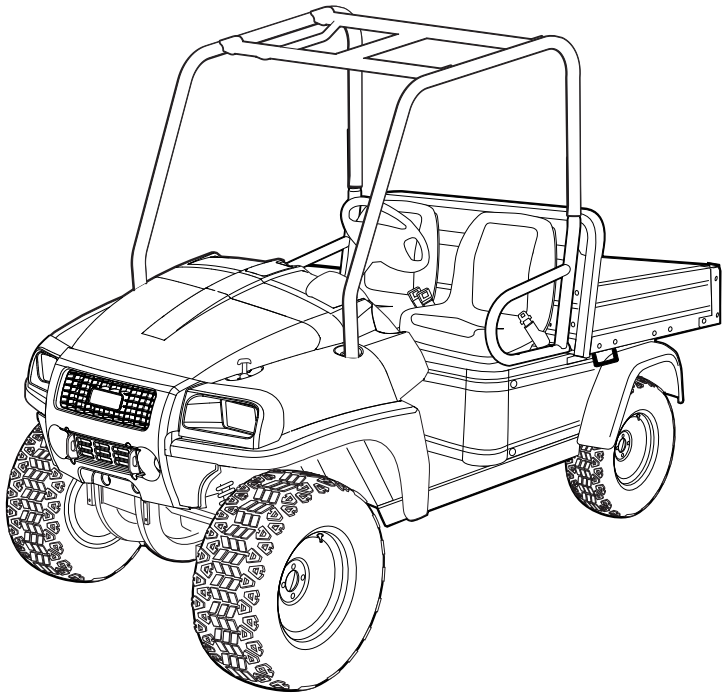
# 2020
# Carryall 1500/1700 and XRT 1550 Maintenance and Service Manual



**Carryall 1500/1700, XRT 1550/1550 SE Gasoline, Diesel and IntelliTach Vehicles**

Manual Number 86753090020
Edition Code B

# 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 1500, Carryall 1700, 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 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.

Club Car offers a full line of training and continuing education classes for technicians who want to learn more about our products. For more information, contact your local dealer or Club Car's Technical Services department for a list of upcoming classes.

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, please contact your nearest authorized Club Car dealer or distributor for assistance.

To find your local authorized Club Car dealer, visit www.clubcardealer.com, call 1-800-ClubCar (258-2227), or scan this Quick Response (QR) code to be taken to the Club Car dealer locator. **Refer to Figure 1.** Download a QR code reader such as RedLaser or Barcode Scanner to your cell phone or tablet.

If you would prefer to write to us, direct your letter to: Club Car LLC, Attention: Marketing Services, P.O. Box 204658, Augusta, Georgia 30917-4658 USA.

**Dealer Locator QR Code**

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# FOREWORD

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## ⚠ WARNING

- **Read Safety on page 1-1 before attempting any service on the 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 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.*

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*There are no warranties expressed or implied in this manual. See the limited warranty found in the vehicle Owner's Manual.*

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# SECTION 1 — SAFETY



## SAFETY DETAILS

### ⚠ WARNING

- **This owner's manual should be read completely before attempting to drive or service the vehicle. Failure to follow the instructions in this manual could result in property damage, severe personal injury, or death.**

### PERSONAL SAFETY

It is important to note that some vital statements throughout this manual and on the decals affixed to the vehicle are preceded by the words DANGER, WARNING, or CAUTION. For your protection, we recommend that you take special notice of these safety precautions. Safety precautions are essential and must be followed.

If any of the operation or warning decals on the vehicle become damaged, have been removed, or cannot be easily read, they should be replaced immediately to avoid possible property damage, personal injury, or death. Contact your dealer.

### ⚠ DANGER

- **A DANGER indicates an immediate hazard that will result in severe personal injury or death. The color associated with Danger is RED.**

### ⚠ WARNING

- **A WARNING indicates an immediate hazard that could result in severe personal injury or death. The color associated with Warning is ORANGE.**

### ⚠ CAUTION

- **A CAUTION with the safety alert symbol indicates a hazard or unsafe practice that could result in minor personal injury. The color associated with Caution is YELLOW.**

### MACHINE SAFETY

### CAUTION

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

A CAUTION, without the safety alert symbol, is intended for machine and property safety. It is used throughout this manual followed by specific instructions to prevent machine or property damage. Failure to follow these CAUTION messages could result in machine or property damage.

### INFORMATION

***NOTE:*** *Instructions that clarify steps, procedures, or other information in this manual.*

# GENERAL WARNINGS

The following safety statements must be heeded whenever the vehicle is being operated, repaired, or serviced. 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.**
- **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 that can quickly accumulate in an enclosed cab. Do not run the engine in a parked vehicle without proper cab ventilation. Move to fresh air if you feel nausea, headache, dizziness, drowsiness or weakness.**
- **The vehicle will not provide protection from lightning, flying objects, or other storm-related hazards. If caught in a storm while driving this vehicle, exit the vehicle and seek shelter in accordance with applicable safety guidelines for your location.**
- **Do not weld to a wheel or rim until the tire is completely removed. Inflated tires can generate a gas mixture with the air that can be ignited by high temperatures from welding procedures performed on the wheel or rim. Removing the air or loosening the tire on the rim (breaking the bead) will NOT eliminate the hazard. This condition can exist whether tires are inflated or deflated. The tire MUST be completely removed from the wheel or rim prior to welding the wheel or rim. Failure to comply will result in death or serious injury.**

## ⚠ 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.**
- **This vehicle is not intended to be used where risk of falling objects exist. If your vehicle will be used in such an environment, contact your local dealer.**
- **Do not leave children unattended on vehicle.**
- **Children requiring a child safety seat must not ride on the vehicle. Comply with state and local laws pertaining to child safety.**
- **The driver and passenger must be restrained at all times with the seat belts provided to help prevent injury in the event of sudden braking, collision, or roll-over.**
- **No more than one person per bucket seat at one time. No more than two persons per bench seat at one time. Do not allow people to ride in any part of the vehicle that is not equipped with a seat and a seat belt. Do not allow a passenger to hold a child in his or her lap while the vehicle is moving.**
- **Prior to leaving the vehicle unattended or servicing the vehicle, place attachment on the ground, set the park brake, place the Forward/Reverse handle in the NEUTRAL position, turn the key switch to the OFF position, and remove the key. Chock the wheels when servicing the vehicle.**

**WARNING CONTINUED ON NEXT PAGE**

## ⚠ WARNING

- **Improper use of the vehicle or failure to properly maintain it could result in decreased vehicle performance, severe personal injury, or death.**
- **Any modification or change to the vehicle that affects the electrical system, stability or handling of the vehicle, or increases maximum vehicle speed beyond factory specifications, could result in severe personal injury or death.**
- **Check the vehicle for proper location of all vehicle safety and operation decals and make sure they are in place and are easy to read.**
- **For vehicles with cargo beds, remove all cargo (including accessories) 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.**
- **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.**
- **To avoid unintentionally starting the vehicle, disconnect battery and spark plug (Gas only) wires. See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
- **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.**
- **Use insulated tools when working near batteries or electrical connections. Use extreme caution to avoid shorting of components or wiring.**
- **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), front or rear, with traction .**

## DISABLING THE VEHICLE

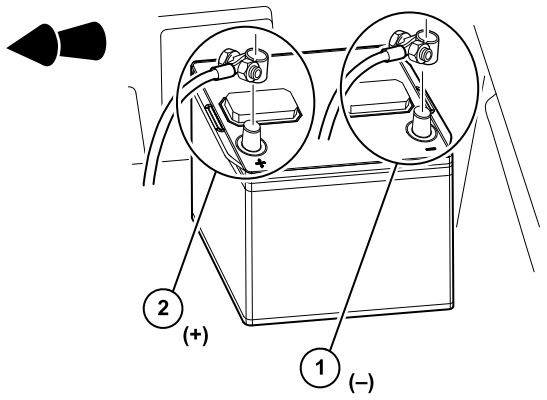
1. Set the park brake.
2. Turn the key switch OFF and remove the key.
3. Place the Forward/Reverse control in the NEUTRAL position.
4. In addition, chock the wheels if servicing or repairing the vehicle.

## DISCONNECTING THE BATTERY- GASOLINE/DIESEL VEHICLES

1. Disable the vehicle. **See Disabling the Vehicle on page 1-3.**
2. Remove positive terminal cover.
3. Disconnect the battery cables, negative (–) cable first, as shown **(Figure 1-1)**.
4. Disconnect the spark plug wire(s) from the spark plug(s).

## CONNECTING THE BATTERY- GASOLINE/DIESEL VEHICLES

1. Connect the battery cables, positive (+) cable first.
2. Tighten battery terminals to 41 in·lb (4.3 N·m).
3. Coat terminals with Battery Terminal Protector Spray to minimize corrosion.
4. Attach positive terminal cover.
5. **Gasoline Vehicles Only:** Connect the spark plug wire(s) to the spark plug(s).




(Viewed from driver side of vehicle)
1. Remove positive terminal cover.
2. Remove negative battery cable.
3. Remove positive battery cable.

Connect battery cables in reverse order.

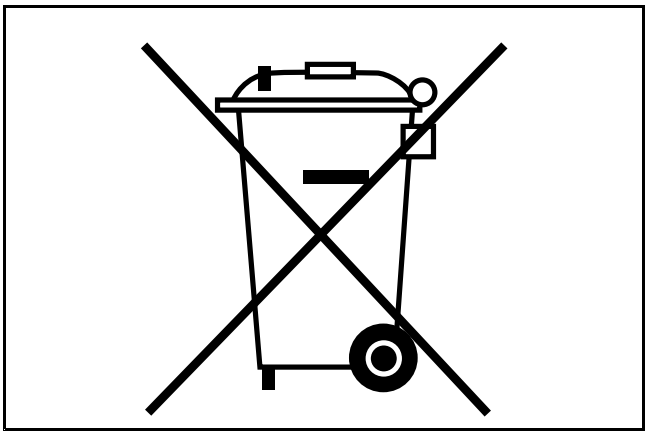
**Figure 1-1 Top-Post Battery- Battery Cable Removal-Gasoline Vehicles**

## RECYCLING LEAD-ACID BATTERIES

### ⚠ WARNING

- **Lead-acid batteries contain lead (Pb), other metals, acids and other compounds. If improperly handled, they can contaminate both water and soil, causing environmental damage and personal injury.**

Lead-acid batteries are identified by the symbol shown below and should be properly recycled **(Figure 1-2)**. They cannot be disposed as municipal waste and must be collected separately. Responsibility for environmental protection must be shared, not only by the manufacturers of the batteries, but by people who use the batteries as well. Please contact your nearest dealer for information on how to properly recycle your batteries.



1403

**Figure 1-2 Dispose of Lead-acid Batteries Properly**

## INTERNATIONAL SAFETY SYMBOLS ON BATTERIES

Anyone using, repairing, or servicing the vehicle must understand and heed the safety symbols on the vehicle battery or batteries.




1. Shield eyes.
2. Read and follow operating instructions.
3. No smoking, no open flames, no sparks.
4. Keep away from children.
5. Battery acid hazard.
6. Explosive gas hazard.

Refer to General Warnings for more information.

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**Figure 1-3 International Safety Symbols on Batteries**

Pagination Page

# SECTION 2 — VEHICLE SPECIFICATIONS



***NOTE:*** *Engine horsepower specifications are provided by the engine manufacturer. Actual horsepower in use may differ and is dependent on environmental conditions as well as maintenance condition of the engine.*

## 1500/1700 AND 1550/1550 SE SPECIFICATIONS

| SPECIFICATIONS | TWO PASSEN-GER | TWO PASSEN-GER | FOUR PASSEN-GER | FOUR PASSEN-GER |
|---|---|---|---|---|
| **POWER SOURCE** | **GASO-LINE** | **DIESEL** | **GASO-LINE** | **DIESEL** |
| **Engine:** (Kawasaki) 4-cycle OHV, 675 cc, 20.1 Engine Horsepower (15.0 kW) rated @ 3400 RPM (per SAE J1349), twin-cylinder, air-cooled, with pressure lubrication system | • | | • | |
| **Engine:** 4-cycle OHV, 719 cc, 20.0 Engine Horsepower (15.0 kW) rated @ 3600 RPM (per SAE J1995), 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 or mechanical fuel pump | | • | | • |
| **Battery:** 12-volt, Top-Post Battery | • | • | • | • |
| **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, 525 CCA, 85 minute reserve capacity | • | • | • | • |
| **Gasoline vehicle electrical charging system:** 13-amp charging capacity (with built-in generator), 50-amp charging capacity (with alternator accessory) | • | | • | |
| **Diesel vehicle electrical charging system:** 13 amps at idle and 38.8 amps at maximum RPM. | | • | | • |
| **Torque converter:** Automatic, variable-speed, dry type | • | • | • | • |
| **STEERING/SUSPENSION/BRAKES** | | | | |
| **Suspension:**<br>**Front:** Independent double A-arms with coil-over shock absorbers<br>**Rear:** Semi-independent four-link suspension 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:** Molded-in color | • | • | • | • |

**TABLE CONTINUED ON NEXT PAGE**

| SPECIFICATIONS | TWO PASSEN-GER | TWO PASSEN-GER | FOUR PASSEN-GER | FOUR PASSEN-GER |
|---|---|---|---|---|
| **POWER SOURCE** | **GASO-LINE** | **DIESEL** | **GASO-LINE** | **DIESEL** |
| **Tires: All Terrain:** 25 x 10.5 – 12 front and rear; tubeless, 4-ply rated load range<br>**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:**<br>without mirror<br>with mirror | 58.5 in. (148.5 cm)<br>63.6 in. (161.5 cm) | | | |
| ***Overall height** (with ROPS):<br>with mud tires<br>with all-terrain tires | 82.3 in. (209 cm) | | 80.3 in. (203.8 cm) | |
| Wheelbase | 81.5 in. (207 cm) | | 114 in. (289.5 cm) | |
| **Ground clearance:**<br>under differential | 8.2 in. (20.8 cm) | | | |
| Front and rear wheel tread | 48.8 in. (124 cm) | | | |
| ***Weight:**<br>2-passenger gasoline with electric bed lift, mud tires, and without brush guard<br>2-passenger diesel with electric bed lift, mud tires, and brush guard<br>4-passenger gasoline with all-terrain tires<br>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.<br>(122 x 127 x 28 cm)<br>(15.3 cubic feet) | | | |
| **Maximum payload capacity** (level surface only)<br>(cargo load, optional accessories, and trailer tongue weight) | 800 lb (363 kg)<br>High capacity option:<br>1050 lb. (476 kg) | | 800 lb (363 kg) | |
| **Vehicle rated capacity** (payload and occupants; level surface only) | 1200 lb (544 kg)<br>High capacity option:<br>1450 lb (658 kg) | | 1600 lb (725.5 kg) | |
| **Maximum gross vehicle weight** (fully loaded vehicle, including accessories) | 2750 lb (1247 kg)<br>High capacity option:<br>3012 lb. (1366 kg) | | 3350 lb (1519.1 kg) | |
| Standard seating capacity | 2 | | 4 | |
| **LIQUID CAPACITIES** | | | | |

**TABLE CONTINUED ON NEXT PAGE**

| SPECIFICATIONS | TWO PASSEN-GER | TWO PASSEN-GER | FOUR PASSEN-GER | FOUR PASSEN-GER |
|---|---|---|---|---|
| **POWER SOURCE** | **GASO-LINE** | **DIESEL** | **GASO-LINE** | **DIESEL** |
| **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 to 22 psi (1.38 to 1.52 Bars) | | | |

## INTELLITACH SPECIFICATIONS

| SPECIFICATIONS | CARRYALL 1500 & XRT 1550 INTELLITACH |
|---|---|
| **POWER SOURCE** | **DIESEL** |
| **Engine:** 4-cycle OHV, 719 cc, 20.0 Engine Horsepower (15.0 kW) rated @ 3600 RPM (per SAE J1995), three-cylinder, liquid-cooled, with pressure lubrication system | • |
| **Fuel system:** Mechanical injection, fuel water separator, fuel filters, and electric fuel pump | • |
| **Battery:** 12-volt, Top-Post Battery | • |
| **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, 525 CCA, 85 minute reserve capacity | • |
| **Diesel vehicle electrical charging system:** 13 amps at idle and 38.8 amps at maximum RPM. | • |
| **Torque converter:** Automatic, variable-speed, dry type | • |
| **STEERING/SUSPENSION/BRAKES** | |
| **Suspension:**<br>**Front:** Independent double A-arms with coil-over shock absorbers<br>**Rear:** Semi-independent four-link suspension 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:** Molded-in color | • |
| **Tires: All Terrain:** 25 x 10.5 – 12 front and rear; tubeless, 4-ply rated load range<br>**Mud:** 25 x 10.5 – 12 front and rear; tubeless, 4-ply rated load range | • |
| **DIMENSIONS/WEIGHT** | |
| **Overall length**<br>**with cylinders "stored" and no attachment arm or interface**<br>with attachment arm and interface and both cylinders fully retracted<br>with both cylinders in position for maximum overall vehicle length | 121 in. (307 cm)<br>136 in. (345 cm)<br>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:**<br>under differential<br>under floorboard | 7.3 in. (18.5cm)<br>11.1 in. (28 cm) |
| **Front wheel tread** | 48.25 in. (122.5 cm) |
| **Rear wheel tread** | 48.63 in. (123.5 cm) |

**TABLE CONTINUED ON NEXT PAGE**

| SPECIFICATIONS | CARRYALL 1500 & XRT 1550 INTELLITACH |
|---|---|
| **Weight** (with all-terrain tires) | 1800 lb. (815 kg) |
| **Forward speed** | 25 mph (40 kph) |
| **Governed RPM** | 3825 |
| **Turning radius** (per SAE J 695) | 138 in. (350.5) |
| **Load bed height** | 32.5 in. (83 cm) |
| **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) (cargo load, optional accessories, and trailer tongue weight) | 800 lb. (363 kg) |
| **Vehicle rated capacity** (payload and occupants; 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 to 22 psi (1.38 to 1.52 Bars) |

Pagination Page

## ⚠ DANGER

- **See General Warnings, Section 1, Page 1-2.**

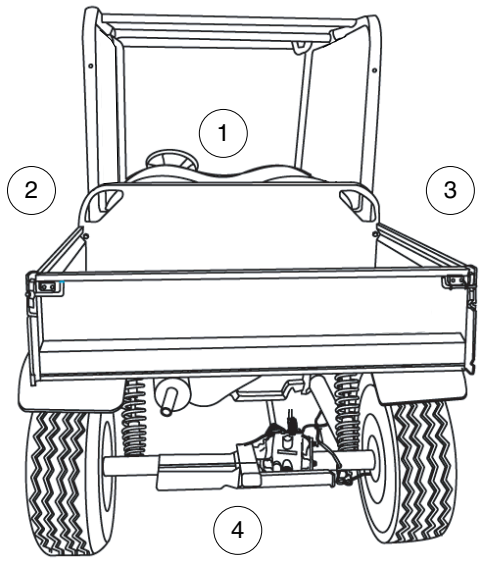
## ⚠ WARNING

- **See General Warnings, Section 1, Page 1-2.**

Throughout this manual, important features unique to each model are highlighted. The manufacturer recommends the owner/operator read and understand this manual and pay special attention to features specific to their vehicle(s).

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

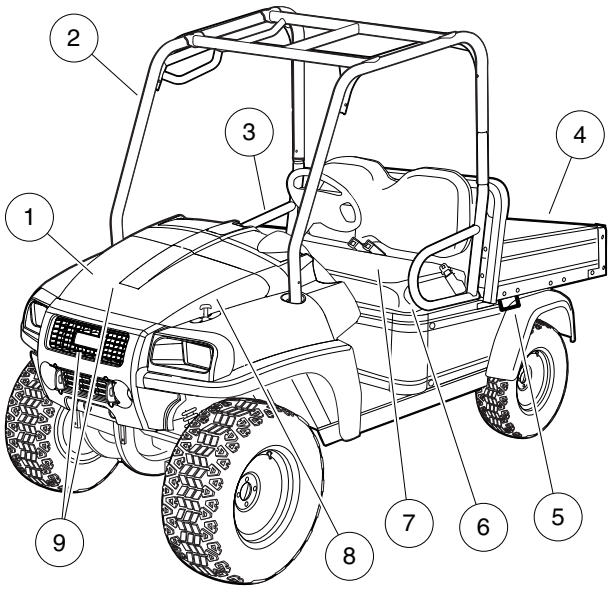
- Safety Decal Identification
- Controls and Indicators
- Driving Instructions
- Towing with the Vehicle
- Transporting on a Trailer
- Engine Oil and Filter Change
- Accessory Equipment
- Subsequent Owner Registration
- Warranties




The terms front (1), left-hand (2), right-hand (3) and rear (4) are used in this manual to indicate the sides as they are seen from the operator's seat.

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**Figure 3-1 Vehicle Orientation**




1. Hood 2. ROPS 3. Fuel Fill Cap 4. Cargo Bed 5. Bed Lift Latch – vehicles with manual (standard) bed lift only 6. Engine Compartment, Battery, Fuel Tank (under seat; for four-passenger model, engine compartment is under rear seat) 7. Seat 8. Brake Fluid Reservoir (under hood) 9. Radiator and Coolant Reservoir (under hood) – diesel engine model only

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**Figure 3-2 Vehicle Components**

# MODEL IDENTIFICATION

The serial number of each vehicle is printed on a bar code decal mounted either below the passenger side cup holder or above the accelerator or brake pedal (Example: PH0901-583947) **(Figure 3-3)**.

The two letters (1) at the beginning of the serial number indicate the vehicle model. The following four digits (2) indicate the model year and production week during which the vehicle was built. The six digits (3) following the hyphen represent the unique sequential number assigned to each vehicle built within a given model year. **See following NOTE.**

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

*A 17-digit Product Information Number (PIN) is included on this vehicle in the engine compartment, on the frame above the battery. This number may be used to register the vehicle where required.*

**Build Code:** The build code (4) is a five-digit number that appears on the vehicle serial number decal. The build code exists to enable the user to identify the correct owner's manual for a vehicle. This owner's manual is valid for the build code range indicated on the back cover of this owner's manual.

## IDENTIFICATION NUMBERS

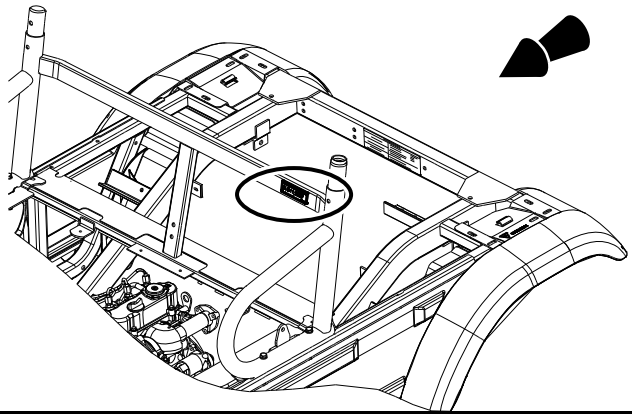
Write your vehicle model number, model serial number and engine serial number on the lines provided below. If needed, give these numbers to your dealer when you need parts or information for your vehicle. Make a record of the numbers. Keep the record and your Manufacturer's Statement of Origin in a safe place. If the vehicle is stolen, report the numbers to your local law enforcement agency.

| | |
|---|---|
| Vehicle Model and Type | |
| Vehicle Serial Number **(Figure 3-3)** | |
| Year of Build **(Figure 3-3)** | |
| Vehicle PIN Number | |
| ROPS Serial Number **(Figure 3-4)** | |
| Engine Serial Number **(Figure 3-5)(Figure 3-6)** | |
| Differential Serial Number **(Figure 3-7)** | |



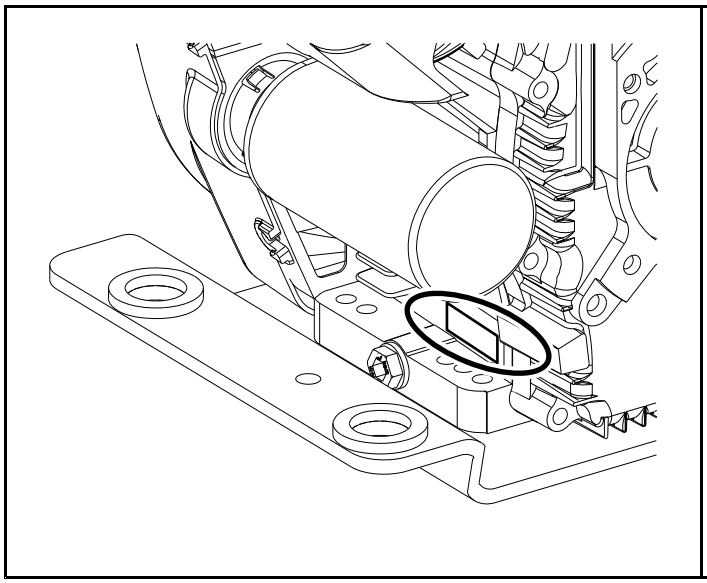

1400

**Figure 3-3 Serial Number Decal with the Vehicle Build Code**



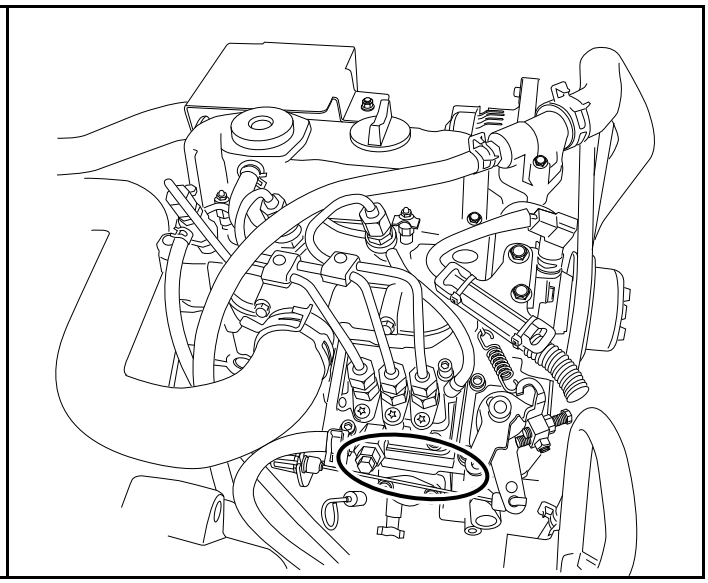
2474

**Figure 3-4 ROPS Serial Number Location**



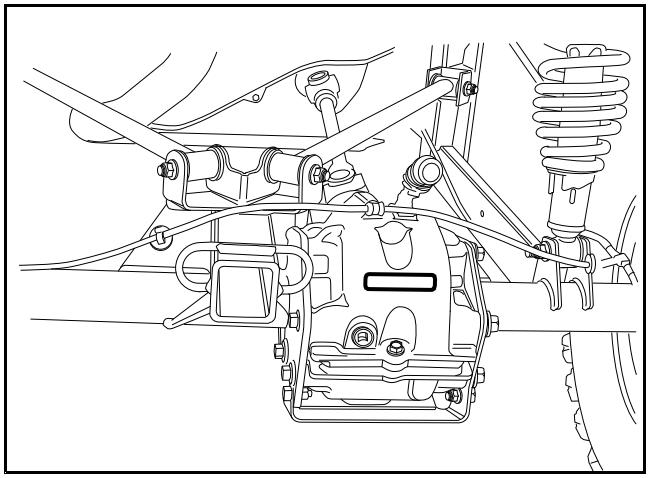
830

**Figure 3-5 Gasoline Engine Serial Number Location**



831

**Figure 3-6 Diesel Engine Serial Number Location**



2703

**Figure 3-7 Differential Serial Number Location**

# STORAGE

**See General Warnings on page 1-2.**

## ⚠ 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

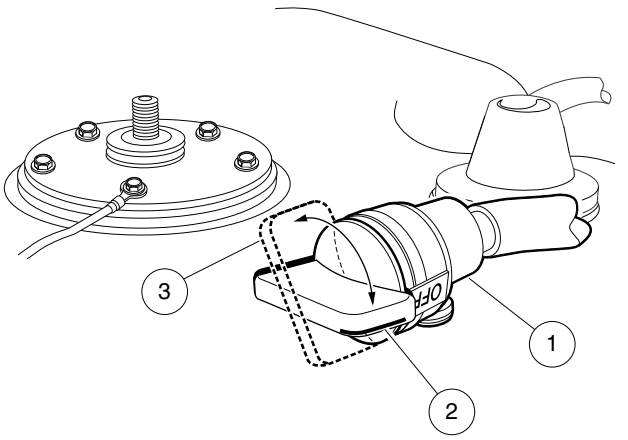
- **Turn the key switch to the OFF position, remove the key, and leave the Forward/Reverse handle in the NEUTRAL position during storage. This is to prevent unintentionally starting the vehicle or a fire hazard.**
- **Gasoline vehicles only: Turn fuel shut-off valve to the closed (OFF) position (Figure 3-8).**
- **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.**

**CAUTION CONTINUED ON NEXT PAGE**

## ⚠ CAUTION




**1. Fuel Shut-off Valve**
**2. Closed (OFF)**
**3. Open (ON)**
**NOTE: When selecting valve position, ensure that it is fully opened or fully closed.**

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**Figure 3-8 Fuel Shut-off Valve**

## 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. If the battery is dead, see Using A Booster Battery (Jump Starting) on page 3-9.
3. Make sure the key switch is in the OFF position and the Forward/Reverse handle is in the NEUTRAL position. Chock the wheels.
4. **Gasoline vehicles:**

   Prepare the fuel tank.

4.1. Fill the tank with fresh fuel.

4.2. Following the 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 11-23, Page 11-20)**.

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.
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 11-24, Page 11-20)**.

6.3. Plug the fuel tank vent nipple so that it is air tight. The manufacturer recommends using a slip-on vinyl cap.

7. **All vehicles:**

   Change engine oil. **See Engine Oil and Filter Change on page 11-11.**

8. Disconnect battery and spark plug (Gas only) wires. **See Disconnecting the Battery – Gasoline/Diesel Vehicle on page See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**.

9. The battery should be clean and free of corrosion. Wash the battery top and terminals with a solution of baking soda and water (1 cup (237 mL) baking soda per 1 gallon (3.8 L) of water). Rinse the solution off the battery. Do not allow this solution to enter the battery. Let the terminals dry and then coat them with Battery Terminal Protector Spray.
10. Adjust the tires to the recommended tire pressure. **See Vehicle Specifications on page 2-1.**
11. Perform semiannual periodic lubrication. **See Periodic Service Schedule on page 11-1.**
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.

### 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 11-23 or Figure 11-24)**.

2.1. Remove the plug from the fuel tank vent.

2.2. Connect the vent tube to the fuel tank vent.

3. Connect battery and spark plug (Gas only) wires. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**
4. **Gasoline vehicles only:** Completely open the fuel shut-off valve **(Figure 3-8, Page 3-6)**. Ensure 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.
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 (all vehicles) and the engine starts. Turn the engine off. **See following NOTE.**

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

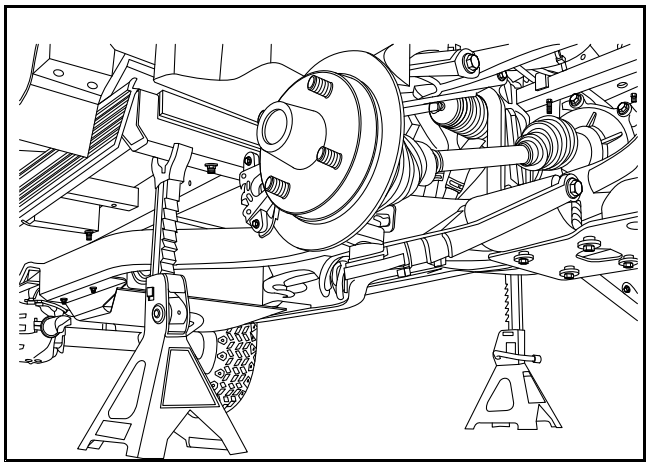
6. Perform the Pre-Operation and Daily Safety Checklist. **See the Pre-Operation and Daily Safety Checklist in the vehicle owner's manual.**

## LIFTING THE VEHICLE

**See General Warnings on page 1-2.**

### LIFTING ONLY THE FRONT

1. Place vehicle on a level surface.
2. Chock the rear wheels.
3. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
4. If removing wheel, loosen the front wheel lug nuts.
5. Lift front of vehicle and support on jack stands **(Figure 3-9, Page 3-8)**. **See WARNING "Lift only one end..." in General Warnings on page 1-2.**

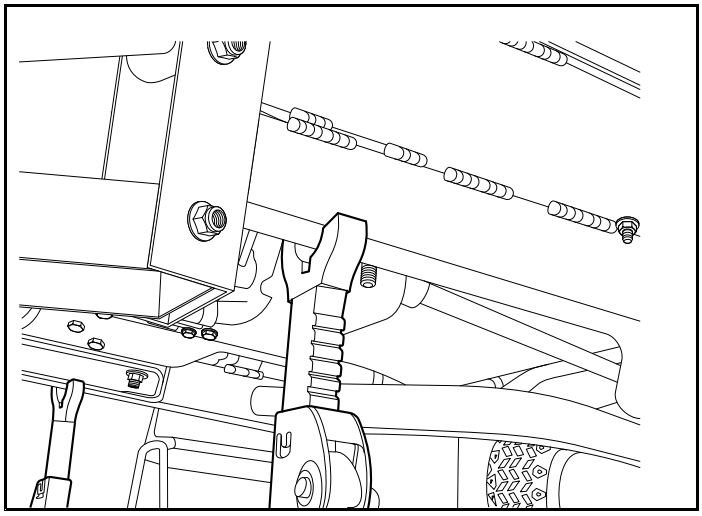


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**Figure 3-9 Front Jack Stand Placement**

## LIFTING ONLY THE REAR

1. Place vehicle on a level surface.
2. Chock the front wheels.
3. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
4. If removing wheel, loosen the rear wheel lug nuts.
5. Lift rear of vehicle and support on jack stands **(Figure 3-10, Page 3-8)**. **See WARNING "Lift only one end..." in General Warnings on page 1-2.**



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**Figure 3-10 Rear Jack Stand Placement**

### LIFTING THE ENTIRE VEHICLE

## ⚠ WARNING

- **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.**

1. Place vehicle on a level surface.
2. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
3. Chock the front or rear wheels and loosen the lug nuts.
4. If removing wheels, loosen the lug nuts.
5. Release the park brake and lift the front of the vehicle with a chain hoist or floor jack. **See preceding WARNING.**
6. Place jack stands under the outer front frame and lower onto stands **(Figure 3-9, Page 3-8)**.
7. 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.**

## ⚠ 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.**

8. Once vehicle is level, place jack stands under the rear axle tubes and lower onto stands.

## 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.**

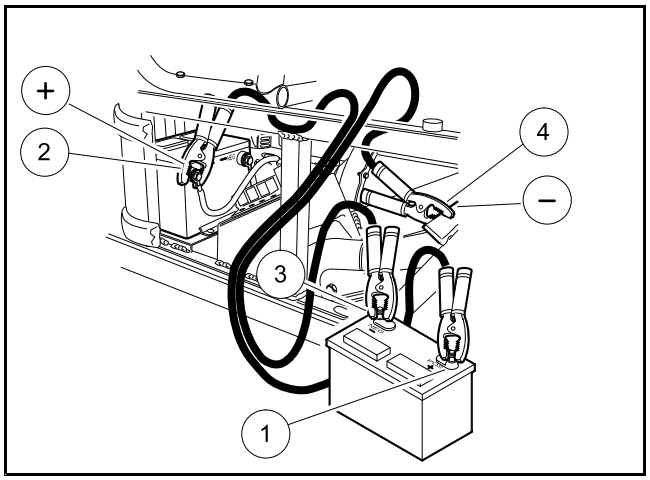
***NOTE:*** *A starting battery is recommended but a deep cycle battery can be used if necessary.*

3. Access the engine compartment by raising the cargo bed. **See WARNING "For vehicles with cargo beds..." in General Warnings on page 1-2.**
4. Locate the vehicle battery on the driver's side of the vehicle under the cargo bed **(Figure 3-11)**.

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 Warnings on page 1-2.**
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's 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

- **The alternator can be damaged if the following actions occur:**
  - **– Engine is operated with battery cables disconnected.**
  - **– Booster cables are connected wrong.**




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**Figure 3-11 Jump Starting**

# SECTION 4 — BODY AND TRIM



## ⚠ DANGER

- **See General Warnings, Section 1, Page 1-2.**

## ⚠ WARNING

- **See General Warnings, Section 1, Page 1-2.**

## GENERAL INFORMATION

The hood, center and side cowl panels are molded-in color, Geloy XTW plastic (except camo finishes and low-volume finishes, such as black, which remain painted but over the closest matching, molded-in color).

## CLEANING THE VEHICLE

**See General Warnings, Section 1, Page 1-2.**

## 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.**

## 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 Warnings, Section 1, Page 1-2.**

## 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 Warnings, Section 1, Page 1-2.**

## 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 battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
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 glovebox.
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. **Kawasaki Powered Gasoline vehicles:** Remove the choke cable from the engine choke lever. **See Choke Cable Removal on page 19-21.**
12. 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 17-7.**
3. **Kawasaki Powered Gasoline vehicles:** Connect the choke cable to the engine choke lever. **See Choke Cable Installation on page 19-22.**
4. 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.
5. 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.
6. 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).
7. 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.)
8. Install the knob for the Forward/Reverse shift handle by screwing the knob onto the shaft clockwise.
9. Install the steering wheel. **See Steering Wheel Installation, Section 7, Page 7-2.**
10. Connect battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**
11. 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), if equipped. **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 (if equipped) 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 (if equipped) 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 (if equipped) passes through the clearance hole in the side cowl panel.
3. Rotate the side cowl panel down and over the ROPS cowl support (if equipped) 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 4-4.**
9. Replace, lower and secure hood. **See Hood Installation on page 4-4.**
10. Reinstall Roll-over Protective Structure (ROPS), if equipped. **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 floorboard 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 4-4.**
7. Replace, lower and secure hood. **See Hood Installation on page 4-4.**

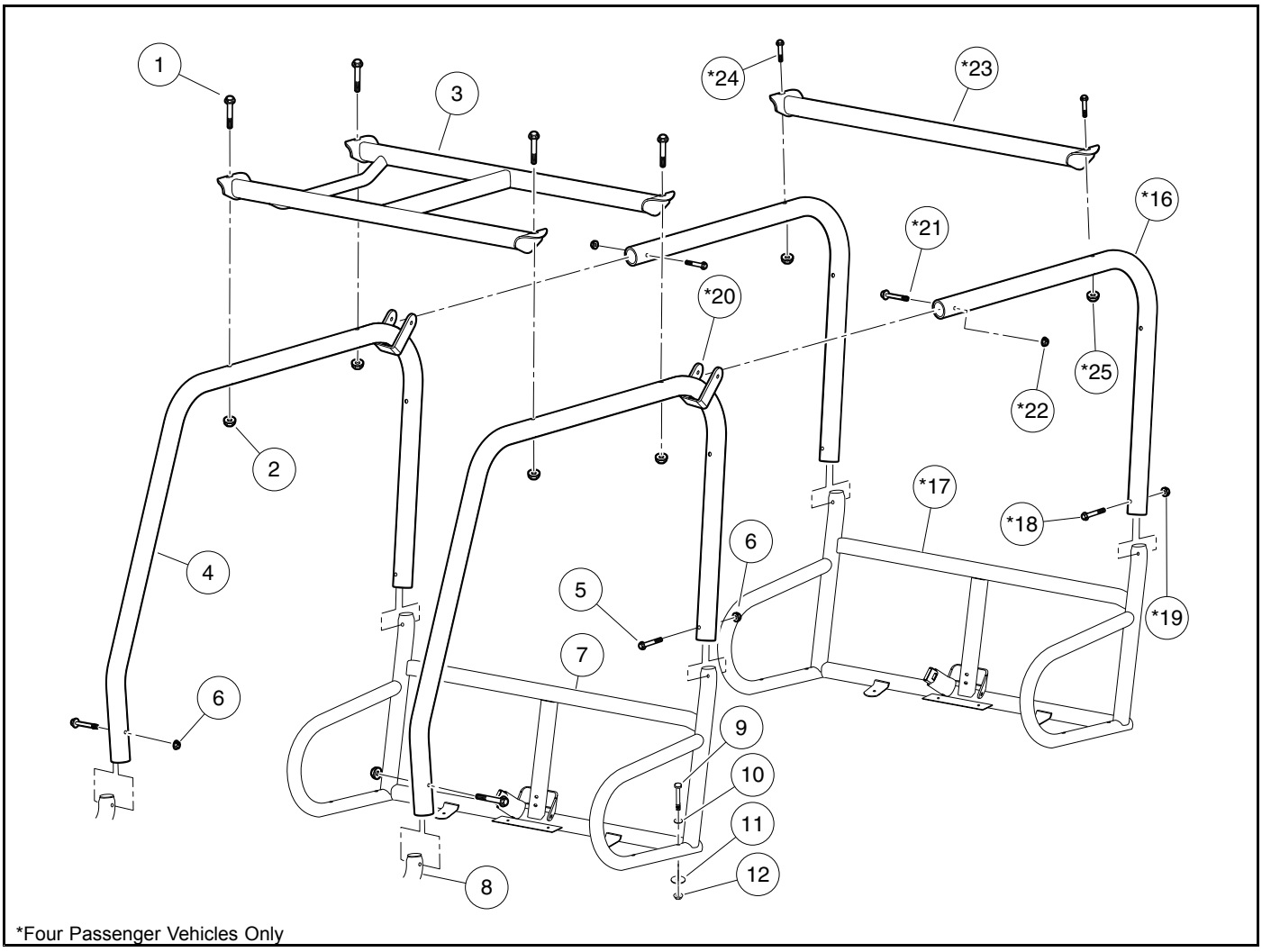
## ROLL-OVER PROTECTIVE STRUCTURE (ROPS)

**See General Warnings, Section 1, Page 1-2.**

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.**




*Four Passenger Vehicles Only

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**Figure 4-1 Roll-Over Protective Structure (ROPS) – Two and Four Passenger**

## 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)**.
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 Warnings, Section 1, Page 1-2.**

## 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 WARNING.**
3. Bench seat
3.1. Hold center seatbelt buckles (if equipped) 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).

## SEAT BELTS

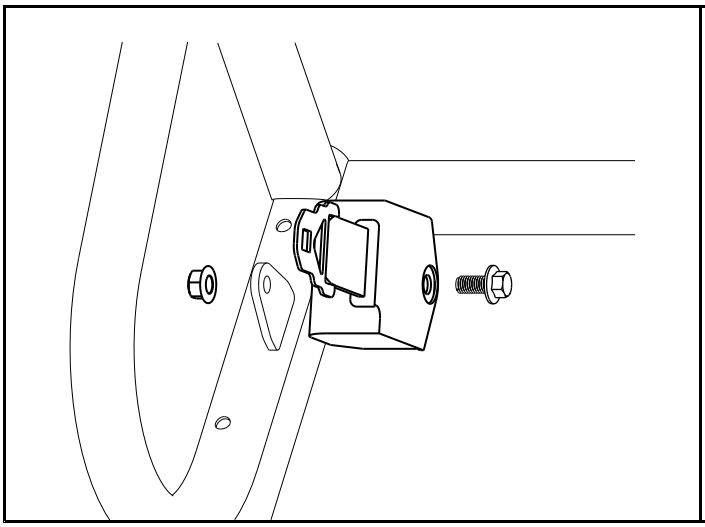
**See General Warnings, Section 1, Page 1-2.**

### ⚠ 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.**

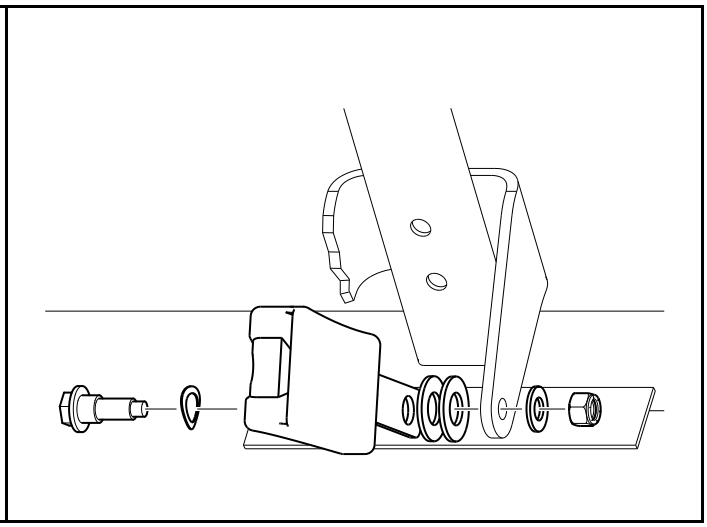
### BENCH SEAT BELT REMOVAL

1. Remove the flange bolt and nut from the base of the coiled seat belt assembly (outside location) **(Figure 4-2, Page 4-11)**.
2. Remove the coiled seat belt assembly.
3. Remove the nut, small washer and two large washers from the seat belt buckle assembly (center location) **(Figure 4-3, Page 4-11)**.
4. Remove the shoulder bolt, spring washer and seat belt buckle assembly.



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**Figure 4-2 Coiled Seat Belt Assembly**



1447

**Figure 4-3 Center Seat Belt Fastener**

### BENCH SEAT BELT INSTALLATION

1. Install the center seat belt buckle assembly to the seat belt bracket with hardware previously removed except for the lock nut **(Figure 4-3, Page 4-11)**. Use a new lock nut. Orient the assembly with the buckle end pointed up slightly and tighten the new lock nut to 33 ft-lb (44.7 N·m).
2. Secure the coiled seat belt assembly on the outside of the ROPS seat support with the shoulder bolt and a new lock nut **(Figure 4-2, Page 4-11)**. Orient the assembly with the tang end pointed up slightly and tighten the new lock nut to 35 ft-lb (47.5 N·m).

## CARGO BED – ELECTRIC LIFT

**See General Warnings, Section 1, Page 1-2.**

### TESTING THE BED LIFT MOTOR

**Gasoline Vehicles: See Test Procedure 35 – Bed Lift Motor on page 17-38.**

### 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 battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
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. With the bed in the down position, working from under the vehicle, mount the base of the bed lift motor to the frame bracket.

1.1. Slide the metal sleeve into the bed lift motor base rod with two spacer washers on each side.

1.2. Slide a lockwasher onto the bolt and up against the bolt head.

1.3. Fit the base between the frame bracket.

1.4. Slide the bolt through the frame bracket and actuator base.

1.5. Attach a lockwasher and nylon locknut finger tight.

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

2. Attach the rod end of the bed lift motor to the bed frame bracket.

2.1. Repeat steps 1.1 through 1.4 for the rod end of the bed lift motor.

2.2. Attach a lockwasher and nylon locknut and tighten to 23 ft-lb (31 N·m).

3. Tighten the locknut on the bed lift motor base to 30 ft-lb (41 N·m).
4. Attach the two electric wire connectors, red to red and yellow to yellow.
5. Connect battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

## 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 Warnings, Section 1, Page 1-2.**

## 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 4-15)**.
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 4-15)**.
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.

# REAR FENDER

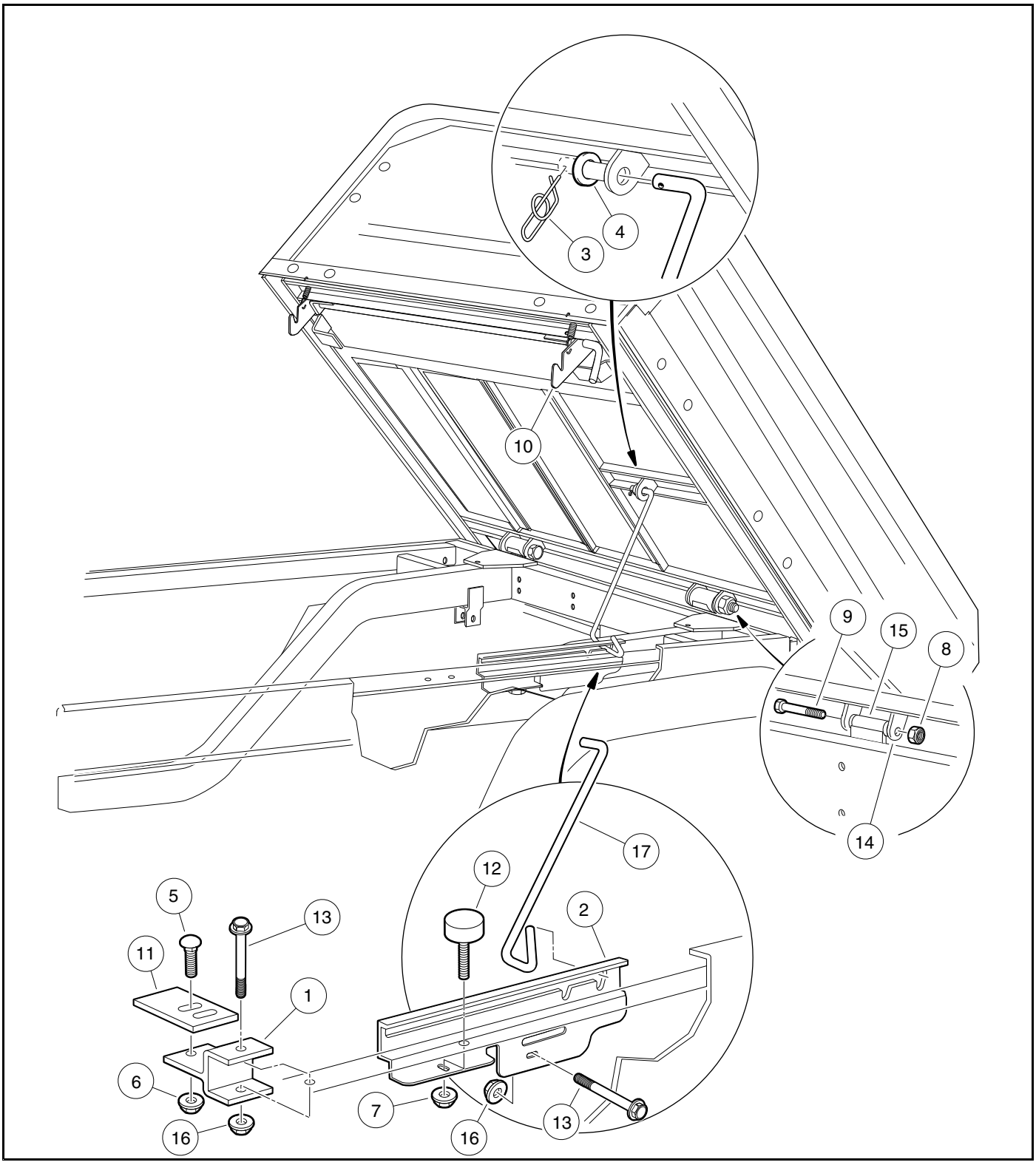
**See General Warnings, Section 1, Page 1-2.**

## 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.




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**Figure 4-4 Cargo Bed**

Pagination Page

# SECTION 5 — ACCELERATOR AND BRAKE PEDAL ASSEMBLIES



## ⚠ DANGER

- **See General Warnings, Section 1, Page 1-2.**

## ⚠ WARNING

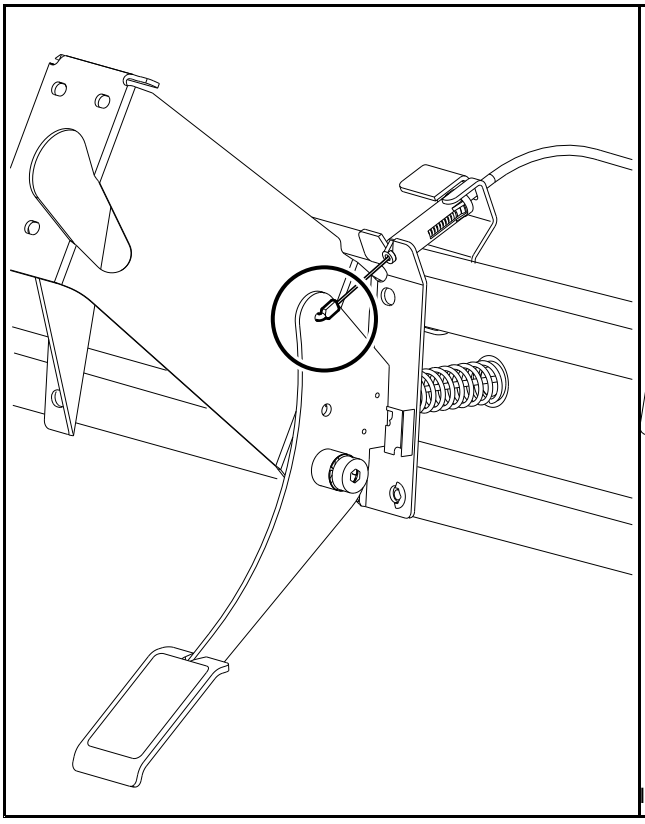
- **See General Warnings, Section 1, Page 1-2.**

## ACCELERATOR PEDAL

**See General Warnings, Section 1, Page 1-2.**

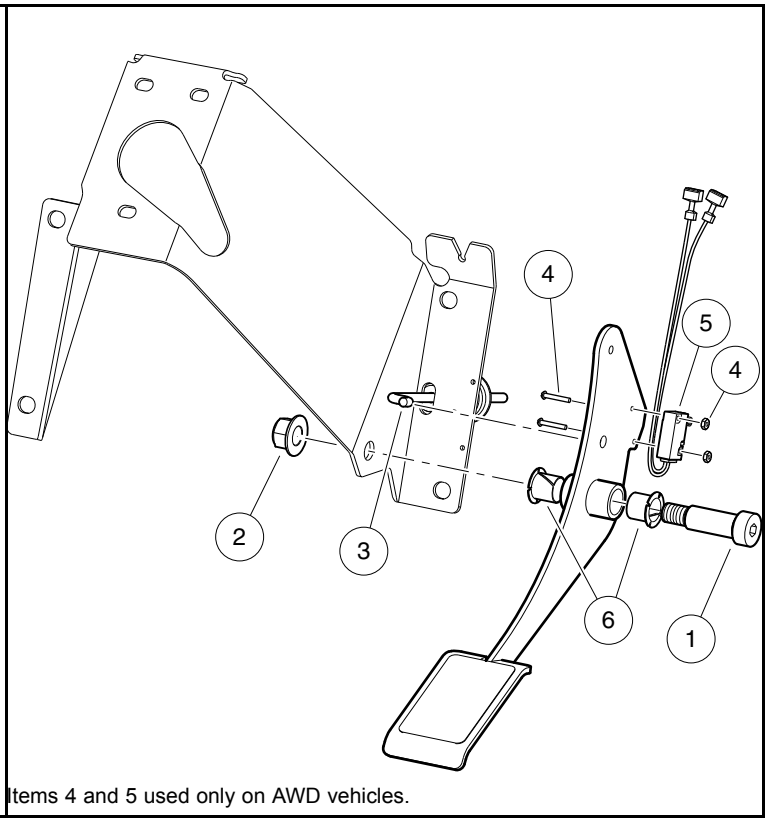
### ACCELERATOR PEDAL REMOVAL

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Disconnect the Z-shaped end of the accelerator cable from the pedal **(Figure 5-1, Page 5-1)**.



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**Figure 5-1 Z-Shaped Cable End At Accelerator Pedal**




Items 4 and 5 used only on AWD vehicles.

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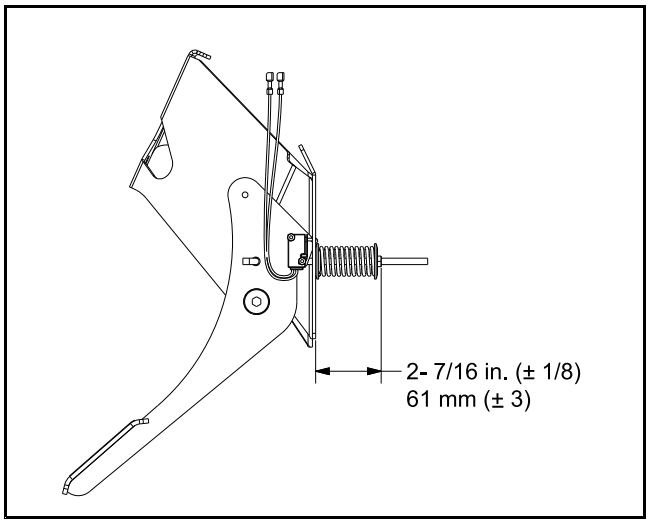
**Figure 5-2 Accelerator Pedal Mounting Hardware**

3. Remove the pedal pivot bolt (1) and locknut (2) that secure the pedal assembly to the chassis **(Figure 5-2, Page 5-1)**.
4. Remove the pedal assembly from the return spring pullrod (3). Loosen spring retaining nut if necessary.
5. **AWD only:** Remove hardware (4) securing the front differential limit switch (5) to the pedal.

6. Inspect the pedal bushings (6) for wear and replace if worn.

## ACCELERATOR PEDAL INSTALLATION

1. Installation is reverse of removal procedure.
2. Check return spring length and adjust if necessary **(Figure 5-3, Page 5-2)**.
3. Tighten pedal pivot bolt (1) and locknut (2) to 30 ft-lb (68 N·m).
4. Connect battery and spark plug wire(s). **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**



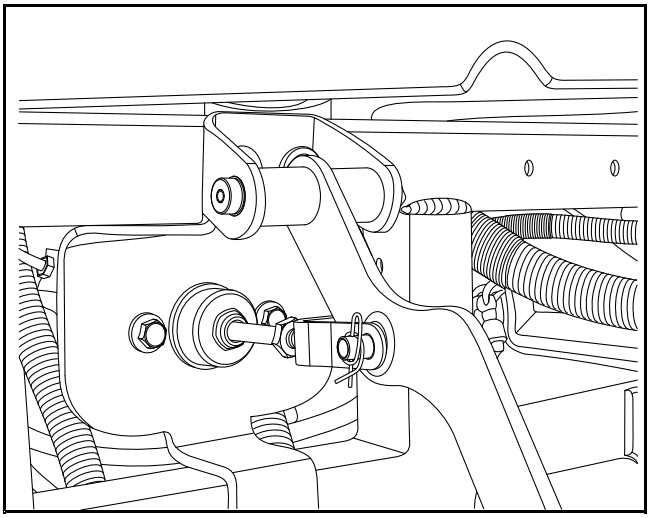

2361
**Figure 5-3 Accelerator Pedal Return Spring Length (To Face Of Nut As Shown)**

# BRAKE PEDAL

**See General Warnings, Section 1, Page 1-2.**

## BRAKE PEDAL REMOVAL

1. Disable the vehicle. **See Disabling the Vehicle on page 1-3.**
2. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
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.



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**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 battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

## BRAKE PEDAL ADJUSTMENT

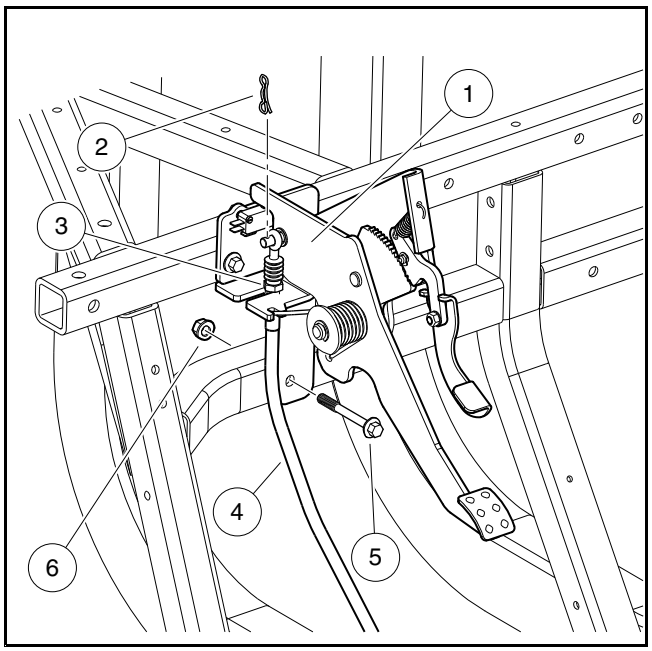
1. Loosen the master cylinder rod and clevis jam nut **(Figure 5-4, Page 5-3)**.
2. Rotate the master cylinder rod to extend or retract the clevis and brake pedal to the desired position.
3. Tighten the jam nut to 14 ft-lb (19 N·m).
4. Perform all brake system inspections to ensure that the hydraulic 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 Warnings, Section 1, Page 1-2.**

## PARK BRAKE PEDAL ASSEMBLY REMOVAL

1. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Remove the driver side cup holder to access the cable end at the park brake pedal assembly.
3. Disconnect the cable end from the park brake pedal assembly (1) by removing the bow tie locking pin (2) **(Figure 5-5, Page 5-4)**.
4. Loosen the park brake cable jam nuts (3) that secure the cable sheath to the pedal and remove cable (4).
5. Remove the three bolts (5) and locknuts (6) that secure the park brake pedal assembly to the chassis.
6. Remove the park brake pedal assembly from the vehicle.




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**Figure 5-5 Park Brake Pedal Removal**

## PARK BRAKE PEDAL ASSEMBLY INSTALLATION

1. If installing a used assembly, be sure to use a small, stiff brush to remove all dirt and debris from the ratchet teeth **(Figure 5-5, Page 5-4)**.
2. Install the park brake pedal assembly and secure with three bolts (3) and locknuts (4). Tighten the locknuts to 15 ft-lb (20 N·m).
3. Install the cable sheath into the pedal assembly and finger-tighten the jam nuts.
4. Connect the cable end to the park brake pedal and secure with bow tie locking pin (1).
5. Connect battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**
6. Adjust the park brake cable. **See Park Brake Adjustment on page 6-23.**

# SECTION 6 — HYDRAULIC BRAKE AND PARK BRAKE SYSTEMS



## ⚠ DANGER

- **See General Warnings, Section 1, Page 1-2.**

## ⚠ WARNING

- **See General Warnings, Section 1, Page 1-2.**

## ⚠ CAUTION

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

## GENERAL INFORMATION

The hydraulic service brake system consists of a master cylinder actuating dual piston front calipers and single piston rear calipers.

The mechanical park brake system consists of a foot-operated pedal actuating a transmission-mounted caliper through a single cable. The park brake disc is installed on the front output shaft of the transmission. Upon engaging the park brake pedal, an indicator light illuminates in the dash panel.

## BRAKE SYSTEM INSPECTION

**See General Warnings, Section 1, Page 1-2.**

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 5-3.**
- 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 6-18.**
- Hold the brake pedal down with medium foot pressure (25 to 35 lb (11 to 16 kg)) 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 6-18.**

## MASTER CYLINDER INSPECTION

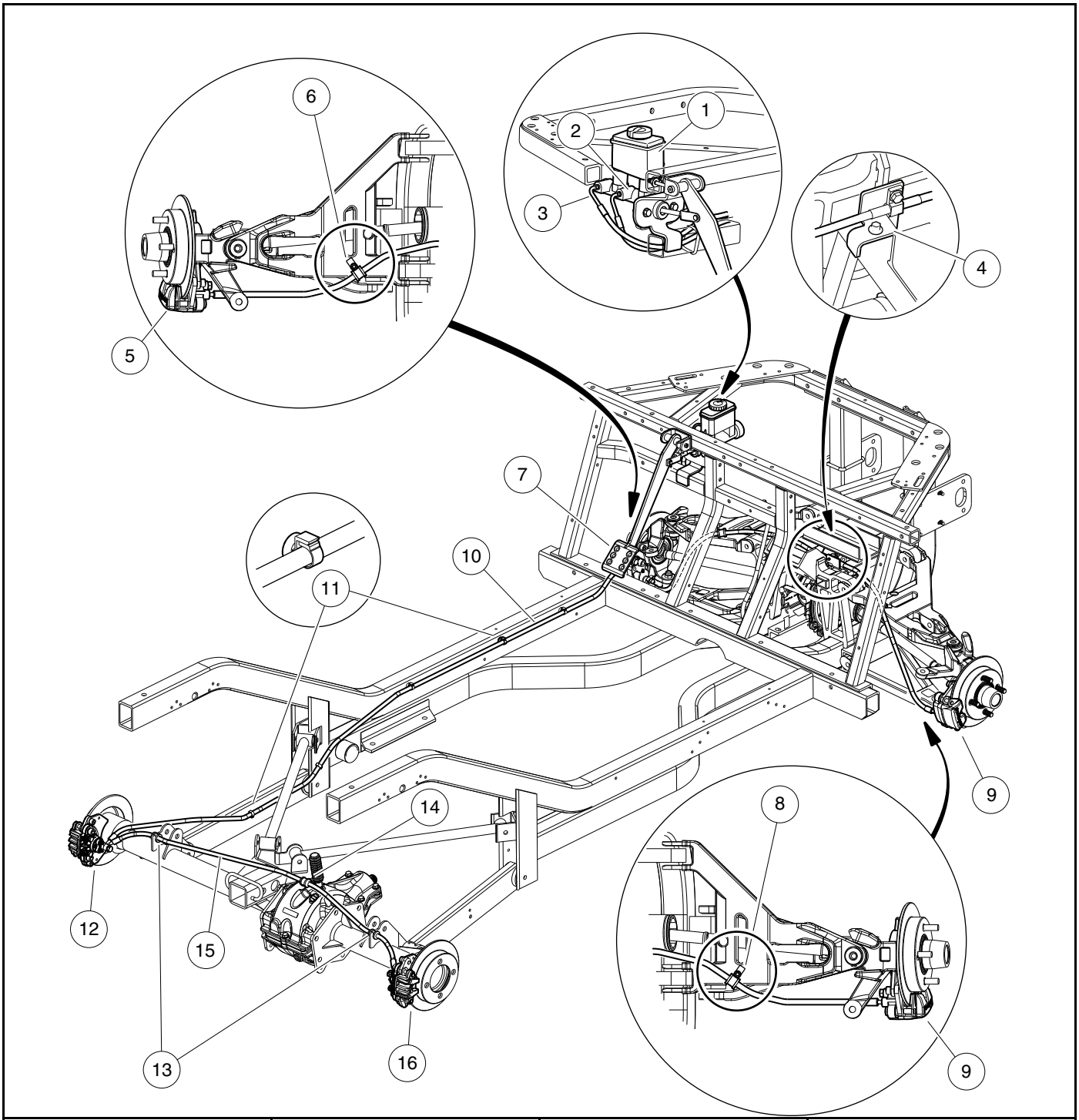
- Inspect the exterior of the master cylinder. Replace any leaking components and bleed the hydraulic brake system. **See Bleeding the Hydraulic Brake System on page 6-18.**
- Check the brake fluid level. **See Brake Fluid Reservoir on page 11-10.**
- Remove the reservoir cap and inspect the brake fluid. If the brake fluid is contaminated, purge the brake fluid and refill the hydraulic system. **See Master Cylinder and Reservoir on page 6-17.**
- 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.

## BRAKE HOSE INSPECTION

- Inspect the brake hoses and fittings for leakage. They must be flexible and free of leaks, cuts, cracks or bulges. Replace as needed. **See Brake Hose Replacement on page 6-14.**
- Turn the steering wheel all the way from left to right and back again. Contact between the brake hoses and any other moving 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 6-7.** Also Brake Hose Replacement on page 6-14.

## 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 Adjustment on page 6-23.**
- Check the park brake cable and linkage for damage. The cable should not come in contact with moving or rotating parts.
- Inspect park brake disc. It should not be warped or have excessive scores or heat checks.




| | | | |
|---|---|---|---|
| 1. Brake Fluid Reservoir | 5. Driver Side Front Brake Caliper | 9. Passenger Side Front Brake Caliper | 13. Grommet |
| 2. Master Cylinder | 6. Driver Side P-Clamp | 10. Mid Brake Hydraulic Hose | 14. P-Clamp |
| 3. Front Brake Hydraulic Hose | 7. Brake Pedal | 11. Anchor | 15. Rear Brake Hydraulic Hose |
| 4. T-Bracket | 8. Passenger Side P-Clamp | 12. Driver Side Rear Brake Caliper | 16. Passenger Side Rear Brake Caliper |

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**Figure 6-1 Hydraulic Disc Brake System**

## 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 (3.81 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.

  It is highly recommended that brake calipers, both front and rear, be thoroughly cleaned whenever the vehicle is subjected to extreme environments that can allow a large accumulation of mud or ice/snow to become packed between the inside of the wheel rim and the brake calipers. Pressure washing, or equivalent, is recommended to remove such accumulation from the calipers.

### ⚠ WARNING

- **Long-term operation of a vehicle with material packed around the calipers can inhibit brake function and possibly damage brake components, leading to possible severe personal injury or death.**

- 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 (0.508 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 Brake Pads and Caliper on page 6-7.** |
| | Leak in the hydraulic system | Check the master cylinder, brake hoses and connections for leaks. Replace all damaged parts and bleed brake system. |
| | Air in the hydraulic system | **See Bleeding the Hydraulic Brake System on page 6-18.** |
| | Weak (bulging) brake hose | Replace the worn hose. **See Brake Hose Replacement on page 6-14.** |
| | Improperly adjusted master cylinder push rod | **See Brake Pedal Adjustment, Section 5, Page 5-3.** |
| Springy or spongy brake pedal – brake pedal has soft, springy, or spongy feel when pressed | Cracked or thin disc | Replace brake discs. **See Brake Discs on page 6-13.** |
| | 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 6-20.** |
| | Weak (bulging) brake hoses that expand under pressure | Check the master cylinder and brake hoses for leaks or bulges. Replace all damaged parts. |
| | Air in the hydraulic system | **See Bleeding the Hydraulic Brake System on page 6-18.** |
| 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 Pads and Caliper on page 6-7.** |
| | Glazed brake pads | Replace the brake pads. **See Brake Pads and Caliper on page 6-7.** |
| | Damaged or distorted brake pads | Replace the brake pads. **See Brake Pads and Caliper on page 6-7.** |
| | Clogged brake hoses | Replace brake hoses as required. **See Brake Hose Replacement on page 6-14.** |
| | Frozen master cylinder piston or bent rod | Replace master cylinder. **See Master Cylinder and Reservoir on page 6-17.** |
| Over- aggressive braking | Incorrect or distorted brake pads | Replace the brake pads. **See Brake Pads and Caliper on page 6-7.** |

**TABLE CONTINUED ON NEXT PAGE**

| TROUBLESHOOTING GUIDE | | |
|---|---|---|
| **SYMPTOM** | **POSSIBLE CAUSES** | **CORRECTIVE ACTION** |
| Vehicle pulls to one side | Incorrect or distorted brake pads | Replace the brake pads. **See Brake Pads and Caliper on page 6-7.** |
| | Grease or brake fluid on the brake pads | Replace hub, axle seal, or caliper, and replace the brake pads. **See Brake Pads and Caliper on page 6-7.** |
| | Scored or warped brake disc | Replace the brake disc. **See Brake Discs on page 6-13.** |
| | 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 6-7.** |
| | Faulty suspension parts or alignment | **See Steering and Front Suspension on page 7-1 or Rear Suspension on page 9-1.** |
| Pulsating brake pedal | Warped or worn brake discs | Replace the brake discs. **See Brake Discs on page 6-13.** |
| | Bent wheel | Replace the wheel. |
| | Worn or damaged wheel bearings | Replace bearings. **See Front Hubs on page 8-3 or Rear Axle Tubes, Axle Shafts and Wheel Bearings on page 10-16.** |
| Decreasing brake pedal travel | Sticking caliper piston | Replace the caliper. **See Brake Pads and Caliper on page 6-7.** |
| 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 6-7.** |
| | Worn brake pads | Replace the brake pads. **See Brake Pads and Caliper on page 6-7.** |
| | Foreign material embedded in brake pads | Replace the brake pads. **See Brake Pads and Caliper on page 6-7.** |
| | Brake discs are cracked or scored | Replace the brake discs. **See Brake Discs on page 6-13.** |
| All brakes drag | Binding brake pedal | Replace bushings and adjust. Also replace any bent or damaged components. **See Accelerator and Brake Pedal Assemblies on page 5-1.** |
| | Soft or swollen rubber parts | Replace master cylinder and/or calipers. **See Master Cylinder and Reservoir on page 6-17. See Brake Pads and Caliper on page 6-7.** |
| | Binding park brake cable | Adjust or replace cable. |
| | Improper park brake adjustment | **See Park Brake System on page 6-21.** |

**TABLE CONTINUED ON NEXT PAGE**

| TROUBLESHOOTING GUIDE | | |
|---|---|---|
| **SYMPTOM** | **POSSIBLE CAUSES** | **CORRECTIVE ACTION** |
| One brake drags | Sticking caliper pistons | Replace the caliper. **See Brake Pads and Caliper on page 6-7.** |
| | Bent or distorted brake pads | Replace the brake pads. **See Brake Pads and Caliper on page 6-7.** |
| | Worn front or rear wheel bearings | Replace front wheel bearings. See Front Hubs on page 8-3 or Rear Axle Tubes, Axle Shafts and Wheel Bearings on page 10-16. |
| | Damaged brake hose | Replace brake hoses as required. **See Brake Hose Replacement on page 6-14.** |

# BRAKE PADS AND CALIPER

**See General Warnings on page 1-2.**

## FRONT BRAKE PAD REMOVAL

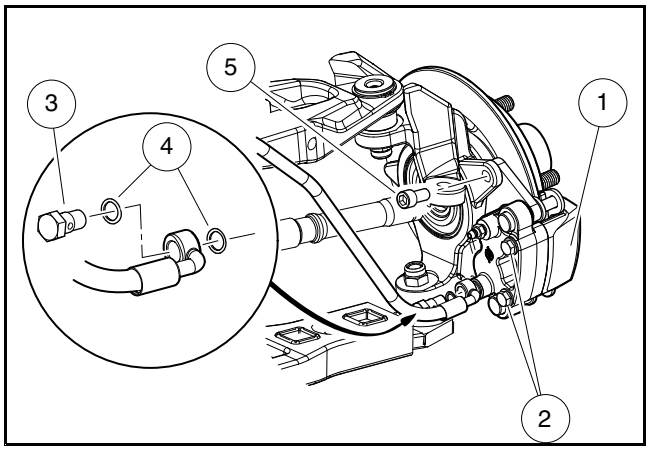
### ⚠ WARNING

- **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 6-18.**
- **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 the 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. Lift and support the front or entire vehicle and remove the wheel(s). **See Lifting The Vehicle, Section 3, Page 3-7.**
2. Remove the hex-head bolts (2) **(Figure 6-2, Page 6-8)** holding the caliper halves together.
3. Remove the outer caliper half and the outer brake pad (1).
4. Remove the brake disc from the hub.
5. Remove the inner brake pad.




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**Figure 6-2 Front Brake Pad and Caliper**

## FRONT BRAKE PAD 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 6-18.**

1. Place inner brake pad onto caliper pins. **See following NOTE and WARNING.**

***NOTE:*** *To help prevent noise, a silicone-based brake lubricant may be applied to the surfaces (on the back side of the brake pads) that contact the caliper. A thin film may also be applied to the slide-pins. Always follow lubricant manufacturer's directions.*

### ⚠ WARNING

- **To reduce the possibility of diminished brake performance or failure, never use petroleum-based lubricants on brake system components, and ensure lubricant does not contact friction surfaces of brake pads or rotors.**

2. Install brake disc onto hub.
3. Place outer brake pad onto caliper pins.
4. Install outer caliper half and secure with two hex-head bolts (2). Tighten bolts to 360 in-lb (40.6 N·m).
5. Repeat procedure for the opposite brake if necessary.
6. Install the tire and wheel. Finger-tighten the lug nuts.
7. Lower the vehicle and use a crisscross pattern to tighten the lug nuts to 85 ft-lb (115 N·m).
8. Inspect the brake system. **See Brake System Inspection on page 6-1.**
9. 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 eight to twelve times.

## FRONT 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 6-18.**
- **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 the 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. Lift and support the front or entire vehicle and remove the wheel(s). **See Lifting The Vehicle, Section 3, Page 3-7.**
2. Remove the banjo bolt (3) and copper washers (4) holding brake hose to caliper **(Figure 6-2)**. Discard the copper washers. **See following NOTE.**

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

3. If the caliper will be used again, plug the banjo bolt hole to prevent dirt and debris entering the caliper.
4. Place a plastic bag over the hose fitting to prevent dirt and debris entering the hose.
5. Remove the two socket-head bolts (5) securing the caliper assembly to the steering upright.
6. Lift the caliper assembly (1) off the steering upright and brake disc.

## FRONT 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 6-18.**

1. Place the caliper assembly (1) onto the steering upright making sure the brake disc slides between the inner and outer brake pads.

***NOTE:*** *To help prevent noise, a silicone-based brake lubricant may be applied to the surfaces (on the back side of the brake pads) that contact the caliper. A thin film may also be applied to the slide-pins. Always follow lubricant manufacturer's directions.*

## ⚠ WARNING

- **To reduce the possibility of diminished brake performance or failure, never use petroleum-based lubricants on brake system components, and ensure lubricant does not contact friction surfaces of brake pads or rotors.**

2. Secure caliper assembly to steering upright with two, new socket-head bolts (5). Tighten bolts to 37 lb-ft (50 N·m).
3. Secure the brake hose to the caliper with banjo bolt (3) and new copper washers (4). Tighten to 13 lb-ft (18 N·m). **See following CAUTION.**

## CAUTION

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

4. Fill the reservoir of the master cylinder and bleed the hydraulic system. **See Bleeding the Hydraulic Brake System on page 6-18. See following WARNING.**

## ⚠ WARNING

- **Ensure hydraulic hoses cannot contact any moving parts that will cause wear and damage.**

5. Repeat procedure for the opposite brake if necessary.
6. Install the tire and wheel. Finger-tighten the lug nuts.
7. Lower the vehicle and use a crisscross pattern to tighten the lug nuts to 85 ft-lb (115 N·m).
8. Inspect the brake system. **See Brake System Inspection on page 6-1.**

### REAR BRAKE PAD AND CALIPER REMOVAL

## ⚠ WARNING

- **Due to piston size, 2-passenger and 4-passenger vehicles have different rear calipers. Be careful not to interchange parts.**
- **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 6-18.**
- **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

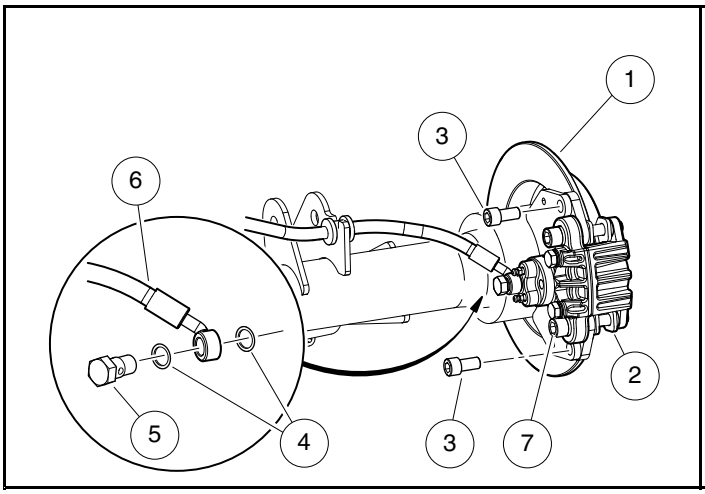
- **Do not pump the brake pedal without brake fluid in the master cylinder and reservoir.**
- **Worn or damaged brake discs cannot be machined to refinish them. Replace as necessary.**

1. Lift and support the rear or entire vehicle and remove the wheel(s). **See Lifting The Vehicle, Section 3, Page 3-7.**
2. If replacing pads only, skip to step 6.
3. If replacing caliper, remove the banjo bolt (5) and copper washers (4) holding brake hose to caliper. Discard the copper washers **(Figure 6-3, Page 6-11)**. **See following NOTE.**

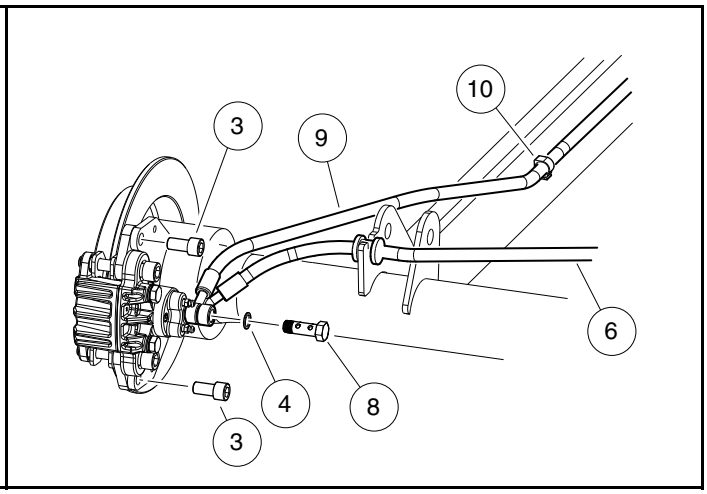
***NOTE:*** *Driver's side brake hose connection uses 2 hoses (6 and 9) and a double length banjo bolt (8).* ***(Figure 6-4, Page 6-11)****.*

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

4. If the caliper will be used again, plug the banjo bolt hole to prevent dirt and debris entering the caliper.
5. Place a plastic bag over the hose fitting to prevent dirt and debris entering the hose.
6. Remove the two socket-head slide-pin bolts (7) securing the caliper (2) to its mounting bracket.
7. Pull the caliper (2) off the mounting bracket and remove the pads.




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**Figure 6-3 Rear Brake Caliper and Pads (Passenger side)**




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**Figure 6-4 Rear Brake Caliper and Pads (Driver side)**

## 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 6-18.**

1. Place and hold the brake pads in the caliper (2) and install the caliper onto its mounting bracket. **See following NOTE and WARNING.**

***NOTE:*** *To help prevent noise, a silicone-based brake lubricant may be applied to the surfaces (on the back side of the brake pads) that contact the caliper. A thin film may also be applied to the slide-pins. Always follow lubricant manufacturer's directions.*

### ⚠ WARNING

- **To reduce the possibility of diminished brake performance or failure, never use petroleum-based lubricants on brake system components, and ensure lubricant does not contact friction surfaces of brake pads or rotors.**

2. Insert the socket-head slide-pin bolts (7) through the caliper (2), mounting bracket and brake pads. Thread the slide-pin bolts into the mounting bracket and tighten to 32 ft-lb (43 N·m).

3. **Caliper Only:** Secure the brake hose (6) to the caliper with banjo bolt (5) and new copper washers (4) **(Figure 6-3, Page 6-11)**. Tighten to 146 in-lb (16.5 N·m). **See following CAUTION and NOTE.**

## ⚠ CAUTION

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

***NOTE:*** *Driver's side brake hose connection uses 2 hoses (6 and 9) and a double length banjo bolt (8).* ***(Figure 6-4, Page 6-11)****.*

4. Fill the reservoir of the master cylinder and bleed the hydraulic system. **See Bleeding the Hydraulic Brake System on page 6-18. See following WARNING.**

## ⚠ WARNING

- **Use the top bleeding port on each caliper to bleed that respective rear wheel.**
- **Ensure hydraulic hoses cannot contact any moving parts that will cause wear and damage.**

5. Repeat procedure for the opposite brake if necessary.
6. Install the tire and wheel. Finger-tighten the lug nuts.
7. Lower the vehicle and use a crisscross pattern to tighten the lug nuts to 85 ft-lb (115 N·m).
8. Inspect the brake system. **See Brake System Inspection on page 6-1.**
9. 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 eight to twelve times.

# BRAKE DISCS

**See General Warnings on page 1-2.**

## 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 6-18.**

### ⚠ CAUTION

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

1. Remove the caliper. **See Front Caliper Removal on page 6-9 or . 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.**

2. Slide the disc off the wheel studs to remove.

## 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 6-18.**

1. Place disc onto wheel studs in hub flange making sure it is fully seated against hub.
2. Inspect the brake pads for wear and replace if necessary. **See Brake Disc and Pad Inspection on page 6-4.**

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

3. Install the pads and caliper. **See Front Caliper Installation on page 6-9 or .**

# BRAKE HOSE REPLACEMENT

**See General Warnings, Section 1, Page 1-2.**

## ⚠ 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 6-18.**
- **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 hoses are provided as assemblies without separating unions other than those at the wheels and master cylinder.*

## FRONT BRAKE HOSE 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 hose at the master cylinder. **See following NOTE.**

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

4. Remove the banjo bolt and copper washers from each front caliper. **(Figure 6-2, Page 6-8)**.

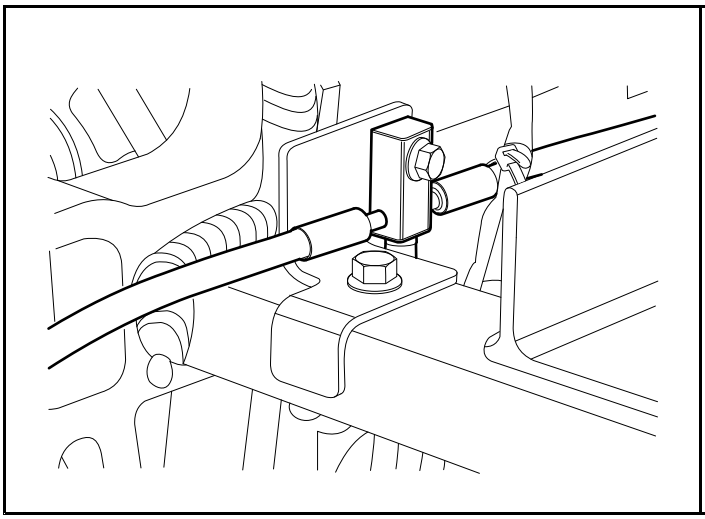
***NOTE:*** *Place a pan under each caliper to collect brake fluid.*

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

5. Unsnap the three brake hose clips.
6. Remove the screws that secure the T-bracket (1) to the frame **(Figure 6-5)** and P-clamps to the upper A-arms **(Figure 6-6, Page 6-15)**.
7. Remove front brake hose from vehicle.

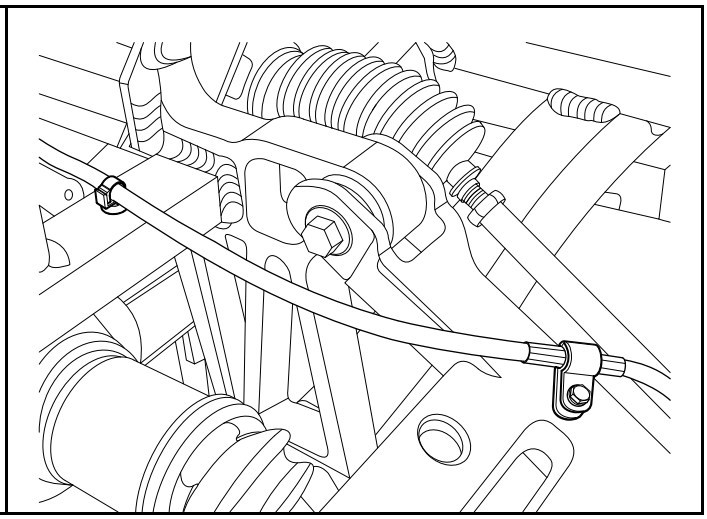
## FRONT BRAKE HOSE INSTALLATION

1. Install new front brake hose following same routing as old brake hose.
2. Carefully insert the flared end of the brake hose end into the master cylinder and tighten the hardware to 132 in-lb (15 N·m).
3. Install the T-bracket (1) on the frame **(Figure 6-5, Page 6-15)** and P-clamps on the upper A-arms **(Figure 6-6, Page 6-15)**. Tighten screws to 85 in-lb (9.6 N·m).
4. Secure the hoses in the three snap clips.



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**Figure 6-5 Front Brake Hose T-Bracket**



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**Figure 6-6 Front Brake Hose Snap Clip and P-clamp**

5. Connect front brake hose to each front caliper with banjo bolts and new copper washers. Tighten banjo bolts to 13 ft-lb (18 N·m). **See following CAUTION.**

## ⚠ CAUTION

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

6. Fill the reservoir of the master cylinder and bleed the hydraulic system. **See Bleeding the Hydraulic Brake System on page 6-18.**
7. 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.**

8. Close hood.

### MID BRAKE HOSE REMOVAL

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

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

4. Remove the double banjo bolt and copper washers from the driver side rear caliper **(Figure 6-3, Page 6-11)**. **See following NOTE.**

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

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

5. Unsnap the brake hose clips along the driver side frame rail and remove hose from vehicle.

## MID BRAKE HOSE INSTALLATION

1. Install new mid brake hose and position it along the driver side frame rail and up to the master cylinder.
2. Carefully install the flared end of the brake hose into the master cylinder and tighten to 132 in-lb (15 N·m).
3. Connect mid brake hose and rear brake hose to the driver side rear caliper with double banjo bolt and new copper washers. Tighten the double banjo bolt to 13 ft-lb (18 N·m). **See following CAUTION.**

### CAUTION

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

4. Secure the mid brake hose in the snap clips on the frame.
5. Fill the reservoir of the master cylinder and bleed the hydraulic system. **See Bleeding the Hydraulic Brake System on page 6-18.**
6. Perform all of the brake system inspections. **See Brake System Inspection on page 6-1.**

## REAR BRAKE HOSE REMOVAL

1. Chock the front wheels and set the park brake.
2. Remove the double banjo bolt and copper washers from the driver side rear caliper **(Figure 6-3, Page 6-11)**. **See following NOTE.**

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

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

3. Remove the banjo bolt and copper washers from the passenger side rear caliper **(Figure 6-3, Page 6-11)**. **See preceding NOTE.**
4. Remove the screw that secures the P-clamp to the top of differential.
5. Remove rear brake hose grommet from each axle tube and remove hose from vehicle.

## REAR BRAKE HOSE INSTALLATION

1. Install new rear brake hose and position it on the rear axle.
2. Connect rear brake hose and mid brake hose to the driver side rear caliper with double banjo bolt and new copper washers. Tighten the double banjo bolt to 13 ft-lb (18 N·m). **See following CAUTION.**

### CAUTION

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

3. Connect rear brake hose to the passenger side rear caliper with banjo bolt and new copper washers. Tighten the banjo bolt to 13 ft-lb (18 N·m). **See preceding CAUTION.**
4. Secure the P-clamp to the top of differential with screw. Tighten screw to 85 in-lb (9.6 N·m).
5. Secure the rear brake hose grommets to each axle tube.
6. Fill the reservoir of the master cylinder and bleed the hydraulic system. **See Bleeding the Hydraulic Brake System on page 6-18.**
7. Perform all of the brake system inspections. **See Brake System Inspection on page 6-1.**

# MASTER CYLINDER AND RESERVOIR

**See General Warnings, Section 1, Page 1-2.**

## 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.

## 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 6-18.**

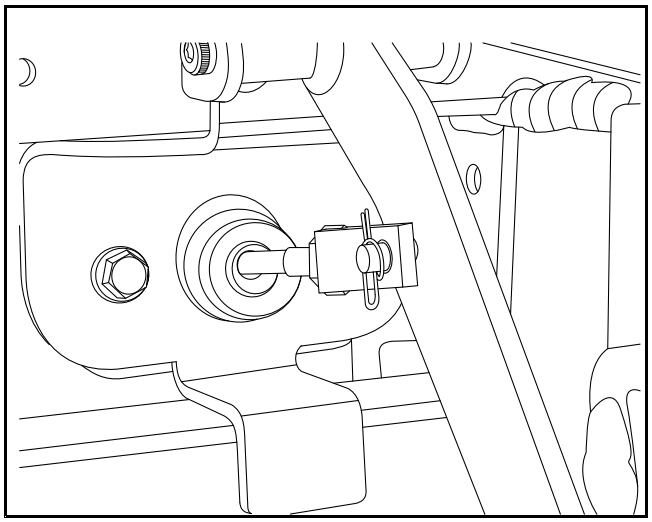
1. Chock the wheels and set the park brake.
2. Open hood.
3. Use a flare-nut wrench to remove the front and rear brake hoses from the master cylinder. **See following NOTE.**

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

4. Remove the rue pin and clevis pin from the brake pedal and push rod clevis **(Figure 6-7, Page 6-18)**.
5. Remove the two bolts and locknuts that secure the master cylinder to the frame.
6. 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 6-7, Page 6-18)**.
3. Carefully secure the front and rear brake hose flare fittings to the master cylinder. Finger-tighten the hardware.
4. Use a flare-nut wrench to tighten the brake hose fittings to 11 ft-lb (15 N·m).
5. Fill the reservoir with brake fluid specified for this vehicle and bleed the hydraulic brake system. **See Bleeding the Hydraulic Brake System on page 6-18.**
6. 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 5-3.**
7. Inspect the brake system. **See Brake System Inspection on page 6-1.**



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**Figure 6-7 Master Cylinder Rod and Brake Pedal**

## BLEEDING THE HYDRAULIC BRAKE SYSTEM

**See General Warnings, Section 1, Page 1-2.**

### ⚠ 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 (including accessories) in preparation for lifting the vehicle. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL. **See Disabling the Vehicle on page 1-3.**
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 5-3.**

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. Lift and support the vehicle and remove the wheels. **See Lifting The Vehicle on page 3-7.**

5.2. Connect the vacuum-type brake bleeder.

5.2.1. **Front 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 front caliper assemblies.

5.2.2. **Rear 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 rear caliper assemblies.

5.3. Connect an air hose to the vacuum brake bleeder. The air pressure must be regulated at 12 to 15 psig (82.7 to 103.4 kPa).

5.4. Press the handle on the brake bleeder to start the vacuum.

5.5. With the vacuum running, open each of the top brake bleeder valves 1/4 turn on the front wheel calipers.

5.6. 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 hoses. **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.*

5.7. With the vacuum still running, tighten the two top front brake bleeder valves to 25 in·lb (3 N·m).

5.8. 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. See Lifting The Vehicle on page 3-7.**

The following procedure will enable correct bleeding:

6.1. Lift and support the vehicle and remove the wheels. **See Lifting The Vehicle on page 3-7.**

6.2. 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. (473 mL) 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.

6.3. 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 hoses.

6.4. 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.

6.5. 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.

6.6. 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.*

6.7. 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.

6.8. 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

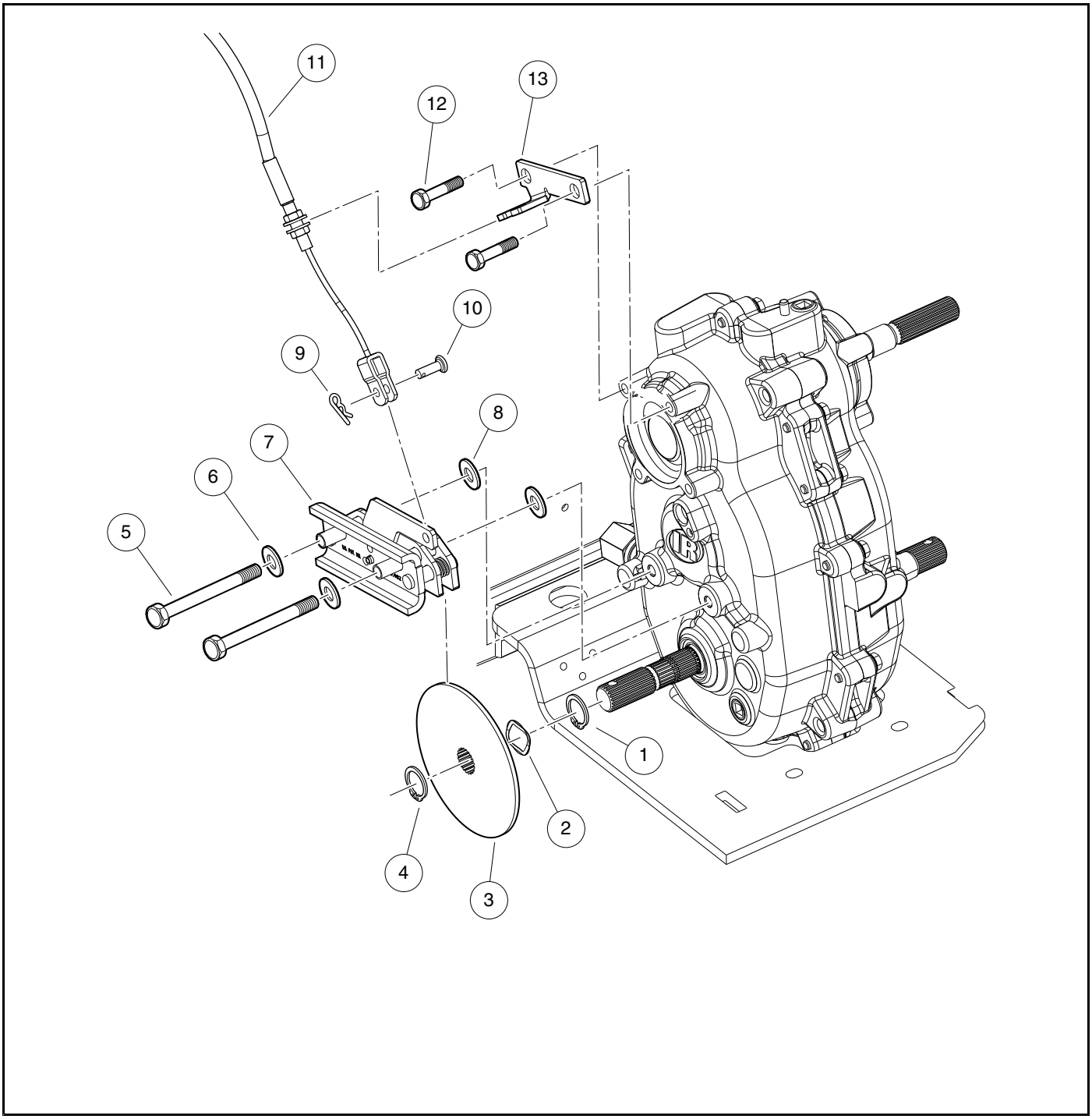
In some cases it may be necessary to completely drain the front, rear, or entire hydraulic brake system of brake fluid. To completely purge the hydraulic system, perform the following procedure.

1. Perform steps 2 through 6.5 of Bleeding the Hydraulic Brake System on page 6-18.
2. Draw 1 qt. (0.95 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 Warnings, Section 1, Page 1-2.**

***NOTE:*** *The park brake pads are not replaceable. Once pads are worn, the park brake caliper and pad assembly must be replaced as a unit.*




2742a

**Figure 6-8 Park Brake Caliper, and Disc**

## PARK BRAKE CALIPER AND PAD REPLACEMENT

***NOTE:*** *A wave washer is to be used during the park brake disc/rotor installation to keep pressure against the rotor to eliminate noise.*

1. Chock the wheels, and release the park brake.
2. Remove the seat bottom.
3. Unload and raise the cargo bed.
4. Remove bow-tie clip (9) and clevis pin (10) securing park brake cable (11) to caliper (7) **(Figure 6-8, Page 6-21)**.
5. Remove two bolts securing caliper to transmission.
6. Remove park brake caliper (7) from vehicle.
7. Inspect park brake disc (3) for wear and thickness. **See Park Brake Inspection on page 6-2.** If park brake disc needs to be replaced, **See Park Brake Disc Replacement on page 6-22.**
8. Place new caliper onto transmission making sure the disc is between the pads. Secure caliper with new bolts and tighten bolts to 35 lb-ft (48 N·m).
9. Attach park brake cable to caliper with clevis pin (10) and bow-tie clip (9). If necessary, loosen jam nuts at park brake cable bracket to provide slack.
10. Adjust park brake. **See Park Brake Adjustment on page 6-23.**
11. Lower cargo bed.
12. Install seat bottom.

## PARK BRAKE DISC REPLACEMENT

1. Chock the wheels, and release the park brake.
2. Remove the seat bottom.
3. Unload and raise the cargo bed.
4. Remove bow-tie clip (9) and clevis pin (10) securing park brake cable (11) to caliper (7) **(Figure 6-8, Page 6-21)**.
5. Lift caliper from disc (3).
6. Remove external retaining ring (4), securing disc on transmission output shaft and slide disc off of shaft.
7. With wave washer (2) in place on shaft, install new disc (3) onto transmission output shaft.
8. Install caliper making sure the disc is between the pads. Secure caliper with new bolts and tighten bolts to 35 lb-ft (48 N·m).
9. Check park brake function and adjust if necessary. **See Park Brake Adjustment on page 6-23.**
10. Lower cargo bed.
11. Install seat bottom.

## PARK BRAKE CABLE REPLACEMENT

1. Chock the rear wheels and release the park brake.
2. Remove the seat bottom.
3. Unload and raise the cargo bed.
4. Remove bow-tie clip (9) and clevis pin (10) securing park brake cable (11) to caliper (7) **(Figure 6-8, Page 6-21)**.
5. Loosen jam nuts securing cable (11) to bracket (13) on transmission.
6. At park brake pedal, remove bow-tie clip securing cable end to pedal **(Figure 5-5, Page 5-4)**.
7. Loosen jam nut securing cable to pedal bracket.
8. Cut tie wraps securing cable to chassis, (note cable routing) and remove cable from vehicle.
9. Install new cable along same route as old cable.

10. At pedal, install cable in bracket and secure with jam nuts **(Figure 5-5, Page 5-4)**. Tighten jam nuts to 18 lb-ft (25 N·m).
11. Place cable end over pin on pedal and secure with bow-tie clip.
12. At transmission, install cable (11) in bracket (13) and finger-tighten jam nuts. Attach cable end to park brake caliper (7) with clevis pin (10) and bow-tie clip (9).
13. Adjust park brake. **See Park Brake Adjustment on page 6-23.**
14. Lower cargo bed.
15. Install seat bottom.

## PARK BRAKE ADJUSTMENT

1. Chock the rear wheels and release the park brake.
2. Remove the seat bottom.
3. Unload and raise the cargo bed.
4. Loosen jam nuts securing park brake cable (11) to bracket (13) on transmission **(Figure 6-8, Page 6-21)**.
5. Set pedal to first ratchet tooth. Adjust upper jam nut until caliper (7) engages park brake disc (3).
6. Release park brake at pedal and verify caliper pads do not drag on rotor.
7. Once proper adjustment is achieved, tighten jam nuts.
8. Lower cargo bed.
9. Install seat bottom.
10. Verify park brake functions properly before returning vehicle to service.

## PARK BRAKE SWITCH

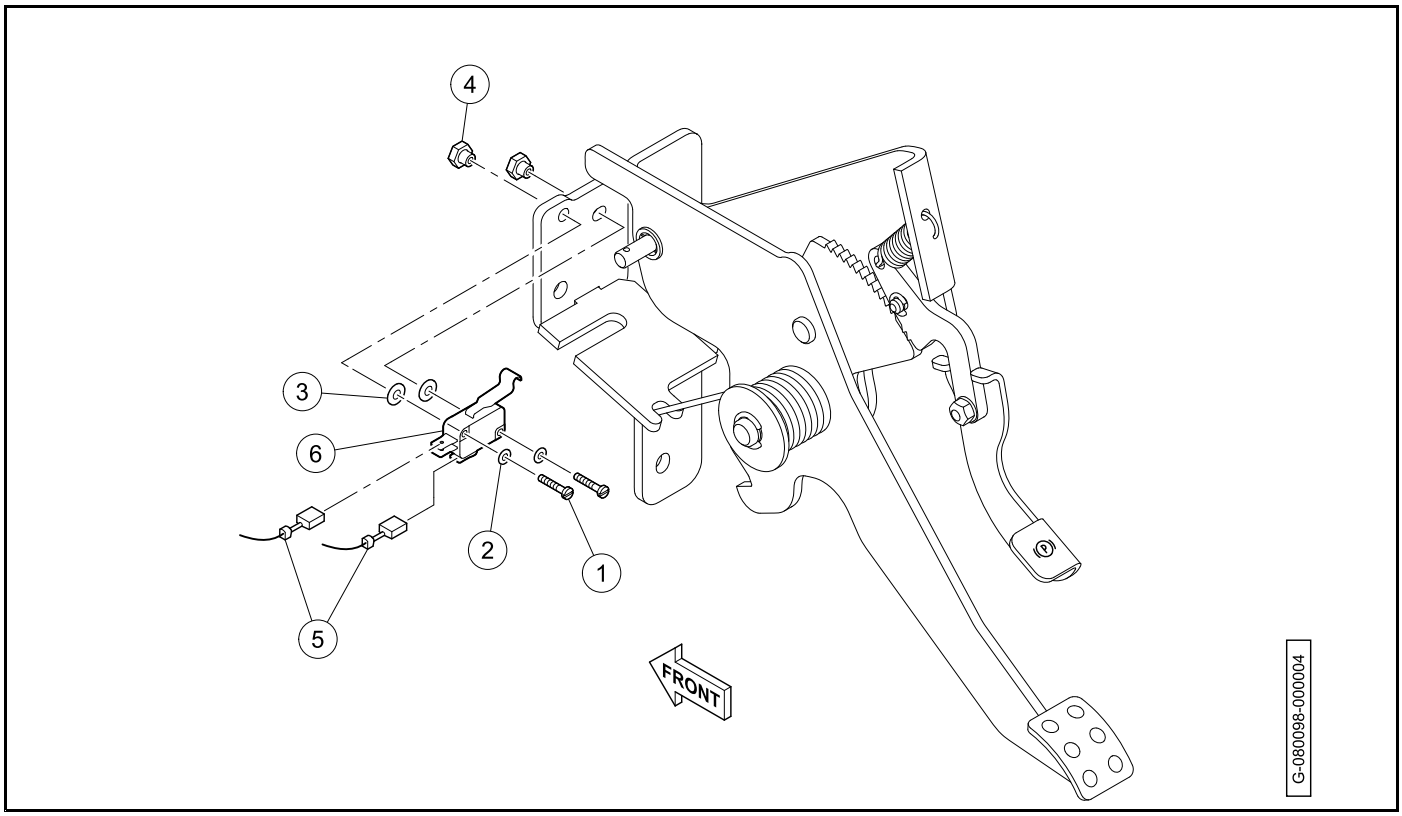



**Figure 6-9 Park Brake Switch**

### Park Brake Switch Removal

1. Disable the vehicle.
2. Make sure the park brake is engaged.

***NOTE:*** *When the park brake is engaged, there is more room to remove and install the park brake switch.*

3. Remove the screws (1), washers (2 and 3), and barrel nuts (4) **(Figure 6-9)**.
4. Label the wires (5).
5. Disconnect the wires.
6. Remove the park brake switch (6).

### Park Brake Switch Installation

1. Connect the wires (5) **(Figure 6-9)**.
2. Install the barrel nuts (4) into the bracket.
3. Install the washers (3), park brake switch (6), washers (2), and screws (1). Do not over tighten the screws.

# SECTION 7 — STEERING AND FRONT SUSPENSION



## ⚠ DANGER

- **See General Warnings, Section 1, Page 1-2.**

## ⚠ WARNING

- **See General Warnings, Section 1, Page 1-2.**

## STEERING WHEEL

**See General Warnings, Section 1, Page 1-2.**

### STEERING WHEEL REMOVAL

1. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. **Gasoline vehicles:** Disconnect the spark plug wires.
3. Rotate steering wheel to a straight ahead position.

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

4. Remove two screws (1) securing cover (2) to steering wheel (3) **(Figure 7-1, Page 7-2)**.
5. Loosen and remove the steering wheel retaining bolt (4).
6. Remove the steering wheel. **See following NOTE.**

***NOTE:*** *The steering wheel has a tapered hex fitting. A steering wheel puller may be required to remove the steering wheel.*

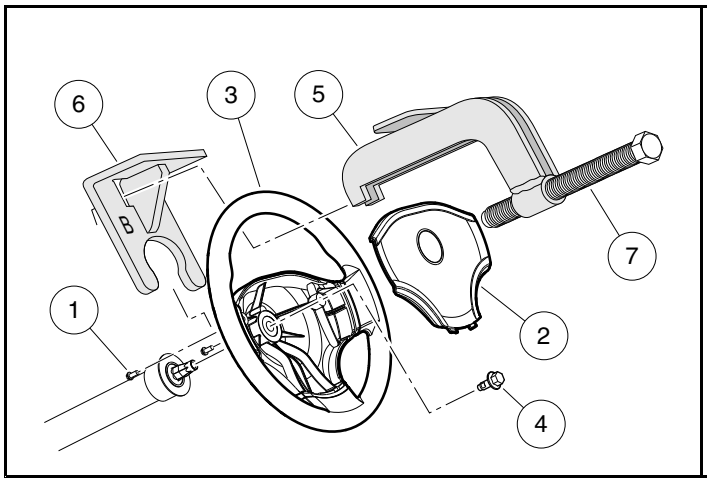
6.1. Place the puller anvil (5) through the top opening of the steering wheel **(Figure 7-1, Page 7-2)**.

6.2. Insert the anvil feet through the two slots in the base plate (marked “B”) (6).

6.3. Rotate the anvil screw (6) clockwise until the base plate (5) contacts the bottom of the steering wheel (2) at the steering column **(Figure 7-2, Page 7-2)**.

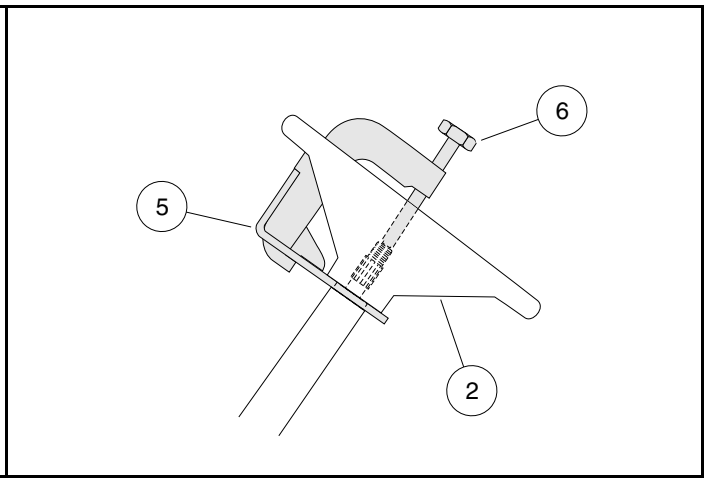
6.4. Use a 1/2-inch drive air impact wrench to tighten the anvil screw (6) until the steering wheel releases from the steering shaft.

6.5. Remove the steering wheel from the steering column.




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**Figure 7-1 Steering Wheel Removal**




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**Figure 7-2 Steering Wheel Puller**

### STEERING WHEEL INSTALLATION

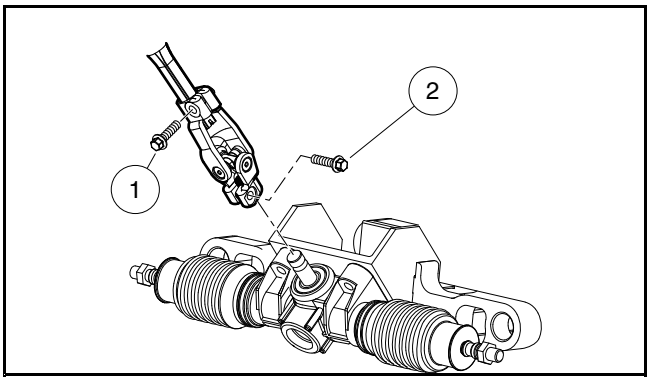
1. Install the steering wheel (3) on the hex portion of the steering shaft. Align the hex fitting of the wheel with the steering column shaft **(Figure 7-1, Page 7-2)**.
2. Install steering wheel retaining bolt (4) and tighten to 37 ft-lb (50 N·m).
3. Place cover (2) onto steering wheel and secure with two screws (1). Tighten screws to 15 in-lb (1.7 N·m).
4. Connect battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

## STEERING COLUMN

### STEERING COLUMN REMOVAL

1. Disable the vehicle.
2. Disconnect the battery.
3. Remove the steering wheel.
4. Remove the instrument panel.
5. Raise the hood.

6. Loosen the bolt (1) on the top yoke **(Figure 7-3)**.
7. Remove the bolt (2) from the bottom yoke.

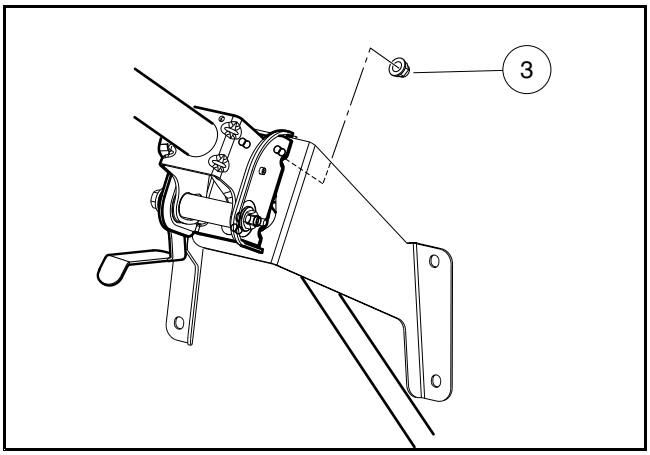



000070-006A

**Figure 7-3 Remove Steering Column from Rack and Pinion**

8. Remove the three locknuts (3) from the steering column mount bolts **(Figure 7-4)**.

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

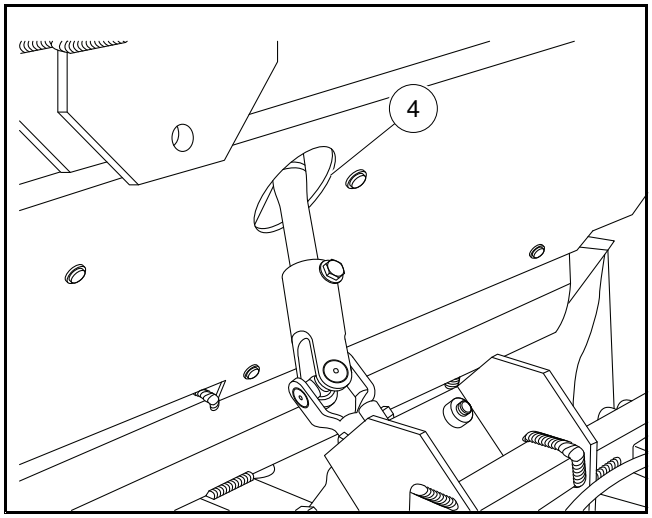



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**Figure 7-4 Steering Column Removal**

9. Remove the yoke from the rack and pinion shaft.

10. Remove the steering column assembly through the hole (4) in the splash guard **(Figure 7-5)**.

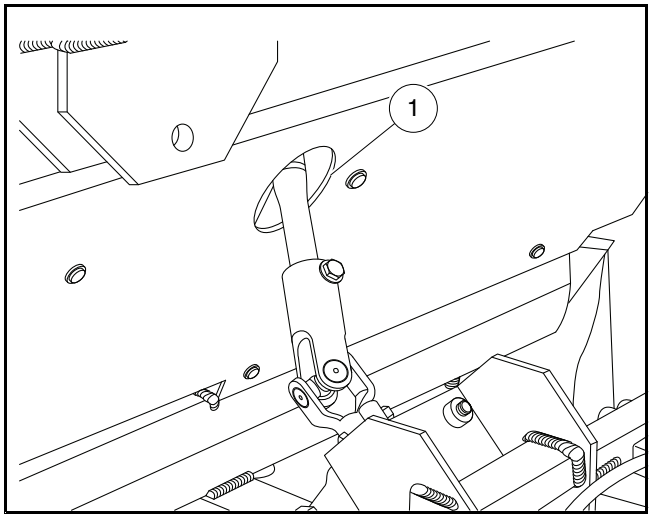



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**Figure 7-5 Hole in Splash Guard**

## STEERING COLUMN INSTALLATION

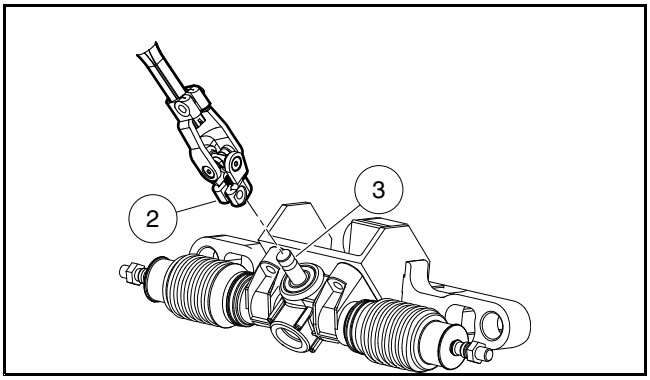
1. Install the steering column assembly through the column mounting bracket, frame opening, and down through the hole (1) in the splash guard **(Figure 7-6)**.




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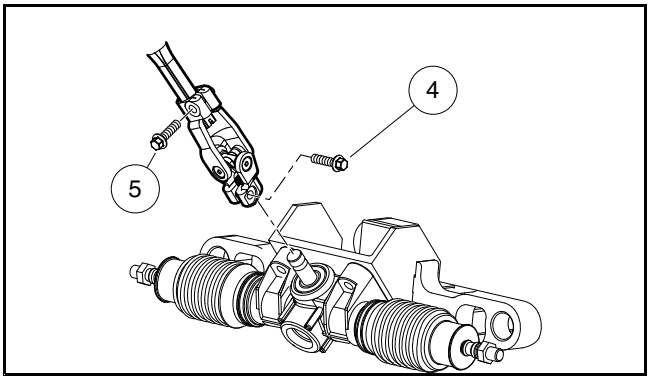
**Figure 7-6 Install Steering Column Through Hole**

2. Install the bottom yoke (2) onto the rack and pinion shaft (3) **(Figure 7-7)**.



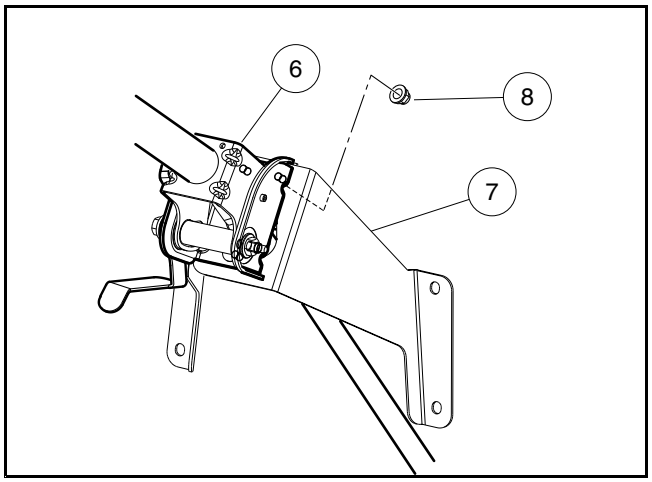

000070-006C
**Figure 7-7 Bottom Yoke onto Rack and Pinion**

3. Install the bolt (4) on the bottom yoke. Tighten the bolt to 18 ft-lb (24 N·m) **(Figure 7-8)**.
4. Loosen the bolt (5) on the top yoke.




000070-006D
**Figure 7-8 Install Steering Column onto Rack and Pinion**

5. Install the steering column (6) onto the column mounting bracket (7) **(Figure 7-9, Page 7-6)**.
6. Move the steering column toward the drivers-side of the vehicle within the slots on the column mounting bracket.
7. Install the locknuts (8). Tighten the hardware to 15 ft-lb (20 N·m).




000070-006E
**Figure 7-9 Install Steering Column onto Mounting Bracket**

8. Tighten the bolt (5) on the top yoke to 15 ft-lb (20 N·m) **(Figure 7-8, Page 7-5)**.
9. Rotate the steering wheel to the point of least clearance (A) between the steering intermediate shaft and the accelerator pivot bolt **(Figure 7-10)**. The clearance at this point must be more than 0.060 in.
10. If the clearance is less than 0.060 in:

10.1. Loosen the bolts (9) and locknuts (10) on the passengers-side of the column mounting bracket.

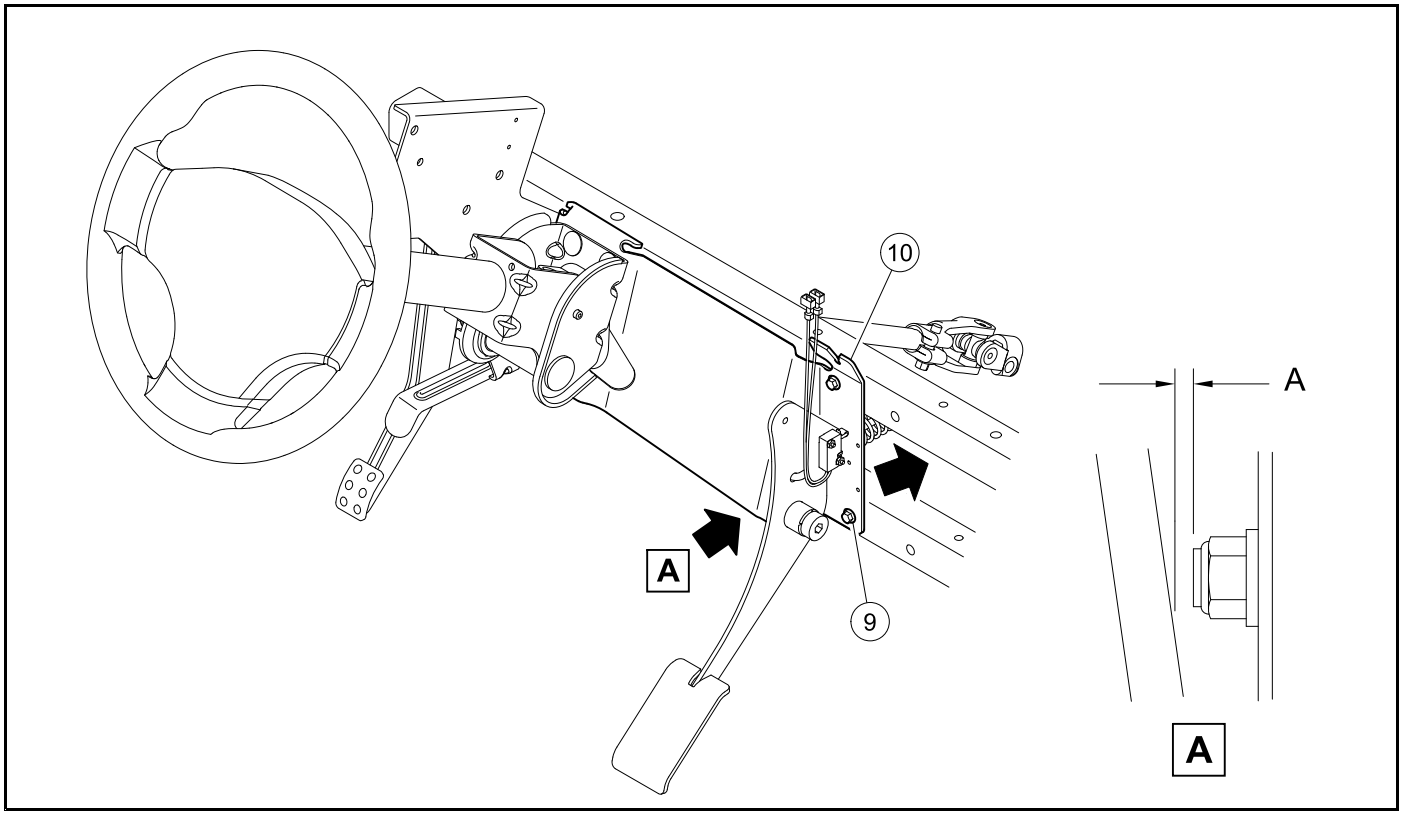



**Figure 7-10 Column Mounting Bracket**

10.2. Move the column mounting bracket up and towards the passengers-side. Hold the column mounting bracket in position and tighten the bolts and locknuts to 15 ft-lb (20 N·m).

10.3. Measure the clearance between the steering intermediate shaft and the accelerator pivot bolt. The clearance must be more than 0.060 in.

11. Install the instrument panel.
12. Lower and secure the hood.
13. Install the steering wheel.
14. **Gasoline vehicles:** Connect the spark plug.
15. Connect the battery.

# RACK AND PINION

**See General Warnings, Section 1, Page 1-2.**

## CAUTION

- **Front impacts that bend tie rods and/or drag links can possibly damage internal steering gear components. See Rack and Pinion Inspection on page 7-7. The manufacturer recommends inspecting the rack and pinion and replacing if damaged.**

## RACK AND PINION INSPECTION

Look for obvious damage to the chassis, where the rack and pinion is mounted, and the rack and pinion housing. Particularly check the housing for broken mounting points.

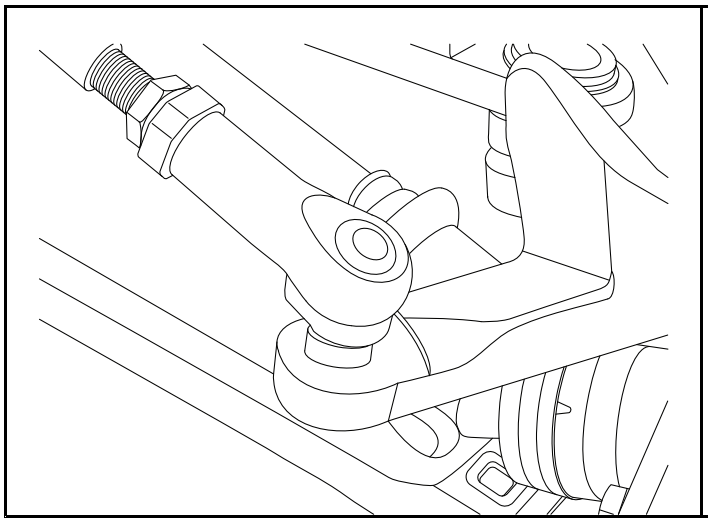
Compare the toe measurement against the specification. **See Wheel Alignment on page 7-14.**

If obvious visible damage is found, such as a bent tie rod, check the steering gear for abnormal free-play, noise, binding or clunking while it is under a load. With the steering system fully assembled and all four tires on the ground/floor, turn the steering wheel from stop to stop. While turning, feel for any binding, clunking or tight/loose spots. Listen for unusual noises. Replace the rack and pinion as an assembly if any is found.

In the event of a known impact and obvious visible damage is not found in the method described above, disconnect the tie rods and/or drag links from the spindles. Turn the steering wheel from stop to stop. While turning, feel for any binding or tight/loose spots. Listen for unusual noises. Replace the rack and pinion as an assembly if any is found.

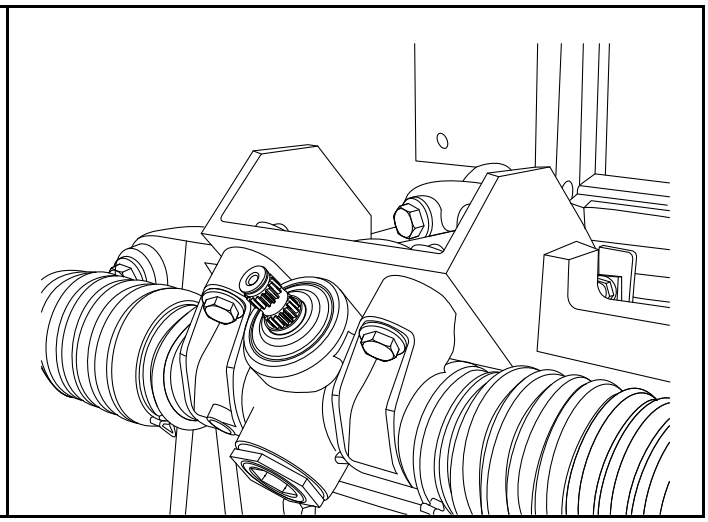
## RACK AND PINION REMOVAL

1. Lift and support the front of vehicle and remove the wheels. **See Lifting The Vehicle on page 3-7.**
2. Remove the outer drag link ball joints from the upright assemblies and inspect for excessive wear and seal damage **(Figure 7-11, Page 7-8)**.



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**Figure 7-11 Drag Link Ball Joint**



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**Figure 7-12 Rack and Pinion Bolts**

3. Loosen the bolts on the steering universal joint that secure the steering column shaft and the rack and pinion shaft.
4. 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.
5. 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 7-12, Page 7-8)**.

## 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 7-12, Page 7-8)**.
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). **See following NOTE.**

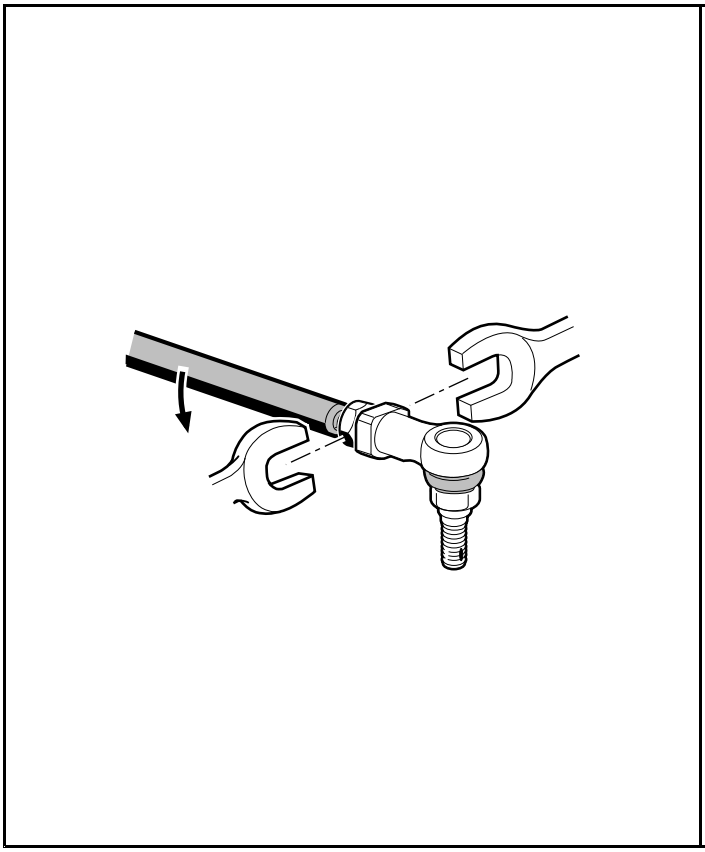
***NOTE:*** *Be sure to tighten the bolt at the universal joint on the rack and pinion shaft before tightening the steering column coupling bolt.*

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 7-11, Page 7-8)**.
8. Align the front wheels. **See Wheel Alignment on page 7-14.**
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

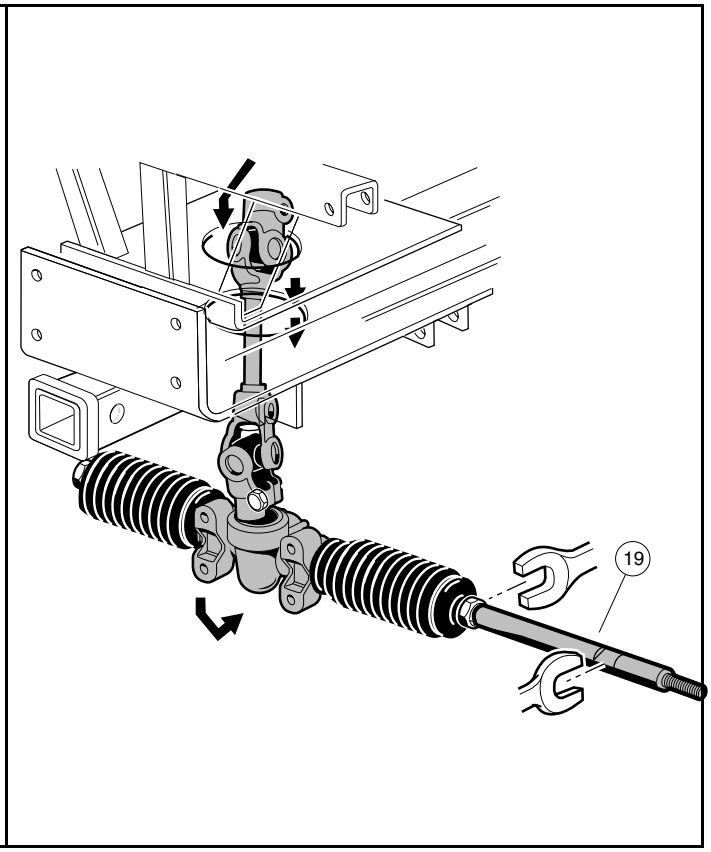
1. Remove the rack and pinion and drag link assembly. **See Rack and Pinion Removal on page 7-7.**
2. Remove the two outer ball joints from the drag links **(Figure 7-13, Page 7-9)**.

3. Remove both drag links (19) **(Figure 7-14, Page 7-9)**.



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**Figure 7-13 Drag Link Ball Joint**

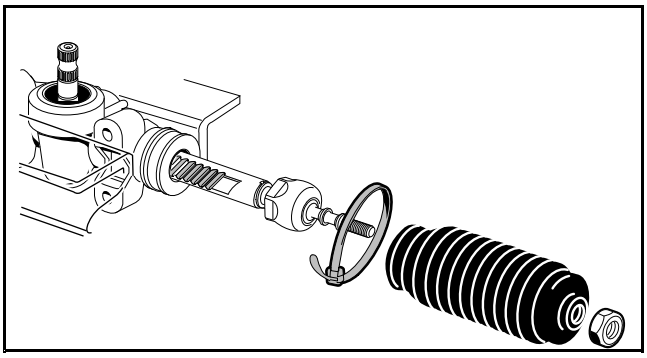



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**Figure 7-14 Drag Link**

4. Remove both bellows clamps (metal clamps or plastic wire ties) **(Figure 7-15, Page 7-9)**. **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.*

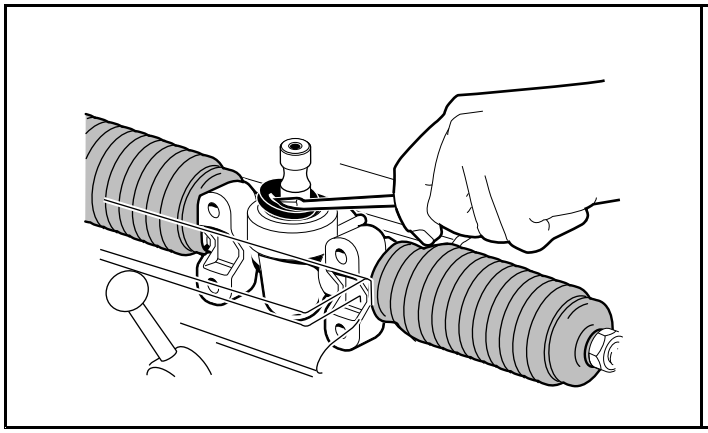


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**Figure 7-15 Dust Bellows Clamp**

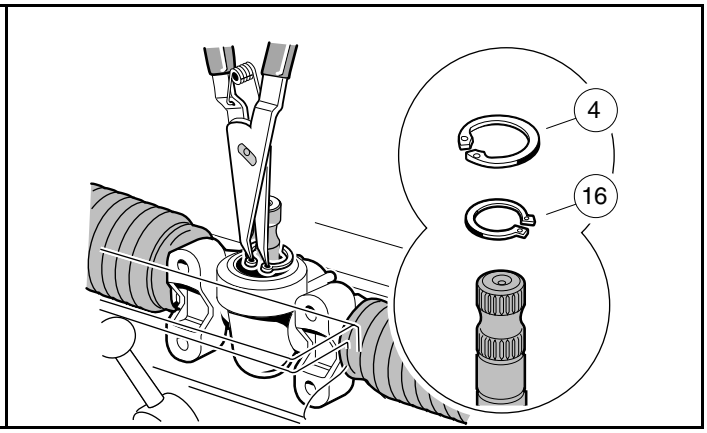
5. Remove the two hex nuts from the inner ball-joint ends, and remove both of the dust seal bellows.
6. Remove the rack screw nut (8), rack guide screw (7), rack guide pressure spring (6), and the rack guide (5) **(Figure 7-22, Page 7-12)**.
7. Remove the dust seal **(Figure 7-16, Page 7-10)**.

8. Remove the snap ring (4) **(Figure 7-17, Page 7-10)**.



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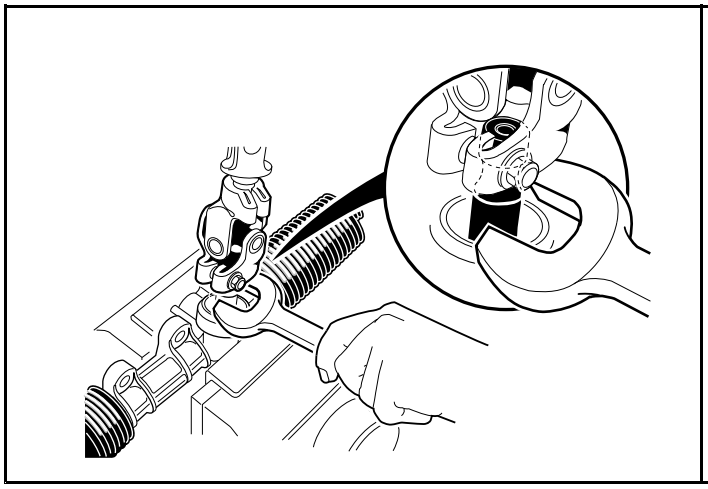
**Figure 7-16 Remove Dust Seal**




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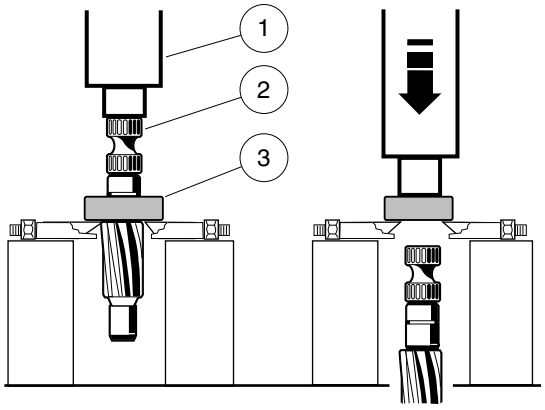
**Figure 7-17 Remove Pinion Snap Ring**

9. Install the universal joint on the pinion, and place a fork or a large open-end wrench under the universal joint **(Figure 7-18, Page 7-10)**. 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 7-17, Page 7-10)**, and use a press to remove the bearing **(Figure 7-19, Page 7-10)**.



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**Figure 7-18 Remove Pinion from Housing**




1. Press Ram 2. Pinion Gear 3. Bearing

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**Figure 7-19 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 7-22, Page 7-12)**.
13. Inspect the inner ball joints for wear **(Figure 7-22, Page 7-12)**. If either is excessively worn, replace both ball joints.

13.1. Secure the rack and housing assembly in a vise **(Figure 7-20, Page 7-11)**. **See following CAUTION.**

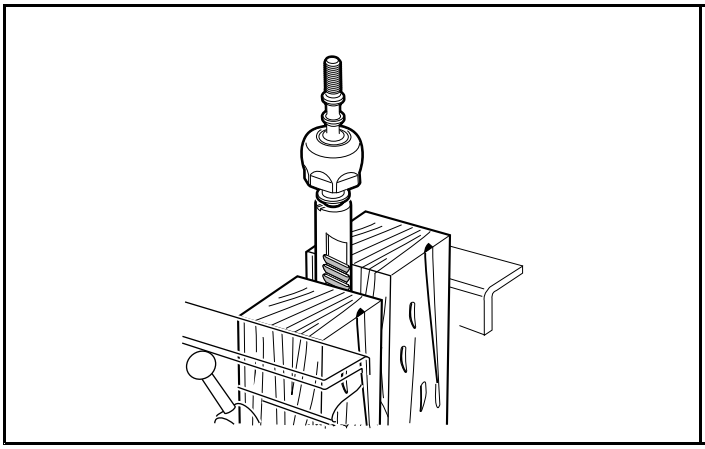
## CAUTION

- **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 7-21, Page 7-11)**.

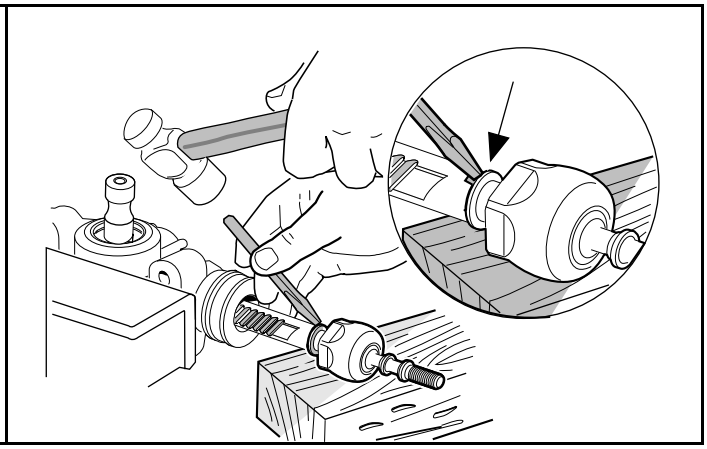
13.3. Remove the ball joint from the rack.

14. Remove the rack (2) from the housing (1) **(Figure 7-22, Page 7-12)**.



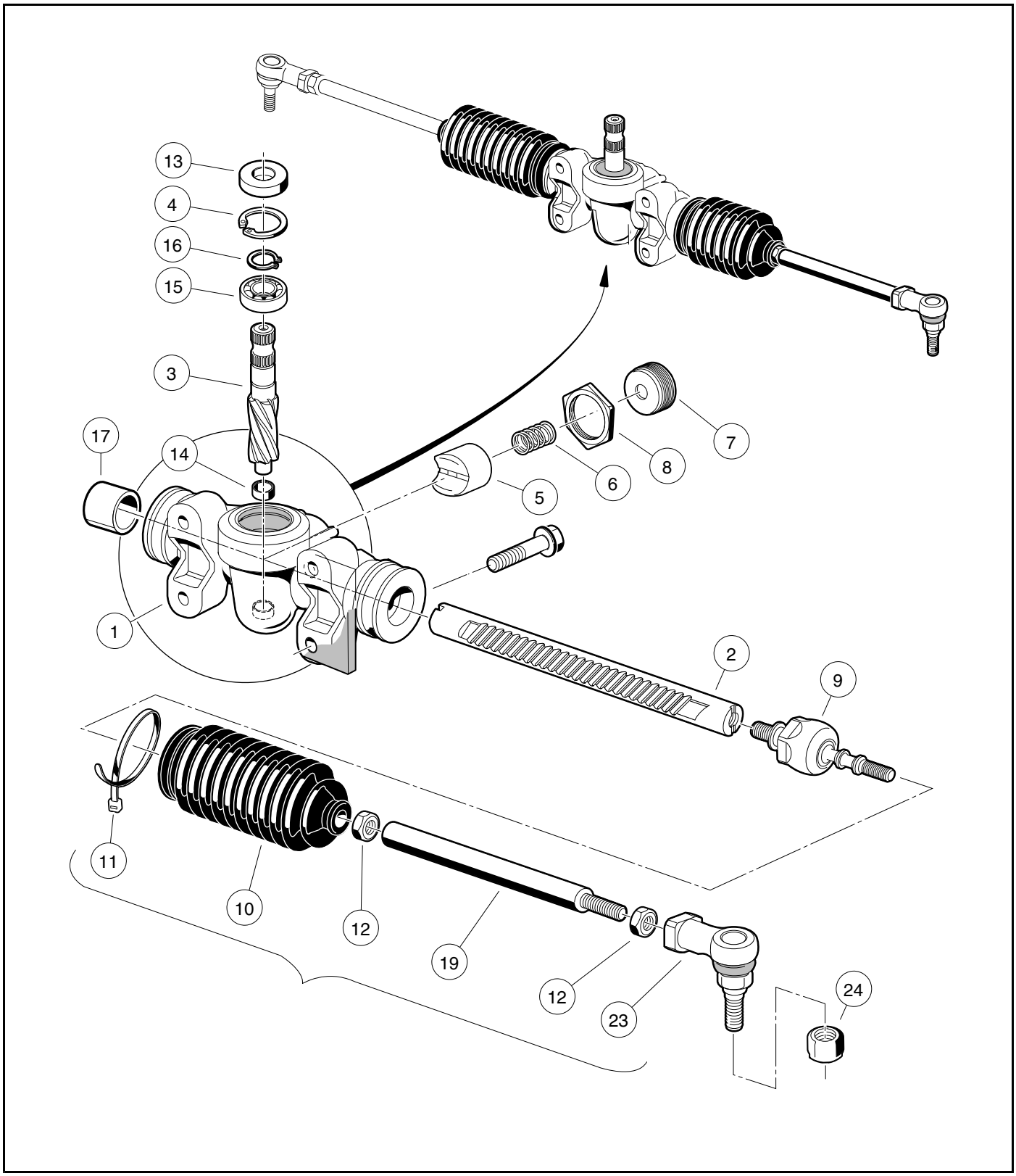
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**Figure 7-20 Secure Racks**



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**Figure 7-21 Remove Inner Ball Joints**




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**Figure 7-22 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 7-22, Page 7-12)**.

## CAUTION

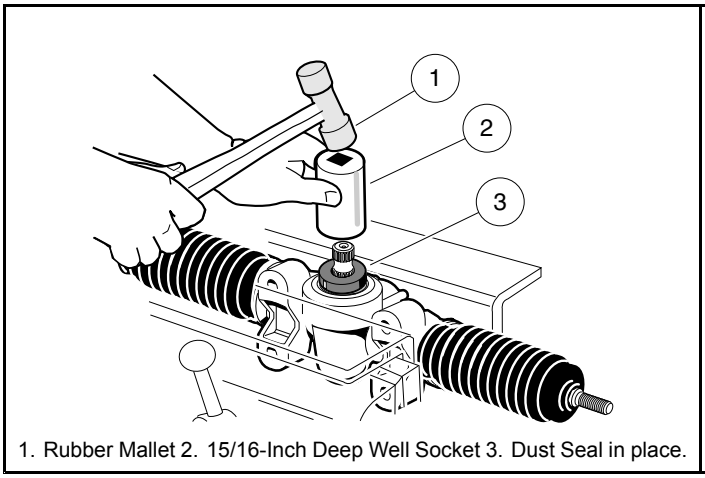
- **In step 2, do not press against the outer race of the bearing.**

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.**

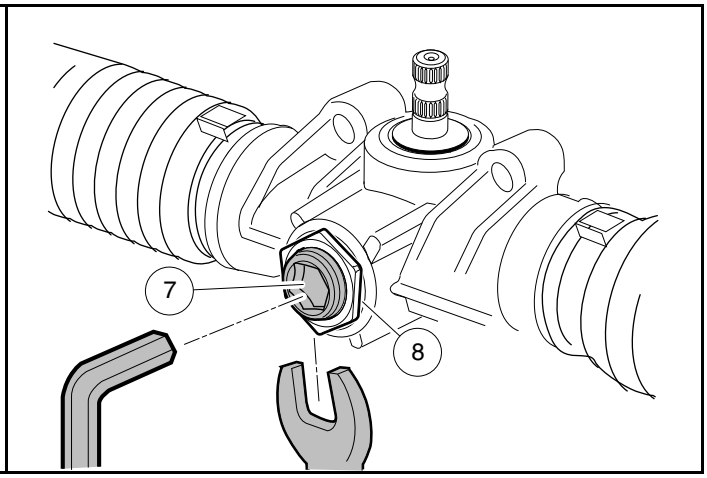
4. Install the snap ring (4).
5. Use a socket to apply pressure evenly, and press in a new dust seal **(Figure 7-23, Page 7-13)**.




1. Rubber Mallet 2. 15/16-Inch Deep Well Socket 3. Dust Seal in place.

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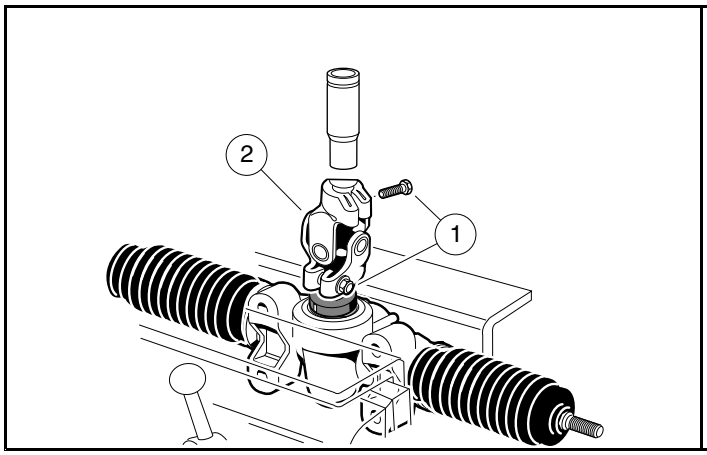
**Figure 7-23 Press In Dust Seal**




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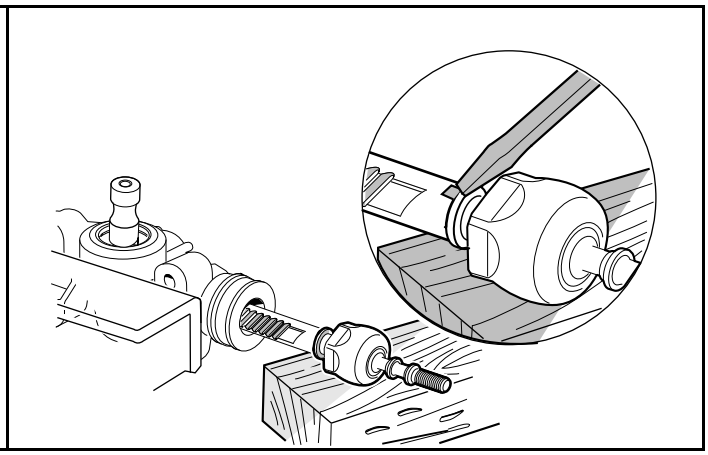
**Figure 7-24 Rack and Pinion Adjustment**

6. Apply a small amount of grease to the rack guide (5) where it contacts the rack (2) **(Figure 7-22, Page 7-12)**.
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 7-26, Page 7-14)**.
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 7-24, Page 7-13)**.
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 7-22, Page 7-12)**.




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**Figure 7-25 Adjust Rack and Pinion Resistance**



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**Figure 7-26 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 7-25, Page 7-14)**.
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 7-24, Page 7-13)**. **See following NOTE.**

***NOTE:*** *When the nut (8) is tightened, make sure the screw (7) adjustment does not change* ***(Figure 7-24, Page 7-13)****.*

14. Install the two dust seal bellows (10) **(Figure 7-15, Page 7-9)**.
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 7-14, Page 7-9)**. Nuts will be tightened during the toe-adjustment procedure. **See Wheel Alignment on page 7-14.**
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 7-13, Page 7-9)**. Nuts will be tightened during the toe-adjustment procedure. **See Wheel Alignment on page 7-14.**
20. Install the rack and pinion assembly. **See Rack and Pinion Installation on page 7-8.**

# FRONT SUSPENSION

**See General Warnings, Section 1, Page 1-2.**

## WHEEL ALIGNMENT

### ⚠ CAUTION

- **These vehicles require toe-out unless the steering damper accessory is installed. All vehicles equipped with a steering damper must use a toe-in setting.**

Wheel alignment consists of adjusting the toe-in or toe-out and camber of the front wheels. **See Toe-in Measurement – for vehicles equipped with steering damper accessory on page 7-15. See Toe-Out Measurement on page 7-15. Also see Camber Measurement on page 7-16.** Always adjust the toe 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.*

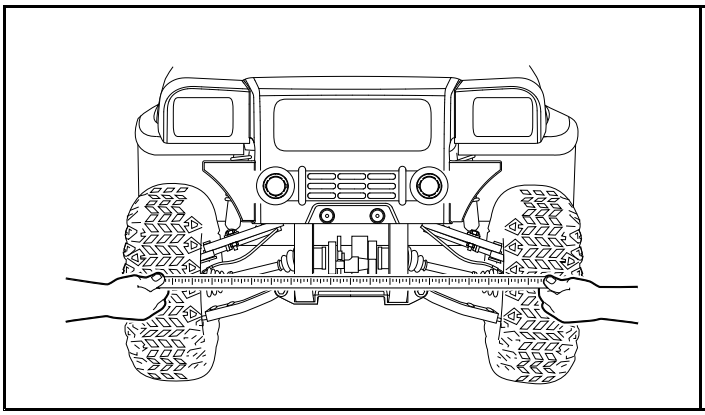
**Toe-Out Measurement**

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.*

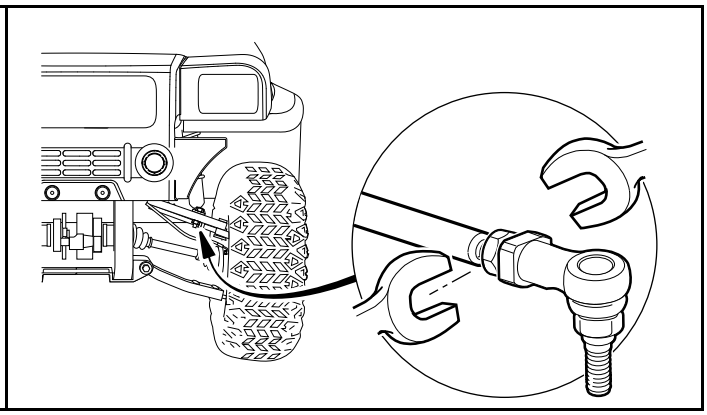
2. Mark each front tire at the center of the tread face that is facing the rear of the vehicle. The marks should be at the same height as the center of each hub. Measure the distance between the marks.
3. Roll the vehicle forward one-half wheel revolution until the marks appear on the forward facing surfaces of the tires at the same height as the center of each hub. Measure the distance between the marks **(Figure 7-27, Page 7-15)**. **See following NOTE.**

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



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**Figure 7-27 Measure Toe-Out**



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**Figure 7-28 Adjust Toe-Out**

4. Subtract the rear face tire measurement from the front face tire measurement. Proper toe-out is 3/16 to 1/4 inch (4.8 to 6.35 mm) ±3/16 inch (4.8 mm).

**Toe-Out Adjustment**

1. Loosen the jam nuts on both ends of each drag link **(Figure 7-28, Page 7-15)**.
2. Rotate both of the drag links equally. To increase the toe-out, rotate both drag links clockwise. To decrease the toe-out, rotate both drag links counterclockwise. Maintain an equal distance from the ball joint to the end of the threads on each drag link **(Figure 7-31, Page 7-16)**.
3. Tighten the jam nuts to 21 ft-lb (28 N·m).
4. Check the toe-out, and repeat the adjustment procedure if necessary.
5. After the toe-out 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.**

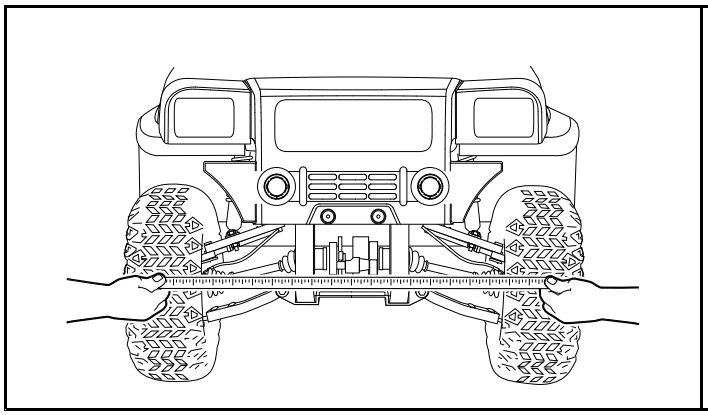
**Toe-in Measurement – for vehicles equipped with steering damper accessory**

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.*

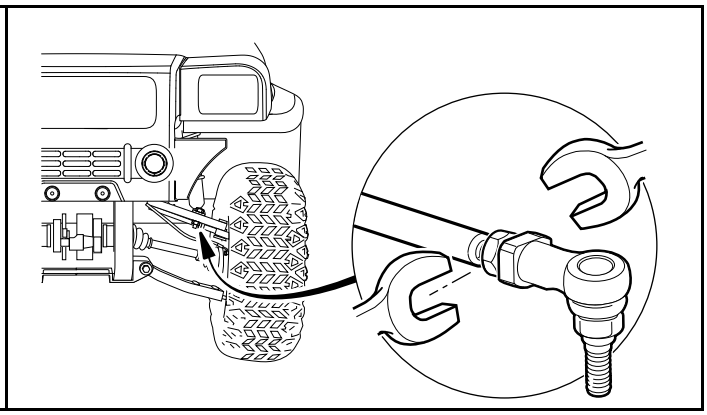
2. Mark each front tire at the center of the tread face that is facing the rear of the vehicle. The marks should be at the same height as the center of each hub. Measure the distance between the marks.
3. Roll the vehicle forward one-half wheel revolution until the marks appear on the forward facing surfaces of the tires at the same height as the center of each hub. Measure the distance between the marks **(Figure 7-29, Page 7-16)**. **See following NOTE.**

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



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**Figure 7-29 Measure Toe-in**



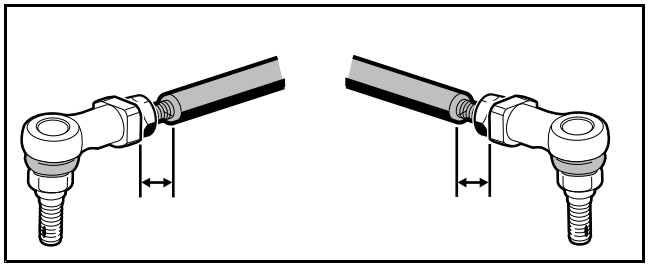
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**Figure 7-30 Adjust Toe-in**

4. Subtract the front face tire measurement from the rear face tire measurement. Proper toe-in is 3/16 to 1/4 inch (4.8 to 6.35 mm) ±3/16 inch (4.8 mm).

**Toe-in Adjustment – for vehicles equipped with steering damper accessory**

1. Loosen the jam nuts on both ends of each drag link **(Figure 7-30, Page 7-16)**.
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 7-31, Page 7-16)**.
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.**



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**Figure 7-31 Adjust Both Drag Links To An Equal Distance**

**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 7-32, Page 7-17)**.

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.**

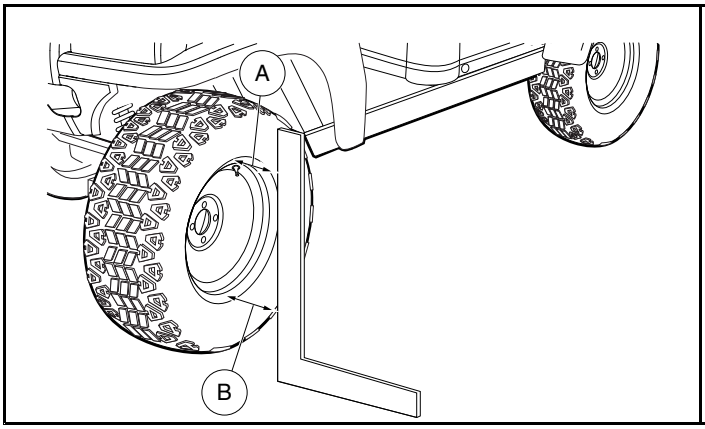
***NOTE:*** *If dimension (A) is greater than dimension (B), the camber is positive. A negative camber is desirable, with dimension (A) being less than dimension (B).*

5. The negative 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) negative camber on each wheel.*

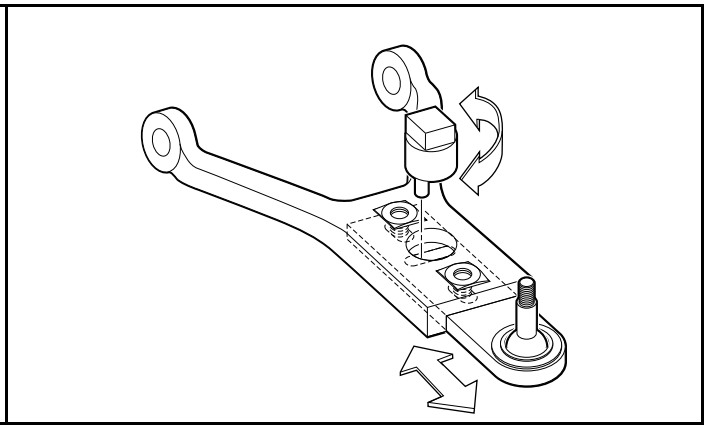
**Camber Adjustment**

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 7-33, Page 7-17)**.
2. Insert the cam tool 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.




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**Figure 7-32 Measure Camber**



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**Figure 7-33 Adjust Camber**

# FRONT SUSPENSION COMPONENTS

**See General Warnings, Section 1, Page 1-2.**

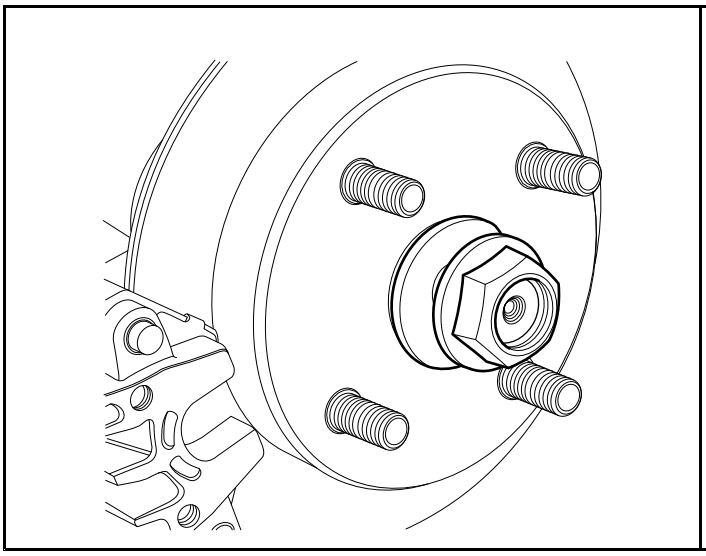
***NOTE:*** *Camber adjustment bars are marked with a D for driver side and P for passenger side and must be installed correctly.*

## STEERING UPRIGHT REMOVAL

1. Disconnect battery and spark plug wire(s) **(gasoline vehicles only)**. **See Disconnecting the Battery-Gasoline/Diesel Vehicles on page 1-3.**
2. Loosen the lug nuts.
3. Remove the rubber spindle nut cover from front wheel.
4. Loosen the axle spindle nut **(Figure 7-34, Page 7-18)**.
5. Lift and support the front of vehicle and remove the wheel. **See Lifting The Vehicle on page 3-7.**
6. Remove the axle spindle nut and washer. **See following NOTE.**

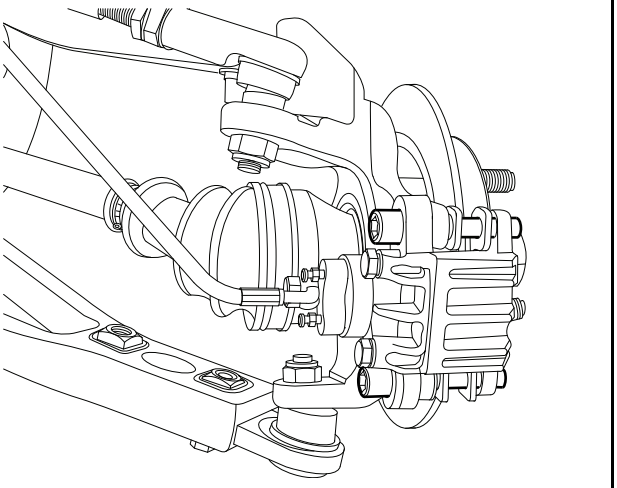
***NOTE:*** *A new spindle nut will be required during assembly.*

7. **2WD only:** Remove stub-shaft from hub.



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**Figure 7-34 Axle Spindle Nut and Washer**



Halfshaft shown is used in AWD vehicles only.

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**Figure 7-35 Brake Caliper and Upright**

8. Remove and discard the two hex-head bolts that secure the caliper assembly to the upright **(Figure 7-35, Page 7-18)**.
9. Rest the brake caliper on the A-arm. Ensure that there is no strain on the brake hose. **See following WARNING.**

### ⚠ WARNING

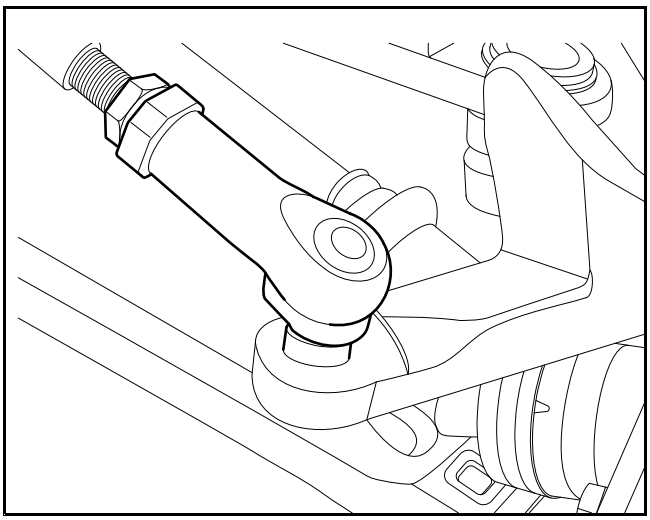
- **Strain on the brake hose or the brake hose fittings can result in damage to the line or fittings and cause a leak in the hydraulic system, diminished brake performance, or brake failure.**

**WARNING CONTINUED ON NEXT PAGE**

## ⚠ 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.**

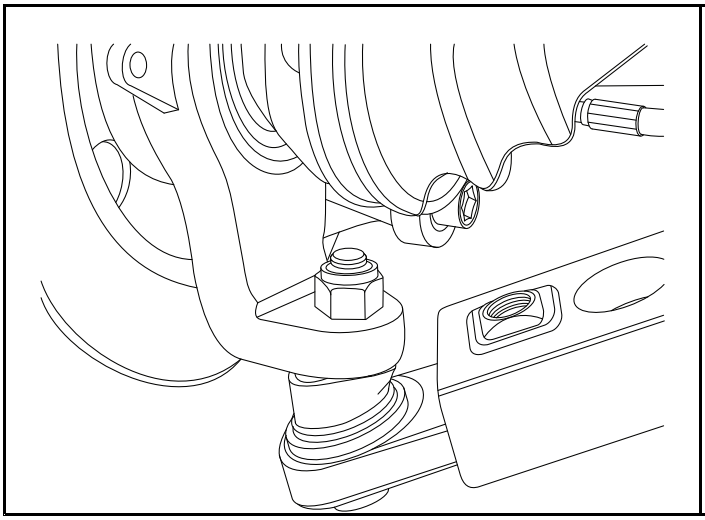
10. Remove brake disc from hub.
11. Remove the outer drag link ball joints from the upright assemblies **(Figure 7-36, Page 7-19)**.



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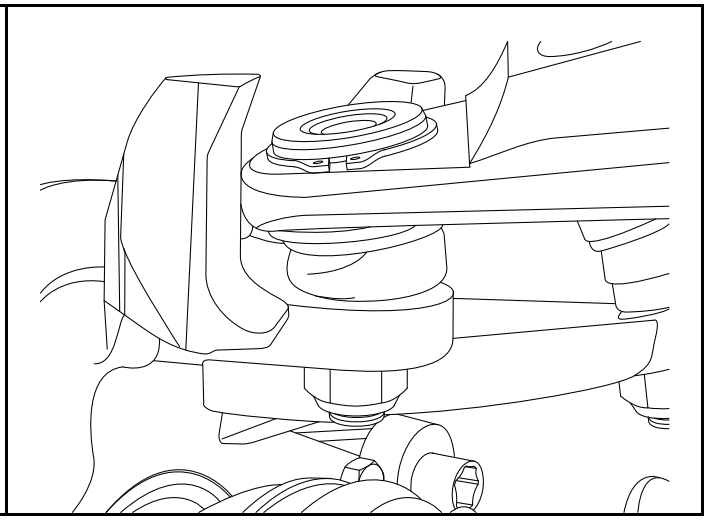
**Figure 7-36 Drag Link Ball Joint**

12. Remove the lower and upper ball joint locknuts.
13. Remove the lower ball joint from the upright **(Figure 7-37, Page 7-19)**. **See NOTE and CAUTION below.**



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**Figure 7-37 Lower Ball Joint and Upright**



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**Figure 7-38 Upper Ball Joint and Upright**

14. **AWD only:** Swing the lower A-arm down, and separate the upright and hub assembly from the half-shaft.
15. Remove the upper ball joint from the upright **(Figure 7-38, Page 7-19)**. **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.**

16. Remove the upright assembly from the vehicle.

### STEERING UPRIGHT INSTALLATION

1. Inspect the ball joint boots for damage. Replace the ball joint and boot assemblies if necessary.
2. Apply anti-seize compound to the hub splines.
3. **AWD only:** Slide upright assembly onto halfshaft. **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. **See preceding CAUTION.**
5. Secure the upright assembly to the upper ball joint **(Figure 7-38, Page 7-19)**. Use a new nylon locknut and tighten the hardware to 18 ft-lb (24 N·m).
6. Secure the upright assembly to the lower ball joint **(Figure 7-37, Page 7-19)**. Use a new nylon locknut and tighten the hardware to 18 ft-lb (24 N·m).
7. Secure the drag link ball joints to the upright assemblies **(Figure 7-36, Page 7-19)**. Use a new nylon locknut and tighten locknut to 70 ft-lb (95 N·m).
8. Install brake disc onto hub.
9. Inspect the brake pads for wear and replace if necessary.

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

10. Install the brake caliper on the upright.
11. **2WD only:** Install stub-shaft into hub.
12. Install the hardened washer and new axle spindle nut. Tighten, but do not torque the hardware to its finished value.
13. Install the tire and wheel and finger-tighten the lug nuts.
14. Lower the front of the vehicle.
15. Tighten the axle spindle nut to 150 ft-lb (203 N·m).
16. Install rubber spindle nut cover onto wheel.
17. Tighten the lug nuts to 85 ft-lb (115 N·m) using a crisscross pattern.
18. Connect battery and spark plug wire(s) **(gasoline vehicles only)**. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**
19. Check the brakes.
20. Align the front wheels. **See Wheel Alignment on page 7-14.**

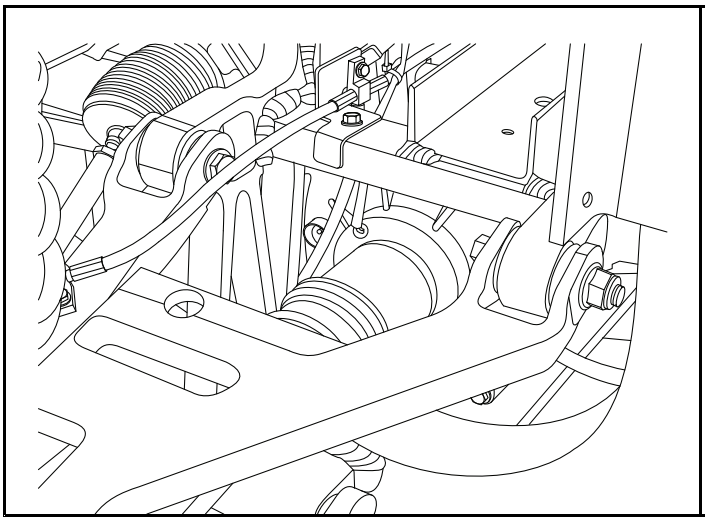
### UPPER A-ARM REMOVAL

1. Lift and support the front of vehicle and remove the wheels. **See Lifting The Vehicle on page 3-7.**
2. Remove the brake line bracket from the A-arm.
3. Remove the shock absorber.

3.1. Remove the bolt from the bottom mount of the shock absorber, and remove the shock absorber from the A-arm. **See following NOTE.**

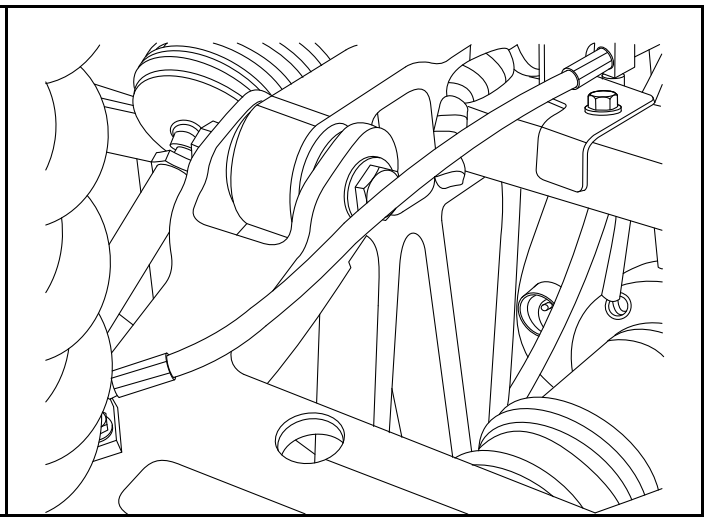
***NOTE:*** *It may be necessary to place a floor jack under the A-arm assembly and raise it slightly to relieve pressure from the bottom shock absorber bolt.*

4. Remove the nut from the ball joint.
5. Remove the front and rear bolts, washers, and flanged locknuts from the A-arm and frame.
6. Remove the A-arm from the frame and bushings.



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**Figure 7-39 Upper Front A-Arm Attachment**



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**Figure 7-40 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.**

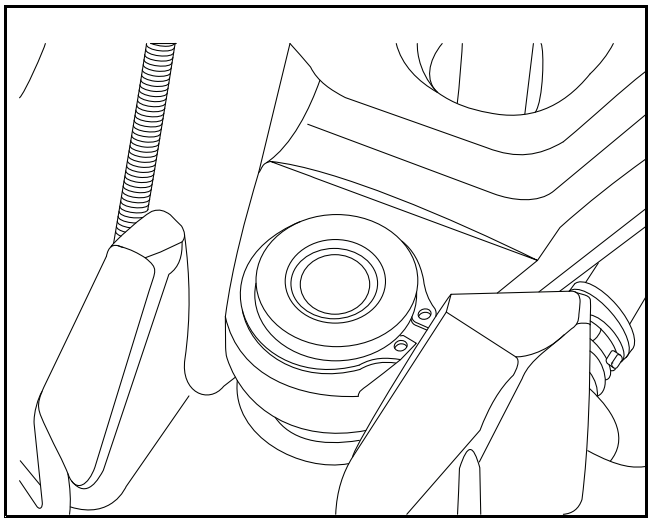
***NOTE:*** *The ball joint is press-fit and secured with 641 Loctite and requires approximately 250 lb. (113.4 kg) of force to press it from the casting.*

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.*



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**Figure 7-41 Ball Joint C-Clip**

## UPPER A-ARM INSTALLATION

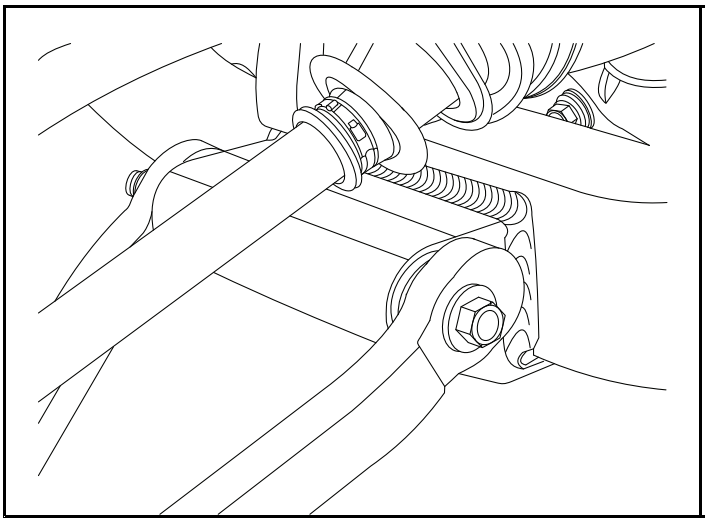
1. Install a new ball joint if necessary. **See Upper Ball Joint Installation on page 7-21.**
2. Install new A-arm frame bushings. **See following NOTE.**

***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. **See Wheel Alignment on page 7-14.**

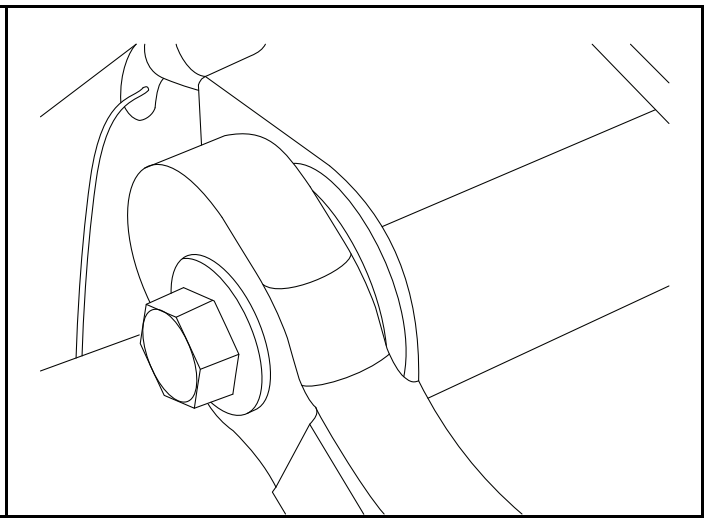
## LOWER A-ARM REMOVAL

1. Lift and support the front of vehicle and remove the wheels. **See Lifting The Vehicle on page 3-7.**
2. Remove lower ball joint nut and separate lower ball joint from upright.
3. Remove the bolt, washer, and flanged locknut from the lower A-arm and frame.
4. Remove the A-arm from the frame and the bushings.



2071

**Figure 7-42 Lower A-Arm Attachment**



2072

**Figure 7-43 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. (113.4 kg) 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 7-23.**
2. Install new A-arm frame bushings **(Figure 7-43, Page 7-23)**. **See following NOTE.**

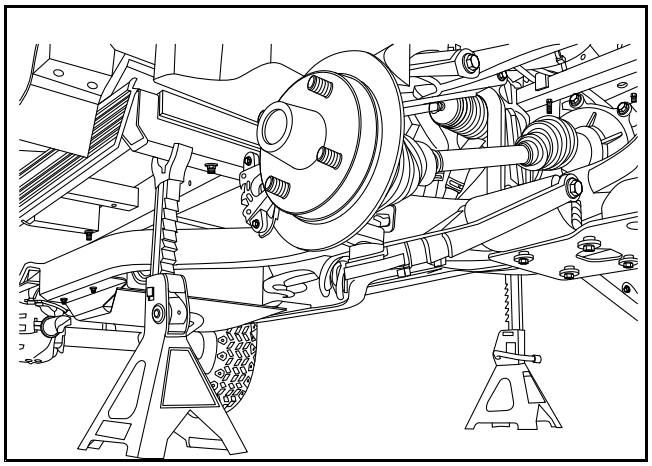
***NOTE:*** *The urethane bushings fit tightly. It may be necessary to press them into place. Use the assembly bolts and large flat washers to draw the bushings together in the frame brackets.*

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. **See Wheel Alignment on page 7-14.**

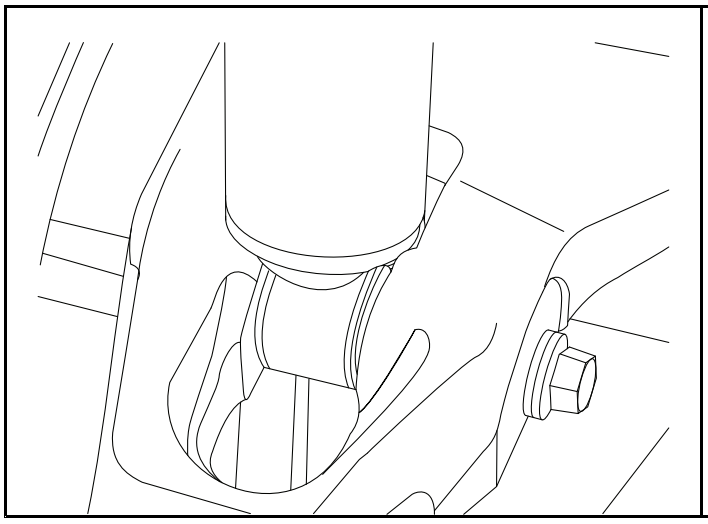
## FRONT COIL-OVER SHOCK ABSORBER REMOVAL

1. Lift and support the front of vehicle and remove the wheels. **See Lifting The Vehicle on page 3-7.**
2. 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.
3. Remove the flange-head bolt. Separate the bottom of the shock absorber from the top A-arm assembly **(Figure 7-45, Page 7-24)**.
4. Remove the bolt and flanged locknut from the top of the shock mount. Remove the shock absorber.
5. Repeat steps for the remaining shock absorber.



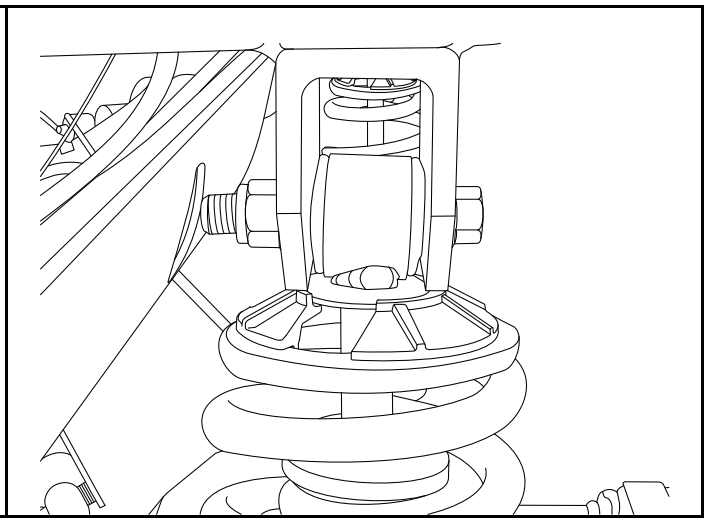
1890

**Figure 7-44 Jack Stand Placement**



2073

**Figure 7-45 Front Shock Bottom Mount**



2074

**Figure 7-46 Front Shock Top Mount**

## FRONT COIL-OVER SHOCK ABSORBER INSTALLATION

***NOTE:*** *The standard-duty front coil-over springs and shocks are painted black. Heavy-duty front coil-over springs and shocks have shock housings painted black and springs painted silver.*

*When front shock absorbers are installed, ensure both 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 7-46, Page 7-24)**. **See previous NOTES.**
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 7-45, Page 7-24)**.
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.

Pagination Page

# SECTION 8 — WHEELS, TIRES AND HUBS



## ⚠ DANGER

- **See General Warnings, Section 1, Page 1-2.**

## ⚠ WARNING

- **See General Warnings, Section 1, Page 1-2.**

## 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 Vehicle Specifications on page 2-1. 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)**.

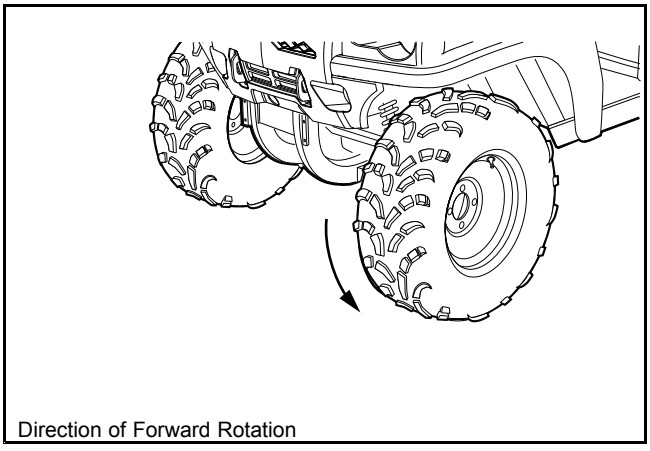



**Figure 8-1 Mud Tire Rotation**

The wheels are not interchangeable with any other similar wheel designs used on other utility vehicles offered by this manufacturer.

- Keep tires properly inflated. **See Vehicle Specifications on page 2-1.**
- 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 Warnings, Section 1, Page 1-2.**

## 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. **See Lifting The Vehicle on page 3-7.**
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 Warnings, Section 1, Page 1-2.**

## 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.**

## FRONT HUBS

**See General Warnings, Section 1, Page 1-2.**

### FRONT HUB REMOVAL

1. Remove the upright assembly from the vehicle. **See Steering Upright Removal on page 7-18.**
2. Remove the hub from the bearing and upright. **See following CAUTION and NOTE.**

#### CAUTION

- **The hub is press-fit into the wheel bearing. Removing the hub will destroy the wheel bearing and will require a new wheel bearing during assembly.**

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

2.1. Place 2 x 2-inch, or larger, steel blocks (1) onto the platen bars of a hydraulic press **(Figure 8-2, Page 8-4)**.

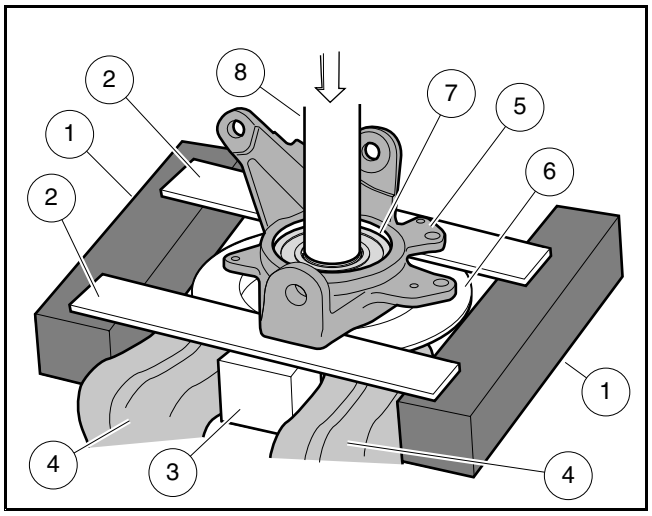
2.2. Position the upright assembly (5) between the blocks.

2.3. Place a 2 x 1/4-inch flat steel bar (2) under each arm of the upright (5) on the steel blocks (1).

2.4. Position a shim block (3) under each of the two flat steel bars (2) directly under each arm location.

2.5. Use a rod or bar (8) slightly smaller than the inside diameter of the inner bearing race (7) and press the hub from the bearing. **See following NOTE.**

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

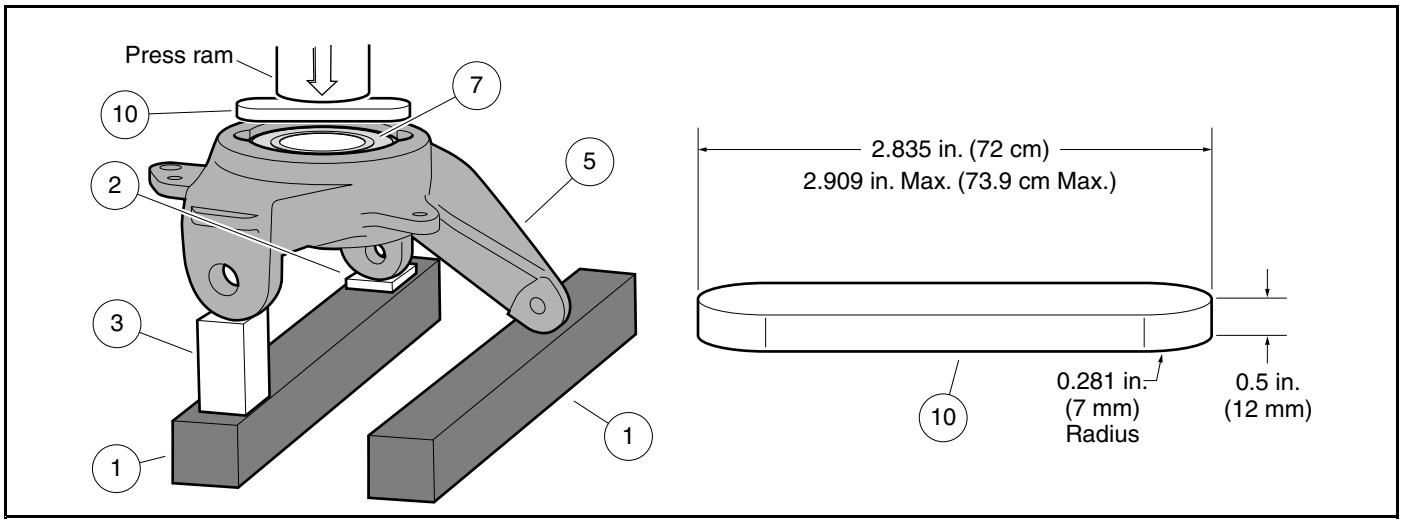



1899

**Figure 8-2 Position Steel Blocks and Upright on Press**

3. Press the bearing out of the upright.

3.1. 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 8-3, Page 8-4)**.




2030

**Figure 8-3 Bearing Removal**

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

3.3. 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.

## FRONT 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.**

1. Install new bearing into upright.

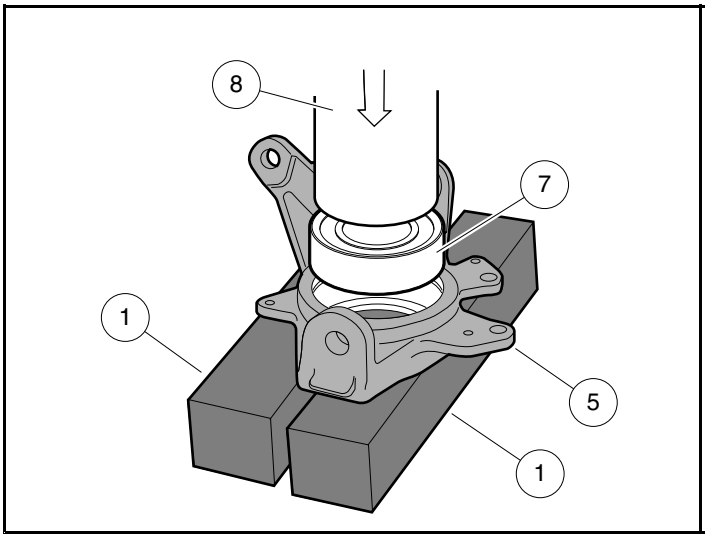
1.1. Position the upright (5) on 2 x 2-inch, or larger, steel blocks (1) as shown **(Figure 8-4, Page 8-5)**.

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

1.3. 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.**

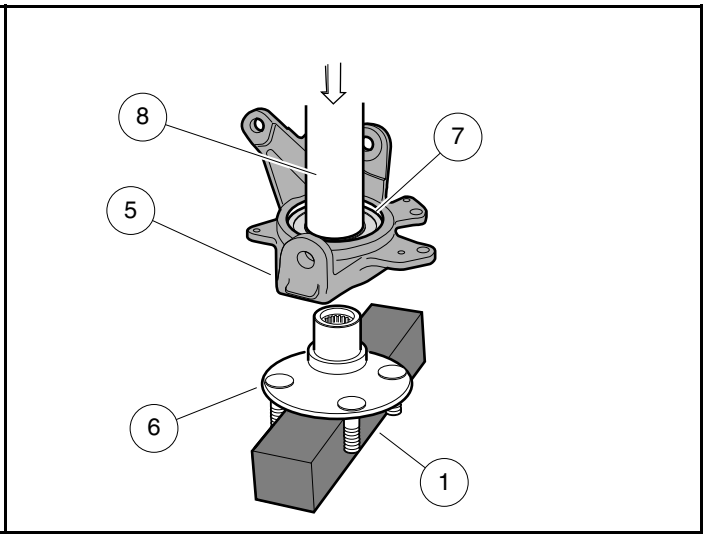
### CAUTION

- **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.**




2031

**Figure 8-4 Position Upright for New Bearing**




2562

**Figure 8-5 Press Hub into Bearing**

2. Press hub into bearing.

2.1. Position the hub (6) onto a 2 x 2-inch, or larger, steel block as shown **(Figure 8-5, Page 8-5)**. **See following CAUTION.**

### CAUTION

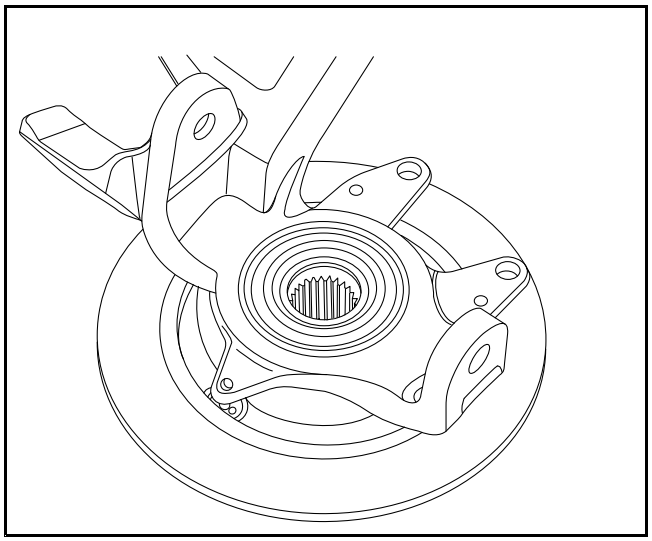
- **Do not press against the lug bolts. Press only against the center of the hub.**

2.2. Apply anti-seize compound to the hub shaft.

2.3. Position the upright (5) and bearing (7) onto the shaft of the hub as level as possible.

2.4. Use a rod or bar (8) larger than the inner race diameter of the bearing (7) and press the bearing onto the hub until it bottoms out against the shoulder of the hub shaft.

3. The hub shaft should be approximately 3/32 inch (2.38 mm) below the bearing inner race surface **(Figure 8-6, Page 8-6)**.



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**Figure 8-6 Upright, Bearing and Hub Assembly**

4. Install the upright assembly on the vehicle. **See Steering Upright Installation on page 7-20.**

# REAR HUBS

## REAR HUB REMOVAL

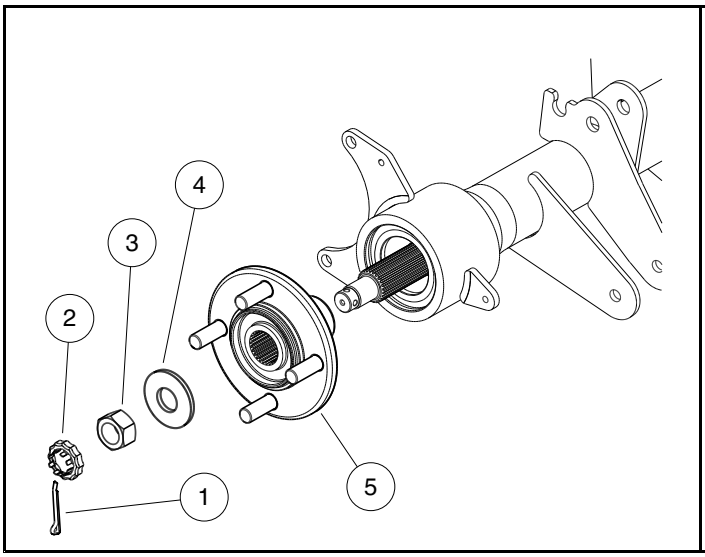
1. Disconnect battery and spark plug wire(s) **(gasoline vehicles only)**. **See Disconnecting the Battery-Gasoline/Diesel Vehicles on page 1-3.**
2. Loosen the lug nuts.
3. Remove the rubber dust cap.
4. Remove and discard the cotter pin (1) **(Figure 8-7, Page 8-7)**.
5. Remove nut locking cap (2) and loosen the axle nut (3) on the axle shaft.
6. Lift and support the rear of vehicle and remove the wheel(s). **See Lifting The Vehicle on page 3-7.**
7. Remove the lug nuts and wheel.
8. Remove the rear caliper from the axle tube. Secure the rear caliper to the suspension or chassis with wire ties to prevent strain on the fittings and brake line. **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.**
- **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.**

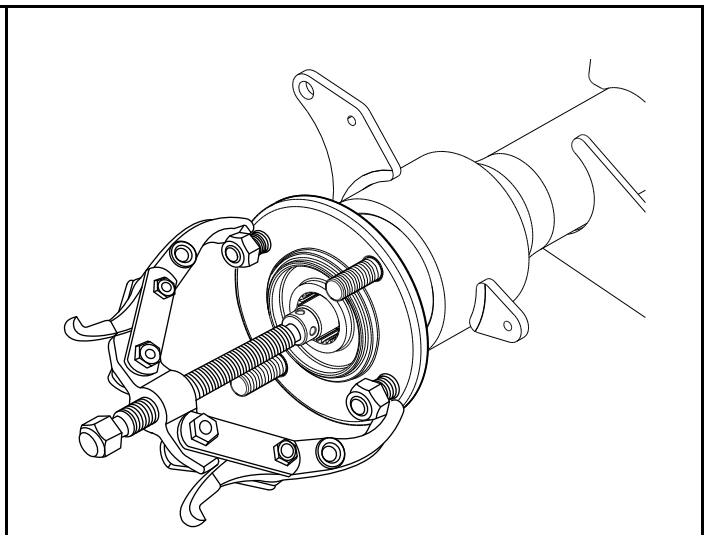
9. Remove brake disc from hub.
10. Remove axle nut (3) and large flat washer (4) and pull hub (5) off axle shaft. **See following NOTE.**

***NOTE:*** *If the hub (5) does not slide easily from the axle shaft, use a two or four-jaw wheel puller to remove the hub* ***(Figure 8-8, Page 8-7)****.*




2560

**Figure 8-7 Rear Hub Exploded View**



2561

**Figure 8-8 Puller Removing Rear Hub (If Necessary)**

### REAR HUB INSTALLATION

1. Clean the spline and threaded portion of the axle shaft.
2. Apply anti-seize compound to both the axle shaft splines and hub (5) splines. **See following CAUTION.**

## CAUTION

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

3. Slide hub (5) onto axle shaft **(Figure 8-7, Page 8-7)**. **See following NOTE.**

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

4. Install the large flat washer (4) onto the threaded portion of the axle.
5. Install axle nut (3) and advance the nut to the large flat washer.
6. Install brake disc onto hub.

7. Inspect the brake pads for wear and replace if necessary.

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

8. Install rear brake caliper onto axle tube. **See following NOTE.**

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

9. Install the tire and wheel and finger-tighten the lug nuts.
10. Lower the rear of the vehicle.
11. Tighten the axle nut (3) to 80 ft-lb (108 N·m). Position the locking cap (2) and install new cotter pin (1).
12. Install rubber dust cap onto wheel.
13. Tighten the lug nuts to 85 ft-lb (115 N·m) using a crisscross pattern.
14. Connect battery and spark plug wire(s) **(gasoline vehicles only)**. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

# SECTION 9 — REAR SUSPENSION



## ⚠ DANGER

- **See General Warnings, Section 1, Page 1-2.**

## ⚠ WARNING

- **See General Warnings, Section 1, Page 1-2.**

## REAR COIL-OVER SHOCK ABSORBER

**See General Warnings, Section 1, Page 1-2.**

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. The rear standard-duty and heavy-duty shock absorbers are designed differently. **See following NOTE.**

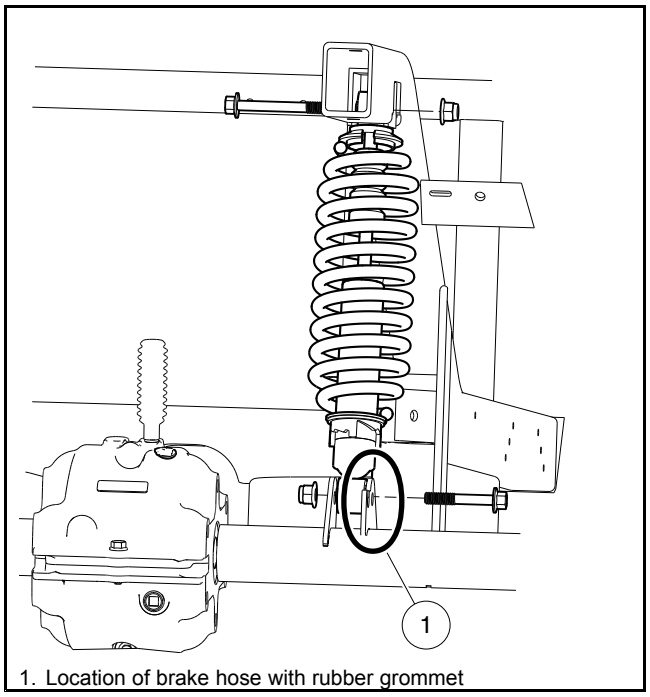
***NOTE:*** *The standard-duty rear coil-over springs and shocks are painted black. Heavy-duty rear coil-over springs and shocks have shock housings painted black and springs painted silver.*

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

The part number for standard-duty rear shock absorbers is different from 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. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Lift and support the rear of vehicle and remove the wheels. **See Lifting The Vehicle on page 3-7.**
3. Position the floor jack under the differential, and raise the jack arm until the pad touches the differential.
4. If more clearance is needed, remove the brake hose and rubber grommet from the lower shock bracket (1) and move brake hose out of the way **(Figure 9-1, Page 9-2)**.
5. Remove the lock nut and bolt securing the rear shock absorber to the rear axle **(Figure 9-1, Page 9-2)**. Discard lock nut.
6. Remove the lock nut and bolt securing the rear shock absorber to the chassis. Discard lock nut.




1. Location of brake hose with rubber grommet

2494

**Figure 9-1 Rear Shock Absorber Removal**

## REAR SHOCK 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. Installation is the reverse of removal.
2. Tighten the upper and lower hardware, using new lock nuts, to 73 ft-lb (99 N·m).
3. If detached during removal, secure the brake hose and rubber grommet in the lower shock bracket.
4. Install wheel and lower vehicle. **See Wheel Installation on page 8-2.**
5. Connect battery and spark plug wire(s). **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

# TRAILING ARMS AND LATERAL LINKS

**See General Warnings, Section 1, Page 1-2.**

## LATERAL LINK REMOVAL

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Lift and support the rear of vehicle and remove the wheel. **See Lifting The Vehicle, Section 3, Page 3-7.**
3. Support the rear axle.
4. Remove the hardware securing the lateral link (1) to the chassis **(Figure 9-2, Page 9-4)**.
5. Remove the hardware securing the lateral link (1) to the rear axle.

## LATERAL LINK INSTALLATION

1. Installation is the reverse of removal **(Figure 9-2, Page 9-4)**. Orient hardware as shown.
2. Tighten hardware at each end of link to 57 ft-lb (77 N·m).
3. Install wheel and lower vehicle. **See Wheel Installation on page 8-2.**
4. Connect battery and spark plug wire(s). **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

## TRAILING ARM REMOVAL

**See General Warnings on page 1-2.**

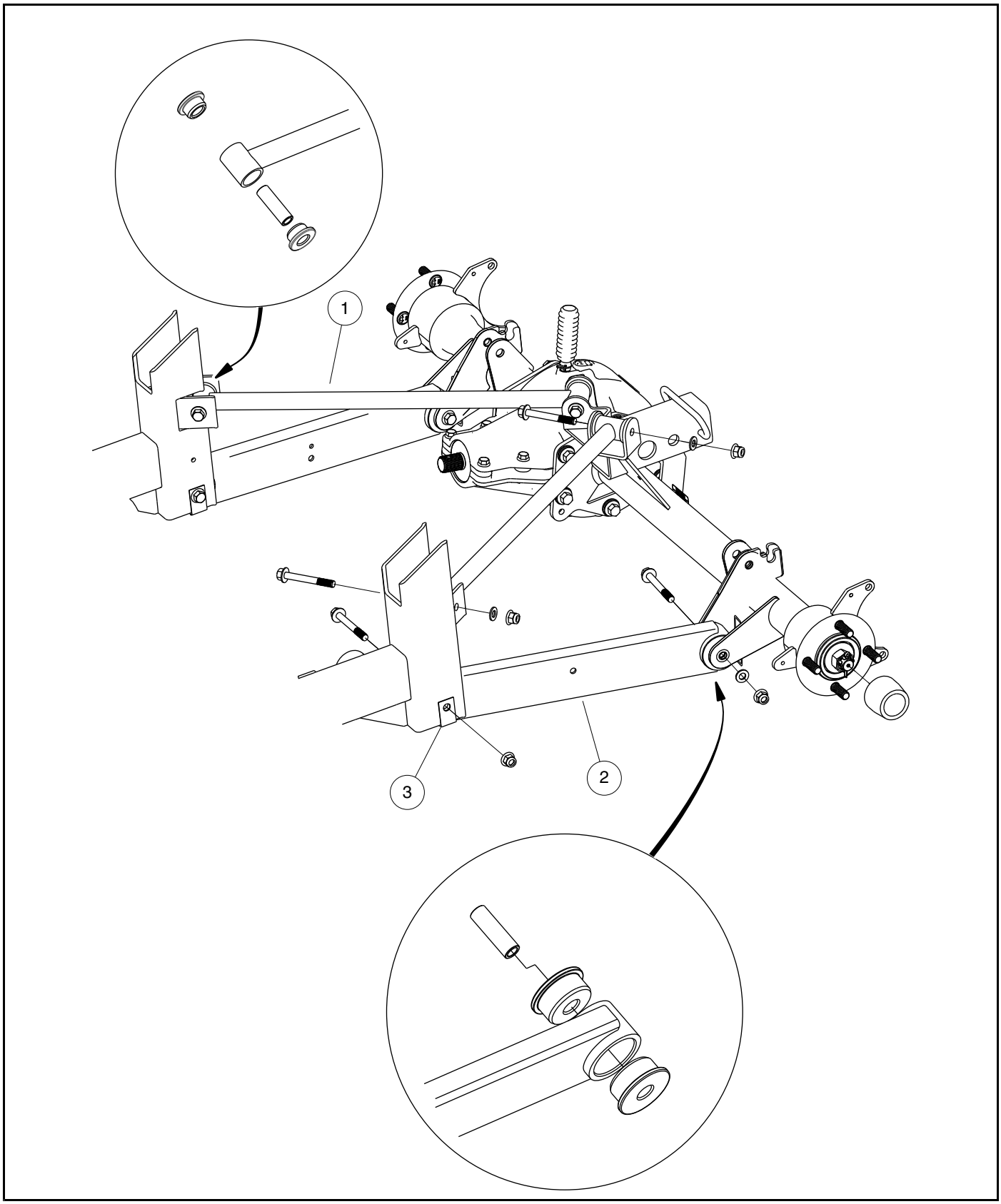
1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Raise the cargo bed. **See Body and Trim, Section 4, Page 4-1.**
3. Lift and support the rear of vehicle and remove the wheel. **See Lifting The Vehicle, Section 3, Page 3-7.**
4. Support the rear axle.
5. Remove the hardware securing the trailing arm (2) to the rear axle **(Figure 9-2, Page 9-4)**.
6. Remove the hardware securing the front of the trailing arm to the chassis and remove the trailing arm.

## TRAILING ARM INSTALLATION

1. Installation is the reverse of removal **(Figure 9-2, Page 9-4)**. Orient hardware as shown. **See following NOTE.**

***NOTE:*** *Be sure the wear clip (3) is in place on chassis when trailing arm is installed and secured with hardware.*

2. Tighten the trailing arm hardware to 57 ft-lb (77 N·m).
3. Install wheel and lower vehicle. **See Wheel Installation on page 8-2.**
4. Lower the cargo bed. **See Body and Trim, Section 4, Page 4-1.**
5. Connect battery and spark plug wire(s). **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**




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**Figure 9-2 Rear Suspension Components – 4 Link**

## ⚠ DANGER

- **See General Warnings, Section 1, Page 1-2.**

## ⚠ WARNING

- **See General Warnings, Section 1, Page 1-2.**

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.**

# HALF SHAFTS

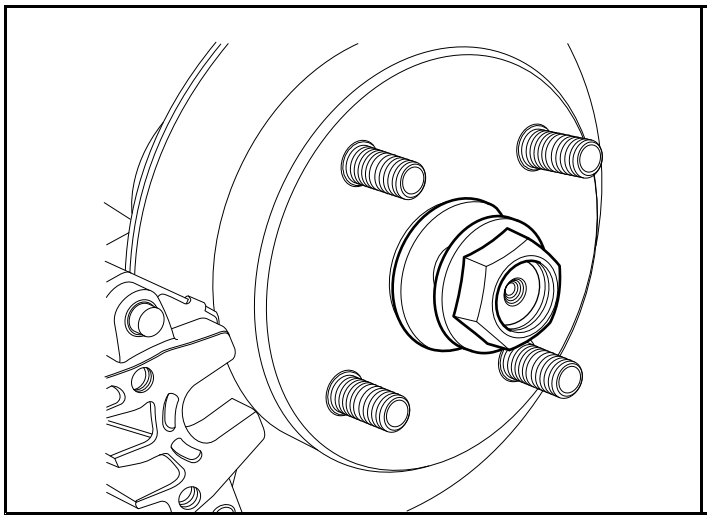
## HALF SHAFT REMOVAL

1. Disconnect battery and spark plug wire(s) **(gasoline vehicles only)**. **See Disconnecting the Battery-Gasoline/Diesel Vehicles on page 1-3.**
2. Loosen the lug nuts on both front wheels.
3. Remove the rubber spindle nut covers from both front wheels.
4. Loosen the axle spindle nuts **(Figure 10-1, Page 10-2)**.
5. Lift and support the front of vehicle and remove the wheel(s). **See Lifting The Vehicle on page 3-7.**
6. Remove both spindle nuts and large washers **(Figure 10-1, Page 10-2)**.
7. Remove the upper shock absorber bolt and locknut.
8. Remove the lower shock absorber bolts and flanged locknuts. Remove the shock absorber and coil-over spring.
9. Remove the front brake caliper from the upright and remove the brake disc.
10. Position the caliper on the top of the upper A-arm and secure it with a wire tie. **See following CAUTION.**

## ⚠ CAUTION

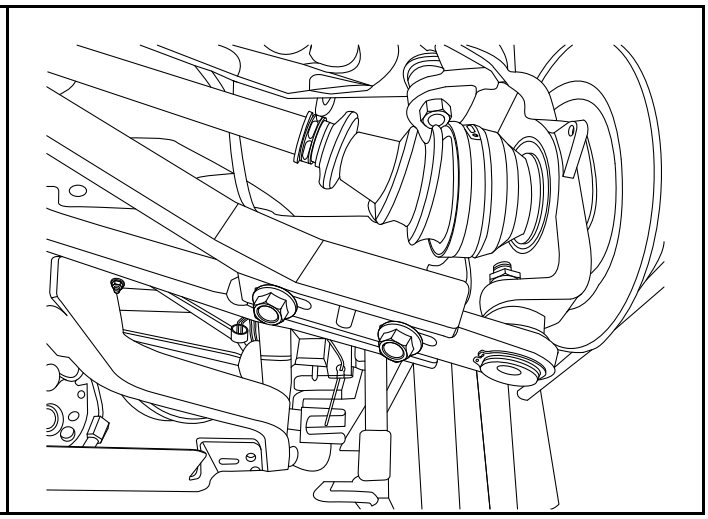
- **Do not kink, twist, or damage the hydraulic brake hoses.**

11. Remove the two flanged bolts and square nuts from the camber adjustment bar **(Figure 10-2, Page 10-2)**.
12. 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.



1895

**Figure 10-1 Axle Spindle Nut And Washer**



2193

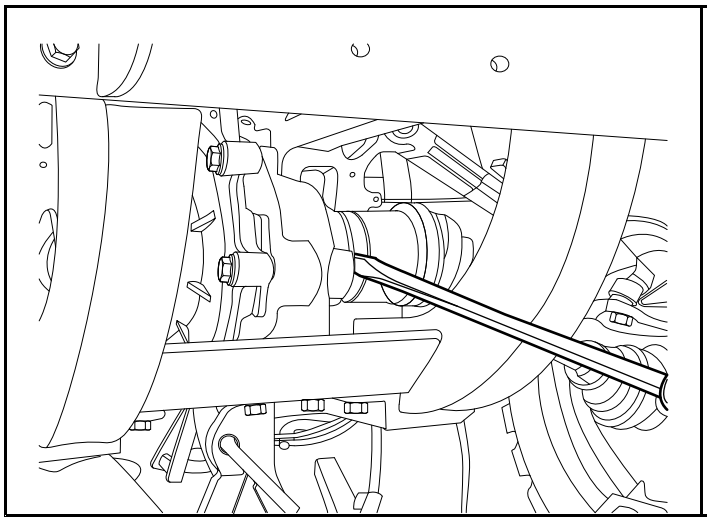
**Figure 10-2 Camber Adjustment Bar**

13. Separate the half shaft hub from the differential and remove the half shaft **(Figure 10-3, Page 10-2)**. **See following NOTE.**

***NOTE:*** *Use a 5/16-inch wide flat blade screwdriver to separate the half shaft hub and differential.*

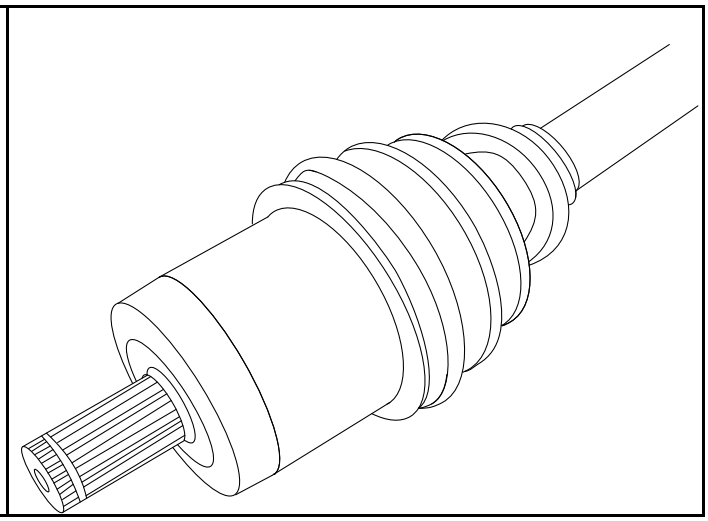
*The hub end of the half shaft has a round compression ring and groove. The compression ring mates with a groove inside the differential* ***(Figure 10-4, Page 10-2)****.*

14. Repeat steps for the remaining half shaft.



2194

**Figure 10-3 Separate Half Shaft from Differential**



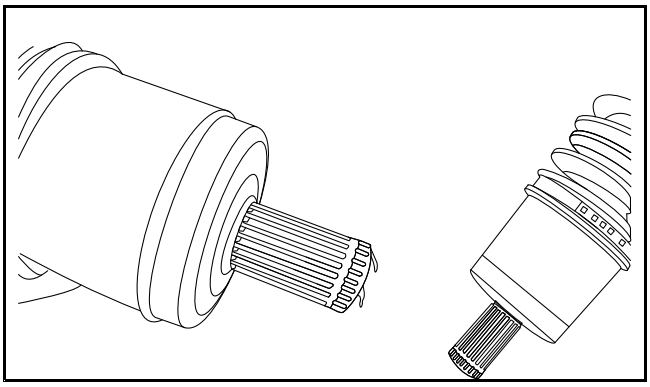
2195

**Figure 10-4 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 10-5, Page 10-3)**.



2196

**Figure 10-5 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 10-2, Page 10-2)**.
5. Install a large washer and new nut on the half shaft spindle and wheel hub. Finger-tighten the hardware.
6. Install the front caliper and disc on the upright.
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 10-1, Page 10-2)**.
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. Lower the front of the vehicle.
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 7-17.**
15. Connect battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

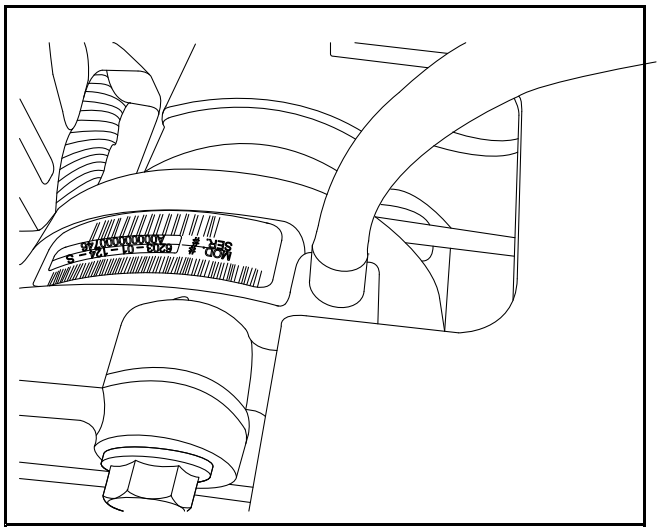
# FRONT DIFFERENTIAL

## FRONT DIFFERENTIAL REMOVAL

**See General Warnings, Section 1, Page 1-2.**

1. Disconnect battery and spark plug wire(s) **(gasoline vehicles only)**. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Loosen the lug nuts on both front wheels.
3. Remove the rubber spindle nut covers from both front wheels.
4. Loosen the axle spindle nuts **(Figure 10-1, Page 10-2)**.
5. Lift and support the front of vehicle and remove the wheel(s). **See Lifting The Vehicle on page 3-7.**

6. Remove both half shafts. **See Half Shaft Removal on page 10-1.**
7. Remove the lock nut and bolt securing the front driveshaft to the differential pinion shaft **(Figure 10-9, Page 10-7)**.
8. Remove the vent tube from the differential housing **(Figure 10-6, Page 10-4)**.



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**Figure 10-6 Differential Vent Tube**

9. Disconnect the electric clutch harness from the differential at the connector behind the splash guard **(Figure 10-7, Page 10-5)**. **See following NOTE.**

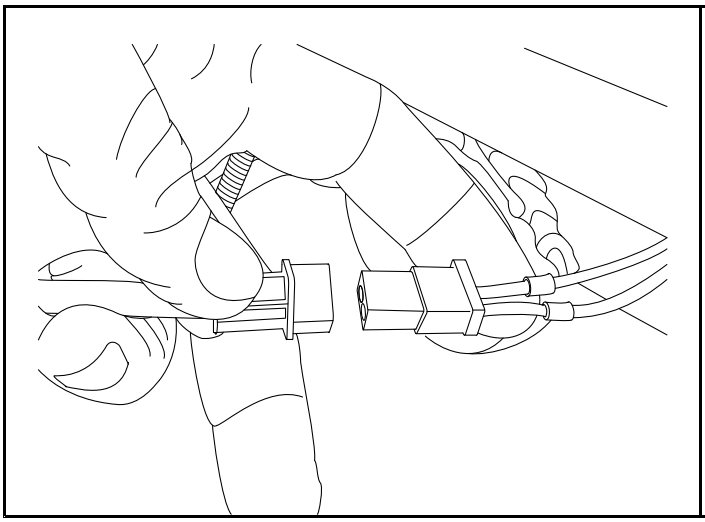
***NOTE:*** *It may be necessary to open one or two splash guard fasteners to access the connector.*

10. Remove the four flange-head bolts from the frame support weldments **(Figure 10-8, Page 10-5)**. **See following NOTE.**

***NOTE:*** *Do not remove the flange-head bolts from the differential plate and differential housing.*

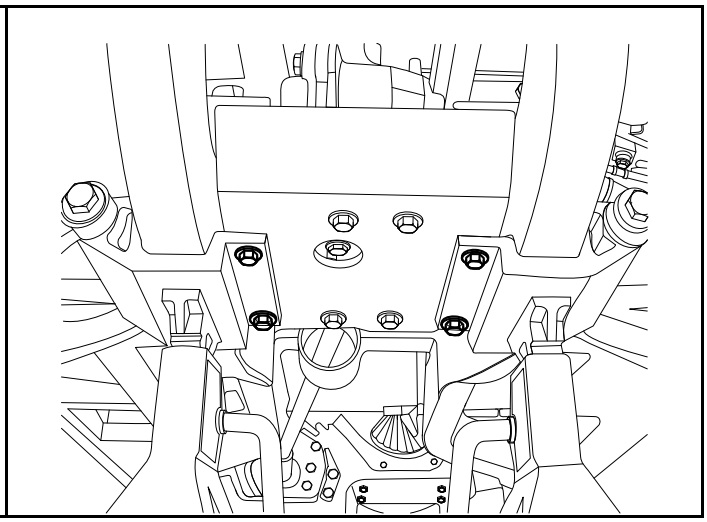
11. Pull the front differential and differential plate forward and out of the driveshaft. Tip the unit downward and remove it from the vehicle. **See following NOTE.**

***NOTE:*** *It is not necessary to remove the differential from its mounting plate to repair or service the unit.*



2199

**Figure 10-7 Differential Clutch Connector**



2200

**Figure 10-8 Front Differential Plate Bolts**

## FRONT DIFFERENTIAL INSTALLATION

**See General Warnings, Section 1, Page 1-2.**

***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 10-8, Page 10-5)**.
5. Connect the electric clutch harness to the connector behind splash guard **(Figure 10-7, Page 10-5)**.
6. Connect the vent tube to the differential housing **(Figure 10-6, Page 10-4)**. **See following NOTE.**

***NOTE:*** *If the tube shows signs of cracking or splitting, trim the end before the tube is connected or replaced.*

7. Secure the driveshaft universal joint coupling to the differential pinion shaft with bolt and lock nut. Tighten lock nut to 17 ft-lb (23 N·m).
8. Fill the front differential with the specified lubricant. **See Periodic Lubrication Schedule, Section 11, Page 11-6.**
9. Install the half shafts. **See Half Shaft Installation on page 10-2.**
10. Connect battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

# FRONT DRIVESHAFT

## FRONT DRIVESHAFT REMOVAL

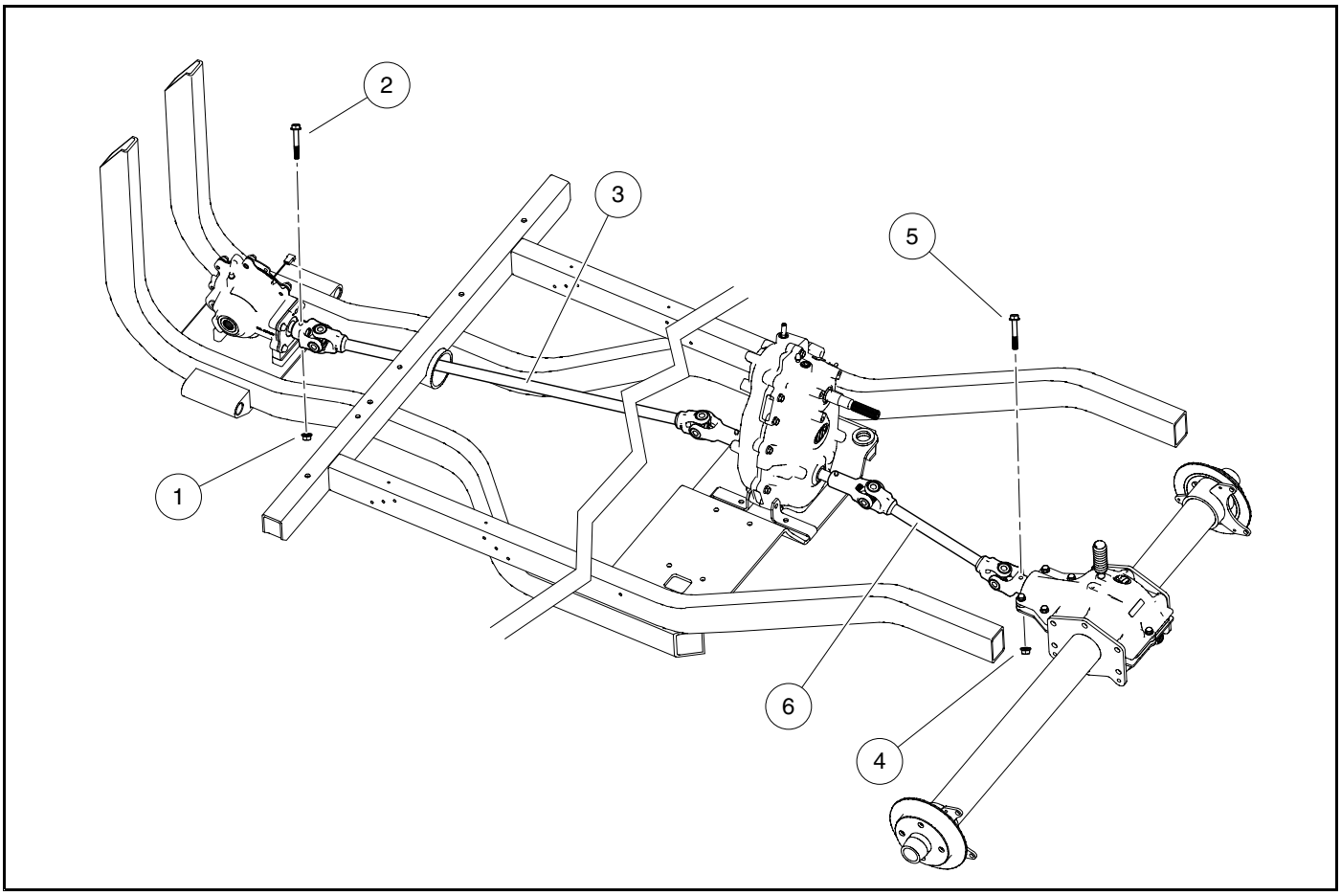
**See General Warnings, Section 1, Page 1-2.**

1. Push the vehicle to a position that enables easy access to the roll pin securing the front driveshaft to the differential pinion shaft. Chock the rear wheels.
2. Disconnect battery and spark plug wire(s) **(gasoline vehicles only)**. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
3. Remove the lock nut (1) and bolt (2) securing the front driveshaft (3) to the differential pinion shaft **(Figure 10-9, Page 10-7)**.
4. Slide the front driveshaft (3) toward the transmission until the universal joint clears the front differential pinion shaft.
5. Slide the driveshaft (3) off the transmission, through the oval-shaped frame shield, and remove from vehicle.

## FRONT DRIVESHAFT INSTALLATION

**See General Warnings, Section 1, Page 1-2.**

1. Apply a light coat of anti-seize compound to the differential pinion shaft and splined shaft of transmission.
2. Slide the front driveshaft (3) through the oval-shaped frame shield and onto the splined shaft of the transmission **(Figure 10-9, Page 10-7)**.
3. Slide the front differential pinion shaft into the universal joint so the holes in the driveshaft (3) and differential pinion shaft are aligned.
4. Secure the driveshaft universal joint coupling to the differential pinion shaft with bolt (2) and lock nut (1). Tighten lock nut (1) to 17 ft-lb (23 N·m).
5. Connect battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**




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**Figure 10-9 Driveshaft Hardware**

# TRANSMISSION

## TRANSMISSION REMOVAL

**See General Warnings, Section 1, Page 1-2.**

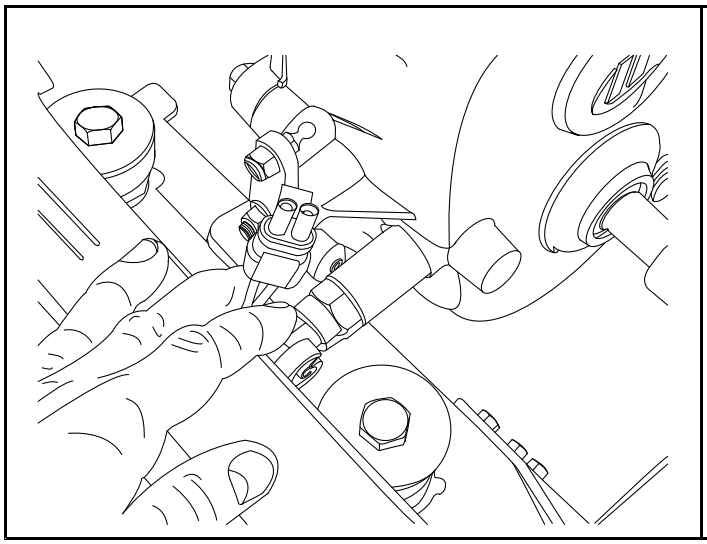
1. Disconnect battery and spark plug wire(s) **(gasoline vehicles only)**. **See Disconnecting the Battery-Gasoline/Diesel Vehicles on page 1-3.**
2. Remove the outer clutch cover. **See Clutch Outer Cover Removal on page 19-36 (gasoline vehicles). See Clutch Outer Cover Removal on page 14-31 (diesel vehicles).**
3. Remove the drive belt. **See Drive Belt Removal on page 19-29 (gasoline vehicles). See Drive Belt Removal on page 14-24 (diesel vehicles).**
4. Remove the drive clutch. **See Drive Clutch Removal on page 19-30 (gasoline vehicles). See Drive Clutch Removal on page 14-25 (diesel vehicles).**
5. Remove the driven clutch. **See Driven Clutch Removal on page 19-33 (gasoline vehicles). See Driven Clutch Removal on page 14-28 (diesel vehicles).**
6. Detach the rear driveshaft. **See Rear Driveshaft Removal on page 10-13.**

7. Detach the front driveshaft. **See Front Driveshaft Removal on page 10-5.**
8. Remove the clutch inner cover. **See Clutch Inner Cover Removal on page 19-36 (gasoline vehicles). See Clutch Inner Cover Removal on page 14-31 (diesel vehicles).**
9. Remove the passenger seat.
10. Disconnect forward/reverse shifter cable from transmission shifter arm by removing clip **(Figure 10-13, Page 10-11)**
11. Disconnect the neutral sensing connector from the transmission **(Figure 10-10, Page 10-8)**.
12. Remove the two flange-head bolts, washers, and locknuts from the transmission slotted base brackets and engine mounting plate **(Figure 10-11, Page 10-8)**. **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).*

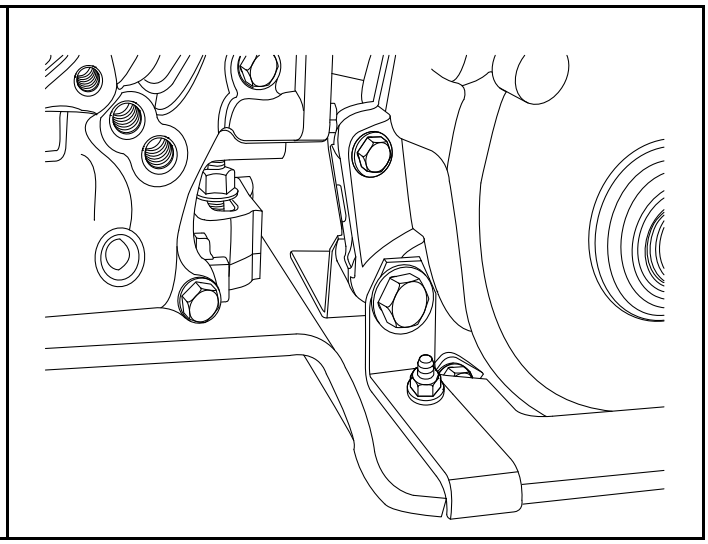
*If the transmission is not replaced, leave the base brackets attached to help stabilize the transmission during repair.*

13. Lift the transmission body slightly to clear the opening in the engine mounting plate and remove the transmission from the rear of the vehicle.



2207

**Figure 10-10 Neutral Sensing Connector**



2208

**Figure 10-11 Transmission Base Mount**

## TRANSMISSION INSTALLATION

**See General Warnings, Section 1, Page 1-2.**

1. Apply a light coat of anti-seize to the front splined shaft of the transmission.
2. Ensure the base brackets are installed on the transmission and install the transmission on the engine mounting plate.
3. 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.*

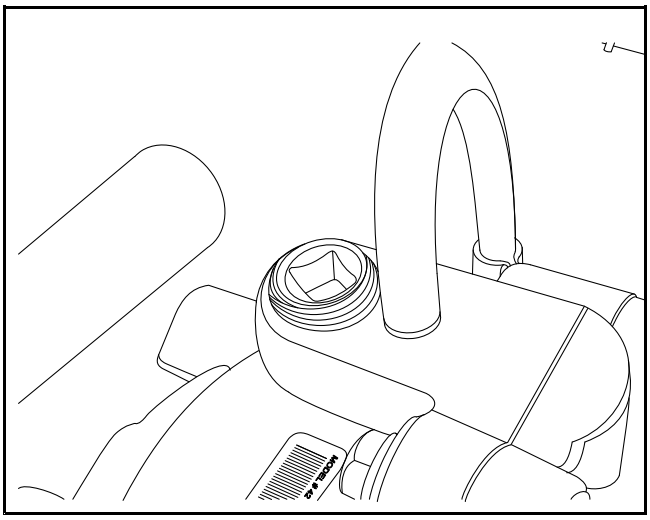
*If the transmission is new or the base brackets have been removed, leave the base brackets loose.*

4. 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 on page 19-36. Diesel vehicles: See Clutch Inner Cover Installation on page 19-36. 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.*

5. Tighten the transmission body base flange-head bolt and flange-head locknut to 39 ft-lb (53 N·m).
6. If removed, install two new bolts, flat washers, and new flanged locknuts on the transmission base brackets and engine mounting plate **(Figure 10-11, Page 10-8)**. Tighten the hardware to 21 ft-lb (29 N·m).
7. Connect the neutral sensing connector on the transmission to the wire harness **(Figure 10-10, Page 10-8)**.
8. Attach forward/reverse shifter cable to transmission shifter arm **(Figure 10-13, Page 10-11)**. Secure with clip.
9. Attach the rear driveshaft. **See Rear Driveshaft Installation on page 10-13.**
10. Attach the front driveshaft. **See Front Driveshaft Installation on page 10-6.**
11. Install the driven clutch. **See Driven Clutch Installation on page 19-35 (gasoline vehicles). See Driven Clutch Installation on page 14-30 (diesel vehicles).**
12. Install the drive clutch. **See Drive Clutch Installation on page 19-33 (gasoline vehicles). See Drive Clutch Installation on page 14-28 (diesel vehicles).**
13. Install the drive belt. **See Drive Belt Installation on page 19-29 (gasoline vehicles). See Drive Belt Installation on page 14-24 (diesel vehicles).**
14. Install the clutch outer cover. **See Clutch Outer Cover Installation on page 19-36 (gasoline vehicles). See Clutch Outer Cover Installation on page 14-31 (diesel vehicles).**



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**Figure 10-12 Lubrication Fill Plug and Vent Tube**

15. Attach vent tube and check lubricant level of transmission **(Figure 10-12, Page 10-9)**. **See Periodic Maintenance, Section 11, Page 11-1.**
16. Tighten wheel lug nuts to 85 ft-lb (115 N·m).
17. **Gasoline vehicles:** Connect the spark plug wires.
18. Connect battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

## FORWARD/REVERSE SHIFTER CABLE

**See General Warnings, Section 1, Page 1-2.**

**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. Disconnect battery and spark plug wire(s) **(gasoline vehicles only)**. **See Disconnecting the Battery-Gasoline/Diesel Vehicles on page 1-3.**
2. Raise the hood.
3. Disconnect cable end from Forward/Reverse shifter handle in the dash by removing clip **(Figure 10-13, Page 10-11)**.
4. Loosen the flanged nuts on the cable at the shifter handle bracket **(Figure 10-13, Page 10-11)**.

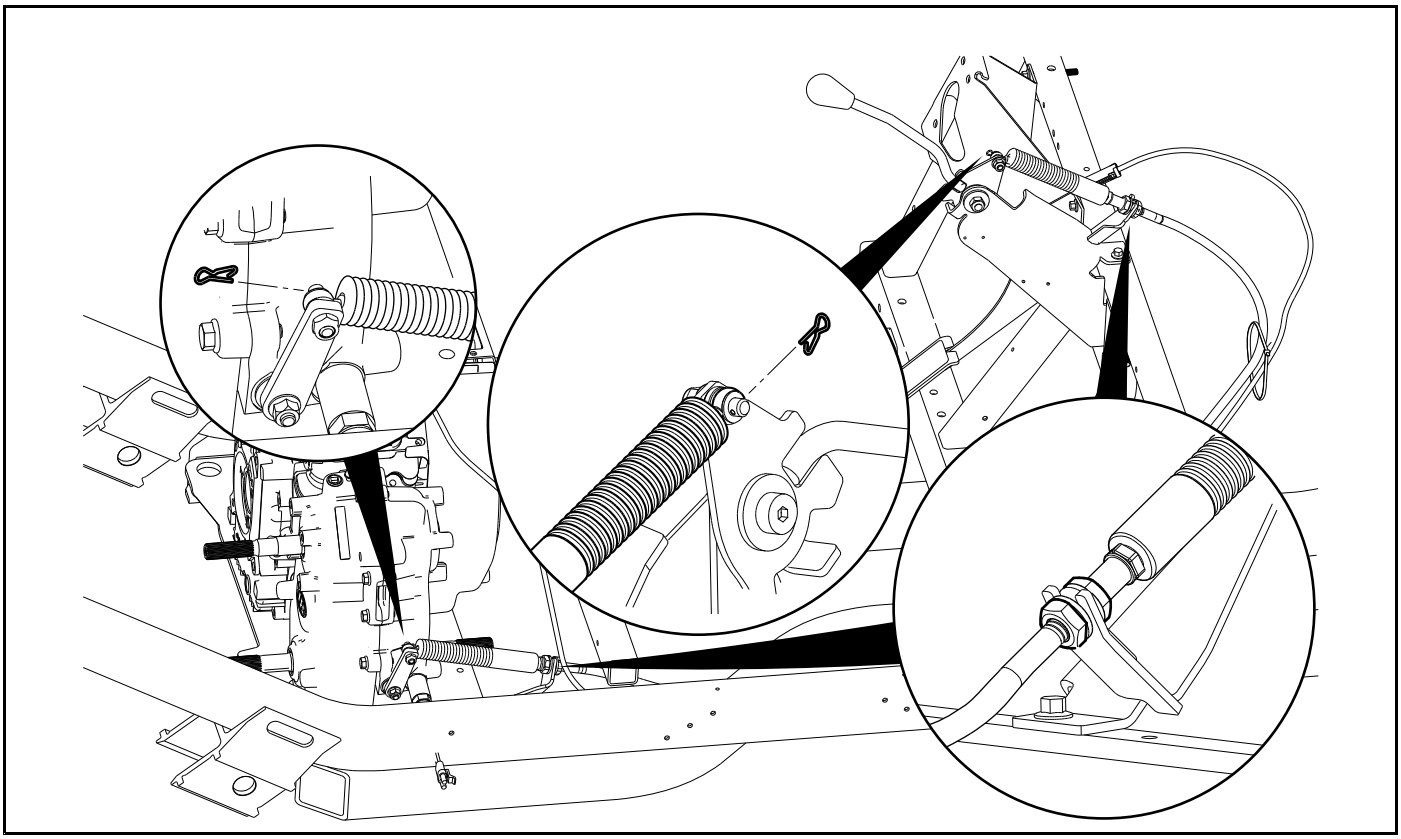
***NOTE:*** *Note the positions of the flanged nuts on the cable. The nut farthest from the handle should be at the farthest end of the threaded portion of the cable.*

5. Remove seat.
6. Note the positions of the wire ties that secure the cable between the dash and the transmission and then remove the wire ties.
7. Disconnect cable end from transmission shifter arm by removing clip **(Figure 10-13, Page 10-11)**
8. Loosen the flanged nuts from the cable bracket that is below and forward of the transmission shifter arm **(Figure 10-13, Page 10-11)**. **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.*

9. Remove the shifter cable.



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**Figure 10-13 Forward/Reverse Cable Connections At Shifter Handle and 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. Attach cable end to Forward/Reverse shifter handle in the dash **(Figure 10-13, Page 10-11)**. Secure with clip.
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 shifter bracket on the dash frame.
5. Adjust the shifter cable. **See Forward/Reverse Shifter Cable Adjustment on page 10-11.**

**Forward/Reverse Shifter Cable Adjustment**

1. Verify that the transmission shifter arm is in the NEUTRAL position.
2. Loosen the flanged nuts from the cable bracket that is below and forward of the transmission shifter arm **(Figure 10-13, Page 10-11)**.
3. Attach cable end to transmission shifter arm **(Figure 10-13, Page 10-11)**. Secure with clip.
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.*

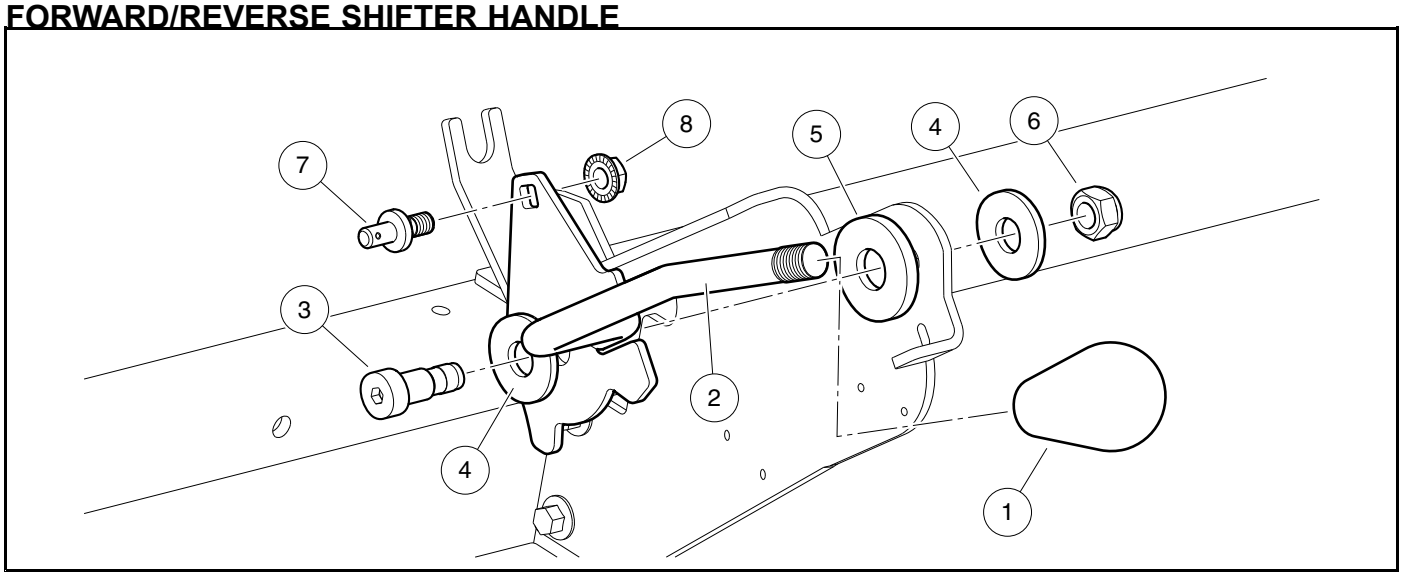
5. Advance the front flanged nut, closest to the transmission shifter arm, up against the front side of the cable bracket.
6. Advance the rear flanged nut, farthest away from the transmission shifter arm, down next to the back side of the cable bracket and tighten the front nut to 25 ft-lb (34 N·m).
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 battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

## FORWARD/REVERSE SHIFTER HANDLE




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**Figure 10-14 Shifter Handle Components**

### Shifter Handle Removal

1. Disconnect battery and spark plug wire(s) **(gasoline vehicles only)**. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Remove the shifter knob (1) **(Figure 10-14, Page 10-12)**.
3. Raise the hood.
4. Disconnect cable end from Forward/Reverse shifter handle (2) in the dash by removing clip **(Figure 10-13, Page 10-11)**.
5. Remove the socket-head pivot shoulder bolt (3), two large flat washers (4), bushing (5), and nylon locknut (6) from the shifter handle and frame bracket **(Figure 10-14, Page 10-12)**.
6. Remove the shifter handle (2).
7. Remove cable pin (7) and locknut (8) from the shifter handle (2).

### Shifter Handle Installation

1. Secure the shifter handle (2) with a new socket-head pivot shoulder bolt (3) , bushing (5), two large flat washers (4), and a new nylon locknut (6) as shown **(Figure 10-14, Page 10-12)**. Tighten locknut (6) to 40 in-lb (5 N·m). **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. Install cable pin (7) and locknut (8) on shifter handle (2). Tighten locknut (8) to 19 ft-lb (25 N·m).
3. Attach cable end to Forward/Reverse shifter handle **(Figure 10-13, Page 10-11)**. Secure with clip.
4. Install the shifter knob (1).
5. Lower and secure the hood.
6. **Gasoline vehicles:** Connect the spark plug wires.
7. Connect battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

# REAR DRIVESHAFT

## REAR DRIVESHAFT REMOVAL

**See General Warnings, Section 1, Page 1-2.**

1. Push the car to a position that enables easy access to the roll pin securing the rear driveshaft to the differential pinion shaft. Chock the front wheels.
2. Disconnect battery and spark plug wire(s) **(gasoline vehicles only)**. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
3. Remove the lock nut (4) and bolt (5) securing the rear driveshaft (6) to the differential pinion shaft **(Figure 10-9, Page 10-7)**.
4. Slide the driveshaft (6) 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 Warnings, Section 1, Page 1-2.**

1. Apply a light coat of anti-seize on the splined shaft of the differential.
2. Slide the universal joint (with grease fitting) of the driveshaft (6) onto the splined transmission shaft.
3. Slide the differential pinion shaft into driveshaft universal joint. Align the holes in the driveshaft (6) with the hole in the differential pinion shaft.
4. Secure the driveshaft universal joint coupling to the differential pinion shaft with bolt (5) and lock nut (4) **(Figure 10-9, Page 10-7)**. Tighten lock nut (4) to 17 ft-lb (23 N·m).
5. **Gasoline vehicles:** Connect the spark plug wires.
6. Connect battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

# REAR AXLE

## REAR AXLE REMOVAL

1. Disconnect battery and spark plug wire(s) **(gasoline vehicles only)**. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Loosen the lug nuts on both rear wheels.

3. Lift and support the rear of vehicle and remove the wheel(s). **See Lifting The Vehicle on page 3-7.**
4. Detach rear brake hose where anchored to rear axle **(Figure 10-15, Page 10-15)**.
5. Remove brake calipers from rear axle and temporarily hang them from the chassis with a piece of wire. **See following CAUTION.**

## ⚠ CAUTION

- **Do not kink, twist, or damage the hydraulic brake lines.**

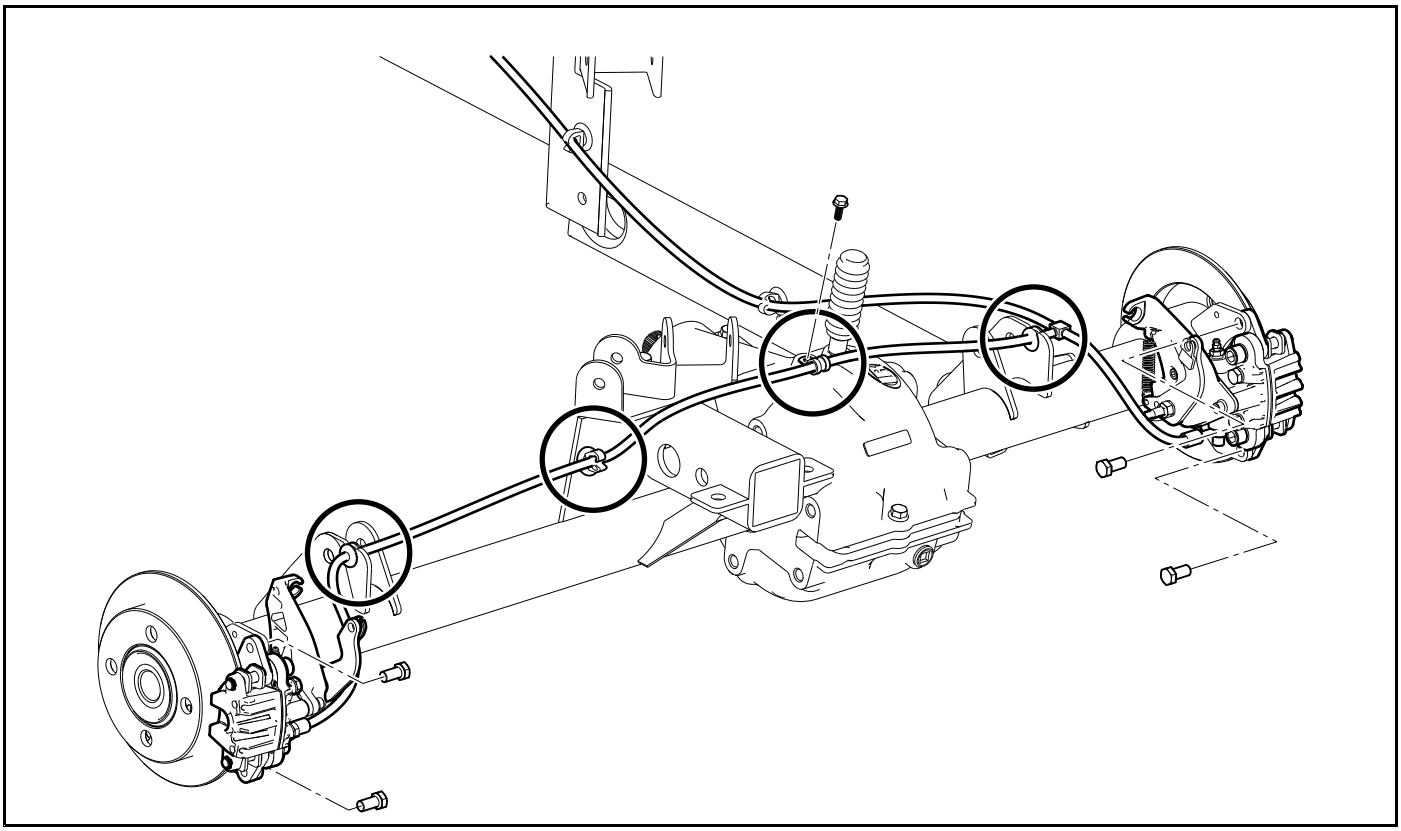
6. Position the floor jack under the differential and raise the jack just enough to support the axle.
7. Detach rear shock absorbers from axle. **See Rear Coil-Over Shock Absorber on page 9-1.**
8. Detach rear driveshaft from rear axle. **See Rear Driveshaft Removal on page 10-13.**
9. Remove the four bolts, washers, and flanged locknuts securing axle to trailing arms and lateral links. **See Trailing Arms and Lateral Links on page 9-3.** Discard locknuts. **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 suspension, 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.**

10. Support the rear axle and slide it out the rear of the vehicle. **See preceding NOTE.**



2502

**Figure 10-15 Rear Brake Caliper and Hose Removal – 4 Link**

## REAR AXLE INSTALLATION

***NOTE:*** *These procedures are best performed with the help of an assistant.*

1. Place rear axle on floor jack, with differential resting on jack pad, and roll axle under rear suspension.
2. Support the long axle tube and raise axle up to trailing arms and lateral links.
3. Secure axle to trailing arms and lateral links at four locations with bolts, washers and new locknuts. **See Trailing Arms and Lateral Links on page 9-3.** If new locknuts are not available, clean existing bolts and add Loctite 2760 per instructions.
4. Attach rear driveshaft to rear axle. **See Rear Driveshaft Installation on page 10-13.**
5. Secure shock absorbers to axle. **See Rear Coil-Over Shock Absorber on page 9-1.**
6. Attach both rear brake calipers to axle.
7. Anchor the rear brake hose to rear axle at all original locations **(Figure 10-15, Page 10-15)**. **See following CAUTION.**

### ⚠ CAUTION

- **Do not kink, twist, or damage the hydraulic brake lines.**

8. Install both rear wheels and finger-tighten the lug nuts.
9. Lower the rear of the vehicle.
10. Use a crisscross pattern to tighten the lug nuts on both rear wheels. **See Wheel Installation on page 8-2.**

11. Ensure differential has appropriate type and volume of oil. **See Gearcase Lubrication on page 11-16.**
12. **Gasoline vehicles:** Connect the spark plug wires.
13. Connect battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

# REAR AXLE TUBES, AXLE SHAFTS AND WHEEL BEARINGS

## REAR AXLE TUBE AND AXLE SHAFT REMOVAL

**See General Warnings, Section 1, Page 1-2.**

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. Drain oil. Install plug after draining.
2. If removing entire rear axle from vehicle, remove the rear axle and clean it in preparation for disassembly. **See Rear Axle Removal on page 10-13. See following NOTE.**

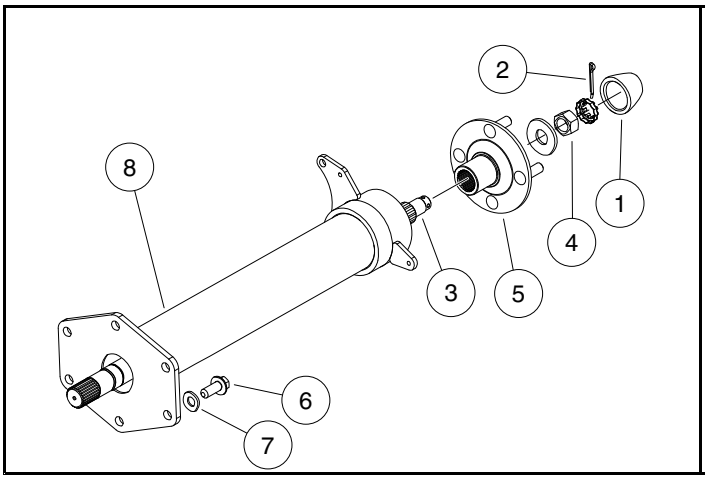
***NOTE:*** *After cleaning, move the rear axle and differential assembly to a clean location before disassembly.*

3. If removing only one axle tube (8) or shaft (3) **(Figure 10-16, Page 10-17)** from vehicle, clean that tube and hub in preparation for disassembly.
4. Remove rear hub (5). **See Rear Hub Removal on page 8-6.**
5. Remove the six flange-head bolts (6) and flat washers (7) securing each axle tube (8) to the differential **(Figure 10-16, Page 10-17)**. **See following CAUTION.**

### CAUTION

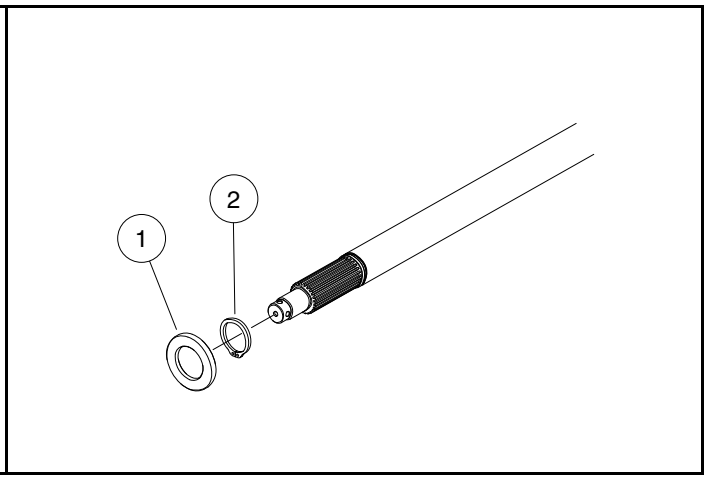
- **The differential and axle tubes have been assembled with Loctite 2760 Threadlocker compound. Use a non-flammable heat source to heat the flange area and bolts during the removal and replacement of each of the six bolts. Once removed, the manufacturer recommends that each thread location be tapped with the same thread (M12 x 1.75 pitch) before new bolts are installed.**

6. Cover or tape the axle shaft (3) splines to protect the hub seals in the axle tube (8).
7. Separate each axle tube (8) from the differential and carefully pull tube straight away until it clears the splined end of the axle shaft (3).
8. Avoiding damage caused by dragging splines across lip of seal in differential, carefully pull axle shaft from differential.
9. If replacing shaft, transfer washer (1) and retaining ring (2) from old shaft to new **(Figure 10-17, Page 10-17)**.




2566

**Figure 10-16 Axle Shaft and Brake Rotor**




2214

**Figure 10-17 Axle Shaft Retaining Ring and Washer**

## REAR AXLE TUBE AND AXLE SHAFT INSTALLATION

1. Clean and lubricate the seals in the differential with appropriate oil. **See Periodic Lubrication Schedule on page 11-6.**
2. Clean axle shaft (3), particularly the splined ends. Avoiding damage caused by dragging splines across lip of seal, carefully insert shaft into 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 axle tube (8) flange and differential. Also clean the threads of the six axle tube mounting holes in the differential. Apply Loctite 2760 to new flange-head bolts (6). **See following CAUTION.**

## CAUTION

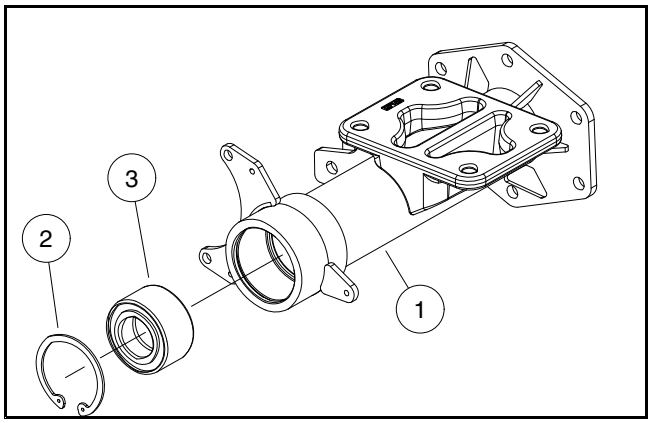
- **Clean each thread location with a thread tap (M12 x 1.75 pitch) before installing new bolts. Apply Loctite 2760 Threadlocker to the bolt threads.**

4. Apply a 3/16-inch wide bead of Three Bond No. 1215 to the mating surface of the differential.
5. Secure axle tube (8) to differential housing with the new flange-head bolts (6) and flat washers (7). Use a crisscross pattern to tighten the hardware to 100 ft-lb (136 N·m).
6. Install the rear hubs (5). **See Rear Hub Installation on page 8-7.**
7. If entire rear axle was removed from vehicle, install rear axle. **See Rear Axle Installation on page 10-15.**
8. Refill differential with appropriate type and volume of oil. **See Gearcase Lubrication on page 11-16.**

## REAR WHEEL BEARING REMOVAL

The axle tubes must be unbolted from the differential to access the wheel bearings. The hub seals are incorporated into the bearings.

1. Remove axle tube (1) from differential **(Figure 10-18, Page 10-18)**. **See Rear Axle Tube and Axle Shaft Removal on page 10-16.**
2. Remove the retaining ring (2) that is in front of the bearing (3).
3. Drive bearing (3) from axle tube (1) by applying force to the outer race.




2215

**Figure 10-18 Rear Wheel Bearing**

## REAR WHEEL BEARING INSTALLATION

1. Clean inside axle tube (1) where new bearing will sit and lightly lubricate the bore with anti-seize compound **(Figure 10-18, Page 10-18)**.
2. Using an appropriate sized bearing driver that fits the outer race, drive in new bearing (3) until fully seated.
3. Install retaining ring (2).
4. Clean axle shaft and carefully install axle tube (1) to avoid damaging new seals. **See Rear Axle Tube and Axle Shaft Installation on page 10-17.**

## ⚠ DANGER

- **See General Warnings, Section 1, Page 1-2.**

## ⚠ WARNING

- **See General Warnings, Section 1, Page 1-2.**

# PERIODIC SERVICE SCHEDULE

**See General Warnings, Section 1, Page 1-2.**

## ⚠ WARNING

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

***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** | Pre-Operation and Daily Safety Checklist | See Pre-Operation and Daily Safety Checklist in the Owner's Manual. |
| | Performance Inspection | See Performance Inspection in the Owner's Manual. |
| **Daily service by owner or trained technician** | Engine | Check engine oil level; add if necessary. **See Engine Oil Level Check on page 11-11.** |
| | | **Diesel vehicles:** Check engine coolant; add if necessary. **See Engine Coolant Level Check on page 11-19.** |
| | | Clean debris from radiator. |
| | Fuel filters | **Diesel vehicles:** Drain water from fuel filter. **See Draining Water from Fuel Filter on page 11-20.** |
| | Brakes | Check brake fluid; add if necessary. Check brake pedal for proper operation. **See Performance Inspection in the vehicle owner's manual.** |

**TABLE 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 Wheels, Tires and Hubs on page 8-1.** |
| | Transmission and differentials | Check lubricant levels. Add if necessary. **See Gearcase Lubrication on page 11-16.** |
| | 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. **See Battery on page 18-17 (gasoline vehicles) or Battery on page 13-21 (diesel vehicles).** |
| | Front wheel alignment and toe-in | Check and adjust if necessary. **See Wheel Alignment on page 7-14.** |
| | 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 |

**TABLE 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 11-15.** |
| | | **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 19-26.** |
| | | 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. |
| | Safety decals | Check safety decals. Replace if damaged or illegible. |
| **Every 200 hours of operation by trained technician only.** | Drive Belt | Inspect drive belt for cracks/damage. Replace if necessary. |

# PERIODIC SERVICE SCHEDULE – INTELLITACH

**See General Warnings, Section 1, Page 1-2.**

## ⚠ WARNING

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

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

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

| **PERIODIC SERVICE SCHEDULE** | | |
|---|---|---|
| **REGULAR INTERVAL** | **SERVICE** | |
| **Daily service by owner** | Pre-Operation and Daily Safety Checklist | See Pre-Operation and Daily Safety Checklist in the Owner's Manual. |
| | Performance Inspection | See Performance Inspection in the Owner's Manual. |
| **Daily service by owner or trained technician** | Engine | Check engine oil level; add if necessary. **See Engine Oil Level Check on page 11-11.** |
| | | **Diesel vehicles:** Check engine coolant; add if necessary. **See Engine Coolant Level Check on page 11-19.** |
| | | Clean debris from radiator. |
| | Fuel filters | **Diesel vehicles:** Drain water from fuel filter. **See Draining Water from Fuel Filter on page 11-20.** |
| | Brakes | Check brake fluid; add if necessary. Check brake pedal for proper operation. **See Performance Inspection in the vehicle owner's manual.** |
| | Hydraulic System | 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 Wheels, Tires and Hubs on page 8-1.** |
| | Transmission and differentials | Check lubricant levels. Add if necessary. **See Gearcase Lubrication on page 11-16.** |
| | General vehicle | Wash engine compartment and underside of vehicle. Do not wash engine when hot. |

**TABLE CONTINUED ON NEXT PAGE**

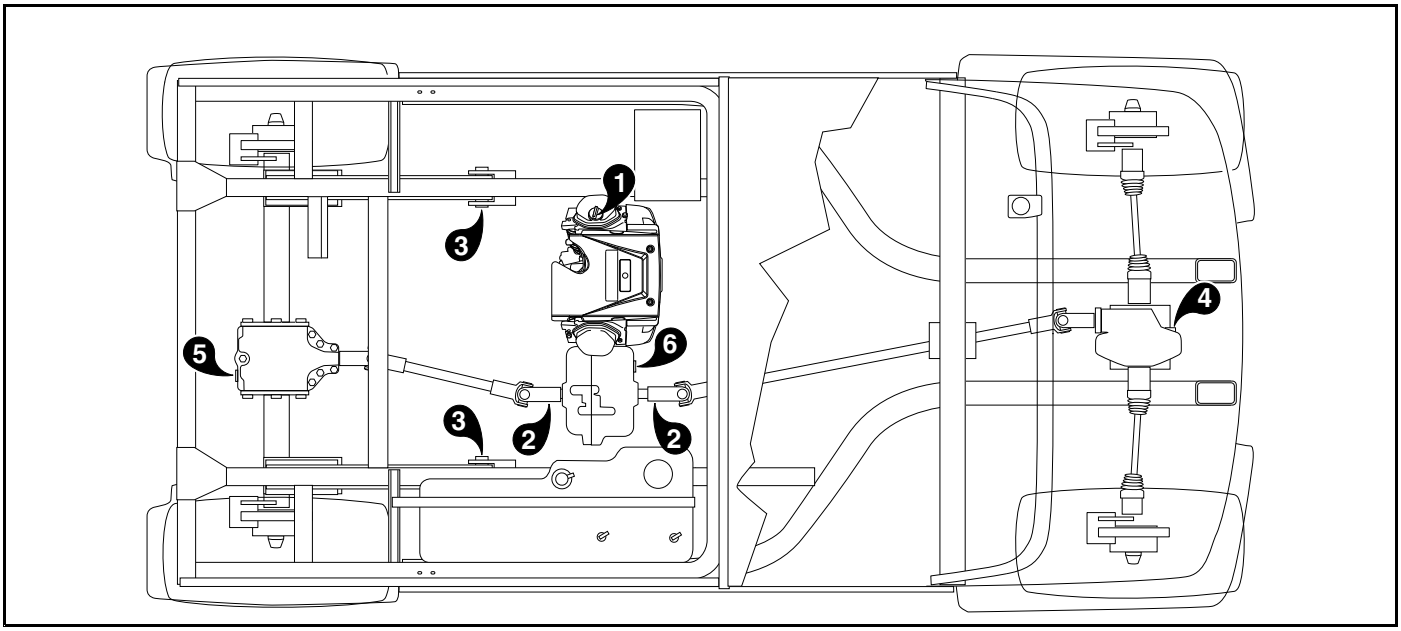
| PERIODIC SERVICE SCHEDULE | | |
|---|---|---|
| **REGULAR INTERVAL** | **SERVICE** | |
| **Semiannual service by trained technician only (or every 50 hours of operation, whichever comes first)** | Battery | Clean terminals and wash dirt from casing. **See page Battery on page 13-21.** |
| | Front wheel alignment and toe-in | Check and adjust if necessary. **See Steering and Front Suspension Section in the appropriate maintenance and service manual.** |
| | 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 |
| **Annual service by trained technician only (or every 100 hours of operation, whichever comes first)** | Engine | Check for leaks around gaskets, fill plugs, etc. |
| | | **Diesel vehicles:** Check the v-belt for proper tension or damage. Adjust or replace if necessary. |
| | | **Diesel vehicles:** Change engine coolant. **See Radiator and Cooling System Section in the maintenance and service manual.** |
| | 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 19-26.** |
| | | 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. |
| | Safety decals | Check safety decals. Replace if damaged or illegible. |
| Every 200 hours of operation by trained technician only. | Drive Belt | Inspect drive belt for cracks/damage. Replace if necessary. |

## ⚠ 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.**

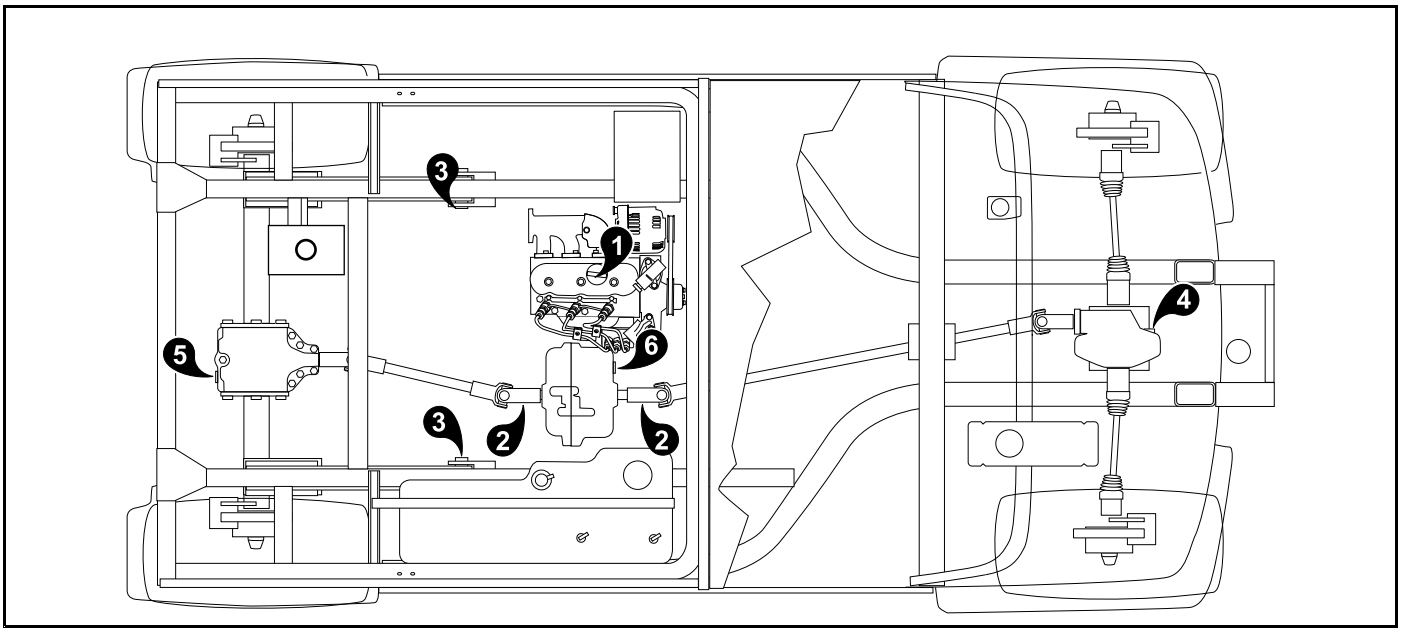
# PERIODIC LUBRICATION SCHEDULE

| 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 (1.5 L) with filter **Diesel vehicles:** 3 qt. (2.8 L) with filter **See Oil Viscosity on page 11-14.** |
| **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)** | Rear suspension (2 fittings) | 3 | 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 | 4 | 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 | 5 | 20 oz. (600 mL) Mobil 424, Exxon Hydraul 560, or Esso Hydraul 56 lubricant |
| | Change transmission lubricant | 6 | 20 oz. (600 mL) Mobil 424, Exxon Hydraul 560, or Esso Hydraul 56 lubricant |




2080

**Figure 11-1 Lubrication Points – Gasoline Vehicles**

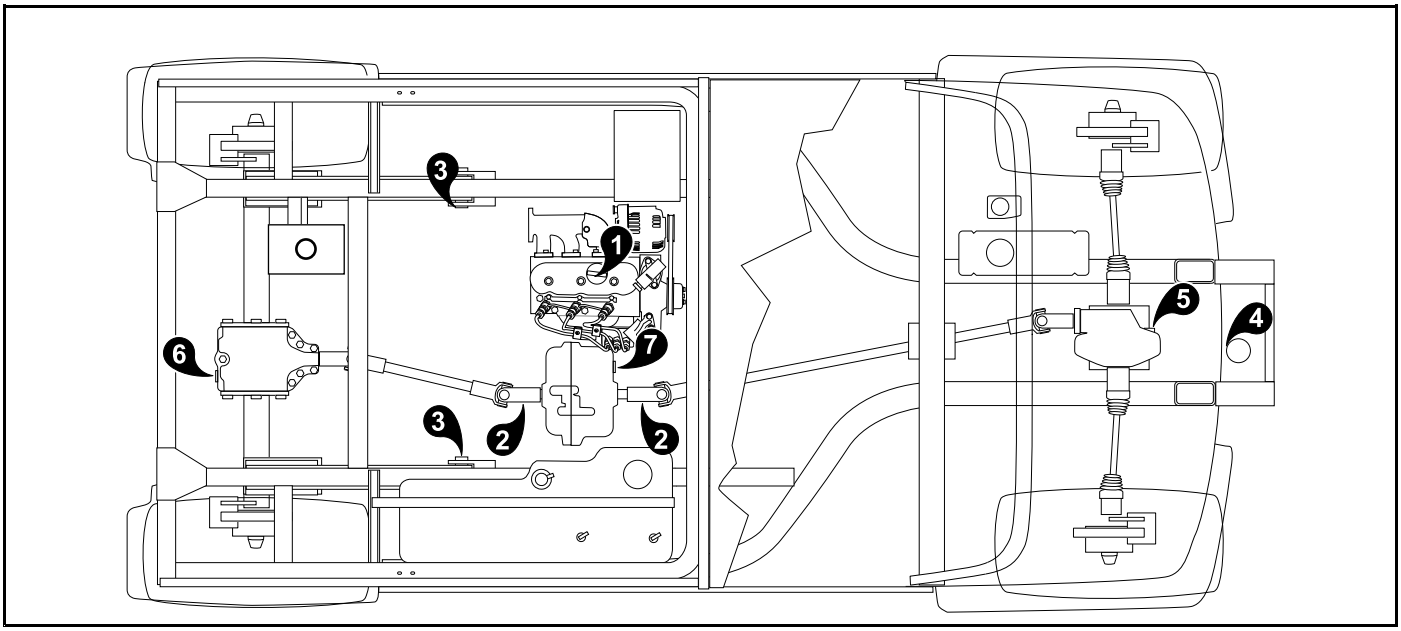



200

**Figure 11-2 Lubrication Points – Diesel Vehicles**

# PERIODIC LUBRICATION SCHEDULE – INTELLITACH

| PERIODIC LUBRICATION SCHEDULE | | | |
|---|---|---|---|
| **REGULAR INTERVAL** | **SERVICE** | **LUBRICATION POINTS** | **RECOMMENDED LUBRICANT** |
| 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 | **Diesel vehicles:** 3 qt. (2.8 L) with filter. **See Oil Viscosity on page 11-14.** |
| 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) | Rear suspension (2 fittings) | 3 | Chassis Lube (EP NLGI Grade 2) |
| | Attachment Arm and Interface (8 fittings) | 4 | 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 | 5 | 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 | 6 | 20 oz. (600 mL) Mobil 424, Exxon Hydraul 560, or Esso Hydraul 56 lubricant |
| | Change transmission lubricant | 7 | 20 oz. (600 mL) Mobil 424, Exxon Hydraul 560, or Esso Hydraul 56 lubricant |




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**Figure 11-3 Lubrication Points – Diesel Vehicles with Hydraulic Attachment**

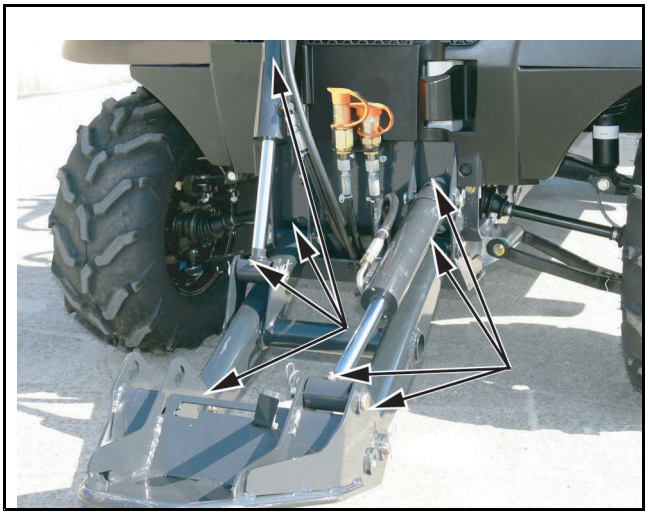
# LUBRICATING THE ATTACHMENT ARM AND INTERFACE – INTELLITACH

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 11-4)**:

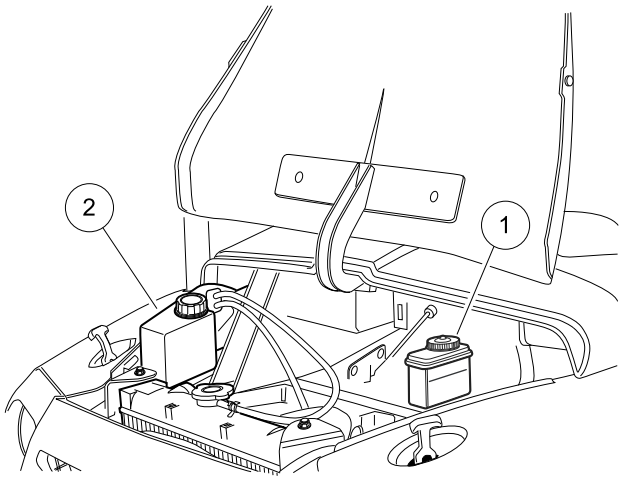
1. Attachment Interface Cylinder (both ends).
2. Attachment Arm Pivot - vehicle side (both sides).
3. Attachment Arm Cylinder (both ends).
4. Attachment Arm Pivot - interface side (both sides).



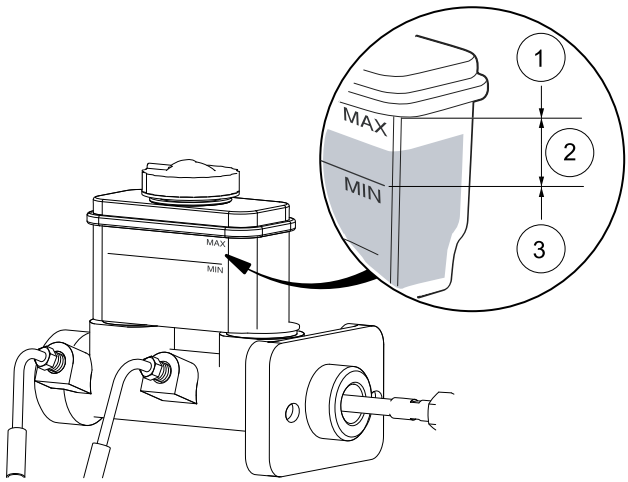
265

**Figure 11-4 Lubricate Grease Zerks located on Cylinder and Attachment Arm Ends**

# BRAKE FLUID RESERVOIR




2692
**Figure 11-5 Brake Fluid and Coolant Access (diesel only)**




1. Full Level 2. Safe Level 3. Low Level

2693
**Figure 11-6 Brake Fluid Reservoir Level**

The brake fluid reservoir (1) is located under the hood. Raise the hood to check the brake fluid level.

During the brake fluid level inspection, 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 11-6)**. 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

Even though the low oil warning light on the instrument panel should illuminate if the oil level 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 the engine with oil.

## OIL PRESSURE – GASOLINE ENGINE

Kawasaki 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 to 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 11-7 and Figure 11-8)**. **See following CAUTION.**

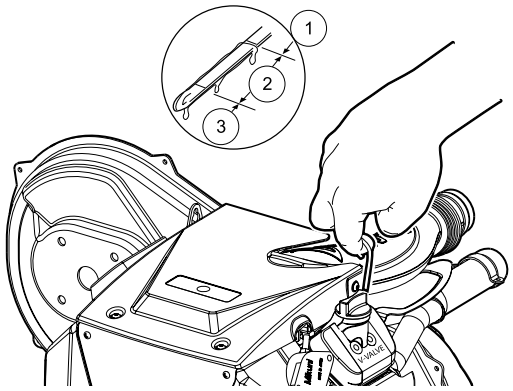
### ⚠ CAUTION

- **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 to the engine until the level is between low and full levels (safe level). **See following CAUTION.**

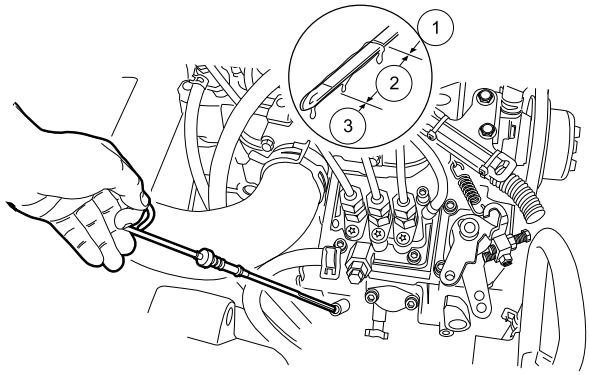
### CAUTION

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




1. Full Level 2. Safe Level 3. Low Level

205
**Figure 11-7 Engine Oil Level Check – Kawasaki Gasoline Vehicles**




1. Full Level 2. Safe Level 3. Low Level

204
**Figure 11-8 Engine Oil Level Check – Diesel Vehicles**

## ENGINE OIL AND FILTER CHANGE

The engine oil and oil filter should be changed at the following intervals:

- 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**

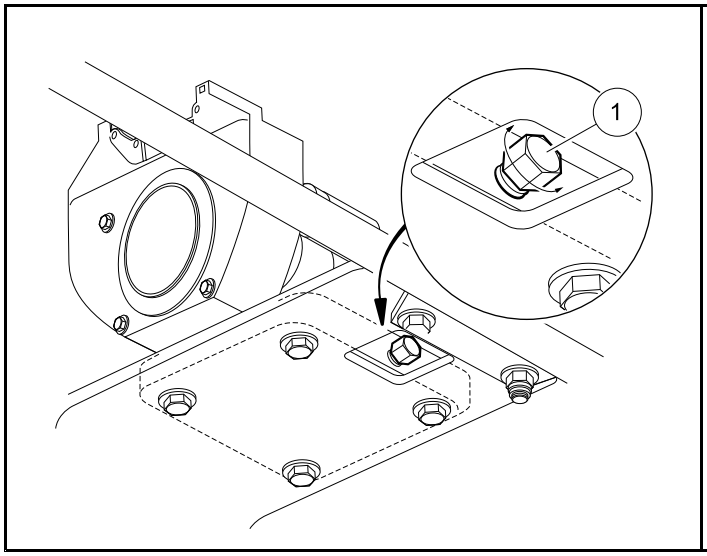
1. Turn the key switch to the OFF position and remove the key. Place the Forward/Reverse handle in the NEUTRAL position. Chock the front wheels.

2. Disconnect battery and spark plug (Gas only) wires. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
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 **(Figure 11-9 or Figure 11-10)**.
5. From the underside of the vehicle, use a socket or wrench to remove the drain plug (1). Turn the plug counterclockwise and drain the engine oil into the pan. **See following WARNING.**

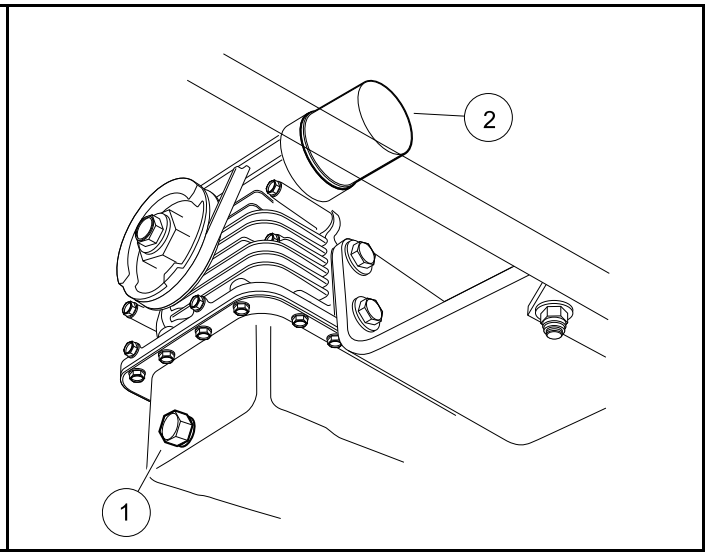
## ⚠ WARNING

- **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.**

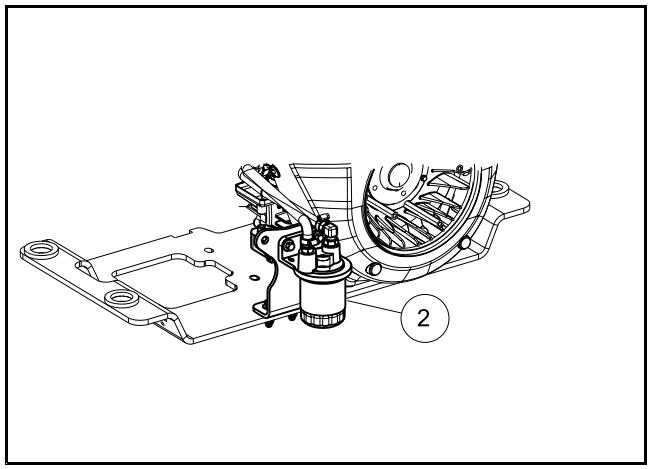
6. Clean the oil drain plug threads with solvent to remove oil and oil residue. Make sure that the compression washer or sealing o-ring remains on the drain plug. Inspect the compression washer or the sealing o-ring and replace if necessary.
7. Use a socket or wrench to replace the oil drain plug (1) **(Figure 11-9 or Figure 11-10)**. Turn the plug clockwise and tighten to 14.5 ft-lb (20 N·m) for gas vehicles or to 31 ft-lb (42 N·m) for diesel vehicles.




207
**Figure 11-9 Engine Oil Drain Plug and Pan – Gasoline Vehicles**




208
**Figure 11-10 Engine Oil Drain Plug and Oil Filter – Diesel Vehicles**




210

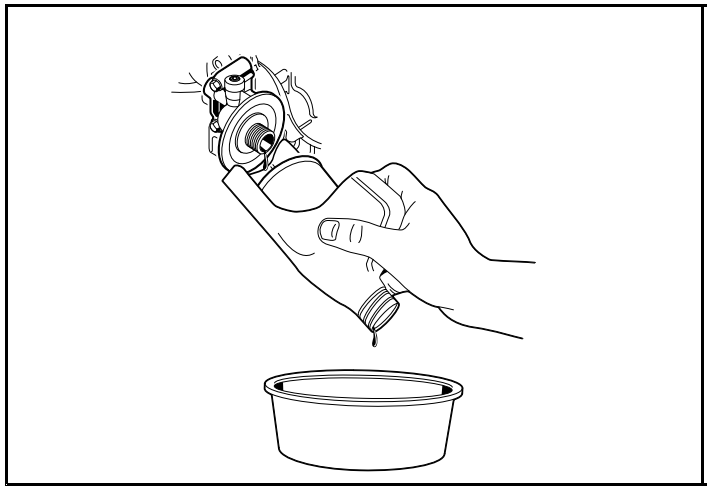
**Figure 11-11 Replace Engine Oil Filter – Kawasaki Gasoline Vehicles**

**Engine Oil Filter Change**

1. Drain the engine oil. **See Engine Oil Draining on page 11-11.**
2. Place the oil drain pan under the engine oil filter (2) **(Figure 11-10 or Figure 11-11)**.
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.**

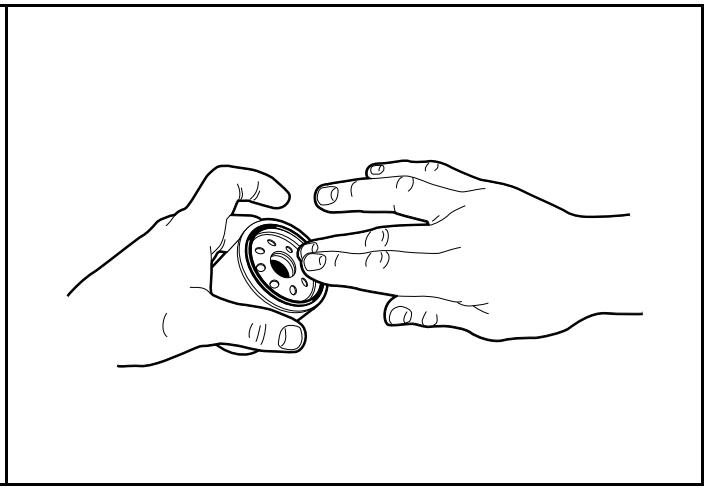
***NOTE:*** *An oil drip guard can be used to prevent excess oil from dripping onto the engine base plate **(Figure 11-12)**. Use an empty quart (one liter) container and cut the bottom off at an angle, then slide the open area of the container up and under the oil filter before removal. Position the port of the plastic container so oil will be directed into the oil pan. 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.*



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**Figure 11-12 Remove Engine Oil Filter**



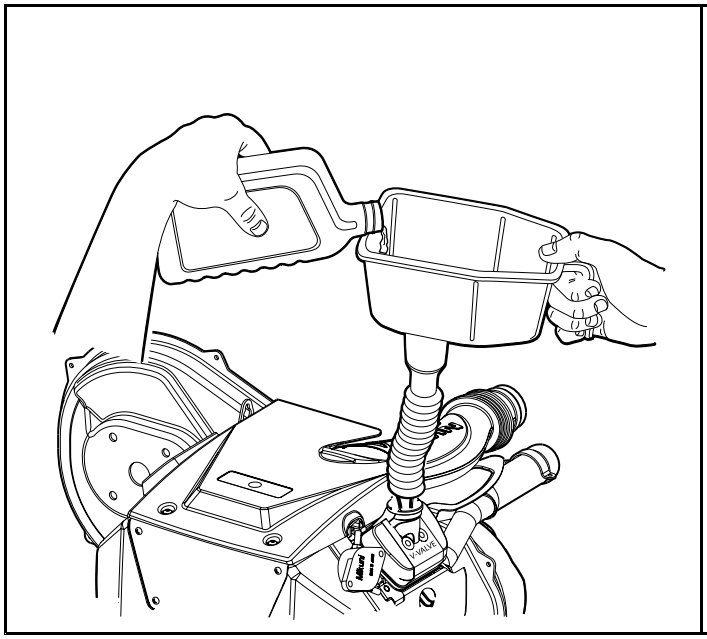
27

**Figure 11-13 Coat Rubber Seal**

4. Use a clean rag to wipe the oil filter mounting bracket surface clean where the oil filter gasket seats.
5. Coat filter gasket with clean engine oil **(Figure 11-13, Page 11-13)**.
6. Install the new oil filter. **See following NOTE.**

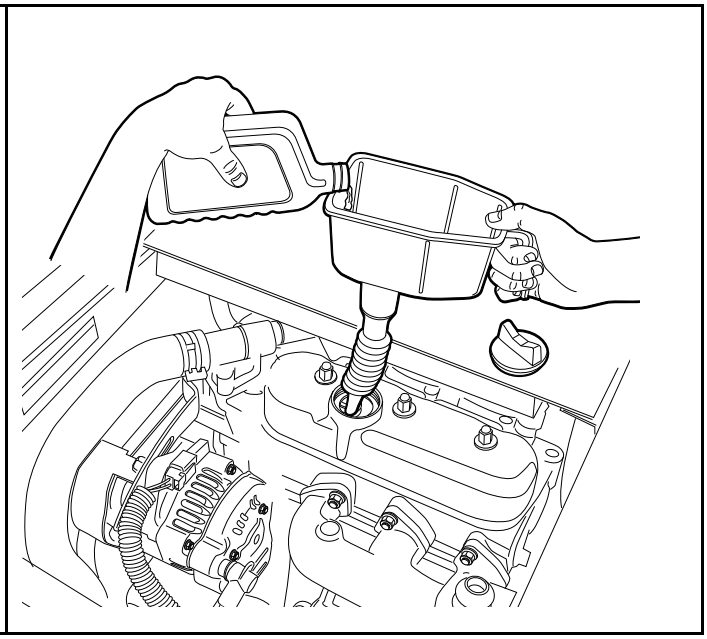
***NOTE:*** *Only use oil filters designed for this engine.*

7. Hand tighten 2/3 to 3/4 turn after the filter gasket contacts the mounting surface.



203

**Figure 11-14 Add Engine Oil – Gasoline Vehicles**



212

**Figure 11-15 Add Engine Oil – Diesel Vehicles**

**Engine Oil Filling**

1. Add engine oil **(Figure 11-14 or Figure 11-15)**. With filter change, the engine requires the following amounts:
   – 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 11-16 or Figure 11-17)**. **See following CAUTION.**

## CAUTION

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

3. Install the oil filler cap.
4. Connect battery and spark plug (Gas only) wires. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**
5. With the Forward/Reverse handle in the NEUTRAL position, start and run the engine for three minutes and check for leaks. Observe both the drain plug and the oil filter from under the vehicle and watch for oil leaks. If the filter leaks, tighten an additional 1/4 turn and retest. If the oil drain plug leaks, re-torque and retest.

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

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

## OIL VISCOSITY

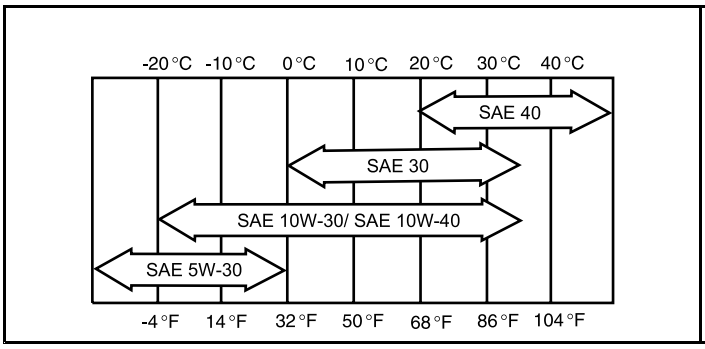
Choose the viscosity according to the temperature as shown in the appropriate oil viscosity chart **(Figure 11-16 or Figure 11-17)**. **See following NOTE.**

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

*Gasoline Vehicles Only: Below 40°F (4°C), the use of SAE 30 may result in hard starting.*

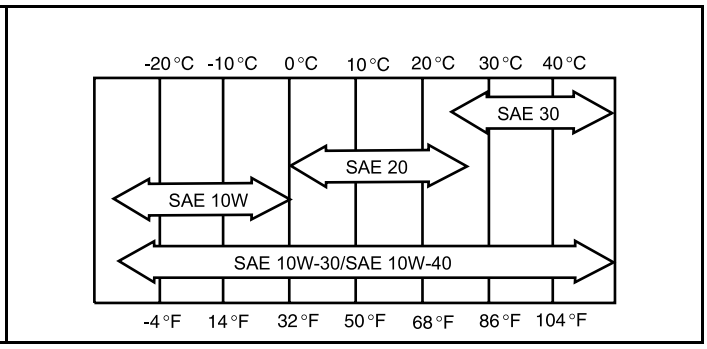
*Gasoline Vehicles Only: Above 80°F (27°C), the use of 10W-30 may cause increased oil consumption. Check oil level more frequently.*

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




213

**Figure 11-16 Oil Viscosity Chart – Gasoline Vehicles**




214

**Figure 11-17 Oil Viscosity Chart – Diesel Vehicles**

# 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

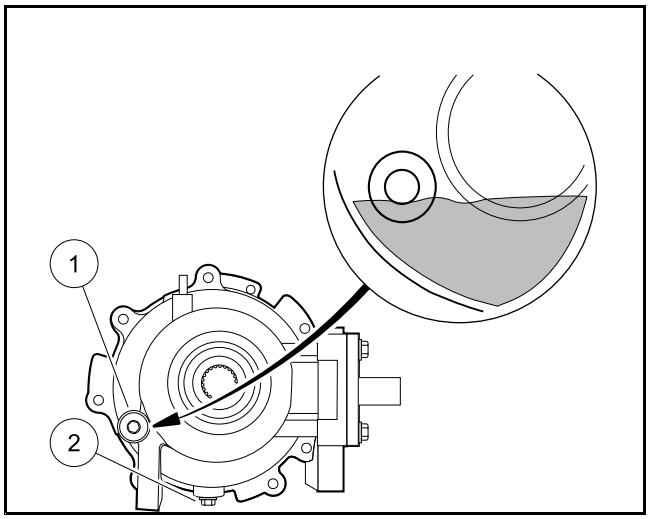
1. Measure the gap with a wire-type thickness gauge.
2. If the gap is incorrect, carefully bend the side electrode with a suitable tool to obtain the correct gap.
   – **Spark Plug Gap: 0.030 in. (0.75 mm)**

# GEARCASE LUBRICATION

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

**Front differential:**

When the vehicle is on a level surface, use the level indicator hole (1) as a lubricant level indicator **(Figure 11-18)**. Lubricant level should be even with the bottom of level indicator hole (1).




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**Figure 11-18 Front Differential Level Indicator, Fill and Drain Plug**

**Transmission:**

When the vehicle is on a level surface, use the level indicator hole (1) as a lubricant level indicator **(Figure 11-19)**. Lubricant level should be even with the bottom of level indicator hole (1).

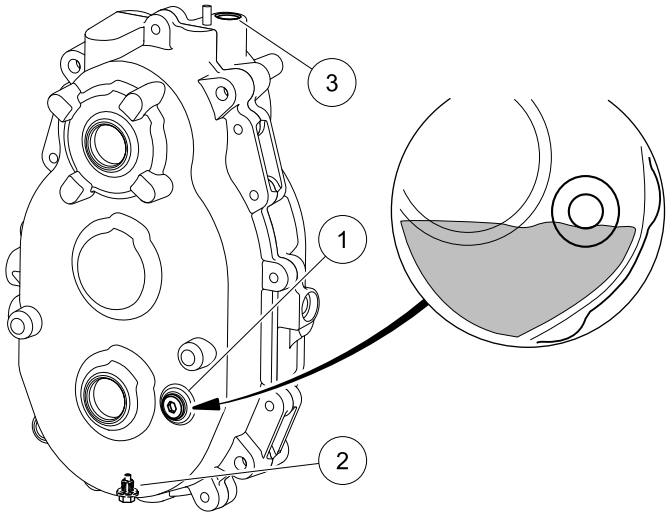
**Rear differential:**

The rear differential does not have a level indicator hole. It is filled by volume. Inspect rear differential for leakage at specified interval. **See Periodic Service Schedule on page 11-1.** If oil leakage is found, drain oil, repair leak and refill with specified oil type and volume. **See Lubrication Change for Front Differential, Transmission and Rear Differential on page 11-16.**

## LUBRICATION CHANGE FOR FRONT DIFFERENTIAL, TRANSMISSION AND REAR DIFFERENTIAL

***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.*

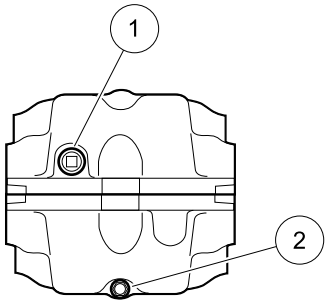
*Dispose of used oil according to the environmental laws and regulations for your area.*




1. Lubricant Level Indicator 2. Drain Plug 3. Fill Plug

2558

**Figure 11-19 Transmission Level Indicator, Fill and Drain Plugs**




1. Fill Plug
2. Drain Plug

2480

**Figure 11-20 Rear Differential Fill and Drain Plugs**

**Front differential:**

Clean and install the drain plug (2) and washer before filling the front differential with new lubricant **(Figure 11-18)**. 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 11-6.** Tighten the level indicator plug to 120 in-lb (14 N·m).

**Transmission:**

Use the lower plug (2) for drainage **(Figure 11-19)**. Remove both drain (2) and fill plugs (3) to allow the lubricant to drain faster. **See preceding NOTE.**

Clean and install the drain plug (2) before filling transmission with new lubricant **(Figure 11-19)**. Tighten drain plug to 96 in-lb (11 N·m). Remove fill plug (3) and lubricant level indicator plug (1). Using a funnel, fill transmission to the bottom of the level indicator hole (1) with specified lubricant. **See Periodic Lubrication Schedule on page 11-6.** Apply Loctite 567 to the threads of the fill plug (3) and level indicator plug (1) and tighten them to 21 ft-lb (28 N·m).

**Rear differential:**

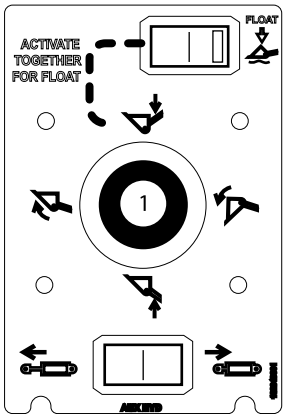
Use the lower plug (2) for drainage **(Figure 11-20)**. Remove both drain (2) and fill plugs (1) to allow the lubricant to drain faster. **See preceding NOTE.**

Clean and install the drain plug (2) and washer before filling the rear differential with new lubricant **(Figure 11-20)**. Tighten the drain plug to 96 in-lb (10.8 N·m). Remove fill plug (1). Using a funnel, fill the differential through the fill hole (1) with specified oil type and volume. **See Periodic Lubrication Schedule on page 11-6.** Apply Loctite 567 to the threads of the fill plug (1) and tighten to 21 ft-lb (28 N·m).

# HYDRAULIC SYSTEM – INTELLITACH VEHICLE

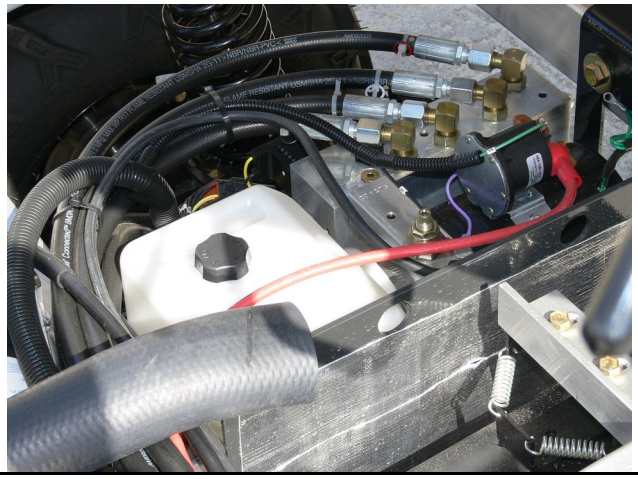
## ⚠ WARNING

- **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.**




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**Figure 11-21 Joystick**



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**Figure 11-22 Hydraulic Fluid Tank**

Inspect the hydraulic fluid level daily.

Use only recommended fluid in the hydraulic system. **See Intellitach Specifications, Section 2, Page 2-4.**

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 11-21, Page 11-18)**.
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 11-22, Page 11-18)**.
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 Warnings, Section 1, Page 1-2.**

## ENGINE COOLANT LEVEL CHECK

The coolant reserve tank (2) is located under the hood on the passenger side **(Figure 11-5, Page 11-10)**. 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 Warnings on page 1-2.**

### ⚠ DANGER

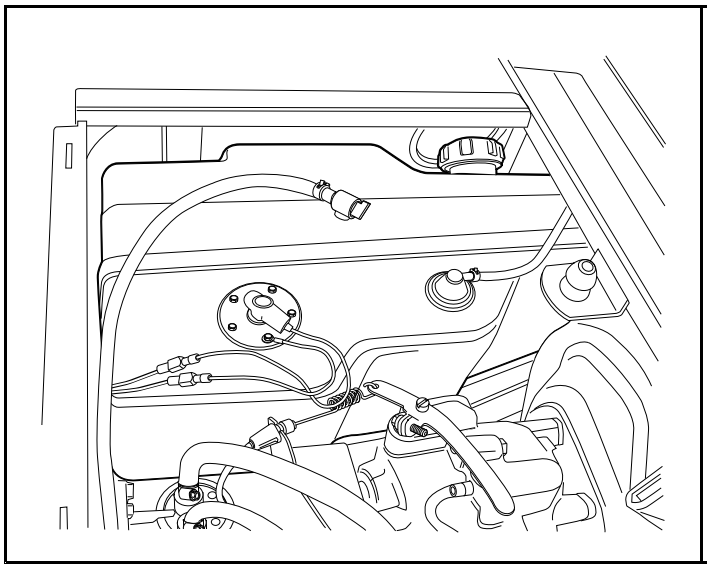
- **Turn the key switch to the OFF position before fueling.**
- **Do not pour fuel into the fuel tank when the engine is hot or while it is running.**
- **To avoid electric arc caused by static electricity, the fuel storage/pumping device must be grounded. If the pump is not grounded, the vehicle must 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 CAUTION.**

### CAUTION

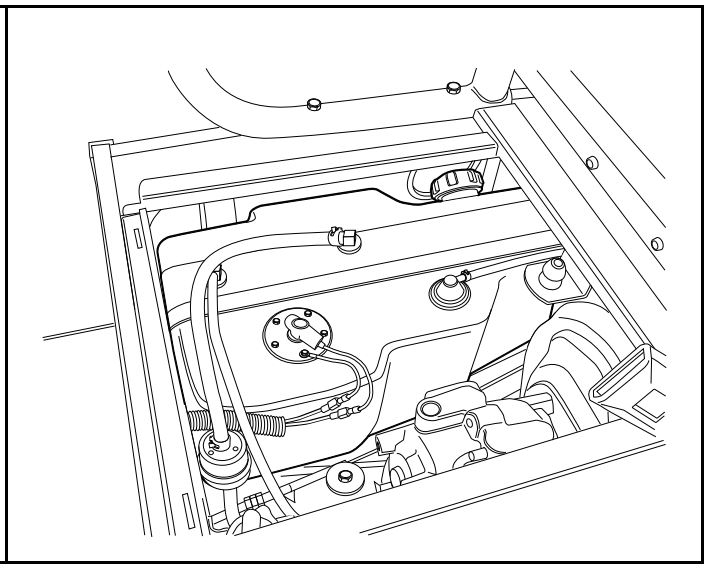
- **Gasoline vehicles: Use unleaded gasoline only.**
- **Whenever possible, avoid using oxygenated and blended fuels.**
- **Do not use any fuel with an alcohol content that exceeds 10% by volume (such as E85). Ethanol is an alcohol that readily absorbs moisture causing corrosion of fuel system components. It also damages neoprene and other plastic and rubber components. Use of these fuels in this vehicle will void the warranty.**
- **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.



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**Figure 11-23 Fuel Tank – Gasoline Vehicles**



220

**Figure 11-24 Fuel Tank – Diesel Vehicles**

## 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 11-25)**.

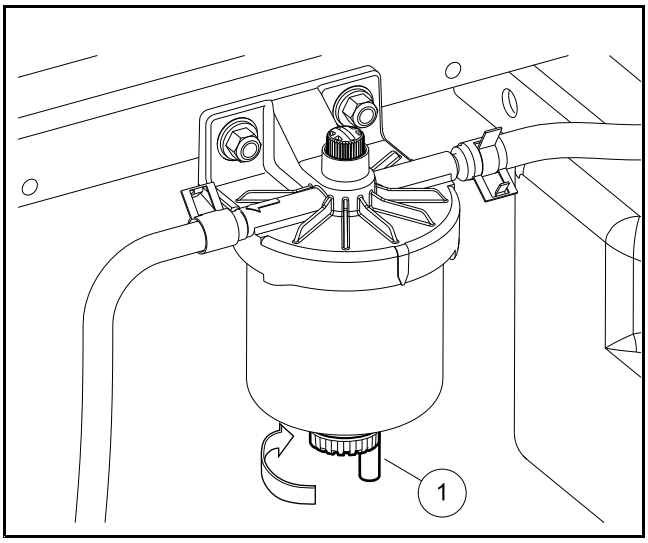
1. Position a pan under the fuel filter.
2. Lift the passenger-side seat.
3. Locate the valve (1) on the underside of the filter. Turn the valve clockwise until water begins to stream from the filter.
4. Drain the water until it changes color (to fuel). **See following WARNING.**

### ⚠ 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.*




2327

**Figure 11-25 Fuel Filter with Water Separator**

## BATTERY

**For periodic battery maintenance, see Battery on page 18-17 (gasoline vehicles) or page 13-21 (diesel vehicles).**

Pagination Page

# SECTION 12 — DIESEL VEHICLE - TROUBLESHOOTING AND ELECTRICAL SYSTEM



## ⚠ DANGER

- **See General Warnings, Section 1, Page 1-2.**

## ⚠ WARNING

- **See General Warnings, Section 1, Page 1-2.**

## DIODES, FUSES, AND RELAYS

## CAUTION

- **Only use a fuse with the correct current and voltage rating. Refer to the illustrated parts catalog for the applicable part number.**

### FUSE BLOCK - MAIN HARNESS STYLE A

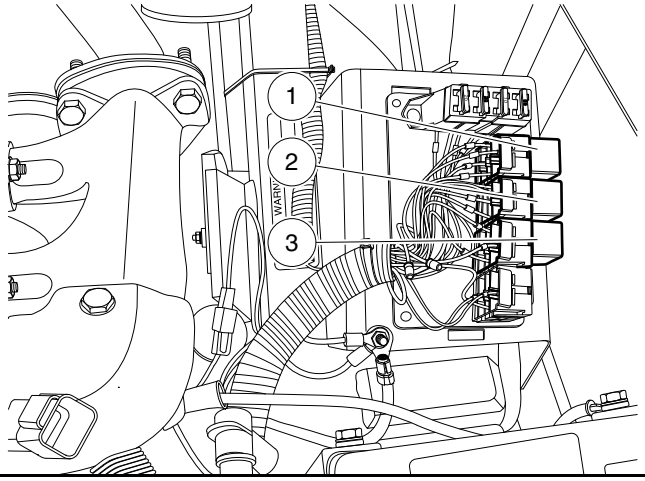
The fuse block is located under the seat.

### RELAY LOCATIONS

**Fuse Block Relays**

**See General Warnings, Section 1, Page 1-2.**

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 12-1, Page 12-1)**.




2134

**Figure 12-1 Relays**

## FUSE BLOCK - MAIN HARNESS STYLE B

### Fuse Block Cover Removal

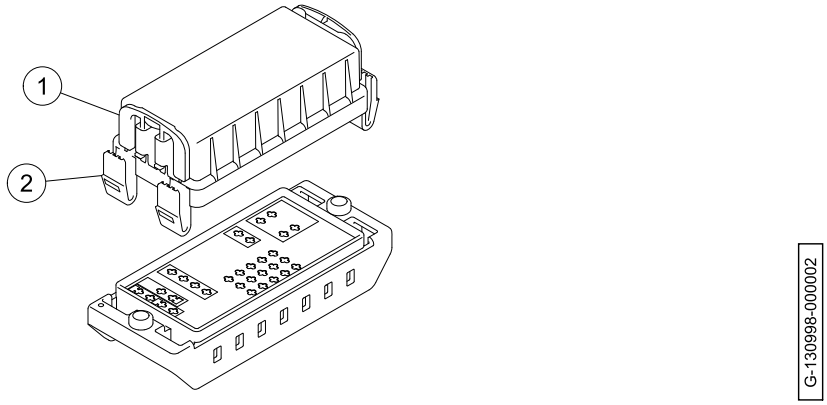



**Figure 12-2 Fuse Block Cover**

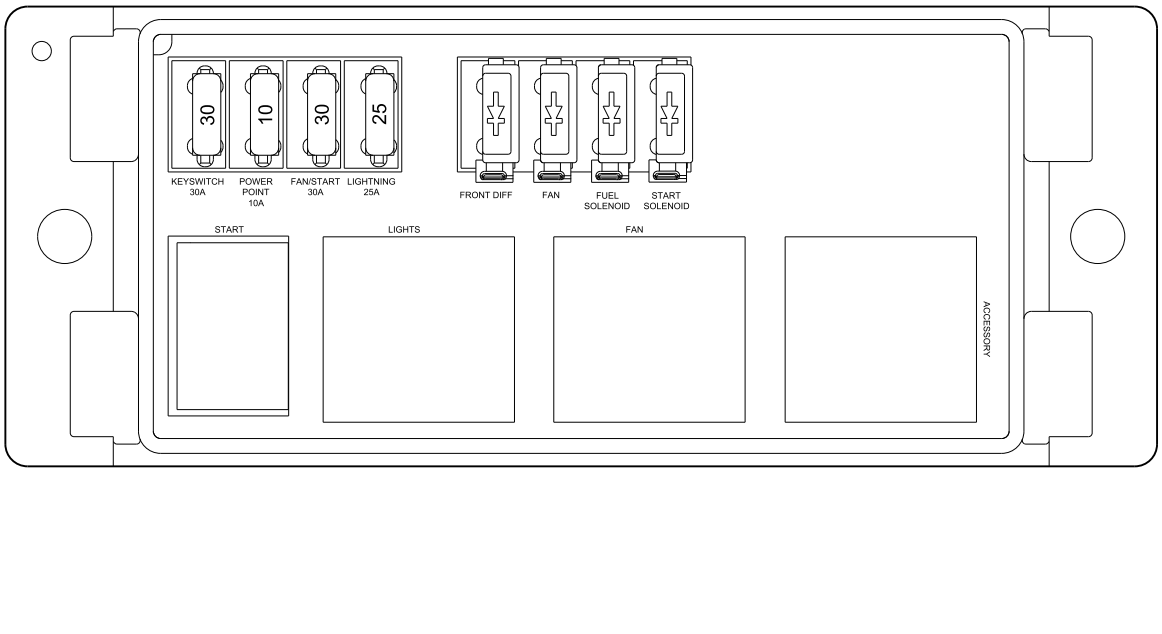
1. Pull up on the yellow tabs (1) **(Figure 12-2, Page 12-2)**.
2. Push the four tabs (2) in.
3. Remove the fuse block cover.

### Fuse Block Cover Installation

1. Install the fuse block cover.
2. Make sure that the four tabs (2) engage **(Figure 12-2, Page 12-2)**.
3. Push down the yellow tabs (1). Make sure that the yellow tabs engage.

## FUSE BLOCK TABLE - MAIN HARNESS STYLE B

The fuse block is located under the seat.

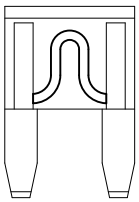
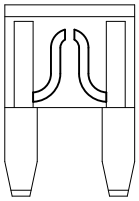



| COMPONENT | DESCRIPTION |
|---|---|
| KEYSWITCH 30A | 30A Fuse - Key Switch |
| POWER POINT 10A | 10A Fuse - 12V Power Point |
| FAN/START 30A | 30A Fuse - Fan and Starter |
| LIGHTING 30A | 30A Fuse - Lighting |
| FRONT DIFF | Diode - Front Differential |
| FAN | Diode - Fan |
| FUEL SOLENOID | Diode - Fuel Solenoid |
| START SOLENOID | Diode - Starter Solenoid |
| START | Starter Relay |
| LIGHTS | Lighting Relay |
| FAN | Fan Relay |
| Blank | Accessory Relay |

**Figure 12-3 Fuse Block - Main Harness Style B**

## ATO AND MINI ATM FUSE INSPECTION

1. Disable the vehicle.
2. Remove the fuse.
3. *Visual Inspection:* Examine the fuse. Replace the fuse as necessary.

| | |
|---|---|
| **Good Fuse** |  G-130998-000004 |
| **Blown Fuse** |  G-130998-000005 |

4. *Multimeter Inspection:* Set a multimeter to check continuity.

4.1. Check for continuity between the tabs on the fuse.

4.2. If there is no continuity, replace the fuse.

## PARK BRAKE RELAY

The park brake relay (1) is located under the hood **(Figure 12-4)**. The screw (2) torque specification is from 5 to 8 lb·in (0.56 to 0.9 N·m).

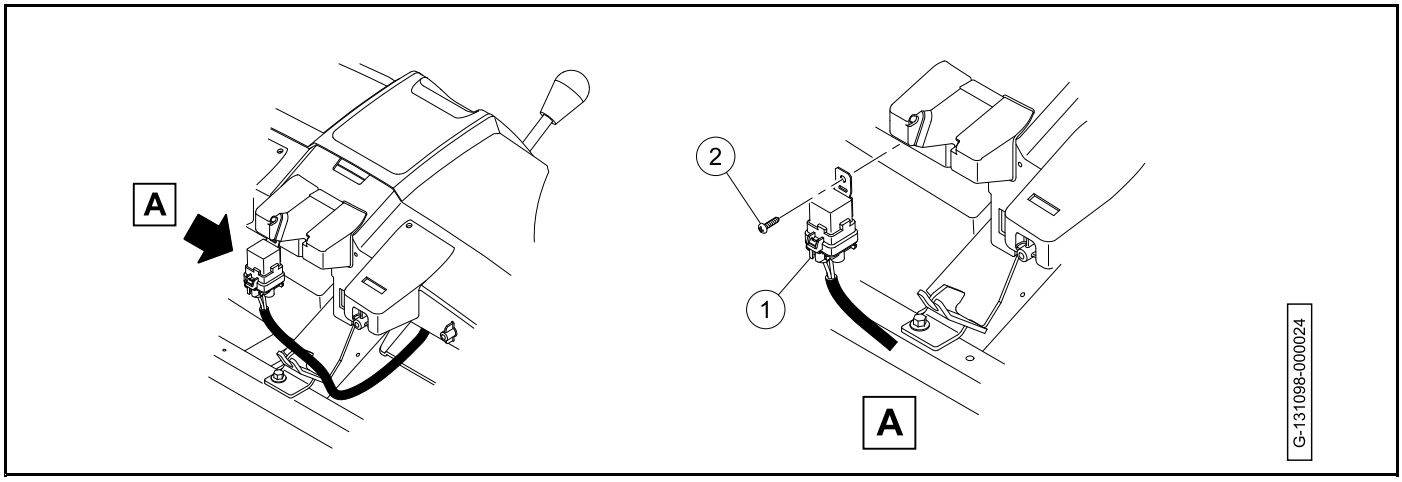



**Figure 12-4 Relays**

# 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 14-8 |
| | 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. |
| | Fuel filter clogged | Replace fuel filter. **See Fuel Filter Replacement on page 14-9.** |
| | Fuel line or pipe(s) clogged | Clean or replace fuel line and/or pipe(s). **See Fuel System on page 14-8.** |
| | Fuel leak caused by loose injection pipe retaining nut | Tighten nut. See the Kubota D722 diesel engine manual. |
| | Air in fuel system | See the Kubota D722 diesel engine manual. |
| | Injection nozzle clogged | |
| | Injection pump failed | |
| | Fuel pump failure | |
| | Incorrect injection timing | |
| | Excessive valve clearance | |
| | Improper valve seat alignment, valve spring broken, or valve seized | |
| | Improper valve timing | |
| | Piston ring worn | |
| | Cylinder compression leak | |
| | Fuel cam shaft worn | |
| | Seizure of crankshaft, camshaft, piston, or bearing | |
| | Fuel solenoid failure | Test Procedure 30 – Fuel Solenoid Pull Coil Circuit on page 12-48 and Test Procedure 31 – Fuel Solenoid Hold Coil Circuit on page 12-48 |
| | Improper idle governor adjustment | Idle RPM Adjustment on page 14-18 |

**TABLE CONTINUED ON NEXT PAGE**

| **TROUBLESHOOTING GUIDE** | | |
|---|---|---|
| **SYMPTOM** | **POSSIBLE CAUSES** | **REFER TO** |
| Engine does not start (starter motor does not function). | Battery is discharged | Test Procedure 1 – Battery on page 12-13 |
| | Key switch failed | Test Procedure 4 – Key Switch (Starter Circuit) on page 12-16 |
| | Failed starter and/or starter solenoid | Test Procedure 7 – Starter Control Circuit on page 12-19 |
| | Start relay failure | Test Procedure 8 – Start Relay - Main Harness Style A on page 12-21 |
| | Loose or improper wiring | Check for proper wiring and tighten any loose connections. **See Wiring Diagram - Main Harness Style A on page 12-10.** |
| | One or both 30-amp fuses blown | Test Procedure 2 – Fuse on page 12-15 |
| | Neutral switch failure (failed open) | Test Procedure 20 – Neutral Switch (Transmission) on page 12-40 |
| | Transmission shifter linkage is binding or is out of adjustment | Forward/Reverse Shifter Cable Adjustment on page 10-11 |
| | Diode 1, 2, 5, or 6 failed closed | Test Procedure 14 – Wire Harness Diodes on page 12-34 |
| Engine does not run smoothly. | Incorrect nozzle opening pressure | See the Kubota D722 diesel engine manual. |
| | Injection nozzle clogged | |
| | Failed injection pump | |
| | Fuel overflow pipe clogged | |
| | Fuel leak caused by loose injection pipe retaining nut | |
| | Fuel pump failure | See the Kubota D722 diesel engine manual. |
| | Air filter is dirty or clogged | Air Filter Replacement on page 14-21 |
| | Fuel filter clogged or dirty | Fuel System on page 14-8 |
| | 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 14-5 |
| | Air filter is dirty or clogged | Air Filter Replacement on page 14-21 |
| | Throttle linkage out of adjustment | Engine Control Linkages on page 14-17 |
| | Restricted fuel flow | Fuel System on page 14-8 |
| | Clutches are not backshifting properly | Clutches on page 14-23 |
| | Low cylinder compression | See the Kubota D722 diesel engine manual. |
| | Incorrect injection timing | |
| | Seized engine parts | |
| | Uneven fuel injection | |
| | Poor injection nozzle performance | |

**TABLE CONTINUED ON NEXT PAGE**

| TROUBLESHOOTING GUIDE | | |
|---|---|---|
| **SYMPTOM** | **POSSIBLE CAUSES** | **REFER TO** |
| 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. |
| | Low oil warning circuit malfunction | Test Procedure 32 – Low Oil Warning Light Circuit on page 12-49 |
| High oil pressure. | Improper engine oil | See the Kubota D722 diesel engine manual. |
| | 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. |
| | 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 13 – Fan Motor on page 12-31 |
| | Thermostat switch failure | Test Procedure 12 – Thermostat Switch on page 12-29 |
| | Fan relay failure | Test the fan relay. |
| | 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. Section 15 — Diesel Vehicle - Radiator and Coolant System |
| | Coolant lines corroded | Clean or replace coolant lines. Section 15 — Diesel Vehicle - Radiator and Coolant System |
| | Failed radiator cap | Replace radiator cap. |
| | Failed radiator hose | Replace radiator hose. Section 15 — Diesel Vehicle - Radiator and Coolant System |
| | Failed thermostat | See the Kubota D722 diesel engine manual. |
| | 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. |
| | Piston ring groove worn | |
| | Valve stem and/or guide worn | |
| | Crankshaft bearing and crank pin bearing worn | |

**TABLE CONTINUED ON NEXT PAGE**

| **TROUBLESHOOTING GUIDE** | | |
|---|---|---|
| **SYMPTOM** | **POSSIBLE CAUSES** | **REFER TO** |
| Fuel mixed into engine lubricant oil. | Worn injection pump plunger | See the Kubota D722 diesel engine manual. |
| Water mixed into engine lubricant oil. | Failed head gasket | See the Kubota D722 diesel engine manual. |
| | 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. |
| | 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 14-9.** |
| | Air cleaner clogged | Replace air filter. **See Air Filter Replacement on page 14-21.** |
| Excessive vehicle vibration. | Engine mounting nuts or bolts are loose | Section 14 — Diesel Vehicle - Engine, Muffler, Fuel System, and Clutches |
| | Misaligned muffler mounting clamp | Exhaust System on page 14-5 |
| | Damaged drive belt | Clutches on page 14-23 |
| | Damaged drive clutch | Clutches on page 14-23 |
| | Damaged driven clutch | Clutches on page 14-23 |
| | RPM setting is incorrect | Engine RPM Adjustment on page 14-18 |
| Transmission does not engage or disengage smoothly. | Transmission shifter linkage is binding or is out of adjustment | Forward/Reverse Shifter Cable Adjustment on page 10-11 |
| | Idle RPM setting is set too high | Idle RPM Adjustment on page 14-18 |
| | Insufficient (low) level of lubricant or wrong type of lubricant in transmission | Gearcase Lubrication on page 11-16 |
| | Internal gears are damaged or worn | See the Engines and Drivetrain Components manual. |
| Front differential does not engage front wheels. | Failed front drive gearcase engagement coil | Test Procedure 23 – Front Drive Gearcase Coil on page 12-42 |
| | Failed differential limit switch | Test Procedure 22 – Front Differential Limit Switch on page 12-41 |
| | Neutral switch failure (failed closed) | Test Procedure 20 – Neutral Switch (Transmission) on page 12-40 |
| | Failed front gearcase | See the Engines and Drivetrain Components manual. |

**TABLE CONTINUED ON NEXT PAGE**

| TROUBLESHOOTING GUIDE | | |
|---|---|---|
| **SYMPTOM** | **POSSIBLE CAUSES** | **REFER TO** |
| Torque converter does not shift smoothly. | Drive belt is worn, cracked, glazed, or frayed | Drive Belt Removal on page 14-24 |
| | Drive clutch malfunction | Drive Clutch Cleaning and Inspection on page 14-25 |
| | Driven clutch malfunction | Driven Clutch on page 14-28 |
| Battery discharged. | Loose alternator belt | **See Alternator and V-belt Installation on page 13-15.** |
| | Loose electrical connection(s) | Check for proper wiring and tighten any loose connections. See Wiring Diagram on page 11b6. |
| | Failed alternator | Test Procedure 24 – Alternator on page 12-43 |
| | Failed battery | Test Procedure 1 – Battery on page 12-13 |
| | 60-amp fusible link failed | Test Procedure 25 – 60-Amp Fusible Link on page 12-43 |
| Hour meter adds increments with key switch ON and engine not running. | Oil pressure switch failed open | See the Kubota D722 diesel engine manual. |
| Hour meter does not function. | Failed low oil warning light or oil pressure sensor | Test Procedure 32 – Low Oil Warning Light Circuit on page 12-49 |
| | Oil pressure switch failed closed | See the Kubota D722 diesel engine manual. |
| | Failed hour meter | Test Procedure 36 – Hour Meter on page 12-53 |
| 30-amp fuse (on w125) blows repeatedly. | Diode 1 or diode 5 in wire harness failed | Test Procedure 15 – Diode 1 on wire 32 on page 12-35 and Test Procedure 17 – Diode 3 on wire 123 on page 12-36 |
| 30-amp fuse (on w109) blows repeatedly. | Diode 2 or diode 6 in wire harness failed | Test Procedure 16 – Diode 2 on wire 40 on page 12-36 and Test Procedure 18 – Diode 4 on wire 129 on page 12-37 |
| Bed lift does not function | Bed lift motor failed | Test Procedure 39 – Bed Lift Motor on page 12-55 |
| | Bed lift switch failed | Test Procedure 40 – Bed Lift Switch on page 12-56 |
| | Bed lift circuit breaker failed | Test Procedure 41 – Bed Lift Circuit Breaker on page 12-58 |

# WIRING DIAGRAM - MAIN HARNESS STYLE A

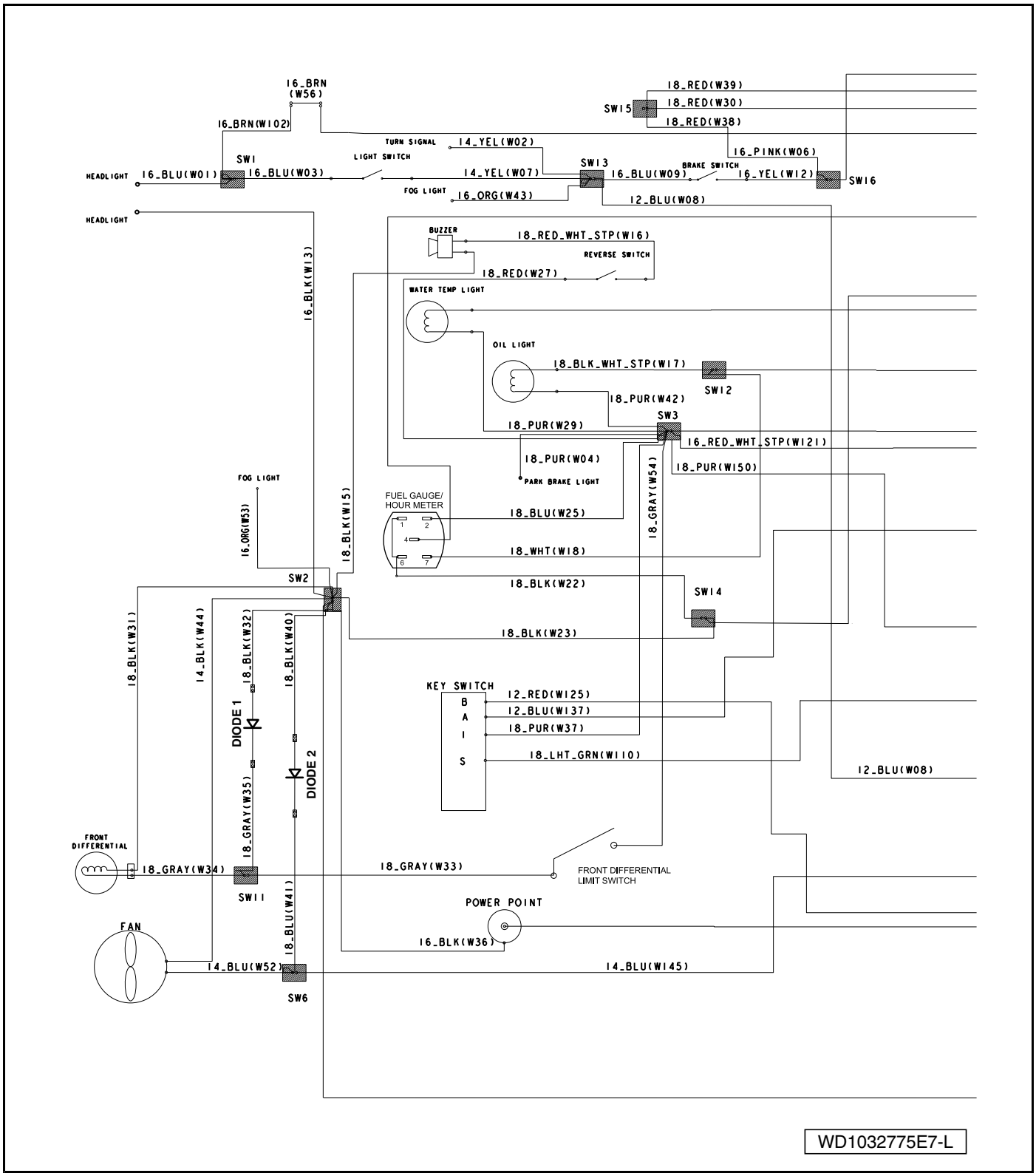



**Figure 12-5**

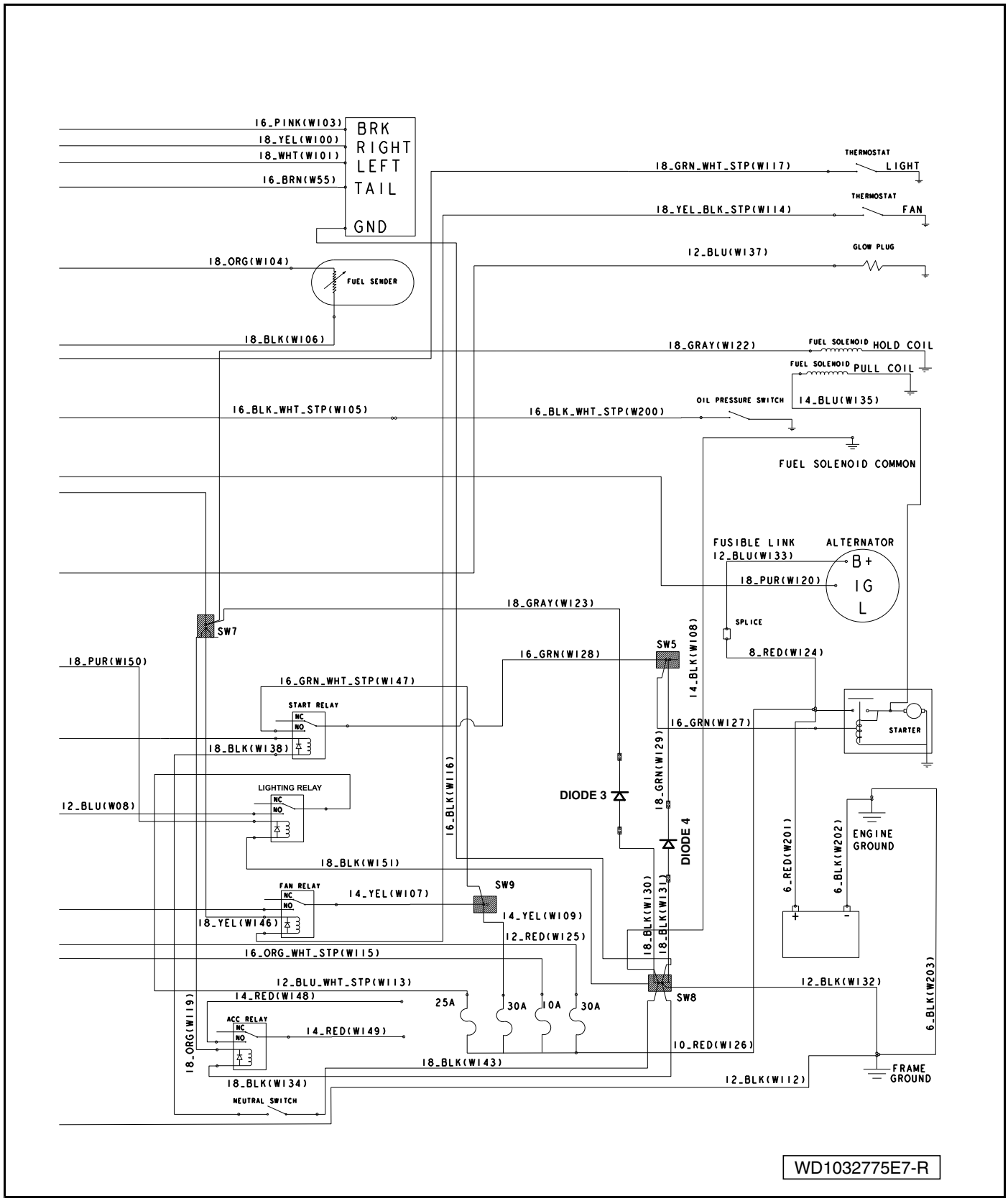
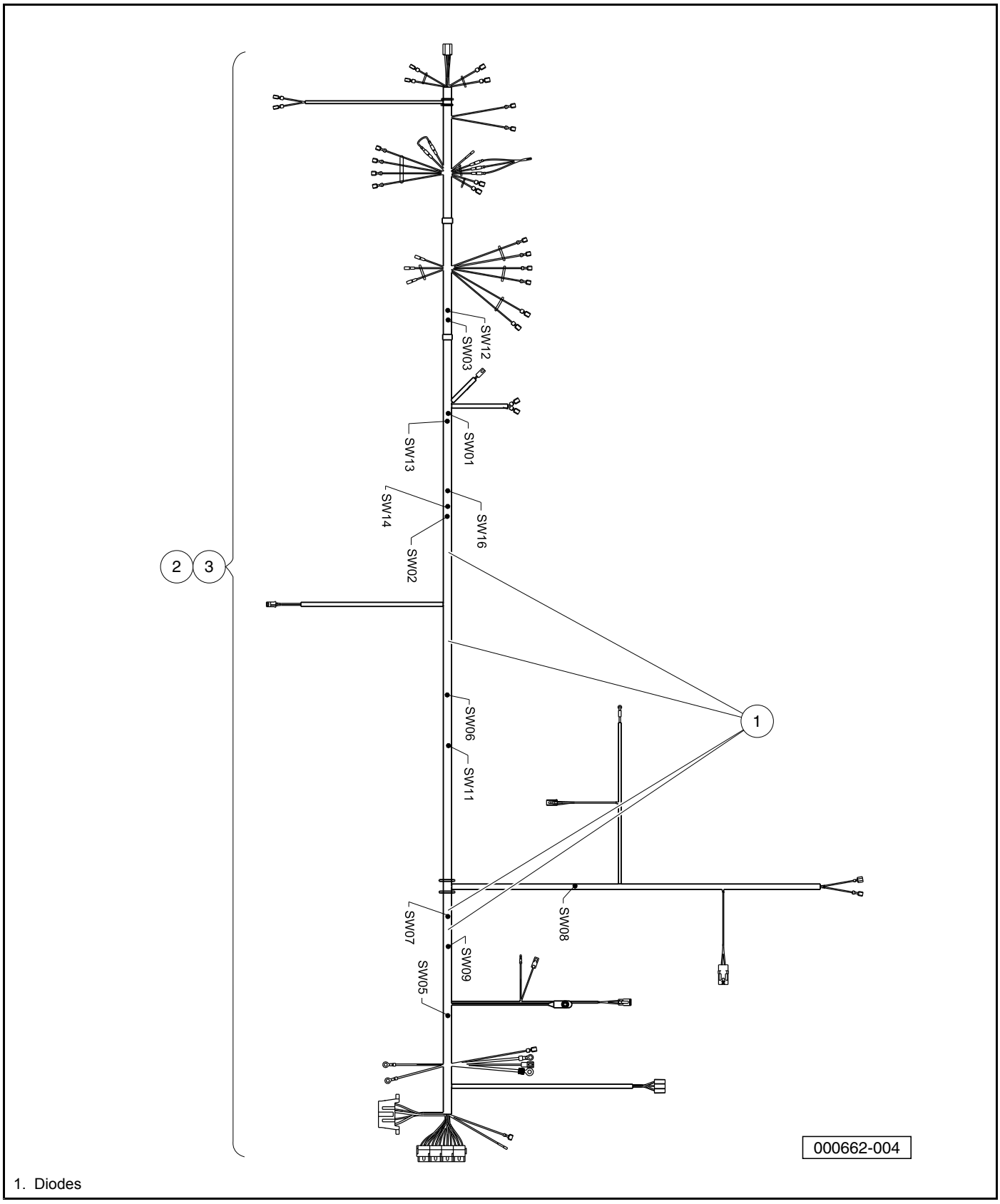



**Figure 12-6 Continued**




1. Diodes

**Figure 12-7 Sonic Weld and Diode Locations (Approximate)**

# WIRING DIAGRAM - MAIN HARNESS STYLE B

See Wiring Diagrams chapter.

# TEST PROCEDURES

## Index of Test Procedures

1 – Battery
2 – Fuse
3 – Ground Cables
4 – Key Switch (Starter Circuit)
5 – Key Switch (ON Position)
6 – Key Switch (Glow Plug Circuit)
7 – Starter Control Circuit
8 – Start Relay - Main Harness Style A
9 – Start Relay - Main Harness Style B
10 – Fan Relay - Main Harness Style A
11 – Fan Relay - Main Harness Style B
12 – Thermostat Switch
13 – Fan Motor
14 – Wire Harness Diodes
15 – Diode 1 on wire 32
16 – Diode 2 on wire 40
17 – Diode 3 on wire 123
18 – Diode 4 on wire 129
19 – Fuse Block Diodes
20 – Neutral Switch (Transmission)
21 – Wire Continuity
22 – Front Differential Limit Switch
23 – Front Drive Gearcase Coil
24 – Alternator
25 – 60-Amp Fusible Link
26 – Coolant Temperature Warning Light Circuit
27 – Glow Plug Circuit
28 – Reverse Warning Buzzer Limit Switch (If Equipped)
29 – Reverse Warning Buzzer (If Equipped)
30 – Fuel Solenoid Pull Coil Circuit
31 – Fuel Solenoid Hold Coil Circuit
32 – Low Oil Warning Light Circuit
33 – 12-Volt Accessory Receptacle
34 – Fuel Level Sending Unit
35 – Fuel Gauge
36 – Hour Meter
37 – Light Switch
38 – Voltage at Headlight Socket
39 – Bed Lift Motor
40 – Bed Lift Switch
41 – Bed Lift Circuit Breaker

## TEST PROCEDURE 1 – Battery

**See General Warnings, Section 1, Page 1-2.**

## ⚠ 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 can be found in* ***Battery on page 13-21*** *of this manual.*

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels.
2. Check for loose or corroded battery terminal connections. Clean, tighten and replace connections as necessary.

**Voltage Test**

1. Disable the vehicle. **See Disabling the Vehicle on page 1-3.**
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, recharge the battery. If battery voltage is greater than 12.4 volts, the problem is not with the battery. If the battery does not reach 12.4 volts replace the battery. **See following NOTE.**

***NOTE:*** *Open-circuit voltage, the battery voltage with no electrical load, should be at least 12.4 volts.*

**Load Test**

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

1. Disable the vehicle. **See Disabling the Vehicle on page 1-3.**
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. 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.

## TEST PROCEDURE 2 – Fuse

**See General Warnings, Section 1, Page 1-2.**

### ⚠ WARNING

- **Failure to use properly rated fuse can result in a fire hazard.**

The fuse block is located on the electrical component mounting plate .

1. Disconnect battery.**See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Remove the fuse block cover.
3. *Fuse Block Style 1:* Make sure that the wires are connected correctly and are tight. If they are not, rewire or tighten as necessary.
4. Remove the fuse to be tested from the fuse block.
5. 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

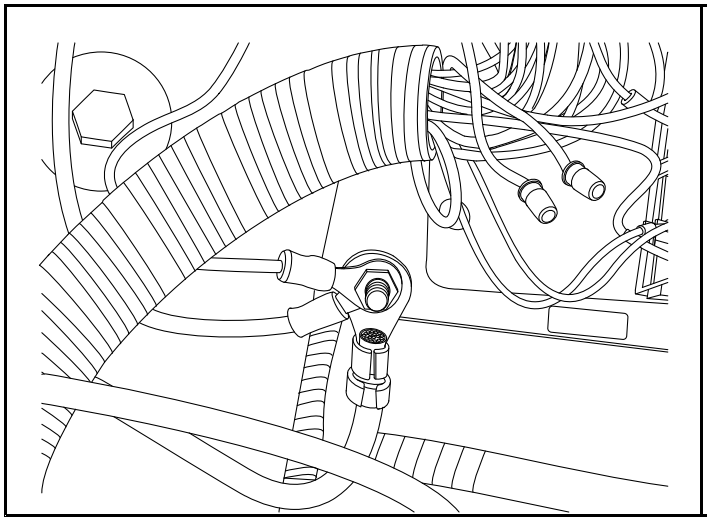
- **If a fuse is blown, determine the cause of the failure and make necessary repairs before installing a new fuse. Use the appropriately rated fuse; if a fuse with a higher amp rating is used, damage to the vehicle electrical system may occur.**

## TEST PROCEDURE 3 – Ground Cables

**See General Warnings, Section 1, Page 1-2.**

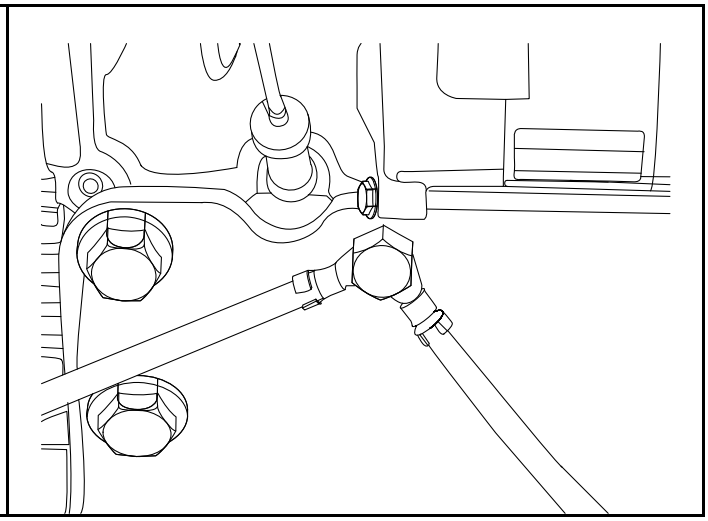
1. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Check the frame ground connection for loose connections and damaged terminals **(Figure 12-8, Page 12-16)**. Repair or replace as required.
3. Check the negative (–) battery terminal and 6-gauge black wire (w202) for damage. Repair or replace as required.
4. 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 12-9, Page 12-16)**. Repair or replace as required.
5. Set the multimeter to 200 ohms.
6. Check for continuity between the 6-gauge wire (w202) terminal, disconnected from the negative (–) battery terminal, and the frame.

7. Check for continuity between the 6-gauge wire (w203) terminal, disconnected from the negative (–) battery terminal, and the engine.
8. 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.



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**Figure 12-8 Frame Ground**



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**Figure 12-9 Engine Ground (Under Starter)**

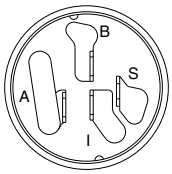
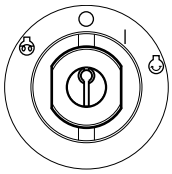
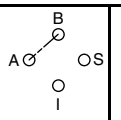
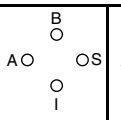
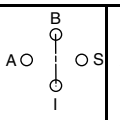
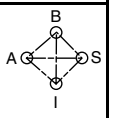
## TEST PROCEDURE 4 – Key Switch (Starter Circuit)

**See General Warnings, Section 1, Page 1-2.**

1. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Remove the key switch. **See Key Switch Removal on page 13-7.**
3. Ensure that the key switch connector is connected correctly and is tight. If it is not, repair or replace as necessary.
4. Set the multimeter to 200 ohms.
5. Check the B and A key switch terminals.

5.1. Use alligator clips to connect the multimeter probes between the B and A terminals. With the key switch in the START position, the multimeter should indicate continuity **(Figure 12-10, Page 12-17)**. If the multimeter does not indicate continuity, the key switch has failed and should be replaced. **See Key Switch Removal on page 13-7.**

5.2. If the multimeter indicates continuity between the B and A terminals with the key in any position other than START, the key switch has failed and should be replaced. **See Key Switch Removal on page 13-7.**

| REAR VIEW | FRONT VIEW | | | |
|---|---|---|---|---|
|  |  | | | |
| **Continuity Diagram** |  |  |  |  |
| **Key Position** | PRE-HEAT | **O** OFF | **I** ON | START |

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**Figure 12-10 Key Switch Terminals and Continuity Diagram**

6. Check the B and I terminals.

6.1. Use alligator clips to connect the multimeter probes between the B and I terminals. With the key in the START position, the multimeter should indicate continuity **(Figure 12-10, Page 12-17)**. If the multimeter does not indicate continuity, the key switch has failed and should be replaced. **See Key Switch Removal on page 13-7.**

6.2. If the multimeter indicates continuity between the B and I 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 on page 13-7.**

7. Check the B and S terminals.

7.1. Use alligator clips to connect the multimeter probes between the B and S terminals. With the key in the START position, the multimeter should indicate continuity **(Figure 12-10, Page 12-17)**. If the multimeter does not indicate continuity, the key switch has failed and should be replaced. **See Key Switch Removal on page 13-7.**

7.2. If the multimeter indicates continuity between the B and S terminals with the key in any position other than START, the key switch has failed and should be replaced. **See Key Switch Removal on page 13-7.**

## TEST PROCEDURE 5 – Key Switch (ON Position)

**See General Warnings, Section 1, Page 1-2.**

1. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Ensure that the key switch connector is connected correctly and is tight. If it is not, repair or replace as necessary.
3. Remove the key switch. **See Key Switch Removal on page 13-7.**
4. Set the multimeter to 200 ohms.
5. Check the B and I terminals.

5.1. Use alligator clips to connect the multimeter probes between the B and I terminals. With the key switch in the ON position, the multimeter should indicate continuity **(Figure 12-10, Page 12-17)**. If the multimeter does not indicate continuity, the key switch has failed and should be replaced. **See Key Switch Removal on page 13-7.**

5.2. If the multimeter indicates continuity between the B and I 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 on page 13-7.**

## TEST PROCEDURE 6 – Key Switch (Glow Plug Circuit)

**See General Warnings, Section 1, Page 1-2.**

1. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Ensure that the key switch connector is connected correctly and is tight. If it is not, repair or replace as necessary.
3. Remove the key switch. **See Key Switch Removal on page 13-7.**
4. Set the multimeter to 200 ohms.
5. Check the B and A terminals.

5.1. Use alligator clips to connect the multimeter probes between the B and A terminals. With the key in the PREHEAT position, the multimeter should indicate continuity **(Figure 12-10, Page 12-17)**. If the multimeter does not indicate continuity, the key switch has failed and should be replaced. **See Key Switch Removal on page 13-7.**

5.2. If the multimeter indicates continuity between the B and A terminals with the key in any position other than PREHEAT, the key switch has failed and should be replaced. **See Key Switch Removal on page 13-7.**

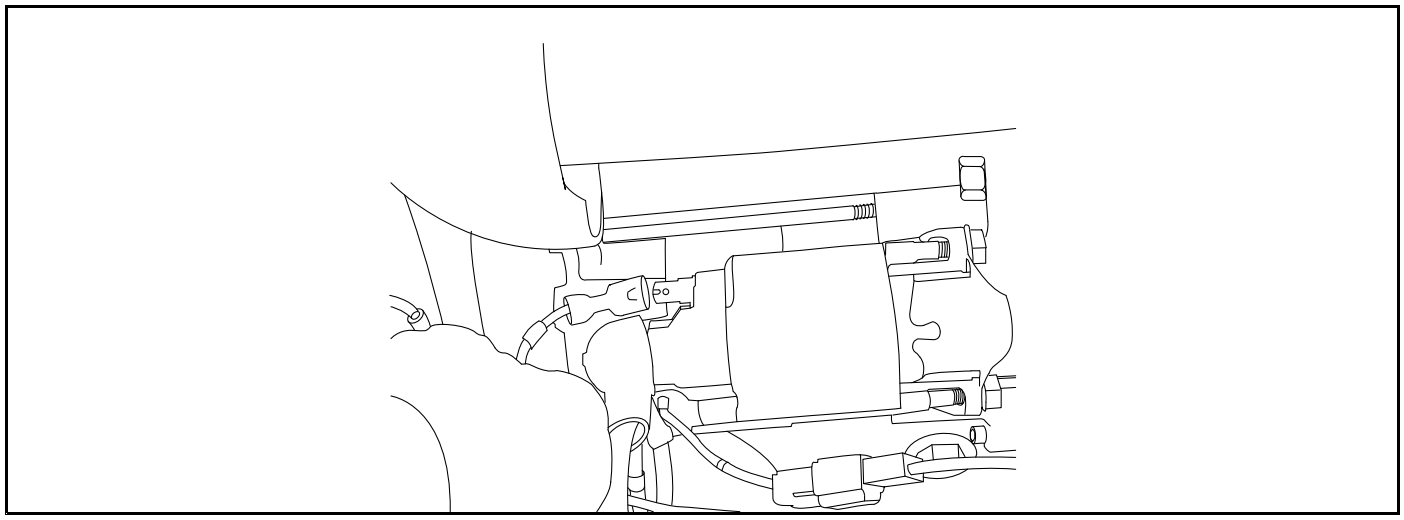
## TEST PROCEDURE 7 – Starter Control Circuit

**See General Warnings, Section 1, Page 1-2.**

1. Disable the vehicle. **See Disabling the Vehicle on page 1-3.**
2. Disconnect the 16-gauge green wire (w127) from the starter solenoid coil to prevent the vehicle from unintentionally starting **(Figure 12-11, Page 12-19)**. **See following WARNING.**

### ⚠ WARNING

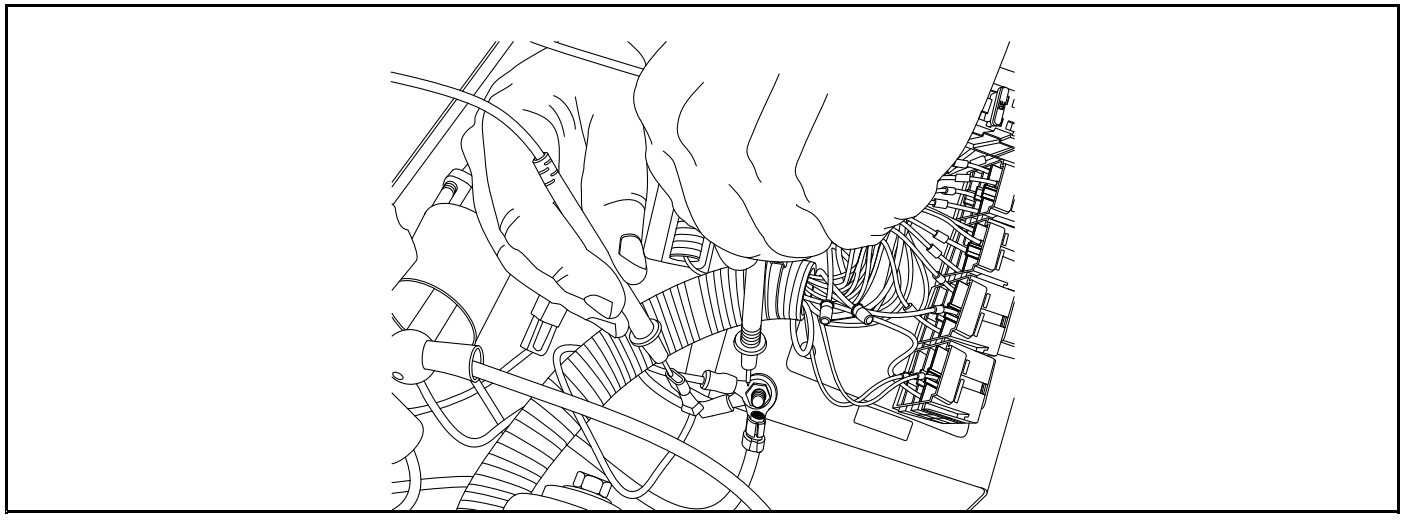
- **Failure to disconnect the wire from the solenoid coil could result in an unexpected engine start when performing this test.**



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**Figure 12-11 Solenoid Coil Wire (w127) Removed**

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 12-12, Page 12-19)**.



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**Figure 12-12 Starter Circuit Test**

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.
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 12-13.**
   – *Main Harness Style A:*
     – Check the 30-amp fuse on w109 at the fuse block. **See Test Procedure 2 – Fuse on page 12-15.**
     – Check diode 4. **See See Diode 4 on wire 129 on page 12-37..**
     – Check the start relay. **See Test Procedure 8 – Start Relay - Main Harness Style A on page 12-21.**
     – Check for continuity of the wire harness on wires 127, 128, 147, and 109. **See Wiring Diagram - Main Harness Style A on page 12-10.**
   – *Main Harness Style B:*
     – Check the 30A starter fuse in the fuse block.
     – Check the starter solenoid diode in the fuse block.
     – Check the starter relay. **See See Start Relay - Main Harness Style B on page 12-23..**
     – Check for continuity between pin 14 and pin 4 in the fuse block **(Figure 12-13)**.

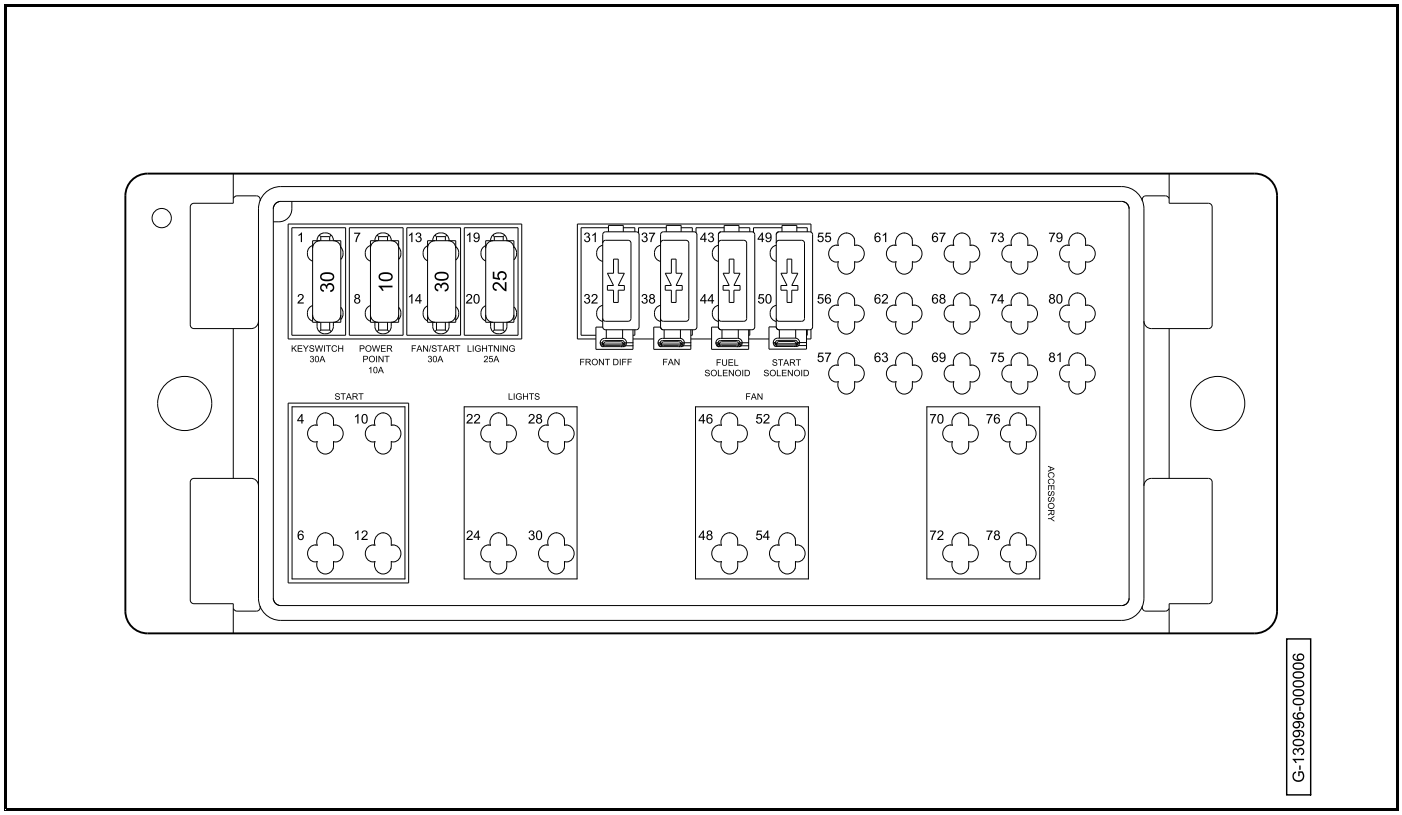



**Figure 12-13**

   – Check for continuity between pin 12 in the fuse block and the 16-gauge green wire from the starter solenoid coil.
   – Check the neutral switch on the transmission housing. **See Test Procedure 20 – Neutral Switch (Transmission) on page 12-40.**

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.**

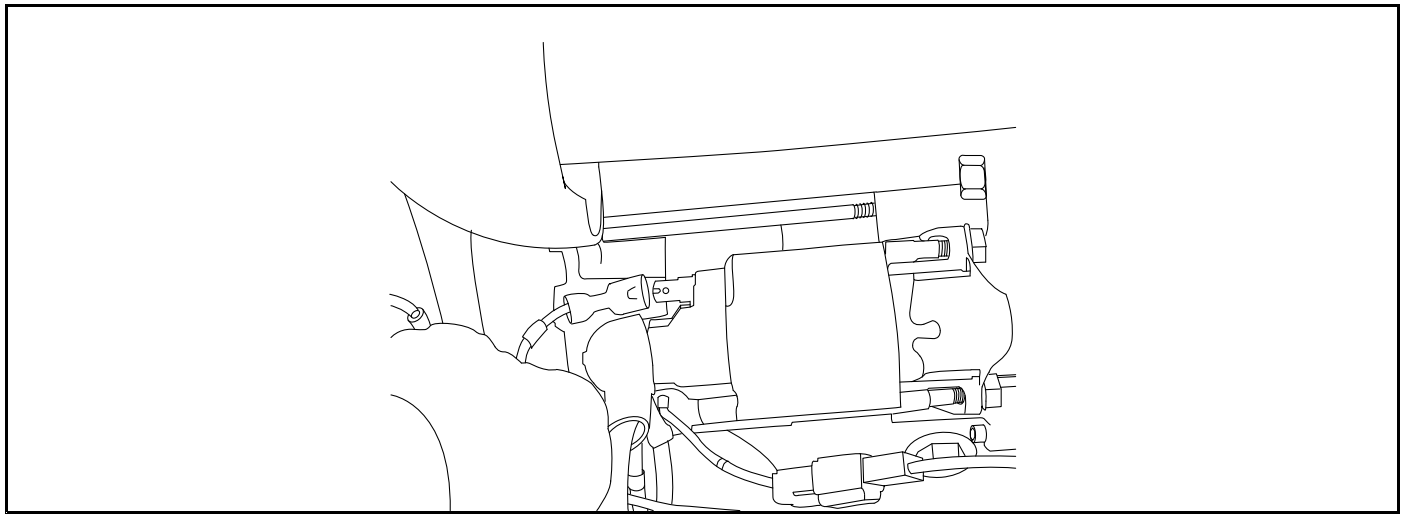
## TEST PROCEDURE 8 – Start Relay - Main Harness Style A

**See General Warnings, Section 1, Page 1-2.**

1. Disable the vehicle. **See Disabling the Vehicle on page 1-3.**
2. Disconnect the 16-gauge green wire (w127) from the starter solenoid coil to prevent the vehicle from unintentionally starting **(Figure 12-14, Page 12-21)**. **See following WARNING.**

### ⚠ WARNING

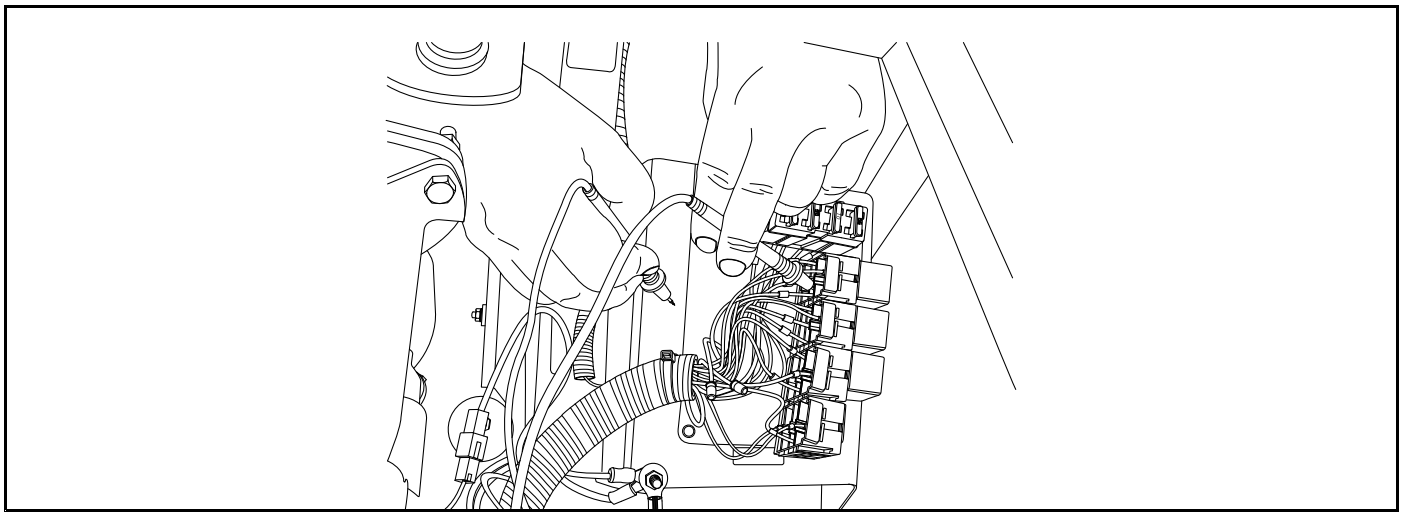
- **Failure to disconnect the wire from the solenoid coil could result in an unexpected engine start when performing this test.**



2109

**Figure 12-14 Solenoid Coil Wire (w127) Removed**

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 12-15, Page 12-22)**.



2111

**Figure 12-15 Style A - Start Relay Coil Circuit Test**

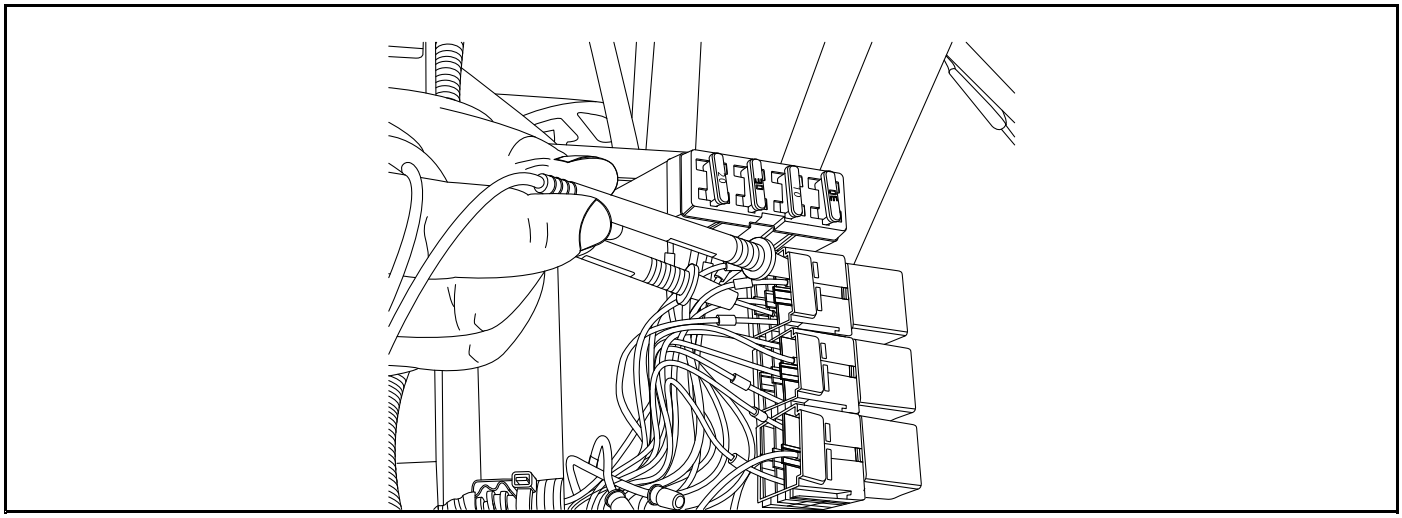
5. Monitor the multimeter. The reading should indicate 0 volts with the key in the OFF and ON positions. The reading should indicate approximately 12 VDC when the key is in the START position and the relay should click. **See following NOTE.**

***NOTE:*** *The 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 12-16, Page 12-22)**.



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**Figure 12-16 Start Relay Contact Test**

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 12-13.**
   – Check the 30-amp fuse (on w125). **See Test Procedure 2 – Fuse on page 12-15.**
   – Check the key switch. **See Test Procedure 4 – Key Switch (Starter Circuit) on page 12-16.**
   – Check the neutral switch on the transmission housing. **See Test Procedure 20 – Neutral Switch (Transmission) on page 12-40.**
   – Check for continuity of the wire harness on wires w141, w138, w110, and w125. **See Wiring Diagram - Main Harness Style A on page 12-10.**

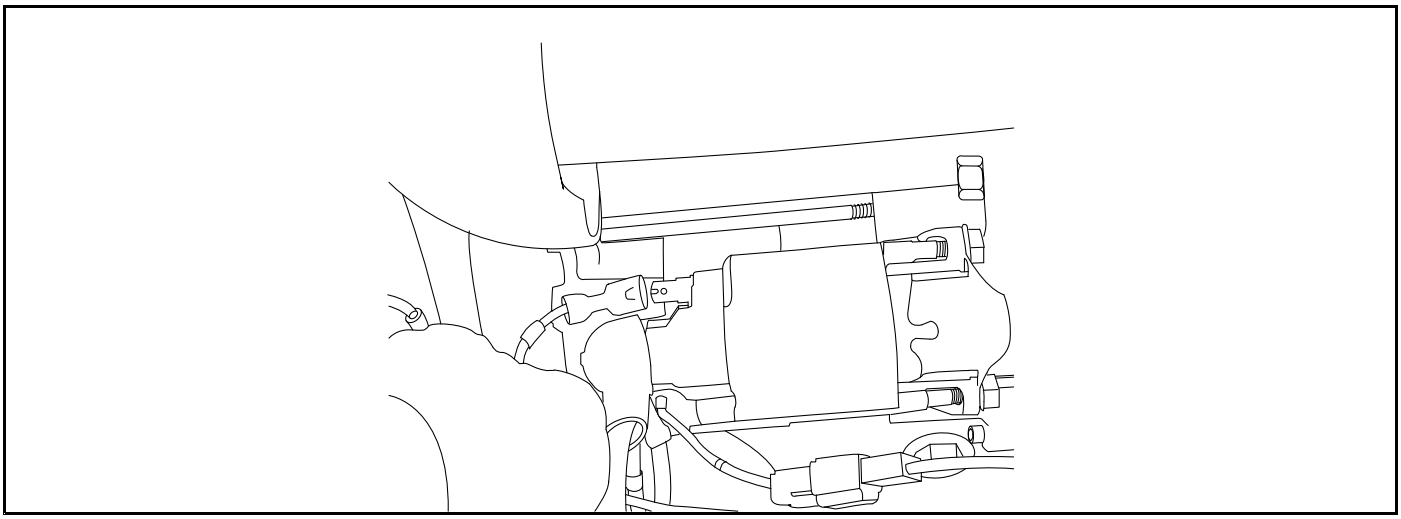
## TEST PROCEDURE 9 – Start Relay - Main Harness Style B

**See General Warnings, Section 1, Page 1-2.**

1. Disable the vehicle. **See Disabling the Vehicle on page 1-3.**
2. Disconnect the 16-gauge green wire (w127) from the starter solenoid coil to prevent the vehicle from unintentionally starting **(Figure 12-14, Page 12-21)**. **See following WARNING.**

### ⚠ WARNING

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



2109

**Figure 12-17 Solenoid Coil Wire (w127) Removed**

3. Set the key to START. The starter relay should click. **See following NOTE.**

***NOTE:*** *The lights, fan, and accessory relays may be removed to isolate the sound of the starter relay click.*

4. Remove the starter relay.
5. Set the multimeter to 20 VDC.

6. Measure the voltage between the pin 6 and the frame ground **(Figure 12-18)**.

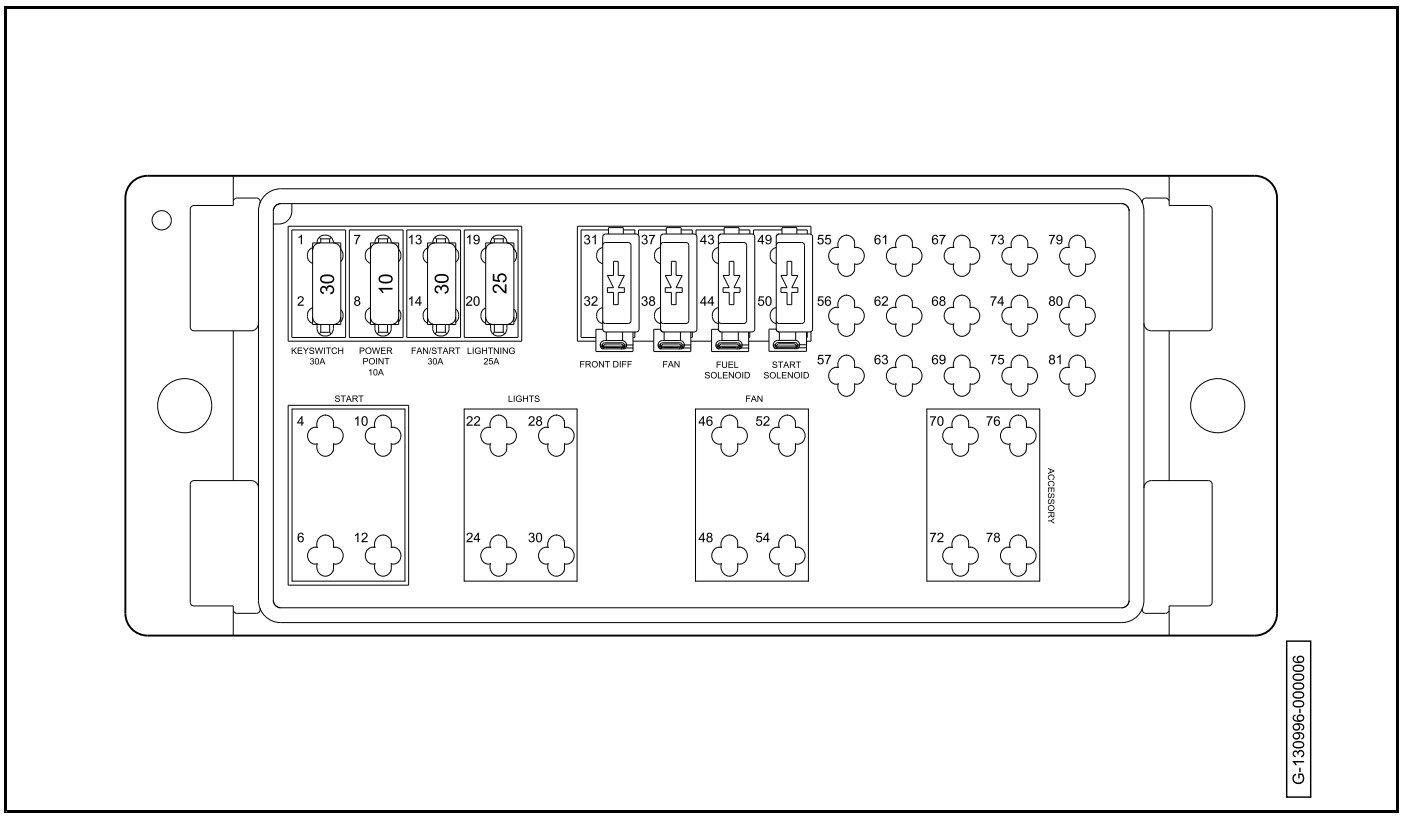



**Figure 12-18**

7. 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.

7.1. If the reading is not 12 VDC, go to step 10.

8. If the reading is 12 VDC and the relay did not click when the key switch is turned to the START position, replace the relay.

9. If the reading is 12 VDC and the relay clicked when the key is in the START position, check the relay contacts.

9.1. Set the multimeter to 200 ohms.

9.2. Measure the resistance on pins 85 and 86.

9.2.1. If the resistance is between 110 and 135 ohms, go to step 10.

9.2.2. If the resistance is less than 110 ohms or greater than 350 ohms, replace the relay.

10. Perform the following test procedures:
- Check the battery.
- Check the 30A key switch fuse in the fuse block.
- Check for continuity between pin 2 in the fuse block and the key switch red wire.
- Check for continuity between pin 6 in the fuse block and the key switch light green wire.
- Check for continuity between pin 12 in the fuse block and the neutral switch black/light green wire.
- Check the key switch. **See Test Procedure 4 – Key Switch (Starter Circuit) on page 12-16.**
- Check the neutral switch on the transmission housing. **See Test Procedure 20 – Neutral Switch (Transmission) on page 12-40.**

## TEST PROCEDURE 10 – Fan Relay - Main Harness Style A

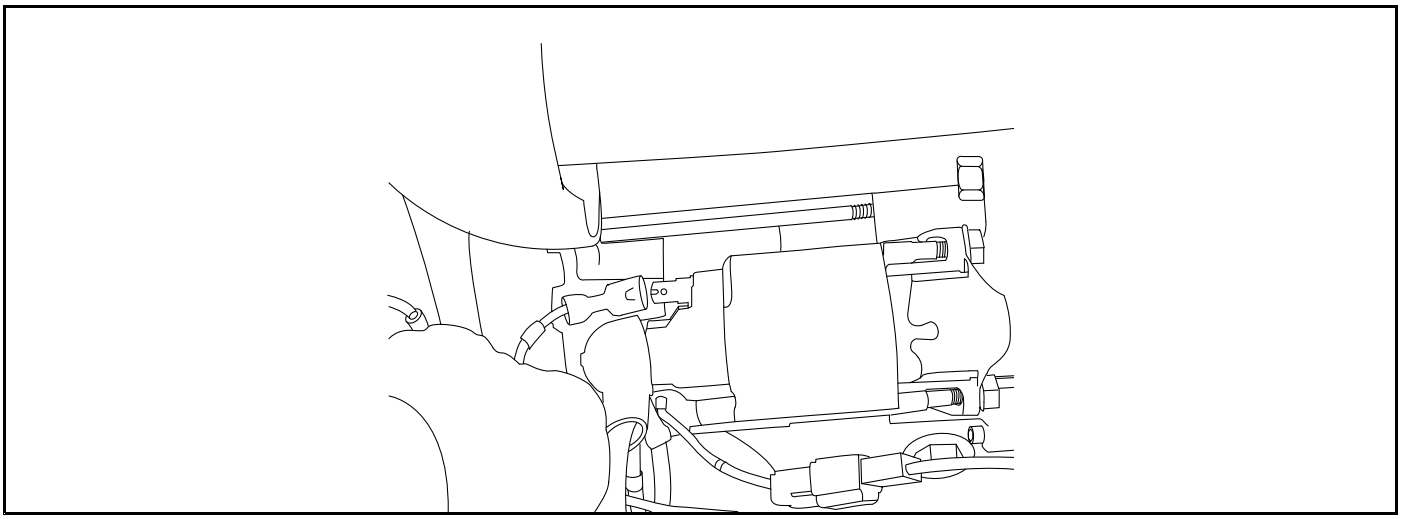
**See General Warnings, Section 1, Page 1-2.**

The fan relay activates the radiator fan when the engine coolant reaches a temperature range of 187 °F to 198 °F (86 °C to 92 °C) and closes the fan thermostat switch.

1. Disable the vehicle. **See Disabling the Vehicle on page 1-3.**
2. Disconnect the 16-gauge green wire (w127) from the starter solenoid coil to prevent the vehicle from unintentionally starting . **See following WARNING.**

### ⚠ WARNING

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

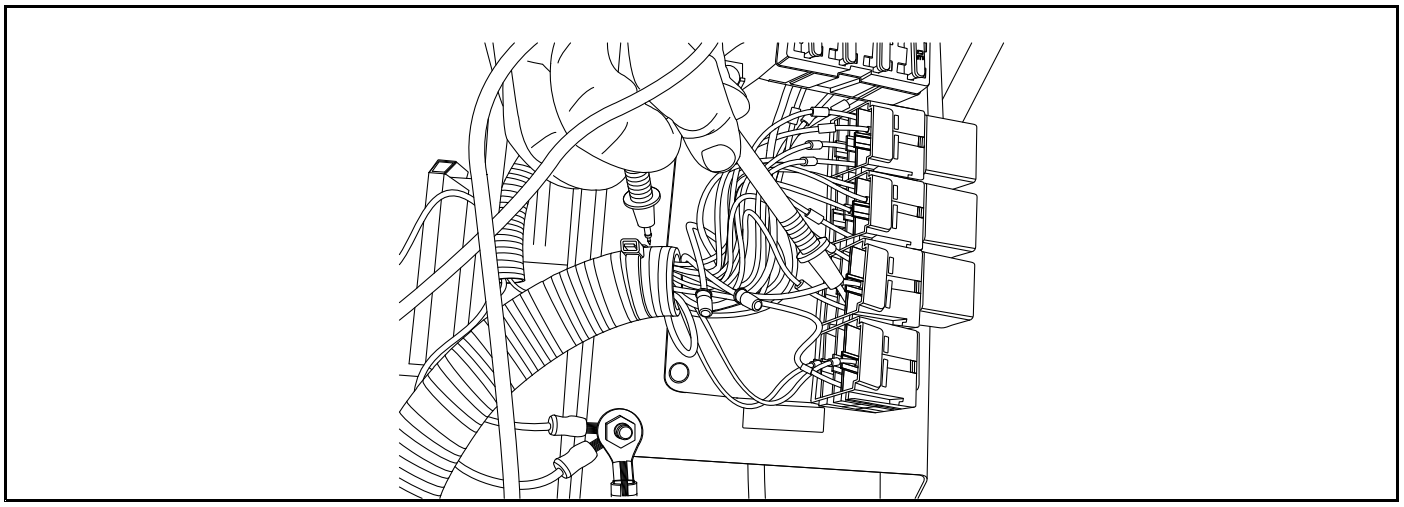


2109

**Figure 12-19 Solenoid Coil Wire (w127) Removed**

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 12-20, Page 12-26)**.



2113

**Figure 12-20 Check Power To Fan Relay**

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 12-13.**

– Check the 30-amp fuse (on w125). **See Test Procedure 2 – Fuse on page 12-15.**

– Check the key switch. **See Test Procedure 5 – Key Switch (ON Position) on page 12-17.**

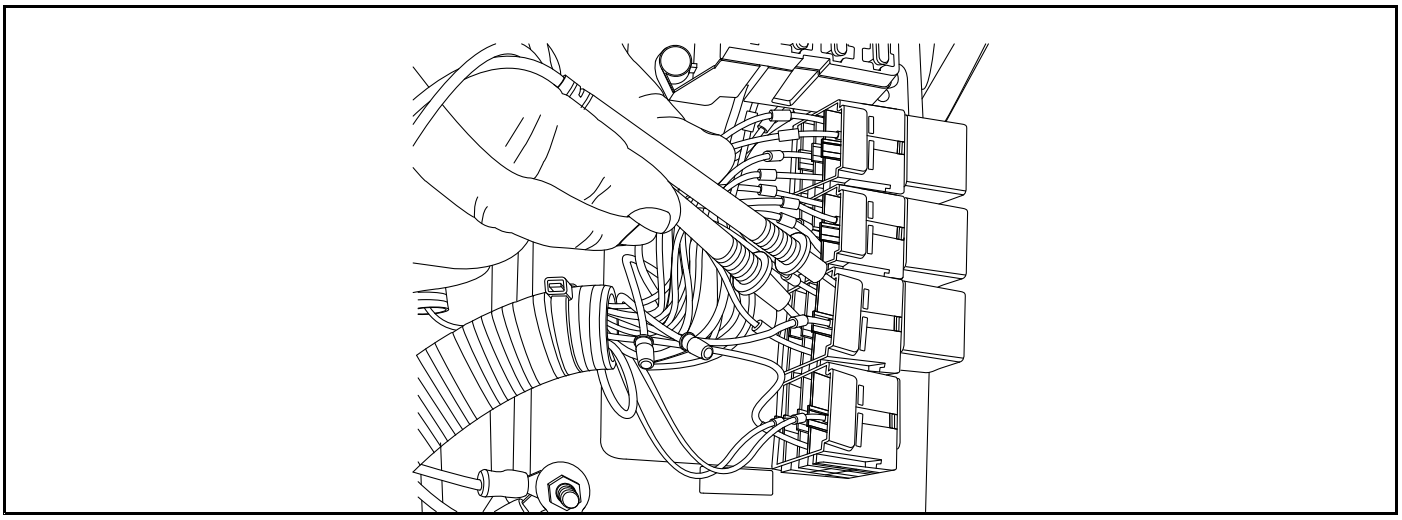
– Check diode 2. **See Test Procedure 16 – Diode 2 on wire 40 on page 12-36.**

– Check for continuity of the wire harness on wires w114, w146, w121, w120, w37, and w125. **See Wiring Diagram - Main Harness Style A on page 12-10.**

– Check the engine coolant thermostat switch. **See Test Procedure 12 – Thermostat Switch on page 12-29.**

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 12-21, Page 12-27)** when the relay is activated.



2114

**Figure 12-21 Fan Relay Contact Test**

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 and accessory relays may be removed temporarily to isolate the sound of the fan relay click.*

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 – Fan Relay - Main Harness Style B

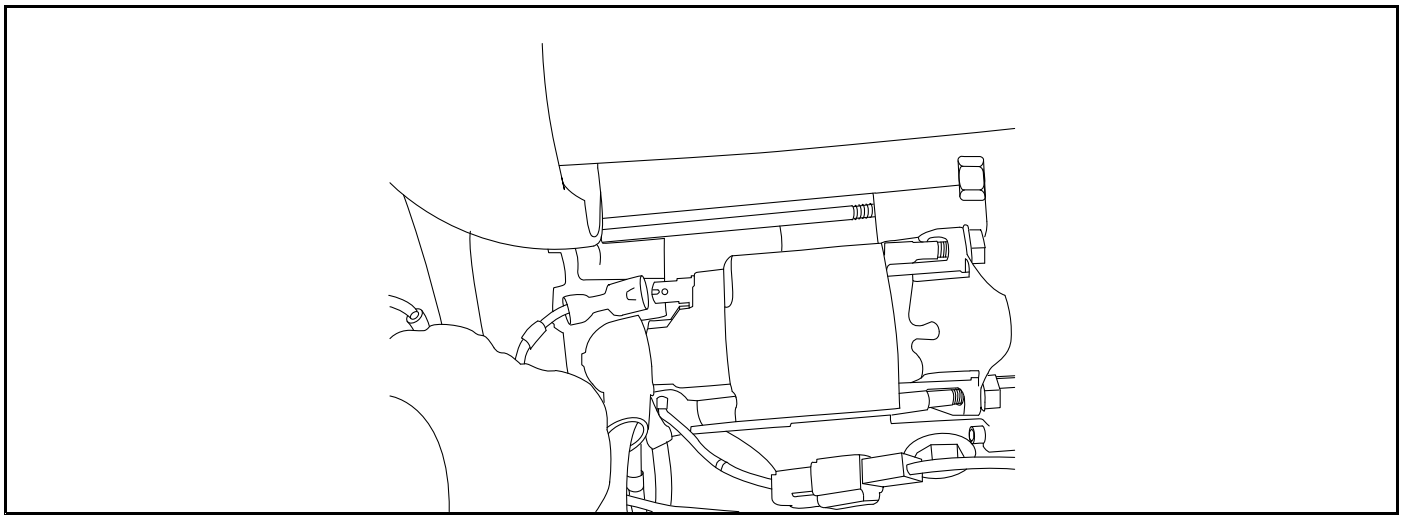
**See General Warnings, Section 1, Page 1-2.**

The fan relay activates the radiator fan when the engine coolant reaches a temperature range of 187 °F to 198 °F (86 °C to 92 °C) and closes the fan thermostat switch.

1. Disable the vehicle. **See Disabling the Vehicle on page 1-3.**
2. Disconnect the 16-gauge green wire from the starter solenoid coil to prevent the vehicle from unintentionally starting **(Figure 12-22, Page 12-28)**. **See following WARNING.**

### ⚠ WARNING

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



2109

**Figure 12-22 Solenoid Coil Wire Removed**

3. Check power to the relay.

3.1. Set the multimeter to 20 VDC and place the probes to measure the voltage between the pin 48 in the fuse block and the frame ground.

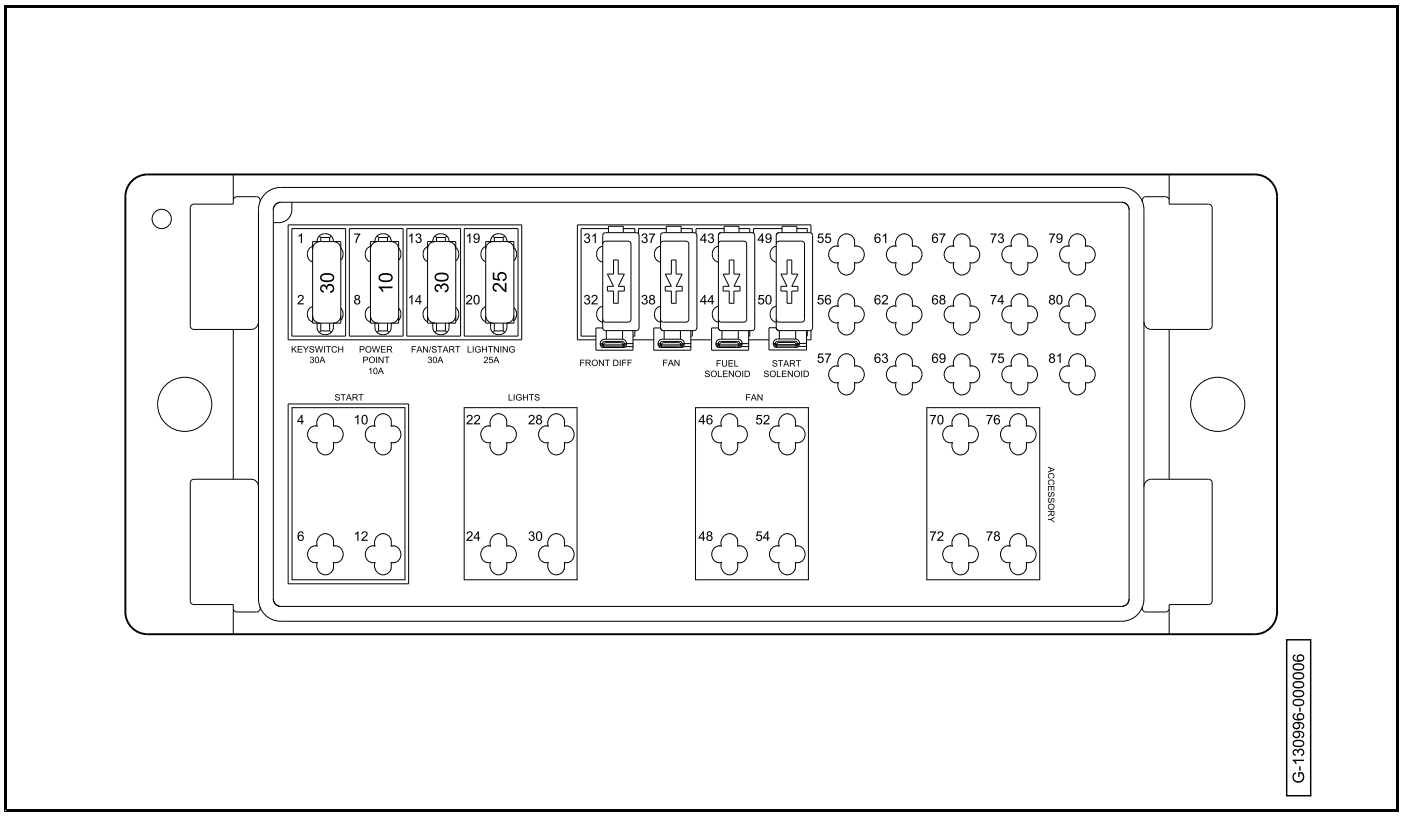



**Figure 12-23**

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 pin 48 and the key switch.

3.3. The reading should indicate approximately 12 VDC with key in the ON position. If so, go to step 4.If not, perform the following test procedures:

– Check the battery. **See Test Procedure 1 – Battery on page 12-13.**

– Check the 30A key switch fuse.

– Check the key switch. **See Test Procedure 5 – Key Switch (ON Position) on page 12-17.**

– Check the fan diode in the fuse block.

– Check for continuity between the thermostat yellow/black wire and pin 52 in the fuse block.

– Check for continuity between the key switch purple wire and pin 48 in the fuse block.

– Check the engine coolant thermostat switch. **See Test Procedure 12 – Thermostat Switch on page 12-29.**

4. If the reading is 12 VDC with key in the ON position, check the 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 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 and accessory relays may be removed temporarily to isolate the sound of the fan relay click.*

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 12 – Thermostat Switch

**See General Warnings, Section 1, Page 1-2.**

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 activates the radiator fan when the engine coolant reaches a temperature range of 187 °F to 198 °F (86 °C to 92 °C) and closes the fan thermostat switch.

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. Disable the vehicle. **See Disabling the Vehicle on page 1-3.**
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 12-24, Page 12-30)**.
4. Test for failed switches in closed condition.

4.1. Set a multimeter to 200 ohms.

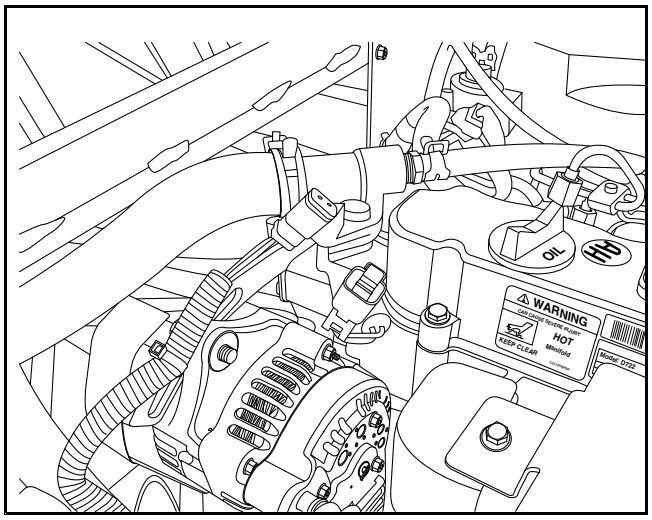
4.2. Use an alligator clip to connect the black (–) probe of the multimeter to the frame (ground).

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 on page 13-18.**

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 on page 13-18.**




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**Figure 12-24 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 12-25, Page 12-31)**.

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 on page 13-18.**

6.6. Fill the kitchen pot with water so that approximately half of the thermostat housing is submerged as shown **(Figure 12-25, Page 12-31)**.

6.7. Place the kitchen pot on a stove and bring the water to a boil. **See following WARNING.**

## ⚠ WARNING

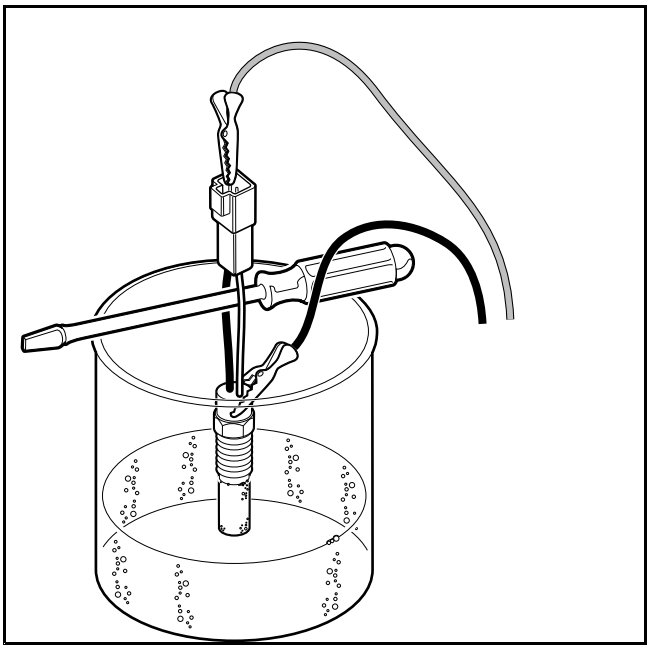
- **Hot! Do not touch hot surfaces or boiling water. Contact with hot surfaces or boiling water will result in severe burns. Allow hot surfaces to cool adequately before touching them.**

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 on page 13-18.**

6.9. Turn off the stove. **See following WARNING.**

## ⚠ WARNING

- **Allow surfaces to cool adequately before touching them.**



2116

**Figure 12-25 Fan Thermostat Switch Test Setup**

## TEST PROCEDURE 13 – Fan Motor

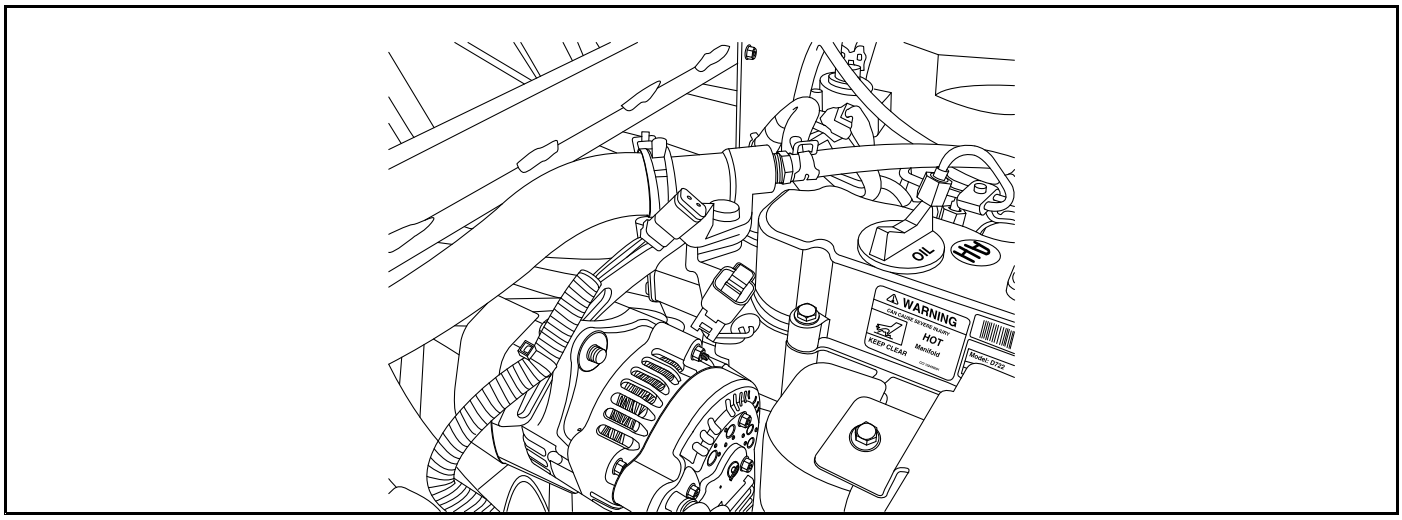
**See General Warnings, Section 1, Page 1-2.**

The fan relay activates the radiator fan when the engine coolant reaches a temperature range of 187 °F to 198 °F (86 °C to 92 °C) and closes the fan thermostat switch.

**Fan Motor**

1. Disable the vehicle. **See Disabling the Vehicle on page 1-3.**

2. Disconnect the two-pin connector from the thermostat switch **(Figure 12-26)** and install a jumper wire between the frame and the 18-gauge yellow/black wire in the connector.



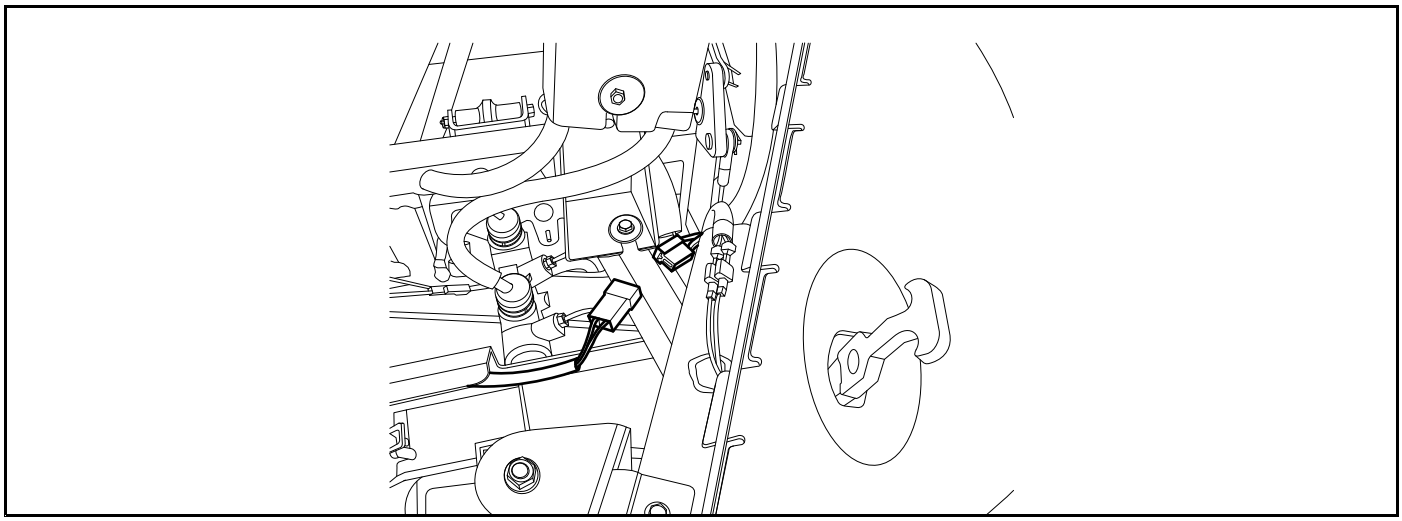

2118

**Figure 12-26 Thermostat Switch 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, test voltage to fan motor.

**Voltage to Fan Motor**

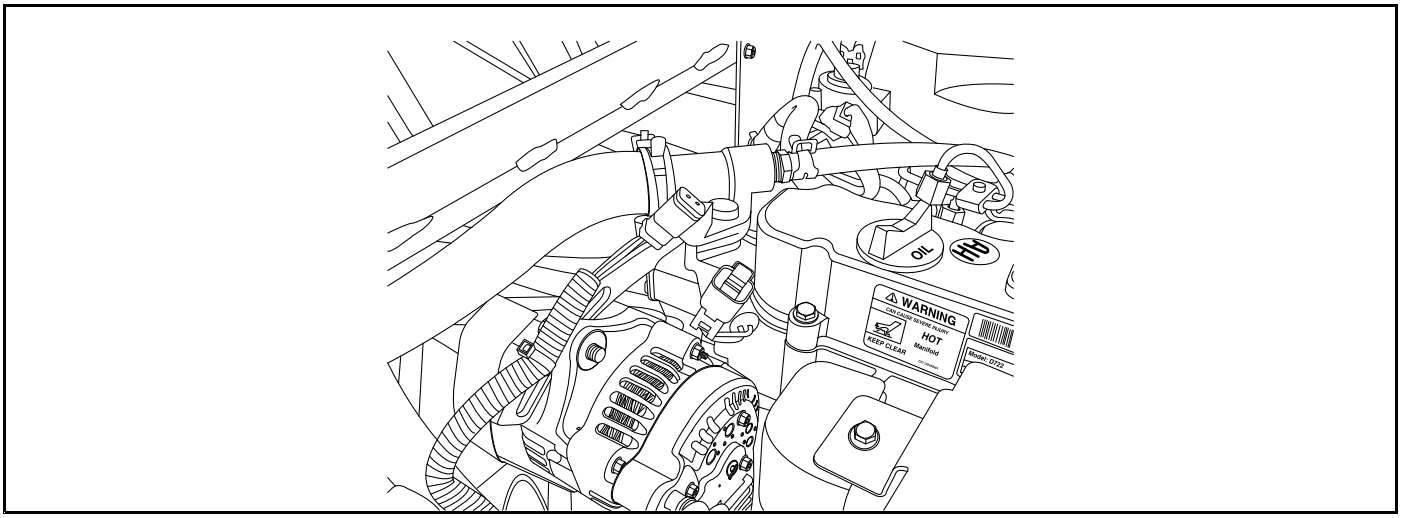
1. Disable the vehicle. **See Disabling the Vehicle on page 1-3.**
2. Raise the hood.
3. Disconnect the two-pin connector from the fan motor **(Figure 12-27, Page 12-32)**.



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**Figure 12-27 Fan Motor Connector**

4. Disconnect the two-pin connector from the thermostat switch **(Figure 12-28, Page 12-33)**.




2118

**Figure 12-28 Thermostat Switch Connector**

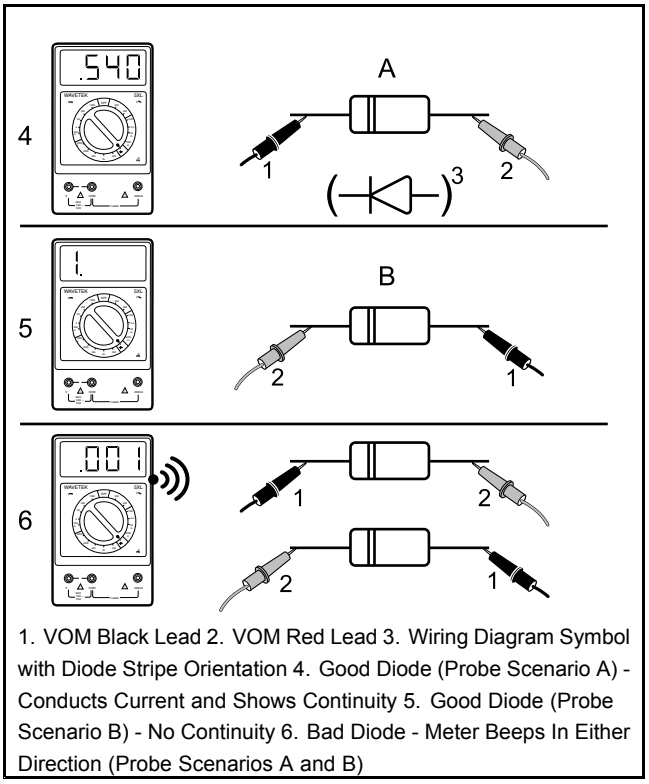
5. Place a jumper wire between the frame and the 18-gauge yellow/black wire at the two-pin connector disconnected from the thermostat switch.
6. Set a multimeter to measure 20 VDC.
7. Place the multimeter probes into each terminal of the two-pin connector disconnected from the fan motor (wire harness side).
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.
12. If the voltage reading is not approximately 12 VDC with the key switch in the ON position, check the following:
    - *Main Harness Style A:*
      - Diode 2 for failure in closed condition. **See Test Procedure 16 – Diode 2 on wire 40 on page 12-36.**
      - Fan relay for proper wiring and function.
      - Both 30-amp fuses (on wires w109 and w125). **See Test Procedure 2 – Fuse on page 12-15.**
      - Key switch. **See Test Procedure 5 – Key Switch (ON Position) on page 12-17.**
      - Connections and wire continuity for wires w112, w44, w52, w51, w107, w109, w114, w146, w125, and w120.
    - *Main Harness Style B:*
      - Fan diode.
      - Fan relay and fan relay circuit.
      - 30A key switch and fan/start fuses and fuse circuit.
      - Key switch. **See Test Procedure 5 – Key Switch (ON Position) on page 12-17.**
      - Check the fan motor ground circuit.

## TEST PROCEDURE 14 – Wire Harness Diodes

**See General Warnings, Section 1, Page 1-2.**

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 12-29, Page 12-34)****.*




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)

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**Figure 12-29 Basic Diode Information**

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 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 | 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 4 | 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 15 – Diode 1 on wire 32

**See General Warnings, Section 1, Page 1-2.**

1. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Disconnect the two-pin connector between the front gearcase and the wire harness.
3. Set the multimeter to the diode test function.
4. Connect the black (–) probe of the multimeter to the frame (ground).
5. 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.*

6. 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 on page 13-20.**
7. Reverse the multimeter probes and note the reading. The multimeter should indicate approximately 540 mV, however, a range of 400 to 700 mV is acceptable.
8. If the readings obtained in the previous steps are incorrect, replace the diode. **See Wire Harness Diode Removal on page 13-20.**

## TEST PROCEDURE 16 – Diode 2 on wire 40

**See General Warnings, Section 1, Page 1-2.**

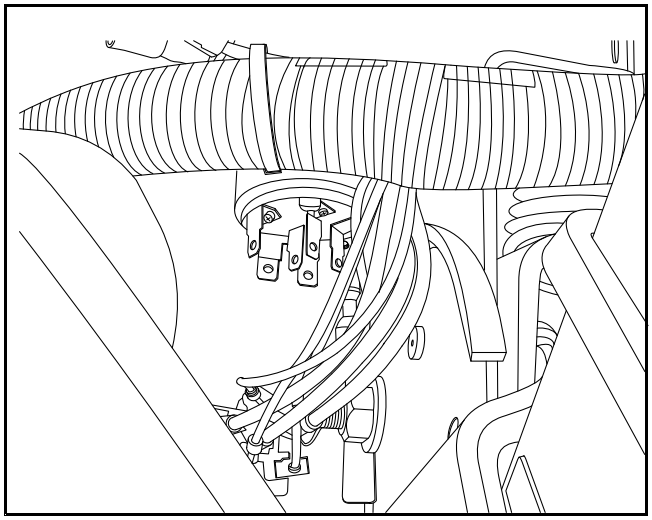
1. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Raise the hood.
3. Disconnect the two-pin connector between the fan and the wire harness **(Figure 12-27, Page 12-32)**.
4. Set the multimeter to the diode test function.
5. Connect the black (–) probe of the multimeter to the frame (ground).
6. Connect the red (+) probe of the multimeter to the 14-gauge blue wire (w52) 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 on page 13-20.**
8. Reverse the multimeter probes and note the reading. The multimeter should indicate approximately 540 mV, however, a range of 400 to 700 mV is acceptable.
9. If the readings obtained in the previous steps are incorrect, replace the diode. **See Wire Harness Diode Removal on page 13-20.**

## TEST PROCEDURE 17 – Diode 3 on wire 123

**See General Warnings, Section 1, Page 1-2.**

1. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Raise the hood.
3. Disconnect the multi-pin connector from the key switch **(Figure 12-30, Page 12-36)**. **See following NOTE.**

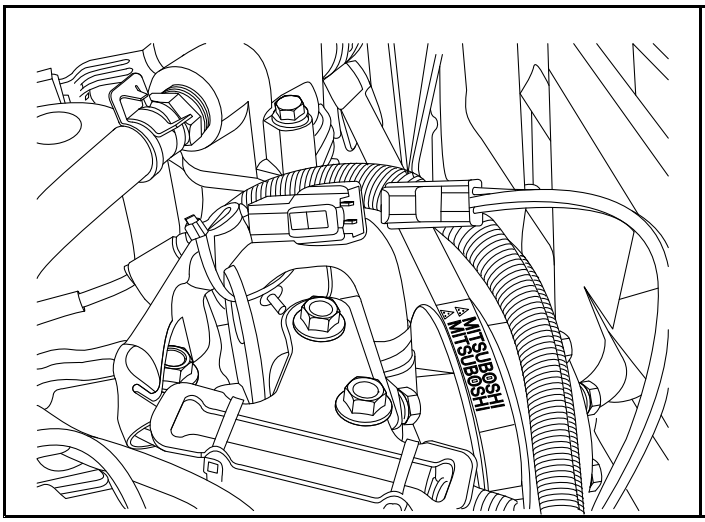
***NOTE:*** *Failure to disconnect the multi-pin connector from the key switch will result in unreliable results when the diodes connected to the key switch circuit are tested.*



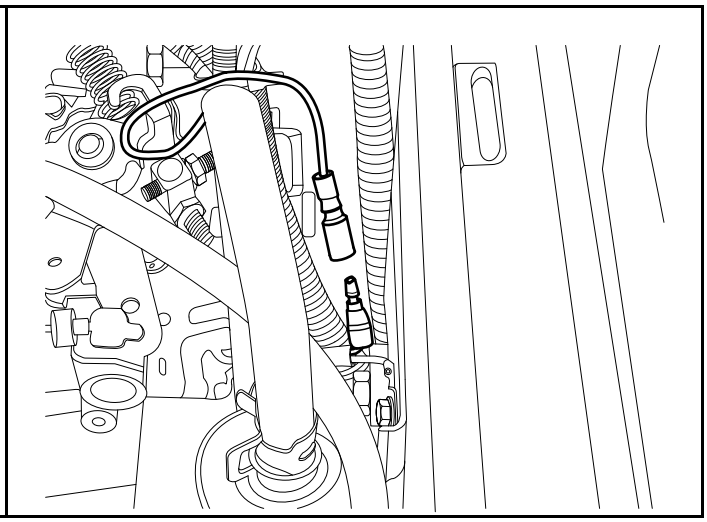
2119
**Figure 12-30 Disconnected Multi-Pin Connector at Key Switch**

4. Disconnect the three-pin connector (w122, w135, w108) between the fuel solenoid and the wire harness **(Figure 12-31, Page 12-37)**.

5. Disconnect the bullet connector, on the gray wire (w140), between the fuel pump and the wire harness **(Figure 12-32, Page 12-37)**.
6. Set the multimeter to the diode test function.




2120
**Figure 12-31 Fuel Solenoid Three-Pin Connector**



2121
**Figure 12-32 Fuel Pump Bullet Connector**

7. Connect the black (–) probe of the multimeter to the frame (ground).
8. Connect the red (+) probe of the multimeter to the 18-gauge gray wire (w140) at the bullet connector (wire harness side).
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 on page 13-20.**
10. Reverse the multimeter probes and note the reading. The multimeter should indicate approximately 540 mV, however, a range of 400 to 700 mV is acceptable.
11. If the readings obtained in the previous steps are incorrect, replace the diode. **See Wire Harness Diode Removal on page 13-20.**

## TEST PROCEDURE 18 – Diode 4 on wire 129

**See General Warnings, Section 1, Page 1-2.**

1. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Disconnect the 16-gauge green wire (w127) from the starter solenoid coil **(Figure 12-11, Page 12-19)**.
3. Set the multimeter to the diode test function.
4. Connect the black (–) probe to the frame (ground).
5. Connect the red (+) probe to the 16-gauge green wire (w127) at the connector.
6. 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 on page 13-20.**
7. Reverse the multimeter probes and note the reading. The multimeter should indicate approximately 540 mV, however, a range of 400 to 700 mV is acceptable.
8. If the readings obtained in the previous steps are incorrect, replace the diode. **See Wire Harness Diode Removal on page 13-20.**

## TEST PROCEDURE 19 – Fuse Block Diodes

**See General Warnings, Section 1, Page 1-2.**

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 12-29, Page 12-34)****.*

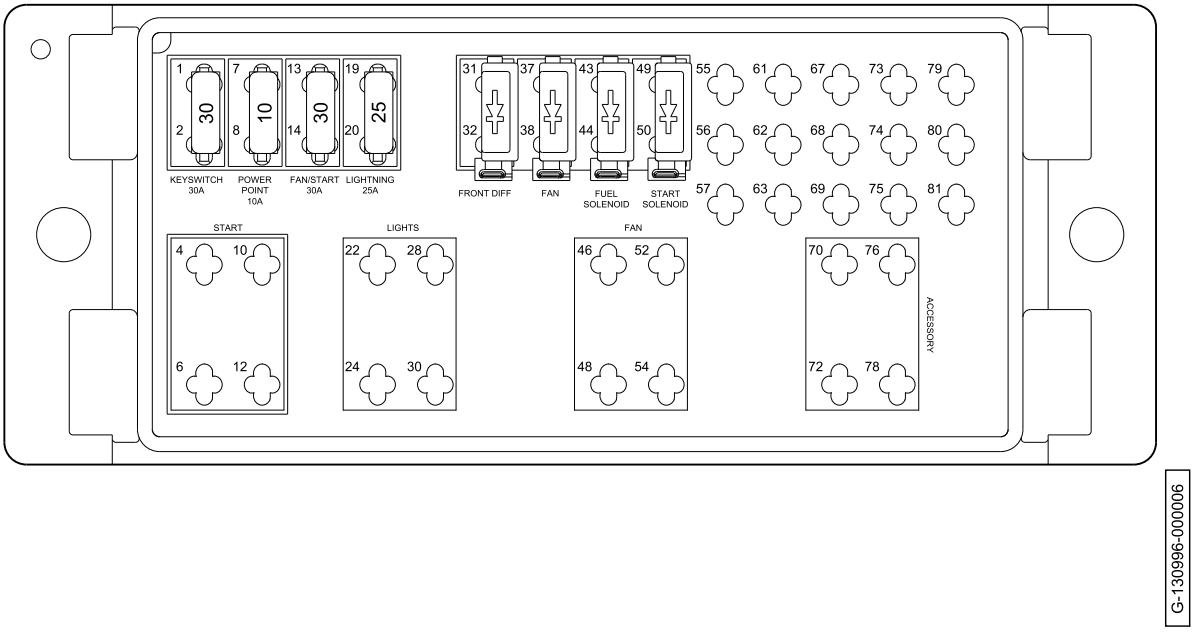



**Figure 12-33**

| DIODE TROUBLESHOOTING GUIDE | | | |
|---|---|---|---|
| **DIODE** | **FUNCTION** | **FAILURE CONDITION** | **SYMPTOM/COMMENT** |
| FRONT DIFF | Differential solenoid coil flyback diode | Open | Will contribute to the premature failure of the differential limit switch contacts. |
| | | Closed | With key switch ON, the 30A key switch fuse will blow repeatedly until the diode has been replaced. |

**TABLE CONTINUED ON NEXT PAGE**

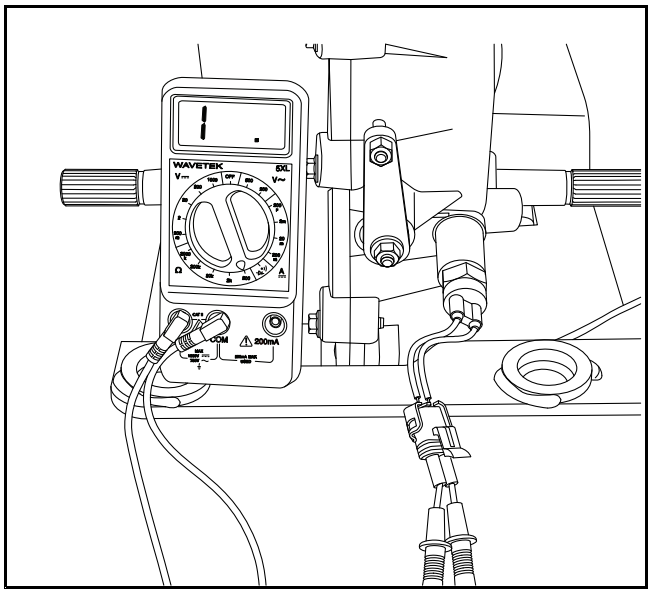
| DIODE TROUBLESHOOTING GUIDE | | | |
|---|---|---|---|
| **DIODE** | **FUNCTION** | **FAILURE CONDITION** | **SYMPTOM/COMMENT** |
| FAN | Fan motor flyback diode | Open | Will contribute to the premature failure of the fan relay contacts. |
| | | Closed | The 30A fan/start fuse will blow repeatedly until the diode has been replaced. |
| FUEL SOLEDNOID | Fuel pump and hold coil flyback diode | Open | Will contribute to the premature failure of the key switch contacts. |
| | | Closed | The 30A key switch fuse will blow repeatedly until the diode has been replaced. |
| START SOLENOID | Starter solenoid coil flyback diode | Open | Will contribute to the premature failure of the start relay contacts. |
| | | Closed | The 30A fan/start fuse will blow repeatedly until the diode has been replaced. |

## TEST PROCEDURE 20 – Neutral Switch (Transmission)

**See General Warnings, Section 1, Page 1-2.**

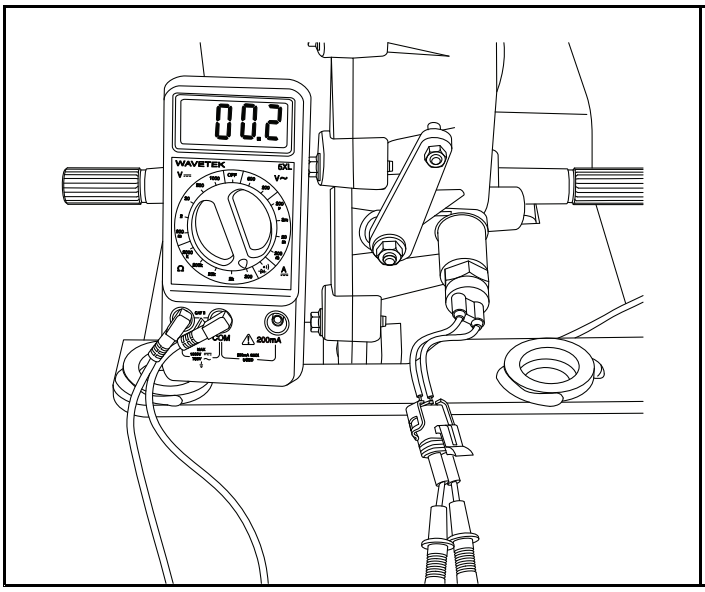
The neutral switch is located on the transmission housing.

1. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Disconnect the two-pin connector between the neutral switch and the wire harness (w143 and w142).
3. Check for continuity on the switch contacts with the Forward/Reverse handle in the FORWARD position **(Figure 12-34, Page 12-40)**. The multimeter should indicate no continuity.
4. Check for continuity on the switch contacts with the Forward/Reverse handle in the NEUTRAL position **(Figure 12-35, Page 12-41)**. The multimeter should indicate continuity.
5. Check for continuity on the switch contacts with the Forward/Reverse handle in the REVERSE position **(Figure 12-36, Page 12-41)**. The multimeter should indicate no continuity.
6. If any of the continuity readings are incorrect, replace the neutral switch. **See Neutral Switch Removal on page 13-1.**

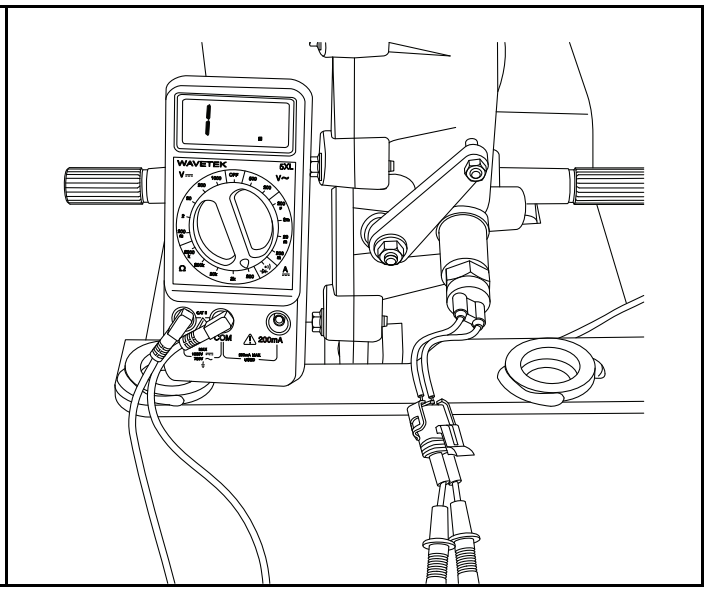



2091

**Figure 12-34 Neutral Switch – Forward Position**




2092
**Figure 12-35 Neutral Switch – Neutral Position**




2094
**Figure 12-36 Neutral Switch – Reverse Position**

## TEST PROCEDURE 21 – Wire Continuity

**See General Warnings, Section 1, Page 1-2.**

1. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. To test a wire for continuity, disconnect either end from the electrical component to which it is attached.
3. 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 14 – Wire Harness Diodes on page 12-34.***

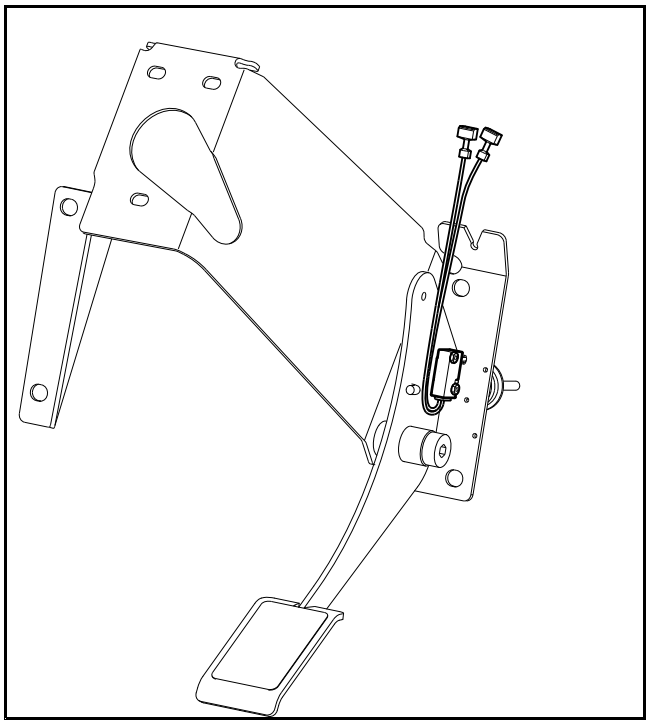
## TEST PROCEDURE 22 – Front Differential Limit Switch

**See General Warnings, Section 1, Page 1-2.**

***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. Disable the vehicle. **See Disabling the Vehicle on page 1-3.**
2. Check for proper wiring and tight connections at the front differential limit switch **(Figure 12-37, Page 12-42)**.



2363

**Figure 12-37 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 13-13.**

## TEST PROCEDURE 23 – Front Drive Gearcase Coil

**See General Warnings, Section 1, Page 1-2.**

1. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Disconnect the two-pin connector between the wire harness and the front drive gearcase located under the front floorboard.
3. Set the multimeter to 200 ohms.
4. Measure the resistance between the two wires at the two-pin connector (front drive gearcase side).
5. The resistance should be 24.7 to 27.3 ohms.
6. If the resistance is not within the stated range, replace the large output cover sub-assembly. **See the Engines and Drivetrain Components manual.**

## TEST PROCEDURE 24 – Alternator

**See General Warnings, Section 1, Page 1-2.**

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

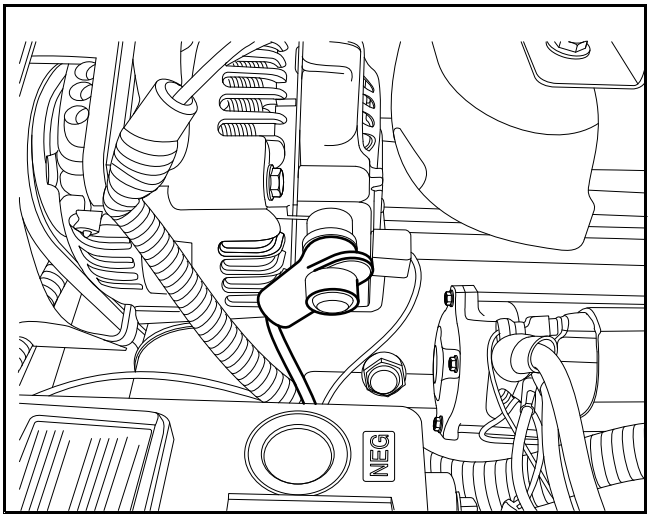
1. Disable the vehicle. **See Disabling the Vehicle on page 1-3.**
2. Ensure that the wires are connected correctly and are tight. If they are not, rewire or tighten as necessary.
3. Check engine RPM setting to ensure it is adjusted correctly. **See Engine RPM Adjustment on page 14-18.**
4. With the 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 12-13.**
7. If the reading is less than 14.2 volts and not rising or higher than 14.8 volts, replace the alternator.

## TEST PROCEDURE 25 – 60-Amp Fusible Link

**See General Warnings, Section 1, Page 1-2.**

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

1. Disable the vehicle. **See Disabling the Vehicle on page 1-3.**
2. Raise the driver side seat and locate blue fusible link wire attached to alternator **(Figure 12-38, Page 12-43)**.




2122

**Figure 12-38 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 12-13.**
   – Loose connection at large post of starter solenoid.
   – Wire continuity of between the battery red (+) wire and the blue fusible link wire. **See Test Procedure 21 – Wire Continuity on page 12-41.**
9. If no problems were found in step 8, the fusible link has failed and must be replaced. **See 60-Amp Fusible Link Removal on page 13-4.**

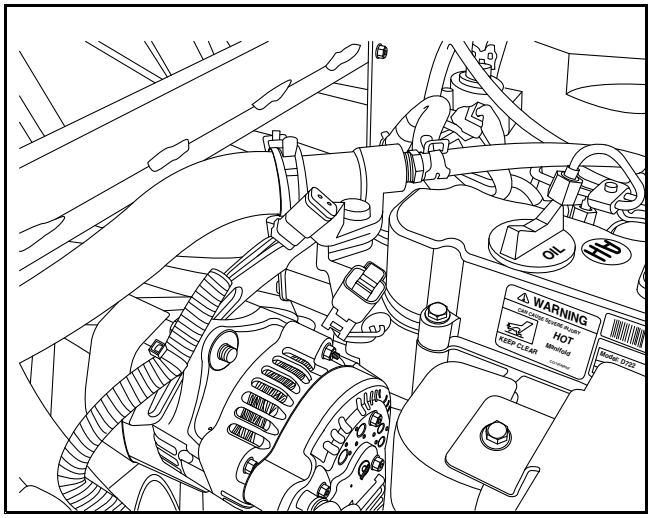
## TEST PROCEDURE 26 – Coolant Temperature Warning Light Circuit

**See General Warnings, Section 1, Page 1-2.**

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. Disable the vehicle. **See Disabling the Vehicle on page 1-3.**
2. At driver side, raise the seat and disconnect the two-pin connector from the thermostat switch **(Figure 12-28, Page 12-33)**.




2115

**Figure 12-39 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 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.

8.1. 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 12-17.**

8.2. If the voltage reading obtained is correct, check the filament of the warning light.

8.2.1. Set the multimeter to 200 ohms.

8.2.2. Check for continuity between the warning light terminals.

8.2.3. The reading should indicate continuity. If not, replace the coolant temperature warning light. **See Warning Light Removal on page 13-5.**

8.3. If the voltage reading obtained in step 8 is not approximately 12 VDC with the key switch in the ON position, check the following:

– *Main Harness Style A:*
  – 30-amp fuse (on wire w125). **See Test Procedure 2 – Fuse on page 12-15.**
  – Key switch. **See Test Procedure 5 – Key Switch (ON Position) on page 12-17.**
  – Connections and wire continuity for wires w117, w45, w29, w37, w125, and w126. **See Test Procedure 21 – Wire Continuity on page 12-41.**

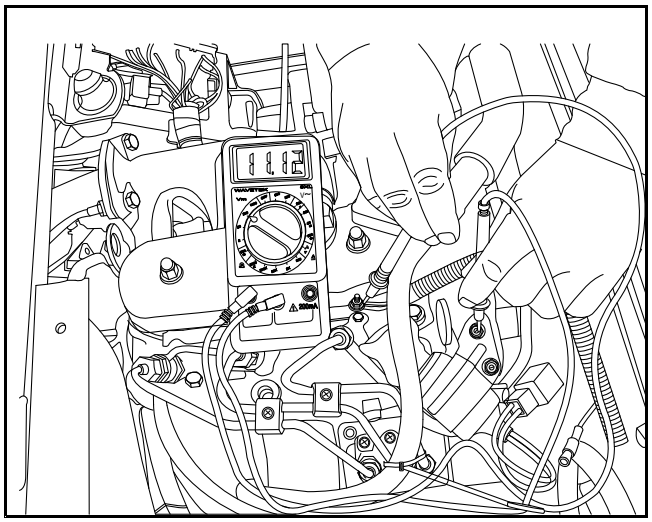
– *Main Harness Style B:*
  – 30A key switch fuse and fuse circuit.
  – Key switch and key switch circuit. **See Test Procedure 5 – Key Switch (ON Position) on page 12-17.**
  – Coolant temperature warning light circuit.

## TEST PROCEDURE 27 – Glow Plug Circuit

**See General Warnings, Section 1, Page 1-2.**

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

1. Disable the vehicle. **See Disabling the Vehicle on page 1-3.**
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 12-40, Page 12-46)**.
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.



2124

**Figure 12-40 Glow Plug Circuit Test**

7. If the readings in the previous two steps are incorrect, check the following:
   – *Main Harness Style A:*
     – 30-amp fuse (on wire w125). **See Test Procedure 2 – Fuse on page 12-15.**
     – Key Switch. **See Test Procedure 6 – Key Switch (Glow Plug Circuit) on page 12-18.**
     – Wire continuity of wires w125, w26, w133, and w137. **See Test Procedure 21 – Wire Continuity on page 12-41.**
   – *Main Harness Style B:*
     – 30A key switch fuse and key switch circuit.
     – Key Switch. **See Test Procedure 6 – Key Switch (Glow Plug Circuit) on page 12-18.**
     – Wire continuity of the wire between the glow plug and key switch.
     – 60A fusible link circuit.

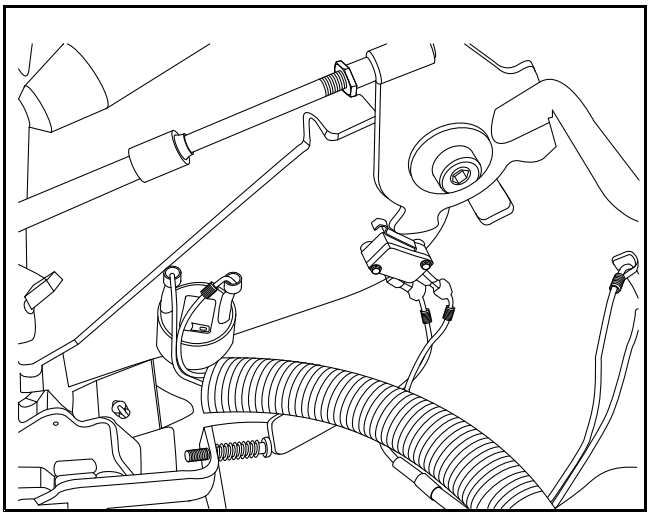
## TEST PROCEDURE 28 – Reverse Warning Buzzer Limit Switch (If Equipped)

**See General Warnings, Section 1, Page 1-2.**

***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. Disable the vehicle. **See Disabling the Vehicle on page 1-3.**
2. Check for proper wiring and tight connections at the reverse warning buzzer and the reverse warning buzzer limit switch **(Figure 12-41, Page 12-47)**.
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 12-41, Page 12-47)**.



2098
**Figure 12-41 Reverse Warning Buzzer and Limit Switch**

## TEST PROCEDURE 29 – Reverse Warning Buzzer (If Equipped)

**See General Warnings, Section 1, Page 1-2.**

1. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. 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 - Main Harness Style A on page 12-10.** If the buzzer does not function when properly wired, replace the buzzer. **See Reverse Warning Buzzer Removal on page 13-10.**

## TEST PROCEDURE 30 – Fuel Solenoid Pull Coil Circuit

**See General Warnings, Section 1, Page 1-2.**

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

1. Disable the vehicle. **See Disabling the Vehicle on page 1-3.**
2. Disconnect the three-pin connector between the fuel solenoid and the wire harness **(Figure 12-31, Page 12-37)**.
3. Disconnect the light green wire from starter solenoid.
4. Set a multimeter to 20 VDC.
5. *Main Harness Style A:* Place the red (+) probe on the 14-gauge blue wire (w135) of the three-pin connector at the fuel solenoid (wire harness side).
6. *Main Harness Style B:* Place the red (+) probe on the 14-gauge white wire of the three-pin connector at the fuel solenoid (wire harness side).
7. Place the black (–) probe on the frame or engine block (ground).
8. The multimeter should indicate 0 VDC with the key in the OFF position.
9. Monitor the multimeter and turn the key switch to the ON position. The multimeter should indicate 0 VDC.
10. Monitor the multimeter and turn the key switch to the START position. The multimeter should indicate between 10 and 11.5 VDC.
11. 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 on page 13-3.**
12. If any of the above readings are incorrect, check the following items:
    - Battery. **See Test Procedure 1 – Battery on page 12-13.**
    - Key switch. **See Test Procedure 4 – Key Switch (Starter Circuit) on page 12-16.**
    - Starter solenoid. **See the Kubota D722 diesel engine manual.**
    - *Main Harness Style A:* Wire continuity of w135. **See Test Procedure 21 – Wire Continuity on page 12-41.**
    - *Main Harness Style B:* Wire continuity of the 14-gauge white wire of the three-pin connector at the fuel solenoid (wire harness side). **See Test Procedure 21 – Wire Continuity on page 12-41.**

## TEST PROCEDURE 31 – Fuel Solenoid Hold Coil Circuit

**See General Warnings, Section 1, Page 1-2.**

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

1. Disable the vehicle. **See Disabling the Vehicle on page 1-3.**
2. Disconnect the three-pin connector between the fuel solenoid and the wire harness **(Figure 12-31, Page 12-37)**.
3. Set a multimeter to 20 VDC.
4. *Main Harness Style A:* Place the red (+) probe on the 18-gauge gray wire (w122) of the three-pin connector at the fuel solenoid (wire harness side).
5. *Main Harness Style B:* Place the red (+) probe on the 18-gauge red wire of the three-pin connector at the fuel solenoid (wire harness side).
6. Place the black (–) probe on the frame or engine block (ground).
7. The multimeter should indicate 0 VDC with the key switch in the OFF position.
8. Monitor the multimeter and turn the key switch to the ON position. The multimeter should indicate approximately 12 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 on page 13-3.**

10. If any of the above readings are incorrect, check the following items:
    - Battery and battery wiring circuit. **See Test Procedure 1 – Battery on page 12-13.**
    - 30A key switch fuse and fuse circuit.
    - Key switch. **See Test Procedure 5 – Key Switch (ON Position) on page 12-17.**
    - Starter solenoid. **See the Kubota D722 diesel engine manual.**
    - *Main Harness Style A:* Wire continuity of wires w122, w121, w37, and w120. **See Test Procedure 21 – Wire Continuity on page 12-41.**
    - *Main Harness Style B:*
      - Continuity between the key switch purple wire and the 18-gauge red wire of the three-pin connector at the fuel solenoid.
      - Continuity between the alternator purple wire and key switch purple wire.

## TEST PROCEDURE 32 – Low Oil Warning Light Circuit

**See General Warnings, Section 1, Page 1-2.**

If the low oil warning light stays on, test the oil pressure switch. **See the Kubota D722 diesel engine manual.** 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. Disable the vehicle. **See Disabling the Vehicle on page 1-3.**
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 from the low oil warning light terminal.
5. Leave the 18-gauge purple wire 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 for continuity between the terminal at the low oil warning light and the 18-gauge purple wire at the key switch. Also check the continuity between the terminal on the 18-gauge black/white wire and the terminal on the oil pressure switch 16-gauge black/white wire.
10. If there is continuity between the 18-gauge purple wire at the low oil warning light and the 18-gauge purple wire at the key switch, replace the low oil warning light. **See Warning Light Removal on page 13-5.**
11. If the problem is not corrected by performing the previous steps, test the oil pressure switch. **See the Kubota D722 diesel engine manual.**

## TEST PROCEDURE 33 – 12-Volt Accessory Receptacle

**See General Warnings, Section 1, Page 1-2.**

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

1. Disable the vehicle. **See Disabling the Vehicle on page 1-3.**
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 12-15.**
5. If the fuse is good, check the continuity of the wires connected to the accessory receptacle.

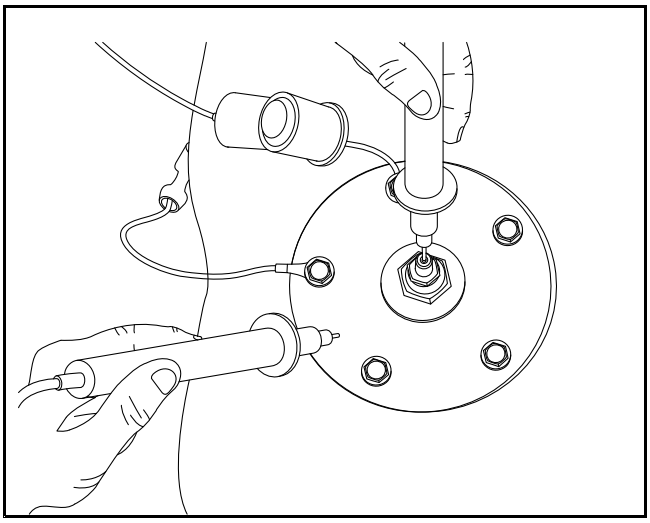
## TEST PROCEDURE 34 – Fuel Level Sending Unit

**See General Warnings, Section 1, Page 1-2.**

### ⚠ 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. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Disconnect the orange wire from the center post of the fuel level sending unit.
3. 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 12-42, Page 12-51)**.



2100

**Figure 12-42 Fuel Level Sending Unit Test**

4. 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 |

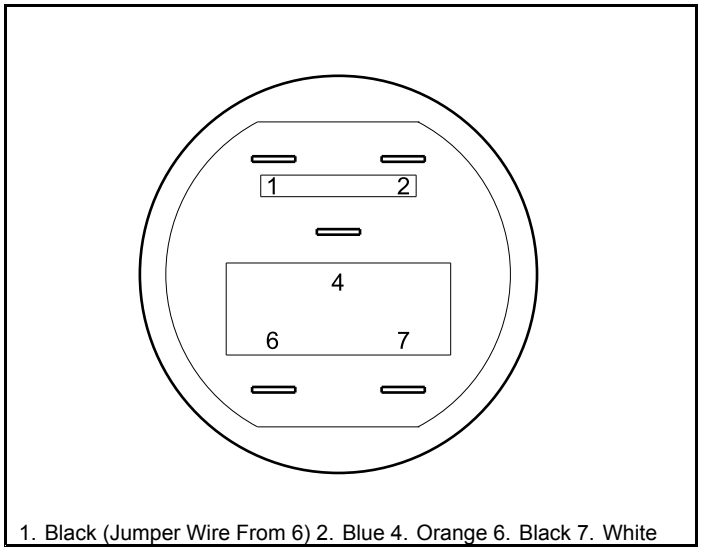
5. If the readings are within the specifications listed in the preceding chart, the fuel level sending unit is working properly. If the readings are incorrect, the fuel level sending unit has failed and the fuel tank must be replaced. **See Fuel Tank Removal on page 14-14.**
6. If the readings are correct 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 from the fuel gauge/hour meter to the key switch purple wire.
   – Black ground wires at the fuel level sending unit and at the fuel gauge/hour meter.

7. 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 35 – Fuel Gauge on page 12-52.**

## TEST PROCEDURE 35 – Fuel Gauge

**See General Warnings, Section 1, Page 1-2.**

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

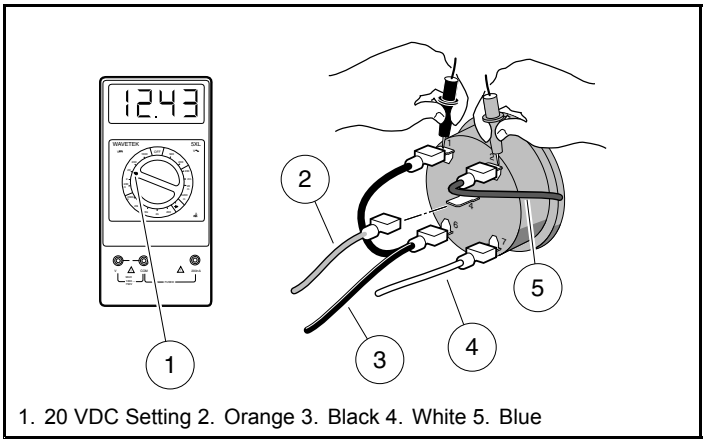



1. Black (Jumper Wire From 6) 2. Blue 4. Orange 6. Black 7. White

480

**Figure 12-43 Fuel Gauge/Hour Meter**

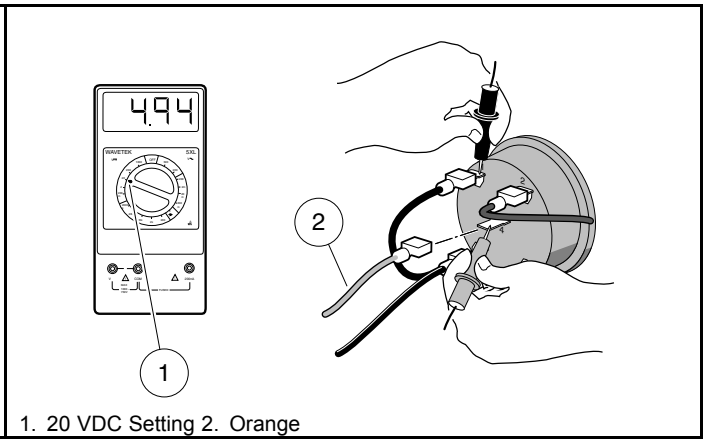
1. Disable the vehicle. **See Disabling the Vehicle on page 1-3.**
2. Raise the hood.
3. Disconnect the orange wire from the fuel gauge/hour meter.
4. Set a multimeter to 20 volts DC and place the red (+) probe on the positive (+) post of the battery. Place the black (–) probe on the negative (–) post 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 (w25) is connected. Place the black (–) probe on the (1) terminal of the fuel gauge/hour meter with the black wire.
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.
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 12-45, Page 12-53)**. The voltage reading should be approximately 4.94 volts. If the reading is incorrect, replace the fuel gauge/hour meter.




1. 20 VDC Setting 2. Orange 3. Black 4. White 5. Blue

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**Figure 12-44 Fuel Gauge Voltage Test - Terminal 2**




1. 20 VDC Setting 2. Orange

482

**Figure 12-45 Fuel Gauge Voltage Test - Terminal 4**

## TEST PROCEDURE 36 – Hour Meter

**See General Warnings, Section 1, Page 1-2.**

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

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 32 – Low Oil Warning Light Circuit on page 12-49.**

***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 37 – Light Switch

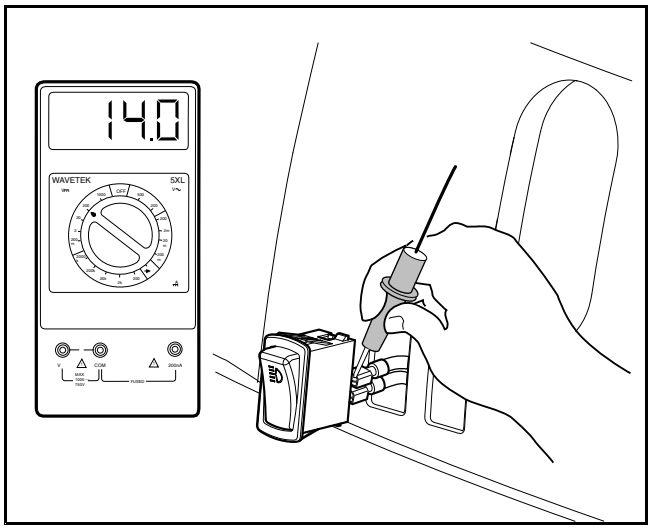
**See General Warnings, Section 1, Page 1-2.**

***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 12-15.***

*Keep the battery connected during this test procedure.*

1. Disable the vehicle. **See Disabling the Vehicle on page 1-3.**
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 12-46, Page 12-54)**.
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 from the fuse block to the starter solenoid. Check the continuity of the 14-gauge yellow wire and the 14-gauge blue wires from the light switch to the fuse block. Check the lighting fuse. **See Test Procedure 2 – Fuse on page 12-15.** If the wires and fuse show continuity and the readings are still incorrect, replace the switch. **See Light Switch Removal on page 13-9.**




1130

**Figure 12-46 Light Switch Test**

## TEST PROCEDURE 38 – Voltage at Headlight Socket

**See General Warnings, Section 1, Page 1-2.**

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

1. Disable the vehicle. **See Disabling the Vehicle on page 1-3.**
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 12-47, Page 12-55)**.
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.

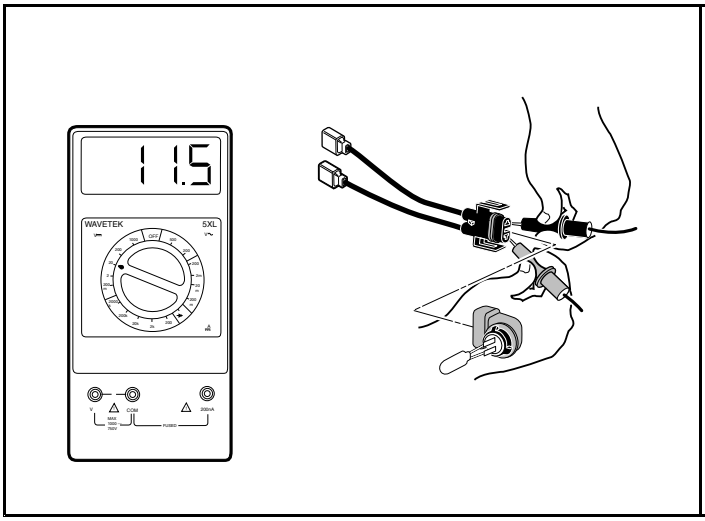
6.2. Use an alligator clip to attach the black (–) probe onto the negative (–) battery terminal and place the red (+) probe into the blue wire terminal of the wire harness. If the multimeter reading is approximately 12 volts, the blue wire has continuity.

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.

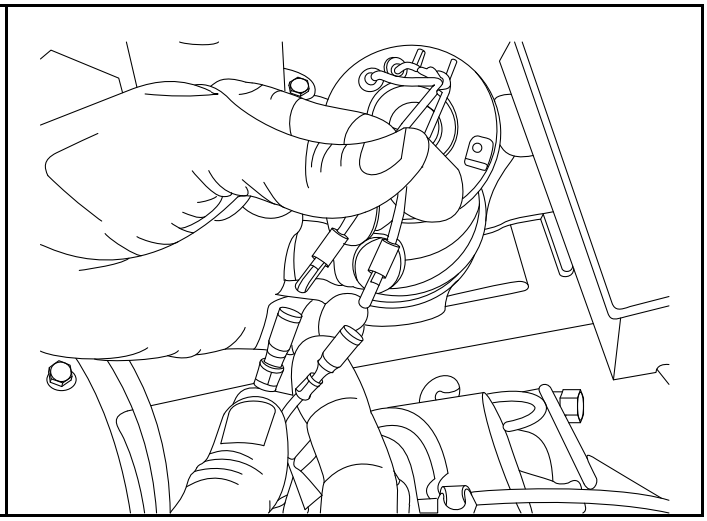
7.2. Place the black (–) probe of multimeter into the black wire (w13) terminal of the wire harness and use an alligator clip to attach the red (+) probe onto the positive (+) battery terminal. If the multimeter reading is approximately 12 volts, the black wire has continuity.

8. If the readings are correct in all of the previous steps, replace the headlight bulb.




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**Figure 12-47 Voltage At Headlight Socket**



2101

**Figure 12-48 Bed Lift Motor Wires**

## TEST PROCEDURE 39 – Bed Lift Motor

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

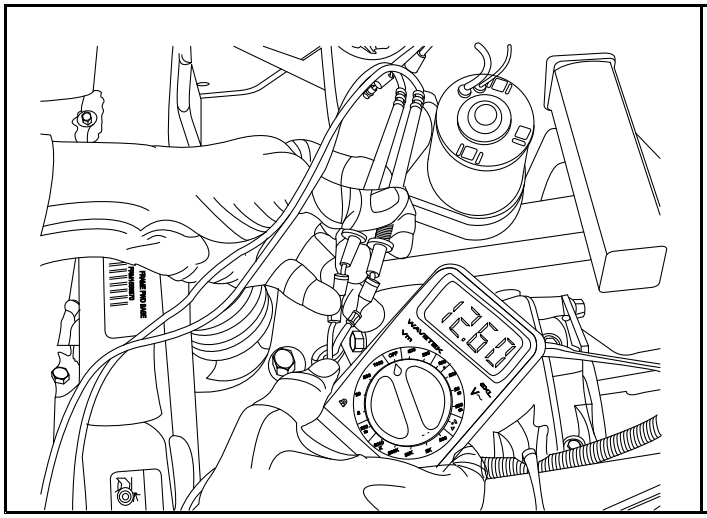
*Ensure that the battery is fully-charged before performing this test procedure.*

1. Disable the vehicle. **See Disabling the Vehicle on page 1-3.**
2. Disconnect the red and yellow wires from the bed lift motor **(Figure 12-48, Page 12-55)**.
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 12-49, Page 12-56)**.
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 - Main Harness Style A on page 12-10.**
   – 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 12-50, Page 12-56)**.
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.

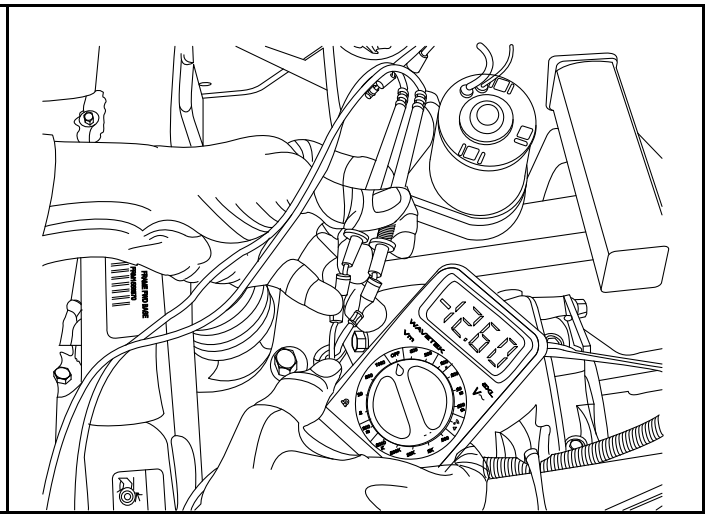
– A reading of approximately + (positive) 12 VDC indicates that the bed lift harness or switch are wired incorrectly. Check the wiring of the bed lift harness and bed lift switch. **See Wiring Diagram - Main Harness Style A on page 12-10.**

– 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.**



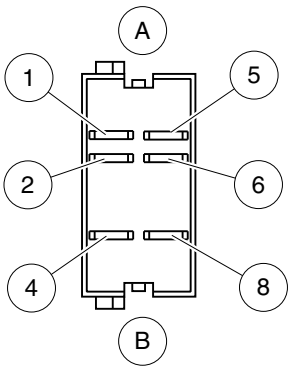

2102
**Figure 12-49 Bed Lift Motor Voltage Reading with Switch in UP position**




2103
**Figure 12-50 Bed Lift Motor Voltage Reading with Switch in DOWN position**

## TEST PROCEDURE 40 – Bed Lift Switch

1. Remove the bed lift switch. **See Bed Lift Switch Removal on page 13-8.**
2. Check continuity between the terminals **(Figure 12-51, Page 12-57)** 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 on page 13-9.**




A. Up Position B. Down Position

Terminal:

1. #14 Black w2 2. #14 Red w3 4. #14 Red w7 5. #14 Red w7 6. #14 Yellow w5 8. #14 Black w2

2104

**Figure 12-51 Bed Lift Switch Terminals (Rear View)**

| 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 41 – Bed Lift Circuit Breaker

1. Remove the bed lift circuit breaker. **See Bed Lift Circuit Breaker Removal on page 13-9.**
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 on page 13-9.**

## ⚠ DANGER

- **See General Warnings, Section 1, Page 1-2.**

## ⚠ WARNING

- **See General Warnings, Section 1, Page 1-2.**

## STARTER AND STARTER SOLENOID

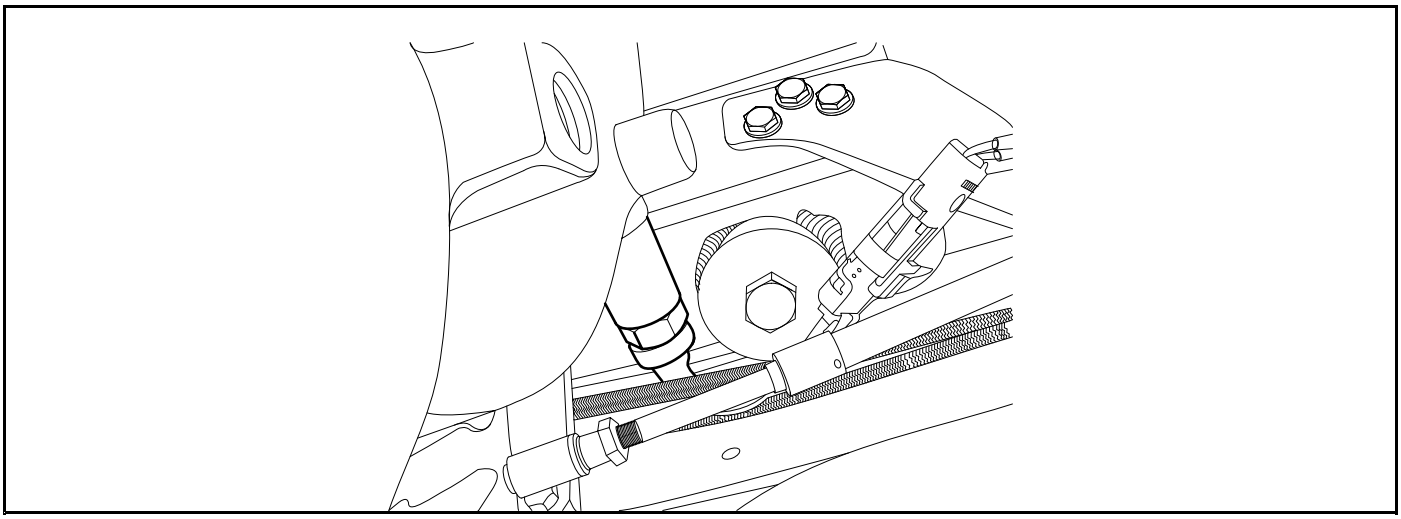
**See General Warnings, Section 1, Page 1-2.**

**Refer to the engine manual for testing, removal, disassembly, and installation procedures. See the Kawasaki FH680D engine manual.**

## NEUTRAL SWITCH

**See General Warnings, Section 1, Page 1-2.**

The neutral switch (1) is located on the transmission housing **(Figure 13-1, Page 13-1)**.



2135

**Figure 13-1 Neutral Switch**

### TESTING THE NEUTRAL SWITCH

**See Test Procedure 20 – Neutral Switch (Transmission) on page 12-40.**

### NEUTRAL SWITCH REMOVAL

1. Disable the vehicle. **See Disabling the Vehicle on page 1-3.**
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 battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

# FUEL SOLENOID

**See General Warnings, Section 1, Page 1-2.**

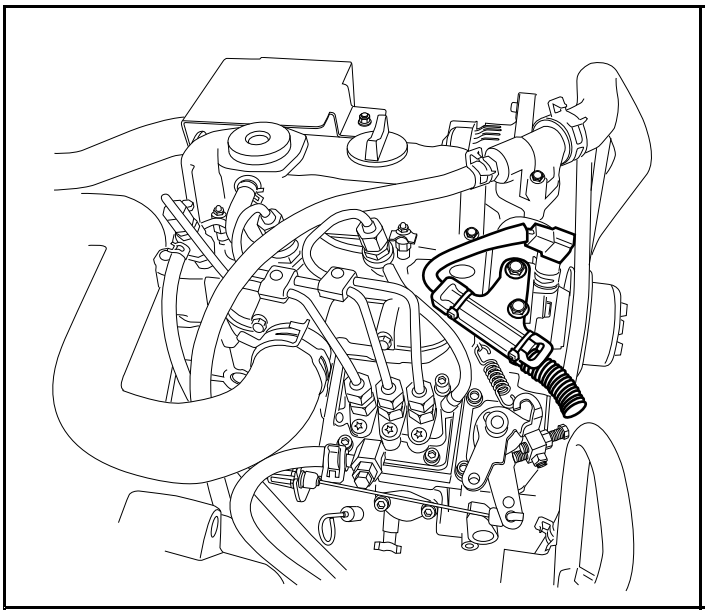
The fuel solenoid is mounted to the passenger-side of the engine block at the front of the injector pump.

## TESTING THE FUEL SOLENOID

**See Test Procedure 30 – Fuel Solenoid Pull Coil Circuit on page 12-48. See also Test Procedure 31 – Fuel Solenoid Hold Coil Circuit on page 12-48.**

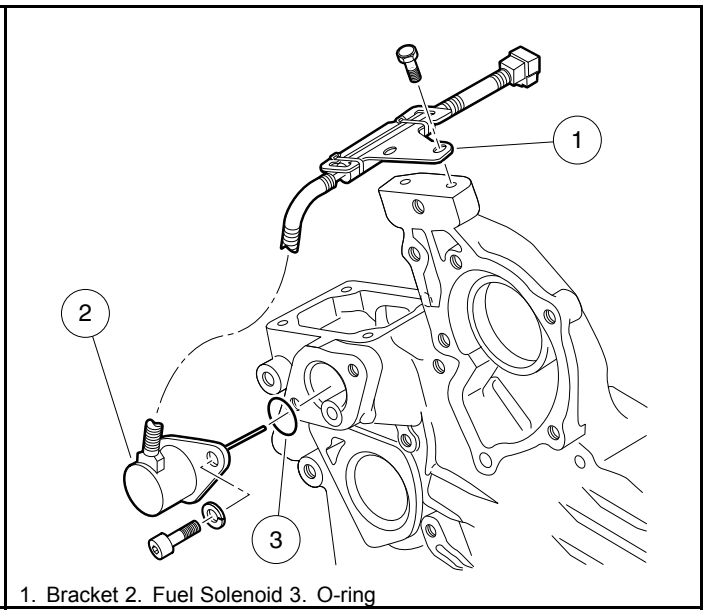
## FUEL SOLENOID REMOVAL

1. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Disconnect the three-pin connector between the fuel solenoid and the wire harness **(Figure 13-2, Page 13-3)**.
3. 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 13-3, Page 13-3)**.



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**Figure 13-2 Fuel Solenoid Three-Pin Connector**




1. Bracket 2. Fuel Solenoid 3. O-ring

2137

**Figure 13-3 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 13-3, Page 13-3)**.
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 13-2, Page 13-3)**.
4. Connect battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

# 60-AMP FUSIBLE LINK

**See General Warnings, Section 1, Page 1-2.**

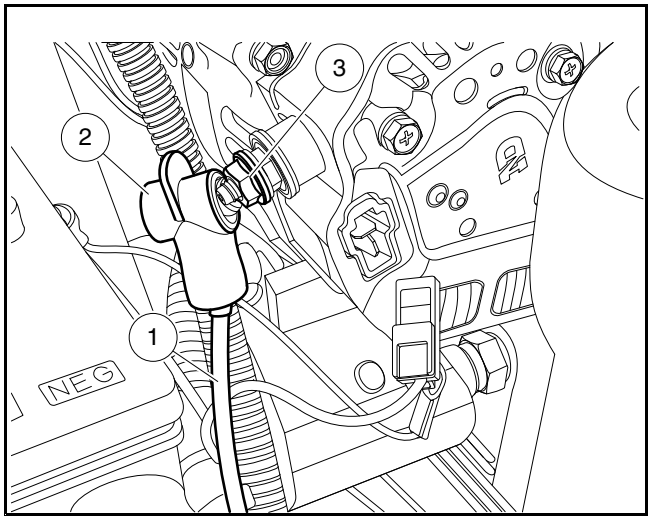
## TESTING THE 60-AMP FUSIBLE LINK

**See Test Procedure 25 – 60-Amp Fusible Link on page 12-43.**

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. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Move the terminal cover (2) and remove the nut (3) that secures the fusible link wire assembly (1) to the alternator **(Figure 13-4, Page 13-4)**.




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**Figure 13-4 60-Amp Fusible Link**

3. Cut the wire ties necessary to free the nearly 6 inches (150 mm) of fusible link wire assembly (1) that runs through the harness.
4. Remove the nut and lock washer that secures the red wires to the starter solenoid and pull the fusible link wire assembly (1) from vehicle and discard.

## 60-AMP FUSIBLE LINK INSTALLATION

1. Attach the red end of the fusible link wire assembly (1) 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 (1) to the alternator and secure with nut (3) **(Figure 13-4, Page 13-4)**. Tighten the nut to 84 in-lb (9.5 N·m) and move the terminal cover (2) over the connection.
3. Push the fusible link wire assembly into the harness and secure with new wire ties.
4. Connect battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

# WARNING LIGHTS

**See General Warnings, Section 1, Page 1-2.**

## TESTING THE WARNING LIGHTS

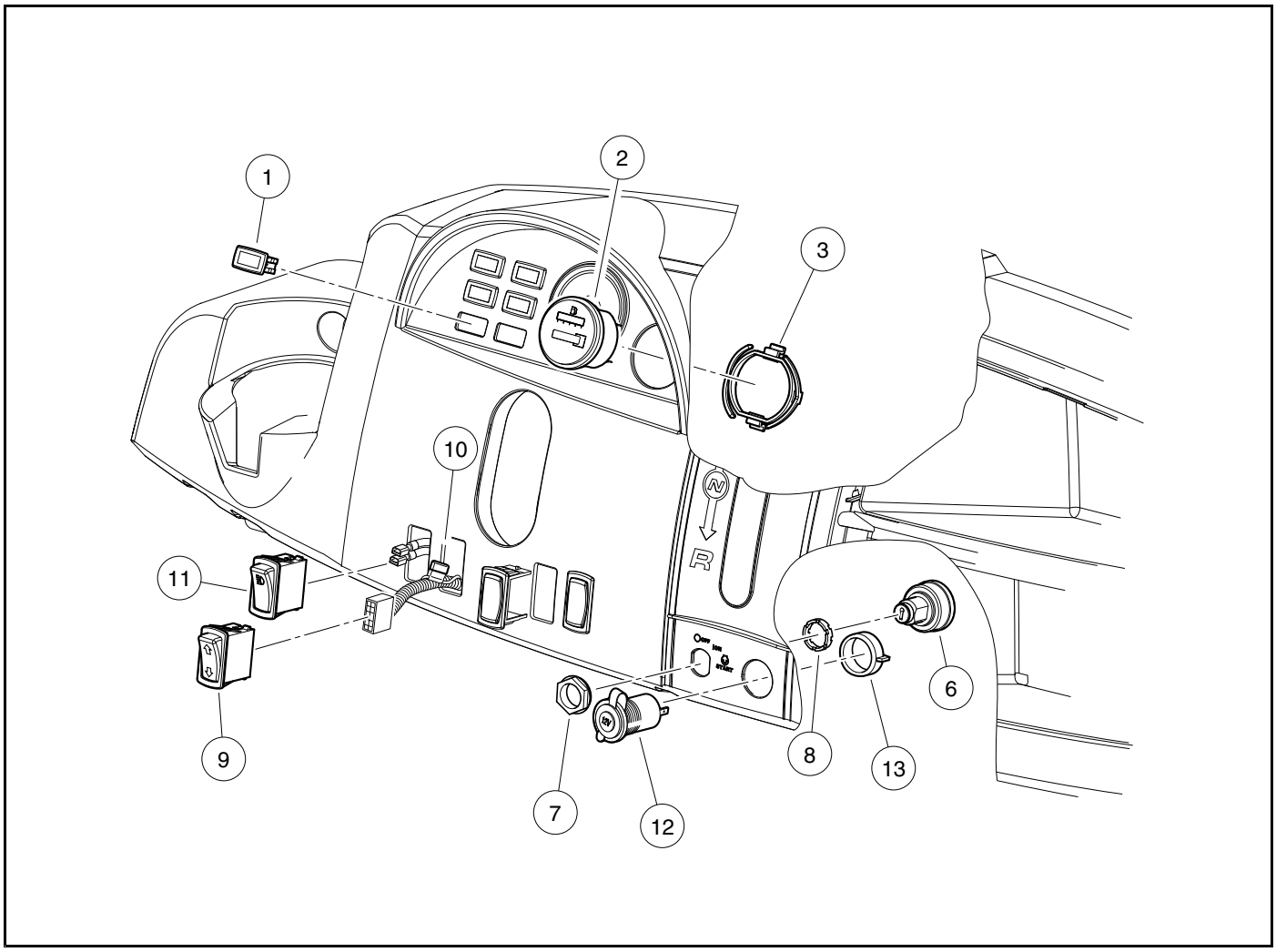
**See Test Procedure 26 – Coolant Temperature Warning Light Circuit on page 12-44. Also see Test Procedure 32 – Low Oil Warning Light Circuit on page 12-49.**

## WARNING LIGHT REMOVAL

1. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Raise the hood.
3. Disconnect the wires from the warning light (1) **(Figure 13-5, Page 13-6)**.
4. 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 13-5, Page 13-6)**.
2. Reconnect the wires from the wire harness to the warning light.
3. Lower and secure the hood.
4. Connect battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**




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**Figure 13-5 Instrument Panel Electrical Components**

# FUEL GAUGE/HOUR METER

**See General Warnings, Section 1, Page 1-2.**

## TESTING THE FUEL GAUGE/HOUR METER

**See Test Procedure 35 – Fuel Gauge on page 12-52. Also see Test Procedure 36 – Hour Meter on page 12-53.**

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. 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 blinks.

### FUEL GAUGE/HOUR METER REMOVAL

1. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Raise the hood.
3. Disconnect the wires from the fuel gauge/hour meter (2) **(Figure 13-5, Page 13-6)**.
4. Remove the mounting clip (3) 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 13-5, Page 13-6)**.
2. Force the mounting clip (3) 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 - Main Harness Style A on page 12-10.**
4. Coat the terminals with Battery Terminal Protector Spray.
5. Lower and secure the hood.
6. Connect battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

## KEY SWITCH

**See General Warnings, Section 1, Page 1-2.**

### TESTING THE KEY SWITCH

**See Test Procedure 4 – Key Switch (Starter Circuit) on page 12-16. Also see Test Procedure 5 – Key Switch (ON Position) on page 12-17 and Test Procedure 6 – Key Switch (Glow Plug Circuit) on page 12-18.**

### 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 battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
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 13-5, Page 13-6)**. 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 battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

# 12-VOLT ACCESSORY RECEPTACLE

**See General Warnings, Section 1, Page 1-2.**

## TESTING THE 12-VOLT ACCESSORY RECEPTACLE

**See Test Procedure 33 – 12-Volt Accessory Receptacle on page 12-49.**

## 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 battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
3. Raise the hood.
4. From under the hood, disconnect the wires from the accessory receptacle (12) **(Figure 13-5, Page 13-6)**.
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 battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

# BED LIFT SWITCH

## TESTING THE BED LIFT SWITCH

**See Test Procedure 40 – Bed Lift Switch on page 12-56.**

## BED LIFT SWITCH REMOVAL

1. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Raise the hood.
3. Press the upper and lower retaining tabs and push the bed lift switch (9) out of the instrument panel **(Figure 13-5, Page 13-6)**.
4. 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 battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

## BED LIFT CIRCUIT BREAKER

### TESTING THE BED LIFT CIRCUIT BREAKER

**See Test Procedure 41 – Bed Lift Circuit Breaker on page 12-58.**

### BED LIFT CIRCUIT BREAKER REMOVAL

1. Push the bed lift switch (9) out of the instrument panel. **See Bed Lift Switch Removal on page 13-8.**
2. Locate the bed lift circuit breaker (10) on the orange wire of the wire harness connected to the switch **(Figure 13-5, Page 13-6)**.
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 Warnings, Section 1, Page 1-2.**

### TESTING THE LIGHT SWITCH

**See Test Procedure 37 – Light Switch on page 12-53.**

### LIGHT SWITCH REMOVAL

1. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Raise the hood.
3. Press the upper and lower retaining tabs and push the light switch (11) out of the instrument panel **(Figure 13-5, Page 13-6)**.
4. 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 battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

## FUSE

**See General Warnings, Section 1, Page 1-2.**

### ⚠ WARNING

- **Failure to use properly rated fuse can result in a fire hazard.**

### TESTING THE FUSE

**See Test Procedure 2 – Fuse on page 12-15.**

### FUSE REMOVAL

1. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Remove the electrical component cover (located near the battery).
3. 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 battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

## REVERSE WARNING BUZZER (IF EQUIPPED)

**See General Warnings, Section 1, Page 1-2.**

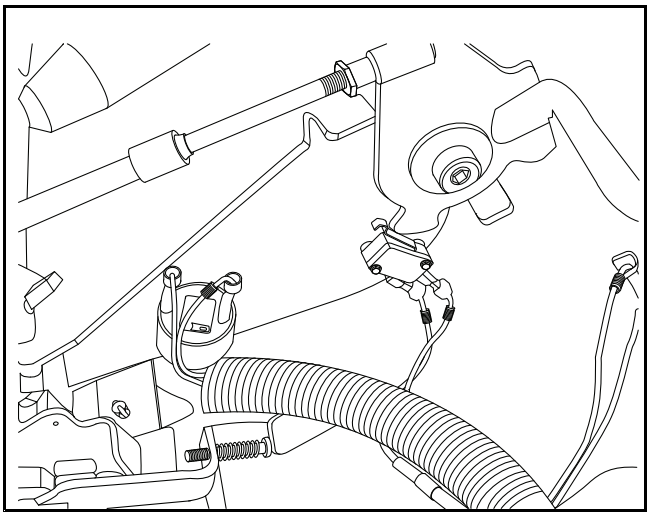
### TESTING THE REVERSE WARNING BUZZER

**See Test Procedure 29 – Reverse Warning Buzzer (If Equipped) on page 12-47.**

### REVERSE WARNING BUZZER REMOVAL

1. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Raise the hood.

3. Remove the plastic rivets securing the reverse warning buzzer and remove the reverse warning buzzer **(Figure 13-6, Page 13-11)**.



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**Figure 13-6 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 battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

## REVERSE WARNING BUZZER LIMIT SWITCH (IF EQUIPPED)

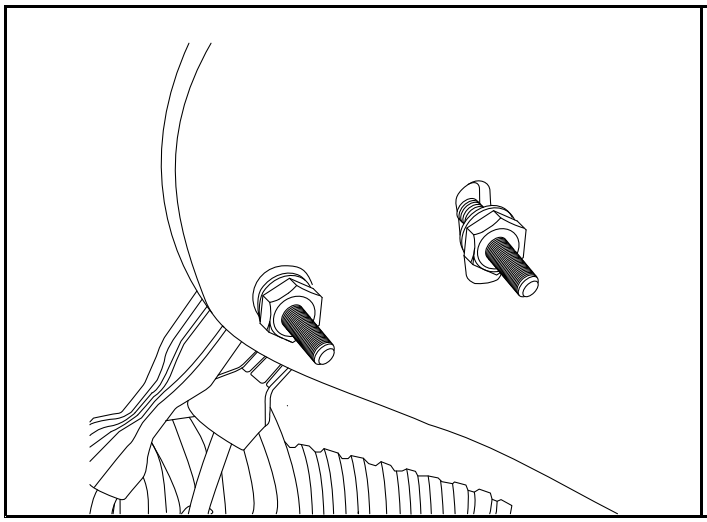
**See General Warnings, Section 1, Page 1-2.**

### TESTING THE REVERSE WARNING BUZZER LIMIT SWITCH

**See Test Procedure 28 – Reverse Warning Buzzer Limit Switch (If Equipped) on page 12-46.**

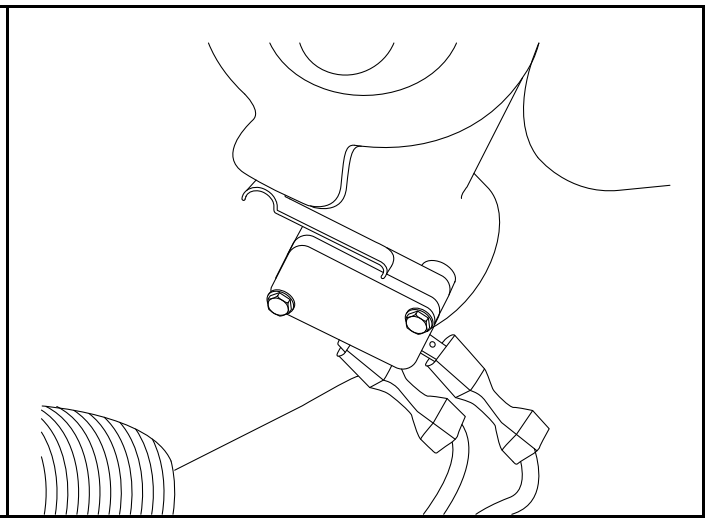
### REVERSE WARNING BUZZER LIMIT SWITCH REMOVAL

1. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Raise the hood.
3. Disconnect the wires from the reverse warning buzzer limit switch **(Figure 13-6, Page 13-11)**.
4. Remove the screws, nuts, washers, and lockwashers that secure the limit switch.
5. Remove the limit switch.



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**Figure 13-7 Reverse Warning Buzzer Limit Switch Adjustment Slot**



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**Figure 13-8 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 13-7, Page 13-12)**.
4. Rotate the limit switch so that the lobe on the Forward/Reverse handle activates the limit switch as shown **(Figure 13-8, Page 13-12)**.
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 battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**
10. Turn the key switch to the ON position. With the Forward/Reverse handle in REVERSE, the buzzer should sound.

## FRONT DIFFERENTIAL LIMIT SWITCH

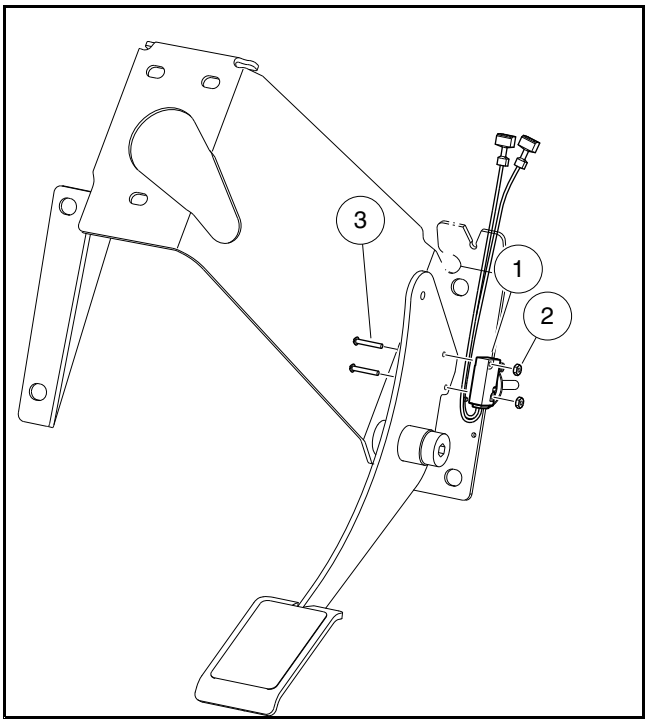
**See General Warnings, Section 1, Page 1-2.**

## TESTING THE FRONT DIFFERENTIAL LIMIT SWITCH

**See Test Procedure 22 – Front Differential Limit Switch on page 12-41.**

## FRONT DIFFERENTIAL LIMIT SWITCH REMOVAL

1. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Locate front differential limit switch above accelerator pedal.
3. Disconnect wire leads of switch (1) from wire harness **(Figure 13-9, Page 13-13)**.
4. Remove the nuts (2) and screws (3) that secure the switch (1) and remove the switch.




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**Figure 13-9 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 13-9, Page 13-13)**. **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 wire leads of switch to wire harness.
4. Connect battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

# FUEL LEVEL SENDING UNIT

**See General Warnings, Section 1, Page 1-2.**

Thoroughly test the fuel level sending unit before replacing the unit.

## TESTING THE FUEL LEVEL SENDING UNIT

**See Test Procedure 34 – Fuel Level Sending Unit on page 12-51.**

## FUEL LEVEL SENDING UNIT REMOVAL

**See Fuel Level Sending Unit Removal on page 14-11.**

## FUEL LEVEL SENDING UNIT INSTALLATION

**See Fuel Level Sending Unit Installation on page 14-12.**

# ALTERNATOR

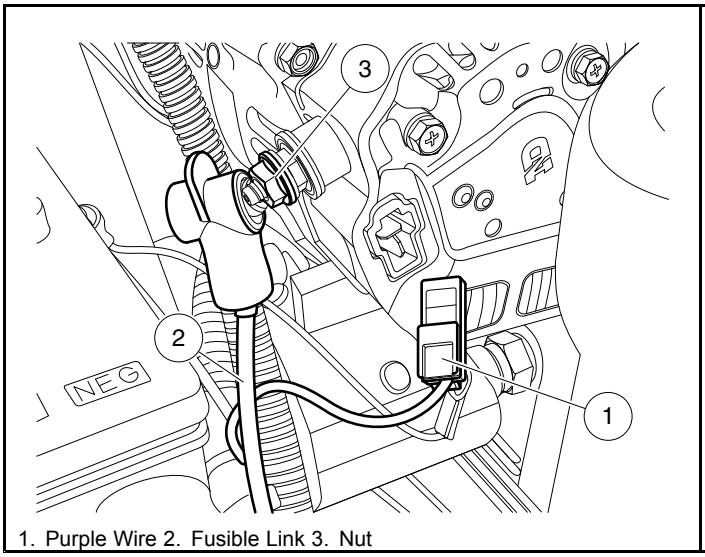
**See General Warnings, Section 1, Page 1-2.**

## TESTING THE ALTERNATOR

**See Test Procedure 24 – Alternator on page 12-43.**

## ALTERNATOR AND V-BELT REMOVAL

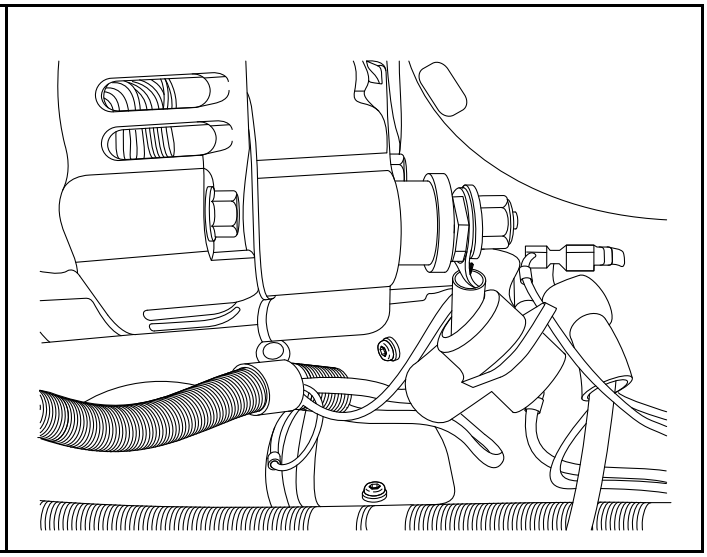
1. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Disconnect the 18-gauge purple wire from the alternator **(Figure 13-10, Page 13-15)**.
3. Disconnect the 12-gauge blue fusible link from the alternator **(Figure 13-10, Page 13-15) (Figure 13-11, Page 13-15)**.




1. Purple Wire 2. Fusible Link 3. Nut

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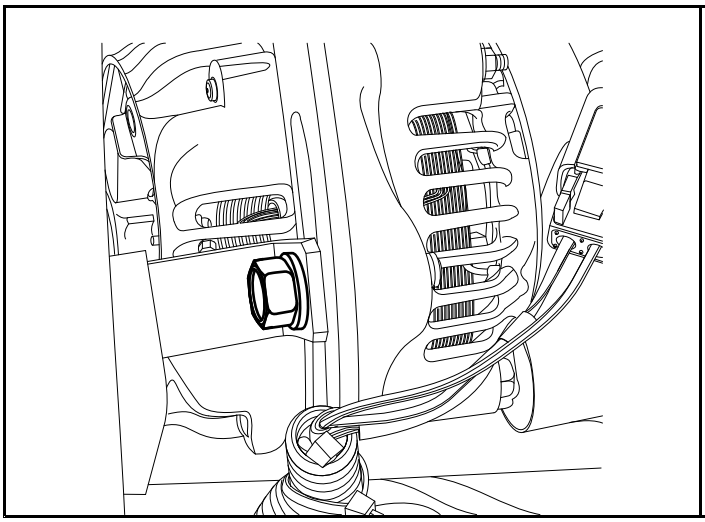
**Figure 13-10 18-Gauge Purple Wire and 12-Gauge Blue Fusible Link at Alternator (60 Amp Shown)**



2144

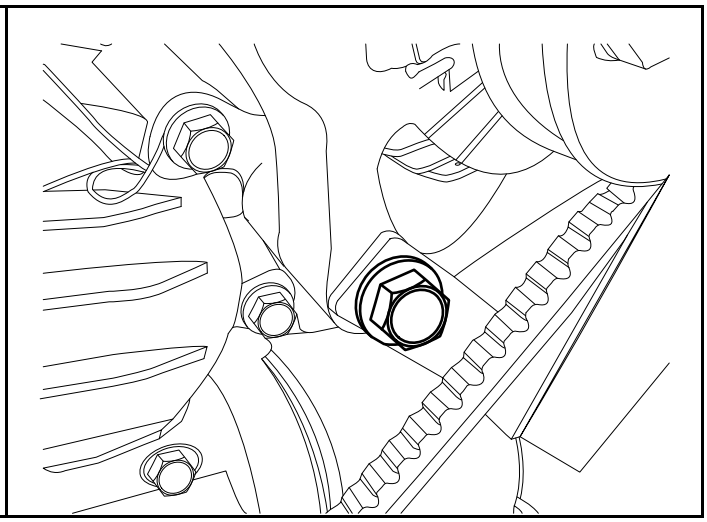
**Figure 13-11 12-Gauge Blue Fusible Link at Alternator (40 Amp Shown)**

4. Loosen and remove the belt tension adjustment bolt at the top of the alternator **(Figure 13-12, Page 13-15)**.
5. Loosen and remove the alternator mounting bolt at the bottom of the alternator **(Figure 13-13, Page 13-15)**.
6. Remove the belt shield and the alternator from the engine compartment.
7. If necessary, remove the V-belt.



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**Figure 13-12 Belt Tension Adjustment Bolt**



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**Figure 13-13 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 13-13, Page 13-15)**. 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 13-12, Page 13-15)**. 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 13-12, Page 13-15)**.
6. Tighten the alternator mounting bolt to 19.0 ft-lb (25.8 N·m) **(Figure 13-13, Page 13-15)**. **See following CAUTION.**

## CAUTION

- **Remove pry bar before starting engine.**

7. Connect the 12-gauge blue fusible link to the alternator **(Figure 13-11, Page 13-15)**. Tighten the nut to 84 in-lb (9.5 N·m).
8. Connect the 18-gauge purple wire to the alternator **(Figure 13-10, Page 13-15)**.
9. Connect battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

# OIL PRESSURE SENSOR

**See General Warnings, Section 1, Page 1-2.**

**Refer to the engine manual for testing, removal, disassembly, and installation procedures. See the Kawasaki FH680D engine manual.**

# HEADLIGHTS

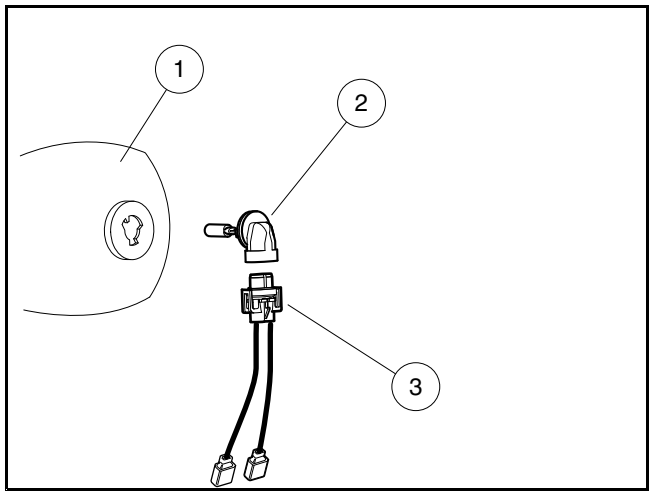
**See General Warnings, Section 1, Page 1-2.**

## TESTING THE HEADLIGHT BULB AND SOCKET

**See Test Procedure 38 – Voltage at Headlight Socket on page 12-54. See also Test Procedure 37 – Light Switch on page 12-53.**

## HEADLIGHT BULB REMOVAL

1. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. From the front of the vehicle, reach under the cowl and turn the connector harness/halogen bulb assembly clockwise one-quarter turn **(Figure 13-14, Page 13-17)**.
3. Remove the connector harness/halogen bulb assembly from the headlight lens (1).
4. Lift the retaining tabs on the connector (3) and remove the halogen bulb (2).




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**Figure 13-14 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 13-14, Page 13-17)**.

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 battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

## THERMOSTAT SWITCH

**See General Warnings, Section 1, Page 1-2.**

### TESTING THE THERMOSTAT SWITCH

**See Test Procedure 12 – Thermostat Switch on page 12-29.**

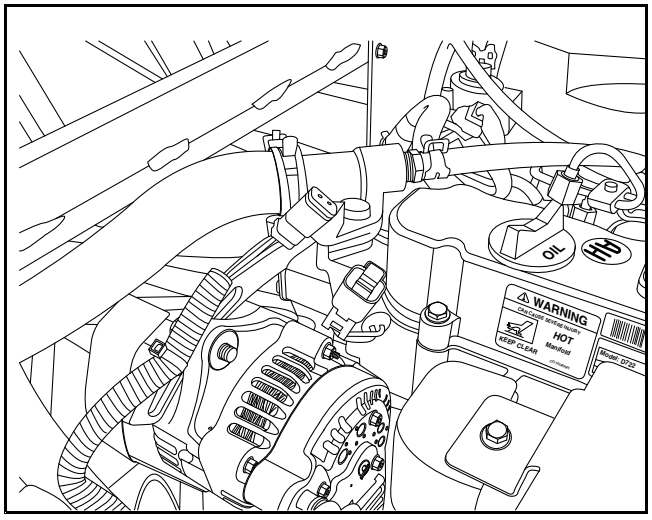
### THERMOSTAT SWITCH REMOVAL

1. Disable the vehicle. **See Disabling the Vehicle on page 1-3.**
2. Disconnect the two-pin connector between the thermostat switch and the wire harness **(Figure 13-15, Page 13-18)**. **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.**




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**Figure 13-15 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 11, Page 11-19.**
5. Connect battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

# FAN

**See General Warnings, Section 1, Page 1-2.**

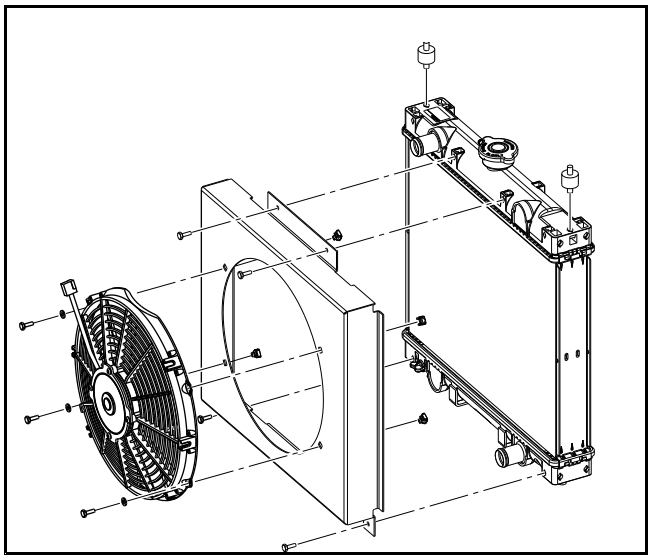
## TESTING THE FAN MOTOR

**See Test Procedure 13 – Fan Motor on page 12-31.**

## FAN REMOVAL

1. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Raise the hood.
3. Disconnect the two-pin connector between the fan motor and wire harness **(Figure 13-16, Page 13-20)**.
4. 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 13-16, Page 13-20)**. **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.*



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**Figure 13-16 Fan and Shroud**

### 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 13-16, Page 13-20)**.
3. Lower and secure the hood.
4. Connect battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

## WIRE HARNESS DIODES

**See General Warnings, Section 1, Page 1-2.**

The wire harness is equipped with several in-line diodes.

### TESTING THE WIRE HARNESS DIODES

**See Test Procedure 14 – Wire Harness Diodes on page 12-34.**

### WIRE HARNESS DIODE REMOVAL

1. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Locate the diode to be replaced by removing the wire conduit and tracing the wire.
3. 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.
4. 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 battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

# BATTERY

**See General Warnings, Section 1, Page 1-2.**

## ⚠ 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 a 12-volt battery. 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 26, top-post battery, 525 CCA at 0 °F (-17.8 °C) and a reserve capacity of at least 85 minutes. The group 26 classification indicates battery size: 8 inches W x 6-3/4 inches D x 7 inches H (20.8 cm W x 17.3 cm D x 19.7 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 – Battery on page 12-13.**

## 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 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 13-22.**
3. Check the battery periodically to ensure that it is in a full state of charge. **See Charging the Battery on page 13-23.**
4. Keep the battery hold-down clamp tight. **See Vibration Damage on page 13-22.**

## 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 13-23.**

## 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.

## BATTERY REMOVAL

**See General Warnings on page 1-2.**

1. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Remove the driver-side seat.
3. Remove the battery hold-down located on the bottom of the battery.
4. 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

**Also see DANGER at beginning of Battery topic.**

1. Charge the battery using an automotive type 12-volt battery charger. Follow all warnings and procedures supplied by the battery charger manufacturer.
2. Attach the positive (+) charger cable to the positive (+) battery post.
3. Attach the negative (–) charger cable to the negative (–) battery post.
4. The battery may be charged with a slow charge (3 to 10 amps) or a fast charge (20 to 30 amps). Charge until the battery voltage is greater than 12.4 volts. **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 Warnings on page 1-2.**

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 battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

## BATTERY STORAGE

**See General Warnings on page 1-2.**

1. Keep the battery clean and free of corrosion.
2. The battery cables should be disconnected from the battery so the battery can be connected to the charger. The battery can be left in the vehicle. Disconnect the negative (–) cable first.
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 voltage drops below 12.4 volts, 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 for state of charge every month. 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 Warnings on page 1-2.**

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.**

# PARK BRAKE LIMIT SWITCH

## PARK BRAKE LIMIT SWITCH REMOVAL

1. Disable the vehicle.
2. Unlatch, raise, and securely prop open the hood.
3. Disconnect the wires from the park brake limit switch (1) **(Figure 13-17)**.

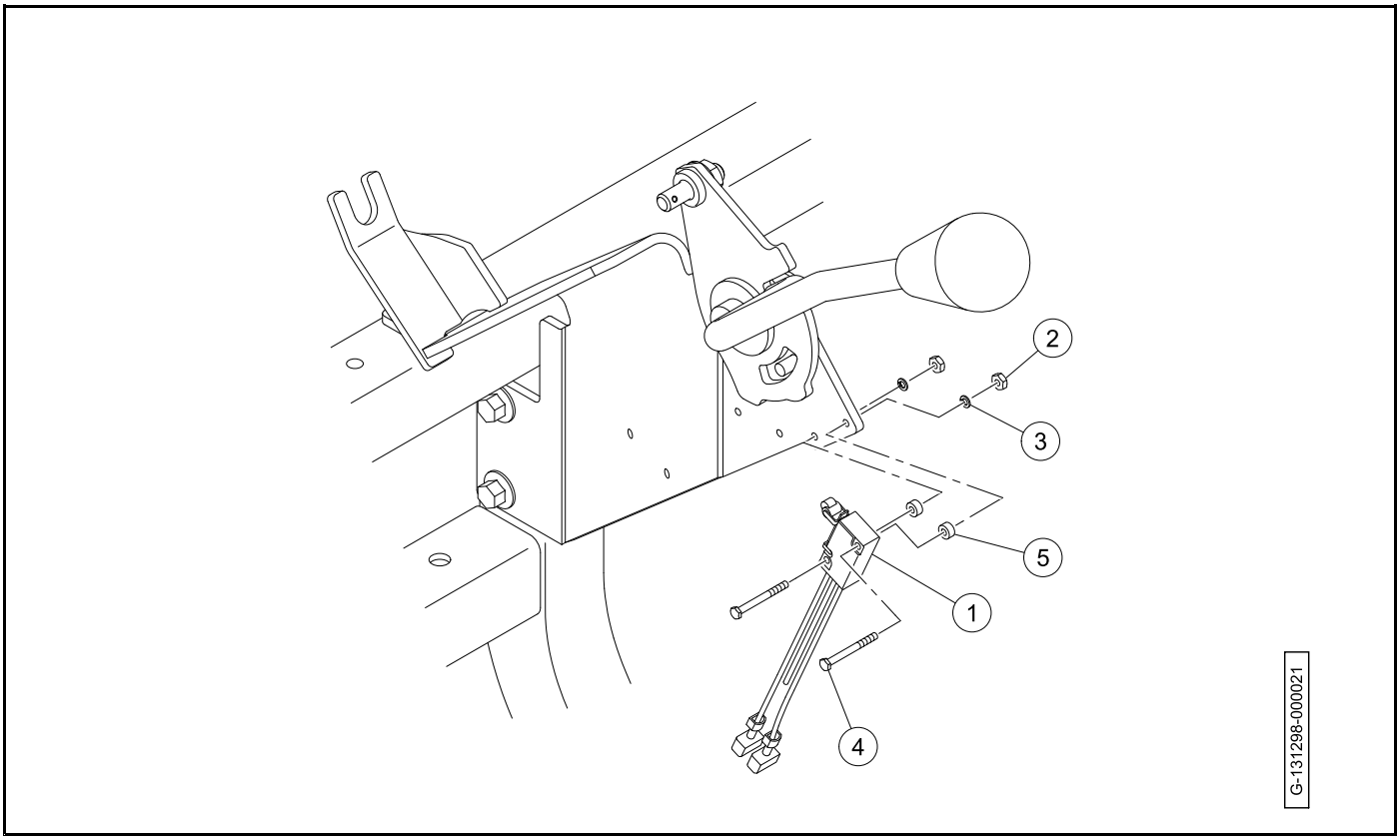



**Figure 13-17**

4. Remove the nuts (2) and washers (3).
5. Remove the bolts (4), park brake limit switch, and lock washers (5).

## PARK BRAKE LIMIT SWITCH INSTALLATION

1. Install the lock washers (5), park brake limit switch (1), and bolts (4) **(Figure 13-17)**.
2. Install the washers (3) and nuts (2). Tighten the nuts from 3 to 5 lb·in (0.34 to 0.56 N·m).
3. Connect the park brake limit switch red wire to the interlock harness red wire.
4. Connect the park brake limit switch black wire to the interlock harness black wire.

Pagination Page

# SECTION 14 — DIESEL VEHICLE - ENGINE, MUFFLER, FUEL SYSTEM, AND CLUTCHES



## ⚠ DANGER

- **See General Warnings, Section 1, Page 1-2.**

## ⚠ WARNING

- **See General Warnings, Section 1, Page 1-2.**

## DIESEL ENGINE

**See General Warnings, Section 1, Page 1-2.**

***NOTE:*** *During the 2015 Model Year, the Kubota E4B-series diesel engine superseded the E3B-series diesel engine.*

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.**

### ENGINE REMOVAL

**See General Warnings, Section 1, Page 1-2.**

## CAUTION

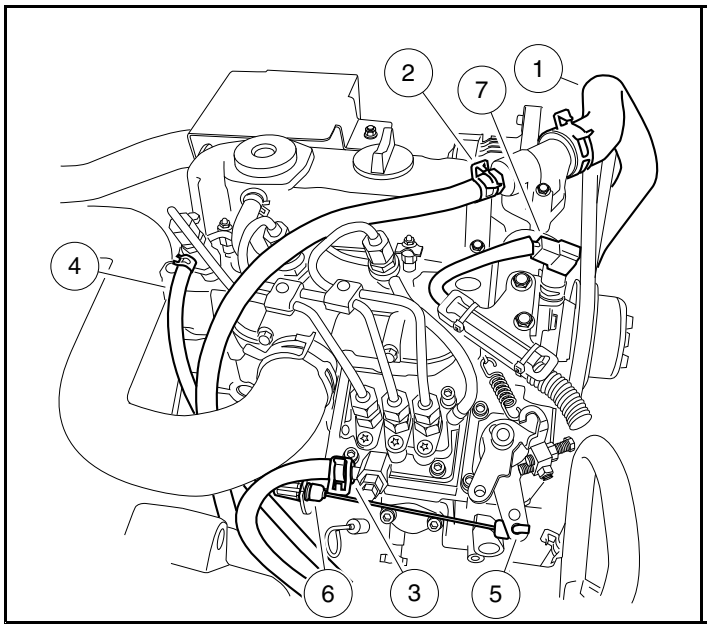
- **Before removal and disassembly, clean the engine.**

1. Remove both seats.
2. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
3. Remove the cargo bed. **See Cargo Bed Removal, Section 4, Page 4-12.**
4. Remove the top of the ROPS (Roll Over Protection Structure). **See ROPS Removal, Section 4, Page 4-7.**
5. Remove the lower rear ROPS bars and seat frame assembly. **See ROPS Removal, Section 4, Page 4-7.**
6. Drain the engine and radiator coolant system. **See Engine Coolant Change, Section 15, Page 15-1.**
7. Release the clamps securing the upper (1) and lower coolant hoses to the engine and remove hoses.
8. Release the clamp securing the coolant overflow/bypass hose (2) to the thermostat cover and remove hose.
9. Remove the fuel supply line (3) at the engine fuel injection pump (vehicles with electric fuel pump) or engine mounted fuel pump (vehicles with mechanical fuel pump) and securely plug the fuel supply line **(Figure 14-1, Page 14-2)**. **See following DANGER.**

## ⚠ DANGER

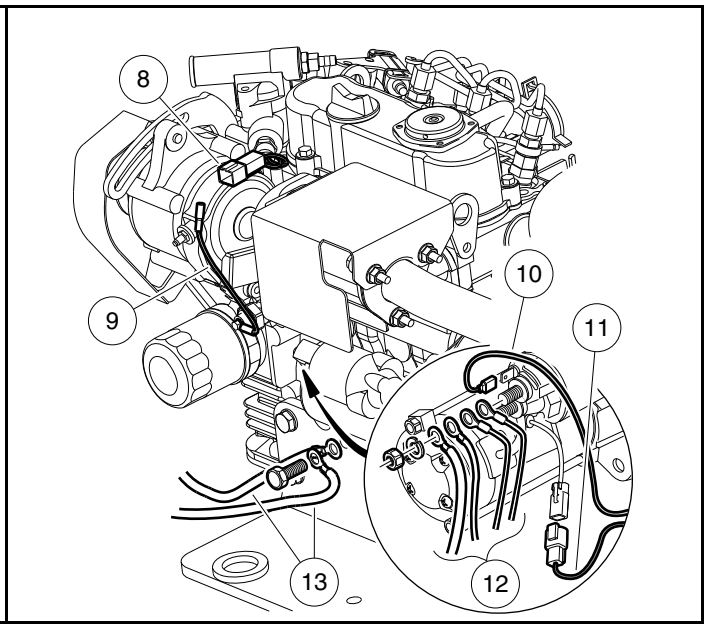
- **The diesel fuel tank does not have a fuel line valve. When the fuel line is removed from the engine, fuel can siphon fuel from the tank if the fuel line rests below the fuel level in the fuel tank. Securely cap or plug the fuel line immediately after it is removed from the fuel injector to prevent fuel leakage.**

- **Diesel fuel! Flammable! Explosive! Do not smoke. Keep sparks and flames away from the vehicle and service area.**




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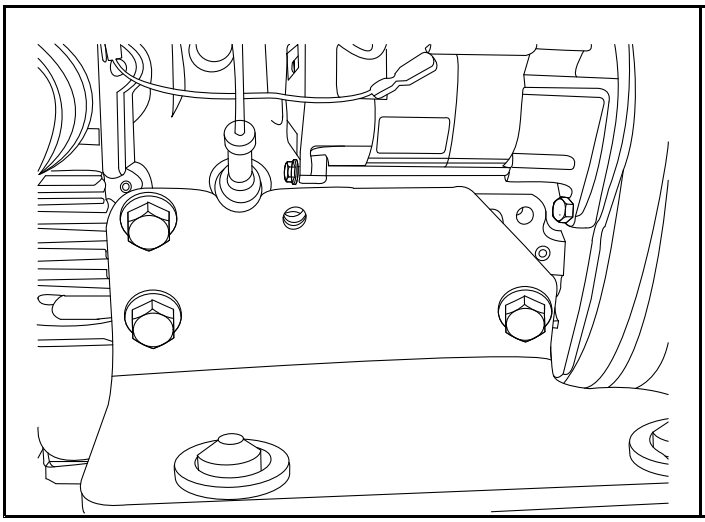
**Figure 14-1 Disconnect Coolant Hoses, Fuel Lines, Accelerator Cable and Fuel Solenoid Valve Connector**




2178

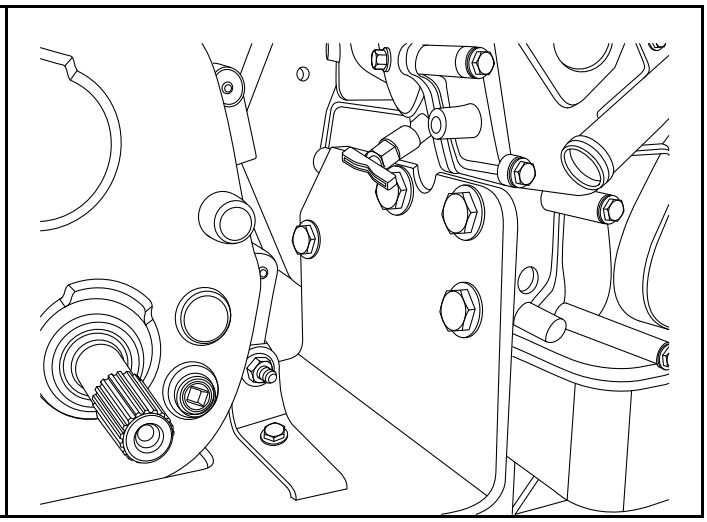
**Figure 14-2 Disconnect Thermostat Switch, Starter Wires and Ground Wires**

10. Remove the fuel return line (4) at the engine relief valve port and securely plug the fuel return line **(Figure 14-1, Page 14-2)**. **See previous DANGER.**
11. Remove the accelerator cable (5) from the accelerator lever **(Figure 14-1, Page 14-2)**.
12. Remove the accelerator cable sheath strain relief (6) from the engine bracket.
13. Disconnect the three-pin connector (7) on the fuel solenoid valve from the engine **(Figure 14-1, Page 14-2)**.
14. Disconnect the thermostat switch connector (8) from the wire harness **(Figure 14-2, Page 14-2)**.
15. Disconnect the oil pressure switch connector (9) from the wire harness.
16. 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 14-2, Page 14-2)**.
17. Disconnect the red wires (12) from the starter solenoid.
18. Disconnect the two black ground wires (13) from the engine block.
19. Disconnect the air filter outlet hose from the intake manifold.
20. Loosen the hardware that secures the muffler. **See Muffler Removal on page 14-5.**



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**Figure 14-3 Driver Side Diesel Engine Mount**



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**Figure 14-4 Passenger Side Diesel Engine Mount**

21. 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 14-6.**
22. Remove the clutch outer cover. **See Clutch Outer Cover Removal on page 14-31.**
23. Remove the drive belt. **See Drive Belt Installation on page 14-24.**
24. Remove the clutches. **See Drive Clutch Removal on page 14-25.** Also see Driven Clutch Removal on page 14-28
25. Remove the clutch inner cover. **See Clutch Inner Cover Removal on page 14-31.**
26. Remove the engine mounting hardware **(Figures 14-3 and 14-4, Page 14-3)**. **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.*

27. Use the engine lift tabs on top of the engine to lift the engine from the mounting plate.
28. If replacing engine, remove cvt adapter shaft from flywheel and retain for use on replacement engine.

## ENGINE INSTALLATION

**See General Warnings, Section 1, Page 1-2.**

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 14-3, Page 14-3)**. **Also see Figure 14-4, Page 14-3.**
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 14-32.**
5. Install the clutches. **See Drive Clutch Installation on page 14-28. Also see Driven Clutch Installation on page 14-30.**
6. Install the drive belt. **See Drive Belt Installation on page 14-24.**
7. Install the clutch outer cover. **See Clutch Outer Cover Installation on page 14-31.**

8. Using new gasket, slide exhaust system forward and secure the manifold pipe to the exhaust manifold. **See Manifold Pipe Installation on page 14-6.**
9. Tighten the hardware that secures the muffler. **See Muffler Installation on page 14-6.**
10. Attach the air filter outlet hose to the intake manifold.
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 14-2, Page 14-2)**.
14. Connect the oil pressure switch connector (9) to the wire harness.
15. Connect the thermostat switch connector (8) to the wire harness **(Figure 14-2, Page 14-2)**.
16. Connect the fuel solenoid valve three-pin connector (7) to the engine **(Figure 14-1, Page 14-2)**.
17. Connect the accelerator cable sheath (6) to the engine bracket **(Figure 14-1, Page 14-2)**.
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 14-1, Page 14-2)**. **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 (vehicles with electric fuel pump) or the engine mounted fuel pump (vehicles with mechanical fuel pump) with a new clamp **(Figure 14-1, Page 14-2)**. **See previous DANGER.**
21. Bleed air from the fuel system, if necessary, and check for leaks. **See Bleeding Air From Fuel System on page 14-9.**
22. Attach the overflow/bypass hose (2) to the thermostat cover and secure with new clamp.
23. Attach the upper (1) and lower radiator hoses to the engine and secure with new clamps.
24. Refill the engine and radiator coolant system. **See Engine Coolant Change, Section 15, Page 15-1.**
25. Install seat frame and lower ROPS (Roll Over Protection Structure). **See Seat Support Installation, Section 4, Page 4-10.**
26. Install the upper ROPS frame. **See ROPS Installation, Section 4, Page 4-8.**
27. Install the cargo bed. **See Cargo Bed Installation, Section 4, Page 4-12.**
28. Check the engine oil level. **See Engine Oil Level Check on page 11-11.**
29. Connect battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**
30. Adjust the engine RPM setting if required. **See Engine RPM Adjustment on page 14-18.**
31. Install both seats.
32. Test-drive the vehicle to ensure all systems are functional and adjusted correctly.

# EXHAUST SYSTEM

## MUFFLER REMOVAL

1. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Loosen the muffler spring suspension bracket bolts.
3. Remove the two springs that secure the muffler inlet to the intermediate pipe **(Figure 14-5, Page 14-5)**. **See following NOTE.**

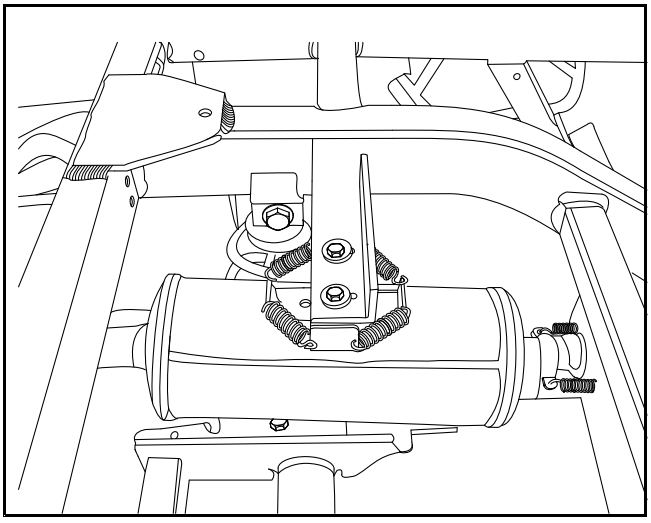
***NOTE:*** *Shift the end of the muffler inlet and intermediate pipe from side to side to relax and disconnect the springs.*

4. 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.*



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**Figure 14-5 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

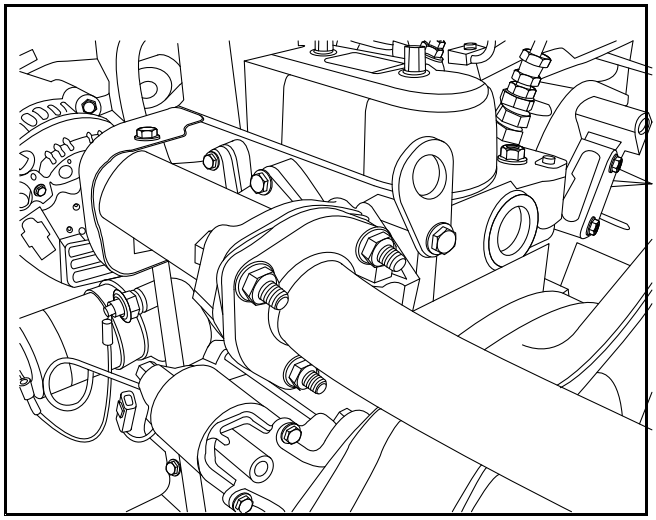
- **Always wear eye protection when springs are removed or installed.**

***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 14-6, Page 14-6)**.
2. Separate the manifold pipe from the engine exhaust manifold.



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**Figure 14-6 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 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 14-6, Page 14-6)**.

## 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.*

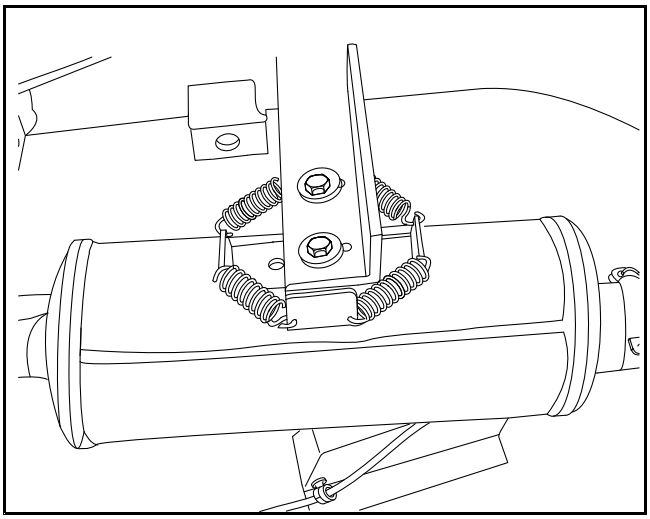
1. Loosely secure the muffler and spring suspension bracket to the chassis with two bolts and large flat washers **(Figure 14-7, Page 14-7)**.
2. Secure the muffler inlet to the intermediate pipe with new springs. **See following WARNING and NOTE.**

## ⚠ 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.**



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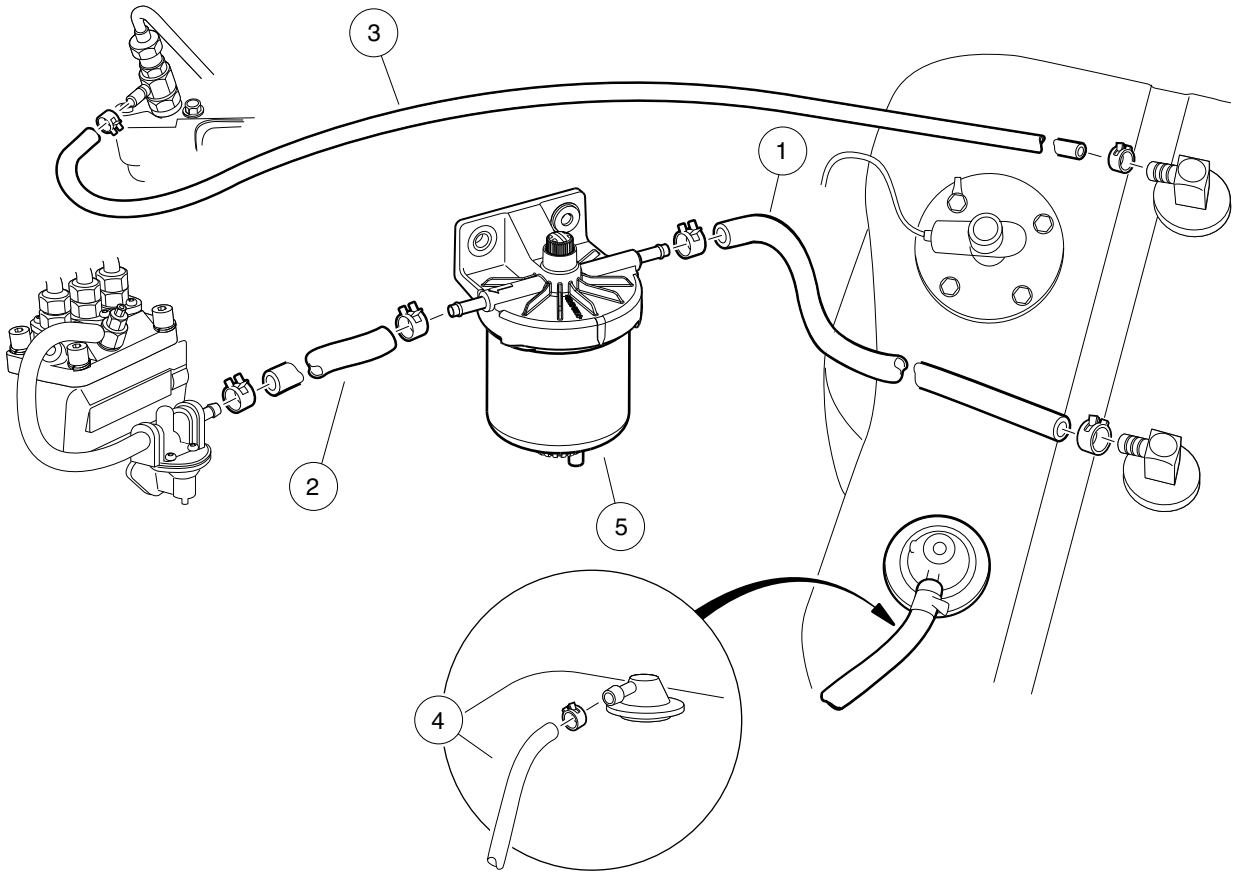
**Figure 14-7 Muffler and Bracket**

4. Connect battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**
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. | DIAMETER Ø | ROUTING | LENGTH | |
|---|---|---|---|---|
| | | | SOLID COLOR | CLEAR |
| 1 | 5/16 in. (8 mm) | Fuel tank to water separator | 23.0 in. (58.4 cm) | |
| 2 | 5/16 in. (8 mm) | Water separator to fuel pump | 13.0 in. (33.0 cm) | |
| 3 | 3/16 in. (5 mm) | Fuel return hose | 29.0 in. (73.5 cm) | |
| 4 | 3/16 in. (5 mm) | Vent tube (fuel tank) | | 22.0 in. (55.8 cm) |
| | | Total: | 36.0 in. (91.4 cm) of ø5/16 in. (8 mm) 29.0 in. (73.5 cm) of ø3/16 in. (5 mm) | 22.0 in. (55.8 cm) |

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**Figure 14-8 Fuel System (Diesel Vehicles)**

## FUEL LINES

**See General Warnings, Section 1, Page 1-2.**

The fuel lines must be properly routed and all hose clamps must be tight **(Figure 14-8, Page 14-8)**. 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.**

## BLEEDING AIR FROM FUEL SYSTEM

**See General Warnings, Section 1, Page 1-2.**

### ⚠ WARNING

- **Do not bleed the fuel system while the engine is hot. Fire could result if fuel contacts hot surfaces.**
- **Diesel fuel under pressure can penetrate skin or eyes, causing serious injury or death. Fuel 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.**

Bleed air from the fuel system in the following circumstances:

- fuel tank runs empty
- after hoses and/or components have been disconnected for service or maintenance
- prior to starting the engine after prolonged storage

Air Bleeding Procedure

1. Fill the fuel tank to the FULL mark.
2. Operate the fuel pump for a few seconds by turning key switch to the START position and hold for a few seconds.
3. Loosen the air vent on top of the fuel filter assembly to allow air bubbles to escape. Tighten vent once bubbling stops.
4. Operate the fuel pump again for a few seconds.
5. Open the air vent on top of the injection pump to allow air bubbles to escape. Tighten vent once bubbling stops.

## FUEL FILTER REPLACEMENT

**See General Warnings, Section 1, Page 1-2.**

The fuel system contains a fuel filter with an integrated water separator **(Figure 14-9, Page 14-10)**. The fuel filter, fuel lines, and the fuel tank vent 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 11-1. See following NOTE.**

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

**Draining Water from Fuel Filter**

Water should be drained from the fuel filter daily. The fuel filter is mounted to the chassis under the passenger-side seat **(Figure 14-9)**.

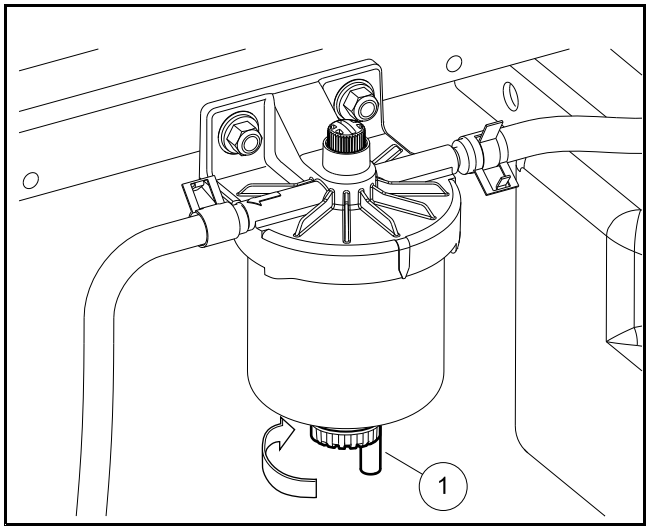
1. Lift the passenger-side seat.
2. Position a pan under the fuel filter.
3. Locate the valve (1) at the bottom of the filter and attach a drain hose to the spout.
4. Turn the valve in the direction shown until water begins to stream from the filter.
5. Drain water into the pan until the fluid changes 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.**

6. Close the valve by rotating it in the opposite direction until the valve is firmly sealed and detach the drain hose. **See following NOTE.**

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




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**Figure 14-9 Fuel Filter with Water Separator**

**Fuel Filter Removal**

**See General Warnings, Section 1, Page 1-2.**

The 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. **See Draining Water from the Fuel Filter above.**

1. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Place a large pan under the fuel filter to catch fuel.
3. 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.**

**Fuel Filter Installation**

**See General Warnings, Section 1, Page 1-2.**

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 14-8, Page 14-8)**.
3. Install new fuel filter on the manifold. Tighten the filter by hand a fraction of a turn until filter hits positive stop. Do not use a band wrench or channel lock pliers.
4. Verify the water separator drain valve is closed, bleed air from the system and check for leaks. **See Bleeding Air From Fuel System on page 14-9.**

## FUEL PUMP

**See General Warnings, Section 1, Page 1-2.**

**Mechanical Fuel Pump Removal**

The mechanical fuel pump is located on the passenger side of the engine under the injector pump. It only operates when the engine is rotating.

**See the Kubota D722 diesel engine manual.**

**Mechanical Fuel Pump Installation**

**See the Kubota D722 diesel engine manual.**

## FUEL LEVEL SENDING UNIT

**See General Warnings, Section 1, Page 1-2.**

**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.**

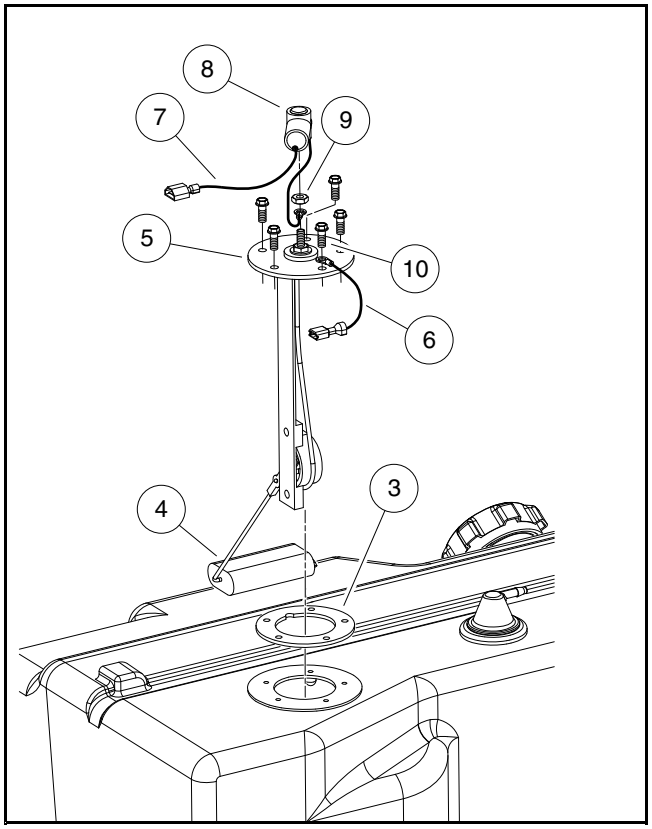
1. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Remove the passenger seat. **See Seat Removal, Section 4, Page 4-9.**
3. Remove the rubber boot (8) from the center post on the fuel level sending unit. Remove the nut (9) from the center post and remove the orange wire (7) **(Figure 14-10, Page 14-12)**. Retain the hardware.
4. 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.
5. Remove the four remaining hex-head plastic thread screws from the fuel level sending unit flange (5). Retain the hardware.

6. 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 passenger's side surface of the fuel tank.*




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**Figure 14-10 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.**

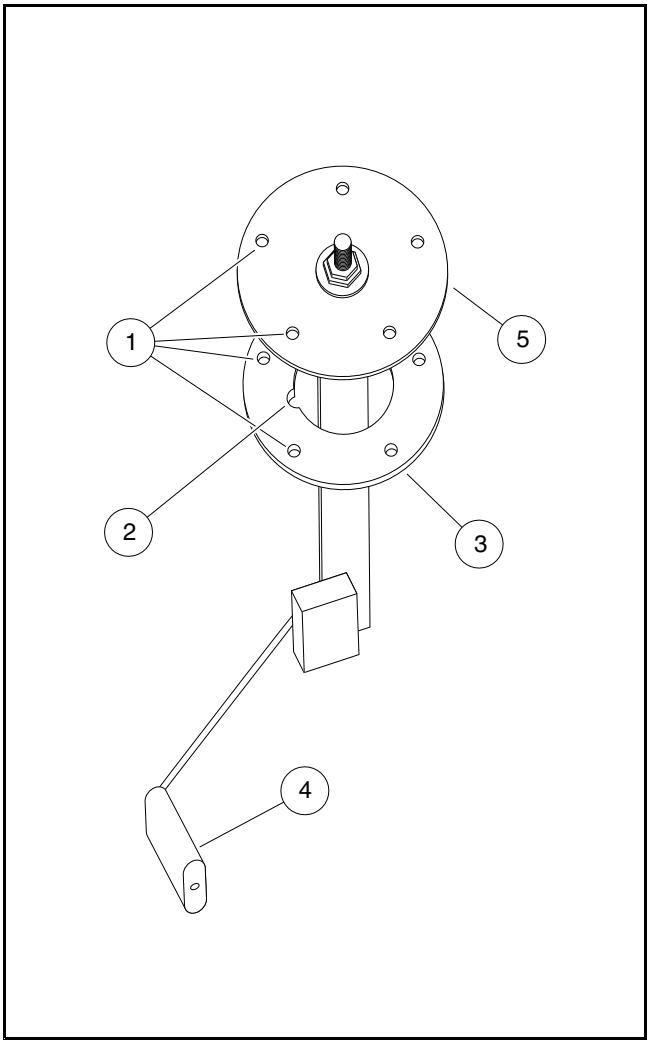
## ⚠ WARNING

- **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 14-11, Page 14-13)**. **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.*




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**Figure 14-11 Fuel Level Sending Unit Alignment**

2. Feed a new sending unit rheostat arm and float (4) into the fuel tank **(Figure 14-10, Page 14-12)**. The rheostat arm and float should be positioned toward the passenger's side surface of the fuel tank **(Figure 14-12, Page 14-14)**.
3. Align the flange identification mounting holes (1) directly over the corresponding mounting holes in the gasket and fuel tank **(Figure 14-11, Page 14-13)**. **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.*

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 14-10, Page 14-12)**. **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 14-10, Page 14-12)**. 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 battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

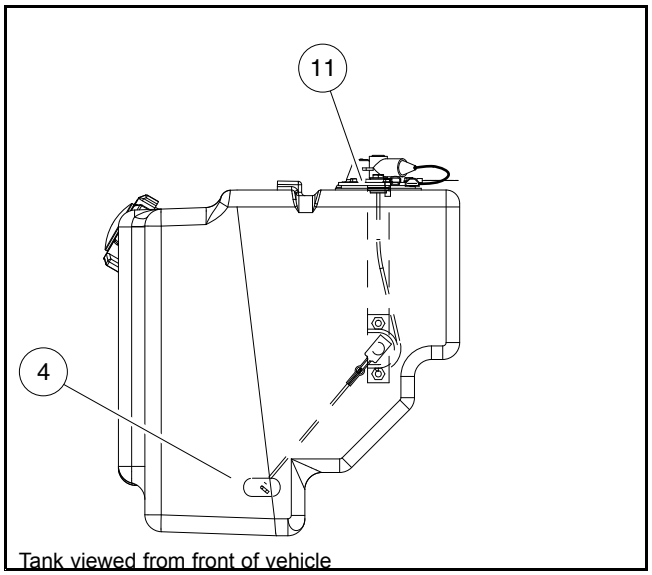



**Figure 14-12 Fuel Level Sending Unit Position**

### FUEL TANK

**See General Warnings, Section 1, Page 1-2.**

## ⚠ 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. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Remove seat(s) and, if equipped, the center seat plate.

3. Remove the upper portion of the ROPS (Roll Over Protection Structure) frame. **See ROPS Removal, Section 4, Page 4-7.**
4. Remove the seat frame. **See Seat Support Removal, Section 4, Page 4-10.**
5. 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 14-8, Page 14-8)**. **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.**

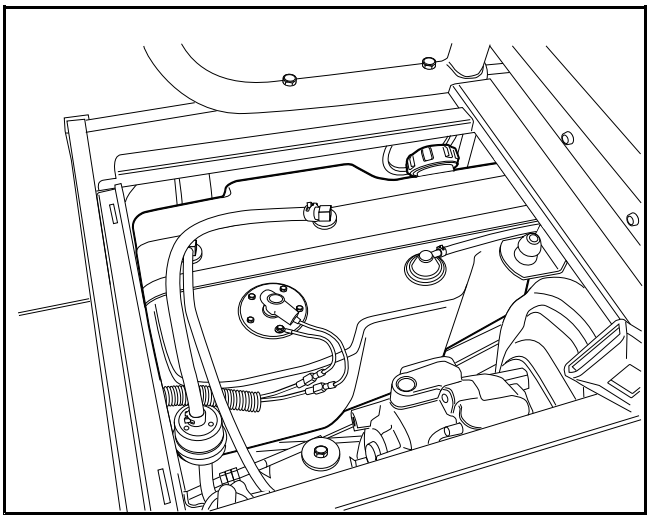
6. Disconnect the fuel return line (5) from the engine and raise the end of the hose above the fuel tank. Plug the line. **See previous NOTE and DANGER.**
7. Loosen the clamp and remove the vent tube from the fuel tank.
8. Remove the fuel tank cap.
9. Use a siphon with a built-in suction device to siphon 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.**



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**Figure 14-13 Diesel Fuel Tank**

10. 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.

11. Remove the nut from the fuel tank strap below the passenger seat area.
12. Lift the strap end and remove the opposite end from the slotted bracket.
13. Remove the passenger-side bed latch bracket from the frame.
14. 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.**

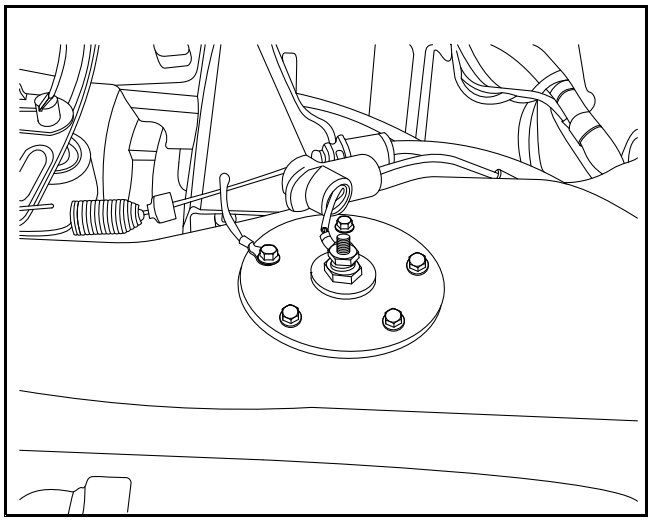
## ⚠ WARNING

- **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.
7. Connect the black wire and orange wire to the sensor **(Figure 14-14, Page 14-16)**.



2157

**Figure 14-14 Fuel Level Sensor**

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 battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**
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

## GENERAL INFORMATION

For proper vehicle operation, it is important the accelerator cable, idle RPM and high-speed RPM adjustments are done correctly and in the proper sequence. **See following CAUTION.**

## CAUTION

- **Improper adjustment can result in poor vehicle performance and/or damage to the engine components.**

## GROUND SPEED

***NOTE:*** *If possible, the manufacturer recommends measuring ground speed when setting engine RPM.*

This vehicle should reach a ground speed of 25 mph (40 km/h). If the ability to measure vehicle ground speed is not available, the closest engine RPM setting to achieve 25 mph (40 km/h) is 3825 ±25 RPM. **See Engine RPM Adjustment on page 14-18.**

## ACCELERATOR CABLE

**See General Warnings, Section 1, Page 1-2.**

## ⚠ WARNING

- **To avoid unintentionally starting a diesel vehicle, disconnect the battery.**

**Accelerator Cable Removal**

1. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Raise the hood.

3. Remove the passenger seat. **See Seat Removal, Section 4, Page 4-9.**
4. Disconnect the accelerator cable at the pedal.

4.1. Disconnect the Z-shaped end of the accelerator cable from the pedal **(Figure 14-15, Page 14-18)**.

4.2. Disconnect the cable strain relief at the pedal bracket.

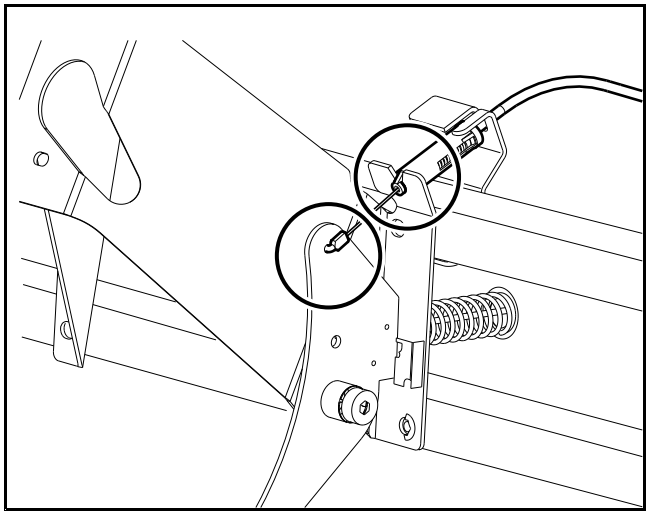
5. Disconnect the accelerator cable from the engine.

5.1. Disconnect the Z-shaped end of the accelerator cable (5) from the engine **(Figure 14-1, Page 14-2)**.

5.2. Remove the cable strain relief (6) from the engine bracket.

6. 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. When removing the cable, 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.*



2362
**Figure 14-15 Accelerator Cable At Pedal (Z-Shaped Cable End and Anchor)**

**Accelerator Cable Installation**

1. Installation is reverse of removal procedure.
2. Connect battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

## ENGINE RPM ADJUSTMENT

**Vehicle Creep**

New vehicles or vehicles with a new drive belt or clutches may crawl forward with the shifter in FORWARD and the engine idling. This is considered normal until the drive belt is “broken-in” (approximately 15 hours of use). Other possible symptoms include difficulty or inability to shift into or out of gear and engine stalling.

1. Operate the vehicle as usual through the "break-in" period. If this condition persists beyond 15 hours of use, go to step 2.
2. Inspect the accelerator pedal and cable. Check idle and high-speed RPM. **See Idle RPM Adjustment on page 14-18. See High-Speed RPM Adjustment on page 14-20.**

**Idle RPM Adjustment**

A tachometer is required to set the RPM adjustments on this engine. A special diesel probe is also required when the tachometer is used. **See following DANGER.**

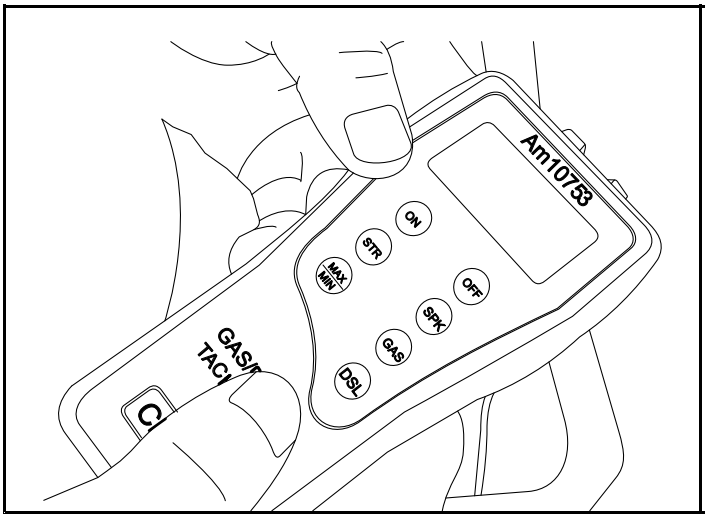
## ⚠ DANGER

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

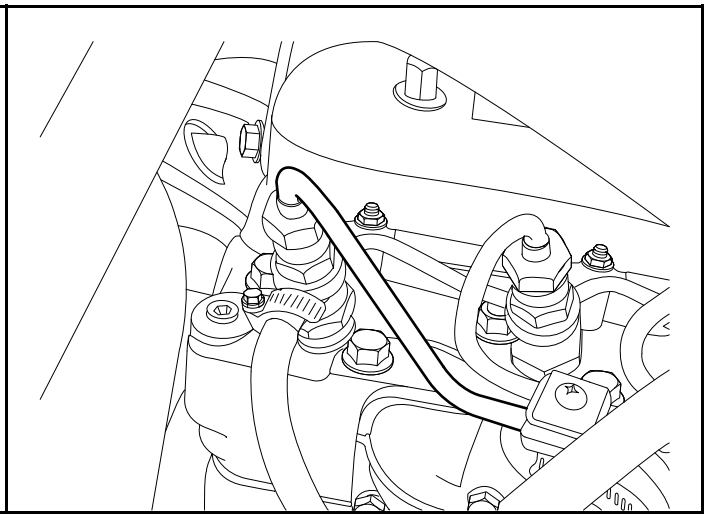
1. Disable the vehicle. **See Disabling the Vehicle on page 1-3.**
2. Clean paint, grease, and dirt from one of the three fuel injector lines **(Figure 14-17, Page 14-19)**. **See following NOTES.**

***NOTE:*** *It is very important that the line be cleaned enough to expose the metal.*

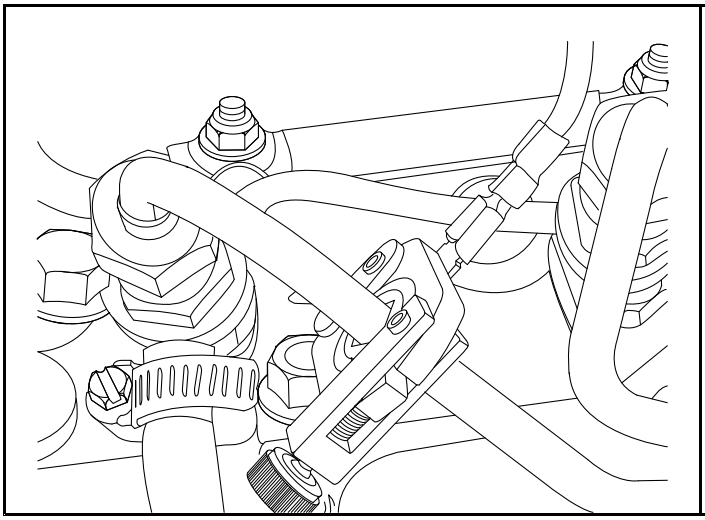
*Read the tachometer and diesel probe instructions before any RPM adjustments are made.*



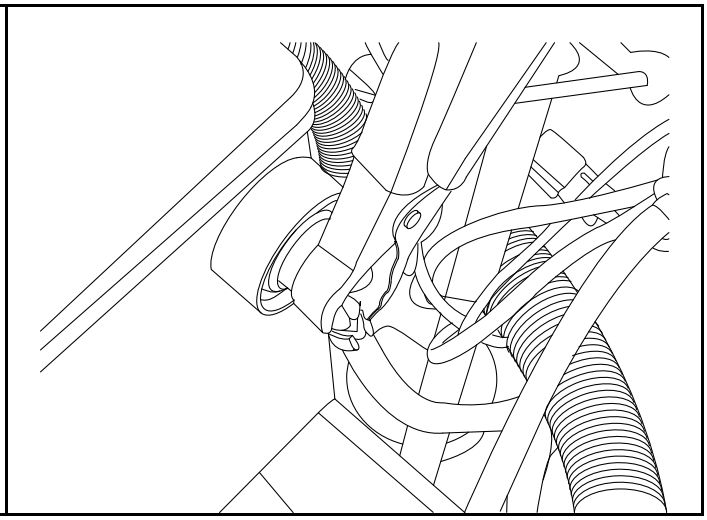

2185
**Figure 14-16 Tachometer For Engine RPM**



2186
**Figure 14-17 Clean Metal Fuel Line**



2187
**Figure 14-18 Diesel Probe Fuel Line Clamp On Engine**

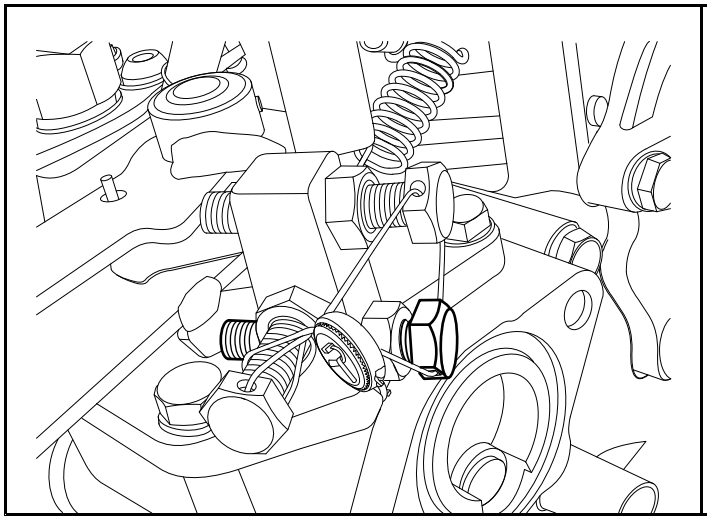


2188
**Figure 14-19 Diesel Probe Battery Cable Clamp**

3. Secure the fuel line probe clamp to the clean area of the fuel injector line **(Figure 14-18, Page 14-19)**.
4. Secure the negative (–) line clamp to the negative (–) battery post **(Figure 14-19, Page 14-19)**.
5. Secure the diesel probe to the tachometer **(Figure 14-16, Page 14-19)**. **See following NOTE.**

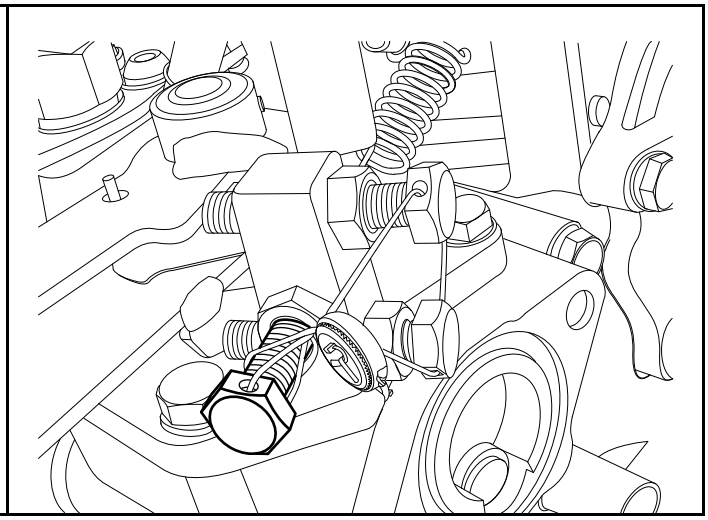
***NOTE:*** *It may be necessary to cut the wire attached to the adjustment screws. The manufacturer recommends that a new wire be secured to the screws after new RPM settings are established.*

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 1300 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 14-20, Page 14-20)**.
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.**



2189

**Figure 14-20 Idle Throttle Adjustment Screw**



3077

**Figure 14-21 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 14-17, Page 14-19)**. **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 14-18, Page 14-19)**.
3. Secure the negative (–) line clamp to the negative (–) battery post **(Figure 14-19, Page 14-19)**.
4. Secure the diesel probe to the tachometer **(Figure 14-16, Page 14-19)**. **See following NOTE.**

***NOTE:*** *It may 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 lower the RPM, or counterclockwise to raise 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 Warnings, Section 1, Page 1-2.**

## 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 11, Page 11-1.** 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 because it is part of the air intake system. Failure to heed this caution could damage the engine by allowing excessive contamination or water to enter the air intake system.**

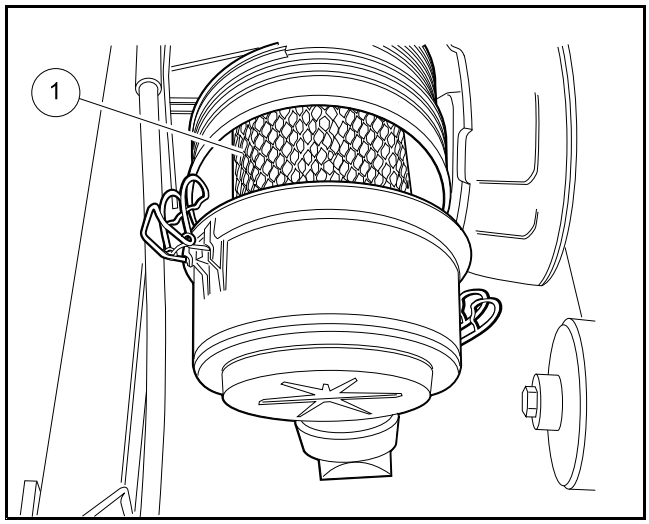
**Air Filter Removal**

1. Release both canister tab locks **(Figure 14-22, Page 14-21)**.
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 the direct replacement part.*

**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 14-22, Page 14-21)**.
3. Secure the canister cap with both tab locks.



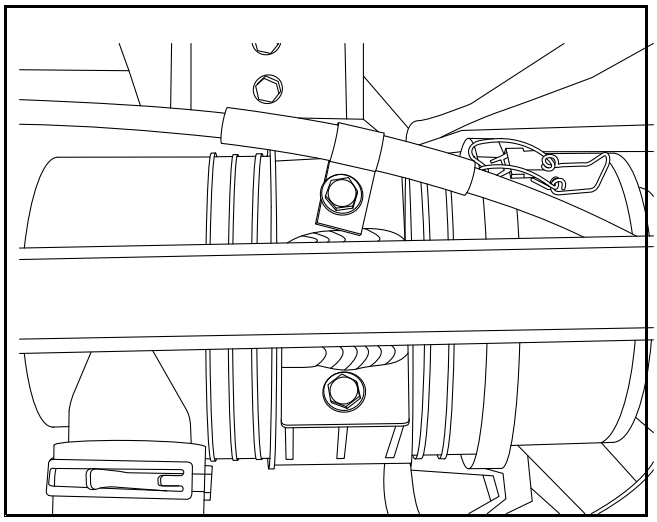

218

**Figure 14-22 Air Filter Cartridge**

## AIR CANISTER REMOVAL

1. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**

2. Remove the air filter cartridge. **See Air Filter Removal on page 14-21.**
3. Remove the bottom (inlet) hose from the canister.
4. Remove the top (outlet) hose from the canister.
5. Remove the two bolts and park brake cable from the canister and remove the canister.



2041

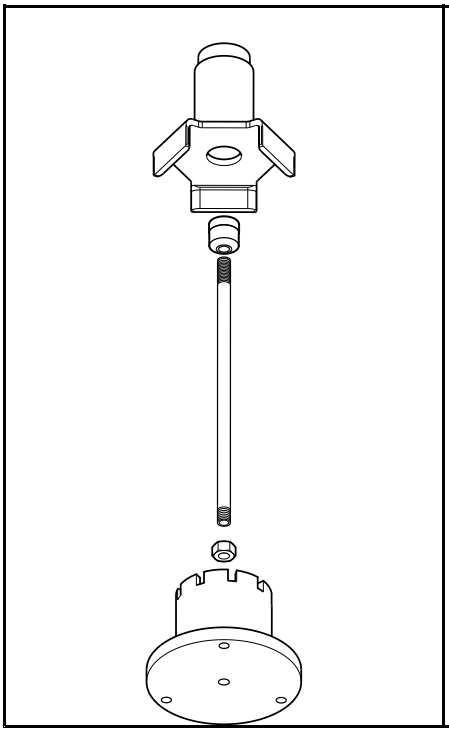
**Figure 14-23 Air Filter Canister**

## 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 14-21.**
6. Connect battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

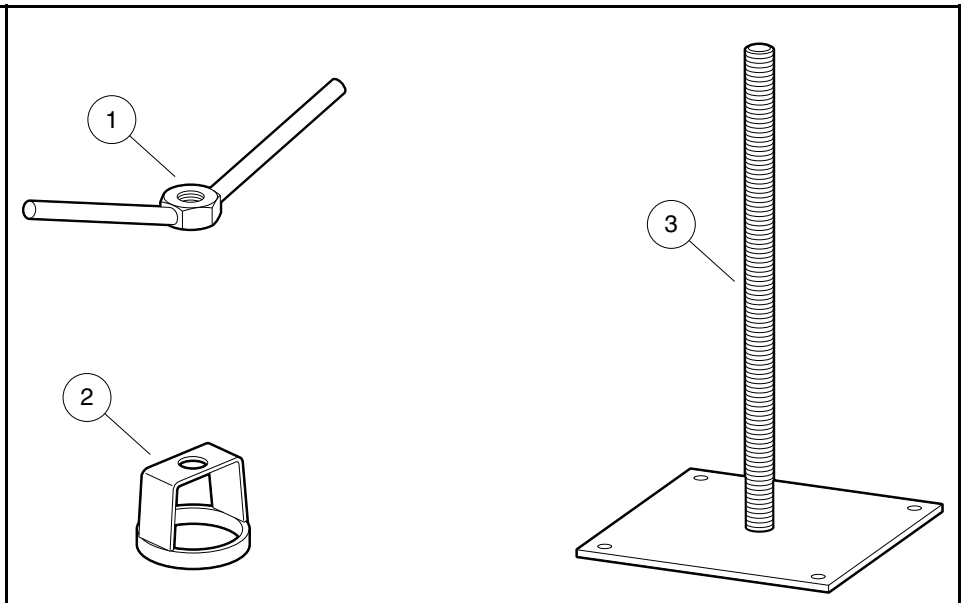
# CLUTCHES

The following service tools are required to disassemble the clutches properly and are available from a service parts representative **(Figure 14-24, Page 14-23) and (Figure 14-25, Page 14-23)**:



2498

**Figure 14-24 Drive Clutch Service Tool – Three-Weight Design**




1. Spring compression nut 2. Spring compression collar 3. Spring compression base

2499

**Figure 14-25 Driven Clutch Service Tools**

## CLUTCH TROUBLESHOOTING

**See General Warnings, Section 1, Page 1-2.**

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 14-18.**

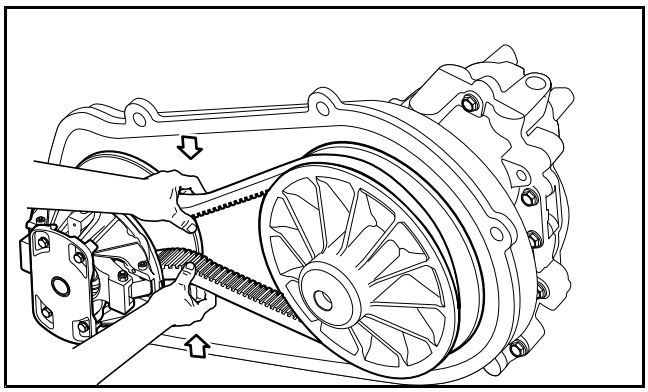
If the clutches are not operating properly, perform the following:

1. Check the throttle settings. **See Engine RPM Adjustment on page 14-18.**
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 14-24. See also Driven Clutch on page 14-28.**
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 14-25.**
5. Check the drive clutch rollers and weights for wear.

## DRIVE BELT

**See General Warnings, Section 1, Page 1-2.**

The drive belt should be inspected periodically for wear and glazing. If it is excessively worn, frayed, or glazed, replace the belt.



2171

**Figure 14-26 Drive Belt Removal**

**Drive Belt Removal**

1. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Remove the clutch outer cover. **See Clutch Outer Cover Removal on page 14-31.**
3. Grasp the belt midway between the drive and driven clutches and squeeze the belt together as tightly as possible.
4. Guide the belt over the driven clutch and roll the belt off the driven clutch by rotating the clutch clockwise **(Figure 14-26, Page 14-24)**. **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 14-31.**
4. Connect battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

## DRIVE CLUTCH

**See General Warnings, Section 1, Page 1-2.**

### 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. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Remove the top air filter hose (outlet) from the air filter canister.
3. Remove the clutch outer cover. **See Clutch Outer Cover Removal on page 14-31.**
4. Remove the drive belt. **See Drive Belt Removal on page 14-24.**
5. Remove the center bolt on the drive clutch.
6. Thread the clutch removal tool 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.**
- **Do not hit or tap the clutch with a hammer. Do not pry the clutch. These actions will damage the clutch.**

7. Remove the drive clutch from the vehicle. **See previous CAUTION.**

**Drive Clutch Cleaning and Inspection**

1. Use a dry, lint-free cloth to clean clutch parts. **See following CAUTION.**

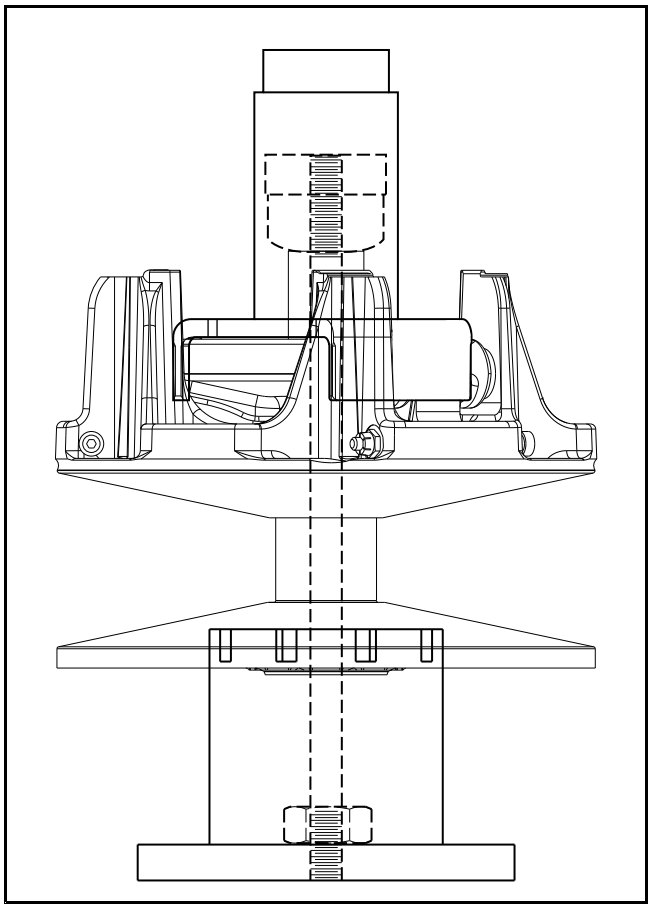
## CAUTION

- **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 14-28, Page 14-27). 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.

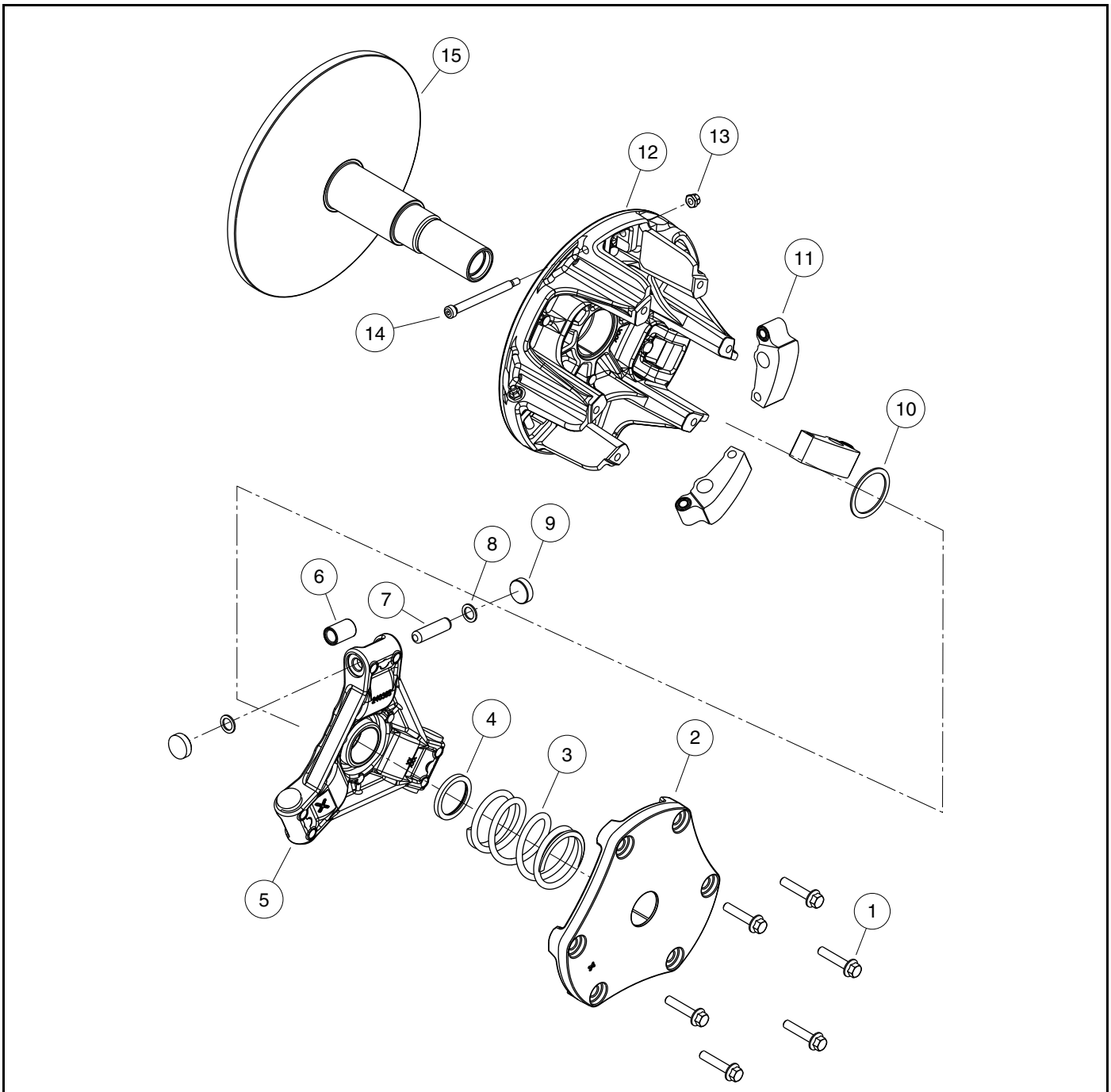
**Drive Clutch Disassembly – Three-Weight Design**

1. Remove the six bolts (1) that secure the cover plate (2) to the moveable sheave (12) **(Figure 14-28, Page 14-27)**.
2. Remove the cover (2), spring (3) and spacer (4) from the clutch spider (5).
3. Inspect the rollers (6), pins (7) and weights (11). Replace if necessary.
4. Secure the drive clutch service tool into a vice or mount the tool to a flat work surface.
5. Place the drive clutch onto the service tool and secure the fixed sheave (15) as shown **(Figure 14-27, Page 14-26)**.
6. Place the spider tool on top of the spider.
7. Use a 1/2-inch drive ratchet to disengage the moveable sheave (12) and spider (5), which will come off as an assembly, from the fixed sheave (15) **(Figure 14-28, Page 14-27)**.



2500

**Figure 14-27 Using the Drive Clutch Service Tool (Three-Weight)**




| | | | | | |
|---|---|---|---|---|---|
| 1. | Screw, Hex Flange Head, 1/4–20x1.25 | 6. | Roller | 11. | Weight |
| 2. | Cover Plate | 7. | Pin, 0.375x1.375 | 12. | Moveable Sheave |
| 3. | Spring, Compression, 2.0 OD Black/Or | 8. | Washer, Flat | 13. | Locknut, #10-24 |
| 4. | Spacer, Clutch, 1.44x1.125x0.15 | 9. | Button, Torque Primary | 14. | Screw, Shoulder, Hex Socket, 0.25x2.5 |
| 5. | Spider | 10. | Shim, 1.63x1.33 | 15. | Fixed Sheave |

2501

**Figure 14-28 Drive Clutch Components (Three-Weight)**

**Drive Clutch Component Inspection – Three-Weight Design**

1. Inspect the rollers (6) and pins (7) **(Figure 14-28, Page 14-27)**. Ensure they rotate freely without roughness or loose play. If they do not, the entire drive clutch must be replaced. The rollers and pins can not be replaced.
2. Inspect the weights (11). There should be no noticeable wear. If the weights are worn, scratched, or damaged, replace them.

2.1. Remove the bolts (14) and flex locknuts (13) that secure the weights (11) to the moveable sheave (12).

2.2. Install new weights with bolts and flex locknuts. Tighten the locknuts to 45 in-lb (5 N·m).

**Drive Clutch Assembly – Three-Weight Design**

***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 (12), shim (10) and spider (5) onto the fixed sheave (15). Note the location of the "X" so the remaining components with an "X" can be aligned **(Figure 14-28, Page 14-27)**.
2. Use a spider removal tool to tighten the moveable sheave and spider to 265 ft-lb (359 N·m).
3. Install the spacer (4) and spring (5) onto the shaft.
4. Place the cover plate (2) onto the shaft.
5. Pull the moveable sheave upward and start threading bolts (1) into holes.
6. Use a crisscross pattern to continue tightening the bolts to 113 in-lb (12.7 N·m).

**Drive Clutch Installation**

1. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Place the drive clutch assembly on the crankshaft taper.
3. Install the mounting washer and retaining bolt. Tighten the hardware to 39 ft-lb (53 N·m).
4. Install the drive belt as instructed. **See Drive Belt Installation on page 14-24.**
5. Install the clutch cover and tighten the bolts to 72 in-lb (8.0 N·m).
6. 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.*

7. Connect battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**
8. Drive the vehicle and check for proper operation.

## DRIVEN CLUTCH

**See General Warnings, Section 1, Page 1-2.**

### 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.**

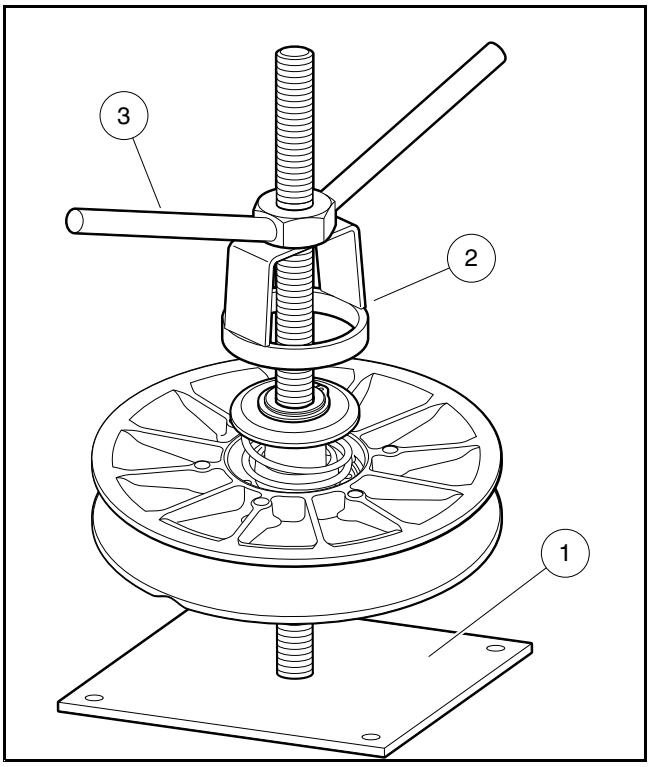
**Driven Clutch Removal**

1. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Remove the top air filter hose from the filter canister.
3. Remove the clutch outer cover. **See Clutch Outer Cover Removal on page 14-31.**

4. Remove the drive belt as instructed. **See Drive Belt Removal on page 14-24.**
5. Remove the bolt and washer from the center of the clutch and discard bolt.
6. 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.**



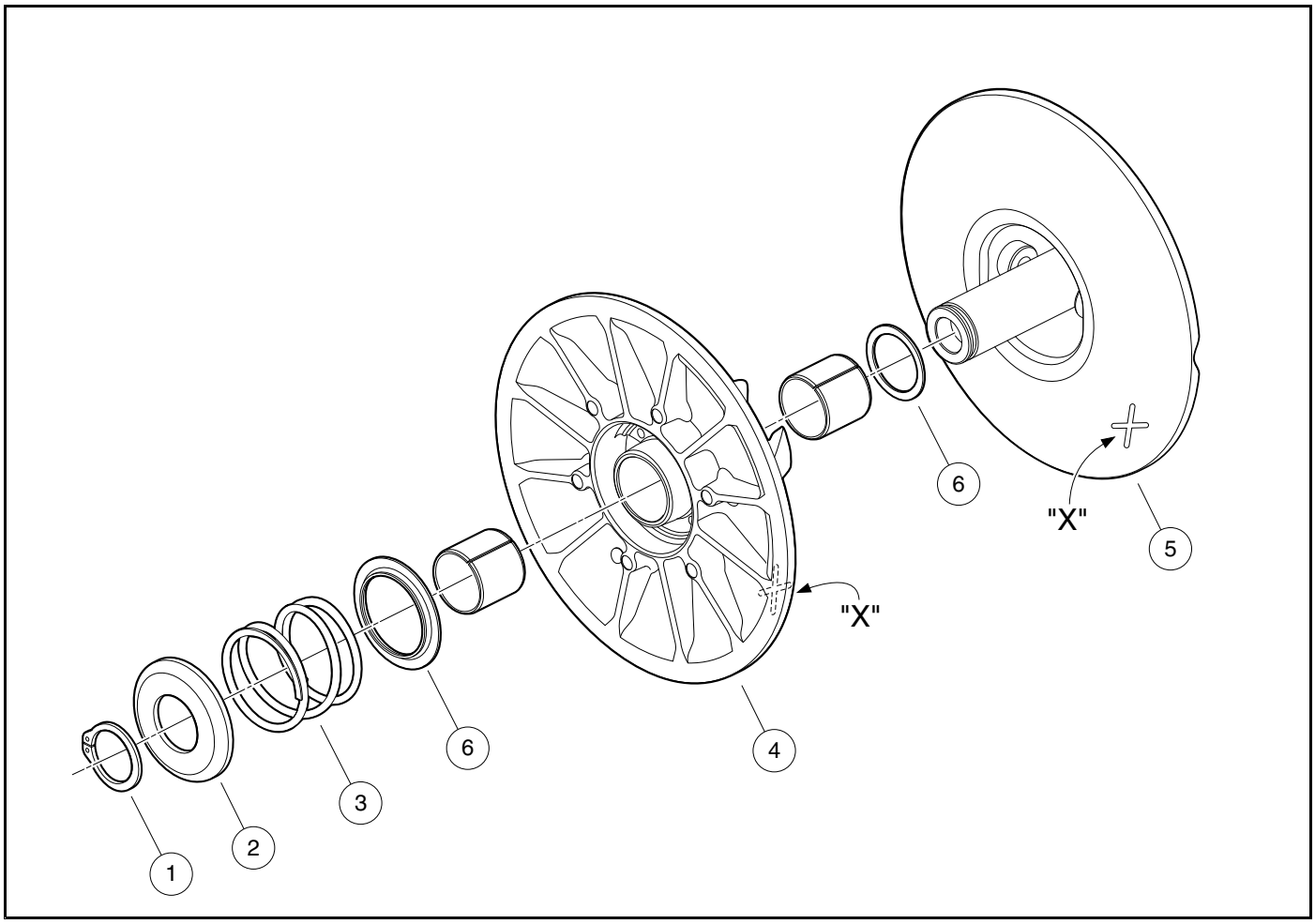

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**Figure 14-29 Driven Clutch Service Tools**

**Driven Clutch Disassembly**

1. Place the driven clutch onto the Spring compression base (1) **(Figure 14-29, Page 14-29)**.
2. Place the Spring compression collar ( (2) onto the driven clutch.
3. Thread the Spring compression nut (3) 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 14-30, Page 14-30)**.
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.*




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**Figure 14-30 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 14-30, Page 14-30)**.
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 14-29, Page 14-29)**.
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. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Install the driven clutch assembly on the transmission splined shaft.
3. Install the mounting washer and new retaining bolt. Tighten retaining bolt to 39 ft-lb (53 N·m).
4. Install the drive belt as instructed. **See Drive Belt Installation on page 14-24.**
5. Install the clutch outer cover and tighten the screws to 72 in-lb (8 N·m).

6. 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.*

7. Connect battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**
8. Drive the vehicle and check for proper operation.

## CLUTCH COVER

### Clutch Outer Cover Removal

1. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Remove the top air filter hose from the filter canister.
3. 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 battery.**See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4. See following NOTE.**

***NOTE:*** *Ensure the hose clamp is tightly installed and positioned between the filter canister and canister port bead.*

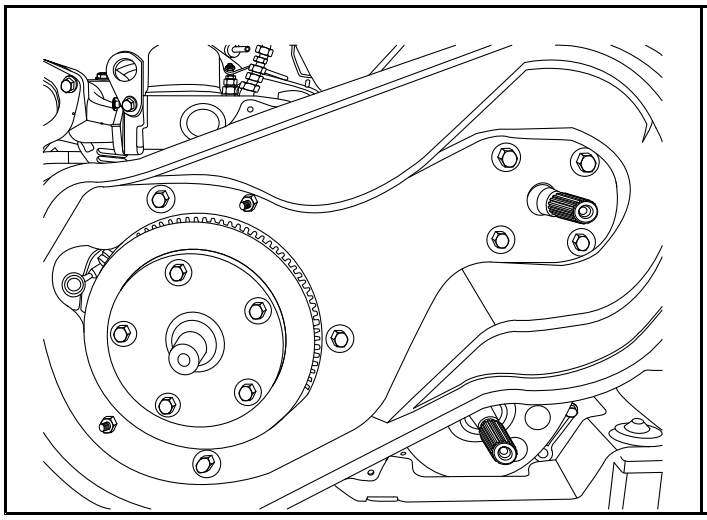
### Clutch Inner Cover Removal

1. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Remove the outer clutch cover. **See Clutch Outer Cover Removal on page 14-31.**
3. Remove the drive belt. **See Drive Belt Removal on page 14-24.**
4. Remove the driven clutch. **See Driven Clutch Removal on page 14-28.**
5. Remove the bolts, nuts, and washers from the inner clutch cover **(Figure 14-31, Page 14-32)**. **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.*

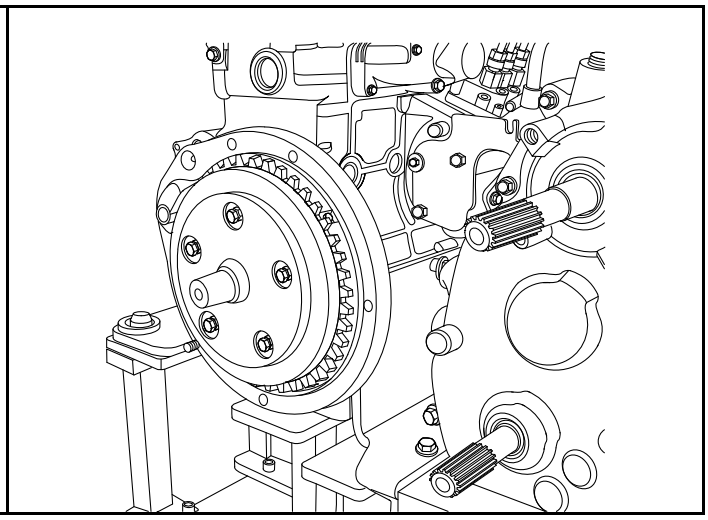
*Ensure the studs remain on the engine block when the nuts are removed.*

6. Remove the clutch inner cover.
7. Remove the inner cover spacer between the inner cover and the engine block **(Figure 14-32, Page 14-32)**.



2191

**Figure 14-31 Diesel Inner Cover Assembly**



2192

**Figure 14-32 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 14-32, Page 14-32)**.
2. Align the mounting holes in the inner cover with the transmission and engine bolt holes **(Figure 14-31, Page 14-32)**.
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 14-30.**
9. Install the drive belt. **See Drive Belt Installation on page 14-24.**
10. Install the outer cover. **See Clutch Outer Cover Installation on page 14-31.**
11. Connect battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

# SECTION 15 — DIESEL VEHICLE - RADIATOR AND COOLANT SYSTEM



## ⚠ DANGER

- **See General Warnings, Section 1, Page 1-2.**

## ⚠ WARNING

- **See General Warnings, Section 1, Page 1-2.**

## GENERAL INFORMATION

**See General Warnings, Section 1, Page 1-2.**

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 11, Page 11-19.**

### ENGINE COOLANT CHANGE

1. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. 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.**

3. Place a large drain pan under the radiator and engine drain plugs.
4. 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.*

5. Turn the drain valve on the engine counterclockwise to drain coolant **(Figure 15-1, Page 15-2)**.
6. 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.*

7. Check the hoses and clamps for looseness or damage. Replace if necessary.
8. 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.
9. Close both drain valves but leave the engine block coolant plug open.
10. 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.**

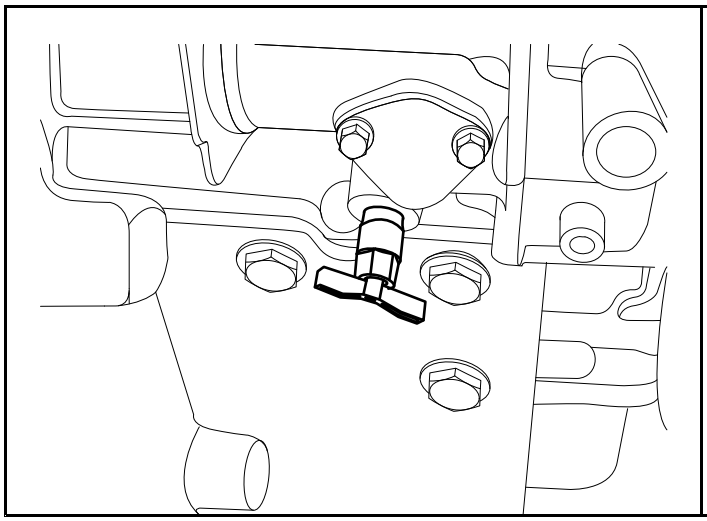
***NOTE:*** *Use a mixture of 45% water and 55% propylene glycol with anti-corrosion additives.*

11. 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).
12. Continue adding to the reservoir until coolant reaches the radiator fill spout. Replace the radiator cap.
13. Fill the reservoir to the FULL mark with coolant and check for leaks. Replace the reservoir cap.
14. Start and run the engine until it reaches operating temperature. Monitor the coolant level in the reservoir.
15. Stop the engine and allow the engine and coolant to cool. **See following WARNING.**

## ⚠ WARNING

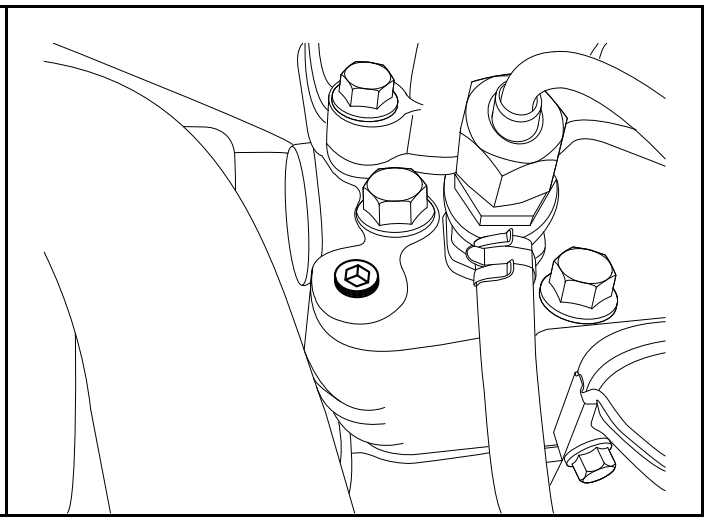
- **Coolant reservoir and radiator are pressurized. Remove caps slowly to relieve pressure.**
- **Hot! Coolant system is pressurized. Do not remove radiator cap while engine is hot.**

16. If necessary, remove reservoir cap and fill to the FULL mark. Replace cap. **See preceding WARNING.**
17. Lower and secure the hood.



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**Figure 15-1 Engine Block Coolant Drain Valve**



2217

**Figure 15-2 Engine Block Coolant Plug**

# COOLANT RESERVOIR

**See General Warnings, Section 1, Page 1-2.**

## COOLANT RESERVOIR REMOVAL

1. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. 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.**

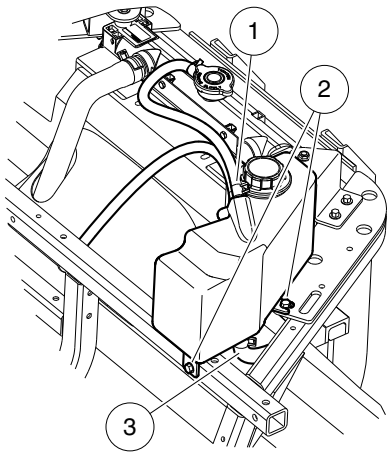
3. Place a large drain pan under the radiator and front differential to collect coolant. **See following NOTE.**

***NOTE:*** *Do not remove the drain pan until the reservoir has been replaced and the hoses attached.*

4. 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.*

5. 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)**.
6. Release the clamps securing the two hoses at top of reservoir and remove hoses.
7. 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.
8. Lift up rear of reservoir to clear mounting tab of chassis and pull reservoir forward and up to remove.




1. Clamps 2. Mounting Points 3. 5/8” Hose Clamp

2218

**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 battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**
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 Warnings, Section 1, Page 1-2.**

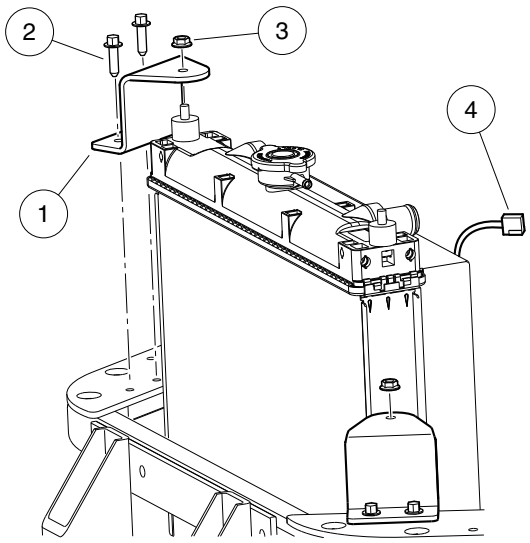
### RADIATOR REMOVAL

1. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Raise the hood.
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 clamp securing the hose to the radiator fill spout and remove hose.
5. Release the clamps securing the upper and lower radiator hoses to the radiator and remove hoses.
6. Disconnect the two-pin connector between the fan motor and the wire harness **(Figure 15-4, Page 15-5)**.
7. Remove the flanged locknuts and flanged bolts securing the two radiator support brackets to the chassis and remove brackets.




1. Radiator Support Bracket 2. Flanged Bolts 3. Flanged Nut
4. Two-Pin Connector

2219

**Figure 15-4 Radiator Bracket Attachment**

8. 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.**

9. 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 battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**
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 Warnings, Section 1, Page 1-2.**

### COOLANT PIPE WELDMENT REMOVAL

1. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. 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.**

3. 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.
4. 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.
5. Remove the flanged locknut securing the front of the weldment to the chassis. Leave bolt in chassis.
6. 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 144 in-lb (16 N·m).
3. Tighten the rear hardware to 144 in-lb (16 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 battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**
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 Warnings, Section 1, Page 1-2.**

## FAN REMOVAL

**See Fan Removal on page 13-19.**

## FAN INSTALLATION

**See Fan Installation on page 13-20.**

Pagination Page

# SECTION 16 — DIESEL VEHICLE - HYDRAULIC ATTACHMENT SYSTEM



## ⚠ DANGER

- **See General Warnings, Section 1, Page 1-2.**

## ⚠ WARNING

- **See General Warnings, Section 1, Page 1-2.**
- **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.

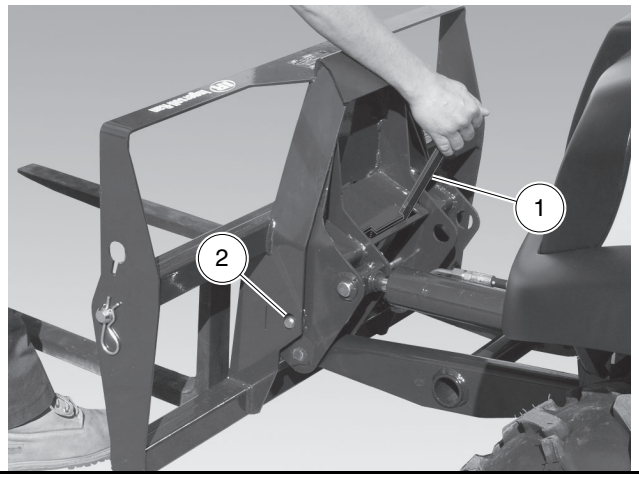
# ATTACHMENT INTERFACE

## INSPECTION

### Hand Lever

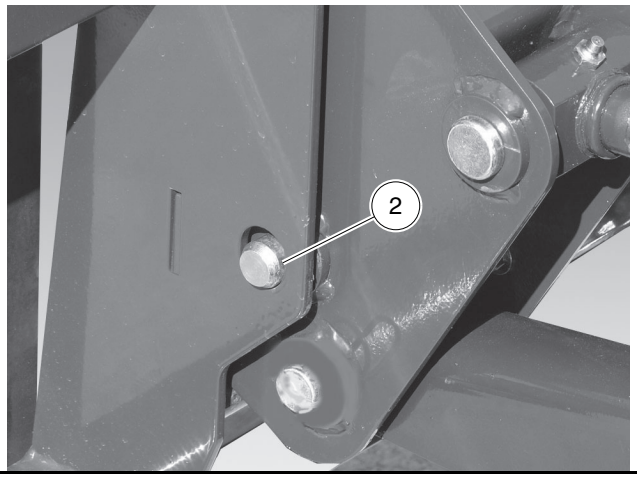
**⚠ WARNING**

- **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.**




2220

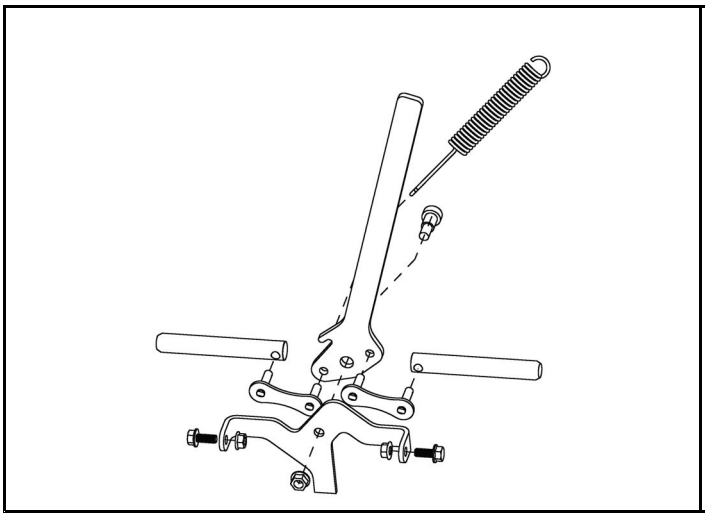
**Figure 16-1 Hand Lever**



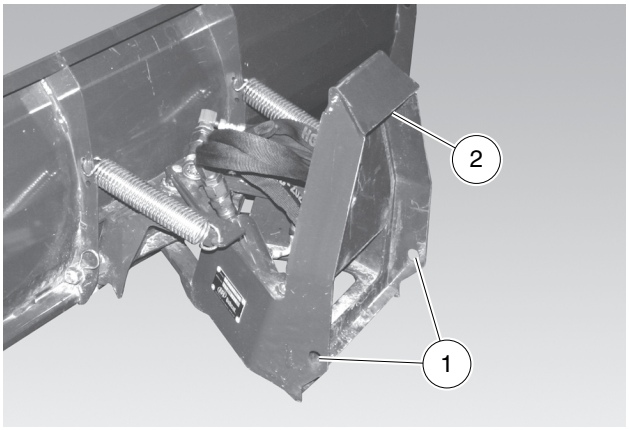

2221

**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.



2222
**Figure 16-3 Hand Lever Linkages and Pins**




2223
**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

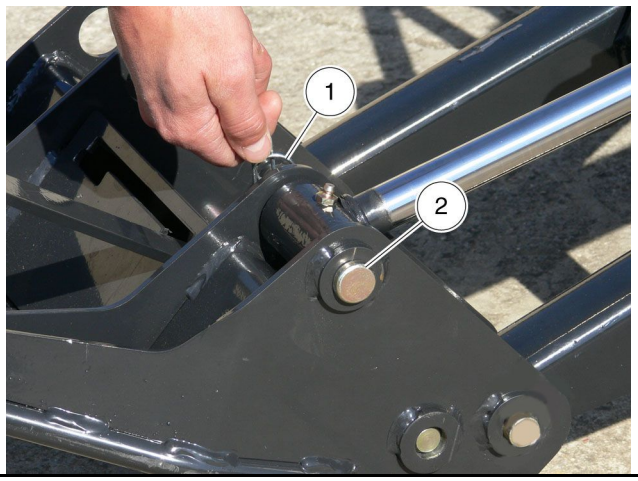
When the attachment arm mechanism is not being used, it can be removed from the vehicle.

***NOTE:*** *Remove the bucket or the attachment before attempting to remove the attachment arm mechanism from the vehicle.*

**Attachment Arm Removal**



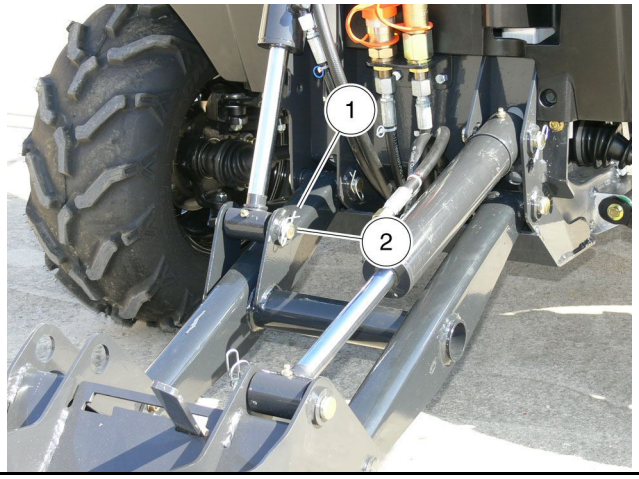
2224
**Figure 16-5 Lower Arm and Tilt Interface Forward**




2225
**Figure 16-6 Remove Interface Cylinder Retaining Pin**

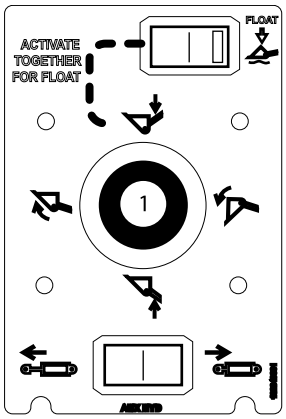
***NOTE:*** *When removing the cylinders from the attachment arm or the interface, the cylinders may need to be retracted slightly. Do not have hands in the area of the cylinders when extending or retracting the cylinders.*

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)**.




2226

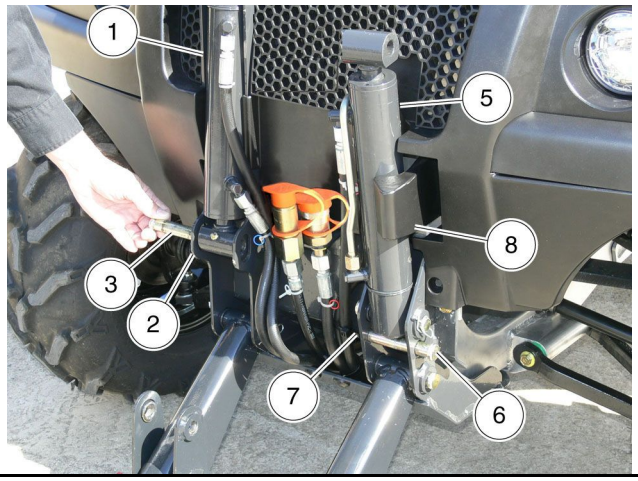
**Figure 16-7 Remove Attachment Cylinder Retaining Pin**



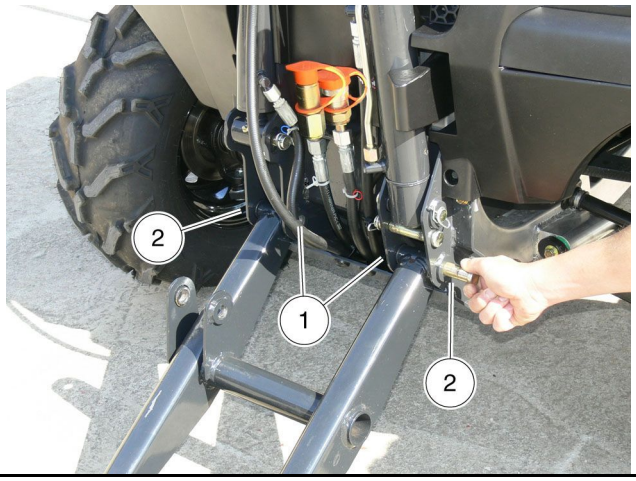

256

**Figure 16-8 Joystick**

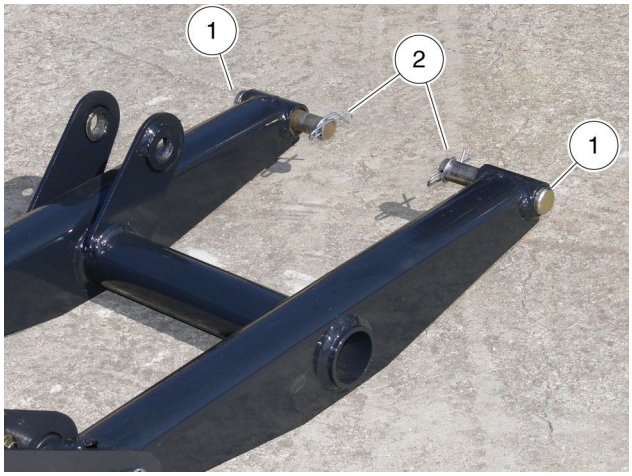
5. Turn the start key to the ON position but DO NOT start the engine.
6. Retract the attachment arm cylinder fully by moving the joystick (1) back **(Figure 16-8, Page 16-4)**.
7. Retract the attachment interface cylinder fully by moving the joystick (1) to the left.
8. Turn the start key to the OFF 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)**.




2227
**Figure 16-9 Secure Attachment and Interface Cylinders**




2228
**Figure 16-10 Remove Attachment Arm Retaining Pins**




2229
**Figure 16-11 Attachment Arm Pins and Retaining Rings**



2230
**Figure 16-12 Align the Vehicle to Attachment Arms**

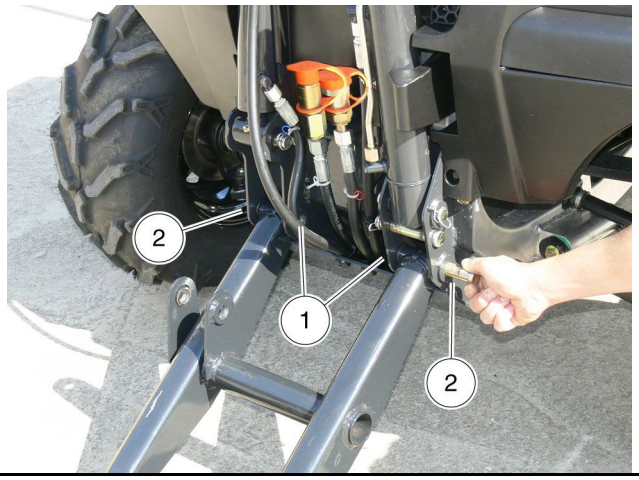
### Attachment Arm Installation

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

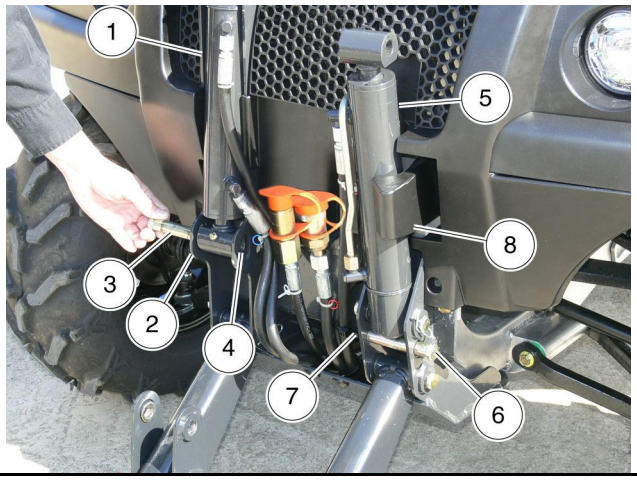
- **Do not have hands in the area of the cylinders when extending or retracting the cylinders.**

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)**.



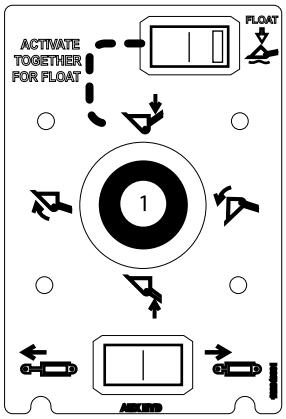

2228

**Figure 16-13 Align the Attachment Arm Holes**



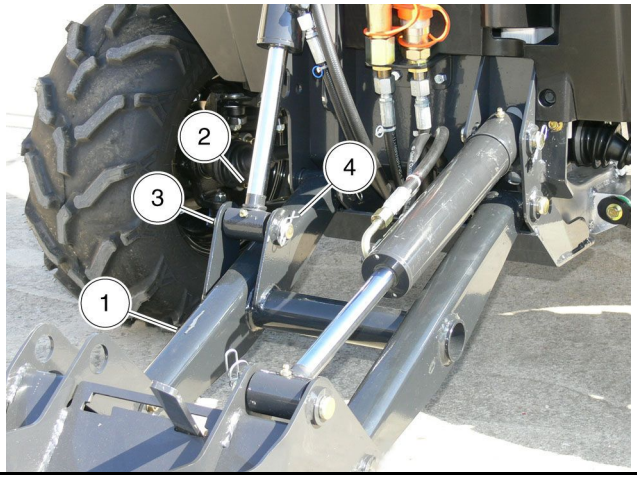

2232

**Figure 16-14 Remove Retainer Pins from Both Cylinders**




256

**Figure 16-15 Joystick**



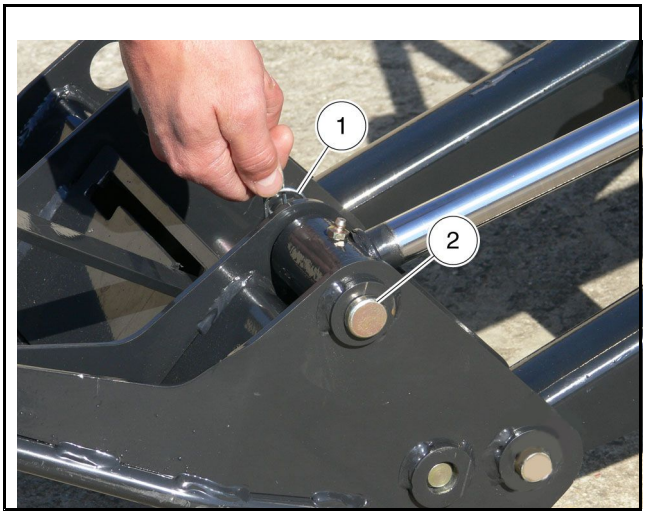

2234

**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)**.




2225
**Figure 16-17 Raise Interface, Install Pin and Retainer Ring**

# ELECTRICAL

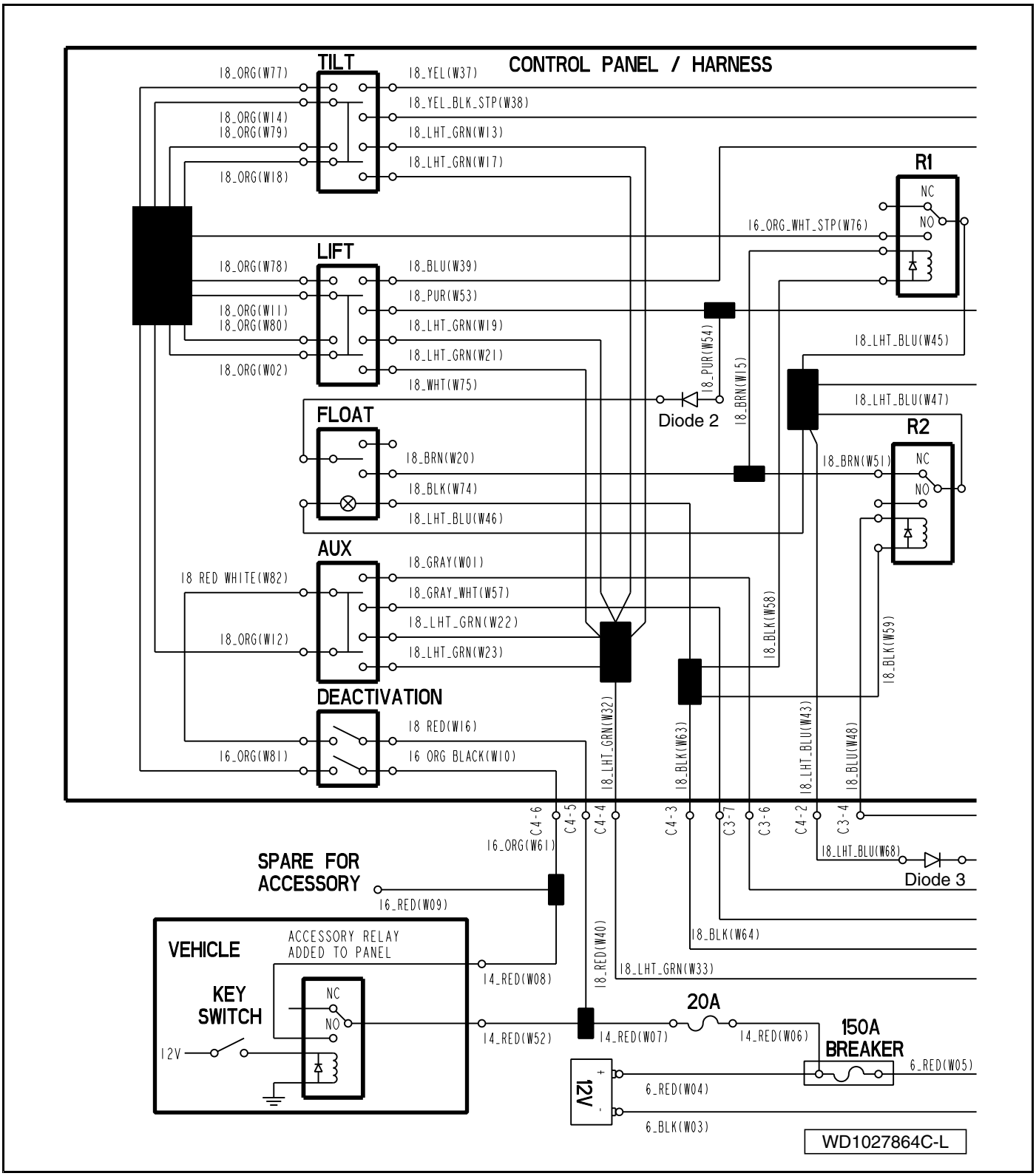



**Figure 16-18 Wiring Diagram for Hydraulic Attachment System Vehicles (Front)**

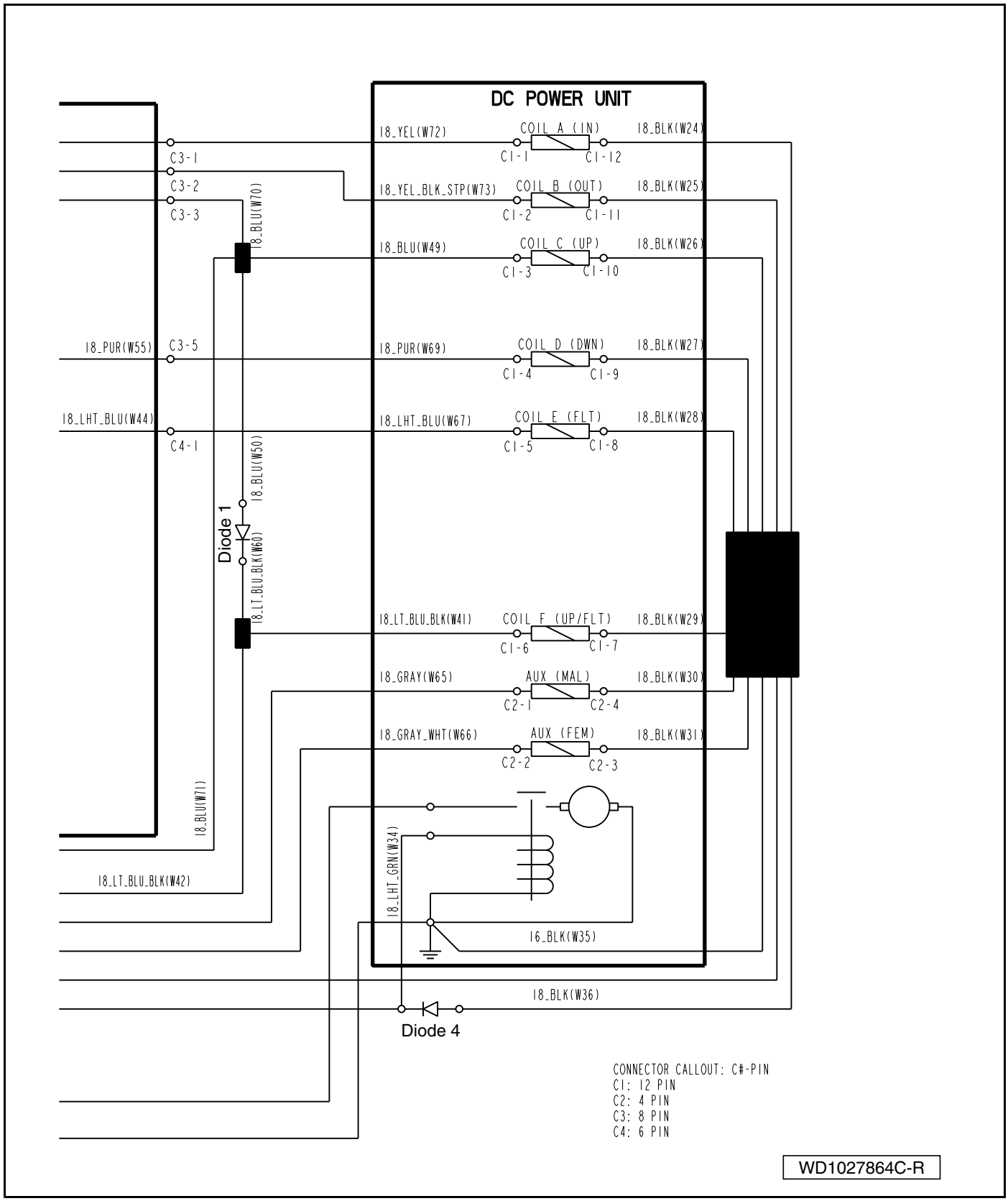
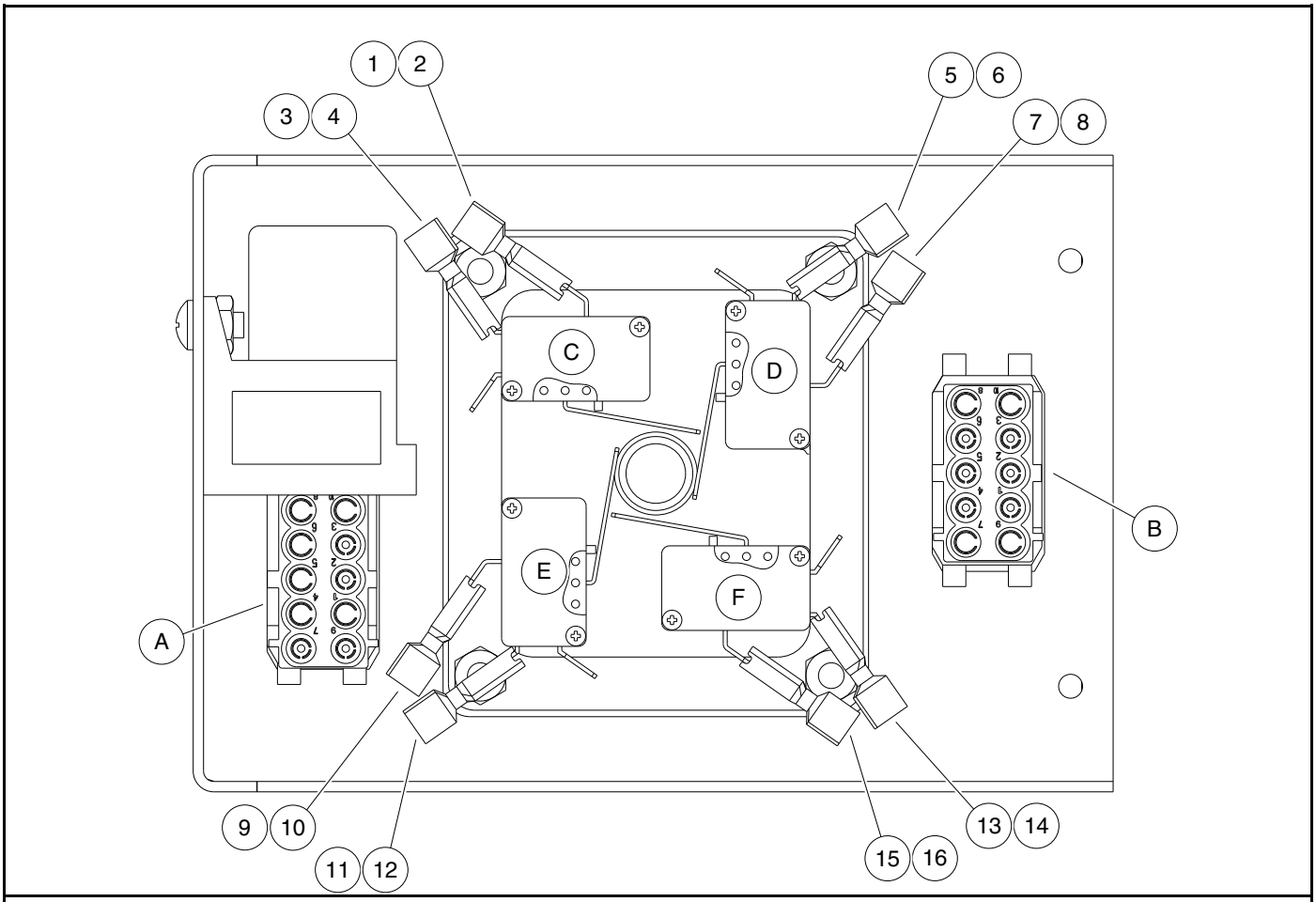



**Figure 16-19 Wiring Diagram for Hydraulic Attachment System Vehicles (Rear)**

## JOYSTICK

**See General Warnings, Section 1, Page 1-2.**




| Bottom View (Wire Harness Removed For Clarity) | | | |
|---|---|---|---|
| A. FLOAT SWITCH: 8 - Pin Connector (4 Wires) | | B. AUX SWITCH: 8 - Pin Connector (6 Wires) ON-OFF Switch Removed For Clarity | |
| C. Lift Down (Top Switch) | 1. W18_ORG (Top Switch)<br>2. W14_ORG (Bottom Switch)<br>3. W17_GRN (Top Switch)<br>4. W38_YEL (Bottom Switch) | D. Tilt In (Top Switch) | 5. W21_GRN (Top Switch)<br>6. W53_PUR (Bottom Switch)<br>7. W02_ORG (Top Switch)<br>8. W11_ORG (Bottom Switch) |
| E. Tilt Out (Top Switch) | 9. W80_ORG (Top Switch)<br>10. W78_ORG (Bottom Switch)<br>11. W19_GRN (Top Switch)<br>12. W39_BLU (Bottom Switch) | F. Lift Up (Top Switch) | 13. W13_GRN (Top Switch)<br>14. W37_YEL (Bottom Switch)<br>15. W79_ORG (Top Switch)<br>16. W77_ORG (Bottom Switch) |

2236

**Figure 16-20 Joystick Wiring**

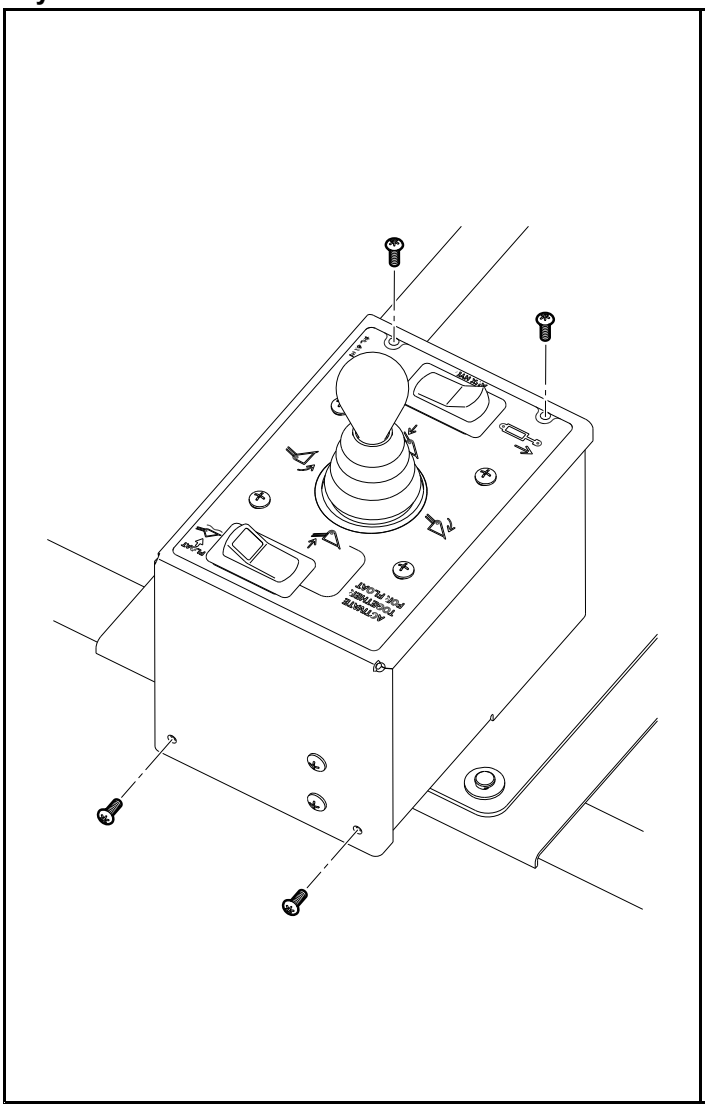
### Testing the Joystick

***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 12-15***

1. Access the underside of joystick but do not completely remove joystick or disconnect the wiring. **See Joystick Removal on page 16-11.**

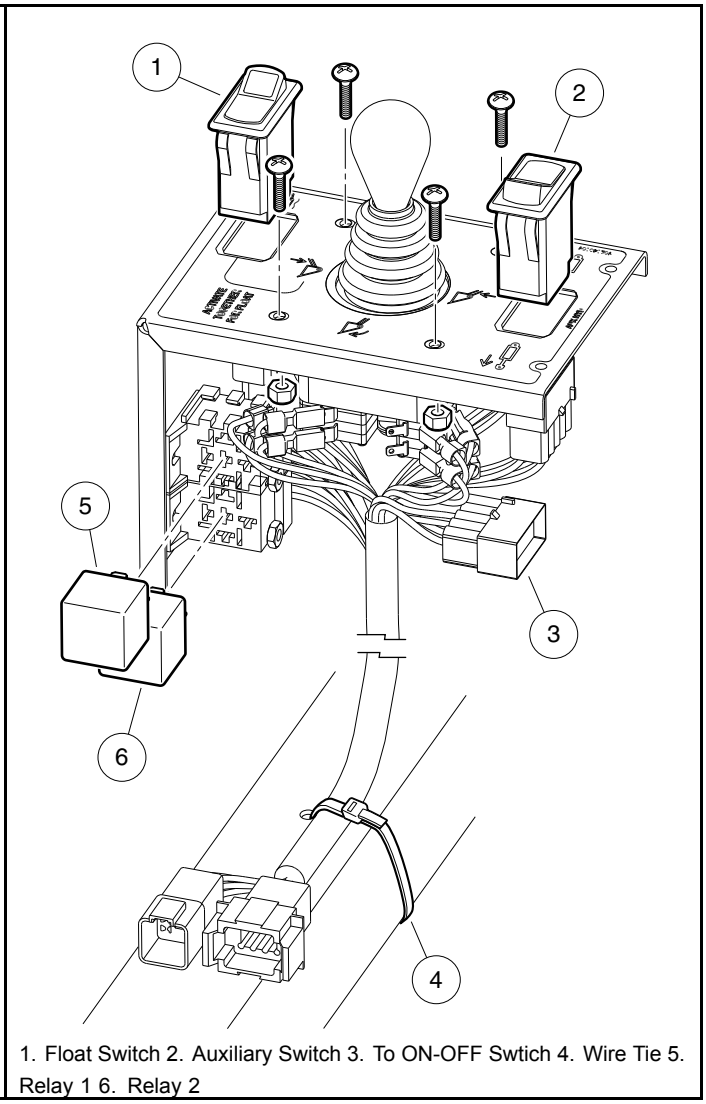
2. Check each switch, between the wired terminals, for no continuity with the joystick at “rest” and continuity with the joystick acting on the switch.
3. If a switch does not work as stated in step 2, replace switch.
4. If a switch does work as stated in step 2 and the joystick still does not work, check the following items:
   – Fuse
   – Joystick ON/OFF switch
   – Accessory relay
   – Control valves. **See Control Valves on page 16-19.**
   – Continuity of the wires involved
   – Key switch

**Joystick Removal**



2237

**Figure 16-21 Joystick Hardware**




1. Float Switch 2. Auxiliary Switch 3. To ON-OFF Swtich 4. Wire Tie 5. Relay 1 6. Relay 2

2238

**Figure 16-22 Joystick Components**

1. Set the joystick ON/OFF switch to OFF and remove both seats.
2. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**

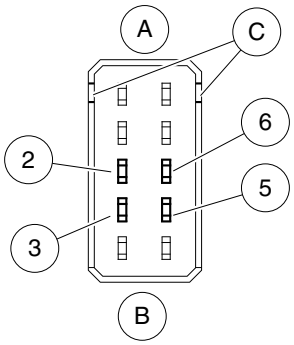
3. Cut the wire tie securing joystick harness to chassis **(Figure 16-22, Page 16-11)**.
4. Remove four screws securing control box cover/joystick assembly and pull assembly out enough to access the underside of joystick **(Figure 16-21, Page 16-11)**.
5. Ensure the wires are connected correctly and are tight. If they are not, rewire or tighten as necessary.
6. Unplug harness from the eight switches under joystick **(Figure 16-22, Page 16-11)**.
7. 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 23 in-lb (2.6 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 battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

## JOYSTICK ON/OFF SWITCH

**See General Warnings, Section 1, Page 1-2.**




A. ON Position B. OFF Position C. Alignment Notches

**Terminals:**

2. #16 Orange w81 3. #16 Orange/ Black w10
5. #18 Red/White w82 6. #18 Red w16

2239

**Figure 16-23 ON/OFF Switch Test (Rear View)**

**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 12-15.***

1. Remove the ON/OFF switch. **See Joystick ON/OFF Switch Removal on page 16-13.**
2. Check the following locations 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 following items:
   – Fuse.
   – Continuity of the 14-gauge red wire (w06) from the “hot” side of the circuit breaker to the fuse.

– Ccontinuity of the 14-gauge red wire (w52) from the fuse to the Accessory Relay

– Continuity of the 18-gauge red wire (w40) from the fuse to the ON/OFF switch.

– 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.

– 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**

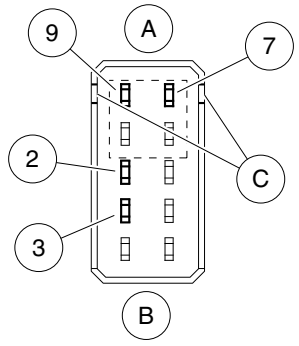
1. Set the joystick ON/OFF switch to OFF and remove both seats.
2. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
3. Cut the wire tie securing joystick harness to chassis **(Figure 16-22, Page 16-11)**.
4. Access the joystick ON/OFF switch. **See Joystick 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. 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 battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

## ATTACHMENT ARM FLOAT SWITCH

**See General Warnings, Section 1, Page 1-2.**




A. Lighted Position B. Rest Position C. Alignment Notches

**Terminals:**

2. #18 White w75 3. #18 Brown w20

7. #18 Light Blue w46 9. #18 Black w74

2240

**Figure 16-24 Float Switch Test (Rear View)**

**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 12-15.***

1. Remove the float switch. **See Float Switch Removal on page 16-14.**

2. Check the following location for no continuity with switch at “rest” and continuity with switch in the ON position **(Figure 16-24, Page 16-13)**:
   – 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 16-19.**
   – Continuity of the wires involved.

**Float Switch Removal**

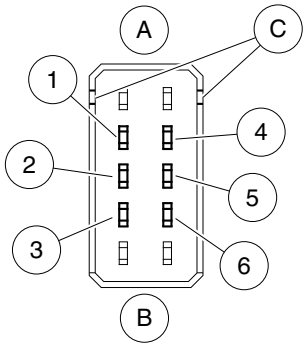
1. Set the joystick ON/OFF switch to OFF and remove both seats.
2. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
3. Cut the wire tie securing joystick harness to chassis **(Figure 16-22, Page 16-11)**.
4. Access the float switch. **See Joystick Removal on page 16-11.**
5. Ensure the wires are connected correctly and are tight. If they are not, rewire or tighten as necessary.
6. 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 battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

## AUXILIARY HYDRAULIC SWITCH

**See General Warnings, Section 1, Page 1-2.**




A. Extend Position B. Retract Position C. Alignment Notches

**Terminals:**

1. #18 Gray w1 2. #18 Red/White w82 3. #18 Gray w57
4. #18 Green w22 5. #18 Orange w12 6. #18 Yellow w23

2241

**Figure 16-25 Auxiliary Hydraulic Switch Test (Rear View)**

### 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 12-15.***

1. Remove the auxiliary hydraulic switch. **See Auxiliary Switch Removal on page 16-15.**
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 16-15.**
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 16-19.**
   – Continuity of the wires involved.

### Auxiliary Switch Removal

1. Set the joystick ON/OFF switch to OFF and remove both seats.
2. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
3. Cut the wire tie securing joystick harness to chassis **(Figure 16-22, Page 16-11)**.
4. 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.**
5. Ensure the wires are connected correctly and are tight. If they are not, rewire or tighten as necessary.

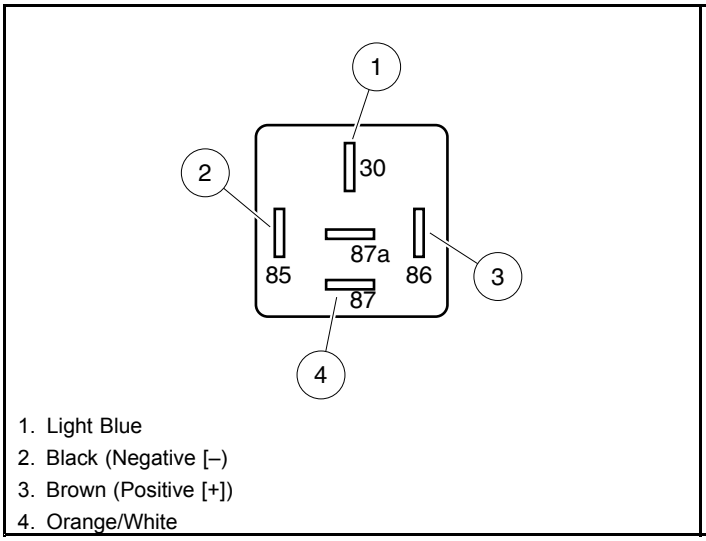
6. Unplug harness from switch **(Figure 16-22, Page 16-11)**. Note orientation of alignment notches **(Figure 16-25, Page 16-15)**. Squeeze tabs at each end of switch and push switch out the top of the control box cover.

**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 battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

## RELAYS

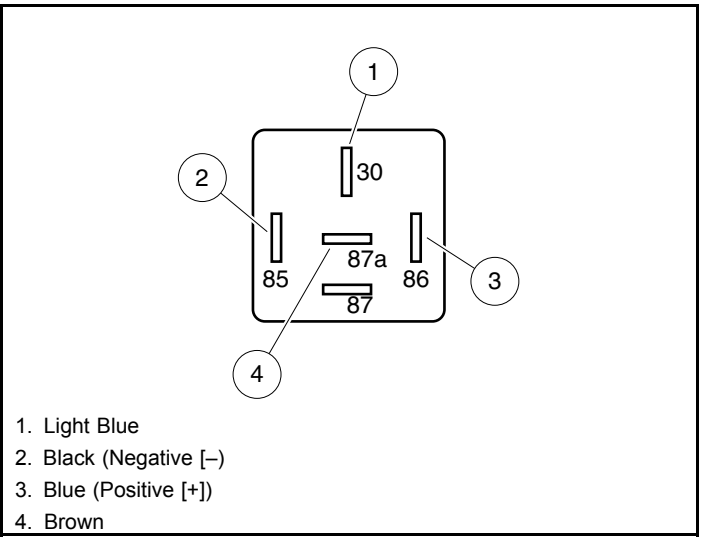
**See General Warnings, Section 1, Page 1-2.**




1. Light Blue
2. Black (Negative [–)
3. Brown (Positive [+])
4. Orange/White

2245

**Figure 16-26 Relay 1 Wiring and Testing**




1. Light Blue
2. Black (Negative [–)
3. Blue (Positive [+])
4. Brown

2243

**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 16-16)**.
2. Test for no continuity between terminal 87 (orange/white wire) and terminal 30 (light blue wire) **(Figure 16-26, Page 16-16)**.
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 16-16)**.
2. Test for continuity between terminal 87a (brown wire) and terminal 30 (light blue wire) **(Figure 16-27, Page 16-16)**.
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. Set the joystick ON/OFF switch to OFF.
2. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
3. 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.**
4. Ensure the wires are connected correctly and are tight. If they are not, rewire or tighten as necessary.
5. Locate and pull or pry the relay out of the multi-pin connector to remove **(Figure 16-22, Page 16-11)**.

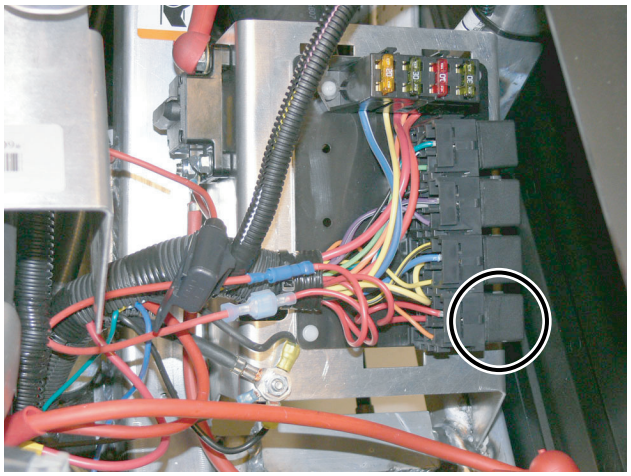
**Float Relay 1 and 2 Installation**

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.*

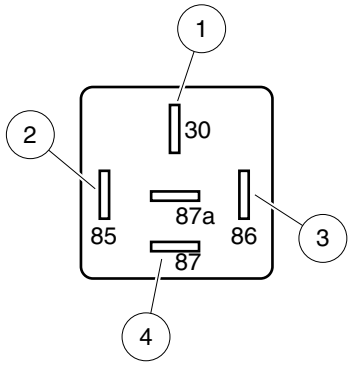
2. Install control box cover/joystick assembly and secure with the four screws.
3. Connect battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

**Testing the Accessory Relay**



2244

**Figure 16-28 Accessory Relay Location**




1. Red
2. Black (Negative [–)
3. Orange (Positive [+])
4. Red

2245

**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 16-17)**.
2. Test for no continuity between terminals 87 and 30 (red wires) **(Figure 16-29, 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 terminals 87 and 30 (red wires).

**Accessory Relay Removal**

1. Remove driver seat.
2. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
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. Locate and pull or pry the accessory relay out of the multi-pin connector to remove **(Figure 16-28, Page 16-17)**.

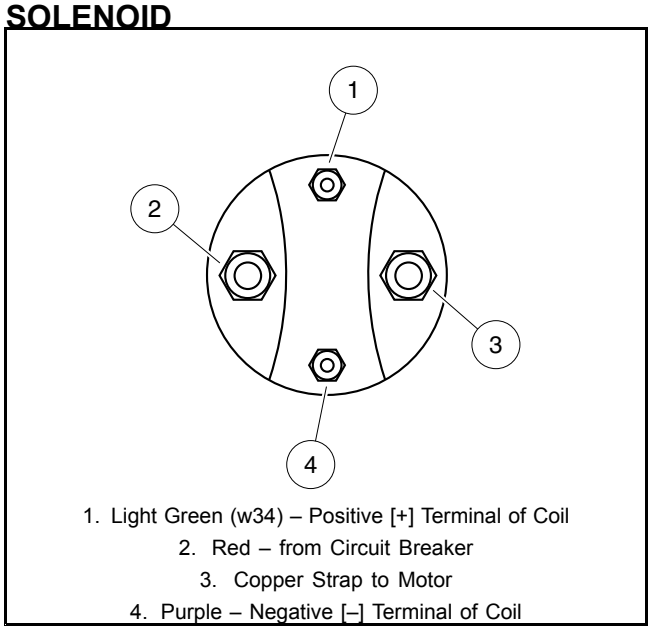
**Accessory Relay Installation**

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 battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**
3. Install the electrical component cover and driver seat.

## SOLENOID




1. Light Green (w34) – Positive [+] Terminal of Coil
2. Red – from Circuit Breaker
3. Copper Strap to Motor
4. Purple – Negative [–] Terminal of Coil

2246

**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 16-18)**.
2. Test for no continuity between the two large terminals (red wire and copper strap) **(Figure 16-30, Page 16-18)**.
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. Set the joystick ON/OFF switch to OFF.
3. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
4. Note wiring and disconnect wires and copper strap from solenoid.
5. 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 battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**
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. Set the joystick ON/OFF switch to OFF.

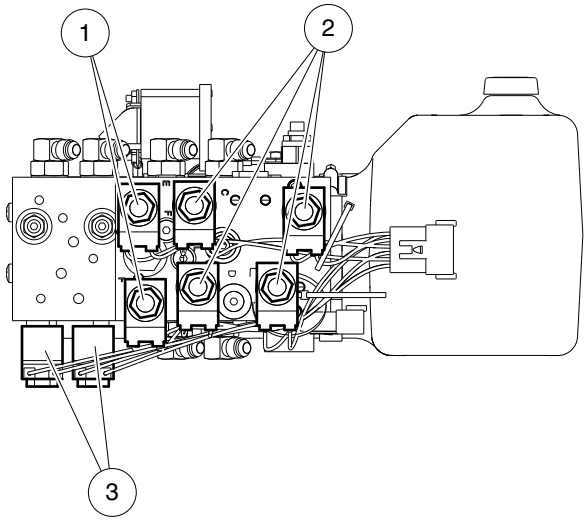
3. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
4. Disconnect wires from each post of circuit breaker.
5. Remove hardware securing breaker to chassis and remove breaker.

**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 battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**
4. Lower the cargo bed.

## CONTROL VALVES

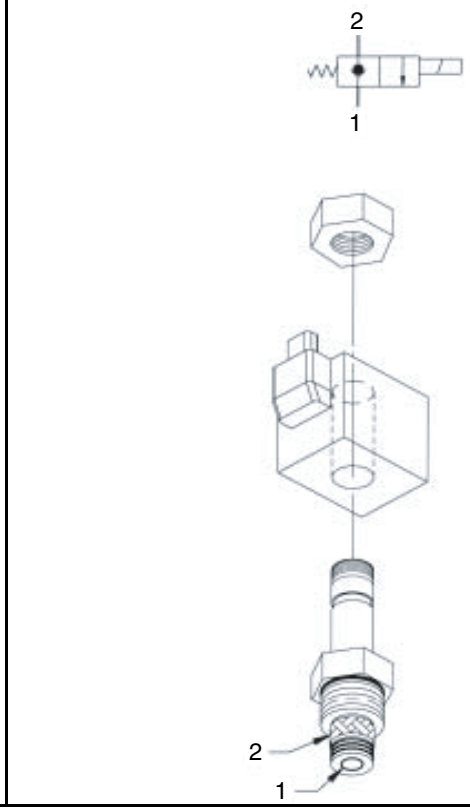
**Two-Way 2-Position Normally Closed Valves**




1. Two-Way 2-Position Control Valves
2. Three-Way 2-Position Control Valves
3. Four-Way 2-Position Control Valves

2247

**Figure 16-31 Control Valve Identification**




2248

**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 16-19)**.

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.

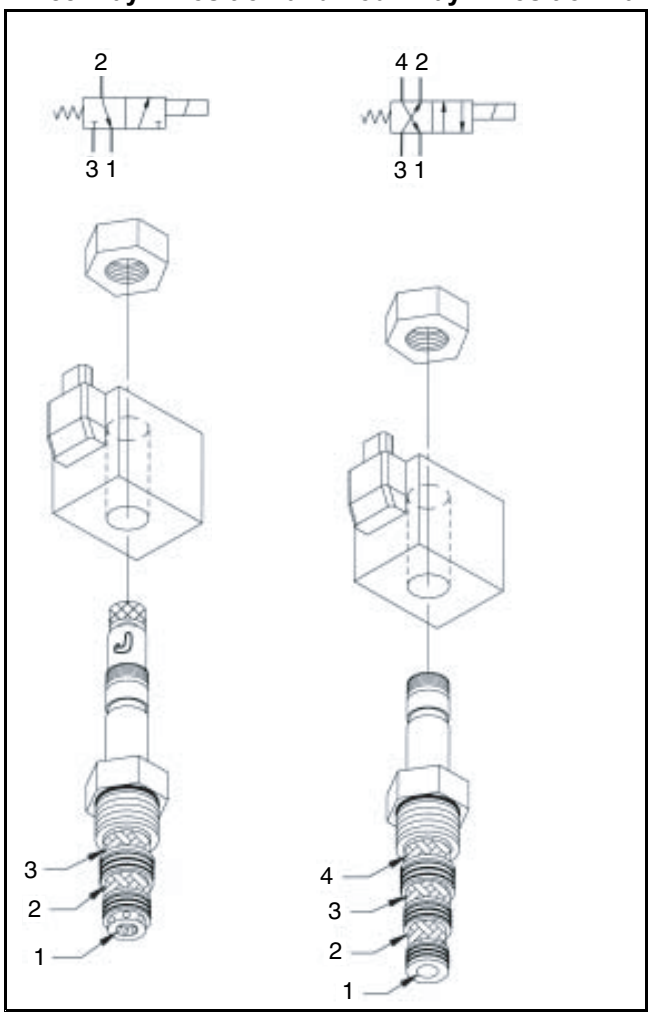
– A bent valve stem. Replace valve.

– 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**




2249

**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 16-20)**:

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.

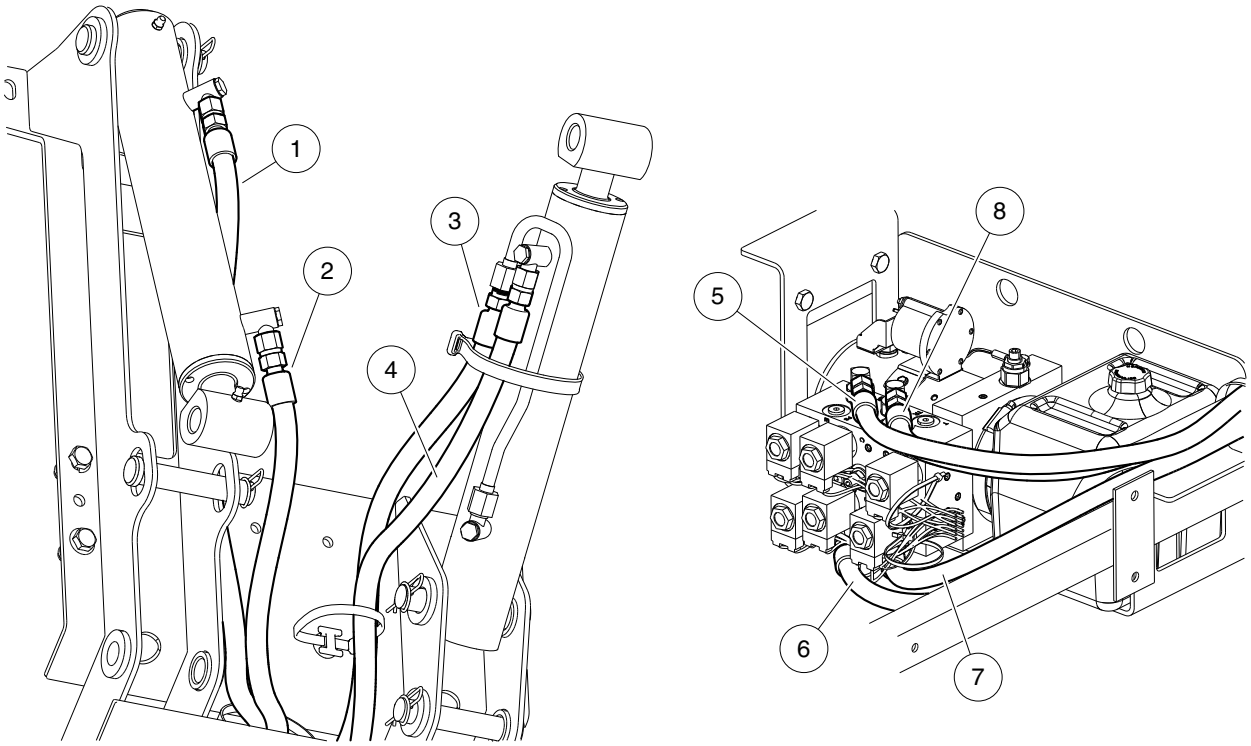
– Any debris in the valve cartridge.
  – Check for debris by energizing the valve without starting the motor and listening for the “valve shift” (a definite “Click” is heard when the valve in energized).

  – 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

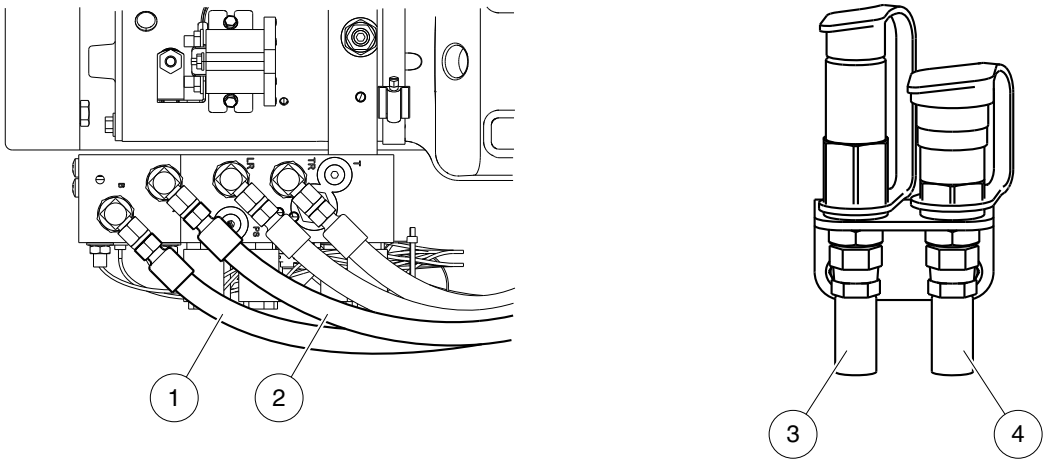
## HOSE ROUTING




**At Lift and Lower Cylinder:** 1. Green 2. Blue
**At Tilt Up and Tilt Down Cylinder:** 3. Pink 4. No Color
**At Pump:** 5. Blue 6. Green 7. Pink 8. No Color

2250

**Figure 16-34 Lift And Tilt Circuit Hoses**




1. Red Hose At Pump 2. White Hose At Pump 3. White Hose At Quick Connect Fittings 4. Red Hose At Quick Connect Fittings

2251

**Figure 16-35 Auxiliary Circuit Hoses**

## HOSE REMOVAL

1. Relieve pressure in hydraulic system. **See Relieving Hydraulic System Pressure on page 16-1.**
2. Set the joystick ON/OFF switch to OFF, remove driver seat and disable vehicle. **See Disabling the Vehicle on page 1-3.**
3. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
4. Thoroughly clean the hose fittings and the area around the ends of the hose being removed **(Figure 16-34, Page 16-21)**.
5. 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.*

6. 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.*

7. 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 16-21)**.

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)



2252

**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. Set the joystick ON/OFF switch to OFF, remove driver seat and disable vehicle. **See Disabling the Vehicle on page 1-3.**
3. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
4. Thoroughly clean the fittings and the area around them.
5. Mark hoses to ease reassembly and disconnect hoses from quick connect fittings. **See following NOTE.** Cover hoses and fittings to keep out debris.

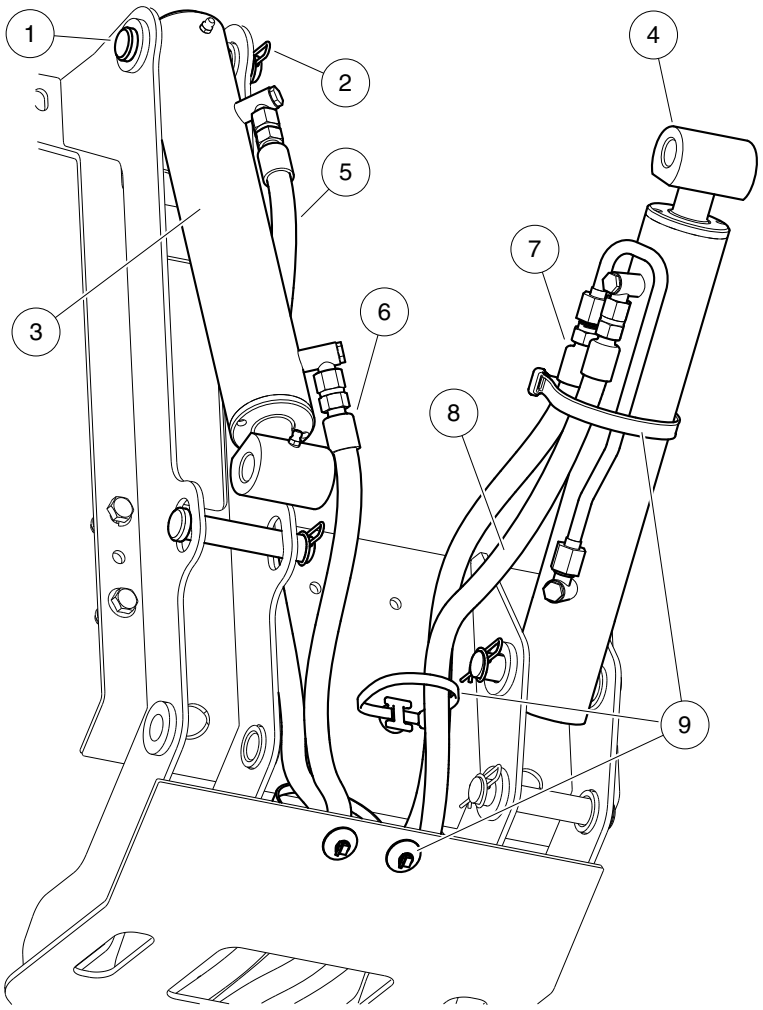
***NOTE:*** *Mark hoses for correct installation if factory markings are not found.*

6. Remove the lock nut securing the quick connect fitting to the bracket **(Figure 16-36, Page 16-23)**.

## 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 16-22)**. Tighten fittings to 22 ft-lb (30 N·m).

# CYLINDERS




1. Pivot Pin 2. Retaining Pin 3. Cylinder (Lift and Lower) 4. Cylinder (Tilt Up and Tilt Down) 5. Green 6. Blue 7. Pink 8. No Color 9. Wire Ties

2253

**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. Set the joystick ON/OFF switch to OFF, remove driver seat and disable vehicle. **See Disabling the Vehicle on page 1-3.**
3. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
4. Thoroughly clean the cylinder, hose fittings and the area around them **(Figure 16-37, Page 16-24)**.
5. Mark hoses to ease reassembly and disconnect hoses from cylinders. Cover hoses and fittings to keep out debris.
6. Remove retaining pin(s) and pivot pin(s) securing cylinder to chassis and remove cylinder **(Figure 16-37, Page 16-24)**.

**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 16-24)**. Tighten fittings to 22 ft-lb (30 N·m).
3. Lubricate attachment ends. **See Lubricating the Attachment Arm and Interface – IntelliTach, Section 11, Page 11-9.**
4. Refill and prime system. **See Priming the Pump, Section 16, Page 16-47.**

## 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.**

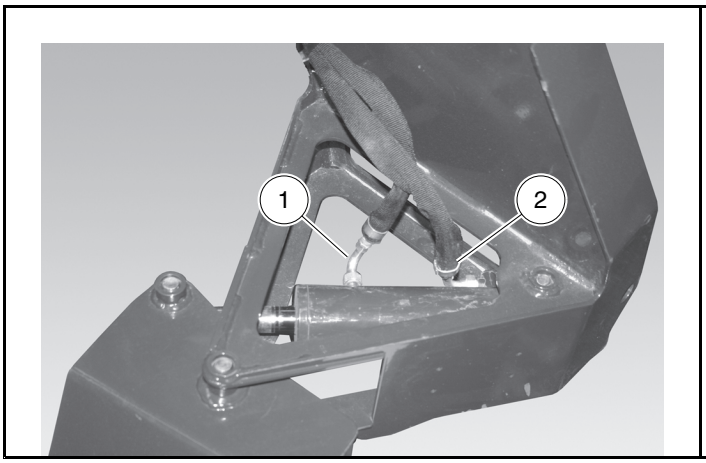
***NOTE:*** *Contain and dispose of any leaking oil in an environmentally safe manner.*

*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 16-26)**. **See following NOTE.**

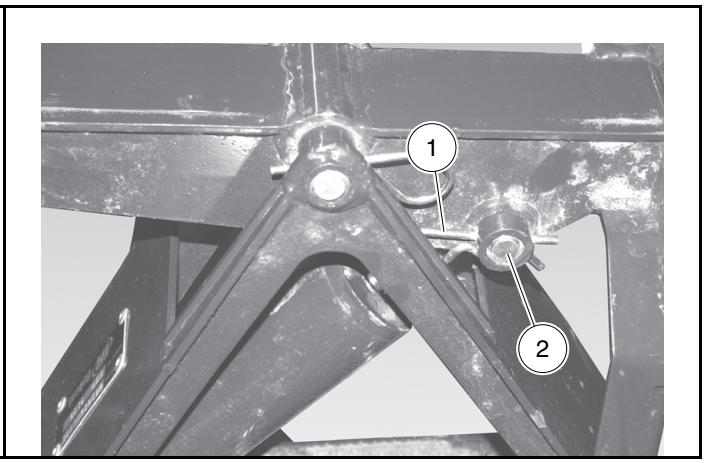
***NOTE:*** *Mark hoses for correct installation if factory markings are not found.*

2. Remove retaining pin (1) and pivot pin (2) from rod end of hydraulic cylinder **(Figure 16-39, Page 16-26)**.




2254

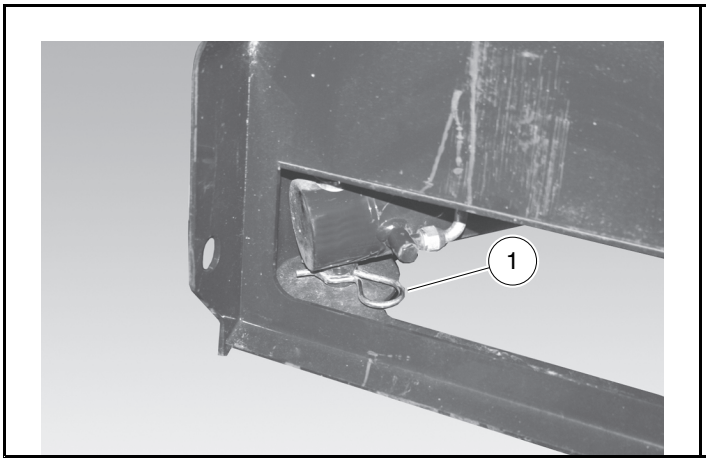
**Figure 16-38 Hoses**




2255

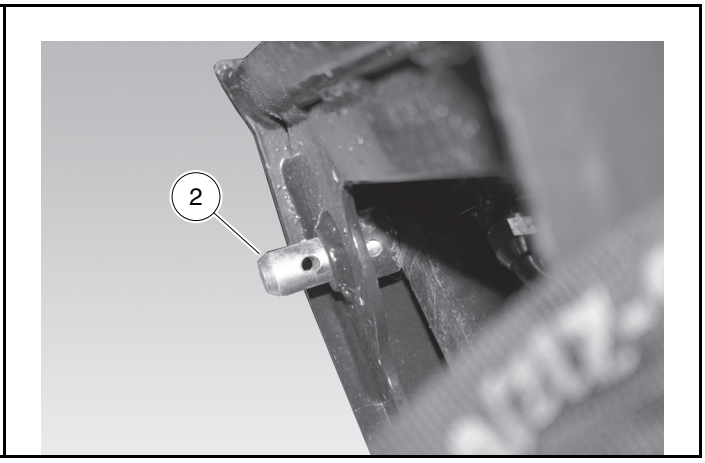
**Figure 16-39 Remove Rod End Pins**

3. Remove retaining pin (1) from the base end of the hydraulic cylinder **(Figure 16-40, Page 16-26)**.
4. Remove pivot pin (2) **(Figure 16-41, Page 16-26)** from the base end of the hydraulic cylinder and remove cylinder.




2256

**Figure 16-40 Remove Retaining Pin**




2257

**Figure 16-41 Remove Pivot Pin**

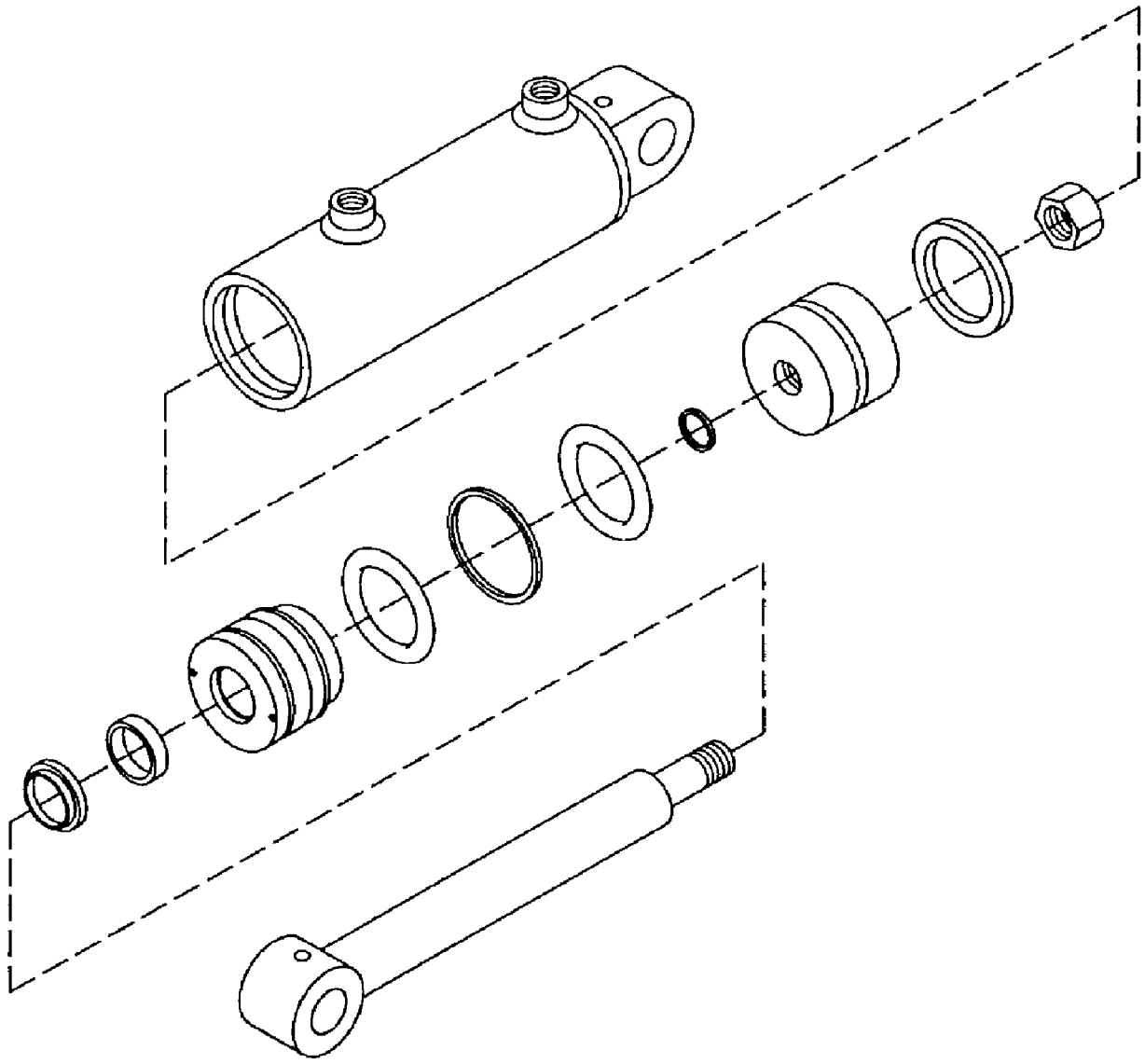
**Auxiliary Cylinder Installation**

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 16-26)**. **See following NOTE.**

***NOTE:*** *If installed incorrectly, this retaining pin will restrict attachment travel.*

## CYLINDER DISASSEMBLY

### Parts Identification



NOTE: The drawing may not show your hydraulic cylinder exactly as it appears, but the internal assembly is the same.

| | | |
|---|---|---|
| 1. Case | 5. O-ring | 9. Head |
| 2. Nut | 6. O-ring | 10. Oil Seal |
| 3. Seal | 7. Back-up Ring | 11. Dust Seal |
| 4. Piston | 8. O-ring | 12. Rod |

2258

**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.**

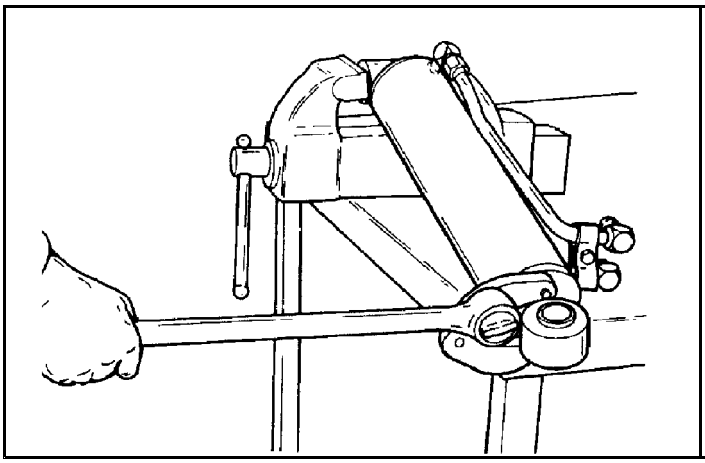
***NOTE:*** *Contain and dispose of any leaking oil in an environmentally safe manner.*

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)

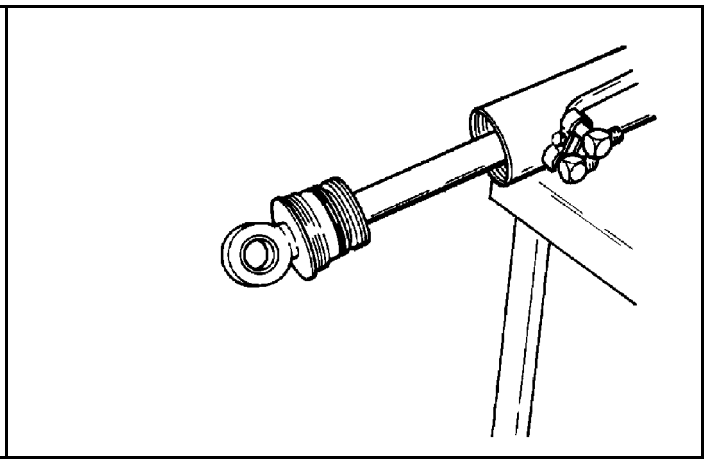
***NOTE:*** *The drawings may not show the cylinder exactly as it appears, but the procedure is correct for all the cylinders.*

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 16-29)**.
5. Remove the rod assembly from the cylinder case **(Figure 16-44, Page 16-29)**.
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 16-29)**.
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 16-29)**.



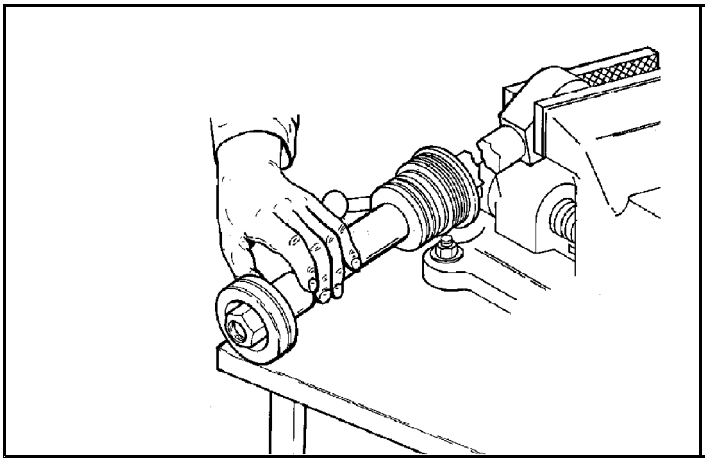
2259

**Figure 16-43 Loosen the Head**



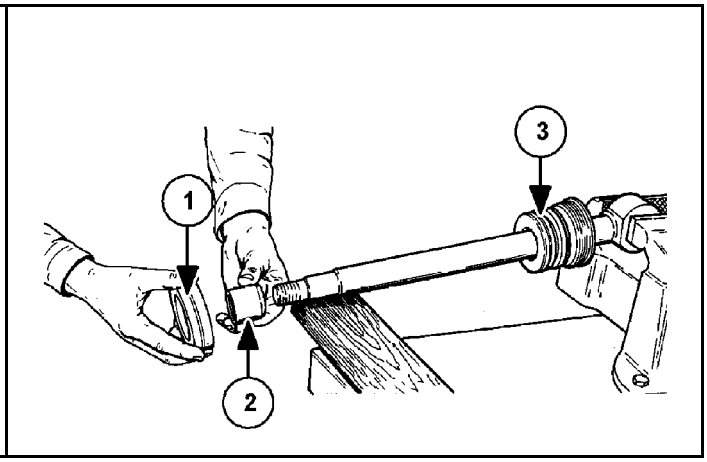
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**Figure 16-44 Remove Rod Assembly**



2261

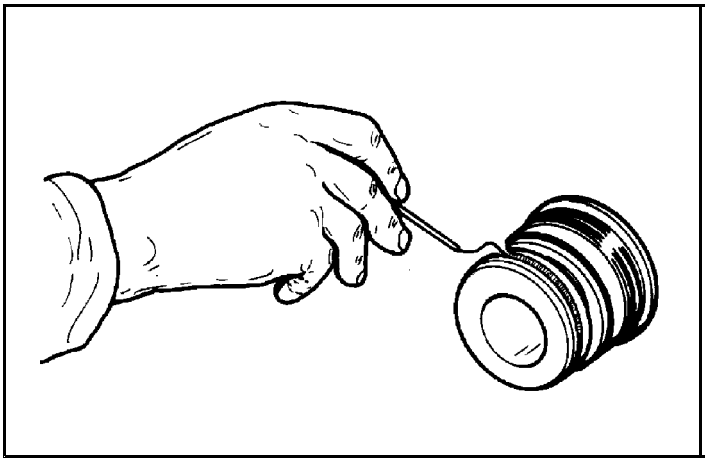
**Figure 16-45 Remove Nut from Piston**




2262

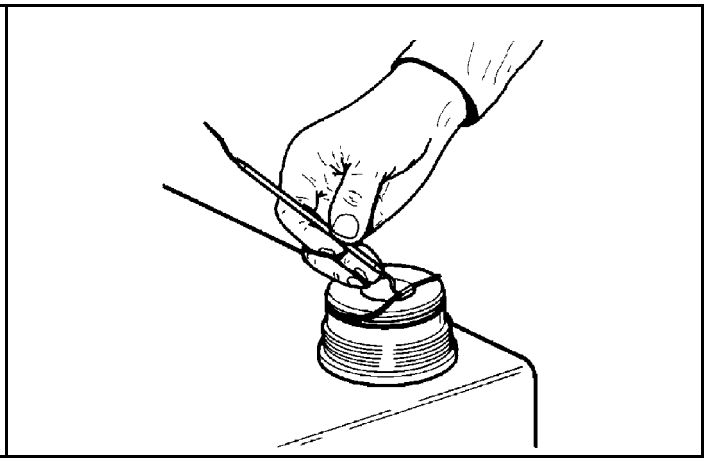
**Figure 16-46 Pull Components from Rod**

10. If the head has a seal, remove the seal from the head **(Figure 16-47, Page 16-29)**.
11. Remove the O-ring and back-up washer from the head **(Figure 16-48, Page 16-29)**.



2263

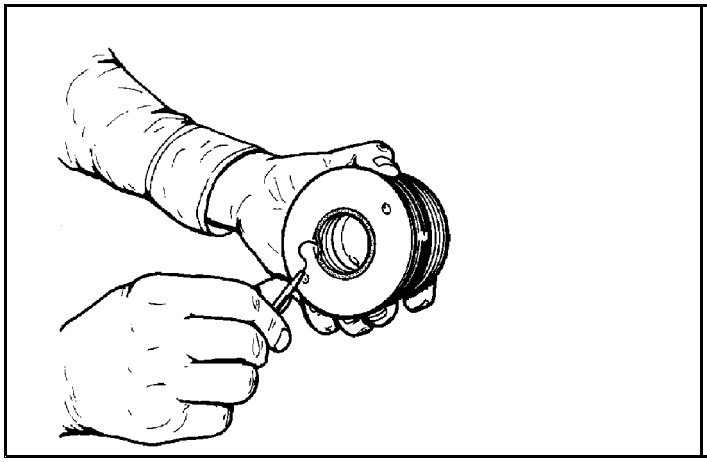
**Figure 16-47 Remove Seal**



2264

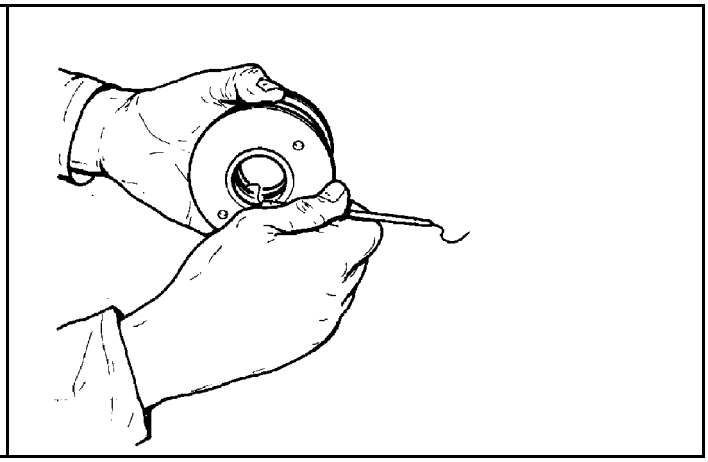
**Figure 16-48 Remove O-ring and Back-up Washer**

12. Remove the wiper seal **(Figure 16-49, Page 16-30)**.
13. Remove the oil seal from the head **(Figure 16-50, Page 16-30)**.



2265

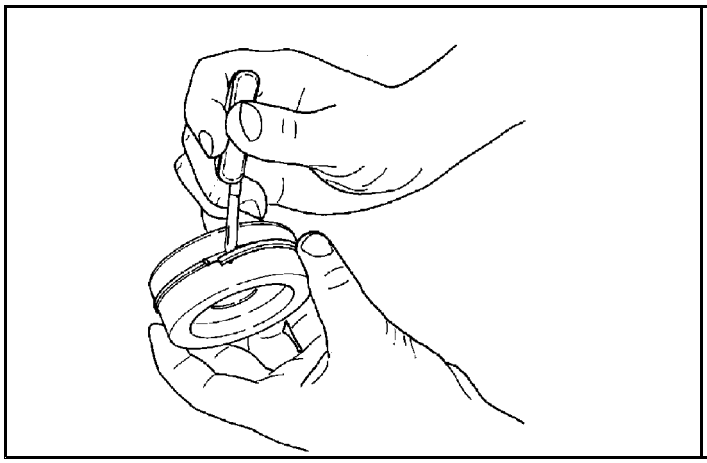
**Figure 16-49 Remove Wiper Seal**



2266

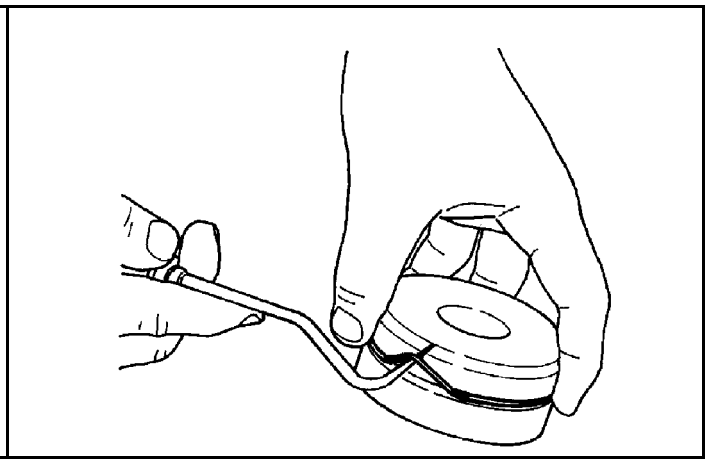
**Figure 16-50 Remove Oil Seal**

14. Remove the piston seal from the piston **(Figure 16-51, Page 16-30)**.
15. Remove the O-ring from the piston **(Figure 16-52, Page 16-30)**.



2267

**Figure 16-51 Remove Piston Seal**



2268

**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

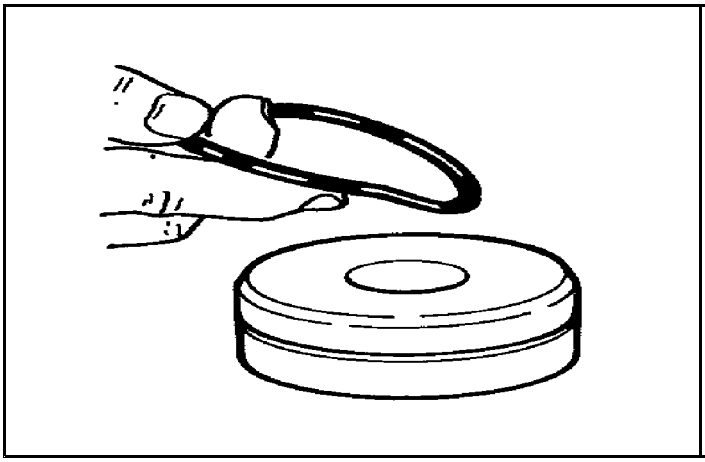
- **Wear safety glasses to prevent eye injury when any of the following conditions exist:**
  - **Fluids are under pressure.**
  - **Flying debris or loose material is present.**
  - **Engine is running.**
  - **Tools are being used.**

1. Install the O-ring on the piston **(Figure 16-53, Page 16-31)**.

***NOTE:*** *Do not overstretch the seal.*

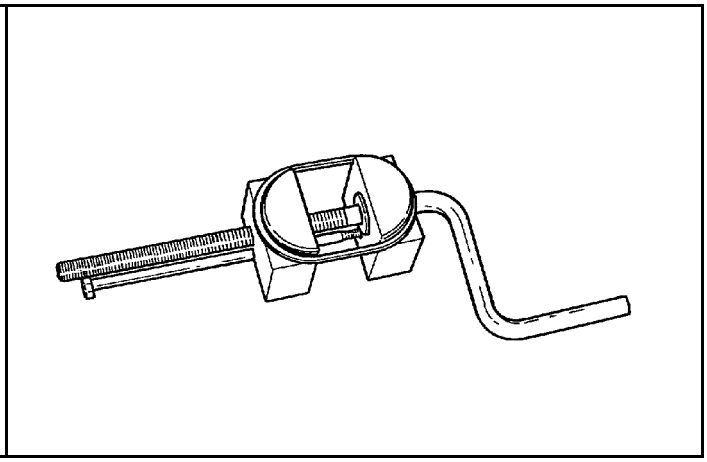
2. Install the seal on the tool and stretch it until it fits the piston **(Figure 16-54, Page 16-31)**. Allow the O-ring to stretch for 30 seconds before removing it from the tool.
3. Install the seal on the piston **(Figure 16-55, Page 16-32)**.
4. Use the ring compressor to compress the seal to the correct size **(Figure 16-56, Page 16-32)**.

***NOTE:*** *Leave the piston in the ring compressor for three minutes.*



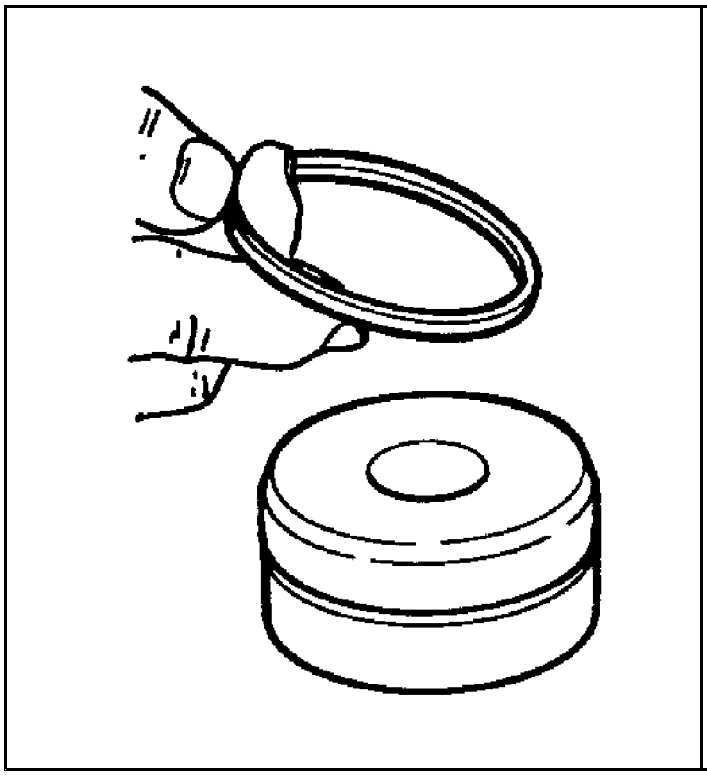
2269

**Figure 16-53 Install Piston O-ring**



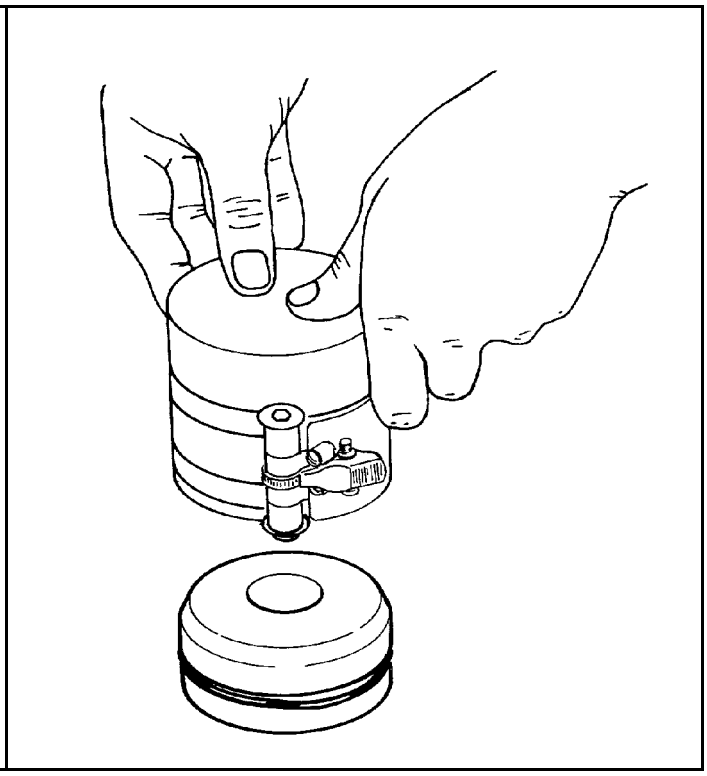
2270

**Figure 16-54 Stretch Piston Seal**



2271

**Figure 16-55 Install Piston Seal**



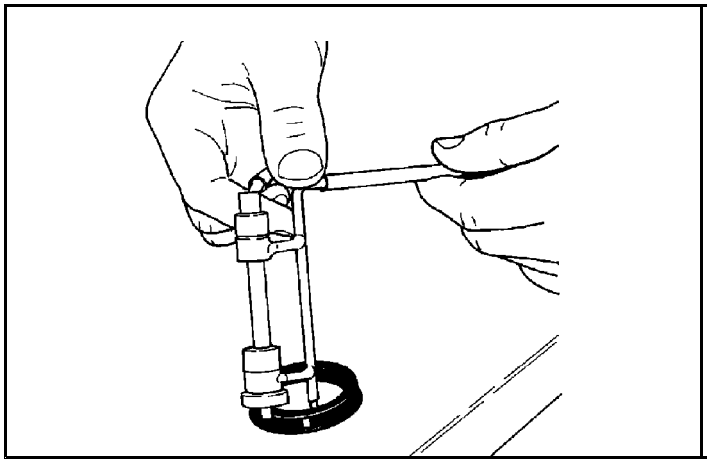
2272

**Figure 16-56 Compress Piston Seal**

5. Install the oil seal on the rod seal tool **(Figure 16-57, Page 16-32)**.

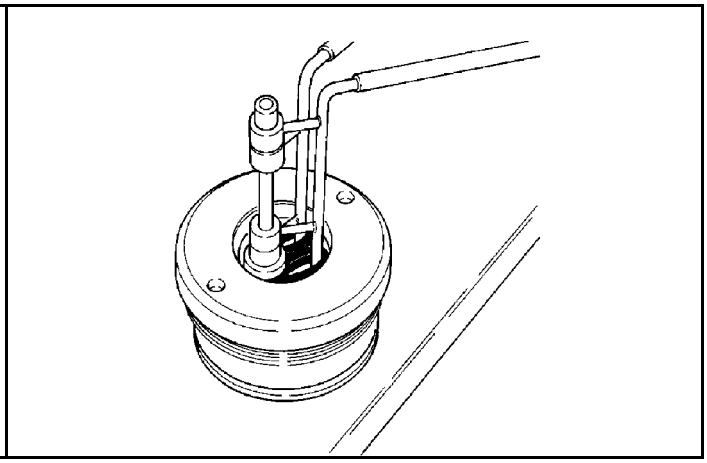
***NOTE:*** *The O-ring side of the oil seal goes toward the inside of the cylinder.*

6. Install the oil seal in the head **(Figure 16-58, Page 16-32)**.



2273

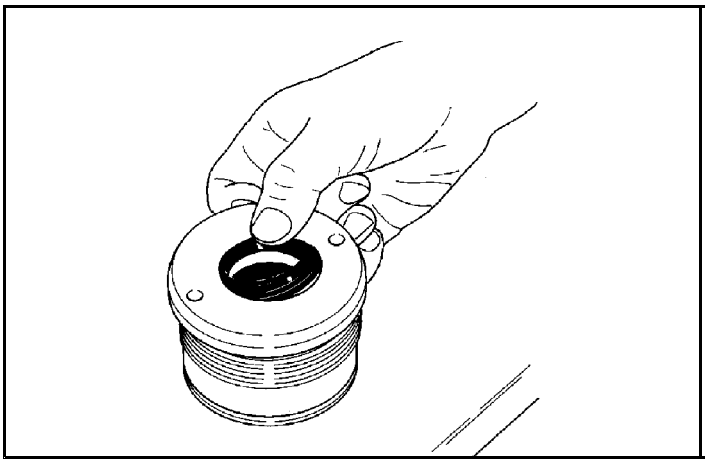
**Figure 16-57 Rod Seal Tool**



2274

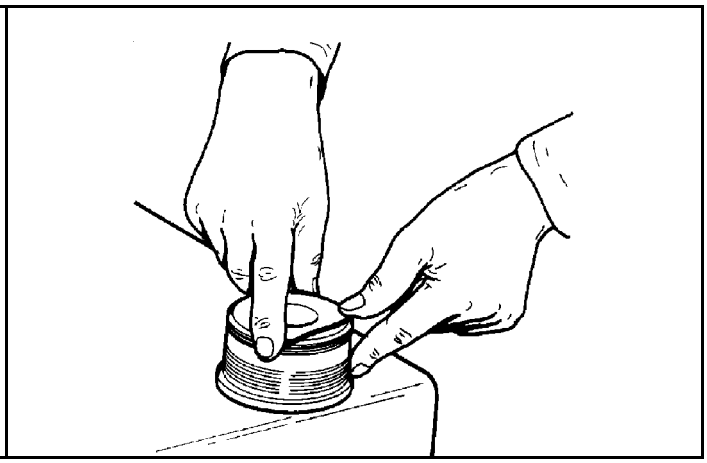
**Figure 16-58 Install Oil Seal in Head**

7. Install the wiper seal with the lip toward the outside of the head **(Figure 16-59, Page 16-33)**.
8. Install the back-up washer on the head **(Figure 16-60, Page 16-33)**.



2275

**Figure 16-59 Install Wiper Seal**



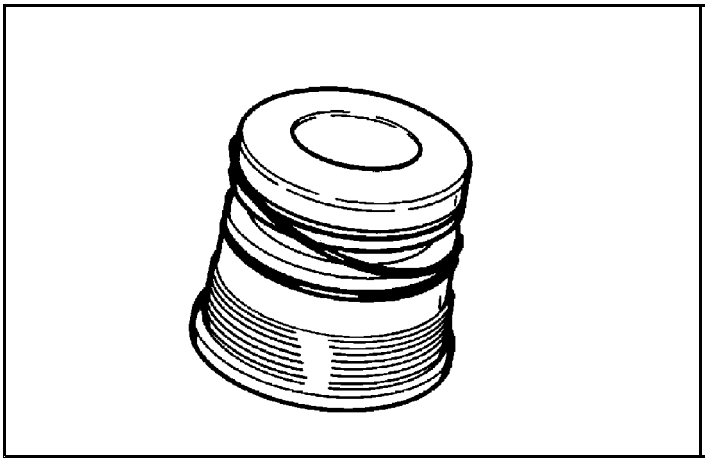
2276

**Figure 16-60 Install Back-up Washer**

9. Install the O-ring next to the back-up ring as shown **(Figure 16-61, Page 16-33)**.
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 16-33)**.
12. Install the seal on the head using the guide **(Figure 16-62, Page 16-33)**. **See following CAUTION.**

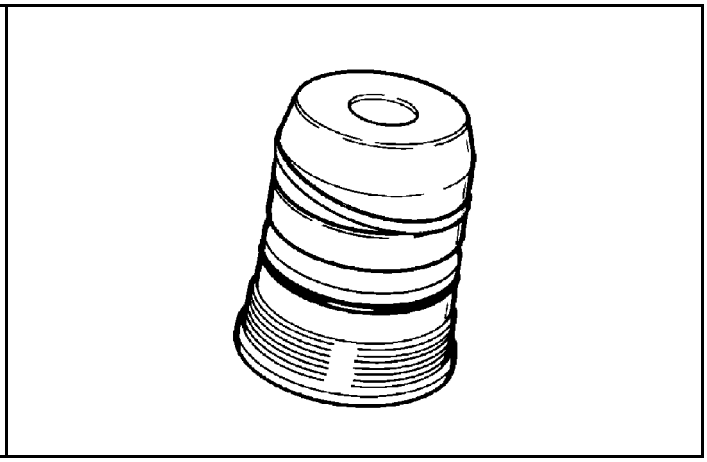
## CAUTION

- **Do not turn (roll) the seal as you install it. Damage to the seal may result.**



2277

**Figure 16-61 Install O-ring on Head**



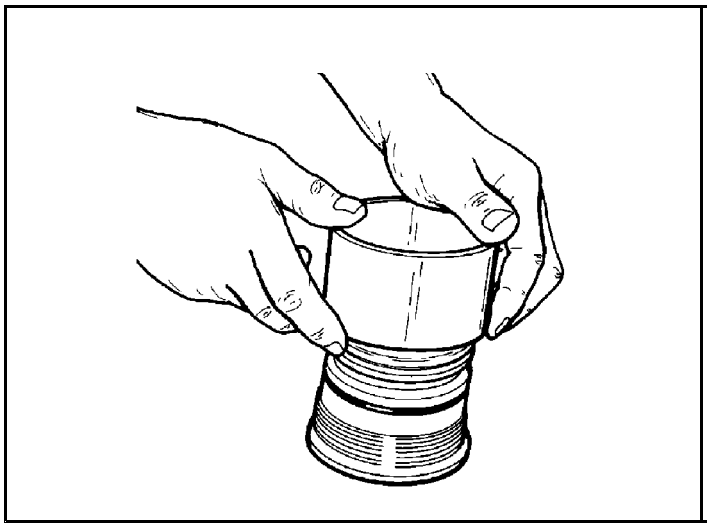
2278

**Figure 16-62 Install Seal**

13. Use a ring compressor to compress the seal to the correct size **(Figure 16-63, Page 16-34)**. Leave the tool over the Teflon seal for five minutes.
14. Install the head on the rod **(Figure 16-64, Page 16-34)**.
15. Note piston type and install according to the following criteria:

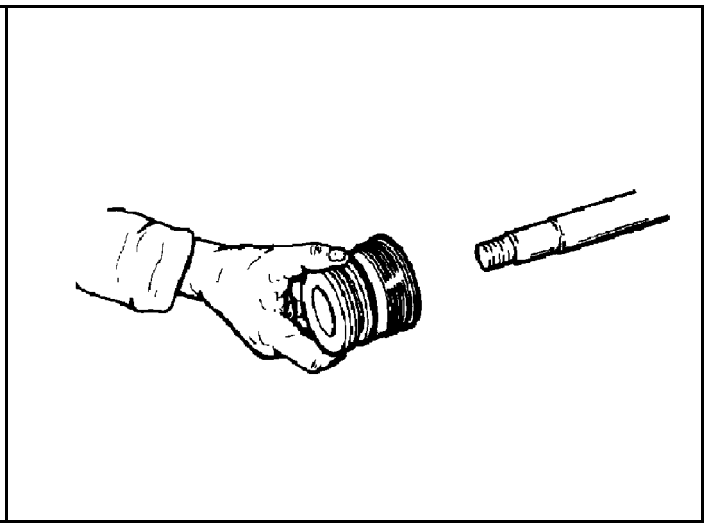
15.1. For cylinders with a cushioned piston, install the piston on the rod with the tapered end first (toward the head) **(Figure 16-65, Page 16-34)**.

15.2. For all other cylinders, install the cushion sleeve (if so equipped) and piston on the rod **(Figure 16-66, Page 16-34)**.



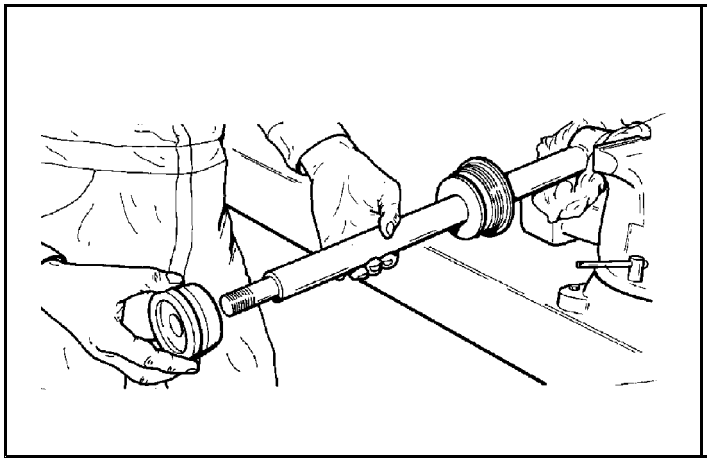
2279

**Figure 16-63 Compress Seal**



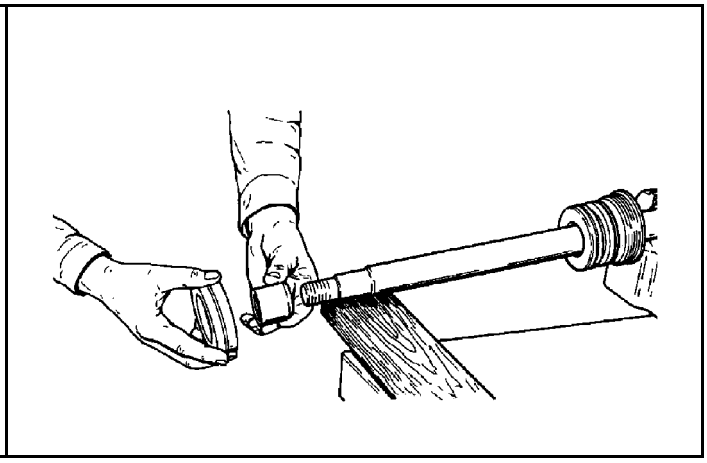
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**Figure 16-64 Install Head on Rod**



2281

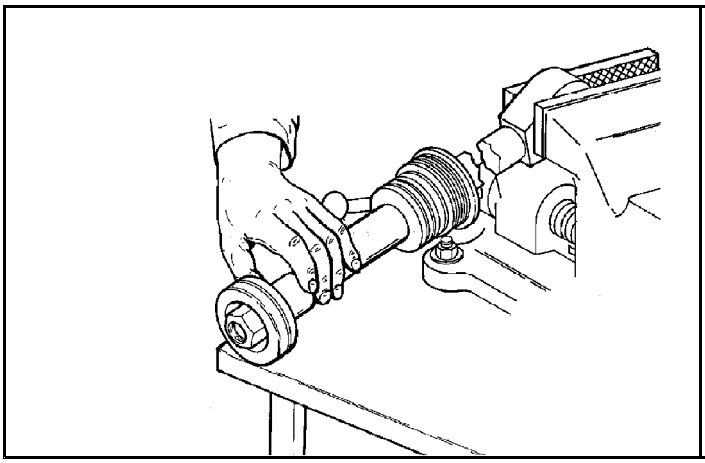
**Figure 16-65 Install Cushioned Piston (If Equipped)**



2282

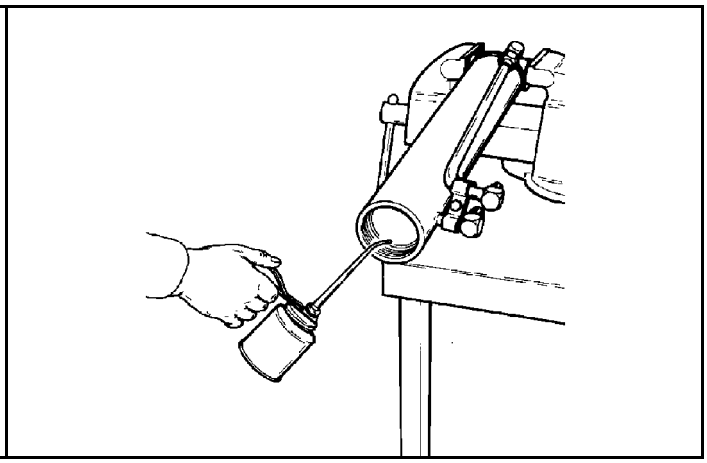
**Figure 16-66 Install Cushion Sleeve (If Equipped) and Piston**

16. Install and tighten nut to 150 to 185 ft-lb (203 to 251 N·m) torque **(Figure 16-67, Page 16-35)**.
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 16-35)**.



2283

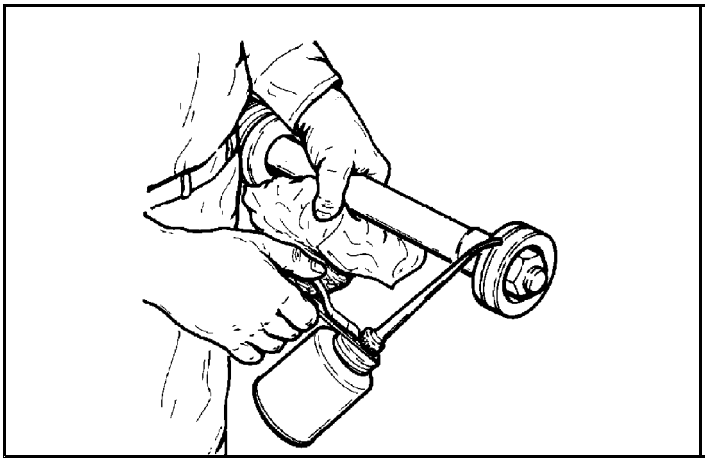
**Figure 16-67 Install and Tighten Piston Nut**



2284

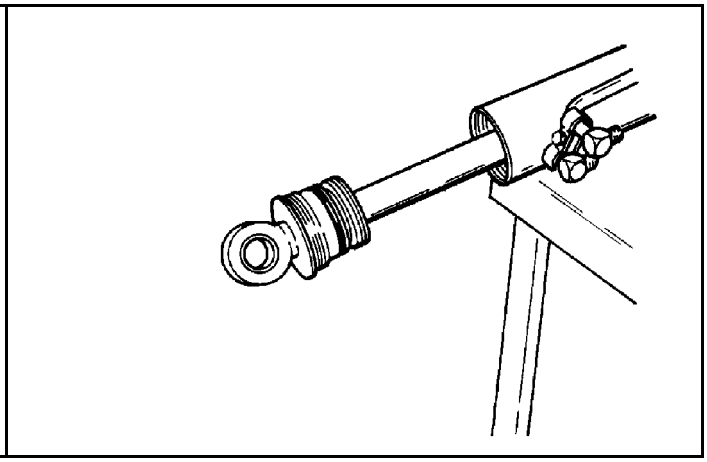
**Figure 16-68 Lubricate Seal**

20. Put oil on the Teflon seal on the piston **(Figure 16-69, Page 16-35)**.
21. Install the rod assembly in the cylinder case **(Figure 16-70, Page 16-35)**.
22. Put oil on the seals and threads on the head **(Figure 16-71, Page 16-36)**.
23. Use the adjustable gland nut wrench to tighten the head until the head is flush with the case **(Figure 16-72, Page 16-36)**.



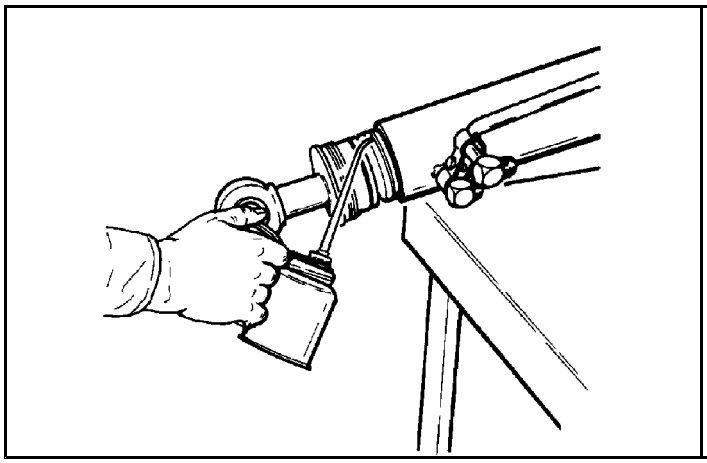
2285

**Figure 16-69 Lubricate Piston Seal**



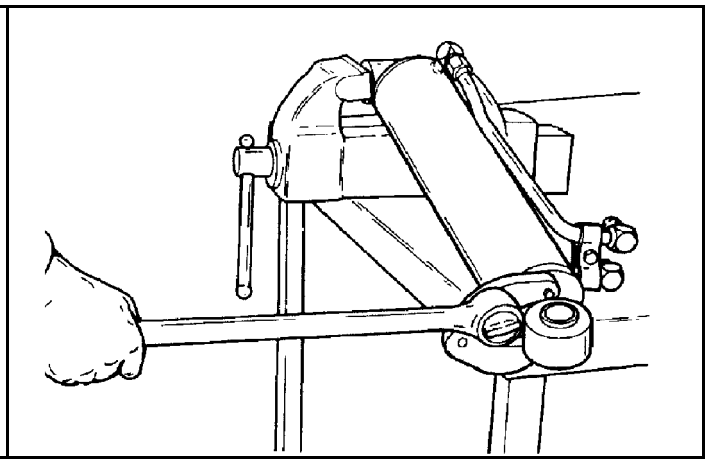
2286

**Figure 16-70 Install Rod Assembly**



2287

**Figure 16-71 Lubricate Head Seals**



2288

**Figure 16-72 Tighten Head Against Case**

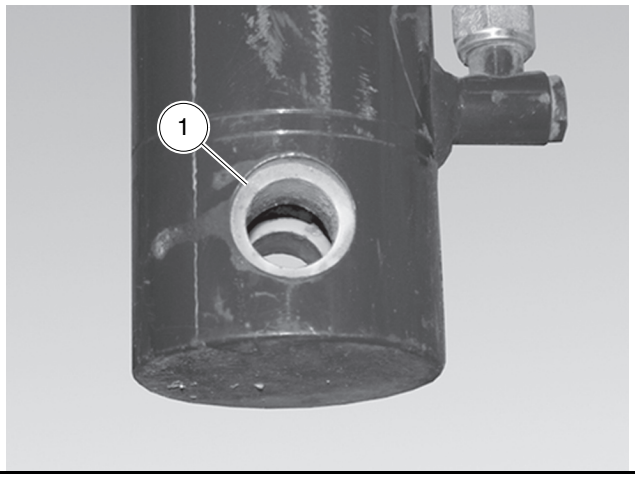
## CYLINDER BUSHINGS (IF EQUIPPED)

**Removal and Installation**

### ⚠ WARNING

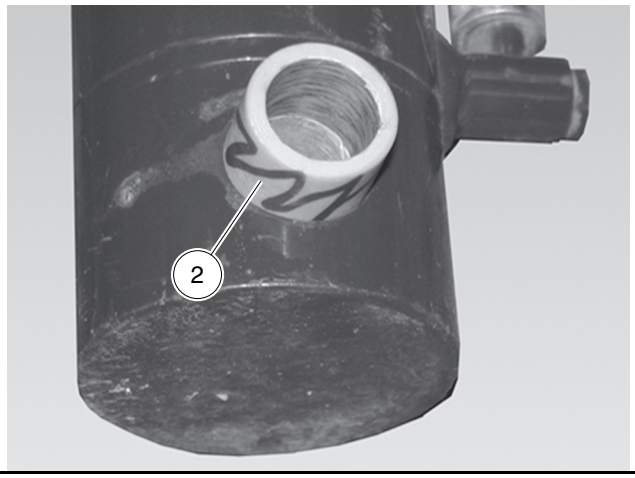
- **Wear safety glasses to prevent eye injury when any of the following conditions exist:**
  - **Fluids are under pressure.**
  - **Flying debris or loose material is present.**
  - **Engine is running.**
  - **Tools are being used.**

1. Remove bushing(s) (1) **(Figure 16-73, Page 16-36)** 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 16-36)**.




2289

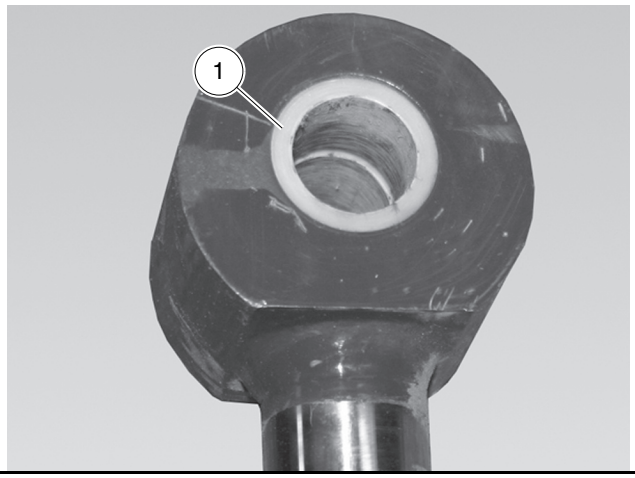
**Figure 16-73 Remove Bushings From Base**



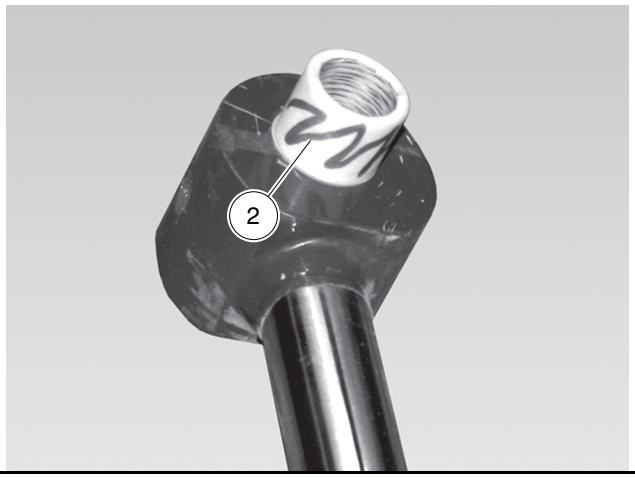

2290

**Figure 16-74 Apply LOCTITE and Install Bushings Into Base**

3. Remove the two bushing(s) (1) **(Figure 16-75, Page 16-37)** 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 16-37)**.




2291
**Figure 16-75 Remove Bushings from Rod End**




2292
**Figure 16-76 Apply LOCTITE and Install Bushings Into Rod End**

## ANGLE FRAME BUSHINGS

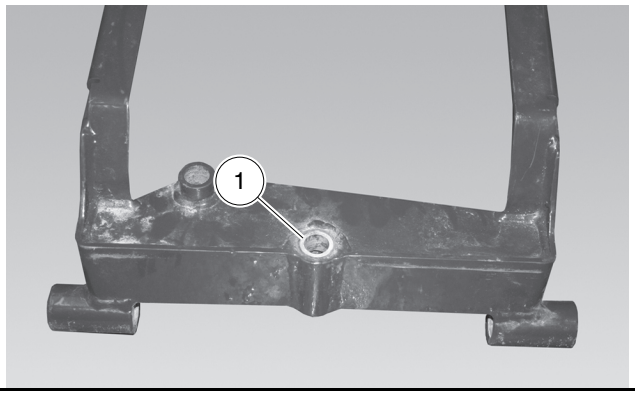
### SNOW BLADE ANGLE FRAME

**Removal and Installation**

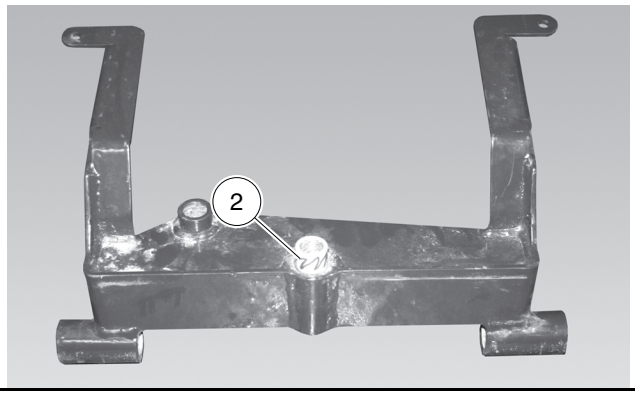
**⚠ WARNING**

- **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 16-38)** 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 16-38)** on both sides of the angle frame.

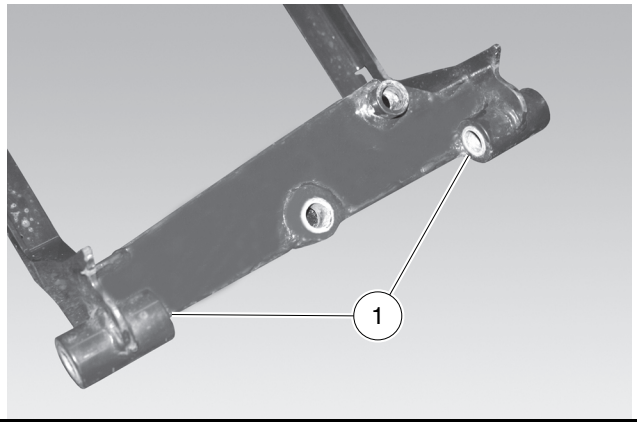



2293
**Figure 16-77 Remove Snow Blade Angle Pivot Bushings**

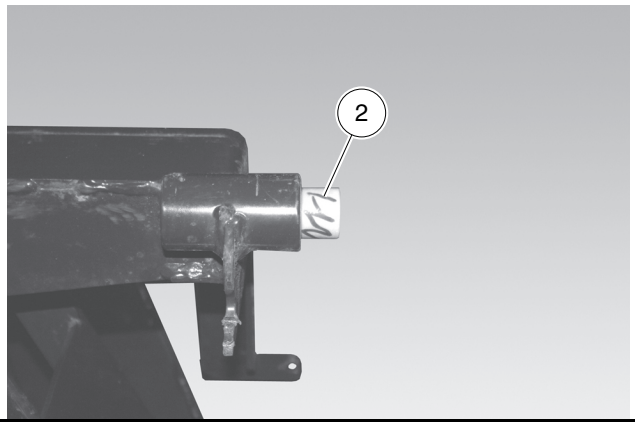



2294
**Figure 16-78 Apply LOCTITE and Install Angle Pivot Bushings**

4. Remove the four bushings (1) **(Figure 16-79, Page 16-38)** 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 16-38)**.
6. Install the four bushings (2) on both ends of the angle frame.



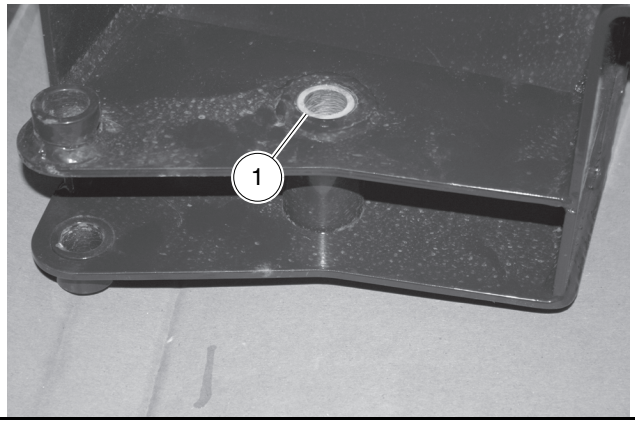

2295
**Figure 16-79 Remove Four Pivot Bushings**



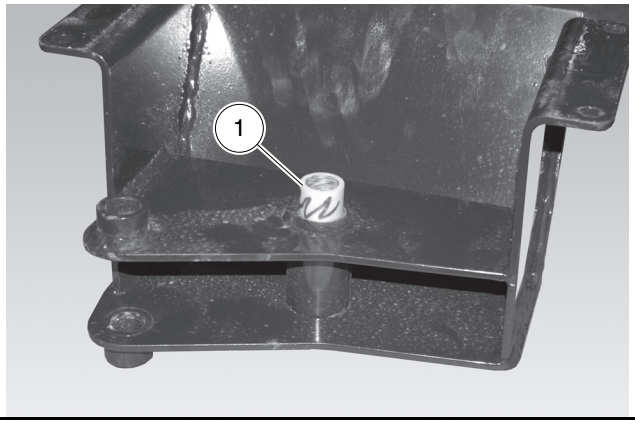

2296
**Figure 16-80 Apply LOCTITE and Install Four Pivot Bushings**

## WHISK BROOM ANGLE FRAME

**Removal and Installation**




2297
**Figure 16-81 Remove Whisk Broom Pivot Bushings**

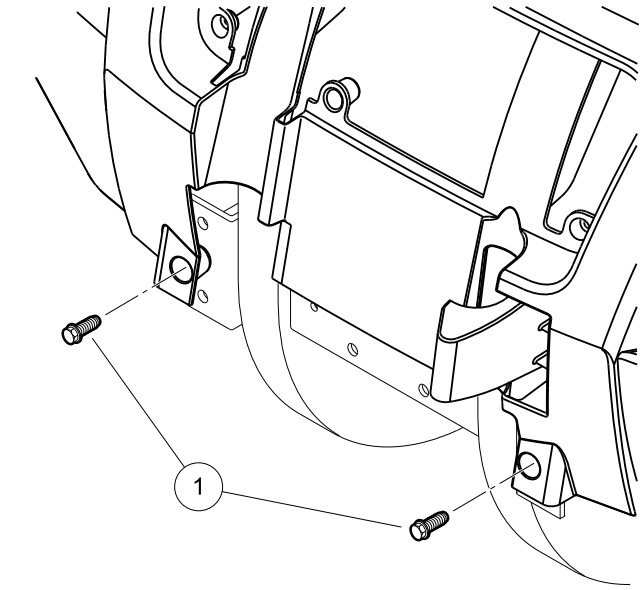



2298
**Figure 16-82 Apply LOCTITE and Install Pivot Bushings**

1. Remove the two bushings (1) **(Figure 16-81, Page 16-39)** 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 16-39)** on both sides of the angle frame.

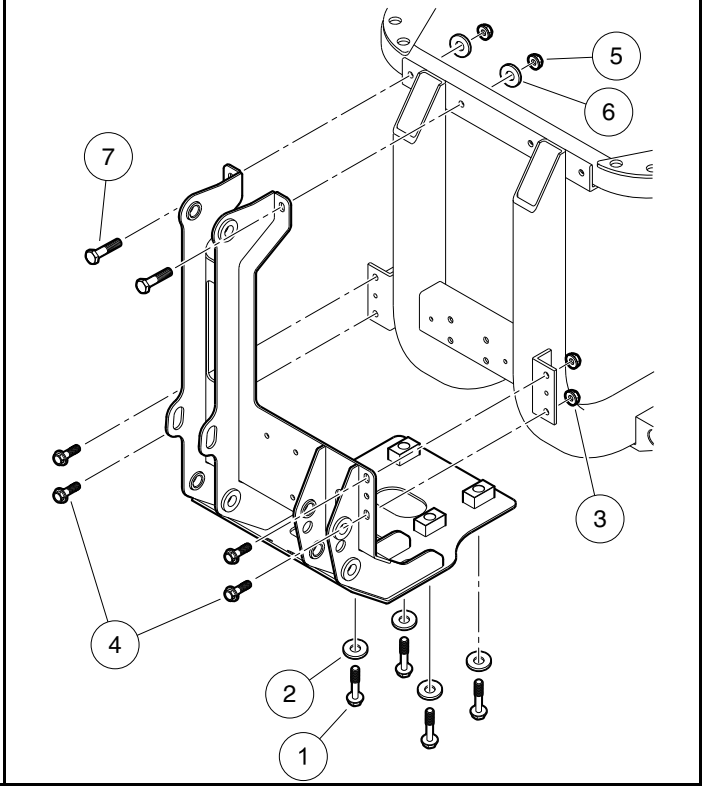
# FRONT MOUNT

## FRONT MOUNT REMOVAL




2299

**Figure 16-83 Front Fascia Bolts**




2300

**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 16-24. See also Quick Connect Fittings (Auxiliary Hydraulic Circuit only) on page 16-23.**
8. Remove cylinders. **See Vehicle Mounted Cylinders on page 16-24.**
9. Loosen bottom of front fascia by removing two bolts securing it to vehicle **(Figure 16-83, Page 16-40)**.
10. Remove four bolts (1) and washers (2) from lower part of mount under front of vehicle **(Figure 16-84, Page 16-40)**.
11. Remove four locknuts (3) and bolts (4) securing front of mount to vehicle **(Figure 16-84, Page 16-40)**.
12. Remove two nuts (5), washers (6) and bolts (7) securing top of mount to vehicle **(Figure 16-84, Page 16-40)**.
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 16-21)**. 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 11, Page 11-18.**

## FLUID CHANGE

**If replacing the hydraulic fluid with fresh fluid, follow steps below.**

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 16-24. See also Quick Connect Fittings (Auxiliary Hydraulic Circuit only) on page 16-23.**
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 pressing 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 16-47.**

**If foreign fluid is present within power unit that must be drained before operation, follow steps above except add the following procedures:**

1. For step 6, also slowly loosen and disconnect hoses at pump.
2. For step 10, 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

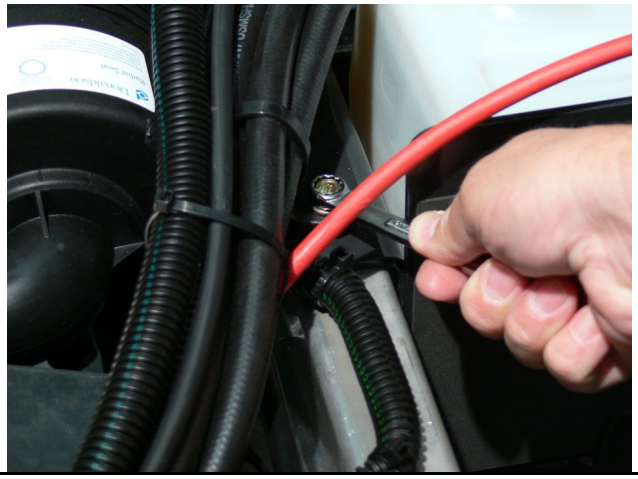
- **When repairing hydraulic systems, clean the work area before disassembly and keep all parts clean. Always use caps and plugs on hoses, tubelines and ports to keep dirt out. Dirt can quickly damage the system.**

***NOTE:*** *Mark hoses for correct installation if factory markings are not found.*

*Contain and dispose of any leaking oil in an environmentally safe manner.*

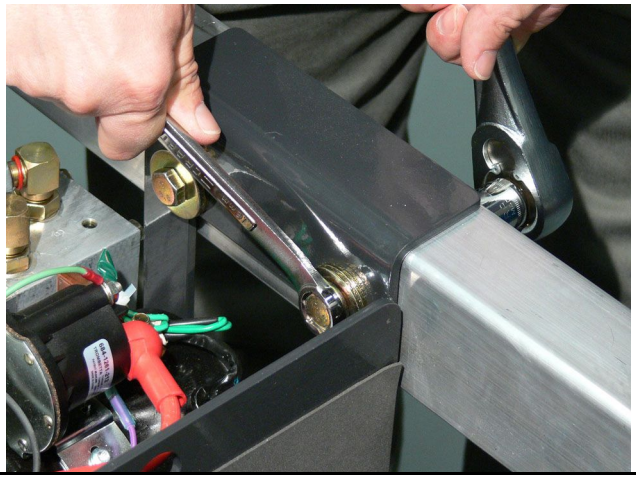
**Pump Assembly Removal**

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. Set the joystick ON/OFF switch to OFF and remove driver seat.
4. Disconnect battery. **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
5. Release the clamp securing the vent hose to top of clutch cover and remove hose.
6. Thoroughly clean the filler cap, reservoir, pump assembly, hose connections and the area around the pump assembly.
7. Loosen two bolts, located under pump assembly, securing pump assembly to cradle **(Figure 16-90, Page 16-44)**.
8. Remove three bolts securing cradle to chassis **(Figure 16-85, Page 16-43)** and **(Figure 16-86, Page 16-43)**.



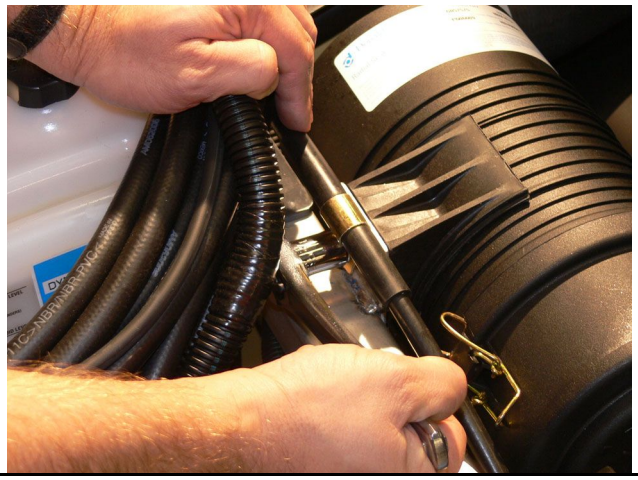
2301

**Figure 16-85 Front Cradle Bolt**



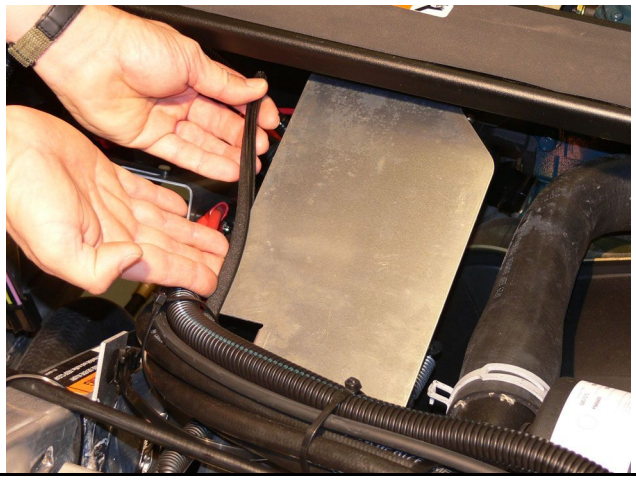
2302

**Figure 16-86 Rear Cradle Bolts**



2303

**Figure 16-87 Park Brake Cable Bolt**



2304

**Figure 16-88 Cover Edge of Heat Shield**

9. Remove bolt securing the passenger side park brake cable to the chassis, at the air filter, and move cable forward **(Figure 16-87, Page 16-43)**.
10. Cover edge of heat shield to protect hoses and wires while lifting pump assembly from chassis **(Figure 16-88, Page 16-43)**.
11. Remove wire tie securing hoses/wire harness to chassis **(Figure 16-89, Page 16-44)**.



2305

**Figure 16-89 Wire Tie to Chassis**



2306

**Figure 16-90 Pump To Cradle Bolts**

12. 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.**

13. Remove two bolts securing pump assembly to cradle and remove cradle **(Figure 16-90, Page 16-44)**.
14. Disconnect wires at motor solenoid. **See Solenoid Removal on page 16-18.**
15. Disconnect wire harness from control valve leads.
16. 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**

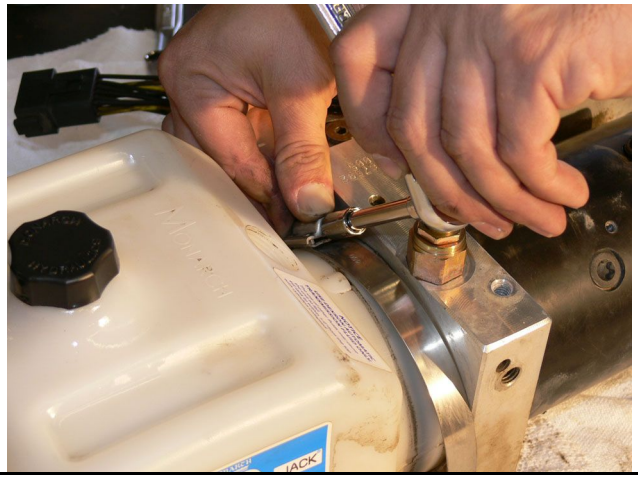
1. Reverse the removal procedure to install pump assembly to the vehicle but finger-tighten hardware until all hardware is in place.
2. Match color of hose to fitting and tighten connections to 22 ft-lb (30 N·m). **See Hose Routing on page 16-21.**
3. Tighten the two bolts, securing pump to cradle, to 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 battery. **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**
9. Refill and prime system. **See Priming the Pump, Section 16, Page 16-47.**

## RESERVOIR

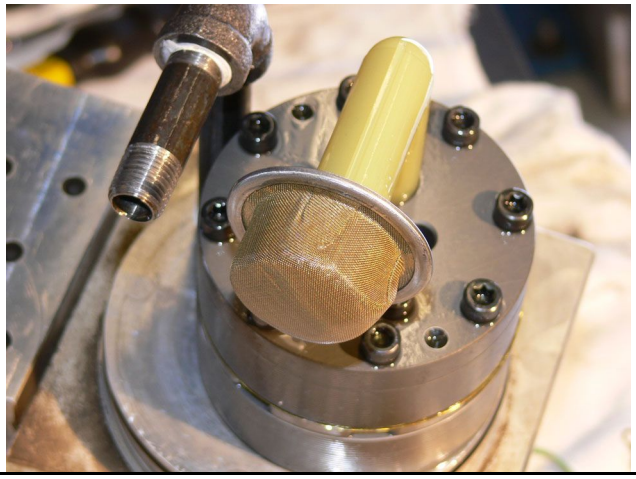
### Reservoir Removal

1. Remove pump assembly. **See Pump Assembly Removal on page 16-43.**
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 16-45)**.



2307

**Figure 16-91 Loosen Band Clamp**



2308

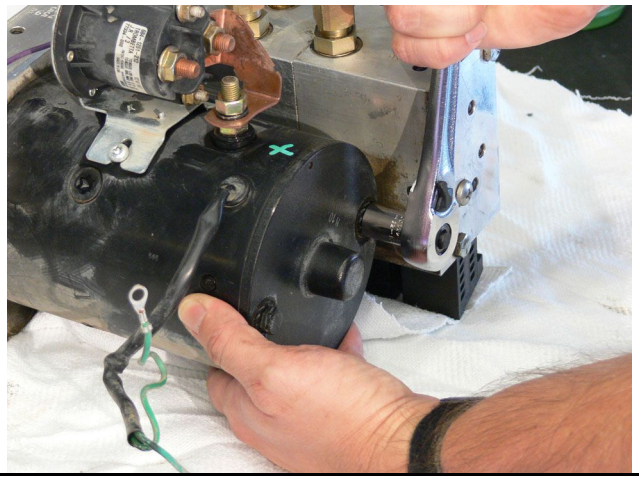
**Figure 16-92 Suction Tube Filter**

### Reservoir Installation

1. Drain remaining fluid and wipe or flush reservoir clean.
2. Clean or replace suction tube filter **(Figure 16-92, Page 16-45)**.
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 16-44.**

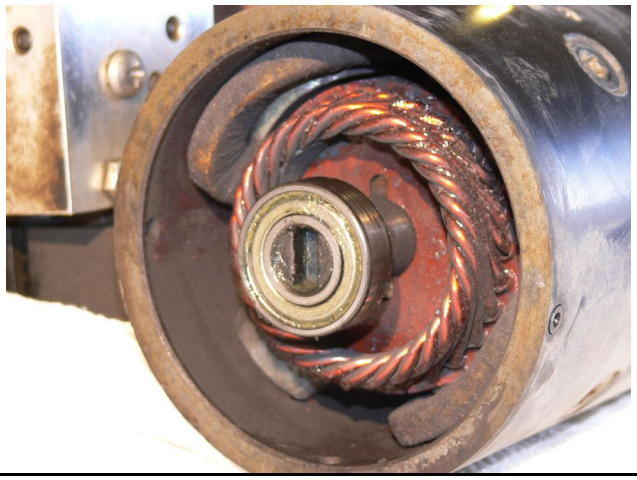
## MOTOR

### Motor Removal



2309

**Figure 16-93 Remove Motor Bolts**



2310

**Figure 16-94 Motor Bearing**

1. Lift pump assembly out of chassis and remove cradle. **See Pump Assembly Removal on page 16-43.**
2. Note location of and disconnect solenoid wires and remove solenoid.
3. Match-mark the motor housing to ease reassembly alignment.
4. Remove two bolts and end cover from motor **(Figure 16-93, Page 16-46)**.
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 16-46)****.*

### Motor Installation

1. Align slot in motor armature with pump driveshaft and carefully push the motor and bearing into place **(Figure 16-95, Page 16-47) (Figure 16-96, Page 16-47)**. 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 16-18.**
4. Assemble pump assembly to cradle and place unit in chassis. **See Pump Assembly Installation on page 16-44.**



2311

**Figure 16-95 Align Slot In Armature**



2312

**Figure 16-96 Driveshaft**

## PUMP

**Pump Removal**

**See Pump Assembly Removal on page 16-43.**

**Pump Installation**

**See Instructions for Installing Modular Pump on Existing Unit following page 16-47.**

## 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.

Pagination Page

## ⚠ DANGER

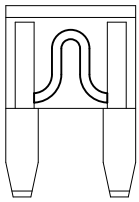
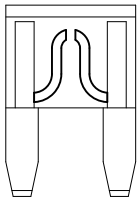
- **See General Warnings, Section 1, Page 1-2.**

## ⚠ WARNING

- **See General Warnings, Section 1, Page 1-2.**

## ATO AND MINI ATM FUSE INSPECTION

1. Disable the vehicle.
2. Remove the fuse.
3. *Visual Inspection:* Examine the fuse. Replace the fuse as necessary.

| | |
|---|---|
| **Good Fuse** |  G-130998-000004 |
| **Blown Fuse** |  G-130998-000005 |

4. *Multimeter Inspection:* Set a multimeter to check continuity.
5. Check for continuity between the tabs on the fuse.

5.1. If there is no continuity, replace the fuse.

## PARK BRAKE RELAY

The park brake relay (1) is located under the hood **(Figure 12-4)**. The screw (2) torque specification is from 5 to 8 lb·in (0.56 to 0.9 N·m).

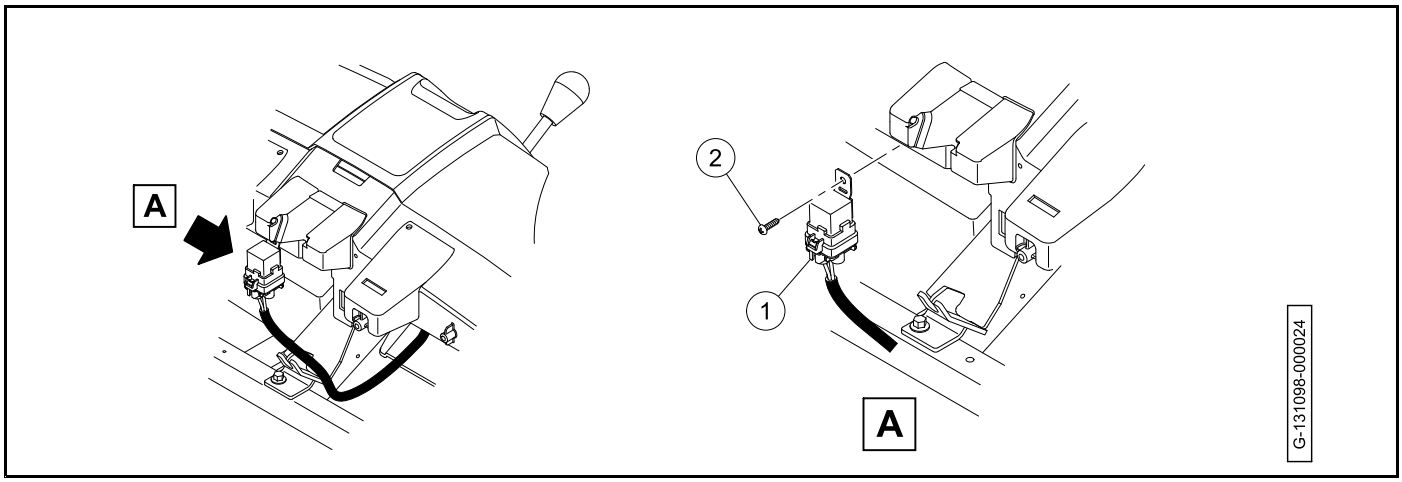



**Figure 17-1 Relays**

## 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 11-15 |
| | Spark plug wire is damaged or loose | See the Kawasaki FH680D engine manual. |
| | Intermittent ignition coil failure | See the Kawasaki FH680D engine manual. |
| | Low cylinder compression | See the Kawasaki FH680D engine manual. |
| | Water or dirt in the fuel system and/or carburetor; dirty or clogged fuel filter | Fuel System on page 19-8 |
| | Carburetor improperly adjusted | Engine RPM Adjustment on page 19-24 |
| | Starter failure | See the Kawasaki FH680D engine manual. |
| | Carburetor solenoid failure | Test Procedure 27 – Carburetor Solenoid Circuit on page 17-31 |
| | Diode 3 failed open | Test Procedure 12 – Diode 3 on wire 45 and 39 on page 17-21 |
| | Diode 5 failed open | Test Procedure 14 – Diode 5 on wire 131 and 129 on page 17-22 |

**TABLE 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 11-15 |
| | Spark plug wire is damaged or loose | See the Kawasaki FH680D engine manual. |
| | Intermittent ignition coil failure | Test Procedure 21 – Ignition Spark on page 17-28, Test Procedure 22 – Engine Kill Wire on page 17-28, and Test Procedure 23 – Grounded Kill Wire on page 17-29 |
| | Water or dirt in the fuel system and/or carburetor; dirty or clogged fuel filter | Fuel System on page 19-8 |
| | Fuel pump malfunction; fuel pressure to carburetor too low | Fuel System on page 19-8 |
| Engine turns but fails to start. | Fuel tank is empty | Fuel System on page 19-8 |
| | Fuel line or filters clogged | Fuel System on page 19-8 |
| | Fouled spark plug | Spark Plugs on page 11-15 |
| | Spark plug wire damaged or loose | Section 19 — Gasoline Vehicle - 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 19-8 |
| | Ignition coil failure | Test Procedure 21 – Ignition Spark on page 17-28, Test Procedure 22 – Engine Kill Wire on page 17-28, and Test Procedure 23 – Grounded Kill Wire on page 17-29 |
| | Kill circuit grounded | Test Procedure 23 – Grounded Kill Wire on page 17-29 |
| | Carburetor solenoid failure | Test Procedure 27 – Carburetor Solenoid Circuit on page 17-31 |
| | Improper idle governor adjustment | Engine Control Linkages on page 19-20 |
| Engine overheats. | Fan screen is partially blocked or plugged | See the Kawasaki FH680D engine manual. |
| | Governor is improperly adjusted | Engine Control Linkages on page 19-20 |
| | Carburetor is too lean; check main jet size | Carburetor on page 19-9 |
| Engine pre-ignites. | Excessive carbon deposits on piston head or in combustion chamber | See the Kawasaki FH680D engine manual. |
| | Spark plug heat range is incorrect | Spark Plugs on page 11-15 |
| | Unsuitable or contaminated fuel | Fuel System on page 19-8 |

**TABLE 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. |
| | Muffler or exhaust pipe restricted with carbon or other substance | Exhaust System on page 19-6 |
| | Ignition coil failure | Test Procedure 21 – Ignition Spark on page 17-28 |
| | Air filter is dirty or clogged | Air Filter Replacement on page 19-26 |
| | Governor is improperly adjusted | Engine Control Linkages on page 19-20 |
| | Throttle linkage out of adjustment | Engine Control Linkages on page 19-20 |
| | Low cylinder compression | See the Kawasaki FH680D engine manual. |
| | Spark plug failed | Spark Plugs on page 11-15 |
| | Restricted fuel flow | Fuel System on page 19-8 |
| | Clutches are not backshifting properly | Clutches on page 19-28 |
| Spark plug fouls repeatedly. | Incorrect plug | Spark Plugs on page 11-15 |
| | Unsuitable fuel, or incorrect (rich) fuel mixture | Fuel System on page 19-8 |
| | Spark plug wire is damaged | See the Kawasaki FH680D engine manual. |
| | Dirt entering combustion chamber | Fuel System on page 19-8 |
| | Ignition coil failed | See the Kawasaki FH680D engine manual. |
| | Rings are heavily worn, low cylinder pressure | See the Kawasaki FH680D engine manual. |
| Carburetor floods. | Inlet valve or seat is leaking, dirty, worn, or damaged | See the Kawasaki FH680D engine manual. |
| | Float is damaged and filled with gasoline | See the Kawasaki FH680D engine manual. |
| | Carburetor vent is clogged | See the Kawasaki FH680D engine manual. |
| | Float needle valve not functioning properly | See the Kawasaki FH680D engine manual. |

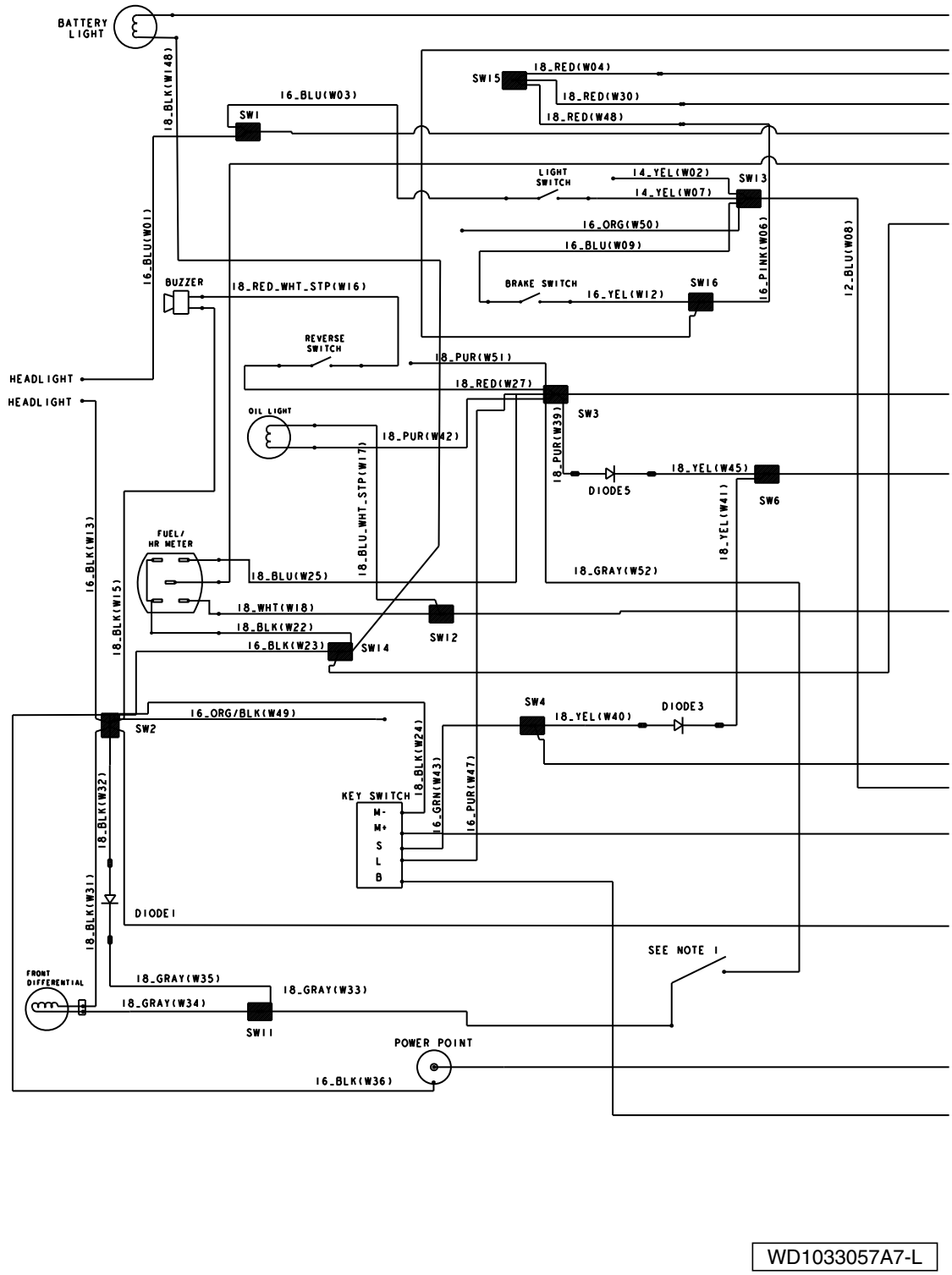
**TABLE CONTINUED ON NEXT PAGE**

| TROUBLESHOOTING GUIDE | | |
|---|---|---|
| **SYMPTOM** | **POSSIBLE CAUSES** | **REFER TO** |
| Starter fails to operate. | Starter control circuit is not operating | Test Procedure 6 – Starter Control Circuit on page 17-14 |
| | Start relay failure | Test Procedure 7 – Start Relay on page 17-15 |
| | Fuse is blown | Test Procedure 2 – Fuse on page 17-12 |
| | Battery is dead | Test Procedure 1 – Battery on page 17-10 |
| | Charge coil failed | Test Procedure 19 – Charge Coil on page 17-26 |
| | Loose or broken wire in charge coil circuit | Test Procedure 19 – Charge Coil on page 17-26 |
| | Voltage Regulator failure | Test Procedure 20 – Voltage Regulator on page 17-26 |
| | Starter solenoid or starter motor failure | Test Procedure 6 – Starter Control Circuit on page 17-14 |
| | Key switch failure | Test Procedure 5 – Key Switch (Starter Circuit) on page 17-14 |
| | Cylinder and/or crankcase flooded with fuel | See the Kawasaki FH680D engine manual. |
| | Neutral switch failure (failed open) | Test Procedure 15 – Neutral Switch (Transmission) on page 17-23 |
| | Transmission shifter linkage is binding or is out of adjustment | Forward/Reverse Shifter Cable Adjustment on page 10-11 |
| Charge coil does not charge battery. | Loose or broken wire in charge coil circuit | Test Procedure 19 – Charge Coil on page 17-26 |
| | Charge coil is shorted (failed closed) | Test Procedure 19 – Charge Coil on page 17-26 |
| | 25-amp fuse is blown | Test Procedure 2 – Fuse on page 17-12 |
| | Voltage Regulator failure | Test Procedure 20 – Voltage Regulator on page 17-26 |
| | Battery failure | Test Procedure 1 – Battery on page 17-10 |
| Transmission does not engage or disengage smoothly. | Transmission shifter linkage is binding or is out of adjustment | Forward/Reverse Shifter Cable Adjustment on page 10-11 |
| | Idle RPM Setting is set too high | Engine RPM Adjustment on page 19-24 |
| | Insufficient (low) level of lubricant or wrong type of lubricant in transmission | Gearcase Lubrication on page 11-16 |
| | Internal gears are damaged or worn | See the Engines and Drivetrain Components manual. |

**TABLE CONTINUED ON NEXT PAGE**

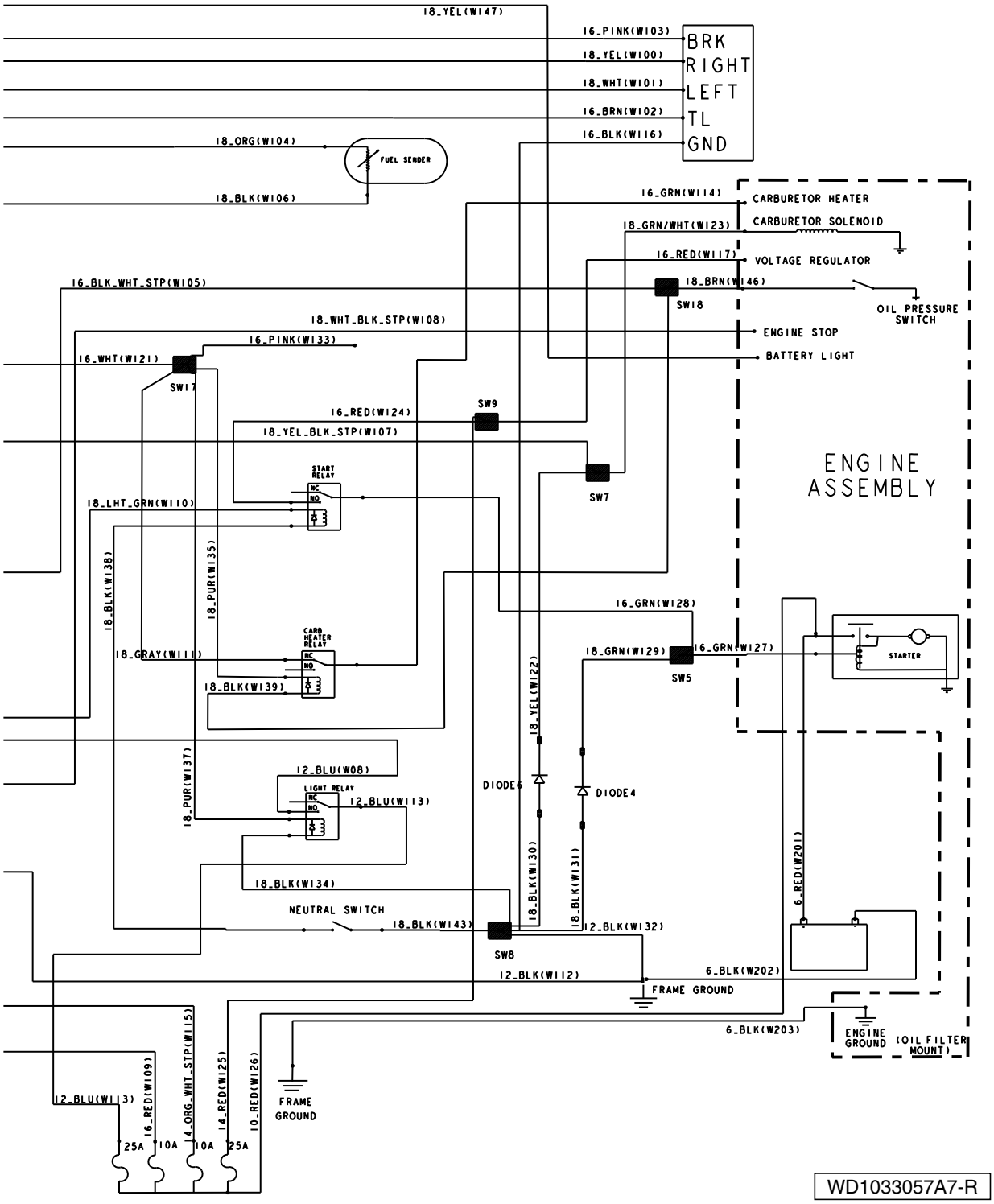
| **TROUBLESHOOTING GUIDE** | | |
|---|---|---|
| **SYMPTOM** | **POSSIBLE CAUSES** | **REFER TO** |
| Excessive vehicle vibration. | Engine mounting nuts or bolts are loose | Section 19 — Gasoline Vehicle - Engine, Muffler, Fuel System, and Clutches |
| | Misaligned muffler mounting clamp | Exhaust System on page 19-6 |
| | Damaged drive belt | Clutches on page 19-28 |
| | Damaged drive clutch | Clutches on page 19-28 |
| | Damaged driven clutch | Clutches on page 19-28 |
| | RPM setting is incorrect | Engine RPM Adjustment on page 19-24 |
| Torque converter does not shift smoothly. | Drive belt is worn, cracked, glazed, or frayed | Drive Belt Removal on page 19-29 |
| | Drive clutch malfunction | Drive Clutch Cleaning and Inspection on page 19-30 |
| | Driven clutch malfunction | Drive Clutch Cleaning and Inspection on page 19-30 |
| | Governor is sticking | Engine Control Linkages on page 19-20 |
| Engine won't stop running. | Kill circuit wire is disconnected from the ignition coil | Test Procedure 22 – Engine Kill Wire on page 17-28 |
| | Key switch failure | Test Procedure 24 – Key Switch (Engine Kill Circuit) on page 17-30 |
| Low oil warning light stays on. | Oil level sensor failure | See the Kawasaki FH680D engine manual. |
| | Shorted wire harness wire(s) | Test Procedure 28 – Low Oil Warning Light Circuit on page 17-32 |
| Hour meter does not function. | Failed low oil warning light or oil pressure sensor | Test Procedure 28 – Low Oil Warning Light Circuit on page 17-32 |
| | Oil pressure switch failed closed | See the Kawasaki FH680D engine manual. |
| | Failed hour meter | Test Procedure 32 – Hour Meter on page 17-35 |
| Hour meter adds increments with key switch ON and engine not running. | Oil pressure switch failed open | See the Kawasaki FH680D engine manual. |
| 10-amp fuse blows repeatedly. | Diode 1 failed closed | Test Procedure 10 – Diode 1 on wire 32 and 35 on page 17-20 |
| 25-amp fuse blows repeatedly. | Diode 4 failed closed | Test Procedure 13 – Diode 4 on wire 130 and 122 on page 17-21 |
| Starter motor engages when key switch is in the ON position. | Diode 3 failed closed | Test Procedure 12 – Diode 3 on wire 45 and 39 on page 17-21 |
| Bed lift does not function | Bed lift motor failed | Test Procedure 35 – Bed Lift Motor on page 17-38 |
| | Bed lift switch failed | Test Procedure 36 – Bed Lift Switch on page 17-39 |
| | Bed lift circuit breaker failed | Test Procedure 37 – Bed Lift Circuit Breaker on page 17-39 |

# WIRING DIAGRAM



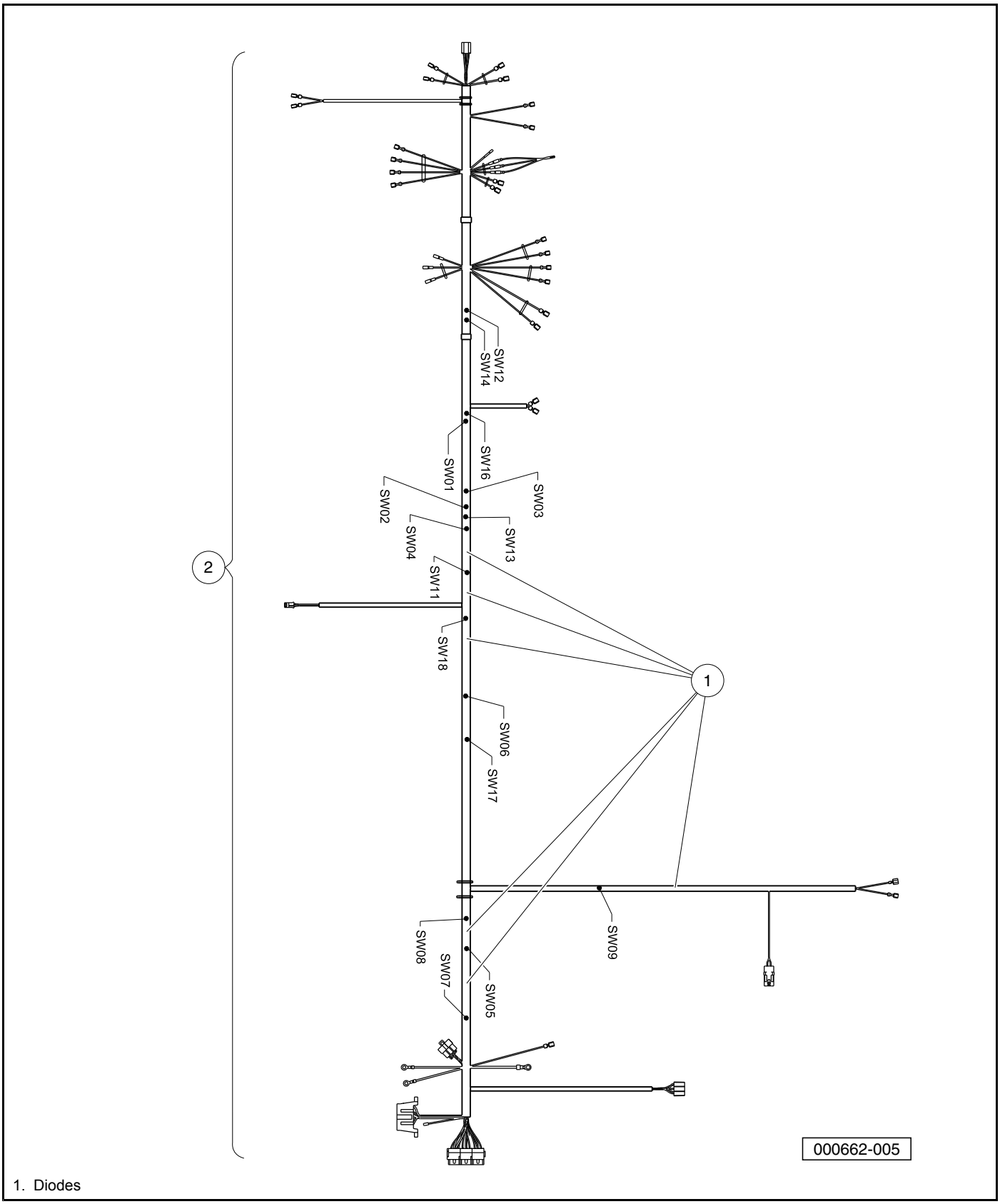

NOTE: AWD diagram shown; 2-wheel drive vehicle uses same harness

**Figure 17-2 Wiring Diagram – Front**




NOTE: AWD diagram shown; 2-wheel drive vehicle uses same harness

**Figure 17-3 Wiring Diagram – Rear**




1. Diodes

**Figure 17-4 Sonic Weld and Diode Locations (Approximate) – Gasoline**

# TEST PROCEDURES

## Index of Test Procedures

1 – Battery
2 – Fuse
3 – Ground Cables
4 – Key Switch (ON Position)
5 – Key Switch (Starter Circuit)
6 – Starter Control Circuit
7 – Start Relay
8 – Carburetor Heater Relay
9 – Wire Harness Diodes
10 – Diode 1 on wire 32 and 35
11 – Diode 2 on wire 40 and 41
12 – Diode 3 on wire 45 and 39
13 – Diode 4 on wire 130 and 122
14 – Diode 5 on wire 131 and 129
15 – Neutral Switch (Transmission)
16 – Wire Continuity
17 – Front Differential Limit Switch
18 – Front Drive Gearcase Coil
19 – Charge Coil
20 – Voltage Regulator
21 – Ignition Spark
22 – Engine Kill Wire
23 – Grounded Kill Wire
24 – Key Switch (Engine Kill Circuit)
25 – Reverse Warning Buzzer Limit Switch (If Equipped)
26 – Reverse Warning Buzzer (If Equipped)
27 – Carburetor Solenoid Circuit
28 – Low Oil Warning Light Circuit
29 – 12-Volt Accessory Receptacle
30 – Fuel Level Sending Unit
31 – Fuel Gauge
32 – Hour Meter
33 – Light Switch
34 – Voltage at Headlight Socket
35 – Bed Lift Motor
36 – Bed Lift Switch
37 – Bed Lift Circuit Breaker

## TEST PROCEDURE 1 – Battery

**See General Warnings, Section 1, Page 1-2.**

### ⚠ DANGER

- **Due to the danger of an exploding battery, wear a full face shield and rubber gloves when working around a battery.**

**DANGER CONTINUED ON NEXT PAGE**

## ⚠ DANGER

- **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 can be found in* ***Battery on page 18-17*** *of this manual.*

**Voltage Test**

1. Disable the vehicle. **See Disabling the Vehicle on page 1-3.**
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, recharge the battery. If battery voltage is greater than 12.4 volts, the problem is not with the battery. If the battery does not reach 12.4 volts after charging, replace the battery. **See following NOTE.**

***NOTE:*** *Open-circuit voltage, the battery voltage with no electrical load, should be at least 12.4 volts.*

**Load Test**

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

1. Disable the vehicle. **See Disabling the Vehicle on page 1-3.**
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. 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.

## TEST PROCEDURE 2 – Fuse

**See General Warnings, Section 1, Page 1-2.**

### ⚠ WARNING

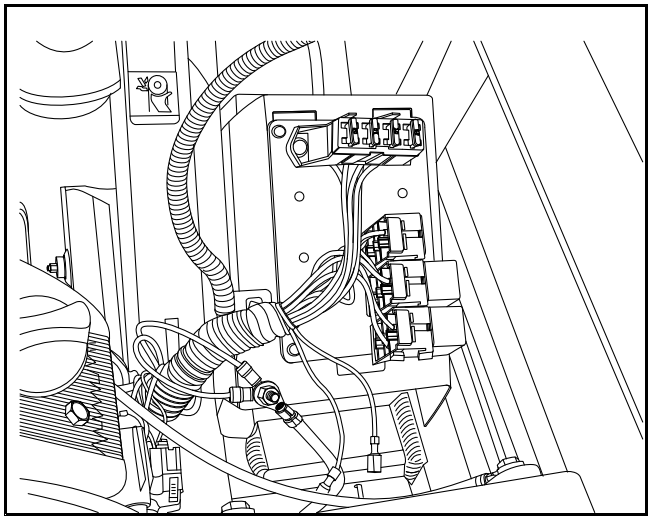
- **Failure to use properly rated fuse can result in a fire hazard.**

The fuse block is located on the electrical component mounting plate **(Figure 17-5, Page 17-12)**.

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Remove the electrical component cover.
3. Ensure the wires are connected correctly and are tight. If they are not, rewire or tighten as necessary.
4. Remove the fuse to be tested from the fuse block.
5. 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.**



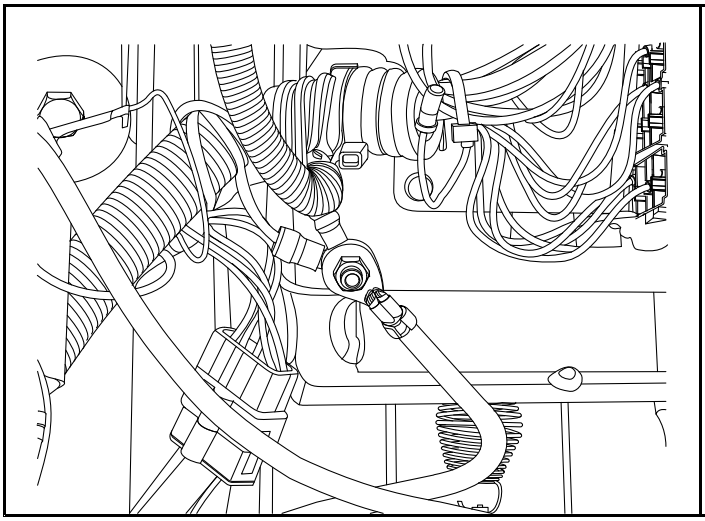
2081

**Figure 17-5 Electrical Component Mounting Plate**

## TEST PROCEDURE 3 – Ground Cables

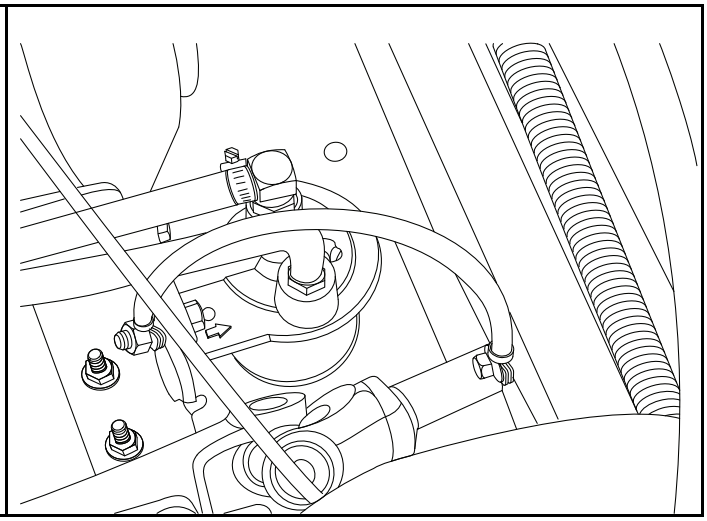
**See General Warnings, Section 1, Page 1-2.**

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Check the frame ground for corrosion, loose connections, and/or damaged terminals **(Figure 17-6, Page 17-13)**. Repair or replace as required.
3. 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.
4. Check the engine ground wire (w203), located on the remote oil filter bracket, for corrosion, loose connections, and/or damage **(Figure 17-7, Page 17-13)**. Repair or replace as required.
5. Set the multimeter to 200 ohms.
6. Check for continuity between the 6-gauge wire (w202) terminal, disconnected from the negative (–) battery terminal, and the frame.
7. Check for continuity between the 6-gauge wire (w203) terminal, disconnected from the frame, and the engine.
8. 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.



2082

**Figure 17-6 Frame Ground**



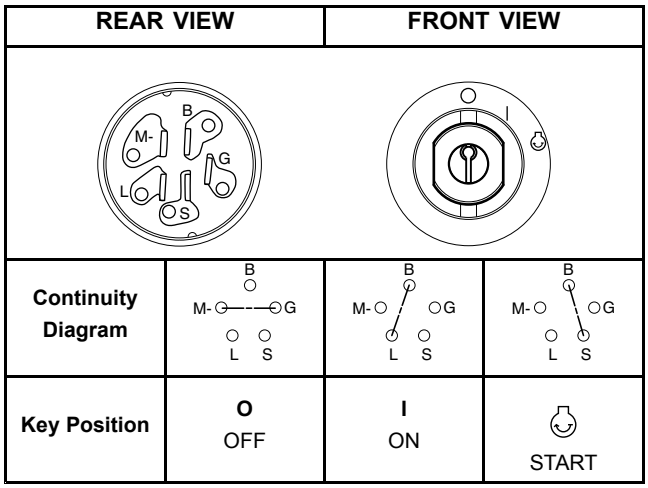
2083

**Figure 17-7 Engine Ground to Frame**

## TEST PROCEDURE 4 – Key Switch (ON Position)

**See General Warnings, Section 1, Page 1-2.**

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Ensure that the key switch connector is connected correctly and is tight. If it is not, repair or replace as necessary.
3. Remove the key switch. **See Key Switch Removal on page 18-7.**
4. Set the multimeter to 200 ohms.
5. 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 17-8, Page 17-14)**. **See Key Switch Removal on page 18-7.**




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**Figure 17-8 Key Switch Terminals and Continuity Diagram**

## TEST PROCEDURE 5 – Key Switch (Starter Circuit)

**See General Warnings, Section 1, Page 1-2.**

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Ensure that the key switch connector is connected correctly and is tight. If it is not, repair or replace as necessary.
3. Remove the key switch. **See Key Switch Removal on page 18-7.**
4. Set the multimeter to 200 ohms.
5. With the key switch 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 on page 18-7.** If the reading does not indicate continuity, leave the probes connected and proceed to step 7.
6. 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 17-8, Page 17-14)**. 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 on page 18-7.**

## TEST PROCEDURE 6 – Starter Control Circuit

**See General Warnings, Section 1, Page 1-2.**

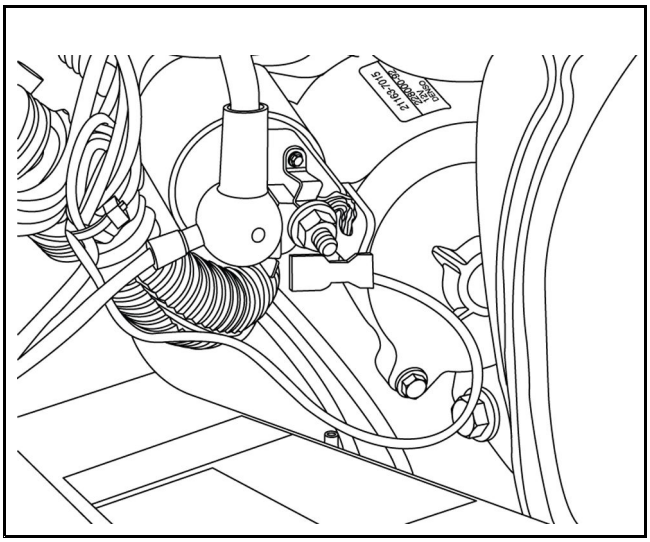
1. Disable the vehicle. **See Disabling the Vehicle on page 1-3.**
2. Disconnect the 16-gauge green wire (w127) from the starter solenoid coil to prevent the vehicle from unintentionally starting **(Figure 17-9, Page 17-15)**. **See following WARNING.**

### ⚠ 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.



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**Figure 17-9 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 17-10.**
   – Check the 25-amp fuse at the fuse block. **See Test Procedure 2 – Fuse on page 17-12.**
   – Check the start relay. **See Test Procedure 7 – Start Relay on page 17-15.**
   – Check diode 5. **See Test Procedure 14 – Diode 5 on wire 131 and 129 on page 17-22.**
   – Check the neutral switch on the transmission housing. **See Test Procedure 15 – Neutral Switch (Transmission) on page 17-23.**
   – Check for continuity of the wire harness on wires 127, 129, 128, 124, and 125. **See Wiring Diagram on page 17-7.**
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.**

## TEST PROCEDURE 7 – Start Relay

**See General Warnings, Section 1, Page 1-2.**

1. Disable the vehicle. **See Disabling the Vehicle on page 1-3.**
2. Disconnect the 16-gauge green wire (w127) from the starter solenoid coil to prevent the vehicle from unintentionally starting **(Figure 17-9, Page 17-15)**. **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 17-10, Page 17-16)**.

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.*

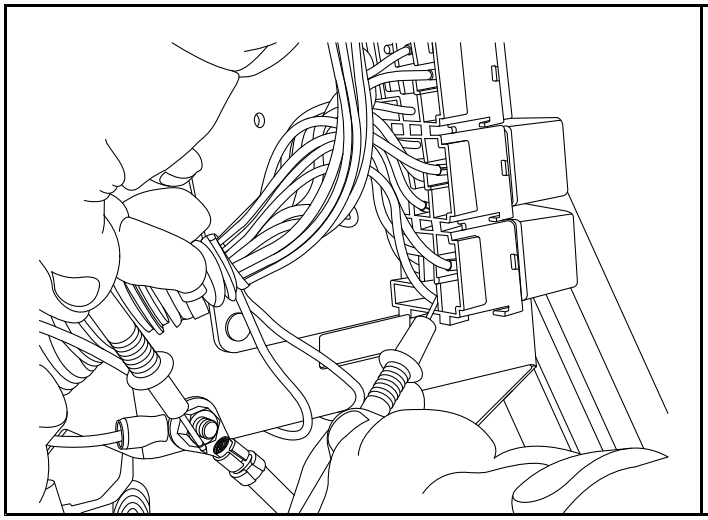
6. If the reading is 12 VDC and the relay does not click when the key switch is turned to the START position, replace the relay.
7. If the reading is 12 VDC and the relay clicks when the key is in the START position, check the relay contacts.

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 17-11, Page 17-16)**.

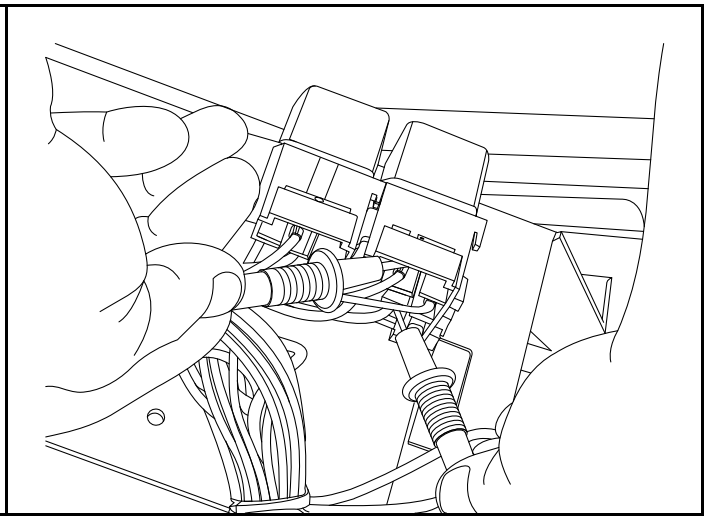
7.3. Monitor the multimeter. The multimeter should not indicate continuity with the key in the OFF or ON positions. The multimeter should indicate continuity when the key is in the START position.

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.



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**Figure 17-10 Start Relay Coil Circuit Test**



2086

**Figure 17-11 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 17-10.**
   - Check the 10-amp fuse (on w109). **See Test Procedure 2 – Fuse on page 17-12.**
   - Check the key switch. **See Test Procedure 5 – Key Switch (Starter Circuit) on page 17-14.**
   - Check the neutral switch on the transmission housing. **See Test Procedure 15 – Neutral Switch (Transmission) on page 17-23.**
   - Check for continuity of the wire harness on wires w138, w110, and w43. **See Wiring Diagram on page 17-7.**

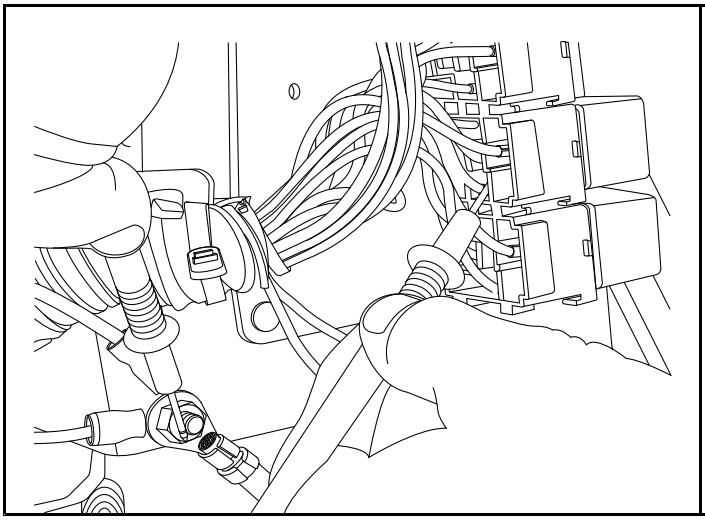
## TEST PROCEDURE 8 – Carburetor Heater Relay

**See General Warnings, Section 1, Page 1-2.**

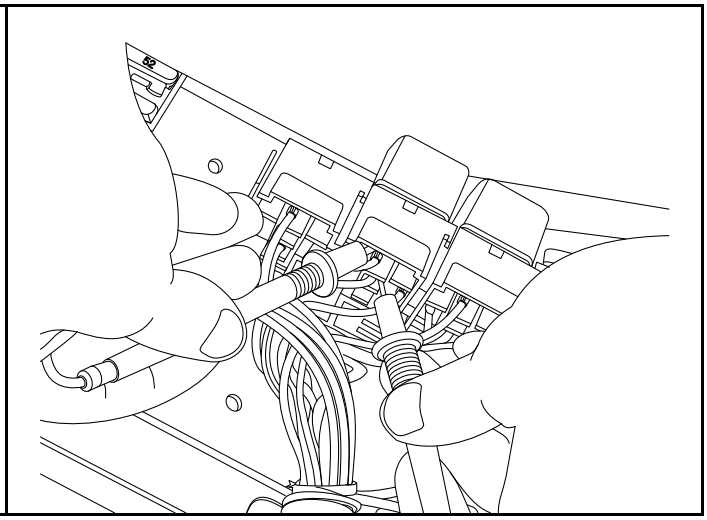
***NOTE:*** *Keep the battery connected during this test procedure.*

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. Disable the vehicle. **See Disabling the Vehicle on page 1-3.**
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 17-12, Page 17-17)**.
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.



2087
**Figure 17-12 Carburetor Heater Relay Coil Circuit Test**



2088
**Figure 17-13 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 17-13, Page 17-17)**.

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.

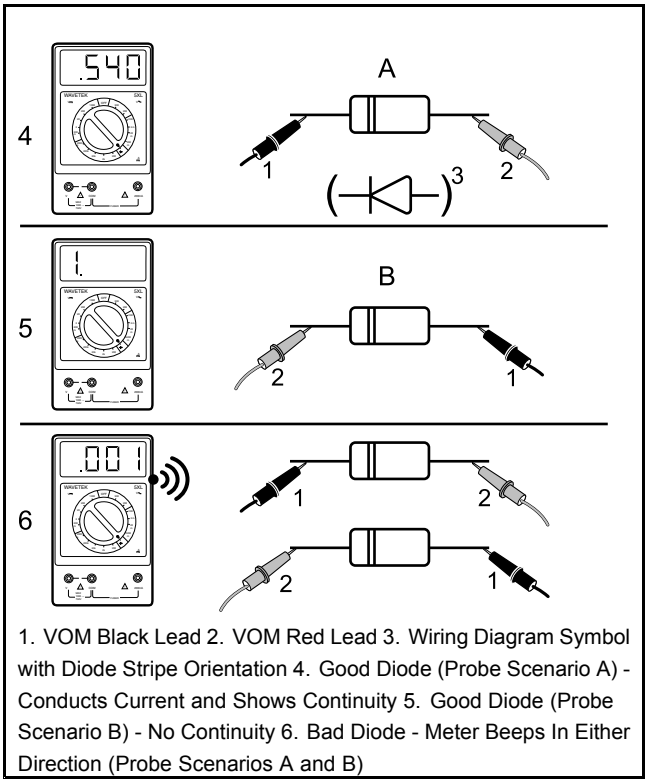
7. If the reading obtained in step 5 is not 12 VDC when the engine starts, perform the following test procedures:
   - Check the battery. **See Test Procedure 1 – Battery on page 17-10.**
   - Check the oil pressure switch. **See the Kawasaki FH680D engine manual.**
   - Check the 10-amp fuse (on w109). **See Test Procedure 2 – Fuse on page 17-12.**
   - Check the key switch. **See Test Procedure 5 – Key Switch (Starter Circuit) on page 17-14.**
   - Check the neutral switch on the transmission housing. **See Test Procedure 15 – Neutral Switch (Transmission) on page 17-23.**
   - Check for continuity of the wire harness on wires w139, w135, and w47. **See Wiring Diagram on page 17-7.**

## TEST PROCEDURE 9 – Wire Harness Diodes

**See General Warnings, Section 1, Page 1-2.**

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 17-14, Page 17-18)****.*




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)

1127

**Figure 17-14 Basic Diode Information**

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 (only used in AWD applications but still present in 2-wheel drive vehicle harness) | Open | Will contribute to the premature failure of the limit switch (switch is only used in AWD vehicle). |
| | | | 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 10 – Diode 1 on wire 32 and 35

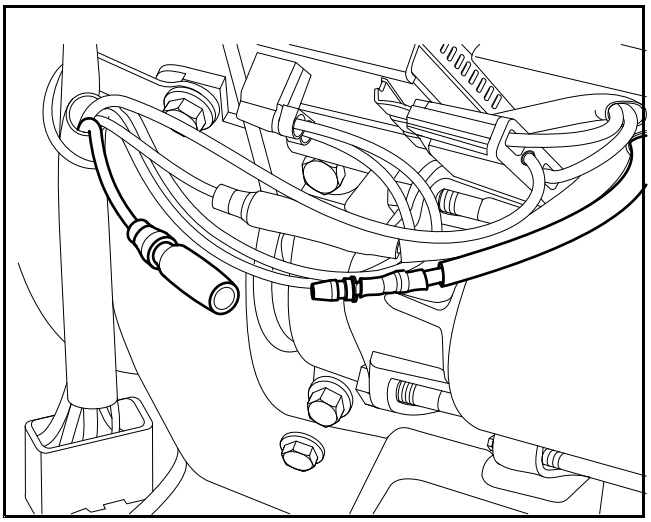
**See General Warnings, Section 1, Page 1-2.**

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Disconnect the two-pin connector between the front gearcase and the wire harness.
3. Set the multimeter to the diode test function.
4. Connect the black (–) probe of the multimeter to the frame (ground).
5. Connect the red (+) probe of the multimeter to the 18-gauge gray wire (w34) on the two-pin connector (wire harness side).
6. 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 on page 18-17.**
7. Reverse the multimeter probes and note the reading. The multimeter should indicate approximately 540 mV, however, a range of 400 to 700 mV is acceptable.
8. If the readings obtained in the previous steps are incorrect, replace the diode. **See Wire Harness Diode Removal on page 18-17.**

## TEST PROCEDURE 11 – Diode 2 on wire 40 and 41

**See General Warnings, Section 1, Page 1-2.**

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Remove the start relay from the multi-pin connector located on the electrical component mounting plate.
3. Disconnect the bullet connector in the carburetor solenoid green wire **(Figure 17-15, Page 17-21)**.
4. Set the multimeter to the diode test function.
5. Connect the black (–) probe of the multimeter to the 18-gauge light-green wire (w110) at the start relay multi-pin connector.
6. Connect the red (+) probe of the multimeter to the female side of the carburetor solenoid bullet 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 on page 18-17.**
8. Reverse the multimeter probes and note the reading. The multimeter should indicate approximately 540 mV, however, a range of 400 to 700 mV is acceptable.
9. If the readings obtained in the previous steps are incorrect, replace the diode. **See Wire Harness Diode Removal on page 18-17.**



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**Figure 17-15 Carburetor Solenoid Bullet Connector**

## TEST PROCEDURE 12 – Diode 3 on wire 45 and 39

**See General Warnings, Section 1, Page 1-2.**

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Raise the hood and disconnect the multi-pin connector from the key switch.
3. Disconnect the bullet connector in the carburetor solenoid green wire **(Figure 17-15, Page 17-21)**.
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 starter relay, carburetor heater relay and, if equipped, 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 female side of the carburetor solenoid bullet connector.
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 on page 18-17.**
11. Reverse the multimeter probes and note the reading. The multimeter should indicate approximately 540 mV, however, a range of 400 to 700 mV is acceptable.
12. If the readings obtained in the previous steps are incorrect, replace the diode. **See Wire Harness Diode Removal on page 18-17.**

## TEST PROCEDURE 13 – Diode 4 on wire 130 and 122

**See General Warnings, Section 1, Page 1-2.**

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Raise the hood and disconnect the multi-pin connector from the key switch.
3. Disconnect the bullet connector in the carburetor solenoid green wire **(Figure 17-15, Page 17-21)**.

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 female side of the carburetor solenoid bullet 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 on page 18-17.**
8. Reverse the multimeter probes and note the reading. The multimeter should indicate approximately 540 mV, however, a range of 400 to 700 mV is acceptable.
9. If the readings obtained in the previous steps are incorrect, replace the diode. **See Wire Harness Diode Removal on page 18-17.**

## TEST PROCEDURE 14 – Diode 5 on wire 131 and 129

**See General Warnings, Section 1, Page 1-2.**

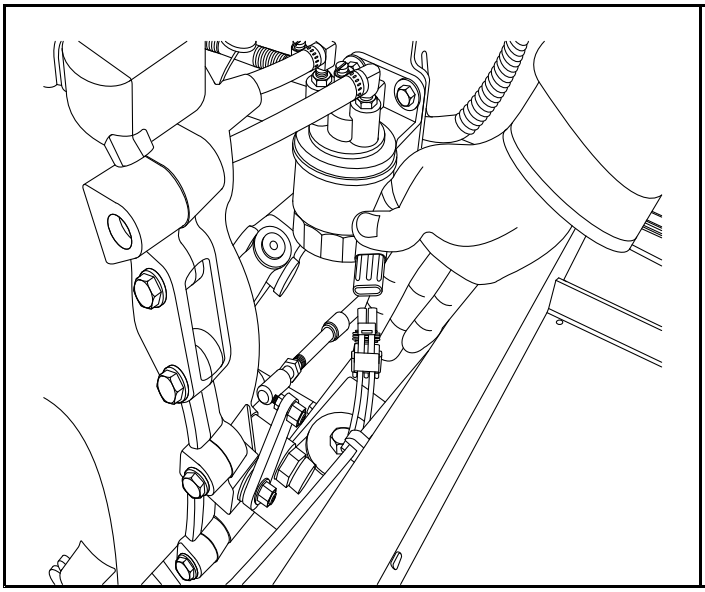
1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Raise the hood and disconnect the multi-pin connector from the key switch.
3. Disconnect the six wire engine harness connector located near the starter **(Figure 17-22, Page 17-29)**.
4. Disconnect the 16-gauge green wire (w127) from the starter solenoid coil **(Figure 17-9, Page 17-15)**.
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 16-gauge green wire (w127) at the spade 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 on page 18-17.**
9. Reverse the multimeter probes and note the reading. The multimeter should indicate approximately 540 mV, however, a range of 400 to 700 mV is acceptable.
10. If the readings obtained in the previous steps are incorrect, replace the diode. **See Wire Harness Diode Removal on page 18-17.**

## TEST PROCEDURE 15 – Neutral Switch (Transmission)

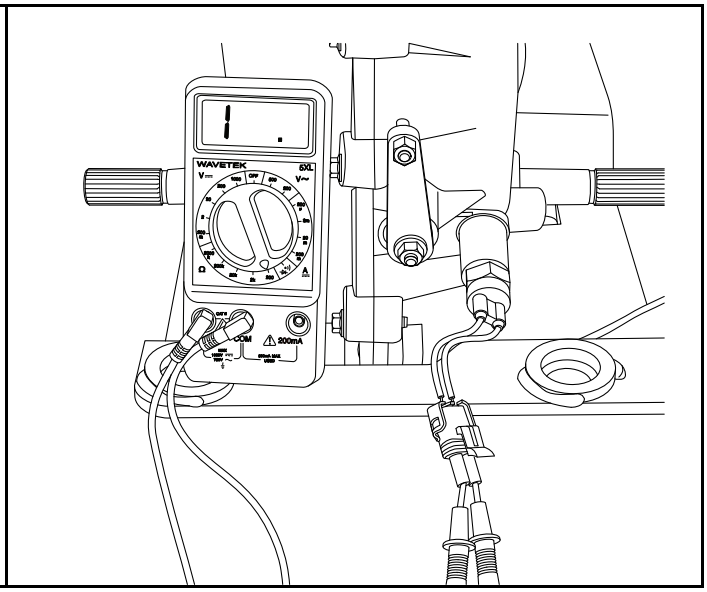
**See General Warnings, Section 1, Page 1-2.**

The neutral switch is located on the transmission housing.

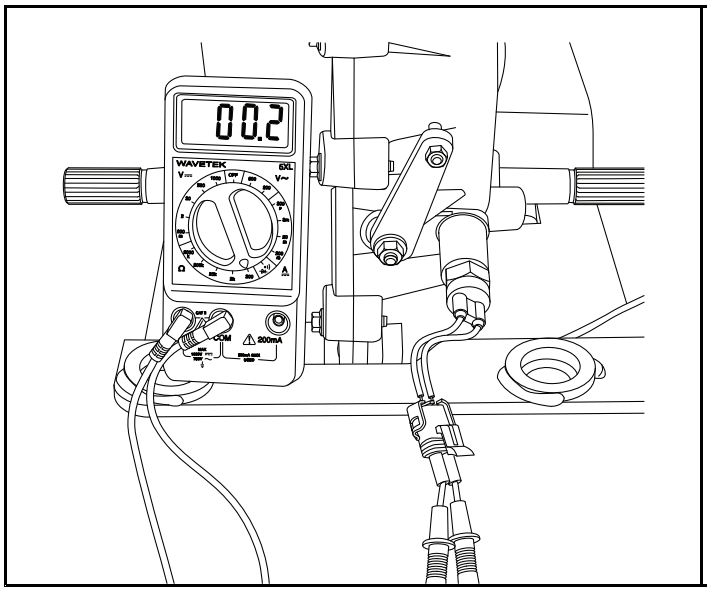
1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Disconnect the two-pin connector between the neutral switch and the wire harness (w138 and w143) **(Figure 17-16, Page 17-23)**.
3. Check for continuity on the switch contacts with the Forward/Reverse handle in the FORWARD position **(Figure 17-17, Page 17-23)**. The multimeter should indicate no continuity.



2090
**Figure 17-16 Neutral Switch Two-Pin Connector**

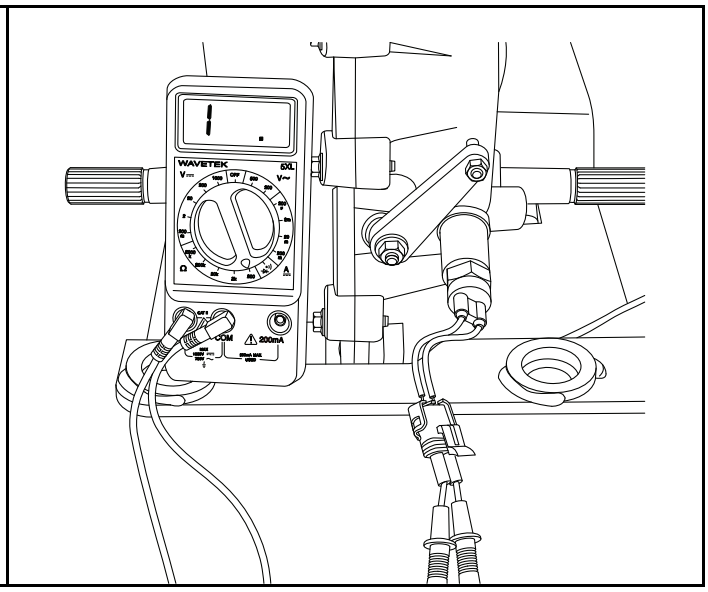



2091
**Figure 17-17 Neutral Switch – Forward Position**




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**Figure 17-18 Neutral Switch – Neutral Position**




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**Figure 17-19 Neutral Switch – Reverse Position**

4. Check for continuity on the switch contacts with the Forward/Reverse handle in the NEUTRAL position **(Figure 17-18, Page 17-24)**. The multimeter should indicate continuity.
5. Check for continuity on the switch contacts with the Forward/Reverse handle in the REVERSE position **(Figure 17-19, Page 17-24)**. The multimeter should indicate no continuity.
6. If any of the continuity readings are incorrect, replace the neutral switch. **See Neutral Switch Removal on page 18-2.**

## TEST PROCEDURE 16 – Wire Continuity

**See General Warnings, Section 1, Page 1-2.**

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. To test a wire for continuity, disconnect either end from the electrical component to which it is attached.
3. 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.**

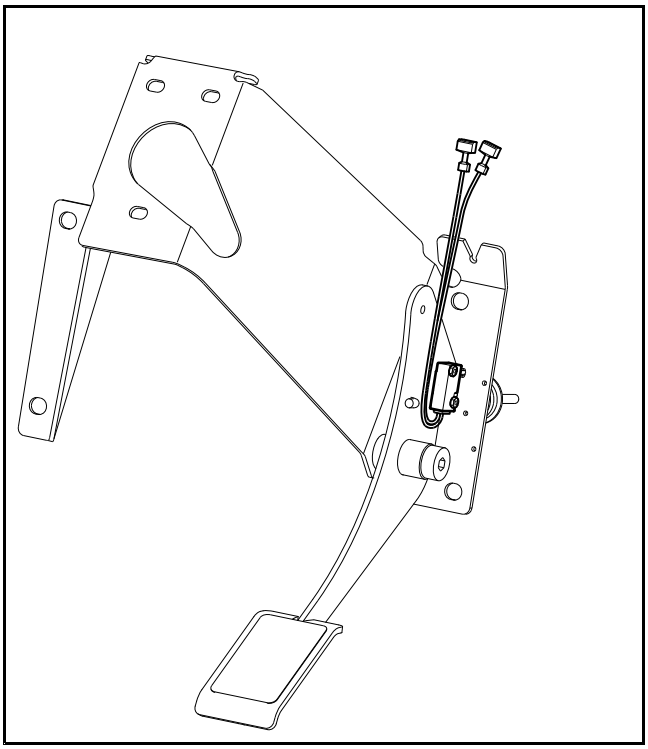
***NOTE:*** *When checking continuity of wires in the wire harness, observe the polarity of diodes. Testing continuity of certain wires will require the appropriate diode test procedure.* ***See Test Procedure 9 – Wire Harness Diodes on page 17-18.***

## TEST PROCEDURE 17 – Front Differential Limit Switch

**See General Warnings, Section 1, Page 1-2.**

***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.



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**Figure 17-20 Front Differential Switch**

1. Disable the vehicle. **See Disabling the Vehicle on page 1-3.**
2. Check for proper wiring and tight connections at the front differential limit switch **(Figure 17-20, Page 17-25)**.
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 18-13.**

## TEST PROCEDURE 18 – Front Drive Gearcase Coil

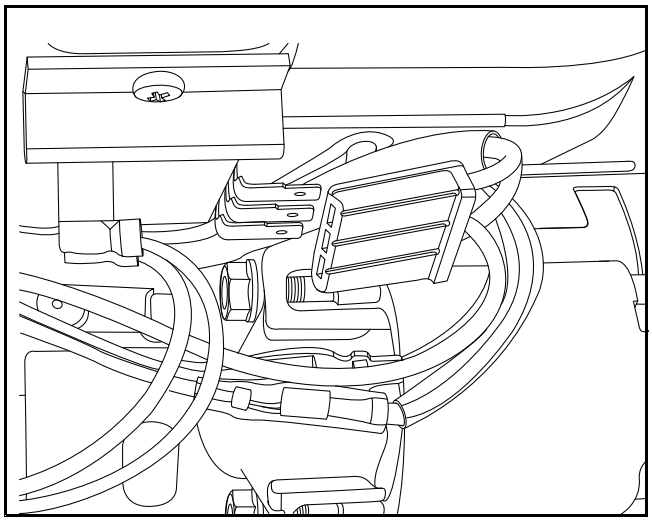
**See General Warnings, Section 1, Page 1-2.**

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Disconnect the two-pin connector between the wire harness and the front drive gearcase located under the hood.
3. Set the multimeter to 200 ohms.
4. Measure the resistance between the two wires at the two-pin connector (front drive gearcase side).
5. The resistance should be 24.7 to 27.3 ohms.
6. If the resistance is not within the stated range, replace the large output cover sub-assembly. **See the Engines and Drivetrain Components manual.**

## TEST PROCEDURE 19 – Charge Coil

**See General Warnings, Section 1, Page 1-2.**

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Disconnect the 3-pin connector from the voltage regulator.
3. Measure the resistance of the charge coil on the two white wires of the multi-pin connector **(Figure 17-21, Page 17-26)**. The resistance should be 0.01 - 0.1 ohm.
4. If the resistance is high, or the multimeter indicates an over limit (no continuity), the coil has failed. **See the Kawasaki FH680D engine manual.**



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**Figure 17-21 Charge Coil Test (At Voltage Regulator Multi-Pin Connector)**

## TEST PROCEDURE 20 – Voltage Regulator

**See General Warnings, Section 1, Page 1-2.**

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

1. Disable the vehicle. **See Disabling the Vehicle on page 1-3.**
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 on page 19-24.**
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 17-10.**
7. If the reading is less than 14.0 volts and not rising, check the charge coil. **See Test Procedure 19 – Charge Coil on page 17-26.** 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 18-5.**

## TEST PROCEDURE 21 – Ignition Spark

**See General Warnings, Section 1, Page 1-2.**

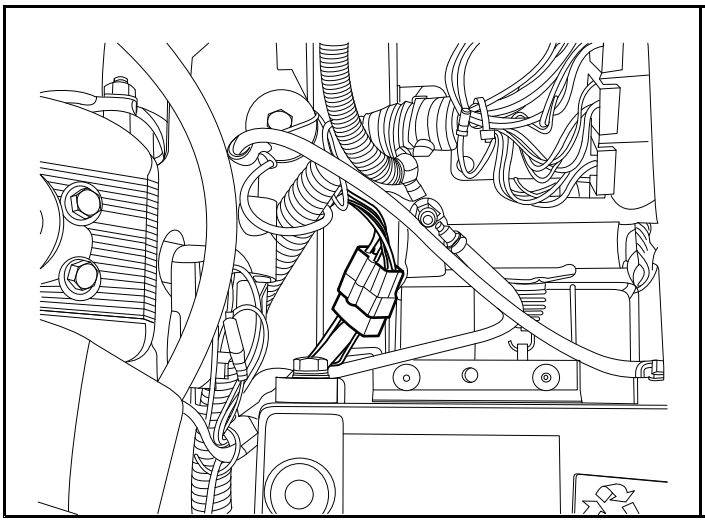
***NOTE:*** *Keep the battery connected during this test procedure.*

1. Disable the vehicle. **See Disabling the Vehicle on page 1-3.**
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.**
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 11, Page 11-15.**

## TEST PROCEDURE 22 – Engine Kill Wire

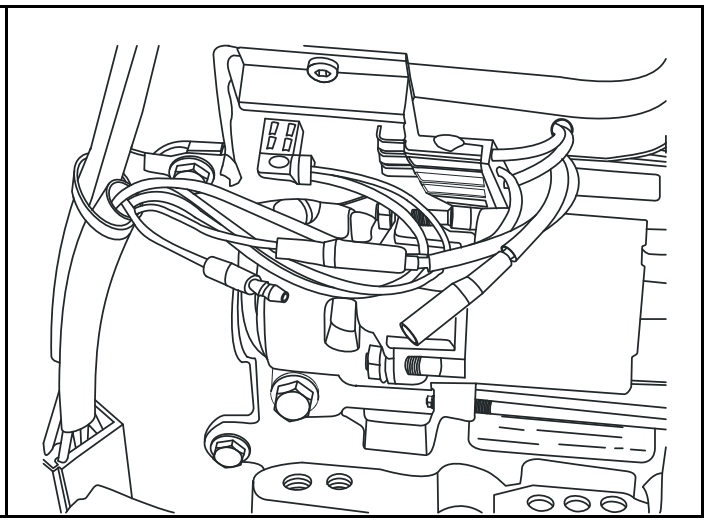
**See General Warnings, Section 1, Page 1-2.**

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Disconnect the six wire engine harness connector located near the starter **(Figure 17-22, Page 17-29)**.
3. 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.
4. 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.
5. 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 23 – Grounded Kill Wire on page 17-29.** Also check the key switch for proper operation. **See Test Procedure 24 – Key Switch (Engine Kill Circuit) on page 17-30.**



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**Figure 17-22 Engine Harness Connector**



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**Figure 17-23 Engine Kill Wire**

## TEST PROCEDURE 23 – Grounded Kill Wire

**See General Warnings, Section 1, Page 1-2.**

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

1. Disable the vehicle. **See Disabling the Vehicle on page 1-3.**
2. Disconnect the engine kill black wire of engine harness at the bullet connector located near the starter **(Figure 17-23, Page 17-29)**. **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 22 – Engine Kill Wire on page 17-28. 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 24 – Key Switch (Engine Kill Circuit) on page 17-30. 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 21 – Ignition Spark on page 17-28.

## TEST PROCEDURE 24 – Key Switch (Engine Kill Circuit)

**See General Warnings, Section 1, Page 1-2.**

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Raise the hood.
3. Remove the connector from the key switch.
4. 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 17-8, Page 17-14)**.
5. 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.

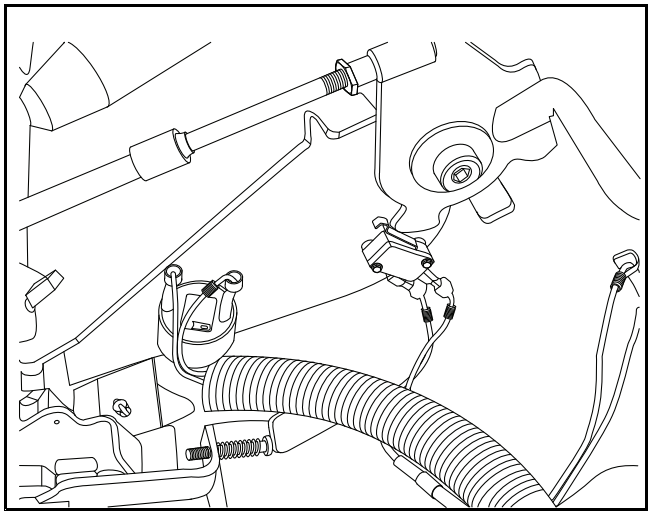
## TEST PROCEDURE 25 – Reverse Warning Buzzer Limit Switch (If Equipped)

**See General Warnings, Section 1, Page 1-2.**

***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. Disable the vehicle. **See Disabling the Vehicle on page 1-3.**
2. Check for proper wiring and tight connections at the reverse warning buzzer and the reverse warning buzzer limit switch **(Figure 17-24, Page 17-30)**.
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.



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**Figure 17-24 Reverse Warning Buzzer and Limit Switch**

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 17-24, Page 17-30)**.

## TEST PROCEDURE 26 – Reverse Warning Buzzer (If Equipped)

**See General Warnings, Section 1, Page 1-2.**

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. 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 on page 17-7.** If the buzzer does not function when properly wired, replace the buzzer. **See Reverse Warning Buzzer Removal on page 18-11.**

## TEST PROCEDURE 27 – Carburetor Solenoid Circuit

**See General Warnings, Section 1, Page 1-2.**

***NOTE:*** *Keep the battery connected while performing this test procedure.*

1. Check the carburetor solenoid coil circuit.

1.1. Disable the vehicle. **See Disabling the Vehicle on page 1-3.**

1.2. Disconnect the green wire of engine harness at the bullet connector located near the starter **(Figure 17-25, Page 17-32)**.

1.3. Disconnect the 16-gauge green wire (w127) from the starter solenoid coil to prevent the vehicle from unintentionally starting **(Figure 17-9, Page 17-15)**. **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 5 – Key Switch (Starter Circuit) on page 17-14.**

– Diode 2. **See Test Procedure 11 – Diode 2 on wire 40 and 41 on page 17-20.**

– Diode 3. **See Test Procedure 12 – Diode 3 on wire 45 and 39 on page 17-21.**

– Diode 4. **See Test Procedure 13 – Diode 4 on wire 130 and 122 on page 17-21.**

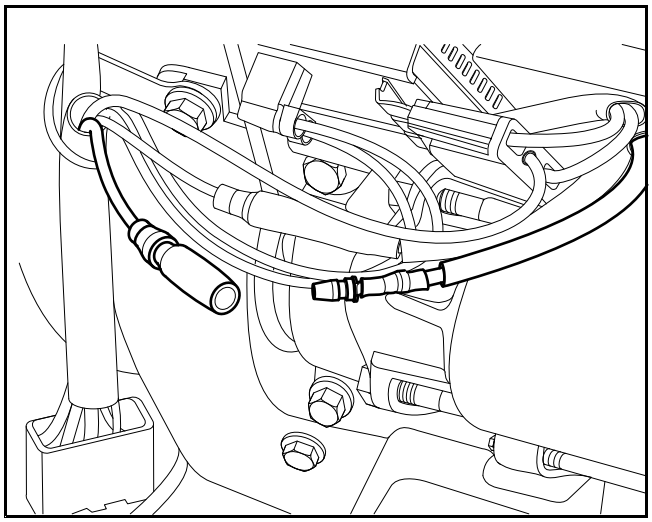
2. Check the carburetor solenoid coil.

2.1. Disconnect battery and spark plug wire(s).**See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**

2.2. Set the multimeter to 200 ohms.

2.3. Measure the resistance between the male side of the carburetor solenoid bullet connector and the engine (ground) **(Figure 17-25, Page 17-32)**. The resistance should be approximately 30 ohms.

2.4. If the resistance reading is incorrect, replace the solenoid coil. **See the Kawasaki FH680D engine manual.**



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**Figure 17-25 Carburetor Solenoid Bullet Connector**

## TEST PROCEDURE 28 – Low Oil Warning Light Circuit

**See General Warnings, Section 1, Page 1-2.**

If the low oil warning light stays on, test the oil pressure switch. **See the Kawasaki FH680D engine manual.** 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. Disable the vehicle. **See Disabling the Vehicle on page 1-3.**
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 on page 18-6.**
11. If the problem is not corrected by performing the previous steps, test the oil pressure switch. **See the Kawasaki FH680D engine manual.**

## TEST PROCEDURE 29 – 12-Volt Accessory Receptacle

**See General Warnings, Section 1, Page 1-2.**

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

1. Disable the vehicle. **See Disabling the Vehicle on page 1-3.**
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 17-12.**
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.

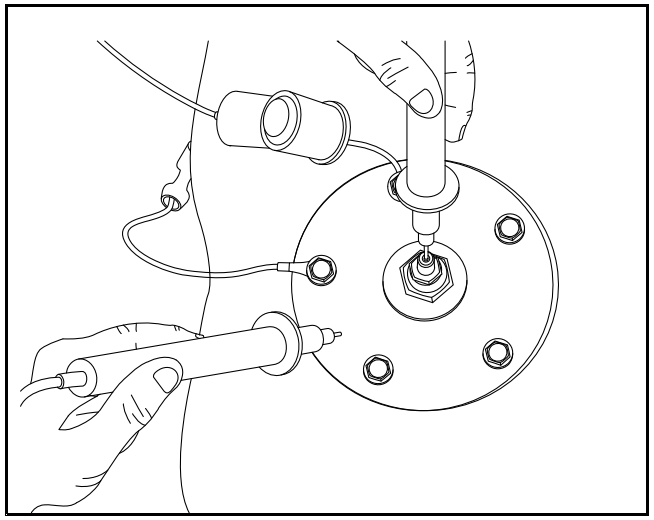
## TEST PROCEDURE 30 – Fuel Level Sending Unit

**See General Warnings, Section 1, Page 1-2.**

### ⚠ 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. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Disconnect the orange wire from the center post of the fuel level sending unit.
3. 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 17-26, Page 17-33)**.



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**Figure 17-26 Fuel Level Sending Unit Test**

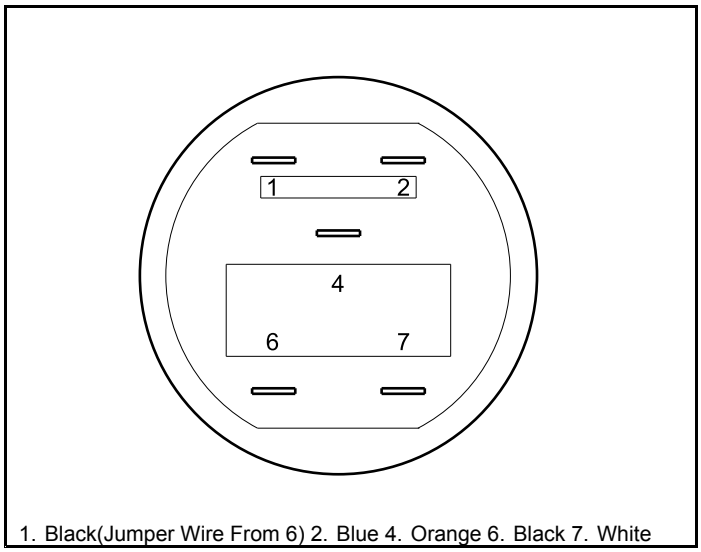
4. The following resistance readings (in ohms) should be indicated, depending on the position of the float inside the fuel tank. The resistance reading will vary according to the exact position of the float. The following table may be used as a guideline to determine if the fuel level sending unit is 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 |

5. 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 on page 19-15.**
6. 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 on page 18-7.**
7. 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 31 – Fuel Gauge on page 17-34.**

## TEST PROCEDURE 31 – Fuel Gauge

**See General Warnings, Section 1, Page 1-2.**




1. Black(Jumper Wire From 6) 2. Blue 4. Orange 6. Black 7. White

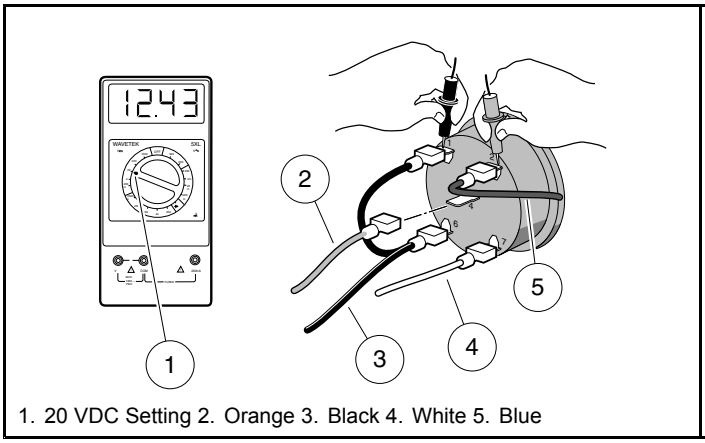
480

**Figure 17-27 Fuel Gauge/Hour Meter**

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

1. Disable the vehicle. **See Disabling the Vehicle on page 1-3.**
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.

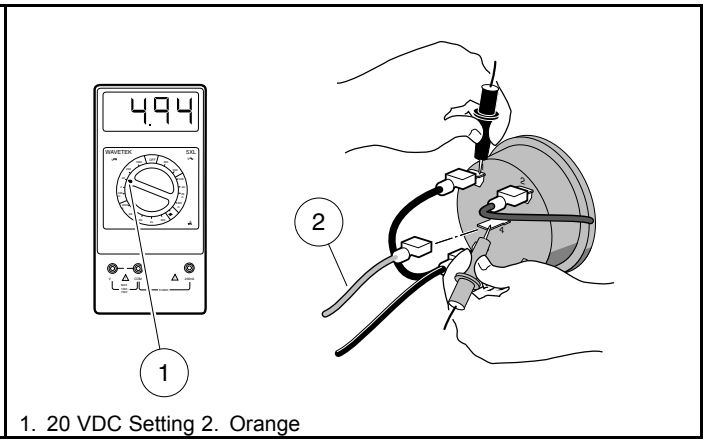
5. Set a multimeter to 20 volts DC and place the red (+) probe on the (2) terminal of the fuel gauge/hour meter where the blue wire (w25) is connected. Place the black (–) probe on the (1) terminal of the fuel gauge/hour meter with the black wire (w22) **(Figure 17-28, Page 17-35)**.
6. Turn the key 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 17-28, Page 17-35)**.
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 17-29, Page 17-35)**. The voltage reading should be approximately 4.94 volts. If the reading is incorrect, replace the fuel gauge/hour meter.




1. 20 VDC Setting 2. Orange 3. Black 4. White 5. Blue

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**Figure 17-28 Fuel Gauge Voltage Test - Terminal 2**




1. 20 VDC Setting 2. Orange

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**Figure 17-29 Fuel Gauge Voltage Test - Terminal 4**

## TEST PROCEDURE 32 – Hour Meter

**See General Warnings, Section 1, Page 1-2.**

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

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 alsoTest Procedure 28 – Low Oil Warning Light Circuit on page 17-32.**

***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.*

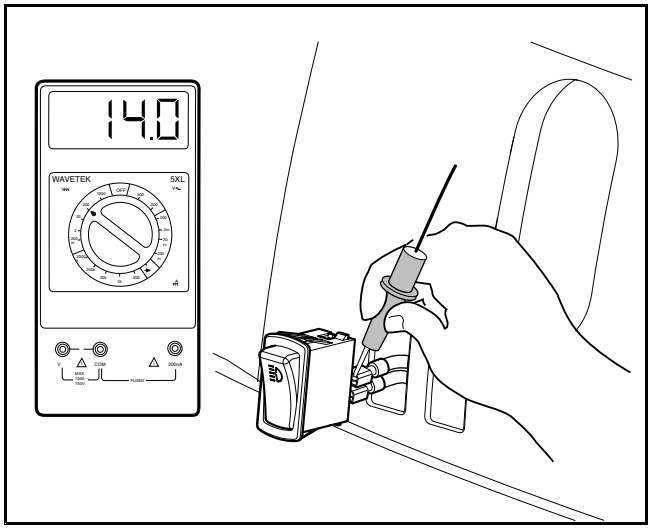
5. If the hour meter still does not function after the low oil warning light, oil pressure switch, and all of the appropriate wires have been checked for continuity, replace the fuel gauge/hour meter.

## TEST PROCEDURE 33 – Light Switch

**See General Warnings, Section 1, Page 1-2.**

***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 17-12.***

1. Disable the vehicle. **See Disabling the Vehicle on page 1-3.**
2. Remove the light switch from the instrument panel. **See Light Switch Removal on page 18-10.**
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 17-30, Page 17-36)**.




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**Figure 17-30 Light Switch Test**

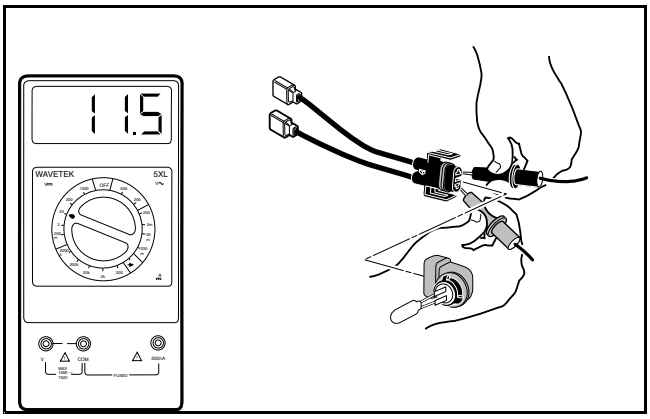
4. Connect the black (–) probe of the multimeter to the negative (–) post of the battery.
5. With the light switch in the OFF position, the reading should indicate 0 volts. With the light in the ON position, the reading should indicate between 11 and 12.5 volts. If the there is no voltage reading, check the continuity of the 10-gauge red wire (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 17-12.** If the wires and fuse show continuity and the readings are still incorrect, replace the switch. **See Light Switch Removal on page 18-10.**

## TEST PROCEDURE 34 – Voltage at Headlight Socket

**See General Warnings, Section 1, Page 1-2.**

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

1. Disable the vehicle. **See Disabling the Vehicle on page 1-3.**
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 17-31, Page 17-37)**.
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.




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**Figure 17-31 Voltage Measurement at Headlight Socket**

6. If there is no voltage reading at the wire harness, check the continuity of the 16-gauge blue 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.

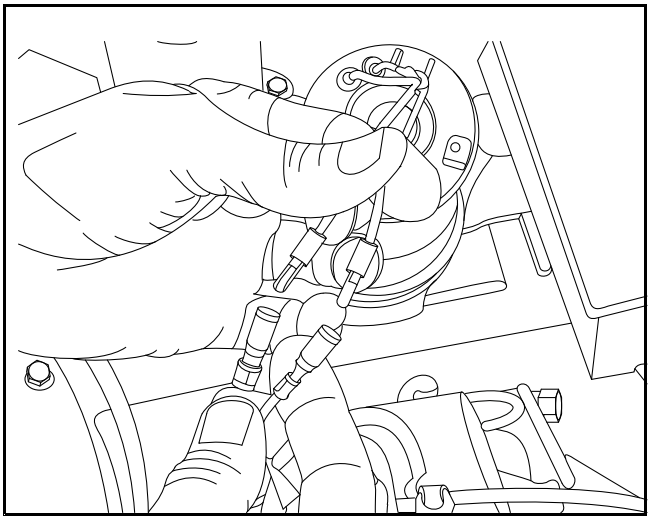
7. Check the continuity of the 16-gauge black wire (w13) from the headlight to the frame ground.

7.1. Set the multimeter to 20 VDC.

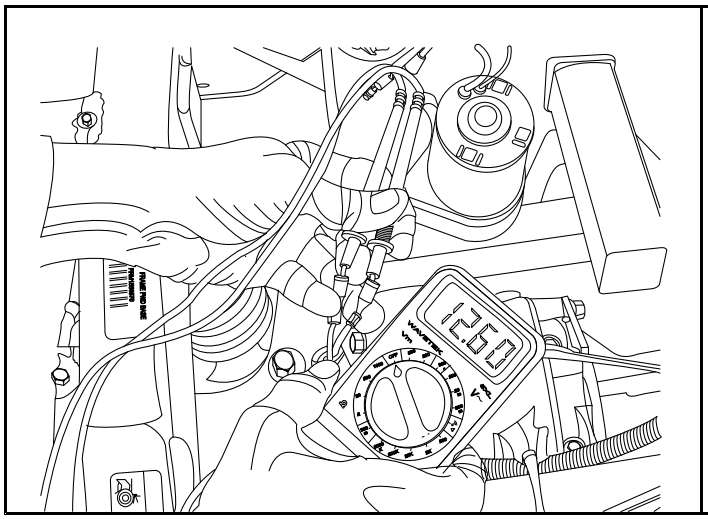
7.2. Place the black (–) probe of multimeter into the black wire terminal (w13) of the wire harness and use an alligator clip to attach the red (+) probe onto the positive (+) battery terminal. If the multimeter reading is approximately 12 volts, the black wire has continuity.

8. Check the continuity of the headlight jumper harness wires.

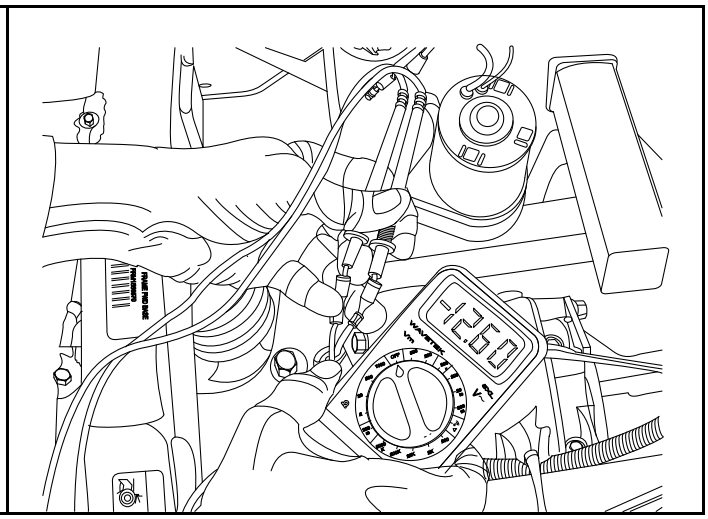
9. If the readings are correct in all of the previous steps, replace the headlight bulb.



2101
**Figure 17-32 Bed Lift Motor Wires**



2102
**Figure 17-33 Bed Lift Motor Voltage Reading with Switch in UP position**



2103
**Figure 17-34 Bed Lift Motor Voltage Reading with Switch in DOWN position**

## TEST PROCEDURE 35 – Bed Lift Motor

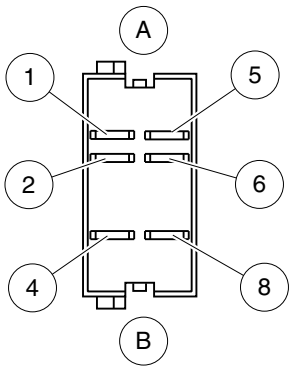
***NOTE:*** *Keep the battery connected during this test procedure.*

*Ensure that the battery is fully-charged before performing this test procedure.*

1. Disable the vehicle. **See Disabling the Vehicle on page 1-3.**
2. Disconnect the red and yellow wires from the bed lift motor **(Figure 17-32, Page 17-37)**.
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 17-33, Page 17-38)**.
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 17-7.**
   – 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 17-34, Page 17-38)**.
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 17-7.**
   – 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 36 – Bed Lift Switch

1. Remove the bed lift switch. **See Bed Lift Switch Removal on page 18-9.**
2. Check continuity between the terminals **(Figure 17-35, Page 17-39)** 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 on page 18-9.**




A. Up Position B. Down Position
Terminal:
1. #14 Black w2 2. #14 Red w3 4. #14 Red w7 5. #14 Red w7 6. #14 Yellow w5 8. #14 Black w2

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**Figure 17-35 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 37 – Bed Lift Circuit Breaker

1. Remove the bed lift circuit breaker. **See Bed Lift Circuit Breaker Removal on page 18-9.**
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 on page 18-9.**

Pagination Page

# SECTION 18 — GASOLINE VEHICLE - ELECTRICAL COMPONENTS



## ⚠ DANGER

- **See General Warnings, Section 1, Page 1-2.**

## ⚠ WARNING

- **See General Warnings, Section 1, Page 1-2.**

## STARTER AND STARTER SOLENOID

**See General Warnings, Section 1, Page 1-2.**

**Refer to the engine manual for testing, removal, disassembly, and installation procedures. See the Kawasaki FH680D engine manual.**

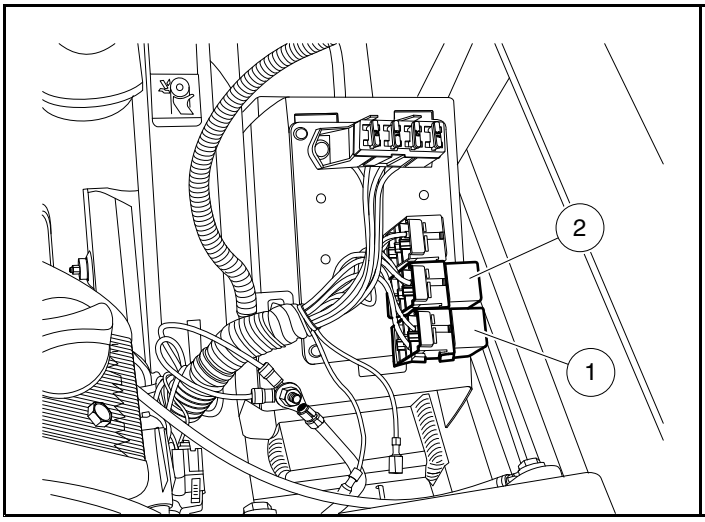
## RELAYS

**See General Warnings, Section 1, Page 1-2.**

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 18-1, Page 18-1)**.

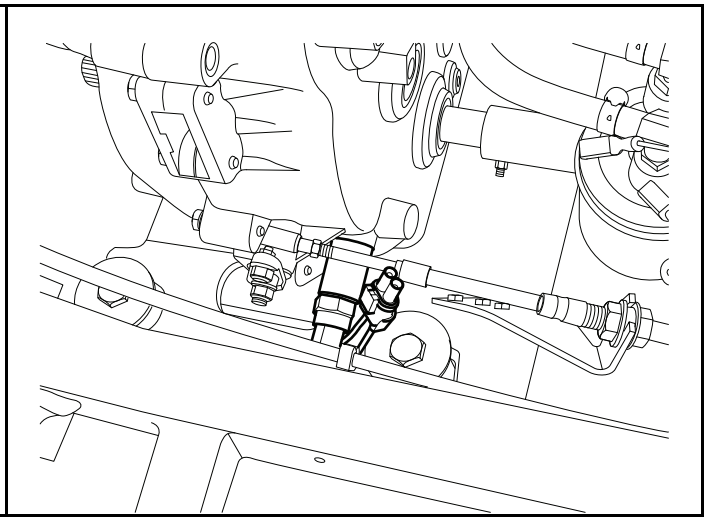
### TESTING THE RELAY

**See Test Procedure 7 – Start Relay on page 17-15. See also Test Procedure 8 – Carburetor Heater Relay on page 17-16.**




2126

**Figure 18-1 Relays**



2127

**Figure 18-2 Neutral Switch**

### RELAY REMOVAL

1. Disable the vehicle. **See Disabling the Vehicle on page 1-3.**
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 Warnings, Section 1, Page 1-2.**

The neutral switch (1) is located on the transmission housing **(Figure 18-2, Page 18-1)**.

### TESTING THE NEUTRAL SWITCH

**See Test Procedure 15 – Neutral Switch (Transmission) on page 17-23.**

### NEUTRAL SWITCH REMOVAL

1. Disable the vehicle. **See Disabling the Vehicle on page 1-3.**
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 battery and spark plug wire(s). **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

## CARBURETOR SOLENOID

**See General Warnings, Section 1, Page 1-2.**

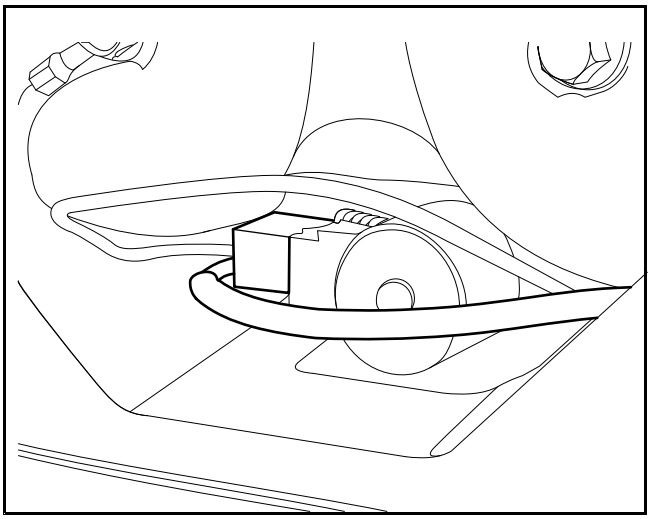
The carburetor solenoid is located on the bottom of the carburetor.

### TESTING THE CARBURETOR SOLENOID

**See Test Procedure 27 – Carburetor Solenoid Circuit on page 17-31.**

### CARBURETOR SOLENOID REMOVAL

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Remove the front cover from the engine.
3. Disconnect the two-pin connector from the carburetor solenoid **(Figure 18-3, Page 18-3)**.
4. Remove the solenoid from the carburetor. **See the Kawasaki FH680D engine manual.**



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**Figure 18-3 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.**
2. Connect the two-pin connector to the carburetor solenoid **(Figure 18-3, Page 18-3)**.
3. Install the engine front cover.
4. Connect battery and spark plug wire(s). **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

## CARBURETOR HEATER

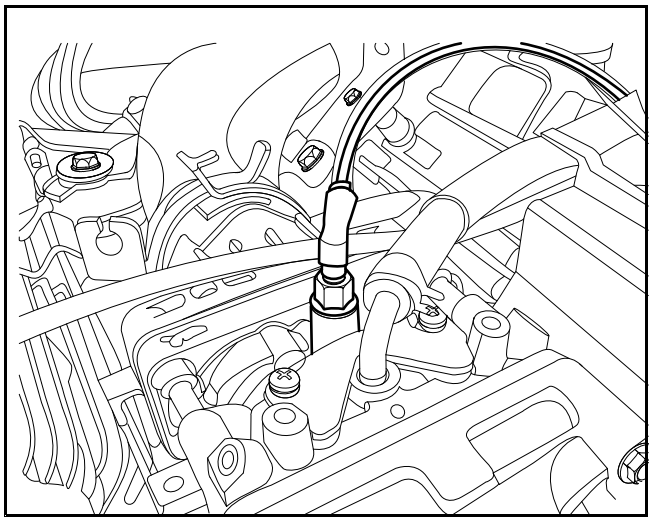
**See General Warnings, Section 1, Page 1-2.**

The carburetor heater is located on top of the carburetor.

### CARBURETOR HEATER REMOVAL

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Remove the top cover from the engine.

3. Disconnect the green wire from the carburetor heater (1) **(Figure 18-4, Page 18-4)**.
4. Remove the heater from the carburetor.



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**Figure 18-4 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 18-4, Page 18-4)**.
3. Install the engine top cover.
4. Connect battery and spark plug wire(s). **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

# VOLTAGE REGULATOR

**See General Warnings, Section 1, Page 1-2.**

## TESTING THE VOLTAGE REGULATOR

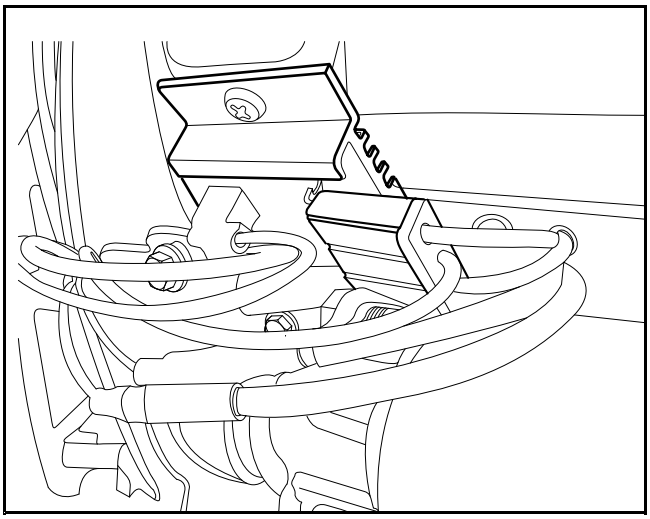
**See Test Procedure 20 – Voltage Regulator on page 17-26.**

## VOLTAGE REGULATOR REMOVAL

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Disconnect the multi-pin connector and the yellow and green wires from the voltage regulator **(Figure 18-5, Page 18-5)**.
3. 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 18-5, Page 18-5)**.
2. Connect the multi-pin connector and the yellow and green wires to the voltage regulator.
3. Connect battery and spark plug wire(s). **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**
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 20 – Voltage Regulator on page 17-26.**



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**Figure 18-5 Voltage Regulator**

# WARNING LIGHTS

**See General Warnings, Section 1, Page 1-2.**

## TESTING THE WARNING LIGHTS

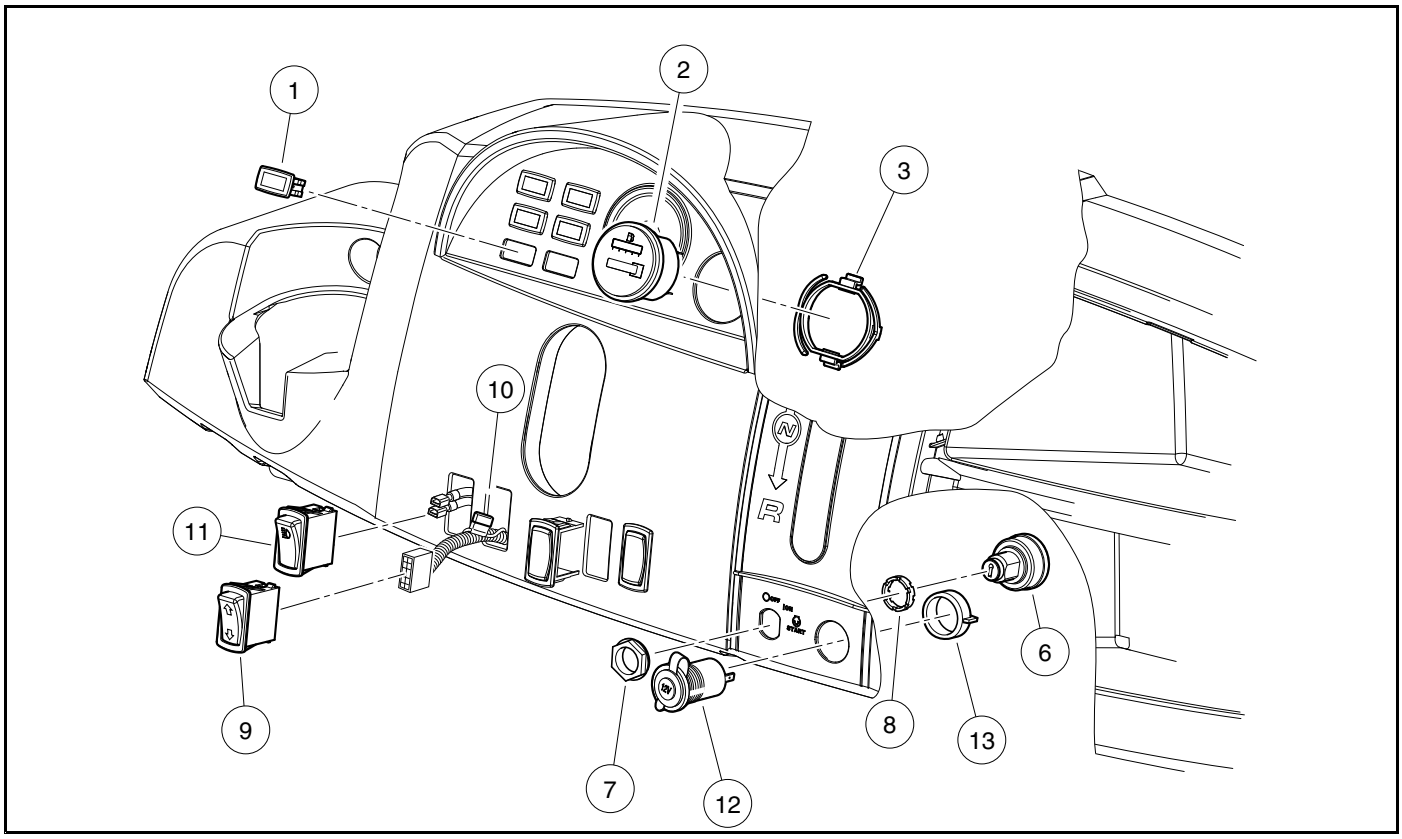
**See Test Procedure 28 – Low Oil Warning Light Circuit on page 17-32.**

## WARNING LIGHT REMOVAL

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Raise the hood.
3. Disconnect the wires from the warning light (1) **(Figure 18-6, Page 18-6)**.
4. 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 18-6, Page 18-6)**.
2. Reconnect the wires from the wire harness to the warning light.
3. Lower and secure the hood.
4. Connect battery and spark plug wire(s). **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**




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**Figure 18-6 Instrument Panel Electrical Components**

# FUEL GAUGE/HOUR METER

**See General Warnings, Section 1, Page 1-2.**

## TESTING THE FUEL GAUGE/HOUR METER

**See Test Procedure 31 – Fuel Gauge on page 17-34. Also see Test Procedure 32 – Hour Meter on page 17-35.**

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. 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 blinks.

## FUEL GAUGE/HOUR METER REMOVAL

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Raise the hood.
3. Disconnect the wires from the fuel gauge/hour meter (2) **(Figure 18-6, Page 18-6)**.
4. Remove the mounting clip (3) 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 18-6, Page 18-6)**.
2. Force the mounting clip (3) 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 on page 17-7.**
4. Coat the terminals with Battery Terminal Protector Spray.
5. Lower and secure the hood.
6. Connect battery and spark plug wire(s). **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

# KEY SWITCH

**See General Warnings, Section 1, Page 1-2.**

## TESTING THE KEY SWITCH

**See Test Procedure 5 – Key Switch (Starter Circuit) on page 17-14. Also see Test Procedure 24 – Key Switch (Engine Kill Circuit) on page 17-30.**

## KEY SWITCH REMOVAL

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Raise the hood.

3. From under the hood, remove the multi-pin connector from the key switch.
4. Reach under the instrument panel to hold the key switch and remove the key switch nut (7) **(Figure 18-6, Page 18-6)**. 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 battery and spark plug wire(s). **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

## 12-VOLT ACCESSORY RECEPTACLE

**See General Warnings, Section 1, Page 1-2.**

### TESTING THE 12-VOLT ACCESSORY RECEPTACLE

**See Test Procedure 29 – 12-Volt Accessory Receptacle on page 17-33.**

### 12-VOLT ACCESSORY RECEPTACLE REMOVAL

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Raise the hood.
3. From under the hood, disconnect the wires from the accessory receptacle (12) **(Figure 18-6, Page 18-6)**.
4. 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.*

5. 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 battery and spark plug wire(s). **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

# BED LIFT SWITCH

## TESTING THE BED LIFT SWITCH

**See Test Procedure 36 – Bed Lift Switch on page 17-39.**

## BED LIFT SWITCH REMOVAL

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Raise the hood.
3. Press the upper and lower retaining tabs and push the bed lift switch (9) out of the instrument panel **(Figure 18-6, Page 18-6)**.
4. 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 battery and spark plug wire(s). **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

# BED LIFT CIRCUIT BREAKER

## TESTING THE BED LIFT CIRCUIT BREAKER

**See Test Procedure 37 – Bed Lift Circuit Breaker on page 17-39.**

## BED LIFT CIRCUIT BREAKER REMOVAL

1. Push the bed lift switch (9) out of the instrument panel. **See Bed Lift Switch Removal on page 18-9.**
2. Locate the bed lift circuit breaker (10) on the orange wire of the wire harness connected to the switch **(Figure 18-6, Page 18-6)**.
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 Warnings, Section 1, Page 1-2.**

### TESTING THE LIGHT SWITCH

**See Test Procedure 33 – Light Switch on page 17-36.**

### LIGHT SWITCH REMOVAL

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Raise the hood.
3. Press the upper and lower retaining tabs and push the light switch (11) out of the instrument panel **(Figure 18-6, Page 18-6)**.
4. 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 battery and spark plug wire(s). **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

## FUSE

**See General Warnings, Section 1, Page 1-2.**

**⚠ WARNING**

- **Failure to use properly rated fuse can result in a fire hazard.**

### TESTING THE FUSE

**See Test Procedure 2 – Fuse on page 17-12.**

### FUSE REMOVAL

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. 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 battery and spark plug wire(s). **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

# REVERSE WARNING BUZZER (IF EQUIPPED)

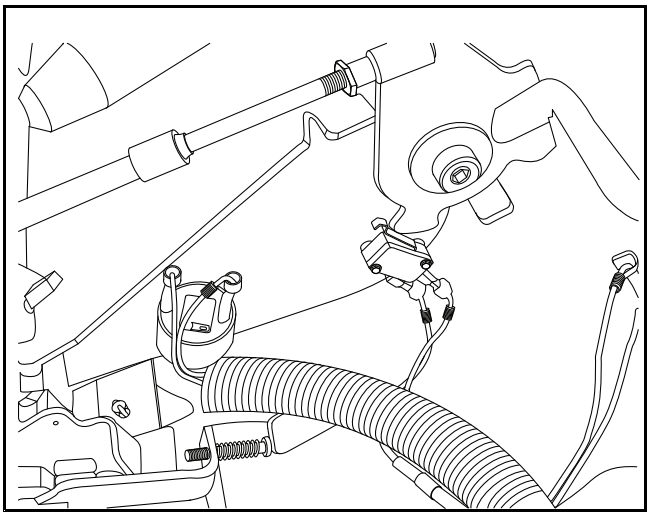
**See General Warnings, Section 1, Page 1-2.**

## TESTING THE REVERSE WARNING BUZZER

**See Test Procedure 26 – Reverse Warning Buzzer (If Equipped) on page 17-31.**

## REVERSE WARNING BUZZER REMOVAL

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Raise the hood.
3. Remove the plastic rivets securing the reverse warning buzzer and remove the reverse warning buzzer **(Figure 18-7, Page 18-11)**.



2098
**Figure 18-7 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 battery and spark plug wire(s). **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

# REVERSE WARNING BUZZER LIMIT SWITCH (IF EQUIPPED)

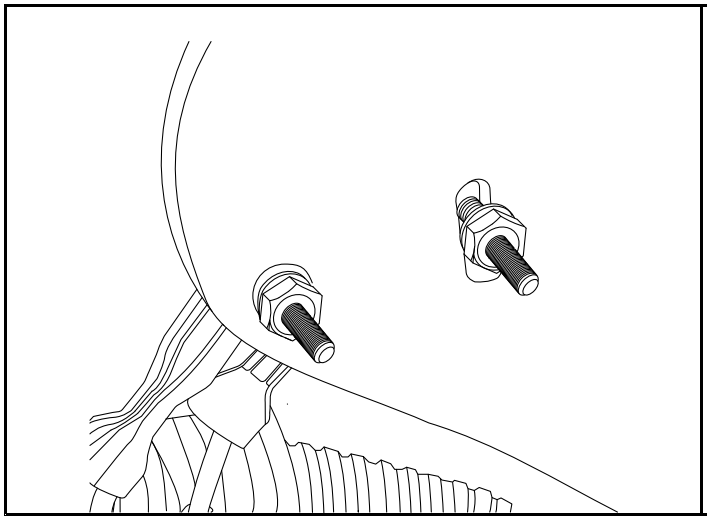
**See General Warnings, Section 1, Page 1-2.**

## TESTING THE REVERSE WARNING BUZZER LIMIT SWITCH

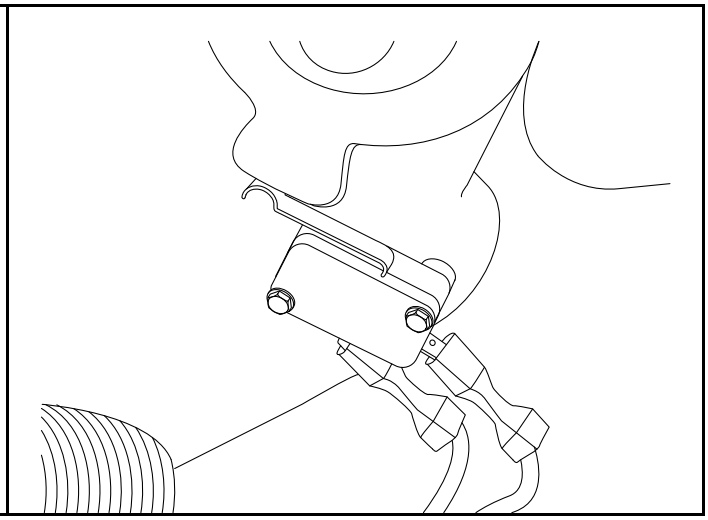
**See Test Procedure 25 – Reverse Warning Buzzer Limit Switch (If Equipped) on page 17-30.**

## REVERSE WARNING BUZZER LIMIT SWITCH REMOVAL

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Raise the hood.
3. Disconnect the wires from the reverse warning buzzer limit switch **(Figure 18-7, Page 18-11)**.
4. Remove the screws, nuts, washers, and lockwashers that secure the limit switch.
5. Remove the limit switch.



2141
**Figure 18-8 Reverse Warning Buzzer Limit Switch Adjustment Slot**



2142
**Figure 18-9 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 18-8, Page 18-12)**.
4. Rotate the limit switch so that the lobe on the Forward/Reverse handle activates the limit switch as shown **(Figure 18-9, Page 18-12)**.
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 battery and spark plug wire(s). **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**
10. Turn the key switch to the ON position. With the Forward/Reverse handle in REVERSE, the buzzer should sound.

# FRONT DIFFERENTIAL LIMIT SWITCH

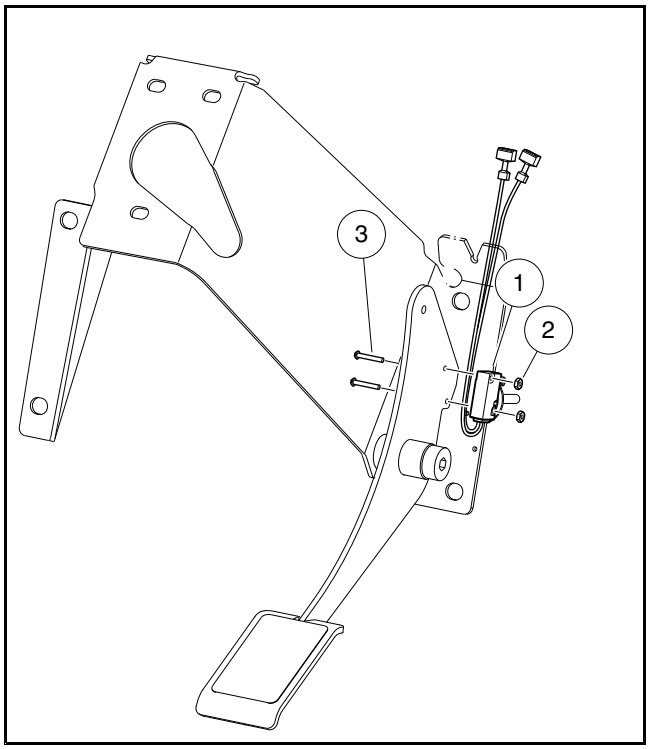
**See General Warnings, Section 1, Page 1-2.**

## TESTING THE FRONT DIFFERENTIAL LIMIT SWITCH

**See Test Procedure 17 – Front Differential Limit Switch on page 17-24.**

## FRONT DIFFERENTIAL LIMIT SWITCH REMOVAL

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Locate front differential limit switch above accelerator pedal.
3. Disconnect wire leads of switch (1) from wire harness **(Figure 18-10, Page 18-14)**.
4. Remove the nuts (2) and screws (3) that secure the switch (1) and remove the switch.




2496
**Figure 18-10 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 18-10, Page 18-14)**. **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 wire leads of switch to wire harness.
4. Connect battery and spark plug wire(s). **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

## FUEL LEVEL SENDING UNIT

**See General Warnings, Section 1, Page 1-2.**

Thoroughly test the fuel level sending unit before replacing the unit.

### TESTING THE FUEL LEVEL SENDING UNIT

**See Test Procedure 30 – Fuel Level Sending Unit on page 17-33.**

### FUEL LEVEL SENDING UNIT REMOVAL

**See Fuel Level Sending Unit Removal on page 19-11.**

### FUEL LEVEL SENDING UNIT INSTALLATION

**See Fuel Level Sending Unit Installation on page 19-12.**

## IGNITION COIL AND CHARGE COIL

**See General Warnings, Section 1, Page 1-2.**

It is recommended that the ignition coil and charge coil be thoroughly tested prior to replacement.

### TESTING THE IGNITION COIL

**See Test Procedure 21 – Ignition Spark on page 17-28. See also Test Procedure 22 – Engine Kill Wire on page 17-28, Test Procedure 23 – Grounded Kill Wire on page 17-29. For charge coil testing, see Test Procedure 19 – Charge Coil on page 17-26.**

### 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 19-1.**

**Refer to the engine manual for additional testing, removal, disassembly, and installation procedures. See the Kawasaki FH680D engine manual.**

## OIL PRESSURE SENSOR

**See General Warnings, Section 1, Page 1-2.**

**Refer to the engine manual for additional testing, removal, disassembly, and installation procedures. See the Kawasaki FH680D engine manual.**

## HEADLIGHTS

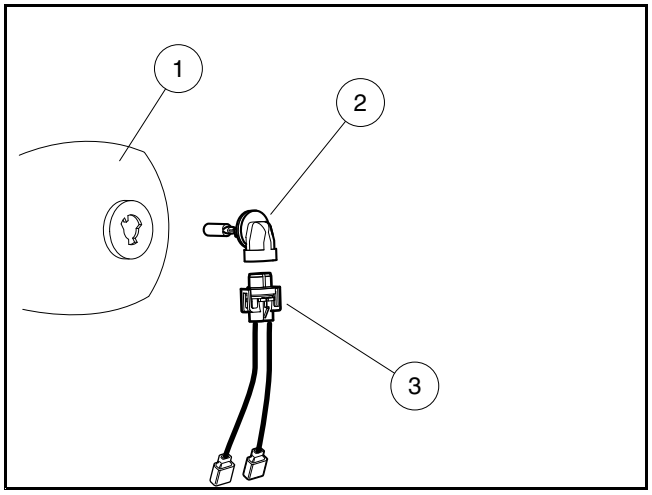
**See General Warnings, Section 1, Page 1-2.**

## TESTING THE HEADLIGHT BULB AND SOCKET

**See Test Procedure 34 – Voltage at Headlight Socket on page 17-36. See also Test Procedure 33 – Light Switch on page 17-36.**

## HEADLIGHT BULB REMOVAL

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. From the front of the vehicle, reach under the cowl and turn the connector harness/halogen bulb assembly clockwise one-quarter turn **(Figure 18-11, Page 18-16)**.
3. Remove the connector harness/halogen bulb assembly from the headlight lens.
4. Lift the retaining tabs on the connector and remove the halogen bulb.




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**Figure 18-11 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 18-11, Page 18-16)**.
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 battery and spark plug wire(s). **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

# WIRE HARNESS DIODES

**See General Warnings, Section 1, Page 1-2.**

The wire harness is equipped with several in-line diodes.

### TESTING THE WIRE HARNESS DIODES

**See Test Procedure 9 – Wire Harness Diodes on page 17-18.**

### WIRE HARNESS DIODE REMOVAL

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Locate the diode to be replaced by removing the wire conduit and tracing the wire.
3. 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.
4. 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 battery and spark plug wire(s). **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

## BATTERY

**See General Warnings, Section 1, Page 1-2.**

### ⚠ 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 a 12-volt battery. 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 26, top-post battery, 525 CCA at 0 °F (-17.8 °C) and a reserve capacity of at least 85 minutes. The group 26 classification indicates battery size: 8 inches W x 6-3/4 inches D x 7 inches H (20.8 cm W x 17.3 cm D x 19.7 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 – Battery on page 17-10.**

## 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 41 in-lb (4.3 N·m), coat terminals with Battery Terminal Protector Spray 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 18-18.**
3. Check the battery periodically to ensure that it is in a full state of charge. **See Charging the Battery on page 13-23.**
4. Keep the battery hold-down clamp tight. **See Vibration Damage on page 18-18.**

## 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 18-19.**

## 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.

## BATTERY REMOVAL

**See General Warnings on page 1-2.**

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Remove the driver-side seat.
3. Remove the battery hold-down located on the bottom of the battery.
4. 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 Warnings on page 1-2. Also see DANGER at beginning of Battery topic.**

1. Charge the battery using an automotive type 12-volt battery charger. Follow all warnings and procedures supplied by the battery charger manufacturer.
2. Attach the positive (+) charger cable to the positive (+) battery post.
3. Attach the negative (–) charger cable to the negative (–) battery post.
4. The battery may be charged with a slow charge (3 to 10 amps) or a fast charge (20 to 30 amps). Charge until the battery voltage is greater than 12.4 volts. **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 Warnings on page 1-2.**

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 battery and spark plug wire(s). **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

## BATTERY STORAGE

**Also see DANGER at beginning of Battery topic.**

1. Keep the battery clean and free of corrosion.
2. The battery cables should be disconnected from the battery so the battery can be connected to the charger. The battery can be left in the vehicle. Disconnect the negative (–) cable first.
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 voltage drops below 12.4 volts, 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 for state of charge every month. 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 Warnings on page 1-2.**

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.**

# PARK BRAKE LIMIT SWITCH

## PARK BRAKE LIMIT SWITCH REMOVAL

1. Disable the vehicle.
2. Unlatch, raise, and securely prop open the hood.
3. Disconnect the wires from the park brake limit switch (1) **(Figure 18-12)**.

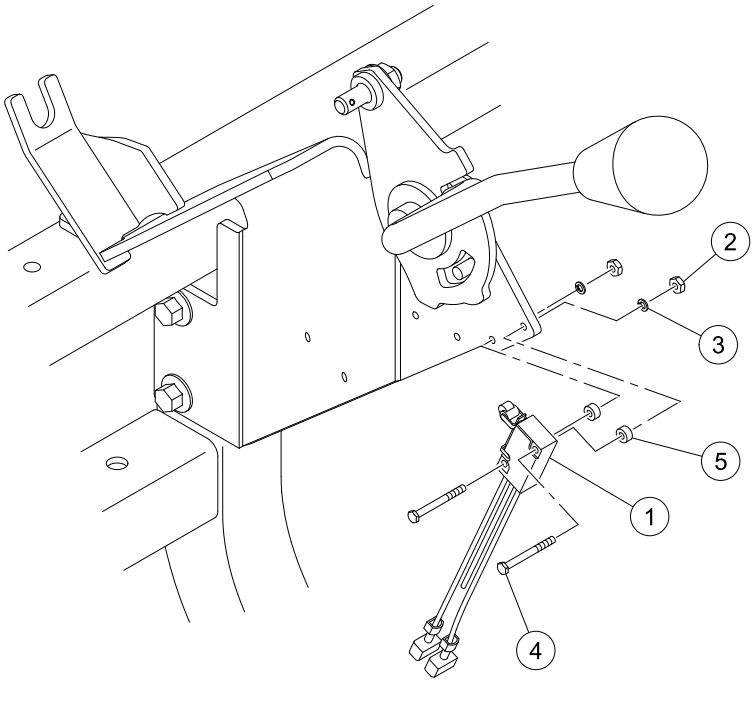



**Figure 18-12**

4. Remove the nuts (2) and washers (3).
5. Remove the bolts (4), park brake limit switch, and lock washers (5).

## PARK BRAKE LIMIT SWITCH INSTALLATION

1. Install the lock washers (5), park brake limit switch (1), and bolts (4) **(Figure 18-12)**.
2. Install the washers (3) and nuts (2). Tighten the nuts from 3 to 5 lb·in (0.34 to 0.56 N·m).
3. Connect the park brake limit switch red wire to the interlock harness red wire.
4. Connect the park brake limit switch black wire to the interlock harness black wire.

Pagination Page

# SECTION 19 — GASOLINE VEHICLE - ENGINE, MUFFLER, FUEL SYSTEM, AND CLUTCHES



## ⚠ DANGER

- **See General Warnings, Section 1, Page 1-2.**

## ⚠ WARNING

- **See General Warnings, Section 1, Page 1-2.**

## GASOLINE ENGINE

**See General Warnings, Section 1, Page 1-2.**

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.**

### ENGINE REMOVAL

**See General Warnings, Section 1, Page 1-2.**

## CAUTION

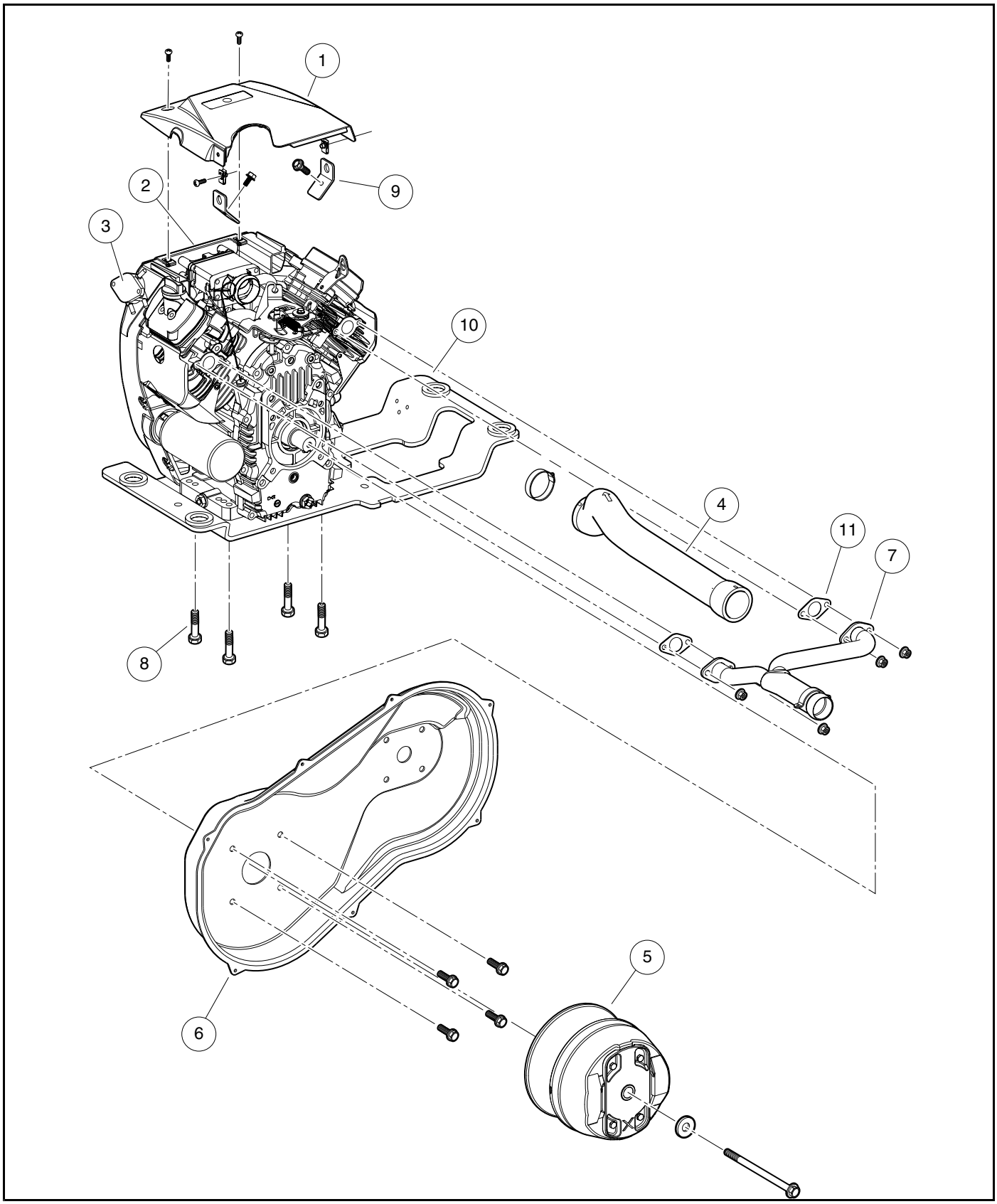
- **Before removal and disassembly, clean the engine.**

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Remove the cargo bed. **See Cargo Bed Removal, Section 4, Page 4-12.**
3. Remove seat(s) and remove the center seat plate (bucket seat vehicles only).
4. Remove the ROPS (Roll Over Protection Structure) and the lower rear ROPS bars. **See ROPS Removal, Section 4, Page 4-7.**
5. Remove the seat frame. **See Seat Support Removal, Section 4, Page 4-10.**
6. Remove the engine top cover (1) **(Figure 19-1, Page 19-2)**.
7. Remove the engine front cover (2).
8. Close the shut-off valve on the fuel tank.
9. 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.**

10. Remove the choke cable. **See Choke Cable Removal on page 19-21.**
11. Remove the engine air inlet hose (4).




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**Figure 19-1 Engine Removal and Installation Components**

12. Remove the accelerator cable. **See Accelerator Cable Removal on page 19-20.**
13. Remove the muffler. **See Muffler Removal on page 19-6.**
14. Remove the intermediate exhaust pipe. **See Intermediate Pipe Removal on page 19-6.**
15. Remove the clutch outer cover. **See Clutch Outer Cover Removal on page 19-36.**
16. Remove the clutches (5). **See Drive Clutch Removal on page 19-30.** Also **See Driven Clutch Removal on page 19-33.**
17. Remove the clutch inner cover (6). **See Clutch Inner Cover Removal on page 19-36.**
18. Remove the exhaust manifold (7).
19. Remove the electrical connectors:

19.1. Disconnect the engine harness from the chassis harness.

19.2. 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.*

20. Drain the engine oil. **See Engine Oil and Filter Change on page 11-11.**
21. Remove engine oil inlet and outlet hoses from the engine. **See Oil Filter Hose Removal on page 19-5. See also following NOTE.**

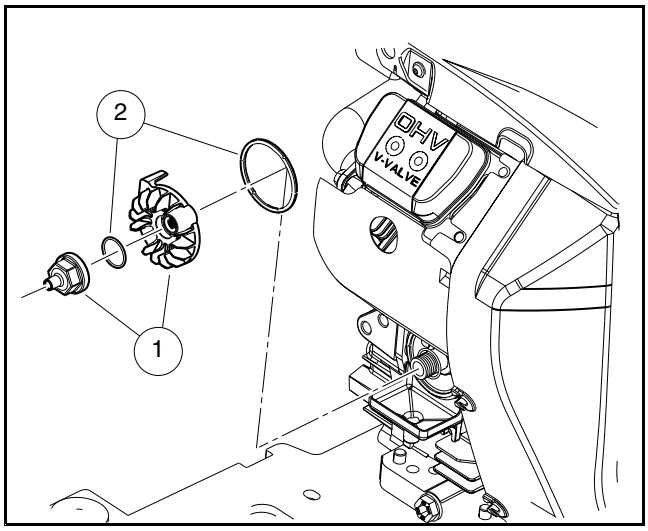
***NOTE:*** *Plug each line as it is removed from the engine. Without plugs, oil will leak from the lines.*

22. Remove the engine mounting hardware (8) **(Figure 19-1, Page 19-2)**.
23. Lift the engine out by its lift tabs (9).
24. If a new engine will be installed, remove and retain the following:
    – Oil Filter Adapter (1) **(Figure 19-2, Page 19-4)**
    – Engine Lift Tabs
    – Choke Cable Return Spring

## ENGINE INSTALLATION

**See General Warnings, Section 1, Page 1-2.**

1. Before a new engine is installed, the following components must be installed:
    – Oil Filter Adapter (1) (new o-rings (2) required) **(Figure 19-2, Page 19-4)**; 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 19-1, Page 19-2)**.
3. Secure the engine oil inlet and outlet hoses to the engine ports with new clamps. **See Oil Filter Hose Installation on page 19-5.**




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**Figure 19-2 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 17-2, Page 17-7.**

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 19-1, Page 19-2)**. Tighten the hardware to 21 ft-lb (28 N·m).
7. Install the clutch inner cover (6). **See Clutch Inner Cover Installation on page 19-36.**
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 19-33. Also see Driven Clutch Installation on page 19-35.**
10. Install the drive belt. **See Drive Belt Installation on page 19-29.**
11. Install the clutch outer cover. **See Clutch Outer Cover Installation on page 19-36.**
12. Install the intermediate exhaust pipe. **See Intermediate Pipe Installation on page 19-7.**
13. Install the muffler. **See Muffler Installation on page 19-7.**
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 19-22.**
16. Connect the accelerator cable. **See Accelerator Cable Installation on page 19-21.**
17. Install the engine air inlet hose (4).
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 on page 4-10 and ROPS Installation on 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 on page 11-10.**
25. Check the engine oil level. **See Engine Oil Level Check on page 11-11.**
26. Connect battery and spark plug wire(s). **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**
27. Adjust the engine RPM setting. **See Engine RPM Adjustment on page 19-24.**
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.

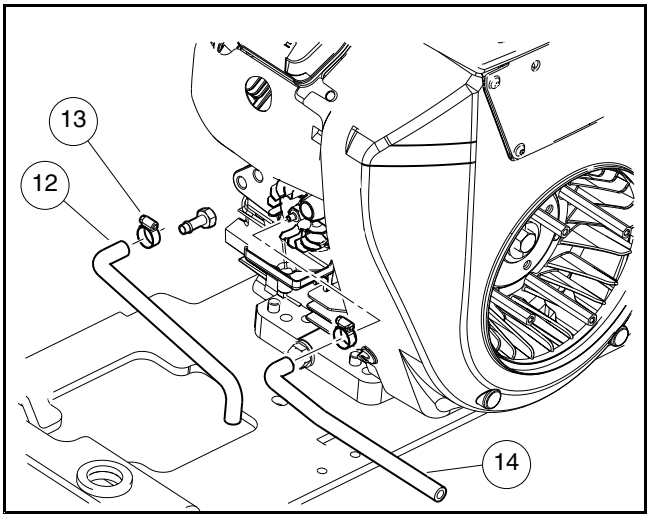
## OIL FILTER HOSES

### Oil Filter Hose Removal

1. Drain the engine oil. **See Engine Oil on page 11-10.**
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.




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**Figure 19-3 Oil Filter Hose Routing**

### Oil Filter Hose Installation

1. Replace the oil hoses with OEM hoses **(Figure 19-3, Page 19-5)**. **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 on page 11-10.**

# EXHAUST SYSTEM

## MUFFLER REMOVAL

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Loosen the muffler spring suspension bracket bolts.
3. Remove the two springs that secure the muffler inlet to the intermediate pipe **(Figure 19-4, Page 19-6)**. **See following NOTE.**

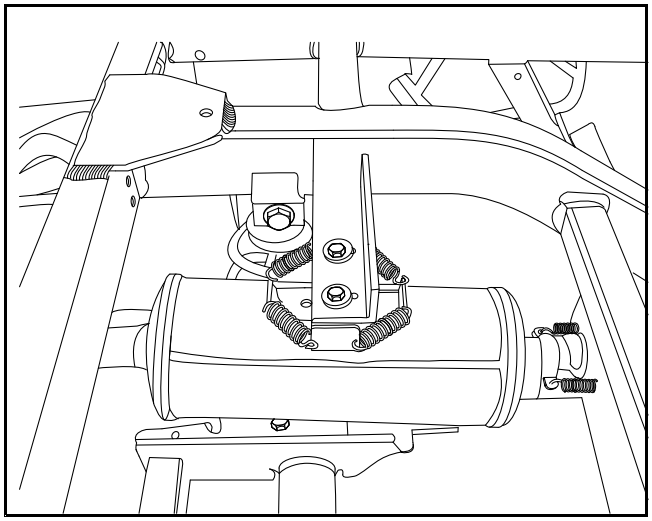
***NOTE:*** *Shift the end of the muffler inlet and intermediate pipe from side to side to relax and disconnect the springs.*

4. 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.*



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**Figure 19-4 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 19-4, Page 19-6)**.
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.**

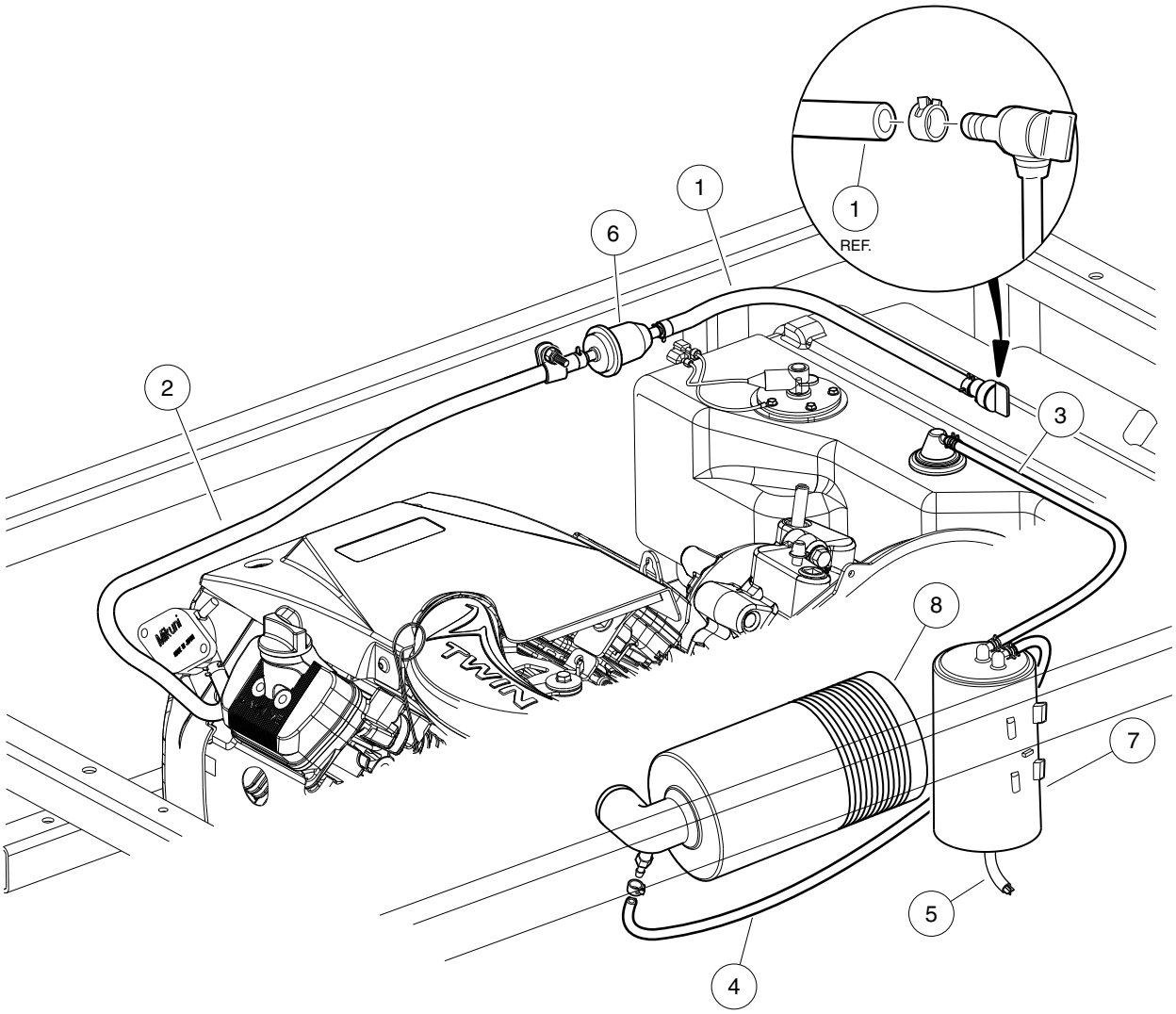
***NOTE:*** *Shift the end of the muffler inlet and intermediate pipe from side to side to connect the spring that is least extended.*

3. Align the muffler with the intermediate pipe and tighten the muffler spring bracket hardware to 21 ft-lb (29 N·m).
4. Connect battery and spark plug wire(s). **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**
5. 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. | DIAMETER Ø | ROUTING |
|---|---|---|
| 1 | 5/16 in. (8 mm) | Fuel tank to fuel filter (6) |
| 2 | 5/16 in. (8 mm) | Fuel filter (6) to fuel pump |
| 3 | 1/4 in. (6.35 mm)** | Vent Tube (Fuel Tank to Canister (7)) |
| 4 | 3/16 in. (5 mm) | Vent Tube (Canister (7) to Air Filter Canister (8)) |
| 5 | 5/16 in. (8 mm) | Vent Tube (Canister (7) to Atmosphere) |

** A 3/16 inch -to- 1/4 inch flared vent hose connected the fuel tank to the carbon canister. During 2012 model year, a running change to a 1/4 inch tank vent nipple eliminated the need for the flared end.

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**Figure 19-5 Fuel and Evaporative Emission System**

## FUEL LINES

**See General Warnings, Section 1, Page 1-2.**

The fuel lines must be properly routed and all hose clamps must be tight **(Figure 19-5, Page 19-8)**. The fuel lines should be kept clean. **See following NOTE and WARNING.**

***NOTE:*** *Use only 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 Warnings, Section 1, Page 1-2.**

One in-line filter (6) is installed between the fuel tank and the fuel pump **(Figure 19-5, Page 19-8)**. 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 11-1.** Replace the fuel filter as instructed. **See the Kawasaki FH680D engine manual.**

## FUEL PUMP

**See General Warnings, Section 1, Page 1-2.**

Procedures for inspection, removal, and installation can be found in the engine manual. **See the Kawasaki FH680D engine manual.**

## CARBURETOR

**See General Warnings, Section 1, Page 1-2.**

### ⚠ WARNING

- **The carburetor is equipped with an electric heater and must be grounded to the engine in order to prevent the risk of a spark. Always have a ground wire properly installed.**

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.**
- Air filter element. **See Air Filter Replacement on page 19-26.**
- Fuel filters. **See Fuel Filter on page 19-9.**
- Choke and air intake system (for restriction of air flow). **See Air Intake System on page 19-26.**
- Fuel pump. **See the Kawasaki FH680D engine manual.**
- Fuel lines (from fuel tank to filter to pump to carburetor). **See Fuel Lines on page 19-9.**
- Exhaust system (for restrictions).

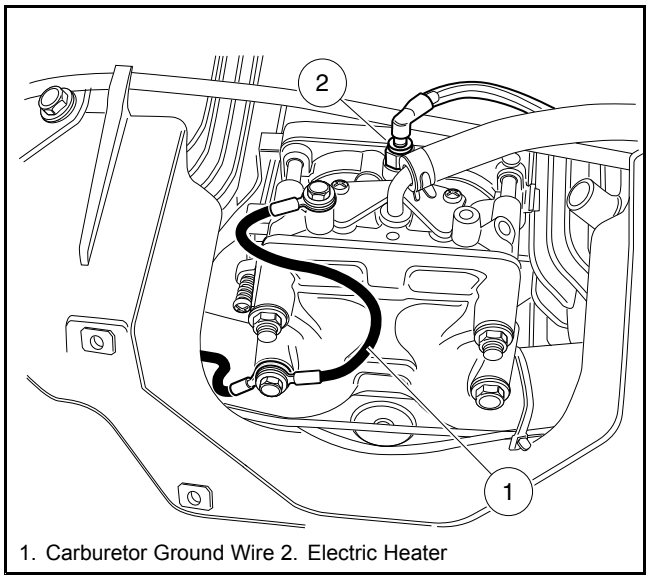
If the carburetor has failed, replace it. **See the Kawasaki FH680D engine manual.**

### Carburetor Grounding

**⚠ WARNING**

- **The carburetor is equipped with an electric heater and must be grounded to the engine in order to prevent the risk of a spark. Always have a ground wire properly installed.**

The carburetor is equipped with an electric heater and must be grounded to the engine in order to prevent the risk of a spark. Always have a ground wire installed **(Figure 19-6, Page 19-10)**. If a ground wire is not present and installed properly, do not operate the vehicle until carburetor is properly grounded. A Ground Wire Kit is available through Service Parts.




1. Carburetor Ground Wire 2. Electric Heater

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**Figure 19-6 Carburetor Ground Wire**

### 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 Main Jet Elevation/Size Chart on page 19-11.** After the proper jet size is determined, replace the main jet. **See the Kawasaki FH680D engine manual.**

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**

| KAWASAKI FH680 ENGINE MODEL/REVISION | CARBURETOR NUMBER | JET SIZE | | |
|---|---|---|---|---|
| | | 0-3300 FT. (0-1000 M) | 3300-6600 FT. (1000-2000 M) | 6600 FT. AND HIGHER (2000 M AND HIGHER) |
| AS09, BS09 | 47007 | 102/102 | 99/99 | 96/96 |
| | 47038 | | | |
| CS09 | 47050 | Left: 102 Right: 104 | 99/99 | 96/96 |
| DS09 to current | 40755 | | | |

## FUEL LEVEL SENDING UNIT

**See General Warnings, Section 1, Page 1-2.**

**Fuel Level Sending Unit Removal**

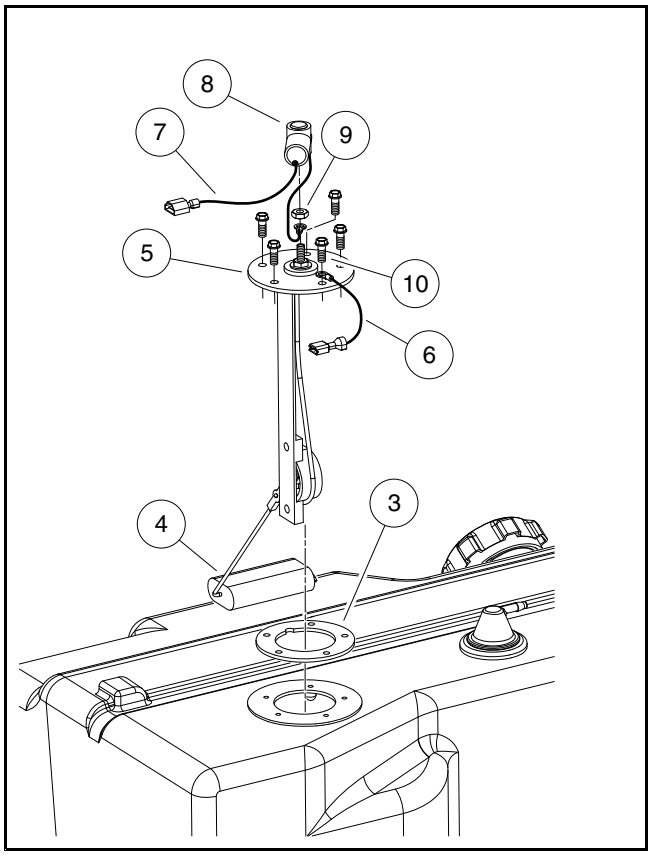
### ⚠ DANGER

- **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. Disconnect battery and spark plug wire(s).**See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Remove the passenger seat. **See Seat Removal, Section 4, Page 4-9.**
3. 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 19-7, Page 19-12)**. Retain the hardware.




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**Figure 19-7 Fuel Level Sending Unit Removal**

4. 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.
5. Remove the four remaining hex-head plastic thread screws from the fuel level sending unit flange (5). Retain the hardware.
6. 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 passenger's side surface of the fuel tank.*

**Fuel Level Sending Unit Installation**

## ⚠ 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. Place a new rubber gasket on the fuel tank with the notch (2) centered between the flange identification mounting holes (1). **(Figure 19-8, Page 19-14)**. **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).*

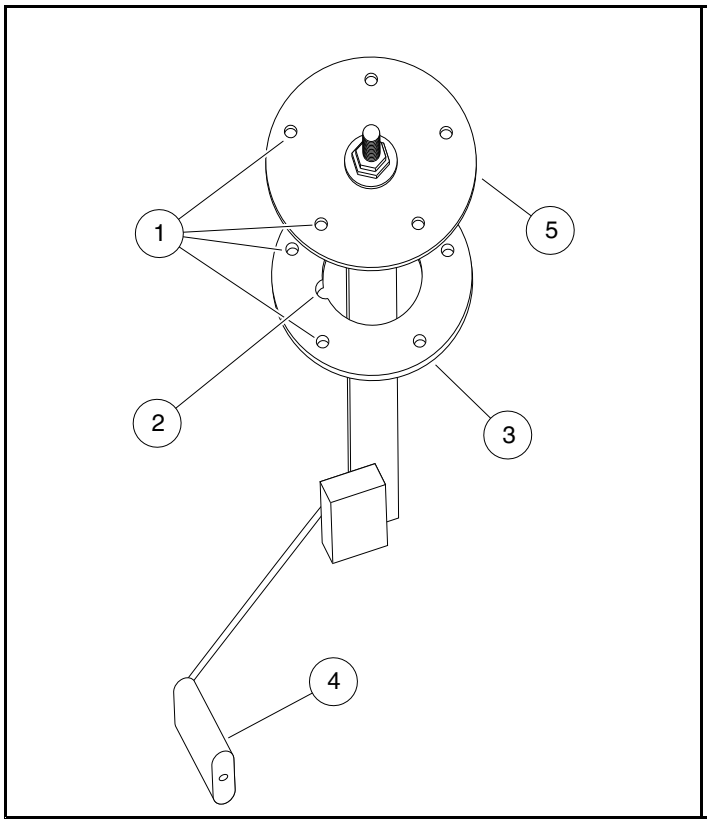
*Ensure the replacement gasket is rubber and that the mounting holes in the gasket are aligned properly with the mounting holes on the fuel tank.*

2. Feed a new sending unit rheostat arm and float (4) into the fuel tank **(Figure 19-7, Page 19-12)**. The rheostat arm and float should be positioned toward the passenger's side surface of the fuel tank **(Figure 19-9, Page 19-14)**.
3. Align the flange identification mounting holes (1) directly over the corresponding mounting holes in the gasket and fuel tank **(Figure 19-8, Page 19-14)**. **See following CAUTION and NOTE.**

## ⚠ CAUTION

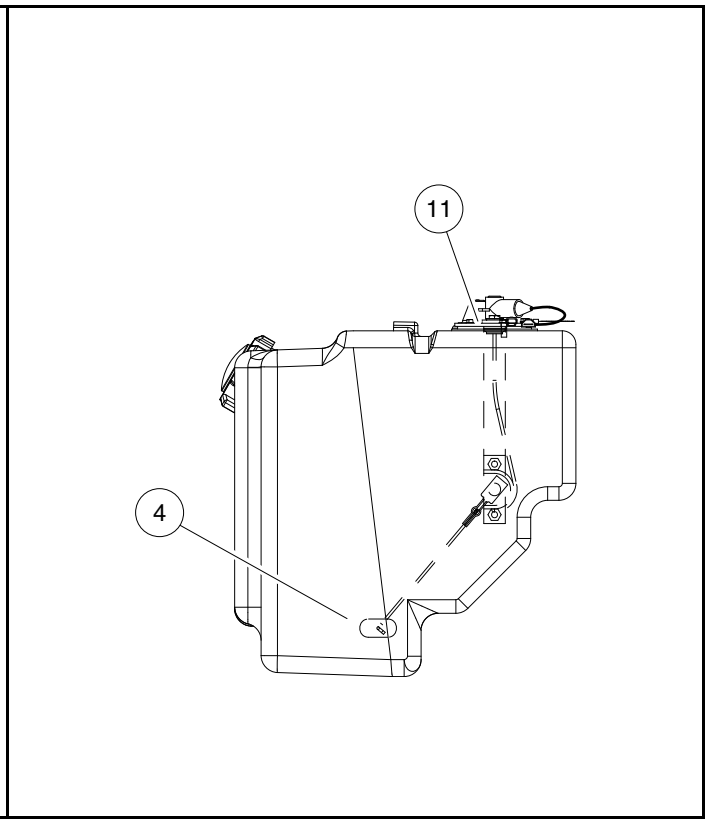
- **Ensure all mounting holes in the fuel level sending unit, gasket, and fuel tank are aligned properly before hardware is installed. Improper alignment of the mounting holes could result in an incomplete seal between the fuel level sending unit and the fuel tank.**

***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.*




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**Figure 19-8 Fuel Level Sending Unit Alignment**




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**Figure 19-9 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 19-7, Page 19-12)**. **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 19-7, Page 19-12)**. 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 battery and spark plug wire(s). **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

## FUEL TANK

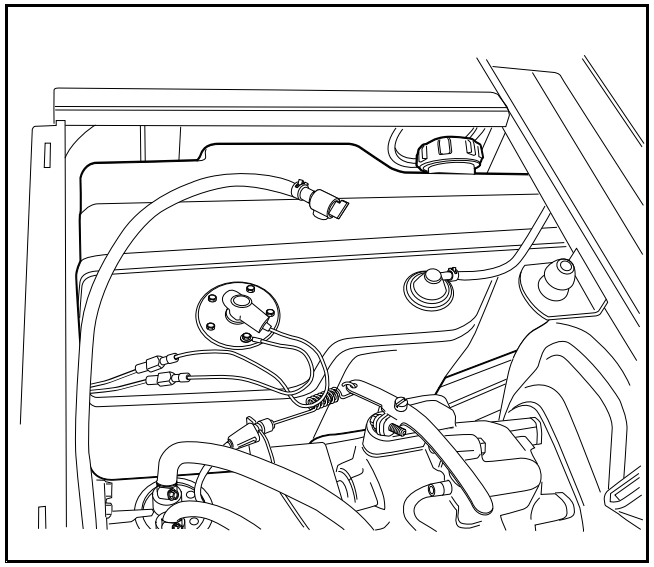
**See General Warnings, Section 1, Page 1-2.**

### ⚠ 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. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Remove both seats.
3. Remove the center seat plate.
4. Remove the upper portion of the ROPS. **See ROPS Removal, Section 4, Page 4-7.**
5. Remove the bolts, washers and flanged locknuts from the seat frame, seat side plates, and engine cover plate.
6. Turn the fuel shut-off valve to the closed (OFF) position **(Figure 19-13, Page 19-19)**.
7. Run the engine until all fuel in the carburetor, fuel pump, and fuel lines is used and the engine stalls.
8. Loosen the clamp and disconnect the fuel line from the fuel tank shut-off valve **(Figure 19-10, Page 19-15)**.



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**Figure 19-10 Gasoline Fuel Tank**

9. Loosen the clamp and remove the vent tube from the fuel tank.
10. Remove the fuel tank cap.
11. 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.**

12. 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.
13. Remove the nut from the strap end below the passenger seat area.
14. Lift the strap end and remove the opposite end from the slotted bracket.
15. Remove the passenger side bed latch bracket from the frame.
16. 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.**

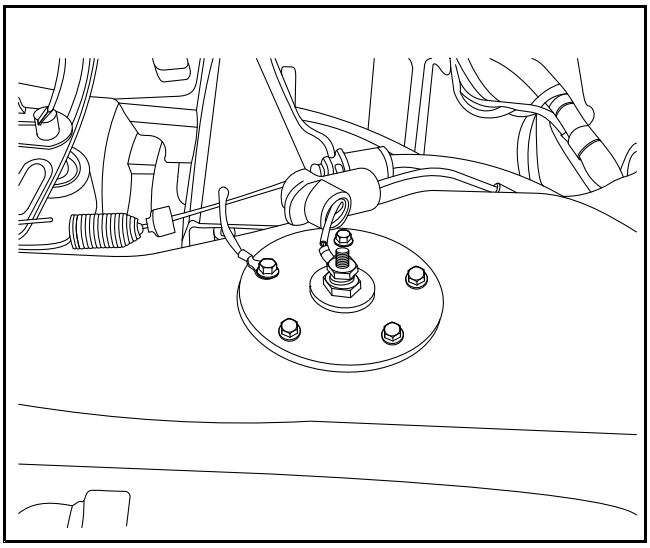
## ⚠ WARNING

- **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 19-11, Page 19-17)**.
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.**



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**Figure 19-11 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 19-13, Page 19-19)**.
14. Connect battery and spark plug wire(s). **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**
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.**

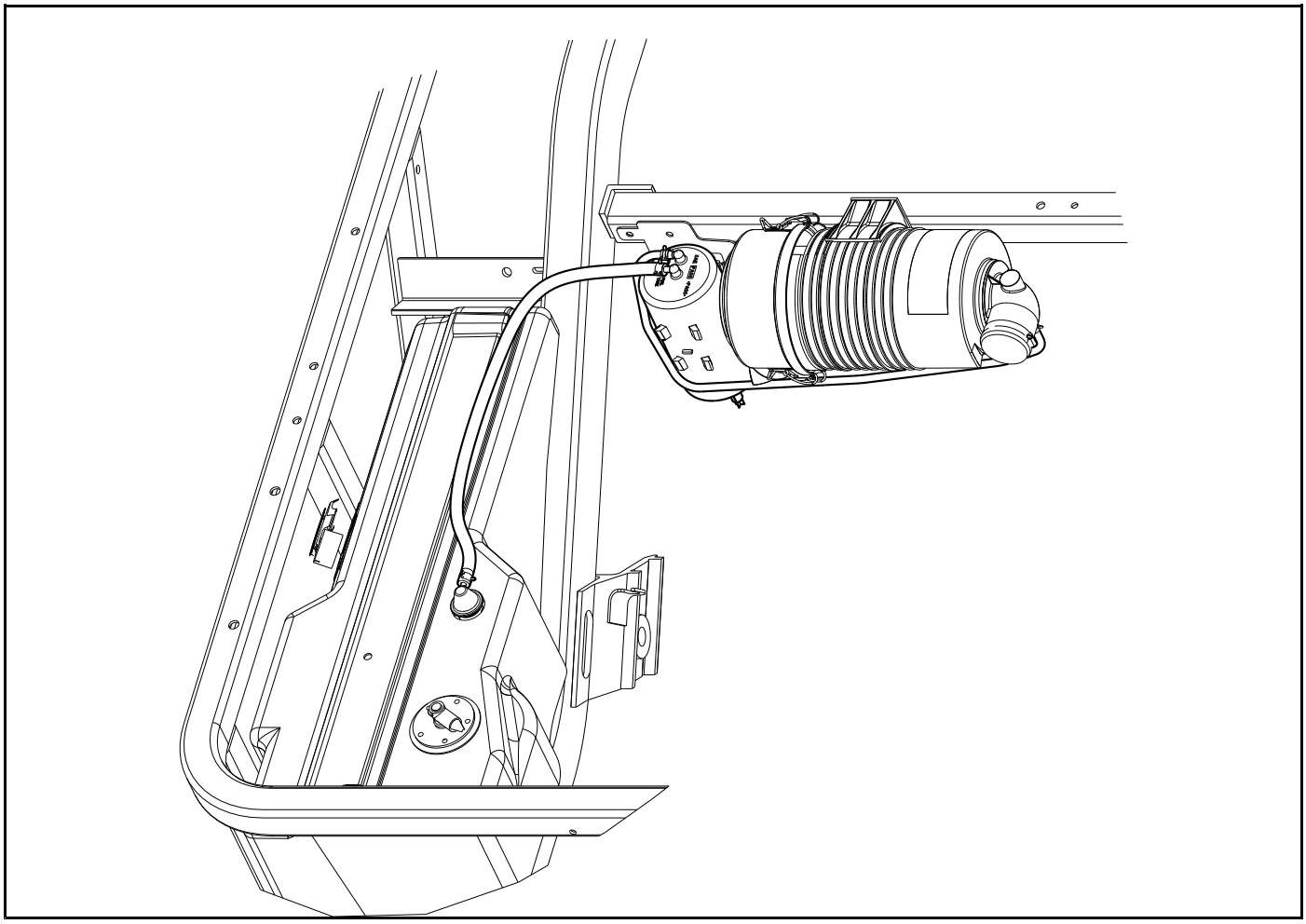
17. Inspect each fuel line connection for leaks.

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.

## CARBON CANISTER

**See General Warnings, Section 1, Page 1-2.**



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**Figure 19-12 Carbon Canister, Hoses and Routing**

### ⚠ WARNING

- **If the carbon canister is damaged, replace it. Do not attempt to repair it. See the following canister removal procedure.**

**Carbon Canister Removal**

1. Disable the vehicle. **See Disabling the Vehicle on page 1-3.**
2. Lift cargo bed and secure in raised position.
3. Remove hose clamps, securing three hoses to canister, and disconnect hoses **(Figure 19-12, Page 19-18)**.
4. Push/pull the canister to force it from its mounting bracket.

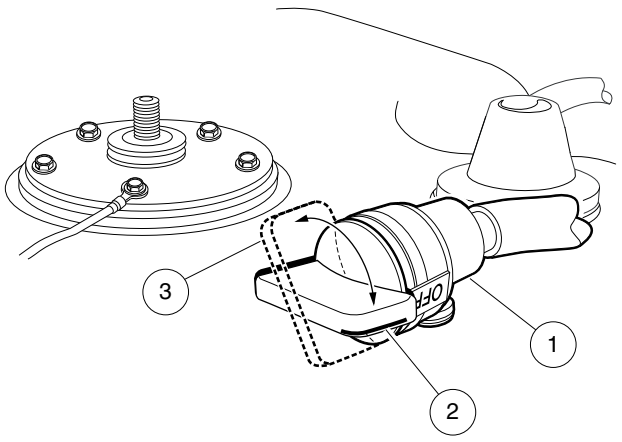
**Carbon Canister Installation**

1. Align canister mounting tabs with slots in mounting bracket and push/pull the canister into bracket **(Figure 19-12, Page 19-18)**. Force it in until fully seated.
2. Attach hoses to appropriate locations on carbon canister and secure with hose clamps.
3. Lower cargo bed.

## FUEL SHUT-OFF VALVE

**See General Warnings, Section 1, Page 1-2.**

The fuel shut-off valve is located on top of the fuel tank. 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 19-13, Page 19-19)**.




1. Fuel Shut-off Valve
2. Closed (OFF)
3. Open (ON)

NOTE: When selecting valve position, ensure that it is fully opened or fully closed.

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**Figure 19-13 Fuel Shut-off Valve**

# ENGINE CONTROL LINKAGES

## GENERAL INFORMATION

For proper vehicle operation, it is important the accelerator cable, governor, idle RPM and high-speed RPM adjustments are done correctly and in the proper sequence. **See following CAUTION.**

### CAUTION

- **Improper adjustment can result in poor vehicle performance and/or damage to the engine components.**

## GROUND SPEED

***NOTE:*** *If possible, the manufacturer recommends measuring ground speed when setting engine RPM.*

This vehicle should reach a ground speed of 25 mph (40 km/h). If the ability to measure vehicle ground speed is not available, the closest engine RPM setting to achieve 25 mph (40 km/h) is 3825 ±25 RPM. **See Engine RPM Adjustment on page 19-24.**

## ACCELERATOR CABLE

**See General Warnings, Section 1, Page 1-2.**

### ⚠ WARNING

- **To avoid unintentionally starting a gasoline vehicle, disconnect the battery and spark plug wire.**

**Accelerator Cable Removal**

***NOTE:*** *When the accelerator cable is replaced, the high-speed RPM must be adjusted.* ***See High-Speed RPM Adjustment on page 19-25.***

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Raise the hood.
3. Remove the seat(s) and the engine top cover. **See Seat Removal, Section 4, Page 4-9.**
4. Disconnect the accelerator cable at the pedal.

4.1. Disconnect the Z-shaped end of the accelerator cable from the pedal **(Figure 19-14, Page 19-21)**.

4.2. Disconnect the cable strain relief at the pedal bracket.

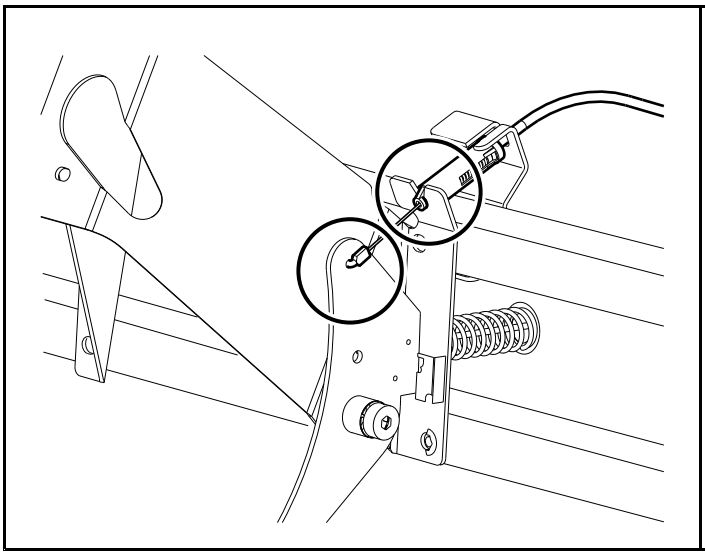
5. Disconnect the accelerator cable (3) from the engine.

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) **(Figure 19-15, Page 19-21)**.

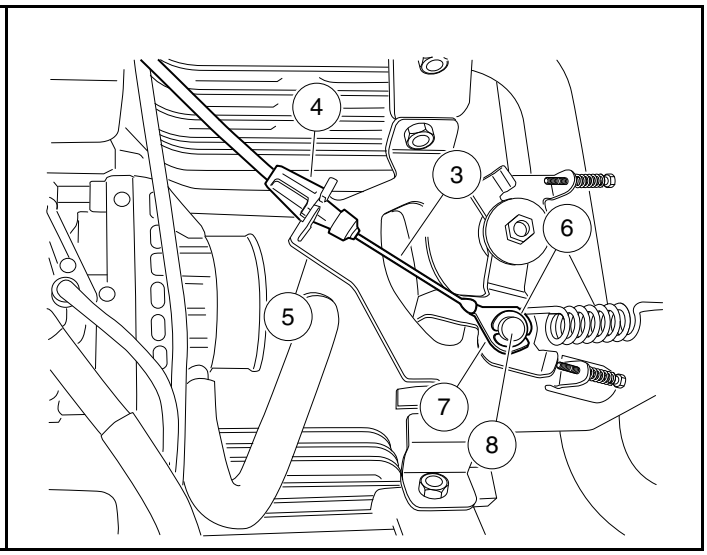
5.2. Remove the cable sheath strain relief (4) from the bracket (5).

6. Remove the accelerator cable from the plastic retaining clips 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 each end of the cable before removing it from the vehicle. When removing the cable, allow the cord to travel from the attachment points and under the frame. The routed cord can then be used during installation.*



2362
**Figure 19-14 Accelerator Cable at Pedal (Z-Shaped Cable End and Anchor)**




2160
**Figure 19-15 Accelerator Cable at Engine**

### Accelerator Cable Installation

***NOTE:*** *When the accelerator cable is replaced, the high-speed RPM must be adjusted.* ***See High-Speed RPM Adjustment on page 19-25.***

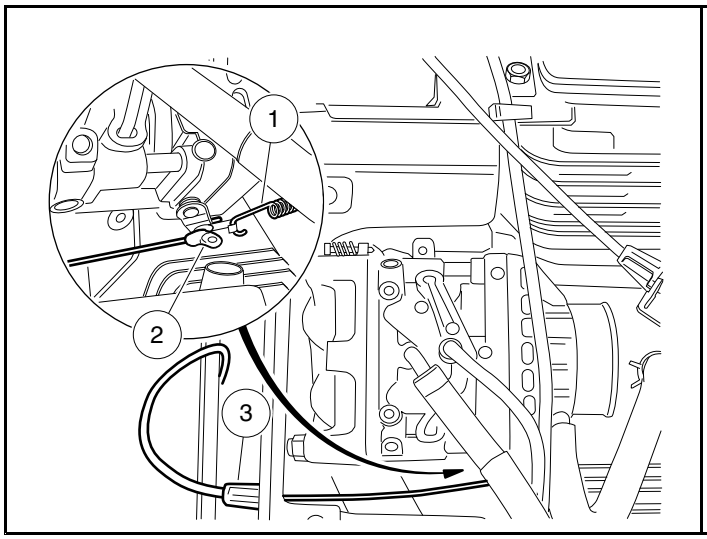
1. Installation is reverse of removal procedure.
2. Connect battery and spark plug wire(s). **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

## CHOKE CABLE

### Choke Cable Removal

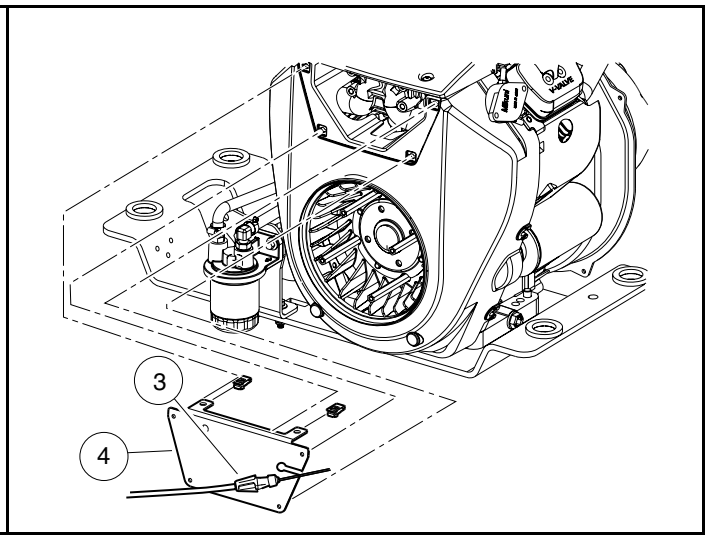
1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Remove seat(s).
3. Remove the center seat plate (bucket seat vehicles only).
4. Remove the engine top cover.
5. Remove the choke cable return spring (1) from the hook on the choke lever **(Figure 19-16, Page 19-22)**.
6. Remove the Z-shaped cable end (2) from the choke lever on the carburetor.
7. Remove the engine front cover (4) **(Figure 19-17, Page 19-22)**.
8. Remove the cable sheath strain relief (3) from the engine front cover **(Figure 19-17, Page 19-22)**.
9. Raise the hood.
10. 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. When 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.*




2162

**Figure 19-16 Choke Cable on Engine**




2163

**Figure 19-17 Choke Cable Through Front Cover**

**Choke Cable Installation**

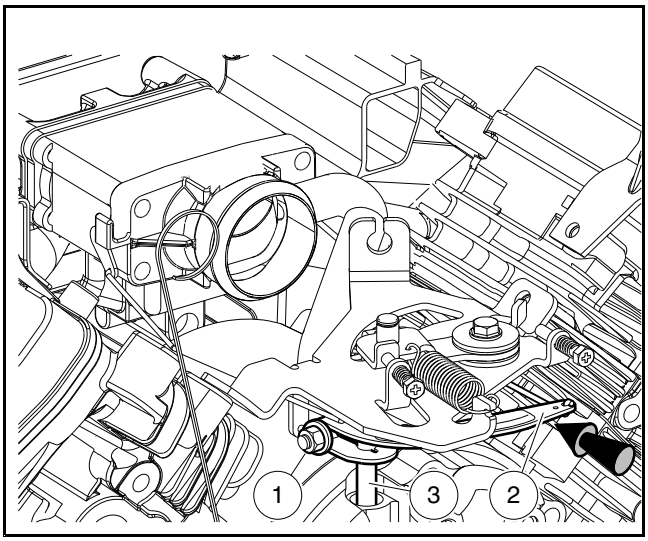
1. Secure a new choke cable to the nylon cord outside of the instrument panel. At the engine compartment, pull the nylon cord until the choke cable reaches the engine.
2. Push the choke cable ferrule into the instrument panel hole so the tines engage behind the panel.
3. Secure the choke cable to the 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 19-17, Page 19-22)**.
5. Feed the Z-shaped cable end (2) of the choke cable through the engine front cover **(Figure 19-16, Page 19-22)**.
6. Push the cable sheath strain relief (3) into the engine front cover (4) until it snaps into place **(Figure 19-17, Page 19-22)**.
7. Insert and secure the Z-shaped end of the choke cable (2) to the choke lever on the side of the carburetor **(Figure 19-16, Page 19-22)**.
8. Secure the choke cable return spring (1) to the hook on the choke lever.
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 battery and spark plug wire(s). **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**
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 Warnings, Section 1, Page 1-2.**

**Engine Governor Arm Adjustment**

1. Loosen nut (1) on governor arm (2) **(Figure 19-18, Page 19-23)**.
2. Force governor arm (2) forward until it stops. Hold in this position.
3. Insert small allen wrench into shaft (3) and rotate shaft counterclockwise (CCW) until it stops. Hold in this position.
4. Tighten nut (1).




2503

**Figure 19-18 Governor Arm**

**Engine Governor Arm Removal and Installation**

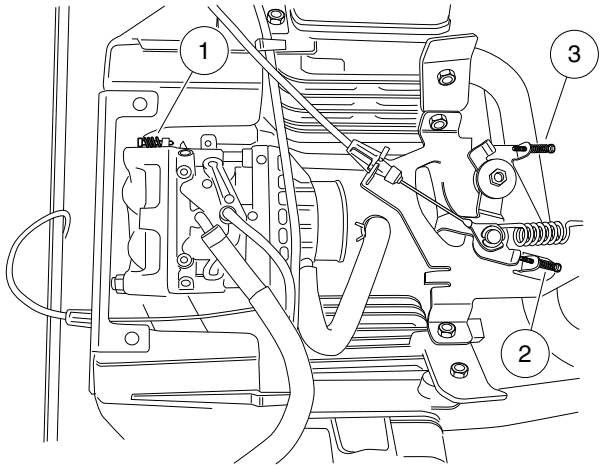
**Refer to the engine manual for additional testing, removal, disassembly, and installation procedures. See the Kawasaki FH680D engine manual.**

## ENGINE RPM ADJUSTMENT

### Vehicle Creep

New vehicles or vehicles with a new drive belt or clutches may crawl forward with the shifter in FORWARD and the engine idling. This is considered normal until the drive belt is “broken-in” (approximately 15 hours of use). Other possible symptoms include difficulty or inability to shift into or out of gear and engine stalling.

1. Operate the vehicle as usual through the "break-in" period. If this condition persists beyond 15 hours of use, go to step 2.
2. Inspect the accelerator pedal and cable. Check idle and high-speed RPM. **See Idle RPM Adjustment on page 19-24. See High-Speed RPM Adjustment on page 19-25.** Check governor. **See Engine Governor Arm Adjustment on page 19-23.**




1. Carburetor idle stop screw 2. Engine governed idle screw
3. High-speed RPM screw

2504

**Figure 19-19 Overview of RPM Adjustment Screws**

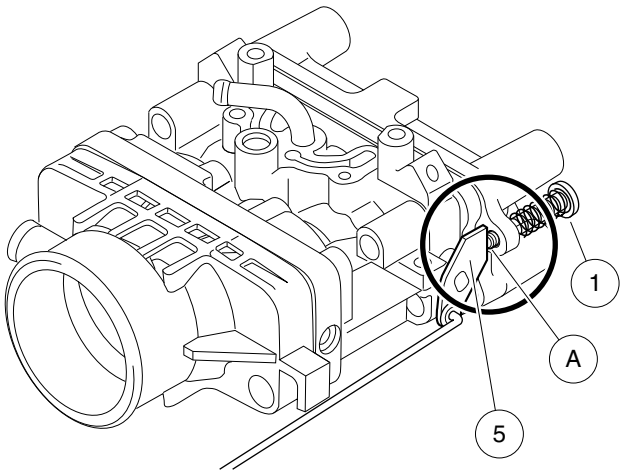
### Idle RPM Adjustment

**⚠ 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. Place Forward/Reverse handle in NEUTRAL. Start engine and bring it up to operating temperature. Measure the engine RPM with a tachometer approved for this engine.
2. Hold the throttle lever (5) **(Figure 19-20, Page 19-25)** on the carburetor against the carburetor idle stop screw (1) by pushing the governor arm (4) clockwise **(Figure 19-21, Page 19-25)** as far as it will go.
3. Adjust carburetor idle stop screw (1) until tachometer displays 1200 ±25 RPM **(Figure 19-20, Page 19-25)**.
4. Release throttle lever (5) and governor arm (4). Adjust engine governed idle screw (2) **(Figure 19-21, Page 19-25)** until tachometer displays 1300 ±25 RPM. **See following NOTE.**

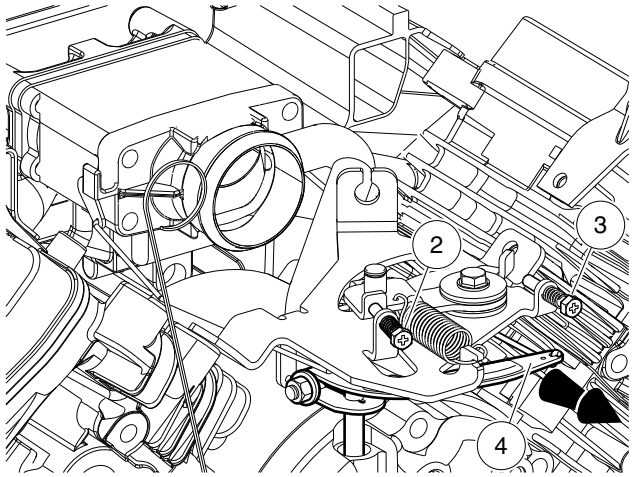
***NOTE:*** *With engine at operating temperature and idling at specified RPM, it is normal to have a small gap between the throttle lever (5) and carburetor idle stop screw (1)* ***(Figure 19-20, Page 19-25)****.*




Throttle lever (5) against carburetor idle stop screw (1) with no gap (A).

2505

**Figure 19-20 Carburetor Idle Stop Screw**




2506

**Figure 19-21 Push Governor Arm Clockwise**

**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. With engine at operating temperature, press the accelerator pedal all the way to the floor.
2. Measure the engine RPM with a tachometer approved for this engine.
3. Adjust the high-speed RPM screw (3) until the tachometer displays 3825 ±25 RPM **(Figure 19-21, Page 19-25)**. **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 Warnings, Section 1, Page 1-2.**

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

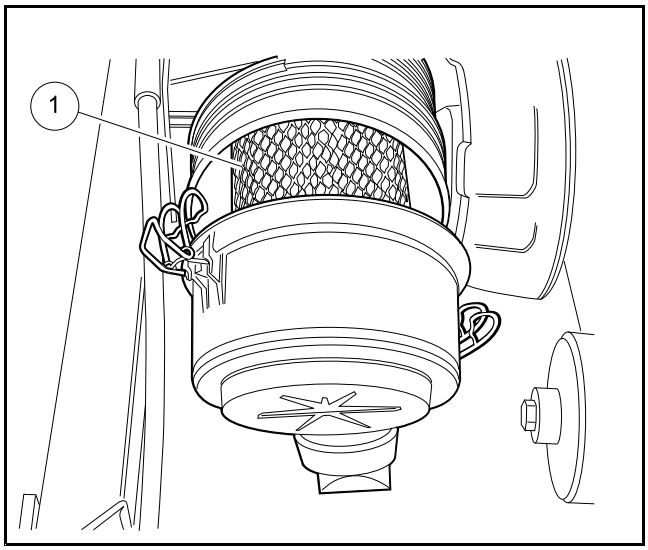
- **Do not drill into the driver-side frame because it is part of the air intake system. Failure to heed this caution could damage the engine by allowing excessive contamination to enter the air intake system.**

## 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 11, Page 11-1.** 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 because it is part of the air intake system. Failure to heed this caution could damage the engine by allowing excessive contamination to enter the air intake system.**




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**Figure 19-22 Air Filter Cartridge**

**Air Filter Removal**

1. Release both canister tab locks **(Figure 19-22, Page 19-26)**.
2. Pull the canister cap away from the canister.
3. Remove the air filter cartridge (1). **See following NOTE.**

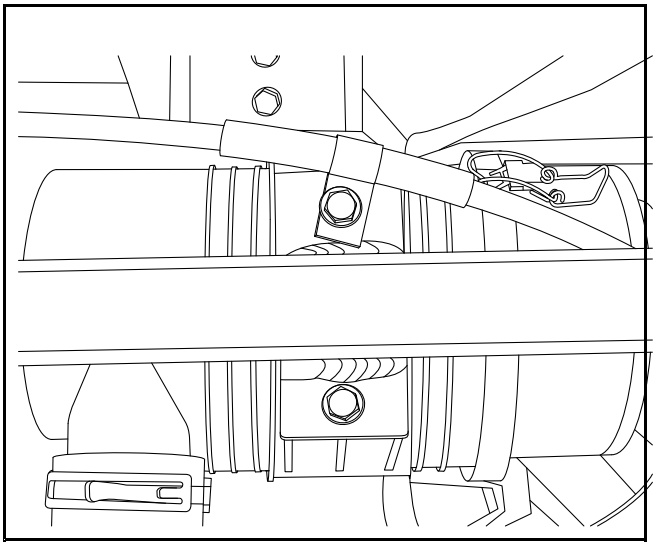
***NOTE:*** *The filter cartridge is specifically designed for this engine. It fits into the canister only one way. Use only the direct replacement part.*

**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 19-22, Page 19-26)**.
3. Use both tab locks on the sides of the cap to secure the canister cap.

## AIR CANISTER REMOVAL

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Remove the air filter cartridge. **See Air Filter Removal on page 19-26.**
3. Remove the bottom (inlet) hose from the canister.
4. Remove the top (outlet) hose from the canister.
5. Remove the two bolts and park brake cable from the canister and remove the canister.



2041

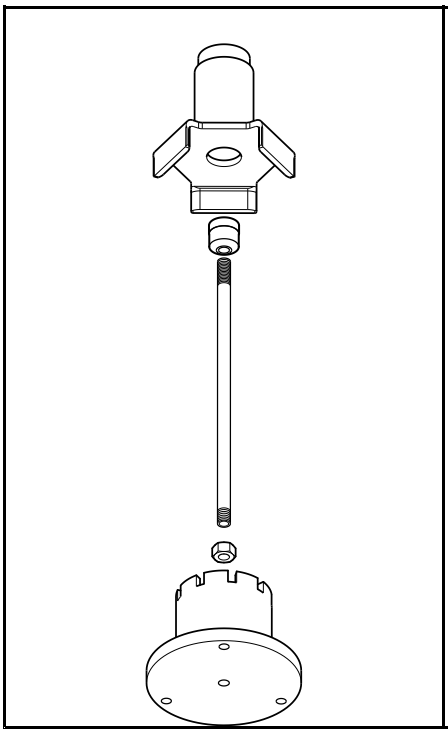
**Figure 19-23 Air Filter Canister**

## 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 19-27.**
6. Connect battery and spark plug wire(s). **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

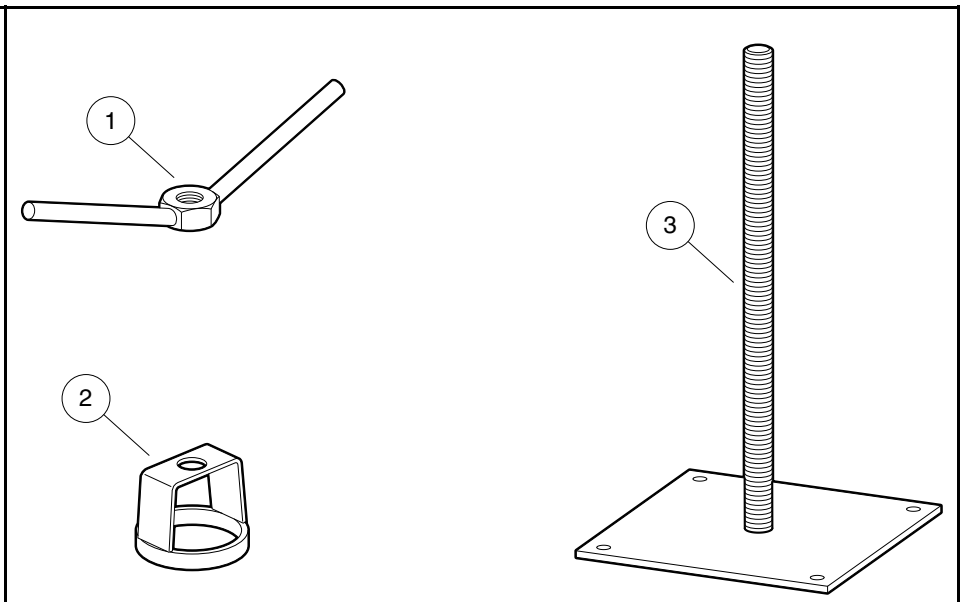
# CLUTCHES

The following service tools are required to disassemble the clutches properly and are available from a service parts representative **(Figure 19-24, Page 19-28) and (Figure 19-25, Page 19-28)**:



2498

**Figure 19-24 Drive Clutch Service Tool – Three-Weight Design**




1. Spring compression nut 2. Spring compression collar 3. Spring compression base

2499

**Figure 19-25 Driven Clutch Service Tools**

## CLUTCH TROUBLESHOOTING

**See General Warnings, Section 1, Page 1-2.**

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 19-24.**

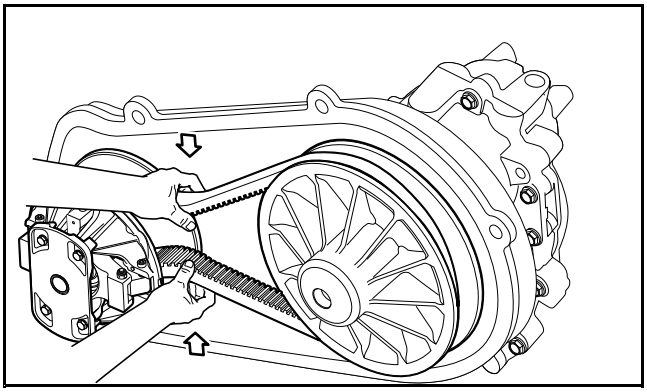
If the clutches are not operating properly, perform the following:

1. Check the governor and throttle settings. **See Engine RPM Adjustment on page 19-24.**
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 19-29. See also Driven Clutch on page 19-33.**
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 and driven clutches.
5. Check the drive clutch rollers and weights for wear. **See Drive Clutch Cleaning and Inspection on page 19-30.**

## DRIVE BELT

**See General Warnings, Section 1, Page 1-2.**

The drive belt should be inspected periodically for wear and glazing. If it is excessively worn, frayed, or glazed, replace the belt.



2171

**Figure 19-26 Drive Belt Removal**

**Drive Belt Removal**

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Remove the outer clutch cover. **See Clutch Outer Cover Removal on page 19-36.**
3. Grasp the belt midway between the drive and driven clutches and squeeze the belt together as tightly as possible **(Figure 19-26, Page 19-29)**.
4. 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. 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 outer clutch cover. **See Clutch Outer Cover Installation on page 19-36.**
4. Connect battery and spark plug wire(s). **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**

## DRIVE CLUTCH

**See General Warnings, Section 1, Page 1-2.**

### 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. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Remove the top air filter hose (outlet) from the air filter canister.
3. Remove the clutch outer cover. **See Clutch Outer Cover Removal on page 19-36.**
4. Remove the drive belt. **See Drive Belt Removal on page 19-29.**
5. Remove the retaining bolt and mounting washer from center of drive clutch. Discard retaining bolt.
6. Thread the clutch removal tool 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.**
- **Do not hit or tap the clutch with a hammer. Do not pry the clutch. These actions will damage the clutch.**

7. Remove the drive clutch from the vehicle. **See previous CAUTION.**

**Drive Clutch Cleaning and Inspection**

1. Use a dry, lint-free cloth to clean clutch parts. **See following CAUTION.**

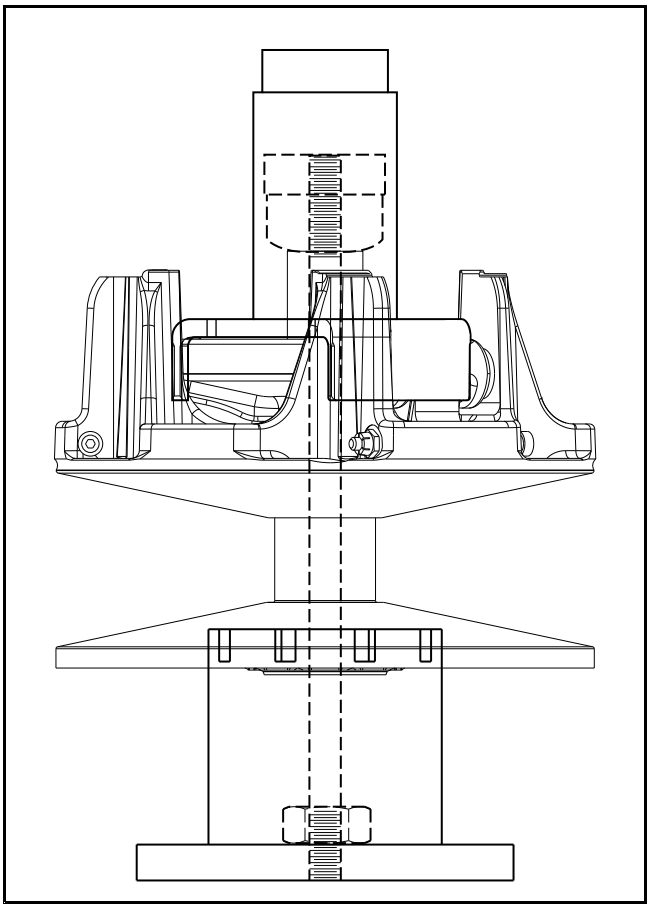
## CAUTION

- **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 19-28, Page 19-32). 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.

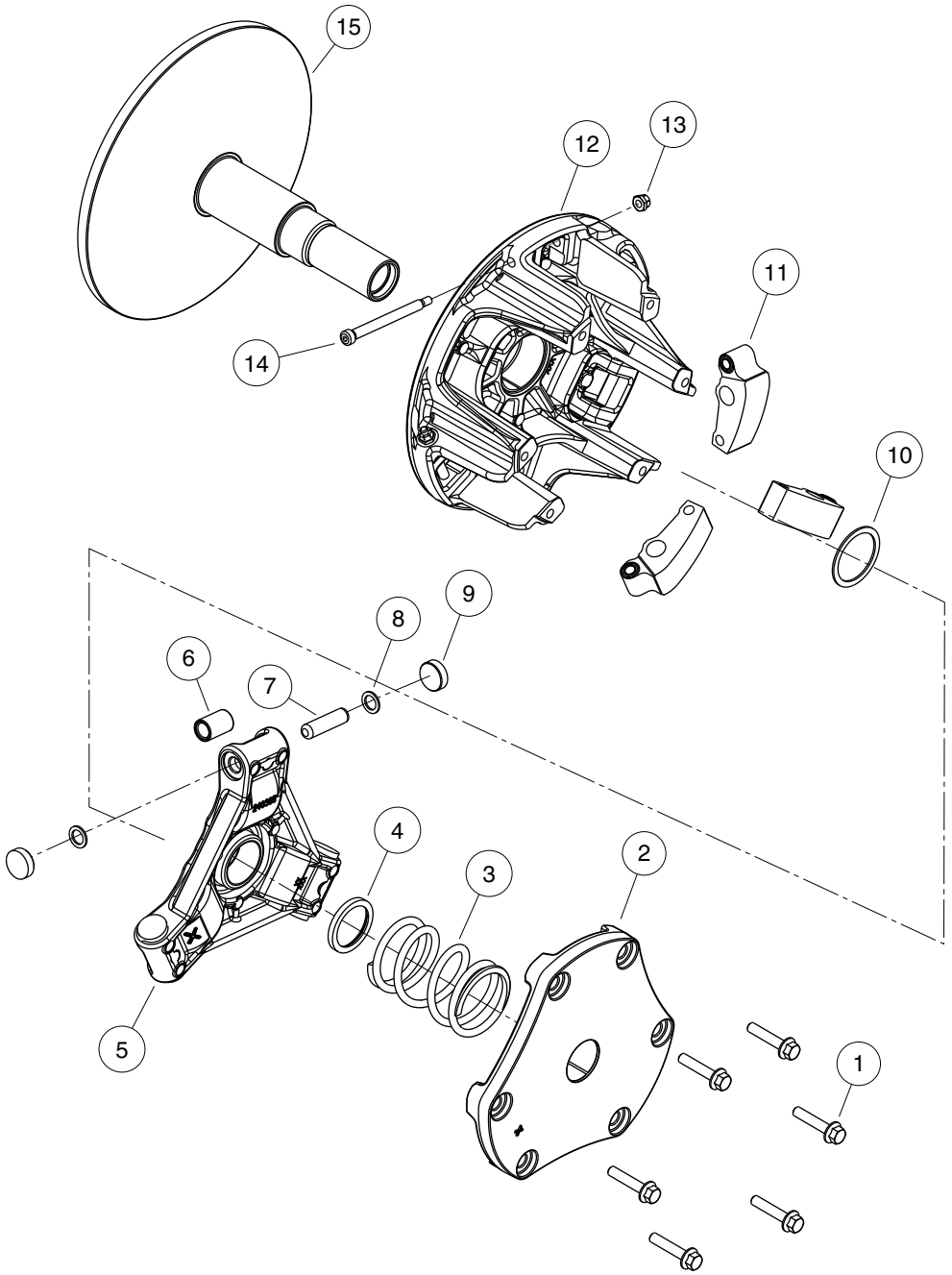
**Drive Clutch Disassembly – Three-Weight Design**

1. Remove the six bolts (1) that secure the cover plate (2) to the moveable sheave (12) **(Figure 19-28, Page 19-32)**.
2. Remove the cover (2), spring (3) and spacer (4) from the clutch spider (5).
3. Inspect the rollers (6), pins (7) and weights (11). Replace if necessary.
4. Secure the drive clutch service tool into a vice or mount the tool to a flat work surface.
5. Place the drive clutch onto the service tool and secure the fixed sheave (15) as shown **(Figure 19-27, Page 19-31)**.
6. Place the spider tool on top of the spider.
7. Use a 1/2-inch drive ratchet to disengage the moveable sheave (12) and spider (5), which will come off as an assembly, from the fixed sheave (15) **(Figure 19-28, Page 19-32)**.



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**Figure 19-27 Using the Drive Clutch Service Tool (Three-Weight)**




| | | | | | |
|---|---|---|---|---|---|
| 1. | Screw, Hex Flange Head, 1/4–20x1.25 | 6. | Roller | 11. | Weight |
| 2. | Cover Plate | 7. | Pin, 0.375x1.375 | 12. | Moveable Sheave |
| 3. | Spring, Compression, 2.0 OD Black/Or | 8. | Washer, Flat | 13. | Locknut, #10-24 |
| 4. | Spacer, Clutch, 1.44x1.125x0.23 | 9. | Button, Torque Primary | 14. | Screw, Shoulder, Hex Socket, 0.25x2.5 |
| 5. | Spider | 10. | Shim, 1.63x1.33 | 15. | Fixed Sheave |

2501

**Figure 19-28 Drive Clutch Components (Three-Weight) (19 MPH)**

**Drive Clutch Component Inspection – Three-Weight Design**

1. Inspect the rollers (6) and pins (7) **(Figure 19-28, Page 19-32)**. Ensure they rotate freely without roughness or loose play. If they do not, the entire drive clutch must be replaced. The rollers and pins can not be replaced.
2. Inspect the weights (11). There should be no noticeable wear. If the weights are worn, scratched, or damaged, replace them.

2.1. Remove the bolts (14) and flex locknuts (13) that secure the weights (11) to the moveable sheave (12).

2.2. Install new weights with bolts and flex locknuts. Tighten the locknuts to 45 in-lb (5 N·m).

**Drive Clutch Assembly – Three-Weight Design**

***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 (12), shim (10) and spider (5) onto the fixed sheave (15). Note the location of the "X" so the remaining components with an "X" can be aligned **(Figure 19-28, Page 19-32)**.
2. Use a spider removal tool to tighten the moveable sheave and spider to 265 ft-lb (359 N·m).
3. Install the spacer (4) and spring (5) onto the shaft.
4. Place the cover plate (2) onto the shaft.
5. Pull the moveable sheave upward and start threading bolts (1) into holes.
6. Use a crisscross pattern to continue tightening the bolts to 113 in-lb (12.7 N·m).

**Drive Clutch Installation**

1. Place the drive clutch assembly on the crankshaft taper.
2. Install the mounting washer and new retaining bolt. Tighten new retaining bolt to 21 ft-lb (28.5 N·m).
3. Install the drive belt as instructed. **See Drive Belt Installation on page 19-29.**
4. Install the clutch outer cover and tighten the bolts to 72 in-lb (8.0 N·m).
5. 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.*

6. Connect battery and spark plug wire(s). **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**
7. Drive the vehicle and check for proper operation.

## DRIVEN CLUTCH

**See General Warnings, Section 1, Page 1-2.**

### 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.**

**Driven Clutch Removal**

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Remove the top air filter hose from the filter canister.
3. Remove the clutch outer cover. **See Clutch Outer Cover Removal on page 19-36.**

4. Remove the drive belt as instructed. **See Drive Belt Removal on page 19-29.**
5. Remove the bolt and washer from the center of the clutch and discard bolt.
6. Remove the driven clutch. **See following CAUTION.**

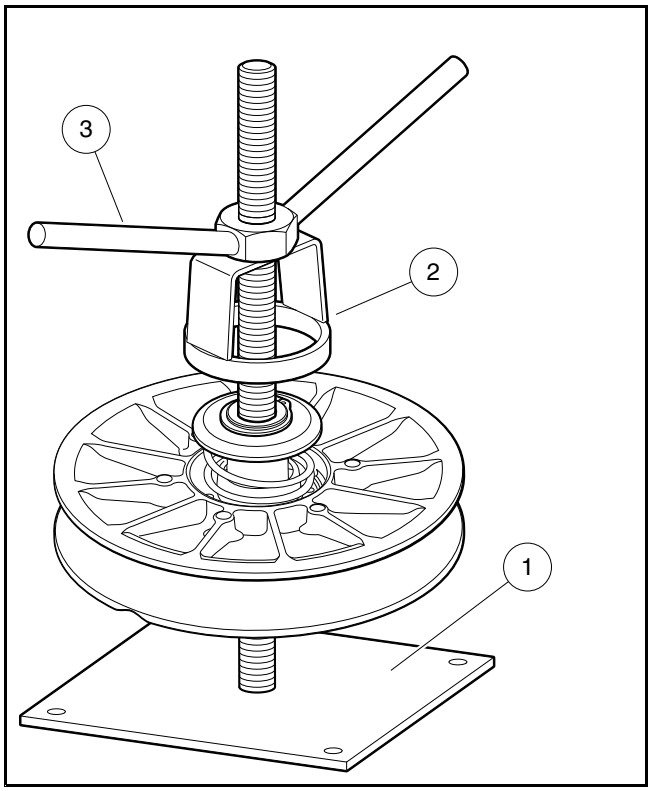
## CAUTION

- **Do not hit or tap the clutch with a hammer. Do not pry the clutch. These actions will damage the clutch.**

**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
- Spring compression collar
- Spring compression nut



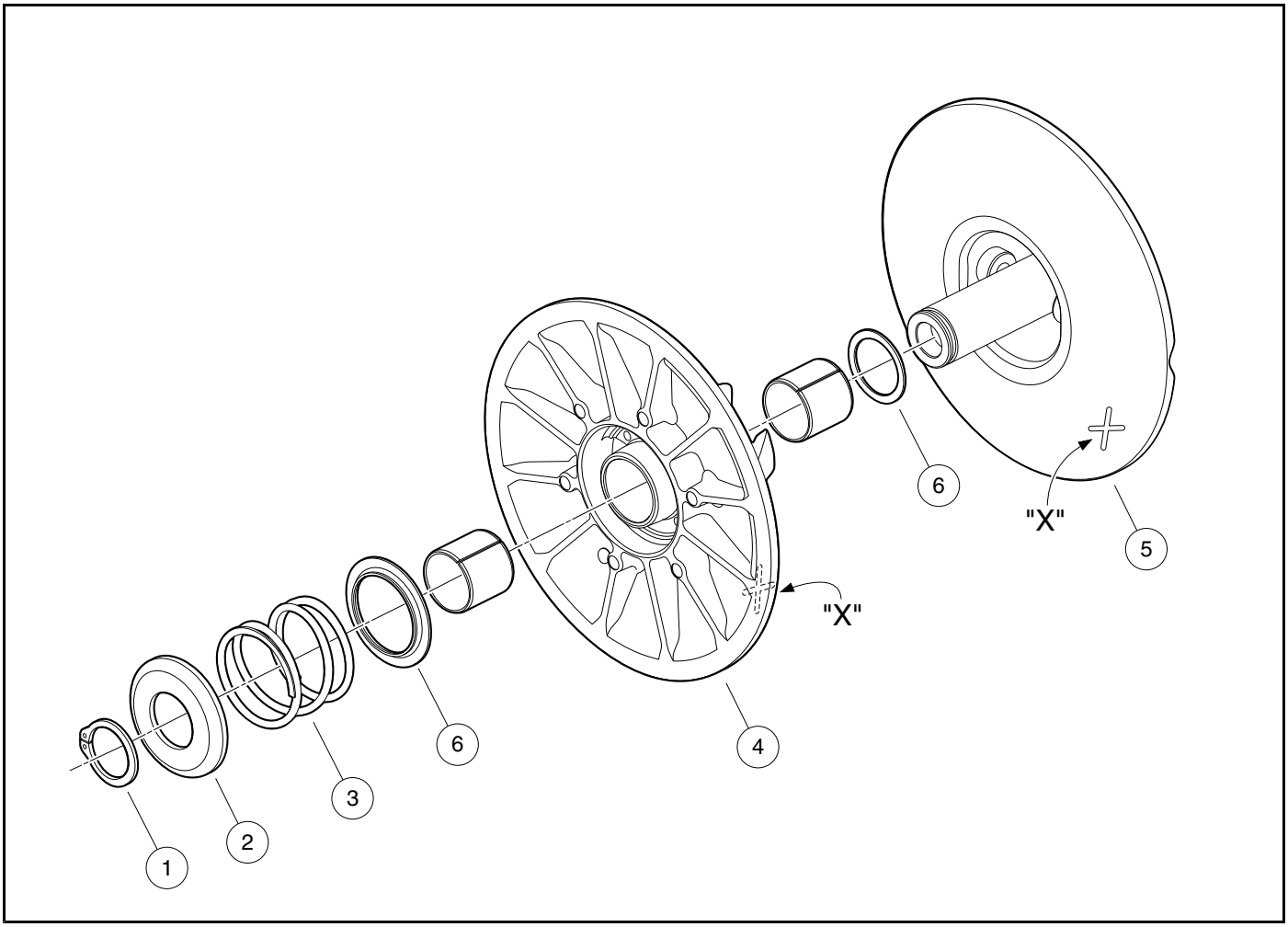

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**Figure 19-29 Driven Clutch Service Tools**

1. Place the driven clutch onto the Spring compression base (1) **(Figure 19-29, Page 19-34)**.
2. Place the Spring compression collar (2) onto the driven clutch.
3. Thread the Spring compression nut (3) 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 19-30, Page 19-35)**.
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.*




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**Figure 19-30 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 19-30, Page 19-35)**.
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 19-29, Page 19-34)**.
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. Install the driven clutch assembly on the transmission splined shaft.

2. Install the mounting washer and new retaining bolt. Tighten retaining bolt to 39 ft-lb (53 N·m).
3. Install the drive belt as instructed. **See Drive Belt Installation on page 19-29.**
4. Install the clutch outer cover and tighten the screws to 72 in-lb (8 N·m).
5. 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.*

6. Connect battery and spark plug wire(s). **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**
7. Drive the vehicle and check for proper operation.

## CLUTCH COVER

### Clutch Outer Cover Removal

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Remove the top air filter hose from the filter canister.
3. 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 battery and spark plug wire(s). **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4. 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

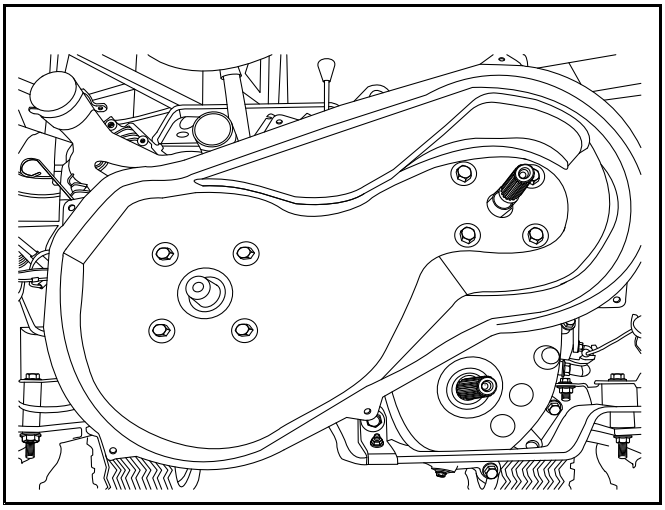
1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery- Gasoline/Diesel Vehicles on page 1-3.**
2. Remove the outer clutch cover. **See Clutch Outer Cover Removal on page 19-36.**
3. Remove the drive belt. **See Drive Belt Removal on page 19-29.**
4. Remove the drive clutch. **See Drive Clutch Removal on page 19-30.**
5. Remove the driven clutch. **See Driven Clutch Removal on page 19-33.**
6. Remove the bolts and washers from the clutch inner cover **(Figure 19-31, Page 19-37)**.
7. 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 19-35.**
7. Install the drive clutch. **See Drive Clutch Installation on page 19-33.**
8. Install drive belt. **See Drive Belt Installation on page 19-29.**
9. Install the clutch outer cover. **See Clutch Outer Cover Installation on page 19-36.**
10. Connect battery and spark plug wire(s). **See Connecting the Battery- Gasoline/Diesel Vehicles on page 1-4.**



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**Figure 19-31 Clutch Inner Cover**

Pagination Page

# SECTION 20 — WIRING DIAGRAMS

20

## GENERAL INFORMATION

### Wire Description

EXAMPLE: 18_GRN_RED

- 18 = 18 gauge wire
- GRN_RED = Green wire with red stripe

### Wire Colors

***NOTE:*** *The following colors will represented as a black wire in the wiring diagrams:*

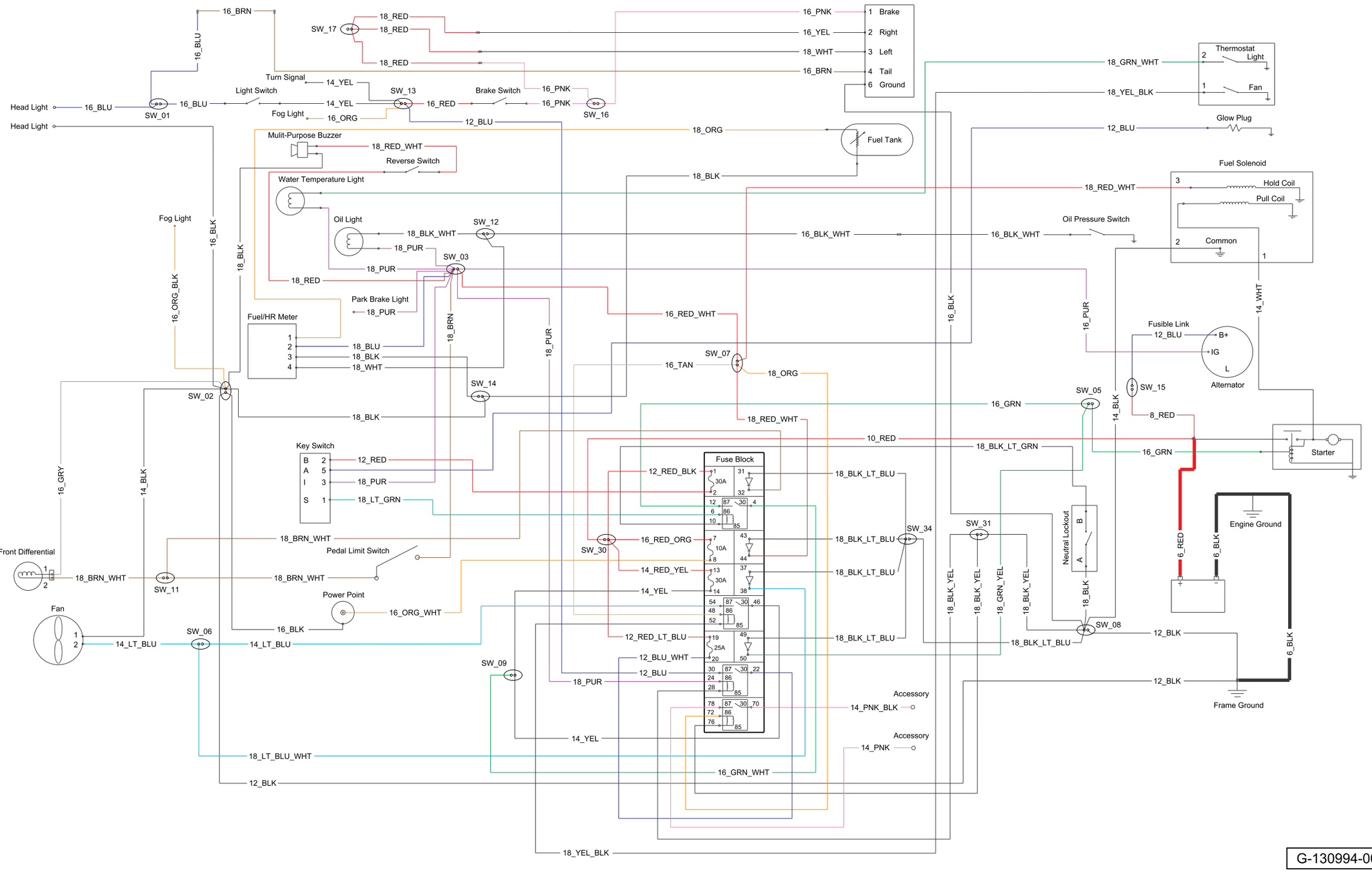
- *Black*
- *White*
- *Yellow*
- *White with Black Stripe*

| Abbreviation | Wire Color |
|---|---|
| BLK | Black |
| BLU | Blue |
| LT BLU | Light Blue |
| BRN | Brown |
| GRAY | Gray |
| GRN | Green |
| ORG | Orange |
| PINK | Pink |
| PUR | Purple |
| RED | Red |
| TAN | Tan |
| WHT | White |
| YEL | Yellow |
| BLK_LT_BLUE | Black with Light Blue Stripe |
| BLK_ORG | Black with Orange Stripe |
| BLK_PINK | Black with Pink Stripe |
| BLK_WHT | Black with White Stripe |
| BLK_YEL | Black with Yellow Stripe |
| BLU_WHT | Blue with White Stripe |
| BRN_WHT | Brown with White Stripe |
| GRN_RED | Green with Red Stripe |

**TABLE CONTINUED ON NEXT PAGE**

| | |
|---|---|
| GRN_WHT | Green with White Stripe |
| ORG_BLK | Orange with Black Stripe |
| ORG_WHT | Orange with White Stripe |
| PUR_WHT | Purple with White Stripe |
| RED_GRN | Red with Green Stripe |
| RED_WHT | Red with White Stripe |
| RED_YEL | Red with Yellow Stripe |
| WHT_BLK | White with Black Stripe |

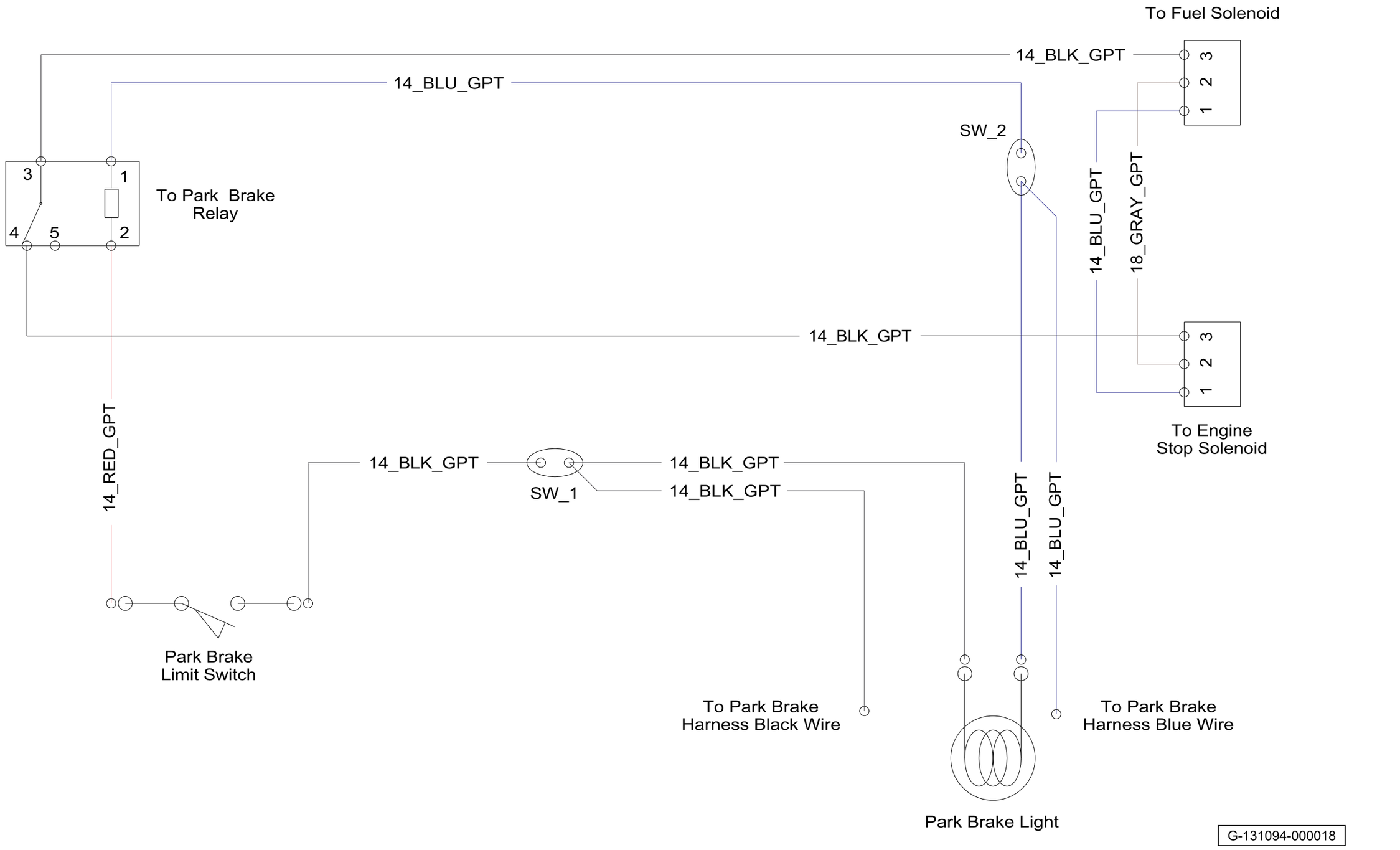
# DIESEL MAIN HARNESS - STYLE B




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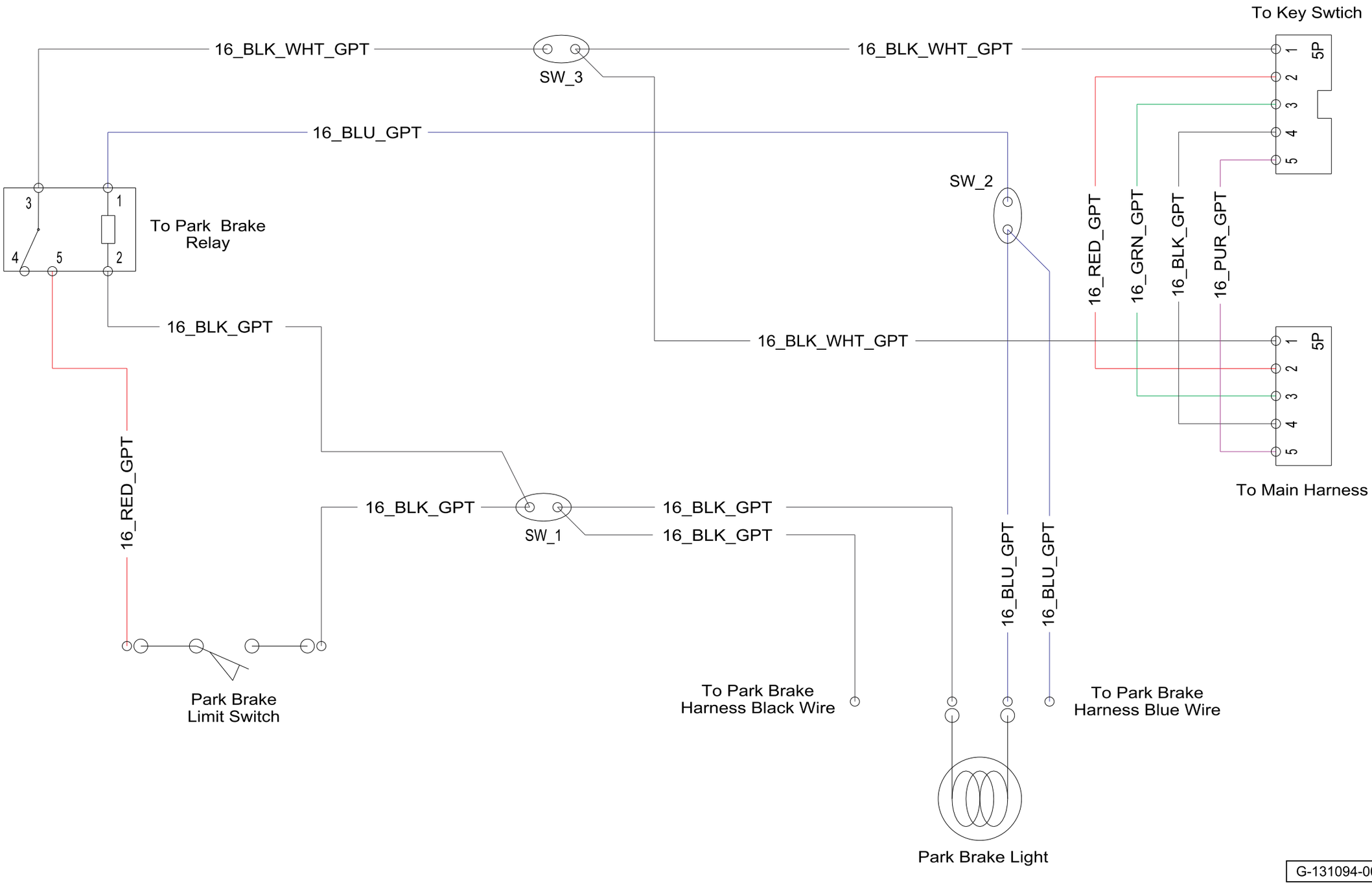
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# DIESEL INTERLOCK HARNESS



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# GASOLINE INTERLOCK HARNESS



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# NOTES

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