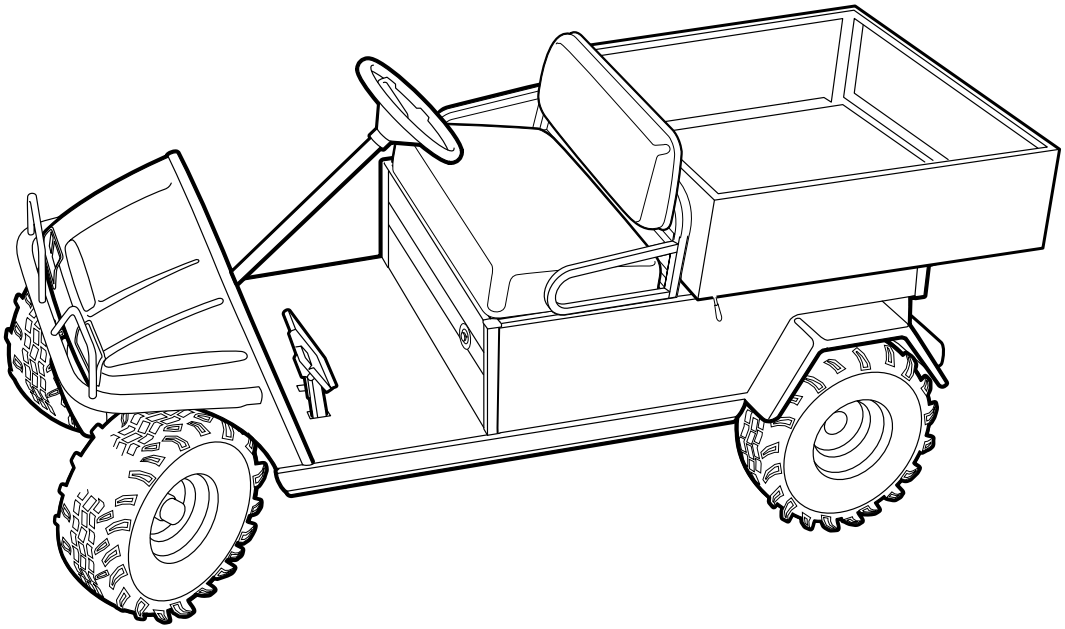
2007-2009 Turf 252, Carryall 252 and XRT 900 Maintenance and Service Manual



Gasoline and Electric Vehicles

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Edition Code 1008C0312B

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 the Club Car Turf 252, Carryall 252 and XRT 900 series vehicles, and should be thoroughly reviewed prior to servicing the vehicle. The procedures provided must be properly implemented, and the DANGER, WARNING, and CAUTION statements must be heeded.

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

It is the policy of Club Car, Inc. to assist its distributors and dealers in continually updating their service knowledge and facilities so they can provide prompt and efficient service for vehicle owners. Regional technical representatives, 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. You may also write to us at: Club Car, Inc., P.O. Box 204658; Augusta, GA 30917–4658 USA, Attention: Technical Services.

⚠ WARNING

- **Read See Section 1 – Safety. 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.*

Club Car reserves the right to change specifications and designs at any time without notice and without the obligation of making changes to units previously sold.

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

To ensure the safety of those servicing Club Car vehicles, and to protect the vehicles from possible damage resulting from improper service or maintenance, the procedures in this manual must be followed.

It is important to note that throughout this manual there are statements labeled DANGER, WARNING, or CAUTION. These special statements relate to specific safety issues, and must be read, understood, and heeded before proceeding with procedures. There are statements labeled NOTE, which provide other essential service or maintenance information.

⚠ DANGER

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

⚠ WARNING

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

⚠ CAUTION

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

CAUTION

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

GENERAL WARNING

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

⚠ DANGER

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

DANGER CONTINUED ON NEXT PAGE

⚠ DANGER

- **Gasoline – 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 gasoline vehicle in an enclosed area without proper ventilation. The engine produces carbon monoxide, which is an odorless, deadly poison.**

⚠ WARNING

- **Follow the procedures exactly as stated in this manual, and heed all DANGER, WARNING, and CAUTION statements in this manual as well as those on the vehicle.**
- **Only trained technicians should service or repair the vehicle. Anyone doing even simple repairs or service should have knowledge and experience in electrical and mechanical repair. The appropriate instructions must be used when performing maintenance, service, or accessory installation.**
- **Prior to servicing the vehicle or leaving the vehicle unattended, turn the key switch OFF, remove the key, and place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels when servicing the vehicle.**

Gasoline vehicles only:

- **To avoid unintentionally starting a gasoline vehicle, disconnect the battery and spark plug wire. See Disconnecting the Battery – Gasoline 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.**

Electric vehicles only:

- **Place Tow/Run switch in the TOW position before disconnecting or connecting the batteries. Failure to heed this warning could result in a battery explosion or severe personal injury.**
- **To avoid unintentionally starting an electric vehicle, disconnect the batteries and discharge the controller. See Disconnecting the Batteries – Electric Vehicles on page 1-4.**
- **After disconnecting the batteries, wait 90 seconds for the controller capacitors to discharge.**
- **IQ Plus vehicles only: Use only 4-gauge (AWG) with low resistance terminals to replace battery wires.**

All vehicles:

- **Wear safety glasses or approved eye protection when servicing the vehicle. Wear a full face shield and rubber gloves when working on or near batteries.**
- **Do not wear loose clothing or jewelry such as rings, watches, chains, etc., when servicing the vehicle.**
- **Moving parts! Do not attempt to service the vehicle while it is running.**
- **Ensure battery connections are clean and properly tightened. See Battery Care on page 25-3.**
- **Hot! Do not attempt to service hot engine or exhaust system. Failure to heed this warning could result in severe burns.**
- **Use insulated tools when working near batteries or electrical connections. Use extreme caution to avoid shorting of components or wiring.**
- **Check the vehicle owner's manual for proper location of all vehicle safety and operation decals and make sure they are in place and are easy to read.**

WARNING CONTINUED ON NEXT PAGE

⚠ WARNING

- **Any modification or change to the vehicle that affects the stability or handling of the vehicle, or increases maximum vehicle speed beyond factory specifications, could result in severe personal injury or death.**
- **Lift only one end of the vehicle at a time. Use a suitable lifting device (chain hoist or hydraulic floor jack) with 1000 lb. (454 kg) minimum lifting capacity. Do not use lifting device to hold vehicle in raised position. Use approved jack stands of proper weight capacity to support the vehicle and chock the wheels that remain on the floor. When not performing a test or service procedure that requires movement of the wheels, lock the brakes.**
- **If wires are removed or replaced, make sure wiring and wire harness are properly routed and secured. Failure to properly route and secure wiring could result in vehicle malfunction, property damage, personal injury, or death.**
- **For vehicles with cargo beds, remove all cargo before raising the bed or servicing the vehicle. If the vehicle is equipped with a prop rod, ensure that it is securely engaged while bed is raised. Do not close bed until all persons are clear of cargo bed area. Keep hands clear of all crush areas. Do not drop cargo bed; lower gently and keep entire body clear. Failure to heed this warning could result in severe personal injury or death.**
- **Improper use of the vehicle or failure to properly maintain it could result in decreased vehicle performance, severe personal injury, or death.**
- **Do not leave children unattended on vehicle.**

DISABLING THE VEHICLE

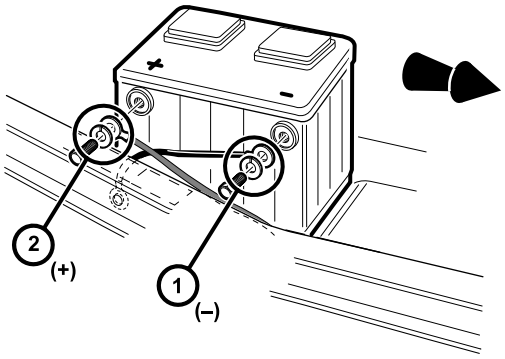
1. Set the park brake.
2. Turn the key switch OFF and remove the key.
3. Place the Forward/Reverse control in the NEUTRAL position.
4. In addition, chock the wheels if servicing or repairing the vehicle.

DISCONNECTING THE BATTERY – GASOLINE VEHICLES

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

CONNECTING THE BATTERY – GASOLINE VEHICLES

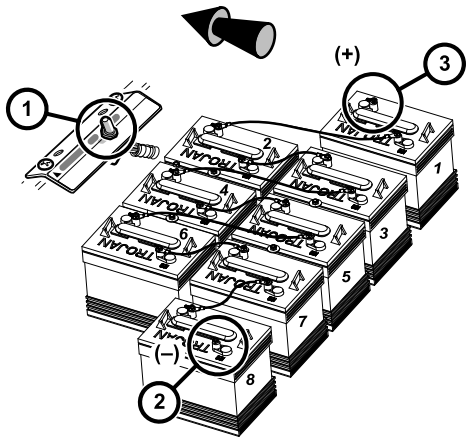
1. Connect the battery cables, positive (+) cable first.
2. Tighten battery terminals to 80 in-lb (9 N·m).
3. Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305) to minimize corrosion.
4. Connect the spark plug wire(s) to the spark plug(s).



(Viewed from passenger side of vehicle)
1. Remove negative battery cable.
2. Remove positive battery cable.
Connect battery cables in reverse order.

1

Figure 1-1 Gasoline Vehicle



(Viewed from driver side of vehicle)
1. Place TOW/RUN Switch in TOW before disconnecting or connecting battery cables.
2. Remove negative battery cable.
3. Remove positive battery cable.
Connect battery cables in reverse order.

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Figure 1-2 IQ Plus Electric Vehicle

DISCONNECTING THE BATTERIES – ELECTRIC VEHICLES

1. Disable the vehicle. **See Disabling the Vehicle on page 1-3.**
2. Place Tow/Run switch in the TOW position before disconnecting or connecting the batteries. Failure to heed this warning could result in a battery explosion or severe personal injury.
3. Disconnect the batteries, negative (–) cable first, as shown **(Figure 1-2, Page 1-4)**.
4. After disconnecting the batteries, wait 90 seconds for the controller capacitors to discharge.

CONNECTING THE BATTERIES – ELECTRIC VEHICLES

⚠ CAUTION

- **IQ Plus vehicles only: Use only 4-gauge (AWG) with low resistance terminals to replace battery wires.**

1. Ensure the Tow/Run switch is in the TOW position.
2. Connect the battery cables, positive (+) cable first.
3. Tighten battery terminals to 110 in-lb (12.4 N·m).
4. Coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305) to minimize corrosion.

VEHICLE SPECIFICATIONS – GASOLINE VEHICLES

SPECIFICATIONS	XRT 900 GASOLINE	TURF 252 CARRYALL 252 GASOLINE
POWER SOURCE		
Engine: 4 cycle, OHV, 351 cc, 11.5 maximum hp @ 3600 RPM (per SAE J 1940/1349), single cylinder, air cooled, with pressure lubrication system	•	•
Fuel system: Side-draft carburetor with float bowl, fixed jets, fuel filters, and impulse fuel pump	•	•
Governor: Automatic ground-speed sensing, internally geared in unitized transaxle	•	•
Ignition: Transistor electronic ignition with electronic RPM limiter	•	•
Unitized transaxle: Fully synchronized forward and reverse with neutral (11.8:1 forward, 17.1:1 reverse)	•	•
Electrical system: 12 volt, 500 cca at 0 °F (–17.8 °C), 650 at 32 °F (0 °C). 105-minute reserve capacity and 35-amp charging capacity	•	•
Torque converter: Automatic, variable-speed, dry type	•	•
STEERING/SUSPENSION/BRAKES		
Steering: Self-adjusting rack and pinion	•	•
Suspension: Front and rear multi-leaf springs with dual hydraulic shocks	•	•
Brakes: Mechanical brake cable system to manually adjusted drum brakes on each wheel with automatic-release park brake	•	•
BODY/CHASSIS		
Frame/Chassis: Twin I-Beam welded aluminum	•	•
Side and rear body: All aluminum with a powder-coated steel box bed	•	
Side and rear body: All aluminum		•
Front body: ArmorFlex®	•	•
Front body finish: Matched paint finish over molded-in color	•	•
Tires: Heavy Duty All Terrain: tubeless, 6-ply rated Turf: tubeless, 4-ply rated	22 x 11.00 x 10 in.	23 x 10.50 x 12 in.
DIMENSIONS/WEIGHT		
Overall length	120.4 in. (305 cm)	
Overall width	51.3 in. (130 cm)	
Overall height (at steering wheel)	51.1 in. (129 cm)	
Overall height (at light bar)	75.3 in. (191 cm)	
Wheelbase	78.5 in. (199 cm)	
Ground clearance (under differential)	6.4 in. (16 cm)	

TABLE CONTINUED ON NEXT PAGE

SPECIFICATIONS	XRT 900 GASOLINE	TURF 252 CARRYALL 252 GASOLINE
Ground clearance (under foot platform)	11.0 in. (27.9 cm)	
Front wheel tread	36.5 in. (92 cm)	
Rear wheel tread	41.3 in. (104 cm)	
Weight (standard vehicle with off-road tires (dry))	937 lb. (425 kg)	
Forward speed	17-19 mph (27-31 km/h)	15-17 mph (24-27 km/h)
Governed RPM	3050 ±30	2900 ±30
Curb clearance circle (diameter)	21 ft.-8 in. (660 cm)	
Turning radius (per SAE J 695)	130 in. (330 cm)	
Load bed height	29.8 in. (75 cm)	
Load bed size (box bed inside dimensions)	48.0 x 49.8 x 10.9 in. (121.9 x 126 x 28 cm) (15.3 cubic feet)	48.8 x 49.8 x 10.9 in. (124 x 126 x 28 cm) (15.3 cubic feet)
Floorboard height	16.0 in. (40 cm)	
Seat height (at seat bottom)	28.0 in. (71 cm)	
Vehicle rated capacity (level surface only)	900 lb. (408 kg)	
Bed load capacity (level surface only)	500 lb. (227 kg)	
Standard seating capacity	2	
LIQUID CAPACITIES		
Engine crankcase without filter	32 oz. (.95 liters)	
Engine crankcase with filter	38 oz. (1.12 liters)	
Unitized transaxle	27 oz. (.8 liters)	
Fuel tank	7 gallons (26.5 liters)	
TIRE PRESSURE		
Off-road tread	14-18 psi (.97-1.24 Bars)	
Turf tread	18-20 psi (1.24-1.38 Bars)	

VEHICLE SPECIFICATIONS – ELECTRIC VEHICLES

SPECIFICATIONS	XRT 900 ELECTRIC	TURF 252 CARRYALL 252 ELECTRIC
POWER SOURCE		
Drive motor: Direct drive, 48 volts DC, shunt wound, 3.7 hp	•	•
Transaxle: Double reduction helical gear with 12.3:1 direct drive axle	•	•
Electrical system: 48 volts DC, reduced speed reverse	•	•
Batteries: High capacity, deep cycle, Trojan 6-volt, 160 min. capacity	•	•
Charger: Automatic, 17 amp; UL and CSA listed	•	•
STEERING/SUSPENSION/BRAKES		
Steering: Self-adjusting rack and pinion	•	•
Suspension: Front mono-leaf and rear multi-leaf springs with dual hydraulic shocks	•	•
Brakes: Mechanical brake cable system to manually-adjusted drum brakes on all four wheels. Park brake is automatically released.	•	•
BODY/CHASSIS		
Frame/chassis: Twin I-Beam welded aluminum	•	•
Side and rear body: All aluminum with a powder-coated steel box bed	•	
Side and rear body: All aluminum		•
Front body: ArmorFlex®	•	•
Front body finish: Matched paint finish over molded-in color	•	•
Tires: Heavy Duty All Terrain: tubeless, 6-ply rated Turf: tubeless, 4-ply rated	•	•
DIMENSIONS/WEIGHT		
Overall length: Standard flatbed configuration	120.4 in. (305 cm)	
Overall width	51.3 in. (130 cm)	
Overall height: At steering wheel	51.1 in. (129 cm)	
Wheelbase	78.5 in. (199 cm)	
Ground clearance (under differential)	6.4 in. (16 cm)	
Ground clearance (under foot platform)	11.0in. (27.9 cm)	
Front wheel tread	36.5 in. (92 cm)	
Rear wheel tread	41.3 in. (104 cm)	
Weight: Standard electric vehicle	1322 lb. (600 kg)	1322 lb. (600 kg)

TABLE CONTINUED ON NEXT PAGE

SPECIFICATIONS	XRT 900 ELECTRIC	TURF 252 CARRYALL 252 ELECTRIC
Forward speed	17-19 mph (27-31 km/h)	15-17 mph (24-27 km/h)
Curb clearance circle (diameter)	21 ft.-8 in. (660 cm)	
Turning radius per SAE J 695	130 in. (330 cm)	
Load bed height	31.5 in. (80 cm)	
Load bed size (box bed inside dimensions)	48.0 x 49.8 x 10.9 in. (121.9 x 126 x 28 cm) (15.3 cubic feet)	48.8 x 49.8 x 10.9 in. (124 x 126 x 28 cm) (15.3 cubic feet)
Floorboard height	16.0 in. (40 cm)	
Seat height	28.0 in. (71 cm)	
Vehicle rated capacity: Level surface only	900 lb. (408 kg)	
Bed load capacity (level surface only)	500 lb. (227 kg)	
Standard seating capacity	2	
LIQUID CAPACITIES		
Transaxle	22 oz. (0.67 liters)	
TIRE PRESSURE		
Off-road tread	14-18 psi (.97-1.24 Bars)	
Turf tread	18-20 psi (1.24-1.38 Bars)	

⚠ DANGER

- **See General Warning on page 1-1.**

⚠ WARNING

- **See General Warning on page 1-1.**

Important features unique to the different models covered in this manual are highlighted. Club Car, Inc. recommends the owner/operator read and understand this manual and pay special attention to features specific to their vehicle(s).

Each vehicle is equipped with either a two-position key switch or a three-position key switch. Vehicles equipped with a two-position key switch are referred to as “pedal-start” and vehicles equipped with a three-position key switch are referred to as “key-start.”

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

- Controls and Indicators
- Pre-Operation and Daily Safety Checklist
- Driving Instructions
- Bed Latch
- Prop Rod
- Loading and Unloading
- Towing with a Vehicle
- Transporting on a Trailer
- Subsequent Owner Registration
- Warranties

SERIAL NUMBER IDENTIFICATION

The serial number of the vehicle is printed on a bar code decal mounted on the frame directly above the accelerator pedal (Example: EG0601-123456) **(Figure 3-1, Page 3-2)**. There is a second serial number decal mounted on the front body frame behind the center dash panel. The center dash panel must be removed to view this number **(Figure 3-2, Page 3-2)**. **See following NOTE.**

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

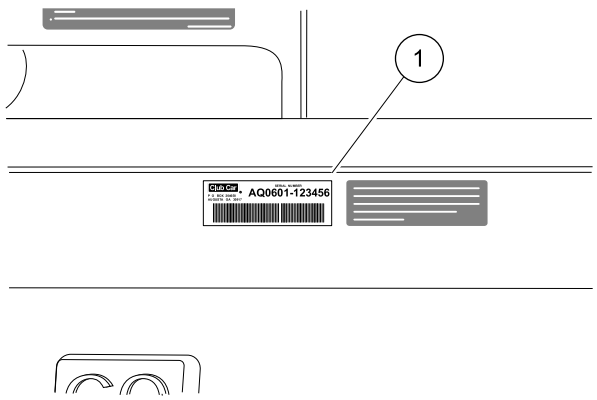

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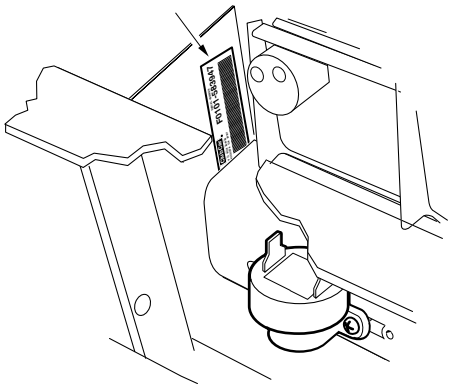
Figure 3-1 Serial Number Decal



Rear of center dash viewed from the front of the vehicle (front body removed).

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Figure 3-2 Serial Number Decal Behind Dash

STORAGE – GASOLINE VEHICLE

See General Warning on page 1-1.

⚠ DANGER

- **Never attempt to drain gasoline when the engine is hot or while it is running.**
- **Be sure to clean up any spilled gasoline 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

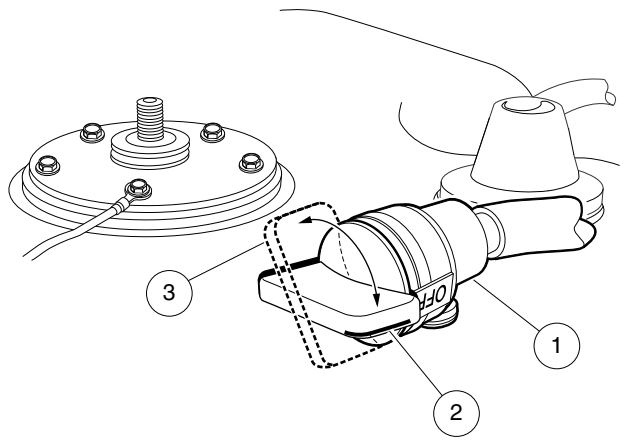
- **Turn the key switch to the OFF position, remove the key, and leave the Forward/Reverse handle in the NEUTRAL position during storage. This is to prevent unintentionally starting the vehicle or a fire hazard.**
- **Turn the fuel shut-off valve (1) the closed (OFF) position (Figure 3-3, Page 3-3 or Figure 3-4, Page 3-3).**
- **Do not attempt to charge frozen batteries or batteries with bulged cases. Discard the battery. Frozen batteries can explode.**

⚠ CAUTION

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

PREPARING THE GASOLINE VEHICLE FOR EXTENDED STORAGE

1. Unload the vehicle so that tires are supporting only the weight of the vehicle.
2. Store 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.
3. Drain carburetor and seal the fuel tank.
   - 3.1. **Pedal-start vehicles:** Place the Forward/Reverse handle in the NEUTRAL position and the neutral lockout switch in the MAINTENANCE position. Turn the fuel shut-off valve (1) to the closed (OFF) position **(Figure 3-3, Page 3-3 or Figure 3-4, Page 3-3)** and run the engine until fuel remaining in the carburetor and fuel lines is depleted and the engine stalls. Return the neutral lockout switch to the OPERATE position.
   - 3.2. **Key-start vehicles:** Place the Forward/Reverse handle in the NEUTRAL position. Turn the fuel shut-off valve (1) to the closed (OFF) position **(Figure 3-3, Page 3-3 or Figure 3-4, Page 3-3)** and run the engine until fuel remaining in the carburetor and fuel lines is depleted and the engine stalls.



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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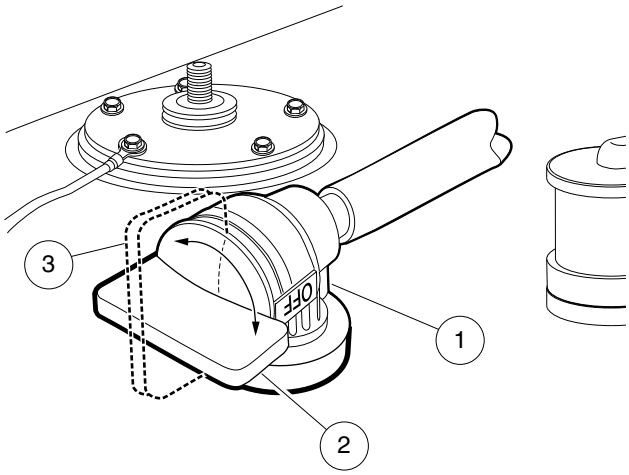
Figure 3-3 Fuel Shut-off Valve – 49-State Fuel Tank Shown



(Viewed from driver side of vehicle)

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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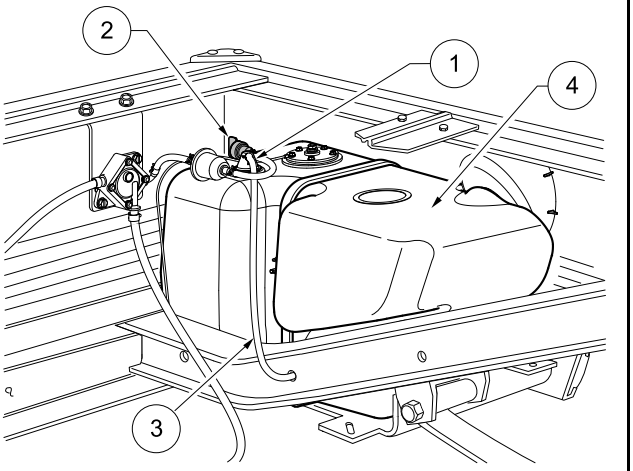
Figure 3-4 Fuel Shut-off Valve – California Fuel Tank Shown

- 3.3. Loosen, but do not remove, the carburetor drain screw and drain fuel remaining in bowl into a small, clean container, then pour the fuel from the container into vehicle fuel tank. Tighten the carburetor drain screw.
- 3.4. Fill fuel tank to about 1 inch (2.5 cm) from top of fuel tank and, following manufacturer's directions, add a commercially available fuel stabilizer (such as Sta-Bil®).
- 3.5. Disconnect fuel vent line from fuel tank vent nipple **(Figure 3-5, Page 3-4)**.
- 3.6. Plug the fuel tank vent nipple so that it is air tight. We recommend using a slip-on vinyl cap.



1. Vent 2. Fuel Shut-off Valve 3. Fuel Vent Line 4. Fuel Tank

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Figure 3-5 Fuel Tank, Vent, and Lines

4. Disconnect battery. **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
5. Batteries should be clean and free of corrosion. Wash tops and terminals of batteries with a solution of baking soda and water (1 cup (237 mL) baking soda per 1 gallon (3.8 L) of water). Rinse solution off batteries. Do not allow this solution to enter the batteries. Be sure terminals are tight. Let the terminals dry and then coat them with Battery Terminal Protector Spray (CCI P/N 1014305).
6. To protect the engine, remove spark plug and pour 1/2 ounce (14.2 mL) of SAE 10 weight oil into the engine through the spark plug hole. Rotate engine crankshaft by hand several times and then install the spark plug.
7. Adjust tires to recommended tire pressure. **See Vehicle Specifications – Gasoline Vehicles on page 2-1.**
8. Perform semiannual periodic lubrication. **See Periodic Maintenance on page 10-1.**
9. Thoroughly clean front body, rear body, seats, cargo bed, engine compartment, and underside of vehicle.
10. Do not engage the park brake. Chock the wheels to prevent the vehicle from rolling.

RETURNING THE STORED GASOLINE VEHICLE TO SERVICE

1. Restore fuel system to operation.
   1.1. Remove plug from the fuel tank vent **(Figure 3-5, Page 3-4)**.
   1.2. Connect vent tube to fuel tank vent.
2. Connect battery. **See Connecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
3. Completely open the fuel shut-off valve (1) **(Figure 3-3, Page 3-3 or Figure 3-4, Page 3-3)**. Make sure 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.
4. **Pedal-start vehicles:** Place the Forward/Reverse handle in the NEUTRAL position and the neutral lockout switch in the MAINTENANCE position. Crank the engine until fuel is pumped into the carburetor and fuel lines and the engine starts. Turn the engine off and return the neutral lockout switch to the OPERATE position. **See following NOTE.**
5. **Key-start vehicles:** Place the Forward/Reverse handle in the NEUTRAL position. Crank the engine until fuel is pumped into the carburetor and fuel lines and the engine starts. Turn the engine off. **See following NOTE.**

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

6. Adjust tires to recommended tire pressure. **See Vehicle Specifications – Gasoline Vehicles on page 2-1.**
7. Perform the Pre-Operation and Daily Safety Checklist and the Performance Inspection. **See Pre-Operation and Daily Safety Checklist, Section 10, Page 10-1.**

STORAGE – ELECTRIC VEHICLE

See General Warning on page 1-1.

⚠ WARNING

- **Turn the key switch to the OFF position, remove the key, and leave the Forward/Reverse handle or switch in the NEUTRAL position during storage. This is to prevent unintentionally starting the vehicle or a fire hazard. Place Tow/Run switch in the TOW position.**
- **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.**
- **To avoid exposing electrical components to moisture and subsequent damage, do not use any type of pressure washing or steam cleaning equipment to wash the vehicle.**
- **IQ System and IQ Plus vehicles only: Place the Tow/Run switch in the TOW position.**

PREPARING THE ELECTRIC VEHICLE FOR EXTENDED STORAGE

1. Unload the vehicle so that tires are supporting only the weight of the vehicle.
2. Fully charge batteries. **See Batteries section.**
3. Batteries should be clean and free of corrosion. Wash tops and terminals of batteries with a solution of baking soda and water (1 cup (237 mL) baking soda per 1 gallon (3.8 L) of water). Rinse solution off batteries. Do not allow this solution to enter the batteries. Be sure terminals are tight. Let the terminals dry and then coat them with Battery Terminal Protector Spray (CCI P/N 1014305).
4. Store vehicle in a cool, dry place. This will minimize battery self-discharge.
5. Adjust tires to recommended tire pressure. **See Vehicle Specifications – Electric Vehicles on page 2-3.**
6. Perform semiannual periodic lubrication. **See Periodic Maintenance on page 10-1.**
7. Thoroughly clean front body, rear body, seats, cargo bed, battery compartment, and underside of vehicle.
8. Do not engage the park brake. Chock the wheels to prevent the vehicle from rolling.
9. Keep batteries fully charged during storage.
   - 9.1. Leave battery chargers plugged in during storage. The onboard computer (OBC) will automatically activate the charger when necessary.
   - 9.2. If the battery charger is left plugged in during extended storage, check the electrolyte level and charger function monthly to ensure that proper operation is maintained. To check charger function, disconnect the DC cord (stationary charger) from the vehicle or the AC cord (onboard charger) from the power source, wait five seconds, then reconnect it. The charger is functioning properly if the ammeter indicates current.

NOTE: The OBC keeps track of the time spent in storage mode. When the OBC detects that the storage charge cycles may have depleted the available electrolyte, it will stop the charger from further operation. *Disconnecting then reconnecting the DC cord (stationary charger) or AC cord (onboard charger) indicates the electrolyte levels have been maintained and allows the OBC to resume operation.*

While in storage, the Tow/Run switch should be in Tow. When in Tow mode, the amber battery warning light will not illuminate. Do not attempt to use the battery light as an indication of battery state while in storage.

9.3. If AC power is off for 7 days or longer, the OBC will not function or charge the vehicle again until it has been restarted. To restart the computer, make sure AC power has been restored, disconnect the DC cord (stationary charger) from the vehicle or the AC cord (onboard charger) from the power source, wait five seconds, then reconnect it.

CAUTION

- **Be sure to check the batteries and charger monthly to maintain correct battery water level and to ensure the charger is operating correctly during storage.**

9.4. If the charger cannot remain plugged in, AC power will not be available during extended storage, or electrolyte levels will not be maintained, then disconnect the batteries for storage **(Figure 1-2, Page 1-4)**.

RETURNING THE STORED ELECTRIC VEHICLE TO SERVICE

1. If necessary, connect batteries. **See Connecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**
2. Fully charge batteries. **See Batteries section.**
3. Adjust tires to recommended tire pressure. **See Vehicle Specifications – Electric Vehicles on page 2-3.**
4. Perform the Pre-Operation and Daily Safety Checklist and the Performance Inspection. **See Pre-Operation and Daily Safety Checklist, Section 10, Page 10-1.**

⚠ DANGER

- **See General Warning on page 1-1.**

⚠ WARNING

- **See General Warning on page 1-1.**

CLEANING THE VEHICLE

See General Warning on page 1-1.

CAUTION

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

Each vehicle is equipped with an injection molded ArmorFlex® front body, an aluminum rear body and either an aluminum or powder-coated steel cargo bed. Use a mild soap or detergent with a sponge or soft cloth for normal cleaning. Battery acid, fertilizers, tars, asphalt, creosote, paint, or chewing gum should be removed immediately to prevent possible stains. Because the finish on the front body is the same as the finish on today's automobiles, commercial automotive cleaning products should be used. For general cleaning of the aluminum rear body, use a mild liquid soap and a sponge or soft bristle brush. To remove oxidation or discoloration from aluminum, use a commercially available aluminum cleaner paste and fine grade (no. 00) steel wool.

Club Car 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.

The seats of the vehicle will last longer with proper cleaning. To preserve seat appearance, clean regularly with mild soap or detergent applied with a sponge or soft cloth. Use a soft bristle brush to clean areas that are especially soiled. Use the following guidelines:

Light Soiling – A solution of 10% liquid 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.

For 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.

CAUTION

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

FRONT BODY REPAIR

See General Warning on page 1-1.

STRESS LINES OR STREAKS

Repeatedly flexing the front body may cause white stress lines or streaks in the finish. To remove them:

1. Hold a heat gun 12 inches (30 cm) away from the affected area, with the gun on its lowest heat setting.
2. Slowly wave the heat gun back and forth over the affected area until the streak fades.
3. It may be necessary to move the gun closer to the body to fade the streak, but under no circumstance should the gun be held closer than 6 inches (15 cm) to the body. **See following CAUTION.**

CAUTION

- **Holding heat gun too close to body could melt body or damage finish.**

MINOR IMPACT DAMAGE/DEFORMATIONS

Minor impact damage in the front body can be repaired using a procedure similar to the one used to remove stress lines. To remove deformations resulting from minor impact damage:

1. Hold a heat gun 12 inches (30 cm) away from the affected area, with the gun on its lowest heat setting.
2. Periodically remove the heat gun and bend the body, using a push block, in the opposite direction of the deformation.
3. Continue heating and bending the body until the original shape returns. Under no circumstance should the gun be held closer than 6 inches (15 cm) to the body. **See preceding CAUTION.**

MINOR SCRATCHES AND SURFACE BLEMISHES

For minor scratches or blemishes in the ArmorFlex body that do not penetrate the finish:

1. Thoroughly clean the affected area using a strong, non-abrasive detergent and hot water, then clean with Ultra-Kleen® Solvent Cleaner to remove any oil-based contaminants.
2. Lightly buff imperfection with a clean, soft cloth or buff pad. Do not use any kind of polishing compound on monocoat finished body assemblies.
3. Wax the entire body part to restore luster and weather protection.

SMALL SCRATCHES THAT CANNOT BE BUFFED OUT

1. Thoroughly clean the affected area and then dry.
2. Using 240 grit or finer sandpaper, lightly sand scratch to feather edges. Finish sand scratch with 320 grit or finer paper to remove gloss from surface. Sand as little body surface as possible beyond scratch. **See following CAUTION.**

CAUTION

- **Be careful not to sand completely through the finish to the body material. If the finish is sanded through and the thermo plastic olefin (TPO) body material is exposed, refer to Gouges, Punctures, Tears, Large Scratches, and Abrasions on page 4-3.**

3. Using the brush provided with the touch-up paint (available from Club Car Service Parts, see following color chart), apply paint to the scratch. Multiple layers of paint may be required to fill the scratch.
4. Allow paint to dry completely (approximately 10-20 minutes), then lightly buff the imperfection.
5. Apply wax to the entire body part to restore luster and weather protection.

TOUCH-UP PAINT COLOR CHART

COLOR	CCI P/N
Beige	101997201
White	101997202
Red	101997203
Gray	101997204
Dark Gray	101997205
Royal Blue (Pacific Blue)	101997206
Black	101997207
Dark Green	101997209
Classic Blue (Navy)	101997211
Burgundy	101997212

GOUGES, PUNCTURES, TEARS, 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 TPO bodies.

FRONT BODY

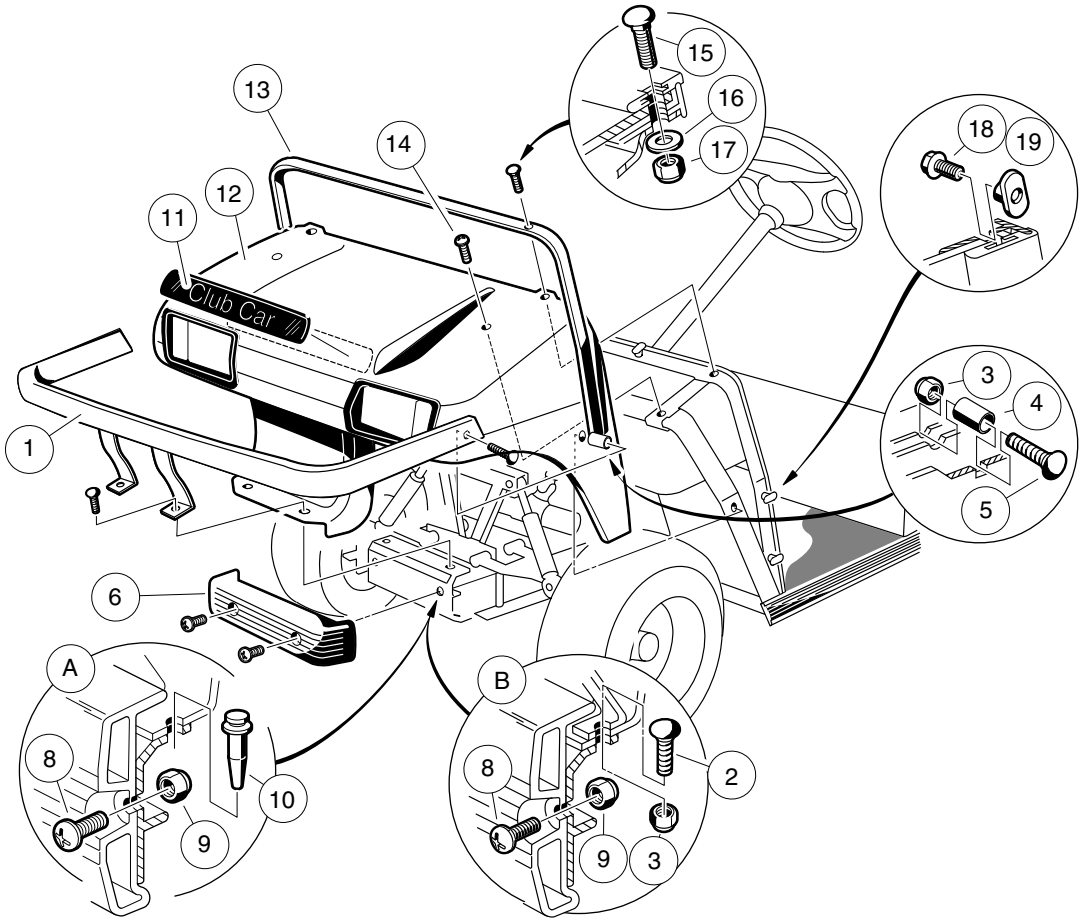
See General Warning on page 1-1.

FRONT BODY REMOVAL

1. Remove screws (8) and lock nuts (9) and lift front bumper (6) from vehicle frame **(Figure 4-1, Page 4-4)**.

1.1. **Vehicles without heavy-duty bumper:** Remove blind rivets (10).

2. **Vehicles equipped with a heavy-duty front bumper (1):**
   2.1. Remove the two carriage bolts (5), lock nuts (3), and spacers (4) from the heavy-duty bumper mounting positions located on both sides of the front body.
   2.2. Remove carriage bolts (2) and lock nuts (3) from the heavy-duty bumper support braces and remove bumper.
3. Remove carriage bolts (15), lock nuts (17), and washers (16) from front body trim. Remove screws (14) from top of front body.
4. Loosen, but do not remove, screws (18) holding front body trim against front body.
5. **Vehicles equipped with headlights:** Disconnect the light wiring harness from the headlight assemblies.
6. Pull front body (12) from under trim (13) and remove from vehicle.



Detail A. Front Bumper
Detail B. Heavy-Duty Front Bumper

Figure 4-1 Front Body Assembly

FRONT BODY INSTALLATION

1. Install front body (12) under trim (13), align holes and finger-tighten screws (14) holding front body against frame **(Figure 4-1, Page 4-4)**.
2. Install carriage bolts (15), washers (16), and lock nuts (17) onto front body trim. Tighten bolts to 11 ft-lb (14.9 N·m). Tighten screws (14) to 20 in-lb (2.3 N·m). **See following NOTE.**

NOTE: *If installing a new front body, two 5/16-inch holes must be drilled after the body has been placed on the vehicle. Use the body trim (13) as a guide for drilling the holes.*

3. Tighten screws (18) holding front body trim against front body to 17 in-lb (1.9 N·m).
4. **Vehicles equipped with headlights:** Reconnect the light wiring harness to the headlight assemblies.
5. **Vehicles equipped with a heavy-duty front bumper:**
   5.1. Install two carriage bolts (2) and lock nuts (3) from the heavy-duty front bumper support braces and install bumper (1). Tighten bolts to 65 in-lb (7.3 N·m) **(Figure 4-1, Page 4-4)**.
   5.2. Install two carriage bolts (5), spacers (4), and lock nuts (3) into heavy-duty bumper mounting positions located on sides of front body (12). Tighten bolts to 65 in-lb (7.3 N·m).
6. **Vehicles without heavy-duty bumper:** Install two push type blind rivets (10) that secure lower front body to frame **(Figure 4-1, Page 4-4)**.
7. Install front bumper onto vehicle and install screws (8) and lock nuts (9). Tighten to 65 in-lb (7.3 N·m).

TILT BED

See General Warning on page 1-1.

NOTE: *Tilt bed removal and installation will be easier with a helper.*

TILT BED REMOVAL

1. Raise bed and secure prop rod (17) in prop rod track (18). Hold bed securely in an upright position. Remove cotter pin (23) and flat washer (22) from top end of prop rod where prop rod attaches to bed. Remove prop rod (17) from bed and place prop rod between prop rod track (18) and rear body panel. Lower bed onto vehicle frame **(Figure 4-2, Page 4-6)**.
2. Remove two lock nuts (10) from left and right hinge assemblies (3 and 25).
3. Apply slight upward pressure (by hand) on the rear of the bed to relieve pressure on the hinges, and remove the hinge bolts (9) from the hinge assemblies.
4. Raise rear edge of bed approximately 6 inches (15.2 cm) and pull bed assembly toward rear of vehicle approximately 3 inches (7.6 cm) to release bed latch assembly (2) from latch plate (1).
5. Lift bed from vehicle.

TILT BED INSTALLATION

1. Hold bed at a slight angle (front of bed lower than rear of bed) to vehicle and place front edge of bed onto vehicle frame. Bed latches (5) should engage with latch plates (1) **(Figure 4-2, Page 4-6)**.
2. Lower edge of bed onto vehicle and align hinge brackets (3) with bed hinge (25).
3. Start the bolts (9) into left and right hinge assemblies (3 and 25). It may be necessary to use an alignment tool to align holes in hinge bracket with steel bushing in hinge assembly.
4. Use a small hammer to lightly tap bolts through hinge assembly.
5. Install a nylon lock nut (10) on each bolt (9) and tighten to 180 in-lb (21 N·m).
6. Lift bed and place the prop rod (17) in bed mounting hole. Install a 3/8-inch flat washer (22) and a new cotter pin (23) on prop rod **(Figure 4-2, Page 4-6)**.

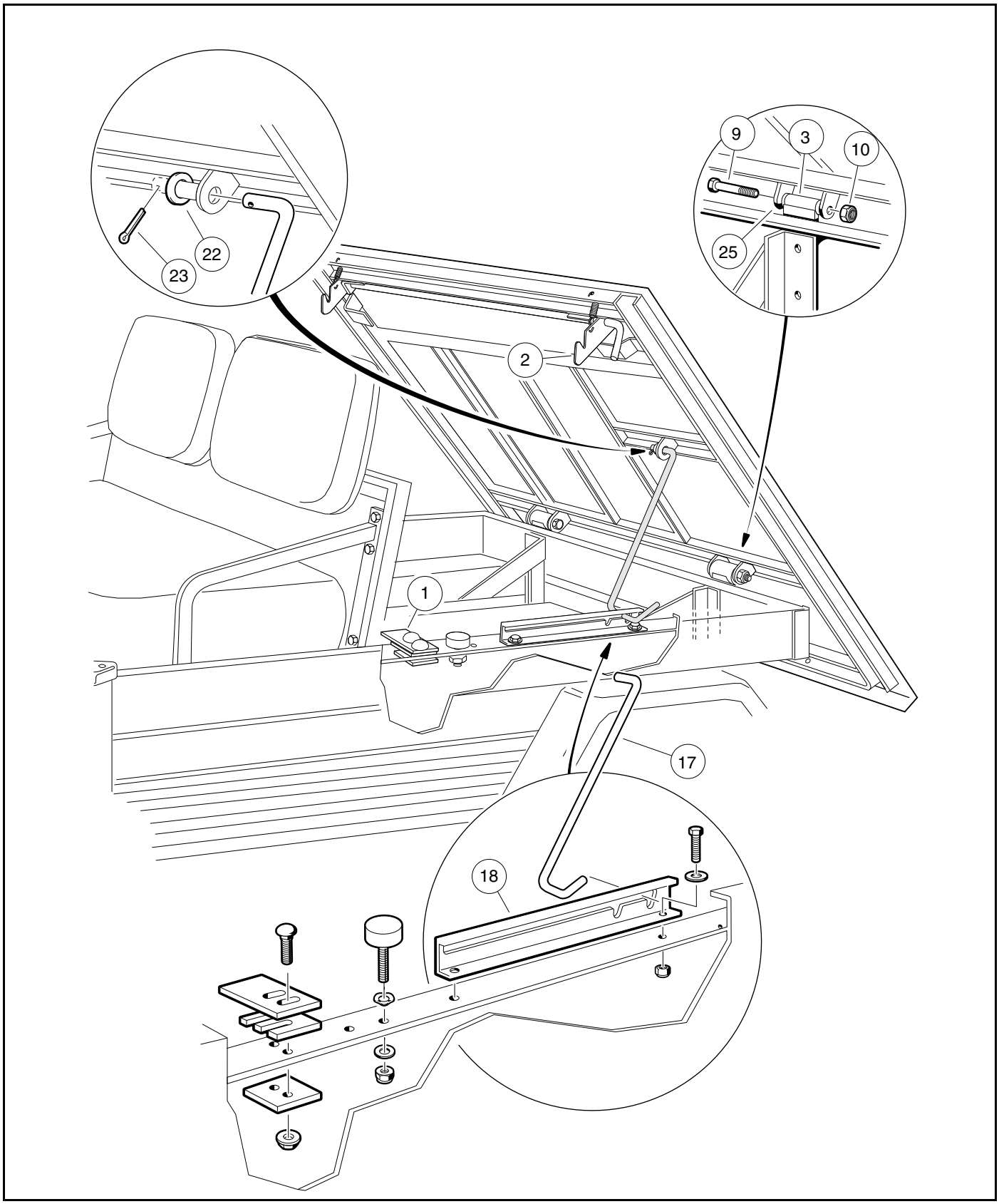


Figure 4-2 Tilt Bed – Turf, Carryall, and XRT

REAR FENDER

See General Warning on page 1-1.

REAR FENDER REMOVAL

Vehicles with taillights:

1. Remove taillight assembly.
   1.1. Remove the two screws that secure taillight to the rear fender.
   1.2. Disconnect the three taillight wires.
2. **All vehicles:**

   Remove two nylon lock nuts (3), flat washers (1), and 1/4 x 1 bolts (2) from front of fender (6) **(Figure 4-3, Page 4-8)**.
3. Remove two nylon lock nuts (3), flat washers (1), and 1/4 x 1 bolts (2) from the top of fender (6).
4. **Vehicles with rear reverse buzzer:**

   Remove the rear reverse buzzer.

   4.1. Remove pan-head screws connecting reverse buzzer to rear fender (6) and disconnect the two wires from the reverse buzzer.
5. **All vehicles:**

   Remove fender (6) from vehicle **(Figure 4-3, Page 4-8)**.

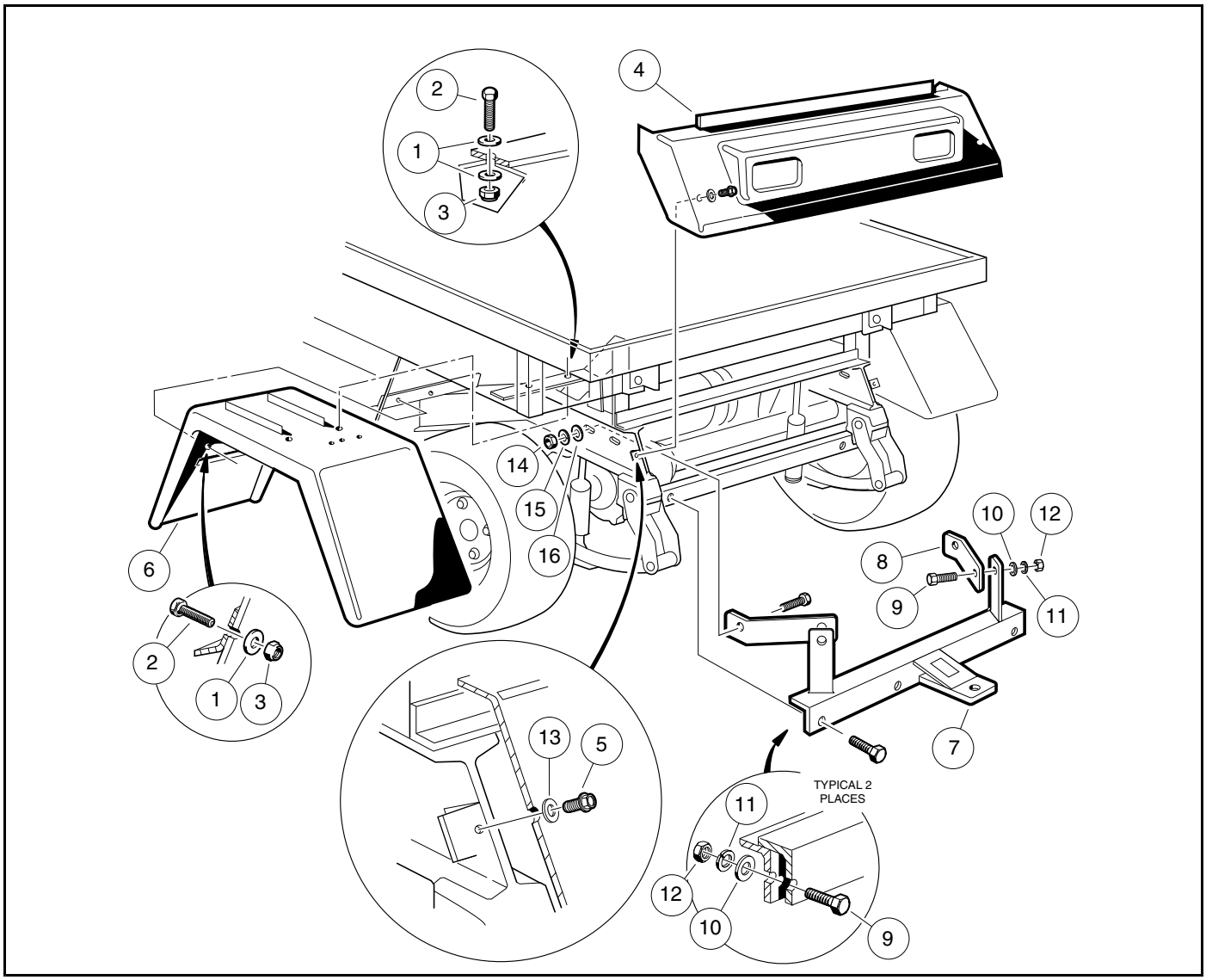


Figure 4-3 Rear Fender, Trailer Hitch, and Tailskirt – Turf, Carryall, and XRT

REAR FENDER INSTALLATION

1. Install rear fender in the reverse order of removal. Tighten lock nuts (3) to 35 in-lb (4.0 N·m).

TRAILER HITCH (OPTIONAL ON SOME MODELS)

See General Warning on page 1-1.

TRAILER HITCH REMOVAL

1. Remove the tailskirt. **See Tailskirt Removal on page 4-10.**

2. Where the hitch (7) is mounted to frame, remove two nuts (12), lock washers (11), flat washers (10), and bolts (9) **(Figure 4-3, Page 4-8)**.
3. Where the hitch (7) is mounted to hitch brace (8), remove the nut (12), lock washer (11), flat washer (10), and bolt (9).
4. Remove hitch (7) from vehicle.

TRAILER HITCH INSTALLATION

1. Install trailer hitch (7) in the reverse order of removal **(Figure 4-3, Page 4-8)**. Tighten hardware to 180 in-lb (20.3 N·m).

RECEIVER HITCH (OPTIONAL ON SOME MODELS)

See General Warning on page 1-1.

RECEIVER HITCH REMOVAL

1. Remove the tailskirt. **See Tailskirt Removal on page 4-10.**
2. Remove two 5/16-18 hex nuts (6), lockwashers (7), flat washers (5) and 5/16-18 x 1-inch bolts (2) from the top of hitch (4) **(Figure 4-4, Page 4-10)**.
3. Remove two 5/16-18 hex nuts (6), lockwashers (7), flat washers (5) and 5/16-18 x 1-inch bolts (2) where the hitch (4) mounts to the vehicle frame and remove the hitch.

RECEIVER HITCH INSTALLATION

1. Reverse the receiver hitch removal process and tighten nuts to 180 in-lb (20.3 N·m) **(Figure 4-4, Page 4-10)**.
2. Install the tailskirt. **See Tailskirt Installation on page 4-10.**

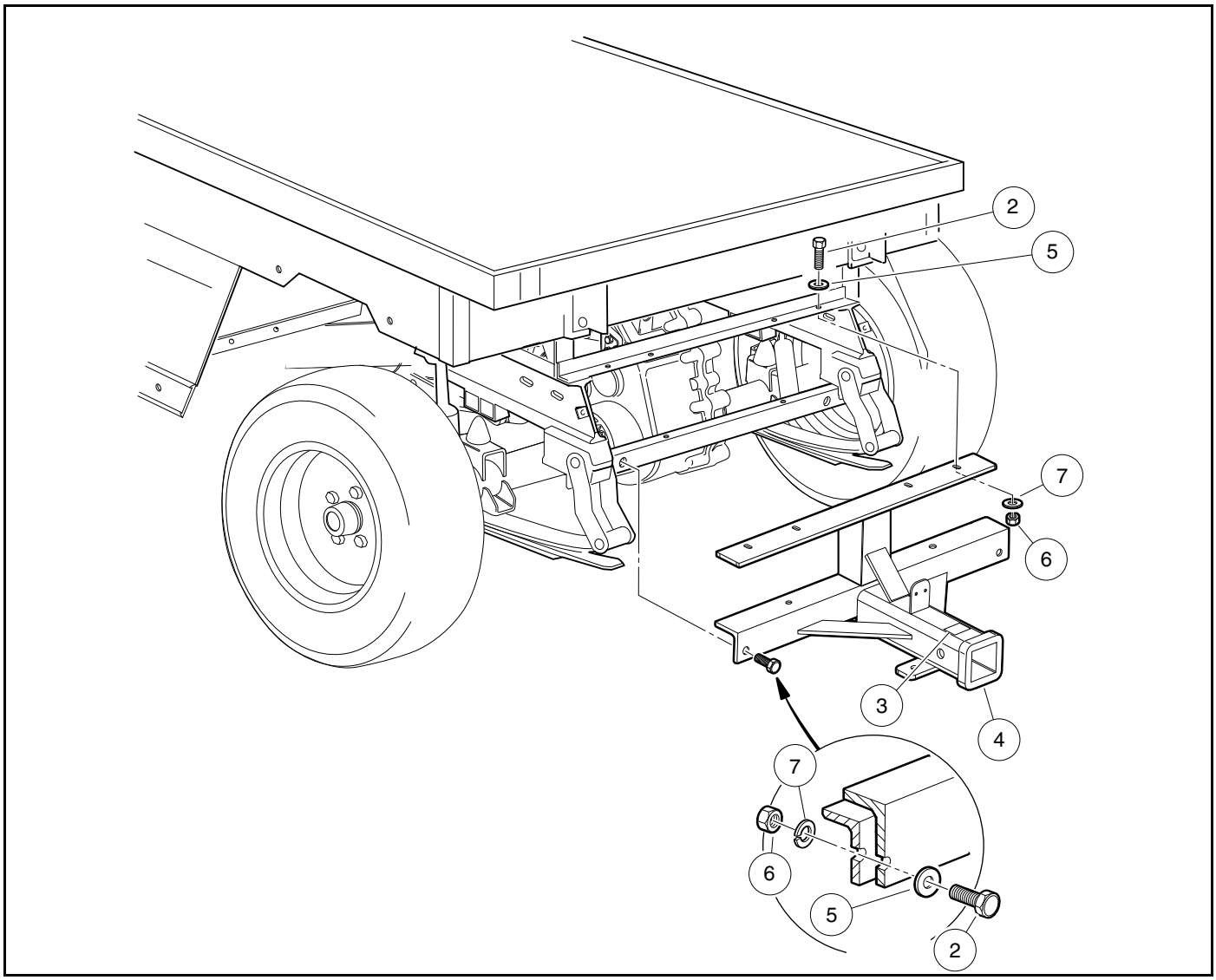


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Figure 4-4 Receiver Hitch

TAILSKIRT

See General Warning on page 1-1.

TAILSKIRT REMOVAL

1. Remove two thread-forming screws (5) and flat washers (13) from tailskirt (4) and lift tailskirt from vehicle frame **(Figure 4-3, Page 4-8)**.

TAILSKIRT INSTALLATION

1. Insert upper edge of tailskirt (4) under, and in front of, back edge of rear body **(Figure 4-3, Page 4-8)**.

2. Align holes in tailskirt (4) with holes in vehicle frame. Position tailskirt flush against frame.
3. Install two thread-forming screws (5) and flat washers (13) in tailskirt and tighten to 80 in-lb (9.0 N·m).

FLOOR MAT

See General Warning on page 1-1.

FRONT FLOOR MAT REMOVAL

1. Remove the brake and accelerator pedals. **See Accelerator and Brake Pedal Group on page 5-1.**
2. Remove horn switch if so equipped.
3. Remove the top edge of the floor mat from the overlapping flange under the dash.
4. Lift the mat from the vehicle.

FRONT FLOOR MAT INSTALLATION

1. Install the floor mat in the reverse order of removal.
2. Install the brake and accelerator pedals. **See Accelerator and Brake Pedal Group on page 5-1.**

⚠ DANGER

- **See General Warning on page 1-1.**

⚠ WARNING

- **See General Warning on page 1-1.**

BRAKE PEDAL AND PARK BRAKE

See General Warning on page 1-1.

BRAKE PEDAL REMOVAL

1. Disconnect the battery cables and either discharge the controller or disconnect the spark plug wire(s). **See Disconnecting the Batteries – Electric Vehicles, Section 1, Page 1-4. See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
2. Place chocks under the rear wheels and lift the front end of the vehicle with a chain hoist or floor jack. Place jack stands under the front cross tube of the vehicle frame and lower the vehicle onto the jack stands. **See following WARNING.**

⚠ WARNING

- **Lift only one end of the vehicle at a time. Use a suitable lifting device (chain hoist or hydraulic floor jack) with 1000 lb. (454 kg) minimum lifting capacity. Do not use lifting device to hold vehicle in raised position. Use approved jack stands of proper weight capacity to support the vehicle and chock the wheels that remain on the floor. When not performing a test or service procedure that requires movement of the wheels, lock the brakes.**

3. Remove the brake pedal assembly.
   - 3.1. Disconnect the equalizer rod(s) (14 and 36) from the pedal shaft by removing the clevis pin(s) (16) and bow-tie pin(s) (15) **(Figure 5-1, Page 5-2)**.
   - 3.2. Remove the nuts (34), flat washers (27), bolts (28), and mounting blocks (26). If the mounting blocks (26) show signs of excessive wear or are damaged, they must be replaced with new ones before installing pedal assembly.
   - 3.3. Remove the nut (25) and brake stop bumper (24).
   - 3.4. Lift the pedal assembly (10) through the floorboard **(Figure 5-2, Page 5-3)**.

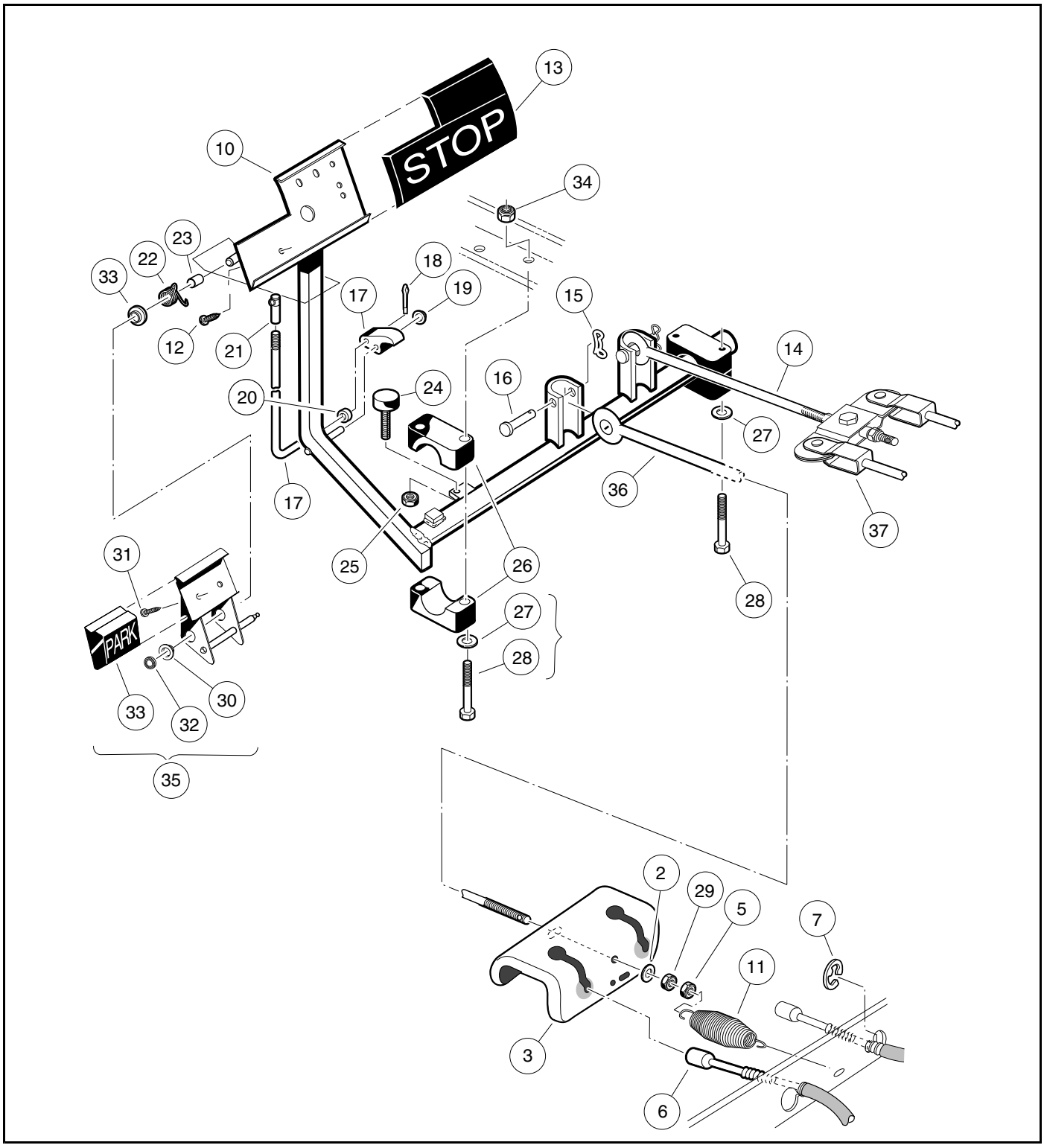


Figure 5-1 Brake and Park Brake Pedal Assembly and Mounting – Four-Wheel Brake Vehicles

BRAKE PEDAL INSTALLATION

1. From the top side of the floorboard, insert the brake pedal assembly (10) **(Figure 5-1, Page 5-2)** through the opening in the floor as shown **(Figure 5-2, Page 5-3)** and install the brake pedal stop bumper (24) **(Figure 5-1, Page 5-2)** on the brake pedal assembly, but do not tighten the jam nut (25) at this time.
2. Secure the equalizer rod(s) (14 and 36) to the brake pedal assembly (10) with clevis pin(s) (16) and bow-tie pin(s) (15) as shown **(Figure 5-1, Page 5-2)**. Tighten to 17 in-lb (1.9 N·m). **See following NOTE.**

NOTE: *For 77.5 in. (196.9 cm) and 78.5 in. (199.4 cm) wheelbase vehicles with four-wheel brakes, there are two equalizer rods. The long rod (21-1/4 inches (54 cm)) is secured to the left (driver-side) channel, and the short rod (9-1/4 inches (23.5 cm)) is secured to the right (passenger-side) channel on the brake pedal weldment.*

3. Position and attach brake pedal assembly, mounting blocks (26), and washers (27) to vehicle frame as shown. Tighten the bolts (28) and nuts to 95 in-lb (10.7 N·m) **(Figure 5-1, Page 5-2)**.
4. Adjust the pedal group. Refer to the appropriate adjustment procedure:
   – **For gasoline vehicles, see Pedal Group Adjustment – Gasoline Vehicles on page 5-10.**
   – **For electric vehicles, see Pedal Group Adjustment – Electric Vehicles on page 5-15.**

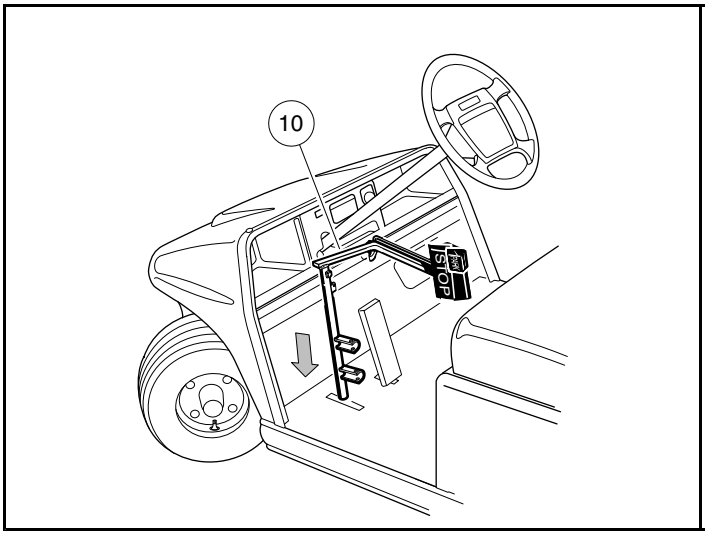


Figure 5-2 Brake Pedal Weldment Through Floor

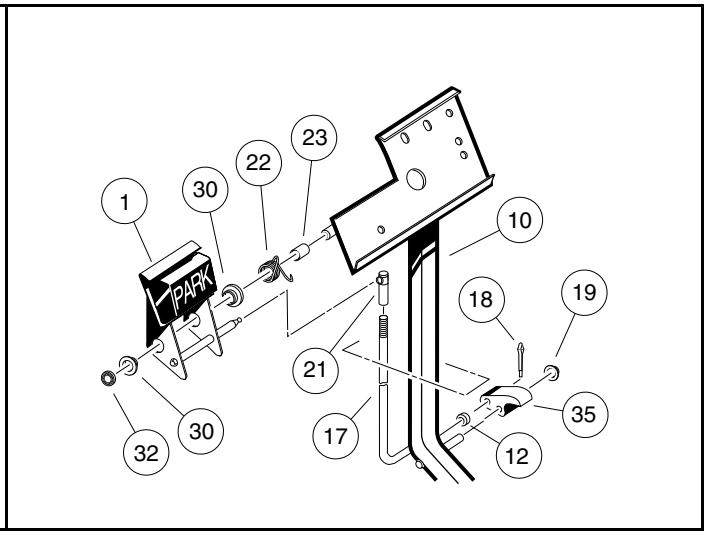


Figure 5-3 Park Brake Assembly

PARK BRAKE REMOVAL

1. Disconnect the battery cables and either discharge the controller or disconnect the spark plug wire(s). **See Disconnecting the Batteries – Electric Vehicles, Section 1, Page 1-4. See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
2. Place chocks under the rear wheels and lift the front end of the vehicle with a chain hoist or floor jack. Place jack stands under the front cross tube of the vehicle frame and lower the vehicle onto the jack stands. **See following WARNING.**

⚠ WARNING

- **Lift only one end of the vehicle at a time. Use a suitable lifting device (chain hoist or hydraulic floor jack) with 1000 lb. (454 kg) minimum lifting capacity. Do not use lifting device to hold vehicle in raised position. Use approved jack stands of proper weight capacity to support the vehicle and chock the wheels that remain on the floor. When not performing a test or service procedure that requires movement of the wheels, lock the brakes.**

3. Remove the park brake assembly.

3.1. To remove the park brake rod and pawl assembly (17 through 20), remove the push nut (19) and disconnect the ball joint sleeve (21) from the park brake pedal (35) **(Figure 5-1, Page 5-2)**. **See following NOTE.**

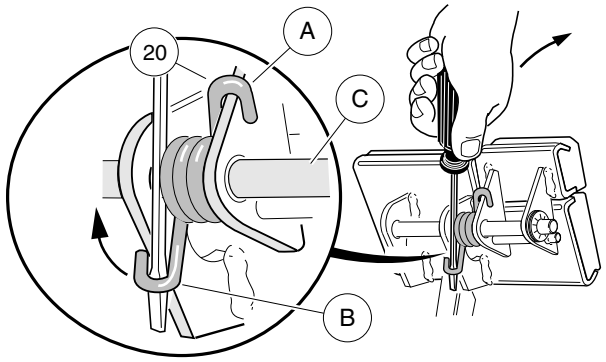
NOTE: *New push nuts (19) and (32) must be used when reassembling the park brake* ***(Figure 5-3, Page 5-3)****.*

3.2. To remove the park brake pedal (1), remove the push retainer nut (32), disconnect the torsion spring (22) **(Figure 5-3, Page 5-3)** and slide the pedal off of the shaft. **See preceding NOTE.**

3.3. Inspect all parts for wear and damage and replace as necessary.

PARK BRAKE INSTALLATION

1. From the bottom side of the floorboard, insert the park brake rod (17) through the brake pedal assembly opening as shown **(Figure 5-3, Page 5-3)**. Then install the park brake pawl (35) onto the shaft on the brake pedal assembly (10) and also insert the park brake rod (17) into the park brake pawl.
2. Install the push nut (19) on to the park brake pawl shaft.
3. Install the spacer (23) and torsion spring (22) on the park brake pedal shaft on the brake pedal assembly.
4. Install the two bushings (30) in the park brake pedal and position the park brake pedal on the shaft on the brake pedal assembly weldment (10) **(Figure 5-3, Page 5-3)**. Then attach the ends of the torsion spring to the park brake pedal and to the brake pedal weldment as shown **(Figure 5-4, Page 5-4)**.
5. Install the push nut (32) on the park brake pedal shaft **(Figure 5-3, Page 5-3)**.
6. Connect park brake rod (17) with ball joint (21) to the ball stud on the park brake pedal assembly **(Figure 5-3, Page 5-3)**.
7. Adjust the pedal group. Refer to the appropriate adjustment procedure:
   – **For gasoline vehicles, see Pedal Group Adjustment – Gasoline Vehicles on page 5-10.**
   – **For electric vehicles, see Pedal Group Adjustment – Electric Vehicles on page 5-15.**



A. Hook one end of spring (20) on park brake weldment.
B. Lift other end of spring (20) up and over brake weldment by prying down on shaft with small screwdriver.
C. Shaft

Figure 5-4 Torsion Spring Installation

ACCELERATOR PEDAL – GASOLINE VEHICLES

See General Warning on page 1-1.

ACCELERATOR PEDAL REMOVAL – GASOLINE VEHICLES

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
2. Place chocks under the rear wheels and lift the front end of the vehicle with a chain hoist or floor jack. Place jack stands under the front cross tube of the vehicle frame and lower the vehicle onto the jack stands. **See following WARNING.**

⚠ WARNING

- **Lift only one end of the vehicle at a time. Use a suitable lifting device (chain hoist or hydraulic floor jack) with 1000 lb. (454 kg) minimum lifting capacity. Do not use lifting device to hold vehicle in raised position. Use approved jack stands of proper weight capacity to support the vehicle and chock the wheels that remain on the floor. When not performing a test or service procedure that requires movement of the wheels, lock the brakes.**

3. Disconnect the accelerator rod assembly (17, 25, and 24) **(Figure 5-5, Page 5-6)** at the front and rear ball studs and remove it from the vehicle.
4. Use a 9/16-inch socket and 9/16-inch wrench to remove the nut (7), two washers (5), and bolt (4) securing the accelerator pedal (1) to the pivot rod (6).
5. Remove the nut (10) and ball stud (8) from the accelerator pivot rod assembly (6).
6. Slide the spring retainer (11) off of the accelerator pivot rod.
7. Inspect the pivot support bearing (9) for wear and replace if necessary.
8. Use a marker to mark the position of the park brake ratchet (23) on the accelerator pivot rod (6). **See following NOTE.**

NOTE: *Failure to mark position of the ratchet could cause it to be reinstalled improperly, resulting in improper adjustment and possible failure of the park brake.*

9. Remove the lock nut (26) from the accelerator pivot rod **(Figure 5-5, Page 5-6)**.
10. Press the brake pedal slightly and slide the park brake ratchet (23) toward the end of the accelerator pivot rod. Rotate the ratchet and remove it from the pivot rod.
11. Remove the pivot rod (6) and spacer (20) from the accelerator pivot rod supports (21).
12. Inspect the accelerator pivot rod supports (21) for wear and damage and replace if necessary. If the pivot rod supports do not require replacement, loosen, but do not remove, the four bolts (22) and lock nuts (18) to make installation of the pivot rod easier.
13. Remove the accelerator pedal (1) from the vehicle.
14. Inspect all parts for wear and damage. Replace as necessary.

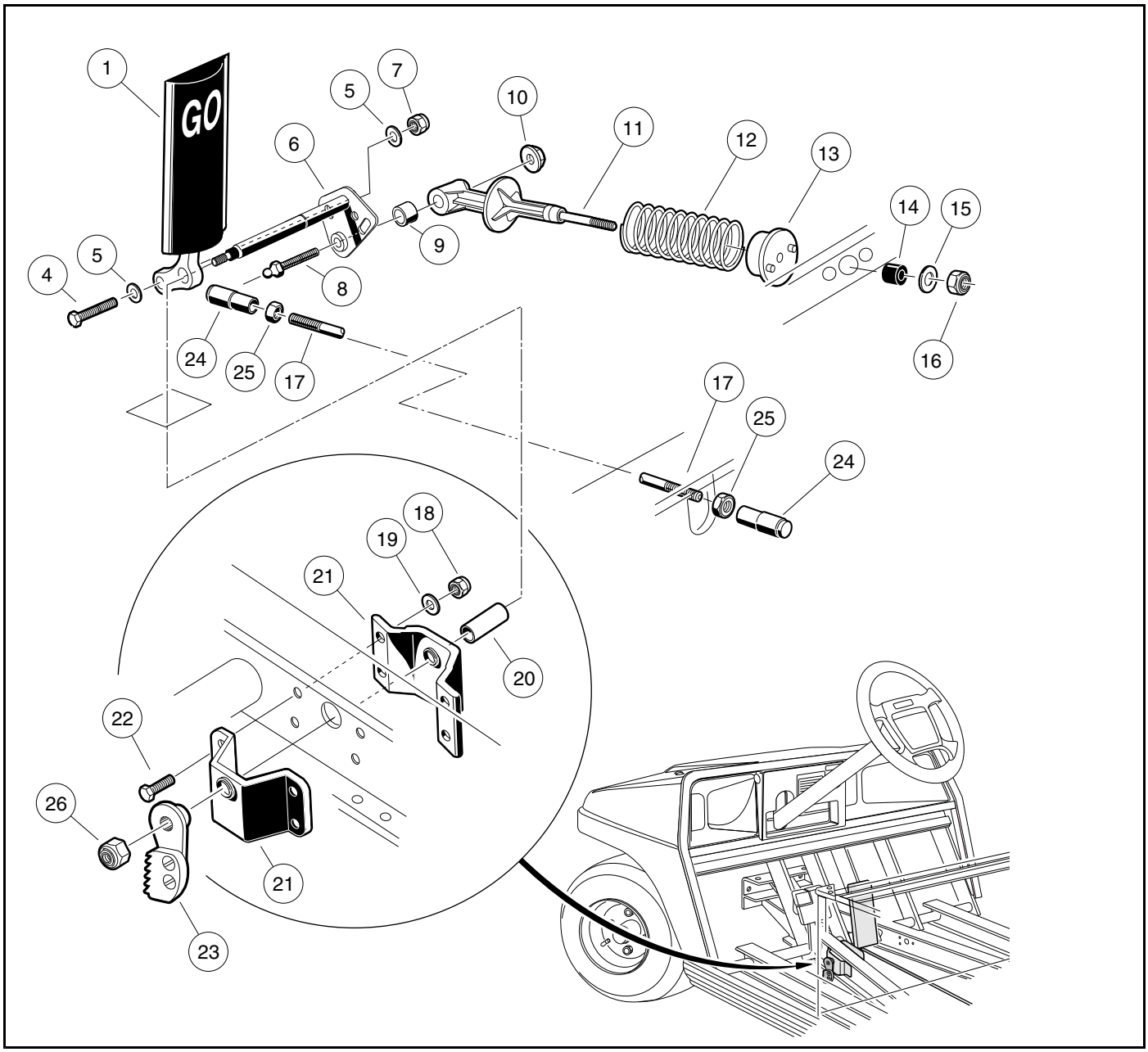


Figure 5-5 Accelerator Pedal – Gasoline Vehicles

ACCELERATOR PEDAL INSTALLATION – GASOLINE VEHICLES

1. If the accelerator pivot rod supports were replaced, position the supports (21) on the vehicle frame and install the four bolts (22), flat washers (19), and lock nuts (18). Finger-tighten nuts at this time **(Figure 5-5, Page 5-6)**.
2. Insert the lower end of the accelerator pedal (1) through the floorboard and install the accelerator pivot rod (6) through the uppermost hole in the pedal.
3. Install the plastic spacer (20) on the pivot rod (6).
4. Insert the pivot rod through the pivot rod supports on the vehicle frame.
5. Tighten the four bolts (22) attaching the pivot rod supports to the frame to 75 in-lb (8.5 N·m).
6. Install the bolt (4), two washers (5), and a new lock nut (7) through the lower hole in the pedal and through the pivot rod. Finger-tighten nut at this time.

7. Install the ball stud (8) through the pivot rod. Install the spring retainer (11) onto the ball stud. Secure these parts with the nut (10) **(Figure 5-5, Page 5-6)**. Tighten the nut to 50 in-lb (5.7 N·m).
8. Press the brake pedal slightly, and with the park brake ratchet oriented so that the tip of the ratchet is pointed toward the rear of vehicle, slide the ratchet onto the pivot rod (do not slide the ratchet onto the pivot rod splines). Release the brake pedal and allow the ratchet to rotate until its tip is pointed downward **(Figure 5-6, Page 5-7)**. The ratchet should now rotate freely on the rod.

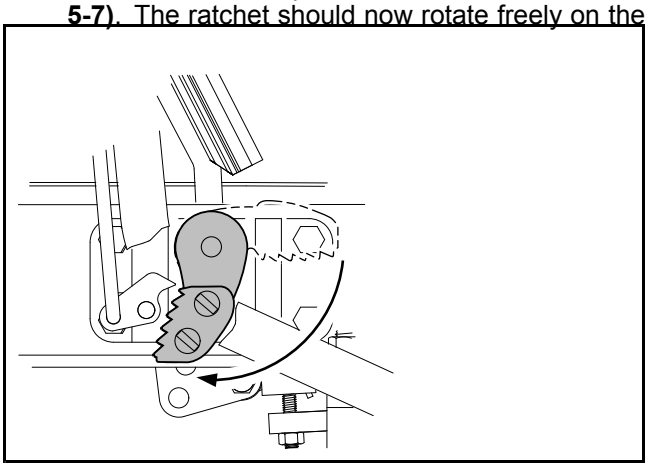


Figure 5-6 Ratchet Installation

9. Rotate the ratchet clockwise until it touches the park brake pawl, then slide the ratchet onto the splines of the pivot rod (it may be necessary to push the pivot rod toward the driver side of the vehicle to make the splines accessible). The ratchet may have to be rotated counterclockwise slightly to align the splines.
10. Move the pivot rod back toward the driver side of the vehicle and line up the match marks on the pivot rod and ratchet. Rotate the pivot rod back and forth slightly to align the splines and slide the ratchet onto the splines.
11. Install the nylon lock nut (26) on the pivot rod and tighten the nut to 18 ft-lb (24 N·m) **(Figure 5-5, Page 5-6)**.
12. Install the accelerator rod assembly (17, 25, and 24) **(Figure 5-5, Page 5-6)**.
13. Adjust the pedal group. **See Pedal Group Adjustment – Gasoline Vehicles on page 5-10.**

ACCELERATOR PEDAL – ELECTRIC VEHICLES

See General Warning on page 1-1.

ACCELERATOR PEDAL REMOVAL – ELECTRIC VEHICLES

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**
2. Place chocks under the rear wheels and lift the front end of the vehicle with a chain hoist or floor jack. Place jack stands under the front cross tube of the vehicle frame and lower the vehicle onto the jack stands. **See following WARNING.**

⚠ WARNING

- **Lift only one end of the vehicle at a time. Use a suitable lifting device (chain hoist or hydraulic floor jack) with 1000 lb. (454 kg) minimum lifting capacity. Do not use lifting device to hold vehicle in raised position. Use approved jack stands of proper weight capacity to support the vehicle and chock the wheels that remain on the floor. When not performing a test or service procedure that requires movement of the wheels, lock the brakes.**

3. Remove the MCOR (2) and drive bar (3) as instructed **(Figure 5-7, Page 5-9)**. **See MCOR Removal on page 24-6.**
4. Use a 9/16-inch socket and 9/16-inch wrench to remove the nut (7), two washers (5), and bolt (4) securing the accelerator pedal (1) to the pivot rod (6) **(Figure 5-7, Page 5-9)**.
5. Remove the nut (10) and bolt (8) from the accelerator pivot rod assembly (6).
6. Slide the spring retainer (11) off of the accelerator pivot rod.
7. Inspect the pivot support bearing (9) for wear and replace if necessary.
8. Use a marker to mark the position of the park brake ratchet (24) on the accelerator pivot rod (6). **See following NOTE.**

NOTE: *Failure to mark position of the ratchet could cause it to be installed improperly, resulting in improper adjustment and possible failure of the park brake.*

9. Remove the lock nut (23) from the accelerator pivot rod.
10. Press the brake pedal slightly and slide the park brake ratchet (24) toward the end of the accelerator pivot rod. Rotate the ratchet and remove it from the pivot rod.
11. Remove the pivot rod (6) and spacer (20) from the accelerator pivot rod supports (21) **(Figure 5-7, Page 5-9)**.
12. Inspect the accelerator pivot rod supports (21) for wear and damage and replace as necessary. If the pivot rod supports do not require replacement, loosen, but do not remove, the four bolts (22) and lock nuts (15) to make installation of the pivot rod easier.
13. Remove the accelerator pedal (1) from the vehicle **(Figure 5-7, Page 5-9)**.
14. Inspect all parts for wear and damage. Replace as necessary.

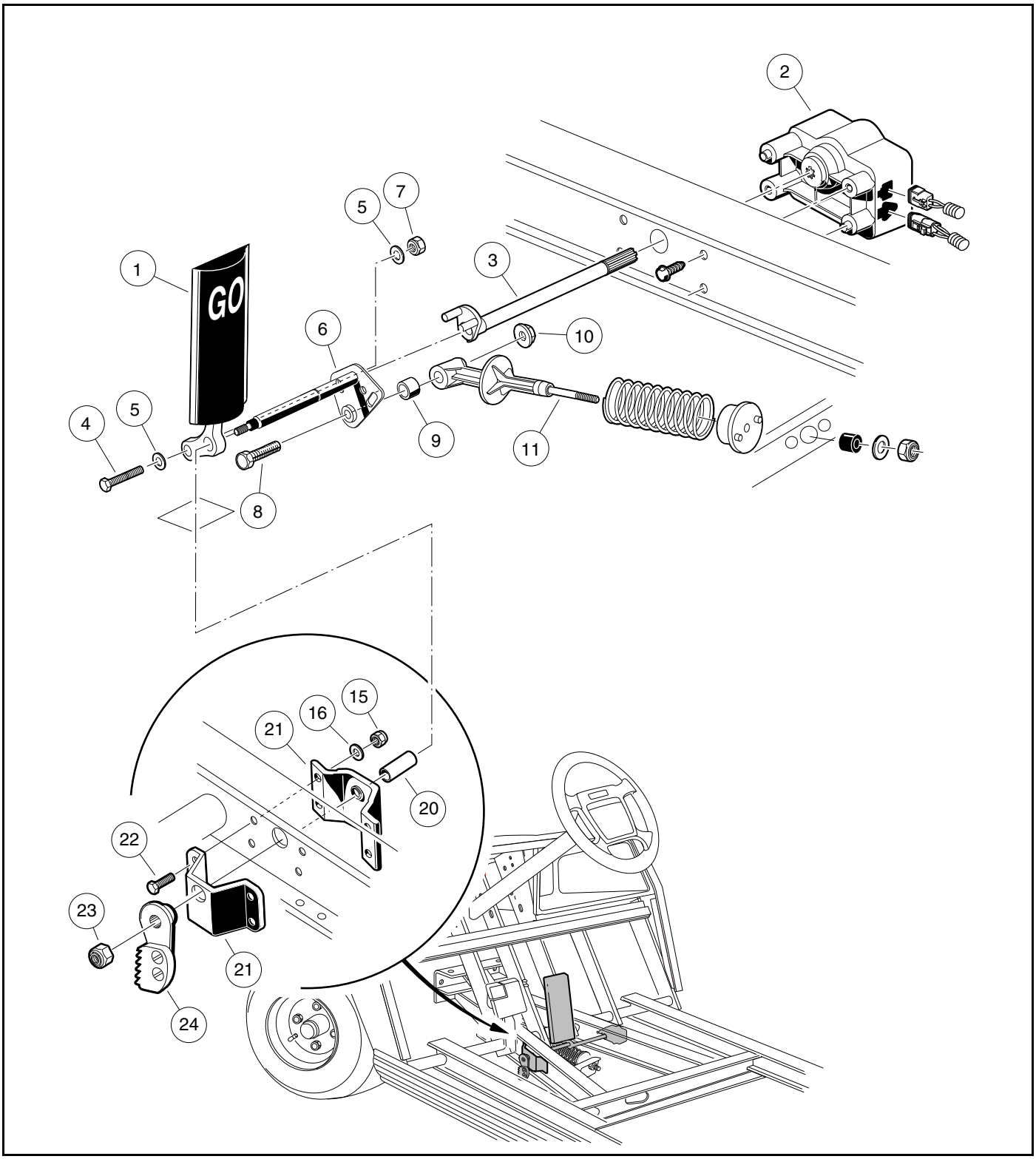


Figure 5-7 Accelerator Pedal – Electric Vehicle

ACCELERATOR PEDAL INSTALLATION – ELECTRIC VEHICLES

1. If the accelerator pivot rod supports were replaced, position the supports (21) on the vehicle frame and install the four bolts (22), flat washers (16), and lock nuts (15) **(Figure 5-7, Page 5-9)**. Finger-tighten nuts at this time.
2. Insert the lower end of the accelerator pedal (1) through the floorboard and install the accelerator pivot rod (6) through the uppermost hole in the pedal.
3. Install plastic spacer (20) on pivot rod (6).
4. Insert the pivot rod through the pivot rod supports (21) on the vehicle frame.
5. Tighten the four bolts (22) attaching the pivot rod supports to the frame to 75 in-lb (8.5 N·m) **(Figure 5-7, Page 5-9)**.
6. Insert the bolt (4), two washers (5), and a new lock nut (7) through the lower hole in the pedal and through the pivot rod. Finger-tighten lock nut at this time.
7. Install the bolt (8) through the pivot rod (6) and spring retainer (11). Secure these parts with the nut (10) **(Figure 5-7, Page 5-9)**. Tighten the nut to 50 in-lb (5.5 N·m).
8. Press the brake pedal slightly, and with the park brake ratchet oriented so that the tip of the ratchet is pointed toward the rear of the vehicle, slide the ratchet onto the pivot rod (do not slide the ratchet onto the pivot rod splines). Release the brake pedal and allow the ratchet to rotate until its tip is pointed downward **(Figure 5-6, Page 5-7)**. The ratchet should now rotate freely on the rod.
9. Rotate the ratchet clockwise until it touches the park brake pawl, then slide the ratchet onto the splines of the pivot rod (it may be necessary to push the pivot rod toward the driver side of the vehicle to make the splines accessible). The ratchet may have to be rotated counterclockwise slightly to align the splines.
10. Move the pivot rod back toward the driver side of the vehicle and line up the match marks on the pivot rod and ratchet. Rotate the pivot rod back and forth slightly to align the splines and slide the ratchet onto the splines.
11. Install lock nut (23) on pivot rod **(Figure 5-7, Page 5-9)**. Tighten to 18 ft-lb (24.5 N·m).
12. Install the MCOR (2) and drive bar (3) as instructed. **See MCOR Installation on page 24-6.**
13. Adjust the pedal group. **See Pedal Group Adjustment – Electric Vehicles on page 5-15.**

PEDAL GROUP ADJUSTMENT – GASOLINE VEHICLES

See General Warning on page 1-1.

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
2. Adjust brake pedal height.
   - 2.1. Chock wheels and release park brake. Lift rear of vehicle and place jack stands under the axle tubes to support the vehicle.
   - 2.2. To provide slack in the brake cables, loosen the equalizer retaining nuts (2 and 3) on the equalizer rod (1) **(Figure 5-8, Page 5-11)**.
   - 2.3. **Four-wheel brake vehicles only:** Loosen the front brake equalizer rod **(Figure 5-9, Page 5-11)**.

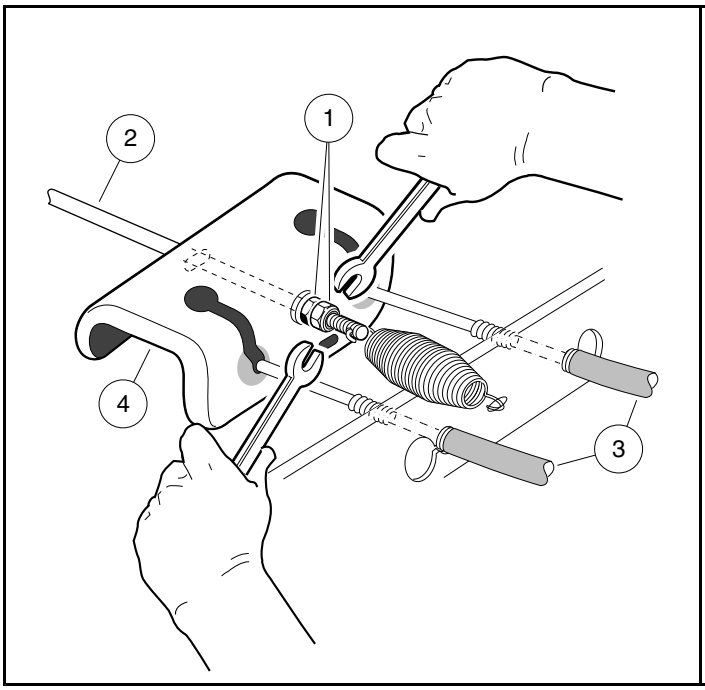


Figure 5-8 Loosen Rear Brake Equalizer Rod Nuts

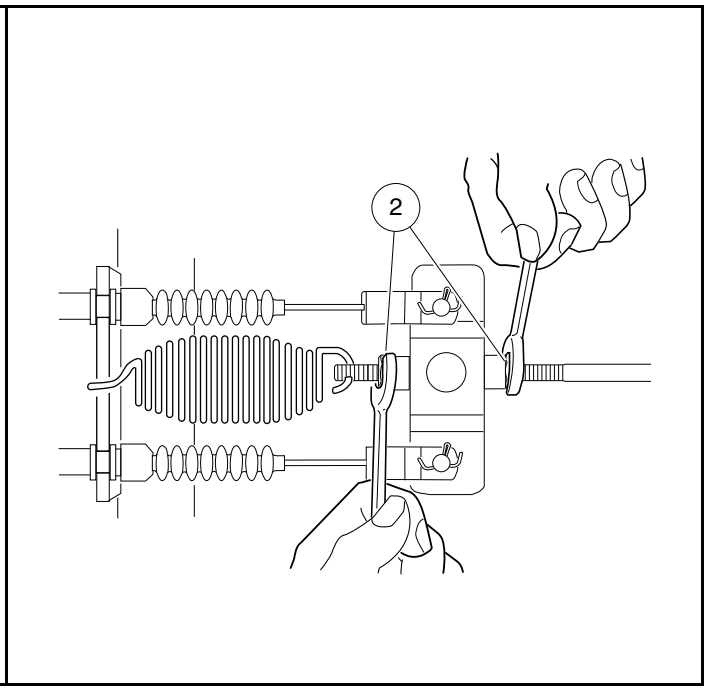


Figure 5-9 Loosen Front Brake Equalizer Rod Nuts

2.4. Loosen the brake stop jam nut (31), then relieve pedal pressure on the stop by pushing down slightly on the pedal. Next, adjust the brake stop bumper (22) up or down **(Figure 5-10, Page 5-11)**. Adjusting the bumper upward decreases distance between pedal and floorboard. Adjusting the bumper downward increases distance between pedal and floorboard. Proper brake pedal height is 6 inches (15.2 cm) **(Figure 5-11, Page 5-11)**.

2.5. Tighten the jam nut (31) to 8 ft-lb (9.5 N·m) **(Figure 5-10, Page 5-11)**.

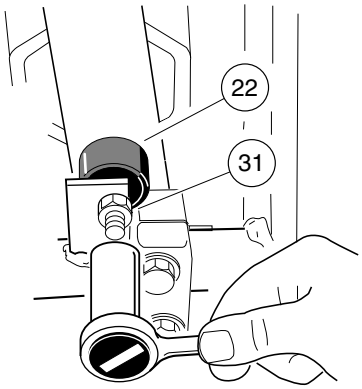
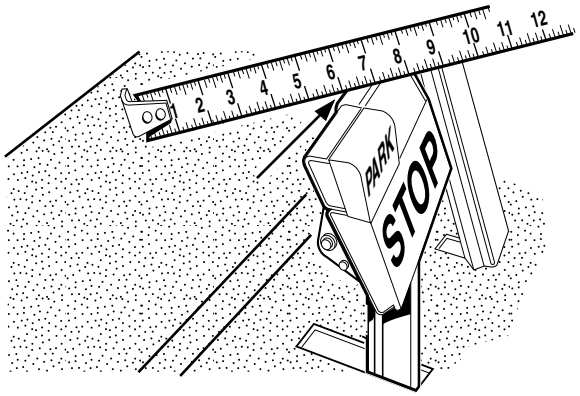


Figure 5-10 Brake Pedal Height Adjustment



Correct pedal position is 6 inches (15.2 cm)from floormat to back of brake pedal.

Figure 5-11 Brake Pedal Height Measurement

3. Adjust park brake ratchet/pawl gap and pawl engagement.

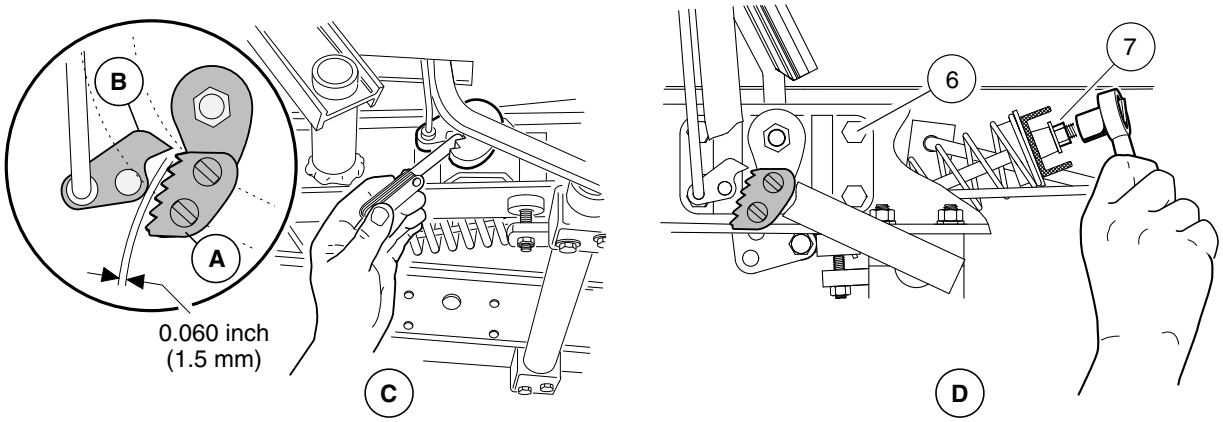
3.1. Inspect the park brake pawl and ratchet for excessive wear, grooves, cracks, or chips. If either the pawl or ratchet is damaged, both must be replaced.

3.2. Adjust retaining nut (7) on spring support rod until there is a 0.060 inch (1.5 mm) gap between the pawl and the tips of the ratchet teeth. Use a feeler gauge to verify the gap **(Figure 5-12, Page 5-12)**. The gap should be consistent through range of pawl movement. If the gap is not consistent, loosen the four bolts (6) securing the accelerator pivot rod supports and adjust the supports. If the gap becomes smaller as the park brake pedal is pressed, move the pivot rod supports slightly rearward until the gap is consistent. If the gap

becomes larger as the park brake pedal is pressed, move the pivot rod supports slightly forward until gap is consistent. **See following NOTE.**

NOTE: *The accelerator rod must also be checked if the ratchet/pawl gap is adjusted.* ***See step 5 of Pedal Group Adjustment – Gasoline Vehicles on page 5-14.***

The accelerator rod must be disconnected before proceeding to step 3.3.



C. Bottom View
D. Cutaway Side View

Figure 5-12 Park Brake Ratchet/Pawl Gap Adjustment

3.3. With the park brake unlocked, measure and note the distance from the top of the accelerator pedal to the floorboard, then lock the park brake **(Figure 5-13, Page 5-12)**.

3.4. With the park brake locked, make sure at least 75% of ratchet tooth length engages the pawl **(Figure 5-14, Page 5-12)**. Tooth engagement should be between the two lines marked on the pawl.

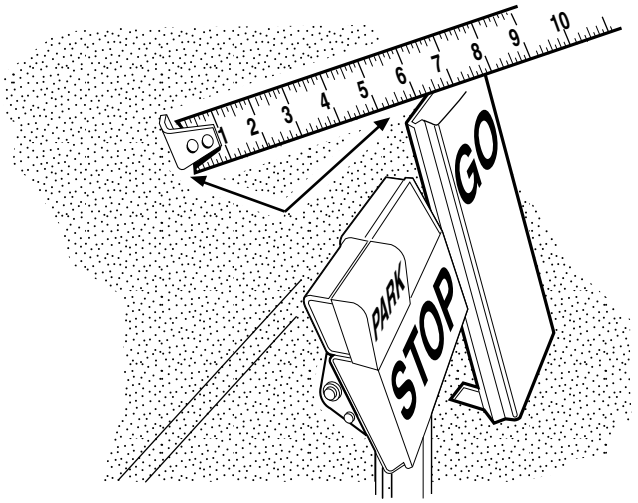
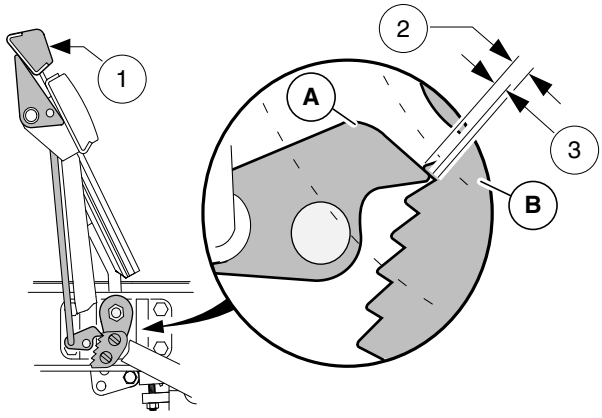


Figure 5-13 Accelerator Pedal Height Measurement



1. Locked Position
2. Ratchet (B) Tooth Length
3. Make sure pawl (A) engages at least 75% of ratchet tooth length (B).

Figure 5-14 Ratchet/Pawl Tooth Engagement

3.5. With park brake still locked, measure the distance from the top of accelerator pedal to floorboard. If the measurement has changed, ratchet tooth engagement is too deep and must be adjusted.

3.6. If ratchet/pawl engagement must be adjusted, disconnect the ball joint at the top of the brake rod and rotate the ball joint sleeve clockwise to increase engagement or counterclockwise to decrease engagement. Reconnect ball joint **(Figure 5-15, Page 5-13)**.

3.7. If the accelerator push rod was disconnected from the accelerator pedal, reconnect it.

3.8. Check for proper brake operation prior to driving the vehicle.

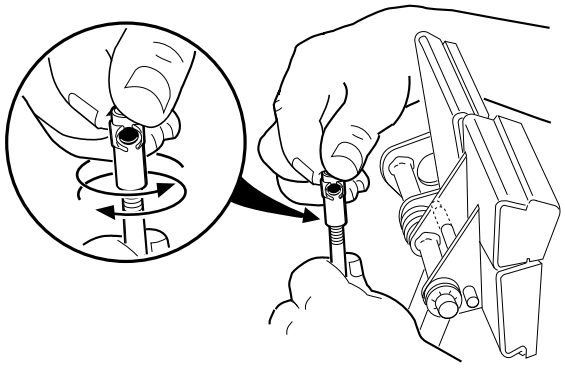
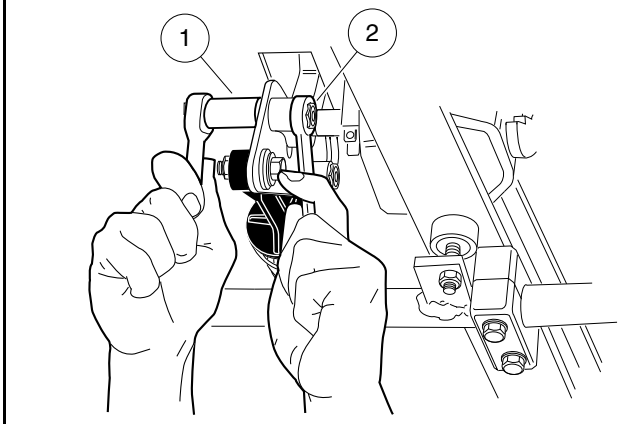


Figure 5-15 Brake Rod Adjustment

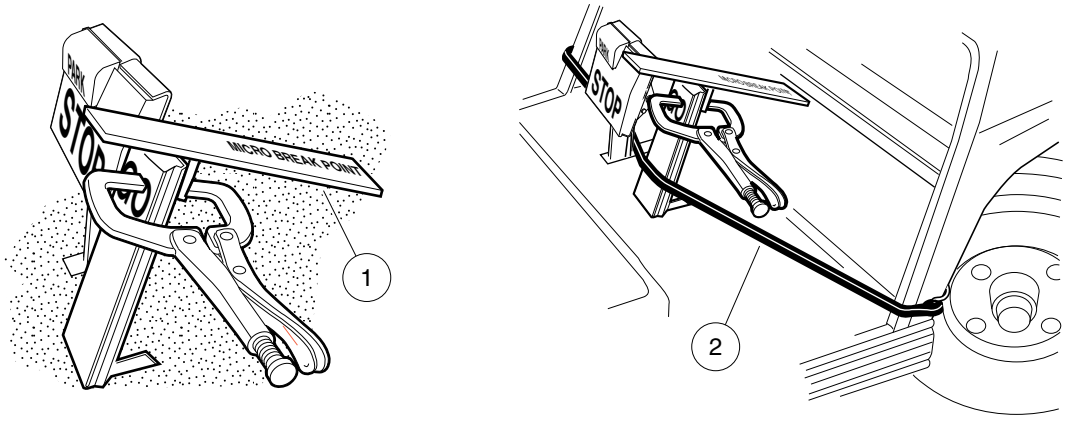


1. 1/2-Inch Socket
2. 1/2-Inch Wrench

Figure 5-16 Accelerator Pedal Height Adjustment

4. Adjust accelerator pedal height.

   4.1. Loosen the nut and bolt **(Figure 5-16, Page 5-13)** securing the accelerator pedal to the pivot plate. Clamp the accelerator pedal adjustment tool (CCI P/N 101871001) to the accelerator pedal, with the end marked *accelerator pedal height* closest to the floorboard. Press the accelerator pedal until the end of the tool rests against the floorboard; pedal height should be 5-5/8 inches (14.3 cm). Use a rubber strap to hold pedal in position against the floorboard and then tighten nut to 26 ft-lb (35.3 N·m) **(Figure 5-17, Page 5-13)**.



1. Accelerator Pedal Adjustment Tool (CCI P/N 101871001)
2. Rubber Strap

Figure 5-17 Accelerator Pedal Height Adjustment

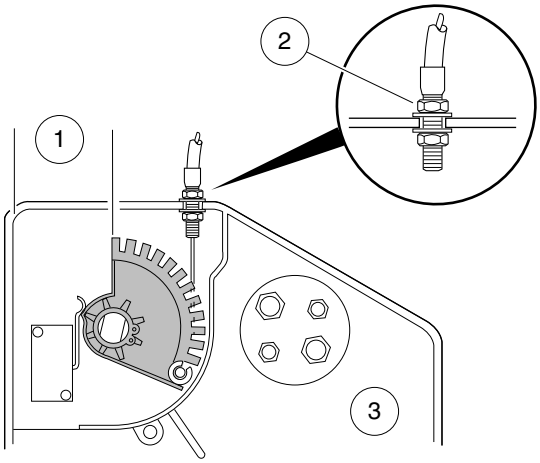
5. Adjust the accelerator rod. **See following DANGER.**

⚠ DANGER

- **Before servicing, turn the key switch to the OFF position and place the Forward/Reverse handle in the NEUTRAL position.**
- **To prevent accidentally starting the vehicle, disconnect the battery cables. See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3. This will prevent the possibility of the vehicle running over you when you are adjusting the accelerator rod.**

5.1. Remove the electrical box screw and cover. **See preceding DANGER.**

5.2. Loosen the jam nuts (25) and disconnect the accelerator rod (17) at the accelerator pedal **(Figure 5-5, Page 5-6)**. Adjust the length of the rod so the indicated cam edge is parallel with the edge of the electrical component box as shown **(Figure 5-18, Page 5-14)**. **See following CAUTION.**



1. Cam Parallel with Box
2. Retaining Nuts
3. Top View of the Electrical Component Box

Figure 5-18 Accelerator Cable

⚠ CAUTION

- **After accelerator rod adjustment, make sure that approximately the same number of threads are exposed at each end of the accelerator rod.**
- **If the lever on the limit switch in the electrical box is bent, replace the limit switch.**
- **When loosening jam nuts on the accelerator rod with one end disconnected, hold the disconnected accelerator rod with locking pliers.**
- **When tightening jam nuts on the accelerator rod, hold the disconnected ball joint with locking pliers.**

5.3. Reconnect the accelerator rod at the accelerator pedal.

5.4. Before tightening jam nuts on accelerator rod, set park brake to first ratchet and pawl position. Press accelerator pedal and make sure the following events occur in the exact order shown:

EVENT	APPROXIMATE PEDAL TRAVEL
Park brake release	2°-4°
Solenoid activation	4°-8°
Carburetor throttle actuation	8°-12°

5.5. If the events above occur as they should, hold the ball joint at each end of the accelerator rod with pliers and tighten the accelerator rod jam nut against it.

5.6. Ensure that the events occur as described in step 5.4 above. **See following NOTE.**

NOTE: *After the pedal group and accelerator rod are adjusted, the final governed engine RPM should be set.* ***See Engine RPM Adjustment on page 17-11.***

5.7. Install the electrical box cover and screw.

6. Adjust the brakes. **See Brake Adjustment (Manually-Adjusted Brakes) on page 6-7.**

PEDAL GROUP ADJUSTMENT – ELECTRIC VEHICLES

See General Warning on page 1-1.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**
2. Adjust brake pedal height.
   2.1. Chock wheels and release park brake. Lift rear of vehicle and place jack stands under the axle tubes to support the vehicle.
   2.2. To provide slack in the brake cables, loosen the equalizer retaining nuts (2 and 3) on the equalizer rod (1) **(Figure 5-19, Page 5-15)**.
   2.3. **Four-wheel brake vehicles only:** Loosen the front brake equalizer rod **(Figure 5-20, Page 5-15)**.

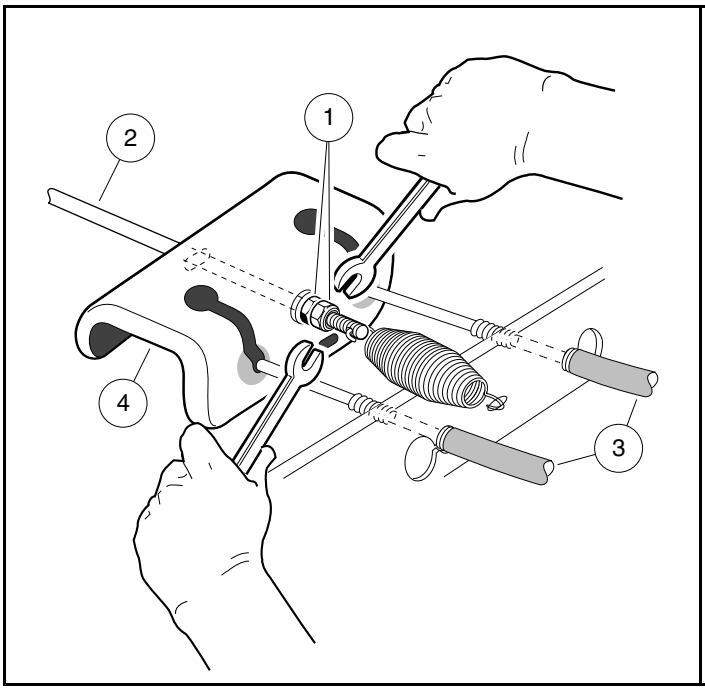


Figure 5-19 Loosen Rear Brake Equalizer Rod Nuts

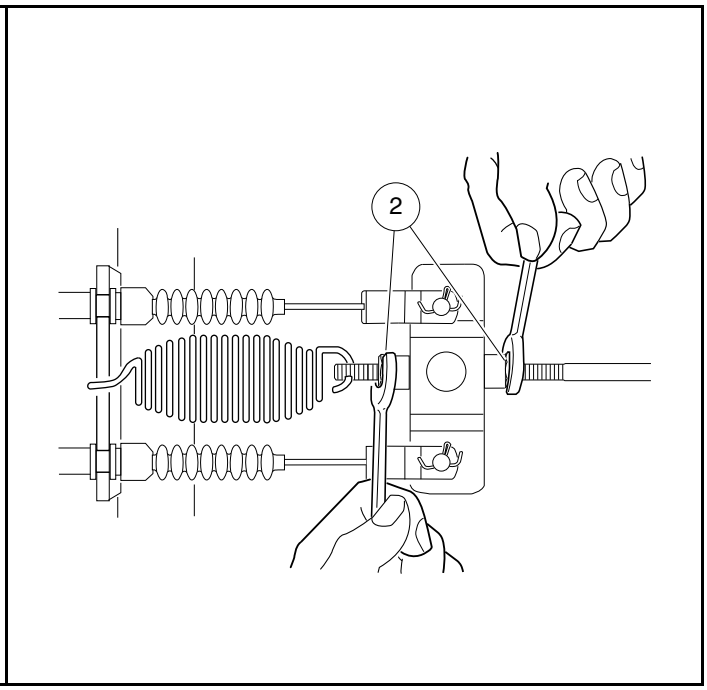


Figure 5-20 Loosen Front Brake Equalizer Rod Nuts

   2.4. Loosen the brake stop jam nut (31), then relieve pedal pressure on the stop by pushing down slightly on the pedal. Next, adjust the brake stop bumper (22) up or down **(Figure 5-21, Page 5-16)**. Adjusting the bumper upward decreases distance between pedal and floorboard. Adjusting the bumper downward increases distance between pedal and floorboard. Proper brake pedal height is 6 inches (15.2 cm) **(Figure 5-22, Page 5-16)**.
   2.5. Tighten the jam nut (31) to 8 ft-lb (9.5 N·m) **(Figure 5-21, Page 5-16)**.

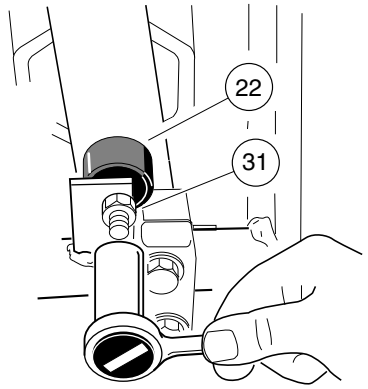
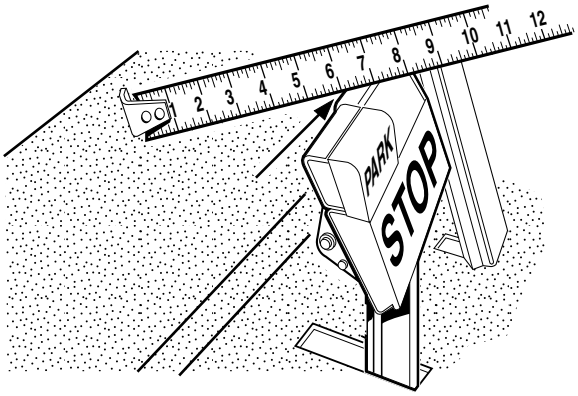


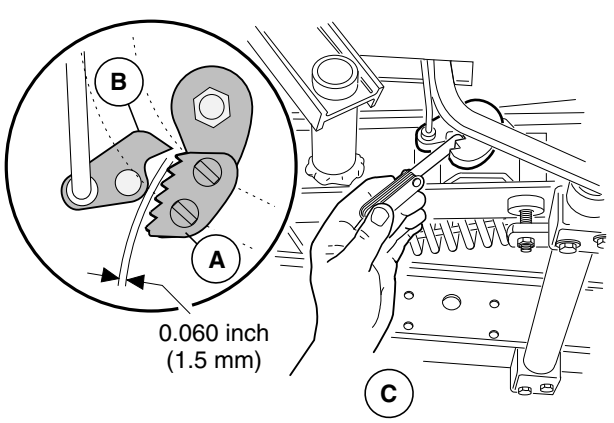
Figure 5-21 Brake Pedal Height Adjustment

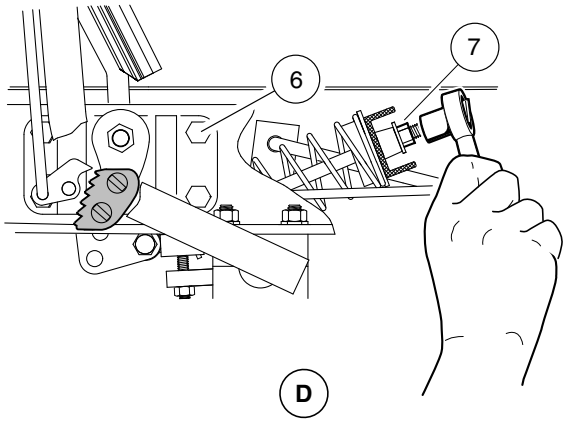


Correct pedal position is 6 inches (15.2 cm)from floormat to back of brake pedal.

Figure 5-22 Brake Pedal Height Measurement

3. Adjust park brake ratchet/pawl gap and pawl engagement.
   3.1. Inspect the park brake pawl and ratchet for excessive wear, grooves, cracks, or chips. If either the pawl or ratchet is damaged, both must be replaced.
   3.2. Adjust retaining nut (7) on spring support rod until there is a 0.060 inch (1.5 mm) gap between the pawl and the tips of the ratchet teeth. Use a feeler gauge to verify the gap **(Figure 5-23, Page 5-16)**. The gap should be consistent through range of pawl movement. If the gap is not consistent, loosen the four bolts (6) securing the accelerator pivot rod supports and adjust the supports. If the gap becomes smaller as the park brake pedal is pressed, move the pivot rod supports slightly rearward until the gap is consistent. If the gap becomes larger as the park brake pedal is pressed, move the pivot rod supports slightly forward until gap is consistent.





C. Bottom View
D. Cutaway Side View

Figure 5-23 Park Brake Ratchet/Pawl Gap Adjustment

   3.3. With the park brake unlocked, measure and note the distance from the top of the accelerator pedal to the floorboard, then lock the park brake **(Figure 5-24, Page 5-17)**.
   3.4. With the park brake locked, make sure at least 75% of ratchet tooth length engages the pawl **(Figure 5-25, Page 5-17)**. Tooth engagement should be between the two lines marked on the pawl.

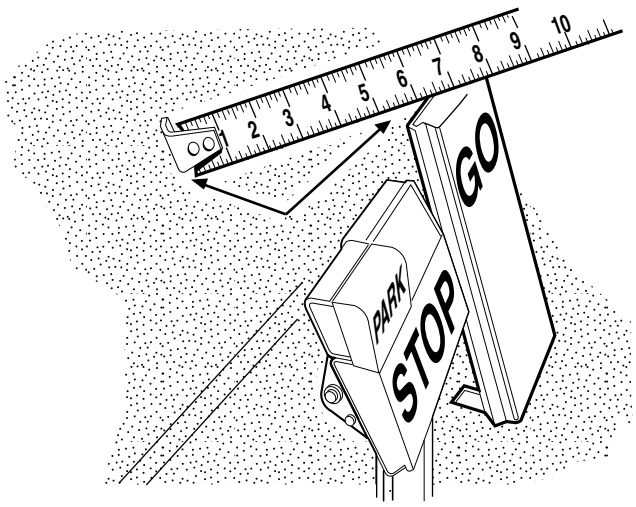
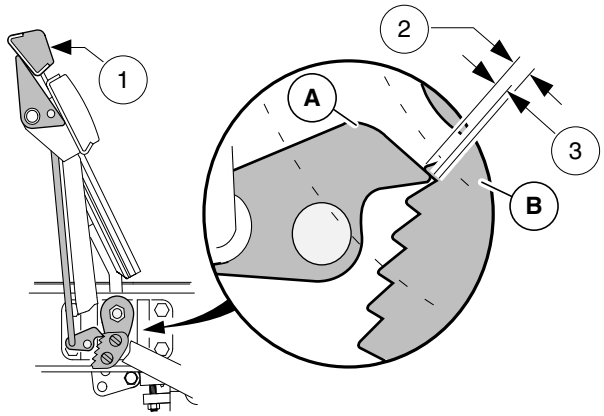


Figure 5-24 Accelerator Pedal Height Measurement



1. Locked Position
2. Ratchet (B) Tooth Length
3. Make sure pawl (A) engages at least 75% of ratchet tooth length (B).

Figure 5-25 Ratchet/Pawl Tooth Engagement

3.5. With park brake still locked, measure the distance from the top of accelerator pedal to floorboard. If the measurement has changed, ratchet tooth engagement is too deep and must be adjusted.

3.6. If ratchet/pawl engagement must be adjusted, disconnect the ball joint at the top of the brake rod and rotate the ball joint sleeve clockwise to increase engagement or counterclockwise to decrease engagement. Reconnect ball joint **(Figure 5-26, Page 5-17)**.

3.7. Check for proper brake operation prior to driving the vehicle.

4. Adjust accelerator pedal height.

4.1. Loosen the nut and bolt **(Figure 5-27, Page 5-17)** securing the accelerator pedal to the pivot plate. Clamp the accelerator pedal adjustment tool (CCI P/N 101871001) to the accelerator pedal, with the end marked *accelerator pedal height* closest to the floorboard. Press the accelerator pedal until the end of the tool rests against the floorboard; pedal height should be 5-5/8 inches (14.3 cm). Use a rubber strap to hold pedal in position against the floorboard and then tighten nut to 26 ft-lb (35.3 N·m) **(Figure 5-28, Page 5-18)**.

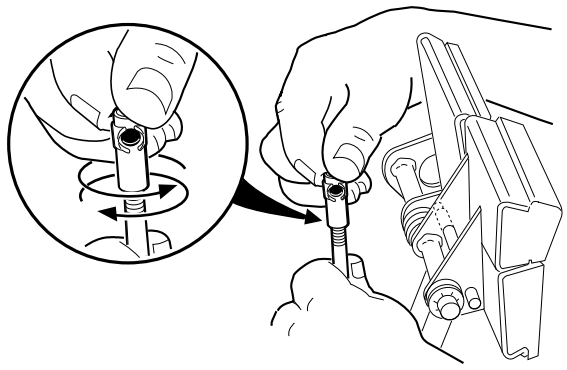
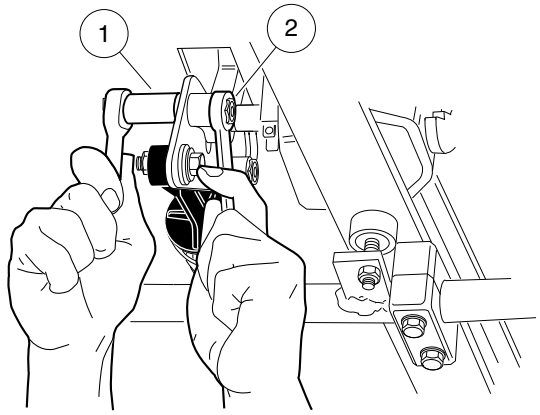
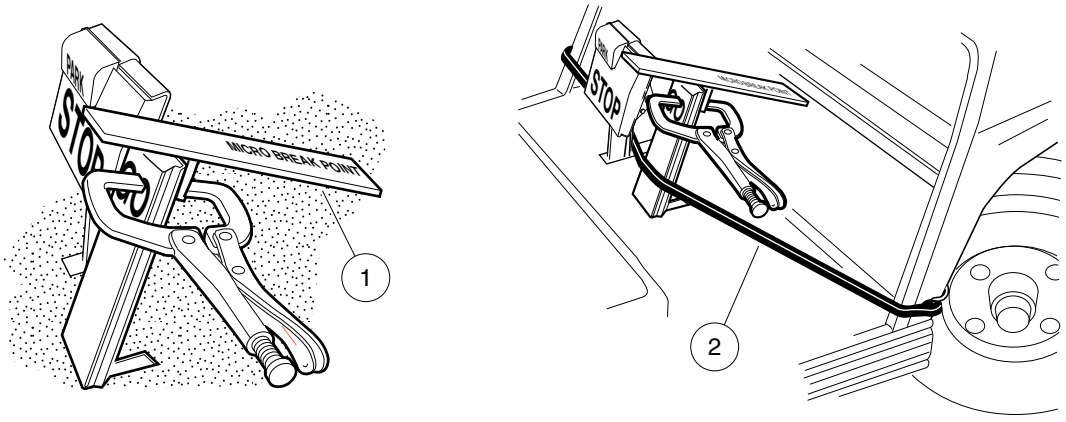


Figure 5-26 Brake Rod Adjustment



1. 1/2-Inch Socket
2. 1/2-Inch Wrench

Figure 5-27 Accelerator Pedal Height Adjustment



1. Accelerator Pedal Adjustment Tool (CCI P/N 101871001)
2. Rubber Strap

Figure 5-28 Accelerator Pedal Height Adjustment

5. Adjust the brakes. **See Brake Adjustment (Manually-Adjusted Brakes), Section 6, Page 6-7.**

⚠ DANGER

- **See General Warning on page 1-1.**

⚠ WARNING

- **See General Warning on page 1-1.**
- **Some aftermarket brake shoes contain asbestos fiber, and asbestos dust is created when these brake mechanisms are handled. Wear approved eye and respiratory protection when disassembling and cleaning brake mechanisms. Inhalation of asbestos could result in severe personal injury or death. Do not use compressed air or aerosol sprays to clean the brake mechanism. Clean brake mechanism using the negative pressure enclosure/hepa vacuum system or low pressure/wet cleaning method per OSHA/29 CFR - 1910.1001.**

GENERAL INFORMATION

The Club Car vehicles covered in this manual are equipped with four-wheel manually-adjusted brakes. **See Vehicle Specifications on page 2-1.**

BRAKE SHOE REMOVAL

See General Warning on page 1-1. See also WARNING on page 6-1.

1. To remove rear brake shoes, place chocks at the front wheels, loosen the rear wheel lug nuts, and lift the rear of the vehicle with a chain hoist or floor jack. Place jack stands under the axle tubes to support the vehicle.
2. Release park brake if latched and loosen equalizer retaining nuts (1) on equalizer rod (2) to slightly loosen brake cable **(Figure 6-1, Page 6-2)**.

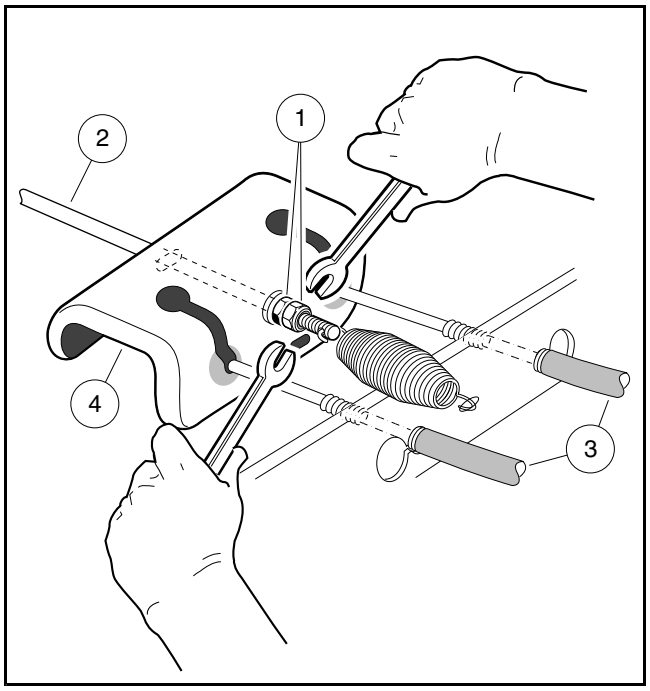


Figure 6-1 Loosen Equalizer Nuts

3. Remove the rear wheels and remove the brake drums. **See following CAUTION.**

⚠ CAUTION

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

4. Remove the axle shaft.
   4.1. Using 90° snap ring pliers (CCI P/N 1012560), remove axle retaining ring (1) **(Figure 6-2, Page 6-2)**.
   4.2. Pull the axle shaft (2) from the axle tube **(Figure 6-2, Page 6-2)**.

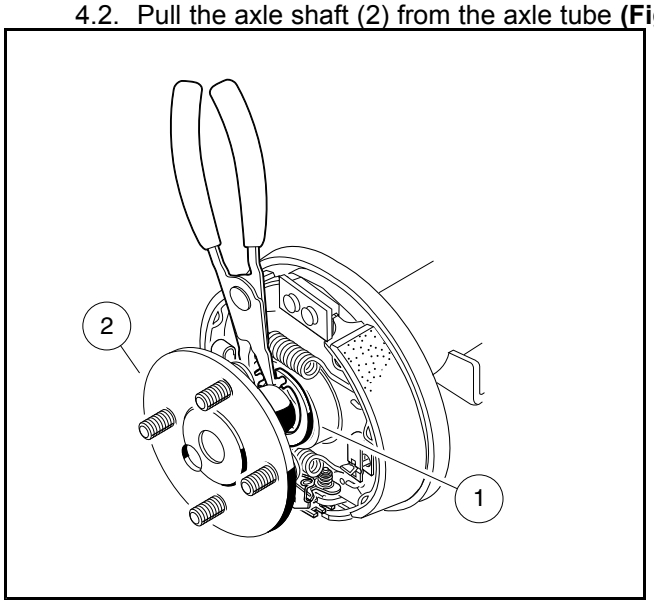


Figure 6-2 Remove Axle Retaining Ring

5. Using needle nose pliers, rotate the clip retainer pin (1) 90° to remove the shoe retainer clip (2) on each shoe **(Figure 6-3, Page 6-3)**. **See following CAUTION.**

⚠ CAUTION

- **The brake shoes are under spring pressure and can release suddenly when brake shoe retainers are removed.**

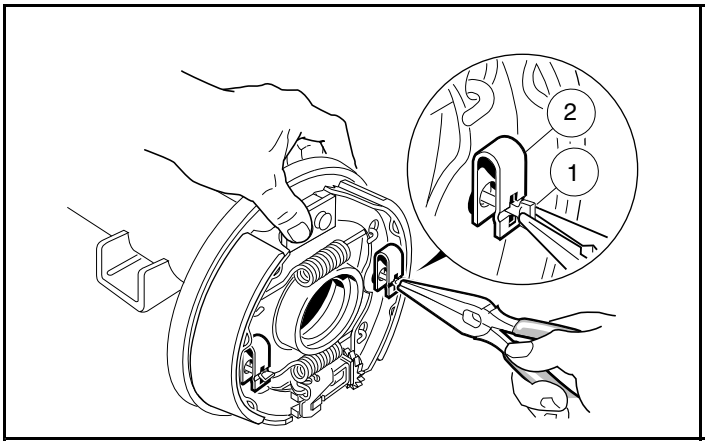


Figure 6-3 Rotate Clip Retainer

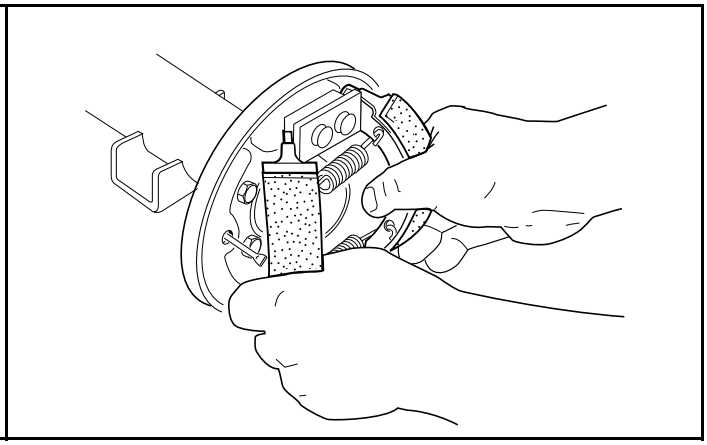


Figure 6-4 Remove Shoes

6. Grasp both brake shoes and pull them, with the springs, out of brake assembly **(Figure 6-4, Page 6-3)**.

BRAKE ASSEMBLY CLEANING (MANUALLY-ADJUSTED BRAKES)

See General Warning on page 1-1. See also WARNING on page 6-1.

1. Carefully clean the brake backing plate and all mechanical components.
2. Remove rubber boot from backing plate and wipe with a clean, damp cloth.
3. Lubricate slide (1) and slide plate (2) with dry moly lubricant (CCI P/N 1012151) on both sides of the backing plate. After lubricating, work slide back and forth to ensure it slides smoothly and easily **(Figure 6-5, Page 6-4)**. Reinstall rubber boot onto backing plate. **See following WARNING.**

⚠ WARNING

- **Apply grease carefully when performing the following steps. Do not allow any grease to get on the friction surfaces of the brake shoe pads. Failure to heed this warning could cause diminished brake performance, possibly resulting in property damage or severe personal injury.**

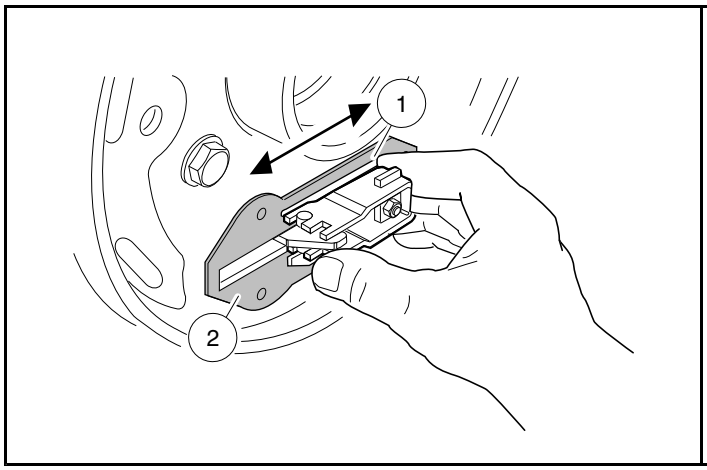


Figure 6-5 Lubricate Slide

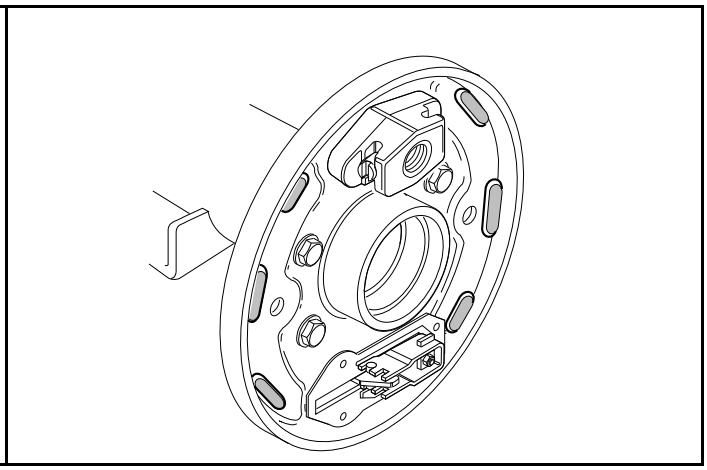


Figure 6-6 Lubricate Raised Bosses

4. Use a small brush to carefully apply a light coat of white lithium NLGI #2 grease (Dow Corning BR2-Plus or equivalent) on each of the six raised bosses on brake backing plate **(Figure 6-6, Page 6-4)**. **See preceding WARNING.**
5. Use a small brush to carefully apply a light coat of white lithium NLGI #2 grease (Dow Corning BR2-Plus or equivalent) to each end of both brake shoes and into the slots in the brake shoe mounting block as shown **(Figure 6-7, Page 6-4)**. **See preceding WARNING.**
6. Use a small brush to carefully apply a light coat of white lithium NLGI #2 grease (Dow Corning BR2-Plus or equivalent) to the brake actuator assembly as shown **(Figure 6-8, Page 6-4)**. **See preceding WARNING.**

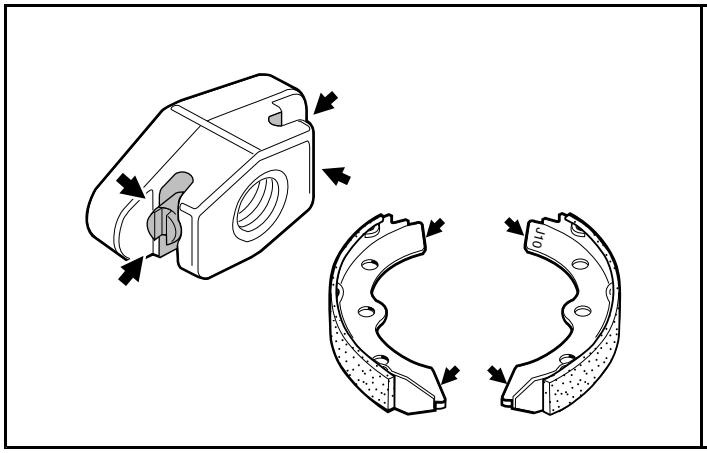


Figure 6-7 Lubricate Shoes

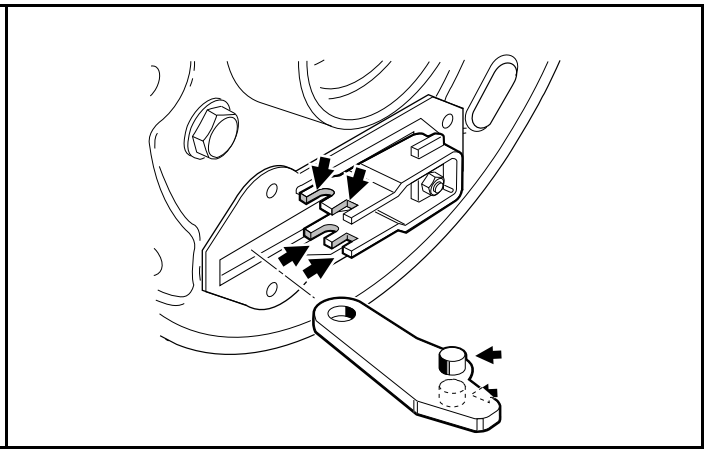


Figure 6-8 Lubricate Actuator

BRAKE SHOE INSTALLATION (MANUALLY-ADJUSTED BRAKES)

See General Warning on page 1-1. See also WARNING on page 6-1.

NOTE: *Components of the front wheel brake assembly are identical to the rear wheel manually-adjusted brake assembly. The front brake assembly is rotated 90° (when compared to the rear brake assembly) so the adjusting bolt on each assembly is oriented to the rear of the vehicle rather than at the top of the assembly* ***(Figure 6-18, Page 6-10)****.*

1. Position one shoe in the slots in the mounting block anchor piston and brake actuator **(Figure 6-9, Page 6-5)**. **See following WARNING.**

⚠ WARNING

- **When installing brake shoes, the shoes must be oriented with tips stamped J10 inserted into the mounting block anchor piston slots rather than into the brake actuator slots (Figure 6-9, Page 6-5). Incorrectly installed brake shoes will be too tight and make adjustment of the brake impossible.**

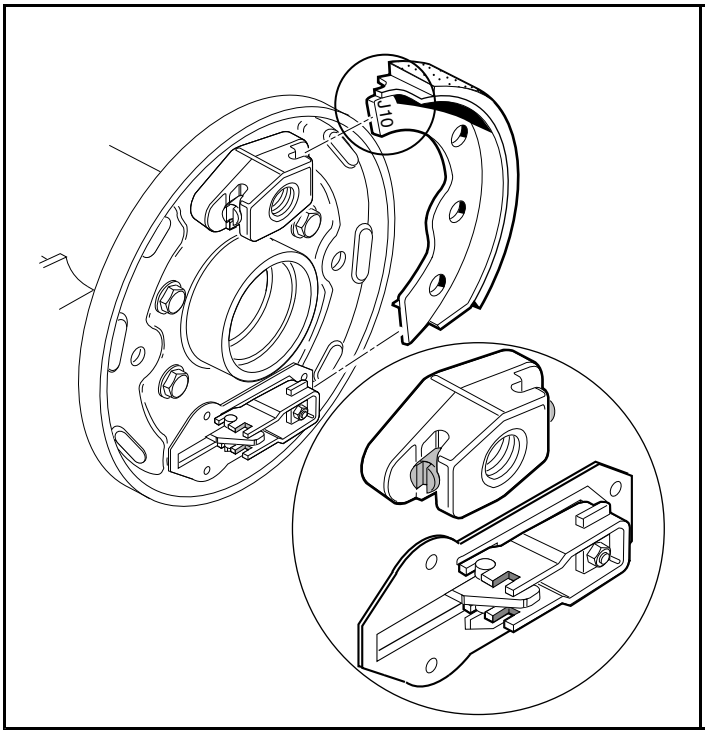


Figure 6-9 Orient and Insert Shoes

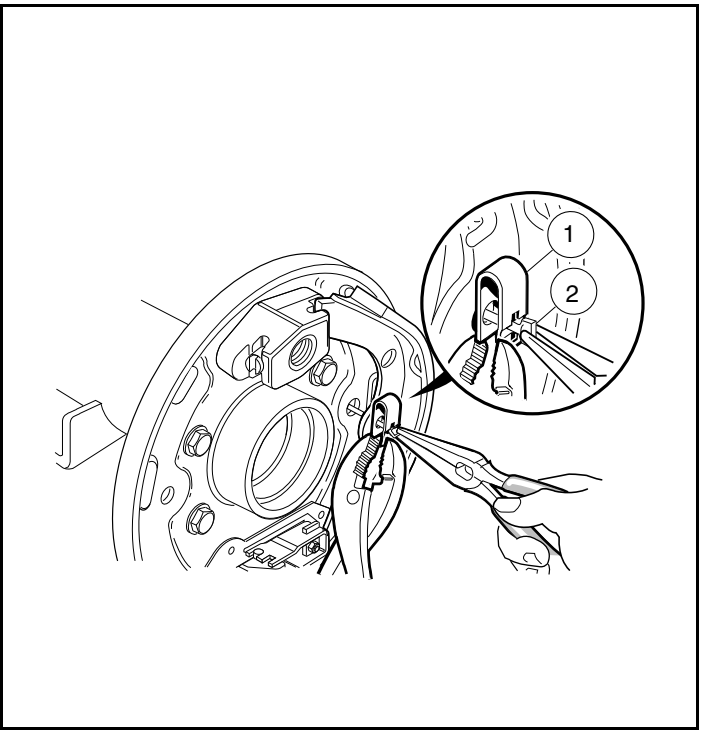


Figure 6-10 Retainer Clip

2. Install shoe retainer clip (1), using pliers to compress clip while turning clip retainer pin (2) into position **(Figure 6-10, Page 6-5)**.
3. Attach the springs (with hooks pointing outwards) onto the shoe already installed. Then hold the other shoe next to it, correctly oriented, and attach the springs to it **(Figure 6-11, Page 6-6)**. **See following NOTE.**

NOTE: *With brake shoe tips marked J10 oriented to the mounting block, the stamping will be visible on one shoe only. The other J10 stamping will be facing the backing plate and will not be visible.*

4. While maintaining spring attachment on both shoes, position the tips of the second shoe into mounting slots and then push shoe into place. Hold shoe in position and install the retaining clip and pin **(Figure 6-11, Page 6-6)**.
5. After the shoes are installed, move them together up and down and side to side to make sure that they will easily slide approximately 1/4 to 3/8 inch (6.3 to 9.5 mm) without binding. Make sure the shoes are positioned vertically

so the tips (1) of the shoes are positioned flush with the top surface of the shoe mounting blocks as shown **(Figure 6-12, Page 6-6)**. **See following CAUTION.**

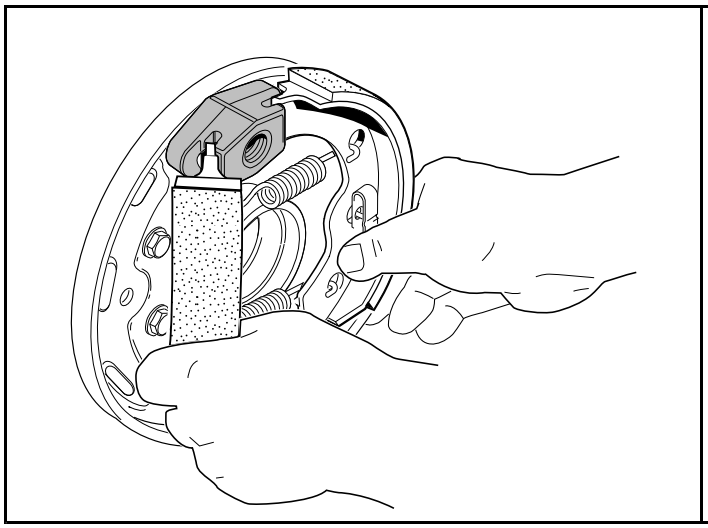


Figure 6-11 Attach Springs and Install Other Shoe

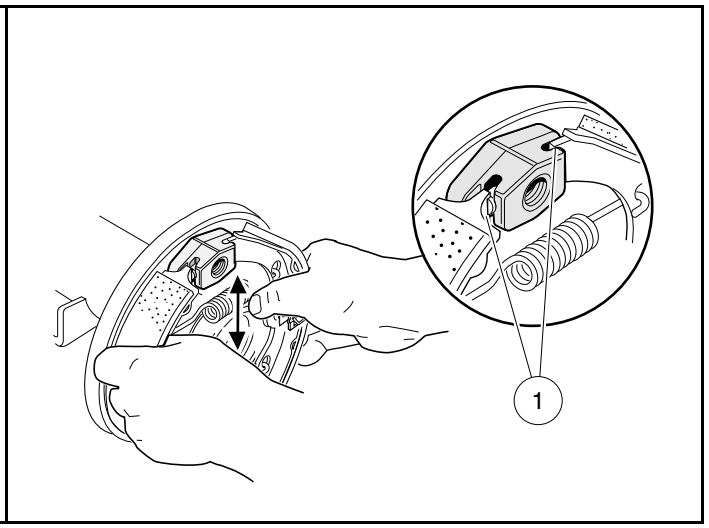


Figure 6-12 Position Shoes in Mounting Block

⚠ CAUTION

- **Clean any residual oil from the exposed end of the axle shaft and from the oil seal area prior to installing the axle shaft.**

6. Install axle shaft (2) into axle tube and install retaining ring (1) **(Figure 6-2, Page 6-2)**. **See following WARNING.**

⚠ WARNING

- **Be sure retaining ring is properly seated in groove. If ring is not properly installed, axle assembly will separate from transaxle and damage axle assembly and other components. Loss of vehicle control could result in severe personal injury or death.**

7. Install the brake drum and make sure that it is properly seated. **See following NOTE.**

NOTE: *If drum installation is difficult, the brake shoes may need to be adjusted vertically in the mounting slots.*

8. After the drum is installed, make sure the axle and drum turn freely.

BRAKE ADJUSTMENT (MANUALLY-ADJUSTED BRAKES)

See General Warning on page 1-1. See also WARNING on page 6-1.

⚠ CAUTION

- **Pedal group adjustment must be within specifications prior to beginning brake adjustment. Perform the appropriate pedal group adjustment.**
  - **– For gasoline vehicles, refer to See Pedal Group Adjustment – Gasoline Vehicles, Section 5, Page 5-10.**
  - **– For electric vehicles, refer to See Pedal Group Adjustment – Electric Vehicles, Section 5, Page 5-15.**

NOTE: *All brake cluster components must be clean, lubricated, and in good working condition prior to beginning brake adjustment.*

All wheels must be installed on the vehicle and lug nuts properly tightened. ***See Wheel Installation, Section 8, Page 8-1.***

BRAKE CLUSTER ADJUSTMENT

1. Chock wheels.
   1.1. To provide slack in the brake cables, loosen the equalizer retaining nuts (1 and 5) on the equalizer rod (2) **(Figure 6-13, Page 6-7)**.
2. **Four-wheel brake vehicles only:** Loosen the front brake equalizer rod **(Figure 6-14, Page 6-7)**.
3. Remove the dust cover (4) on the left and right rear brake cluster assemblies **(Figure 6-15, Page 6-8 and Figure 6-16, Page 6-8)**.

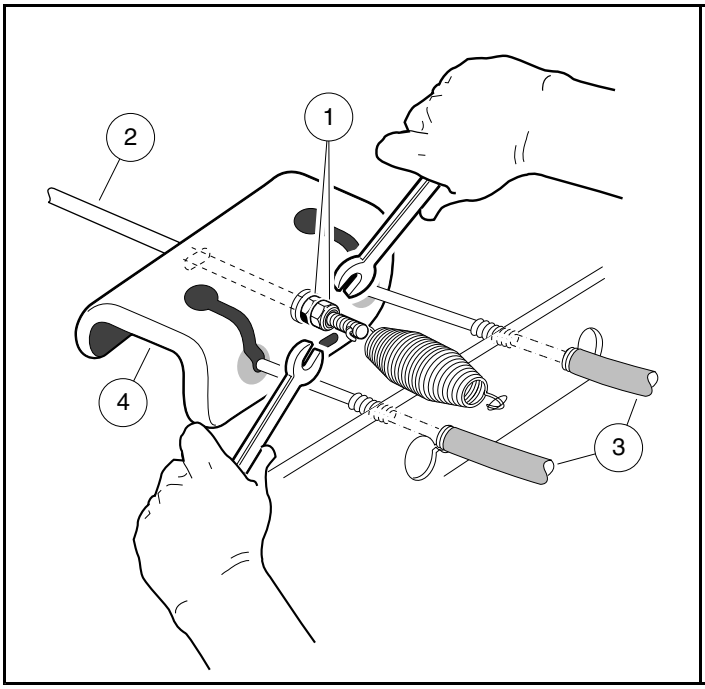


Figure 6-13 Rear Equalizer Adjustment

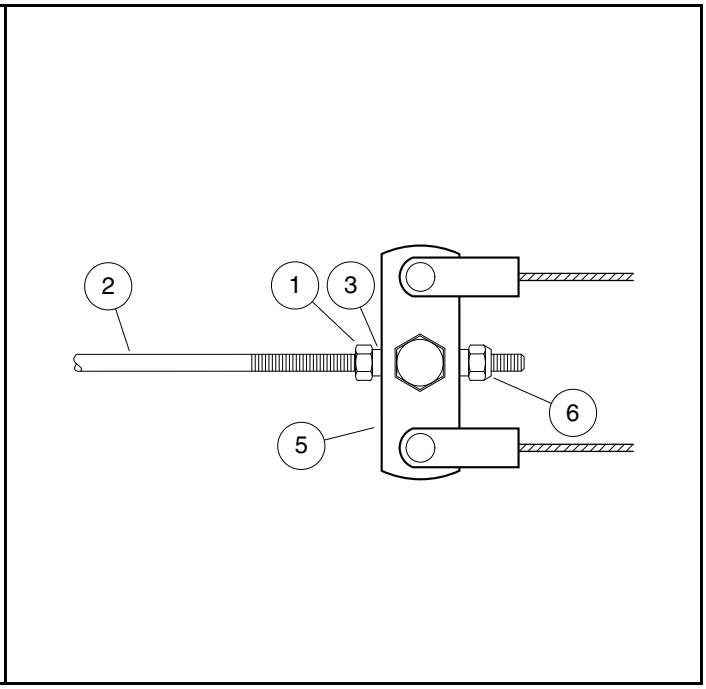


Figure 6-14 Front Equalizer Adjustment

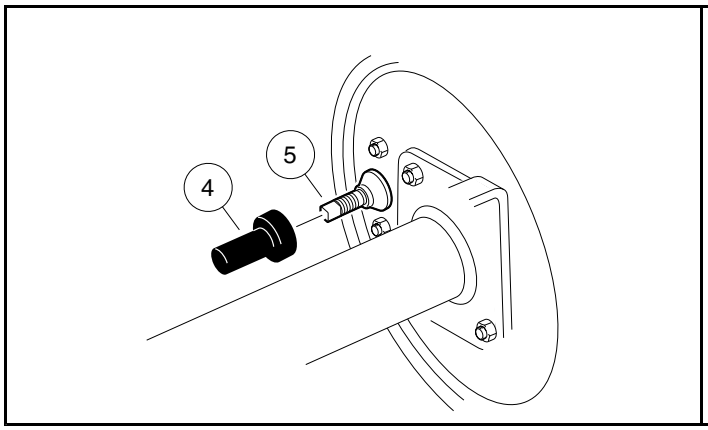


Figure 6-15 Front Brake Adjustment Bolt

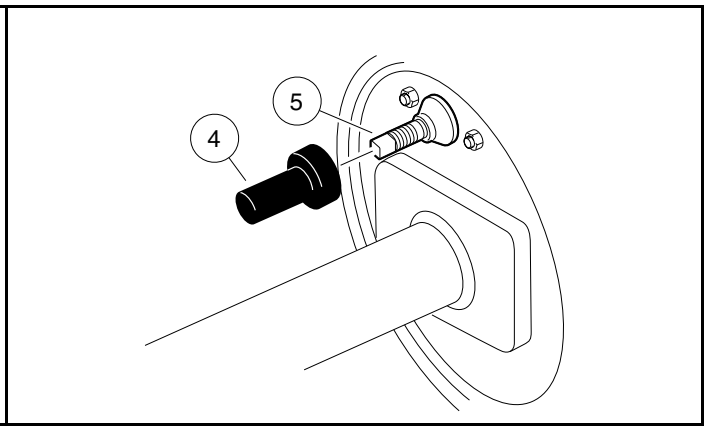


Figure 6-16 Rear Brake Adjustment Bolt

4. Use a torque wrench and a 7-mm 8-point socket or Club Car brake adjustment tool (CCI P/N 1013582) to turn the brake adjustment bolt (5) on each brake clockwise until it is tightened to 15 ft-lb (20.3 N·m) and continue clockwise rotation to the point at which torque is released. Stop tightening the bolt as soon as the torque releases, or the brake will not be properly adjusted. **See following NOTE.**

NOTE: *If a wheel can still be turned by hand after step 4, inspect the brake clusters and clean and/or replace all parts that do not work properly.*

5. **Four-wheel brake vehicles only:** Repeat procedure at front brake clusters.

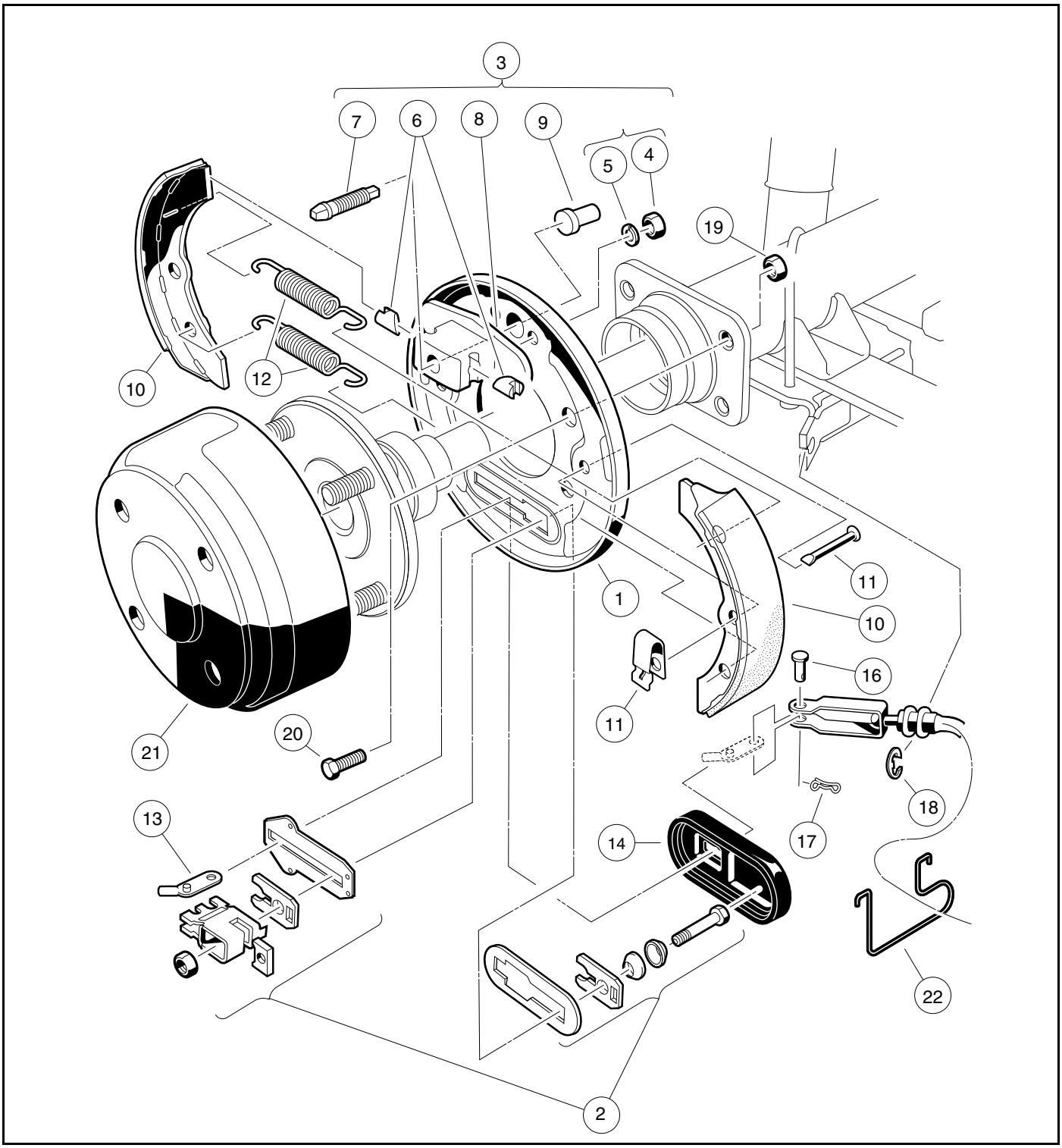


Figure 6-17 Rear Manually-Adjusted Brake Assembly

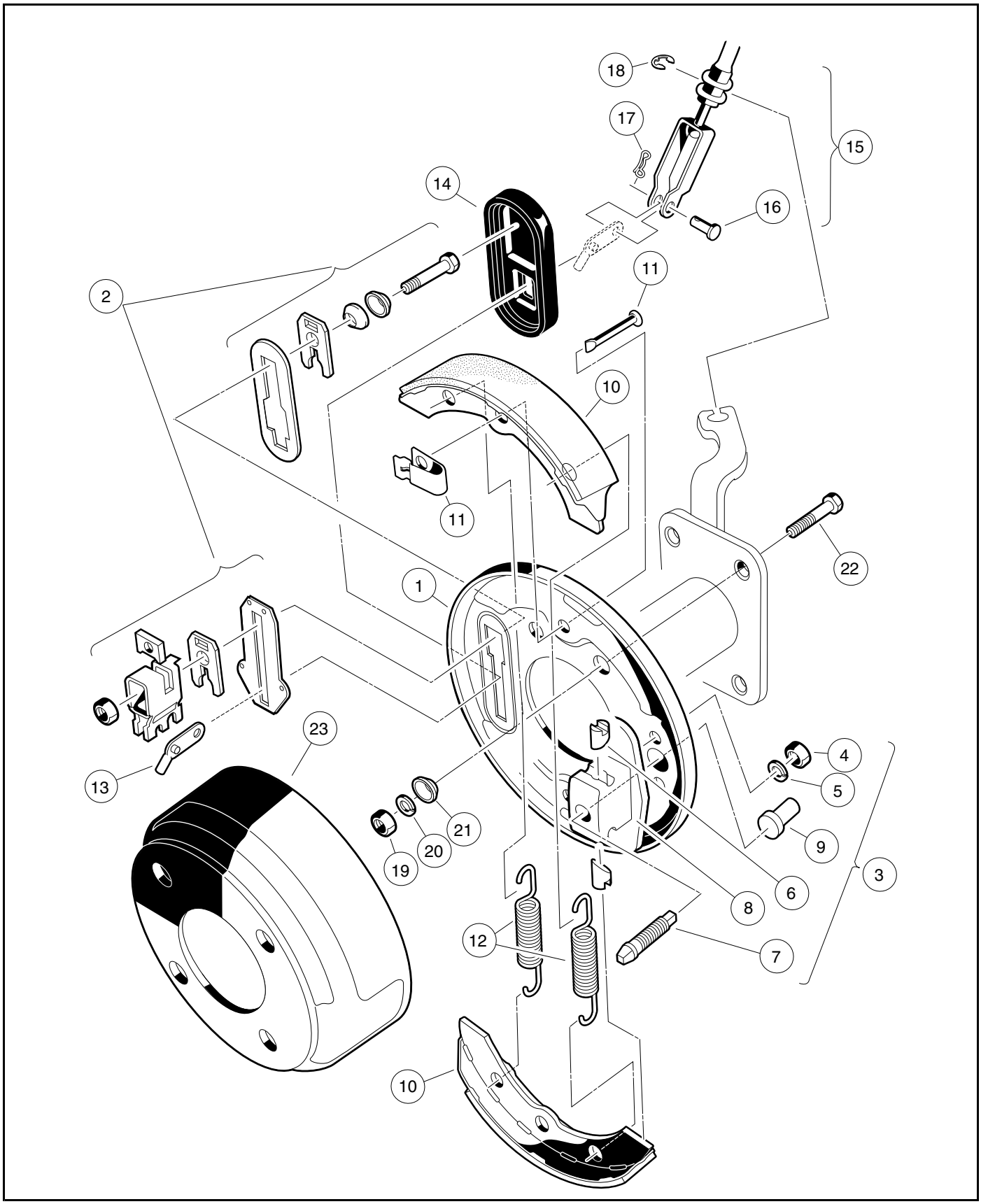


Figure 6-18 Front Manually-Adjusted Brake Assembly

BRAKE CABLE EQUALIZATION

1. Set park brake in the third tooth of the ratchet. Place a wedge between the park brake pedal and brake pedal to prevent the park brake from disengaging while equalizing the brake cables **(Figure 6-19, Page 6-11)**.

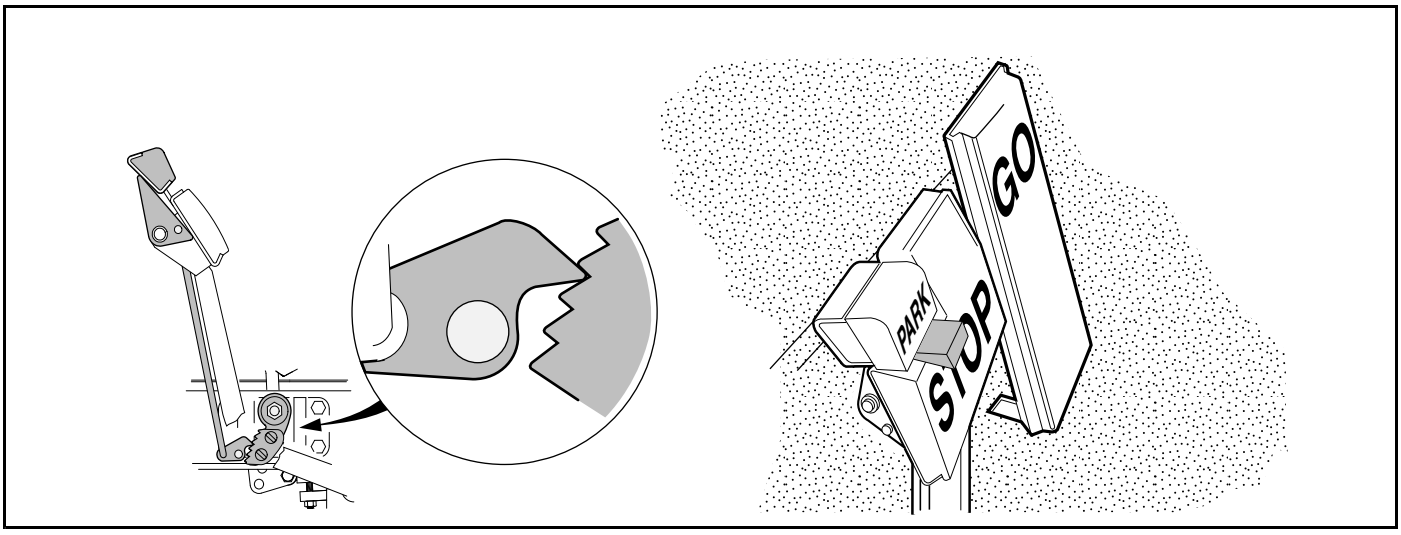


Figure 6-19 Set Park Brake and Insert Wedge

2. Equalize the brake cables.
   2.1. **Four-wheel brake vehicles only:** Tighten the nylon lock nut (6) on the front equalizer rod (2) to 35 in-lb (4 N·m) **(Figure 6-14, Page 6-7)**.
   2.2. Tighten the jam nut (5) on the rear equalizer rod (2) clockwise to 35 in-lb (4 N·m) **(Figure 6-13, Page 6-7)**.
   2.3. Repeat steps 2.1 and 2.2 until the nuts remain on the torque setting.
   2.4. Hold the lock nut (6) on the front equalizer rod (2) in place with a wrench and tighten the jam nut (1) to 13 ft-lb (17.6 N·m) **(Figure 6-14, Page 6-7)**.
   2.5. Hold the jam nut (5) on the rear equalizer rod (2) in place with a wrench and tighten the lock nut (1) to 13 ft-lb (17.6 N·m) **(Figure 6-13, Page 6-7)**. **See following CAUTION.**

⚠ CAUTION

- **If the brake pedal return spring (6) was disconnected while equalizing the brake cables, be sure to reconnect it before proceeding (Figure 6-13, Page 6-7).**

FINAL BRAKE CLUSTER ADJUSTMENT

1. To adjust the brake shoes, turn the adjustment bolt counterclockwise five clicks.
2. Repeat step 1 at other brake cluster(s).
3. Install the rubber dust covers (4) over the brake adjustment bolts (5) **(Figure 6-15, Page 6-8 and Figure 6-16, Page 6-8)**.
4. Carefully support the vehicle with the lifting device, remove jack stands and lower the vehicle to the ground.
5. Connect the battery cables. **See Connecting the Battery – Gasoline Vehicles, Section 1, Page 1-3. See Connecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**

TEST DRIVE VEHICLE

1. With the vehicle on a level surface, release the park brake and push the vehicle by hand. If brake drag exists, readjust cable tension and brakes. **See Brake Cable Equalization on page 6-11. See also Final Brake Cluster Adjustment on page 6-11.**
2. Pedal free play should be less than 1 inch (2.5 cm). If free play exceeds 1 inch (2.5 cm), check pedal group adjustment, and readjust cable tension and brakes. **See Brake Cable Equalization on page 6-11. See also Final Brake Cluster Adjustment on page 6-11. See following NOTE.**

NOTE: *Brake pedal free play is the distance the brake pedal can be pressed before the brake actuator arm (at the brake cluster) moves.*

3. Test drive vehicle. Be sure the brakes function properly. When brake pedal is fully pressed under moderate pressure, it should **not** go more than halfway to floor, and the vehicle should come to a smooth, straight stop. If the brake pedal goes more than halfway to the floor, or if the vehicle swerves or fails to stop, check pedal group adjustment, and readjust cable tension and brakes. **See Brake Cable Equalization on page 6-11. See also Final Brake Cluster Adjustment on page 6-11.** Brake adjustment must be maintained so the brake pedal cannot be pressed to the floor under any circumstance.

BRAKE CLUSTER REMOVAL AND INSTALLATION

See General Warning on page 1-1. See also WARNING on page 6-1.

REAR BRAKE CLUSTER REMOVAL

1. Place chocks at the front wheels, loosen the lug nuts on the rear wheels and lift the rear of the vehicle with a chain hoist or floor jack. Place jack stands under the axle tubes to support the vehicle.
2. Release park brake and loosen equalizer retaining nuts (1 and 5) on equalizer rod (2) to slightly loosen brake cable **(Figure 6-13, Page 6-7)**.
3. Remove the rear wheels and then the brake drums.
4. Remove the axle:
   4.1. Using 90° snap ring pliers, remove the axle retaining ring (1) **(Figure 6-2, Page 6-2)**.
   4.2. Pull the axle shaft (2) from the axle tube **(Figure 6-2, Page 6-2)**.
5. Remove cotter pin (17) and clevis pin (16) from brake cable **(Figure 6-17, Page 6-9 or Figure 6-18, Page 6-10)**.
6. Remove 4 bolts (20) and cone lock nuts (19) that mount the brake assembly to the transaxle **(Figure 6-17, Page 6-9 or Figure 6-18, Page 6-10)**.
7. Remove rear brake cluster assembly from transaxle.

REAR BRAKE CLUSTER INSTALLATION

1. Install in reverse order of disassembly. Use new bow-tie pins when installing brake cables. **See following CAUTION.**

⚠ CAUTION

- **Clean any residual oil from the exposed end of the axle shaft and from the oil seal area prior to installing the axle shaft.**

2. Be sure bolts (20) and new cone lock nuts (19) are used to mount the brake assembly **(Figure 6-17, Page 6-9 or Figure 6-18, Page 6-10)**.
3. Tighten bolts to 30 ft-lb (40 N·m). **See following WARNING.**

⚠ WARNING

- **Be sure retaining ring is properly seated in groove. If ring is not properly installed, axle assembly will separate from transaxle and damage axle assembly and other components. Loss of vehicle control could result in severe personal injury or death.**

4. Adjust brakes as previously described in this section for the appropriate vehicle. **See Brake Adjustment (Manually-Adjusted Brakes) on page 6-7.**

FRONT BRAKE CLUSTER REMOVAL

1. Place chocks at rear wheels, loosen lug nuts on front wheels, and lift the front of the vehicle with a chain hoist or floor jack. Place jack stands under the round tube crossmember of the frame to support vehicle.
2. Release park brake.
3. Loosen the equalizer retaining nuts (1 and 6) on the front equalizer rod (2) to slightly loosen the brake cable **(Figure 6-14, Page 6-7)**.
4. Remove the front wheels and then the brake drums.
5. Remove bow-tie pin (17) and clevis pin (16) from brake cable **(Figure 6-18, Page 6-10)**.
6. Remove dust cap (6) on hub and bearing assembly **(Figure 6-20, Page 6-14)**.
7. Remove cotter pin (5) and hex nut (7) from spindle shaft **(Figure 6-20, Page 6-14)**.

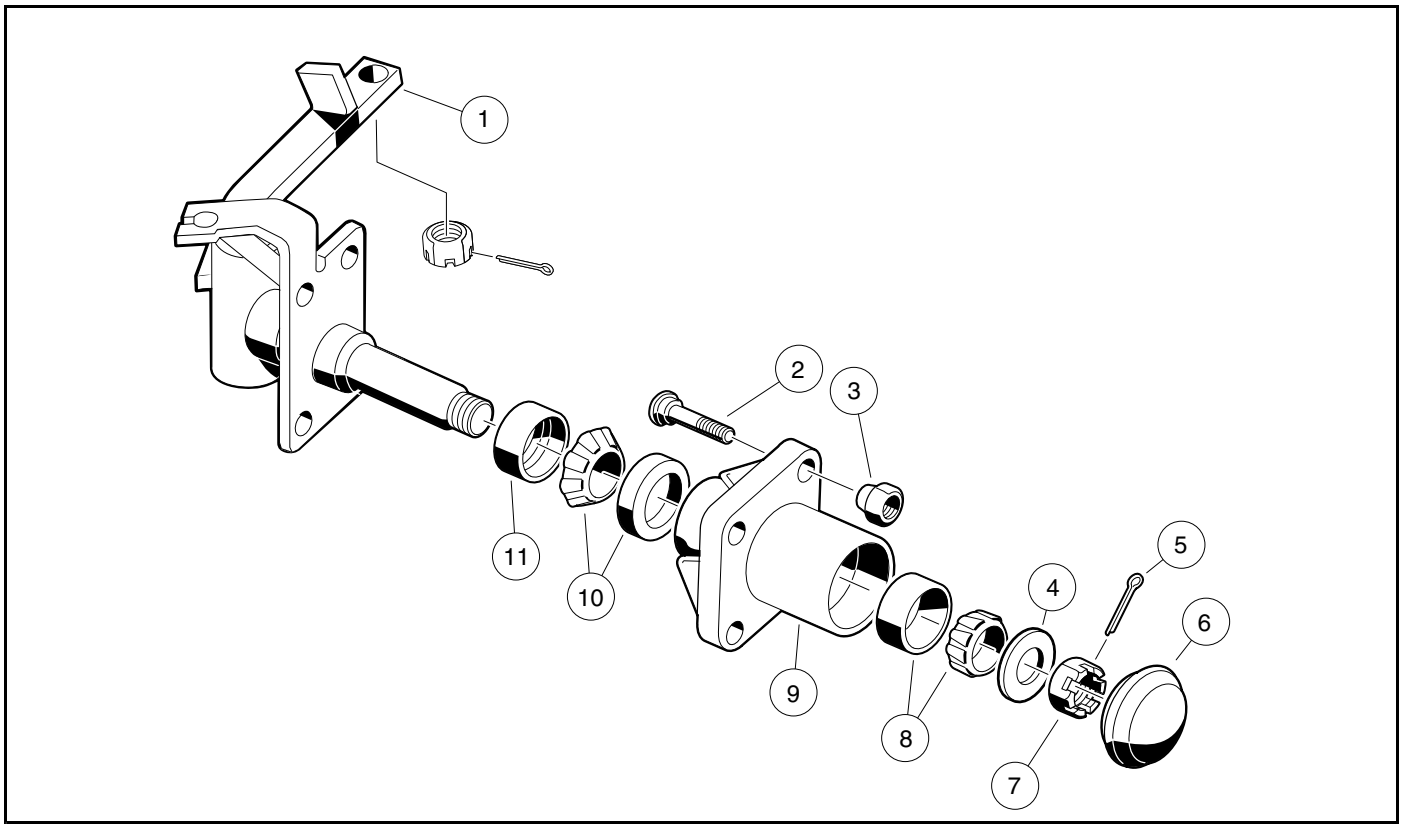


Figure 6-20 Front Spindle Assembly (Four-Wheel Brake Vehicles)

8. Remove hub and bearing assembly from spindle shaft. Remove four bolts (22), cone washers (21), lock washers (20) and hex nuts (19) that mount the brake assembly to the spindle **(Figure 6-18, Page 6-10)**.
9. Remove brake cluster assembly from spindle.

FRONT BRAKE CLUSTER INSTALLATION

1. Install in reverse order of removal. Use bolts (22), cone washers (21), lock washers (20) and hex nuts (19) to mount brake assembly **(Figure 6-18, Page 6-10)**.
2. Tighten bolts to 30 ft-lb (41 N·m). Adjust brakes as previously described in this section for the appropriate vehicle. Use new bow-tie pins when reconnecting brake cables.

FRONT BRAKE CABLES

See General Warning on page 1-1. See also WARNING on page 6-1.

FRONT BRAKE CABLE REMOVAL

1. Remove bow-tie pin (2) and clevis pin (3) from brake lever arm on front brake cluster **(Figure 6-21, Page 6-15)**.
2. Remove E-clip (1) from brake cable housing at the front spindle bracket and remove cable from spindle **(Figure 6-21, Page 6-15)**.

3. Remove cotter pin (9), clevis pin (10), and E-clip (8) from brake cable at equalizer (18) **(Figure 6-22, Page 6-16)**.
4. Remove bolt (4) and nut (6) from brake cable clamp (5) **(Figure 6-21, Page 6-15)**.
5. Remove cable from vehicle.

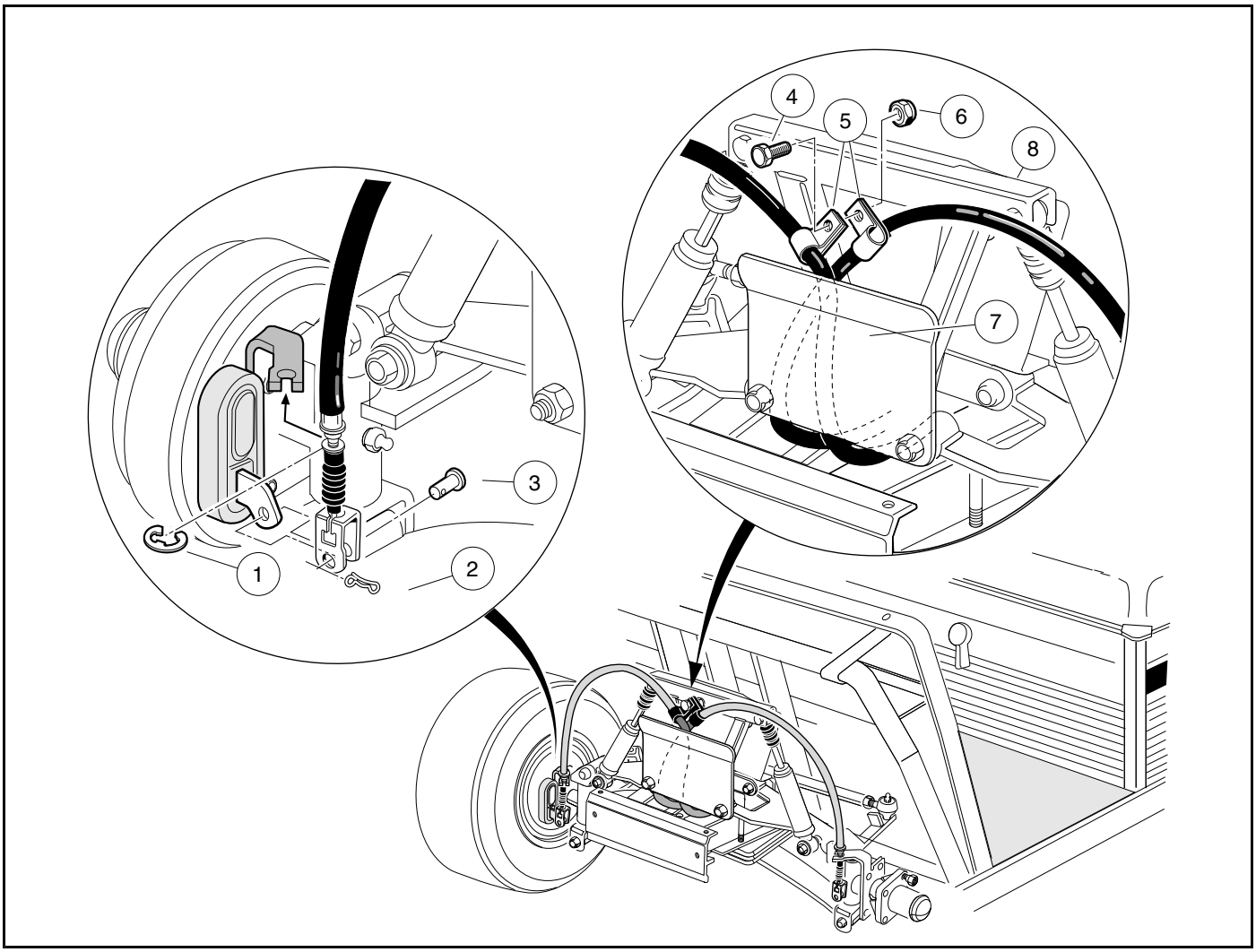


Figure 6-21 Front Brake Cables

FRONT BRAKE CABLE INSTALLATION

1. Place brake cable through frame mounting hole behind equalizer and install E-clip (8) on cable housing **(Figure 6-22, Page 6-16)**.

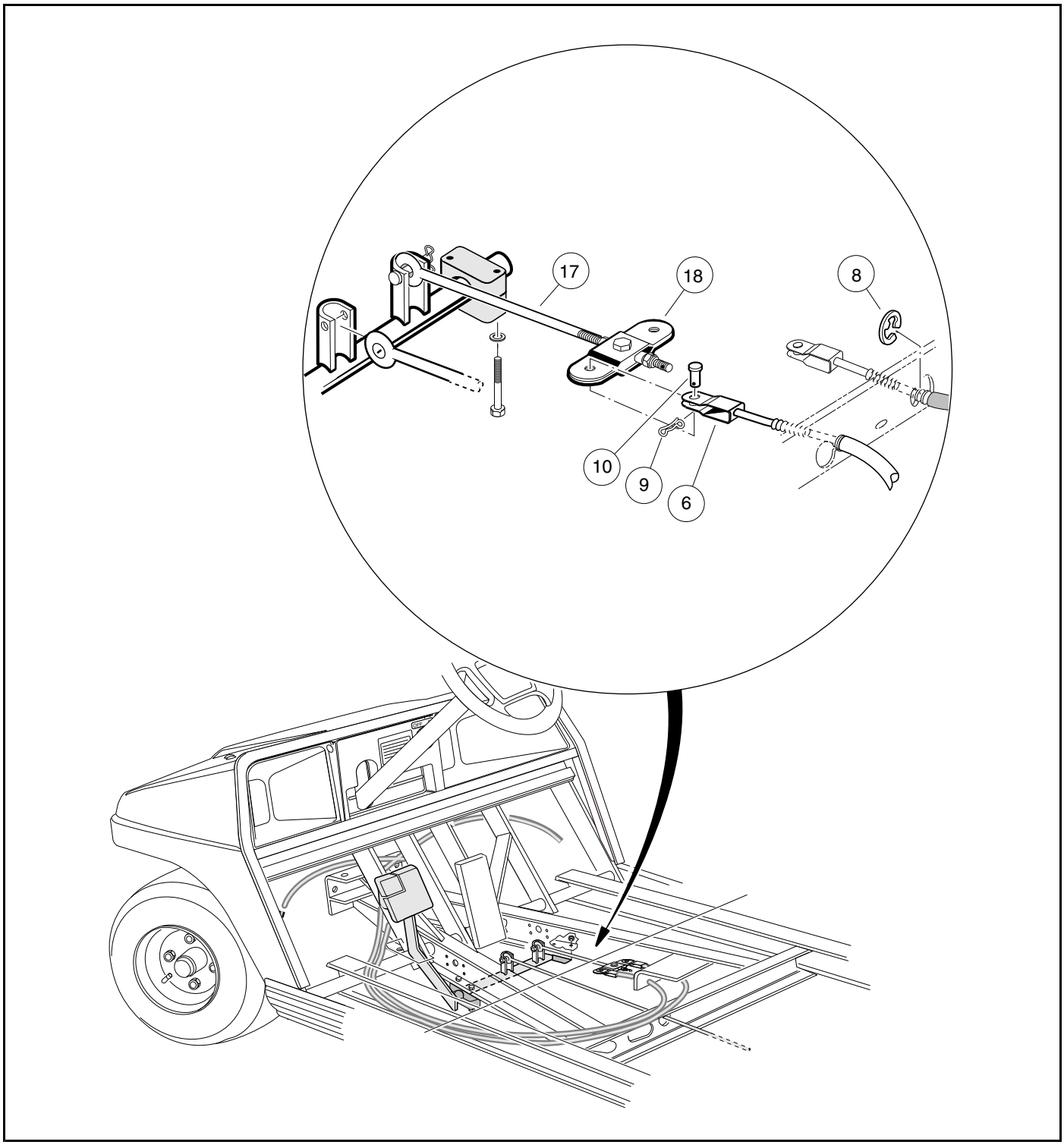


Figure 6-22 Brake Equalizer

2. Place brake cable clevis (6) on equalizer (18) and install the clevis pin (10) and new cotter pin (9).
3. Route cable towards the rear of vehicle and over to the driver-side I-beam and secure with wire ties so that the brake cable does not touch the brake equalizer **(Figure 6-23, Page 6-17)**.

NOTE: 77.5 in. (196.9 cm) and 78.5 in. (199.4 cm) wheelbase vehicles: *The cable should pass over the inside I-beam* ***(Figure 6-23, Page 6-17)****.*

4. Route cable along I-beam towards front of the vehicle and secure as shown **(Figure 6-23, Page 6-17)**.

NOTE: 77.5 in. (196.9 cm) and 78.5 in. (199.4 cm) wheelbase electric vehicles: *Route cable through hole in I-beam crossmember.*

5. Route brake cable between the shock support (8) and brake cable guide bracket (7) **(Figure 6-21, Page 6-15)**. Secure brake cable retainer clips (5) with a bolt (4) and nut (6).
6. Install brake cable through the front spindle brackets and install E-clip (1).
7. Install brake cable clevis onto brake lever arm and install clevis pin (3) and a new bow-tie pin (2).
8. Adjust brakes as described in this section for the appropriate vehicle.

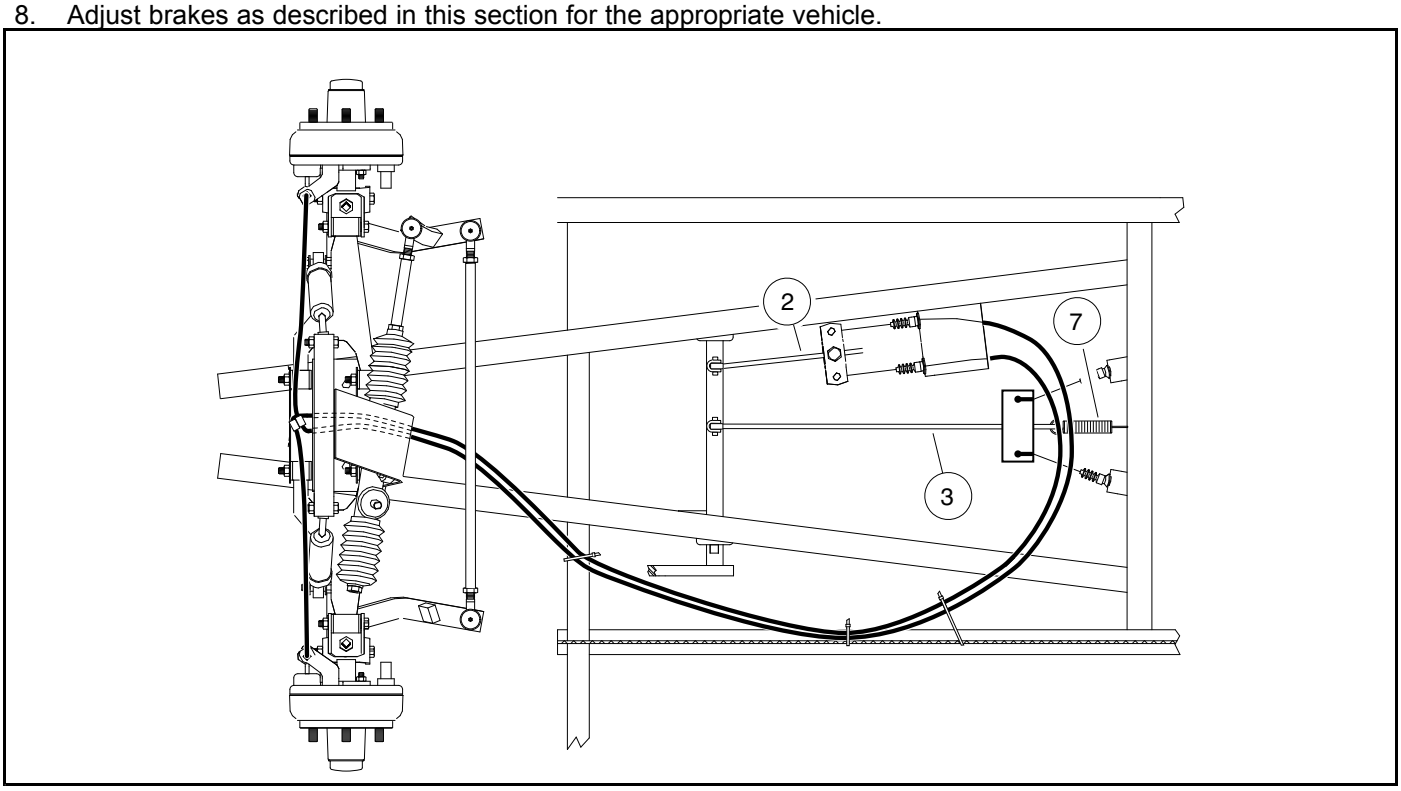


Figure 6-23 Front Brake Cable Routing

REAR BRAKE CABLES

See General Warning on page 1-1. See also Warning, on Page 6-1.

REAR BRAKE CABLE REMOVAL

1. Chock wheels to keep vehicle from unintentionally moving.
2. Release park brake if latched and loosen equalizer retaining nuts (1) on equalizer rod (2) to slightly loosen brake cables (3) **(Figure 6-24, Page 6-18)**.
3. Rotate brake cables upward and pull ends through holes in top of equalizer.
4. Disconnect brake cables at rear wheels.
   4.1. Remove bow-tie pins (1), clevis pins (2), and E-clips (3) **(Figure 6-25, Page 6-18)**.
   4.2. Remove cable (4) from cable support bracket (5).
   4.3. Note location of hangers (for installation of cables). Pull cables out of vehicle.

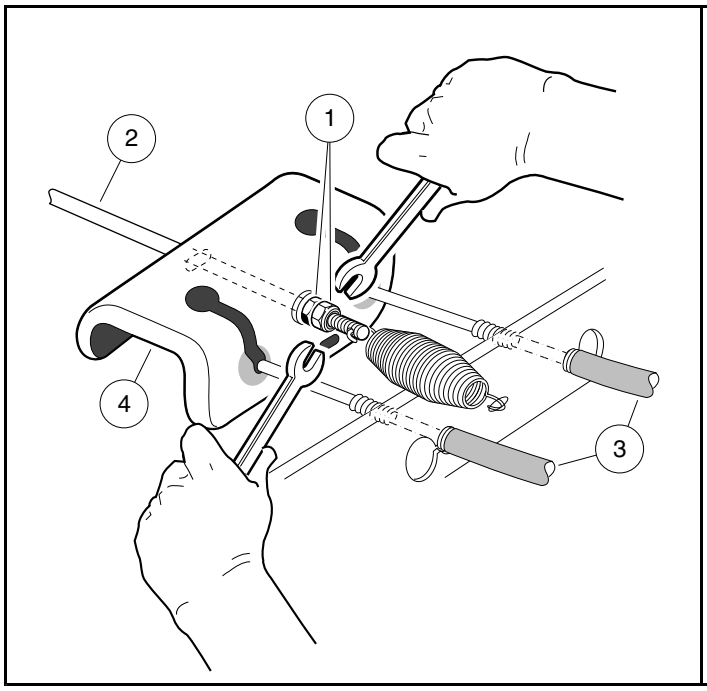


Figure 6-24 Loosen Equalizer Nut

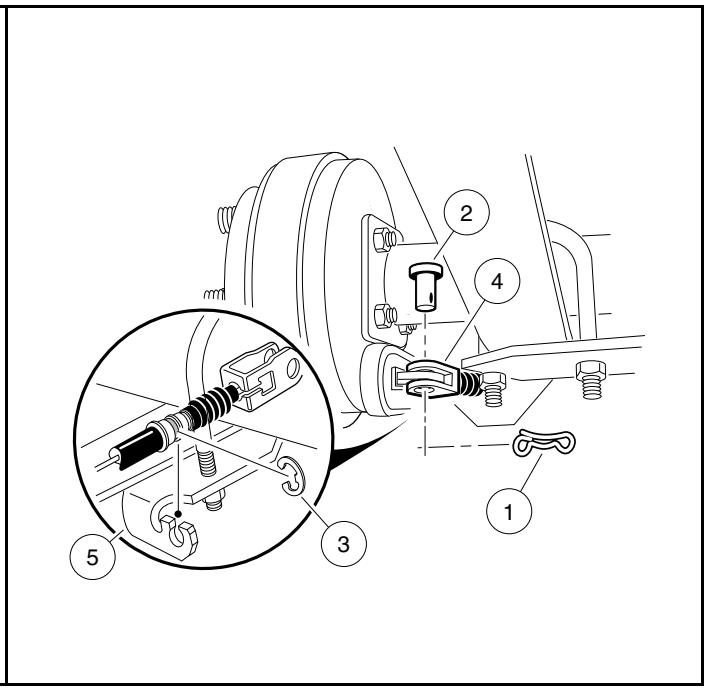


Figure 6-25 Disconnect Cables at Rear Brakes

REAR BRAKE CABLE INSTALLATION

1. Place the cable ends in the equalizer (4) **(Figure 6-24, Page 6-18)**. Route cables through hangers in the same manner as the ones removed.
2. At the rear wheel brakes, connect the cables to the brake actuator arms using clevis pins (2) and new bow-tie pins (1) **(Figure 6-25, Page 6-18)**.
3. Place cables in cable support bracket (5) and secure with E-clips.
4. Adjust brakes as described in this section for the appropriate vehicle.

⚠ DANGER

- **See General Warning on page 1-1.**

⚠ WARNING

- **See General Warning on page 1-1.**

GENERAL INFORMATION

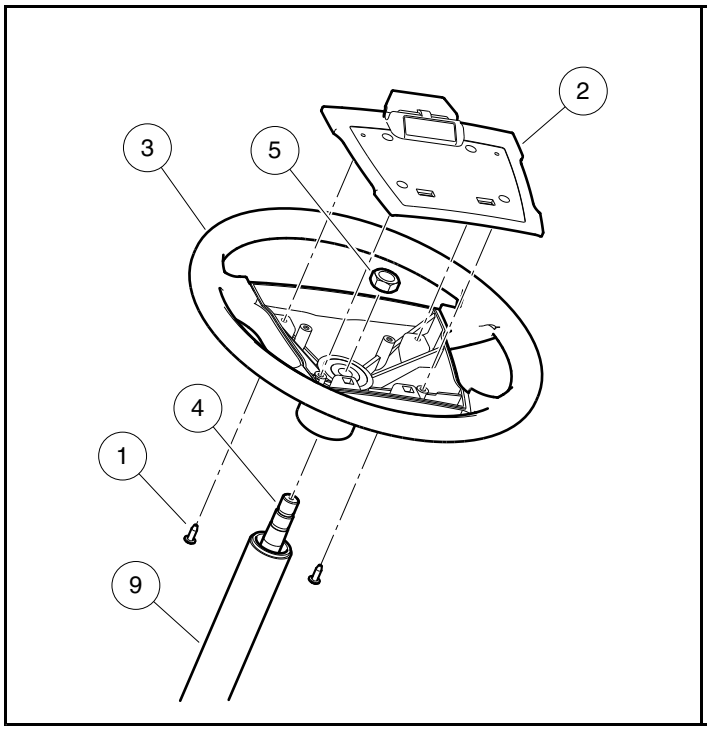
Steering is controlled through a rack and pinion steering assembly that is connected by a steering column to a steering wheel. No manual adjustment to the rack and pinion gear assembly is required. A spring loaded self-adjusting mechanism is incorporated into the assembly.

STEERING WHEEL

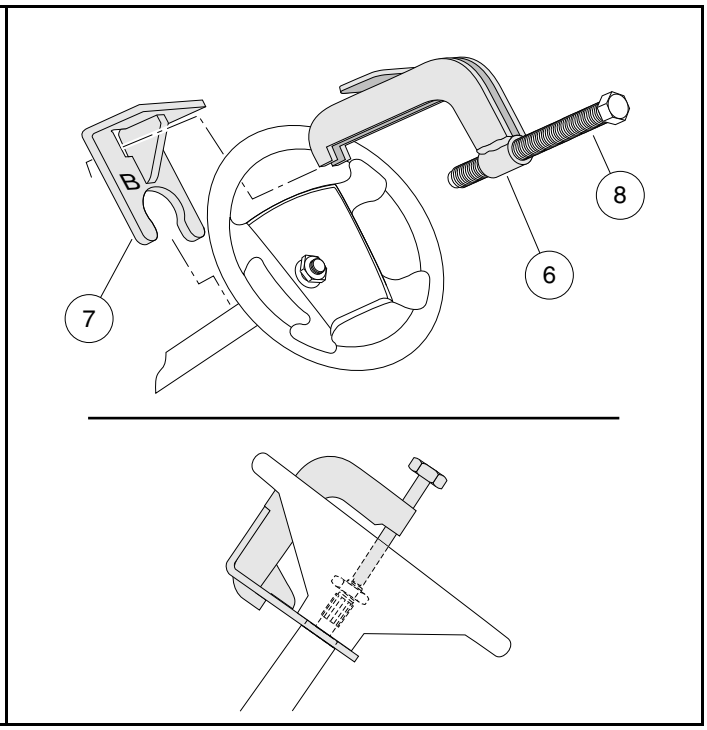
See General Warning on page 1-1.

STEERING WHEEL REMOVAL

1. Disconnect the battery cables and either discharge the controller or disconnect the spark plug wire(s). **See Disconnecting the Batteries – Electric Vehicles, Section 1, Page 1-4. See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
2. Remove the two mounting screws (1) and plate (2) **(Figure 7-1, Page 7-2)**.
3. Match mark the steering wheel (3) and steering column shaft (4) so when the steering wheel is removed it can be placed back in exactly the same position on steering column shaft.
4. Loosen the steering wheel nut (5) and back it off approximately 1/4 inch (6 mm). Do not remove the nut.
5. Use the steering wheel puller (CCI P/N 102061201) to remove steering wheel.
   5.1. Place the puller anvil (6) through the top opening of the steering wheel **(Figure 7-2, Page 7-2)**.
   5.2. Insert the anvil feet through the two slots in the base plate (marked “B”) (7) as shown.
   5.3. Rotate the anvil screw (8) clockwise until the base plate contacts the bottom of the steering wheel where it attaches to the steering column.
   5.4. Use a 1/2-inch drive air impact wrench to tighten the anvil screw (8) until the steering wheel breaks free from the steering shaft.
   5.5. Remove the steering wheel puller.
   5.6. Remove the steering wheel nut (5) and the steering wheel (3) from the steering column (9) **(Figure 7-1, Page 7-2)**.



1500-18300-10252
Figure 7-1 Steering Wheel Removal



1500-18300-10253
Figure 7-2 Steering Wheel Puller

STEERING WHEEL INSTALLATION

NOTE: *To minimize corrosion and to make future removal of the steering wheel easier, apply a small amount of oil or anti-seize compound to steering shaft splines and taper before installing the steering wheel.*

1. Install the steering wheel (3) on the splines of the steering shaft (4). Be sure to align the match marks placed on the wheel and steering column shaft in step 2 above **(Figure 7-1, Page 7-2)**.
2. Install the steering wheel nut (5) and tighten to 156 in-lb (17.6 N·m).
3. Install the plate (2) and screws (1) **(Figure 7-1, Page 7-2)**. Tighten screws to 16 in-lb (1.8 N·m).
4. Connect the battery cables. **See Connecting the Battery – Gasoline Vehicles, Section 1, Page 1-3. See Connecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**

STEERING COLUMN

See General Warning on page 1-1.

STEERING COLUMN REMOVAL

1. Remove the steering wheel as previously instructed.
2. Remove the front body. **See Front Body Removal on page 4-3.**

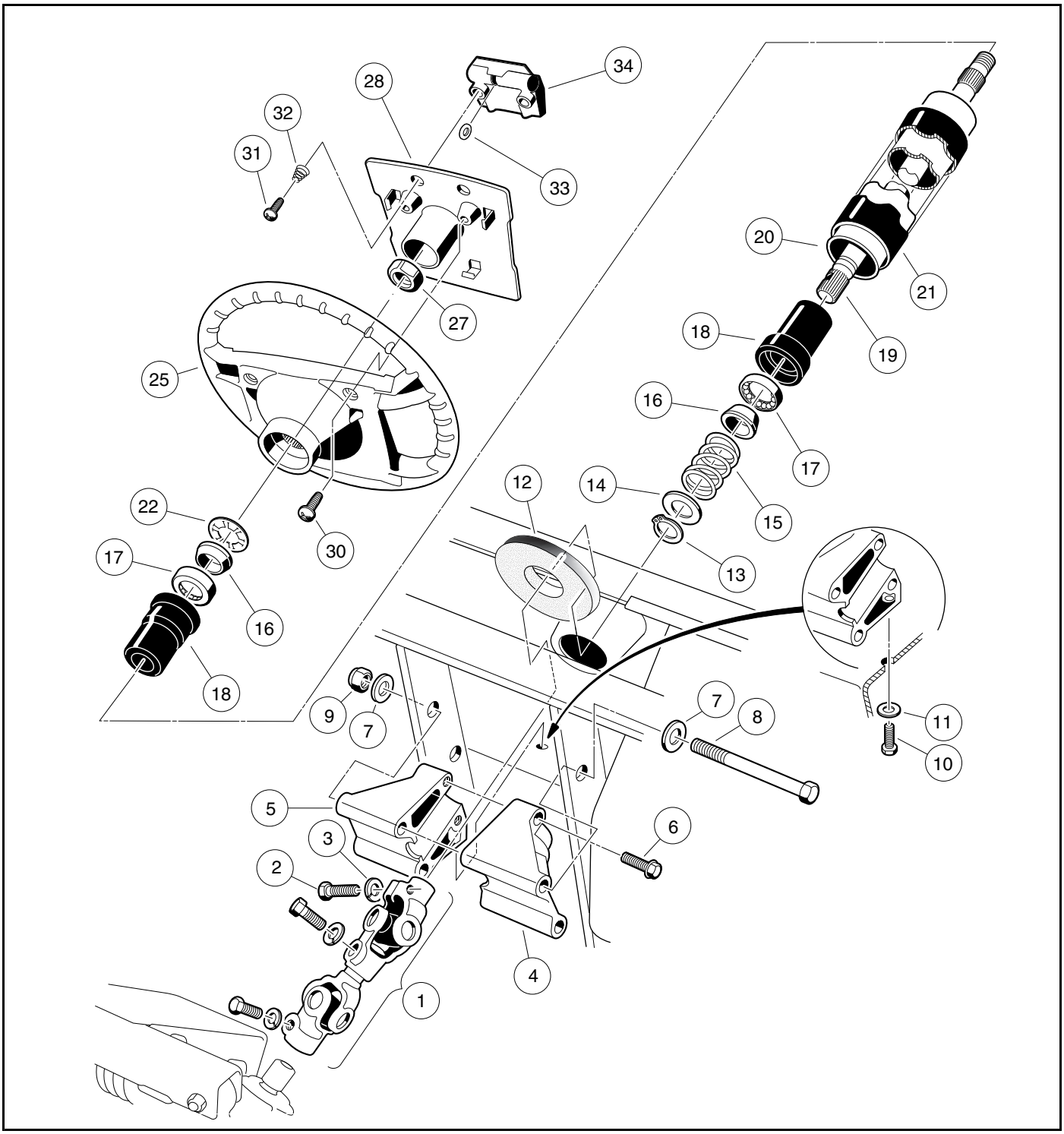


Figure 7-3 Steering Column

3. Remove the center dash panel. **See Key Switch Removal in the Electrical Components Section.**
4. Remove the driver-side dash pocket.
   4.1. Remove the flange lock screw from the top of the dash pocket.
   4.2. Drill out the two pop rivets holding the dash pocket in place.
   4.3. Slide dash pocket out of vehicle.

5. Remove the upper bolt (2) and lock washer (3) from the universal joint **(Figure 7-3, Page 7-3)**.
6. Remove the nuts (9), bolts (8 and 10), and washers (7 and 11) from the steering column mount (4 and 5) **(Figure 7-3, Page 7-3)**.
7. Remove the steering column from the vehicle.

STEERING COLUMN DISASSEMBLY

1. Remove bolts (6) and mounts (4 and 5) from steering column. Remove boot (12) **(Figure 7-3, Page 7-3)**.
2. While supporting steering column (20) on a workbench, remove snap ring (13) from shaft. **See following NOTE.**

NOTE: *Do not allow the steering shaft to slide out of the steering tube when removing the snap ring.*

3. Remove the washer (14), spring (15), and wedge (16).
4. Turn the steering column over and slide the shaft out of the tube to expose the retaining ring (22). Use pliers to twist the retaining ring (22) until it breaks off, then remove the wedge (16).
5. Remove the shaft (19) from the bottom of the tube (20).
6. Use steering shaft (19) to push bearing seat (18) out from the opposite end of the steering tube (20).
7. Insert a flat blade screwdriver between the bottom of the outer race of the bearing (17) and the bottom lip of the bearing seat (18) and remove the bearing (17). **See following NOTE.**

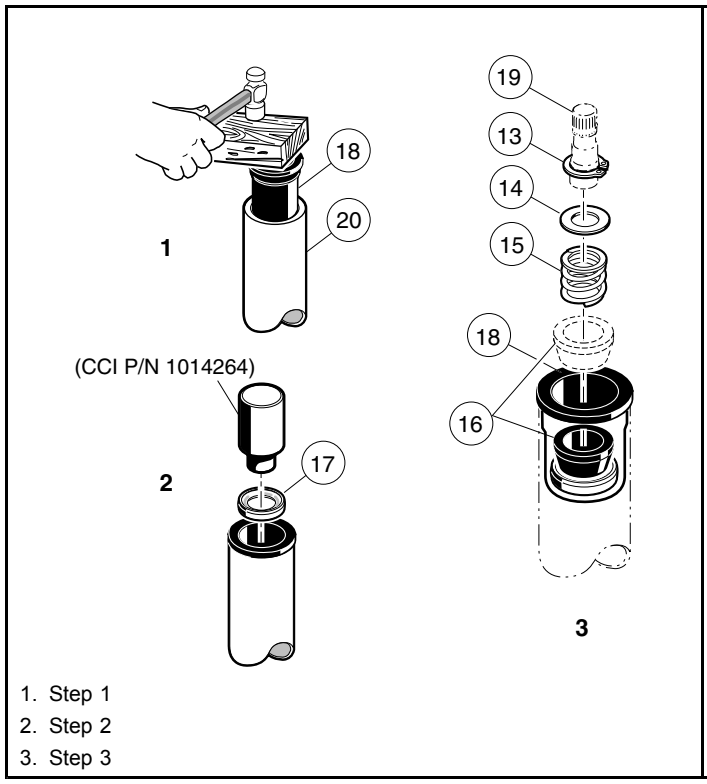
NOTE: *Use new retaining rings and bearings for reassembly.*

STEERING COLUMN ASSEMBLY

1. Insert bearing seat (18) into both ends of steering tube (20). Place a block of wood on bearing seat and tap lightly on block until bearing seat (18) is fully seated in steering tube (20) **(Figure 7-4, Page 7-5)**.
2. Press the bearing (17) all the way into the bearing seat (18) using a steering column bearing press tool (CCI P/N 1014264) or a metal tube approximately six inches (15.2 cm) long with a maximum outer diameter of 1-3/16 inches (3.3 cm) and a minimum inside diameter of 7/8 inch (2.2 cm). Be sure the bearing is installed in the bearing seat as shown **(Figure 7-4, Page 7-5)** so the wedge (16) will ride against the inner race of the bearing.
3. Install the wedge (16), spring (15), washer (14), and snap ring (13) onto the bottom end of the steering shaft (19) **(Figure 7-4, Page 7-5)**.
4. Insert the shaft (19) from the bottom of the steering tube (20) **(Figure 7-3, Page 7-3)**.
5. Turn the assembly over and place the shaft (19) on a bench. Install the wedge (16) and retaining ring (22) onto the top of the shaft. Be sure the prongs on the retaining ring face up and away from the wedge. Use a steering column retaining ring tool (CCI P/N 1014259) to seat the retaining ring to the proper depth. Support end of tube while pressing. If you do not have the recommended tool, use the same tube as was used in step 2 to press the retaining ring onto the top of the shaft. The retaining ring should be pressed onto the shaft until 2 to 2-1/8 inches (5.1-5.4 cm) of the shaft extends from the top of the bearing seat in the steering tube **(Figure 7-5, Page 7-5)**.

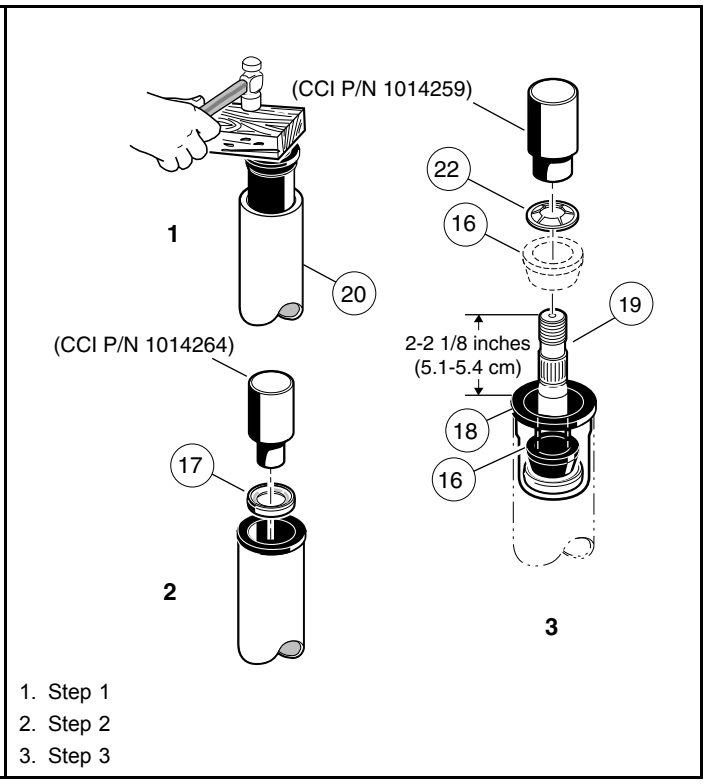
STEERING COLUMN INSTALLATION

1. Install boot (12). Reinstall mount (4 and 5) onto the end of the steering column. Tighten bolts (6) to 20 ft-lb (27 N·m) **(Figure 7-3, Page 7-3)**.
2. For ease of assembly and to prevent corrosion, apply a light coat of anti-seize or lubricating compound to both splined ends of the steering shaft.



1. Step 1
2. Step 2
3. Step 3

Figure 7-4 Steering Shaft – Bottom End



1. Step 1
2. Step 2
3. Step 3

Figure 7-5 Steering Shaft – Top End

3. Position the steering column assembly in the vehicle while inserting the steering column shaft into the upper universal joint (1). The flat portion of the steering shaft spline (19) must be aligned with the bolt hole in the universal joint (1) before sliding the spline into the universal joint. While holding the steering column in place, attach it to the frame using bolts (8), washers (7), and nuts (9) **(Figure 7-3, Page 7-3)**. Thread the nuts onto the bolts but do not tighten them.
4. Install washer (11) and screw (10). Tighten to 20 ft-lb (27 N·m) **(Figure 7-3, Page 7-3)**.
5. Install the bolt (2) and lock washer (3) on the upper universal joint and finger-tighten.
6. Tighten the two nuts (9) and bolts (8) to 18 ft-lb (24.4 N·m) **(Figure 7-3, Page 7-3)**.
7. Tighten the bolt (2) on the upper universal joint to 15 ft-lb (20 N·m) **(Figure 7-3, Page 7-3)**.
8. Check the other two bolts of the universal joint (1) to ensure that they are properly tightened to 15 ft-lb (20 N·m) **(Figure 7-3, Page 7-3)**.
9. Reinstall dash pocket and related hardware.
10. Reinstall center dash panel in reverse order of disassembly. Make sure the key switch terminals do not touch the frame and the center dash panel is properly seated and snapped into place.
11. Install front body and bumper. **See Front Body Installation on page 4-4.**
12. Connect the battery cables. **See Connecting the Battery – Gasoline Vehicles, Section 1, Page 1-3. See Connecting the Batteries – Electric Vehicles, Section 1, Page 1-4.**

STEERING ADJUSTMENT

See General Warning on page 1-1.

1. Turn the steering wheel all the way to the right. Note the distance between the passenger side spindle stop (2) and passenger side A-plate (3) **(Figure 7-6, Page 7-7)**. The internal stop on the rack must reach its limit of travel

against rack and pinion housing at exactly the same time the spindle stops against the passenger side A-plate (with vehicle wheels turned to the right). If simultaneous contact occurs, steering is in correct adjustment; proceed to step 4. If simultaneous contact does not occur, proceed to step 2.

2. Loosen the nuts (27 and 29) and turn the drag link (28) **(Figure 7-11, Page 7-9)** to adjust the drag link rod. Adjust the link rod with the steering wheel turned all the way to the right, so the passenger side spindle stop lightly touches the passenger side A-plate. The internal stop on the rack must reach its limit of travel at the same time the spindle stops against the passenger side A-plate (with vehicle wheels turned to the right). **See following CAUTION.**

CAUTION

- **The drag link has both left and right-hand threads. The end of the drag link toward the spindle has left-hand threads, and the end toward the rack has right-hand threads. To prevent damage to threaded parts, care should be taken when servicing the drag link.**

3. When all adjustments have been completed, tighten the nuts (27 and 29) on the drag link assembly with an open end wrench. Tighten nuts to 21 ft-lb (28.4 N·m) **(Figure 7-11, Page 7-9)**.**See following CAUTION.**

CAUTION

- **When tightening the nuts (27 and 29), make sure the drag link (28) does not turn (Figure 7-11, Page 7-9).**

4. Straighten wheels and turn steering wheel from lock to lock. Wheels should turn smoothly and easily. If steering wheel does not turn smoothly and easily, inspect steering assemblies as follows:
   – ball joints (23) **(Figure 7-11, Page 7-9)** and (6 and 13) **(Figure 7-20, Page 7-17)**
   – spindle bushings (3 and 4) **(Figure 7-21, Page 7-18)**
   – wave washers (20) **(Figure 7-21, Page 7-18)**
   – rack assembly (17) **(Figure 7-11, Page 7-9)**
5. Also inspect front suspension assemblies as follows:
   – A-plates (1) **(Figure 7-20, Page 7-17)**
   – urethane bushings (2) **(Figure 7-20, Page 7-17)**
   – leaf springs (6) **(Figure 7-21, Page 7-18)**
6. Replace components as necessary.

RACK AND PINION

See General Warning on page 1-1.

RACK AND PINION REMOVAL

1. Remove the front body. **See Front Body on page 4-3.**
2. Remove the cotter pin (22) and ball joint retaining nut (25) **(Figure 7-11, Page 7-9)**.
3. Using a ball joint removal tool **(Figure 7-7, Page 7-7)**, remove the ball joint (23) **(Figure 7-11, Page 7-9)** from the spindle assembly.

4. Remove the bolts (30), washers (31), and lock nuts (32) from the steering rack assembly mounting bracket **(Figure 7-11, Page 7-9)**.
5. Remove the bolt (2) and flat washer (3) on the upper universal joint, then remove the rack assembly and universal joint from the vehicle **(Figure 7-3, Page 7-3)** .

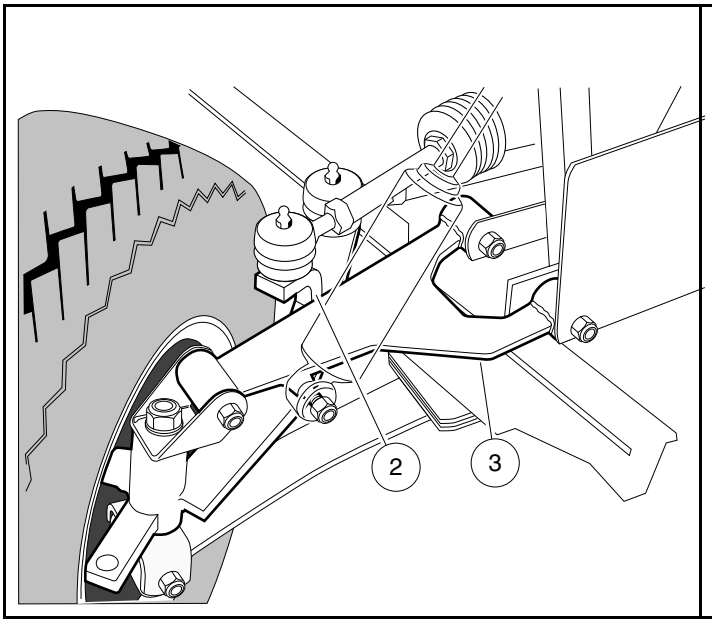


Figure 7-6 Adjust Steering Alignment

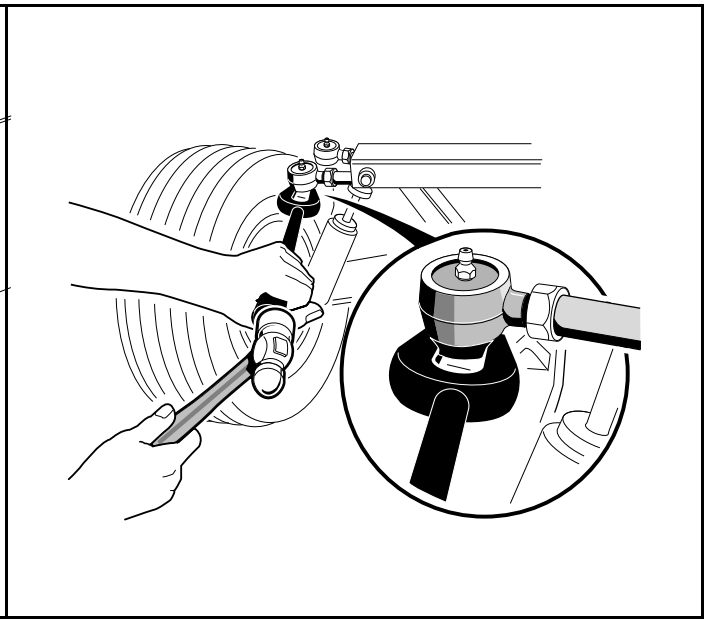


Figure 7-7 Ball Joint Tool

RACK AND PINION DISASSEMBLY

CAUTION

- **The ball joint (23) (Figure 7-11, Page 7-9) has left-hand threads.**

1. Remove ball joint from the spindle and inspect it for excessive wear **(Figure 7-7, Page 7-7)**.
2. Remove the drag link (28) **(Figure 7-11, Page 7-9)**.
3. Remove both bellows clamps (2) (plastic wire ties).
4. Remove the hex nut (29) and slide off the dust seal bellows (1).
5. Remove the retaining ring (21), then slide off dust seal bellows (20).
6. Remove the rack screw lock nut (15), rack guide screw (16), rack guide pressure spring (14), and the rack guide (13) **(Figure 7-11, Page 7-9)**.
7. Remove the universal joint assembly from the pinion (8) by fully removing the bolt and then sliding off the universal joint.

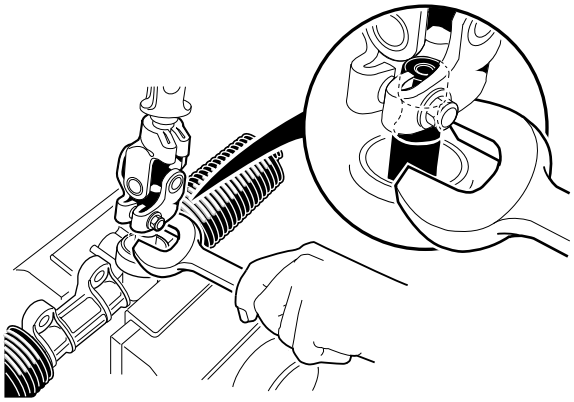
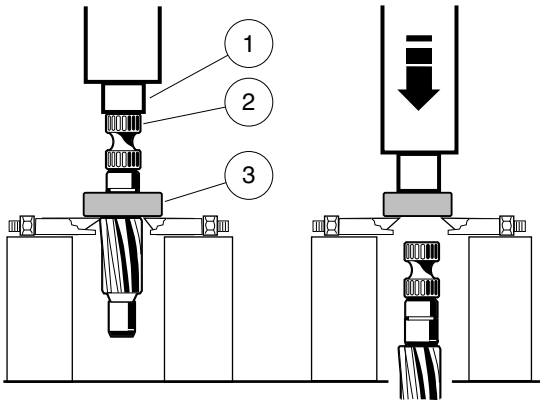


Figure 7-8 Remove Pinion from Housing



1. Press Ram 2. Pinion Gear 3. Bearing

Figure 7-9 Remove Bearing from Pinion

8. If necessary, remove the dust seal (12). **See following NOTE.**

NOTE: *If the dust seal (12) is removed, replace with a new one.*

9. Use snap ring pliers to remove the internal snap ring (11) **(Figure 7-11, Page 7-9)**.
10. Install the universal joint onto the pinion and place a large open end wrench under the universal joint **(Figure 7-8, Page 7-8)**. Use the wrench as a lever to pull the pinion from the housing.
11. If the ball bearing (9) has been damaged, remove the external snap ring (10) **(Figure 7-11, Page 7-9)** and press the bearing off **(Figure 7-9, Page 7-8)**.
12. Remove retaining ring (19) and stop washer (18), then remove rack (17) from housing (6) **(Figure 7-11, Page 7-9)**.
13. If the inner ball joint (3) is excessively worn, remove the ball joint and tab washer (4) from the rack **(Figure 7-10, Page 7-8)**.
    13.1. Secure the rack in a vise using wood blocks (5) between the rack and the jaws of the vise to protect the rack from damage **(Figure 7-10, Page 7-8)**.
    13.2. Loosen and remove the inner ball joint with a wrench.

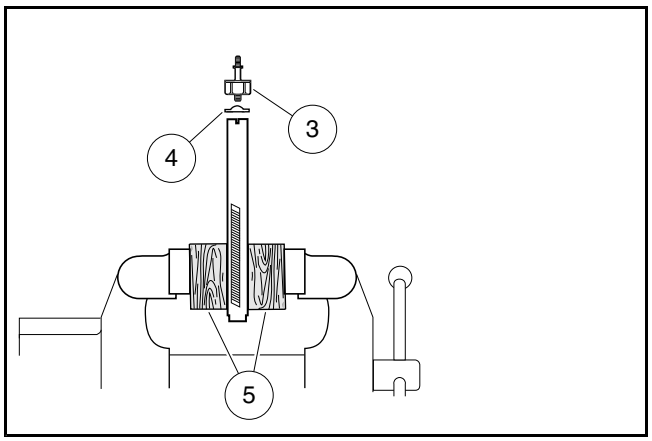


Figure 7-10 Secure Rack in Vise

14. Inspect the bushing (5) for excessive wear. If wear is excessive, replace the steering box assembly (CCI P/N 101878302) **(Figure 7-11, Page 7-9)**.

RACK AND PINION ASSEMBLY

1. Install a new tab washer (4) and an inner ball joint (3) **(Figure 7-10, Page 7-8)**. Install the ball joint onto the rack by securing the rack in a vise using wood blocks between the rack and the jaws of the vise to protect the rack from damage. Tighten the ball joint to 60 ft-lb (81 N·m).
2. Bend the edges of the tab washer (4) up against the ball joint (3) **(Figure 7-10, Page 7-8)**.
3. Apply a light coating of EP grease to the teeth of the rack (17), then slide the rack through the bushing (5) and housing (6). Install the stop washer (18) and retaining ring (19) to the end of the rack **(Figure 7-11, Page 7-9)**.

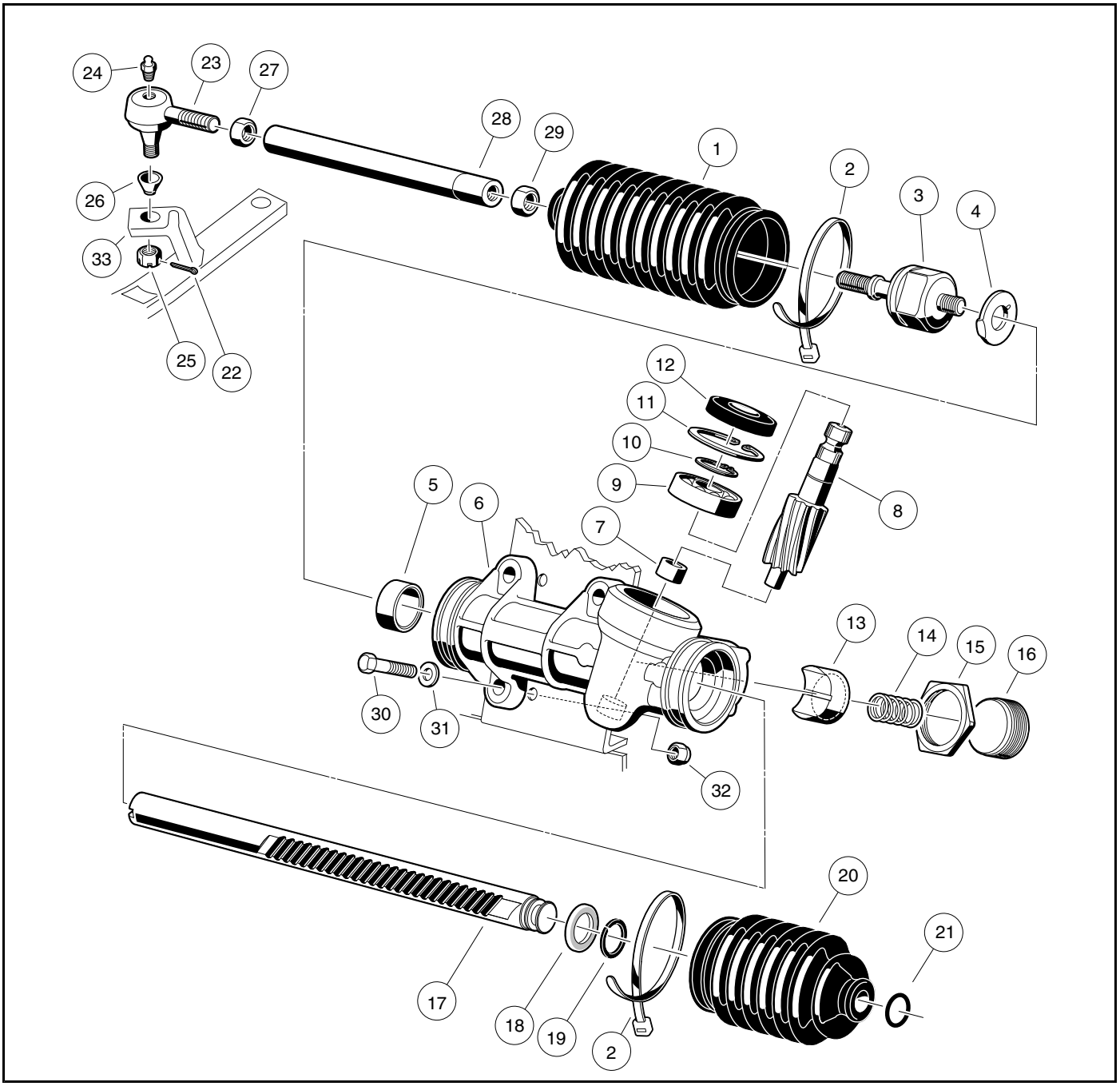


Figure 7-11 Steering Gear

CAUTION

- **In step 4, do not press against the outer race of the bearing.**

4. If the bearing (9) was removed, press on a new bearing, exerting all pressure on the inner race (grease the bearing before installing it). Then install the external snap ring (10) **(Figure 7-11, Page 7-9)**. **See preceding CAUTION.**
5. If the needle bearing (7) is damaged, the steering box assembly (CCI P/N 101878302) must be replaced **(Figure 7-11, Page 7-9)**.
6. Install pinion (8) and bearing (9) assembly into the housing (6) **(Figure 7-11, Page 7-9)**. Make sure the rack gear teeth will mesh with the gear teeth on the pinion. The rack may need to be rotated slightly while lightly tapping on 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.**

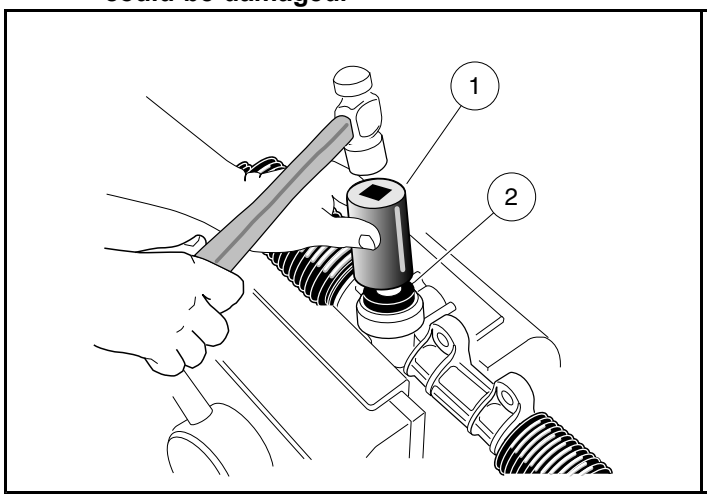


Figure 7-12 Press In Dust Seal

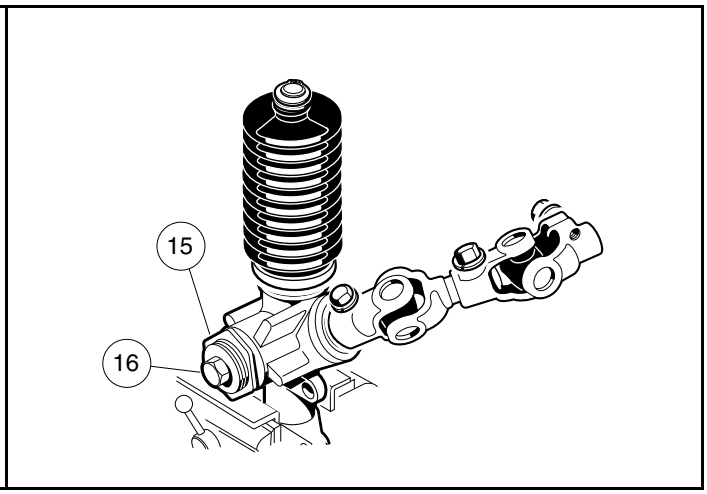


Figure 7-13 Rack and Pinion Adjustment

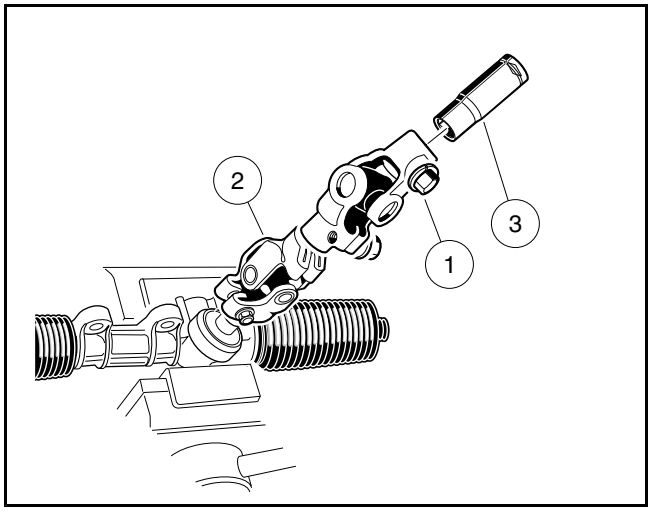


Figure 7-14 Rack and Pinion Resistance

7. Install the internal snap ring (11) **(Figure 7-11, Page 7-9)**.
8. Using an appropriate size deep well socket (1) to apply pressure evenly, press in a new dust seal (2) **(Figure 7-12, Page 7-10)**.

9. Apply a small amount of grease to the rack guide (13) where it comes into contact with the rack (17) **(Figure 7-11, Page 7-9)**.
10. Place a few drops of Loctite® 222 to the threads of the screw (16) **(Figure 7-11, Page 7-9)**.
11. Install the rack guide (13), pressure spring (14), and screw (16). The screw should be threaded in until a rotational torque of 10 in-lb (1.13 N·m) is achieved **(Figure 7-11, Page 7-9)**.
    11.1. Reposition the rack and pinion in a vise.
    11.2. Insert a 3/8-inch deep well socket (3) into the steering column end of the universal joint (2) and tighten the bolt (1) to 15 ft-lb (20.3 N·m) **(Figure 7-14, Page 7-10)**.
    11.3. Use a torque wrench connected to the 3/8-inch deep well socket (3) to measure the resistance of the rack and pinion. Rotational resistance should measure 7 to 15 in-lb (0.8 to 1.7 N·m).
    11.4. If measured resistance does not equal 7 to 15 in-lb, loosen the lock nut (15) and tighten the screw (16) until it bottoms out, then back the screw off one quarter turn. Tighten the lock nut to 28 ft-lb (38 N·m) **(Figure 7-13, Page 7-10)**. **See following NOTE.**

NOTE: *When tightening the lock nut (15) make sure the screw (16) does not change adjustment* ***(Figure 7-13, Page 7-10)***.

12. Install the dust seal bellows (20) and retaining ring (21) **(Figure 7-11, Page 7-9)**.
13. Install the dust seal bellows (1) and hex nut (29) **(Figure 7-11, Page 7-9)**.
14. Install the universal joint on the pinion. Tighten the bolt to 15 ft-lb (20 N·m).
15. Install new bellows clamps (wire ties) (2) **(Figure 7-11, Page 7-9)**.
16. Install the drag link (28) by fully threading the ground end into the inner ball joint (3). **See following CAUTION.**

CAUTION

- **The ball joint (23) (Figure 7-11, Page 7-9) has left-hand threads.**
- **The tie rod and drag link have right-hand threads on one end and left-hand threads on the other end. Right-hand threads are identified by a groove in the tie rod or drag link.**

17. Install the ball joint (23) **(Figure 7-11, Page 7-9)**. **See preceding CAUTION.**

RACK AND PINION INSTALLATION

1. Position the steering gear box assembly on the shock and gear support and install the bolts (30), washers (31), and nuts (32). Do not tighten the mounting bolts **(Figure 7-11, Page 7-9)**.
2. For ease of assembly and to prevent corrosion, apply a light coat of anti-seize and lubricating compound to the splined end of the steering column shaft.
3. Align the flat portion of the steering shaft spline with the bolt hole in the universal joint and then slide the shaft into the upper universal joint. Install the bolt and lock washer on the upper universal joint and tighten it to 15 ft-lb (20 N·m).
4. Tighten the steering rack mounting bolts (30) to 22 ft-lb (29.8 N·m) **(Figure 7-11, Page 7-9)**.
5. Adjust the steering. **See Steering Adjustment on page 7-5.**

TIE ROD AND DRAG LINK

See General Warning on page 1-1.

TIE ROD AND DRAG LINK REMOVAL

1. Using locking pliers to hold tie rod and drag link, loosen jam nuts (7 and 12) on tie rod ball joints **(Figure 7-20, Page 7-17)**and loosen jam nuts (27 and 29) on the drag link **(Figure 7-11, Page 7-9)**.
2. Remove the cotter pins (22) and ball joint retaining nuts (20) **(Figure 7-20, Page 7-17)**.
3. Use a ball joint removal tool to remove ball joints (13 and 6) **(Figure 7-20, Page 7-17)** and (23) **(Figure 7-11, Page 7-9)** from the spindles.
4. Remove the ball joints from the tie rod (11) **(Figure 7-20, Page 7-17)**.
5. Remove drag link (28) from inner ball joint assembly (3) and drag link ball joint (23) **(Figure 7-11, Page 7-9)**.

TIE ROD AND DRAG LINK INSTALLATION

1. Thread ball joints (6 and 13) into tie rod (11) to a depth of 1/2-inch (12.5 mm) **(Figure 7-20, Page 7-17)**. **See following WARNING and CAUTION.**

⚠ WARNING

- **The ball joints must be threaded into the rod at least 5/16 of an inch (8 mm). Failure to thread ball joints in deep enough may cause a ball joint to separate from the rod during adjustment or while being operated, possibly resulting in loss of vehicle control and severe personal injury.**

CAUTION

- **The tie rod and drag link have right-hand threads on one end and left-hand threads on the other end. Right-hand threads are identified by a groove in the tie rod or drag link.**

2. Install ball joint ends (6 and 13) into the left and right-hand spindle arms (23), then install the retaining nuts (20) and cotter pins (22) **(Figure 7-20, Page 7-17)**.
3. Thread the drag link rod (28) all the way onto the threaded stud of the inner ball joint assembly (3) (right-hand threads) **(Figure 7-11, Page 7-9)**.
4. Thread the ball joint (23) into the drag link rod (28) (left-hand threads) to full thread depth **(Figure 7-11, Page 7-9)**.
5. Install the ball joint (23) on the spindle arm riser (33), then install the retaining nut and a new cotter pin (22) **(Figure 7-11, Page 7-9)**. Tighten nut to 18 ft-lb (2.0 N·m).
6. Adjust camber and toe-in. **See** Camber Adjustment on page 7-13 and Toe-in Adjustment on page 7-14.
7. Adjust steering. **See Steering Adjustment on page 7-5.**

FRONT SUSPENSION

See General Warning on page 1-1.

LUBRICATION

Five grease fittings are provided (one in each spindle housing, one in the ball joint on each end of the tie rod, and one in the ball joint of the steering drag link). Lubricate these fittings at the recommended interval with the proper lubricant. **See Periodic Lubrication Schedules on page 10-6.**

CAUTION

- **To ensure proper lubrication of the front suspension and steering linkages, raise front of vehicle to lubricate. See General Warning on page 1-1.**

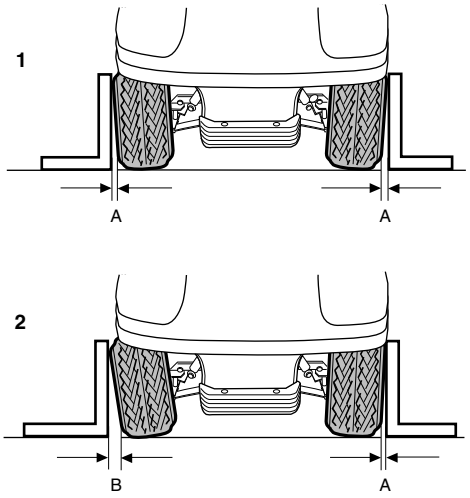
WHEEL ALIGNMENT

Wheel alignment is limited to equalizing the camber angle of each front wheel and adjusting toe-in of the front wheels. There is also a drag link adjustment to equalize the turning radius in both directions. **See Steering Adjustment on page 7-5. See following NOTE.**

NOTE: *Prior to making any front suspension adjustments, inspect components for wear and damage and repair or replace as necessary.*

Camber Adjustment

1. Check each front wheel with a framing square. At the floor (or ground), there should be an equal amount of space between each tire and the framing square **(Figure 7-15, Page 7-13)**.
2. Loosen, but do not remove, the four nuts (32) that secure the leaf spring (6) to the bottom spring plate (29) **(Figure 7-21, Page 7-18)**. **See also Figure 7-16, Page 7-13.**



1. Proper Camber Adjustment 2. Improper Camber Adjustment

Figure 7-15 Check Camber

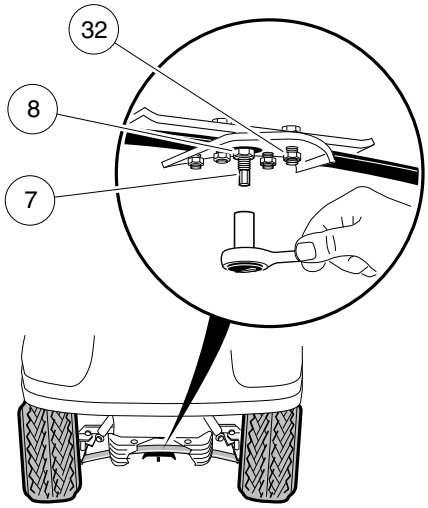


Figure 7-16 Adjust Camber

3. Loosen, but do not remove, the hex nut (8) on the adjustment eccentric (7) **(Figure 7-21, Page 7-18)** in the center of the spring. **See also Figure 7-16, Page 7-13.**
4. Use a 7 mm deep well socket to rotate the eccentric **(Figure 7-16, Page 7-13)**.
5. After adjusting camber, tighten the four spring retaining nuts (32) **(Figure 7-21, Page 7-18)** to 23 ft-lb (31 N·m). Then roll the vehicle forward one full tire revolution and recheck the camber. **See also Figure 7-15, Page 7-13.**
6. Tighten the hex nut (8) on the adjustment eccentric (7) to 120 in-lb (13.5 N·m) **(Figure 7-21, Page 7-18)**. **See also Figure 7-16, Page 7-13.**

Toe-in Adjustment

1. On a level surface, roll the vehicle forward, then stop. Make sure the front wheels are pointed straight ahead. Do not turn the steering wheel again during this procedure.
2. On each front tire, mark (as closely as possible) the center of the tread face that is oriented toward the rear of the vehicle. The marks should be even with the bottom surfaces of the vehicle frame I-beams.
3. Measure the distance between the marks on the rear-facing surfaces of the tires, and then roll the vehicle **forward** one and one-half wheel revolutions until the marks appear on the forward facing surfaces of the tires at about the same height from the floor **(Figure 7-17, Page 7-14)**.

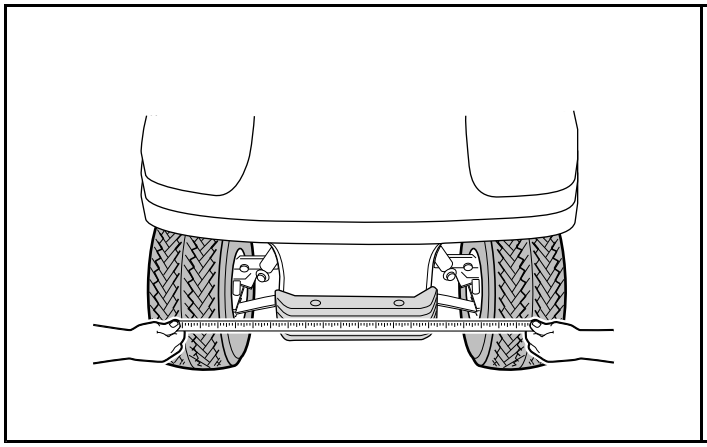


Figure 7-17 Check Toe-In

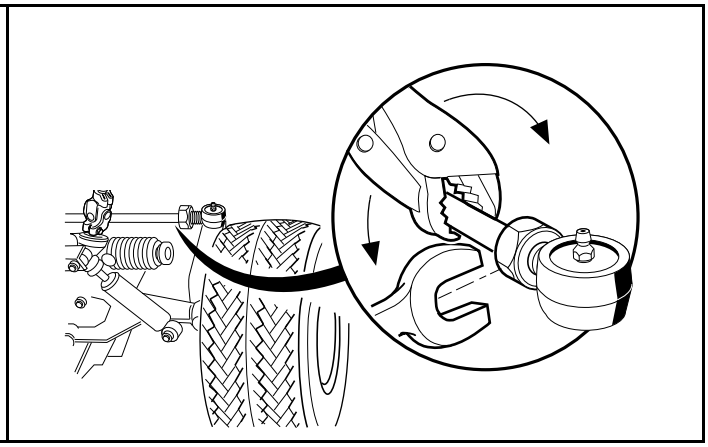


Figure 7-18 Adjust Toe-In

4. Measure the distance between the marks on the forward-facing surfaces of the tires. **See following NOTE.**

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

5. Subtract the measurement on the front of the tires from the measurement on the rear of the tires. The difference is the toe-in. Proper toe-in is 1/8 to 3/8 of an inch (3.2 to 9.5 mm).
6. If adjustment is necessary, loosen the jam nut on each tie rod ball joint and rotate the tie rod to increase or decrease toe-in **(Figure 7-18, Page 7-14)**. **See following CAUTION.**

CAUTION

- **The tie rod has right-hand threads on one end and left-hand threads on the other end. Right-hand threads are identified by a groove in the tie rod.**

7. Tighten nuts (loosened in step 6) to 21 ft-lb (28 N·m) and recheck toe-in.
8. After toe-in adjustment is made and with wheels in the straight ahead position, the steering wheel should be at the center of its travel. There should be equal travel to the left and right. **See following NOTE.**

NOTE: *If the minimum turning radius is not the same for both left and right turns, adjust the steering.* ***See Steering Adjustment on page 7-5.***

FRONT SUSPENSION COMPONENTS

See General Warning on page 1-1.

LEAF SPRING REMOVAL

1. Loosen lug nuts on both front wheels and raise front of vehicle with a chain hoist or floor jack. Place jack stands under the front cross tube of the vehicle frame and lower the vehicle onto the jack stands.
2. Remove both front wheels.
3. Remove the nuts (14) and bolts (25) from the bottom of each king pin (26) **(Figure 7-21, Page 7-18)**.
4. Remove the four bolts (30), four nuts (32), four lock washers (31), and bottom spring plate (29).
5. Remove tapered leaf spring (6).
6. Check the condition of the urethane bushings (27) and steel sleeves (28). Replace any that are worn or damaged.

LEAF SPRING INSTALLATION

1. Install urethane bushings (27) and steel sleeves (28) into leaf spring eyes **(Figure 7-21, Page 7-18)**.
2. Install tapered leaf spring (6), bottom spring plate (29), four bolts (30), four lock washers (31), and four nuts (32). Using a crisscross pattern sequence, tighten bolts to 23 ft-lb (31 N·m).
3. Install spring in king pins (26) with bolts (25) and nuts (14). Tighten to 23 ft-lb (31 N·m).
4. Install the wheels and finger-tighten the lug nuts.
5. Lower the vehicle and finish tightening lug nuts (using a crisscross pattern). **See Wheel Installation, Section 8, Page 8-1.**
6. Adjust camber and toe-in. **See Camber Adjustment on page 7-13 and Toe-in Adjustment on page 7-14.**

KINGPIN AND STEERING SPINDLE REMOVAL

1. Remove the front hub. **See Front Wheel Bearings and Hubs – 4-Wheel Brake Vehicles on page 7-20.**
2. **Vehicles with four-wheel brakes only:** Disconnect the front brake cables.
   2.1. Remove the cotter pins (1), brake cable clevis pins (2), and cable retaining clips (3). Remove the brake cables (4) from the spindle brackets **(Figure 7-19, Page 7-16)**.

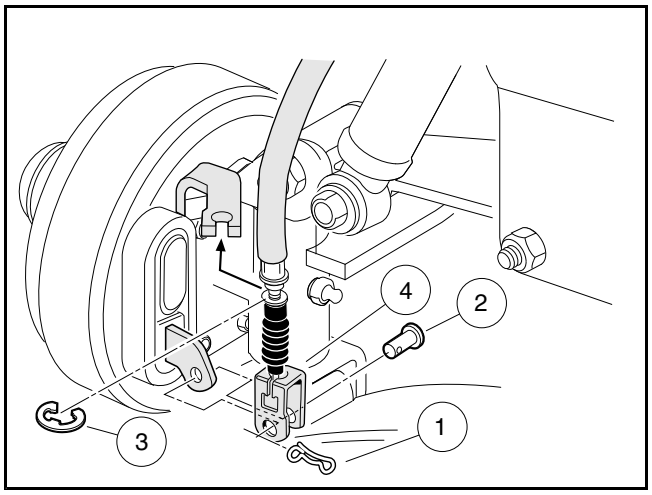


Figure 7-19 Connect Front Brake Cables

3. Remove cotter pins (22) and nuts (20), then remove ball joints from the spindles **(Figure 7-20, Page 7-17)**. Remove drag link ball joint. **See also Tie Rod and Drag Link Removal on page 7-12.**
4. Remove the nut (17) from the top of the kingpin (26) **(Figure 7-21, Page 7-18)**.
5. Raise the upper clevis (16) from the kingpin.
6. Remove the thrust washer (19).
7. Slide the spindle off the kingpin (26).
8. Remove the wave washer (20) and inspect it. If the washer is broken or has a wave bottom to wave crest height dimension of less than 0.040 inch (0.10 cm), it must be replaced.
9. Remove bolt (25) and nut (14) from bottom of kingpin (26) and remove kingpin.
10. Inspect the kingpin and spindle. If either is worn or damaged, it must be replaced.
11. Inspect the bushings (3 and 4). If the bushings are worn or damaged, remove them and press in new ones. **See following NOTE.**

NOTE: *If the bushings are replaced, ream new bushings to 0.750-0.752 (3/4 inch) (19.05-19.10 mm) in diameter. The reamer should be long enough to ream both bushings from one direction.*

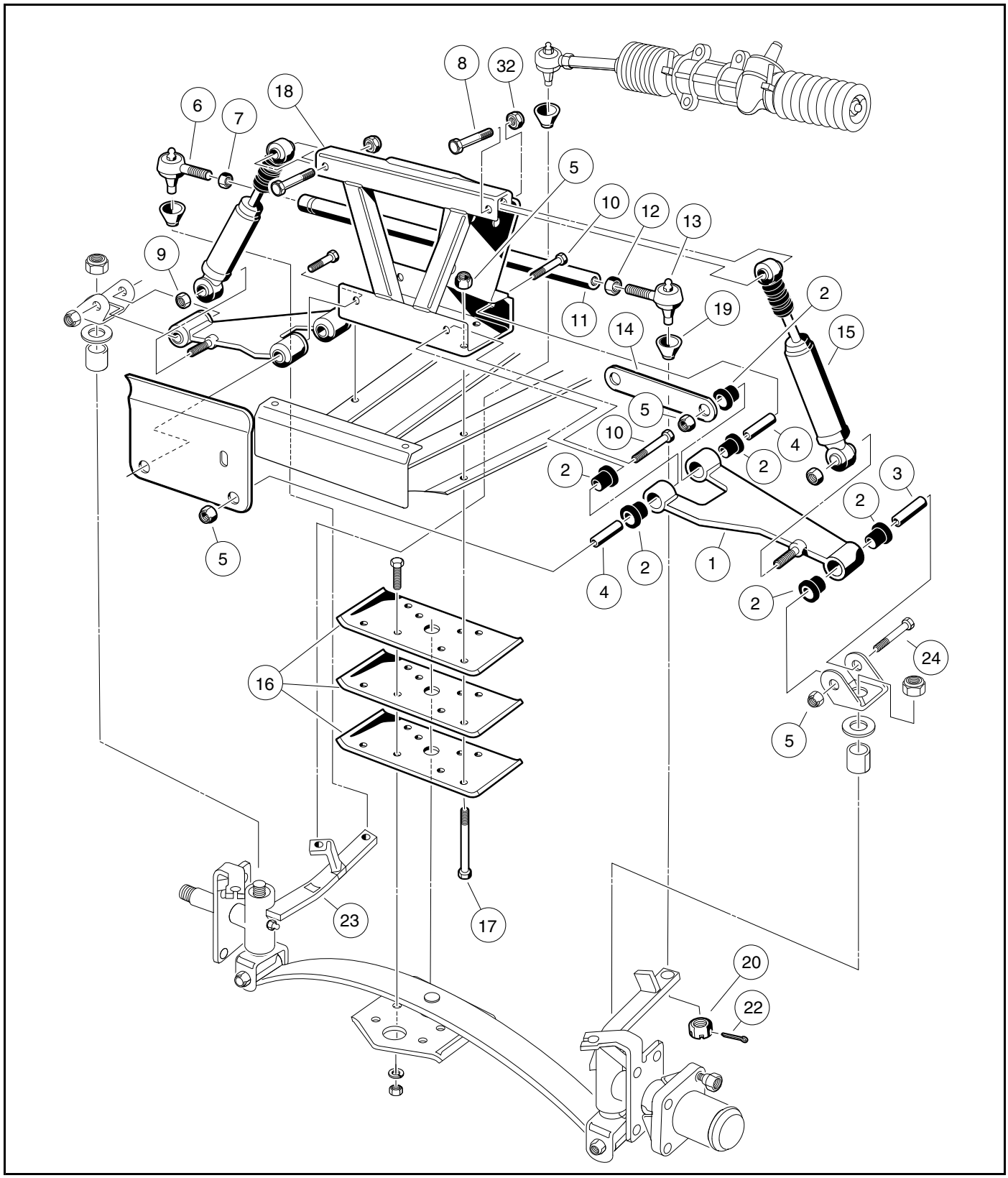


Figure 7-20 Four-Wheel Brake Vehicle – Upper Portion

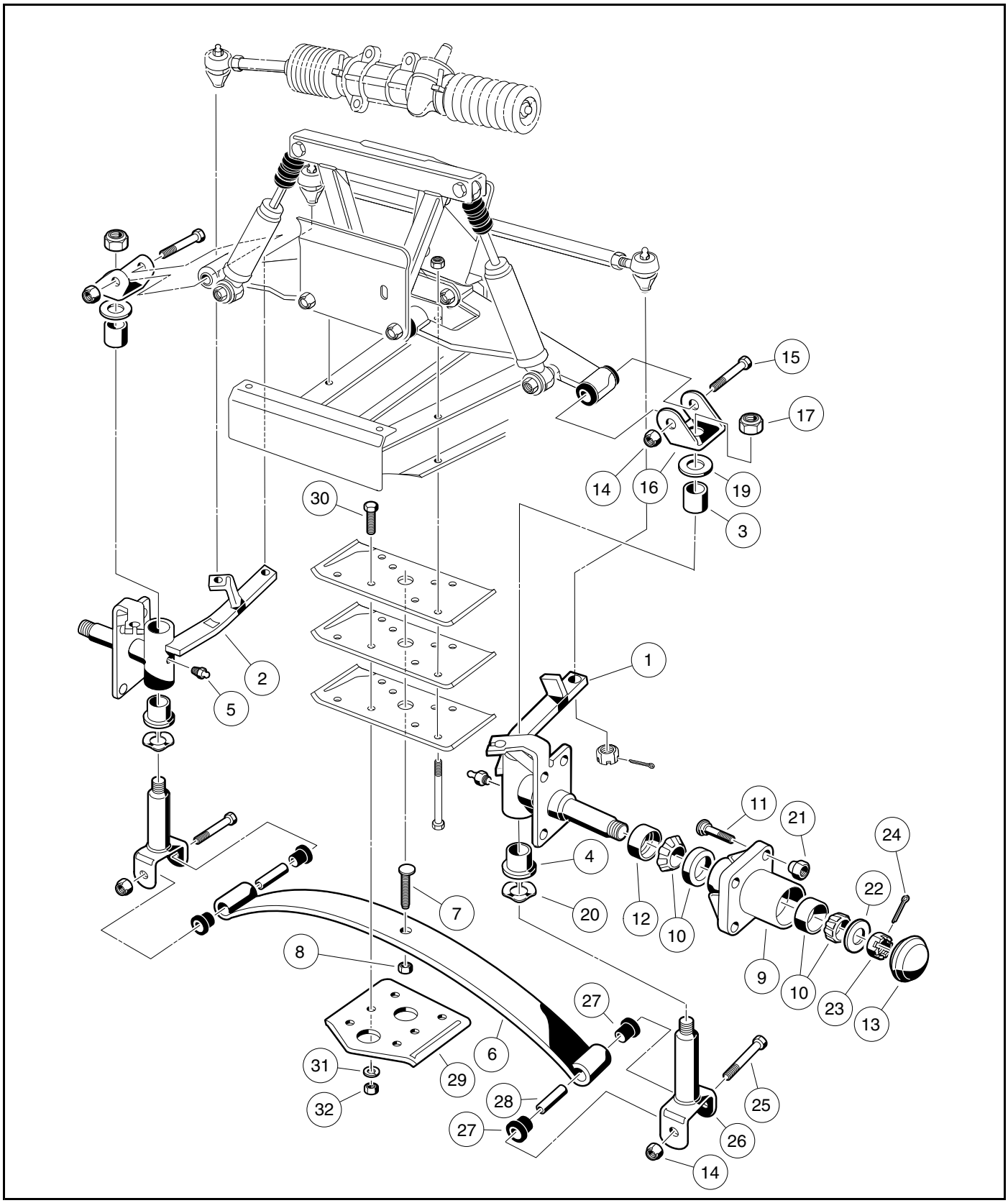


Figure 7-21 Four-Wheel Brake Vehicle – Lower Portion

KINGPIN AND STEERING SPINDLE INSTALLATION

1. Inspect all parts and replace them as necessary.
2. Install the kingpin (26) over the leaf spring eye. Insert the bolt (25) and install the nut (14) **(Figure 7-21, Page 7-18)**. Tighten the bolt to 23 ft-lb (31 N·m).
3. Install the wave washer (20).
4. Install the steering spindle on the kingpin. Then install the thrust washer (19), upper plate clevis (16), and nut (17). Tighten the nut to 40 ft-lb (54.2 N·m).
5. Attach the ball joints (6 and 13) to the spindle arm, install and tighten the nut (20), and install the cotter pin (22) **(Figure 7-20, Page 7-17)**.
6. Install the drag link ball joint. **See Tie Rod and Drag Link Installation on page 7-12.**
7. **Vehicles with four-wheel brakes only:** Connect the front brake cables on four-wheel brake vehicle in reverse order of disassembly **(Figure 7-19, Page 7-16)**.
8. Install front hub and wheel. **See Front Wheel Bearings and Hub Installation on page 7-21.**

DELTA A-PLATE REMOVAL

1. Loosen lug nuts on both front wheels and raise front of the vehicle with a chain hoist or floor jack. Place jack stands under the front cross tube of the vehicle frame and lower the vehicle onto the jack stands.
2. Remove wheel. Remove bolts (10 and 24), A-Plate straps (14), and nuts (5) **(Figure 7-20, Page 7-17)**.
3. Remove the lower shock absorber mounting nut (9), then slide the shock absorber free of the Delta A-Plate.
4. Remove the Delta A-Plate (1).
5. Inspect the bushings (2) and sleeves (3 and 4) in the Delta A-Plate and replace them if necessary.

DELTA A-PLATE INSTALLATION

1. Install the A-Plate in reverse order of removal. Tighten the A-Plate suspension bolts (10 and 24) to 20 ft-lb (27 N·m) **(Figure 7-20, Page 7-17)**.
2. Install the wheels and adjust the wheel alignment. **See Wheel Alignment on page 7-13.**

SHOCK ABSORBER REMOVAL

1. Inspect the shock absorbers for fluid leakage at the point where the shaft enters the shock absorber body. Leaking shock absorbers should be replaced.
2. Remove the nut (9) attaching the shock absorber to the A-Plate **(Figure 7-20, Page 7-17)**.
3. Remove the nut (32) and bolt (8) attaching the shock absorber to the shock and gear support.
4. Remove the shock absorber.

SHOCK ABSORBER INSTALLATION

NOTE: *When installing shock absorbers, make sure front shocks have identical part numbers and rear shocks have identical part numbers.*

1. Install the shock absorber by reversing the removal procedure.

2. Tighten the nuts to 20 ft-lb (27 N·m).

FRONT WHEEL BEARINGS AND HUBS – 4-WHEEL BRAKE VEHICLES

See General Warning on page 1-1.

FRONT WHEEL FREE PLAY INSPECTION

1. Raise the front of the vehicle.
2. Using your hands, attempt to rock the wheel and hub assembly back and forth on the spindle. If there is any observable movement of the wheel and hub on the spindle, remove dust cap (1) and cotter pin (2), and then tighten the spindle nut (3) until the bearing (5) fully seats in the bearing race (7).
3. Loosen spindle nut one cotter pin position. If the hub does not turn freely, loosen spindle nut one more cotter pin position.
4. Install a new cotter pin (2). If movement continues, replace the wheel bearings (5) as required **(Figure 7-22, Page 7-20)**.

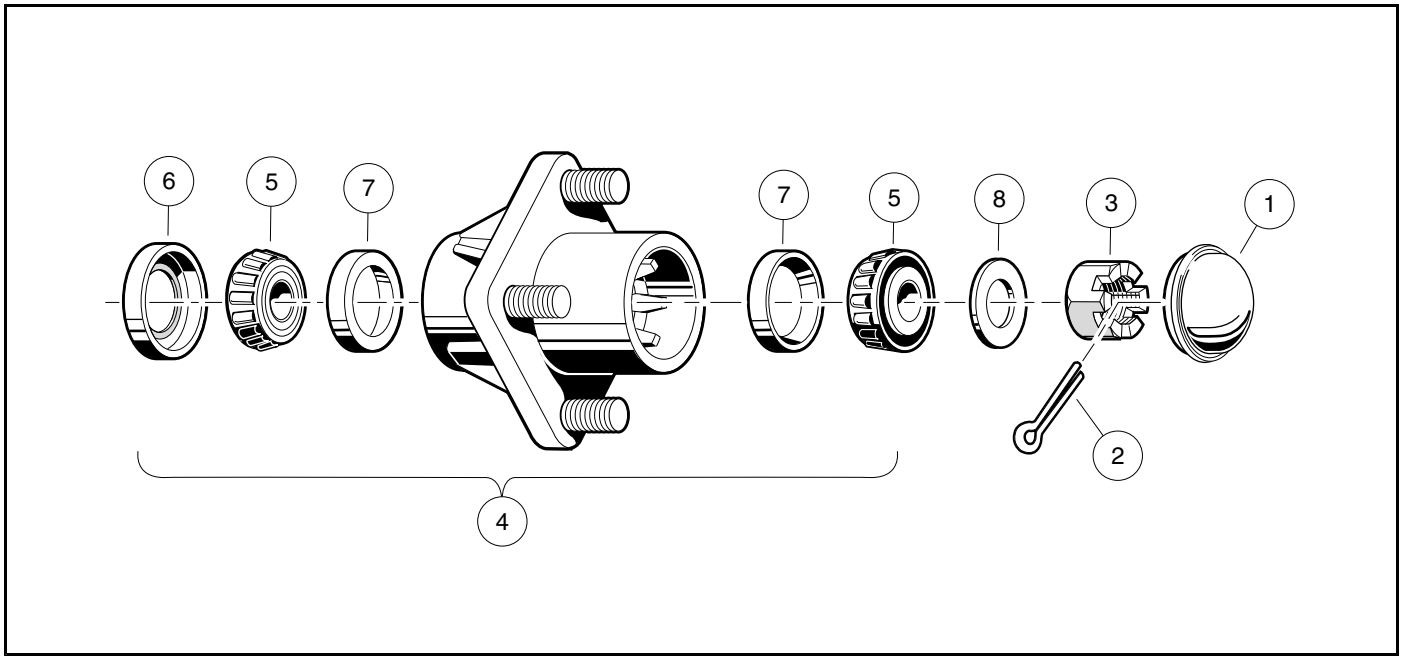


Figure 7-22 Front Wheel Bearings and Hub – Four-Wheel Brake Vehicles

FRONT WHEEL BEARINGS AND HUB REMOVAL

1. Remove the front wheels. **See Wheel Removal on page 8-1.**
2. Remove the front wheel hubs.
   2.1. Remove dust cover (1), cotter pin (2), spindle nut (3), and flat washer (8) **(Figure 7-22, Page 7-20)**.
   2.2. Remove the hub assembly (4) from the spindle shaft.
3. Remove the seal (6) and the bearings (5) from the hub.
4. Inspect the bearing cups (7). If they are worn or pitted, remove the cups by inserting a drift punch from the opposite end of the hub and tapping lightly around them.

5. Clean all parts and inspect them for wear. Replace any damaged or worn parts. **See following NOTE.**

NOTE: *Do not use compressed air to dry wheel bearings after cleaning.*

6. Inspect the surface of the spindle shaft where the seal (6) seats. It should be clean and smooth.

FRONT WHEEL BEARINGS AND HUB INSTALLATION

1. Pack the wheel bearings (5) and hub cavities, and lubricate cups (7) with wheel bearing grease or chassis lube. Make sure the grease is forced between the rollers **(Figure 7-22, Page 7-20)**.
2. If bearing cups (7) were removed, press new ones in squarely against stops in the hub. **See following NOTE.**

NOTE: *Install new cups when new bearings are installed.*

3. Install the wheel bearings (5) into the hub and install a new seal (6), with the metal edge toward the hub. **See following NOTE.**

NOTE: *Apply grease around dust seal inner lip before installation.*

4. Install the hub assembly (4) and flat washer (8) on the spindle and start the spindle nut (3).
5. Tighten the spindle nut until the hub is hard to turn, then back the nut (3) off until the hub turns freely. Install a new cotter pin (2). **See following NOTE.**

NOTE: *When the cotter pins are bent, make sure they do not contact the hub or dust cap.*

6. Check front wheel free play. **See Front Wheel Free Play Inspection on page 7-20.**
7. Install the dust cap (1).
8. Repeat the procedure for the opposite wheel.
9. Install the wheels and then finger-tighten the lug nuts.
10. Lower the vehicle and finish tightening lug nuts (using a crisscross pattern). **See Wheel Installation, Section 8, Page 8-1.**

⚠ DANGER

- **See General Warning on page 1-1.**

⚠ WARNING

- **See General Warning on page 1-1.**

GENERAL INFORMATION

Maximum tire life and good vehicle handling qualities are directly related to proper wheel and tire care.

- Keep tires properly inflated. **See Vehicle Specifications on page 2-1.**
- Keep lug nuts properly tightened.
- Keep the front end properly aligned and adjusted.

WHEELS

See General Warning on page 1-1.

WHEEL REMOVAL

1. Slightly 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. Make sure the wheels are off the ground. **See WARNING "Lift only one end of the vehicle..." in General Warning on page 1-1.**
3. Remove the lug nuts and remove the wheel.

WHEEL INSTALLATION

1. Install wheel(s), and tighten the lug nuts, using a crisscross pattern, until they are snug.
2. Lower the vehicle and finish tightening the lug nuts, using a crisscross pattern, to 55 ft-lb (74.6 N·m) for steel wheels or 65 ft-lb (88 N·m) for alloy mag wheels.

TIRES

See General Warning on page 1-1.

TIRE REMOVAL

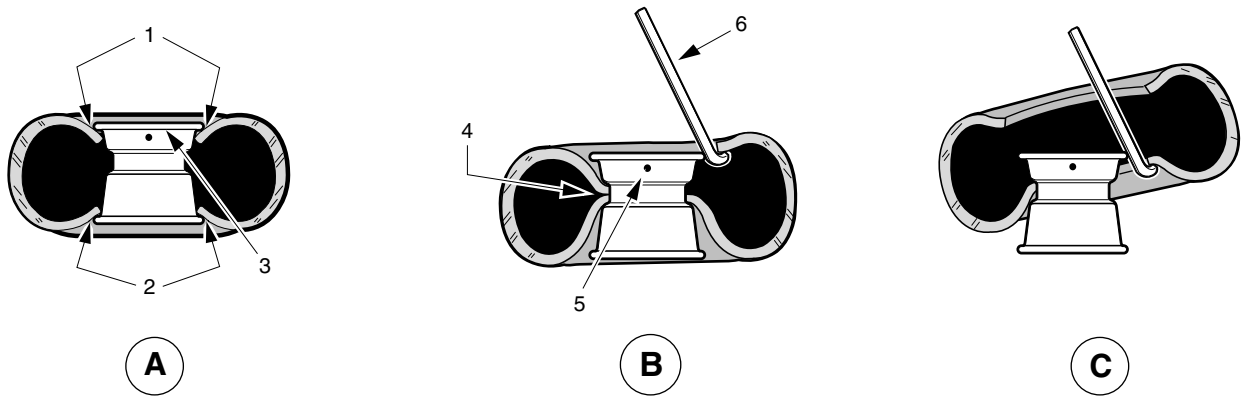
NOTE: *Tire must be removed or installed from the valve stem side of the rim.*

1. Remove the tire and wheel assembly from the vehicle as instructed above. **See Wheel Removal on page 8-1.**
2. Remove the valve cap and valve core and allow air to escape from the tire.
3. If possible, use a tire machine to remove the tire from the rim.
   3.1. If a tire machine is not available, loosen both tire beads by applying pressure to the tire side walls and pushing the tire bead away from the rim flange and into the rim well **(Figure 8-1, Page 8-2, Detail A)**.
   3.2. With the valve stem side of the wheel up, use a tire tool to carefully start the upper bead over the edge of the rim **(Figure 8-1, Page 8-2, Detail B)**. **See following CAUTION.**

CAUTION

- **To avoid damage to the tire, do not use excessive force when starting the bead over the edge of the rim.**

   3.3. When top bead is free of the rim, pull the bead from the bottom side of the rim up into the upper part of the rim well. Insert the tire tool under the lower bead as shown **(Figure 8-1, Page 8-2, Detail C)** and carefully pry the lower bead over the rim flange.
   3.4. Once the lower bead is started over the rim flange, the tire can be removed from the rim by hand.



1. Upper Tire Beads 2. Lower Tire Beads 3. Rim Flange 4. Tire Beads Positioned In Rim Well 5. Valve Stem Side Up 6. Tire Tool

Figure 8-1 Tire Removal

TIRE REPAIR

1. Determine the location and cause of the air leak.
   1.1. Remove the wheel. **See Wheel Removal on page 8-1.** Inflate the tire to no more than 20 psi (1.38 Bars).
   1.2. Immerse the tire in water and then mark the point where bubbles are formed by escaping air.
   1.3. Determine the cause of the air leak. **See following NOTE.**

NOTE: *An air leak could be due to a punctured casing, faulty valve core, improperly seated valve stem, or improperly seated tire bead.*

Small holes in the casing can be plugged using a standard automotive tubeless tire repair kit available at auto supply stores.

2. When the cause of the air leak has been determined, remove tire from the rim and repair as required. **See Tire Removal on page 8-2.**

TIRE INSTALLATION

⚠ WARNING

- **While mounting or inflating tire, keep hands, fingers, etc. from exposed areas between the tire bead and rim.**

1. Clean both tire beads to remove dirt or other foreign matter.
2. Where the tire beads seat, clean the rim with a wire brush. Wipe away any debris with a clean cloth. **See following NOTE.**

NOTE: *Because tubeless tires require a perfect seal in order to seat, keeping the tire and rim clean is very important.*

3. Apply a liberal amount of tire-mounting lubricant (soap and water solution) to both tire beads and rim flanges.
4. Install the tire on the rim from the valve stem side. If there is no tire machine available, use a rubber mallet and tire iron.
5. Remove the valve core, and position the tire so that both beads are on the rim flange narrow bead seats.
6. Place the tire and wheel assembly against a wall in an upright position and push it against the wall while inflating the tire to the recommended pressure. **See Vehicle Specifications on page 2-1.** The three-point contact (wall, floor, and hand) will help ensure that beads snap into place and form a proper seal as the tire is inflated **(Figure 8-2, Page 8-4)**. **See following WARNING.**

⚠ WARNING

- **Do not use a compressed air source with pressure over 100 psi (6.90 Bars). Due to the low pressure requirements of a small tire, over-inflation could be reached almost instantly when using a high pressure air supply. Over-inflation could cause the tire to explode, possibly resulting in personal injury.**

7. Quickly remove the air nozzle and install the valve core.
8. Adjust air pressure in the tire to recommended pressure. **See Vehicle Specifications on page 2-1.**
9. Immerse the wheel and tire assembly in water to make sure there are no leaks.

Figure 8-2 Inflate Tire

⚠ DANGER

- **See General Warning on page 1-1.**

⚠ WARNING

- **See General Warning on page 1-1.**

GENERAL INFORMATION

The rear suspension and powertrain of the vehicle move independently from the vehicle frame. The suspension includes two multi-leaf springs controlled by two hydraulic shock absorbers mounted between the spring mounting plate and the frame. On the gasoline vehicle, the engine is mounted on an engine mounting plate that moves with the suspension. At the front of the mounting plate, a snubber limits the mounting plate motion. The rear suspension of the gasoline Turf 252, Carryall 252 and XRT 900 includes a stabilizer bar that reduces side-to-side sway.

SHOCK ABSORBERS

See General Warning on page 1-1.

SHOCK ABSORBER INSPECTION AND REMOVAL

1. Check shock absorbers (7) for damage and fluid leakage around the lower housing of the shock absorber body. Replace damaged or leaking shock absorbers Figure 9-3, Page 9-4.
2. To remove a shock absorber (7), remove the nut (5), cup washer (9), and rubber bushing (10) from the upper shock absorber stem.
3. Remove lower mounting hardware (5, 9 and 10) on shock absorber lower mount **(Figure 9-3, Page 9-4)**. **See also Figure 9-1, Page 9-2.**
4. Compress the shock absorber to remove it.

SHOCK ABSORBER INSTALLATION

NOTE: *When installing shock absorbers, make sure front shocks have identical part numbers and rear shocks have identical part numbers.*

1. Install shock absorber in the reverse order of removal.
2. On the upper shock absorber mount, tighten nut (5) until rubber bushing (10) expands to size of cup washer (9) **(Figure 9-3, Page 9-4)**.
3. On the lower shock absorber mount, install mounting hardware. Tighten the nut (5) until the rubber bushing (10) expands to the same diameter as the cup washer.

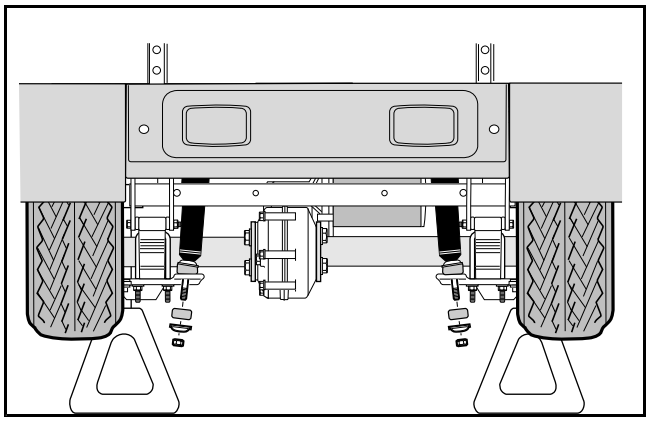


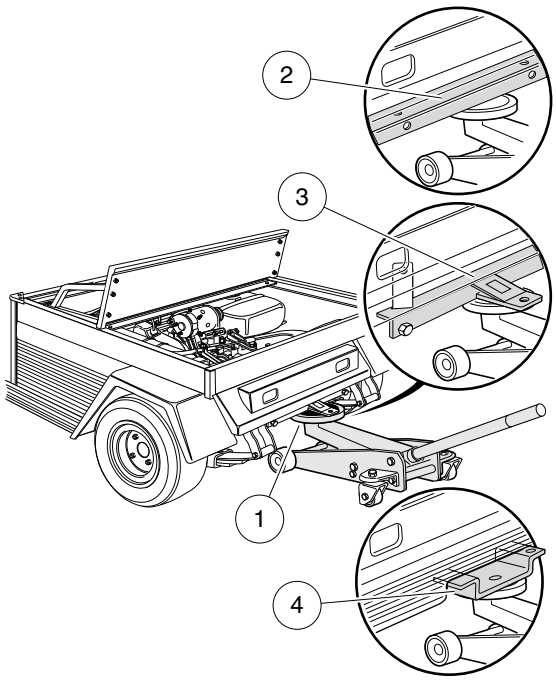
Figure 9-1 Shock Absorber Removal

MULTI-LEAF SPRINGS

See General Warning on page 1-1.

MULTI-LEAF SPRING REMOVAL

1. Loosen the lug nuts on the wheel(s) to be removed.
2. Place chocks at the front wheels and lift rear of vehicle with a chain hoist or floor jack **(Figure 9-2, Page 9-3)**. Position jack stands under the frame crossmember between the rear leaf spring front frame mount and the side stringer, just forward of each rear wheel. Lower the vehicle to let the jack stands support the vehicle.**See WARNING "Lift only one end of the vehicle..." in General Warning on page 1-1.**
3. Place a floor jack under the transaxle housing to support (but not lift) the powertrain. Raise it just enough to relieve tension on the shock absorbers without compressing them.
4. Remove tire and wheel assembly on the side from which the spring is to be removed. Thread one lug nut onto a stud on the rear hub. This will keep the brake drum on the hub.
5. Remove lower nut (5), cup washer (9), and rubber bushing (10) from shock absorber (7) **(Figure 9-3, Page 9-4)**.
6. Remove the lock nuts (14) attaching the U-bolt (11) to the shock mount bracket (16). Do not disconnect brake cable from bracket **(Figure 9-3, Page 9-4)**.
7. Raise axle with floor jack until axle saddle (23) is 1 inch (2.5 cm) above spring **(Figure 9-3, Page 9-4)**.
8. Remove bolt (15) and lock nut (2) attaching the leaf spring (12) to the rear shackle (1) **(Figure 9-3, Page 9-4)**.
9. Allow rear of leaf spring (12) to rest on the ground and remove the bolt (24) and lock nut (25) attaching the front of the spring to the vehicle frame **(Figure 9-3, Page 9-4)**. Remove spring from vehicle.
10. Inspect the rubber bushings (4) and steel sleeves (3) in the spring eyes and replace them if they are worn or damaged **(Figure 9-3, Page 9-4)**.



1. Position floor jack under hitch bracket or frame.
2. Lifting Position For Standard Turf 1 and Carryall 1
3. Lifting Position For Turf 2 and 252, Carryall 2 and 252, Carryall 2 Plus and XRT 900
4. Lifting Position For Turf 6 And Carryall 6

Figure 9-2 Lift Vehicle

MULTI-LEAF SPRING INSTALLATION

NOTE: *When installing rear leaf springs, make sure that both springs have identical part numbers.*

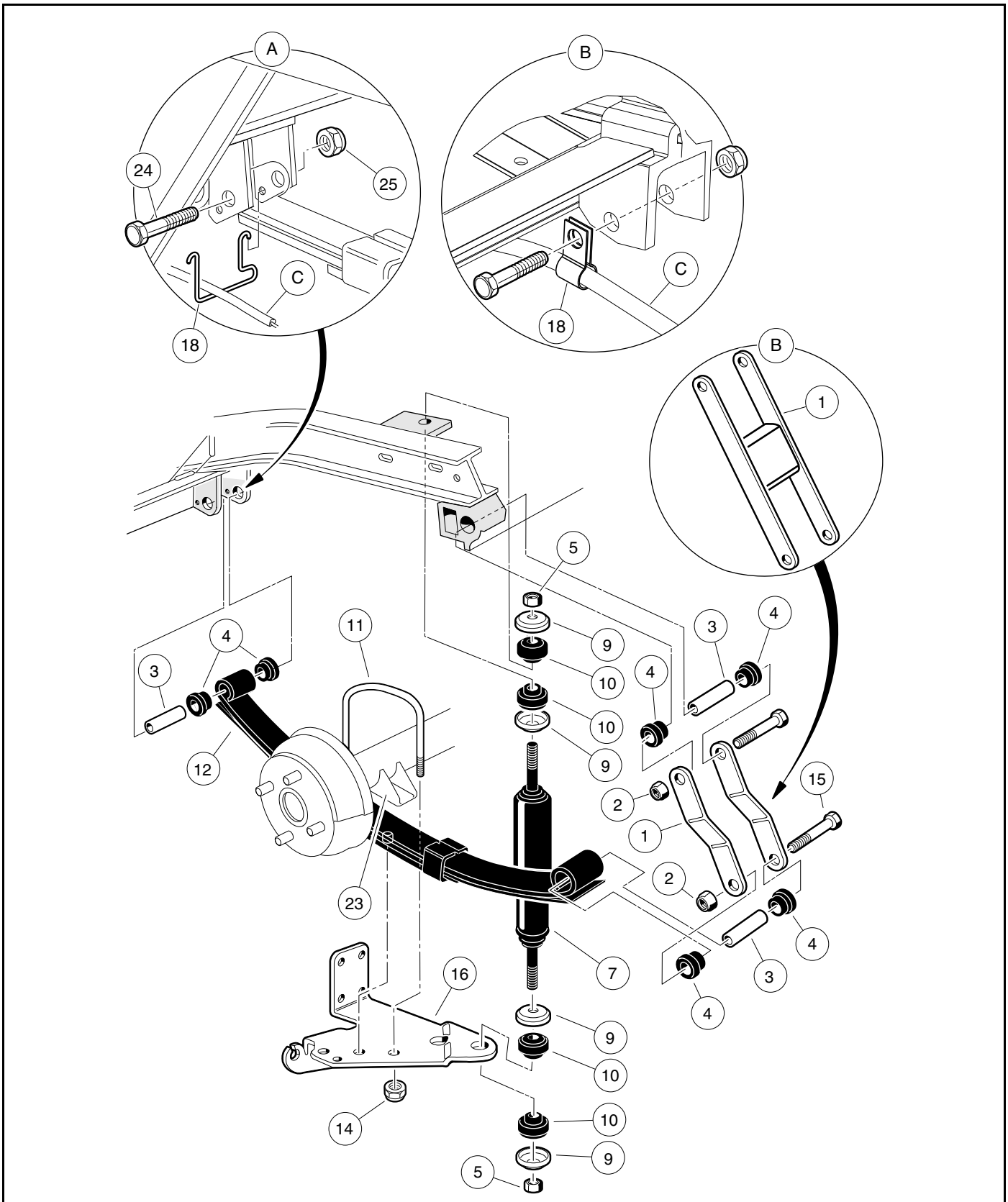
1. Install rubber bushings (4) and steel sleeves (3) into leaf spring eyes if bushings were removed **(Figure 9-3, Page 9-4)**.
2. Place front of leaf spring (12) into vehicle frame and insert bolt (24) through frame and leaf spring eye. Install lock nut (25) and tighten to 15 ft-lb (20.3 N·m).
3. Align the other end of leaf spring with the holes in the spring shackles (1). Insert bolt (15) through leaf spring eye and shackles. Install lock nut (2) and tighten to 15 ft-lb (20.3 N·m). Lower transaxle onto leaf spring (12). **See following CAUTION.**

CAUTION

- **When placing transaxle on spring, be sure to position locating bolt on the spring in the locating hole in the transaxle saddle (23) (Figure 9-3, Page 9-4).**

4. Install shock mount bracket (16) onto locating bolt at bottom center of leaf-spring **(Figure 9-3, Page 9-4)**. **See following NOTE.**
   4.1. Install U-bolt (11) and lock nuts (14). Tighten U-bolt to 25 ft-lb (34 N·m) **(Figure 9-3, Page 9-4)**.
5. Install shock absorber. **See Shock Absorber Installation on page 9-1. See following NOTE.**

NOTE: *When installing shock absorbers, make sure rear shocks have identical part numbers.*



A. Gasoline Vehicles Only B. Electric Vehicles Only C. Rear Brake Cable

Figure 9-3 Rear Suspension – All Turf/Carryall 252 and XRT 900 Vehicles

SNUBBER

See General Warning on page 1-1.

NOTE: *The snubber is installed on the gasoline vehicle only.*

SNUBBER REMOVAL

1. Support the powertrain with a floor jack under the engine mounting plate so that the snubber (1) is raised slightly and does not rest on the vehicle frame.
2. Remove the two bolts (2) and two lock nuts (3) securing the snubber mounting bracket (4) to the engine mounting plate **(Figure 9-4, Page 9-5)**.
3. Slide snubber and bracket assembly toward battery to remove it from vehicle.

SNUBBER INSTALLATION

1. Install in the reverse order of removal.
2. Tighten snubber bracket mounting lock nuts (3) to 156 in-lb (17.6 N·m) **(Figure 9-4, Page 9-5)**.

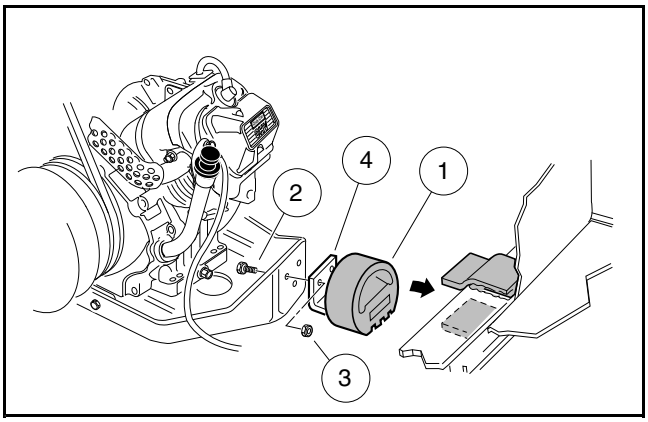


Figure 9-4 Snubber Brackets

STABILIZER BAR

See General Warning on page 1-1.

NOTE: *A stabilizer bar is installed on gasoline Turf 252, Carryall 252 and XRT 900 vehicles.*

STABILIZER BAR REMOVAL

1. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame crossmember between the spring mount and the side stringer, just forward of each rear wheel. Lower vehicle to let the jack stands support the vehicle. **See General Warning on page 1-1.**
2. Remove bolt (6), lock washer (7), flat washers (4), compression mounts (3), and spacer (2) from left and right stabilizer bar links (5). Do not remove the stabilizer bar links from frame **(Figure 9-5, Page 9-7)**.
3. Remove bolts (14) and lock nuts (15) from the left and right stabilizer bar bushing support (12) and remove supports and stabilizer bar (1) from vehicle.
4. Remove bushings (13) from stabilizer bar (1).

STABILIZER BAR INSTALLATION

1. Position stabilizer bar at the transaxle mounting brackets. Install a bushing (13) onto bar, making sure the bushing is located in the center of the four mounting holes in the bracket **(Figure 9-5, Page 9-7)**.
2. Place the bushing support (12) onto the bushing. Install four hex-head bolts (14) through the bushing support and transaxle mounting bracket.
3. Install four lock nuts (15) and tighten to 75 in-lb (8.4 N·m).
4. Repeat steps 1, 2, and 3 for the other side of the stabilizer bar.
5. Place lock washer (7), flat washer (4), spacer (2), and compression mount (3) onto bolt (6). Install bolt through mounting hole in stabilizer bar and place another compression mount (3) and flat washer (4) onto bolt **(Figure 9-5, Page 9-7)**.
6. Install the bolt (6) with hardware into the stabilizer bar link (5) and finger-tighten.
7. Repeat steps 5 and 6 for the other side of the stabilizer bar.
8. Tighten bolts (6) in the stabilizer bar links (5) to 17 ft-lb (23 N·m).
9. Place jack under transaxle and raise vehicle enough to remove jack stands. Lower the vehicle to the ground.

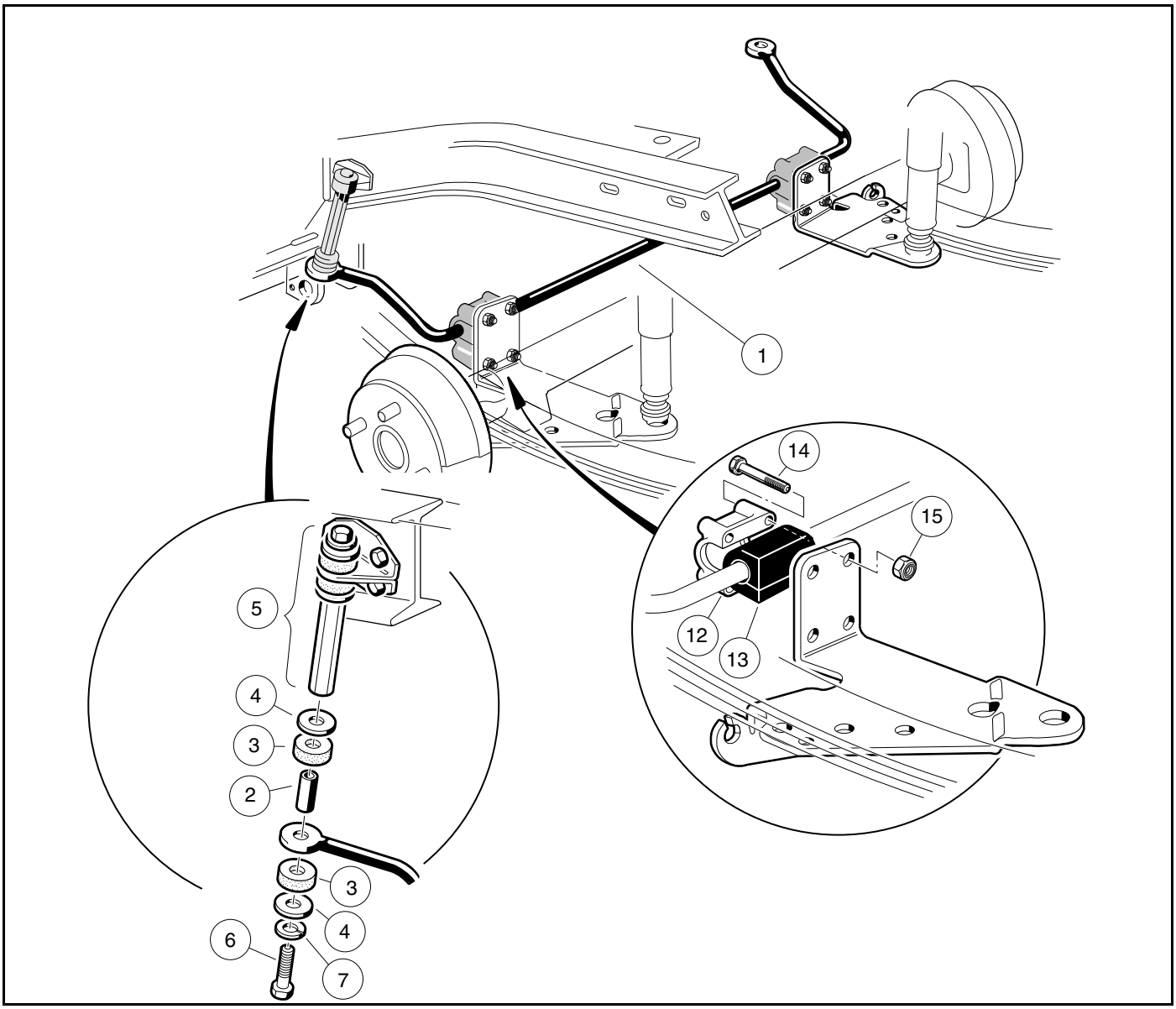


Figure 9-5 Stabilizer Bar

GENERAL INFORMATION

See General Warning on page 1-1.

To ensure trouble-free vehicle performance, it is very important to follow an established preventive maintenance program (regularly scheduled service). Regular and consistent vehicle maintenance can prevent vehicle down-time and expensive repairs that result from neglect. Any vehicle not functioning correctly should be removed from use until it is properly repaired. This will prevent further damage to the vehicle and avoid the possibility of injury due to unsafe conditions.

Contact your local authorized distributor/dealer to perform all repairs and semiannual and annual periodic service.

PRE-OPERATION AND DAILY SAFETY CHECKLIST

Each Club Car vehicle has been thoroughly inspected and adjusted at the factory; however, upon receiving your new vehicle(s), you should become familiar with its controls, indicators, and operation. Carefully inspect each vehicle to ensure that it is in proper working condition before accepting delivery.

Use the following checklist as a guide to inspect the vehicle. This checklist should be used daily to ensure that the vehicle is in proper working condition and in conjunction with the Performance Inspection on page 10-2 and the Periodic Service Schedules on page 10-3. Any problems should be corrected by a Club Car distributor/dealer or a trained technician.

- **General:** All the parts should be in place and properly installed. Be sure that all nuts, bolts, and screws are tight. On gasoline vehicles, check all hose clamps for tight fit as well as the starter belt for tightness.
- **Safety and information decals:** Check to ensure that all safety and information decals are in place. **See Safety Decal and Feature Identification section the appropriate Owner's Manual.**
- **Tires:** Check for proper tire pressure. Visually inspect for wear, damage, and proper inflation on a daily basis. **See Vehicle Specifications – Gasoline Vehicles on page 2-1. See Vehicle Specifications – Electric Vehicles on page 2-3.**
- **Battery(ies):** Check electrolyte to ensure that it is at its proper level **(Figure 1-1, Page 1-4 or Figure 1-2, Page 1-4)**. Check battery posts. Wires should be tight and free of corrosion. On electric vehicles, charge batteries fully before first use of vehicle.
- **Charger cord, plug, and receptacle (electric vehicles):** Visually inspect for cracks, loose connections, and frayed wiring. **See Charger Receptacle Inspection, Section 24, Page 24-13.**
- **Engine (gasoline vehicles):** Check for proper engine oil level. **See Engine Oil – Gasoline Vehicle on page 10-7.**
- **Fuel (gasoline vehicles):** Check fuel level. **See Fueling Instructions, Section 17, Page 17-26.** Check fuel tank, lines, cap, pump, fuel filters, and carburetor for fuel leakage on a daily basis.
- **Exhaust system (gasoline vehicles):** Check for leaks.
- **Performance Inspection:** Inspect as instructed. **See Performance Inspection on page 10-2.**

⚠ WARNING

- **Be sure the plastic has been removed from the seat bottom before operating the vehicle. Failure to do so may result in a fire, property damage, personal injury, or death.**

PERFORMANCE INSPECTION

After you have familiarized yourself with the vehicle controls and have read and understood the driving instructions, take the vehicle for a test drive.
Use the following checklist, in conjunction with the Pre-Operation and Daily Safety Checklist, as a guide to inspect the vehicle and check daily for proper operation. Any problems should be corrected by a Club Car distributor/dealer or a trained technician.

All Vehicles

- **Forward/Reverse control:** Check for proper operation. **See Controls And Indicators section the appropriate Owner's Manual.**
- **Brakes:** Be sure the brakes function properly. When brake pedal is fully pressed under moderate pressure, it should not go more than halfway to the floor, and vehicle should come to a smooth, straight stop. If the brake pedal goes more than halfway to the floor, or if the vehicle swerves or fails to stop, have the brake system checked and adjusted as required. Brake adjustment must be maintained so that the brake pedal cannot be pressed to the floor under any circumstance.
- **Park brake:** When latched, the park brake should lock the wheels and hold the vehicle stationary (on an incline of 20% or less). It should release when either the accelerator or brake pedal is pressed.
- **Reverse buzzer:** The reverse buzzer should sound as a warning when the Forward/Reverse handle or switch is in the REVERSE position.
- **Steering:** The vehicle should be easy to steer and should not have any play in the steering wheel.
- **General:** Listen for any unusual noises such as squeaks or rattles. Check the vehicle ride and performance. Have a Club Car distributor/dealer or a trained technician investigate anything unusual.

Electric Vehicles

- **Accelerator:** With the key switch in the ON position and the Forward/Reverse switch in the FORWARD position, as the accelerator pedal is pressed, the motor should start and the vehicle should accelerate smoothly to full speed. Club Car vehicles operate at reduced speed in reverse. When the pedal is released, it should return to the original position and the motor should rotate freely or go into motor braking mode. **See Pedal Up Motor Braking below.**
- **Walk-Away Braking:** With the vehicle parked on level ground and the park brake disengaged, place the Tow/Run switch in the RUN position and attempt to push the vehicle. Motor braking should engage and cause resistance to rolling (moving at no more than 1 to 3 mph) (1.5 to 4.8 km/h) with the Forward/Reverse switch in any position. When walk-away braking is engaged, the reverse buzzer should emit a distinct pattern of beeps. **See following WARNING.**

⚠ WARNING

- **Walk-away braking will not limit vehicle speed to 1 mph (1.6 km/h) on very steep grades. Do not operate vehicle on slopes exceeding 20% grades.**

- **Pedal Up Motor Braking:** Accelerate the vehicle to full speed and then release the accelerator pedal. Motor braking should quickly and smoothly slow the vehicle. Motor braking will disengage when vehicle slows to the programmed speed for IQ Plus vehicles. This feature is programmable for IQ Plus vehicles. Contact your local Club Car dealer/distributor to inquire about this adjustable feature.
- **Pedal Down Motor Braking:** Accelerate down an incline with the accelerator pedal pressed. When the vehicle reaches maximum programmed speed, motor braking should engage and limit the vehicle to its maximum

programmed speed. On very steep grades, the vehicle may slightly exceed its maximum programmed speed, requiring use of the brake pedal.

Gasoline Vehicles

- **Accelerator for pedal-start vehicle:** With the key switch in the ON position and the Forward/Reverse handle in the FORWARD position, as the accelerator pedal is pressed, the engine should start and the vehicle should accelerate smoothly to full speed. When the pedal is released it should return to the original position and the engine should stop. Club Car vehicles operate at reduced speed in reverse.
- **Accelerator for key-start vehicle:** After starting the engine with the key switch and placing the Forward/Reverse handle in the FORWARD position, the vehicle should accelerate smoothly to full speed as the accelerator pedal is pressed. When the accelerator pedal is released it should return to the original position and the engine should idle.
- **Governor:** Check maximum speed of the vehicle. The gasoline Turf 252 and Carryall 252 should operate at 15-17 mph (24-27 km/h) on a level surface. The gasoline XRT 900 should operate at 17-19 mph (27-31 km/h) on a level surface. Turf 252 and Carryall 252 electric vehicles should operate at a standard speed of 15-17 mph (24-27 km/h) on a level surface. They can be adjusted to a maximum speed of 17-19 mph (27-31 km/h) on a level surface. XRT 900 electric vehicles can be set at the factory to operate at either 15-17 mph (24-27 km/h) or to 17-19 mph (27-31 km/h) on a level surface.

PERIODIC SERVICE SCHEDULES

See General Warning on page 1-1.

⚠ WARNING

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

NOTE: *If the vehicle is constantly hauling heavy loads or hauling a trailer, these preventive maintenance procedures should be performed more often than recommended in the Periodic Service Schedule.*

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

PERIODIC SERVICE SCHEDULE – ELECTRIC VEHICLES		
REGULAR INTERVAL	**SERVICE**	
Daily service by owner	Pre-Operation and Daily Safety Checklist	**See Pre-Operation and Daily Safety Checklist on page 10-1.**
	Performance Inspection	**See Performance Inspection on page 10-2.**
	Batteries	Charge batteries (after each daily use only).
Weekly service by owner	Batteries	Check electrolyte level. Add water if necessary. **See page 25-3.**
Monthly service by owner or trained technician	Batteries	Wash battery tops and clean terminals with baking soda/water solution.
	Tires	Check air pressure and adjust if necessary. **See Vehicle Specifications – Electric Vehicles on page 2-3.**
	General vehicle	Wash battery compartment and underside of vehicle.
Semiannual service by trained technician only (or every 50 hours of operation, whichever comes first)	Brake system	Check brake shoes; replace if necessary or adjust as required. **See Wheel Brake Assemblies Section.**
		Lubricate brake slides per Lubrication Schedule. **See Wheel Brake Assemblies Section.**
		Check brake cables for damage; replace if necessary.
	Electrical wiring and connections	Check for tightness and damage.
	Forward/Reverse switch	Check condition of contacts and wire connections; make sure connections are tight.
	Front wheel alignment and camber	Check and adjust as required. **See Steering and Front Suspension Section.**
	Motor Controller Output Regulator (MCOR)	Check for loose hardware, cracks, or other damage.
Annual service by trained technician only (or every 100 hours of operation, whichever comes first)	Batteries	If batteries are not performing as expected, see Batteries Section in the maintenance and service manual.

PERIODIC SERVICE SCHEDULE – GASOLINE VEHICLES		
REGULAR INTERVAL	**SERVICE**	
Daily service by owner	Pre-Operation and Daily Safety Checklist	**See Pre-Operation and Daily Safety Checklist on page 10-1.**
	Performance Inspection	**See Performance Inspection on page 10-2.**
Monthly service by owner or trained technician	Engine	Check engine oil level; change if necessary. **See Periodic Lubrication Schedules on page 10-6.** Dispose of used oil properly.
		Check engine cooling air intake; visually inspect unshrouded area around engine exhaust for grass and debris, and clean if necessary.
	Tires	Check air pressure and adjust if necessary. **See Vehicle Specifications – Gasoline Vehicles on page 2-1.**
	General vehicle	Wash engine compartment and underside of vehicle. Do not wash engine when hot.
Semiannual service by trained technician only (or every 50 hours of operation, whichever comes first)	Battery	Clean terminals and wash dirt from casing; check electrolyte level. **See page 13-37.**
	Front wheel alignment and camber	Check and adjust if necessary. **See Steering and Front Suspension Section.**
	Electrical wiring and connections	Check for tightness and damage.
	Brake system	Check brake shoes; replace if necessary or adjust as required. **See Wheel Brake Assemblies Section.**
		Lubricate brake slides per Lubrication Schedule. **See Wheel Brake Assemblies Section.**
		Check brake cables for damage; replace as required.
Annual service by trained technician only (or every 100 hours of operation, whichever comes first)	Engine	Check for leaks around gaskets, fill plugs, etc.
		Inspect, clean and gap spark plug; replace if necessary.
	Engine air intake system	Check air filter element; clean or replace if necessary.
		Check clamps for tightness; check hose for cracks.
	General vehicle	Check for loose hardware and tighten if necessary.
Two year service by trained technician only (or every 200 hours of operation, whichever comes first)	Fuel filters	Replace. Dispose of used filters properly.

PERIODIC LUBRICATION SCHEDULES

PERIODIC LUBRICATION SCHEDULE – ELECTRIC VEHICLES			
REGULAR INTERVAL	**SERVICE**	**LUBRICATION POINTS**	**RECOMMENDED LUBRICANT**
Semiannually by owner or trained technician (or every 50 hours of operation, whichever comes first)	Brake pedal shaft bearings	1	Dry Moly Lube (CCI P/N 1012151)
	Brake linkage and pivots	2	Dry Moly Lube (CCI P/N 1012151)
	Accelerator pivot rod supports	3	Dry Moly Lube (CCI P/N 1012151)
	Charger Receptable	4	WD-40
	Brake slides	5	Dry Moly Lube (CCI P/N 1012151)
	Front suspension (5 fittings)	6	Chassis Lube – EP NLGI Grade 2
Annually by trained technician only (or every 100 hours of operation, whichever comes first)	Check/fill transaxle to plug level	7	22 oz. (0.67 liters) SAE 30 WT. API Class SE, SF, or SG Oil (or higher)
	Inspect front wheel bearings (Repack as necessary)	8	Chassis Lube – EP NLGI Grade 2

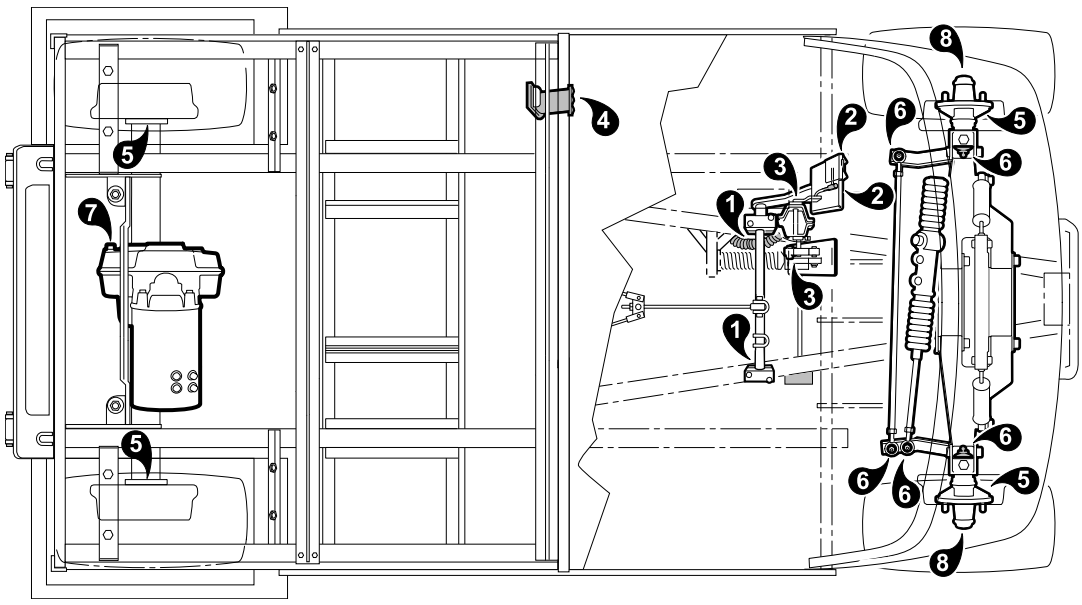


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Figure 10-1 Lubrication Points – Electric Vehicles

PERIODIC LUBRICATION SCHEDULE – GASOLINE VEHICLES			
REGULAR INTERVAL	**SERVICE**	**LUBRICATION POINTS**	**RECOMMENDED LUBRICANT**
Semiannually by owner or trained technician (or every 50 hours of operation, whichever comes first)	Brake pedal shaft bearings	1	Dry Moly Lube (CCI P/N 1012151)
	Brake linkage and pivots	2	Dry Moly Lube (CCI P/N 1012151)
	Accelerator pivot rod supports and shifter cable pivots	3	Dry Moly Lube (CCI P/N 1012151)
	Front suspension (5 fittings)	4	Chassis Lube (EP NLGI Grade 2)
	Brake slides	5	Dry Moly Lube (CCI P/N 1012151)
Annually by trained technician only (or every 100 hours of operation, whichever comes first)	Check/fill unitized transaxle to plug level	6	27 oz. (.8 liters) 80-90 WT. API Class GL-3 or 80-90 WT. AGMA Class EP Gear Lube
	Inspect front wheel bearings (Repack as necessary)	7	Chassis Lube – EP NLGI Grade 2
First change 100 hours – additional change every 200 hours of operation or annually, whichever comes first	Change engine oil and oil filter	8	32 oz. (.95 liters) without filter; 38 oz. (1.12 liters) with filter **(Figure 10-7, Page 10-10)**.

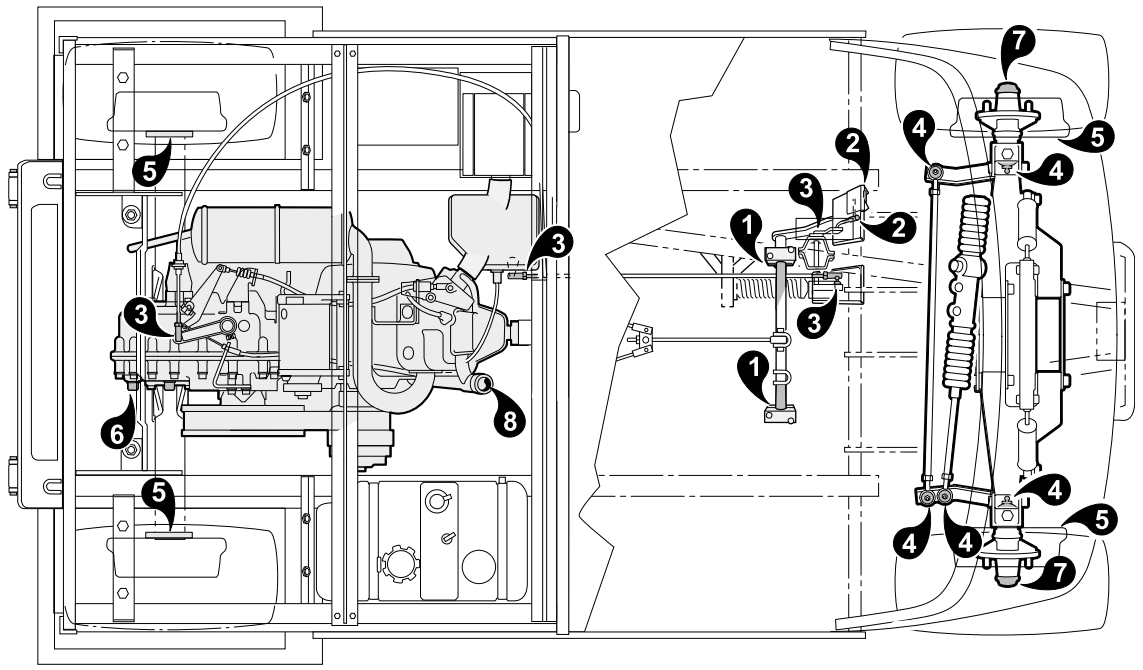

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Figure 10-2 Lubrication Points – Gasoline Vehicles

ENGINE OIL – GASOLINE VEHICLE

Even though the low oil warning light on the dash should illuminate if oil level becomes low, engine oil level should be checked monthly. Vehicle should be on a level surface when checking oil. Do not overfill with oil.

ENGINE OIL LEVEL CHECK

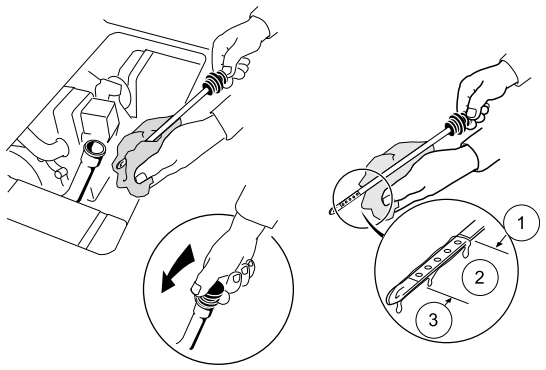
1. Remove the oil level dipstick from the oil filler tube, and wipe oil off dipstick (1) **(Figure 10-3)**. **See following CAUTION.**

CAUTION

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

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

NOTE: *Properly recycle or dispose of used oil in accordance with local, state, and federal regulations.*



1.Full level 2. Safe level 3. Low level.

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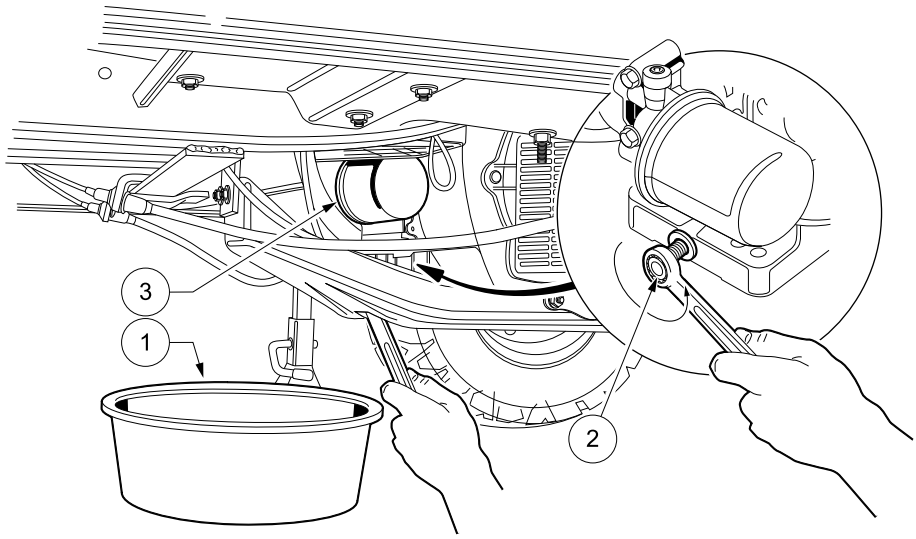
Figure 10-3 Engine Oil Level Check

ENGINE OIL AND FILTER CHANGE

Engine oil and oil filter should be changed after the first 100 hours of operation. After that, they should be changed every 200 hours of operation or annually, whichever comes first.

1. Turn the key switch to the OFF position, then remove the key. Place the Forward/Reverse handle in the neutral POSITION. Chock the front wheels.
2. Access the engine compartment.
3. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
4. Position a pan designed for oil changes under the front drain plug **(Figure 10-4)**.



1. Drain pan 2. Drain plug 3. Oil filter.

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Figure 10-4 Engine Oil Drain Plug and Pan

5. Use a 14 mm socket or wrench to remove the drain plug, turning it counterclockwise, and allow the engine oil to drain into the pan. **See following WARNING.**

⚠ WARNING

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

6. Clean the oil drain plug threads with solvent to remove oil and oil residue. Make sure that the compression washer remains on the drain plug.
7. Use a 14 mm socket or wrench and replace the front oil drain plug, turning it clockwise, and tighten to 18 ft-lb (24.4 N·m).
8. Relocate the oil drain pan to a position under the engine oil filter **(Figure 10-4)**.
9. Remove the engine oil filter (1), turning it counterclockwise, allowing the residual oil in the filter port and filter to drain into the oil drain pan (2) **(Figure 10-5)**. **See following NOTE.**

NOTE: *An oil drip guard (3) can be used to prevent excess oil from dripping into the engine base plate. Use an empty quart (one liter) container and cut the bottom off at an angle, then slide the open area of the container up and under the oil filter prior to removing. Position the port of the plastic container so oil will be directed into the oil pan. Or, make a drip guard 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.

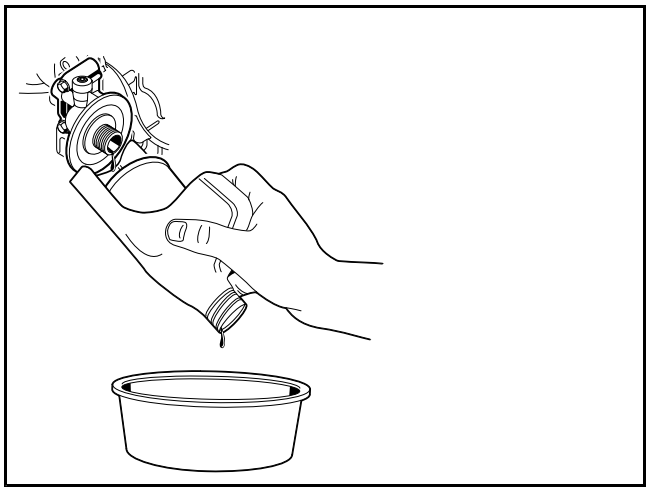

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Figure 10-5 Remove Engine Oil Filter

10. Use a clean rag and wipe the oil filter mounting bracket surface clean where the oil filter gasket seats.
11. Install a new oil filter (CCI P/N 1016467) onto the engine oil filter port. Apply a light coat of white lithium NLGI Number 2 grease (Dow Corning® BR2-Plus or equivalent) or new engine oil to the rubber seal around the outside surface of the filter before attaching it to the oil filter port **(Figure 10-6)**. This will help seal the filter to the oil filter mounting bracket.

NOTE: *Use only Club Car oil filters (CCI P/N 1016467) designed for this engine.*

12. Tighten the oil filter by hand until tight. Do not use a band wrench or channel lock plier to tighten.
13. Remove the dipstick and add engine oil into the dipstick port. Use a funnel or pour spout to direct the oil into the dipstick port. With filter change, the engine requires 38 ounces (1.12 liters) of oil per change. Refer to oil viscosity guidelines for selection of oil grade **(Figure 10-7)**. Replace the dipstick.

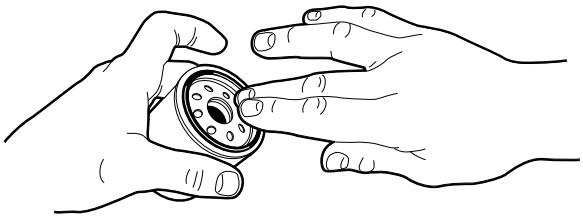

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Figure 10-6 Coat Oil Filter Rubber Seal

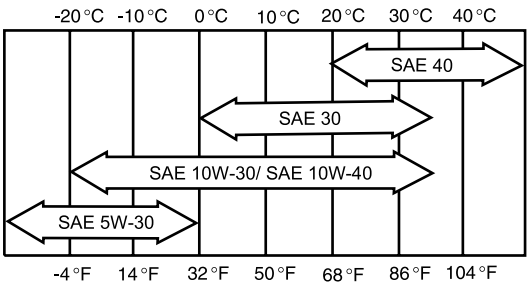

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Figure 10-7 Oil Viscosity Chart

14. Connect battery and spark plug wire(s). **See Connecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
15. With the Forward/Reverse handle in the NEUTRAL position, start and run the engine for a few minutes. Observe both the drain plug and the oil filter from under the vehicle and watch for oil leaks. If leaks appear, begin with step 1 and repeat the appropriate step for either or both items to correct the problem.
16. Remove the dip stick and check the engine oil as a final step. Replace the dip stick.

⚠ DANGER

- **See General Warning on page 1-1.**

⚠ WARNING

- **See General Warning on page 1-1.**

GENERAL INFORMATION

This section contains the information required to correctly troubleshoot the gasoline vehicle. A troubleshooting guide is provided for general troubleshooting. For issues pertaining solely to the electrical system, proceed to Electrical System on page 11-6.

In addition to troubleshooting, this section contains general information on the electrical system and the electrical circuits of the system.

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. The procedures used in making these checks can be found in the referenced sections of this maintenance and service manual.

TROUBLESHOOTING GUIDE		
SYMPTOM	**POSSIBLE CAUSES**	**REFER TO**
Engine does not start easily.	Spark plug is partially fouled or in poor condition	See Section 15 – S10 FE 350 Engine. See Section 16 – S27 FE 350 Engine.
	Spark plug wire is damaged or loose	See Section 15 – S10 FE 350 Engine. See Section 16 – S27 FE 350 Engine.
	Loose wire connection at ignition coil or RPM limiter	Test Procedures 14 – *Ignition Spark*, 15 – *RPM Limiter*, and 16 – *Ignition Coil*
	Intermittent ignition coil failure	Test Procedures 14 – *Ignition Spark*, 15 – *RPM Limiter*, and 16 – *Ignition Coil*
	Low cylinder compression	See Section 15 – S10 FE 350 Engine. See Section 16 – S27 FE 350 Engine.
	Water or dirt in the fuel system and/or carburetor; dirty or clogged fuel filter	See Section 17 – S10 FE 350 Fuel System. See Section 18 – S27 FE 350 Fuel System.
	Carburetor improperly adjusted	See Section 17 – S10 FE 350 Fuel System. See Section 18 – S27 FE 350 Fuel System.
	Starter/generator belt is slipping	Belt Tension Adjustment on page 13-12

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	See Section 15 – S10 FE 350 Engine. See Section 16 – S27 FE 350 Engine.
	Spark plug wire is damaged or loose	See Section 15 – S10 FE 350 Engine. See Section 16 – S27 FE 350 Engine.
	Intermittent ignition coil failure	Test Procedures 14 – *Ignition Spark*, 15 – *RPM Limiter*, and 16 – *Ignition Coil*
	Water or dirt in the fuel system and/or carburetor; dirty or clogged fuel filter	See Section 17 – S10 FE 350 Fuel System. See Section 18 – S27 FE 350 Fuel System.
	Fuel pump malfunction; fuel pressure to carburetor too low	See Section 17 – S10 FE 350 Fuel System. See Section 18 – S27 FE 350 Fuel System.
Engine turns but fails to start.	Fuel tank is empty	See Section 17 – S10 FE 350 Fuel System. See Section 18 – S27 FE 350 Fuel System.
	Fuel line or filters clogged	See Section 17 – S10 FE 350 Fuel System. See Section 18 – S27 FE 350 Fuel System.
	Fouled spark plug	See Section 15 – S10 FE 350 Engine. See Section 16 – S27 FE 350 Engine.
	Spark plug wire damaged or loose	See Section 15 – S10 FE 350 Engine. See Section 16 – S27 FE 350 Engine.
	Loose wire connection at ignition coil or RPM limiter	Test Procedures 14 – *Ignition Spark*, 15 – *RPM Limiter*, and 16 – *Ignition Coil*
	Engine flooded with fuel as result of excess choking	See Owner's Manual, Controls and Indicators. See Choke.
	Fuel pump malfunction or failure	See Section 17 – S10 FE 350 Fuel System. See Section 18 – S27 FE 350 Fuel System.
	Ignition coil or RPM limiter failed	Test Procedures 14 – *Ignition Spark*, 15 – *RPM Limiter*, and 16 – *Ignition Coil*
	Kill circuit grounded	Test Procedures 17 – *Key Switch (Engine Kill Circuit)* and 18 – *Engine Kill Wire*
Engine overheats.	Fan screen is partially blocked or plugged	See the Engines and Transaxles manual (CCI P/N 102396501)
	Governor is improperly adjusted	See Section 17 – S10 FE 350 Fuel System. See Section 18 – S27 FE 350 Fuel System.
	Carburetor is too lean; check main jet size	See Section 17 – S10 FE 350 Fuel System. See Section 18 – S27 FE 350 Fuel System.
Engine pre-ignites.	Excessive carbon deposits on piston head or in combustion chamber	See the Engines and Transaxles manual (CCI P/N 102396501)
	Spark plug heat range is incorrect	See Section 15 – S10 FE 350 Engine. See Section 16 – S27 FE 350 Engine.
	Unsuitable or contaminated fuel	See Section 17 – S10 FE 350 Fuel System. See Section 18 – S27 FE 350 Fuel System.

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 Engines and Transaxles manual (CCI P/N 102396501)
	Muffler or exhaust pipe restricted with carbon or other substance	See Section 19 – Exhaust System: Gasoline Vehicles.
	Ignition coil failed	Test Procedures 14 – *Ignition Spark*, 15 – *RPM Limiter*, and 16 – *Ignition Coil*
	Air filter is dirty or clogged	See Section 17 – S10 FE 350 Fuel System. See Section 18 – S27 FE 350 Fuel System.
	Governor is improperly adjusted	See Section 17 – S10 FE 350 Fuel System. See Section 18 – S27 FE 350 Fuel System.
	Throttle linkage out of adjustment	See Section 17 – S10 FE 350 Fuel System. See Section 18 – S27 FE 350 Fuel System.
	Low cylinder compression	See Section 15 – S10 FE 350 Engine. See Section 16 – S27 FE 350 Engine.
	Spark plug failed	See Section 15 – S10 FE 350 Engine. See Section 16 – S27 FE 350 Engine.
	Restricted fuel flow	See Section 17 – S10 FE 350 Fuel System. See Section 18 – S27 FE 350 Fuel System.
	Torque converter is not backshifting properly	See Section 21 – Torque Converter: Gasoline Vehicles.
Spark plug fouls repeatedly.	Incorrect plug	See Section 15 – S10 FE 350 Engine. See Section 16 – S27 FE 350 Engine.
	Unsuitable fuel, or incorrect (rich) fuel mixture	See Section 15 – S10 FE 350 Engine. See Section 16 – S27 FE 350 Engine.
	Spark plug wire is damaged	See Section 15 – S10 FE 350 Engine. See Section 16 – S27 FE 350 Engine.
	Dirt entering combustion chamber	See Section 17 – S10 FE 350 Fuel System. See Section 18 – S27 FE 350 Fuel System.
	Ignition coil failed	Test Procedures 14 – *Ignition Spark*, 15 – *RPM Limiter*, and 16 – *Ignition Coil*
	Rings are heavily worn, low cylinder pressure	See the Engines and Transaxles manual (CCI P/N 102396501)
Carburetor floods.	Inlet valve or seat is leaking, dirty, worn, or damaged	See Section 17 – S10 FE 350 Fuel System. See Section 18 – S27 FE 350 Fuel System.
	Float is damaged and filled with gasoline	See Section 17 – S10 FE 350 Fuel System. See Section 18 – S27 FE 350 Fuel System.
	Carburetor vent is clogged	See Section 17 – S10 FE 350 Fuel System. See Section 18 – S27 FE 350 Fuel System.
	Float needle valve not functioning properly	See Section 17 – S10 FE 350 Fuel System. See Section 18 – S27 FE 350 Fuel System.

TABLE CONTINUED ON NEXT PAGE

TROUBLESHOOTING GUIDE		
SYMPTOM	**POSSIBLE CAUSES**	**REFER TO**
Starter fails to operate.	Fuse is blown	Test Procedure 2 – *Fuse*
	Battery is dead	Test Procedure 1 – *Battery*
	Starter control circuit is not operating	Test Procedure 8 – *Starter/Generator (Starter Function)*
	Starter/generator failed	Test Procedure 8 – *Starter/Generator (Starter Function)*
	Starter solenoid failed	Test Procedure 6 – *Solenoid*
	Key switch failed	Test Procedure 4 – *Key Switch (Starter Circuit)*
	Lockout limit switch failed	Test Procedure 7 – *Neutral Lockout Limit Switch*
	Loose or broken wire in starter/generator circuit	Starter/Generator on page 13-1
	Cylinder and/or crankcase flooded with fuel	See Section 17 – S10 FE 350 Fuel System. See Section 18 – S27 FE 350 Fuel System.
Starter/Generator does not charge battery.	Diode failed (open condition)	Test Procedure 10 – *Diode (Generator Circuit)*
	Loose or broken wire in the starter/ generator circuit	Test Procedure 11 – *Starter/Generator (Generator Function)*
	Generator field coil is shorted	Test Procedure 11 – *Starter/Generator (Generator Function)*
	Brushes are worn or commutator is dirty	Starter/Generator on page 13-1
	Starter/generator belt is loose or slipping	Belt Tension Adjustment on page 13-12
	Voltage regulator failed	Test Procedure 12 – *Voltage Regulator*
	Battery failed	Test Procedure 1 – *Battery*
Transmission does not engage or disengage smoothly.	Transmission shifter linkage is binding or is out of adjustment	Forward/Reverse Shifter Cable Adjustment on page 20-22
	Idle RPM Setting is set too high	See Section 17 – S10 FE 350 Fuel System. See Section 18 – S27 FE 350 Fuel System.
	Insufficient (low) level of lubricant or wrong type of lubricant in transmission	Lubrication on page 20-3
	Internal gears are damaged or worn	See the Engines and Transaxles manual (CCI P/N 102396501)
	Synchronizer rings are worn, damaged or jammed	See the Engines and Transaxles manual (CCI P/N 102396501)

TABLE CONTINUED ON NEXT PAGE

TROUBLESHOOTING GUIDE		
SYMPTOM	**POSSIBLE CAUSES**	**REFER TO**
Excessive vehicle vibration.	Engine mounting nuts or bolts are loose	See Section 15 – S10 FE 350 Engine. See Section 16 – S27 FE 350 Engine.
	Snubber on frame is worn or damaged	See Section 15 – S10 FE 350 Engine. See Section 16 – S27 FE 350 Engine.
	Misaligned muffler mounting clamp	See Section 19 – Exhaust System: Gasoline Vehicles.
	Damaged drive belt or starter belt	See Section 21 – Torque Converter: Gasoline Vehicles.
	Damaged drive clutch	See Section 21 – Torque Converter: Gasoline Vehicles.
	Damaged driven clutch	See Section 21 – Torque Converter: Gasoline Vehicles.
	Damaged starter/generator pulley	Starter/Generator Removal on page 13-1
	RPM setting is incorrect	Engine RPM Adjustment on page 17-11
Torque converter does not shift smoothly.	Drive belt is worn, cracked, glazed, or frayed	Drive Belt on page 21-2
	Drive clutch malfunction	Driven Clutch Inspection on page 21-13
	Driven clutch malfunction	Driven Clutch Inspection on page 21-13
	Governor is sticking	See the Engines and Transaxles manual (CCI P/N 102396501)
Engine won't stop running.	Kill circuit wire is disconnected from the ignition coil	Test Procedure 13 – *Grounded Kill Wire*
	Key switch failure	Test Procedures 4 – *Key Switch (Starter Circuit)* and 17 – *Key Switch (Engine Kill Circuit)*
	Carburetor is too lean; check main and pilot jet sizes	See Section 17 – S10 FE 350 Fuel System. See Section 18 – S27 FE 350 Fuel System.
	Carburetor throttle stop screw out of adjustment	See Section 17 – S10 FE 350 Fuel System. See Section 18 – S27 FE 350 Fuel System.

ELECTRICAL SYSTEM

The electrical system on the gasoline key-start vehicles is 12 volts DC with negative ground to frame. It consists of the following:

- Starter Circuit
- Generator Circuit
- Engine Ignition Circuit
- Engine Kill Circuit
- Reverse Buzzer Circuit
- Low Oil Warning Circuit
- Fuel Gauge and Sending Unit Circuit
- Hour Meter Circuit
- Lighting Circuit

A key-start with neutral rev vehicle uses the ignition key to activate the electrical system and start the engine. It allows the engine to run at idle or advanced RPM using the accelerator pedal when the Forward/Reverse handle is in the NEUTRAL position.

WIRING DIAGRAMS

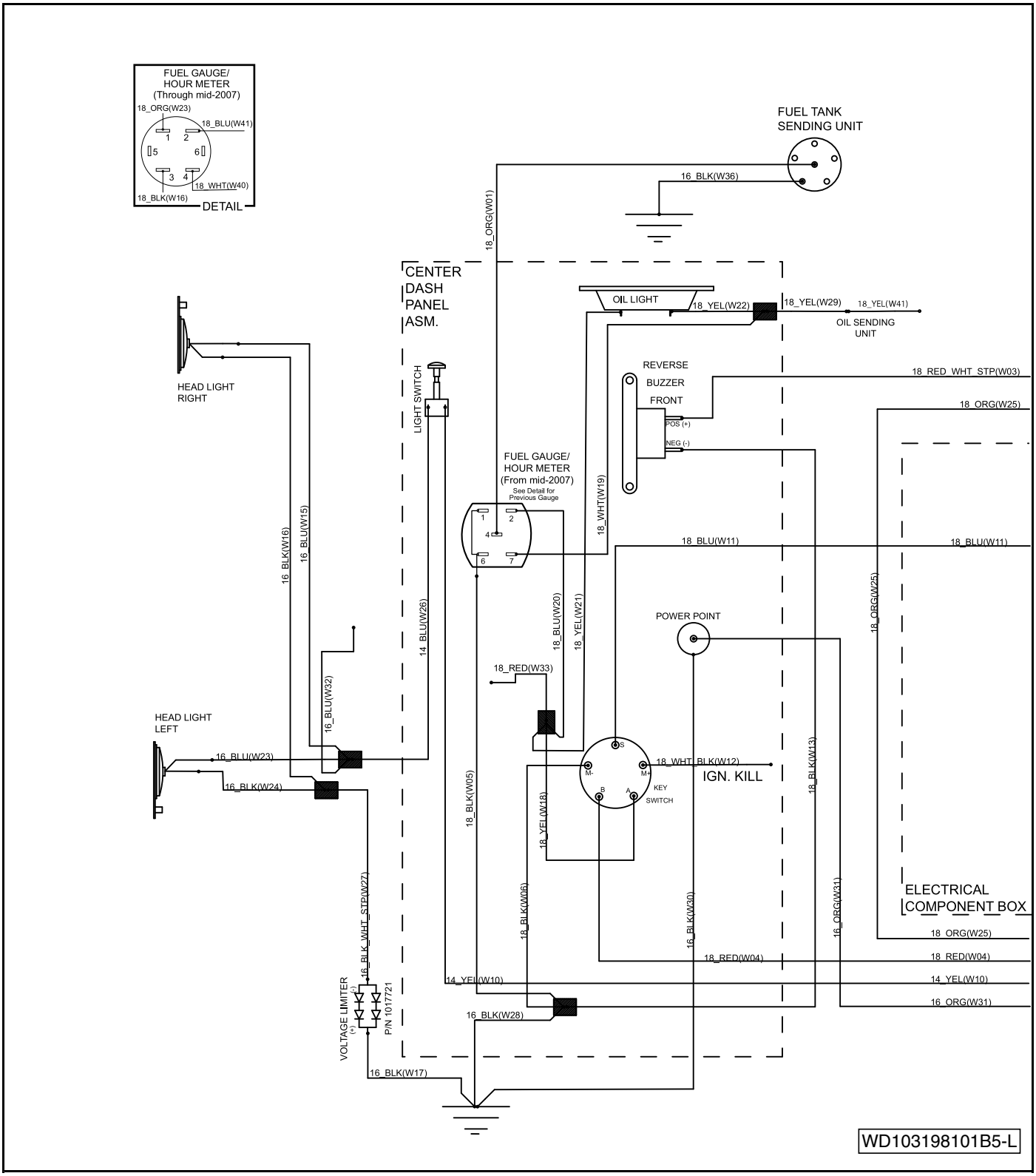


Figure 11-1 Wiring Diagram for Key-Start (Neutral Rev) Gasoline Vehicles

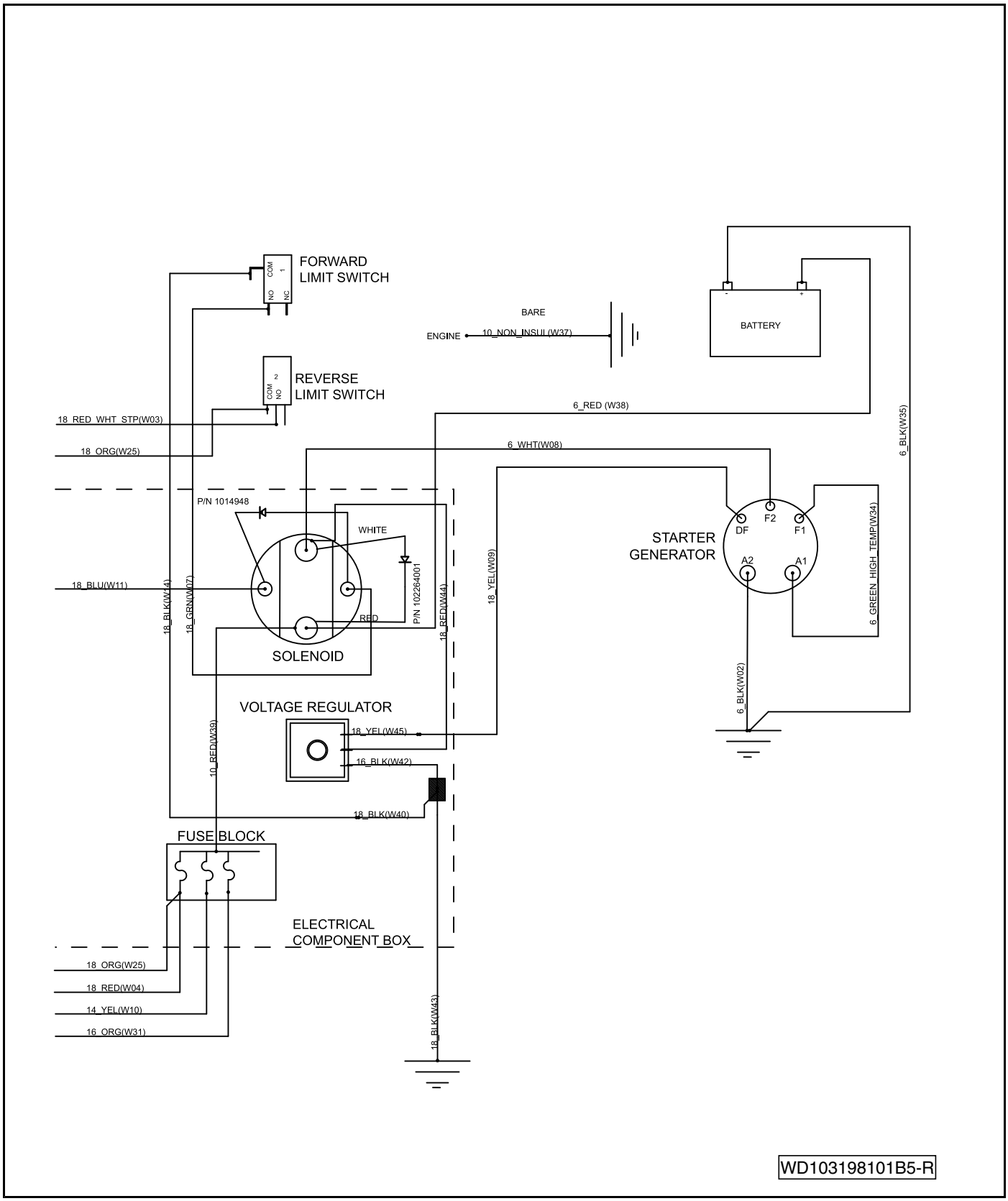


Figure 11-2 Wiring Diagram for Key-Start (Neutral Rev) Gasoline Vehicles

TEST PROCEDURES

Index of Test Procedures

TEST PROCEDURE 1 – Battery

See General Warning on page 1-1.

⚠ DANGER

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

DANGER CONTINUED ON NEXT PAGE

⚠ DANGER

- **Internal: Drink large quantities of milk or water. Follow with milk of magnesia or vegetable oil. Call a physician immediately.**
- **Eyes: Flush with water for 15 minutes. Call a physician immediately.**

NOTE: *The battery must be properly maintained and fully charged in order to perform the following test procedures. Battery maintenance procedures, including watering information and allowable mineral content, can be found in the Battery Section of this manual.* ***See Battery, Section 13, Page 13-35.***

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.

Hydrometer Test

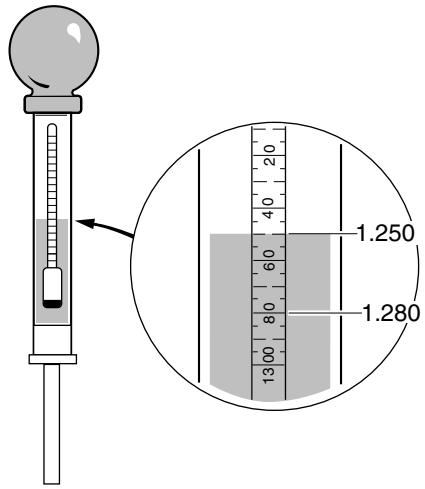
A hydrometer (CCI P/N 1011478) measures the specific gravity. The higher the specific gravity, the higher the state of charge of the battery. A fully charged battery should read between 1.250 and 1.280 at 80 °F (27 °C). Never add acid to the battery to obtain a higher specific gravity **(Figure 11-3,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

CAUTION

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

Performing the Hydrometer Test

1. Be sure that the battery has sufficient water to cover the plates by approximately 1/2-inch (13 mm) and is fully charged prior to beginning the test. If water must be added, recharge the battery before performing the hydrometer test **(Figure 11-4, Page 11-11)**.
2. Remove the vent cap.
3. Using a battery thermometer (CCI P/N 1011767), record the electrolyte temperature of a center cell.
4. Squeeze the rubber bulb of the hydrometer and insert into the cell. Slowly release the bulb, drawing electrolyte up into the glass tube of the hydrometer.
5. When the float rises off the bottom, adjust the electrolyte level so that the float rides free of the bottom but does not strike the bottom of the rubber bulb. Remove the hydrometer from the cell and release the pressure from the bulb.
6. Hold the hydrometer vertically, ensuring that the float is not contacting the sides of the glass tube. Hold the hydrometer at eye level and read the scale at the level of electrolyte **(Figure 11-3, Page 11-11)**.
7. Record the reading.
8. Return the electrolyte to the cell from which it was taken. Replace vent cap.
9. Repeat steps 2 through 8 on all cells.



View at eye level.

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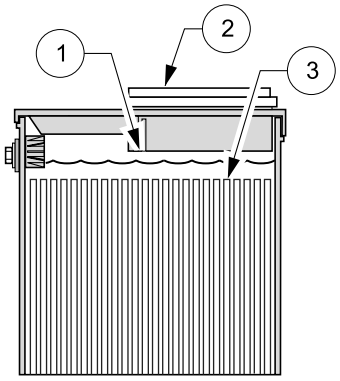
Figure 11-3 Hydrometer Test



1. Level Indicator
2. Cap
3. Plates

Electrolyte level at least 1/2 inch (13 MM) above plates or to level indicator.

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Figure 11-4 Battery Electrolyte Level

Hydrometer Calibration

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

Interpreting the Results of the Hydrometer Test

The approximate state of charge can be determined by referring to the following table:

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

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

Voltage Test

Place the red (+) probe of a multimeter set at Volts DC, 20 volt range, on the positive (+) cable and place the black (–) probe on the negative (–) post of the battery and take a voltage reading. If it shows less than 12.4 volts, or if the lowest specific gravity reading from the hydrometer test is less than 1.225, recharge the battery. If battery voltage is greater than 12.4 volts and specific gravity is greater than 1.225, the problem is not with the battery. If the battery does not reach 12.4 volts, or if the specific gravity of a cell is still less than 1.225 after charging, replace the battery. **See following NOTE.**

NOTE: *A fully charged battery that is in good condition should have a specific gravity of at least 1.225 in all cells, and the difference in the specific gravity of any two cells should be less than 50 points. Open circuit voltage should be at least 12.4 volts.*

Load Test

1. Connect a 160-ampere load tester to the battery posts.
2. Turn the switch on the load tester to the ON position.
3. Read the battery voltage after the load tester has been turned ON for 15 seconds. Compare the battery's voltage reading with the table below. Make sure you have the correct ambient temperature.
4. If the battery is found to be good, or if the electrical problem continues after the battery has been replaced with a good one, test the electrical circuits.

IF TEMPERATURE IS	MINIMUM CRANKING VOLTAGE
70 °F (20 °C) and above	9.6 V
60 °F (16 °C)	9.5 V
50 °F (10 °C)	9.4 V
40 °F (4 °C)	9.3 V
30 °F (-1 °C)	9.1 V
20 °F (-7 °C)	8.9 V
10 °F (-12 °C)	8.7 V
0 °F (-18 °C)	8.5 V

TEST PROCEDURE 2 – Fuse

See General Warning on page 1-1.

The fuse (red 10 amp) is located in the electrical component box.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels.
2. Disconnect battery. **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
3. Remove the cover on the electrical component box.
4. Check that wires are connected correctly and are tight. If they are not, rewire or tighten as necessary.
5. Remove fuse to be tested from the fuse block. **See Fuse Removal, Section 13, Page 13-20.** The red 10 amp fuse protects the solenoid for the starter (cranking) circuit. The 20 amp fuse at the yellow wire connection protects the headlights.
6. Connect the probes of a multimeter set to 200 ohms to the fuse terminals. The reading should be continuity. If there is no continuity, determine and repair the cause of the fuse failure. Replace the fuse with a properly rated new one.
7. Connect battery and spark plug wire(s). **See Connecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**

TEST PROCEDURE 3 – Ground Cables

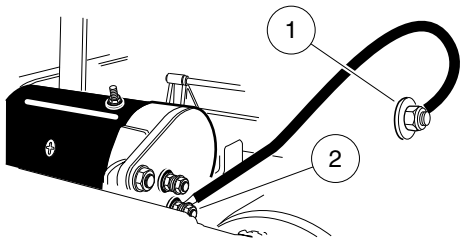
See General Warning on page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels.
2. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
3. Check the starter/generator ground strap.
   3.1. Set the multimeter to 200 ohms. Place the red (+) probe on the (A2) terminal of the starter/generator and place the black (–) probe on the vehicle frame **(Figure 11-5, Page 11-13)**. The reading should be continuity.

If the reading is incorrect, clean and tighten wire connections. If the connections are good and the reading is incorrect, repair or replace the wire.

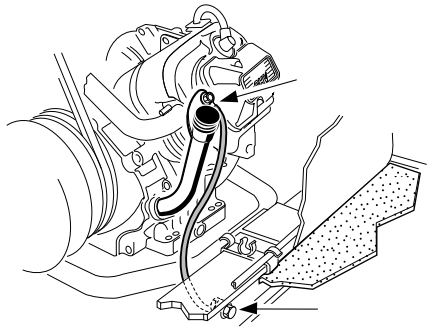
4. Check the engine ground strap.

   4.1. Place the red (+) probe of the multimeter on the ground strap terminal end located on the oil filler bracket on the engine **(Figure 11-6, Page 11-13)**. Place the black (–) probe on the vehicle frame. The reading should be continuity. If the reading is incorrect, clean and tighten wire connections. If the connections are good and the reading is incorrect, repair or replace the wire.



1. Ground to Chassis
2. A2 Terminal

Figure 11-5 Test Starter/Generator Ground Strap



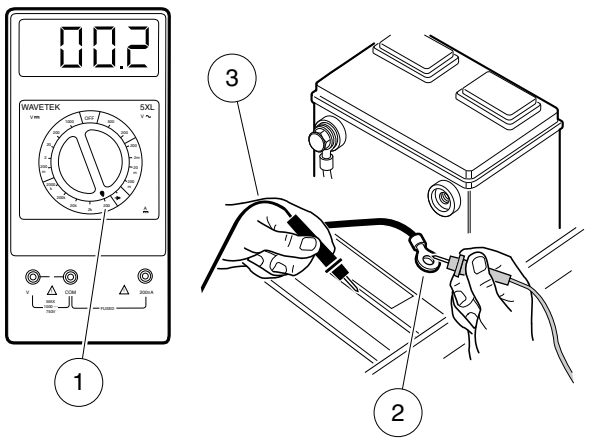
Place test probes at each end of ground cable.

Figure 11-6 Test Engine Ground Strap

5. Check voltage regulator ground connection (at battery frame ground). Make sure it is clean and tight.
6. Check the battery ground cable.

   6.1. A 6-gauge black wire connects the negative battery post to the frame. The frame connection should be clean and tight. Visual inspection of the connection on the frame is very difficult. The best check for tightness is to pull on the black wire. If the wire moves at the connection end, disassemble the frame connection and clean the bolt, ring terminal, and nut. Install the frame connection.

   6.2. Set the multimeter to 200 ohms. Place the red (+) probe on the unconnected end of the 6-gauge black wire, and place the black (–) probe on the vehicle frame **(Figure 11-7, Page 11-13)**. The reading should be continuity. If the reading is incorrect, check that terminal connections are clean and tight. If the connections are good and the reading is incorrect, repair or replace the wire.



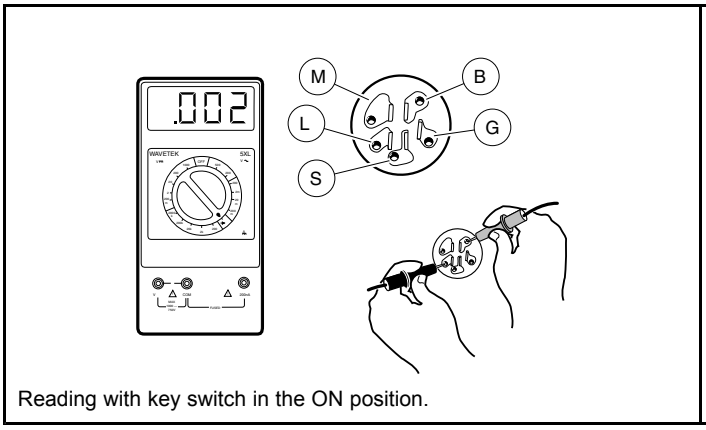
1. Disconnect the 6-gauge black wire from the battery. Place red (+) probe on disconnected end of cable.
2. Place black (–) probe on frame.

Figure 11-7 Battery Ground Cable Test

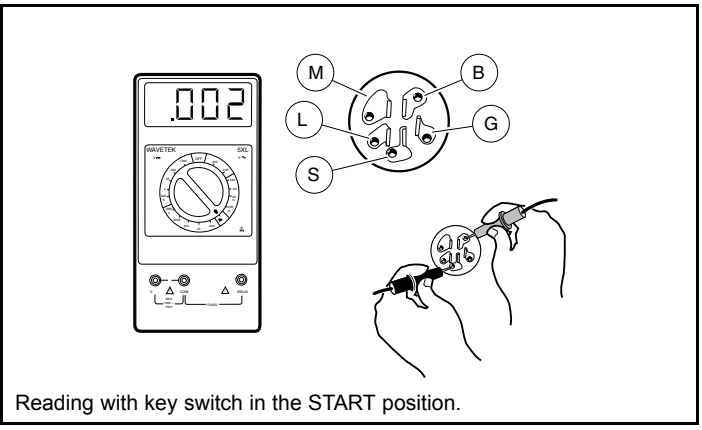
TEST PROCEDURE 4 – Key Switch (Starter Circuit)

See General Warning on page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels.
2. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
3. Remove the instrument panel. **See Key Switch Removal, Section 13, Page 13-17.**
4. Ensure that the connector is connected correctly and is tight. If it is not, repair or replace as necessary.
5. Insert the key and turn the key to 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 be continuity. If the reading is incorrect, replace the key switch **(Figure 11-8, Page 11-14)**. **See Key Switch Removal, Section 13, Page 13-17.**
6. With the key still in the ON position, place the red (+) probe of the multimeter on the (B) terminal and the black (–) probe on the (S) terminal of the key switch. The reading should show no continuity. If the reading is incorrect, replace the key switch. **See Key Switch Removal, Section 13, Page 13-17.** If the reading is correct, leave the probes connected and proceed to the next step.
7. Insert the key and hold the key in the START position. The reading should be continuity. If the reading is incorrect, replace the key switch **(Figure 11-9, Page 11-14)**. With 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 be continuity. If either reading is incorrect, replace the key switch. **See Key Switch Removal, Section 13, Page 13-17.**



Reading with key switch in the ON position.



Reading with key switch in the START position.

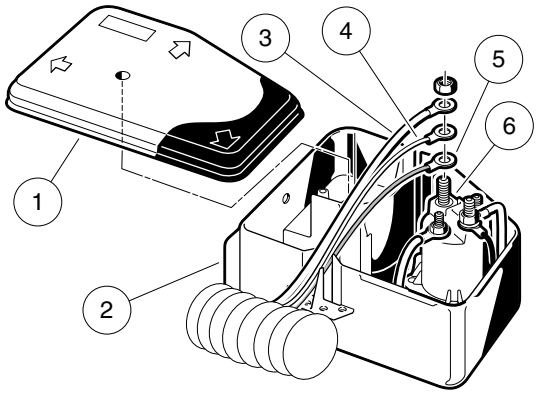
Figure 11-8 Key Switch Test – Accessory Terminal

Figure 11-9 Key Switch Test – Starter Circuit

TEST PROCEDURE 5 – Key Switch (Accessory Terminal)

See General Warning on page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels.
2. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
3. Remove the instrument panel. **See Key Switch Removal, Section 13, Page 13-17.**
4. Ensure that the connector is connected correctly and is tight. If it is not, repair or replace as necessary.
5. Insert the key and turn the switch to the ON position. With the multimeter set to 200 ohms, place the red (+) probe of the multimeter on the (B) terminal and the black (–) probe on the (L) terminal of the key switch **(Figure 11-8, Page 11-14)**. The reading should be continuity. If the reading is incorrect, replace the key switch. **See Key Switch Removal, Section 13, Page 13-17.**



1. Cover
2. Electrical Component Box
3. 6 Ga. White Wire
4. 16 Ga. White Wire
5. 16 Ga. Red Wire
6. Solenoid

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Figure 11-10 Remove Solenoid Wires

TEST PROCEDURE 6 – Solenoid

See General Warning on page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels.
2. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
3. Remove the electrical component box cover.
4. Check that the wires are connected correctly and are tight. If they are not, rewire or tighten as necessary.
5. Set a multimeter to 200 ohms. Place the red (+) probe on one of the small posts of the solenoid and place the black (–) probe on the other small post. The reading should be 14 to16 ohms. If the reading is not within limits, replace the solenoid.
6. Remove the wires from the large post of the solenoid. Do not allow the wires to touch the frame or other components of the vehicle **(Figure 11-10, Page 11-15)**.
7. Set the multimeter to 200 ohms. Connect the red (+) probe to one of the large posts of the solenoid and connect the black (–) probe to the other large post **(Figure 11-11, Page 11-16)**.
8. With the key switch in the OFF position, connect the battery, positive (+) cable first.
9. Place the Forward/Reverse handle in the NEUTRAL position. With the key in the OFF position, the reading on the multimeter should be no continuity. Turn the key switch to the START position and listen for the solenoid click. While holding the key in the START position, there should be continuity. After the key is released, it should rotate to the ON position and should be no continuity. If either reading is incorrect, replace the solenoid.
10. With the Forward/Reverse handle still in the NEUTRAL position, set the multimeter to 20 volts DC and place the red (+) probe on the large post that does *not* have wires connected to it. Place the black (–) probe on the vehicle frame **See Solenoid Ground Test, Section 11, Page 11-16.**. Turn key switch to the START position and listen for the solenoid click. While holding the key in the START position, the meter should read full battery voltage. If the reading is incorrect, replace the solenoid.

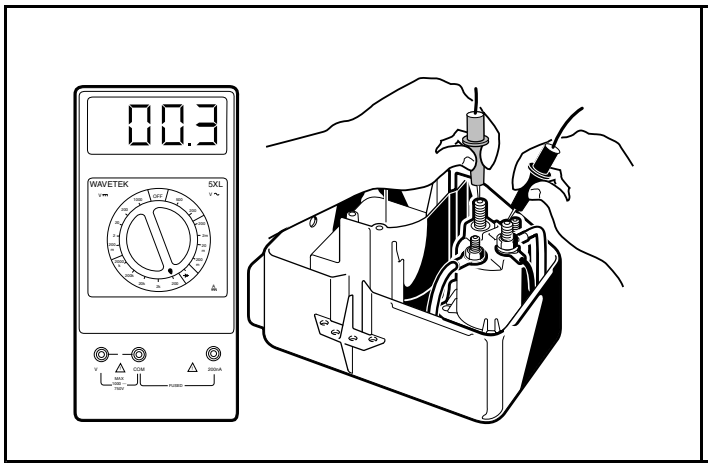

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Figure 11-11 Solenoid Continuity Test

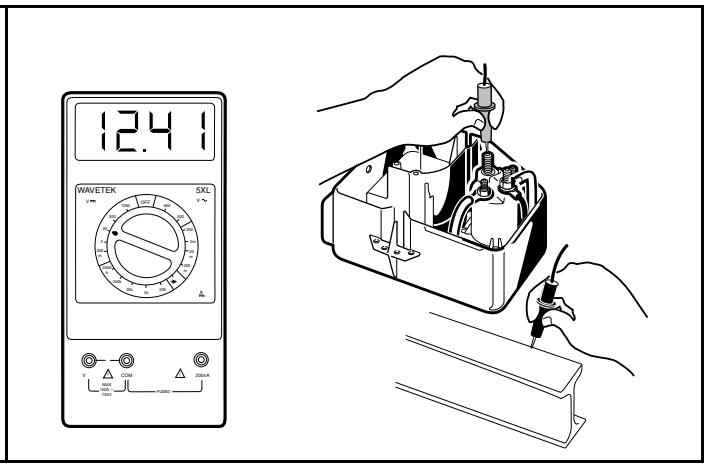

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Figure 11-12 Solenoid Ground Test

11. Disconnect the 6-gauge black wire from the negative post of the battery before reconnecting the wires to the solenoid.
12. Reconnect the solenoid. **See Solenoid Installation, Section 13, Page 13-19. See also following WARNING.**

⚠ WARNING

- **Incorrect wiring could result in severe injury or death.**
- **Diode and solenoid connections must have correct polarity.**
- **Keep all persons clear of engine belts when making final connections.**

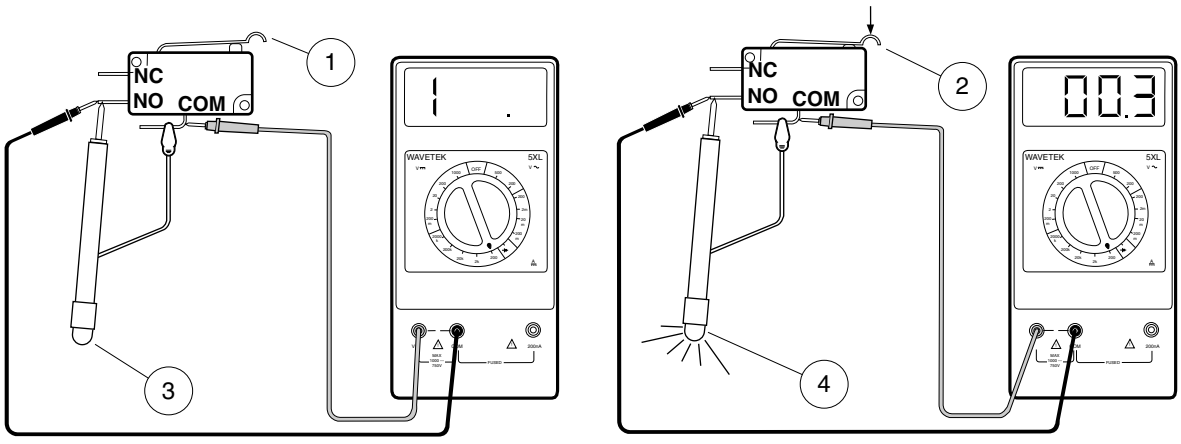
13. Connect battery and spark plug wire(s). **See Connecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**

TEST PROCEDURE 7 – Neutral Lockout Limit Switch

See General Warning on page 1-1.

This switch is located on the Forward/Reverse control assembly. A black/light blue wire, a gray wire, and a tan wire are connected to this limit switch.

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
2. Check for proper wiring and tight connections.
3. Set the multimeter to 200 ohms. Place the red (+) probe of the multimeter on the common (COM) terminal of the limit switch. Place the black (–) probe on the normally open (NO) terminal of the switch. Without the lever pressed, the reading should be no continuity. Press the lever, and the reading should be continuity. If either reading is incorrect, replace the limit switch **(Figure 11-13, Page 11-17)**.
4. Check to be sure the lobe on the cam is pressing the neutral lockout limit switch as the Forward/Reverse shifter is being shifted. The limit switch should make an audible click as it is pressed. If it does not, check for wear on the cam lobe and replace cam if necessary.



1. Lever Up 2. Lever Depressed 3. Tester light is OFF. Meter reads 1. 4. Tester light is ON. Meter reads approx. zero ohms.

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Figure 11-13 Neutral Lockout Limit Switch Test

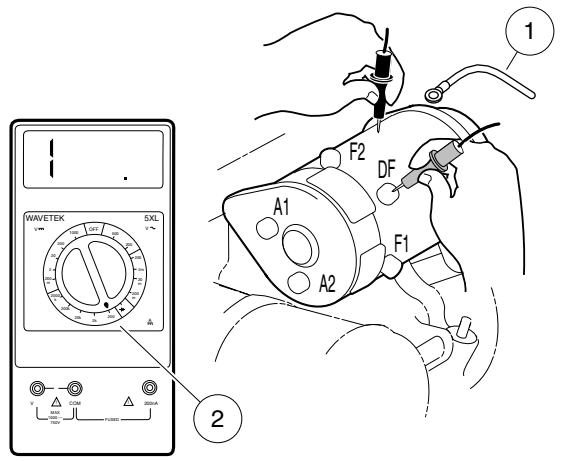
5. Connect battery and spark plug wire(s). **See Connecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**

TEST PROCEDURE 8 – Starter/Generator (Starter Function)

See General Warning on page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels.
2. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
3. Check that wires are connected correctly and are tight. If they are not, rewire or tighten as necessary.
4. Disconnect the wires from all the terminals on the starter/generator. Then place the black (–) probe of a multimeter, set to ohms, on the starter/generator housing (scratch through the finish to ensure a good ground). While holding the black probe against the housing, place the red (+) probe (one at a time) on the A1, A2, F1, F2 and DF terminals respectively **(Figure 11-14, Page 11-18)**. The readings should be no continuity. If the readings are incorrect, the starter/generator will need to be removed from the vehicle and disassembled by a qualified technician. **See Starter/Generator Removal, Section 13, Page 13-1.**
   – An incorrect reading from the A1 or A2 terminal indicates three possible problems: 1) a grounded A1 or A2 terminal, 2) a grounded wire in the brush area, or 3) a grounded armature/commutator.
   – If the F1 or F2 reading is incorrect, it indicates a possible grounded F1 or F2 terminal or a grounded field coil.
   – If the DF reading is incorrect, it indicates a possible grounded DF terminal or a grounded field coil.
5. Disconnect the ground wire from the A2 terminal and the green wire from the A1 terminal on starter/generator.
6. Using a multimeter set to 200 ohms, place the red (+) probe on the A1 terminal and the black (–) probe on the A2 terminal. The reading should be continuity. If the reading is incorrect, a possible open or poor contact in a brush assembly and/or open armature windings may be the cause. The starter/generator will need to be removed from the vehicle and disassembled by a qualified technician. **See Starter/Generator Removal, Section 13, Page 13-1.**
7. With the wires still disconnected, using a multimeter set on 200 ohms, place the red (+) probe on the F1 terminal and the black (–) probe on the F2 terminal. The reading should be between approximately 0.1 and 0.3 ohms. If the reading is incorrect, a possible open field coil or bad connections at terminals may be the cause. The starter/generator will need to be removed from the vehicle and disassembled by a qualified technician. **See Starter/Generator Removal, Section 13, Page 13-1.**
8. With the wires still disconnected, using a multimeter set to 200 ohms, place the red (+) probe on the DF terminal and the black (–) probe on the F1 terminal. The reading should be between 4.5 and 5.5 ohms. If the reading is incorrect, a possible grounded DF terminal and/or grounded field coil may be the cause. The starter/generator

will need to be removed from the vehicle and disassembled by a qualified technician. **See Starter/Generator Removal, Section 13, Page 13-1.**



1. Yellow Wire
2. 200 Ohm Setting

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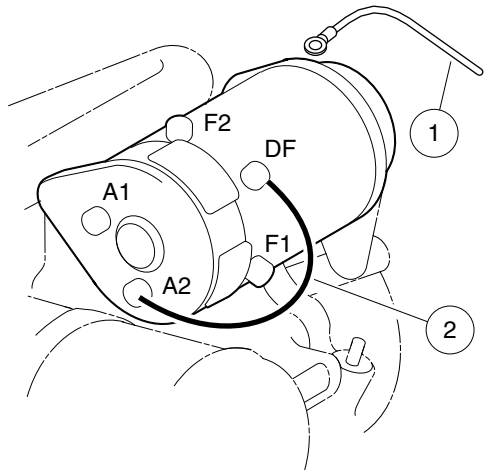
Figure 11-14 Check Starter Terminal Continuity



1. Yellow Wire
2. Jumper Wire

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Figure 11-15 Jumper Wire Ground – DF to A2

TEST PROCEDURE 9 – Wire Continuity

See General Warning on page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels.
2. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
3. To test a wire for continuity, disconnect either end from the electrical component it is attached to.
4. Set the multimeter to 200 ohms and place the red (+) probe on the terminal at one end of the wire. Place the black (–) probe on the other terminal end of the wire. The reading should be continuity. If the reading is incorrect, repair or replace the wire.

TEST PROCEDURE 10 – Diode (Generator Circuit)

See General Warning on page 1-1.

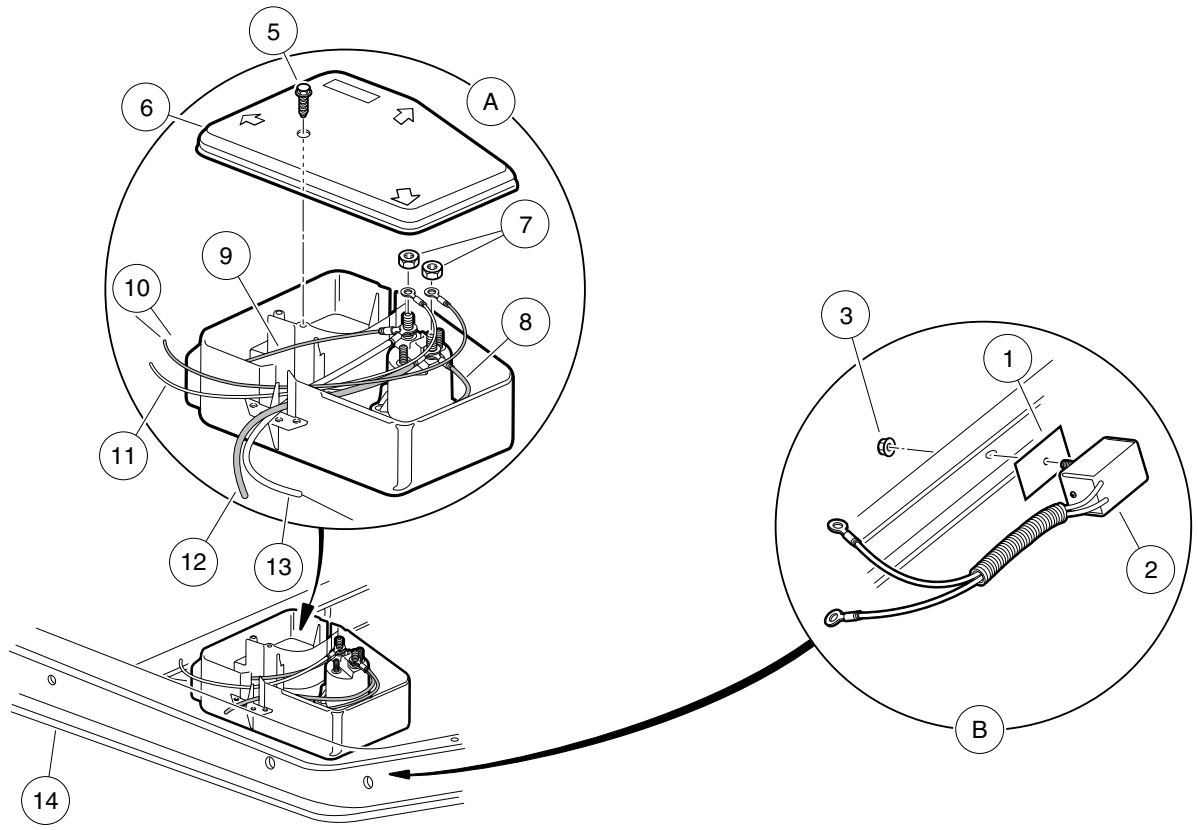
1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels.
2. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
3. Disconnect the red and white wires of the diode assembly from the solenoid posts, located within the electrical component box.
   - 3.1. Remove the intake hose to the carburetor at the carburetor intake port and move the hose to allow easy access to the electrical component box cover.
   - 3.2. Remove the cover retaining screw (5) and electrical component box cover (6) **(Figure 11-16, Page 11-19)**.
   - 3.3. Remove the locknuts (7) from the two large solenoid posts and disconnect the diode wires from the solenoid.
4. With the multimeter set to the diode test function (ç), connect the black (–) probe of the multimeter to the white lead of the diode and the red (+) probe of the multimeter to the red lead of the diode **(Figure 11-17, Page 11-20)**.

The reading should indicate an overload (no continuity). A diode is designed to conduct current in one direction only. If a diode conducts current (shows continuity) with the meter probes as described, the diode has failed and must be replaced. **See Diode Removal, Section 13, Page 13-15.**

5. Reverse the multimeter probes and note the reading. With the black (–) probe of the multimeter to the red lead of the diode and the red (+) probe of the multimeter to the white lead, the meter should read approximately 450 mV, however, a range of 400-500 mV is acceptable **(Figure 11-18, Page 11-20)**.
6. Connect either the black (–) or red (+) lead of the multimeter to the diode body (case). Connect the other multimeter lead to both the red and white lead terminals of the diode. The multimeter should indicate an overload, (no continuity). If continuity reading does occur, it indicates that one or both of the diode leads are grounded to the diode body (case) and the diode must be replaced. **See Diode Removal, Section 13, Page 13-15.**
7. If the diode tests good, reconnect the diode leads. **See Diode Installation, Section 13, Page 13-15. See also following WARNING.**

⚠ WARNING

- **Incorrect wiring could result in severe injury or death.**
- **Diode and solenoid connections must have correct polarity.**
- **Keep all persons clear of engine belts when making final connections.**



A. Some wires omitted for clarity.

B. Viewed from inside driver side frame

8. Red wire from fuse block 9. Red wire from voltage regulator 10. Red wire from diode 11. White wire from diode 12. Red wire from battery 13. White wire from starter/generator 14. Frame

Figure 11-16 Electrical Control Box and Diode Orientation

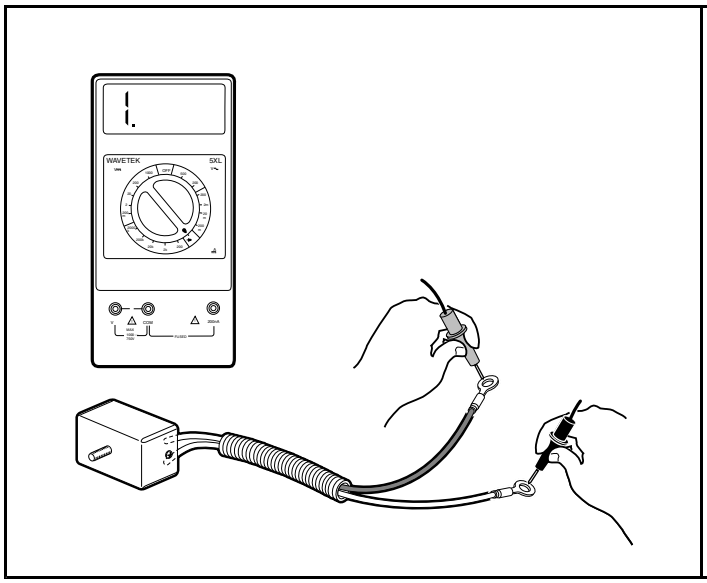


Figure 11-17 Diode Test

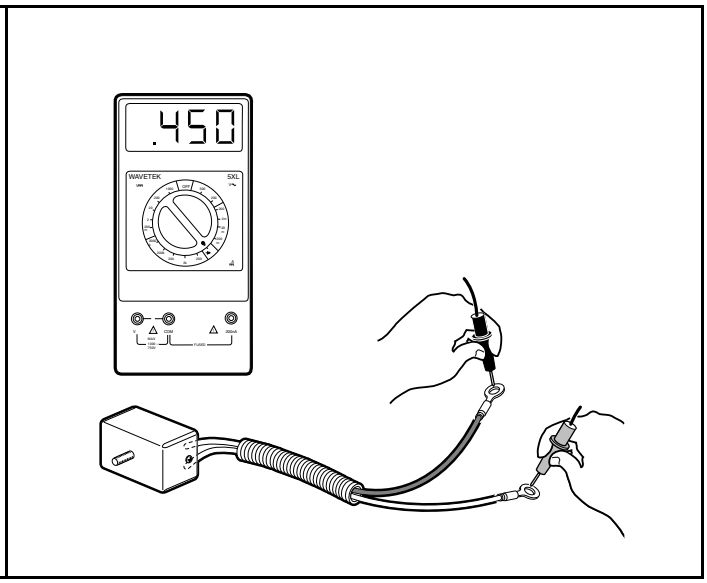


Figure 11-18 Diode Test – Probes Reversed

TEST PROCEDURE 11 – Starter/Generator (Generator Function)

See General Warning on page 1-1.

NOTE: *Perform **Test Procedure 10 – Diode (Generator Circuit) on page 11-18** before proceeding with this test procedure.*

Keep the battery connected while performing this test procedure.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels.
2. Ensure that the wires are connected correctly and are tight. If they are not, rewire or tighten as necessary.
3. Disconnect the yellow wire from the DF terminal on the starter/generator. Cover the connector on the yellow wire to make sure the yellow wire will not short to ground. Then, using a jumper wire, ground the DF terminal to the A2 terminal **(Figure 11-15, Page 11-18)**.
4. Using a multimeter set to 20 volts DC, place the red (+) probe on the positive (+) cable of the battery, and place the black (–) probe on the negative (–) post. Start the engine and run it at full governed speed. The reading should show the voltage rising on the meter. If the voltage rises, see Test Procedure 12 – Voltage Regulator on page 11-20. If the voltage does not rise, and the diode was found to be functioning properly in Test Procedure 10 – Diode (Generator Circuit) on page 11-18, a tear-down inspection of the starter/generator will be necessary. **See Starter/Generator Removal on page 13-1.**
5. Reconnect the yellow wire to the DF terminal on the starter/generator.

TEST PROCEDURE 12 – Voltage Regulator

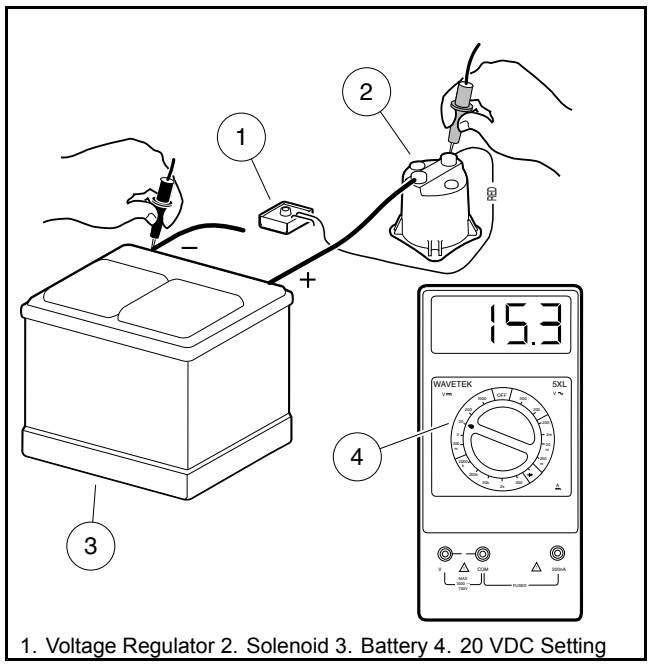
See General Warning on page 1-1.

NOTE: *Perform **Test Procedure 10 – Diode (Generator Circuit) on page 11-18** and before proceeding with this test procedure.*

Keep the battery connected while performing this test procedure.

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

2. Check 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 17-11.**
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. Turn the key switch to the OFF position, killing the engine. Using a multimeter set to 20 volts DC, place the red (+) probe on the large post of the solenoid with the red wire from the voltage regulator attached. Place the black (–) probe on the negative (–) battery post **(Figure 11-19, Page 11-21)**. With the Forward/Reverse handle in the NEUTRAL position and the wheels chocked, turn the key switch to the START position to start the engine. Press the accelerator to run the engine at full governed speed. If the reading is between 14.7 and 15.3 volts, the regulator is good. If the reading is lower than 14.7 volts but rising steadily, check battery condition. **See Hydrometer Test on page 12-11.** If the reading is lower than 14.7 volts and not rising, and the starter/generator is good; or if the reading is over 15.3 volts and continues to rise, replace voltage regulator. **See Voltage Regulator Removal, Section 13, Page 13-13.**



1. Voltage Regulator 2. Solenoid 3. Battery 4. 20 VDC Setting

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Figure 11-19 Test Voltage Regulator

TEST PROCEDURE 13 – Grounded Kill Wire

See General Warning on page 1-1.

NOTE: *Keep the battery connected while performing this test procedure.*

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels.
2. Disconnect the engine-kill white/black wire at the bullet connector located next to the RPM limiter **(Figure 11-21, Page 11-22)**.

NOTE: *Disconnecting the engine-kill wire removes it from the start/stop circuit.*

3. Turn the key switch to the START position and release after the engine starts. If the engine starts and continues to idle, check the kill-wire for grounding, the kill limit switch, and the key switch. **See Engine Kill Wire on page 11-29. See following WARNING.**

⚠ WARNING

- **When the white/black engine kill wire is disconnected, the engine will not stop running 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.**

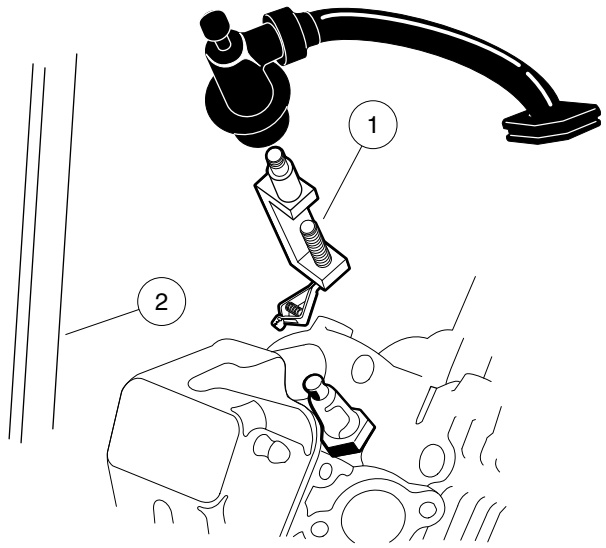
4. If the engine does not run, connect the white/black wire at the bullet connector next to the RPM limiter and proceed to Test Procedure 14 – Ignition Spark on page 11-22.

TEST PROCEDURE 14 – Ignition Spark

See General Warning on page 1-1.

NOTE: *Keep the battery connected while performing this test procedure.*

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels.
2. Remove the plug wire from the spark plug. Using an ignition spark gap test tool (Thexton 404® or equivalent), check for correct spark **(Figure 11-20, Page 11-22)**.
   2.1. Adjust the tester probes to approximately to 18,000 volts (18 Kv) setting (SE – *Small Engine Setting* on the Thexton 404 tool). Connect the tester to the spark plug wire, and connect the alligator clip to a solid engine ground.
   2.2. Start the engine. There should be a strong blue spark between the probes of the spark gap tester. If there is no spark, or if the spark is a faint yellow or red color, test components of the ignition circuit.
3. If the spark gap tester tool indicates a strong blue spark, it is possible the spark plug has failed internally. Check the spark plug gap. The gap should be set at 0.027 to 0.031 of an inch (0.69 to 0.79 mm). If the gap is correct, replace the spark plug with a new part and test the engine for proper operation.



1. Ignition Gap Test Tool
2. Chassis

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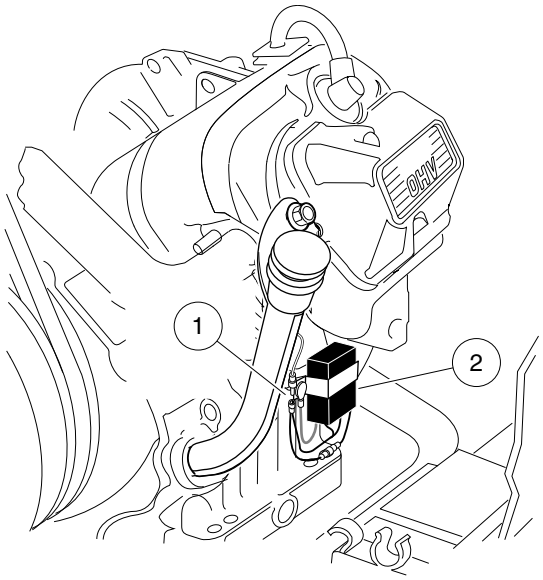
Figure 11-20 Ignition Spark Test



1. Disconnect White/Black Engine Kill Wire
2. RPM Limiter

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Figure 11-21 White/Black Engine Kill Wire

TEST PROCEDURE 15 – RPM Limiter

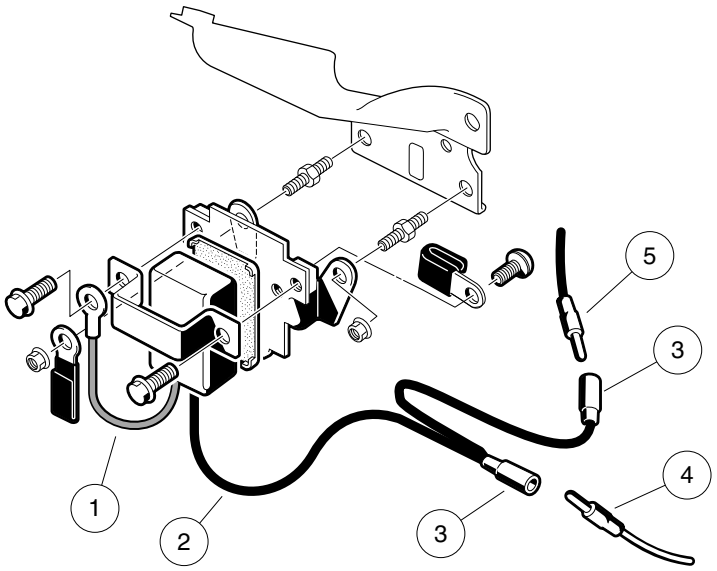
See General Warning on page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels.
2. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
3. Disconnect both of the bullet terminals **(Figure 11-22, Page 11-23)**.
4. Using a multimeter set to 200 ohms, place the red (+) probe on the brown ground wire and place the black (–) probe on one of the black wire female bullet connectors. The reading should be no continuity. If the reading is not correct, replace the RPM limiter.
5. This test will find most bad RPM limiters. Some of them may bench test okay but fail under a load due to heat while operating. Another method of testing is to replace the RPM limiter and then run the engine. If the engine runs properly, keep the new RPM limiter in the circuit.

TEST PROCEDURE 16 – Ignition Coil

See General Warning on page 1-1.

The following test procedures will properly detect a coil that has failed in most cases; however, in rare cases, some ignition coils can fail to operate at normal (warmer) operating temperatures. If the ignition coil has tested okay in the vehicle and on the bench, but fails to operate reliably, replace the coil with a known good coil and operate the engine for several minutes to ensure that the coil functions at normal operating temperature. If the new coil functions properly, keep the new coil in the circuit.



1. Brown Wire
2. Black Wire
3. Female Bullet Terminal
4. White/Black Kill Circuit Wire
5. Ignition Coil Black Wire

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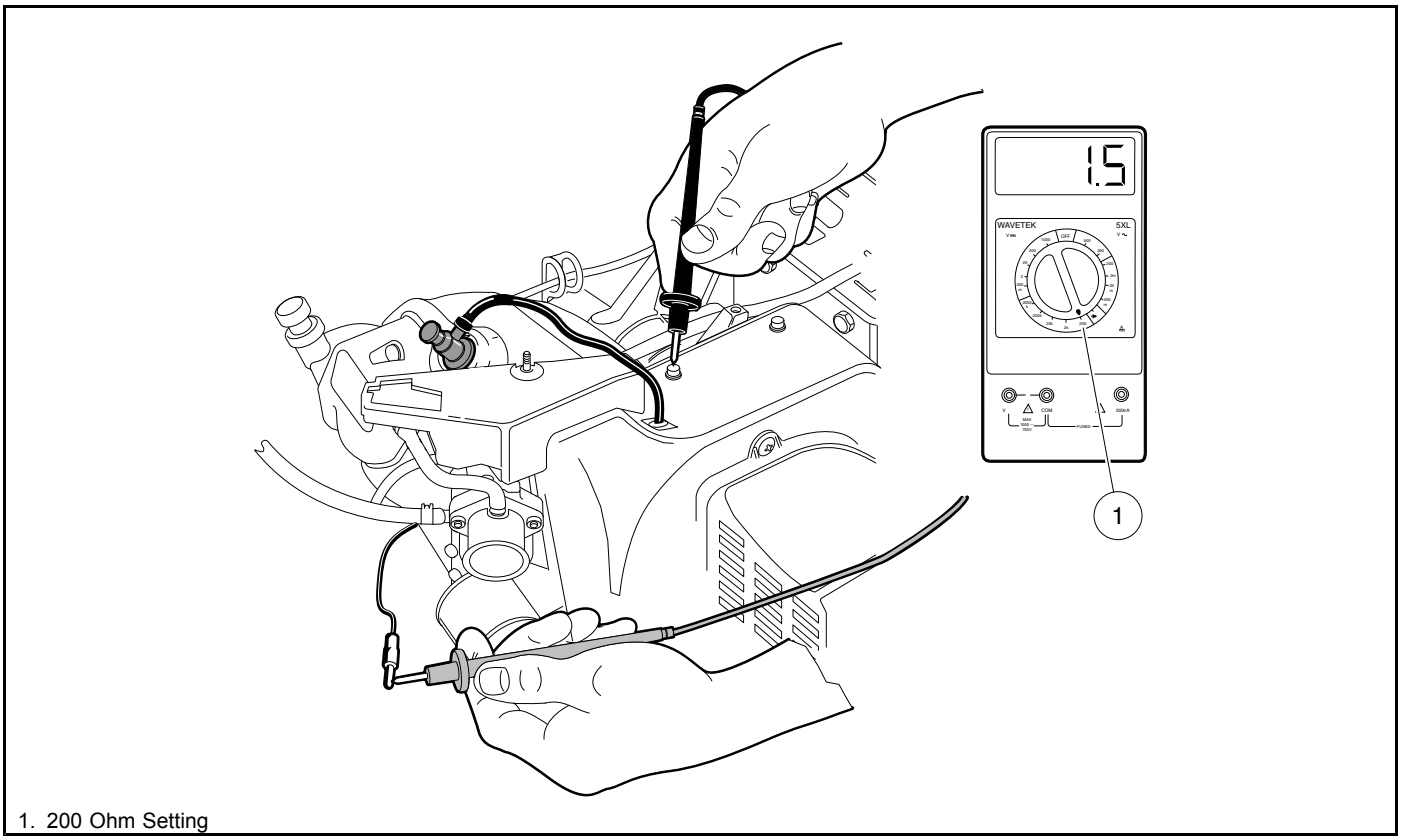
Figure 11-22 RPM Limiter



1. 200 Ohm Setting

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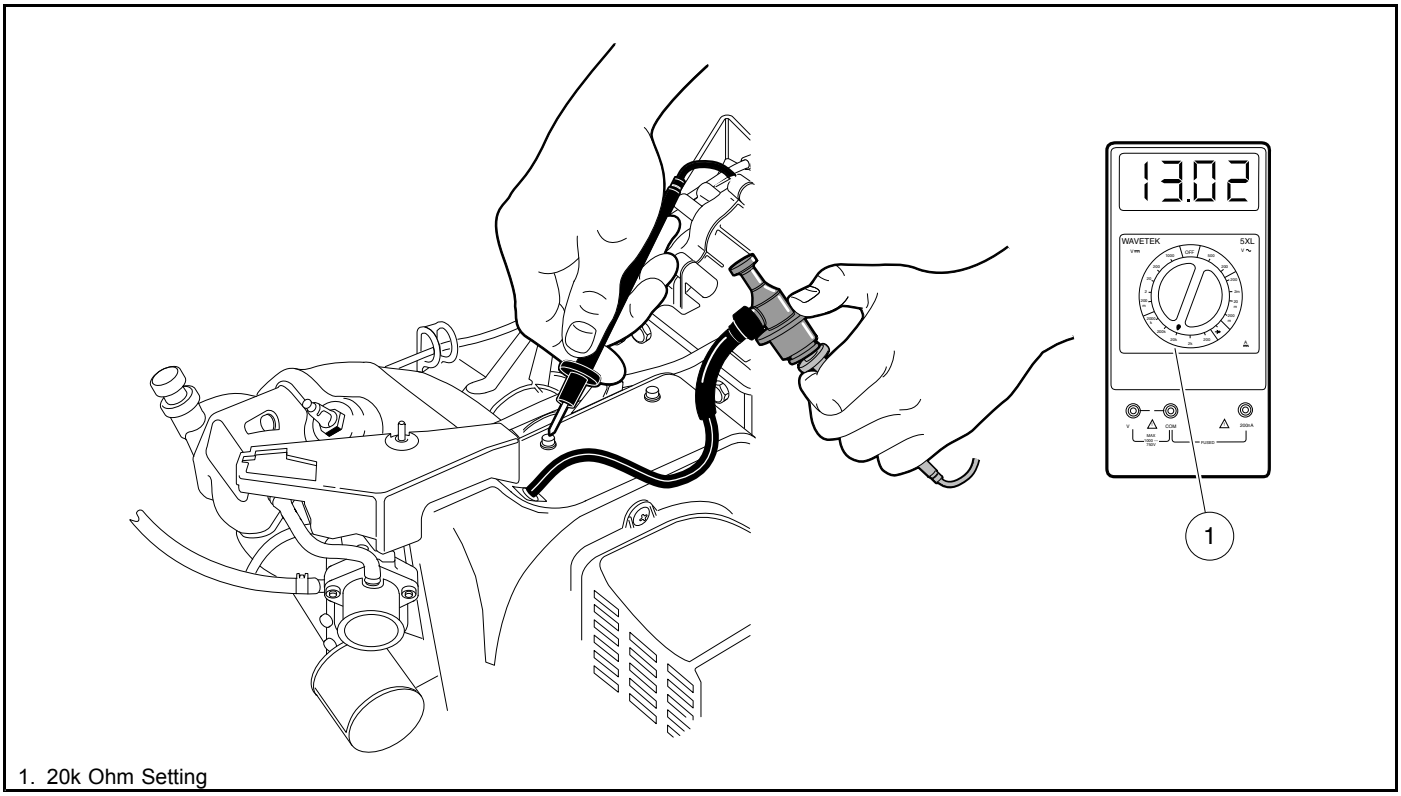
Figure 11-23 Primary Coil Resistance – In Vehicle Test



1. 20k Ohm Setting

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Figure 11-24 Secondary Coil Test – In Vehicle Test

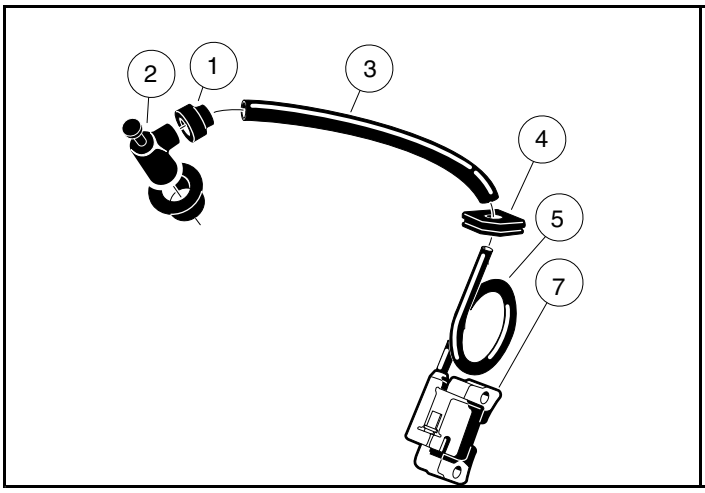

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Figure 11-25 Ignition Coil and Cap

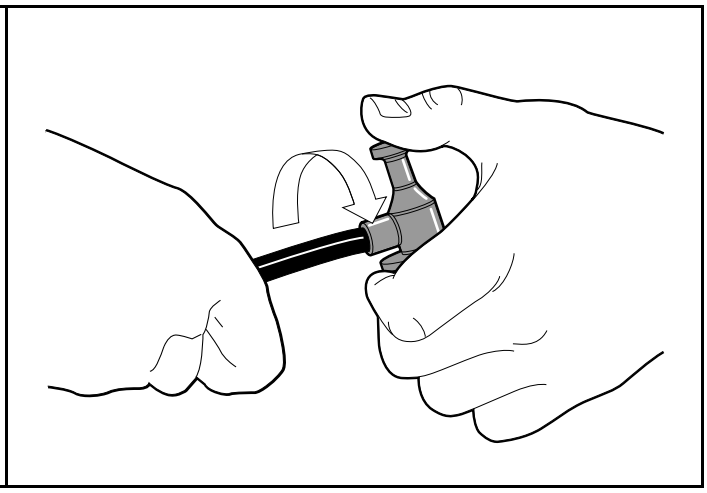

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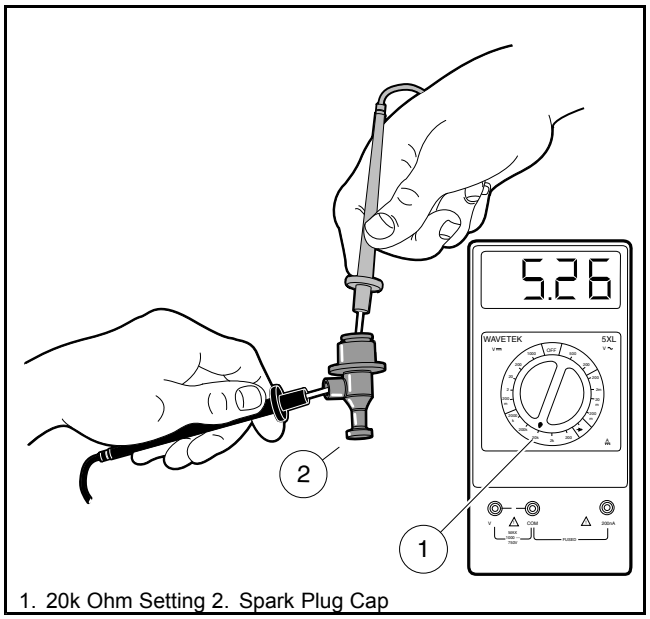
Figure 11-26 Spark Plug Cap Removal

Ignition Coil – In Vehicle Test

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels.
2. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
3. Using a multimeter set to 200 ohms, measure the primary coil resistance.
   3.1. Disconnect both of the bullet terminals at the RPM limiter **(Figure 11-22, Page 11-23)**. Place the red (+) probe of the meter on the male bullet terminal of the wire connecting to the ignition coil under the fan housing, and place the black (–) probe on a clean unpainted surface of the engine or frame **(Figure 11-23, Page 11-24)**.
   3.2. If the resistance is not between 0.6 - 1.7 ohms, bench test the ignition coil.
4. Using a multimeter set to 20k ohms, measure the resistance of the secondary coil and spark plug cap together.
   4.1. Place the red (+) probe of the meter into the end of the spark plug cap that normally connects to the spark plug and place the black (–) probe on a clean unpainted surface of the engine or frame **(Figure 11-24, Page 11-24)**.
   4.2. If the resistance is between 12.0k - 14.0k ohms, the secondary coil and spark plug cap are within acceptable limits; proceed to step 7. If the resistance is not between 12.0k - 14.0k ohms, the spark plug cap and secondary coil must be tested independently from each other.
5. Test the spark plug cap separately from the secondary coil.
   5.1. Remove the rubber gasket (1) on the plug cap (2) by rolling back the gasket onto the spark plug wire (3) **(Figure 11-25, Page 11-25)**.
   5.2. Remove the cap from the wire by turning the cap counterclockwise three or four revolutions while gently pulling it off the wire **(Figure 11-26, Page 11-25)**.
   5.3. Using a multimeter set to 20k ohms, place the red (+) probe of the multimeter into the end of the spark plug cap that normally connects to the spark plug and place the black (–) probe into the end of the cap with the internal screw **(Figure 11-27, Page 11-26)**. If the resistance is not between 4.5k - 6.0k ohms, the cap has failed and must be replaced. Proceed to the next step with the spark plug cap still removed.
6. Test the secondary coil separately from the spark plug cap.
   6.1. Using a multimeter set to 20k ohms, place the red (+) probe of the meter into the end of the spark plug wire and place the black (–) probe on a clean unpainted surface of the engine or frame **(Figure 11-28, Page 11-27)**. If the resistance is between 6.0k - 11.0k ohms, the secondary coil is within acceptable limits. If the resistance is not between 6.0k - 11.0k ohms, bench test the ignition coil.
7. If the preceding procedures indicate that the ignition coil resistance readings are within acceptable ranges, but the coil fails to function properly, proceed to the following bench test procedures.



1. 20k Ohm Setting 2. Spark Plug Cap

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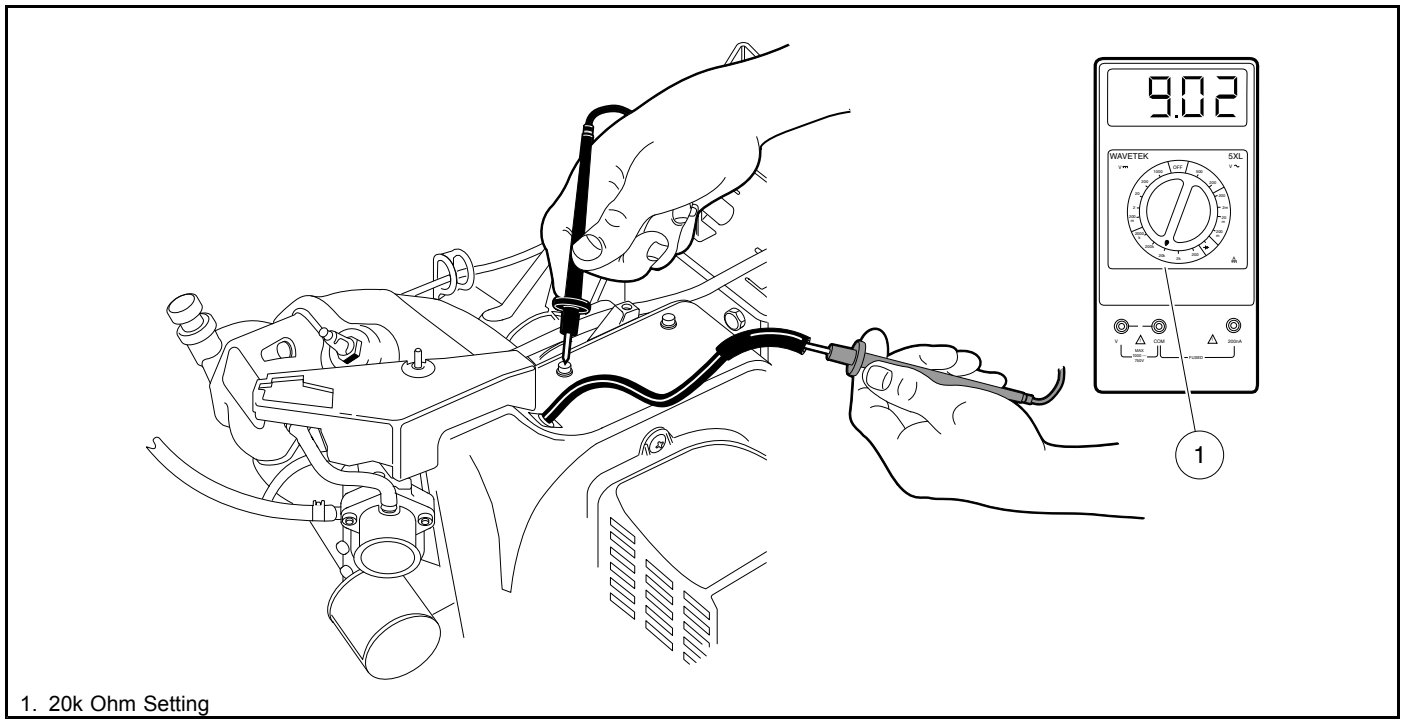
Figure 11-27 Spark Plug Cap Test

Ignition Coil – Bench Test

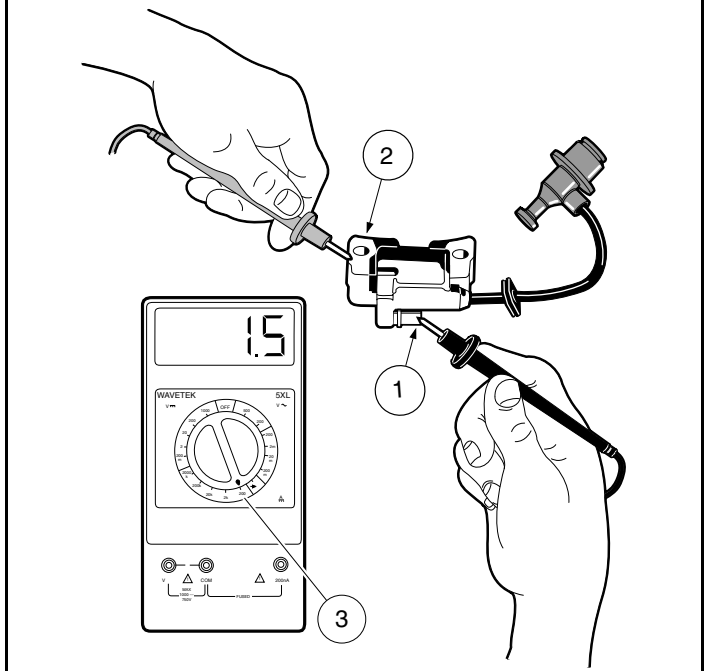
1. Remove the coil from the engine. **See Ignition Coil Removal, Section 13, Page 13-29.**
2. Using a multimeter set to 200 ohms, measure the primary coil resistance.
   2.1. Place the black (–) probe of the meter on the terminal on the ignition coil (1), and place the red (+) probe on the core (2) **(Figure 11-29, Page 11-27)**.
   2.2. If the resistance is not between 0.6 - 1.7 ohms, replace the ignition coil.
3. Using a multimeter set to 20k ohms, measure the resistance of the secondary coil and spark plug cap together.
   3.1. Place the red (+) probe of the meter into the end of the spark plug cap that normally connects to the spark plug (3) and place the black (–) probe on the core (2) **(Figure 11-30, Page 11-27)**.
   3.2. If the resistance is between 12.0k - 14.0k ohms, the secondary coil and spark plug cap are within acceptable limits; proceed to step 6. If the resistance is not between 12.0k - 14.0k ohms, the spark plug cap and secondary coil must be tested independently from each other.
4. If not previously tested, test the spark plug cap separately from the secondary coil.
   4.1. Remove the rubber gasket (1) on the plug cap (2) by rolling back the gasket onto the spark plug wire (3) **(Figure 11-25, Page 11-25)**.
   4.2. Remove the cap from the wire by turning the cap counterclockwise three or four revolutions while gently pulling it off the wire **(Figure 11-26, Page 11-25)**.
   4.3. Using a multimeter set to 20k ohms, place the red (+) probe of the multimeter into the end of the spark plug cap that normally connects to the spark plug and place the black (–) probe into the end of the cap with the internal screw **(Figure 11-27, Page 11-26)**. If the resistance is not between 4.5k - 6.0k ohms, the cap has failed and must be replaced. Proceed to the next step with the spark plug cap still removed.
5. Test the secondary coil separately from the spark plug cap.
   5.1. Using a multimeter set to 20k ohms, place the red (+) probe of the meter into the end of the spark plug wire and place the black (–) probe on the core (2) **(Figure 11-31, Page 11-28)**. If the resistance is between 6.0k - 11.0k ohms, the secondary coil is within acceptable limits. If the resistance is not between 6.0k - 11.0k ohms, the ignition coil has failed and must be replaced.
6. If the preceding procedures indicate that the ignition coil resistance readings are within acceptable ranges, but the coil fails to function properly, replace the ignition coil and cap.



1. 20k Ohm Setting

472

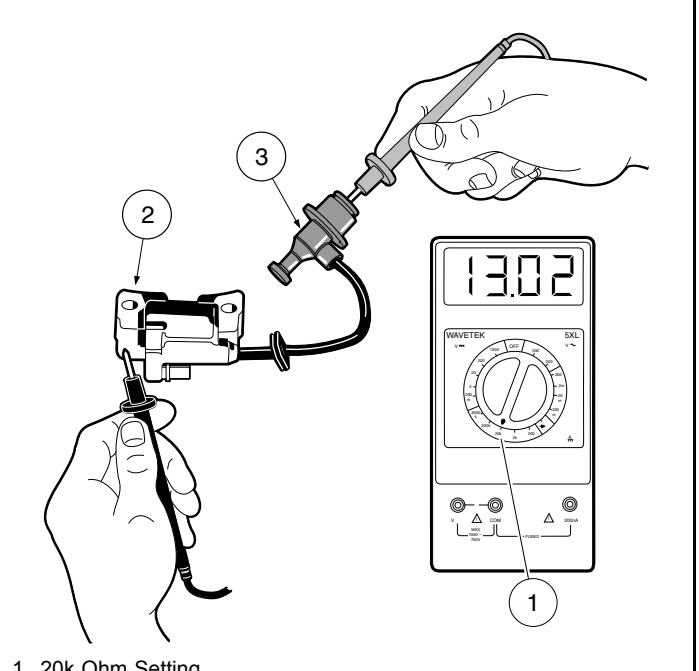
Figure 11-28 Secondary Coil Test Without Cap



1. Ignition Coil Terminal
2. Core
3. 200 Ohm Setting

473

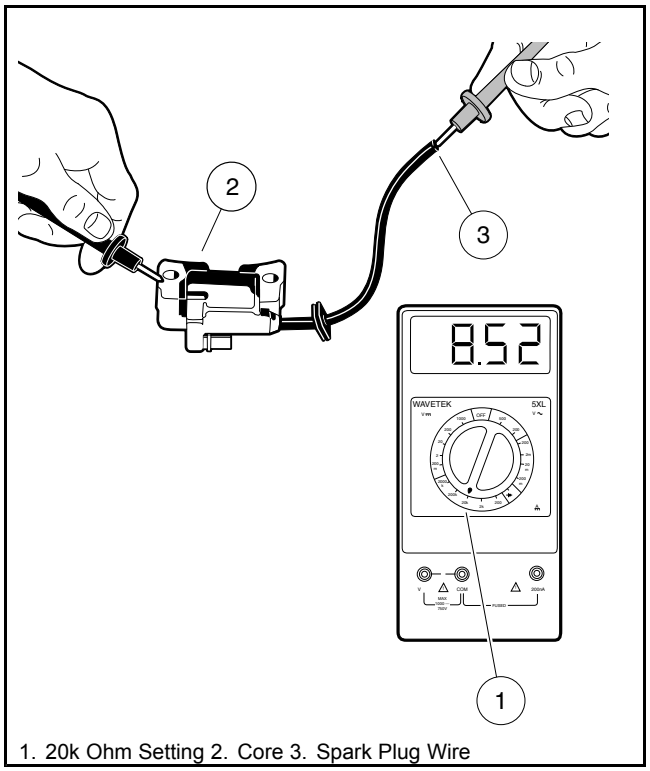
Figure 11-29 Primary Coil Resistance – Bench Test



1. 20k Ohm Setting
2. Core
3. Spark Plug Cap

474

Figure 11-30 Secondary Coil and Cap Resistance – Bench Test



1. 20k Ohm Setting 2. Core 3. Spark Plug Wire

475
Figure 11-31 Secondary Coil Resistance – Bench Test

TEST PROCEDURE 17 – Key Switch (Engine Kill Circuit)

See General Warning on page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels.
2. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
3. Remove the instrument panel. **See Key Switch Removal, Section 13, Page 13-17.**
4. Remove the connector from the key switch.
5. Place the red (+) probe on the (M) terminal and the black (–) probe on the (G) terminal. With the key switch OFF, the reading should be continuity. With the key switch turned ON, the reading should be no continuity. If either reading is incorrect, replace the key switch **(Figure 11-32, Page 11-29)**.
6. Reconnect the key switch to the wire harness. Ensure that the connector is connected correctly and is tight. If it is not, repair or replace as necessary.

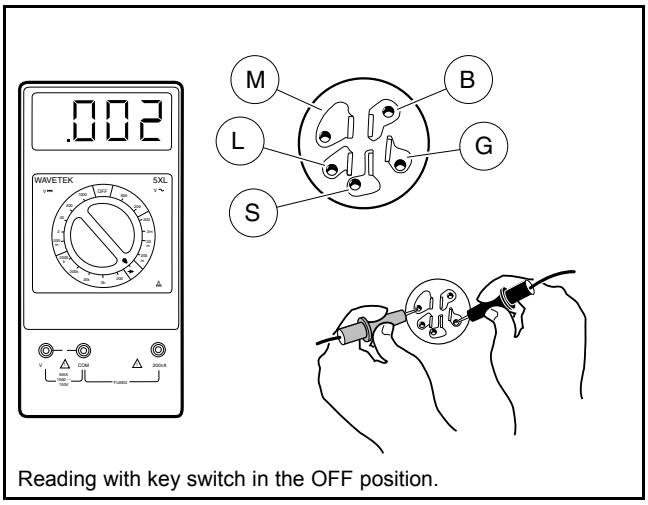


Figure 11-32 Test Key Switch – Engine Kill Circuit

TEST PROCEDURE 18 – Engine Kill Wire

See General Warning on page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels.
2. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
3. Disconnect white/black wire bullet connector located at the engine RPM limiter **(Figure 11-21, Page 11-22)**.
4. Connect red (+) probe of multimeter to the male bullet terminal on the white/black wire and connect the black (–) probe to the vehicle frame.
5. With the Forward/Reverse handle in the NEUTRAL position, turn the key switch to the ON position and note the multimeter reading. Turn the key and hold it in the START position while noting the multimeter reading. There should be no continuity when the key switch is in the ON or START position. If there is continuity, check for worn insulation on the white/black wire that is allowing the wire to ground to the frame.

TEST PROCEDURE 19 – Reverse Buzzer Limit Switch

See General Warning on page 1-1.

NOTE: *Keep the battery connected while performing this test procedure.*

The reverse buzzer limit switch is located on the Forward/Reverse shifter; red/white and orange wires are connected to it.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels.
2. 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.
3. 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. Without the lever pressed, the reading should be no continuity. Press the lever and the reading should be continuity. If either reading is incorrect, replace limit switch.

TEST PROCEDURE 20 – Reverse Buzzer

See General Warning on page 1-1.

The front reverse buzzer is mounted to the instrument panel under the front body.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels.
2. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
3. Remove the instrument panel. **See Key Switch Removal, Section 13, Page 13-17.**
4. Check for proper wiring and tight connections. Using a multimeter, individually check for continuity through each wire that connects to the reverse buzzer. If the buzzer will not function when properly wired, replace the buzzer. **See Reverse Warning Buzzer, Section 13, Page 13-23.**

TEST PROCEDURE 21 – Oil Level Sensor

See General Warning on page 1-1.

NOTE: *Keep the battery connected while performing this test procedure.*

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels.
2. Disconnect the spark plug wire. **See WARNING "To avoid unintentionally starting..." in General Warning on page 1-1.**
3. Ensure that the low oil warning light and all connecting wires are functioning correctly. **See Oil Warning Light on page 11-30.**
4. Drain the engine oil into an approved container and properly dispose of used oil.
5. Turn the key switch ON, closing the circuit. The oil light should illuminate. If the low oil warning light does not illuminate, the oil level sensor may need to be replaced. Refer to Test Procedure 22 before replacing sensor. **See Oil Level Sensor Removal, Section 15, Page 15-5.**
6. Fill the engine with new oil and install a new oil filter before returning the vehicle to service. **See Engine Oil – Gasoline Vehicle, Section 10, Page 10-7.**

TEST PROCEDURE 22 – Oil Warning Light

See General Warning on page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels.
2. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
3. Remove the instrument panel. **See Key Switch Removal, Section 13, Page 13-17.**
4. Ensure that the wires are connected correctly and are tight. If they are not, rewire or tighten as necessary.
5. Disconnect the yellow wire (to the oil level sensor) from the terminal on the oil light. Using an alligator clip jumper wire, connect the oil light terminal to the vehicle frame. Connect the red (+) battery cable to the positive (+) battery post, then attach the black (–) cable to the negative (–) battery post.
6. Turn the key switch to the ON position. The oil light should illuminate. If it does not, check continuity of the yellow wire that connects the key switch to the oil light through a sonic weld connection within the wire harness. If there is no continuity in the wire, replace the wire. Then test the key switch. **See Key Switch (Starter Circuit) on page 11-14.** If the yellow wire and the key switch test okay, then replace the oil light.

TEST PROCEDURE 23 – Battery Test (Under Load)

See General Warning on page 1-1.

NOTE: *Keep the battery connected while performing this test procedure.*

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels.
2. Set a multimeter to 20 volts and place the red (+) probe on the F2 (white wire) terminal on the starter/generator. Place the black (–) probe on the negative battery post.
3. Turn the key switch to the START position and hold it in the START position while noting the voltage reading on the multimeter (with the key in the START position the battery is under load).
   3.1. If the voltage reading is over 9.6 volts at 70 °F (21 °C) (electrolyte temperature) check the starter/generator. **See following NOTE.**

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

   3.2. If the reading is below 9.6 volts at 70 °F (21 °C) (electrolyte temperature), check the battery. **See Battery on page 11-9.**
   3.3. If the reading is zero, there may be NO continuity across the large posts of the solenoid. **See Solenoid on page 11-15.**
4. If all of the test results are good and the voltage reading is zero, there may be a broken or damaged 6- gauge white wire from the solenoid to the starter/generator. **See Starter/Generator (Starter Function) on page 11-17.**

TEST PROCEDURE 24 – Fuel Level Sending Unit

See General Warning on page 1-1.

⚠ WARNING

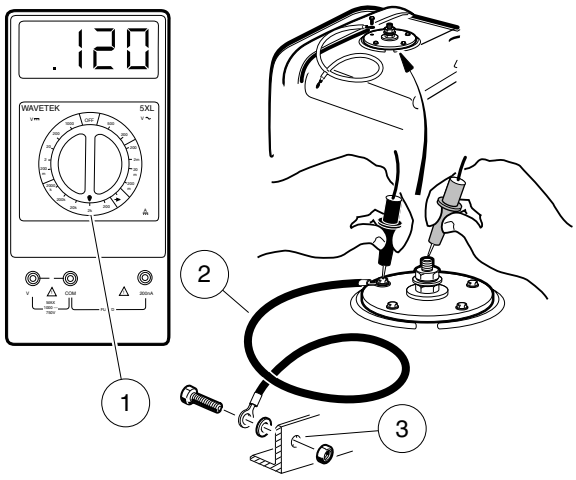
- **To avoid the possibility of fire or explosion, make sure the fuel tank cap is securely in place while performing this test procedure.**

1. Turn the key switch to OFF and remove the key. Place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels.
2. Disconnect battery. **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
3. Disconnect the orange wire from the center post of the fuel level sending unit.
4. With a multimeter set to 2k ohms, place the red (+) probe of the multimeter on the center post of the sending unit. Place the black (–) probe on the ground connection of the sending unit **(Figure 11-33, Page 11-32)**
5. The following resistance readings (in ohms) should be obtained 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 chart below may be used as a guideline to determine if the fuel level sending unit is operating correctly. Make sure the float is at the surface of the fuel in the tank.

FLOAT POSITION	RESISTANCE READING	FUEL GAUGE READINGS
Lower position (tank empty)	240 ± 20 ohms	Empty
Center position (tank half full)	120 ± 20 ohms	Half full
Upper position (tank full)	60 ± 20 ohms	Full

6. If the readings are within the specifications listed above, 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 17-22.**

7. If the readings are correct and the fuel gauge does not function correctly, check the continuity of the orange wire from the fuel level sending unit to the fuel gauge/hour meter. Leave the battery disconnected while checking continuity. Also check the continuity of the yellow wire from the fuel gauge/hour meter to the key switch, and the black ground wires at the fuel level sending unit and at the fuel gauge/hour meter. **See Fuel Gauge/Hour Meter Removal, Section 13, Page 13-26.**
8. If the readings are correct according to the position of the float, but give an incorrect reading on the fuel gauge/hour meter, test the fuel gauge/hour meter. **See Fuel Gauge on page 11-33.**



1. 2k Ohm Setting
2. Black Wire
3. Ground

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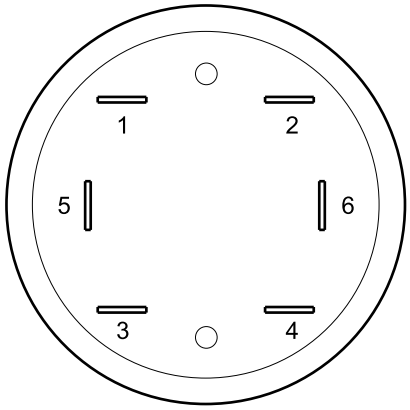
Figure 11-33 Test Fuel Level Sending Unit

TEST PROCEDURE 25 – Fuel Gauge

See General Warning on page 1-1.

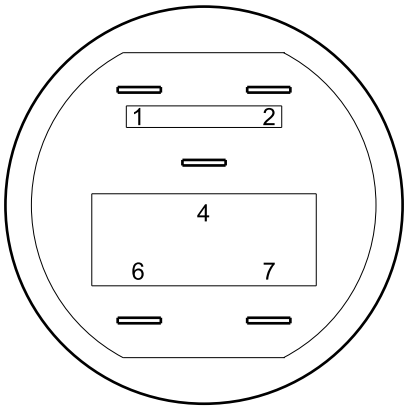
Two fuel gauges were used for model year 2007 **(Figure 11-34, Page 11-33 and Figure 11-35, Page 11-33)**. The terminal configuration on the back of the gauge easily denotes the type. Follow the appropriate procedure. The gauge used through mid-2007 has the orange wire connected to terminal 1 whereas the gauge used from mid-2007 has it connected to terminal 4 in the center of the gauge. In addition, the gauge used through mid-2007 has one terminal (3) to ground it whereas the gauge used from mid-2007 has two ground terminals (1 and 6) with a black jumper wire connecting them. **See following NOTE.**

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



1. Orange 2. Blue 3. Black 4. White 5. Not used 6. Not used

1600-14100-10400
Figure 11-34 Fuel Gauge/Hour Meter – Through mid-2007



1. Black(Jumper Wire From 6) 2. Blue 4. Orange 6. Black 7. White

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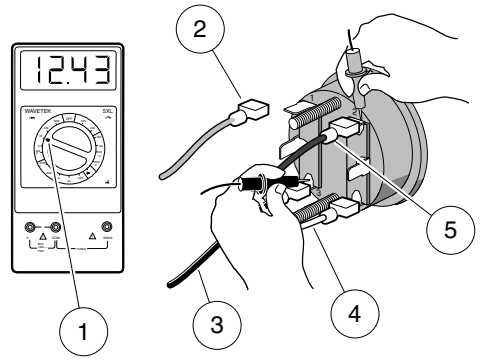
Figure 11-35 Fuel Gauge/Hour Meter – From mid-2007

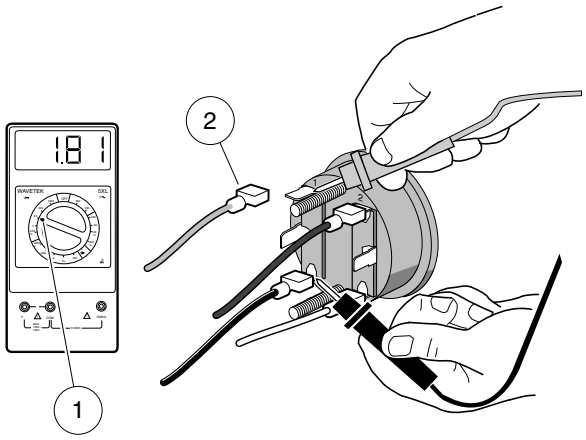
Fuel Gauge (Through mid-2007)

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels.
2. Remove the instrument panel to gain access to the back of the fuel gauge/hour meter. **See Key Switch Removal, Section 13, Page 13-17.**
3. Place a sheet of insulating material between the front frame and the electrical connections on the rear of the instrument panel to prevent contact between the two.
4. Disconnect the orange wire from the fuel gauge/hour meter.
5. Set a multimeter to 20 volts DC and place the red (+) probe of the multimeter on the positive post of the battery. Place the black (–) probe on the negative post of the battery. Record the voltage reading.
6. Set a multimeter to 20 volts DC and place the red (+) probe of the multimeter on the (2) terminal of the fuel gauge/hour meter with the blue wire. Place the black (–) probe on the (3) terminal of the fuel gauge/hour meter with the black wire **(Figure 11-36, Page 11-34)**.
7. Connect battery. **See Connecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
8. 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 11-36, Page 11-34)**.
9. The orange wire should remain disconnected for this step. With the black probe still on the (3) terminal of the fuel gauge/hour meter, place the red (+) probe of the multimeter on the (1) terminal of the fuel gauge/hour meter **(Figure 11-37, Page 11-34)**. The voltage reading should be approximately 1.81 volts. If the reading is incorrect, replace fuel gauge/hour meter.



1. 20 VDC Setting 2. Orange 3. Black 4. White 5. Blue

Figure 11-36 Fuel Gauge Voltage Test - Terminal 2

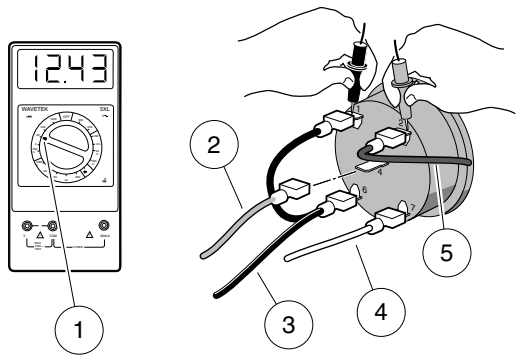


1. 20 VDC Setting 2. Orange

Figure 11-37 Fuel Gauge Voltage Test - Terminal 1

Fuel Gauge (From mid-2007)

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels.
2. Remove the instrument panel to gain access to the back of the fuel gauge/hour meter. **See Key Switch Removal, Section 13, Page 13-17.**
3. Place a sheet of insulating material between the front frame and the electrical connections on the rear of the instrument panel to prevent contact between the two.
4. Disconnect the orange wire from the fuel gauge/hour meter.
5. Set a multimeter to 20 volts DC and place the red (+) probe of the multimeter on the positive post of the battery. Place the black (–) probe on the negative post of the battery. Record the voltage reading.
6. Set a multimeter to 20 volts DC and place the red (+) probe on the (2) terminal of the fuel gauge/hour meter with the blue wire is connected. Place the black (–) probe on the (1) terminal of the fuel gauge/hour meter with the black wire **(Figure 11-38, Page 11-35)**.
7. Connect battery. **See Connecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
8. 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 11-38, Page 11-35)**.
9. 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 11-39, Page 11-35)**. 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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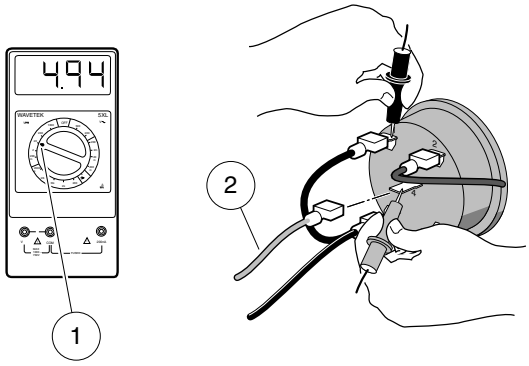
Figure 11-38 Fuel Gauge Voltage Test - Terminal 2



1. 20 VDC Setting 2. Orange

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Figure 11-39 Fuel Gauge Voltage Test - Terminal 4

TEST PROCEDURE 26 – Hour Meter

See General Warning on page 1-1.

Two hour meters were used for model year 2007 **(Figure 11-34, Page 11-33 and Figure 11-35, Page 11-33)**. The display and the terminal configuration on the back of the meter easily denotes the type. Follow the appropriate procedure. The display on the meter used through mid-2007 only appears when the key switch is ON whereas the display on the meter used from mid-2007 is always on. The meter used through mid-2007 has the orange wire connected to terminal 1 whereas the meter used from mid-2007 has it connected to terminal 4 in the center of the meter. In addition, the meter used through mid-2007 has one terminal (3) to ground it whereas the meter used from mid-2007 has two ground terminals (1 and 6) with a black jumper wire connecting them. **See following NOTE.**

NOTE: *Keep the battery connected while performing this test procedure.*

Hour Meter (Through mid-2007)

1. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Turn the key switch ON to verify the display appears.
3. Start the engine and let it idle. **See following DANGER.**

⚠ DANGER

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

4. With engine idling, the "hour glass" icon should flash slowly. If not, check the low oil warning light and the oil pressure switch. **See following NOTE. See also Test Procedure 22 – Oil Warning Light on page 11-30.**

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.

Hour Meter (From mid-2007)

1. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.

2. With the key switch OFF, check the hour meter display. It is powered by an internal battery and should always be on, even with the engine off and the key removed.
3. Start the engine and let it idle. **See following DANGER.**

⚠ DANGER

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

4. With engine idling, the "hour glass" icon should flash. If not, check the low oil warning light and the oil pressure switch. **See following NOTE. See also Test Procedure 22 – Oil Warning Light on page 11-30.**

NOTE: *The hour meter is designed to record actual engine running time and will not start adding increments until the engine is running and the oil pressure switch has opened.*

5. If the hour meter still does not function after the low oil warning light, oil pressure switch, and all of the appropriate wires have been checked for continuity, replace the fuel gauge/hour meter.

TEST PROCEDURE 27 – Light Switch

See General Warning on page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels.
2. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
3. Remove the instrument panel. **See Key Switch Removal, Section 13, Page 13-17.**
4. Using a multimeter set on 20 volts DC, place alligator clips on the multimeter probes. Connect the red (+) probe to the light switch terminal with the blue wire connected to it **(Figure 11-40, Page 11-36)**.
5. Connect battery and spark plug wire(s). **See Connecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
6. Connect the black (–) probe of the multimeter to the negative (–) post of the battery.
7. With the light switch in the OFF position, the reading should be zero volts. With the light in the ON position, the reading should be between 11 and 12.5 volts. If the there is no voltage reading, check continuity of the 10-gauge red wire from the fuse block to the solenoid. Check continuity of the 14-gauge yellow wire from the light switch to the fuse block. Check the fuse. **See Fuse on page 11-12.** If the headlight diode is functioning correctly, the wires and fuse show continuity and the readings are still incorrect, replace the switch. **See Light Switch Removal on page 13-35.**

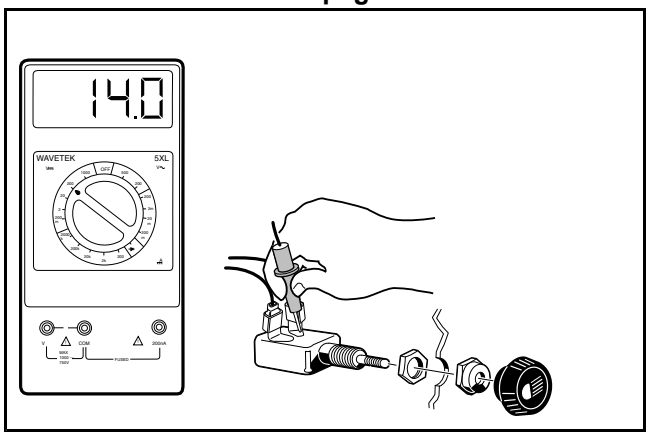

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Figure 11-40 Light Switch Test

TEST PROCEDURE 28 – Headlight Diode

See General Warning on page 1-1.

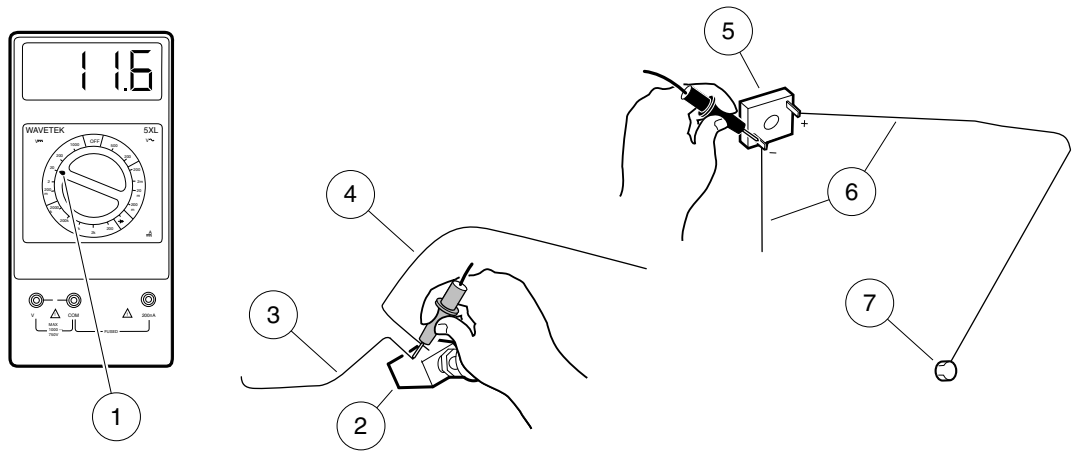
1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels.
2. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
3. Remove the instrument panel. **See Key Switch Removal, Section 13, Page 13-17.**
4. Using a multimeter set on 20 volts DC, connect the red (+) probe to the light switch terminal with the yellow wire **(Figure 11-41, Page 11-37)**.
5. Loosen the black wire connector (on the end of the long black wire) at the headlight diode assembly just enough to maintain the connection and yet expose part of the metal terminal in the connector. Place black (–) probe on the connector **(Figure 11-41, Page 11-37)**.
6. Connect battery and spark plug wire(s). **See Connecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
7. Pull the light switch to the ON position. The reading should be 11-12 volts. If the there is no voltage reading, check continuity of the 16-gauge black wire from the headlight to the headlight diode. Check continuity of the 16-gauge black wire from headlight diode to the vehicle frame. If the wires show continuity and the readings are still incorrect, replace the headlight diode. **See Voltage Limiter Removal, Section 13, Page 13-34.**
8. With the Forward/Reverse handle in the NEUTRAL position and the wheels chocked, start the engine and press the accelerator pedal to the floor.
9. Push the light switch to the OFF position. The reading should be 14.7-15.3 volts.
10. Pull the light switch to the ON position. The reading should be 11-13 volts. If the reading does not drop from 14.5-15.5 volts to 11-13 volts, replace the voltage limiter.

TEST PROCEDURE 29 – Voltage at Headlight Socket

See General Warning on page 1-1.

NOTE: *Keep the battery connected while performing this test procedure.*

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



1. 20 VDC Setting 2. Light Switch 3. Yellow Wire 4. Blue Wire 5. Voltage Limiter 6. Black Wires 7. Frame Ground

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Figure 11-41 Headlight Diode Circuit Test

2. Inspect wires at light bulb socket. Make sure wires are securely fastened to the contacts inside socket.
3. Remove the wire harness from the headlight **(Figure 11-42, Page 11-38)**.
4. Using a multimeter set to 20 volts DC, place the black (–) probe of multimeter 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 reads approximately 12 volts, replace the bulb.
6. If there is no voltage reading at the wire harness, check continuity of the 16-gauge blue wire from the headlight to the light switch. Using a multimeter set to 20 volts DC, attach using an alligator clip, the black (–) probe of multimeter onto the negative battery terminal and place the red (+) probe into the blue wire terminal of the wire harness. If multimeter reading is approximately 12 volts, the blue wire has continuity.
7. Check continuity of the 16-gauge black wire from the headlight to the ground terminal. Using a multimeter set to 20 volts DC, place the black (–) probe of multimeter into the black wire terminal of the wire harness and attach using an alligator clip, the red (+) probe onto the positive battery terminal. If the multimeter reading is approximately 12 volts, the black wire has continuity.

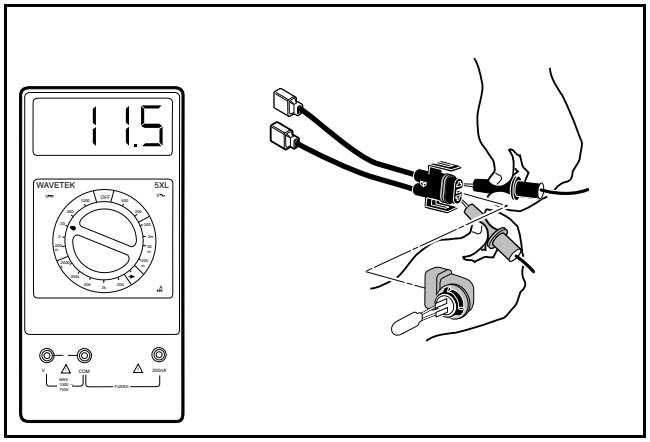

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Figure 11-42 Check Voltage to Headlight Socket

⚠ DANGER

- **See General Warning on page 1-1.**

⚠ WARNING

- **See General Warning on page 1-1.**

GENERAL INFORMATION

This section contains the information required to correctly troubleshoot the vehicle. A troubleshooting guide is provided for general troubleshooting.

In addition to troubleshooting, this section contains general information on the electrical system and the circuits of the electrical system.

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. The procedures used in making these checks can be found in the referenced sections of the maintenance and service manual.

TROUBLESHOOTING GUIDE		
SYMPTOM	**POSSIBLE CAUSES**	**CORRECTIVE ACTION**
Engine does not start easily.	Spark plug is partially fouled or in poor condition	See Section 15 – S10 FE 350 Engine. See Section 16 – S27 FE 350 Engine.
	Spark plug wire is damaged or loose	See Section 15 – S10 FE 350 Engine. See Section 16 – S27 FE 350 Engine.
	Loose wire connection at ignition coil or RPM limiter	Test Procedures 13 – *Ignition Spark*, 14 – *RPM Limiter*, and 15 – *Ignition Coil*
	Intermittent ignition coil failure	Test Procedures 13 – *Ignition Spark*, 14 – *RPM Limiter*, and 15 – *Ignition Coil*
	Low cylinder compression	See Section 15 – S10 FE 350 Engine. See Section 16 – S27 FE 350 Engine.
	Water or dirt in the fuel system and/or carburetor; dirty or clogged fuel filter	See Section 17 – S10 FE 350 Fuel System. See Section 18 – S27 FE 350 Fuel System.
	Carburetor improperly adjusted	See Section 17 – S10 FE 350 Fuel System. See Section 18 – S27 FE 350 Fuel System.
	Starter/generator belt is slipping	Belt Tension Adjustment on page 14-12

TABLE CONTINUED ON NEXT PAGE

TROUBLESHOOTING GUIDE		
SYMPTOM	**POSSIBLE CAUSES**	**CORRECTIVE ACTION**
Engine starts but does not run smoothly.	Spark plug is fouled or in poor condition	See Section 15 – S10 FE 350 Engine. See Section 16 – S27 FE 350 Engine.
	Spark plug wire is damaged or loose	See Section 15 – S10 FE 350 Engine. See Section 16 – S27 FE 350 Engine.
	Intermittent ignition coil failure	Test Procedures 13 – *Ignition Spark*, 14 – *RPM Limiter*, and 15 – *Ignition Coil*
	Water or dirt in the fuel system and/or carburetor; dirty or clogged fuel filter	See Section 17 – S10 FE 350 Fuel System. See Section 18 – S27 FE 350 Fuel System.
	Fuel pump malfunction; fuel pressure to carburetor too low	See Section 17 – S10 FE 350 Fuel System. See Section 18 – S27 FE 350 Fuel System.
Engine turns but fails to start.	Fuel tank is empty	See Section 17 – S10 FE 350 Fuel System. See Section 18 – S27 FE 350 Fuel System.
	Fuel line or filters clogged	See Section 17 – S10 FE 350 Fuel System. See Section 18 – S27 FE 350 Fuel System.
	Fouled spark plug	See Section 15 – S10 FE 350 Engine. See Section 16 – S27 FE 350 Engine.
	Spark plug wire damaged or loose	See Section 15 – S10 FE 350 Engine. See Section 16 – S27 FE 350 Engine.
	Loose wire connection at ignition coil or RPM limiter	Test Procedures 13 – *Ignition Spark*, 14 – *RPM Limiter*, and 15 – *Ignition Coil*
	Ignition coil or RPM limiter failed	Test Procedures 13 – *Ignition Spark*, 14 – *RPM Limiter*, and 15 – *Ignition Coil*
	Engine flooded with fuel as result of excess choking	See Owner's Manual, Controls and Indicators. See Choke.
	Kill circuit grounded	Test Procedures 16 – *Kill Limit Switch*, 17 – *Key Switch (Engine Kill Circuit)*, and 18 – *Engine Kill Wire*
	Fuel pump malfunction or failure	See Section 17 – S10 FE 350 Fuel System. See Section 18 – S27 FE 350 Fuel System.
Engine overheats.	Fan screen is partially blocked or plugged	See Section 15 – S10 FE 350 Engine. See Section 16 – S27 FE 350 Engine.
	Governor is improperly adjusted	See Section 17 – S10 FE 350 Fuel System. See Section 18 – S27 FE 350 Fuel System.
	Carburetor is too lean; check main jet size	See Section 17 – S10 FE 350 Fuel System. See Section 18 – S27 FE 350 Fuel System.
Engine pre-ignites.	Excessive carbon deposits on piston head or in combustion chamber	See Section 15 – S10 FE 350 Engine. See Section 16 – S27 FE 350 Engine.
	Spark plug heat range is incorrect	See Section 15 – S10 FE 350 Engine. See Section 16 – S27 FE 350 Engine.
	Unsuitable or contaminated fuel	See Section 17 – S10 FE 350 Fuel System. See Section 18 – S27 FE 350 Fuel System.

TABLE CONTINUED ON NEXT PAGE

TROUBLESHOOTING GUIDE		
SYMPTOM	**POSSIBLE CAUSES**	**CORRECTIVE ACTION**
Loss of engine power.	Exhaust valve is restricted with carbon deposit	See Section 15 – S10 FE 350 Engine. See Section 16 – S27 FE 350 Engine.
	Muffler or exhaust pipe restricted with carbon or other substance	See Section 19 – Exhaust System: Gasoline Vehicles.
	Ignition coil failed	Test Procedures 13 – *Ignition Spark*, 14 – *RPM Limiter*, and 15 – *Ignition Coil*
	Air filter is dirty or clogged	See Section 17 – S10 FE 350 Fuel System. See Section 18 – S27 FE 350 Fuel System.
	Governor is improperly adjusted	See Section 17 – S10 FE 350 Fuel System. See Section 18 – S27 FE 350 Fuel System.
	Throttle linkage out of adjustment	See Section 17 – S10 FE 350 Fuel System. See Section 18 – S27 FE 350 Fuel System.
	Low cylinder compression	See Section 15 – S10 FE 350 Engine. See Section 16 – S27 FE 350 Engine.
	Spark plug failed	See Section 15 – S10 FE 350 Engine. See Section 16 – S27 FE 350 Engine.
	Restricted fuel flow	See Section 17 – S10 FE 350 Fuel System. See Section 18 – S27 FE 350 Fuel System.
	Torque converter is not backshifting properly	See Section 21 – Torque Converter: Gasoline Vehicles.
Spark plug fouls repeatedly.	Incorrect plug	See Section 15 – S10 FE 350 Engine. See Section 16 – S27 FE 350 Engine.
	Spark plug wire is damaged	See Section 15 – S10 FE 350 Engine. See Section 16 – S27 FE 350 Engine.
	Unsuitable fuel, or incorrect (rich) fuel mixture	See Section 17 – S10 FE 350 Fuel System. See Section 18 – S27 FE 350 Fuel System.
	Ignition coil failed	Test Procedures 13 – *Ignition Spark*, 14 – *RPM Limiter*, and 15 – *Ignition Coil*
	Dirt entering combustion chamber	Check intake system for leaks. See Section 17 – S10 FE 350 Fuel System. See Section 18 – S27 FE 350 Fuel System.
	Rings are heavily worn, low cylinder pressure	See Section 15 – S10 FE 350 Engine. See Section 16 – S27 FE 350 Engine.
Carburetor floods.	Inlet valve or seat is leaking, dirty, worn, or damaged	See Section 17 – S10 FE 350 Fuel System. See Section 18 – S27 FE 350 Fuel System.
	Float is damaged and filled with fuel	See Section 17 – S10 FE 350 Fuel System. See Section 18 – S27 FE 350 Fuel System.
	Float needle valve not functioning properly	See Section 17 – S10 FE 350 Fuel System. See Section 18 – S27 FE 350 Fuel System.
	Carburetor vent is clogged	See Section 17 – S10 FE 350 Fuel System. See Section 18 – S27 FE 350 Fuel System.

TABLE CONTINUED ON NEXT PAGE

TROUBLESHOOTING GUIDE		
SYMPTOM	**POSSIBLE CAUSES**	**CORRECTIVE ACTION**
Starter fails to operate.	Neutral lockout switch is in the wrong position	See Section 12 – Troubleshooting and Electrical System: Pedal-Start Gas Vehicle.
	Fuse is blown	Test Procedure 2 – *Fuse*
	Battery is dead	Test Procedure 1 – *Battery*
	Starter control circuit is not operating	See Section 12 – Troubleshooting and Electrical System: Pedal-Start Gas Vehicle.
	Starter/generator failed	Test Procedure 7 – *Neutral Lockout Limit Switch*
	Starter solenoid failed	Test Procedure 6 – *Solenoid*
	Accelerator pedal limit switch failed	Test Procedure 5 – *Accelerator Pedal Limit Switch*
	Key switch failed	Test Procedure 4 – *Key Switch (Starter Circuit)*
	Neutral lockout limit switch failed	Test Procedure 7 – *Neutral Lockout Limit Switch*
	Loose or broken wire in starter/generator circuit	See Section 14 – Electrical Components: Pedal-Start Gas Vehicle. Starter/Generator on page 14-1
	Cylinder and/or crankcase flooded with fuel	See Section 17 – S10 FE 350 Fuel System. See Section 18 – S27 FE 350 Fuel System.
Starter/generator does not charge battery.	Loose or broken wire in the starter/ generator circuit	Test Procedure 10 – *Starter/Generator (Generator Function)*
	Generator field coil is shorted	Test Procedure 10 – *Starter/Generator (Generator Function)*
	Brushes are worn or commutator is dirty	See Section 14 – Electrical Components: Pedal-Start Gas Vehicle. Starter/Generator on page 14-1
	Starter/generator belt is loose or slipping	See Section 14 – Electrical Components: Pedal-Start Gas Vehicle. Belt Tension Adjustment on page 14-12
	Voltage regulator failed	Test Procedure 11 – *Voltage Regulator*
	Battery failed	Test Procedure 1 – *Battery*
Transmission does not engage or disengage smoothly.	Transmission shifter linkage is binding or is out of adjustment	See Section 20 – Unitized Transaxle: Dash-Mounted Shifter.
	Insufficient (low) level of lubricant or wrong type of lubricant in transmission	See Section 20 – Unitized Transaxle: Dash-Mounted Shifter.
	Internal gears are damaged or worn	See Section 20 – Unitized Transaxle: Dash-Mounted Shifter.
	Synchronizer rings are worn, damaged or jammed	See Section 20 – Unitized Transaxle: Dash-Mounted Shifter.

TABLE CONTINUED ON NEXT PAGE

TROUBLESHOOTING GUIDE		
SYMPTOM	**POSSIBLE CAUSES**	**CORRECTIVE ACTION**
Excessive vehicle vibration.	Engine mounting nuts or bolts are loose	See Section 15 – S10 FE 350 Engine. See Section 16 – S27 FE 350 Engine.
	Snubber on frame is worn or damaged	See Section 15 – S10 FE 350 Engine.
	Misaligned muffler mounting clamp	See Section 19 – Exhaust System: Gasoline Vehicles.
	Damaged drive belt or starter belt	See Section 21 – Torque Converter: Gasoline Vehicles.
	Damaged drive clutch	See Section 21 – Torque Converter: Gasoline Vehicles.
	Damaged starter/generator pulley	See Section 14 – Electrical Components: Pedal-Start Gas Vehicle. Starter/Generator on page 14-1
	RPM setting is incorrect	See Section 17 – S10 FE 350 Fuel System. See Section 18 – S27 FE 350 Fuel System. Engine RPM Adjustment on page 17-11
Torque converter does not shift smoothly.	Drive belt is worn, cracked, glazed, or frayed	See Section 21 – Torque Converter: Gasoline Vehicles.
	Drive clutch malfunction	See Section 21 – Torque Converter: Gasoline Vehicles.
	Governor is sticking	See Section 20 – Unitized Transaxle: Dash-Mounted Shifter.
Engine won't stop running.	Kill circuit wire is disconnected from the ignition coil	Test Procedure 12 – *Disconnected Kill Wire*
	Accelerator pedal linkage out of adjustment causing engine kill limit switch not to activate	See Section 17 – S10 FE 350 Fuel System. See Section 18 – S27 FE 350 Fuel System.
	Carburetor is too lean; check main and pilot jet sizes	See Section 17 – S10 FE 350 Fuel System. See Section 18 – S27 FE 350 Fuel System.
	Carburetor throttle stop screw out of adjustment	See Section 17 – S10 FE 350 Fuel System. See Section 18 – S27 FE 350 Fuel System.

WIRING DIAGRAM

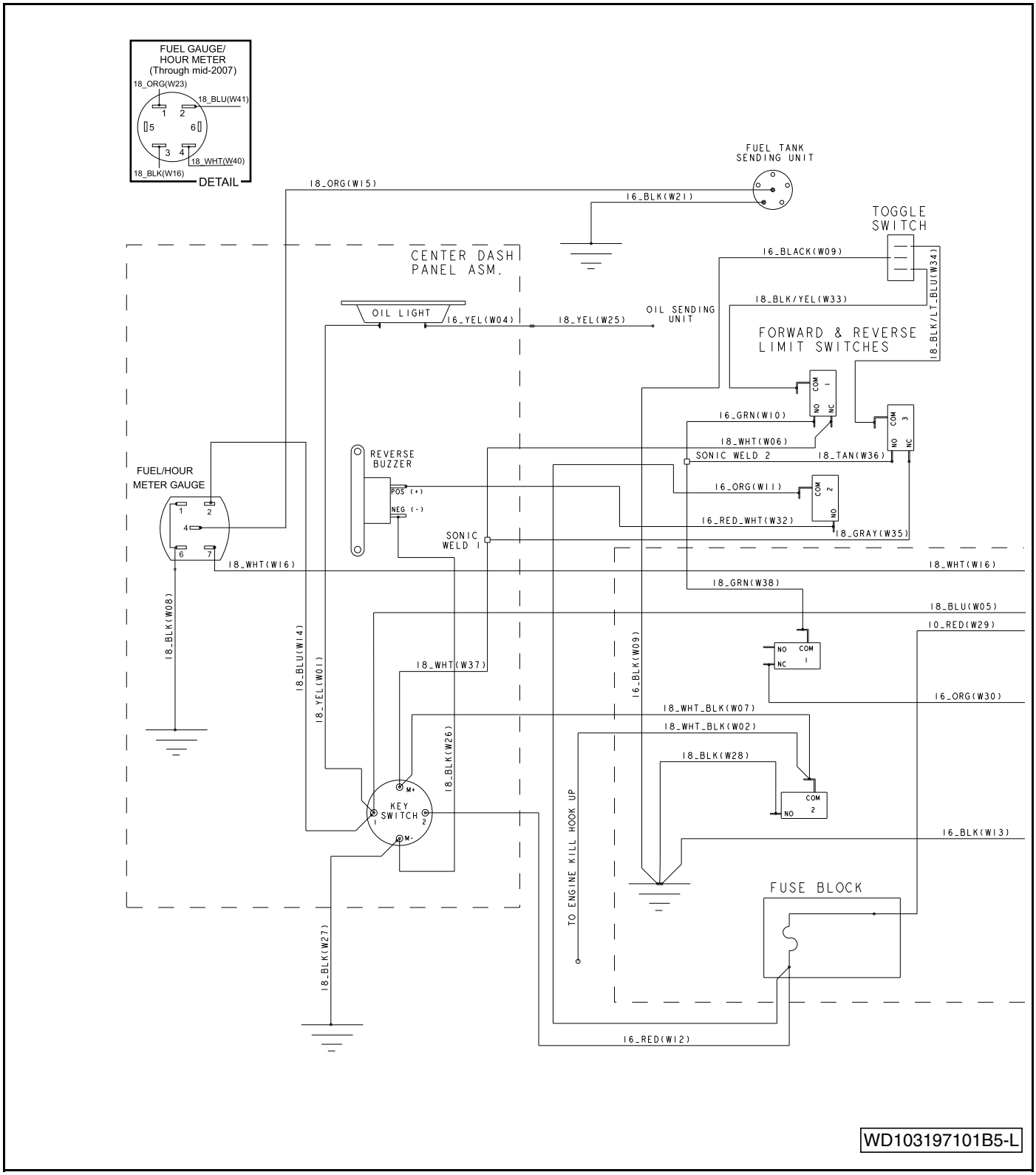


Figure 12-1 Wiring Diagram for Pedal-Start Gasoline Vehicle

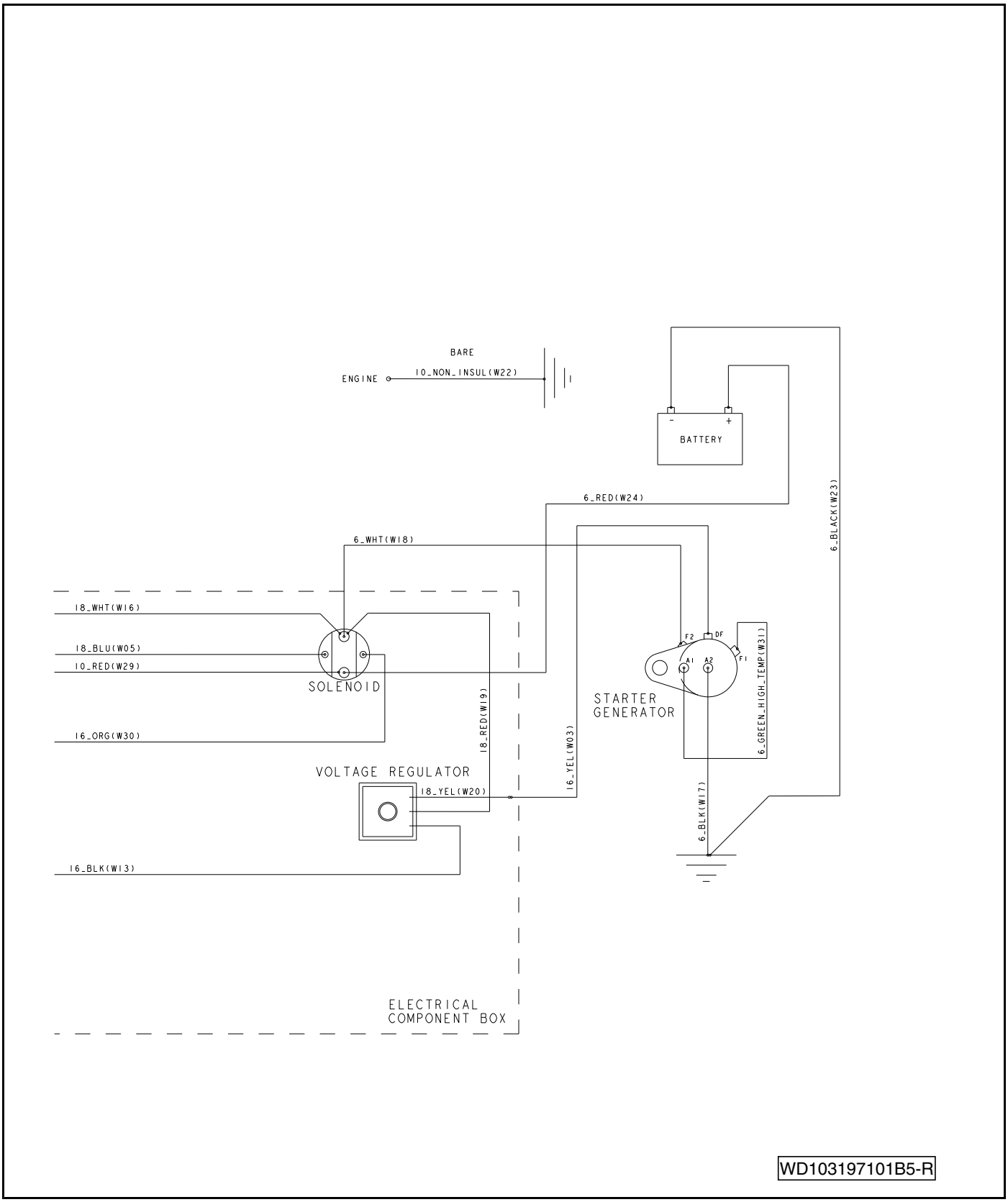


Figure 12-2 Wiring Diagram for Pedal-Start Gasoline Vehicle

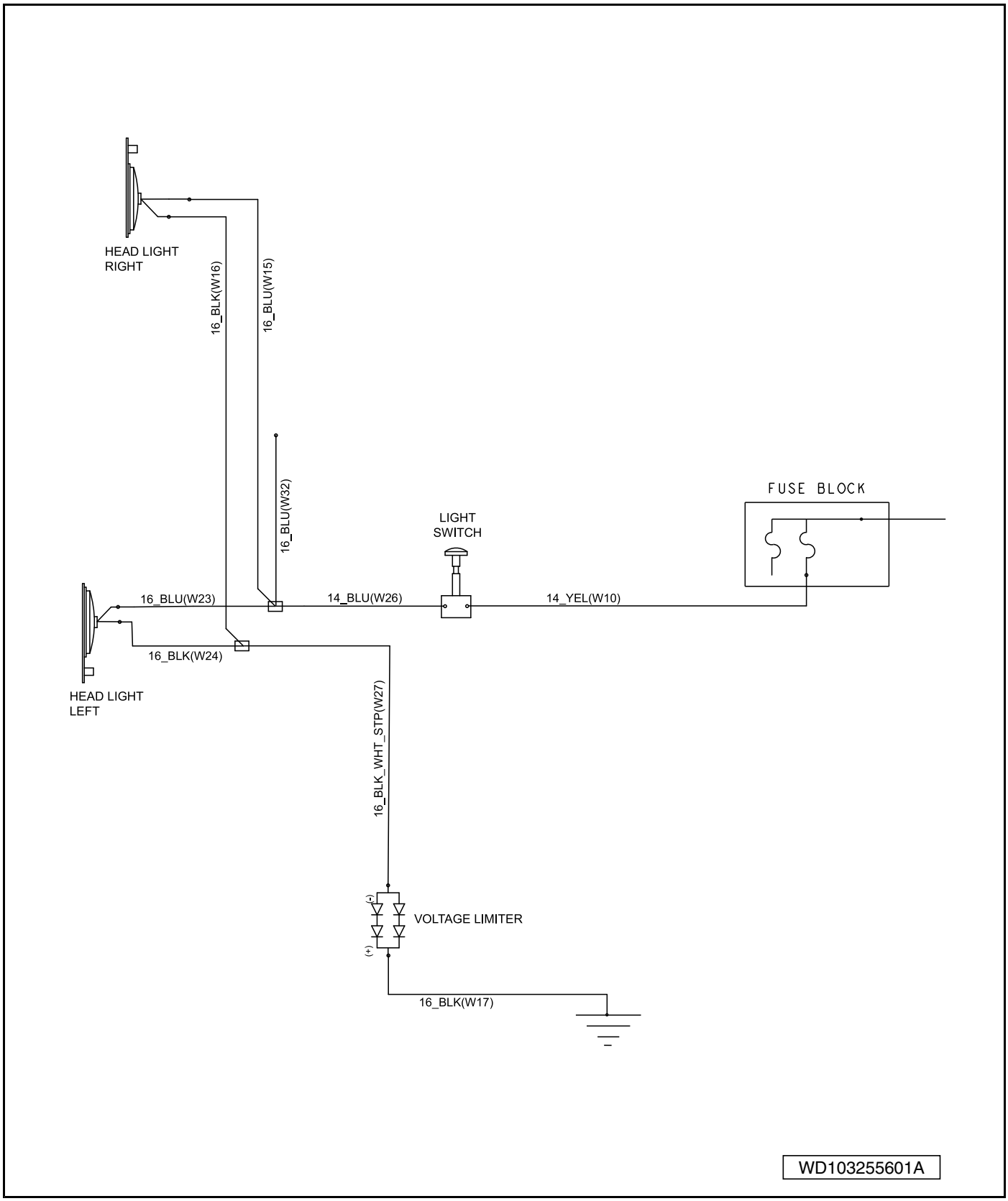


Figure 12-3 Wiring Diagram – Headlights

ELECTRICAL SYSTEM

The electrical system on the gasoline vehicle is 12 volts DC with negative (–) ground to frame, and consists of the following circuits that are easily identified:

- Starter Circuit
- Generator Circuit
- Engine Ignition Circuit
- Engine Kill Circuit
- Reverse Buzzer Circuit
- Low Oil Warning Light Circuit
- Neutral Lockout Circuit
- Fuel Gauge and Sending Unit Circuit
- Hour Meter Circuit
- Lighting Circuit

Recognizing and understanding the function of each of these circuits will help to quickly isolate the source of an electrical problem. Use the appropriate test procedure to correct the electrical problem. **See Test Procedures on page 12-9.**

For a complete wiring diagram, see page 12-6.

TEST PROCEDURES

Index of Test Procedures

21 – Low Oil Warning Light
22 – Oil Level Sensor
23 – Neutral Lockout Switch
24 – Battery Test (Under Load)
25 – Fuel Level Sending Unit
26 – Fuel Gauge
27 – Hour Meter
28 – Light Switch
29 – Voltage Limiter
30 – Voltage at Headlight Socket

TEST PROCEDURE 1 – Battery

See General Warning on page 1-1.

⚠ DANGER

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

NOTE: *The battery must be properly maintained and fully charged in order to perform the following test procedures. Battery maintenance procedures, including watering information and allowable mineral content, can be found in section* ***Electrical Components: Pedal-Start Gas Vehicle on page 14-1*** *of this manual.* ***See Battery on page 14-32.***

1. Place the Forward/Reverse handle in the NEUTRAL position and the neutral lockout switch in the MAINTENANCE position. Chock the wheels.
2. Check for loose or corroded battery terminal connections. Remove the negative (–) cable first and clean, tighten, and replace connections as necessary.

Hydrometer Test

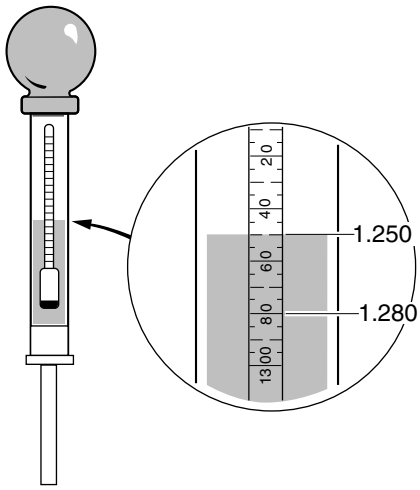
A hydrometer (CCI P/N 1011478) measures the specific gravity. The greater the specific gravity, the greater the state of charge of the battery. A fully charged battery should read between 1.250 and 1.280 at 80 °F (27 °C). Never add acid to the battery to obtain a higher specific gravity **(Figure 12-4, Page 12-11)**.

⚠ CAUTION

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

Performing the Hydrometer Test

1. Be sure that the battery has sufficient water to cover the plates by approximately 1/2 inch (12.7 mm) and is fully charged prior to beginning the test. If water must be added, recharge the battery before performing the hydrometer test **(Figure 12-5, Page 12-11)**.
2. Remove the vent cap.
3. Using a battery thermometer (CCI P/N 1011767), record the electrolyte temperature of a center cell.
4. Squeeze the rubber bulb of the hydrometer and insert into the cell. Slowly release the bulb, drawing electrolyte up into the glass tube of the hydrometer.
5. When the float rises off the bottom, adjust the electrolyte level so that the float rides free of the bottom but does not strike the bottom of the rubber bulb. Remove the hydrometer from the cell and release the pressure from the bulb.
6. Hold the hydrometer vertically, ensuring that the float is not contacting the sides of the glass tube. Hold the hydrometer at eye level and read the scale at the level of electrolyte **(Figure 12-4, Page 12-11)**.
7. Record the reading.
8. Return the electrolyte to the cell from which it was taken. Replace vent cap.
9. Repeat steps 2 through 8 on all cells.



View at eye level.

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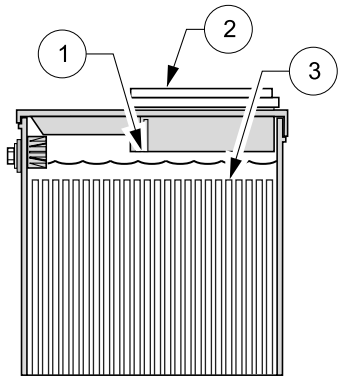
Figure 12-4 Hydrometer Test



1. Level Indicator 2. Cap 3. Plates

Electrolyte level at least 1/2 inch (13 MM) above plates or to level indicator.

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Figure 12-5 Battery Electrolyte Level

Hydrometer Calibration

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

Interpreting the Results of the Hydrometer Test

The approximate state of charge can be determined by referring to the following table:

TABLE CONTINUED ON NEXT PAGE

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

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

Voltage Test

1. Take a voltage reading with a multimeter set to 20 VDC by placing the red (+) probe on the positive (+) battery post and the black (–) probe on the negative (–) battery post. If it shows less than 12.4 volts, or if the lowest specific gravity reading from the Hydrometer Test is less than 1.225, recharge the battery. If battery voltage is greater than 12.4 volts and specific gravity is greater than 1.225, the problem is not with the battery. If the battery does not reach 12.4 volts, or if the specific gravity of a cell is still less than 1.225 after charging, replace the battery. **See following NOTE.**

NOTE: *A fully charged battery that is in good condition should have a specific gravity of at least 1.225 in all cells, and the difference in the specific gravity of any two cells should be less than 50 points. Open circuit voltage should be at least 12.4 volts.*

Load Test

1. Connect a 160-ampere load tester to the battery posts.
2. Turn the switch on the load tester to the ON position.
3. Read the battery voltage after the load tester has been turned ON for 15 seconds. Compare the battery's voltage reading with the following table. Make sure you have the correct ambient temperature.

IF TEMPERATURE IS	MINIMUM CRANKING VOLTAGE
70 °F (20 °C and above)	9.6 V
60 °F (16 °C)	9.5 V
50 °F (10 °C)	9.4 V
40 °F (4 °C)	9.3 V
30 °F (-1 °C)	9.1 V
20 °F (-7 °C)	8.9 V
10 °F (-12 °C)	8.7 V
0 °F (-18 °C)	8.5 V

4. If the battery is found to be good, or if the electrical problem continues after the battery has been replaced with a good one, test the electrical circuits.

TEST PROCEDURE 2 – Fuse

See General Warning on page 1-1.

The fuse (red 10-amp) is located in the electrical component box.

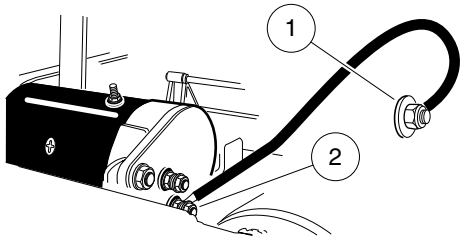
1. Disconnect battery. **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
2. Remove the cover from the electrical component box.
3. Ensure that wires are connected correctly and are tight. If they are not, rewire or tighten as necessary.

4. Remove fuse to be tested from the fuse block. **See Fuse Removal on page 14-16.** The red 10-amp fuse protects the solenoid for the starter (cranking) circuit. The 20-amp fuse at the yellow wire connection protects the headlights and brake lights (if equipped). The fuse at the red/white wire connection protects the horn.
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.

TEST PROCEDURE 3 – Ground Cables

See General Warning on page 1-1.

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
2. Check the starter/generator ground cable.
   2.1. Set the multimeter to 200 ohms. Place the red (+) probe on the (A2) terminal of the starter/generator and place the black (–) probe on the vehicle frame **(Figure 12-6, Page 12-13)**. The reading should be continuity. If the reading is incorrect, clean and tighten cable connections. If the connections are good and the reading is incorrect, repair or replace the cable.
3. Check the engine ground cable.
   3.1. Place the red (+) probe of the multimeter on the ground cable terminal end located on the oil filler bracket on the engine **(Figure 12-7, Page 12-13)**. Place the black (–) probe on the vehicle frame. The reading should be continuity. If the reading is incorrect, clean and tighten cable connections. If the connections are good and the reading is incorrect, repair or replace the cable.



1. Ground to Chassis 2. A2 Terminal

Figure 12-6 Starter/Generator Ground Cable Test

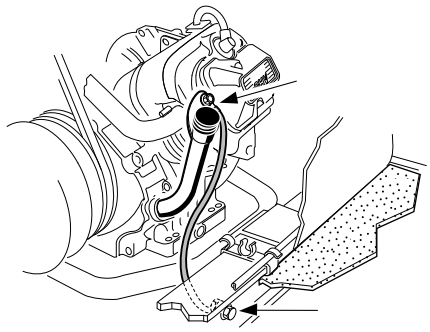
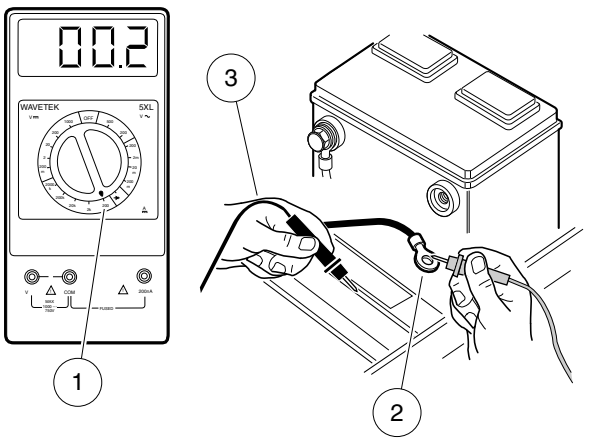

Place test probes at each end of ground cable.

Figure 12-7 Engine Ground Cable Test

4. Check voltage regulator ground connection (at battery frame ground). Make sure it is clean and tight.
5. Check the battery ground cable.
   5.1. A 6-gauge black cable connects the negative (–) battery post to the frame. The frame connection should be clean and tight. Visual inspection of the connection on the frame is very difficult. The best check for tightness is to pull on the black cable. If the cable moves at the connection end, disassemble the frame connection and clean the bolt, ring terminal, and nut. Reinstall the frame connection.
   5.2. Set the multimeter to 200 ohms. Place the red (+) probe on the unconnected end of the 6-gauge black cable, and place the black (–) probe on the vehicle frame **(Figure 12-8, Page 12-14)**. The reading should be continuity. If the reading is incorrect, ensure that terminal connections are clean and tight. If the connections are good and the reading is incorrect, repair or replace the cable.



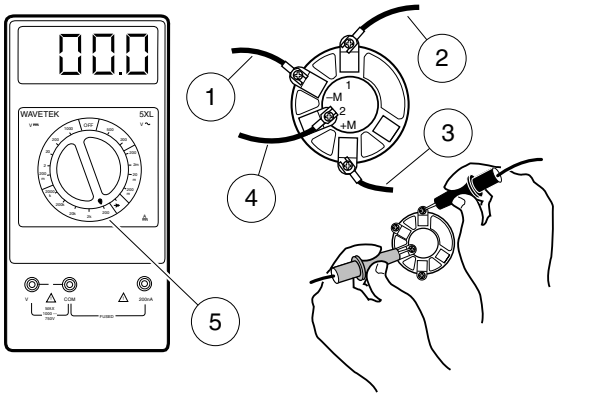
1. 200 Ohm Setting
2. Disconnect the 6-gauge black wire from the battery. Place red (+) probe on disconnected end of cable.
3. Place black (–) probe on frame.

Figure 12-8 Battery Ground Cable Test

TEST PROCEDURE 4 – Key Switch (Starter Circuit)

See General Warning on page 1-1.

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
2. Remove the center dash assembly. **See Key Switch Removal on page 13-17.**
3. Ensure that the wires are connected correctly and are tight. If they are not, rewire or tighten as necessary.
4. Insert the key and turn the key to ON. Place the red (+) probe of the multimeter on the (2) terminal and the black (–) probe on the (1) terminal of the key switch. The reading should be continuity. If the reading is incorrect, replace the key switch **(Figure 12-9, Page 12-14)**.



1. Black/White 2. Blue 3. White/Black 4. Red 5. 200 Ohm Setting

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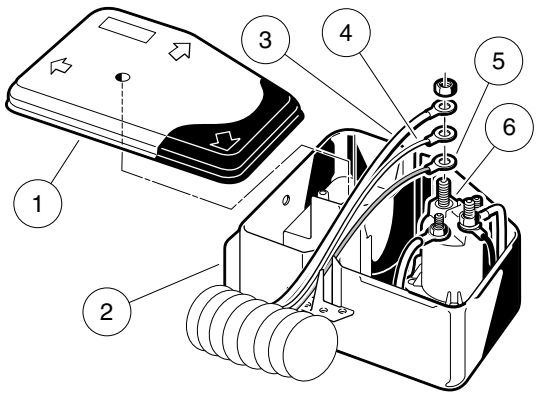
Figure 12-9 Key Switch Starter Circuit Test – For Pedal-Start Vehicles

TEST PROCEDURE 5 – Accelerator Pedal Limit Switch

See General Warning on page 1-1.

The accelerator pedal limit switch is the top switch located in the electrical component box. There is an 18-gauge green wire and an 18-gauge orange wire connected to this limit switch.

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
2. Check for proper wiring and tight connections **(Figure 12-1, Page 12-6)**.
3. Set the multimeter to 200 ohms. Place the red (+) probe on the common (COM) terminal (green wire) of the limit switch and place the black (–) probe on the normally closed (NC) terminal (orange wire) of the limit switch.
4. Make sure the battery is disconnected. With the key switch in the OFF position, the Forward/Reverse handle in NEUTRAL, and the accelerator pedal in the UP position, the reading should be no continuity. With the accelerator pedal pressed, the reading should be continuity. If readings are incorrect, replace the switch.



1. Cover 2. Electrical Component Box 3. 6 Ga. White Wire 4. 18 Ga. White Wire 5. 18 Ga. Red Wire 6. Solenoid

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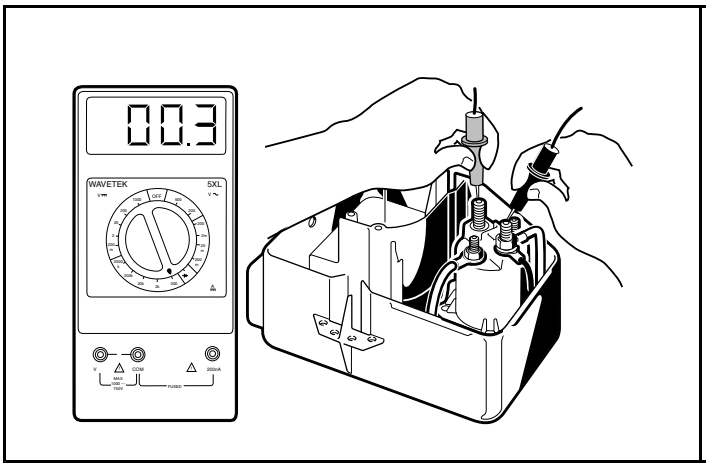
Figure 12-10 Solenoid Wire Removal

TEST PROCEDURE 6 – Solenoid

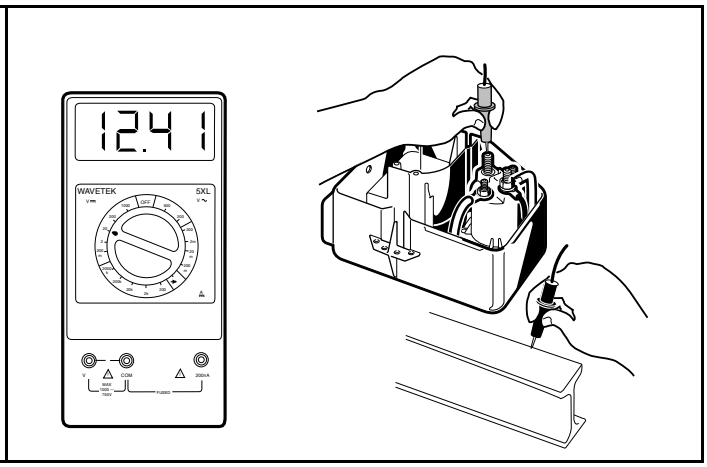
See General Warning on page 1-1.

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
2. Remove the electrical component box cover.
3. Ensure that the wires are connected correctly and are tight. If they are not, rewire or tighten as necessary.
4. Set a multimeter to 200 ohms. Place the red (+) probe on one of the small posts of the solenoid and place the black (–) probe on the other small post. The reading should be 14 to16 ohms. If the reading is not within limits, replace the solenoid.
5. Remove the 6-gauge white wire, the 16-gauge red wire, and 16-gauge white wire from the large post of the solenoid. Do not allow the wires to touch the frame or other components of the vehicle **(Figure 12-10, Page 12-15)**.
6. Set the multimeter to 200 ohms. Connect the red (+) probe to one of the large posts of the solenoid and connect the black (–) probe to the other large post **(Figure 12-11, Page 12-16)**.
7. Connect battery and spark plug wire(s). **See Connecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
8. Place the Forward/Reverse handle in the NEUTRAL position and the neutral lockout switch in the MAINTENANCE position. Turn the key switch to the ON position. With the accelerator in the UP position, the reading on the multimeter should be no continuity. Press the accelerator pedal and listen for the solenoid click. There should be continuity. If either reading is incorrect, replace the solenoid.
9. With the Forward/Reverse handle still in NEUTRAL and the neutral lockout switch in the MAINTENANCE position, set the multimeter to 20 volts DC and place the red (+) probe on the large post that does not have wires connected to it. Place the black (–) probe on the vehicle frame. Turn key switch to the ON position, press accelerator pedal, and listen for solenoid click. The meter should read full battery voltage. If the reading is incorrect, replace the solenoid **(Figure 12-12, Page 12-16)**.
10. Disconnect the 6-gauge black wire from the negative (–) post of the battery before reconnecting the wires to the solenoid.



458

Figure 12-11 Solenoid Continuity Test



459

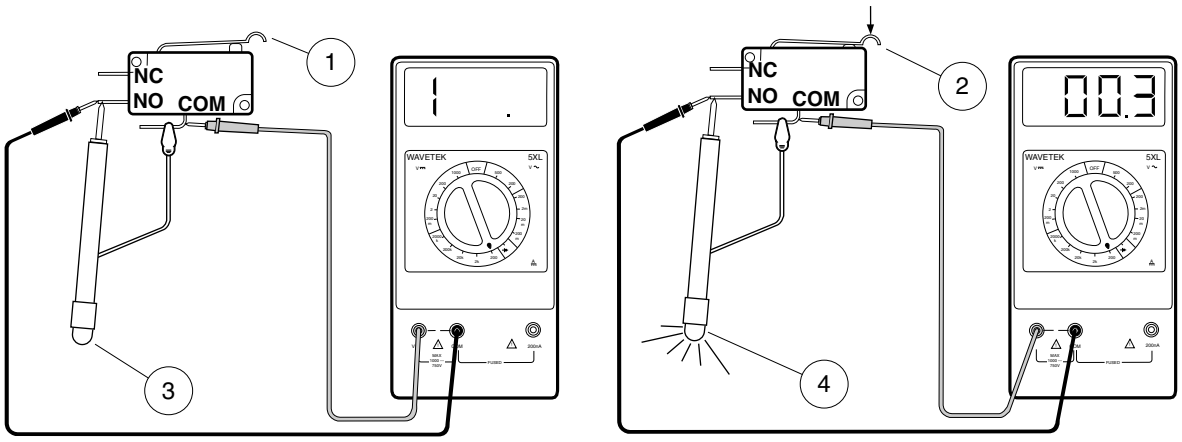
Figure 12-12 Solenoid Ground Test

TEST PROCEDURE 7 – Neutral Lockout Limit Switch

See General Warning on page 1-1.

This switch is located on the Forward/Reverse switch assembly. A black/light blue wire, a gray wire, and a tan wire are connected to this limit switch.

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
2. Check for proper wiring and tight connections.
3. Set the multimeter to 200 ohms. Place the red (+) probe of the multimeter on the common (COM) terminal of the limit switch. Place the black (–) probe on the normally open (NO) terminal of the switch. Without the lever pressed, the reading should be no continuity. Press the lever, and the reading should be continuity. If either reading is incorrect, replace the limit switch **(Figure 12-13, Page 12-17)**.
4. Check to be sure the lobe on the cam is pressing the neutral lockout limit switch as the Forward/Reverse shifter is being shifted. The limit switch should make an audible click as it is pressed. If it does not, check for wear on the cam lobe and replace cam if necessary.



1. Lever Up 2. Lever Depressed 3. Tester light is OFF. Meter reads 1. 4. Tester light is ON. Meter reads approx. zero ohms.

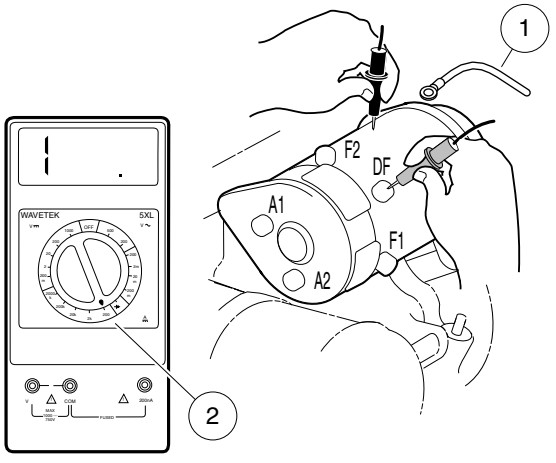
460

Figure 12-13 Neutral Lockout Limit Switch Test

TEST PROCEDURE 8 – Starter/Generator (Starter Function)

See General Warning on page 1-1.

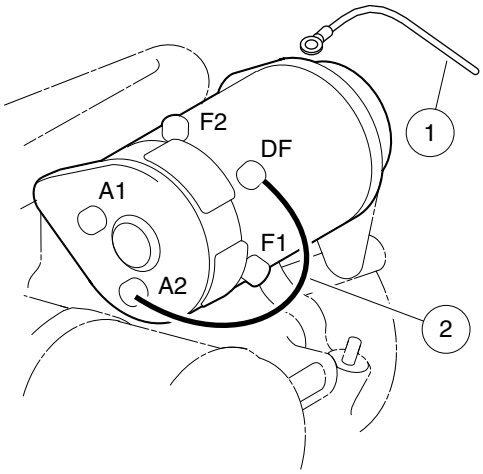
1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
2. Ensure that wires are connected correctly and are tight. If they are not, rewire or tighten as necessary.
3. Disconnect the wires from all the terminals on the starter/generator. Then place the black (–) probe of a multimeter, set to 200 ohms, on the starter/generator housing (scratch through the finish to ensure a good ground). While holding the black (–) probe against the housing, place the red (+) probe (one at a time) on the A1, A2, F1, F2 and DF terminals respectively **(Figure 12-14, Page 12-18)**. The readings should be no continuity. If the readings are incorrect, the starter/generator will need to be removed from the vehicle and disassembled by a qualified technician. **See Starter/Generator Removal on page 14-1.**
   – An incorrect reading from the A1 or A2 terminal indicates three possible problems: 1) a grounded A1 or A2 terminal, 2) a grounded wire in the brush area, or 3) a grounded armature/commutator.
   – If the F1 or F2 reading is incorrect, it indicates a possible grounded F1 or F2 terminal or a grounded field coil.
   – If the DF reading is incorrect, it indicates a possible grounded DF terminal or a grounded field coil.
4. Disconnect the ground wire from the A2 terminal and the green wire from the A1 terminal on the starter/generator.
5. Using a multimeter set to 200 ohms, place the red (+) probe on the A1 terminal and the black (–) probe on the A2 terminal. The reading should be continuity. If the reading is incorrect, a possible open or poor contact in a brush assembly and/or open armature windings may be the cause. The starter/generator will need to be removed from the vehicle and disassembled by a qualified technician. **See Starter/Generator Removal on page 14-1.**
6. With the wires still disconnected, using a multimeter set on 200 ohms, place the red (+) probe on the F1 terminal and the black (–) probe on the F2 terminal. The reading should be between approximately 0.1 and 0.3 ohms. If the reading is incorrect, a possible open field coil or bad connections at terminals may be the cause. The starter/generator will need to be removed from the vehicle and disassembled by a qualified technician. **See Starter/Generator Removal on page 14-1.**
7. With the wires still disconnected, using a multimeter set to 200 ohms, place the red (+) probe on the DF terminal and the black (–) probe on the F1 terminal. The reading should be between 4.5 and 5.5 ohms. If the reading is incorrect, a possible grounded DF terminal and/or grounded field coil may be the cause. The starter/generator will need to be removed from the vehicle and disassembled by a qualified technician. **See Starter/Generator Removal on page 14-1.**



1. Yellow Wire 2. 200 Ohm Setting

461

Figure 12-14 Check Starter Terminal Continuity



1. Yellow Wire 2. Jumper Wire

462

Figure 12-15 Jumper Wire Ground – DF to A2

TEST PROCEDURE 9 – Wire Continuity

See General Warning on page 1-1.

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
2. To test a wire for continuity, disconnect either end from the electrical component it is attached to.
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 be continuity. If the reading is incorrect, repair or replace the wire.

TEST PROCEDURE 10 – Starter/Generator (Generator Function)

See General Warning on page 1-1.

NOTE: *Keep the battery connected while performing this test procedure.*

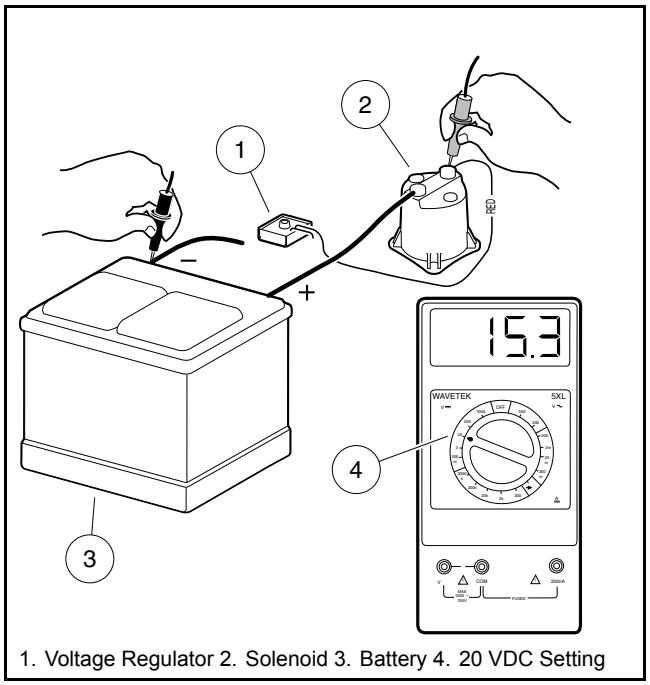
1. Place the Forward/Reverse handle in the NEUTRAL position and the neutral lockout switch in the MAINTENANCE position. Chock the wheels.
2. Ensure that the wires are connected correctly and are tight. If they are not, rewire or tighten as necessary.
3. Disconnect the yellow wire from the DF terminal on the starter/generator. Cover the connector on the yellow wire to make sure the yellow wire will not short to ground. Then, using a jumper wire, ground the DF terminal to the A2 terminal **(Figure 12-15, Page 12-18)**.
4. Using a multimeter set to 20 volts DC, place the red (+) probe on the positive (+) post of the battery, and place the black (–) probe on the negative (–) post. Start the engine and run it at full governed speed. The reading should show the voltage rising on the meter. If the voltage rises above 15.3 volts DC, test the voltage regulator. **See Voltage Regulator on page 12-19.** If the voltage does not rise, a tear-down inspection of the starter/generator will be necessary. **See Starter/Generator Removal on page 14-1.**
5. Connect the yellow wire to the DF terminal on the starter/generator.

TEST PROCEDURE 11 – Voltage Regulator

See General Warning on page 1-1.

NOTE: *Keep the battery connected while performing this test procedure.*

1. Place the Forward/Reverse handle in the NEUTRAL position and the neutral lockout switch in the MAINTENANCE position. Chock the wheels.
2. Ensure that the wires are connected correctly and are tight. If they are not, rewire or tighten as necessary.
3. Check the engine RPM setting to ensure that it is adjusted correctly. **See Engine RPM Adjustment on page 17-11.**
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. Turn the key switch to the OFF position, killing the engine. Using a multimeter set to 20 volts DC, place the red (+) probe on the large post of the solenoid with the red wire from the voltage regulator attached. Place the black (–) probe on the negative (–) battery post **(Figure 12-16, Page 12-20)**. Turn the key switch to the ON position. Press the accelerator to start the engine and run it at full governed speed. If the reading is between 14.7 and 15.3 volts, the regulator is good. If the reading is lower than 14.7 volts but rising steadily, check battery condition. If the reading is lower than 14.7 volts and not rising, and the starter/generator is good; or if the reading is over 15.3 volts and continues to rise, replace voltage regulator. **See Voltage Regulator Removal on page 14-12.**



1. Voltage Regulator 2. Solenoid 3. Battery 4. 20 VDC Setting

463

Figure 12-16 Voltage Regulator Test

TEST PROCEDURE 12 – Disconnected Kill Wire

See General Warning on page 1-1.

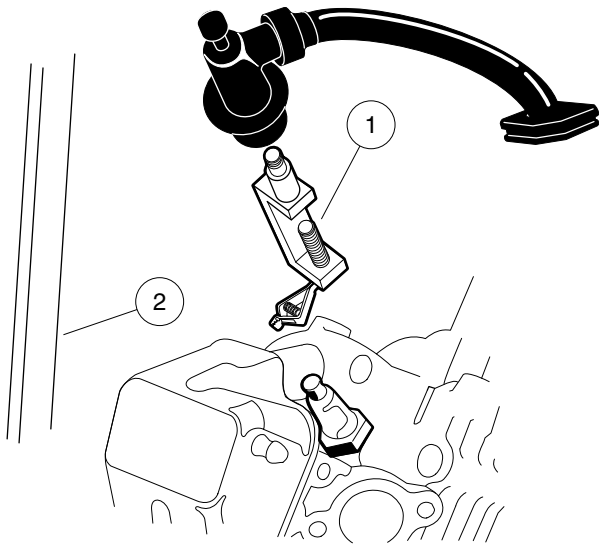
NOTE: *Keep the battery connected while performing this test procedure.*

1. Place the Forward/Reverse handle in the NEUTRAL position and the neutral lockout switch in the MAINTENANCE position. Chock the wheels.
2. Disconnect the engine kill white/black wire at the bullet connector located next to the RPM limiter **(Figure 12-18, Page 12-21)**.
3. Start the engine in a well ventilated area.
   – Turn the key switch to the ON position. Press the accelerator pedal to start the engine.
4. If the engine begins to run, test the engine kill circuit for a shorted wire or other failed components in the engine kill circuit. **See Key Switch (Engine Kill Circuit) on page 12-30. See following WARNING.**

⚠ WARNING

- **When the white/black engine kill wire is disconnected, the engine will not stop running after the accelerator pedal is released. It will be necessary to pull and hold the choke handle until the engine stops running.**

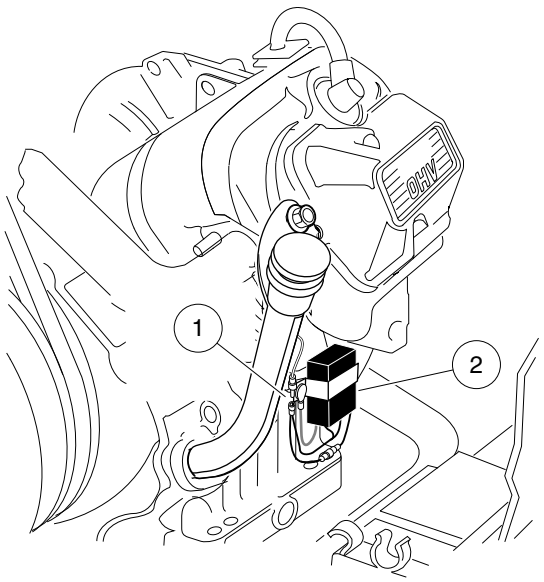
5. If the engine does not run, proceed to Test Procedure 13 – Ignition Spark on page 12-21.



1. Ignition Gap Test Tool 2. Chassis

464

Figure 12-17 Ignition Spark Test



1. Disconnect White/Black Engine Kill Wire 2. RPM Limiter

465

Figure 12-18 White/Black Engine Kill Wire

TEST PROCEDURE 13 – Ignition Spark

See General Warning on page 1-1.

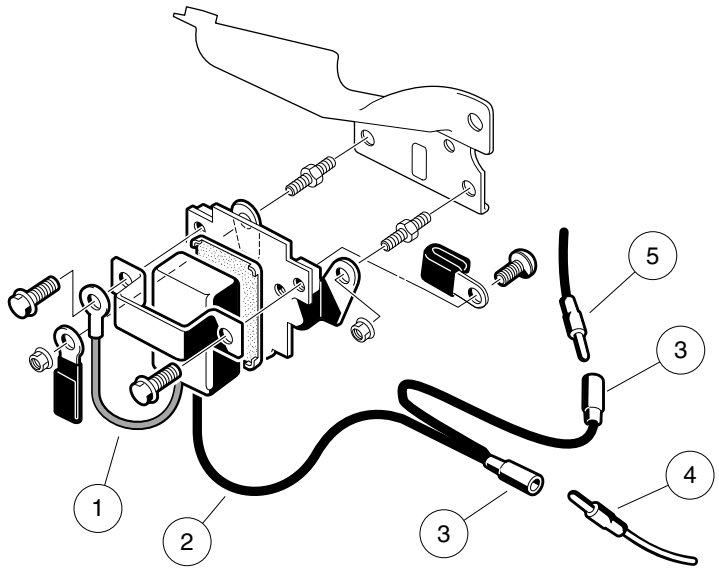
NOTE: *Keep the battery connected while performing this test procedure.*

1. Place the Forward/Reverse handle in the NEUTRAL position and the neutral lockout switch in the MAINTENANCE position. Chock the wheels.
2. Remove the plug wire from the spark plug. Using an ignition spark gap test tool (Thexton 404® or equivalent), check for correct spark **(Figure 12-17, Page 12-21)**.
   2.1. Adjust the tester probes to approximately 18,000 volts (18 Kv) setting (SE – *Small Engine Setting* on the Thexton 404 tool). Connect the tester to the spark plug wire, and connect the alligator clip to a solid engine ground.
   2.2. Start the engine. There should be a strong blue spark between the probes of the spark gap tester. If there is no spark, or if the spark is a faint yellow or red color, test components of the ignition circuit. **See Ignition Coil on page 12-23.**
3. If the spark gap tester tool indicates a strong blue spark, it is possible the spark plug has failed internally. Check the spark plug gap. The gap should be set at 0.027 to 0.031 of an inch (0.69 to 0.79 mm). If the gap is correct, replace the spark plug with a new part and test the engine for proper operation.

TEST PROCEDURE 14 – RPM Limiter

See General Warning on page 1-1.

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
2. Disconnect both of the bullet terminals **(Figure 12-19, Page 12-22)**.
3. Using a multimeter set to 200 ohms, place the red (+) probe on the brown ground wire and place the black (–) probe on one of the black wire female bullet connectors. The reading should be no continuity. If the reading is not correct, replace the RPM Limiter.
4. This test will find most bad RPM Limiters. Some of them may bench test okay but fail under a load due to heat while operating. Another method of testing is to replace the RPM Limiter and then run the engine. If the engine runs properly, keep the new RPM Limiter in the circuit.



1. Brown Wire 2. Black Wire 3. Female Bullet Terminal 4. White/Black Kill Circuit Wire 5. Ignition Coil Black Wire

466

Figure 12-19 RPM Limiter

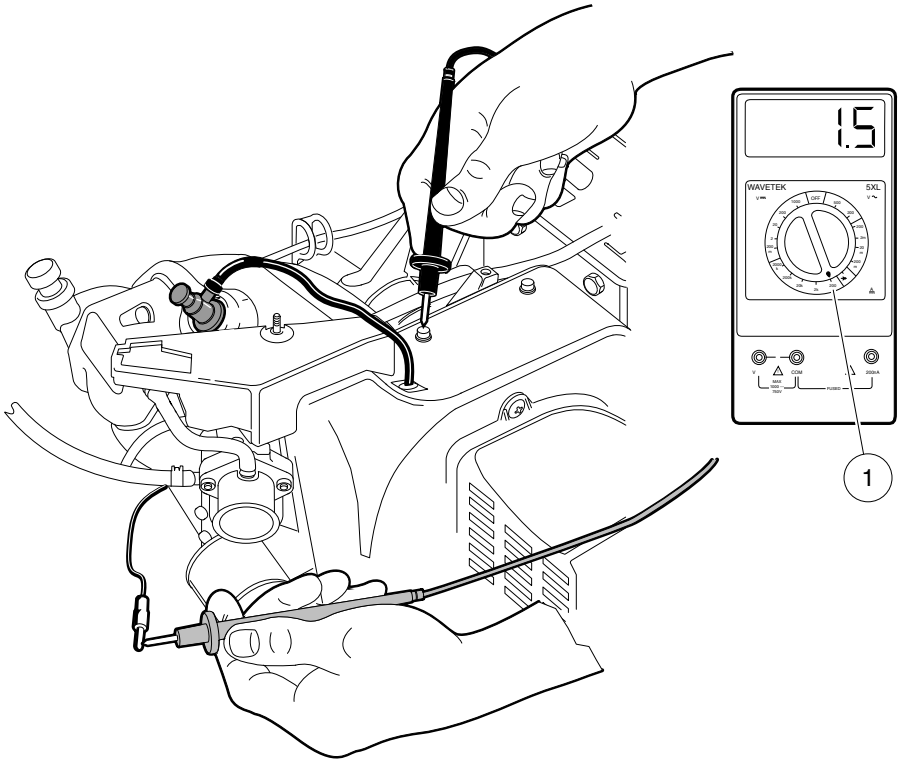
TEST PROCEDURE 15 – Ignition Coil

See General Warning on page 1-1.

The following test procedures will properly detect a coil that has failed in most cases; however, in rare cases, some ignition coils can fail to operate at normal (warmer) operating temperatures. If the ignition coil has tested okay in the vehicle and on the bench, but fails to operate reliably, replace the coil with a known good coil and operate the engine for several minutes to ensure that the coil functions at normal operating temperature. If the new coil functions properly, keep the new coil in the circuit.

Ignition Coil – In Vehicle Test

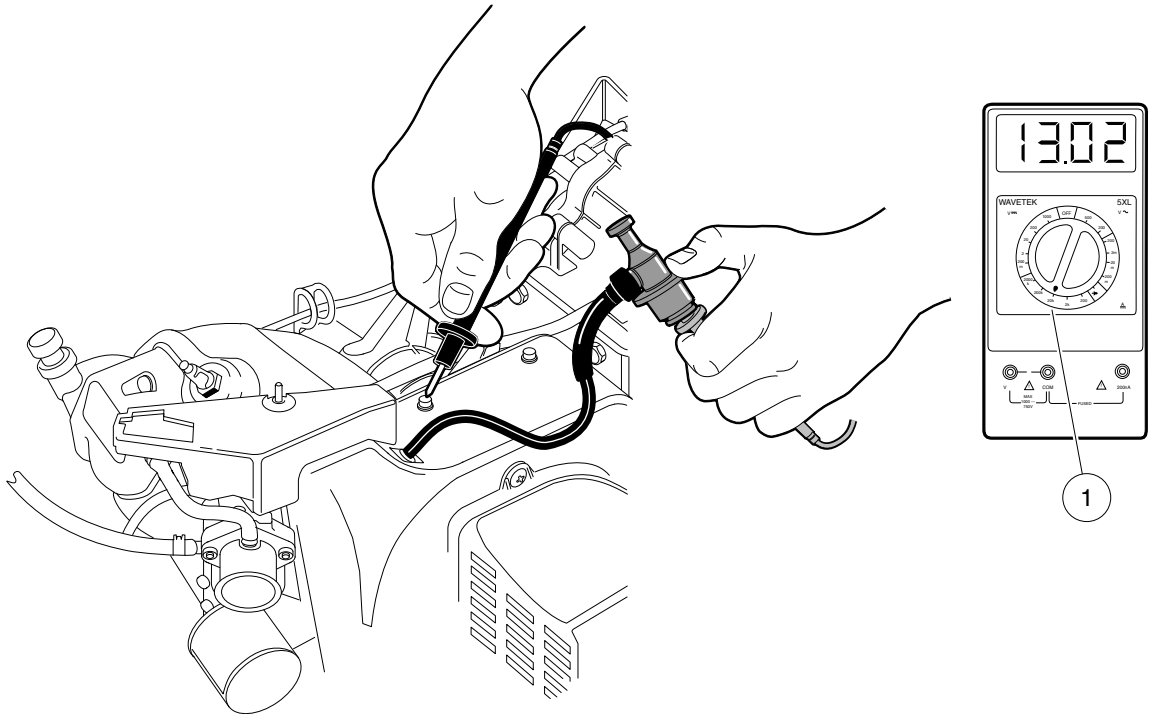
1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
2. Using a multimeter set to 200 ohms, measure the primary coil resistance.
   2.1. Disconnect both of the bullet terminals at the RPM limiter **(Figure 12-19, Page 12-22)**. Place the red (+) probe of the meter on the male bullet terminal of the wire connecting to the ignition coil under the fan housing, and place the black (–) probe on a clean unpainted surface of the engine or frame **(Figure 12-20, Page 12-23)**.
   2.2. If the resistance is not between 0.6 - 1.7 ohms, bench test the ignition coil.



1. 200 Ohm Setting

467

Figure 12-20 Primary Coil Resistance – In Vehicle Test

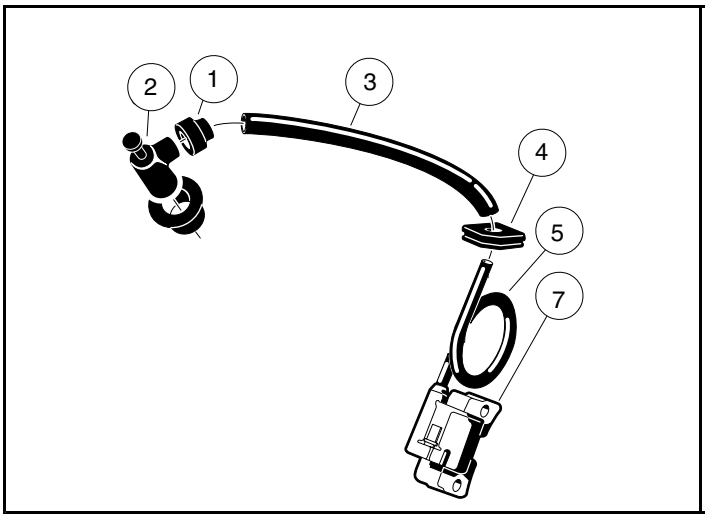


1. 20k Ohm Setting

468

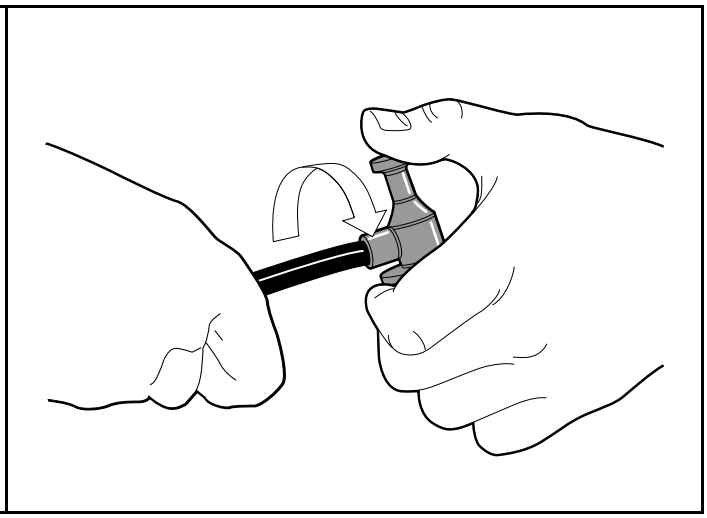
Figure 12-21 Secondary Coil Test – In Vehicle Test

3. Using a multimeter set to 20k ohms, measure the resistance of the secondary coil and spark plug cap together.
   3.1. Place the red (+) probe of the meter into the end of the spark plug cap that normally connects to the spark plug and place the black (–) probe on a clean unpainted surface of the engine or frame **(Figure 12-21, Page 12-24)**.
   3.2. If the resistance is between 12.0k - 14.0k ohms, the secondary coil and spark plug cap are within acceptable limits; proceed to step 6 on page 12-25. If the resistance is not between 12.0k - 14.0k ohms, the spark plug cap and secondary coil must be tested independently from each other.
4. Test the spark plug cap separately from the secondary coil.
   4.1. Remove the rubber gasket (1) on the plug cap (2) by rolling back the gasket onto the spark plug wire (3) **(Figure 12-22, Page 12-25)**.
   4.2. Remove the cap from the wire by turning the cap counterclockwise three or four revolutions while gently pulling it off the wire **(Figure 12-23, Page 12-25)**.



469

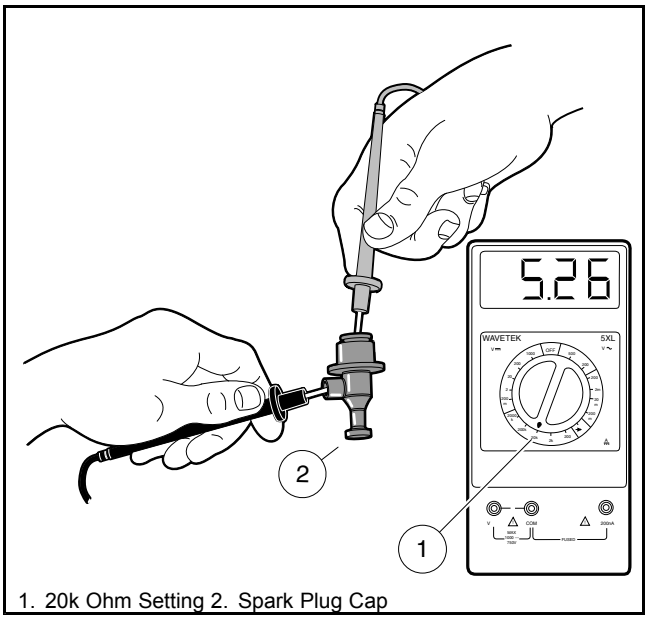
Figure 12-22 Ignition Coil and Cap



470

Figure 12-23 Spark Plug Cap Removal

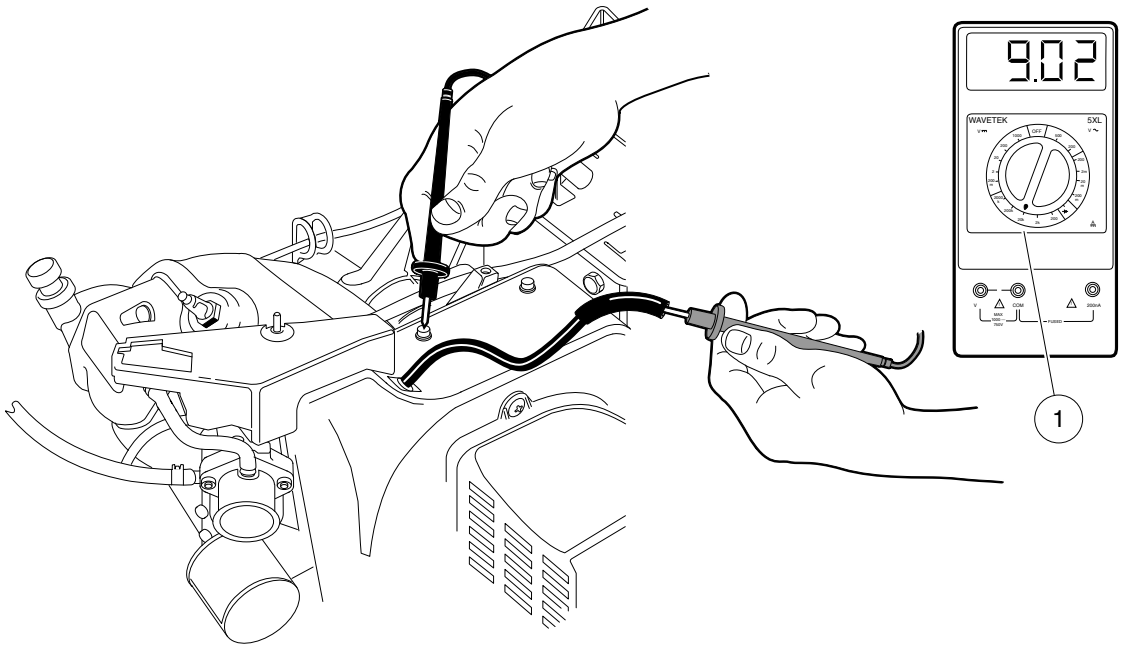
4.3. Using a multimeter set to 20k ohms, place the red (+) probe of the multimeter into the end of the spark plug cap that normally connects to the spark plug and place the black (–) probe into the end of the cap with the internal screw **(Figure 12-24, Page 12-25)**. If the resistance is not between 4.5k - 6.0k ohms, the cap has failed and must be replaced. Proceed to the next step with the spark plug cap still removed.



1. 20k Ohm Setting 2. Spark Plug Cap

471

Figure 12-24 Spark Plug Cap Test



1. 20k Ohm Setting

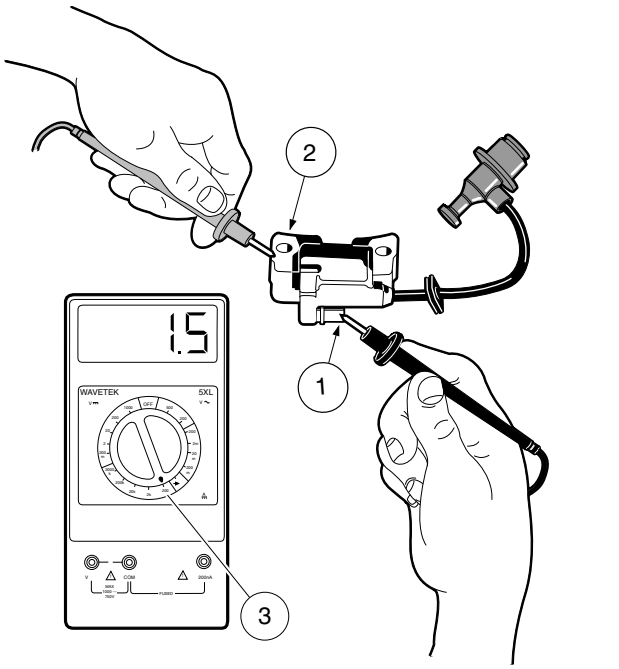
472

Figure 12-25 Secondary Coil Test Without Cap

5. Test the secondary coil separately from the spark plug cap.
   5.1. Using a multimeter set to 20k ohms, place the red (+) probe of the meter into the end of the spark plug wire and place the black (–) probe on a clean unpainted surface of the engine or frame **(Figure 12-25, Page 12-26)**. If the resistance is between 6.0k - 11.0k ohms, the secondary coil is within acceptable limits. If the resistance is not between 6.0k - 11.0k ohms, bench test the ignition coil.
6. If the preceding tests indicate that the ignition coil resistance readings are within acceptable ranges, but the coil fails to function properly, proceed to the following bench test procedures.

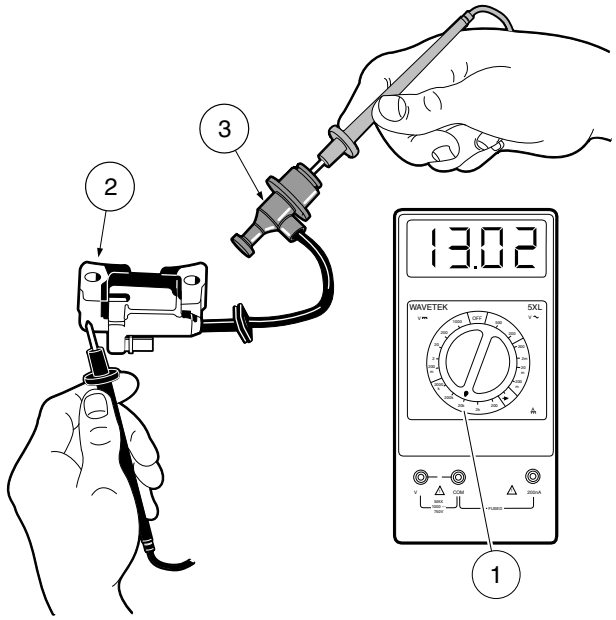
Ignition Coil – Bench Test

1. Remove the coil from the engine. **See Ignition Coil Removal on page 14-26.**
2. Using a multimeter set to 200 ohms, measure the primary coil resistance.
   2.1. Place the black (–) probe of the meter on the terminal on the ignition coil (1), and place the red (+) probe on the core (2) **(Figure 12-26, Page 12-27)**.



1. Ignition Coil Terminal 2. Core 3. 200 Ohm Setting

473
Figure 12-26 Primary Coil Resistance – Bench Test



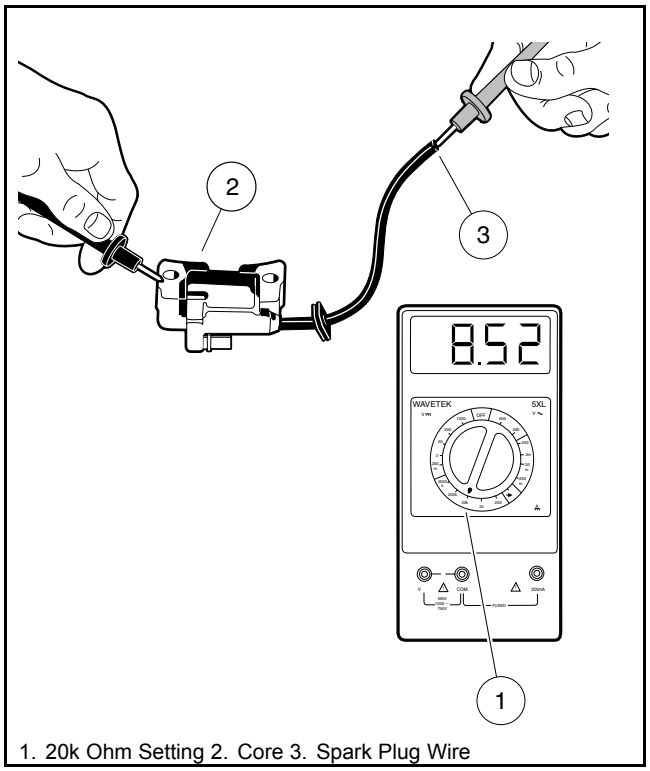
1. 20k Ohm Setting 2. Core 3. Spark Plug Cap

474
Figure 12-27 Secondary Coil and Cap Resistance – Bench Test

2.2. If the resistance is not between 0.6 - 1.7 ohms, replace the ignition coil.

3. Using a multimeter set to 20k ohms, measure the resistance of the secondary coil and spark plug cap together.

3.1. Place the red (+) probe of the meter into the end of the spark plug cap (3) that normally connects to the spark plug and place the black (–) probe on the core (2) **(Figure 12-27, Page 12-27)**.



1. 20k Ohm Setting 2. Core 3. Spark Plug Wire

475
Figure 12-28 Secondary Coil Resistance – Bench Test

3.2. If the resistance is between 12.0k - 14.0k ohms, the secondary coil and spark plug cap are within acceptable limits; proceed to step 6 on page 12-26. If the resistance is not between 12.0k - 14.0k ohms, the spark plug cap and secondary coil must be tested independently from each other.

4. If not previously tested, test the spark plug cap separately from the secondary coil.

4.1. Remove the rubber gasket (1) on the plug cap (2) by rolling back the gasket onto the spark plug wire (3) **(Figure 12-22, Page 12-25)**.

4.2. Remove the cap from the wire by turning the cap counterclockwise three or four revolutions while gently pulling it off the wire **(Figure 12-23, Page 12-25)**.

4.3. Using a multimeter set to 20k ohms, place the red (+) probe of the multimeter into the end of the spark plug cap that normally connects to the spark plug and place the black (–) probe into the end of the cap with the internal screw **(Figure 12-24, Page 12-25)**. If the resistance is not between 4.5k - 6.0k ohms, the cap has failed and must be replaced. Proceed to the next step with the spark plug cap still removed.

5. Test the secondary coil separately from the spark plug cap.

5.1. Using a multimeter set to 20k ohms, place the red (+) probe of the meter into the end of the spark plug wire (3) and place the black (–) probe on the core (2) **(Figure 12-28, Page 12-28)**. If the resistance is between 6.0k - 11.0k ohms, the secondary coil is within acceptable limits. If the resistance is not between 6.0k - 11.0k ohms, the ignition coil has failed and must be replaced.

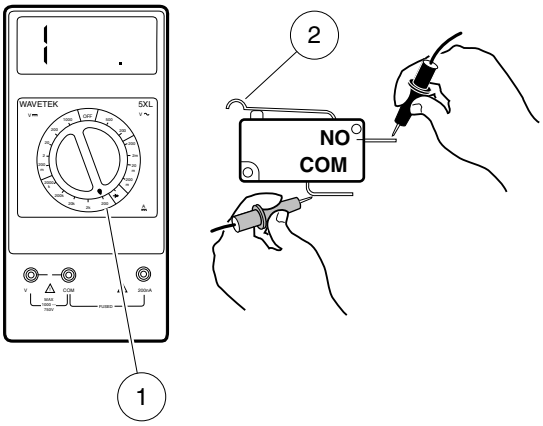
6. If the preceding tests indicate that the ignition coil resistance readings are within acceptable ranges, but the coil fails to function properly, replace the ignition coil and cap.

TEST PROCEDURE 16 – Kill Limit Switch

See General Warning on page 1-1.

The kill limit switch is located inside the electrical component box. The accelerator kill switch is the lower of the two limit switches and has a white/black wire and black wire connected to it.

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
2. Check for proper wiring and tight connections.
3. Disconnect the wires from the limit switch and test the limit switch for continuity.
   – Place the red (+) probe of the multimeter on the common (COM) terminal (white/black wire) of the limit switch. Place the black (–) probe on the normally open (NO) terminal (black wire) of the limit switch. Without the lever pressed, the reading should be no continuity. Press the lever, and the reading should be continuity. If either reading is incorrect, replace the limit switch **(Figure 12-29, Page 12-29)**.
4. Connect wires to limit switch and check for tight connections.



1. 200 Ohm Setting 2. Lever Up

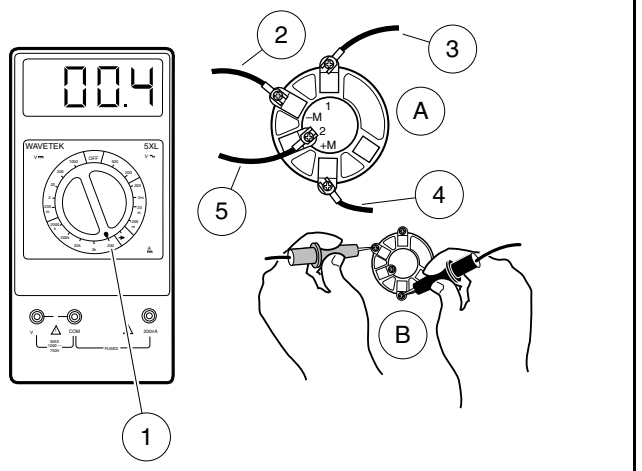
476

Figure 12-29 Kill Limit Switch Test

TEST PROCEDURE 17 – Key Switch (Engine Kill Circuit)

See General Warning on page 1-1.

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
2. Remove the center dash assembly. **See Key Switch Removal on page 13-17.**
3. Disconnect wires from the (+M) and (–M) terminals of the key switch.
4. Place the red (+) probe on the (+M) terminal and the black (–) probe on the (–M) terminal. With the key switch OFF, the reading should be continuity. With the key switch ON, the reading should be no continuity. If either reading is incorrect, replace the key switch **(Figure 12-30, Page 12-30)**.
5. Connect wires to the key switch. Make sure wires are connected correctly and are tight. If they are not, rewire or tighten as necessary.
6. Install dash panel in reverse order of removal.



1. 200 Ohm Setting 2. Black/White 3. Blue 4. White/Black 5. Red
A. Key Switch OFF B. Engine Kill Circuit

477

Figure 12-30 Key Switch Test – Engine Kill Circuit

TEST PROCEDURE 18 – Engine Kill Wire

See General Warning on page 1-1.

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
2. Disconnect white/black wire bullet connector located at the engine RPM limiter **(Figure 12-18, Page 12-21)**.
3. Connect red (+) probe of multimeter to the male bullet terminal on the white/black wire and connect the black (–) probe to the vehicle frame.
4. Turn the key switch ON, place the Forward/Reverse handle in FORWARD, and press the accelerator pedal. There should be no continuity. If there is continuity, check for worn insulation on the white/black wire that may be allowing the engine kill wire to ground to the frame.

TEST PROCEDURE 19 – Reverse Buzzer Limit Switch

See General Warning on page 1-1.

NOTE: *Keep the battery connected while performing this test procedure.*

The reverse buzzer limit switch is located on the Forward/Reverse shifter; red/white and orange wires are connected to it.

1. Place the Forward/Reverse handle in the NEUTRAL position and the neutral lockout switch in the MAINTENANCE position. Chock the wheels.
2. 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.
3. 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. Without the lever pressed, the reading should be no continuity. Press the lever and the reading should be continuity. If either reading is incorrect, replace limit switch. **See Reverse Buzzer Limit Switch Removal on page 14-21.**

TEST PROCEDURE 20 – Reverse Buzzer

See General Warning on page 1-1.

The front reverse buzzer is mounted to the center dash assembly under the front body. The rear reverse buzzer is mounted on a bracket at the left rear of the vehicle.

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
2. To test the front reverse buzzer, remove center dash panel. **See Key Switch Removal on page 13-17.**
3. Check for proper wiring and tight connections. Using a multimeter, individually check for continuity through each wire that connects to the reverse buzzer. **See Wiring Diagram on page 12-6.** If the buzzer will not function when properly wired, replace the buzzer.

TEST PROCEDURE 21 – Low Oil Warning Light

See General Warning on page 1-1.

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
2. Remove the center dash assembly. **See Key Switch Removal on page 13-17.**
3. Ensure that the wires are connected correctly and are tight. If they are not, rewire or tighten as necessary. **See Wiring Diagram on page 12-6.**
4. Disconnect the yellow wire (to the oil level sensor) from the terminal on the low oil warning light. Using an alligator clip jumper wire, connect the low oil warning light terminal to the vehicle frame. Connect the red (+) battery cable to the positive (+) battery post, then attach the black (–) cable to the negative (–) battery post.
5. Turn the key switch ON. The low oil warning light should illuminate. If it does not, check continuity of the yellow wire that connects the key switch to the low oil warning light. If there is no continuity in the wire, replace the wire. Then test the key switch. **See Key Switch (Starter Circuit) on page 12-14.** If the yellow wire and the key switch test okay, then replace the low oil warning light.

TEST PROCEDURE 22 – Oil Level Sensor

See General Warning on page 1-1.

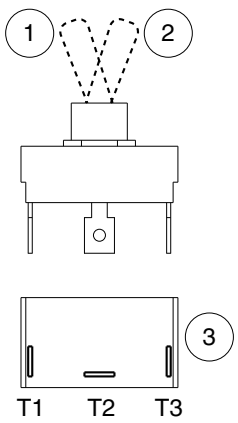
NOTE: *Keep the battery connected while performing this test procedure.*

1. Place the Forward/Reverse handle in the NEUTRAL position, the neutral lockout switch in the MAINTENANCE position, turn the key switch to the OFF position, disconnect the spark plug wire, and chock the wheels.
2. Ensure that the low oil warning light and all connecting wires are functioning correctly. **See Low Oil Warning Light on page 12-32.**
3. Drain the engine oil into an approved container and properly dispose of used oil.
4. Turn the key switch ON, closing the circuit. The low oil warning light should illuminate. If the low oil warning light does not illuminate, the oil level sensor needs to be replaced. **See Oil Level Sensor Removal on page 15-5.**
5. Install a new oil filter and fill the engine with new oil before returning the vehicle to service. **See Engine Oil – Gasoline Vehicle, Section 10, Page 10-7.**

TEST PROCEDURE 23 – Neutral Lockout Switch

See General Warning on page 1-1.

1. Remove the wires from the switch **(Figure 12-31, Page 12-33)**.
2. With switch in position 1:
   2.1. Check for no continuity between terminals T1 and T2.
   2.2. Check for continuity between terminals T2 and T3.
3. With switch in position 2:
   3.1. Check for no continuity between terminals T2 and T3.
   3.2. Check for continuity between terminals T1 and T2.



T1 – Black/Light Blue Stripe T2 – Black T3 – Black/Yellow Stripe
1. Position 1
2. Position 2

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Figure 12-31 Neutral Lockout Switch Test – for Pedal-Start Vehicles

Toggle Position Operates:	
Position 1	Position 2
ON	ON
T2 – T3	T1 – T2

4. If switch:
   4.1. does not work as stated in previous steps, replace switch.
   4.2. does work as stated and the MAINTENANCE/OPERATE modes still do not work:
   – Check the fuse.
   – Check the limit switches.
   – Check continuity of the wires involved.

TEST PROCEDURE 24 – Battery Test (Under Load)

See General Warning on page 1-1.

NOTE: *Keep the battery connected while performing this test procedure.*

1. Place the Forward/Reverse handle in the NEUTRAL position and the neutral lockout switch in the MAINTENANCE position. Chock the wheels.
2. Set a multimeter to 20 volts DC and place the red (+) probe on the F2 (white wire) terminal on the starter/generator. Place the black (–) probe on the negative (–) battery post.
3. Turn the key switch to the ON position, leave the Forward/Reverse shifter in the NEUTRAL position and press the accelerator pedal (with the accelerator pedal pressed, the battery is under load).
   3.1. If the voltage reading is over 9.6 volts, with an electrolyte temperature of 70 °F (21 °C), check the starter/generator. **See following NOTE.**

NOTE: *The voltage reading listed is for electrolyte at 70 °F (21 °C). At lower electrolyte temperatures the voltage reading will be lower.*

4. If the reading is below 9.6 volts, with an electrolyte temperature of 70 °F (21 °C), check the battery. **See Battery on page 12-10.**
   4.1. If the reading is zero, there may be no continuity across the large posts of the solenoid. **See Solenoid on page 12-16.**
5. If all of the test results are good and the voltage reading is zero, there may be a broken or damaged 6-gauge white wire from the solenoid to the starter/generator. **See Starter/Generator (Starter Function) on page 12-18.**

TEST PROCEDURE 25 – Fuel Level Sending Unit

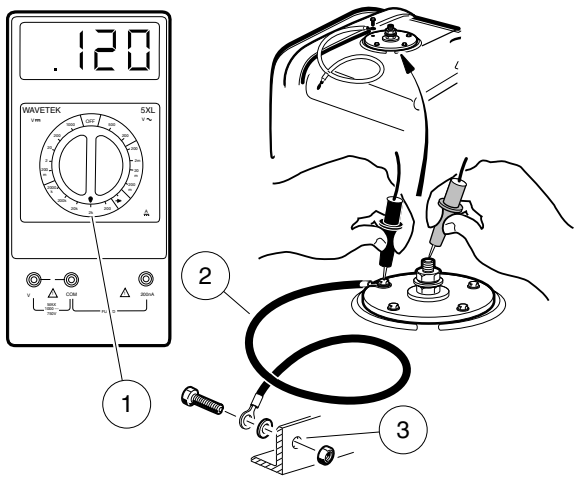
See General Warning on page 1-1.

⚠ WARNING

- **To avoid the possibility of fire or explosion, make sure the fuel tank cap is securely in place while performing this test procedure.**

1. Disconnect battery. **See Disconnecting the Battery – Gasoline Vehicles, Section 1, 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 of the multimeter on the center post of the sending unit. Place the black (–) probe on the ground connection of the sending unit **(Figure 12-32, Page 12-35)**.
4. The following resistance readings (in ohms) should be obtained 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 chart below 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



1. 2k Ohm Setting 2. Black Wire 3. Ground

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Figure 12-32 Fuel Level Sending Unit Test

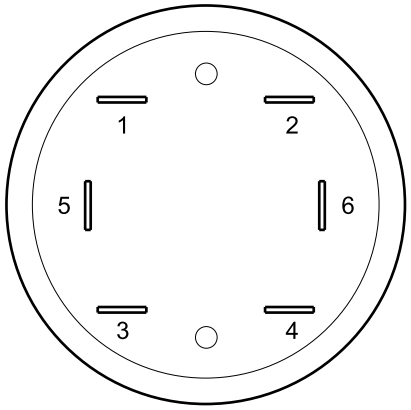
5. If the readings are within the specifications listed above, the fuel level sending unit is working properly. If the readings are incorrect, the fuel level sending unit has failed and the fuel tank must be replaced. **See Fuel Tank Removal on page 17-22.**
6. If the readings are correct and the fuel gauge does not function correctly, check the continuity of the orange wire from the fuel level sending unit to the fuel gauge/hour meter. Leave the battery disconnected while checking continuity. Also check the continuity of the blue wire from the fuel gauge/hour meter to the key switch, and the black ground wires at the fuel level sending unit and at the fuel gauge/hour meter. **See Fuel Gauge/Hour Meter Removal on page 14-23.**
7. If the readings are correct according to the position of the float, but give an incorrect reading on the fuel gauge/hour meter, test the fuel gauge/hour meter. **See Fuel Gauge on page 12-36.**

TEST PROCEDURE 26 – Fuel Gauge

See General Warning on page 1-1.

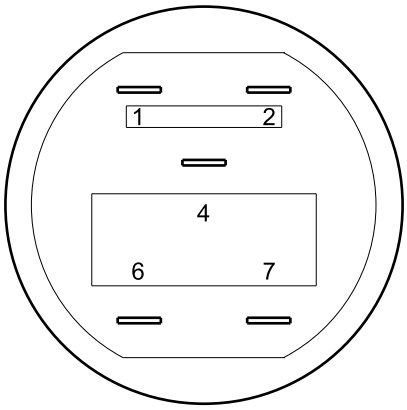
Two fuel gauges were used for model year 2007 **(Figure 12-33, Page 12-36 and Figure 12-34, Page 12-36)**. The terminal configuration on the back of the gauge easily denotes the type. Follow the appropriate procedure. The gauge used through mid-2007 has the orange wire connected to terminal 1 whereas the gauge used from mid-2007 has it connected to terminal 4 in the center of the gauge. In addition, the gauge used through mid-2007 has one terminal (3) to ground it whereas the gauge used from mid-2007 has two ground terminals (1 and 6) with a black jumper wire connecting them. **See following NOTE.**

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



1. Orange 2. Blue 3. Black 4. White 5. Not used 6. Not used

Figure 12-33 Fuel Gauge/Hour Meter – Through mid-2007



1. Black(Jumper Wire From 6) 2. Blue 4. Orange 6. Black 7. White

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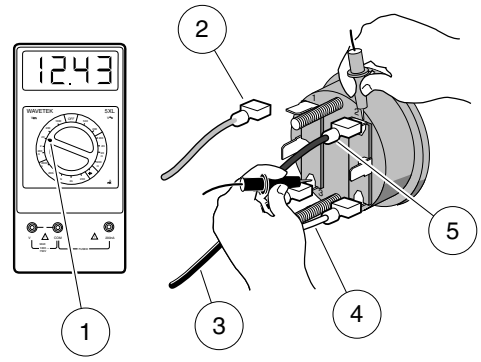
Figure 12-34 Fuel Gauge/Hour Meter – From mid-2007

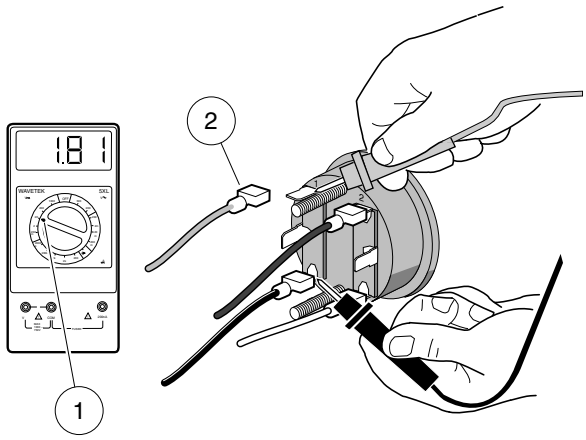
Fuel Gauge (Through mid-2007)

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels.
2. Remove the instrument panel to gain access to the back of the fuel gauge/hour meter. **See Key Switch Removal, Section 13, Page 13-17.**
3. Place a sheet of insulating material between the front frame and the electrical connections on the rear of the instrument panel to prevent contact between the two.
4. Disconnect the orange wire from the fuel gauge/hour meter.
5. Set a multimeter to 20 volts DC and place the red (+) probe of the multimeter on the positive post of the battery. Place the black (–) probe on the negative post of the battery. Record the voltage reading.
6. Set a multimeter to 20 volts DC and place the red (+) probe of the multimeter on the (2) terminal of the fuel gauge/hour meter with the blue wire. Place the black (–) probe on the (3) terminal of the fuel gauge/hour meter with the black wire **(Figure 12-35, Page 12-37)**.
7. Connect battery. **See Connecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
8. 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 12-35, Page 12-37)**.
9. The orange wire should remain disconnected for this step. With the black probe still on the (3) terminal of the fuel gauge/hour meter, place the red (+) probe of the multimeter on the (1) terminal of the fuel gauge/hour meter **(Figure 12-36, Page 12-37)**. The voltage reading should be approximately 1.81 volts. If the reading is incorrect, replace fuel gauge/hour meter.



1. 20 VDC Setting 2. Orange 3. Black 4. White 5. Blue

Figure 12-35 Fuel Gauge Voltage Test - Terminal 2

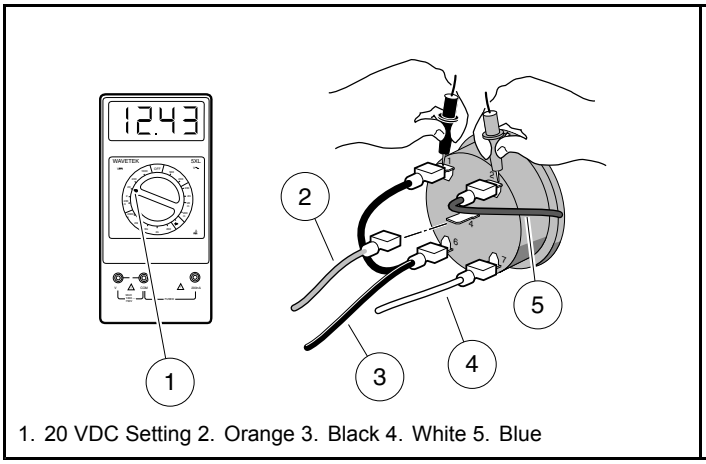


1. 20 VDC Setting 2. Orange

Figure 12-36 Fuel Gauge Voltage Test - Terminal 1

Fuel Gauge (From mid-2007)

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels.
2. Remove the instrument panel to gain access to the back of the fuel gauge/hour meter. **See Key Switch Removal, Section 14, Page 14-13.**
3. Place a sheet of insulating material between the front frame and the electrical connections on the rear of the instrument panel to prevent contact between the two.
4. Disconnect the orange wire from the fuel gauge/hour meter.
5. Set a multimeter to 20 volts DC and place the red (+) probe of the multimeter on the positive post of the battery. Place the black (–) probe on the negative post of the battery. Record the voltage reading.
6. Set a multimeter to 20 volts DC and place the red (+) probe on the (2) terminal of the fuel gauge/hour meter with the blue wire is connected. Place the black (–) probe on the (1) terminal of the fuel gauge/hour meter with the black wire **(Figure 12-37, Page 12-38)**.
7. Connect battery. **See Connecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
8. 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 12-37, Page 12-38)**.
9. 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 12-38, Page 12-38)**. 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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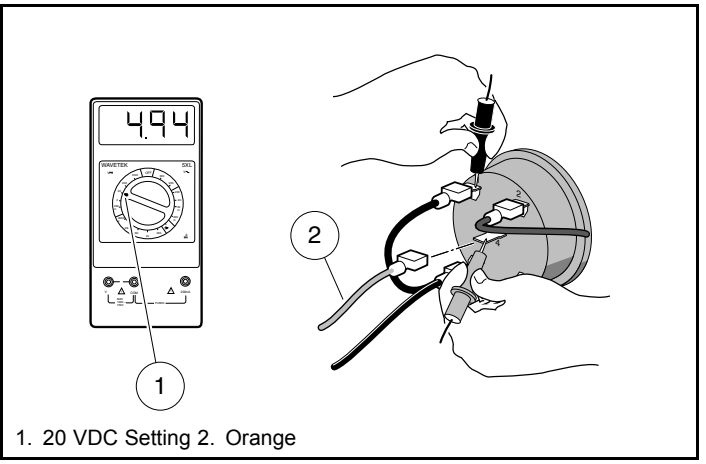
Figure 12-37 Fuel Gauge Voltage Test - Terminal 2



1. 20 VDC Setting 2. Orange

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Figure 12-38 Fuel Gauge Voltage Test - Terminal 4

TEST PROCEDURE 27 – Hour Meter

See General Warning on page 1-1.

Two hour meters were used for model year 2007 **(Figure 12-33, Page 12-36 and Figure 12-34, Page 12-36)**. The display and the terminal configuration on the back of the meter easily denotes the type. Follow the appropriate procedure. The display on the meter used through mid-2007 only appears when the key switch is ON whereas the display on the meter used from mid-2007 is always on. The meter used through mid-2007 has the orange wire connected to terminal 1 whereas the meter used from mid-2007 has it connected to terminal 4 in the center of the meter. In addition, the meter used through mid-2007 has one terminal (3) to ground it whereas the meter used from mid-2007 has two ground terminals (1 and 6) with a black jumper wire connecting them. **See following NOTE.**

NOTE: *Keep the battery connected while performing this test procedure.*

Hour Meter (Through mid-2007)

1. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
2. Turn the key switch ON to verify the display appears.
3. Start the engine and let it idle. **See following DANGER.**

⚠ DANGER

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

4. With engine idling, the "hour glass" icon should flash slowly. If not, check the low oil warning light and the oil pressure switch. **See following NOTE. See also Test Procedure 22 – Oil Warning Light on page 11-30.**

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.

Hour Meter (From mid-2007)

1. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.

2. With the key switch OFF, check the hour meter display. It is powered by an internal battery and should always be on, even with the engine off and the key removed.
3. Start the engine and let it idle. **See following DANGER.**

⚠ DANGER

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

4. With engine idling, the "hour glass" icon should flash. If not, check the low oil warning light and the oil pressure switch. **See following NOTE. See also Test Procedure 22 – Oil Warning Light on page 11-30.**

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 28 – Light Switch

See General Warning on page 1-1.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels.
2. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
3. Remove the instrument panel. **See Key Switch Removal, Section 14, Page 14-13.**
4. Using a multimeter set on 20 volts DC, place alligator clips on the multimeter probes. Connect the red (+) probe to the light switch terminal with the blue wire connected to it **(Figure 12-39, Page 12-39)**.
5. Connect battery and spark plug wire(s). **See Connecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
6. Connect the black (–) probe of the multimeter to the negative (–) post of the battery.
7. With the light switch in the OFF position, the reading should be zero volts. With the light in the ON position, the reading should be between 11 and 12.5 volts. If the there is no voltage reading, check continuity of the 10-gauge red wire from the fuse block to the solenoid. Check continuity of the 14-gauge yellow wire from the light switch to the fuse block. Check the fuse. **See Fuse on page 12-12.** If the voltage limiter is functioning correctly, the wires and fuse show continuity and the readings are still incorrect, replace the switch. **See Light Switch Removal, Section 13, Page 13-35.**

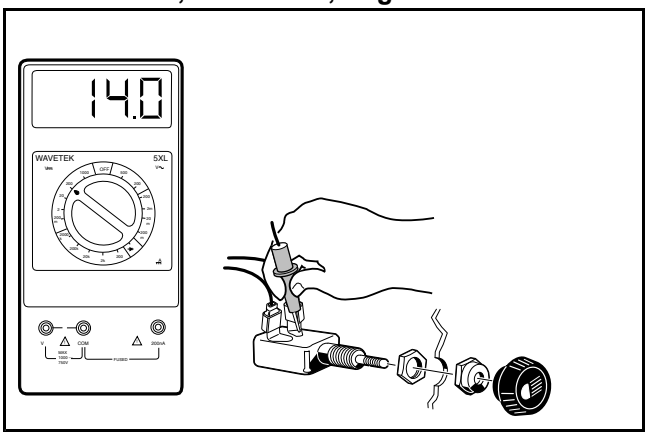

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Figure 12-39 Light Switch Test

TEST PROCEDURE 29 – Voltage Limiter

See General Warning on page 1-1.

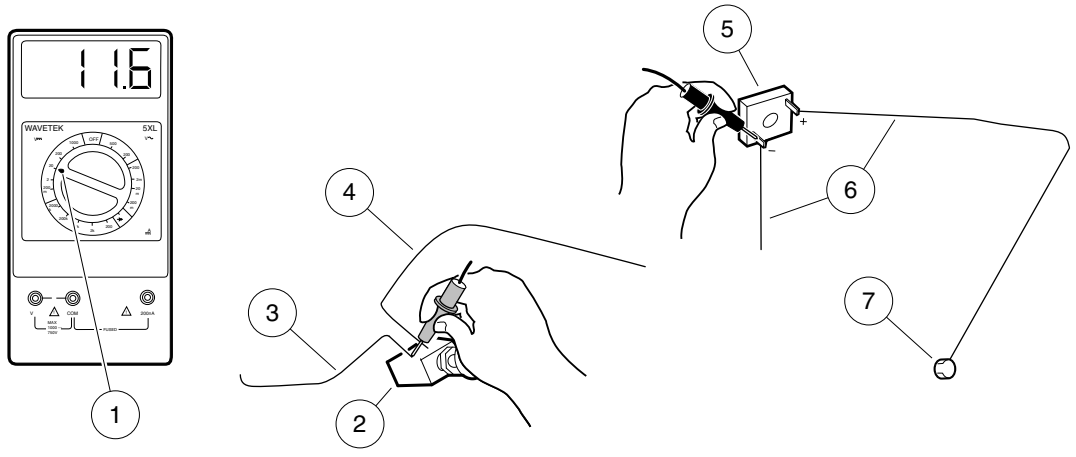
1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels.
2. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
3. Remove the instrument panel. **See Key Switch Removal, Section 14, Page 14-13.**
4. Using a multimeter set on 20 volts DC, connect the red (+) probe to the light switch terminal with the yellow wire **(Figure 12-40, Page 12-40)**.
5. Loosen the black wire connector (on the end of the long black wire) at the voltage limiter just enough to maintain the connection and yet expose part of the metal terminal in the connector. Place black (–) probe on the connector **(Figure 12-40, Page 12-40)**.
6. Connect battery and spark plug wire(s). **See Connecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
7. Pull the light switch to the ON position. The reading should be 11-12 volts. If the there is no voltage reading, check continuity of the 16-gauge black wire from the headlight to the voltage limiter. Check continuity of the 16-gauge black wire from voltage limiter to the vehicle frame. If the wires show continuity and the readings are still incorrect, replace the voltage limiter. **See Voltage Limiter Removal, Section 13, Page 13-34.**
8. With the Forward/Reverse handle in the NEUTRAL position and the wheels chocked, start the engine and press the accelerator pedal to the floor.
9. Push the light switch to the OFF position. The reading should be 14.7-15.3 volts.
10. Pull the light switch to the ON position. The reading should be 11-13 volts. If the reading does not drop from 14.5-15.5 volts to 11-13 volts, replace the voltage limiter.

TEST PROCEDURE 30 – Voltage at Headlight Socket

See General Warning on page 1-1.

NOTE: *Keep the battery connected while performing this test procedure.*

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



1. 20 VDC Setting 2. Light Switch 3. Yellow Wire 4. Blue Wire 5. Voltage Limiter 6. Black Wires 7. Frame Ground

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Figure 12-40 Voltage Limiter Circuit Test

2. Inspect wires at light bulb socket. Make sure wires are securely fastened to the contacts inside socket.
3. Remove the wire harness from the headlight **(Figure 12-41, Page 12-41)**.
4. Using a multimeter set to 20 volts DC, place the black (–) probe of multimeter 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 reads approximately 12 volts, replace the bulb.
6. If there is no voltage reading at the wire harness, check continuity of the 16-gauge blue wire from the headlight to the light switch. Using a multimeter set to 20 volts DC, attach using an alligator clip, the black (–) probe of multimeter onto the negative battery terminal and place the red (+) probe into the blue wire terminal of the wire harness. If multimeter reading is approximately 12 volts, the blue wire has continuity.
7. Check continuity of the 16-gauge black wire from the headlight to the ground terminal. Using a multimeter set to 20 volts DC, place the black (–) probe of multimeter into the black wire terminal of the wire harness and attach using an alligator clip, the red (+) probe onto the positive battery terminal. If the multimeter reading is approximately 12 volts, the black wire has continuity.

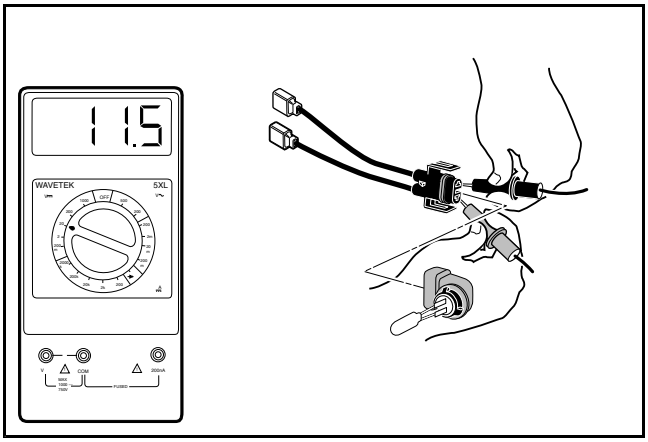

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Figure 12-41 Check Voltage to Headlight Socket

⚠ DANGER

- **See General Warning on page 1-1.**

⚠ WARNING

- **See General Warning on page 1-1.**

STARTER/GENERATOR

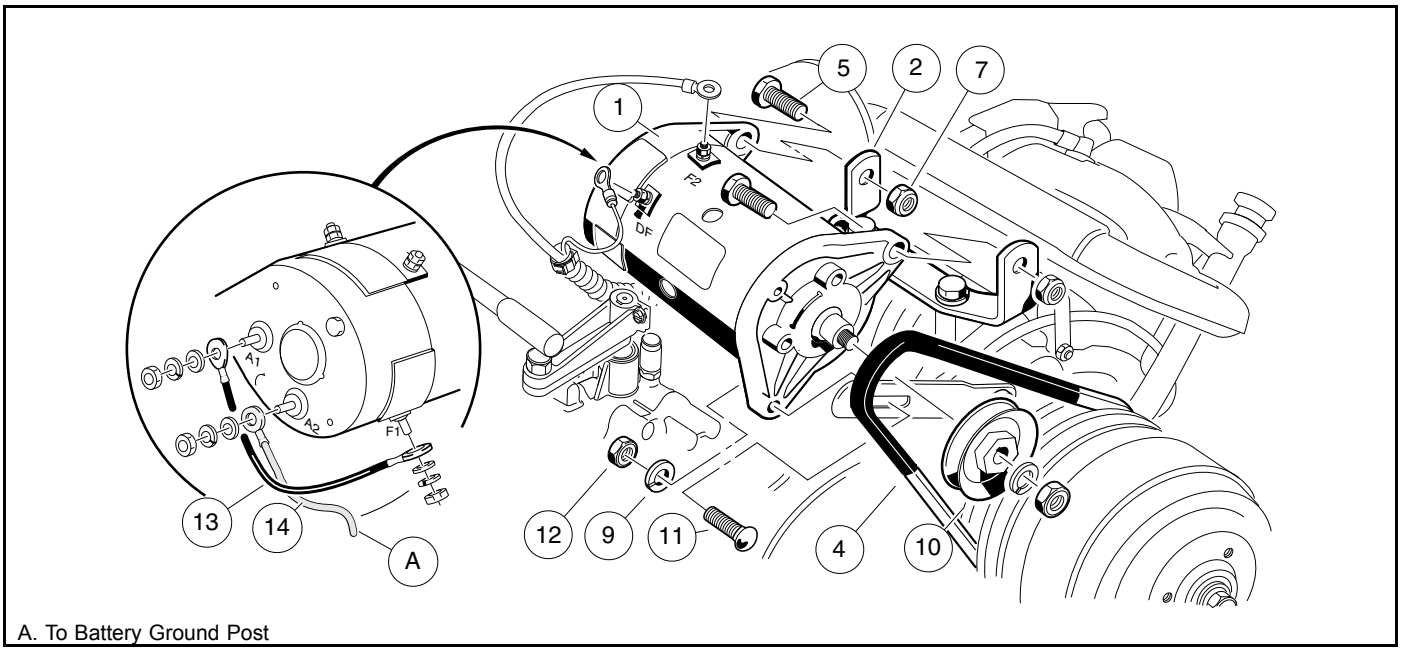
See General Warning on page 1-1.

TESTING THE STARTER/GENERATOR

See Test Procedure 8 – Starter/Generator (Starter Function) on page 11-17. Also see Test Procedure 11 – Starter/Generator (Generator Function) on page 11-20.

STARTER/GENERATOR REMOVAL

1. Make sure the key switch is OFF and the Forward/Reverse handle is in the NEUTRAL position. Chock the wheels.
2. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
3. Disconnect the wires from the starter/generator (1). Mark wires before disconnecting. Loosen the pivot nuts (7) and bolts (5) **(Figure 13-1, Page 13-2)**.
4. Remove the mounting/adjustment nut (12), washer (9) and bolt (11). Lower the starter/generator and slip the belt (4) off the pulley (10).
5. Support the starter/generator so that when the pivot bolts are removed the starter/generator will not fall to the ground. Remove the two pivot nuts (7) and bolts (5) from the mounting bracket.
6. Remove the starter/generator.



A. To Battery Ground Post

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Figure 13-1 Starter/Generator Removal

DISASSEMBLY OF THE STARTER/GENERATOR TO SERVICE THE BRUSHES

1. Remove the two bolts (20) and pull commutator end cover (23) free of starter/generator housing (24) **(Figure 13-2, Page 13-2)**. **See following NOTE.**

NOTE: *Brushes must be removed to avoid damage from commutator removal. Lift the brush springs out of the notches in the brushes and pull the brushes back from the center of the commutator end cover. The springs will help prevent them from sliding back towards the center* ***(Figure 13-6, Page 13-4)****.*

2. Remove brush covers (29 and 30), screws (25), lockwashers (26), brush springs (28) and brushes (27) **(Figure 13-3, Page 13-2)**. **See following NOTE.**

NOTE: *To clean and inspect the armature/commutator and the bearings,* ***see Disassembly of the Starter/Generator to Service the Armature/Commutator on page 13-4****.*

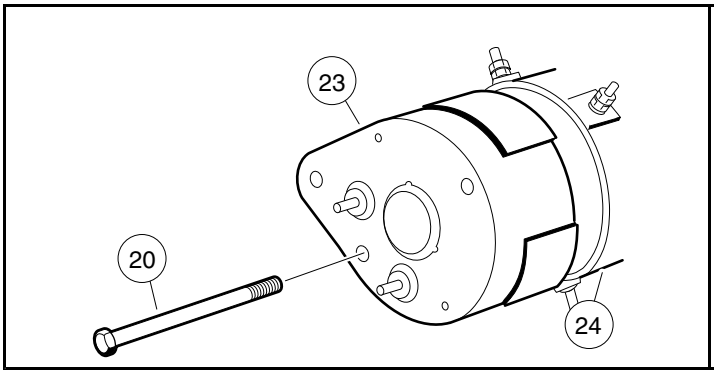

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Figure 13-2 Commutator End Cover

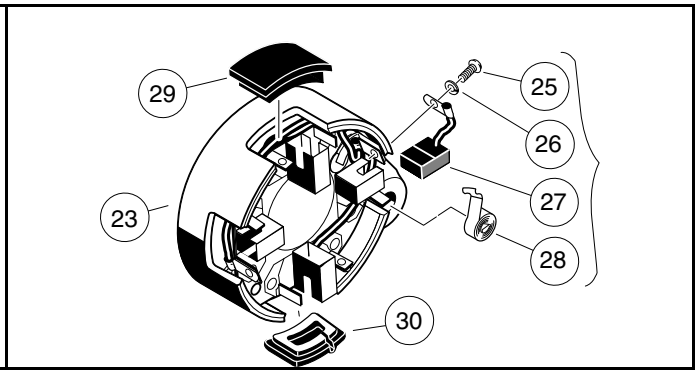

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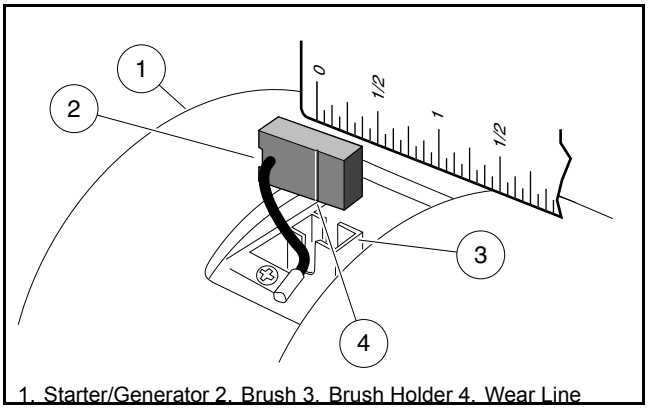
Figure 13-3 Brush Covers and Brushes

BRUSH INSPECTION AND REPLACEMENT

1. Visually inspect brushes. Replace brushes that are cracked or severely chipped.

2. Check the wear line on the side of the brush. If the end of the brush is within 1/16-inch (1.6 mm) of the wear line, replace all four brushes **(Figure 13-4, Page 13-3)**.



1. Starter/Generator 2. Brush 3. Brush Holder 4. Wear Line

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Figure 13-4 Inspect Brushes

BRUSH SPRING INSPECTION AND REPLACEMENT

1. Visually inspect springs. Replace all four springs if any spring is discolored from heat (straw or bluish in color).
2. Install the four brushes (27) into their holders and insert the four brush springs (28) **(Figure 13-3, Page 13-2)**. Using a spring scale, test brush spring tension. If any spring has a tension less than 24 ounces (6.67 N), replace all four springs **(Figure 13-5, Page 13-3)**. **See following CAUTION.**

CAUTION

- **When checking brush spring tension, do not push springs beyond the point they would normally be if there were new brushes installed. Exerting excessive force or pushing brush springs beyond their normal maximum extension point will damage springs.**

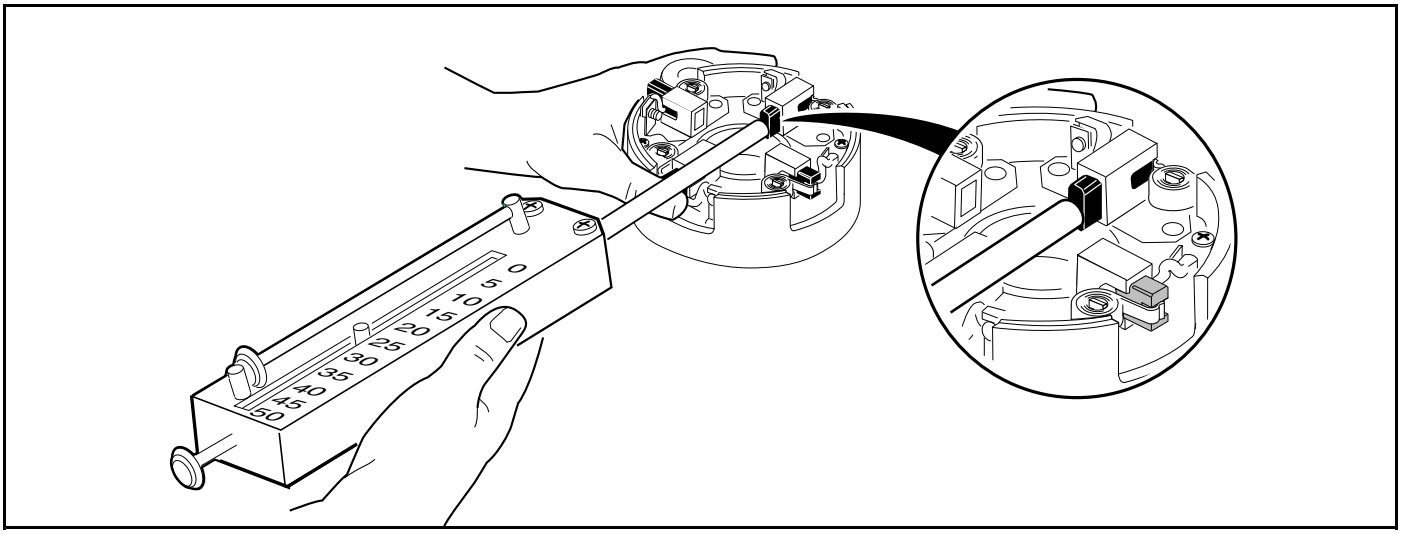

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Figure 13-5 Brush Spring Tension Test

STARTER/GENERATOR ASSEMBLY

1. Connect the brush wires to the holders using four lockwashers (26) and four screws (25). Make sure the crossover leads are also connected. Tighten the screws to 31 in-lb (3.5 N·m) **(Figure 13-3, Page 13-2)**.

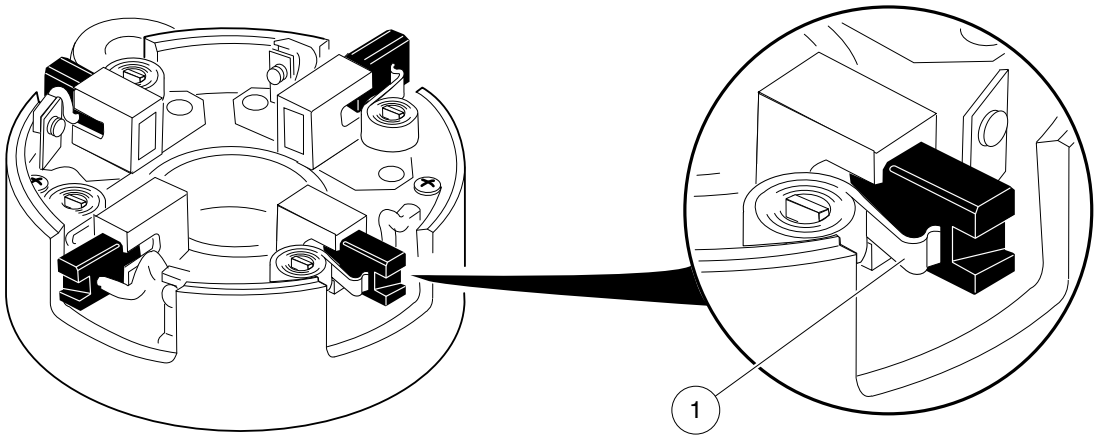
2. Install the commutator. Lift the brush springs out of the notches in the brushes and pull the brushes back from the center of the commutator end cover to avoid interference. The springs will rest on the sides of the brushes and help prevent them from sliding to the center **(Figure 13-6, Page 13-4)**.
3. Install the commutator end cover (23) onto the armature shaft. Align the locating pin and hole in the cover. Install two M6 x 180 mm bolts (20) and tighten to 100 in-lb (11.3 N·m) **(Figure 13-2, Page 13-2)**.
4. Push the brushes down into the holders. Place springs into the notches in the brushes. Install the brush cover (30) that has the drain hole in it next to the A2 terminal. Install the remaining three brush covers (29) onto the openings in the commutator end cover (23) **(Figure 13-3, Page 13-2)**.

DISASSEMBLY OF THE STARTER/GENERATOR TO SERVICE THE ARMATURE/COMMUTATOR

1. Remove the two bolts (20), and pull commutator end cover (23) free of the starter/generator housing (24) **(Figure 13-2, Page 13-2)**. **See following NOTE.**

NOTE: *Brushes must be removed to avoid damaged from commutator removal. Lift the brush springs out of the notches in the brushes and pull the brushes back from the center of the commutator and cover. The springs will help prevent them from sliding back towards the center **(Figure 13-6, Page 13-4)**.*

2. Remove nut (41), lockwasher (40), pulley (39), shaft key (34), spacer (37) and bearing retainer screws (43) and separate armature (33) from output end cover (36) **(Figure 13-7, Page 13-5)**.



1. Brush being held by brush spring.

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Figure 13-6 Pull Brushes Away From Center of the Commutator End Cover

BEARING CLEANING AND INSPECTION

1. Wipe the carbon dust from the two bearings. Inspect bearings by spinning them by hand and checking for both axial (A) and radial (B) play **(Figure 13-8, Page 13-5)**.
2. Replace the bearing if it is noisy, does not spin smoothly or has excessive play. Replace if rusted, worn, cracked, or if there is an abnormal color change in the metal of the bearing. Replace if there is extensive wear or pitting on the balls or rolling surfaces. Do not remove bearings unless they are to be replaced.

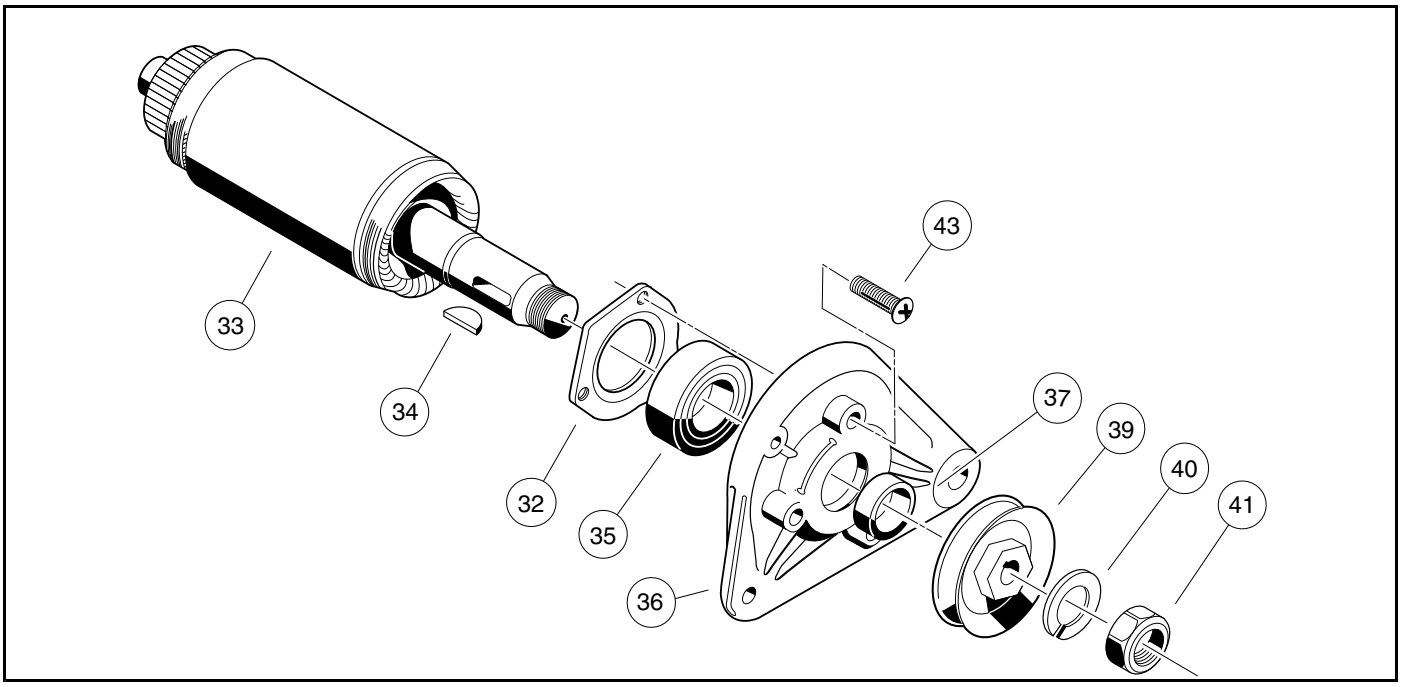

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Figure 13-7 Armature and Output End Cover Assembly

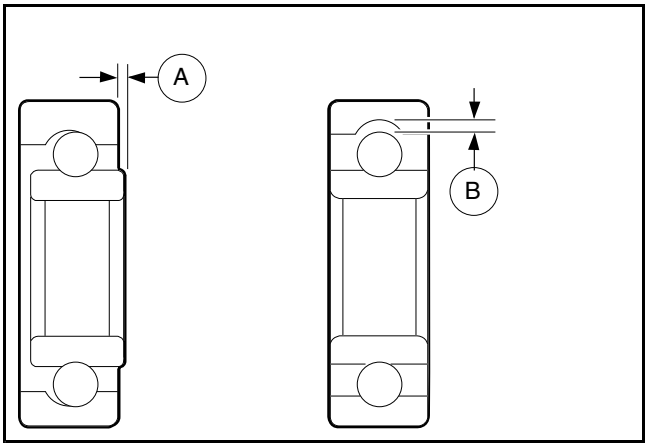

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Figure 13-8 Bearing Play Inspection

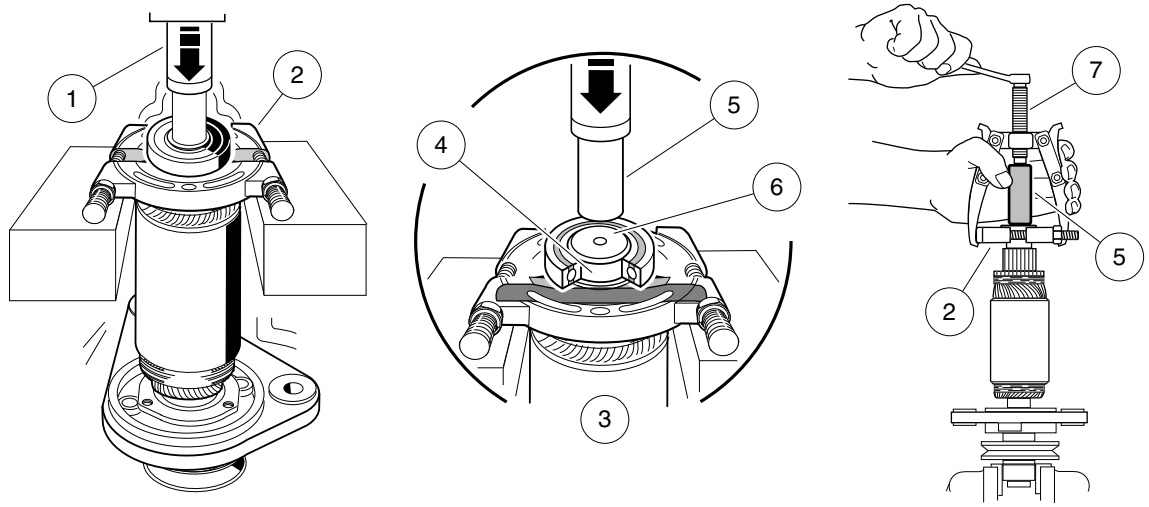
BEARING REMOVAL

1. Place the wedge attachment tool (CCI P/N 1012812) between the bearing and the armature. Make sure the wedge attachment tool is supporting the inner race of the bearing. If a press is not available, secure a bearing puller (CCI P/N 1012811) to the wedge attachment tool and pull the bearing off of the end of the armature shaft. Support the armature so that it will not drop when the bearing is removed **(Figure 13-9, Page 13-6)**.
2. Discard the bearings.
3. Slide the bearing retainer (32) off of the output end of the shaft **(Figure 13-7, Page 13-5)**.

FIELD COIL REMOVAL

1. Remove the retaining nut from each field coil terminal and slide the insulator out of the slots in the housing. Remove the four pole piece screws from the housing. Remove the four pole pieces from inside the housing. Remove the field coils from the inside of the housing **(Figure 13-10, Page 13-6)**. **See following NOTE.**

NOTE: *Do not remove the insulators or the field coils unless an electrical test indicates that it is necessary* ***(Figure 13-10, Page 13-6)****.* ***See Test Procedure 8 – Starter/Generator (Starter Function) on page 11-17.***



1. Press Ram 2. Wedge Attachment Tool 3. Bearing is sectioned for clarity. 4. Support inner race of bearing. 5. Use a 1/2 inch (12mm) socket or pipe. 6. Press against armature shaft. 7. Bearing Puller Tool

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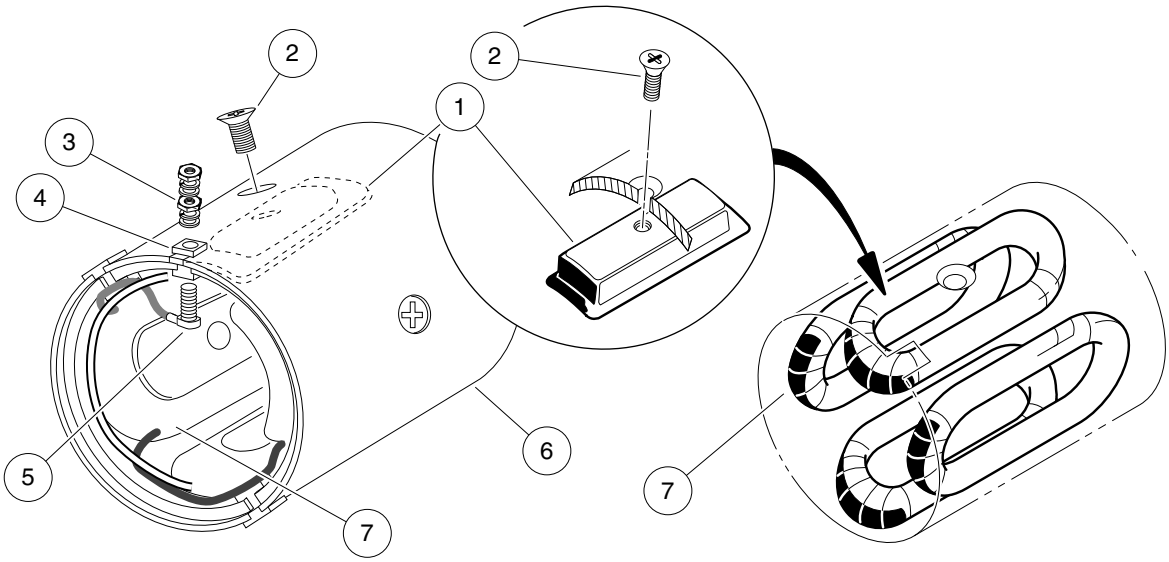
Figure 13-9 Bearing Removal



1. Pole Piece 2. Pole Piece Screw 3. Retaining Nut 4. Insulator 5. Field Coil Terminal 6. Housing 7. Field Coil

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Figure 13-10 Field Coil Removal

VISUAL INSPECTION OF ARMATURE AND COMMUTATOR

Some defects can be seen by examining the armature and commutator. Defects seen during the visual inspection can aid in diagnosing the original cause of the failure. Items to look for are listed below.

- Burned, charred or cracked insulation
- Improperly cured varnish
- Thrown solder
- Flared armature windings
- Worn, burned or glazed commutator
- Loose or raised commutator bars
- Bruised or damaged armature core laminations
- Worn armature bearing or shaft
- Dirty or oily commutator

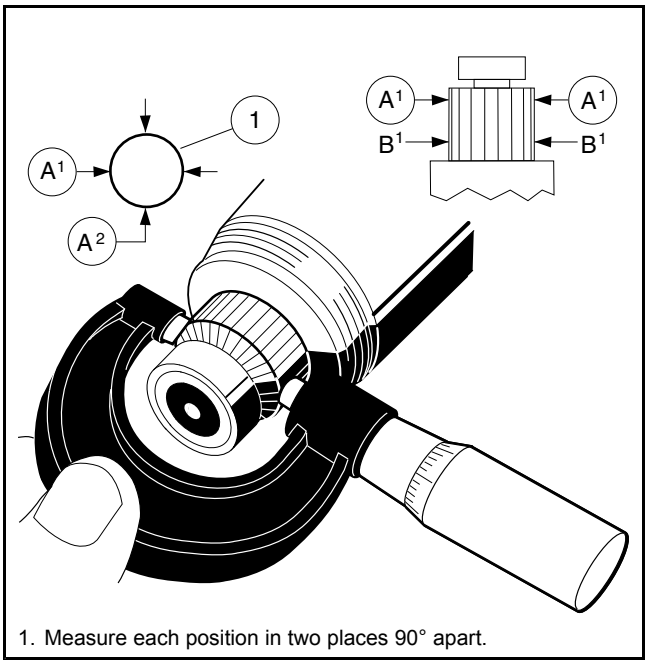
COMMUTATOR CLEANING AND INSPECTION

1. Clean the carbon dust, dirt and oil from the commutator. Slight roughness of the commutator can be polished away with 400 grit (or finer) sandpaper. **See following CAUTION.**

CAUTION

- **Never use emery cloth on the commutator. Particles of emery are conductive and may short-circuit the commutator bars. Never use oil or lubricants on the commutator or brushes.**

2. Use a micrometer and measure the outside diameter at four points: two points 90° to each other to the outside end of the commutator (A1 and A2), and two points 90° to each other to the inside of the commutator (B1 and B2). If the commutator diameter is less than 1.535 inches (39 mm) at any of the four locations, replace the armature assembly and bearings **(Figure 13-11, Page 13-8)**.



1. Measure each position in two places 90° apart.

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Figure 13-11 Inspect Commutator

ARMATURE GROUND TEST

CAUTION

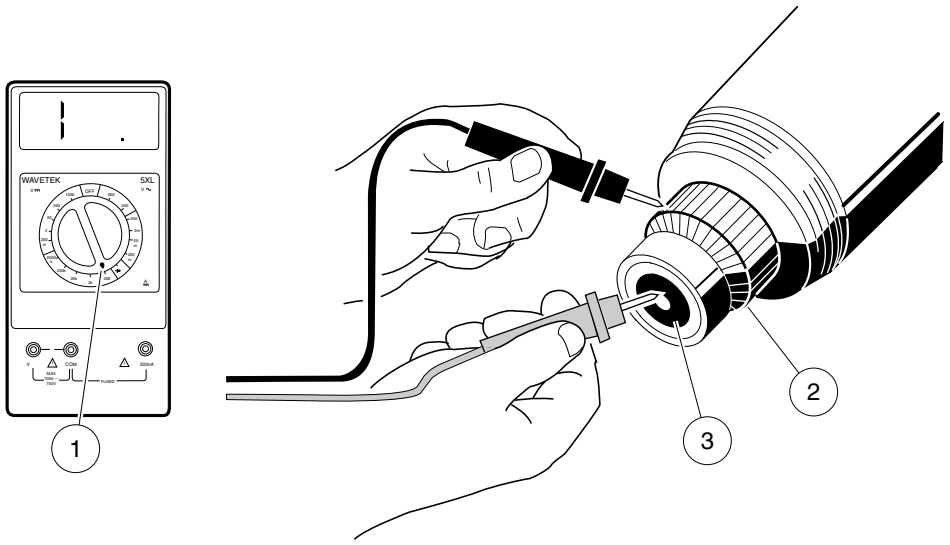
- **Do not submerge armature in solvent.**

NOTE: *Before testing, wipe the armature with a clean cloth and remove carbon dust and metal particles from between commutator bars.*

1. Use a multimeter set on 200 ohms and place the positive (+) probe on the commutator bars and the negative (–) probe on the armature core. The reading should be no continuity. If the reading is incorrect, replace the armature and the two bearings ***(Figure 13-12, Page 13-9)***.

VISUAL INSPECTION OF FIELD COILS

Burned, blackened, charred or scorched coil insulation indicates the starter/generator has overheated due to overloads, grounding or shorted coil windings and should be replaced. Be sure the insulators are tight in the housing.



1. 200 Ohm Setting 2. Commutator 3. Armature Shaft

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Figure 13-12 Armature Ground Test

STARTER/GENERATOR REWORK

Any rework must be performed by a qualified technician. Starter/Generator service specifications are listed in the following table.

ITEM	SERVICE LIMIT
Commutator diameter (minimum)	1.535 in. (39 mm)
Concentric with armature shaft within	0.002 in. (0.051 mm)
Limit depth of cut when machining commutator	0.007 in. (0.2 mm)
If undercut of segment insulator is less than 0.016 inch (0.406 mm), then it should be undercut to	0.031 in. (0.8 mm)
Dielectric strength	500 VAC for one minute
Armature insulation resistance	0.2M ohms at 500 VDC
Starter field coil resistance	0.006-0.01 ohms
Generator field coil resistance	4.5-5.5 ohms

STARTER/GENERATOR ASSEMBLY

1. Place the field coil into the housing. The two insulators that look alike fit into the slots next to the F1 and F2 markings on the outside of the housing. The insulator that looks different slides into the slot next to the DF marking.
2. After the insulators are seated in the slots, install the threaded terminals through the wire connectors and then through the insulators. Install a flat washer, lockwasher and nut onto each threaded terminal on the outside of the housing. Tighten nuts to 47.5 in-lb (5.4 N·m) **(Figure 13-10, Page 13-6)**. **See following CAUTION.**

CAUTION

- **Route the field terminal wires so that they will not contact the armature.**

3. Install the four pole pieces into the housing. Use the four screws to secure pole pieces to the inside of the housing to retain the field wires. Tighten screws to 9 ft-lb (12.2 N·m) **(Figure 13-10, Page 13-6)**.

4. Slide the bearing retainer onto the output end of the armature shaft (33) so that it will hold the outside of the bearing (35) only **(Figure 13-7, Page 13-5)**.
5. Press a new ball bearing (35) onto the output end of the armature **(Figure 13-7, Page 13-5)**. Press a new ball bearing onto the commutator end of the armature shaft. **See following CAUTION.**

CAUTION

- **Use care while pressing new bearing onto the output end of the shaft to prevent damage to the retainer.**
- **Press against the inner race of the new bearing until it is fully seated.**

6. Install the output end cover (36) onto the armature. Secure the bearing retainer (32) to the cover and tighten the screws (43) to 39 in-lb (4.4 N·m) **(Figure 13-7, Page 13-5)**.
7. Slide the housing with field coils over the armature. Use the locating pin to align housing to the cover.

NOTE: *The terminal insulators should be on the commutator end of the housing.*

8. Install the commutator. Lift the brush springs out of the notches in the brushes and pull the brushes back from the center of the commutator end cover to avoid interference. The springs will rest on the sides of the brushes and help prevent them from sliding to the center of the cover **(Figure 13-6, Page 13-4)**.
9. Install the commutator end cover (23) onto the armature shaft. Align the locating pin and hole in the cover. Install the two M6 x 180 mm bolts (20) and tighten to 100 in-lb (11.3 N·m) **(Figure 13-2, Page 13-2)**.
10. Push the brushes down into the holders. Place springs into the notches in the brushes. Install the brush cover (30) that has the drain hole in it next to the A2 terminal. Install the remaining three brush covers (29) onto the openings in the commutator end cover (23) **(Figure 13-3, Page 13-2)**.
11. Slide the spacer (37) onto the end of the shaft. Insert the shaft key (34) into the shaft. Install the belt pulley (39) onto the shaft and install the lockwasher (40) and M14 nut (41) and tighten the nut to 28 ft-lb (38 N·m) **(Figure 13-7, Page 13-5)**.

STARTER/GENERATOR INSTALLATION

1. Install the green wire from the F1 terminal to the A1 terminal on the starter/generator **(Figure 13-1, Page 13-2)**. Install a flat washer, lockwasher, and nut onto each terminal and tighten to 48 in-lb (5.4 N·m).
2. Install two 3/8-inch hex-head pivot bolts (5) into the mounting bracket with the heads of the bolts facing towards the driver side of the vehicle. Position the starter/generator in the mounting bracket so that the bolts will go through the starter/generator before going through the bracket. Install a locknut (7) onto each bolt and tighten to finger-tight **(Figure 13-13, Page 13-11)**.
3. Install the adjustment bolt (11) through the adjusting bracket (4) and then through the starter/generator. Install a lockwasher (9) and 5/16-inch nut (12) onto the end of the adjustment bolt (11) and tighten to finger- tight **(Figure 13-13, Page 13-11)**.
4. Install the belt (3), then tighten the mounting bolts. **See Belt Tension Adjustment on page 13-12.**
5. Connect the yellow wire from the voltage regulator to the DF terminal on the starter/generator. Install a flat washer, lockwasher and nut onto the terminal and tighten the nut to 31 in-lb (3.5 N·m).
6. Install the white wire from the solenoid to the F2 terminal on the starter/generator. Install the black wire from the frame to the A2 terminal on the starter/generator. Install a flat washer, lockwasher and nut onto each terminal, and tighten the nut to 48 in-lb (5.4 N·m).
7. Connect battery and spark plug wire(s). **See Connecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**

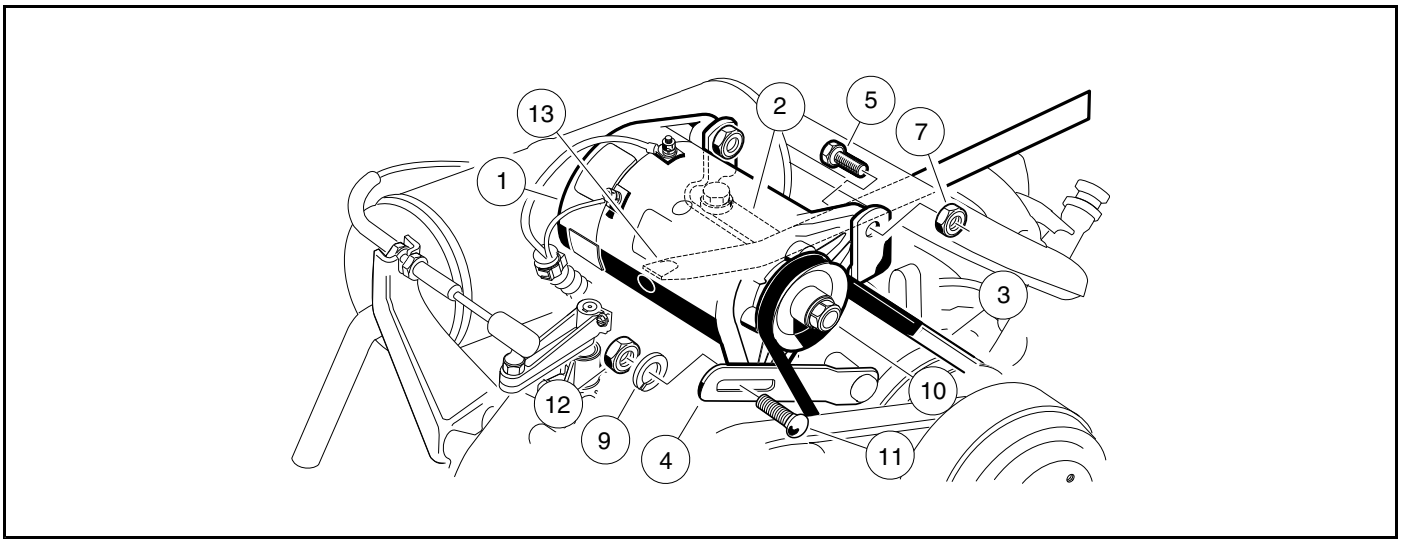

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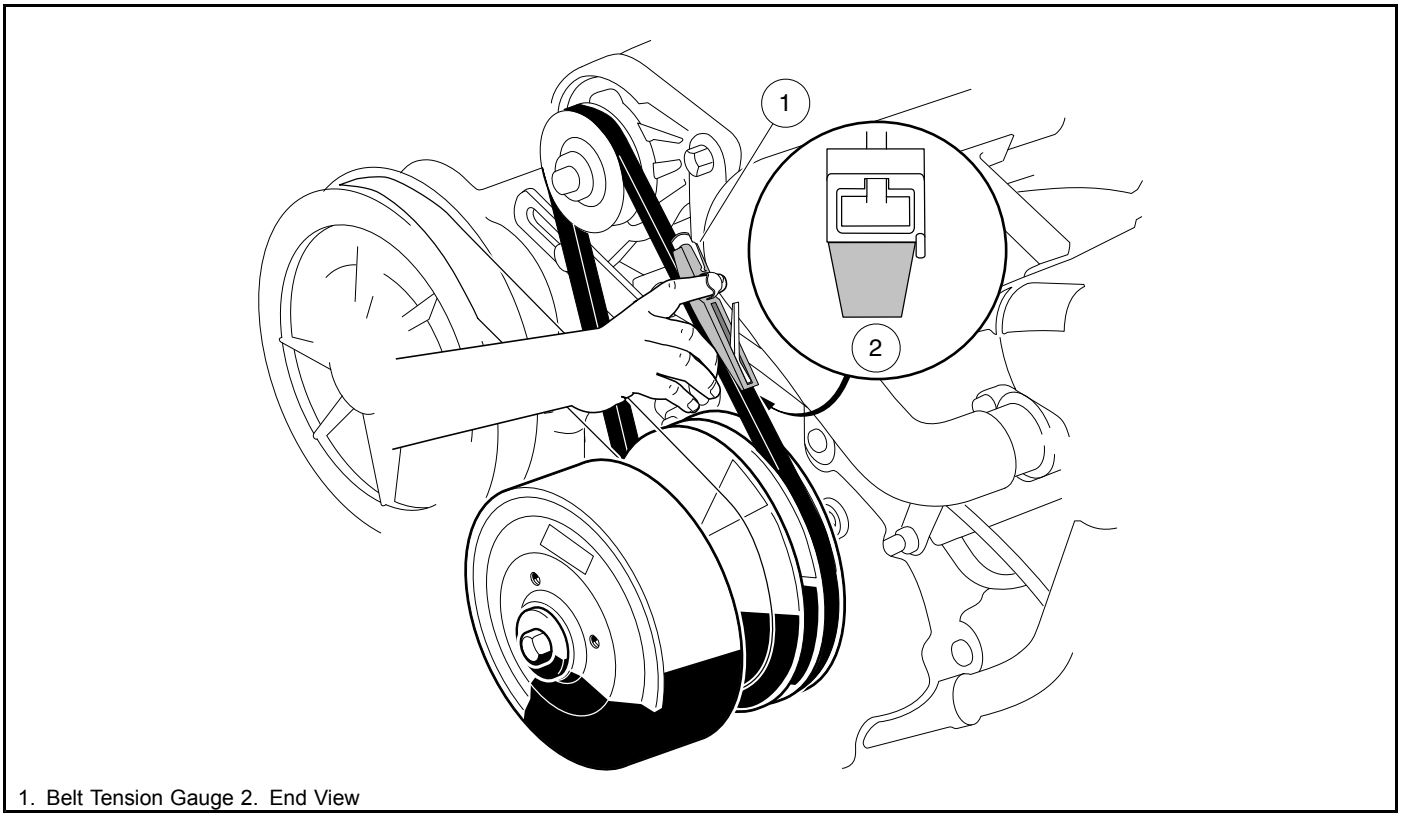
Figure 13-13 Starter/Generator Installation



1. Belt Tension Gauge 2. End View

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Figure 13-14 Belt Tension Gauge

BELT TENSION ADJUSTMENT

Belt tension should be checked periodically. If the belt slips when starter/generator motor operates, adjust belt to correct tension.

1. Turn the key switch is OFF and remove the key. Place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels.
2. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
3. Make sure the two pivot bolts (5) on the mounting bracket, carriage bolt (11) and hex nut (12) are finger-tight **(Figure 13-13, Page 13-11)**.
4. Push the starter/generator down to its lowest point of adjustment travel. With the starter/generator belt in place around the drive clutch pulley, install the starter/generator belt (3).
5. Place a pry bar (13) between the top of the starter/generator mounting bracket (2) and the underside of the starter/generator, by passing the pry bar under the exhaust header.
6. Hold the pry bar and measure the belt tension using a Krikit® gauge (1) (available at NAPA® Auto Parts stores), or equivalent. Proper tension for a new starter/generator belt should be 75 lb (101.7 N), or 45 lb (61 N) for an existing belt **(Figure 13-14, Page 13-11)**.
7. While maintaining the tension, tighten the adjustment nut (12) to 144 in-lb (16.3 N·m). Tighten the two pivot bolts (5) and hex nuts (7) to 23 ft-lb (31.2 N·m) **(Figure 13-13, Page 13-11)**. **See following CAUTION.**

⚠ CAUTION

- **Remove pry bar before starting engine.**

8. Connect battery and spark plug wire(s). **See Connecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**

VOLTAGE REGULATOR

See General Warning on page 1-1.

TESTING THE VOLTAGE REGULATOR

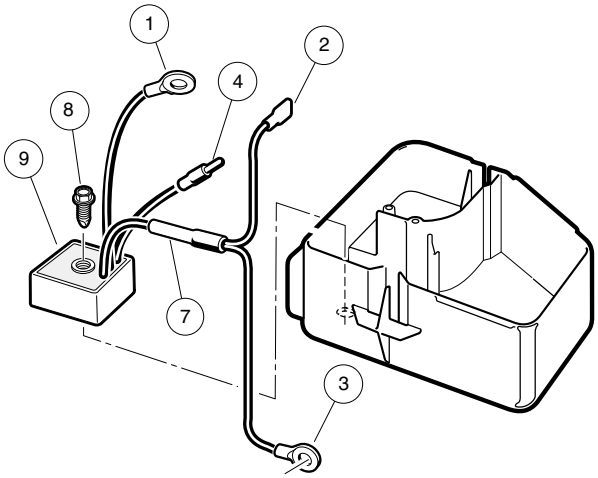
See Test Procedure 12 – Voltage Regulator on page 11-20.

VOLTAGE REGULATOR REMOVAL

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels.
2. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
3. Remove the air intake hose from the carburetor.
4. Remove the electrical component box cover.
5. Disconnect the voltage regulator red wire (1) at the large post on the solenoid, the yellow wire (4) at the bullet connector and the black wire (7) from the wire harness and at the battery frame ground **(Figure 13-15, Page 13-14)**.
6. Remove the voltage regulator mounting screw (8) and remove the voltage regulator (9).

VOLTAGE REGULATOR INSTALLATION

1. Position the voltage regulator (9) in the electrical component box and install the mounting screw (8) and tighten screw to 23 in-lb (2.6 N·m) **(Figure 13-15, Page 13-14)**.
2. Connect the voltage regulator red wire (1) at the large post on the solenoid with the other red wires, the yellow wire (4) at the bullet connector and the black wire (7) to the wire harness and the battery frame ground **(Figure 13-15, Page 13-14)**.
3. Install electrical component box cover. Be sure to firmly press down all corners. Install screw and tighten to 18 in-lb (2 N·m).
4. Install the air intake hose onto the carburetor.
5. Connect battery and spark plug wire(s). **See Connecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
6. With the Forward/Reverse handle in the NEUTRAL position, start the engine and check regulator for proper functioning as described in the voltage regulator test procedure. **See Voltage Regulator on page 11-20.**



1. Red wire to solenoid. 2. To kill limit switch. 3. To frame ground. 4. To bullet connector.

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Figure 13-15 Voltage Regulator

DIODE

See General Warning on page 1-1.

TESTING THE DIODE

See Test Procedure 10 – Diode (Generator Circuit) on page 11-18.

DIODE REMOVAL

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels.
2. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
3. Remove the carburetor air intake hose to allow easy access to the electrical component box cover.
4. Remove the cover screw (1) and electrical component box cover (2) **(Figure 13-16, Page 13-16)**.
5. Remove the nuts (3) from the two large solenoid posts and disconnect the diode wires from the solenoid (4).
   5.1. Observe color orientation of the wires with the terminal locations on the solenoid. The 12-gauge red wire (5) from the diode should be attached to the same terminal as the red wire (6) from the fuse block, and the red wire (7) from the battery. The 12-gauge white wire (8) should be attached to the other large solenoid post, along with the red wire (9) from the voltage regulator and the white wire (10) from the starter/generator.
6. Remove the nut (11) and remove the diode (12) and thermal transfer pad (13) from the vehicle frame I-beam (14) **(Figure 13-16, Page 13-16)**.

DIODE INSTALLATION

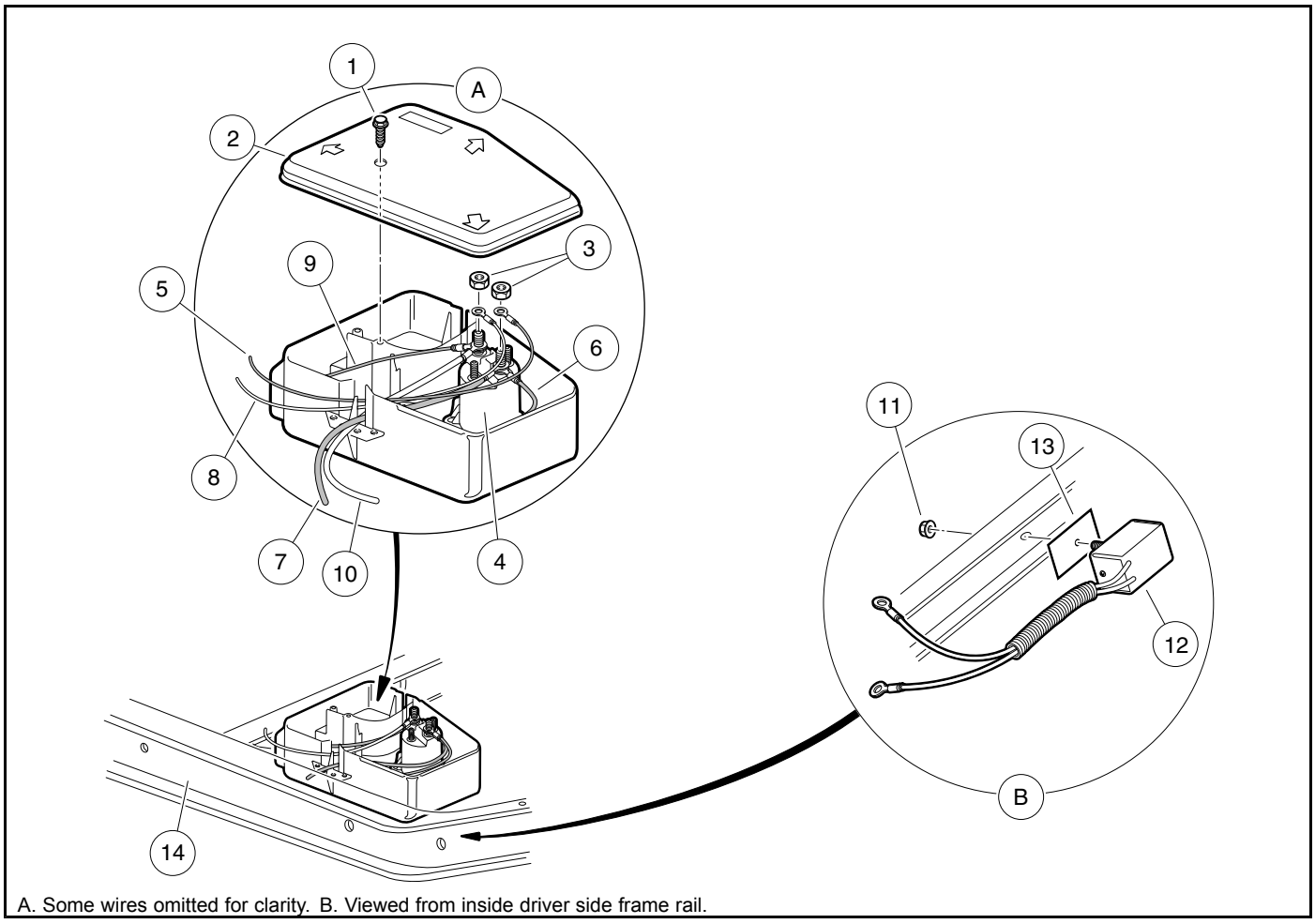
1. Thoroughly clean and dry the area of the I-beam (14) where the new diode (12) is to be attached.
2. Peel the protective film from both sides of the new thermal pad (13) **(Figure 13-16, Page 13-16)**. **See following CAUTION.**

CAUTION

- **Be sure to remove and discard the protective film from both sides of the thermal pad before installing it. If not removed, the film will reduce the thermal heat transfer and therefore reduce the power handling capability of the diode, causing it to overheat and damage the electrical system.**

3. Mount the diode (12) using the thermal transfer pad (13) and mounting nut (11) and tighten to 25 in-lb (2.8 N·m) **(Figure 13-16, Page 13-16)**. **See following NOTE.**

NOTE: *Diodes are mounted in one of two different locations, depending on the vehicle model* ***(Figure 13-16, Page 13-16)****.*



A. Some wires omitted for clarity. B. Viewed from inside driver side frame rail.

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Figure 13-16 Electrical Component Box and Diode Orientation

4. Route and connect the red (5) and white (8) diode wires to the solenoid posts in the electrical component box. **See following WARNING.**

⚠ WARNING

- **Incorrect wiring could result in severe injury or death.**
- **Diode and solenoid connections must have correct polarity.**
- **Keep all persons clear of engine belts when making final connections.**

4.1. Connect the 12-gauge red wire (5) from the diode to the solenoid post with the fuse block and battery red wires (6 and 7) and tighten locknut (3) to 55 in-lb (6.2 N·m) **(Figure 13-16, Page 13-16)**.

4.2. Connect the 12-gauge white wire (8) to the other large solenoid post, along with the red wire (9) from the voltage regulator and white wire (10) from the starter/generator and tighten nut (3) to 55 in-lb (6.2 N·m).

5. Replace the electrical component box cover (2) and screw (1) and tighten the screw to 18 in-lb (2.0 N·m).
6. Connect the intake hose to the carburetor and secure the hose with the hose clamp.
7. Connect battery and spark plug wire(s). **See Connecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**

KEY SWITCH

See General Warning on page 1-1.

TESTING THE KEY SWITCH

See Test Procedure 4 – Key Switch (Starter Circuit) on page 11-14. Also see Test Procedure 17 – Key Switch (Engine Kill Circuit) on page 11-28.

KEY SWITCH REMOVAL

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
2. Remove the center dash panel.
   2.1. Remove the plastic cap (1) covering the mounting screw (2) on each side of the center dash panel (3) **(Figure 13-17, Page 13-17)**.
   2.2. Loosen, but do not remove, the screw (2) on each side of the center dash panel (3).
   2.3. Insert screwdriver at the top center of the dash between dash and cowl brace. Gently pry center dash out slightly from under edge of cowl brace.
   2.4. Pull center dash out from the frame and disconnect the wires from the electrical components mounted on the dash panel. Do not allow wires to touch. **See following NOTE.**

NOTE: *Take care to prevent key switch terminals and wires from touching the metal frame around the dash.*

   2.5. Slide center dash panel up the steering column.

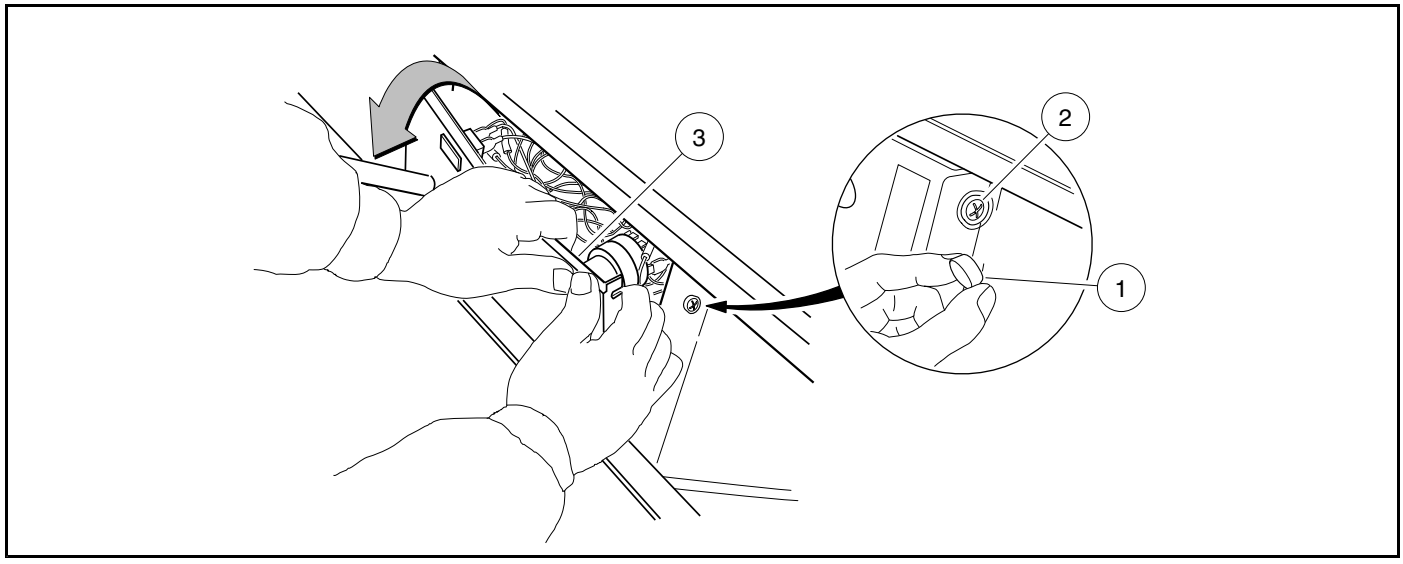

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Figure 13-17 Center Dash Panel Removal

3. Disconnect the wires from the key switch.
4. Remove the key switch:
   4.1. Remove the key switch cap with a small, flat-blade screwdriver.
   4.2. Remove key switch (2) from the dash by holding the key switch and turning the nut (1) on the outside of the dash with a 1-inch socket wrench **(Figure 13-18, Page 13-18)**. Remove the keyed washer with key switch.

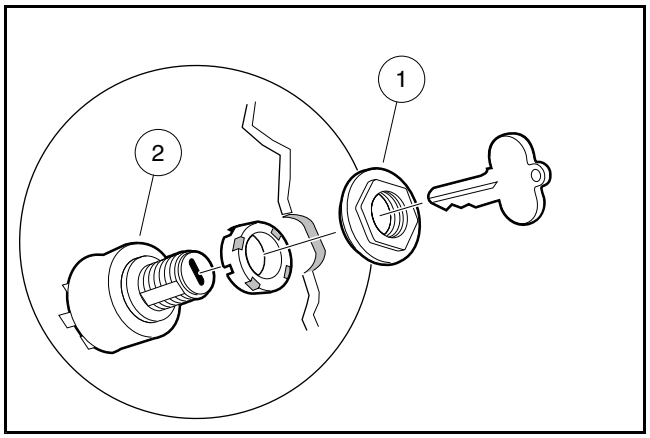

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Figure 13-18 Key Switch Removal

KEY SWITCH INSTALLATION

1. Reverse removal procedures to install key switch in the dash. Connect wires to key switch. **See Wiring Diagrams on page 11-7.** Coat the connectors with Battery Terminal Protector Spray (CCI P/N 1014305) to prevent corrosion. Be sure that key switch terminals cannot touch the frame and that panel is properly seated and snapped in place.
2. Connect battery and spark plug wire(s). **See Connecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**

SOLENOID

See General Warning on page 1-1.

TESTING THE SOLENOID

See Test Procedure 6 – Solenoid on page 11-15.

SOLENOID REMOVAL

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels.
2. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
3. Remove the air intake hose from the carburetor.
4. Remove electrical component box cover.
5. Disconnect all the wires from the solenoid.
6. Remove the two screws securing the solenoid in place.

SOLENOID INSTALLATION

1. Install the solenoid in the electrical component box using two screws to secure the solenoid to the box and tighten to 14 in-lb (1.6 N·m). **See following WARNING.**

⚠ WARNING

- **Incorrect wiring could result in severe injury or death.**
- **Diode and solenoid connections must have correct polarity.**
- **Keep all persons clear of engine belts when making final connections.**

2. Connect all wires as indicated.
   2.1. Connect the 6-gauge white wire from the starter/generator, 18-gauge red wire from the voltage regulator, and the 12-gauge white wire from the diode to the large post on the solenoid. **See Wiring Diagrams on page 11-7.**
   2.2. Connect the 6-gauge red wire from the battery, the 10-gauge red wire from the fuse block, and the 12-gauge red wire from the diode to the other large post on the solenoid.
   2.3. Connect the 18-gauge blue wire from the key switch to the small post on the solenoid.
   2.4. Connect the 18-gauge green wire from the Forward/Reverse limit switch to the other small post on the solenoid.
3. Tighten the hex nuts on the large solenoid posts to 55 in-lb (6.2 N·m). Tighten the nuts on the small solenoid posts to 22 in-lb (2.5 N·m).
4. Install the snap-on electrical box cover by firmly pressing down on all corners and install the screw and tighten to 18 in-lb (2 N·m).
5. Install the air intake hose onto the carburetor.
6. Connect battery and spark plug wire(s). **See Connecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**

FUSE

See General Warning on page 1-1.

TESTING THE FUSE

See Test Procedure 2 – Fuse on page 11-12.

FUSE REMOVAL

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels.
2. Disconnect battery. **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
3. Remove the air intake hose from the carburetor.
4. Remove electrical component box cover.
5. 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 snap-on electrical box cover by firmly pressing down on all corners and install the screw and tighten to 18 in-lb (2 N·m).
3. Install the air intake hose onto the carburetor.
4. Connect battery and spark plug wire(s). **See Connecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**

NEUTRAL LOCKOUT LIMIT SWITCH

See General Warning on page 1-1.

TESTING THE NEUTRAL LOCKOUT LIMIT SWITCH

See Test Procedure 7 – Neutral Lockout Limit Switch on page 11-16.

NEUTRAL LOCKOUT LIMIT SWITCH REMOVAL

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
2. Remove the center dash panel **(Figure 13-17, Page 13-17)**.
   - 2.1. Remove the plastic cap (1) covering the mounting screw (2) on each side of the center dash panel (3).
   - 2.2. Loosen, but do not remove, the screw (2) on each side of the center dash panel (3).
   - 2.3. Use a screwdriver to gently pry center dash out slightly from under edge of cowl brace.
   - 2.4. Untwist and remove forward/reverse shifter knob and pull center dash out from the frame.
   - 2.5. Rotate center dash panel counter-clockwise around the steering column to gain access to the limit switches **(Figure 13-19, Page 13-21)**. **See following NOTE.**

NOTE: *Take care to manipulate under-dash wires to prevent damage to wires. It may be nessesary to remove key switch from the dash panel to allow dash panel to rotate.*

3. Disconnect the wires from the neutral lockout limit switch located on the top of the Forward/Reverse control.
4. Use a wrench and a pair of needle-nosed pliers to remove the two nuts and washers and remove the limit switch **(Figure 13-20, Page 13-21)**.

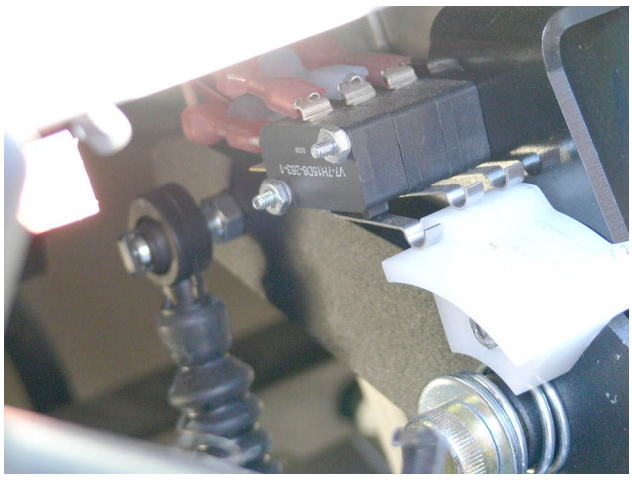

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Figure 13-19 Neutral Lockout (left) and Reverse Buzzer (center) Limit Switches (Third Switch (right) Not Used on Key-Start Vehicle)

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Figure 13-20 Removal of Limit Switches

NEUTRAL LOCKOUT LIMIT SWITCH INSTALLATION

1. Install the neutral lockout limit switch with two washers and two nuts **(Figure 13-20, Page 13-21)**. Tighten to 5 in-lb (0.6 N·m). Place the Forward/Reverse handle in REVERSE to make sure that both switches actuate. **See following CAUTION.**

⚠ CAUTION

- **Do not overtighten the retaining nuts. If the nuts are overtightened, limit switches could be damaged.**

2. Connect wires to neutral lockout limit switch:
   – Connect the black wire to common (COM) terminal and the green wire to the normally open (NO) terminal of the neutral lockout limit switch. **See Wiring Diagrams on page 11-7.**
3. Connect battery and spark plug wire(s). **See Connecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
4. Check limit switch operation.
   – Place the Forward/Reverse handle in the NEUTRAL position. Make sure everyone is clear of the vehicle. Turn the key switch to the START position and hold until the engine is running smoothly. Release the key and it will return to the ON position and the engine should idle. With the Forward/Reverse handle still in the NEUTRAL position, engine RPM should increase when pressing the accelerator pedal. If the engine speed does not increase, turn the key switch OFF and readjust the shift linkage.
5. Test drive the vehicle in both forward and reverse to check for proper operation.

REVERSE WARNING BUZZER

See General Warning on page 1-1.

TESTING THE REVERSE WARNING BUZZER

See Test Procedure 20 – Reverse Buzzer on page 11-30.

REVERSE WARNING BUZZER REMOVAL

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels.
2. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
3. Remove the instrument panel. **See Key Switch Removal on page 13-17.**
4. Disconnect the wires from the reverse warning buzzer (2) **(Figure 13-21, Page 13-23)**.
5. Remove the screw (3), nut (4), lockwasher (5) and flat washer (6) securing the buzzer to the vertical frame support.

REVERSE WARNING BUZZER INSTALLATION

1. Install the screw (3) through the buzzer (2) bracket tab and frame, secure with hardware, and tighten to 14 in-lb (1.6 N·m) **(Figure 13-21, Page 13-23)**. **See following NOTE.**

NOTE: *The reverse warning buzzer is secured at one hole only.*

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. Install the dash in reverse order of removal. **See Key Switch Removal on page 13-17.**
5. Connect battery and spark plug wire(s). **See Connecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**

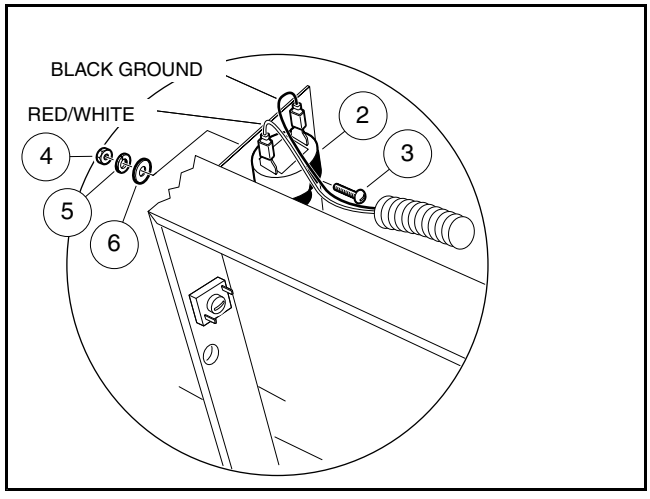

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Figure 13-21 Front Reverse Warning Buzzer

REVERSE BUZZER LIMIT SWITCH

See General Warning on page 1-1.

TESTING THE REVERSE BUZZER LIMIT SWITCH

See Test Procedure 19 – Reverse Buzzer Limit Switch on page 11-29.

REVERSE BUZZER LIMIT SWITCH REMOVAL

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
2. Remove the center dash panel **(Figure 13-17, Page 13-17)**.
   2.1. Remove the plastic cap (1) covering the mounting screw (2) on each side of the center dash panel (3).
   2.2. Loosen, but do not remove, the screw (2) on each side of the center dash panel (3).
   2.3. Use a screwdriver to gently pry center dash out slightly from under edge of cowl brace.
   2.4. Untwist and remove forward/reverse shifter knob and pull center dash out from the frame.
   2.5. Rotate center dash panel counter-clockwise around the steering column to gain access to the limit switches **(Figure 13-19, Page 13-21)**. **See following NOTE.**

NOTE: *Take care to manipulate under-dash wires to prevent damage to wires. It may be nessesary to remove key switch from the dash panel to allow dash panel to rotate.*

3. Disconnect the wires from the reverse buzzer limit switch located on the top of the Forward/Reverse control.
4. Use a wrench and a pair of needle-nosed pliers to remove the two nuts and washers securing the limit switches **(Figure 13-20, Page 13-21)**.
5. Slide the neutral lockout limit switch off of the screws. Do not disconnect the wires.
6. Slide the reverse buzzer limit switch off the screws.

REVERSE BUZZER LIMIT SWITCH INSTALLATION

1. Place the reverse buzzer limit switch onto the two screws, followed by the neutral lockout limit switch, and secure with the two washers and two nuts **(Figure 13-20, Page 13-21)**. Tighten to 5 in-lb (0.6 N·m). Place the Forward/Reverse control in REVERSE to make sure that both switches actuate. **See following CAUTION.**

⚠ CAUTION

- **Do not overtighten the retaining nuts. If the nuts are overtightened, limit switches could be damaged.**

2. Connect wires to reverse buzzer limit switch:
   – Connect the orange wire to the common (COM) terminal and the red/white wire to the normally open (NO) terminal of the reverse buzzer limit switch. **See Wiring Diagrams on page 11-7.**
3. Connect battery and spark plug wire(s). **See Connecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
4. Check limit switch operation.
   – Turn the key switch to the ON position. Shift the Forward/Reverse handle to the REVERSE position. The buzzer should sound.

5. Test drive the vehicle in both forward and reverse to check for proper operation.

OIL WARNING LIGHT

See General Warning on page 1-1.

TESTING THE OIL WARNING LIGHT

See Test Procedure 22 – Oil Warning Light on page 11-30.

OIL WARNING LIGHT REMOVAL

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
2. Remove the center dash panel. **See Key Switch Removal on page 14-13.**
3. Disconnect the wires from the low oil warning light (11) **(Figure 13-22, Page 13-25)**. Do not allow wires to touch.
4. Press the retaining tabs and remove the low oil warning light from the center dash.

OIL WARNING LIGHT INSTALLATION

1. Push a new unit into hole in dash until plastic tabs engage dash **(Figure 13-22, Page 13-25)**.
2. Connect yellow wire from the key switch and yellow wire from the oil level sensor to the low oil warning light.
3. Install the center dash in reverse order of removal. Be sure that key switch terminals cannot touch the frame and that panel is properly seated and snapped in place.
4. Connect battery and spark plug wire(s). **See Connecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**

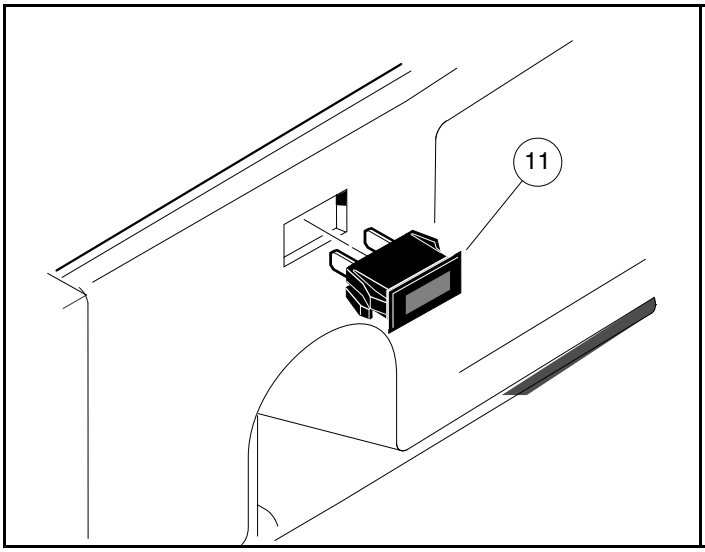

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Figure 13-22 Low Oil Warning Light

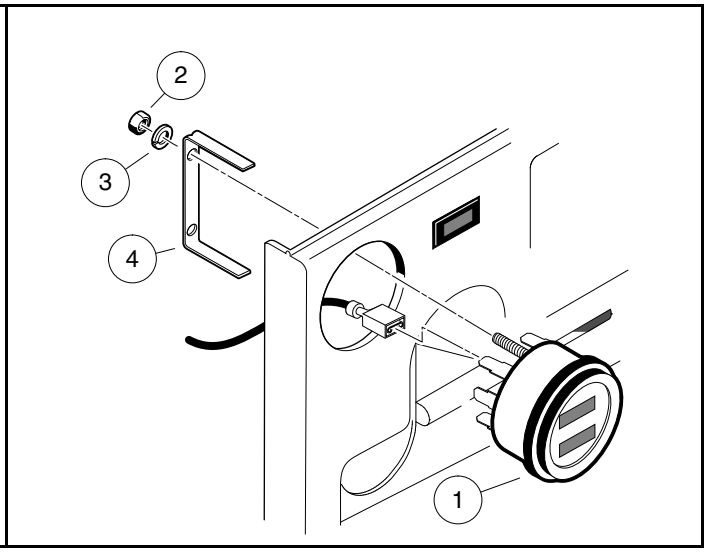

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Figure 13-23 Fuel Gauge/Hour Meter Installation – Early to Mid-2007 Vehicles

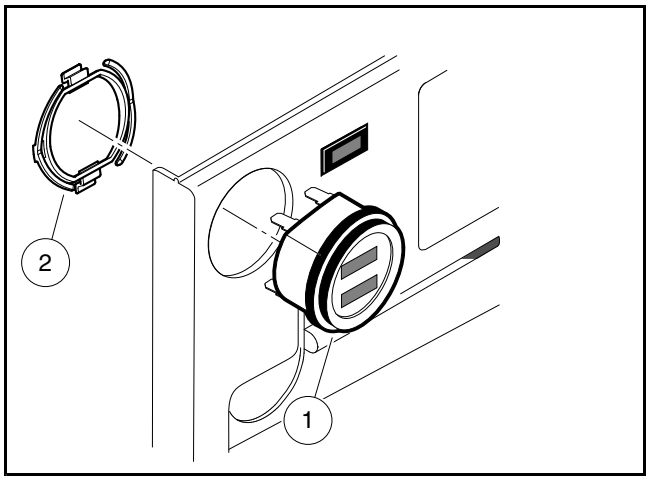

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Figure 13-24 Fuel Gauge/Hour Meter Installation – Mid-2007 and Newer Vehicles

FUEL GAUGE/HOUR METER

See General Warning on page 1-1.

TESTING THE FUEL GAUGE/HOUR METER

See Test Procedure 25 – Fuel Gauge on page 11-33. Also see Test Procedure 26 – Hour Meter on page 11-35.

Early to mid-2007 vehicles: With the key switch in the OFF position, the fuel gauge/hour meter fields are blank. When the key switch is turned to ON, both fields activate. **Mid-2007 and newer vehicles:** With the key switch in the OFF position, the fuel gauge field is blank; however, the hour meter field is always ON. When the key switch is turned to ON, the fuel gauge field activates. **All model years:** The fuel gauge initially registers full before indicating the actual fuel level.

The hour meter displays the number of hours of use in increments of 0.1 (one tenth) hour, but does not record additional time unless the key switch is in the ON position and the engine is on. When recording, the hourglass icon on the left blinks (slowly on Early 2007 vehicles).

FUEL GAUGE/HOUR METER REMOVAL

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
2. Remove the center dash panel. **See Key Switch Removal on page 13-17.**
3. Disconnect the wires from the fuel gauge/hour meter (1). Do not allow wires to touch.
4. Remove the fuel gauge/hour meter.
   - 4.1. **Early to mid-2007 vehicles:** Remove the two hex nuts (2) and lockwashers (3) from the threaded studs on the back of the gauge **(Figure 13-23, Page 13-25)**. Remove the mounting bracket (4) from the back side of the gauge/meter and remove it from the instrument panel.
   - 4.2. **Mid-2007 and newer vehicles:** Remove the mounting clip (2) that secures the gauge/meter **(Figure 13-24, Page 13-26)**. 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 (1) into the hole in the instrument panel until the flange seats against the dash.
2. Secure the fuel gauge/hour meter.
   2.1. **Early to mid-2007 vehicles:** Slide the mounting bracket (4) onto the two threaded studs on the fuel gauge/hour meter **(Figure 13-23, Page 13-25)**. Secure the fuel gauge/hour meter with two lockwashers (3) and two hex nuts (2). Tighten to 2.5 in-lb (.28 N·m). Place one drop of Loctite on each hex nut. Do not allow Loctite to come into contact with the fuel gauge/hour meter casing.
   2.2. **Mid-2007 and newer vehicles:** Force the mounting clip (2) onto the back of the fuel gauge/hour meter until fully seated **(Figure 13-24, Page 13-26)**.
3. Connect the wires to the fuel gauge/hour meter. **See Wiring Diagram for Key-Start (Neutral Rev) Gasoline Vehicles on page 11-7.**
4. Coat the terminals with Battery Terminal Protector Spray (CCI P/N 1014305).
5. Install the center dash in reverse order of removal. Be sure that key switch terminals cannot touch the frame and that panel is properly seated and snapped in place.
6. Connect battery and spark plug wire(s). **See Connecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**

FUEL LEVEL SENDING UNIT

See General Warning on page 1-1.

The fuel level sending unit is an integral part of the fuel tank and should never be removed. Thoroughly test the fuel level sending unit before replacing the fuel tank.

TESTING THE FUEL LEVEL SENDING UNIT

See Test Procedure 24 – Fuel Level Sending Unit on page 11-31.

RPM LIMITER

See General Warning on page 1-1.

TESTING THE RPM LIMITER

See Test Procedure 15 – RPM Limiter on page 11-23.

RPM LIMITER REMOVAL

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels.
2. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
3. Disconnect the white/black wire (1) from the black wire (2) at the bullet connector (3) located near the RPM limiter (4) **(Figure 13-25, Page 13-28)**.

4. Disconnect the black wire (5) at the other bullet connector (6) near the RPM limiter.
5. Remove the flange head bolts (7) from the RPM limiter band (8) and remove the RPM limiter and damper (9) **(Figure 13-25, Page 13-28)**.

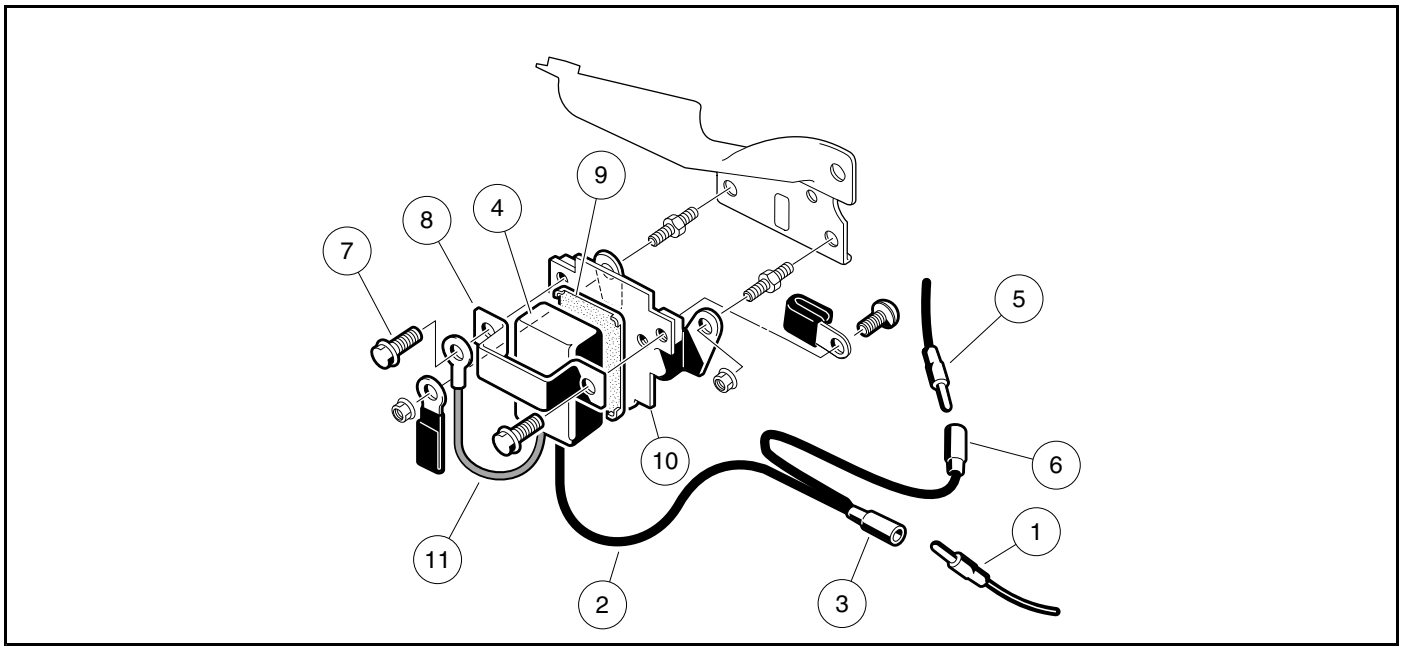

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Figure 13-25 RPM Limiter Assembly

RPM LIMITER INSTALLATION

1. Place the RPM limiter (4) on the damper (9) squarely so that RPM limiter fits tightly against the damper.
2. Place the RPM limiter with damper on the front of the RPM limiter mounting bracket (10) **(Figure 13-25, Page 13-28)**.
3. Place the band (8) over the RPM limiter and align the holes. Place the brown wire ring connector (11) onto the flange head bolt (7) and secure the left side of the band. Use another flange head bolt to secure the other side of the band. Make sure the band holds the RPM limiter securely in place. Tighten fasteners to 7 ft-lb (9.5 N·m).
4. Connect the black wire (2) to the white/black kill circuit wire (1) at the female bullet connector (3).
5. Connect the black wire (2) to the black wire (5) at the female bullet connector (6).
6. Connect battery and spark plug wire(s). **See Connecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**

IGNITION COIL

See General Warning on page 1-1.

The ignition coil is located under the flywheel shroud of the engine. To replace it requires the removal and installation of the engine and transaxle. It is recommended that the ignition coil be thoroughly tested prior to replacement.

TESTING THE IGNITION COIL

See Test Procedure 14 – Ignition Spark on page 11-22. Also see Test Procedure 15 – RPM Limiter on page 11-23 and Test Procedure 16 – Ignition Coil on page 11-23.

IGNITION COIL REMOVAL

Removing the ignition coil requires the removal of the engine and unitized transaxle. **See Unitized Transaxle Removal on page 20-7. See following CAUTION.**

CAUTION

- **Before removal and disassembly, clean the engine.**

1. Remove the starter/generator. **See Starter/Generator Removal on page 13-1. See following NOTE.**

NOTE: *The crankshaft has left-hand threads at the clutch mounting hole.*

2. Remove the muffler. **See Muffler Removal on page 19-1.**
3. Remove the engine mounting hardware (items 1, 2, and 5) **(Figure 15-4, Page 15-5)**.
4. Remove the two nuts (6) and washers (3) from the stud bolts on the engine body.
5. Slide the engine away from the transaxle housing and lift the engine from the mounting plate.
6. Place the engine on a solid, flat surface, preferably on a sturdy work bench.
7. Remove the pan head bolts (5) securing the fan shroud (8) to the fan housing (9) **(Figure 13-26, Page 13-30)**.
8. Loosen, but do not remove, three bolts (6) attaching the fan housing as shown.
9. Remove the remaining four bolts (10) attaching the fan housing **(Figure 13-26, Page 13-30)**, then while opening the housing, detach the spark plug wire grommet (4) from the housing **(Figure 13-28, Page 13-31)**.
10. Disconnect the 18-gauge black wire (12) from the spade terminal (13) on the ignition coil (11) and remove the coil by removing two bolts (10) **(Figure 13-27, Page 13-30)**.

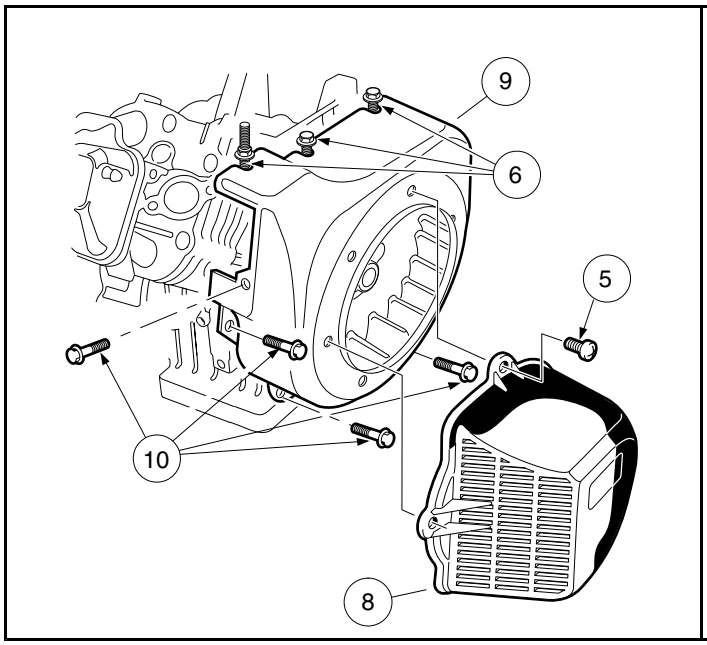

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Figure 13-26 Fan Housing Removal

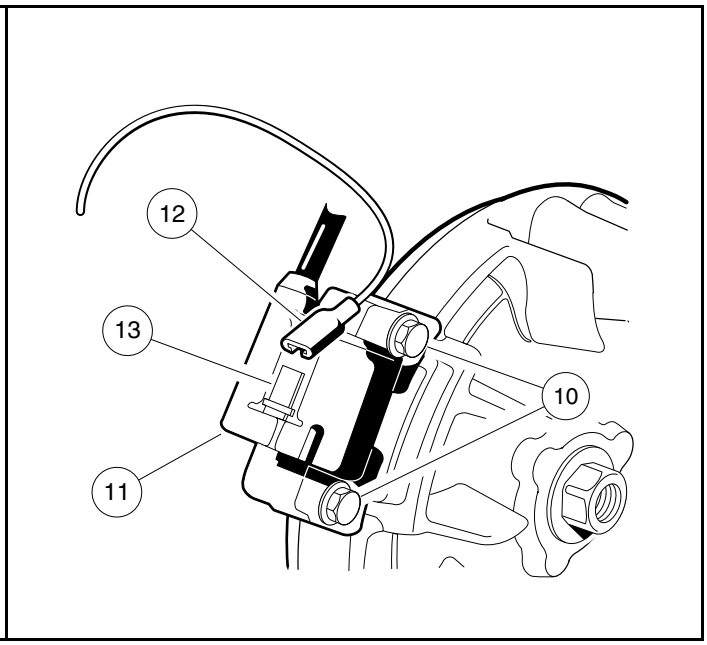

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Figure 13-27 Ignition Coil Removal

IGNITION COIL INSTALLATION

NOTE: *If a new ignition coil is being installed, the spark plug cap, gasket, protector tube and grommet must be removed from the old coil and installed on the new coil.* ***See steps 1 through 8 for procedures to remove and install these existing parts. If the existing ignition coil will be remounted, proceed to step 9.***

1. Remove the rubber gasket (1) on the plug cap (2) by rolling back the gasket onto the spark plug wire.
2. Remove the cap (2) from the wire by turning the cap counterclockwise three or four revolutions while gently pulling it off the wire **(Figure 13-28, Page 13-31)**.
3. Remove the gasket (1) and protector tube (3) from the old coil. **See following NOTE.**

NOTE: *Moisten the spark plug wire with water to make gasket removal and installation easier.*

4. Remove the grommet (4) from the old spark plug wire. Clean the grommet and place it on the new spark plug wire (5).
5. Install the protector tube (3) onto the new wire **(Figure 13-28, Page 13-31)**.
6. Slide the gasket (1) onto the end of the new spark plug wire.
7. Install the cap (2) on the new coil spark plug wire by rotating it clockwise three or four revolutions while applying light pressure on the cap.
8. Install the gasket (1) on the cap (2).
9. Position the ignition coil (7) onto the cast mounting bosses on the engine crankcase and tighten the two mounting bolts (6) finger-tight.
10. Rotate the flywheel (8) until the magnet is positioned directly under the ignition coil. Use a 0.012 inch (0.304 mm) bronze feeler gauge to set the air gap between the ignition coil and the flywheel magnet. Tighten the two mounting bolts (6) to 30 in-lb (3.4 N·m) **(Figure 13-29, Page 13-31)**.
11. Connect 18-gauge black (12) wire to the spade terminal (13) on the coil **(Figure 13-27, Page 13-30)**.
12. Position the fan housing close to the engine crankcase and slide the plug wire grommet into the notch on the housing.

13. When installing fan housing, make sure the top front corner of the housing is above the upper cylinder shroud. The front edge of the fan housing should be behind the lower cylinder shroud. Align the slots in the housing with the flanged bolts (6) loosened earlier **(Figure 13-26, Page 13-30)**.
14. Install the four remaining flanged bolts (10) that secure the fan housing to the engine crankcase. Tighten all seven mounting bolts (6) and (10) to 90 in-lb (10.2 N·m).
15. Install the fan shroud with four pan-head bolts (5) and tighten to 50 in-lb (5.7 N·m).
16. Place the engine onto the engine mounting plate and slide the two washers (3) onto the two engine body bolts, then slide the bolts through the mounting plate and transaxle housing. Loosely attach the two nuts (6) finger-tight **(Figure 15-4, Page 15-5)**.
17. Attach the engine to the bottom of the engine mounting plate using the bolts (1), washers (2) and nuts (5). Tighten hardware to 21 ft-lb (28.4 N·m) **(Figure 15-4, Page 15-5)**.
18. Tighten the two engine body bolt nuts (6) to 17 ft-lb (23.1 N·m).
19. Install the engine and transaxle assembly. **See Unitized Transaxle Installation on page 20-14. See following CAUTION.**

CAUTION

- **Make sure wire harness is routed and secured away from the muffler.**

20. Install the muffler. **See Muffler Installation, Section 19, Page 19-1.**

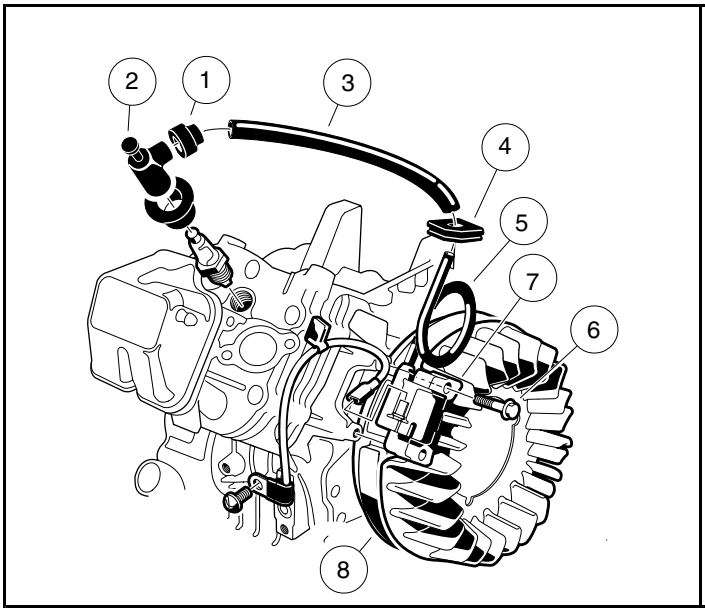

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Figure 13-28 Clean Grommet

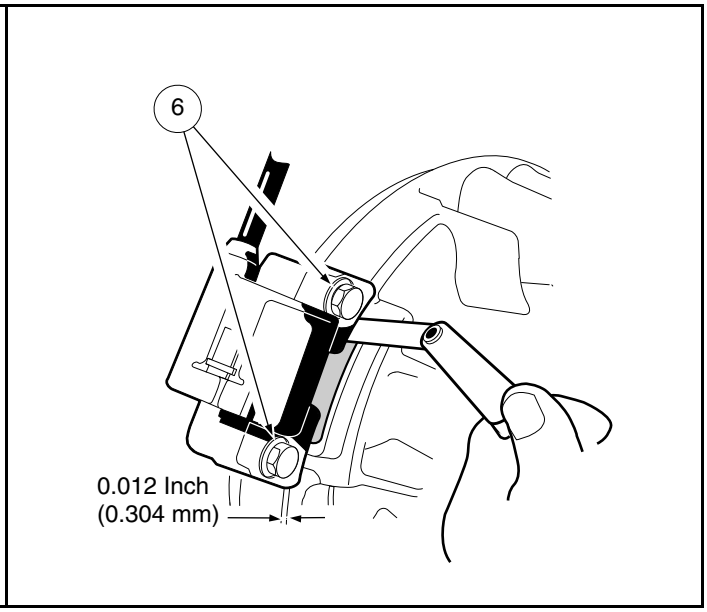

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Figure 13-29 Mount Ignition Coil Using Feeler Gauge

21. Install the starter/generator and belt. **See Starter/Generator Installation on page 13-10.**
22. Connect battery and spark plug wire(s). **See Connecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**

OIL LEVEL SENSOR

See General Warning on page 1-1.

TESTING THE OIL LEVEL SENSOR

See Test Procedure 21 – Oil Level Sensor on page 11-30.

OIL LEVEL SENSOR REMOVAL

See Oil Level Sensor Removal on page 15-5.

OIL LEVEL SENSOR INSTALLATION

See Oil Level Sensor Installation on page 15-5.

HEADLIGHTS

See General Warning on page 1-1.

TESTING THE HEADLIGHT SOCKET

See Test Procedure 29 – Voltage at Headlight Socket on page 11-37.

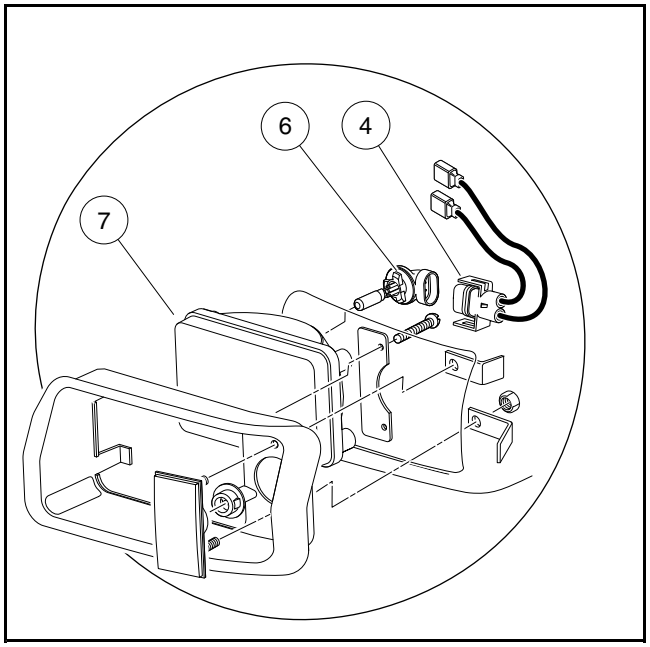

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Figure 13-30 Headlight Assembly

HEADLIGHT BULB REMOVAL

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels.
2. Disconnect battery. **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
3. From the front of vehicle, reach under body and turn the wire harness/halogen bulb assembly (4 and 6) clockwise one-quarter turn **(Figure 13-30, Page 13-32)**.
4. Remove the wire harness/halogen bulb assembly (4 and 6) from the headlight lens (7).
5. Lift the retaining tabs on the connector (4) and remove halogen bulb assembly (6).

HEADLIGHT BULB INSTALLATION

NOTE: *When handling halogen bulbs, do not touch glass portion of bulb. Oil from finger tips can cause premature failure of bulb.*

1. Connect wire harness (4) to the halogen bulb assembly (6). The retaining tab should lock onto the halogen bulb assembly **(Figure 13-30, Page 13-32)**.
2. From the front of vehicle, reach under body and insert wire harness/halogen bulb assembly (4 and 6) into the headlight lens (7).
3. Turn the wire harness/halogen bulb assembly (4 and 6) counterclockwise one-quarter turn.
4. Connect battery and spark plug wire(s). **See Connecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**

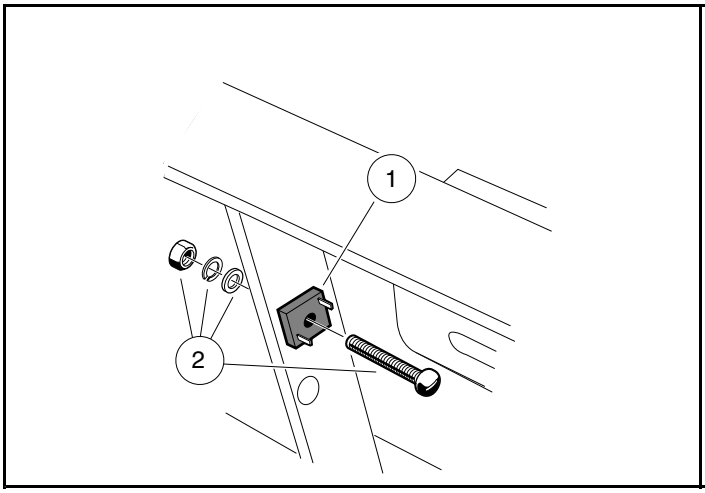

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Figure 13-31 Voltage Limiter

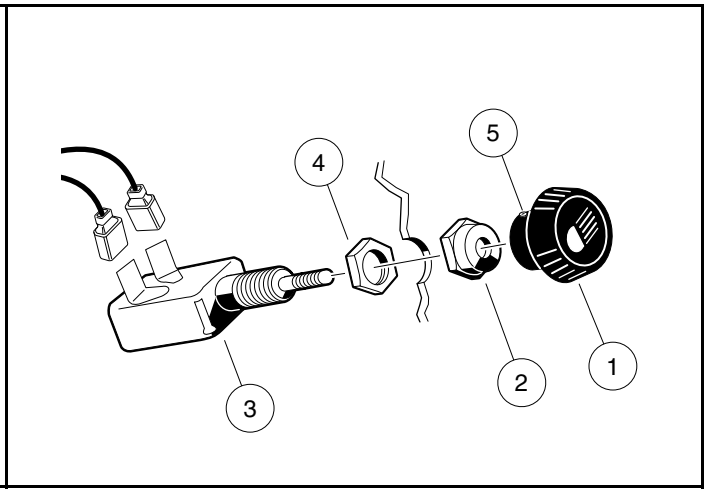

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Figure 13-32 Light Switch

VOLTAGE LIMITER

See General Warning on page 1-1.

TESTING THE VOLTAGE LIMITER

See Test Procedure 28 – Headlight Diode on page 11-37.

VOLTAGE LIMITER REMOVAL

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels.
2. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
3. Remove the instrument panel. **See Key Switch Removal on page 13-17.**
4. Disconnect wires from the voltage limiter (1). Do not allow wires to touch **(Figure 13-31, Page 13-33)**.

NOTE: *Identify terminal for solid black wire and terminal for black/white wire.*

5. Remove the mounting hardware (2) from the voltage limiter and remove it from the vehicle.

VOLTAGE LIMITER INSTALLATION

1. Mount the voltage limiter to the frame using the mounting hardware and tighten to 25 in-lb (2.8 N·m) **(Figure 13-31, Page 13-33)**.
2. Connect the black/white wire from harness to the negative (–) terminal on the diode.
3. Connect the solid black wire from the ground terminal block to the positive (+) terminal on the diode.
4. Install the instrument panel in reverse order of removal. **See Key Switch Removal on page 13-17.**
5. Connect battery and spark plug wire(s). **See Connecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**

LIGHT SWITCH

See General Warning on page 1-1.

TESTING THE LIGHT SWITCH

See Test Procedure 27 – Light Switch on page 11-36.

LIGHT SWITCH REMOVAL

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels.
2. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
3. Loosen the set screw (5) locking the light switch knob (1) to the shaft **(Figure 13-32, Page 13-33)**.
4. Remove the instrument panel. **See Key Switch Removal on page 13-17.**
5. Disconnect the wires from the light switch (3).
6. Remove the outer nut (2) from the light switch and remove.

LIGHT SWITCH INSTALLATION

1. Connect the wires to the light switch (3). **See Wiring Diagrams on page 11-7.**
2. Thread the check nut (4) onto the switch until an equal number of threads show on both sides. Install to the instrument panel with nut (2) on the outside of the dash and tighten the nut to 14 in-lb (1.6 N·m) **(Figure 13-32, Page 13-33)**.
3. Push the light switch shaft in. Screw the knob (2) onto the end of the shaft until the knob touches the outer nut. Then turn the knob in the opposite direction until the headlight beams on the knob are horizontal to the ground. Tighten the set screw (5) to lock the knob to the shaft.
4. Install the instrument panel in reverse order of removal. **See Key Switch Removal on page 13-17.**
5. Connect battery and spark plug wire(s). **See Connecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**

BATTERY

See General Warning on page 1-1.

⚠ DANGER

- **Due to the danger of an exploding battery, wear a full face shield and rubber gloves when working on or near batteries.**
- **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.**

DANGER CONTINUED ON NEXT PAGE

⚠ DANGER

- **Tools, wires, and metal objects can cause sparks when shorted across a battery.**
- **Follow all instructions carefully when working with batteries.**
- **Charge battery in a well-ventilated area only.**
- **Battery – Poison! Contains acid! Causes severe burns. Avoid contact with skin, eyes, or clothing. Antidotes:**
  - **External: Flush with water. Call a physician immediately.**
  - **Internal: Drink large quantities of milk or water followed with milk of magnesia or vegetable oil. Call a physician immediately.**
  - **Eyes: Flush with water for 15 minutes. Call a physician immediately.**

⚠ WARNING

- **Do not jump start a dead battery using another battery and jumper cables.**

GENERAL INFORMATION

See preceding DANGER and WARNING statements.
Gasoline vehicles are equipped with 12-volt, low-maintenance batteries that requires infrequent watering. 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.
A group 70, side-post battery (CCI P/N 1012328), with a 650 cranking amp rating at 32 °F (0 °C) (500 CCA at 0 °F (-17.8 °C)) and a reserve capacity of at least 105 minutes is recommended. The group 70 classification indicates battery size: 8-1/4 inches W x 6-1/2 inches D x 7-1/4 inches H (21.0 cm W x 16.5 cm D x 18.4 cm H). It is important to use the proper size to ensure that the battery clamp will fit correctly.

TESTING THE BATTERY

See Test Procedure 1 – Battery on page 11-9.
See Test Procedure 23 – Battery Test (Under Load) on page 11-31.

PREVENTIVE MAINTENANCE

1. To keep the battery in good operating condition, remove any corrosion immediately. Post connections should be clean and tight. Any frayed or worn wires should be replaced. After all cables have been connected and properly tightened to 144 in-lb (16 N·m), coat terminals with Battery Terminal Protector Spray (CCI P/N 1014305) to prevent future corrosion. **See preceding WARNINGS and following CAUTION.**

⚠ CAUTION

- **If battery wire terminals are damaged or corroded, replace or clean them as necessary. Failure to do so may cause them to overheat during operation and could result in a fire, property damage, or personal injury.**

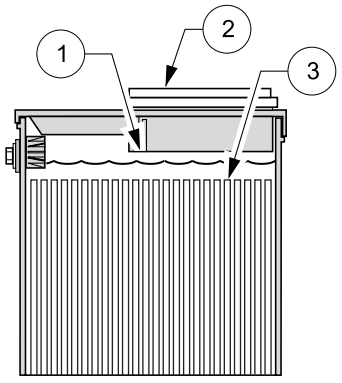
2. The battery should be kept clean and dry to prevent self-discharge. Any dirt, grime or acid spillage should be removed. Wash the battery with a bristle brush using water and bicarbonate of soda (1 cup (237 mL) baking soda per 1 gallon (3.8 L) of water). Rinse with water. Do not allow solution to enter battery through the vent cap holes. **See Self-Discharge on page 13-37.**
3. Maintain proper water level. **See Water Level on page 13-37.**
4. Check battery periodically to see that it is in a full state of charge. **See Charging the Battery on page 13-39.**
5. Keep battery hold-down clamp tight. **See Vibration Damage on page 13-38.**

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. In hotter climates, therefore, the battery should be checked more often. When storing the battery, keep in a cool place. **See Battery Storage on page 13-40.**

WATER LEVEL

The water level should be checked semi-annually to be sure water is at its proper level **(Figure 13-33, Page 13-37)**. Never allow the water level to fall below the tops of the plates because this will cause the exposed part of the plate to become permanently inactive. Check the water level more frequently in hot weather or when the battery becomes old.



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

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Figure 13-33 Battery Electrolyte Level

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 out of the vent caps and corrosion to build up on surrounding metal parts. The acid that is lost reduces the capacity of the battery and cannot be replaced.

MINERAL CONTENT

For the longest battery life, distilled water should be used in the battery. However, if tap water is going to be used, contact your local water department to be sure mineral contents are below the levels listed in the following table. **See following NOTE.**

NOTE: *Contact your local water department for mineral content analysis.*

IMPURITY	ALLOWABLE CONTENT (PARTS PER MILLION)	EFFECTS OF IMPURITY
Suspended matter	Trace	—
Total solids	100.0	—
Calcium	40.0	Increase of positive shedding
Magnesium	40.0	Reduced life
Iron	3.0	Increased self-discharge at both plates, lower on-charge voltage
Ammonia	8.0	Slight self-discharge of both plates
Organic matter	50.0	Corrosion of positive plate
Nitrates	10.0	Increased sulfation at negative
Nitrites	5.0	Corrosion at both plates, loss of capacity, reduced life
Chloride	5.0	Loss of capacity in both plates, greater loss in positive
Color	Clear and “White”	—
Antimony	5.0	Self-discharge by local action, reduces life, lower on-charge voltage
Arsenic	0.5	Self-discharge, can form poisonous gas at negative
Copper	5.0	Increased self-discharge, lower oncharge voltage
Nickel	None Allowed	Intense lowering of on-charge voltage
Platinum	None Allowed	Violent self-discharge, lower on-charge voltage
Selenium	2.0	Positive shedding
Zinc	4.0	Slight self-discharge at negative

BATTERY REMOVAL

See General Warning on page 1-1. Also see DANGER at beginning of Battery topic.

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels.
2. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
3. Remove the battery hold-down clamp from the battery.
4. Lift the battery from the vehicle. **See following WARNING.**

⚠ WARNING

- **Keep the battery in an upright position to prevent electrolyte leakage. Tipping the battery beyond a 45° angle in any direction can allow a small amount of electrolyte to leak out of the vent hole. Do not exceed this 45° angle when lifting, carrying or installing battery. The battery acid could cause severe personal injury when accidentally coming in contact with the skin or eyes, and could damage clothing.**

CHARGING THE BATTERY

See General Warning on page 1-1. 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 (3-10 amps) or a fast charge (20-30 amps). Charge until the specific gravity reaches 1.250. **See following WARNING.**

⚠ WARNING

- **If the battery case feels hot (approximately 125 °F (52 °C) or more), emits gases, or fluid boils from vents, stop charging immediately. Failure to stop charging battery when any of these conditions are present could result in an explosion, personal injury and/or damage to the battery.**
- **Do not disconnect the charger DC leads from the battery when the charger is on. The resulting arcing between the DC leads and battery post could cause an explosion.**
- **If the charger must be stopped, disconnect the AC supply cord from the wall outlet before disconnecting the DC leads from the battery. Allow the battery to cool to room temperature and resume charging battery at a lower amp rate.**

BATTERY INSTALLATION

See General Warning on page 1-1. Also see DANGER at beginning of Battery topic.

1. Place the battery into the vehicle with the battery posts facing the engine.
2. Secure the battery to the vehicle with the clamp and install bolt, washer and locknut and tighten to 144 in-lb (16.3 N·m). A loose battery clamp may allow the battery to become damaged from vibration or jarring.
3. Connect battery and spark plug wire(s). **See Connecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**

BATTERY STORAGE

See General Warning on page 1-1. Also see DANGER at beginning of Battery topic.

1. Keep the battery clean and free of corrosion. **See Preventive Maintenance on page 13-36.**
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. **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
3. Fully charge the battery prior to storage.
4. Store in a cool, dry area. The colder the area in which the battery is stored, the less the battery will self-discharge. A battery stored at 0 °F (-17.8 °C) will discharge very little over a four-month period. A battery stored at 80 °F (27 °C) will have to be recharged every few weeks.
5. Check the state of charge periodically. A battery that is discharged and left in a cold environment can freeze and crack. If the specific gravity drops below 1.220, the battery should be recharged. **See following WARNING.**

⚠ WARNING

- **If the battery is frozen or the container is bulged, discard battery. A frozen battery can explode.**

6. The frequency of recharging required depends on the temperature of the storage area, but it is recommended that the battery be monitored 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 Warning on page 1-1. Also see DANGER at beginning of Battery topic.
The vehicle is equipped with a starter/generator. The generator is not designed to charge a dead battery. If the vehicle battery has become discharged, it must be charged using a properly rated automotive type charger. **See following WARNING.**

⚠ WARNING

- **Do not jump-start a dead battery using another battery and jumper cables.**

GROUND CABLES

TESTING THE GROUND CABLES

See Test Procedure 3 – Ground Cables on page 11-12.

⚠ DANGER

- **See General Warning on page 1-1.**

⚠ WARNING

- **See General Warning on page 1-1.**

STARTER/GENERATOR

See General Warning on page 1-1.

TESTING THE STARTER/GENERATOR

See Test Procedure 8 – Starter/Generator (Starter Function) on page 12-18.

See Test Procedure 10 – Starter/Generator (Generator Function) on page 12-19.

STARTER/GENERATOR REMOVAL

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery – Gasoline Vehicles, Section 1, Page 1-3.**
2. Place the neutral lockout switch in the MAINTENANCE position. Access the engine compartment by removing the seat.
3. Disconnect the wires from the starter/generator (1). Mark wires before disconnecting. Loosen the pivot nuts (7) and bolts (5) **(Figure 14-1, Page 14-2)**.
4. Remove the mounting/adjustment nut (12), washer (9) and bolt (11). Lower the starter/generator and remove the belt (4) from the pulley (10).
5. Support the starter/generator so that when the pivot bolts are removed the starter/generator will not fall to the ground. Remove the two pivot nuts (7) and bolts (5) from the mounting bracket.
6. Remove the starter/generator.

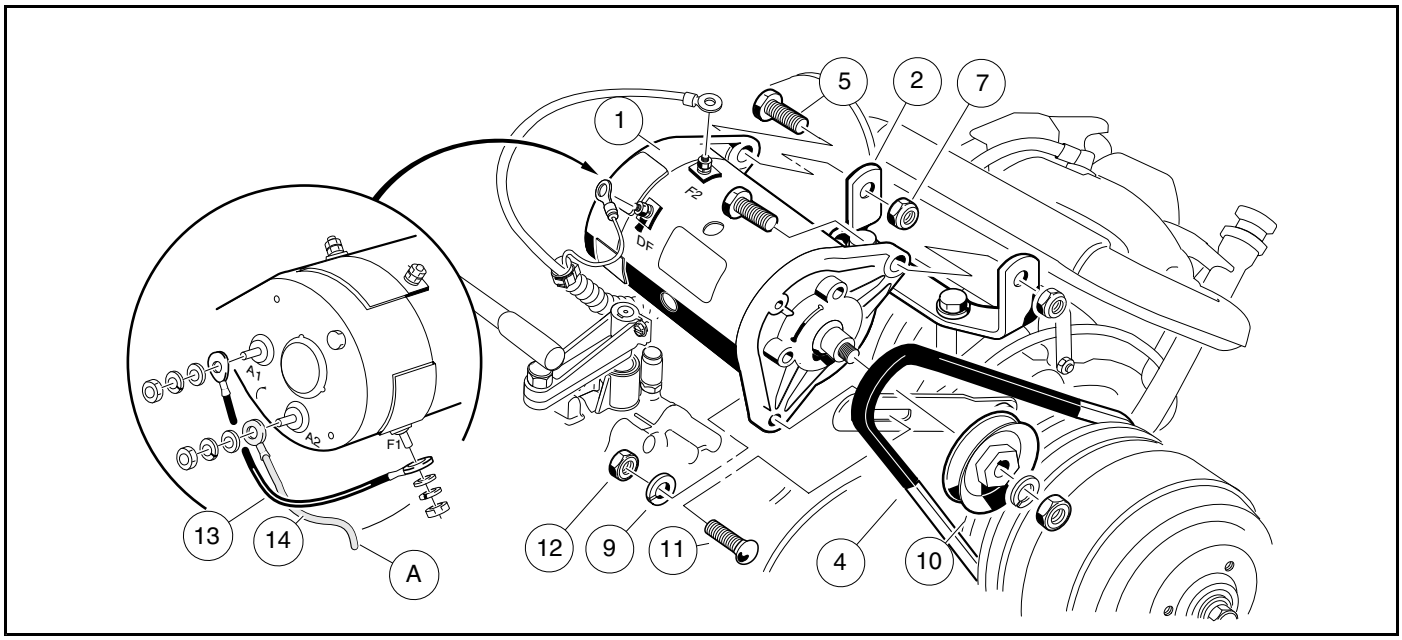

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Figure 14-1 Starter/Generator Removal

DISASSEMBLY OF THE STARTER/GENERATOR TO SERVICE THE BRUSHES

1. Remove the two bolts (20) and pull commutator end cover (23) free of starter/generator housing (24) **(Figure 14-2, Page 14-2)**. **See following NOTE.**

NOTE: *If the brushes are not removed, contact between the brushes and commutator as the commutator end cover is being removed or installed could damage the brushes. Lift the brush springs out of the notches in the brushes and pull the brushes back from the center of the commutator end cover. The springs will rest on the sides of the brushes and help prevent them from sliding towards the center of the cover* ***(Figure 14-6, Page 14-4)****.*

2. Remove brush covers (29 and 30), screws (25) and lock washers (26), brush springs (28), and brushes (27) **(Figure 14-3, Page 14-2)**. **See following NOTE.**

NOTE: *To clean and inspect the armature/commutator and the bearings, see* ***Disassembly of the Starter/Generator to Service the Armature/Commutator on page 14-4****.*

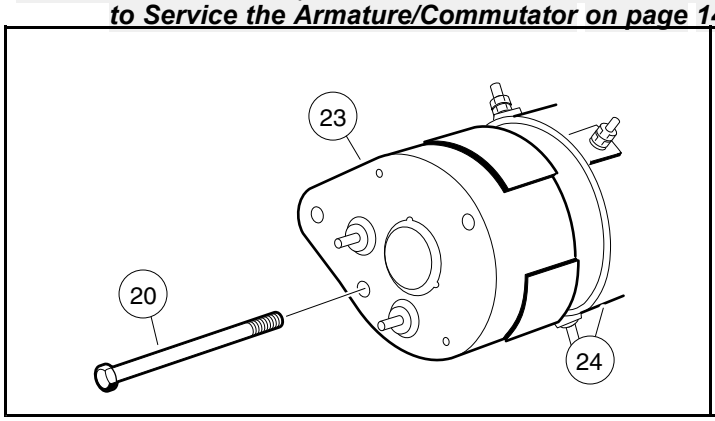

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Figure 14-2 Commutator End Cover

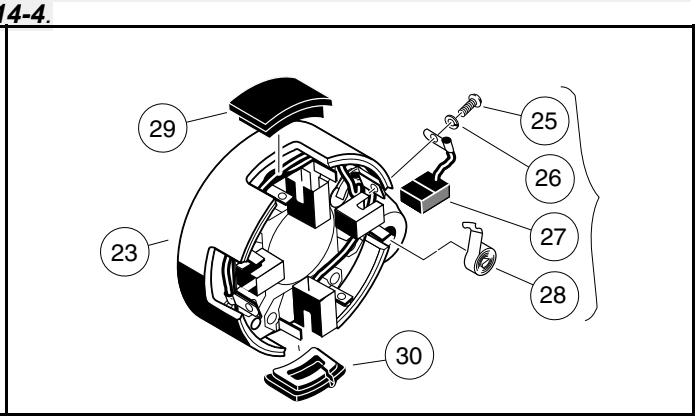

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Figure 14-3 Brush Covers and Brushes

BRUSH INSPECTION AND REPLACEMENT

1. Visually inspect brushes. Replace brushes that are cracked or severely chipped.

2. Check the wear line on the side of the brush. If the end of the brush is within 1/16 inch (1.6 mm) of the wear line, replace all four brushes **(Figure 14-4, Page 14-3)**.

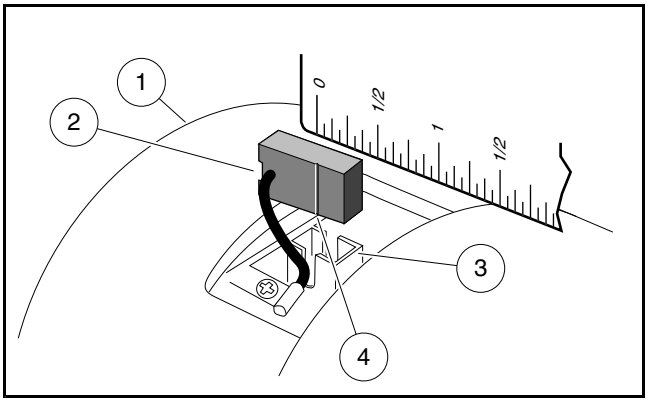

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Figure 14-4 Inspect Brushes

BRUSH SPRING INSPECTION AND REPLACEMENT

1. Visually inspect springs. Replace all four springs if any spring is discolored from heat (straw or bluish in color).
2. Install the four brushes (27) into their holders and insert the four brush springs (28) **(Figure 14-3, Page 14-2)**. Using a spring scale, test brush spring tension. If any spring has a tension less than 24 ounces (6.67 N), replace all four springs **(Figure 14-5, Page 14-3)**. **See following CAUTION.**

⚠ CAUTION

- **When checking brush spring tension, do not push springs beyond the point they would normally be if there were new brushes installed. Exerting excessive force or pushing brush springs beyond their normal maximum extension point will damage springs.**

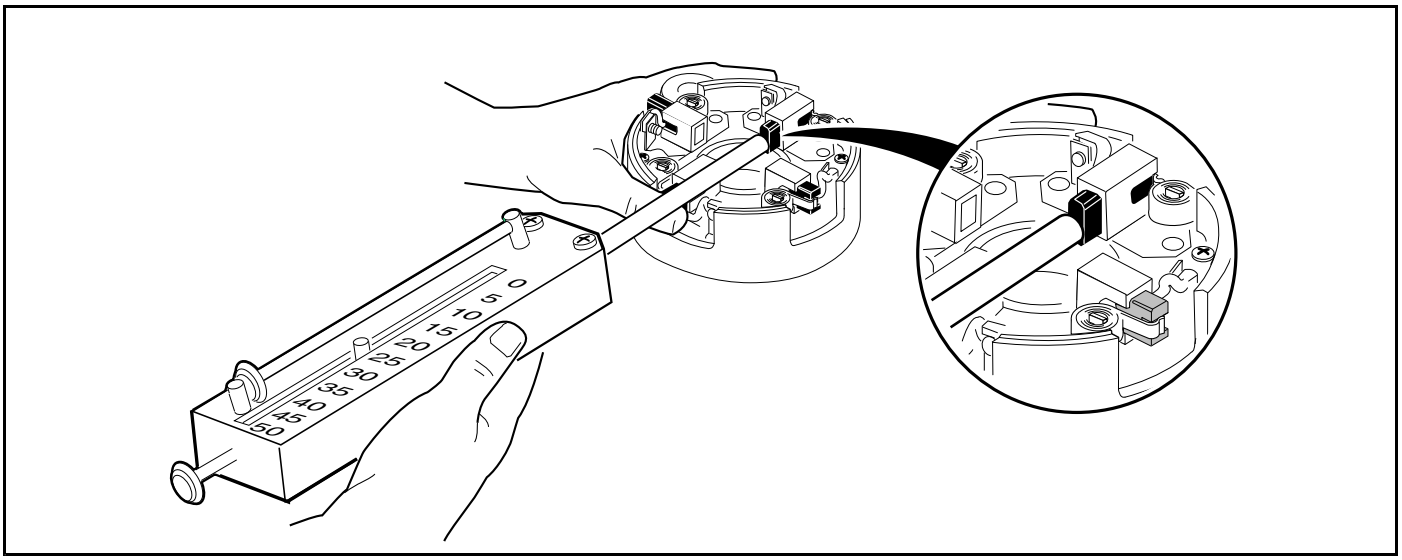

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Figure 14-5 Brush Spring Tension Test

STARTER/GENERATOR ASSEMBLY

1. Connect the brush wires to the holders using four lock washers (26) and four screws (25), making sure the crossover leads are connected also. Tighten the screws to 31 in-lb (3.5 N·m) **(Figure 14-3, Page 14-2)**.

2. To prevent contact between the brushes and commutator as the commutator is installed, and possible damage to the brushes, lift the brush springs out of the notches in the brushes and pull the brushes back from the center of the commutator end cover. The springs will rest on the sides of the brushes and help prevent them from sliding towards the center of the cover **(Figure 14-6, Page 14-4)**.
3. Install the commutator end cover (23) onto the armature shaft. Align the locating pin with the pin hole in the cover. Install two M6 x 180 mm bolts (20) and tighten to 100 in-lb (11.3 N·m) **(Figure 14-2, Page 14-2)**.
4. Push the brushes down into the holders. Position springs into the notches in the brushes. Install the brush cover (30) that has the drain hole in it next to the A2 terminal. Install the remaining three brush covers (29) in the openings in the commutator end cover (23) **(Figure 14-3, Page 14-2)**.

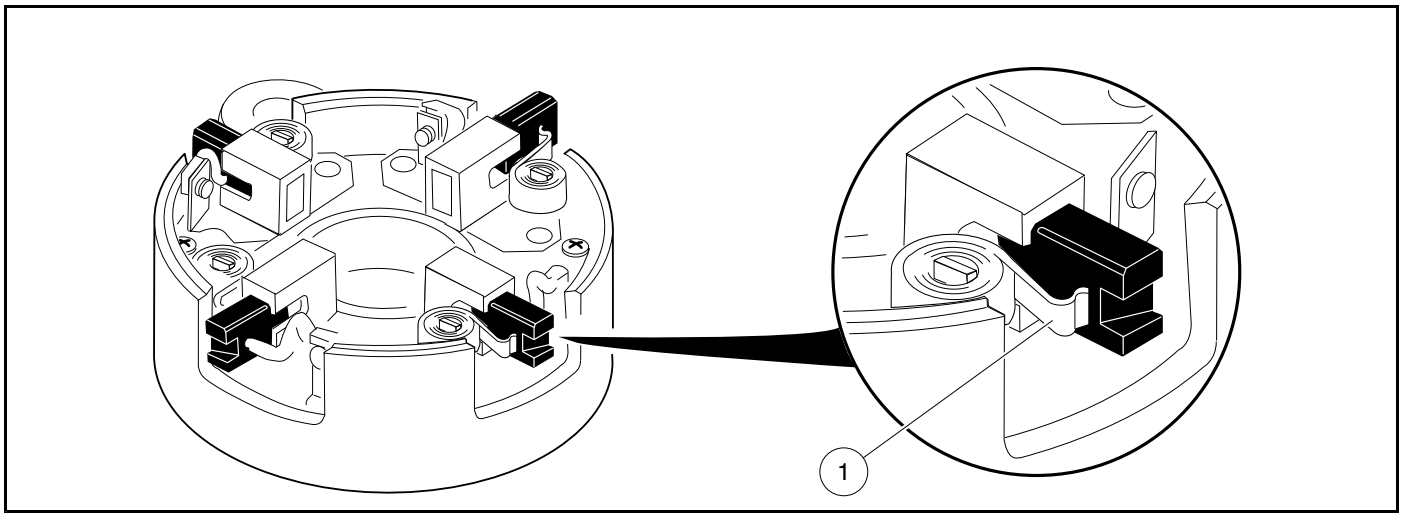

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Figure 14-6 Pull Brushes Away From Center of the Commutator End Cover

DISASSEMBLY OF THE STARTER/GENERATOR TO SERVICE THE ARMATURE/COMMUTATOR

1. If the brushes are not removed, contact between the brushes and commutator as the commutator end cover is being removed or installed could damage the brushes.
   1.1. Lift the brush springs out of the notches in the brushes and pull the brushes back from the center of the commutator end cover. The springs will rest on the sides of the brushes and help prevent them from sliding towards the center of the cover **(Figure 14-6, Page 14-4)**.
2. Remove the two bolts (20), and pull commutator end cover (23) free of the starter/generator housing (24) **(Figure 14-2, Page 14-2)**.
3. To separate armature (33) from output end cover (36), remove nut (41), lock washer (40), pulley (39), shaft key (34), spacer (37), and bearing retainer screws (43) **(Figure 14-7, Page 14-5)**.

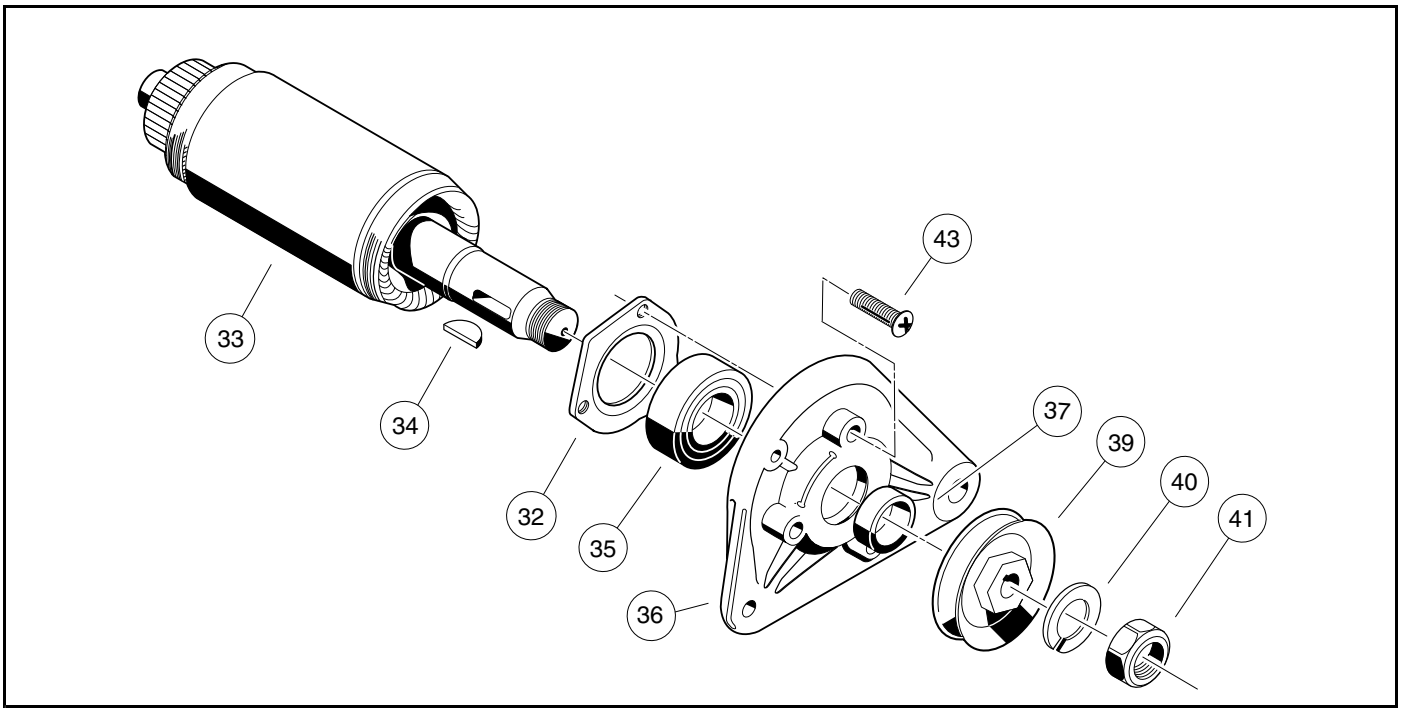

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Figure 14-7 Armature and Output End Cover Assembly

BEARING CLEANING AND INSPECTION

1. Using a clean cloth, wipe the carbon dust from the two bearings. Inspect bearings by spinning them by hand and checking for both axial (A) and radial (B) play **(Figure 14-8, Page 14-5)**.
2. Replace the bearing if it is noisy, does not spin smoothly, or has excessive play. Check the bearings and replace if rusted, worn, cracked, or if there is an abnormal color change in the metal of the bearing. Bearings should be replaced if there is extensive wear or pitting on the balls or on the rolling surfaces. Do not remove the bearings unless they are to be replaced.

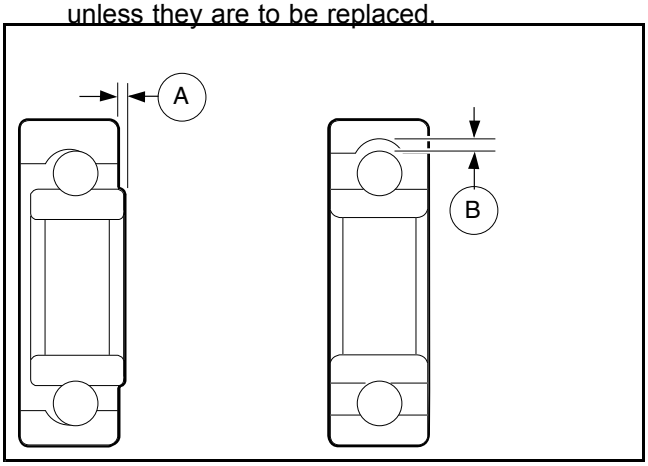

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Figure 14-8 Bearing Play Inspection

BEARING REMOVAL

1. Place the wedge attachment tool (CCI P/N 1012812) between the bearing and the armature. Make sure the wedge attachment tool is supporting the inner race of the bearing. If a press is not available, secure a bearing puller (CCI P/N 1012811) to the wedge attachment tool and pull the bearing off of the end of the armature shaft. Support the armature so that it will not drop when the bearing is removed **(Figure 14-9, Page 14-6)**.

2. Discard the bearings.
3. Slide the bearing retainer (32) off of the output end of the shaft **(Figure 14-7, Page 14-5)**.

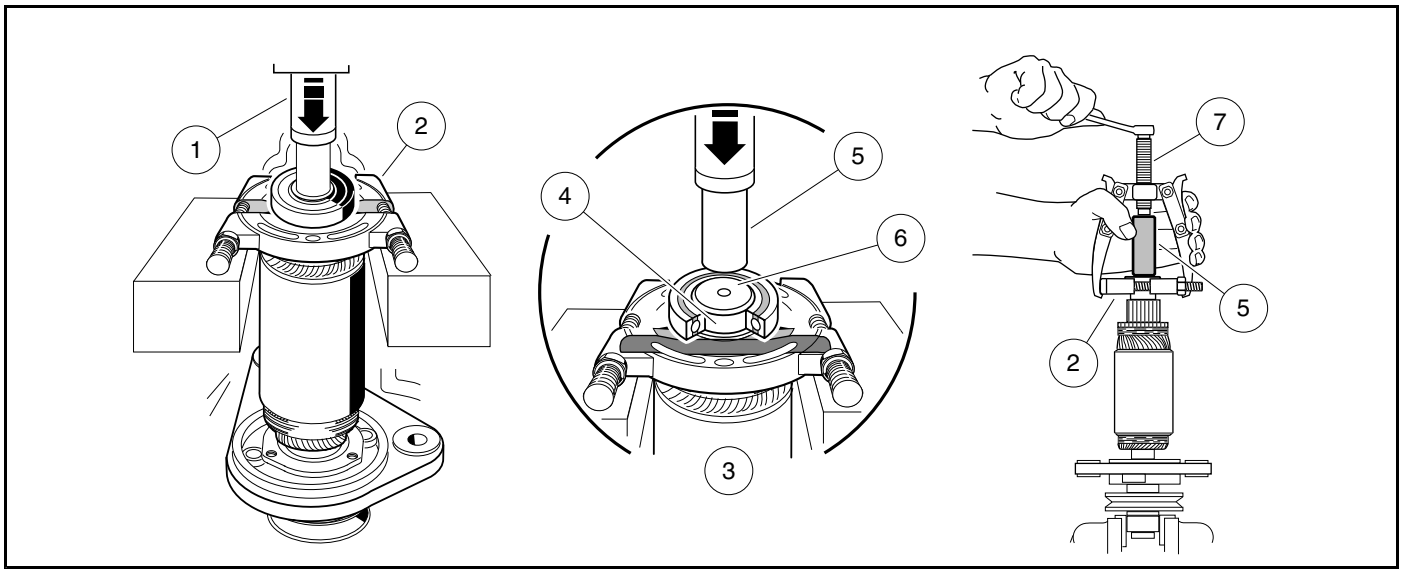

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Figure 14-9 Bearing Removal

FIELD COIL REMOVAL

1. Remove the retaining nut from each field coil terminal and slide the insulator out of the slots in the housing. Remove the four pole piece screws from the housing. Remove the four pole pieces from inside the housing. Remove the field coils from the inside of the housing **(Figure 14-10, Page 14-7)**. **See following NOTE.**

NOTE: *Do not remove the insulators or the field coils unless an electrical test indicates that it is necessary* ***(Figure 14-10, Page 14-7). See Starter/Generator (Starter Function) on page 12-18.***

VISUAL INSPECTION OF ARMATURE

Obvious defects can be seen by examining the armature. If an armature has frayed or charred insulation, broken wires or thrown solder, it is obvious without testing that it should be replaced. Faults seen during the visual inspection can aid in diagnosing the original cause of the failure. Items to look for are listed below.

- Burned, charred, or cracked insulation
- Improperly cured varnish
- Thrown solder
- Flared armature windings
- Worn, burned, or glazed commutator
- Loose or raised commutator bars
- Bruised or damaged armature core laminations
- Worn armature bearing or shaft
- Dirty or oily commutator

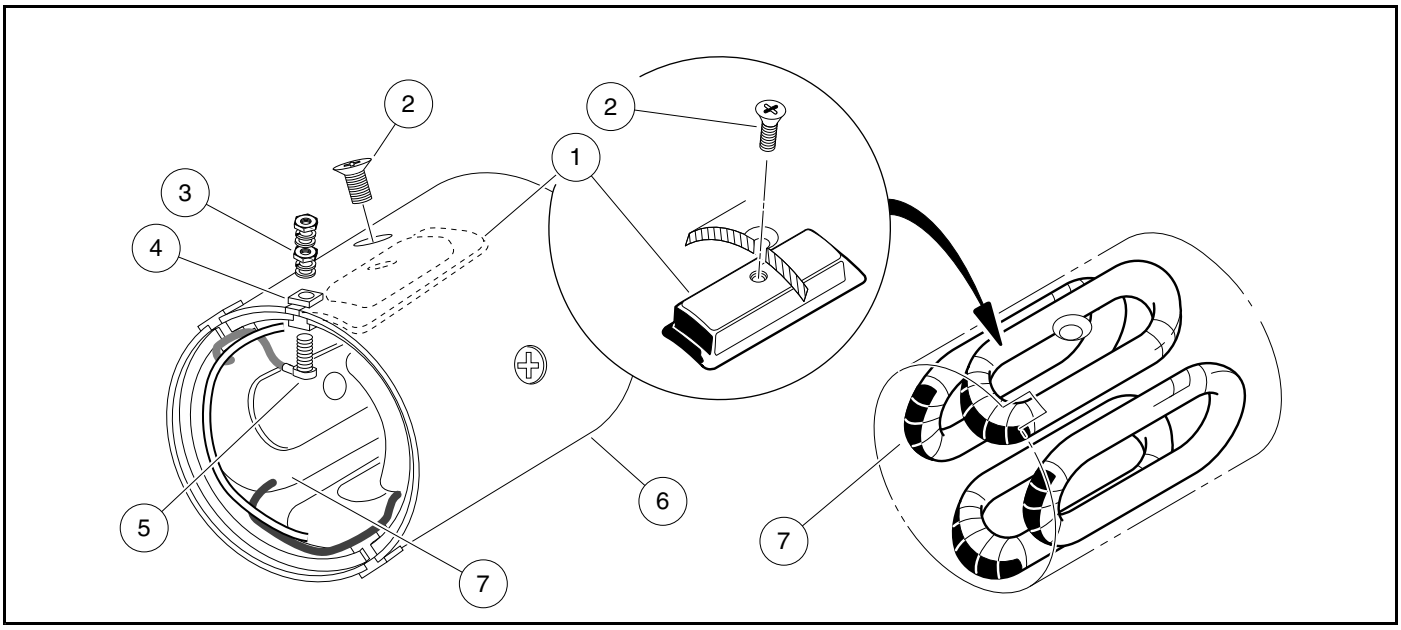

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Figure 14-10 Field Coil Assembly

COMMUTATOR CLEANING AND INSPECTION

1. Clean the carbon dust, dirt and oil from the commutator. Visually inspect the commutator for worn, burned or glazed areas. Check for loose or raised commutator bars. Slight roughness of the commutator can be polished away with 400 grit (or finer) sandpaper. **See following CAUTION.**

⚠ CAUTION

- **Do not use emery cloth on the commutator. Particles of emery are conductive and may short-circuit the commutator bars. Do not use oil or lubricants on the commutator or brushes.**

2. Using a micrometer, measure the outside diameter at two points along the commutator. If the commutator outside diameter is less than 1.535 inches (39 mm), replace the armature and bearings **(Figure 14-11, Page 14-8)**.

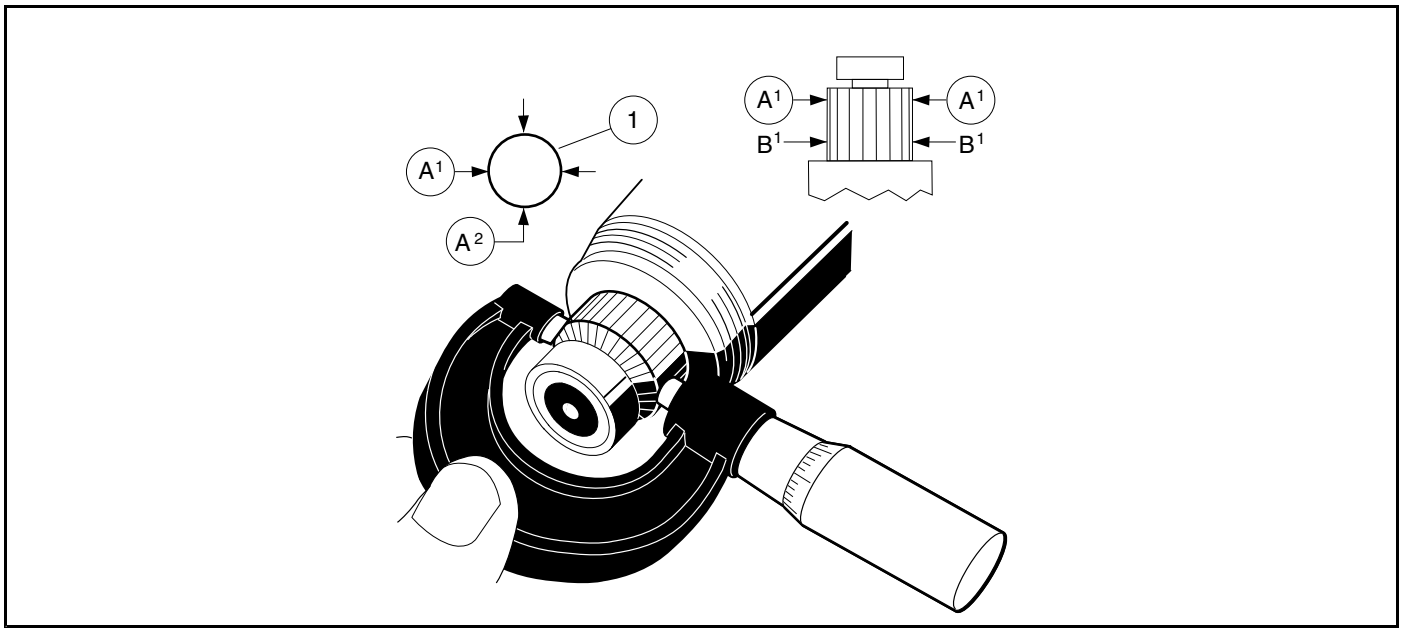

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Figure 14-11 Inspect Commutator

ARMATURE GROUND TEST

⚠ CAUTION

- **Do not submerge armature in solvent.**

NOTE: *Before testing, wipe the armature with a clean cloth and remove carbon dust and metal particles from between commutator bars.*

1. Using a multimeter set on 200 ohms, place the positive (+) probe on the commutator bars and the negative (–) probe on the armature core. The reading should be no continuity. If the reading is incorrect, replace the armature and the two bearings ***(Figure 14-12, Page 14-8)***.

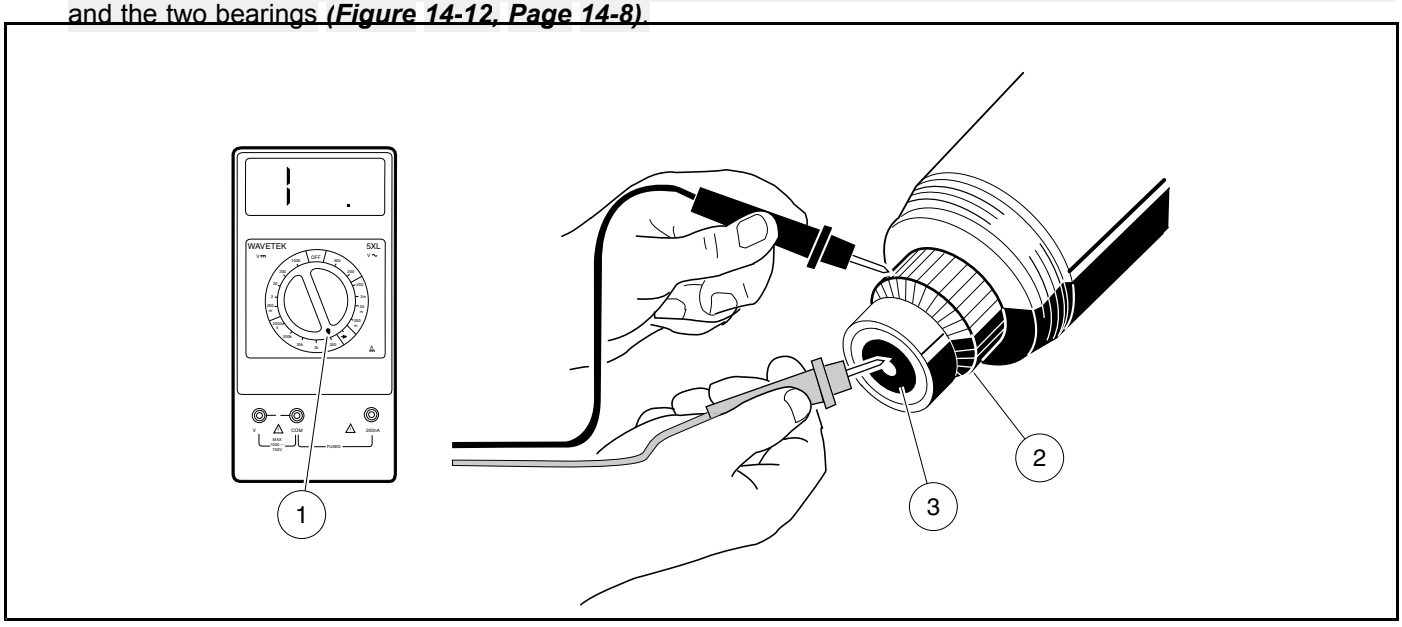

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Figure 14-12 Armature Ground Test