

2014 Café Express Maintenance and Service Manual



Gasoline Vehicle with Subaru EX40 Engine

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FOREWORD

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

This manual provides detailed information for the maintenance and repair of the 2014 Café Express vehicle, 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 to assist its distributors and dealers in continually updating their service knowledge and facilities so they can provide prompt and efficient service for vehicle owners. Regional technical representatives, vehicle service seminars, periodic service bulletins, maintenance and service manuals, and other service publications also represent Club Car's continuing commitment to customer support.

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

This manual covers all aspects of typical vehicle service; however, unique situations sometimes occur when servicing a vehicle. If it appears that a service question is not answered in this manual, please contact your nearest authorized Club Car dealer or distributor for assistance. You may also write to us at: Club Car, LLC, P.O. Box 204658; Augusta, GA 30917-4658 USA, Attention: Technical Services.

▲ WARNING

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

MAINTENANCE ITEMS	
Battery Terminal Protector Spray CC PN 1014305	Engine Air Filter (404 cc) CC PN 102558201
Chassis Lube EP NLGI Grade 2 (commercially available)	Spark Plug O.H.C. (404 cc) CC PN 105017801
Dry Moly Lube CC PN 1012151	

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 i – INDEX

SAFETY DETAILS

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.

PERSONAL SAFETY

DANGER

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

WARNING

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

CAUTION

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

MACHINE SAFETY

CAUTION

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

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

INFORMATION

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

GENERAL WARNINGS

The following safety statements must be heeded whenever the vehicle is being operated, repaired, or serviced. Other specific safety statements appear throughout this manual and on the vehicle.

DANGER

- **Battery – Explosive gases! Do not smoke. Keep sparks and flames away from the vehicle and service area. Ventilate when charging or operating vehicle in an enclosed area. Wear a full face shield and rubber gloves when working on or near batteries.**
- **Gasoline – Flammable! Explosive! Do not smoke. Keep sparks and flames away from the vehicle and service area. Service only in a well-ventilated area.**
- **Do not operate engine in an enclosed area without proper ventilation. The engine produces carbon monoxide, which is an odorless, deadly poison.**
- **The vehicle will not provide protection from lightning, flying objects, or other storm-related hazards. If caught in a storm while driving a Club Car vehicle, exit the vehicle and seek shelter in accordance with applicable safety guidelines for your location.**

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 and battery charger.**
- **Do not leave children unattended in vehicle at any time.**
- **Prior to leaving the vehicle unattended or servicing the vehicle, set the park brake, place the Forward/Reverse handle or switch in the NEUTRAL position, turn the key switch to the OFF position, and remove the key. Chock the wheels when servicing the vehicle.**
- **Improper use of the vehicle or failure to properly maintain it can result in decreased vehicle performance, serious personal injury, or death.**
- **Any modification or change to the vehicle that affects the electrical system, stability or handling of the vehicle, or increases maximum vehicle speed beyond factory specifications, can result in serious personal injury or death.**
- **Check the vehicle for proper location of all vehicle safety and operation decals and make sure they are in place and are easy to read.**
- **For vehicles with cargo beds, remove all cargo (including accessories) before raising the bed or servicing the vehicle. If the vehicle is equipped with a prop rod, ensure that it is securely engaged while bed is raised. Do not close bed until all persons are clear of cargo bed area. Keep hands clear of all crush areas. Do not drop cargo bed; lower gently and keep entire body clear. Failure to heed this warning can result in serious personal injury or death.**
- **Only trained technicians should service or repair the vehicle. Anyone doing even simple repairs or service should have knowledge and experience in electrical and mechanical repair. The appropriate instructions must be used when performing maintenance, service, or accessory installation.**
- **To avoid unintentionally starting the vehicle, disconnect the battery and spark plug wire. See Disconnecting the Battery on page 1-3.**

WARNING CONTINUED ON NEXT PAGE

⚠ WARNING

- **Frame ground – Do not allow tools or other metal objects to contact frame when disconnecting battery cables or other electrical wiring. Do not allow a positive wire to touch the vehicle frame, engine, or any other metal component.**
- **Wear safety glasses or approved eye protection when servicing the vehicle. Wear a full face shield and rubber gloves when working on or near batteries.**
- **Do not wear loose clothing or jewelry such as rings, watches, chains, etc., when servicing the vehicle.**
- **Use insulated tools when working near batteries or electrical connections. Use extreme caution to avoid shorting of components or wiring.**

DISABLING THE VEHICLE

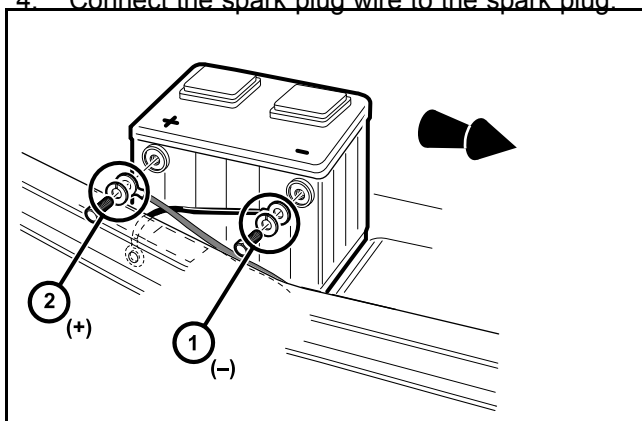
1. Engage park brake to lock wheels.
2. Turn the key switch OFF and remove the key.
3. Place the Forward/Reverse control in the NEUTRAL position.
4. In addition, chock the wheels if servicing or repairing the vehicle.

DISCONNECTING THE BATTERY

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**).
3. Disconnect the spark plug wire from the spark plug.

CONNECTING THE BATTERY

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 to minimize corrosion.
4. Connect the spark plug wire to the spark plug.



1

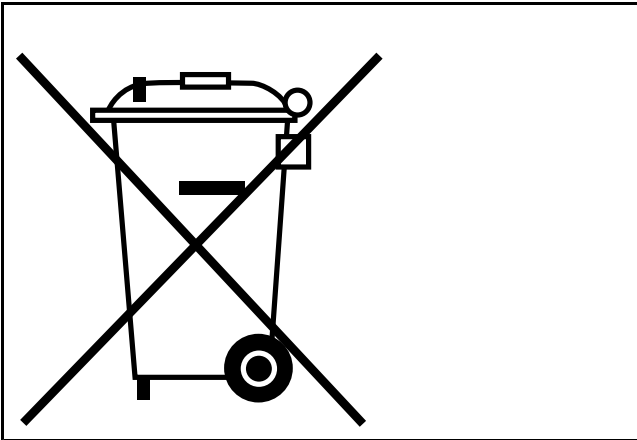
Figure 1-1 Battery Cable Removal

RECYCLING LEAD-ACID BATTERIES

⚠ WARNING

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

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



¹⁴⁰³ **Figure 1-2 Dispose of Lead-acid Batteries Properly**

INTERNATIONAL SAFETY SYMBOLS ON BATTERIES

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



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

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Figure 1-3 International Safety Symbols on Batteries

VEHICLE SPECIFICATIONS

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

SPECIFICATIONS	CAFE EXPRESS
POWER SOURCE	GASOLINE
Engine: 4 cycle, OHC, 404 cc, 14.0 Horsepower (10.4 kW) rated engine @ 3600 RPM (per SAE J 1940), single cylinder, air cooled, with splash lubrication system	•
Fuel system: Electronic fuel injection (EFI), high-pressure rotary fuel pump with 10 micron fuel filter	•
Governor: Automatic ground speed sensing, internally geared in transaxle	•
Ignition: Digital CDI with electronic RPM limiter	•
Transaxle: Precision helical gears, forward/reverse with neutral position (11.47:1 forward; 15.63:1 reverse), with optional limited slip differential	•
Electrical system: 12 volt, 500 cca at 0 °F (-17.8 °C), 650 cca at 32 °F (0 °C). 105-minute reserve capacity	•
Gasoline Vehicle Electrical Charging System: 23 amps at max. RPM.	•
Torque converter: Automatic, variable speed, dry type	•
STEERING/SUSPENSION/BRAKES	
Steering: Self-adjusting rack and pinion	•
Suspension: Independent leaf spring with dual hydraulic shocks	•
Brakes: Mechanical brake cable system to manually-adjusted drum brakes on all four wheels. Park brake is automatically released. Multi-latch ratchet and pawl.	•
BODY/CHASSIS	
Frame/chassis: Twin I-Beam welded aluminum	•
Side and rear body: Aluminum	•
Front body: ArmorFlex®	•
Front body finish: Automotive-grade paint with clear-coat finish	•
Tires: 20 x 10 - 10 tubeless, 6-ply rated load range front and rear	•
DIMENSIONS/WEIGHT	
Overall length: Standard configuration Add for Heavy-Duty Bumper: 1.8 in (4.5 cm)	125.5 in (318.7 cm)
Overall width with mirrors:	51.4 in (130.5 cm) 62.6 in (159.0 cm)
Overall height: at steering wheel	47.1 in (119.6 cm)
Overall height: with canopy	70.7 in (179.5 cm)
Wheelbase	78.1 in (198.3 cm)

TABLE CONTINUED ON NEXT PAGE

SPECIFICATIONS	CAFE EXPRESS
POWER SOURCE	GASOLINE
Ground clearance	5.2 in (13.2 cm)
Front wheel tread	36.6 in (92.9 cm)
Rear wheel tread	39.5 in (100.3 cm)
Weight: Standard gasoline vehicle with Cafe Express unit (dry fuel tank) Curb weight:	1147 lb (520.2 kg) 1175 lb (532.9 kg)
Maximum forward speed	12 to 14 mph (19 to 23 km/h)
Outside clearance circle (diameter)	258.5 in (656.5 cm)
Turning radius (per SAE J 695)	123 in (312.4 cm)
Intersecting aisle clearance	94 in (238.7 cm)
Floorboard height	7.2 in (18.2 cm)
Load bed size: Cafe Express unit dimensions	56.7 x 50.5 x 41.5 in (144 x 128.2 x 105.4 cm)
Vehicle rated capacity: Level surface only	850 lb (385.6 kg)
Standard seating capacity: (persons)	2
LIQUID CAPACITIES	
Engine crankcase	40.5 fl-oz (1.2 L)
Transaxle	67.6 fl-oz (2 L)
Fuel tank	4.6 gallons (17.4 L)
TIRE PRESSURE	
Front and rear	28 to 32 psig (193 to 221 kPa)
NOISE AND VIBRATION	
Drive-by noise level to operator Test method: EN 12053:2001	77.2 dBa Uncertainty: 2 dBa
Vibration at driver's seat Test method: EN 13059:2002	Unknown at time of printing. Uncertainty: 0.23 m/s ²

⚠ DANGER

- See General Warnings on page 1-2.

⚠ WARNING

- See General Warnings on page 1-2.

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

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

- 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

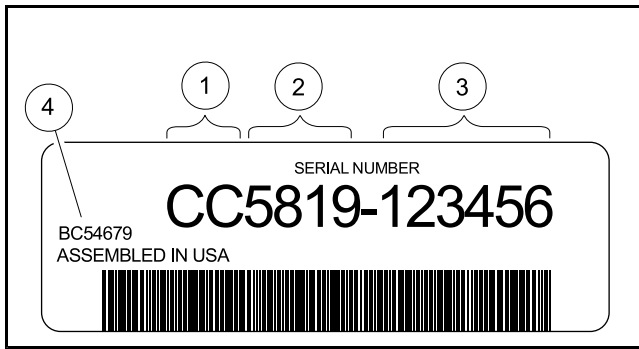
MODEL IDENTIFICATION

The serial number of each vehicle is printed on a bar code decal mounted below the center dash panel (Example: CC5819-123456) (**Figure 3-1**).

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

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

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



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Figure 3-1 Serial Number Decal

STORAGE

See General Warnings on page 1-2.

⚠ DANGER

- Do not attempt to drain fuel when the engine is hot or while it is running.
- 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

- 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.
- 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.
- 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. Seal the fuel tank.
 - 3.1. Fill fuel tank, and, following manufacturer's directions, add a commercially available fuel stabilizer (such as Sta-Bil®).
 - 3.2. Disconnect fuel vent line from fuel tank vent nipple.
 - 3.3. Plug the fuel tank vent nipple so that it is air tight. We recommend using a slip-on vinyl cap.

NOTE: *It is not necessary to drain the fuel line.*

4. Disconnect battery and spark plug wire. **See Disconnecting the Battery on 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: use 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. Let the terminals dry and then coat them with Battery Terminal Protector Spray.
6. To protect the engine, remove spark plug and pour 0.5 fl-oz (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 and tighten it to 20 ft-lb (27 N·m).
7. Adjust tires to recommended tire pressure. **See Vehicle Specifications on page 2-1.**
8. Perform semiannual periodic lubrication. **See Periodic Lubrication Schedule on page 10-5.**
9. Thoroughly clean front body, rear body, seats, cargo bed, engine compartment, and underside of vehicle.
10. Thoroughly clean and wipe dry all storage compartments in the refreshment center.
11. 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 14-17, Page 14-24**).
 - 1.2. Connect vent tube to fuel tank vent.
2. Connect battery and spark plug wire. **See Connecting the Battery on page 1-3.**
3. Place the Forward/Reverse handle in the NEUTRAL position and the neutral lockout switch in the MAINTENANCE position. Crank the engine until the engine starts. Turn the engine off and return the neutral lockout switch to the OPERATE position. **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.*

4. Adjust tires to recommended tire pressure. **See Vehicle Specifications on page 2-1.**
5. Perform the Pre-Operation and Daily Safety Checklist on page 10-1 and the Performance Inspection on page 10-2.

⚠ DANGER

- See General Warnings on page 1-2.

⚠ WARNING

- See General Warnings on page 1-2.

CLEANING THE VEHICLE

See General Warnings on page 1-2.

CAUTION

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

These vehicles are equipped with painted TPO front bodies and aluminum only rear bodies with black polypropylene rear fender and tailskirt. The cargo beds are steel with aluminum sheet and Rhino Lining®.

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

For regular cleaning, use commercially available automotive cleaning solutions with a sponge or soft cloth. The painted finish is the same paint used in automotive applications. Automotive cleaning/polishing products are available at automotive specialty and hardware stores.

Use non-abrasive wax products. Battery acid, fertilizers, tars, asphalt, creosote, paint, or chewing gum should be removed immediately to prevent possible stains.

SEAT CLEANING

Clean seats regularly using the following guidelines:

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

NOTE: *Dispose of waste water properly.*

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

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

CAUTION

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

FRONT BODY REPAIR

See General Warnings on page 1-2.

LIGHT SCRATCHES

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

ABRASIONS AND HAZE

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

LARGE SCRATCHES AND ABRASIONS

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

TOUCH-UP PAINT COLOR CHART

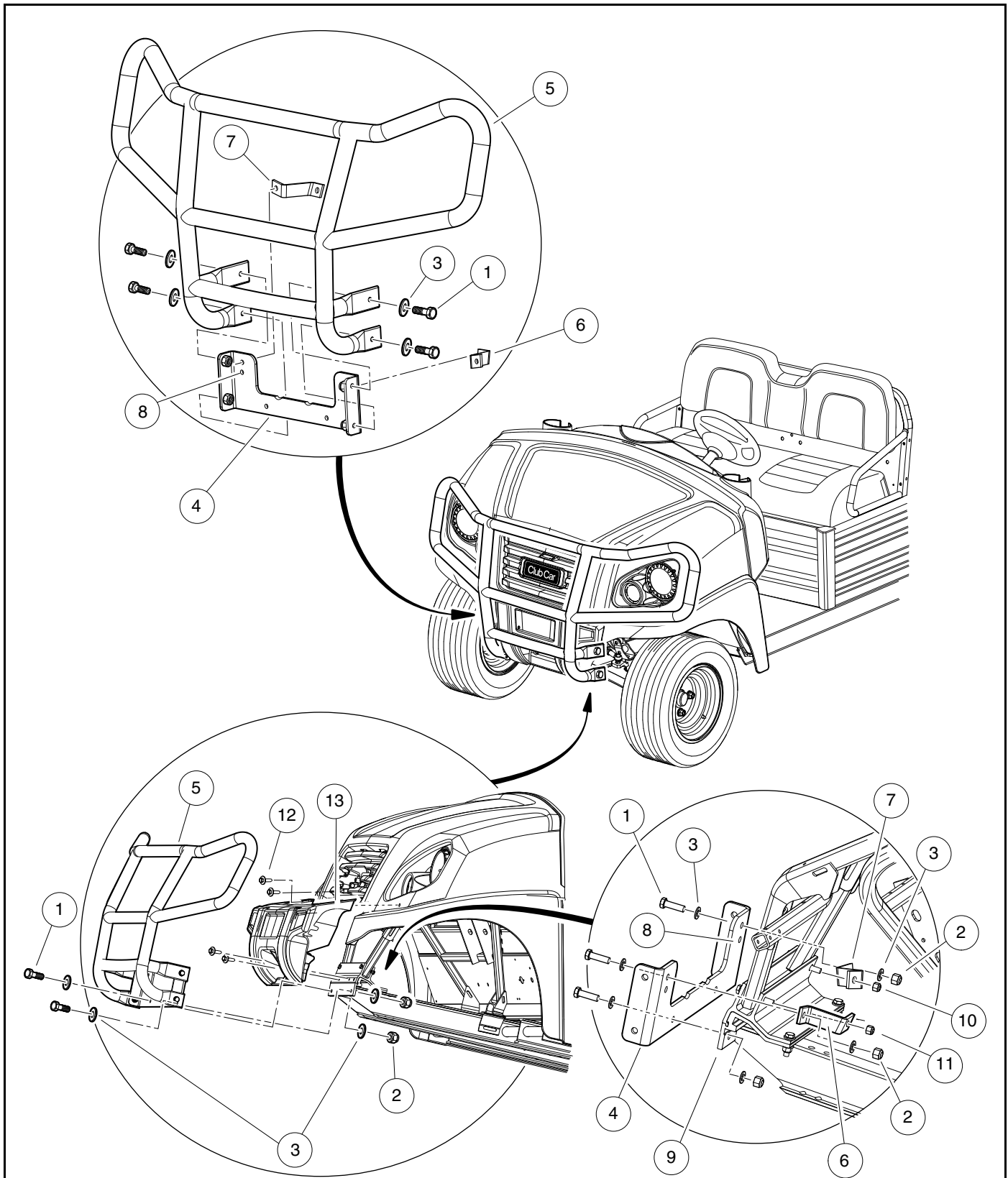
COLOR	CC P/N
White	105117701
Classic Blue	105117702
Dark Green	105117703
Red	105117704
Dark Gray	105117705
Black	105117706
Tan	105117707
Bright Blue	105117708
TITN Silver	105117709
Light Gray	105117710

FRONT BODY

See General Warnings on page 1-2.

HEAVY DUTY BUMPER REMOVAL

1. Disconnect the battery. **See Disconnecting the Battery, Section 1, Page 1-3.**
2. Loosen and remove screws (1), washers (3) and locknuts (2) that attach heavy duty (HD) bumper mounting bracket (4) to HD bumper weldment (5). **(Figure 4-1, Page 4-4).**
3. Remove plastic bumper (13).
4. Remove HD bumper and weldment.



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Figure 4-1 Heavy Duty Bumper

HEAVY DUTY BUMPER INSTALLATION

1. Position brush guard mounting bracket (4) onto brush guard weldment (5). Align holes and secure with four screws (1), eight washers (3), and four locknuts (2) (**Figure 4-1, Page 4-4**).
2. Attach plastic bumper (13).
3. Use the existing fastener holes in the mounting bracket and vehicle structure as an alignment guide.
4. Secure the brush guard mounting bracket to the vehicle using two screws (1), four washers (3) and locknuts (2).
5. Tighten all attaching hardware to 15 ft·lb (20.3 N·m).
6. Connect the battery. **See Connecting the Battery, Section 1, Page 1-3.**

COWL REMOVAL

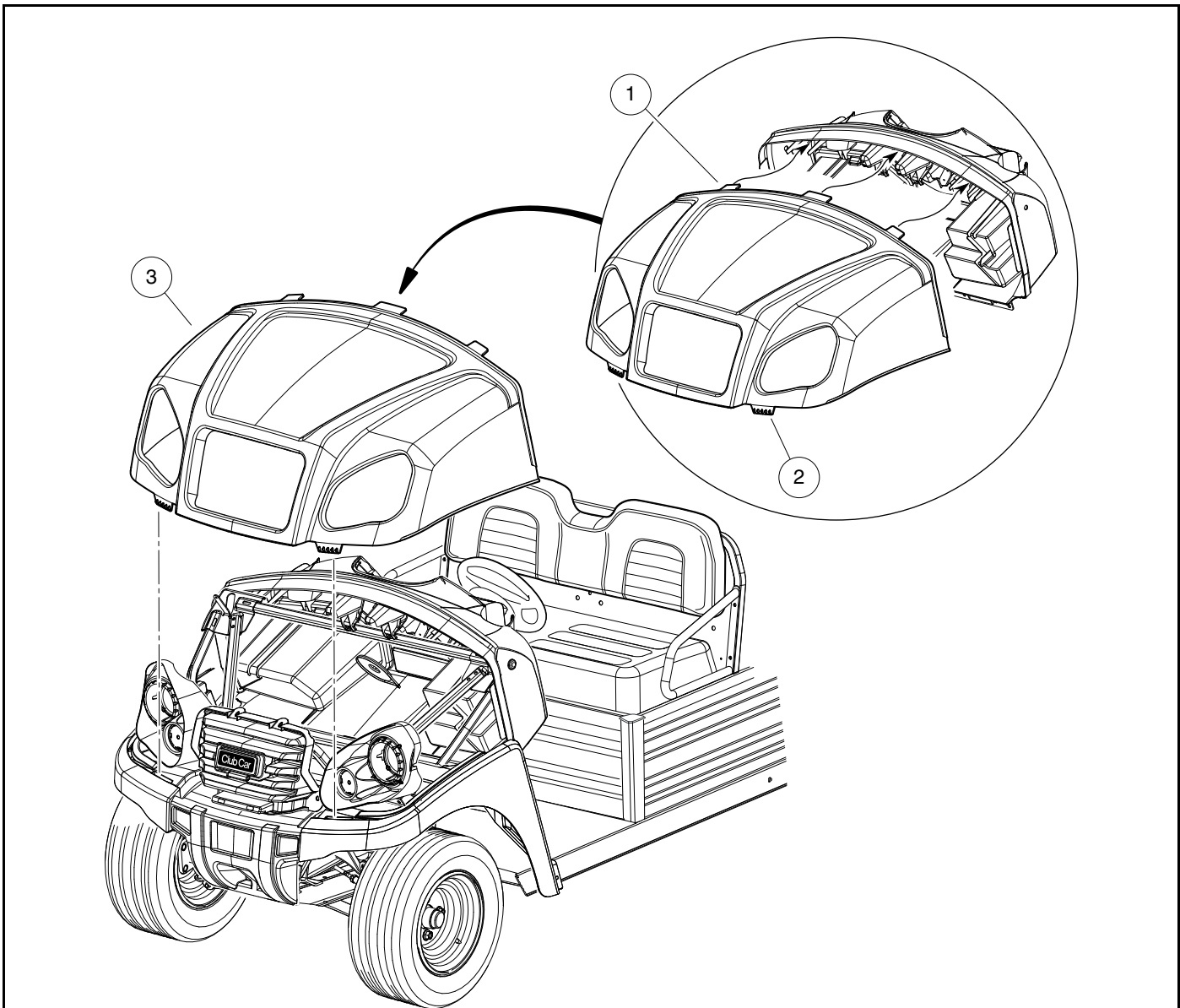
1. Park vehicle and chock tires.
2. Disconnect the battery. **See Disconnecting the Battery, Section 1, Page 1-3.**
3. The cowl is secured by tabs located behind the front fenders (2) , and under the lip of the dash (1). (**Figure 4-2, Page 4-6**).
4. Push down and rearward on front fenders to unsnap cowl in two locations.
5. Slide cowl forward until free, then lift out cowl.

COWL INSTALLATION

1. Slide bottom edges of cowl into grooves in front fenders.
2. Ensure the three tabs on cowl install under lip of dash (1). (**Figure 4-2, Page 4-6**).
3. Ensure sides of cowl (3) assemble between the two ribs on side of dash.
4. Ensure center tab on cowl assembles beneath the rib in the grille.
5. With fenders disengaged from the front bumper, press down on front fenders, line up cowl tabs and fully engage snap tabs.
6. Ensure front corners of cowl are engaged with front fender (2).
7. Engage the front fenders to the body clips under the front bumper.

NOTE: Ensure that cowl is fully engaged to prevent dislodging during use.

8. Connect the battery. **See Connecting the Battery, Section 1, Page 1-3.**
9. Remove tire chocks.



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Figure 4-2 Front Cowl

GRILLE REMOVAL

1. Park vehicle and chock the tires.
2. Disconnect the battery. **See Disconnecting the Battery, Section 1, Page 1-3.**
3. Remove HD bumper (if equipped). **See Heavy Duty Bumper Removal, Section 4, Page 4-3.**
4. Remove cowl. **See Cowl Removal on page 4-5.**
5. Loosen and remove the two M6 self-tapping fasteners (1) at the top of grille (7) (**Figure 4-3, Page 4-7**).
6. Loosen and remove the two lower left and right side bolts (1 and 7) that attach the grille and plastic bumper (6).
7. Remove charger receptacle (if equipped) by removing the three screws that attach the receptacle or disconnect connector (quick connect).

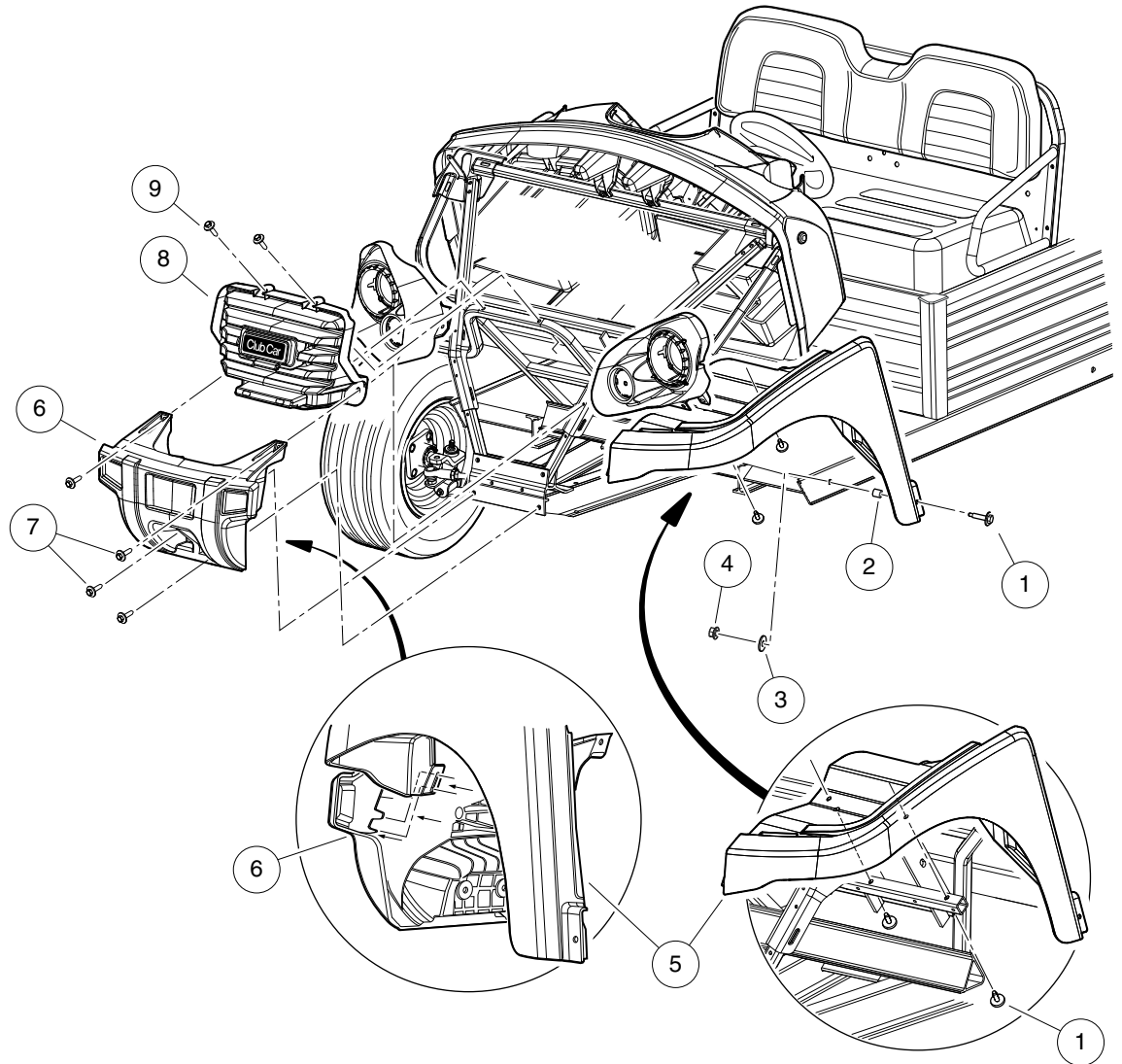


Figure 4-3 Front Grille, Bumper, and Side Fenders

GRILLE INSTALLATION

1. Connect the charger receptacle or connector (quick connect).
2. Install, but do not tighten upper M6 screws. (Do not tighten screws until plastic bumper is installed).
3. Lower grille holes are shared with the front bumper, ensure lower bumper screws are attached first then install grille.
4. Line up upper and lower bolt holes.
5. Install and tighten upper bolts, then lower right and left side bolts. Tighten to 44 in·lb (5 N·m).
6. Connect the battery. **See Connecting the Battery, Section 1, Page 1-3.**

FRONT BUMPER AND SIDE FENDER REMOVAL

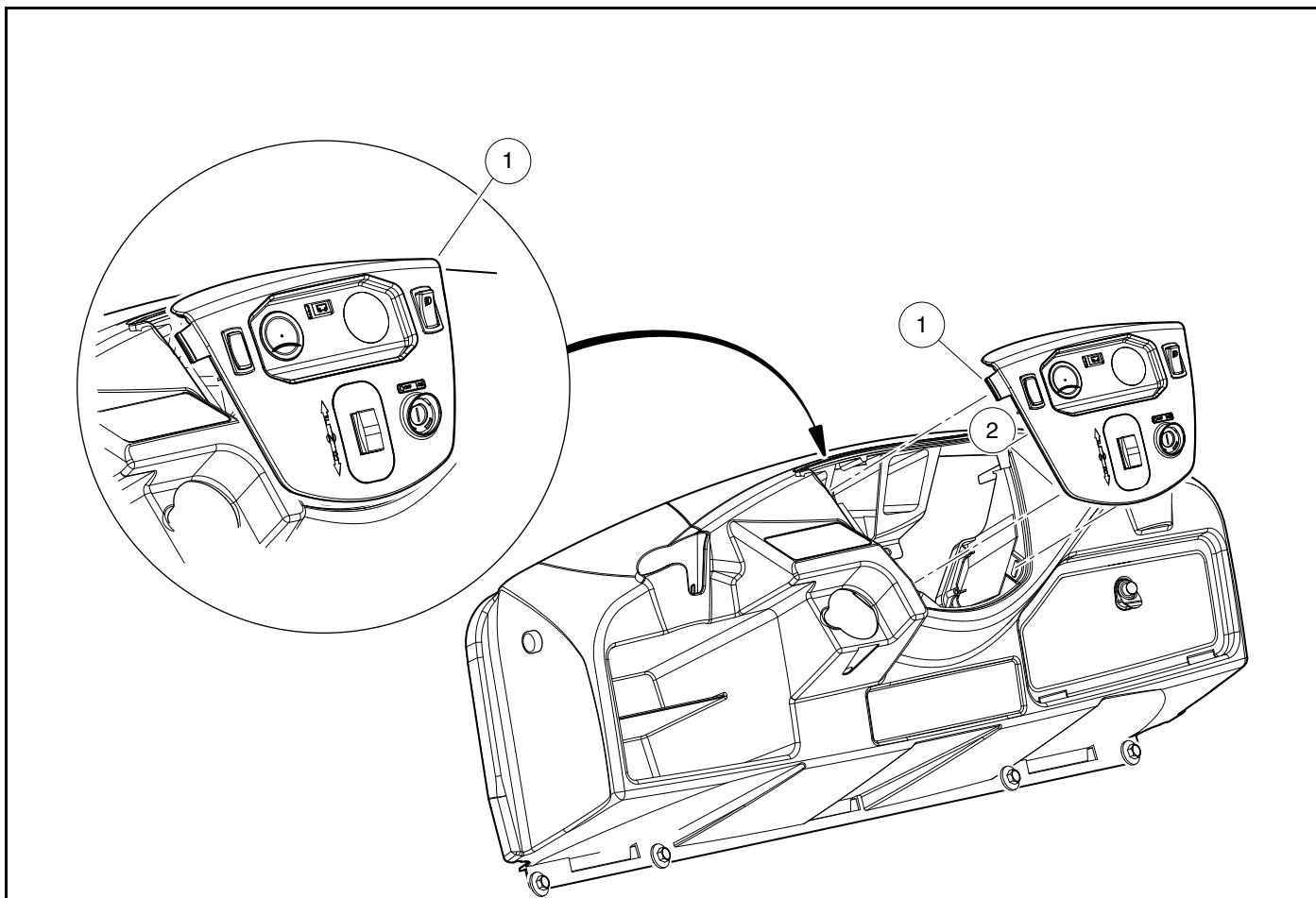
1. Park the vehicle, chock tires.
2. Disconnect the battery. **See Disconnecting the Battery, Section 1, Page 1-3.**
3. Remove HD bumper, (if equipped). **See Heavy Duty Bumper Removal on page 4-3.**
4. Remove the front cowl. **See Front Cowl on page 4-6.**
5. Remove the grille. **See Grille Removal on page 4-6.**
6. Loosen and remove the two upper and lower bolts (7) that attach the bumper to the vehicle frame. Push down and rearward on front fenders near the bumper. **(Figure 4-3, Page 4-7).**
7. Remove front bumper (6).
8. Loosen and remove the inner screws, nuts and spacers (1, 2, 3, and 4) that attach the side fender to the frame. (repeat procedure on opposite side).
9. Unsnap body clips and remove side fenders (5).

FRONT BUMPER AND SIDE FENDER INSTALLATION

1. Install side fenders (5) by snapping in body clips.
2. Install inner screws, nuts and spacers (1, 2, 3, and 4) that attach the side fender to the frame.
3. Install front bumper (6).
4. Install the two upper and lower bolts (7) that attach the bumper to the vehicle frame. Push down and rearward on front fenders near the bumper to install.
5. Install the grille. **See Grille Installation, Section 4, Page 4-8.**
6. Install the front cowl. **See Cowl Installation, Section 4, Page 4-5.**
7. Install HD bumper (if equipped). **See Heavy Duty Bumper Installation, Section 4, Page 4-5.**
8. Connect the battery. **See Connecting the Battery, Section 1, Page 1-3.**
9. Remove tire chocks.

INSTRUMENT PANEL REMOVAL

1. Disconnect the battery. **See Disconnecting the Battery, Section 1, Page 1-3.**
2. Remove front cowl. **See Cowl Removal, Section 4, Page 4-5.**
3. From the inside of the dash, press upper snap tabs (1) of the instrument panel inward to release from dash.
4. Then push the instrument panel near the bottom (2) to pop out the lower body clips, (be careful not to pry the lower clips off), push the bottom of the instrument panel to pop out.
5. Pull instrument panel out from the dash panel (2).



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Figure 4-4 Instrument Panel

INSTRUMENT PANEL INSTALLATION

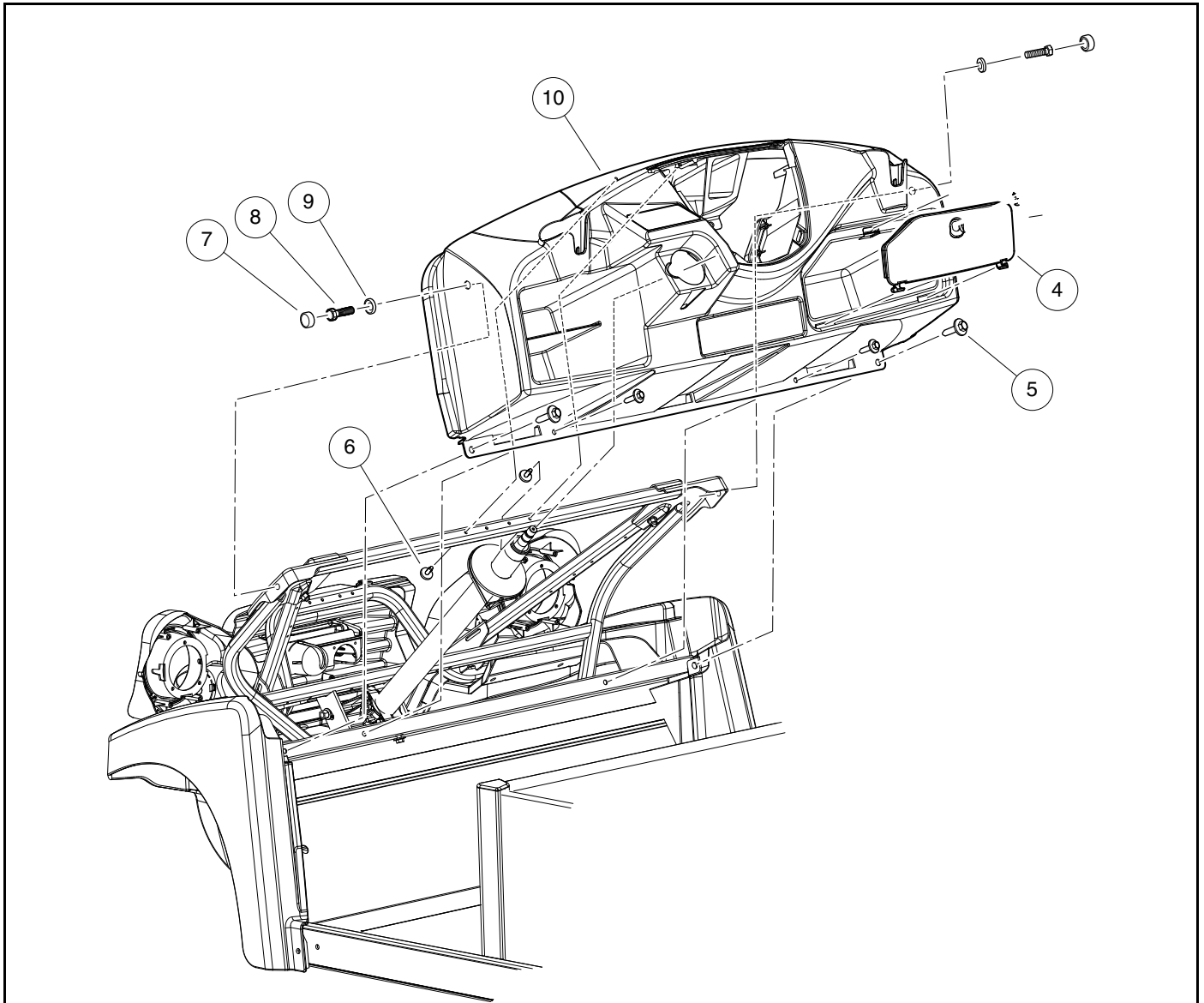
1. Place upper tab of instrument panel into slot (1).
2. Snap panel into dash while pushing in on the driver and passenger side tabs and sliding the top portion of the panel into place.
3. Snap lower body clips in at each lower corner.
4. Connect the battery. **See Connecting the Battery, Section 1, Page 1-3.**

DASH REMOVAL

1. Disconnect the battery. **See Disconnecting the Battery, Section 1, Page 1-3.**
2. Remove cowl. **See Cowl Removal on page 4-5.**
3. Remove steering wheel. **See Steering Wheel Removal, Section 7, Page 7-1.**
4. Disconnect instrument panel wiring.
5. Remove the bolts, and washers (5, 6, 7, 8, and 9) from the top, sides and bottom of the dash (10) (**Figure 4-5, Page 4-11**).
6. Remove dash assembly.

DASH INSTALLATION

1. Install dash assembly.
2. Install the bolts, and washers (5, 6, 7, 8, and 9) to the top, sides and bottom of dash (10) (**Figure 4-5, Page 4-11**).
3. Connect instrument panel wiring.
4. Install steering wheel. **See Steering Wheel Installation, Section 7, Page 7-2.**
5. Install cowl. **See Cowl Installation, Section 4, Page 4-5.**
6. Connect the battery. **See Connecting the Battery, Section 1, Page 1-3.**



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Figure 4-5 Dash Assembly

TILT BED

See General Warnings on page 1-2.

TILT BED REMOVAL

NOTE: This procedure requires two people.

⚠ WARNING

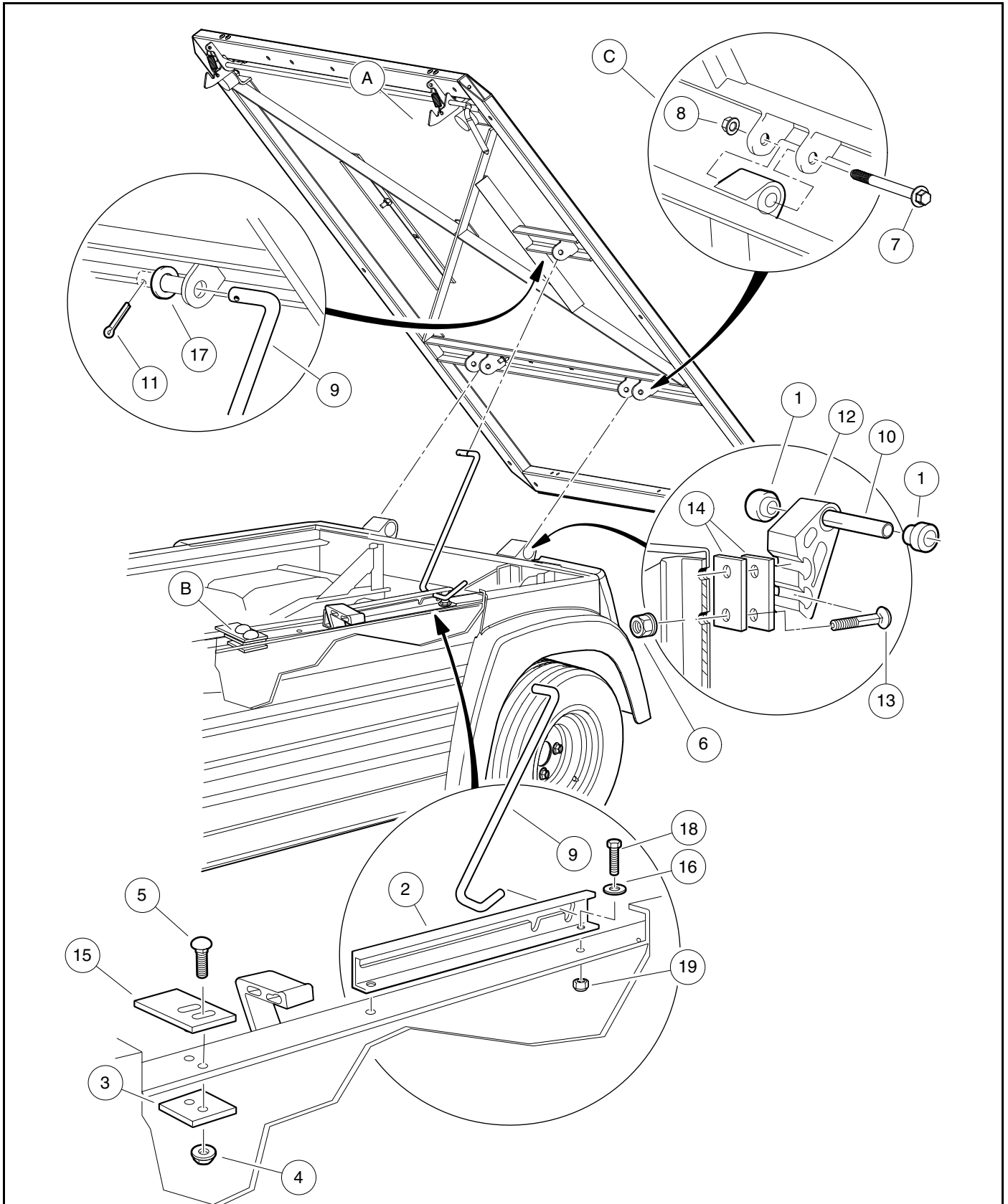
- **Remove all cargo before raising the bed or servicing the vehicle. If the vehicle is equipped with a prop rod, ensure that it is securely engaged while bed is raised. Do not close bed until all persons are clear of cargo bed area. Keep hands clear of all crush areas. Do not drop cargo bed; lower gently and keep entire body clear. Failure to heed this warning could result in severe personal injury or death.**
1. Raise bed and secure prop rod (9) in prop rod track (2). Hold bed securely in an upright position. Remove cotter pin (11) and flat washer (17) from top end of prop rod where prop rod attaches to bed. Remove prop rod (9) from bed and place prop rod between prop rod track (2) and rear body panel. Lower bed onto vehicle frame. **(Figure 4-6, Page 4-13).**
 2. Remove two lock nuts (8) from left and right hinge assemblies (C).
 3. Apply slight upward pressure (by hand) on the rear of the bed to relieve pressure on the hinges, and remove the hinge bolts (7) 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 (A) from latch plate (B).
 5. Lift bed from vehicle.

TILT BED INSTALLATION

NOTE: This procedure requires two people.

Lubricate the hinge clevis pins (3) with light motor oil prior to assembly.

1. Install prop rod track assembly (2, 9, 16, 18, and 19).
2. Install hinge assembly (1, 10, 12, 13, and 14). Start the bolts into left and right hinge assemblies (C). It may be necessary to use an alignment tool to align holes in hinge bracket with steel bushing in hinge assembly.
3. Install bed hinge (C, 7, and 8) actuate up then, loosely hand-tighten nut. Install a nylon lock nut (8) on each bolt (7) and tighten to 15 ft·lb (21 N·m).
4. Install prop rod assembly (9, 11, and 17).
5. Assemble latch (3, 4, 5, and 15). 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 should engage with latch plates (B). Tighten to 20 to 25 ft·lb (27 to 33 N·m).
6. Lift bed and place the prop rod (9) in bed mounting hole. Install a 3/8-inch flat washer (17) and a new cotter pin (11) on prop rod.
7. Install a nylon lock nut (8) on each bolt (7) and tighten to 15 ft·lb (21 N·m).



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Figure 4-6 Tilt Bed Mounting

BED LATCH ASSEMBLY REMOVAL

NOTE: This procedure requires the aid of an assistant

1. Park the vehicle and chock the tires.
2. Disconnect the battery. **See Disconnecting the Battery, Section 1, Page 1-3.**
3. Instruct an assistant to secure the bed to help prevent it from falling during removal of the bed latch and prop rod. **See following WARNING.**

⚠ WARNING

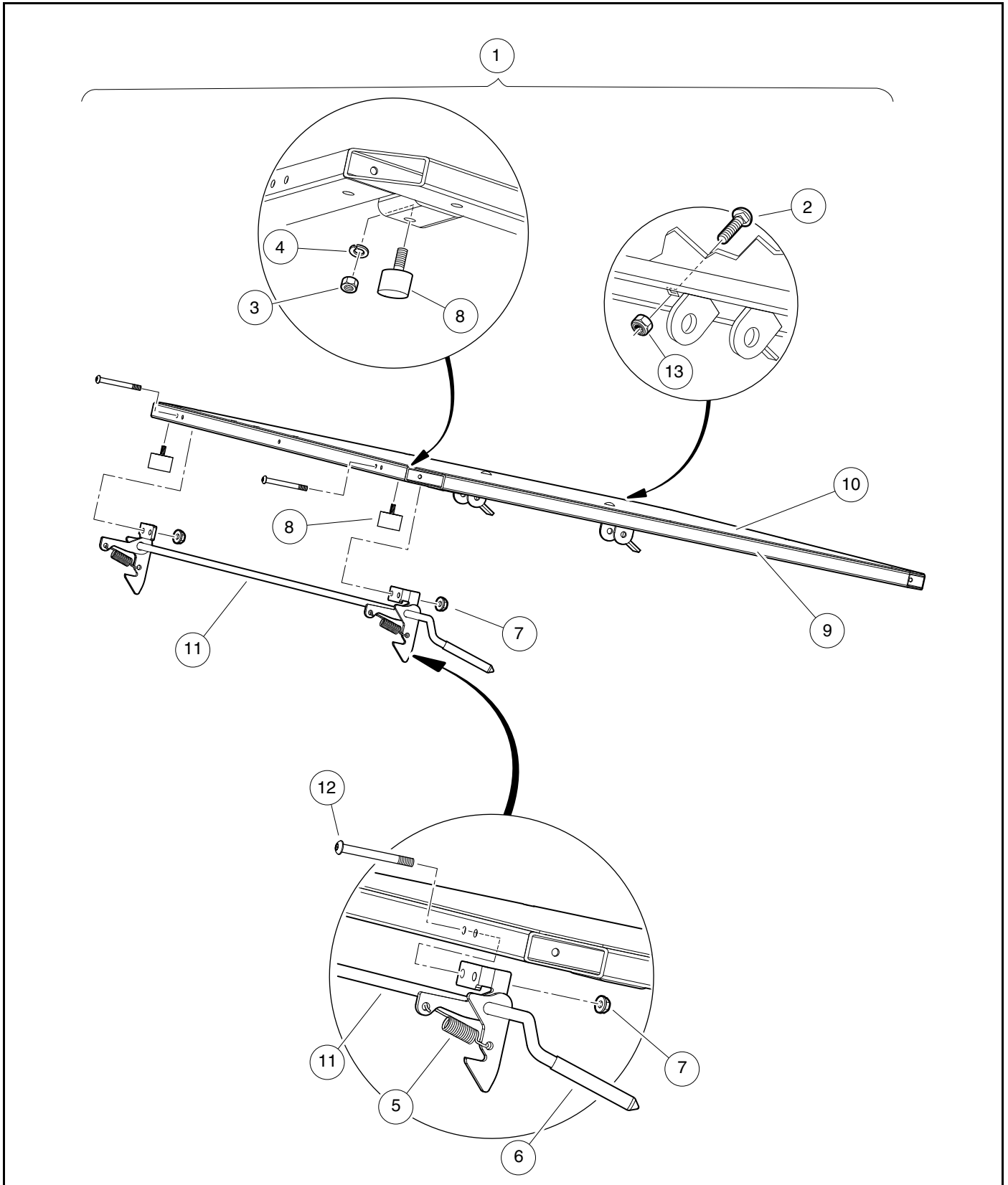
- Remove all cargo before raising the bed or servicing the vehicle. If the vehicle is equipped with a prop rod, ensure that it is securely engaged while bed is raised. Do not close bed until all persons are clear of cargo bed area. Keep hands clear of all crush areas. Do not drop cargo bed; lower gently and keep entire body clear. Failure to heed this warning could result in severe personal injury or death.
4. Remove the four bolts (12) and lock nuts (7) that secure the bed latch (6) to the underside of the bed. **(Figure 4-7, Page 4-15).**
 5. Remove the bed latch (6) and springs (5).

BED LATCH ASSEMBLY INSTALLATION

1. Install bed latch (6) and springs (5).

NOTE: Latch assembly needs to sit open exactly as shown in Ref. 11. **(Figure 4-7, Page 4-15).**

2. Install the four bolts (12) and lock nuts (7) that secure the bed latch (6) to the underside of the bed. Tighten to 70 to 80 in·lb (8 to 9 N·m).
3. Connect the battery. **See Connecting the Battery, Section 1, Page 1-3.**
4. Remove tire chocks.

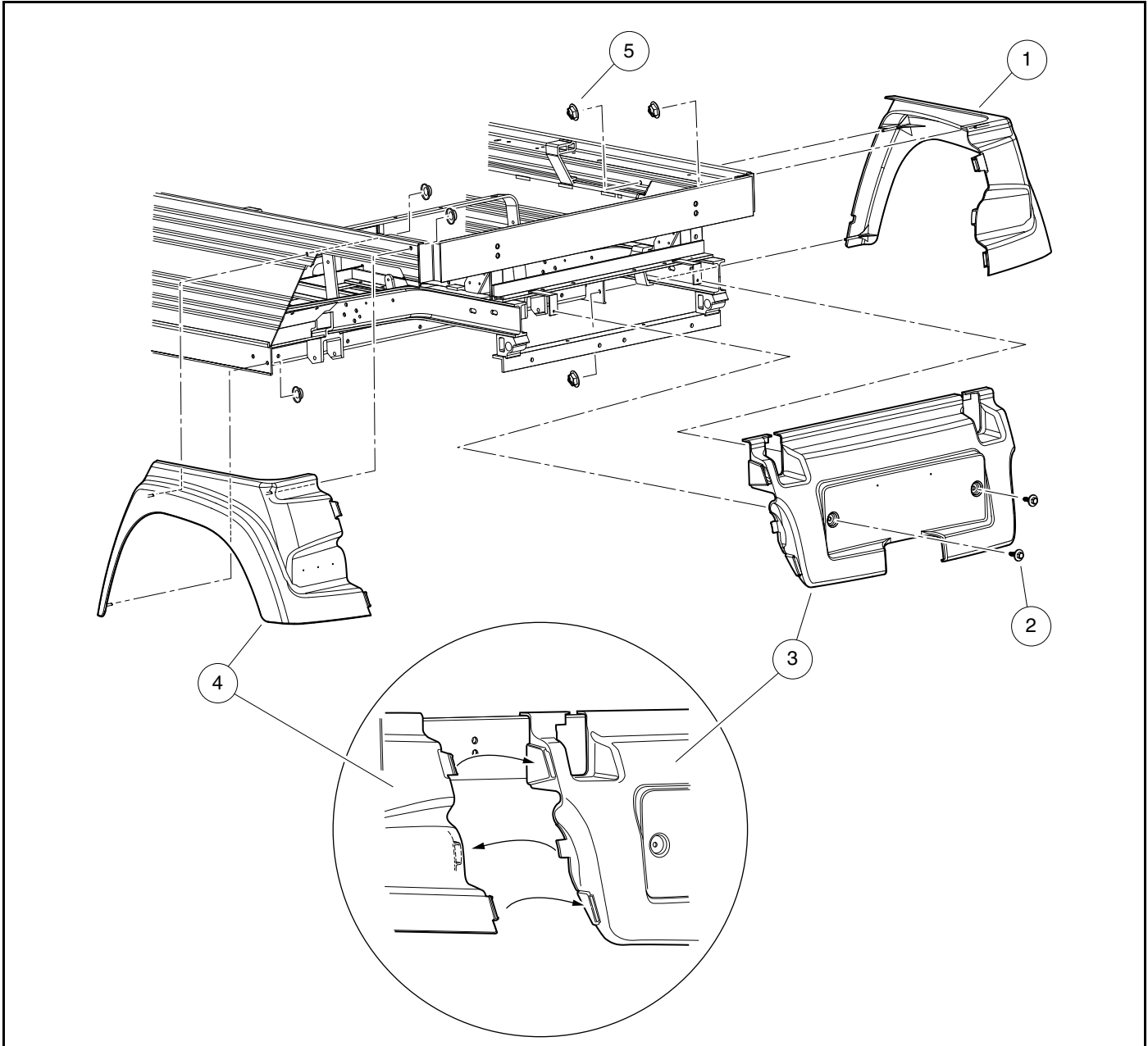


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Figure 4-7 Bed Latch Assembly

REAR FENDERS AND TAILSKIRT

See General Warnings on page 1-2.



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Figure 4-8 Rear Fender and Tailskirt

REAR FENDER AND TAILSKIRT REMOVAL

1. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in NEUTRAL and set the park brake. Chock the wheels.
2. Disconnect the battery cables and either discharge the controller or disconnect the spark plug wire(s). **See Disconnecting the Battery, Section 1, Page 1-3.**
3. Remove the tilt bed. **See Tilt Bed Removal on page 4-12.**
4. Disconnect the three taillight wires.
5. Using a 10 mm socket, remove the three fasteners (5) that attach the rear fender (4) to vehicle frame. **(Figure 4-8, Page 4-16)**
6. Using a 10 mm socket, remove the two M6 screws (2) that attach the tailskirt (3) to the vehicle frame.
7. Remove fenders and tailskirt.

REAR FENDER AND TAILSKIRT INSTALLATION

- Using a 10 mm socket, install the two screws (2) that attach the tailskirt (3) to the vehicle frame. Tighten to 44 in·lb (5 N·m).
- Using a 10 mm socket, install the three fasteners (5) that attach the rear fender (4) to the vehicle frame. Tighten to 5 in·lb (.56 N·m). Do not over torque.
- Connect the taillight wires.
- Install the two bolts and nuts that secure taillight to the rear fender.
- Connect the three taillight wires.
- Install the tilt bed. **See Tilt Bed Installation on page 4-12.**
- Connect the battery. **See Connecting the Battery, Section 1, Page 1-3.**

ELECTRIC BED LIFT

ELECTRIC BED LIFT REMOVAL

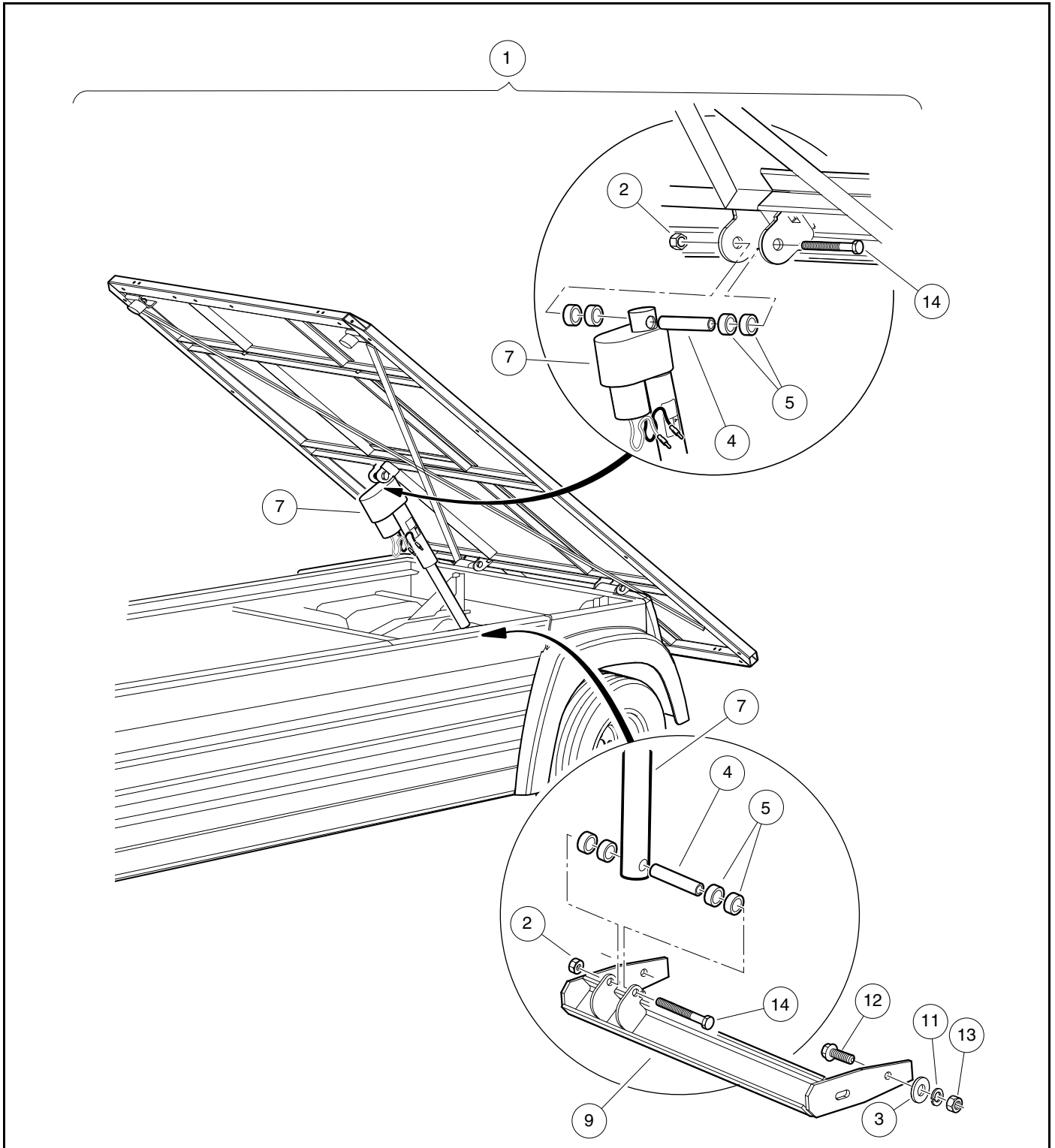
NOTE: This procedure requires the aid of an assistant.

NOTE: For vehicles equipped with an electric bed lift.

1. Disconnect the battery. **See Disconnecting the Battery on page 1-3.**
2. Raise the bed.
3. Disconnect actuator wires.
4. Remove actuator hardware that secures lift (7). **(Figure 4-9, Page 4-19).**
5. Lower the bed.
6. Remove the hex-head bolts, lock nuts, spacers and bushings (1, 2, 5, 6, 7, and 8). **(Figure 4-10, Page 4-20).**

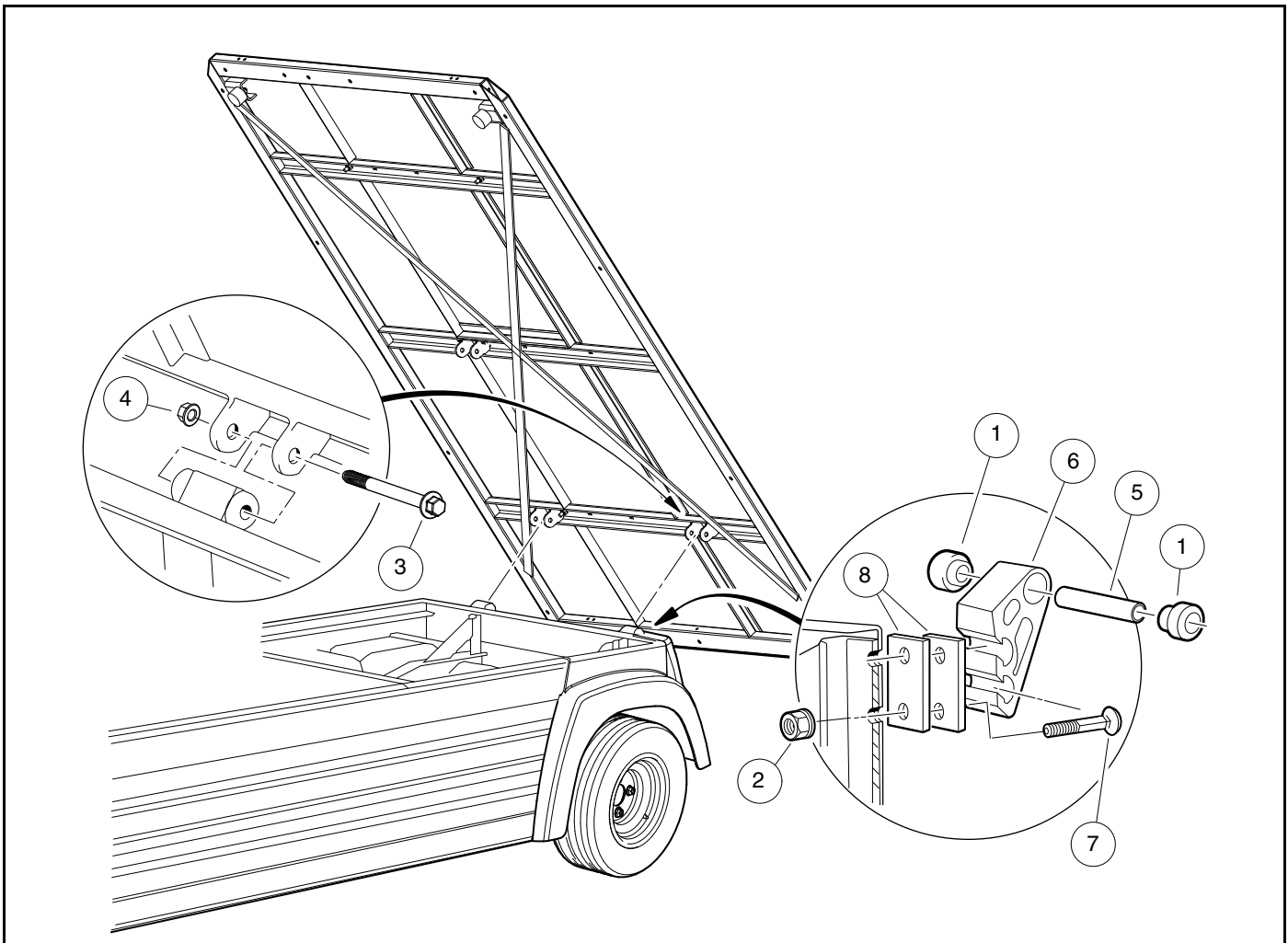
ELECTRIC BED LIFT INSTALLATION

1. Install hex-head bolts, lock nuts, spacers and bushings (1, 2, 5, 6, 7, and 8). **(Figure 4-10, Page 4-20).**
2. Lift bed.
3. Install actuator hardware that secures lift (7). **(Figure 4-9, Page 4-19).**
4. Connect actuator wires.
5. Lower bed.
6. Connect the battery. **See Connecting the Battery on page 1-3.**



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Figure 4-9 Electric Bed Lift



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Figure 4-10 Rear Bed Actuator (Not Shown)

FLOOR MAT

See General Warnings on page 1-2.

FLOOR MAT REMOVAL

1. Remove the brake and accelerator pedals. **See Accelerator and Brake Pedal Group, Section 5, Page 5-1.**
2. Remove the top edge of the floor mat from the overlapping flange under the dash.
3. Lift the mat from the vehicle.

FLOOR MAT INSTALLATION

1. Install mat into vehicle. Ensure mat is laying flat.
2. Install top edge of the floor mat into the overlapping flange under the dash.
3. Install the brake and accelerator pedals. **See Accelerator and Brake Pedal Group, Section 5, Page 5-1.**

⚠ DANGER

- See General Warnings on page 1-2.

⚠ WARNING

- See General Warnings on page 1-2.

BRAKE PEDAL AND PARK BRAKE

See General Warnings on page 1-2.

BRAKE PEDAL REMOVAL

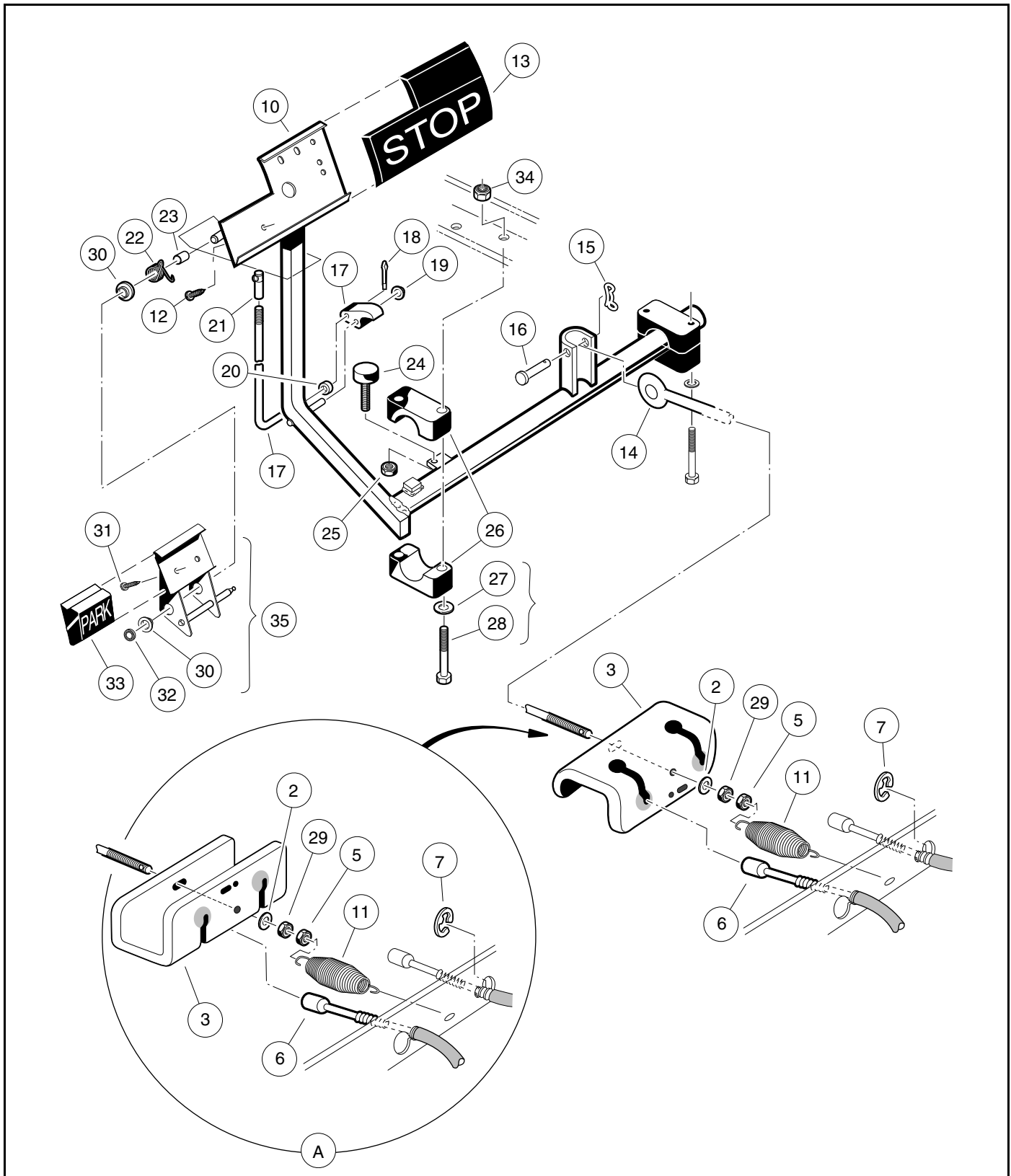
1. Disconnect the battery cables and either discharge the controller or disconnect the spark plug wire(s). **See Disconnecting the Battery, Section 1, Page 1-3.**
2. Place chocks under the rear wheels and lift the front end of the vehicle with a chain hoist or floor jack. Place jack stands under the 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 (14) from the pedal shaft by removing the clevis pin (16) and bow-tie pin (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) and lift pedal assembly (10) through the floorboard (**Figure 5-2, Page 5-3**).

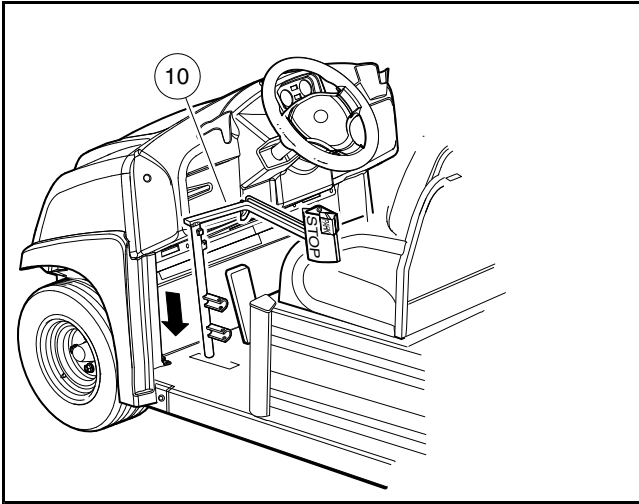
BRAKE PEDAL INSTALLATION

1. From the top side of the floorboard, insert the brake pedal assembly (10) 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 (14) to the brake pedal assembly (10) with clevis pin (16) and bow-tie pin (15) as shown.



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Figure 5-1 Brake and Park Brake Pedal Assembly and Mounting



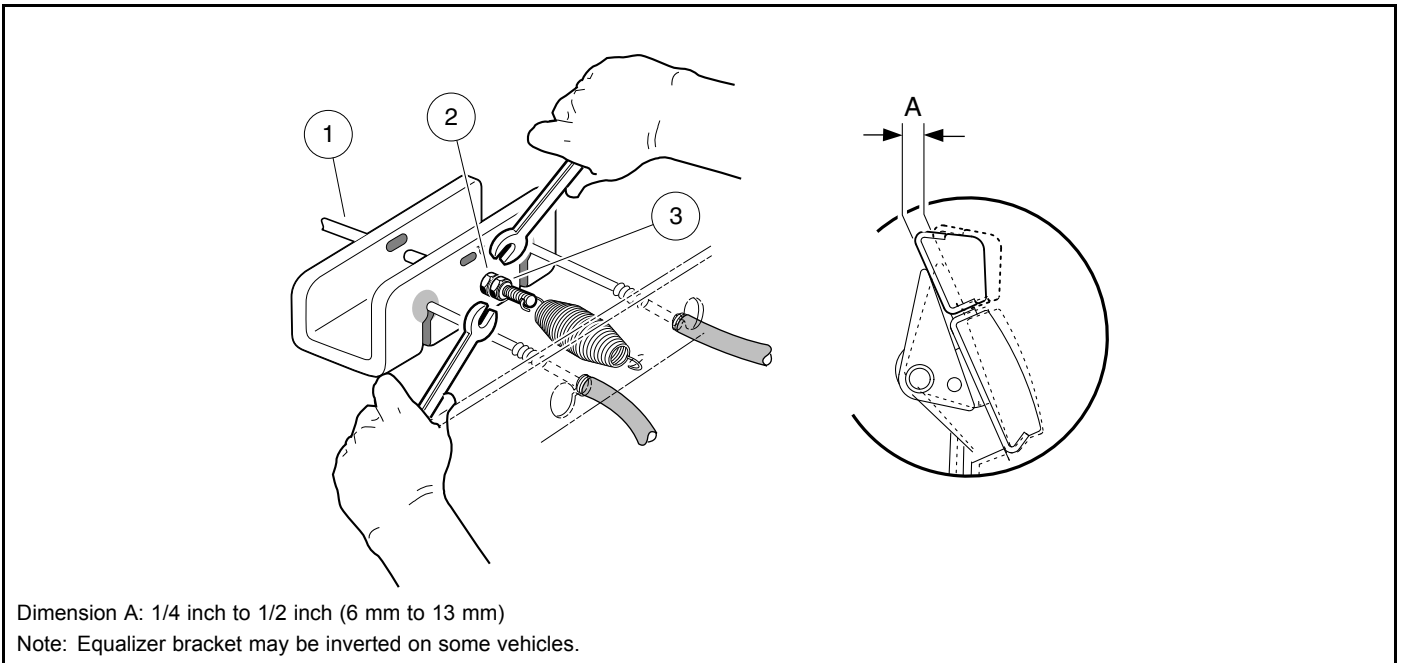
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Figure 5-2 Brake Pedal Weldment Through Floor

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).
4. Tighten the nut (2) on the equalizer rod (1) so that brake pedal free-play is from 1/4 inch to 1/2 inch (6 mm to 13 mm) (**Figure 5-3, Page 5-3**). See following NOTE.

NOTE: Brake pedal free-play is the distance the brake pedal can be pressed before the brake actuator arm moves.

5. Tighten the jam nut (3) while holding the adjustment nut (2) in the correct position.
6. Adjust the pedal group. Refer to the appropriate adjustment procedure:
 - For gasoline vehicles, see Pedal Group Adjustment on page 5-7.



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Figure 5-3 Brake Pedal Free-Play Adjustment

PARK BRAKE REMOVAL

1. Disconnect the battery cables and either discharge the controller or disconnect the spark plug wire(s). **See Disconnecting the Battery, 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 (1) (**Figure 5-4, Page 5-4**). **See following NOTE.**

NOTE: New push nuts (19) and (32) must be used when reassembling the park brake.

- 3.2. To remove the park brake pedal (1), remove the push retainer nut (32), disconnect the torsion spring (22) and slide the pedal off of the shaft. **See preceding NOTE.**
- 3.3. Inspect all parts for wear and damage and replace as necessary.

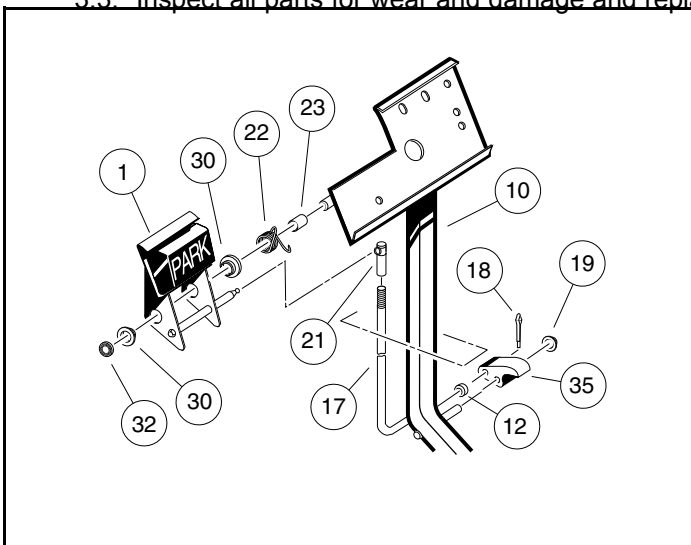


Figure 5-4 Park Brake Assembly

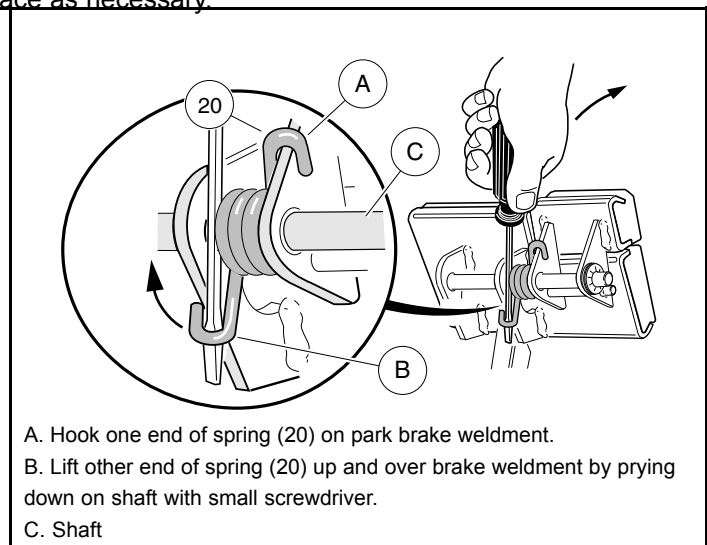


Figure 5-5 Torsion Spring Installation

PARK BRAKE INSTALLATION

1. From the bottom side of the floorboard, insert the park brake rod (17) through the brake pedal assembly opening. 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 (**Figure 5-4, Page 5-4**).
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). Then attach the ends of the torsion spring to the park brake pedal and to the brake pedal weldment as shown (**Figure 5-5, Page 5-4**).

5. Install the push nut (32) on the park brake pedal shaft (**Figure 5-4, Page 5-4**).
6. Connect park brake rod (17) with ball joint (21) to the ball stud on the park brake pedal assembly.
7. Adjust park brake ratchet/pawl gap and pawl engagement. Refer to the appropriate adjustment procedure:
 - **For gasoline vehicles, see Pedal Group Adjustment on page 5-7.**

ACCELERATOR PEDAL

See General Warnings on page 1-2.

ACCELERATOR PEDAL REMOVAL – GASOLINE VEHICLES

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery, 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.**

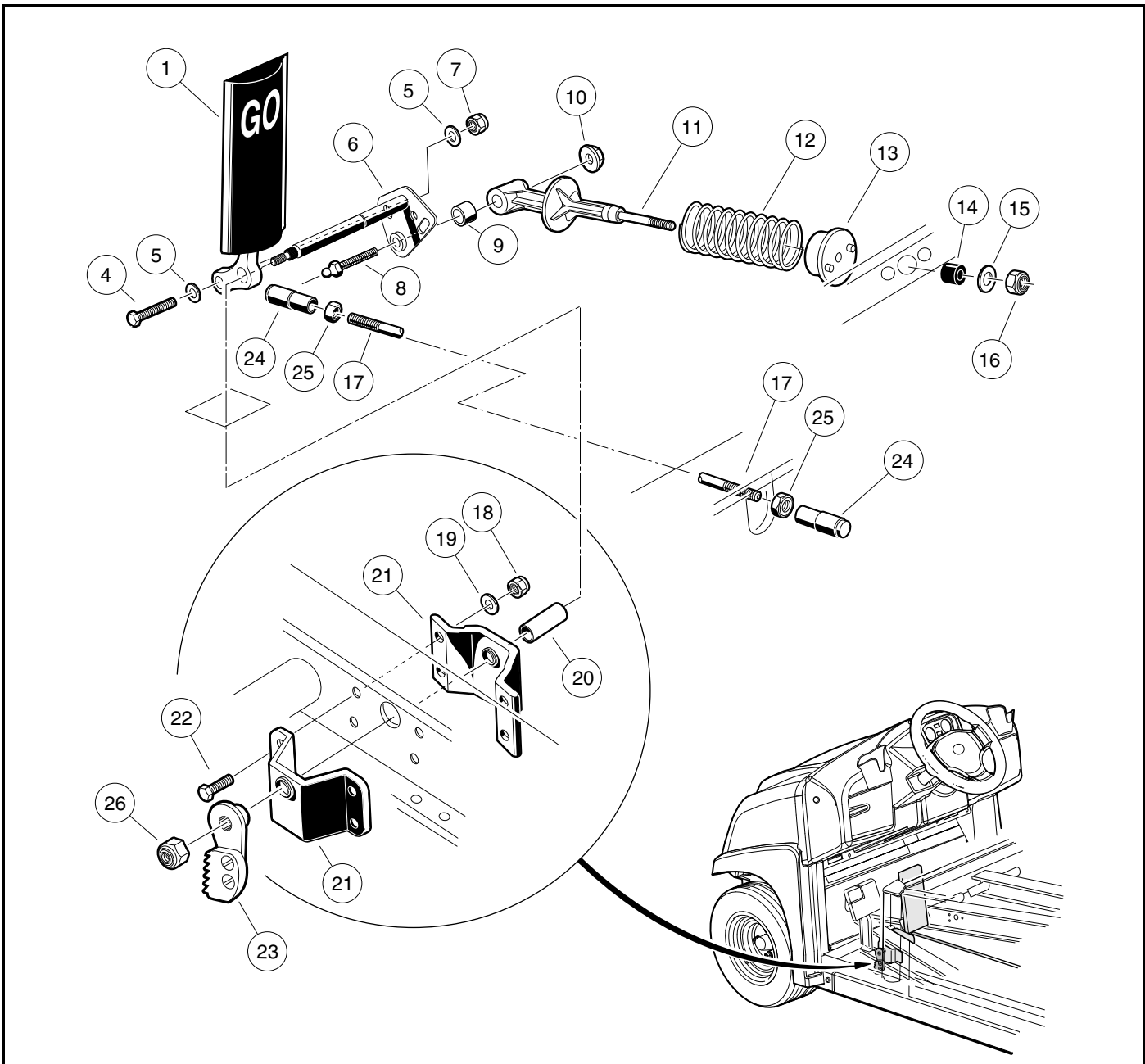
⚠ WARNING

- **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 5-6, Page 5-6**) at the front and rear ball studs and remove it from the vehicle.
4. Use a 9/16-inch (14 mm) socket and 9/16-inch (14 mm) 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 5-6, 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.



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Figure 5-6 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 5-6, 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 bearing (9) and spring retainer (11) onto the ball stud. Secure these parts with the nut (10). 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 5-7, Page 5-7**). The ratchet should now rotate freely on the rod.

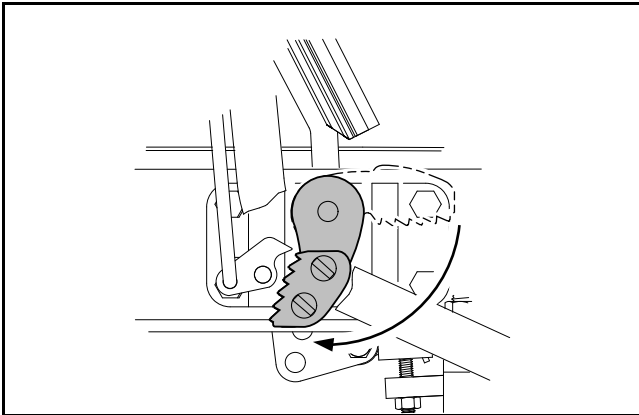


Figure 5-7 Ratchet Installation

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. Install the nylon lock nut (26) on the pivot rod and tighten the nut to 18 ft-lb (24 N·m) (**Figure 5-6, Page 5-6**).
11. Install the accelerator rod assembly (17, 25, and 24).
12. Adjust the accelerator pedal height and accelerator rod. **See Pedal Group Adjustment on page 5-7.**

PEDAL GROUP ADJUSTMENT

See General Warnings on page 1-2.

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery, 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 (1) on the equalizer rod (2) (**Figure 5-8, Page 5-8**).

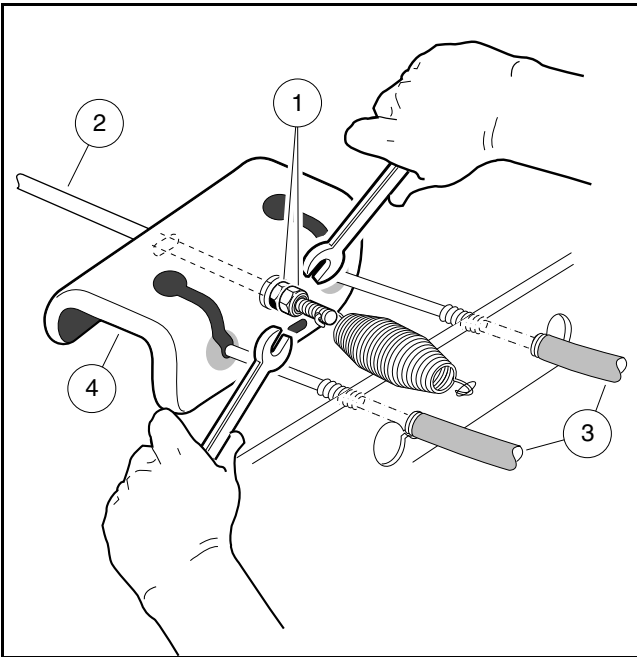


Figure 5-8 Loosen Rear Brake Equalizer Rod Nuts

- 2.3. 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 5-9, Page 5-8**). 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 5-10, Page 5-8**).
- 2.4. Tighten the jam nut (31) to 8 ft·lb (9.5 N·m) (**Figure 5-9, Page 5-8**).

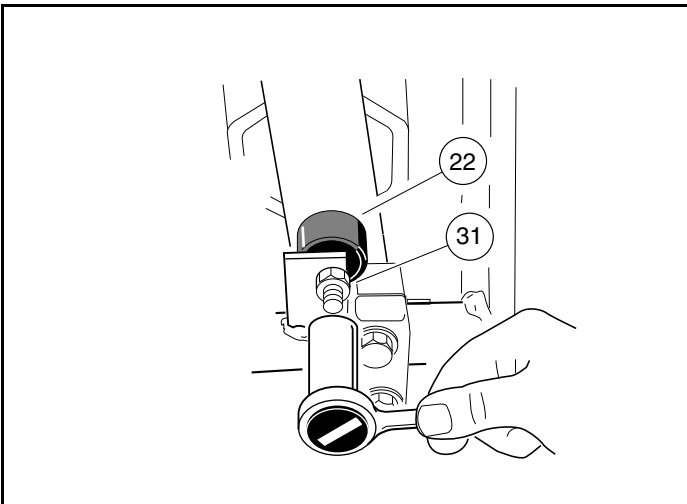


Figure 5-9 Brake Pedal Height Adjustment

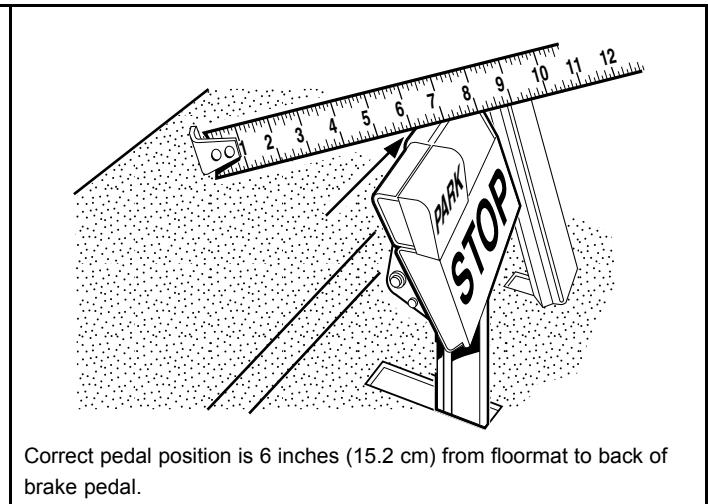


Figure 5-10 Brake Pedal Height Measurement

3. Adjust brake pedal free play. **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.

- 3.1. Measure perpendicularly from the floorboard to the back of the brake pedal, then press the brake pedal and measure the distance that the pedal moves before all of the slack is taken out of the brake cables (**Figure 5-10, Page 5-8**).

- 3.2. Tighten the nut (2) on the equalizer rod (1) so that the brake pedal free play is 1/4 to 1/2 inch (6 mm to 13 mm) (**Figure 5-3, Page 5-3**).
- 3.3. Tighten the jam nut (3) while holding the adjustment nut (2) in the correct position
4. Adjust park brake ratchet/pawl gap and pawl engagement.
 - 4.1. 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.
 - 4.2. 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 5-11, Page 5-9**). 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 6.**

The accelerator rod must be disconnected before proceeding to the next step.

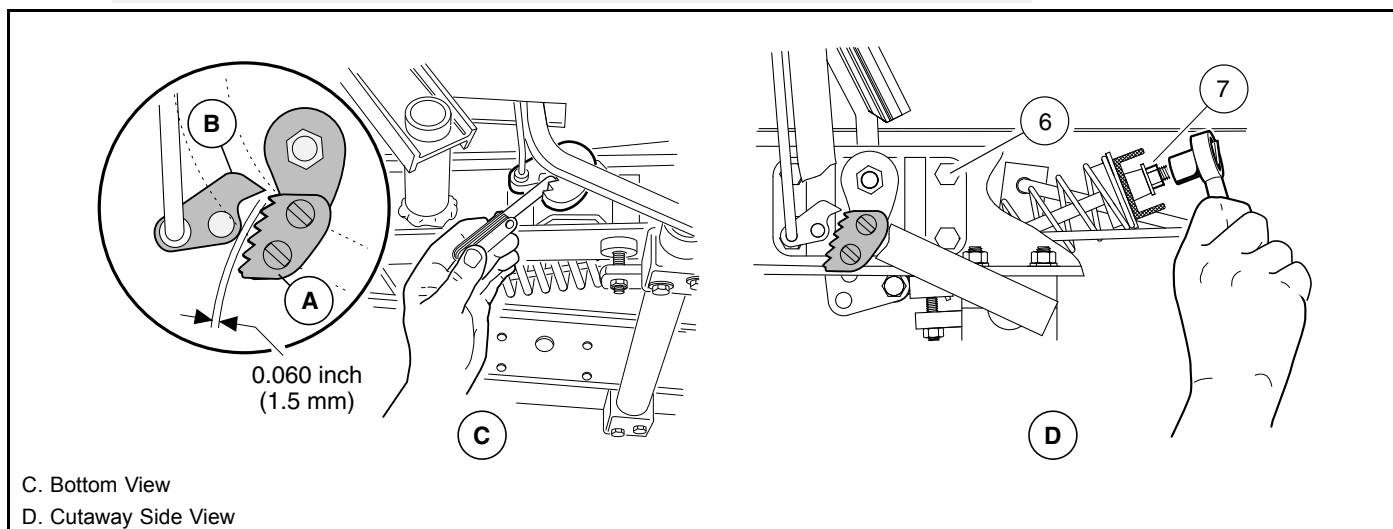


Figure 5-11 Park Brake Ratchet/Pawl Gap Adjustment

- 4.3. 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 5-12, Page 5-10**).
- 4.4. With the park brake locked, make sure at least 75% of ratchet tooth length engages the pawl (**Figure 5-13, Page 5-10**). Tooth engagement should be between the two lines marked on the pawl.

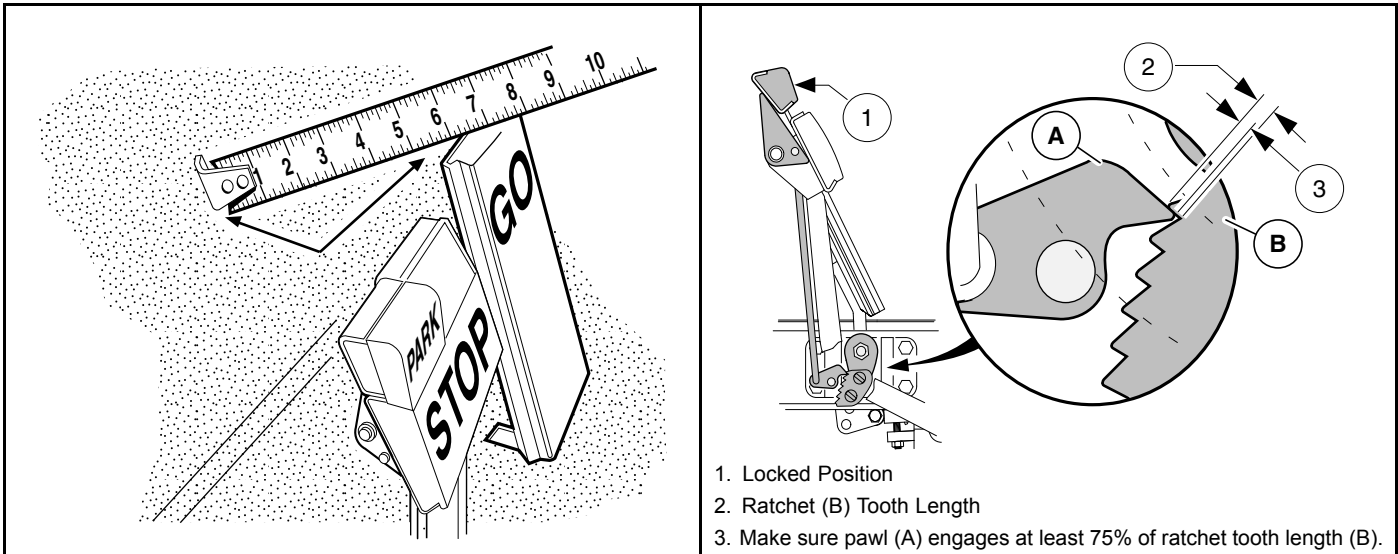


Figure 5-12 Accelerator Pedal Height Measurement

Figure 5-13 Ratchet/Pawl Tooth Engagement

- 4.5. 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.
- 4.6. 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 5-14, Page 5-10**).
- 4.7. If the accelerator push rod was disconnected from the accelerator pedal, reconnect it.
- 4.8. Check for proper brake operation prior to driving the vehicle.

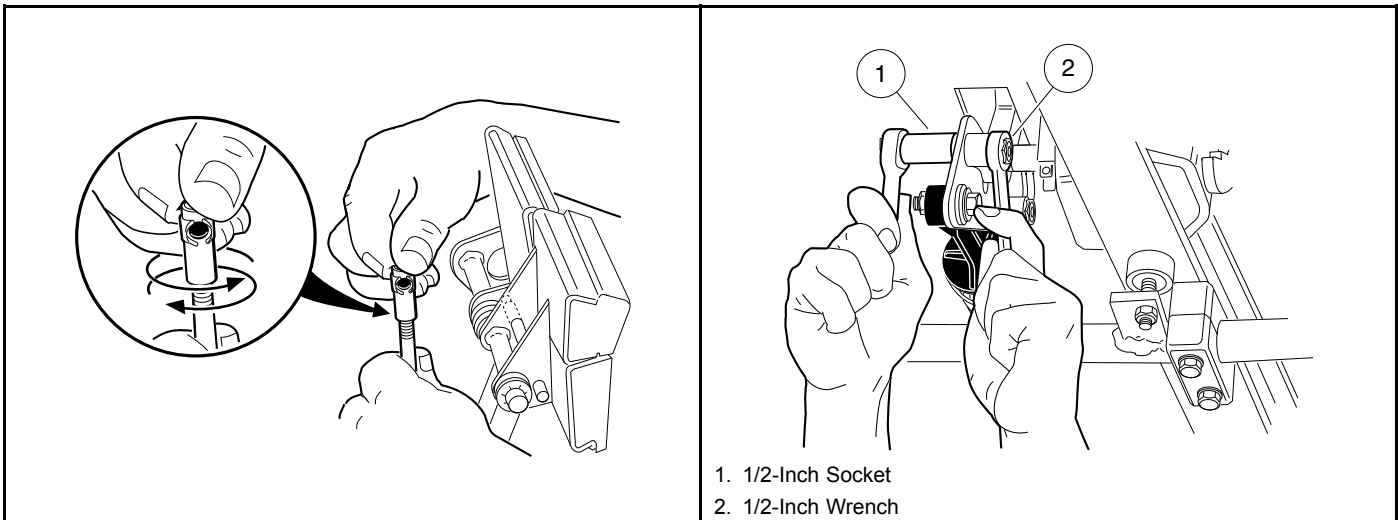


Figure 5-14 Brake Rod Adjustment

Figure 5-15 Accelerator Pedal Height Adjustment

5. Adjust accelerator pedal height.
 - 5.1. Loosen the nut and bolt (**Figure 5-15, Page 5-10**) securing the accelerator pedal to the pivot plate. Clamp the accelerator pedal adjustment tool (CC 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 5-16, Page 5-11**).

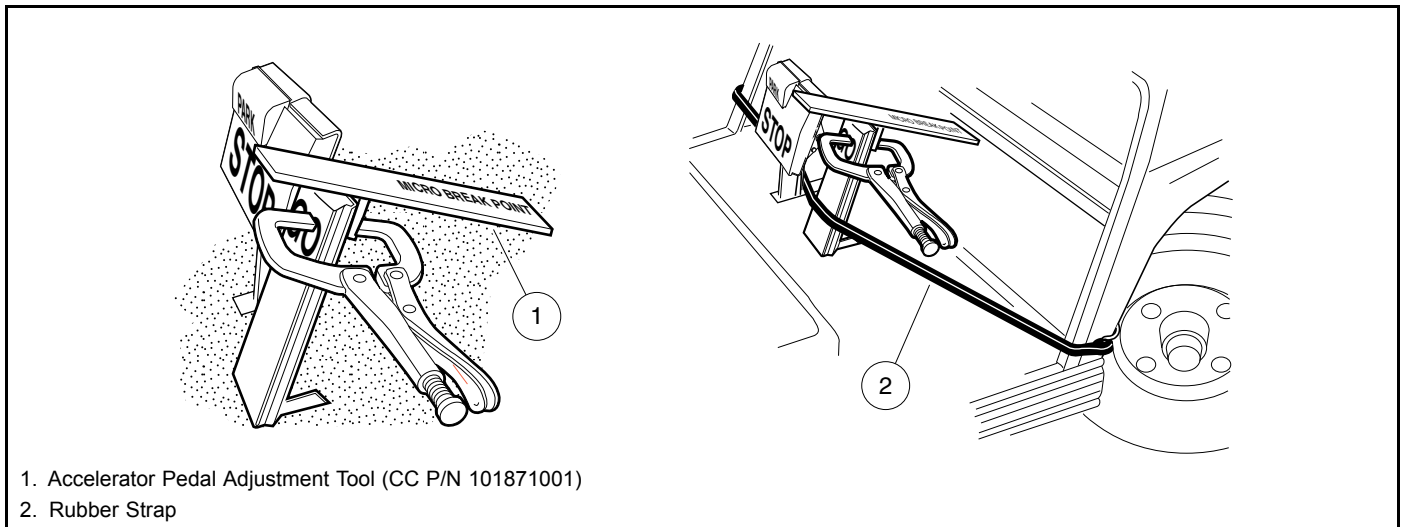


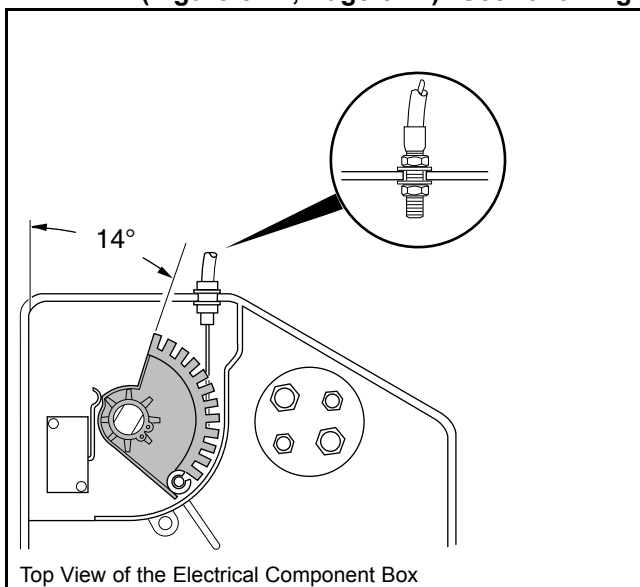
Figure 5-16 Accelerator Pedal Height Adjustment

6. 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 as instructed. See **Disconnecting the Battery**, Section 1, Page 1-3. This will prevent the possibility of the vehicle running over you when you are adjusting the accelerator rod.

- 6.1. Remove the electrical box screw and cover. **See preceding DANGER.**
- 6.2. Loosen the jam nuts (25) and disconnect the accelerator rod (17) at the accelerator pedal (**Figure 5-6**, **Page 5-6**). Adjust the length of the rod to obtain an accelerator cable cam position of 14° as shown (**Figure 5-17**, **Page 5-11**). **See following CAUTION.**



1344

Figure 5-17 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.

6.3. Reconnect the accelerator rod at the accelerator pedal.

6.4. 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° to 4°
Solenoid activation	4° to 8°
Carburetor throttle actuation	8° to 12°

6.5. 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.

6.6. Ensure that the events occur as described in the table 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, Section 14, Page 14-11.**

6.7. Install the electrical box cover and screw.

7. Adjust the brakes. **See Brake Adjustment, Section 6, Page 6-7.**

8. Connect the battery cables. **See Connecting the Battery, Section 1, Page 1-3.**

⚠ DANGER

- See General Warnings on page 1-2.

⚠ WARNING

- See General Warnings on page 1-2.

Asbestos Dust Warning

- 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 vehicles covered in this manual are equipped with a mechanical brake cable system to manually-adjusted drum brakes on all four wheels. **See Section 2 – Vehicle Specifications.**

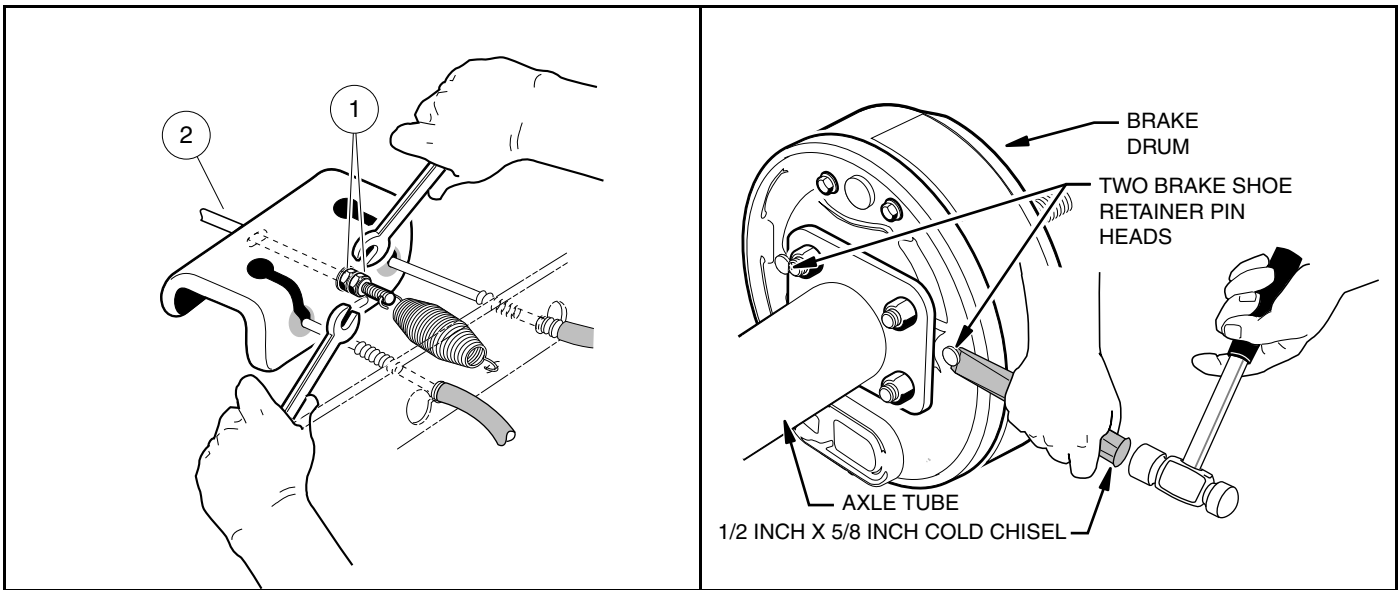
BRAKE SHOE REMOVAL

See General Warnings on page 1-2. See also Asbestos Dust 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**).
3. Remove the rear wheels and brake drums. If the brake drums were easily removed, proceed to remove axle (for electric vehicles only) or remove wheel hub (for gasoline vehicles only). **See following CAUTION and NOTE.**

⚠ CAUTION

- **Worn or damaged brake drums cannot be machined to refinish them. Replace as necessary.**
4. Removing brake drums with badly worn brake shoes.
 - 4.1. On the back of each brake cluster assembly, locate the heads of two brake shoe retainer pins. It may be necessary to remove sealant material around the head of each pin.



2814

Figure 6-1 Loosen Equalizer Nut

2834a

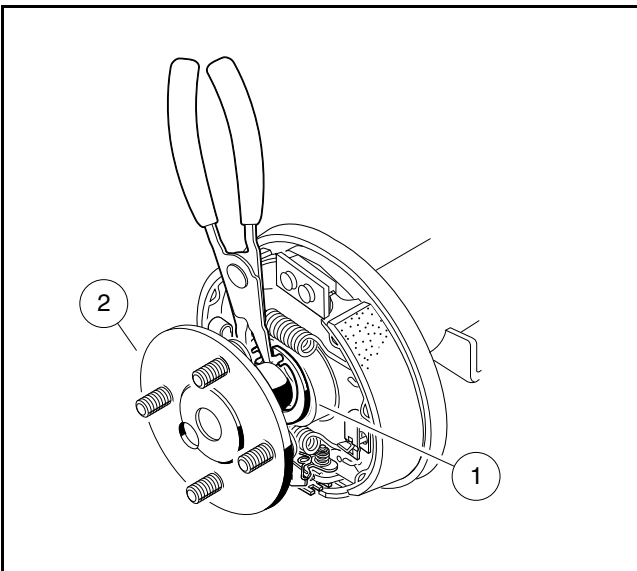
Figure 6-2 Shoe Retainer Pins

- 4.2. Insert a 1/2 inch x 5/8 inch cold chisel (1) under the head (2) of each pin and shear them off as illustrated (**Figure 6-2, Page 6-2**). This will release the shoes from the backing plate, allowing them to pivot away from the inside of the brake drum (3), which should then allow the brake drum to be pulled free. After completing step 6, skip step 7. **See following NOTE.**

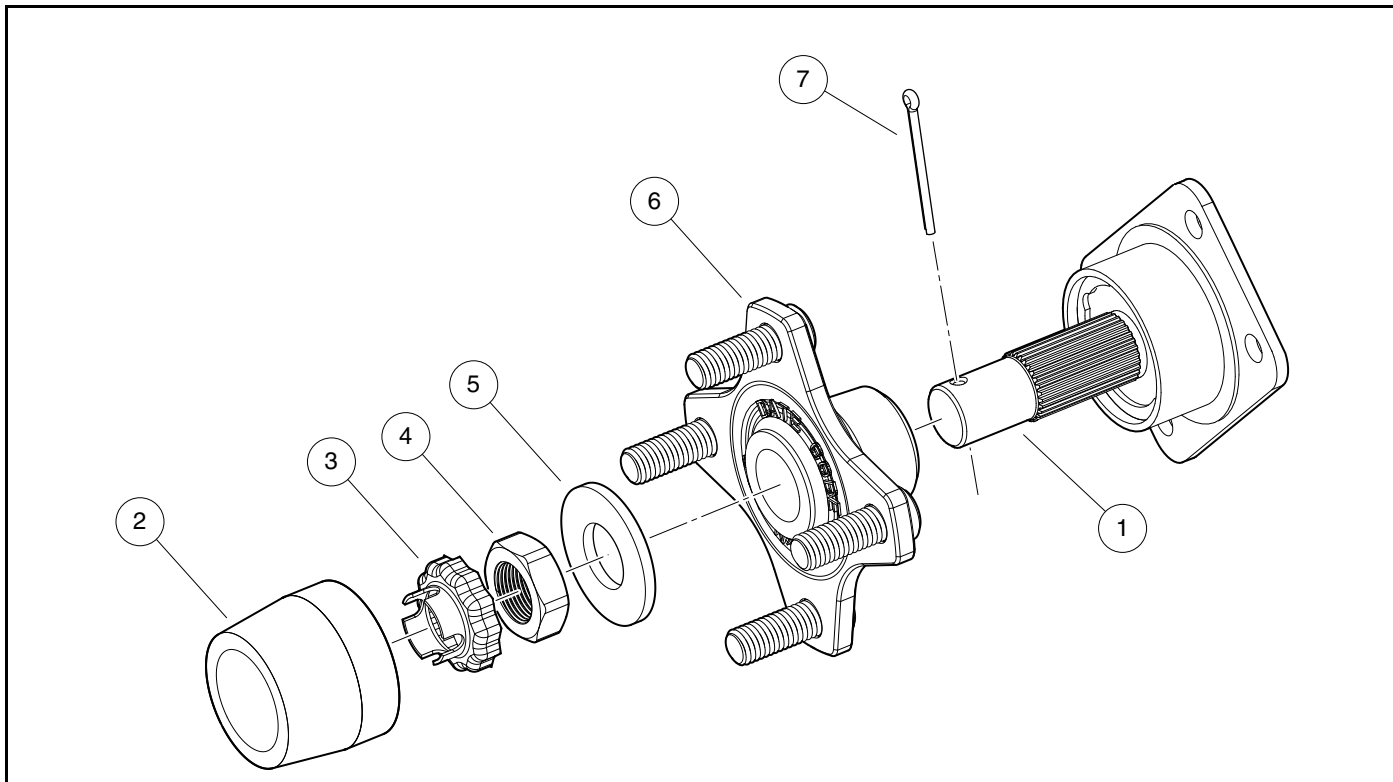
NOTE: Although step 6 allows easier access to the brake shoes, it is not imperative to do so in order to remove the brake shoes.

5. **For electric vehicles:** Remove the axle shaft.

- 5.1. Using 90° snap ring pliers (CC P/N 1012560), remove axle retaining ring (1) (**Figure 6-3, Page 6-2**).
- 5.2. Pull the axle shaft (2) from the axle tube (**Figure 6-3, Page 6-2**).

**Figure 6-3 Remove Axle Retaining Ring (For electric vehicles only)**

6. **For gasoline vehicles:** Remove the wheel hub assembly. (**Figure 6-4, Page 6-3**)



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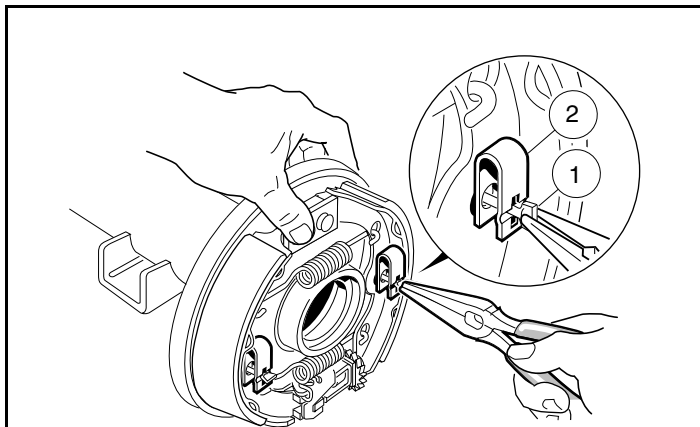
Figure 6-4 Remove Wheel Hub Assembly (For gasoline vehicles)

- Using needle nose pliers, turn the clip retainer pin (1) 90° to remove the shoe retainer clip (2). **See following CAUTION.**

⚠ CAUTION

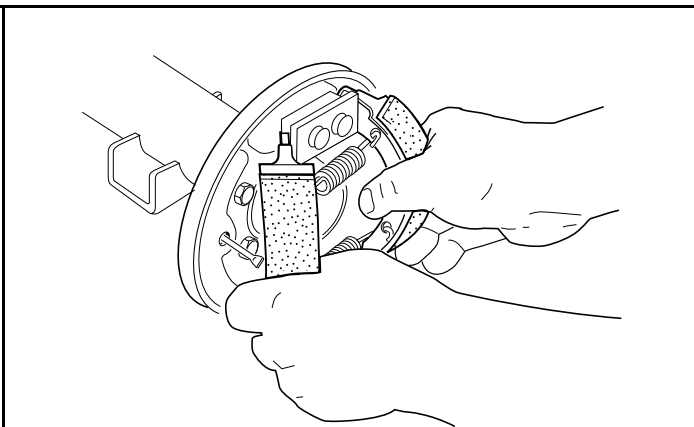
- The brake shoes are under spring pressure and can release suddenly when brake shoe retainers are removed.

- Grasp both brake shoes and pull them, together with the springs, out of the brake assembly as shown.



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Figure 6-5 Rotate Clip Retainer



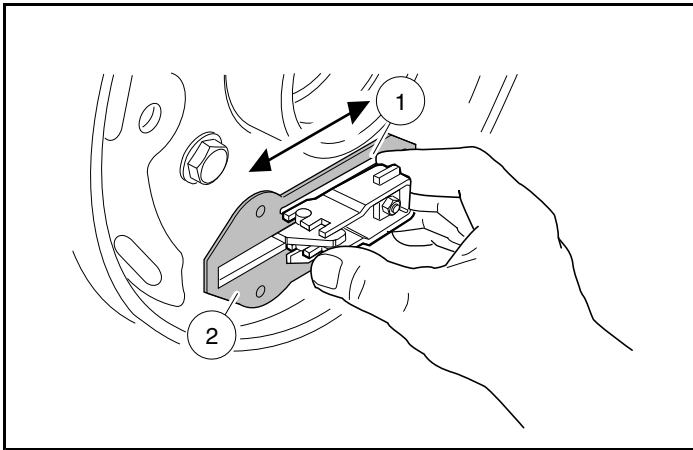
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Figure 6-6 Remove Shoes

BRAKE ASSEMBLY CLEANING

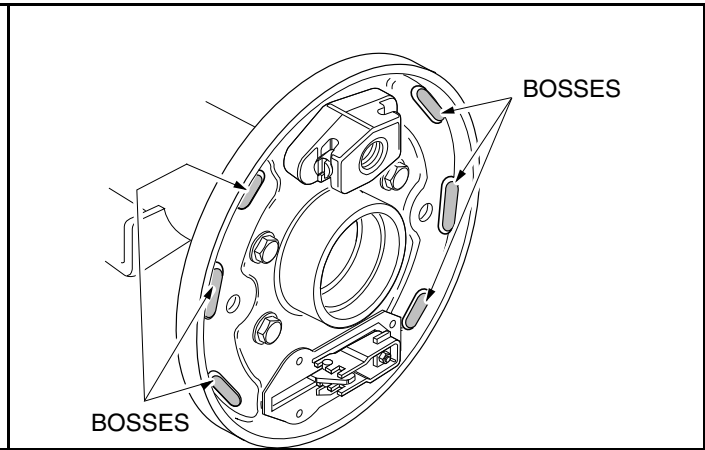
See General Warnings on page 1-2. See also Asbestos Dust Warning on page 6-1.

1. Carefully clean the brake backing plate and all mechanical components.
2. Remove the rubber boot from backing plate and wipe with a clean damp cloth.



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Figure 6-7 Lubricate Slide



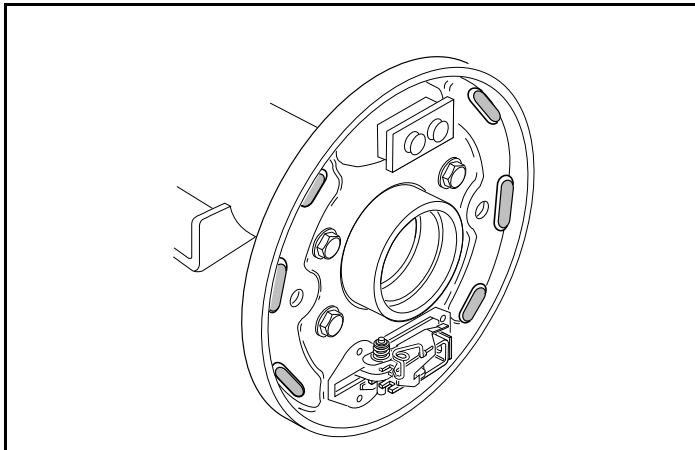
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Figure 6-8 Lubricate Raised Bosses

3. Lubricate the slide (1) and slide plate (2) with dry moly lubricant (P/N 1012151) on both sides of the backing plate. After lubricating, work slide back and forth against backing plate to ensure that it slides smoothly and easily (**Figure 6-7, Page 6-4**). Install rubber boot onto backing plate. Reinstall rubber boot onto backing plate. **See following WARNING**

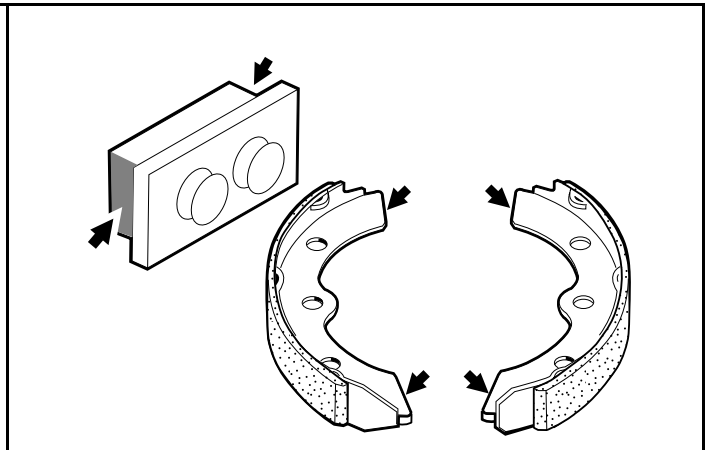
⚠ WARNING

- **Apply grease carefully when performing the following steps. Do not allow any grease to get onto the friction surfaces of the brake shoe pads or the brake drum. Failure to heed this warning could cause diminished brake performance, possibly resulting in property damage or severe personal injury.**
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 6-9, Page 6-5**). **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 6-12, Page 6-5**). **See preceding WARNING.**



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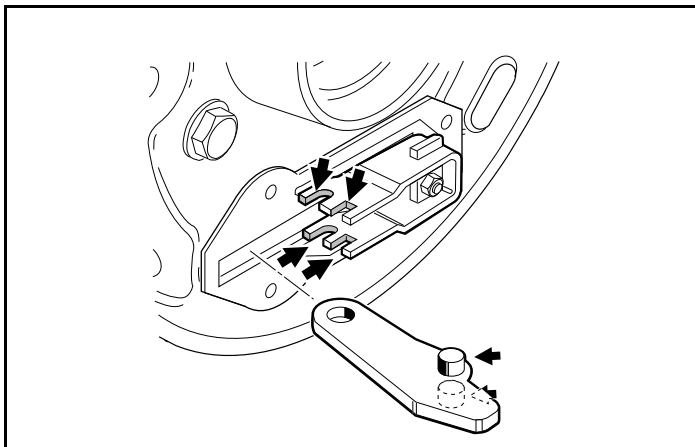
Figure 6-9 Lubricate Bosses



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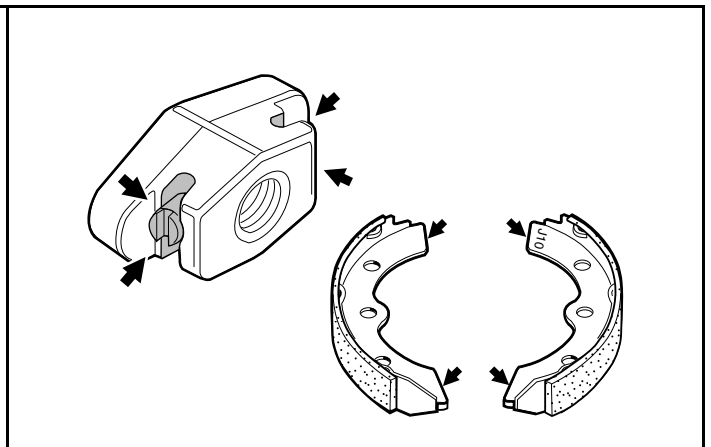
Figure 6-10 Lubricate Brake Shoes and Slots

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 6-11, Page 6-5**). See preceding **WARNING**.



2799

Figure 6-11 Lubricate Actuator



2819

Figure 6-12 Lubricate Shoes

BRAKE SHOE INSTALLATION

See General Warnings on page 1-2. See also Asbestos Dust Warning on page 6-1.

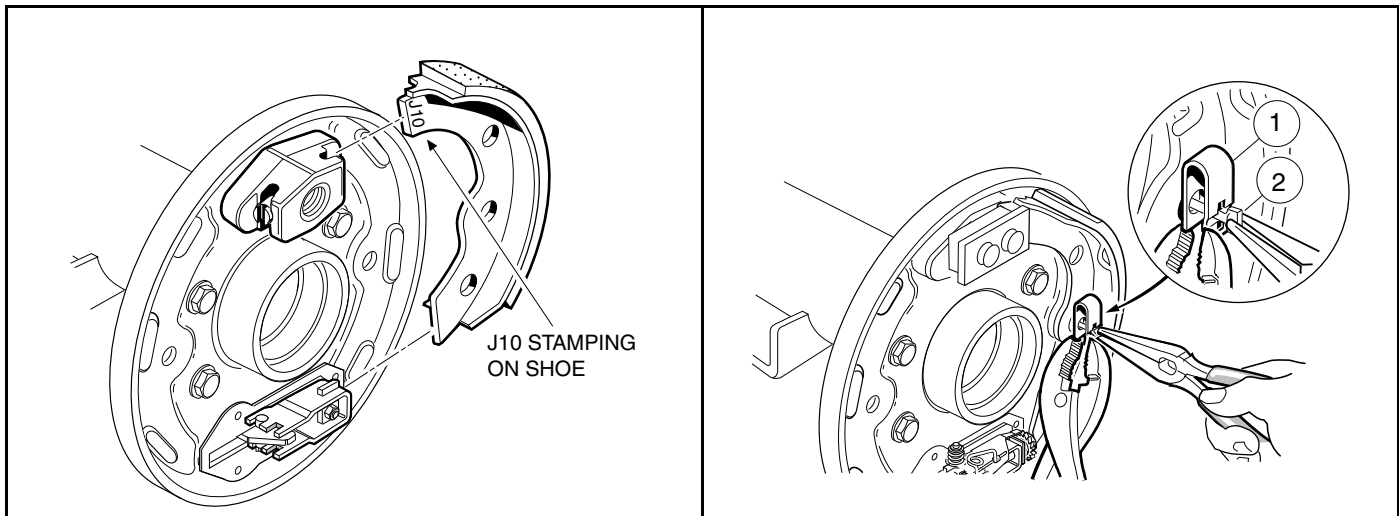
NOTE: Components of the front wheel brake assembly are identical to the rear wheel manually-adjusted brake assembly. The front brake assembly is rotated 90° (when compared to the rear brake assembly) so the adjusting bolt on each assembly is oriented to the rear of the vehicle rather than at the top of the assembly (Figure 6-25, Page 6-16).

1. Position one shoe in the slots in the mounting block anchor piston and brake actuator (Figure 6-16, Page 6-7). 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 6-16, Page 6-7). Incorrectly installed brake shoes will be too tight and make adjustment of the brake impossible.
2. Install the shoe retainer clip, using pliers to compress the clip (1) while turning the retainer pin (2) into position (Figure 6-14, Page 6-6).
 3. Attach the springs (with hooks pointing outwards) onto the trailing shoe already installed. Then hold the leading shoe next to the trailing shoe, correctly oriented, and attach the springs to it. (Figure 6-15, Page 6-7).

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.



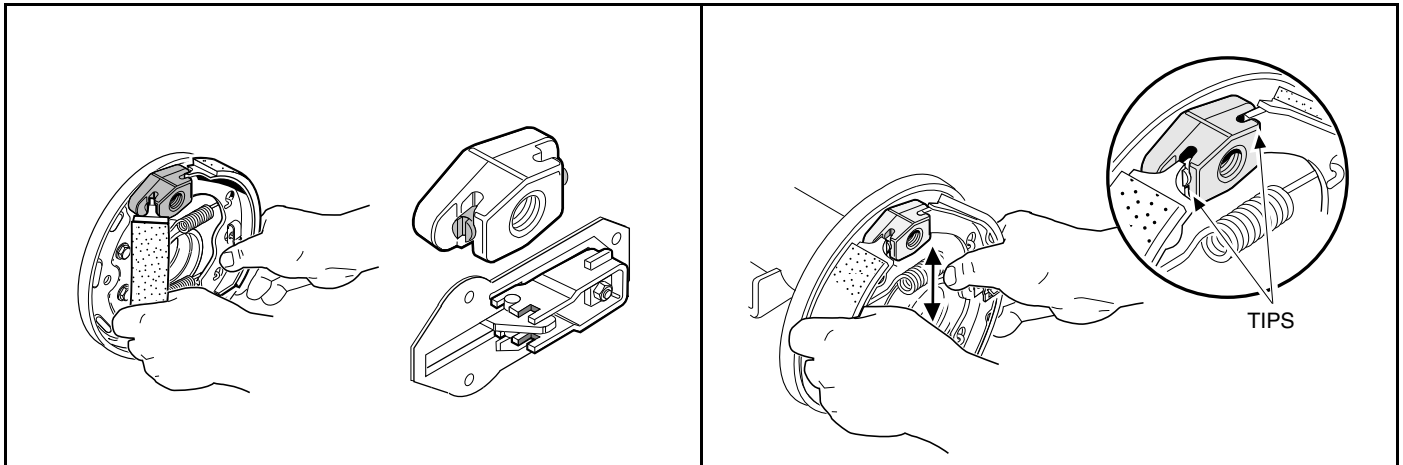
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Figure 6-13 Position Shoes

644

Figure 6-14 Retainer Clip

4. While maintaining spring attachment on both shoes, position tips of the second shoe (1) in the mounting slots and then push shoe into place. Hold shoe in position and install retaining clip.
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 inch to 3/8 inch (6.3 mm to 9.5 mm) without binding. Make sure the shoes are positioned vertically so the tips of the shoes are positioned flush with the top surface of the shoe mounting blocks as shown in (Figure 6-15, Page 6-7). See following Caution.



2808

Figure 6-15 Insert Shoes

2800

Figure 6-16 Position Shoes

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. **For electric vehicles only:** Install axle shaft (2) into axle tube and install retaining ring (1) . **See following WARNING below.**
7. **For gas vehicles only:** Install wheel hub assembly. **See Rear Hub Installation, Section 17, Page 17-4.**
8. 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.

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

BRAKE ADJUSTMENT

See General Warnings on page 1-2. See also Asbestos Dust 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 Pedal Group Adjustment on page 5-7.

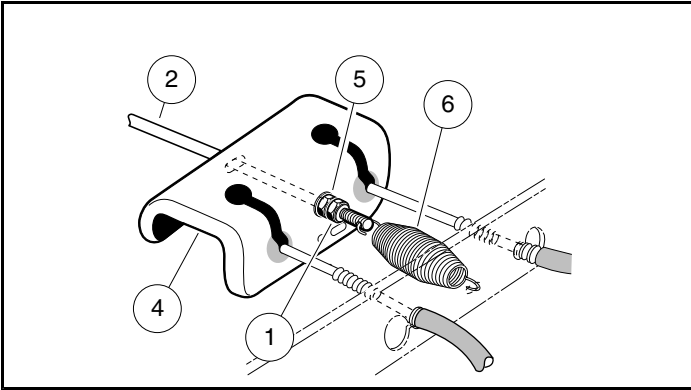
NOTE: All brake cluster components must be clean, lubricated, and in good working condition prior to beginning brake adjustment.

All wheels must be installed on the vehicle and lug nuts tightened to 65 ft-lb (88 N·m).

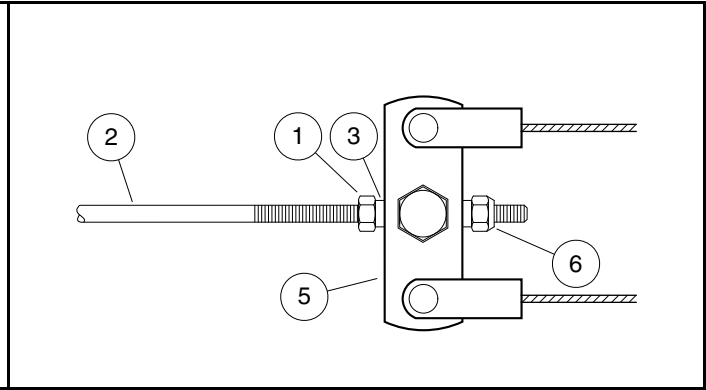
BRAKE CLUSTER ADJUSTMENT

1. Chock the wheels.

2. To provide slack in the brake cables, loosen the equalizer retaining nuts (1 and 5) on the equalizer rod (2) (**Figure 6-17, Page 6-8**).
3. Loosen the front brake equalizer rod (**Figure 6-18, Page 6-8**).



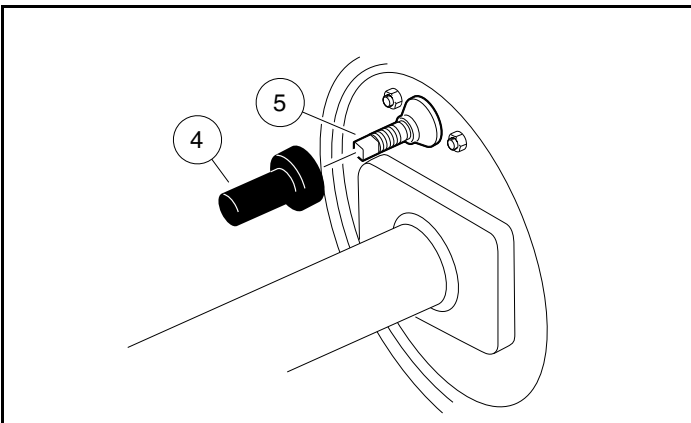
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Figure 6-17 Rear Equalizer Adjustment

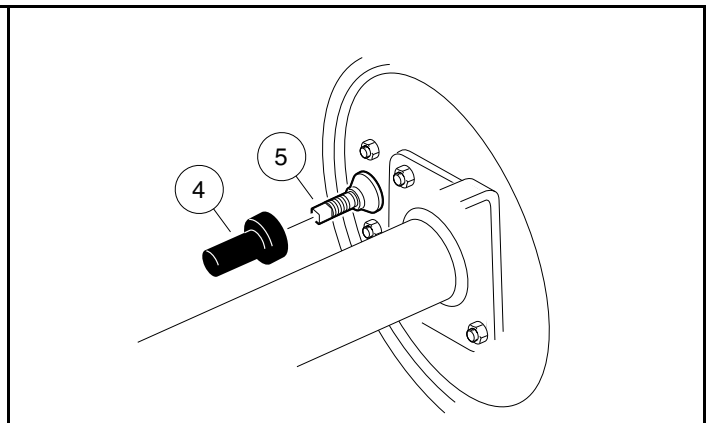
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Figure 6-18 Front Equalizer Adjustment

4. Remove the dust cover (4) on the left and right rear brake cluster assemblies (**Figure 6-19, Page 6-8**).



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Figure 6-19 Rear Brake Adjustment Bolt

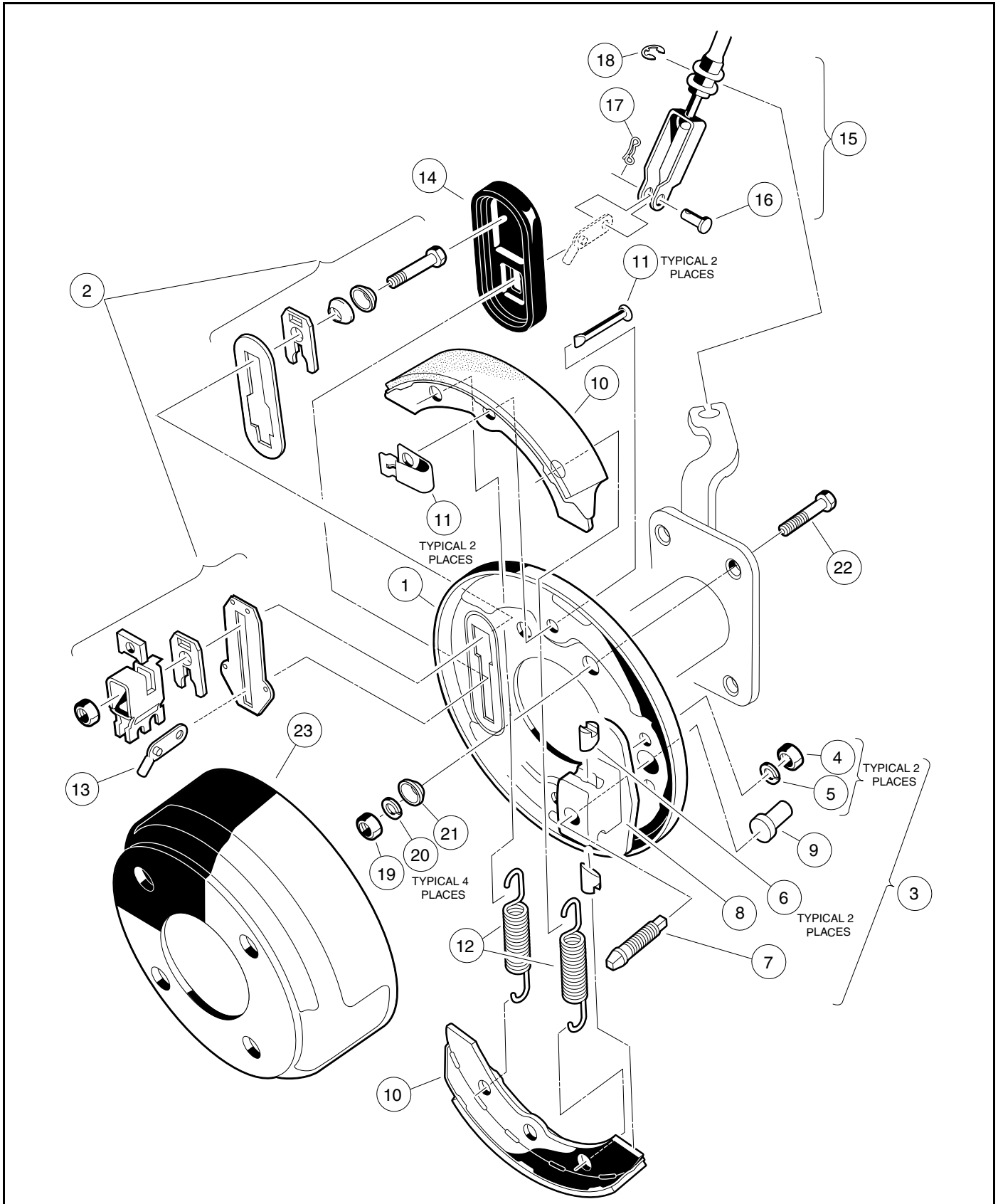
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Figure 6-20 Front Brake Adjustment Bolt

5. Use a torque wrench and a 7 mm 8-point socket or Club Car brake adjustment tool (CC 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) then back off 5 clicks. **See following NOTE**

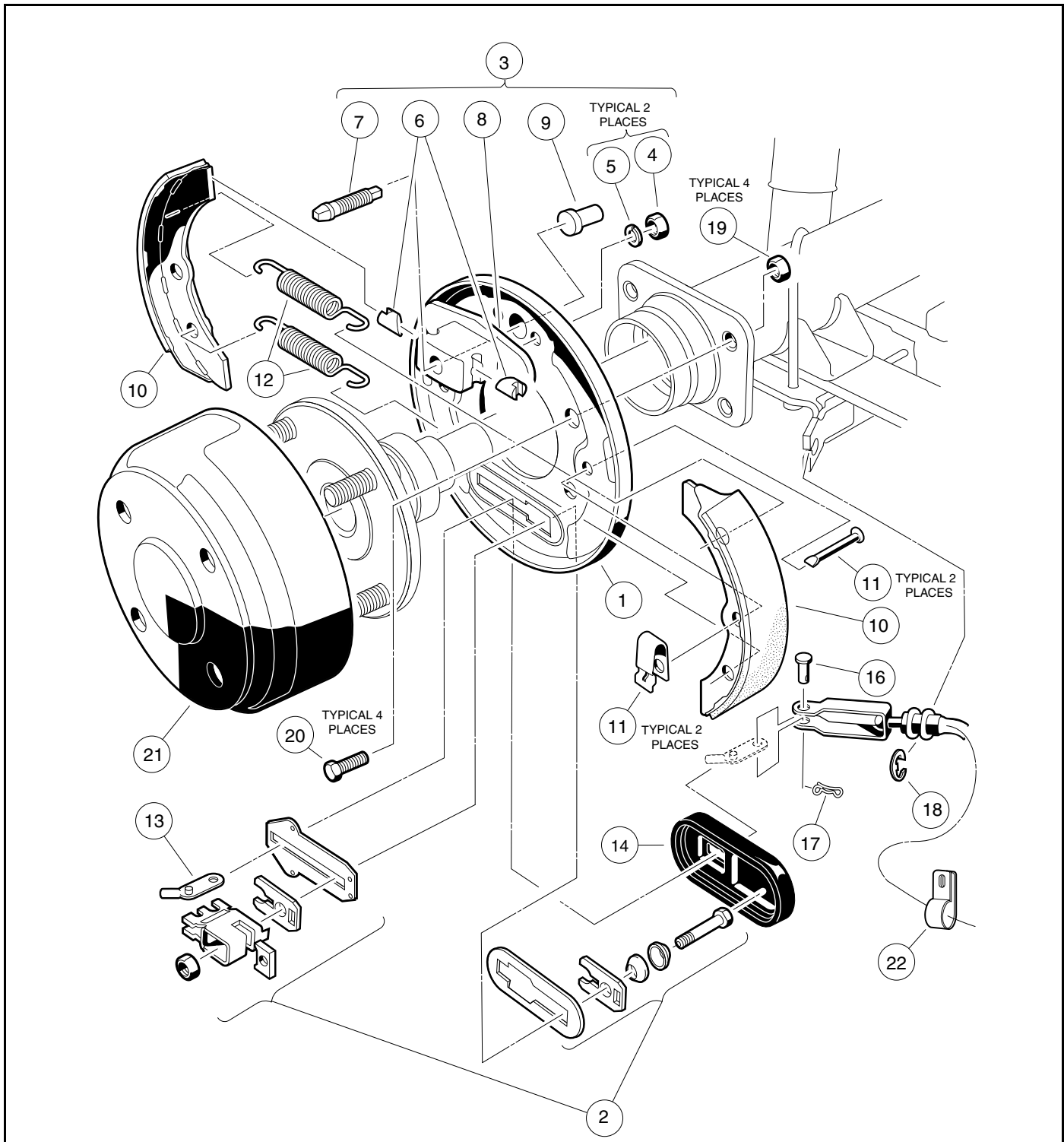
NOTE: If a wheel can still be turned by hand after step 4, inspect the brake clusters and clean and/or replace all parts that do not work properly.

6. Repeat procedure at front brake clusters.



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Figure 6-21 Front Manually Adjusted Brake Assembly

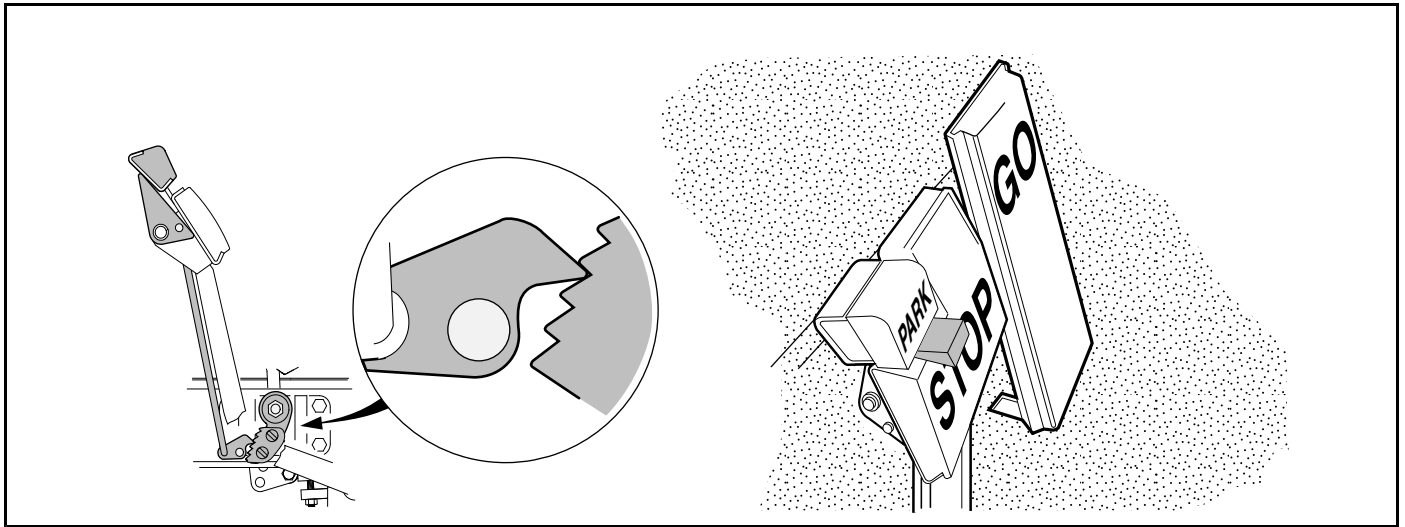


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Figure 6-22 Rear Manually-Adjusted Brake Assembly

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 6-23, Page 6-11**).



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Figure 6-23 Set Park Brake and Insert Wedge

2. Equalize the brake cables.
 - 2.1. Tighten the nylon lock nut (6) on the front equalizer rod (2) to 35 in·lb (4 N·m) (Figure 6-18, Page 6-8).
 - 2.2. Tighten the jam nut (5) on the rear equalizer rod (2) clockwise to 35 in·lb (4 N·m) (Figure 6-17, Page 6-8).
 - 2.3. Repeat steps 3 and 4 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 6-18, Page 6-8).
 - 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 6-17, Page 6-8). 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 6-17, Page 6-8).

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 6-19, Page 6-8) and (Figure 6-20, Page 6-8).
4. Carefully support the vehicle with the lifting device, remove jack stands and lower the vehicle to the ground.

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 6-10. See 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 6-10. See 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 6-10. See 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

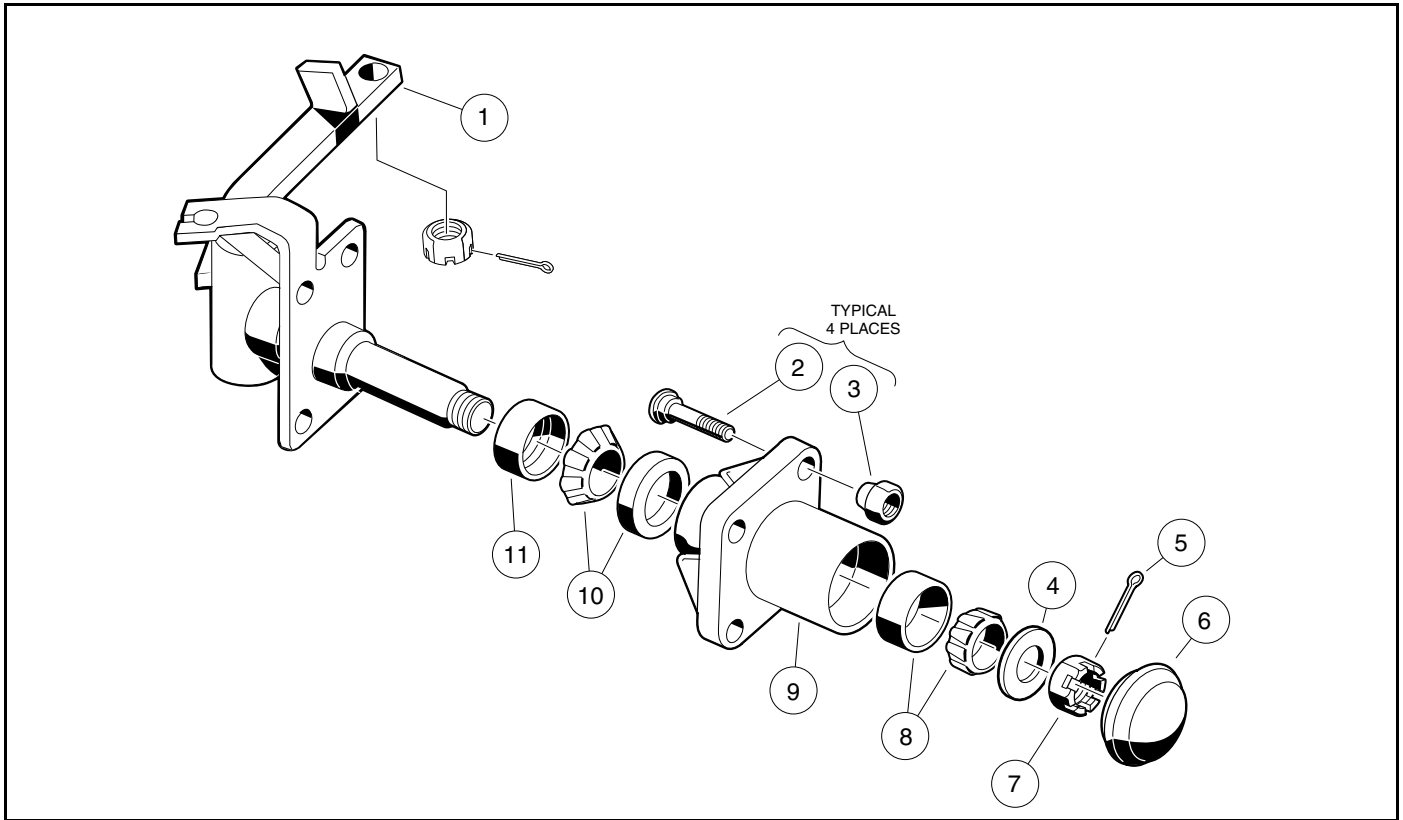
See General Warnings on page 1-2. See also Asbestos Dust Warning on page 6-1.

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 6-18, Page 6-8**).
4. Remove the front wheels and then the brake drums.
5. Remove bow-tie pin (17) and clevis pin (16) from brake cable (**Figure 6-25, Page 6-16**) (**Figure 6-24, Page 6-13**).
6. Remove dust cap (6) on hub and bearing assembly.
7. Remove cotter pin (5) and hex nut (7) from spindle shaft (**Figure 6-24, Page 6-13**).
8. Remove hub and bearing assembly from spindle shaft. Remove four bolts (22), cone washers (21), lockwashers (20) and hex nuts (19) that mount the brake cluster to the spindle (**Figure 6-25, Page 6-16**).
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 cluster (**Figure 6-25, Page 6-16**).
2. Tighten bolts to 30 ft·lb (41 N·m). Adjust brakes as previously described in this section. Use new bow-tie pins when reconnecting brake cables.



2810

Figure 6-24 Front Spindle Assembly

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 6-17, Page 6-8**).
3. Remove the rear wheels and then the brake drums. **See following NOTE.**

NOTE: When servicing vehicles with brake drums that cannot be removed by normal methods, perform step 4 of **Brake Shoe Removal on page 6-1**, then continue with this procedure.

4. **Electric Vehicles:** Remove the axle shaft.
 - 4.1. Use 90° snap ring pliers to remove the axle retaining ring (1) .
 - 4.2. Pull the axle shaft from the axle tube.
5. **Gasoline Vehicles:** Remove the rear hub. **See Rear Hub Removal, Section 17, Page 17-4.**
6. Remove bow-tie pin (17) and clevis pin (16) from brake cable (**Figure 6-22, Page 6-10**).
7. Remove 4 bolts (20) and cone lock nuts (19) that mount the brake cluster to the transaxle (**Figure 6-22, Page 6-10**).
8. Remove rear brake cluster assembly from transaxle.

REAR BRAKE CLUSTER INSTALLATION

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

⚠ CAUTION

- Clean any residual oil from the exposed end of the axle tube and from the oil seal area prior to installing the axle shaft.
2. Be sure bolts (20) and new lock nuts (19) are used to mount the brake cluster (**Figure 6-22, Page 6-10**).
 3. Tighten nuts to 17 ft·lb (23.0 N·m). If torquing the bolt heads, torque to 30 ft·lb (40 N·m). **See following WARNING for Electric Vehicles.**

⚠ 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.

FRONT BRAKE CABLES

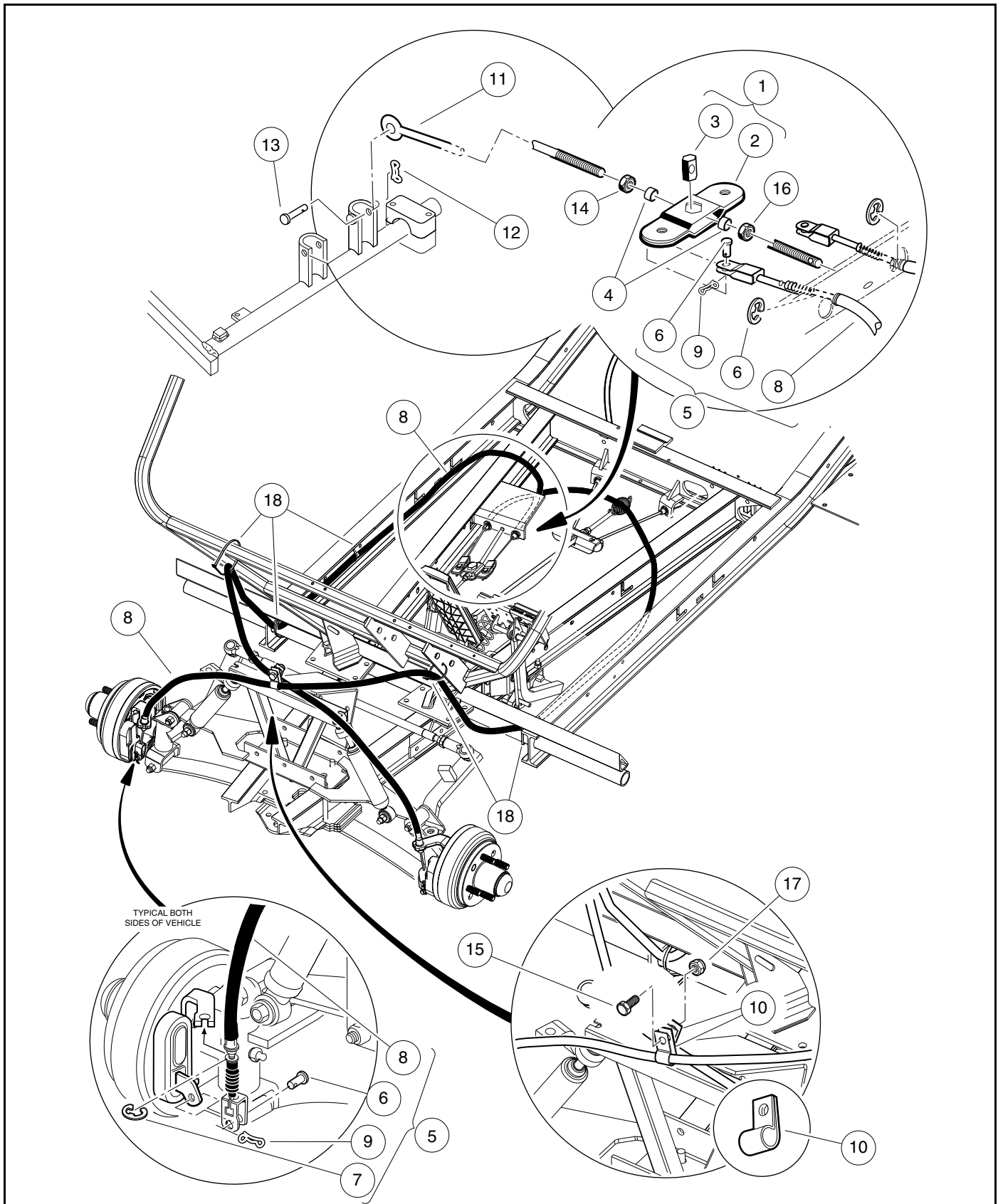
See General Warnings on page 1-2. See also Asbestos Dust Warning on page 6-1.

FRONT BRAKE CABLE REMOVAL

1. Remove bow-tie pin (9) and clevis pin (6) from brake lever arm on front brake cluster **(Figure 6-25, Page 6-16)**.
2. Remove E-clip (7) from brake cable housing at the front spindle bracket and remove cable (8) from spindle.
3. Remove bow-tie pin (9), clevis pin (6), and E-clip (7) from brake cable (8) at equalizer (2).
4. Remove bolt (15) and nut (17) from brake cable clamp (10).
5. Remove front brake cable (8) from vehicle.

FRONT BRAKE CABLE INSTALLATION

1. Place brake cable (8) through frame mounting hole behind equalizer (2) and install E-clip (7) on cable housing **(Figure 6-25, Page 6-16)**.
2. Place brake cable (8) clevis on equalizer (2) and install the clevis pin (6) and new bow-tie pin (9).
3. Route cable (8) 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 rear brake equalizer.
4. Route cables (8) along I-beam towards front of the vehicle through hole in crossmember and secure as shown **(Figure 6-25, Page 6-16)**.
5. Route brake cable between the shock support and brake cable guide bracket. Secure brake cable clamp (10) with a bolt (15) and nut (17).
6. Install brake cable (8) through the front spindle brackets and install E-clip (7).
7. Install brake cable clevis onto brake lever arm and install clevis pin (6) and a new bow-tie pin (9).
8. Adjust brakes as described in this section for the appropriate vehicle.



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Figure 6-25 Front Brake Cables and Equalizer

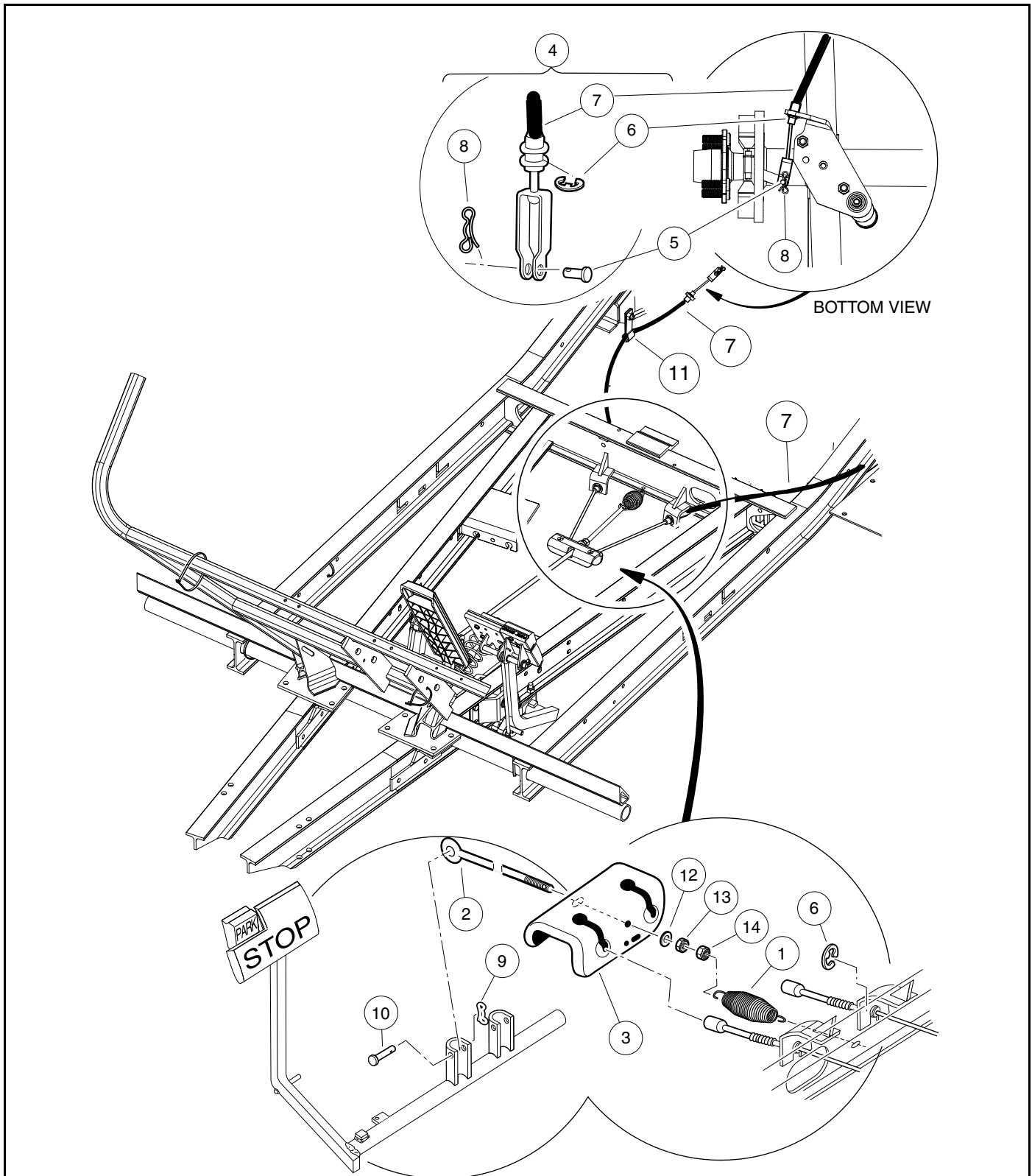
REAR BRAKE CABLES

REAR BRAKE CABLE REMOVAL

1. Chock wheels to keep vehicle from unintentionally moving.
2. Release park brake if latched and loosen equalizer retaining nuts (13 and 14) on equalizer rod (2) to slightly loosen brake cables (7) (**Figure 6-26, Page 6-18**).
3. Rotate brake cables (7) upward and pull ends through holes in top of equalizer (3).
4. Disconnect brake cables (7) at rear wheels.
 - 4.1. Remove bow-tie pins (8), clevis pins (5), and E-clips (6) (**Figure 6-26, Page 6-18**).
 - 4.2. Remove cable (7) from plate under leaf spring.
 - 4.3. Note location of hangers (for installation of cables) and pull cables out of vehicle.

REAR BRAKE CABLE INSTALLATION

1. Place the cable ends in the equalizer (3) (**Figure 6-26, Page 6-18**). Route cables through hangers in the same manner as the ones removed.
2. At the rear wheel brakes, connect the cables (7) to the brake actuator arms using clevis pins (5) and new bow-tie pins (8).
3. Place cables (7) in plate under leaf springs and secure with E-clips (6).
4. Adjust brakes as described in this section for the appropriate vehicle.



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Figure 6-26 Rear Brake Cables and Equalizer

⚠ DANGER

- See General Warnings on page 1-2.

⚠ WARNING

- See General Warnings on page 1-2.

GENERAL INFORMATION

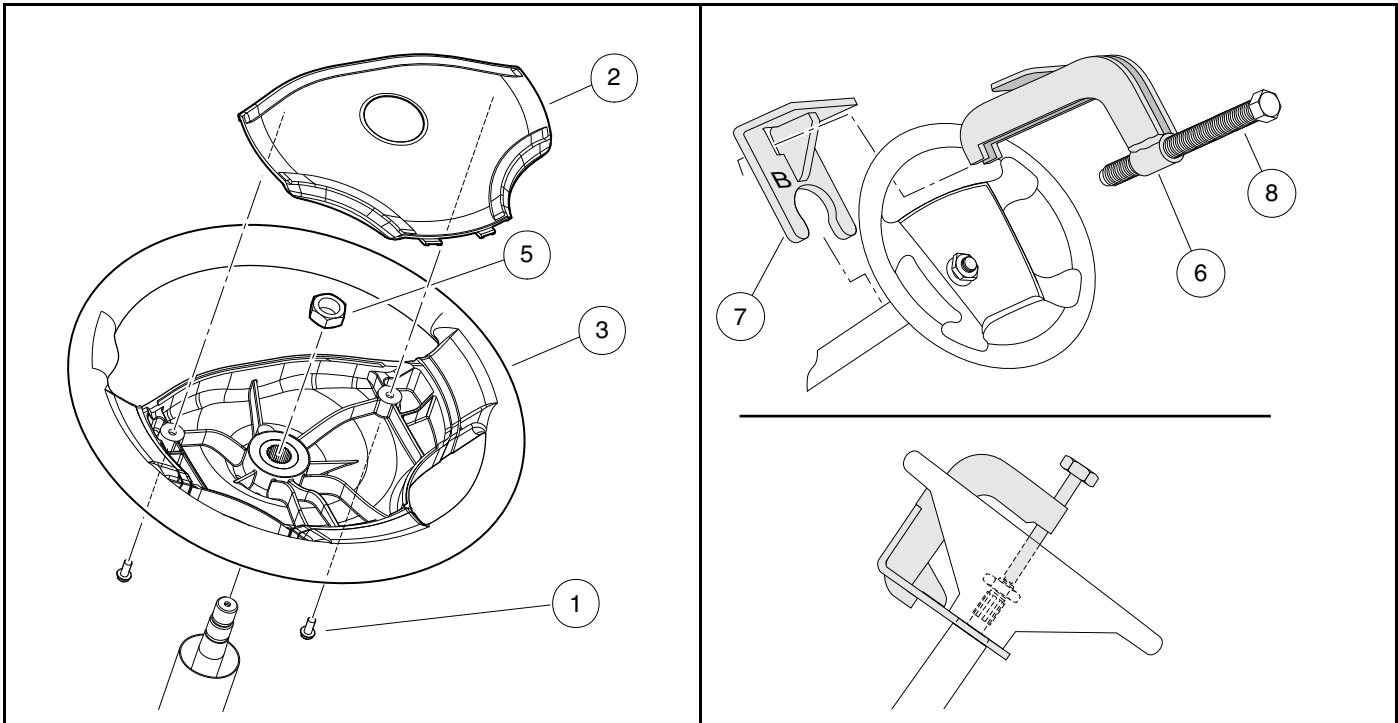
Steering is controlled through a rack and pinion steering assembly that is connected by a steering column to a steering wheel. No manual adjustment to the rack and pinion gear assembly is required. A spring loaded self-adjusting mechanism is incorporated into the assembly.

STEERING WHEEL

See General Warnings on page 1-2.

STEERING WHEEL REMOVAL

1. Disconnect the battery cables and either discharge the controller or disconnect the spark plug wire(s). **See Disconnecting the Battery, 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 (CC 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**).



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Figure 7-1 Steering Wheel

1500-18300-10253

Figure 7-2 Steering Wheel Puller

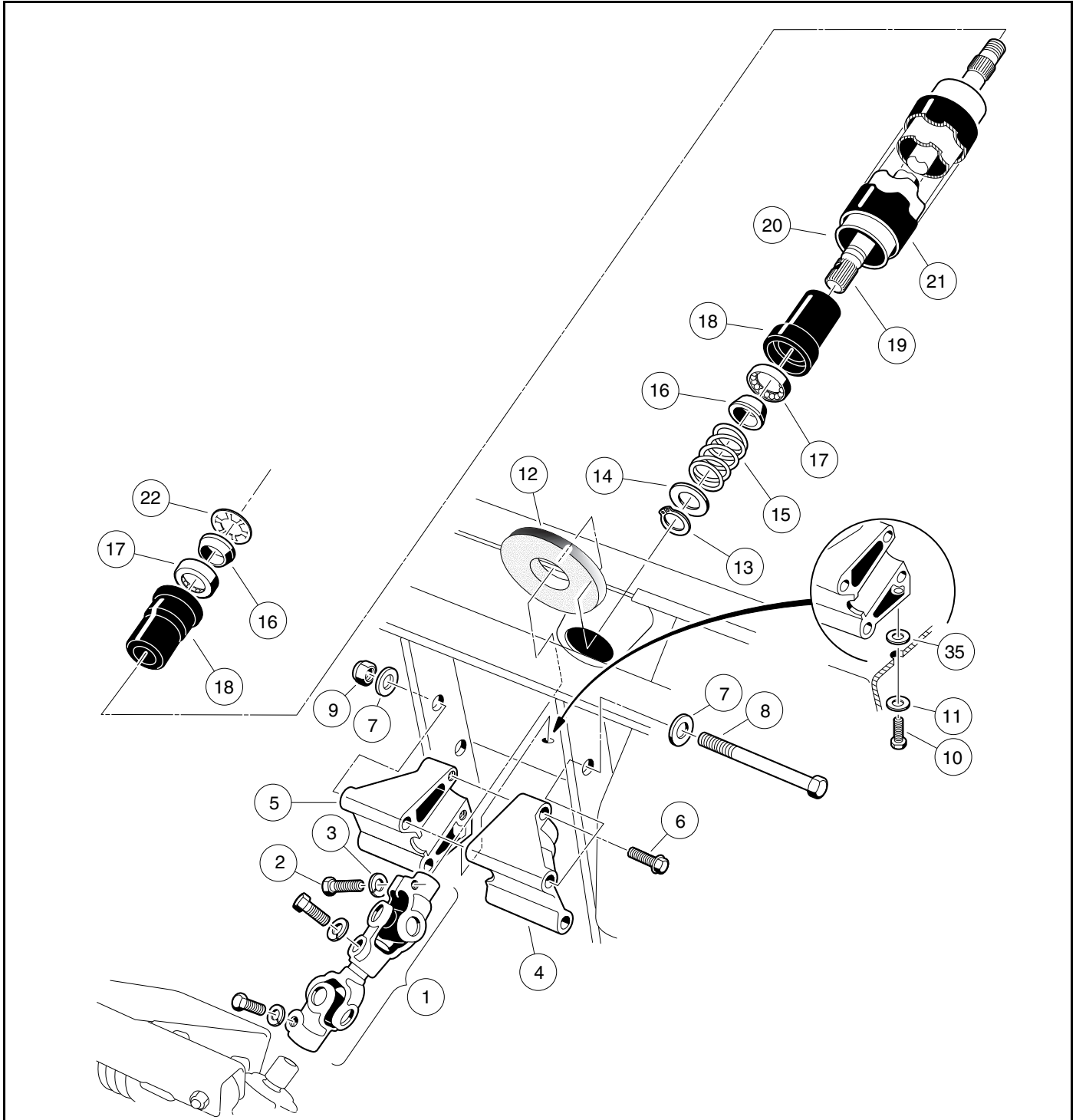
STEERING WHEEL INSTALLATION

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 3 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, Section 1, Page 1-3.**

STEERING COLUMN

See General Warnings on page 1-2.



2609

Figure 7-3 Steering Column

STEERING COLUMN REMOVAL

1. Remove the steering wheel as previously instructed.
2. Remove cowl. **See Cowl Removal, Section 4, Page 4-5.**
3. Remove the upper bolt (2) and lock washer (3) from the universal joint (**Figure 7-3, Page 7-3**).
4. 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**).
5. 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 (CC 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 (CC 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 inches to 2-1/8 inches (5.1 cm to 5.4 cm) of the shaft extends from the top of the bearing seat in the steering tube (**Figure 7-5, Page 7-5**).

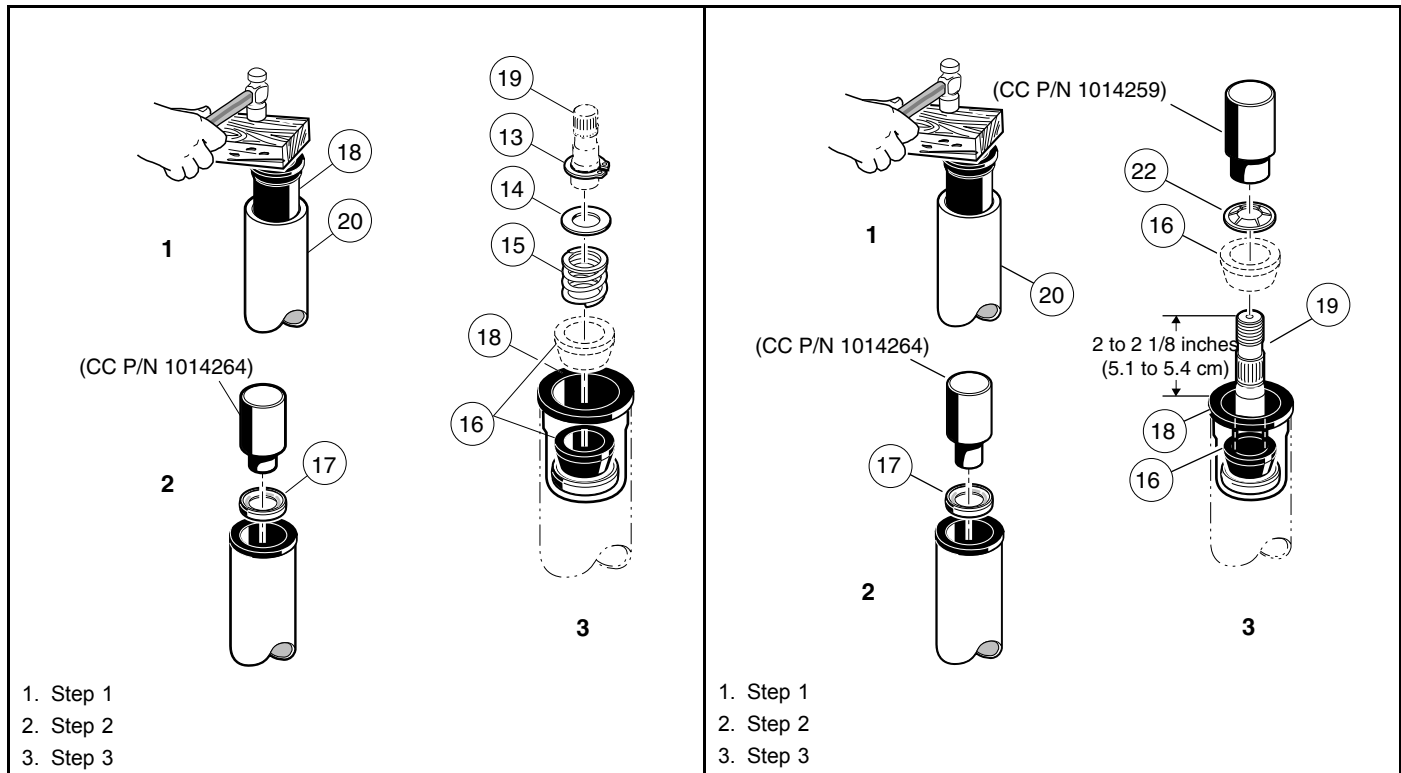


Figure 7-4 Steering Shaft – Bottom End

Figure 7-5 Steering Shaft – Top End

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.
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 wide washer (35), 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. Install cowl. **See Cowl Installation, Section 4, Page 4-5.**
10. Install the steering wheel. **See Steering Wheel Installation on page 7-2.**

STEERING ADJUSTMENT

See General Warnings on page 1-2.

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 7-8**). 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 7-10, Page 7-10**) 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 7-10, Page 7-10**). **See following CAUTION.**

CAUTION

- **When tightening the nuts (27 and 29), make sure the drag link (28) does not turn (Figure 7-10, Page 7-10).**
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 7-10, Page 7-10**) and (6 and 13) (**Figure 7-18, Page 7-17**)
 - spindle bushings (3 and 4) (**Figure 7-19, Page 7-18**)
 - wave washers (20) (**Figure 7-19, Page 7-18**)
 - rack assembly (17) (**Figure 7-10, Page 7-10**)
 5. Also inspect front suspension assemblies as follows:
 - A-plates (1) (**Figure 7-18, Page 7-17**)
 - urethane bushings (2) (**Figure 7-18, Page 7-17**)
 - leaf springs (6) (**Figure 7-19, Page 7-18**)
 6. Replace components as necessary.

RACK AND PINION

See General Warnings on page 1-2.

CAUTION

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

RACK AND PINION INSPECTION

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

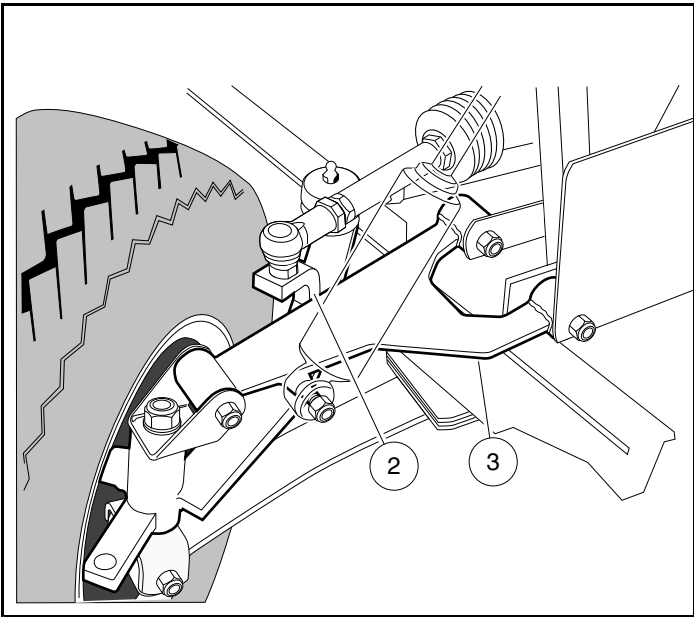
Compare the toe-in against the specification. **See Toe-in Adjustment on page 7-15.**

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

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

RACK AND PINION REMOVAL – MAINTENANCE-FREE BALL JOINTS

1. Remove the front body. **See Front Body, Section 4, Page 4-3.**
2. Remove the drag link ball joint retaining nut (25) (**Figure 7-10, Page 7-10**).
3. Remove the outer drag link ball joint (23) from the spindle assembly (33) and inspect for excessive wear and seal damage.
4. Remove the bolts (30), washers (31), and lock nuts (32) from the steering rack assembly mounting bracket (**Figure 7-10, Page 7-10**).
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**).



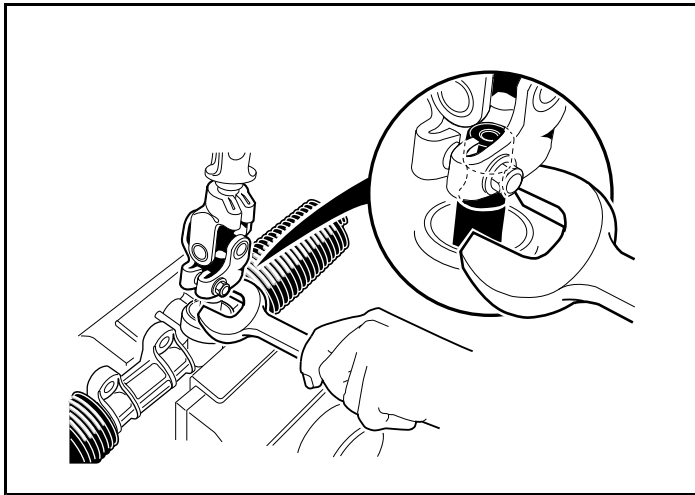
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Figure 7-6 Adjust Steering Alignment

RACK AND PINION DISASSEMBLY

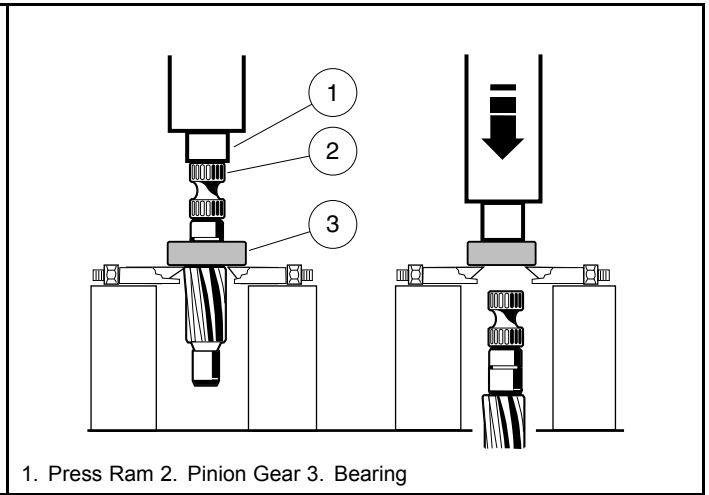
CAUTION

- The ball joint (23) (Figure 7-10, Page 7-10) has left-hand threads.
1. Remove ball joint from the spindle and inspect it for excessive wear.
 2. Remove the drag link (28) (Figure 7-10, Page 7-10).
 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 7-10, Page 7-10).
 7. Remove the universal joint assembly from the pinion (8) by fully removing the bolt and then sliding off the universal joint.



1500-18400-10259

Figure 7-7 Remove Pinion from Housing



1500-18400-10260

Figure 7-8 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 7-10, Page 7-10**).

10. Install the universal joint onto the pinion and place a large open end wrench under the universal joint (**Figure 7-7, Page 7-9**). Use the wrench as a lever to pull the pinion from the housing.

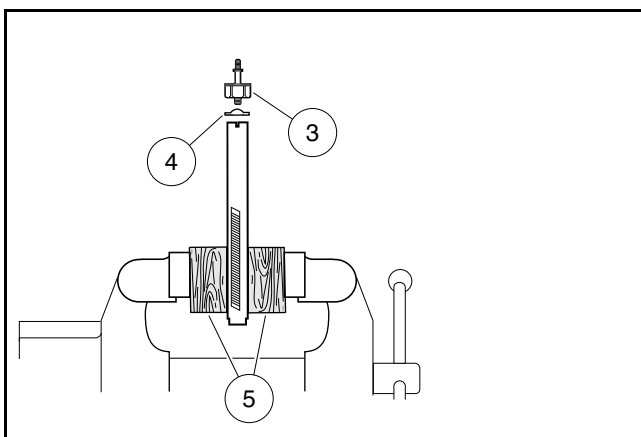
11. If the ball bearing (9) has been damaged, remove the external snap ring (10) (**Figure 7-10, Page 7-10**) and press the bearing off (**Figure 7-8, Page 7-9**).

12. Remove retaining ring (19) and stop washer (18), then remove rack (17) from housing (6) (**Figure 7-10, Page 7-10**).

13. If the inner ball joint (3) is excessively worn, remove the ball joint and tab washer (4) from the rack (**Figure 7-9, Page 7-9**).

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 7-9, Page 7-9**).

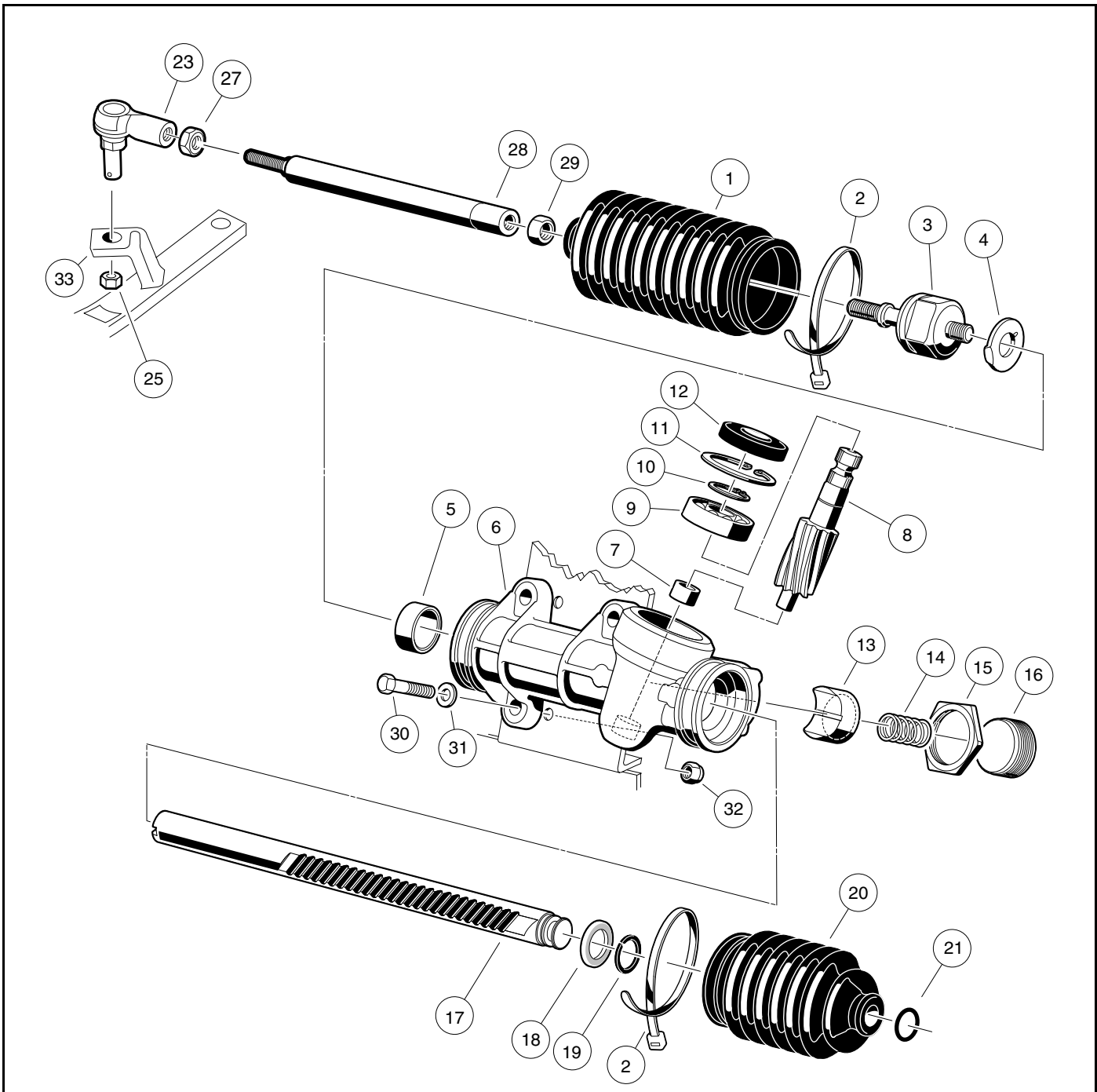
13.2. Loosen and remove the inner ball joint with a wrench.



1500-18400-10261

Figure 7-9 Secure Rack in Vise

14. Inspect the bushing (5) for excessive wear. If wear is excessive, replace the steering box assembly (CC P/N 101878302) (**Figure 7-10, Page 7-10**).



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Figure 7-10 Steering Gear – Maintenance-Free Ball Joints

RACK AND PINION ASSEMBLY

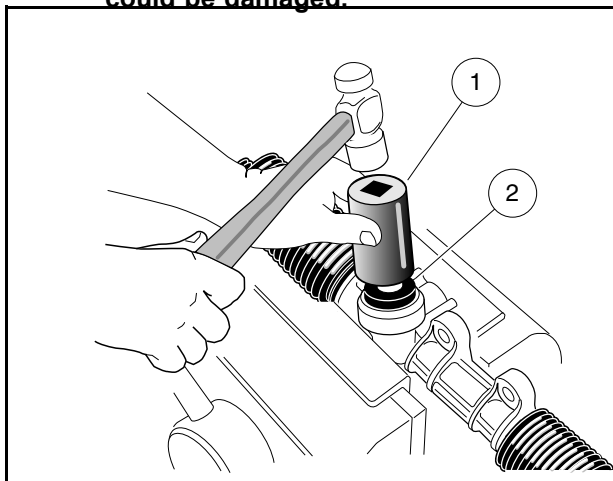
1. Install a new tab washer (4) and an inner ball joint (3) (**Figure 7-9, Page 7-9**). Install the ball joint onto the rack by securing the rack in a vise using wood blocks between the rack and the jaws of the vise to protect the rack from damage. Tighten the ball joint to 60 ft-lb (81 N-m).
2. Bend the edges of the tab washer (4) up against the ball joint (3) (**Figure 7-9, Page 7-9**).
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 7-10, Page 7-10**).

CAUTION

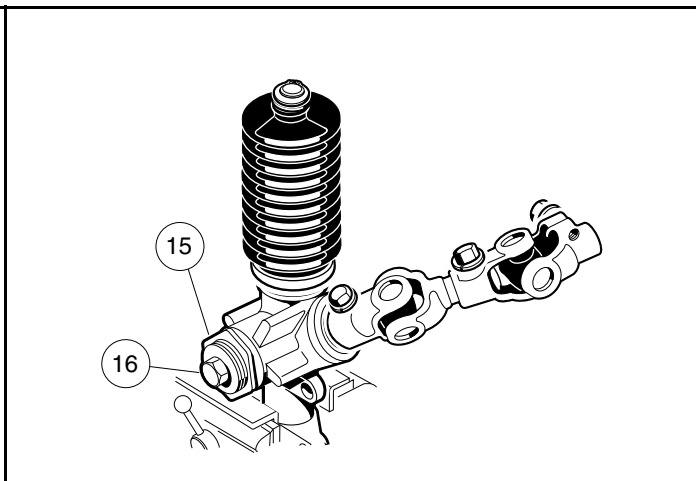
- In step 4, do not press against the outer race of the bearing.
4. If the bearing (9) was removed, press on a new bearing, exerting all pressure on the inner race (grease the bearing before installing it). Then install the external snap ring (10) (**Figure 7-10, Page 7-10**). **See preceding CAUTION.**
 5. If the needle bearing (7) is damaged, the steering box assembly (CC P/N 101878302) must be replaced (**Figure 7-10, Page 7-10**).
 6. Install pinion (8) and bearing (9) assembly into the housing (6) (**Figure 7-10, Page 7-10**). 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

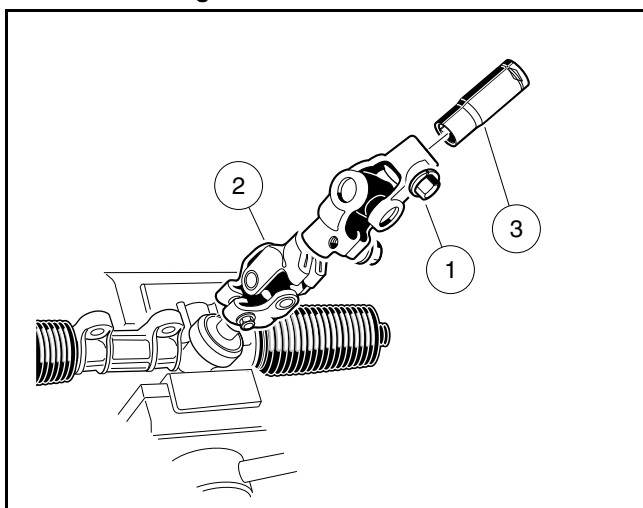
- Do not force the pinion-bearing assembly into the housing. The gear teeth or the small bearing could be damaged.



1500-18400-10263

Figure 7-11 Press In Dust Seal

1500-18400-10264

Figure 7-12 Rack and Pinion Adjustment

1500-18400-10265

Figure 7-13 Rack and Pinion Resistance

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

9. Apply a small amount of grease to the rack guide (13) where it comes into contact with the rack (17) **(Figure 7-10, Page 7-10)**.
10. Place a few drops of Loctite® 222 to the threads of the screw (16) **(Figure 7-10, Page 7-10)**.
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 7-10, Page 7-10)**.
 - 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 7-13, Page 7-11)**.
 - 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 7-12, Page 7-11)**. **See following NOTE.**

NOTE: When tightening the lock nut (15) make sure the screw (16) does not change adjustment **(Figure 7-12, Page 7-11)**.

12. Install the dust seal bellows (20) and retaining ring (21) **(Figure 7-10, Page 7-10)**.
13. Install the dust seal bellows (1) and hex nut (29) **(Figure 7-10, Page 7-10)**.
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 7-10, Page 7-10)**.
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 7-10, Page 7-10)** 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 7-10, Page 7-10)**. **See preceding CAUTION.**

RACK AND PINION INSTALLATION – MAINTENANCE-FREE BALL JOINTS

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 7-10, Page 7-10)**.
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 7-10, Page 7-10)**.
5. Install the drag link ball joint (23) on the spindle arm riser (33) and secure with retaining nut (25). Tighten nut to 40 ft·lb (54 N·m).
6. Adjust the steering. **See Steering Adjustment on page 7-6.**

TIE ROD AND DRAG LINK

See General Warnings on page 1-2.

TIE ROD AND DRAG LINK REMOVAL – MAINTENANCE-FREE BALL JOINTS

1. Using locking pliers to hold tie rod and drag link, loosen jam nuts (7 and 12) on tie rod ball joints (**Figure 7-18, Page 7-17**) and loosen jam nuts (27 and 29) on the drag link (**Figure 7-10, Page 7-10**).
2. Remove the ball joint retaining nuts (20) (**Figure 7-18, Page 7-17**).
3. Remove ball joints (13 and 6) (**Figure 7-18, Page 7-17**) and (23) (**Figure 7-10, Page 7-10**) from the spindles.
4. Remove the ball joints from the tie rod (11) (**Figure 7-18, Page 7-17**).
5. Remove drag link (28) from inner ball joint assembly (3) and drag link ball joint (23) (**Figure 7-10, Page 7-10**).

TIE ROD AND DRAG LINK INSTALLATION – MAINTENANCE-FREE BALL JOINTS

1. Thread ball joints (6 and 13) into tie rod (11) to a depth of 1/2-inch (12.5 mm) (**Figure 7-18, 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. Attach the tie rod ball joints (6 and 13) to the spindle tabs (23), then install and tighten the nuts (20) to 40 ft·lb (54 N·m) (**Figure 7-18, 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 7-10, Page 7-10**).
 4. Thread the ball joint (23) into the drag link rod (28) (left-hand threads) to full thread depth (**Figure 7-10, Page 7-10**).
 5. Install the drag link ball joint (23) on the spindle arm riser (33) and secure with retaining nut (25) (**Figure 7-10, Page 7-10**). Tighten nut to 40 ft·lb (54 N·m).
 6. Adjust camber and toe-in. See **Camber Adjustment** on page 7-14 and **Toe-in Adjustment** on page 7-15.
 7. Adjust steering. See **Steering Adjustment** on page 7-6.

FRONT SUSPENSION

See General Warnings on page 1-2.

LUBRICATION

Two grease fittings (one in each spindle housing) are provided. Lubricate these fittings at the recommended interval with the proper lubricant. **See Periodic Lubrication Schedule, Section 10, Page 10-5.**

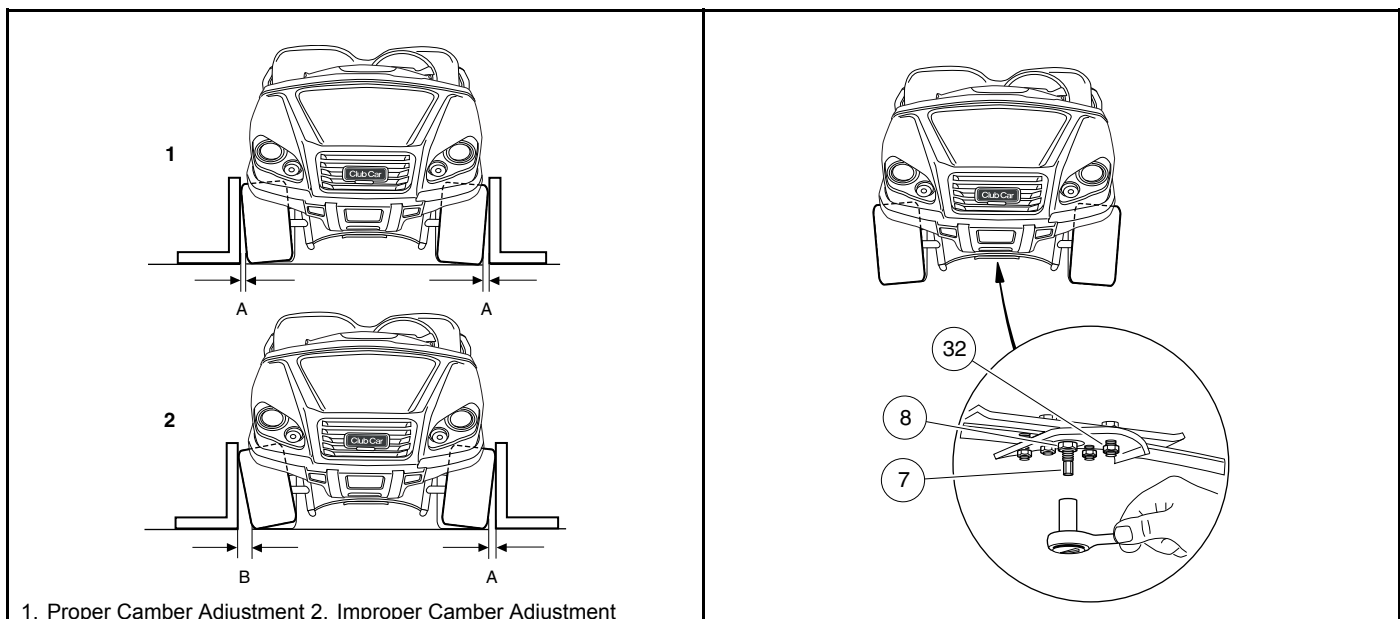
WHEEL ALIGNMENT

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 7-6. 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 7-14, Page 7-14**).
2. Loosen, but do not remove, the four nuts (32) that secure the leaf spring (6) to the bottom spring plate (29) (**Figure 7-19, Page 7-18**). **See also Figure 7-15, Page 7-14.**



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Figure 7-14 Check Camber

2869

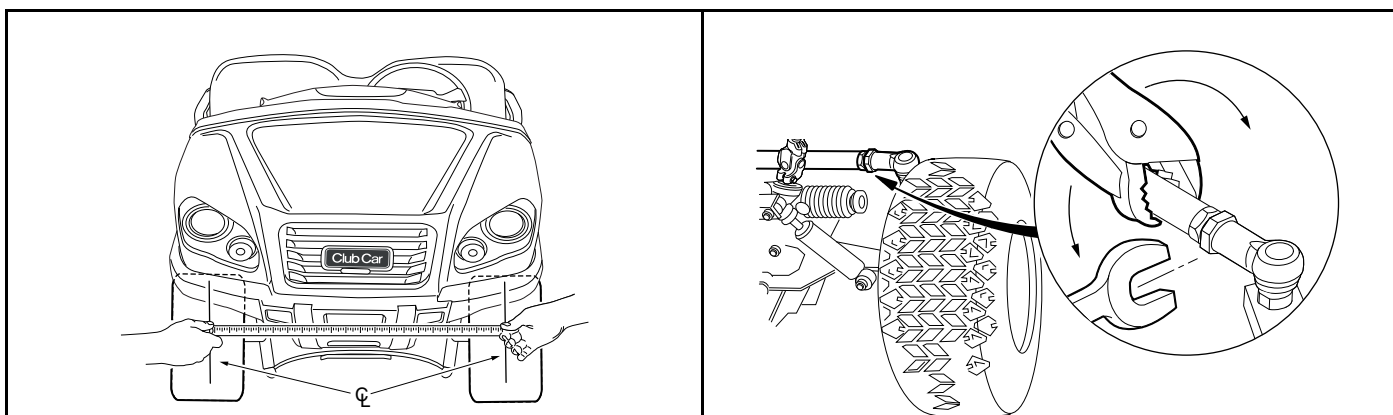
Figure 7-15 Adjust Camber

3. Loosen, but do not remove, the hex nut (8) on the adjustment eccentric (7) (**Figure 7-19, Page 7-18**) in the center of the spring. **See also Figure 7-15, Page 7-14.**
4. Use a 7 mm deep well socket to rotate the eccentric (**Figure 7-15, Page 7-14**).

5. After adjusting camber, tighten the four spring retaining nuts (32) (**Figure 7-19, Page 7-18**) to 23 ft·lb (31 N·m). Then roll the vehicle forward one full tire revolution and recheck the camber. Adjust as required. **See also Figure 7-14, Page 7-14.**
6. Tighten the hex nut (8) on the adjustment eccentric (7) to 23 ft·lb (31 N·m) (**Figure 7-19, Page 7-18**). **See also Figure 7-15, Page 7-14.**

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 a half wheel revolutions until the marks appear on the forward facing surfaces of the tires at about the same height from the floor (**Figure 7-16, Page 7-15**).



2870

Figure 7-16 Check Toe-In

2620

Figure 7-17 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 7-17, Page 7-15**). **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 7-6.*

FRONT SUSPENSION COMPONENTS

See General Warnings on page 1-2.

LEAF SPRING REMOVAL

1. Disconnect the battery cables and either discharge the controller or disconnect the spark plug wire(s). **See Disconnecting the Battery, Section 1, Page 1-3.**
2. Remove both front wheels. **See Wheel Removal, Section 8, Page 8-1.**
3. Remove the nuts (14) and bolts (25) from the bottom of each king pin (26) (**Figure 7-19, Page 7-18**).
4. Remove the four bolts (30), four nuts (32), four lock washers (31), and bottom spring plate (29).
5. Remove leaf spring (6).
6. Check the condition of the urethane bushings (27) and steel sleeves (28). Replace any that are worn or damaged.

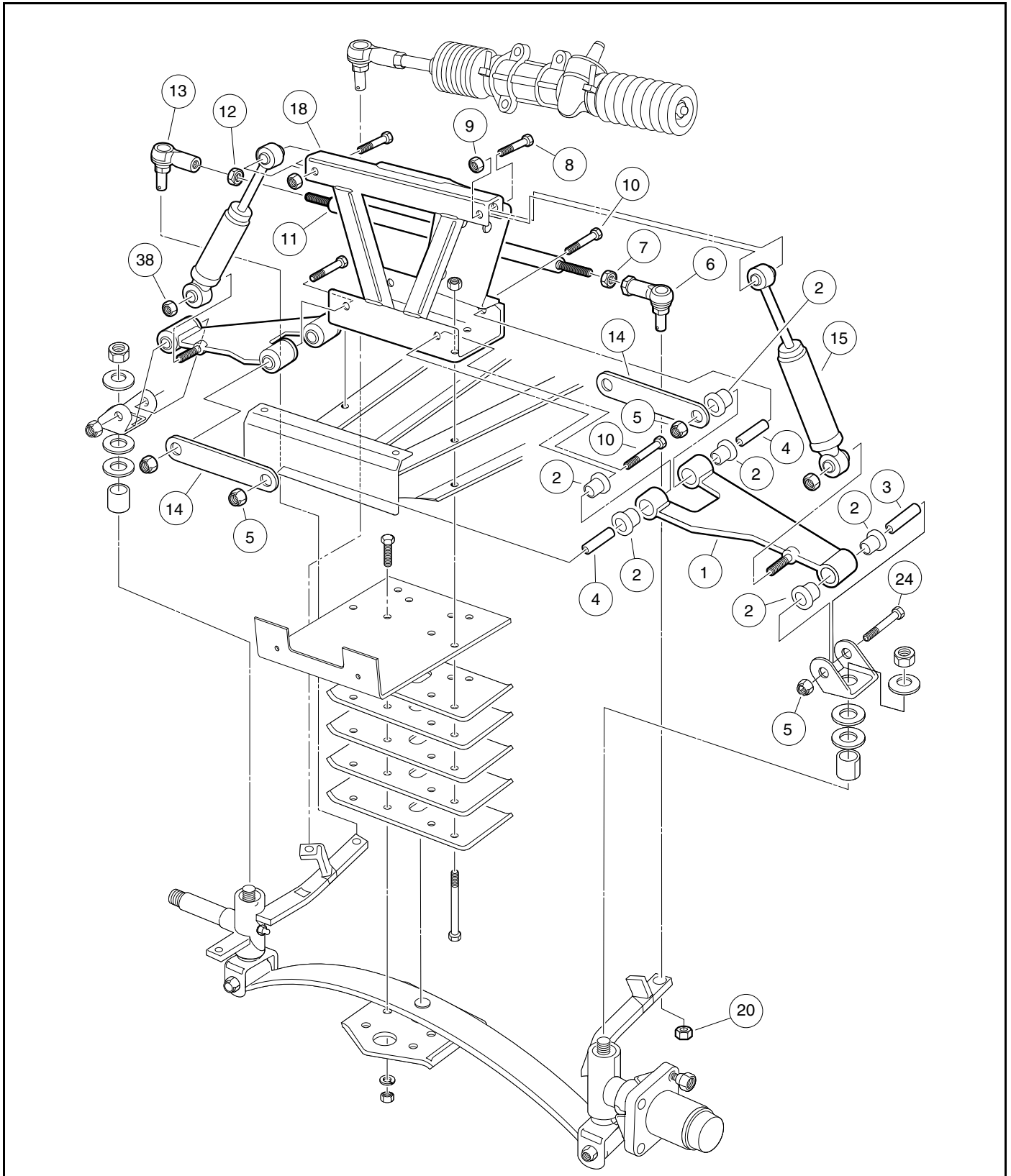
LEAF SPRING INSTALLATION

1. Install urethane bushings (27) and steel sleeves (28) into leaf spring eyes (**Figure 7-19, 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 17 ft·lb (23 N·m).
4. Install the wheels and lower the vehicle. **See Wheel Installation, Section 8, Page 8-1.**
5. Adjust camber and toe-in. **See Camber Adjustment on page 7-14 and Toe-in Adjustment on page 7-15.**

KINGPIN AND STEERING SPINDLE REMOVAL – MAINTENANCE-FREE BALL JOINTS

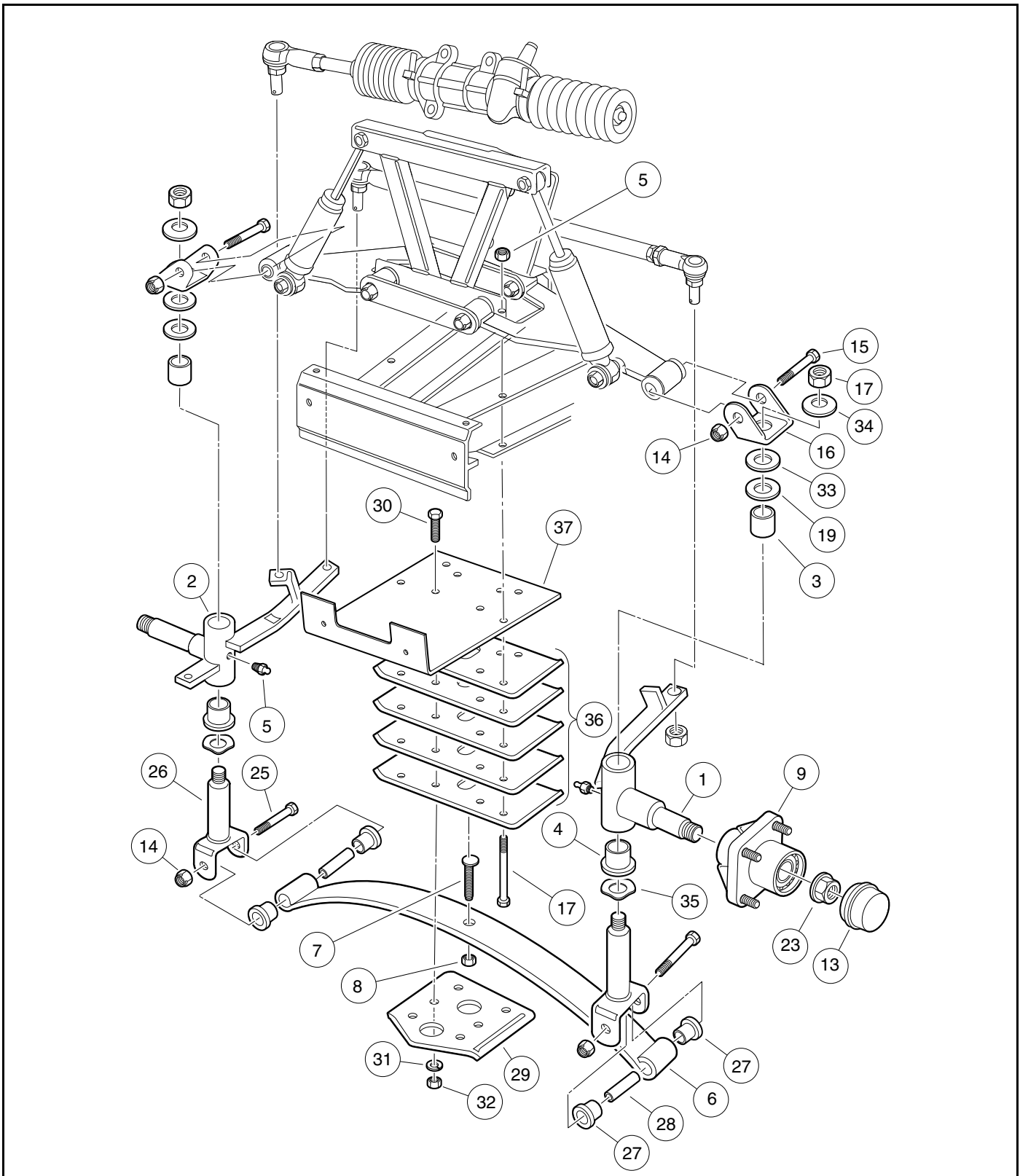
1. Remove the front hub. **See Front Hub Removal on page 7-20.**
2. Remove nuts (20) and remove ball joints from spindles (**Figure 7-18, Page 7-17**). Remove drag link ball joint. **See also Tie Rod and Drag Link Removal – Maintenance-Free Ball Joints on page 7-13.**
3. Remove the lock nut (17) and conical washer (34) from the top of the kingpin (26) (**Figure 7-19, Page 7-18**).
4. Raise the upper clevis (16) from the kingpin.
5. Remove the flat washer (33) and thrust washer (19).
6. Slide the spindle (1 or 2) off the kingpin (26).
7. Remove the wave washer (35) 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.
8. Remove bolt (25) and nut (14) from bottom of kingpin (26) and remove kingpin.
9. Inspect the kingpin and spindle. If either is worn or damaged, it must be replaced.
10. 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 from 0.750 to 0.752 (3/4 inch) (19.05 to 19.10 mm) in diameter. The reamer should be long enough to ream both bushings from one direction.



2610

Figure 7-18 Front Suspension – Upper Portion



2611

Figure 7-19 Front Suspension – Lower Portion

KINGPIN AND STEERING SPINDLE INSTALLATION – MAINTENANCE-FREE BALL JOINTS

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 7-19, Page 7-18**). Tighten the bolt to 17 ft·lb (23 N·m).
3. Install the wave washer (35).
4. Install the steering spindle on the kingpin. Then install the thrust washer (19), flat washer (33), upper plate clevis (16), conical washer (34), and nut (17). Tighten the nut to 65 ft·lb (88 N·m).
5. Attach the tie rod ball joints (6 and 13) to the spindle tabs, then install and tighten the nuts (20) to 40 ft·lb (54 N·m) (**Figure 7-18, Page 7-17**).
6. Install the drag link ball joint. **See Tie Rod and Drag Link Installation – Maintenance-Free Ball Joints on page 7-13.**
7. Install front hub and wheel. **See Front Hub Installation on page 7-20.**

DELTA A-PLATE REMOVAL

1. Remove front wheel(s). **See Wheel Removal, Section 8, Page 8-1.**
2. Remove bolts (10 and 24), A-Plate straps (14), and nuts (5) (**Figure 7-18, Page 7-17**).
3. Remove the lower shock absorber mounting nut (38), then slide the shock absorber (15) free of the Delta A-Plate (1).
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 (1) in reverse order of removal. Tighten the A-Plate suspension bolts (10 and 24) to 20 ft·lb (27 N·m) (**Figure 7-18, Page 7-17**).
2. Tighten shock absorber mounting nut (38) to 20 ft·lb (27.1 N·m).
3. Install the wheel(s). **See Wheel Installation, Section 8, Page 8-1.**
4. Adjust the wheel alignment. **See Wheel Alignment on page 7-14.**

SHOCK ABSORBER REMOVAL

1. Inspect the shock absorbers (15) for fluid leakage at the point where the shaft enters the shock absorber body. Leaking shock absorbers should be replaced.
2. Remove the nut (38) attaching the shock absorber to the A-Plate (1) (**Figure 7-18, Page 7-17**).
3. Remove the nut (9) and bolt (8) attaching the shock absorber to the shock and gear support (18).
4. Remove the shock absorber (15).

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 (9 and 38) to 20 ft·lb (27 N·m).

FRONT WHEEL BEARINGS AND HUBS

See General Warnings on page 1-2.

NOTE: *The front wheel bearings are pressed into the spindle and are not serviceable. If excessive free-play is detected the entire hub should be replaced.*

FRONT WHEEL FREE PLAY INSPECTION

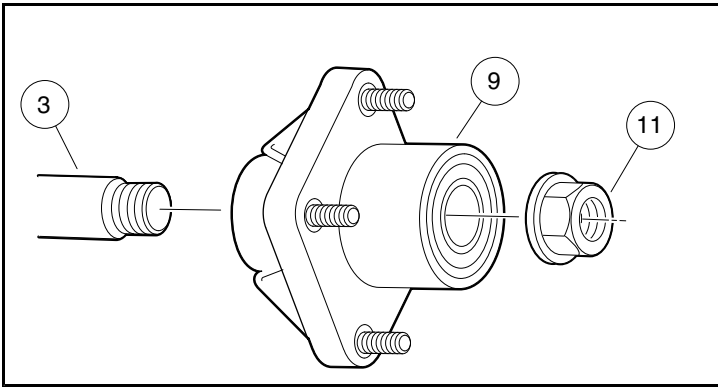
1. Raise the front of the vehicle.
2. Use your hands to attempt to rock the wheel and hub assembly back and forth on the spindle. Movement of the wheel and hub on the spindle indicates that the hub bearing is worn; therefore, the hub assembly must be replaced. **See Front Hub Removal on page 7-20.**

FRONT HUB REMOVAL

1. Remove the front wheels. **See Wheel Removal on page 8-1.**
2. Remove dust cap (12) and lock nut (11) (**Figure 7-20, Page 7-21**).
3. Slide the hub assembly (9) off of the spindle shaft (3).
4. Lightly sand spindle shaft to clean away any light rust.
5. Inspect the surface of the spindle shaft for surface damage. It should be clean and smooth. If severe pitting from rust or corrosion has occurred, replace the spindle assembly. **See Kingpin and Steering Spindle Removal – Maintenance-Free Ball Joints on page 7-16.**

FRONT HUB INSTALLATION

1. Clean and apply a light coat of anti-seize lubricant to the spindle shaft (3).
2. Slide the hub assembly (9) onto the spindle shaft (**Figure 7-20, Page 7-21**).
3. Install a new flanged lock nut (11) and tighten to 50 ft·lb (68 N·m).
4. Rotate the hub. The hub should rotate smoothly without binding, side play, or any indication of rough spots.
5. Repeat the procedure for the opposite wheel.
6. Install wheels and finger-tighten lug nuts.
7. Lower the vehicle and finish tightening lug nuts, using a crisscross pattern. **See Wheel Installation, Section 8, Page 8-1.**



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Figure 7-20 Front Wheel Hub

⚠ DANGER

- See General Warnings on page 1-2.

⚠ WARNING

- See General Warnings on page 1-2.

GENERAL INFORMATION

***NOTE:** Use only Club Car approved tires when replacing tires.*

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 Warnings on page 1-2.

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 Warnings on page 1-2.**
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 65 ft·lb (88 N·m).

TIRES

See General Warnings on page 1-2.

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.

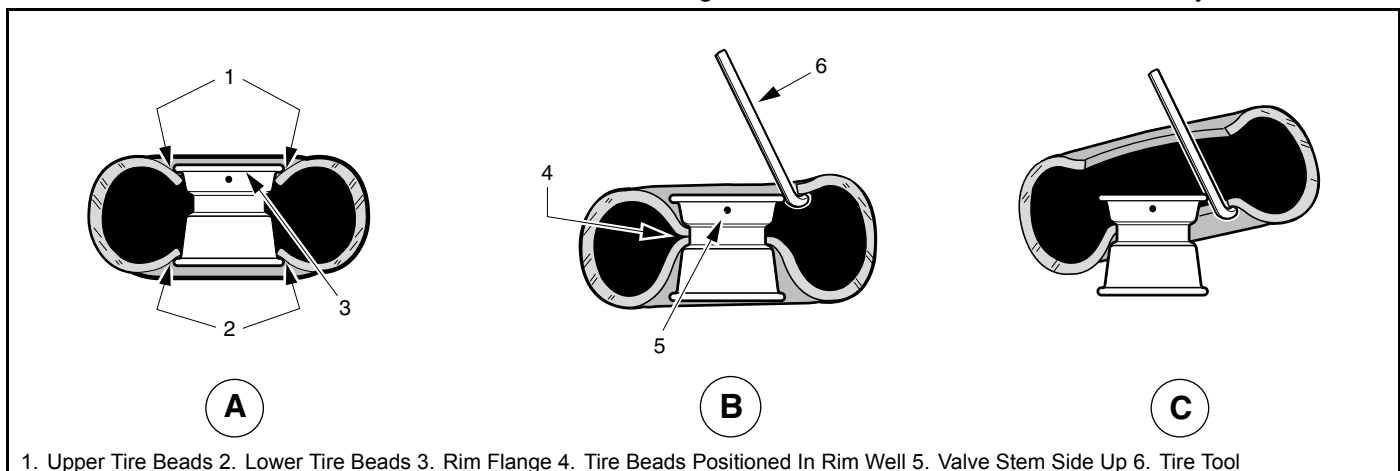


Figure 8-1 Tire Removal

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 (138 kPa).
 - 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 psig (689.5 kPa). 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.

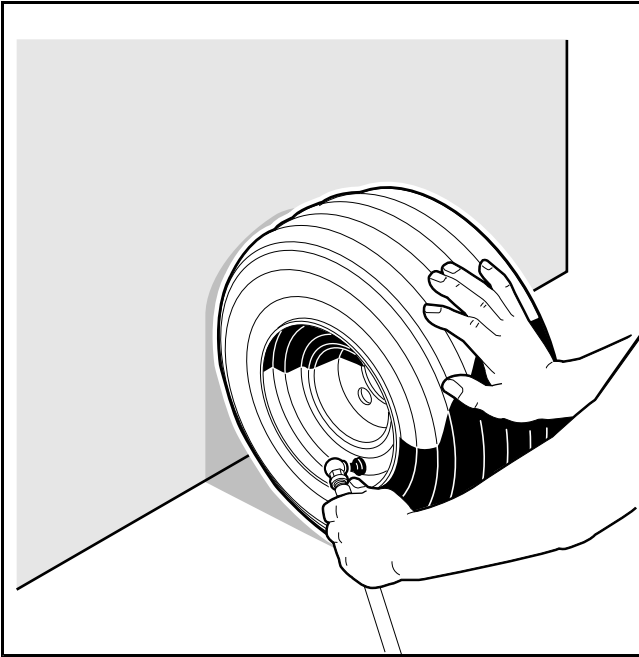


Figure 8-2 Inflate Tire

⚠ DANGER

- See General Warnings on page 1-2.

⚠ WARNING

- See General Warnings on page 1-2.

GENERAL INFORMATION

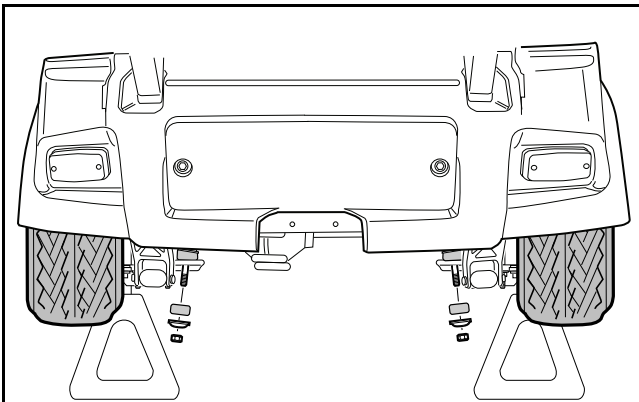
The rear suspension and powertrain of the vehicle move independently from the vehicle frame. It consists of two leaf springs controlled by two shock absorbers mounted between the springs and the vehicle frame.

SHOCK ABSORBERS

See General Warnings on page 1-2.

SHOCK ABSORBER INSPECTION AND REMOVAL

1. Check shock absorbers (19) for damage or fluid leakage at the point where the shaft enters the shock absorber body. Replace damaged or leaking shock absorbers (**Figure 9-1, Page 9-1**) and (**Figure 9-4, Page 9-5**).
2. To remove a shock absorber, remove the nut (1), cup washers (4) and rubber bushings (3) from the stem at the top of the shock absorber.
3. Remove lower mounting hardware (1, 3, and 4) on shock absorber lower mount.
4. Compress the shock absorber to remove it.



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Figure 9-1 Shock Absorber Removal

SHOCK ABSORBER INSTALLATION

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

NOTE: Tighten 3/8 hex nut at shock absorber until shock absorber cushions are approximately the same diameter as the retainers. Do not over tighten.

1. On the upper and lower shock absorber mounting stems, tighten the nut (1) until the rubber bushing (3) expands to the size of the cup washer (4).

MULTI-LEAF SPRINGS

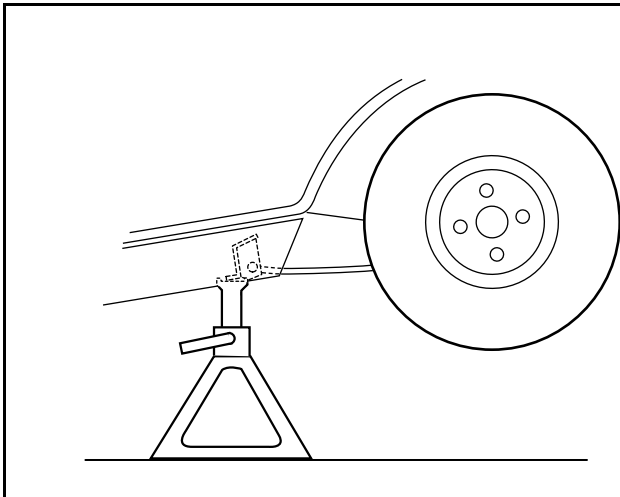
See General Warnings on page 1-2.

MULTI-LEAF SPRING REMOVAL

1. Disconnect the battery cables and either discharge the controller or disconnect the spark plug wire(s). **See Disconnecting the Battery, Section 1, Page 1-3.**
2. Loosen, but do not remove, lug nuts on tire and wheel assembly on the side from which the spring is to be removed. 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 the vehicle to let the jack stands support the vehicle (**Figure 9-2, Page 9-4**). **See following WARNING.**

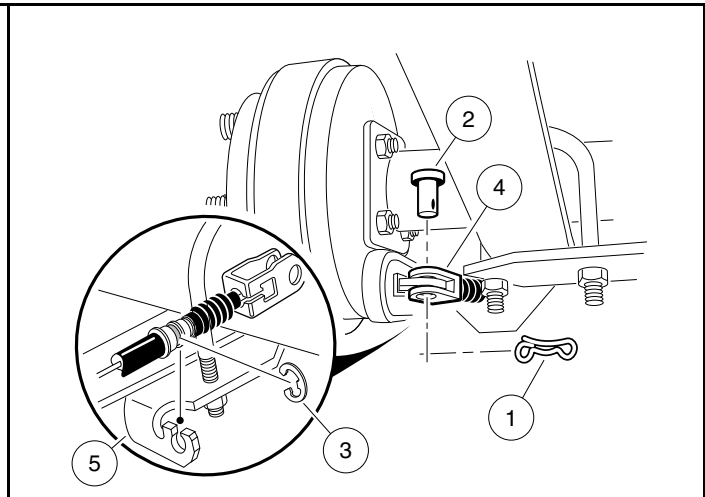
▲ WARNING

- **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. Place a floor jack under the transaxle differential casing to support (but not lift) the drivetrain. Raise it just enough to relieve tension on the shock absorbers without compressing them.
 4. Remove the tire and wheel assembly on the side from which the spring is to be removed.
 5. Remove the bow-tie pin (1) and the clevis pin (2) at the brake lever and brake cable connection and pull the clevis (3) away from the lever (**Figure 9-3, Page 9-4**). Detach the brake cable from the shock mount bracket (**Figure 9-2, Page 9-4**).
 6. Remove the nut (1), cup washers (4), and rubber bushings (3) from the lower mounting stem of the shock absorber (**Figure 9-4, Page 9-5**).
 7. Remove the nuts (7) and the U-bolt (9) securing the spring to the shock mounting bracket (16). Remove the shock mount bracket (6), angle bracket (8) and the U-bolt (**Figure 9-4, Page 9-5**).
 8. Remove the nut (11) and bolt (17) attaching the rear spring to the lower end of the shackle brackets (13).
 9. Remove the nut (11) and bolt (17) attaching the front of the spring to the vehicle frame and remove the spring.
 10. Inspect the bushings and spacers in the spring eyes and replace them if they are worn or damaged.



2600-30000-10369

Figure 9-2 Support Vehicle on Jack Stands



1400-18100-10243

Figure 9-3 Disconnect Brake Cable

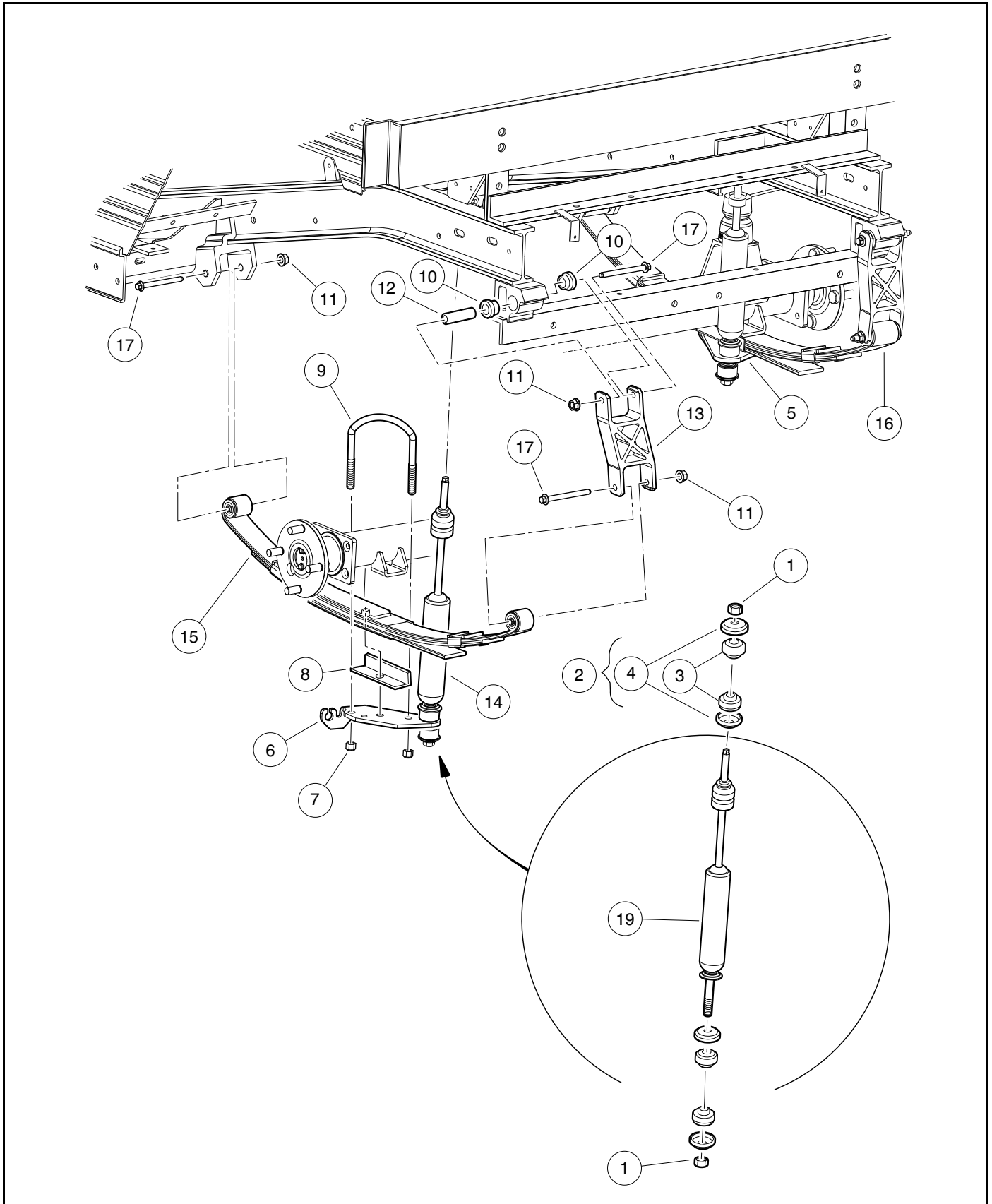
MULTI-LEAF SPRING INSTALLATION

NOTE: Tighten bolt (11) after clamp from brake cable has been positioned between nut and frame component.

1. Install the bushings and spacers in the spring eyes. **See following CAUTION.**

CAUTION

- When positioning the spring on the transaxle, be sure to insert the locating bolt on the spring in the locating hole in the transaxle saddle.
2. Install the nut (11) and bolt (17) attaching the front of the spring to the vehicle frame and install the spring.
 3. Install the nut (11) and bolt (17) attaching the rear spring to the lower end of the shackle brackets (13).
 4. Install the nuts (7) and the U-bolt (9) securing the spring to the shock mounting bracket (16). Install the shock mount bracket (6), angle bracket (13) and the U-bolt.
 5. Tighten the nuts (7) on the U-bolt (9) to 22 to 27 ft·lb (30 to 37 N·m).
 6. Install the nut (1), cup washers (4), and rubber bushings (3) to the lower mounting stem of the shock absorber
 7. Tighten nylon lock nuts (11) on spring mounting bolts (17) to 17 to 20 ft·lb (24 to 28 N·m) (**Figure 9-4, Page 9-5**).
 8. Tighten the nuts (1) until the rubber bushing (3) expands to the size of the cup washer (4).
 9. Connect the battery cables. **See Connecting the Battery, Section 1, Page 1-3.**



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Figure 9-4 Rear Suspension Assembly and Mounting

GENERAL INFORMATION

See General Warnings on page 1-2.

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 Schedule on page 10-3. Any problems should be corrected by a Club Car distributor/dealer or a trained technician.

Do not operate the vehicle until the upper cabinet, canopy, and windshield have been installed.

- **Safety Video:** Have all operators view the safety video that was provided with the vehicle and understand the safety warnings it illustrates before operating the vehicle.
- **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.
- **Windshield:** Ensure that the windshield is installed before driving the vehicle.
- **Safety and information decals:** Check to ensure that all safety and information decals are in place.
- **Tires:** Check for proper tire pressure upon delivery and on a daily basis when the vehicle is in service. **See Vehicle Specifications on page 2-1.**
- **Loading:** Before driving the vehicle, ensure that the load weight is evenly distributed in the Café Express refreshment center.
- **Battery:** Check electrolyte to ensure that it is at its proper level (**Figure 12-22**). Check battery posts. Wires should be tight and free of corrosion. On electric vehicles, charge batteries fully before first use of vehicle.
- **Engine:** Check for proper engine oil level. **See Engine Oil – Gasoline Vehicle on page 13-2.** Inspect air intake for blockage.
- **Fuel:** Check fuel level. **See Fueling Instructions – Gasoline Vehicle on page 14-23.** Check fuel tank, fuel injector, lines, cap, and pump for fuel leakage on a daily basis.
- **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 can 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.

- **Governor:** Check maximum speed of the vehicle. The vehicle should operate at 14 mph (23 km/h) or less on a level surface. With the neutral lockout switch in the MAINTENANCE position, check the maximum engine RPM with a tachometer. The correct setting for safe operation is 2350 RPM (± 30).
- **Forward/Reverse control:** Check for proper operation.
- **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.
- **Accelerator pedal:** 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.

MAINTENANCE

See General Warnings on page 1-2.

To ensure trouble-free vehicle performance, it is very important to follow an established preventive maintenance program. Regular and consistent vehicle maintenance can prevent vehicle downtime and expensive repairs that can result from neglect. Use the Pre-Operation and Daily Safety Checklist on page 10-1 and the following *Periodic Service Schedule* and *Periodic Lubrication Schedule* to keep the vehicle in proper working condition.

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 Club Car distributor/dealer to perform all repairs and semiannual and annual periodic service.

WARNING

- If any problems are found during scheduled inspection or service, do not operate the vehicle until repairs are made. Failure to make necessary repairs can result in fire, property damage, serious personal injury, or death.
- Only trained technicians should service or repair the vehicle. Anyone doing even simple repairs or service should have knowledge and experience in electrical and mechanical repair. The appropriate instructions must be used when performing maintenance, service, or accessory installation.
- Do not work on vehicle powertrain or under the cargo bed when it is loaded.
- Do not wear loose clothing or jewelry, such as rings, watches, chains, etc., when servicing the vehicle.
- Turn the key switch to OFF, remove the key, place the Forward/Reverse handle or switch in the NEUTRAL position, and chock tires prior to servicing.
- Do not close bed until all persons are clear of the bed area. Failure to follow these instructions can result in serious personal injury.
- Moving parts: Do not attempt to service gasoline vehicle while the engine is running.
- Hot! Do not attempt to service hot engine or exhaust system. Failure to heed this warning can result in serious burns.
- To avoid unintentionally starting the vehicle, disconnect battery and spark plug wire. See Disconnecting the Battery on page 1-3.
- Frame ground – Do not allow tools or other metal objects to contact frame when disconnecting batteries or other electrical wiring. Never allow a positive wire to touch the vehicle frame, engine, or other metal component.

PERIODIC SERVICE SCHEDULE

See General Warnings on page 1-2.

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 can result in fire, property damage, serious 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.*

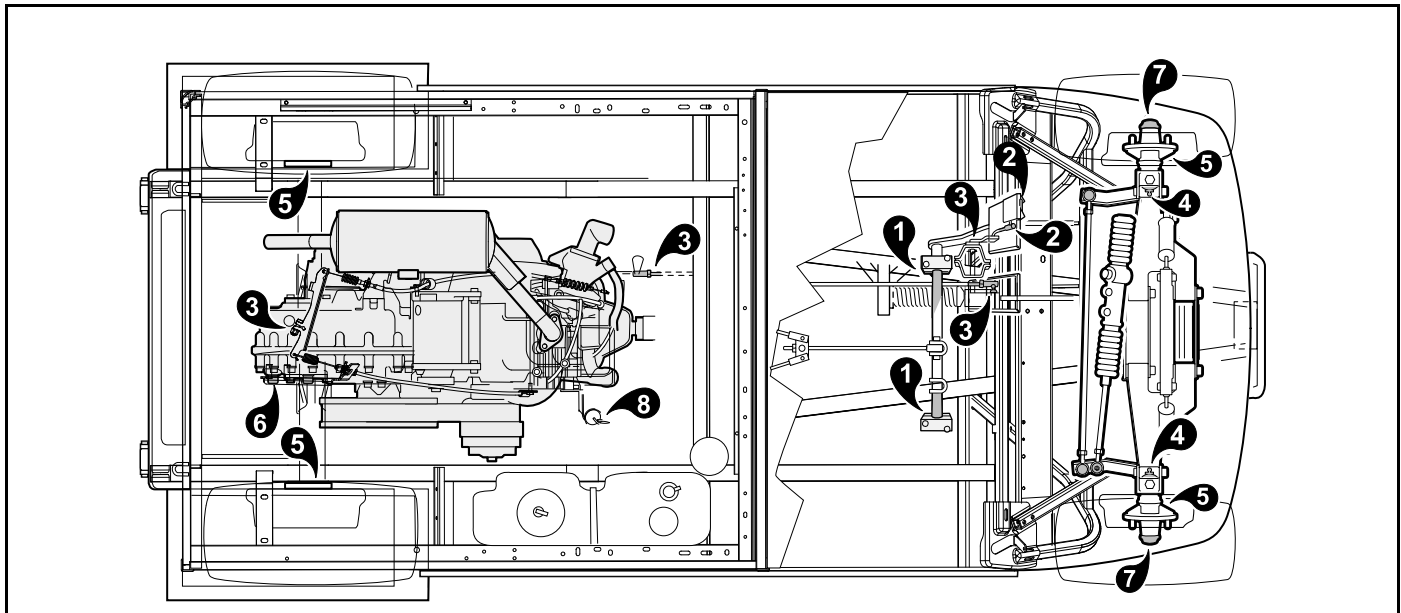
Both the Periodic Service Schedule and the Periodic Lubrication Schedule must be followed to keep vehicle in optimum operating condition.

TABLE CONTINUED ON NEXT PAGE

PERIODIC SERVICE SCHEDULE		
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.
	Tires	Check air pressure and adjust if necessary. See Vehicle Specifications on page 2-1.
Monthly service by owner or trained technician	Engine	Check engine oil level; change if necessary. See Periodic Lubrication Schedule on page 10-5. 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.
	General vehicle	Wash engine compartment and underside of vehicle. Do not wash engine when hot.
	Door locks	Lubricate with a dry lubricant.
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 (Figure 12-22).
	Front wheel alignment and camber	Check and adjust if necessary. See Steering and Front Suspension section in the maintenance and service manual.
	Electrical wiring and connections	Check for tightness and damage.
	Brake system	Check brake shoes; replace if necessary or adjust as required.
		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.
	Safety decals	Check safety decals. Replace if damaged or illegible.
Two-year service by trained technician only.	Engine	Check and adjust valve lash as needed.

PERIODIC LUBRICATION SCHEDULE

PERIODIC LUBRICATION SCHEDULE			
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 (CC PN 1012151)
	Brake linkage and pivots	2	Dry Moly Lube (CC PN 1012151)
	Accelerator pivot rod supports and shifter cable pivots	3	Dry Moly Lube (CC PN 1012151)
	Front suspension	4	Chassis Lube (EP NLGI Grade 2)
	Brake slides	5	Dry Moly Lube (CC PN 1012151)
Annually by trained technician only (or every 100 hours of operation, whichever comes first)	Transaxle: Check/fill to plug level	6	67.6 fl-oz (2 L) SAE 80W-90 API Class GL-5
	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	8	40.5 fl-oz (1.2 L) 10W-30 or 5W-30 grade SE or higher See also Figure 13-3, Page 13-5.



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Figure 10-1 Lubrication Points

⚠ DANGER

- See General Warnings on page 1-2.

⚠ WARNING

- See General Warnings on page 1-2.

GENERAL INFORMATION

⚠ WARNING

- To prevent damage to the ECU, never mix the black and gray connectors that attach to it. The black connector is tethered to the ECU mounting plate to help prevent accidentally installing it in the gray port.

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.

ACCESSORIES

For powered accessories that do not need to be controlled by the key switch, use the red/white and black/yellow wires with female, quick-disconnect terminals located behind the instrument panel.

LOW OIL WARNING LIGHT

NOTE: *When the key switch is placed in the ON position, the Low Oil Warning Light will illuminate for approximately 3 seconds as a bulb check function.*

The gasoline vehicle is equipped with a low oil warning light (4), located at the top of the instrument panel. If the warning light comes on, oil should be checked and added to the engine as necessary before continuing to use the vehicle. **See following CAUTION.** The vehicle should never be driven when the low oil warning light remains on. If the warning light goes on and off, the vehicle may be driven, but oil should be added at the first opportunity. The light will flash repeatedly to indicate a possible problem with the electronic fuel injection (EFI) system. If the oil level is correct and the warning light stays on, have a trained technician check the vehicle.

CAUTION

- Failure to add oil immediately when the low oil warning light stays on may result in permanent engine damage.

GROUND LOCATIONS

Electrical grounds are located at the following areas:

- **Below the Battery:** The battery, starter/generator, voltage regulator and main wire harness are all grounded to the chassis on the frame rail below the battery.
- **In Front of Engine:** The engine is grounded to the chassis cross-member with an un-insulated, braided wire.
- **Top of Fuel Tank:** The fuel tank is grounded to the chassis through the main wire harness.

FEATURES OF THE ELECTRONIC FUEL INJECTION (EFI) SYSTEM

- Open-loop system (i.e. oxygen sensor not used)
- Controls fuel pump, fuel injector, oil lamp
- Inputs: MAP, engine block temperature, ignition timing
- Blink fault codes through the Low Oil Warning Lamp
- Separate EFI wire harness
- The ECU and throttle body/fuel injector assembly are matched pairs

TROUBLESHOOTING GUIDE

The following troubleshooting guides will be helpful in identifying operating difficulties should they occur. The guides include 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.

ECU ERROR CODES (DISPLAYED BY THE LOW OIL WARNING LIGHT)

Failure Mode Table – When Ignition Is Initially Switched ON

DISPLAY MODE	CONDITION	LAMP CONTROL
Blink Code	No Failure	Step 1: Lamp ON Two Seconds
		Step 2: Lamp OFF Four Seconds
		Step 3: Lamp OFF
	Detect Failure	Step 1: Lamp ON Two Seconds
		Step 2: Lamp OFF Four Seconds
		Step 3: Display Blink Code

Failure Mode Table – After Ignition Has Been In ON Position (i.e. During Use of Vehicle)

DISPLAY MODE	CONDITION	LAMP CONTROL
Blink Code	No Failure	Step 1: Lamp OFF
	Detect Failure	Step 1: Lamp OFF Four Seconds
		Step 2: Display Blink Code

Error Codes – ECU

BLINK CODE	CODE DESCRIPTION	CORRECTIVE ACTION
21	Low Battery Voltage	Check battery voltage. Charge/replace battery as necessary.
22	MAP Sensor: Open or Shorted Connection	Check connector at ECU & Throttle module. If connection is made and no corrosion is present, replace ECU and Throttle Module.
23	Temperature Sensor: Open or Shorted Connection	Check connector at ECU & Throttle module. If connection is made and no corrosion is present, replace ECU and Throttle Module.
31	Fuel Pump: Open Connection	Check fuel pump and fuel system. Check electrical connections at ECU, Throttle module and fuel pump.
41	Fuel Injector: Open Connection	Check connector at ECU & Throttle module. If connection is made and no corrosion is present, replace ECU and Throttle Module.
51	Ignition Pulse: Open Connection	Check spark plug, coil, ECU. Replace failed components.

GASOLINE POWERTRAIN

TROUBLESHOOTING GUIDE		
SYMPTOM	POSSIBLE CAUSES	CORRECTIVE ACTION
Engine does not start easily.	Spark plug is partially fouled or in poor condition	Clean or replace
	Spark plug is damaged or loose	Replace or tighten
	Incorrect spark plug gap	Adjust gap
	Spark plug wire is damaged or loose	Replace or reconnect
	Loose wire connection at ignition coil	Test Procedures 15 – <i>Ignition Spark</i> and 16 – <i>Ignition Coil</i>
	Intermittent ignition coil failure	Test Procedures 15 – <i>Ignition Spark</i> and 16 – <i>Ignition Coil</i>
	Low fuel level in fuel tank	Refill
	Fuel line pinched or clogged	Clean or replace
	Poor fuel quality or contaminated fuel	Replace
	Water or dirt in the fuel system and/or throttle body/fuel injector; dirty or clogged fuel filter	See Section 14 – Fuel System: Gasoline Vehicles.
	Throttle body dirty or improperly adjusted	Clean or adjust. See Section 14 – Fuel System: Gasoline Vehicles.
	Low cylinder compression	See Section 13 – Engine (Subaru EX40).
	Cylinder head bolts not tighten properly	Check and retighten. See Section 13 – Engine (Subaru EX40).
	Intake or exhaust valve not sealing	Repair. See Section 13 – Engine (Subaru EX40).
	Incorrect valve clearance	Adjust. See Section 13 – Engine (Subaru EX40).
Vacuum leak	Retighten hardware or replace gasket(s)	
Starter/generator belt is slipping	Belt Tension Adjustment on page 12-11	
Engine starts but does not run smoothly.	Spark plug is fouled or in poor condition	See Section 13 – Engine (Subaru EX40).
	Spark plug wire is damaged or loose	See Section 13 – Engine (Subaru EX40).
	Intermittent ignition coil failure	Test Procedures 15 – <i>Ignition Spark</i> and 16 – <i>Ignition Coil</i>
	Water or dirt in the fuel system and/or throttle body/fuel injector; dirty or clogged fuel filter	See Section 14 – Fuel System: Gasoline Vehicles.
	Fuel pump malfunction; fuel pressure to throttle body too low	See Section 14 – Fuel System: Gasoline Vehicles.

TABLE CONTINUED ON NEXT PAGE

TROUBLESHOOTING GUIDE		
SYMPTOM	POSSIBLE CAUSES	CORRECTIVE ACTION
Engine turns but fails to start.	Fuel tank is empty	See Section 14 – Fuel System: Gasoline Vehicles.
	Fuel line or filter clogged	See Section 14 – Fuel System: Gasoline Vehicles.
	Fouled spark plug	See Section 13 – Engine (Subaru EX40).
	Spark plug wire damaged or loose	See Section 13 – Engine (Subaru EX40).
	Loose wire connection at ignition coil	Test Procedures 15 – <i>Ignition Spark</i> and 16 – <i>Ignition Coil</i>
	Ignition coil failed	Test Procedures 15 – <i>Ignition Spark</i> and 16 – <i>Ignition Coil</i>
	Kill circuit grounded	Test Procedures 14 – <i>Kill Limit Switch – Pedal-Start Vehicles Only</i> and 6 – <i>Key Switch (Engine Kill Circuit)</i>
	Fuel pump malfunction or failure	See Section 14 – Fuel System: Gasoline Vehicles.
Engine overheats.	Fan screen is partially blocked or plugged	See Section 13 – Engine (Subaru EX40).
	Governor is improperly adjusted	See Section 14 – Fuel System: Gasoline Vehicles.
	Excessive back pressure in exhaust	Check and clean or replace
	Fuel/air mixture is too lean; check EFI	See Section 14 – Fuel System: Gasoline Vehicles.
	Overloading	Reduce to rated load
	Poor quality engine oil	Replace
Engine pre-ignites.	Excessive carbon deposits on piston head or in combustion chamber	See Section 13 – Engine (Subaru EX40).
	Spark plug heat range is incorrect	See Section 13 – Engine (Subaru EX40).
	Unsuitable or contaminated fuel	See Section 14 – Fuel System: Gasoline Vehicles.
Loss of engine power.	Exhaust valve is restricted with carbon deposit	See Section 13 – Engine (Subaru EX40).
	Muffler or exhaust pipe restricted with carbon or other substance	See Section 15 – Exhaust System: Gasoline Vehicles.
	Ignition coil failed	Test Procedures 15 – <i>Ignition Spark</i> and 16 – <i>Ignition Coil</i>
	Air filter is dirty or clogged	See Section 14 – Fuel System: Gasoline Vehicles.
	Governor is improperly adjusted	See Section 14 – Fuel System: Gasoline Vehicles.
	Throttle linkage out of adjustment	See Section 14 – Fuel System: Gasoline Vehicles.
	Low cylinder compression	See Section 13 – Engine (Subaru EX40).

TABLE CONTINUED ON NEXT PAGE

TROUBLESHOOTING GUIDE		
SYMPTOM	POSSIBLE CAUSES	CORRECTIVE ACTION
	Spark plug failed	See Section 13 – Engine (Subaru EX40).
	Restricted fuel flow	See Section 14 – Fuel System: Gasoline Vehicles.
	Torque converter is not backshifting properly	See Section 16 – Clutches: Gasoline Vehicles.
Spark plug fouls repeatedly.	Incorrect plug	See Section 13 – Engine (Subaru EX40).
	Spark plug wire is damaged	See Section 13 – Engine (Subaru EX40).
	Unsuitable fuel, or incorrect (rich) fuel mixture	See Section 14 – Fuel System: Gasoline Vehicles.
	Ignition coil failed	Test Procedures 15 – <i>Ignition Spark</i> and 16 – <i>Ignition Coil</i>
	Dirt entering combustion chamber	Check intake system for leaks. See Section 14 – Fuel System: Gasoline Vehicles.
	Rings are heavily worn, low cylinder pressure	See Section 13 – Engine (Subaru EX40).
Starter fails to operate.	Neutral lockout switch is in the MAINTENANCE position	Place switch in the OPERATE position.
	Fuse is blown	Test Procedure 2 – <i>Fuses, ATM- and ATC-style</i>
	Battery is dead	Test Procedure 1 – <i>Battery</i>
	Starter control circuit is not operating	Test Procedure 5 – <i>Key Switch (Start Circuit)</i>
	Starter/generator failed	Test Procedure 12 – <i>Starter/Generator (Starter Function)</i>
	Starter solenoid failed	Test Procedure 8 – <i>Solenoid</i>
	Accelerator pedal limit switch failed	Test Procedure 7 – <i>Accelerator Pedal Limit Switch – Pedal-Start Vehicles Only</i>
	Key switch failed	Test Procedure 5 – <i>Key Switch (Start Circuit)</i>
	Neutral lockout limit switch failed	Test Procedure 10 – <i>Neutral Lockout Limit Switch – Pedal-Start Vehicles Only</i>
	Loose or broken wire in starter/generator circuit	See Section 12 – Electrical Components: Pedal-Start Gas Vehicle. Starter/Generator on page 12-1
	Cylinder and/or crankcase flooded with fuel	See Section 14 – Fuel System: Gasoline Vehicles.

TABLE CONTINUED ON NEXT PAGE

TROUBLESHOOTING GUIDE		
SYMPTOM	POSSIBLE CAUSES	CORRECTIVE ACTION
Starter/generator does not charge battery.	Loose or broken wire in the starter/ generator circuit	Test Procedure 11 – <i>Starter/Generator (Generator Function)</i>
	Generator field coil is shorted	Test Procedure 11 – <i>Starter/Generator (Generator Function)</i>
	Brushes are worn or commutator is dirty	See Section 12 – Electrical Components: Pedal-Start Gas Vehicle. Starter/Generator on page 12-1
	Starter/generator belt is loose or slipping	See Section 12 – Electrical Components: Pedal-Start Gas Vehicle. Belt Tension Adjustment on page 12-11
	Voltage regulator failed	Test Procedure 13 – <i>Voltage Regulator</i>
	Battery failed	Test Procedure 1 – <i>Battery</i>
Transmission does not engage or disengage smoothly.	Transmission shifter linkage is binding or is out of adjustment	See Section 17 – Transaxle (ED65): Gasoline Vehicles.
	Insufficient (low) level of lubricant or wrong type of lubricant in transmission	See Section 17 – Transaxle (ED65): Gasoline Vehicles.
	Internal gears are damaged or worn	See Section 17 – Transaxle (ED65): Gasoline Vehicles.
	Dog clutch jammed or broken	See Section 17 – Transaxle (ED65): Gasoline Vehicles.
Excessive vehicle vibration.	Engine mounting nuts or bolts are loose	See Section 13 – Engine (Subaru EX40).
	Snubber on frame is worn or damaged	See Section 13 – Engine (Subaru EX40).
	Loose muffler mounting hardware	See Section 15 – Exhaust System: Gasoline Vehicles.
	Damaged drive belt or starter belt	See Section 16 – Clutches: Gasoline Vehicles.
	Damaged drive clutch	See Section 16 – Clutches: Gasoline Vehicles.
	Damaged starter/generator pulley	See Section 12 – Electrical Components: Pedal-Start Gas Vehicle. Starter/Generator on page 12-1
	RPM setting is incorrect	See Section 14 – Fuel System: Gasoline Vehicles. Engine RPM Adjustment on page 14-11
Clutches do not shift smoothly.	Drive belt is worn, cracked, glazed, or frayed	See Section 16 – Clutches: Gasoline Vehicles.
	Drive clutch malfunction	See Section 16 – Clutches: Gasoline Vehicles.
	Governor is sticking	See Section 17 – Transaxle (ED65): Gasoline Vehicles.

TABLE CONTINUED ON NEXT PAGE

TROUBLESHOOTING GUIDE		
SYMPTOM	POSSIBLE CAUSES	CORRECTIVE ACTION
Engine won't stop running.	Kill circuit wire is disconnected from the ignition coil	Test Procedure 14 – Kill Limit Switch – Pedal-Start Vehicles Only
	Accelerator pedal linkage out of adjustment causing engine kill limit switch not to activate	See Section 14 – Fuel System: Gasoline Vehicles.
	Fuel mixture is too lean; check EFI	See Section 14 – Fuel System: Gasoline Vehicles.
	Throttle stop screw out of adjustment at governor arm	See Section 14 – Fuel System: Gasoline Vehicles.

WIRING DIAGRAMS

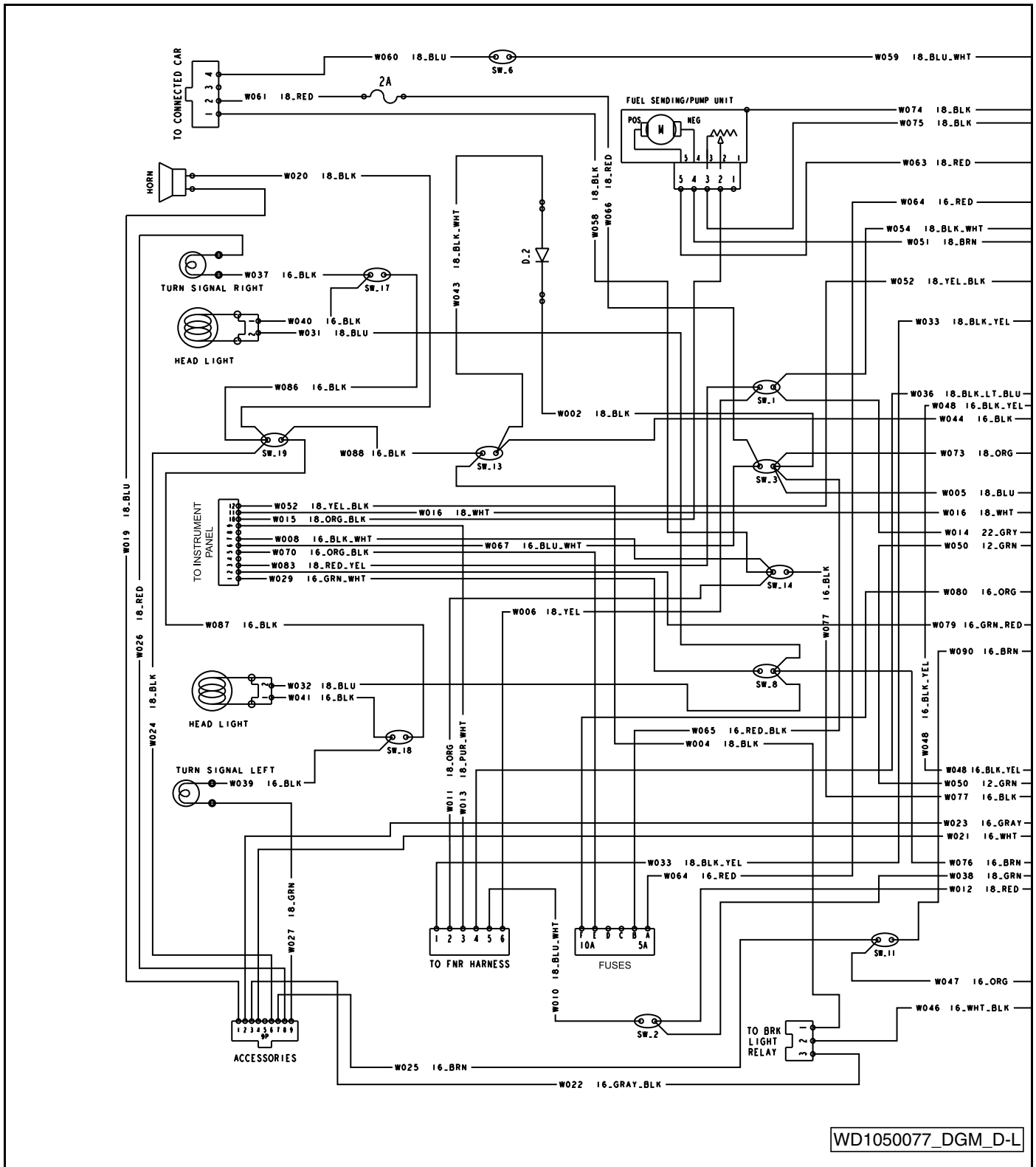


Figure 11-1 Wiring Diagram for Pedal-Start Gasoline Vehicle

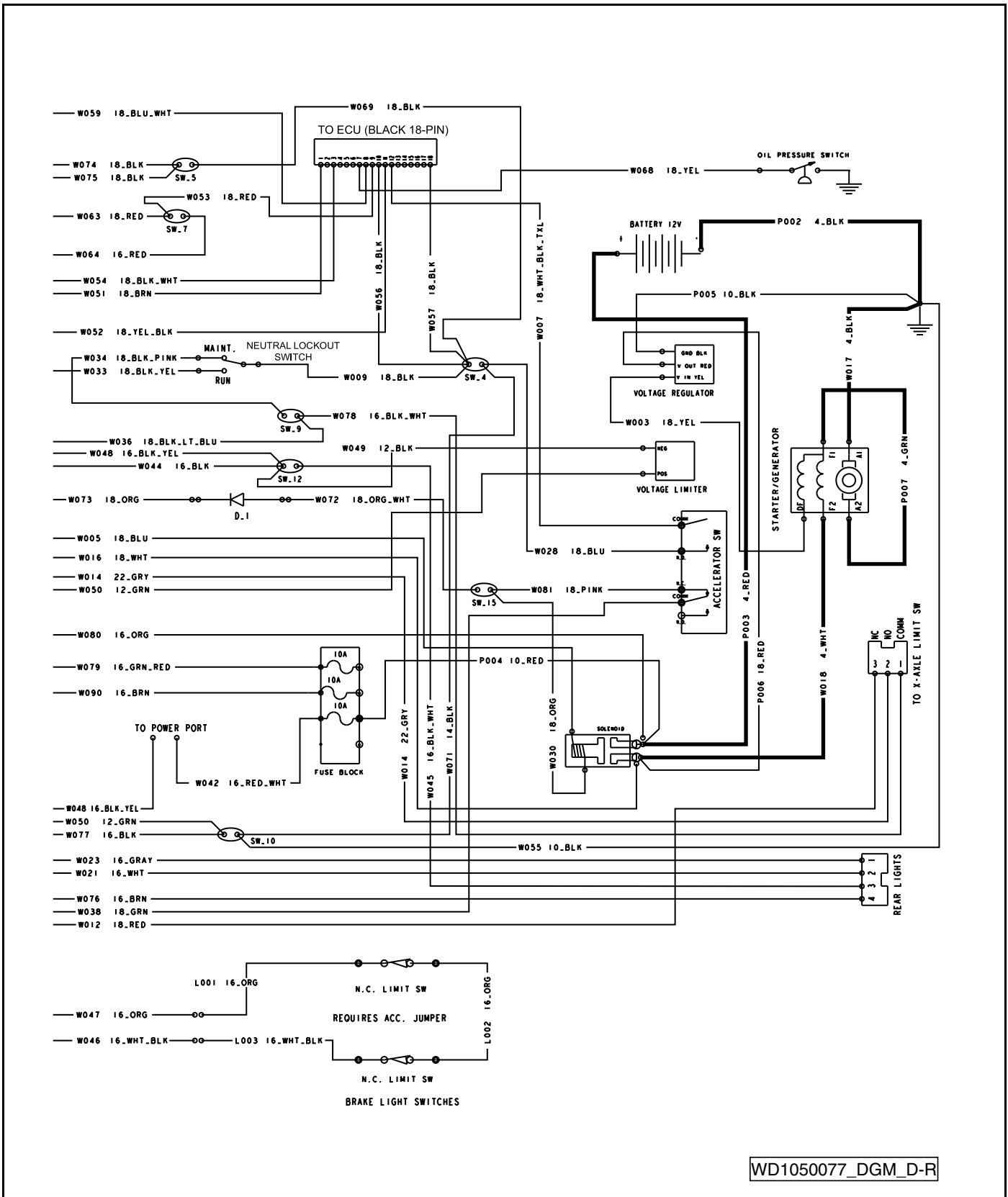


Figure 11-2 Wiring Diagram for Pedal-Start Gasoline Vehicle – Continued

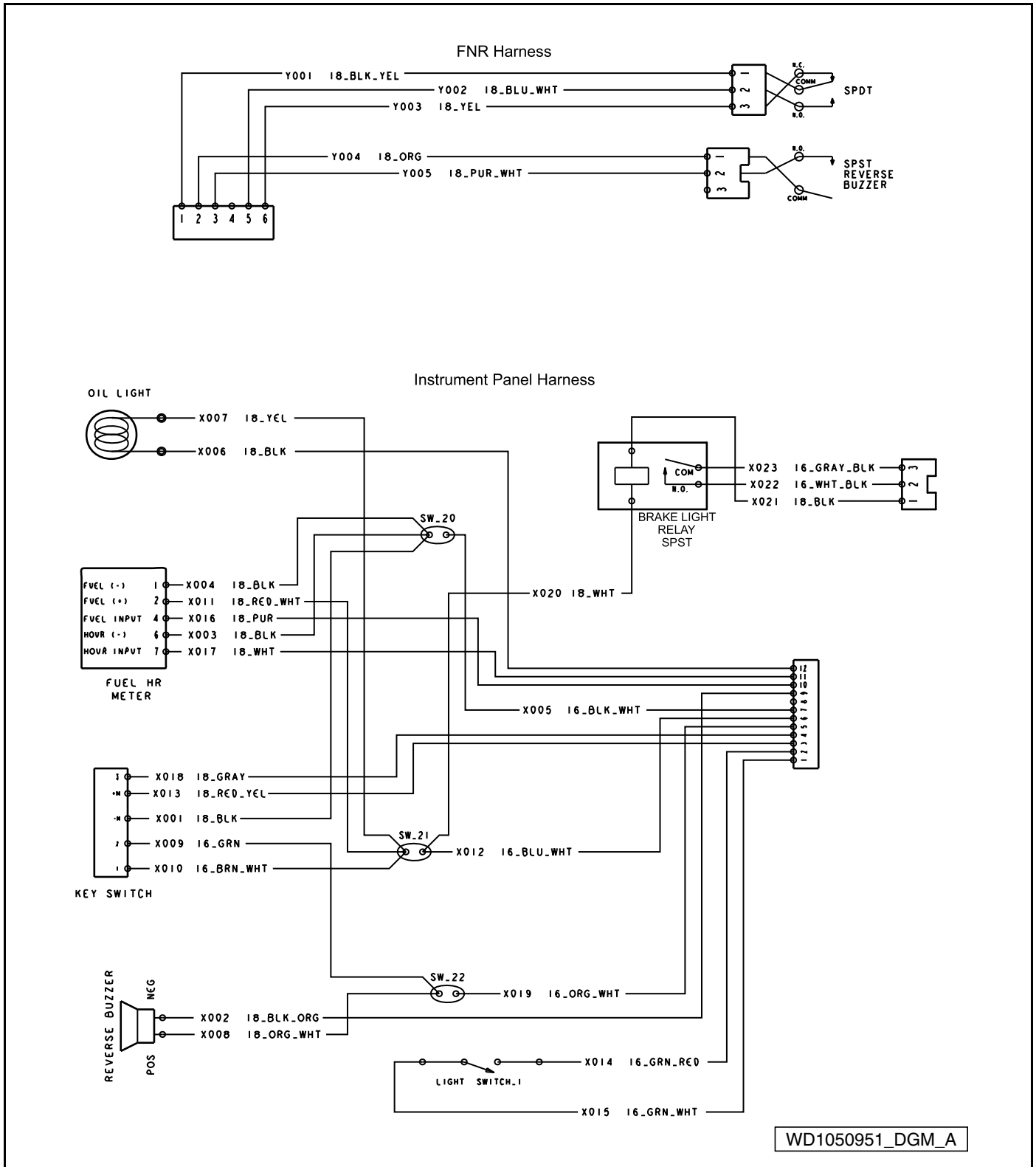
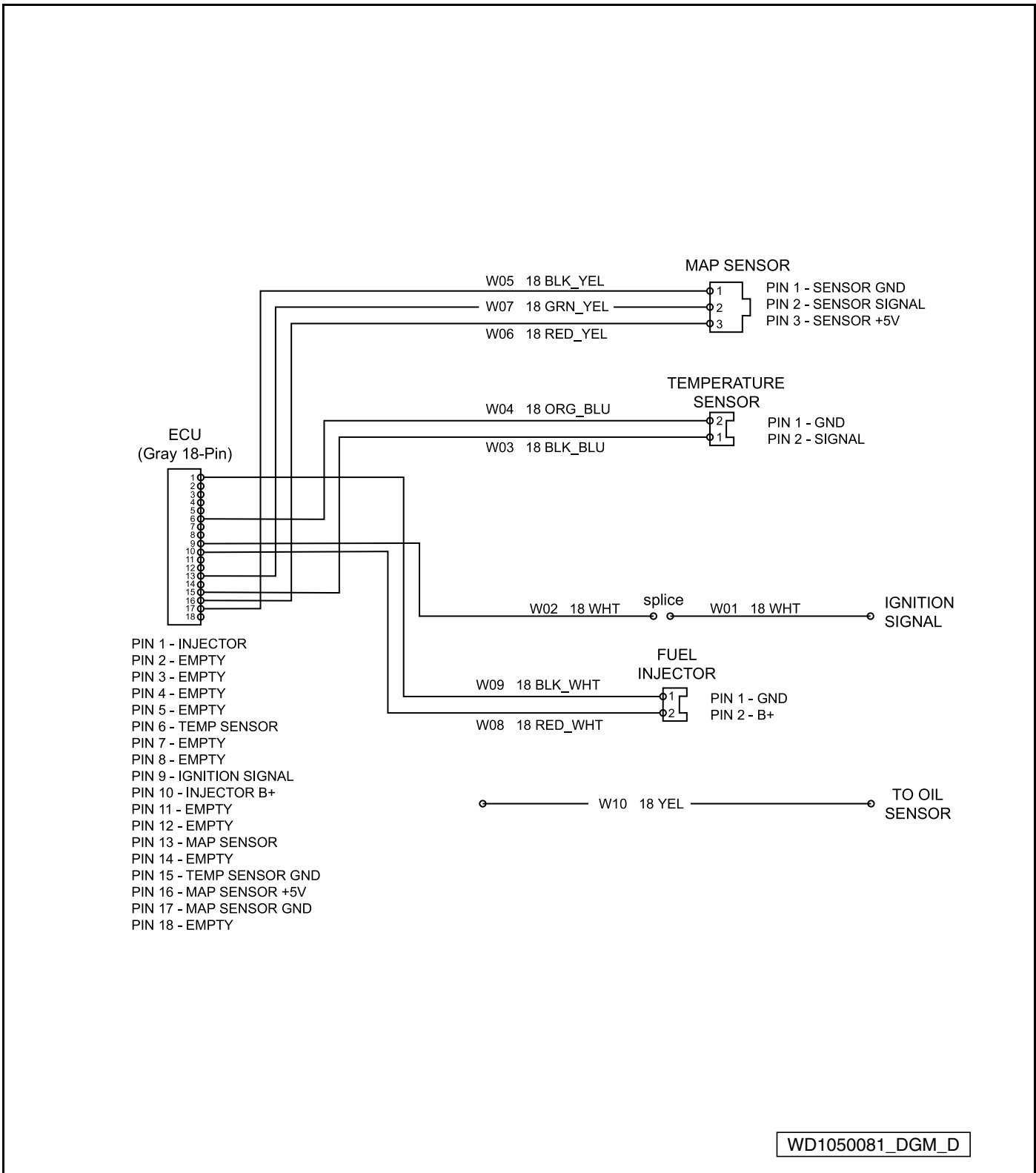


Figure 11-3 Wiring Diagram – Instrument Panel and FNR Shifter



WD1050081_DGM_D

Figure 11-4 Wiring Diagram – EFI and Engine

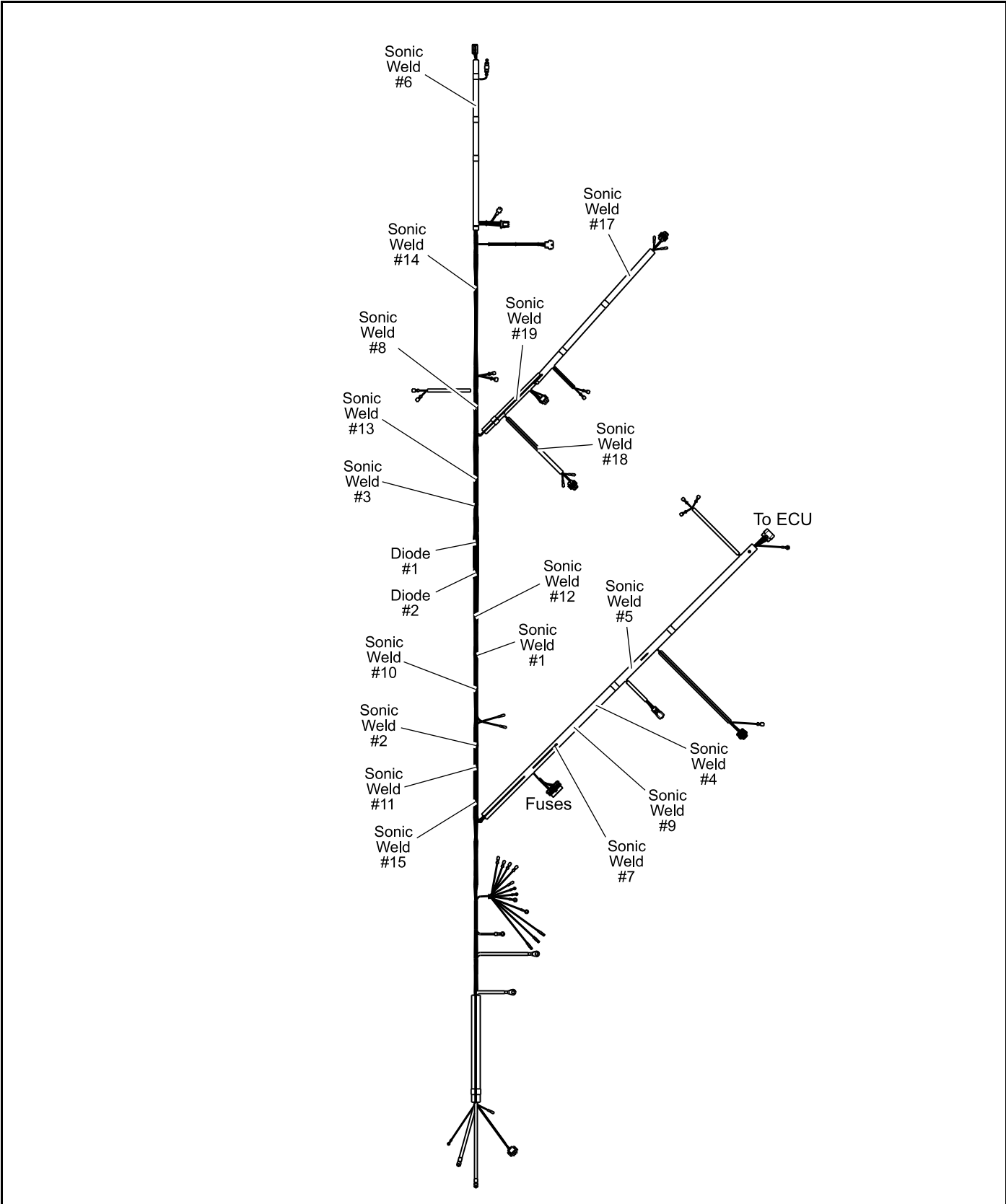


Figure 11-5 Sonic Weld and Diode Locations (Approximate) – CA500/550/Cafe Express

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
- Electronic Fuel Injection Circuit
- Engine Ignition Circuit
- Engine Kill Circuit
- Reverse Buzzer Circuit
- Low Oil Warning Light Circuit
- Neutral Lockout Circuit
- Fuel Pump 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 11-15.**

For a complete wiring diagram, see Wiring Diagram for Pedal-Start Gasoline Vehicle on page 11-9.

TEST PROCEDURES

Using the following procedures, the entire electrical system can be tested without major disassembly of the vehicle.

⚠ WARNING

- **If wires are removed or replaced, make sure wiring and wire harness is properly routed and secured. Failure to properly route and secure wiring could result in vehicle malfunction, property damage, personal injury, or death.**

For some tests, the electrical component box cover must be removed to gain access to the various components that are mounted inside the component box. **See following WARNING.**

⚠ WARNING

- **Shorting of battery terminals can cause personal injury or death.**

After test procedures are completed, be sure to replace the cover. **See following CAUTION.**

CAUTION

- **Exposure to water and the elements may damage electrical components. Do not operate vehicle without the cover properly installed.**

TESTING BASICS

- Battery voltage will be referenced throughout the test procedures. Battery voltage is accessed in **Test Procedure 1 – Battery on page 11-17.**
- The MAINTENANCE/OPERATE switch, in the MAINTENANCE position, grounds and kills the ignition if the FNR shifter is placed in FORWARD or REVERSE.
- The key switch powers the ECU, fuel pump, solenoid, lights, and the connected car device.
- The 2-amp fuse is powered by the key switch via the 10-amp ATM fuse and carries battery voltage to the connected car device.
- The term “back-probe” refers to probing the side of a connector that the wire enters. This is usually done when the connector must remain connected to a device. An alternative method is to use an insulation-piercing probe. **See following CAUTION.**

CAUTION

- **Be careful not to damage the wire or terminal when back-probing.**
- When testing voltage, the battery must remain connected.
- When testing voltage, unless specifically directed to do otherwise in a procedure, connect the black (–) probe of the multimeter to chassis ground.
- When testing resistance or continuity, turn off power to the circuit being measured and discharge any capacitor(s). The presence of voltage can cause inaccurate readings.

Index of Test Procedures

- 1 – Battery
- 2 – Fuses, ATM- and ATC-style
- 3 – Ground Cables
- 4 – EFI System (ECU and Sensors)
- 5 – Key Switch (Start Circuit)
- 6 – Key Switch (Engine Kill Circuit)
- 7 – Accelerator Pedal Limit Switch – Pedal-Start Vehicles Only
- 8 – Solenoid
- 9 – Maintenance/Operate Switch – Pedal-Start Vehicles
- 10 – Neutral Lockout Limit Switch – Pedal-Start Vehicles Only
- 11 – Starter/Generator (Generator Function)
- 12 – Starter/Generator (Starter Function)
- 13 – Voltage Regulator
- 14 – Kill Limit Switch – Pedal-Start Vehicles Only
- 15 – Ignition Spark
- 16 – Ignition Coil
- 17 – Reverse Buzzer and Reverse Buzzer Limit Switch
- 18 – Low Oil Warning Light (LED)
- 19 – Oil Level Sensor
- 20 – Battery Test (Under Load)
- 21 – Fuel Level Sending Unit
- 22 – Fuel Gauge
- 23 – Hour Meter
- 24 – Light Switch
- 25 – Voltage at Headlight Socket
- 26 – Voltage Limiter
- 27 – 4-Pin Connector (for Connected Car Device)

TEST PROCEDURE 1 – Battery

See General Warnings on page 1-2.

⚠ 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 12-1** of this manual. See **Battery on page 12-30**.

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 (CC 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 11-6, Page 11-18**).

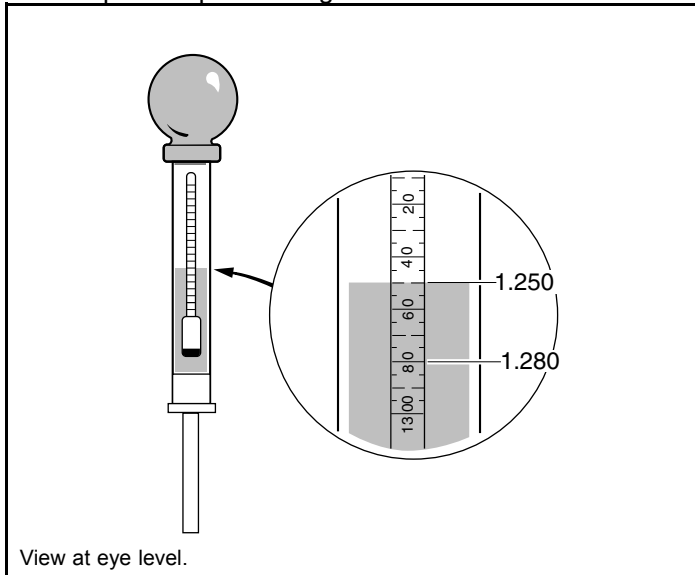
⚠ CAUTION

- 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

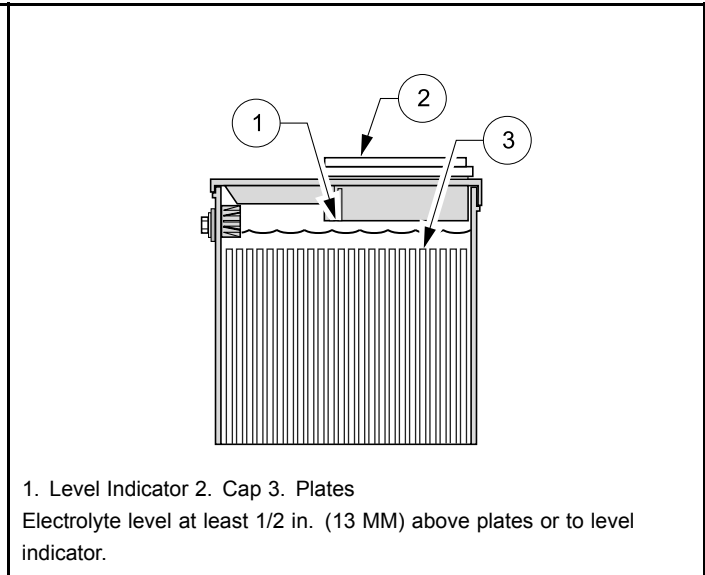
1. Be sure that the battery has sufficient water to cover the plates by approximately 1/2 inch (12.7 mm) and is fully charged prior to beginning the test. If water must be added, recharge the battery before performing the hydrometer test (**Figure 11-7, Page 11-18**).
2. Remove the vent cap.
3. Using a battery thermometer (CC 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 11-6, Page 11-18**).
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.



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Figure 11-6 Hydrometer Test



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Figure 11-7 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 to 1.280	100%
1.220 to 1.240	75%
1.190 to 1.210	50%
1.160 to 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.

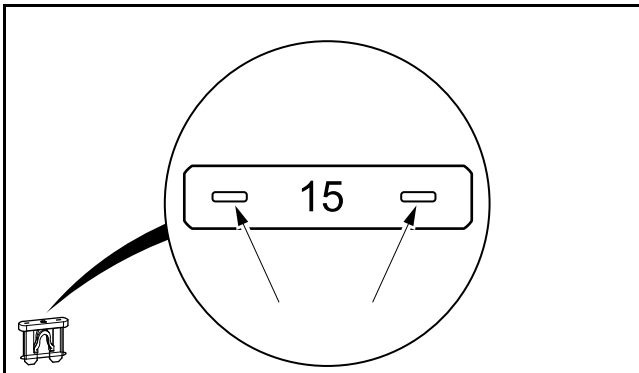
TEST PROCEDURE 2 – Fuses, ATM- and ATC-style

See General Warnings on page 1-2.

⚠ WARNING

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

NOTE: This is a voltage test.



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Figure 11-8 Testing the Fuse

ATC-style fuses are located inside the electrical component box near the battery.

ATM-style fuses are located on the main wire harness in front of the engine.

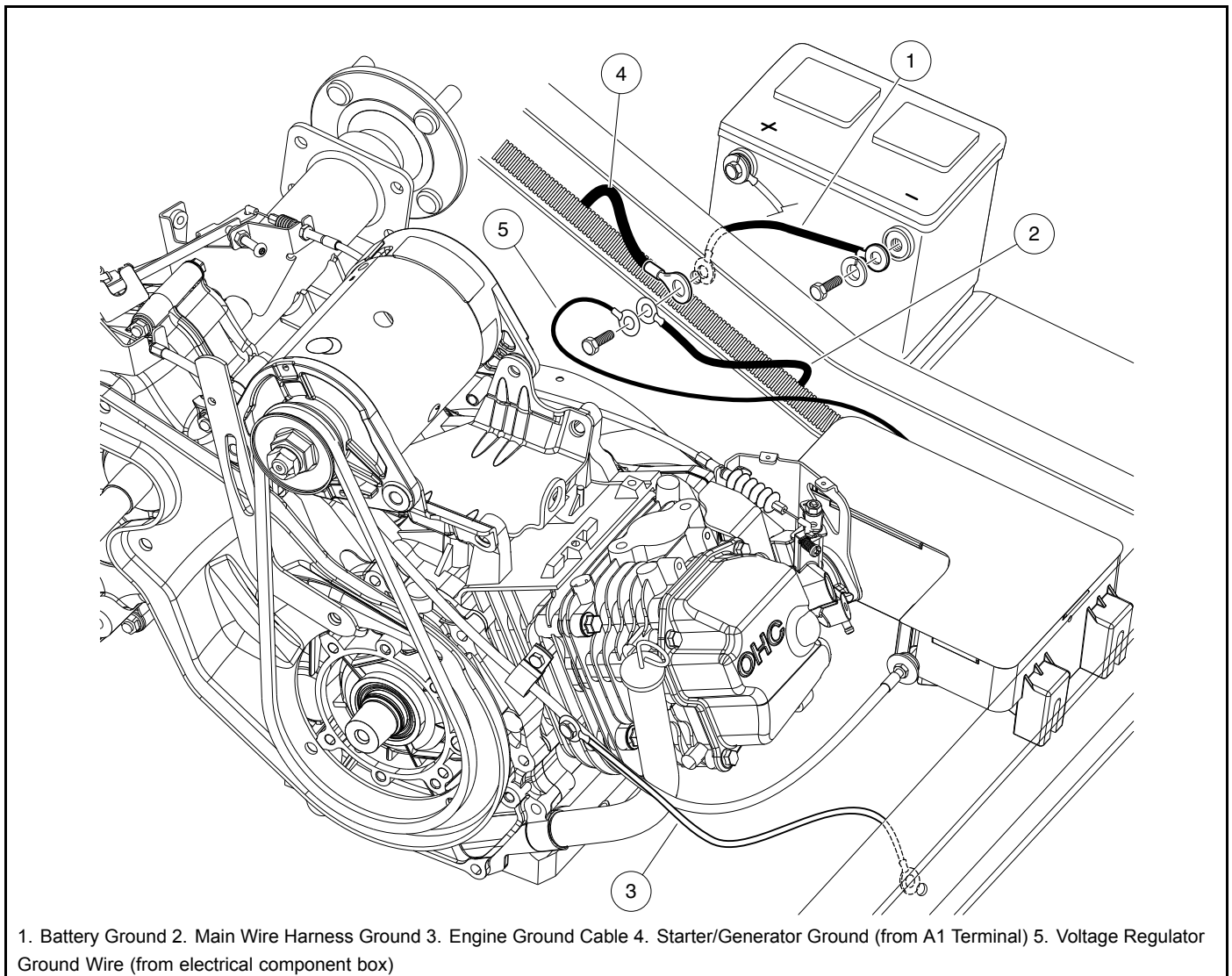
1. If necessary, see Testing Basics on page 11-15.
2. Access the fuse but do not remove it.
3. **All Fuses:** With the battery and solenoid connected:
 - 5-amp ATM Fuse Only:** With the key switch in the ON position:
 - 3.1. Probe the two, small metal contacts on the top of the fuse (**Figure 11-8, Page 11-20**).
 - 3.2. Each contact should show battery voltage.
 - 3.3. If only one side shows battery voltage, replace fuse.
 - 3.4. If neither side of a fuse shows battery voltage, inspect the following locations:
 - **All Fuses:** Wire connections at the solenoid.
 - **5-amp ATM Fuse Only:** 12-pin dash wire harness connector, key switch and sonic weld 3.

TEST PROCEDURE 3 – Ground Cables

See General Warnings on page 1-2.

NOTE: This is a continuity test.

1. If necessary, see Testing Basics on page 11-15.
2. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery, Section 1, Page 1-3.**
3. Check the following wires and cables for clean, tight connections and continuity (**Figure 11-9, Page 11-21**):
 - Check the starter/generator ground cable (black wire) from A1 terminal to chassis.
 - Check the battery ground cable from the disconnected terminal to chassis.
 - Check the engine ground cable from engine block to chassis.
4. 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 wire or cable.



1. Battery Ground 2. Main Wire Harness Ground 3. Engine Ground Cable 4. Starter/Generator Ground (from A1 Terminal) 5. Voltage Regulator Ground Wire (from electrical component box)

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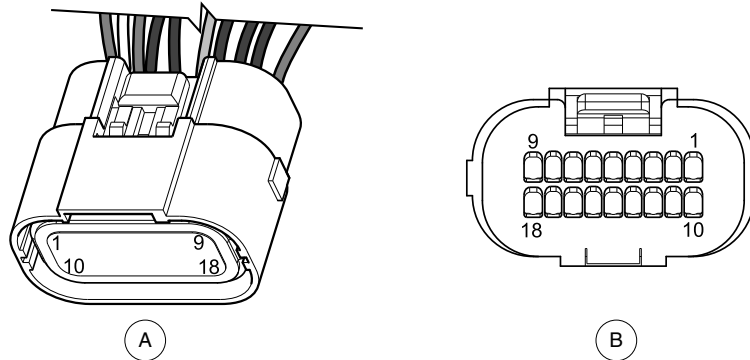
Figure 11-9 Ground Wires and Cables

TEST PROCEDURE 4 – EFI System (ECU and Sensors)

See General Warnings on page 1-2.

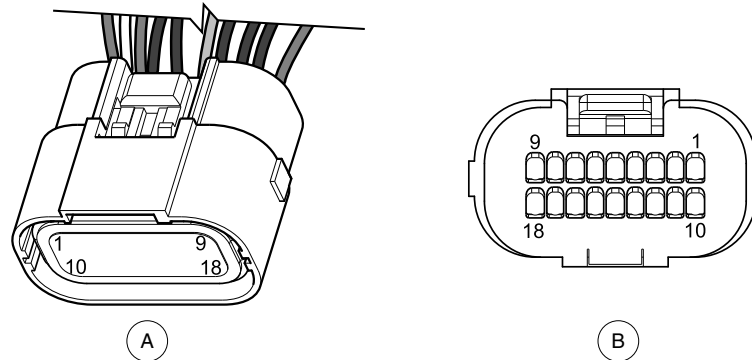
 WARNING

- This procedure involves testing voltage, resistance and continuity. If necessary, see Testing Basics on page 11-15.

**18-PIN CONNECTOR (GRAY AND BLACK): A. ECU SIDE OF CONNECTOR B. WIRE ENTRY SIDE OF CONNECTOR**

PIN I.D.	CONNECTOR COLOR	FUNCTION	TEST TYPE & PROBE BETWEEN LOCATIONS	TEST RESULT	CONDITION
1	Gray	Fuel Injector Control	Resistance: ECU Gray Pin 1 (Black/White) and ECU Gray Pin 10 (Red/White)	Approx. 13 ohms	Key OFF
6	Gray	Engine Temperature Sensor Input	Resistance: ECU Gray Pin 6 (Orange/Blue) and ECU Gray Pin 15 (Black/Blue)	Approx. 12.2 kOhms	Key OFF
9	Gray	Ignition Coil Input	Resistance: ECU Gray Pin 9 (White) and Ground	Approx. 10.1 kOhms	Key OFF
10	Gray	Fuel Injector VB+	Voltage: ECU Gray Pin 10 (Red/White) and Ground	Battery Voltage	Key ON
13	Gray	MAP Sensor Input	Resistance: ECU Gray Pin 13 (Green/Yellow) and ECU Gray Pin 17 (Black/Yellow)	Infinity	Key OFF
15	Gray	Engine Temperature Sensor Ground	Continuity: ECU Gray Pin 15 (Black/Blue) and Ground	Zero (0) ohm	Key OFF
16	Gray	MAP Sensor Reference Voltage (+5)	Voltage: ECU Gray Pin 16 (Red/Yellow) and ECU Gray Pin 17 (Black/Yellow)	5 volts	Key ON
17	Gray	MAP Sensor Ground	Continuity: ECU Gray Pin 17 (Black/Yellow) and Ground	Zero (0) ohm	Key OFF
1	Black	Fuel Pump Input	Voltage: ECU Black Pin 1 (Brown) and ECU Black Pin 10 (Black)	Battery Voltage (after pump stops running)	Key ON
3	Black	Ignition OFF Input	Continuity: ECU Black Pin 3 (Black/White) and Ground	Zero (0) ohm	Key OFF
7	Black	Low Oil Sensor Input	Continuity: ECU Black Pin 7 (Yellow) and Ground	Approx. 2.3 kOhms	Key OFF
8	Black	Connected Car Link	Voltage: ECU Black Pin 8 (Blue/White) and Ground	11.8 volts	Key ON
9	Black	B+ Input	Voltage: ECU Black Pin 9 (Red) and ECU Black Pin 10 (Black)	Battery Voltage	Key ON
10	Black	Ground for Pin 9	Continuity: ECU Black Pin 10 (Black) and Ground	Zero (0) ohm	Key OFF

TABLE CONTINUED ON NEXT PAGE



18-PIN CONNECTOR (GRAY AND BLACK): A. ECU SIDE OF CONNECTOR B. WIRE ENTRY SIDE OF CONNECTOR

PIN I.D.	CONNECTOR COLOR	FUNCTION	TEST TYPE & PROBE BETWEEN LOCATIONS	TEST RESULT	CONDITION
11	Black	Diagnosis (low oil) Lamp Control	Voltage: ECU Black Pin 11 (Yellow/Black) and Ground	Less than 1 Volt initially. 7 to 8 volts after lamp is OFF.	Key ON
12	Black	Foot Input	Continuity: ECU Black Pin 12 (White/Black) and Black Pin 18 (Black)	Zero (0) ohm Infinity	Key OFF with: Accel. Pedal UP Accel. Pedal DOWN
18	Black	Ground for ECU Housing	Continuity: ECU Black Pin 18 (Black) and Ground	Zero (0) ohm	Key OFF

TEST PROCEDURE 5 – Key Switch (Start Circuit)

See General Warnings on page 1-2.

NOTE: This is a voltage test.

The key switch provides power and KEY INPUT to the ECU.

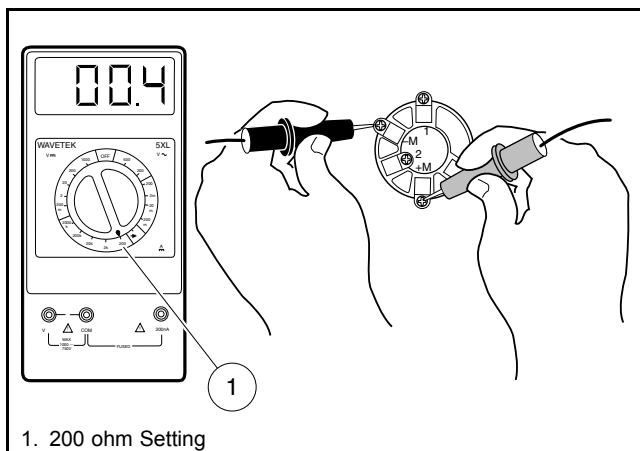
1. If necessary, see Testing Basics on page 11-15.
2. Remove instrument panel to access the back of the key switch but do not disconnect wires. **See Instrument Panel Removal on page 4-9.**
3. With the key switch in the OFF position:
 - The green wire should show battery voltage coming to the switch.
 - The brown/white wire should show zero (0) volts. If it shows battery voltage, the switch has failed CLOSED and must be replaced.
4. With the key switch in the ON position:
 - The brown/white wire should show battery voltage passing through the key switch to sonic weld 3, the 5-amp fuse, the solenoid, and the 4-pin connected car plug. If it does not show battery voltage, the switch has failed OPEN and must be replaced.

TEST PROCEDURE 6 – Key Switch (Engine Kill Circuit)

See General Warnings on page 1-2.

NOTE: This is a continuity test.

1. If necessary, see Testing Basics on page 11-15.
2. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery, Section 1, Page 1-3.**
3. Remove the instrument panel. **See Instrument Panel Removal on page 4-9.**
4. Disconnect wires from the (+M) and (–M) terminals of the key switch (**Figure 11-10, Page 11-24**).
5. 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.
6. Connect wires to the key switch. Make sure wires are connected correctly and are tight. If they are not, rewire or tighten as necessary.
7. Install dash panel in reverse order of removal.



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Figure 11-10 Key Switch Test – Engine Kill Circuit

TEST PROCEDURE 7 – Accelerator Pedal Limit Switch – Pedal-Start Vehicles Only

See General Warnings on page 1-2.

NOTE: This is a continuity test.

The accelerator pedal limit switch is the top switch located in the electrical component box. There is a green wire and a pink wire connected to this limit switch.

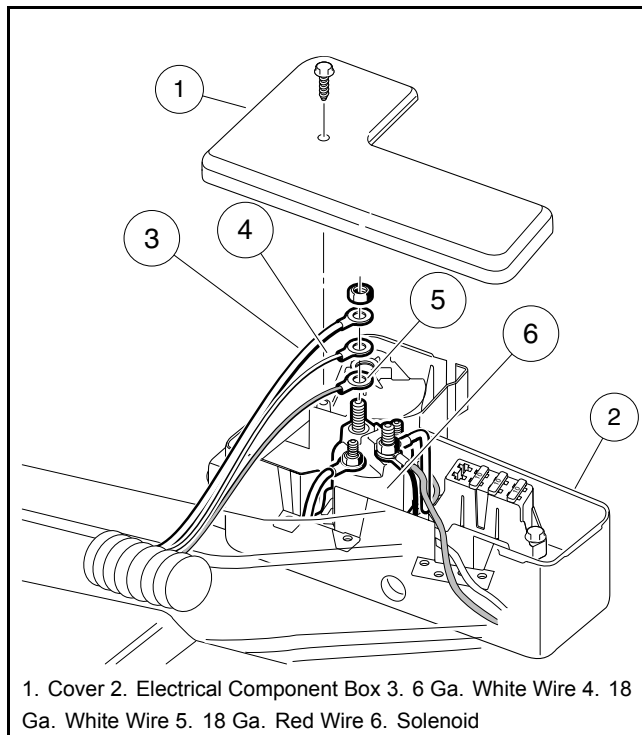
1. If necessary, see Testing Basics on page 11-15.
2. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery, Section 1, Page 1-3.**
3. Check for proper wiring and tight connections (**Figure 11-1, Page 11-9**).
4. Set the multimeter to 200 ohms. Place the red (+) probe on the common (COM) terminal (green wire) of the limit switch and place the black (–) probe on the normally closed (NC) terminal (pink wire) of the limit switch.
5. 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.

TEST PROCEDURE 8 – Solenoid

See General Warnings on page 1-2.

NOTE: This is a resistance, continuity and voltage test.

1. If necessary, see Testing Basics on page 11-15.
2. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery, Section 1, Page 1-3.**
3. Remove the electrical component box cover.
4. Ensure 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 to 16 ohms. If the reading is not within limits, replace the solenoid.
6. 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 11-11, Page 11-25**).

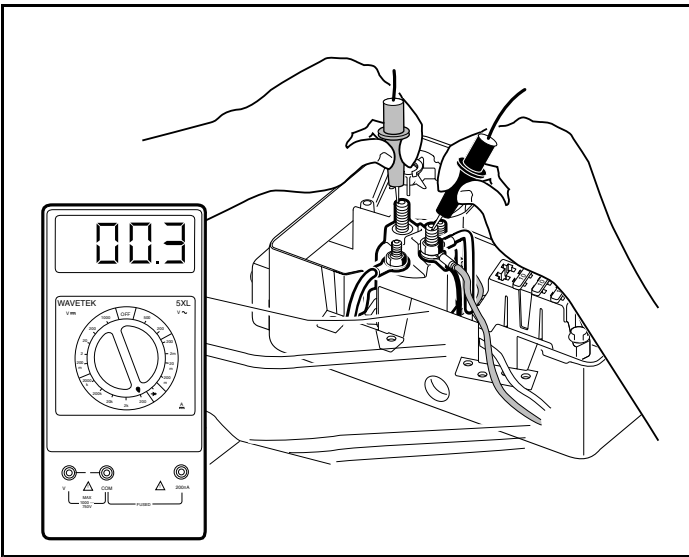


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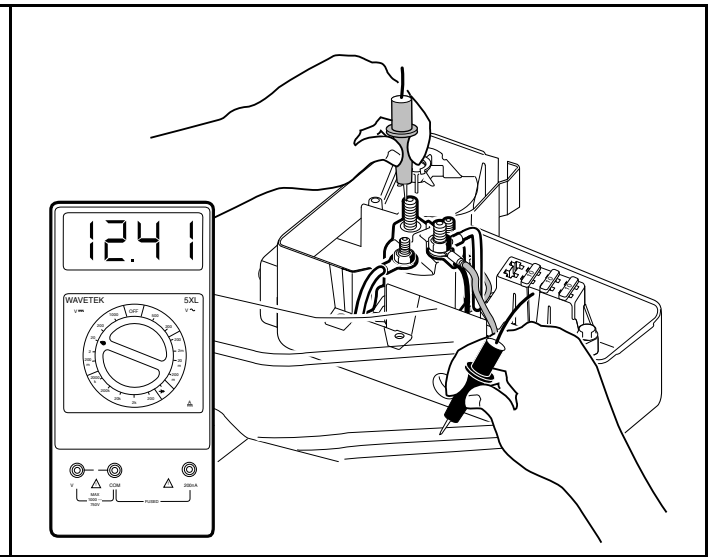
Figure 11-11 Solenoid Wire Removal

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 11-12, Page 11-26**).
8. Connect battery and spark plug wire(s). **See Connecting the Battery, Section 1, Page 1-3.**
9. 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.
10. 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 11-13, Page 11-26**).

11. Disconnect the 6-gauge black wire from the negative (-) post of the battery before reconnecting the wires to the solenoid.



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Figure 11-12 Solenoid Continuity Test

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Figure 11-13 Solenoid Ground Test

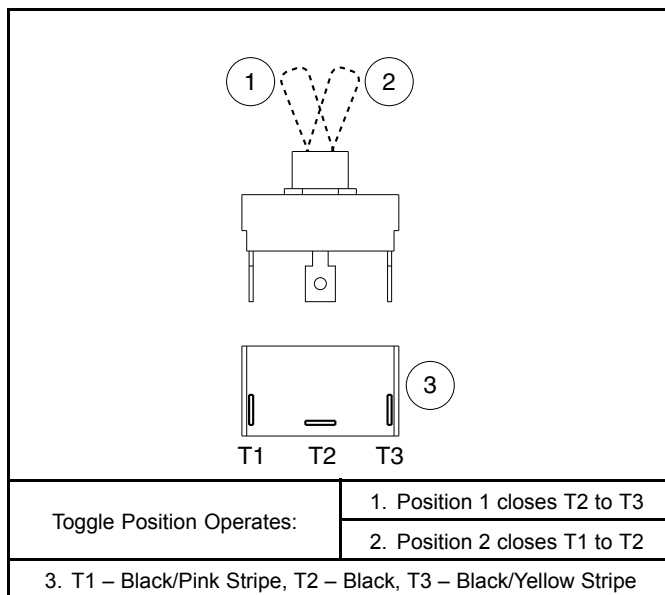
TEST PROCEDURE 9 – Maintenance/Operate Switch – Pedal-Start Vehicles

See General Warnings on page 1-2.

NOTE: This is a continuity test.

The Maintenance/Operate Switch is also known as the Neutral Lockout Switch.

1. If necessary, see Testing Basics on page 11-15.
2. Remove wires from switch (**Figure 11-14, Page 11-27**).
3. With switch in position 1:
 - 3.1. Check for no continuity between terminals T1 and T2.
 - 3.2. Check for continuity between terminals T2 and T3.
4. With switch in position 2:
 - 4.1. Check for no continuity between terminals T2 and T3.
 - 4.2. Check for continuity between terminals T1 and T2.



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Figure 11-14 Maintenance/Operate Switch Test – for Pedal-Start Vehicles

5. If switch:
 - 5.1. does not work as stated in previous steps, replace switch.
 - 5.2. 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.

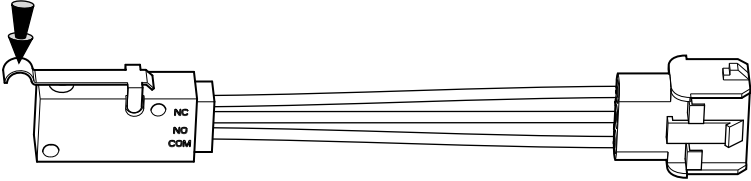
TEST PROCEDURE 10 – Neutral Lockout Limit Switch – Pedal-Start Vehicles Only

See General Warnings on page 1-2.

NOTE: This is a continuity test.

This switch is located on the transaxle. A black/white wire, a gray wire, and a red wire are connected to this limit switch with a 3-pin connector.

1. If necessary, see Testing Basics on page 11-15.
2. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery, Section 1, Page 1-3.**
3. At transaxle, disconnect neutral lockout limit switch three-wire lead from main wire harness.
4. Check to be sure the cam lobe on the shift lever 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 shift lever if necessary.
5. Check the following terminals for no continuity with the lever released and continuity with the lever engaged (**Figure 11-15, Page 11-28**):

	
PROBE BETWEEN LOCATIONS	TEST RESULT
Between terminal 1 "COM" (black/white wire) and terminal 2 "NO" (gray wire)	With lever released: No continuity
	With lever pressed: Continuity
Between terminal 1 "COM" (black/white wire) and terminal 3 "NC" (red wire)	With lever released: Continuity
	With lever pressed: No continuity

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Figure 11-15 Neutral Lockout Limit Switch Test

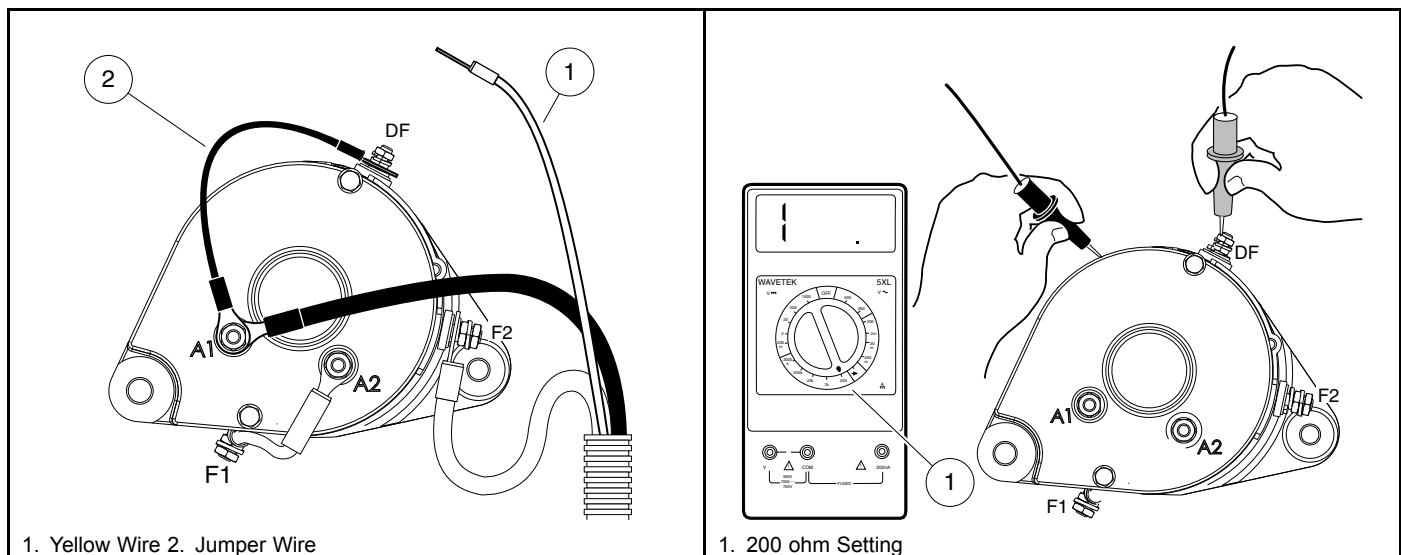
6. If switch does not work as stated in previous step, replace switch. **See Neutral Lockout Limit Switch Removal, Section 12, Page 12-15.**

TEST PROCEDURE 11 – Starter/Generator (Generator Function)

See General Warnings on page 1-2.

NOTE: This is a voltage test.

1. If necessary, see Testing Basics on page 11-15.
2. Place the Forward/Reverse handle in the NEUTRAL position and the neutral lockout switch in the MAINTENANCE position. Chock the wheels.
3. Ensure that the wires are connected correctly and are tight. If they are not, rewire or tighten as necessary.
4. Disconnect yellow wire from DF terminal on starter/generator. Cover terminal on yellow wire to make sure it will not short to ground. Then, using a jumper wire, ground DF terminal to A1 terminal (**Figure 11-16, Page 11-29**).
5. 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 11-31**. If the voltage does not rise, a tear-down inspection of the starter/generator will be necessary. See **Starter/Generator Removal on page 12-1**.
6. Remove jumper wire.
7. Reconnect yellow wire to DF terminal on starter/generator.



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Figure 11-16 Jumper Wire Ground – DF to A1

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Figure 11-17 Check Starter Terminal Continuity

TEST PROCEDURE 12 – Starter/Generator (Starter Function)

See General Warnings on page 1-2.

NOTE: Observe the following before testing the starter/generator:

- This is only testing continuity.
- Tag the starter/generator wires for identification before disconnecting.
- Remove starter/generator wire from one of the “A” terminals and one of the “F” terminals if testing while starter/generator is in vehicle.
- When disconnecting wires from starter/generator terminals, use a second wrench on the lower nut of the terminal post to hold post steady.

- Scrape a small amount of paint from starter/generator housing (ground) and use this location when testing motor terminals to electrical ground.

MOTOR TERMINALS	CONTINUITY TEST RESULT
A1 to A2 F1 to F2	Continuity
A1 to F1 A1 to F2	No Continuity
A2 to F1 A2 to F2	No Continuity
A1 to Ground A2 to Ground	No Continuity
F1 to Ground F2 to Ground	No Continuity

1. If necessary, see Testing Basics on page 11-15.
2. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery, Section 1, Page 1-3.**
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 11-17, Page 11-29**). 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 12-1.**
 - 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. 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 12-1.**
5. 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 12-1.**
6. 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 12-1.**

Ensure that wires are connected correctly and are tight. If they are not, rewire or tighten as necessary.

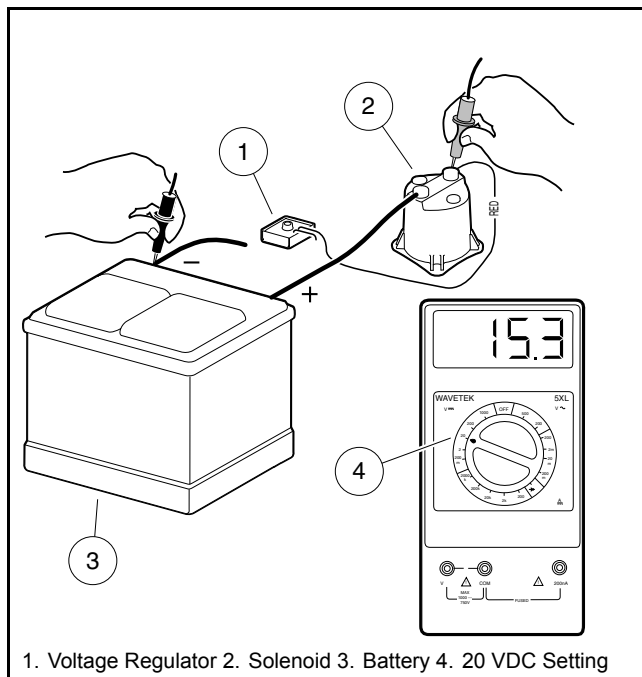
TEST PROCEDURE 13 – Voltage Regulator

See General Warnings on page 1-2.

NOTE: This is a voltage test.

Keep the battery connected while performing this test procedure.

1. If necessary, see Testing Basics on page 11-15.
2. Place the Forward/Reverse handle in the NEUTRAL position and the neutral lockout switch in the MAINTENANCE position. Chock the wheels.
3. Ensure that the wires are connected correctly and are tight. If they are not, rewire or tighten as necessary.
4. Check the engine RPM setting to ensure that it is adjusted correctly. **See Engine RPM Adjustment on page 14-11.**
5. With the battery in good condition and fully charged, run the engine for several minutes to bring the voltage regulator to operating temperature.
6. 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 11-18, Page 11-31**). 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 12-12.**



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Figure 11-18 Voltage Regulator Test

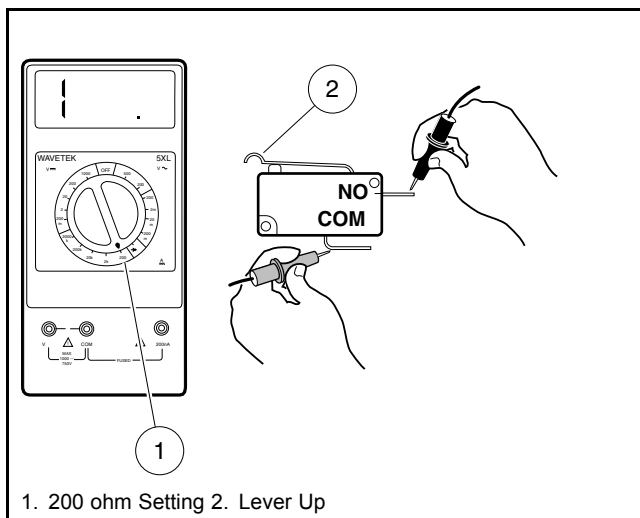
TEST PROCEDURE 14 – Kill Limit Switch – Pedal-Start Vehicles Only

See General Warnings on page 1-2.

NOTE: This is a continuity test.

The kill limit switch is the lower of the two limit switches located in the electrical component box. There is a white/black wire and a blue wire connected to this limit switch.

1. If necessary, see Testing Basics on page 11-15.
2. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery, Section 1, Page 1-3.**
3. Remove the electrical component box cover.
4. Check for proper wiring and tight connections. **See Wiring Diagrams on page 11-9.**
5. Disconnect the wires from the lower of the two limit switches 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 (blue 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 11-19, Page 11-32**).
6. Reconnect wires to limit switch.



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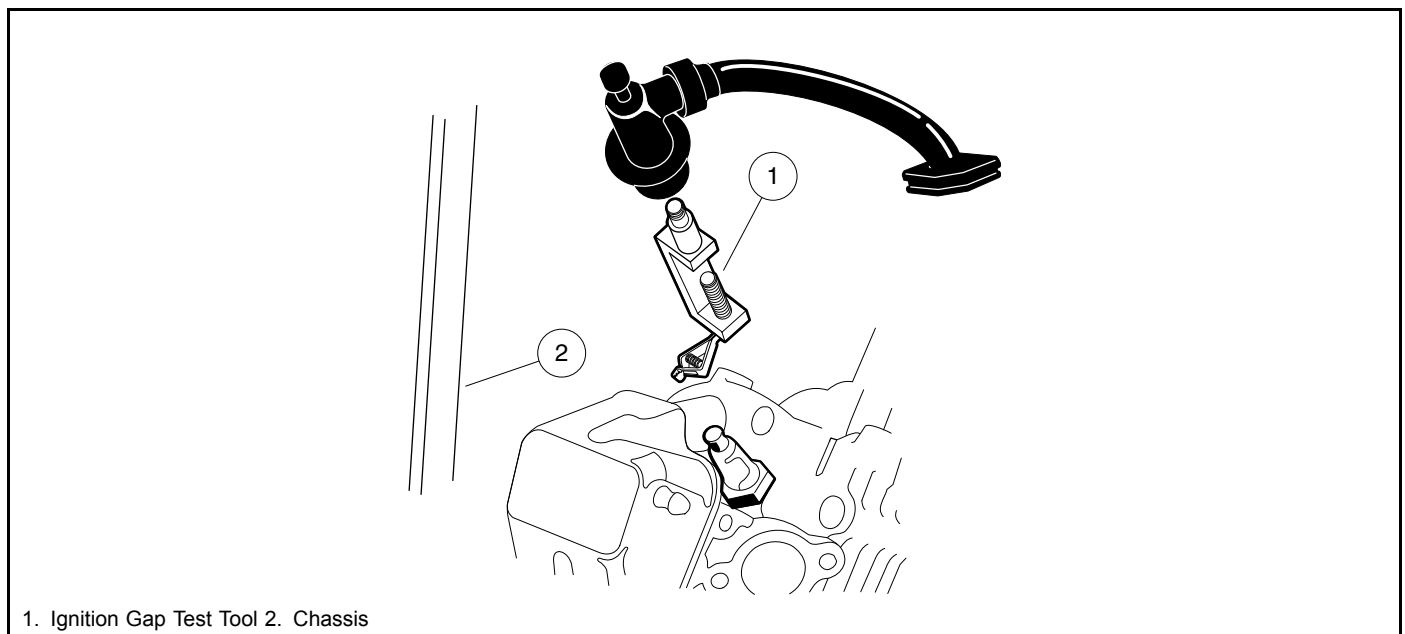
Figure 11-19 Kill Limit Switch Test

TEST PROCEDURE 15 – Ignition Spark

See General Warnings on page 1-2.

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

1. If necessary, see Testing Basics on page 11-15.
2. Place the Forward/Reverse handle in the NEUTRAL position and the neutral lockout switch in the MAINTENANCE position. Chock the wheels.
3. 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 11-33**).
 - 3.1. 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.
 - 3.2. 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 11-34.**
4. 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 0.024 to 0.028 in. (0.6 to 0.7 mm). If the gap is correct, replace the spark plug with a new part and test the engine for proper operation.



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Figure 11-20 Ignition Spark Test

TEST PROCEDURE 16 – Ignition Coil

See General Warnings on page 1-2.

NOTE: This is a resistance test.

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.

NOTE: Resistance value ranges given in these tests reflect a tolerance of $\pm 40\%$.

Please note that these values are rough standard and it is impossible to reach an exact conclusion with the resistance reading.

1. If necessary, see Testing Basics on page 11-15.
2. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery, Section 1, Page 1-3.**
3. At engine, access white wire in ECU wire harness that connects to ignition coil lead at back of engine.
4. Using a multimeter set to 200k ohms, measure resistance between the following locations listed in table below.

IGNITION COIL TERMINALS	TEST RESULT
White Signal Wire to Ground	9 to 11 kOhms
White Signal Wire to Spark Plug Cap	17 to 20 kOhms
Spark Plug Cap to Ground	8 to 13 kOhms

TEST PROCEDURE 17 – Reverse Buzzer and Reverse Buzzer Limit Switch

See General Warnings on page 1-2.

NOTE: Reverse Buzzer: This is a voltage test.

Reverse Buzzer Limit Switch: This is a continuity test.

A reverse buzzer is mounted on the back side of the instrument panel. On some models, another reverse buzzer is also mounted on a bracket at the left rear of the vehicle. The reverse buzzer is powered by the 10-amp ATM fuse located on the main wire harness in front of the engine.

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

1. If necessary, see Testing Basics on page 11-15.
2. To test the front reverse buzzer, remove instrument panel. **See Instrument Panel Removal on page 4-9.**
3. Check for proper wiring and tight connections.
4. Check that battery voltage is present in the orange/white wire at buzzer.
5. Place the Forward/Reverse handle in the REVERSE position. The buzzer should sound. If not, check limit switch in the next steps.
6. Disconnect black/orange wire from buzzer.
7. With Forward/Reverse handle still in the REVERSE position, there should be continuity between the black/orange wire and ground. With Forward/Reverse handle still in the FORWARD position, there should be no continuity. If either reading is incorrect, replace limit switch. **See Reverse Buzzer Limit Switch Removal on page 12-21.**
8. If limit switch is operating properly, replace buzzer. **See Reverse Warning Buzzer Removal, Section 12, Page 12-19.**

TEST PROCEDURE 18 – Low Oil Warning Light (LED)

See General Warnings on page 1-2.

NOTE: This is a voltage test.

When the key switch is placed in the ON position, the Low Oil Warning Light will illuminate for approximately 3 seconds as a bulb check function.

1. If low oil warning light does not illuminate for approximately 3 seconds when the key switch is placed in the ON position, proceed with the steps below.
2. If necessary, see Testing Basics on page 11-15.
3. Remove the instrument panel. **See Instrument Panel Removal on page 4-9.**
4. Ensure that the wires are connected correctly and are tight. If they are not, rewire or tighten as necessary. **See Wiring Diagrams on page 11-9.**
5. With key switch in ON position, test for battery voltage at yellow wire to low oil warning light. If no voltage, check key switch. **See Key Switch (Start Circuit) on page 11-23.**
6. If battery voltage is present, use a test lead to ground the black wire terminal of low oil warning light. Light should illuminate. If not, replace low oil warning light.

TEST PROCEDURE 19 – Oil Level Sensor

See General Warnings on page 1-2.

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

This procedure requires the oil to be drained from the engine.

1. If necessary, see Testing Basics on page 11-15.
2. 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.
3. Ensure that the low oil warning light and all connecting wires are functioning correctly. **See Low Oil Warning Light (LED) on page 11-35.**
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 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 13-12.**
6. Fill the engine with new oil before returning the vehicle to service. **See Engine Oil – Gasoline Vehicle on page 13-2.**

TEST PROCEDURE 20 – Battery Test (Under Load)

See General Warnings on page 1-2.

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

1. If necessary, see Testing Basics on page 11-15.
2. Place the Forward/Reverse handle in the NEUTRAL position and the neutral lockout switch in the MAINTENANCE position. Chock the wheels.
3. 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.
4. 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).
 - 4.1. 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.

5. If the reading is below 9.6 volts, with an electrolyte temperature of 70 °F (21 °C), check the battery. **See Battery on page 11-17.**
 - 5.1. If the reading is zero, there may be no continuity across the large posts of the solenoid. **See Solenoid on page 11-25.**
6. 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 11-29.**

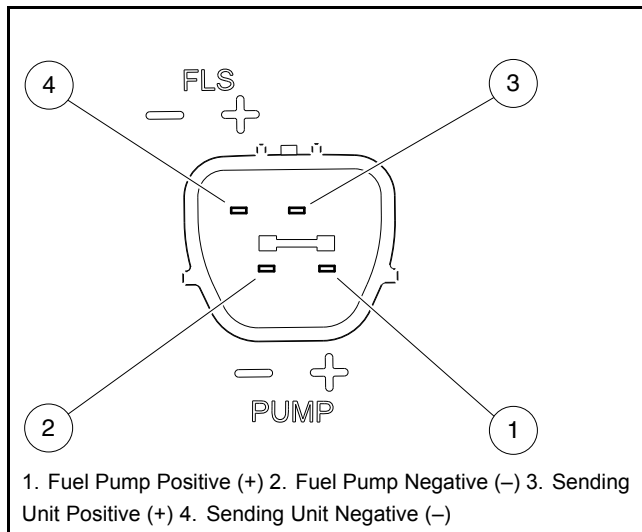
TEST PROCEDURE 21 – Fuel Level Sending Unit

See General Warnings on page 1-2.

⚠ WARNING

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

NOTE: This is a resistance test.



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Figure 11-21 Fuel Pump Module Terminals

- If necessary, see Testing Basics on page 11-15.
- Disconnect battery. **See Disconnecting the Battery, Section 1, Page 1-3.**
- Disconnect the 5-pin connector from the top of the fuel pump module (**Figure 11-21, Page 11-37**).
- Probe between pin 2 and pin 3 terminals in module.
- 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.

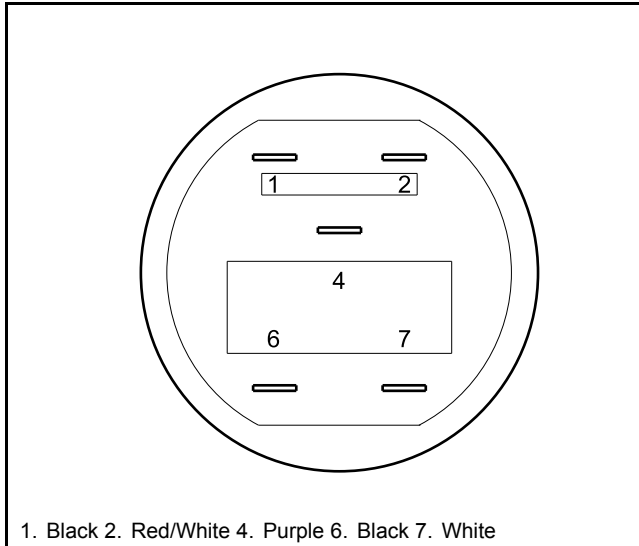
FLOAT POSITION	RESISTANCE READING	FUEL GAUGE READINGS
Lower position (tank empty)	250 ohms (± 10)	Empty
Center position (tank half full)	141 ohms (± 8)	Half full
Upper position (tank full)	33.3 ohms (± 6)	Full

- 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 pump module must be replaced. **See Fuel Pump Module Removal on page 14-17.**
- If the readings are correct and the fuel gauge does not function correctly, check the continuity of the orange/black wire from the fuel level sending unit to the purple wire on the fuel gauge/hour meter. Leave the battery disconnected while checking continuity. Also check the continuity of the red/white wire from the fuel gauge/hour meter to the brown/white wire on 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 12-24.**
- 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 11-38.**

TEST PROCEDURE 22 – Fuel Gauge

See General Warnings on page 1-2.

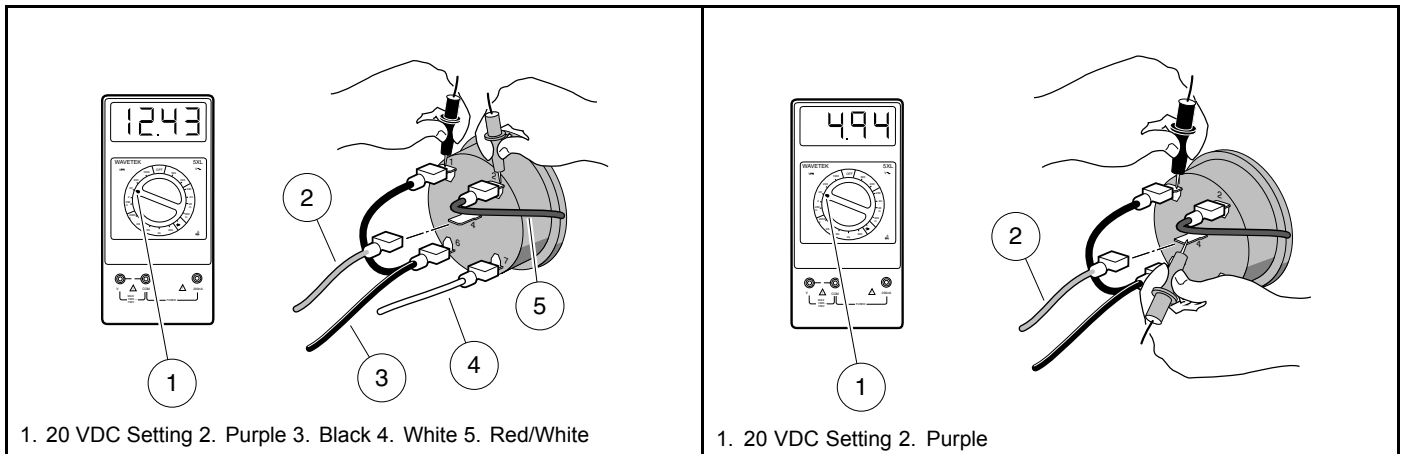
NOTE: This is a voltage test.



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Figure 11-22 Fuel Gauge/Hour Meter

1. If necessary, see Testing Basics on page 11-15.
2. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels.
3. Remove the instrument panel to gain access to the back of the fuel gauge/hour meter. **See Instrument Panel Removal on page 4-9.**
4. 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.
5. Disconnect the purple wire from the fuel gauge/hour meter.
6. 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.
7. Set a multimeter to 20 volts DC and place the red (+) probe on the (2) terminal of the fuel gauge/hour meter with the red/white wire is connected. Place the black (-) probe on the (1) terminal of the fuel gauge/hour meter with the black wire (**Figure 11-23, Page 11-39**).
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 red/white and black wires (**Figure 11-23, Page 11-39**).
9. The purple 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 11-24, Page 11-39**). The voltage reading should be approximately 4.94 volts. If the reading is incorrect, replace the fuel gauge/hour meter.



481 **Figure 11-23 Fuel Gauge Voltage Test - Terminal 2**

482 **Figure 11-24 Fuel Gauge Voltage Test - Terminal 4**

TEST PROCEDURE 23 – Hour Meter

See General Warnings on page 1-2.

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

1. If necessary, see Testing Basics on page 11-15.
2. Place the Forward/Reverse handle in NEUTRAL. Chock the wheels.
3. 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.
4. 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.

5. 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 18 – Low Oil Warning Light (LED) on page 11-35.**

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.

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

TEST PROCEDURE 24 – Light Switch

See General Warnings on page 1-2.

NOTE: The headlight circuit is protected by the 20-amp fuse. Check the fuse before this procedure is performed. See Test Procedure 2 – Fuses, ATM- and ATC-style on page 11-20.

This is a voltage test.

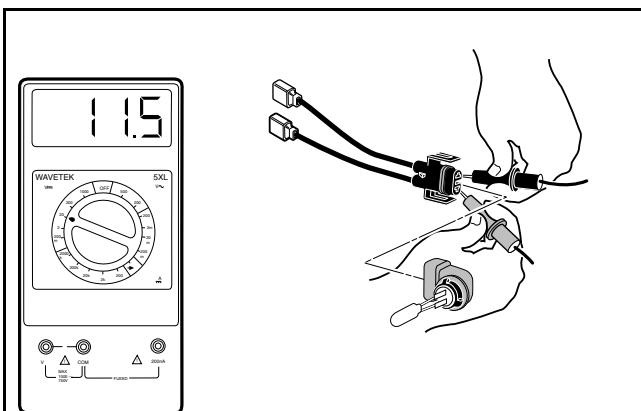
1. If necessary, see Testing Basics on page 11-15.
2. Remove instrument panel. See Instrument Panel Removal on page 4-9.
3. Use a multimeter set to 20 volts DC and place alligator clips on the multimeter probes. Connect the red (+) probe to the light switch terminal where the green/white wire is connected.
4. Connect the black (–) probe of the multimeter to ground.
5. With the light switch in the OFF position, the reading should indicate 0 volts. With the light in the ON position, the reading should indicate battery voltage. If there is no voltage reading, check associated wiring and 10-amp fuse (located in electrical component box). See Test Procedure 2 – Fuses, ATM- and ATC-style on page 11-20. If the wires and fuse show continuity and the readings are still incorrect, replace the switch. See Headlight Switch Removal, Section 12, Page 12-26.

TEST PROCEDURE 25 – Voltage at Headlight Socket

See General Warnings on page 1-2.

NOTE: This is a voltage test.

1. If necessary, see Testing Basics on page 11-15.
2. Inspect the wires at the light bulb socket. Make sure the wires are securely fastened to the contacts inside the socket and that wires are oriented correctly - black to black and blue to blue.
3. Remove the wire harness connector from the headlight bulb (Figure 11-25, Page 11-40).
4. With the light switch in the ON position, probe across the two terminals in the connector. If battery voltage is shown, check/replace the headlight bulb.



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Figure 11-25 Voltage Measurement at Headlight Socket

5. If there is no voltage reading, check associated wiring, light switch and 10-amp fuse (located in electrical component box). See Test Procedure 2 – Fuses, ATM- and ATC-style on page 11-20. See Test Procedure 24 – Light Switch on page 11-40.

TEST PROCEDURE 26 – Voltage Limiter

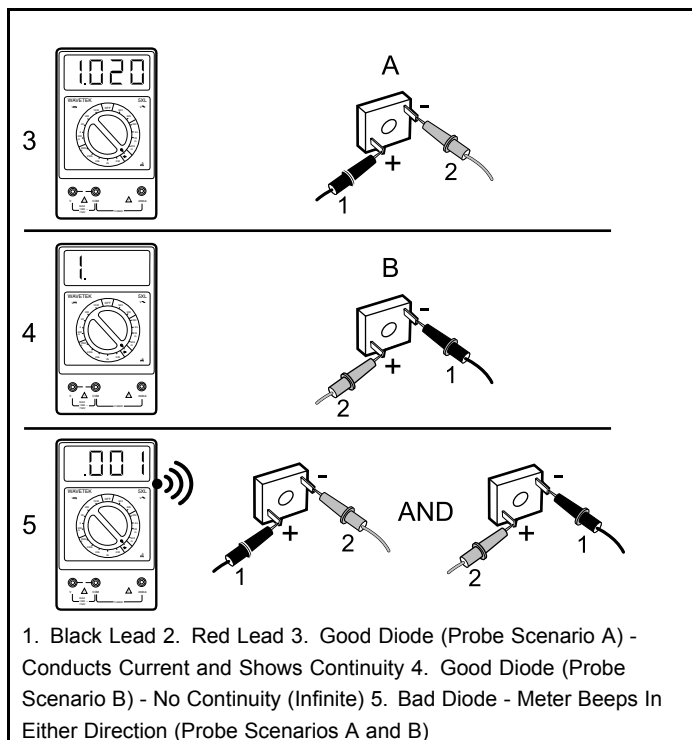
See General Warnings on page 1-2.

NOTE: This is a diode test.

The voltage limiter is a diode. Diodes are designed to conduct current in one direction only. **See following NOTE.**

NOTE: If the voltage limiter conducts current in both directions, the diode has failed closed. If the voltage limiter will not conduct current in either direction, the diode has failed open.

1. If necessary, see Testing Basics on page 11-15.
2. Turn the key switch OFF and remove the key. Place the Forward/Reverse handle in the NEUTRAL position. Chock the wheels.
3. Remove the cowl. **See Cowl Removal, Section 4, Page 4-5.**
4. Disconnect green wire from positive (+) terminal of voltage limiter and black wire from negative (-) terminal.
5. Using a multimeter on diode setting, test voltage limiter as shown (**Figure 11-26, Page 11-41**).



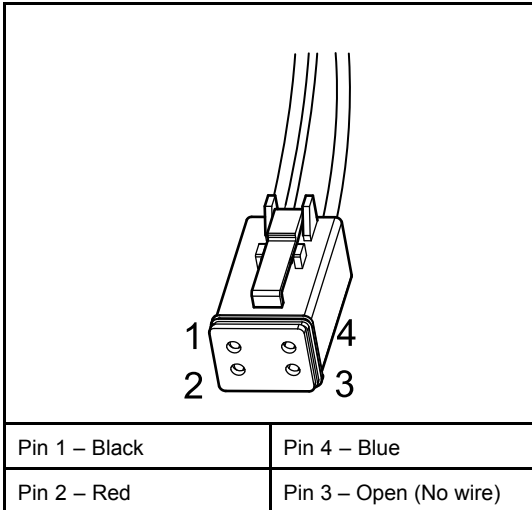
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Figure 11-26 Voltage Limiter Test

TEST PROCEDURE 27 – 4-Pin Connector (for Connected Car Device)

See General Warnings on page 1-2.

NOTE: This is a voltage and continuity test.



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Figure 11-27 4-Pin Connector

1. If necessary, see Testing Basics on page 11-15.
2. Check for continuity between pin 1 (black wire) (**Figure 11-27, Page 11-42**) and pin 18 (black wire) of the black 18-pin connector on the ECU. It should indicate continuity. If not, check sonic welds no. 4, 10, and 14.
3. Probe pin 2 (red wire). It should show battery voltage with the key switch in the ON position. If not, check 2-amp fuse near 4-pin connector. **See following NOTE.**

NOTE: The red wire only has battery voltage with the key switch in the ON position.

4. Probe pin 4 (blue wire). It should show approximately 11.8 volts supplied by pin 8 (blue/white wire) of the black 18-pin connector on the ECU. If not, check wiring and then ECU. **See following NOTE.**

NOTE: The blue wire only has voltage with the key switch in the ON position.

If pin 4 has no voltage, the ECU LIN (Local Interconnect bus) may have failed. The vehicle can be driven if it is not used with Guardian or Visage and will not show any symptoms. Otherwise, Guardian or Visage will disable the vehicle until communication is restored.

⚠ DANGER

- See General Warnings on page 1-2.

⚠ WARNING

- See General Warnings on page 1-2.

STARTER/GENERATOR

See General Warnings on page 1-2.

TESTING THE STARTER/GENERATOR

See Test Procedure 12 – Starter/Generator (Starter Function) on page 11-29.

See Test Procedure 11 – Starter/Generator (Generator Function) on page 11-29.

STARTER/GENERATOR REMOVAL

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery, Section 1, Page 1-3.**
2. Place the neutral lockout switch in the MAINTENANCE position. Access the engine compartment by removing the seat or raising the cargo bed.
3. Disconnect the wires from the starter/generator (1) (**Figure 12-13, Page 12-10**).
4. Loosen the pivot nuts (7) and bolts (5) (**Figure 12-12, Page 12-9**).
5. Remove the adjustment nut (4), washer (6) and adjustment bolt (1) (**Figure 12-12, Page 12-9**). Lower the starter/generator and remove the belt (2) from the pulley.
6. Support the starter/generator so that when the pivot bolts (5) are removed the starter/generator will not fall. Remove the two pivot nuts (7) and bolts (5) from the mounting bracket.
7. Remove the starter/generator.

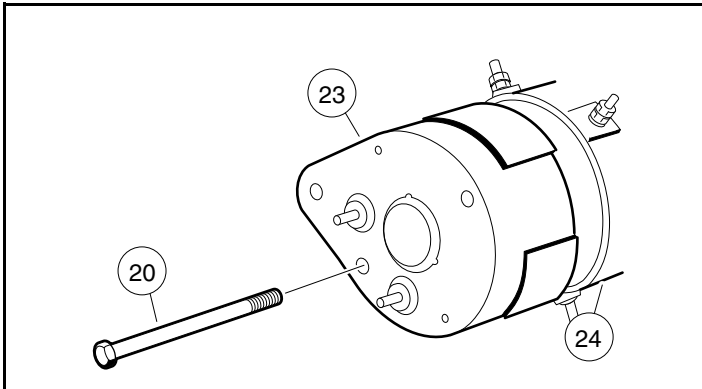
DISASSEMBLY OF THE STARTER/GENERATOR TO SERVICE THE BRUSHES

1. Remove the two bolts (20) and pull commutator end cover (23) free of starter/generator housing (24) (**Figure 12-1, Page 12-2**). **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 12-5, Page 12-3**).*

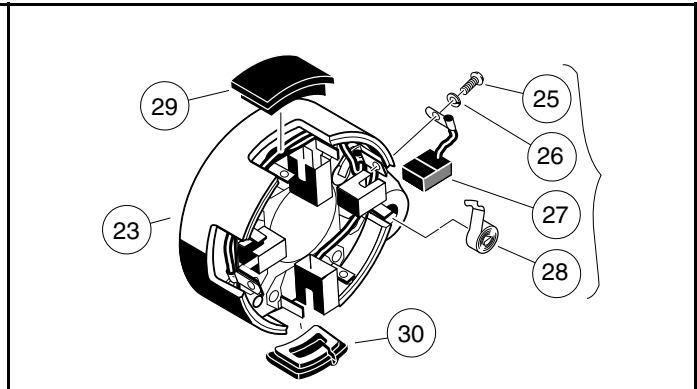
2. Remove brush covers (29 and 30), screws (25) and lock washers (26), brush springs (28), and brushes (27) (**Figure 12-2, Page 12-2**). **See following NOTE.**

NOTE: To clean and inspect the armature/commutator and the bearings, see **Disassembly of the Starter/Generator to Service the Armature/Commutator on page 12-4.**



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Figure 12-1 Commutator End Cover

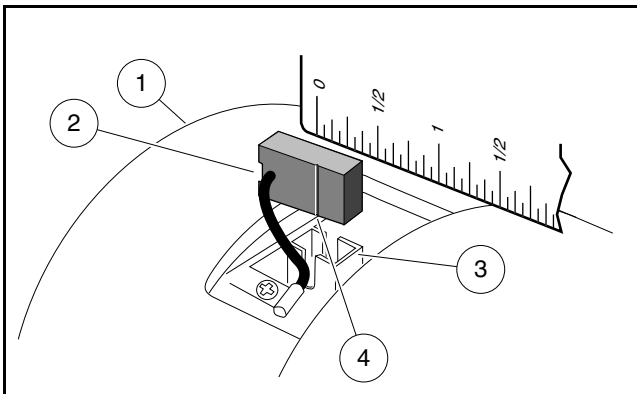


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Figure 12-2 Brush Covers and Brushes

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 12-3, Page 12-2**).



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Figure 12-3 Inspect Brushes

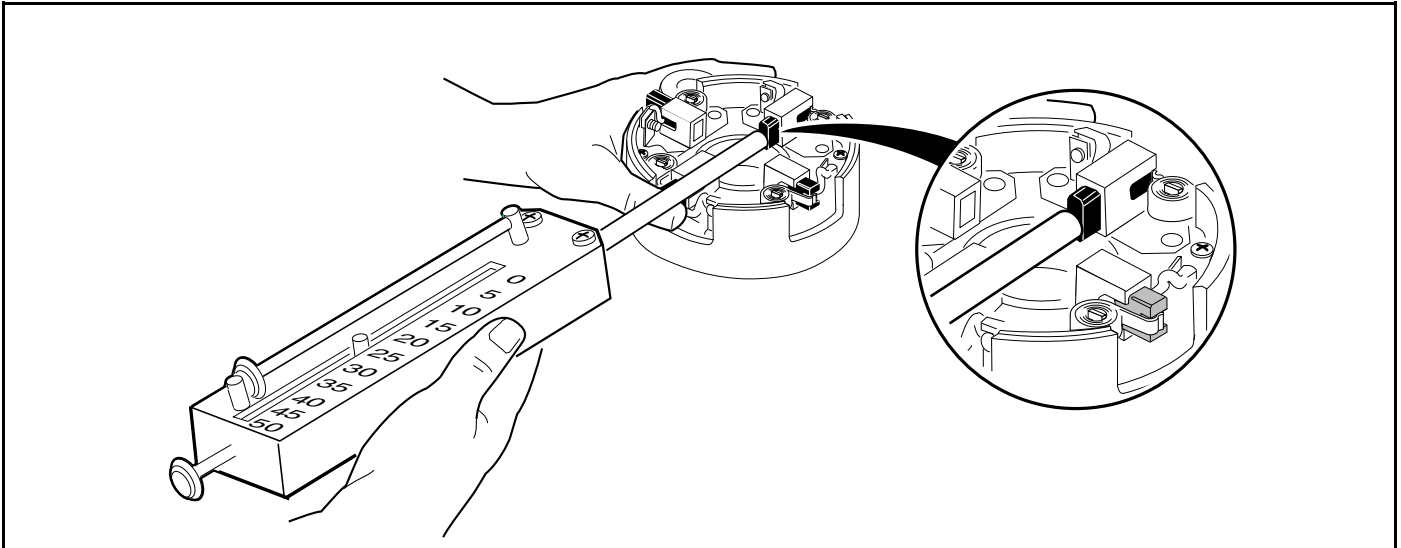
BRUSH SPRING INSPECTION AND REPLACEMENT

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 12-2, Page 12-2**). Using a spring scale, test brush spring tension. If any spring has a tension less than 24 ozf. (6.67 N·m), replace all four springs (**Figure 12-4, Page 12-3**). 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.

CAUTION CONTINUED ON NEXT PAGE

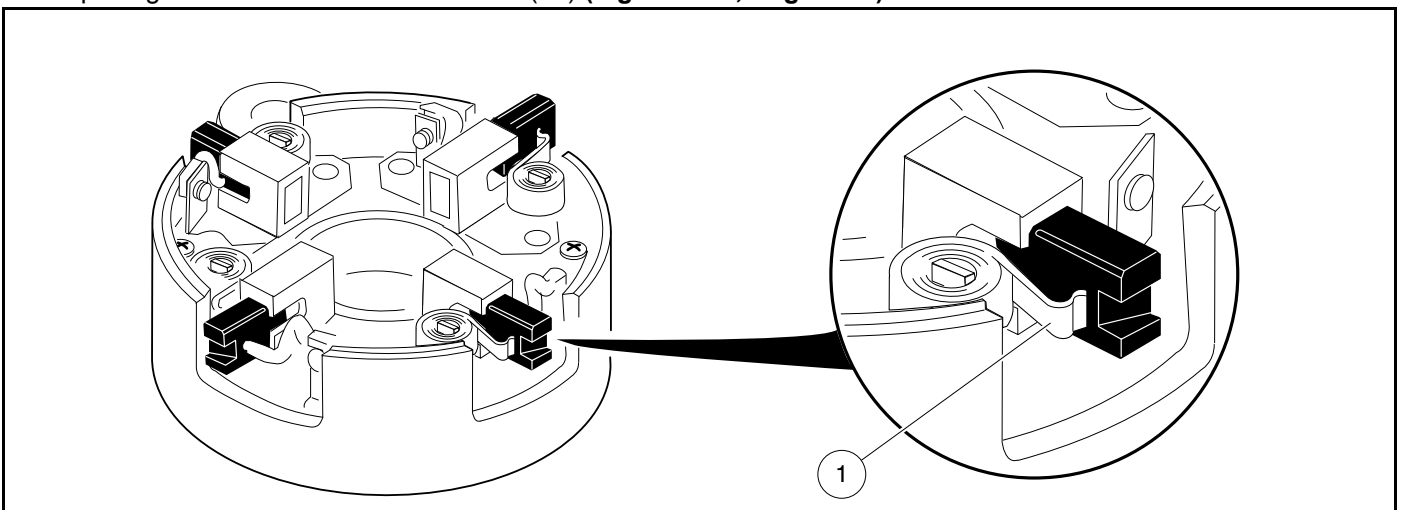
⚠ CAUTION

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Figure 12-4 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 12-2, Page 12-2**).
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 12-5, Page 12-3**).
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 12-1, Page 12-2**).
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 12-2, Page 12-2**).

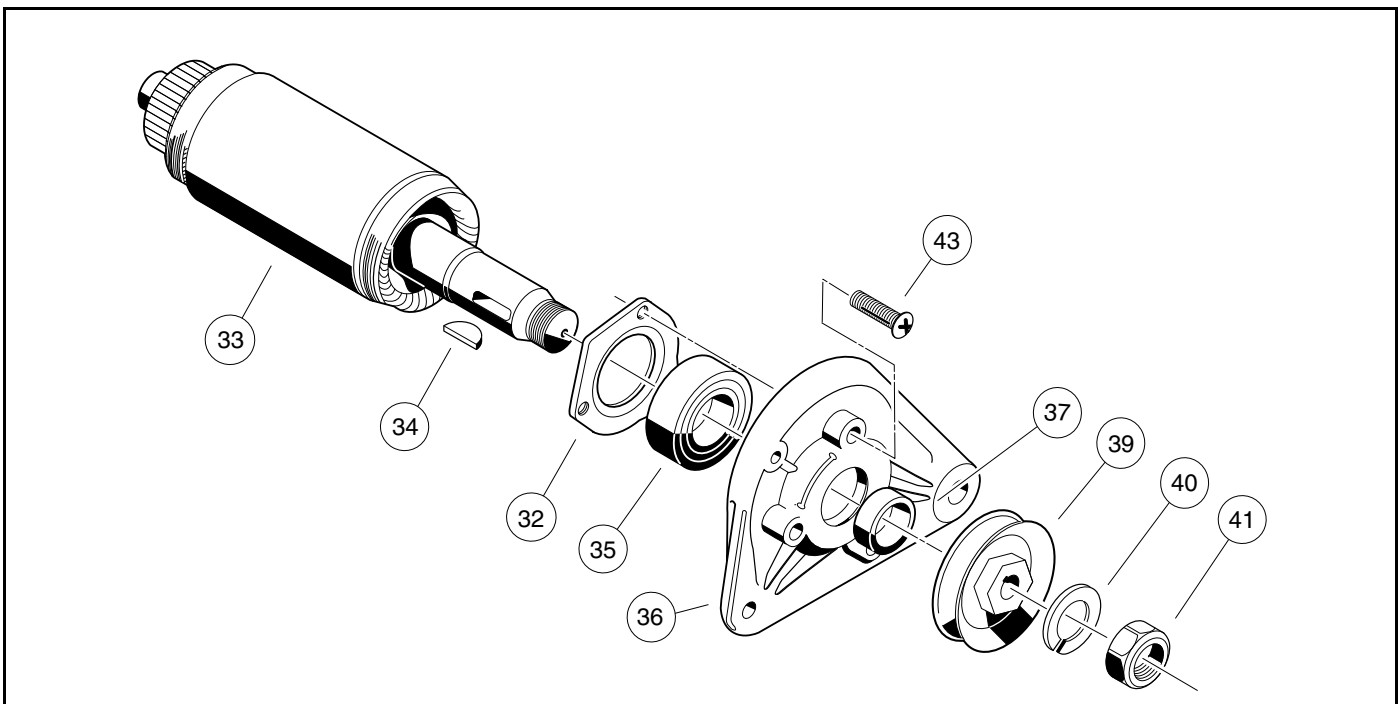


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Figure 12-5 Pull Brushes Away From Center of the Commutator End Cover

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 12-5, Page 12-3**).
2. Remove the two bolts (20), and pull commutator end cover (23) free of the starter/generator housing (24) (**Figure 12-1, Page 12-2**).
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 12-6, Page 12-4**).

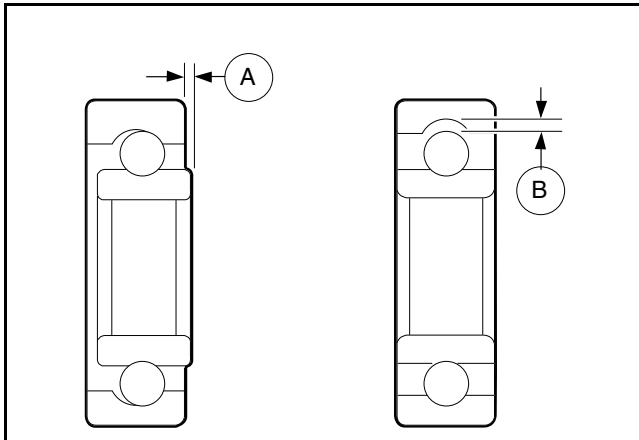


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Figure 12-6 Armature and Output End Cover Assembly

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 12-7, Page 12-5**).
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.

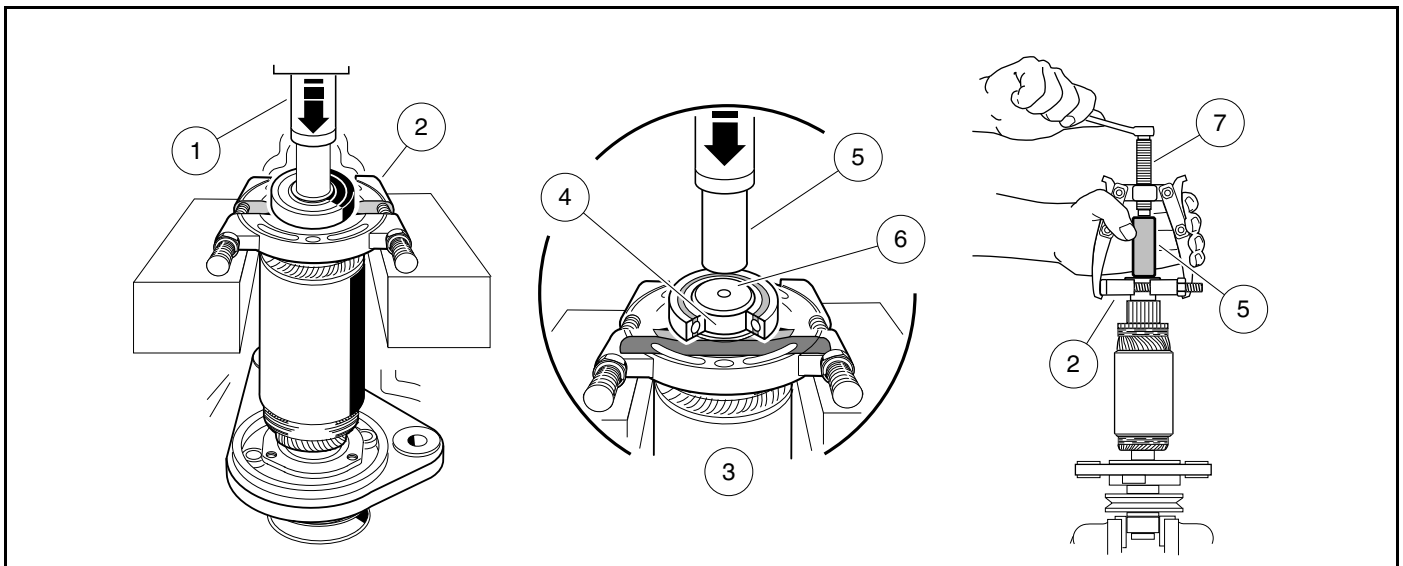


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Figure 12-7 Bearing Play Inspection

BEARING REMOVAL

1. Place the wedge attachment tool (CC 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 (CC 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 12-8, Page 12-5).
2. Discard the bearings.
3. Slide the bearing retainer (32) off of the output end of the shaft (Figure 12-6, Page 12-4).



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Figure 12-8 Bearing Removal

FIELD COIL REMOVAL

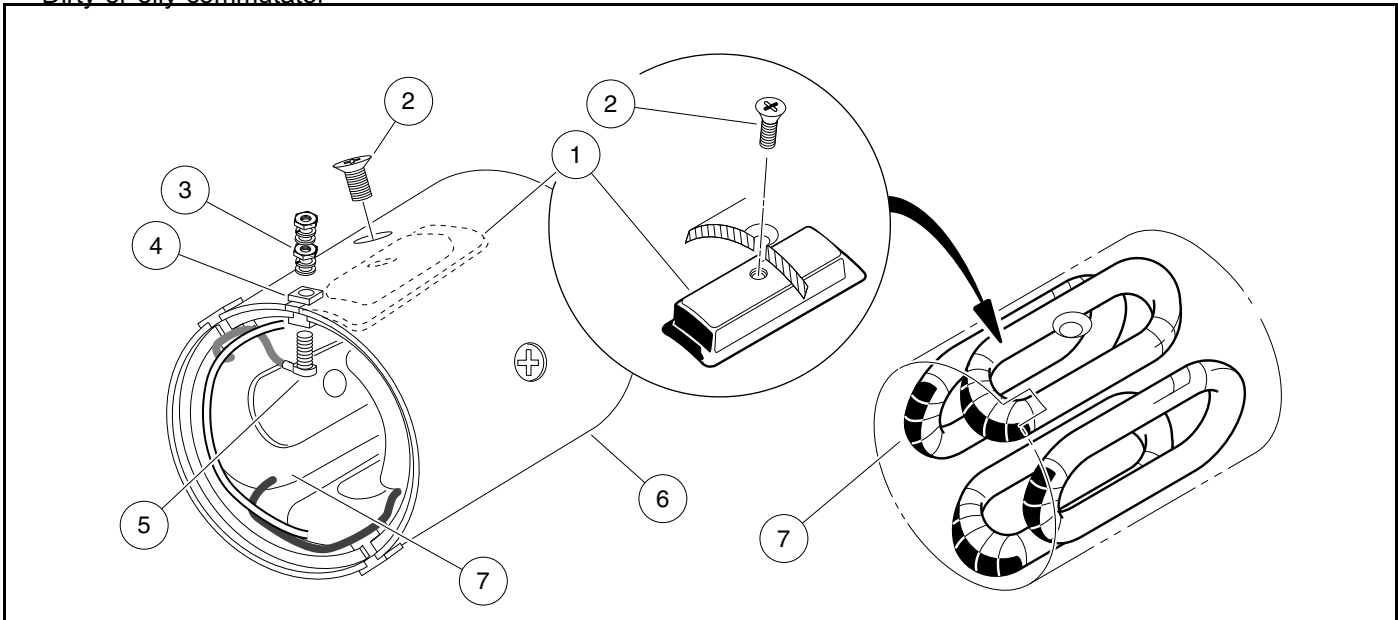
1. Remove the retaining nut from each field coil terminal and slide the insulator out of the slots in the housing. Remove the four pole piece screws from the housing. Remove the four pole pieces from inside the housing. Remove the field coils from the inside of the housing (Figure 12-9, Page 12-6). See following NOTE.

NOTE: Do not remove the insulators or the field coils unless an electrical test indicates that it is necessary (Figure 12-9, Page 12-6). See Starter/Generator (Starter Function) on page 11-29.

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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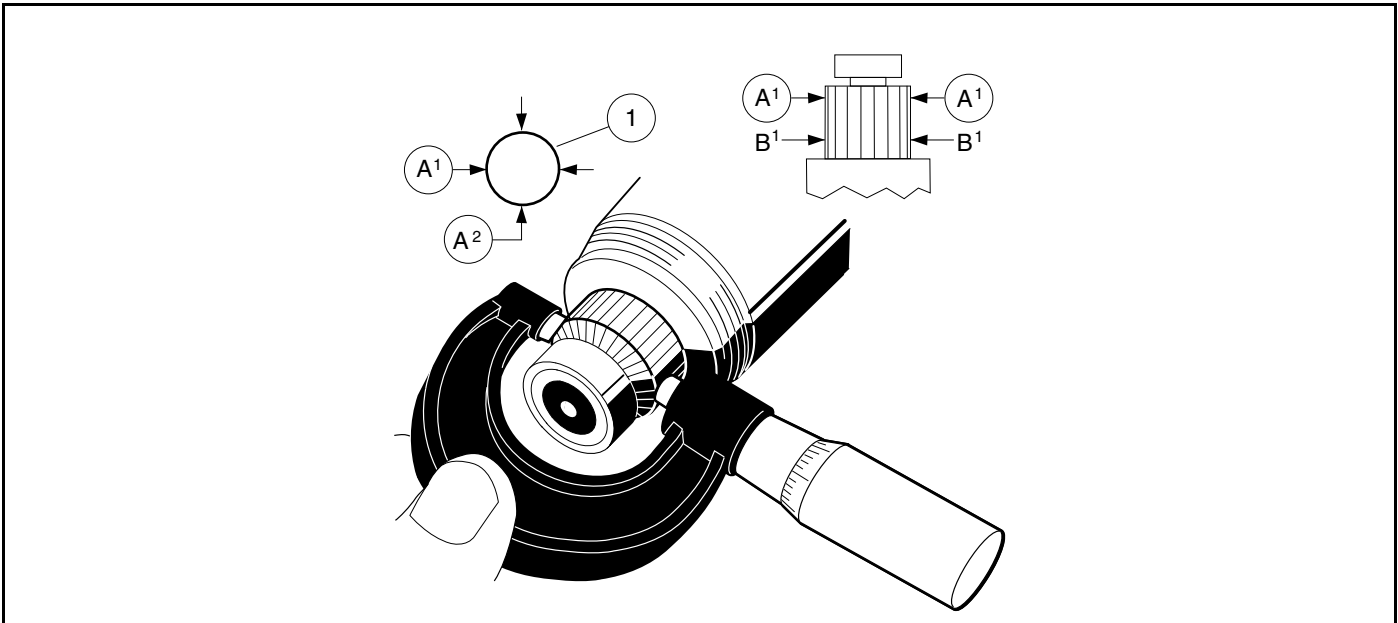
Figure 12-9 Field Coil Assembly

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 12-10, Page 12-7**).



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Figure 12-10 Inspect Commutator

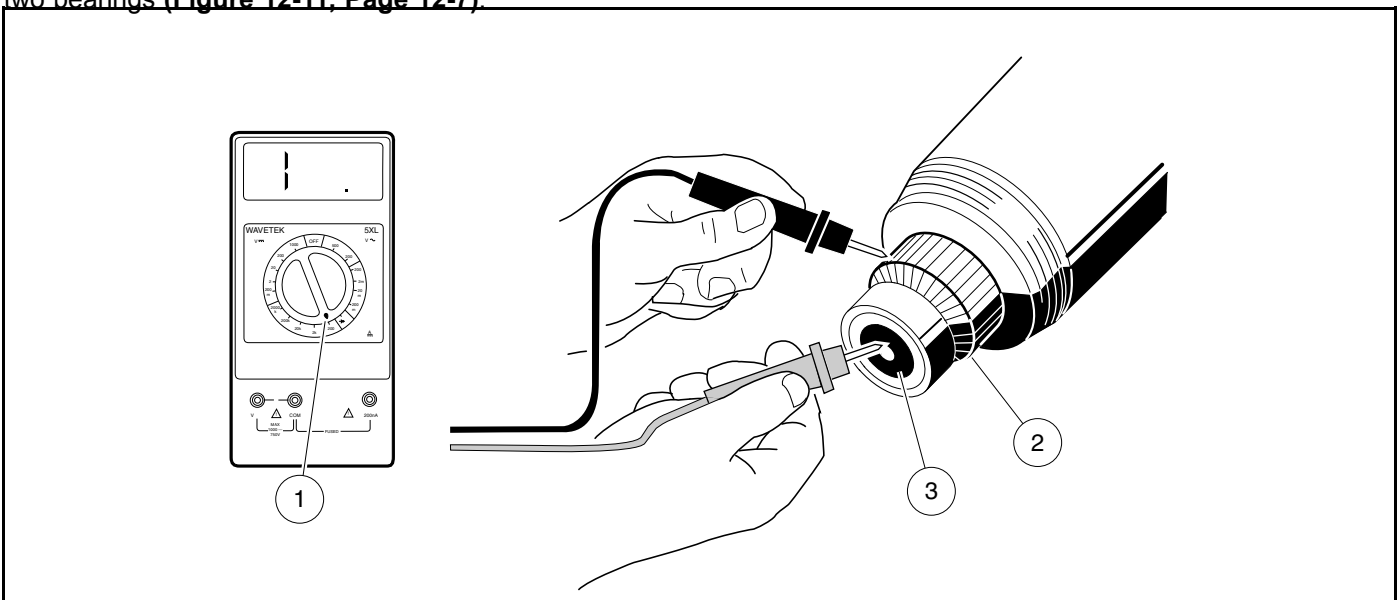
ARMATURE GROUND TEST

⚠ 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.

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 12-11, Page 12-7).



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Figure 12-11 Armature Ground Test

VISUAL INSPECTION OF FIELD COILS

If the insulation on the field coils appears blackened or charred, the serviceability of the coils is questionable. Burned or scorched coil insulation indicates the starter/generator has overheated due to overloads or grounded or shorted coil windings. Be sure the insulators are tight in the housing.

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 to 0.01 ohms
Generator field coil resistance	4.5 to 5.5 ohms

STARTER/GENERATOR ASSEMBLY

- 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.
- 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, lock washer and nut onto each threaded terminal on the outside of the housing. Tighten nuts to 47.5 in-lb (5.4 N·m) (**Figure 12-9, Page 12-6**).

⚠ CAUTION

- Route the field terminal wires so that they will not contact the armature.
- 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 12-9, Page 12-6**).
 - 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.
 - Press a new ball bearing (35) onto the output end of the armature (**Figure 12-6, Page 12-4**). Press a new ball bearing onto the commutator end of the armature shaft. **See following CAUTION.**

⚠ CAUTION

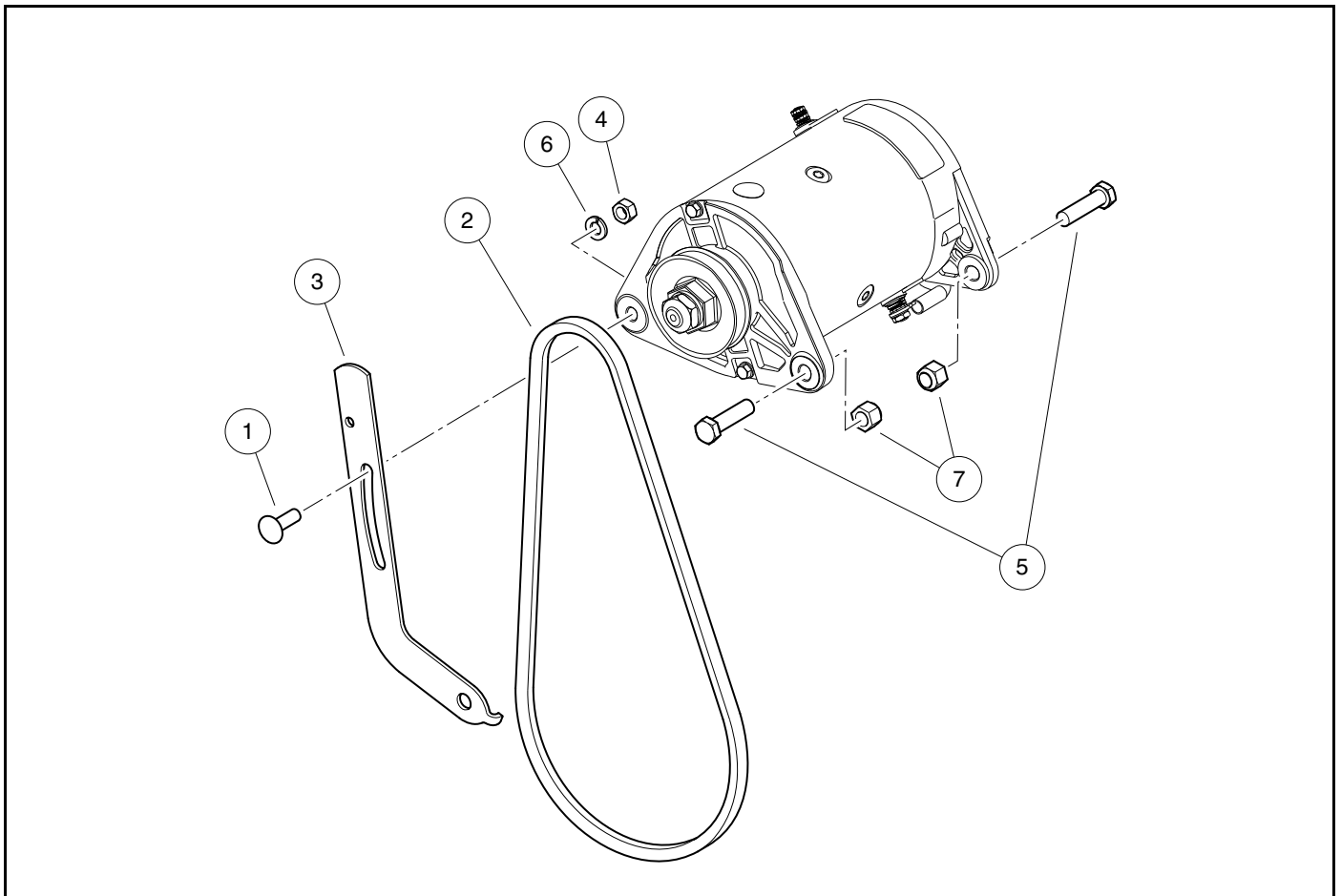
- To prevent damage to the retainer, use care while pressing new bearing onto the output end of the shaft.
- Press against the inner race of the new bearing until it is fully seated.

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 12-6, Page 12-4)**.
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. To prevent contact between the brushes and commutator as the commutator cover 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 12-5, Page 12-3)**.
9. Install the commutator end cover (23) onto the armature shaft. Align the locating pin with the pin hole in the cover. Install the two M6 x 180 mm bolts (20), and tighten to 100 in·lb (11.3 N·m) **(Figure 12-1, Page 12-2)**.
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) in the openings in the commutator end cover (23) **(Figure 12-2, Page 12-2)**.
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 lock washer (40) and M14 nut (41). Tighten the nut to 28 ft·lb (38.0 N·m) **(Figure 12-6, Page 12-4)**.

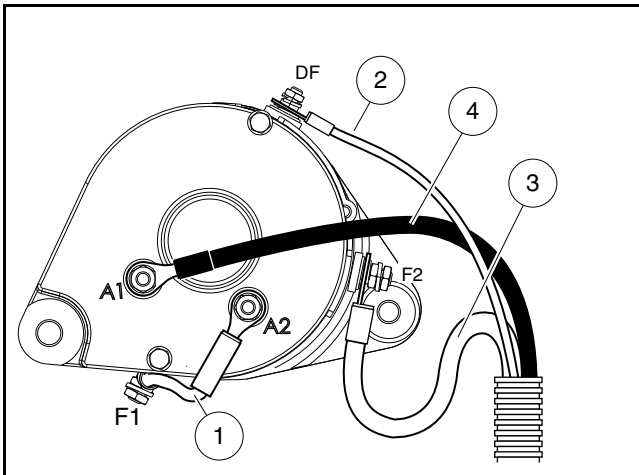
STARTER/GENERATOR INSTALLATION



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Figure 12-12 Starter/Generator Installation

1. Install the green wire (1) from the F1 terminal to the A2 terminal on the starter/generator (**Figure 12-13, Page 12-10**). Install a flat washer, lock washer, and nut onto each terminal and tighten to 48 in·lb (5.4 N·m).
2. Position the starter/generator over the mounting bracket so that the bolts will go through the starter/generator before going through the bracket. Install pivot bolts (5) with the heads of the bolts facing as shown (**Figure 12-12, Page 12-9**). Install lock nuts (7) finger-tight.
3. Install the adjustment bolt (1) through the adjusting bracket (3) and then through the starter/generator. Install a lock washer (6) and nut (4) onto adjustment bolt (1) finger-tight (**Figure 12-12, Page 12-9**).
4. Install the belt (2), then tighten the mounting bolts. **See Belt Tension Adjustment on page 12-11.**
5. Connect the yellow wire (2) from the voltage regulator to the DF terminal on the starter/generator (**Figure 12-13, Page 12-10**). Install a flat washer, lock washer, and nut onto the terminal. Tighten the nut to 31 in·lb (3.5 N·m).
6. Install the white wire (3) from the solenoid to the F2 terminal on the starter/generator (**Figure 12-13, Page 12-10**). Install the black wire (4) from the frame to the A1 terminal on the starter/generator. Install a flat washer, lock washer 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, Section 1, Page 1-3.**

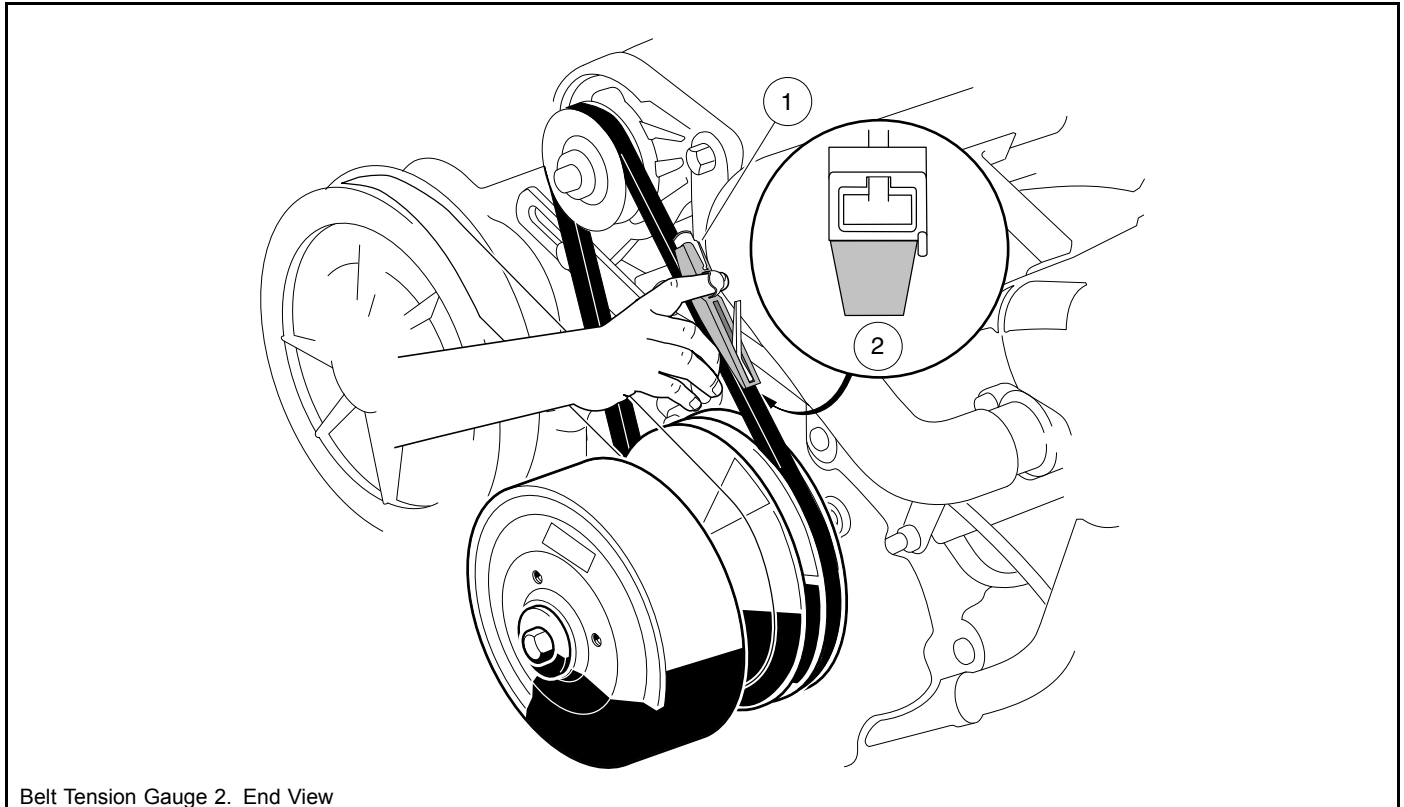


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Figure 12-13 Starter/Generator Wiring

BELT TENSION ADJUSTMENT

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



Belt Tension Gauge 2. End View

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Figure 12-14 Belt Tension Gauge

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery, Section 1, Page 1-3.**
2. Remove the seat to access engine compartment. See Section 4 – Body and Trim.
3. Make sure the two pivot bolts (5) on the mounting bracket are finger-tight. The carriage bolt (1) and hex nut (4) are to be finger-tight also (**Figure 12-12, Page 12-9**).
4. Push the starter/generator down so it is at the lowest point of its adjustment travel. With the starter/generator belt in place around the drive clutch pulley, install the starter/generator belt (2) around the starter/generator pulley.
5. Position a pry bar between the top of the starter/generator mounting bracket and the underside of the starter/generator by passing the pry bar under the exhaust header.
6. While holding the pry bar, measure the belt tension using a Kriket® gauge (1) (available at NAPA® Auto Parts stores), or equivalent (**Figure 12-14, Page 12-11**). Proper tension for a new starter/generator belt (2) should be 75 lb (101.7 N) or 45 lb (61 N) for an existing belt.
7. While maintaining the tension, tighten the adjustment nut (4) 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 12-12, Page 12-9**). **See following CAUTION.**

⚠ CAUTION

- Remove pry bar before starting engine.

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

VOLTAGE REGULATOR

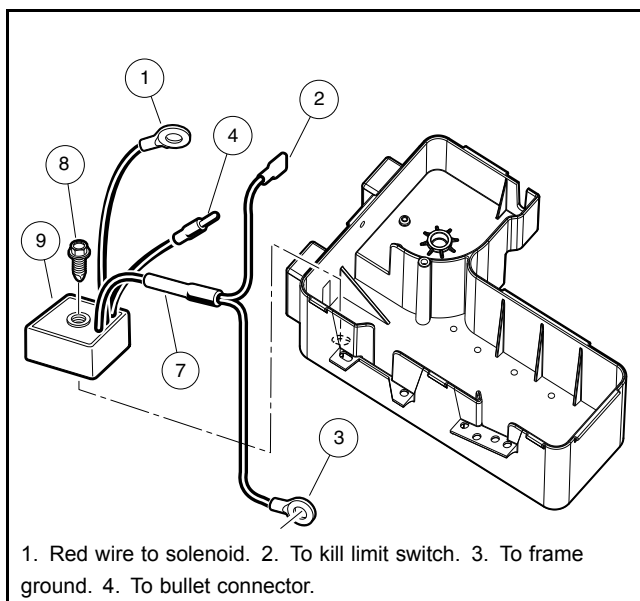
See General Warnings on page 1-2.

TESTING THE VOLTAGE REGULATOR

See Test Procedure 13 – Voltage Regulator on page 11-31.

VOLTAGE REGULATOR REMOVAL

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery, Section 1, Page 1-3.**
2. Remove the electrical component box cover.
3. 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 (NO) terminal of the kill limit switch and at the battery frame ground (**Figure 12-15, Page 12-12**).
4. Remove the voltage regulator mounting screw (8) and remove the voltage regulator (9).



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Figure 12-15 Voltage Regulator

VOLTAGE REGULATOR INSTALLATION

1. Position the voltage regulator (9) in the electrical component box and install the mounting screw (8) (**Figure 12-15, Page 12-12**). Tighten screw to 23 in·lb (2.6 N·m).
2. Connect 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) at the battery frame ground (**Figure 12-15, Page 12-12**).
3. Install snap-on electrical component box cover. Be sure to firmly press down all corners. Install screw and tighten to 18 in·lb (2 N·m).
4. Connect battery and spark plug wire(s). **See Connecting the Battery, Section 1, Page 1-3.**
5. Place Forward/Reverse handle in NEUTRAL and place the neutral lockout switch in the MAINTENANCE position. Start the engine and check regulator for proper functioning as described in the voltage regulator test procedure. **See Voltage Regulator on page 11-31.**

ENGINE CONTROL UNIT (ECU)

CAUTION

- The Engine Control Unit (ECU) and Throttle Body are to be purchased as one unit. They are matched pairs with matching serial numbers. Do not mix an ECU with another Throttle Body of a different serial number.

The ECU is located in the engine compartment.

TESTING THE ENGINE CONTROL UNIT

See Test Procedure 4 – EFI System (ECU and Sensors) on page 11-22.

ENGINE CONTROL UNIT REMOVAL

1. Disconnect battery. **See Disconnecting the Battery on page 1-3.**
2. Remove ECU mounting plate bolts.
3. Disconnect gray and black wire connectors.

ENGINE CONTROL UNIT INSTALLATION

WARNING

- To prevent damage to the ECU, never mix the black and gray connectors that attach to it. The black connector is tethered to the ECU mounting plate to help prevent accidentally installing it in the gray port.
1. Mount ECU to plate with bolts and tighten to 108 in·lb (12.2 N·m).
 2. Install gray connector to the gray port on the ECU. **See preceding WARNING.**
 3. Install black connector to the black port on the ECU.
 4. Connect the battery. **See Connecting the Battery on page 1-3.**

KEY SWITCH

See General Warnings on page 1-2.

TESTING THE KEY SWITCH

See Test Procedure 5 – Key Switch (Start Circuit) on page 11-23.

See Test Procedure 6 – Key Switch (Engine Kill Circuit) on page 11-24.

KEY SWITCH REMOVAL

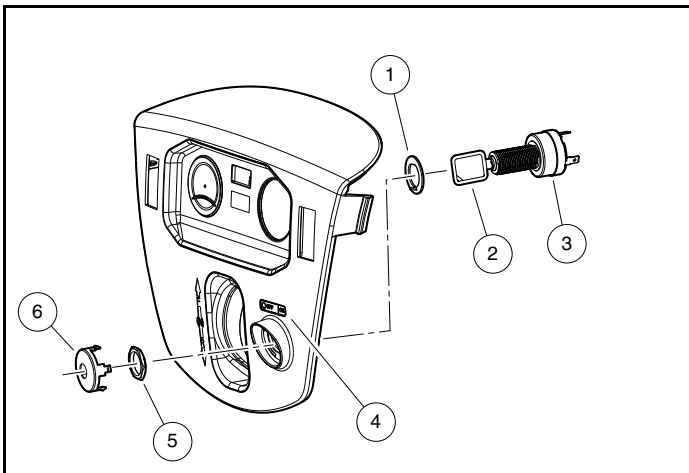
1. Disconnect the batteries and spark plug. **See Disconnecting the Battery, Section 1, Page 1-3.**
2. Remove instrument panel. **See Instrument Panel Removal on page 4-9.**

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

3. Disconnect the wires from the key switch. Do not allow wires to touch.
4. From the back of the instrument panel, push down on the retaining tabs surrounding the key switch (3) and remove the key switch cap (6). Using a 1-inch socket, hold the key switch (3) and remove the switch retaining nut (5) from the outside of the instrument panel (**Figure 12-16, Page 12-14**).

KEY SWITCH INSTALLATION

1. Position the key switch (3) and key switch washer (1) in the instrument panel, then install and tighten the key switch nut (5) to 35 to 45 in·lb (4 to 5 N·m). Install key switch cap (6) into instrument panel, align the bent washer tab with the slot in the plastic (**Figure 12-16, Page 12-14**).
2. Refer to the wiring diagram to connect the wires to the key switch terminals. **See Wiring Diagrams, Section 11, Page 11-9.**
3. Install instrument panel. **See Instrument Panel Installation on page 4-9.**
4. Connect the battery and spark plug. **See Connecting the Battery, Section 1, Page 1-3.**



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Figure 12-16 Key Switch

MAINTENANCE/OPERATE SWITCH

TESTING THE MAINTENANCE/OPERATE SWITCH

See Test Procedure 9 – Maintenance/Operate Switch – Pedal-Start Vehicles on page 11-27.

MAINTENANCE/OPERATE SWITCH REMOVAL

1. Disconnect the battery and spark plug wire(s). **See Disconnecting the Battery on page 1-3.**
2. Using a 5/8 inch (16 mm) wrench, remove maintenance/operate boot/hex nut.
3. Remove maintenance/operate switch from bracket.
4. Disconnect the two spade terminals and remove switch.

MAINTENANCE/OPERATE SWITCH INSTALLATION

1. Connect the three spade terminals (**Figure 11-14, Page 11-27**).
2. Make sure groove switch is aligned with tang on bracket and install switch. Tighten maintenance/operate switch boot/hex nut to 16 in·lb (1.8 N·m).
3. Connect the battery. **See Connecting the Battery on page 1-3.**

NEUTRAL LOCKOUT LIMIT SWITCH

See General Warnings on page 1-2.

TESTING THE NEUTRAL LOCKOUT LIMIT SWITCH

See Test Procedure 10 – Neutral Lockout Limit Switch – Pedal-Start Vehicles Only on page 11-28.

NEUTRAL LOCKOUT LIMIT 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, Section 1, Page 1-3.**
3. Disconnect the 3-wire connector from the neutral lockout limit switch (1) located on the transaxle.
4. Remove two nuts (3) and washers (4) from the neutral lockout limit switch (1) and slide the limit switch off of the screws.

NEUTRAL LOCKOUT LIMIT SWITCH INSTALLATION

1. Install the limit switch (1) with washers (4) and nuts (3) and tighten to 5 in·lb (0.6 N·m). Move the Forward/Reverse handle to make sure the switch actuates. **See following CAUTION.**

⚠ CAUTION

- **Do not overtighten the retaining nuts. If the nuts are overtightened, limit switches could be damaged.**
2. Connect the 3-wire connector to the neutral lockout limit switch lead.
 3. Connect battery and spark plug wire(s). **See Connecting the Battery, Section 1, Page 1-3.**
 4. Test drive the vehicle in both forward and reverse for proper operation.

SOLENOID

See General Warnings on page 1-2.

TESTING THE SOLENOID

See Test Procedure 8 – Solenoid on page 11-25.

SOLENOID REMOVAL

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery, Section 1, Page 1-3.**
2. Remove electrical component box cover (**Figure 12-17, Page 12-19**).
3. Disconnect all the wires from the solenoid.
4. Remove the two screws securing the solenoid in place. Remove the solenoid.

SOLENOID INSTALLATION

1. Install the solenoid in the electrical component box (**Figure 12-17, Page 12-19**). Use two screws to secure the solenoid to the box and tighten to 14 in·lb (1.6 N·m).
2. Connect all wires as indicated. **See Wiring Diagrams on page 11-9.**
 - 2.1. Connect the 4-gauge white wire from the starter/generator, the 18-gauge white wire from the fuel gauge/hour meter, and the 18-gauge red wire from the voltage regulator to the large post on the solenoid.
 - 2.2. Connect the 4-gauge red wire from the positive (+) battery terminal and the 10-gauge red wire and 16-gauge orange wire from the fuse blocks to the other large post on the solenoid.
 - 2.3. Connect the 18-gauge orange wire from accelerator pedal limit switch to small post on the solenoid.
 - 2.4. Connect the 18-gauge blue wire from the key switch to the other small post on the solenoid.
3. Tighten the hex nuts on the large solenoid posts to 60 in·lb (6.8 N·m). Tighten the nuts on the small solenoid posts to 22 in·lb (2.5 N·m).
4. Install the electrical box cover.
5. Connect battery and spark plug wire(s). **See Connecting the Battery, Section 1, Page 1-3.**

FUSE

See General Warnings on page 1-2.

ATC-style fuses are located inside the electrical component box near the battery.

ATM-style fuses are located on the main wire harness in front of the engine.

TESTING THE FUSE

See Test Procedure 2 – Fuses, ATM- and ATC-style on page 11-20.

FUSE REMOVAL

1. Disconnect battery. See **Disconnecting the Battery, Section 1, Page 1-3**.
2. **ATC Fuse Only:** Remove electrical component box cover.
ATM Fuse Only: Remove fuse holder cover.
3. Remove the fuse from the fuse block.

FUSE INSTALLATION

1. Install the fuse. See following **WARNING**.

⚠ WARNING

- If a fuse is blown, determine the cause of the failure and make necessary repairs before installing a new fuse. Use the appropriately rated fuse; if a fuse with a higher amp rating is used, damage to the vehicle electrical system may occur.
2. **ATC Fuse Only:** Install the snap-on electrical box cover by pressing down firmly on all corners and install the screw, tightening to 18 in·lb (2 N·m).
ATM Fuse Only: Install the fuse holder cover.
 3. Connect battery. See **Connecting the Battery, Section 1, Page 1-3**.

KILL LIMIT SWITCH

See General Warnings on page 1-2.

TESTING THE KILL LIMIT SWITCH

See Test Procedure 14 – Kill Limit Switch – Pedal-Start Vehicles Only on page 11-32.

KILL LIMIT SWITCH REMOVAL

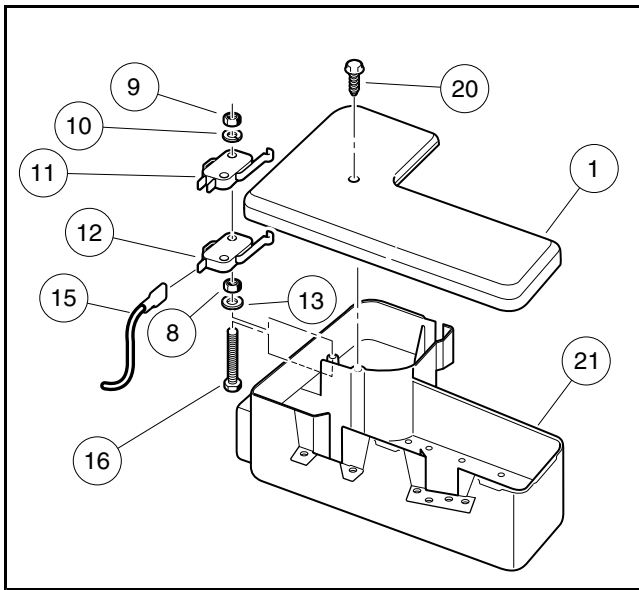
1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery, Section 1, Page 1-3.**
2. Remove electrical component box cover (1) (**Figure 12-17, Page 12-19**).
3. Remove the two nuts (9) and washers (10) securing the accelerator pedal limit switch (11). Do not disconnect the wires attached to accelerator pedal limit switch (11) (**Figure 12-17, Page 12-19**).
4. Disconnect the wires from the kill limit switch (12).
5. Remove the kill limit switch (12).

KILL LIMIT SWITCH INSTALLATION

1. Connect the white/black wire to the common (COM) terminal and the blue wire to the normally open (NO) terminal of the kill limit switch (12) and place the switch on the mounting screws located in the electrical component box (**Figure 12-17, Page 12-19**). Place the accelerator limit switch (11) on the mounting screws located in the electrical component box.
2. Secure the switches using two washers (10) and two nuts (9). Tighten to 5 in·lb (0.6 N·m). **See following CAUTION.**

⚠ CAUTION

- **Do not overtighten the retaining nuts. If the nuts are overtightened, limit switches could be damaged.**
3. Press and release the accelerator pedal to make sure that both switches are being activated when the pedal is released.
 4. Install electrical component box cover (1) (**Figure 12-17, Page 12-19**). Be sure to press down firmly all corners. Install screw (20) and tighten to 18 in·lb (2 N·m).
 5. Connect battery and spark plug wire(s). **See Connecting the Battery, Section 1, Page 1-3.**



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Figure 12-17 Accelerator Starter and Kill Limit Switches

REVERSE WARNING BUZZER

See General Warnings on page 1-2.

TESTING THE REVERSE WARNING BUZZER

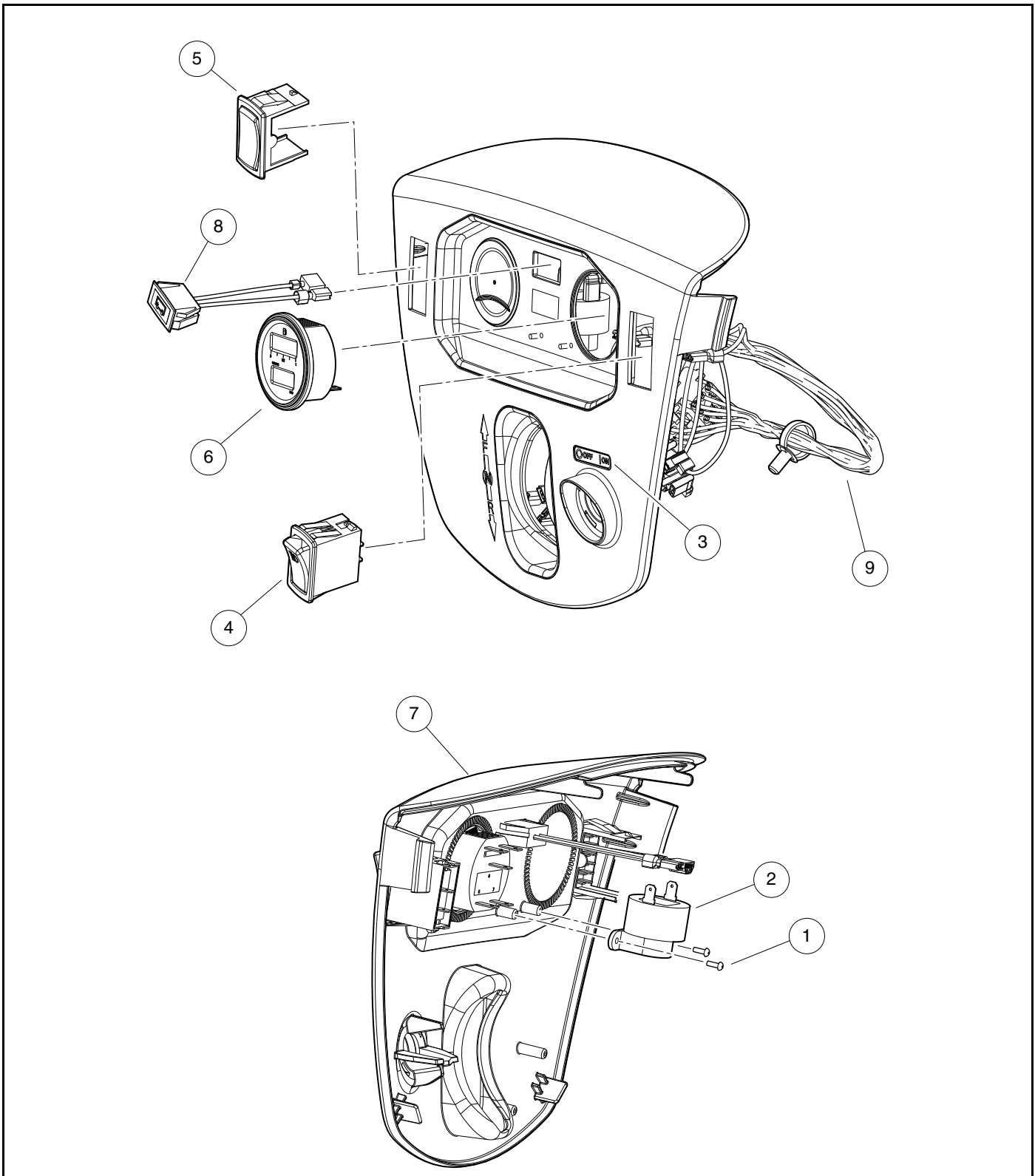
See Test Procedure 17 – Reverse Buzzer and Reverse Buzzer Limit Switch on page 11-35.

REVERSE WARNING BUZZER REMOVAL

1. Disconnect battery and spark plug wire(s). See **Disconnecting the Battery, Section 1, Page 1-3**.
2. Remove the instrument panel. See **Instrument Panel Removal, Section 4, Page 4-9**.
3. Disconnect the wires from the reverse warning buzzer (2) (**Figure 12-18, Page 12-20**). Do not allow wires to touch.
4. Remove the mounting screws (1) securing the buzzer (2) to the instrument panel.

REVERSE WARNING BUZZER INSTALLATION

1. Install the screws (1) through the buzzer (2) mounting tabs and tighten to 3.5 in-lb (0.40 N·m) (**Figure 12-18, Page 12-20**).
2. Connect the black wire from the key switch to the negative (–) terminal on the buzzer.
3. Connect the orange/white wire from the wire harness to the positive (+) terminal on the buzzer.
4. Install instrument panel. See **Instrument Panel Installation, Section 4, Page 4-9**. Be sure that the key switch terminals cannot touch the frame and that the panel is properly seated and snapped in place.
5. Connect battery and spark plug wire(s). See **Connecting the Battery, Section 1, Page 1-3**.



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Figure 12-18 Instrument Panel Switches

REVERSE BUZZER LIMIT SWITCH

See General Warnings on page 1-2.

TESTING THE REVERSE BUZZER LIMIT SWITCH

See Test Procedure 17 – Reverse Buzzer and Reverse Buzzer Limit Switch on page 11-35.

REVERSE BUZZER LIMIT SWITCH REMOVAL

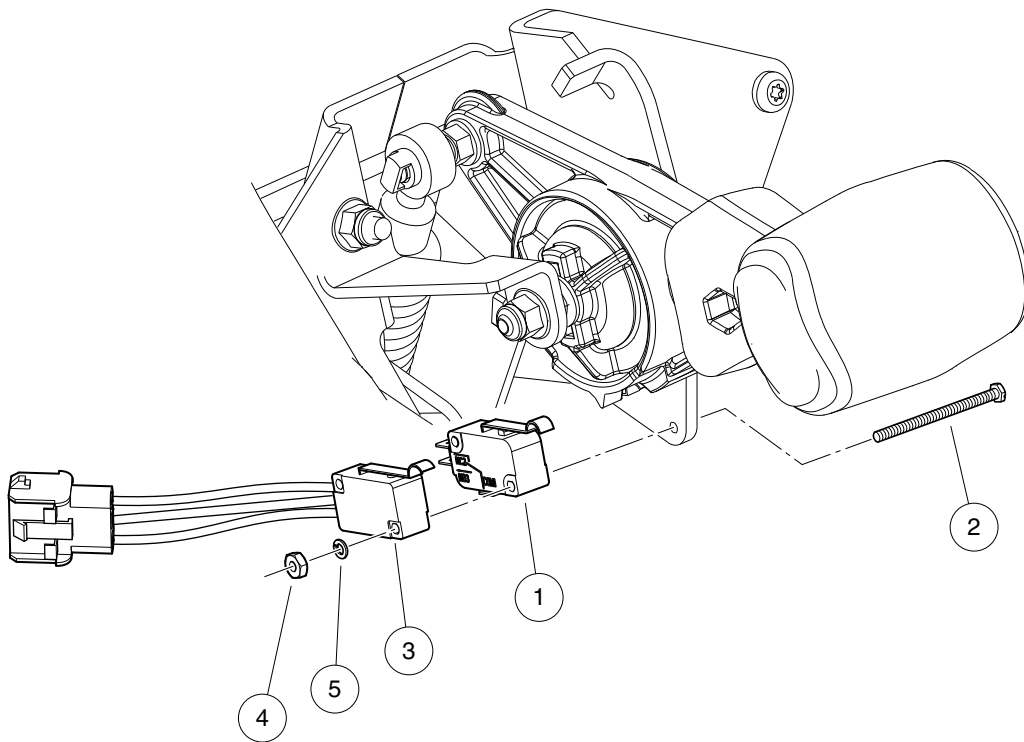
1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery, Section 1, Page 1-3.**
2. Cut the wire tie that retains the limit switch leads to the instrument panel harness.
3. Disconnect the wire connector from the reverse buzzer limit switch (3) located on the back of the Forward/Reverse shifter assembly (**Figure 12-19, Page 12-22**).
4. Remove the nuts (4) and washers (5) from the reverse buzzer switch (3) and slide the reverse buzzer switch off of the screws (2).

REVERSE BUZZER LIMIT SWITCH INSTALLATION

1. Install the reverse buzzer switch (3) with two screws (2) (**Figure 12-19, Page 12-22**), that attach the buzzer to the shifter assembly. Install washers (5) and tighten nuts (4) to 5 in-lb (0.6 N·m). **See following CAUTION.**

⚠ CAUTION

- **Do not overtighten the retaining nuts. If the nuts are over tightened, limit switches could be damaged.**
2. Place the Forward/Reverse handle in REVERSE and make sure that both switches actuate.
 3. Connect the two wire connector to the reverse buzzer limit switch (3).
 4. Connect battery and spark plug wire(s). **See Connecting the Battery, Section 1, Page 1-3.**
 5. Turn the key switch to the ON position. Shift the Forward/Reverse handle to the REVERSE position. The buzzer should sound.



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Figure 12-19 Forward/Reverse Assembly Switches

LOW OIL WARNING LIGHT

See General Warnings on page 1-2.

TESTING THE LOW OIL WARNING LIGHT

See Test Procedure 18 – Low Oil Warning Light (LED) on page 11-35.

LOW OIL WARNING LIGHT REMOVAL

1. Disconnect battery and spark plug wire(s). See **Disconnecting the Battery, Section 1, Page 1-3**.
2. Remove the instrument panel. See **Instrument Panel Removal, Section 4, Page 4-9**.
3. Disconnect the wires from the low oil warning light (6) (**Figure 12-18, Page 12-20**). Do not allow wires to touch.
4. Press the retaining tabs and remove the low oil warning light from the instrument panel.

LOW OIL WARNING LIGHT INSTALLATION

1. Push a new unit into hole in the instrument panel until plastic tabs engage instrument panel (**Figure 12-18, Page 12-20**).
2. Connect yellow wire to positive (+) terminal and black wire to negative (-) terminal of the low oil warning light.
3. Install the instrument panel. See **Instrument Panel Installation, Section 4, Page 4-9**. 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, Section 1, Page 1-3**.

FUEL GAUGE/HOUR METER

See General Warnings on page 1-2.

TESTING THE FUEL GAUGE/HOUR METER

See Test Procedure 22 – Fuel Gauge on page 11-38. Also see Test Procedure 23 – Hour Meter on page 11-39.

GENERAL INFORMATION

With the key switch in the OFF position, the fuel gauge field is blank; however, the hour meter field is always ON. When the key switch is turned to ON, the fuel gauge field activates. The fuel gauge initially registers full before indicating the actual fuel level.

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

FUEL GAUGE/HOUR METER REMOVAL

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery, Section 1, Page 1-3.**
2. Remove the instrument panel. **See Instrument Panel Removal, Section 4, Page 4-9.**
3. Disconnect the wires from the fuel gauge/hour meter (6) (**Figure 12-18, Page 12-20**). Do not allow wires to touch.
4. 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 (6) into the hole in the instrument panel until the flange seats against the instrument panel (**Figure 12-18, Page 12-20**).
2. Connect the wires to the fuel gauge/hour meter. **See Wiring Diagrams on page 11-9.**
3. Install the instrument panel. **See Instrument Panel Installation, Section 4, Page 4-9.** 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, Section 1, Page 1-3.**

FUEL LEVEL SENDING UNIT

See General Warnings on page 1-2.

The fuel level sending unit is an integral part of the fuel pump module and is not replaceable. Thoroughly test the fuel level sending unit before replacing the fuel pump module.

TESTING THE FUEL LEVEL SENDING UNIT

See Test Procedure 21 – Fuel Level Sending Unit on page 11-37.

OIL LEVEL SENSOR

See General Warnings on page 1-2.

TESTING THE OIL LEVEL SENSOR

See Test Procedure 19 – Oil Level Sensor on page 11-36.

OIL LEVEL SENSOR REMOVAL

See Oil Level Sensor Removal on page 13-12.

OIL LEVEL SENSOR INSTALLATION

See Oil Level Sensor Installation on page 13-12.

VOLTAGE LIMITER

See General Warnings on page 1-2.

TESTING THE VOLTAGE LIMITER

See Test Procedure 26 – Voltage Limiter on page 11-41.

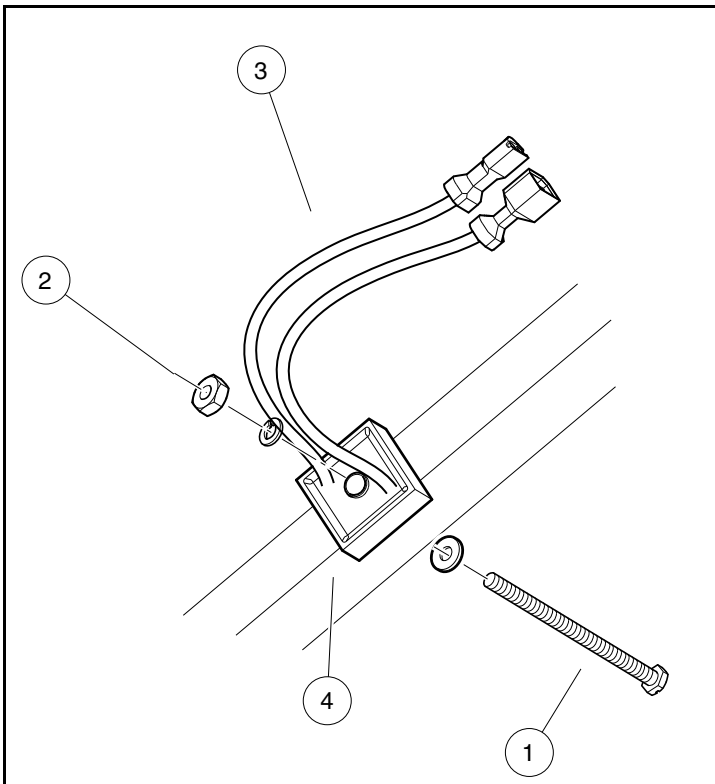
VOLTAGE LIMITER REMOVAL

NOTE: Battery will charge reducing the voltage going to accessories.

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, Section 1, Page 1-3.**
3. Remove the cowl. **See Cowl Removal, Section 4, Page 4-5.**
4. The voltage limiter is located on the driver side cowl frame.
5. Disconnect wires from the voltage limiter (1). Do not allow wires to touch (**Figure 12-20, Page 12-26**).
6. Remove the mounting hardware (2) from the voltage limiter and remove from vehicle.

VOLTAGE LIMITER INSTALLATION

1. Mount the voltage limiter to the driver side frame using the mounting hardware and tighten to 25 in·lb (2.8 N·m) (**Figure 12-20, Page 12-26**).
2. Connect the black wire from harness to the black wire from limiter.
3. Connect the green wire from the harness to the green wire from the limiter.
4. Install the cowl. **See Cowl Installation, Section 4, Page 4-5.**
5. Connect battery and spark plug wire(s). **See Connecting the Battery, Section 1, Page 1-3.**



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Figure 12-20 Voltage Limiter

HEADLIGHT SWITCH

See General Warnings on page 1-2.

TESTING THE LIGHT SWITCH

See Test Procedure 24 – Light Switch on page 11-40.

HEADLIGHT SWITCH REMOVAL

1. Remove the instrument panel. **See Instrument Panel Removal, Section 4, Page 4-9.**
2. Disconnect the wires from the light switch (4 and 9) (**Figure 12-18, Page 12-20**).
3. Collapse the tabs and un-snap the light switch (4) from instrument panel.

HEADLIGHT SWITCH INSTALLATION

1. Connect the wires to the light switch (4 and 9) (**Figure 12-18, Page 12-20**).
2. Reinsert light switch (4) to instrument panel.
3. Install the instrument panel. **See Instrument Panel Installation on page 4-9.** Be sure that key switch terminals cannot touch the frame and the instrument panel is properly seated and snapped in place.
4. Connect battery and spark plug wire(s). **See Connecting the Battery, Section 1, Page 1-3.**

HEADLIGHTS

See General Warnings on page 1-2.

TESTING THE HEADLIGHT SOCKET

See Test Procedure 25 – Voltage at Headlight Socket on page 11-40.

HEADLIGHT BEZEL REMOVAL

1. Disconnect the battery. Disconnecting the Battery on page 1-3
2. Remove the cowl. **See Cowl Removal, Section 4, Page 4-5.**
3. Remove the front fenders. **See Front Bumper and Side Fender Removal, Section 4, Page 4-8.**
4. Loosen and remove the M6 self-tapping bolts (3) that attach the bezel (1) to the vehicle frame (**Figure 12-21, Page 12-29**).

HEADLIGHT BEZEL INSTALLATION

1. Install bezel (1) to vehicle frame.
2. Install the three M6 self-tapping bolts (3) that attach the bezel onto frame. Tighten to 44 in·lb (5 N·m).
3. Install the front fenders. **See Front Bumper and Side Fender Installation, Section 4, Page 4-8.**
4. Install the cowl. **See Cowl Installation, Section 4, Page 4-5.**
5. Connect the battery. **See Connecting the Battery, Section 1, Page 1-3.**

HEADLIGHT BULB REMOVAL (HALOGEN)

1. Disconnect the battery. **See Disconnecting the Battery, Section 1, Page 1-3.**
2. Remove cowl. **See Cowl Removal, Section 4, Page 4-5.**
3. Remove front fenders. **See Front Bumper and Side Fender Removal, Section 4, Page 4-8.**
4. Rotate the bulb (4) (but do not touch) in a 90° angle and pull out of lens assembly (5) (**Figure 12-21, Page 12-29**).

HEADLIGHT BULB INSTALLATION (HALOGEN)

1. Install bulb (4) (but do not touch) into socket, install into lens assembly (5) (**Figure 12-21, Page 12-29**).
2. Connect the battery. **See Connecting the Battery on page 1-3.**
3. Install front fenders. **See Front Bumper and Side Fender Installation, Section 4, Page 4-8.**
4. Install cowl. **See Cowl Installation, Section 4, Page 4-5.**

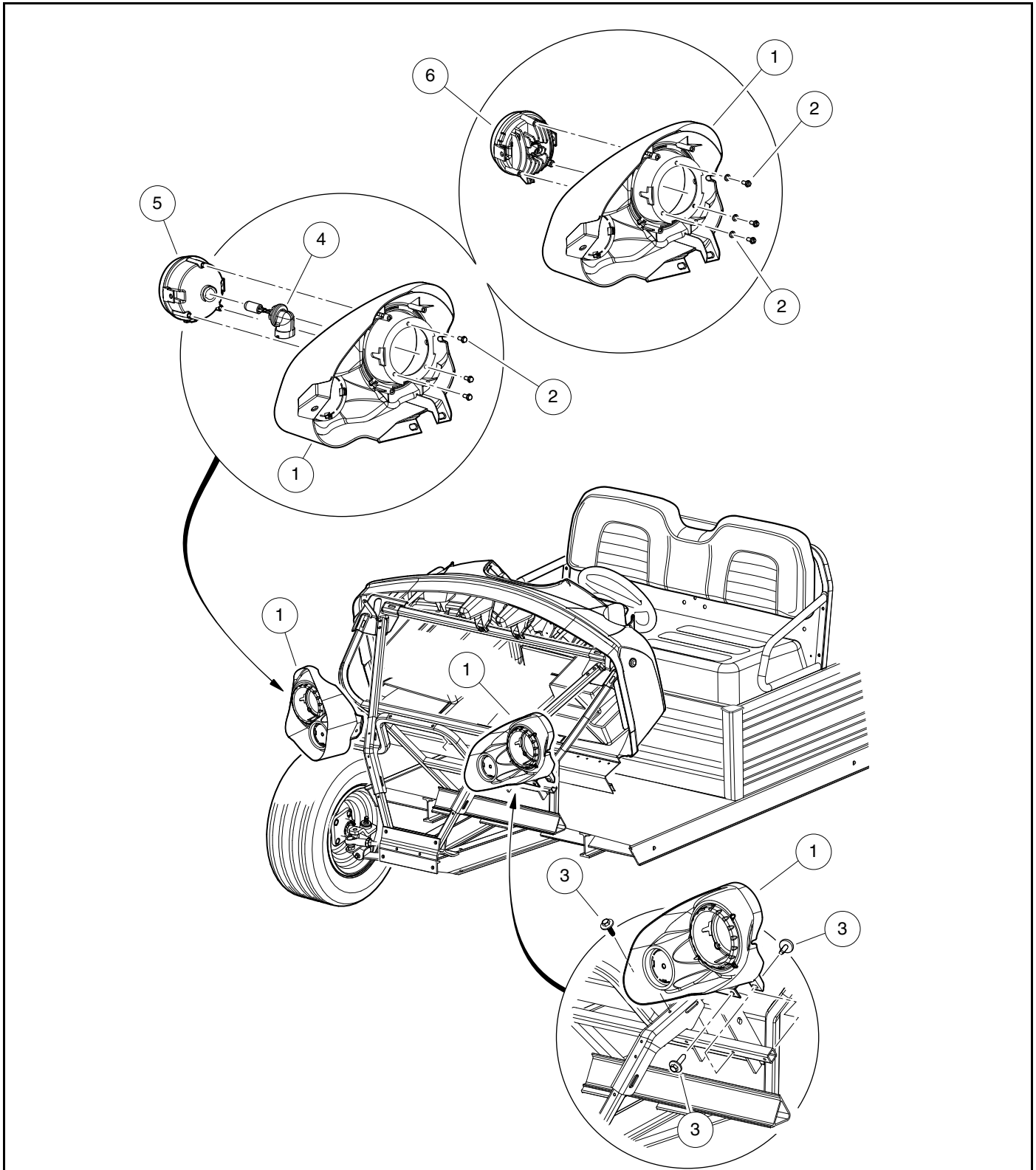
HEADLIGHT BULB REMOVAL (LED)

1. Disconnect the batteries.

2. Remove cowl. **See Cowl Removal, Section 4, Page 4-5.**
3. Remove front fenders. **See Front Bumper and Side Fender Removal, Section 4, Page 4-8.**
4. Remove the three screws (2) and pull bulb assembly (6) out of bezel (1) (**Figure 12-21, Page 12-29**).

HEADLIGHT BULB INSTALLATION (LED)

1. Install bulb assembly (6) into bezel (1) and secure with screws (2) (**Figure 12-21, Page 12-29**).
2. Connect the battery. **See Connecting the Battery on page 1-3.**
3. Install front fenders. **See Front Bumper and Side Fender Installation, Section 4, Page 4-8.**
4. Install cowl. **See Cowl Installation, Section 4, Page 4-5.**



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Figure 12-21 Headlight Assembly

BATTERY

See General Warnings on page 1-2.

⚠ 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.
- 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 (CC 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 11-17.

See Test Procedure 20 – Battery Test (Under Load) on page 11-36.

PREVENTIVE MAINTENANCE

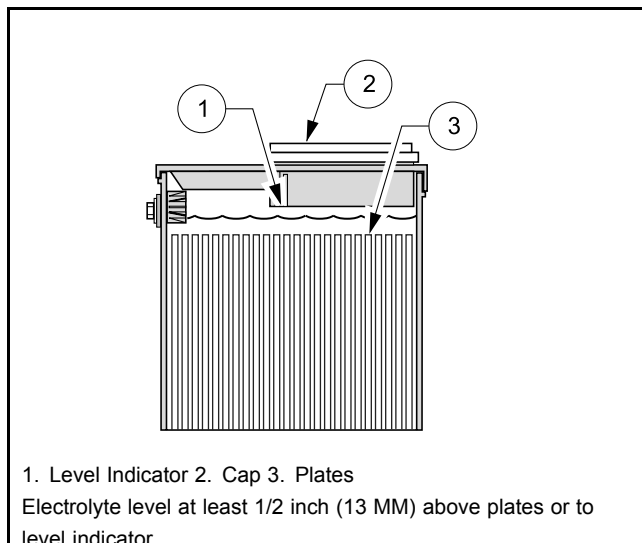
1. To keep the battery in good operating condition, remove any corrosion immediately. Post connections should be clean and tight. Any frayed or worn wires should be replaced. After all cables have been connected and properly tightened to 144 in·lb (16 N·m), coat terminals with Battery Terminal Protector Spray (CC 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 12-31.**
 3. Maintain proper water level. **See Water Level on page 12-31.**
 4. Check battery periodically to see that it is in a full state of charge. **See Charging the Battery on page 12-34.**
 5. Keep battery hold-down clamp tight. **See Vibration Damage on page 12-32.**

WATER LEVEL

The water level should be checked semi-annually to be sure water is at its proper level (**Figure 12-22, Page 12-31**). 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.



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Figure 12-22 Battery Electrolyte Level

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 12-35.**

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 Warnings on page 1-2. 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, 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 Warnings on page 1-2. Also see DANGER at beginning of Battery topic.

1. Charge the battery using an automotive type 12-volt battery charger. Follow all warnings and procedures supplied by the battery charger manufacturer.
2. Attach the positive (+) charger cable to the positive (+) battery post.
3. Attach the negative (-) charger cable to the negative (-) battery post.
4. The battery may be charged with a slow charge (3 to 10 amps) or a fast charge (20 to 30 amps). Charge until the 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 Warnings on page 1-2. 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, Section 1, Page 1-3**.

BATTERY STORAGE

See General Warnings on page 1-2. Also see DANGER at beginning of Battery topic.

1. Keep the battery clean and free of corrosion. See Preventive Maintenance on page 12-31.
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, 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 Warnings on page 1-2. 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

NOTE: Verify that all cables (fuel tank, engine, battery, starter/generator and voltage regulator) are connected securely.

TESTING THE GROUND CABLES

See Test Procedure 3 – Ground Cables on page 11-21.

⚠ DANGER

- See General Warnings on page 1-2.

⚠ WARNING

- See General Warnings on page 1-2.

GENERAL INFORMATION

See General Warnings on page 1-2.

This vehicle is powered by a Subaru EX40, high-compression, chain driven, overhead cam engine. The engine offers a heavy-duty construction featuring cast iron cylinder liner for longer life, dual ball bearing crankshaft support, low oil level sensor and heavy-duty air cleaner system, to name a few characteristics. **See following NOTE.**

NOTE: *Engine rotation is counterclockwise as viewed from the clutch side of the engine.*

This section contains information for removing and replacing the engine. For complete instruction on engine disassembly, repair, rebuilding, and reassembly, see your authorized dealer.

Test cylinder compression using a standard compression tester. Low compression would normally indicate a problem in the cylinder assembly such as defective rings, gaskets, etc. Compression should be:

At a normal cranking speed of 550 to 600 RPM, the compression should typically be approximately 167 psig (1151 kPa). This value could vary slightly depending on wear of components affecting compression.

See the Subaru EX40 Engine Repair and Rebuild Manual for complete teardown, rebuild and repair information.

BEFORE SERVICING

Carefully read the applicable information and instructions before beginning engine service. Diagrams, DANGER, WARNING, CAUTION and NOTE statements and detailed descriptions have been included wherever necessary. Anyone attempting engine service should have knowledge and experience in small engine service and repair.

ENGINE ROTATION

When turning the crankshaft by hand, always turn it counterclockwise as viewed from the clutch side of the engine.

TORQUE SPECIFICATIONS

ITEM	SIZE	TORQUE	
Flywheel retaining nut	M18	80 ft·lb (110 N·m)	
Crankcase cover to block bolts	M8	250 in·lb (28.3 N·m)	
Cylinder head bolts	M10	1st Step New head and bolts: 159 in·lb (18 N·m)	2nd Step New head and bolts: 336 in·lb (38 N·m)
		Used head and bolts: 159 in·lb (18 N·m)	Used head and bolts: 265 in·lb (30 N·m)
	M8	159 in·lb (18 N·m)	2 nd step not needed
Connecting rod bolts	M8	221 in·lb (25 N·m)	
Spark plug	13/16 in. (21 mm) plug socket	New: 120 in·lb (13.5 N·m)	
		Re-tightening: 216 in·lb (24.5 N·m)	
Exhaust flange nuts	M8	177 in·lb (20 N·m)	
Ignition coil	M6	71 in·lb (8 N·m)	
Oil sensor	M6	80 in·lb (9 N·m)	
Oil drain plug	M14	18 ft·lb (24.4 N·m)	
Fan housing screws	M6	90 in·lb (10 N·m)	
Fan cover screws	M6	25 in·lb (2.8 N·m)	
Bolts marked with "4" (when used with nuts)	M8	130 in·lb (15 N·m)	
	M6	50 in·lb (5.9 N·m)	
	M5	30 in·lb (3.4 N·m)	

ADJUSTMENTS AND SETTINGS

ITEM	VALUES
Spark plug gap	0.024 to 0.028 in. (0.6 to 0.7 mm)
Valve clearance – Intake & Exhaust (cold)	0.0047 to 0.0059 in. (0.12 to 0.15 mm)
Ignition coil air gap	0.012 to 0.020 in. (0.3 to 0.5 mm)
Compression pressure:	167 psig (1151 kPa) Allowable Lower Pressure: 120 psig (827 kPa)

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.

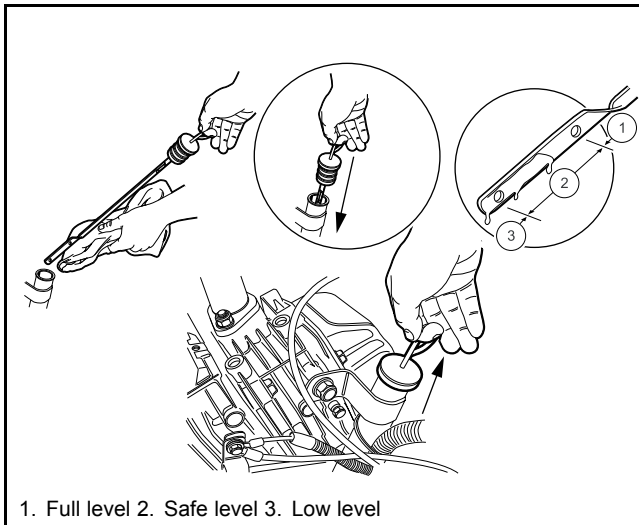
Engine Oil Level Check

1. Remove the oil level dipstick from the oil filler tube, and wipe oil off dipstick (**Figure 13-1**). **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 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).
 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.



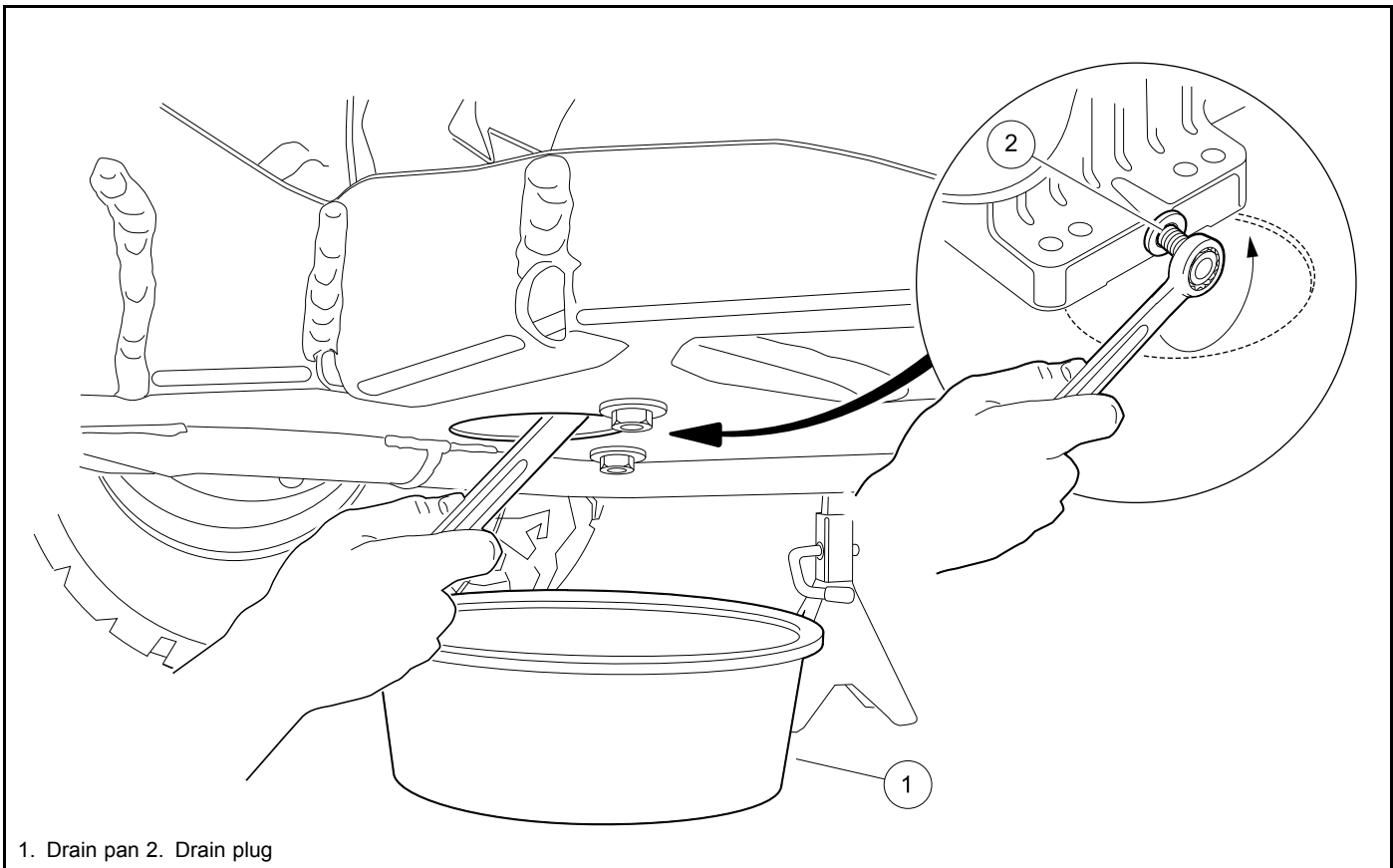
2662

Figure 13-1 Engine Oil Level Check

Engine Oil Change

Engine oil should be changed after the first 100 hours of operation. After that, it 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. **See Disconnecting the Battery on page 1-3.**
4. Position a pan designed for oil changes under the drain plug (1) (**Figure 13-2**).



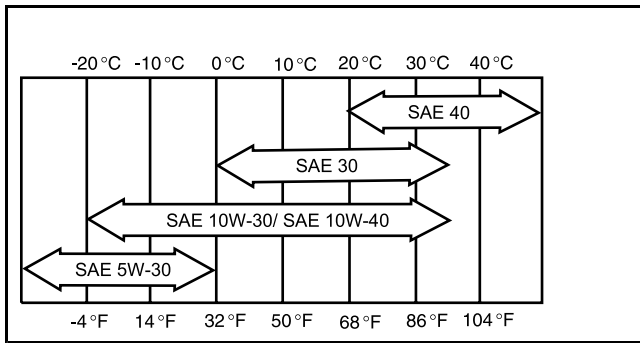
2667

Figure 13-2 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 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 oil drain plug, turning it clockwise, and tighten to 18 ft·lb (24.4 N·m).
8. 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. The engine requires 40.5 fl-oz (1.2 L) of oil per change. 10W-30 or 5W-30 grade SE or higher is recommended. Refer to oil viscosity guidelines for selection of oil grade (**Figure 13-3**). Replace the dipstick.



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Figure 13-3 Oil Viscosity Chart

9. Connect battery and spark plug wire. **See Connecting the Battery on page 1-3.**
10. With the Forward/Reverse handle in the NEUTRAL position and the Maintenance/Service switch in the SERVICE position, start and run the engine for a few minutes. Observe the drain plug from under the vehicle and watch for oil leaks. If leaks appear, begin with step 1 and repeat the appropriate steps as needed to correct the problem.
11. Remove the dip stick and check the engine oil as a final step. Replace the dip stick.

SPARK PLUG

Spark plugs are selected to suit specific engine design and vehicle operating conditions. The spark plug (CC P/N 105017801) is designed to give maximum life and efficient combustion of fuel. The spark gap should be set to 0.024 in. to 0.028 in. (0.6 mm to 0.7 mm).

Spark Plug Removal

See General Warnings on page 1-2.

⚠ CAUTION

- Before removal and disassembly, clean the engine.

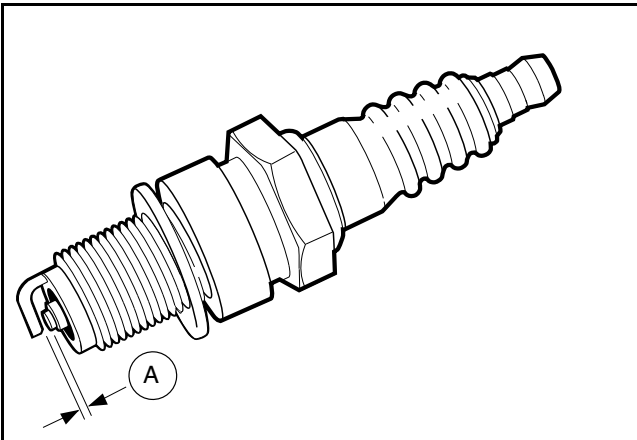
Remove all dirt from plug base in the cylinder head before removing plug. Use a 13/16 in. (21 mm), deep well socket with ratchet or spark plug wrench to loosen the plug.

Spark Plug Cleaning, Inspection and Repair

Examine the plug (**Figure 13-4, Page 13-6**). The deposits on the plug base and electrode are an indication of the correct heat range and efficiency as well as a guide to the general condition of the engine, fuel and air mixture and ignition system. If all of the above conditions are proper, the spark plug should be a light brown color. There should be no bridging between the electrode and base. The electrode should not be eroded. Black color, excessive carbon, and/or a wet plug indicates that the fuel is too rich. White, burned or melted electrodes indicate the fuel is too lean or pre-igniting. Oily deposits on the plug electrode are an indication of worn rings, valve guides, cylinder wall, etc. Also examine the spark plug wire. Remove rubber boot and inspect internal spring for damage. Inspect spark plug wire for damage and be sure spring coil is securely attached to spark plug. **See following WARNING.**

⚠ WARNING

- Remove spark plug wire to avoid accidental start up of the engine when servicing vehicle. To avoid ignition of fuel and serious personal injury or death, never try to start the engine with plug removed from engine.



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Figure 13-4 Spark Plug

Testing the Spark Plug

Check the sparking ability of a cleaned and properly gapped plug on a sparking comparator if possible. Spark should be blue and strong and able to jump a 5/16-in. (8 mm) gap.

Setting the Spark Gap

1. Pass a contact point file between the electrodes to produce flat, parallel surfaces to facilitate accurate gauging.
2. Use a wire type gauge. Bend the outside or ground electrode so only a slight drag on the gauge is felt when passing it between the electrode. Never make an adjustment by bending the center electrode. Set gap (A) to 0.024 in. to 0.028 in. (0.6 mm to 0.7 mm) (**Figure 13-4, Page 13-6**).

Spark Plug Installation

NOTE: Before installing the plug, check the condition of the threads in the cylinder head. Soften deposits in cylinder head threads with penetrating oil and clean the threads with a tap if necessary.

Use a high temperature, anti-seize lubricant on the threads of the spark plug to reduce friction when installing a new plug, and reduce "galling" and thread seizing for future replacements.

Install the spark plug by threading it in until finger tight, then tighten the spark plug to the following torque:

- **New:** 120 in·lb (13.5 N·m).
- **Re-tightening:** 216 in·lb (24.5 N·m).

BREATHER

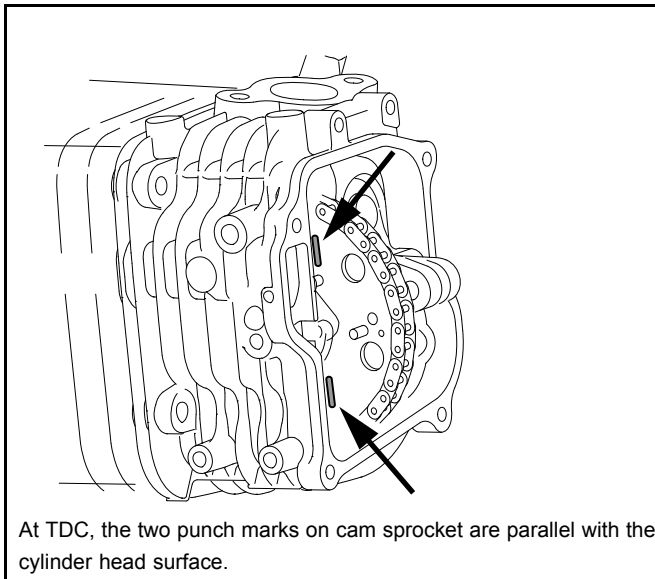
The function of the breather is to create a vacuum in the crankcase which prevents oil from being forced out of the engine through the piston rings, oil seals or gaskets. The breather has a reed valve which limits the direction of air flow caused by the piston moving up and down. Air can flow out of the crankcase, but the one-way reed valve blocks return flow and therefore maintains a vacuum in the crankcase.

Oil laden air in the crankcase passes through the reed valve and expands into the rocker chamber. In the rocker chamber most oil separates from the air and drains back to the crankcase. The air passes through a tube and vents to the intake manifold.

VALVE CLEARANCE CHECK AND ADJUSTMENT

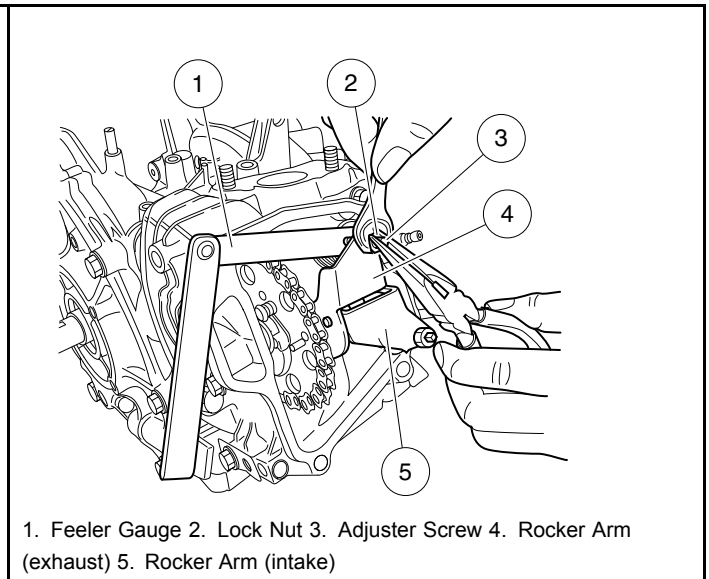
NOTE: Check and adjust clearance when the engine is cold.

1. Turn the crankshaft until the piston is at top dead center of the compression stroke (**Figure 13-5, Page 13-7**).
2. Using a feeler gauge (1), measure the clearance between the adjuster screw (3) and the top of the valve stem (**Figure 13-6, Page 13-7**).
3. If necessary, loosen the lock nut (2) and turn the adjuster (3) up or down to adjust the clearance to 0.0047 in. (0.12 mm) for both intake and exhaust. Once clearance is correct, tighten the lock nut (2) to 52 in-lb (6 N·m).
4. After adjusting valve clearances, rotate the crankshaft several full revolutions and verify that the intake and exhaust valve clearance are still correct.



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Figure 13-5 Top Dead Center (TDC) – EX40 Engine



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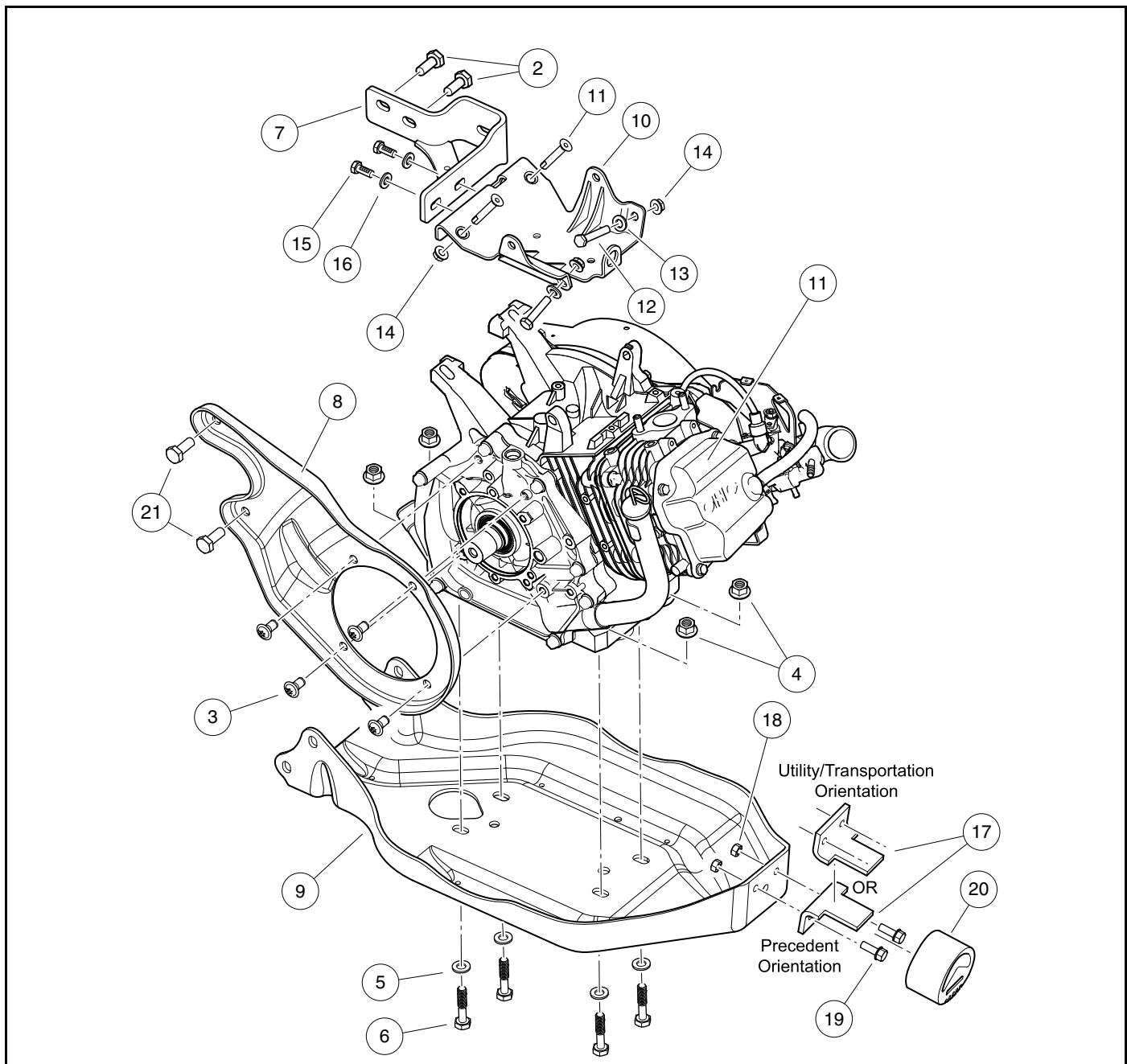
Figure 13-6 Setting Valve Clearance – EX40 Engine

ENGINE REMOVAL

See General Warnings on page 1-2.

CAUTION

- Before removal and disassembly, clean the engine.



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Figure 13-7 EX40 Engine and Mounting Brackets

1. Disconnect battery and spark plug wire(s). See **Disconnecting the Battery, Section 1, Page 1-3.**

2. For some vehicles, the engine (1) can be removed by lifting it up and out of the chassis. For other vehicles, it is easier to remove the entire powertrain assembly first. If removing powertrain, **see Transaxle Removal on page 17-9.**
3. Disconnect governor cable and P-clamp, air intake hose, fuel line, wire harness connectors, ground cable and accelerator cable P-clamp. **See Fuel System: Gasoline Vehicles, Section 14, Page 14-1.**
4. Remove starter/generator and belt. **See Starter/Generator Removal, Section 12, Page 12-1.**
5. Remove drive clutch. **See Drive Clutch Removal, Section 16, Page 16-5.**
6. Remove muffler. **See Muffler Removal, Section 15, Page 15-1.**
7. Remove engine mounting hardware (2, 3, 4, 5, and 6) from muffler bracket (7), clutch plate (8), and engine pan (9) (**Figure 13-7, Page 13-8**).
8. Lift engine (1) from engine pan (9). **See following NOTE.**

NOTE: *The engine weighs approximately 54 lb (24.5 kg).*

9. Remove crankcase oil drain plug and drain all oil from crankcase. Dispose of engine oil properly.
10. If replacing engine (1), remove starter/generator mounting weldment (10) and retain for installation on new engine. **See following NOTE.**

NOTE: *If replacing engine and throttle body, the ECU must also be replaced. Throttle bodies and ECU's are matched pairs.*

ENGINE INSTALLATION

See General Warnings on page 1-2.

1. If replacing engine (1), install starter/generator mounting weldment (10) on engine with screws (11), bolts (12), washers (13) and locknuts (14) (**Figure 13-7, Page 13-8**). Tighten locknuts (14) only finger-tight at this time.
2. Install oil drain plug and tighten to 18 ft·lb (24.4 N·m).
3. Place engine (1) onto engine pan (9) and secure with mounting hardware (4, 5 and 6). Leave flange nuts (4) loose at this time.
4. Install clutch plate (8) with screws (3) and bolts (21). Leave screws (3) and bolts (21) loose at this time.
5. Install bolts (2) through muffler bracket (7) into transaxle but do not tighten.
6. Tighten hardware in the following order:
 - 6.1. Tighten screws (3) to 23 ft·lb (31 N·m).
 - 6.2. Tighten bolts (21) to 50 ft·lb (68 N·m).
 - 6.3. Tighten bolts (2) to 50 ft·lb (68 N·m).
 - 6.4. Tighten flange nuts (4) to 33 ft·lb (40.6 N·m).
7. Install drive clutch. **See Drive Clutch Installation, Section 16, Page 16-11.**
8. Install muffler. **See Muffler Installation, Section 15, Page 15-1.**
9. Install starter/generator and belt. **See Starter/Generator Installation, Section 12, Page 12-9.**
10. If necessary, install powertrain. **See Transaxle Installation, Section 17, Page 17-12.**
11. Connect air intake hose, fuel line, wire harness connectors, ground cable and governor cable. **See Fuel System: Gasoline Vehicles, Section 14, Page 14-1.**
12. Secure accelerator cable and governor cable P-clamps to engine. Tighten P-clamp bolts to 36 in·lb (4.0 N·m).
13. Check all hardware for proper torque/tightness.
14. Fill engine to proper level with correct type of oil. **See Engine Oil – Gasoline Vehicle, Section 13, Page 13-2.**

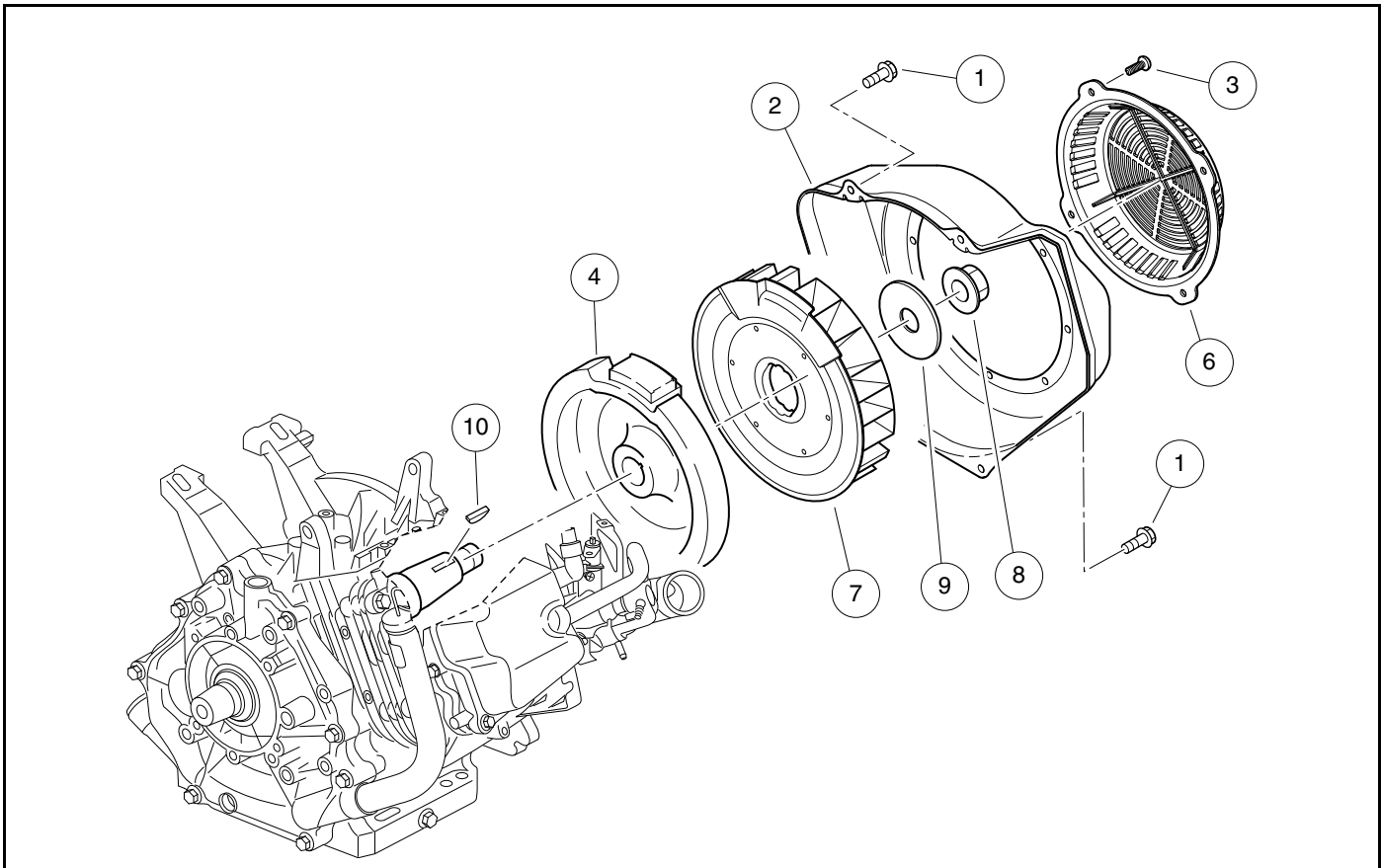
⚠ CAUTION

- Do not overfill with oil.

15. Connect battery and spark plug wire(s). See **Connecting the Battery, Section 1, Page 1-3.**
16. Adjust the engine RPM setting. See **Engine RPM Adjustment on page 14-11.**
17. Test-drive vehicle to ensure all systems are functional and correctly adjusted.

FLYWHEEL

See General Warnings on page 1-2.



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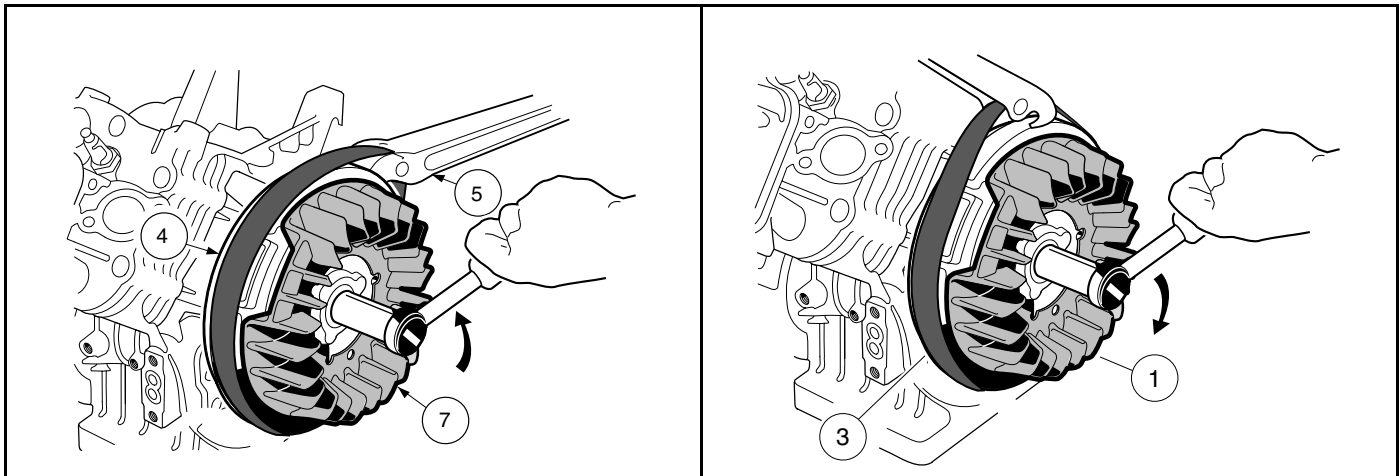
Figure 13-8 Flywheel, Fan and Fan Housing – EX40

FLYWHEEL REMOVAL

1. Remove screws (1) and fan housing (2) (**Figure 13-8, Page 13-10**).
2. Hold flywheel (4) only, not fan (7), with strap wrench (5) and use a 24 mm socket to remove flywheel nut (8) and flat washer (9) by turning it counterclockwise (**Figure 13-9, Page 13-11**). See following **CAUTION**.

⚠ CAUTION

- The flywheel nut has right-hand threads. Turn it clockwise to tighten, or counterclockwise to loosen.
 - Do not damage the fan blades with the strap wrench. Do not place screwdriver or pry bar in the fan blades.
3. Temporarily install flywheel nut (8) onto end of crankshaft to protect threads and to prevent flywheel (4) from falling off while being pulled.
 4. Detach flywheel (4) from crankshaft with puller (CC P/N 1016627).
 5. Remove flywheel nut (8) and flywheel (4) from crankshaft.
 6. Remove woodruff key (10) from groove in crankshaft.



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Figure 13-9 Flywheel Nut Removal

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Figure 13-10 Fan and Flywheel Installation

FLYWHEEL INSTALLATION

1. Wipe off any oil on tapered portions of crankshaft and flywheel (4) (Figure 13-8, Page 13-10).
2. Insert woodruff key (10) into keyway of crankshaft. Then align groove in flywheel (4) to woodruff key (10) and push flywheel onto crankshaft until it seats. Install fan (7), flat washer (9) and nut (8) finger-tight.
3. Use a strap wrench (3) to keep flywheel and fan assembly (1) from turning while tightening flywheel nut to 80 ft·lb (110 N·m) (Figure 13-10, Page 13-11). See following CAUTION.

⚠ CAUTION

- The flywheel nut has right-hand threads. Turn it clockwise to tighten, or counterclockwise to loosen.
 - Be careful not to damage the fan blades. Use a strap wrench to hold flywheel. Do not place screwdriver or pry bar between fan blades.
4. Install fan housing (2) and tighten screws (1) to 90 in·lb (10 N·m) (Figure 13-8, Page 13-10).

OIL LEVEL SENSOR

TESTING THE OIL LEVEL SENSOR

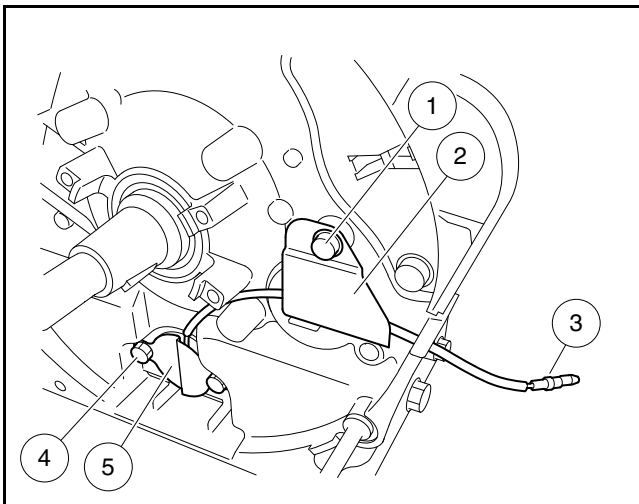
See Oil Level Sensor on page 11-36.

OIL LEVEL SENSOR REMOVAL

1. Drain oil from engine. **See Engine Oil – Gasoline Vehicle, Section 13, Page 13-2.**
2. Remove flywheel. **See Flywheel Removal on page 13-10.**
3. Remove bolt (1) securing oil sensor wire clamp (2) to engine.
4. Disconnect oil level sensor wire (3) from wire harness (**Figure 13-11, Page 13-12**).
5. Remove two bolts (4) securing oil sensor (5) in engine.
6. Pull oil level sensor (5) out of engine.

OIL LEVEL SENSOR INSTALLATION

1. Lubricate oil level sensor o-ring with oil and carefully insert sensor (5) into engine until fully seated.
2. Secure sensor (5) to engine with two bolts (4) and tighten to 80 in·lb (9 N·m) (**Figure 13-11, Page 13-12**).
3. Connect oil level sensor wire (3) to wire harness.
4. Secure oil sensor wire (3) with clamp (2) and bolt (1). Tighten bolt to 80 in·lb (9 N·m).
5. Install flywheel and fan shroud. **See Ignition Coil Removal on page 13-13.**
6. Fill engine to proper level with correct type of oil. **See Engine Oil – Gasoline Vehicle, Section 13, Page 13-2.**



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Figure 13-11 Oil Level Sensor – EX40

IGNITION COIL

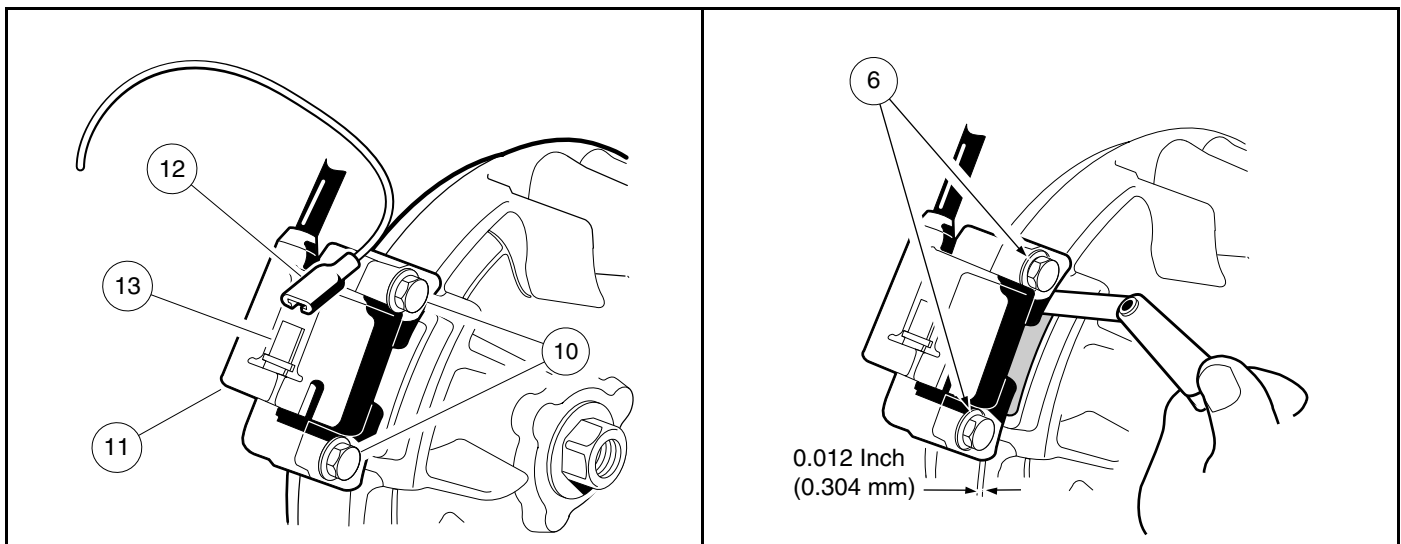
See General Warnings on page 1-2.

TESTING THE IGNITION COIL

See Test Procedure 15 – Ignition Spark on page 11-33 and Test Procedure 16 – Ignition Coil on page 11-34.

IGNITION COIL REMOVAL

1. Remove screws (1) and fan housing (2) (**Figure 13-8, Page 13-10**).
2. Disconnect ignition coil primary lead wire (12) from spade terminal (13) on ignition coil (11) (**Figure 13-12, Page 13-13**).
3. Remove two bolts (10) and pull ignition coil (11) from engine.



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Figure 13-12 Ignition Coil

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Figure 13-13 Adjust Ignition Coil Air Gap

IGNITION COIL INSTALLATION

1. Position ignition coil (11) onto engine and tighten two mounting bolts (10) finger-tight at this time (**Figure 13-12, Page 13-13**).
2. Rotate flywheel until its magnet is positioned directly under ignition coil (11). Use a bronze feeler gauge to set air gap between ignition coil and flywheel magnet to 0.012 to 0.020 in. (0.3 to 0.5 mm) (**Figure 13-13, Page 13-13**).
3. Tighten ignition coil bolts (6) to 71 in·lb (8 N·m).
4. Connect ignition coil primary lead wire (12) to terminal (13) on coil (**Figure 13-12, Page 13-13**).

SNUBBER

See General Warnings on page 1-2.

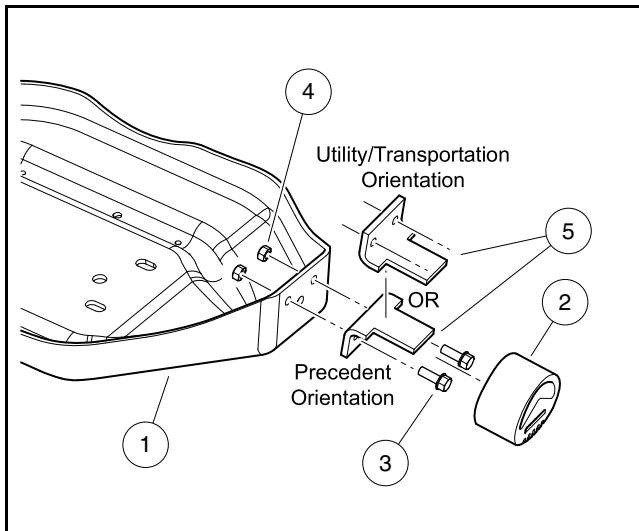
NOTE: The snubber is installed on the gasoline vehicle only.

SNUBBER REMOVAL

1. Support the powertrain with a floor jack under the engine pan (1) so that the snubber (2) is raised slightly and does not rest on the vehicle frame (**Figure 13-14, Page 13-14**).
2. Remove the two bolts (3) and two lock nuts (4) securing the snubber bracket (5) to the engine pan (1).
3. Slide snubber (2) and bracket (5) assembly toward battery to remove it from vehicle.
4. Slide snubber (2) off bracket (5).

SNUBBER INSTALLATION

1. Slide snubber (2) onto bracket (5) (**Figure 13-14, Page 13-14**).
2. Install bracket and snubber assembly onto engine pan (1).
3. Tighten lock nuts (4) to 20 to 25 ft·lb (27.1 to 33.9 N·m).



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Figure 13-14 Snubber

⚠ DANGER

- See General Warnings on page 1-2.

⚠ WARNING

- See General Warnings on page 1-2.
- To prevent damage to the ECU, never mix the black and gray connectors that attach to it. The black connector is tethered to the ECU mounting plate to help prevent accidentally installing it in the gray port.

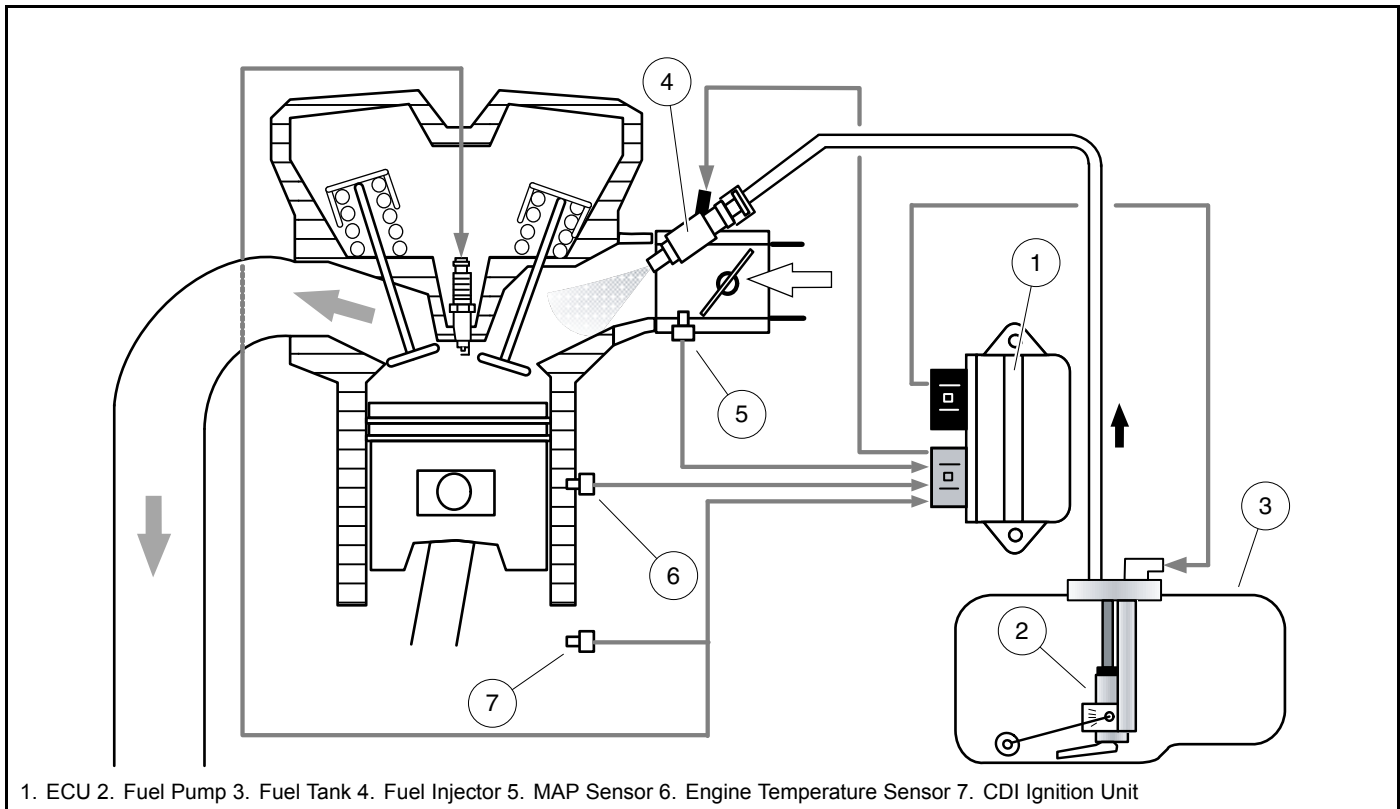
GENERAL INFORMATION

The engine is equipped with a throttle body/fuel injector assembly that is controlled by an ECU and requires no adjustment. The ECU monitors engine conditions through inputs from a MAP sensor, engine block temperature sensor and ignition timing.

EFI SYSTEM FEATURES/SPECIFICATIONS

NOTE: *This manual covers ECU software version F6i33051.*

- The ECU and throttle body/fuel injector assembly are matched pairs and are not available separately
- Fuel pump and low oil warning light operates for a few seconds when key switch is turned to the ON position; it stops if no engine RPM is detected by the ECU
- The ECU blinks fault codes through the Low Oil Warning Lamp
- In-tank fuel pump
- Return-less system
- High fuel pressure system (36 to 38 psig (250 to 260 kPa))
- Controls fuel pump, fuel injector, and oil lamp
- Automatic altitude compensation
- Flow: 16 L per hour minimum @ 12-volts/36 psig (250 kPa)
- Current draw: 2-amps maximum
- Throttle Body Bore: 31 mm diameter
- Open-loop system (i.e. oxygen sensor not used)
- Separate EFI wire harness
- Fail-safe function



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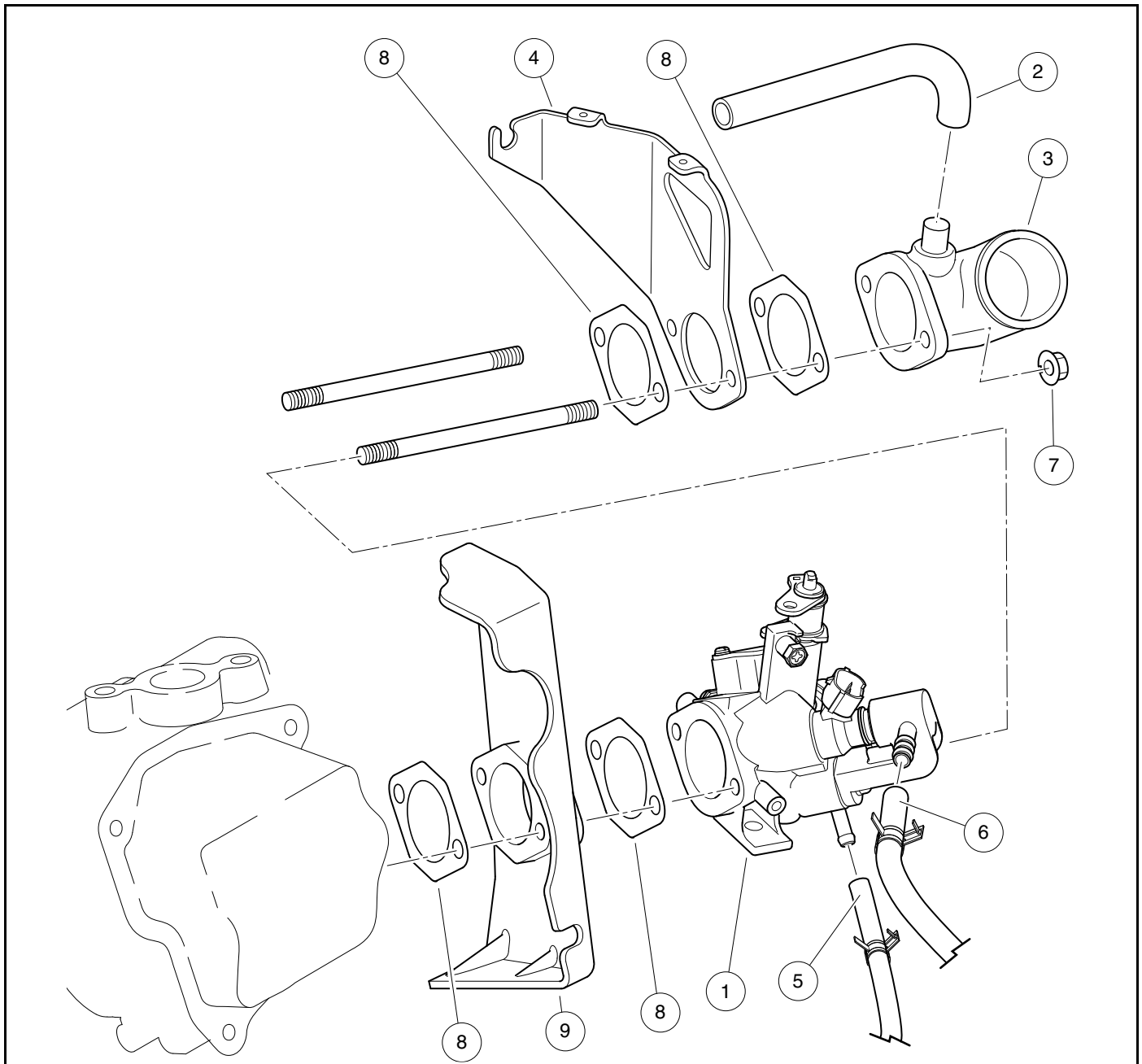
Figure 14-1 EFI System Components

THROTTLE BODY

See General Warnings on page 1-2.

Before suspecting the throttle body as the cause of poor engine performance, make sure the fuel and ignition systems are in proper operating condition. Check the following items:

- Spark plug and gap condition. **See Spark Plug on page 13-5.**
- Air filter element. **See Air Filter on page 14-13.**
- Air intake system (for restriction of air flow). **See Air Intake System on page 14-12.**
- Exhaust system (for restrictions). **See Exhaust System: Gasoline Vehicles on page 15-1.**
- Fuel pump. **See Fuel Pump Module on page 14-17.**
- Fuel line. **See Fuel Line on page 14-15.**
- Fuel pickup screen or filter. **See Fuel Filter on page 14-22.**



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Figure 14-2 Throttle Body – Exploded View

THROTTLE BODY REMOVAL

See General Warnings on page 1-2.

1. Turn the key switch to the OFF position and remove the key, place the Forward/Reverse handle in the NEUTRAL position, and chock the wheels.
2. Disconnect battery. **See Disconnecting the Battery, Section 1, Page 1-3.**
3. Clean the throttle body (1) and surrounding area (**Figure 14-2, Page 14-3**).
4. Disconnect breather hose (2) from air intake adapter (3).
5. Disconnect governor cable from bracket (4).

6. Disconnect fuel injector and MAP sensor.
7. Remove spring clamps securing fuel line (6) and vent hose (5) to throttle body (1) and disconnect vent hose (5).
8. Disconnect fuel line (6) and drain into an appropriate container. **See following WARNING.** Temporarily plug fuel line to prevent fuel leakage.

⚠ WARNING

- **Fuel may be under pressure. Use extreme caution when disconnecting fuel line to prevent the spray of fuel onto hot engine.**
 - **Carefully drain any fuel into an approved container. Add drained fuel back into fuel tank or dispose of properly.**
9. Loosen air intake hose clamp and disconnect air intake hose.
 10. Remove two flange nuts (7) and slide air intake adapter (3), bracket (4), gaskets (8), insulator (9) and throttle body (1) off threaded studs.

THROTTLE BODY INSTALLATION

See General Warnings on page 1-2.

1. Install throttle body (1) and its related components onto threaded studs in order as shown (**Figure 14-2, Page 14-3**).
2. Install two flange nuts (7) and tighten to 50 in·lb (5.7 N·m).
3. Connect fuel line (6) and vent hose (5). Secure with spring clamps.
4. Connect fuel injector and MAP sensor.
5. Connect governor cable to bracket (4).
6. Connect breather hose (2) to air intake adapter (3).
7. Connect air intake hose and secure with hose clamp.
8. Clean spilled and remove any drained gasoline from the area.
9. Connect battery. **See Connecting the Battery, Section 1, Page 1-3.**
10. Place the Forward/Reverse handle in the NEUTRAL position, chock the wheels, and the neutral lockout switch in the MAINTENANCE position (**Figure 17-1, Page 17-1**).
11. Turn the key switch to the ON position and check for fuel leaks. Repeat as necessary to build fuel pressure. Any leaks found must be fixed.

⚠ DANGER

- **Repair all fuel leaks before returning the vehicle to service.**
12. If no leaks are found, place the neutral lockout switch in the OPERATE position (**Figure 17-1, Page 17-1**).
 13. Test drive vehicle to ensure proper operation.

ENGINE CONTROL LINKAGES

See General Warnings on page 1-2.

▲ DANGER

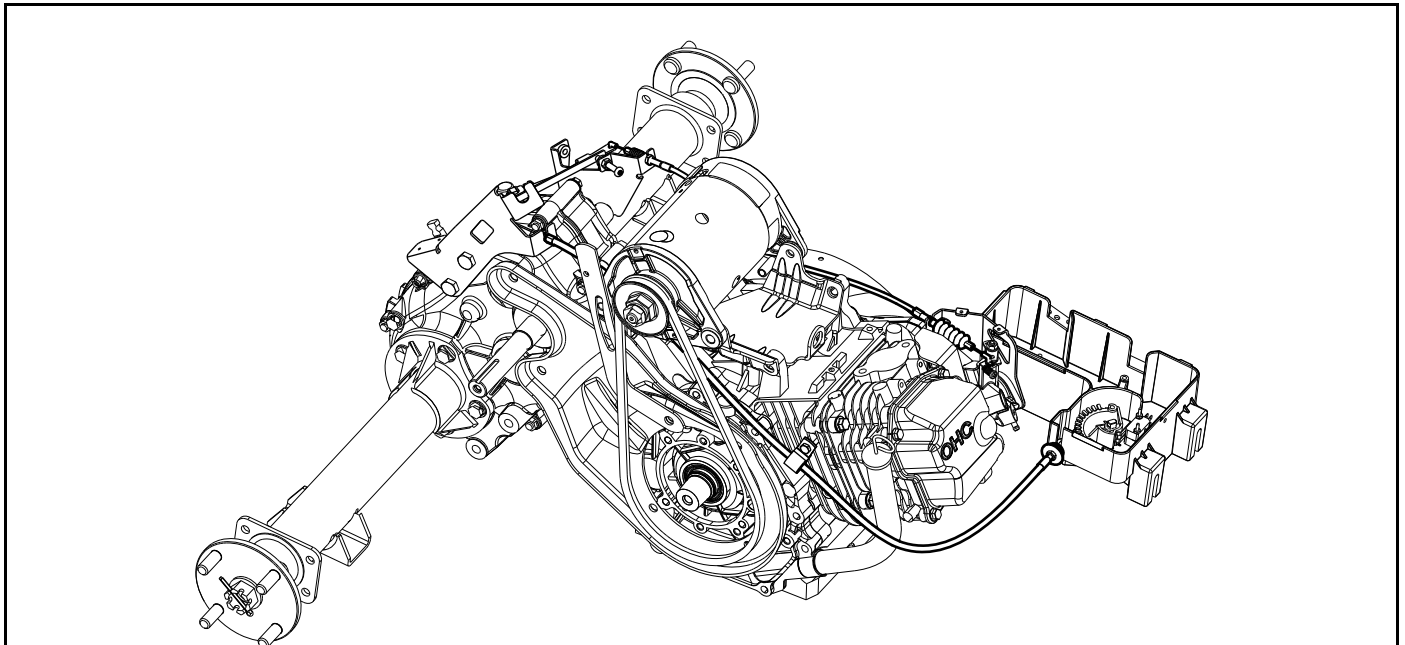
- To ensure the vehicle does not run over you while you disconnect or adjust the accelerator push rod, do the following:
 - Turn key switch OFF and remove key, place Forward/Reverse handle in the NEUTRAL position, and chock the wheels prior to servicing the vehicle.
 - Disconnect battery cables, negative (-) cable first.
 - Disconnect the spark plug wire from the spark plug.
 - See Disconnecting the Battery, Section 1, Page 1-3.

GENERAL INFORMATION

For proper vehicle operation, it is important the accelerator pedal, governor linkage, and throttle adjustments are done correctly and in the proper sequence. **See following CAUTION.**

▲ CAUTION

- Improper adjustment can result in poor vehicle performance and/or damage to the engine components.



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Figure 14-3 Engine Control Linkages – EFI vehicles

GROUND SPEED

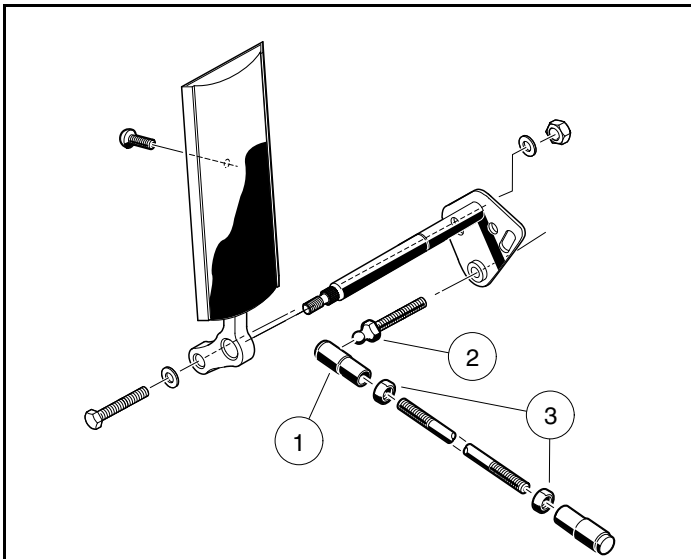
NOTE: If possible, the manufacturer recommends measuring ground speed when setting engine RPM.

This vehicle should reach the forward ground speed specified in **Section 2 – Vehicle Specifications**. See **How to Measure Ground Speed on page 14-11**.

ACCELERATOR ROD

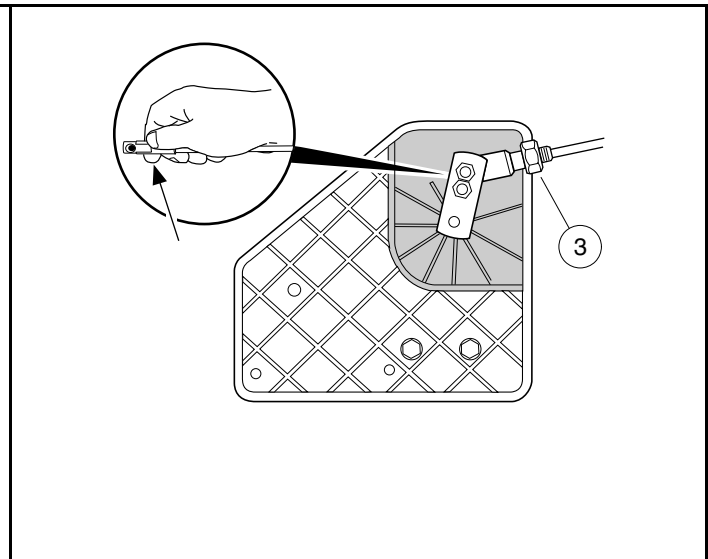
Accelerator Rod Removal

1. Raise the front of the vehicle. Place chocks at the rear wheels and lift the front of the vehicle with a chain hoist or floor jack. Place jack stands under the round frame cross tube to support the vehicle. **See preceding DANGER. See also WARNING “Lift only one end of the vehicle...” in General Warnings on page 1-2.**
2. Remove the accelerator rod by disconnecting the ball joint (1) from the ball stud (2) on the accelerator pedal (**Figure 14-4, Page 14-6**) and from the bell crank at the electrical box (**Figure 14-5, Page 14-6**).



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Figure 14-4 Accelerator Rod



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Figure 14-5 Accelerator Rod – Pull Spring Release to Attach (Bottom View)

Accelerator Rod Installation and Adjustment

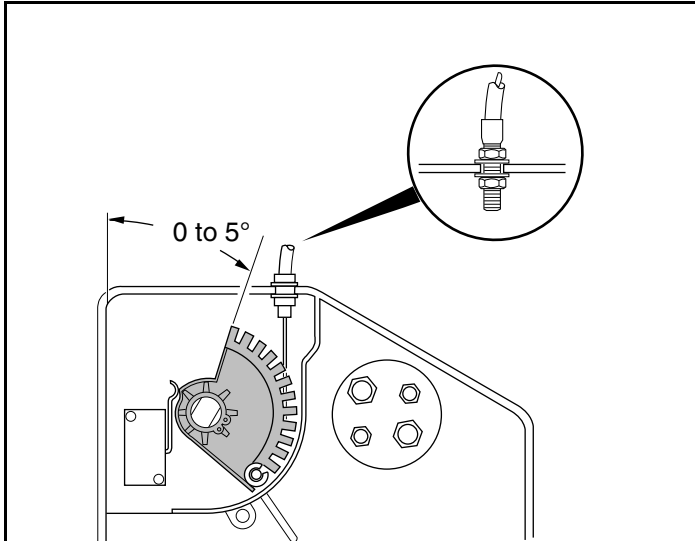
1. Before installing the accelerator rod, adjust accelerator pedal position. **See Pedal Group Adjustment – Gasoline Vehicles in the Accelerator and Brake Pedal Group Section.**
2. Install the ball joint (1) on the ball stud (2) at the accelerator pedal (**Figure 14-4, Page 14-6**).
3. Access the engine compartment.
4. Remove the electrical component box screw and cover (**Figure 14-6, Page 14-7**).
5. Adjust length of accelerator rod. With the ball joint jam nuts (3) loose (**Figure 14-4, Page 14-6**), adjust the length of the rod to obtain an accelerator cable cam position of 5° as shown (**Figure 14-6, Page 14-7**). **See following CAUTION.**

CAUTION

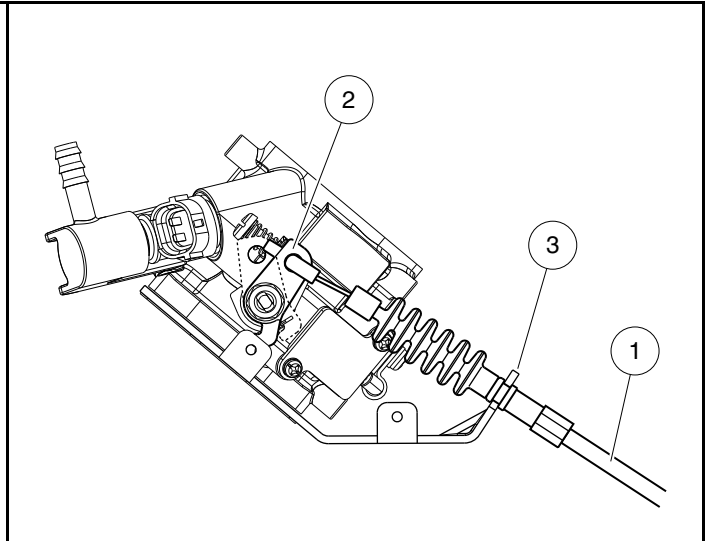
- Be sure that approximately an equal number of threads are exposed at each end of the accelerator rod.
6. Install the accelerator rod on the bell crank ball joint on the electrical component box (**Figure 14-5, Page 14-6**). **See following CAUTION.**

⚠ CAUTION

- Inspect the limit switches inside the electrical component box. If a limit switch lever is bent, replace the switch.



3016 **Figure 14-6 Accelerator Cable Cam Position – 5° (Top View)**



3043 **Figure 14-7 Governor Cable At Throttle Body**

7. Before tightening the jam nuts (3), set the park brake to the first latch and pawl position and check for proper activation of switches.
8. While pressing the accelerator pedal, the following events should occur in exactly the order shown:

EVENT	APPROXIMATE PEDAL TRAVEL
Park brake release	0° to 4°
Solenoid activation	4° to 8°
Throttle body actuation	8° to 12°

9. While holding the accelerator ball joint with pliers, tighten the jam nuts against the ball joints, accelerator ball joint first, at each end of the accelerator rod.
10. Check rod adjustment for proper switch activation.
11. After the pedal group and accelerator rod are properly adjusted, adjust the engine RPM setting. **See Engine RPM Adjustment on page 14-11.**
12. Install the electrical component box cover and tighten retaining screw to 18 in·lb (2.0 N·m).
13. Connect battery and spark plug wire(s). **See Connecting the Battery, Section 1, Page 1-3.**

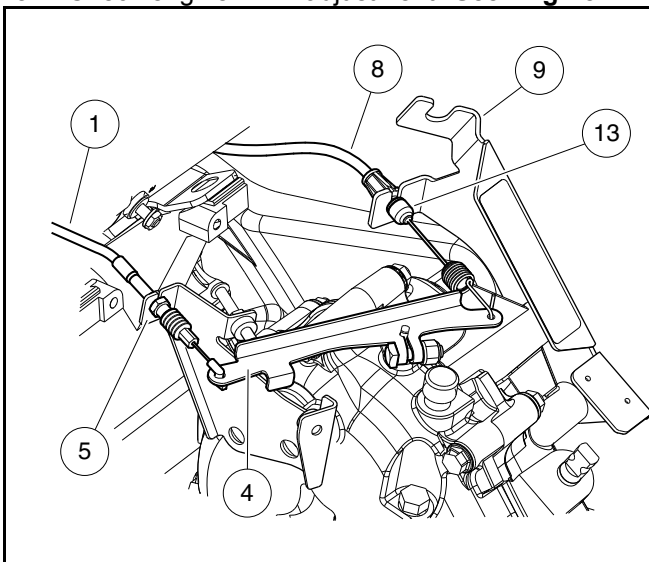
GOVERNOR CABLE

Governor Cable Removal

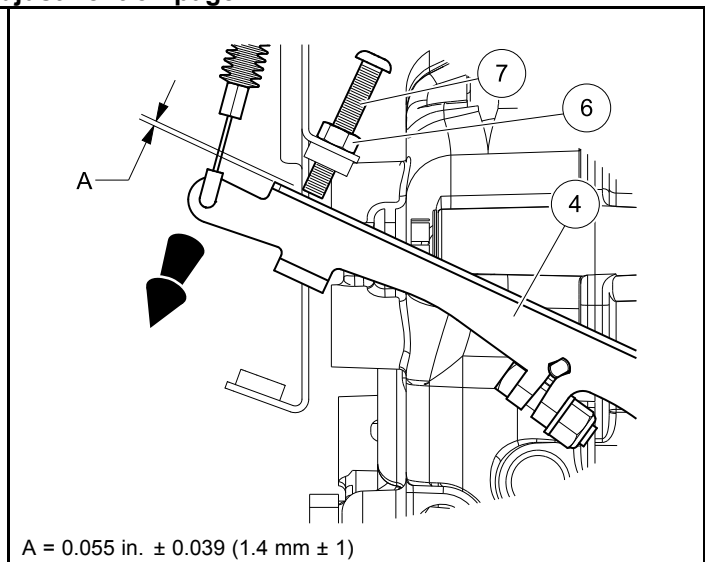
1. Turn the key switch to the OFF position and remove the key, place the Forward/Reverse handle in the NEUTRAL position, and chock the wheels.
2. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery, Section 1, Page 1-3.**
3. At engine:
 - 3.1. Disconnect "Z" fitting of governor cable (1) from throttle lever (2) (**Figure 14-7, Page 14-7**).
 - 3.2. Unsnap governor cable (1) from throttle body bracket (3).
4. At transaxle:
 - 4.1. Disconnect "Z" fitting of governor cable (1) from governor arm (4) (**Figure 14-8, Page 14-8**).
 - 4.2. Loosen jam nuts at governor bracket (5) and remove cable (1) from vehicle.

Governor Cable Installation and Adjustment

1. At engine:
 - 1.1. Snap governor cable (1) into throttle body bracket (3) (**Figure 14-7, Page 14-7**).
 - 1.2. Connect "Z" fitting of governor cable (1) to throttle lever (2).
2. At transaxle:
 - 2.1. Slide bellows off threaded end of cable housing, separate jam nuts and place threaded end into governor bracket (5) (**Figure 14-8, Page 14-8**).
 - 2.2. Finger-tighten jam nuts.
 - 2.3. Push bellows back onto threaded end of cable housing.
 - 2.4. Connect "Z" fitting of governor cable (1) to governor arm (4).
3. Rotate governor arm (4) counterclockwise until it stops and hold in this position (**Figure 14-9, Page 14-8**).
4. Adjust jam nuts until throttle lever (2) is at "wide open throttle" (WOT) (**Figure 14-7, Page 14-7**). Then, tighten the jam nuts to 36 in·lb (4.0 N·m).
5. Release governor arm (4) and loosen jam nut (6) on throttle stop screw (7) (**Figure 14-9, Page 14-8**).
6. Adjust gap between governor arm (4) and throttle stop screw (7) to 0.055 in. (± 0.039) (1.4 mm (± 1)) as shown.
7. Tighten stop screw jam nut (6) to 36 in·lb (4.0 N·m).
8. Check engine RPM adjustment. **See Engine RPM Adjustment on page 14-11.**



3044
Figure 14-8 Governor and Accelerator Cables At Governor Arm



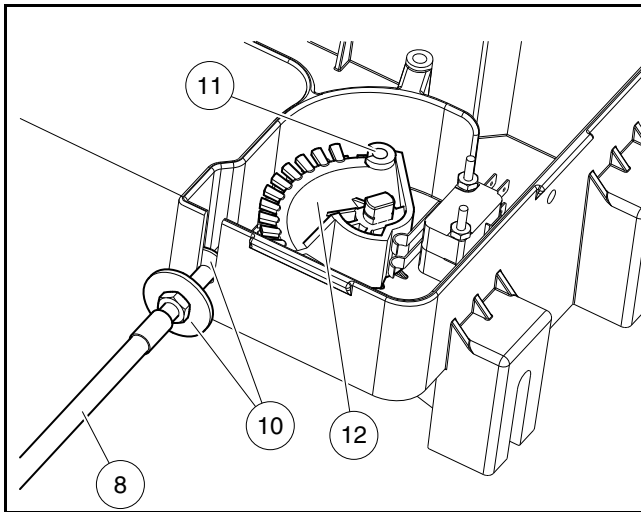
A = 0.055 in. \pm 0.039 (1.4 mm \pm 1)

3045
Figure 14-9 Throttle Stop Screw Gap

ACCELERATOR CABLE

Accelerator Cable Removal

1. Turn the key switch to the OFF position and remove the key, place the Forward/Reverse handle in the NEUTRAL position, and chock the wheels.
2. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery, Section 1, Page 1-3.**
3. At transaxle:
 - 3.1. Unhook spring fitting of accelerator cable (8) from governor arm (4) (**Figure 14-8, Page 14-8**).
 - 3.2. Unsnap accelerator cable (8) from FNR/accelerator cable bracket (9).
4. At electrical component box:
 - 4.1. Remove electrical component box cover and loosen jam nuts (10) on side of electrical component box (**Figure 14-10, Page 14-9**).
 - 4.2. Disconnect barrel fitting (11) of accelerator cable (8) from cam (12) in electrical component box and remove accelerator cable (8) from vehicle.



3046

Figure 14-10 Accelerator Cable At Electrical Component Box

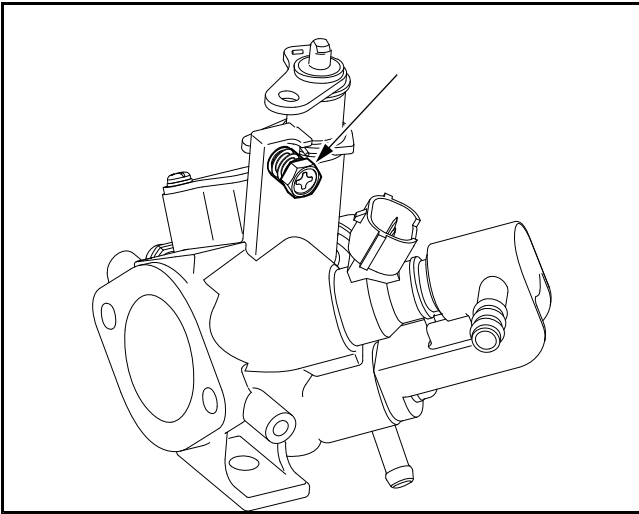
Accelerator Cable Installation

1. At transaxle:
 - 1.1. Hook spring fitting of accelerator cable (8) to governor arm (4) (**Figure 14-8, Page 14-8**).
 - 1.2. Snap accelerator cable (8) into FNR/accelerator cable bracket (9).
 - 1.3. Push dust shield (13) onto end of cable housing.
2. At electrical component box:
 - 2.1. Insert barrel fitting (11) of accelerator cable (8) into cam (12) in electrical component box (**Figure 14-10, Page 14-9**).
 - 2.2. Separate jam nuts (10) on cable and place threaded end into slot of electrical component box. Tighten jam nuts (10) finger-tight.
 - 2.3. Before tightening the cable jam nuts (10), make sure the engine RPM adjustment is correct. **See Engine RPM Adjustment on page 14-11.**
 - 2.4. Install electrical component box cover and tighten screw to 18 in·lb (2.0 N·m).
3. Connect battery and spark plug wire(s). **See Connecting the Battery, Section 1, Page 1-3.**

CLOSED THROTTLE OR IDLE ADJUSTMENT – PEDAL-START VEHICLES

When the accelerator pedal is released, the engine will stop. Therefore, it is not possible to measure or set idling speed under normal vehicle operating conditions. Set throttle valve as follows:

1. Loosen the throttle body idle screw so that it is not touching the throttle lever (**Figure 14-11, Page 14-10**).
2. Slowly tighten the idle screw until it lightly touches the throttle lever, then tighten it an additional 1/4 turn.



3047

Figure 14-11 Idle Screw

CLOSED THROTTLE OR IDLE ADJUSTMENT – KEY-START VEHICLES

Adjust the idle screw until idle RPM is 1200 (± 25) (**Figure 14-11, Page 14-10**).

HOW TO MEASURE GROUND SPEED

Best Method

An easy way to check ground speed is by using a GPS device or smartphone application (app). If these are not available, use the alternate method below.

Alternate Method (Calculated)

Ground speed is easily determined by a known distance travelled, divided by the amount of time it took to travel that known distance ($Rate = Distance/Time$).

1. Establish a known distance to travel (example: 100 ft (30.5 m) in a safe location using cones or other type of marker.
2. Drive vehicle and bring to maximum speed before reaching the first cone.
3. Using a stopwatch, record the amount of time it takes to travel from the first cone to the second cone at maximum speed.
4. With distance and time determined, calculate ground speed:
 - 4.1. **Rate in seconds:** Divide distance (100 ft (30.5 m)) by time (5 seconds) = 20 ft/sec (6.1 m/sec).
 - 4.2. **Convert seconds to hour:** Multiply 20 ft/sec (6.1 m/sec) by 3600 (the number of seconds in an hour) = 72000 ft/hour (21960 m/hour)
 - 4.3. **Convert to MPH:** Divide 72000 feet/hour by 5280 (number of feet in 1 mile) = 13.64 miles/hour
Convert to KPH: Move the decimal point over three places; 21960 m/hour = 21.96 km/hour

ENGINE RPM ADJUSTMENT

DANGER

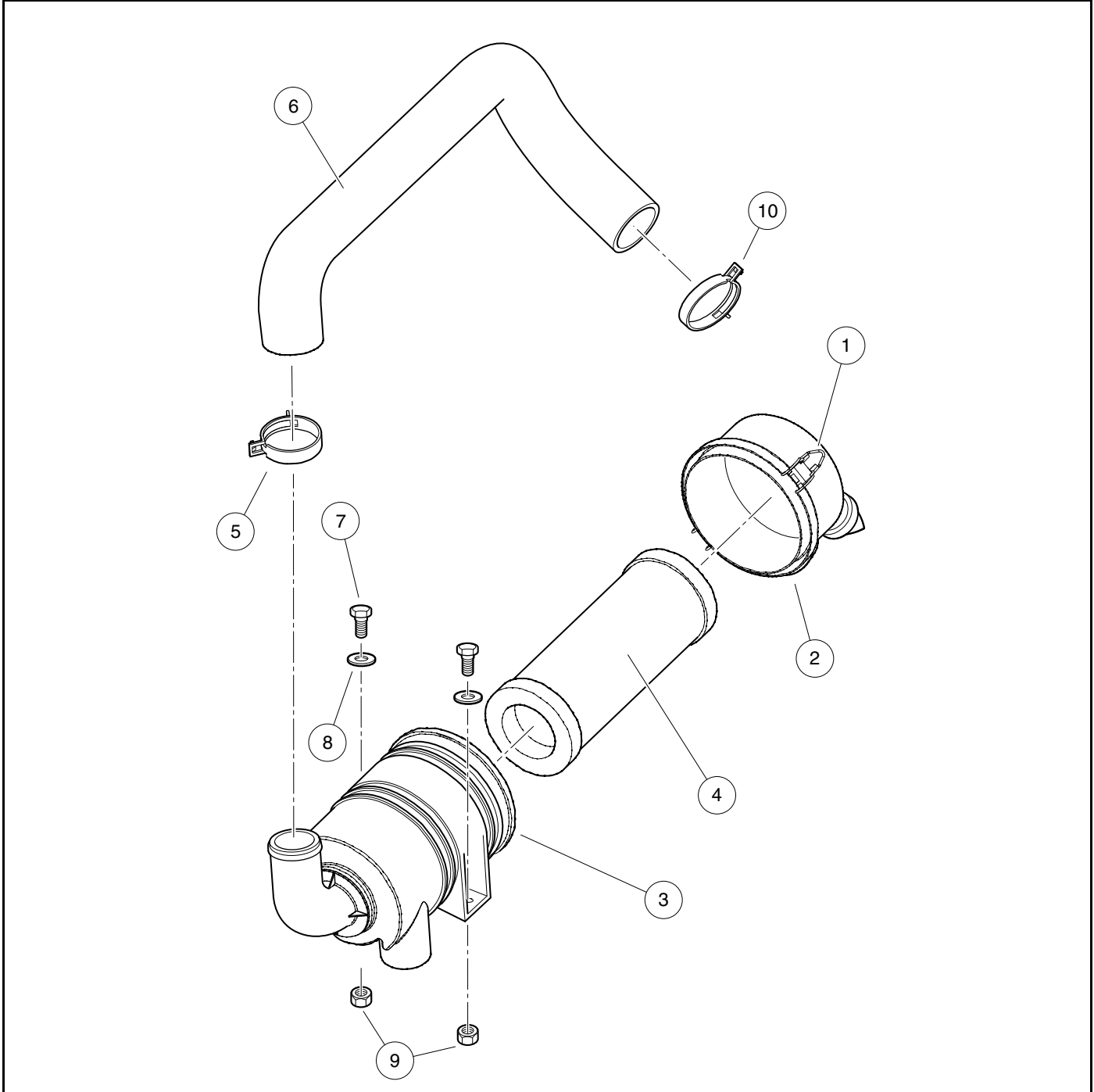
- **Do not operate gasoline vehicle in an enclosed area without proper ventilation. The engine produces carbon monoxide, which is an odorless, deadly poison.**

1. If governor is adjusted, proceed to step 2; otherwise, adjust governor. **See Governor Cable Installation and Adjustment on page 14-8.**
2. Connect battery and spark plug wire(s). **See Connecting the Battery, Section 1, Page 1-3.**
3. Measure vehicle ground speed. **See How to Measure Ground Speed on page 14-11.**
4. Compare measured ground speed with forward ground speed specified in **Section 2 – Vehicle Specifications.**
5. If adjustment is necessary, use the following procedures:
 - 5.1. To **reduce** RPM, loosen the accelerator cable jam nut on the outside of the electrical component box and tighten the jam nut on the inside of the box until specified ground speed is reached (**Figure 14-10, Page 14-9**). **See Section 2 – Vehicle Specifications.**
 - 5.2. To **increase** RPM, loosen the jam nut inside the electrical component box and tighten the jam nut outside the box until specified ground speed is reached.
 - 5.3. Be sure both jam nuts are locked against the electrical component box and check ground speed again. If ground speed needs to be adjusted, repeat previous step. **See following NOTE.**

NOTE: *If more adjustment is required than the cable housing will allow, make sure the spring fitting on the other end of the accelerator cable is properly installed. Excessive drive belt and clutch wear can also prevent proper ground speed adjustment. Check them for excessive wear. See Section 16 – Clutches: Gasoline Vehicles.*

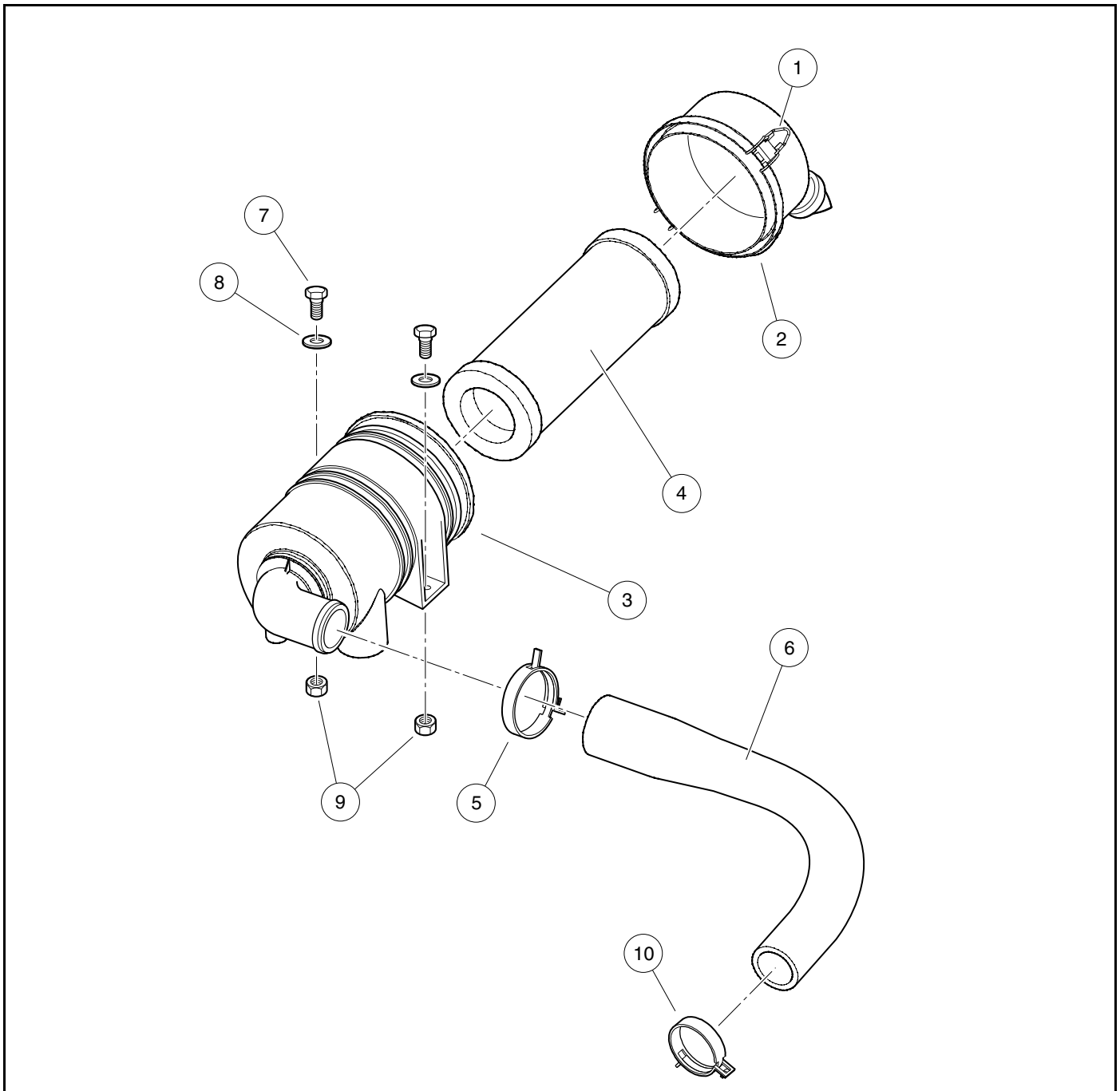
AIR INTAKE SYSTEM

See General Warnings on page 1-2.



3048

Figure 14-12 Air Intake System – CA 300



3049

Figure 14-13 Air Intake System – CA 500/550/700/Transporter

AIR FILTER

The air filter should be inspected periodically and replaced when necessary. Filter changes should not exceed the recommended interval. **See Periodic Service Schedule, Section 10, Page 10-3.** More frequent service may be required in extremely dirty operating environments. In the event of a loss of power, sluggish acceleration, or a roughly running engine, service the air filter immediately.

Air Filter Replacement

1. Release both wire latches (1) (**Figure 14-12, Page 14-12**).

2. Pull cap (2) away from air cleaner (3).
3. Remove air filter (4). **See following NOTE.**

NOTE: *The filter is specifically designed for this engine. It fits into the canister only one way. Use only direct replacement part.*

4. Using a clean cloth, wipe away any dust or dirt from inside the air cleaner (3).
5. Push the new filter (4) onto the nozzle inside the air cleaner (3).
6. Position and place cap (2) onto air cleaner (3) so the "TOP" mark is at the 12 o'clock position.
7. Fasten wire latches (1). Make sure latches are securely engage. **See following CAUTION.**

⚠ CAUTION

- Engine damage will occur if the air cleaner cap is not properly secured.
- If air cleaner is extremely dirty, remove air cleaner from vehicle and clean thoroughly.
- Use only Club Car replacement air filters. The use of other air filters could result in engine damage and void the warranty.

AIR CLEANER REMOVAL

1. Turn key switch to the OFF position and remove key, place Forward/Reverse handle in the NEUTRAL position, and chock the wheels.
2. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery, Section 1, Page 1-3.**
3. Remove clamp (5) and disconnect air intake hose (6) from air cleaner (3) (**Figure 14-12, Page 14-12**).
4. Remove hardware (7, 8, and 9) securing air cleaner (3) to vehicle.

AIR CLEANER INSTALLATION

1. Place air cleaner (3) into vehicle and secure with hardware (7, 8, and 9) (**Figure 14-12, Page 14-12**). Tighten locknuts (9) to 85 in·lb (9.5 N·m).
2. Connect air intake hose (6) to air cleaner (3) and secure with clamp (5).
3. Connect battery and spark plug wire(s). **See Connecting the Battery, Section 1, Page 1-3.**

FUEL LINE

See General Warnings on page 1-2.

NOTE: This EFI gasoline vehicle is equipped with SAEJ30R9 fuel hose rated for high-pressure systems. Always replace the fuel line on this vehicle with approved Club Car replacement part. Do not attempt to repair, patch or splice the fuel line.

The fuel line must be properly routed from the fuel tank to the throttle body. A small, spring steel band clamp is used on the fuel line connection at the throttle body and must be tight. A plastic, dual-locking connector is used at the fuel tank. **See following WARNING.**

⚠ WARNING

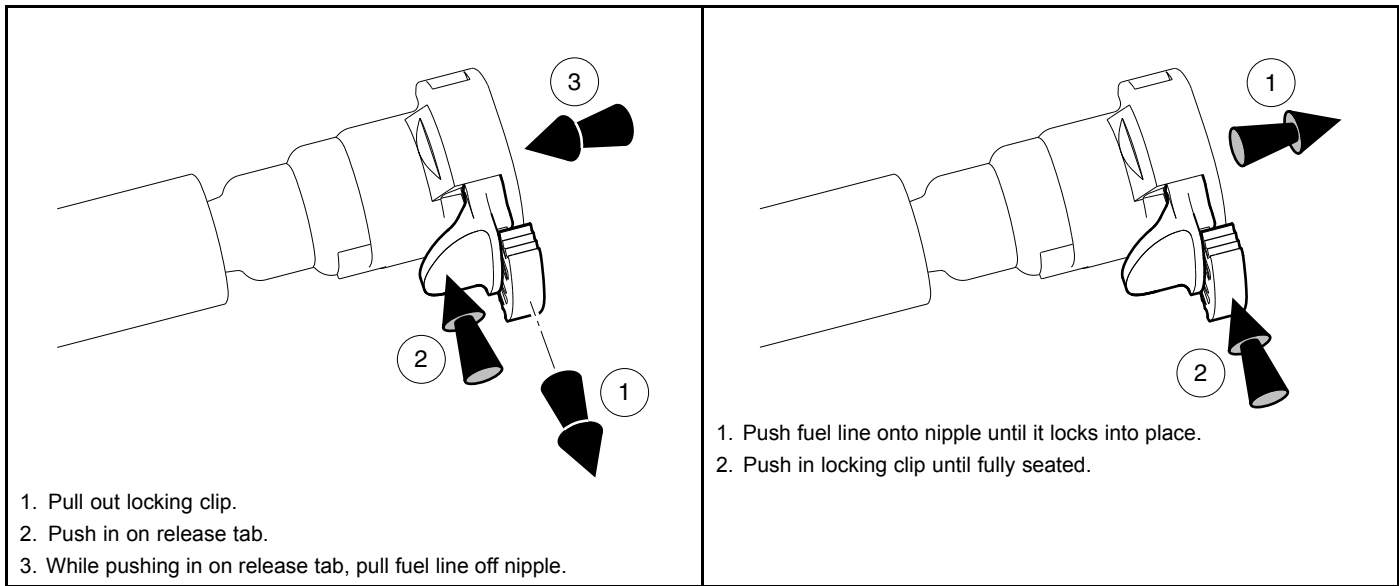
- **Make sure fuel line is the correct length and properly routed. Failure to heed this warning could result in damage to fuel line and fire.**
- **Fuel may be under pressure. Use extreme caution when disconnecting fuel line to prevent the spray of fuel onto hot engine.**

FUEL LINE REMOVAL

1. Turn the key switch to the OFF position and remove the key, place the Forward/Reverse handle in the NEUTRAL position, and chock the wheels.
2. Disconnect battery. **See Disconnecting the Battery, Section 1, Page 1-3.**
3. Clean the top of the fuel tank and fuel pump module.
4. At engine:
 - 4.1. Remove spring clamp securing fuel line to throttle body.
 - 4.2. Disconnect fuel line and drain into an appropriate container. **See following WARNING.**

⚠ WARNING

- **Fuel may be under pressure. Use extreme caution when disconnecting fuel line to prevent the spray of fuel onto hot engine.**
 - **Carefully drain any fuel into an approved container. Add drained fuel back into fuel tank or dispose of properly.**
5. At fuel tank:
 - 5.1. Disengage clip as shown (**Figure 14-14, Page 14-16**).
 - 5.2. Push in tab to unlock connector and pull fuel line from nipple on fuel pump module and remove line from vehicle.



3050 **Figure 14-14 Fuel Line Connector – To Disconnect**

3051 **Figure 14-15 Fuel Line Connector – To Connect**

FUEL LINE INSTALLATION

1. At fuel tank:
 - 1.1. Clean the nipple on top of fuel pump module.
 - 1.2. Push fuel line fully onto nipple until it locks in place (**Figure 14-15, Page 14-16**).
 - 1.3. Engage locking clip by pushing in until fully seated and completely prevents the line from being pulled off nipple.
2. At engine:
 - 2.1. Connect fuel line to throttle body and secure with spring clamp. **See following DANGER.**

⚠ DANGER

- **Ensure line is connected properly to avoid a leak that can cause a fire.**
3. Clean spilled and remove any drained gasoline from the area.
 4. Connect battery. **See Connecting the Battery, Section 1, Page 1-3.**
 5. Place the Forward/Reverse handle in the NEUTRAL position, chock the wheels, and the neutral lockout switch in the MAINTENANCE position (**Figure 17-1, Page 17-1**).
 6. Turn the key switch to the ON position and check for fuel leaks. Repeat as necessary to build fuel pressure. Any leaks found must be fixed.

⚠ DANGER

- **Repair all fuel leaks before returning the vehicle to service.**
7. If no leaks are found, place the neutral lockout switch in the OPERATE position (**Figure 17-1, Page 17-1**).

FUEL PUMP MODULE

See General Warnings on page 1-2.

GENERAL INFORMATION

NOTE: *The fuel pump and fuel level sending unit themselves are not replaceable. If necessary, the fuel pump module must be replaced as an assembly.*

The fuel pump module can be disassembled to replace the fuel filter.

The EFI gasoline vehicle is equipped with an electric fuel pump. The fuel pump is protected by a filter and pickup screen.

FUEL PUMP MODULE REMOVAL

1. Turn the key switch to the OFF position and remove the key, place the Forward/Reverse handle in the NEUTRAL position, and chock the wheels.
2. Disconnect battery. **See Disconnecting the Battery, Section 1, Page 1-3.**
3. Clean the top of the fuel tank and fuel pump module (1) (**Figure 14-16, Page 14-19**).
4. With a marker pen, make a mark across the top of the module (1) and onto the tank to note orientation before removal.
5. Disconnect wire harness plug (2).
6. Disconnect the fuel line (3) and drain into an appropriate container. **See Fuel Line Removal on page 14-15. See following WARNING.**

⚠ WARNING

- **Fuel may be under pressure. Use extreme caution when disconnecting fuel line to prevent the spray of fuel onto hot engine.**
 - **Carefully drain any fuel remaining in the hose or pump module into an approved container. Add drained fuel back into fuel tank or dispose of properly.**
7. Loosen fuel tank retaining strap (4) to allow tank to move and provide access to all of the fuel pump module hardware (5).
 8. Remove hardware (5) securing hold down ring (6) and ground wire (7) to fuel tank.
 9. Lift fuel pump module (1) out of fuel tank and drain into an appropriate container. Discard fuel module o-ring (8). **See preceding WARNING and following NOTE.**

NOTE: *If equipped with a fuel level sending unit, carefully maneuver module so as to avoid damaging the float arm mechanism.*

FUEL PUMP MODULE INSTALLATION

1. Clean the groove on top of fuel tank.
2. Place new fuel module o-ring (8) into groove on top of fuel tank (**Figure 14-16, Page 14-19**).
3. Lower fuel pump module (1) into fuel tank noting correct orientation marked before removal. **See following NOTE and CAUTION.**

NOTE: If equipped with a fuel level sending unit, carefully maneuver module so as to avoid damaging the float arm mechanism.

⚠ CAUTION

- Ensure o-ring stays seated in place during fuel pump module installation.
4. Install hold down ring (6) and ground wire (7) with hardware (5) and tighten in a crisscross pattern to 66 in·lb (7.5 N·m). **See following WARNING.**

⚠ WARNING

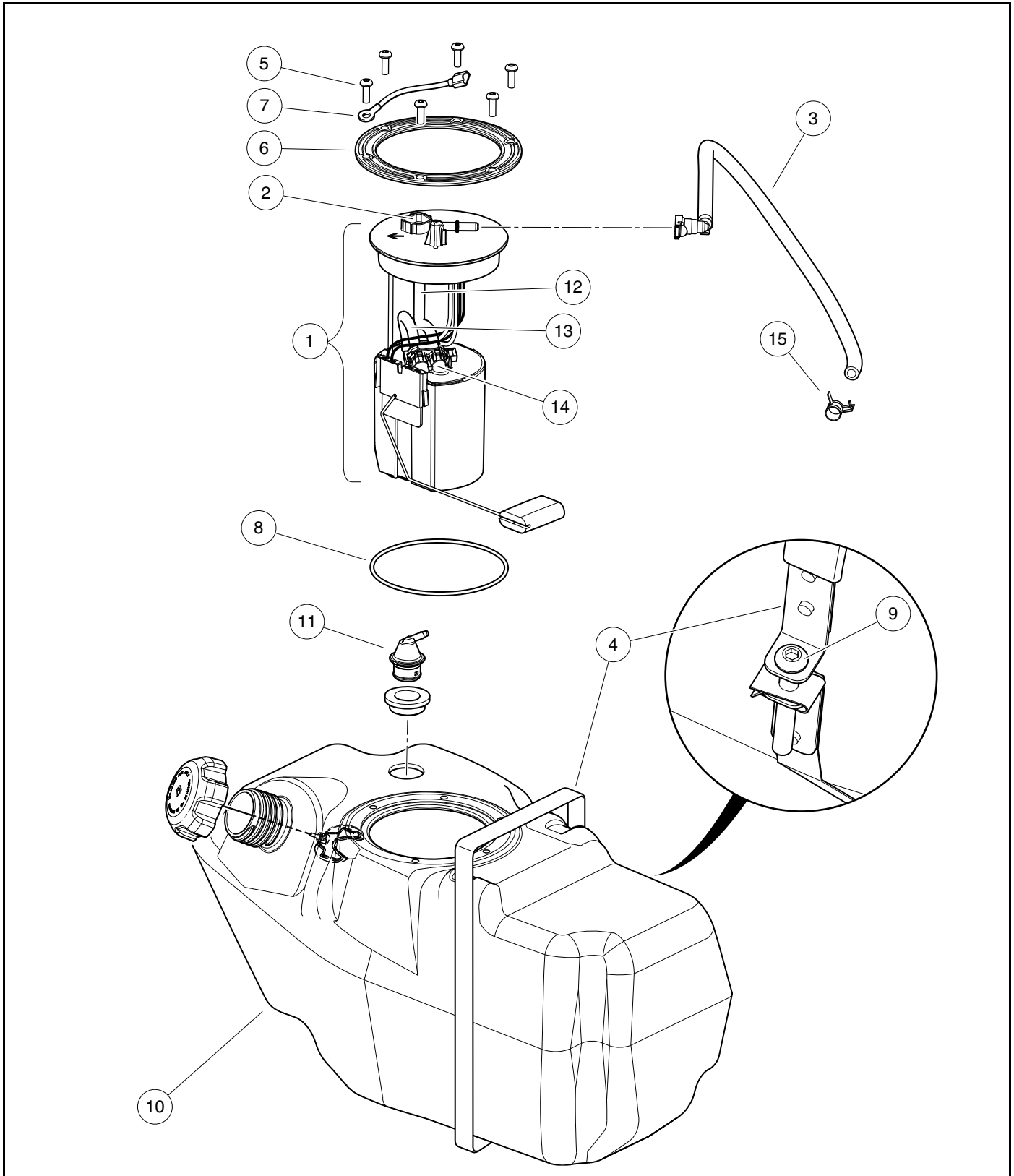
- Always install ground wires during reassembly.
5. Tighten fuel tank retaining strap screw (9) to 26.5 in·lb (3 N·m).
 6. Connect fuel line (3) to fuel pump module (1). **See Fuel Line Installation on page 14-16. See following DANGER.**

⚠ DANGER

- Ensure line is connected properly to avoid a leak that can cause a fire.
7. Connect wire harness plug (2) to fuel pump module (1).
 8. Clean spilled and remove any drained gasoline from the area.
 9. Connect battery. **See Connecting the Battery, Section 1, Page 1-3.**
 10. Place the Forward/Reverse handle in the NEUTRAL position, chock the wheels, and the neutral lockout switch in the MAINTENANCE position (**Figure 17-1, Page 17-1**).
 11. Turn key switch to the ON position and check for fuel leaks. Repeat as necessary to build fuel pressure. Any leaks found must be fixed.

⚠ DANGER

- Repair all fuel leaks before returning the vehicle to service.
12. If no leaks are found, place the neutral lockout switch in the OPERATE position (**Figure 17-1, Page 17-1**).



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Figure 14-16 Fuel System (Side-Fill) – Exploded View

FUEL TANK

See General Warnings on page 1-2.

GENERAL INFORMATION

The vehicle is equipped with a high impact, plastic fuel tank.

WARNING

- If the fuel tank is damaged, replace it. Do not attempt to repair it. See the following tank removal and disposal procedure.

CAUTION

- Add only unleaded fuel to the tank. Do not put oil in the fuel tank.

NOTE: This gasoline vehicle complies with the California Air Resources Board (CARB) and EPA evaporative emissions regulations when equipped with SAEJ30R9 1/4 in (6.3 mm) fuel vent hose (CC P/N 102865101) and 3/16 in (4.78 mm) fuel vent hose (CC P/N 1015137). To remain in compliance with California and EPA regulations, replace any fuel vent hose on this vehicle with Club Car P/N's 102865101, 1015137, or equivalent.

FUEL TANK REMOVAL

1. Place the Forward/Reverse handle in the NEUTRAL position, chock the wheels, and the neutral lockout switch in the MAINTENANCE position.
2. Turn key switch to OFF position and remove key.
3. Disconnect battery. **See Disconnecting the Battery, Section 1, Page 1-3.**
4. Clean the top of the fuel tank (10) and fuel pump module (1) (**Figure 14-16, Page 14-19**).
5. Remove gas cap and siphon all fuel from tank into an approved container. **See following DANGER and WARNING.**

DANGER

- Gasoline – Flammable! Explosive! Do not smoke. Keep sparks and flames away from the vehicle and service area. Service only in a well-ventilated area.

WARNING

- Do not attempt to siphon fuel using a hose that does not have a built-in suction device.
 - Do not attempt to siphon fuel using your mouth.
6. Disconnect wire harness plug (2) from fuel pump module (1).
 7. Disconnect vent hose from fuel tank vent (11).
 8. Disconnect the fuel line (3) from the fuel pump module (1) and drain into an appropriate container. **See Fuel Line Removal on page 14-15. See following WARNING.**

⚠ WARNING

- Fuel may be under pressure. Use extreme caution when disconnecting fuel line to prevent the spray of fuel onto hot engine.
 - Carefully drain any fuel remaining in the hose or pump module into an approved container. Add drained fuel back into fuel tank or dispose of properly.
9. Disconnect fuel pump module ground wire (7).
 10. Loosen screw (9) securing fuel tank retaining strap (4) and remove fuel tank (10).

FUEL TANK DISPOSAL

1. Remove gas cap and fuel pump module from tank. **See Fuel Pump Module Removal on page 14-17.** The cap may be discarded or kept as a spare.
2. In a well-ventilated area, flush the fuel tank with water to remove any remaining fuel.
3. In a well-ventilated area, set the tank upside down so that the water can drain out of it. To make sure that the tank dries completely, allow the tank to sit for 24 hours. **See following CAUTION.**

⚠ CAUTION

- Dispose of wastewater and fuel tank in accordance with local, state, and federal laws and ordinances.

FUEL TANK STORAGE

1. Remove gas cap and fuel pump module from tank. **See Fuel Pump Module Removal on page 14-17.**
2. In a well-ventilated area, flush the fuel tank with water to remove any remaining fuel.
3. In a well-ventilated area, set the tank upside down so that the water can drain out of it. To make sure that the tank dries completely, allow the tank to sit for 24 hours.
4. Completely drain gas from fuel pump module and allow to module to dry.
5. After module is completely dry, install in fuel tank. **See Fuel Pump Module Installation on page 14-17.**
6. Store the tank upside down, with the cap installed, in a well-ventilated area.

FUEL TANK INSTALLATION

NOTE: This gasoline vehicle complies with the California Air Resources Board (CARB) and EPA evaporative emissions regulations when equipped with SAEJ30R9 1/4 in (6.3 mm) fuel vent hose (CC P/N 102865101) and 3/16 in (4.78 mm) fuel vent hose (CC P/N 1015137). To remain in compliance with California and EPA regulations, replace any fuel vent hose on this vehicle with Club Car P/N's 102865101, 1015137, or equivalent.

1. Place fuel tank (10) in vehicle.
2. Secure tank with retaining strap (4).
 - 2.1. Position the strap (4) in the indentation of the tank (10) (**Figure 14-16, Page 14-19**).
 - 2.2. Install the screw (9) into retaining strap (4) and tighten to 26.5 in·lb (3 N·m).
3. Connect fuel pump module ground wire (7) to main wire harness. **See following WARNING.**

⚠ WARNING

- Always install ground wires during reassembly.
4. Connect fuel line (3) to fuel pump module (1). **See Fuel Line Installation on page 14-16. See following DANGER.**

⚠ DANGER

- Ensure line is connected properly to avoid a leak that can cause a fire.
5. Connect wire harness plug (2) to fuel pump module (1).
 6. Clean spilled and remove any drained gasoline from the area.
 7. Connect battery. **See Connecting the Battery, Section 1, Page 1-3.**
 8. Add fuel to tank.
 9. Place the Forward/Reverse handle in the NEUTRAL position, chock the wheels, and the neutral lockout switch in the MAINTENANCE position (**Figure 17-1, Page 17-1**).
 10. Turn key switch to the ON position and check for fuel leaks. Repeat as necessary to build fuel pressure. Any leaks found must be fixed.

⚠ DANGER

- Repair all fuel leaks before returning the vehicle to service.
11. If no leaks are found, place the neutral lockout switch in the OPERATE position (**Figure 17-1, Page 17-1**).

FUEL FILTER

See General Warnings on page 1-2.

GENERAL INFORMATION

The fuel filter is located in the fuel tank. It is part of the fuel pump module assembly and should last the life of the vehicle; however, it is replaceable if the need should arise. In addition, the module assembly features a fuel pickup screen to catch larger particles before entering the fuel filter.

FUEL FILTER REMOVAL

1. Turn the key switch to the OFF position and remove the key, place the Forward/Reverse handle in the NEUTRAL position, and chock the wheels.
2. Disconnect battery. **See Disconnecting the Battery, Section 1, Page 1-3.**
3. Remove fuel pump module (1). **See Fuel Pump Module Removal on page 14-17.**
4. Disconnect flex hoses (12 and 13) from filter (14) (**Figure 14-16, Page 14-19**).
5. Remove filter (14) from module (1) and dispose of properly.

FUEL FILTER INSTALLATION

⚠ CAUTION

- Fuel filter flex hoses are keyed to aid proper installation into fuel pump module.

1. Insert fuel filter (14) into fuel pump module (1) (Figure 14-16, Page 14-19).
2. Connect flex hoses (12 and 13) to the fuel filter (14).
3. Install fuel pump module (1). See Fuel Pump Module Installation on page 14-17.
4. Connect battery and spark plug wire(s). See Connecting the Battery, Section 1, Page 1-3.
5. Place the Forward/Reverse handle in the NEUTRAL position, chock the wheels, and the neutral lockout switch in the MAINTENANCE position (Figure 17-1, Page 17-1).
6. Start the engine and check for fuel leaks. See following DANGER.

⚠ DANGER

- Repair all fuel leaks before operating the vehicle.

7. If no leaks are found, place the neutral lockout switch in the OPERATE position (Figure 17-1, Page 17-1).

FUELING INSTRUCTIONS – GASOLINE VEHICLE

See General Warnings on page 1-2.

⚠ DANGER

- Turn the key switch to the OFF position before fueling.
- Do not pour fuel into the fuel tank when the engine is hot or while it is running.
- Be sure the fuel tank ground wire on the tank is properly connected before fueling the vehicle.
- To avoid electric arc caused by static electricity, the fuel storage/pumping device must be grounded. If the pump is not grounded, the vehicle must be grounded to the pump before and during the fueling operation.
- If the vehicle has an all-weather enclosure installed, be sure the fuel tank is properly vented as shown in Figure 14-17.
- To avoid the possibility of fire, clean up any spilled fuel before operating the vehicle.

CAUTION

- Use unleaded gasoline only.
- Whenever possible, avoid using oxygenated and blended fuels.

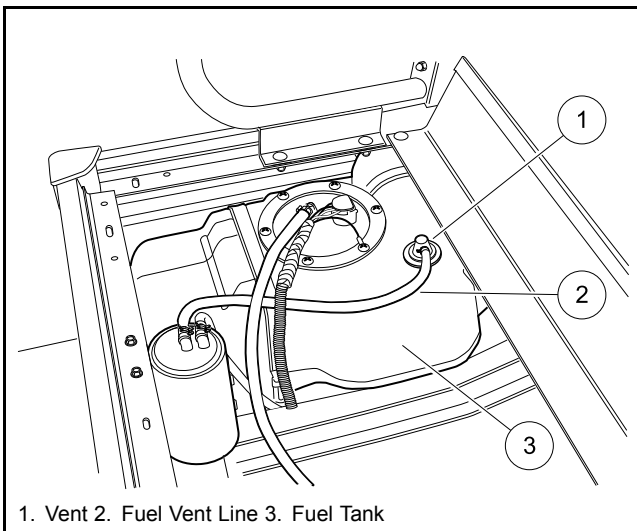
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CAUTION

- Do not use any fuel with an alcohol content that exceeds 10% by volume (such as E15 and E85). Ethanol is an alcohol that readily absorbs moisture, causing corrosion of fuel system components. It also damages neoprene and other plastic and rubber components. Use of these fuels in this vehicle will void the warranty.
- Do not repeatedly attempt to start a vehicle when the fuel pump is dry (no gas in tank). Doing so can damage the fuel pump.

NOTE: Whenever possible, avoid using oxygenated fuels and fuels that are blended with alcohol. Vehicles to be stored for extended periods should be prepared for storage as instructed. See **Preparing the Gasoline Vehicle for Extended Storage** on page 3-2.

1. Remove the fuel cap located on the passenger-side panel and fill the fuel tank with fresh unleaded gasoline only. See preceding **CAUTION** and **NOTE**.
2. Replace fuel cap on tank. Ensure cap is tightened securely (tighten until it clicks).



2832

Figure 14-17 Fuel Tank

⚠ DANGER

- See General Warnings on page 1-2.

⚠ WARNING

- See General Warnings on page 1-2.

MUFFLER**MUFFLER REMOVAL**

1. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery, Section 1, Page 1-3.**
2. Remove the locknut (1) securing the muffler (2) to its mounting bracket (**Figure 15-1, Page 15-2**).
3. Remove the hex nuts (3) and lock washers (4) at the cylinder head and remove muffler (2) from vehicle.

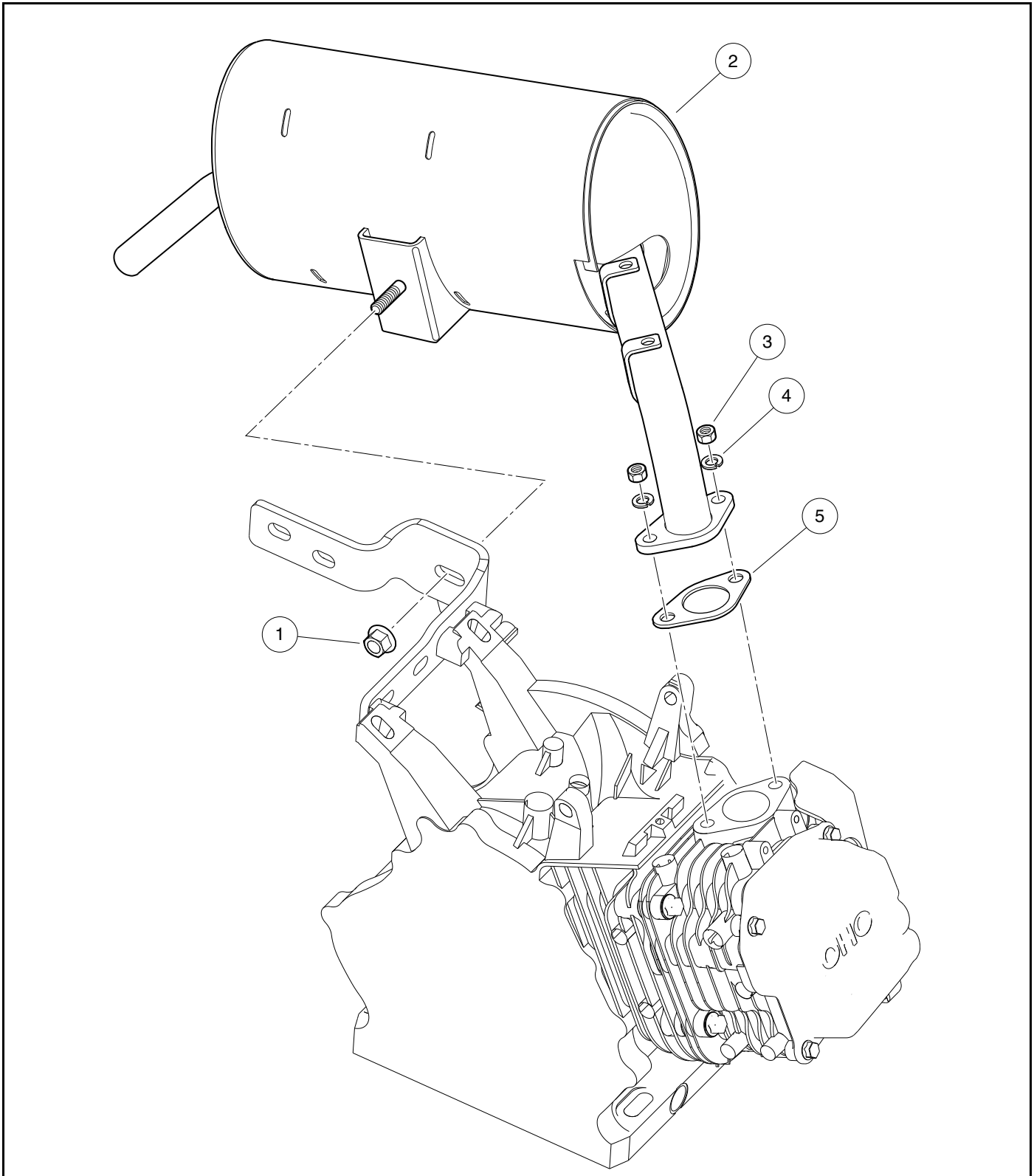
MUFFLER INSTALLATION

NOTE: Any time the muffler is removed from the vehicle, install a new exhaust gasket (5) (CC P/N 103993601) (**Figure 15-1, Page 15-2**).

1. Replace exhaust gasket (5) on the cylinder head exhaust port studs with new gasket.
2. Place muffler (2) into position and loosely secure it to mounting bracket with locknut (1) and to cylinder head with lock washers (4) and hex nuts (3).
3. Tighten hardware in the following order:
 - 3.1. At the mounting bracket, tighten locknut (1) to 34 ft·lb (46 N·m).
 - 3.2. At the cylinder head, tighten passenger-side hex nut (3) to 15 ft·lb (20 N·m).
 - 3.3. At the cylinder head, tighten driver-side hex nut (3) to 15 ft·lb (20 N·m).
4. Connect battery and spark plug wire(s). **See Connecting the Battery, Section 1, Page 1-3.**
5. Place the Forward/Reverse handle in the NEUTRAL position, chock the wheels, and the neutral lockout switch in the MAINTENANCE position.
6. Start the engine and check for exhaust leaks and proper engine operation. **See following DANGER.**

⚠ DANGER

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



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Figure 15-1 Exhaust System

⚠ DANGER

- See General Warnings on page 1-2.

⚠ WARNING

- See General Warnings on page 1-2.

GENERAL INFORMATION

The torque converter consists of a drive clutch, a driven clutch, and a drive belt. The drive clutch, which is mounted to the engine, is in the open position when the engine is at idle. At this point, the belt is riding at a low position (smaller diameter) on the drive clutch. The driven clutch is mounted on the transaxle. It is in the closed position, and the drive belt is riding at a high position (large diameter) on it when the engine is at idle.

At the point of clutch engagement, the speed ratio of the drive clutch to the driven clutch provides excellent starting and low-speed torque.

As engine speed increases, centrifugal force on internal weights close the drive clutch, pushing the belt up to a higher position on the clutch (increasing the diameter of the belt loop). As the diameter of the belt loop increases at the drive clutch, the driven clutch is forced open as the diameter of its belt loop decreases.

On steep grades, or when the vehicle is heavily loaded, higher torques are achieved through the use of a torque-sensing ramp device on the driven clutch. This device overcomes the force of the centrifugal weights to close the driven clutch and open the drive clutch, thus increasing axle torque with little or no change in engine RPM.

The engine and torque converter rotate counter-clockwise as viewed from the clutch side of the engine.

To provide optimum performance for the engine and powertrain, the vehicle uses a pair of tuned clutches.

To properly assemble and disassemble the torque converter, the following tools should be used:

- Clutch Tools (**Figure 16-1, Page 16-2**).
- Scribe or small pick (not included with clutch tools).

TROUBLESHOOTING

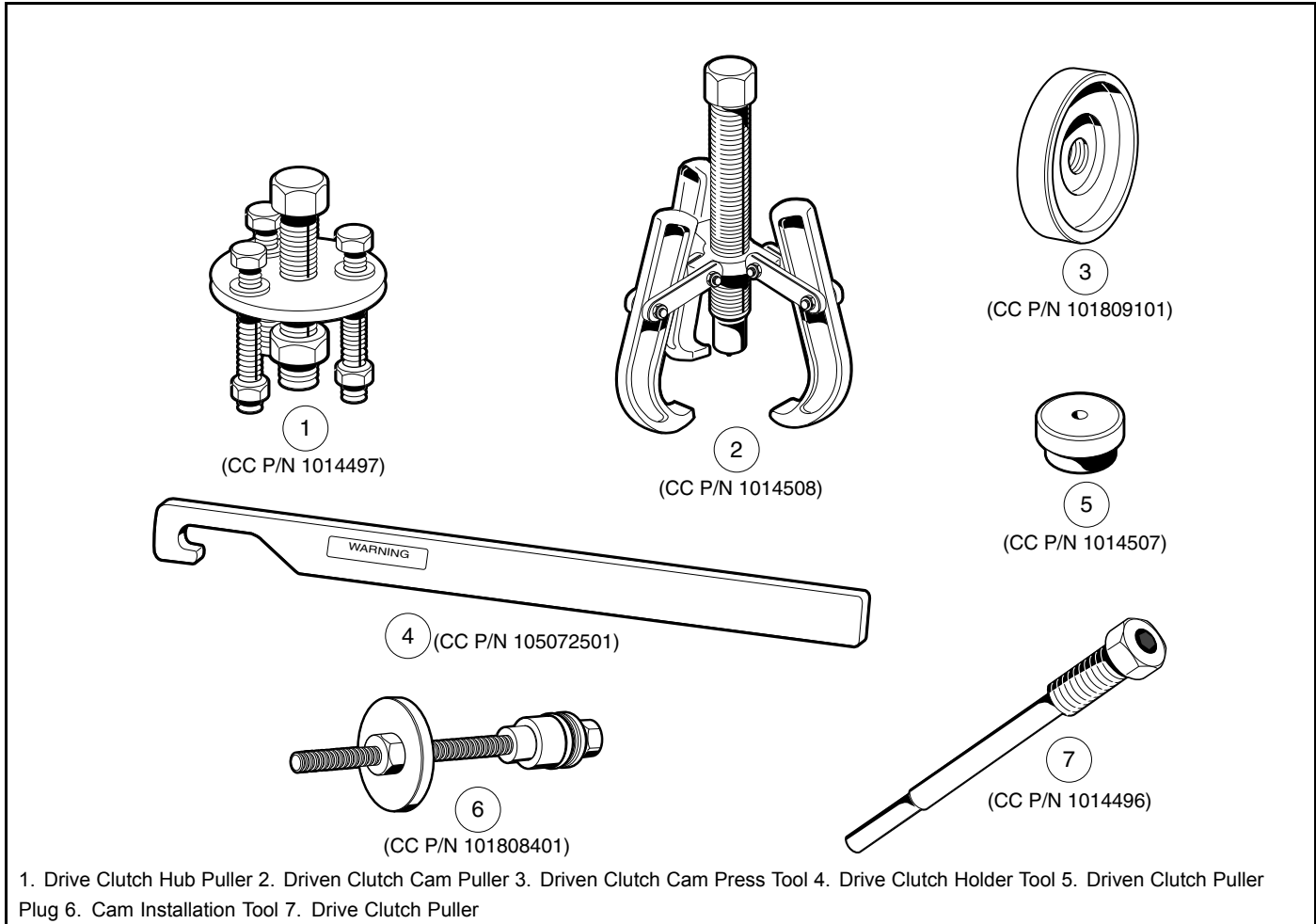
See General Warnings on page 1-2.

Maintaining proper adjustment of the engine and governor, as well as the torque converter, is essential to the troubleshooting process. If these adjustments are within specifications and, when climbing a steep hill, the engine begins to lose RPM before the drive belt reaches the top of the driven clutch, there is a torque converter problem.

If the torque converter is not operating properly, perform the following steps:

1. Check the governor and throttle settings. **See Engine Control Linkages on page 14-5.**

2. Inspect the driven clutch for dirt and dust buildup on its component parts. Clean the driven clutch with water to remove any dust or dirt, then drive the vehicle and check for proper operation.
3. If cleaning the driven clutch does not solve the problem, disassemble and thoroughly clean all parts of the drive clutch. Be sure to clean the plastic drive buttons (7) (Figure 16-3, Page 16-4).



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Figure 16-1 Clutch Tools

DRIVE BELT

See General Warnings on page 1-2.

The drive belt should be inspected semiannually for wear and (or) glazing. If it is excessively worn, frayed, or glazed, replace the belt.

As the drive belt wears, the engine RPM will increase to compensate for the change in torque converter ratio. This will keep the vehicle's maximum ground speed correct. See Section 2 – Vehicle Specifications.

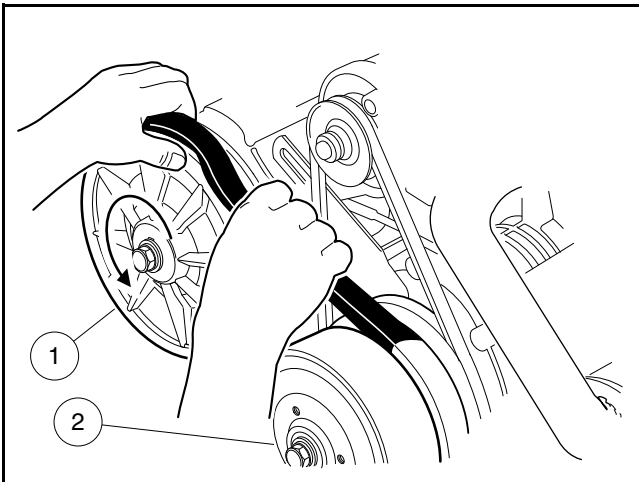
DRIVE BELT REMOVAL

1. Disconnect battery and spark plug wire(s). See Disconnecting the Battery, Section 1, Page 1-3.
2. Grasp the belt midway between the drive (2) and driven (1) clutches. Lift upward on the belt to force the sheaves of the driven clutch (1) apart, then roll the belt off the driven clutch by rotating the clutch counterclockwise (Figure 16-2, Page 16-3). See following CAUTION.

⚠ CAUTION

- Make sure fingers are not underneath the belt when rolling the belt off the driven clutch.

3. Remove the belt from the drive clutch (2).



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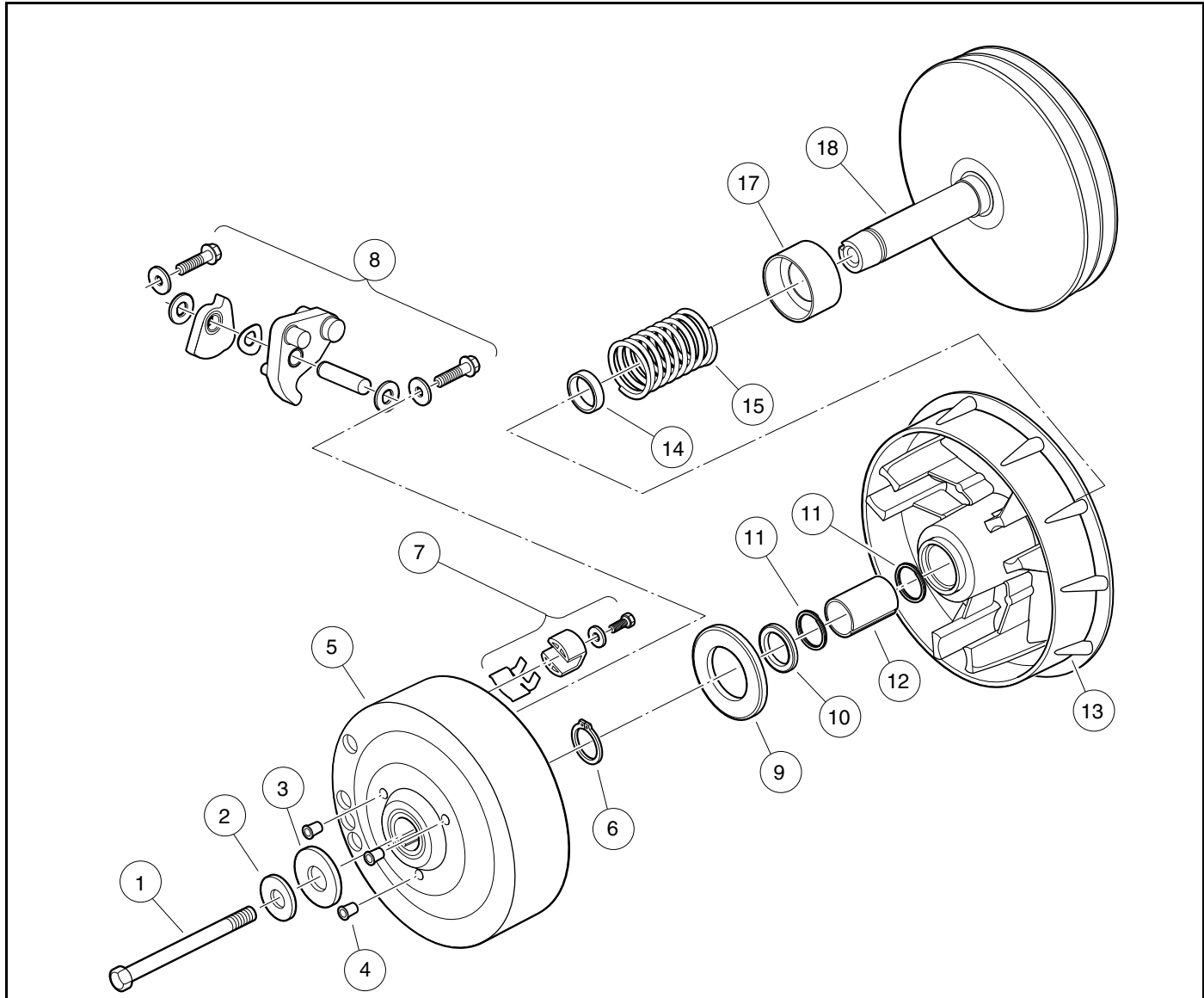
Figure 16-2 Drive Belt Removal

DRIVE BELT INSTALLATION

1. Position the new belt on the drive clutch (2), then start the belt over the top of the driven clutch (1).
2. With the belt started onto the driven clutch (1), rotate the driven clutch counterclockwise and roll the belt over the outer, moveable sheave.
3. Connect battery and spark plug wire(s). See Connecting the Battery, Section 1, Page 1-3.

DRIVE CLUTCH

See General Warnings on page 1-2.



1. Screw, 3/8-24 x 5.75, Patch

2. Washer, Hard, M10

3. Washer, 3/8, Type A, Flat

4. Cap Plug

5. Drive Hub Assy, Drive Clutch

6. Ring, 0.810 in. (20.5 mm) Internal Retaining

7. Drive Clutch Button

8. Drive Clutch Weight

9. Thrust Washer

10. Retainer

11. Ring, Spiral Backup

12. Bushing, Split, Drive Clutch

13. Sheave, Moveable, Drive

14. Spacer, Fixed Face Shaft

15. Spring, Drive Clutch

16. No Item to Show

17. Spacer, Idler, Drive

18. Sheave, Fixed, Drive

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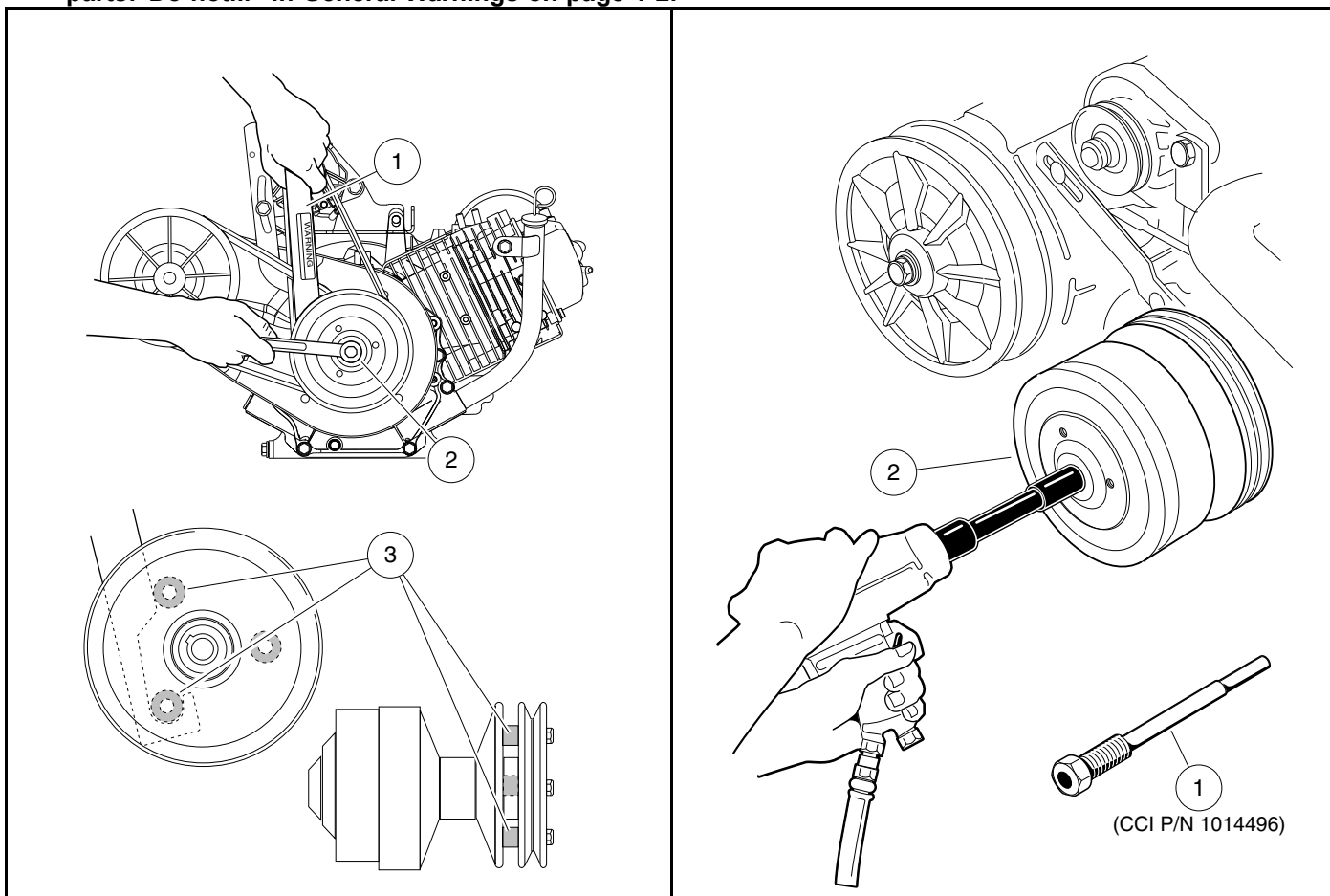
Figure 16-3 Drive Clutch – Exploded View

⚠ CAUTION

- Be very careful when handling the clutches. A clutch that has been dropped will not be properly balanced. If either clutch is dropped, assume that it is damaged and replace it.

DRIVE CLUTCH REMOVAL

1. Remove the drive belt as instructed. **See Drive Belt Removal on page 16-3.**
2. Loosen starter/generator mounting and adjusting hardware and remove starter belt. **See WARNING “Moving parts! Do not...” in General Warnings on page 1-2.**



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Figure 16-4 Loosen Retaining Bolt

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Figure 16-5 Drive Clutch Removal

3. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Place jack stands under the chassis to support the vehicle. The weight of the powertrain will allow the centerline of the drive clutch to drop below the frame I-beam for access to the bolt securing the drive clutch. **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.

4. Remove the drive clutch retaining bolt (1) and mounting washers (2 and 3) (**Figure 16-3, Page 16-4**). See also **Figure 16-4, Page 16-5**. See following **NOTE**.

NOTE: *The drive clutch mounting bolt has right-hand threads.*

The crankshaft has right-hand threads at the clutch mounting hole.

- 4.1. Use the drive clutch holder tool (1) while tightening or loosening the drive clutch retaining bolt (2) (**Figure 16-4, Page 16-5**).
- 4.2. Hook clutch holder on boss (3) of pulley located behind drive clutch and push against the adjacent boss with holder.
5. Lubricate the threaded portion of the clutch puller tool (1) with a light oil and thread the clutch puller tool into the clutch retaining bolt hole (**Figure 16-5, Page 16-5**).
6. Use a 1/2-in. drive air wrench to tighten the clutch puller tool. The drive clutch (2) will pull free of the crankshaft.
7. Support the drive clutch assembly in your hand and back the clutch puller tool out of the crankshaft.

⚠ CAUTION

- Do not hit or tap the clutch with a hammer. Do not pry the clutch. These actions will damage the clutch.

DRIVE CLUTCH CLEANING AND INSPECTION

1. Use a dry, lint-free cloth to clean clutch parts.

⚠ CAUTION

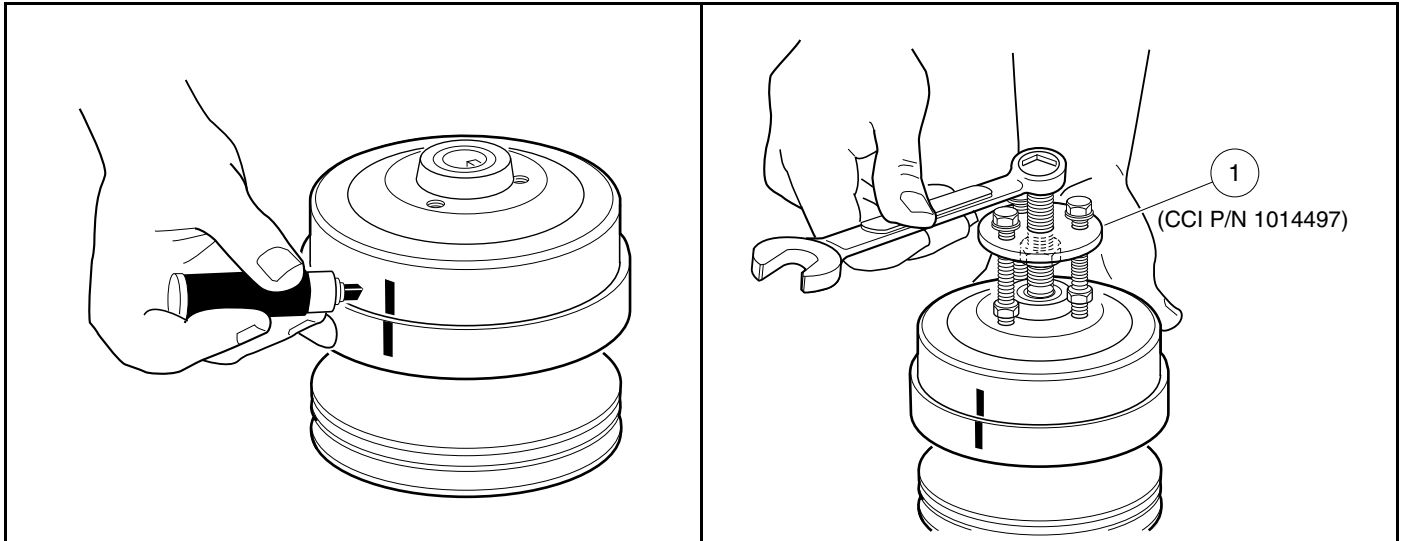
- Do not lubricate the drive clutch. Lubricants attract dirt and dust, which interfere with proper clutch operation.
 - Use only a dry cloth to lightly wipe the shaft of the fixed sheave (18) (**Figure 16-3, Page 16-4**). Do not use a brush or steel wool. These will damage the surface of the shaft.
 - Do not use solvents. Solvents will damage the lubricating characteristics of the bushings.
2. Inspect the belt contact surfaces of the clutch sheaves for wear. If any area of a sheave contact surface has wear of 0.060 in. (1.52 mm) or more, the clutch should be replaced.

DRIVE CLUTCH DISASSEMBLY

⚠ CAUTION

- The drive clutch is balanced as an assembly. Before disassembly, make match marks on the drive clutch hub and on the moveable sheave so they can be reassembled in the same positions (**Figure 16-6, Page 16-7**).
1. Make match marks on the drive clutch hub and on the moveable face (**Figure 16-6, Page 16-7**).
 2. Remove the drive clutch hub (5) (**Figure 16-3, Page 16-4**):
 - 2.1. Remove the three plugs (4) from the clutch puller attachment holes.

- 2.2. Thread the center bolt of the Drive Clutch Hub Puller (1) (CC P/N 1014497) into clutch until the stop nut touches the clutch, then back the bolt out one-half turn (**Figure 16-7, Page 16-7**).
- 2.3. Thread the three small bolts of the puller into corresponding holes in the clutch. Tighten bolts evenly, making sure the face of the puller plate is parallel to the face of the clutch (**Figure 16-7, Page 16-7**).
- 2.4. Unscrew the puller center bolt out of the clutch to pull drive clutch hub off.



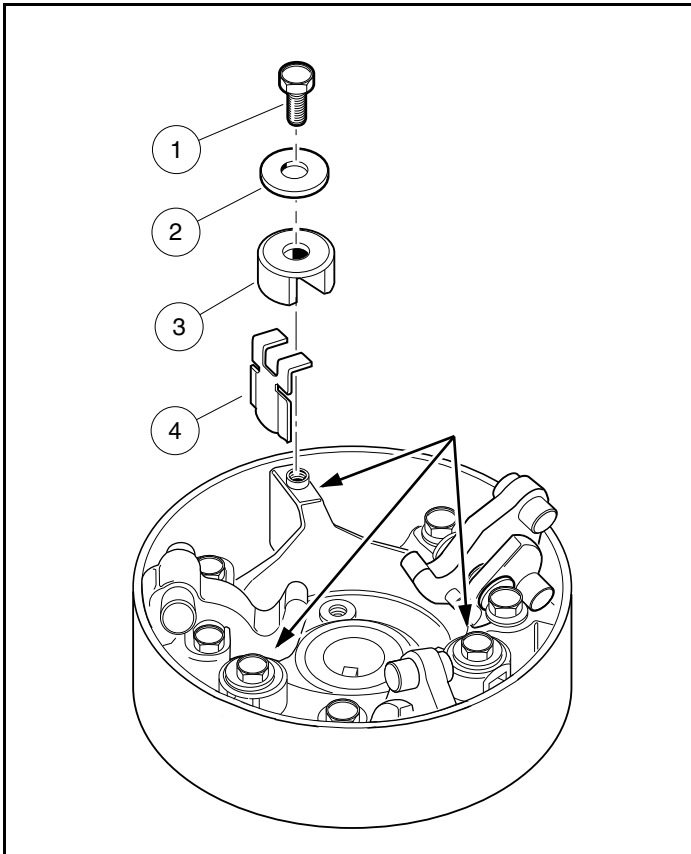
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Figure 16-6 Mark Drive Clutch Hub

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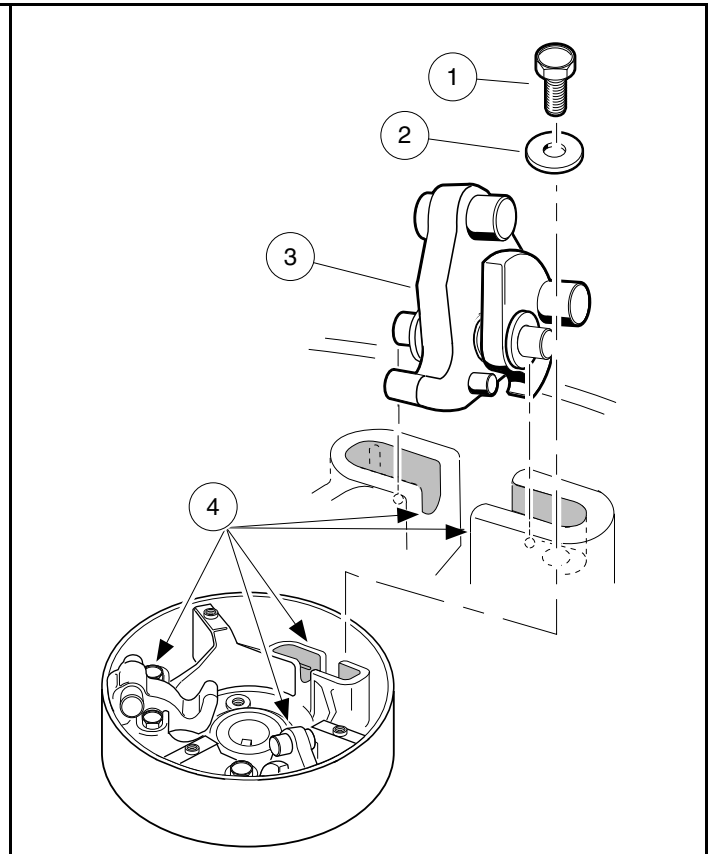
Figure 16-7 Remove Drive Clutch Hub

3. Remove the thrust washer (9) from the moveable sheave (13) (**Figure 16-3, Page 16-4**).
4. Remove the drive buttons (3) by removing the screws (1), flat washers (2), and drive button take-up springs (4) as shown (**Figure 16-8, Page 16-8**).



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Figure 16-8 Drive Button Mounting



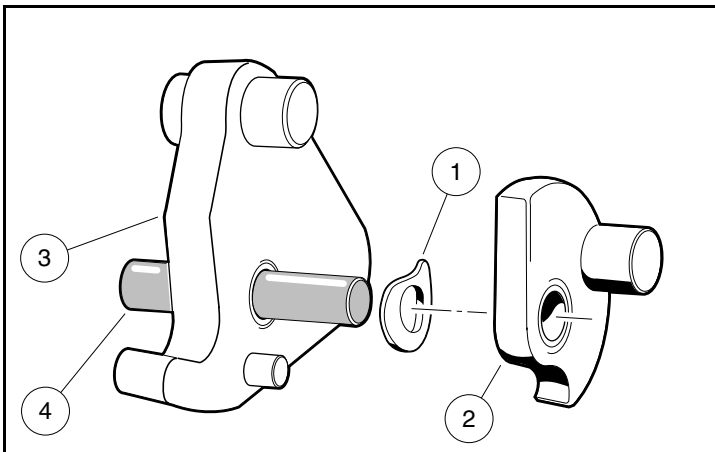
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Figure 16-9 Weight Position

5. Remove the clutch weights:
 - 5.1. Remove the screws (1) and flat washers (2) attaching the weights (3) as shown (Figure 16-9, Page 16-8).
 - 5.2. Pull the weight assemblies (3), with pins, from slots (4) in the clutch. **See following NOTE.**

NOTE: Before removing, note the orientation of the wave washer (1) and secondary weight (2) on the primary weight (3) (Figure 16-10, Page 16-8).

- 5.3. Remove the plastic washers, weights (2 and 3) and wave washer (1) from the pin (4). Retain all parts.



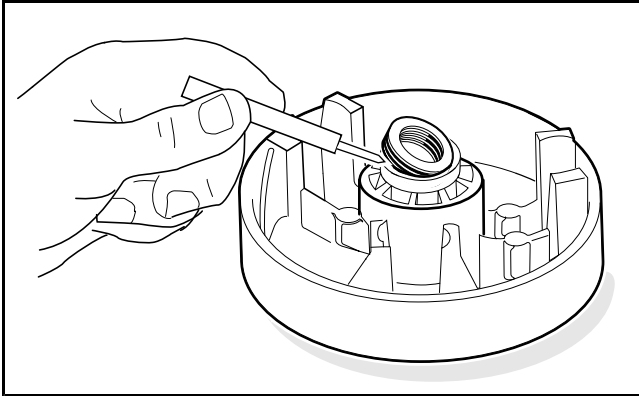
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Figure 16-10 Primary and Secondary Weights, Wave Washer and Pin

6. Remove the retaining ring (6) from the shaft of the fixed sheave (18) and slide the moveable sheave (13) off the shaft (**Figure 16-3, Page 16-4**). See following **NOTE**.

NOTE: If the moveable sheave is removed from the hub of the fixed sheave, the spiral back-up rings (11) must be replaced with new rings (**Figure 16-3, Page 16-4**).

7. Remove the spacer (14) and spring (15) (**Figure 16-3, Page 16-4**).
8. Use a scribe or small pick to remove the spiral backup rings (11) from each end of the bore in the fixed sheave (**Figure 16-3, Page 16-4**). See also **Figure 16-11, Page 16-9**. Discard the rings.



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Figure 16-11 Spiral Back-up Rings

INSPECTION OF DRIVE CLUTCH PARTS

1. Inspect the idler spacer (17) for smoothness (**Figure 16-3, Page 16-4**).
2. Inspect the bore of the moveable sheave (13) for scarring or wear. The moveable sheave must be replaced if the bore is worn to a diameter of 0.883 in. (22.4 mm) or larger (**Figure 16-3, Page 16-4**).
3. Inspect the steel shaft on the fixed sheave (18). There should be no measurable wear anywhere on the shaft. Replace the shaft if it is worn, scratched, or damaged.
4. Inspect the thrust washer (9) for wear. If it is worn more than 0.030 in. (0.76 mm), turn it over or replace it with a new one.
5. Inspect the primary weights (8) and the hub casting for wear. If the primary weights show signs they are touching the casting, the tips of the weights have worn beyond specification and they must be replaced.
6. Inspect the pins on the primary weights (8). There should be no measurable wear. Replace them if they are worn, scratched, or damaged.
7. Inspect the drive belt pulley sheaves for excessive wear or damage. If the sheaves are excessively worn or damaged, replace the entire fixed sheave.

DRIVE CLUTCH ASSEMBLY

1. Install the spring (15) into the cup of the idler spacer (17).
2. Install the spacer (14) onto the shaft of the fixed sheave.
3. Install a new spiral backup ring (11) in each end of the bore of the moveable sheave (13).
4. Install the moveable sheave (13) onto the shaft of the fixed sheave (18).

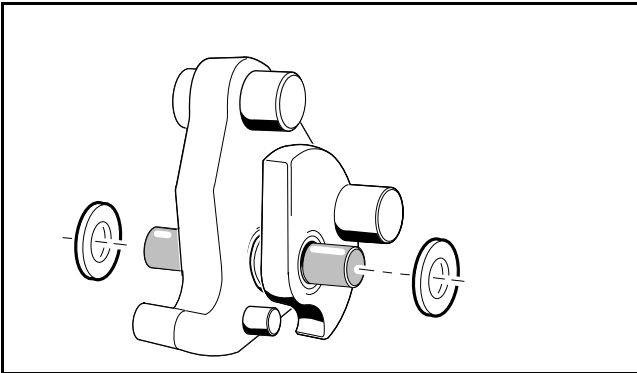
⚠ CAUTION

- To avoid damaging the spiral back-up rings, be very careful when installing the moveable sheave.

4.1. Rotate the moveable sheave clockwise while installing it onto the shaft.

4.2. Install the retaining ring (6) (**Figure 16-3, Page 16-4**).

5. Install the primary weights (3) on the mounting pins (4) (**Figure 16-10, Page 16-8**).
6. Install a wave washer (1) on each mounting pin (4). Make sure that the concave side of the washer faces the side of the primary weight (3) with the small guide pin protruding from it (**Figure 16-10, Page 16-8**).
7. Install the secondary weights (2) onto the mounting pins (4) with the weight pins on the secondary weights pointing away from the primary weights (3). The wave washers should be between the primary and secondary weights (**Figure 16-10, Page 16-8**).
8. Install white plastic flat washers on each end of the mounting pin and push them against the outside surfaces of the weights. Center the weights and washers on the mounting pin (**Figure 16-12, Page 16-10**).
9. Install the weight assemblies into the slots (4) in the hub casting (**Figure 16-9, Page 16-8**). Make sure the mounting pin protrudes an equal amount on each side of the weights when the assemblies are in position (**Figure 16-12, Page 16-10**).



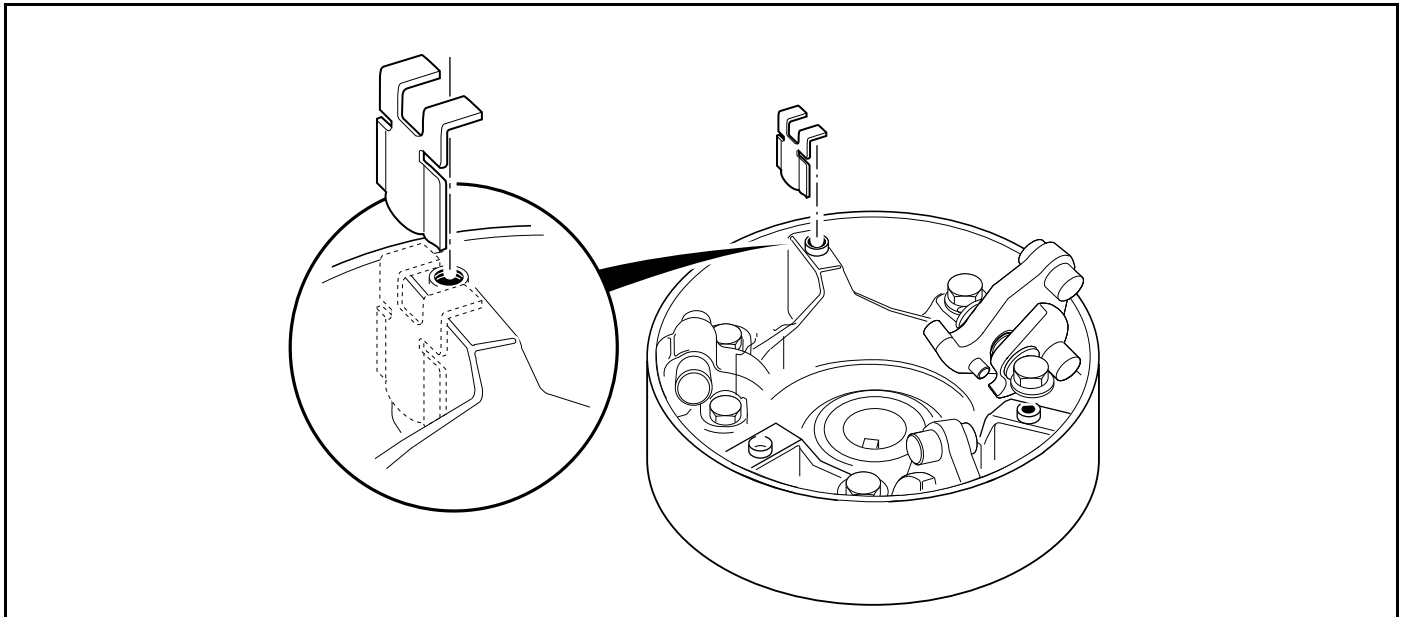
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Figure 16-12 Install White Washers

10. Install the 1/4-20 bolts (1) and washers (2) and tighten them to 10 ft·lb (13 N·m) (**Figure 16-9, Page 16-8**).
See following NOTE.

NOTE: Make sure there is at least a (minimum) gap of 0.020 in. (0.51 mm) between each end of the mounting pin and the mounting bolt.

11. Install three drive button take-up springs.
 - 11.1. Install each spring on right-hand side of the three button mounting posts (when looking into the interior of the clutch drive hub, and with the rib at a twelve o'clock position) as shown (**Figure 16-13, Page 16-11**).
12. Compress each take-up spring and install the drive button over the rib and take-up spring (**Figure 16-8, Page 16-8**).
13. Install a drive button retaining bolt (1) with flat washer (2) through each button (3) and into the rib. Tighten the bolts to 34 in·lb (3.8 N·m) (**Figure 16-8, Page 16-8**).
14. Install the thrust washer (9) onto the moveable sheave (13) (**Figure 16-3, Page 16-4**).
15. Install the hub assembly (5) on the moveable sheave (13) and align the match marks made before disassembling the clutch. Press the hub assembly on by hand.
16. Replace the three plastic plugs (4) into the holes (**Figure 16-3, Page 16-4**).



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Figure 16-13 Correct Orientation of Drive Button Take-up Springs

DRIVE CLUTCH INSTALLATION

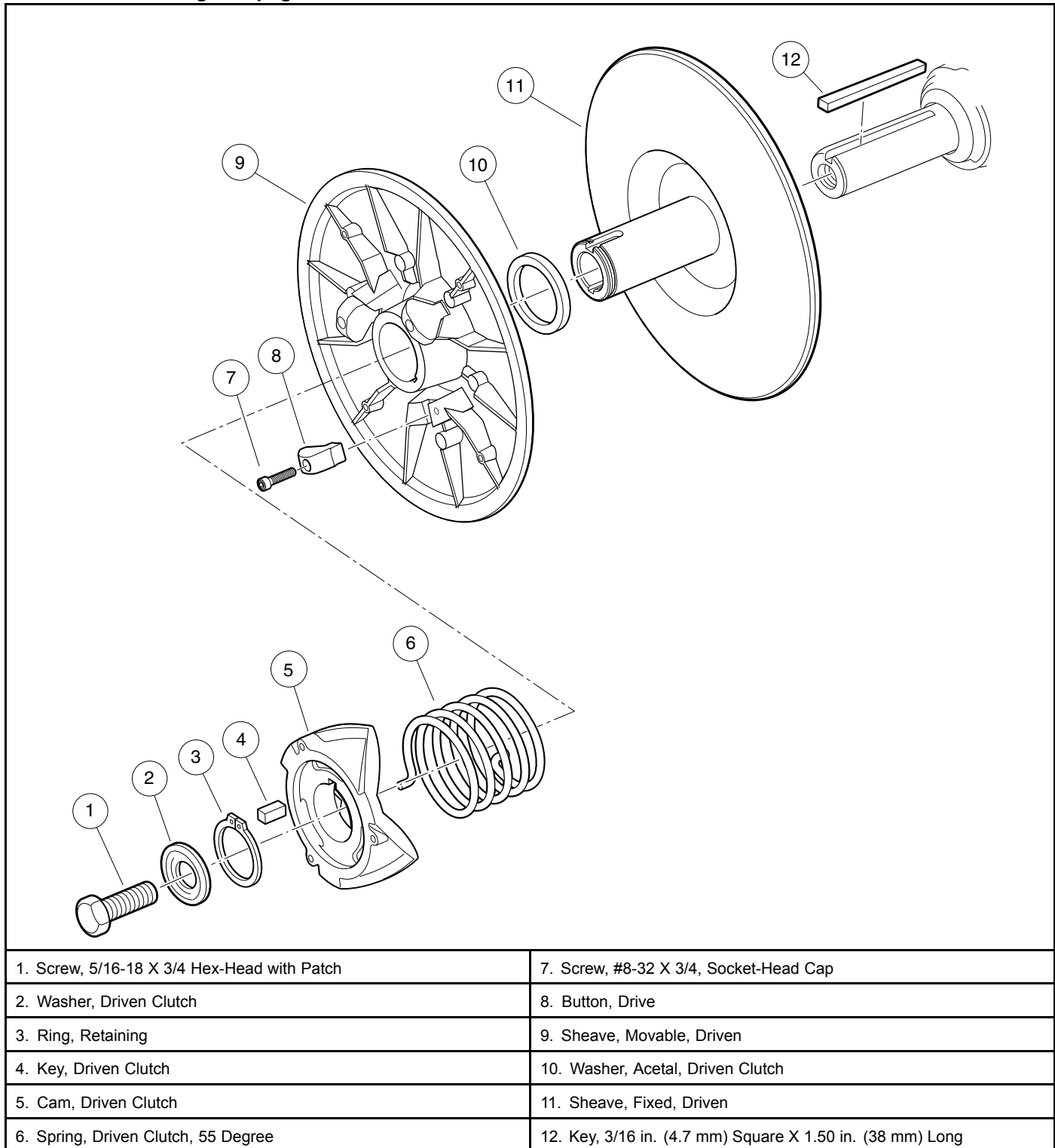
1. Place the drive clutch assembly on the crankshaft taper. Position the mounting washers (2 and 3) on the bolt (1) and start the bolt into the crankshaft (**Figure 16-3, Page 16-4**). **See following NOTE.**

NOTE: *The drive clutch retaining bolt has right-hand threads. The manufacturer recommends replacing the drive clutch retaining bolt (CC PN 103976101) when installing the drive clutch. If a new bolt is not available, clean the threads of the original bolt and apply Loctite® 242 to the threaded end prior to installation.*

2. Tighten the drive clutch retaining bolt (1) to 35 ft·lb (47.5 N·m) (**Figure 16-3, Page 16-4**).
3. Install the starter/generator belt and adjust belt tension as instructed. **See Belt Tension Adjustment, Section 12, Page 12-11.**
4. Install the drive belt as instructed. **See Drive Belt Installation on page 16-3.**
5. Connect battery and spark plug wire(s). **See Connecting the Battery, Section 1, Page 1-3.**
6. Drive the vehicle and check for proper operation.

DRIVEN CLUTCH

See General Warnings on page 1-2.



1. Screw, 5/16-18 X 3/4 Hex-Head with Patch

2. Washer, Driven Clutch

3. Ring, Retaining

4. Key, Driven Clutch

5. Cam, Driven Clutch

6. Spring, Driven Clutch, 55 Degree

7. Screw, #8-32 X 3/4, Socket-Head Cap

8. Button, Drive

9. Sheave, Movable, Driven

10. Washer, Acetal, Driven Clutch

11. Sheave, Fixed, Driven

12. Key, 3/16 in. (4.7 mm) Square X 1.50 in. (38 mm) Long

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Figure 16-14 Driven Clutch – Exploded View

DRIVEN CLUTCH REMOVAL

1. Remove the drive belt as instructed. **See Drive Belt Removal on page 16-3.**
2. Remove the bolt (1) and mounting washer (2) from the transaxle input shaft (**Figure 16-14, Page 16-12**).
3. Grasp the driven clutch assembly and slide it off the shaft.
4. Leave the key (12) in the keyway.

DRIVEN CLUTCH DISASSEMBLY

⚠ CAUTION

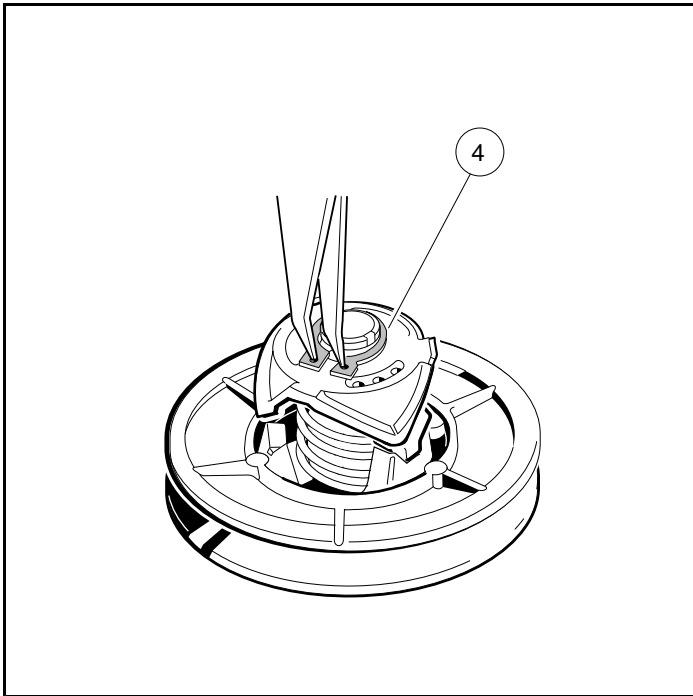
- **The driven clutch is balanced as an assembly. Before disassembly, make match marks on the driven clutch fixed sheave and moveable sheave so they can be reassembled in the same positions.**

1. Make match marks on the driven clutch fixed sheave and on the moveable sheave to maintain balance upon reassembly.
2. Using external snap ring pliers, remove the retaining ring (4) (**Figure 16-15, Page 16-14**). **See following WARNING.**

⚠ WARNING

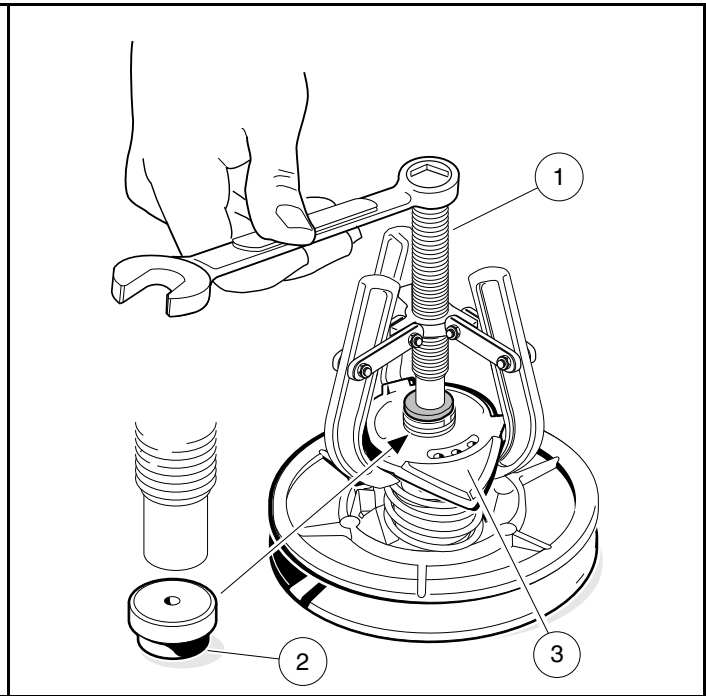
- **Do not place fingers under the cam when removing the cam. The moveable face may spin when the cam buttons release from the cam ramps, resulting in severe personal injury.**

3. Insert a puller plug (2) (CC P/N 1014507) (**Figure 16-16, Page 16-14**) into the shaft bore and use a driven clutch cam puller (1) (CC P/N 1014508) to remove the cam (3) from the fixed sheave.
4. Remove the spring (6) (**Figure 16-14, Page 16-12**).
5. Retain the key (4).
6. Slide the moveable sheave (9) off the fixed sheave (11).



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Figure 16-15 Remove Retaining Ring



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Figure 16-16 Driven Clutch Disassembly

DRIVEN CLUTCH INSPECTION

1. Inspect the cam (5) for excessive wear (**Figure 16-14, Page 16-12**). Replace it if necessary.
2. Inspect the drive buttons (8) for excessive wear. Replace if necessary. To remove the drive buttons (8), remove the socket-head cap screws (7) and then the buttons.
3. Inspect the smooth surface on the fixed and moveable sheaves. Sheaves must be replaced if surfaces are worn more than 0.060 in. (1.5 mm).
4. Inspect the bronze bearing in the moveable sheave. If the bearing bore diameter is more than 1.384 in. (35.15 mm), the entire moveable sheave must be replaced.
5. Inspect the shaft of the fixed sheave. There should be no noticeable wear. Replace the fixed sheave if it is worn, scratched or damaged.

DRIVEN CLUTCH ASSEMBLY

1. Place the three drive buttons (8) in position. Apply one drop of Loctite® 222 to each of the socket-head cap screws (7) and then install and tighten them to 8 in·lb (0.9 N·m) (**Figure 16-14, Page 16-12**).
2. Slide the acetal washer (10) and moveable sheave (9) onto the fixed sheave (11).
3. Place the end of the spring (6) into the hole in the moveable sheave (9).
4. Install the key (4) into the keyway of the fixed sheave (11) shaft.
5. Holding the cam (5) in position for assembly on the shaft, install the other end of the spring (6) into the center spring hole of the cam. Rotate the cam until the keyway is aligned with the key (4) on the fixed sheave, and then start the cam onto the shaft approximately 1/4 to 3/8 in. (6.3 to 9.5 mm).

5.1. Press Assembly Process:

- 5.1.1. Place the clutch assembly in a press and position the cam press tool (CC P/N 101809101) on the cam (2) as shown (**Figure 16-17, Page 16-15**).

5.1.2. Hold the fixed sheave (3) and rotate the moveable sheave (1) one-third turn counterclockwise, then press the cam (2) onto the fixed sheave (**Figure 16-17, Page 16-15**). The match marks made before disassembly should now align.

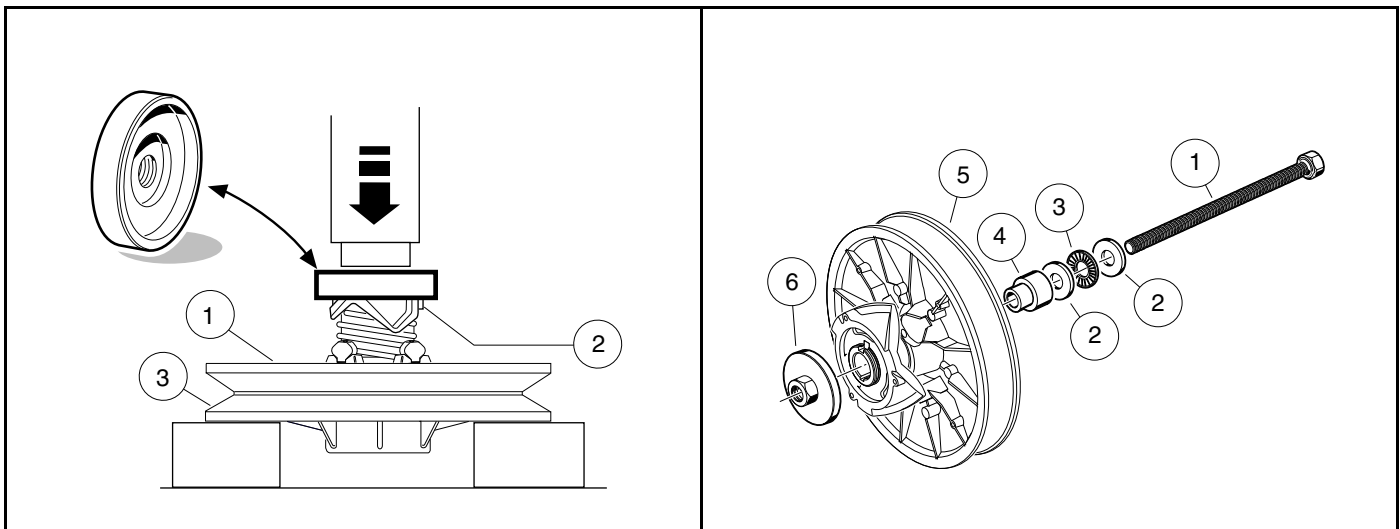
5.1.3. Install the retaining ring (4) (**Figure 16-15, Page 16-14**). See following **NOTE**.

NOTE: The retaining ring (4) can be reused if the O.D. does not exceed 1.607 in. (40.82 mm); otherwise, it must be replaced with a new ring (CC P/N 1014080).

5.1.4. While holding onto the cam, tap the end of the fixed sheave lightly with a plastic mallet until the cam seats against the retaining ring (4). See following **CAUTION**.

⚠ CAUTION

- Do not use a metal hammer to tap the fixed sheave. A metal hammer will damage the shaft.



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Figure 16-17 Cam Press Tool

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Figure 16-18 Cam Installation Tool

5.2. Field Assembly Process:

NOTE: This process is for field assembly requirements where hydraulic and pneumatic press equipment is not available. Use the cam installation tool (CC P/N 101808401) for this process.

5.2.1. With the clutch loosely assembled, set the edge of the clutch body (5) on a clean, flat surface (**Figure 16-18, Page 16-15**).

5.2.2. Assemble the threaded bolt (1) through the washer (2), the thrust bearing assembly (3), the second washer (2), and the hub guide (4).

NOTE: It is very important that the bolt, washers, and thrust bearing assembly be assembled in the order described and shown.

5.2.3. Slide the bolt (1) through the clutch body (5) until the threaded bolt, washers, bearing, and hub guide are against the fixed sheave (**Figure 16-18, Page 16-15**).

5.2.4. Hold the clutch assembly and cam installation tool together and place the fixed sheave down on spaced blocks (**Figure 16-17, Page 16-15**).

5.2.5. Place the cam press hub (6) onto the cam installation bolt and thread it down onto the cam hub, centering the press hub onto the cam hub.

- 5.2.6. Hold the fixed sheave of the clutch (5) and rotate the moveable sheave of the clutch one-third turn counterclockwise (**Figure 16-18, Page 16-15**). The match marks made before disassembly should now align.
- 5.2.7. Use two wrenches and hold the bolt head (1) while tightening the cam press hub (6) to press the cam onto the keyed shaft. Advance the press hub (6) until it is firm against the shaft end.
- 5.2.8. Remove the cam press hub (6) and installation tool.
- 5.2.9. Install the retaining ring (4) (**Figure 16-15, Page 16-14**).

NOTE: The retaining ring (4) can be reused if the O.D. does not exceed 1.607 in. (40.82 mm); otherwise, it must be replaced with a new ring (CC P/N 1014080).

DRIVEN CLUTCH INSTALLATION

1. To install the driven clutch, reverse the removal procedure. Make sure that the washer (2) is mounted with the flat portion of the washer against the driven clutch (**Figure 16-14, Page 16-12**). Secure with a new bolt (1). **See following NOTE.**

NOTE: The bolt (1) must be replaced with a new bolt (CC P/N 102242101) containing a locking patch that will prevent the bolt from loosening.

2. Tighten the bolt (1) to 18 ft·lb (24.4 N·m).
3. Connect battery and spark plug wire(s). **See Connecting the Battery, Section 1, Page 1-3.**

▲ DANGER

- See General Warnings on page 1-2.

▲ WARNING

- See General Warnings on page 1-2.

GENERAL INFORMATION

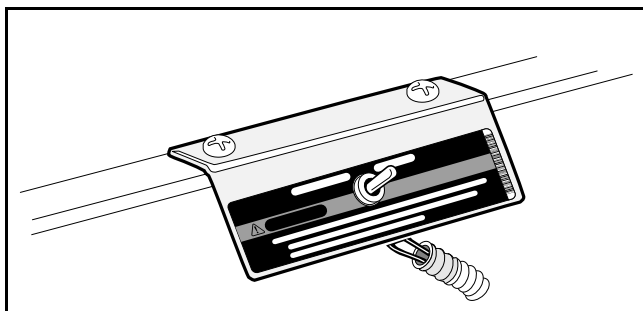
The vehicles addressed in this manual are equipped with heavy-duty transaxles. The transaxle utilizes internal gearing to change vehicle direction. Because the transaxle is used to reverse vehicle direction, the engine, drive clutch, belt, and driven clutch rotate in the same direction; therefore, the engine and clutches are not subjected to reversing loads. This reduces maintenance requirements on the engine and clutches. With the transaxle, power is transferred from the engine through the drive clutch, the drive belt, the driven clutch, and then through the transaxle to the wheels.

SHIFTER LEVER

A shifter lever, connected to a shifter arm, is used to change the gears to one of three shift positions: FORWARD (F), NEUTRAL (N), or REVERSE (R). Bring the vehicle to a complete stop before changing FORWARD or REVERSE direction.

NEUTRAL LOCKOUT

For the convenience of the trained technician, there is a neutral lockout switch located on the seat support panel under the seat (**Figure 17-1, Page 17-1**). The neutral lockout switch has two positions, MAINTENANCE and OPERATE, which are clearly marked.



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Figure 17-1 MAINTENANCE/OPERATE Switch

Pedal-Start Vehicles

During normal vehicle operation, the neutral lockout switch in the OPERATE position prevents the engine from running when the Forward/Reverse handle is in the NEUTRAL position. If a vehicle is started in FORWARD or REVERSE and then shifted to NEUTRAL, the engine will stop running.

When the switch is in the MAINTENANCE position, it will allow the technician to run the engine in the NEUTRAL position to perform certain maintenance and/or repair functions. With the switch in this position, the vehicle will not operate if the Forward/Reverse handle is placed in either the FORWARD or REVERSE position. **See following WARNING and NOTE.**

▲ WARNING

- With the switch in the MAINTENANCE position and the engine running, the vehicle may move suddenly if the Forward/Reverse handle is shifted or accidentally bumped. To prevent this, chock the front and rear wheels and firmly set the park brake before servicing or leaving the vehicle.

NOTE: Be sure to return the switch to the OPERATE position after servicing the vehicle, or it will not run with the Forward/Reverse handle in either the FORWARD or REVERSE position.

Key-Start Vehicles

During normal vehicle operation, the neutral lockout switch in the OPERATE position allows the engine to start only when the Forward/Reverse handle is in the NEUTRAL position. In addition, it allows the engine to run and increase RPM's with the Forward/Reverse handle in any position.

With the switch in the MAINTENANCE position, it allows the technician to start, run, and increase the engine RPM's only in the NEUTRAL position to perform certain maintenance and/or repair functions. With the switch in this position, the engine will shut off if the Forward/Reverse handle is placed in either the FORWARD or REVERSE position. **See preceding WARNING and NOTE.**

GOVERNOR SYSTEM

The governor system regulates vehicle ground speed. It is mounted inside the transaxle and is driven by transaxle gears. If any of the governor linkages are removed in order to service other components, readjustment of the governor linkage is required. **See Governor Cable Installation and Adjustment on page 14-8.**

TRANSAXLE SERVICE

The transaxle is extremely durable and should require very little service under normal operating conditions. The only service required is to maintain proper lubricant level. **See Lubrication on page 17-2.** Under normal operating conditions, adjustment to the system should not be required.

LUBRICATION

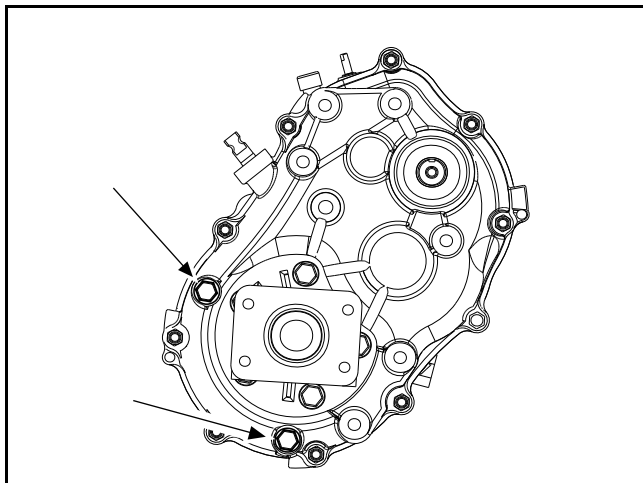
There are two oil port plugs located on the right (driven clutch) side of the transaxle (**Figure 17-2, Page 17-3**). When the vehicle is on a level surface, use the upper plug as a lubricant level indicator. Lubricant level should be even with the bottom of level indicator hole. Use the lower plug for draining. **See following NOTE.**

NOTE: Observe the following for transaxles equipped with a limited-slip differential:

- Uses a magnetic drain plug.
- Unlike most limited-slip differentials, this unit **does not** use a friction modifier added to the gear oil.

Oil Change – Transaxle

1. When draining transaxle oil, remove both plugs to allow the oil to drain faster.
2. Clean and reinstall the drain plug and gasket before filling the transaxle with new lubricant. Tighten drain plug to 17 ft·lb (23 N·m).
3. Use a funnel when filling the transaxle through the lubricant level indicator hole. Fill with 67.6 fl-oz (2 L) 80-90 WT. API class GL or 80-90 WT. AGMA class 5 EP gear lubricant (or until lubricant begins to run out of the level indicator hole).
4. Install upper plug and gasket and tighten to 17 ft·lb (23 N·m).



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Figure 17-2 Lubricant Level Plug and Drain Plug

TOOLS REQUIRED FOR THIS SECTION

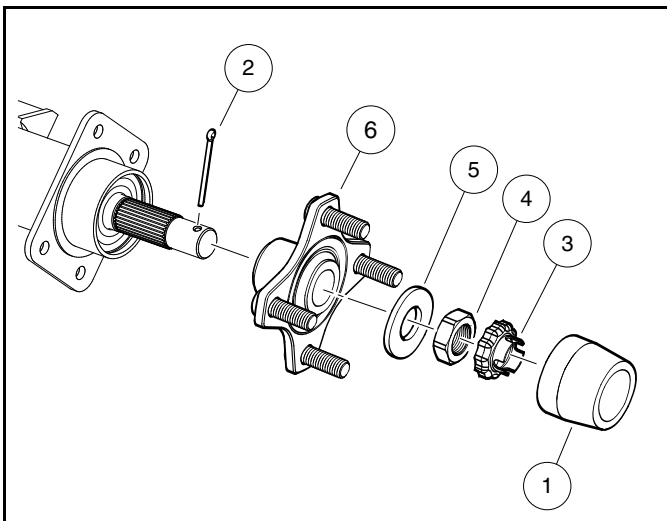
Hydraulic floor jack (or chain hoist)	Torque wrench, 3/8-in. drive	1/2-in. combination wrench
Jack stands (2) (one ton capacity)	3/8-in. socket, 3/8-in. drive	9/16-in. combination wrench
Standard slip joint pliers	7/16-in. socket, 3/8-in. drive	Small flat blade screwdriver
External snap ring pliers (0.047-in. tip)	1/2-in. socket, 3/8-in. drive	Medium flat blade screwdrivers (2)
90° Internal snap ring pliers (0.090-in. tip)	9/16-in. socket, 3/8-in. drive	No. 2 phillips-head screwdriver
16-in. rolling head prybar	5/8-in. socket, 3/8-in. drive	1/4-in. nut driver
Plastic or rubber mallet	Axle seal tool (CC P/N 1014162)	5/16-in. nut driver
Ratchet wrench, 3/8-in. drive	7/16-in. combination wrench	

REAR HUBS

REAR HUB REMOVAL

1. Turn the key switch to the OFF position and remove the key, and place the Forward/Reverse handle in the NEUTRAL position.
2. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery, Section 1, Page 1-3.**
3. Place chocks at the front wheels and loosen lug nuts on both rear wheels.
4. Remove the rubber dust cap (1).
5. Remove and discard the cotter pin (2) (**Figure 17-3, Page 17-4**).
6. Remove nut locking cap (3) and loosen the hub nut (4) on the axle shaft.
7. Lift and support the rear of vehicle.
8. Remove the lug nuts and wheel.
9. Slide brake drum off hub.
10. Remove hub nut (4) and large flat washer (5) and pull hub (6) off axle shaft. **See following NOTE.**

NOTE: If the hub (6) does not slide easily off the axle shaft, use a two or four-jaw wheel puller to remove the hub.



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Figure 17-3 Rear Hub Exploded View

REAR HUB INSTALLATION

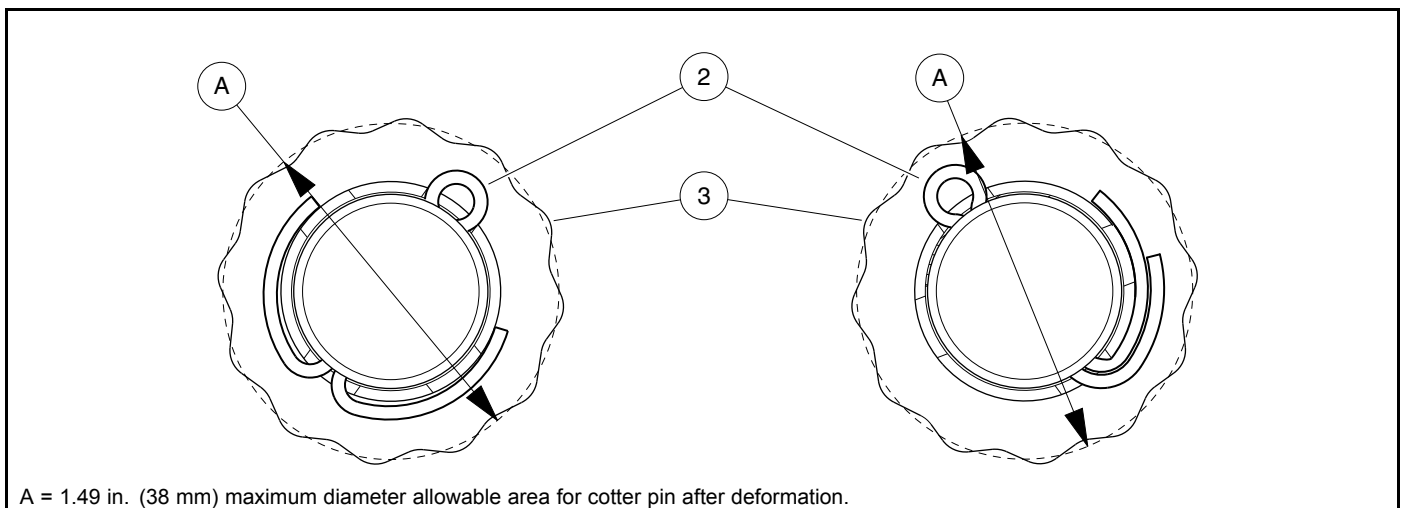
1. Inspect brake shoes for wear and replace if necessary. **See Wheel Brake Assemblies section.**

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

2. Clean the splines and threaded portion of the axle shaft.
3. Apply anti-seize compound to both the axle shaft splines and hub (6) splines. **See following CAUTION.**

CAUTION

- Do not allow anti-seize compound to contact the brake drum or shoes.
4. Slide hub (6) onto axle shaft (**Figure 17-3, Page 17-4**).
 5. Install the large flat washer (5) onto the threaded portion of the axle.
 6. Install hub nut (4) and advance the nut to the large flat washer.
 7. Install brake drum onto hub.
 8. Install the tire and wheel and finger-tighten the lug nuts.
 9. Lower the rear of the vehicle.
 10. Tighten the hub nut (4) to 147 ft·lb (200 N·m) initially. If possible, position the locking cap (3) on hub nut (4) and install new cotter pin (2). If necessary, tighten hub nut (4) further (177 ft·lb (240 N·m) max.) until the locking cap (3) and new cotter pin (2) can be installed.
 11. Deform cotter pin (2) as shown (**Figure 17-4, Page 17-5**). Either way is acceptable. No part of the cotter pin (2) should protrude beyond the perimeter of the locking cap (3).
 12. Install rubber dust cap (1).
 13. Tighten lug nuts to 65 ft·lb (88 N·m) using a crisscross pattern.
 14. Connect battery and spark plug wire(s). **See Connecting the Battery, Section 1, Page 1-3.**



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Figure 17-4 Cotter Pin Deformation

AXLE TUBES, AXLE SHAFTS AND WHEEL BEARINGS

Removal of the transaxle is not required for servicing or replacing axle shafts, axle bearings, or axle shaft oil seals. If the transaxle is to be removed from the vehicle, do not remove the wheels, axle shafts, or axle tubes first. Instructions for removing the transaxle from the vehicle begin on page 17-9.

NOTE: The axle shaft oil seals (7) are located in the transaxle gearcase (4), not the axle tubes (2) (**Figure 17-5, Page 17-6**). The axle tubes must be removed in order to replace these oil seals.

AXLE TUBE AND AXLE SHAFT REMOVAL

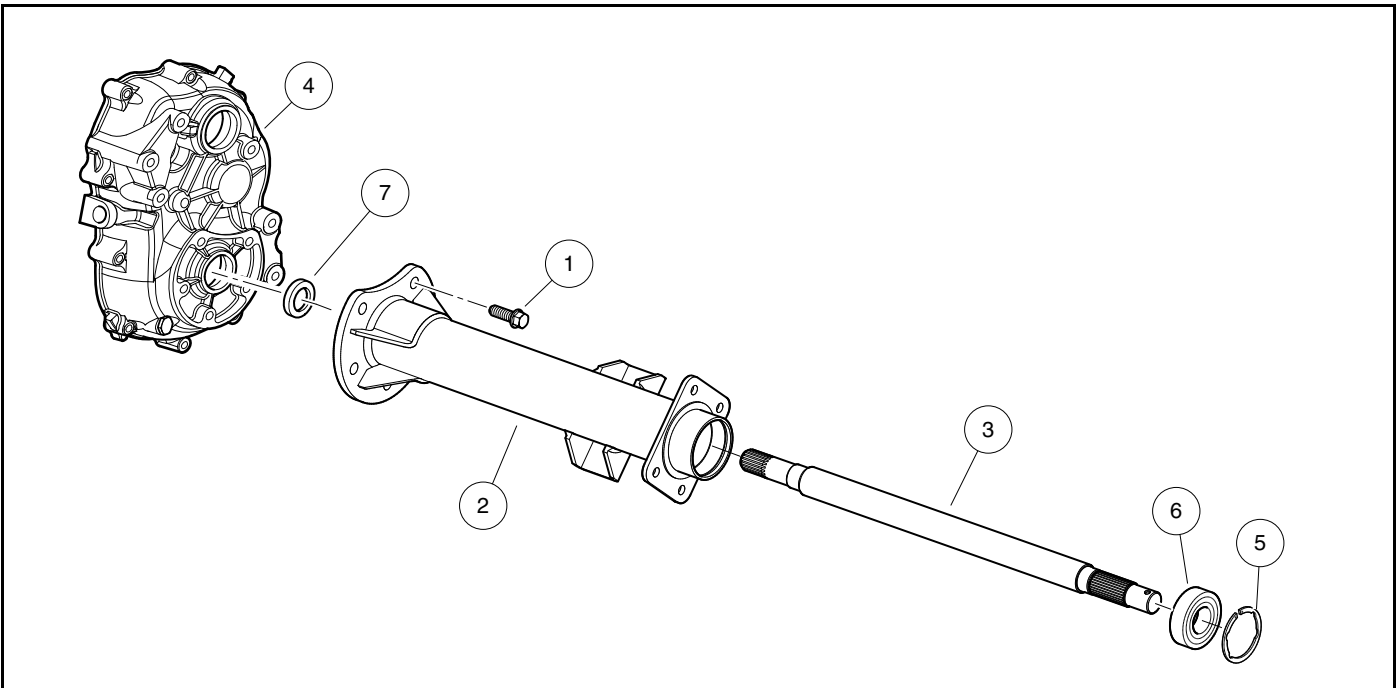
See General Warnings, Section 1, Page 1-2.

The transaxle has two axle shafts. If only a tube or shaft is to be serviced, it can be done one side at a time without removing the transaxle.

1. Clean debris from drain plug and area around it at the bottom of the transaxle. Drain oil. Install plug after draining.
2. If removing entire transaxle from vehicle, remove the transaxle and clean it in preparation for disassembly. **See Transaxle Removal on page 17-9. See following NOTE.**

NOTE: After cleaning, move transaxle to a clean location before disassembly.

3. If removing only one axle tube or shaft from vehicle, clean that tube and hub in preparation for disassembly.
4. Remove hub. **See Rear Hub Removal on page 17-4.**
5. Remove the five flange-head bolts (1) securing axle tube (2) to transaxle (**Figure 17-5, Page 17-6**).
6. Avoiding damage caused by dragging splines across lip of oil seal (7) in transaxle gearcase, carefully pull axle tube (2) and shaft (3) from transaxle.



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Figure 17-5 Axle Tube, Shaft, Bearing and Oil Seal

AXLE TUBE AND AXLE SHAFT INSTALLATION

1. Clean mating surfaces of axle tube (2) flange and transaxle gearcase (4). Also clean the threads of the five axle tube mounting holes in the gearcase. **See following CAUTION.**

CAUTION

- If necessary, clean each mounting hole with a thread tap (M10 x 1.25 pitch) before installing flange bolts.
2. Clean and lubricate the oil seal (7) in the transaxle gearcase (4) with oil (**Figure 17-5, Page 17-6**).
 3. Clean inner end of axle shaft (3). Avoiding damage caused by dragging splines across lip of oil seal (7) in transaxle gearcase (4), carefully install axle shaft (3) and tube (2). **See following NOTE.**

NOTE: It may be necessary to rotate each shaft (3) slightly to engage the splines in the differential.

4. Secure axle tube (2) to gearcase (4) with flange bolts (1). Use a crisscross pattern to tighten flange bolts to 28 ft·lb (38 N·m).
5. Install hub. **See Rear Hub Installation on page 17-4.**
6. If entire transaxle was removed from vehicle, install transaxle. **See Transaxle Installation on page 17-12.**
7. Refill transaxle with appropriate type and volume of oil. **See Oil Change – Transaxle on page 17-3.**

REAR WHEEL BEARING REMOVAL

A rear wheel bearing can be replaced without removing the axle tube but this risks damaging the oil seal when reinstalling axle shaft; therefore, the preferred method is to first remove the axle tube and shaft as an assembly from the transaxle and then replace bearing.

1. Remove hub. **See Rear Hub Removal on page 17-4.**
2. Remove axle tube (2) from transaxle. **See Axle Tube and Axle Shaft Removal on page 17-5.**
3. Remove the snap ring (5) that is in front of the bearing (6) and discard (**Figure 17-5, Page 17-6**).
4. Drive axle shaft (3) and bearing (6) from outer end of axle tube (2) as an assembly.
5. Use a puller to remove bearing (6) from axle shaft (3). **See following CAUTION.**

CAUTION

- To prevent damaging the threads on end of axle shaft (3), install hub nut to cover initial threads prior to using puller.

REAR WHEEL BEARING INSTALLATION

1. Press new bearing (6) onto axle shaft (3) until fully seated.
2. Clean inside axle tube (2) where new bearing (6) will sit and lightly lubricate the bore (**Figure 17-5, Page 17-6**).
3. Using an appropriate sized bearing driver that fits the outer race, drive in bearing/shaft assembly (3 and 6) until fully seated in tube (2).
4. Install new snap ring (5).
5. Install axle tube (2). **See Axle Tube and Axle Shaft Installation on page 17-6.**
6. Install hub. **See Rear Hub Installation on page 17-4.**

AXLE SHAFT OIL SEAL REMOVAL

The rear axle tubes (2) must be unbolted from the transaxle to replace oil seals (7) (**Figure 17-5, Page 17-6**).

1. Clean debris from drain plug and area around it at the bottom of the transaxle. Drain oil. Install plug after draining.
2. Remove axle tube (2) from gearcase (4) (**Figure 17-5, Page 17-6**). **See Axle Tube and Axle Shaft Removal on page 17-5.**
3. Pull oil seal (7) from gearcase (4).

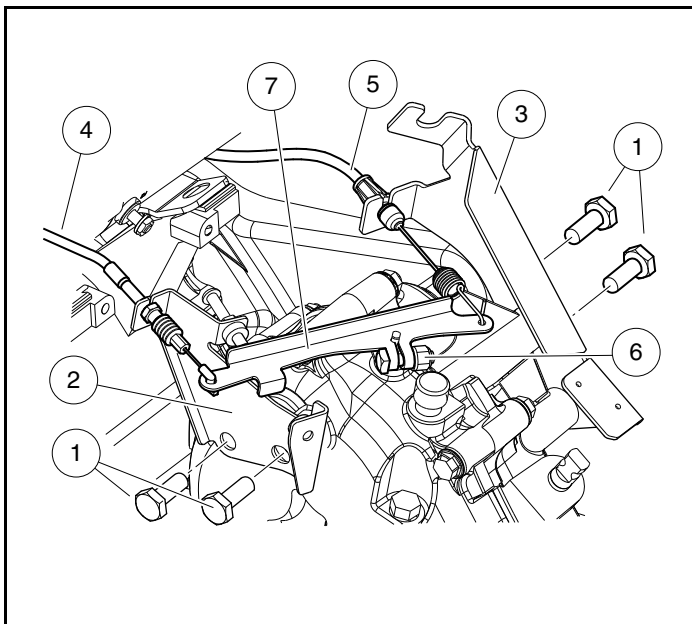
AXLE SHAFT OIL SEAL INSTALLATION

1. Clean bore in gearcase (4) where new oil seal (7) will sit (**Figure 17-5, Page 17-6**).
2. Using an appropriate sized seal driver, drive in new oil seal (7) until 0.0393 in. (1 mm) below surface, not fully seated.
3. Clean end of axle shaft (3) and carefully install axle tube (2) to avoid damaging new oil seal (7) with splines of axle shaft. **See Axle Tube and Axle Shaft Installation on page 17-6.**
4. Refill transaxle with appropriate type and volume of oil. **See Oil Change – Transaxle on page 17-3.**

TRANSAXLE REMOVAL

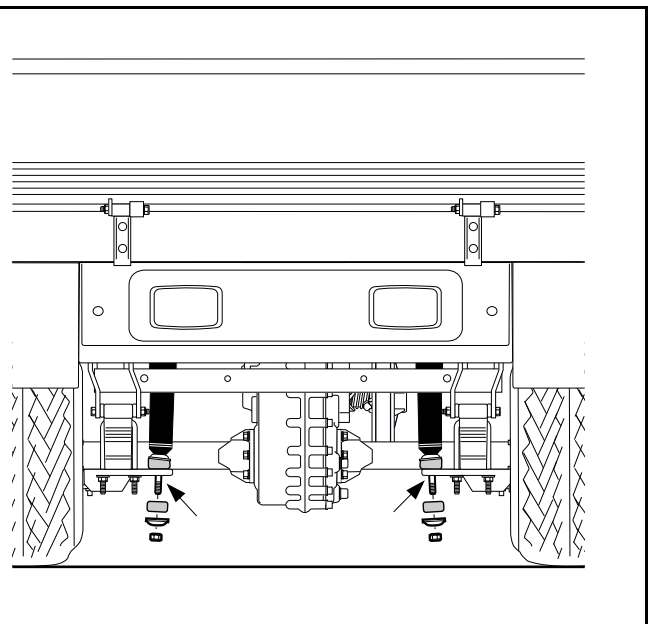
See General Warnings on page 1-2.

1. Turn the key switch to the OFF position and remove the key, and place the Forward/Reverse handle in the NEUTRAL position.
2. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery, Section 1, Page 1-3.**
3. Place chocks at the front wheels and loosen lug nuts on both rear wheels.
4. Disconnect air intake hose, vent hose, and fuel line from throttle body and accelerator cable from electrical component box. **See Fuel System: Gasoline Vehicles, Section 14, Page 14-1.**
5. Disconnect gray 18-pin connector from ECU.
6. Disconnect braided ground cable from engine (**Figure 11-9, Page 11-21**).
7. **Pedal-Start Vehicles Only:** Disconnect 3-wire plug from limit switch on transaxle.
8. Disconnect three wires of main wire harness from starter/generator (**Figure 12-13, Page 12-10**).
9. Loosen jam nuts (1) securing shifter cable (2) to FNR/accelerator cable mounting bracket. Then, remove bowtie clip (3) to disconnect shifter cable end (4) from transaxle shift lever (5) and set shifter cable (2) aside (**Figure 17-14, Page 17-13**).
10. Remove bolts (1) securing governor cable bracket (2) and FNR/accelerator cable bracket (3) to transaxle (**Figure 17-6, Page 17-9**). Do not disconnect cables (4 and 5).
11. Unhook governor cable (4) and accelerator cable (5) from the governor arm (7).



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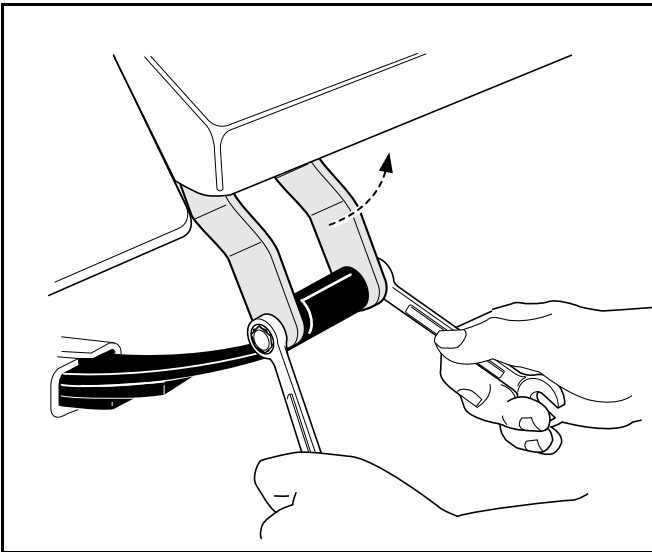
Figure 17-6 Governor Arm, Cable and Brackets



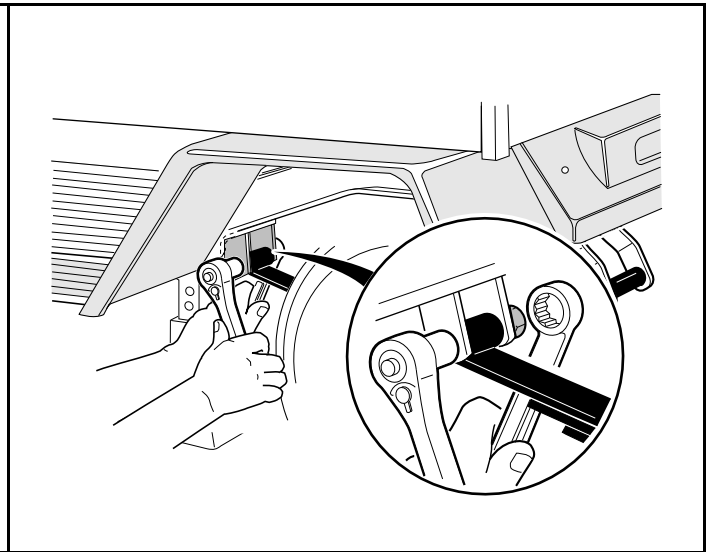
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Figure 17-7 Disconnect Shock Absorbers

12. Disconnect brake cables from brake assemblies. **See Wheel Brake Assemblies section.**
13. Remove lower shock mounting hardware from both rear shocks (**Figure 17-7, Page 17-9**).



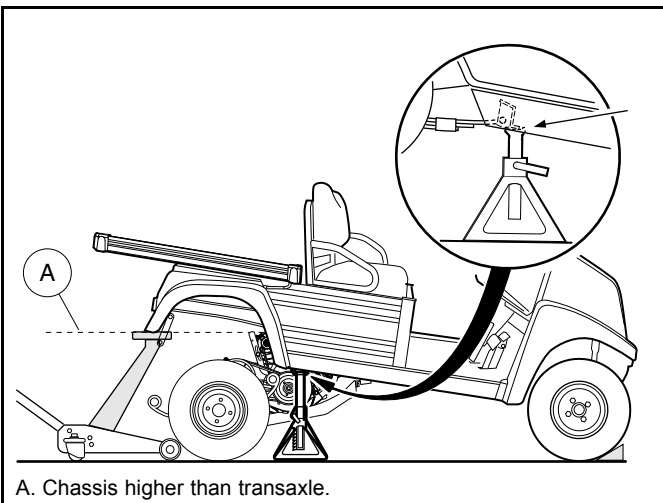
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Figure 17-8 Disconnect Rear Shackles

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Figure 17-9 Disconnect Front of Leaf Spring

14. Position floor jack under rear crossmember of chassis or trailer hitch mount (if equipped) (**Figure 17-10, Page 17-10**). **See WARNING “Lift only one end of the vehicle...” in General Warnings on page 1-2.**
15. Raise vehicle just enough to relieve weight on leaf springs, then remove bolts securing leaf springs to shackles (**Figure 17-8, Page 17-10**).
16. Remove bolts securing front of leaf springs (**Figure 17-9, Page 17-10**).



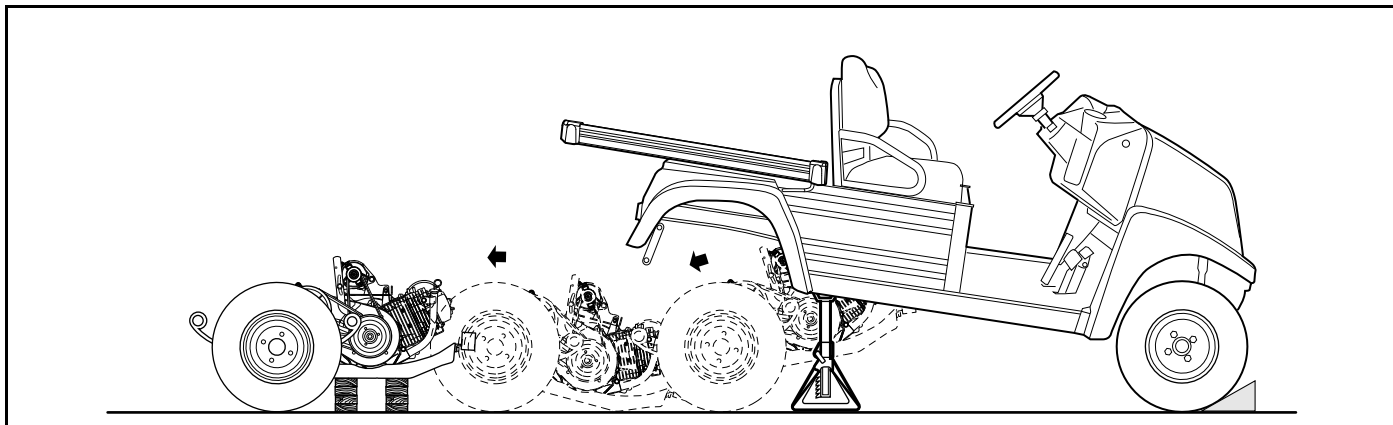
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Figure 17-10 Raise Vehicle and Support On Jack Stands

17. Continue raising vehicle until chassis is higher than the top of the transaxle (i.e. enough to allow powertrain to be rolled out from under vehicle) (**Figure 17-10, Page 17-10**). Position jack stands, adjusted to support the vehicle at this height, under the frame crossmember between the leaf spring mounts and side stringers, just forward of each rear wheel. Lower the floor jack to allow the jack stands to support the vehicle.
18. Remove floor jack from beneath vehicle.
19. Grasp ends of leaf springs at rear of vehicle and carefully pull the powertrain until snubber at front of engine pan is free of the chassis. Gently lower front of powertrain to the floor (**Figure 17-11, Page 17-11**). The powertrain should be completely disconnected from vehicle and resting on floor.
20. Roll powertrain out from under vehicle.

21. Place blocks under the engine pan so they will completely support the engine and keep it **level to the floor** (Figure 17-11, Page 17-11). See following NOTE.

NOTE: Place the blocks so they will support the engine when the transaxle is detached and moved away from the powertrain.



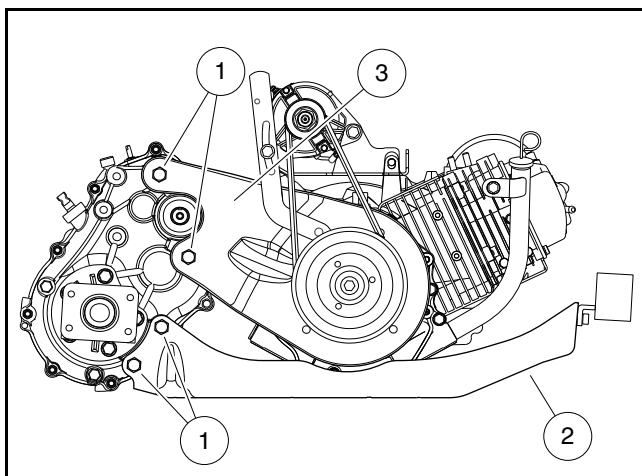
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Figure 17-11 Remove Powertrain and Place Wood Blocks Under Engine Pan

22. Remove oil drain plug and drain all oil from transaxle. Dispose of gear oil properly.
23. Remove driven clutch. See **Driven Clutch Removal, Section 16, Page 16-13**.
24. Remove eight bolts (1) total that secure transaxle to powertrain (Figure 17-12, Page 17-11) at the following locations:
- Four bolts (1) at engine pan (2).
 - Two bolts (1) at clutch plate (3).
 - Two bolts (1) at muffler bracket.
25. Roll transaxle from engine pan (2). See following NOTE.

NOTE: The transaxle weighs approximately 58 lb (26.2 kg).

26. If replacing transaxle, remove leaf springs, wheels, hubs and brake assemblies and retain for installation on new transaxle. See **Rear Suspension section**. See **Wheel Brake Assemblies section**.



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Figure 17-12 Transaxle Mounting Bolts

TRANSAXLE INSTALLATION

See General Warnings on page 1-2.

1. Installation is reverse of removal procedure. When attaching transaxle to powertrain, initially install the eight bolts (1) finger-tight (**Figure 17-12, Page 17-11**). Then, tighten fasteners in the following order:
 - 1.1. Tighten the two bolts (1) at clutch plate (3) to 50 ft·lb (68 N·m).
 - 1.2. Tighten the four bolts (1) at engine pan (2) to 50 ft·lb (68 N·m).
 - 1.3. Tighten the two bolts (1) at muffler bracket to 50 ft·lb (68 N·m).
 - 1.4. Tighten the governor cable bracket (2) and FNR/accelerator cable bracket (2) bolts to 50 ft·lb (68 N·m) (**Figure 17-6, Page 17-9**).
 - 1.5. Tighten leaf spring hardware to 19 ft·lb (26 N·m) at chassis and shackle. **See Rear Suspension section.**
 - 1.6. Tighten lower nuts of shock absorbers until cushions expand to be the same diameter as the mounting washers.
 - 1.7. Tighten transaxle drain plug to 17 ft·lb (23.5 N·m).
2. Fill transaxle with appropriate type and volume of oil. **See Oil Change – Transaxle on page 17-3.**
3. Ensure that all wires and cables are secured properly with wire ties. **See following WARNING.**

⚠ WARNING

- **If wires and cables are removed or replaced make sure they are properly routed and secured to vehicle frame. Failure to properly route and secure wires and cables could result in vehicle malfunction, property damage or personal injury.**
4. Connect battery and spark plug wire(s). **See Connecting the Battery, Section 1, Page 1-3.**
 5. Check governor adjustment and correct if necessary. **See Governor Cable Installation and Adjustment, Section 14, Page 14-8.**
 6. Check engine RPM setting. Adjust if necessary. **See Engine RPM Adjustment, Section 14, Page 14-11.**

SHIFTER CABLE

See General Warnings on page 1-2.

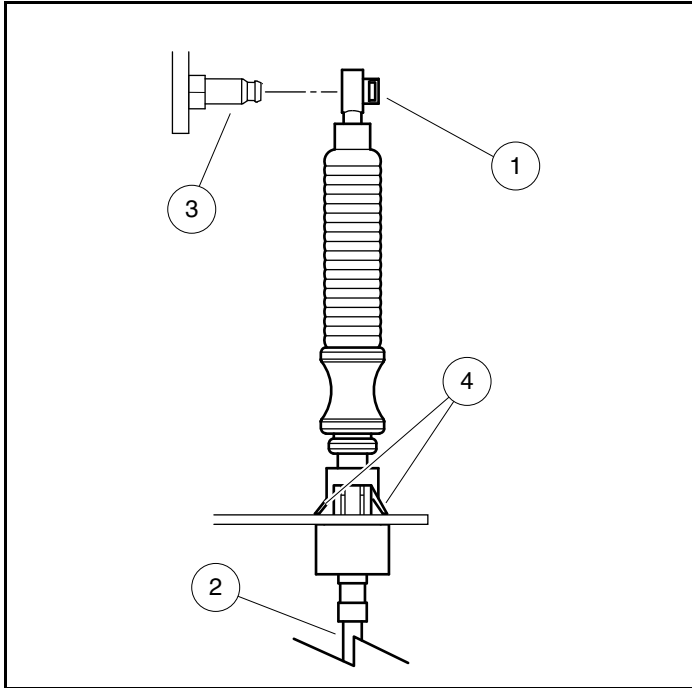
If the Forward/Reverse shifter cable is damaged in any way, it must be replaced.

SHIFTER CABLE REMOVAL

NOTE: Before removing cable, note cable routing and positions of wire ties or other devices securing the cable to the vehicle. When installed, cable must be routed and secured as it was originally.

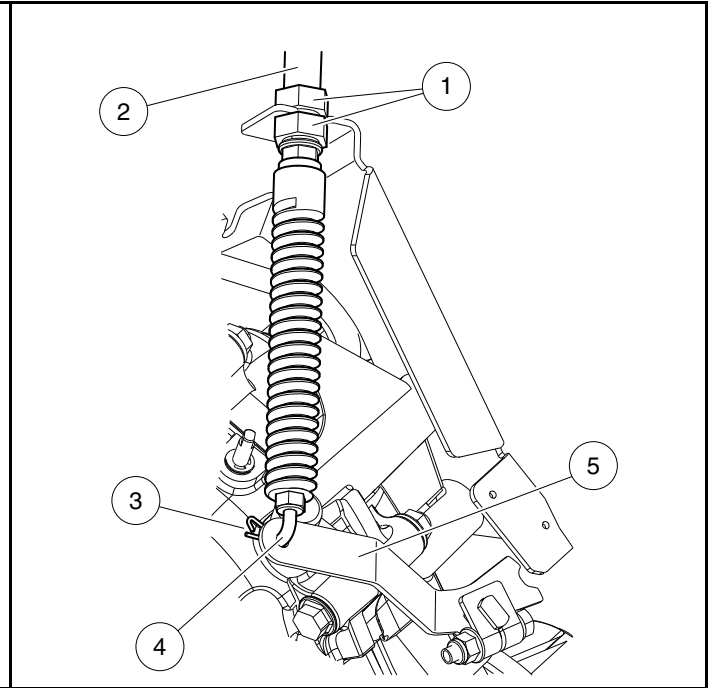
1. Turn the key switch to the OFF position and remove the key. Place the Forward/Reverse handle in the NEUTRAL position and chock the wheels.
2. Disconnect battery and spark plug wire(s). **See Disconnecting the Battery, Section 1, Page 1-3.**
3. Push the cable end socket (1) off the stud (3) on the Forward/Reverse shifter handle (**Figure 17-13, Page 17-13**).
4. Press in tangs (4) anchoring shifter cable (2) to chassis and push out of mounting hole.

5. Loosen jam nuts (1) securing shifter cable (2) to FNR/accelerator cable bracket (3) (**Figure 17-14, Page 17-13**). Then, remove bowtie clip (3) to disconnect shifter cable end (4) from transaxle shift lever (5).
6. Cut wire ties securing shifter cable to chassis.
7. Make note of cable routing, then remove shifter cable from vehicle.



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Figure 17-13 Shifter Cable at FNR Handle



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Figure 17-14 Shifter Cable at Transaxle

SHIFTER CABLE INSTALLATION

1. Install shifter cable (2), routing it exactly as it was originally, from instrument panel to transaxle.
2. Place rear of cable (2) in FNR/accelerator cable bracket with a jam nut (1) on each side of bracket (**Figure 17-14, Page 17-13**). Tighten jam nuts (1) to 22 ft·lb (29.8 N·m).
3. Hook shifter cable end (4) into transaxle shift lever (5) and secure with bowtie clip (3).
4. Feed front of cable (2) through its mounting hole and push the plastic anchor into hole until tangs (4) snap into place (**Figure 17-13, Page 17-13**).
5. Snap cable end socket (1) onto stud (3) of Forward/Reverse shifter handle.
6. Secure shifter cable along chassis with wire ties.
7. Connect battery and spark plug wire(s). **See Connecting the Battery, Section 1, Page 1-3.**

SHIFTER CABLE ADJUSTMENT

Cable is properly adjusted when both the Forward/Reverse handle at instrument panel and shift lever on transaxle are in the NEUTRAL position at the same time.

To adjust, the jam nuts (6) at the FNR/accelerator cable bracket must be loosened and moved forward or backward as required (**Figure 17-14, Page 17-13**). Tighten jam nuts (6) to 22 ft·lb (29.8 N·m).

⚠ DANGER

- See General Warnings on page 1-2.

⚠ WARNING

- See General Warnings on page 1-2.

GENERAL INFORMATION

REFRESHMENT CENTER COMPARTMENTS

Cold Storage Compartments

The cold storage compartments are designed to carry canned beverages and cooling ice. Pre-packaged, non-hazardous foods and snacks can also be served from these compartments. We recommend they be kept in original packaging if placed directly on the ice, so that food will remain dry.

Pre-cooling the canned beverages will minimize the amount of ice required to keep the product cool. Maintaining ice in the cold storage compartments when they are not in service will help to maintain a colder temperature when the unit is put back into service.

⚠ WARNING

- Operate vehicle only with all compartment loads equally distributed.
- Do not use the cold storage compartments to store unprotected food, or ice that is intended for human consumption. Failure to heed this warning can result in food poisoning.

Consumable Ice Compartments

The consumable ice compartments, located in the rear driver and passenger sides of the Cafe Express refreshment center should be used for consumable ice only. In order to prevent contamination of consumable ice, do not place food in these compartments. Consumable ice should not be stored in any other compartment of the Cafe Express refreshment center.

Trash Compartment

The trash compartment is located in the rear of the base unit. The trash bin should be lined with a disposable plastic bag to maintain cleanliness. This compartment should not be used for storing or transporting consumable ice, drinks, or food.

CLEANING

INTERIOR ALUMINUM SURFACES

The interior surfaces of the refreshment center should be cleaned and sanitized daily with an approved product before being used. Check with your local Health Department for rules and regulations in your area.

EXTERIOR ALUMINUM SURFACES

The exterior surfaces should be cleaned on a daily basis using a soap and water solution. Periodic cleaning with an aluminum or stainless steel cleaner is recommended.

CAUTION

- **Using abrasive cleaners on aluminum will damage or scratch the surface. Use a soft cloth with an industrial type aluminum cleaner/polish to clean the aluminum surfaces.**
- **Do not use steel wool on refreshment center aluminum surfaces.**

DRAINS

The drains should be flushed with a hose on a daily basis. Periodically, the drains should be cleaned and sanitized.

REFRESHMENT CENTER DOORS

The sliding doors should be cleaned daily with a mild soap and water solution. Dry with a clean, damp chamois. Do not use window cleaning sprays or paper towels.

CANOPY COVER

Periodically clean the canopy cover by spraying the fabric with water and allowing fabric to dry on the canopy frame.

WINDSHIELD

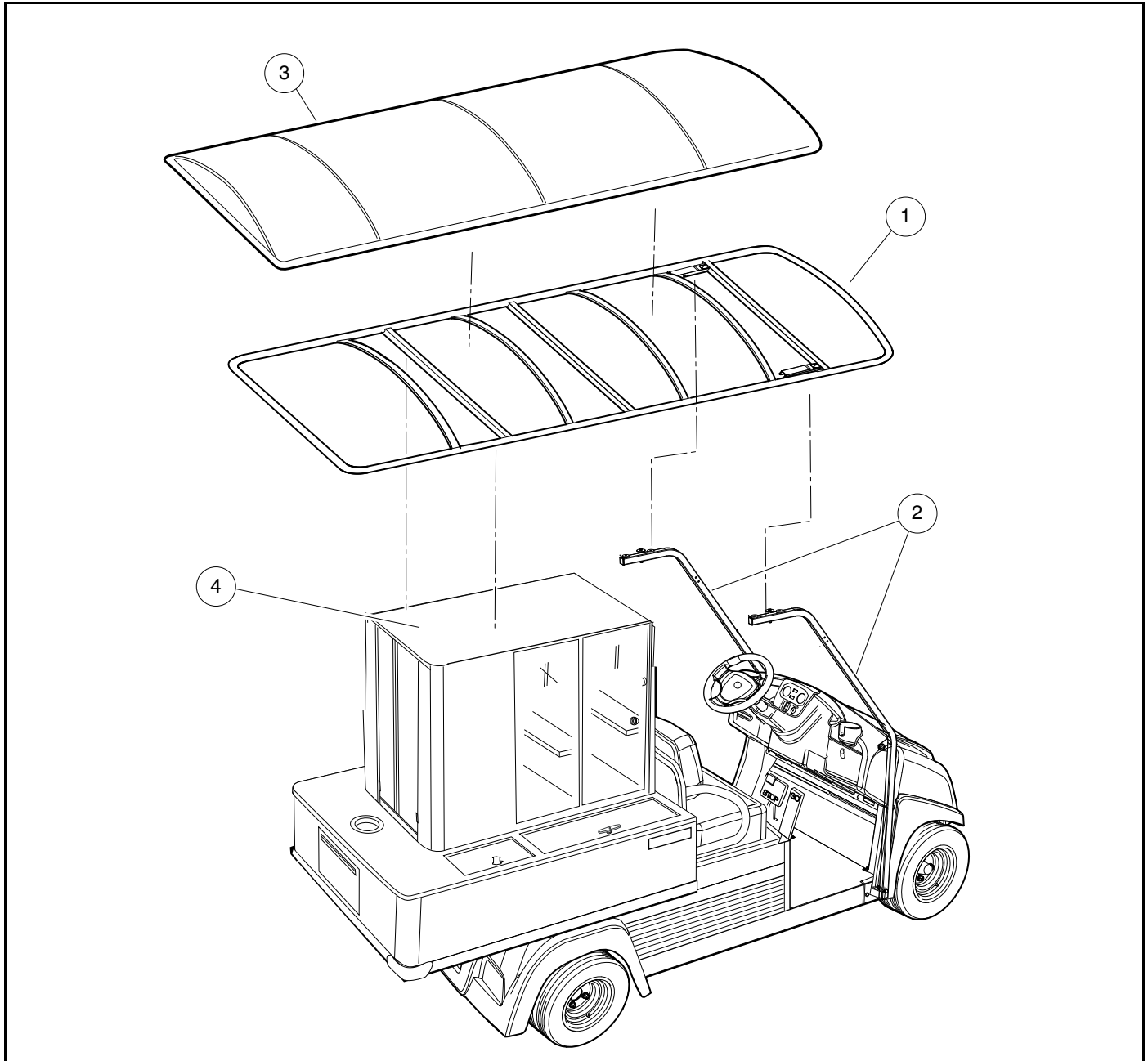
Use only mild liquid dishwasher soap with a sponge or soft cloth for cleaning the windshield.

CAUTION

- **Do not use glass-cleaning products on the windshield.**

CANOPY

See General Warnings on page 1-2.



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Figure 18-1 Canopy – Café Express

CANOPY REMOVAL

1. Unhook retention cord loops from underside of canopy frame (1).
2. Release the hook-and-loop strip at the rear of the canopy frame (1).
3. Slip each end of canopy (3) off the frame (1) and remove canopy. **See following NOTE.**

NOTE: The canopy (3) is attached to the frame in a manner similar to a “fitted” bed sheet on a mattress.

CANOPY INSTALLATION

NOTE: Canopy Orientation: The canopy (3) fits onto the frame one way. The rear has open corners and also has a hook-and-loop strip in the center.

1. Place canopy (3) onto frame (2) and slip the front edge over the front of the frame.
2. Pull canopy (3) tight towards the rear and secure over frame with the hook-and-loop strip.
3. Secure retention cord loops to the hooks on the underside of canopy frame.

CANOPY FRAME REMOVAL

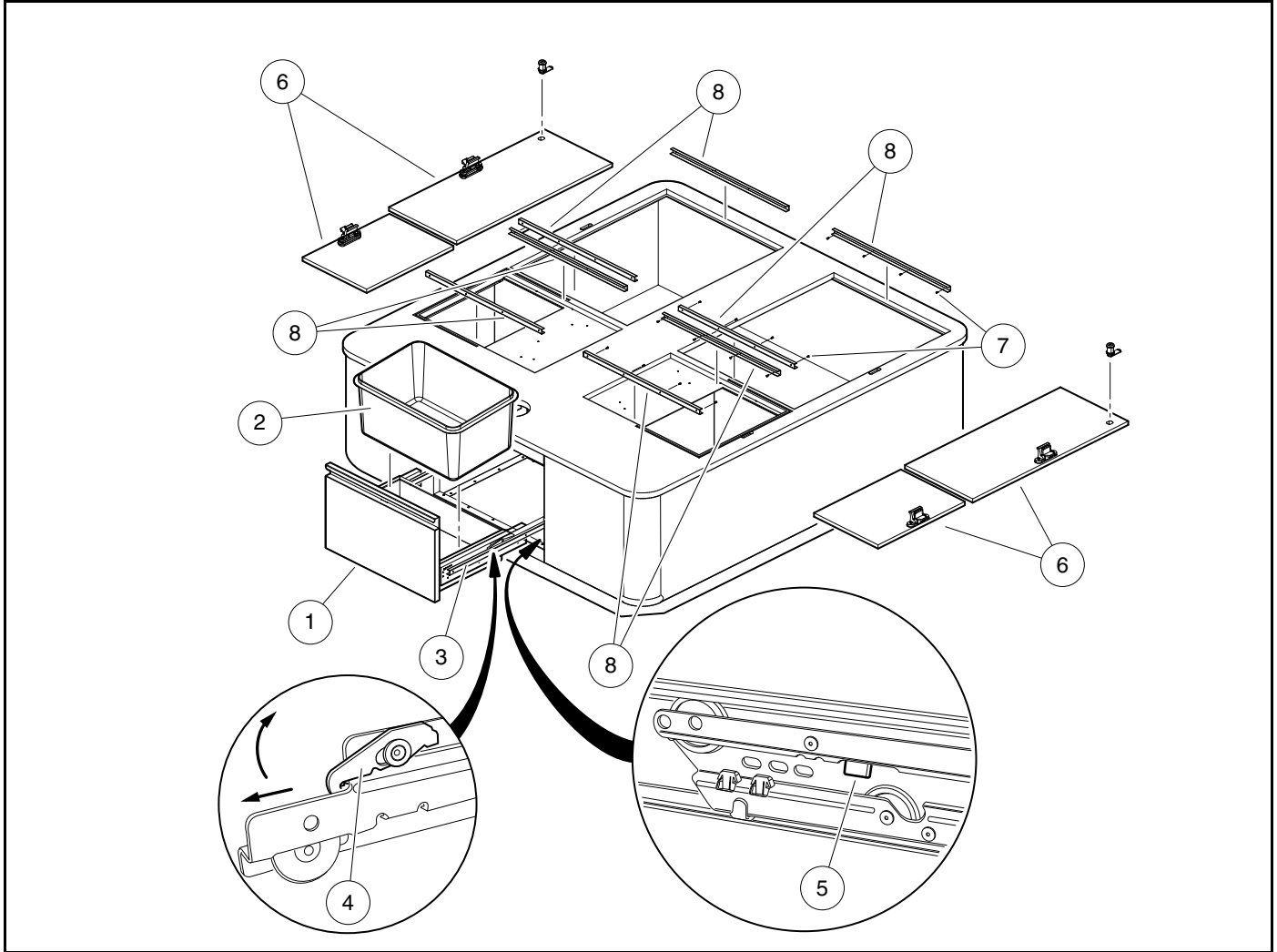
1. Remove canopy from frame. **See Canopy Removal on page 18-3.**
2. Remove clevis pins securing canopy frame (1) to front supports (2) (**Figure 18-1, Page 18-3**).
3. Remove hardware securing canopy frame (1) to upper cabinet (4).
4. With the aid of an assistant, lift frame (1) off upper cabinet.

CANOPY FRAME INSTALLATION

1. With the aid of an assistant, lift and place canopy (1) onto vehicle.
2. Install hardware securing canopy frame (1) to upper cabinet (4) (**Figure 18-1, Page 18-3**). Tighten only finger-tight at this time.
3. Install clevis pins securing canopy frame (1) to front supports (2). Fold spring retainer down to lock each clevis pin into place.
4. Tighten hardware at upper cabinet to 40 in·lb (4.5 N·m).
5. Install canopy on frame. **See Canopy Installation on page 18-4.**

UNIT MAINTENANCE AND REPAIRS

See General Warnings on page 1-2.



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Figure 18-2 Lower Cabinet – Café Express

TRASH DRAWER

See General Warnings on page 1-2.

Trash Drawer Removal

1. Pull drawer (1) out as far as it will go and remove the trash can (2) (Figure 18-2, Page 18-5).
2. Unlock drawer (1) from track slides (3).
 - 2.1. Push the white locking tab (4) towards the drawer front to disengage the track slide. **See following NOTE.**

NOTE: The white locking tab (4) slides and pivots on the pin that retains it.

- 2.2. Then, rotate the white locking tab (4) up to clear the track slide (3).
3. Lift drawer (1) up and pull out to remove drawer.

4. To remove the track slide (3), push up and hold the upper gray tab (5) near the rear of the track slide and pull slide straight out. Repeat for other side.

Trash Drawer Installation

Installation is reverse of removal. **See following WARNING.**

⚠ WARNING

- Ensure both white locking tabs (4) are engaged before returning vehicle to service.

SLIDE DOORS

See General Warnings on page 1-2.

Horizontal Slide Door Removal

1. Push slide door (6) open (**Figure 18-2, Page 18-5**).
2. Remove screws (7) securing tracks (8) to lower cabinet.
3. Remove door (6) and tracks (8) from lower cabinet.

Horizontal Slide Door Installation

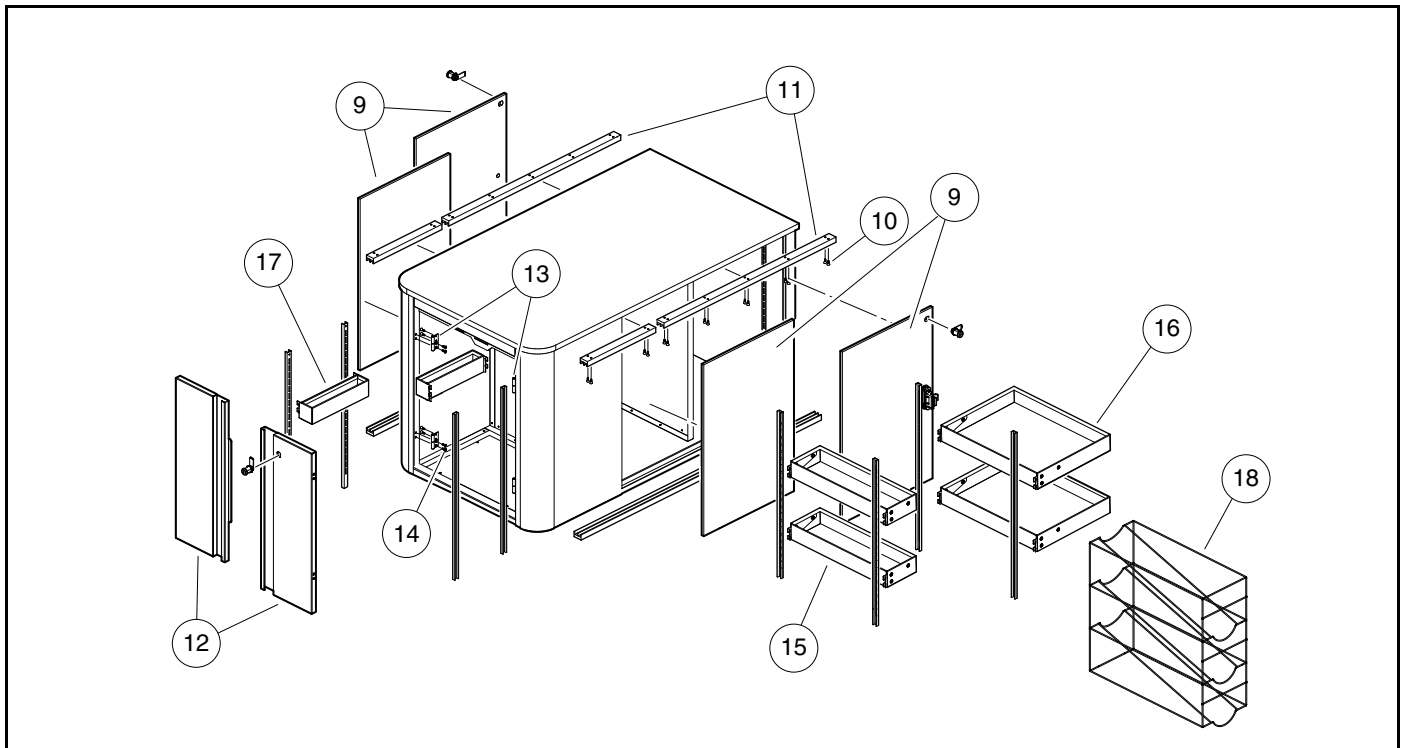
1. Place tracks (8) onto door (6), maintaining access to the front screw hole, and install into lower cabinet (**Figure 18-2, Page 18-5**).
2. Secure tracks (8) with a screw (7) in each track finger-tight.
3. Push door (6) fully open and install remaining screws (7). Tighten screws (7) firmly; being careful not to over-tighten and strip the plastic.

Vertical Slide Door Removal

1. Push slide doors (9) open (**Figure 18-3, Page 18-7**).
2. Remove screws (10) securing track (11) to top of upper cabinet, moving doors (9) as required.
3. Remove doors (9) and track (11) from upper cabinet.
4. Repeat for other doors if required.

Vertical Slide Door Installation

1. Place track (11) onto doors (9) and install into upper cabinet (**Figure 18-3, Page 18-7**).
2. Secure track (11) with a couple of screws (10) finger-tight.
3. Move doors (9) as required and install remaining screws (10). Tighten screws (10) firmly; being careful not to over-tighten and strip the plastic.



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Figure 18-3 Upper Cabinet – Café Express

COFFEE DOORS

See General Warnings on page 1-2.

Coffee Door Removal

NOTE: Coffee doors use flag hinges that separate easily. For temporary removal of the coffee doors (e.g. cleaning), simply open the door and lift straight up.

1. Open coffee door (12) to access hinges (13) (**Figure 18-3, Page 18-7**).
2. Remove screws (14) securing coffee door (12) to hinges (13).
3. Remove coffee door (12). Repeat for other door if required.

Coffee Door Installation

1. Installation is reverse of removal.
2. Tighten screws (14) firmly; being careful not to over-tighten and strip the threads.

CONTAINERS

See General Warnings on page 1-2.

Container Removal

NOTE: The hanger brackets used are a wedge-fit.

1. Open vertical sliding doors (9) of upper cabinet for medium (15) and large (16) containers (**Figure 18-3, Page 18-7**). Open coffee doors (12) of upper cabinet for small containers (17).
2. Unlock the hanger bracket on each side of container (15, 16, or 17) by striking bracket straight up to release.
3. Grasping both sides of container (15, 16, or 17), lift both sides straight up and pull straight out to unhook hanger brackets from slots.
4. Remove container (15, 16, or 17) from upper cabinet.

Container Installation

Installation is reverse of removal. Ensure hanger brackets are wedged in tight. **See following WARNING.**

⚠ WARNING

- Ensure containers (15, 16, or 17) are fully wedged into place before returning vehicle to service.

CUP HOLDER

See General Warnings on page 1-2.

Cup Holder Removal

NOTE: The hanger brackets used are a wedge-fit.

1. Open vertical sliding doors (9) of upper cabinet (**Figure 18-3, Page 18-7**).
2. Unlock the hanger bracket on each side of cup holder (18) by striking bracket straight up to release.
3. Grasping both sides of cup holder (18), lift both sides straight up and pull straight out to unhook hanger brackets from slots.
4. Remove cup holder (18) from upper cabinet.

Cup Holder Installation

Installation is reverse of removal. Ensure hanger brackets are wedged in tight. **See following WARNING.**

⚠ WARNING

- Ensure cup holder (18) is fully wedged into place before returning vehicle to service.

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