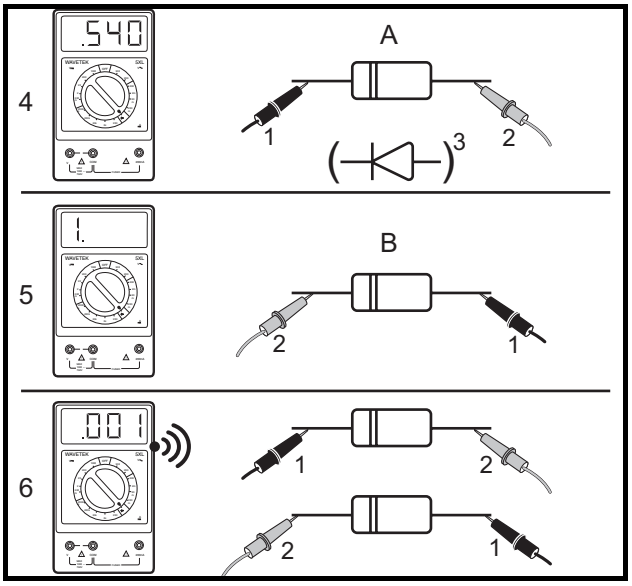


Figure 11c-25 Basic Diode Information

1. VOM Black Lead 2. VOM Red Lead 3. Wiring Diagram Symbol with Diode Stripe Orientation 4. Good Diode (Probe Scenario A) - Conducts Current and Shows Continuity 5. Good Diode (Probe Scenario B) - No Continuity 6. Bad Diode - Meter Beeps In Either Direction (Probe Scenarios A and B)

The early 2-piece wire harness is equipped with six in-line diodes. It was later replaced with a 1-piece wire harness retaining four of the in-line diodes (diodes 1, 2, 5, & 6). The following table describes each diode's function in the electrical system, location in the wire harness, and symptom(s) of failure.

DIODE TROUBLESHOOTING GUIDE

DIODE	IN-LINE WIRE LOCATION (WIRES)	FUNCTION	FAILURE CONDITION	SYMPTOM/COMMENT
Diode 1	w32 and w35	Differential solenoid coil flyback diode	Open	Will contribute to the premature failure of the differential relay or limit switch contacts.
			Closed	With key switch ON, the 30-amp fuse (on w125) will blow repeatedly until the diode has been replaced.
Diode 2	w40 and w41	Fan motor flyback diode	Open	Will contribute to the premature failure of the fan relay contacts.
			Closed	The 30-amp fuse (on w109) will blow repeatedly until the diode has been replaced.
Diode 3	w144 and w139	Differential relay coil isolation diode (blocking diode) – Early 2007 Only	Open	Differential solenoid is energized all of the time, even when Forward/ Reverse handle is in the NEUTRAL position.
			Closed	May allow the vehicle to be started when Forward/Reverse handle is in FORWARD or REVERSE positions.

Troubleshooting Guide continued on next page...

DIODE TROUBLESHOOTING GUIDE

DIODE	IN-LINE WIRE LOCATION (WIRES)	FUNCTION	FAILURE CONDITION	SYMPTOM/COMMENT
Diode 4	w141 and w138	Start relay coil isolation diode – Early 2007 Only	Open	Vehicle will not start. Start relay will not be energized when key switch is in the START position.
			Closed	Loss of start relay coil isolation.
Diode 5	w123 and w130	Fuel pump and hold coil flyback diode	Open	Will contribute to the premature failure of the key switch contacts.
			Closed	The 30-amp fuse (on w125) will blow repeatedly until the diode has been replaced.
Diode 6	w129 and w131	Starter solenoid coil flyback diode	Open	Will contribute to the premature failure of the start relay contacts.
			Closed	The 30-amp fuse (on w109) will blow repeatedly until the diode has been replaced.

Test Procedure 13A – Diode 1 on wire 32

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Disconnect the two-pin connector between the front gearcase and the wire harness.
4. Set the multimeter to the diode test function (→|←).
5. Connect the black (–) probe of the multimeter to the frame (ground).
6. Connect the red (+) probe of the multimeter to the 18-gauge gray wire (w35) on the two-pin connector (wire harness side). **See following NOTE.**

NOTE: *Ensure probe is connected to the correct gray wire. Gray wire (w33) is powered up by the key switch. Gray wire (w35) is attached to diode 1.*

7. The reading should indicate an over limit (no continuity). If the diode conducts current (shows continuity) with the meter probes connected as described, the diode has failed and must be replaced. **See Wire Harness Diode Removal, Section 12c, Page 12c-20.**
8. Reverse the multimeter probes and note the reading. The multimeter should indicate approximately 540 mV, however, a range of 400-700 mV is acceptable.
9. If the readings obtained in the previous steps are incorrect, replace the diode. **See Wire Harness Diode Removal, Section 12c, Page 12c-20.**

Test Procedure 13B – Diode 2 on wire 40

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Raise the hood.
4. Disconnect the two-pin connector between the fan and the wire harness **(Figure 11c-23, Page 11c-28)**.
5. Set the multimeter to the diode test function (→|←).
6. Connect the black (–) probe of the multimeter to the frame (ground).
7. Connect the red (+) probe of the multimeter to the 14-gauge blue wire (w52) on the two-pin connector (wire harness side).
8. The reading should indicate an over limit (no continuity). If the diode conducts current (shows continuity) with the meter probes connected as described, the diode has failed and must be replaced. **See Wire Harness Diode Removal, Section 12c, Page 12c-20.**
9. Reverse the multimeter probes and note the reading. The multimeter should indicate approximately 540 mV, however, a range of 400-700 mV is acceptable.
10. If the readings obtained in the previous steps are incorrect, replace the diode. **See Wire Harness Diode Removal, Section 12c, Page 12c-20.**

Test Procedure 13C – Diode 3 on wire 144

Diode 3 is only used on early 2007 vehicles equipped with the two piece wire harness and a differential relay.

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Remove the start relay, differential relay, fan relay, and accessory relay from the multi-pin connector located on the electrical component mounting plate.
4. Disconnect the two-pin connector between the neutral switch and the wire harness **(Figure 11c-26, Page 11c-32)**.
5. Set the multimeter to the diode test function (→|←).
6. Connect the black (–) probe of the multimeter to the 18-gauge black/white wire (w142) at the neutral switch two-pin connector.
7. Connect the red (+) probe of the multimeter to the 18-gauge black wire (w139) on the multi-pin differential relay connector located on the electrical component mounting plate.

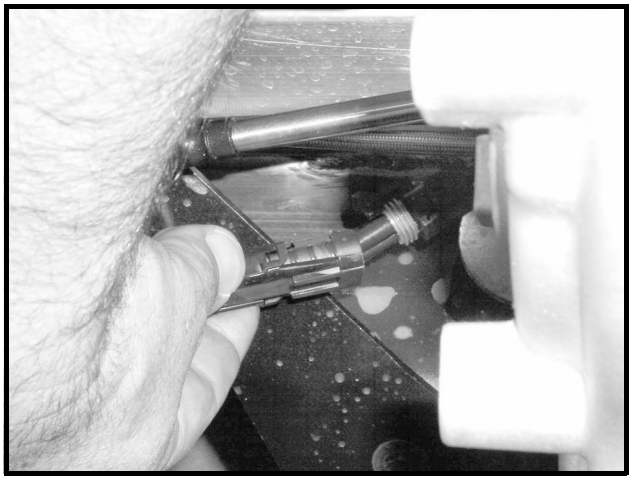


Figure 11c-26 Neutral Switch Two-Pin Connector

8. The reading should indicate an over limit (no continuity). If the diode conducts current (shows continuity) with the meter probes connected as described, the diode has failed and must be replaced. **See Wire Harness Diode Removal, Section 12c, Page 12c-20.**
9. Reverse the multimeter probes and note the reading. The multimeter should indicate approximately 540 mV, however, a range of 400-700 mV is acceptable.
10. If the readings obtained in the previous steps are incorrect, replace the diode. **See Wire Harness Diode Removal, Section 12c, Page 12c-20.**

Test Procedure 13D – Diode 4 on wire 141

Diode 4 is only used on early 2007 vehicles equipped with the two piece wire harness and a differential relay.

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Remove the start relay, differential relay, fan relay, and accessory relay from the multi-pin connector located on the electrical component mounting plate.
4. Disconnect the two-pin connector between the neutral switch and the wire harness **(Figure 11c-26, Page 11c-32)**.
5. Set the multimeter to the diode test function (→|←).
6. Connect the black (–) probe of the multimeter to the 18-gauge black/white wire (w142) at the neutral switch two-pin connector.
7. Connect the red (+) probe of the multimeter to the 18-gauge black wire (w138) on the multi-pin start relay connector located on the electrical component mounting plate.
8. The reading should indicate an over limit (no continuity). If the diode conducts current (shows continuity) with the meter probes connected as described, the diode has failed and must be replaced. **See Wire Harness Diode Removal, Section 12c, Page 12c-20.**

9. Reverse the multimeter probes and note the reading. The multimeter should indicate approximately 540 mV, however, a range of 400-700 mV is acceptable.

10. If the readings obtained in the previous steps are incorrect, replace the diode. **See Wire Harness Diode Removal, Section 12c, Page 12c-20.**

Test Procedure 13E – Diode 5 on wire 123

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.

2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**

3. Raise the hood.

4. Disconnect the multi-pin connector from the key switch **(Figure 11c-27, Page 11c-33)**. **See following NOTE.**

NOTE: *Failure to disconnect the multi-pin connector from the key switch will result in unreliable results when the diodes connected to the key switch circuit are tested.*

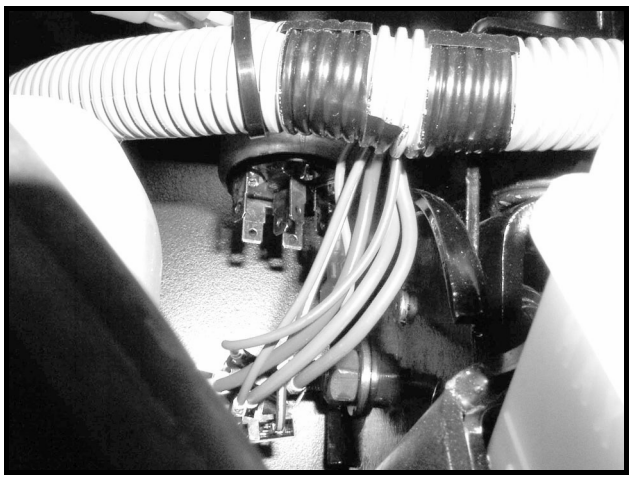


Figure 11c-27 Disconnected Multi-Pin Connector at Key Switch

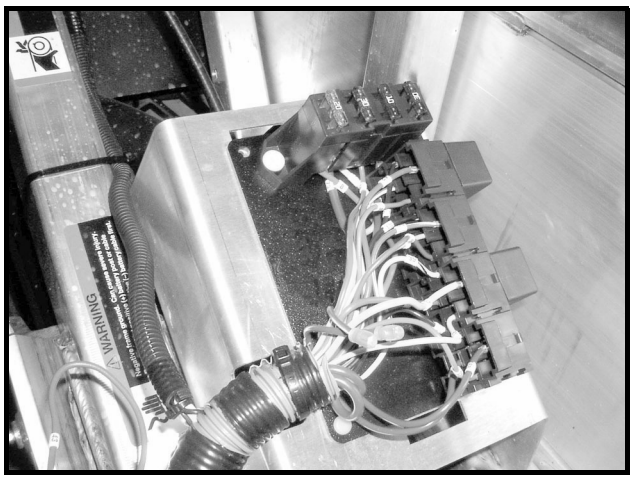


Figure 11c-28 Differential Relay Removed – Early 2007 Only

5. Remove the differential relay, if equipped, from the socket on the electrical component mounting plate **(Figure 11c-28, Page 11c-33)**.

6. Disconnect the three-pin connector (w122, w135, w108) between the fuel solenoid and the wire harness **(Figure 11c-29, Page 11c-34)**.

7. Disconnect the bullet connector, on the gray wire (w140), between the fuel pump and the wire harness **(Figure 11c-30, Page 11c-34)**.

8. Set the multimeter to the diode test function (→|←).

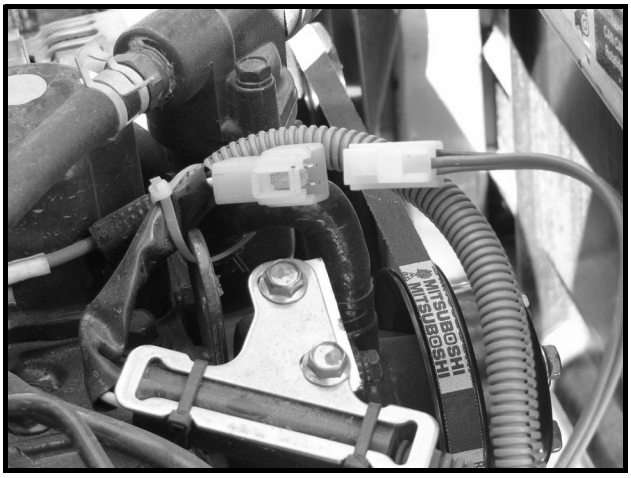


Figure 11c-29 Fuel Solenoid Three-Pin Connector

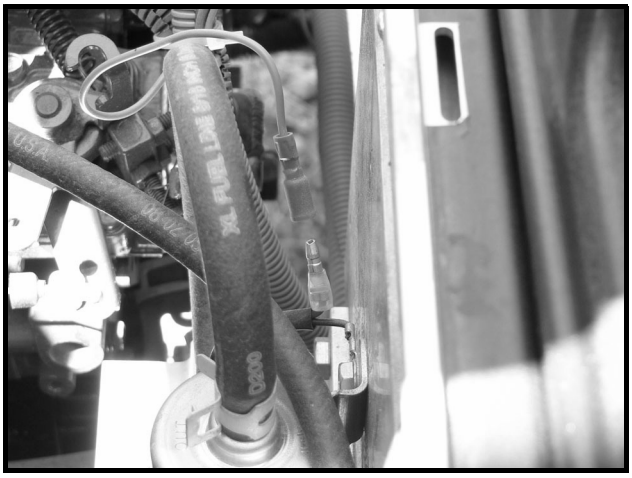


Figure 11c-30 Fuel Pump Bullet Connector

9. Connect the black (–) probe of the multimeter to the frame (ground).
10. Connect the red (+) probe of the multimeter to the 18-gauge gray wire (w140) at the bullet connector (wire harness side).
11. The reading should indicate an over limit (no continuity). If the diode conducts current (shows continuity) with the meter probes connected as described, the diode has failed and must be replaced. **See Wire Harness Diode Removal, Section 12c, Page 12c-20.**
12. Reverse the multimeter probes and note the reading. The multimeter should indicate approximately 540 mV, however, a range of 400-700 mV is acceptable.
13. If the readings obtained in the previous steps are incorrect, replace the diode. **See Wire Harness Diode Removal, Section 12c, Page 12c-20.**

Test Procedure 13F – Diode 6 on wire 129

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Disconnect the 16-gauge green wire (w127) from the starter solenoid coil **(Figure 11c-13, Page 11c-20)**.
4. Set the multimeter to the diode test function (→|←).
5. Connect the black (–) probe to the frame (ground).
6. Connect the red (+) probe to the 16-gauge green wire (w127) at the connector.
7. The reading should indicate an over limit (no continuity). If the diode conducts current (shows continuity) with the meter probes connected as described, the diode has failed and must be replaced. **See Wire Harness Diode Removal, Section 12c, Page 12c-20.**
8. Reverse the multimeter probes and note the reading. The multimeter should indicate approximately 540 mV, however, a range of 400-700 mV is acceptable.
9. If the readings obtained in the previous steps are incorrect, replace the diode. **See Wire Harness Diode Removal, Section 12c, Page 12c-20.**

TEST PROCEDURE 14 – NEUTRAL SWITCH (TRANSMISSION)

See General Warning, Section 1, Page 1-1.

The neutral switch is located on the transmission housing.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Disconnect the two-pin connector between the neutral switch and the wire harness (w143 and w142) **(Figure 11c-26, Page 11c-32)**.
4. Check for continuity on the switch contacts with the Forward/Reverse handle in the FORWARD position **(Figure 11c-31, Page 11c-35)**. The multimeter should indicate no continuity.
5. Check for continuity on the switch contacts with the Forward/Reverse handle in the NEUTRAL position **(Figure 11c-32, Page 11c-36)**. The multimeter should indicate continuity.
6. Check for continuity on the switch contacts with the Forward/Reverse handle in the REVERSE position **(Figure 11c-33, Page 11c-36)**. The multimeter should indicate no continuity.
7. If any of the continuity readings are incorrect, replace the neutral switch. **See Neutral Switch Removal, Section 12c, Page 12c-2.**

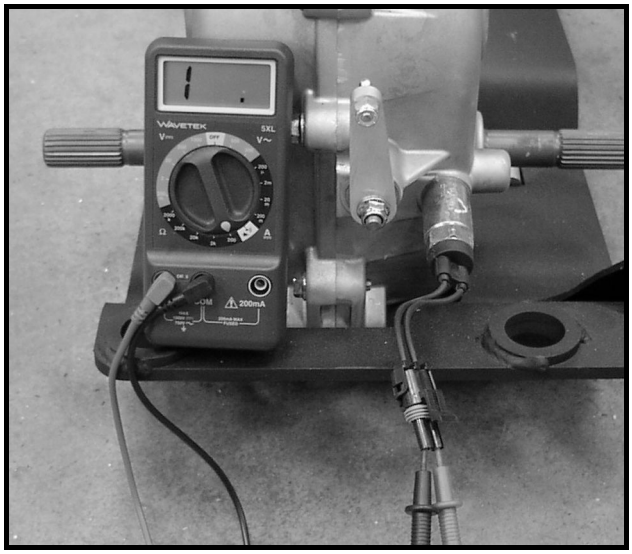


Figure 11c-31 Neutral Switch – Forward Position

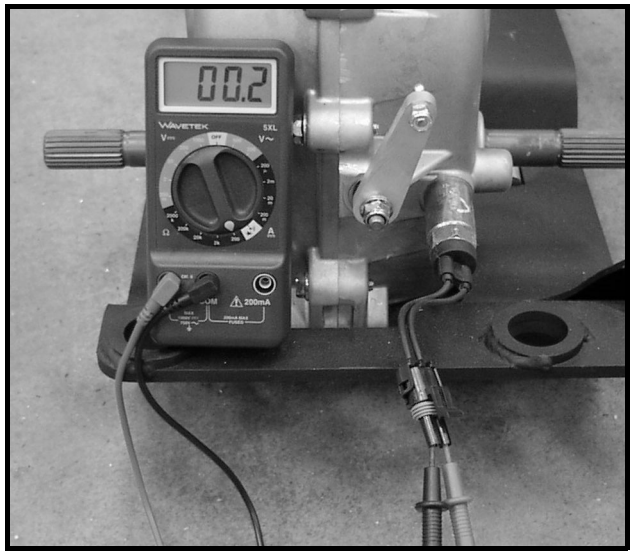


Figure 11c-32 Neutral Switch – Neutral Position

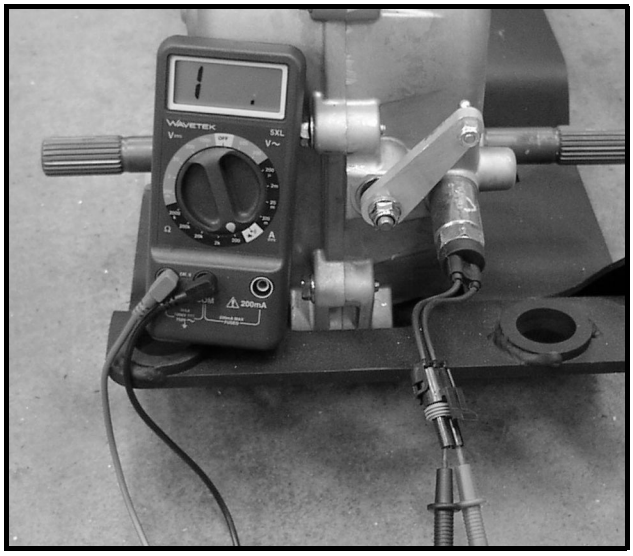


Figure 11c-33 Neutral Switch – Reverse Position

TEST PROCEDURE 15 – WIRE CONTINUITY

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. To test a wire for continuity, disconnect either end from the electrical component to which it is attached.
4. Set the multimeter to 200 ohms and place the red (+) probe on the terminal at one end of the wire. Place the black (–) probe on the other terminal end of the wire. The reading should indicate continuity. If the reading is incorrect, repair or replace the wire. **See following NOTE.**

NOTE: *When checking continuity of wires in the wire harness, observe the polarity of diodes. Testing continuity of certain wires will require the appropriate diode test procedure.* ***See Test Procedure 13 – Wire Harness Diodes on page 11c-28.***

TEST PROCEDURE 16 – FRONT DIFFERENTIAL LIMIT SWITCH

The front differential limit switch is only used on late 2007 vehicles equipped with the one piece wire harness.

See General Warning, Section 1, Page 1-1.

NOTE: *Keep the battery connected during this test procedure.*

The front differential limit switch is located under the hood where the accelerator pedal mounts to the chassis.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Check for proper wiring and tight connections at the front differential limit switch **(Figure 11c-34, Page 11c-37)**.

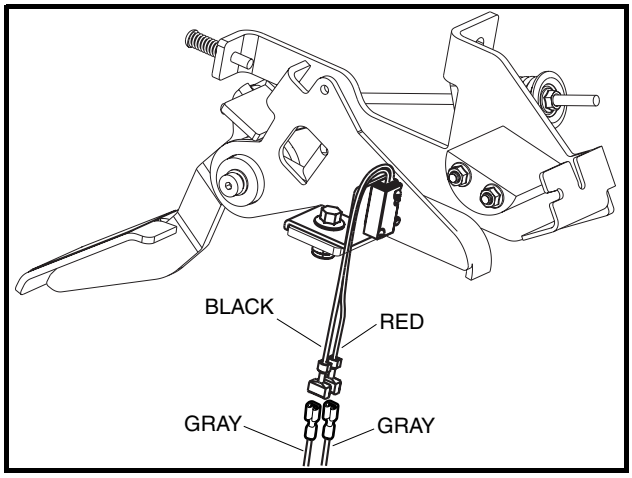


Figure 11c-34 Front Differential Switch

3. Move the accelerator pedal and listen for an audible click from the switch. If there is no click, check the limit switch for proper alignment and switch arm movement.
4. Place the red (+) probe of the multimeter on one terminal and the black (–) probe on the other terminal of the switch. With the accelerator pedal fully released, the reading should be no continuity.
5. Apply the accelerator pedal to activate the switch. The multimeter should indicate continuity when the switch lever is activated. If either reading is incorrect, replace the switch. **See Front Differential Limit Switch Removal on page 12a-13.**

TEST PROCEDURE 17 – FRONT DRIVE GEARCASE COIL

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Disconnect the two-pin connector between the wire harness and the front drive gearcase located under the front floorboard.
4. Set the multimeter to 200 ohms.
5. Measure the resistance between the two wires at the two-pin connector (front drive gearcase side).
6. The resistance should be 24.7 to 27.3 ohms.
7. If the resistance is not within the stated range, replace the large output cover sub-assembly. **See the Engines and Drivetrain Components manual (CCI P/N 102396501).**

TEST PROCEDURE 18 – ALTERNATOR

See General Warning, Section 1, Page 1-1.

NOTE: *Keep the battery connected during this test procedure.*

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Ensure that the wires are connected correctly and are tight. If they are not, rewire or tighten as necessary.

3. Check the engine RPM setting to ensure that it is adjusted correctly. **See Engine RPM Adjustment, Section 13c, Page 13c-20.**
4. With the battery in good condition and fully charged, run the engine for several minutes to bring the voltage regulator to operating temperature.
5. Set the multimeter for 20 VDC.
6. With the engine running at full-governed RPM, measure the battery voltage at the battery posts. If the reading is between 14.2 and 14.8 volts, the alternator is good. If the reading is less than 14.2 volts but rising steadily, check battery condition. **See Test Procedure 1 – Battery on page 11c-13.**
7. If the reading is less than 14.2 volts and not rising or higher than 14.8 volts, replace the alternator.

TEST PROCEDURE 19 – 60-AMP FUSIBLE LINK

See General Warning, Section 1, Page 1-1.

NOTE: *Keep the battery connected during this test procedure.*

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Raise the driver side seat and locate the blue fusible link wire attached to the alternator **(Figure 11c-35, Page 11c-38)**.

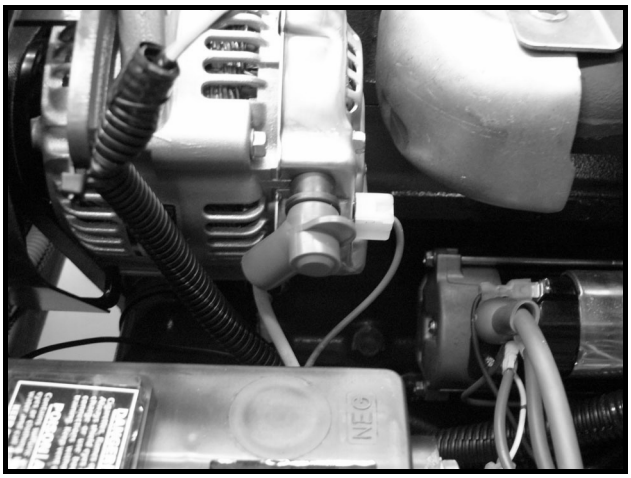


Figure 11c-35 60-Amp Fusible Link

3. The easiest way to test them is to tug on them. A blown link will stretch like a rubber band. Fusible links can either fail gradually or suddenly, depending on the cause. Sluggish electrical accessories, an unusual pause before the starter turns, and odd behavior of accessories plugged into the power socket are all symptoms of a failing fusible link.
4. Ensure that the nuts securing the link to the alternator and the large post of the starter solenoid are connected correctly and are tight. If they are not, rewire or tighten as necessary.
5. Set the multimeter to 20 VDC.
6. Place the black (–) probe on the frame (ground).
7. Place the red (+) probe on the fusible link ring terminal atttached to the alternator stud. The reading should indicate approximately 12 VDC (or full battery voltage).

8. If the multimeter did not indicate voltage, check the following:
   - Battery. **See Test Procedure 1 – Battery on page 11c-13.**
   - Loose connection at large post of starter solenoid.
   - Wire continuity of wires w201 and w124. **See Test Procedure 15 – Wire Continuity on page 11c-36.**
9. If no problems were found in step 8, the fusible link has failed and must be replaced. **See 60-Amp Fusible Link Removal, Section 12c, Page 12c-4.**

TEST PROCEDURE 20 – COOLANT TEMPERATURE WARNING LIGHT CIRCUIT

See General Warning, Section 1, Page 1-1.

The engine coolant thermostat switch provides a ground to the coolant temperature warning light when the engine block reaches a temperature range of 216 °F to 226 °F (102 °C to 108 °C) and closes the thermostat switch. **See following NOTE.**

NOTE: *Keep the battery connected during this test procedure.*

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. At driver side, raise the seat and disconnect the two-pin connector from the thermostat switch **(Figure 11c-24, Page 11c-28)**.

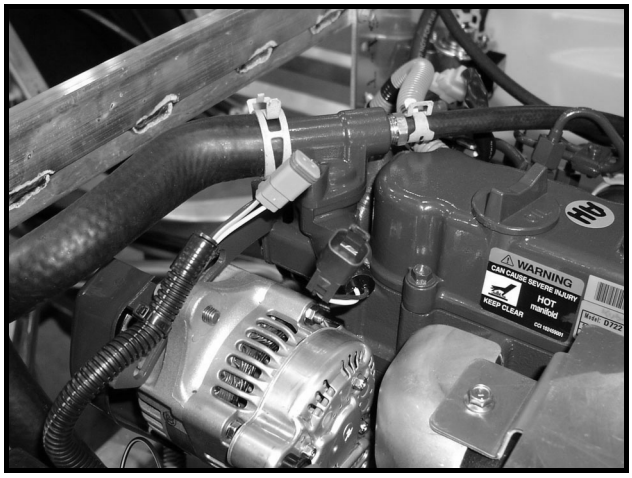


Figure 11c-36 Thermostat Switch Connector

3. Place a jumper wire between the frame and the 18-gauge Green/White wire at the two-pin connector disconnected from the thermostat switch.
4. Raise the hood to access the back of the coolant temperature warning light.
5. Set multimeter to 20 VDC.
6. Place the red multimeter probe into the green/white wire (w117) terminal connected to the coolant temperature warning light. Place the black multimeter probe on the frame (ground).
7. Leave the Forward/Reverse handle in the NEUTRAL position.
8. Monitor the multimeter while turning the key switch to the ON position. The multimeter should indicate 0 (zero) VDC with the key in the OFF position and approximately 12 VDC with the key switch in the ON position.

9. If the voltage reading is approximately 12 VDC with the key switch in the OFF position, check the key switch for proper wiring and function. **See Test Procedure 5 – Key Switch (ON Position) on page 11c-19.**
10. If the voltage reading obtained in step 8 is correct, check the filament of the warning light.
    10.1. Set the multimeter to 200 ohms.
    10.2. Check for continuity between the warning light terminals.
    10.3. The reading should indicate continuity. If not, replace the coolant temperature warning light. **See Warning Light Removal, Section 12c, Page 12c-5.**
11. If the voltage reading obtained in step 8 is not approximately 12 VDC with the key switch in the ON position, check the following:
    - 30-amp fuse (on wire w125). **See Test Procedure 2 – Fuse on page 11c-16.**
    - Key switch. **See Test Procedure 5 – Key Switch (ON Position) on page 11c-19.**
    - Connections and wire continuity for wires w117, w45, w29, w37, w24, w125, and w126. **See Test Procedure 15 – Wire Continuity on page 11c-36.**

TEST PROCEDURE 21 – GLOW PLUG CIRCUIT

See General Warning, Section 1, Page 1-1.

NOTE: *Keep the battery connected during this test procedure.*

1. Turn the key switch OFF. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Set a multimeter to 20 VDC.
3. Place the red (+) probe on the wire terminal where the 12-gauge blue wire (w137) connects to the glow plug and glow plug buss bar **(Figure 11c-37, Page 11c-40)**.
4. Place the black (–) probe on the frame or engine block (ground).
5. The multimeter should indicate 0 VDC with the key in the OFF position.
6. Monitor the multimeter and turn the key to the PREHEAT position. Hold it for 5 seconds. The multimeter should indicate 11 to 12 VDC.

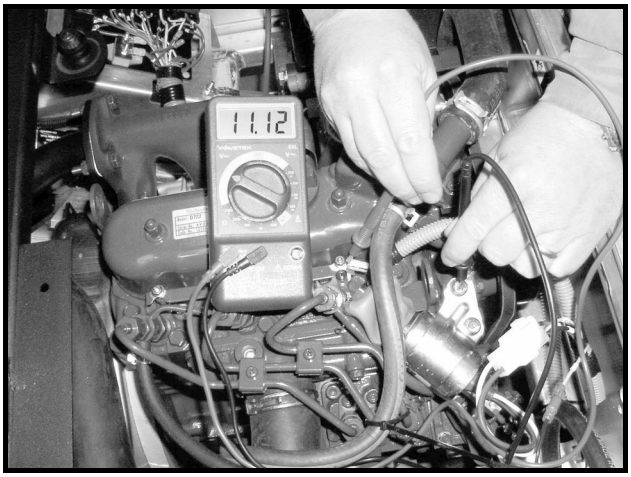


Figure 11c-37 Glow Plug Circuit Test

7. If the readings in the previous two steps are incorrect, check the following:
   - 30-amp fuse (on wire w125). **See Test Procedure 2 – Fuse on page 11c-16.**
   - Key Switch. **See Test Procedure 6 – Key Switch (Glow Plug Circuit) on page 11c-19.**
   - Wire continuity of wires w125, w24, w26, w47, and w137. **See Test Procedure 15 – Wire Continuity on page 11c-36.**

TEST PROCEDURE 22 – REVERSE WARNING BUZZER LIMIT SWITCH (IF EQUIPPED)

See General Warning, Section 1, Page 1-1.

NOTE: *Keep the battery connected during this test procedure.*

The reverse warning buzzer limit switch is located on the Forward/Reverse handle under the hood.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Check for proper wiring and tight connections at the reverse warning buzzer and the reverse warning buzzer limit switch **(Figure 11c-38, Page 11c-41)**.
3. Move the Forward/Reverse handle to REVERSE and listen for an audible click from the limit switch. If there is no click, check the switch for proper alignment and switch arm movement.
4. If the switch is being activated but the buzzer does not function, place the red (+) probe of the multimeter on one terminal and the black (–) probe on the other terminal of the limit switch. With the limit switch lever fully released, the reading should be no continuity.
5. Place the Forward/Reverse handle in the REVERSE position to activate the limit switch. The multimeter should indicate continuity when the limit switch lever is activated. If either reading is incorrect, replace the limit switch **(Figure 11c-38, Page 11c-41)**.

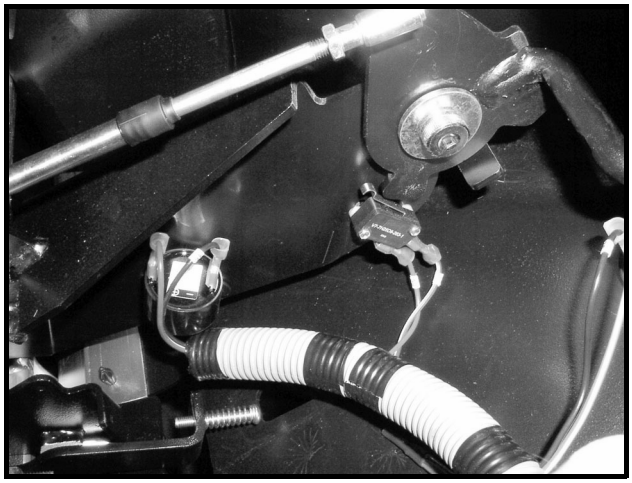


Figure 11c-38 Reverse Warning Buzzer and Limit Switch

TEST PROCEDURE 23 – REVERSE WARNING BUZZER (IF EQUIPPED)

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Check for proper wiring and tight connections. Use a multimeter and check for continuity through each wire that connects to the reverse warning buzzer individually. **See Wiring Diagram, Section 11c, Page 11c-6.** If the buzzer does not function when properly wired, replace the buzzer. **See Reverse Warning Buzzer Removal, Section 12c, Page 12c-10.**

TEST PROCEDURE 24 – FUEL SOLENOID PULL COIL CIRCUIT

See General Warning, Section 1, Page 1-1.

NOTE: *Keep the battery connected during this test procedure.*

1. Turn the key switch OFF. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the three-pin connector between the fuel solenoid and the wire harness **(Figure 11c-29, Page 11c-34)**.
3. Set a multimeter to 20 VDC.
4. Place the red (+) probe on the 14-gauge blue wire (w135) of the three-pin connector at the fuel solenoid (wire harness side).
5. Place the black (–) probe on the frame or engine block (ground).
6. The multimeter should indicate 0 VDC with the key in the OFF position.
7. Monitor the multimeter and turn the key switch to the ON position. The multimeter should indicate 0 VDC.
8. Monitor the multimeter and turn the key switch to the START position. The multimeter should indicate between 10 and 11.5 VDC.
9. If the reading obtained in the previous step is correct and the fuel solenoid does not operate correctly, replace the fuel solenoid. **See Fuel Solenoid Removal, Section 12c, Page 12c-2.**
10. If any of the above readings are incorrect, check the following items:
    - Battery. **See Test Procedure 1 – Battery on page 11c-13.**
    - Key switch. **See Test Procedure 4 – Key Switch (Starter Circuit) on page 11c-18.**
    - Starter solenoid. **See the Kubota D722 diesel engine manual (CCI P/N 102615501).**
    - Wire continuity of w135. **See Test Procedure 15 – Wire Continuity on page 11c-36.**

TEST PROCEDURE 25 – FUEL SOLENOID HOLD COIL CIRCUIT

See General Warning, Section 1, Page 1-1.

NOTE: *Keep the battery connected during this test procedure.*

1. Turn the key switch OFF. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the three-pin connector between the fuel solenoid and the wire harness **(Figure 11c-29, Page 11c-34)**.
3. Set a multimeter to 20 VDC.

4. Place the red (+) probe on the 18-gauge gray wire (w122) of the three-pin connector at the fuel solenoid (wire harness side).
5. Place the black (–) probe on the frame or engine block (ground).
6. The multimeter should indicate 0 VDC with the key switch in the OFF position.
7. Monitor the multimeter and turn the key switch to the ON position. The multimeter should indicate approximately 12 VDC.
8. If the reading obtained in the previous step is correct and the fuel solenoid does not operate correctly, replace the fuel solenoid. **See Fuel Solenoid Removal, Section 12c, Page 12c-2.**
9. If any of the above readings are incorrect, check the following items:
   - Battery. **See Test Procedure 1 – Battery on page 11c-13.**
   - 30-amp fuse on w125. **See Test Procedure 2 – Fuse on page 11c-16.**
   - Key switch. **See Test Procedure 5 – Key Switch (ON Position) on page 11c-19.**
   - Starter solenoid. **See the Kubota D722 diesel engine manual (CCI P/N 102615501).**
   - Wire continuity of wires w122, w121, w37, w48, w24, w125, w126, and w201. **See Test Procedure 15 – Wire Continuity on page 11c-36.**

TEST PROCEDURE 26 – FUEL PUMP CIRCUIT

See General Warning, Section 1, Page 1-1.

NOTE: *Keep the battery connected during this test procedure.*

1. Turn the key switch OFF. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the gray wire (w140) bullet connector between the fuel pump and the wire harness **(Figure 11c-30, Page 11c-34)**.
3. Set a multimeter to 20 VDC.
4. Place the red (+) probe on the 18-gauge gray wire (w140) disconnected from the fuel pump (wire harness side).
5. Place the black (–) probe on the frame or engine block (ground).
6. The multimeter should indicate 0 (zero) VDC with the key switch in the OFF position.
7. Monitor the multimeter and turn the key switch to the ON position. The multimeter should indicate approximately 12 VDC with the key in the ON position.
8. If the reading obtained in the previous step is correct and the fuel pump does not operate correctly, replace the fuel pump. **See Fuel Pump Removal, Section 13c, Page 13c-11.**
9. If any of the above readings are incorrect, check the following items:
   - Battery. **See Test Procedure 1 – Battery on page 11c-13.**
   - 30-amp fuse on w125. **See Test Procedure 2 – Fuse on page 11c-16.**
   - Key switch. **See Test Procedure 5 – Key Switch (ON Position) on page 11c-19.**
   - Wire continuity of wires w140, w121, w48, w37, w24, w125, w126, and w201. **See Test Procedure 15 – Wire Continuity on page 11c-36.**

TEST PROCEDURE 27 – LOW OIL WARNING LIGHT CIRCUIT

See General Warning, Section 1, Page 1-1.

If the low oil warning light stays on, test the oil pressure switch. **See the Kubota D722 diesel engine manual (CCI P/N 102615501).** If the low oil warning light does not illuminate and the vehicle is low on oil, proceed to step 1. **See following NOTE.**

NOTE: *The low oil warning light should illuminate when the key switch is turned to the ON position. After the engine has been started, the low oil warning light should remain illuminated until the oil pressure switch has been activated.*

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Raise the hood.
3. Ensure that the wires are connected correctly and are tight. If they are not, rewire or tighten as necessary.
4. Disconnect the 18-gauge black/white wire (w17) from the low oil warning light terminal.
5. Leave the 18-gauge purple wire (w42) connected to the low oil warning light.
6. Place a jumper wire on the terminal of the low oil warning light where the black/white wire was removed.
7. Touch the frame (ground) with the remaining end of the jumper wire.
8. Turn the key switch to the ON position. The low oil warning light should illuminate.
9. If the low oil warning light does not illuminate when the key switch is in the ON position, check the 18-gauge purple wire (w42) for continuity between the terminal at the low oil warning light and the 18-gauge purple wire (w37) at the key switch. Also check the continuity between the terminal on the 18-gauge black/white wire (w17) and the terminal on the oil pressure switch 16-gauge black/white wire (w200).
10. If there is continuity between the 18-gauge purple wire (w42) at the low oil warning light and the 18-gauge purple wire (w37) at the key switch, replace the low oil warning light. **See Warning Light Removal, Section 12c, Page 12c-5.**
11. If the problem is not corrected by performing the previous steps, test the oil pressure switch. **See the Kubota D722 diesel engine manual (CCI P/N 102615501).**

TEST PROCEDURE 28 – 12-VOLT ACCESSORY RECEPTACLE

See General Warning, Section 1, Page 1-1.

NOTE: *Keep the battery connected during this test procedure.*

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Set the multimeter to 20 VDC.
3. Measure the voltage between the center contact and the outer contact of the accessory receptacle. The voltage should be approximately 12 VDC.
4. If the voltage is not approximately 12 VDC, check the 10-amp fuse on orange/white wire (w115) located on the electrical component mounting plate. **See Test Procedure 2 – Fuse on page 11c-16.**
5. If the fuse is good, check the continuity of the wires connected to the accessory receptacle.

TEST PROCEDURE 29 – FUEL LEVEL SENDING UNIT

See General Warning, Section 1, Page 1-1.

⚠ WARNING

- **To avoid the possibility of fire or explosion, make sure the fuel tank cap is securely in place while performing this test procedure.**

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Disconnect the orange wire (w104) from the center post of the fuel level sending unit.
4. With a multimeter set to 2k ohms, place the red (+) probe on the center post of the sending unit. Place the black (–) probe on the ground connection of the sending unit **(Figure 11c-39, Page 11c-45)**.

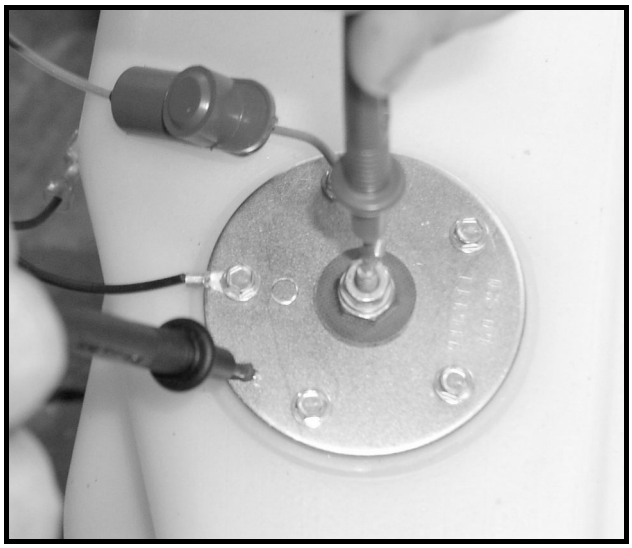


Figure 11c-39 Fuel Level Sending Unit Test

5. The following resistance readings (in ohms) should be indicated, depending on the position of the float inside the fuel tank. The resistance reading will vary according to the exact position of the float. The following table may be used as a guideline to determine if the fuel level sending unit is operating correctly. Make sure the float is at the surface of the fuel in the tank.

FLOAT POSITION	RESISTANCE READING	FUEL GAUGE READINGS
Lower position (tank empty)	240 ± 20 ohms	Empty
Center position (tank half full)	120 ± 20 ohms	Half full
Upper position (tank full)	60 ± 20 ohms	Full

6. If the readings are within the specifications listed in the preceding chart, the fuel level sending unit is working properly. If the readings are incorrect, the fuel level sending unit has failed and the fuel tank must be replaced. **See Fuel Tank Removal, Section 13c, Page 13c-16.**
7. If the readings are correct and the fuel gauge does not function correctly, leave the battery disconnected and check the continuity of the following:
   - Orange wire (w104 and w20) from the fuel level sending unit to the fuel gauge/hour meter.
   - Blue wire (w25) and purple wire (w37) from the fuel gauge/hour meter to the key switch.
   - Black ground wires at the fuel level sending unit (w106) and at the fuel gauge/hour meter (w22). **See Fuel Gauge/Hour Meter Removal, Section 12c, Page 12c-6.**
8. If the readings are correct according to the position of the float, but the reading on the fuel gauge/hour meter is incorrect, test the fuel gauge/hour meter. **See Test Procedure 30 – Fuel Gauge on page 11c-46.**

TEST PROCEDURE 30 – FUEL GAUGE

See General Warning, Section 1, Page 1-1.

Two fuel gauges were used for model year 2007 **(Figure 11c-40, Page 11c-46 and Figure 11c-41, Page 11c-46)**. The terminal configuration on the back of the gauge easily denotes the type. Follow the appropriate procedure. The early 2007 gauge has the orange wire connected to terminal 1 whereas late 2007 has it connected to terminal 4 in the center of the gauge. In addition, the early 2007 gauge has one terminal (3) to ground it whereas the late 2007 has two ground terminals (1 and 6) with a black jumper wire connecting them. **See following NOTE.**

NOTE: *Keep the battery connected during this test procedure.*

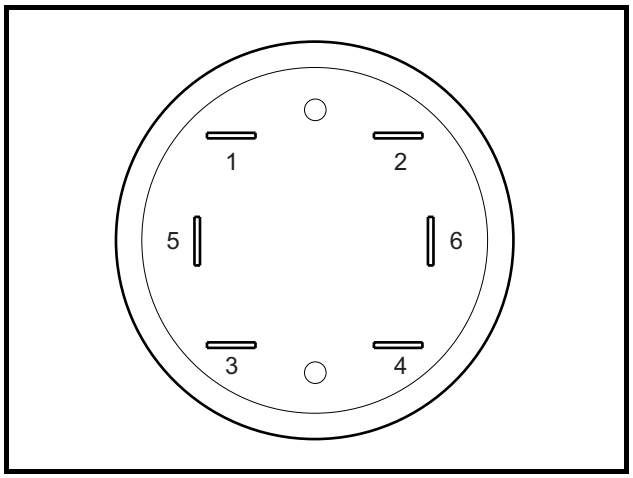


Figure 11c-40 Fuel Gauge/Hour Meter – Early 2007

1. Orange 2. Blue 3. Black 4. White 5. Not used 6. Not used

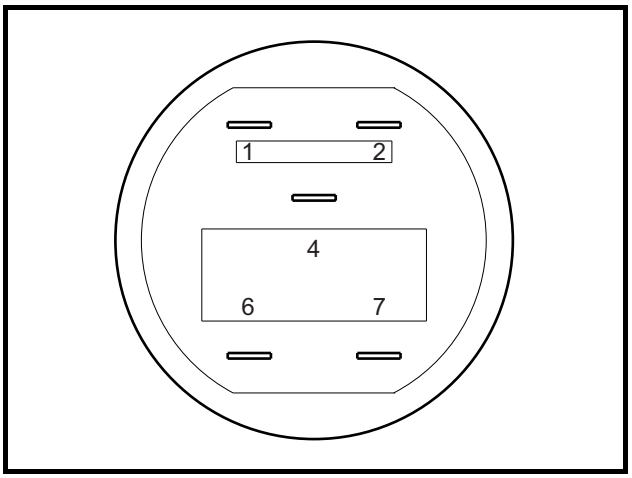


Figure 11c-41 Fuel Gauge/Hour Meter – Late 2007

1. Black(Jumper Wire From 6 2. Blue 4. Orange 6. Black 7. White

Test Procedure 30A – Fuel Gauge (Early 2007)

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Raise the hood.
3. Disconnect the orange wire (w104) from the fuel gauge/hour meter.

4. Set a multimeter to 20 volts DC and place the red (+) probe on the positive (+) post of the battery. Place the black (–) probe on the negative (–) post of the battery. Record the voltage reading.

5. Set a multimeter to 20 volts DC and place the red (+) probe on the (2) terminal of the fuel gauge/hour meter where the blue wire (w25) is connected. Place the black (–) probe on the (3) terminal of the fuel gauge/hour meter with the black wire (w22) **(Figure 11c-42, Page 11c-47)**.

6. Turn the key switch ON. The voltage reading should be the same as the battery voltage reading recorded earlier. If not, check the continuity of the blue and black wires **(Figure 11c-42, Page 11c-47)**.

7. The orange wire should remain disconnected for this step. Place the black probe of the multimeter on the (3) terminal of the fuel gauge/hour meter and place the red (+) probe on the (1) terminal of the fuel gauge/hour meter **(Figure 11c-43, Page 11c-47)**. The voltage reading should be approximately 1.81 volts. If the reading is incorrect, replace the fuel gauge/hour meter.

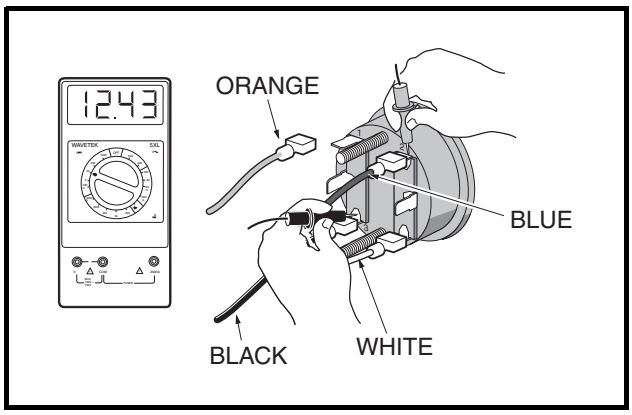


Figure 11c-42 Fuel Gauge Voltage Test - Terminal 2

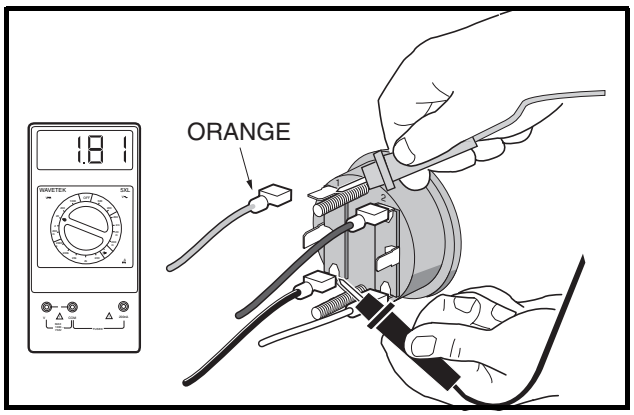


Figure 11c-43 Fuel Gauge Voltage Test - Terminal 1

Test Procedure 30B – Fuel Gauge (Late 2007)

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.

2. Raise the hood.

3. Disconnect the orange wire (w104) from the fuel gauge/hour meter.

4. Set a multimeter to 20 volts DC and place the red (+) probe on the positive (+) post of the battery. Place the black (–) probe on the negative (–) post of the battery. Record the voltage reading.

5. Set a multimeter to 20 volts DC and place the red (+) probe on the (2) terminal of the fuel gauge/hour meter where the blue wire (w25) is connected. Place the black (–) probe on the (1) terminal of the fuel gauge/hour meter with the black wire (w22) **(Figure 11c-44, Page 11c-48)**.

6. Turn the key switch ON. The voltage reading should be the same as the battery voltage reading recorded earlier. If not, check the continuity of the blue and black wires **(Figure 11c-44, Page 11c-48)**.

7. The orange wire should remain disconnected for this step. Place the black probe of the multimeter on the (1) terminal of the fuel gauge/hour meter and place the red (+) probe on the (4) terminal of the fuel gauge/hour meter **(Figure 11c-45, Page 11c-48)**. The voltage reading should be approximately 4.94 volts. If the reading is incorrect, replace the fuel gauge/hour meter.

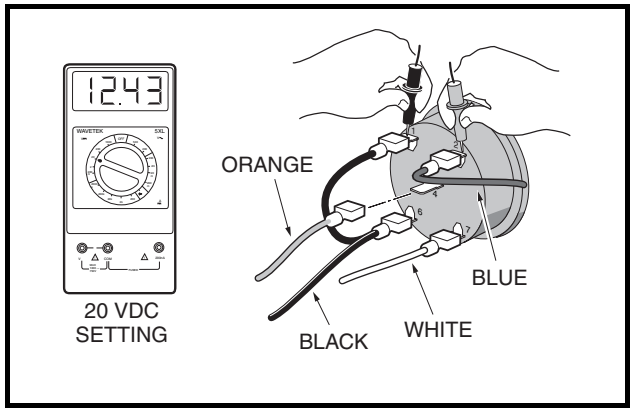


Figure 11c-44 Fuel Gauge Voltage Test - Terminal 2

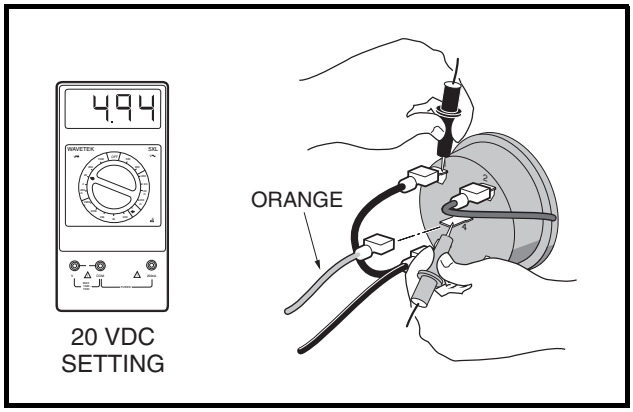


Figure 11c-45 Fuel Gauge Voltage Test - Terminal 4

TEST PROCEDURE 31 – HOUR METER

See General Warning, Section 1, Page 1-1.

Two hour meters were used for model year 2007 **(Figure 11c-40, Page 11c-46 and Figure 11c-41, Page 11c-46)**. The display and the terminal configuration on the back of the meter easily denotes the type. Follow the appropriate procedure. The display on the early 2007 meter only appears when the key switch is ON whereas the display on the late 2007 meter is always on. The early 2007 meter has the orange wire connected to terminal 1 whereas late 2007 has it connected to terminal 4 in the center of the meter. In addition, the early 2007 meter has one terminal (3) to ground it whereas the late 2007 has two ground terminals (1 and 6) with a black jumper wire connecting them. **See following NOTE.**

NOTE: *Keep the battery connected during this test procedure.*

Test Procedure 31A – Hour Meter (Early 2007)

1. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Turn the key switch ON to verify the display appears.
3. Start the engine and let it idle. **See following DANGER.**

⚠ DANGER

- **Do not operate vehicle in an enclosed area without proper ventilation. The engine produces carbon monoxide, which is an odorless, deadly poison.**

4. With engine idling, the "hour glass" icon should flash slowly. If not, check the low oil warning light and the oil pressure switch. **See following NOTE. See also Test Procedure 27 – Low Oil Warning Light Circuit on page 11c-44.**

NOTE: *The hour meter is designed to record actual engine running time and will not start adding increments until the engine is running and the oil pressure switch has opened.*

5. If the hour meter still does not function after the low oil warning light, oil pressure switch, and all of the appropriate wires have been checked for continuity, replace the fuel gauge/hour meter.

Test Procedure 31B – Hour Meter (Late 2007)

1. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.

2. With the key switch OFF, check the hour meter display. It is powered by an internal battery and should always be on, even with the engine off and the key removed.

3. Start the engine and let it idle. **See following DANGER.**

⚠ DANGER

- **Do not operate vehicle in an enclosed area without proper ventilation. The engine produces carbon monoxide, which is an odorless, deadly poison.**

4. With engine idling, the "hour glass" icon should flash. If not, check the low oil warning light and the oil pressure switch. **See following NOTE. See also Test Procedure 27 – Low Oil Warning Light Circuit on page 11c-44.**

NOTE: *The hour meter is designed to record actual engine running time and will not start adding increments until the engine is running and the oil pressure switch has opened.*

5. If the hour meter still does not function after the low oil warning light, oil pressure switch, and all of the appropriate wires have been checked for continuity, replace the fuel gauge/hour meter.

TEST PROCEDURE 32 – LIGHT SWITCH

See General Warning, Section 1, Page 1-1.

NOTE: *The headlight circuit is protected by the 20-amp fuse. Check the fuse before this procedure is performed.* ***See Test Procedure 2 – Fuse on page 11c-16.***

Keep the battery connected during this test procedure.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.

2. Raise the hood.

3. Press the upper and lower retaining tabs and push the light switch out of the instrument panel.

4. Use a multimeter set to 20 volts DC and place alligator clips on the multimeter probes. Connect the red (+) probe to the light switch terminal where the blue wire (w03) is connected **(Figure 11c-46, Page 11c-50)**.

5. Connect the black (–) probe of the multimeter to the negative (–) post of the battery.

6. With the light switch in the OFF position, the reading should indicate 0 volts. With the light in the ON position, the reading should indicate between 11 and 12.5 volts. If the there is no voltage reading, check the continuity of the 10-gauge red wire (w126) from the fuse block to the starter solenoid. Check the continuity of the 14-gauge yellow wire (w07) and the 14-gauge blue wires (w08 and w113) from the light switch to the fuse block. Check the fuse. **See Test Procedure 2 – Fuse on page 11c-16.** If the wires and fuse show continuity and the readings are still incorrect, replace the switch. **See Light Switch Removal, Section 12c, Page 12c-9.**

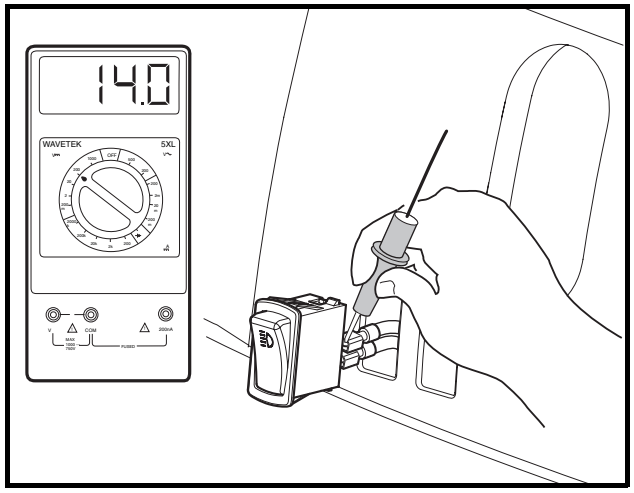


Figure 11c-46 Light Switch Test

TEST PROCEDURE 33 – VOLTAGE AT HEADLIGHT SOCKET

See General Warning, Section 1, Page 1-1.

NOTE: *Keep the battery connected during this test procedure.*

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Inspect the wires at the light bulb socket. Make sure the wires are securely fastened to the contacts inside the socket.
3. Remove the wire harness from the headlight bulb **(Figure 11c-47, Page 11c-51)**.
4. Use a multimeter set to 20 volts DC and place the black (–) probe into the black wire terminal of the wire harness. Place the red (+) probe into the blue wire terminal.
5. Pull the light switch to the ON position. If the multimeter indicates approximately 12 volts, replace the headlight bulb.
6. If there is no voltage reading at the wire harness, check the continuity of the 16-gauge blue wire (w01 and w03) from the headlight to the light switch.
   6.1. Set the multimeter to 20 VDC.
   6.2. Use an alligator clip to attach the black (–) probe onto the negative (–) battery terminal and place the red (+) probe into the blue wire terminal of the wire harness. If the multimeter reading is approximately 12 volts, the blue wire has continuity.
7. Check the continuity of the 16-gauge black wire from the headlight to the ground terminal.
   7.1. Set the multimeter to 20 VDC.
   7.2. Place the black (–) probe of multimeter into the black wire (w13) terminal of the wire harness and use an alligator clip to attach the red (+) probe onto the positive (+) battery terminal. If the multimeter reading is approximately 12 volts, the black wire has continuity.
8. If the readings are correct in all of the previous steps, replace the headlight bulb.

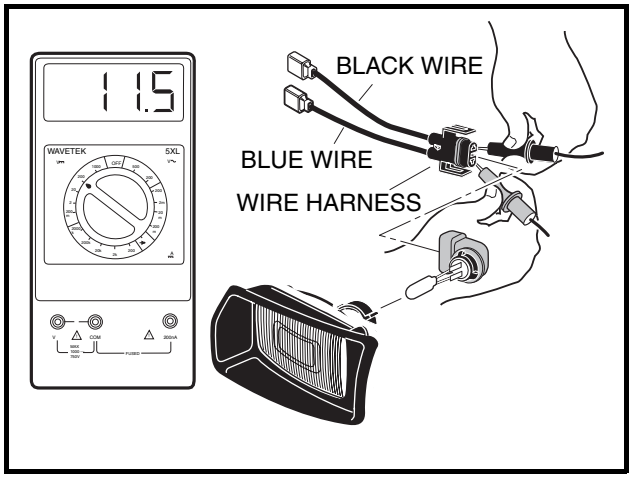


Figure 11c-47 Voltage At Headlight Socket

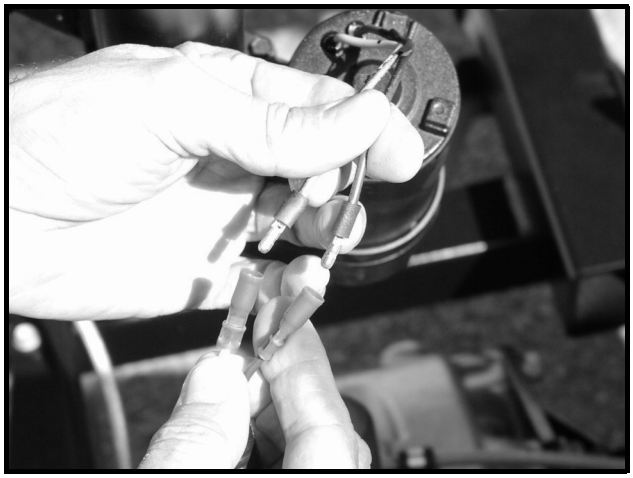


Figure 11c-48 Bed Lift Motor Wires

TEST PROCEDURE 34 – BED LIFT MOTOR

NOTE: *Keep the battery connected during this test procedure.*

Ensure that the battery is fully-charged before performing this test procedure.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the red and yellow wires from the bed lift motor **(Figure 11c-48, Page 11c-51)**.
3. Set a multimeter for 20 VDC.

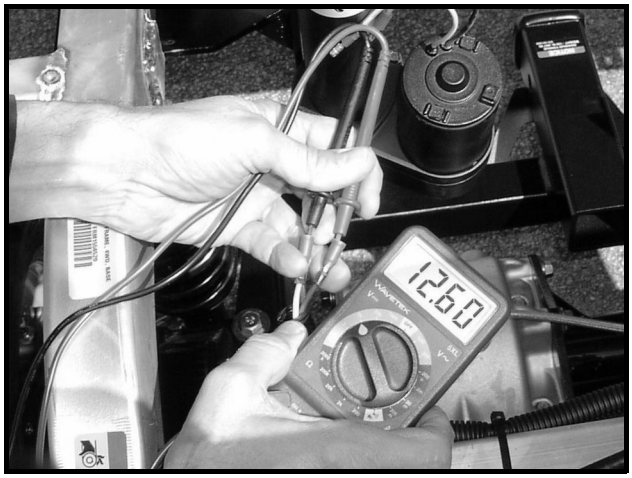


Figure 11c-49 Bed Lift Motor Voltage Reading with Switch in UP position

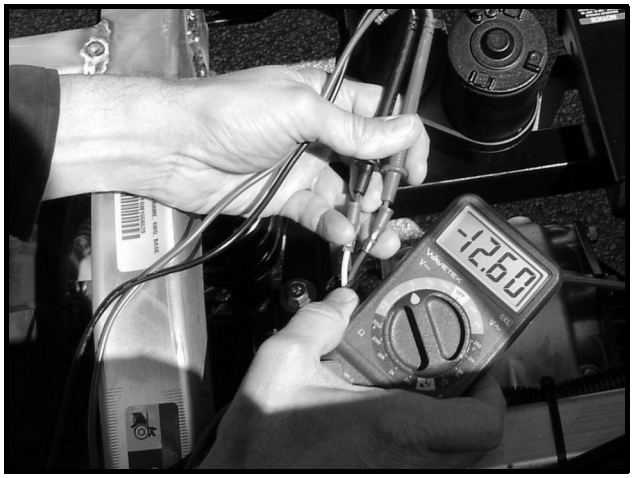


Figure 11c-50 Bed Lift Motor Voltage Reading with Switch in DOWN position

4. Place the red probe in the bullet connector on the red wire (wire harness side) and place the black probe in the bullet connector on the black wire (wire harness side) **(Figure 11c-49, Page 11c-51)**.
5. Have an assistant press the bed lift switch in the UP position and monitor the multimeter:

- A reading of approximately + (positive) 12 VDC indicates that the bed lift harness and switch are wired correctly. Proceed to step 6.

- A reading of approximately – (negative) 12 VDC indicates that the bed lift harness or switch are wired incorrectly. Check the wiring of the bed lift harness and bed lift switch. **See Wiring Diagram on page 11c-6.**
- A reading of approximately 0 VDC indicates a failed bed lift switch, failed bed lift circuit breaker, a poor connection in the bed lift wire harness, or a broken wire.

6. Place the red probe in the bullet connector on the red wire (wire harness side) and place the black probe in the bullet connector on the black wire (wire harness side) **(Figure 11c-50, Page 11c-51)**.
7. Have an assistant press the bed lift switch in the DOWN position and monitor the multimeter:

- A reading of approximately – (negative) 12 VDC indicates that the bed lift harness and switch are wired correctly. Proceed to step 8.
- A reading of approximately + (positive) 12 VDC indicates that the bed lift harness or switch are wired incorrectly. Check the wiring of the bed lift harness and bed lift switch. **See Wiring Diagram on page 11c-6.**
- A reading of approximately 0 VDC indicates a failed bed lift switch, failed bed lift circuit breaker, a poor connection in the bed lift wire harness, or a broken wire.

8. If the bed lift motor does not function and the readings obtained in the previous steps are correct, the bed lift motor has failed and must be replaced. **See Bed Lift Motor Removal, Section 4, Page 4-11.**

TEST PROCEDURE 35 – BED LIFT SWITCH

1. Remove the bed lift switch. **See Bed Lift Switch Removal, Section 12c, Page 12c-8.**
2. Check continuity between the terminals **(Figure 11c-51, Page 11c-52)** of the switch and compare the readings with the Bed Lift Switch Continuity Table. If continuity readings do not match the table, replace the switch. **See Bed Lift Switch Installation, Section 12c, Page 12c-8.**

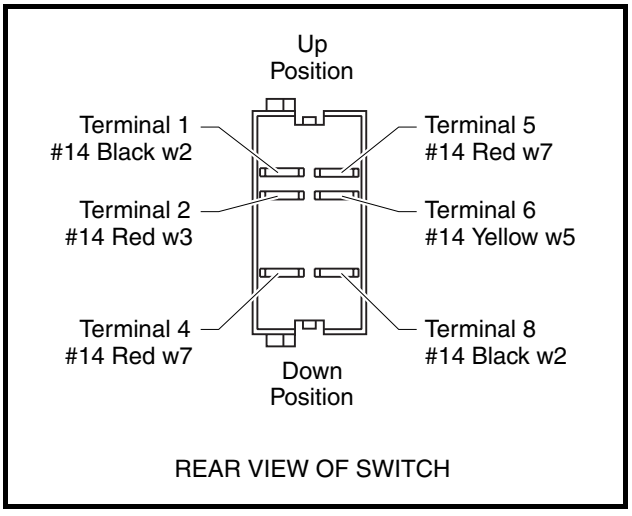


Figure 11c-51 Bed Lift Switch Terminals

BED LIFT SWITCH CONTINUITY						
Between Terminals	**1**	**2**	**4**	**5**	**6**	**8**
1		Cont. when pushed DOWN				
2	Cont. when pushed DOWN		Cont. when pushed UP			
4		Cont. when pushed UP				
5					Cont. when pushed DOWN	
6				Cont. when pushed DOWN		Cont. when pushed UP
8					Cont. when pushed UP	

TEST PROCEDURE 36 – BED LIFT CIRCUIT BREAKER

1. Remove the bed lift circuit breaker. **See Bed Lift Circuit Breaker Removal, Section 12c, Page 12c-9.**
2. Place the red probe of the multimeter on the circuit breaker terminals. If the multimeter does not indicate continuity, replace the circuit breaker. **See Bed Lift Circuit Breaker Installation, Section 12c, Page 12c-9.**

SECTION 12A – ELECTRICAL COMPONENTS: KAWASAKI POWERED GASOLINE VEHICLES

⚠ DANGER

- **See General Warning, Section 1, Page 1-1.**

⚠ WARNING

- **See General Warning, Section 1, Page 1-1.**

STARTER AND STARTER SOLENOID

See General Warning, Section 1, Page 1-1.

Refer to the engine manual for testing, removal, disassembly, and installation procedures. See the Kawasaki FH680D engine manual (CCI P/N 103351201).

RELAYS

See General Warning, Section 1, Page 1-1.

The start relay (1), carburetor heater relay (2), and accessory relay (optional, not shown) are housed on the electrical component mounting plate located under the driver-side seat near the battery **(Figure 12a-1, Page 12a-1)**.

Testing the Relay

See Test Procedure 6, Section 11a, Page 11a-15. See also Test Procedure 7 – Carburetor Heater Relay on page 11a-16.

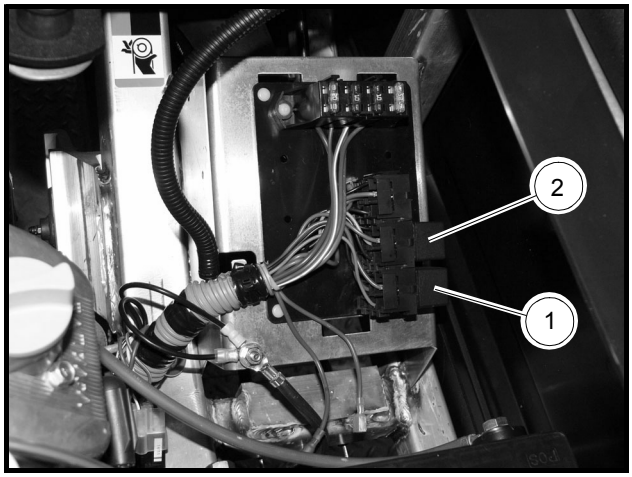


Figure 12a-1 Relays

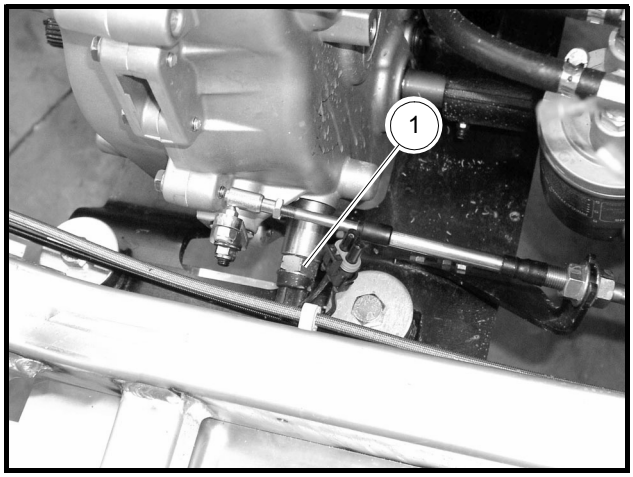


Figure 12a-2 Neutral Switch

Relay Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Remove the electrical component cover.
3. Remove the relay from the multi-pin connector.

Relay Installation

1. Insert the relay into the multi-pin connector. **See following NOTE.**

NOTE: *The relay contacts are keyed to ensure that the relay can only be installed in the correct orientation. If the relay is not easy to insert, rotate the relay until the correct contact orientation is obtained.*

2. Replace the electrical component cover.

NEUTRAL SWITCH

See General Warning, Section 1, Page 1-1.

The neutral switch (1) is located on the transmission housing **(Figure 12a-2, Page 12a-1)**.

Testing the Neutral Switch

See Test Procedure 9, Section 11a, Page 11a-22.

Neutral Switch Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the two-pin connector between the neutral switch and the wire harness.
3. Use a wrench to loosen and remove the neutral switch from the transmission housing.

Neutral Switch Installation

1. Install the neutral switch to the transmission housing. Tighten the hardware to 20.5 ft-lb (27.8 N·m).
2. Connect the two-pin connector between the neutral switch and the wire harness.
3. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

CARBURETOR SOLENOID

See General Warning, Section 1, Page 1-1.

The carburetor solenoid is located on the bottom of the carburetor.

Testing the Carburetor Solenoid

See Test Procedure 21, Section 11a, Page 11a-30.

Carburetor Solenoid Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.

2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally..." in General Warning, Section 1, Page 1-2.**
3. Remove the front cover from the engine.
4. Disconnect the two-pin connector from the carburetor solenoid **(Figure 12a-3, Page 12a-3)**.
5. Remove the solenoid from the carburetor. **See the Kawasaki FH680D engine manual (CCI P/N 103351201).**

Figure 12a-3 Carburetor Solenoid Connector

Carburetor Solenoid Installation

1. Install the carburetor solenoid and tighten to 168 in-lb (19 N·m). **See the Kawasaki FH680D engine manual (CCI P/N 103351201).**
2. Connect the two-pin connector to the carburetor solenoid **(Figure 12a-3, Page 12a-3)**.
3. Install the engine front cover.
4. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

CARBURETOR HEATER

See General Warning, Section 1, Page 1-1.

The carburetor heater is located on top of the carburetor.

Carburetor Heater Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally..." in General Warning, Section 1, Page 1-2.**
3. Remove the top cover from the engine.
4. Disconnect the green wire from the carburetor heater (1) **(Figure 12a-4, Page 12a-4)**.
5. Remove the heater from the carburetor.

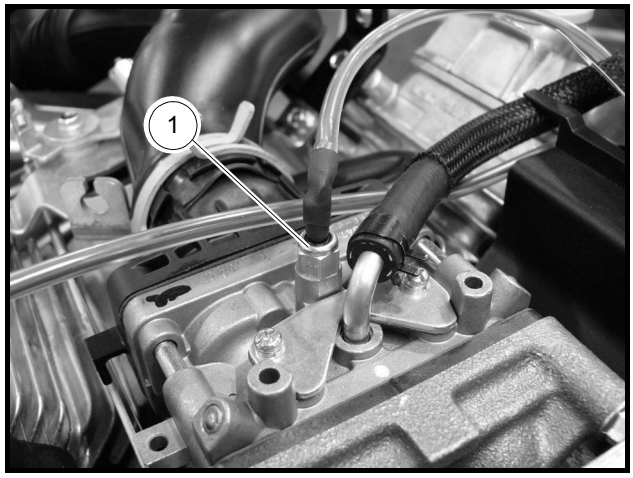


Figure 12a-4 Carburetor Heater

Carburetor Heater Installation

1. Install the carburetor heater and tighten to 65 in-lb (7 N·m).
2. Connect the green wire to the heater **(Figure 12a-4, Page 12a-4)**.
3. Install the engine top cover.
4. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

VOLTAGE REGULATOR

See General Warning, Section 1, Page 1-1.

Testing the Voltage Regulator

See Test Procedure 14, Section 11a, Page 11a-26.

Voltage Regulator Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally..." in General Warning, Section 1, Page 1-2.**
3. Disconnect the multi-pin connector and the yellow and green wires from the voltage regulator **(Figure 12a-5, Page 12a-5)**.
4. Remove the voltage regulator mounting screw and remove the voltage regulator.

Voltage Regulator Installation

1. Position the voltage regulator on the mounting plate and install the mounting screw. Tighten screw to 30 in-lb (3.4 N·m) **(Figure 12a-5, Page 12a-5)**.
2. Connect the multi-pin connector and the yellow and green wires to the voltage regulator.
3. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

4. With the Forward/Reverse handle in NEUTRAL, start the engine and check the regulator for proper functioning as described in the voltage regulator test procedure. **See Test Procedure 14, Section 11a, Page 11a-26.**

Figure 12a-5 Voltage Regulator

WARNING LIGHTS

See General Warning, Section 1, Page 1-1.

Testing the Warning Lights

See Test Procedure 22, Section 11a, Page 11a-31.

Warning Light Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Raise the hood.
4. Disconnect the wires from the warning light (1) **(Figure 12a-6, Page 12a-6)**.
5. Press the retaining tabs and remove the warning light from the instrument panel.

Warning Light Installation

1. Push a new warning light into the hole in the instrument panel until the plastic tabs are securely engaged **(Figure 12a-6, Page 12a-6)**.
2. Reconnect the wires from the wire harness to the warning light.
3. Lower and secure the hood.
4. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

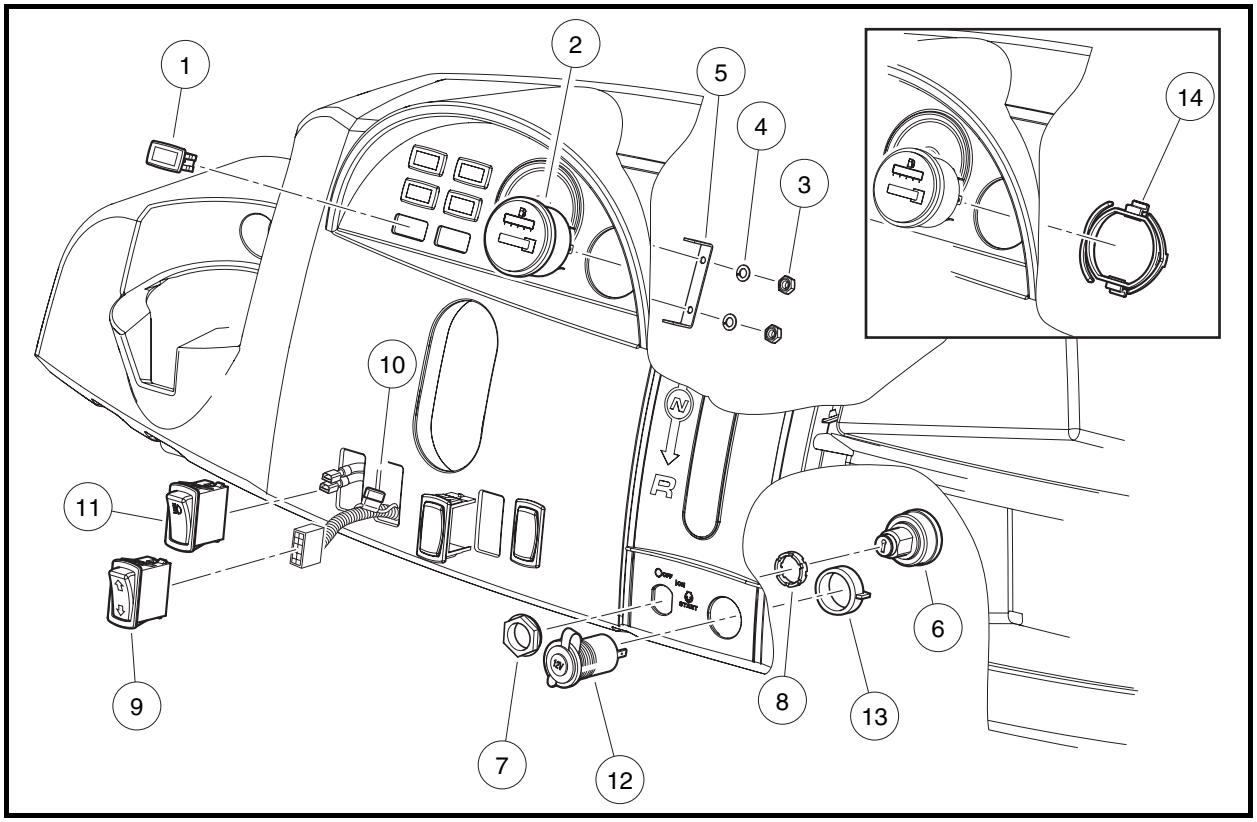


Figure 12a-6 Instrument Panel Electrical Components

FUEL GAUGE/HOUR METER

See General Warning, Section 1, Page 1-1.

Testing the Fuel Gauge/Hour Meter

See Test Procedure 25, Section 11a, Page 11a-34. Also see Test Procedure 26 – Hour Meter on page 11a-36.

Early 2007 vehicles: With the key switch in the OFF position, the fuel gauge/hour meter fields are blank. When the key switch is turned to ON, both fields activate. **Late 2007 vehicles:** With the key switch in the OFF position, the fuel gauge field is blank; however, the hour meter field is always ON. When the key switch is turned to ON, the fuel gauge field activates. **All 2007 vehicles:** The fuel gauge initially registers full before indicating the actual fuel level.

The hour meter displays the number of hours of use in increments of 0.1 (one tenth) hour, but does not record additional time unless the key switch is in the ON position and the engine is on. When recording, the hour-glass icon on the left blinks (slowly on Early 2007 vehicles).

Fuel Gauge/Hour Meter Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Raise the hood.

4. Disconnect the wires from the fuel gauge/hour meter (2) **(Figure 12a-6, Page 12a-6)**.
5. Remove the fuel gauge/hour meter.
   5.1. **Early 2007 vehicles:** Remove the two hex nuts (3) and lockwashers (4) from the threaded studs on the back of the gauge. Remove the mounting bracket (5) from the back side of the gauge/meter and remove it from the instrument panel.
   5.2. **Late 2007 vehicles:** Remove the mounting clip (14) that secures the gauge/meter. Alternate pulling the lower and upper tabs away from the gauge housing to remove clip. Pull gauge/meter from the instrument panel.

Fuel Gauge/Hour Meter Installation

1. Install a new fuel gauge/hour meter (2) into the hole in the instrument panel until the flange seats against the instrument panel **(Figure 12a-6, Page 12a-6)**.
2. Remove the fuel gauge/hour meter.
   2.1. **Early 2007 vehicles:** Slide the mounting bracket onto the two threaded studs on the fuel gauge/hour meter. Secure the fuel gauge/hour meter with two lockwashers and two hex nuts. Tighten to 2.5 in-lb (.28 N·m). Place one drop of Loctite on each hex nut. Do not allow Loctite to come into contact with the fuel gauge/hour meter casing.
   2.2. **Late 2007 vehicles:** Force the mounting clip (14) onto the back of the fuel gauge/hour meter until fully seated.
3. Connect the wires to the fuel gauge/hour meter. **See Wiring Diagram, Section 11a, Page 11a-6.**
4. Coat the terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
5. Lower and secure the hood.
6. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

KEY SWITCH

See General Warning, Section 1, Page 1-1.

Testing the Key Switch

See Test Procedure 4, Section 11a, Page 11a-13. Also see Test Procedure 18 – Key Switch (Engine Kill Circuit) on page 11a-28.

Key Switch Removal

1. Turn the key switch (6) OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Raise the hood.
4. From under the hood, remove the multi-pin connector from the key switch.
5. Reach under the instrument panel to hold the key switch and remove the key switch nut (7) **(Figure 12a-6, Page 12a-6)**. Pull the key switch, with spacer (8), from the back side of the instrument panel.

Key Switch Installation

1. Place spacer on key switch and reverse the removal procedure to install switch in the instrument panel. Tighten the key switch nut firmly.
2. From under the hood, connect the multi-pin connector to the key switch.
3. Lower and secure the hood.
4. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

12-VOLT ACCESSORY RECEPTACLE

See General Warning, Section 1, Page 1-1.

Testing the 12-Volt Accessory Receptacle

See Test Procedure 23, Section 11a, Page 11a-32.

12-Volt Accessory Receptacle Removal

1. Turn the key switch (6) OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Raise the hood.
4. From under the hood, disconnect the wires from the accessory receptacle (12) **(Figure 12a-6, Page 12a-6)**.
5. Reach under the instrument panel to remove the retainer (13) securing the accessory receptacle. **See following NOTE.**

NOTE: *The retainer works like a nut but can be removed quickly by turning only enough to align the two small patches of retainer threads with the two smooth sections in the receptacle threads. Once aligned, the retainer can slide off.*

6. Pull the accessory receptacle from the front side of the instrument panel.

12-Volt Accessory Receptacle Installation

1. Reverse the removal procedure to install receptacle in the instrument panel. Tighten the retainer firmly.
2. From under the hood, connect the the wires to the accessory receptacle.
3. Lower and secure the hood.
4. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

BED LIFT SWITCH

Testing the Bed Lift Switch

See Test Procedure 30, Section 11a, Page 11a-40.

Bed Lift Switch Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Raise the hood.
4. Press the upper and lower retaining tabs and push the bed lift switch (9) out of the instrument panel **(Figure 12a-6, Page 12a-6)**.
5. Disconnect the wire harness from the bed lift switch.

Bed Lift Switch Installation

1. Match the terminal numbers molded onto the connector and switch and reconnect the wire harness.
2. Push the bed lift switch into the instrument panel until fully seated.
3. Lower and secure the hood.
4. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

BED LIFT CIRCUIT BREAKER

Testing the Bed Lift Circuit Breaker

See Test Procedure 31, Section 11a, Page 11a-41.

Bed Lift Circuit Breaker Removal

1. Push the bed lift switch (9) out of the instrument panel. **See Bed Lift Switch Removal on page 12a-9.**
2. Locate the bed lift circuit breaker (10) on the orange wire of the wire harness connected to the switch **(Figure 12a-6, Page 12a-6)**.
3. Pull the circuit breaker out of the in-line fuse holder to remove.

Bed Lift Circuit Breaker Installation

Install the circuit breaker in the reverse order of removal.

LIGHT SWITCH

See General Warning, Section 1, Page 1-1.

Testing the Light Switch

See Test Procedure 27, Section 11a, Page 11a-37.

Light Switch Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Raise the hood.
4. Press the upper and lower retaining tabs and push the light switch (11) out of the instrument panel **(Figure 12a-6, Page 12a-6)**.
5. Disconnect the wire harness from the light switch.

Light Switch Installation

1. Match the terminal numbers molded onto the connector and switch and reconnect the wire harness.
2. Push the light switch into the instrument panel until fully seated.
3. Lower and secure the hood.
4. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

FUSE

See General Warning, Section 1, Page 1-1.

Testing the Fuse

See Test Procedure 2, Section 11a, Page 11a-12.

Fuse Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Remove the electrical component cover (located near the battery) and remove the fuse from the fuse block.

Fuse Installation

1. Install the fuse. **See following WARNING.**

⚠ WARNING

- **If a fuse is blown, determine the cause of the failure and make necessary repairs before installing a new fuse. Use the appropriately rated fuse; if a fuse with a higher amp rating is used, damage to the vehicle electrical system may occur.**

2. Install the electrical component cover.
3. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

REVERSE WARNING BUZZER (IF EQUIPPED)

See General Warning, Section 1, Page 1-1.

Testing the Reverse Warning Buzzer

See Test Procedure 20, Section 11a, Page 11a-30.

Reverse Warning Buzzer Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Raise the hood.
4. Remove the plastic rivets securing the reverse warning buzzer and remove the reverse warning buzzer **(Figure 12a-7, Page 12a-11)**.

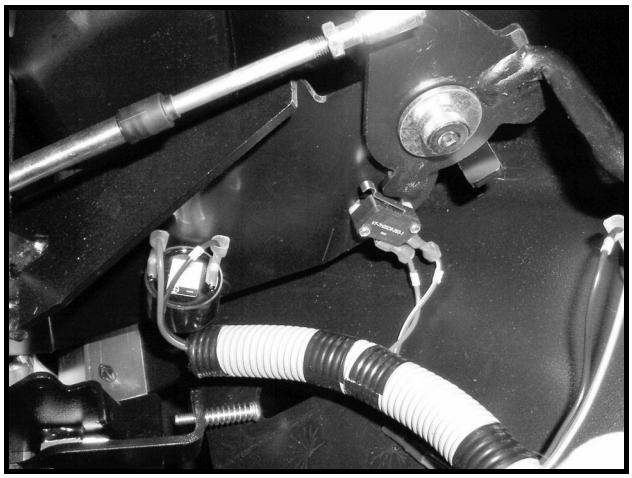


Figure 12a-7 Reverse Warning Buzzer and Limit Switch

Reverse Warning Buzzer Installation

1. Install the reverse warning buzzer and secure it with two plastic rivets.
2. Connect the black wire from the wire harness to the negative (–) terminal on the buzzer.
3. Connect the red/white wire from the wire harness to the positive (+) terminal on the buzzer.
4. Lower and secure the hood.
5. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

REVERSE WARNING BUZZER LIMIT SWITCH (IF EQUIPPED)

See General Warning, Section 1, Page 1-1.

Testing the Reverse Warning Buzzer Limit Switch

See Test Procedure 19, Section 11a, Page 11a-29.

Reverse Warning Buzzer Limit Switch Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Raise the hood.
4. Disconnect the wires from the reverse warning buzzer limit switch **(Figure 12a-7, Page 12a-11)**.
5. Remove the screws, nuts, washers, and lockwashers that secure the limit switch.
6. Remove the limit switch.

Figure 12a-8 Reverse Warning Buzzer Limit Switch Adjustment Slot

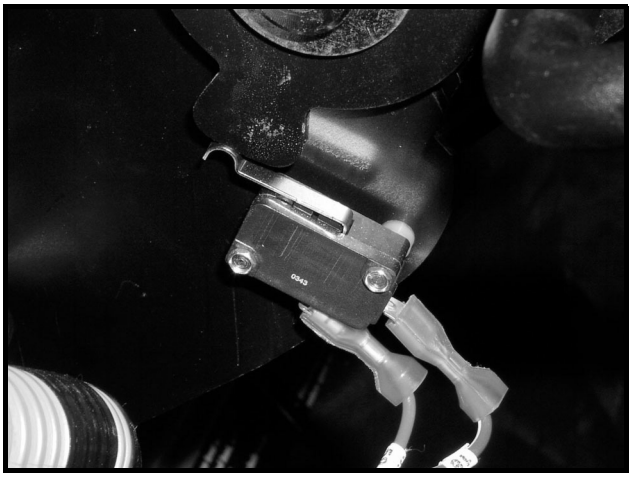


Figure 12a-9 Reverse Warning Buzzer Limit Switch (Properly Adjusted)

Reverse Warning Buzzer Limit Switch Installation

1. Install the reverse warning buzzer limit switch in the reverse order of removal.
2. Place the Forward/Reverse handle in the REVERSE position.
3. Tighten the limit switch mounting screws so that they are snug, but the limit switch can still be rotated in the adjustment slot **(Figure 12a-8, Page 12a-12)**.
4. Rotate the limit switch so that the lobe on the Forward/Reverse handle activates the limit switch as shown **(Figure 12a-9, Page 12a-12)**.
5. Hold the limit switch in position and tighten the mounting screws and nuts to 4 in-lb (0.5 N·m). **See following CAUTION.**

CAUTION

- **Do not overtighten the retaining nuts. If the nuts are overtightened, the limit switch could become damaged.**

6. Place the Forward/Reverse handle in NEUTRAL and then back to REVERSE to ensure that the limit switch lever is being properly activated.
7. Connect the 18-gauge red and 18-gauge red/white wires to the limit switch.
8. Lower and secure the hood.
9. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
10. Turn the key switch to the ON position. With the Forward/Reverse handle in REVERSE, the buzzer should sound.

FRONT DIFFERENTIAL LIMIT SWITCH

See General Warning, Section 1, Page 1-1.

Testing the Front Differential Limit Switch

See Test Procedure 11, Section 11a, Page 11a-24.

Front Differential Limit Switch Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Raise the hood.
4. Disconnect the black and red wire leads of the switch (1) from the gray wires of the wire harness **(Figure 12a-10, Page 12a-13)**.
5. Remove the nuts (2) and screws (3) that secure the switch (1) and remove the switch.

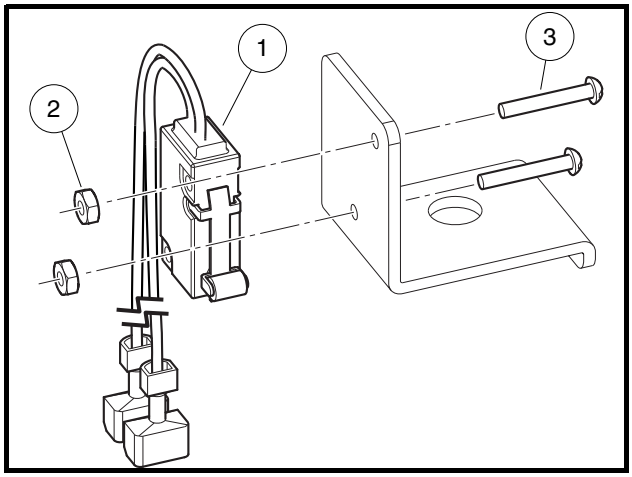


Figure 12a-10 Front Differential Limit Switch Removal

Front Differential Limit Switch Installation

1. Install the front differential limit switch (1) in the reverse order of removal and tighten the nuts (2) to 4 in-lb (0.5 N·m) **(Figure 12a-10, Page 12a-13)**. **See following CAUTION.**

CAUTION

- **Do not overtighten the retaining nuts. If the nuts are overtightened, the switch could become damaged.**

2. Move the accelerator pedal back and forth to ensure that the switch lever is being properly activated.
3. Connect the black and red wire leads of the switch to the gray wires of the wire harness.
4. Lower and secure the hood.
5. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

FUEL LEVEL SENDING UNIT

See General Warning, Section 1, Page 1-1.

Thoroughly test the fuel level sending unit before replacing the unit.

Testing the Fuel Level Sending Unit

See Test Procedure 24, Section 11a, Page 11a-32.

Fuel Level Sending Unit Removal

See Fuel Level Sending Unit Removal, Section 13a, Page 13a-11.

Fuel Level Sending Unit Installation

See Fuel Level Sending Unit Installation, Section 13a, Page 13a-12.

IGNITION COIL AND CHARGE COIL

See General Warning, Section 1, Page 1-1.

It is recommended that the ignition coil and charge coil be thoroughly tested prior to replacement.

Testing the Ignition Coil

See Test Procedure 15, Section 11a, Page 11a-26. See also Test Procedure 16 – Engine Kill Wire on page 11a-27, Test Procedure 17 – Grounded Kill Wire on page 11a-28. For charge coil testing, see Test Procedure 13 – Charge Coil on page 11a-25.

Ignition Coil and/or Charge Coil Removal

The ignition coils are located under the flywheel shroud of the engine and the charge coil is located behind the flywheel. Replacement requires the removal and installation of the engine. It is recommended to thoroughly test the coils prior to replacement. **See Engine Removal on page 13a-1.**

Refer to the engine manual for additional testing, removal, disassembly, and installation procedures. See the Kawasaki FH680D engine manual (CCI P/N 103351201).

OIL PRESSURE SENSOR

See General Warning, Section 1, Page 1-1.

Refer to the engine manual for additional testing, removal, disassembly, and installation procedures. See the Kawasaki FH680D engine manual (CCI P/N 103351201).

HEADLIGHTS

See General Warning, Section 1, Page 1-1.

Testing the Headlight Bulb and Socket

See Test Procedure 28, Section 11a, Page 11a-38. See also Test Procedure 27 – Light Switch on page 11a-37.

Headlight Bulb Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. From the front of the vehicle, reach under the cowl and turn the connector harness/halogen bulb assembly clockwise one-quarter turn **(Figure 12a-11, Page 12a-15)**.
4. Remove the connector harness/halogen bulb assembly from the headlight lens.
5. Lift the retaining tabs on the connector and remove the halogen bulb.

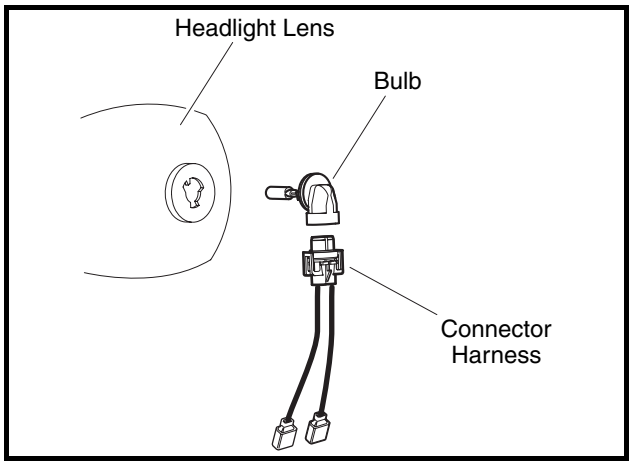


Figure 12a-11 Headlight Bulb

Headlight Bulb Installation

NOTE: *When handling halogen bulbs, do not touch the glass portion of bulb. Oil from finger tips can cause premature failure of the bulb.*

1. Attach the connector harness to the halogen bulb. The retaining tab should lock onto the halogen bulb **(Figure 12a-11, Page 12a-15)**.

2. From the front of vehicle, reach under the cowl and insert the bulb assembly into the headlight lens.
3. Turn the bulb assembly counterclockwise one-quarter turn.
4. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

WIRE HARNESS DIODES

See General Warning, Section 1, Page 1-1.

The wire harness is equipped with several in-line diodes.

Testing the Wire Harness Diodes

See Test Procedure 8, Section 11a, Page 11a-18.

Wire Harness Diode Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Locate the diode to be replaced by removing the wire conduit and tracing the wire.
4. Note the polarity of the diode, as indicated by the silver stripe on one end of the diode, and mark the wire on the side of the silver stripe.
5. Cut the wires attached to each side of the diode and discard the diode.

Wire Harness Diode Installation

1. Slide a piece of heatshrink tubing over one of the wire ends where the diode will be attached.
2. Install the new diode using in-line wire splicing connectors. Make sure to observe polarity and place the end of the diode with the silver stripe on the wire that was marked when the diode was removed.
3. Slide the heatshrink tubing over the diode and ensure that it will, after being activated, adequately cover the uninsulated diode leads.
4. Activate the heatshrink by carefully applying heat to the tubing.
5. Bundle the wires into the plastic wire conduit and replace any wire ties that were removed when the wires were traced.
6. Restore the wire harness routing to the original routing and secure the harness with wire ties as required.
7. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

BATTERY

See General Warning, Section 1, Page 1-1.

⚠ DANGER

- **Due to the danger of an exploding battery, wear a full face shield and rubber gloves when working around a battery.**
- **Battery – Explosive gases! Do not smoke. Keep sparks and flames away from the vehicle and service area. Ventilate when charging or using in an enclosed space. Wear a full face shield and rubber gloves when working on or near batteries. For added protection, cover top of the battery when servicing the vehicle.**
- **Battery – Poison! Contains acid! Causes severe burns! Avoid contact with skin, eyes, or clothing.**
  - **External: Flush with water. Call a physician immediately.**
  - **Internal: Drink large quantities of milk or water. Follow with milk of magnesia or vegetable oil. Call a physician immediately.**
  - **Eyes: Flush with water for 15 minutes. Call a physician immediately.**

GENERAL INFORMATION

See preceding DANGER statement.

Gasoline vehicles are equipped with 12-volt, low-maintenance batteries. When changing a 12-volt battery in any gasoline-powered vehicle, the same size battery with adequate amperage ratings should be used as a replacement.

The manufacturer recommends a group 70, side-post battery (CCI P/N 1012328), with a 650 cranking amp rating at 32 °F (0 °C), 500 CCA at 0 °F (-17.8 °C) and a reserve capacity of at least 105 minutes. The group 70 classification indicates battery size: 8-1/4 inches W x 6-1/2 inches D x 7-1/4 inches H (21.0 cm W x 16.5cm D x 18.4 cm H). It is important to use the proper size to ensure that the battery clamp will fit correctly.

Testing the Battery

See Test Procedure 1, Section 11a, Page 11a-9.

Preventive Maintenance

1. To keep the battery in good operating condition, remove corrosion immediately. Post connections should be clean and tight. Frayed or worn wires should be replaced. After all cables have been connected and properly tightened to 144 in-lb (16 N·m), coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305) to prevent future corrosion.
2. The battery should be kept clean and dry to prevent self-discharge. Dirt, grime, and acid spillage should be removed. Wash the battery with a bristle brush and a solution of water and bicarbonate of soda (1 cup (237 ml) baking soda – per 1 gallon (3.8 l) of water). Rinse with water. Do not allow any solution to enter the battery through the vent cap holes. **See Self-Discharge on page 12a-18.**
3. Maintain the proper water level. **See Water Level on page 12a-18.**
4. Check the battery periodically to ensure that it is in a full state of charge. **See Charging the Battery on page 12a-19.**
5. Keep the battery hold-down clamp tight. **See Vibration Damage on page 12a-18.**

Self-Discharge

Dirt and battery acid can provide a path for a small current draw that slowly discharges the battery. To prevent self-discharge, the battery should always be kept clean.

Hot weather also has an effect on a battery's self-discharge rate. The higher the temperature, the quicker a battery will discharge. Therefore, the battery should be checked more often in hotter climates. When storing the battery, keep it in a cool place. **See Battery Storage on page 12a-19.**

Water Level

The water level should be checked semi-annually to ensure the proper level is maintained. Never allow the water level to fall below the tops of the plates because this will cause the exposed part of the plate to become permanently inactive. Check the water level more frequently in hot weather and when the battery becomes old. **See Figure 11a-4, Section 11a, Page 11a-10.**

Vibration Damage

The battery hold-down clamp should always be tight enough to keep the battery from bouncing. Battery life may be severely shortened if the clamp is too loose. Excessive vibration shortens the life of the battery. It may also cause acid to leak from the vent caps and corrosion to build up on surrounding metal parts. The acid that is lost reduces the capacity of the battery and cannot be replaced.

Mineral Content

For the longest battery life, distilled water should be used in the battery. However, if tap water is going to be used, contact your local water department to be sure mineral contents are below the levels listed in the following table. **See following NOTE.**

NOTE: *Contact your local water department for mineral content analysis.*

IMPURITY	ALLOWABLE CONTENT (PARTS PER MILLION)
Suspended matter	Trace
Total solids	100.0
Calcium and magnesium oxides	40.0
Iron	5.0
Ammonia	8.0
Organic matter	50.0
Nitrates	10.0
Nitrites	5.0
Chloride	5.0

Battery Removal

See General Warning, Section 1, Page 1-1 and DANGER on page 12a-17.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Remove the driver-side seat.
4. Remove the battery hold-down located on the bottom of the battery.

5. Remove the battery. **See following WARNING.**

⚠ WARNING

- **Keep the battery in an upright position to prevent electrolyte leakage. Tipping the battery beyond a 45° angle in any direction can allow a small amount of electrolyte to leak out of the vent hole. Do not exceed this 45° angle when lifting, carrying or installing battery. The battery acid could cause severe personal injury when accidentally coming in contact with the skin or eyes and could damage clothing.**

Charging the Battery

See General Warning, Section 1, Page 1-1 and DANGER on page 12a-17.

1. Charge the battery with an automotive type 12-volt battery charger. Follow all warnings and procedures supplied by the battery charger manufacturer.
2. Attach the charger, positive (+) cable to the positive (+) battery post and negative (–) cable to the negative (–) battery post.
3. The battery may be charged with a slow charge (3-10 amps) or a fast charge (20-30 amps). Charge until the specific gravity reaches 1.250. **See following WARNING.**

⚠ WARNING

- **If the battery case feels hot (approximately 125 °F (52 °C) or more), emits gases, or fluid boils from vents, stop charging immediately. Failure to stop charging battery when any of these conditions are present could result in an explosion, personal injury and/or damage to the battery.**
- **Do not disconnect the charger DC leads from the battery when the charger is on. The resulting arcing between the DC leads and battery post could cause an explosion.**
- **If the charger must be stopped, disconnect the AC supply cord from the wall outlet before disconnecting the DC leads from the battery. Allow the battery to cool to room temperature and resume charging battery at a lower amp rate.**

Battery Installation

See General Warning, Section 1, Page 1-1 and DANGER on page 12a-17.

1. Place the battery into the vehicle with the battery posts facing the rear of the vehicle.
2. Secure the battery to the vehicle with the clamp at the bottom of the battery. Tighten the clamp retaining bolt to 9 ft-lb (12.2 N·m).
3. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

Battery Storage

See General Warning, Section 1, Page 1-1 and DANGER on page 12a-17.

1. Keep the battery clean and free of corrosion. **See Preventive Maintenance on page 12a-17.**
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Fully charge the battery prior to storage.

4. Store in a cool, dry area. The colder the area in which the battery is stored, the less the battery will self-discharge. A battery stored at 0 °F (-17.8 °C) will discharge very little over a four-month period. A battery stored at 80 °F (27 °C) will have to be recharged every few weeks.
5. Check the state of charge periodically. A battery that is discharged and left in a cold environment can freeze and crack. If the specific gravity drops below 1.220, the battery should be recharged. **See following WARNING.**

⚠ WARNING

- **If the battery is frozen or the container is bulged, discard battery. A frozen battery can explode.**

6. The frequency of recharging required depends on the temperature of the storage area, but it is recommended that the battery be monitored monthly for state of charge. Also, if the storage area is unheated in a cold climate and recharging is required, it is recommended that the area be heated to at least 60 °F (16 °C) prior to charging. The battery will not charge effectively in cold temperatures for the same reasons that it does not discharge as rapidly in cold temperatures.

Charging a Dead Battery

See General Warning, Section 1, Page 1-1 and DANGER on page 12a-17.

The charge coil is not designed to charge a dead battery. If the vehicle battery has become discharged, it must be charged with a properly rated automotive type charger. **See following WARNING.**

⚠ WARNING

- **Do not jump-start a dead battery with another battery and jumper cables.**

SECTION 12B – ELECTRICAL COMPONENTS: HONDA POWERED GASOLINE VEHICLES

⚠ DANGER

- **See General Warning, Section 1, Page 1-1.**

⚠ WARNING

- **See General Warning, Section 1, Page 1-1.**

STARTER AND STARTER SOLENOID

See General Warning, Section 1, Page 1-1.

Refer to the engine manual for testing, removal, disassembly, and installation procedures. See the Honda GX620 engine manual (CCI P/N 102615401).

RELAYS

See General Warning, Section 1, Page 1-1.

The start relay (1), differential relay (2), and accessory relay (optional, not shown) are housed on the electrical component mounting plate located under the driver-side seat near the battery **(Figure 12b-1, Page 12b-1)**.

Testing the Relay

See Test Procedure 7, Section 11b, Page 11b-16. See also Test Procedure 8 – Differential Relay on page 11b-17.

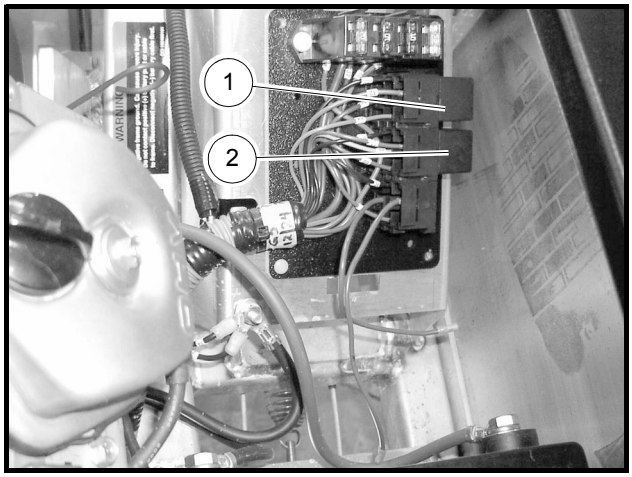


Figure 12b-1 Relays

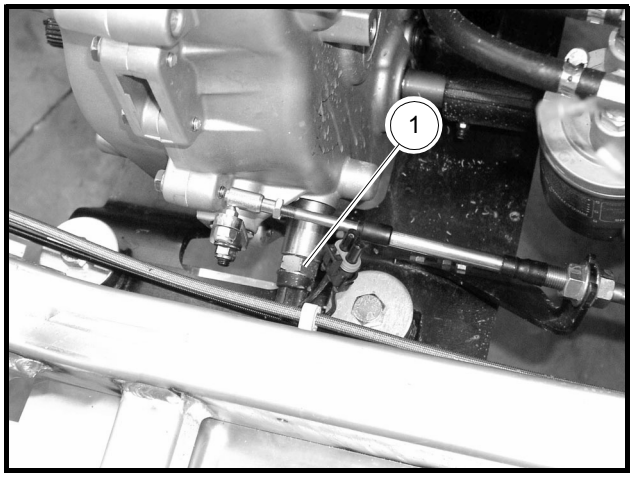


Figure 12b-2 Neutral Switch

Relay Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Remove the electrical component cover.
3. Remove the relay from the multi-pin connector.

Relay Installation

1. Insert the relay into the multi-pin connector. **See following NOTE.**

NOTE: *The relay contacts are keyed to ensure that the relay can only be installed in the correct orientation. If the relay is not easy to insert, rotate the relay until the correct contact orientation is obtained.*

2. Replace the electrical component cover.

NEUTRAL SWITCH

See General Warning, Section 1, Page 1-1.

The neutral switch (1) is located on the transmission housing **(Figure 12b-2, Page 12b-1)**.

Testing the Neutral Switch

See Test Procedure 10, Section 11b, Page 11b-24.

Neutral Switch Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the two-pin connector between the neutral switch and the wire harness.
3. Use a wrench to loosen and remove the neutral switch from the transmission housing.

Neutral Switch Installation

1. Install the neutral switch to the transmission housing. Tighten the hardware to 20.5 ft-lb (27.8 N·m).
2. Connect the two-pin connector between the neutral switch and the wire harness.
3. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

CARBURETOR SOLENOID

See General Warning, Section 1, Page 1-1.

The carburetor solenoid is located on the bottom of the carburetor.

Testing the Carburetor Solenoid

See Test Procedure 21, Section 11b, Page 11b-31.

Carburetor Solenoid Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.

2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally..." in General Warning, Section 1, Page 1-2.**
3. Remove the intake hose from the carburetor intake adapter and remove the carburetor.
4. Disconnect the 18-gauge yellow wire (w39) from the carburetor solenoid bullet connector **(Figure 12b-3, Page 12b-3)**.
5. Remove the solenoid from the carburetor. **See the Honda GX620 engine manual (CCI P/N 102615401).**

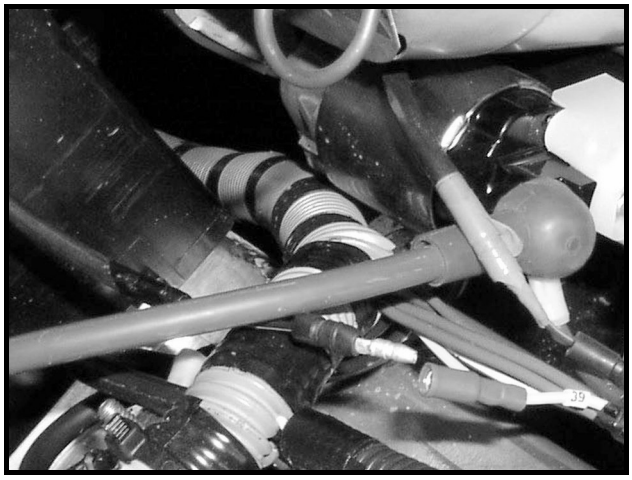


Figure 12b-3 Carburetor Coil Bullet Connector

Carburetor Solenoid Installation

1. Install the carburetor solenoid on the carburetor and install the carburetor. **See the Honda GX620 engine manual (CCI P/N 102615401).**
2. Install the intake hose on the carburetor intake adapter.
3. Connect the 18-gauge yellow wire (w39) from the carburetor solenoid to the wire harness **(Figure 12b-3, Page 12b-3)**.
4. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

VOLTAGE REGULATOR

See General Warning, Section 1, Page 1-1.

Testing the Voltage Regulator

See Test Procedure 14, Section 11b, Page 11b-27.

Voltage Regulator Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally..." in General Warning, Section 1, Page 1-2.**

3. Disconnect the multi-pin connector between the voltage regulator and the wire harness **(Figure 12b-4, Page 12b-4)**.
4. Remove the voltage regulator mounting screws and remove the voltage regulator.

Voltage Regulator Installation

1. Position the voltage regulator on the mounting plate and install the mounting screws. Tighten screws to 108 in-lb (12.2 N·m) **(Figure 12b-4, Page 12b-4)**.
2. Connect the multi-pin connector from the voltage regulator to the wire harness.
3. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
4. With the Forward/Reverse handle in NEUTRAL, start the engine and check the regulator for proper functioning as described in the voltage regulator test procedure. **See Test Procedure 14, Section 11b, Page 11b-27.**

Figure 12b-4 Voltage Regulator

WARNING LIGHTS

See General Warning, Section 1, Page 1-1.

Testing the Warning Lights

See Test Procedure 22, Section 11b, Page 11b-32.

Warning Light Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Raise the hood.
4. Disconnect the wires from the warning light (1) **(Figure 12b-5, Page 12b-5)**.
5. Press the retaining tabs and remove the warning light from the instrument panel.

Warning Light Installation

1. Push a new warning light into the hole in the instrument panel until the plastic tabs are securely engaged **(Figure 12b-5, Page 12b-5)**.
2. Reconnect the wires from the wire harness to the warning light.
3. Lower and secure the hood.
4. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

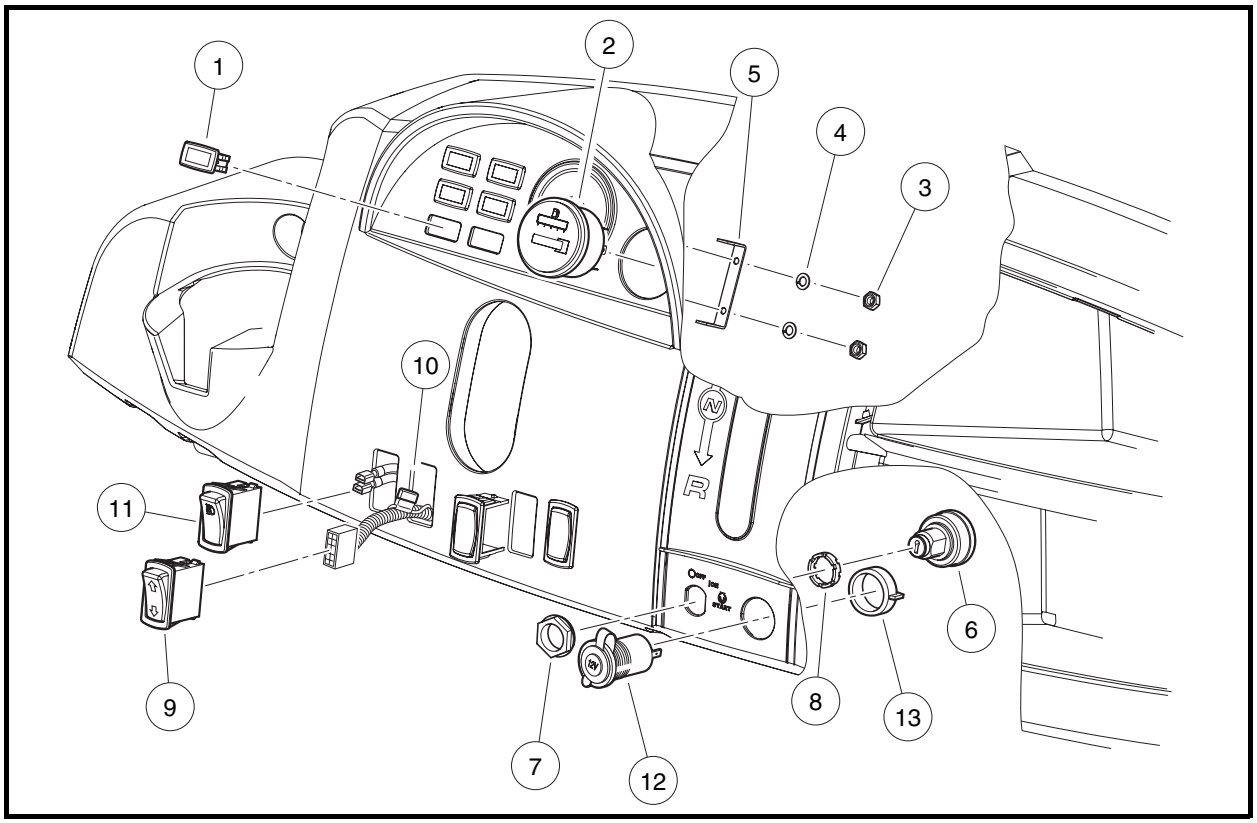


Figure 12b-5 Instrument Panel Electrical Components

FUEL GAUGE/HOUR METER

See General Warning, Section 1, Page 1-1.

Testing the Fuel Gauge/Hour Meter

See Test Procedure 25, Section 11b, Page 11b-34. Also see Test Procedure 26 – Hour Meter on page 11b-35.

With the key switch in the OFF position, the fuel gauge/hour meter fields are blank. When the key switch is turned to ON, both fields activate. The fuel gauge initially registers full before indicating the actual fuel level.

The hour meter displays the number of hours of use in increments of 0.1 (one tenth) hour, but does not record additional time unless the key switch is in the ON position and the engine is on. When recording, the hour-glass icon on the left blinks slowly.

Fuel Gauge/Hour Meter Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Raise the hood.
4. Disconnect the wires from the fuel gauge/hour meter (2) **(Figure 12b-5, Page 12b-5)**.
5. Remove the two hex nuts (3) and lockwashers (4) from the threaded studs on the back of the gauge. Remove the mounting bracket (5) from the back side of the gauge/meter and remove it from the instrument panel.

Fuel Gauge/Hour Meter Installation

1. Install a new fuel gauge/hour meter into the hole in the instrument panel until the flange seats against the instrument panel **(Figure 12b-5, Page 12b-5)**.
2. Slide the mounting bracket onto the two threaded studs on the fuel gauge/hour meter. Secure the fuel gauge/hour meter with two lockwashers and two hex nuts. Tighten to 2.5 in-lb (.28 N·m). Place one drop of Loctite on each hex nut. Do not allow Loctite to come into contact with the fuel gauge/hour meter casing.
3. Connect the wires to the fuel gauge/hour meter. **See Wiring Diagram, Section 11b, Page 11b-6.**
4. Coat the terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
5. Lower and secure the hood.
6. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

KEY SWITCH

See General Warning, Section 1, Page 1-1.

Testing the Key Switch

See Test Procedure 4, Section 11b, Page 11b-13. Also see Test Procedure 5 – Key Switch (Accessory Terminal) on page 11b-14 and Test Procedure 18 – Key Switch (Engine Kill Circuit) on page 11b-29.

Key Switch Removal

1. Turn the key switch (6) OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Raise the hood.
4. From under the hood, remove the multi-pin connector from the key switch.
5. Reach under the instrument panel to hold the key switch and remove the key switch nut (7) **(Figure 12b-5, Page 12b-5)**. Pull the key switch, with spacer (8), from the back side of the instrument panel.

Key Switch Installation

1. Place spacer on key switch and reverse the removal procedure to install switch in the instrument panel. Tighten the key switch nut firmly.
2. From under the hood, connect the multi-pin connector to the key switch.
3. Lower and secure the hood.
4. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

12-VOLT ACCESSORY RECEPTACLE

See General Warning, Section 1, Page 1-1.

Testing the 12-Volt Accessory Receptacle

See Test Procedure 23, Section 11b, Page 11b-33.

12-Volt Accessory Receptacle Removal

1. Turn the key switch (6) OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Raise the hood.
4. From under the hood, disconnect the wires from the accessory receptacle (12) **(Figure 12b-5, Page 12b-5)**.
5. Reach under the instrument panel to remove the retainer (13) securing the accessory receptacle. **See following NOTE.**

NOTE: *The retainer works like a nut but can be removed quickly by turning only enough to align the two small patches of retainer threads with the two smooth sections in the receptacle threads. Once aligned, the retainer can slide off.*

6. Pull the accessory receptacle from the front side of the instrument panel.

12-Volt Accessory Receptacle Installation

1. Reverse the removal procedure to install receptacle in the instrument panel. Tighten the retainer firmly.
2. From under the hood, connect the the wires to the accessory receptacle.
3. Lower and secure the hood.
4. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

BED LIFT SWITCH

Testing the Bed Lift Switch

See Test Procedure 30, Section 11b, Page 11b-39.

Bed Lift Switch Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Raise the hood.
4. Press the upper and lower retaining tabs and push the bed lift switch (9) out of the instrument panel **(Figure 12b-5, Page 12b-5)**.
5. Disconnect the wire harness from the bed lift switch.

Bed Lift Switch Installation

1. Match the terminal numbers molded onto the connector and switch and reconnect the wire harness.
2. Push the bed lift switch into the instrument panel until fully seated.
3. Lower and secure the hood.
4. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

BED LIFT CIRCUIT BREAKER

Testing the Bed Lift Circuit Breaker

See Test Procedure 31, Section 11b, Page 11b-40.

Bed Lift Circuit Breaker Removal

1. Push the bed lift switch (9) out of the instrument panel. **See Bed Lift Switch Removal on page 12b-8.**
2. Locate the bed lift circuit breaker (10) on the orange wire of the wire harness connected to the switch **(Figure 12b-5, Page 12b-5)**.
3. Pull the circuit breaker out of the in-line fuse holder to remove.

Bed Lift Circuit Breaker Installation

Install the circuit breaker in the reverse order of removal.

LIGHT SWITCH

See General Warning, Section 1, Page 1-1.

Testing the Light Switch

See Test Procedure 27, Section 11b, Page 11b-36.

Light Switch Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Raise the hood.
4. Press the upper and lower retaining tabs and push the light switch (11) out of the instrument panel **(Figure 12b-5, Page 12b-5)**.
5. Disconnect the wire harness from the light switch.

Light Switch Installation

1. Match the terminal numbers molded onto the connector and switch and reconnect the wire harness.
2. Push the light switch into the instrument panel until fully seated.
3. Lower and secure the hood.
4. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

FUSE

See General Warning, Section 1, Page 1-1.

Testing the Fuse

See Test Procedure 2, Section 11b, Page 11b-12.

Fuse Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Remove the electrical component cover (located near the battery) and remove the fuse from the fuse block.

Fuse Installation

1. Install the fuse. **See following WARNING.**

⚠ WARNING

- **If a fuse is blown, determine the cause of the failure and make necessary repairs before installing a new fuse. Use the appropriately rated fuse; if a fuse with a higher amp rating is used, damage to the vehicle electrical system may occur.**

2. Install the electrical component cover.
3. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

REVERSE WARNING BUZZER

See General Warning, Section 1, Page 1-1.

Testing the Reverse Warning Buzzer

See Test Procedure 20, Section 11b, Page 11b-30.

Reverse Warning Buzzer Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Raise the hood.
4. Remove the plastic rivets securing the reverse warning buzzer and remove the reverse warning buzzer **(Figure 12b-6, Page 12b-10)**.

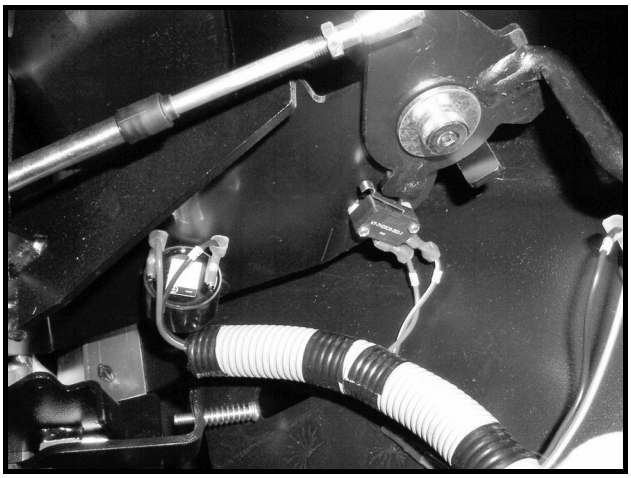


Figure 12b-6 Reverse Warning Buzzer and Limit Switch

Reverse Warning Buzzer Installation

1. Install the reverse warning buzzer and secure it with two plastic rivets.
2. Connect the black wire from the wire harness to the negative (–) terminal on the buzzer.
3. Connect the red/white wire from the wire harness to the positive (+) terminal on the buzzer.
4. Lower and secure the hood.
5. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

REVERSE WARNING BUZZER LIMIT SWITCH

See General Warning, Section 1, Page 1-1.

Testing the Reverse Warning Buzzer Limit Switch

See Test Procedure 19, Section 11b, Page 11b-30.

Reverse Warning Buzzer Limit Switch Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Raise the hood.
4. Disconnect the wires from the reverse warning buzzer limit switch **(Figure 12b-6, Page 12b-10)**.
5. Remove the screws, nuts, washers, and lockwashers that secure the limit switch.
6. Remove the limit switch.

Figure 12b-7 Reverse Warning Buzzer Limit Switch Adjustment Slot

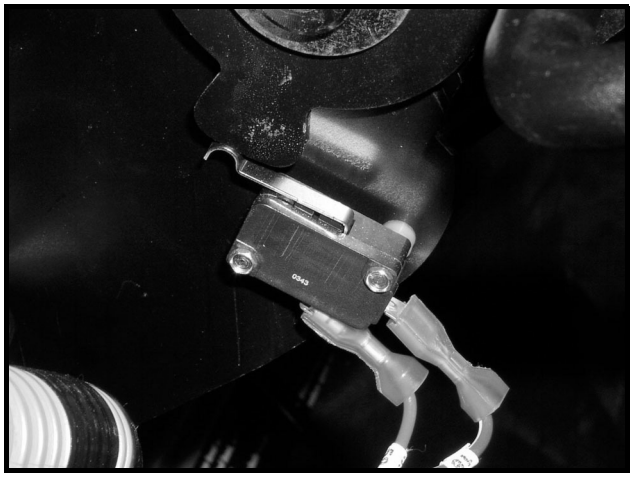


Figure 12b-8 Reverse Warning Buzzer Limit Switch (Properly Adjusted)

Reverse Warning Buzzer Limit Switch Installation

1. Install the reverse warning buzzer limit switch in the reverse order of removal.
2. Place the Forward/Reverse handle in the REVERSE position.
3. Tighten the limit switch mounting screws so that they are snug, but the limit switch can still be rotated in the adjustment slot **(Figure 12b-7, Page 12b-11)**.
4. Rotate the limit switch so that the lobe on the Forward/Reverse handle activates the limit switch as shown **(Figure 12b-8, Page 12b-11)**.
5. Hold the limit switch in position and tighten the mounting screws and nuts to 4 in-lb (0.5 N·m). **See following CAUTION.**

CAUTION

- **Do not overtighten the retaining nuts. If the nuts are overtightened, the limit switch could become damaged.**

6. Place the Forward/Reverse handle in NEUTRAL and then back to REVERSE to ensure that the limit switch lever is being properly activated.
7. Connect the 18-gauge red and 18-gauge red/white wires to the limit switch.
8. Lower and secure the hood.
9. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
10. Turn the key switch to the ON position. With the Forward/Reverse handle in REVERSE, the buzzer should sound.

FUEL LEVEL SENDING UNIT

See General Warning, Section 1, Page 1-1.

Thoroughly test the fuel level sending unit before replacing the unit.

Testing the Fuel Level Sending Unit

See Test Procedure 24, Section 11b, Page 11b-33.

Fuel Level Sending Unit Removal

See Fuel Level Sending Unit Removal, Section 13b, Page 13b-9.

Fuel Level Sending Unit Installation

See Fuel Level Sending Unit Installation, Section 13b, Page 13b-10.

IGNITION COIL AND CHARGE COIL

See General Warning, Section 1, Page 1-1.

It is recommended that the ignition coil and charge coil be thoroughly tested prior to replacement.

Testing the Ignition Coil

See Test Procedure 15, Section 11b, Page 11b-27. See also Test Procedure 16 – Engine Kill Wire on page 11b-28, Test Procedure 17 – Grounded Kill Wire on page 11b-28. For charge coil testing, see Test Procedure 13 – Charge Coil on page 11b-26.

Ignition Coil and/or Charge Coil Removal

The ignition coil is located under the flywheel shroud of the engine. Replacement requires the removal and installation of the engine. **See Engine Removal on page 13b-1.**

Refer to the engine manual for additional testing, removal, disassembly, and installation procedures. See the Honda GX620 engine manual (CCI P/N 102615401).

CHARGE COIL

See General Warning, Section 1, Page 1-1.

The charge coil is located under the flywheel shroud of the engine. To replace it requires the removal and installation of the engine. It is recommended that the ignition coil be thoroughly tested prior to replacement.

Refer to the engine manual for additional testing, removal, disassembly, and installation procedures. See the Honda GX620 engine manual (CCI P/N 102615401).

OIL PRESSURE SENSOR

See General Warning, Section 1, Page 1-1.

Refer to the engine manual for additional testing, removal, disassembly, and installation procedures. See the Honda GX620 engine manual (CCI P/N 102615401).

HEADLIGHTS

See General Warning, Section 1, Page 1-1.

Testing the Headlight Bulb and Socket

See Test Procedure 28, Section 11b, Page 11b-36. See also Test Procedure 27 – Light Switch on page 11b-36.

Headlight Bulb Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. From the front of the vehicle, reach under the cowl and turn the connector harness/halogen bulb assembly clockwise one-quarter turn **(Figure 12b-9, Page 12b-14)**.
4. Remove the connector harness/halogen bulb assembly from the headlight lens.
5. Lift the retaining tabs on the connector and remove the halogen bulb.

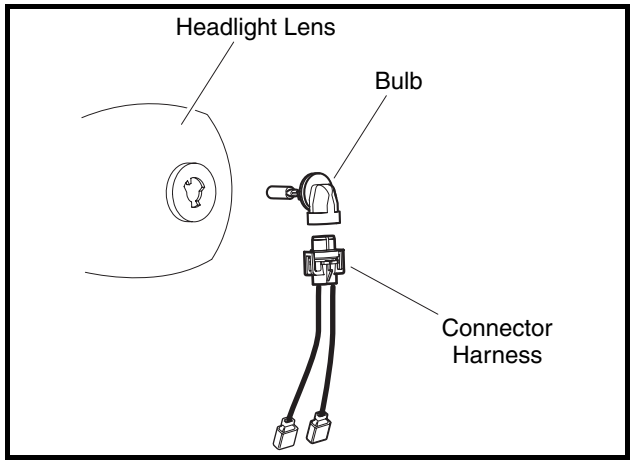


Figure 12b-9 Headlight Bulb

Headlight Bulb Installation

NOTE: *When handling halogen bulbs, do not touch the glass portion of bulb. Oil from finger tips can cause premature failure of the bulb.*

1. Attach the connector harness to the halogen bulb. The retaining tab should lock onto the halogen bulb **(Figure 12b-9, Page 12b-14)**.
2. From the front of vehicle, reach under the cowl and insert the bulb assembly into the headlight lens.
3. Turn the bulb assembly counterclockwise one-quarter turn.
4. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

WIRE HARNESS DIODES

See General Warning, Section 1, Page 1-1.

The wire harness is equipped with several in-line diodes.

Testing the Wire Harness Diodes

See Test Procedure 9, Section 11b, Page 11b-18.

Wire Harness Diode Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Locate the diode to be replaced by removing the wire conduit and tracing the wire.
4. Note the polarity of the diode, as indicated by the white stripe on one side of the diode, and mark the wire on the side of the white stripe.
5. Cut the wires attached to each side of the diode and discard the diode.

Wire Harness Diode Installation

1. Slide a piece of heatshrink tubing over one of the wire ends where the diode will be attached.
2. Install the new diode using in-line wire splicing connectors. Make sure to observe polarity and place the side of the diode with the white stripe on the wire that was marked when the diode was removed.
3. Slide the heatshrink tubing over the diode and ensure that it will, after being activated, adequately cover the uninsulated diode leads.
4. Activate the heatshrink by carefully applying heat to the tubing.
5. Bundle the wires into the plastic wire conduit and replace any wire ties that were removed when the wires were traced.
6. Restore the wire harness routing to the original routing and secure the harness with wire ties as required.
7. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

BATTERY

See General Warning, Section 1, Page 1-1.

⚠ DANGER

- **Due to the danger of an exploding battery, wear a full face shield and rubber gloves when working around a battery.**
- **Battery – Explosive gases! Do not smoke. Keep sparks and flames away from the vehicle and service area. Ventilate when charging or using in an enclosed space. Wear a full face shield and rubber gloves when working on or near batteries. For added protection, cover top of the battery when servicing the vehicle.**
- **Battery – Poison! Contains acid! Causes severe burns! Avoid contact with skin, eyes, or clothing.**
  - **External: Flush with water. Call a physician immediately.**
  - **Internal: Drink large quantities of milk or water. Follow with milk of magnesia or vegetable oil. Call a physician immediately.**
  - **Eyes: Flush with water for 15 minutes. Call a physician immediately.**

GENERAL INFORMATION

See preceding DANGER statement.

Gasoline vehicles are equipped with 12-volt, low-maintenance batteries. When changing a 12-volt battery in any gasoline-powered vehicle, the same size battery with adequate amperage ratings should be used as a replacement.

The manufacturer recommends a group 70, side-post battery (CCI P/N 1012328), with a 650 cranking amp rating at 32 °F (0 °C), 500 CCA at 0 °F (-17.8 °C) and a reserve capacity of at least 105 minutes. The group 70 classification indicates battery size: 8-1/4 inches W x 6-1/2 inches D x 7-1/4 inches H (21.0 cm W x 16.5cm D x 18.4 cm H). It is important to use the proper size to ensure that the battery clamp will fit correctly.

Testing the Battery

See Test Procedure 1, Section 11b, Page 11b-9.

Preventive Maintenance

1. To keep the battery in good operating condition, remove corrosion immediately. Post connections should be clean and tight. Frayed or worn wires should be replaced. After all cables have been connected and properly tightened to 144 in-lb (16 N·m), coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305) to prevent future corrosion.
2. The battery should be kept clean and dry to prevent self-discharge. Dirt, grime, and acid spillage should be removed. Wash the battery with a bristle brush and a solution of water and bicarbonate of soda (1 cup (237 ml) baking soda – per 1 gallon (3.8 l) of water). Rinse with water. Do not allow any solution to enter the battery through the vent cap holes. **See Self-Discharge on page 12b-16.**
3. Maintain the proper water level. **See Water Level on page 12b-16.**
4. Check the battery periodically to ensure that it is in a full state of charge. **See Charging the Battery on page 12b-17.**
5. Keep the battery hold-down clamp tight. **See Vibration Damage on page 12b-16.**

Self-Discharge

Dirt and battery acid can provide a path for a small current draw that slowly discharges the battery. To prevent self-discharge, the battery should always be kept clean.

Hot weather also has an effect on a battery's self-discharge rate. The higher the temperature, the quicker a battery will discharge. Therefore, the battery should be checked more often in hotter climates. When storing the battery, keep it in a cool place. **See Battery Storage on page 12b-18.**

Water Level

The water level should be checked semi-annually to ensure the proper level is maintained. Never allow the water level to fall below the tops of the plates because this will cause the exposed part of the plate to become permanently inactive. Check the water level more frequently in hot weather and when the battery becomes old. **See Figure 11b-4, Section 11b, Page 11b-10.**

Vibration Damage

The battery hold-down clamp should always be tight enough to keep the battery from bouncing. Battery life may be severely shortened if the clamp is too loose. Excessive vibration shortens the life of the battery. It may also cause acid to leak from the vent caps and corrosion to build up on surrounding metal parts. The acid that is lost reduces the capacity of the battery and cannot be replaced.

Mineral Content

For the longest battery life, distilled water should be used in the battery. However, if tap water is going to be used, contact your local water department to be sure mineral contents are below the levels listed in the following table. **See following NOTE.**

NOTE: *Contact your local water department for mineral content analysis.*

IMPURITY	ALLOWABLE CONTENT (PARTS PER MILLION)
Suspended matter	Trace
Total solids	100.0
Calcium and magnesium oxides	40.0
Iron	5.0
Ammonia	8.0

IMPURITY	ALLOWABLE CONTENT (PARTS PER MILLION)
Organic matter	50.0
Nitrates	10.0
Nitrites	5.0
Chloride	5.0

Battery Removal

See General Warning, Section 1, Page 1-1 and DANGER on page 12b-15.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Remove the driver-side seat.
4. Remove the battery hold-down located on the bottom of the battery.
5. Remove the battery. **See following WARNING.**

⚠ WARNING

- **Keep the battery in an upright position to prevent electrolyte leakage. Tipping the battery beyond a 45° angle in any direction can allow a small amount of electrolyte to leak out of the vent hole. Do not exceed this 45° angle when lifting, carrying or installing battery. The battery acid could cause severe personal injury when accidentally coming in contact with the skin or eyes and could damage clothing.**

Charging the Battery

See General Warning, Section 1, Page 1-1 and DANGER on page 12b-15.

1. Charge the battery with an automotive type 12-volt battery charger. Follow all warnings and procedures supplied by the battery charger manufacturer.
2. Attach the charger, positive (+) cable to the positive (+) battery post and negative (–) cable to the negative (–) battery post.
3. The battery may be charged with a slow charge (3-10 amps) or a fast charge (20-30 amps). Charge until the specific gravity reaches 1.250. **See following WARNING.**

⚠ WARNING

- **If the battery case feels hot (approximately 125 °F (52 °C) or more), emits gases, or fluid boils from vents, stop charging immediately. Failure to stop charging battery when any of these conditions are present could result in an explosion, personal injury and/or damage to the battery.**
- **Do not disconnect the charger DC leads from the battery when the charger is on. The resulting arcing between the DC leads and battery post could cause an explosion.**
- **If the charger must be stopped, disconnect the AC supply cord from the wall outlet before disconnecting the DC leads from the battery. Allow the battery to cool to room temperature and resume charging battery at a lower amp rate.**

Battery Installation

See General Warning, Section 1, Page 1-1 and DANGER on page 12b-15.

1. Place the battery into the vehicle with the battery posts facing the rear of the vehicle.
2. Secure the battery to the vehicle with the clamp at the bottom of the battery. Tighten the clamp retaining bolt to 9 ft-lb (12.2 N·m).
3. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

Battery Storage

See General Warning, Section 1, Page 1-1 and DANGER on page 12b-15.

1. Keep the battery clean and free of corrosion. **See Preventive Maintenance on page 12b-16.**
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Fully charge the battery prior to storage.
4. Store in a cool, dry area. The colder the area in which the battery is stored, the less the battery will self-discharge. A battery stored at 0 °F (-17.8 °C) will discharge very little over a four-month period. A battery stored at 80 °F (27 °C) will have to be recharged every few weeks.
5. Check the state of charge periodically. A battery that is discharged and left in a cold environment can freeze and crack. If the specific gravity drops below 1.220, the battery should be recharged. **See following WARNING.**

⚠ WARNING

- **If the battery is frozen or the container is bulged, discard battery. A frozen battery can explode.**

6. The frequency of recharging required depends on the temperature of the storage area, but it is recommended that the battery be monitored monthly for state of charge. Also, if the storage area is unheated in a cold climate and recharging is required, it is recommended that the area be heated to at least 60 °F (16 °C) prior to charging. The battery will not charge effectively in cold temperatures for the same reasons that it does not discharge as rapidly in cold temperatures.

Charging a Dead Battery

See General Warning, Section 1, Page 1-1 and DANGER on page 12b-15.

The charge coil is not designed to charge a dead battery. If the vehicle battery has become discharged, it must be charged with a properly rated automotive type charger. **See following WARNING.**

⚠ WARNING

- **Do not jump-start a dead battery with another battery and jumper cables.**

SECTION 12C – ELECTRICAL COMPONENTS: DIESEL VEHICLES

⚠ DANGER

- **See General Warning, Section 1, Page 1-1.**

⚠ WARNING

- **See General Warning, Section 1, Page 1-1.**

STARTER AND STARTER SOLENOID

See General Warning, Section 1, Page 1-1.

Refer to the engine manual for testing, removal, disassembly, and installation procedures. See the Kubota D722 diesel engine manual (CCI P/N 102615501).

RELAYS

See General Warning, Section 1, Page 1-1.

The start relay (1), differential relay (2), fan relay (3), and accessory relay (optional, not shown) are housed on the electrical component mounting plate located under the driver-side seat near the battery **(Figure 12c-1, Page 12c-1)**.

Testing the Relay

See Test Procedure 8, Section 11c, Page 11c-21. See also Test Procedure 9 – Differential Relay on page 11c-22 and Test Procedure 10 – Fan Relay on page 11c-23.

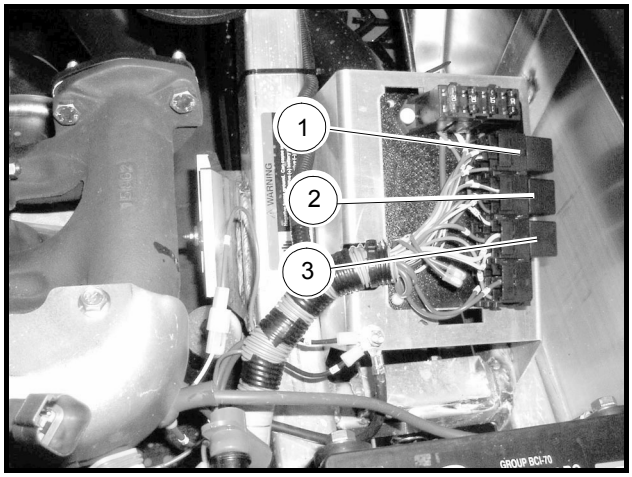


Figure 12c-1 Relays

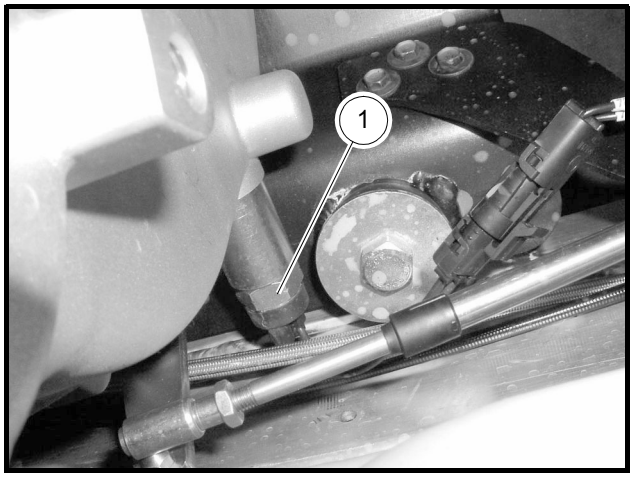


Figure 12c-2 Neutral Switch

Relay Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Remove the electrical component cover.
3. Remove the relay from the multi-pin connector.

Relay Installation

1. Insert the relay into the multi-pin connector. **See following NOTE.**

NOTE: *The relay contacts are keyed to ensure that the relay can only be installed in the correct orientation. If the relay is not easy to insert, rotate the relay until the correct contact orientation is obtained.*

NEUTRAL SWITCH

See General Warning, Section 1, Page 1-1.

The neutral switch (1) is located on the transmission housing **(Figure 12c-2, Page 12c-1)**.

Testing the Neutral Switch

See Test Procedure 14, Section 11c, Page 11c-35.

Neutral Switch Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the two-pin connector between the neutral switch and the wire harness.
3. Use a wrench to loosen and remove the neutral switch from the transmission housing.

Neutral Switch Installation

1. Install the neutral switch to the transmission housing. Tighten to 20.5 ft-lb (27.8 N·m).
2. Connect the two-pin connector between the neutral switch and the wire harness.
3. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

FUEL SOLENOID

See General Warning, Section 1, Page 1-1.

The fuel solenoid is mounted to the passenger-side of the engine block at the front of the injector pump.

Testing the Fuel Solenoid

See Test Procedure 24, Section 11c, Page 11c-42. See also Test Procedure 25 – Fuel Solenoid Hold Coil Circuit on page 11c-42.

Fuel Solenoid Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.

2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally..." in General Warning, Section 1, Page 1-2**.
3. Disconnect the three-pin connector between the fuel solenoid and the wire harness **(Figure 12c-3, Page 12c-3)**.
4. Remove the two bolts securing the wire lead bracket and the two bolts securing the fuel solenoid to the engine. Pull the solenoid and o-ring from the engine **(Figure 12c-4, Page 12c-3)**.

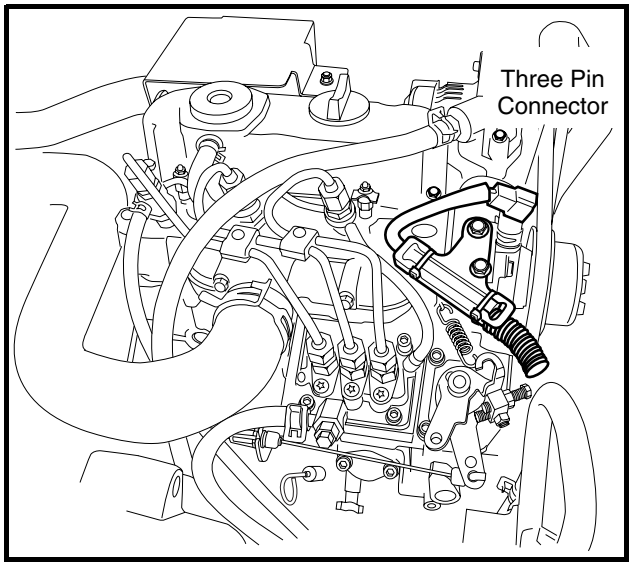


Figure 12c-3 Fuel Solenoid Three-Pin Connector

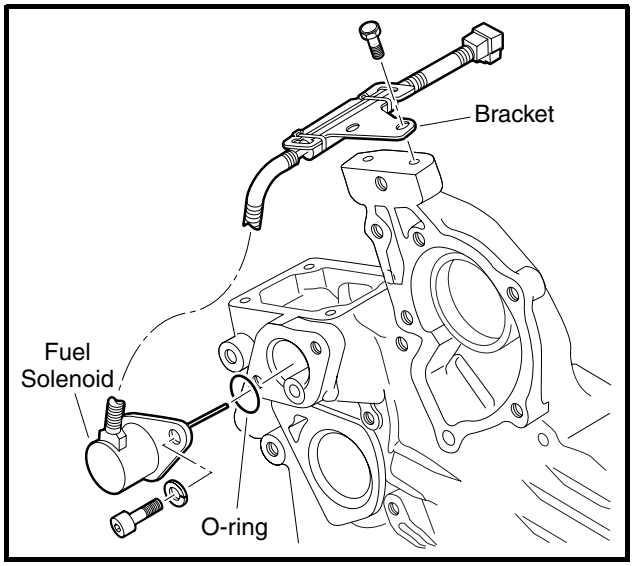


Figure 12c-4 Fuel Solenoid, O-ring and Bracket

Fuel Solenoid Installation

1. Lubricate and install new o-ring. Insert the fuel solenoid into the engine and secure with two bolts. Tighten the bolts to 77 in-lb (8.7 N·m). **(Figure 12c-4, Page 12c-3)**.
2. Secure the wire lead bracket to the engine with two bolts and tighten firmly.
3. Connect the three-pin connector from the fuel solenoid to the wire harness **(Figure 12c-3, Page 12c-3)**.
4. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

60-AMP FUSIBLE LINK

See General Warning, Section 1, Page 1-1.

Testing the 60-Amp Fusible Link

See Test Procedure 19, Section 11c, Page 11c-38.

The fusible link is a short length of special, high temperature insulated wire and should not be confused with standard wire. It is part of the wire assembly that runs from the alternator to the starter solenoid and is several wire gauges smaller than the circuit which it protects. Under no circumstances should a fusible link replacement repair be made using a length of standard wire. If the fusible link is blown, determine the cause of the open fusible link before replacing it.

60-Amp Fusible Link Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally..." in General Warning, Section 1, Page 1-2.**
3. Move the terminal cover and remove the nut that secures the fusible link wire assembly to the alternator **(Figure 12c-5, Page 12c-4)**.

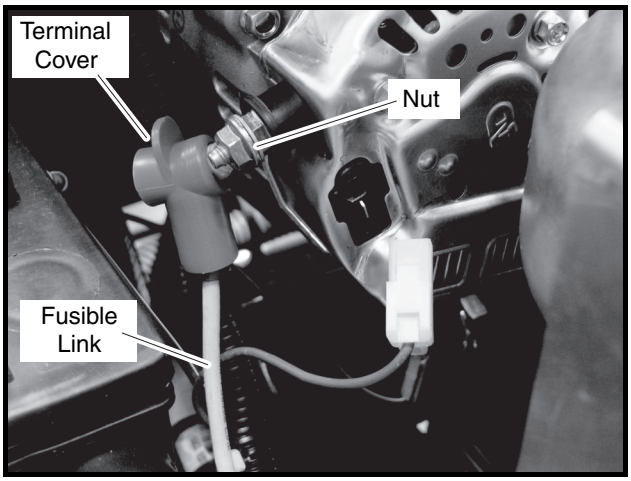


Figure 12c-5 60-Amp Fusible Link

4. Cut the wire ties necessary to free the nearly 6 inches (150 mm) of fusible link wire assembly that runs through the harness.
5. Remove the nut and lock washer that secures the red wires to the starter solenoid and pull the fusible link wire assembly from vehicle and discard.

60-Amp Fusible Link Installation

1. Attach the red end of the fusible link wire assembly to the starter solenoid, along with the other red wires removed, and secure with lock washer and nut. Tighten the nut to 90 in-lb (10.3 N·m).
2. Attach the other end of the fusible link wire assembly to the alternator and secure with nut. Tighten the nut to 84 in-lb (9.5 N·m) and move the terminal cover over the connection.
3. Push the fusible link wire assembly into the harness and secure with new wire ties.
4. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

WARNING LIGHTS

See General Warning, Section 1, Page 1-1.

Testing the Warning Lights

See Test Procedure 20, Section 11c, Page 11c-39. Also see Test Procedure 27 – Low Oil Warning Light Circuit on page 11c-44.

Warning Light Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Raise the hood.
4. Disconnect the wires from the warning light (1) **(Figure 12c-6, Page 12c-5)**.
5. Press the retaining tabs and remove the warning light from the instrument panel.

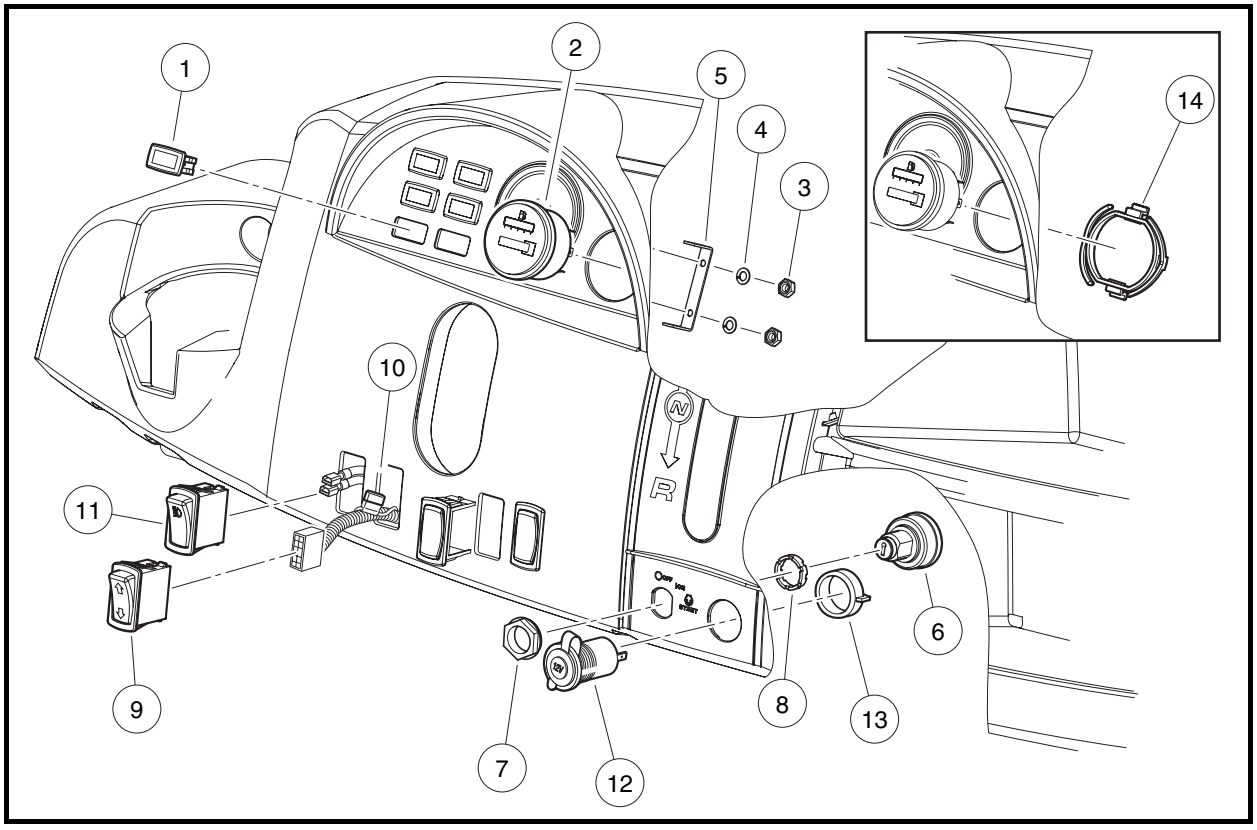


Figure 12c-6 Instrument Panel Electrical Components

Warning Light Installation

1. Push a new warning light into the hole in the instrument panel until the plastic tabs are securely engaged **(Figure 12c-6, Page 12c-5)**.
2. Reconnect the wires from the wire harness to the warning light.

3. Lower and secure the hood.
4. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

FUEL GAUGE/HOUR METER

See General Warning, Section 1, Page 1-1.

Testing the Fuel Gauge/Hour Meter

See Test Procedure 30, Section 11c, Page 11c-46. Also see Test Procedure 31 – Hour Meter on page 11c-48.

Early 2007 vehicles: With the key switch in the OFF position, the fuel gauge/hour meter fields are blank. When the key switch is turned to ON, both fields activate. **Late 2007 vehicles:** With the key switch in the OFF position, the fuel gauge field is blank; however, the hour meter field is always ON. When the key switch is turned to ON, the fuel gauge field activates. **All 2007 vehicles:** The fuel gauge initially registers full before indicating the actual fuel level.

The hour meter displays the number of hours of use in increments of 0.1 (one tenth) hour, but does not record additional time unless the key switch is in the ON position and the engine is on. When recording, the hourglass icon on the left blinks (slowly on Early 2007 vehicles).

Fuel Gauge/Hour Meter Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Raise the hood.
4. Disconnect the wires from the fuel gauge/hour meter (2) **(Figure 12c-6, Page 12c-5)**.
5. Remove the fuel gauge/hour meter.
   5.1. **Early 2007 vehicles:** Remove the two hex nuts (3) and lockwashers (4) from the threaded studs on the back of the gauge. Remove the mounting bracket (5) from the back side of the gauge/meter and remove it from the instrument panel.
   5.2. **Late 2007 vehicles:** Remove the mounting clip (14) that secures the gauge/meter. Alternate pulling the lower and upper tabs away from the gauge housing to remove clip. Pull gauge/meter from the instrument panel.

Fuel Gauge/Hour Meter Installation

1. Install a new fuel gauge/hour meter (2) into the hole in the instrument panel until the flange seats against the instrument panel **(Figure 12c-6, Page 12c-5)**.
2. Remove the fuel gauge/hour meter.
   2.1. **Early 2007 vehicles:** Slide the mounting bracket onto the two threaded studs on the fuel gauge/hour meter. Secure the fuel gauge/hour meter with two lockwashers and two hex nuts. Tighten to 2.5 in-lb (.28 N·m). Place one drop of Loctite on each hex nut. Do not allow Loctite to come into contact with the fuel gauge/hour meter casing.
   2.2. **Late 2007 vehicles:** Force the mounting clip (14) onto the back of the fuel gauge/hour meter until fully seated.
3. Connect the wires to the fuel gauge/hour meter. **See Wiring Diagram, Section 11c, Page 11c-6.**

4. Coat the terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
5. Lower and secure the hood.
6. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

KEY SWITCH

See General Warning, Section 1, Page 1-1.

Testing the Key Switch

See Test Procedure 4, Section 11c, Page 11c-18. Also see Test Procedure 5 – Key Switch (ON Position) on page 11c-19 and Test Procedure 6 – Key Switch (Glow Plug Circuit) on page 11c-19.

Key Switch Removal

1. Turn the key switch (6) OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Raise the hood.
4. From under the hood, remove the multi-pin connector from the key switch.
5. Reach under the instrument panel to hold the key switch and remove the key switch nut (7) **(Figure 12c-6, Page 12c-5)**. Pull the key switch, with spacer (8), from the back side of the instrument panel.

Key Switch Installation

1. Place spacer on key switch and reverse the removal procedure to install switch in the instrument panel. Tighten the key switch nut firmly.
2. From under the hood, connect the multi-pin connector to the key switch.
3. Lower and secure the hood.
4. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

12-VOLT ACCESSORY RECEPTACLE

See General Warning, Section 1, Page 1-1.

Testing the 12-Volt Accessory Receptacle

See Test Procedure 28, Section 11c, Page 11c-44.

12-Volt Accessory Receptacle Removal

1. Turn the key switch (6) OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**

3. Raise the hood.
4. From under the hood, disconnect the wires from the accessory receptacle (12) **(Figure 12c-6, Page 12c-5)**.
5. Reach under the instrument panel to remove the retainer (13) securing the accessory receptacle. **See following NOTE.**

NOTE: *The retainer works like a nut but can be removed quickly by turning only enough to align the two small patches of retainer threads with the two smooth sections in the receptacle threads. Once aligned, the retainer can slide off.*

6. Pull the accessory receptacle from the front side of the instrument panel.

12-Volt Accessory Receptacle Installation

1. Reverse the removal procedure to install receptacle in the instrument panel. Tighten the retainer firmly.
2. From under the hood, connect the the wires to the accessory receptacle.
3. Lower and secure the hood.
4. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

BED LIFT SWITCH

Testing the Bed Lift Switch

See Test Procedure 35, Section 11c, Page 11c-52.

Bed Lift Switch Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Raise the hood.
4. Press the upper and lower retaining tabs and push the bed lift switch (9) out of the instrument panel **(Figure 12c-6, Page 12c-5)**.
5. Disconnect the wire harness from the bed lift switch.

Bed Lift Switch Installation

1. Match the terminal numbers molded onto the connector and switch and reconnect the wire harness.
2. Push the bed lift switch into the instrument panel until fully seated.
3. Lower and secure the hood.
4. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

BED LIFT CIRCUIT BREAKER

Testing the Bed Lift Circuit Breaker

See Test Procedure 36, Section 11c, Page 11c-53.

Bed Lift Circuit Breaker Removal

1. Push the bed lift switch (9) out of the instrument panel. **See Bed Lift Switch Removal on page 12c-8.**
2. Locate the bed lift circuit breaker (10) on the orange wire of the wire harness connected to the switch **(Figure 12c-6, Page 12c-5)**.
3. Pull the circuit breaker out of the in-line fuse holder to remove.

Bed Lift Circuit Breaker Installation

Install the circuit breaker in the reverse order of removal.

LIGHT SWITCH

See General Warning, Section 1, Page 1-1.

Testing the Light Switch

See Test Procedure 32, Section 11c, Page 11c-49.

Light Switch Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Raise the hood.
4. Press the upper and lower retaining tabs and push the light switch (11) out of the instrument panel **(Figure 12c-6, Page 12c-5)**.
5. Disconnect the wire harness from the light switch.

Light Switch Installation

1. Match the terminal numbers molded onto the connector and switch and reconnect the wire harness.
2. Push the light switch into the instrument panel until fully seated.
3. Lower and secure the hood.
4. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

FUSE

See General Warning, Section 1, Page 1-1.

Testing the Fuse

See Test Procedure 2, Section 11c, Page 11c-16.

Fuse Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Remove the electrical component cover (located near the battery).
4. Remove the fuse from the fuse block.

Fuse Installation

1. Install the fuse. **See following WARNING.**

⚠ WARNING

- **If a fuse is blown, determine the cause of the failure and make necessary repairs before installing a new fuse. Use the appropriately rated fuse; if a fuse with a higher amp rating is used, damage to the vehicle electrical system may occur.**

2. Install the electrical component cover.
3. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

REVERSE WARNING BUZZER (IF EQUIPPED)

See General Warning, Section 1, Page 1-1.

Testing the Reverse Warning Buzzer

See Test Procedure 23, Section 11c, Page 11c-42.

Reverse Warning Buzzer Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Raise the hood.
4. Remove the plastic rivets securing the reverse warning buzzer and remove the reverse warning buzzer **(Figure 12c-7, Page 12c-11)**.

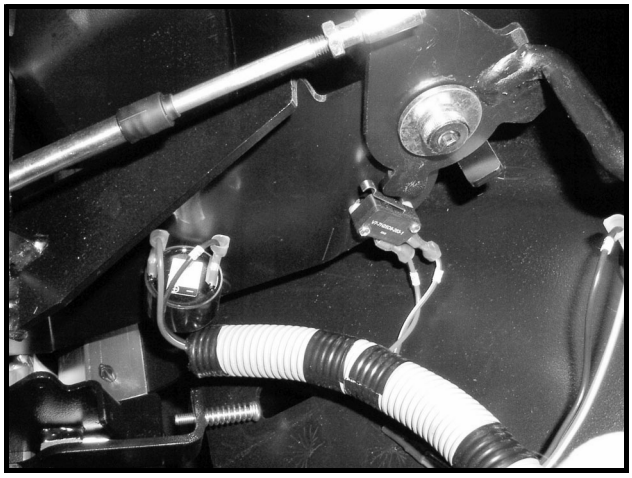


Figure 12c-7 Reverse Warning Buzzer and Limit Switch

Reverse Warning Buzzer Installation

1. Install the reverse warning buzzer and secure it with two plastic rivets.
2. Connect the black wire from the wire harness to the negative (–) terminal on the buzzer.
3. Connect the red/white wire from the wire harness to the positive (+) terminal on the buzzer.
4. Lower and secure the hood.
5. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

REVERSE WARNING BUZZER LIMIT SWITCH (IF EQUIPPED)

See General Warning, Section 1, Page 1-1.

Testing the Reverse Warning Buzzer Limit Switch

See Test Procedure 22, Section 11c, Page 11c-41.

Reverse Warning Buzzer Limit Switch Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Raise the hood.
4. Disconnect the wires from the reverse warning buzzer limit switch **(Figure 12c-7, Page 12c-11)**.
5. Remove the screws, nuts, washers, and lockwashers that secure the limit switch.
6. Remove the limit switch.

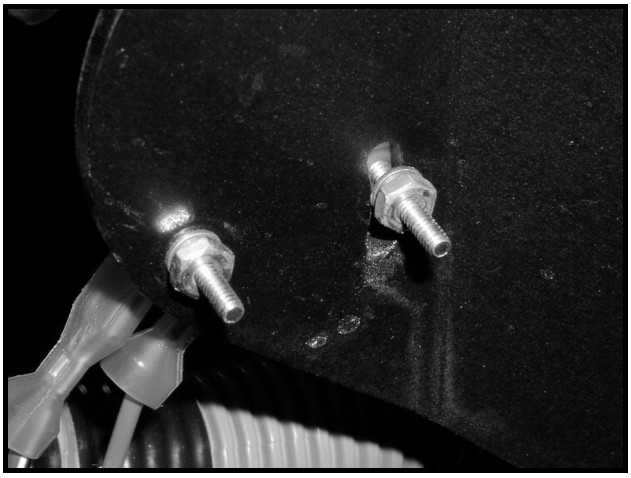


Figure 12c-8 Reverse Warning Buzzer Limit Switch Adjustment Slot

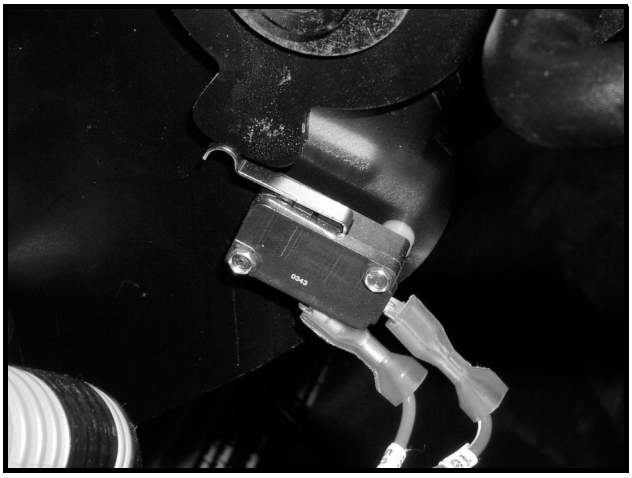


Figure 12c-9 Reverse Warning Buzzer Limit Switch (Properly Adjusted)

Reverse Warning Buzzer Limit Switch Installation

1. Install the reverse warning buzzer limit switch in the reverse order of removal.
2. Place the Forward/Reverse handle in the REVERSE position.
3. Tighten the limit switch mounting screws so that they are snug, but the limit switch can still be rotated in the adjustment slot **(Figure 12c-8, Page 12c-12)**.
4. Rotate the limit switch so that the lobe on the Forward/Reverse handle activates the limit switch as shown **(Figure 12c-9, Page 12c-12)**.
5. Hold the limit switch in position and tighten the mounting screws and nuts to 4 in-lb (0.5 N·m). **See following CAUTION.**

CAUTION

- **Do not overtighten the retaining nuts. If the nuts are overtightened, the limit switch could become damaged.**

6. Place the Forward/Reverse handle in NEUTRAL and then back to REVERSE to ensure that the limit switch lever is being properly activated.
7. Connect the 18-gauge red and 18-gauge red/white wires to the limit switch.
8. Lower and secure the hood.
9. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
10. Turn the key switch to the ON position. With the Forward/Reverse handle in REVERSE, the buzzer should sound.

FRONT DIFFERENTIAL LIMIT SWITCH

See General Warning, Section 1, Page 1-1.

Testing the Front Differential Limit Switch

See Test Procedure 16, Section 11c, Page 11c-36.

Front Differential Limit Switch Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Raise the hood.
4. Disconnect the black and red wire leads of the switch (1) from the gray wires of the wire harness **(Figure 12c-10, Page 12c-13)**.
5. Remove the nuts (2) and screws (3) that secure the switch (1) and remove the switch.

Front Differential Limit Switch Installation

1. Install the front differential limit switch (1) in the reverse order of removal and tighten the nuts (2) to 4 in-lb (0.5 N·m) **(Figure 12c-10, Page 12c-13)**. **See following CAUTION.**

CAUTION

- **Do not overtighten the retaining nuts. If the nuts are overtightened, the switch could become damaged.**

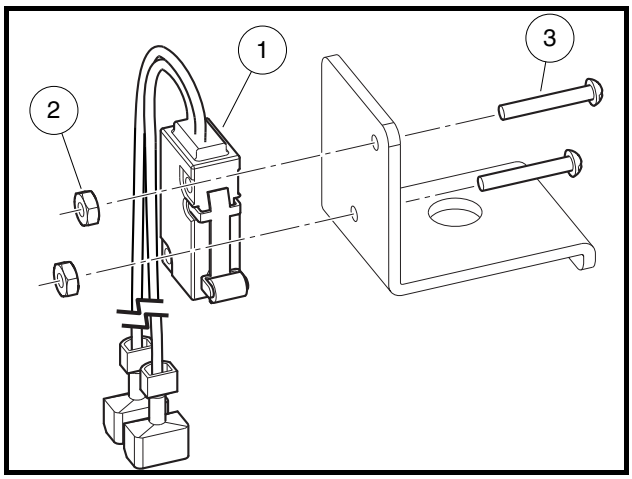


Figure 12c-10 Front Differential Limit Switch Removal

2. Move the accelerator pedal back and forth to ensure that the switch lever is being properly activated.
3. Connect the black and red wire leads of the switch to the gray wires of the wire harness.
4. Lower and secure the hood.
5. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

ELECTRIC FUEL PUMP

See General Warning, Section 1, Page 1-1.

Testing the Fuel Pump

See Test Procedure 26, Section 11c, Page 11c-43.

In addition to the test procedure referenced above, perform the following tests:

- Make sure all hose clamps are tight.
- Inspect the fuel lines for damage and clogging.
- Make sure the fuel filters are not clogged.
- Test the electric fuel pump circuit. **See Test Procedure 26, Section 11c, Page 11c-43.**

Electric Fuel Pump Removal

See Fuel Pump Removal, Section 13c, Page 13c-11.

Electric Fuel Pump Installation

See Fuel Pump Installation, Section 13c, Page 13c-12.

FUEL LEVEL SENDING UNIT

See General Warning, Section 1, Page 1-1.

Thoroughly test the fuel level sending unit before replacing the unit.

Testing the Fuel Level Sending Unit

See Test Procedure 29, Section 11c, Page 11c-45.

Fuel Level Sending Unit Removal

See Fuel Level Sending Unit Removal, Section 13c, Page 13c-12.

Fuel Level Sending Unit Installation

See Fuel Level Sending Unit Installation, Section 13c, Page 13c-14.

ALTERNATOR

See General Warning, Section 1, Page 1-1.

Testing the Alternator

See Test Procedure 18, Section 11c, Page 11c-37.

Alternator and V-belt Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING “To avoid unintentionally starting...” in General Warning, Section 1, Page 1-2.**
3. Disconnect the 18-gauge purple wire from the alternator **(Figure 12c-11, Page 12c-15)**.

4. Disconnect the 12-gauge blue fusible link from the alternator **(Figure 12c-11, Page 12c-15) (Figure 12c-12, Page 12c-15)**.

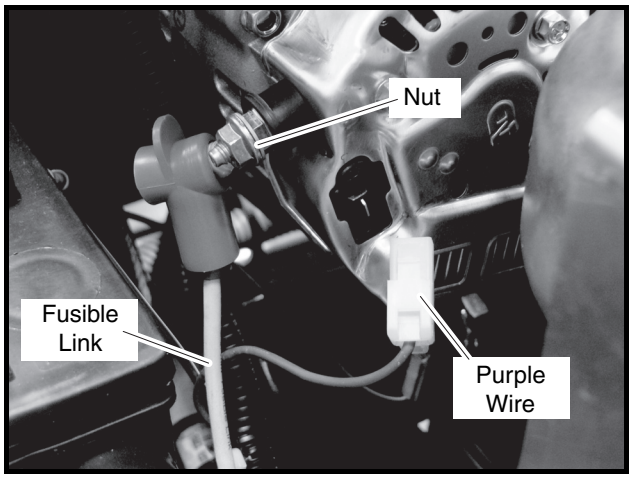


Figure 12c-11 18-Gauge Purple Wire and 12-Gauge Blue Fusible Link at Alternator (60 Amp Shown)

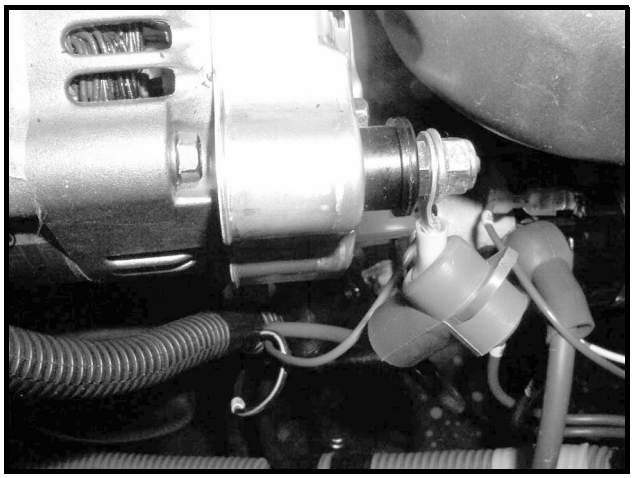


Figure 12c-12 12-Gauge Blue Fusible Link at Alternator (40 Amp Shown)

5. Loosen and remove the belt tension adjustment bolt at the top of the alternator **(Figure 12c-13, Page 12c-15)**.
6. Loosen and remove the alternator mounting bolt at the bottom of the alternator **(Figure 12c-14, Page 12c-15)**.
7. Remove the belt shield and the alternator from the engine compartment.
8. If necessary, remove the V-belt.

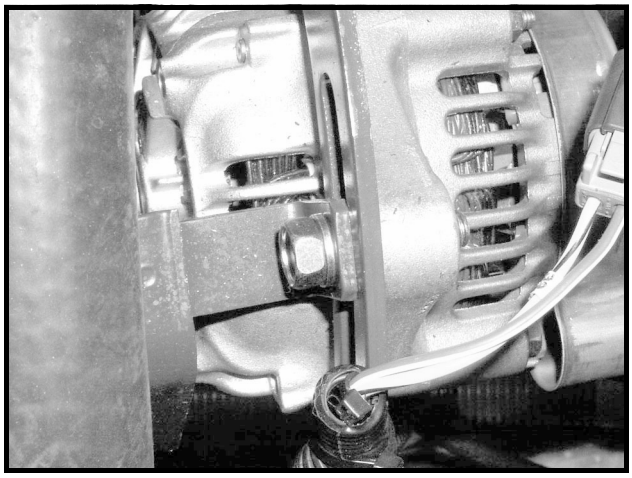


Figure 12c-13 Belt Tension Adjustment Bolt

Figure 12c-14 Alternator Mounting Bolt

Alternator and V-belt Installation

1. Place the alternator and belt shield on the engine and insert the alternator mounting bolt through the shield and alternator and into the engine block **(Figure 12c-14, Page 12c-15)**. Tighten the bolt so that it is snug but will allow the alternator to pivot when the belt tension is adjusted.

2. Insert the belt tension adjustment bolt through the belt shield mounting hole and adjustment slot and into the alternator housing **(Figure 12c-13, Page 12c-15)**. Tighten the bolt so that it is snug, but will allow the alternator to pivot when the belt tension is adjusted.
3. Place the V-belt on the alternator pulley.
4. Place a belt tension gauge on the V-belt and use a pry bar to increase the belt tension. Use a Krikit brand belt tension gauge to measure the belt tension. The belt tension adjustment for a new belt is 45 lb and the tension adjustment for a used belt is 30 lb.
5. Hold the pry bar to maintain the proper belt tension adjustment and tighten the belt tension adjustment bolt to 19.0 ft-lb (25.8 N·m) **(Figure 12c-13, Page 12c-15)**.
6. Tighten the alternator mounting bolt to 19.0 ft-lb (25.8 N·m) **(Figure 12c-14, Page 12c-15)**. **See following CAUTION.**

⚠ WARNING

- **Remove pry bar before starting engine.**

7. Connect the 12-gauge blue fusible link to the alternator **(Figure 12c-12, Page 12c-15)**. Tighten the nut to 84 in-lb (9.5 N·m).
8. Connect the 18-gauge purple wire to the alternator **(Figure 12c-11, Page 12c-15)**.
9. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

OIL PRESSURE SENSOR

See General Warning, Section 1, Page 1-1.

Refer to the engine manual for testing, removal, disassembly, and installation procedures. See the Kubota D722 diesel engine manual (CCI P/N 102615501).

HEADLIGHTS

See General Warning, Section 1, Page 1-1.

Testing the Headlight Bulb and Socket

See Test Procedure 33, Section 11c, Page 11c-50. See also Test Procedure 32 – Light Switch on page 11c-49.

Headlight Bulb Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. From the front of the vehicle, reach under the cowl and turn the connector harness/halogen bulb assembly clockwise one-quarter turn **(Figure 12c-15, Page 12c-17)**.
4. Remove the connector harness/halogen bulb assembly from the headlight lens.

5. Lift the retaining tabs on the connector and remove the halogen bulb.

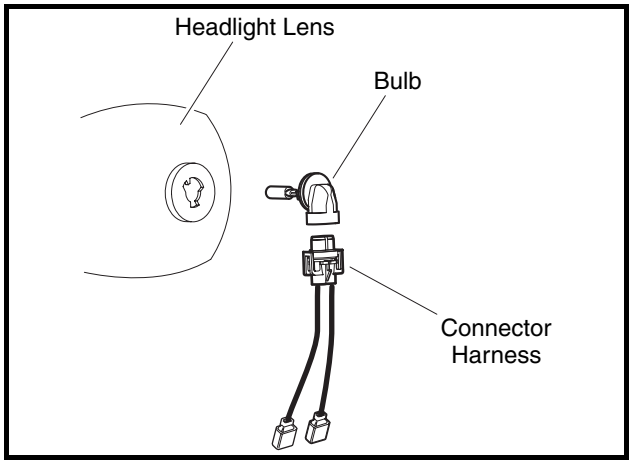


Figure 12c-15 Headlight Bulb

Headlight Bulb Installation

NOTE: *When handling halogen bulbs, do not touch the glass portion of bulb. Oil from finger tips can cause premature failure of the bulb.*

1. Attach the connector harness to the halogen bulb. The retaining tab should lock onto the halogen bulb **(Figure 12c-15, Page 12c-17)**.
2. From the front of vehicle, reach under the cowl and insert the bulb assembly into the headlight lens.
3. Turn the bulb assembly counterclockwise one-quarter turn.
4. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

THERMOSTAT SWITCH

See General Warning, Section 1, Page 1-1.

Testing the Thermostat Switch

See Test Procedure 11, Section 11c, Page 11c-25.

Thermostat Switch Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the two-pin connector between the thermostat switch and the wire harness **(Figure 12c-16, Page 12c-18)**. **See following WARNING.**

⚠ WARNING

- **Hot! Coolant system is pressurized. Do not remove thermostat switch while engine is hot.**

3. Loosen the radiator cap to relieve pressure.

4. Unscrew the thermostat switch from the engine block. **See preceding WARNING.**

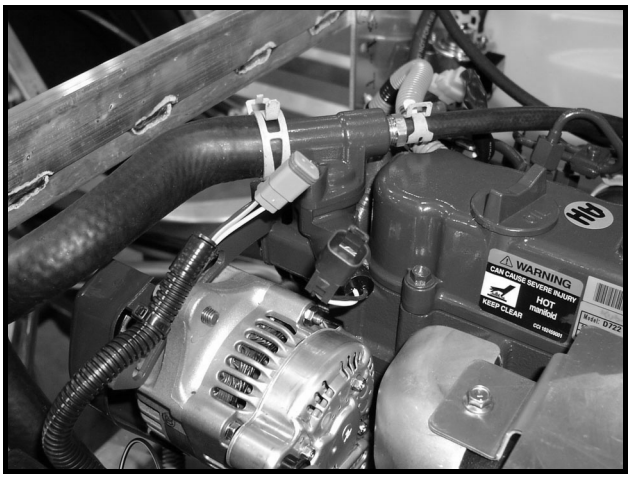


Figure 12c-16 Thermostat Switch

Thermostat Switch Installation

1. Apply Loctite 567 Liquid Thread Sealer to the threads of the thermostat switch. **See following CAUTION.**

CAUTION

- **Do not use any thread-sealing tape on the threads of the thermostat switch. The housing of the thermostat switch must make a good connection to the engine block. If thread sealer insulates the thermostat switch housing from the engine block, the radiator fan will not function and the high-temperature warning lamp will not illuminate. Thus, the engine will over-heat and the operator will not be alerted to the potential engine damage.**

2. Hand-tighten the thermostat switch and then tighten two full revolutions.
3. Connect the two-pin connector from the thermostat switch to the wire harness.
4. Tighten the radiator cap. Check the coolant level in the reservoir. If the coolant level is at or below the LOW mark, add pre-mixed coolant until the level reaches the FULL mark. **See Engine Coolant – Diesel Vehicles, Section 10a, Page 10a-16.**
5. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

FAN

See General Warning, Section 1, Page 1-1.

Testing the Fan Motor

See Test Procedure 12, Section 11c, Page 11c-27.

Fan Removal

1. Turn the key switch OFF and remove the key. Set the park brake and chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in See General Warning, Section 1, Page 1-1.**
3. Raise the hood.
4. Disconnect the two-pin connector between the fan motor and wire harness **(Figure 12c-17, Page 12c-19)**.
5. Remove the four bolts securing fan assembly to shroud and remove the fan by pulling it through opening between driver side front tire and underside of fender flare **(Figure 12c-17, Page 12c-19)**. **See following NOTE.**

NOTE: *To aid reassembly, note the orientation of the electric fan assembly on the fan shroud, particularly the wire lead of the motor.*

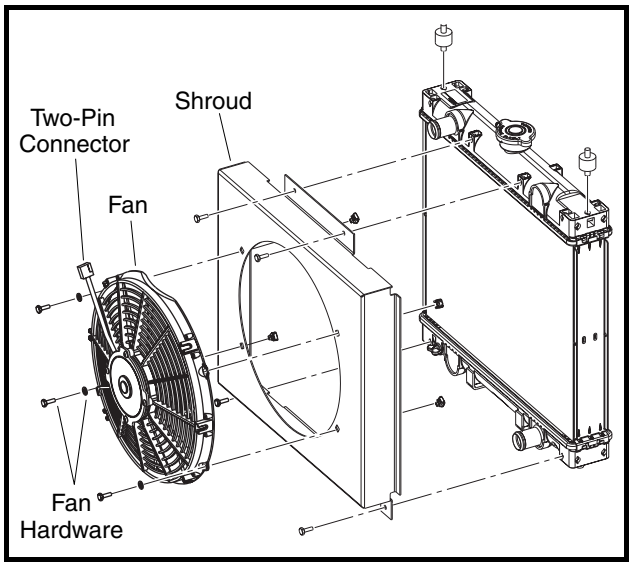


Figure 12c-17 Fan Motor

Fan Installation

1. Correctly position the electric fan assembly on the fan shroud and secure with four lock-patch bolts. Tighten the hardware to 48 in-lb (5 N·m). **See preceding NOTE.**
2. Connect the two-pin connector from the fan motor to the wire harness **(Figure 12c-17, Page 12c-19)**.
3. Lower and secure the hood.
4. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

WIRE HARNESS DIODES

See General Warning, Section 1, Page 1-1.

The wire harness is equipped with several in-line diodes.

Testing the Wire Harness Diodes

See Test Procedure 13, Section 11c, Page 11c-28.

Wire Harness Diode Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Locate the diode to be replaced by removing the wire conduit and tracing the wire.
4. Note the polarity of the diode, as indicated by the silver stripe on one end of the diode, and mark the wire on the side of the silver stripe.
5. Cut the wires attached to each side of the diode and discard the diode.

Wire Harness Diode Installation

1. Slide a piece of heatshrink tubing over one of the wire ends where the diode will be attached.
2. Use in-line wire splicing connectors to install the new diode. Make sure to observe polarity and place the end of the diode with the silver stripe on the wire that was marked when the diode was removed.
3. Slide the heatshrink tubing over the diode and ensure that it will, after being activated, adequately cover the uninsulated diode leads.
4. Activate the heatshrink by carefully applying heat to the tubing.
5. Bundle the wires into the plastic wire conduit and replace any wire ties that were removed when the wires were traced.
6. Restore the wire harness routing to the original routing and secure the harness with wire ties as required.
7. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

BATTERY

See General Warning, Section 1, Page 1-1.

⚠ DANGER

- **Due to the danger of an exploding battery, wear a full face shield and rubber gloves when working around a battery.**
- **Battery – Explosive gases! Do not smoke. Keep sparks and flames away from the vehicle and service area. Ventilate when charging or using in an enclosed space. Wear a full face shield and rubber gloves when working on or near batteries. For added protection, cover top of the battery when servicing the vehicle.**
- **Battery – Poison! Contains acid! Causes severe burns! Avoid contact with skin, eyes, or clothing.**
  - **External: Flush with water. Call a physician immediately.**
  - **Internal: Drink large quantities of milk or water. Follow with milk of magnesia or vegetable oil. Call a physician immediately.**
  - **Eyes: Flush with water for 15 minutes. Call a physician immediately.**

GENERAL INFORMATION

See preceding DANGER statement.

Gasoline vehicles are equipped with 12-volt, low-maintenance batteries. When changing a 12-volt battery in any gasoline-powered vehicle, the same size battery with adequate amperage ratings should be used as a replacement.

The manufacturer recommends a group 70, side-post battery (CCI P/N 1012328) with a 650 cranking amp rating at 32 °F (0 °C), 500 CCA at 0 °F (-17.8 °C) and a reserve capacity of at least 105 minutes. The group 70 classification indicates battery size: 8-1/4 inches W x 6-1/2 inches D x 7-1/4 inches H (21.0 cm W x 16.5cm D x 18.4 cm H). It is important to use the proper size to ensure that the battery clamp will fit correctly.

Testing the Battery

See Test Procedure 1, Section 11c, Page 11c-13.

Preventive Maintenance

1. To keep the battery in good operating condition, remove corrosion immediately. Post connections should be clean and tight. Frayed or worn wires should be replaced. After all cables have been connected and properly tightened to 20 ft-lb (27.1 N·m), coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305) to prevent future corrosion.
2. The battery should be kept clean and dry to prevent self-discharge. Dirt, grime or acid spillage should be removed. Wash the battery with a bristle brush and a solution of water and bicarbonate of soda (1 cup (237 ml) baking soda – per 1 gallon (3.8 l) of water). Rinse with water. Do not allow any solution to enter the battery through the vent cap holes. **See Self-Discharge on page 12c-22.**
3. Maintain the proper water level. **See Water Level on page 12c-22.**
4. Check the battery periodically to ensure that it is in a full state of charge. **See Charging the Battery on page 12c-23.**
5. Keep the battery hold-down clamp tight. **See Vibration Damage on page 12c-22.**

Self-Discharge

Dirt and battery acid can provide a path for a small current draw that slowly discharges the battery. To prevent self-discharge, the battery should always be kept clean.

Hot weather also has an effect on a battery's self-discharge rate. The higher the temperature, the quicker a battery will discharge. Therefore, the battery should be checked more often in hotter climates. When storing the battery, keep it in a cool place. **See Battery Storage on page 12c-23.**

Water Level

The water level should be checked semi-annually to ensure the proper level is maintained. Never allow the water level to fall below the tops of the plates because this will cause the exposed part of the plate to become permanently inactive. Check the water level more frequently in hot weather and when the battery becomes old. **See Figure 11c-8, Section 11c, Page 11c-14.**

Vibration Damage

The battery hold-down clamp should always be tight enough to keep the battery from bouncing. Battery life may be severely shortened if the clamp is too loose. Excessive vibration shortens the life of the battery. It may also cause acid to leak from the vent caps and corrosion to build up on surrounding metal parts. The acid that is lost reduces the capacity of the battery and cannot be replaced.

Mineral Content

For the longest battery life, distilled water should be used in the battery. However, if tap water is going to be used, contact your local water department to be sure mineral contents are below the levels listed in the following table. **See following NOTE.**

NOTE: *Contact your local water department for mineral content analysis.*

IMPURITY	ALLOWABLE CONTENT (PARTS PER MILLION)
Suspended matter	Trace
Total solids	100.0
Calcium and magnesium oxides	40.0
Iron	5.0
Continued on next page	
Ammonia	8.0
Organic matter	50.0
Nitrates	10.0
Nitrites	5.0
Chloride	5.0

Battery Removal

See General Warning, Section 1, Page 1-1 and DANGER on page 12c-21.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Remove the driver-side seat.

4. Remove the battery hold-down located on the bottom of the battery.
5. Remove the battery. **See following WARNING.**

⚠ WARNING

- **Keep the battery in an upright position to prevent electrolyte leakage. Tipping the battery beyond a 45° angle in any direction can allow a small amount of electrolyte to leak out of the vent hole. Do not exceed this 45° angle when lifting, carrying or installing battery. The battery acid could cause severe personal injury when accidentally coming in contact with the skin or eyes and could damage clothing.**

Charging the Battery

See General Warning, Section 1, Page 1-1 and DANGER on page 12c-21.

1. Charge the battery with an automotive type 12-volt battery charger. Follow all warnings and procedures supplied by the battery charger manufacturer.
2. Attach the charger, positive (+) cable to the positive (+) battery post and negative (–) cable to the negative (–) battery post.
3. The battery may be charged with a slow charge (3-10 amps) or a fast charge (20-30 amps). Charge until the specific gravity reaches 1.250. **See following WARNING.**

⚠ WARNING

- **If the battery case feels hot (approximately 125 °F (52 °C) or more), emits gases, or fluid boils from vents, stop charging immediately. Failure to stop charging battery when any of these conditions are present could result in an explosion, personal injury and/or damage to the battery.**
- **Do not disconnect the charger DC leads from the battery when the charger is on. The resulting arcing between the DC leads and battery post could cause an explosion.**
- **If the charger must be stopped, disconnect the AC supply cord from the wall outlet before disconnecting the DC leads from the battery. Allow the battery to cool to room temperature and resume charging battery at a lower amp rate.**

Battery Installation

See General Warning, Section 1, Page 1-1 and DANGER on page 12c-21.

1. Place the battery into the vehicle with the battery posts facing the rear of the vehicle.
2. Secure the battery to the vehicle with the clamp at the bottom of the battery. Tighten the clamp retaining bolt to 9 ft-lb (12.2 N·m).
3. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

Battery Storage

See General Warning, Section 1, Page 1-1 and DANGER on page 12c-21.

1. Keep the battery clean and free of corrosion. **See Preventive Maintenance on page 12c-21.**
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Fully charge the battery prior to storage.

4. Store in a cool, dry area. The colder the area in which the battery is stored, the less the battery will self-discharge. A battery stored at 0 °F (-17.8 °C) will discharge very little over a four-month period. A battery stored at 80 °F (27 °C) will have to be recharged every few weeks.
5. Check the state of charge periodically. A battery that is discharged and left in a cold environment can freeze and crack. If the specific gravity drops below 1.220, the battery should be recharged. **See following WARNING.**

⚠ WARNING

- **If the battery is frozen or the container is bulged, discard battery. A frozen battery can explode.**

6. The frequency of recharging required depends on the temperature of the storage area, but it is recommended that the battery be monitored monthly for state of charge. Also, if the storage area is unheated in a cold climate and recharging is required, it is recommended that the area be heated to at least 60 °F (16 °C) prior to charging. The battery will not charge effectively in cold temperatures for the same reasons that it does not discharge as rapidly in cold temperatures.

Charging a Dead Battery

See General Warning, Section 1, Page 1-1 and DANGER on page 12c-21.

The charge coil is not designed to charge a dead battery. If the vehicle battery has become discharged, it must be charged with a properly rated automotive type charger. **See following WARNING.**

⚠ WARNING

- **Do not jump-start a dead battery with another battery and jumper cables.**

SECTION 13A – KAWASAKI GASOLINE ENGINE, MUFFLER, FUEL SYSTEM, AND CLUTCHES

⚠ DANGER

- **See General Warning, Section 1, Page 1-1.**

⚠ WARNING

- **See General Warning, Section 1, Page 1-1.**

GASOLINE ENGINE

See General Warning, Section 1, Page 1-1.

This section contains information on removing and installing the Kawasaki gasoline engine. For complete instructions on engine disassembly, repair, rebuilding, and reassembly, refer to the engine manual. **See the Kawasaki FH680D engine manual (CCI P/N 103351201).**

ENGINE REMOVAL

See General Warning, Section 1, Page 1-1.

CAUTION

- **Before removal and disassembly, clean the engine.**

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally..." in General Warning, Section 1, Page 1-2.**
3. Remove the cargo bed. **See Cargo Bed Removal, Section 4, Page 4-12.**
4. Remove seat(s) and remove the center seat plate (bucket seat vehicles only).
5. Remove the ROPS (Roll Over Protection Structure) and the lower rear ROPS bars. **See ROPS Removal, Section 4, Page 4-7.**
6. Remove the seat frame. **See Seat Support Removal, Section 4, Page 4-10.**
7. Remove the engine top cover (1).
8. Remove the engine front cover (2).
9. Close the shut-off valve on the fuel tank.
10. Remove the fuel line from the fuel pump (3) on the engine. **See following DANGER.**

⚠ DANGER

- **Gasoline! Flammable! Explosive! Do not smoke. Keep sparks and flames away from the vehicle and service area.**

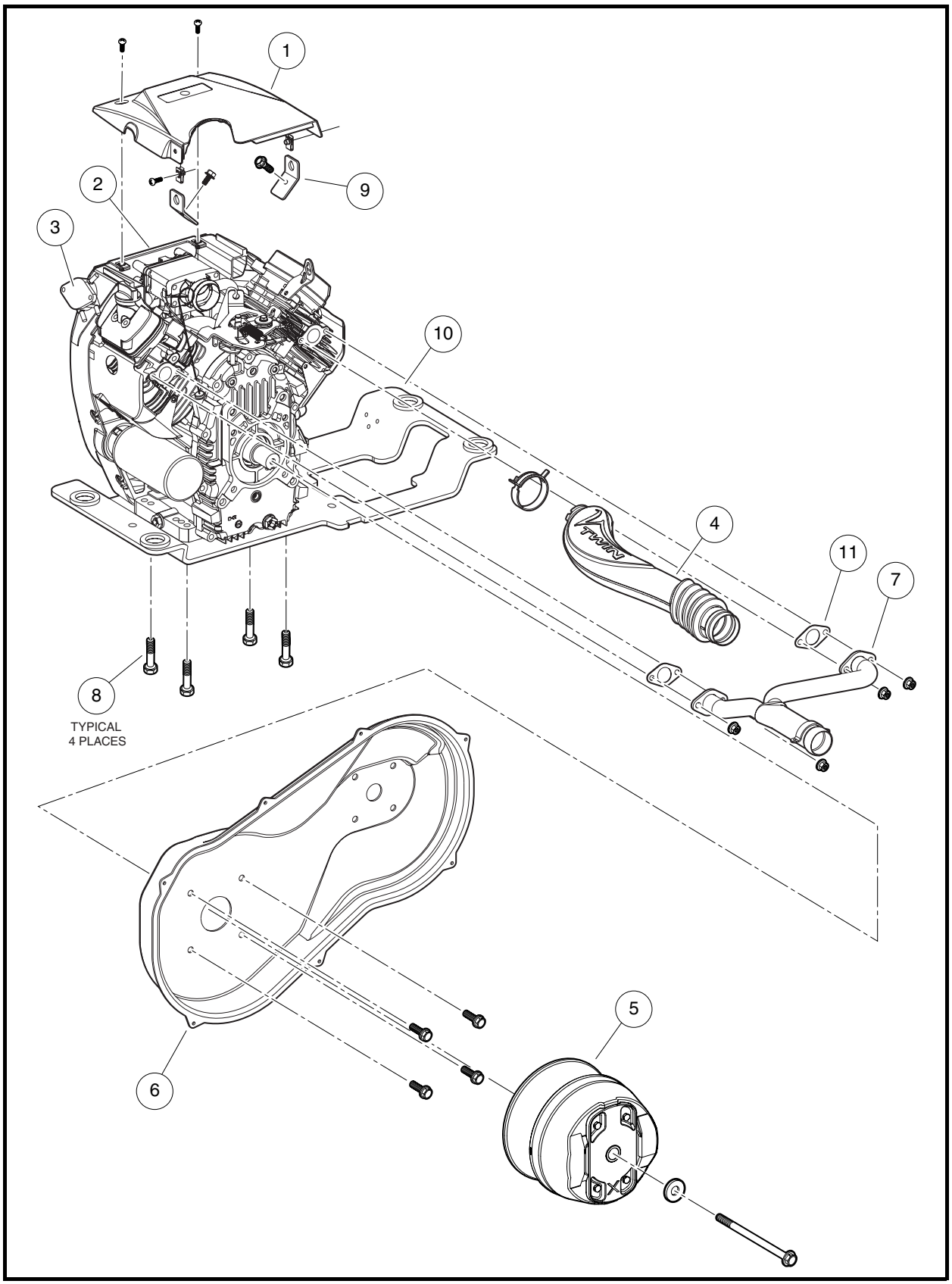


Figure 13a-1 Engine Removal and Installation Components

11. Remove the choke cable. **See Choke Cable Removal on page 13a-20.**
12. Remove the engine air inlet hose (4). **See Air Filter Outlet Hose Removal on page 13a-26.**
13. Remove the accelerator cable. **See Accelerator Cable Removal on page 13a-18.**
14. Remove the muffler. **See Muffler Removal on page 13a-6.**
15. Remove the intermediate exhaust pipe. **See Intermediate Pipe Removal on page 13a-7.**
16. Remove the clutch outer cover. **See Clutch Outer Cover Removal on page 13a-37.**
17. Remove the clutches (5). **See Drive Clutch Removal on page 13a-29. Also See Driven Clutch Removal on page 13a-34.**
18. Remove the clutch inner cover (6). **See Clutch Inner Cover Removal on page 13a-37.**
19. Remove the exhaust manifold (7).
20. Remove the electrical connectors:
    20.1. Disconnect the engine harness from the chassis harness.
    20.2. Disconnect all wires attached to the starter solenoid. **See following NOTE.**

NOTE: *Mark or tape together, for identification, the connectors on the starter solenoid posts.*

21. Drain the engine oil. **See Engine Oil and Filter Change, Section 10b, Page 10b-8.**
22. Remove engine oil inlet and outlet hoses from the engine. **See Oil Filter Hose Removal on page 13a-5. See also following NOTE.**

NOTE: *Plug each line as it is removed from the engine. Without plugs, oil will leak from the lines.*

23. Remove the engine mounting hardware (8) **(Figure 13a-1, Page 13a-2)**.
24. Lift the engine out by its lift tabs (9).
25. If a new engine will be installed, remove and retain the following:
    - Oil Filter Adapter (1) **(Figure 13a-2, Page 13a-4)**
    - Engine Lift Tabs
    - Choke Cable Return Spring

ENGINE INSTALLATION

See General Warning, Section 1, Page 1-1.

1. Before a new engine is installed, the following components must be installed:
    - Oil Filter Adapter (1) (new o-rings (2) required) **(Figure 13a-2, Page 13a-4)** – Tighten the hardware to 33 ft-lb (44 N·m)
    - Engine Lift Tabs – Tighten the hardware to 21 ft-lb (28 N·m)
    - Choke Cable Return Spring
2. Lower the engine into the engine compartment and closely align the engine block mounting holes with the holes in the engine plate (10) **(Figure 13a-1, Page 13a-2)**.

3. Secure the engine oil inlet and outlet hoses to the engine ports with new clamps. **See Oil Filter Hose Installation on page 13a-6.**

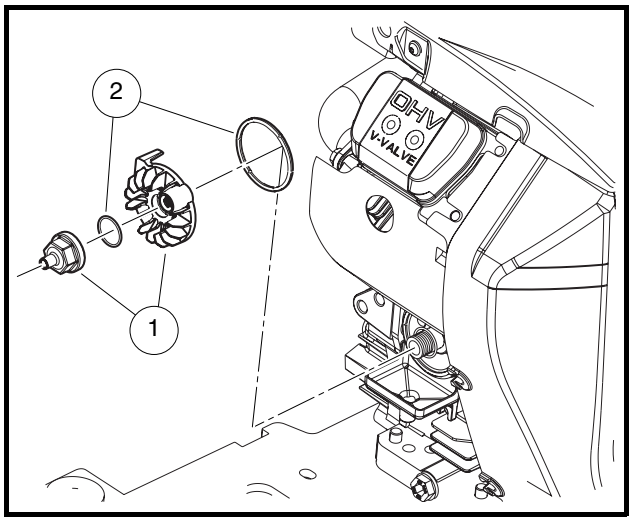


Figure 13a-2 Secure Oil Adapter to Engine

4. Loosely install new flange-head bolts (8) up through engine plate and into engine mounting base. **See following NOTE.**

NOTE: *Engine mounting bolts will be tightened after the engine and transmission are aligned, the clutch inner cover is installed, and the cover bolts are tightened to maintain the alignment.*

5. Connect all electrical connections. **See Figure 11a-1, Section 11a, Page 11a-6.**
   5.1. Connect the engine harness to the chassis harness.
   5.2. Connect all wires attached to the two terminal posts on the starter solenoid.
6. Use new gaskets (11) and install the exhaust manifold **(Figure 13a-1, Page 13a-2)**. Tighten the hardware to 21 ft-lb (28 N·m).
7. Install the clutch inner cover (6). **See Clutch Inner Cover Installation on page 13a-38.**
8. Tighten the engine mounting bolts (8) to 39 ft-lb (53 N·m).
9. Install the clutches (5). **See Drive Clutch Installation on page 13a-32. Also See Driven Clutch Installation on page 13a-36.**
10. Install the drive belt. **See Drive Belt Installation on page 13a-29.**
11. Install the clutch outer cover. **See Clutch Outer Cover Installation on page 13a-37.**
12. Install the intermediate exhaust pipe. **See Intermediate Pipe Installation on page 13a-7.**
13. Install the muffler. **See Muffler Installation on page 13a-8.**
14. Install the engine front cover (2) and tighten the screws to 54 in-lb (6 N·m).
15. Connect the choke cable. **See Choke Cable Installation on page 13a-21.**
16. Connect the accelerator cable. **See Accelerator Cable Installation on page 13a-19.**
17. Install the engine air inlet hose (4). **See Air Filter Outlet Hose Installation on page 13a-26.**
18. Secure the fuel line to the fuel pump (3) with a new clamp. **See following DANGER.**

⚠ DANGER

- **Gasoline! Flammable! Explosive! Do not smoke. Keep sparks and flames away from the vehicle and service area.**

19. Open the fuel valve on the fuel tank.
20. Install the engine top cover (1) and tighten the four bolts to 35 in-lb (4 N·m).
21. Install the seat frame and lower rear ROPS (Roll Over Protection Structure) bars. **See Seat Support Installation, Section 4, Page 4-10 and ROPS Installation, Section 4, Page 4-8.**
22. Install the upper ROPS frame. **See ROPS Installation, Section 4, Page 4-8.**
23. Install the cargo bed. **See Cargo Bed Installation, Section 4, Page 4-12.**
24. Add engine oil. **See Engine Oil and Filter Change, Section 10b, Page 10b-8.**
25. Check the engine oil level. **See Engine Oil Level Check, Section 10b, Page 10b-8.**
26. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
27. Adjust the engine RPM setting. **See Engine RPM Adjustment on page 13a-22.**
28. Install the center seat plate (bucket seat vehicles only).
29. Install seat(s).
30. Test-drive the vehicle to ensure all systems are functional and adjusted correctly.

OIL FILTER HOSES

Oil Filter Hose Removal

1. Drain the engine oil. **See Engine Oil Draining, Section 10b, Page 10b-9.**
2. Place a pan under the oil filter hose connections on the engine. **See following NOTE.**

NOTE: *It's best to disconnect the engine hoses first when removing to allow oil to drain from hoses and engine hose ports.*

3. Loosen the clamps on the oil hoses at the engine ports and slide them from the engine port nozzles.

4. Loosen the clamps on the oil hoses at the filter ports and slide them from the filter port nozzles.

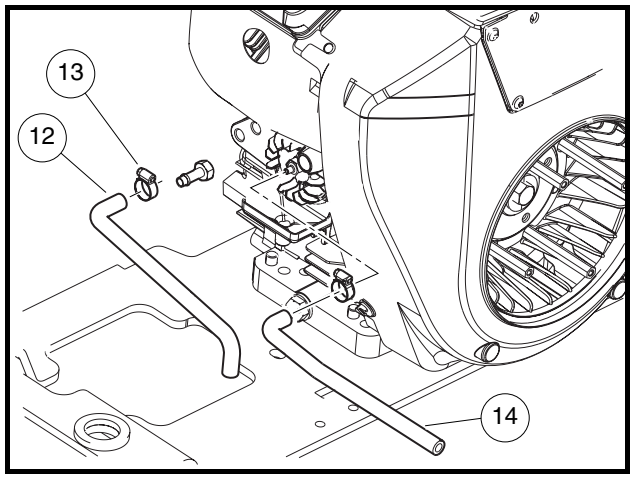


Figure 13a-3 Oil Filter Hose Routing

Oil Filter Hose Installation

1. Replace the oil hoses with OEM hoses **(Figure 13a-3, Page 13a-6)**. **See following NOTE.**

NOTE: *Both oil hoses are molded parts. Do not replace with standard cut-to-length hose. Replace with OEM hoses.*

2. Secure the hoses to the port nozzles with clamps. **See following NOTE.**

NOTE: *Make sure the outlet port on the engine is connected to the inlet port on the oil filter and the outlet port of the oil filter is connected to the inlet port on the engine.*

Use new clamps when the hoses are replaced.

3. Fill the engine with engine oil. **See Engine Oil Filling, Section 10b, Page 10b-11.**

EXHAUST SYSTEM

MUFFLER REMOVAL

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. Remove the spark plug wires. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Loosen the muffler spring suspension bracket bolts.
4. Remove the two springs that secure the muffler inlet to the intermediate pipe **(Figure 13a-4, Page 13a-7)**. **See following NOTE.**

NOTE: *Shift the end of the muffler inlet and intermediate pipe from side to side to relax and disconnect the springs.*

5. Remove the two bolts and large flat washers that secure the muffler to the chassis and remove the muffler. **See following WARNING and NOTE.**

⚠ WARNING

- **Always wear eye protection when springs are removed or installed.**

NOTE: *Replace springs that show signs of brittleness, broken coils, or loss of tension.*

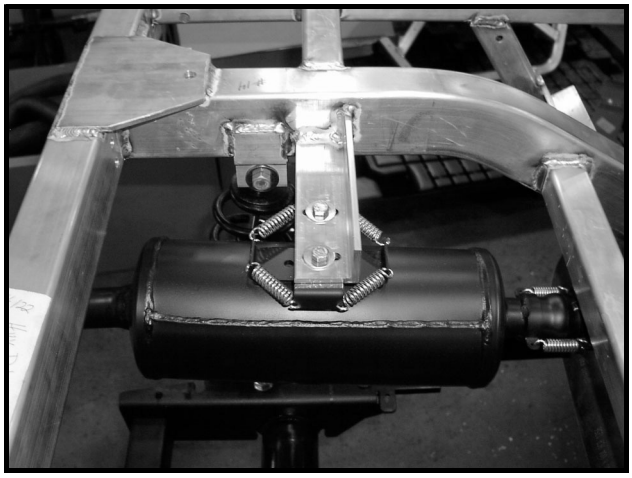


Figure 13a-4 Muffler Bracket and Inlet Pipe

INTERMEDIATE PIPE REMOVAL

1. Loosen the muffler spring suspension bracket bolts.
2. Remove the springs from the intermediate pipe and muffler inlet. **See following WARNING and NOTE.**

⚠ WARNING

- **Always wear eye protection when springs are removed or installed.**

NOTE: *Shift the end of the muffler inlet and intermediate pipe from side to side to relax and disconnect the springs.*

3. Remove the springs from the intermediate pipe and manifold pipe and remove the pipe.

INTERMEDIATE PIPE INSTALLATION

1. Secure the intermediate pipe to the manifold pipe with new springs. **See following WARNING and NOTE.**

⚠ WARNING

- **Always wear eye protection when springs are removed or installed.**

NOTE: *Shift the end of the muffler inlet and intermediate pipe from side to side to relax and connect the springs.*

2. Secure the intermediate pipe to the muffler inlet with new springs. **See previous NOTE and WARNING.**
3. Align the muffler with the intermediate pipe and tighten the muffler spring suspension bracket bolts to 21 ft-lb (29 N·m).

MUFFLER INSTALLATION

NOTE: *Replace springs that show signs of brittleness, broken coils, or loss of tension.*

1. Loosely secure the muffler and spring suspension bracket to the chassis with two bolts and large flat washers **(Figure 13a-4, Page 13a-7)**.
2. Secure the muffler inlet to the intermediate pipe with new springs. **See following WARNING and NOTE.**

⚠ WARNING

- **Always wear eye protection when springs are removed or installed.**

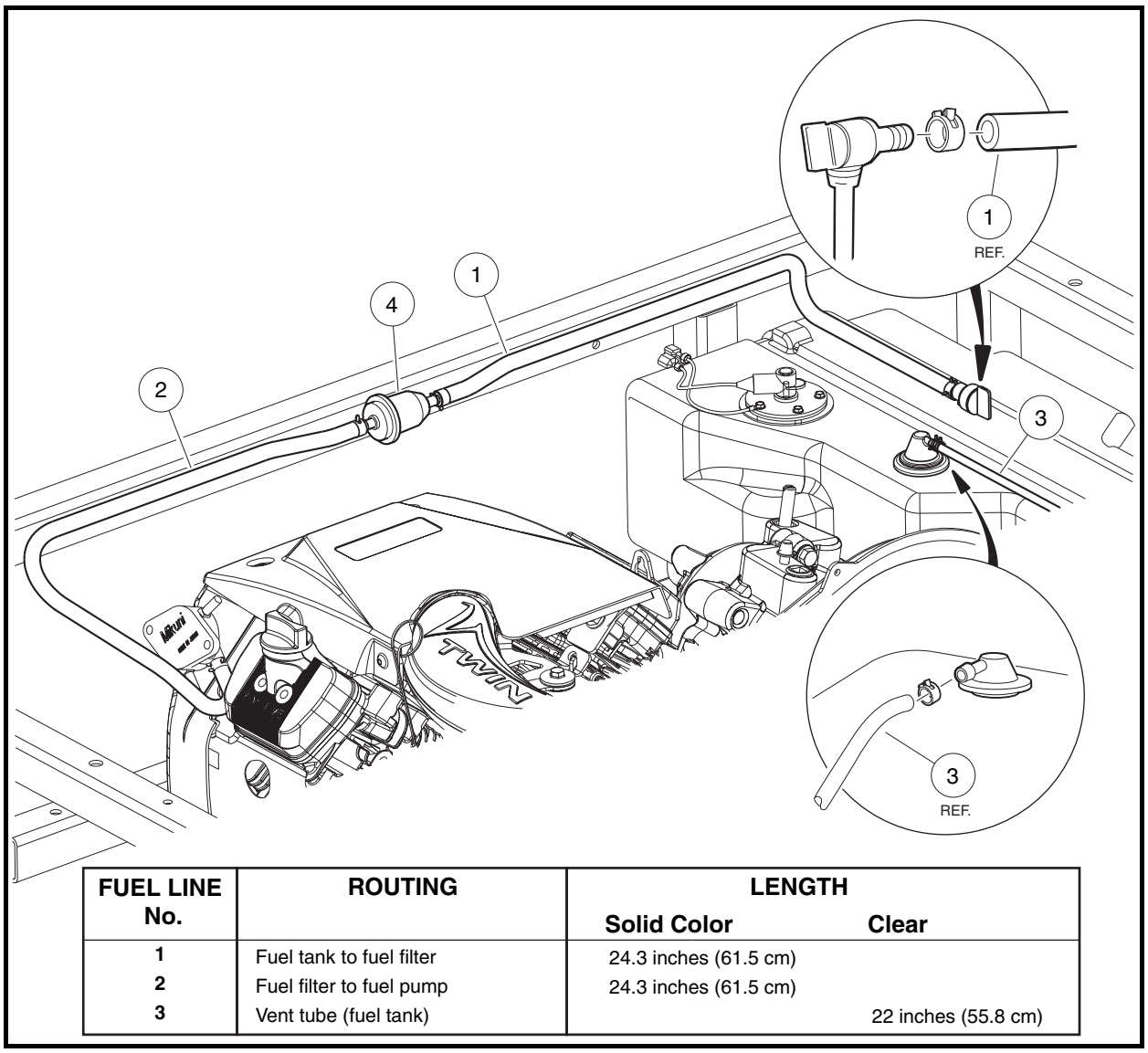
NOTE: *Shift the end of the muffler inlet and intermediate pipe from side to side to connect the spring that is least extended.*

3. Align the muffler with the intermediate pipe and tighten the muffler spring bracket hardware to 21 ft-lb (29 N·m).
4. Connect the spark plug wires.
5. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
6. Place the Forward/Reverse handle in NEUTRAL and turn the key switch to start the engine. Check for exhaust leaks and proper engine operation. **See following DANGER.**

⚠ DANGER

- **The engine produces carbon monoxide, which is an odorless, deadly poison. Do not operate the engine in an enclosed area without proper ventilation.**

FUEL SYSTEM



FUEL LINE No.	ROUTING	LENGTH	
		Solid Color	Clear
1	Fuel tank to fuel filter	24.3 inches (61.5 cm)	
2	Fuel filter to fuel pump	24.3 inches (61.5 cm)	
3	Vent tube (fuel tank)		22 inches (55.8 cm)

Figure 13a-5 Fuel System (Kawasaki Powered Gasoline Vehicles)

FUEL LINES

See General Warning, Section 1, Page 1-1.

The fuel lines must be properly routed and all hose clamps must be tight **(Figure 13a-5, Page 13a-9)**. The fuel lines should be kept clean. **See following NOTE and WARNING.**

NOTE: *Use only 1/4-inch hoses with SAE J30R7 rating to replace the fuel lines.*

⚠ WARNING

- **Make sure fuel lines are the correct length and are properly routed. Failure to heed this warning could result in damage to the fuel lines and fire.**

FUEL FILTER

See General Warning, Section 1, Page 1-1.

One in-line filter (4) is installed between the fuel tank and the fuel pump **(Figure 13a-5, Page 13a-9)**. Fuel filters, fuel lines, and the fuel tank vent should be inspected periodically for leaks and replaced when necessary. Filter changes should not exceed the recommended interval. **See Periodic Service Schedule on page 10b-1.** Replace the fuel filter as instructed. **See the Kawasaki FH680D engine manual (CCI P/N 103351201).**

FUEL PUMP

See General Warning, Section 1, Page 1-1.

Procedures for inspection, removal, and installation can be found in the engine manual. **See the Kawasaki FH680D engine manual (CCI P/N 103351201).**

CARBURETOR

See General Warning, Section 1, Page 1-1.

Before suspecting the carburetor as the cause of poor engine performance, make sure the fuel and ignition systems are in proper operating condition. Check the following items:

- Spark plug and gap condition. **See the Kawasaki FH680D engine manual (CCI P/N 103351201).**
- Air filter element. **See Air Filter Replacement on page 13a-23.**
- Fuel filters. **See Fuel Filter on page 13a-10.**
- Choke and air intake system (for restriction of air flow). **See Air Intake System on page 13a-23.**
- Fuel pump. **See the Kawasaki FH680D engine manual (CCI P/N 103351201).**
- Fuel lines (from fuel tank to filter to pump to carburetor). **See Fuel Lines on page 13a-9.**
- Exhaust system (for restrictions).

If the carburetor has failed, replace it. **See the Kawasaki FH680D engine manual (CCI P/N 103351201).**

Carburetor Jetting

The Kawasaki FH680D engine is equipped with a carburetor that has fixed jets. These fixed jets do not require adjustment. The size of the main jet is determined by the altitude where the engine will be operating. The main jet size is set for the operating elevation of customer destination at the time of manufacture. In the event that carburetor jetting needs to be changed, determine the proper jet size for the operating altitude. **See the Main Jet Elevation/Size Chart.** After the proper jet size is determined, replace the main jet. **See the Kawasaki FH680D engine manual (CCI P/N 103351201).**

No adjustment of the pilot air screw is recommended.

The following chart lists the elevation ratings for various jet sizes.

Main Jet Elevation/Size Chart

ALTITUDE	KAWASAKI FH680 ENGINE MAIN JET SIZE
0-3300 ft. (0-1000 m)	102
3300-6600 ft. (1000-2000 m)	99
6600 ft. and higher (2000 m and higher)	96

FUEL LEVEL SENDING UNIT

See General Warning, Section 1, Page 1-1.

Fuel Level Sending Unit Removal

⚠ DANGER

- **Gasoline! Flammable! Explosive! Do not smoke. Keep sparks and flames away from the vehicle and service area.**

⚠ WARNING

- **Do not use electrically powered tools to remove or install the fuel level sending unit. Failure to heed this warning could result in a fire or explosion.**

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Disconnect the spark plug wires. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
4. Remove the passenger seat. **See Seat Removal, Section 4, Page 4-9.**
5. Remove the rubber boot (8) from the center post on the fuel level sending unit. Remove the nut (9) from the center post and remove the orange wire (7) **(Figure 13a-6, Page 13a-12)**. Retain the hardware.
6. Remove the hex-head plastic thread screw (10) securing the black ground wire (6) to the fuel level sending unit and remove the black ground wire. Retain the hardware.
7. Remove the four remaining hex-head plastic thread screws from the fuel level sending unit flange (5). Retain the hardware.
8. Carefully remove the sending unit and gasket (3). Feed the rheostat arm and float (4) through the fuel tank hole. Immediately place the fuel level sending unit in a pan to catch fuel. **See following DANGER and NOTE.**

⚠ DANGER

- **Clean up any spilled fuel before operating the vehicle.**

NOTE: *The rheostat arm and float should be positioned toward the outside surface of the fuel tank.*

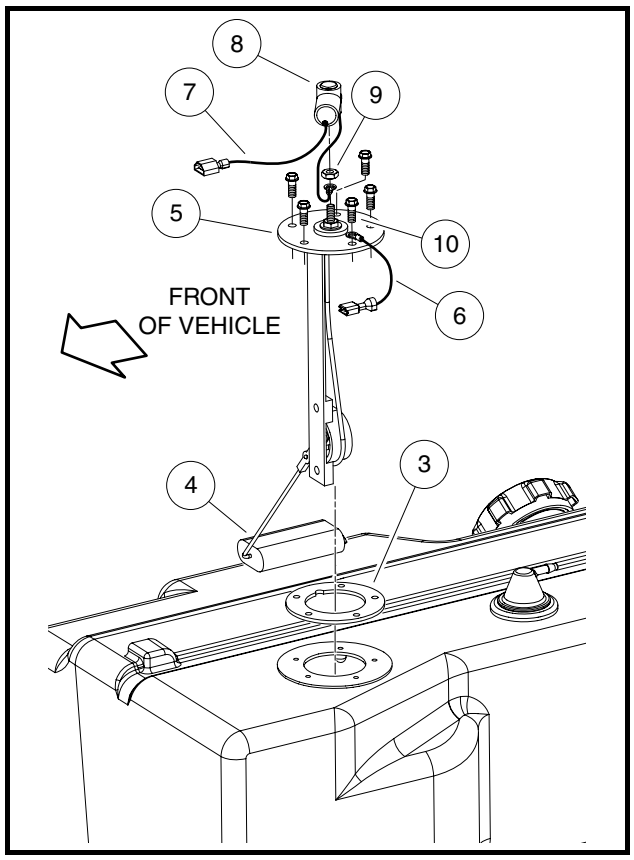


Figure 13a-6 Fuel Level Sending Unit Removal

Fuel Level Sending Unit Installation

⚠ WARNING

- **Do not use electrically powered tools to remove or install the fuel level sending unit. Failure to heed this warning could result in a fire or explosion.**

⚠ DANGER

- **Gasoline! Flammable! Explosive! Do not smoke. Keep sparks and flames away from the vehicle and service area.**

1. Place a new rubber gasket on the fuel tank with the notch (2) centered between the flange identification mounting holes (1). **(Figure 13a-7, Page 13a-13)**. **See following NOTE.**

NOTE: *The distance between the flange identification mounting holes (1) is larger than the distance between any of the other mounting holes in the sending unit flange (5).*

Ensure the replacement gasket is rubber and that the mounting holes in the gasket are aligned properly with the mounting holes on the fuel tank.

2. Feed a new sending unit rheostat arm and float (4) into the fuel tank **(Figure 13a-6, Page 13a-12)**. The rheostat arm and float should be positioned toward the outside surface of the fuel tank **(Figure 13a-8, Page 13a-13)**.
3. Align the flange identification mounting holes (1) directly over the corresponding mounting holes in the gasket and fuel tank **(Figure 13a-7, Page 13a-13)**. **See following CAUTION and NOTE.**

⚠ CAUTION

- **Ensure all mounting holes in the fuel level sending unit, gasket, and fuel tank are aligned properly before hardware is installed. Improper alignment of the mounting holes could result in an incomplete seal between the fuel level sending unit and the fuel tank.**

NOTE: *The fuel level sending unit mounts to the fuel tank only one way. If the unit does not fit on the fuel tank correctly, adjust the unit until it is properly aligned with the fuel tank.*

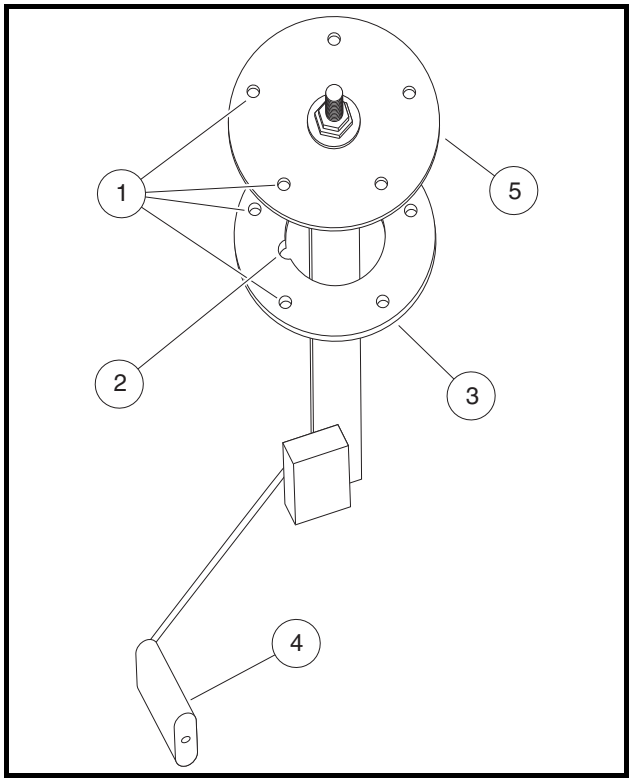


Figure 13a-7 Fuel Level Sending Unit Alignment

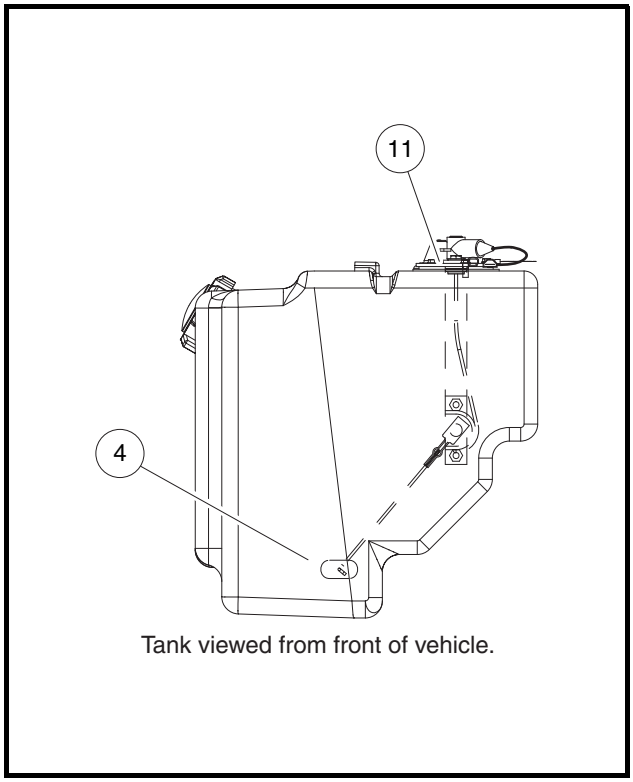


Figure 13a-8 Fuel Level Sending Unit Position

4. Carefully thread each hex-head screw by hand, with the ring terminal on the black ground wire (6) under the screw head closest to the engine **(Figure 13a-6, Page 13a-12)**. **See following CAUTION.**

CAUTION

- **Use only the existing screws or new plastic-thread screws made for plastics applications. Do not use sheet metal screws as replacement hardware.**

5. Use a crisscross pattern to tighten the hardware to 9 in-lb (1 N·m). If the hardware cannot be tightened to 9 in-lb (1 N·m), the fuel tank must be replaced. **See following CAUTION.**

CAUTION

- **Do not overtighten the screws. Overtightening the screws will strip the mounting holes in the fuel tank.**

6. Secure the orange wire (7) to the center post with the nut (9) previously removed **(Figure 13a-6, Page 13a-12)**. Tighten the hardware to 17 in-lb (1.9 N·m) and secure the rubber boot (8) to the center post.
7. Install the passenger seat. **See Seat Installation, Section 4, Page 4-9.**
8. Connect the spark plug wires.
9. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

FUEL TANK

See General Warning, Section 1, Page 1-1.

⚠ WARNING

- **If the fuel tank is damaged, replace it. Do not attempt to repair it. See the following tank removal and disposal procedure.**

Fuel Tank Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Remove both seats.
4. Remove the center seat plate.
5. Remove the upper portion of the ROPS. **See ROPS Removal, Section 4, Page 4-7.**
6. Remove the bolts, washers and flanged locknuts from the seat frame, seat side plates, and engine cover plate.
7. Turn the fuel shut-off valve to the closed (OFF) position **(Figure 13a-11, Page 13a-17)**.
8. Run the engine until all fuel in the carburetor, fuel pump, and fuel lines is used and the engine stalls.
9. Loosen the clamp and disconnect the fuel line from the fuel tank shut-off valve **(Figure 13a-9, Page 13a-15)**.
10. Loosen the clamp and remove the vent tube from the fuel tank**.**
11. Remove the fuel tank cap.
12. Use a siphon with a built-in suction device to siphon all fuel from the tank and into an approved container. **See following DANGER and WARNING.**

⚠ DANGER

- **Gasoline! Flammable! Explosive! Do not smoke. Keep sparks and flames away from the vehicle and service area.**

⚠ WARNING

- **Never attempt to siphon fuel with a hose that does not have a built-in suction device.**
- **Never attempt to siphon fuel with your mouth.**

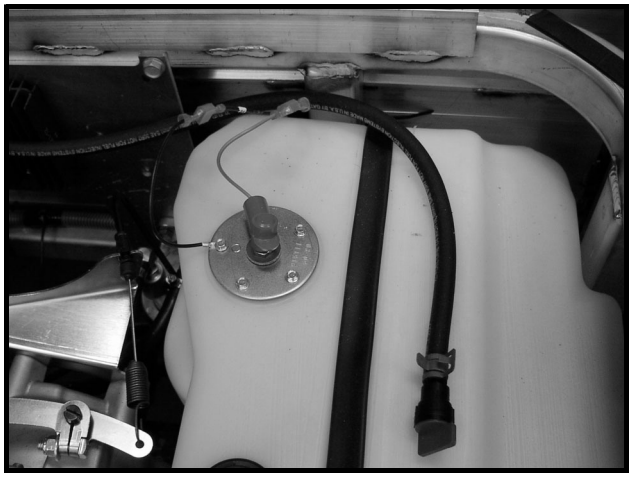


Figure 13a-9 Gasoline Fuel Tank

13. Disconnect the black wire and orange wire from the fuel level sensor on the tank. Do not remove the lower nut from the center stud of the sensor.
14. Remove the nut from the strap end below the passenger seat area.
15. Lift the strap end and remove the opposite end from the slotted bracket.
16. Remove the passenger side bed latch bracket from the frame.
17. Remove the fuel tank.

Fuel Tank Storage or Disposal

1. Remove the cap from the tank and thoroughly rinse it with water. The cap may be discarded or kept as a spare.
2. Use a well-ventilated area and flush the fuel tank with water to remove any remaining fuel.
3. Set the tank upside down in a well-ventilated area so that the water can drain. Allow the tank to sit for 24 hours to dry. **See following WARNING.**

⚠ WARNING

- **Dispose of wastewater and fuel tank in accordance with federal, state, and local laws and ordinances.**

4. Store the tank upside down with the cap installed in a well-ventilated area.

Fuel Tank Installation

1. Install the fuel tank in the vehicle.
2. Insert the tab end of the strap into the frame bracket and place the strap in the indentions on the tank.
3. Feed the threaded tab end down into the bottom of the frame. Install a nylon locknut and tighten the nut to 40 in-lb (4.5 N·m). **See following NOTE.**

4. Connect the clear vent tube to the fuel tank vent and secure the tube with a new clamp.
5. Connect the fuel line to the fuel tank shut-off valve and secure the line with a new clamp.
6. Connect the black wire and orange wire to the sensor **(Figure 13a-10, Page 13a-16)**.
7. Slide the rubber boot over the stud.
8. Install the passenger-side bed latch bracket on the frame with a bolt and flanged nylon locknut. Tighten the hardware to 20 ft-lb (27 N·m).
9. Install the seat frame on the vehicle frame. Secure the seat side plates with bolts, flat washers, and flanged locknuts. Tighten the nut to 37 ft-lb (50 N·m).
10. Install the top portion of the ROPS. **See ROPS Installation, Section 4, Page 4-8.**

Figure 13a-10 Fuel Level Sensor

11. Install the center seat plate.
12. Add the appropriate fuel to the fuel tank.
13. Ensure the fuel shut-off valve on top of the fuel tank is in the open (ON) position **(Figure 13a-12, Page 13a-17 and Figure 13a-13, Page 13a-17)**.
14. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
15. Install both seats.
16. With the Forward/Reverse handle in NEUTRAL, start the engine and allow it to idle. Run the engine for a few minutes to ensure that the fuel lines are full of fuel. **See following DANGER.**

⚠ DANGER

- **The engine produces carbon monoxide, which is an odorless, deadly poison. Do not operate the engine in an enclosed area without proper ventilation.**
- **After installing the fuel tank and adding fuel, carefully check all fuel lines and connections for leaks. Repair leaks before the vehicle is returned to service.**

17. Inspect each fuel line connection for leaks.
    17.1. Check all clamps at the carburetor, fuel filters, fuel pump, and fuel tank for leaks.
    17.2. Inspect each fuel line to ensure that the lines are not cracked, cut, or worn.

FUEL SHUT-OFF VALVE

See General Warning, Section 1, Page 1-1.

The fuel shut-off valve is located on top of the fuel tank **(Figure 13a-9, Page 13a-15)**. The fuel shut-off valve should always be turned to the closed (OFF) position during vehicle storage, towing or trailering, and maintenance and service **(Figure 13a-11, Page 13a-17)**.

Fully Open Position

To open the valve fully, it must be turned approximately 120° from the closed (OFF) position (until it cannot be turned any further) **(Figure 13a-12, Page 13a-17).** If the valve becomes partially closed, the engine will be starved for fuel and will not run properly **(Figure 13a-13, Page 13a-17)**.

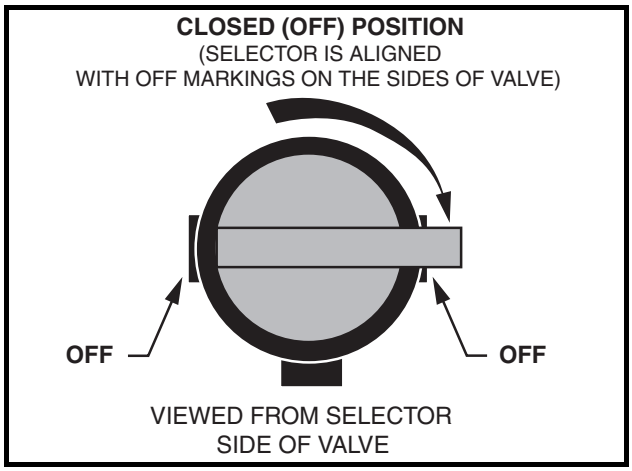


Figure 13a-11 Closed Fuel Shut-Off Valve

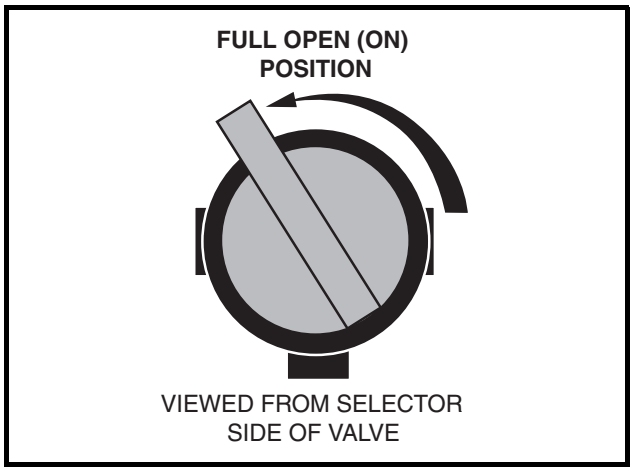


Figure 13a-12 Open Fuel Shut-Off Valve

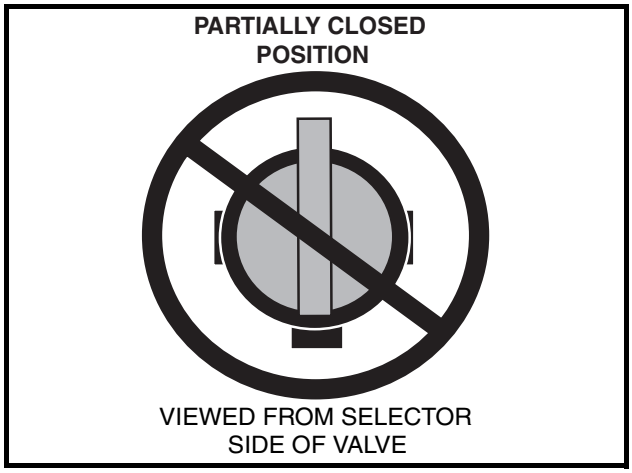


Figure 13a-13 Incorrect Fuel Shut-Off Valve

ENGINE CONTROL LINKAGES

ACCELERATOR CABLE

See General Warning, Section 1, Page 1-1.

⚠ WARNING

- **To avoid unintentionally starting the vehicle:**
  - **Disconnect battery cables, negative (–) cable first (Figure 1-2, Page 1-3).**
  - **Disconnect the spark plug wires from the spark plugs.**

Accelerator Cable Removal

NOTE: *When the accelerator cable is replaced, the high-speed RPM must be adjusted.* ***See High-Speed RPM Adjustment on page 13a-22.***

1. Turn the key switch OFF and place the Forward/Reverse handle in NEUTRAL. Remove the key. Chock the rear wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Raise the hood.
4. Remove the seat(s) and the engine top cover. **See Seat Removal, Section 4, Page 4-9.**
5. Disconnect the accelerator cable (3) from the engine **(Figure 13a-16, Page 13a-19)**.
   5.1. Remove the E-clip (6) securing the cable ring end (7) and remove the accelerator cable (3) from the accelerator linkage pin (8)
   5.2. Remove the cable sheath strain relief (4) from the bracket (5).
6. Release the retention clip (2) at the pedal bracket **(Figure 13a-15, Page 13a-18)**.
7. Disconnect the Z-shaped end (1) on the accelerator cable from the pedal **(Figure 13a-14, Page 13a-18).**

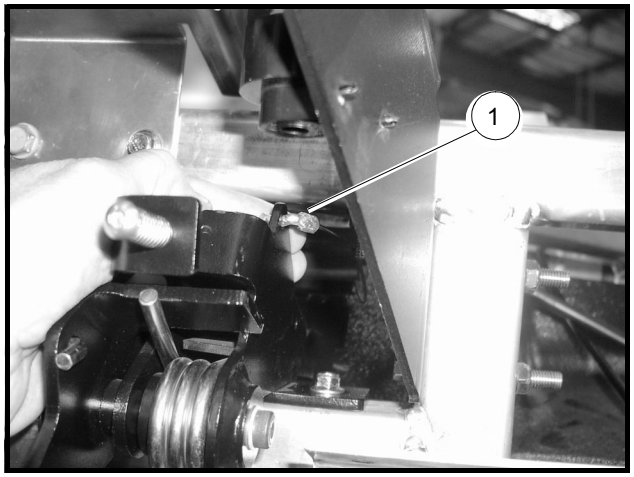


Figure 13a-14 Z-Shaped Cable End (Gasoline Vehicles)

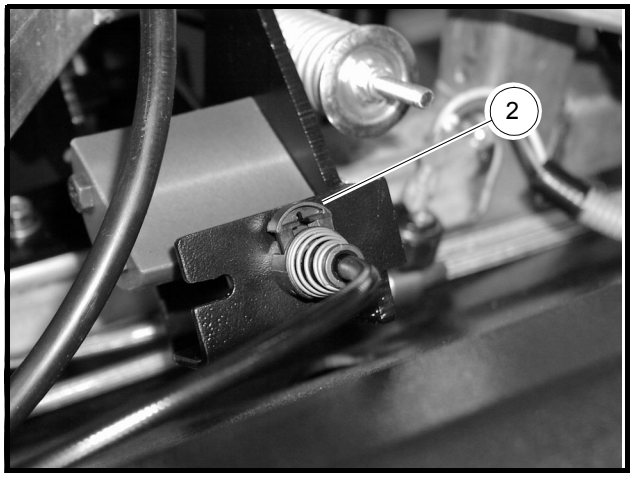


Figure 13a-15 Accelerator Cable Pedal Bracket (Gasoline Vehicles)

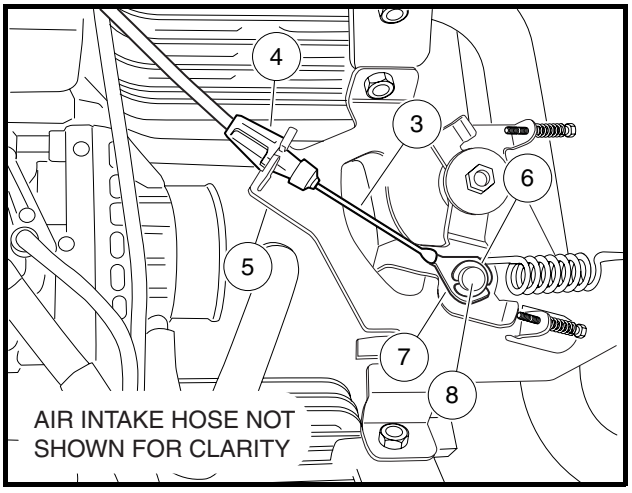


Figure 13a-16 Accelerator Cable at Engine

8. Remove the accelerator cable from the plastic retaining clips under the passenger side of the frame. Pull the cable at the dashboard to remove it from the engine compartment. **See following NOTE.**

NOTE: *Tie a nylon cord to each end of the cable before removing it from the vehicle. Allow the cord to travel from the attachment points and under the frame. The routed cord can then be used during installation.*

Accelerator Cable Installation

NOTE: *When the accelerator cable is replaced, the high-speed RPM must be adjusted. See High-Speed RPM Adjustment on page 13a-22.*

1. Feed the pedal end and governor end of the accelerator cable up into place from under the vehicle on the passenger side. **See following NOTE.**

NOTE: *Tie the nylon cord routed during removal to the engine end of the cable. Pull the nylon cord to help feed the cable back through the instrument panel area and engine compartment.*

2. Secure the cable to the plastic retaining clips under the passenger side of the frame.
3. Connect the accelerator cable to the pedal.
   3.1. Insert the Z-shaped end of cable (1) into the hole in the pedal **(Figure 13a-17, Page 13a-20)**.
   3.2. Secure the retention clip (2) at the pedal bracket **(Figure 13a-15, Page 13a-18)**.
4. Connect the accelerator cable (3) to the accelerator linkage pin (8) on the engine **(Figure 13a-16, Page 13a-19)**.
   4.1. Secure the cable sheath strain relief (4) to the bracket (5).
   4.2. Secure the cable ring end (7) with the E-clip (6).

5. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

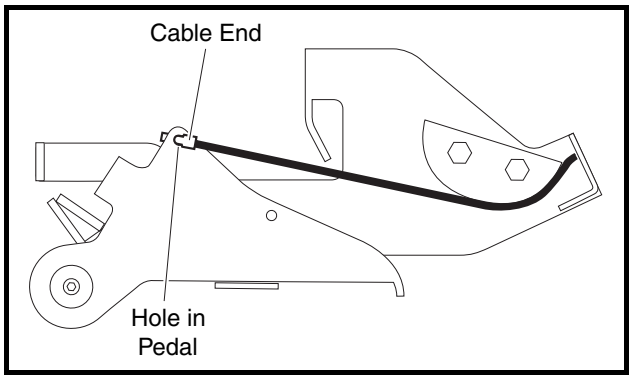


Figure 13a-17 Z-Shaped Cable End in Hole at Pedal

CHOKE CABLE

Choke Cable Removal

1. Turn the key switch OFF and remove the key. Set the park brake. Place the Forward/Reverse handle in NEUTRAL and chock the rear wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Remove seat(s).
4. Remove the center seat plate (bucket seat vehicles only).
5. Remove the engine top cover.
6. Remove the choke cable return spring (1) from the hook on the choke lever **(Figure 13a-18, Page 13a-21)**.
7. Remove the Z-shaped cable end (2) from the choke lever on the carburetor.
8. Remove the engine front cover (4) **(Figure 13a-19, Page 13a-21)**.
9. Remove the cable sheath strain relief (3) from the engine front cover **(Figure 13a-19, Page 13a-21)**.
10. Raise the hood.
11. Compress the choke ferrule tines on the back side of the instrument panel. Pull the cable up from the engine compartment and remove the cable. **See following NOTE.**

NOTE: *Tie a heavy nylon cord to the cable end before removing the cable. Allow the cord to travel from the engine compartment up through the instrument panel hole. Use the cord to route the cable during installation.*

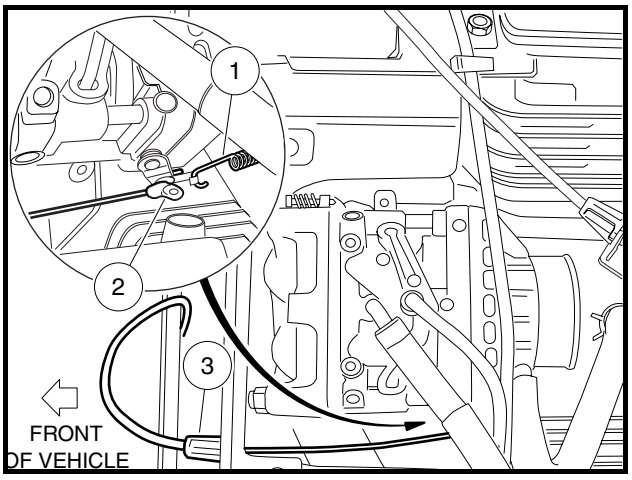


Figure 13a-18 Choke Cable on Engine

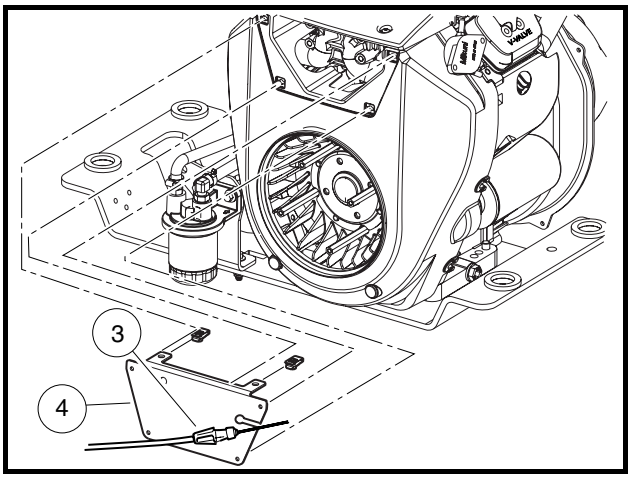


Figure 13a-19 Choke Cable Through Front Cover

Choke Cable Installation

1. Secure a new choke cable to the nylon cord outside of the instrument panel. At the engine compartment, pull the nylon cord until the choke cable reaches the engine.
2. Push the choke cable ferrule into the instrument panel hole so the tines engage behind the panel.
3. Secure the choke cable to the frame with the plastic retention clips.
4. Install the engine front cover (4) and secure with pan-head screws tightened to 54 in-lb (6 N·m) **(Figure 13a-19, Page 13a-21)**.
5. Feed the Z-shaped cable end (2) of the choke cable through the engine front cover **(Figure 13a-19, Page 13a-21)**.
6. Push the cable sheath strain relief (3) into the engine front cover (4) until it snaps into place.
7. Insert and secure the Z-shaped end of the choke cable (2) to the choke lever on the side of the carburetor.
8. Secure the choke cable return spring (1) to the hook on the choke lever **(Figure 13a-18, Page 13a-21)**.
9. Install the engine top cover and tighten the four bolts to 35 in-lb (4 N·m).
10. Install the center seat plate.
11. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
12. Install the center seat plate (bucket seat vehicles only).
13. Install seat(s).
14. Lower and secure the hood.

ENGINE GOVERNOR ARM

See General Warning, Section 1, Page 1-1.

Engine Governor Arm Removal and Installation

Refer to the engine manual for additional testing, removal, disassembly, and installation procedures. See the Kawasaki FH680D engine manual (CCI P/N 103351201).

ENGINE RPM ADJUSTMENT

Idle RPM Adjustment

⚠ DANGER

- **Do not operate the engine in an enclosed area without proper ventilation. The engine produces carbon monoxide, which is an odorless, deadly poison.**

1. Turn the key switch to start and run the engine. Place the Forward/Reverse handle in NEUTRAL. Place a tachometer (CCI P/N 1016112) close to the spark plug wire and plug.
2. Hold the throttle lever against the stop screw and adjust the carburetor idle screw (1) on the carburetor until the tachometer displays 1125 ± 50 RPM **(Figure 13a-20, Page 13a-22)**.
3. Release the throttle lever.
4. Adjust the engine idle screw (2) until the tachometer displays 1300 ± 50 RPM.

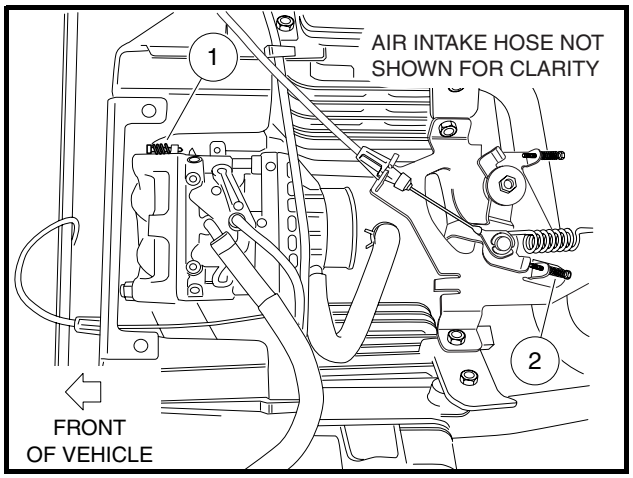


Figure 13a-20 Idle RPM Adjustment Screws

Figure 13a-21 High-speed RPM Adjustment Screw

High-Speed RPM Adjustment

⚠ DANGER

- **Do not operate the engine in an enclosed area without proper ventilation. The engine produces carbon monoxide, which is an odorless, deadly poison.**

1. Press the accelerator pedal all the way to the floor.
2. Place a tachometer (CCI P/N 1016112) close to the spark pug wire and plug.
3. Adjust the high-speed RPM screw (1) until the tachometer displays 3825 ± 25 RPM **(Figure 13a-21, Page 13a-22)**. **See following NOTE.**

NOTE: *Turn the screw counterclockwise to raise the RPM and clockwise to lower the RPM.*

4. Release the accelerator pedal.

AIR INTAKE SYSTEM

See General Warning, Section 1, Page 1-1.

AIR FILTER REPLACEMENT

The air filter should be inspected periodically and replaced when necessary. Filter changes should not exceed the recommended interval. **See Periodic Service Schedule, Section 10b, Page 10b-1.** More frequent service may be required in extremely dirty operating environments. In the event of a loss of power, sluggish acceleration, or a roughly running engine with excessive black exhaust, service the air filter immediately.

CAUTION

- **Do not drill into the driver-side frame. Failure to heed this caution could damage the engine by allowing excessive contamination to enter the air intake system.**

Air Filter Removal

1. Release both canister tab locks **(Figure 13a-22, Page 13a-24)**.
2. Pull the canister cap away from the canister.
3. Remove the air filter cartridge. **See following NOTE.**

NOTE: *The filter cartridge is specifically designed for this engine. It fits into the canister only one way. Use only direct replacement part (CCI P/N 102498601).*

Air Filter Installation

1. Push the new filter cartridge onto the nozzle inside the canister.
2. Position the canister cap so the TOP mark is at the top center of the canister **(Figure 13a-22, Page 13a-24)**.

3. Use both tab locks on the sides of the cap to secure the canister cap.

Figure 13a-22 Air Filter Cartridge

AIR CANISTER REMOVAL

1. Turn the key switch OFF and remove the key. Set the park brake. Place the Forward/Reverse handle in NEUTRAL.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Remove the air filter cartridge. **See Air Filter Removal on page 13a-23.**
4. Remove the bottom (inlet) hose from the canister **(Figure 13a-26, Page 13a-26)**.
5. Remove the top (outlet) hose from the canister.
6. Remove the two bolts and park brake cable from the canister and remove the canister.

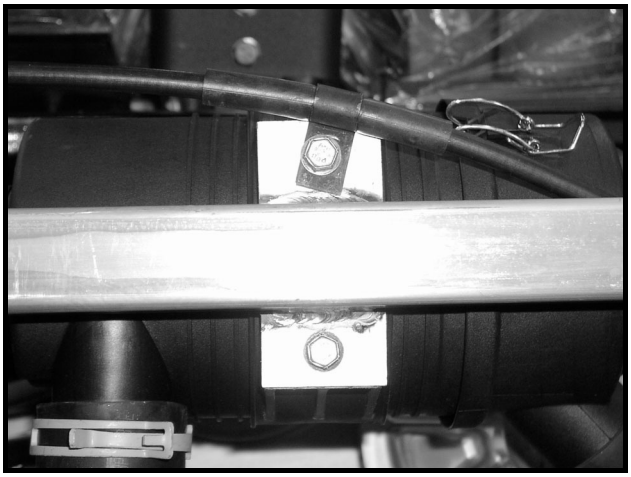


Figure 13a-23 Air Filter Canister

AIR CANISTER INSTALLATION

1. Position the canister next to the frame bracket with the rubber valve down.

2. Install two bolts to secure the canister base bracket and vehicle frame bracket. Tighten the hardware to 21 ft-lb (28.5 N·m).
3. Secure the bottom (inlet) hose to the canister port.
4. Secure the top (outlet) hose to the canister port.
5. Install a new air filter cartridge. **See Air Filter Installation on page 13a-23.**
6. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

AIR FILTER INTAKE HOSE REMOVAL

The air filter intake hose fits between the driver-side frame and the inlet port on the air filter canister. The frame serves as a duct to carry air from a location at the top of the front of the vehicle.

⚠ CAUTION

- **Do not drill holes or attach anything to the driver side of the frame. A penetrating fastener will create passages that could allow moisture and/or dirt to enter the engine air intake system.**

1. Turn the key switch OFF and remove the key. Set the park brake. Place the Forward/Reverse handle in NEUTRAL.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Remove the hose from under the filter canister.
4. Remove the hose from under the vehicle body on the frame.
5. Slide the hose through the frame support bracket and remove the hose from the vehicle **(Figure 13a-24, Page 13a-25)**.

Figure 13a-24 Air Intake Support Bracket

AIR FILTER INTAKE HOSE INSTALLATION

1. Slide the air intake hose through the frame support bracket **(Figure 13a-24, Page 13a-25)**.
2. Secure the air intake hose to the air port under the vehicle body **(Figure 13a-25, Page 13a-26)**.

3. Secure the air intake hose under the filter canister (inlet) port **(Figure 13a-26, Page 13a-26)**. **See following NOTE.**

NOTE: *Ensure the hose is positioned against the port surfaces and the clamps are positioned between the port bead and port surface.*

4. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

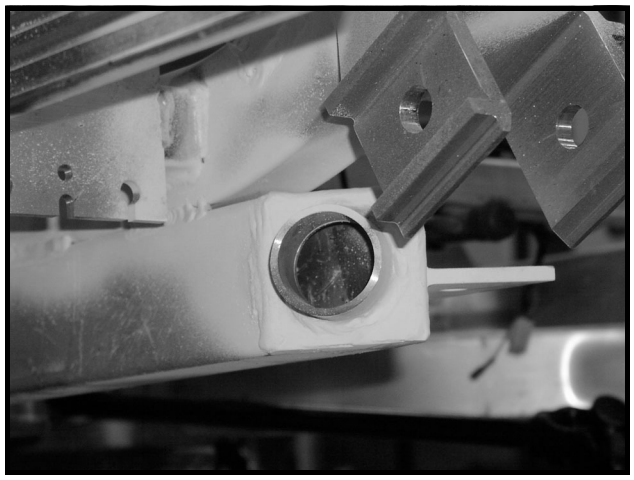


Figure 13a-25 Air Port on Frame

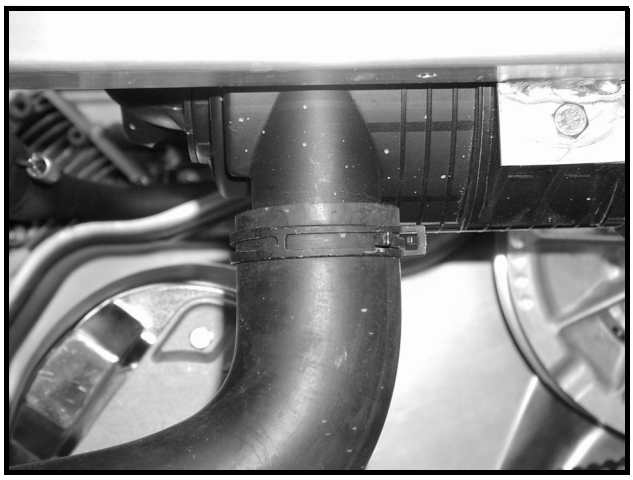


Figure 13a-26 Air Filter Inlet Hose

AIR FILTER OUTLET HOSE REMOVAL

1. Turn the key switch OFF and remove the key. Set the park brake. Place the Forward/Reverse handle in NEUTRAL.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Remove the hose end from the air filter canister outlet port.
4. Remove the hose end from the carburetor inlet port and remove the hose.

AIR FILTER OUTLET HOSE INSTALLATION

1. Connect the air filter outlet hose to the air filter outlet port and secure it with a clamp.
2. Connect the air filter outlet hose to the carburetor inlet port and secure it with a clamp.

3. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

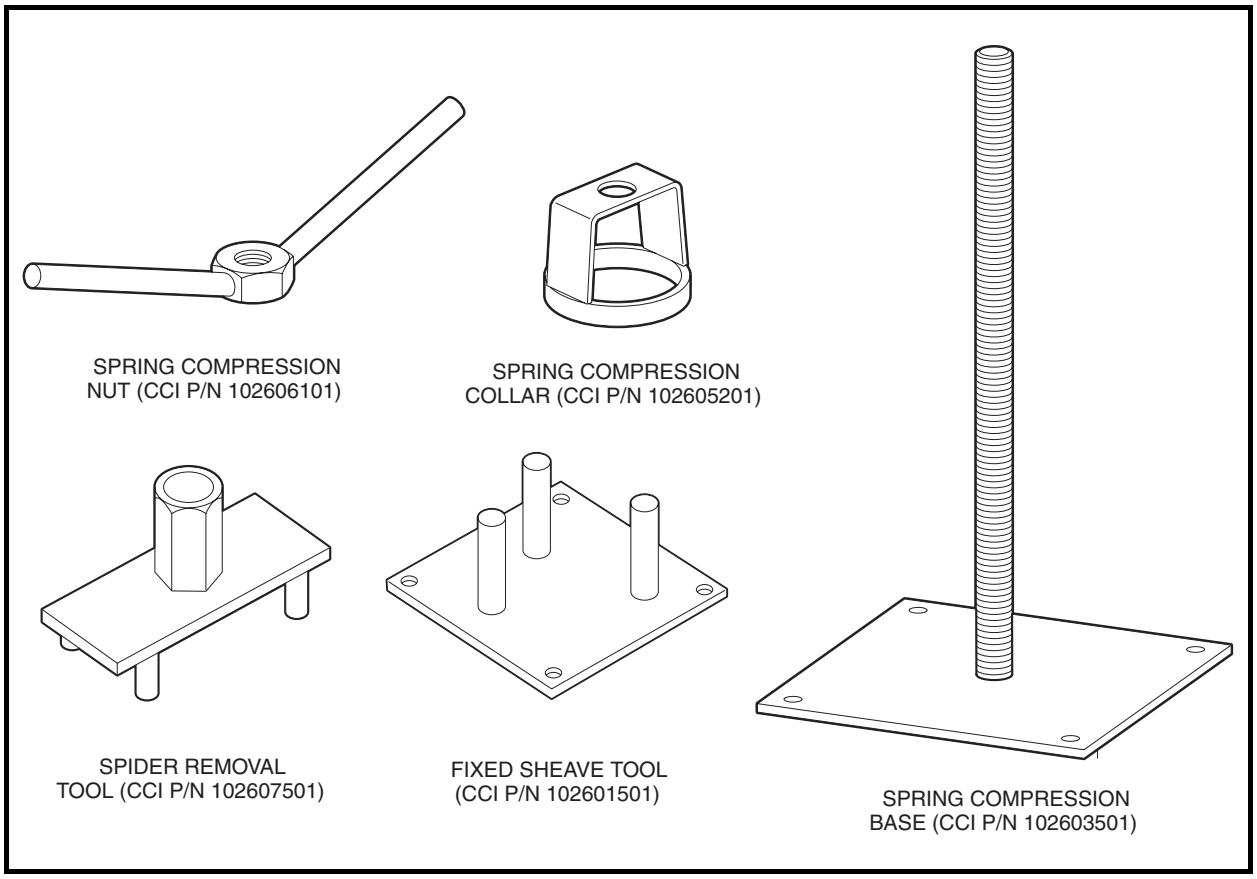


Figure 13a-27 Clutch Service Tools

CLUTCHES

To assemble and disassemble the drive and driven clutches properly, the following tools should be used:

- Drive clutch service tools:
  - Spider removal tool CCI P/N 102607501
  - Fixed sheave tool CCI P/N 102601501
- Driven clutch service tools:
  - Spring compression base CCI P/N 102603501
  - Spring compression collar CCI P/N 102605201
  - Spring compression nut CCI P/N 102606101

CLUTCH TROUBLESHOOTING

See General Warning, Section 1, Page 1-1.

Use a tachometer during vehicle operation to determine if the engine begins to lose RPM when the vehicle climbs a steep hill. Check the engine RPM and governor adjustments. If these adjustments are within specifications, there is a clutch problem. **See Engine RPM Adjustment on page 13a-22.**

If the clutches are not operating properly, perform the following:

1. Check the governor and throttle settings. **See Engine RPM Adjustment on page 13a-22.**
2. Inspect both clutches for dirt and debris buildup on component parts. Clean the exterior surfaces of both clutches with water to remove any dust or dirt, then drive the vehicle and check for proper operation. **See Drive Clutch on page 13a-29. See also Driven Clutch on page 13a-34.**
3. Check the clean clutches for wear.
4. If cleaning both clutches does not solve the problem, disassemble and thoroughly clean all parts in the drive and driven clutches.
5. Check the drive clutch rollers and weights for wear. **See Drive Clutch Cleaning and Inspection on page 13a-30.**

DRIVE BELT

See General Warning, Section 1, Page 1-1.

The drive belt should be inspected periodically for wear and glazing. If it is excessively worn, frayed, or glazed, replace the belt.

As the drive belt wears, the engine RPM will increase to compensate for the change in torque ratio. This RPM increase helps maintain the correct maximum ground speed of 25 mph (40 km/h).

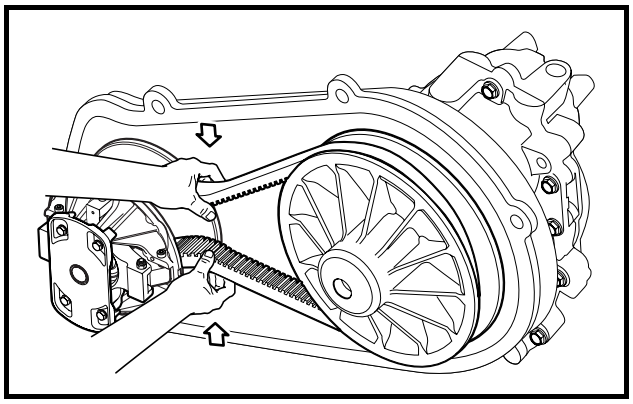


Figure 13a-28 Drive Belt Removal

Drive Belt Removal

1. Turn the key switch OFF and remove the key. Set the park brake. Place the Forward/Reverse handle in NEUTRAL.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Disconnect the spark plug wires. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
4. Remove the outer clutch cover. **See Clutch Outer Cover Removal on page 13a-37.**
5. Grasp the belt midway between the drive and driven clutches and squeeze the belt together as tightly as possible **(Figure 13a-28, Page 13a-28)**.
6. Guide the belt over the driven clutch and roll the belt off the driven clutch by rotating the clutch clockwise. **See following CAUTION.**

⚠ CAUTION

- **Make sure your fingers are not underneath the belt when rolling the belt off the driven clutch.**

Drive Belt Installation

1. Turn the key switch OFF and remove the key. Set the park brake. Place the Forward/Reverse handle in NEUTRAL.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Disconnect the spark plug wires. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
4. Remove the outer clutch cover. **See Clutch Outer Cover Removal on page 13a-37.**
5. Position the new belt on the drive clutch and then start the belt over the top of the driven clutch.
6. Rotate the driven clutch clockwise and roll the belt over the driven clutch sheaves and onto the clutch.
7. Install the outer clutch cover. **See Clutch Outer Cover Installation on page 13a-37.**
8. Connect the spark plug wires.
9. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

DRIVE CLUTCH

See General Warning, Section 1, Page 1-1.

CAUTION

- **Be very careful with the clutches. A clutch that has been dropped will not be properly balanced. If either clutch is dropped, assume that it is damaged and replace it.**

Drive Clutch Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Disconnect the spark plug wires. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
4. Remove the top air filter hose (outlet) from the air filter canister.
5. Remove the clutch outer cover. **See Clutch Outer Cover Removal on page 13a-37.**
6. Remove the drive belt. **See Drive Belt Removal on page 13a-28.**
7. Remove the bolt and washer from the center of the clutch.
8. Thread the clutch removal tool (CCI P/N 102686101) into the drive clutch center and advance the tool until the clutch is released from the crankshaft. **See following CAUTION.**

CAUTION

- **Hold the clutch assembly firmly when the clutch removal tool is advanced. Once loosened, the clutch will drop quickly. Do not allow the clutch to fall on a hard surface.**

9. Remove the drive clutch from the vehicle. **See following CAUTION.**

CAUTION

- **Do not hit or tap the clutch with a hammer. Do not pry the clutch. These actions will damage the clutch.**

Drive Clutch Cleaning and Inspection

1. Use a dry, lint-free cloth to clean clutch parts. **See following CAUTION**.

CAUTION

- **Do not lubricate the drive clutch. Lubricants attract dirt and dust, which interfere with proper clutch operation.**
- **Use only a dry cloth and lightly wipe the shaft of the fixed face assembly (15) (Figure 13a-30, Page 13a-33). Do not use a brush or steel wool. These abrasives will damage the surface of the shaft.**
- **Do not use solvents. Solvents will damage the lubricating characteristics of the bushings.**

2. Inspect the belt contact surfaces of the clutch sheaves for wear. If any area of a sheave contact surface has wear of 0.060 inch (1.52 mm) or more, the clutch should be replaced.

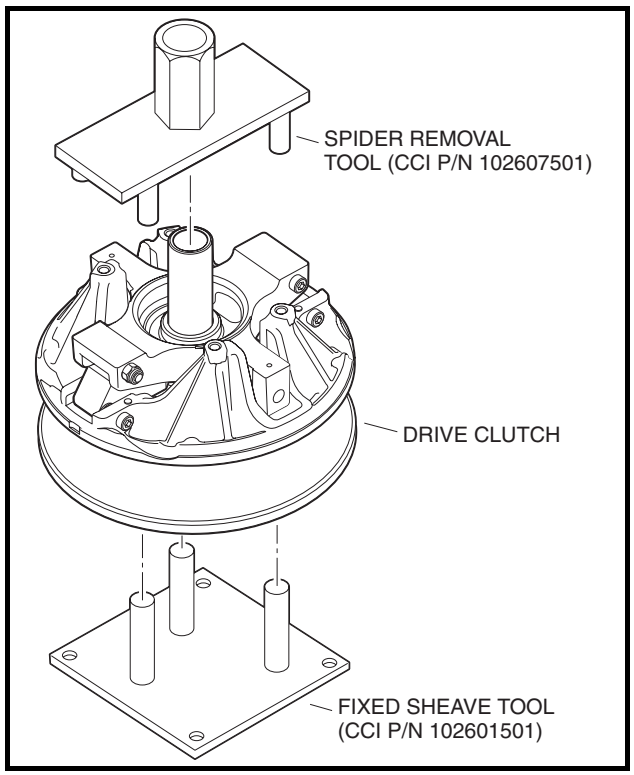


Figure 13a-29 Drive Clutch Service Tools

Drive Clutch Disassembly

The following service tools are required to disassemble the drive clutch and are available from a service parts representative:

- Fixed sheave tool (CCI P/N 102601501)
- Spider removal tool (CCI P/N 102607501)

1. Use a 7/16-inch socket to remove the four bolts (1) and washers (2) that secure the plate (3) to the clutch cover (4) **(Figure 13a-30, Page 13a-33)**.
2. Remove the cover (4) and spring (5) from the clutch spider (6).
3. Inspect the torque rollers (7), weights (11) and rollers (10). Replace if necessary.
4. Secure the Fixed sheave tool (CCI P/N 102601501) into a vise, or mount the tool to a flat work surface **(Figure 13a-29, Page 13a-30)**.
5. Place the fixed sheave of the drive clutch onto the service tool so that the drive clutch is stationary.
6. Place the Spider removal tool (CCI P/N 102607501) on top of the spider.
7. Use a 1/2-inch drive ratchet to disengage the moveable sheave (14) and spider (6), which will come off as an assembly, from the fixed sheave (15) **(Figure 13a-30, Page 13a-33)**.

Drive Clutch Component Inspection

1. Use a feeler gauge to inspect the torque rollers (7) and replace the rollers if necessary **(Figure 13a-30, Page 13a-33)**.
   1.1. Use a pin driver to drive out the pin (8), which will release a pin (9) and allow the rollers (7) to slide out of the spider (6).
   1.2. Install new rollers and secure the rollers with pins.
2. Inspect the rollers (10) and weights (11). There should be no noticeable wear. If the rollers or weights are worn, scratched, or damaged, replace them.
   2.1. Remove the bolts (12) and flex locknuts (13) that secure the rollers (10) to the spider (6) and the weights (11) to the moveable sheave (14).
   2.2. Install new rollers and weights with bolts and flex locknuts.

Drive Clutch Assembly

NOTE: *The drive clutch components are marked with an X to assist in correct reassembly. It is important to note the location of the X on the components and be sure to align the X's when assembling the drive clutch.*

1. Place the moveable sheave (14) and spider (6) onto the fixed sheave (15). Note the location of the X so the remaining components with an X can be aligned.
2. Use a spider removal tool (CCI P/N 102607501) to tighten the moveable sheave and spider to 225 ft-lb (305 N·m).
3. Install the spring (5) onto the shaft.
4. Install the cover (4) onto the shaft.
5. Align the plate that has holes in the cover with arrows on the same side. Pull the moveable sheave upward and start threading the bolts with washers into holes. **See following NOTE.**

NOTE: *Keep the cover as square to the post as possible to minimize wear between the post and cover.*

6. Use a crisscross pattern to continue tightening the hardware.
7. Tighten the bolts to 120 in-lb (14 N·m).

Drive Clutch Installation

1. Turn the key switch OFF and remove the key. Set the park brake. Place the Forward/Reverse handle in NEUTRAL.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Disconnect the spark plug wires. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
4. Place the drive clutch assembly on the crankshaft taper.
5. Install the mounting washer and retaining bolt. Tighten the hardware to 39 ft-lb (53 N·m).
6. Install the drive belt as instructed. **See Drive Belt Installation on page 13a-29.**
7. Install the clutch outer cover and tighten the bolts to 72 in-lb (8.0 N·m).
8. Secure the top air filter hose (outlet) to the filter canister. **See following NOTE.**

NOTE: *Ensure the hose contacts the canister and the clamp is installed tightly between the port bead and canister.*

9. Connect the spark plug wires.
10. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
11. Drive the vehicle and check for proper operation.

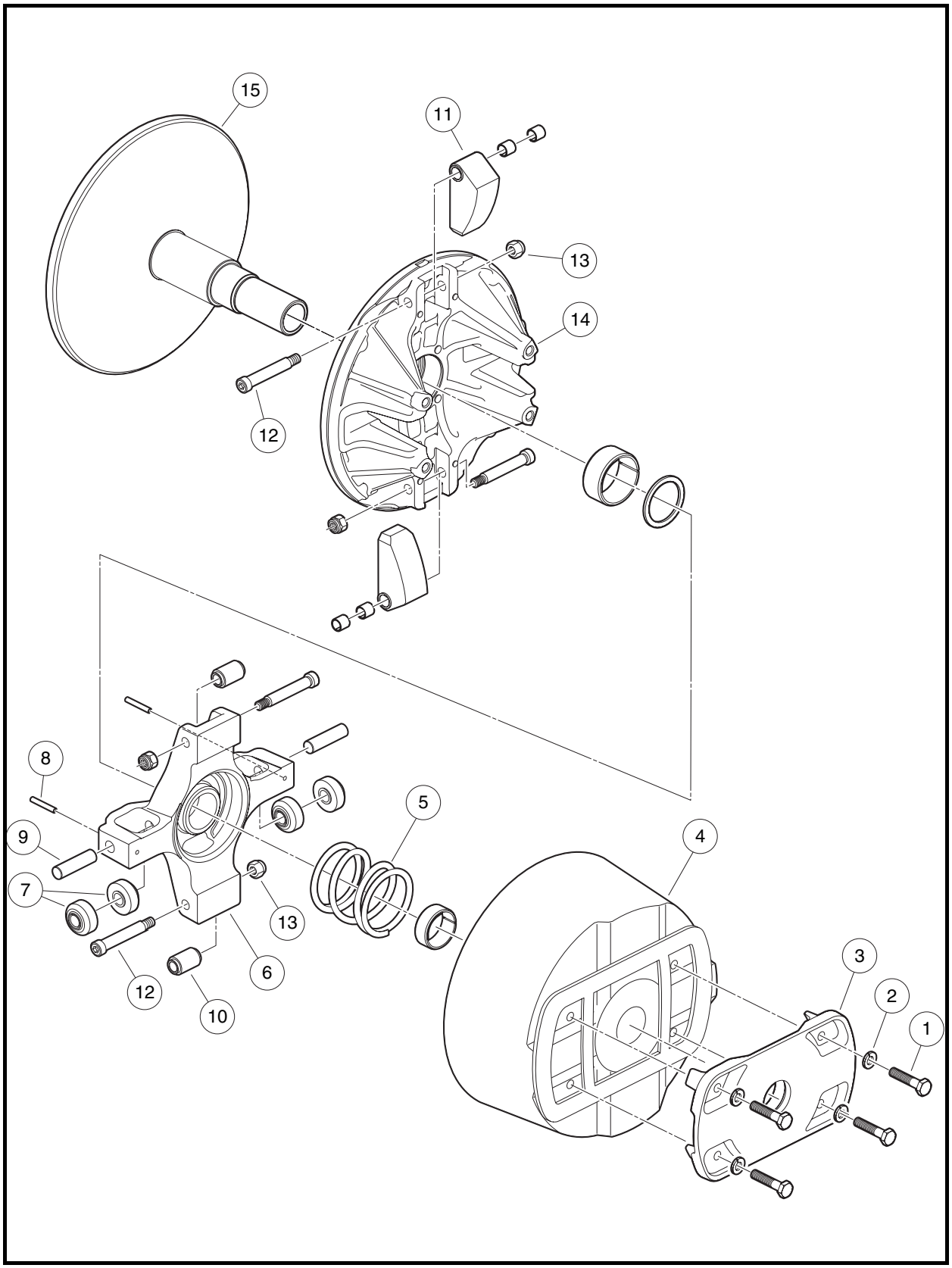


Figure 13a-30 Drive Clutch Assembly

DRIVEN CLUTCH

See General Warning, Section 1, Page 1-1.

Driven Clutch Removal

1. Turn the key switch OFF and remove the key. Set the park brake. Place the Forward/Reverse handle in NEUTRAL.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Disconnect the spark plug wires. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
4. Remove the top air filter hose from the filter canister.
5. Remove the clutch outer cover. **See Clutch Outer Cover Removal on page 13a-37.**
6. Remove the drive belt as instructed. **See Drive Belt Removal on page 13a-28.**
7. Remove the bolt and washer from the center of the clutch.
8. Remove the driven clutch from the vehicle. **See following CAUTION.**

CAUTION

- **Do not hit or tap the clutch with a hammer. Do not pry the clutch. These actions will damage the clutch.**

Driven Clutch Disassembly

The following service tools are required to disassemble and assemble the driven clutch. They are available from a service parts representative:

- Spring compression base (CCI P/N 102603501)
- Spring compression collar (CCI P/N 102605201)
- Spring compression nut (CCI P/N 102606101)

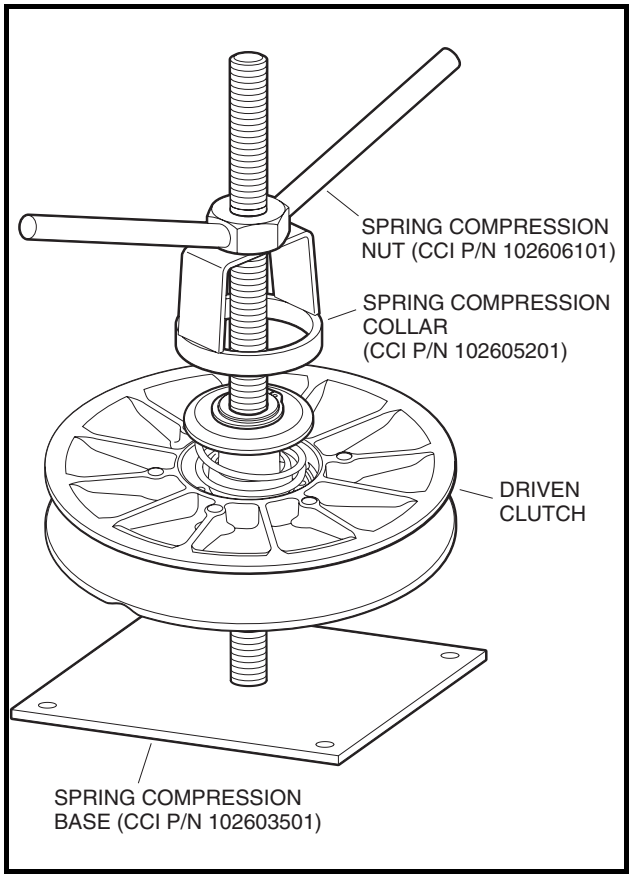


Figure 13a-31 Driven Clutch Service Tools

1. Place the driven clutch onto the Spring compression base (CCI P/N 102603501) **(Figure 13a-31, Page 13a-35)**.
2. Place the Spring compression collar (CCI P/N 102605201) onto the driven clutch.
3. Thread the Spring compression nut (CCI P/N 102606101) down onto the threaded post enough to release the pressure on the snap ring.
4. Use snap-ring pliers to remove the snap ring (1) **(Figure 13a-32, Page 13a-36)**.
5. Slowly remove the spring compression nut. The collar will then rise and release tension on the spring (3).
6. Remove the cup (2) and spring (3).
7. Remove the moveable sheave (4) from the fixed sheave (5). **See following NOTE.**

NOTE: *Both the moveable and fixed sheaves have spacers (6). Be sure to retain the spacers for reassembly of the driven clutch.*

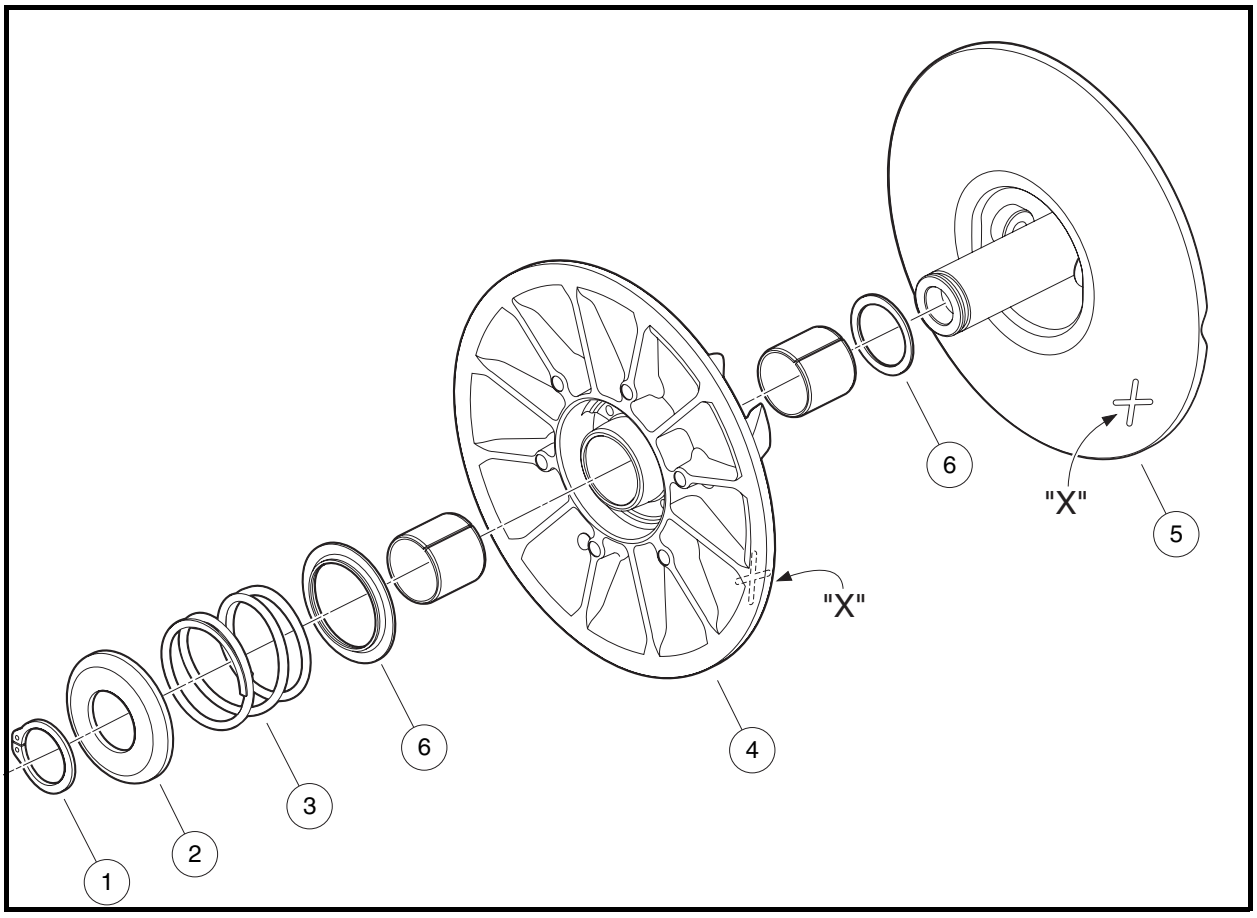


Figure 13a-32 Driven Clutch Assembly

Driven Clutch Assembly

1. Place the fixed sheave (5) onto the spring compression base and note the location of the X so the X on the moveable sheave (4) can be aligned correctly **(Figure 13a-32, Page 13a-36)**.
2. Place the moveable sheave (4) onto the fixed sheave (5) and align the X's on both components.
3. Place the spring (3), cup (2), and snap ring (1) onto the clutch.
4. Place the spring compression collar onto the cup **(Figure 13a-31, Page 13a-35)**.
5. Tighten the spring compression nut just enough to enable the snap ring to be installed.
6. Use snap ring pliers to install the snap ring.

Driven Clutch Installation

1. Turn the key switch OFF and remove the key. Set the park brake. Place the Forward/Reverse handle is in NEUTRAL.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Disconnect the spark plug wires. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
4. Install the driven clutch assembly on the transmission splined shaft.
5. Install the mounting washer and retaining bolt and tighten to 39 ft-lb (53 N·m).

6. Install the drive belt as instructed. **See Drive Belt Installation on page 13a-29.**
7. Install the clutch outer cover and tighten the screws to 72 in-lb (8 N·m).
8. Install the top air filter hose on the filter canister. **See following NOTE.**

NOTE: *Ensure the hose contacts the canister and the clamp is installed tightly between the port bead and canister.*

9. Connect the spark plug wires.
10. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
11. Drive the vehicle and check for proper operation.

CLUTCH COVER

Clutch Outer Cover Removal

1. Turn the key switch OFF and remove the key. Set the park brake. Place the Forward/Reverse handle is in NEUTRAL.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Disconnect the spark plug wires. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
4. Remove the top air filter hose from the filter canister.
5. Remove the self-threading screws and remove the clutch outer cover. **See following WARNING.**

⚠ WARNING

- **Clutch outer cover must be installed before returning the vehicle to normal operation. If the engine is operated with the clutch outer cover removed, keep hands away from the clutches and belt. Failure to heed this warning could result in severe personal injury.**

Clutch Outer Cover Installation

1. Align the mounting holes in the clutch cover with the mounting holes in the inner cover.
2. Install the screws and tighten the hardware to 72 in-lb (8 N·m).
3. Install the top air filter hose on the filter canister.
4. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305). **See following NOTE.**

NOTE: *Ensure the hose clamp is tightly installed and positioned between the filter canister and canister port bead.*

Clutch Inner Cover Removal

1. Turn the key switch OFF and remove the key. Set the park brake. Place the Forward/Reverse handle is in NEUTRAL.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**

3. Disconnect the spark plug wires. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
4. Remove the outer clutch cover. **See Clutch Outer Cover Removal on page 13a-37.**
5. Remove the drive belt. **See Drive Belt Removal on page 13a-28.**
6. Remove the drive clutch. **See Drive Clutch Removal on page 13a-29.**
7. Remove the driven clutch. **See Driven Clutch Removal on page 13a-34.**
8. Remove the bolts and washers from the clutch inner cover **(Figure 13a-33, Page 13a-38)**.
9. Remove the clutch inner cover.

Clutch Inner Cover Installation

1. Align the mounting holes in the clutch cover with the transmission and engine bolt holes.
2. Loosely install one bolt and washer in each transmission and engine mounting hole.
3. Finger-tighten the bolts and washers.

NOTE: *Mounting holes in the clutch inner cover have close tolerances. Align the engine and transmission carefully to ensure the mounting holes in the clutch inner cover match the threaded holes in the engine and transmission.*

4. Tighten the clutch inner cover engine bolts and washers to 21 ft-lb (28.5 N·m).
5. Tighten the transmission bolts and washers to 21 ft-lb (28.5 N·m).
6. Install the driven clutch. **See Driven Clutch Installation on page 13a-36.**
7. Install the drive clutch. **See Drive Clutch Installation on page 13a-32.**
8. Install drive belt. **See Drive Belt Installation on page 13a-29.**
9. Install the clutch outer cover. **See Clutch Outer Cover Installation on page 13a-37.**
10. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

Figure 13a-33 Clutch Inner Cover

SECTION 13B – HONDA GASOLINE ENGINE, MUFFLER, FUEL SYSTEM, AND CLUTCHES

⚠ DANGER

- **See General Warning, Section 1, Page 1-1.**

⚠ WARNING

- **See General Warning, Section 1, Page 1-1.**

GASOLINE ENGINE

See General Warning, Section 1, Page 1-1.

This section contains information on removing and installing the Honda gasoline engine. For complete instructions on engine disassembly, repair, rebuilding, and reassembly, refer to the engine manual. **See the Honda GX620 engine manual (CCI P/N 102615401).**

ENGINE REMOVAL

See General Warning, Section 1, Page 1-1.

CAUTION

- **Before removal and disassembly, clean the engine.**

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally..." in General Warning, Section 1, Page 1-2.**
3. Remove the cargo bed. **See Cargo Bed Removal, Section 4, Page 4-12.**
4. Remove the ROPS (Roll Over Protection Structure). **See ROPS Removal, Section 4, Page 4-7.**
5. Remove the lower rear ROPS bars. **See ROPS Removal, Section 4, Page 4-7.**
6. Remove the seat frame. **See Seat Support Removal, Section 4, Page 4-10.**
7. Remove the engine cover plate. **See following NOTE.**

NOTE: *The engine lift tab must be secured to the engine after the cover plate has been removed. Tighten the bolt to 192 in-lb (22 N·m).*

8. Remove the engine name plate. **See following NOTE.**

NOTE: *Do not discard the name plate. New engines are not supplied with name plates that have fuel line and accelerator cable provisions.*

9. Close the shut-off valve on the fuel tank.
10. Remove the fuel line and in-line filter from the engine. **See following DANGER.**

⚠ DANGER

- **Gasoline! Flammable! Explosive! Do not smoke. Keep sparks and flames away from the vehicle and service area.**

11. Remove the governor cable. **See Governor Cable Removal on page 13b-19.**
12. Remove the choke cable. **See Choke Cable Removal on page 13b-25.**
13. Remove the engine air inlet hose from the engine. **See Air Filter Outlet Hose Removal on page 13b-28.**
14. Remove the muffler. **See Muffler Removal on page 13b-5.**
15. Remove the intermediate exhaust pipe. **See Intermediate Pipe Removal on page 13b-5.**
16. Remove the clutch outer cover. **See Clutch Outer Cover Removal on page 13b-39.**
17. Remove the clutches. **See Drive Clutch Removal on page 13b-31. Also See Driven Clutch Removal on page 13b-36.**
18. Remove the clutch inner cover. **See Clutch Inner Cover Removal on page 13b-39.**
19. Remove the manifold pipe.
20. Remove the electrical connectors:
    20.1. Disconnect the two ground wires on the frame from the starter case.
    20.2. Disconnect the two female bullet connectors from the charge coil.
    20.3. Disconnect the one female bullet connector from the fuel solenoid.
    20.4. Disconnect the one male bullet connector from the engine kill circuit.
    20.5. Disconnect all wires from the two terminal posts on the starter solenoid. **See following NOTE.**

NOTE: *Mark or tape together for identification the connectors on the starter solenoid posts.*

21. Drain the engine oil. **See Engine Oil and Filter Change, Section 10a, Page 10a-8.**
22. Remove the engine mounting hardware **(Figure 13b-1, Page 13b-3)**.
23. Remove engine oil inlet and outlet hoses from the engine. **See Oil Filter Hose Removal on page 13b-16. See also following NOTE.**

NOTE: *Plug each line as it is removed from the engine. Without plugs, oil will leak from the lines.*

24. Use the engine lift tabs to lift the engine off the mounting plate.
25. If a new engine will be installed, remove and retain the following:
    - Carburetor Adapter
    - Carburetor Spring
    - Engine Governor Arm
    - Engine Governor Cable Bracket
    - Governor Wire
    - Oil Filter Adapter
    - Exhaust Manifold

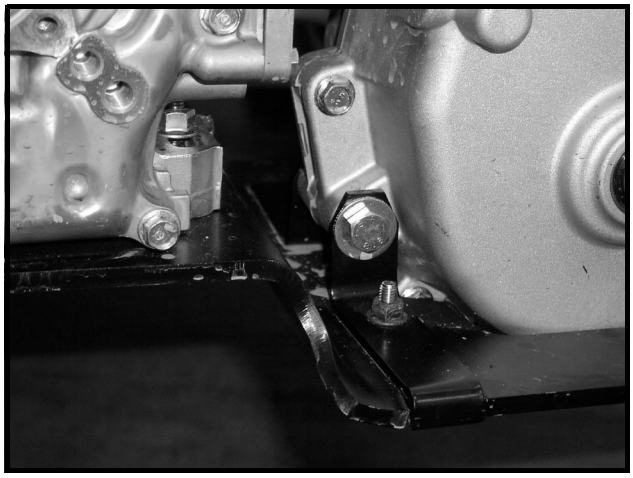


Figure 13b-1 Engine Mounting Bolts

ENGINE INSTALLATION

See General Warning, Section 1, Page 1-1.

1. Before a new engine is installed, the following components must be installed:
   - Exhaust Manifold (new gaskets required) – Tighten the hardware to 21 ft-lb (28 N·m)
   - Oil Filter Adapter (new o-rings required)
   - Carburetor Spring
   - Governor Wire
   - Engine Governor Cable Bracket
   - Engine Governor Arm
   - Carburetor Adapter (new gasket required) – Tighten the hardware to 78 in-lb (9 N·m)
2. Lower the engine into the engine compartment and closely align the base mount with holes in the engine plate.
   2.1. Remove the engine cover plate lift tab and bolt.
3. Secure the engine oil inlet and outlet hoses to the engine ports with new clamps. **See Oil Filter Hose Installation on page 13b-16.**
4. Loosely install new flange-head bolts and flange-head locknuts on the engine base slotted mounts. **See following NOTE.**

NOTE: *Engine block bolts will be tightened after the engine and transmission are aligned, the clutch inner cover is installed, and the cover bolts are tightened to maintain the alignment.*

5. Connect all electrical connections. **See Figure 11b-1, Section 11b, Page 11b-6.**
   5.1. Connect the two ground wires on the frame to the starter case.
   5.2. Connect the two female bullet connectors to the charge coil.
   5.3. Connect the female bullet connector to the fuel solenoid.
   5.4. Connect the male bullet connector to the engine kill circuit.
   5.5. Connect all wires attached to the two terminal posts on the starter solenoid.
6. Use new gaskets and install the exhaust manifold. Tighten the hardware to 21 ft-lb (28 N·m).
7. Install the clutch inner cover. **See Clutch Inner Cover Installation on page 13b-40.**

8. Tighten the engine mounting bolts to 39 ft-lb (53 N·m).
9. Install the clutches. **See Drive Clutch Installation on page 13b-34. Also See Driven Clutch Installation on page 13b-38.**
10. Install the drive belt. **See Drive Belt Installation on page 13b-31.**
11. Install the clutch outer cover. **See Clutch Outer Cover Installation on page 13b-39.**
12. Install the engine air inlet hose to the filter. **See Air Filter Outlet Hose Installation on page 13b-29.**
13. Install the intermediate exhaust pipe. **See Intermediate Pipe Installation on page 13b-6.**
14. Install the muffler. **See Muffler Installation on page 13b-6.**
15. Install the engine name plate and tighten the screws to 38 in-lb (4 N·m).
16. Connect the choke cable. **See Choke Cable Installation on page 13b-26.**
17. Feed the governor cable through the grommet in the engine name plate and connect the cable. Adjust the cable as necessary. **See Governor Cable Installation on page 13b-20. Also see Ground Speed (Transmission) Governor Arm Adjustment on page 13b-21 and Engine Governor Arm on page 13b-23.**
18. Feed the fuel line through the grommet in the engine name plate. Secure the fuel line to the in-line filter on the engine with a new clamp. **See following DANGER.**

⚠ DANGER

- **Gasoline! Flammable! Explosive! Do not smoke. Keep sparks and flames away from the vehicle and service area.**

19. Open the fuel valve on the fuel tank.
20. Install the engine cover plate. The engine lift tab should be on the passenger side.
    20.1. Tighten the two front bolts to 35 in-lb (4 N·m).
    20.2. Tighten the two rear bolts to 192 in-lb (22 N·m).
21. Install the seat frame and lower rear ROPS (Roll Over Protection Structure) bars. **See Seat Support Installation, Section 4, Page 4-10 and ROPS Installation, Section 4, Page 4-8.**
22. Install the upper ROPS frame. **See ROPS Installation, Section 4, Page 4-8.**
23. Install the cargo bed. **See Cargo Bed Installation, Section 4, Page 4-12.**
24. Add engine oil. **See Engine Oil and Filter Change, Section 10a, Page 10a-8.**
25. Check the engine oil level. **See Engine Oil Level Check, Section 10a, Page 10a-8.**
26. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
27. Adjust the engine RPM setting. **See Engine RPM Adjustment on page 13b-23.**
28. Install the center seat plate.
29. Install both seats.
30. Test-drive the vehicle to ensure all systems are functional and adjusted correctly.

EXHAUST SYSTEM

MUFFLER REMOVAL

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. Remove the spark plug wires. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Loosen the muffler spring suspension bracket bolts.
4. Remove the two springs that secure the muffler inlet to the intermediate pipe **(Figure 13b-2, Page 13b-5)**. **See following NOTE.**

NOTE: *Shift the end of the muffler inlet and intermediate pipe from side to side to relax and disconnect the springs.*

5. Remove the two bolts and large flat washers that secure the muffler to the chassis and remove the muffler. **See following WARNING and NOTE.**

⚠ WARNING

- **Always wear eye protection when springs are removed or installed.**

NOTE: *Replace springs that show signs of brittleness, broken coils, or loss of tension.*

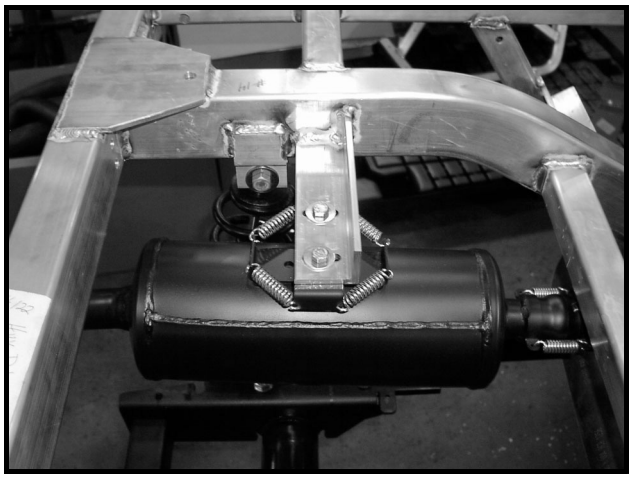


Figure 13b-2 Muffler Bracket and Inlet Pipe

INTERMEDIATE PIPE REMOVAL

1. Loosen the muffler spring suspension bracket bolts.
2. Remove the springs from the intermediate pipe and muffler inlet. **See following WARNING and NOTE.**

⚠ WARNING

- **Always wear eye protection when springs are removed or installed.**

NOTE: *Shift the end of the muffler inlet and intermediate pipe from side to side to relax and disconnect the springs.*

3. Remove the springs from the intermediate pipe and manifold pipe and remove the pipe.

INTERMEDIATE PIPE INSTALLATION

1. Secure the intermediate pipe to the manifold pipe with new springs. **See following WARNING and NOTE.**

⚠ WARNING

- **Always wear eye protection when springs are removed or installed.**

NOTE: *Shift the end of the muffler inlet and intermediate pipe from side to side to relax and connect the springs.*

2. Secure the intermediate pipe to the muffler inlet with new springs. **See previous NOTE and WARNING.**
3. Align the muffler with the intermediate pipe and tighten the muffler spring suspension bracket bolts to 21 ft-lb (29 N·m).

MUFFLER INSTALLATION

NOTE: *Replace springs that show signs of brittleness, broken coils, or loss of tension.*

1. Loosely secure the muffler and spring suspension bracket to the chassis with two bolts and large flat washers **(Figure 13b-2, Page 13b-5)**.
2. Secure the muffler inlet to the intermediate pipe with new springs. **See following WARNING and NOTE.**

⚠ WARNING

- **Always wear eye protection when springs are removed or installed.**

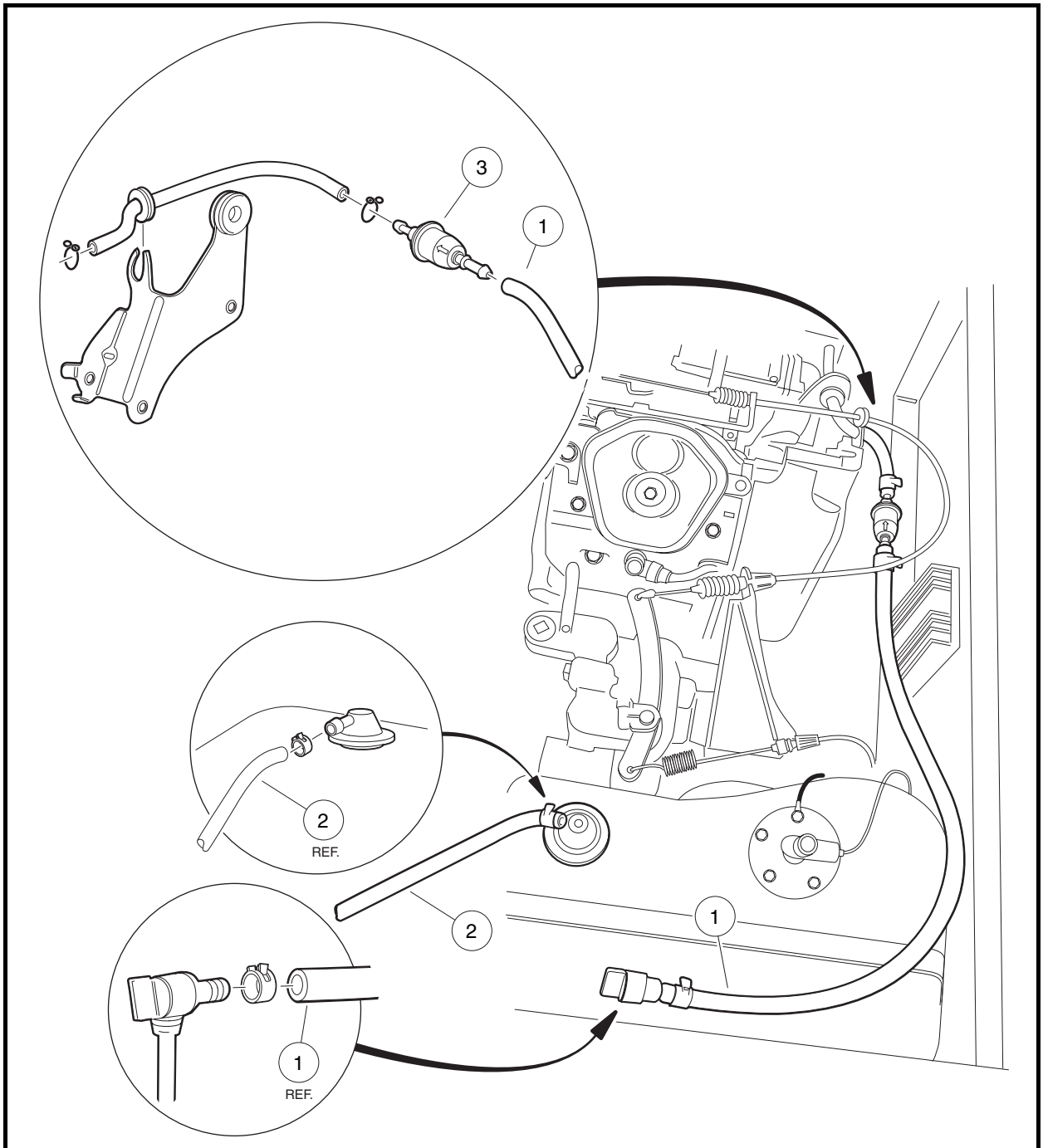
NOTE: *Shift the end of the muffler inlet and intermediate pipe from side to side to connect the spring that is least extended.*

3. Align the muffler with the intermediate pipe and tighten the muffler spring bracket hardware to 21 ft-lb (29 N·m).
4. Connect the spark plug wires.
5. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
6. Place the Forward/Reverse handle in NEUTRAL and turn the key switch to start the engine. Check for exhaust leaks and proper engine operation. **See following DANGER.**

⚠ DANGER

- **The engine produces carbon monoxide, which is an odorless, deadly poison. Do not operate the engine in an enclosed area without proper ventilation.**

FUEL SYSTEM



FUEL LINE No.	ROUTING	LENGTH	
		Solid Color	Clear
1	Fuel tank to fuel filter	24.3 inches (61.5 cm)	
2	Vent tube (fuel tank)		22 inches (55.8 cm)

Figure 13b-3 Fuel System (Honda Powered Gasoline Vehicles)

FUEL LINES

See General Warning, Section 1, Page 1-1.

The fuel lines must be properly routed and all hose clamps must be tight **(Figure 13b-3, Page 13b-7)**. The fuel lines should be kept clean. **See following NOTE and WARNING.**

NOTE: *Use only 1/4-inch hoses with SAE J30R7 rating to replace the fuel lines.*

⚠ WARNING

- **Make sure fuel lines are the correct length and are properly routed. Failure to heed this warning could result in damage to the fuel lines and fire.**

FUEL FILTER

See General Warning, Section 1, Page 1-1.

One in-line filter (3) is installed between the fuel tank and the fuel pump **(Figure 13b-3, Page 13b-7)**. Fuel filters, fuel lines, and the fuel tank vent should be inspected periodically for leaks and replaced when necessary. Filter changes should not exceed the recommended interval. **See Periodic Service Schedule on page 10a-1.** Replace the fuel filter as instructed. **See the Honda GX620 engine manual (CCI P/N 102615401).**

FUEL PUMP

See General Warning, Section 1, Page 1-1.

Procedures for inspection, removal, and installation can be found in the engine manual. **See the Honda GX620 engine manual (CCI P/N 102615401).**

CARBURETOR

See General Warning, Section 1, Page 1-1.

Before suspecting the carburetor as the cause of poor engine performance, make sure the fuel and ignition systems are in proper operating condition. Check the following items:

- Spark plug and gap condition. **See the Honda GX620 engine manual (CCI P/N 102615401).**
- Air filter element. **See Air Filter Replacement on page 13b-24.**
- Fuel filters. **See Fuel Filter on page 13b-8.**
- Choke and air intake system (for restriction of air flow). **See Choke and Air Intake System on page 13b-24.**
- Fuel pump. **See the Honda GX620 engine manual (CCI P/N 102615401).**
- Fuel lines (from fuel tank to filter to pump to carburetor). **See Fuel Lines on page 13b-8.**
- Exhaust system (for restrictions).

If the carburetor has failed, replace it. **See the Honda GX620 engine manual (CCI P/N 102615401).**

Carburetor Jetting

The Honda GX620 engine is equipped with a carburetor that has fixed jets. These fixed jets do not require adjustment. The size of the main jet is determined by the altitude where the engine will be operating. The main jet size is set for the operating elevation of customer destination at the time of manufacture. In the event that carburetor jetting needs to be changed, determine the proper jet size for the operating altitude. **See the Main**

Jet Elevation/Size Chart. After the proper jet size is determined, replace the main jet. **See the Honda GX620 engine manual (CCI P/N 102615401).**

The following chart lists the elevation ratings for various jet sizes. No adjustment is required for the pilot jet. If the vehicle idles roughly, adjust the pilot air screw until the vehicle idles smoothly.

Main Jet Elevation/Size Chart

ALTITUDE	HONDA GX620 ENGINE MAIN JET SIZE
0-5000 ft. (0-1524 m)	108
5000-8000 ft. (1524-2438 m)	105
8000 ft. and higher (2438 m and higher)	102

FUEL LEVEL SENDING UNIT

See General Warning, Section 1, Page 1-1.

Fuel Level Sending Unit Removal

⚠ DANGER

- **Gasoline! Flammable! Explosive! Do not smoke. Keep sparks and flames away from the vehicle and service area.**

⚠ WARNING

- **Do not use electrically powered tools to remove or install the fuel level sending unit. Failure to heed this warning could result in a fire or explosion.**

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Disconnect the spark plug wires. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
4. Remove the passenger seat. **See Seat Removal, Section 4, Page 4-9.**
5. Remove the rubber boot (8) from the center post on the fuel level sending unit. Remove the nut (9) from the center post and remove the orange wire (7) **(Figure 13b-4, Page 13b-10)**. Retain the hardware.
6. Remove the hex-head plastic thread screw (10) securing the black ground wire (6) to the fuel level sending unit and remove the black ground wire. Retain the hardware.
7. Remove the four remaining hex-head plastic thread screws from the fuel level sending unit flange (5). Retain the hardware.
8. Carefully remove the sending unit and gasket (3). Feed the rheostat arm and float (4) through the fuel tank hole. Immediately place the fuel level sending unit in a pan to catch fuel. **See following DANGER and NOTE.**

⚠ DANGER

- **Clean up any spilled fuel before operating the vehicle.**

NOTE: *The rheostat arm and float should be positioned toward the outside surface of the fuel tank.*

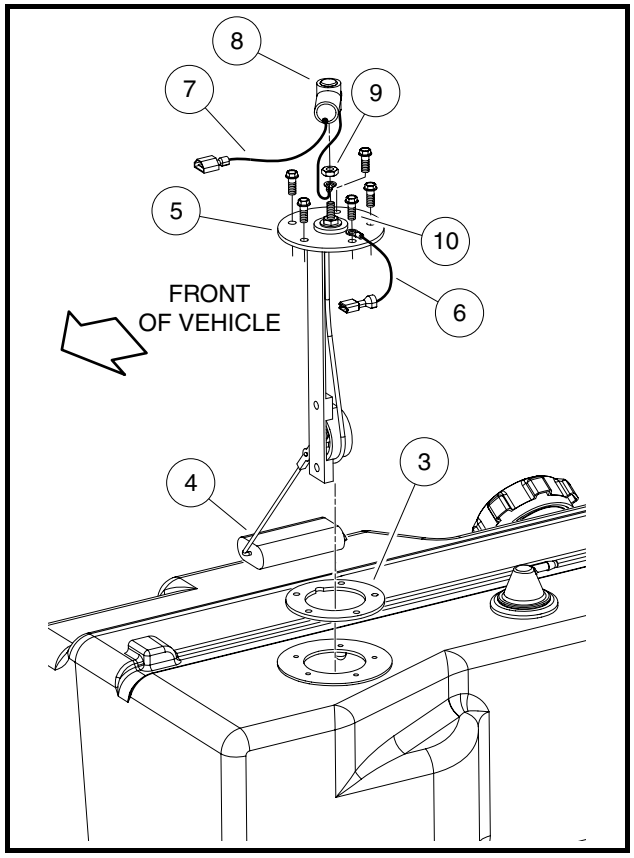


Figure 13b-4 Fuel Level Sending Unit Removal

Fuel Level Sending Unit Installation

⚠ WARNING

- **Do not use electrically powered tools to remove or install the fuel level sending unit. Failure to heed this warning could result in a fire or explosion.**

⚠ DANGER

- **Gasoline! Flammable! Explosive! Do not smoke. Keep sparks and flames away from the vehicle and service area.**

1. Place a new rubber gasket on the fuel tank with the notch (2) centered between the flange identification mounting holes (1). **(Figure 13b-5, Page 13b-11)**. **See following NOTE.**

NOTE: *The distance between the flange identification mounting holes (1) is larger than the distance between any of the other mounting holes in the sending unit flange (5).*

Ensure the replacement gasket is rubber and that the mounting holes in the gasket are aligned properly with the mounting holes on the fuel tank.

2. Feed a new sending unit rheostat arm and float (4) into the fuel tank **(Figure 13b-4, Page 13b-10)**. The rheostat arm and float should be positioned toward the outside surface of the fuel tank **(Figure 13b-6, Page 13b-11)**.
3. Align the flange identification mounting holes (1) directly over the corresponding mounting holes in the gasket and fuel tank **(Figure 13b-5, Page 13b-11)**. **See following CAUTION and NOTE.**

⚠ CAUTION

- **Ensure all mounting holes in the fuel level sending unit, gasket, and fuel tank are aligned properly before hardware is installed. Improper alignment of the mounting holes could result in an incomplete seal between the fuel level sending unit and the fuel tank.**

NOTE: *The fuel level sending unit mounts to the fuel tank only one way. If the unit does not fit on the fuel tank correctly, adjust the unit until it is properly aligned with the fuel tank.*

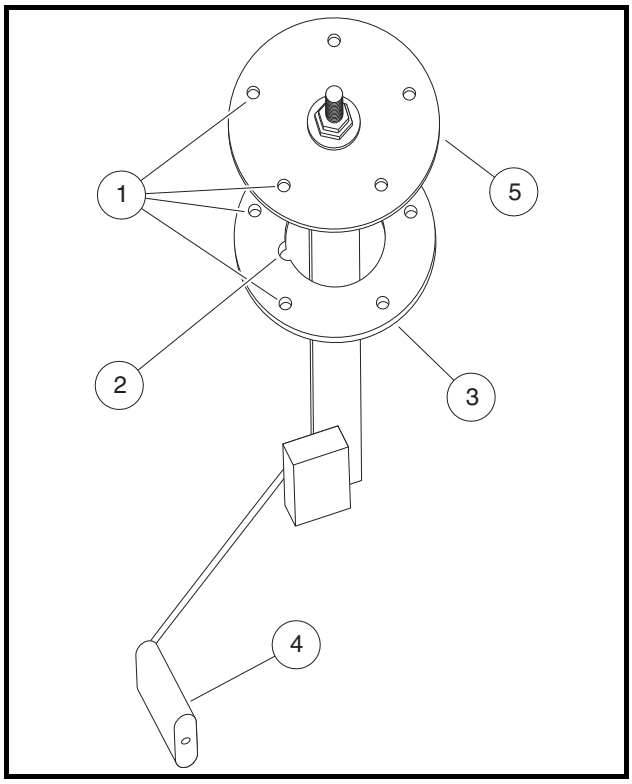
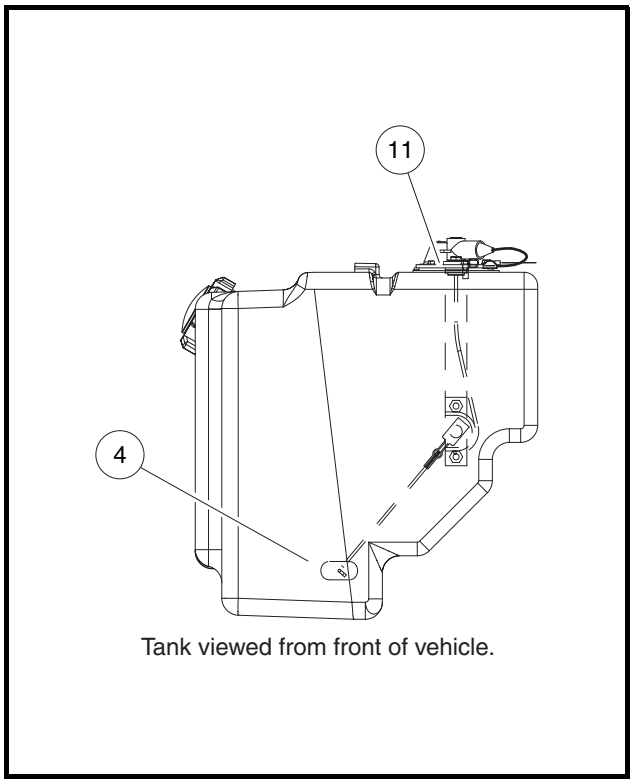


Figure 13b-5 Fuel Level Sending Unit Alignment



Tank viewed from front of vehicle.

Figure 13b-6 Fuel Level Sending Unit Position

4. Carefully thread each hex-head screw by hand, with the ring terminal on the black ground wire (6) under the screw head closest to the engine **(Figure 13b-4, Page 13b-10)**. **See following CAUTION.**

CAUTION

- **Use only the existing screws or new plastic-thread screws made for plastics applications. Do not use sheet metal screws as replacement hardware.**

5. Use a crisscross pattern to tighten the hardware to 9 in-lb (1 N·m). If the hardware cannot be tightened to 9 in-lb (1 N·m), the fuel tank must be replaced. **See following CAUTION.**

CAUTION

- **Do not overtighten the screws. Overtightening the screws will strip the mounting holes in the fuel tank.**

6. Secure the orange wire (7) to the center post with the nut (9) previously removed **(Figure 13b-4, Page 13b-10)**. Tighten the hardware to 17 in-lb (1.9 N·m) and secure the rubber boot (8) to the center post.
7. Install the passenger seat. **See Seat Installation, Section 4, Page 4-9.**
8. Connect the spark plug wires.
9. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

FUEL TANK

See General Warning, Section 1, Page 1-1.

⚠ WARNING

- **If the fuel tank is damaged, replace it. Do not attempt to repair it. See the following tank removal and disposal procedure.**

Fuel Tank Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Remove both seats.
4. Remove the center seat plate.
5. Remove the upper portion of the ROPS. **See ROPS Removal, Section 4, Page 4-7.**
6. Remove the bolts, washers and flanged locknuts from the seat frame, seat side plates, and engine cover plate.
7. Turn the fuel shut-off valve to the closed (OFF) position **(Figure 13b-9, Page 13b-15)**.
8. Run the engine until all fuel in the carburetor, fuel pump, and fuel lines is used and the engine stalls.
9. Loosen the clamp and disconnect the fuel line from the fuel tank shut-off valve **(Figure 13b-7, Page 13b-13)**.
10. Loosen the clamp and remove the vent tube from the fuel tank**.**
11. Remove the fuel tank cap.
12. Use a siphon with a built-in suction device to siphon all fuel from the tank and into an approved container. **See following DANGER and WARNING.**

⚠ DANGER

- **Gasoline! Flammable! Explosive! Do not smoke. Keep sparks and flames away from the vehicle and service area.**

⚠ WARNING

- **Never attempt to siphon fuel with a hose that does not have a built-in suction device.**
- **Never attempt to siphon fuel with your mouth.**

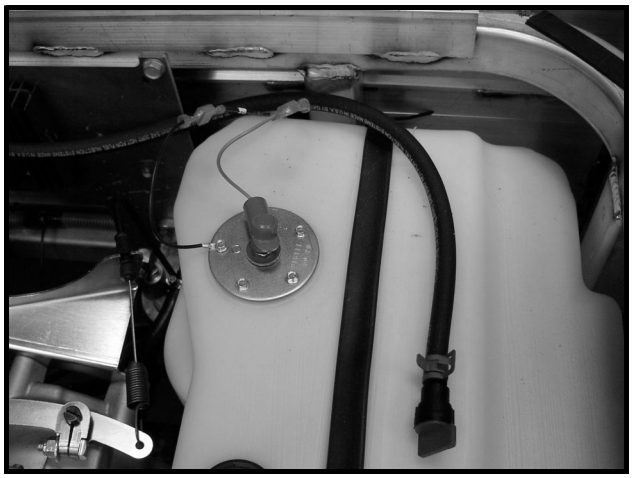


Figure 13b-7 Gasoline Fuel Tank

13. Disconnect the black wire and orange wire from the fuel level sensor on the tank. Do not remove the lower nut from the center stud of the sensor.
14. Remove the nut from the strap end below the passenger seat area.
15. Lift the strap end and remove the opposite end from the slotted bracket.
16. Remove the passenger side bed latch bracket from the frame.
17. Remove the fuel tank.

Fuel Tank Storage or Disposal

1. Remove the cap from the tank and thoroughly rinse it with water. The cap may be discarded or kept as a spare.
2. Use a well-ventilated area and flush the fuel tank with water to remove any remaining fuel.
3. Set the tank upside down in a well-ventilated area so that the water can drain. Allow the tank to sit for 24 hours to dry. **See following WARNING.**

⚠ WARNING

- **Dispose of wastewater and fuel tank in accordance with federal, state, and local laws and ordinances.**

4. Store the tank upside down with the cap installed in a well-ventilated area.

Fuel Tank Installation

1. Install the fuel tank in the vehicle.
2. Insert the tab end of the strap into the frame bracket and place the strap in the indentions on the tank.
3. Feed the threaded tab end down into the bottom of the frame. Install a nylon locknut and tighten the nut to 40 in-lb (4.5 N·m). **See following NOTE.**
4. Connect the clear vent tube to the fuel tank vent and secure the tube with a new clamp.
5. Connect the fuel line to the fuel tank shut-off valve and secure the line with a new clamp.
6. Connect the black wire and orange wire to the sensor **(Figure 13b-8, Page 13b-14)**.
7. Slide the rubber boot over the stud.
8. Install the passenger-side bed latch bracket on the frame with a bolt and flanged nylon locknut. Tighten the hardware to 20 ft-lb (27 N·m).
9. Install the seat frame on the vehicle frame. Secure the seat side plates with bolts, flat washers, and flanged locknuts. Tighten the nut to 37 ft-lb (50 N·m).
10. Install the top portion of the ROPS. **See ROPS Installation, Section 4, Page 4-8.**

Figure 13b-8 Fuel Level Sensor

11. Install the center seat plate.
12. Add the appropriate fuel to the fuel tank.
13. Ensure the fuel shut-off valve on top of the fuel tank is in the open (ON) position **(Figure 13b-10, Page 13b-15 and Figure 13b-11, Page 13b-15)**.
14. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
15. Install both seats.
16. With the Forward/Reverse handle in NEUTRAL, start the engine and allow it to idle. Run the engine for a few minutes to ensure that the fuel lines are full of fuel. **See following DANGER.**

⚠ DANGER

- **The engine produces carbon monoxide, which is an odorless, deadly poison. Do not operate the engine in an enclosed area without proper ventilation.**

- **After installing the fuel tank and adding fuel, carefully check all fuel lines and connections for leaks. Repair leaks before the vehicle is returned to service.**

17. Inspect each fuel line connection for leaks.
    17.1. Check all clamps at the carburetor, fuel filters, fuel pump, and fuel tank for leaks.
    17.2. Inspect each fuel line to ensure that the lines are not cracked, cut, or worn.

FUEL SHUT-OFF VALVE

See General Warning, Section 1, Page 1-1.

The fuel shut-off valve is located on top of the fuel tank **(Figure 13b-7, Page 13b-13)**. The fuel shut-off valve should always be turned to the closed (OFF) position during vehicle storage, towing or trailering, and maintenance and service **(Figure 13b-9, Page 13b-15)**.

Fully Open Position

To open the valve fully, it must be turned approximately 120° from the closed (OFF) position (until it cannot be turned any further) **(Figure 13b-10, Page 13b-15).** If the valve becomes partially closed, the engine will be starved for fuel and will not run properly **(Figure 13b-11, Page 13b-15)**.

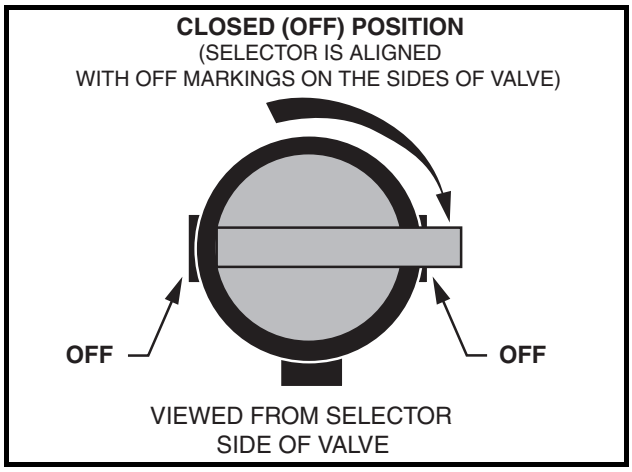


Figure 13b-9 Closed Fuel Shut-Off Valve

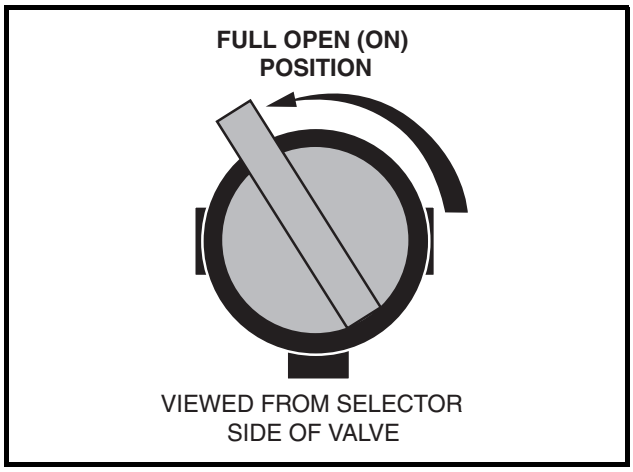


Figure 13b-10 Open Fuel Shut-Off Valve

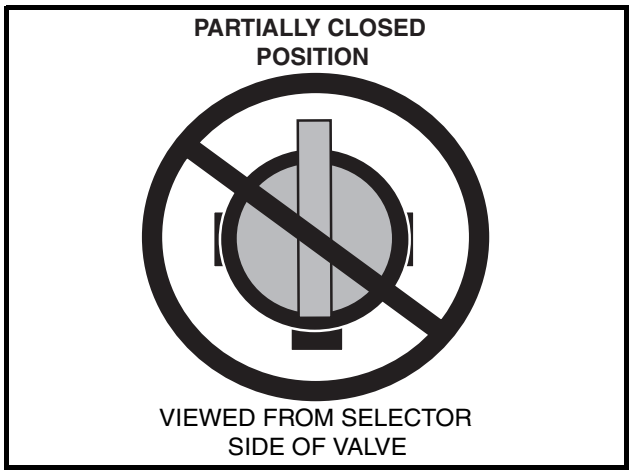


Figure 13b-11 Incorrect Fuel Shut-Off Valve

OIL FILTER HOSES

Oil Filter Hose Removal

1. Drain the engine oil. **See Engine Oil Draining, Section 10a, Page 10a-8.**
2. Place a pan under the oil filter hose connections on the engine. **See following NOTE.**

NOTE: *It's best to disconnect the engine hoses first when removing to allow oil to drain from hoses and engine hose ports.*

3. Loosen the clamps on the oil hoses at the engine ports and slide them from the engine port nozzles.
4. Loosen the clamps on the oil hoses at the filter ports and slide them from the filter port nozzles.

Oil Filter Hose Installation

NOTE: *The inner diameters of the hoses are different sizes. Be sure to connect the hose with the smaller inner diameter to the smaller nozzle and connect the hose with the larger inner diameter to the larger nozzle.*

1. Replace the oil hoses with like hoses. **See following NOTE.**

NOTE: *One oil hose is 3/8 inch (9.5 mm equivalent) and the other is 5/16 inch (7.9 mm equivalent). Both oil hoses are rated SAE J100R6.*

2. Secure the clamps and hoses to the port nozzles with clamps. **See following NOTE.**

NOTE: *Make sure the outlet port on the engine is connected to the inlet port on the oil filter and the outlet port of the oil filter is connected to the inlet port on the engine.*

Use new clamps when the hoses are replaced.

3. Fill the engine with engine oil. **See Engine Oil Filling, Section 10a, Page 10a-12.**

ENGINE CONTROL LINKAGES

ACCELERATOR CABLE

See General Warning, Section 1, Page 1-1.

⚠ WARNING

- **To avoid unintentionally starting the vehicle:**
  - **Disconnect battery cables, negative (–) cable first (Figure 1-2, Page 1-3).**
  - **Disconnect the spark plug wires from the spark plugs.**

Accelerator Cable Removal

NOTE: *When the accelerator cable is replaced, the high-speed RPM must be adjusted.* ***See High-Speed RPM Adjustment on page 13b-24.***

1. Turn the key switch OFF and place the Forward/Reverse handle in NEUTRAL. Remove the key. Chock the rear wheels.

2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Raise the hood.
4. Remove the passenger-side seat. **See Seat Removal, Section 4, Page 4-9.**
5. Disconnect the Z-shaped end (1) on the accelerator cable from the pedal **(Figure 13b-12, Page 13b-17).**
6. Release the retention clip at the pedal bracket **(Figure 13b-13, Page 13b-17)**.
7. Disconnect the accelerator cable (5) from the engine **(Figure 13b-14, Page 13b-17)**.
   7.1. Remove the governor guard. **See Governor Guard Removal on page 13b-19.**
   7.2. Remove the cable strain relief (1) from the transmission governor bracket (2).
   7.3. Disconnect the accelerator cable spring (3) from the transmission governor arm (4).

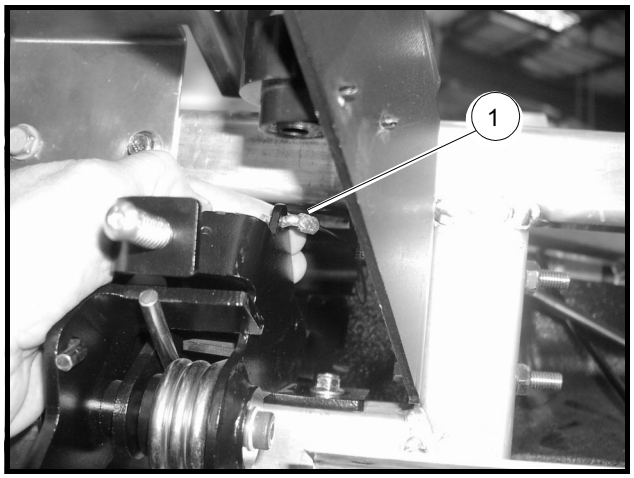


Figure 13b-12 Z-Shaped Cable End (Gasoline Vehicles)

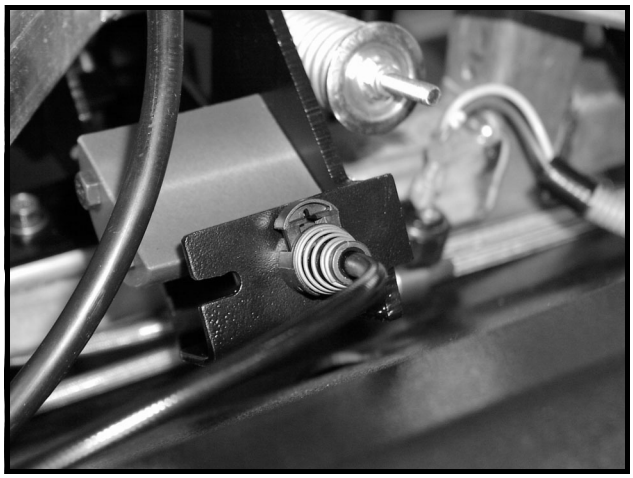


Figure 13b-13 Accelerator Cable Pedal Bracket (Gasoline Vehicles)

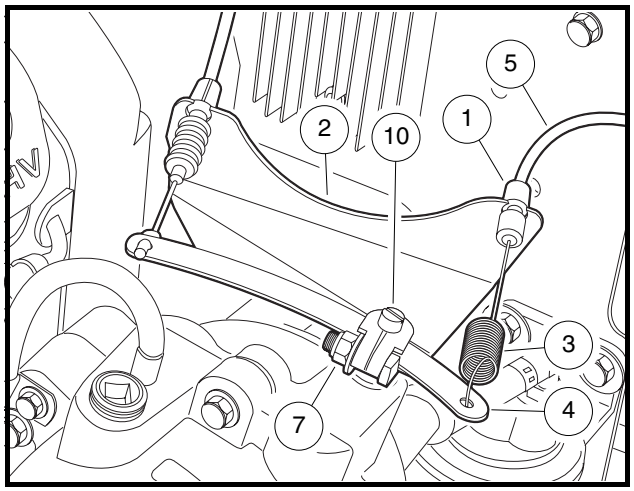


Figure 13b-14 Governor Arm (Gasoline Vehicles)

8. Remove the accelerator cable from the plastic retaining clips under the passenger side of the frame. Pull the cable at the dashboard to remove it from the engine compartment. **See following NOTE.**

NOTE: *Tie a nylon cord to each end of the cable before removing it from the vehicle. Allow the cord to travel from the attachment points and under the frame. The routed cord can then be used during installation.*

Accelerator Cable Installation

NOTE: *When the accelerator cable is replaced, the high-speed RPM must be adjusted. See High-Speed RPM Adjustment on page 13b-24.*

1. Feed the pedal end and governor end of the accelerator cable up into place from under the vehicle on the passenger side. **See following NOTE.**

NOTE: *Tie the nylon cord routed during removal to the engine end of the cable. Pull the nylon cord to help feed the cable back through the instrument panel area and engine compartment.*

2. Secure the cable to the plastic retaining clips under the passenger side of the frame.
3. Connect the accelerator cable to the pedal.
   3.1. Secure the retention clip at the pedal bracket **(Figure 13b-13, Page 13b-17)**.
   3.2. Insert the Z-shaped end of cable into the hole in the pedal **(Figure 13b-15, Page 13b-18)**.
   3.3. Adjust the accelerator cable retention clip. **See Accelerator Cable Retention Clip Adjustment on page 13b-20.**
4. Connect the accelerator cable (5) to the governor arm (4) in the engine compartment **(Figure 13b-14, Page 13b-17)**.
   4.1. Secure the cable strain relief (1) to the transmission governor bracket (2).
   4.2. Connect the accelerator cable spring (3) to the governor arm (4).
5. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

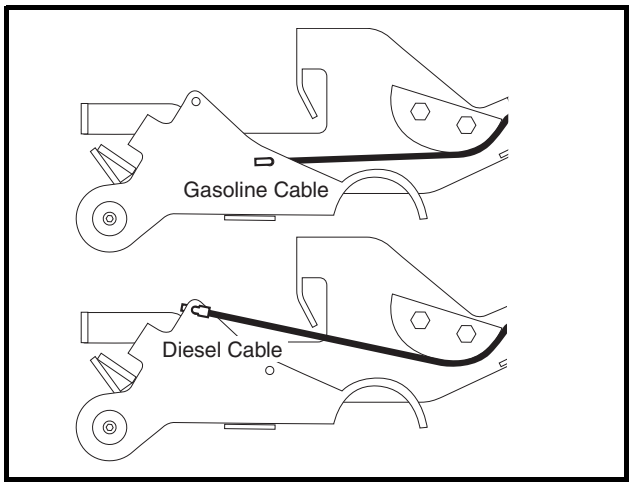


Figure 13b-15 Z-Shaped Cable End in Hole at Pedal

GOVERNOR GUARD

See General Warning, Section 1, Page 1-1.

Governor Guard Removal

1. Remove the passenger seat. **See following NOTE.**

NOTE: *It is not necessary to remove the accelerator and governor cables to remove the governor guard.*

2. Remove the two hex-head bolts (1) from the front (cable side) of the governor guard **(Figure 13b-16, Page 13b-19)**.
3. Remove the nylon locknut (2) from the rear (transmission side) of the governor guard **(Figure 13b-17, Page 13b-19)**.
4. Slide the guard off the bolts.

Governor Guard Installation

1. Slide the rear of the governor guard onto the bolts that extend through the transmission case.
2. Install the front (cable side) governor guard bolts (1) **(Figure 13b-16, Page 13b-19)**. Tighten the hardware to 21 ft-lb (28 N·m).
3. Install a new nylon locknut on the bolt (2) at the rear (transmission side) of the governor guard **(Figure 13b-17, Page 13b-19)**. Tighten the hardware to 21 ft-lb (28 N·m).
4. Install the passenger seat.

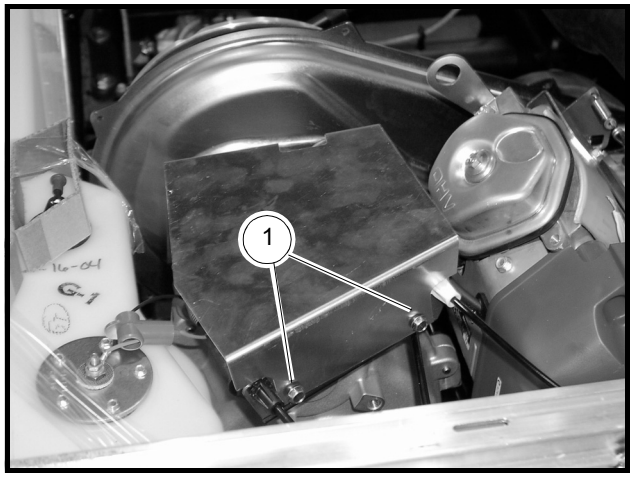


Figure 13b-16 Governor Guard Front Bolts

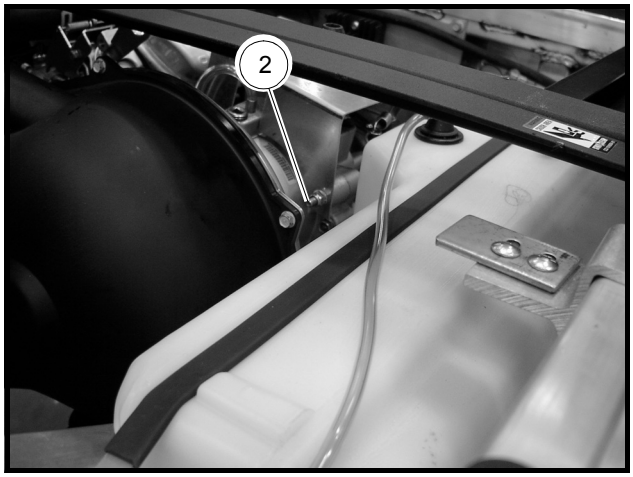


Figure 13b-17 Governor Guard Rear Bolts

GOVERNOR CABLE

See General Warning, Section 1, Page 1-1.

Governor Cable Removal

1. Remove the governor guard. **See Governor Guard Removal on page 13b-19.**
2. Remove the cable sheath strain relief from the cable bracket on the transmission **(Figure 13b-18, Page 13b-20)**.
3. Remove the Z-shaped end of the governor cable from the governor arm on the transmission.

4. Remove the spring end of the cable from the engine bracket **(Figure 13b-19, Page 13b-20)**.

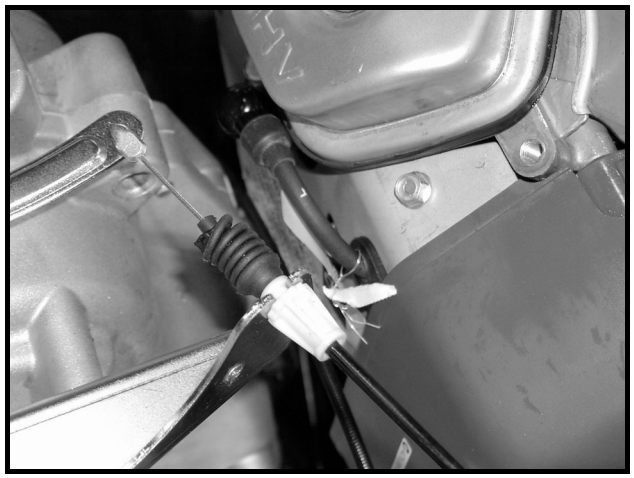


Figure 13b-18 Governor Cable on Transmission

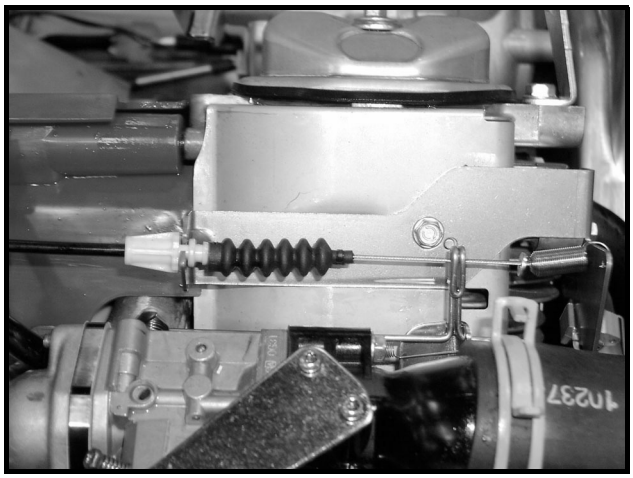


Figure 13b-19 Governor Cable on Engine

5. Slide the cable away from the throttle control wire loop. **See following NOTE.**

NOTE: *Note the position of the small washer between the throttle wire loop and the spring/cable attachment.*

6. Remove the cable sheath strain relief from the engine bracket and remove the governor cable.

Governor Cable Installation

⚠ WARNING

- **If the governor cable is removed or replaced, the governor system must be adjusted. See Ground Speed (Transmission) Governor Arm Adjustment on page 13b-21. Also See High-Speed RPM Adjustment on page 13b-24. Incorrect adjustment may result in severe personal injury or death.**

1. Secure the spring loop on the engine end of the cable to the engine bracket **(Figure 13b-19, Page 13b-20)**.
2. Slide the cable into the throttle wire loop. Ensure the small washer is positioned between the throttle wire loop and the cable/spring attachment.
3. Secure the cable sheath to the engine bracket.
4. Secure the Z-shaped end of the governor cable to the governor arm on the transmission.
5. Secure the cable sheath to the transmission bracket.
6. Install the governor guard. **See Governor Guard Installation on page 13b-19.**

ACCELERATOR CABLE RETENTION CLIP ADJUSTMENT

NOTE: *The accelerator strain relief retention clip must be adjusted if the accelerator pedal, accelerator cable or governor cable was removed, or if the engine idle is too high.*

1. Release the cable sheath retention clip **(Figure 13b-13, Page 13b-17).**

2. Push the carburetor throttle shaft toward the closed direction until it contacts the throttle stop.
3. Adjust the accelerator cable at the transmission until there is a washer-width space between the washer and the governor wire form as shown **(Figure 13b-20, Page 13b-21)**.
4. Press the retention clip to hold accelerator cable in correct adjustment position.
5. Start the engine and verify correct idle speed. Also, verify that the governor cable is not putting pressure on the governor wire form while the engine is idling.

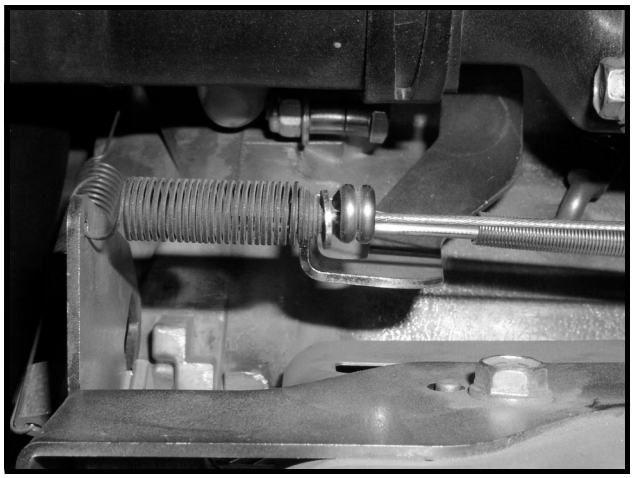


Figure 13b-20 Washer Width Space

GROUND SPEED (TRANSMISSION) GOVERNOR ARM ADJUSTMENT

⚠ WARNING

- **The (transmission) governor arm (4) must be adjusted every time the governor cable (5) is replaced or removed and every time the governor wire (9) is removed (Figure 13b-21, Page 13b-22). Incorrect adjustment may result in severe personal injury or death.**

NOTE: *This procedure may require the aid of an assistant.*

1. Remove the governor guard. **See Governor Guard Removal on page 13b-19.**
2. Loosen the pinch bolt (7) with a 7/16-inch socket to allow vertical movement of the ground speed (transmission) governor arm (4) **(Figure 13b-21, Page 13b-22)**.
3. Set the distance from the top of the pin to the ground speed (transmission) governor arm to 1/4-inch (6.4 mm) as shown **(Figure 13b-22, Page 13b-22)**. Hold the pin in place.
4. Push and hold the transmission governor arm (4) in the full-throttle position so that the washer (8) is just touching the governor wire (9) **(Figure 13b-21, Page 13b-22)**. **See following CAUTION.**

⚠ CAUTION

- **Be careful not to push the transmission governor arm too far because it could cause the governor wire to bend.**

5. Use a flat-head screwdriver to turn the pin (10) counter-clockwise until it stops. Hold the screwdriver in place and use a 7/16-inch socket to tighten the pinch bolt (7) to 35 in-lb (4 N·m).
6. Install the governor guard. **See Governor Guard Installation on page 13b-19.**

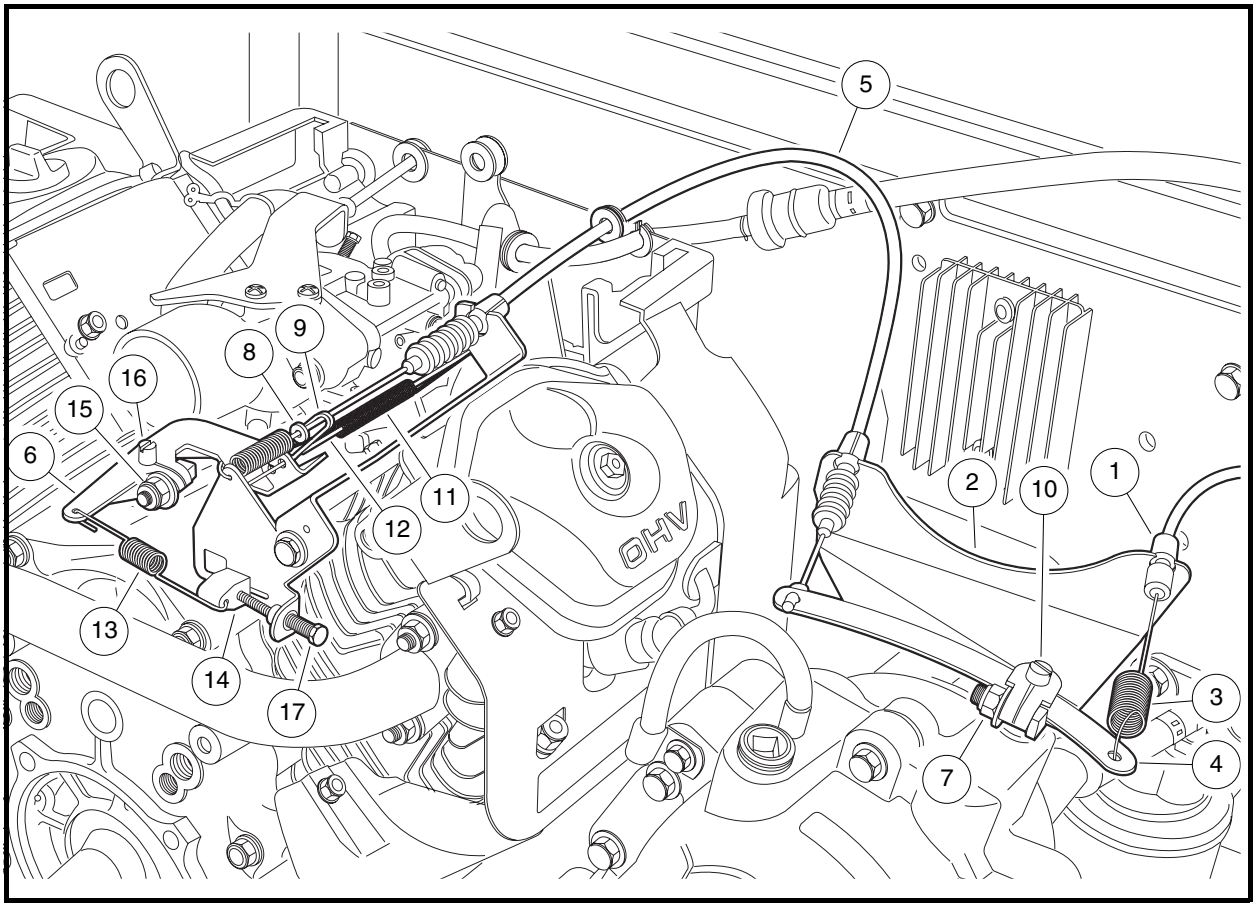


Figure 13b-21 Engine (Honda) and Transmission

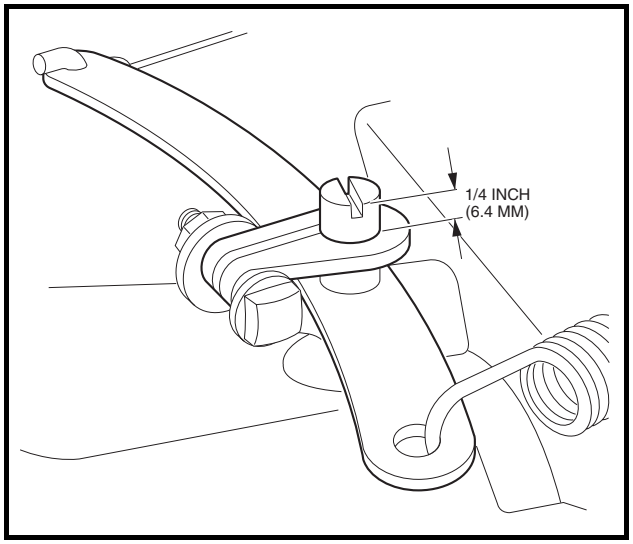


Figure 13b-22 Pin Measurement at (Transmission) Governor Arm

ENGINE GOVERNOR ARM

Engine Governor Arm Removal

1. Remove the governor guard. **See Governor Guard Removal on page 13b-19.**
2. Disconnect the intake hose from the engine.
3. Disconnect the governor wire spring (11) from the engine governor arm (6) **(Figure 13b-21, Page 13b-22)**.
4. Disengage the governor wire (12) from the carburetor and remove it from the engine governor arm (6).
5. Disengage the idle spring (13) from the engine governor arm (6) and idle adjuster (14).
6. Loosen the pinch nut (15) until the governor arm (6) can be removed from the slotted pin (16).

Engine Governor Arm Installation

1. Slide the engine governor arm (6) onto the slotted pin (16) **(Figure 13b-21, Page 13b-22)**.
2. Insert the straight end of the governor wire (12) through the top hole in the engine governor arm as shown **(Figure 13b-21, Page 13b-22)**.
3. Insert the bent end of the engine governor wire (12) into the carburetor throttle. Secure the wire with a clip.
4. Insert the governor wire spring (11) into the bottom hole in the engine governor arm as shown **(Figure 13b-21, Page 13b-22)**.
5. Ensure the governor cable is inserted into the loop in the governor wire (9). Insert the idle spring (13) into the engine governor arm (6) and stretch it to insert it into the idle adjuster (14).
6. Ensure the engine governor arm is in the wide-open throttle position and that it is securely positioned on the slotted pin (16).
7. Ensure the engine governor arm is in the wide-open throttle position. Use a flat-blade screwdriver to rotate the slotted pin (16) counterclockwise until it stops and hold it into position. Hold the screwdriver in place and use a 7/16-inch socket to tighten the pinch nut (15) to 35 in-lb (4 N·m).
8. Connect the intake hose to the engine.
9. Check the engine idle speed. **See Idle RPM Adjustment on page 13b-23.**
10. Install the governor guard. **See Governor Guard Installation on page 13b-19.**

ENGINE RPM ADJUSTMENT

Idle RPM Adjustment

⚠ DANGER

- **Do not operate the engine in an enclosed area without proper ventilation. The engine produces carbon monoxide, which is an odorless, deadly poison.**

1. Turn the key switch to start and run the engine. Place the Forward/Reverse handle in NEUTRAL. Place a tachometer (CCI P/N 1016112) close to the spark plug wire and plug.
2. Hold the throttle against the stop screw and adjust the idle-adjustment screw on the carburetor until the tachometer displays 1125 ± 25 RPM. **See following NOTE.**

NOTE: *Turn the screw counterclockwise to raise the RPM and clockwise to lower the RPM.*

3. Release the throttle.

4. Adjust the idle-adjustment screw above the No. 2 cylinder exhaust port until the tachometer displays 1300 ± 50 RPM. **See previous NOTE.**

High-Speed RPM Adjustment

⚠ DANGER

- **Do not operate the engine in an enclosed area without proper ventilation. The engine produces carbon monoxide, which is an odorless, deadly poison.**

1. Press the accelerator pedal all the way to the floor.
2. Place a tachometer (CCI P/N 1016112) close to the spark pug wire and plug.
3. Adjust the high-speed adjustment screw (1) until the tachometer displays 3825 ± 25 RPM **(Figure 13b-23, Page 13b-24)**. **See following NOTE.**

NOTE: *Turn the screw counterclockwise to raise the RPM and clockwise to lower the RPM.*

4. Release the accelerator pedal.

Figure 13b-23 High-speed Adjustment Screw

CHOKE AND AIR INTAKE SYSTEM

See General Warning, Section 1, Page 1-1.

AIR FILTER REPLACEMENT

The air filter should be inspected periodically and replaced when necessary. Filter changes should not exceed the recommended interval. **See Periodic Service Schedule, Section 10a, Page 10a-1.** More frequent service may be required in extremely dirty operating environments. In the event of a loss of power, sluggish acceleration, or a roughly running engine with excessive black exhaust, service the air filter immediately.

CAUTION

- **Do not drill into the driver-side frame. Failure to heed this caution could damage the engine by allowing excessive contamination to enter the air intake system.**

Air Filter Removal

1. Release both canister tab locks **(Figure 13b-24, Page 13b-25)**.
2. Pull the canister cap away from the canister.
3. Remove the air filter cartridge. **See following NOTE.**

NOTE: *The filter cartridge is specifically designed for this engine. It fits into the canister only one way. Use only direct replacement part (CCI P/N 102498601).*

Air Filter Installation

1. Push the new filter cartridge onto the nozzle inside the canister.
2. Position the canister cap so the TOP mark is at the top center of the canister **(Figure 13b-24, Page 13b-25)**.
3. Use both tab locks on the sides of the cap to secure the canister cap.

Figure 13b-24 Air Filter Cartridge

CHOKE CABLE REMOVAL

1. Turn the key switch OFF and remove the key. Set the park brake. Place the Forward/Reverse handle in NEUTRAL and chock the rear wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Remove both seats.
4. Remove the center seat plate.
5. Remove the engine cover plate.
6. Remove the cable sheath strain relief from the engine bracket **(Figure 13b-25, Page 13b-26)**.
7. Remove the Z-shaped cable end from the choke control on the carburetor.
8. Raise the hood.
9. Compress the choke ferrule tines on the back side of the instrument panel. Pull the cable up from the engine compartment and remove the cable. **See following NOTE.**

NOTE: *Tie a heavy nylon cord to the cable end before removing the cable. Allow the cord to travel from the engine compartment up through the instrument panel hole. Use the cord to route the cable during installation.*

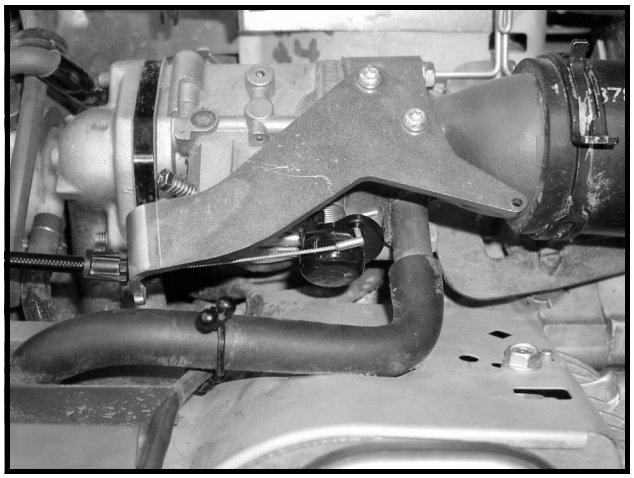


Figure 13b-25 Choke Cable on Engine

CHOKE CABLE INSTALLATION

1. Secure a new choke cable to the nylon cord outside of the instrument panel. Pull the cable from the engine compartment down to the choke cable bracket and choke control **(Figure 13b-25, Page 13b-26)**.
2. Push the choke cable ferrule into the instrument panel hole so the tines engage behind the panel.
3. Secure the choke cable to the frame with the plastic retention clips.
4. Install the Z-shaped end of the choke cable on the choke control at the carburetor.
5. Secure the cable sheath strain relief to the choke cable bracket on the engine.
6. Install the engine cover plate.
   6.1. Tighten the two front bolts to 35 in-lb (4 N·m).
   6.2. Tighten the two rear bolts, with an engine lift tab on the passenger side, to 192 in-lb (22 N·m).
7. Install the center seat plate.
8. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
9. Install both seats.
10. Lower and secure the hood.

AIR CANISTER REMOVAL

1. Turn the key switch OFF and remove the key. Set the park brake. Place the Forward/Reverse handle in NEUTRAL.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Remove the air filter cartridge. **See Air Filter Removal on page 13b-25.**
4. Remove the bottom (inlet) hose from the canister **(Figure 13b-29, Page 13b-28)**.
5. Remove the top (outlet) hose from the canister.

6. Remove the two bolts and park brake cable from the canister and remove the canister.

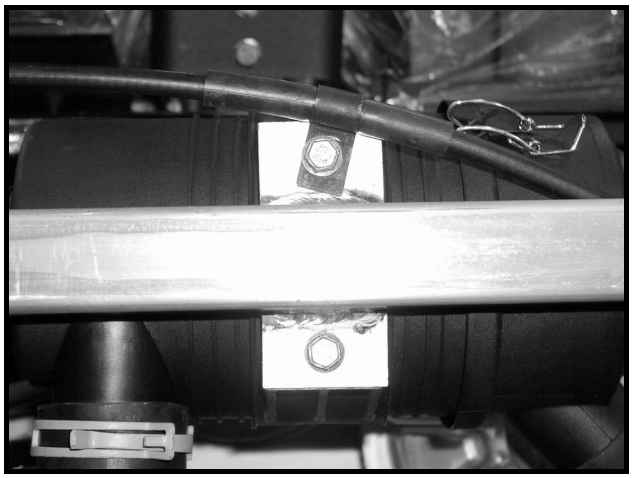


Figure 13b-26 Air Filter Canister

AIR CANISTER INSTALLATION

1. Position the canister next to the frame bracket with the rubber valve down.
2. Install two bolts to secure the canister base bracket and vehicle frame bracket. Tighten the hardware to 21 ft-lb (28.5 N·m).
3. Secure the bottom (inlet) hose to the canister port.
4. Secure the top (outlet) hose to the canister port.
5. Install a new air filter cartridge. **See Air Filter Installation on page 13b-25.**
6. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

AIR FILTER INTAKE HOSE REMOVAL

The air filter intake hose fits between the driver-side frame and the inlet port on the air filter canister. The frame serves as a duct to carry air from a location at the top of the front of the vehicle.

⚠ CAUTION

- **Do not drill holes or attach anything to the driver side of the frame. A penetrating fastener will create passages that could allow moisture and/or dirt to enter the engine air intake system.**

1. Turn the key switch OFF and remove the key. Set the park brake. Place the Forward/Reverse handle in NEUTRAL.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Remove the hose from under the filter canister.
4. Remove the hose from under the vehicle body on the frame.
5. Slide the hose through the frame support bracket and remove the hose from the vehicle **(Figure 13b-27, Page 13b-28)**.

Figure 13b-27 Air Intake Support Bracket

AIR FILTER INTAKE HOSE INSTALLATION

1. Slide the air intake hose through the frame support bracket **(Figure 13b-27, Page 13b-28)**.
2. Secure the air intake hose to the air port under the vehicle body **(Figure 13b-28, Page 13b-28)**.
3. Secure the air intake hose under the filter canister (inlet) port **(Figure 13b-29, Page 13b-28)**. **See following NOTE.**

NOTE: *Ensure the hose is positioned against the port surfaces and the clamps are positioned between the port bead and port surface.*

4. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

Figure 13b-28 Air Port on Frame

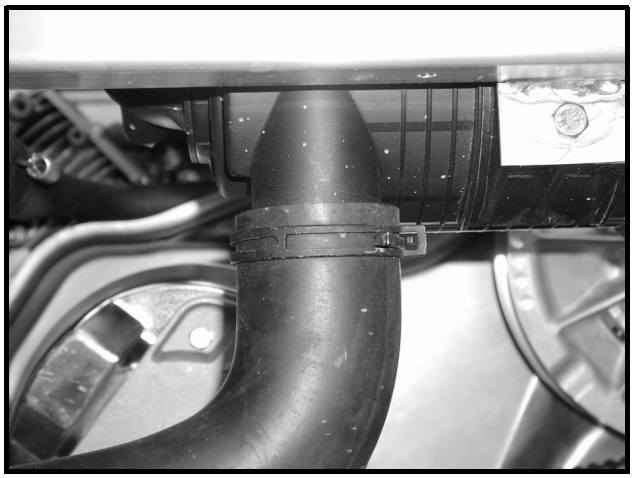


Figure 13b-29 Air Filter Inlet Hose

AIR FILTER OUTLET HOSE REMOVAL

1. Turn the key switch OFF and remove the key. Set the park brake. Place the Forward/Reverse handle in NEUTRAL.

2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Remove the hose end from the air filter canister outlet port.
4. Remove the hose end from the carburetor inlet port and remove the hose.

AIR FILTER OUTLET HOSE INSTALLATION

1. Connect the air filter outlet hose to the air filter outlet port and secure it with a clamp.
2. Connect the air filter outlet hose to the carburetor inlet port and secure it with a clamp.
3. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

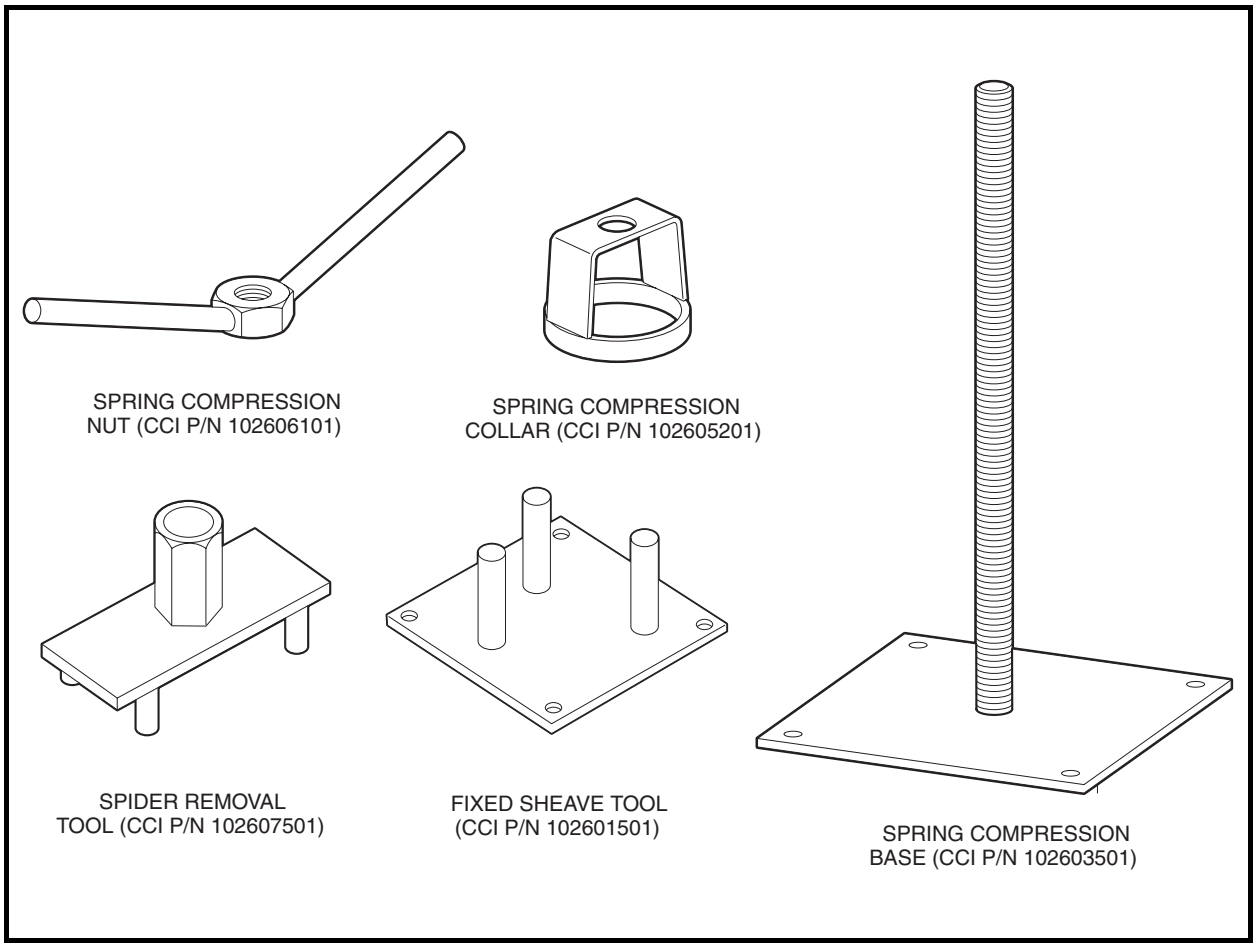


Figure 13b-30 Clutch Service Tools

CLUTCHES

To assemble and disassemble the drive and driven clutches properly, the following tools should be used:

- Drive clutch service tools:
  - Spider removal tool CCI P/N 102607501
  - Fixed sheave tool CCI P/N 102601501

- Driven clutch service tools:
  - Spring compression base CCI P/N 102603501
  - Spring compression collar CCI P/N 102605201
  - Spring compression nut CCI P/N 102606101

CLUTCH TROUBLESHOOTING

See General Warning, Section 1, Page 1-1.

Use a tachometer during vehicle operation to determine if the engine begins to lose RPM when the vehicle climbs a steep hill. Check the engine RPM and governor adjustments. If these adjustments are within specifications, there is a clutch problem. **See Engine RPM Adjustment on page 13b-23. See also Ground Speed (Transmission) Governor Arm Adjustment on page 13b-21.**

If the clutches are not operating properly, perform the following:

1. Check the ground speed governor and throttle settings. **See Governor Cable Installation on page 13b-20.**
2. Inspect both clutches for dirt and debris buildup on component parts. Clean the exterior surfaces of both clutches with water to remove any dust or dirt, then drive the vehicle and check for proper operation. **See Drive Clutch on page 13b-31. See also Driven Clutch on page 13b-36.**
3. Check the clean clutches for wear.
4. If cleaning both clutches does not solve the problem, disassemble and thoroughly clean all parts in the drive and driven clutches.
5. Check the drive clutch rollers and weights for wear. **See Drive Clutch Cleaning and Inspection on page 13b-32.**

DRIVE BELT

See General Warning, Section 1, Page 1-1.

The drive belt should be inspected periodically for wear and glazing. If it is excessively worn, frayed, or glazed, replace the belt.

As the drive belt wears, the engine RPM will increase to compensate for the change in torque ratio. This RPM increase helps maintain the correct maximum ground speed of 25 mph (40 km/h).

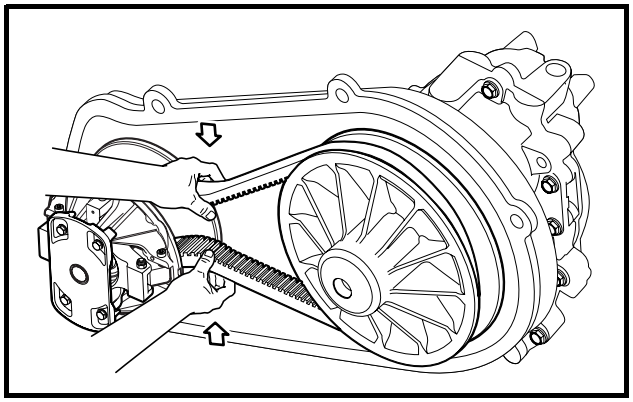


Figure 13b-31 Drive Belt Removal

Drive Belt Removal

1. Turn the key switch OFF and remove the key. Set the park brake. Place the Forward/Reverse handle in NEUTRAL.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Disconnect the spark plug wires. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
4. Remove the outer clutch cover. **See Clutch Outer Cover Removal on page 13b-39.**
5. Grasp the belt midway between the drive and driven clutches and squeeze the belt together as tightly as possible **(Figure 13b-31, Page 13b-30)**.
6. Guide the belt over the driven clutch and roll the belt off the driven clutch by rotating the clutch clockwise. **See following CAUTION.**

⚠ CAUTION

- **Make sure your fingers are not underneath the belt when rolling the belt off the driven clutch.**

Drive Belt Installation

1. Turn the key switch OFF and remove the key. Set the park brake. Place the Forward/Reverse handle in NEUTRAL.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Disconnect the spark plug wires. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
4. Remove the outer clutch cover. **See Clutch Outer Cover Removal on page 13b-39.**
5. Position the new belt on the drive clutch and then start the belt over the top of the driven clutch.
6. Rotate the driven clutch clockwise and roll the belt over the driven clutch sheaves and onto the clutch.
7. Install the outer clutch cover. **See Clutch Outer Cover Installation on page 13b-39.**
8. Connect the spark plug wires.
9. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

DRIVE CLUTCH

See General Warning, Section 1, Page 1-1.

CAUTION

- **Be very careful with the clutches. A clutch that has been dropped will not be properly balanced. If either clutch is dropped, assume that it is damaged and replace it.**

Drive Clutch Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.

2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Disconnect the spark plug wires. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
4. Remove the top air filter hose (outlet) from the air filter canister.
5. Remove the clutch outer cover. **See Clutch Outer Cover Removal on page 13b-39.**
6. Remove the drive belt. **See Drive Belt Removal on page 13b-31.**
7. Remove the bolt and washer from the center of the clutch.
8. Thread the clutch removal tool (CCI P/N 102686101) into the drive clutch center and advance the tool until the clutch is released from the crankshaft. **See following CAUTION.**

CAUTION

- **Hold the clutch assembly firmly when the clutch removal tool is advanced. Once loosened, the clutch will drop quickly. Do not allow the clutch to fall on a hard surface.**

9. Remove the drive clutch from the vehicle. **See following CAUTION.**

CAUTION

- **Do not hit or tap the clutch with a hammer. Do not pry the clutch. These actions will damage the clutch.**

Drive Clutch Cleaning and Inspection

1. Use a dry, lint-free cloth to clean clutch parts. **See following CAUTION**.

CAUTION

- **Do not lubricate the drive clutch. Lubricants attract dirt and dust, which interfere with proper clutch operation.**
- **Use only a dry cloth and lightly wipe the shaft of the fixed face assembly (15) (Figure 13b-33, Page 13b-35). Do not use a brush or steel wool. These abrasives will damage the surface of the shaft.**
- **Do not use solvents. Solvents will damage the lubricating characteristics of the bushings.**

2. Inspect the belt contact surfaces of the clutch sheaves for wear. If any area of a sheave contact surface has wear of 0.060 inch (1.52 mm) or more, the clutch should be replaced.

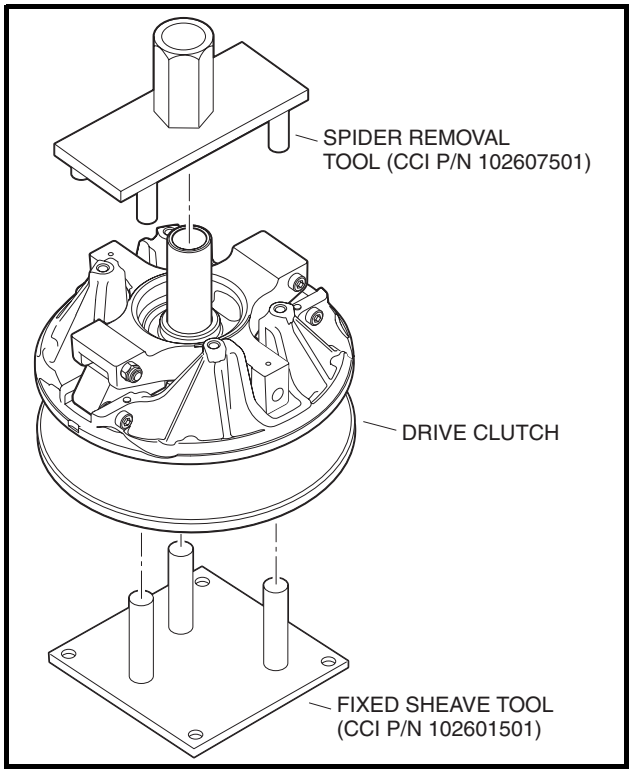


Figure 13b-32 Drive Clutch Service Tools

Drive Clutch Disassembly

The following service tools are required to disassemble the drive clutch and are available from a service parts representative:

- Fixed sheave tool (CCI P/N 102601501)
- Spider removal tool (CCI P/N 102607501)

1. Use a 7/16-inch socket to remove the four bolts (1) and washers (2) that secure the plate (3) to the clutch cover (4) **(Figure 13b-33, Page 13b-35)**.
2. Remove the cover (4) and spring (5) from the clutch spider (6).
3. Inspect the torque rollers (7), weights (11) and rollers (10). Replace if necessary.
4. Secure the Fixed sheave tool (CCI P/N 102601501) into a vise, or mount the tool to a flat work surface **(Figure 13b-32, Page 13b-33)**.
5. Place the fixed sheave of the drive clu
6. tch onto the service tool so that the drive clutch is stationary.
7. Place the Spider removal tool (CCI P/N 102607501) on top of the spider.
8. Use a 1/2-inch drive ratchet to disengage the moveable sheave (14) and spider (6), which will come off as an assembly, from the fixed sheave (15) **(Figure 13b-33, Page 13b-35)**.

Drive Clutch Component Inspection

1. Use a feeler gauge to inspect the torque rollers (7) and replace the rollers if necessary **(Figure 13b-33, Page 13b-35)**.
   1.1. Use a pin driver to drive out the pin (8), which will release a pin (9) and allow the rollers (7) to slide out of the spider (6).

1.2. Install new rollers and secure the rollers with pins.

2. Inspect the rollers (10) and weights (11). There should be no noticeable wear. If the rollers or weights are worn, scratched, or damaged, replace them.
   2.1. Remove the bolts (12) and flex locknuts (13) that secure the rollers (10) to the spider (6) and the weights (11) to the moveable sheave (14).
   2.2. Install new rollers and weights with bolts and flex locknuts.

Drive Clutch Assembly

NOTE: *The drive clutch components are marked with an X to assist in correct reassembly. It is important to note the location of the X on the components and be sure to align the X's when assembling the drive clutch.*

1. Place the moveable sheave (14) and spider (6) onto the fixed sheave (15). Note the location of the X so the remaining components with an X can be aligned.
2. Use a spider removal tool (CCI P/N 102607501) to tighten the moveable sheave and spider to 225 ft-lb (305 N·m).
3. Install the spring (5) onto the shaft.
4. Install the cover (4) onto the shaft.
5. Align the plate that has holes in the cover with arrows on the same side. Pull the moveable sheave upward and start threading the bolts with washers into holes. **See following NOTE.**

NOTE: *Keep the cover as square to the post as possible to minimize wear between the post and cover.*

6. Use a crisscross pattern to continue tightening the hardware.
7. Tighten the bolts to 120 in-lb (14 N·m).

Drive Clutch Installation

1. Turn the key switch OFF and remove the key. Set the park brake. Place the Forward/Reverse handle in NEUTRAL.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Disconnect the spark plug wires. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
4. Place the drive clutch assembly on the crankshaft taper.
5. Install the mounting washer and retaining bolt. Tighten the hardware to 39 ft-lb (53 N·m).
6. Install the drive belt as instructed. **See Drive Belt Installation on page 13b-31.**
7. Install the clutch outer cover and tighten the bolts to 72 in-lb (8.0 N·m).
8. Secure the top air filter hose (outlet) to the filter canister. **See following NOTE.**

NOTE: *Ensure the hose contacts the canister and the clamp is installed tightly between the port bead and canister.*

9. Connect the spark plug wires.
10. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
11. Drive the vehicle and check for proper operation.

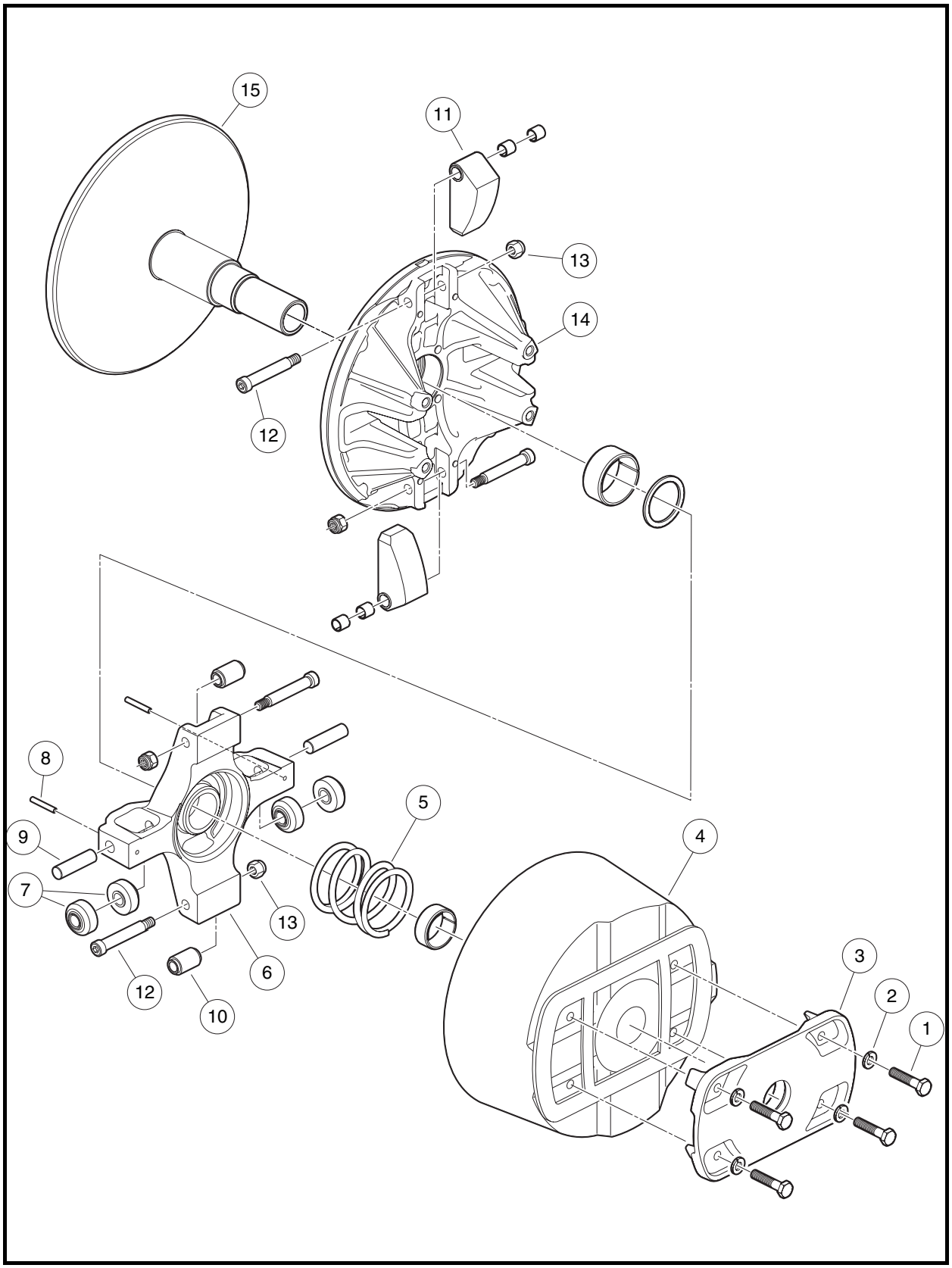


Figure 13b-33 Drive Clutch Assembly

DRIVEN CLUTCH

See General Warning, Section 1, Page 1-1.

Driven Clutch Removal

1. Turn the key switch OFF and remove the key. Set the park brake. Place the Forward/Reverse handle in NEUTRAL.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Disconnect the spark plug wires. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
4. Remove the top air filter hose from the filter canister.
5. Remove the clutch outer cover. **See Clutch Outer Cover Removal on page 13b-39.**
6. Remove the drive belt as instructed. **See Drive Belt Removal on page 13b-31.**
7. Remove the bolt and washer from the center of the clutch.
8. Remove the driven clutch from the vehicle. **See following CAUTION.**

CAUTION

- **Do not hit or tap the clutch with a hammer. Do not pry the clutch. These actions will damage the clutch.**

Driven Clutch Disassembly

The following service tools are required to disassemble and assemble the driven clutch. They are available from a service parts representative:

- Spring compression base (CCI P/N 102603501)
- Spring compression collar (CCI P/N 102605201)
- Spring compression nut (CCI P/N 102606101)

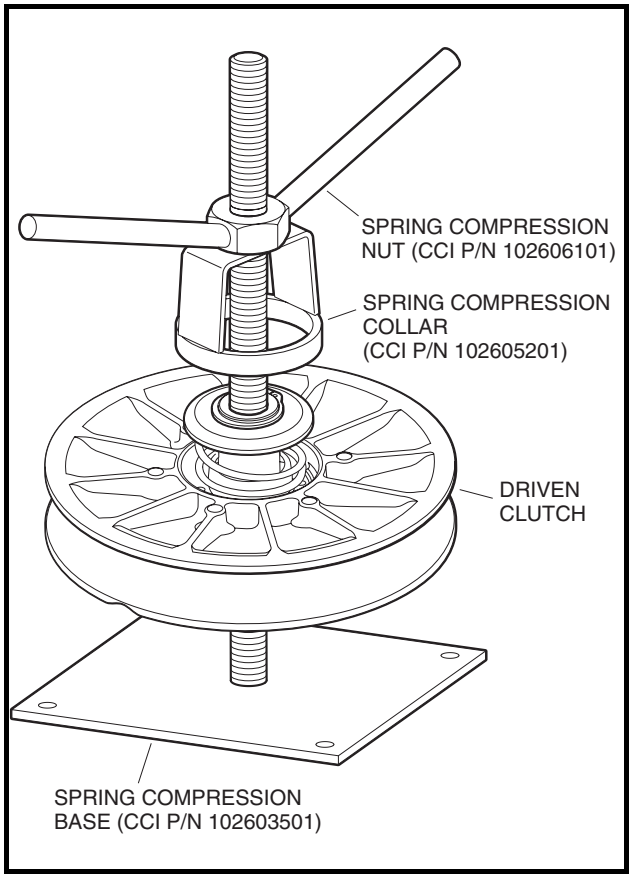


Figure 13b-34 Driven Clutch Service Tools

1. Place the driven clutch onto the Spring compression base (CCI P/N 102603501) **(Figure 13b-34, Page 13b-37)**.
2. Place the Spring compression collar (CCI P/N 102605201) onto the driven clutch.
3. Thread the Spring compression nut (CCI P/N 102606101) down onto the threaded post enough to release the pressure on the snap ring.
4. Use snap-ring pliers to remove the snap ring (1) **(Figure 13b-35, Page 13b-38)**.
5. Slowly remove the spring compression nut. The collar will then rise and release tension on the spring (3).
6. Remove the cup (2) and spring (3).
7. Remove the moveable sheave (4) from the fixed sheave (5). **See following NOTE.**

NOTE: *Both the moveable and fixed sheaves have spacers (6). Be sure to retain the spacers for reassembly of the driven clutch.*

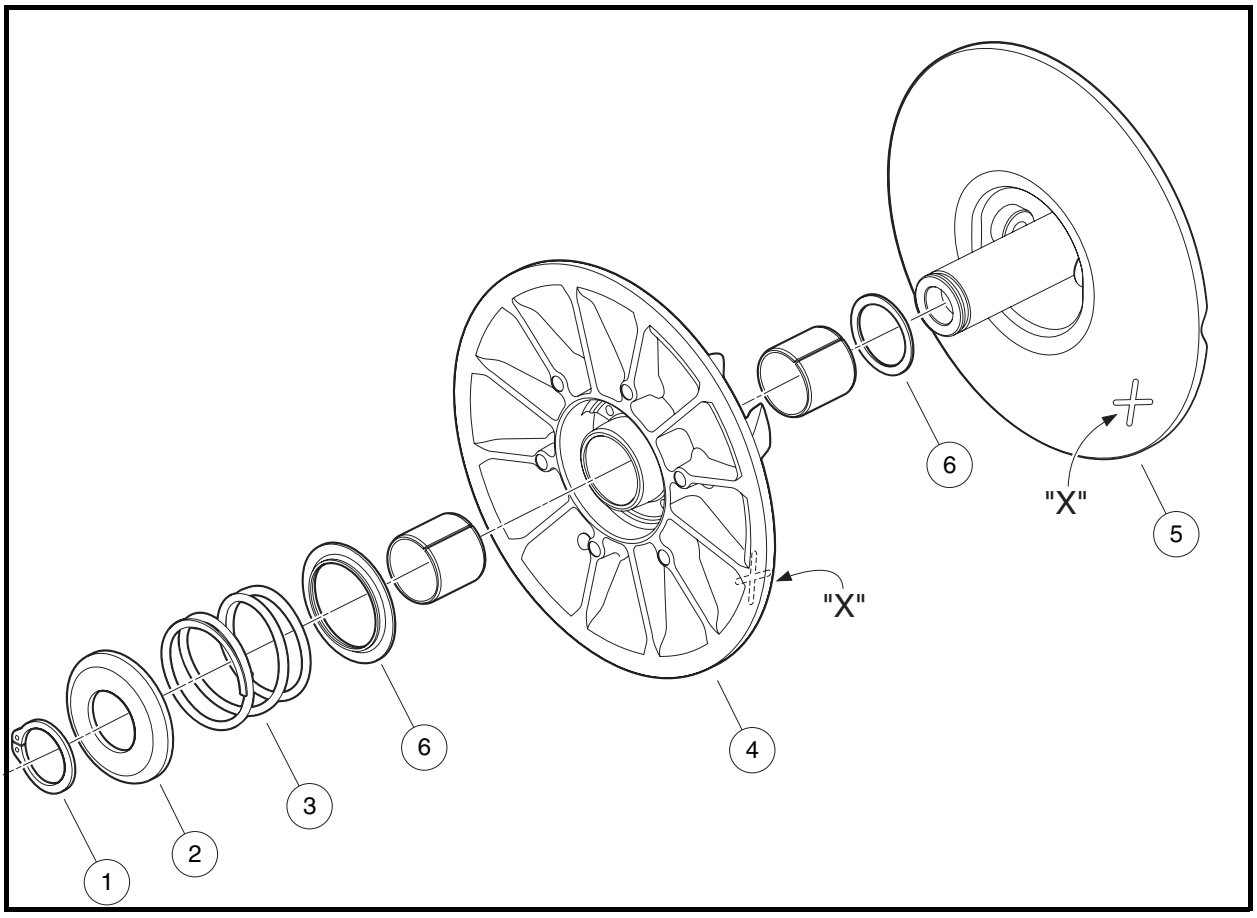


Figure 13b-35 Driven Clutch Assembly

Driven Clutch Assembly

1. Place the fixed sheave (5) onto the spring compression base and note the location of the X so the X on the moveable sheave (4) can be aligned correctly **(Figure 13b-35, Page 13b-38)**.
2. Place the moveable sheave (4) onto the fixed sheave (5) and align the X's on both components.
3. Place the spring (3), cup (2), and snap ring (1) onto the clutch.
4. Place the spring compression collar onto the cup **(Figure 13b-34, Page 13b-37)**.
5. Tighten the spring compression nut just enough to enable the snap ring to be installed.
6. Use snap ring pliers to install the snap ring.

Driven Clutch Installation

1. Turn the key switch OFF and remove the key. Set the park brake. Place the Forward/Reverse handle is in NEUTRAL.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Disconnect the spark plug wires. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
4. Install the driven clutch assembly on the transmission splined shaft.
5. Install the mounting washer and retaining bolt and tighten to 39 ft-lb (53 N·m).

6. Install the drive belt as instructed. **See Drive Belt Installation on page 13b-31.**
7. Install the clutch outer cover and tighten the screws to 72 in-lb (8 N·m).
8. Install the top air filter hose on the filter canister. **See following NOTE.**

NOTE: *Ensure the hose contacts the canister and the clamp is installed tightly between the port bead and canister.*

9. Connect the spark plug wires.
10. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
11. Drive the vehicle and check for proper operation.

CLUTCH COVER

Clutch Outer Cover Removal

1. Turn the key switch OFF and remove the key. Set the park brake. Place the Forward/Reverse handle is in NEUTRAL.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Disconnect the spark plug wires. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
4. Remove the top air filter hose from the filter canister.
5. Remove the self-threading screws and remove the clutch outer cover. **See following WARNING.**

⚠ WARNING

- **Clutch outer cover must be installed before returning the vehicle to normal operation. If the engine is operated with the clutch outer cover removed, keep hands away from the clutches and belt. Failure to heed this warning could result in severe personal injury.**

Clutch Outer Cover Installation

1. Align the mounting holes in the clutch cover with the mounting holes in the inner cover.
2. Install the screws and tighten the hardware to 72 in-lb (8 N·m).
3. Install the top air filter hose on the filter canister.
4. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305). **See following NOTE.**

NOTE: *Ensure the hose clamp is tightly installed and positioned between the filter canister and canister port bead.*

Clutch Inner Cover Removal

1. Turn the key switch OFF and remove the key. Set the park brake. Place the Forward/Reverse handle is in NEUTRAL.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**

3. Disconnect the spark plug wires. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
4. Remove the outer clutch cover. **See Clutch Outer Cover Removal on page 13b-39.**
5. Remove the drive belt. **See Drive Belt Removal on page 13b-31.**
6. Remove the drive clutch. **See Drive Clutch Removal on page 13b-31.**
7. Remove the driven clutch. **See Driven Clutch Removal on page 13b-36.**
8. Remove the bolts and washers from the clutch inner cover **(Figure 13b-36, Page 13b-40)**.
9. Remove the clutch inner cover.

Clutch Inner Cover Installation

1. Align the mounting holes in the clutch cover with the transmission and engine bolt holes.
2. Loosely install one bolt and washer in each transmission and engine mounting hole.
3. Finger-tighten the bolts and washers.

NOTE: *Mounting holes in the clutch inner cover have close tolerances. Align the engine and transmission carefully to ensure the mounting holes in the clutch inner cover match the threaded holes in the engine and transmission.*

4. Tighten the clutch inner cover engine bolts and washers to 21 ft-lb (28.5 N·m).
5. Tighten the transmission bolts and washers to 21 ft-lb (28.5 N·m).
6. Install the driven clutch. **See Driven Clutch Installation on page 13b-38.**
7. Install the drive clutch. **See Drive Clutch Installation on page 13b-34.**
8. Install drive belt. **See Drive Belt Installation on page 13b-31.**
9. Install the clutch outer cover. **See Clutch Outer Cover Installation on page 13b-39.**
10. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

Figure 13b-36 Clutch Inner Cover

SECTION 13C – DIESEL ENGINE, MUFFLER, FUEL SYSTEM, AND CLUTCHES

⚠ DANGER

- **See General Warning, Section 1, Page 1-1.**

⚠ WARNING

- **See General Warning, Section 1, Page 1-1.**

DIESEL ENGINE

See General Warning, Section 1, Page 1-1.

This section contains information on removing and installing the Kubota diesel engine. For complete instructions on engine disassembly, repair, rebuilding, and reassembly, refer to the engine manual. **See the Kubota D722 diesel engine manual (CCI P/N 102615501).**

ENGINE REMOVAL

See General Warning, Section 1, Page 1-1.

CAUTION

- **Before removal and disassembly, clean the engine.**

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Remove both seats.
3. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally..." in General Warning, Section 1, Page 1-2.**
4. Remove the cargo bed. **See Cargo Bed Removal, Section 4, Page 4-12.**
5. Remove the top of the ROPS (Roll Over Protection Structure). **See ROPS Removal, Section 4, Page 4-7.**
6. Remove the lower rear ROPS bars and seat frame assembly. **See ROPS Removal, Section 4, Page 4-7.**
7. Drain the engine and radiator coolant system. **See Engine Coolant Change, Section 15, Page 15-1.**
8. Release the clamps securing the upper (1) and lower coolant hoses to the engine and remove hoses.
9. Release the clamp securing the coolant overflow/bypass hose (2) to the thermostat cover and remove hose.
10. Remove the fuel supply line (3) at the engine fuel injection pump and securely plug the fuel supply line **(Figure 13c-1, Page 13c-2)**. **See following DANGER.**

⚠ DANGER

- **The diesel fuel tank does not have a fuel line valve. When the fuel line is removed from the engine, fuel can siphon fuel from the tank if the fuel line rests below the fuel level in the fuel tank. Securely cap or plug the fuel line immediately after it is removed from the fuel injector to prevent fuel leakage.**
- **Diesel fuel! Flammable! Explosive! Do not smoke. Keep sparks and flames away from the vehicle and service area.**

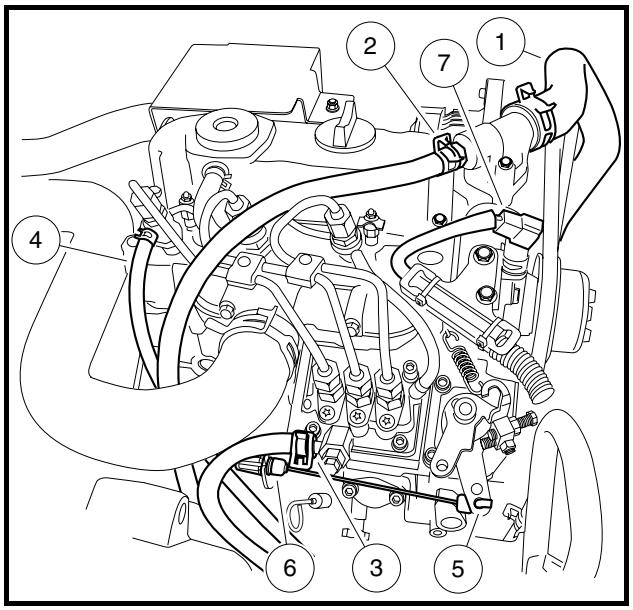


Figure 13c-1 Disconnect Coolant Hoses, Fuel Lines, Accelerator Cable and Fuel Solenoid Valve Connector

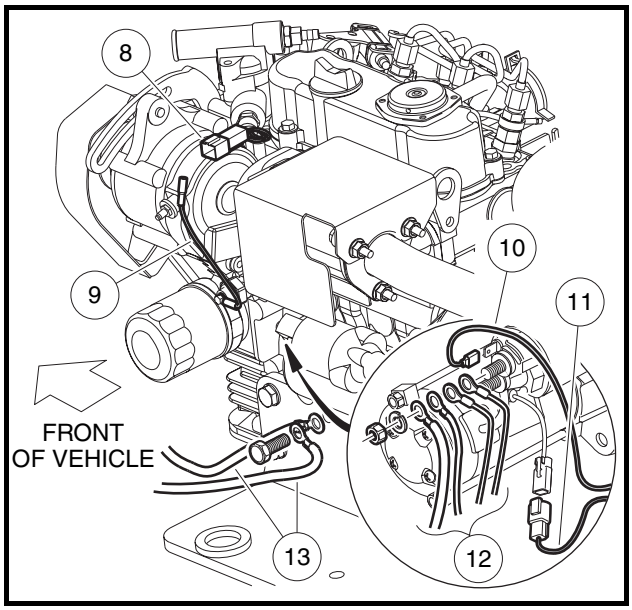


Figure 13c-2 Disconnect Thermostat Switch, Starter Wires and Ground Wires

11. Remove the fuel return line (4) at the engine relief valve port and securely plug the fuel return line **(Figure 13c-1, Page 13c-2)**. **See previous DANGER.**
12. Remove the accelerator cable (5) from the accelerator lever **(Figure 13c-1, Page 13c-2)**.
13. Remove the accelerator cable sheath strain relief (6) from the engine bracket.
14. Disconnect the three-pin connector (7) on the fuel solenoid valve from the engine **(Figure 13c-1, Page 13c-2)**.
15. Disconnect the thermostat switch connector (8) from the wire harness **(Figure 13c-2, Page 13c-2)**.
16. Disconnect the oil pressure switch connector (9) from the wire harness.
17. Disconnect the green wire (10) from the starter solenoid and the blue wire (11) from the white solenoid wire at the one-pin connector **(Figure 13c-2, Page 13c-2)**.
18. Disconnect the red wires (12) from the starter solenoid.
19. Disconnect the two black ground wires (13) from the engine block.
20. Disconnect the air filter outlet hose from the intake manifold. **See Air Filter Outlet Hose Removal on page 13c-26.**
21. Loosen the hardware that secures the muffler. **See Muffler Removal on page 13c-5.**

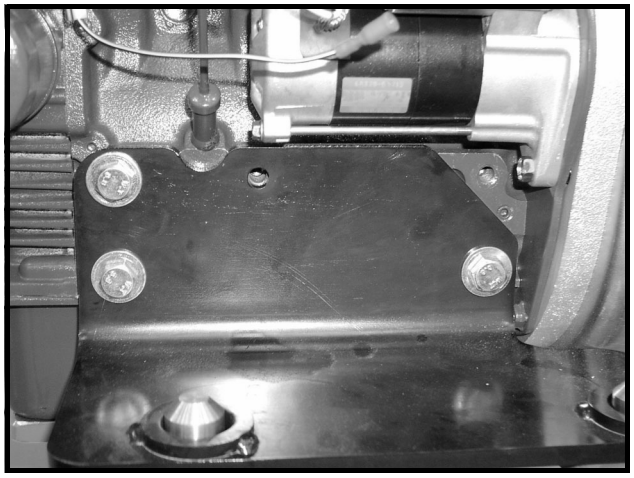


Figure 13c-3 Driver Side Diesel Engine Mount

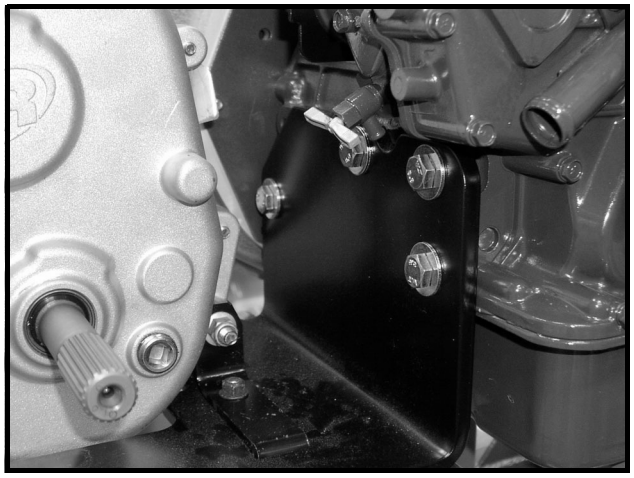


Figure 13c-4 Passenger Side Diesel Engine Mount

22. Remove the hardware securing manifold pipe to exhaust manifold and slide exhaust system as far to the rear as possible. **See Manifold Pipe Removal on page 13c-6.**
23. Remove the clutch outer cover. **See Clutch Outer Cover Removal on page 13c-35.**
24. Remove the drive belt. **See Drive Belt Installation on page 13c-29.**
25. Remove the clutches. **See Drive Clutch Removal on page 13c-29. Also See Driven Clutch Removal on page 13c-33.**
26. Remove the clutch inner cover. **See Clutch Inner Cover Removal on page 13c-36.**
27. Remove the engine mounting hardware **(Figures 13c-3 and 13c-4, Page 13c-3)**. **See following NOTE.**

NOTE: *When removing the engine mounting hardware, note the location of the two black ground wires secured to the driver side of engine.*

28. Use the engine lift tabs on top of the engine to lift the engine from the mounting plate.
29. If replacing engine, remove cvt adapter shaft from flywheel and retain for use on replacement engine.

ENGINE INSTALLATION

See General Warning, Section 1, Page 1-1.

1. If installing replacement engine, center cvt adapter shaft on flywheel and secure with new hardware. Tighten bolts to 21 ft-lb (28.5 N·m).
2. Lower the engine into the engine compartment and fit the engine block between the base plate brackets **(Figure 13c-3, Page 13c-3)**. **Also see Figure 13c-4, Page 13c-3.**
3. Loosely secure new bolts and flat washers to the engine block mounts.

NOTE: *Engine block bolts will be tightened after the engine and transmission are aligned and the clutch inner cover is installed and bolts tightened to hold alignment.*

4. Install the clutch inner cover. **See Clutch Inner Cover Installation on page 13c-36.**
5. Install the clutches. **See Drive Clutch Installation on page 13c-32. Also See Driven Clutch Installation on page 13c-35.**
6. Install the drive belt. **See Drive Belt Installation on page 13c-29.**

7. Install the clutch outer cover. **See Clutch Outer Cover Installation on page 13c-35.**
8. Using new gasket, slide exhaust system forward and secure the manifold pipe to the exhaust manifold. **See Manifold Pipe Installation on page 13c-6.**
9. Tighten the hardware that secures the muffler. **See Muffler Installation on page 13c-7.**
10. Attach the air filter outlet hose to the intake manifold. **See Air Filter Outlet Hose Installation on page 13c-26.**
11. Connect the two black ground wires (13) to the engine block and tighten the bolt to 39 ft-lb (53 N·m).
12. Connect the red wires (12) to starter solenoid and tighten the nut and lock washer to 90 in-lb (10.3 N·m).
13. Connect the green wire (10) to the starter solenoid and the blue wire (11) to the white solenoid wire **(Figure 13c-2, Page 13c-2)**.
14. Connect the oil pressure switch connector (9) to the wire harness.
15. Connect the thermostat switch connector (8) to the wire harness **(Figure 13c-2, Page 13c-2)**.
16. Connect the fuel solenoid valve three-pin connector (7) to the engine **(Figure 13c-1, Page 13c-2)**.
17. Connect the accelerator cable sheath (6) to the engine bracket **(Figure 13c-1, Page 13c-2)**.
18. Connect the accelerator cable (5) to the throttle lever.
19. Remove the plug and secure the fuel return line (4) to the engine relief valve with a new clamp **(Figure 13c-1, Page 13c-2)**. **See following DANGER.**

⚠ DANGER

- **Diesel fuel! Flammable! Explosive! Do not smoke. Keep sparks and flames away from the vehicle and service area.**
- **To prevent fuel from siphoning, keep the fuel supply line above the fuel level in the fuel tank when removing the plug.**

20. Remove the plug and secure the fuel supply line (3) to the fuel injector assembly with a new clamp **(Figure 13c-1, Page 13c-2)**. **See previous DANGER.**
21. Attach the overflow/bypass hose (2) to the thermostat cover and secure with new clamp.
22. Attach the upper (1) and lower radiator hoses to the engine and secure with new clamps.
23. Refill the engine and radiator coolant system. **See Engine Coolant Change, Section 15, Page 15-1.**
24. Install seat frame and lower ROPS (Roll Over Protection Structure). **See Seat Support Installation, Section 4, Page 4-10.**
25. Install the upper ROPS frame. **See ROPS Installation, Section 4, Page 4-8.**
26. Install the cargo bed. **See Cargo Bed Installation, Section 4, Page 4-12.**
27. Check the engine oil level. **See Engine Oil Level Check, Section 10a, Page 10a-8.**
28. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
29. Adjust the engine RPM setting if required. **See Engine RPM Adjustment on page 13c-20.**
30. Install both seats.
31. Test-drive the vehicle to ensure all systems are functional and adjusted correctly.

EXHAUST SYSTEM

MUFFLER REMOVAL

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Loosen the muffler spring suspension bracket bolts.
4. Remove the two springs that secure the muffler inlet to the intermediate pipe **(Figure 13c-5, Page 13c-5)**. **See following NOTE.**

NOTE: *Shift the end of the muffler inlet and intermediate pipe from side to side to relax and disconnect the springs.*

5. Remove the two bolts and large flat washers that secure the muffler to the chassis and remove the muffler. **See following WARNING and NOTE.**

⚠ WARNING

- **Always wear eye protection when springs are removed or installed.**

NOTE: *Replace springs that show signs of brittleness, broken coils, or loss of tension.*

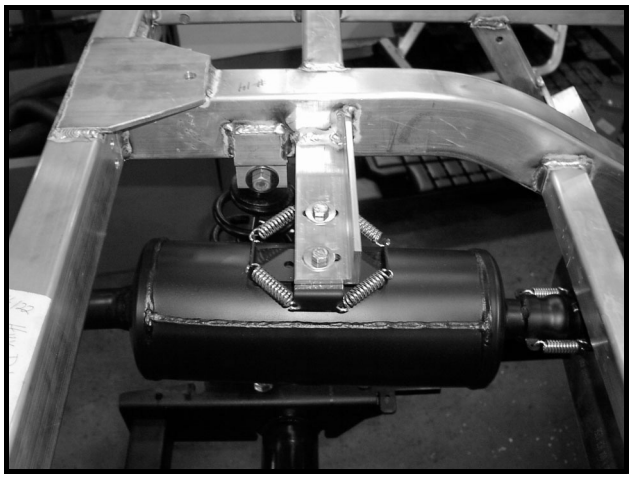


Figure 13c-5 Muffler Bracket and Inlet Pipe

INTERMEDIATE PIPE REMOVAL

1. Loosen the muffler spring suspension bracket bolts.
2. Remove the springs from the intermediate pipe and muffler inlet. **See following WARNING and NOTE.**

⚠ WARNING

- **Always wear eye protection when springs are removed or installed.**

NOTE: *Shift the end of the muffler inlet and intermediate pipe from side to side to relax and disconnect the springs.*

3. Remove the springs from the intermediate pipe and manifold pipe and remove the pipe.

MANIFOLD PIPE REMOVAL

1. Remove the three bolts and flange-head locknuts **(Figure 13c-6, Page 13c-6)**.
2. Separate the manifold pipe from the engine exhaust manifold.

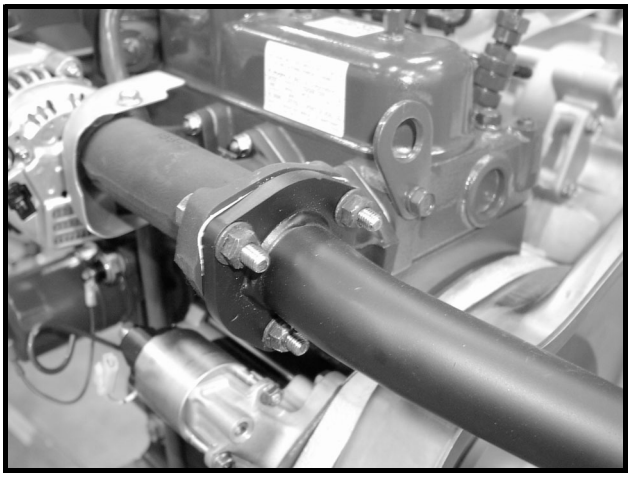


Figure 13c-6 Diesel Manifold Pipe Flange

MANIFOLD PIPE INSTALLATION

1. Clean both the exhaust manifold and the manifold pipe flanges with a scraper or wire brush.
2. Use a new high-temperature flange gasket (CCI P/N 102422301) and align the manifold pipe so the bend directs the pipe in and slightly down.
3. Install new bolts and flange-head locknuts. Tighten the hardware to 21 ft-lb (28.5 N·m) **(Figure 13c-6, Page 13c-6)**.

INTERMEDIATE PIPE INSTALLATION

1. Secure the intermediate pipe to the manifold pipe with new springs. **See following WARNING and NOTE.**

⚠ WARNING

- **Always wear eye protection when springs are removed or installed.**

NOTE: *Shift the end of the muffler inlet and intermediate pipe from side to side to relax and connect the springs.*

2. Secure the intermediate pipe to the muffler inlet with new springs. **See previous NOTE and WARNING.**
3. Align the muffler with the intermediate pipe and tighten the muffler spring suspension bracket bolts to 21 ft-lb (29 N·m).

MUFFLER INSTALLATION

NOTE: *Replace springs that show signs of brittleness, broken coils, or loss of tension.*

1. Loosely secure the muffler and spring suspension bracket to the chassis with two bolts and large flat washers **(Figure 13c-7, Page 13c-7)**.
2. Secure the muffler inlet to the intermediate pipe with new springs. **See following WARNING and NOTE.**

⚠ WARNING

- **Always wear eye protection when springs are removed or installed.**

NOTE: *Shift the end of the muffler inlet and intermediate pipe from side to side to relax and connect the springs.*

3. Align the muffler with the intermediate pipe and tighten the muffler spring bracket hardware to 21 ft-lb (29 N·m). **See previous NOTE and WARNING.**

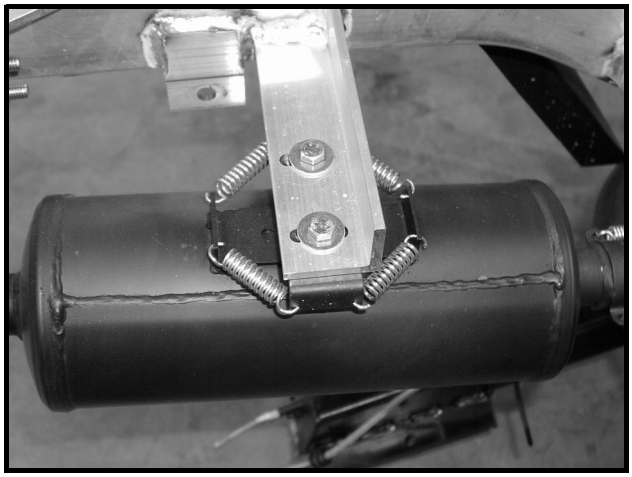


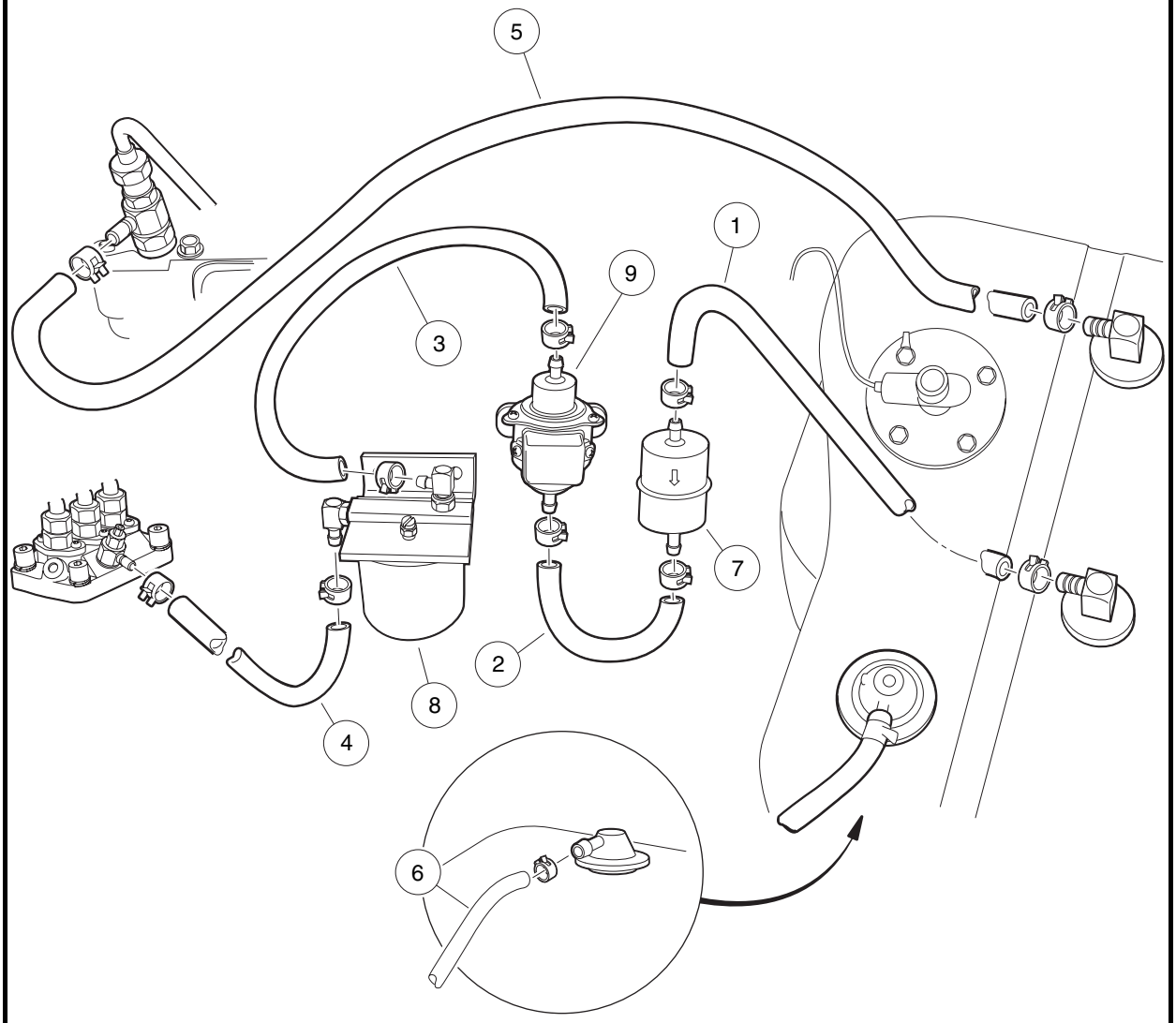
Figure 13c-7 Muffler and Bracket

4. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
5. Place the Forward/Reverse handle in NEUTRAL, start the engine and check for exhaust leaks and proper engine operation. **See following DANGER.**

⚠ DANGER

- **The engine produces carbon monoxide, which is an odorless, deadly poison. Do not operate the engine in an enclosed area without proper ventilation.**

FUEL SYSTEM



FUEL LINE No.	DIA. ø	ROUTING	LENGTH Solid Color	LENGTH Clear
1	5/16 in. (8 mm)	Fuel tank to primary fuel filter	13.6 in. (34.5 cm)	
2	5/16 in. (8 mm)	Primary fuel filter to fuel pump	9.0 in. (23.0 cm)	
3	5/16 in. (8 mm)	Fuel pump to secondary fuel filter	11.9 in. (30.0 cm)	
4	5/16 in. (8 mm)	Secondary fuel filter to fuel injector pump	19.4 in. (49.0 cm)	
5	3/16 in. (5 mm)	Fuel return hose	29.0 in. (73.5 cm)	
6	3/16 in. (5 mm)	Vent tube (fuel tank)		22.0 in. (55.8 cm)
		Total	82.9 in. (210 cm)	22.0 in. (55.8 cm)

Figure 13c-8 Fuel System (Diesel Vehicles)

FUEL LINES

See General Warning, Section 1, Page 1-1.

The fuel lines must be properly routed and all hose clamps must be tight **(Figure 13c-8, Page 13c-8)**. The fuel lines should be kept clean. **See following NOTE and WARNING.**

NOTE: *Use only 5/16-inch and 3/16-inch hoses with SAE J30R7 rating to replace the fuel lines.*

⚠ WARNING

- **Make sure fuel lines are the correct length and are properly routed. Failure to heed this warning could result in damage to the fuel lines and fire.**

FUEL FILTER REPLACEMENT

See General Warning, Section 1, Page 1-1.

The fuel system contains two fuel filters: A primary fuel filter (7) and a secondary fuel filter (8) with an integrated water separator **(Figure 13c-8, Page 13c-8)**. Fuel filters, fuel lines, and the fuel tank vent (6) should be inspected periodically for leaks and replaced when necessary. Fuel filter changes should not exceed the recommended interval. **See Periodic Service Schedule on page 10a-1. See following NOTE.**

NOTE: *Use only OEM fuel filters designed for your engine.*

DRAINING WATER FROM THE SECONDARY FUEL FILTER

The secondary fuel filter also functions as a water separator. It has a drain valve on the bottom of the filter to drain water from the fuel system. Water should be drained from the secondary fuel filter/water separator daily. The fuel filter is mounted on a plate under the passenger-side seat **(Figure 13c-9, Page 13c-9)**.

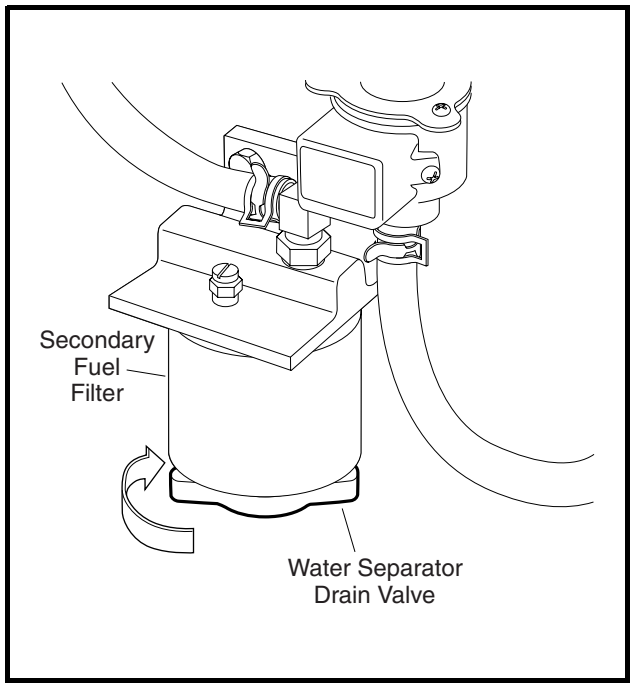


Figure 13c-9 Water Separator Drain Valve

1. Place a drain pan under the fuel filter.
2. Lift the passenger-side seat.
3. Locate the valve on the underside of the filter. Turn the valve clockwise until water begins to stream from the filter **(Figure 13c-9, Page 13c-9)**.
4. Drain the water until it changes color. When the fluid changes color, fuel has begun to escape. **See following WARNING and NOTE.**

⚠ WARNING

- **Clean up spilled fuel. Keep sparks and flames away from the vehicle and service area. Failure to heed this warning could result in an explosion or fire, resulting in severe personal injury or death.**

NOTE: *Dispose of water according to the environmental laws and regulations for your area.*

5. Close the valve. Rotate the valve counterclockwise until it is firmly sealed.
6. To resupply the filter with fuel, turn the key switch to the ON position for 10 seconds.

Primary Fuel Filter Removal

See General Warning, Section 1, Page 1-1.

The primary fuel filter is positioned on the right side of the fuel pump and is the first filter to receive fuel from the fuel tank **(Figure 13c-8, Page 13c-8)**.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Place a large pan under the fuel tank to catch fuel.
4. Disconnect the fuel tank hose (1) from the top (inlet) port of the primary fuel filter (7) **(Figure 13c-8, Page 13c-8)**. **See following WARNING.**

⚠ WARNING

- **Clean up spilled fuel. Keep sparks and flames away from the vehicle and service area. Failure to heed this warning could result in an explosion or fire, resulting in severe personal injury or death.**

5. Disconnect the fuel pump line (2) from the bottom (outlet) of the primary fuel filter.
6. Remove the flange-head, self threading bolt and P-clamp from the fuel filter body and remove the filter.

Primary Fuel Filter Installation

See General Warning, Section 1, Page 1-1.

1. Position the fuel filter body and P-clamp on the filter plate assembly **(Figure 13c-8, Page 13c-8)**.
2. Secure the P-clamp with a new flange-head bolt and tighten the hardware to 21 ft-lb (28 N·m).
3. Secure the bottom (outlet) hose (2) to the filter port with a new clamp **(Figure 13c-8, Page 13c-8)**.
4. Secure the top (inlet) hose (1) to the filter port with a new clamp.

Secondary Fuel Filter Removal

See General Warning, Section 1, Page 1-1.

The secondary fuel filter (8) also functions as a water separator. It has a drain valve on the bottom of the filter to drain water from the fuel system. **See Draining Water from the Secondary Fuel Filter on page 13c-9.**

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Place a large pan under the fuel filters to catch fuel.
4. Turn filter counterclockwise to remove from the filter manifold. Drain the residual fuel in the manifold and filter into the drain pan. **See following WARNING.**

⚠ WARNING

- **Clean up spilled fuel. Keep sparks and flames away from the vehicle and service area. Failure to heed this warning could result in an explosion or fire, resulting in severe personal injury or death.**

Secondary Fuel Filter Installation

See General Warning, Section 1, Page 1-1.

1. Use a clean, lint-free rag to wipe the filter manifold surface clean where the fuel filter gasket seats.
2. To help seal the new fuel filter to the manifold, apply a light coat of new engine oil to the rubber seal before installing filter **(Figure 13c-8, Page 13c-8)**.
3. Install new fuel filter (diesel: CCI P/N 102703401) on the manifold. Tighten the filter by hand 2/3 turn after gasket contact. Do not use a band wrench or channel lock pliers.
4. Verify the water separator drain valve is closed, prime the system and check for leaks. **See following NOTE.**

NOTE: *After the filter is installed, turn the key switch to the ON position and allow the fuel pump to fill the new filter with fuel before the engine is started.*

ELECTRIC FUEL PUMP

See General Warning, Section 1, Page 1-1.

The fuel pump is located between the primary fuel filter and the secondary fuel filter/water separator. It is electrically operated and provides fuel flow from the tank to the engine when the key switch is in the ON position.

Fuel Pump Removal

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Disconnect the white/black wire connector from the wire harness.
4. Place a large pan under the fuel pump to catch fuel. **See following DANGER and WARNING.**

⚠ DANGER

- **Diesel fuel! Flammable! Explosive! Do not smoke. Keep sparks and flames away from the vehicle and service area.**

⚠ WARNING

- **Clean up spilled fuel. Keep sparks and flames away from the vehicle and service area. Failure to heed this warning could result in an explosion or fire, resulting in severe personal injury or death.**

5. Disconnect and securely plug the top (outlet) hose (3) from the fuel pump (9) **(Figure 13c-8, Page 13c-8)**. **See previous DANGER and WARNING.**
6. Disconnect and securely plug the bottom (inlet) hose (2) from the fuel pump.
7. Remove the ground lug bolt from the left side of the fuel pump bracket **(Figure 13c-8, Page 13c-8)**. **See following NOTE.**

NOTE: *The mounting bolts are two different sizes. Note the differences and where they are located.*

8. Remove the flange-head bolt from the right side of the fuel pump bracket and remove the fuel pump.

Fuel Pump Installation

See General Warning, Section 1, Page 1-1.

1. Position a new fuel pump between the fuel filters **(Figure 13c-8, Page 13c-8)**.
2. Loosely secure a new flange-head bolt to the right side of the fuel pump bracket.
3. Loosely secure the ground terminal from the fuel pump coil to the left side of the fuel pump bracket with a hex-head bolt.
4. Tighten the right side flange-head bolt to 21 ft-lb (28 N·m).
5. Tighten the left side hex-head bolt to 48 in-lb (5 N·m).
6. Secure the bottom (inlet) hose (2) to the bottom port of the fuel pump (9) **(Figure 13c-8, Page 13c-8)**.
7. Secure the top (outlet) hose (3) to the top port of the fuel pump.
8. Connect the white/black wire connector to the wire harness.

FUEL LEVEL SENDING UNIT

See General Warning, Section 1, Page 1-1.

Fuel Level Sending Unit Removal

⚠ WARNING

- **Do not use electrically powered tools to remove or install the fuel level sending unit. Failure to heed this warning could result in a fire or explosion.**

⚠ DANGER

- **Diesel fuel! Flammable! Explosive! Do not smoke. Keep sparks and flames away from the vehicle and service area.**

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Remove the passenger seat. **See Seat Removal, Section 4, Page 4-9.**
4. Remove the rubber boot (8) from the center post on the fuel level sending unit. Remove the nut (9) from the center post and remove the orange wire (7) **(Figure 13c-10, Page 13c-13)**. Retain the hardware.
5. Remove the hex-head plastic thread screw (10) securing the black ground wire (6) to the fuel level sending unit and remove the black ground wire. Retain the hardware.
6. Remove the four remaining hex-head plastic thread screws from the fuel level sending unit flange (5). Retain the hardware.
7. Carefully remove the sending unit and gasket (3). Feed the rheostat arm and float (4) through the fuel tank hole. Immediately place the fuel level sending unit in a pan to catch fuel. **See following DANGER and NOTE.**

⚠ DANGER

- **Clean up any spilled fuel before operating the vehicle.**

NOTE: *The rheostat arm and float should be positioned toward the outside surface of the fuel tank.*

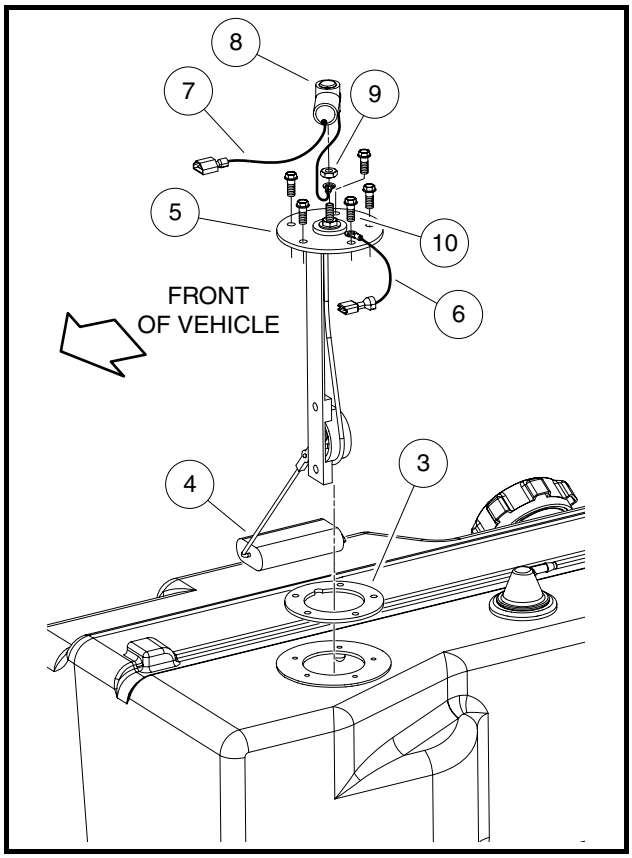


Figure 13c-10 Fuel Level Sending Unit Removal

Fuel Level Sending Unit Installation

⚠ DANGER

- **Diesel fuel! Flammable! Explosive! Do not smoke. Keep sparks and flames away from the vehicle and service area.**

⚠ WARNING

- **Do not use electrically powered tools to remove or install the fuel level sending unit. Failure to heed this warning could result in a fire or explosion.**

1. Place a new rubber gasket (3) on the fuel tank with the notch (2) centered between the flange identification mounting holes (1). **(Figure 13c-11, Page 13c-14)**. **See following NOTE.**

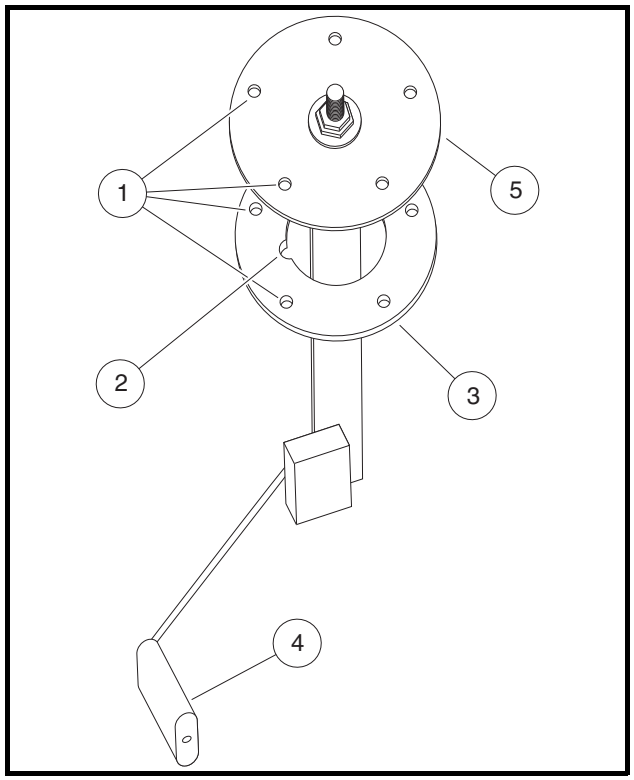


Figure 13c-11 Fuel Level Sending Unit Alignment

NOTE: *The distance between the flange identification mounting holes (1) is larger than the distance between any of the other mounting holes in the sending unit flange (5).*

Ensure the replacement gasket is rubber and that the mounting holes in the gasket are aligned properly with the mounting holes on the fuel tank.

2. Feed a new sending unit rheostat arm and float (4) into the fuel tank **(Figure 13c-10, Page 13c-13)**. The rheostat arm and float should be positioned toward the outside surface of the fuel tank **(Figure 13c-12, Page 13c-15)**.
3. Align the flange identification mounting holes (1) directly over the corresponding mounting holes in the gasket and fuel tank **(Figure 13c-11, Page 13c-14)**. **See following CAUTION and NOTE.**

⚠ CAUTION

- **Ensure all mounting holes in the fuel level sending unit, gasket, and fuel tank are aligned properly before hardware is installed. Improper alignment of the mounting holes could result in an incomplete seal between the fuel level sending unit and the fuel tank.**

NOTE: *The fuel level sending unit mounts to the fuel tank only one way. If the unit does not fit on the fuel tank correctly, adjust the unit until it is properly aligned with the fuel tank.*

4. Carefully thread each hex-head screw by hand, with the ring terminal on the black ground wire (6) under the screw head closest to the engine **(Figure 13c-10, Page 13c-13)**. **See following CAUTION.**

CAUTION

- **Use only the existing screws or new plastic-thread screws made for plastics applications. Do not use sheet metal screws as replacement hardware.**

5. Use a crisscross pattern to tighten the hardware to 9 in-lb (1 N·m). If the hardware cannot be tightened to 9 in-lb (1 N·m), the fuel tank must be replaced. **See following CAUTION.**

CAUTION

- **Do not overtighten the screws. Overtightening the screws will strip the mounting holes in the fuel tank.**

6. Secure the orange wire (7) to the center post with the nut (9) previously removed **(Figure 13c-10, Page 13c-13)**. Tighten the hardware to 17 in-lb (1.9 N·m) and secure the rubber boot (8) to the center post.
7. Install the passenger seat. **See Seat Installation, Section 4, Page 4-9.**
8. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

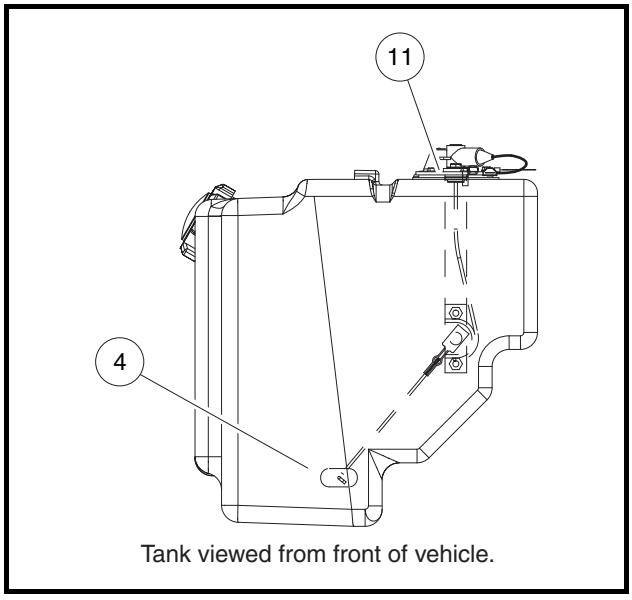


Figure 13c-12 Fuel Level Sending Unit Position

FUEL TANK

See General Warning, Section 1, Page 1-1.

⚠ WARNING

- **If the fuel tank is damaged, replace it. Do not attempt to repair it. See the following tank removal and disposal procedure.**

CAUTION

- **Use only diesel grade no. 2 fuel with a cetane rating of 45 or higher for diesel engines.**

Fuel Tank Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Remove seat(s) and, if equipped, the center seat plate.
4. Remove the upper portion of the ROPS (Roll Over Protection Structure) frame. **See ROPS Removal, Section 4, Page 4-7.**
5. Remove the seat frame. **See Seat Support Removal, Section 4, Page 4-10.**
6. Disconnect the fuel feed line (1) from the fuel tank to the primary fuel filter and raise the end of the hose above the fuel tank. Plug the line **(Figure 13c-8, Page 13c-8)**. **See following NOTE and DANGER.**

NOTE: *The fuel line contains diesel fuel. Squeeze the fuel line closed to prevent fuel flow after the fuel line is removed. Plug or cap the fuel line.*

⚠ DANGER

- **Diesel fuel! Flammable! Explosive! Do not smoke. Keep sparks and flames away from the vehicle and service area.**

7. Disconnect the fuel return line (5) from the engine and raise the end of the hose above the fuel tank. Plug the line. **See previous NOTE and DANGER.**
8. Loosen the clamp and remove the vent tube from the fuel tank.
9. Remove the fuel tank cap.
10. Use a siphon with a built-in suction device to siphon all fuel from the tank and into an approved container. **See following DANGER and WARNING.**

⚠ DANGER

- **Diesel fuel! Flammable! Explosive! Do not smoke. Keep sparks and flames away from the vehicle and service area.**

⚠ WARNING

- **Never attempt to siphon fuel with a hose that does not have a built-in suction device.**
- **Never attempt to siphon fuel with your mouth.**

Figure 13c-13 Diesel Fuel Tank

11. Disconnect the black wire and orange wire from the fuel level sensor on the tank. Do not remove the lower nut on the center stud of the sensor.
12. Remove the nut from the fuel tank strap below the passenger seat area.
13. Lift the strap end and remove the opposite end from the slotted bracket.
14. Remove the passenger-side bed latch bracket from the frame.
15. Remove the fuel tank.

Fuel Tank Storage or Disposal

1. Remove the cap from the tank and thoroughly rinse it with water. The cap may be discarded or kept as a spare.
2. Use a well-ventilated area and flush the fuel tank with water to remove any remaining fuel.
3. Set the tank upside down in a well-ventilated area so that the water can drain. Allow the tank to sit for 24 hours to dry. **See following WARNING.**

⚠ WARNING

- **Dispose of wastewater and fuel tank in accordance with federal, state, and local laws and ordinances.**

4. Store the tank upside down with the cap installed in a well-ventilated area.

Fuel Tank Installation

1. Place the fuel tank in the vehicle.
2. Insert the tab end of the strap into the frame bracket and place the strap in the indentions on the tank.
3. Feed the threaded tab end down into the bottom of the frame. Install a nylon locknut and tighten the nut to 40 in-lb (4.5 N·m).
4. Connect the clear vent tube to the fuel tank vent and secure the tube with a new clamp.
5. Connect the fuel line to the primary fuel filter on the vehicle frame and secure it with a new clamp.

6. Connect the fuel return line to the engine and secure it with a new clamp.

Figure 13c-14 Fuel Level Sensor

7. Connect the black wire and orange wire to the sensor **(Figure 13c-14, Page 13c-18)**.
8. Slide the rubber boot over the stud.
9. Install the passenger-side bed latch bracket on the frame with a bolt and flanged nylon locknut. Tighten the hardware to 20 ft-lb (27 N·m).
10. Install the seat frame. Tighten the nut to 37 ft-lb (50 N·m). **See Seat Support Installation, Section 4, Page 4-10.**
11. Install the top portion of the ROPS (Roll Over Protective Structure). **See ROPS Installation, Section 4, Page 4-8.**
12. Install the center seat plate.
13. Add the appropriate fuel to the fuel tank.
14. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
15. Install both seats.
16. Place the Forward/Reverse handle in NEUTRAL, turn the key switch to start the engine, and allow it to idle. **See following DANGER.**

⚠ DANGER

- **The engine produces carbon monoxide, which is an odorless, deadly poison. Do not operate the engine in an enclosed area without proper ventilation.**
- **After installing the fuel tank and adding fuel, carefully check all fuel lines and connections for leaks. Repair leaks before the vehicle is returned to service.**

17. Run the engine for a few minutes to ensure that the fuel lines are full of fuel.
18. Inspect each fuel line connection for leaks.
    18.1. Check all clamps at the fuel rail, fuel filters, fuel pump, and fuel tank for leaks.
    18.2. Inspect each fuel line to ensure that the lines are not cracked, cut, or worn.

ENGINE CONTROL LINKAGES

ACCELERATOR CABLE

See General Warning, Section 1, Page 1-1.

⚠ WARNING

- **To avoid unintentionally starting the vehicle:**
  - **Disconnect battery cables, negative (–) cable first (Figure 1-2, Page 1-3).**

Accelerator Cable Removal

1. Turn the key switch OFF and place the Forward/Reverse handle in NEUTRAL. Remove the key. Chock the rear wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Raise the hood.
4. Remove the passenger seat. **See Seat Removal, Section 4, Page 4-9.**
5. Disconnect the Z-shaped end (1) of the accelerator cable from the pedal **(Figure 13c-15, Page 13c-19).**
6. Disconnect the cable strain relief at the pedal bracket **(Figure 13c-16, Page 13c-19)**.
7. Disconnect the Z-shaped end of the accelerator cable from the engine **(Figure 13c-15, Page 13c-19)**.
8. Remove the cable strain relief from the engine bracket at the engine.
9. Remove the cable from the rubber grommets under the passenger side of the frame and pull the cable at the dashboard away from the engine compartment. **See following NOTE.**

NOTE: *Tie a nylon cord to the engine end of the cable before it is removed. Allow the cord to travel from the engine, under the frame, and up to the dashboard. This cord can be used to route the cable during installation.*

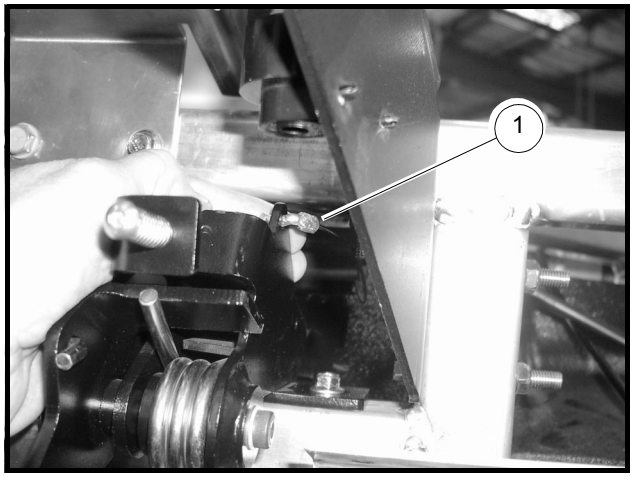


Figure 13c-15 Z-Shaped Cable End

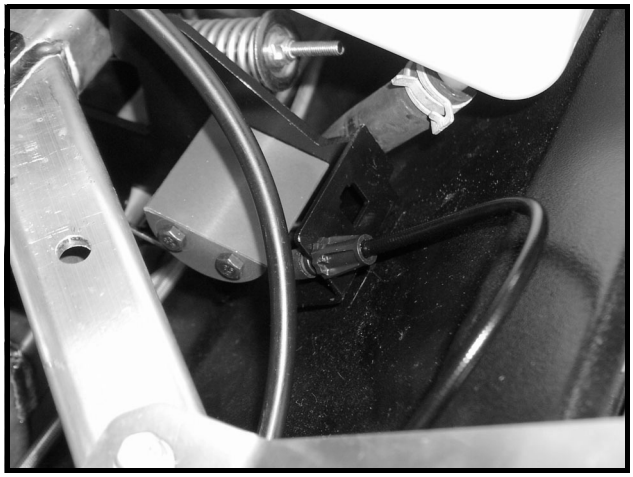


Figure 13c-16 Accelerator Cable Pedal Bracket (Diesel Vehicles)

Accelerator Cable Installation

1. Feed the engine end of the accelerator cable down into place from the dashboard area. **See following NOTE.**

NOTE: *Tie the engine end of the replacement cable to the nylon cord routed during removal. Route the cable to the engine compartment area with the nylon cord.*

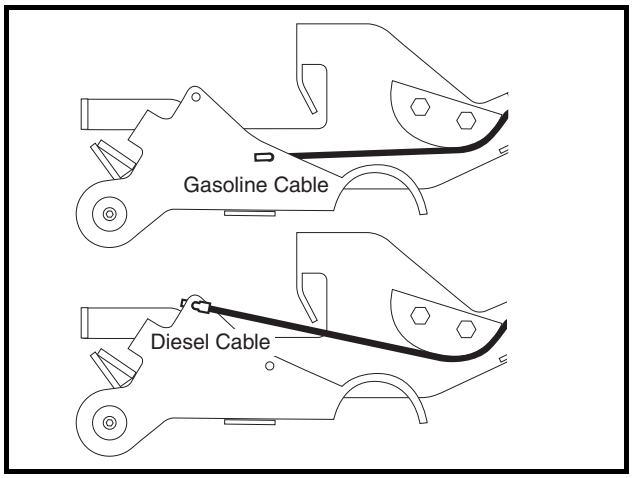


Figure 13c-17 Z-Shaped Cable End in Hole at Pedal

2. Connect the accelerator cable to the pedal **(Figure 13c-17, Page 13c-20)**.
3. Secure the strain relief on the accelerator cable sheath to the slot at the back of the pedal bracket **(Figure 13c-16, Page 13c-19)**.
4. Secure the engine end of the accelerator cable to the throttle lever on the engine **(Figure 13c-1, Page 13c-2)**.
5. Secure the strain relief on the accelerator cable sheath to the engine bracket.
6. Secure the accelerator cable to the rubber grommets under the passenger side of the frame.
7. Lower and secure the hood.
8. Install the passenger seat. **See Seat Installation, Section 4, Page 4-9.**
9. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

ENGINE RPM ADJUSTMENT

Idle RPM Adjustment

A tachometer (CCI P/N AM10753) is required to set the RPM adjustments on this engine. A special diesel probe (CCI P/N AM10771) is also required when the tachometer is used. **See following DANGER.**

⚠ DANGER

- **Do not operate the engine in an enclosed area without proper ventilation. The engine produces carbon monoxide, which is an odorless, deadly poison.**

1. Turn the key switch OFF and place the Forward/Reverse handle in NEUTRAL. Remove the key. Chock the rear wheels.
2. Clean paint, grease, and dirt from one of the three fuel injector lines **(Figure 13c-19, Page 13c-21)**. **See following NOTES**.

NOTE: *It is very important that the line be cleaned enough to expose the metal.*

Read the tachometer and diesel probe instructions before any RPM adjustments are made.

Figure 13c-18 Tachometer For Engine RPM

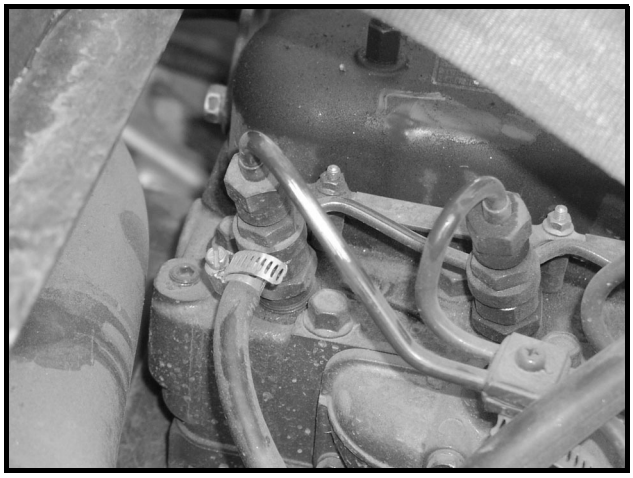


Figure 13c-19 Clean Metal Fuel Line

Figure 13c-20 Diesel Probe Fuel Line Clamp On Engine

Figure 13c-21 Diesel Probe Battery Cable Clamp

3. Secure the fuel line probe clamp to the clean area of the fuel injector line **(Figure 13c-20, Page 13c-21)**.
4. Secure the negative (–) line clamp to the negative (–) battery post **(Figure 13c-21, Page 13c-21)**.
5. Secure the diesel probe to the tachometer **(Figure 13c-18, Page 13c-21)**. **See following NOTE.**

NOTE: *It will be necessary to cut the wire attached to the adjustment screws. The manufacturer recommends that a new wire be secured to the screws after new RPM settings are established.*

6. Turn the key switch to start and run the engine at idle. Measure the RPM with the tachometer and diesel probe attachment. Note the RPM reading. The correct idle RPM setting for this diesel engine is 1250 RPM ± 25.
7. Turn the key switch OFF. Turn the low-speed adjustment screw 1/4 turn clockwise to raise the RPM, or counterclockwise to lower the RPM **(Figure 13c-22, Page 13c-22)**.
8. Turn the key switch to start the engine and allow it to idle. Measure the RPM. Repeat steps 6 and 7 until the idle RPM is correct. **See following NOTE.**

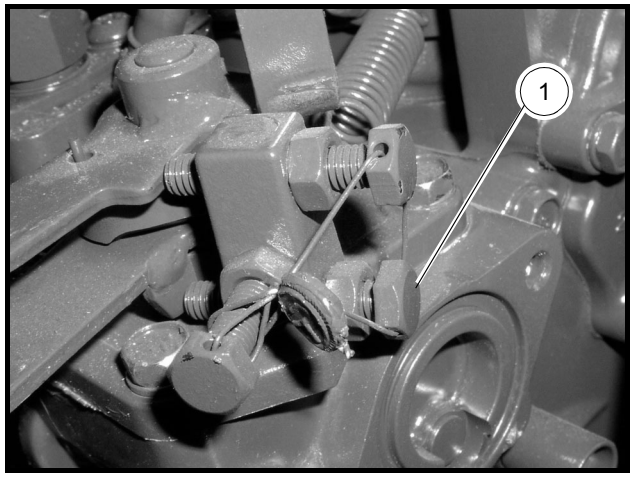


Figure 13c-22 Idle Throttle Adjustment Screw

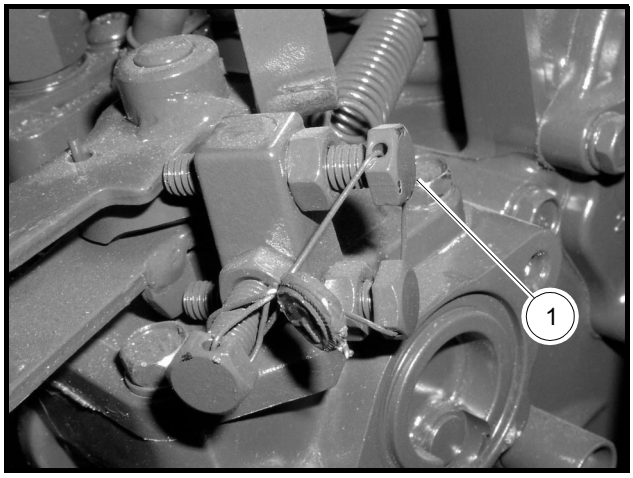


Figure 13c-23 High-Speed Throttle Adjustment Screw

High-Speed RPM Adjustment

1. Clean paint, grease, and dirt from any one of the three fuel injector lines **(Figure 13c-19, Page 13c-21)**. **See following NOTE.**

NOTE: *It is very important that the line be cleaned enough to expose the metal.*

Read the tachometer and diesel probe instructions before any RPM adjustments are made.

2. Secure the fuel line clamp to the clean area of the fuel injector line **(Figure 13c-20, Page 13c-21)**.
3. Secure the negative (–) line clamp to the negative (–) battery post **(Figure 13c-21, Page 13c-21)**.
4. Secure the diesel probe to the tachometer **(Figure 13c-18, Page 13c-21)**. **See following NOTE.**

NOTE: *It will be necessary to cut the wire attached to the adjustment screws. The manufacturer recommends that a new wire be secured to the screws after new RPM settings are established.*

5. Turn the key switch to start and allow the engine to idle. Press the accelerator pedal all the way to the floor. Measure the RPM with the tachometer and diesel probe attachment. Note the RPM reading.
6. Turn the key switch OFF and remove the key. Turn the high-speed adjustment screw 1/4 turn clockwise to raise the RPM, or counterclockwise to lower the RPM.
7. Turn the key switch to start and allow the engine to idle. Press the accelerator pedal all the way to the floor. Measure the RPM. Repeat steps 5 and 6 until the high-speed RPM is correct.

NOTE: *The high-speed RPM for this diesel engine is 3825 RPM ± 25.*

AIR INTAKE SYSTEM

See General Warning, Section 1, Page 1-1.

AIR FILTER REPLACEMENT

The air filter should be inspected periodically and replaced when necessary. Filter changes should not exceed the recommended interval. **See Periodic Service Schedule, Section 10a, Page 10a-1.** More frequent service may be required in extremely dirty operating environments. In the event of a loss of power, sluggish acceleration, or a roughly running engine, service the air filter immediately.

CAUTION

- **Do not drill into the driver-side frame. Failure to heed this caution could damage the engine by allowing excessive contamination or water to enter the air intake system.**

Air Filter Removal

1. Release both canister tab locks **(Figure 13c-24, Page 13c-23)**.
2. Pull the canister cap away from the canister.
3. Remove the air filter cartridge. **See following NOTE.**

NOTE: *The air filter cartridge is specifically designed for this engine. It only fits into the canister one way. Use only direct replacement part (CCI P/N 102498601).*

Air Filter Installation

1. Push the new filter cartridge onto the inside canister nozzle.
2. Place the canister cap, marked TOP, on the top center of the canister **(Figure 13c-24, Page 13c-23)**.
3. Secure the canister cap with both tab locks.

Figure 13c-24 Air Filter Cartridge

AIR CANISTER REMOVAL

1. Turn the key switch OFF and remove the key. Set the park brake. Place the Forward/Reverse handle in NEUTRAL.

2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Remove the air filter cartridge. **See Air Filter Removal on page 13c-23.**
4. Remove the bottom (inlet) hose from the canister **(Figure 13c-28, Page 13c-26)**.
5. Remove the top (outlet) hose from the canister.
6. Remove the two bolts and park brake cable from the canister and remove the canister.

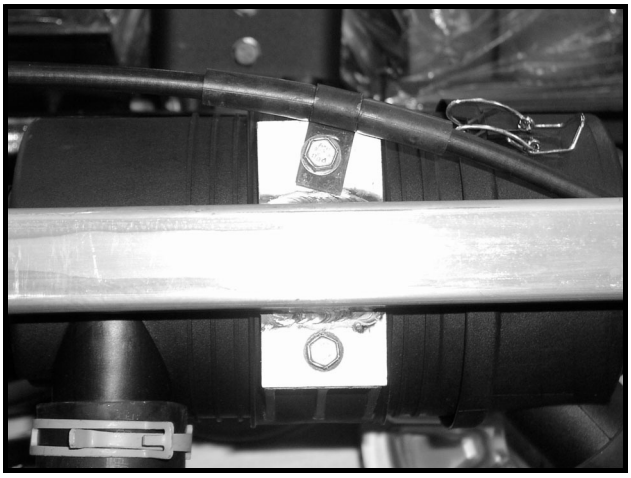


Figure 13c-25 Air Filter Canister

AIR CANISTER INSTALLATION

1. Position the canister next to the frame bracket with the tab lock released and oriented toward the passenger side.
2. Install two bolts on the canister base bracket and vehicle frame bracket. Tighten the bolts to 21 ft-lb (28.5 N·m).
3. Secure the bottom (inlet) hose to the canister port.
4. Secure the top (outlet) hose to the canister port.
5. Install a new air filter cartridge. **See Air Filter Installation on page 13c-23.**
6. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

AIR FILTER INTAKE HOSE REMOVAL

The air filter intake hose fits between the driver-side frame and the inlet port on the air filter canister. The frame serves as a duct to draw air from a location at the top of the front of the vehicle. **See following CAUTION.**

⚠ CAUTION

- **Do not drill holes or attach anything to the driver side of the frame. A penetrating fastener will create passages that could allow moisture and/or dirt to enter the engine air intake system.**

1. Turn the key switch OFF and remove the key. Set the park brake. Place the Forward/Reverse handle in NEUTRAL.

2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Disconnect the air intake hose from under the filter canister.
4. Disconnect the air intake hose from the frame under the vehicle body.
5. Slide the air intake hose through the frame support bracket and remove the hose from the vehicle **(Figure 13c-26, Page 13c-25)**.

Figure 13c-26 Air Intake Support Bracket

AIR FILTER INTAKE HOSE INSTALLATION

1. Slide the air intake hose through the frame support bracket **(Figure 13c-26, Page 13c-25)**.
2. Secure the air intake hose to the air port under the vehicle body **(Figure 13c-27, Page 13c-26)**.
3. Secure the air intake hose under filter canister (inlet) port **(Figure 13c-28, Page 13c-26)**.

NOTE: *Ensure the air intake hose is positioned against the port surfaces and the clamps are positioned between the port bead and port surface.*

4. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

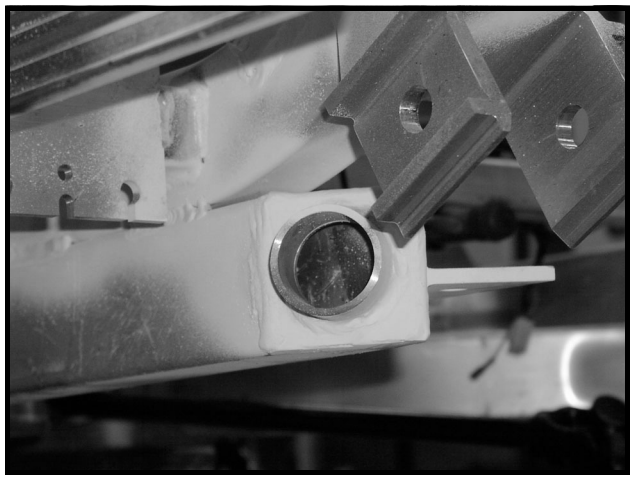


Figure 13c-27 Air Port on Frame

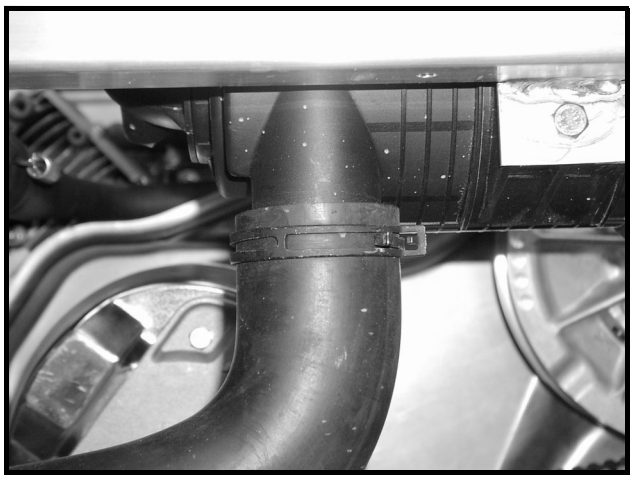


Figure 13c-28 Air Filter Inlet Hose

AIR FILTER OUTLET HOSE REMOVAL

1. Turn the key switch OFF and remove the key. Set the park brake. Place the Forward/Reverse handle in NEUTRAL.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
3. Disconnect the air outlet hose from the air filter canister outlet port.
4. Disconnect the air outlet hose from the carburetor inlet port and remove the hose.

AIR FILTER OUTLET HOSE INSTALLATION

1. Install the air outlet hose at the carburetor inlet port and secure the air outlet hose with a clamp.
2. Install the air outlet hose at the air filter outlet port and secure the air outlet hose with a clamp.
3. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

CLUTCHES

To assemble and disassemble the drive and driven clutches properly, the following tools should be used:

- Drive clutch service tools:
  - Spider removal tool (CCI P/N 102607501)
  - Fixed sheave tool (CCI P/N 102601501)
- Driven clutch service tools:
  - Spring compression base (CCI P/N 102603501)
  - Spring compression collar (CCI P/N 102605201)
  - Spring compression nut (CCI P/N 102606101)

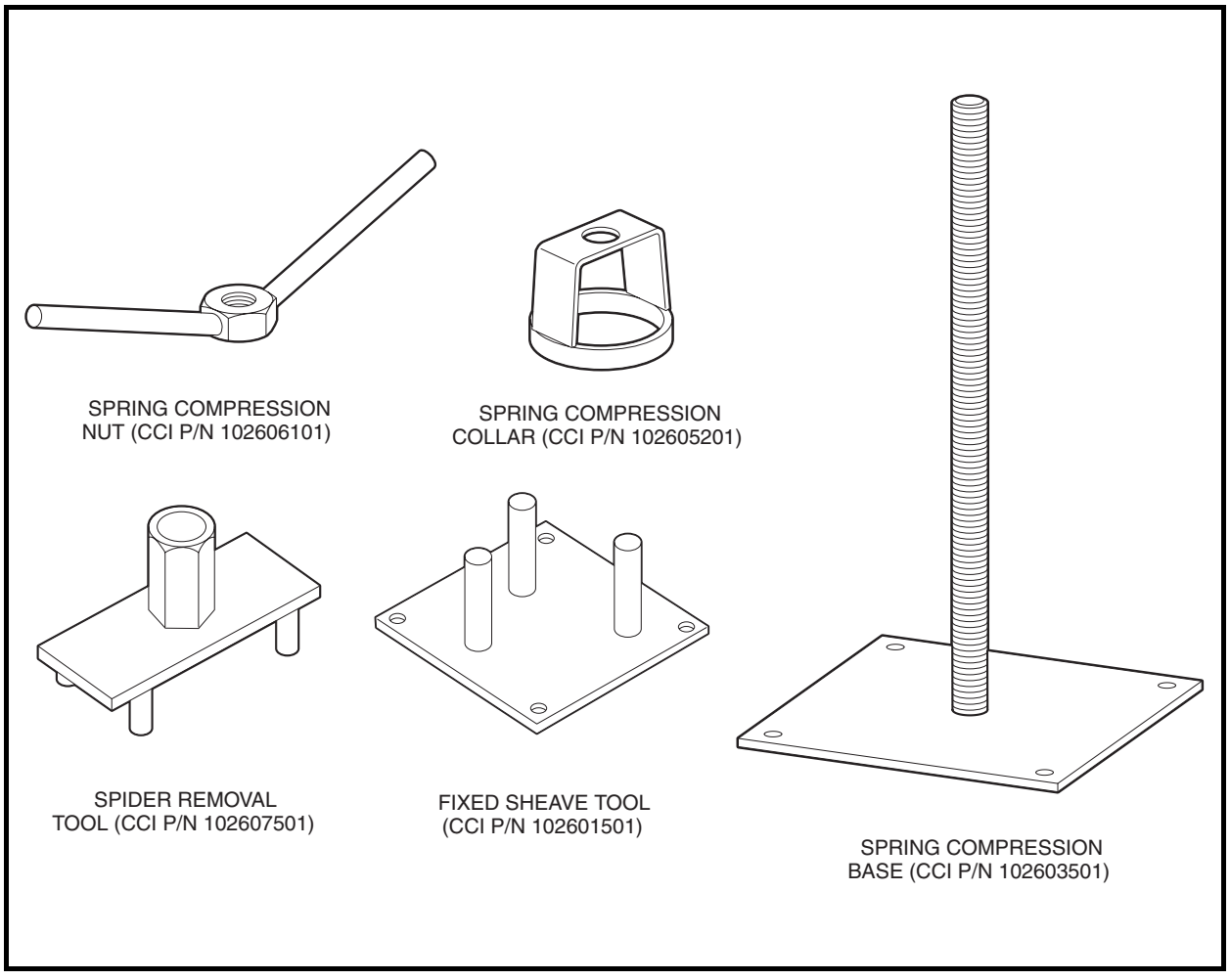


Figure 13c-29 Clutch Service Tools

CLUTCH TROUBLESHOOTING

See General Warning, Section 1, Page 1-1.

Use a tachometer during vehicle operation to determine if the engine begins to lose RPM when the vehicle climbs a steep hill. Check the engine RPM. If engine speed is within manufacturer specifications, there is a clutch problem. **See Engine RPM Adjustment on page 13c-20.**

If the clutches are not operating properly, perform the following:

1. Check the throttle settings. **See Engine RPM Adjustment on page 13c-20.**
2. Inspect both clutches for dirt and debris buildup on component parts. Clean the exterior surfaces of both clutches with water to remove any dust or dirt, then drive the vehicle and check for proper operation. **See Drive Clutch on page 13c-29. See also Driven Clutch on page 13c-33.**
3. Check the clean clutches for wear.
4. If cleaning both clutches does not solve the problem, disassemble and thoroughly clean all parts in the drive clutch. **See Drive Clutch Cleaning and Inspection on page 13c-29.**
5. Check the drive clutch rollers and weights for wear.

DRIVE BELT

See General Warning, Section 1, Page 1-1.

The drive belt should be inspected periodically for wear and glazing. If it is excessively worn, frayed, or glazed, replace the belt.

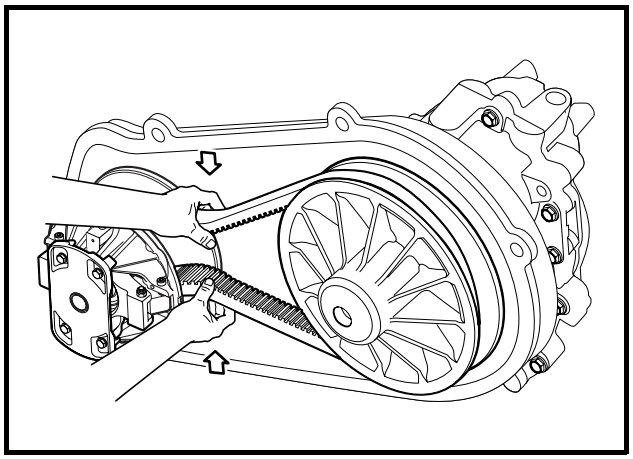


Figure 13c-30 Drive Belt Removal

Drive Belt Removal

1. Turn the key switch OFF and remove the key. Set the park brake. Place the Forward/Reverse handle in NEUTRAL.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Remove the clutch outer cover. **See Clutch Outer Cover Removal on page 13c-35.**
4. Grasp the belt midway between the drive and driven clutches and squeeze the belt together as tightly as possible.
5. Guide the belt over the driven clutch and roll the belt off the driven clutch by rotating the clutch clockwise **(Figure 13c-30, Page 13c-28)**. **See following CAUTION.**

⚠ CAUTION

- **Make sure your fingers are not underneath the belt when rolling the belt off the driven clutch.**

Drive Belt Installation

1. Position the new belt on the drive clutch and then start the belt over the top of the driven clutch.
2. Rotate the driven clutch clockwise and roll the belt over the driven clutch sheaves and onto the clutch.
3. Install the clutch outer cover. **See Clutch Outer Cover Installation on page 13c-35.**
4. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

DRIVE CLUTCH

See General Warning, Section 1, Page 1-1.

CAUTION

- **Be very careful with the clutches. A clutch that has been dropped will not be properly balanced. If either clutch is dropped, assume that it is damaged and replace it.**

Drive Clutch Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Remove the top air filter hose (outlet) from the air filter canister.
4. Remove the clutch outer cover. **See Clutch Outer Cover Removal on page 13c-35.**
5. Remove the drive belt. **See Drive Belt Removal on page 13c-28.**
6. Remove the center bolt on the drive clutch.
7. Thread the clutch removal tool (CCI P/N 102686101) into the drive clutch center and advance the tool until the clutch is released from the adapter shaft. **See following CAUTION.**

CAUTION

- **Hold the clutch assembly firmly when the clutch removal tool is advanced. Once loosened, the clutch will drop quickly. Do not allow the clutch to fall on a hard surface.**

8. Remove the drive clutch from the vehicle. **See following CAUTION.**

CAUTION

- **Do not hit or tap the clutch with a hammer. Do not pry the clutch. These actions will damage the clutch.**

Drive Clutch Cleaning and Inspection

1. Use a dry, lint-free cloth to clean clutch parts. **See following CAUTION**.

CAUTION

- **Do not lubricate the drive clutch. Lubricants attract dirt and dust, which interfere with proper clutch operation.**
- **Use only a dry cloth and lightly wipe the shaft of the fixed face assembly (15) (Figure 13c-32,**

Page 13c-31). Do not use a brush or steel wool. These abrasives will damage the surface of the shaft.

- **Do not use solvents. Solvents will damage the lubricating characteristics of the bushings.**

2. Inspect the belt contact surfaces of the clutch sheaves for wear. If any area of a sheave contact surface has wear of 0.060 inch (1.52 mm) or more, the clutch should be replaced.

Drive Clutch Disassembly

The following service tools are required to disassemble the drive clutch and are available from a service parts representative:

- Fixed sheave tool (CCI P/N 102601501)
- Spider tool (CCI P/N 102607501)

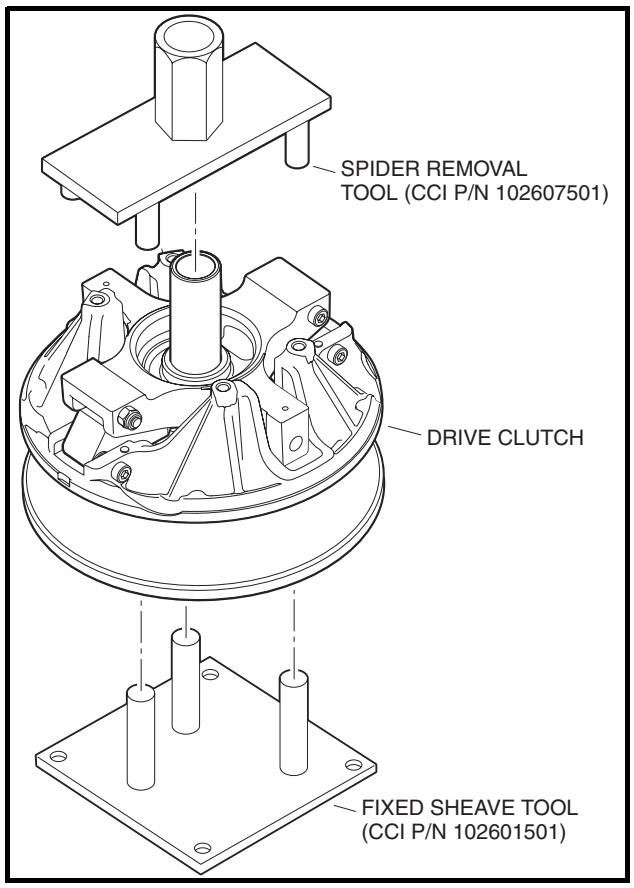


Figure 13c-31 Drive Clutch Service Tools

1. Use a 7/16-inch socket to remove the four bolts (1) and washers (2) that secure the plate (3) to the clutch cover (4) **(Figure 13c-32, Page 13c-31)**.
2. Remove the cover (4) and spring (5) from the clutch spider (6).
3. Inspect the torque rollers (7), weights (11) and rollers (10). Replace if necessary.
4. Secure the Fixed sheave tool (CCI P/N 102601501) into a vice, or mount the tool to a flat work surface **(Figure 13c-31, Page 13c-30)**.
5. Place the fixed sheave of the drive clutch onto the service tool so that the drive clutch is stationary.

6. Place the Spider tool (CCI P/N 102607501) on top of the spider.
7. Use a 1/2-inch drive ratchet to disengage the moveable sheave (14) and spider (6), which will come off as an assembly, from the fixed sheave (15) **(Figure 13c-32, Page 13c-31)**.

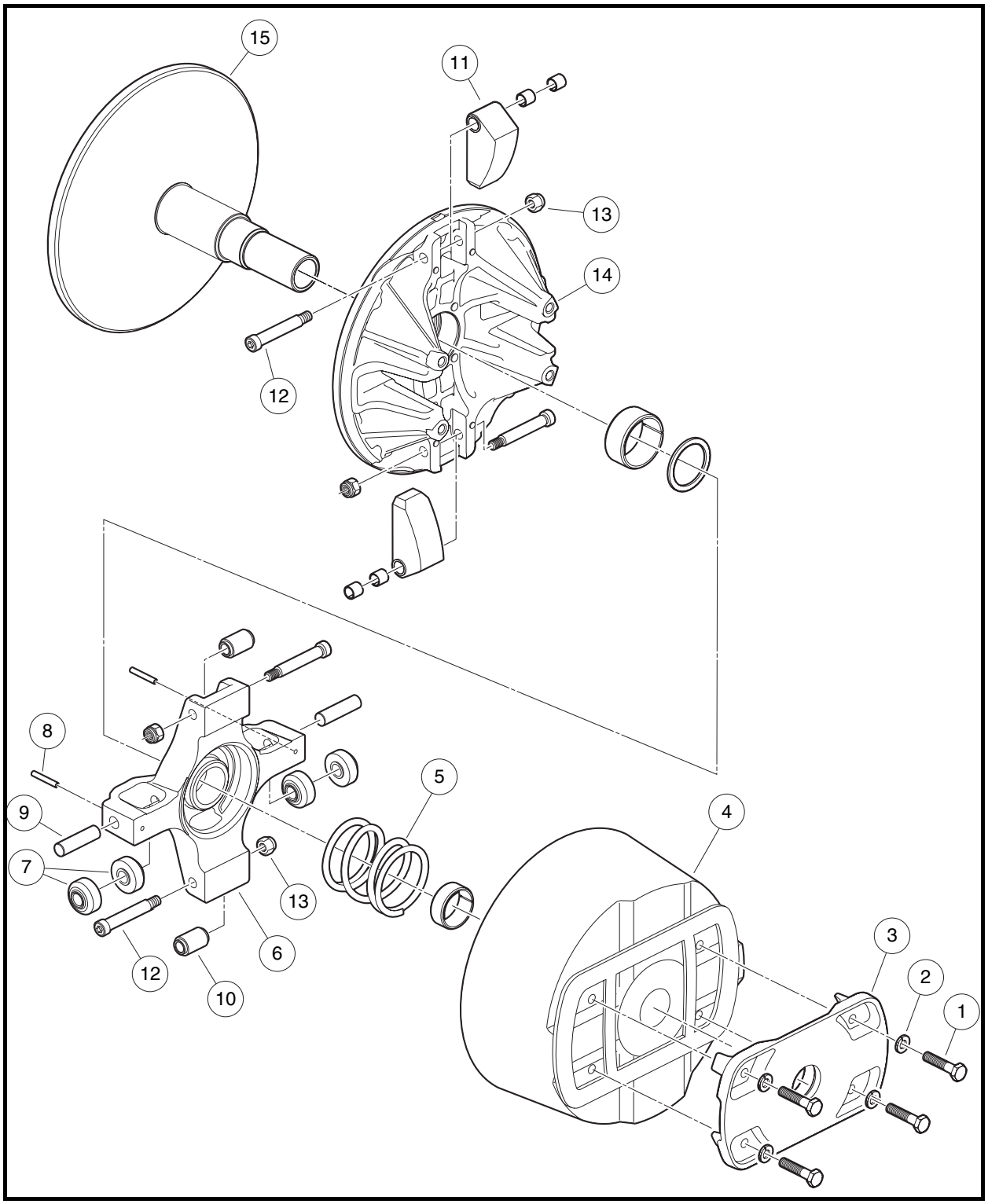


Figure 13c-32 Drive Clutch Assembly

Drive Clutch Component Inspection

1. Use a feeler gauge to inspect the torque rollers (7) and replace the rollers if necessary **(Figure 13c-32, Page 13c-31)**.
   1.1. Use a pin driver to drive out the pin (8), which will release a pin (9) and allow the rollers (7) to slide out of the spider (6).
   1.2. Install new rollers. Secure the rollers with pins.
2. Inspect the rollers (10) and weights (11). There should be no noticeable wear. If the rollers or weights are worn, scratched, or damaged, replace them.
   2.1. Remove the bolts (12) and flex locknuts (13) that secure the rollers (10) to the spider (6) and the weights (11) to the moveable sheave (14).
   2.2. Install new rollers and weights with bolts and flex locknuts.

Drive Clutch Assembly

NOTE: *The drive clutch components are marked with an X to assist in correct reassembly. It is important to note the location of the X on the components and be sure to align the X's when assembling the drive clutch.*

1. Place the moveable sheave (14) and spider (6) onto the fixed sheave (15). Note the location of the X so the remaining components with an X can be aligned.
2. Use a spider removal tool (CCI P/N 102607501) to tighten the moveable sheave and spider to 225 ft-lb (305 N·m).
3. Install the spring (5) onto the shaft.
4. Install the cover (4) onto the shaft.
5. Align the plate that has holes in the cover with the arrows on the same side. Pull the moveable sheave upward and start threading bolts with washers into holes. **See following NOTE.**

NOTE: *Keep the cover as square to the post as possible to minimize wear between the post and cover.*

6. Use a crisscross pattern to continue tightening the hardware.
7. Tighten the bolts to 120 in-lb (14 N·m).

Drive Clutch Installation

1. Turn the key switch OFF and remove the key. Set the park brake. Place the Forward/Reverse handle in NEUTRAL.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Place the drive clutch assembly on the crankshaft taper.
4. Install the mounting washer and retaining bolt. Tighten the hardware to 39 ft-lb (53 N·m).
5. Install the drive belt as instructed. **See Drive Belt Installation on page 13c-29.**
6. Install the clutch cover and tighten the bolts to 72 in-lb (8.0 N·m).
7. Secure the top air filter hose (outlet) to the filter canister.

NOTE: *Ensure the hose is fully seated and the clamp is properly located and tightened.*

8. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
9. Drive the vehicle and check for proper operation.

DRIVEN CLUTCH

See General Warning, Section 1, Page 1-1.

Driven Clutch Removal

1. Turn the key switch OFF and remove the key. Set the park brake. Place the Forward/Reverse handle is in NEUTRAL.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Remove the top air filter hose from the filter canister.
4. Remove the clutch outer cover. **See Clutch Outer Cover Removal on page 13c-35.**
5. Remove the drive belt as instructed. **See Drive Belt Removal on page 13c-28.**
6. Remove the bolt and washer from the center of the clutch.
7. Remove the driven clutch. **See following CAUTION.**

CAUTION

- **Do not hit or tap the clutch with a hammer. Do not pry the clutch. These actions will damage the clutch.**

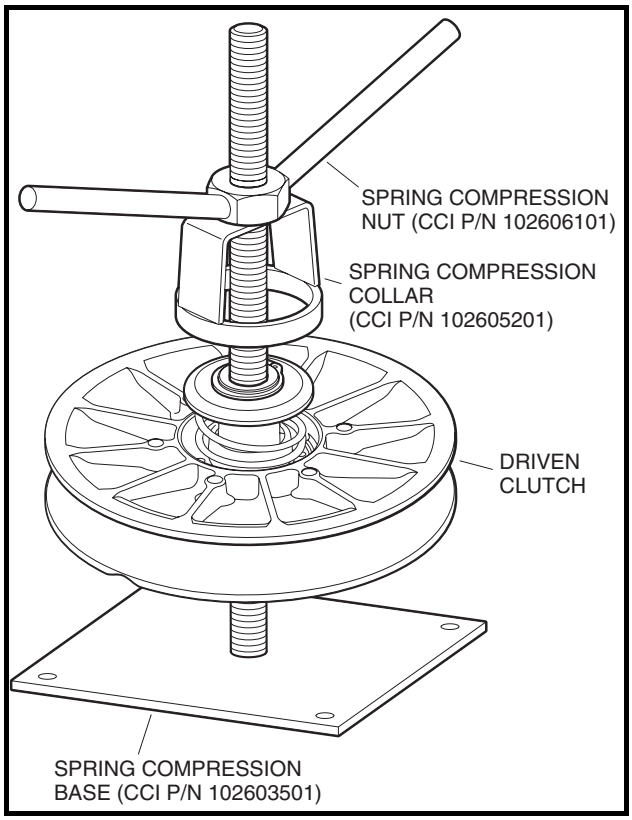


Figure 13c-33 Driven Clutch Service Tools

Driven Clutch Disassembly

The following service tools are required to disassemble and assemble the driven clutch. They are available from a service parts representative:

- Spring compression base (CCI P/N 102603501)
- Spring compression collar (CCI P/N 102605201)
- Spring compression nut (CCI P/N 102606101)

1. Place the driven clutch onto the Spring compression base (CCI P/N 102603501) **(Figure 13c-33, Page 13c-33)**.
2. Place the Spring compression collar (CCI P/N 102605201) onto the driven clutch.
3. Thread the Spring compression nut (CCI P/N 102606101) down onto the threaded post enough to release the pressure on the snap ring.
4. Use snap-ring pliers to remove the snap ring (1) **(Figure 13c-34, Page 13c-34)**.
5. Slowly remove the spring compression nut. The collar will then rise and release tension on the spring (3).
6. Remove the cup (2) and spring (3).
7. Remove the moveable sheave (4) from the fixed sheave (5). **See following NOTE.**

NOTE: *Both the moveable and fixed sheaves have spacers (6). Be sure to retain the spacers for reassembly of the driven clutch.*

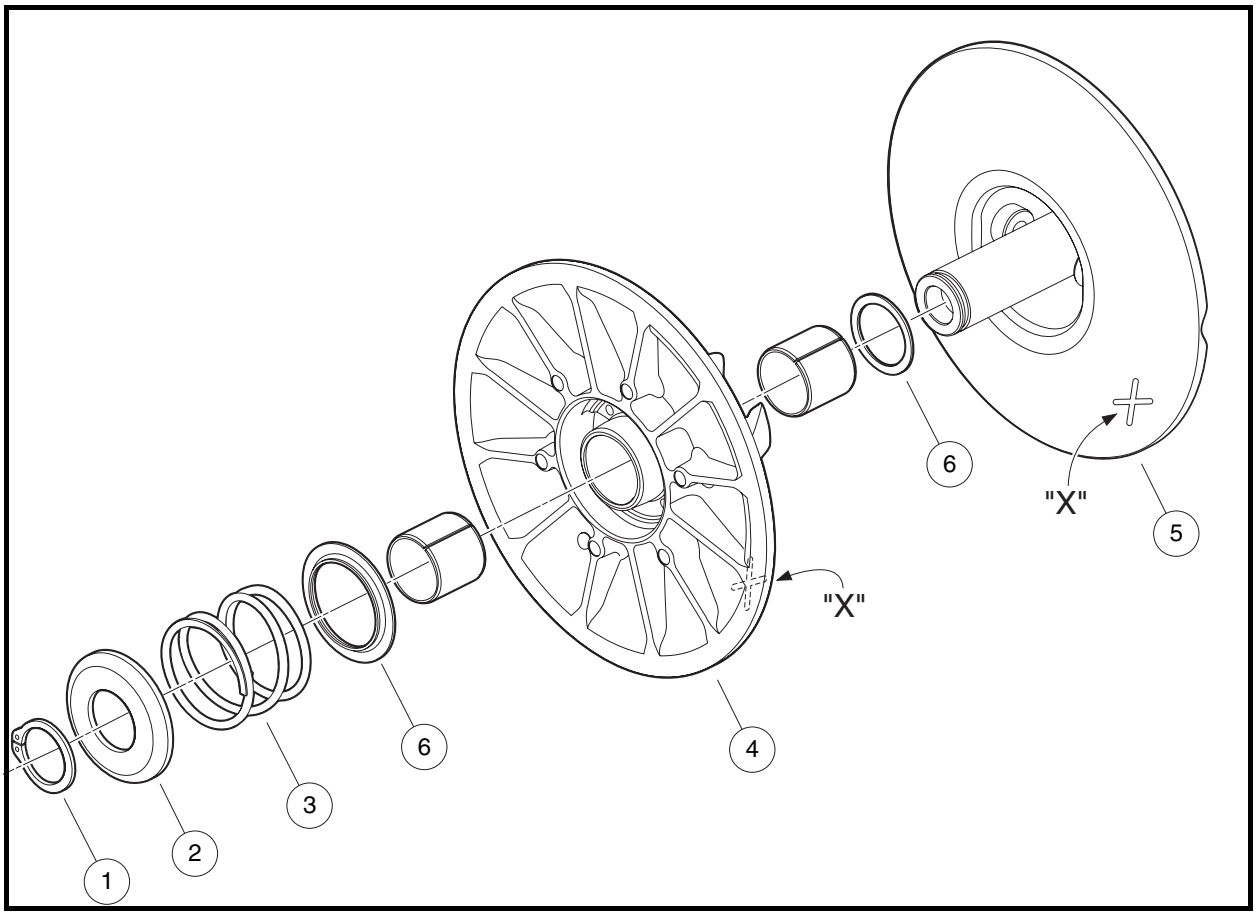


Figure 13c-34 Driven Clutch Assembly

Driven Clutch Assembly

1. Place the fixed sheave (5) onto the spring compression base and note the location of the X so that the X on the moveable sheave (4) can be aligned correctly **(Figure 13c-34, Page 13c-34)**.
2. Place the moveable sheave (4) onto the fixed sheave (5) and align the X's on both components.
3. Place the spring (3), cup (2), and snap ring (1) onto the clutch.
4. Place the spring compression collar onto the cup **(Figure 13c-33, Page 13c-33)**.
5. Tighten the spring compression nut just enough to enable the snap ring to be installed.
6. Use the snap ring pliers to install snap ring.

Driven Clutch Installation

1. Turn the key switch OFF and remove the key. Set the park brake. Place the Forward/Reverse handle in NEUTRAL.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Install the driven clutch assembly on the transmission splined shaft.
4. Install the mounting washer and retaining bolt. Tighten the hardware to 39 ft-lb (53 N·m).
5. Install the drive belt as instructed. **See Drive Belt Installation on page 13c-29.**
6. Install the clutch outer cover and tighten the screws to 72 in-lb (8 N·m).
7. Install the top air filter hose on the filter canister.

NOTE: *Ensure the hose is fully seated and the clamp is properly located and tightened.*

8. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
9. Drive the vehicle and check for proper operation.

CLUTCH COVER

Clutch Outer Cover Removal

1. Turn the key switch OFF and remove the key. Set the park brake. Place the Forward/Reverse handle is in NEUTRAL.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Remove the top air filter hose from the filter canister.
4. Remove the self-threading screws and remove the clutch outer cover.

Clutch Outer Cover Installation

1. Align the mounting holes in the clutch outer cover with the mounting holes in the clutch inner cover.
2. Install the screws and tighten the hardware to 72 in-lb (8 N·m).
3. Install the top air filter hose on the filter canister.
4. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305). **See following NOTE.**

NOTE: *Ensure the hose clamp is tightly installed and positioned between the filter canister and canister port bead.*

Clutch Inner Cover Removal

1. Turn the key switch OFF and remove the key. Set the park brake. Place the Forward/Reverse handle in NEUTRAL.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Remove the outer clutch cover. **See Clutch Outer Cover Removal on page 13c-35.**
4. Remove the drive belt. **See Drive Belt Removal on page 13c-28.**
5. Remove the driven clutch. **See Driven Clutch Removal on page 13c-33.**
6. Remove the bolts, nuts, and washers from the inner clutch cover **(Figure 13c-35, Page 13c-36)**. **See following NOTE.**

NOTE: *When bolts are removed, note any bolt length differences around the flywheel. Some bolt holes have limited depth and require a specific length of bolt thread.*

Ensure the studs remain on the engine block when the nuts are removed.

7. Remove the clutch inner cover.
8. Remove the inner cover spacer between the inner cover and the engine block **(Figure 13c-36, Page 13c-36)**.

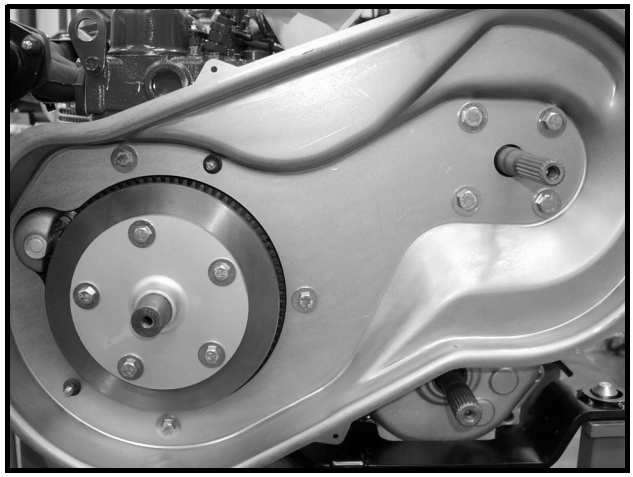


Figure 13c-35 Diesel Inner Cover Assembly

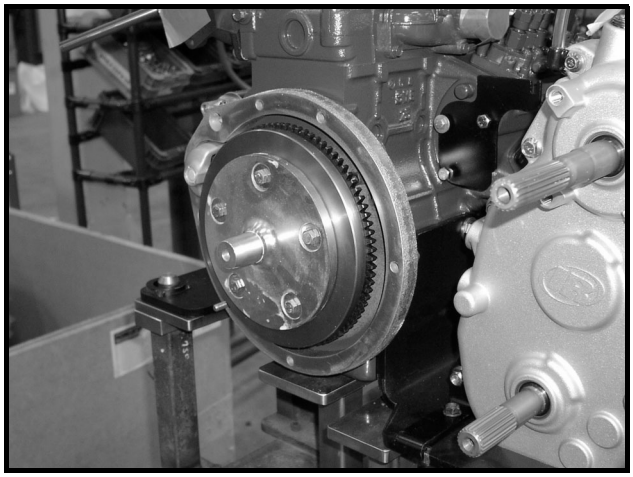


Figure 13c-36 Diesel Inner Cover Spacer

Clutch Inner Cover Installation

1. Position the inner cover spacer on the engine block using the stud bolts for alignment **(Figure 13c-36, Page 13c-36)**.
2. Align the mounting holes in the inner cover with the transmission and engine bolt holes **(Figure 13c-35, Page 13c-36)**.
3. Loosely install one bolt and washer in each transmission and engine bolt hole.
4. Finger-tighten the bolts and washers. **See following NOTE.**

NOTE: *Use bolts with lengths appropriate for the hole depths on the engine block.*

Mounting holes in the clutch inner cover have close tolerances. Align the engine and transmission carefully to ensure the mounting holes in the clutch inner cover match the threaded holes in the engine and transmission.

5. Tighten the engine bolts and washers to 21 ft-lb (28.5 N·m).
6. Tighten the engine stud bolt nuts to 21 ft-lb (28.5 N·m).
7. Tighten the transmission bolts and washers to 21 ft-lb (28.5 N·m).
8. Install the driven clutch. **See Driven Clutch Installation on page 13c-35.**
9. Install the drive belt. **See Drive Belt Installation on page 13c-29.**
10. Install the outer cover. **See Clutch Outer Cover Installation on page 13c-35.**
11. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

SECTION 14 – DRIVETRAIN COMPONENTS

⚠ DANGER

- **See General Warning, Section 1, Page 1-1.**

⚠ WARNING

- **See General Warning, Section 1, Page 1-1.**

This Section contains information on removing and installing the front differential, transmission, and rear differential. Refer to the appropriate manual for complete instructions on disassembly, repair, rebuilding, and reassembly. **See the Engines and Drivetrain Components manual (CCI P/N 102396501).**

HALF SHAFTS

HALF SHAFT REMOVAL

1. Turn the key switch OFF and remove the key. Set the park brake. Place the Forward/Reverse handle in NEUTRAL. Chock the rear wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Loosen the lug nuts on both front wheels.
4. Remove the rubber spindle nut covers from both front wheels.
5. Loosen the spindle nuts and lift the front of the vehicle with a chain hoist or floor jack. **See WARNING "Lift only one end..." in General Warning, Section 1, Page 1-2.**
6. Place jack stands under each end of the floor crossmember and lower vehicle onto stands **(Figure 14-1, Page 14-1)**.

Figure 14-1 Place Jack Stands Under Crossmember

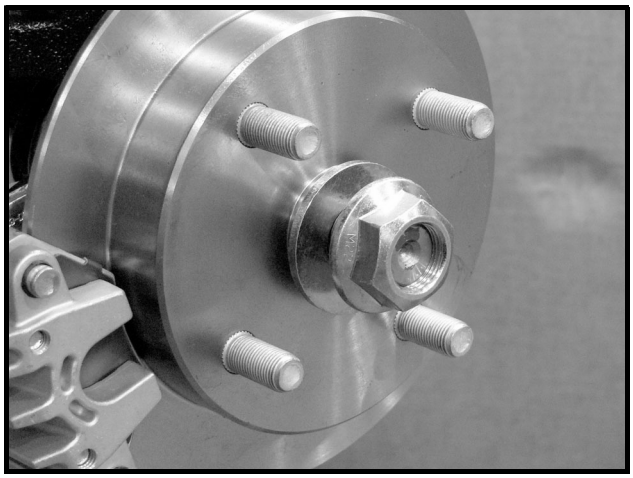


Figure 14-2 Axle Spindle Nut And Washer

7. Remove both front wheels.

8. Remove both spindle nuts and large washers **(Figure 14-2, Page 14-1)**.
9. Remove the upper shock absorber bolt and locknut.
10. Remove the lower shock absorber bolts and flanged locknuts. Remove the shock absorber and coil-over spring.
11. Remove the two hex-head bolts (shown with white marks on bolt heads) securing the caliper to the upright and remove the caliper and discs **(Figure 14-3, Page 14-2)**.
12. Position the caliper and discs on the top of the upper A-frame and secure them with a wire tie. **See following CAUTION.**

⚠ CAUTION

- **Do not kink, twist, or damage the hydraulic brake lines.**

13. Remove the two flanged bolts and square nuts from the camber adjustment bar **(Figure 14-4, Page 14-2)**.
14. Lift the wheel hub up and away from the lower A-frame to remove the half shaft spindle from the wheel hub and remove the camber bar from the lower A-frame.

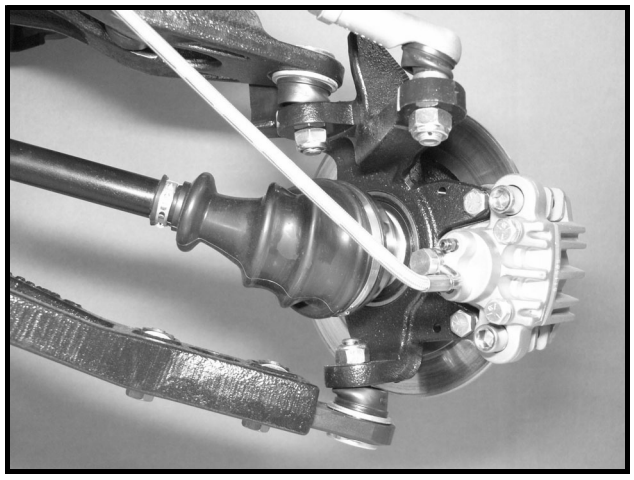


Figure 14-3 Front Caliper and Discs

Figure 14-4 Camber Adjustment Bar

15. Separate the half shaft hub from the differential and remove the half shaft **(Figure 14-5, Page 14-3)**. **See following NOTE.**

NOTE: *Use a 5/16-inch wide flat blade screwdriver to separate the half shaft hub and differential.*

*The hub end of the half shaft has a round compression ring and groove. The compression ring mates with a groove inside the differential **(Figure 14-6, Page 14-3)**.*

16. Repeat steps 9 through 15 for the remaining half shaft.

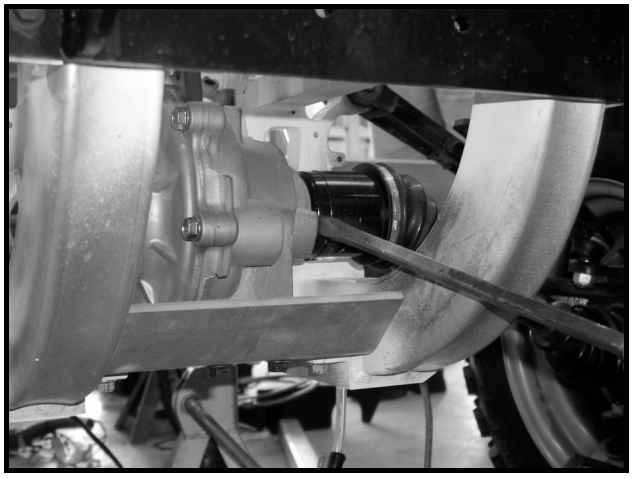


Figure 14-5 Separate Half Shaft from Differential

Figure 14-6 Compression Ring on Spline

HALF SHAFT INSTALLATION

Half shafts are assembled with CV joints and are available only as a complete assembly. If a half shaft is replaced because of wear, the manufacturer recommends that both half shafts be replaced.

1. Apply a light coat of anti-seize compound to each end of the half shaft splines **(Figure 14-7, Page 14-3)**.

Figure 14-7 Apply Anti-Seize to Splined Ends

2. Install the half shaft into the front differential. Advance the half shaft until the compression ring seats into the groove inside the differential housing.
3. Lift the wheel hub and upper A-frame. Slide the half shaft spindle into the wheel hub and insert the camber adjustment bar into the lower A-frame slot.
4. Loosely secure the flanged bolts and new square nuts to the camber adjustment bar and lower A-frame **(Figure 14-4, Page 14-2)**.
5. Install a large washer and new nut on the half shaft spindle and wheel hub. Finger-tighten the hardware.

6. Secure the caliper and discs to the upright and wheel hub disc with new lock-patch bolts. Tighten the hardware to 36 ft-lb (49 N·m) **(Figure 14-3, Page 14-2)**. **See following CAUTION.**

CAUTION

- **If lock-patch bolts are not available, use Loctite 222 on new, standard thread, hex-head bolts.**

7. Secure the lower shock absorber mount to the upper A-frame with new flanged-head bolts and locknuts. Tighten the hardware to 22 ft-lb (30 N·m).
8. Secure the top shock absorber mount to the flanged brackets on the frame with a new flanged-head bolt and flanged locknut. Tighten the hardware to 73 ft-lb (99 N·m) **(Figure 14-2, Page 14-1)**.
9. Install the tire and wheel and finger-tighten the lug nuts.
10. Repeat steps 1 through 9 for the remaining half shaft and wheel.
11. Lift the front of the vehicle with a chain hoist or floor jack, remove the jack stands, and lower the vehicle to the ground. **See WARNING "Lift only one end..." in General Warning, Section 1, Page 1-2.**
12. Use a crisscross pattern to tighten the lug nuts on both front wheels to 85 ft-lb (115 N·m).
13. Tighten both spindle locknuts to 150 ft-lb (203 N·m).
14. Adjust the front wheel camber. **See Camber Adjustment, Section 7, Page 7-12.**
15. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

FRONT DIFFERENTIAL

FRONT DIFFERENTIAL REMOVAL

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Loosen the lug nuts on both front wheels.
4. Loosen the spindle nuts and lift the front of the vehicle with a chain hoist or floor jack. **See WARNING "Lift only one end..." in General Warning, Section 1, Page 1-2.**
5. Place jack stands under the lower A-frame plates and lower the vehicle onto the stands **(Figure 14-1, Page 14-1)**.
6. Remove both half shafts. **See Half Shaft Removal on page 14-1.**
7. Remove the roll pin securing the differential pinion shaft to the front driveshaft **(Figure 14-8, Page 14-5)**. **See following NOTE.**

NOTE: *Use a 1/4-inch roll pin punch to drive-out the roll pin.*

8. Remove the vent tube from the differential housing **(Figure 14-9, Page 14-5)**.

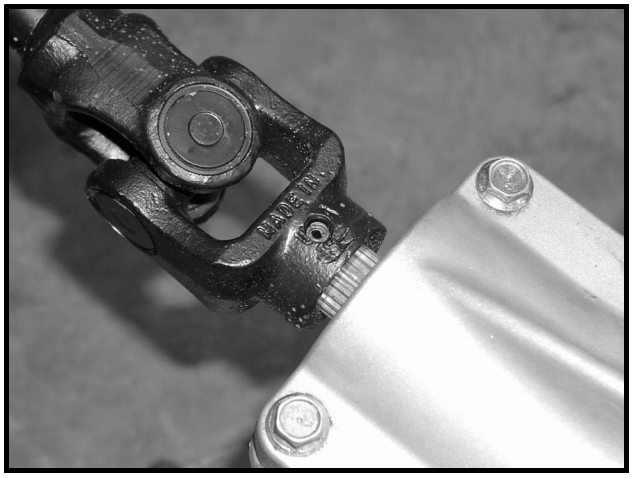


Figure 14-8 Roll Pin in Driveshaft and Pinion Shaft

Figure 14-9 Differential Vent Tube

9. Disconnect the electric clutch harness from the differential at the connector behind the splash guard **(Figure 14-10, Page 14-5)**. **See following NOTE.**

NOTE: *It may be necessary to open one or two splash guard fasteners to access the connector.*

10. Remove the four flange-head bolts from the frame support weldments **(Figure 14-11, Page 14-5)**. **See following NOTE.**

NOTE: *Do not remove the flange-head bolts from the differential plate and differential housing.*

11. Pull the front differential and differential plate forward and out of the driveshaft. Tip the unit downward and remove it from the vehicle. **See following NOTE.**

NOTE: *It is not necessary to remove the differential from its mounting plate to repair or service the unit.*

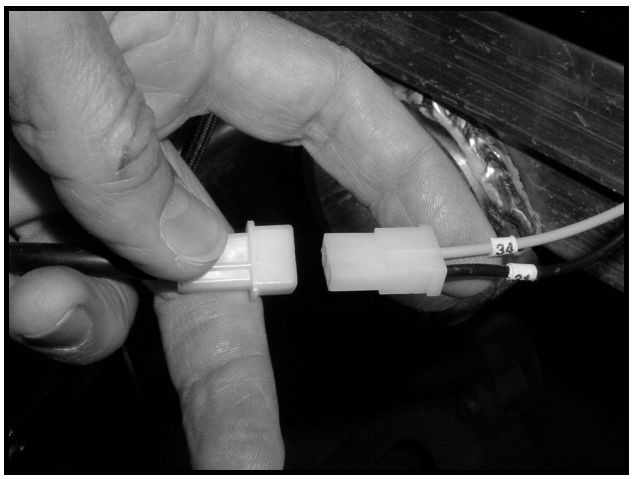


Figure 14-10 Differential Clutch Connector

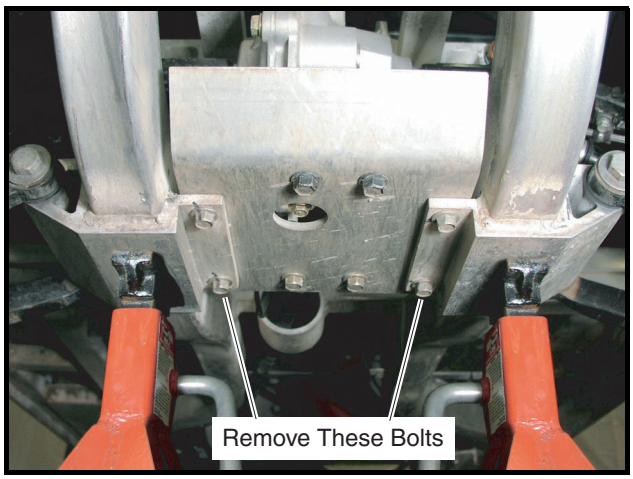


Figure 14-11 Front Differential Plate

FRONT DIFFERENTIAL INSTALLATION

See General Warning, Section 1, Page 1-1.

NOTE: *If the differential was removed or replaced from the differential plate, use new flange-head bolts and tighten the hardware to 30 ft-lb (41 N·m).*

1. Apply a light coat of anti-seize compound to the differential pinion shaft.
2. Position the front differential and plate on the two frame support weldments. Align the splined coupling on the universal joint so the roll pin hole in the spline coupling aligns with the roll pin hole in the differential pinion shaft.
3. Slide the differential pinion shaft into the driveshaft universal joint coupling.
4. Secure the differential plate to the frame support weldments with new flange-head bolts. Tighten the hardware to 23 ft-lb (31 N·m) **(Figure 14-11, Page 14-5)**.
5. Connect the electric clutch harness to the connector behind splash guard **(Figure 14-10, Page 14-5)**.
6. Connect the vent tube to the differential housing **(Figure 14-9, Page 14-5)**. **See following NOTE.**

NOTE: *If the tube shows signs of cracking or splitting, trim the end before the tube is connected or replaced.*

7. Drive a new roll pin into the differential pinion shaft and driveshaft universal joint coupling. **See following NOTE.**

NOTE: *The roll pin should be slightly below the surface on both sides of the coupling.*

Use a 1/4-inch roll pin punch to drive the roll pin into place.

8. Fill the front differential with the specified lubricant. **See Lubrication Change for Front Differential, Transmission, and Rear Differential, Section 10a, Page 10a-13.**
9. Install the half shafts. **See Half Shaft Installation on page 14-3.**
10. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

FRONT DRIVESHAFT

FRONT DRIVESHAFT REMOVAL

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Set the park brake. Place the Forward/Reverse handle in NEUTRAL. Chock the rear wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Remove the roll pin from the differential pinion shaft and front driveshaft **(Figure 14-8, Page 14-5)**. **See following NOTE.**

NOTE: *Use a 1/4-inch roll pin punch to drive-out the roll pin.*

4. Slide the front driveshaft toward the transmission until the universal joint clears the front differential pinion shaft.
5. Slide the driveshaft off the transmission, through the oval-shaped frame shield, and remove from vehicle.

FRONT DRIVESHAFT INSTALLATION

See General Warning, Section 1, Page 1-1.

1. Apply a light coat of anti-seize compound to the differential pinion shaft and splined shaft of transmission.
2. Slide the front driveshaft through the oval-shaped frame shield and onto the splined shaft of the transmission.
3. Slide the front differential pinion shaft into the universal joint so the roll pin holes in the driveshaft and differential pinion shaft are aligned.
4. Secure the differential plate to the frame support weldments with new flange-head bolts. Tighten the hardware to 23 ft-lb (31 N·m) **(Figure 14-11, Page 14-5)**.
5. Drive a new roll pin into the differential pinion shaft and driveshaft universal joint coupling. **See following NOTE.**

NOTE: *The roll pin should be slightly below the surface on both sides of the coupling.*

Use a 1/4-inch roll pin punch to drive the roll pin into place.

6. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

REAR RECEIVER HITCH

REAR RECEIVER HITCH REMOVAL

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Set the park brake. Place the Forward/Reverse handle in NEUTRAL. Chock the rear wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Remove the hydraulic line T-bracket from the passenger side of the receiver hitch.
4. Remove the hydraulic line from the rubber grommets and hitch frame.
5. Remove the four bolts, washers, and flanged locknuts from the receiver hitch frame and swing arm mounting plates and remove the receiver hitch.

REAR RECEIVER HITCH INSTALLATION

1. Position the receiver hitch onto the swing arm mounting plates and mounting holes.
2. Secure the receiver hitch with new bolts, flat washers, and new flanged locknuts. Tighten the hardware to 82 ft-lb (111 N·m).
3. Secure the hydraulic brake line T-fitting and tighten the hardware to 48 in-lb (7 N·m) **(Figure 14-13, Page 14-9)**.

4. Secure the hydraulic brake line in the rubber grommets on the hitch frame.
5. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

REAR AXLE

REAR AXLE REMOVAL

1. Unload the cargo bed. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the front wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. **Gasoline vehicles:** Disconnect the spark plug wires. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
4. Loosen the lug nuts on the rear wheels and lift the rear of the vehicle with a chain hoist or floor jack. **See WARNING "Lift only one end..." in General Warning, Section 1, Page 1-2.**
5. Place jack stands under the outside frames, as close to the rear of the vehicle as the frames will support. Lower the vehicle onto the stands **(Figure 14-12, Page 14-8)**. **See following DANGER.**

⚠ DANGER

- **Ensure that the weight of the vehicle is positioned to the front of the vehicle and the jack stands are as far back on the vehicle frame tubes as possible.**

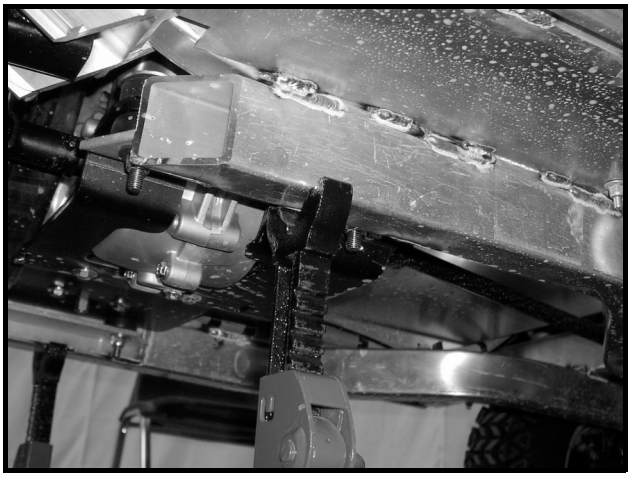


Figure 14-12 Jack Stands Under Rear of Frame

6. Remove both rear wheels.
7. Remove the hydraulic brake line T-fitting and bracket from the passenger-side receiver frame **(Figure 14-13, Page 14-9)**.
8. Remove the hydraulic brake line P-clamp from the rear differential **(Figure 14-14, Page 14-9)**.

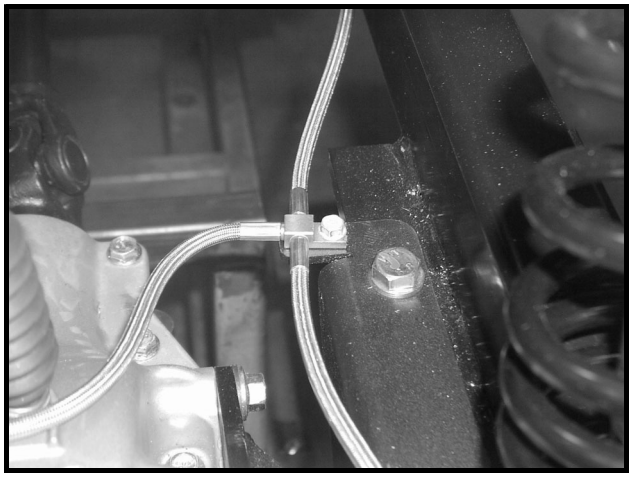


Figure 14-13 Receiver Hitch Brake Line T-Fitting and Bracket

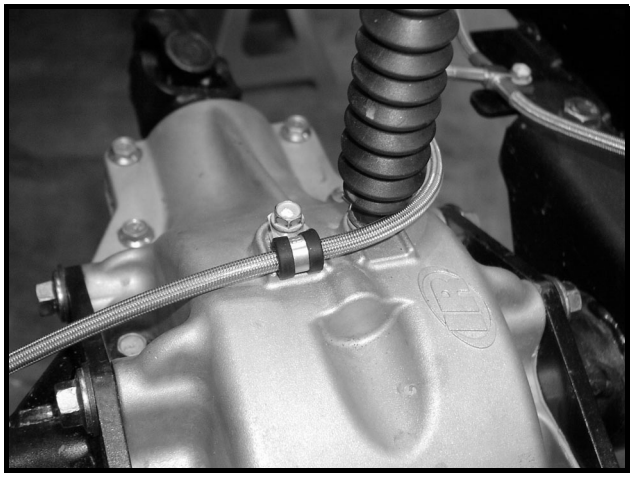


Figure 14-14 Rear Differential Brake Line P-Clamp

9. Remove the hydraulic brake lines from all frame-mounted rubber grommets.
10. Remove both park brake cables from the rear brake calipers and park brake levers **(Figure 14-15, Page 14-10)**. **See Left Rear Cable Removal, Section 6, Page 6-26. See Right Rear Cable Removal, Section 6, Page 6-26.**
11. Remove the hex-head bolts securing the brake caliper to the axle flange. **See Rear Brake Caliper Removal, Section 6, Page 6-8.**
12. Install the brake calipers on the swing arms and fasten them temporarily with wire ties. **See following CAUTION.**

⚠ CAUTION

- **Do not kink, twist, or damage the hydraulic brake lines.**

13. Position the floor jack under the differential and raise the jack just enough to support the axle **(Figure 14-16, Page 14-10)**.
14. Detach rear shock absorbers from axle. **See Rear Shock Absorber Removal, Section 9, Page 9-1.**
15. Remove the rear receiver hitch. **See Rear Receiver Hitch Removal on page 14-7.**
16. Remove the roll pin from the differential pinion shaft and rear driveshaft universal coupling. **See following NOTE.**

NOTE: *Use a 1/4-inch roll pin punch to drive-out the roll pin.*

17. Remove the four bolts, two spacer bars, and flanged locknuts from the axle and swing arm mounting plates. **See following NOTE and CAUTION.**

NOTE: *This procedure is best performed with the help of an assistant.*

⚠ CAUTION

- **The axle assembly is not balanced at the differential. Once released from the swing arms, the axle is free to tip and could fall from the floor jack. Support the longest end of the axle assembly while lowering it to the floor.**

18. Support the rear driveshaft and slide the rear axle out of the driveshaft universal joint and away from the swing arm brackets. **See preceding NOTE.**

19. Move the rear axle to a safe area away from the vehicle. **See previous NOTE.**

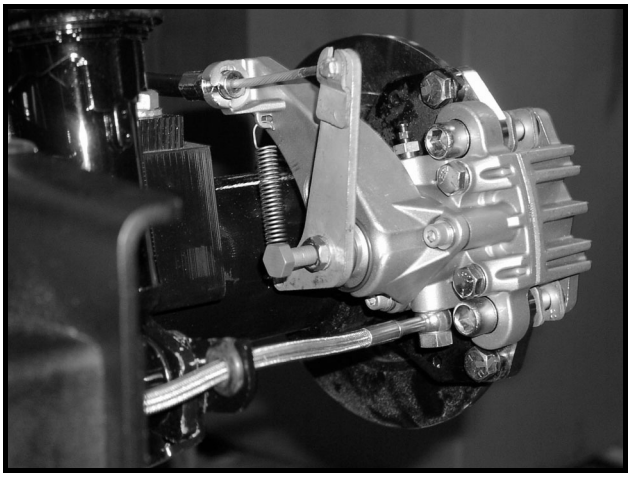


Figure 14-15 Park Brake Cable and Hex-Head Bolts

Figure 14-16 Position Floor Jack Under Differential

REAR AXLE INSTALLATION

NOTE: *These procedures are best performed with the help of an assistant.*

1. Support the differential with a floor jack and place the rear axle under the vehicle, just below the swing arms.

2. Support the longest end of the axle assembly and raise the axle up to the swing arm axle mounting plates.

3. With roll pin holes aligned, slide the differential pinion shaft into the driveshaft universal joint.

4. Center roll pin holes and drive a new roll pin into place. **See following NOTE.**

NOTE: *The roll pin should be slightly below the surface on both sides of the coupling.*

Use a 1/4-inch roll pin punch to drive the roll pin into place.

5. Secure the axle to the outside of the swing arms at four locations with new bolts and washers. If new bolts are not available, clean existing bolts and add Loctite 2760 per instructions. Finger-tighten the hardware.

6. Secure the rear receiver hitch to the inside of the swing arms and axle at four locations with new bolts and washers. If new bolts are not available, clean existing bolts and add Loctite 2760 per instructions. Finger-tighten the hardware.

7. Tighten all eight axle mounting bolts to 95 ft-lb (129 N·m).

8. Secure shock absorbers to axle **(Figure 14-17, Page 14-11)**. **See following NOTE.**

NOTE: *Hydraulic brake line brackets fit to the right side of both lower shock mounts.*

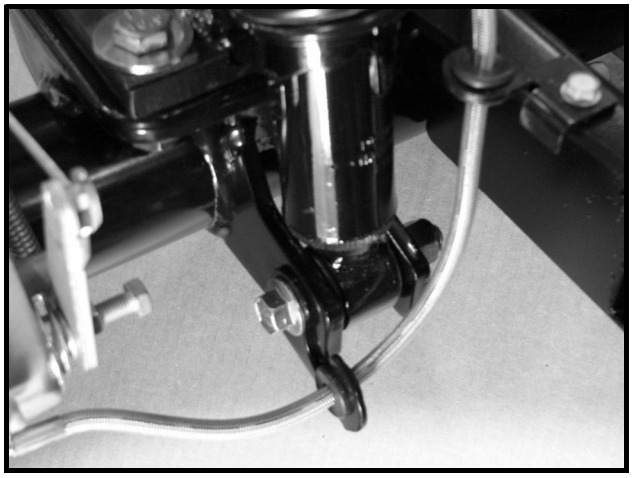


Figure 14-17 Lower Driver Side Shock Mount

9. Install both rear brake calipers to axle. **See Rear Brake Caliper Installation, Section 6, Page 6-9.**
10. Secure the hydraulic brake lines to the rubber grommets at all frame locations. **See following CAUTION.**

⚠ CAUTION

- **Do not kink, twist, or damage the hydraulic brake lines.**

11. Secure the P-clamp to the hydraulic brake line on top of the differential body. Tighten the hardware to 132 in-lb (15 N·m) **(Figure 14-14, Page 14-9)**.
12. Secure the hydraulic line T-fitting to the receiver hitch frame and tighten the bolt to 48 in-lb (7 N·m) **(Figure 14-13, Page 14-9)**.
13. Adjust the park brake. **See Park Brake Adjustment, Section 6, Page 6-25.**
14. Install both rear wheels and finger-tighten the lug nuts.
15. Lift the rear of the vehicle with a chain hoist or floor jack and remove jack stands. **See WARNING "Lift only one end..." in General Warning, Section 1, Page 1-2.**
16. Lower and remove the floor jack.
17. Use a crisscross pattern to tighten the lug nuts on both rear wheels to 85 ft-lb (115 N·m).
18. **Gasoline vehicles:** Connect the spark plug wires.
19. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

REAR DRIVESHAFT

REAR DRIVESHAFT REMOVAL

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL.
2. Push the car to a position that enables easy access to the roll pin securing the rear driveshaft to the differential pinion shaft **(Figure 14-8, Page 14-5)**. Chock the front wheels.

3. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
4. **Gasoline vehicles:** Disconnect the spark plug wires. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
5. Remove the roll pin from the differential pinion shaft and driveshaft universal joint. **See following NOTE.**

NOTE: *Use a 1/4-inch roll pin punch to drive-out the roll pin.*

6. Slide the driveshaft forward on the transmission to release the driveshaft from the differential pinion shaft. Then slide the driveshaft toward the rear and off the transmission shaft.

REAR DRIVESHAFT INSTALLATION

See General Warning, Section 1, Page 1-1.

1. Apply a light coat of anti-seize on the splined shaft of the differential.
2. Slide the universal joint of the driveshaft (with grease fitting) onto the splined transmission shaft.
3. Slide the differential pinion shaft into driveshaft universal joint. Align the roll pin holes in the driveshaft with the pin holes in the differential pinion shaft.
4. Drive a new roll pin into the differential pinion shaft and the driveshaft universal joint coupling. **See following NOTE.**

NOTE: *The roll pin should be slightly below the surface on both sides of the coupling.*

Use a 1/4-inch roll pin punch to drive the roll pin into place.

5. **Gasoline vehicles:** Connect the spark plug wires.
6. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

TRANSMISSION

TRANSMISSION REMOVAL

See General Warning, Section 1, Page 1-1.

1. Turn the key switch OFF and remove the key. Set the park brake. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. **Gasoline vehicles:** Disconnect the spark plug wires. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
4. Remove the outer clutch cover. **See Clutch Outer Cover Removal on page 13b-39 (gasoline vehicles) or Clutch Outer Cover Removal on page 13c-35 (diesel vehicles).**
5. Remove the drive belt. **See Drive Belt Removal on page 13b-31 (gasoline vehicles) or Drive Belt Removal on page 13c-28 (diesel vehicles).**
6. Remove the drive clutch. **See Drive Clutch Removal on page 13b-31 (gasoline vehicles) or Drive Clutch Removal on page 13c-29 (diesel vehicles).**

7. Remove the driven clutch. **See Driven Clutch Removal on page 13b-36 (gasoline vehicles) or Driven Clutch Removal on page 13c-33 (diesel vehicles).**
8. Remove the rear driveshaft. **See Rear Driveshaft Removal on page 14-11.**
9. Remove the clutch inner cover. **See Clutch Inner Cover Removal on page 13b-39 (gasoline vehicles) or Clutch Inner Cover Removal on page 13c-36 (diesel vehicles).**
10. Remove the passenger seat.
11. **Honda Powered Gasoline vehicles:** Remove the governor guard. **See Governor Guard Removal, Section 13b, Page 13b-19.**
    11.1. Disconnect the accelerator cable and strain relief grommet from the governor arm **(Figure 14-18, Page 14-13)**.
    11.2. Disconnect the governor cable and strain relief grommet from the governor arm.
    11.3. Remove the governor arm.

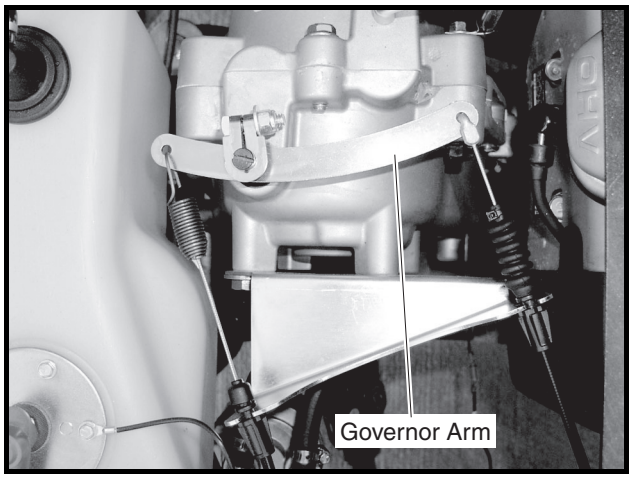


Figure 14-18 Governor Arm

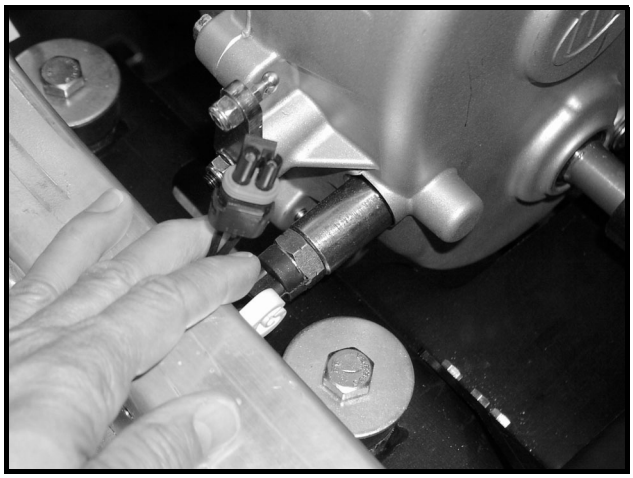


Figure 14-19 Neutral Sensing Connector

12. Remove the transmission Forward/Reverse shifter cable ball socket from the ball stud on the transmission shifter arm **(Figure 14-24, Page 14-17)**.
13. Disconnect the neutral sensing connector from the transmission **(Figure 14-19, Page 14-13)**.
14. Remove the two flange-head bolts, washers, and locknuts from the transmission slotted base brackets and engine mounting plate. **See following NOTE.**

NOTE: *If the transmission is replaced, remove the base brackets and corresponding hardware. Use new hardware and the existing base brackets to install the new transmission. Tighten the base bracket hardware to 39 ft-lb (53 N·m).*

If the transmission is not replaced, leave the base brackets attached to help stabilize the transmission during repair.

15. Lift the transmission body slightly to clear the opening in the engine mounting plate and remove the transmission from the rear of the vehicle sliding the splined shaft out of the front driveshaft.

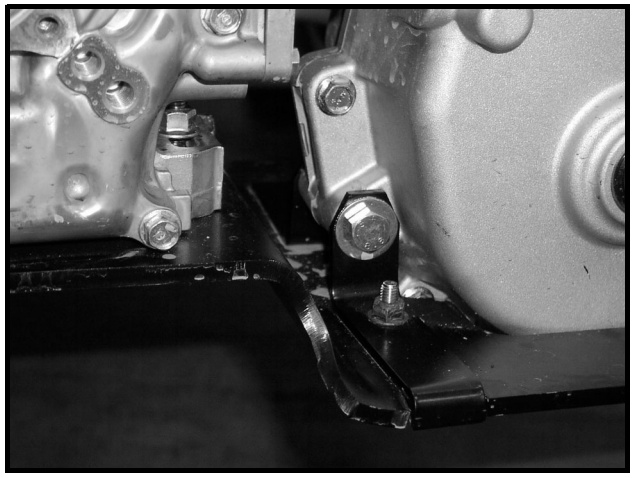


Figure 14-20 Transmission Base Mount

TRANSMISSION INSTALLATION

See General Warning, Section 1, Page 1-1.

1. Apply a light coat of anti-seize to the front splined shaft of the transmission.
1. Ensure the base brackets are installed on the transmission and install the transmission on the engine mounting plate while sliding the splined shaft into the front driveshaft.
2. Align the base bracket slots with the mounting holes in the engine mounting plate. **See following NOTE.**

NOTE: *The right-angle lips on the base brackets should be positioned over each side of the engine mounting plate.*

If the transmission is new or the base brackets have been removed, leave the base brackets loose.

3. Secure the clutch inner cover to the engine and transmission with bolts and washers. Finger-tighten the hardware. **Gasoline vehicles: See Clutch Inner Cover Installation, Section 13b, Page 13b-40. Diesel vehicles: See Clutch Inner Cover Installation, Section 13c, Page 13c-36. See following NOTE.**

NOTE: *Hole tolerances in the inner cover are very close in diameter to bolt sizes. The inner cover is used to align the engine and transmission and is the primary support for the transmission.*

Allow the inner cover plate to assist in aligning the engine and transmission.

4. Tighten the transmission body base flange-head bolt and flange-head locknut to 39 ft-lb (53 N·m).
5. If removed, install two new bolts, flat washers, and new flanged locknuts on the transmission base brackets and engine mounting plate. Tighten the hardware to 21 ft-lb (29 N·m).
6. Connect the neutral sensing connector on the transmission to the wire harness **(Figure 14-19, Page 14-13)**.
7. Secure the Forward/Reverse shifter cable ball socket to the ball stud on the transmission shifter arm **(Figure 14-24, Page 14-17)**. **See following NOTE.**
8. **Honda Powered Gasoline vehicles:** Install the ground speed governor arm **(Figure 14-18, Page 14-13)**.
   8.1. Secure the governor cable from the engine to the governor arm. **See Governor Cable Installation, Section 13b, Page 13b-20.**
   8.2. Secure the accelerator cable to the governor arm. **See Accelerator Cable Installation,**

Section 13b, Page 13b-18.

8.3. Adjust the ground speed governor arm. **See Ground Speed (Transmission) Governor Arm Adjustment, Section 13b, Page 13b-21.**

8.4. Install the governor guard. **See Governor Guard Installation, Section 13b, Page 13b-19.**

9. **Both gasoline and diesel vehicles:** Install the rear driveshaft. **See Rear Driveshaft Installation on page 14-12.**
10. Install the driven clutch. **See Driven Clutch Installation, Section 13b, Page 13b-38 (gasoline vehicles) or Driven Clutch Installation, Section 13c, Page 13c-35 (diesel vehicles).**
11. Install the drive clutch. **See Drive Clutch Installation, Section 13b, Page 13b-34 (gasoline vehicles) or Drive Clutch Installation, Section 13c, Page 13c-32 (diesel vehicles).**
12. Install the drive belt. **See Drive Belt Installation, Section 13b, Page 13b-31 (gasoline vehicles) or Drive Belt Installation, Section 13c, Page 13c-29 (diesel vehicles).**
13. Install the clutch outer cover. **See Clutch Outer Cover Installation, Section 13b, Page 13b-39 (gasoline vehicles) or Clutch Outer Cover Installation, Section 13c, Page 13c-35 (diesel vehicles).**

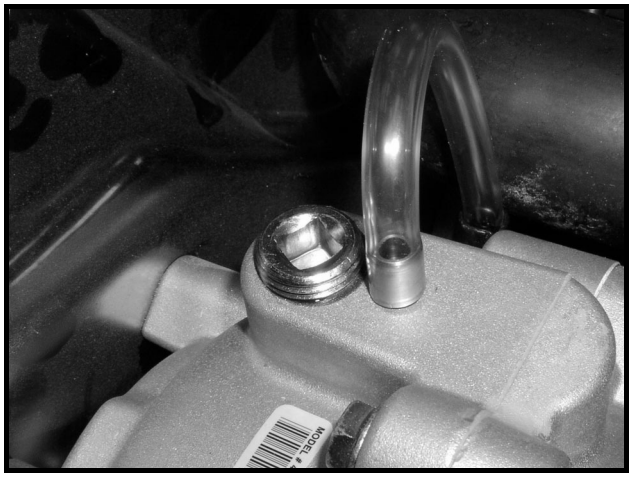


Figure 14-21 Lubrication Fill Plug and Vent Tube

14. Attach vent tube and check lubricant level of transmission **(Figure 14-21, Page 14-15)**. **See Lubrication Level Check for Front Differential, Transmission, and Rear Differential on page 10a-13.**
15. Tighten wheel lug nuts to 85 ft-lb (115 N·m).
16. **Gasoline vehicles:** Connect the spark plug wires.
17. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

FORWARD/REVERSE SHIFTER CABLE

See General Warning, Section 1, Page 1-1.

Forward/Reverse Shifter Cable Removal

NOTE: *Before the Forward/Reverse cable is removed, note the cable routing and the wire tie positions and the positions of other devices securing the cable to the vehicle. When installed, the cable must be routed and secured as it was originally.*

1. Turn the key switch OFF and remove the key. Set the park brake. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. **Gasoline vehicles:** Disconnect the spark plug wires. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
4. Raise the hood.
5. Disconnect the cable ball socket from the shifter handle ball stud **(Figure 14-22, Page 14-16)**.
6. Loosen the flanged nuts from the cable at the shifter handle bracket **(Figure 14-23, Page 14-16)**.

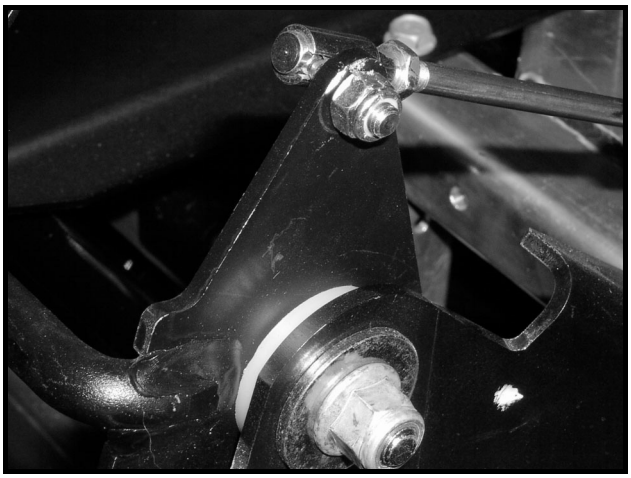


Figure 14-22 Forward/Reverse Shifter Cable Ball Socket At Shifter Handle Ball Stud

Figure 14-23 Forward/Reverse Shifter Cable Flanged Nuts At Shifter Handle Bracket

NOTE: *Note the positions of the flanged nuts on the cable. The nut farthest from the handle should be at the farthest end of the threaded portion of the cable.*

7. Remove the passenger seat.
8. Note the positions of the wire ties that secure the cable between the dash and the transmission and then remove the wire ties.
9. Disconnect the cable ball socket from the ball stud on the transmission shifter arm **(Figure 14-24, Page 14-17)**.
10. Loosen the flanged nuts from the cable bracket that is below and forward of the transmission shifter arm. **See following NOTE.**

NOTE: *Note the positions of the flanged nuts on the cable. This hardware will be used to adjust the handle position during installation.*

Secure a heavy nylon cord to the transmission end of the cable. Pull the cord and cable at the dash frame from the transmission and allow the cord to travel under the body.

11. Remove the shifter cable.

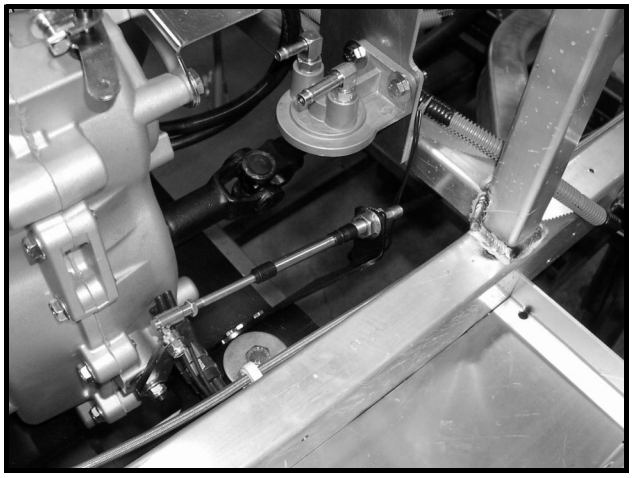


Figure 14-24 Forward/Reverse Shifter Cable at Transmission

Forward/Reverse Shifter Cable Installation

1. Secure a new cable to the transmission end of the nylon cord at the dash frame. Pull and route the cable from the dash frame to the transmission. **See following NOTE.**

NOTE: *If a nylon cord was not used to remove the cable, carefully feed the cable from behind the dash frame down between the splash guard and frame, under the vehicle body, and up to the transmission.*

Use care during cable installation and avoid bending the rigid tubular ends of the cable assembly.

2. Secure the cable ball socket to the ball stud on the Forward/Reverse shifter handle at the dash **(Figure 14-22, Page 14-16)**.
3. Loosen the flanged nut farthest from the handle end as far away from the handle end as the thread will allow.
4. Advance the front flanged nut away from the rear nut. Allow enough room to install the cable and two flanged nuts on the Forward/Reverse cable bracket on the dash frame.
5. Adjust the shifter cable. **See Forward/Reverse Shifter Cable Adjustment on page 14-17.**

Forward/Reverse Shifter Cable Adjustment

1. Verify that the transmission shifter arm is in the NEUTRAL position.
2. Loosen the flanged cable nuts from the cable end at the transmission.
3. Secure the cable ball socket to the ball stud on the transmission shifter arm. **See following NOTE.**
4. Hold the shifter arm on the transmission in the NEUTRAL position and align the shifter handle with the neutral position mark on the instrument panel. **See following NOTE.**

NOTE: *This procedure is best performed with the help of an assistant.*

5. Advance the front flanged nut, closest to the transmission shifter arm, up against the front side of the Forward/Reverse shifter bracket.
6. Advance the rear flanged nut, farthest away from the transmission shifter arm, down next to the back side of the FNR shifter bracket and tighten the front nut to 25 ft-lb (34 N·m).
7. Move the shifter handle to the FORWARD, NEUTRAL, and REVERSE positions.

7.1. Ensure shifter handle is clear of the instrument panel in the FORWARD and REVERSE positions.
7.2. Ensure shifter handle is centered between those positions in the NEUTRAL position.

8. Install the passenger seat.
9. Lower and secure the hood.
10. **Gasoline vehicles:** Connect the spark plug wires.
11. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

FORWARD/REVERSE SHIFTER HANDLE

Shifter Handle Removal

1. Turn the key switch OFF and remove the key. Set the park brake. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-2.**
3. Remove the shifter knob.
4. Raise the hood.
5. Disconnect the cable ball socket from the shifter handle ball stud **(Figure 14-22, Page 14-16)**.
6. Remove the socket-head pivot shoulder bolt, nylon spacer, two large flat washers, and nylon locknut from the shifter handle and frame bracket.
7. Remove the shifter handle.

Shifter Handle Installation

1. Secure the shifter handle with a new socket-head pivot shoulder bolt (CCI P/N 102684601), nylon spacer, two large flat washers, and a new nylon locknut. Tighten the hardware to 40 in-lb (5 N·m) **(Figure 14-22, Page 14-16)**. **See following NOTE.**

NOTE: *If the previously removed shoulder bolt and nylon locknut are used for installation, add Loctite 262 to the bolt threads and tighten the used hardware to 50 in-lb (6 N·m).*

2. Secure the ball socket to the ball stud on the Forward/Reverse shifter handle under the hood.
3. Install the shifter knob.
4. Lower and secure the hood.
5. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

REAR DIFFERENTIAL AND AXLE SHAFTS

REAR DIFFERENTIAL AND AXLE SHAFT REMOVAL

See General Warning, Section 1, Page 1-1.

The rear axle assembly has two axle shafts. The driver side shaft is longer than the passenger side. The axle tubes must be unbolted from the differential to access the axle shafts. If only a tube or shaft is to be replaced, it can be done one side at a time without removing the entire rear axle.

1. Clean debris from drain plug and area around it at the bottom of the differential. Place a large pan under the differential and remove drain plug to empty housng. Install plug after draining.
2. Remove the rubber dust cap (1) and cotter pin (2) from end of axle shaft (3). Discard cotter pin. Loosen the nut (4) on the axle shaft **(Figure 14-25, Page 14-19)**. **See Rear Wheel Disc Removal, Section 6, Page 6-15.**
3. Remove the rear axle and clean it in preparation for disassembly. **See Rear Axle Removal on page 14-8. See following NOTE.**

NOTE: *After cleaning, move the rear axle and differential assembly to a clean location before disassembly.*

4. Remove rear brake rotors (5) **(Figure 14-25, Page 14-19)**. **See Rear Wheel Disc Removal, Section 6, Page 6-15. See following CAUTION.**

CAUTION

- **The differential and axle tubes have been assembled with Loctite 2760 Threadlocker compound. Use a non-flammable heat source to heat the flange area and bolts during the removal and replacement of each of the six bolts. Once removed, the manufacturer recommends that each thread location be tapped with the same thread (M12 x 1.75 pitch) before new bolts are installed.**

5. Remove the six flange-head bolts (6) and flat washers (7) securing each axle tube (8) to the differential **(Figure 14-25, Page 14-19)**.
6. Cover or tape the axle shaft splines to protect the hub seals.
7. Separate each axle tube from the differential and carefully pull tube straight away until it clears the splined end of the axle shaft.
8. Avoiding damage caused by dragging splines across lip of seal, carefully pull each axle shaft from the differential.
9. If replacing shaft, transfer washer (1) and retaining ring (2) from old shaft to new **(Figure 14-26, Page 14-19)**.

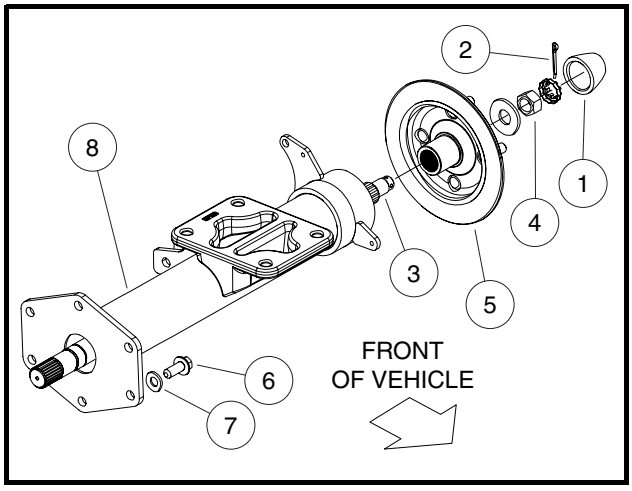


Figure 14-25 Axle Shaft and Brake Rotor

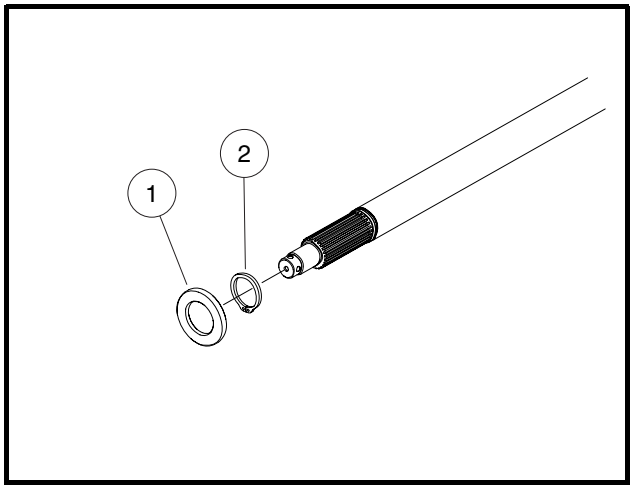


Figure 14-26 Axle Shaft Retaining Ring and Washer

REAR DIFFERENTIAL AND AXLE SHAFT INSTALLATION

1. Clean and lubricate the seals on each side of the differential with appropriate oil. **See Periodic Lubrication Schedule, Section 10a, Page 10a-4.**
2. Clean both axle shafts, particularly the splined ends. Avoiding damage caused by dragging splines across lip of seal, carefully insert shafts into the differential. **See following NOTE.**

NOTE: *It may be necessary to rotate each shaft slightly to engage the splines in the differential housing.*

3. Clean mating surfaces on both axle tube flanges and each side of the differential. Also clean the threads of the six axle tube mounting holes on each side of the differential. Apply Loctite 2760 to new flange-head bolts. **See following CAUTION.**

CAUTION

- **Clean each thread location with a thread tap (M12 x 1.75 pitch) before installing new bolts. Apply Loctite 2760 Threadlocker to the bolt threads.**

4. Apply a 3/16-inch wide bead of Three Bond No. 1215 (CCI P/N 101928701) to the mating surfaces on each side of the differential.
5. Secure the axle tubes to the differential housing with flange-head bolts and flat washers. Use a criss-cross pattern to tighten the hardware to 100 ft-lb (136 N·m).
6. Install the rear brake rotors and calipers. Finger-tighten the nut onto axle shaft. **See Rear Wheel Disc Installation, Section 6, Page 6-16.**
7. Install the rear axle. **See Rear Axle Installation on page 14-10.**
8. Add lubricant to the differential. **See Lubrication Change for Front Differential, Transmission, and Rear Differential on page 10a-13.**

REAR WHEEL BEARINGS

The axle tubes must be unbolted from the differential to access the axle shafts and wheel bearings. The hub seals are incorporated into the bearings.

Rear Wheel Bearing Removal

1. Remove the axle tube (1) from the differential **(Figure 14-27, Page 14-21)**. **See Rear Differential and Axle Shaft Removal on page 14-18.**
2. Remove the retaining ring (2) that is in front of the bearing (3) **(Figure 14-27, Page 14-21)**.
3. Drive bearing from axle tube by applying force to the outer race.

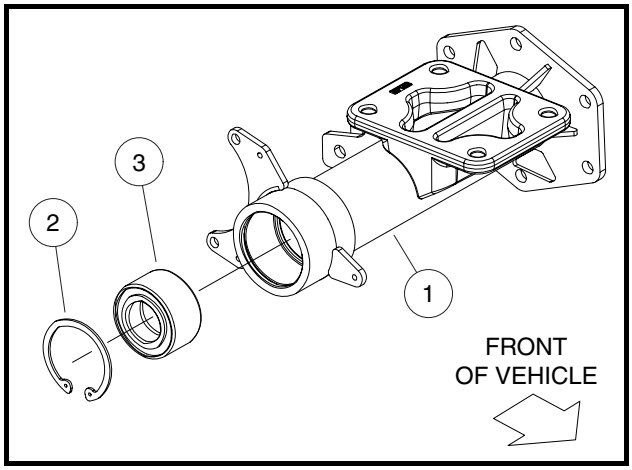


Figure 14-27 Rear Wheel Bearing

Rear Wheel Bearing Installation

1. Clean inside axle tube where new bearing will sit and lightly lubricate the bore with anti-seize compound.
2. Using an appropriate sized bearing driver that fits the outer race, drive in new bearing until fully seated.
3. Install the retaining ring.
4. Clean axle shaft and carefully install axle tube to avoid damaging new seals. **See Rear Differential and Axle Shaft Installation on page 14-20.**

SECTION 15 – RADIATOR AND COOLANT SYSTEM (DIESEL)

⚠ DANGER

- **See General Warning, Section 1, Page 1-1.**

⚠ WARNING

- **See General Warning, Section 1, Page 1-1.**

GENERAL INFORMATION

See General Warning, Section 1, Page 1-1.

The diesel vehicle is equipped with a cooling system that includes a radiator, an electric radiator fan, a reservoir, and a circulating system. This cooling system circulates coolant through the engine and across a thermostat.

ENGINE COOLANT LEVEL CHECK

See Engine Coolant – Diesel Vehicles, Section 10a, Page 10a-16.

ENGINE COOLANT CHANGE

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL and chock the rear wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in See General Warning, Section 1, Page 1-1.**
3. Raise the hood and remove the reservoir cap. **See following WARNING.**

⚠ WARNING

- **Coolant reservoir and radiator are pressurized. Remove caps slowly to relieve pressure.**
- **Hot! Coolant system is pressurized. Do not remove radiator cap while engine is hot.**

4. Place a large drain pan under the radiator and engine drain plugs.
5. Turn the drain valve at the radiator counterclockwise, for one and one-half turns only, to drain coolant from radiator. **See following NOTE.**

NOTE: *The radiator drain valve does not have a drain STOP position. It can be removed from the radiator if turned more than one and one-half rotations.*

6. Turn the drain valve on the engine counterclockwise to drain coolant **(Figure 15-1, Page 15-2)**.
7. Remove the engine block coolant plug from the top rear of engine **(Figure 15-2, Page 15-2)**. **See following NOTE.**

NOTE: *Removing the block plug allows air to escape during the fill process without forming an air lock to coolant flow.*

8. Check the hoses and clamps for looseness or damage. Replace if necessary.
9. Check the radiator for leaks or severe coil damage. Replace the radiator if damage has created a leak, or has caused flow restriction from crushed coils.
10. Close both drain valves but leave the engine block coolant plug open.
11. Fill the cooling system with an appropriate coolant mixture at the reservoir. Allow the coolant to fill until it reaches the hole for the engine block coolant plug. **See following NOTE.**

NOTE: *Use a mixture of 45% water and 55% propylene glycol with anti-corrosion additives.*

12. Apply Loctite 567 Liquid Thread Sealer to the threads of the block coolant plug. Install the plug and tighten to 144 in-lb (16 N·m).
13. Continue adding to the reservoir until coolant reaches the radiator fill spout. Replace the radiator cap.
14. Fill the reservoir to the FULL mark with coolant and check for leaks. Replace the reservoir cap.
15. Start and run the engine until it reaches operating temperature. Monitor the coolant level in the reservoir.
16. Stop the engine and allow the engine and coolant to cool. **See following WARNING.**

⚠ WARNING

- **Coolant reservoir and radiator are pressurized. Remove caps slowly to relieve pressure.**
- **Hot! Coolant system is pressurized. Do not remove radiator cap while engine is hot.**

17. If necessary, remove reservoir cap and fill to the FULL mark. Replace cap. **See preceding WARNING.**
18. Lower and secure the hood.

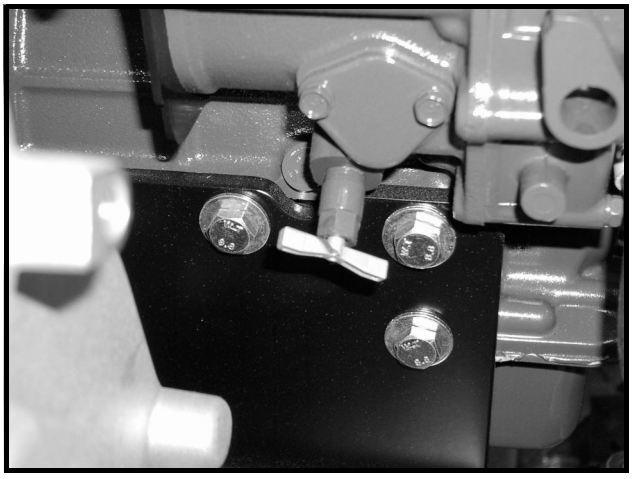


Figure 15-1 Engine Block Coolant Drain Valve

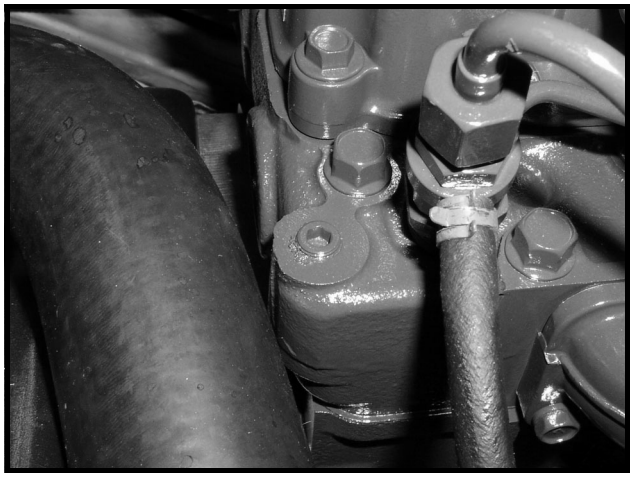


Figure 15-2 Engine Block Coolant Plug

COOLANT RESERVOIR

See General Warning, Section 1, Page 1-1.

COOLANT RESERVOIR REMOVAL

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL and chock the rear wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in See General Warning, Section 1, Page 1-1.**
3. Raise the hood and remove the reservoir cap. **See following WARNING.**

⚠ WARNING

- **Coolant reservoir and radiator are pressurized. Remove caps slowly to relieve pressure.**
- **Hot! Coolant system is pressurized. Do not remove radiator cap while engine is hot.**

4. Place a large drain pan under the radiator and front differential to collect coolant. **See following NOTE.**

NOTE: *Do not remove the drain pan until the reservoir has been replaced and the hoses attached.*

5. Turn the drain valve at the radiator counterclockwise, for one and one-half turns only, to drain enough coolant to empty the reservoir. Once empty, close radiator drain valve. **See following NOTE.**

NOTE: *The radiator drain valve does not have a drain STOP position. It can be removed from the radiator if turned more than one and one-half rotations.*

6. From under the instrument panel, release the clamp securing the 5/8 inch hose to the bottom of the reservoir and remove hose **(Figure 15-3, Page 15-3)**.
7. Release the clamps securing the two hoses at top of reservoir and remove hoses.
8. Remove the two bolts securing reservoir to chassis. Access to rear bolt is from under the instrument panel. Access to the other bolt is between the reservoir and fender.
9. Lift up rear of reservoir to clear mounting tab of chassis and pull reservoir forward and up to remove.

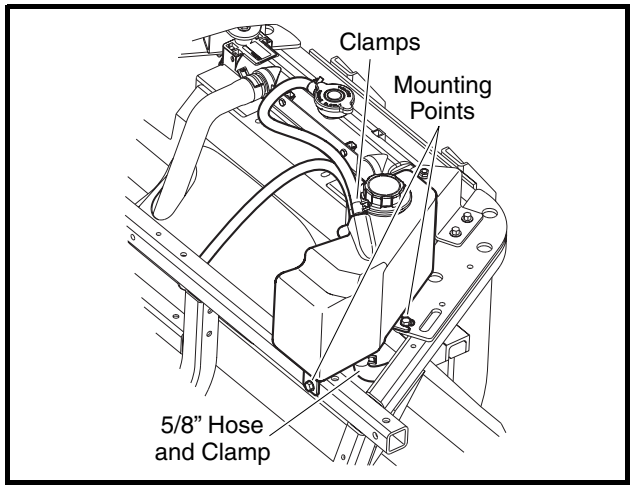


Figure 15-3 Reservoir Hoses And Mounting Points

COOLANT RESERVOIR INSTALLATION

1. Install reservoir, aligning holes in mounting tabs with holes in chassis, and secure with bolts. Tighten the hardware to 132 in-lb (15 N·m).
2. Attach 5/8 inch hose to the bottom of reservoir and secure with clamp.
3. Attach the two hoses to top of reservoir and secure with clamps.
4. Fill the reservoir to the FULL mark with an appropriate coolant mixture and check for leaks. **See following NOTE.**

NOTE: *Use a mixture of 45% water and 55% propylene glycol with anti-corrosion additives.*

5. Replace the reservoir cap.
6. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
7. Start and run the engine until it reaches operating temperature and check for leaks.
8. Stop the engine and allow the engine and coolant to cool. **See following WARNING.**

⚠ WARNING

- **Coolant reservoir and radiator are pressurized. Remove caps slowly to relieve pressure.**
- **Hot! Coolant system is pressurized. Do not remove radiator cap while engine is hot.**

9. If necessary, remove reservoir cap and fill the reservoir to the FULL mark. Replace cap. **See preceding WARNING.**
10. Lower and secure the hood.

RADIATOR

See General Warning, Section 1, Page 1-1.

RADIATOR REMOVAL

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL and chock the rear wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in See General Warning, Section 1, Page 1-1.**
3. Raise the hood.
4. Drain the radiator, reservoir and engine. **See Engine Coolant Change on page 15-1. See following WARNING.**

⚠ WARNING

- **Coolant reservoir and radiator are pressurized. Remove caps slowly to relieve pressure.**
- **Hot! Coolant system is pressurized. Do not remove radiator cap while engine is hot.**

5. Release the clamp securing the hose to the radiator fill spout and remove hose.
6. Release the clamps securing the upper and lower radiator hoses to the radiator and remove hoses.

7. Disconnect the two-pin connector between the fan motor and the wire harness **(Figure 15-4, Page 15-5)**.
8. Remove the flanged locknuts and flanged bolts securing the two radiator support brackets to the chassis and remove brackets.

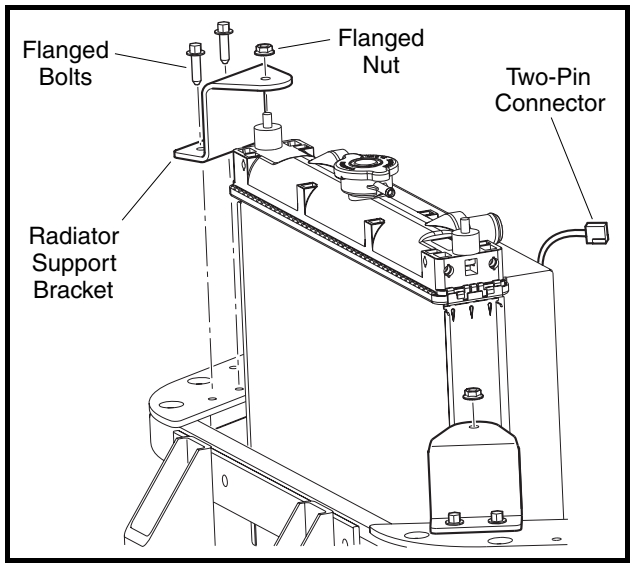


Figure 15-4 Radiator Bracket Attachment

9. Push the splash guard toward the dash and carefully lift the radiator straight up to remove from vehicle. **See following CAUTION.**

CAUTION

- **To prevent damage to the radiator when lifting it out of the vehicle, avoid striking the protruding hardware in upper front crossmember.**

10. Remove the four bolts securing the fan shroud assembly to the radiator and remove the shroud.

RADIATOR INSTALLATION

1. Place fan shroud assembly on radiator and secure with four lock-patch bolts. Tighten the hardware to 48 in-lb (5 N·m).
2. Carefully lower the radiator straight down into chassis to rest in the aluminum frame channel. **See preceding CAUTION.**
3. Install the two radiator support brackets over the studs of the rubber isolators and finger-tighten flanged locknuts. Secure brackets to chassis with flanged bolts tightened to 132 in-lb (15 N·m). Tighten the flanged locknuts to 84 in-lb (9.0 N·m).
4. Connect the two-pin connector from the fan motor to the wire harness.
5. Attach the upper and lower radiator hoses and secure with clamps.
6. Attach the hose to the radiator fill spout and secure with clamp.
7. Refill the cooling system. **See Engine Coolant Change on page 15-1.**

8. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
9. Start and run the engine until it reaches operating temperature and check for leaks.
10. Stop the engine and allow the engine and coolant to cool. **See following WARNING.**

⚠ WARNING

- **Coolant reservoir and radiator are pressurized. Remove caps slowly to relieve pressure.**
- **Hot! Coolant system is pressurized. Do not remove radiator cap while engine is hot.**

11. If necessary, remove reservoir cap and fill to the FULL mark. Replace cap. **See preceding WARNING.**
12. Lower and secure the hood.

COOLANT PIPE WELDMENT

See General Warning, Section 1, Page 1-1.

COOLANT PIPE WELDMENT REMOVAL

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL and chock the rear wheels.
2. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in See General Warning, Section 1, Page 1-1.**
3. Drain the radiator, reservoir and engine. **See Engine Coolant Change on page 15-1. See following WARNING.**

⚠ WARNING

- **Coolant reservoir and radiator are pressurized. Remove caps slowly to relieve pressure.**
- **Hot! Coolant system is pressurized. Do not remove radiator cap while engine is hot.**

4. Release the clamps securing the three hoses to the rear end of the coolant pipes. Using a large drain pan to catch remaining coolant, remove hoses from pipes.
5. Release the clamps securing the three hoses to the front end of the coolant pipes. Relocate drain pan to the front end of the coolant pipes and remove hoses from pipes.
6. Remove the flanged locknut securing the front of the weldment to the chassis. Leave bolt in chassis.
7. Remove the two flanged locknuts and bolts securing the rear of the weldment to the chassis and remove the pipes. **See following NOTE.**

NOTE: *The bar clamp, located between the front mounting plate and chassis, might be removed along with the pipes. If so, retain for use during assembly.*

COOLANT PIPE WELDMENT INSTALLATION

1. Position the coolant pipe weldment under the chassis. Lift to align rear mounting tabs with holes in chassis and insert bolt up through hole on driver side. Finger-tighten a flanged locknut onto the bolt to suspend pipe weldment. Repeat at passenger side hole.

2. Verify bar clamp is in position, between the front mounting plate and chassis, before placing hole in mounting plate over bolt in chassis. Install flanged locknut and tighten to 21 ft-lb (28 N·m).
3. Tighten the rear hardware to 21 ft-lb (28 N·m).
4. Attach the six hoses to each end of the corresponding pipes and secure with clamps.
5. Refill the cooling system. **See Engine Coolant Change on page 15-1.**
6. Connect the battery cables, positive (+) cable first, and tighten the hardware to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
7. Start and run the engine until it reaches operating temperature and check for leaks.
8. Stop the engine and allow the engine and coolant to cool. **See following WARNING.**

⚠ WARNING

- **Coolant reservoir and radiator are pressurized. Remove caps slowly to relieve pressure.**
- **Hot! Coolant system is pressurized. Do not remove radiator cap while engine is hot.**

9. If necessary, remove reservoir cap and fill to the FULL mark. Replace cap. **See preceding WARNING.**
10. Lower and secure the hood.

FAN

See General Warning, Section 1, Page 1-1.

FAN REMOVAL

See Fan Removal, Section 12c, Page 12c-19.

FAN INSTALLATION

See Fan Installation, Section 12c, Page 12c-19.

SECTION 16 – HYDRAULIC ATTACHMENT SYSTEM

⚠ DANGER

- **See General Warning, Section 1, Page 1-1.**

⚠ WARNING

- **See General Warning, Section 1, Page 1-1.**
- **Always wear eye protection and protective clothing when working on and around hydraulic systems.**
- **Remove jewelry and objects that might conduct electricity while working on power units.**
- **Hydraulic fluid poses a fire hazard and can cause burning or skin irritation if not properly handled.**
- **Hydraulic fluid under pressure can penetrate skin or eyes, causing serious injury or death. Fluid leaks under pressure may not be visible. Use a piece of cardboard or wood to find leaks. Do not use your bare hand. Wear safety goggles. If fluid enters skin or eyes, get immediate medical attention from a physician familiar with this injury.**
- **Devices being operated by the hydraulic system should be immobilized so they cannot move and cause injury while being inspected or repaired. Disconnect from electrical source.**
- **Prior to performing any maintenance make sure the equipment is turned off and that any stored energy, for example pressure, is released. Also, extended equipment or cylinders should be lowered and mechanically locked as required.**
- **The manufacturer is not responsible for misuse or misapplication of product. If you have any questions about application, please contact a local dealer.**
- **Fluids should be contained and disposed of properly.**

This section contains procedures for inspection, troubleshooting, removal, installation, maintenance, and regular servicing of vehicles equipped with the hydraulic attachment system.

MODEL IDENTIFICATION

This vehicle uses a Monarch Hydraulics Inc. model M-3518 Pump Unit.

RELIEVING HYDRAULIC SYSTEM PRESSURE

To prevent serious injury or death, hydraulic pressure must be relieved before disconnecting or removing the pump, hoses and valves. Pressure can also cause difficulty in connecting or disconnecting the auxiliary hydraulic quick connect fittings. Use the following procedure to relieve hydraulic pressure in the system.

TO RELIEVE HYDRAULIC FLUID PRESSURE

1. Remove attachment if installed. **See Attachment Interface on page 16-2.**
2. Lower attachment interface, fully extending the lift and tilt cylinders.
3. Turn the key switch to the OFF position to shut off vehicle. Turn the key switch back to the ON position, but DO NOT start the utility vehicle engine. Keep the joystick ON/OFF switch set to ON.

4. Relieve pressure in the desired circuit:
   4.1. For the tilt circuit, slightly retract the tilt cylinder to relieve most of the built up pressure.
   4.2. For the lift circuit, activate the float feature to relieve pressure.
   4.3. For the auxiliary circuit, if equipped, turn the key switch to the OFF position and press the auxiliary hydraulic switch to the right and then to left several times to relieve pressure.
5. Once pressure is relieved from the circuit(s) to be serviced, make sure the key switch is in the OFF position and set the joystick ON/OFF switch to OFF.

ATTACHMENT INTERFACE

INSPECTION

Hand Lever

⚠ WARNING

- **The pins must extend through the holes in attachment. Lever must be fully engaged in the locked position. Failure to secure pins can allow attachment to come off and cause injury or death.**

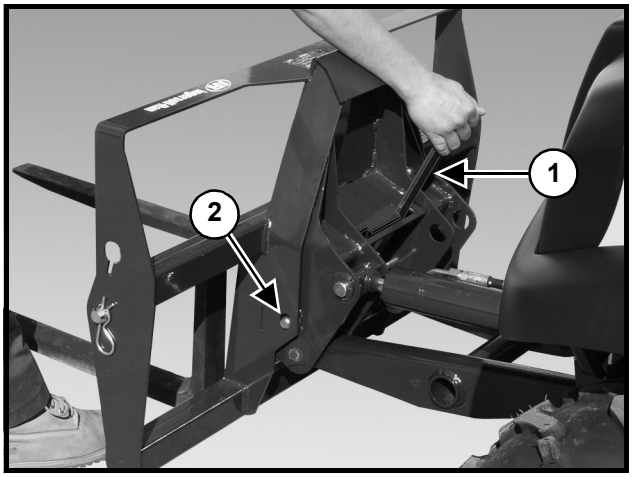


Figure 16-1 Hand Lever

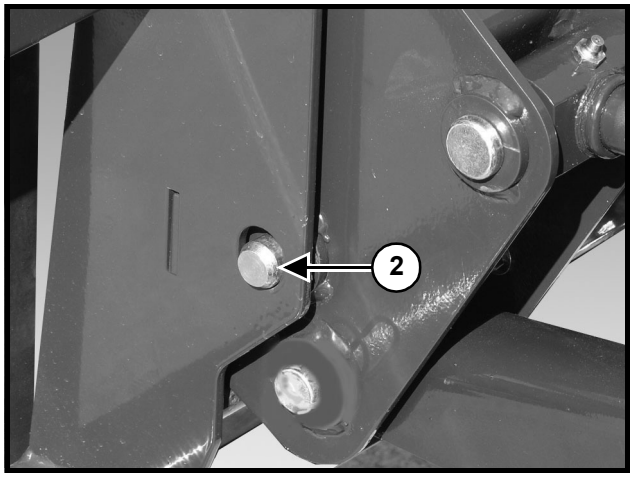


Figure 16-2 Attachment Pins

1. Move the locking hand lever (1) to engage and disengage the pins (2) **(Figure 16-1, Page 16-2)**. The lever and pins must move freely.
2. The pins (2) must extend through the holes in the attachment mounting frame **(Figure 16-2, Page 16-2)**. If the pin does not extend through the hole, the attachment will be loose and can come off the attachment interface.
3. Inspect the linkages and pins for excessive wear or damage **(Figure 16-3, Page 16-3)**. Replace any parts that are damaged, bent or missing. Keep all fasteners tight.

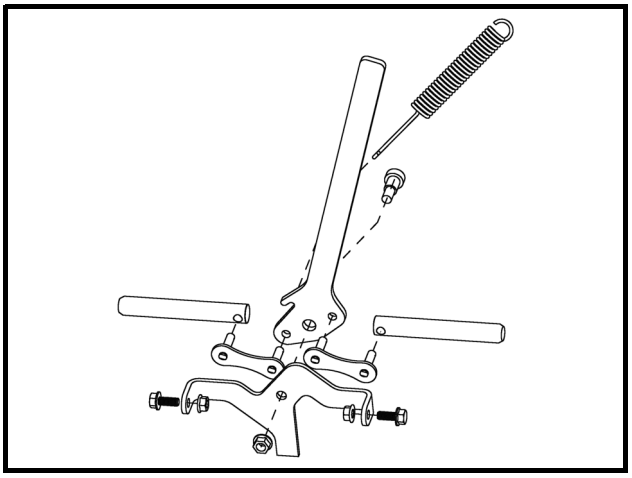


Figure 16-3 Hand Lever Linkages and Pins

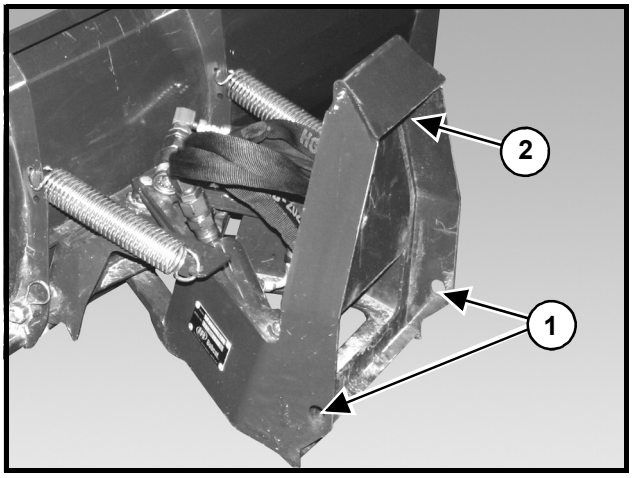


Figure 16-4 Inspect Mount

Mount

NOTE: *The following picture may not show your exact attachment but mounting frame inspections are the same.*

Inspect the pin mounts (1), mounting flange (2) and all welds for wear, damage and cracks **(Figure 16-4, Page 16-3)**. Replace or repair parts as necessary.

REMOVING AND INSTALLING THE ATTACHMENT ARM MECHANISM

When the attachment arm mechanism is not being used, it can be removed from the vehicle.

NOTE: *Remove the bucket or the attachment before attempting to remove the attachment arm mechanism from the vehicle.*

Attachment Arm Removal

Figure 16-5 Lower Arm and Tilt Interface Forward

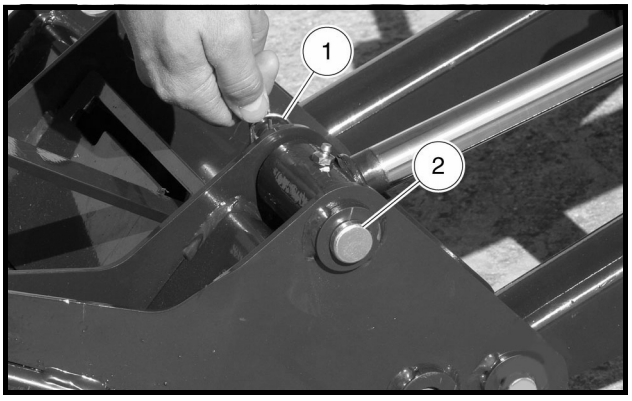


Figure 16-6 Remove Interface Cylinder Retaining Pin

NOTE: *When removing the cylinders from the attachment arm or the interface, the cylinders may need to be retracted slightly. Do not have hands in the area of the cylinders when extending or retracting the cylinders.*

1. Lower the attachment arm to the ground and tilt the attachment interface forward **(Figure 16-5, Page 16-3)**.
2. Stop the engine, put the Forward/Reverse Handle in NEUTRAL, engage the park brake, unfasten your seat belt, and exit the vehicle.
3. Remove the retaining ring (1) and pin (2) from the attachment interface cylinder rod end, and keep the retaining ring and pin for later use in this procedure **(Figure 16-6, Page 16-3)**.
4. Remove the retaining ring (1) and the pin (2) from the attachment arm cylinder rod end **(Figure 16-7, Page 16-4)**.

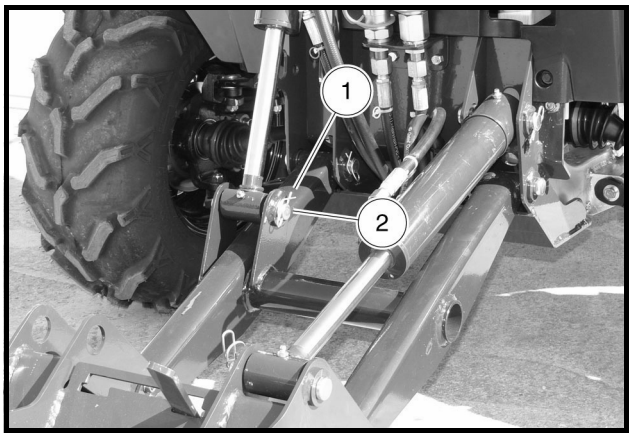


Figure 16-7 Remove Attachment Cylinder Retaining Pin

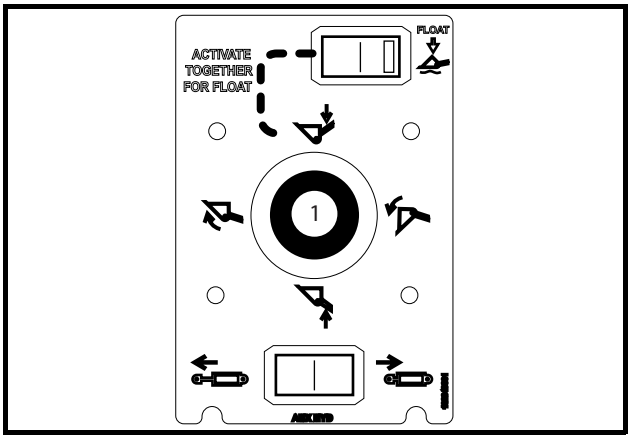


Figure 16-8 Joystick

5. Turn the start key to the ON position but DO NOT start the engine.
6. Retract the attachment arm cylinder fully by moving the joystick (1) back **(Figure 16-8, Page 16-4)**.
7. Retract the attachment interface cylinder fully by moving the joystick (1) to the left.
8. Turn the start key to the OFF position.
9. Rotate the attachment arm cylinder (1) vertically against the mount (2) **(Figure 16-9, Page 16-5)**.
10. Install the existing pin (3) and retaining ring to secure the cylinder to the mount.
11. Rotate the attachment interface cylinder (5) upward against the vehicle and snap it into place (8).
12. Install the existing pin (6) and retaining ring (7) in the locking hole on the mounting plate.
13. Remove the two retaining rings (1) and pins (2) from the attachment arms and mounting plate **(Figure 16-10, Page 16-5)**.
14. Lower the attachment arm to the ground.
15. To store, install pins (1) into the attachment arm holes (both sides) and secure with the retaining pins (2) **(Figure 16-11, Page 16-5)**.

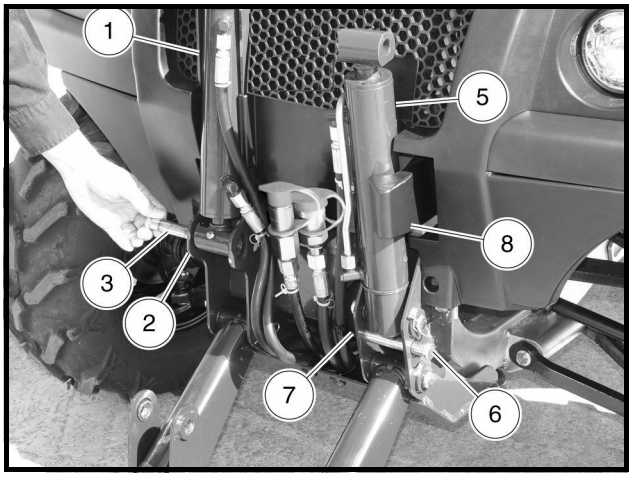


Figure 16-9 Secure Attachment and Interface Cylinders

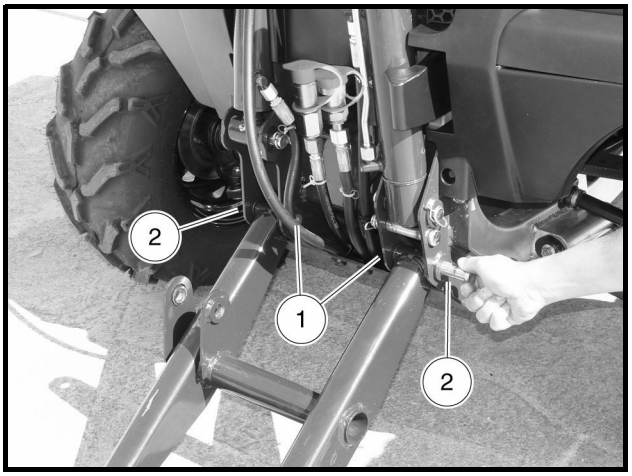


Figure 16-10 Remove Attachment Arm Retaining Pins

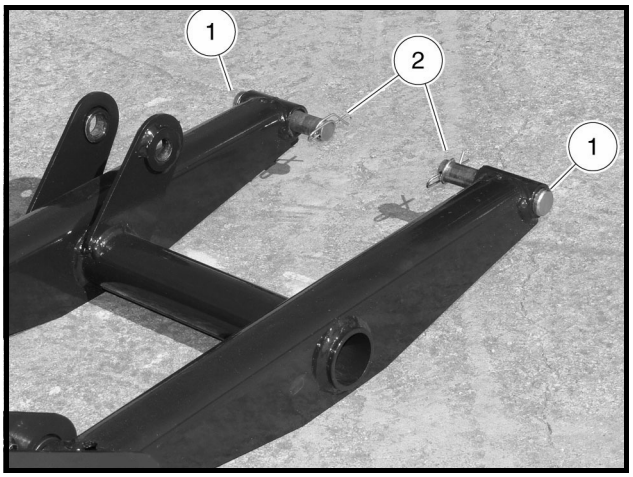


Figure 16-11 Attachment Arm Pins and Retaining Rings

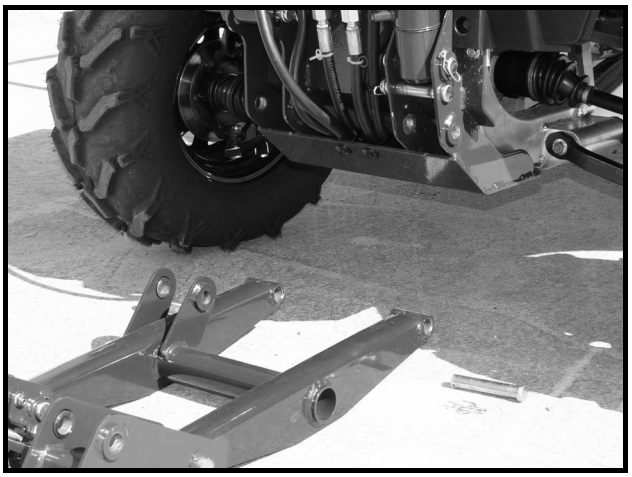


Figure 16-12 Align the Vehicle to Attachment Arms

Attachment Arm Installation

1. Align the vehicle with the attachment arms **(Figure 16-12, Page 16-5)**.
2. Stop the engine, put the Forward/Reverse Handle in NEUTRAL, engage the park brake, unfasten your seat belt, and exit the vehicle.
3. Remove the retaining rings (2) and the pins (1) from the attachment arm (both sides) **(Figure 16-13, Page 16-6)**.
4. Raise the attachment arms and align the holes in the attachment arms to the vehicle mounting holes **(Figure 16-13, Page 16-6)**.
5. Install the pins (2) and retaining rings (1) (both sides).

⚠ WARNING

- **Do not have hands in the area of the cylinders when extending or retracting the cylinders.**

6. Remove the two retaining rings (4 and 7) and pins (3 and 6) that secure the two cylinders (1 and 5) to the mount (2) **(Figure 16-14, Page 16-6)**.

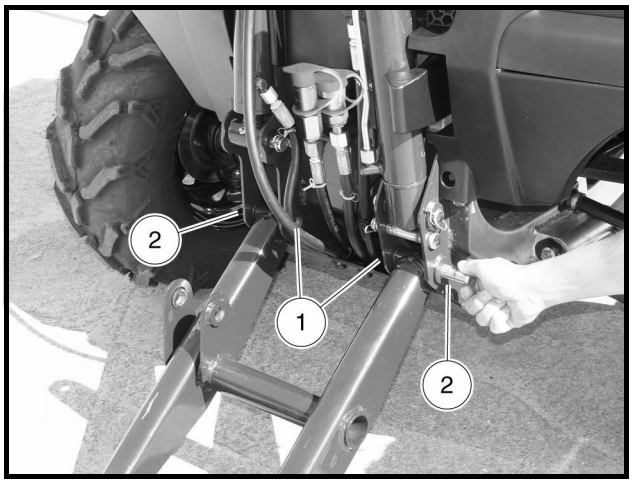


Figure 16-13 Align the Attachment Arm Holes

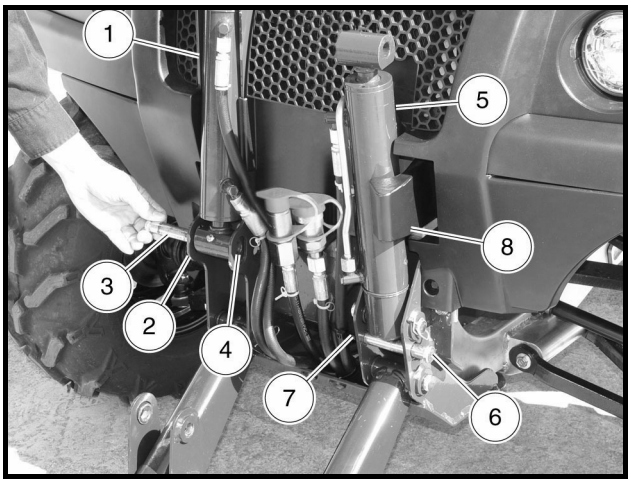


Figure 16-14 Remove Retainer Pins from Both Cylinders

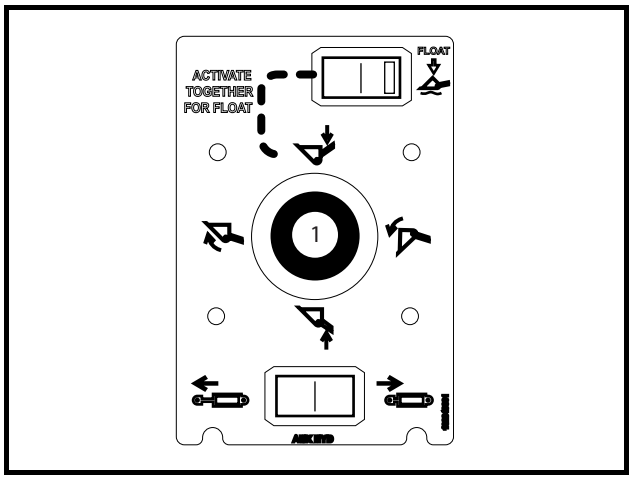


Figure 16-15 Joystick

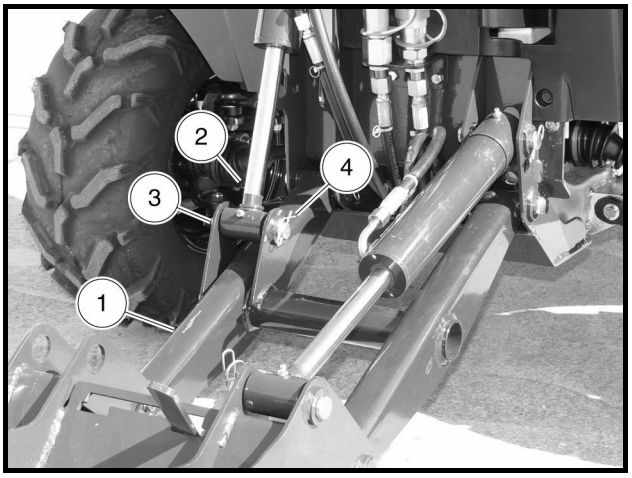


Figure 16-16 Raise Attachment Arm, Install Pin, and Retainer Ring

7. Swing the attachment interface cylinder down.
8. Turn the key to the ON position but DO NOT start the engine.
9. Move the joystick (1) forward to extend the attachment arm cylinder **(Figure 16-15, Page 16-6)**.
10. Move the joystick (1) to the right to extend the attachment interface cylinder.
11. Turn the key to the OFF position.

NOTE: *When aligning the cylinders to the attachment arm and interface during installation, the cylinders may need to be retracted slightly to relieve the hydraulic pressure. Do not have hands in the area of the cylinders when extending or retracting the cylinders.*

12. Raise the attachment arm (1) and align it with the cylinder (2). Install the pin (3) and retaining ring (4) **(Figure 16-16, Page 16-6)**.

13. Raise the attachment interface and align it with the cylinder. Install the pin (2) and the retaining ring (1) **(Figure 16-17, Page 16-7)**.

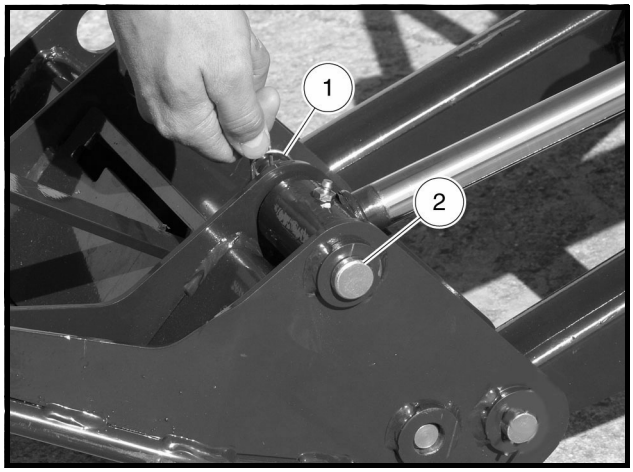


Figure 16-17 Raise Interface, Install Pin and Retainer Ring

ELECTRICAL

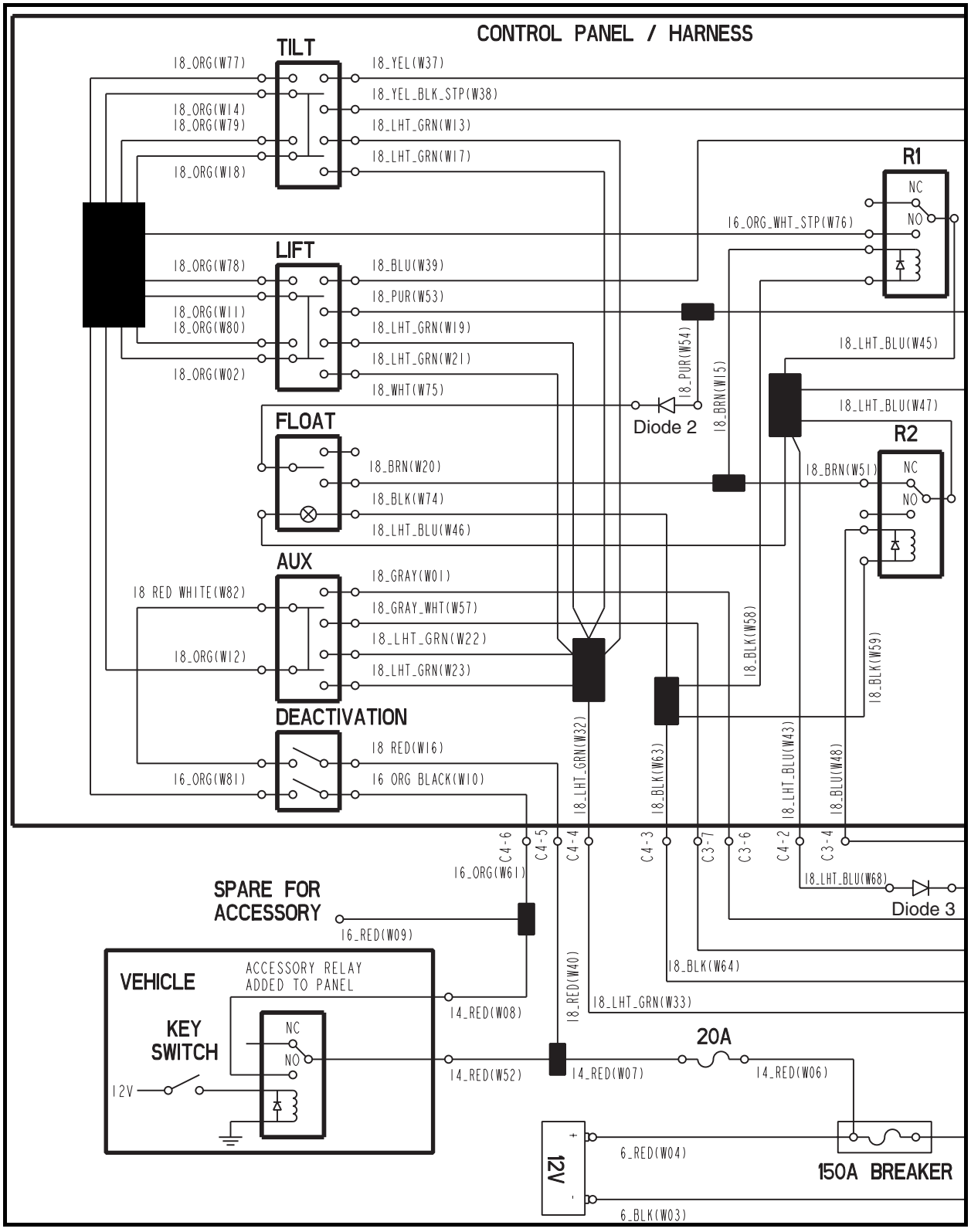


Figure 16-18 Wiring Diagram for Hydraulic Attachment System Vehicles (Front)

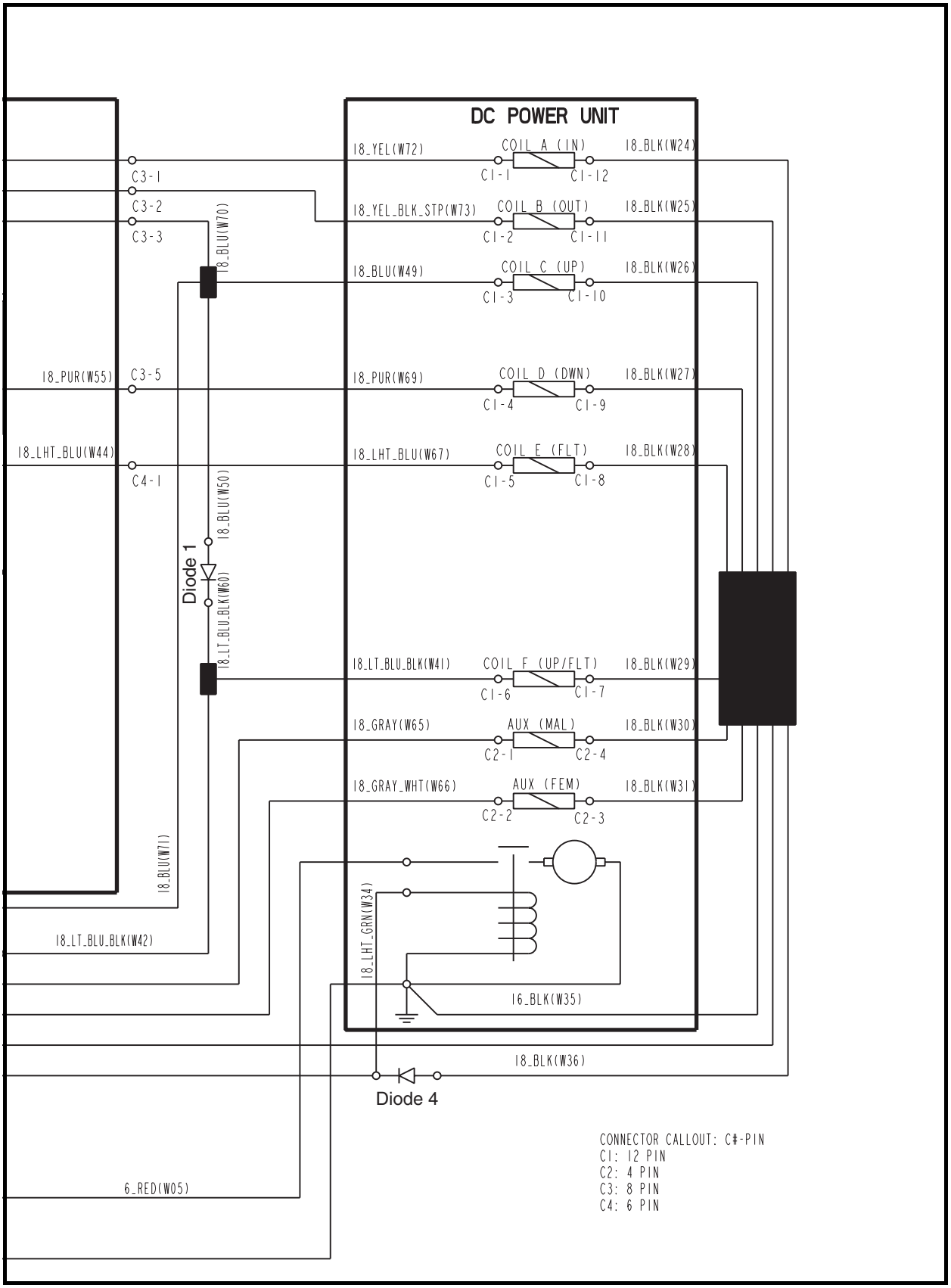


Figure 16-19 Wiring Diagram for Hydraulic Attachment System Vehicles (Rear)

JOYSTICK

See General Warning, Section 1, Page 1-1.

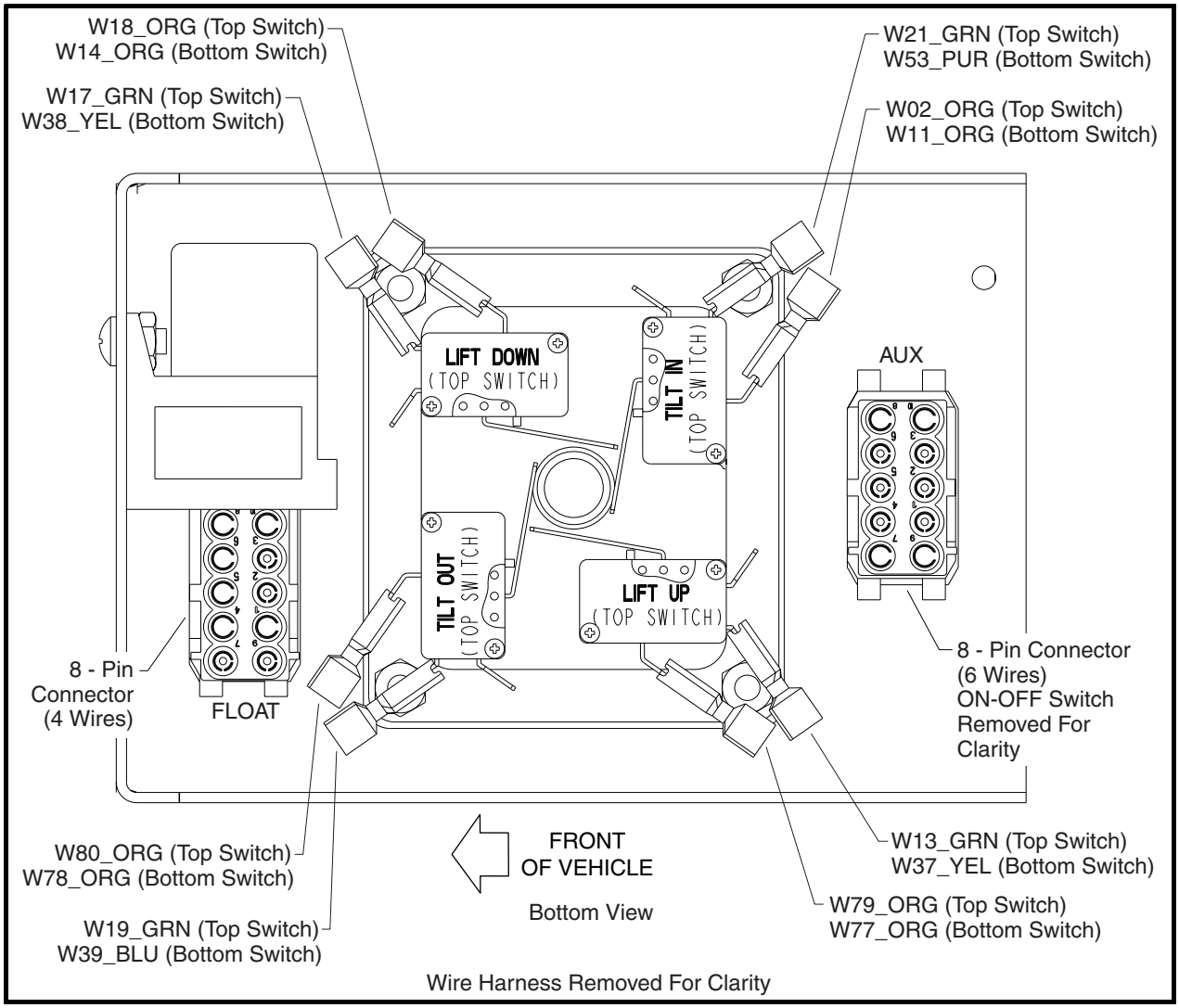


Figure 16-20 Joystick Wiring

Testing the Joystick

NOTE: *The control circuit is protected by a 20-amp fuse. Check the fuse before this procedure is performed.* ***See Test Procedure 2 – Fuse on page 11c-16.***

1. Access the underside of joystick but do not completely remove joystick or disconnect the wiring. **See Joystick Removal on page 16-11.**
2. Check each switch, between the wired terminals, for no continuity with the joystick at “rest” and continuity with the joystick acting on the switch.
3. If a switch:
   3.1. Does not work as stated in previous step, replace switch.
   3.2. Does work as stated in previous step and the joystick still does not work:

- Check the fuse.
- Check the joystick ON/OFF switch.
- Check the Accessory Relay.
- Check the control valves. **See Control Valves on page 16-21.**
- Check continuity of the wires involved.
- Check the key switch.

Joystick Removal

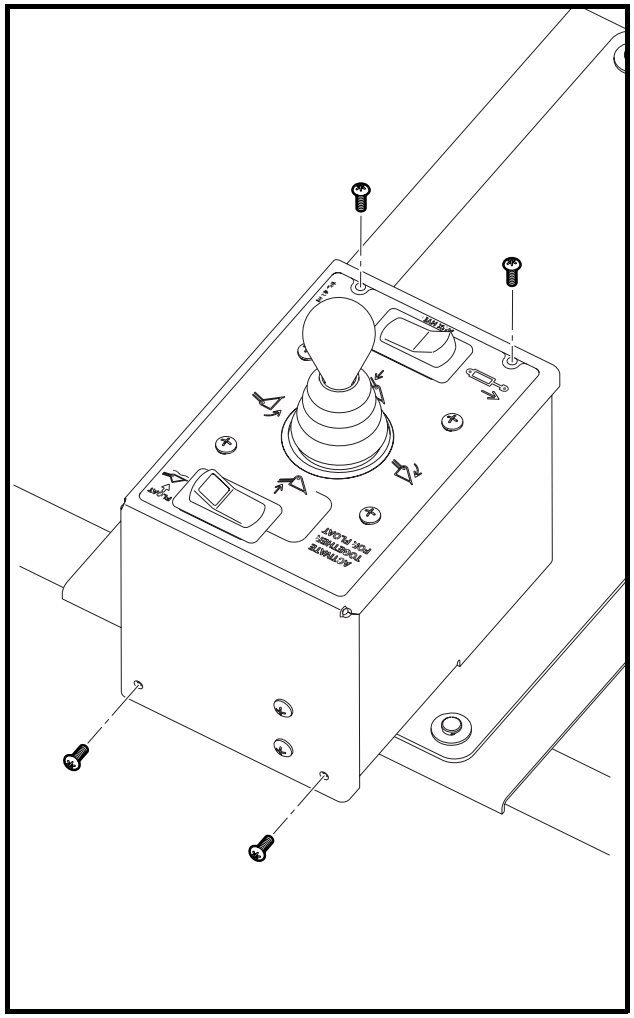


Figure 16-21 Joystick Hardware

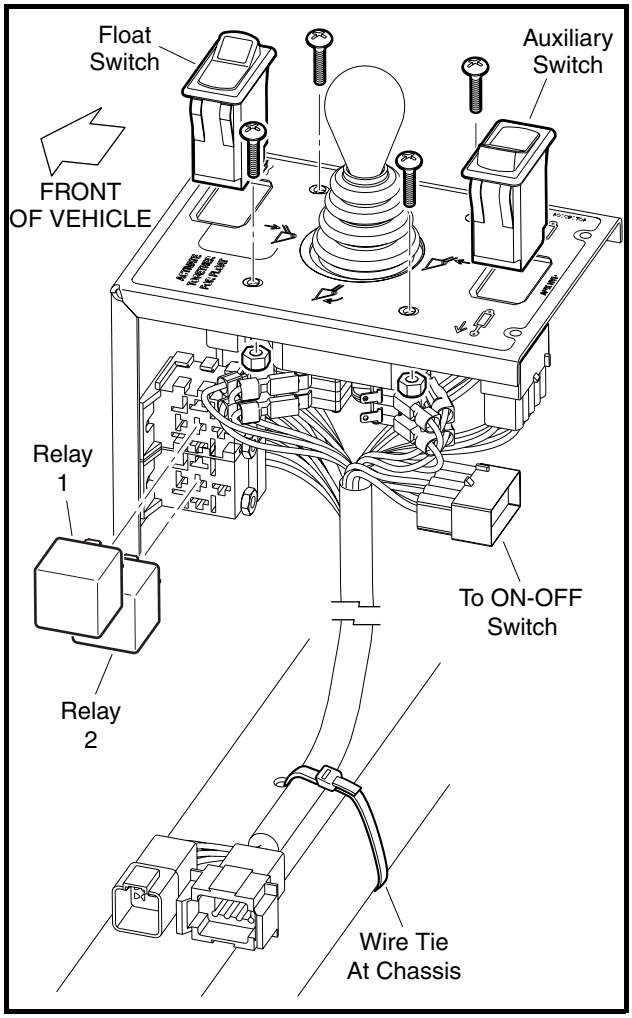


Figure 16-22 Joystick Components

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Set the joystick ON/OFF switch to OFF and remove both seats.
3. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
4. Cut the wire tie securing joystick harness to chassis **(Figure 16-22, Page 16-11)**.

5. Remove four screws securing control box cover/joystick assembly and pull assembly out enough to access the underside of joystick **(Figure 16-21, Page 16-11)**.
6. Ensure the wires are connected correctly and are tight. If they are not, rewire or tighten as necessary.
7. Unplug harness from the eight switches under joystick **(Figure 16-22, Page 16-11)**.
8. Remove four nuts and screws securing joystick to control box cover.

Joystick Installation

1. Insert joystick into control box cover and secure with the four nuts and screws previously removed. Tighten nuts to 54 in-lb (6 N·m).
2. Connect joystick harness wires to the eight switches **(Figure 16-20, Page 16-10)**.
3. Install control box cover/joystick assembly and secure with the four screws.
4. Secure joystick harness to chassis with new wire tie **(Figure 16-22, Page 16-11)**.
5. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

JOYSTICK ON/OFF SWITCH

See General Warning, Section 1, Page 1-1.

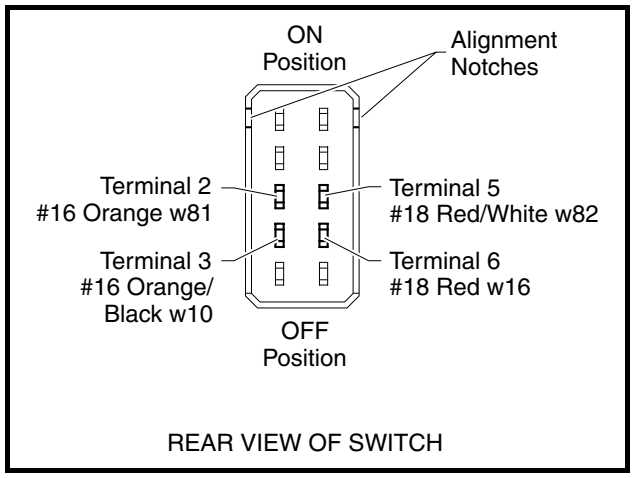


Figure 16-23 ON/OFF Switch Test

Testing the Joystick ON/OFF Switch

NOTE: *The control circuit is protected by a 20-amp fuse. Check the fuse before this procedure is performed.* ***See Test Procedure 2 – Fuse on page 11c-16.***

1. Remove the ON/OFF switch. **See Joystick ON/OFF Switch Removal on page 16-13.**
2. Check for no continuity with switch in the OFF position and continuity with switch in the ON position **(Figure 16-23, Page 16-12)**:
   2.1. Between terminal 3 (orange/black wire w10) and terminal 2 (orange wire w81)
   2.2. Between terminal 6 (red wire w16) and terminal 5 (red/white wire w82)
3. If switch does not work as stated in previous step, replace switch.
4. If switch does work as stated in previous step and the joystick still does not have power:

- Check the fuse.
- Check continuity of the 14-gauge red wire (w06) from the “hot” side of the circuit breaker to the fuse.
- Check continuity of the 14-gauge red wire (w52) from the fuse to the Accessory Relay
- Check continuity of the 18-gauge red wire (w40) from the fuse to the ON/OFF switch.
- Check continuity from the 14-gauge red wire (w08) at the Accessory Relay to the 16-gauge orange/black wire (w10) at the ON/OFF switch.
- Check continuity from the 16-gauge orange wire (w81) at the ON/OFF switch to any 18-gauge orange wire at the joystick.

Joystick ON/OFF Switch Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Set the joystick ON/OFF switch to OFF and remove both seats.
3. Disconnect the battery cables as instructed. **See WARNING “To avoid unintentionally starting...” in General Warning, Section 1, Page 1-1.**
4. Cut the wire tie securing joystick harness to chassis **(Figure 16-22, Page 16-11)**.
5. Access the joystick ON/OFF switch. **See Joystick Removal on page 16-11.**
6. Ensure the wires are connected correctly and are tight. If they are not, rewire or tighten as necessary.
7. Unplug harness from switch **(Figure 16-22, Page 16-11)**. Squeeze tabs at each end of switch and push switch out the back of the control box.

Joystick ON/OFF Switch Installation

1. Insert switch into control box until fully seated.
2. Connect harness plug to switch.
3. Install control box cover/joystick assembly and secure with the four screws.
4. Secure joystick harness to chassis with new wire tie **(Figure 16-22, Page 16-11)**.
5. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

ATTACHMENT ARM FLOAT SWITCH

See General Warning, Section 1, Page 1-1.

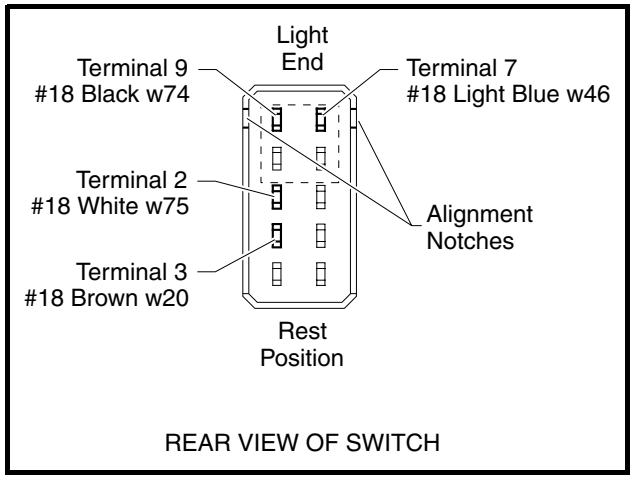


Figure 16-24 Float Switch Test

Testing the Float Switch

NOTE: *The control circuit is protected by a 20-amp fuse. Check the fuse before this procedure is performed.* ***See Test Procedure 2 – Fuse on page 11c-16.***

1. Remove the float switch. **See Float Switch Removal on page 16-15.**
2. Check the following location for no continuity with switch at “rest” and continuity with switch in the ON position **(Figure 16-24, Page 16-14)**:
   - between terminal 2 (white wire w75) and terminal 3 (brown wire w20)
3. Check switch light.
   - 3.1. Without inserting switch into control box cover, reconnect switch to harness.
   - 3.2. Remove light green wire (w34) from motor solenoid and cover its ring terminal to prevent a short.
   - 3.3. Reconnect the battery cables, positive (+) cable first, and turn the key switch ON.
   - 3.4. Switch the joystick ON/OFF switch to ON.
   - 3.5. Push joystick forward (lower attachment) and, at the same time, press the float switch and then release both. The relay and control valve should click and the float switch light should come ON. It should remain ON until the joystick is pulled to the rear (lift attachment) position.
4. If switch does not work as stated in step 3, replace switch.
5. If switch does work as stated in step 3 and the auxiliary hydraulic feature still does not work, check the following items:
   - Fuse.
   - Float and accessory relays.
   - Joystick switches.
   - Control valves. **See Control Valves on page 16-21.**
   - Continuity of the wires involved.

Float Switch Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Set the joystick ON/OFF switch to OFF and remove both seats.
3. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
4. Cut the wire tie securing joystick harness to chassis **(Figure 16-22, Page 16-11)**.
5. Access the float switch. **See Joystick Removal on page 16-11.**
6. Ensure the wires are connected correctly and are tight. If they are not, rewire or tighten as necessary.
7. Unplug harness from switch **(Figure 16-22, Page 16-11)**. Squeeze tabs at each end of switch and push switch out the top of the control box cover.

Float Switch Installation

1. With switch light oriented to the passenger side, insert switch into control box cover until fully seated.
2. Connect harness plug to switch.
3. Install control box cover/joystick assembly and secure with the four screws.
4. Secure joystick harness to chassis with new wire tie **(Figure 16-22, Page 16-11)**.
5. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

AUXILIARY HYDRAULIC SWITCH

See General Warning, Section 1, Page 1-1.

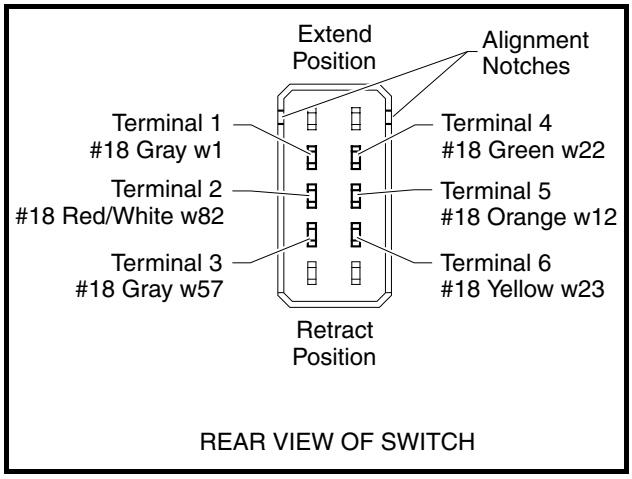


Figure 16-25 Auxiliary Hydraulic Switch Test

Testing the Auxiliary Switch

NOTE: *The control circuit is protected by a 20-amp fuse. Check the fuse before this procedure is performed.* ***See Test Procedure 2 – Fuse on page 11c-16.***

1. Remove the auxiliary hydraulic switch. **See Auxiliary Switch Removal on page 16-16.**

2. Check the following locations for no continuity with switch in the “rest” position and continuity with switch in either the “extend” or “retract” position **(Figure 16-25, Page 16-15)**:
   - Between terminal 5 (orange wire w12) and terminals 4 and 6 (light green wires w22 and 23)
   - Between terminal 2 (red/white wire w82) and terminal 1 (gray wire w01)
   - Between terminal 2 (red/white wire w82) and terminal 3 (gray/white wire w57)
3. If switch does not work as stated in previous step, replace switch. **See Auxiliary Switch Removal on page 16-16.**
4. If switch does work as stated in step 2 and the auxiliary hydraulic feature still does not work, check the following items:
   - Fuse.
   - Joystick ON/OFF switch.
   - Joystick switches.
   - Auxiliary control valves. **See Control Valves on page 16-21.**
   - Continuity of the wires involved.

Auxiliary Switch Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Set the joystick ON/OFF switch to OFF and remove both seats.
3. Disconnect the battery cables as instructed. **See WARNING “To avoid unintentionally starting...” in General Warning, Section 1, Page 1-1.**
4. Cut the wire tie securing joystick harness to chassis **(Figure 16-22, Page 16-11)**.
5. Remove four screws securing control box cover/joystick assembly and pull assembly out enough to access the switch. **See Joystick Removal on page 16-11.**
6. Ensure the wires are connected correctly and are tight. If they are not, rewire or tighten as necessary.
7. Unplug harness from switch **(Figure 16-22, Page 16-11)**. Note orientation of alignment notches **(Figure 16-25, Page 16-15)**. Squeeze tabs at each end of switch and push switch out the top of the control box cover.

Auxiliary Switch Installation

1. Orient alignment notches and insert switch into control box cover until fully seated **(Figure 16-25, Page 16-15)**.
2. Connect harness plug to switch.
3. Install control box cover/joystick assembly and secure with the four screws.
4. Secure joystick harness to chassis with new wire tie **(Figure 16-22, Page 16-11)**.
5. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

RELAYS

See General Warning, Section 1, Page 1-1.

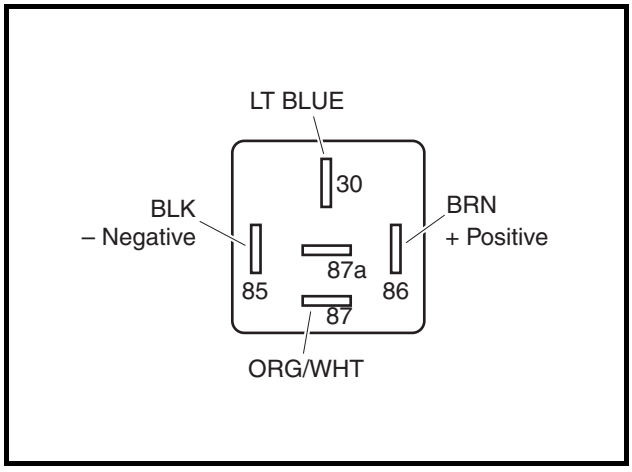


Figure 16-26 Relay 1 Wiring and Testing

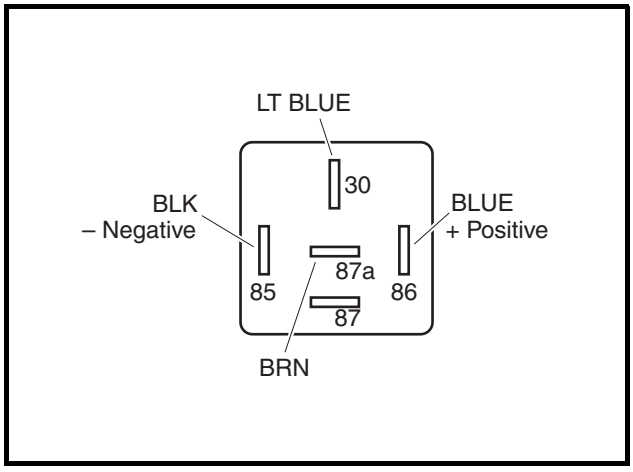


Figure 16-27 Relay 2 Wiring and Testing

Testing Float Relay 1

1. Test for continuity between terminal 85 (black wire) and terminal 86 (brown wire) **(Figure 16-26, Page 16-17)**.
2. Test for no continuity between terminal 87 (orange/white wire) and terminal 30 (light blue wire) **(Figure 16-26, Page 16-17)**.
3. Apply 12 volts with the positive lead connected to terminal 86 and the negative lead connected to terminal 85. The relay should click and show continuity between terminal 87 (orange/white wire) and terminal 30 (light blue wire).

Testing Float Relay 2

1. Test for continuity between terminal 85 (black wire) and terminal 86 (blue wire) **(Figure 16-27, Page 16-17)**.
2. Test for continuity between terminal 87a (brown wire) and terminal 30 (light blue wire) **(Figure 16-27, Page 16-17)**.
3. Apply 12 volts with the positive lead connected to terminal 86 and the negative lead connected to terminal 85. The relay should click and show no continuity between terminal 87a (brown wire) and terminal 30 (light blue wire).

Float Relay 1 and 2 Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Set the joystick ON/OFF switch to OFF.
3. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
4. Remove four screws securing control box cover/joystick assembly and pull assembly out enough to access the relays. **See Joystick Removal on page 16-11.**
5. Ensure the wires are connected correctly and are tight. If they are not, rewire or tighten as necessary.

6. Locate and pull or pry the relay out of the multi-pin connector to remove **(Figure 16-22, Page 16-11)**.

Float Relay 1 and 2 Installation

1. Insert the relay into the multi-pin connector. **See following NOTE.**

NOTE: *The relay contacts are keyed to ensure that the relay can only be installed in the correct orientation. If the relay is not easy to insert, rotate the relay until the correct contact orientation is obtained.*

2. Install control box cover/joystick assembly and secure with the four screws.
3. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).

Testing the Accessory Relay

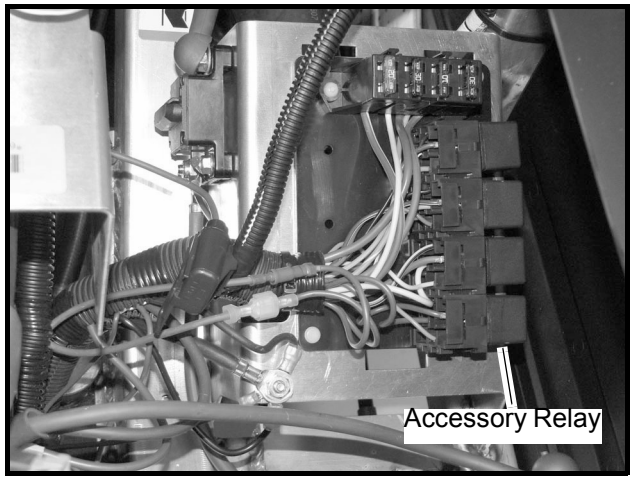


Figure 16-28 Accessory Relay Location

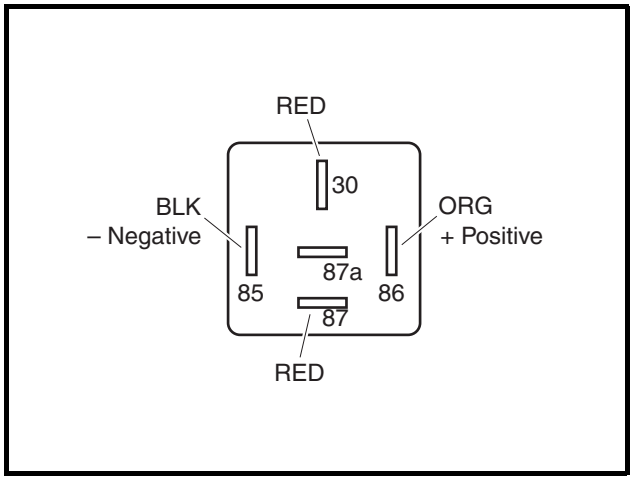


Figure 16-29 Accessory Relay Wiring and Testing

1. Test for continuity between terminal 85 (black wire) and terminal 86 (orange wire) **(Figure 16-29, Page 16-18)**.
2. Test for no continuity between terminals 87 and 30 (red wires) **(Figure 16-29, Page 16-18)**.
3. Apply 12 volts with the positive lead connected to terminal 86 and the negative lead connected to terminal 85. The relay should click and show continuity between terminals 87 and 30 (red wires).

Accessory Relay Removal

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Remove driver seat.
3. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
4. Remove the electrical component cover.
5. Ensure the wires are connected correctly and are tight. If they are not, rewire or tighten as necessary.
6. Locate and pull or pry the accessory relay out of the multi-pin connector to remove **(Figure 16-28, Page 16-18)**.

Accessory Relay Installation

1. Insert the relay into the multi-pin connector. **See following NOTE.**

NOTE: *The relay contacts are keyed to ensure that the relay can only be installed in the correct orientation. If the relay is not easy to insert, rotate the relay until the correct contact orientation is obtained.*

2. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
3. Install the electrical component cover and driver seat.

SOLENOID

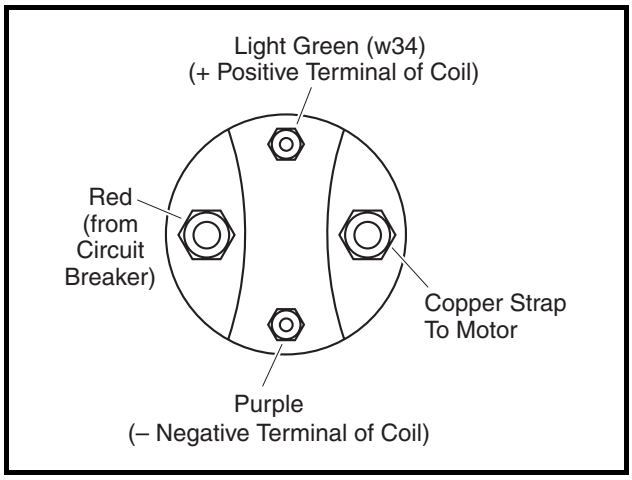


Figure 16-30 Solenoid Wiring and Testing

Testing the Solenoid

1. Test for continuity between the two small coil terminals (light green wire and purple wire) **(Figure 16-30, Page 16-19)**.
2. Test for no continuity between the two large terminals (red wire and copper strap) **(Figure 16-30, Page 16-19)**.
3. Apply 12 volts with the positive lead connected to the positive coil terminal and the negative lead connected to the negative coil terminal. The solenoid should click and show continuity between the two large terminals.

Solenoid Removal

1. Empty and raise cargo bed.
2. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
3. Set the joystick ON/OFF switch to OFF.
4. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
5. Note wiring and disconnect wires and copper strap from solenoid.
6. Remove screws securing solenoid to motor and remove solenoid.

Solenoid Installation

1. Attach solenoid to motor with screws.
2. Connect wires and copper strap to solenoid. Tighten hardware on the small terminals to 10 in-lb (1.1 N·m) and 21 in-lb (2.4 N·m) on the large terminals.
3. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
4. Lower the cargo bed.

CIRCUIT BREAKER

Testing the Circuit Breaker

1. Check for continuity between each post.
2. If there is no continuity, press the reset button and check again for continuity.
3. If there is still no continuity, replace the breaker.

Circuit Breaker Removal

1. Empty and raise cargo bed.
2. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
3. Set the joystick ON/OFF switch to OFF.
4. Disconnect the battery cables as instructed. **See WARNING “To avoid unintentionally starting...” in General Warning, Section 1, Page 1-1.**
5. Disconnect wires from each post of circuit breaker.
6. Remove hardware securing breaker to chassis and remove breaker.

Circuit Breaker Installation

1. Attach breaker to chassis with screws and tighten to 75 in-lb (8.5 N·m).
2. Connect wires to breaker. Tighten nuts to 75 in-lb (8.5 N·m).
3. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
4. Lower the cargo bed.

CONTROL VALVES

Two-Way 2-Position Normally Closed Valves

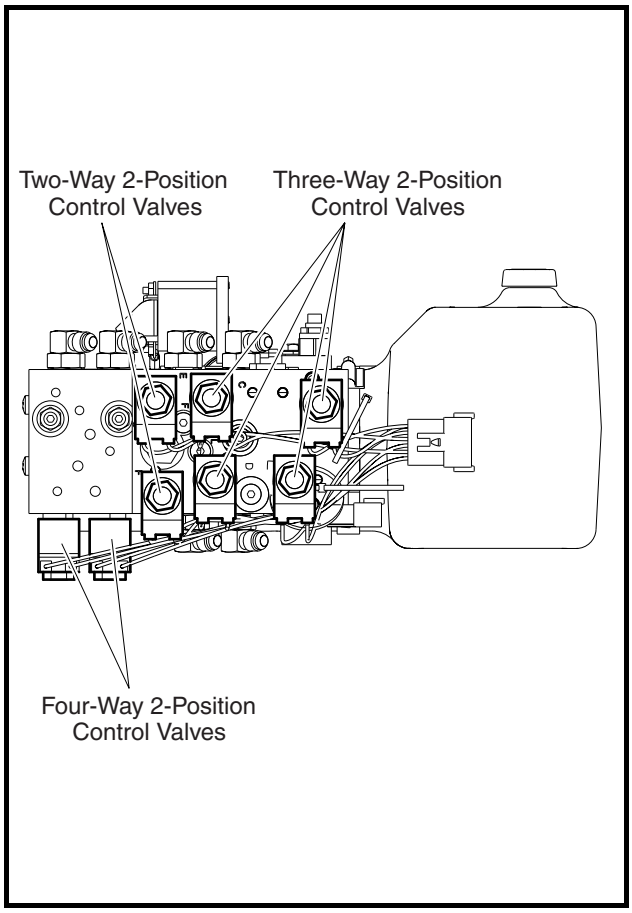


Figure 16-31 Control Valve Identification

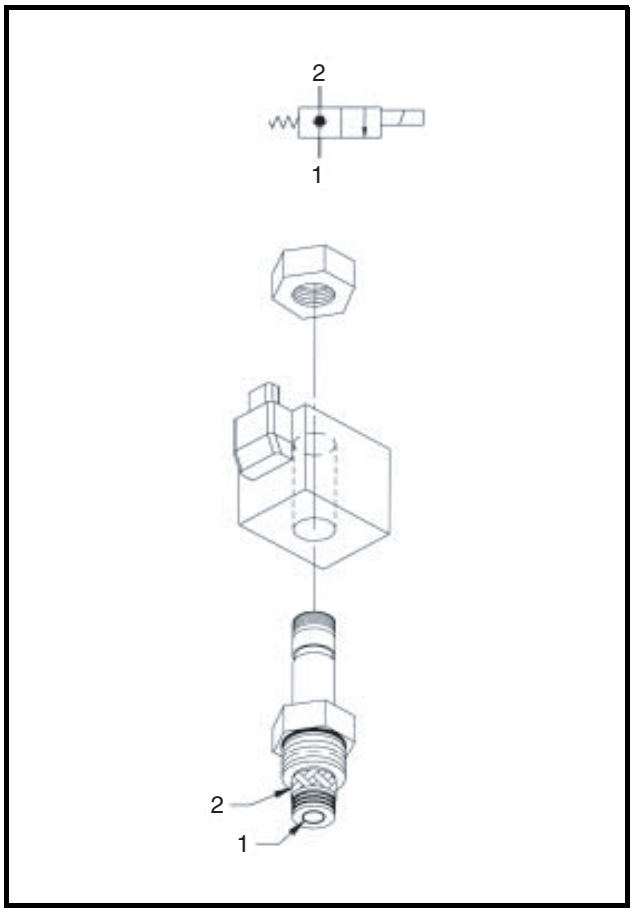


Figure 16-32 Two-Way 2-Position Valve and Coil

These valves allow for free flow in one direction (from the bottom port to the side ports) at all times and controlled flow in the opposite direction until the solenoid coil is energized **(Figure 16-32, Page 16-21)**.

Troubleshoot and repair these valves as follows:

1. If the valve does not shift, check and repair (if necessary) the following items:
   - The valve “hot” wire and ground wire **(Figure 16-19, Page 16-9)**.
   - The switch controlling the valve. **See Electrical on page 16-8.**
   - The supplied voltage.
   - The continuity of the control valve coil.
   - A bent valve stem. Replace valve.
   - Any debris in the valve cartridge.
     - Check for debris by energizing the valve without starting the motor and listening for the valve to shift (a definite “Click” is heard when the valve in energized).
     - If the valve does not shift, remove the cartridge from the valve body.
     - Blow compressed air through the cartridge in both directions while holding the plunger off its seat.

Use a blunt object inserted through bottom of cartridge to move plunger. It will help to have the “body” filter removed. **See following NOTE.**

NOTE: *The cartridge itself cannot be disassembled in the field as the proper tolerances cannot be duplicated. If the dirt cannot be removed the cartridge will have to be replaced.*

2. If the valve does not return to the neutral or unshifted position, check for either dirt in the valve cartridge or a bent stem.

Three-Way 2-Position and Four-Way 2-Position Valves

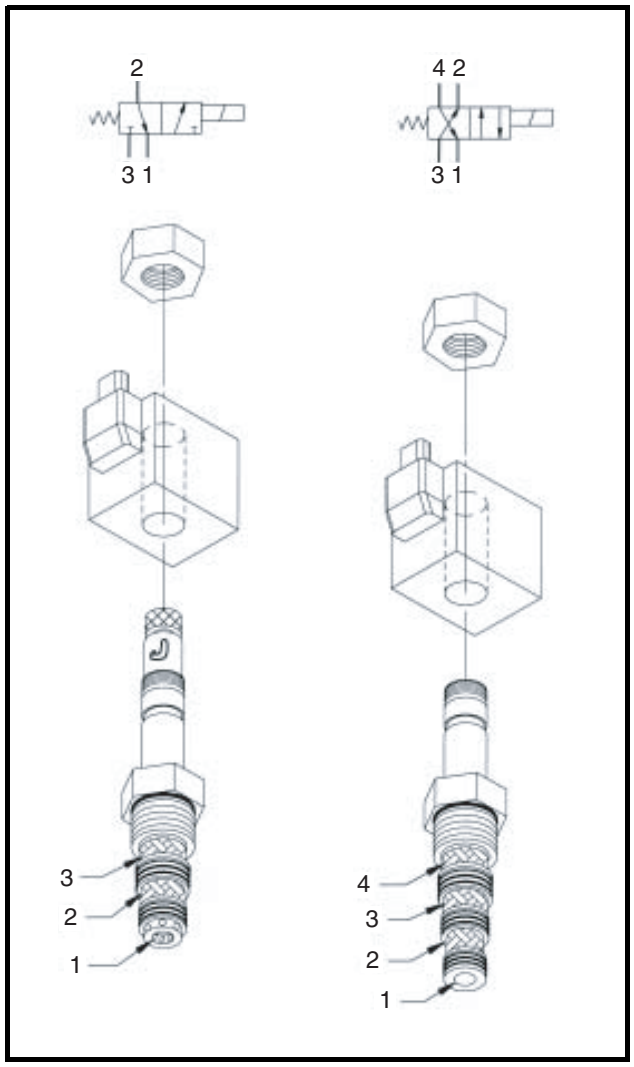


Figure 16-33 Three-Way 2-Position and Four-Way 2-Position Valve and Coil

Troubleshoot and repair these valves as follows **(Figure 16-33, Page 16-22)**:

1. If the valve does not shift, check and repair (if necessary) the following items:
   - The valve “hot” wire and ground wire **(Figure 16-19, Page 16-9)**.
   - The switch controlling the valves. **See Electrical on page 16-8.**

- The supplied voltage.
- The continuity of the control valve coil.
- Any debris in the valve cartridge.
  - Check for debris by energizing the valve without starting the motor and listening for the “valve shift” (a definite “Click” is heard when the valve in energized).
  - If it cannot be heard, remove the cartridge from the valve body and blow compressed air through all parts to dislodge dirt. Clean all parts in solvent, blow dry, and lubricate.

2. If the valve does not return to the neutral or unshifted position, check for dirt in the valve cartridge and repair as described above.

HOSES

HOSE ROUTING

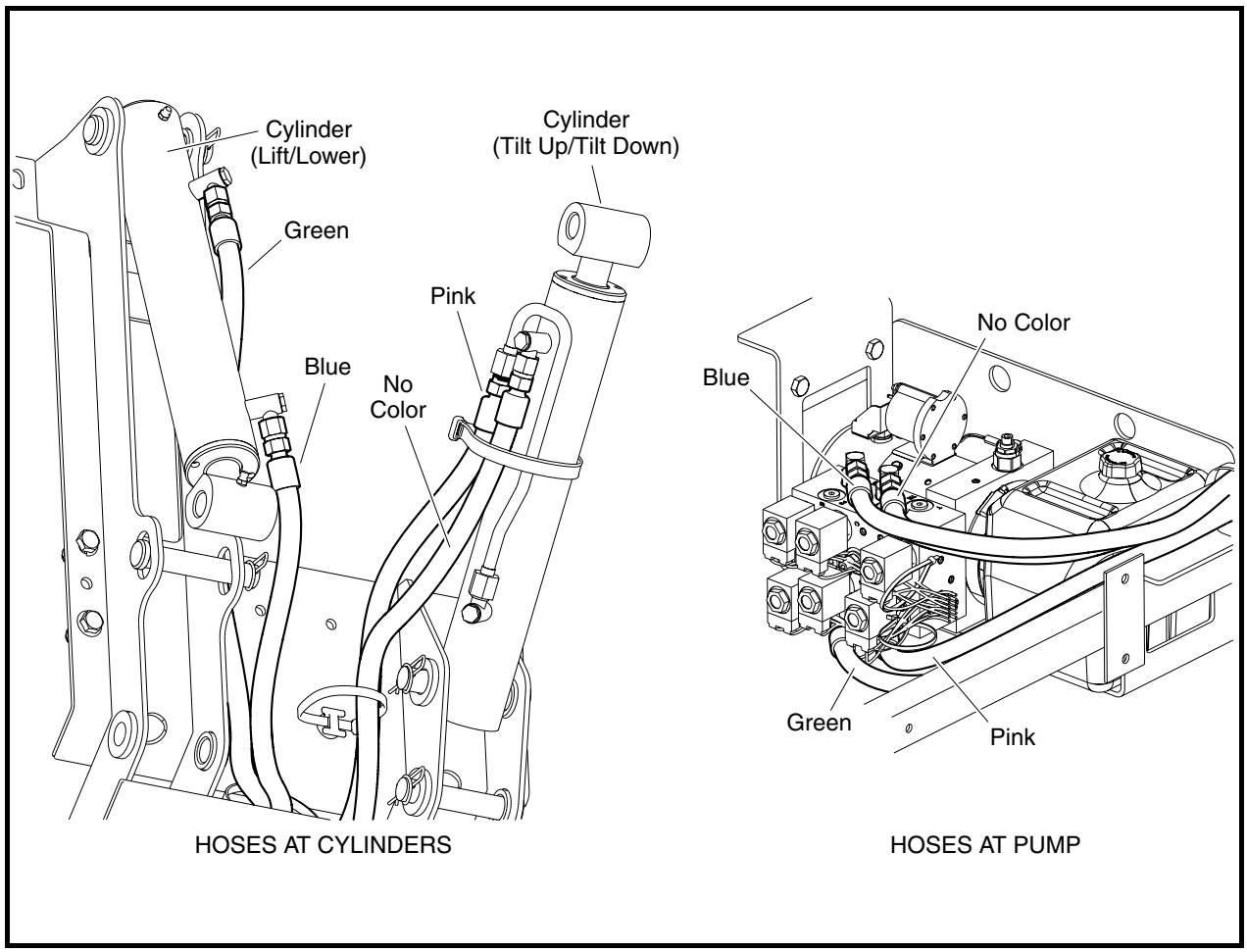


Figure 16-34 Lift And Tilt Circuit Hoses

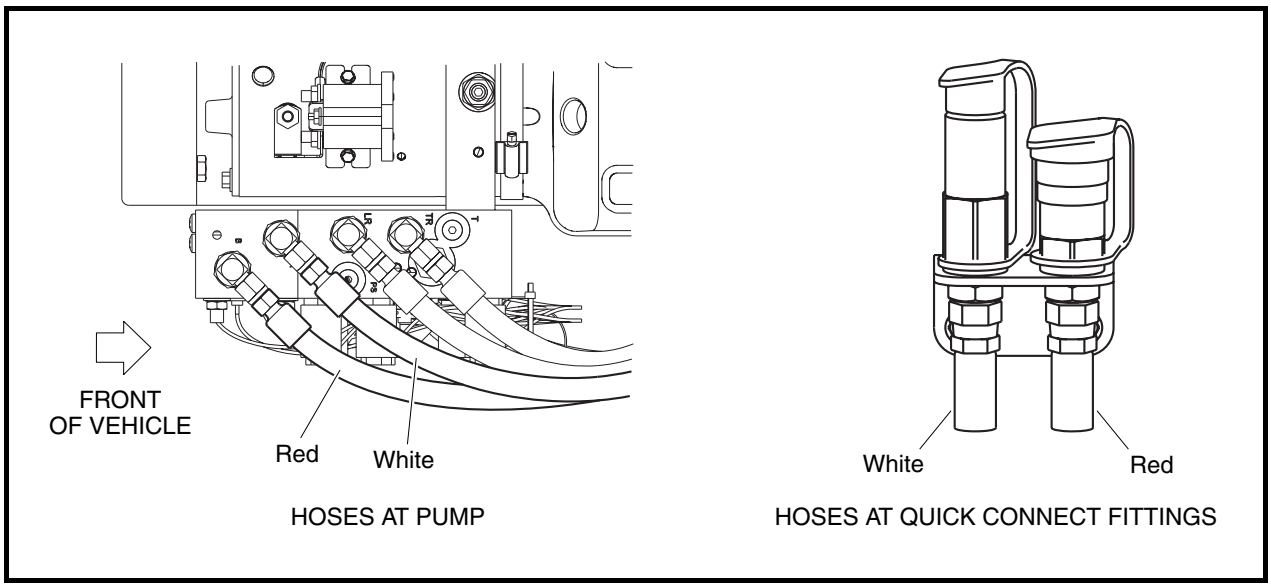


Figure 16-35 Auxiliary Circuit Hoses

HOSE REMOVAL

1. Relieve pressure in hydraulic system. **See Relieving Hydraulic System Pressure on page 16-1.**
2. Turn the key switch OFF and remove the key.
3. Set the joystick ON/OFF switch to OFF, remove driver seat and disable vehicle.
4. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
5. Thoroughly clean the hose fittings and the area around the ends of the hose being removed **(Figure 16-34, Page 16-23)**.
6. If removing more than one hose at a time, locate and note the hose factory color marking to ease reassembly. **See following NOTE.**

NOTE: *Mark hoses for correct installation if factory markings are not found.*

7. Disconnect hose at each end. Cover hose ends and fittings to keep out debris. **See following NOTE.**

NOTE: *Contain and dispose of any leaking oil in an environmentally safe manner.*

8. Cut wire ties securing hose to chassis and remove hose from vehicle.

HOSE INSTALLATION

1. Reverse the removal procedure to install hose(s).
   1.1. Make sure to match factory color marking to correct fitting **(Figure 16-34, Page 16-23)**.
   1.2. Secure with wire ties at all factory established locations.
   1.3. Tighten hose fittings to 22 ft-lb (30 N·m).

QUICK CONNECT FITTINGS (AUXILIARY HYDRAULIC CIRCUIT ONLY)

Figure 16-36 Quick Connect Fitting Removal

QUICK CONNECT REMOVAL

1. Relieve pressure in hydraulic system. **See Relieving Hydraulic System Pressure on page 16-1.**
2. Turn the key switch OFF and remove the key.
3. Set the joystick ON/OFF switch to OFF, remove driver seat and disable vehicle.
4. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
5. Thoroughly clean the fittings and the area around them.
6. Mark hoses to ease reassembly and disconnect hoses from quick connect fittings. **See following NOTE.** Cover hoses and fittings to keep out debris.

NOTE: *Mark hoses for correct installation if factory markings are not found.*

7. Remove the lock nut securing the quick connect fitting to the bracket **(Figure 16-36, Page 16-25)**.

QUICK CONNECT INSTALLATION

1. Reverse the removal procedure to install quick connect fittings. Tighten jam nuts to 30 ft-lb (41 N·m).
2. Match hose to fitting and connect hoses **(Figure 16-35, Page 16-24)**. Tighten fittings to 22 ft-lb (30 N·m).

CYLINDERS

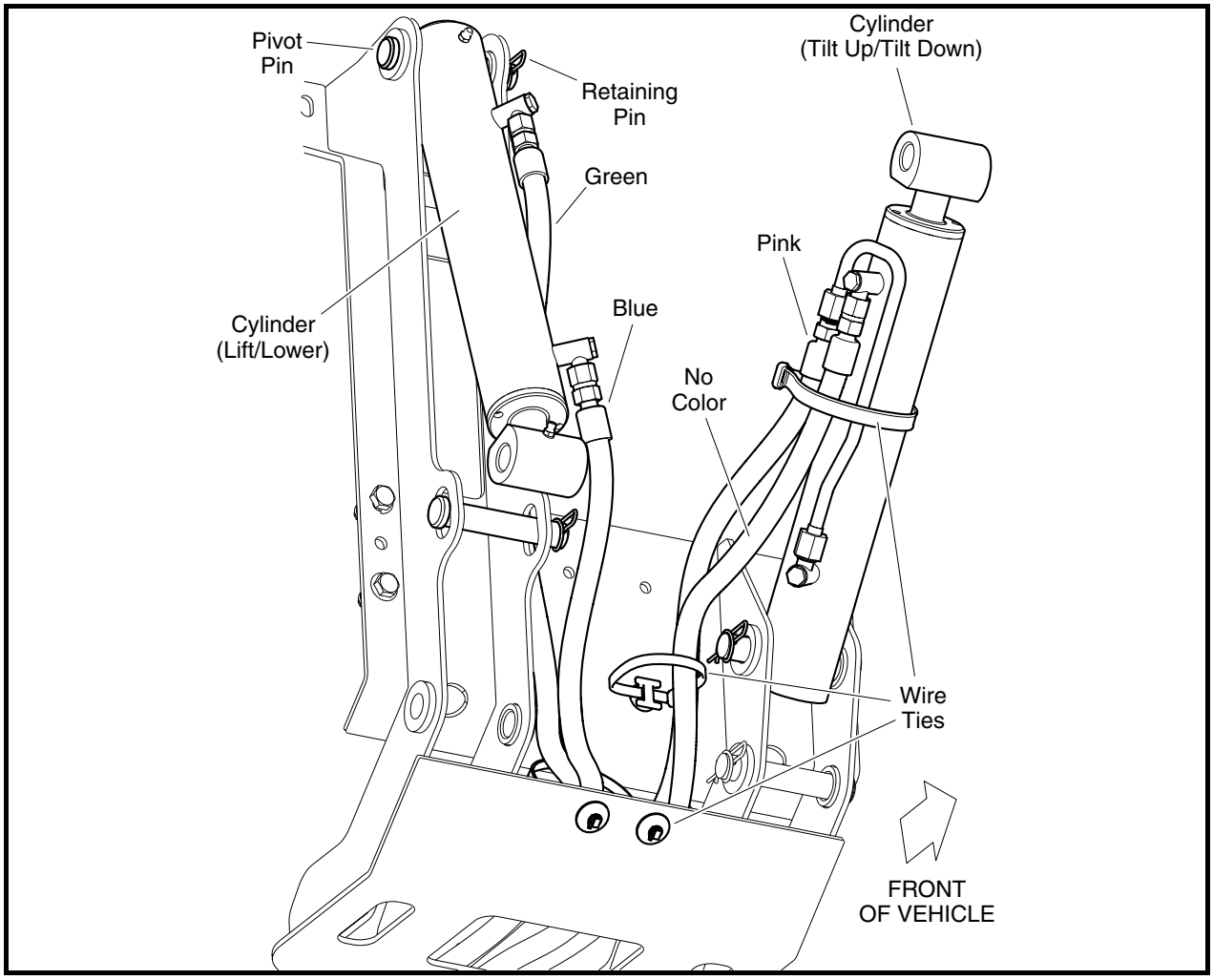


Figure 16-37 Cylinders and Hoses

VEHICLE MOUNTED CYLINDERS

Vehicle Mounted Cylinder Removal

1. Relieve pressure in hydraulic system. **See Relieving Hydraulic System Pressure on page 16-1.**
2. Turn the key switch OFF and remove the key.
3. Set the joystick ON/OFF switch to OFF, remove driver seat and disable vehicle.
4. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
5. Thoroughly clean the cylinder, hose fittings and the area around them **(Figure 16-37, Page 16-26)**.
6. Mark hoses to ease reassembly and disconnect hoses from cylinders. Cover hoses and fittings to keep out debris.
7. Remove retaining pin(s) and pivot pin(s) securing cylinder to chassis and remove cylinder **(Figure 16-37, Page 16-26)**.

Vehicle Mounted Cylinder Installation

1. If installing a used cylinder, clean inside the attachment ends first. Otherwise, orient cylinder, align attachment ends and secure with pivot pin(s) and retaining pin(s).
2. Match and connect hoses to fittings **(Figure 16-37, Page 16-26)**. Tighten fittings to 22 ft-lb (30 N·m).
3. Lubricate attachment ends. **See Lubricating The Attachment Arm And Interface, Section 10a, Page 10a-6.**
4. Refill and prime system. **See Priming the Pump, Section 16, Page 16-49.**

AUXILIARY CYLINDER (OPTIONAL)

Auxiliary Cylinder Removal

⚠ WARNING

- **Wear safety glasses to prevent eye injury when any of the following conditions exist:**
  - **Fluids are under pressure.**
  - **Flying debris or loose material is present.**
  - **Engine is running.**
  - **Tools are being used.**

CAUTION

- **When repairing hydraulic systems, clean the work area before disassembly and keep all parts clean. Always use caps and plugs on hoses, tubelines and ports to keep dirt out. Dirt can quickly damage the system.**

NOTE: *Contain and dispose of any leaking oil in an environmentally safe manner.*

The following pictures may not show your exact attachment but the procedure is the same.

1. Remove hydraulic hoses (items 1 & 2) **(Figure 16-38, Page 16-27)**. **See following NOTE.**

NOTE: *Mark hoses for correct installation if factory markings are not found.*

2. Remove retaining pin (1) and pivot pin (2) from rod end of hydraulic cylinder **(Figure 16-39, Page 16-27)**.

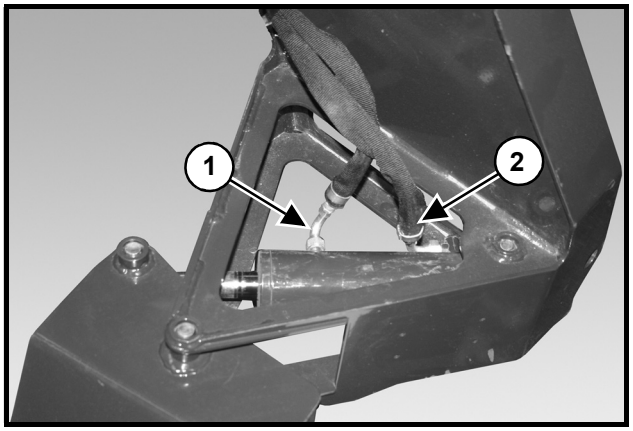


Figure 16-38 Hoses

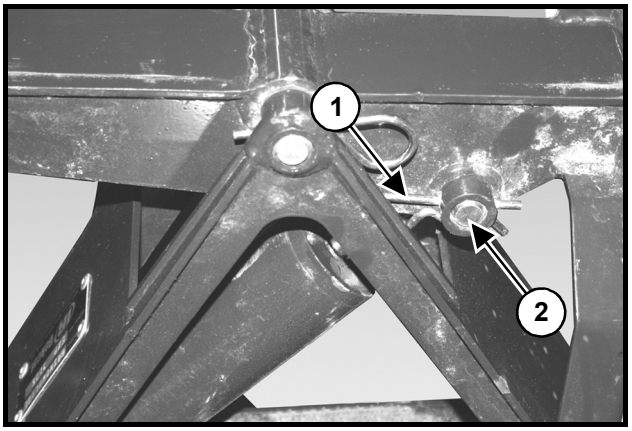


Figure 16-39 Remove Rod End Pins

3. Remove retaining pin (1) from the base end of the hydraulic cylinder **(Figure 16-40, Page 16-28)**.
4. Remove pivot pin (2) **(Figure 16-41, Page 16-28)** from the base end of the hydraulic cylinder and remove cylinder.

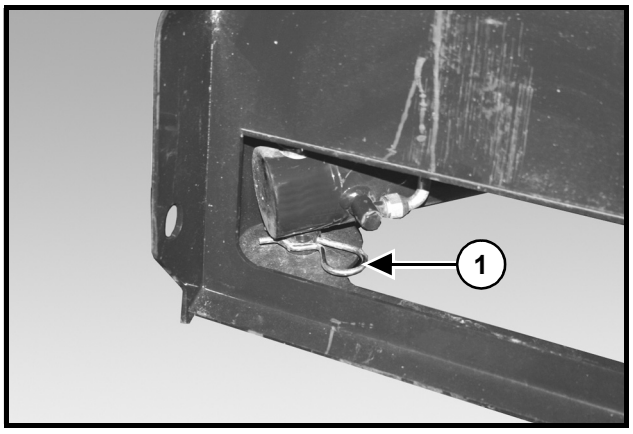


Figure 16-40 Remove Retaining Pin

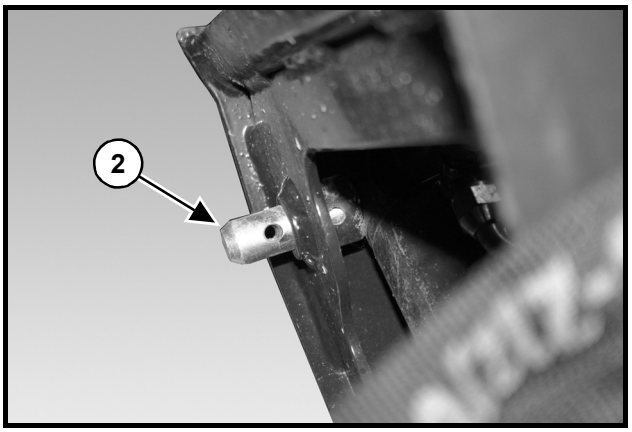


Figure 16-41 Remove Pivot Pin

Auxiliary Cylinder Installation

1. Reverse the removal procedure to install the auxiliary hydraulic cylinder in the attachment.
2. Install the retaining pin (1) as shown **(Figure 16-39, Page 16-27)**. **See following NOTE.**

NOTE: *If installed wrong, this retaining pin will restrict attachment travel.*

CYLINDER DISASSEMBLY

Parts Identification

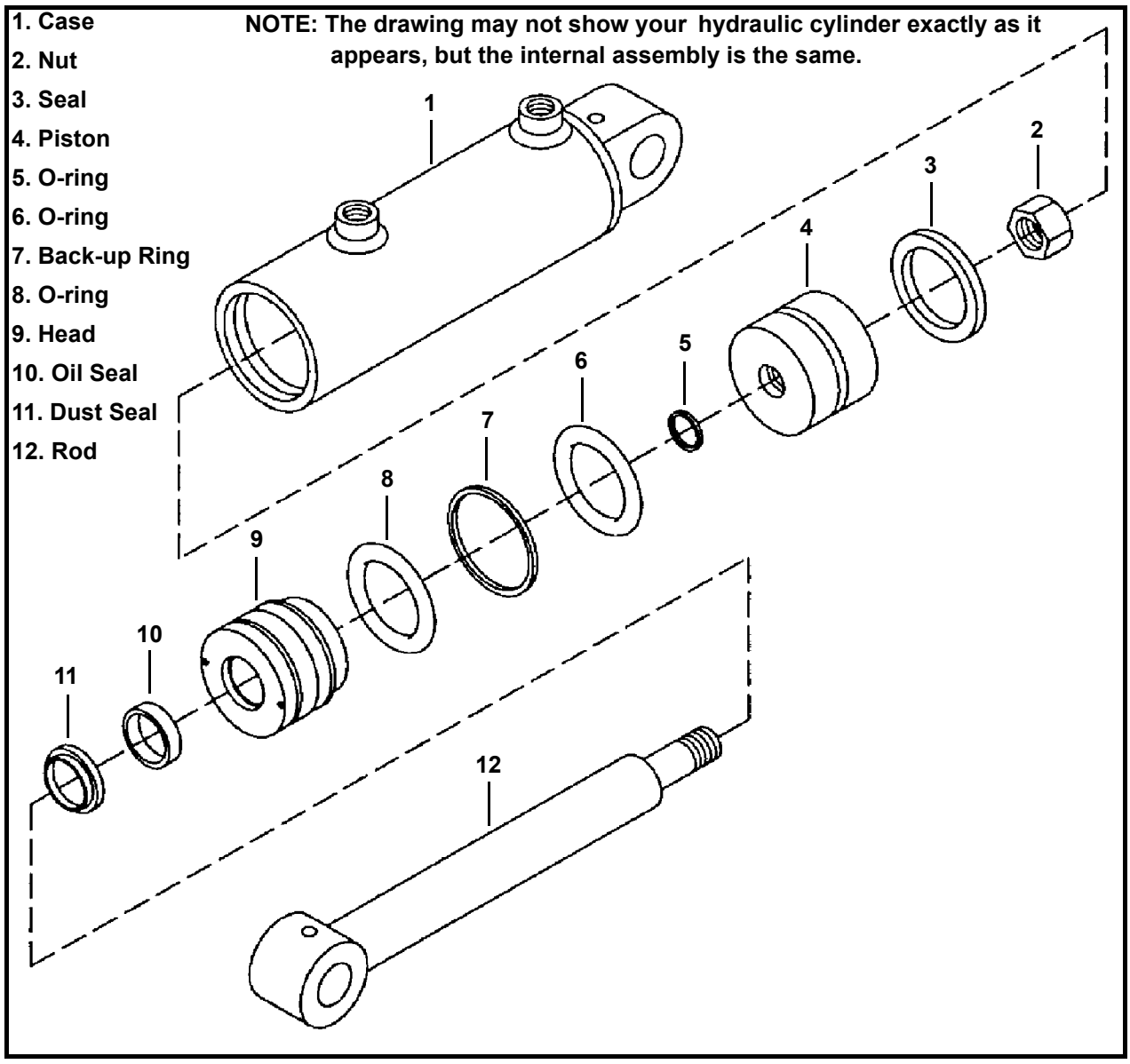


Figure 16-42 Cylinder Exploded View

⚠ WARNING

- **Wear safety glasses to prevent eye injury when any of the following conditions exist:**
  - **Fluids are under pressure.**
  - **Flying debris or loose material is present.**
  - **Engine is running.**
  - **Tools are being used**

CAUTION

- **When repairing hydrostatic and hydraulic systems, clean the work area before disassembly and keep all parts clean. Always use caps and plugs on hoses, tubelines and ports to keep dirt out. Dirt can quickly damage the system.**

NOTE: *Contain and dispose of any leaking oil in an environmentally safe manner.*

Use the following tools to disassemble and assemble the hydraulic cylinder:

- MEL1074 O-Ring Seal Hook
- MEL1396 Seal Installation Tool
- MEL1032 or MEL1033 Rod Seal Installation Tool
- MEL1075 Adjustable Gland Nut Wrench
- MEL1076 Cylinder Wrench
- Torque Multiplier (See your Ingersoll Rand dealer)

NOTE: *The drawings may not show the cylinder exactly as it appears, but the procedure is correct for all the cylinders.*

1. Put the base end of the hydraulic cylinder in a drain pan.
2. Move the rod in and out to remove the fluid from the cylinder. Move the rod slowly so the fluid will go directly into the drain pan.
3. Put the base end of the cylinder in a vise.
4. Use an adjustable gland nut wrench to loosen the head **(Figure 16-43, Page 16-30)**.
5. Remove the rod assembly from the cylinder case **(Figure 16-44, Page 16-30)**.
6. Remove the cylinder case from the vise.
7. Put the rod end in the vise.
8. Remove the nut from the piston end of the rod **(Figure 16-45, Page 16-31)**.
9. Pull the piston (1) off the rod. If the cylinder has a cushion sleeve (2), pull it off the rod. Pull the head (3) off the rod **(Figure 16-46, Page 16-31)**.

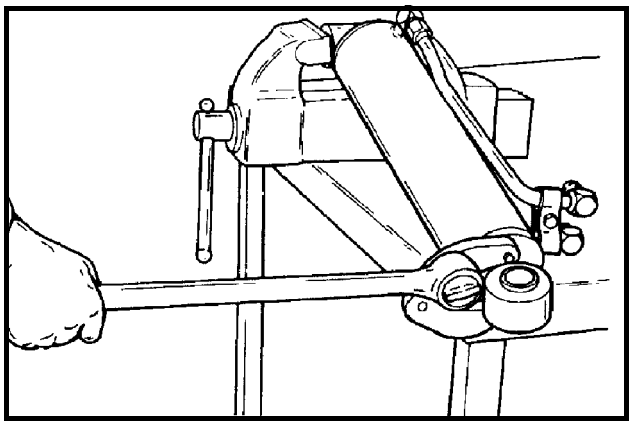


Figure 16-43 Loosen the Head

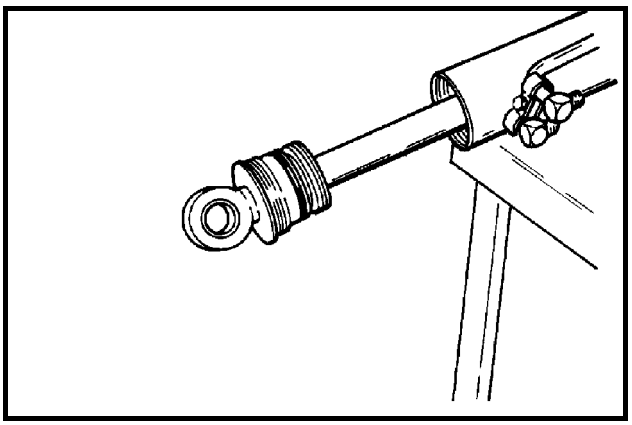


Figure 16-44 Remove Rod Assembly

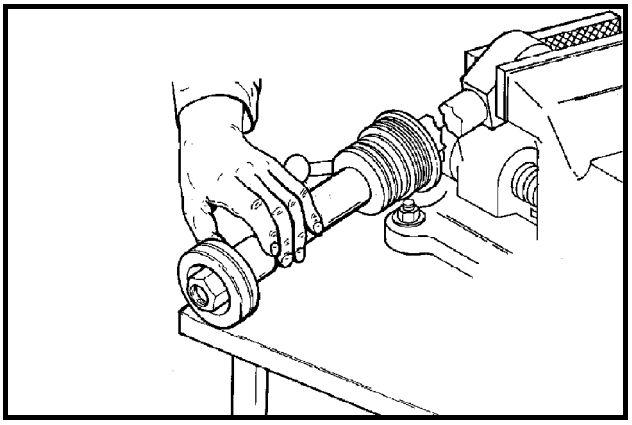


Figure 16-45 Remove Nut from Piston

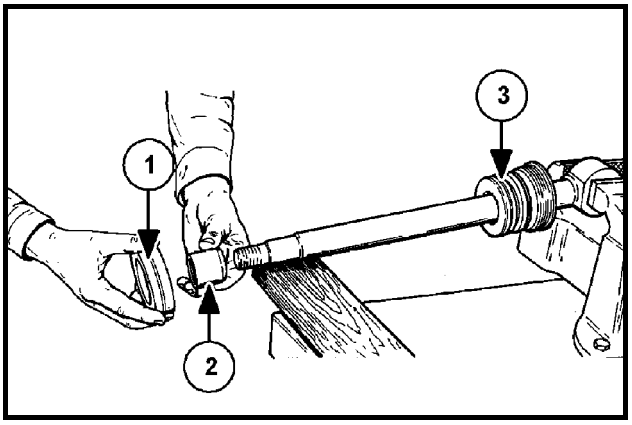


Figure 16-46 Pull Components from Rod

10. If the head has a seal, remove the seal from the head **(Figure 16-47, Page 16-31)**.
11. Remove the O-ring and back-up washer from the head **(Figure 16-48, Page 16-31)**.

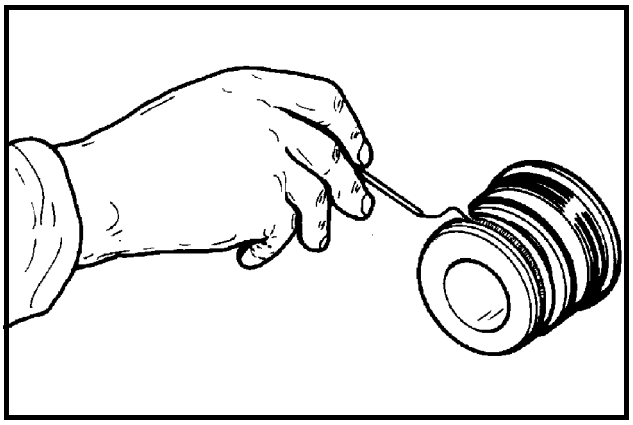


Figure 16-47 Remove Seal

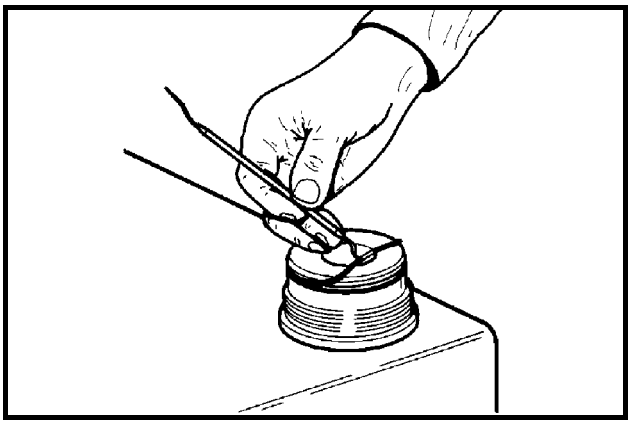


Figure 16-48 Remove O-ring and Back-up Washer

12. Remove the wiper seal **(Figure 16-49, Page 16-31)**.
13. Remove the oil seal from the head **(Figure 16-50, Page 16-31)**.

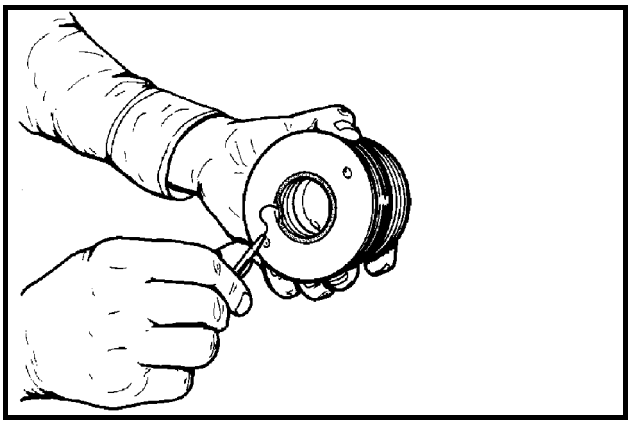


Figure 16-49 Remove Wiper Seal

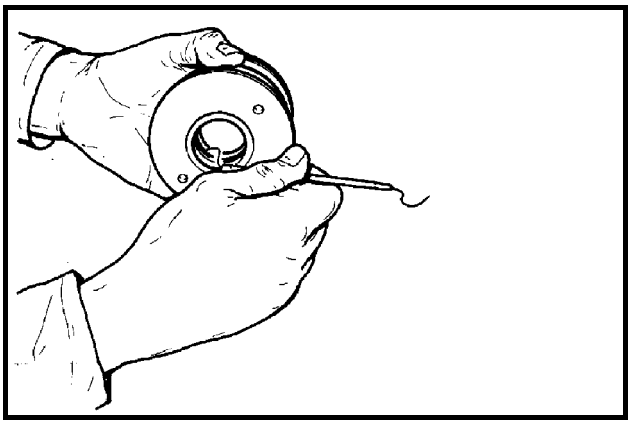


Figure 16-50 Remove Oil Seal

14. Remove the piston seal from the piston **(Figure 16-51, Page 16-32)**.
15. Remove the O-ring from the piston **(Figure 16-52, Page 16-32)**.

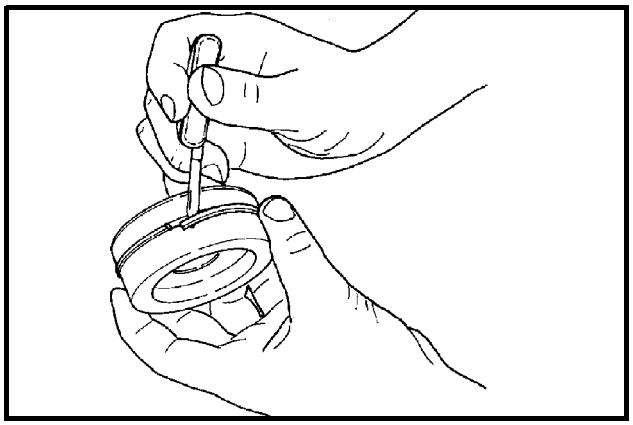


Figure 16-51 Remove Piston Seal

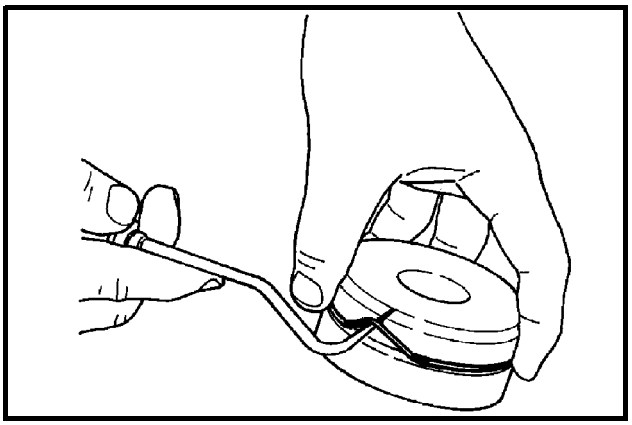


Figure 16-52 Remove Piston O-ring

16. Wash the cylinder parts in clean solvent and dry with compressed air.

NOTE: *While servicing the cylinder do not damage the parts. Inspect for nicks, scratches or otherwise damaged or bent parts before assembling the cylinder. Replace parts that appear damaged in any way. The cylinder may not function correctly if there is damage to any of the parts.*

17. Destroy all the O-rings and seals and replace them with NEW O-rings and seals.

CYLINDER ASSEMBLY

⚠ WARNING

- **Wear safety glasses to prevent eye injury when any of the following conditions exist:**
  - **Fluids are under pressure.**
  - **Flying debris or loose material is present.**
  - **Engine is running.**
  - **Tools are being used.**

1. Install the O-ring on the piston **(Figure 16-53, Page 16-33)**.

NOTE: *Do not overstretch the seal.*

2. Install the seal on the tool and stretch it until it fits the piston **(Figure 16-54, Page 16-33)**. Allow the O-ring to stretch for 30 seconds before removing it from the tool.
3. Install the seal on the piston **(Figure 16-55, Page 16-33)**.
4. Use the ring compressor to compress the seal to the correct size **(Figure 16-56, Page 16-33)**.

NOTE: *Leave the piston in the ring compressor for three minutes.*

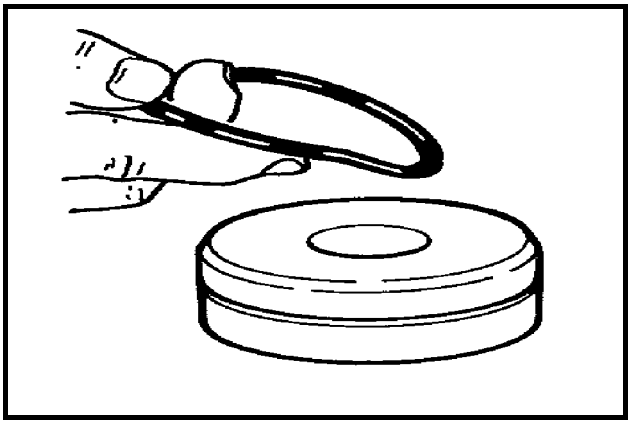


Figure 16-53 Install Piston O-ring

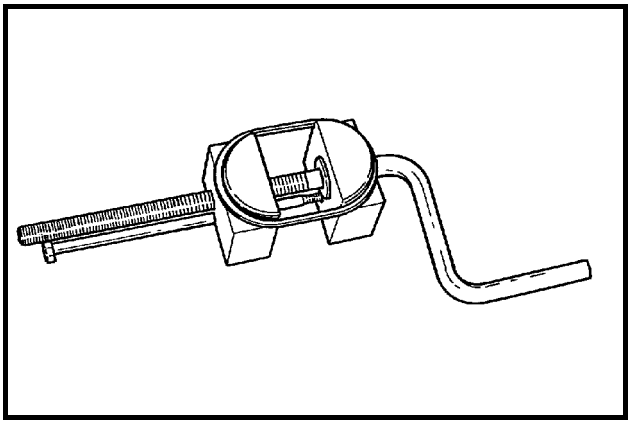


Figure 16-54 Stretch Piston Seal

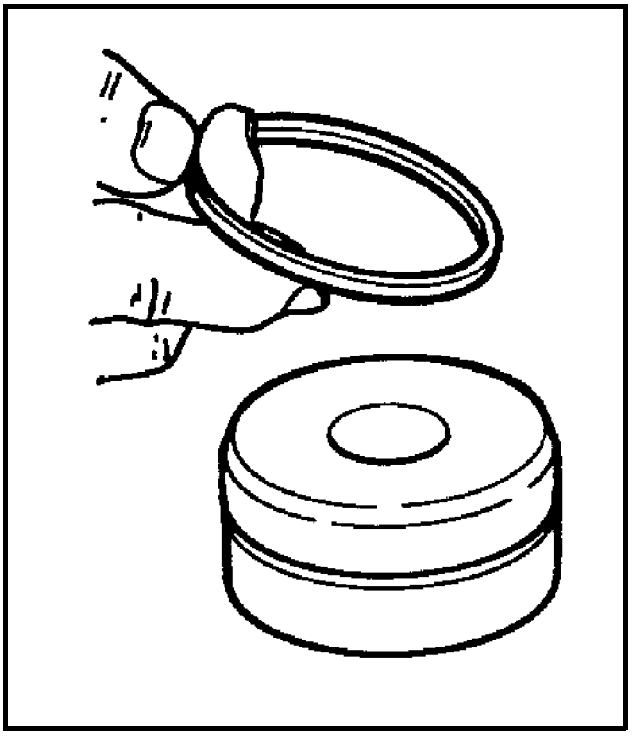


Figure 16-55 Install Piston Seal

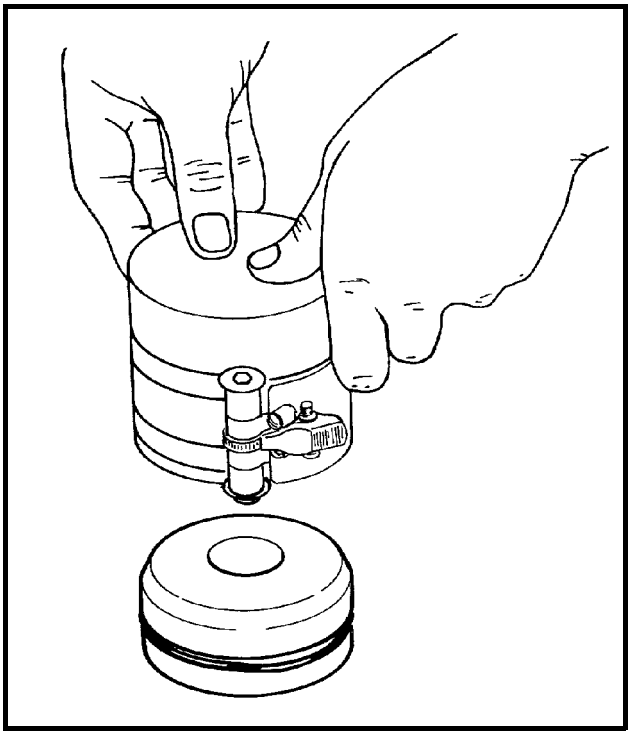


Figure 16-56 Compress Piston Seal

5. Install the oil seal on the rod seal tool **(Figure 16-57, Page 16-34)**.

NOTE: *The O-ring side of the oil seal goes toward the inside of the cylinder.*

6. Install the oil seal in the head **(Figure 16-58, Page 16-34)**.

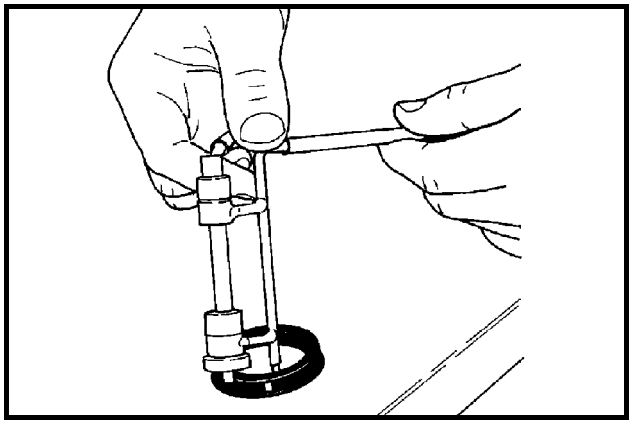


Figure 16-57 Rod Seal Tool

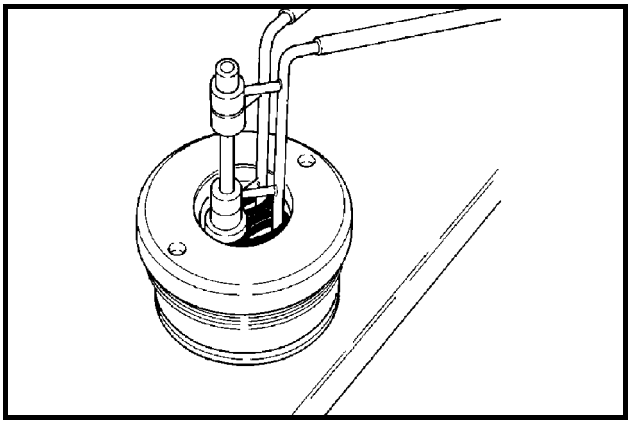


Figure 16-58 Install Oil Seal in Head

7. Install the wiper seal with the lip toward the outside of the head **(Figure 16-59, Page 16-34)**.
8. Install the back-up washer on the head **(Figure 16-60, Page 16-34)**.

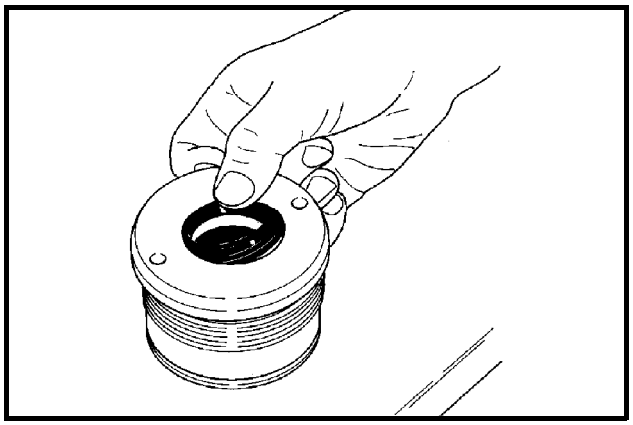


Figure 16-59 Install Wiper Seal

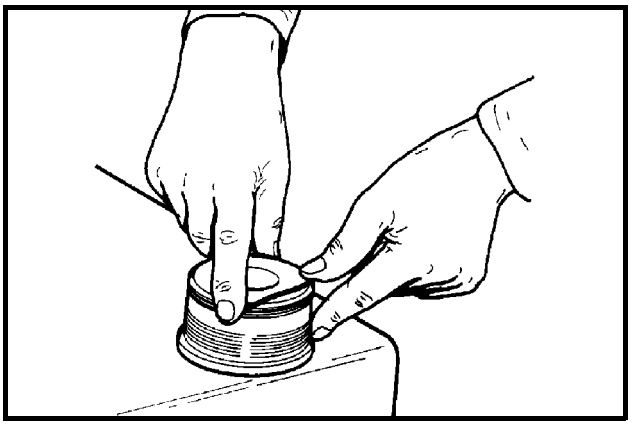


Figure 16-60 Install Back-up Washer

9. Install the O-ring next to the back-up ring as shown **(Figure 16-61, Page 16-35)**.
10. If a seal was removed from the head, use the following procedure to install a new seal.
11. Install the guide with a pilot and an adapter, if they are required, on the head **(Figure 16-62, Page 16-35)**.
12. Install the seal on the head using the guide **(Figure 16-62, Page 16-35)**. **See following CAUTION.**

CAUTION

- **Do not turn (roll) the seal as you install it. Damage to the seal may result.**

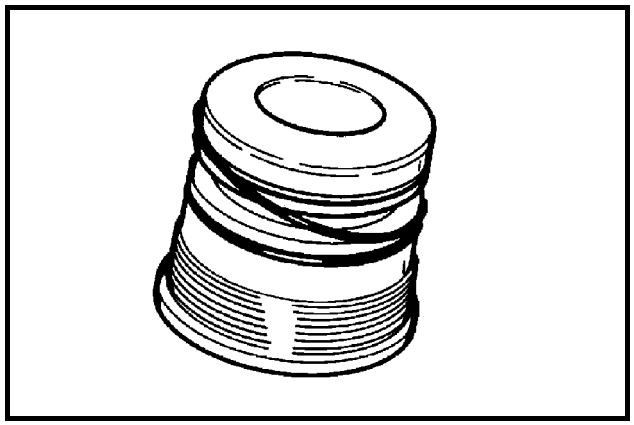


Figure 16-61 Install O-ring on Head

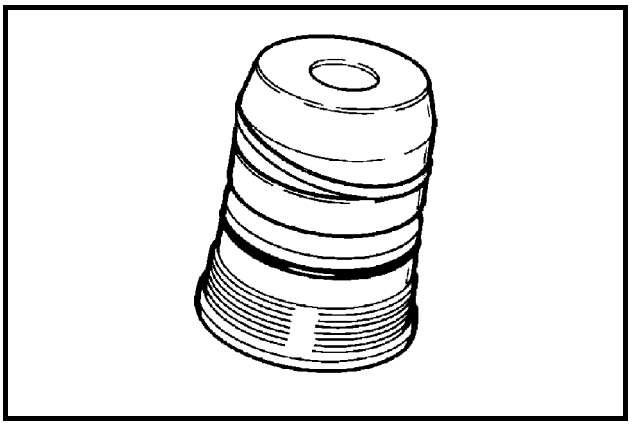


Figure 16-62 Install Seal

13. Use a ring compressor to compress the seal to the correct size **(Figure 16-63, Page 16-35)**. Leave the tool over the Teflon seal for five minutes.
14. Install the head on the rod **(Figure 16-64, Page 16-35)**.
15. Note piston type and install according to the following:
    15.1. For cylinders with a cushioned piston, install the piston on the rod with the tapered end first (toward the head) **(Figure 16-65, Page 16-36)**.
    15.2. For all other cylinders, install the cushion sleeve (if so equipped) and piston on the rod **(Figure 16-66, Page 16-36)**.

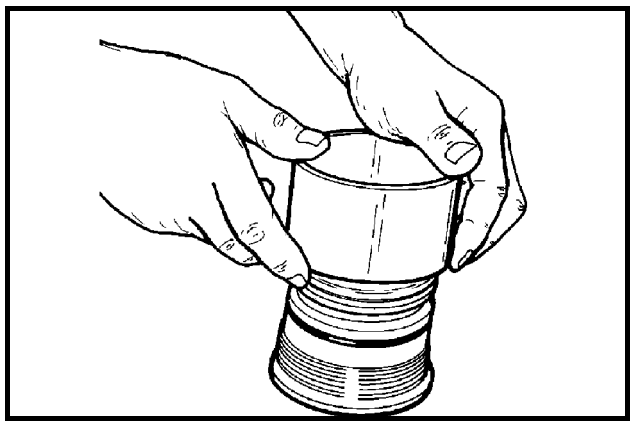


Figure 16-63 Compress Seal

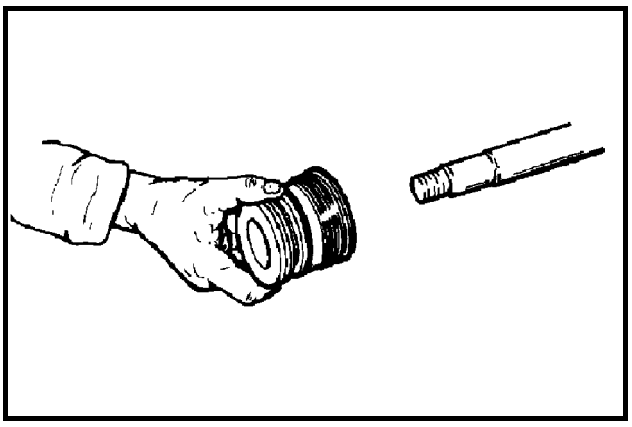


Figure 16-64 Install Head on Rod

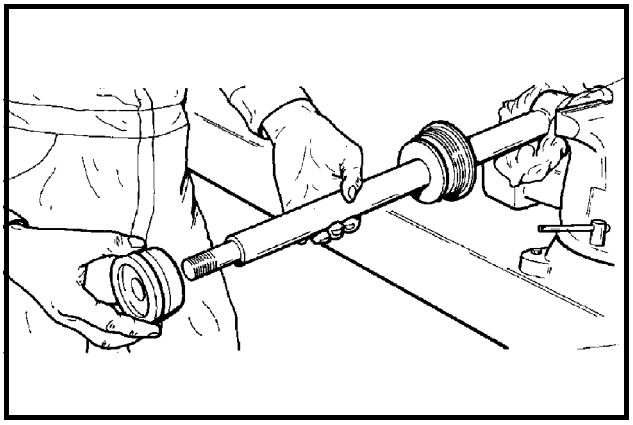


Figure 16-65 Install Cushioned Piston (If Equipped)

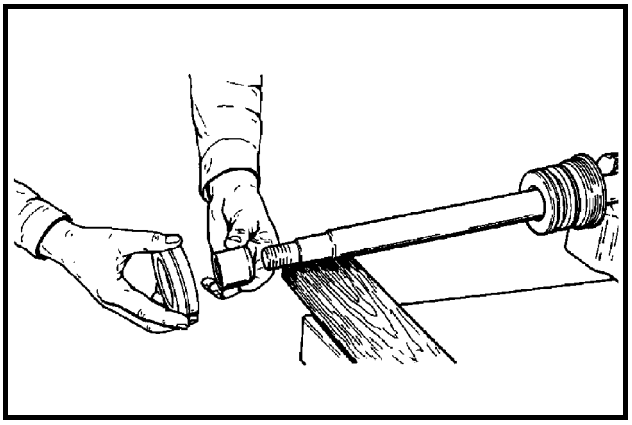


Figure 16-66 Install Cushion Sleeve (If Equipped) and Piston

16. Install and tighten nut to 150-185 ft-lb (203-251 N·m) torque **(Figure 16-67, Page 16-36)**.
17. Remove the rod from the vise.
18. Install the cylinder case in the vise.
19. Put oil on the seal surface of the cylinder case **(Figure 16-68, Page 16-36)**.

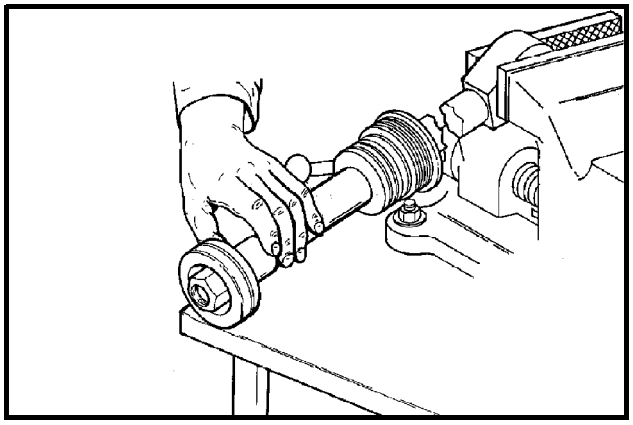


Figure 16-67 Install and Tighten Piston Nut

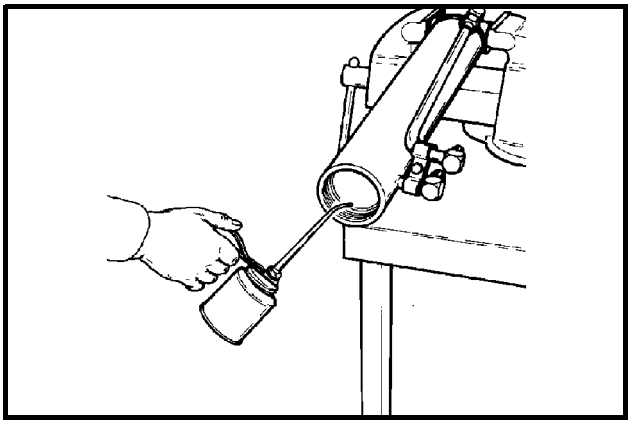


Figure 16-68 Lubricate Seal

20. Put oil on the Teflon seal on the piston **(Figure 16-69, Page 16-37)**.
21. Install the rod assembly in the cylinder case **(Figure 16-70, Page 16-37)**.
22. Put oil on the seals and threads on the head **(Figure 16-71, Page 16-37)**.
23. Use the adjustable gland nut wrench to tighten the head until the head is flush with the case **(Figure 16-72, Page 16-37)**.

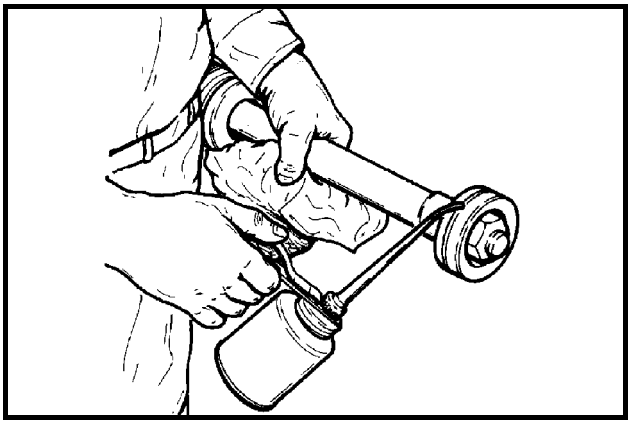


Figure 16-69 Lubricate Piston Seal

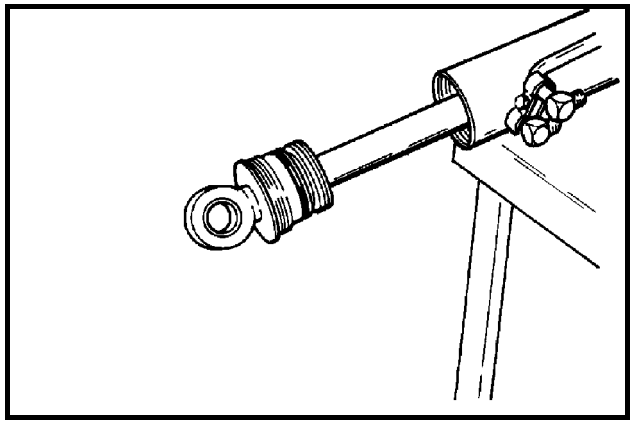


Figure 16-70 Install Rod Assembly

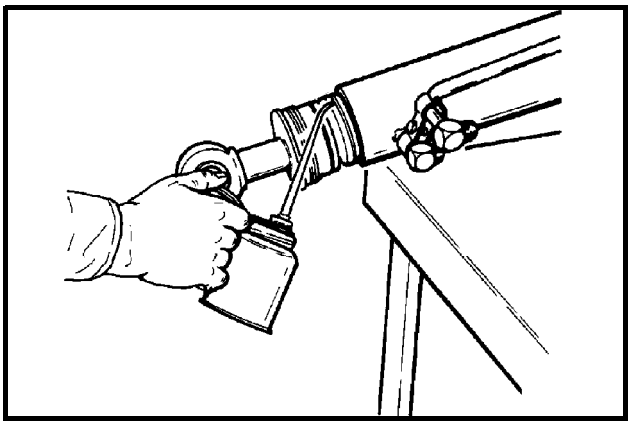


Figure 16-71 Lubricate Head Seals

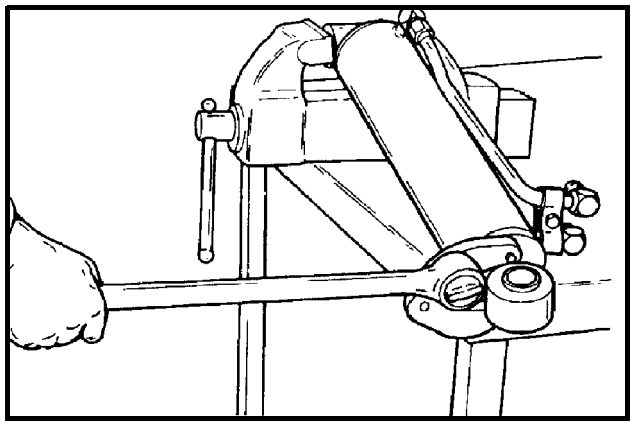


Figure 16-72 Tighten Head Against Case

CYLINDER BUSHINGS (IF EQUIPPED)

Removal and Installation

⚠ WARNING

- **Wear safety glasses to prevent eye injury when any of the following conditions exist:**
  - **Fluids are under pressure.**
  - **Flying debris or loose material is present.**
  - **Engine is running.**
  - **Tools are being used.**

1. Remove bushing(s) (1) **(Figure 16-73, Page 16-38)** from the base end of the hydraulic cylinder. One bushing on each side of cylinder.
2. Apply LOCTITE 271 (Red) to the bushings (2) before installing them into the cylinder **(Figure 16-74, Page 16-38)**.

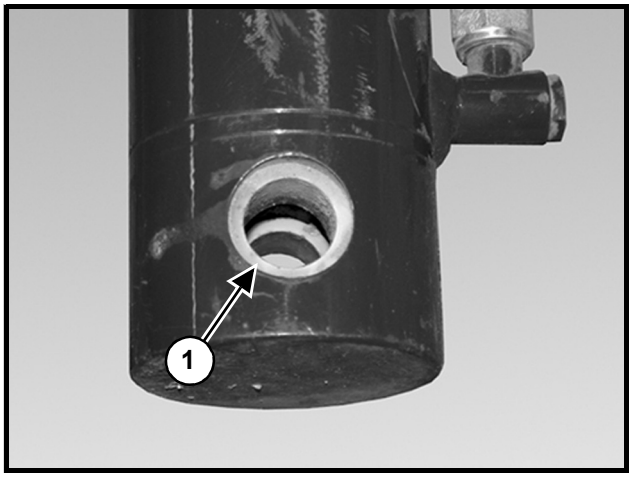


Figure 16-73 Remove Bushings From Base

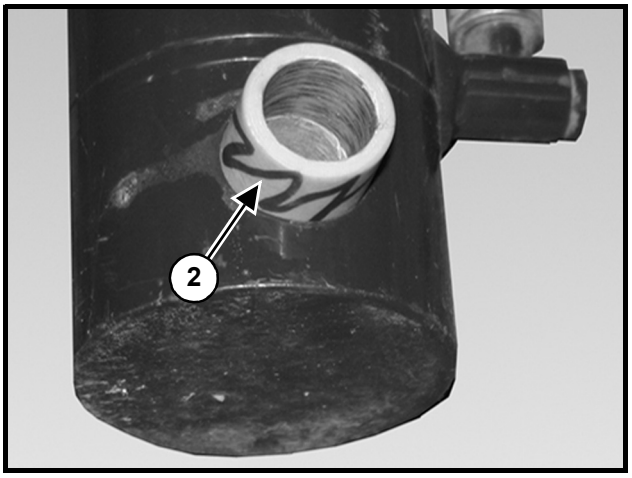


Figure 16-74 Apply LOCTITE and Install Bushings Into Base

3. Remove the two bushing(s) (1) **(Figure 16-75, Page 16-38)** from the rod end of the hydraulic cylinder.
4. Apply LOCTITE 271 (Red) to the bushings (2) before installing them into the cylinder **(Figure 16-76, Page 16-38)**.

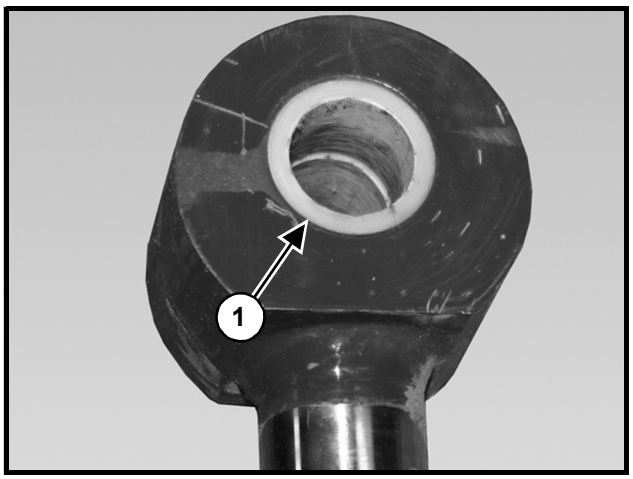


Figure 16-75 Remove Bushings from Rod End

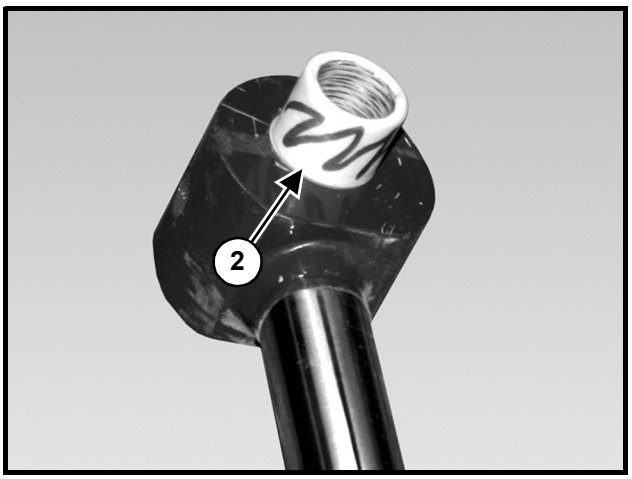


Figure 16-76 Apply LOCTITE and Install Bushings Into Rod End

ANGLE FRAME BUSHINGS

SNOW BLADE ANGLE FRAME

Removal and Installation

⚠ WARNING

- **Wear safety glasses to prevent eye injury when any of the following conditions exist:**
  - **Fluids are under pressure.**
  - **Flying debris or loose material is present.**
  - **Engine is running.**
  - **Tools are being used.**

1. Remove bushings (1) **(Figure 16-77, Page 16-39)** from both sides of angle frame.
2. Apply LOCTITE 271 (Red) to the bushings before installing them into the frame.
3. Install bushings (2) **(Figure 16-78, Page 16-39)** on both sides of the angle frame.

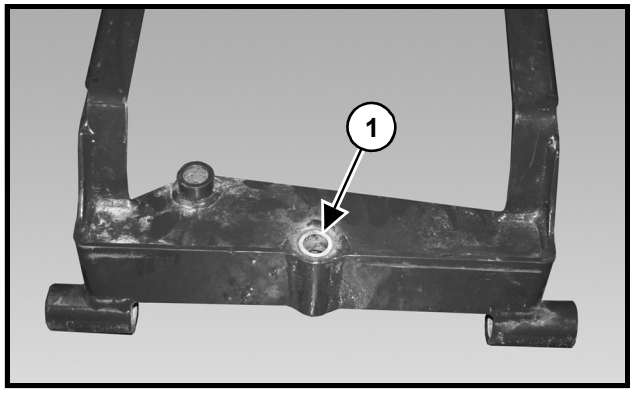


Figure 16-77 Remove Snow Blade Angle Pivot Bushings

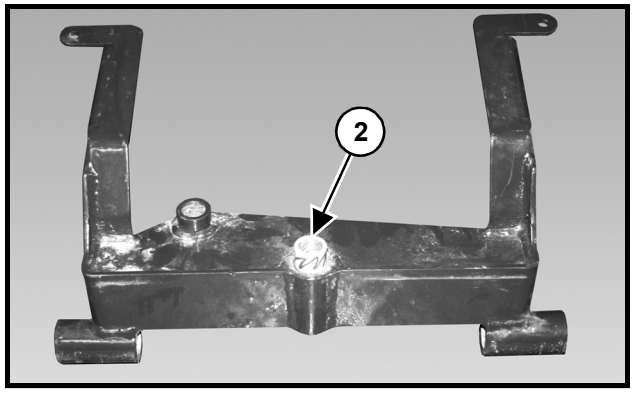


Figure 16-78 Apply LOCTITE and Install Angle Pivot Bushings

4. Remove the four bushings (1) **(Figure 16-79, Page 16-40)** from both ends of the angle frame.
5. Apply LOCTITE 271 (Red) to the bushings before installing them into the angle frame **(Figure 16-80, Page 16-40)**.
6. Install the four bushings (2) on both ends of the angle frame.

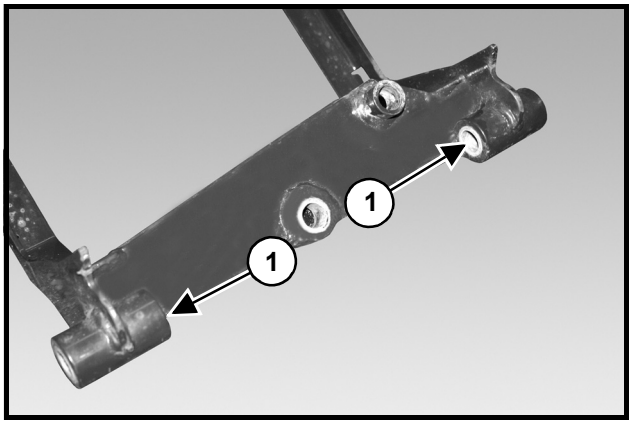


Figure 16-79 Remove Four Pivot Bushings

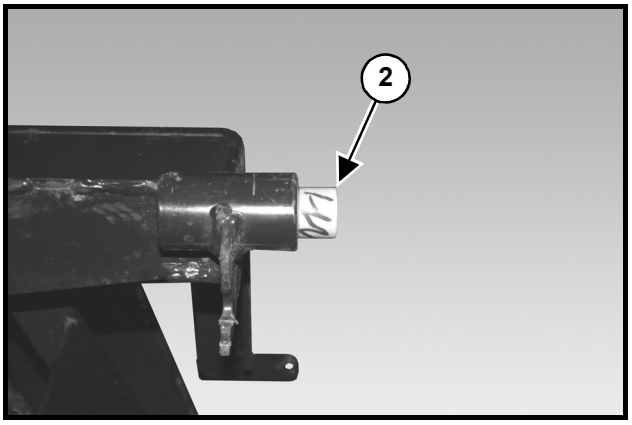


Figure 16-80 Apply LOCTITE and Install Four Pivot Bushings

WHISK BROOM ANGLE FRAME

Removal and Installation

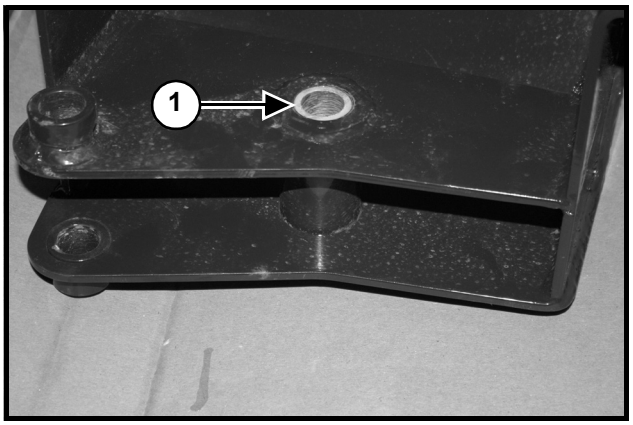


Figure 16-81 Remove Whisk Broom Pivot Bushings

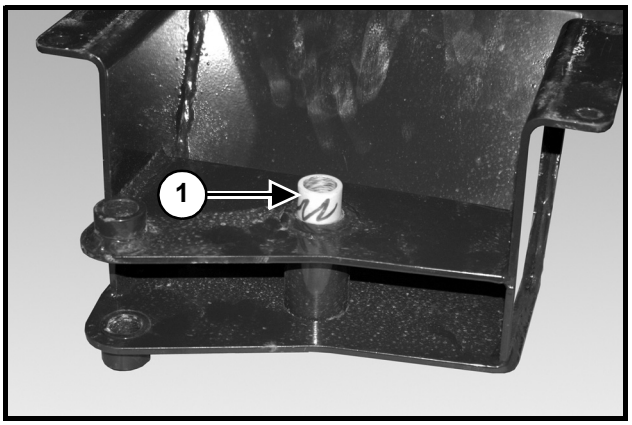


Figure 16-82 Apply LOCTITE and Install Pivot Bushings

1. Remove the two bushings (1) **(Figure 16-81, Page 16-40)** from both sides of the angle frame.
2. Apply LOCTITE 271 (Red) to the bushing before installing them into the angle frame.
3. Install the two bushings (1) **(Figure 16-82, Page 16-40)** on both sides of the angle frame.

FRONT MOUNT

FRONT MOUNT REMOVAL

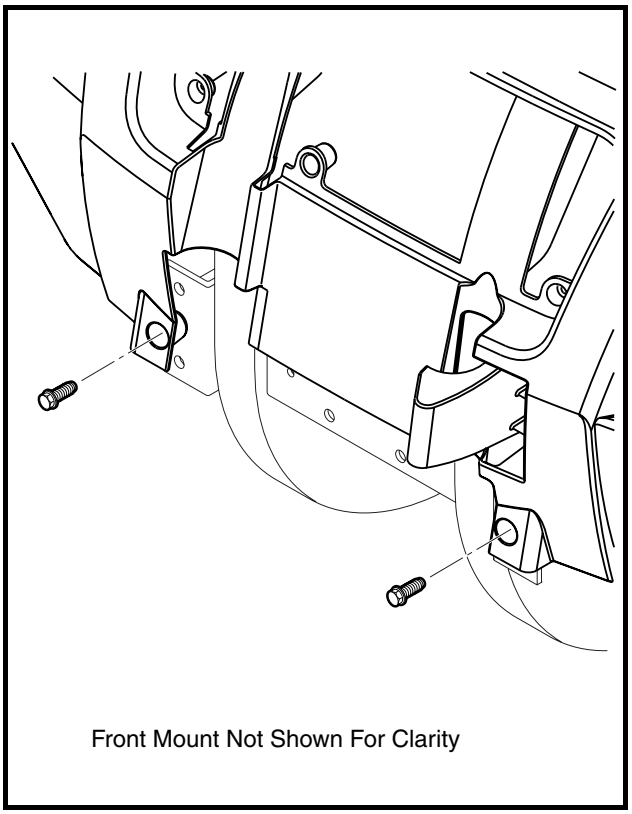


Figure 16-83 Front Fascia Bolts

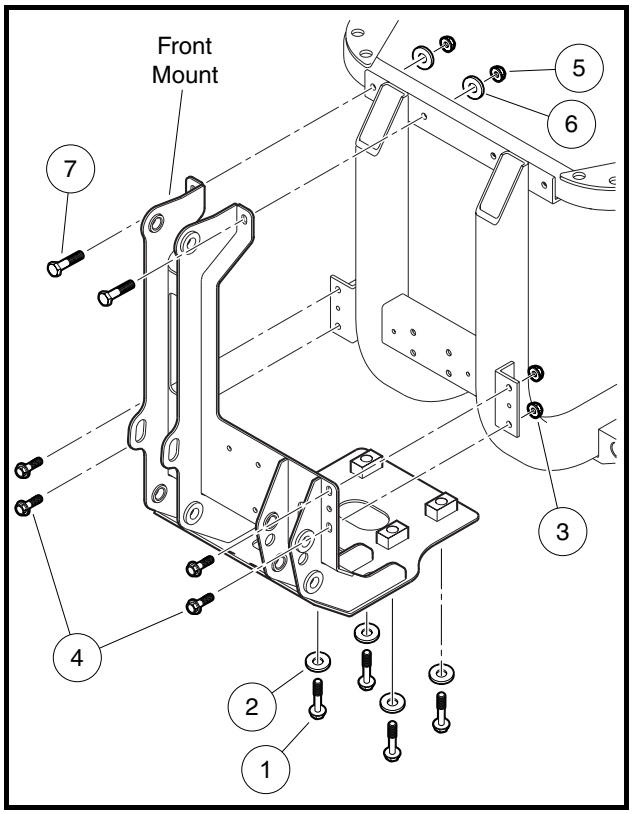


Figure 16-84 Front Mount Hardware

⚠ WARNING

- **Wear safety glasses to prevent eye injury when any of the following conditions exist:**
  - **Fluids are under pressure.**
  - **Flying debris or loose material is present.**
  - **Engine is running.**
  - **Tools are being used.**

CAUTION

- **When repairing hydraulic systems, clean the work area before disassembly and keep all parts clean. Always use caps and plugs on hoses, tubelines and ports to keep dirt out. Dirt can quickly damage the system.**

NOTE: *Mark hoses for correct installation if factory markings are not found.*

Contain and dispose of any leaking oil in an environmentally safe manner.

1. Remove attachment if installed. **See Attachment Interface on page 16-2.**

2. Remove attachment arm and interface assembly. **See Attachment Arm Removal on page 16-3.**
3. Relieve pressure in hydraulic system. **See Relieving Hydraulic System Pressure on page 16-1.**
4. Set the joystick ON/OFF switch to OFF, remove driver seat and disable vehicle.
5. Thoroughly clean the cylinders, hoses, and the area around the front mount.
6. Remove wire ties securing hoses to front mount.
7. Slowly loosen and disconnect hoses at cylinders and, if equipped, quick connect fittings. Cover hose ends and fittings to keep out debris. **See Vehicle Mounted Cylinders on page 16-26. See also Quick Connect Fittings (Auxiliary Hydraulic Circuit only) on page 16-25.**
8. Remove cylinders. **See Vehicle Mounted Cylinders on page 16-26.**
9. Loosen bottom of front fascia by removing two bolts securing it to vehicle **(Figure 16-83, Page 16-41)**.
10. Remove four bolts (1) and washers (2) from lower part of mount under front of vehicle **(Figure 16-84, Page 16-41)**.
11. Remove four locknuts (3) and bolts (4) securing front of mount to vehicle **(Figure 16-84, Page 16-41)**.
12. Remove two nuts (5), washers (6) and bolts (7) securing top of mount to vehicle **(Figure 16-84, Page 16-41)**.
13. Remove front mount, pulling at bottom of front fascia, as necessary, to clear mount.

FRONT MOUNT INSTALLATION

1. Reverse the removal procedure to install front mount to the vehicle but finger-tighten hardware until all hardware is in place.
2. Tighten the four bolts (1) and washers (2), securing bottom of mount to chassis, to 37 ft-lb (50 N·m).
3. Tighten the four locknuts (3) and bolts (4), securing front of mount to vehicle, to 37 ft-lb (50 N·m).
4. Tighten the two nuts (5), washers (6) and bolts (7), securing top of mount to vehicle, to 37 ft-lb (50 N·m).
5. Match hoses to fittings and connect hoses **(Figure 16-34, Page 16-23)**. Tighten fittings to 22 ft-lb (30 N·m).

HYDRAULIC PUMP ASSEMBLY

⚠ WARNING

- **Wear safety glasses to prevent eye injury when any of the following conditions exist:**
  - **Fluids are under pressure.**
  - **Flying debris or loose material is present.**
  - **Engine is running.**
  - **Tools are being used.**

CAUTION

- **When repairing hydraulic systems, clean the work area before disassembly and keep all parts clean. Always use caps and plugs on hoses, tubelines and ports to keep dirt out. Dirt can quickly damage the system.**

NOTE: *Mark hoses for correct installation if factory markings are not found.*

Contain and dispose of any leaking oil in an environmentally safe manner.

FLUID LEVEL INSPECTION

See Hydraulic System – Intellitach Vehicle, Section 10a, Page 10a-15.

FLUID CHANGE

If replacing the hydraulic fluid with fresh fluid

1. Remove attachment if installed. **See Attachment Interface on page 16-2.**
2. Relieve pressure in hydraulic system. **See Relieving Hydraulic System Pressure on page 16-1.**
3. Thoroughly clean the hose fittings and the area around the ends of the hoses being removed.
4. Locate and note the hose factory color marking to ease reassembly. **See following NOTE.**

NOTE: *Mark hoses for correct installation if factory markings are not found.*

5. Place drain pan under cylinders.
6. Slowly loosen and disconnect hoses at cylinders and, if equipped, quick connect fittings. Allow cylinders to drain into pan and then cover cylinder and quick connect fittings to keep out debris. **See Vehicle Mounted Cylinders on page 16-26. See also Quick Connect Fittings (Auxiliary Hydraulic Circuit only) on page 16-25.**
7. Place hose ends into a clean bucket to catch fluid.
8. Reconnect the battery cables, positive (+) cable first, and turn the key switch ON.
9. Switch the joystick ON/OFF switch to ON.
10. Pump fluid out of the hoses by moving the joystick back and forth and side to side several times and press the auxiliary hydraulic switch, if equipped, to the right and left several times until reservoir is nearly empty.
11. Inspect filler cap and replace if necessary.
12. Add fresh hydraulic fluid to reservoir until level is between the Maximum and Minimum Fluid Level lines.

13. Operate pump again using the joystick and auxiliary hydraulic switch to push old fluid out of the hoses.
14. Reconnect hoses and refill reservoir.
15. Prime the pump. **See Priming the Pump, Section 16, Page 16-49.**

If foreign fluid is present within power unit that must be drained before operation

Follow steps above except for the following:

1. For step 5, also slowly loosen and disconnect hoses at pump.
2. For step 9, purge hoses of fluid with compressed air.

PUMP ASSEMBLY

⚠ WARNING

- **Wear safety glasses to prevent eye injury when any of the following conditions exist:**
  - **Fluids are under pressure.**
  - **Flying debris or loose material is present.**
  - **Engine is running.**
  - **Tools are being used.**

CAUTION

- **When repairing hydraulic systems, clean the work area before disassembly and keep all parts clean. Always use caps and plugs on hoses, tubelines and ports to keep dirt out. Dirt can quickly damage the system.**

NOTE: *Mark hoses for correct installation if factory markings are not found.*

Contain and dispose of any leaking oil in an environmentally safe manner.

Pump Assembly Removal

1. Empty and remove cargo bed. **See Cargo Bed Removal, Section 4, Page 4-12.**
2. Relieve pressure. **See Relieving Hydraulic System Pressure on page 16-1.**
3. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
4. Set the joystick ON/OFF switch to OFF and remove driver seat.
5. Disconnect the battery cables as instructed. **See WARNING "To avoid unintentionally starting..." in General Warning, Section 1, Page 1-1.**
6. Release the clamp securing the vent hose to top of clutch cover and remove hose.
7. Thoroughly clean the filler cap, reservoir, pump assembly, hose connections and the area around the pump assembly.
8. Loosen two bolts, located under pump assembly, securing pump assembly to cradle **(Figure 16-90, Page 16-46)**.

9. Remove three bolts securing cradle to chassis **(Figure 16-85, Page 16-45) and (Figure 16-86, Page 16-45)**.

Figure 16-85 Front Cradle Bolt

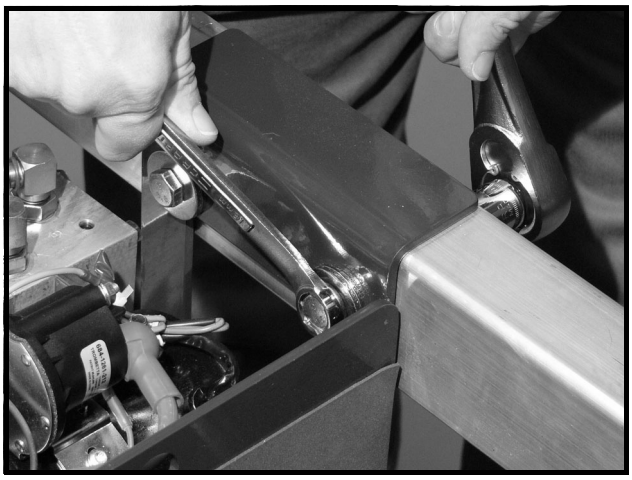


Figure 16-86 Rear Cradle Bolts

Figure 16-87 Park Brake Cable Bolt

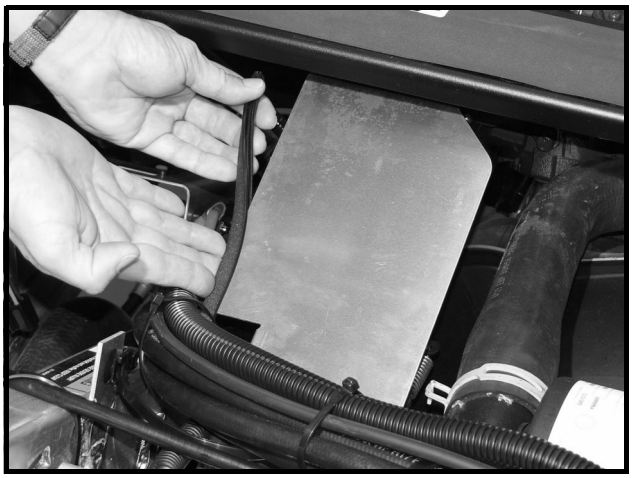


Figure 16-88 Cover Edge of Heat Shield

10. Remove bolt securing the passenger side park brake cable to the chassis, at the air filter, and move cable forward **(Figure 16-87, Page 16-45)**.
11. Cover edge of heat shield to protect hoses and wires while lifting pump assembly from chassis **(Figure 16-88, Page 16-45)**.

12. Remove wire tie securing hoses/wire harness to chassis **(Figure 16-89, Page 16-46)**.

Figure 16-89 Wire Tie to Chassis

Figure 16-90 Pump To Cradle Bolts

13. Lift pump and cradle up and, while guiding the hoses/wiring around heat shield, place on top of chassis. **See following WARNING and CAUTION.**

⚠ WARNING

- **To avoid risk of injury, use proper lifting techniques or, if available, a hoist to lift the pump assembly from the chassis.**

CAUTION

- **Use care to avoid damaging the hoses and wires when moving them around the heat shield.**

14. Remove two bolts securing pump assembly to cradle and remove cradle **(Figure 16-90, Page 16-46)**.
15. Disconnect wires at motor solenoid. **See Solenoid Removal on page 16-19.**
16. Disconnect wire harness from control valve leads.
17. Place drain pan under pump to catch fluid. Slowly loosen and disconnect hoses at pump. Cover all hose ends and fittings to keep out debris.

Pump Assembly Installation

1. Reverse the removal procedure to install pump assembly to the vehicle but finger-tighten hardware until all hardware is in place.
2. Match color of hose to fitting and tighten connections to 22 ft-lb (30 N·m). **See Hose Routing on page 16-23.**
3. Tighten the two bolts, securing pump to cradle, to 33.5 ft-lb (45 N·m).
4. Tighten the two rear cradle hardware lock nuts to 33.5 ft-lb (45 N·m).
5. Tighten the front cradle hardware lock nut to 21 ft-lb (28 N·m).
6. Tighten the park brake cable clamp bolt to 60 in-lb (6.4 N·m).
7. Tighten the small terminals of solenoid to 10 in-lb (1.1 N·m) and 21 in-lb (2.4 N·m) on the large terminals.

8. Connect the battery cables, positive (+) cable first, and tighten the terminals to 144 in-lb (16 N·m). Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
9. Refill and prime system. **See Priming the Pump, Section 16, Page 16-49.**

RESERVOIR

Reservoir Removal

1. Remove pump assembly. **See Pump Assembly Removal on page 16-44.**
2. Lift pump assembly and place it, motor end up, into drain pan. Remove filler cap to drain most of the fluid into pan.
3. Clean and inspect filler cap. Replace cap if damaged or unable to clean.
4. Loosen band clamp and remove reservoir **(Figure 16-91, Page 16-47)**.

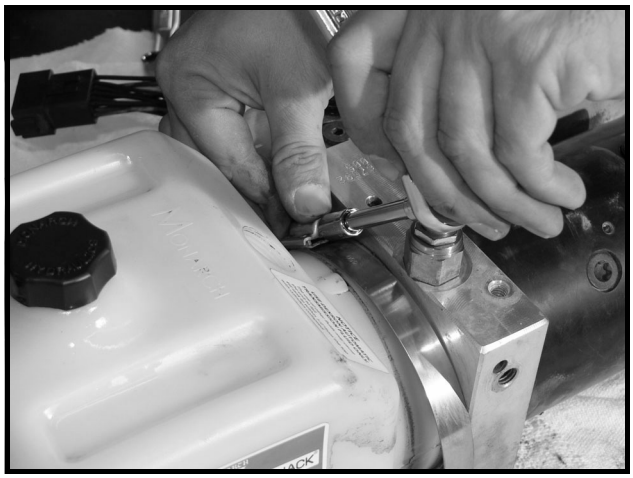


Figure 16-91 Loosen Band Clamp

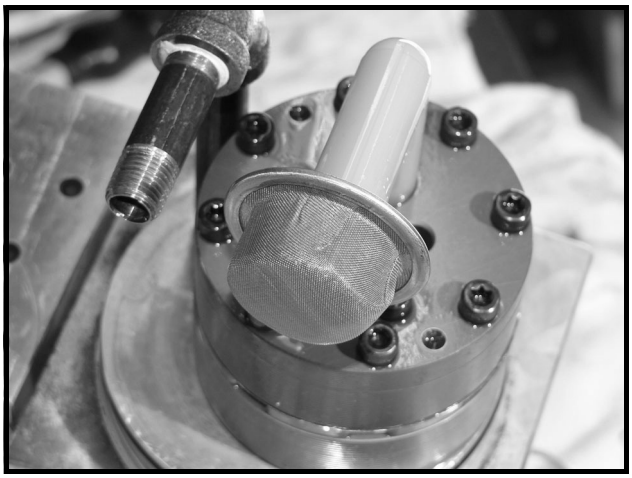


Figure 16-92 Suction Tube Filter

Reservoir Installation

1. Drain remaining fluid and wipe or flush reservoir clean.
2. Clean or replace suction tube filter **(Figure 16-92, Page 16-47)**.
3. Wipe/rinse the pump clean.
4. Clean and inspect reservoir o-ring. Replace if necessary.
5. Lubricate o-ring with new fluid and install reservoir being careful not to pinch or deform the o-ring. Tighten clamp to 57 in-lb (6.3 N·m).
6. Install pump assembly. **See Pump Assembly Installation on page 16-46.**

MOTOR

Motor Removal

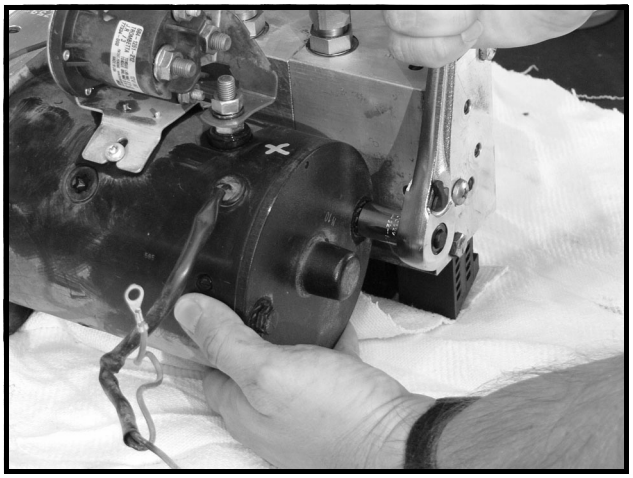


Figure 16-93 Remove Motor Bolts

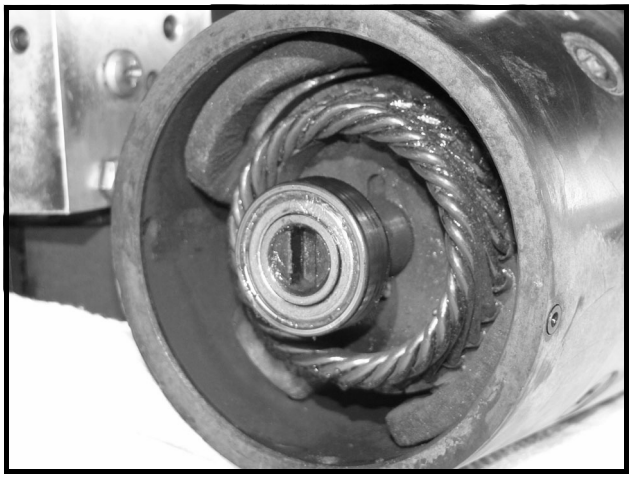


Figure 16-94 Motor Bearing

1. Lift pump assembly out of chassis and remove cradle. **See Pump Assembly Removal on page 16-44.**
2. Note location of and disconnect solenoid wires and remove solenoid.
3. Make a mark from the motor housing to ease reassembly alignment.
4. Remove two bolts and end cover from motor **(Figure 16-93, Page 16-48)**.
5. Grasp motor housing and armature and pull motor from pump. **See following NOTE.**

NOTE: *The motor may require effort to remove because the bearing is also being pulled out of the base* **(Figure 16-94, Page 16-48)**.

Motor Installation

1. Align slot in motor armature with pump driveshaft and carefully push the motor and bearing into place **(Figure 16-95, Page 16-49) (Figure 16-96, Page 16-49)**. Once in place, align mark on motor housing with mark on base.
2. Align hole in end cover with pin on motor housing and install. Secure with bolts previously removed.
3. Attach solenoid to motor and connect wires. **See Solenoid Installation on page 16-20.**
4. Assemble pump assembly to cradle and place unit in chassis. **See Pump Assembly Installation on page 16-46.**

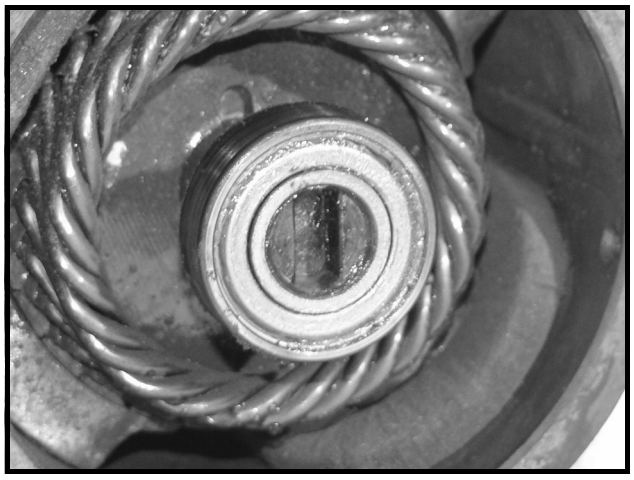


Figure 16-95 Align Slot In Armature

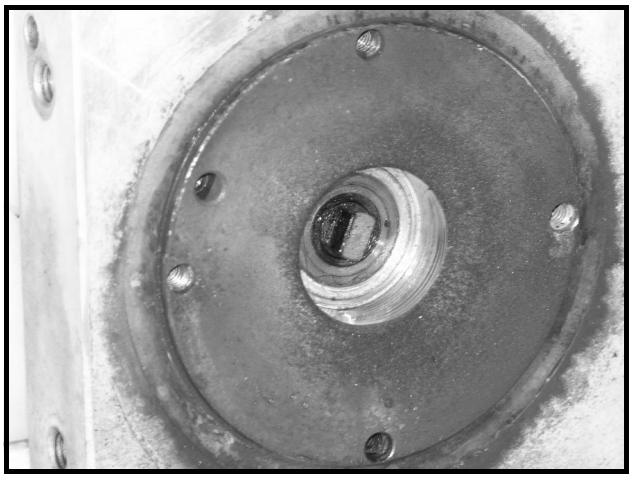


Figure 16-96 Driveshaft

PUMP

Pump Removal

1. **See Pump Assembly Removal on page 16-44.**
2. **See Instructions for Installing Modular Pump on Existing Unit following page 16-49.**

Pump Installation

See Instructions for Installing Modular Pump on Existing Unit following page 16-49.

PRIMING THE PUMP

1. Fill reservoir to the Maximum Fluid Level line.
2. Cycle pump and cylinders, refilling reservoir as necessary, until the trapped air is forced into the reservoir and the cylinders function properly.
3. Once primed, check fluid level again and add as necessary.

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Club Car, Inc.
P.O. Box 204658
Augusta, GA 30917-4658
USA

Web www.clubcar.com
Phone 1.706.863.3000
1.800.ClubCar
Int'l +1 706.863.3000
Fax 1.706.863.5808