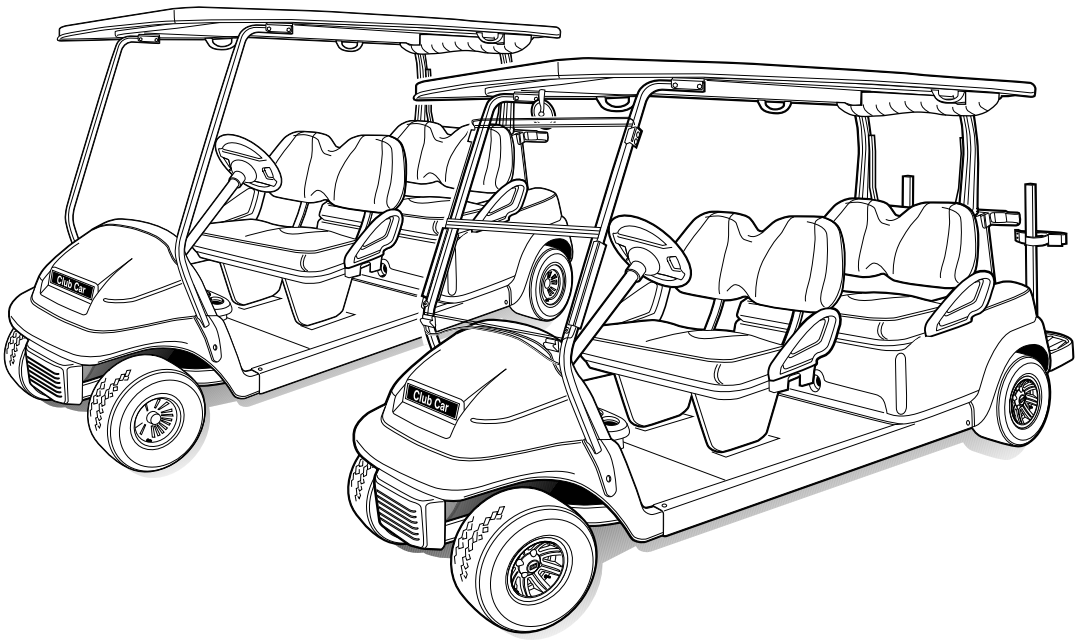
2014 Precedent Stretch and 4Fun Golf Car Maintenance and Service Manual



Electric Vehicle with ERIC Charging System

Manual Number 105062902
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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 2014 Precedent Stretch and 4Fun vehicles, and should be thoroughly reviewed prior to servicing the vehicle. The procedures provided herein 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, LLC to assist its distributors and dealers in continually updating their service knowledge and facilities so they can provide prompt and efficient service for vehicle owners. Regional technical representatives, periodic service bulletins, maintenance and service manuals, and other service publications also represent Club Car's continuing commitment to customer support.

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

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

⚠ WARNING

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

NOTE: *This manual represents the most current information at the time of publication. Club Car, LLC 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, LLC 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 or write to Club Car, LLC, P.O. BOX 204658, Augusta, Georgia 30917-4658 USA, Attention: Warranty Department.

This manual effective April 1, 2014

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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. Vehicle feature identification information is also included. 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.**
- **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

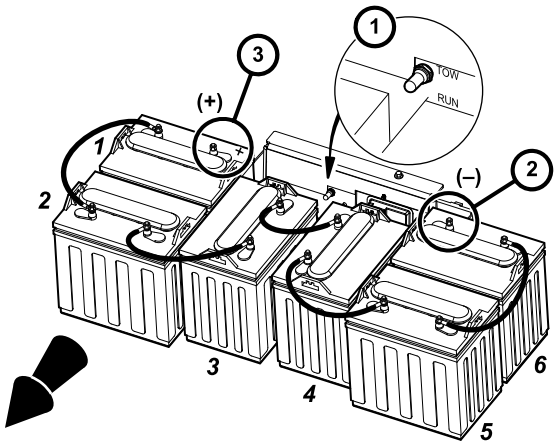
- **Follow the procedures exactly as stated in this manual, and heed all DANGER, WARNING, and CAUTION statements in this manual as well as those on the vehicle and battery charger.**
- **Do not leave children unattended on vehicle.**
- **Prior to leaving the vehicle unattended or servicing the vehicle, set the park brake, place the Forward/Reverse 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 could result in decreased vehicle performance, severe personal injury, or death.**
- **Any modification or change to the vehicle that affects the electrical system, stability or handling of the vehicle, or increases maximum vehicle speed beyond factory specifications, could result in severe personal injury or death.**
- **Check the vehicle for proper location of all vehicle safety and operation decals and make sure they are in place and are easy to read.**
- **Only trained technicians should service or repair the vehicle or battery charger. 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.**
- **Wear safety glasses or approved eye protection when servicing the vehicle or battery charger. 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 or battery charger.**
- **Use insulated tools when working near batteries or electrical connections. Use extreme caution to avoid shorting of components or wiring.**
- **Place Tow/Run switch in the TOW position before disconnecting or connecting the batteries. Failure to heed this warning could result in a battery explosion or severe personal injury.**
- **To avoid unintentionally starting an electric vehicle, disconnect the batteries and discharge the controller. See Disconnecting the Batteries on page 1-3.**

DISABLING THE VEHICLE

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

DISCONNECTING THE BATTERIES

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



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

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Figure 1-1 Battery Cable Removal

CONNECTING THE BATTERIES

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

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.

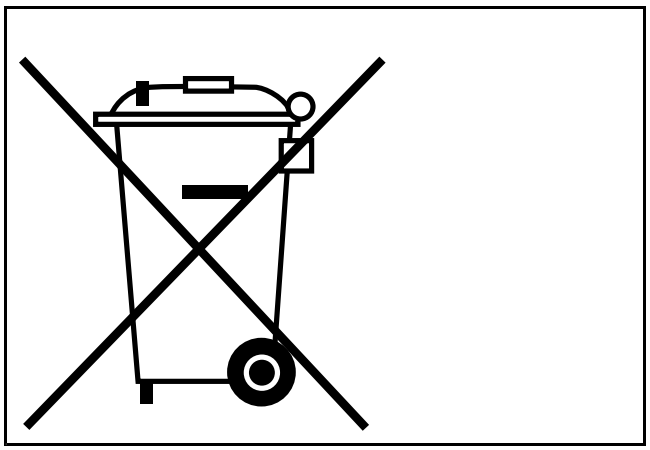

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Figure 1-2 Dispose of Lead-acid Batteries Properly

INTERNATIONAL SAFETY SYMBOLS ON BATTERIES

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

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

Refer to General Warnings for more information.

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Figure 1-3 International Safety Symbols on Batteries

VEHICLE SPECIFICATIONS

SPECIFICATIONS	PRECEDENT STRETCH VEHICLE
POWER SOURCE	
Drive motor: Direct drive, 48 volts DC, shunt-wound, 3.7 hp	•
Transaxle: Double reduction helical gear with 12.3:1 direct drive axle	•
Electrical system: 48 volts DC, reduced speed reverse	•
Batteries: High capacity, deep cycle	•
Charger: Automatic, 48-volt; UL and CSA listed	•
STEERING/SUSPENSION/BRAKES	
Steering: Self-adjusting rack and pinion	•
Suspension: Front and rear tapered mono-leaf springs with dual hydraulic shocks	•
Brakes: Dual rear wheel self-adjusting brakes with cast iron drums and single brake pedal with automatic-release park brake	•
BODY/CHASSIS	
Frame/Chassis: Aluminum and composite	•
Front and rear body: Nylon-based inonmer	•
Body finish: High-gloss molded-in color	•
Tires: 18 x 10 – 8 tubeless, 4 ply rated	•
Lug- Nut Torque Values: Front and Rear tires	55 ft·lb (±5.0) (67.8 to 81.3 N·m)
DIMENSIONS/WEIGHT	
Overall length	127.6 in. (324.1 cm)
Overall width	47.25 in. (120 cm)
Overall height (with canopy)	69 in. (175.3 cm)
Overall height (at steering wheel)	47.3 in. (120 cm)
Wheelbase	101.1 in. (256.8 cm)
Ground clearance	4.5 in. (11 cm)
Front wheel tread	34.5 in. (88 cm)
Rear wheel tread	38.6 in. (98 cm)
Weight (standard electric vehicle with canopy, with batteries)	1176 lb. (533.4 kg)
Forward speed	8 to 15 mph (13 to 24 km/h) maximum

TABLE CONTINUED ON NEXT PAGE

SPECIFICATIONS	PRECEDENT STRETCH VEHICLE
Curb clearance circle (diameter)	24 ft - 10 in. (757 cm)
Standard seating capacity	4
LIQUID CAPACITIES	
Transaxle	22 oz. (0.67 L)
TIRE PRESSURE	
Front and rear	18 to 20 psig (124 to 138 kPa)
NOISE AND VIBRATION	
Drive-by noise level to operator Test method: EN 12053:2001	68.5 dBA Uncertainty: 2 dBA
Vibration at driver's seat Test method:EN 13059:2002	0.8 m/s^2 Uncertainty: 0.072 m/s^2

VEHICLE SPECIFICATIONS

SPECIFICATIONS	PRECEDENT 4FUN VEHICLE
POWER SOURCE	
Drive motor: Direct drive, 48 volts DC, shunt-wound, 3.7 hp	•
Transaxle: Double reduction helical gear with 12.3:1 direct drive axle	•
Electrical system: 48 volts DC, reduced speed reverse	•
Batteries: High capacity, deep cycle	•
Battery Charger: Automatic, 48-volt; UL and CSA listed	•
STEERING/SUSPENSION/BRAKES	
Steering: Self-adjusting rack and pinion	•
Suspension: Front and rear tapered mono-leaf springs with dual hydraulic shocks	•
Brakes: Dual rear wheel self-adjusting brakes with cast iron drums and single brake pedal with automatic-release park brake	•
BODY/CHASSIS	
Frame/Chassis: Aluminum and composite	•
Front and rear body: Nylon-based inonmer	•
Body finish: High-gloss molded-in color	•
Tires: 18 x 10 – 8 tubeless, 4 ply rated	•
Lug- Nut Torque Values: Front and Rear tires	55 ft·lb (±5.0) (67.8 to 81.3 N·m)
DIMENSIONS/WEIGHT	
Overall length	144 in. (367 cm)
Overall width	46.3 in. (117.6 cm)
Overall height (with canopy)	69.4 in. (176 cm)
Overall height (at steering wheel)	46.3 in. (117.6 cm)
Wheelbase	101.75 in. (258.4 cm)
Ground clearance	3.0 in. (7.6 cm)
Front wheel tread	34.5 in. (88 cm)
Rear wheel tread	38.6 in. (98 cm)
Weight (standard electric vehicle with canopy, with batteries)	1236 lb (560.6 kg)
Forward speed	8 to 12.4 mph (13 to 20 km/h) maximum
Curb clearance circle (diameter)	26 ft 10 in. (8.2 m)
Standard seating capacity	4
LIQUID CAPACITIES	
Transaxle	22 fl-oz (0.67 L)
TIRE PRESSURE	
Front and rear	18 to 20 psig (124 to 138 kPa)

CHARGER SPECIFICATIONS

HIGH-FREQUENCY BATTERY CHARGER SPECIFICATIONS	
MODEL NUMBER	IC650-048-CC
AC INPUT	
AC voltage	100 to 240 VAC
Frequency	50 / 60 Hz
POWER CONSUMPTION	
Maximum AC input current (amps)	7.5
DC OUTPUT	
Rated DC voltage (VDC)	48
Maximum DC voltage (VDC)	72
Maximum DC output current (amps)	13.5
DIMENSIONS/WEIGHT	
Case – overall length	9.9 in. (25.2 cm)
Case – overall width	7.3 in. (18.6 cm)
Case – overall height	3.1 in. (8 cm)
AC cord length (standard length)	6 ft (183 cm)
DC cord length (standard length)	9 ft (274 cm)
Weight	6.5 lb (3 kg)
MOUNTING CONFIGURATION	
Mounting: Set on shelf; mount under shelf, on wall or ceiling; or hang securely from ceiling: any orientation.	•

⚠ 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:

- Pre-Operation and Daily Safety Checklist
- Controls and Indicators
- Driving Instructions
- Towing
- Transporting on a Trailer
- Subsequent Owner Registration
- Warranties

MODEL IDENTIFICATION

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

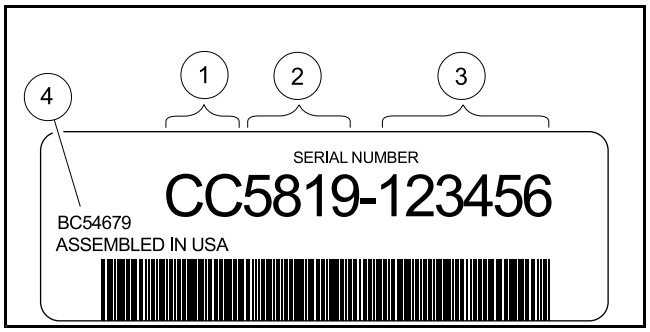

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Figure 3-1 Serial Number Decal

SAFETY COMMITTEE

4Fun Only

If the golf car is to be rented or is part of a fleet, we strongly recommend that a safety committee be appointed. One of the main concerns of this committee should be the safe operation of the golf cars.

This should include at a minimum:

- Where golf cars should be driven.
- Ensuring that proper warnings of driving hazards are displayed and visible. See below for list of signs available from Club Car Service Parts Department.
- Who should and who should not drive golf cars.
- Instructing first time drivers.
- Maintaining golf cars in a safe driving condition
- How various rules are to be enforced.

The safety committee should include all these items and such others as the committee feels necessary or appropriate.

STORAGE

See General Warnings on page 1-2.

⚠ WARNING

- **Turn the key switch to the OFF position, remove the key, and leave the Forward/Reverse switch in the NEUTRAL position during storage. Place Tow/Run switch in the TOW position. 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.**
- **To avoid exposing electrical components to moisture and subsequent damages, do not use any type of pressure washing or steam cleaning equipment to wash the vehicle.**

PREPARING THE ELECTRIC VEHICLE FOR EXTENDED STORAGE

Check Battery Water Levels Two Weeks Prior to Storage
Check water levels at least two weeks prior to winter storage to ensure proper mixing of water and electrolyte. Note that it takes approximately five charge cycles with a minimum of 10 amp hours removed after each charge to properly mix the water with electrolyte. Do NOT water batteries immediately prior to storage because this will not provide sufficient charge time to mix the water with the electrolyte. Freezing can occur when batteries are stored in this condition.

1. Check the water levels in each battery cell. If water is required, fill the cells to cover the plates, charge the batteries, and then use distilled water to fill each cell to the correct level. Electrolyte level should be from 1/2 inch (13 mm) above plates to 1/4 inch (6 mm) below the level indicator **(Figure 15-3)**.

Immediately Prior to Storage, Perform the Following Steps

1. Turn the key switch to the OFF position, remove the key, and leave the Forward/Reverse switch in the NEUTRAL position during storage.
2. If so installed, turn off all accessories, including GPS units, fans, etc.
3. Place the tow/run switch in the TOW position.

NOTE: *All functions of the dash-mounted charge indicator light are disabled when the Tow/Run switch is in the TOW position.*

If Visage or Guardian units are installed on vehicles and remote monitoring will be used during the storage period, make sure the Tow/Run Switch remains in the RUN position rather than in the TOW position required for all other vehicles during storage.

4. 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 (CC P/N 1014305).
5. Tighten all battery cable connections to 110 in·lb (12.4 N·m).
6. Store vehicle in a cool, dry place. This will minimize battery self-discharge.
7. Adjust tires to recommended tire pressure. **See Vehicle Specifications on page 2-3.**

8. Perform all semiannual periodic lubrication. **See Periodic Lubrication Schedule on page 10-6.**
9. Thoroughly clean front body, rear body, seats, battery compartment, and underside of vehicle.
10. Do not engage the park brake. Chock the wheels to prevent the vehicle from rolling.

NOTE: *It is recommended that the vehicles be plugged in and the electrolyte level maintained throughout the storage period. If any of the following conditions exist, however, then disconnect the batteries for storage: 1) The charger cannot remain plugged in, 2) AC power will not be available during extended storage, or 3) Electrolyte levels will not be maintained. To disconnect batteries for storage, go to step 12.*

11. To keep batteries fully charged during storage:
    11.1. Plug the battery charger into the car. Leave battery chargers plugged in during storage. The charger will automatically activate when necessary.
    11.2. Check the electrolyte level and charger function monthly to ensure that proper operation is maintained. The charger is functioning properly if the blue light is ON and the triangular light is OFF.

CAUTION

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

12. If disconnecting the batteries for storage, disconnect the B negative (-) battery cable and secure it in a way that ensures the cable will not come into contact with battery terminal.

RETURNING THE STORED ELECTRIC VEHICLE TO SERVICE

1. If necessary, connect batteries. **See Connecting the Batteries on page 1-3.**
2. Fully charge batteries.

⚠ WARNING

- **Do not attempt to charge frozen batteries or batteries with bulged cases. Discard the battery. Frozen batteries can explode.**

3. Adjust tires to recommended tire pressure. **See Vehicle Specifications on page 2-3.**
4. Perform the Pre-Operation and Daily Safety Checklist on page 10-1.

LIFTING THE VEHICLE

See General Warnings on page 1-2.

⚠ 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.**

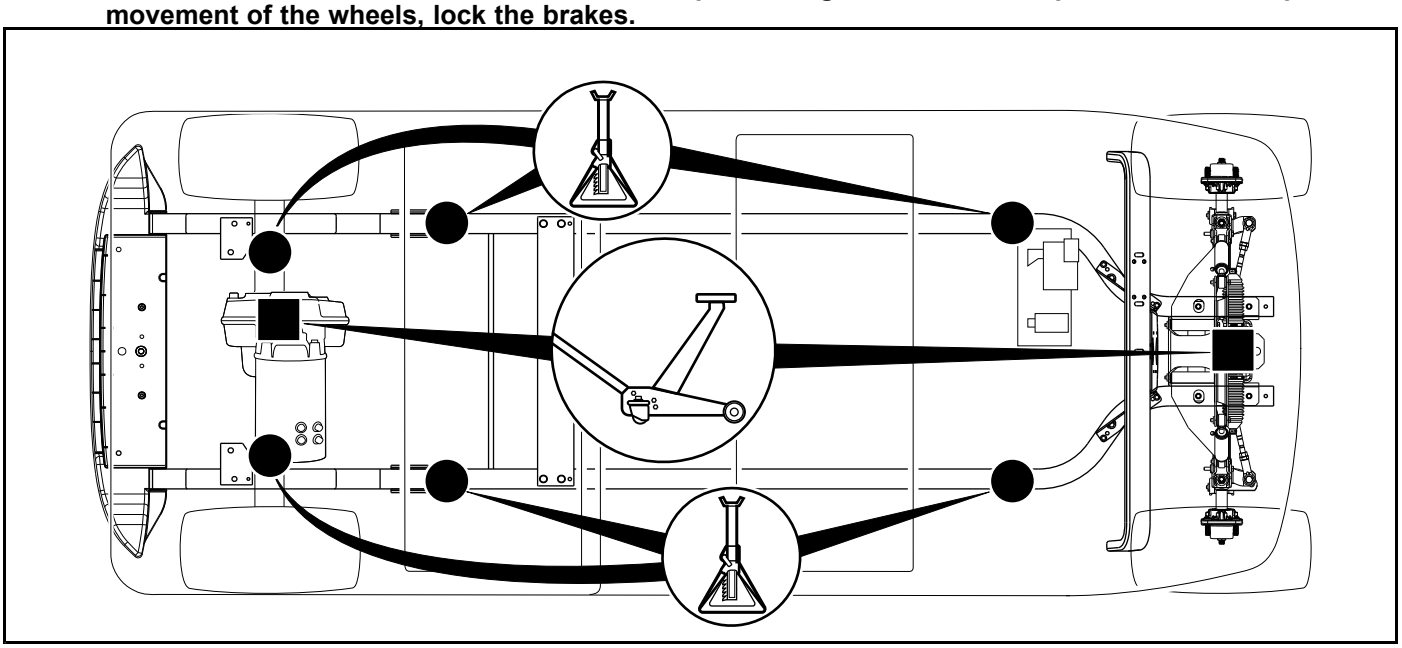

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Figure 3-2 Lifting Points and Jack Stand Locations

LIFTING ONLY THE FRONT

1. Place vehicle on a level surface.
2. Chock the rear tires.
3. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries on page 1-3.**
4. If removing wheel, loosen the front wheel lug nuts.
5. Using a chain hoist or floor jack, lift front of vehicle and support on jack stands as shown **(Figure 3-2, Page 3-5)**. **See preceding WARNING.**

LIFTING ONLY THE REAR

1. Place vehicle on a level surface.
2. Chock the front tires.
3. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries on page 1-3.**
4. If removing wheel, loosen the rear wheel lug nuts.
5. Using a chain hoist or floor jack, lift rear of vehicle and support on jack stands as shown **(Figure 3-2, Page 3-5)**. **See preceding WARNING.**

LIFTING THE ENTIRE VEHICLE

1. Place vehicle on a level surface.
2. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries on page 1-3.**
3. Chock the front or rear tires.
4. If removing wheels, loosen the lug nuts.
5. Release the park brake and lift the front of the vehicle with a chain hoist or floor jack. **See preceding WARNING.**
6. Place jack stands under the frame and lower onto stands **(Figure 3-2, Page 3-5)**.
7. Position jack under rear differential and lift rear of vehicle. Ensure the vehicle is not pulled off the front jack stands while lifting the rear. **See following WARNING.**

⚠ WARNING

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

8. Once vehicle is level, place jack stands as shown under the rear axle tubes or frame and lower onto stands **(Figure 3-2, Page 3-5)**.

⚠ 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.**

Club Car Precedent vehicles are equipped with Surlyn® front and rear bodies. Use only commercially available automotive cleaners with a sponge or soft cloth for normal cleaning. A garden hose at normal residential water pressure is adequate.

Club Car does not recommend any type of pressure washing or steam cleaning. Such a process (especially if the vehicle has a Surlyn® rear body that is removed) will expose electrical components to moisture. Moisture entering electrical components can result in water damage and subsequent component failure.

Use non-abrasive wax products. Do not use abrasive leveling or rubbing compounds; these will permanently dull the gloss. Battery acid, fertilizers, tars, asphalt, creosote, paint, or chewing gum should be removed immediately to prevent possible stains. **See following CAUTION and NOTE.**

CAUTION

- **Use of leveling or rubbing compounds will permanently dull finish of vehicle.**
- **Do not apply wax products to the black plastic material of the front and rear underbody, the front bumper, or the textured area of the rear beauty panel marked "NO STEP." Wax will cause these surfaces to become discolored.**

NOTE: *Dispose of waste water properly.*

SEAT

To preserve seat appearance, clean regularly with mild soap or detergent applied with a sponge or soft cloth. Use a soft bristle brush to clean areas that are especially soiled. Use the following guidelines:

Light Soiling: A solution of 10% liquid 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.

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.

CAUTION

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

FRONT AND REAR BODY REPAIR

See General Warnings on page 1-2.

STRESS LINES OR STREAKS

Repeatedly flexing the Surlyn® body can cause white stress lines or streaks in the finish. To remove them:

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

CAUTION

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

MINOR IMPACT DAMAGE/DEFORMATIONS

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

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

MINOR SCRATCHES AND SURFACE BLEMISHES

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

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

GOUGES, PUNCTURES, TEARS, LARGE SCRATCHES, AND ABRASIONS

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

FRONT BODY

See General Warnings on page 1-2.

FRONT BODY REMOVAL

1. Remove the four screws (2) and pull the brow cap (1) from the brow and fascia assembly (4) **(Figure 4-1, Page 4-4)**.
2. Pull the front beauty panel (3) up and away from the brow and fascia assembly (4), disengaging the snap tabs.
3. If the vehicle is equipped with a canopy, loosen the canopy support cover then loosen, but do not remove, the front canopy support bolts. If there is no canopy, remove the non-canopy cover.
4. Remove the five screws (8) and lift the brow and fascia assembly (4) from the front underbody.
5. Remove the five screws (7) to separate the front fascia (6) from the brow (5).

FRONT BODY INSTALLATION

1. Install fascia (6) to brow (5) with five screws (7). Tighten screws to 40 in·lb (4.5 N·m) **(Figure 4-1, Page 4-4)**.
2. Install brow and fascia assembly (4) to front underbody with five screws (8). Tighten screws to 31 in·lb (3.5 N·m).
3. Install front beauty panel (3) over brow (5). Tabs on the forward edge of the front beauty panel should fit into slots between the fascia and the brow.
4. Position brow cap (1) to cover the edge of both the brow (5) and the front beauty panel (3). Secure brow cap (1) with four screws (2). Tighten screws to 25 in·lb (2.8 N·m).

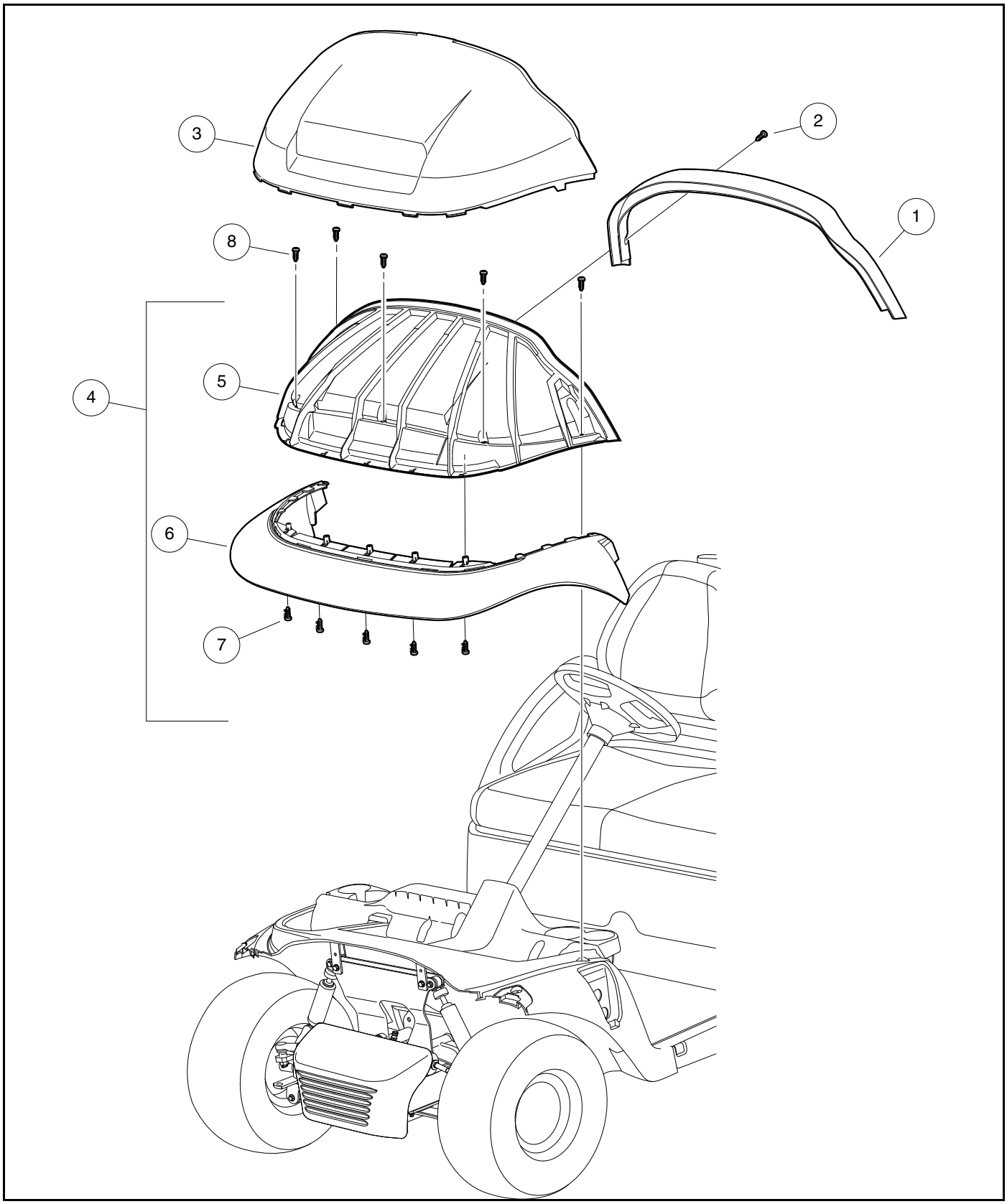

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Figure 4-1 Front Body

FRONT BUMPER

The underbody bracket (1) connects the front suspension to the front underbody **(Figure 4-2, Page 4-5)**. Each bracket is secured in place by two taptite screws (2) tightened to 13 ft·lb (17.6 N·m).

The front bumper (3) is attached to the vehicle frame rails by nuts (5) and bolts (4). The nuts are tightened to 13.3 ft·lb (18 N·m).

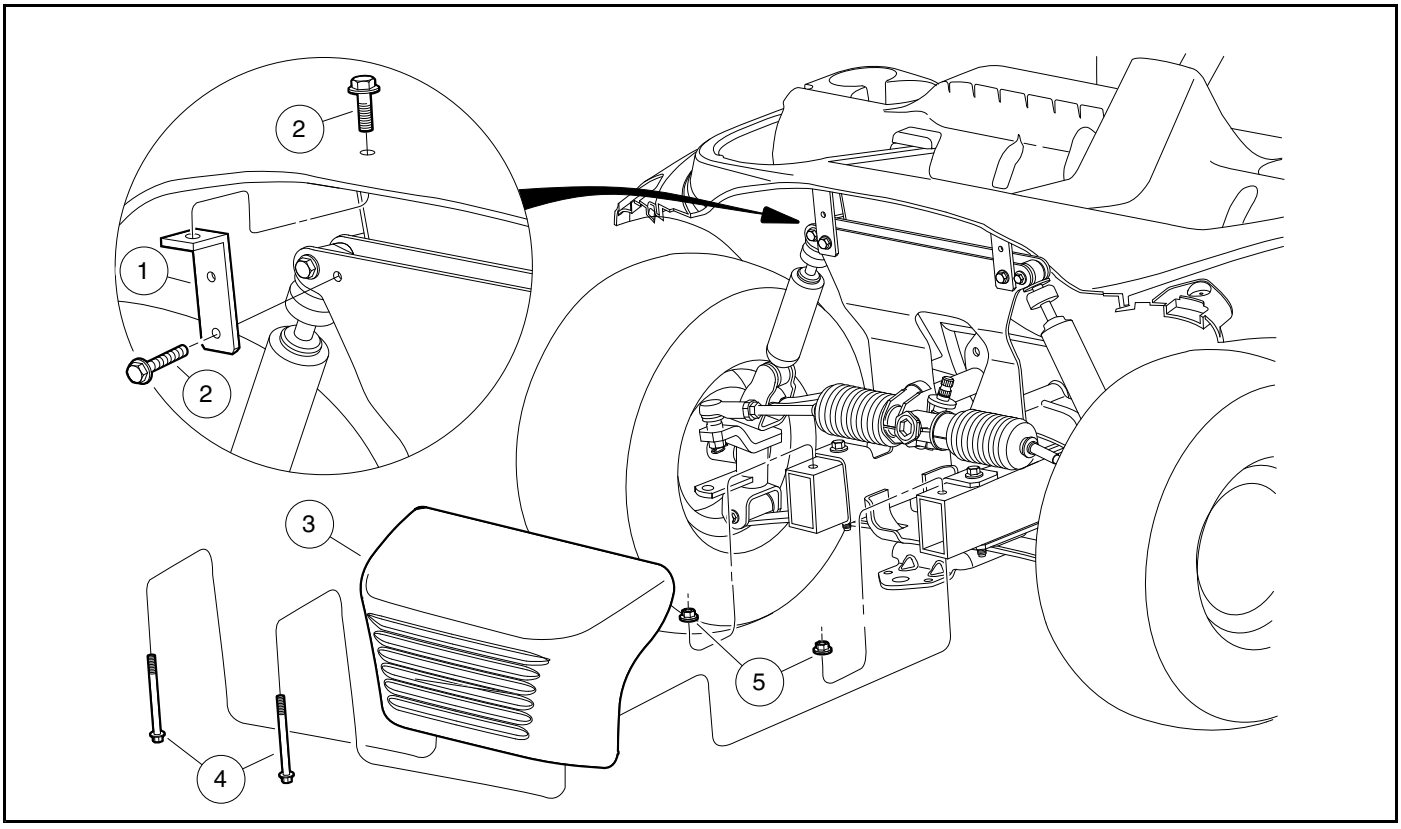

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Figure 4-2 Bracket and Front Bumper

HEADLIGHT ADJUSTMENT

Headlights are available as an accessory on this vehicle. To raise or lower the headlight beam, washers can be added to the mounting hardware between the headlight and the bumper assembly.

See General Warnings on page 1-2.

AIMING THE HEADLIGHT BEAM

1. Park the vehicle on a level surface 5 feet (1.524 m) away from, and facing a vertical surface such as a garage door or wall.
2. On the vertical surface, mark a 24 inch (61 cm) long, horizontal line 15-1/2 inches (39.4 cm) above the ground directly in front of the vehicle.
3. Turn on headlight. Take note where the beam strikes the vertical surface in relation to the marked horizontal line. To raise the beam, add washers (size M6) to the lower mounting screw (1). To lower the beam, add washers to both upper screws. Tighten screws to 66 in·lb (7.5 N·m). While it is possible to add washers with the headlight/bumper assembly mounted to the vehicle, these adjustments may be easier if the headlight/front bumper assembly is unbolted first **(Figure 4-3, Page 4-6)**.

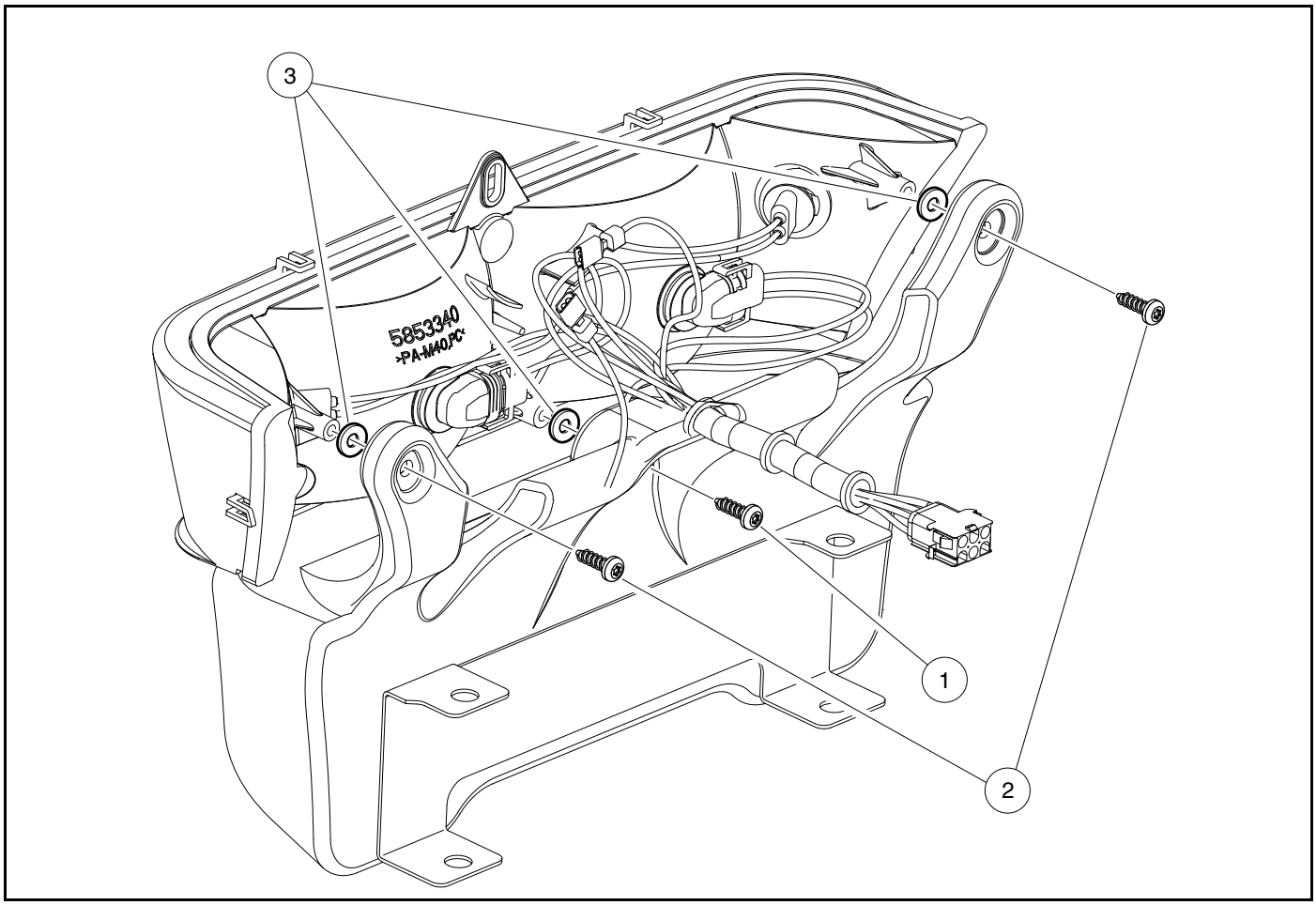

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Figure 4-3 Headlight Aiming

INSTRUMENT PANEL

See General Warnings on page 1-2.

INSTRUMENT PANEL REMOVAL

1. Remove two screws (1) at sides and one screw (2) on top of instrument panel (3) **(Figure 4-4, Page 4-7)**.
2. Tilt instrument panel up to release it from the dash assembly (4).
3. Disconnect the electrical connector on the passenger side of the instrument panel (3) and remove the panel.
4. Remove two screws (5) and plastic rivet (6) and remove dash assembly (4) from vehicle.

INSTRUMENT PANEL INSTALLATION

1. Position dash assembly (4) on vehicle. Make sure tabs on the forward edge engage to front underbody. Secure assembly in place with two screws (5) and plastic rivet (6) **(Figure 4-4, Page 4-7)**. Tighten screws to 8.8 ft·lb (12 N·m).
2. Install the instrument panel.
   2.1. Connect the electrical connector on the instrument panel to the harness connector.
   2.2. Position the instrument panel (3) on the dash assembly. Make sure tabs on upper edge properly engage with the corresponding slots on the dash assembly. Ensure that there are no wires exposed or pinched during positioning.
   2.3. Secure instrument panel to the dash assembly with screws (1 and 2). Tighten screws (1) to 22 in·lb (2.5 N·m). Tighten screw (2) to 7 in·lb (0.8 N·m).

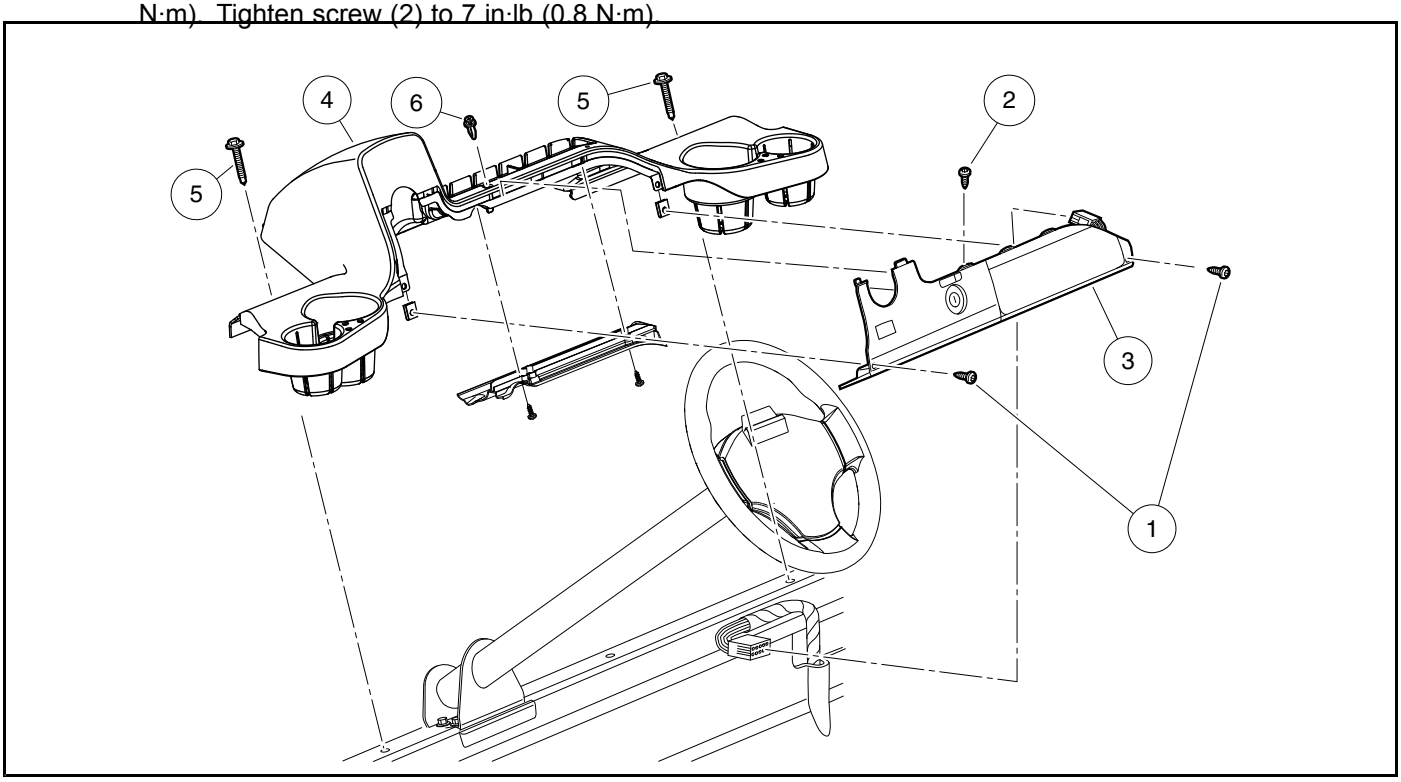

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Figure 4-4 Instrument Panel

FLOOR MATS AND RETAINERS

See General Warnings on page 1-2.

The floor mat retainers (3, 4, 5, 6, 7 and 8) secure the floor mats (1 and 2) to the vehicle and also provide a clean appearance to the side of the vehicle. Normally, if only the floor mats need to be removed, the screws (9) and rivets (10) must be removed to allow the floor mat to be slid from beneath the retainers and threshold (11) **(Figure 4-5, Page 4-8)**.

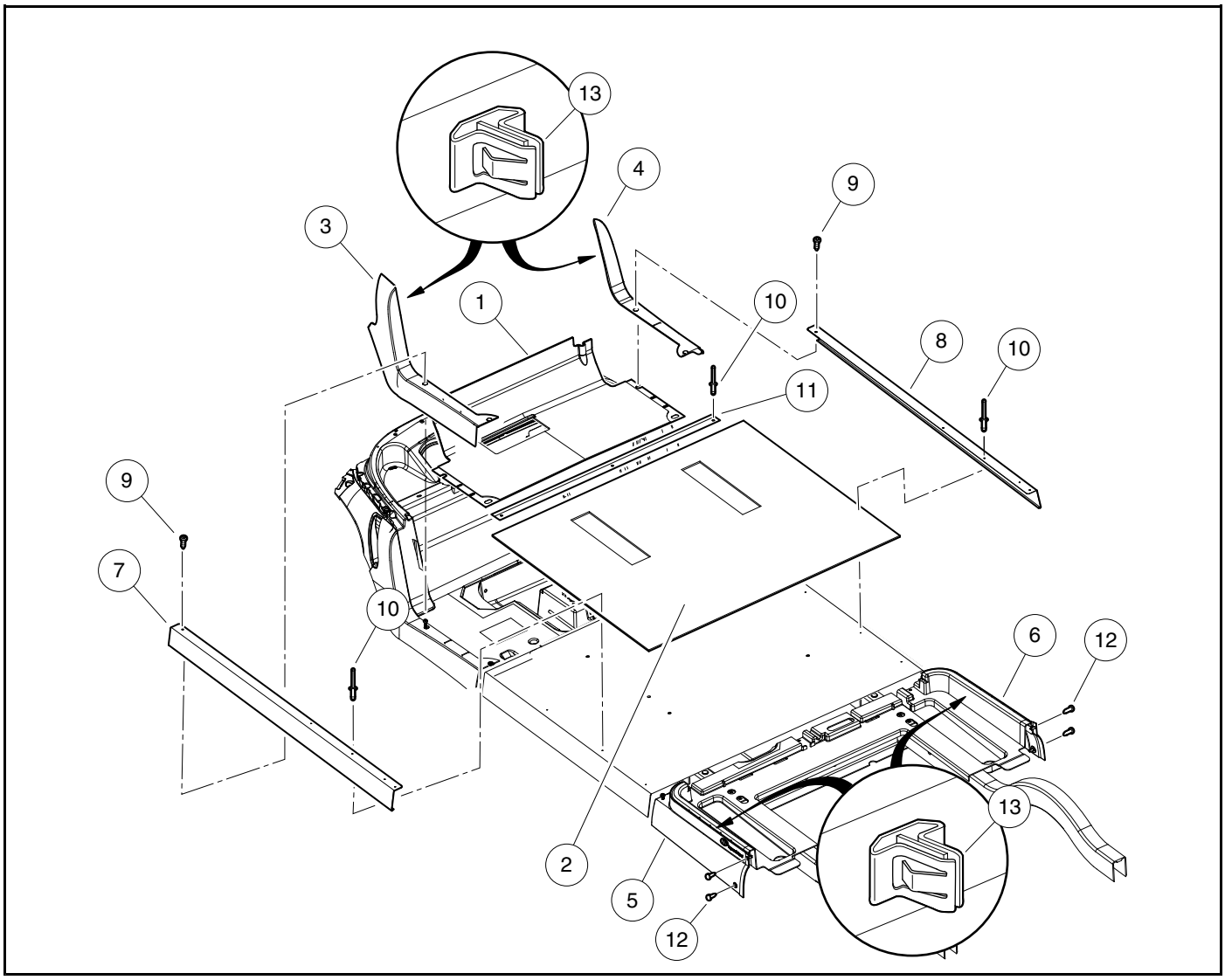

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Figure 4-5 Floor Mats and Retainers

FLOOR MAT AND RETAINER REMOVAL

1. Remove screws (9) from front and rear plastic retainers (3, 4, 5 and 6) **(Figure 4-5, Page 4-8)**.
2. Remove rivets (10) from top of metal retainers (7 and 8) and threshold (11).
3. Remove push rivets (12) from sides of rear plastic retainers (5 and 6).
4. Carefully pull on front and rear plastic retainers to separate the trim clips (13) from their respective slots. Trim clips do not normally need to be removed from the retainer.
5. **If Removing or Replacing Rear Floor Mat:** Remove front seat and seat frame (1) by removing hardware (2, 3 and 4) **(Figure 4-6, Page 4-9)**.
6. Remove floor mat from vehicle.

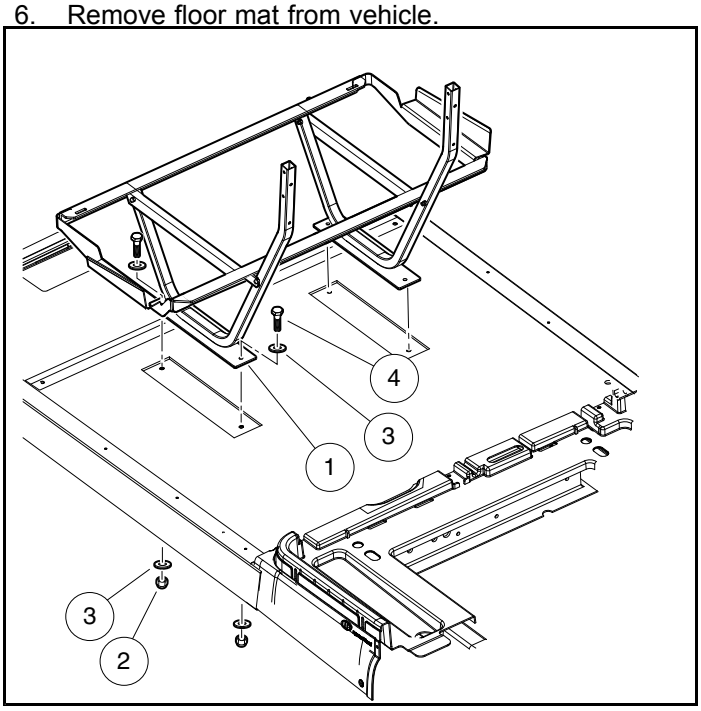

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Figure 4-6 Remove Front Seat Frame

FLOOR MAT AND RETAINER INSTALLATION

1. Position and align front floor mat (1) on front floor board.
2. Snap on the plastic retainers (3 and 4) to the front underbody on both sides.
3. Snap on the plastic retainers (5 and 6) to the rear underbody on both sides.
4. **If Reusing Rear Floor Mat:** Position and align holes in rear floor mat (2) with rear floor board. Proceed to step 6.
5. **If Installing New Rear Floor Mat:** Secure new rear floor mat to the floor board as follows:
   - 5.1. Make sure the new, rear floor mat (2) is square on the floor board.
   - 5.2. Position one 2x4x36-inch piece of wood (A) flush to the edge of the floor mat and floor board **(Figure 4-7, Page 4-10)**. Secure the 2x4 wood with two C-clamps (B).
   - 5.3. Load a 13/64-inch (5.16 mm) drill bit into a drill. From under the vehicle, use the holes in the floor board as a template to drill up and through the floor mat and into the 2x4 wood. Drill all four holes at one time.
   - 5.4. Remove the C-clamps and the 2x4 wood, being careful not to move the floor mat.
   - 5.5. Position metal retainer (7) to the side of the floor board and on top of the edge of the rear floor mat **(Figure 4-5, Page 4-8)**.
   - 5.6. Loosely install torx-pan-head screws (9) through front and rear holes of metal and plastic retainers. Then, insert four long 3/16-in black aluminum rivets (10) through the metal retainer (7) into the newly drilled holes.

5.7. Secure the rivets (10) to the metal retainer and tighten the torx-pan head screw (9) to 22 in·lb (2.5 N·m).

5.8. Repeat above steps on remaining side of rear floor mat.

6. Position the floorboard threshold (11) over the seam between the front and rear floor mat and secure with three long 3/16-in black aluminum rivets (10).

7. Install front seat frame and seat (1) **(Figure 4-6, Page 4-9)**. Tighten hardware (2, 3 and 4), securing seat frame to floor, to 228 in·lb (25.8 N·m).

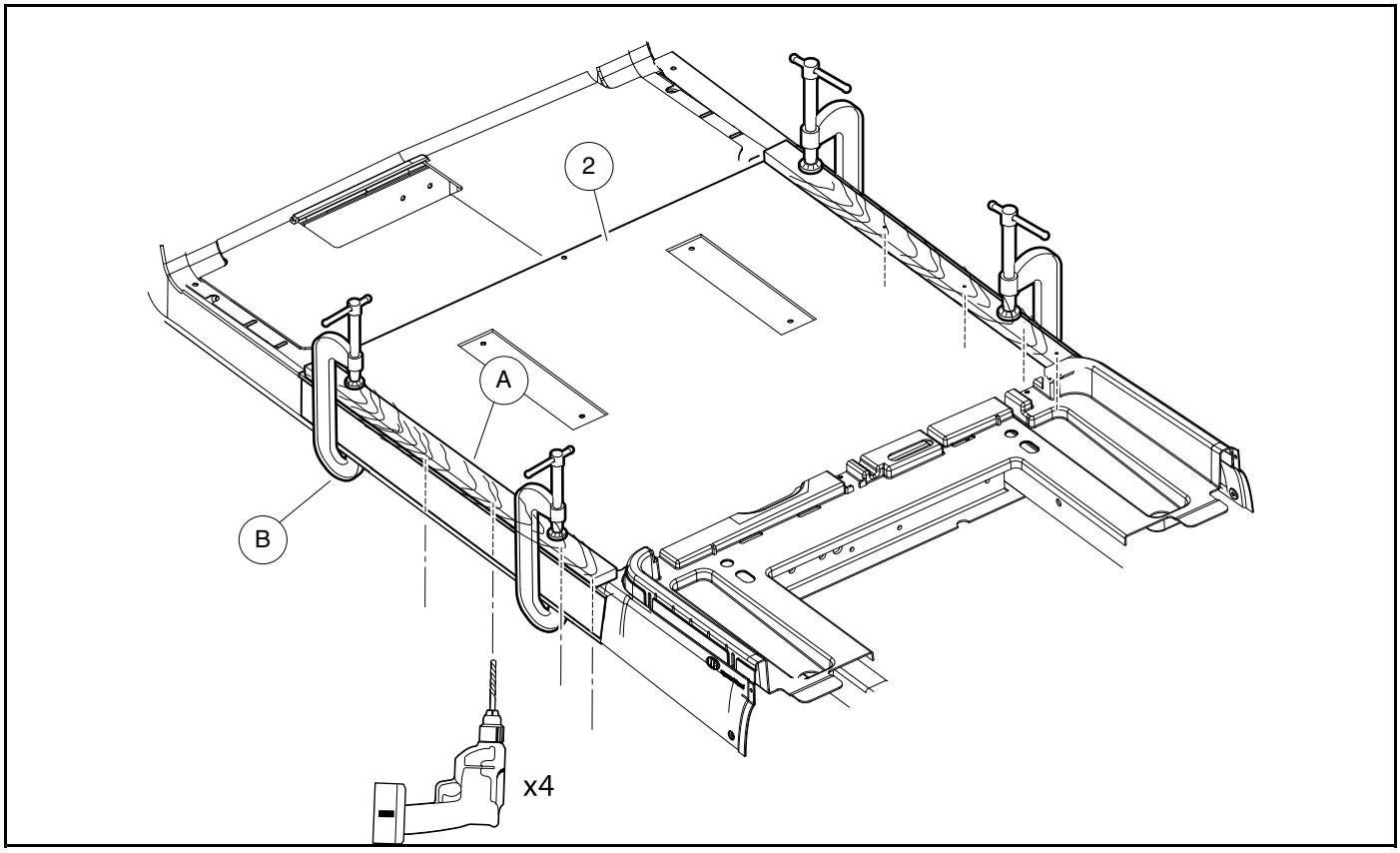

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Figure 4-7 Drill Holes through New, Rear Floor Mat

KICK PLATE AND CHARGER RECEPTACLE BEZEL

See General Warnings on page 1-2.

KICK PLATE AND CHARGER RECEPTACLE BEZEL REMOVAL

1. If charger bezel (4) requires removal, use charger bezel tool (P/N 102562401) to remove bezel from the kick plate **(Figure 4-8, Page 4-11)**.
2. Remove floor mat. **See Floor Mats and Retainers on page 4-8.**
3. Remove three screws (1) that hold the kick plate (2) to the vehicle.
4. Remove the two front screws (3) that hold the beauty panel to the vehicle. Raise the forward portion of the rear beauty panel to disengage it from the tabs on the upper portion of the kick plate.
5. Remove kick plate from vehicle.

KICK PLATE AND CHARGER RECEPTACLE BEZEL INSTALLATION

1. Position the kick plate (2) on the vehicle and secure with three screws (1) **(Figure 4-8, Page 4-11)**. Ensure front lower edge of rear beauty panel mates with the kick plate. Tighten screws to 3.3 ft·lb (4.5 N·m).
2. Install two front screws (3) to secure the rear beauty panel. Tighten screws to 3.7 ft·lb (5 N·m).
3. Install floor mat. **See Floor Mats and Retainers on page 4-8.**
4. Snap charger bezel (4) in place on the kick plate.

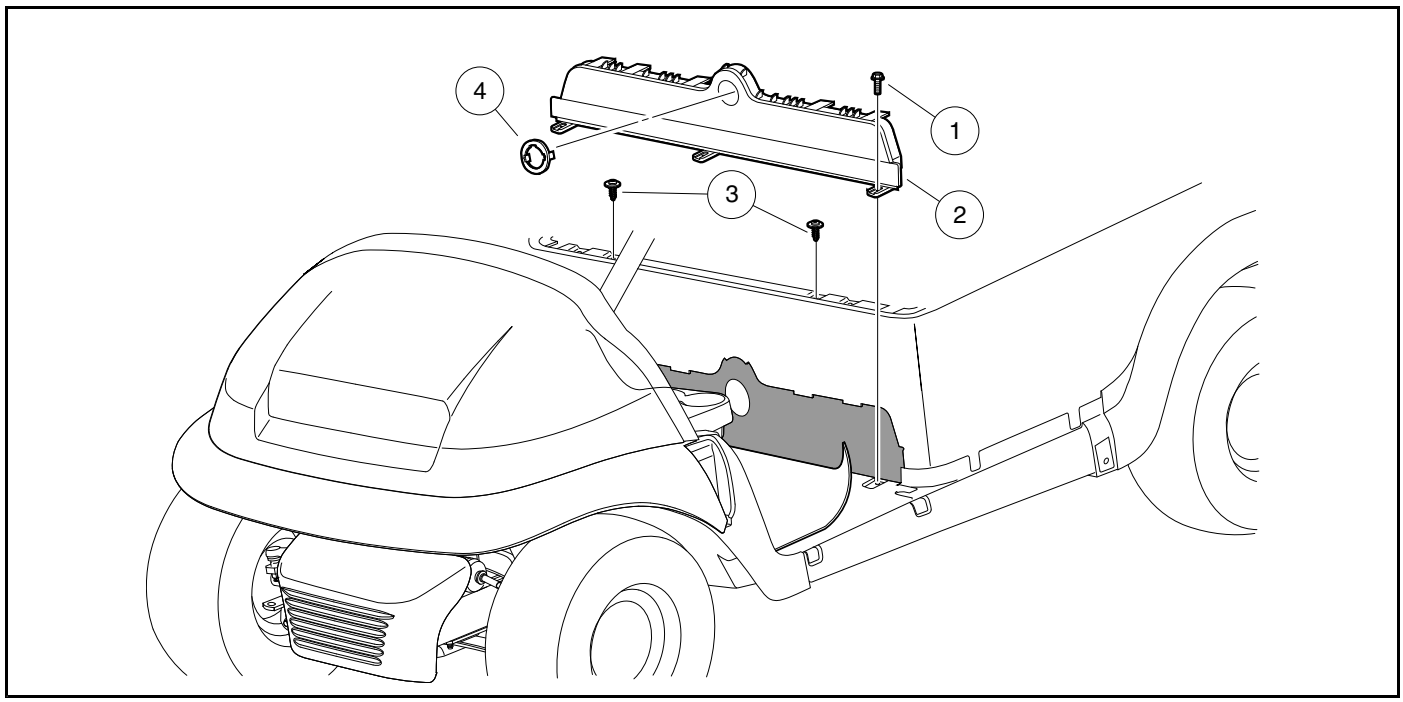

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Figure 4-8 Kick Plate and Charger Receptacle Bezel

SEAT BOTTOM

The seat bottom (1) is secured to the vehicle with two hinges (2) **(Figure 4-9, Page 4-12)** that hook into slots in the body. When replacing the hinges (2), tighten screws (3) to 75 in·lb (8.5 N·m). When replacing hip restraints (4), tighten screws (5) to 65 in·lb (7.3 N·m).

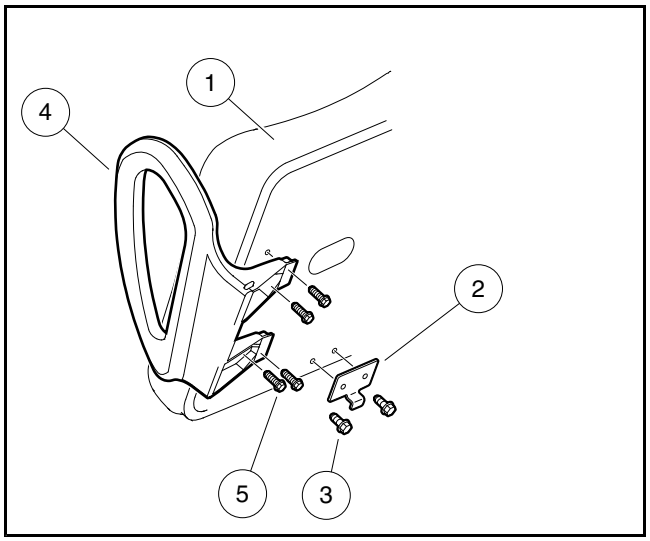

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Figure 4-9 Seat Bottom, Hinge and Hip Restraint

REAR BODY

See General Warnings on page 1-2.

UNIVERSAL ACCESSORY MOUNTING

NOTE: *The Structural Accessory Module (SAM) uses clearance holes for accessories to attach to the canopy support located inside the SAM.*

The Structural Accessory Module (SAM) includes two mounting locations on both the driver side and the passenger side **(Figure 4-10, Page 4-13)**. These serve as common attachment points (1) for various accessories. Accessories that can be mounted on the SAM include single or dual sand bottles, sand bucket, and the club cleaner.

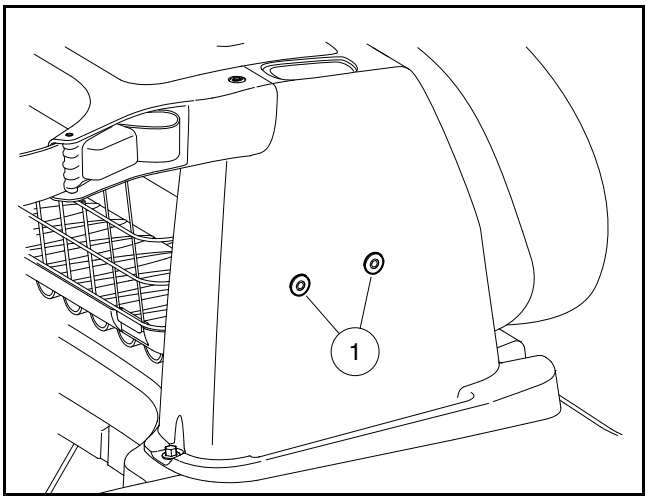

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Figure 4-10 Universal Accessory Mounting

SEAT BACK AND STRUCTURAL ACCESSORY MODULE (SAM)

SAM Removal

1. If the vehicle has a canopy, the rear upright supports must be removed from the SAM.
2. Remove four bolts (4) to release the SAM (3) from the vehicle **(Figure 4-11, Page 4-14)**.

SAM Installation

Position the SAM (3) over its mounting holes and secure with four screws (4). Tighten screws to 71 in·lb (8 N·m).

Seat Back

The seat back (1) is secured to the SAM (3) with two screws (2) **(Figure 4-11, Page 4-14)**. When replacing the backrest, tighten screws (2) to 51 in·lb (5.8 N·m).

Bag Rack Removal

1. Remove two screws (10) to release the bag hoop (6) and related components from the SAM (3) **(Figure 4-11, Page 4-14)**.
2. Bag strap (8) may be released by removing two plastic barrel connectors (9) and one screw (12).
3. Bag strap buckles (7) may be snapped out of bag hoop (6).

Bag Rack Installation

Installation is the reverse of removal. Tighten screw (12) to 31 in·lb (3.5 N·m) and screws (10) to 53 in·lb (6 N·m).

Sweater Basket

The sweater basket (11) is secured to the bag hoop assembly by three screws (12). Tabs on the upper edge of the basket align with holes in the bag hoop (6) for installation purposes. Tighten screws (12) to 31 in·lb (3.5 N·m) for molded-plastic sweater basket **(Figure 4-11, Page 4-14)**.

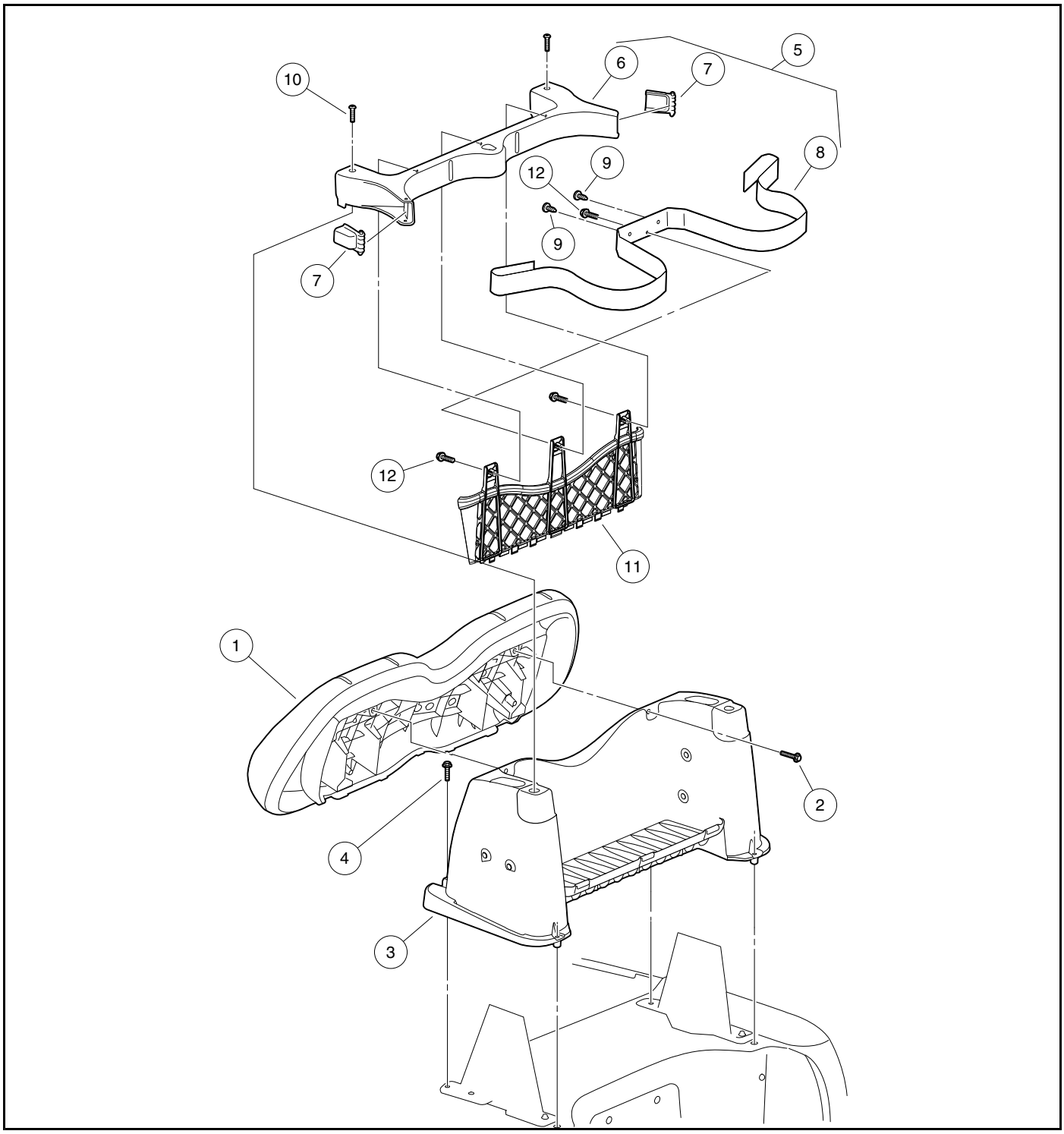

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Figure 4-11 Seat Back, Bag Rack and SAM

REAR BODY COMPONENTS

Rear Beauty Panel Removal

1. Remove SAM. **See SAM Removal on page 4-13.**
2. Remove one screw (3) from each canopy support bracket (1 and 2) **(Figure 4-12, Page 4-16)**. Remove canopy supports.

3. Remove four screws (13) attaching the rear beauty panel (12).
4. Remove two screws (14) and remove Forward/Reverse switch housing (15) from vehicle.
5. Disconnect electrical wires from the Forward/Reverse switch (16).
6. Disengage the two body clips (17) under the rear of the beauty panel from the slots in the rear underbody (4).
7. Lift rear beauty panel (12) from vehicle.

Rear Beauty Panel Installation

1. Install rear beauty panel (12) on vehicle. Make sure body clips (17) on the rear of the beauty panel engage the slots in the rear underbody (4) **(Figure 4-12, Page 4-16)**. Secure beauty panel in place with four screws (13). Tighten screws to 44 in·lb (5 N·m).
2. Connect the three wires to the Forward/Reverse switch (16) as shown.
3. Position the Forward/Reverse switch housing (15) on the front of beauty panel (12) and secure with two screws (14). Tighten screws to 20 in·lb (2.3 N·m).
4. Position canopy support brackets (1 and 2) on vehicle and secure each with one screw (3). Tighten screws to 53 in·lb (6 N·m).

Access Panel

Access panel (6) is secured to the rear underbody (4) with two push rivets (7) **(Figure 4-12, Page 4-16)**.

Rear Underbody Removal

1. Remove four screws (5) attaching the rear underbody (4) to vehicle **(Figure 4-12, Page 4-16)**.
2. Lift the rear edge of the rear underbody (4) until the front portion slides out from beneath the front underbody. Remove the rear underbody from the vehicle.

Rear Underbody Installation

Install rear underbody (4) on the vehicle **(Figure 4-12, Page 4-16)**. Install four screws (5) to secure the underbody to the vehicle. Tighten screws (5) to 71 in·lb (8 N·m).

Rear Crossmember Removal

Remove bolts (10) to release rear crossmember (18) from vehicle **(Figure 4-12, Page 4-16)**.

Rear Crossmember Installation

Position rear crossmember (18) on vehicle and secure with bolts (10) **(Figure 4-12, Page 4-16)**. Bolts (10) thread into J-clips (11) attached to the inner-frame rail. Tighten bolts to 56 in·lb (6.35 N·m) for two-passenger vehicles or 123 in·lb (14 N·m) for four-passenger vehicles.

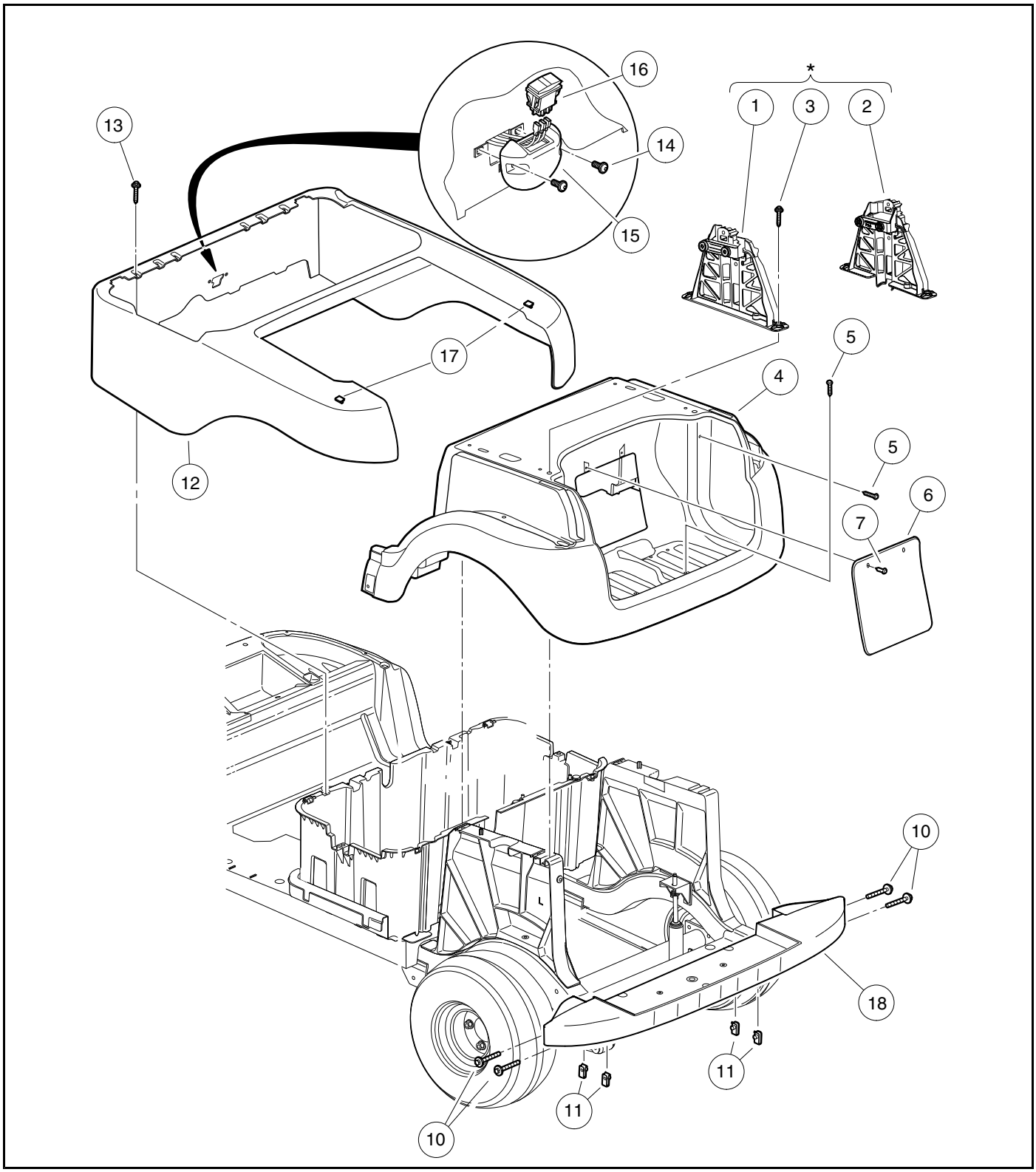

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Figure 4-12 Rear Body Components

BAGWELL – 4FUN

See General Warnings on page 1-2.

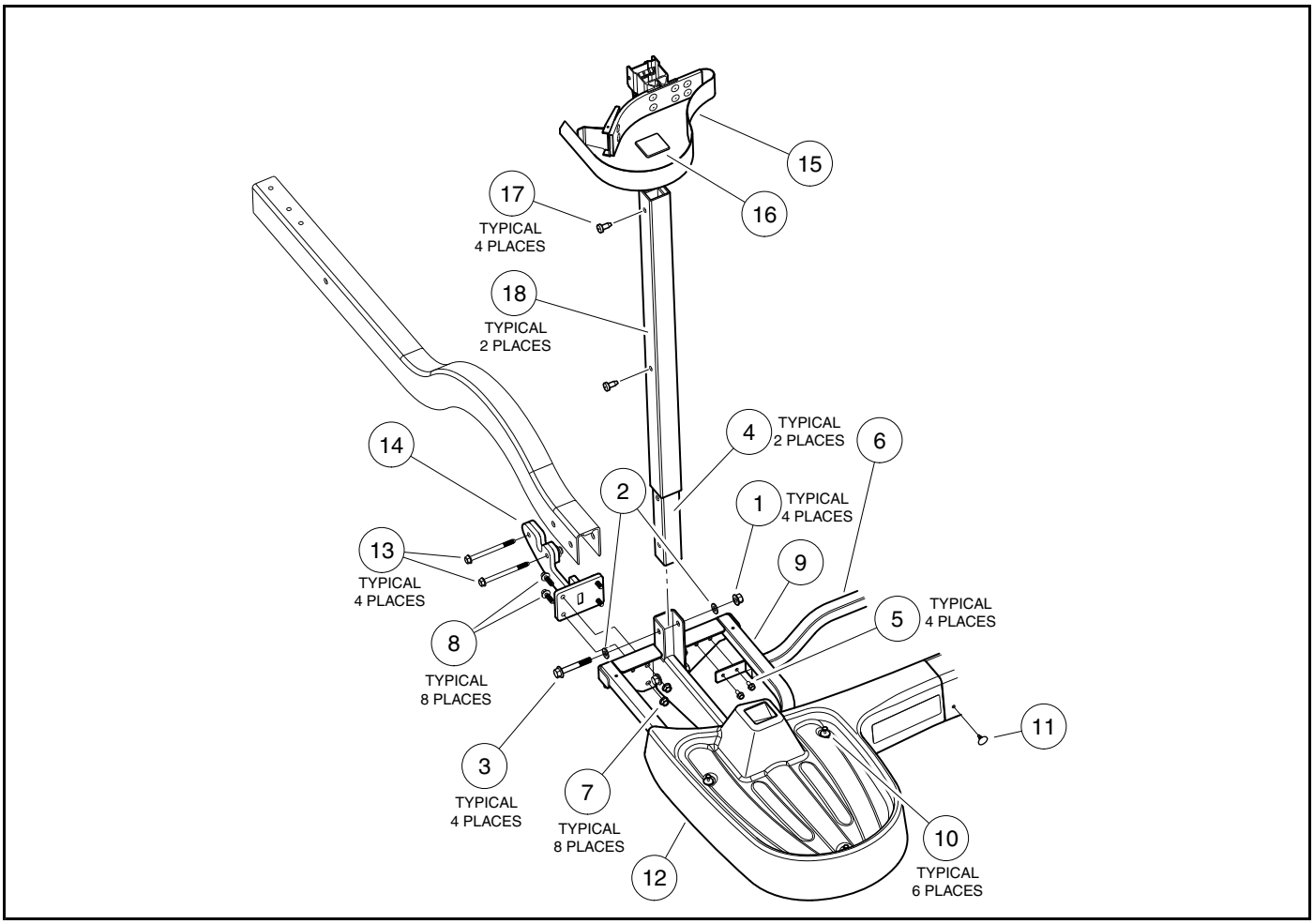

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Figure 4-13 Bagwell (4Fun Vehicles)

BAGWELL REMOVAL

1. Remove flanged nuts (1), washers (2) and flanged bolts (3) securing the vertical tube (4) and remove tube from bag deck weldment (9) **(Figure 4-13, Page 4-17)**.
2. Remove self-tapping screws (5) securing cross tube (6) to bag deck weldment (9).
3. Remove lock nuts (7) and flanged bolts (8) securing the bag deck weldment (9) and remove bag deck weldment from bag deck support weldment (14).
4. Remove rivets (10) and barrel fastener (11) securing the bagwell (12) and remove bag deck weldment from bag deck support weldment (14).
5. Remove flanged bolts (13) securing the bag deck support weldment (14) and remove bag deck support weldment from chassis.
6. To disassemble vertical tube (4), release clamp of bag hoop assembly (15) and slide bag hoop off vertical tube cover (18). Then, remove rubber fasteners (17) securing vertical tube cover (18) to tube (4) and slide cover off.
7. Repeat steps for other side if necessary.

BAGWELL INSTALLATION

1. Install bagwell in reverse order of removal.
2. Tighten fasteners as follows:
   – Flanged bolts (13) to 120 in·lb (14 N·m).
   – Lock nuts (7) to 21 ft·lb (28 N·m).
   – Self-tapping screws (5) to 156 in·lb (17.5 N·m).
   – Flanged nuts (1) to 30 ft·lb (40 N·m).

CANOPY

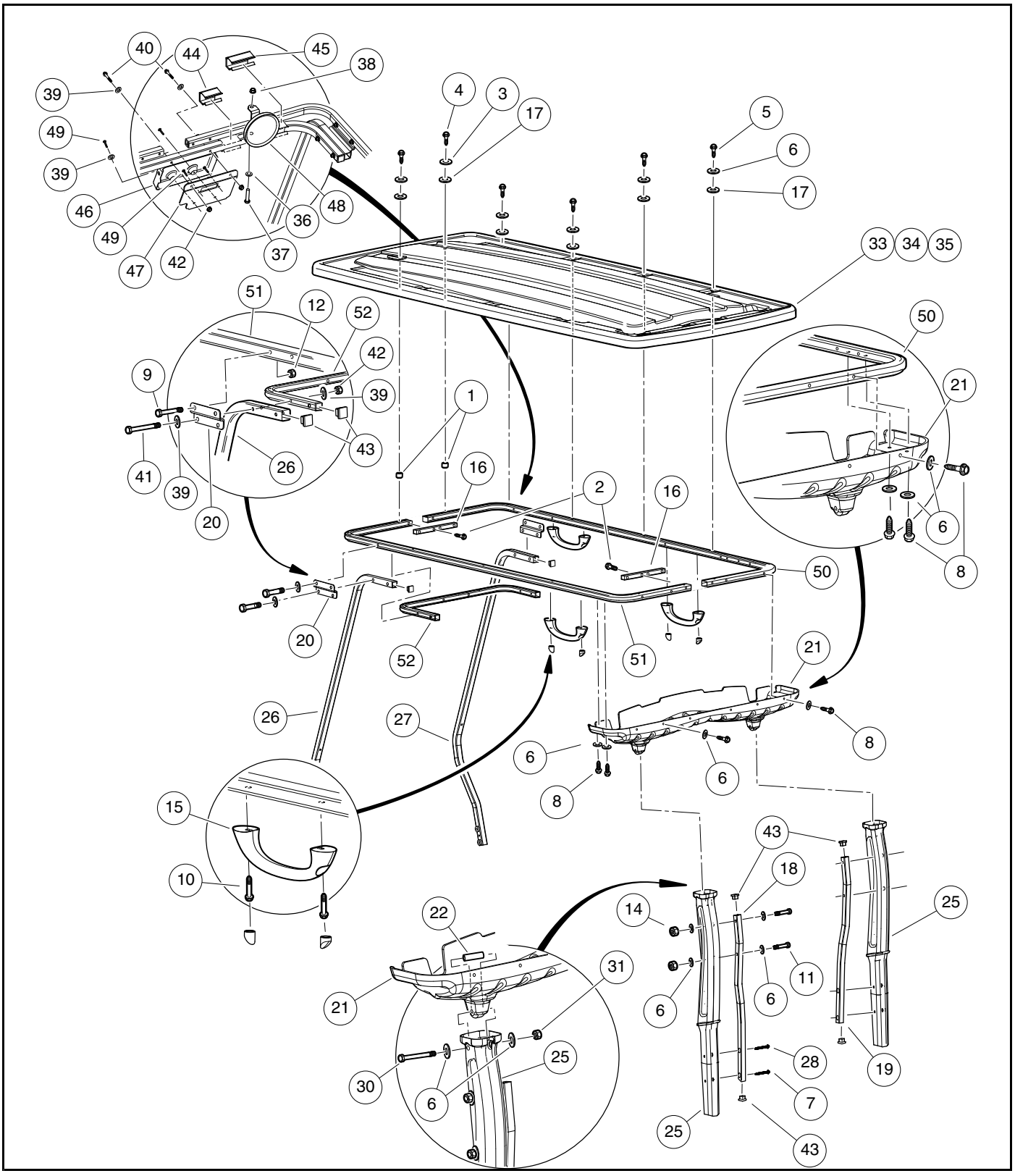

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Figure 4-14 Canopy, Frame and Hardware

CAUTION

- **To prevent damage to the canopy, do not remove the canopy supports from the vehicle without first removing the canopy.**

CANOPY REMOVAL

See General Warnings on page 1-2.

NOTE: *The following steps may require additional personnel.*

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries on page 1-3.**
2. Remove Visage unit (if equipped).
   2.1. Remove two screws (49) and two washers (39) that secure Visage cover (46) to Visage mounting plate (47) **(Figure 4-14, Page 4-19)**.
   2.2. Disconnect wire harness (54) from Visage unit.
   2.3. Remove two screws (49) that secure Visage unit to Visage mount plate (47).
3. Remove canopy.
   3.1. Loosen the attaching hardware that secures the canopy (33, 34, or 35) to the frame **(Figure 4-14, Page 4-19)**.
   3.2. Loosen the attaching hardware that secures the drain tray (21) to the top of the rear canopy supports (25).
   3.3. Loosen the attaching hardware that secures the left and right rear support struts (18 and 19) in the middle of the SAM.
   3.4. Remove two plugs from each hand hold (15).
   3.5. Remove bolts (10) that secure the hand holds (15) to the underside of the canopy frame.
   3.6. At twelve locations, remove screw (5), washer (6), and rubber washer (17) that secure canopy to canopy half frames (50 and 51).
   3.7. At two locations, remove screw (4), washer (3), rubber washer (17), and rubber spacer (1) that secure front of canopy to canopy half frames (50 and 51).
   3.8. Remove canopy (33, 34, or 35) from canopy half frames (50 and 51).
4. Remove canopy half frames.
   4.1. Remove six screws (8) and six flat washers (6) that secure rear of canopy half frames (50 and 51) to drain tray (21) **(Figure 4-14, Page 4-19)**.
   4.2. Loosen two screws (7) that secure left and right rear support struts (18 and 19) to bottom of SAM.
   4.3. Remove four bolts (9) and four nuts (12) that secure front of canopy half frames to canopy brackets (20).
   4.4. Loosen attaching hardware that secures left and right front support struts (26 and 27) to vehicle.
   4.5. With the aid of an assistant, remove canopy frame assembly from top of vehicle.
5. Remove drain tray.
   5.1. Remove screws (8), washers (6), and cap nuts (14) that secure drain tray (21) to canopy supports (25) **(Figure 4-14, Page 4-19)**.
   5.2. Remove spacers (22) and drain tray (21) from canopy supports (25).
6. Remove rear support struts.
   6.1. Remove screws (7 and 28) that secure lower portion of rear support struts (18 and 19) and canopy supports (25) to Structural Accessory Module (SAM) **(Figure 4-14, Page 4-19)**.
   6.2. Remove bolts (11), washers (6), and cap nuts (14) that secure upper portion of rear support struts (18 and 19) to canopy supports (25).

6.3. Remove rear support struts (18 and 19) from canopy supports (25).

6.4. Remove canopy supports (25) from openings on top of SAM (62) **(Figure 4-22, Page 4-24)**.

7. Remove Visage mounting tube and plate.

7.1. Remove small and large windshield clips (44 and 45) that secure wire harness to the Visage mounting tube (52) **(Figure 4-14, Page 4-19)**.

7.2. Remove screw (37), washer (36), and lock nut (38) that secure mirror (48) to Visage mount tube (52) and remove mirror.

7.3. Remove two bolts (40), two washers (39) and two lock nuts (42) that secure Visage mount plate (47) to Visage mount tube (52) and remove mount plate.

7.4. Remove bolts (41), washers (39) and two lock nuts (42) that secure Visage mounting tube (52) and canopy brackets (20) to front support struts (26 and 27) and remove mounting tube.

8. Remove front support struts.

8.1. Remove two bolts (32) that secure left and right front strut covers (23 and 24) **(Figure 4-22, Page 4-24)**.

8.2. Remove bolts (29) that secure front support struts (26 and 27) to vehicle and remove struts.

CANOPY INSTALLATION

See General Warnings on page 1-2.

1. Install front support struts.

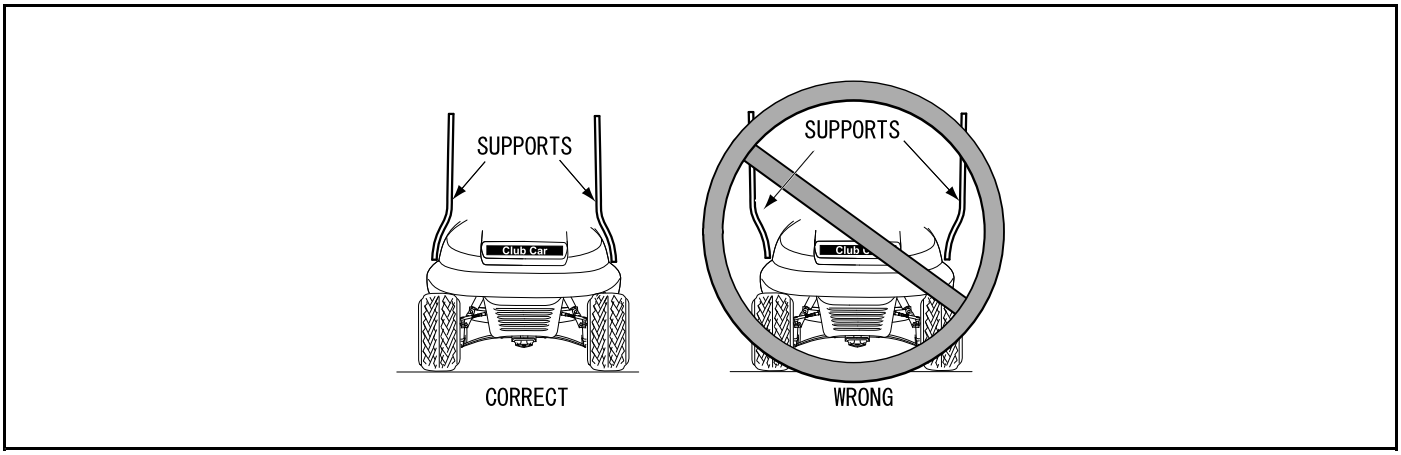

Figure 4-15 Properly Orient the Front Support Struts

1.1. Ensure the front support struts are properly oriented to the correct side of the vehicle as shown **(Figure 4-15)**. The lower profile of each support strut follows the profile of the vehicle.

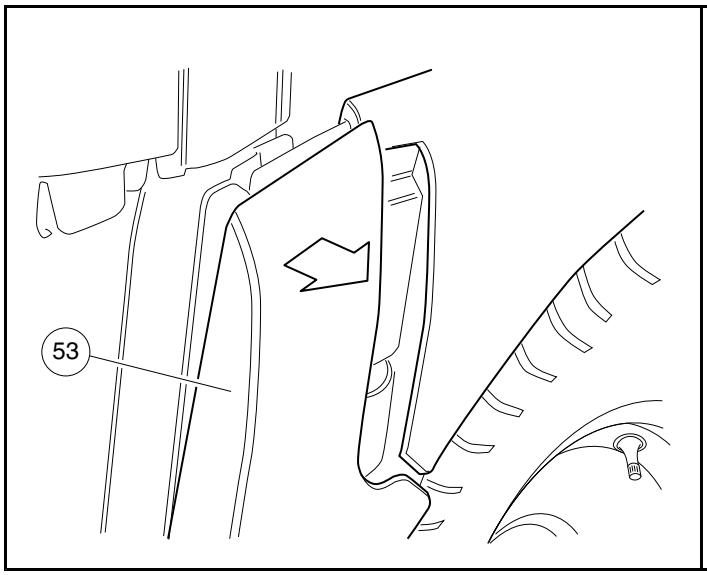

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Figure 4-16 Pull Top of Floor Mat Retainer Outward

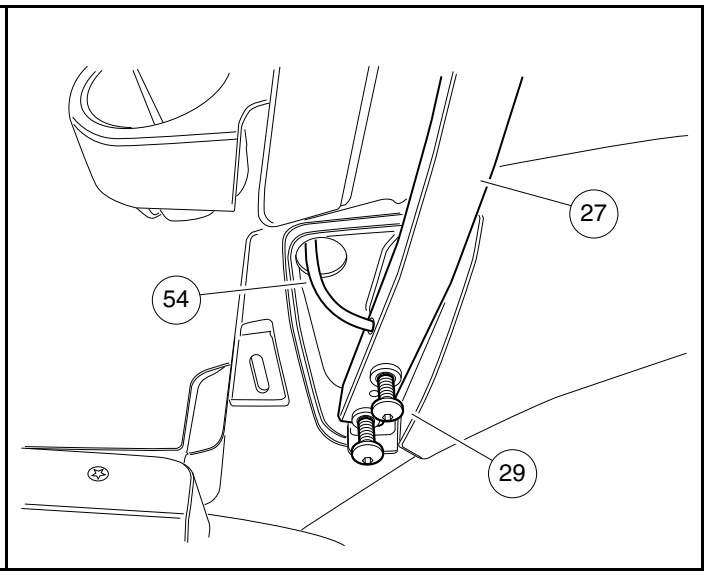

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Figure 4-17 Route Wire Harness Through Hole In Underbody

1.2. Pull back the top part of the passenger side floor mat retainer (53) as shown **(Figure 4-16)**.

1.3. Align the right front support strut (27) with the passenger side mounting holes. Insert two bolts (29) through the support strut and into the mounting holes. The bolts are color-coded with blue thread lock. Hand-tighten-only. This hardware will be tightened in step 5.5.

1.4. Route the wire harness (54) through the existing 1 inch (2.54 cm) hole in the underbody as shown **(Figure 4-17)**.

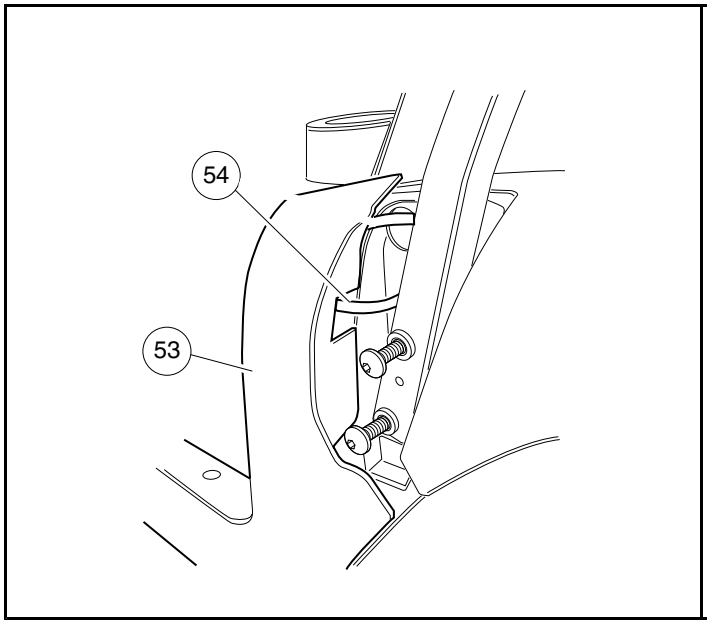

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Figure 4-18 Snap Floor Mat Retainer In Position and Ensure Visage wire harness is Contained in Cutout

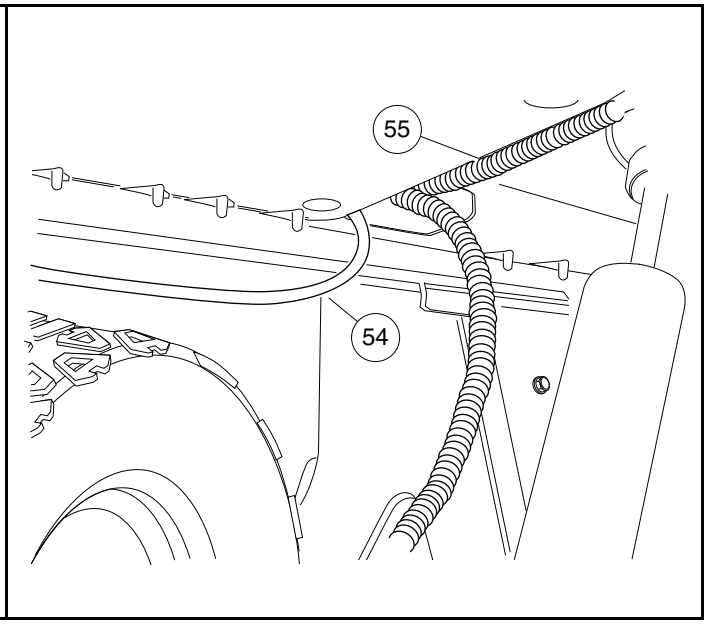

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Figure 4-19 Route Visage wire harness Through Wheel Well

1.5. Ensure that the Visage wire harness (54) is contained in the floor mat retainer (53) cutout, then snap the floor mat retainer back into position as shown **(Figure 4-18)**.

1.6. From the passenger side, reach through the wheel well and pull the lower part of the Visage wire harness (54) through the existing 1 inch (2.54 cm) hole to remove cable slack.

1.7. Route the Visage wire harness through the rear access opening behind the dash with the headlight wire harness (55), then up to the instrument panel opening as shown **(Figure 4-19)**.

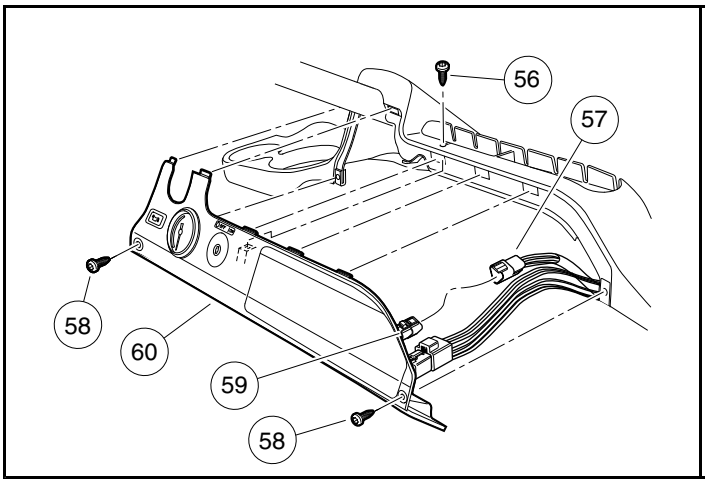

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Figure 4-20 Detach Instrument Panel

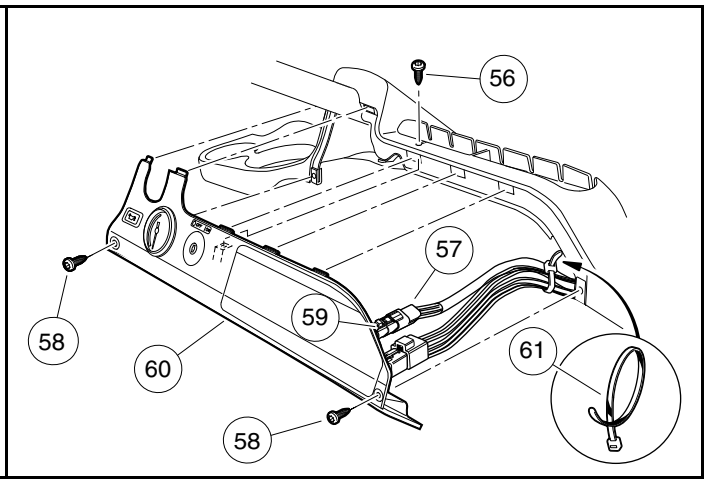

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Figure 4-21 Connect Visage wire harness to Open Connector and Tie Wrap

1.8. Remove the three screws (56 and 58) that secures the instrument panel (60) to the dash. Retain the bolts for reinstallation and position the panel away from the dash **(Figure 4-20)**.

1.9. Locate the open wire harness plug (59) on the main wire harness behind the instrument panel.

1.10. Pull the Visage wire harness (57) down from inside the dash to remove any slack **(Figure 4-20)**.

1.11. Connect the Visage wire harness (57) to the open wire harness plug (59) **(Figure 4-21)**.

1.12. Use a tie wrap (61) to secure both wire harnesses together.

1.13. Position the instrument panel onto the dash using the fastener holes for alignment.

1.14. Secure the panel to the dash using two screws (58) in front of the instrument panel. Hand-tighten only. These screws will be tighten in step 1.16.

1.15. Install the one screw (56) on top of the instrument panel. Hand-tighten only. This screw will be tighten in step 1.17.

1.16. Tighten the two screws (58) in front of the instrument panel to 1.7 ft·lbs (2.25 N·m).

1.17. Tighten the one screw (56) on top of the instrument panel to 7 in·lbs (0.8 N·m).

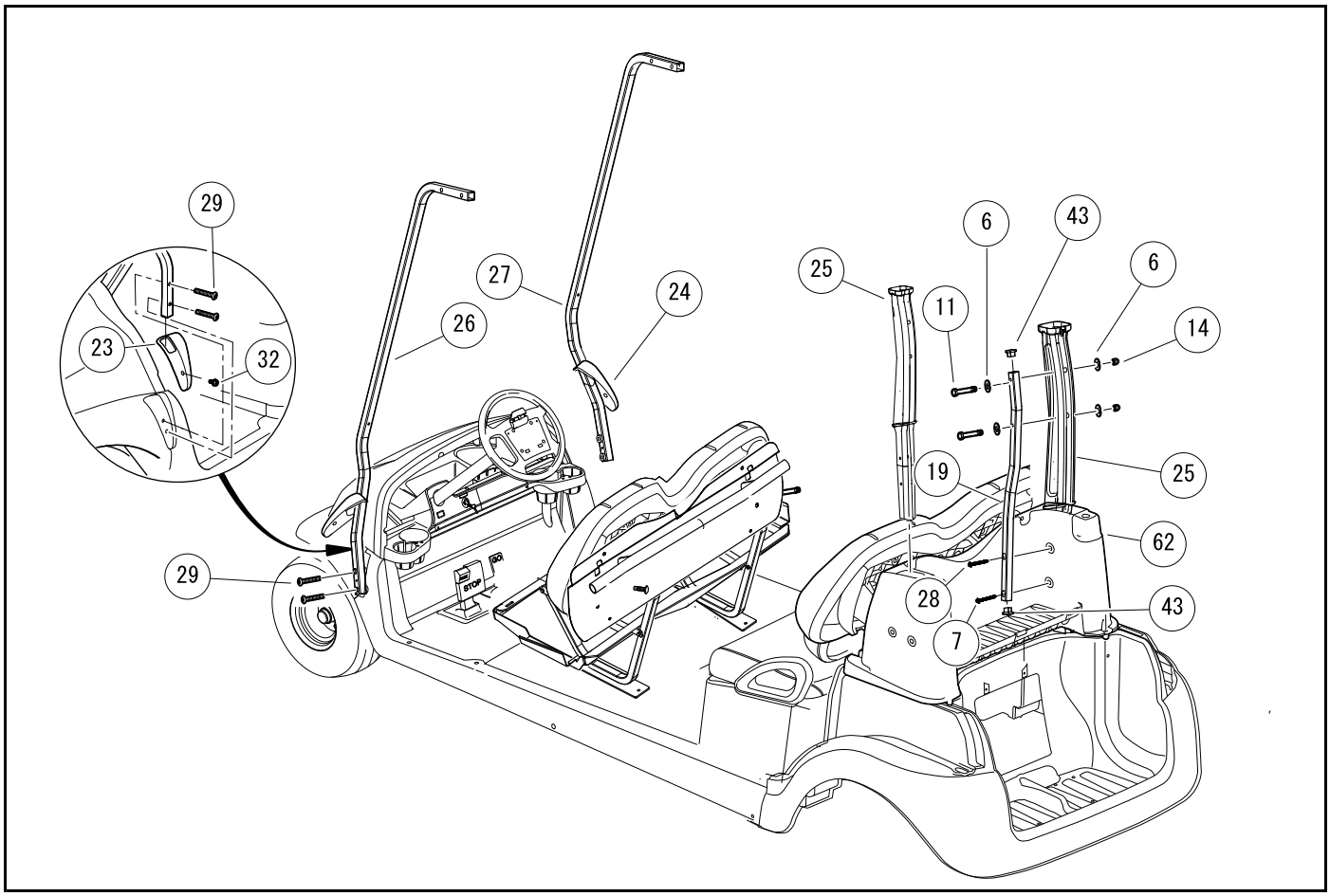

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Figure 4-22 Secure Front and Rear Strut Assemblies

1.18. Align the left front support strut (26) with the mounting holes. Insert two bolts (29) through the support strut and into the mounting holes. The bolts are color-coded with blue thread lock. Hand-tighten only **(Figure 4-22)**. This hardware will be tighten in step 5.5.

NOTE: *The strut covers are marked DRIVER and PASS to identify them as driver and passenger side covers. Ensure that the strut covers are properly oriented prior installation.*

1.19. Position the left strut cover (23) over the left front support strut (26). The cover will be tighten in step 5.6.

1.20. Position the right strut cover (24) over the right front support strut (27). The cover will be tighten in step 5.6.

2. Install Visage mounting tube and plate.

NOTE: *The following steps may require additional personnel. Ensure that the canopy brackets (20) are properly oriented per* ***Figure 4-14****.*

2.1. Using the existing fastener holes as an alignment guide, position one canopy bracket (20) to the outside surface of the left hand front support strut (26). Temporarily hold the bracket in place by using two bolts (41) and two washers (39).

2.2. Repeat step 3.1 for the right hand side of the vehicle.

2.3. Using the attaching hardware in steps 3.1 and 3.2, position the Visage mounting tube (52) on the inside surface of both the left and right hand front support struts (26 and 27). Secure the Visage mounting tube to the support struts using four washers (39) and four lock nuts (42). Hand-tighten only. This hardware will be tighten in step 2.6.

2.4. Press a plug (43) into each end of the Visage mounting tube (52).

2.5. Press a plug (43) into each end of the left and right front support struts (26 and 27).

2.6. Tighten the hardware that secures the Visage mounting tube (52) to the canopy brackets and front support struts (26 and 27) to 65 in·lb (7.3 N·m).

2.7. Attach the Visage mount plate (47) to the Visage mount tube (52). Insert two bolts (40), two washers (39) and two lock nuts (42). Tighten hardware to 75 in·lb (8.5 N·m).

2.8. Attach the mirror (48) to the Visage mount tube (52). Insert one screw (37), one washer (36), and one lock nut (38). Tighten hardware to 120 in·lb (13.6 N·m).

2.9. Attach the large windshield clip (45) to the visage wire harness such that the clip is positioned between the mirror (48) and the right front support strut (26).

2.10. Attach the small windshield clip (44) to the visage wire harness such that the clip is positioned between the mirror (48) and the Visage mounting plate (47).

2.11. Attach the clips to the Visage mounting tube (52). Pull the wire harness to remove any slack between the clips.

3. Install rear support struts.

3.1. At the rear of the vehicle, insert the left and right rear canopy supports (25) into the openings on top of the Structural Accessory Module (SAM) (62) **(Figure 4-22, Page 4-24)**.

3.2. Install the Sand Bottle Kit per kit instruction 103483001, step 4.

NOTE: *When installing the sand bottle kit, drill the sand bottle basket mounting holes in the rear canopy supports before placing the supports into the Structural Accessory Module (SAM). Drilling the holes while outside the SAM will ensure that the sand bottle basket mounting holes are properly aligned. Drill the holes separately at each dimple and on each side of the canopy supports (25) to avoid drill hole misalignment.*

3.3. Install the top and bottom plugs (43) on the left and right rear support struts (18 and 19).

3.4. Position the left rear support strut (18) inside of the left canopy support (25) using the fastener holes for alignment.

3.5. Secure the upper section of the left rear support strut to the canopy using two bolts (11), four washers (6), and two cap nuts (14). Hand-tighten only. This hardware will be tighten in step 6.6.

3.6. Perform steps 4.5 and 4.6 for the right rear support strut (19).

3.7. Align the lower section fastener holes in the left rear support strut (18) and left rear canopy support (25), with the fastener holes in the SAM (67) **(Figure 4-22, Page 4-24)**.

3.8. Secure the left rear support strut (18) and canopy support (25) to the SAM using one screw (7). Hand-tighten only. This hardware will be tighten in step 5.8.

3.9. Repeat step 4.7 and 4.8 for the right rear support strut (19).

CAUTION

- **Drill the hole to penetrate the thickness of the SAM wall. Failure to adhere will result in damage the canopy support.**

3.10. Using the second hole from the bottom of the left rear support strut (18) as a guide, match drill one 5/16-inch (15.87 mm) hole though the wall of the SAM just enough to penetrate the SAM wall **(Figure 4-22, Page 4-24)**.

3.11. Secure the left rear support strut (18) and canopy support (25) to the SAM using one screw (28). Hand-tighten only. This hardware will be tighten in step 5.8.

3.12. Repeat steps 4.10 and 4.11 for the right rear support strut (19).

4. Install drain tray.

4.1. Position the drain tray (21) on top of the canopy supports (25) using the fastener holes for alignment.

4.2. Install one spacer (22) into each drain support, align the spacer with the canopy support mounting holes.

4.3. Secure the drain tray (21) to the canopy supports (25), using two each, screws (8), washers (6), cap nuts (14), and spacers (22). Hand-tighten only. This hardware will be tightened in step 6.7.

5. Install canopy half frames.

NOTE: *Assemble the left and right canopy half frames prior to lifting into position. Ensure that the left and right canopy half frames are oriented properly using the hand hold (15) mounting holes as a guide. The right half frame has mounting holes for two hand holds.*

5.1. Install two long splice bars (16) to each end of the left canopy half frame (50) and secure using four screws (2). Hand-tighten only. This hardware will be tightened in step 6.3.

5.2. Install the right canopy half frame (51) onto the left canopy half frame and long splice bars (16) and secure using four screws (2). Hand-tighten only. This hardware will be tightened in step 6.3.

5.3. Tighten the canopy half frame hardware to 45 in·lb (5.1 N·m).

5.4. With the aid of an assistant, position the assembled canopy frame on top of the vehicle using the fastener holes in the canopy brackets (20) and the drain tray (21) for alignment.

5.5. Tighten the attaching hardware that secures the left and right front support struts (26 and 27) to the vehicle. Tighten the hardware to 18 ft·lb (24.4 N·m).

5.6. Secure the left and right strut covers (23 and 24) using two bolts (32). Tighten the hardware to 31 in·lb (3.5 N·m).

5.7. Secure the front of the canopy half frames to the canopy brackets (20) using four bolts (9) and four nuts (12). Tighten the hardware to 100 in·lb (12.4 N·m).

5.8. Tighten the two screws (7) that secures the left and right rear support struts (18 and 19) to the bottom of the SAM to 88 in·lb (9.9 N·m).

5.9. Secure the rear of the canopy half frames to the drain tray (21) using six screws (8) and six flat washers (6). Tighten the hardware to 45 in·lb (5.1 N·m).

NOTE: *In order to avoid bottoming-out the six screws (8) that secure the drain tray (21), shim the hardware as required using extra flat washer(s) with each screw (8).*

6. Install canopy.

6.1. Position the canopy (33, 34, or 35) on top of the canopy half frames using the half frames and drain tray (21) fastener holes for alignment.

6.2. Secure the upper front of the canopy to the canopy half frames at two locations using one each, screw (4), washer (3), rubber washer (17), and rubber spacer (1). Hand-tighten the hardware until the rubber spacers (1) start to deform. This hardware will be tighten in step 6.8.

NOTE: *Spacers must be positioned between the canopy and half frames.*

6.3. Starting at the upper back of the canopy and moving forward, secure the canopy to the canopy half frames at twelve locations using one each, screw (5), washer (6), and rubber washer (17). Hand-tighten the only. This hardware will be tighten in step 6.8.

6.4. Position the three hand holds (15) to the underside of the canopy frame and secure with six bolts (10). Tighten hardware to 75 in·lb (8.5 N·m).

6.5. Press two plugs (15) into each hand hold.

6.6. Tighten the attaching hardware that secures the left and right rear support struts (18 and 19) in the middle of the SAM to 50 in·lb (5.6 N·m) **(Figure 4-14, Page 4-19)**.

6.7. Tighten the attaching hardware that secures the drain tray (21) to the top of the rear canopy supports (25) to 65 in·lb (7.3 N·m).

6.8. Tighten the attaching hardware that secures the canopy (33, 34, or 35) to the frame to 45 in·lb (5.1 N·m).

7. Install Visage unit.

7.1. Position the Visage unit onto the Visage mount plate (47) using the Visage unit connector and fastener holes for alignment.

7.2. Secure the Visage unit to the Visage mount plate using two screws (49). Tighten the hardware to 43 in·lb (4.9 N·m).

7.3. Connect the Visage wire harness (54) to the Visage unit.

7.4. Position the Visage cover (46) onto the Visage mount plate (47) using the fastener holes for alignment.

7.5. Secure the Visage cover (46) to the Visage mounting plate (47) using two screws (49) and two washers (39). Tighten the hardware to 15 in·lb (1.7 N·m).

8. Connect batteries. **See Connecting the Batteries, Section 1, Page 1-3.**

⚠ DANGER

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

⚠ WARNING

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

PEDAL GROUP – ELECTRIC VEHICLE

See General Warnings on page 1-2.

PEDAL GROUP REMOVAL

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries on page 1-3.**
2. Remove screws (1). Pull floor mat retainer (3) away from the vehicle **(Figure 5-1, Page 5-1)**.
3. Pull floor mat (2) over the pedal group to gain access to the pedal group hardware.

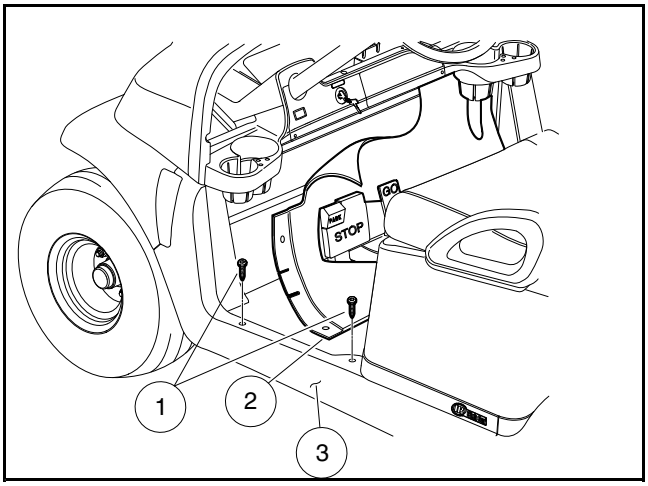

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Figure 5-1 Pedal Group Access

4. Remove fastener (10) and lift off cover plate (7) **(Figure 5-2, Page 5-2)**.
5. Loosen jam nuts (4 and 5) on each side of turnbuckle (6).

NOTE: *Nut (4) has a left-hand thread.*

6. Loosen turnbuckle (6) until the threaded rod (8) from the pedal group (11) is free of the turnbuckle **(Figure 5-2, Page 5-2)**.
7. Remove two screws (2) on the driver side of the pedal group and two screws (1) on the passenger side of the pedal group.
8. Disconnect the wire harness (12) from the MCOR (13).
9. Lift pedal group from vehicle.

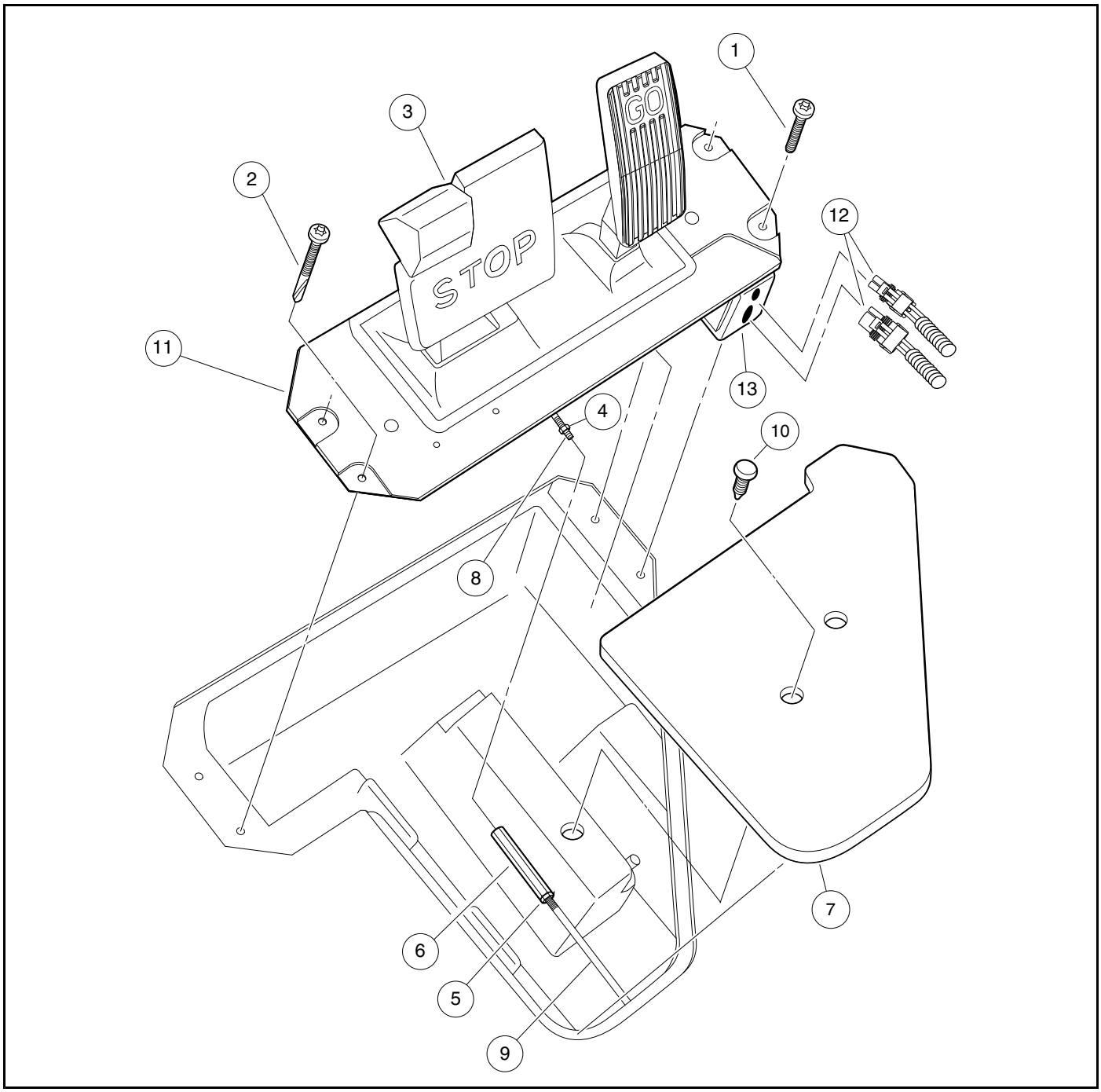

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Figure 5-2 Pedal Group – Electric Vehicle

MCOR

The pedal group for the Precedent electric vehicle includes a Motor Controller Output Regulator (MCOR) mounted on the side of the pedal group. The MCOR detects the position of the GO pedal and sends a corresponding voltage to the motor controller. **For more information see the following procedures:**

- Test Procedure 11 – MCOR Voltage on page 13-26
- Test Procedure 5 – Key Switch and MCOR Limit Switch Circuit on page 13-21
- MCOR Removal on page 14-7
- MCOR Installation on page 14-7

PEDAL GROUP INSTALLATION

1. Connect the wire harness (12) to the MCOR (13) **(Figure 5-2, Page 5-2)**.
2. Position the pedal group in vehicle and secure with two screws (2) on the driver side and two screws (1) on the passenger side. Tighten driver side screws (2) to 97 in·lb (11 N·m). Tighten passenger side screws (1) to 18 in·lb (2 N·m).
3. Remove the turnbuckle (6) and apply Loctite® 242 to the threaded ends of both the rod from the pedal group (8) and the brake actuator rod (9). Connect the rods using the turnbuckle (6).
4. Adjust brake linkages. **See Brake Linkage Adjustment, Section 6, Page 6-13.**
5. Check brake cable equalizer tension. **See Brake Equalizer Adjustment, Section 6, Page 6-14.**
6. Place floor cover plate (7) over the floor opening and secure with fastener (10) **(Figure 5-2, Page 5-2)**.
7. Install the floor mat (2) over the pedal group. Make sure tabs on floor mat sides are beneath the sill (3). Tighten screws (1) to 53 in·lb (6 N·m) **(Figure 5-1, Page 5-1)**.
8. Connect batteries. **See Connecting the Batteries, Section 1, Page 1-3.**

DEBRIS SHIELDS

Debris shields on the top face of the pedal group prevent excessive debris from contacting the moving parts of the pedal group. Both shields (4 and 5) are held in place by tabs that snap into the pedal group mounting plate **(Figure 5-3, Page 5-5)**.

ACCELERATOR PEDAL REMOVAL

1. Remove pedal group from vehicle. **See Pedal Group Removal on page 5-1.**
2. **Electric Vehicle:** Remove the MCOR. **See MCOR Removal on page 14-7.**
3. Remove debris shields (4 and 5) **(Figure 5-3, Page 5-5)**.
4. Remove four screws (13) securing accelerator pedal assembly (7) to pedal group mounting plate and pull accelerator pedal assembly through bottom of pedal group mounting plate.

ACCELERATOR PEDAL INSTALLATION

1. Insert accelerator pedal assembly (7) through bottom of pedal group mounting plate and secure with four screws (13) **(Figure 5-3, Page 5-5)**.
2. Tighten screws (13) to 38 in·lb (4.3 N·m)
3. Install debris shields (4 and 5).
4. **Electric Vehicle:** Install the MCOR. **See MCOR Installation on page 14-7.**
5. Install pedal group in vehicle. **See Pedal Group Installation on page 5-3.**

BRAKE PEDAL REMOVAL

1. Remove pedal group from vehicle. **See Pedal Group Removal on page 5-1.**
2. Remove debris shields (4 and 5) **(Figure 5-3, Page 5-5)**.
3. Remove four screws (12) securing brake pedal assembly (8) to pedal group mounting plate and pull brake pedal assembly through bottom of pedal group mounting plate.

BRAKE PEDAL INSTALLATION

1. Insert brake pedal assembly (8) through bottom of pedal group mounting plate and secure with four screws (12) **(Figure 5-3, Page 5-5)**.
2. Tighten screws (12) to 100 in·lb (11.3 N·m)
3. Install debris shields (4 and 5).
4. Install pedal group in vehicle. **See Pedal Group Installation on page 5-3.**

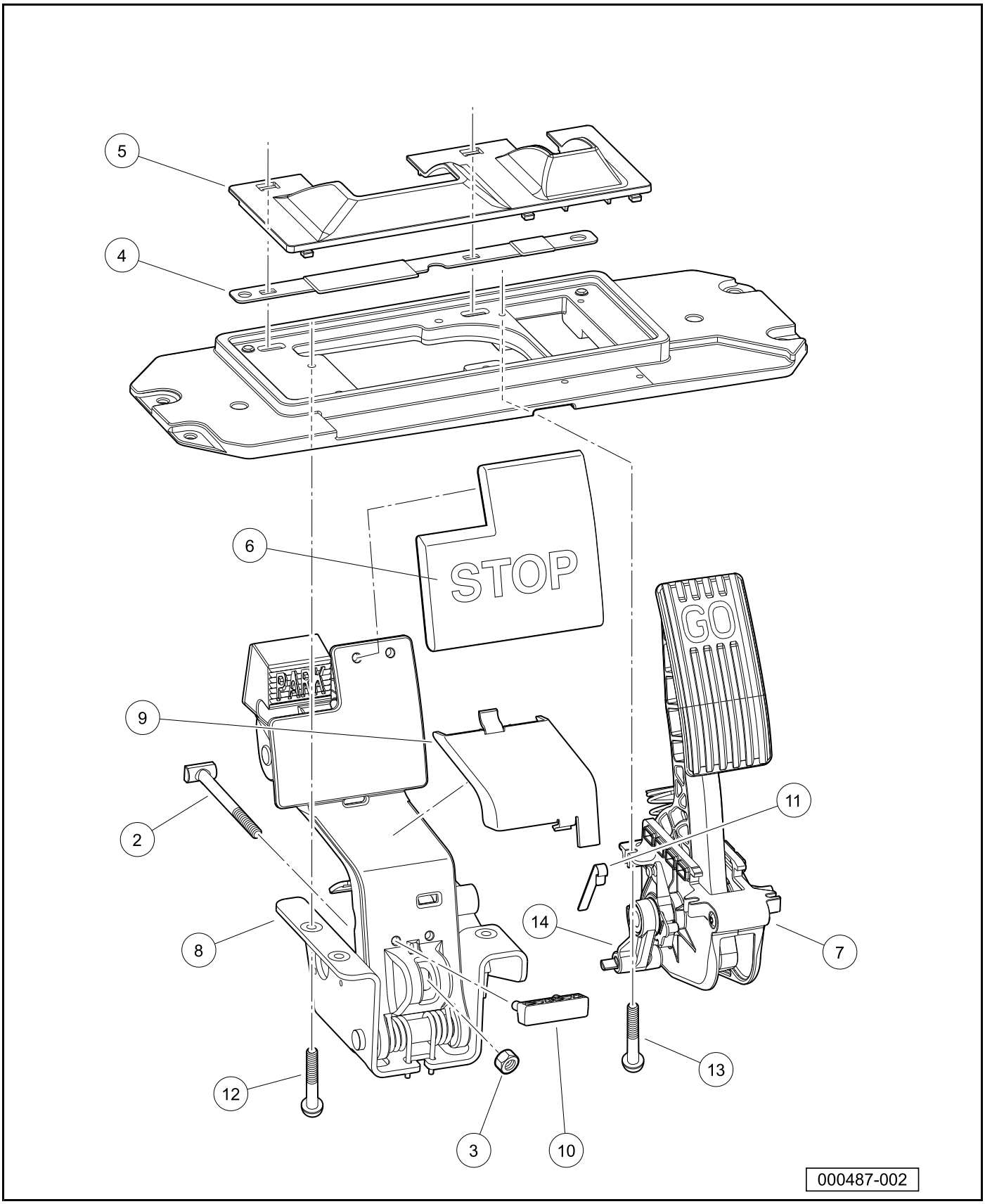

Figure 5-3 Accelerator Pedal Assembly and Brake Pedal Assembly

⚠ 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

This vehicle is equipped with self-adjusting, mechanically-expanding shoe, drum brakes on each rear wheel.

Unlike the 2-passenger Precedent, the long wheel-base Precedent features a modified equalizer system that utilizes a bellcrank to relocate the pull on the cables to the center of the vehicle which allows the use of equal-length brake cables **(Figure 6-1, Page 6-1)**.

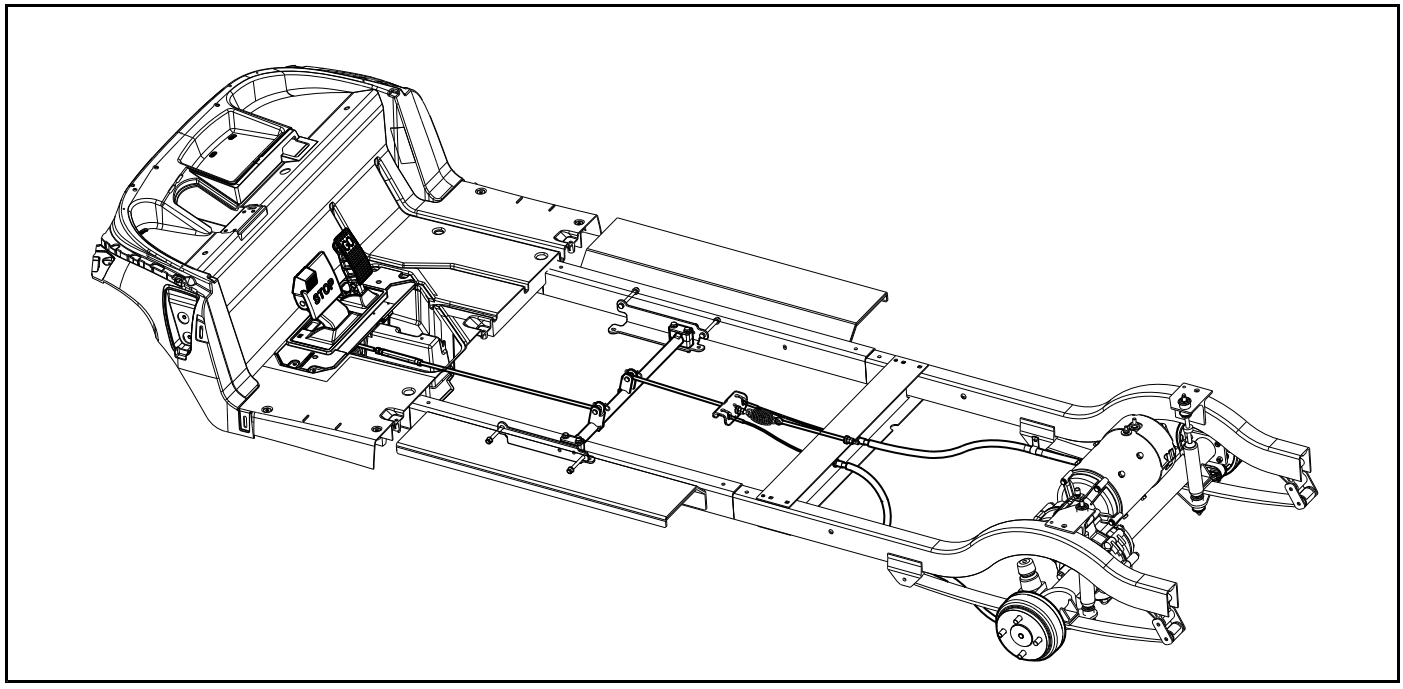

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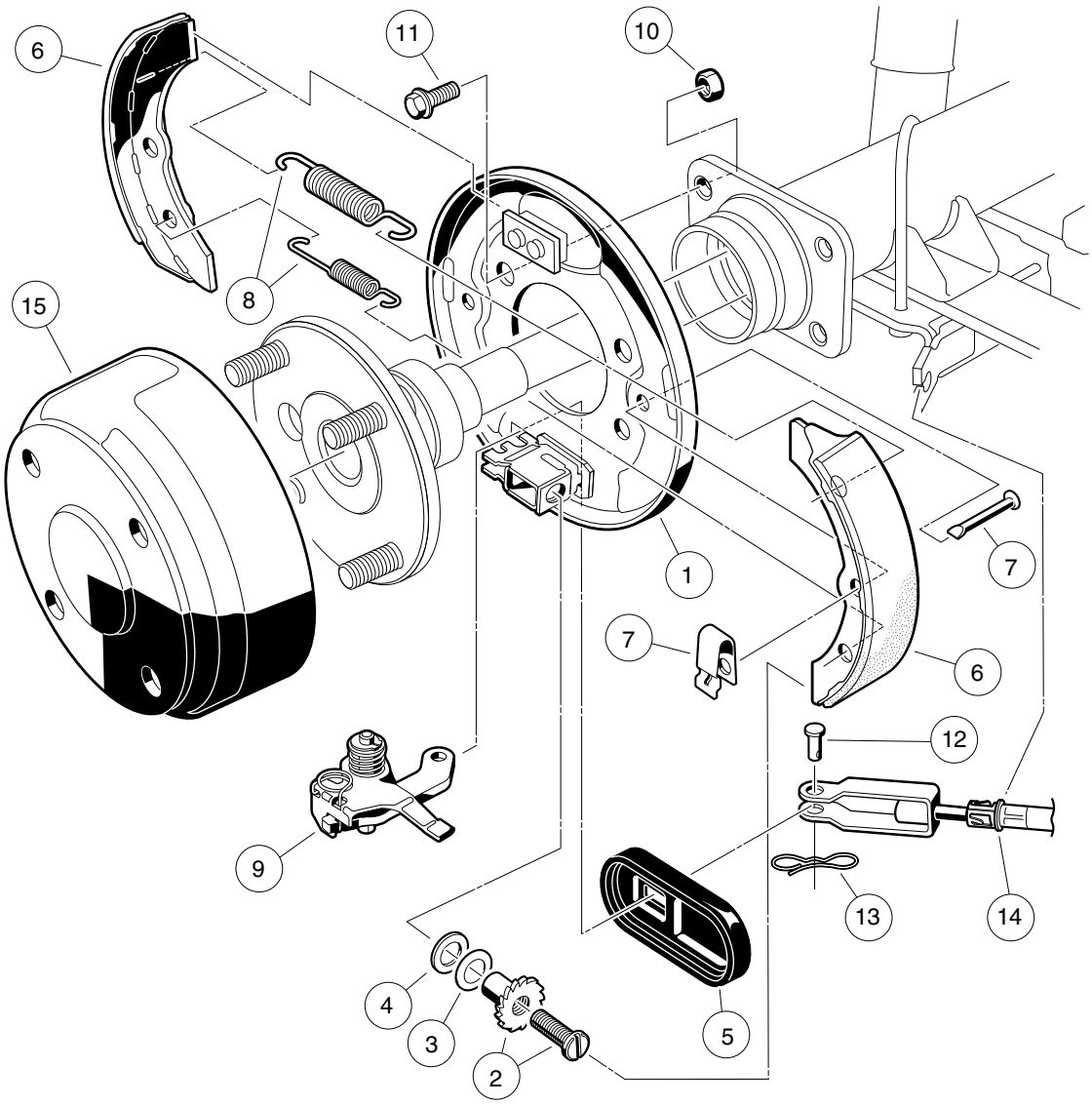
Figure 6-1 Precedent Stretch and 4Fun Brake System

BRAKE COMPONENTS, SELF-ADJUSTING – EXPLODED VIEW



1. Backing Plate	6. Brake Shoes	11. Bolt
2. Adjuster	7. Retainer Pin and Clip	12. Clevis Pin
3. Washer, Thin	8. Springs	13. Bow Tie Locking Pin
4. Washer, Thick	9. Lever Assembly	14. Brake Cable
5. Dust Cover	10. Lock Nut	15. Brake Drum

2731

Figure 6-2 Self-Adjusting, Drum Brake Components

BRAKE DRUMS

BRAKE DRUM REMOVAL

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

⚠ CAUTION

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

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries on page 1-3.**
2. Place chocks at the front wheels. Loosen, but do not remove, lug nuts on 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. **See WARNING "Lift only one end..." in General Warnings on page 1-2.**
3. To release tension in the brake system, disconnect equalizer spring from middle equalizer rod **(Figure 6-3, Page 6-3)**.
4. Remove the rear wheels and then the brake drums. If a brake drum cannot be removed by normal methods, proceed to the next step to minimize damage to the brake cluster and brake components.

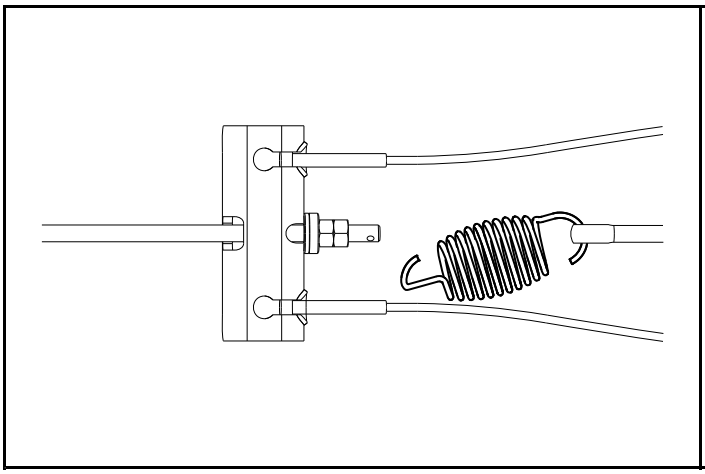


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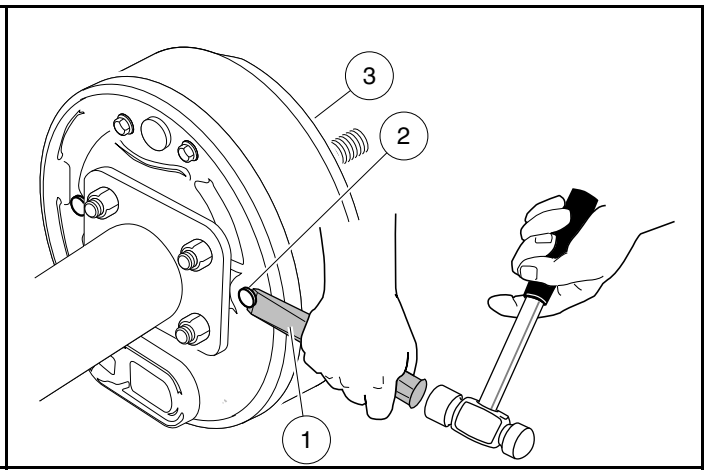
Figure 6-3 Disconnect Equalizer Spring



1400-18100-10220

Figure 6-4 Shoe Retainer Pins

5. To remove brake drums that will not slide off the brake shoes, perform the following steps:
   5.1. On the back of each brake cluster assembly, locate the heads of the two brake shoe retainer pins. It may be necessary to remove sealant material around the head of each pin.
   5.2. 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 6-4, Page 6-3)**. This will release the shoes from the backing plate, allowing them to move away from the inside of the brake drum (3), which should then allow the brake drum to be removed.

BRAKE DRUM INSTALLATION

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

1. Install brake drum onto brake shoes and hub making 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.*

2. After the drum is installed, make sure the axle and drum turn freely and then install the wheel. **See Wheel Installation on page 8-1.**
3. Reconnect equalizer spring to equalizer rods.
4. Check brake adjustment. **See Brake Equalizer Adjustment on page 6-14.**

BRAKE SHOES

BRAKE SHOE REMOVAL

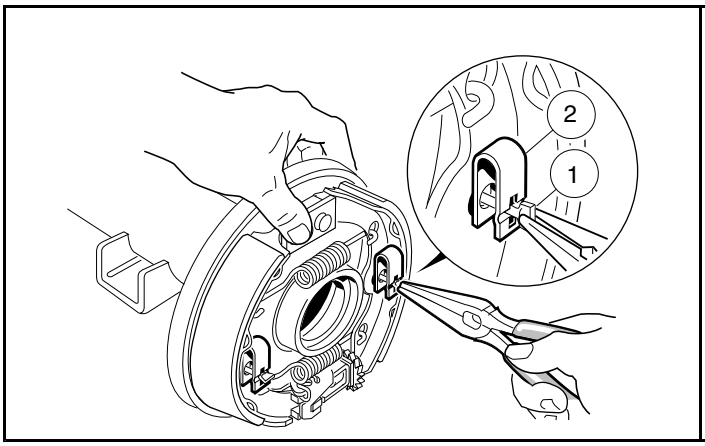
See General Warnings on page 1-2. See also Asbestos Dust Warning on page 6-1.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries on page 1-3.**
2. Place chocks at the front wheels. Loosen, but do not remove, lug nuts on 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. **See WARNING "Lift only one end..." in General Warnings on page 1-2.**
3. Remove the rear wheels and then the brake drums. **See Brake Drum Removal on page 6-3.**
4. Remove axle shaft. **See Axle Shaft and Oil Seal Removal, Section 18, Page 18-1.**
5. Using needle nose pliers, turn the clip retainer pin (1) 90° to remove the shoe retainer clip (2) **(Figure 6-5, Page 6-5)**.

⚠ CAUTION

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

6. Grasp both brake shoes and pull them, together with the springs, out of the brake assembly as shown **(Figure 6-6, Page 6-5)**.
7. Remove adjuster wheel (1) with two washers (2 and 3) from the backing plate **(Figure 6-7, Page 6-5)**.



1400-18100-10222
Figure 6-5 Remove Shoe Retainer Clip

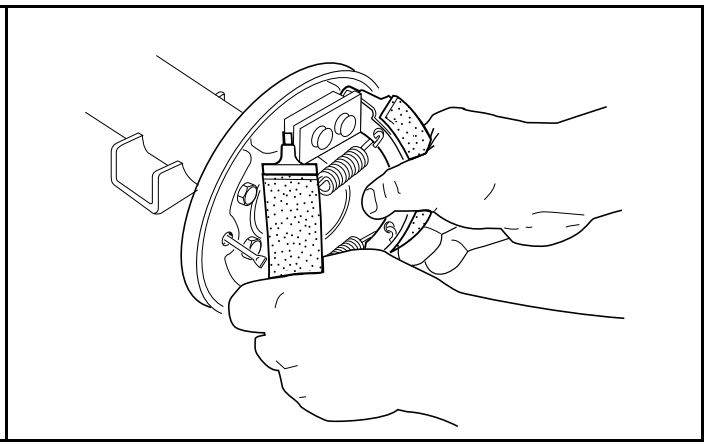


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Figure 6-6 Remove Brake Shoes

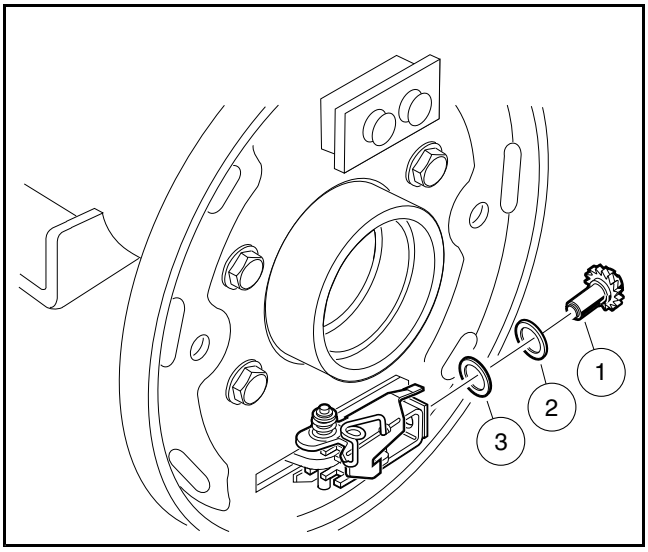

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Figure 6-7 Remove Adjuster Wheel

BRAKE SHOE INSTALLATION

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

1. Turn the adjusting wheel screw so that the shoe slot is vertical, then position the trailing shoe in the slots in the shoe mounting block and adjuster assembly **(Figure 6-8, Page 6-6)**. **See following NOTE.**

NOTE: *The trailing shoe has 17T stamped into the tip of the shoe flange **(Figure 6-8, Page 6-6)**. The leading shoe is stamped 17L. When installing the shoes, the stamping on both shoes should be oriented to the top of the brake assembly. When installing the shoes on the passenger side of the vehicle, the side of the trailing shoe flange marked 17T should be facing out and be visible. On the driver side, the 17L on the leading shoe should be facing out and be visible.*

*When installed on the backing plate, the **leading** shoe (stamped 17L) is **always** oriented toward the **rear** of the vehicle.*

2. Install the shoe retainer clip, using pliers to compress the clip (1) while turning the retainer pin (2) into position **(Figure 6-9, Page 6-6)**.

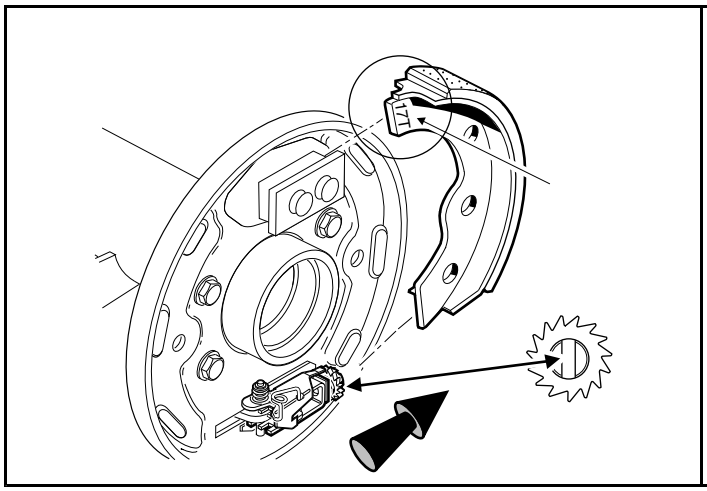

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Figure 6-8 Install Adjuster Wheel, Trailing Shoe

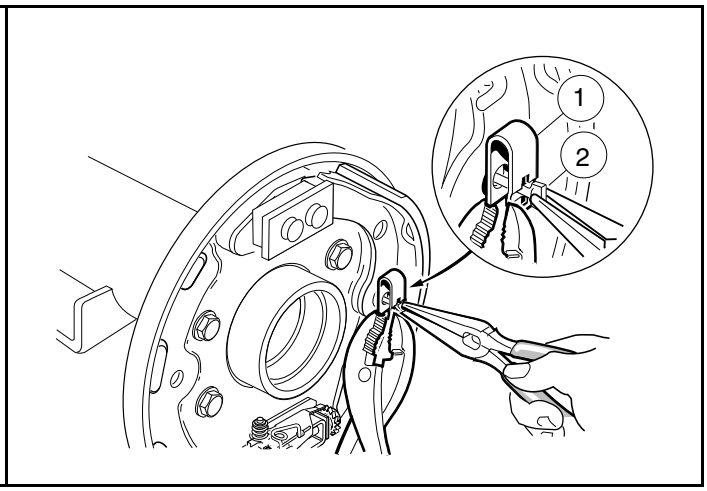

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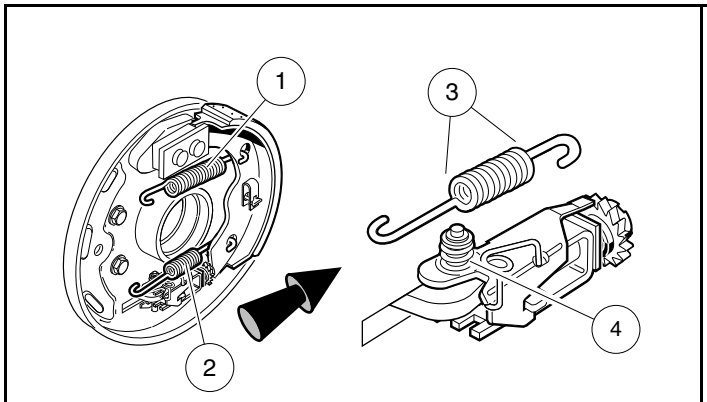
Figure 6-9 Install Trailing Shoe Retainer Clip

3. Attach the springs 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 6-10, Page 6-6)**.
4. While maintaining spring attachment on both shoes, position tips of leading shoe (1) in the mounting slots and then push shoe into place. Hold shoe in position and install retaining clip **(Figure 6-11, Page 6-6)**.



1. Bronze Spring 2. Silver Spring 3. Coils of Silver Spring 4. Adjustment Lever Spring

NOTE: The silver spring (2) is mounted with the coils (3) to the side of the adjustment lever spring (4).

2738

Figure 6-10 Attach Springs

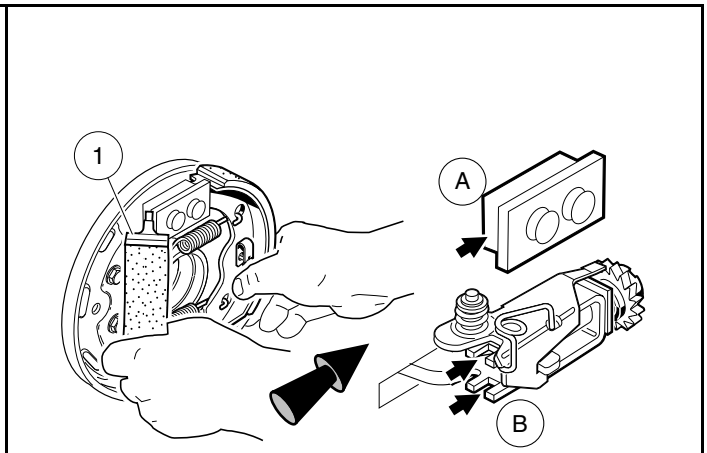


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Figure 6-11 Install Leading Shoe

5. After the shoes are installed, move them together up and down and side to side to make sure that they will easily slide approximately 1/4 to 3/8 inch (6 to 10 mm) without binding **(Figure 6-12, Page 6-7)**.
6. Place a flat-blade screwdriver under the adjusting arm (1) and raise the arm off of the adjusting wheel (2). While holding the arm (1) up, turn the wheel (2) upward until it stops **(Figure 6-13, Page 6-7)**. Remove the screwdriver.

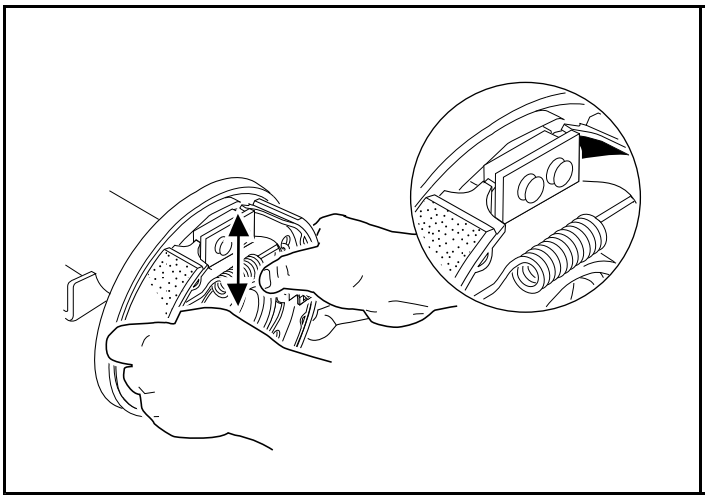

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Figure 6-12 Check Shoe Positions

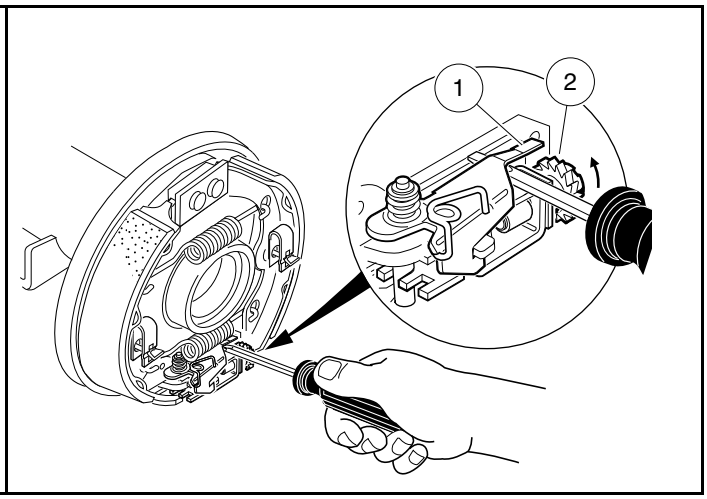

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Figure 6-13 Set Adjusting Wheel

7. Install axle shaft. **See Axle Shaft and Oil Seal Installation, Section 18, Page 18-4.**
8. Install the brake drum and make sure that it is properly seated. **See Brake Drum Installation on page 6-4.**

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 and then install the wheel. **See Wheel Installation on page 8-1.**
10. Adjust the brakes. **See Brake Equalizer Adjustment on page 6-14.**

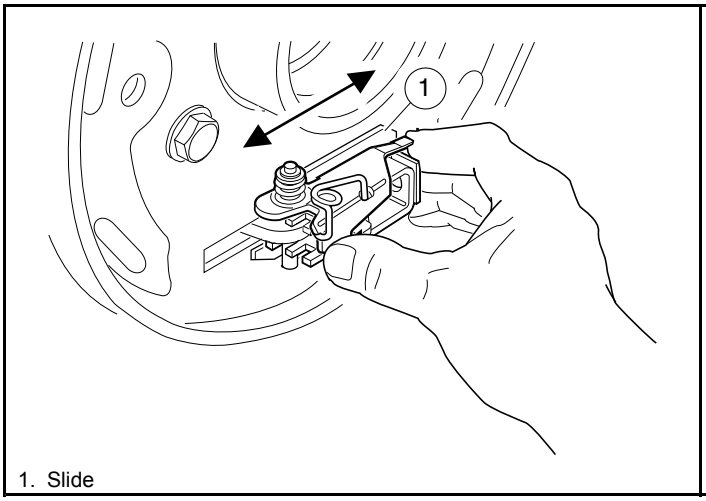
BRAKE CLEANING AND LUBRICATION

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 of its mechanical components.
2. Remove the rubber boot from backing plate and wipe with a clean damp cloth.
3. Lubricate the slide (1) with dry moly lubricant (P/N 1012151) **(Figure 6-14, Page 6-8)**. After lubricating, work slide back and forth against backing plate to ensure that it slides smoothly and easily. Install rubber boot onto backing plate.

⚠ 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.**



1. Slide

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Figure 6-14 Lubricate Slide

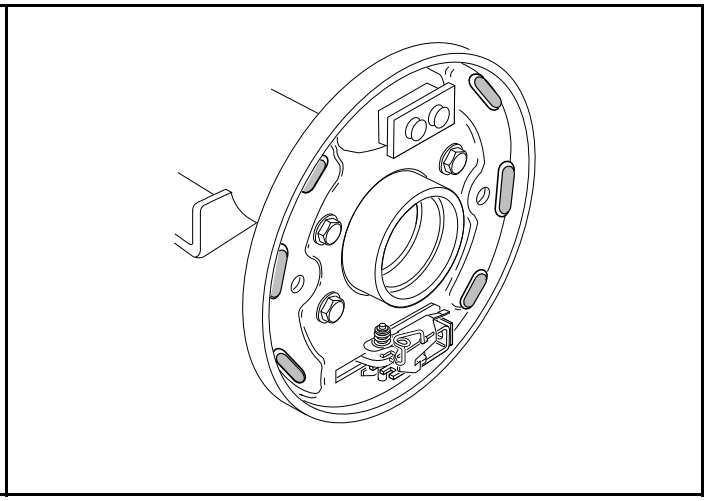

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Figure 6-15 Apply Grease On Bosses

4. Use a small brush to carefully apply a light coat of white lithium NLGI #2 grease (Dow Corning® BR2-Plus or equivalent) on each of the six raised bosses on the brake backing plate **(Figure 6-15, Page 6-8)**. **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 6-16, Page 6-9)**. **See preceding WARNING.**

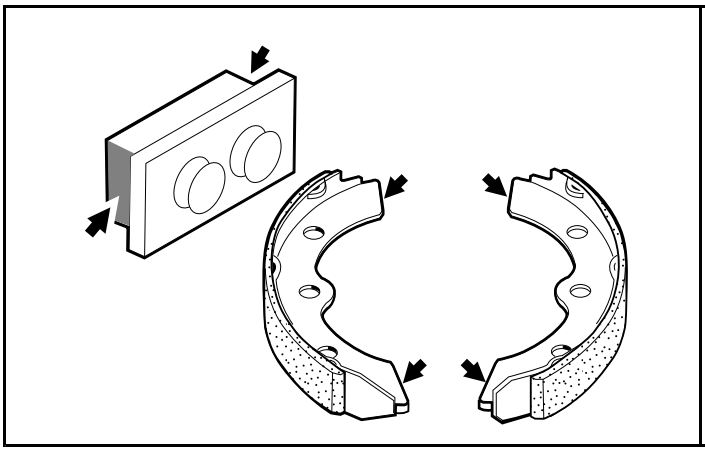

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Figure 6-16 Apply Grease To Brake Shoes and Slots

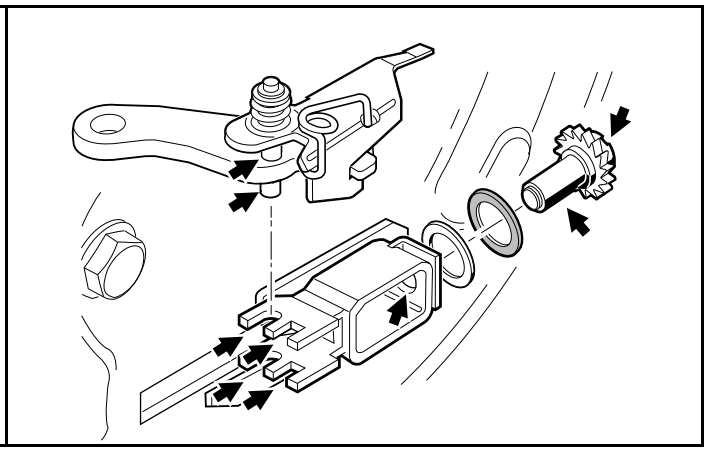

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Figure 6-17 Apply Grease To Brake Adjuster

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 adjuster assembly, adjuster wheel shoe slots, and the shaft of the adjuster wheel as shown **(Figure 6-17, Page 6-9)**. **See preceding WARNING.**
7. Install the adjuster wheel (1) and two washers (2 and 3) into the adjuster assembly **(Figure 6-7, Page 6-5)**.

BRAKE CLUSTERS

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

BRAKE CLUSTER REMOVAL

1. Remove the rear wheel and then the brake drum. **See Brake Drum Removal on page 6-3.**
2. Remove axle shaft. **See Axle Shaft and Oil Seal Removal, Section 18, Page 18-1.**
3. At brake cluster (1), disconnect brake cable clevis by removing bow tie locking pin (2) and the clevis pin (3) from the brake lever **(Figure 6-18, Page 6-10)**.
4. Remove four bolts (4) and lock nuts (5) that mount the brake cluster to the transaxle.
5. Remove brake cluster (1) from transaxle.

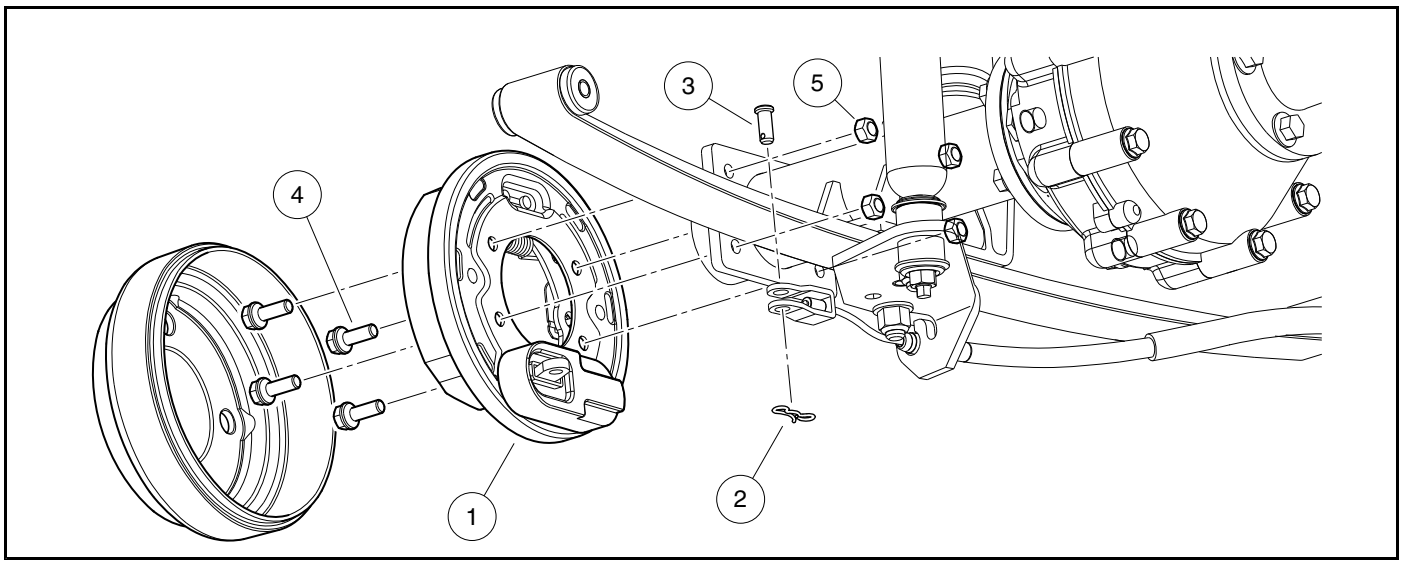

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Figure 6-18 Brake Cluster Removal and Installation

BRAKE CLUSTER INSTALLATION

1. Install in reverse order of disassembly. Use new lock nuts (5) to mount the brake cluster (1) to the transaxle and a new bow tie locking pin (2) to secure the brake cable clevis pin (3) to the brake lever **(Figure 6-18, Page 6-10)**. Tighten lock nuts (5) to 17 ft·lb (23.0 N·m). If tightening the bolt heads (4), use 30 ft·lb (40.6 N·m).
2. Install axle shaft. **See Axle Shaft and Oil Seal Installation, Section 18, Page 18-4.**
3. Install the brake drum and make sure that it is properly seated. **See Brake Drum Installation on page 6-4.**

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

4. After the drum is installed, make sure the axle and drum turn freely and then install the wheel. **See Wheel Installation on page 8-1.**
5. Adjust the brakes. **See Brake Equalizer Adjustment on page 6-14.**

BRAKE CABLES

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

BRAKE CABLE REMOVAL

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries on page 1-3.**
2. Place chocks at the front wheels.
3. Lift rear of vehicle and support on jack stands. **See Lifting Only The Rear, Section 3, Page 3-5.**
4. To release tension in the brake system, disconnect equalizer spring from middle equalizer rod **(Figure 6-19, Page 6-11)**.
5. At each brake cluster, disconnect brake cable clevis (3) by removing bow tie locking pin (1) and the clevis pin (2) from the brake lever **(Figure 6-20, Page 6-11)**.

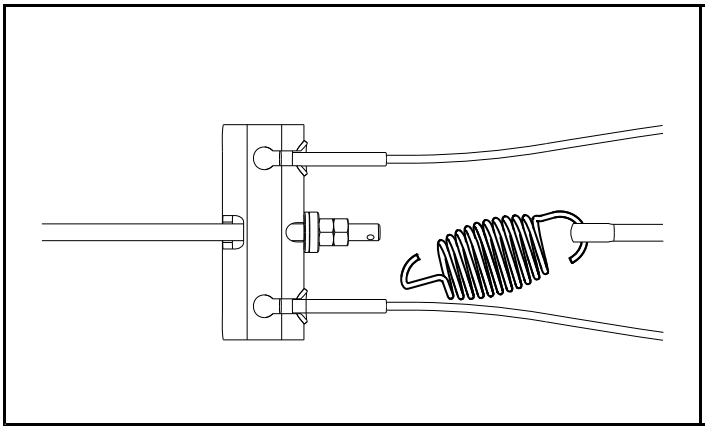

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Figure 6-19 Disconnect Equalizer Spring

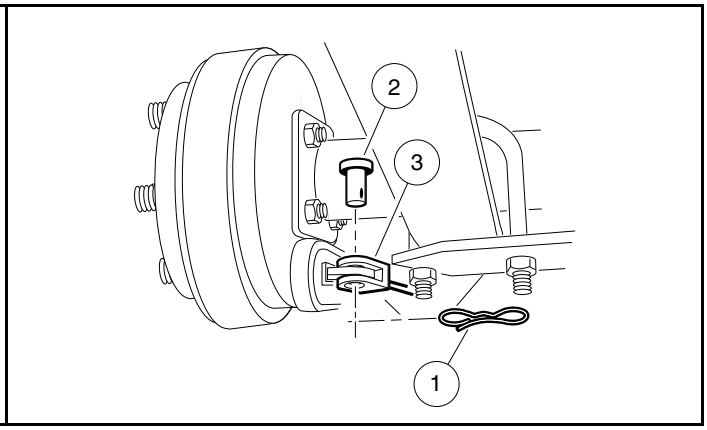

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Figure 6-20 Disconnect Cables at Brake Clusters

6. At the equalizer bracket, disconnect brake cables by unhooking the cable heads from the slotted keyholes in bracket **(Figure 6-21, Page 6-11)**.
7. Release mounting tabs (3) that anchor the cables to the vehicle by removing nuts (1) from bolts (2) that secure front of the leaf spring **(Figure 6-22, Page 6-11)**. Do not remove bolt (2).

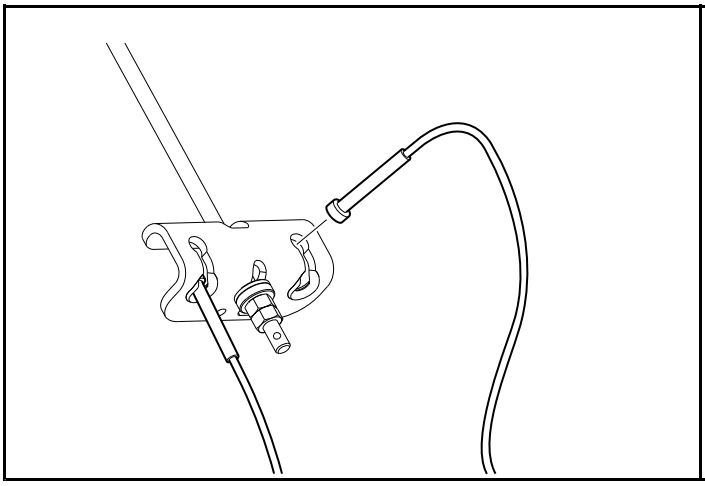

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Figure 6-21 Disconnect Cables at Equalizer Bracket

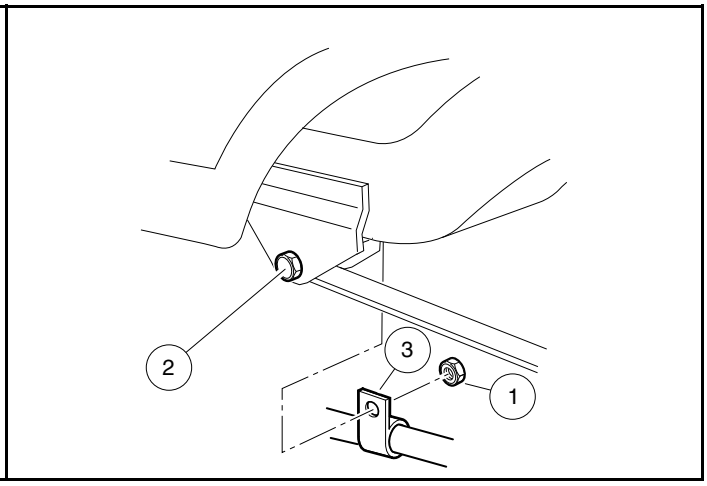

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Figure 6-22 Brake Cable Mounting Tab

8. Using the brake cable release tool (P/N 102555501), compress the retaining clips on each end of the cable sheathing to release cables from frame crossmember **(Figure 6-23, Page 6-12)** and shock mounting bracket **(Figure 6-24, Page 6-12)**.
9. Remove brake cables from vehicle.

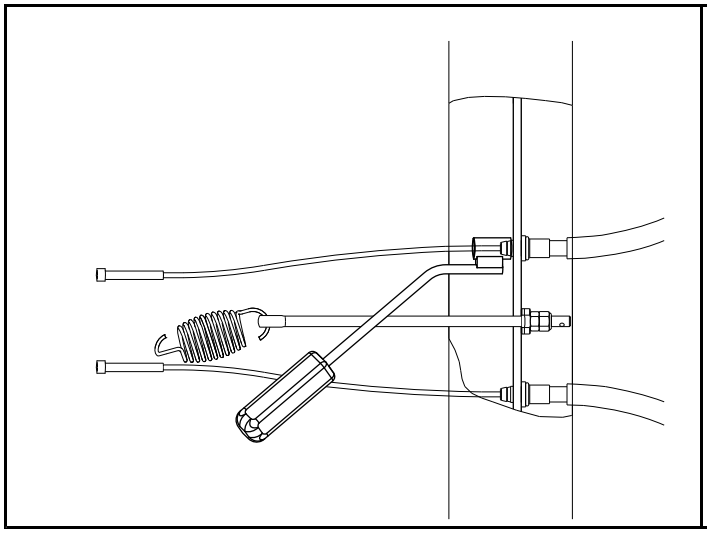

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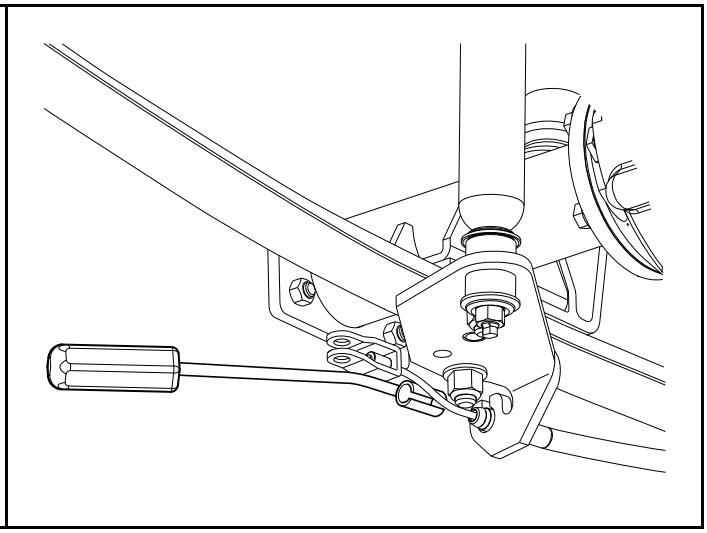
Figure 6-23 Release Brake Cables from Crossmember



3096
Figure 6-24 Release Brake Cables from Shock Mounting Bracket

BRAKE CABLE INSTALLATION

NOTE: *The driver-side and passenger-side brake cables are not interchangeable due to the mounting tab orientation. Make sure the correct cable is used on the correct side.*

1. Insert the front end of the new brake cables through the hole in the frame crossmember. Push the retaining clips on the cable sheathing fully into the frame crossmember to secure in place.
2. Connect the cable heads through the keyholes in the equalizer bracket **(Figure 6-21, Page 6-11)**.
3. Insert the rear end of the new brake cables into the shock mount brackets (4). Push the retaining clips on the cable sheathing fully into the shock mount bracket (4) to secure in place.
4. At each brake cluster, connect brake cable clevis (3) to the brake lever with clevis pin (2) and bow tie locking pin (1) **(Figure 6-20, Page 6-11)**.
5. Place mounting tabs (3) of brake cables onto the forward leaf spring mounting bolts (2) and install nuts (1) **(Figure 6-22, Page 6-11)**. Tighten nuts (1) to 18.4 ft·lb (25 N·m).
6. Adjust the brakes. **See Brake Equalizer Adjustment on page 6-14.**

BRAKE LINKAGE ADJUSTMENT

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

After maintenance or service to the pedal group or brake linkage is complete, the linkage must be adjusted. With the brake pedal in the full up (at rest) position, adjust linkage using the following procedure.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries on page 1-3.**
2. Place chocks at the front wheels.
3. Lift rear of vehicle and support on jack stands. **See Lifting Only The Rear, Section 3, Page 3-5.**
4. To release tension in the brake system, disconnect equalizer spring from middle equalizer rod **(Figure 6-25, Page 6-13)**.
5. Gain access to the turnbuckle (1) by removing the floor mat and access panel **(Figure 6-26, Page 6-13)**. **See Pedal Group Removal on page 5-1.**
6. Loosen the two jam nuts (2 and 3) on either side of turnbuckle (1). Note that the forward jam nut (2) is a left-hand thread. Thread each nut approximately 1/4 to 3/8 inch (6 to 10 mm) away from the turnbuckle.

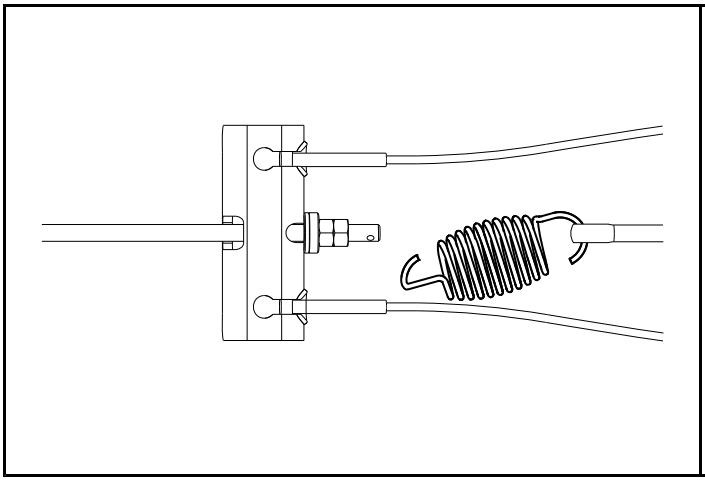


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Figure 6-25 Disconnect Equalizer Spring

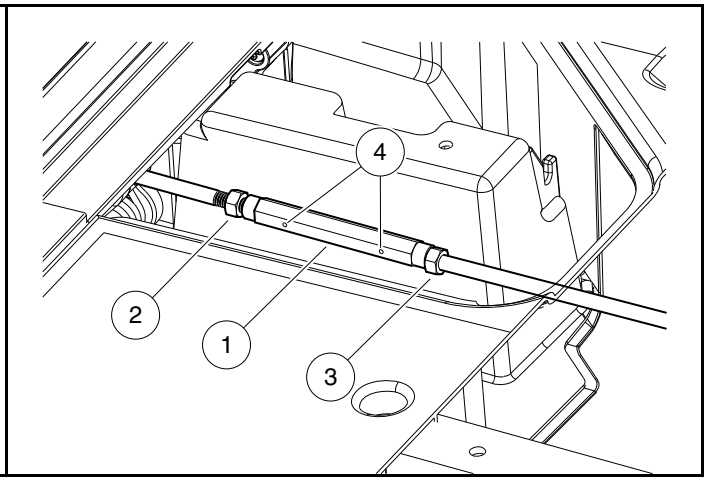

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Figure 6-26 Loosen Turnbuckle

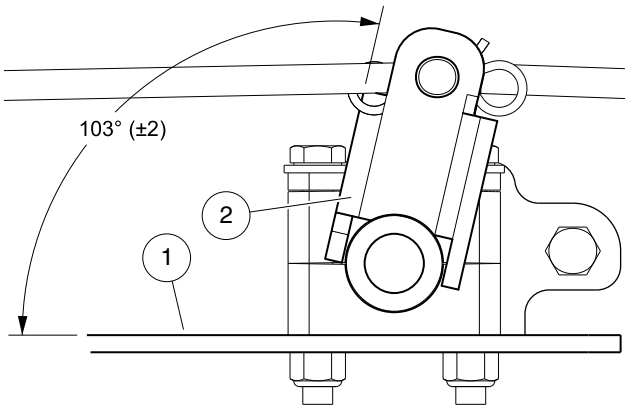
7. Adjust the turnbuckle (1) to achieve proper bellcrank angle. Rotate turnbuckle until the bellcrank arms (2) are 103° (±2) from the bellcrank mounting brackets (1) as shown **(Figure 6-27, Page 6-14)**.
8. At the turnbuckle (1), ensure both threaded rods are visible in the witness holes (4) of the turnbuckle (1) before the jam nuts (2 and 3) are tightened **(Figure 6-26, Page 6-13)**.
9. Apply Loctite® 242 on the threaded rods for both front and rear jam nuts (2 and 3) and thread both jam nuts against turnbuckle (1).
10. Tighten the rear jam nut (3) first to 208 in·lb (23.5 N·m), then tighten the front jam nut (2) to 208 in·lb (23.5 N·m). **See following WARNING.**

⚠ WARNING

- **Reduced braking force could result if the jam nuts (2 and 3) are not tightened in the proper sequence.**

11. Inspect the shortest, threaded rod for proper setup.
    11.1. Verify the cone (1) and cup (2) washers are installed as shown **(Figure 6-28, Page 6-14)**. The flat side of the cone washer must be against the frame crossmember. Then the cupped side of the cup washer (2) fits over the cone washer (1).

11.2. Ensure the shortest threaded rod is installed the correct distance of 7.31 inches (±0.08) (185.7 mm (±2)) from the front face of the crossmember to the forward most part of the hole for the spring **(Figure 6-28, Page 6-14)**.



1. Bellcrank Mounting Bracket 2. Bellcrank Arm

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Figure 6-27 Proper Bellcrank Angle

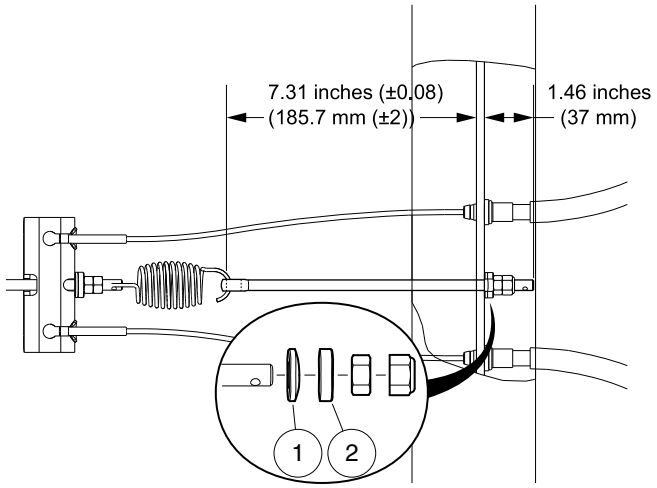

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Figure 6-28 Short Threaded Rod Setting

12. Reconnect equalizer spring to equalizer rods.
13. Check brake cable equalizer tension. **See Brake Equalizer Adjustment on page 6-14.**
14. Lower the vehicle onto the floor and remove chocks.
15. Replace access panel and floor mat. **See Pedal Group Installation, Section 5, Page 5-3.**
16. Connect batteries. **See Connecting the Batteries, Section 1, Page 1-3.**

BRAKE EQUALIZER ADJUSTMENT

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

After maintenance or service to the brake clusters, shoes or cables is complete, the brake cable equalizer must be adjusted. With the brake pedal in the full up (at rest) position, adjust the equalizer using the following procedure.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries on page 1-3.**
2. Place chocks at the front wheels.
3. Lift rear of vehicle and support on jack stands. **See Lifting Only The Rear, Section 3, Page 3-5.**
4. Inspect the shortest, threaded rod for proper setup.
   4.1. Verify the cone (1) and cup (2) washers are installed as shown **(Figure 6-29, Page 6-15)**. The flat side of the cone washer must be against the frame crossmember. Then the cupped side of the cup washer (2) fits over the cone washer (1).
   4.2. Ensure the shortest threaded rod is installed the correct distance of 7.31 inches (±0.08) (185.7 mm (±2)) from the front face of the crossmember to the forward most part of the hole for the spring **(Figure 6-29, Page 6-15)**.

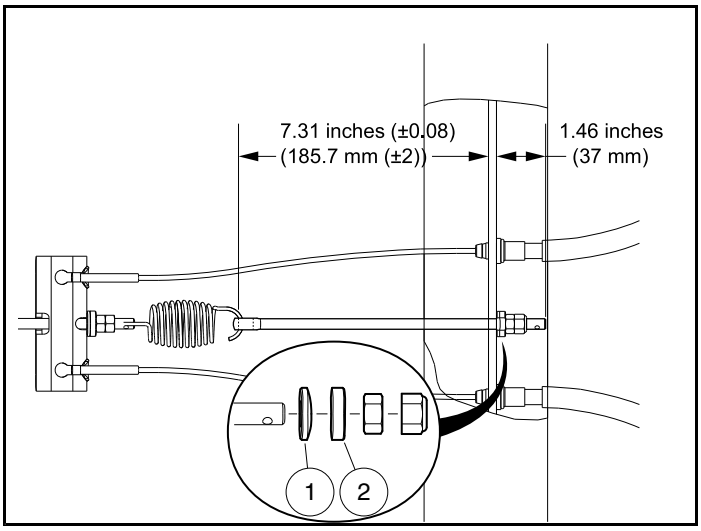

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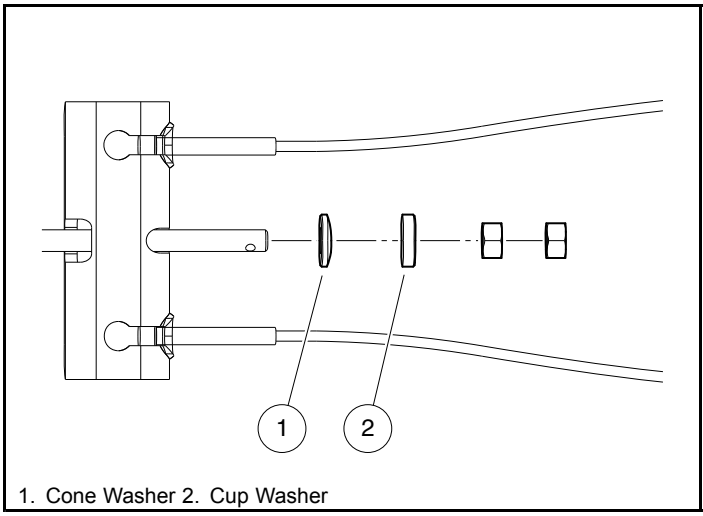
Figure 6-29 Short Threaded Rod Setting

5. Adjust equalizer bracket.
   5.1. Verify the cone (1) and cup (2) washers are properly installed **(Figure 6-30, Page 6-15)**. The flat side of the cone washer must be against the equalizer bracket. Then the cupped side of the cup washer (2) fits over the cone washer (1).
   5.2. Place a 0.06 to 0.10 inch (1.5 to 2.5 mm) shim between cup washer and adjusting nut **(Figure 6-31, Page 6-15)**.
   5.3. Finger-tighten adjusting nut against shim until shim is captured and will stay in place when released from finger grip.
   5.4. Apply Loctite® 242 on the threaded rod between adjusting nut and jam nut.
   5.5. Thread jam nut against the adjusting nut and tighten to 208 in·lb (23.5 N·m).
   5.6. Remove shim.



1. Cone Washer 2. Cup Washer

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Figure 6-30 Cup and Cone Washer Orientation

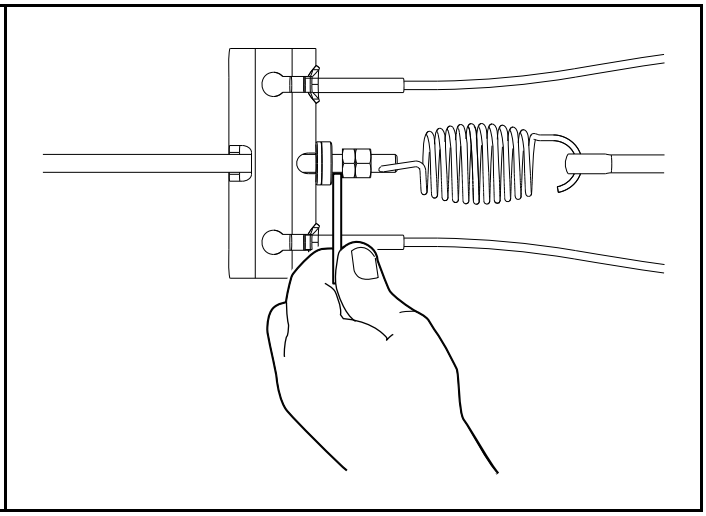

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Figure 6-31 Shim Between Cup Washer and Adjusting Nut

6. Lower the vehicle onto the floor and remove chocks.
7. Connect batteries. **See Connecting the Batteries, Section 1, Page 1-3.**
8. For optimal performance, drive the vehicle and apply the brakes approximately 20 times to burnish the shoes, center the clusters, and adjust the brake mechanism.

⚠ 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. **Electric Vehicle:** Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries on page 1-3.**
2. Rotate steering wheel to a straight ahead position.

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

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

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

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

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

5.3. Rotate the anvil screw (7) clockwise until the base plate (6) contacts the bottom of the steering wheel (3) at the steering column **(Figure 7-2, Page 7-2)**.

5.4. Use a 1/2-inch drive air impact wrench to tighten the anvil screw (7) until the steering wheel releases from the steering shaft.

5.5. Remove the steering wheel from the steering column.

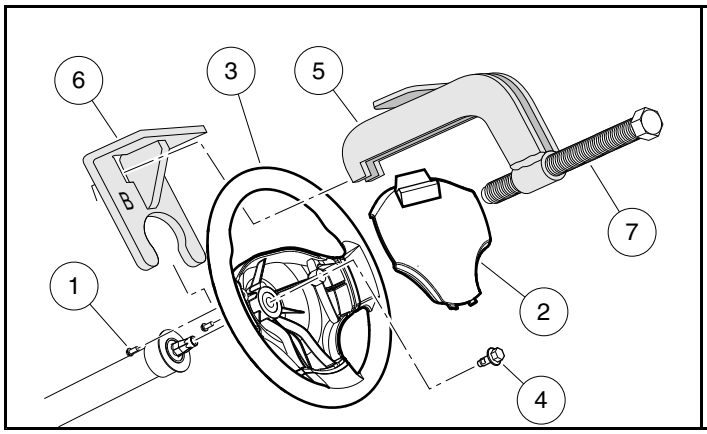

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Figure 7-1 Steering Wheel Removal

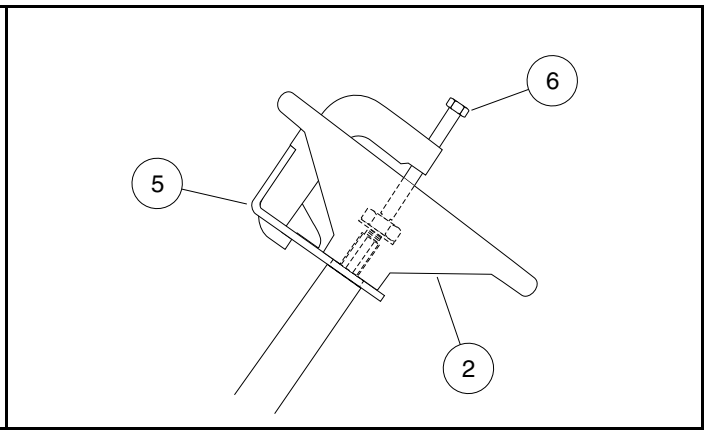

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Figure 7-2 Steering Wheel Puller

STEERING WHEEL INSTALLATION

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 before installing the steering wheel.*

1. Install the steering wheel (3) on the hex portion of the steering shaft. Align the hex fitting of the wheel with the steering column shaft **(Figure 7-1, Page 7-2)**.
2. Install steering wheel retaining bolt (4) and tighten to 37 ft·lb (50 N·m).
3. Place cover (2) onto steering wheel and secure with two screws (1). Tighten screws to 15 in·lb (1.7 N·m).
4. **Electric Vehicle:** Connect batteries. **See Connecting the Batteries, Section 1, Page 1-3.**

STEERING COLUMN

See General Warnings on page 1-2.

STEERING COLUMN REMOVAL

1. **Electric Vehicle:** Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries on page 1-3.**
2. Remove the steering wheel. **See Steering Wheel Removal on page 7-1.**
3. Remove the dash insert, instrument panel, dash assembly, and front bumper. See Section 4 – Body and Trim.
4. Remove the bolt (11) that secures the steering column universal joint to the pinion shaft of the steering gear **(Figure 7-3, Page 7-3)**.
5. Remove the four bolts (10) that secure the steering column to the frame.
6. Remove the steering column from the vehicle.

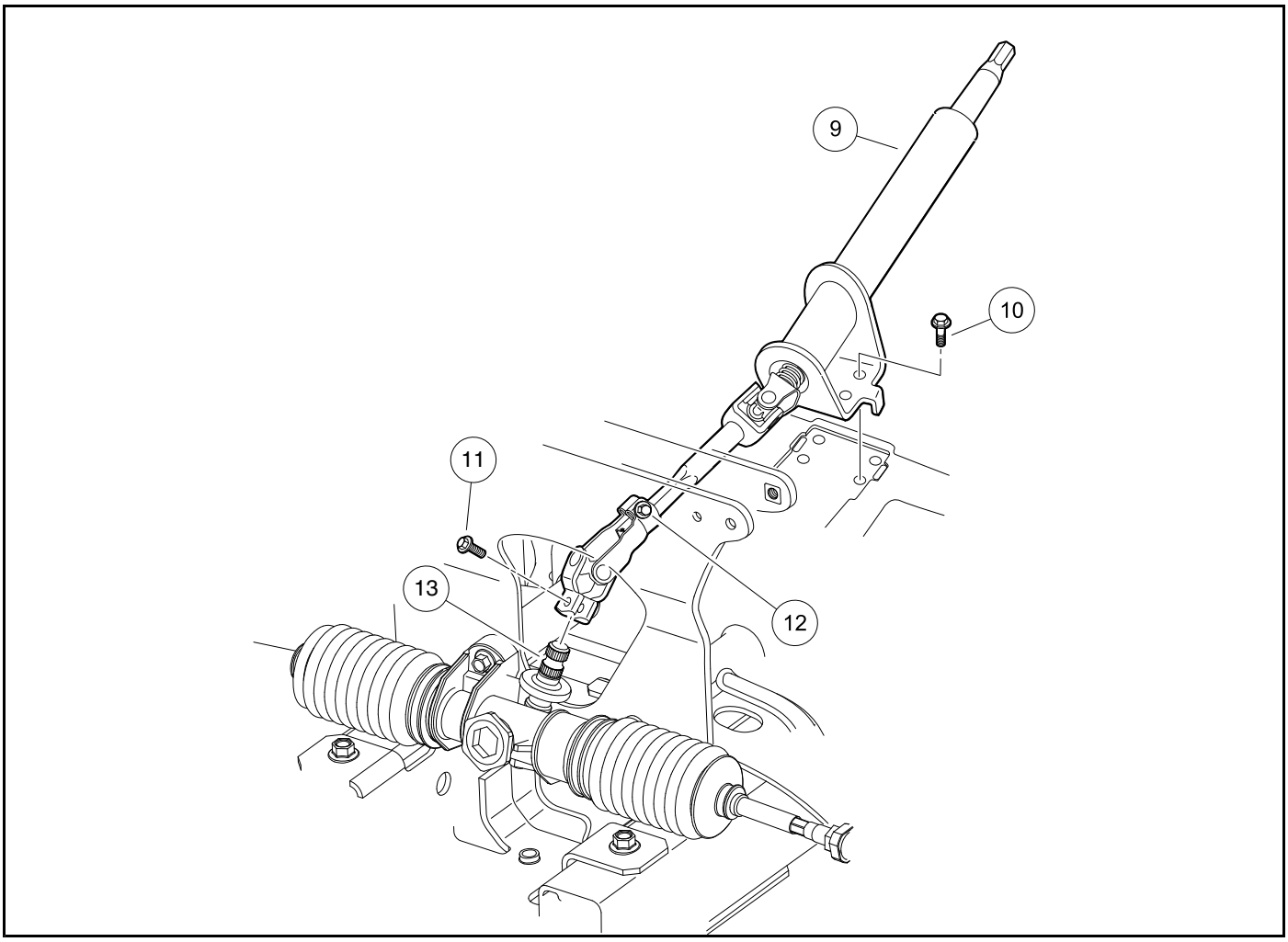

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Figure 7-3 Steering Column

STEERING COLUMN INSTALLATION

1. For ease of assembly and to prevent corrosion, apply a light coat of anti-seize or lubricating compound to the splined stud extending from the steering gear.
2. Insert the end of the steering column with the universal joint through the front underbody. Install universal joint onto pinion shaft of steering gear. Loosely install bolt (11). Do not tighten until steering column is mounted to frame in step 3 **(Figure 7-3, Page 7-3)**.
3. Align the holes in the steering column mounting bracket with holes in the vehicle frame. Secure column to frame with four bolts (10). Tighten bolts to 18.4 ft·lb (25 N·m).
4. Tighten universal joint bolt (11) to 18.4 ft·lb (25 N·m). Verify the upper universal joint bolt (12) torque is 18.4 ft·lb (25 N·m).
5. Install front bumper, dash assembly, dash insert, and instrument panel. See Section 4 – Body and Trim.
6. Install steering wheel. **See Steering Wheel Installation on page 7-2.**
7. **Electric Vehicle:** Connect batteries. **See Connecting the Batteries, Section 1, Page 1-3.**

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 7-4. The manufacturer recommends inspecting the rack and pinion and replacing if damaged.**

RACK AND PINION INSPECTION

1. 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.
2. Compare the toe-in against the specification. **See Toe-in Adjustment on page 7-7.**
3. 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.
4. In the event of an 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.

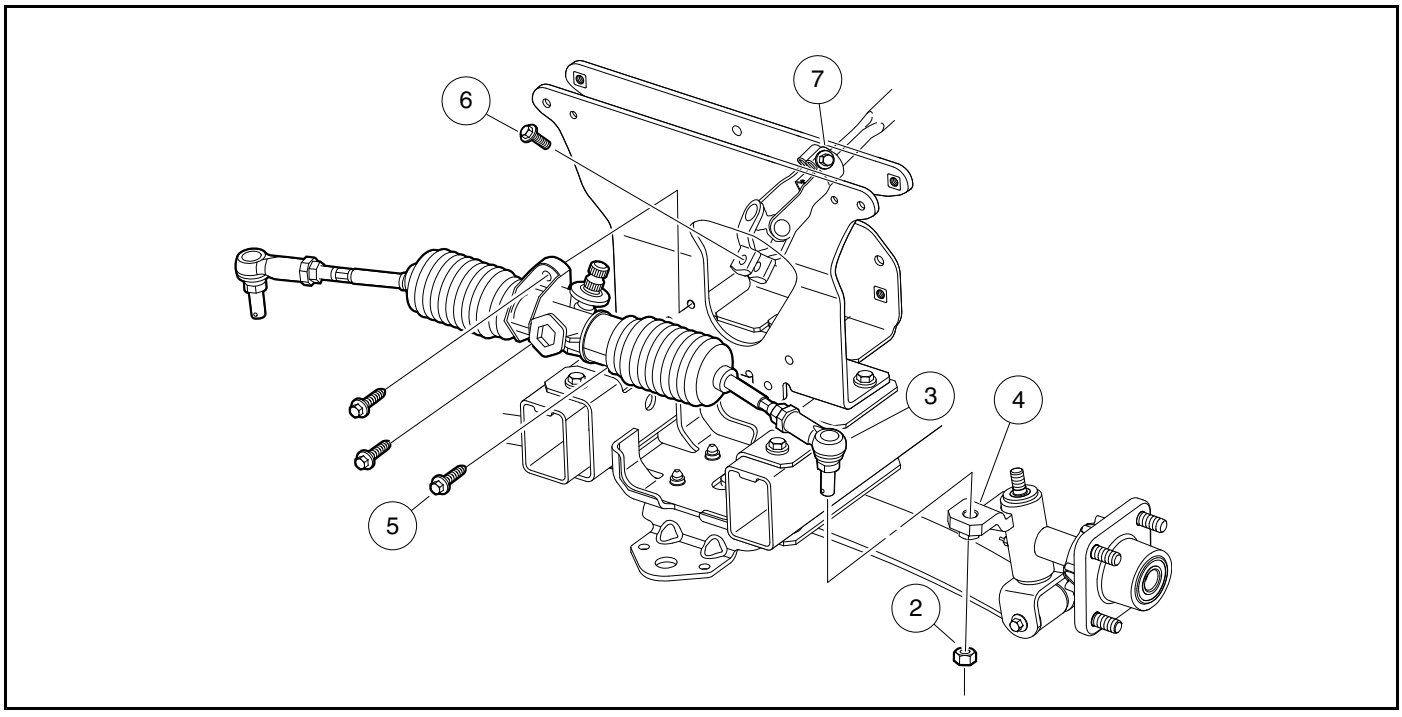

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Figure 7-4 Rack and Pinion Removal

RACK AND PINION REMOVAL

1. **Electric Vehicle:** Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries on page 1-3.**
2. Remove the front bumper as instructed. See Section 4 – Body and Trim.
3. Remove the tie rod end retaining nuts (2) **(Figure 7-4, Page 7-4)**.
4. Remove the tie rod ends (3) from the spindle assemblies.
5. Remove the three bolts (5) from the steering rack and pinion assembly mounting bracket.
6. Remove the upper bolt (7) from the universal joint, then remove the rack and pinion assembly and universal joint from the vehicle.

RACK AND PINION INSTALLATION

1. To minimize corrosion, apply a light coat of anti-seize lubricating compound to the end of the steering column shaft.
2. Simultaneously slide the universal joint over the square end of the steering column shaft and position the assembly over the mounting holes in the chassis.
3. Install three screws to secure the assembly to the chassis. Tighten screws to 22 ft·lb (30 N·m).
4. Install the upper universal joint bolt (7) and tighten to 18.4 ft·lb (25 N·m) **(Figure 7-4, Page 7-4)**.
5. Install the tie rod ends (3) into the left- and right-hand spindle tabs (4), and then install the retaining nuts (2) **(Figure 7-4, Page 7-4)**. **See following WARNING.**

⚠ WARNING

- **Do not operate vehicle until toe-in is adjusted and ball joints are secured.**

6. Adjust the toe-in. **See Toe-in Adjustment on page 7-7.**
7. **Electric Vehicle:** Connect batteries. **See Connecting the Batteries, Section 1, Page 1-3.**
8. Test drive vehicle before returning it to service.

FRONT SUSPENSION

See General Warnings on page 1-2.

LUBRICATION

Two grease fittings are provided (one in each spindle housing). Lubricate these fittings at the recommended interval with the proper lubricant. **See Periodic Lubrication Schedule on page 10-6.**

CAUTION

- **To ensure proper lubrication, raise front of vehicle to lubricate. See General Warnings on page 1-2.**

WHEEL ALIGNMENT

Wheel alignment is limited to equalizing the camber angle of each front wheel and adjusting toe-in of the front wheels.

NOTE: *Prior to making any front suspension adjustments, inspect components for wear or 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 7-5, Page 7-7)**.
2. Loosen, but do not remove, the four bolts (17) that secure the leaf spring (13) to the bottom spring plate (16) **(Figure 7-11, Page 7-12)**. **See also Figure 7-6, Page 7-7.**
3. Loosen, but do not remove, the hex nut (8) on the adjustment eccentric (7) **(Figure 7-6, Page 7-7)** in the center of the spring. **See also Figure 7-11, Page 7-12.**
4. Use a 7 mm deep well socket to rotate the eccentric **(Figure 7-6, Page 7-7)**.
5. After adjusting camber, use a crisscross pattern to tighten the four spring retaining bolts (17) **(Figure 7-11, Page 7-12)** to 37 ft·lb (50 N·m). Then roll the vehicle forward one full tire revolution and recheck the camber. **See also Figure 7-5, Page 7-7.**
6. Tighten the hex nut (8) on the adjustment eccentric (7) to 10 ft·lb (13.5 N·m) **(Figure 7-6, Page 7-7)**. **See also Figure 7-11, Page 7-12.**

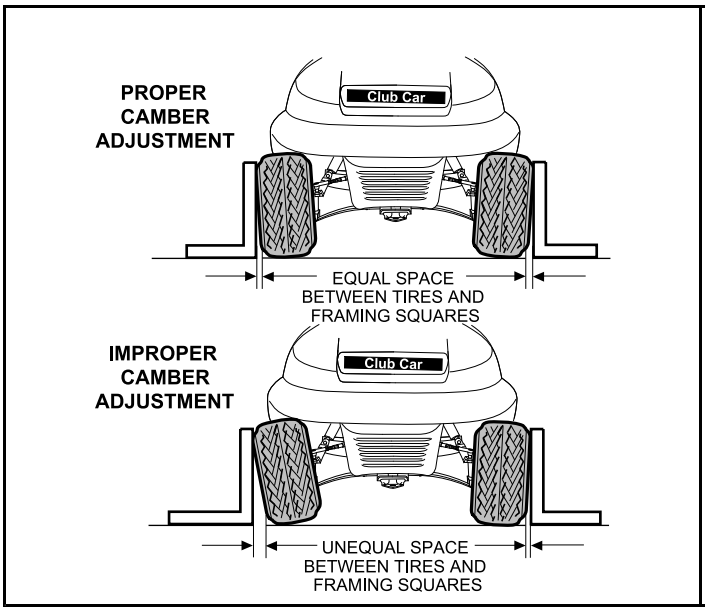

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Figure 7-5 Check Camber

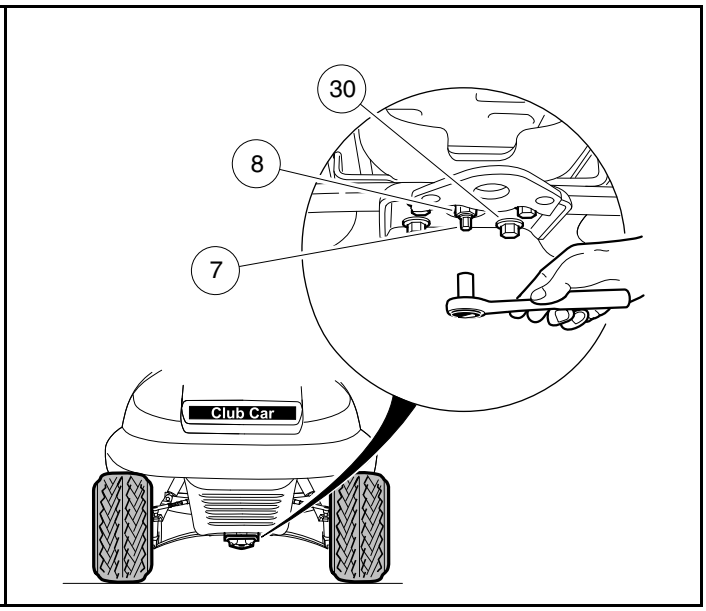

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Figure 7-6 Adjust Camber

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

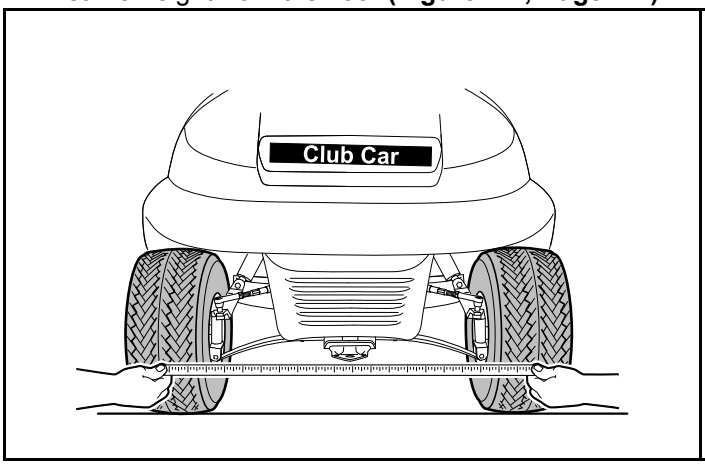

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Figure 7-7 Check Toe-In

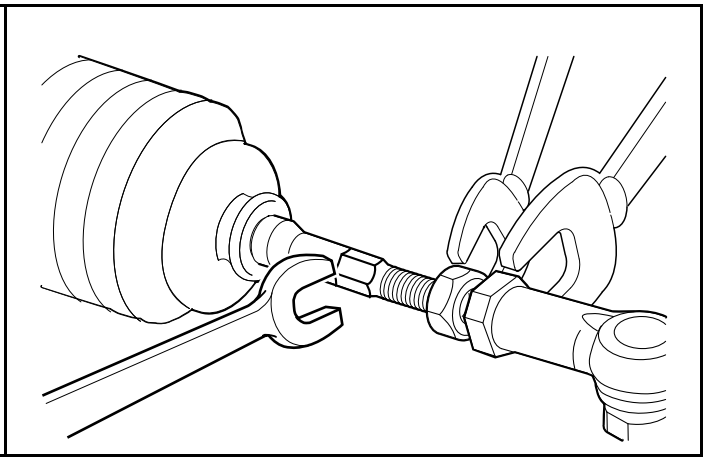

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Figure 7-8 Adjust Toe-In

4. Measure the distance between the marks on the forward-facing surfaces of the tires **(Figure 7-7, Page 7-7)**.

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 3/8 inch (±1/8) (9.5 mm (±3.2)).
6. If adjustment is necessary, proceed as follows:
   6.1. Loosen the jam nuts on both ends of each drag link **(Figure 7-8, Page 7-7)**.

6.2. Rotate both of the drag links equally. To increase the toe-in, rotate both drag links counterclockwise. To decrease the toe-in, rotate both drag links clockwise. Maintain an equal distance from the ball joint to the end of the threads on each drag link **(Figure 7-9, Page 7-8)**.

6.3. Tighten jam nuts to 26 ft·lb (35 N·m).

6.4. Check the toe-in, and repeat the adjustment procedure if necessary.

6.5. 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.

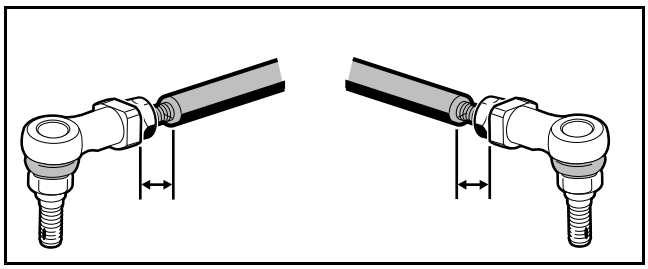

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Figure 7-9 Adjust Both Drag Links To An Equal Distance

FRONT SUSPENSION COMPONENTS

See General Warnings on page 1-2.

TIE ROD END REMOVAL

1. **Electric Vehicle:** Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries on page 1-3.**
2. Loosen jam nuts (13) to allow later rotation of the tie rod ends (12) **(Figure 7-10, Page 7-11)**.
3. Remove the and retaining nuts (14).
4. Lift male thread of tie rod from the hole in the spindle tab.
5. Remove the tie rod ends from the steering gear.
6. To minimize corrosion, apply a light coat of anti-seize lubricating compound to the threads where the tie rod ends are installed.

TIE ROD INSTALLATION

1. Thread tie rod ends (12) onto steering gear to a depth of 1/2 inch (12.5 mm) **(Figure 7-10, Page 7-11)**.

⚠ WARNING

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

2. Install tie rod ends (12) into the spindle tabs. Install the retaining nuts (14) **(Figure 7-10, Page 7-11)**.
3. Adjust wheel toe-in. **See Toe-in Adjustment on page 7-7.**
4. **Electric Vehicle:** Connect batteries. **See Connecting the Batteries, Section 1, Page 1-3.**

LEAF SPRING REMOVAL

1. **Electric Vehicle:** Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries on page 1-3.**
2. Loosen lug nuts on both front wheels and raise front of vehicle with a chain hoist or floor jack. Place jack stands under the aluminum rails of the vehicle frame just aft of the front suspension. Lower the vehicle onto the jack stands. **See General Warnings on page 1-2.**
3. Remove both front wheels.
4. Remove the bolts (8) from the bottom of each kingpin (7) **(Figure 7-11, Page 7-12)**.
5. Remove the four bolts (17) and bottom spring plate (16).
6. Remove leaf spring (13).
7. Check the condition of the urethane bushings (15) and steel sleeves (14). Replace any that are worn or damaged.

LEAF SPRING INSTALLATION

1. Install urethane bushings (15) and steel sleeves (14) into leaf spring eyes **(Figure 7-11, Page 7-12)**.
2. Install leaf spring (13), bottom spring plate (16), and four bolts (17). Using a crisscross pattern sequence, tighten bolts to 37 ft·lb (50 N·m).
3. Install spring in kingpins (7) with bolts (8). Tighten to 30 ft·lb (41 N·m).
4. Install the wheels and finger tighten the lug nuts.
5. Lower the vehicle and finish tightening lug nuts (using a crisscross pattern) to 55 ft·lb (74.6 N·m).
6. Adjust camber and toe-in. **See Wheel Alignment on page 7-6.**
7. **Electric Vehicle:** Connect batteries. **See Connecting the Batteries, Section 1, Page 1-3.**

KINGPIN AND STEERING SPINDLE REMOVAL

1. **Electric Vehicle:** Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries on page 1-3.**
2. Remove the front hub. **See Front Hub Removal on page 7-13.**
3. Remove retaining nuts (14), then remove tie rod ends (12) from the tabs on the spindles **(Figure 7-10, Page 7-11)**.
4. Remove the nut (1) from the top of the kingpin (7) **(Figure 7-11, Page 7-12)**.
5. Raise the upper clevis from the kingpin.
6. Slide the spindle (3) off the kingpin (7).
7. Remove the wave washer (6) and inspect it. If the washer is broken or has a wave bottom to wave crest height dimension of less than 0.040 inch (1 mm), it must be replaced.
8. Remove bolt (8) from bottom of kingpin (7) and remove kingpin.
9. Inspect the kingpin and spindle. If either is worn or damaged, it must be replaced.
10. Inspect the bushings (4). If the bushings are worn or damaged, remove them and press in new ones. **See following NOTE.**

NOTE: *New bushings (4) may not fit the kingpin (7) after installing them into the spindle (3). Ream new bushings as required.*

10.1. After installing new bushings (4), ream bushings to 0.753 inch (±0.0005) (19.13 mm (±0.013)).

KINGPIN AND STEERING SPINDLE INSTALLATION

1. Inspect all parts and replace them as necessary.
2. Install the kingpin (7) over the leaf spring eye. Insert the bolt (8) **(Figure 7-11, Page 7-12)**. Tighten the bolt to 30 ft·lb (41 N·m).
3. Install the wave washer (6) on the kingpin.
4. Install the steering spindle on the kingpin. Place upper clevis over the kingpin threads and install nut (1). Tighten the nut to 70 ft·lb (95 N·m).
5. Attach the tie rod ends (12) to the spindle tabs, then install and tighten the nuts (14) to 70 ft·lb (95 N·m) **(Figure 7-10, Page 7-11)**.
6. Install front hub and wheel. **See Hub Installation on page 7-13.**
7. **Electric Vehicle:** Connect batteries. **See Connecting the Batteries, Section 1, Page 1-3.**

CONTROL ARM REMOVAL

1. **Electric Vehicle:** Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries on page 1-3.**
2. Loosen lug nuts on both front wheels and raise front of the vehicle with a chain hoist or floor jack. Place jack stands under the front aluminum rails of the vehicle frame and lower the vehicle onto the jack stands.
3. Remove wheel.
4. Remove bolts (17) and move rack and pinion to allow clearance for bolt (19) **(Figure 7-10, Page 7-11)**.
5. Remove bolts (11 and 19).
6. Remove the control arm (6).
7. Inspect the bushings (7) and sleeves (8 and 9) in the control arm and replace them if necessary.

CONTROL ARM INSTALLATION

1. Install the control arm in reverse order of removal. Tighten the control arm bolts (11 and 19) to 30 ft·lb (41 N·m) **(Figure 7-10, Page 7-11)**. Tighten three rack and pinion mounting bolts (17) to 22 ft·lb (30 N·m)
2. Install the wheels and adjust the wheel alignment as instructed on page 7-6.
3. **Electric Vehicle:** Connect batteries. **See Connecting the Batteries, Section 1, Page 1-3.**

SHOCK ABSORBER REMOVAL

1. Inspect the shock absorbers for fluid leakage at the point where the shaft enters the shock absorber body. Leaking shock absorbers should be replaced.
2. Remove the upper bolt (18) **(Figure 7-10, Page 7-11)**.
3. Remove the lower bolt (10).
4. Remove the shock absorber.

SHOCK ABSORBER INSTALLATION

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

1. Install the shock absorber by reversing the removal procedure.
2. Tighten the bolts to 16 ft·lb (21 N·m).

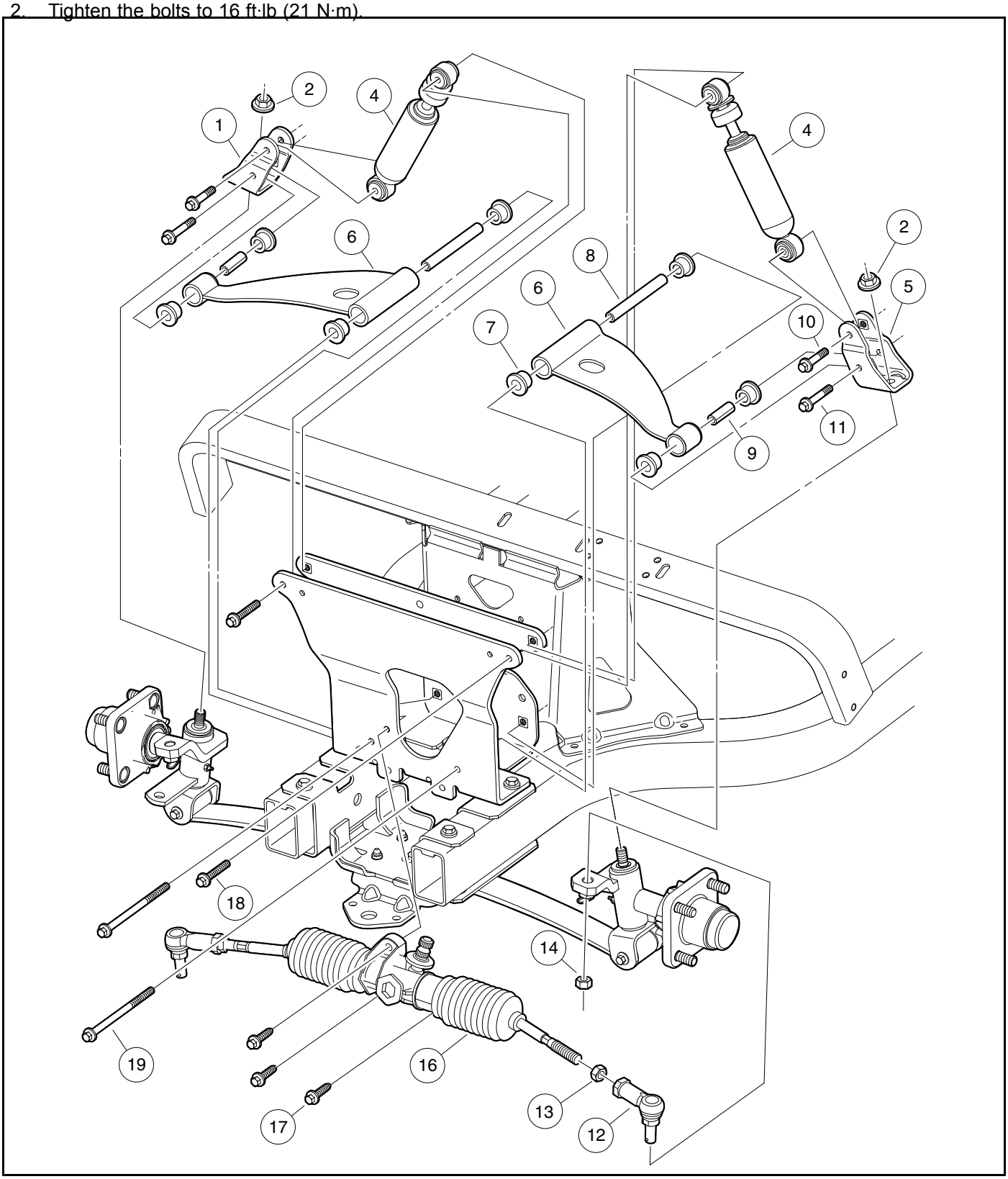

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Figure 7-10 Upper Front Suspension Assembly

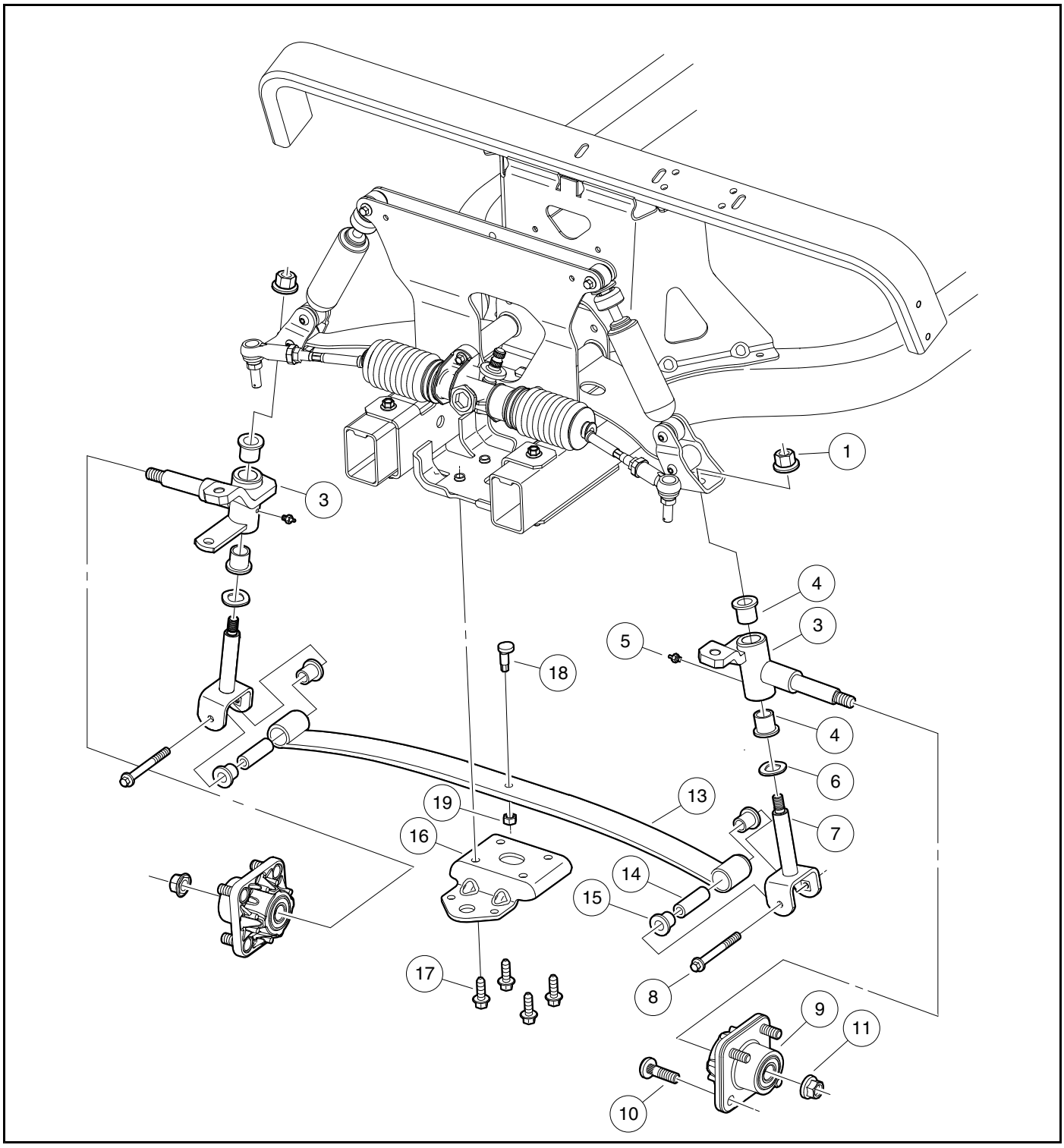

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Figure 7-11 Lower Front Suspension Assembly

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. **Electric Vehicle:** Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries on page 1-3.**
2. Raise the front of the vehicle.
3. 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 7-13.**

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 7-11, Page 7-12)**.
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 on page 7-9.**

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 7-12, Page 7-14)**.
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, to 55 ft·lb (74.6 N·m).
8. **Electric Vehicle:** Connect batteries. **See Connecting the Batteries, Section 1, Page 1-3.**

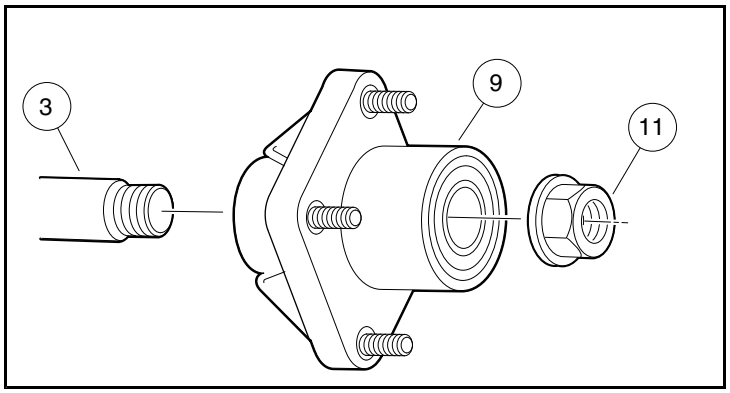

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Figure 7-12 Front Wheel Hub

⚠ DANGER

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

⚠ WARNING

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

GENERAL INFORMATION

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

- Keep tires properly inflated. See Vehicle Specifications.
- Keep lug nuts properly tightened.
- Keep the front end aligned and adjusted.

⚠ WARNING

- **Tires affect vehicle handling. When selecting a replacement tire, use only original equipment or comparable tires.**

WHEELS

See General Warnings on page 1-2.

WHEEL REMOVAL

1. **Electric Vehicle:** Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries on page 1-3.**
2. Slightly loosen the lug nuts on the wheel to be removed.
3. Raise the end of the vehicle from which the wheel is to be removed. Make sure that the wheels are off the ground. **See General Warnings on page 1-2.**
4. 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 lug nuts, using a crisscross pattern, to 55 ft·lb (74.6 N·m).
3. **Electric Vehicle:** Connect batteries. **See Connecting the Batteries, Section 1, Page 1-3.**

TIRES

See General Warnings on page 1-2.

TIRE REMOVAL

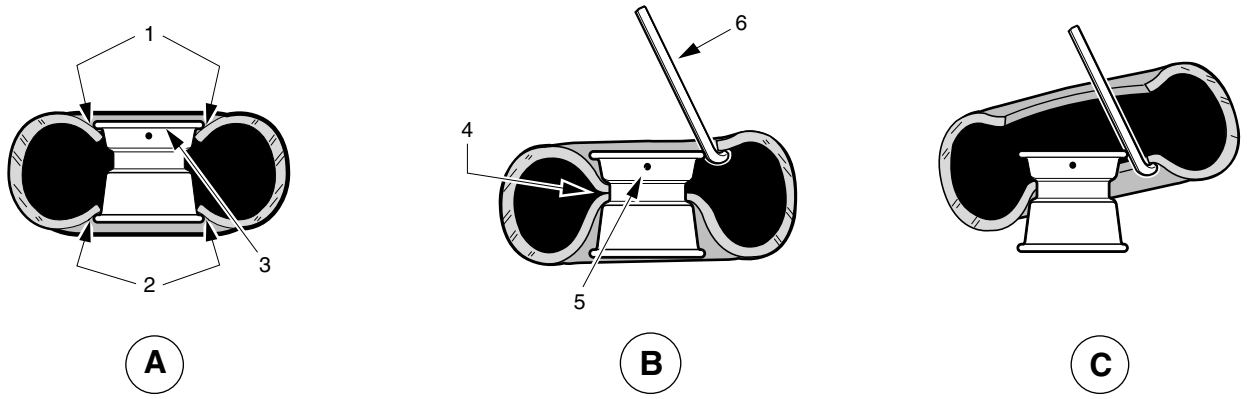
NOTE: *Tire must be removed or installed from the valve stem side of the rim.*

1. Remove the tire and wheel assembly from the vehicle as instructed above.
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 wheel rim **(Figure 8-1, Page 8-2, Detail B)**.

CAUTION

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

4. 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.
5. Once the lower bead is started over the rim flange, the tire can be removed from the rim by hand.



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

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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 psig (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 your local Club Car dealer.

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 wheel rim with a wire brush. Wipe away any debris with a clean cloth.

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 tire so that both beads are on the rim flange narrow bead seats.
6. Place tire and wheel assembly against wall in upright position and push it against wall while inflating tire from 30 through 35 psig (207 to 242 kPa). The three-point contact (wall, floor, and hand) will help ensure that beads snap into place and form a proper seal as tire is inflated **(Figure 8-2, Page 8-4)**. **See following WARNING.**

⚠ WARNING

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

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

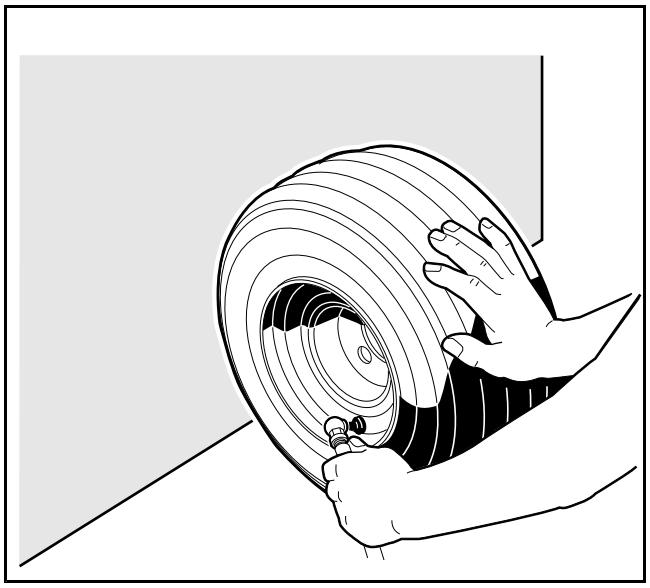

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Figure 8-2 Inflate Tire

⚠ 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 REMOVAL AND INSPECTION

1. Check shock absorbers (7) 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 9-3.
2. To remove a shock absorber, remove the nut (5), cup washer (9) and rubber bushings (10) from the stem at the top of the shock absorber.
3. Remove the nut (5), cup washer (9), and rubber bushings (10) from lower mounting stem.
4. Compress the shock absorber to remove it.

SHOCK ABSORBER INSTALLATION

1. To install, reverse the removal procedure.
2. On the upper and lower shock absorber mounting stems, tighten the nuts until the rubber bushing expands to the size of the cup washer.

LEAF SPRINGS (FOUR-PASSENGER VEHICLES)

See General Warnings on page 1-2.

LEAF SPRING REMOVAL (FOUR-PASSENGER VEHICLES)

1. **Electric Vehicle:** Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries on page 1-3.**
2. Lift rear of vehicle and support on jack stands. **See Lifting Only The Rear, Section 3, Page 3-5.**
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 locking pin (1) and the clevis pin (2) at the brake lever and brake cable connection, and remove cable end (3) from the brake lever **(Figure 6-20, Page 6-11)**. Detach the brake cable from the shock mount bracket (4). **See Brake Cable Removal, Section 6, Page 6-11.**
6. Remove the nut (5), cup washer (9), and rubber bushings (10) from the lower mounting stem of the shock absorber **(Figure 9-1, Page 9-3)**.
7. Remove the nuts (13) and the U-bolt (11) securing the spring and jounce bumper to the transaxle. Remove the shock mount bracket (15), jounce bumper bracket (20), and the U-bolt (11).
8. Remove the bolt (17) and nut (2) attaching the rear of the spring to the shackle (1).
9. Remove the nut (2) and bolt (17) attaching the front of the spring to the vehicle frame and remove the spring.
10. Inspect the bushings (4) and sleeves (3) in the spring eyes and replace them if they are worn or damaged.

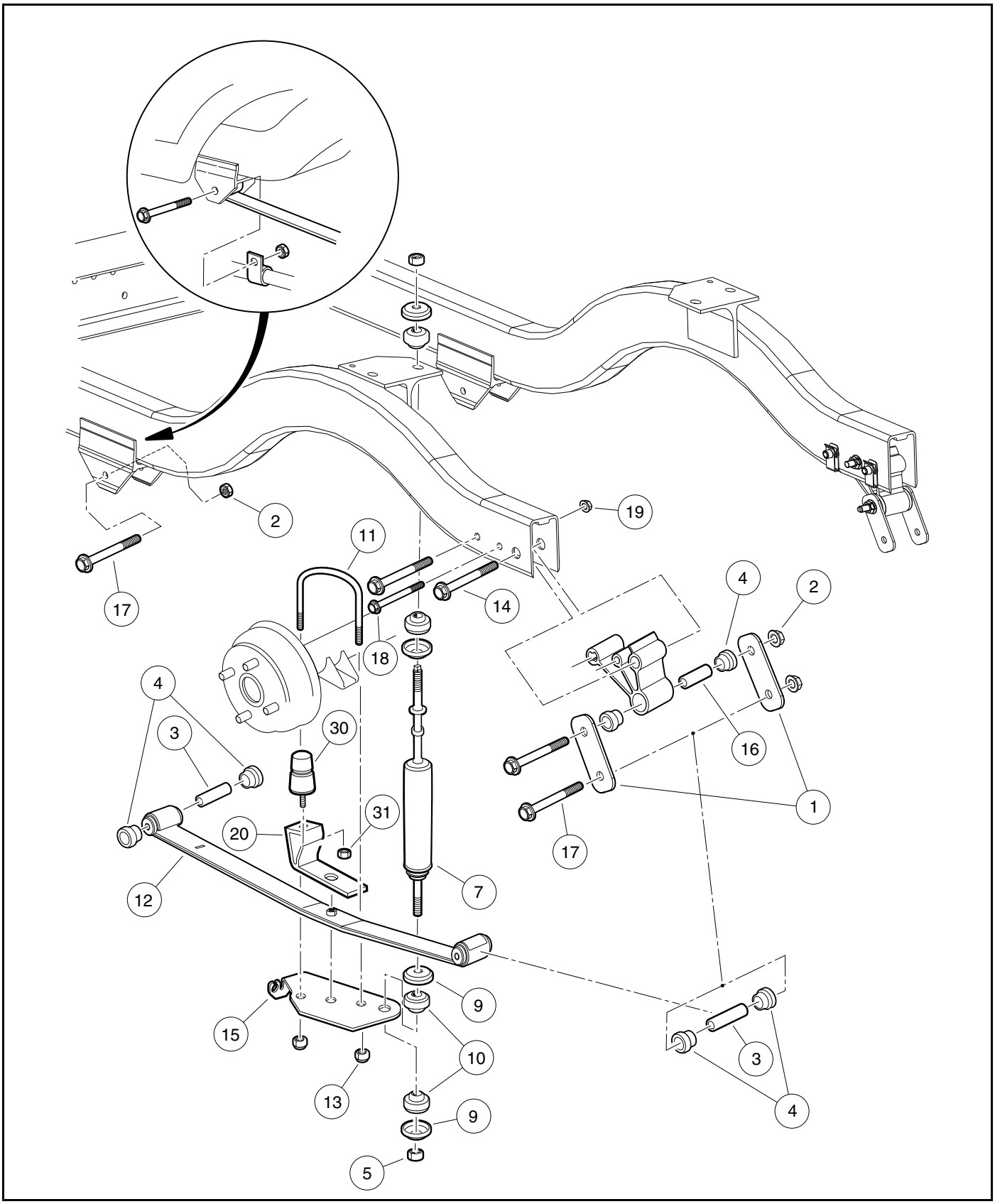

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Figure 9-1 Rear Suspension Assembly and Mounting (Four-Passenger Vehicles)

LEAF SPRING INSTALLATION (FOUR-PASSENGER VEHICLES)

1. To install the springs, reverse the removal procedure. **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. Tighten the nuts on the U-bolts to 25 ft·lb (34 N·m) and tighten nuts (2) on spring mounting bolts (17) to 18.5 ft·lb (25 N·m) **(Figure 9-1, Page 9-3)**.
3. Install tire and wheel assembly. **See Wheel Installation, Section 8, Page 8-1.**
4. **Electric Vehicle:** Connect batteries. **See Connecting the Batteries, Section 1, Page 1-3.**

GENERAL INFORMATION

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. 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.

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 10-1, and the Periodic Service Schedule on page 10-4. Any problems should be corrected by a Club Car distributor/dealer or a trained technician.

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.

- **General:** All the parts should be in place and properly installed. Be sure that all nuts, bolts, and screws are tight.
- **Safety and information decals:** Check to ensure that all safety and information decals are in place.
- **Tires:** Visually inspect tires for wear, damage, and proper inflation on a daily basis. **See Vehicle Specifications on page 2-3.**
- **Performance Inspection:** Inspect as instructed. **See Performance Inspection on page 10-1.**
- **Batteries:** Check electrolyte to ensure that it is at its proper level **(Figure 15-3, Page 15-10)**. Check battery posts. Wires should be tight and free of corrosion. Charge batteries fully before first use of vehicle.
- **Charger cord, plug, and receptacle:** Visually inspect for cracks, loose connections, and frayed wiring. **See Plug and Receptacle on page 16-3.**

⚠ WARNING

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

PERFORMANCE INSPECTION

After you have familiarized yourself with the vehicle controls and have read and understood the driving instructions, take the vehicle for a test drive.

Use the following checklist in conjunction with the Daily Pre-Operation and Safety Checklist as a guide to inspect the vehicle and check daily for proper operation. Any problems should be corrected by a Club Car distributor/dealer or a trained technician.

All Vehicles

- **Forward/Reverse switch:** Check for proper operation.
- **Brakes:** Be sure the brakes function properly. When brake pedal is pressed using moderate pressure, the vehicle should come to a smooth, straight stop. If the vehicle swerves or fails to stop, stops abruptly, or makes a grinding or squeaking noise, have the brake system checked and adjusted as required. Continued, moderate brake pedal pressure should be able to lock the wheels, but using lesser pressure should also permit a slow, gradual deceleration.
- **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 will 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's ride and performance. Have a Club Car distributor/dealer or a trained technician investigate anything unusual.
- **Accelerator:** With the key switch in the ON position and the Forward/Reverse switch in the FORWARD position, as the accelerator pedal is pressed, the motor should start and the vehicle should accelerate smoothly to full speed. When the pedal is released it should return to the original position. All Club Car vehicles operate at reduced speed in reverse.
- **Walk Away Braking:** With the vehicle parked on level ground and the park brake disengaged, place the Tow/Run switch in the RUN position and attempt to push the vehicle. Motor braking should engage and cause resistance to rolling ((moving at no more than 1 to 3 mph) (1.6 to 4.8 km/h)) with the Forward/Reverse switch in any position. When walk away motor braking is engaged, the reverse buzzer should emit a distinct pattern of beeps. **See following WARNING**.

⚠ WARNING

- **Walk Away Braking will not limit vehicle speed to 3 mph (4.8 km/h) on very steep grades. Do not operate vehicle on slopes exceeding 20% grades.**

- **Motor Braking:** Accelerate down an incline with the accelerator pedal fully pressed. When the vehicle reaches maximum programmed speed, motor braking should engage and limit the vehicle to its maximum programmed speed. On very steep grades, the vehicle may slightly exceed its maximum programmed speed, requiring the use of the brake pedal. Also, travel downhill with the accelerator pedal partially pressed. Motor braking should limit speed to less than top speed and maintain speeds proportional to the accelerator pedal position. On a level surface, accelerate the vehicle to full speed and then release the accelerator pedal. Motor braking should smoothly slow the vehicle to a complete stop or else allow the vehicle to coast freely, depending on the selected controller setting.

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 beginning on page 10-1, the Performance Inspection, 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 could result in fire, property damage, severe personal injury, or death.**
- **Only trained technicians should service or repair the vehicle or battery charger. 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.**
- **Hot! Do not attempt to service hot motor. Attempting to do so could cause severe burns.**
- **To avoid unintentionally starting the vehicle, disconnect the batteries and discharge the controller. See Disconnecting the Batteries on page 1-3.**

PERIODIC SERVICE SCHEDULE

NOTE: *If the vehicle is constantly subjected to heavy use or severe operating conditions, the preventive maintenance procedure should be performed more often than recommended in the periodic service and lubrication schedules.*

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

PERIODIC SERVICE SCHEDULE		
REGULAR INTERVAL	**SERVICE**	
Daily service by owner	Pre-Operation and Daily Safety Checklist	**See Pre-Operation and Daily Safety Checklist on page 10-1.**
	Performance Inspection	**See Performance Inspection on page 10-1.**
	Batteries	Charge batteries (after each daily use only).
Weekly service by owner	Batteries (For vehicles NOT equipped with the Single-Point Watering System)	Check electrolyte level. Add water if necessary. **See Battery Care – Vehicles Without the Single-Point Watering System on page 15-9.**
Monthly service by owner or trained technician	Batteries (For vehicles equipped with the Single-Point Watering System). Water monthly or according to the established watering interval.	Water the batteries. Observe that water flow occurs and no water overflows from any cell. **See Battery Care – Vehicles Equipped with the Single-Point Watering System on page 15-8.**
	Batteries	Wash battery tops and clean terminals with baking soda/water solution. Apply Battery Terminal Protector Spray (CC P/N 1014305) to battery terminals.
	Tires	Check air pressure and adjust if necessary. **See Vehicle Specifications on page 2-3.**
	General vehicles	Thoroughly wash vehicle including the underside.
Initial (one-time) inspection by owner or trained technician after six weeks of use	Batteries (For vehicles newly equipped with the SPWS)	For vehicles newly equipped with the SPWS, manually check battery electrolyte levels of all cells to verify correct valve operation. **See page 15-10.**

TABLE CONTINUED ON NEXT PAGE

PERIODIC SERVICE SCHEDULE		
REGULAR INTERVAL	**SERVICE**	
Semiannual service by trained technician only (every 50 hours of operation or 100 rounds of golf)	Brake system	Check brake shoes; replace if necessary.
		Lubricate brake system per Lubrication Schedule.
		Check brake cables for damage; replace if necessary.
		Check brake cable equalizer adjustment; adjust if necessary.
	Electrical wiring and connections	Check for tightness and damage; replace if necessary.
	Front wheel alignment and camber	Check and adjust as required.
Annual service by owner or trained technician (every 100 hours of operation or 200 rounds of golf)	Batteries (For vehicles equipped with the SPWS)	Manually check battery electrolyte levels of all cells to verify correct valve operation. **See page 15-10.**
	Safety decals	Check safety decals. Replace if damaged or illegible.
Annual service by trained technician only (every 100 hours of operation or 200 rounds of golf)	Batteries	If batteries are not performing as expected, contact your local authorized Club Car distributor/dealer.
	Pedal group	Lubricate all rotating joints. **See Periodic Lubrication Schedule on page 10-6.**
	General vehicle	Check for loose hardware; tighten if necessary.

⚠ WARNING

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

PERIODIC LUBRICATION SCHEDULE

PERIODIC LUBRICATION SCHEDULE			
REGULAR INTERVAL	**SERVICE**	**LUBRICATION POINTS**	**RECOMMENDED LUBRICANT**
Semiannually by owner or trained technician (every 50 hours of operation or 100 rounds of golf)	Charger receptacle	1	WD-40®
	Brake system, per maintenance and service manual.	2	Dry Moly Lube (CC P/N 1012151), white lithium grease NLGI #2
	Front suspension (two fittings)	3	Chassis Lube - EP NLGI Grade 2
Annually by trained technician only (every 100 hours of operation or 200 rounds of golf)	Check/fill transaxle to plug level	4	22 fl-oz (0.67 L) SAE 30 WT. API Class SE, SF, or SG Oil (or higher)
	Pedal group (as required)	5	Dupont™ Performance Dry Multi-Use Lubricant

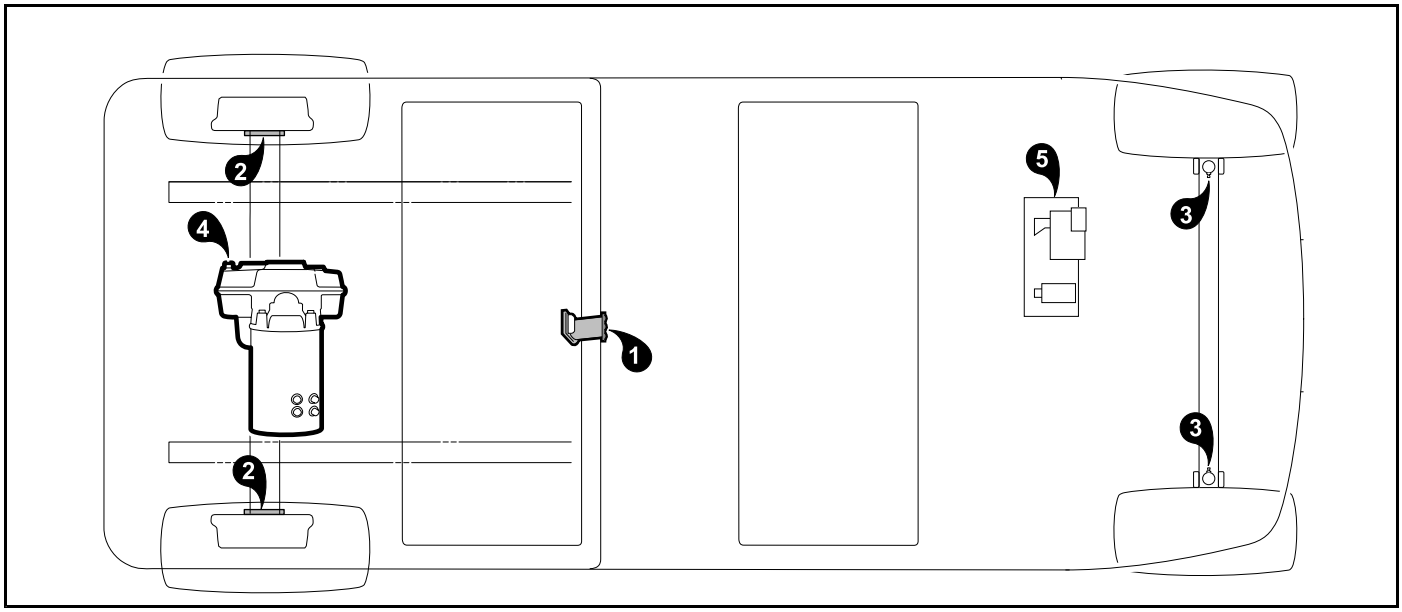

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Figure 10-1 Lubrication Points

⚠ DANGER

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

⚠ WARNING

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

NOTE: *For information specific to the IQDM-P handset programming features,* ***see IQ Display Module Programmer (IQDM-P): Excel System with ERIC Charging on page 12-1.***

The information presented in this section addresses the series 2 versions of the IQDM-P and IQDM handsets. IQDM series 1 and IQDM-P series 1 handsets are not compatible with the Excel System. ***See Figure 11-2, Page 11-1.***

This manual spans software releases version 34 and version 35. The software version can be viewed in the Information menu of the IQDM. ***See Information on page 11-20.***

PLUGGING THE HANDSET INTO THE VEHICLE

1. Connect one end of the cable to the port located on the bottom of the handset.
2. Connect the cable adaptor to the IQDM cable.
3. Find the IQDM port on the vehicle **(Figure 11-1, Page 11-1)**.
4. Remove the dust cap from the IQDM port.
5. Align the keyed portion of the plug with the IQDM port and connect the plug to the port.

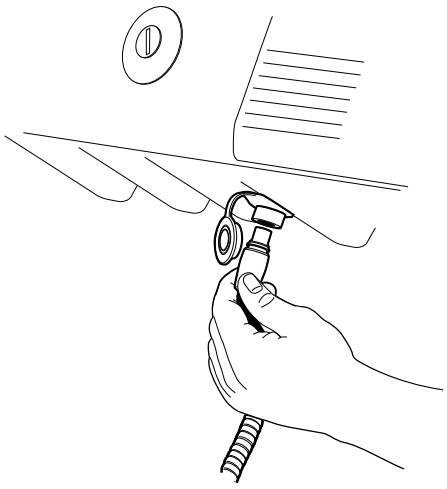

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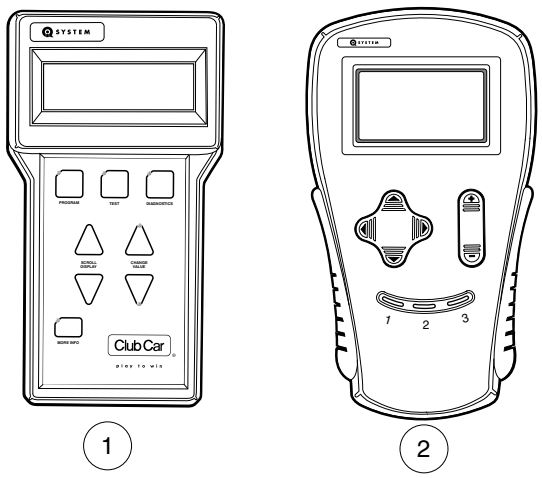
Figure 11-1 IQDM Port Under Instrument Panel



1. IQDM Series 1 (can not be used with Excel System)
2. IQDM Series 2

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Figure 11-2 IQDM Versions

QUICK REFERENCE GUIDE – EXCEL WITH ERIC CHARGING SYSTEM

OPERATION:	
Change screen contrast for better viewing by selecting the following: Programmer Setup, Program, LCD Contrast	
Preset Favorites: Select a frequently viewed screen, push and hold one of the three yellow keys until the display reads, “1,2,3 Bookmark Set”.	
Quick Programming: When changing Code A,B,C, Vehicle S/N, or Vehicle Decal, press and hold either the Plus (+) or Minus (-) key and the yellow keys simultaneously starting with yellow key 1, then 2, and finally 3.	
CONTROLLER FAULTS:	
Anti Tamper: If car is not equipped with Visage, make sure Control Mode is set to zero (0).	**Main Driver Off:** Replace controller.
Current Sense Fault: Clear the Fault History in IQDM. If fault does not return and car operates normally, do not replace controller. If fault remains in System Faults, or Fault History after clearing, and car will not operate, replace controller.	**Main Driver On:** Replace controller.
FLD Missing: Check in order: orange or blue wire broke or disconnected at motor/controller, short in motor. If good, replace controller.	**Main Driver Overcurrent:** Replace controller.
High Speed WalkAway: This is a symptom, not a cause. Most likely due to driver error. If not, check speed sensor on motor and key switch for proper operation.	**Main Dropout:** Solenoid or any component before it in circuit could be at fault. Check components from key switch to solenoid and connections.
HPD: Check throttle %. If at zero (0), is a driver issue.	**Main Dropout 2:** Symptom more than the cause; see other faults that accompany Main Dropout 2.
HW Failsafe: Replace controller.	**Main Weld:** Replace solenoid. If it doesn’t correct fault of car running at half speed, check accessory wiring.
Incorrect Password: Incorrect code being entered into controller, check code A,B,C.	**Motor Stall:** If car moves freely, issue not with vehicle, operator error.
Lockout Fault: This is a symptom, not a cause. Inspect and test the charger interlock circuit. If no problems are found in the charger interlock circuit, replace the controller.	**Overvoltage:** Controller reads 72 volts or more; it’s a symptom, not a cause. See other faults that accompany OV.
Low Battery Voltage: Check Battery Voltage Under a Load less than 34 volts; could be a symptom, not a cause.	**Speed Sensor:** Check connection; replace speed sensor.
Low SoC (State of Charge): This is a symptom, not a cause. Controller only acknowledges it happened and counts the number of occurrences. Charge batteries.	**Thermal Cutback:** Controller heatsink rises above 185° F (85° C); increased resistance causes issue.
M (Main) Coil Open: Broken or disconnected coil wire (B+ or B-), a defective solenoid coil. Replace solenoid.	**Throttle Fault:** Possible MCOR failure; perform additional diagnostic if car is running.
M– Shorted: Replace controller.	
WHEN IQDM IS NOT COMMUNICATING WITH CONTROLLER, CHECK THE FOLLOWING COMPONENTS:	
The main connection port is corroded. Plug directly into the controller. See Figure 11-9 on page 11-25.	The battery pack voltage is below 32 volts. Check pack voltage to see if it is above 32 volts.
The DC cord is plugged into the car for more than 10 minutes. Unplug DC Cord.	Grey wire (pin # 9) to controller (16-pin connector) is loose or broken.
The charger interlock circuit has failed. Check for voltage on Light Blue wire in pin 5 of 16-pin connector. **See Test Procedure 10 – Charger Interlock on page 13-25.**	15 Amp fuse in the harness has failed (Precedent Car only).
Tow/Run switch is in “Tow” position. Switch to “Run” position.	Sonic weld(s) in Tow switch circuit failed (wire harnesses vary; see wiring schematic for that model car)
The Tow circuit has failed. Check Tow switch, 16-pin connector, and wire harness.	The controller has failed.

INTRODUCTORY DISPLAY

Immediately after the handset is connected to the vehicle, it begins loading the vehicle speed controller information. After a few seconds, the screen displays the following menu items:

- Program (IQDM-P only)
- Monitor
- Faults
- Functions
- Information
- Programmer Setup

In the event that the handset does not display any information, or the screen is difficult to read, refer to the IQDM troubleshooting procedures. **See IQDM and IQDM-P Handset Troubleshooting on page 11-22.**

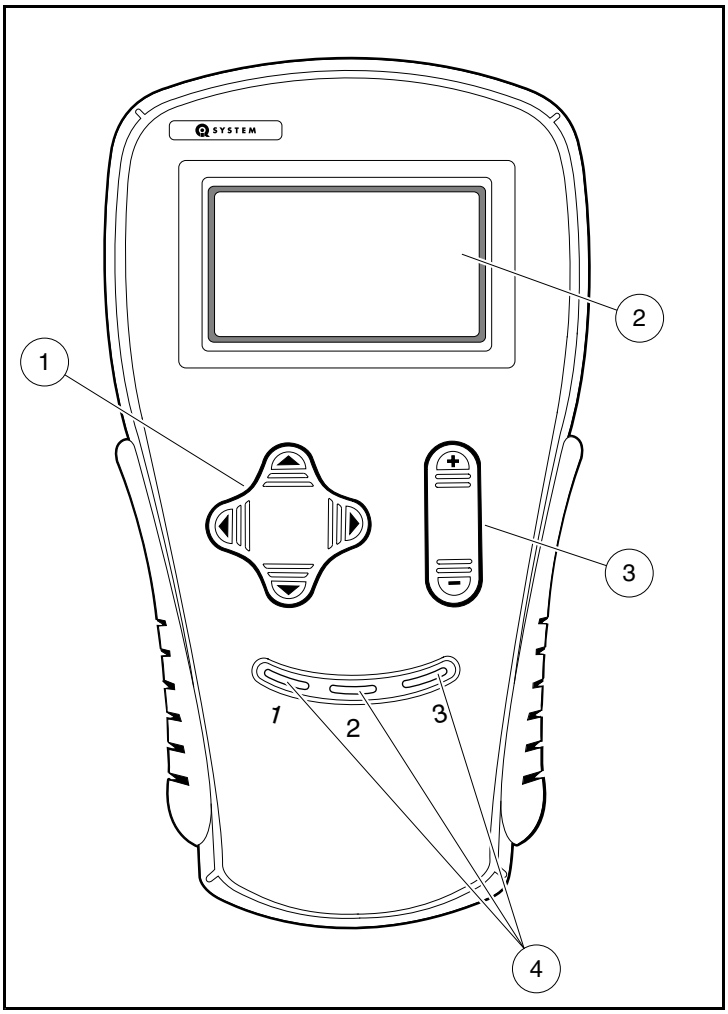

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Figure 11-3 Handset Controls

MENU NAVIGATION

The NAVIGATION BUTTON (1) is the four-arrow button located on the left side of the handset **(Figure 11-3, Page 11-3)**. This button is used to navigate through and select menus. Pressing the up or down arrows allows the user to scroll through the menu items. When the box beside the desired menu is blinking, pressing the right arrow selects that menu item. Pressing the left arrow allows the user to go back one screen (2).

The CHANGE VALUE BUTTON (3) is the button located on the right side of the handset **(Figure 11-3, Page 11-3)**. This button allows the user to change values by pressing "+" or "–".

The three yellow buttons labeled 1, 2 and 3 are BOOKMARK BUTTONS (4) **(Figure 11-3, Page 11-3)**. These buttons allow the user to bookmark up to three specific screens for rapid return to those screens. To bookmark a specific display screen, have the desired screen displayed and simply press and hold a bookmark button until the statement "bookmark set" is displayed. When it is necessary to go back to the bookmarked screen, rapidly press and release the appropriate bookmark button. **See following NOTE.**

NOTE: *When going to a bookmarked display screen, be sure to rapidly press and release the button. If the button is pressed and held for too long, the bookmark will be overridden with the current screen.*

The three yellow buttons also allow for quicker input of serial number and car decal number. Press and hold "+" or "–" while holding buttons 1, 2 or 3 to accelerate a number search.

The following menus are accessible on the IQDM handset:

PROGRAM (IQDM-P ONLY)

The *program* menu allows the user to view and change custom speed controller settings. **See Program Menu on page 12-2.**

MONITOR

The *monitor* menu displays values for certain parameters to facilitate speed controller troubleshooting. **See Monitor Menu on page 11-5.**

FAULTS

The *faults* menu displays all faults recorded by the speed controller since the history was last cleared. Each fault is listed only once, even if the fault has occurred multiple times. **See Faults Menu on page 11-9.**

FUNCTIONS

The *functions* menu allows the user to transfer all current settings from the speed controller to the handset and from the handset to the speed controller. **See Functions Menu on page 11-16.**

INFORMATION

The *information* menu displays the model number, serial number, manufacturer date and software version of the speed controller. **See Information on page 11-20.**

PROGRAMMER SETUP

The *programmer setup* menu allows the user to set the LCD contrast, display the fault history of the programmer as well as various other information pertaining to the handset such as model number, serial number, OEM information, etc. **See Programmer Setup on page 11-21.**

MONITOR MENU

The *monitor* menu is accessed by using the up or down arrow to scroll to *monitor* and pressing the right arrow key to activate the menu. All information in the *monitor* menu is updated in real time, allowing the trained technician to troubleshoot the vehicle by monitoring the handset as the key switch is cycled, Forward/Reverse switch is activated, etc. **See following NOTE.**

NOTE: *Values appearing in these menus represent approximate measurements made by the controller and may differ from measurements made by external instruments.*

Since the *monitor* menu is updated while the vehicle is in operation, the trained technician has the ability to monitor the status of several components in conditions or locations where a problem with vehicle performance has been reported. **See following WARNING.**

⚠ WARNING

- **The vehicle operator should not monitor the handset while the vehicle is in motion. A technician can monitor the handset while traveling as a passenger in the vehicle. Failure to heed this warning could result in severe personal injury or death.**

The following parameters can be monitored in real time with the handset from the *monitor* menu:

BATT VOLTAGE

Displays the current battery voltage at the speed controller.

BDI PERCENT

Battery Display Indicator (BDI) Percent displays the current battery state of charge as a percent. It is based on several parameters monitored by the controller.

SPEED

Vehicle speed in mph. Only visible with the IQDM-P.

THROTTLE

Indicates the position of the accelerator pedal from 0% (pedal not pressed) between 95 and 100% (pedal fully pressed). This item can be monitored when the key switch is in the ON or OFF position.

TEMPERATURE

Displays the temperature (in degrees Celsius) of the speed controller heatsink. During normal operating conditions, the heatsink temperature should be below 185 °F (±9) (85 °C (±5)). **See following NOTE.**

NOTE: *Anything that adds resistance (i.e. improper brake adjustment, low air pressure in tires, low battery voltage, etc.) can cause the operating current to be higher than normal. This higher current increases the temperature of the speed controller heatsink.*

ARM CURRENT

Displays the motor armature current (in amperes).

FIELD CURRENT

Displays the motor field current (in amperes).

ARMATURE PWM

Displays motor armature PWM (pulse width modulation). The range of pulse width modulation is 0% to 100%. When the vehicle is operating at full speed, the pulse width modulation should be at 100%.

FIELD PWM

Displays motor field PWM (pulse width modulation). The range of pulse width modulation is 0% to 100%. When the vehicle is in operation, the pulse width modulation will fluctuate in response to the terrain and throttle input.

SPEED PULSES

The *speed pulses* menu item displays the activity of the motor speed sensor. With the key switch in the OFF position, the Forward/Reverse switch in the NEUTRAL position, and the vehicle at rest, the handset should indicate that speed pulses are off. When the vehicle is gently pushed a short distance, the handset should indicate that speed pulses are on.

FOOT INPUT

Indicates the status of the MCOR (Motor Controller Output Regulator) internal limit switch: on or off. When the accelerator pedal is unpressed, the handset should indicate that the limit switch is off. When the accelerator pedal is pressed and the key switch is in the ON position, the display should indicate that the limit switch is on.

KEY INPUT

Displays the position of the key switch: OFF or ON.

FORWARD INPUT

With the Forward/Reverse switch in the NEUTRAL or REVERSE position, the handset should indicate that the forward input is off. When the Forward/Reverse switch is placed in the FORWARD position, the handset should indicate that the forward input is on.

REVERSE INPUT

With the Forward/Reverse switch in the NEUTRAL or FORWARD position, the handset should indicate that the reverse input is off. When the Forward/Reverse switch is placed in the REVERSE position, the handset should indicate that the reverse input is on.

MODE SWITCH INPUT

This menu is reserved for possible future use and has no application at this time.

CHARGER INHIBIT

Displays charger connection. When the charger is connected and the controller does not drive (inhibited), the handset indicates ON. When the charger is not connected and the controller is allowed to drive, the handset indicates OFF.

MAIN CONT DRIVER

Displays the present solenoid (main contactor) state. When the controller energizes the solenoid coil, the handset indicates ON. When the controller de-energizes the solenoid coil, the handset indicates OFF.

LED DRIVER

Displays the present state of pin 11 in the controller 16-pin connector that operates the charge indicator light on the dash. When pin 11 is activated, power is provided to the light and the handset indicates that the LED Driver is ON. When pin 11 is not activated, the handset indicates that the LED Driver is OFF.

PASSWORD TRIES (IQDM-P ONLY)

A password is required to place the vehicle in “private speed mode” (speed setting 4). The speed controller will log unsuccessful and unauthorized attempts to place the speed controller in “private speed mode”. If repeated attempts are unsuccessful, the speed controller will permanently lock out access to “private speed mode”. In the event that “private speed mode” is locked out, the controller must be removed and shipped to Club Car before it can ever be placed in “private speed mode”. **See Code A, Code B, and Code C on page 12-5.**

ODOMETER

Displays approximate distance travelled in miles.

AMP HOURS DISPLAY

Amp Hours

Displays total accumulated amp hours removed since initial vehicle start-up.

VEHICLE SPEEDS (IQDM-P ONLY)

Press right arrow to display programmed speeds for each speed setting. **See Code A, Code B, and Code C on page 12-5.**

PEDAL COUNTERS

Accumulates accelerator pedal usage.

FAULT COUNTERS

The Fault Counters indicate how many times each fault type has been recorded since the last clearing of fault history. **See following Faults Menu section.**

FAULT COUNT ODOMETERS

The Fault Count Odometers indicate the odometer reading associated with the last occurrence of each fault type. Will indicate 0.0 (miles) if the fault occurred before the last clearing of fault history.

FAULTS MENU

CAUTION

- **A failed motor will damage the controller. Always inspect the motor before replacing the controller. See External Motor Testing, Section 17, Page 17-1.**

NOTE: *The software is subject to frequent updates, and this manual spans many versions. Be aware that some faults listed in this manual may not display in the IQDM, indicating older software.*

The *faults* menu is accessed by using the up or down arrow to scroll to *faults* and pressing the right arrow key to activate the menu.

Faults displayed in the *faults* menu will aid the trained technician in troubleshooting the vehicle. Faults displayed often indicate which components in the electrical system need to be tested.

Since the *faults* menu is updated while the vehicle is in operation, the trained technician has the ability to monitor the occurrence of faults in conditions or locations where a problem with vehicle performance has been reported. **See following WARNING.**

⚠ WARNING

- **The vehicle operator should not monitor the handset while the vehicle is in motion. A technician can monitor the handset while traveling as a passenger in the vehicle. Failure to heed this warning could result in severe personal injury or death.**

SYSTEM FAULTS

The *system faults* menu displays all of the faults detected by the speed controller since the last time the fault history has been cleared. The faults displayed in this menu may or may not be currently active. Once a fault has been detected, it is stored in the memory of the speed controller for display on the *fault history* menu. Each detected fault is listed only once, even if the fault has occurred multiple times.

Causes of Faults

Some common causes of faults are:

- Loose, broken, or disconnected wires or connectors
- Failed components
- Improper adjustment or installation of electrical or mechanical components (examples: brake adjustment, improper MCOR installation)
- Improper wiring of electrical components

As shown above, there are many possible causes for faults to occur, and the speed controller has a programmed reaction to each fault that is based on the fault currently detected. The technician should be familiar with the detected faults and the controller's reactions to faults to ensure a proper diagnosis.

An example of a possible mis-diagnosis of a vehicle due to a fault: If the three-pin speed sensor wire has been disconnected, the speed controller will detect a *speed sensor* fault. When a *speed sensor* fault is detected, the controller responds to the fault by limiting the vehicle speed to 1/2 of its normal top speed. If the technician reaches the conclusion that the vehicle is running slowly because batteries are heavily discharged, he has made an improper diagnosis of the problem.

The vehicle speed controller should be checked for fault codes before any service is performed.

The speed controller, after detecting a fault, will respond in one or more of the following ways:

- A. Reduce vehicle speed to zero by reducing armature current
- B. Reduce vehicle speed to zero by reducing field current to zero
- C. Turn off the solenoid
- D. Cause the vehicle to run at slow speed
- E. Gradually reduce the armature current limit
- F. Quickly reduce the armature current until speed sensor pulses occur
- G. Reduce field current and beep reverse buzzer at a fast rate
- H. Limits vehicle speed per Anti-Tamper setting
- J. Adds the occurrence to the fault counter
- K. Activates a warning device
- L. Locks out Private Speed Mode

CONTROLLER FAULT	CONTROLLER RESPONSE	VEHICLE RESPONSE
HW FAILSAFE	A, B, C	Vehicle comes to a stop
THROTTLE FAULT	A, C	Vehicle comes to a stop
SPEED SENSOR	D	Vehicle runs at slow speed
MAIN WELDED	D	Vehicle runs at slow speed
MAIN DRIVER ON	A, B	Vehicle comes to a stop
MAIN DRIVER OFF	A, C	Vehicle comes to a stop
MAIN COIL OPEN	A	Vehicle comes to a stop
FIELD MISSING	A, B, C	Vehicle comes to a stop
HPD	A	Vehicle comes to a stop
OVERVOLTAGE	A, B, G	Vehicle slows and beeps
LOW BATTERY VOLTAGE	E	Top speed is reduced
THERMAL CUTBACK	E	Top speed is reduced
MOTOR STALL	J	None
MAIN DROPOUT (1 and 2)	A, C	Vehicle comes to a stop
MAX PASSWORD TRIES	L	Vehicle continues to only reach a top speed determined by the Speed Setting
INCORRECT PASSWORD	J	None
MAIN DRIVER OVERCURRENT	A, B	Vehicle comes to a stop
CURRENT SENSE FAULT	A, B, C	Vehicle comes to a stop
M– SHORTED	A, B, C	Vehicle comes to a stop
ANTI-TAMPER	H	Top speed is reduced
HIGH SPEED WALKAWAY	J, K	Vehicle beeps
LOCKOUT FAULT	J	None
LOW SOC	J, K	Charge indicator light ON

FAULT RECOVERY

When a fault is detected by the speed controller, the speed controller will attempt to recover from the fault and resume normal operation. In the case of an intermittent problem such as a loose wiring connection, the controller **may** be able to recover and operate normally for a while, but the problem should be repaired before placing the vehicle in service. Depending on the type of fault, the controller will attempt to recover either immediately after the condition clears or after the accelerator pedal has been cycled (released and pressed again).

CONTROLLER FAULT	CONTROLLER ATTEMPTS TO RECOVER...
HW FAILSAFE	When key switch is cycled
THROTTLE FAULT	When condition clears
SPEED SENSOR	When condition clears
MAIN WELDED	When condition clears
MAIN DRIVER ON	When condition clears
MAIN DRIVER OFF	When accel. pedal is cycled
MAIN COIL OPEN	When accel. pedal is cycled
FIELD MISSING	When accel. pedal is cycled
HPD	When accel. pedal is cycled
OVERVOLTAGE	When condition clears
LOW BATTERY VOLTAGE	When condition clears
THERMAL CUTBACK	When condition clears
MOTOR STALL	When condition clears
MAIN DROPOUT (1 and 2)	When accel. pedal is cycled
MAX PASSWORD TRIES	When Tow/Run switch is cycled
INCORRECT PASSWORD	When Tow/Run switch is cycled
MAIN DRIVER OVERCURRENT	When condition clears
CURRENT SENSE FAULT	Within controller
M– SHORTED	When key switch is cycled
ANTI-TAMPER	When condition clears
HIGH SPEED WALKAWAY	When condition clears
LOCKOUT FAULT	When condition clears
LOW SOC	When condition clears

FAULT DESCRIPTIONS

The following faults can be detected by the white Excel System controller:

INCORRECT PASSWORD (IQDM-P ONLY)

Each vehicle has a password in the form of a unique set of codes used to place the vehicle in “private speed mode”. If a set of codes has been entered incorrectly, the *incorrect password* fault is declared. For additional information on codes, refer to Code A, Code B, and Code C. **See Code A, Code B, and Code C on page 12-5. See also Password Tries (IQDM-P Only) on page 11-8.**

MAX PASSWORD TRIES (IQDM-P ONLY)

The *max password tries* fault is declared when the incorrect password fault has been declared several times. In the event that the *max password tries* fault is indicated, the speed controller must be removed and shipped to Club Car before it can ever be placed in “private speed mode”. **See Code A, Code B, and Code C on page 12-5. See also Password Tries (IQDM-P Only) on page 11-8.**

THROTTLE FAULT

If the MCOR (Motor Controller Output Regulator) voltage is less than 0.20 volts or greater than 4.80 volts, the controller detects a *throttle fault*.
What it means: If the voltage seen by the controller coming out of the MCOR is not within specified limits, this fault occurs and the controller de-energizes the solenoid coil. Perform additional diagnostic if vehicle is running.
What to do: Replace MCOR. **See following NOTE.**

NOTE: *Newer controllers may, infrequently, read voltages above or below limits and give a false fault.*

LOW BATTERY VOLTAGE (UNDERVOLTAGE)

If the battery voltage falls below 34 volts ±5%, the *low battery voltage* fault is detected by the speed controller.
What it means: Could be a symptom, not a cause. Voltage coming into the controller is at, or less than, 34 volts.
What to do: Check battery voltage under a load.

OVERVOLTAGE

If the speed controller detects that the battery voltage is too high (68.4 to 75.6 volts DC), the *overvoltage* fault is detected.
What it means: This is a symptom that occurs when the controller sees 72 or more volts. Reverse Buzzer beeps when fault occurs and the car will freewheel.
What to do: Check to see if car has been towed without being put into “Tow” mode. Check charger relay because, in Excel vehicles, bypassing the relay in the charger could cause the controller to read an overvoltage fault. Note too that Excel vehicles, on hilly courses, may see this fault if the driver turns the key switch off while the vehicle is in motor braking mode.

THERMAL CUTBACK

If the controller heatsink temperature is found to be in excess of 185 °F (±9) (85 °C (±5)) or below –13 °F (±9) (–25 °C (±5)), the *thermal cutback* fault is detected.
What it means: Heatsink temperature rises above 185 °F (85 °C).
What to do: Monitor Heatsink Temp, battery voltage, brakes dragging, car under extreme loads, low or no air pressure in tire(s).

ANTI-TAMPER FAULT

If communication with the Visage or Guardian unit is interrupted, the controller registers an *anti-tamper fault*.
What it means: This is a symptom, not a cause. The controller is set to communicate with a Visage or Guardian unit and it is unable to.
What to do: Clear the Fault History in the IQDM. Ensure wiring is connected and inspect for damaged wires. If the vehicle is not or no longer going to be equipped with these services, change Control Mode setting to zero (0).

HPD

The *HPD* (High Pedal Detect) fault is detected if the accelerator pedal is already depressed when the key switch is turned to the ON position. This fault is also detected if the accelerator pedal is pressed when the selected direction is changed by pressing the Forward/Reverse switch. This fault, when not caused by the operator, can indicate that the pedal limit switch has failed closed.
What it means: The pedal is depressed before the key switch and/or the FNR is switched on. This is a safety control and the controller must see the pedal engaged last in the following sequence: key switch first, FNR second, and then pedal last.
What to do: Check throttle percentage and, if at 0, issue is driver error.

MAIN DRVR OVERCURRENT

If the current on the relay driver exceeds 120 mA, or the current on the solenoid driver exceeds 6A, a *main driver overcurrent* fault is detected.

LOCKOUT FAULT

If the controller receives a signal that the charger interlock is activated while the vehicle is being driven, the controller registers a *lockout fault*.
What it means: This is a symptom, not a cause. The controller should only see charger interlock activated when the charger's DC cord (external charger) is connected to the vehicle or AC cord (onboard charger) is connected to an AC outlet.
What to do: Clear the Fault History in the IQDM. If the fault does not return and the car operates normally, do not replace the controller. If the fault continues to occur, inspect and test the charger interlock circuit. **See Test Procedure 10 – Charger Interlock on page 13-25.** If no problems are found in the charger interlock circuit, replace the controller.

LOW SOC

If the controller sees that the battery pack has reached a low state of charge (SoC), the controller registers a *low SoC fault*.

What it means: This is a symptom, not a cause. The controller records the number of times this occurs.
What to do: Charge batteries. If fault occurs more frequently than normal, test battery pack. See Section 15 – Batteries: Electric Vehicle with ERIC Charging.

MAIN WELDED

If the speed controller detects that the solenoid contacts are welded closed, a *main welded* fault is detected.
What it means: The solenoid contact is welded closed and will not dropout when pedal is released, or key switch is turned to OFF, or FNR is switched to N.
What to do: Replace solenoid. If vehicle continues to operate at half speed, check accessory wiring.

HIGH SPEED WALKAWAY

If the controller receives a signal to activate walk away braking while the vehicle is moving at a speed greater than 2 mph (3.2 km/h), the controller registers a *high speed walkaway fault*.
What it means: This is a symptom, not a cause. The key switch was turned to OFF while the vehicle was coasting faster than 2 mph (3.2 km/h).
What to do: Most likely, this is due to driver error. If not, check speed sensor on motor and key switch for proper operation.

SPEED SENSOR

If the speed controller does not detect pulses from the speed sensor while the controller outputs power (greater than 75% armature PWM) to the motor, a *speed sensor* fault is detected.
What it means: Speed sensor is not working. Check connection.
What to do: Replace speed sensor.

MAIN DRIVER ON

If the FET that controls the closing of the solenoid contacts is found to be energized when it should not be, a *main driver on* fault is detected by the speed controller.
What it means: The controller FET controlling the energizing of the solenoid is on (or energized) when it should not be. This causes main contactors to stay engaged. Pin 12 provides ground for the solenoid coil when FORWARD, REVERSE, KEY, or FOOT INPUT is present at the controller. If the ground continues to be present once either KEY, FOOT, FORWARD or REVERSE INPUT is removed, *main driver on* is detected.
What to do: Replace controller.

MAIN COIL OPEN

If the speed controller determines that the solenoid is not closing as a result of a solenoid coil failure, a *main coil open fault* is detected.
What it means: An open circuit in the solenoid coil. It could be in either the ground side or B+ side of the circuit.
What to do: Check for a broken or disconnected blue wire on the B+ side of the solenoid coil, a broken or disconnected blue/white wire on the B- side of the solenoid coil, a broken coil wire inside the solenoid which would result in zero ohms resistance reading, a defective coil which could result in very low coil resistance (usually less than 40 ohms; large solenoids should read 180 to 190 ohms; small solenoids 200 to 250 ohms), a broken blue/white wire at the 16-pin controller plug or its terminal is loose in the 16-pin plug.

MAIN DROPOUT (1 OR 2)

If the controller detects that the solenoid contacts have opened while the vehicle is in operation, a *main dropout* fault is detected.
What it means: Occurs when the solenoid coil losses ground causing the main contact to lose connection. With Main Dropout 2, the solenoid drops out while the vehicle is in regen/motor braking. Main Dropout 2 is usually a symptom more than a cause.
What to do: Check the following components: key switch, MCOR, batteries, battery cables, FNR, solenoid coil, solenoid contacts, and controller 16-pin connector.

MOTOR STALL

If the motor current is high and there is no movement of the vehicle wheels for a short period of time, a *motor stall* is detected by the speed controller. This fault can be caused by an operator holding the vehicle on a hill by depressing the accelerator pedal instead of the brake pedal.
What it means: This fault appears anytime current is running to the motor and no movement of the armature is registered.
What to do: In most cases this is an operator issue holding the vehicle on an incline with the accelerator pedal, not the brake pedal. **See following NOTE.**

NOTE: *In rare cases, it could be a controller or drivetrain issue. If the vehicle rolls, the drivetrain is okay. Check to see if Armature Current spikes to 250 amps when accelerator pedal is pressed. If so, replace controller.*

MAIN DRIVER OFF

If the FET that controls the closing of the solenoid is **not** energized when it should be, a *main driver off* fault is detected by the speed controller.
What it means: This is the exact opposite of *main driver on*. The controller FET controlling the energizing of the solenoid is off (or not energized) when it should be.
What to do: Replace controller.

CURRENT SENSE FAULT

What it means: If there are problems with the armature current sensor circuitry, a *current sense* fault is detected and the controller de-energizes the solenoid coil.
What to do: Clear the Fault History in the IQDM. If the fault does not return and the car operates normally, do not replace the controller. If the fault remains in System Faults or Fault History after clearing and the car will not operate, replace the controller.

M– SHORTED

If an uncontrolled current path is detected from the motor to B- (bypassing the MOSFETs), an M- shorted fault is detected.

FLD (FIELD) MISSING

If the speed controller is operating at a duty cycle of greater than 90% (almost full speed) and the field current is less than 3 amps, a *field missing* fault is detected by the speed controller.

CAUTION

- **A failed motor will ruin a controller. If a new controller is installed in a vehicle with a bad motor, the bad motor will blow the field FET in the new controller. Always check the motor before replacing a controller when a FLD Missing fault is shown.**

What it means: Not necessarily a controller issue.
What to do: Check in this order: connections and continuity of orange and blue motor field wires, short in motor, and then controller. **See External Motor Testing, Section 17, Page 17-1.**

HW FAILSAFE

The armature drive FETs (field effect transistors) regulate the armature current. If the speed controller detects a failure of the armature drive FETs or circuitry, a *hardware failsafe* fault is detected.
What it means: A catastrophic failure internal to the controller on either the power board or the logic board.
What to do: Check motor before replacing controller.

FAULT HISTORY

The *fault history* menu can be useful in determining the cause of a vehicle problem; however, the fault history alone should not be the factor that determines when a component is replaced. Some faults detected by the speed controller are not the result of a failed component, and are instead the result of vehicle operator error. If a fault appears in the *fault history* menu, the trained technician should attempt to determine when and where the fault has occurred. For example, if the *motor stall* fault is present in the fault history, the trained technician may be able to determine the location on the course where an operator has held the vehicle on a hill by using the accelerator pedal.

CLEAR FAULT HISTORY

After a repair has been made, the fault history should be cleared. This will enable the trained technician to properly troubleshoot the vehicle in the future, in the event that another problem occurs. It is recommended that the fault history be cleared in order to avoid the replacement of a component that caused a fault in the past, but has been replaced and is now functioning correctly. For example, if the MCOR (Motor Controller Output Regulator) was disconnected and the speed controller detected a fault code associated with the throttle, the fault history should be cleared so that any future problem is not diagnosed incorrectly as a throttle problem. **See Clear Fault History on page 11-21.**

FUNCTIONS MENU

The *functions* menu is accessed by using the up or down arrow to scroll to *functions* and pressing the right arrow key to activate the menu.

GET SETTINGS FROM CONTROLLER

This function transfers all of the speed controller settings (except for “private speed mode”) from the vehicle speed controller to the handset. This enables the trained technician to “clone” a speed controller. Once the speed controller

settings have been transferred to the handset, the technician can then connect the handset to another vehicle and transfer the stored settings into the speed controller.

Speed Controller Cloning – Transferring Settings from the Vehicle to the Handset

1. Locate a vehicle that has the desired speed controller settings.
2. Turn the key switch to the OFF position, place the Forward/Reverse handle in the NEUTRAL position, and lock the park brake.
3. Plug the handset into the vehicle.
   3.1. Connect one end of the cable to the port located on the bottom of the handset.
   3.2. Connect the cable adaptor to the IQDM cable.
   3.3. Remove the dust cap from the IQDM port.
   3.4. Align the keyed portion of the plug with the IQDM port and connect the plug to the port **(Figure 11-1, Page 11-1)**.
4. Scroll to the *functions* menu and select.
5. Select *settings*.
6. Select *get settings from controller*.
7. Press “+” on the change value button to confirm the operation.
8. The handset will display an “executing...” message for the next few seconds while the controller settings are being stored in the handset’s memory **(Figure 11-4, Page 11-18)**.
9. When the handset is finished recording the speed controller settings, a confirmation message is displayed **(Figure 11-5, Page 11-18)**.
10. With the controller settings stored in the memory of the handset, the handset can be used to transfer all of the desired speed controller settings to any Excel System vehicle or group of Excel System vehicles. **See Speed Controller Cloning – Transferring Settings from the Handset to the Vehicle on page 11-18.**

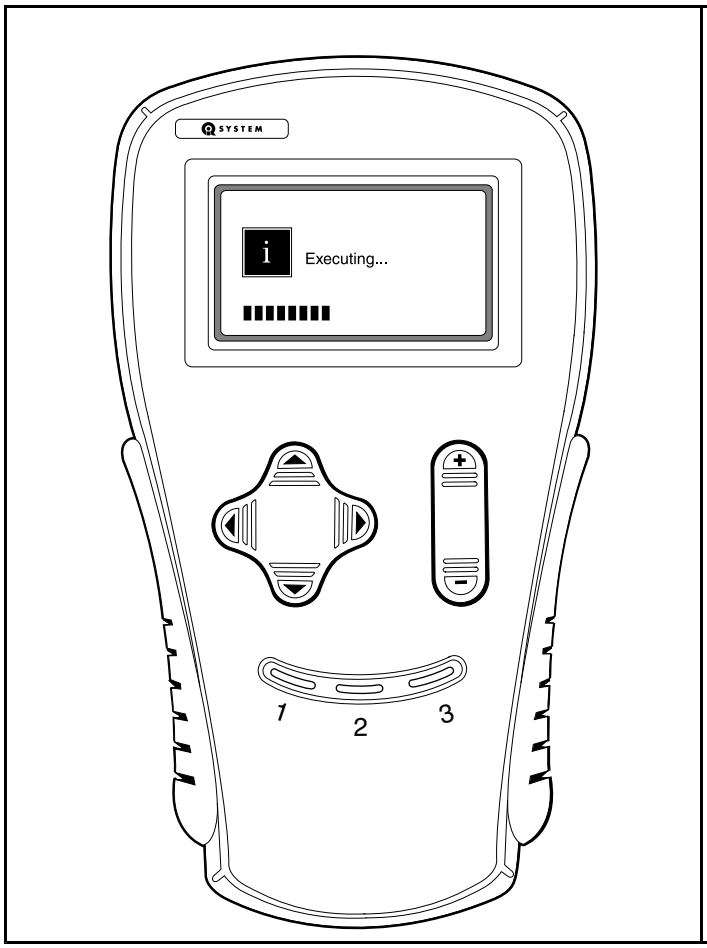

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Figure 11-4 Handset Executing

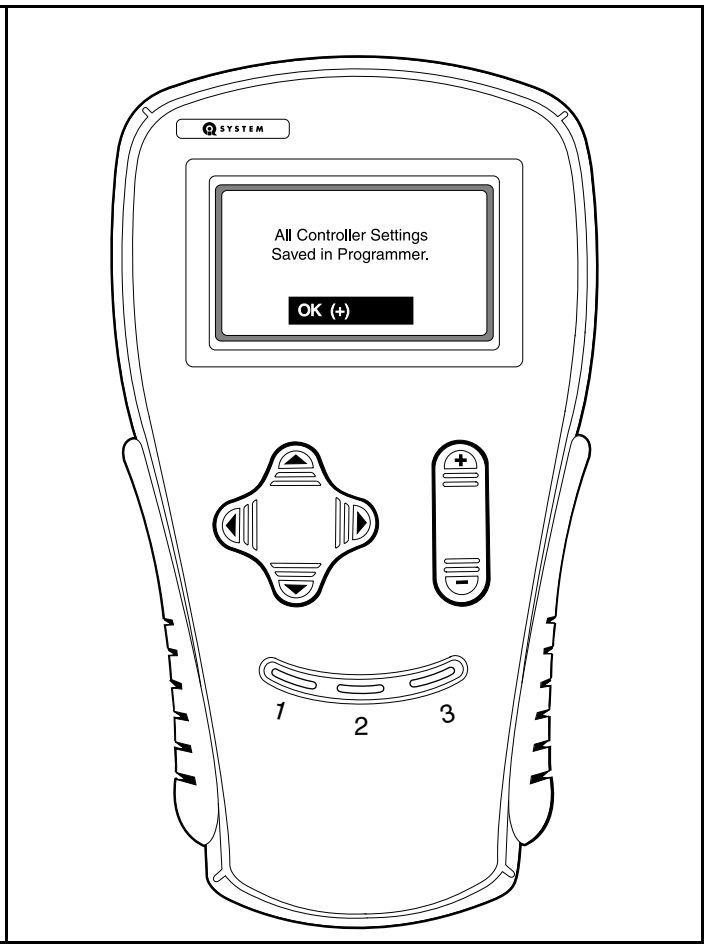

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Figure 11-5 Confirmation Message

WRITE SETTINGS TO CONTROLLER

This function transfers all of the speed controller settings (except for “private speed mode”) from the handset to the vehicle speed controller. This enables the trained technician to “clone” a speed controller. Once the speed controller settings have been transferred to the handset, the technician can then connect the handset to another vehicle and transfer the stored settings into the speed controller.

Speed Controller Cloning – Transferring Settings from the Handset to the Vehicle

1. Perform this procedure with a handset that has the desired speed controller settings. **See Speed Controller Cloning – Transferring Settings from the Vehicle to the Handset on page 11-17.**
2. Locate a vehicle that does **not** have the desired speed controller settings.
3. Turn the key switch to the OFF position, place the Forward/Reverse handle in the NEUTRAL position, and lock the park brake.
4. Plug the handset into the vehicle.
   4.1. Connect one end of the cable to the port located on the bottom of the handset.
   4.2. Connect the cable adaptor to the IQDM cable.
   4.3. Remove the dust cap from the IQDM port.
   4.4. Align the keyed portion of the plug with the IQDM port and connect the plug to the port **(Figure 11-1, Page 11-1)**.
5. Scroll to the *functions* menu and select.
6. Select *settings*.

7. Select *write settings to controller*.
8. Press “+” on the change value button to confirm the operation.
9. The handset will display an “executing...” message for the next few seconds while the controller settings are being stored in the handset’s memory **(Figure 11-4, Page 11-18)**.
10. When the handset is finished transferring the speed controller settings, a confirmation message is displayed **(Figure 11-6, Page 11-19)**.
11. Repeat this procedure for additional vehicles that need to be programmed with the same handset settings.

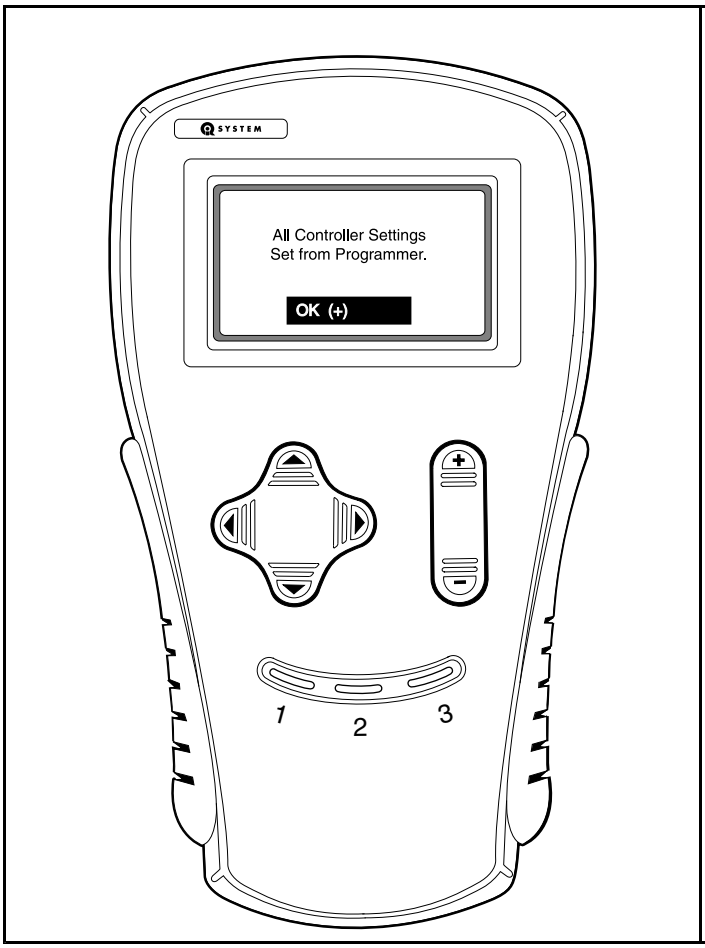

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Figure 11-6 Confirmation Message

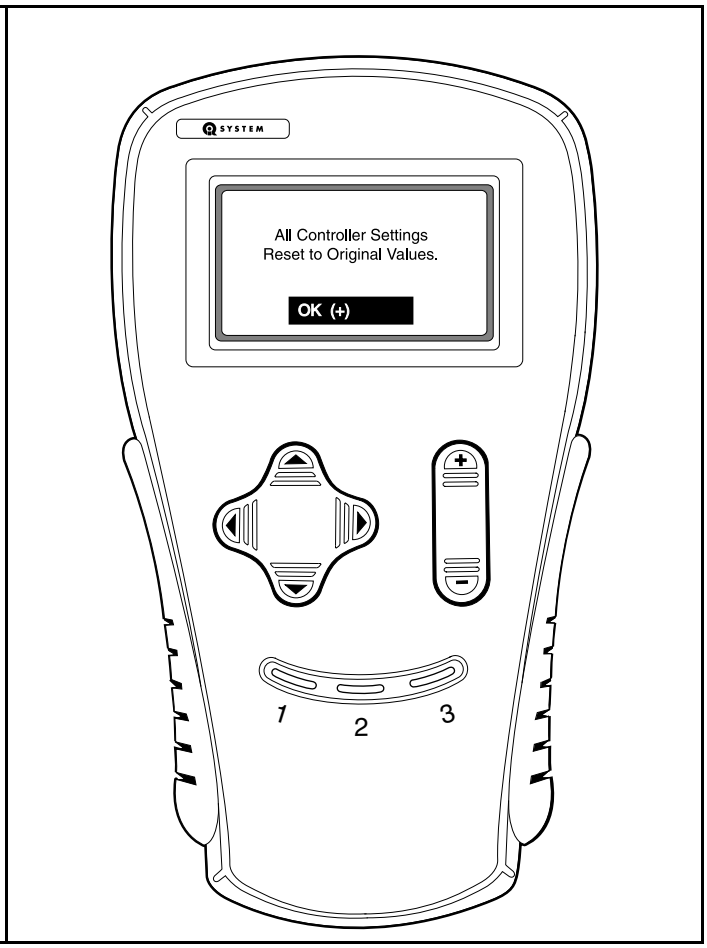

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Figure 11-7 Confirmation Message

RESET ALL SETTINGS

In the event that a mistake was made and one or more changes should not have been made with the handset, the speed controller settings can be reverted to the original settings from the beginning of the session (when the handset was plugged into the vehicle). This function is similar to the “undo” command on a PC and will work correctly only when the handset has **not** been unplugged and power to the speed controller has **not** been interrupted.

Resetting All Settings

1. During an active session when the settings need to be returned to the original values (the values that were active at the beginning of the session), scroll to the *functions* menu and select.
2. Select *settings*.
3. Select *reset all settings*.
4. Press “+” on the change value button to confirm the operation.

5. The handset will display an “executing...” message for the next few seconds while the controller settings are being stored in the handset’s memory **(Figure 11-4, Page 11-18)**.
6. When the handset is finished resetting the speed controller settings, a confirmation message is displayed **(Figure 11-7, Page 11-19)**.

INFORMATION

The *information* menu is accessed by using the up or down arrow to scroll to *information* and pressing the right arrow key to activate the menu.

This menu selection displays information pertaining to the speed controller. The information provided from this menu selection includes:

MODEL NUMBER

Displays the model number of the speed controller.

SERIAL NUMBER

Displays the serial number of the speed controller.

SOFTWARE VERSION

Displays the speed controller software version. **See following NOTE.**

NOTE: *This manual spans software releases version 34 and version 35.*

HARDWARE VERSION

Displays the speed controller hardware version. **See following NOTE.**

NOTE: *This manual covers hardware version 5.*

PARAM BLOCK VERSION

Displays a number that represents the default parameter settings at time of manufacture.

MFG DATE

Displays the date the speed controller was manufactured.

PROGRAMMER SETUP

The *programmer setup* menu selection allows the user to set the LCD display contrast, records the fault history of the handset, and displays information pertaining to the handset.

PROGRAM

This menu allows the user to adjust the contrast on the display screen. After selecting the *LCD–Contrast* menu, use the change value buttons to adjust the contrast for the best readability.

FAULTS

This menu selection displays faults that have been detected within the handset. This *faults* menu does not pertain to any faults detected in the speed controller.
The following faults can be detected within the handset:

CODE NUMBER	TEXT DISPLAYED
14	Communication error with controller
15	Error in handset
16	Handset does not support this function
17	Serial port overrun error
18	Security lockout on program menu

Fault History

This menu displays any faults that have been detected within the handset itself.

Clear Fault History

The *clear fault history* function will erase the history of faults that are stored in the handset.

INFORMATION

This menu selection displays information pertaining to the handset. The information provided in this menu selection includes model number, serial number, the date the handset was manufactured, the handset software version, etc.

IQDM AND IQDM-P HANDSET TROUBLESHOOTING

In the event that the handset does not function as described in this manual, the following troubleshooting guide should be studied and the referenced test procedures should be performed to troubleshoot the handset.

TROUBLESHOOTING GUIDE		
SYMPTOM	**POSSIBLE CAUSES**	**CORRECTIVE ACTION**
Handset display screen is blank	Handset cord and/or adaptor is disconnected	**See Plugging the Handset into the Vehicle on page 11-1.**
	Vehicle batteries – loose terminals or corrosion	See Section 15 – Batteries: Electric Vehicle with ERIC Charging.
	Vehicle batteries – improperly wired	See Section 15 – Batteries: Electric Vehicle with ERIC Charging.
	Vehicle batteries – batteries failed	See Section 15 – Batteries: Electric Vehicle with ERIC Charging.
	Vehicle batteries – batteries not fully charged	See Section 15 – Batteries: Electric Vehicle with ERIC Charging.
	Handset cord has failed	Test Procedure 1 – Handset Cord on page 11-23
	Handset cord adaptor has failed	Test Procedure 2 – Handset Cord Adaptor on page 11-23
	IQDM port (mounted under instrument panel assembly) has failed	Test Procedure 3 – IQDM Ports on page 11-24
	Contrast Setting is too light	**See Program on page 11-21.**
	Controller is in power-down mode (vehicle unused and not charged for 72 hours)	Connect charger or drive the vehicle a short distance and reconnect the handset to the vehicle
	Charger has been connected and charging for more than 10 minutes	Disconnect charger, wait 30 seconds and reconnect charger
	Loose vehicle wire harness connections	Test Procedure 3 – IQDM Ports on page 11-24
	Speed controller malfunction	See Section 13 – Excel System Troubleshooting: with ERIC Charging.
	Handset has failed	Replace handset
Display screen shows jumbled or undecipherable characters	Speed controller malfunction	See Section 13 – Excel System Troubleshooting: with ERIC Charging.
	Handset malfunction	Disconnect the IQDM cord from the vehicle. Wait a few seconds and reconnect the handset to the vehicle
	Loose connection at IQDM port	Test Procedure 3 – IQDM Ports on page 11-24
	Intermittent handset cord failure	Test Procedure 1 – Handset Cord on page 11-23
	Intermittent handset cord adaptor failure	Test Procedure 2 – Handset Cord Adaptor on page 11-23
	Loose vehicle wire harness connections	Test Procedure 3 – IQDM Ports on page 11-24

TABLE CONTINUED ON NEXT PAGE

TROUBLESHOOTING GUIDE		
SYMPTOM	**POSSIBLE CAUSES**	**CORRECTIVE ACTION**
Handset is “locked-up” – buttons do not respond	Handset malfunction	Disconnect the IQDM cord from the vehicle. Wait a few seconds and reconnect the handset to the vehicle
	Vehicle batteries – loose terminals or corrosion	See Section 15 – Batteries: Electric Vehicle with ERIC Charging.
	Vehicle batteries – improperly wired	See Section 15 – Batteries: Electric Vehicle with ERIC Charging.
	Vehicle batteries – batteries failed	See Section 15 – Batteries: Electric Vehicle with ERIC Charging.
	Vehicle batteries – batteries not fully charged	See Section 15 – Batteries: Electric Vehicle with ERIC Charging.
	Speed controller malfunction	See Section 13 – Excel System Troubleshooting: with ERIC Charging.

TEST PROCEDURES

The following test procedures enable the technician to test the IQDM and IQDM-P handsets and the components of the Excel System vehicle that are related to the proper operation of the handset.

⚠ 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.**

Index of Test Procedures

1 – Handset Cord
2 – Handset Cord Adaptor
3 – IQDM Ports

TEST PROCEDURE 1 – Handset Cord

See General Warnings on page 1-2.

1. Using a multimeter set for 200 ohms, place the red (+) probe into one of the terminals on the end of the cord with the square plug.
2. Place the black (–) probe on each of the pins, one at a time, on the plug on the other end of the cord.
3. The multimeter should indicate continuity on only one pin. If any other reading is obtained, the cord must be replaced.
4. Repeat the procedure three more times, each time with the red (+) probe inserted into a different terminal on the end of the cord with the square plug.

TEST PROCEDURE 2 – Handset Cord Adaptor

See General Warnings on page 1-2.

The procedure for testing the handset cord adaptor is similar to the cord test.

1. Using a multimeter set for 200 ohms, place the red (+) probe into one of the terminals on the end of the adapter with the square plug.
2. Place the black (–) probe on each of the pins, one at a time, on the other plug of the adaptor.
3. The multimeter should indicate continuity on only one pin. If any other reading is obtained, the adaptor must be replaced.
4. Repeat the procedure three more times, each time with the red (+) probe inserted into a different terminal on the end of the adaptor with the square plug.

TEST PROCEDURE 3 – IQDM Ports

Inspect the IQDM ports for damage or corrosion.

IQDM PORT (LOCATED UNDER INSTRUMENT PANEL)

See General Warnings on page 1-2.

1. Turn the key switch to the OFF position, place the Forward/Reverse rocker switch in the NEUTRAL position, and lock the park brake.
2. Place the Tow/Run switch in the TOW position, disconnect the batteries, negative (–) cable first, and wait 90 seconds for the speed controller capacitors to discharge. **See General Warnings on page 1-2.**
3. Check the IQDM port mounted under the instrument panel.
   3.1. Remove the three screws (1) that secure the instrument panel assembly (2) to the dash assembly (3) **(Figure 11-8, Page 11-24)**.

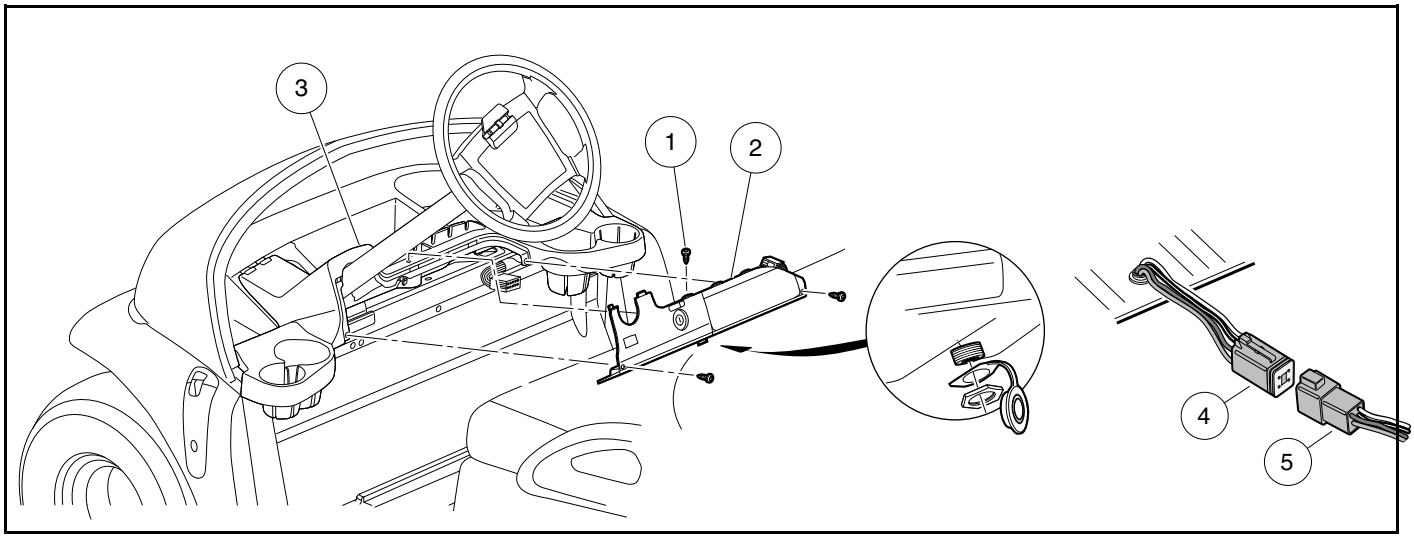

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Figure 11-8 Instrument Panel Assembly Removal and IQDM Port Connection

   3.2. Disconnect the four-pin connectors (4 and 5) and visually inspect the contacts for damage and corrosion. Inspect the IQDM port, mounted under the instrument panel assembly (2). Repair and replace parts as necessary.
   3.3. If no problem is found, connect the four-pin connectors and install the instrument panel assembly.
   3.4. Install the three screws (1) that secure the instrument panel assembly (2) to the dash assembly (3) **(Figure 11-8, Page 11-24)**.
4. Check the IQDM port on the speed controller.
   4.1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries on page 1-3.**

4.2. Remove electronics module cover. **See Electronics Module Cover on page 14-5.**

4.3. Connect IQDM to controller.

4.3.1. Disconnect the square four-pin connector (3) from the speed controller.

4.3.2. Connect the handset cord to the handset.

4.3.3. Connect the other end of the handset cord (without the adapter) (4) to the four-pin connector of the speed controller (2) **(Figure 11-9, Page 11-25)**.

4.3.4. Connect the vehicle batteries, positive (+) cable first.

4.3.5. If the handset functions when connected directly to the speed controller, the adapter plug or vehicle wire harness should be thoroughly tested. **See Test Procedure 2 – Handset Cord Adaptor on page 11-23.** See Section 13 – Excel System Troubleshooting: with ERIC Charging.

4.4. Replace electronics module cover. **See Electronics Module Cover on page 14-5.**

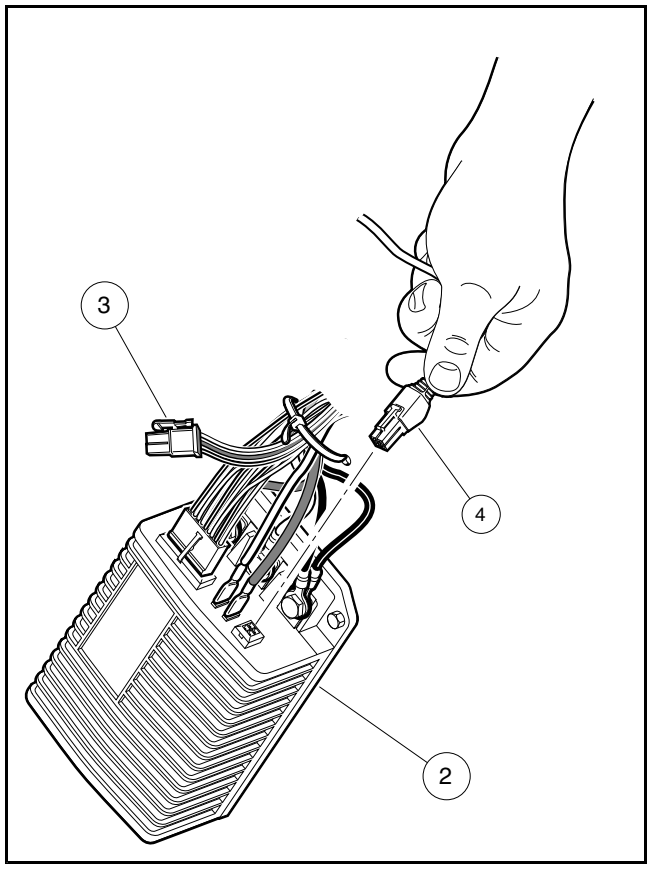

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Figure 11-9 IQDM Connector On Speed Controller

SECTION 12 – IQ DISPLAY MODULE PROGRAMMER (IQDM-P): EXCEL SYSTEM WITH ERIC CHARGING

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⚠ DANGER

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

⚠ WARNING

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

NOTE: *For information pertaining to the introductory display, menu navigation, and monitor, faults and function menus,* ***see IQ Display Module (IQDM) and IQDM-P Diagnostics: Excel System with ERIC Charging on page 11-1.***

The information presented in this section addresses the series 2 versions of the IQDM-P and IQDM handsets. IQDM series 1 and IQDM-P series 1 handsets are not compatible with the Excel System. ***See Figure 12-2, Page 12-1.***

This manual spans software releases version 34 and version 35. The software version can be viewed in the Information menu of the IQDM. ***See Information on page 11-20.***

PLUGGING THE HANDSET INTO THE VEHICLE

1. Connect one end of the cable to the jack located on the bottom of the handset.
2. Connect the cable adaptor to the IQDM cable.
3. Find the IQDM jack on the vehicle **(Figure 12-1, Page 12-1)**.
4. Remove the dust cap from the IQDM jack.
5. Align the keyed portion of the plug with the IQDM jack and connect the plug to the jack.

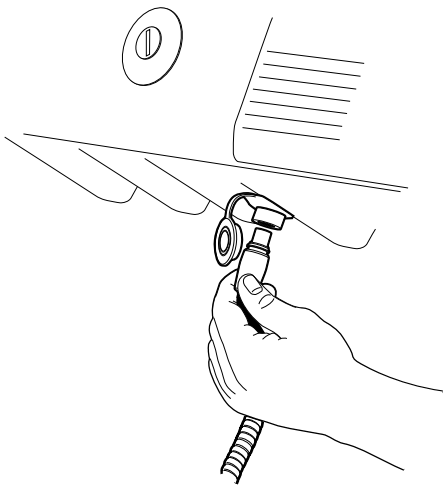

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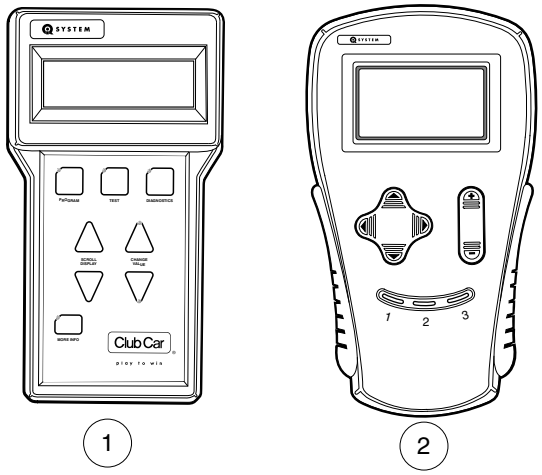
Figure 12-1 IQDM Port Under Instrument Panel



1. IQDM–P Series 1 (can not be used with Excel System)
2. IQDM–P Series 2

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Figure 12-2 IQDM–P Versions

PROGRAM MENU

The *program* menu can be accessed by pressing the right arrow on the navigation button when the square beside *program* is blinking **(Figure 12-3, Page 12-2)**. When the *program* menu is active, use the up or down arrows on the navigation button to go to the desired item in the *program* menu. Again, press the right arrow to select the menu item. Use the change value button to change the values of the selected item as necessary.

The following parameters can be programmed with the handset from the *program* menu:

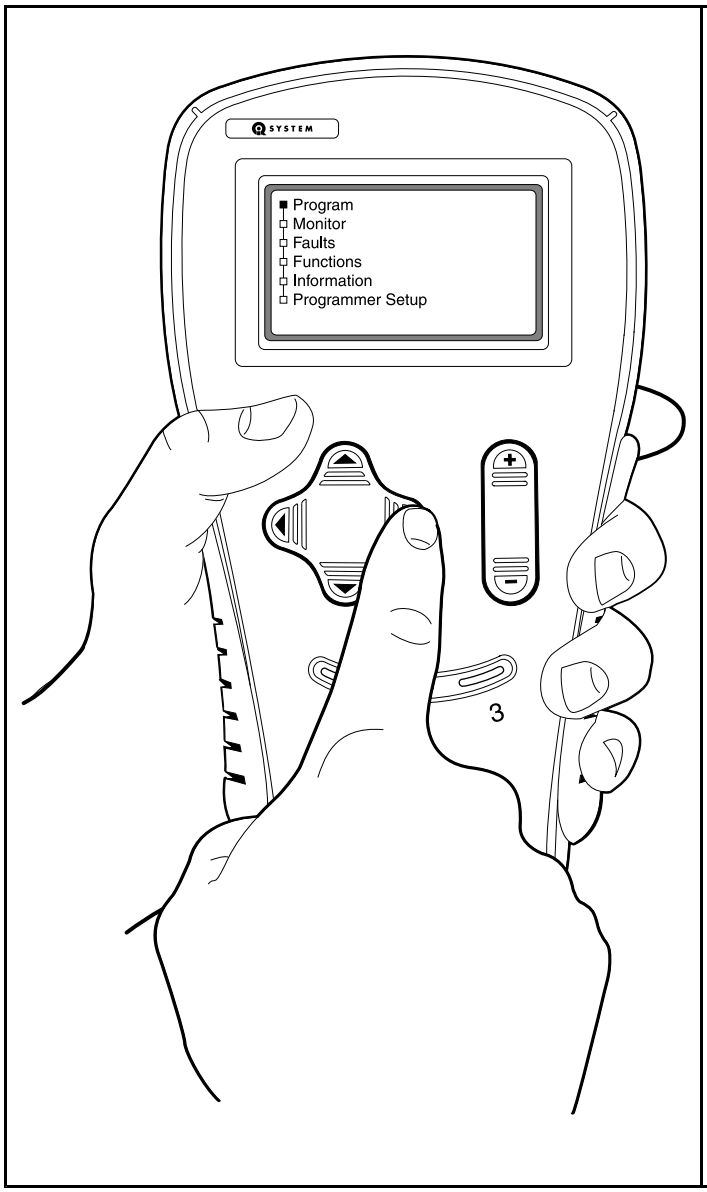

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Figure 12-3 Access Program Menu

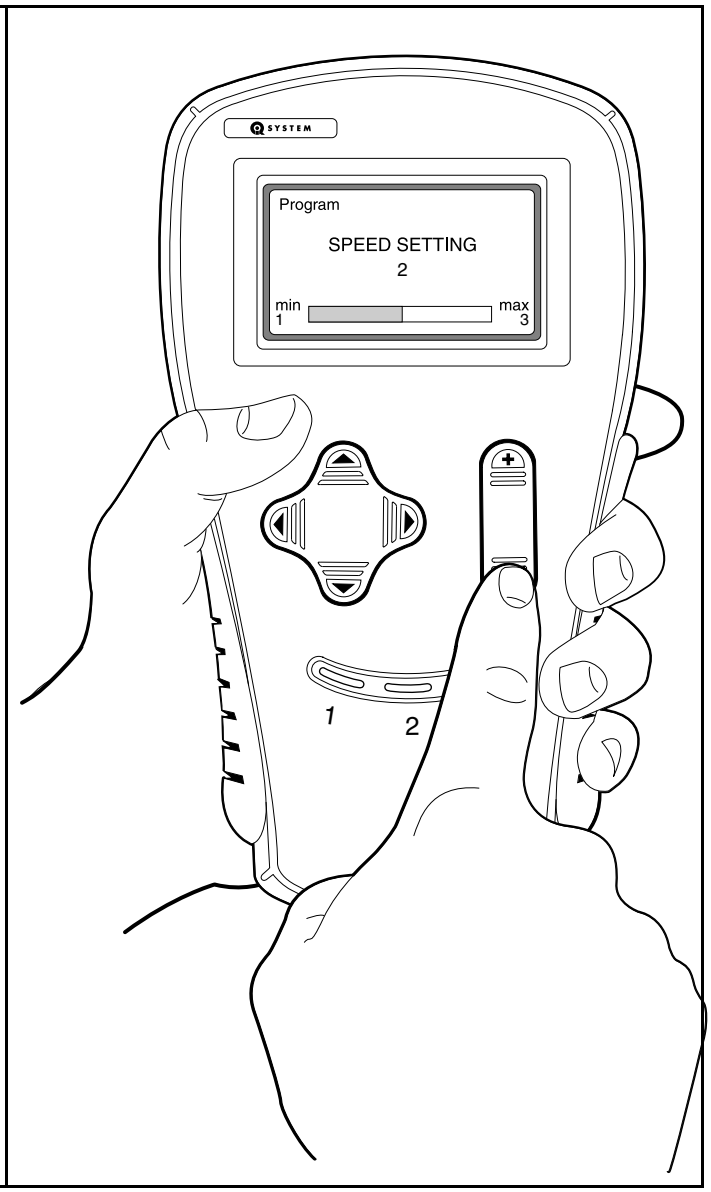

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Figure 12-4 Change Speed Setting

SETTINGS

Speed Setting

The vehicle's top speed can be changed by selecting values 1 through 3 **(Figure 12-4, Page 12-2)**. If a value of 4 is displayed for the speed setting, a special access code has been entered to place the vehicle in "private speed mode." A speed setting of 4 cannot be selected with the *speed setting* menu item. For additional information on speed setting 4, refer to *Code A, Code B, and Code C*. **See Code A, Code B, and Code C on page 12-5.**

SPEED SETTING	DESCRIPTION	VEHICLE SPEED
1	Commercial speed	8.0 mph (12.9 km/h)
2	Slow golf speed	11.4 mph (18.3 km/h)
3	Normal golf speed	Typical 14.8 mph (23.8 km/h). **See S3 FWD Speed on page 12-4.**
4	Private speed mode	19.2 mph (30.9 km/h)

NOTE: *Present speed values for each speed setting may be observed in the monitor menu.* ***See Vehicle Speeds (IQDM-P Only) on page 11-8.***

Fast Accel

Fast accel (fast acceleration) is an option that can be enabled or disabled. With *fast accel* turned on, the vehicle will accelerate at a noticeably faster rate. With this feature turned off, the vehicle speed will gradually increase, even if the accelerator is quickly pressed to the floor. Turn the feature on or off by pressing "+" or "–" on the change value button.

Pedal Up Mode

Three options exist for *pedal up mode* (motor braking). When the accelerator pedal is released, motor braking will slow the vehicle to "near zero speed" when pedal up motor braking is enabled (option 1 or 2). If pedal up motor braking is disabled (option 0), the vehicle will coast to a stop when the accelerator pedal is released. **See following NOTE.**

Change the settings of the Pedal Up Mode by pressing "+" or "–" on the change value button.

NOTE: *Pedal Up Mode does not affect top vehicle speed. When the vehicle is going down an incline, the motor braking function will activate to prevent the vehicle from exceeding the speed setting defined in the Program menu, regardless of Pedal Up Mode setting (0,1,2).* ***See Speed Setting on page 12-3.***

When going down an incline with the accelerator pedal partially pressed, the motor braking function will activate to assist the operator in maintaining a speed less than the top speed setting. For example, if the vehicle is going down an incline with the accelerator pedal pressed half way, the motor braking function will activate to assist the operator in maintaining a speed approximately half of the speed setting defined in the Program Menu.

PEDAL UP MODE SETTING	MODE	OPERATION DESCRIPTION
0	Off	Pedal up motor braking is disabled
1	Mild pedal up	Mild pedal up motor braking
2	Aggressive pedal up	Aggressive pedal up motor braking

Speed Cal

The *speed cal* (speed calibration) menu item allows the user to fine tune the vehicle speed. This feature cannot be used to increase the vehicle speed. The range for speed calibration is 0 to 30. Each time the number is increased, the top speed will be decreased by 0.1 mph (0.16 km/h). The top vehicle speed will be determined by the *speed setting* menu item and the speed calibration setting. For example, if the speed setting is set for a value of 2 (11.4 mph (18.3 km/h)), and the speed calibration is set for 5, the total top speed of the vehicle should be approximately 10.9 mph (17.5 km/h).

NOTE: *The SPEED CAL function will not be necessary in most golf applications since the speed setting 3 is finely adjustable with S3 FWD SPEED.* ***See S3 FWD Speed on page 12-4.***

S3 FWD Speed

The *s3 fwd speed* option allows for adjustability of the SPEED 3 speed setting. From the factory, *s3 fwd speed* will be set to one of 4 options: 12.4, 13.2, 14.0 and 14.8 mph (20.0, 21.3, 22.6 and 23.8 km/h, respectively). The default *s3 fwd speed* is 14.8 mph (23.8 km/h). The *s3 fwd speed* may be adjusted with the handset from 11.4 to 14.8 mph (18.3 to 23.8 km/h) in 0.1 mph (0.16 km/h) increments. The speed value chosen for *s3 fwd speed* may also be observed in the monitor menu. **See Vehicle Speeds (IQDM-P Only) on page 11-8.**

To fine tune vehicle top speed in normal golf speed range (12.4 to 14.8 mph (20.0 to 23.8 km/h)):

1. Access the *program* menu, then the *speed setting* menu with the navigation keys.
2. Select Speed Setting 3 with the change value buttons.
3. Access the *program* menu and the *s3 fwd speed* menu with the navigation keys.
4. Use the change value buttons to select desired speed.

Control Mode

The *control mode* option is used to configure the 1515 controller for different modes of speed control operation. Four modes are avaiable:

- 0 = Standard: Uses maximum speeds defined by the *S1* through *S4 Fwd Speed* , *Rev Speed* and *Speed Cal* parameters.
- 1 = LIN (Local Interconnect bus) (i.e. Guardian or Visage): Uses maximum speeds assigned to a particular location or area as defined by the fleet operator; however, these defined speeds can not override maximums set in the *S1* through *S4 Fwd Speed* , *Rev Speed* and *Speed Cal* parameters.
- 2 = ES-Protocol (UpLink): Uses maximum speeds assigned to a particular location or area as defined by the fleet operator; however, these defined speeds can not override previously set values from other *control mode* options. To avoid this, after changing the *control mode* to 2, cycle power to the controller by placing the Tow/Run Switch in the TOW position for 30 seconds. Then return it to RUN.
- 3 = Deterrent Demo Mode: Uses maximum speeds defined by the *deterrent demo* setting to demonstrate the automatic speed control features of Guardian and UpLink. **See Deterrent Demo on page 12-4.**

Anti-Tamper

The *anti-tamper* setting defines maximum speed if the Anti-Tamper fault is triggered (e.g. controller is disconnected from the Guardian or Visage system). These speeds can only be activated if the Control Mode option is set to 1 (Guardian/Visage) and are intended to be a deterrent. Factory default setting is 1.

- 0 = OFF; uses controller configured speed (*S1* through *S4 Fwd Speed* , *Rev Speed* and *Speed Cal* parameters) even if the Anti-Tamper fault is triggered
- 1 = 2 mph
- 2 = 0 mph
- 3 = 7 mph

Deterrent Demo

The *deterrent demo* setting defines maximum speed of Control Mode 3.

- 0 = Controller configured speed (*S1* through *S4 Fwd Speed* , *Rev Speed* and *Speed Cal* parameters)
- 1 = 10 mph
- 2 = 7 mph
- 3 = 2 mph

Excel Braking

The *excel braking* menu item allows the user to turn this function ON or OFF. With it ON, the vehicle maintains the regen motor braking “feel” of the Excel system. With it OFF, regen motor braking is less aggressive and the vehicle mimics the “feel” of the IQ system.

For example: A *Pedal Up Mode* setting of 2 = 150 amps of regen motor braking. Setting *Excel Braking* to ON increases regen by 30 amps for a total of 180 amps and a more aggressive braking action.

WalkAway Deterrent

The *walkaway deterrent* menu item allows the user to turn this function ON or OFF. *Walkaway deterrent* is triggered by the High Speed WalkAway fault. With it ON, the reverse buzzer will sound immediately upon the key switch being turned OFF at speeds above 2 mph. With it OFF, the buzzer will cycle on and off at a higher frequency (7.5 Hz vs. 2.5 Hz).

Battery Type

The *battery type* menu item allows the user to input the battery make and model installed in the vehicle.

Charger Control

Beep Option

The *Beep Option* controls use of the reverse buzzer to sound a confirmation that charging has started: 0 = OFF, 1 = 1 beep, 2 = 3 beeps. From the factory, the *Beep Option* will be set to 2.

AMP HOURS

Reset Trip Amp Hours

The *reset trip amp hours* menu item allows the user to reset counter to zero (0). To reset, set to ON and then immediately back to OFF.

ACCESS CODES

Code A, Code B, and Code C

The code entries are used to place the vehicle in “private speed mode”, speed setting code 4. Each vehicle has a unique code for placing the vehicle in this mode. A vehicle programmed for “private speed mode”, speed setting 4, does not conform to ANSI Z130.1 – American National Standard for Golf Cars – Safety and Performance Specifications because it is capable of speeds in excess of 15 mph (24.1 km/h). For more information on this feature, contact your local Club Car distributor or dealer.

VEHICLE ID

NOTE: *If controller is replaced, the information below must be entered into the new controller.* ***See Speed Controller Installation, Section 14, Page 14-11.***

Vehicle S/N

Six digit number programmed by vehicle manufacturer.

Vehicle Decal

Decal number ranging from 0 to 999 and programmed by vehicle manufacturer.

Vehicle Date of Manufacture

Four digit number programmed by vehicle manufacturer. **Example:** 1401 represents Model Year 2014, week 1.

⚠ DANGER

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

⚠ WARNING

- **See General Warnings on page 1-2.**
- **Shorting of battery terminals can cause personal injury or death.**
  - **Do not place component mounting plate directly on top of batteries when removing or installing plate.**
  - **Remove plate from vehicle completely.**

GENERAL INFORMATION

The 4Fun and Precedent Stretch vehicle uses a 48-volt, Excel electrical system with a shunt-wound, 3.7 hp motor that is powered by six 8-volt lead-acid batteries and charged by a high-frequency, ERIC Charging system. The Excel vehicle with ERIC Charging system includes several additional features.

ACCESSORIES

For powered accessories that need to be controlled by the key switch, use the gray wire with a female bullet connector located behind the instrument panel.

CHARGE INDICATOR LIGHT

Excel vehicles with ERIC Charging system feature a dash mounted charge indicator light (below the steering column) that serves two functions: 1) Battery low state of charge warning, and 2) Charging confirmation. The charge indicator light is controlled by pin 11 of the controller.

Battery Low State of Charge Warning

- The light comes on and remains solid when the battery state of charge falls below 20%.
- The light begins flashing when the battery state of charge falls below 10%.

Charging Confirmation

- The light will flash three times and the reverse buzzer simultaneously will sound three times to indicate a battery charging session has begun. **See following NOTE.**

NOTE: *The number of flashes and beeps can vary depending on the Beep Option setting.* ***See Beep Option, Section 12, Page 12-5.***

ATTRIBUTES OF THE EXCEL SYSTEM

- Excel is used in Precedent models only.
- Excel utilizes the 1515 controller instead of the 1510A.
- The Excel 1515 controller uses half-bridge technology allowing cooler operating temperatures and increased motor braking.
- The Excel minimum motor braking speed has been lowered to almost zero.
- Excel has higher energy output during regenerative braking due to the lowered minimum motor braking speed.
- The Excel accelerator pedal has more control of downhill speed.
- The programmed speed of the Excel vehicle can now range from 5 to 19.2 mph (8 to 30.8 kph) with fine adjustments in 0.1 mph (0.16 kph) increments.
- Excel provides mileage readings.
- Excel has more diagnostics available.
- Excel offers the ability to change software. See Section 11 – IQ Display Module (IQDM) and IQDM-P Diagnostics: Excel System with ERIC Charging.

KEY DIFFERENCES: GOLF 4FUN AND PRECEDENT STRETCH VS. 2-PASSENGER PRECEDENT

- Uses the existing Precedent main wire harness but adds two jumper harnesses to account for the longer wheelbase.
- Utilizes 4-gauge battery and motor wires instead of 6-gauge.
- Utilizes the 350-amp, 1515S-5306 controller (white in color) instead of the 250-amp, 1515-5206 controller (white in color).
- Uses the 3.7 hp electric motor found in heavy-duty utility vehicles instead of the 3.1 hp golf car motor.

FEATURES

- **Shunt-Wound Motor:** The shunt-wound motor, unlike a series motor, is designed so that the speed controller is able to vary the amount of current passing through the field coils independently from the current passing through the armature.
- **Motor Braking:** Under certain conditions a shunt-wound motor also has the ability to act as an electrical brake to slow the vehicle. There are two features of the Excel electrical system that will activate the motor braking function: Walk Away Braking and Motor Braking (adjustable with the IQDM-P handset).
- **Walk Away Braking:** This feature prevents the vehicle from rolling away uncontrolled should the driver park on a slope and leave the vehicle without locking the park brake. The vehicle will roll at about 1 to 3 mph (1.5 to 4.8 km/h). If the walk away braking function remains engaged for two seconds or more, a warning buzzer will sound to alert the driver that motor braking has been activated.

⚠ WARNING

- **Walk Away Braking will not limit vehicle speed to 3 mph (4.8 km/h) on very steep grades. Do not operate vehicle on slopes exceeding 20% grades.**

- **Motor Braking:** When going down an incline with the accelerator pedal partially pressed, the motor braking function will activate to assist the operator in maintaining a speed less than the speed setting. For example, if the vehicle is going down an incline with the accelerator pedal pressed half way, the motor braking function will activate to assist the operator in maintaining a speed approximately half of the speed setting defined in the Program Menu.
- **Regenerative Braking**: When motor braking is activated, the vehicle motor acts as a generator, slowing the vehicle as it creates energy that is used to charge the batteries.
- **Tow/Run Switch:** When the Tow/Run switch is in the RUN position, the vehicle will function normally. When the switch is in the TOW position, power to the controller is shut off, disabling the vehicle operating circuit and walk away braking, allowing the vehicle to be towed.
- **Motor Protection Circuit:** The operator should never attempt to hold the vehicle on an incline by pressing the accelerator pedal instead of the brake pedal, as motor overheating could result. By reducing the current to the motor during such an occurrence, the motor protection circuit reduces the possibility of motor damage. When this situation arises, a *motor stall fault* is recorded by the speed controller and will be displayed on an IQDM handset in the Diagnostic History menu. **See Motor Stall on page 11-15.**
- **High Pedal Detect:** This function prevents unexpected vehicle movement if the key switch is turned ON after the accelerator is pressed. The vehicle will not move until the accelerator is released and pressed again. When this situation arises, a *HPD fault* is recorded by the speed controller and will be displayed on an IQDM handset in the Diagnostic History menu. **See HPD on page 11-13.**

WIRING DIAGRAMS

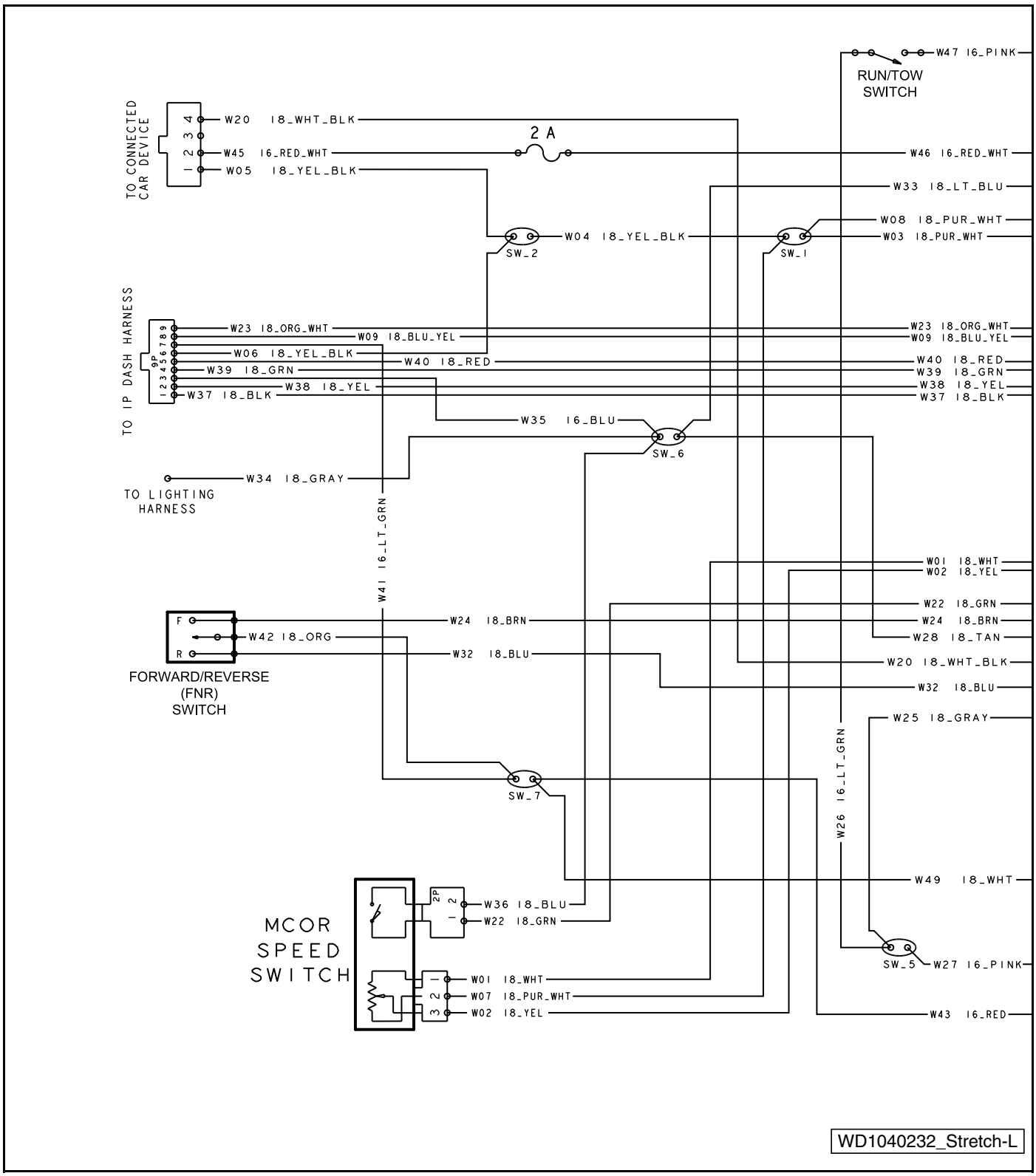

Figure 13-1 Wiring Diagram – Golf 4Fun and Precedent Stretch

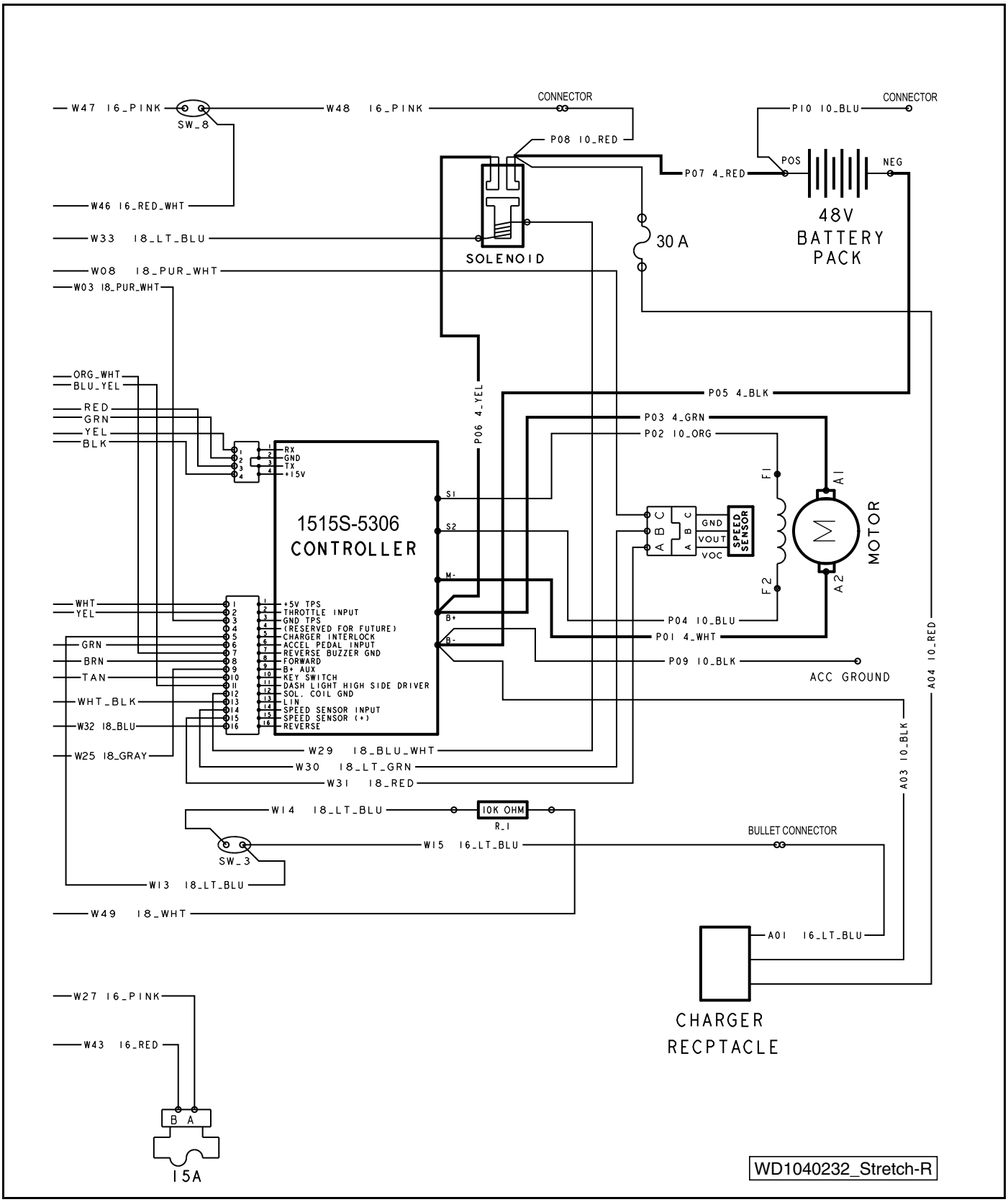

Figure 13-2 Wiring Diagram – Golf 4Fun and Precedent Stretch (Continued)

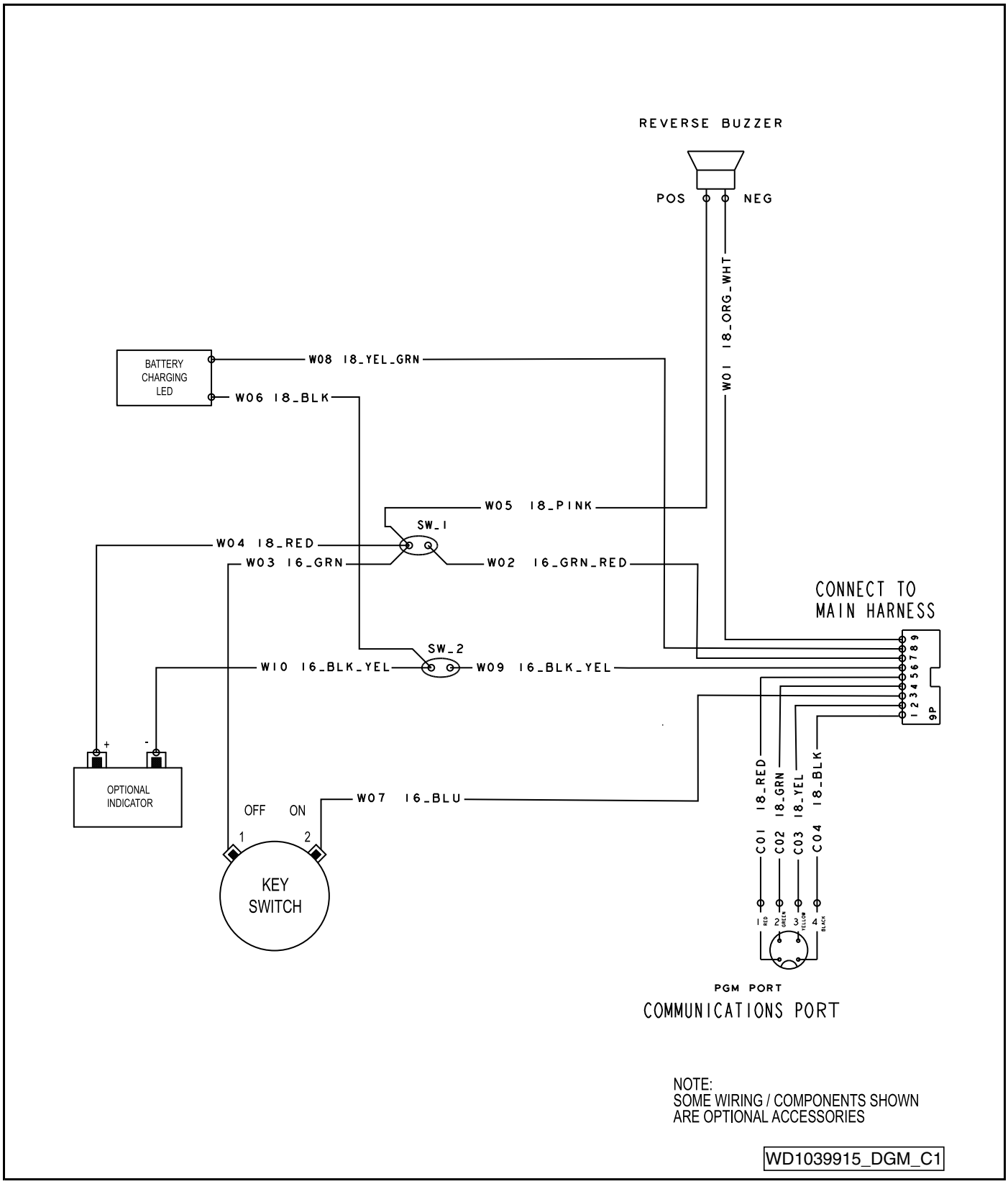

Figure 13-3 Instrument Panel Wiring Diagram – Precedent with ERIC Charging

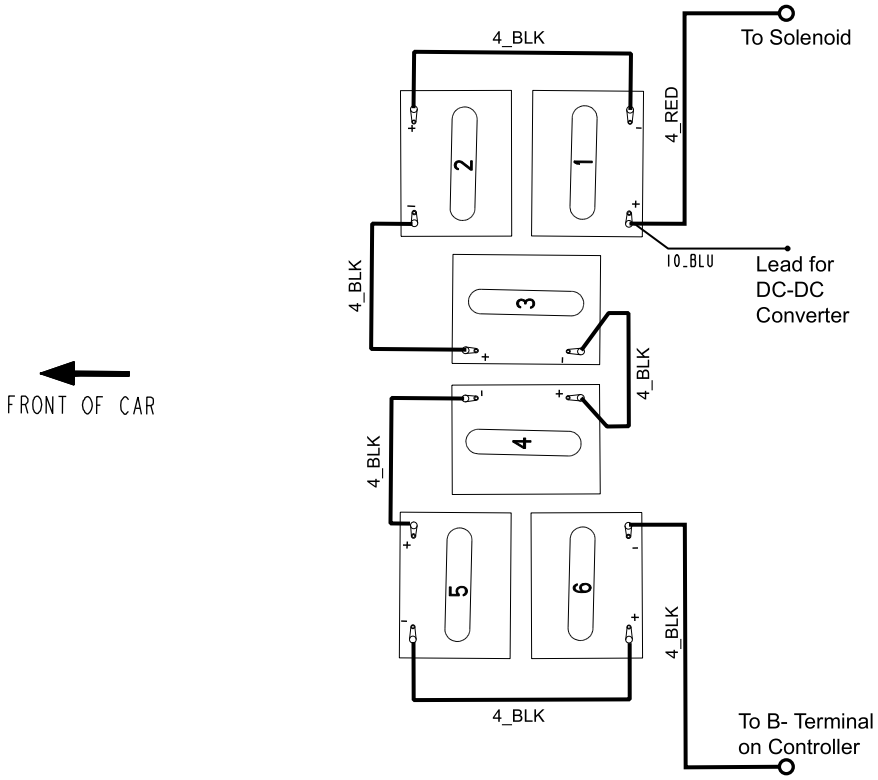

Figure 13-4 Battery Wiring Diagram – Precedent with ERIC Charging

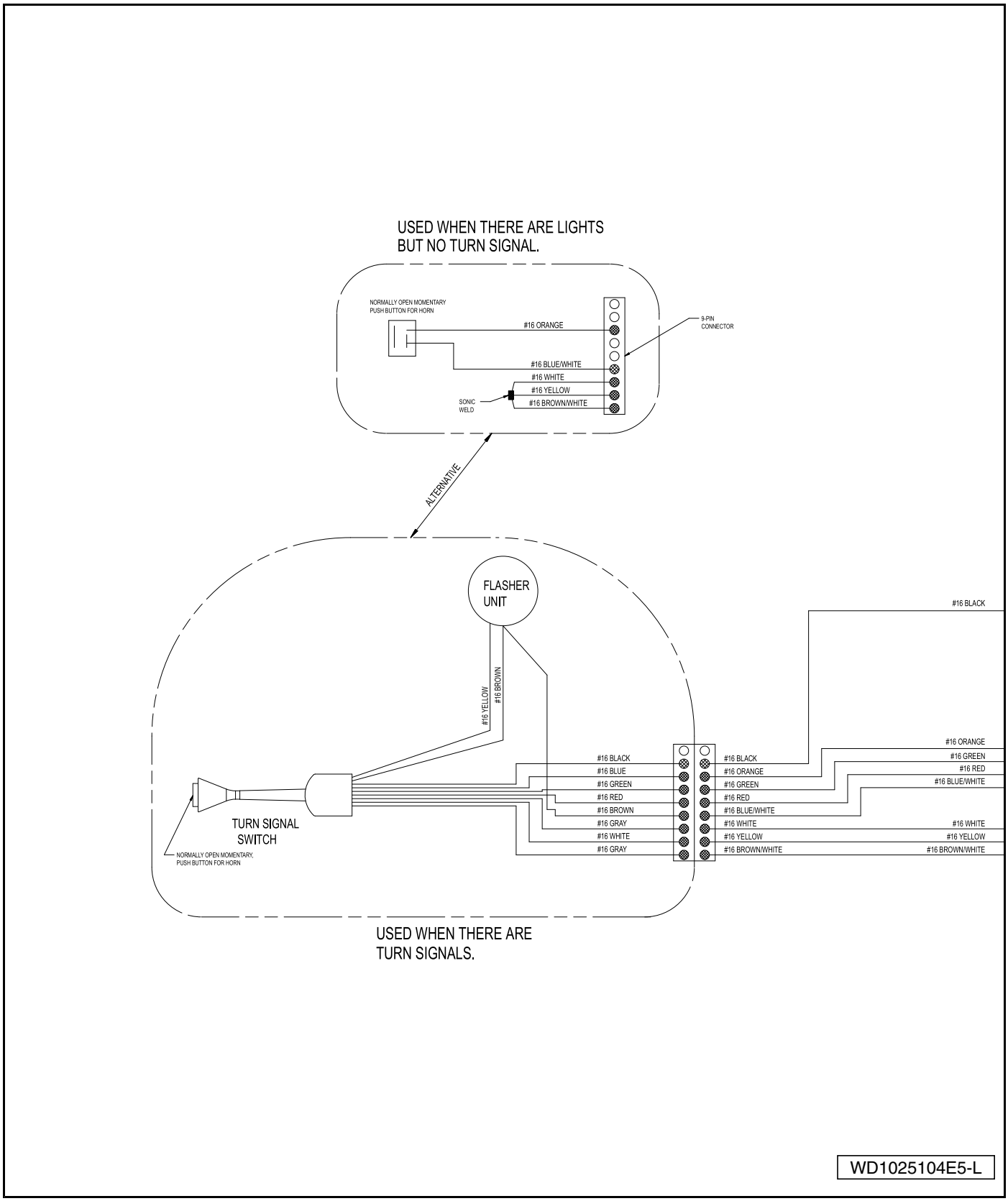

Figure 13-5 Precedent Electric Vehicle Accessory Wiring Diagram

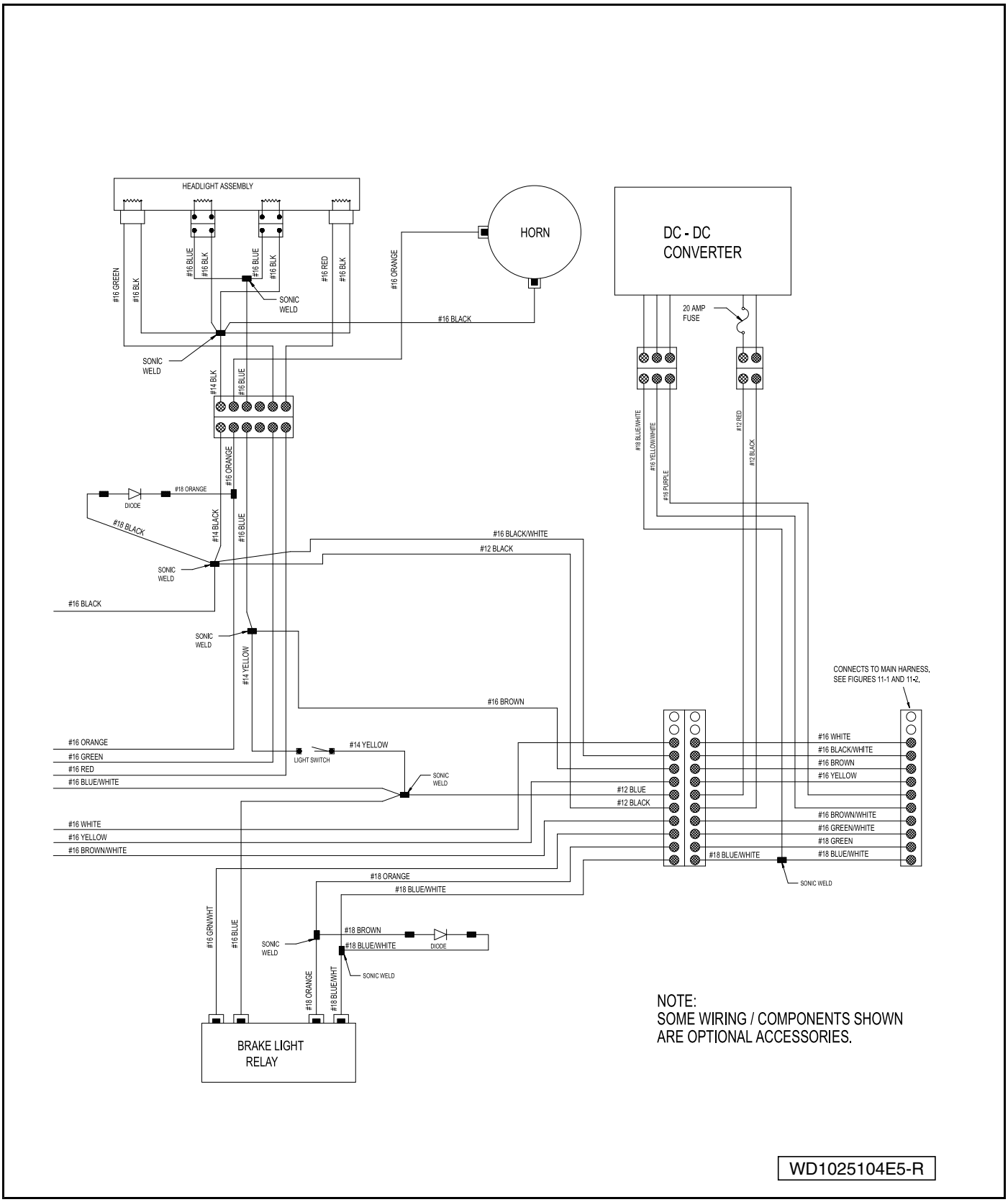

Figure 13-6 Precedent Electric Vehicle Accessory Wiring Diagram (Continued)

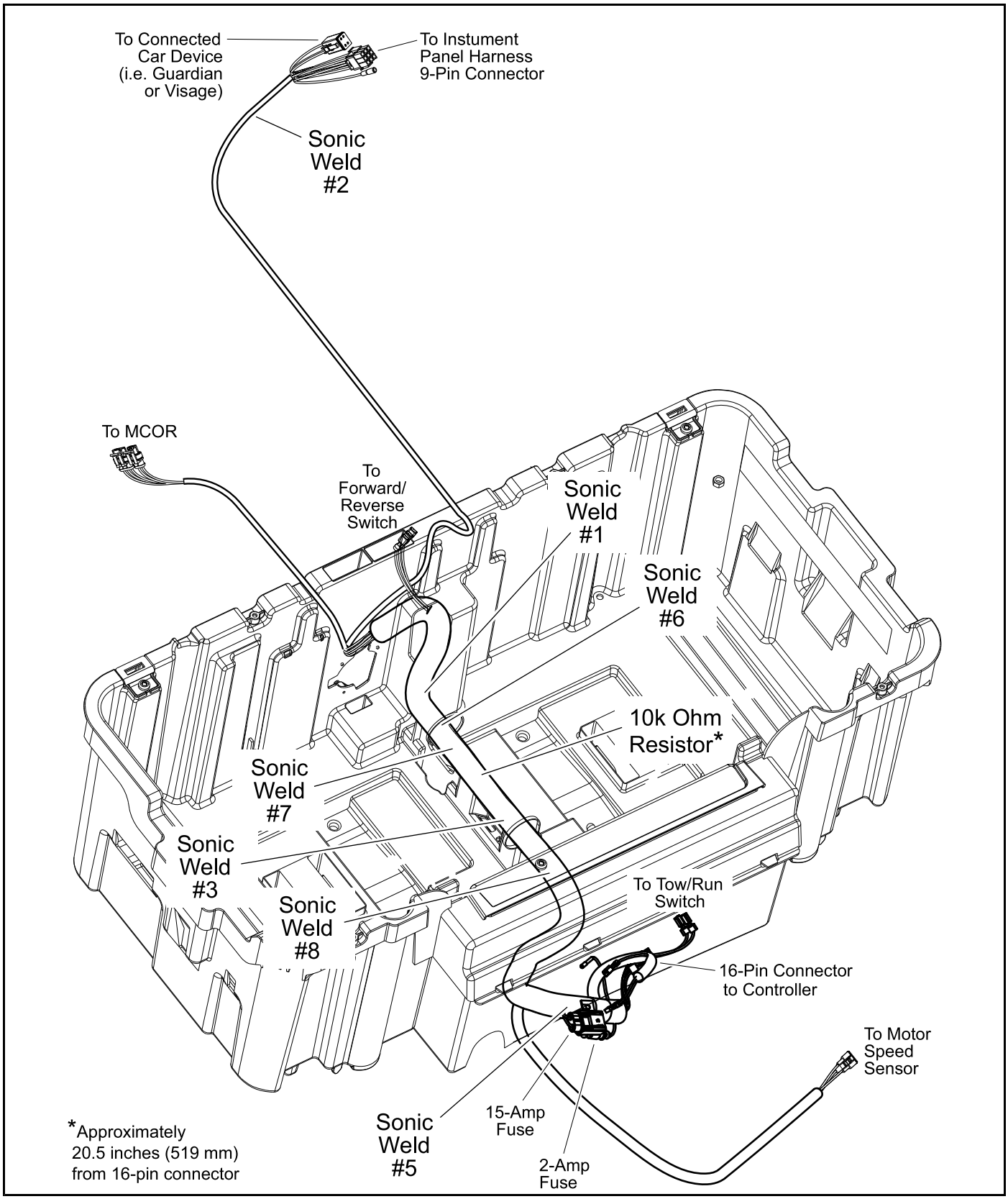

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Figure 13-7 Sonic Weld and 10k Ohm Resistor Locations (Approximate)

TROUBLESHOOTING

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

TROUBLESHOOTING THE VEHICLE WITH THE IQDM

Club Car recommends the use of the IQDM handset for troubleshooting vehicles equipped with the Excel electrical system. Troubleshooting Guide 1 is to be used in conjunction with the IQDM handset. **See IQ Display Module (IQDM) and IQDM-P Diagnostics: Excel System with ERIC Charging on page 11-1** for operating instructions. **See following WARNING.**

⚠ WARNING

- **The vehicle operator should not monitor the IQDM while the vehicle is in motion. A technician can monitor the IQDM while traveling as a passenger in the vehicle. Failure to heed this warning could result in severe personal injury or death.**

In the event that the vehicle is not functioning properly after completing Troubleshooting Guide 1, the technician should proceed to Troubleshooting Guide 2.
If an IQDM handset is unavailable, the technician should proceed to Troubleshooting Guide 2.

TROUBLESHOOTING GUIDE 1

The following troubleshooting guide is intended for use with an IQDM handset. **See following NOTE.**

NOTE: *Before troubleshooting the vehicle, check the diagnostic history from the Special Diagnostics Menu. Note any fault codes.*

TROUBLESHOOTING GUIDE 1		
SYMPTOM	**POSSIBLE CAUSES**	**CORRECTIVE ACTION**
Monitor Menu – THROTTLE % value does not increase as the accelerator pedal is pressed or Diagnostic Menu – THROTTLE FAULT fault code	Loose or disconnected three-pin connector at the MCOR or broken wire	Repair and/or connect the three-pin connector to the MCOR
	Loose or disconnected 16-pin connector at speed controller or broken wire	Repair and/or connect the 16-pin connector to the speed controller
	Failed MCOR	Test Procedure 11 – MCOR Voltage on page 13-26
Monitor Menu – TEMPERATURE °C indicates that temperature is above 85 °C (145 °F) or Diagnostic Menu – THERMAL CUTBACK fault code	Over-adjusted brakes	Section 6 – Wheel Brake Assemblies
	Vehicle is overloaded	Ensure that vehicle is not overloaded before returning to operation
Monitor Menu – ARM PWM value does not reach 100% when vehicle is at full speed	Failed MCOR	Test Procedure 11 – MCOR Voltage on page 13-26

TABLE CONTINUED ON NEXT PAGE

TROUBLESHOOTING GUIDE 1		
SYMPTOM	**POSSIBLE CAUSES**	**CORRECTIVE ACTION**
Monitor Menu – SPEED PULSES menu item indicates that speed pulses are OFF when the vehicle is in motion or Diagnostic Menu – SPEED SENSOR fault code	Loose or disconnected motor speed sensor or broken wire	Repair and/or connect the three-pin connector to the motor speed sensor
	Loose or disconnected 16-pin connector at speed controller or broken wire	Repair and/or connect the 16-pin connector to the speed controller
	Failed motor speed sensor	Test Procedure 12 – Motor Speed Sensor on page 13-29
Monitor Menu – FOOT INPUT menu item indicates that the MCOR internal limit switch is always ON or always OFF.	Loose or disconnected two-pin connector at the MCOR or broken wire	Repair and/or connect the two-pin connector to the MCOR
	Loose or disconnected 16-pin connector at speed controller or broken wire	Repair and/or connect the 16-pin connector to the speed controller
	Failed MCOR	Test Procedure 5 – Key Switch and MCOR Limit Switch Circuit on page 13-21
Monitor Menu – FORWARD INPUT and/or REVERSE INPUT does not indicate the correct reading	Loose or disconnected Forward/Reverse rocker switch (quick disconnect terminals) or broken wire	Repair and/or connect the quick disconnect terminals to the Forward/Reverse switch
	Loose or disconnected Forward/Reverse rocker switch (three-pin connector) or broken wire	Repair and/or connect the three-pin connector from the Forward/Reverse switch to the wire harness
	Loose or disconnected 16-pin connector at speed controller or broken wire	Repair and/or connect the 16-pin connector to the speed controller
	Failed Forward/Reverse rocker switch	Test Procedure 6 – Forward/Reverse Rocker Switch on page 13-22
Monitor Menu – MAIN CONT DRIVER (solenoid) does not indicate ON when the solenoid should be activated. or Diagnostic Menu – MAIN CONT DNC (main contactor in solenoid did not close) fault code	Speed controller logic malfunction	Disconnect the batteries and allow the speed controller capacitors to discharge. **See WARNING "To avoid unintentionally starting..." in General Warnings on page 1-2.** Reconnect the batteries and see if the symptom returns.
	Loose, broken, or disconnected wire(s) at solenoid or B+ speed controller terminal	Repair and/or connect the loose or disconnected wire(s)
	Loose or disconnected 16-pin connector at speed controller or broken wire	Repair and/or connect the 16-pin connector to the speed controller
	Failed solenoid	Replace solenoid. **See Solenoid Removal on page 14-13.**
Monitor Menu – KEY INPUT does not indicate ON when key switch is in the ON position	Loose or disconnected wires at key switch terminals or broken wire	Repair and/or connect the quick disconnect terminals to the Forward/Reverse switch
	Loose or disconnected 16-pin connector at speed controller or broken wire	Repair and/or connect the 16-pin connector to the speed controller
	Failed key switch	Test Procedure 5 – Key Switch and MCOR Limit Switch Circuit on page 13-21

TABLE CONTINUED ON NEXT PAGE

TROUBLESHOOTING GUIDE 1		
SYMPTOM	**POSSIBLE CAUSES**	**CORRECTIVE ACTION**
Diagnostic Menu – THROTTLE FAULT fault code	Loose or disconnected three-pin connector at the MCOR or broken wire	Repair and/or connect the three-pin connector to the MCOR
	Loose or disconnected 16-pin connector at speed controller or broken wire	Repair and/or connect the 16-pin connector to the speed controller
	Failed MCOR	Test Procedure 11 – MCOR Voltage on page 13-26
Diagnostic Menu – HW FAILSAFE (Hardware Failsafe) fault code	Armature drive FETs (field-effect transistors) inside speed controller have failed	Replace the speed controller. **See Speed Controller Removal on page 14-11.**
	Speed controller logic malfunction	Disconnect the batteries and allow the speed controller capacitors to discharge. **See WARNING "To avoid unintentionally starting..." in General Warnings on page 1-2.** Reconnect the batteries and see if the symptom returns.
Diagnostic Menu – MAIN WELDED (main solenoid contacts welded) fault code	solenoid contacts have failed closed	Replace solenoid. **See Solenoid Removal on page 14-13.**
Diagnostic Menu – MAIN DRIVER ON or MAIN DRIVER OFF fault code	Speed controller logic malfunction	Disconnect the batteries and allow the speed controller capacitors to discharge. **See WARNING "To avoid unintentionally starting..." in General Warnings on page 1-2.** Reconnect the batteries and see if the symptom returns.
	Failure of the FET that controls the solenoid coil	Replace the speed controller. **See Speed Controller Removal on page 14-11.**
Diagnostic Menu – MAIN COIL FAULT fault code or Diagnostic Menu – MAIN DROPOUT (1 or 2) fault code	Solenoid coil has failed in an open condition	Replace solenoid. **See Solenoid Removal on page 14-13.**
Diagnostic Menu – FIELD MISSING fault code	Loose or disconnected motor field coil wires at motor or speed controller or broken wire	Repair and/or connect the field coil wires
	Failure of the motor field windings	See Section 17 – Motor (Model DA5-4006).
	Failure of the FETs that control field current	Replace the speed controller. **See Speed Controller Removal on page 14-11.**
Diagnostic Menu – HPD (high pedal detect) fault code	Operator error	Train operators to fully remove foot from accelerator pedal before turning key switch to the ON position or changing the selected direction with the Forward/Reverse switch
Diagnostic Menu – LOW BATTERY fault code	Batteries require charging	Place batteries on battery charger and allow them to fully charge
	Improperly maintained or failed batteries	See Section 15 – Batteries: Electric Vehicle with ERIC Charging.
Diagnostic Menu – MOTOR STALL fault code	Operator error	Train operators to use the brake to hold the vehicle on a hill, rather than holding the vehicle on a hill using the accelerator pedal

TROUBLESHOOTING GUIDE 2

In the event that the vehicle is not functioning properly after completing Troubleshooting Guide 1, use Troubleshooting Guide 2.
If an IQDM handset is unavailable, use Troubleshooting Guide 2.

TROUBLESHOOTING GUIDE 2		
SYMPTOM	**POSSIBLE CAUSES**	**CORRECTIVE ACTION**
Vehicle does not operate	Batteries – batteries discharged	Charge batteries
	Batteries – battery connections	Check vehicle wiring. **See Wiring Diagrams on page 13-4.**
	Battery charger is connected to the vehicle – charger interlock feature has disabled the vehicle	Disconnect the battery charger from the vehicle
	Charger interlock failure	Test Procedure 10 – Charger Interlock on page 13-25
	Key switch and MCOR limit switch circuit	Check for loose or disconnected wires at key switch and MCOR
	Failed key switch	Test Procedure 5 – Key Switch and MCOR Limit Switch Circuit on page 13-21
	Failed MCOR	Test Procedure 5 – Key Switch and MCOR Limit Switch Circuit on page 13-21. See also Test Procedure 11 – MCOR Voltage on page 13-26.
	Forward/Reverse rocker switch	Test Procedure 6 – Forward/Reverse Rocker Switch on page 13-22
	Solenoid – loose wires	Test Procedure 7 – Solenoid Activating Coil on page 13-24
	Solenoid – failed coil	Test Procedure 7 – Solenoid Activating Coil on page 13-24
	Speed controller thermal cutback	Allow controller to cool and ensure that vehicle is not over-loaded before returning to operation
	16-pin connector at speed controller	Check for loose or disconnected wires at the 16-pin connector. **See also Test Procedure 15 – 16-Pin Connector on page 13-32.**
	High pedal detect	Cycle accelerator pedal
	Motor stall	Cycle accelerator pedal
	Motor Failure	See Section 17 – Motor (Model DA5-4006).
	Speed controller failure	Replace speed controller. **See Speed Controller Removal on page 14-11.**
	Motor – motor connections	Check for loose or disconnected wires
	Speed controller – Motor and power connections	Check for loose or disconnected wires

TABLE CONTINUED ON NEXT PAGE

TROUBLESHOOTING GUIDE 2		
SYMPTOM	**POSSIBLE CAUSES**	**CORRECTIVE ACTION**
Vehicle runs slowly	Speed sensor disconnected or failed	Test Procedure 12 – Motor Speed Sensor on page 13-29
	Incorrect speed setting	To change the programmed top speed of the vehicle, an IQDM-P handset must be used
	Wiring – improperly wired	Check vehicle wiring. **See Wiring Diagrams on page 13-4.**
	Batteries – batteries discharged	Charge batteries
	MCOR malfunction	Test Procedure 11 – MCOR Voltage on page 13-26
	Motor – loose wires	Inspect and tighten all wire connections at the motor.
	Failed motor	Replace motor. **See Motor Removal on page 17-2.**
	Vehicle is over-loaded	Ensure that vehicle is not over-loaded before returning to operation.
	Speed controller failure	Replace speed controller. **See Speed Controller Removal on page 14-11.**
	Brakes – improperly adjusted	See Section 6 – Wheel Brake Assemblies.
	Tires – under-inflated or flat tires	See Section 8 – Wheels and Tires.
Vehicle operates but has points in pedal travel where it does not maintain speed nor accelerate	MCOR malfunction	Test Procedure 11 – MCOR Voltage on page 13-26
Vehicle reaches top speed before 100% pedal travel is reached	Speed controller – failed throttle resistor(s)	Replace speed controller. **See Speed Controller Removal on page 14-11.**
Vehicle operates, but motor braking function does not	Wiring – improperly wired	Check vehicle wiring. **See Wiring Diagrams on page 13-4.**
	Speed sensor disconnected or failed	Test Procedure 12 – Motor Speed Sensor on page 13-29
Vehicle will run in forward, but not in reverse or will run in reverse but not forward	Forward/Reverse rocker switch – improperly wired	Test Procedure 6 – Forward/Reverse Rocker Switch on page 13-22
	Motor – improperly wired	Check motor wiring. **See Wiring Diagrams on page 13-4.**
	Speed controller – improperly wired or failed speed controller FET	Check vehicle wiring. **See Wiring Diagrams on page 13-4.**
Vehicle operates, but battery charger does not charge batteries	Charger interlock failure	Test Procedure 10 – Charger Interlock on page 13-25
	Battery charger connections – loose plug or wires at charger, receptacle or batteries	Check wire connections and tighten if necessary.
	Battery charger	See Section 16 – Battery Charger: for ERIC Charging System.

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 many tests, the electronics module cover must be removed to gain access to the various components that are mounted on the component mounting plate. **See Electronics Module Cover on page 14-5. See following WARNING.**

⚠ WARNING

- **Shorting of battery terminals can cause personal injury or death.**
  - **Do not place component mounting plate directly on top of batteries when removing or installing plate.**
  - **Remove plate from vehicle completely.**

After test procedures are completed, be sure to replace the cover. **See Electronics Module Cover on page 14-5. See following CAUTION.**

CAUTION

- **Exposure to water may damage electronic components.**
  - **Do not operate vehicle without the cover properly installed.**
  - **Do not direct a water stream in area of the cover.**

TESTING BASICS

- To use the IQDM, the Tow/Run switch must be in the RUN position. The Tow/Run switch provides power to the logic board and power board inside the controller.
- Battery Pack Voltage (BPV) will be referenced throughout the test procedures. BPV is accessed in **Test Procedure 1 – Batteries / Voltage Check (BPV) on page 13-17**.
- The Tow/Run switch powers the key switch, controller, Forward/Reverse switch, 15-amp fuse, and reverse buzzer.
- The key switch powers the MCOR 2-pin circuit, Forward/Reverse switch, solenoid, and the female bullet connector (W34 shown on **(Figure 13-1)**.
- The MCOR 3-pin circuit, motor speed sensor circuit, the communication point for the car device (white/black wire in position 13 of the 16 pin connector), and charge indicator light is powered by the controller (with Tow/Run switch in RUN).
- The 2-amp fuse is powered directly by the batteries via the solenoid and carries BPV to the connected car device. No switch is involved.
- 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. **See following CAUTION.**

CAUTION

- **Be careful not to damage the wire or terminal when back-probing.**

- When testing voltage, the batteries must remain connected.
- When testing voltage, unless specifically directed to do otherwise in a procedure, connect the black (–) probe of the multimeter to the negative post of battery no. 6 (6 x 8-Volt battery set) or the B- terminal of the controller, whichever is easier to access.
- When testing controller functions, the Run/Tow switch must be in the RUN position. The TOW position removes power to the controller.
- Several test can be performed by accessing components through the access panel in the rear body. If greater access is required, the two center batteries can be removed and the component mounting plate leaned forward; place the two center batteries on the floorboard and reconnect two of the existing battery cables. Use a third, "service only" cable that is long enough to connect the two batteries just for troubleshooting.

Index of Test Procedures

1 – Batteries / Voltage Check (BPV)
2 – 48-Volt Battery Pack Voltage Under Load
3 – Tow/Run Switch
4 – 15-Amp Fuse
5 – Key Switch and MCOR Limit Switch Circuit
6 – Forward/Reverse Rocker Switch
7 – Solenoid Activating Coil
8 – Pre-Charge Resistor
9 – Solenoid Continuity
10 – Charger Interlock
11 – MCOR Voltage
12 – Motor Speed Sensor
13 – A1 and A2 Motor Voltage
14 – Voltage at Charger Receptacle Red Wire Socket
15 – 16-Pin Connector
16 – Reverse Buzzer
17 – Charge Indicator Light
18 – 4-Pin Connector (for Connected Car Device)

TEST PROCEDURE 1 – Batteries / Voltage Check (BPV)

See General Warnings on page 1-2.

NOTE: *This is a voltage test.*

The batteries must be properly maintained and fully charged in order to perform the following test procedures. Battery maintenance procedures, including watering information and allowable mineral content, can be found in the Battery section of this manual. ***See Battery Care on page 15-6.***

The battery voltage can be displayed with the IQDM handset. If an IQDM handset is not available, proceed to **Batteries / Voltage Check without the IQDM Handset**.

Batteries / Voltage Check with the IQDM Handset

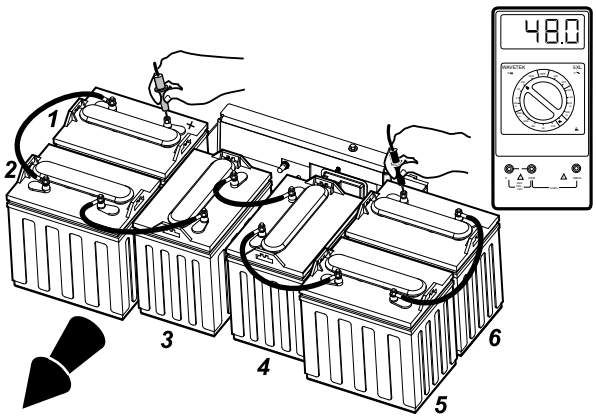
1. Connect the IQDM to the vehicle.
2. Access the Monitor menu and select BATT VOLTAGE by using the SCROLL DISPLAY buttons. The IQDM should indicate at least 48 volts. **See following NOTE.** If not, check for loose battery connections or a battery

installed in reverse polarity. **Refer to Batteries: Electric Vehicle with ERIC Charging on page 15-1 for further details on battery testing.**

NOTE: *The voltage displayed through the IQDM shows what the controller thinks it sees. If the controller is not operating properly, it may display a different voltage from what the battery pack voltage (BPV) really is. Always compare and confirm with readings obtained using a multimeter in the following procedure.*

Batteries / Voltage Check without the IQDM Handset

1. If necessary, see Testing Basics on page 13-16.
2. With batteries connected and using a multimeter set to 200 volts DC, place red (+) probe on the positive (+) post of battery no. 1 and the black (–) probe on the negative (–) post of battery no. 6 **(Figure 13-8, Page 13-18)**.
3. The multimeter should indicate at least 48 volts. If not, check for loose battery connections or a battery installed in reverse polarity. **Refer to Batteries: Electric Vehicle with ERIC Charging on page 15-1 for further details on battery testing.**



(Viewed from driver side of vehicle)
1. RED probe to battery no. 1 (+).
2. BLACK probe to battery no. 6 (-).

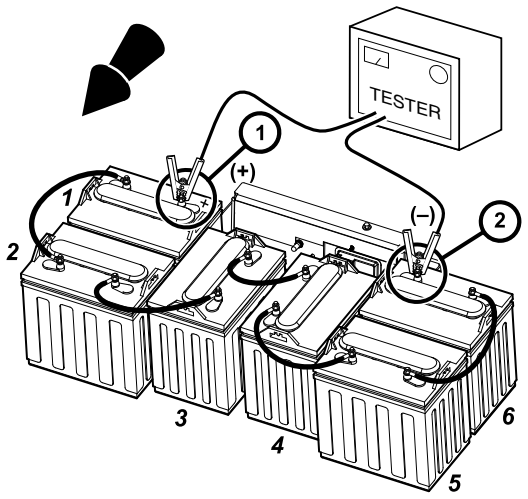
2500-30100-10413
Figure 13-8 Battery Voltage Test

TEST PROCEDURE 2 – 48-Volt Battery Pack Voltage Under Load

See General Warnings on page 1-2.

NOTE: *This is a voltage test.*

1. If necessary, see Testing Basics on page 13-16.
2. Be sure the batteries are fully charged and that the electrolyte level is correct in all cells.
3. Connect the tester leads to the positive (+) post of battery no.1 and negative (–) post of battery no. 6 **(Figure 13-9, Page 13-19)**.



(Viewed from driver side of vehicle)

1. RED probe to battery no. 1 (+).
2. BLACK probe to battery no. 6 (-).

2500-30100-10411

Figure 13-9 Battery Discharge Test

4. Turn the discharge machine on and record the voltage reading of battery pack while under load.
5. A fully charged set of batteries in good condition should read between 46 and 49 volts while under load.
6. A reading of 32 to 46 volts indicates discharged or failed batteries. Each battery should be checked with a multimeter while under load. **See following NOTE.**

NOTE: *If a 48-volt set of batteries is down in the 32 to 38 volt range, the discharge machine will activate but it will think it is testing a 36-volt battery set.*

7. A reading of 31.5 volts or less will not activate discharge machine. If the voltage of the batteries is below 32 volts, the batteries are deeply discharged or have failed.
8. Recording the battery pack voltage reading while under load provides a more accurate diagnosis of the condition of the batteries. When the discharge machine is ON, it places the battery pack under load and many times can help determine if one or more batteries in the set have failed. Testing battery voltage while the batteries are not under load will not always indicate the true condition of the batteries. For more information about the batteries, refer to Batteries: Electric Vehicle with ERIC Charging on page 15-1.

TEST PROCEDURE 3 – Tow/Run Switch

See General Warnings on page 1-2.

NOTE: *This is a voltage test.*

If no voltage is coming to the Tow/Run Switch, inspect the red-to-pink wire spade connection at the solenoid.

Tow/Run Switch Test with the IQDM Handset

1. With the Tow/Run switch in the RUN position, connect the IQDM to the vehicle.
2. Immediately after the IQDM is connected to the vehicle, the screen should display a copyright notice and the IQDM model number.
3. If the IQDM display screen remains blank, the IQDM port has failed. In this case, disconnect the IQDM from the port and connect it directly to the controller **(Figure 11-9, Page 11-25)**.

4. If the IQDM display screen begins to work, proceed to step 5; otherwise, perform the following procedure, **Tow/Run Switch Test without the IQDM Handset**.
5. With the IQDM still connected to vehicle, place Tow/Run Switch in TOW position.
6. If the IQDM display screen goes blank, the Tow/Run switch and connecting wires are operating correctly.
7. If the IQDM display screen is still active, the switch has failed closed. Replace the Tow/Run switch. **See Tow/Run Switch Removal on page 14-6.**

Tow/Run Switch Test without the IQDM Handset

⚠ WARNING

- **The key switch should be placed in the OFF position and left in the OFF position for the duration of this test.**

1. If necessary, see Testing Basics on page 13-16.
2. Access the Tow/Run switch but do not disconnect wires.
3. With the Tow/Run switch in the RUN position:
   3.1. The pink wire should show BPV coming to the switch.
   3.2. The light green wire should also show BPV. If it shows less than 5 volts, the switch has failed OPEN and must be replaced.
4. With the Tow/Run switch in the TOW position:
   4.1. The light green wire should show less than 5 volts. If it still shows BPV, the switch has failed CLOSED and must be replaced.

TEST PROCEDURE 4 – 15-Amp Fuse

See General Warnings on page 1-2.

NOTE: *This is a voltage test.*

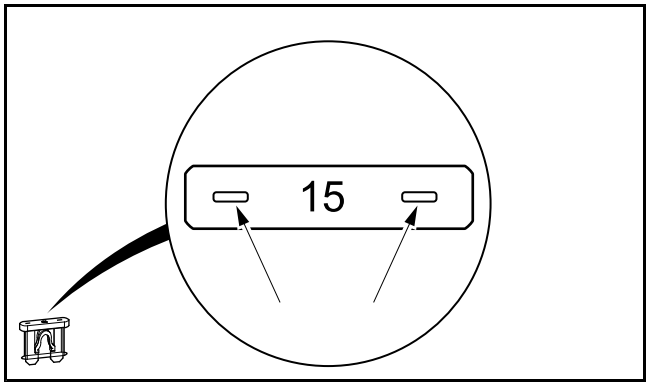


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Figure 13-10 Testing the Fuse

1. If necessary, see Testing Basics on page 13-16.
2. Access the 15-amp fuse but do not remove it.
3. With the Tow/Run switch in the RUN position:
   3.1. Probe the two, small metal contacts on the top of the fuse **(Figure 13-10, Page 13-20)**.
   3.2. Each contact should show BPV.
   3.3. If the red wire side does not show BPV, replace fuse.

3.4. If the pink wire side does not show BPV, make sure Tow/Run switch in the RUN position. If it is in RUN, inspect Tow/Run switch, red-to-pink wire spade connector near the solenoid, and sonic welds 5 and 8.

TEST PROCEDURE 5 – Key Switch and MCOR Limit Switch Circuit

See General Warnings on page 1-2.

NOTE: *This is a voltage test.*

The MCOR provides FOOT INPUT to the controller.

The key switch provides KEY INPUT to the controller.

Key Switch and MCOR Limit Switch Circuit Test with the IQDM Handset

1. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING "Lift only one end..." in General Warnings on page 1-2.**
2. Turn the key switch to the OFF position and place the Forward/Reverse switch in the NEUTRAL position.
3. Connect the IQDM to the vehicle.
4. Test the key switch.
   4.1. Access the Monitor menu and select KEY INPUT by using the SCROLL DISPLAY buttons. The IQDM should indicate OFF when the key switch is in the OFF position.
   4.2. While monitoring the IQDM display screen, turn the key switch to the ON position. The IQDM should indicate ON.
   4.3. If the IQDM does not indicate that KEY INPUT is ON when the key switch is in the ON position, proceed to the following procedure, **Key Switch and MCOR Limit Switch Circuit Test without the IQDM Handset**. If the key switch functions as described, proceed to the following step. **See following NOTE.**

NOTE: *The key switch MUST function properly in order to test the MCOR limit switch with the IQDM handset.*

5. Test the MCOR limit switch.
   5.1. Select FOOT INPUT on the Monitor menu by using the SCROLL DISPLAY buttons on the IQDM.
   5.2. The IQDM should indicate that FOOT INPUT is OFF when the accelerator pedal is not pressed, regardless of the key switch position.
   5.3. With the key switch in the ON position, press the accelerator pedal. The IQDM should indicate that FOOT INPUT is ON when the accelerator pedal is pressed.
6. If any reading is obtained that is not described in steps 4 and 5, perform the following steps:
   6.1. Check the wiring of the key switch and MCOR. **See Wiring Diagrams, Section 13, Page 13-4.**
   6.2. Check the continuity of the key switch wires and the MCOR limit switch wires.
7. If the problem was not found, proceed to the following procedure, **Key Switch and MCOR Limit Switch Circuit Test without the IQDM Handset**.

Key Switch and MCOR Limit Switch Circuit Test without the IQDM Handset

1. If necessary, see Testing Basics on page 13-16.
2. 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 rails just forward of each spring mount. **See WARNING "Lift only one end..." in General Warnings on page 1-2.**
3. Place the Tow/Run switch in the RUN position and the Forward/Reverse switch in the NEUTRAL position.
4. **Pin 6 Green Wire:** Access the controller by removing the access panel in the rear body. **See following NOTE.**

NOTE: *The easiest way to test the key switch and MCOR Limit Switch is to check the pin 6 green wire in the 16-pin connector. Pin 6 is the end of this circuit.*

4.1. Locate and connect an insulation-piercing probe to the pin 6 green wire in the 16-pin connector.

4.2. With the key switch in the OFF position and the accelerator pedal at rest, the green wire should show zero (0) volts.

4.3. With the key switch in the ON position and the accelerator pedal pressed, the green wire should show BPV which is FOOT INPUT to controller.
- If it shows BPV, then the key switch, MCOR and related wiring is functioning properly.
- If not, first check the key switch and then the MCOR limit switch.

5. **Key Switch:** Remove instrument panel to access the back of the key switch but do not disconnect wires. **See Key Switch Removal, Section 14, Page 14-1.**

5.1. With the key switch in the OFF position:
- The green wire should show BPV coming to the switch.
- The blue wire should show zero (0) volts. If it shows BPV, the switch has failed CLOSED and must be replaced.

5.2. With the key switch in the ON position:
- The blue wire should show BPV passing through the key switch to the MCOR. If it does not show BPV, the switch has failed OPEN and must be replaced.

6. **MCOR Limit Switch (FOOT INPUT):** Remove floormat and cover plate to access the MCOR. **See Pedal Group Removal on page 5-1.**

6.1. With the key switch in the ON position:
- With an insulation-piercing probe, check voltage of the blue wire in the MCOR 2-pin connector. It should show BPV coming to the MCOR. If not, check wiring.
- With an insulation-piercing probe, check voltage of the green wire in the MCOR 2-pin connector. It should show zero (0) volts with the accelerator pedal at rest. Press the accelerator pedal and the green wire should show BPV passing through the MCOR to the controller for FOOT INPUT. If not, replace MCOR. **See MCOR Removal on page 14-7.**

TEST PROCEDURE 6 – Forward/Reverse Rocker Switch

See General Warnings on page 1-2.

NOTE: *This is a voltage test.*

The Forward/Reverse Switch provides FORWARD INPUT and REVERSE INPUT to the controller.

If the controller sees both FORWARD INPUT and REVERSE INPUT at the same time, the reverse buzzer will sound in all FNR positions and the vehicle will not operate in either direction. Common causes of this include corrosion across the contacts inside the switch, water inside the switch, or a switch that has failed CLOSED.

Forward/Reverse Rocker Switch Test with the IQDM Handset

1. Turn the key switch to the OFF position and place the Forward/Reverse switch in the NEUTRAL position.
2. Connect the IQDM to the vehicle.
3. Test FORWARD INPUT.

3.1. Access the Monitor menu and select FORWARD INPUT by using the SCROLL DISPLAY buttons. The IQDM should indicate OFF when the Forward/Reverse switch is in the NEUTRAL or REVERSE position.

3.2. Place the Forward/Reverse switch in the FORWARD position. The IQDM should indicate that FORWARD INPUT is ON. If the IQDM indicates any other reading, check vehicle wiring. **See Wiring Diagrams on**

page 13-4. Also check the 16-pin connector at the speed controller. **See Test Procedure 15 – 16-Pin Connector on page 13-32.**

4. Test REVERSE INPUT.
   4.1. Access the Monitor menu and select REVERSE INPUT by using the SCROLL DISPLAY buttons. The IQDM should indicate OFF when the Forward/Reverse switch is in the NEUTRAL or FORWARD position.
   4.2. Place the Forward/Reverse switch in the REVERSE position. The IQDM should indicate that REVERSE INPUT is ON. If the IQDM indicates any other reading, check vehicle wiring. **See Wiring Diagrams on page 13-4.** Also check the 16-pin connector at the speed controller. **See Test Procedure 15 – 16-Pin Connector on page 13-32.**
5. If the IQDM displays readings other than those described above and the wiring is found to be correct, proceed to the following procedure, **Forward/Reverse Rocker Switch Test without the IQDM Handset**.

Forward/Reverse Rocker Switch Test without the IQDM Handset

1. If necessary, see Testing Basics on page 13-16.
2. Place the Tow/Run switch in the RUN position and the Forward/Reverse switch in the NEUTRAL position.
3. Remove Forward/Reverse switch from its housing by carefully prying up each side with a small, flat-tip screwdriver.
4. Back-probe the following three wires connected to the Forward/Reverse switch in each position:
   4.1. **Orange Wire**
   – The orange wire provides power to the switch and should show BPV coming to the switch in all three positions.

   If the orange wire does not show BPV, check the 15-amp fuse, Tow/Run switch, red-to-pink wire spade terminal connection and related wiring.

   4.2. **Brown Wire**
   – The brown wire should show BPV in FORWARD.

   – The brown wire should show zero (0) volts in NEUTRAL and REVERSE

   If the brown wire shows voltage in NEUTRAL, the switch may have corrosion across the contacts or the switch has failed CLOSED and must be replaced. **See Forward/Reverse Rocker Switch Removal on page 14-3.**

   If the brown wire does not show BPV in FORWARD, the switch may have corrosion on the contact or the switch has failed OPEN and must be replaced. **See Forward/Reverse Rocker Switch Removal on page 14-3.**

   4.3. **Blue Wire**
   – The blue wire should show BPV in REVERSE.

   – The blue wire should show zero (0) volts in NEUTRAL and FORWARD.

   If the blue wire shows voltage in NEUTRAL, the switch may have corrosion across the contacts or the switch has failed CLOSED and must be replaced. **See Forward/Reverse Rocker Switch Removal on page 14-3.**

   If the blue wire does not show BPV in REVERSE, the switch may have corrosion on the contact or the switch has failed OPEN and must be replaced. **See Forward/Reverse Rocker Switch Removal on page 14-3.**.
5. When installing the Forward/Reverse switch into its housing, orient the three wire terminals towards the front of the vehicle (i.e. biased closer to the front of the switch housing and farther from the rear body).

TEST PROCEDURE 7 – Solenoid Activating Coil

See General Warnings on page 1-2.

NOTE: *This is a resistance test.*

1. If necessary, see Testing Basics on page 13-16.
2. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries on page 1-3.**
3. Access the solenoid by removing the electronics module cover. **See Electronics Module Cover on page 14-5.**
4. Remove the two small wire terminals from the solenoid.
5. Place red (+) probe of the multimeter on the positive (+) solenoid terminal. Place the black (–) probe on the other small solenoid terminal.
6. A reading of 180 to 190 ohms should be obtained **(Figure 13-11, Page 13-24)**. If not, replace the solenoid.

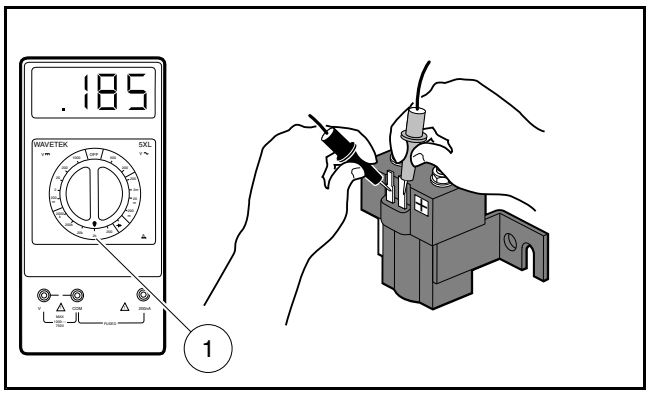

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Figure 13-11 Activating Coil Test

TEST PROCEDURE 8 – Pre-Charge Resistor

See General Warnings on page 1-2.

NOTE: *This is a resistance test.*

1. If necessary, see Testing Basics on page 13-16.
2. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries on page 1-3.**
3. Access the solenoid by removing the access panel in the rear body.
4. Measure resistance between the two large posts of the solenoid. The reading should be approx. 250 Ohms. If not, replace the pre-charge resistor using most of the steps found in **Solenoid Removal on page 14-13**.
5. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries on page 1-3.**

TEST PROCEDURE 9 – Solenoid Continuity

See General Warnings on page 1-2.

Solenoid Continuity Test with the IQDM Handset

1. If necessary, see Testing Basics on page 13-16.
2. 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 rails just forward of each spring mount. **See WARNING "Lift only one end..." in General Warnings on page 1-2.**

3. Connect the IQDM to the vehicle.
4. Access the Monitor menu and select MAIN CONT DRIVER by using the SCROLL DISPLAY buttons. The IQDM should indicate OFF.
5. Turn the key switch to the ON position and place the Forward/Reverse switch in the FORWARD position.
6. Press the accelerator pedal. When the controller energizes the solenoid coil, the IQDM should indicate ON. If not, check the KEY, FORWARD, REVERSE and FOOT INPUTS to the controller. **See Wiring Diagrams on page 13-4.** Also check the 16-pin connector at the speed controller. **See Test Procedure 15 – 16-Pin Connector on page 13-32.**
7. If the IQDM displays readings other than those described above and the wiring is found to be correct, proceed to the following procedure, **Solenoid Continuity Test without the IQDM Handset**.

Solenoid Continuity Test without the IQDM Handset

1. If necessary, see Testing Basics on page 13-16.
2. 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 rails just forward of each spring mount. **See WARNING "Lift only one end..." in General Warnings on page 1-2.**
3. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries on page 1-3.**
4. Disconnect the 4-gauge yellow wire and pre-charge resistor from large post of solenoid. **See following NOTE.**

NOTE: *When disconnecting heavy gauge wires from solenoid, use a second wrench on the lower nut of the terminal post to hold post steady, preventing damage to the solenoid.*

If the pre-charge resistor is not disconnected, the meter will read approx. 250 Ohms.

5. Check for continuity between the two large posts of the solenoid. The reading should be no continuity. If continuity is found, the solenoid has failed CLOSED and must be replace. **See Solenoid Removal on page 14-13.**
6. Reconnect the 4-gauge yellow wire and pre-charge resistor to the solenoid and secure with washer and nut. Tighten nut to 77 in·lb (8.7 N·m).
7. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries on page 1-3.**

⚠ WARNING

- **Keep people and equipment clear from rotating rear wheels. Do not allow persons under the car. Contact with rotating rear wheels could result in serious personal injury.**

8. Change the multimeter to measure resistance.
9. Place the Tow/Run switch in the RUN position, turn the key switch to the ON position, place the Forward/Reverse rocker switch in the FORWARD position, and press the accelerator pedal. The rear tire should rotate and the multimeter should show a change in resistance. If not, replace the solenoid. **See Solenoid Removal on page 14-13.**

TEST PROCEDURE 10 – Charger Interlock

See General Warnings on page 1-2.

Controller Interlock Function Test with the IQDM Handset

1. If necessary, see Testing Basics on page 13-16.
2. Connect the IQDM to the vehicle.

3. Access the Monitor menu and select CHARGER INHIBIT by using the SCROLL DISPLAY buttons. The IQDM should indicate OFF.
4. **For external charger:** Insert the charger DC cord into the vehicle's charger receptacle.

   For onboard charger: Insert the onboard charger AC plug into an AC outlet.
5. In a few seconds, the IQDM should indicate ON and the vehicle can no longer be driven. If not, check the KEY, FORWARD, REVERSE and FOOT INPUTS to the controller.
   – If the IQDM does not indicate ON, check circuit wiring and DC plug connection. See the following procedure **Testing the Interlock Circuit**.
   – If the IQDM does indicate ON, but the vehicle can still be driven, replace the controller. **See Speed Controller Removal, Section 14, Page 14-11.**

Testing the Interlock Circuit

The charger interlock circuit consists of a 48V power source through the RUN/TOW switch, three sonic welds, a 15-amp fuse, a 10k Ohm resistor, a bullet connector, the charger receptacle blue wire and DC plug. **See following NOTE.** Use the following procedure to test the charger interlock circuit:

NOTE: *The following steps involve testing voltage and resistance.*

At the charger end of the DC cord, the black wire and blue wire are crimped together in the same fork terminal. This closes the circuit once the DC cord plug is inserted into the charger receptacle.

1. With batteries connected, place the Tow/Run switch in the RUN position.
2. Remove electronics module cover. **See Electronics Module Cover Removal, Section 14, Page 14-5.**
3. **Check 15-amp fuse: See Test Procedure 4 – 15-Amp Fuse on page 13-20.**
4. **Check power:** Using a multimeter set to 200 volts DC, place red (+) probe (with insulation-piercing probe) on the light blue wire (pin 5 of the 16-pin connector) and black (–) probe on B- terminal of controller. The reading should be approximately 42 to 46 volts. If the reading is not approximately 42 to 46 volts, proceed to check the 10k Ohm resistor. If the reading is approximately 42 to 46 volts, check continuity of circuit wires.
5. **Check 10k Ohm resistor:** Set multimeter to 20k Ohms. Remove the 15-amp fuse. With the red (+) probe (with insulation-piercing probe) still on the light blue wire (pin 5 of the 16-pin connector), place the black (–) probe to the red wire terminal in the 15-amp fuse holder. The reading should be approximately 10.0k Ohms. If the reading is not approximately 10.0k Ohms, replace the resistor or main wire harness **(Figure 13-7, Page 13-10)**.
6. **Check continuity:** Set multimeter to Continuity test. With the red (+) probe (with insulation-piercing probe) still on the light blue wire (pin 5 of the 16-pin connector), place the black (–) probe in the blue wire terminal of the charger receptacle. The meter should beep to indicate continuity. If not, check bullet connector of blue wires.

   Next, probe from the pink wire terminal in the 15-amp fuse holder to the large solenoid post with the red wires attached. The meter should beep to indicate continuity. If not, verify Tow/Run switch is in RUN and check the red-to-pink wire spade connector near the solenoid.

   If the meter does not indicate continuity, check and repair related connections, Tow/Run switch and wiring. If necessary, replace affected wire harness, charger receptacle or Tow/Run switch.
7. When finished, install 15-amp fuse and fuse cover.

TEST PROCEDURE 11 – MCOR Voltage

See General Warnings on page 1-2.

NOTE: *This is a voltage test.*

The accelerator position, which is proportional to the MCOR voltage, can be displayed with the IQDM handset. If an IQDM handset is not available, proceed to **MCOR Voltage Test without the IQDM Handset**.

The following are potential MCOR symptoms:

- Vehicle will not drive due to no FOOT INPUT to the controller.
- Vehicle will not reach top speed because MCOR does not reach 100% throttle position.
- Vehicle does not maintain speed nor will it accelerate due to MCOR having a “dead-spot” in its pedal travel.
- The voltage signal from the MCOR randomly or sporadically fluctuates with pedal at rest, during pedal travel and with pedal fully pressed.

MCOR Voltage Test with the IQDM Handset

1. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING “Lift only one end...” in General Warnings on page 1-2. See also following WARNING.**

⚠ WARNING

- **The key switch should be placed in the OFF position and left in the OFF position for the duration of this test.**

2. Connect the IQDM to the vehicle.
3. Access the Monitor menu and select THROTTLE % by using the SCROLL DISPLAY buttons.
4. The IQDM should indicate 0% with the pedal not pressed. While monitoring the IQDM display screen, slowly press the accelerator pedal. As the pedal is pressed, the IQDM should indicate a steady, incremental rise from 0% (pedal not pressed) to 100% (pedal fully pressed). **See following NOTE.**

NOTE: *Observe closely to see if throttle input percentage randomly or sporadically fluctuates with pedal at rest, during pedal travel and with pedal fully pressed. If it fluctuates, the MCOR is defective and must be replaced.*

5. If the MCOR passes the previous test, press and hold the accelerator pedal to the floor. By hand, gently move the pedal from side to side and see if the throttle input percentage fluctuates from 100%. If it fluctuates, the MCOR is defective and must be replaced.
6. If throttle input percentage does not reach 100% in the previous steps, proceed to **MCOR Voltage Test without the IQDM Handset.**

MCOR Voltage Test without the IQDM Handset

1. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING “Lift only one end...” in General Warnings on page 1-2. See also following WARNING.**

⚠ WARNING

- **The key switch should be placed in the OFF position and left in the OFF position for the duration of this test.**

2. With the batteries connected, place Tow/Run switch in RUN. Using a multimeter set to 200 volts DC, place red (+) probe on battery no. 1 positive post and place black (–) probe (with insulation-piercing probe) on the purple/white wire at a point close to the three-pin connector at the MCOR. The reading should be approximately 48 to 50 volts (full battery voltage).
3. If reading is zero volts, check the purple/white wire continuity from the three-pin connector at the MCOR to the 16-pin connector at the speed controller. Check terminal positions in three-pin connector at the MCOR and the 16-pin connector. If all of the continuity readings are correct and the connectors are wired correctly, replace the speed controller.

4. With multimeter set to 20 volts DC, place the black (–) probe on battery no. 6 (6 x 8-Volt battery set) negative post and the red (+) probe (with insulation-piercing probe) on the white wire at a point close to the three-pin connector at the MCOR. The reading should be approximately 4.65 volts.
5. If reading is zero volts, check the white wire continuity from the three-pin connector at the MCOR to the 16-pin connector at the speed controller. Check terminal positions in three-pin connector at the MCOR and the 16-pin connector. If all of the continuity readings are correct and the connectors are wired correctly, replace the speed controller.
6. With multimeter set to 20 volts DC, place the black (–) probe on battery no. 6 (6 x 8-Volt battery set) negative post and the red (+) probe (with insulation-piercing probe) on the yellow wire at a point close to three-pin connector at the MCOR. The reading should be zero (0) volts with the pedal up. Slowly press the accelerator pedal and note the readings on the multimeter. As the pedal is pressed, the reading should increase until it reaches approximately 4.65 volts when the pedal is fully pressed.
7. If reading does not increase as the pedal is pressed, replace the MCOR. **See following NOTE.**

NOTE: *Observe closely to see if voltage randomly or sporadically fluctuates with pedal at rest, during pedal travel and with pedal fully pressed. If it fluctuates, the MCOR is defective and must be replaced.*

TEST PROCEDURE 12 – Motor Speed Sensor

See General Warnings on page 1-2.

Motor Speed Sensor Test without any Tool

⚠ CAUTION

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

1. Place the Forward/Reverse switch in the REVERSE position to verify reverse buzzer is functioning properly. If not, repair or replace the buzzer.
2. With Tow/Run switch in the RUN position, turn the key switch to the OFF position and place the Forward/Reverse switch in the NEUTRAL position.
3. Slowly push the vehicle a short distance (about 3 feet (1 meter)). The reverse buzzer should sound and motor braking should engage while the vehicle is rolling.
4. If the reverse buzzer does not sound and motor braking does not engage while the vehicle is rolling, replace the Motor Speed Sensor.

Motor Speed Sensor Test with the IQDM Handset

⚠ CAUTION

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

1. Turn the key switch to the OFF position and place the Forward/Reverse switch in the NEUTRAL position.
2. Connect the IQDM to the vehicle.
3. Access the Monitor menu and select SPEED PULSES by using the SCROLL DISPLAY buttons. The IQDM should indicate OFF when the vehicle is at rest.
4. While monitoring the IQDM display screen, slowly push the vehicle a short distance (about 3 feet (1 meter)). The IQDM should indicate ON for speed sensor pulses while the wheels are in motion.
5. If the IQDM does not indicate ON while the wheels are in motion, proceed to the following procedure, Motor Speed Sensor Test without the IQDM Handset.

Motor Speed Sensor Test without the IQDM Handset

NOTE: *This is a voltage test.*

1. Turn the key switch to the OFF position and place the Forward/Reverse switch in the NEUTRAL position.
2. With batteries connected, disconnect the three-pin connector at the motor speed sensor.
3. Check voltage at purple/white wire:
   3.1. Using a multimeter set to 200 volts DC, place the red (+) probe on the battery no. 1 positive post and place the black (–) probe on the purple/white wire terminal socket in the three-pin connector. The voltage reading should be 48 to 50 volts (full battery voltage).
   3.2. If the reading is zero volts, check the continuity of the purple/white wire from the 16-pin connector at the speed controller to the three-pin connector at the motor speed sensor. If the continuity is correct, replace the speed controller.
4. Check voltage at the red motor speed sensor wire:

4.1. With Tow/Run switch in the RUN position and using a multimeter set to 20 volts DC, place the black (–) probe on the battery no. 6 (6 x 8-Volt battery set) negative post and place red (+) probe on red wire terminal socket in three-pin connector. The voltage reading should be approximately 15 to 16 volts.

4.2. If the voltage reading is zero volts, check the continuity of the red wire from the 16-pin connector at the speed controller to the three-pin connector at the motor speed sensor. If the wire continuity is correct, replace the speed controller.

4.3. If the reading is below 14 volts, replace the speed controller.

4.4. If the voltage reading is correct, proceed to the following step.

5. Check voltage at the light green wire:

5.1. Using a multimeter set to 20 volts DC, place the black (–) probe on the battery no. 6 (6 x 8-Volt battery set) negative post and place the red (+) probe on the light green wire female terminal in the three-pin connector at the motor speed sensor. The voltage reading should be from 4.60 to 4.90 volts.

5.2. If the voltage is zero volts, check the continuity of the light green wire from the 16-pin connector at the speed controller to the three-pin connector at the motor speed sensor. If the continuity is correct, replace the speed controller.

5.3. If reading is below 3.50 volts, check the continuity of the wires and plug and replace the speed controller if necessary.

6. Reconnect the three-pin connector at the motor speed sensor. Using a multimeter set to 20 volts DC, place the black (–) probe on the battery no. 6 (6 x 8-Volt battery set) negative post and place the red (+) probe (with insulation-piercing probe) on the green wire between the three-pin connector and the motor speed sensor.

6.1. Raise one rear wheel off ground. Slowly turn the rear wheel to rotate the motor armature. As the armature rotates, the voltage reading should alternate from zero to approximately 4.85 volts. The voltage reading will fluctuate from zero to 4.85 volts and back to zero four times for each revolution of the motor armature.

NOTE: *The voltage reading of 4.85 is an approximate reading. The actual reading may vary from 4.50 to 5.00 volts.*

6.2. Replace the speed sensor if any of the following results occur:
- There is no voltage reading.
- The voltage reading is not above 3.50.
- The voltage reading does not fluctuate as the motor is turned.

TEST PROCEDURE 13 – A1 and A2 Motor Voltage

See General Warnings on page 1-2.

NOTE: *This is a voltage test.*

1. Place chocks at the front wheels and lift the rear of the vehicle with a chain hoist or floor jack. Position jack stands under the frame rails just forward of each spring mount. **See WARNING "Lift only one end..." in General Warnings on page 1-2. See also following WARNING.**

⚠ WARNING

- **Keep people and equipment clear from rotating rear wheels. Do not allow persons under the car. Contact with rotating rear wheels could result in serious personal injury.**

2. With the batteries connected and using a multimeter set to 200 volts DC, place the black (–) probe on the A2 motor terminal (white wire) and connect the red (+) probe to the A1 (green wire) motor terminal.
3. With Tow/Run switch in the RUN position, place the Forward/Reverse switch in the FORWARD position, turn key switch to the ON position and slowly press accelerator pedal.

4. As the accelerator pedal is pressed, the voltage reading should increase from approximately 5 volts RMS when the MCOR limit switch closes, to approximately 48 volts RMS with the accelerator pedal fully pressed. **See following NOTE.**

NOTE: *Voltage can vary depending on controller speed setting as well as which zone a Guardian equipped vehicle is located.*

Example: *Speed setting 1 may only read 30 volts.*

4.1. If there is no voltage reading, check the MCOR. **See MCOR Voltage on page 13-26.** Also check the continuity of the large posts of the solenoid. **See Solenoid Continuity on page 13-24.**

4.2. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries on page 1-3.**

4.3. Check continuity on A1 and A2 motor terminal posts and continuity of the F1 and F2 motor terminal posts. Also, check continuity of all motor wires. See Section 17 – Motor (Model DA5-4006).

TEST PROCEDURE 14 – Voltage at Charger Receptacle Red Wire Socket

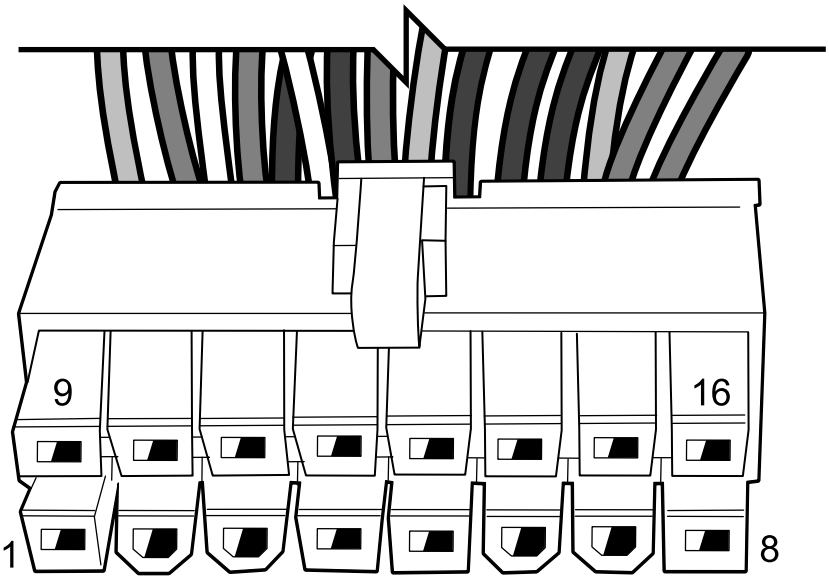
See General Warnings on page 1-2.

NOTE: *This is a voltage test.*

1. If necessary, see Testing Basics on page 13-16.
2. Probe the charger receptacle socket connected to the red, 10-gauge wire. The reading should be BPV.
3. If the reading is zero volts, check the following items:
   – The 30-amp fuse (located near solenoid) in the 10-gauge red wire of the charger receptacle harness.
   – Continuity of the 10-gauge red wire from the solenoid to the receptacle socket.
   – Continuity of the 4-gauge red wire from the positive post of battery no. 1 to the solenoid.
4. If the reading is less than BPV, inspect related wiring and connections for tightness, damage and corrosion.

TEST PROCEDURE 15 – 16-Pin Connector

See General Warnings on page 1-2.



Pin 1 – White	Pin 5 – Light Blue	Pin 9 – Gray	Pin 13 – White/Black
Pin 2 – Yellow	Pin 6 – Green	Pin 10 – Tan	Pin 14 – Light Green
Pin 3 – Purple/White	Pin 7 – Orange/White	Pin 11 – Blue/Yellow	Pin 15 – Red
Pin 4 – Open (No wire)	Pin 8 – Brown	Pin 12 – Blue/White	Pin 16 – Blue

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Figure 13-12 Pin And Wire Color

Inspection and General Information

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries on page 1-3.**
2. Disconnect the 16-pin connector from the speed controller. Inspect terminal ends inside plug to ensure they are in position and seated in plug housing. If any terminals look like they are not pushed all the way into the connector, gently push the terminals until they are firmly seated in the 16-pin connector. After each terminal has been pushed into the housing, gently pull on the wire to ensure it is locked into place.
3. Check wires in the plug to make sure none are broken at the terminal pin crimp. Repair or replace as required.
4. Check the wire colors of each wire and make sure that the colors for each pin position match the wire colors as shown in **Figure 13-12, Page 13-32**.
5. When connecting the 16-pin connector to the controller, push plug into controller receptacle with enough force to lock plug into place. An audible click will be heard when plug is properly seated to the controller.

A procedure is provided for testing each of the wires in the 16-pin connector. For testing, wires have been grouped together based on purpose as either controller input or controller output. Tests vary whether the 16-pin must be connected or disconnected from the controller to get the appropriate result.

If 16-pin must be disconnected:

1. Keep the 16-pin connector disconnected from the controller.
2. With Tow/Run switch in the TOW position, reconnect the batteries. **See Connecting the Batteries on page 1-3.**

3. Place the Tow/Run switch in the RUN position and then check the appropriate wires.

If 16-pin must be connected:

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries on page 1-3.**
2. Connect the 16-pin connector to the controller. **See following NOTE.**

NOTE: *When connecting the 16-pin connector to the controller, push plug into controller receptacle with enough force to lock plug into place. An audible click will be heard when plug is properly seated to the controller.*

3. With Tow/Run switch in the TOW position, reconnect the batteries. **See Connecting the Batteries on page 1-3.**
4. Place the Tow/Run switch in the RUN position and then check the appropriate wires.

Refer to the following tables. Each table contains the following information:

- What function the wire performs.
- Whether or not the 16-pin connector must remain connected during the test.
- The appropriate test result for each pin.

If results differ from those described in the procedure, check the continuity of the wires in the wire harness and test the connected components with the appropriate test procedures. **See Index of Test Procedures.**

Testing Controller Inputs

CONTROLLER INPUTS	PERFORM TEST WITH 16-PIN CONNECTED TO CONTROLLER? (IF YES, BACK-PROBE TO TEST)	TEST PROCEDURE
THROTTLE INPUT Pin 2 – Yellow	Yes	Range of zero (0) volts (with accelerator pedal at rest) to 4.65 volts (with accelerator pedal fully pressed) from MCOR 3-pin circuit
GROUND FOR PINS 1 AND 15 Pin 3 – Purple/White	Yes	BPV measured between solenoid post with red wires and pin 3
CHARGER INTERLOCK INPUT Pin 5 – Light Blue	Yes	Approx. 42 to 46 volts (can vary depending on BPV) with charger disconnected. **See Test Procedure 10 – Charger Interlock on page 13-25.**
FOOT INPUT Pin 6 – Green	No	BPV from MCOR limit switch (Key switch must be ON)
REVERSE BUZZER INPUT Pin 7 – Orange/White	No	BPV from Reverse Buzzer with Tow/Run switch in RUN (Key switch either ON or OFF)
FORWARD INPUT Pin 8 – Brown	No	BPV from Forward/Reverse switch in FWD (Key switch either ON or OFF)
B+ INPUT Pin 9 – Gray Powers the controller logic and power boards.	No	BPV from Tow/Run switch in RUN
KEY SWITCH INPUT Pin 10 – Tan	No	BPV from Key switch in ON
SOLENOID INPUT Pin 12 – Blue/White	No	BPV from Solenoid Activating Coil (result of Key switch in ON)

TABLE CONTINUED ON NEXT PAGE

CONTROLLER INPUTS	PERFORM TEST WITH 16-PIN CONNECTED TO CONTROLLER? (IF YES, BACK-PROBE TO TEST)	TEST PROCEDURE
SPEED SENSOR INPUT Pin 14 – Light Green	Yes	Alternates from zero (0) to approx. 4.85 volts depending on speed sensor position. Rotate rear wheel to see voltage switch (Key switch either ON or OFF)
REVERSE INPUT Pin 16 – Blue	No	BPV from Forward/Reverse switch in REV (Key switch either ON or OFF)

Testing Controller Outputs

CONTROLLER OUTPUTS	PERFORM TEST WITH 16-PIN CONNECTED TO CONTROLLER? (IF YES, BACK-PROBE TO TEST*)	TEST PROCEDURE
THROTTLE OUTPUT Pin 1 – White Supplies approximately 5 volts in MCOR 3-pin circuit.	Yes	4 to 5 volts measured between pin 1 and B- terminal on controller (Key switch either ON or OFF)
CHARGE INDICATOR LIGHT OUTPUT Pin 11 – Blue/Yellow Supplies a positive (+), controlled current source to power the charge indicator light on the instrument panel.	Yes* Do not back-probe for this test.	Start a charging session. After a few seconds, light should flash. Can also be seen under LED Driver in the Monitor menu of the IQDM.
CONNECTED CAR OUTPUT Pin 13 – White/Black Supplies approximately 13 volts to the Guardian/Visage unit.	Yes	Approximately 13 volts measured between pin 1 and B- terminal on controller (Key switch either ON or OFF)
SPEED SENSOR OUTPUT Pin 15 – Red Supplies approximately 15 to 16 volts to the motor speed sensor.	Yes	Approximately 15 to 16 volts measured between pin 1 and B- terminal on controller (Key switch either ON or OFF)

TEST PROCEDURE 16 – Reverse Buzzer

See General Warnings on page 1-2.

NOTE: *This is a voltage test.*

1. If necessary, see Testing Basics on page 13-16.
2. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries on page 1-3.**
3. Remove the instrument panel. **See Key Switch Removal, Section 14, Page 14-1.**
4. Disconnect the orange/white and pink wires from the reverse buzzer.
5. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries on page 1-3.**
6. Place the key switch in the OFF position and the Tow/Run switch in the RUN position.
7. Using a multimeter set to 200 volts DC, place the black (–) probe on battery no. 6 (6 x 8-Volt battery set) negative post and place the red (+) probe on the pink wire terminal end that was disconnected from the reverse buzzer. The reading should be approximately 48 volts (full battery voltage).

7.1. If the voltage reading is correct, proceed to step 7.

7.2. If reading is zero volts, check wire continuity, 9-pin connector, 15-amp fuse and Tow/Run switch. **See Test Procedure 3 – Tow/Run Switch on page 13-19.**

7.3. If the continuity readings are not correct, repair or replace the pink wire.

7.4. If the continuity readings are correct, proceed to step 7.

8. Place the Forward/Reverse switch in REVERSE. Using a multimeter set to 200 volts DC, place the black (–) probe on the orange/white wire terminal end (that was disconnected from the reverse buzzer) and place the red (+) probe on battery no. 1 positive post. The reading should be approximately 48 volts (full battery voltage).

8.1. If the voltage reading is correct, replace the reverse buzzer.

8.2. If reading is zero volts, check orange/white wire continuity and connection at Pin 7 in 16-Pin connector.

8.3. If there is no continuity in the orange/white wire, or the pin 7 terminal in the 16-pin connector is not properly seated, repair or replace as required.

8.4. If the orange/white wire continuity and 16-Pin connector are correct and there is no voltage at the orange wire, replace the controller.

TEST PROCEDURE 17 – Charge Indicator Light

See General Warnings on page 1-2.

1. With batteries connected, Tow/Run switch in the RUN position and the key switch in the OFF position, connect charger DC cord to vehicle.
2. In a few seconds, the light will flash three times and the reverse buzzer simultaneously will sound three times to indicate charging has begun. **See following NOTE.**

NOTE: *The number of flashes and beeps can vary depending on the Beep Option setting.* ***See Beep Option, Section 12, Page 12-5.***

3. If charge indicator light does not flash three times, disconnect charger DC cord from vehicle and connect an IQDM to the vehicle.
4. Access the Monitor menu and select LED Driver by using the SCROLL DISPLAY buttons. The IQDM should indicate OFF.
5. Reconnect charger DC cord to vehicle.
6. In a few seconds, the IQDM should quickly display ON just once while the dash-mounted charge indicator light flashes three times. **See following NOTE.**

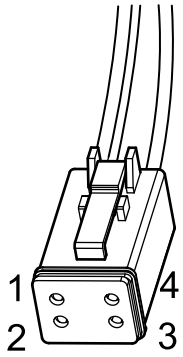
NOTE: *The IQDM will still flash ON even with a failed or missing charge indicator light.*

7. If the IQDM quickly displays ON but the charge indicator light still does not flash, check the following items:
   – Condition of the blue/yellow wire terminal in the 16-pin connector.
   – Condition of the 9-pin connector behind instrument panel.
   – Condition of the yellow/green wire terminal in the instrument panel wire harness.
   – Continuity of the wires in the wire harnesses.
8. If no problems exist in the above items, replace the charge indicator light.

TEST PROCEDURE 18 – 4-Pin Connector (for Connected Car Device)

See General Warnings on page 1-2.

NOTE: *This is a voltage and continuity test.*



Pin 1 – Yellow/Black	Pin 4 – White/Black
Pin 2 – Red/White	Pin 3 – Open (No wire)

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Figure 13-13 4-Pin Connector

1. If necessary, see Testing Basics on page 13-16.
2. Check for continuity between pin 1 (yellow/black wire) **(Figure 13-13, Page 13-36)** and pin 3 (purple/white wire) of the 16-pin connector. It should indicate continuity. If not, check sonic welds no. 1 and no. 2.
3. Probe pin 2 (red/white wire). It should show BPV. If not, check 2-amp fuse. **See following NOTE.**

NOTE: *The red/white wire has BPV with the Run/Tow switch in either position.*

4. Probe pin 4 (white/black wire). It should show approximately 13 volts supplied by the controller. If not, check wiring and then controller. **See following NOTE.**

NOTE: *The white/black wire only has voltage with the Run/Tow switch in the RUN position.*

If pin 4 has no voltage, the controllers 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.**

KEY SWITCH

See General Warnings on page 1-2.

TESTING THE KEY SWITCH

See the appropriate troubleshooting section for the type of electrical system used in the vehicle.
See Test Procedure 5 – Key Switch and MCOR Limit Switch Circuit on page 13-21.

KEY SWITCH REMOVAL

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries on page 1-3.**
2. Remove the instrument panel **(Figure 14-1, Page 14-2)**.
   2.1. Remove three screws (1) from the instrument panel (2).
   2.2. Rotate the instrument panel up and away from the dash to disengage the tabs at the top of the panel.
   2.3. Disconnect the electrical connector (3) to the instrument panel.
3. Disconnect the wires from the key switch.
4. From the back of the instrument panel, push down on the retaining tabs surrounding the key switch (4) and remove the key switch cap (8). Hold the key switch and remove the switch retaining nut (6) from the outside of the instrument panel **(Figure 14-2, Page 14-2)**.

KEY SWITCH INSTALLATION

1. Position the key switch and flat washer (9) in the instrument panel, then install and tighten the switch retaining nut (6) to 40 in·lb (4.5 N·m). Install key switch cap (8) in center dash **(Figure 14-2, Page 14-2)**.
2. Connect the blue and green wires to the key switch terminals. Either orientation is correct. **See 13-4.**
3. Install the instrument panel.
   3.1. Connect the electrical connector (3) **(Figure 14-1, Page 14-2)**.
   3.2. Position the instrument panel (2) on the dash assembly. Make sure tabs on upper edge properly engage with the corresponding slots on the dash assembly. Ensure that there are no wires exposed or pinched during positioning.
   3.3. Secure instrument panel to the dash assembly with three screws (1). Tighten screws to 1.8 ft·lb (2.5 N·m).

4. Connect the batteries. **See Connecting the Batteries on page 1-3.**

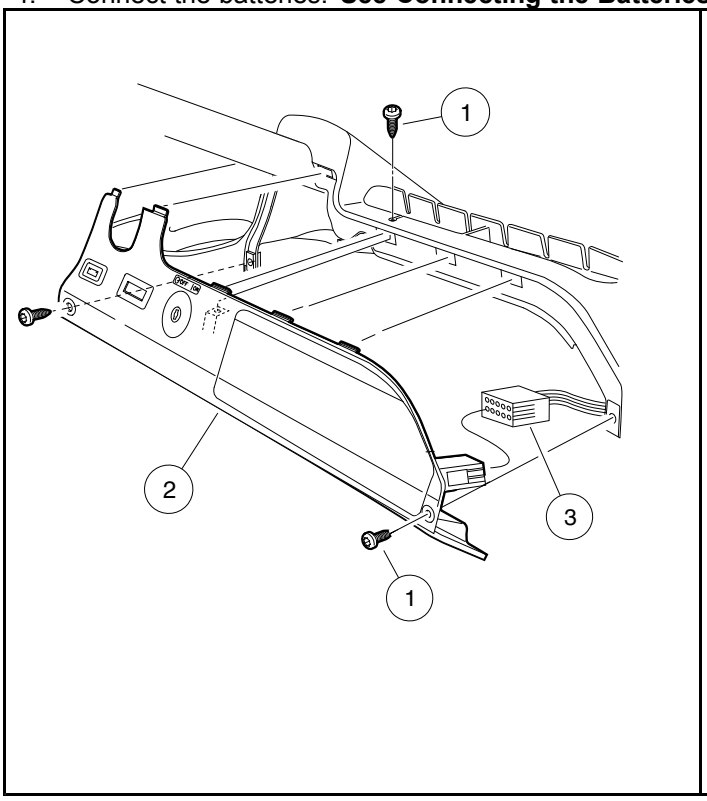

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Figure 14-1 Instrument Panel Removal

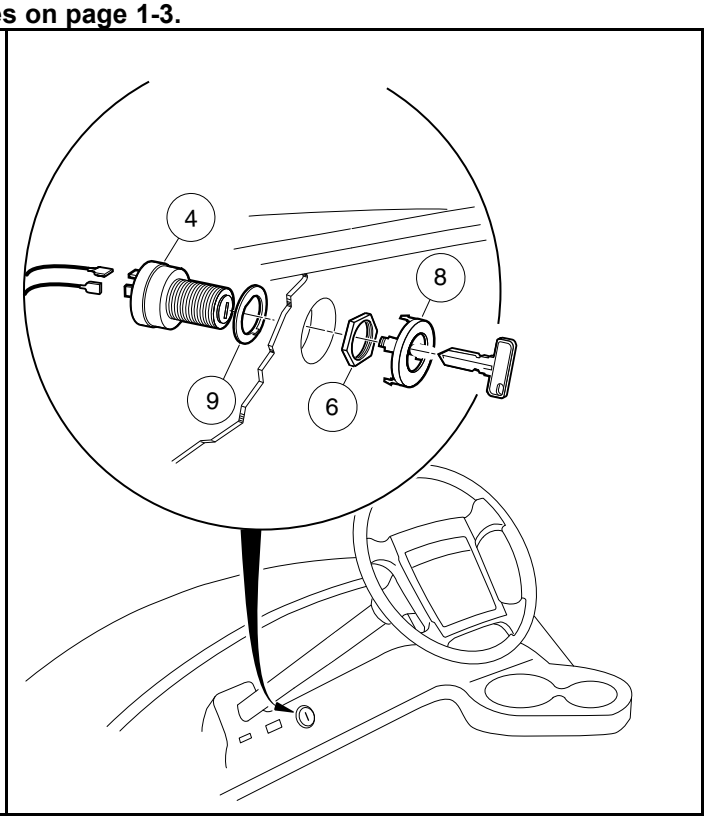

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Figure 14-2 Key Switch

CHARGE INDICATOR LIGHT

See General Warnings on page 1-2.

TESTING THE CHARGE INDICATOR LIGHT

See Test Procedure 17 – Charge Indicator Light on page 13-35.

CHARGE INDICATOR LIGHT REMOVAL

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries on page 1-3.**
2. Remove instrument panel. **See Key Switch Removal on page 14-1.**
3. Disconnect the wires at the warning light.
4. Press the two retaining tabs (1) and remove the light from the center dash **(Figure 14-3, Page 14-3)**.

CHARGE INDICATOR LIGHT INSTALLATION

1. Install in reverse order of removal.

2. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries on page 1-3.**

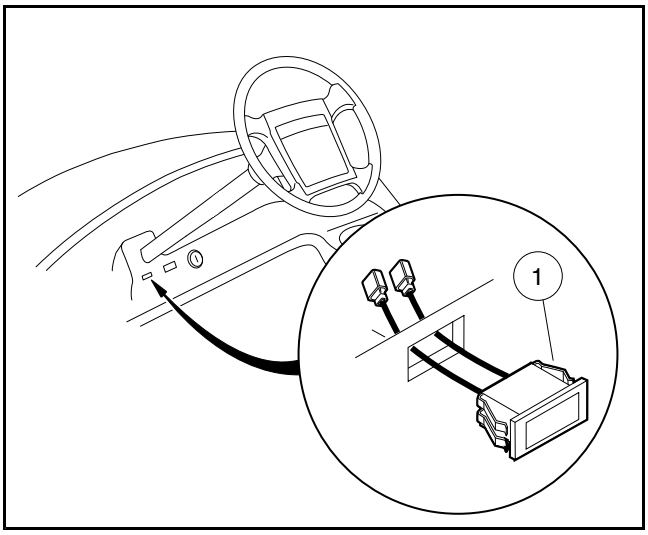

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Figure 14-3 Charge Indicator Light

FORWARD/REVERSE ROCKER SWITCH

See General Warnings on page 1-2.

TESTING THE FORWARD/REVERSE ROCKER SWITCH

See Test Procedure 6 – Forward/Reverse Rocker Switch on page 13-22.

FORWARD/REVERSE ROCKER SWITCH REMOVAL

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries on page 1-3.**
2. Remove instrument panel. **See Key Switch Removal on page 14-1.**
3. Press in on the locking tabs (1) on each end of forward/reverse rocker switch (2), and push switch out of dash **(Figure 14-4, Page 14-4)**.
4. Disconnect the three wires (3) from the rocker switch (2).

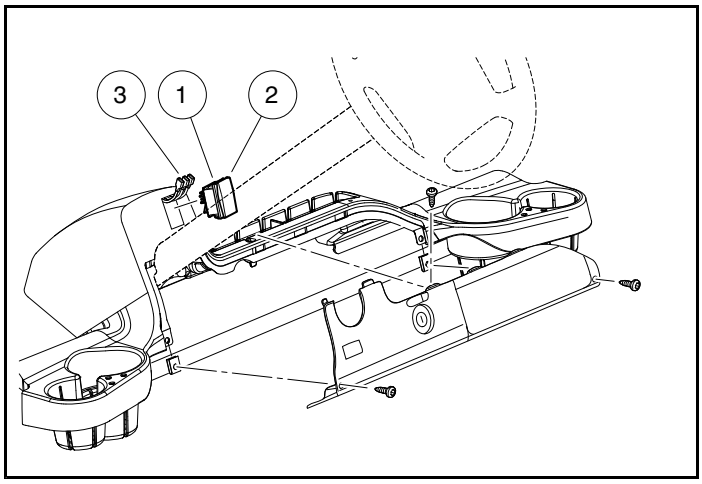

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Figure 14-4 Forward/Reverse Rocker Switch

FORWARD/REVERSE ROCKER SWITCH INSTALLATION

1. Install in reverse order of removal **(Figure 14-4, Page 14-4)**.
2. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries on page 1-3.**
3. Place the Tow/Run switch in the RUN position.
4. Inspect the vehicle for proper operation.

⚠ WARNING

- **Make sure that the vehicle operates in the forward direction when the Forward/Reverse switch is in the FORWARD position.**
- **Make sure that the vehicle operates in the reverse direction when the Forward/Reverse switch is in the REVERSE position. The reverse buzzer will sound as a warning when the Forward/Reverse switch is in REVERSE.**
- **Make sure that the vehicle does not operate when the Forward/Reverse switch is in the NEUTRAL position.**

ELECTRONICS MODULE COVER

See General Warnings on page 1-2.

The electronics module cover needs to be removed to gain access to the speed controller, Tow/Run switch, and solenoid.

ELECTRONICS MODULE COVER REMOVAL

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries on page 1-3.**
2. Remove the two plastic rivets (1) that secure the access panel (2) to the vehicle **(Figure 14-5, Page 14-6)**.
3. Remove cover (5) by first releasing the four tabs (3) from the matching holes in the hood of the battery bucket. Then, maneuver the cover to release the two hooks (4) that secure the cover to the battery bucket.

CAUTION

- **Be careful not to break the two hooks (4) on the bottom of the cover. Push the bottom of the cover up to release the hooks before pulling cover away from battery bucket.**

ELECTRONICS MODULE COVER INSTALLATION

1. Install cover (5) by first hooking the four tabs (3) into the matching holes in the hood of the battery bucket **(Figure 14-5, Page 14-6)**. Then, use the two hooks (4) to secure the cover to the battery bucket.
2. Place access panel (2) on vehicle and secure with the two plastic rivets (1). **See following CAUTION.**

CAUTION

- **Exposure to water may damage electronic components.**
  - **Do not operate vehicle without this cover properly installed.**
  - **Do not direct water stream in the area of the cover.**

3. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries on page 1-3.**

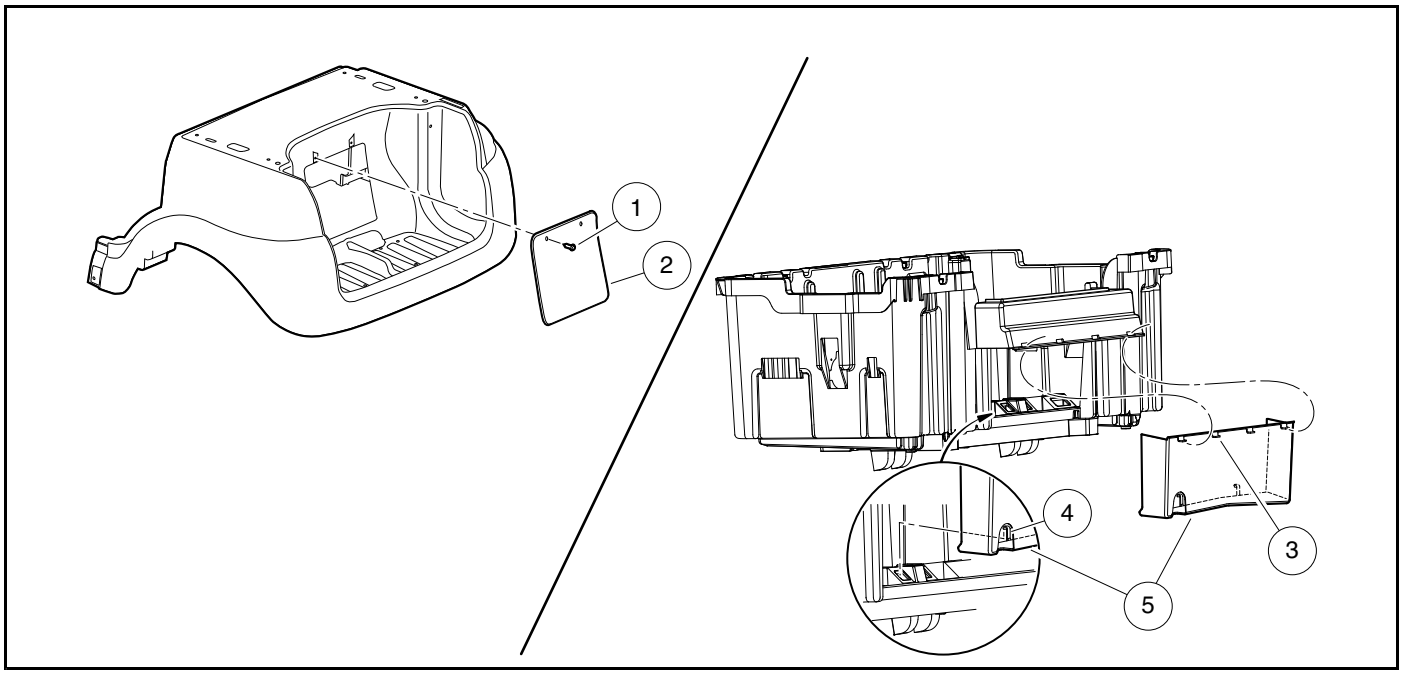

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Figure 14-5 Access and Remove Electronics Module Cover

TOW/RUN SWITCH

See General Warnings on page 1-2.

TESTING THE TOW/RUN SWITCH

See Test Procedure 3 – Tow/Run Switch on page 13-19.

TOW/RUN SWITCH REMOVAL

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries on page 1-3.**
2. Remove the electronics module cover to access back side of the Tow/Run switch (2). **See Electronics Module Cover Removal on page 14-5.**
3. Remove Tow/Run switch boot/hex nut (1) **(Figure 14-6, Page 14-7)**.
4. Remove Tow/Run switch (2) from electronics module and disconnect the pink wire (3) and light green wire (4).

TOW/RUN SWITCH INSTALLATION

1. Installation is reverse of removal. Make sure flat on switch is aligned with flat part of D-shaped hole in electronics module **(Figure 14-6, Page 14-7)**. Tighten Tow/Run switch boot/hex nut (1) to 16 in·lb (1.8 N·m).
2. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries on page 1-3.**

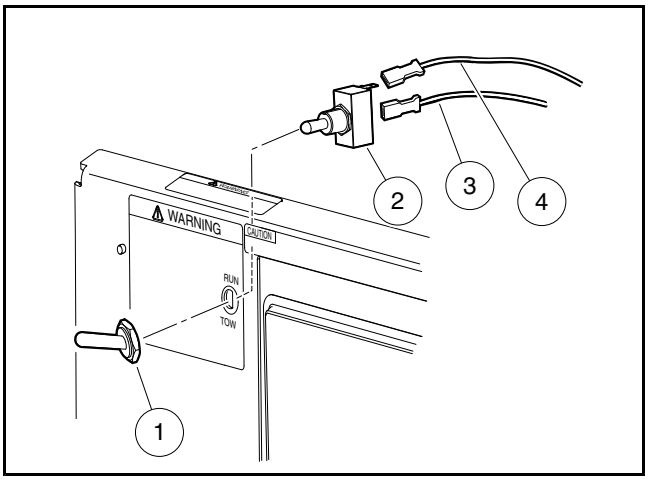

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Figure 14-6 Tow/Run Switch

MOTOR CONTROLLER OUTPUT REGULATOR (MCOR)

See General Warnings on page 1-2.

TESTING THE MCOR

See Test Procedure 11 – MCOR Voltage on page 13-26 and Test Procedure 5 – Key Switch and MCOR Limit Switch Circuit on page 13-21.

MCOR REMOVAL

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries on page 1-3.**
2. Remove pedal group. **See Pedal Group Removal, Section 5, Page 5-1.**
3. Disconnect the two-pin and three-pin connectors from the MCOR.
4. Remove the T25 torx screw securing the MCOR to the pedal group.
5. Detach the two tabs from the accelerator pedal and remove the MCOR from vehicle.

MCOR INSTALLATION

1. Align the two tabs of the MCOR (2) with the slots in the accelerator pedal on the pedal group. Insert the MCOR into the accelerator pedal until the tabs engage. **See following NOTE.**

NOTE: *Rotate the pedal back and forth if necessary to align the D-shaped end of shaft with the MCOR.*

2. Secure MCOR to pedal group with T25 torx screw. Tighten screw to 19 in·lb (2.1 N·m).
3. Connect the two-pin and three-pin connectors from the wire harness to the MCOR.
4. Install the pedal group. **See Pedal Group Installation on page 5-3.**
5. Connect the batteries. **See Connecting the Batteries on page 1-3.**

REVERSE BUZZER

See General Warnings on page 1-2.

TESTING THE REVERSE BUZZER

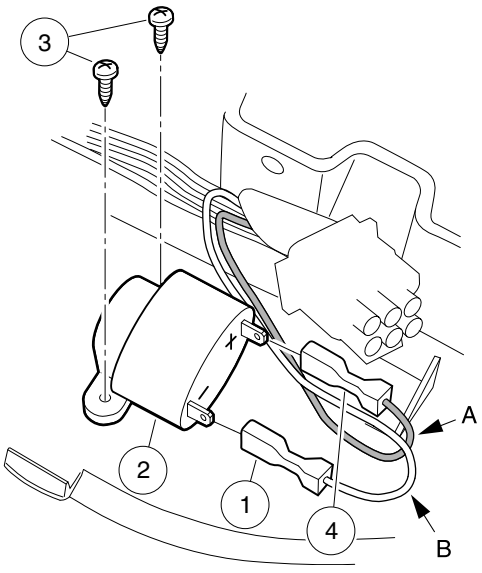
See 13-34.

REVERSE BUZZER REMOVAL

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries on page 1-3.**
2. Remove instrument panel. **See Key Switch Removal on page 14-1.**
3. Disconnect the 18-gauge pink and orange/white wires from reverse buzzer.
4. Remove the two screws from the reverse buzzer. Remove the reverse buzzer from the dash panel.

REVERSE BUZZER INSTALLATION

1. Install the reverse buzzer in the reverse order of removal. Pink wire must be connected to the positive terminal. Tighten screws to 4 in·lb (0.45 N·m).
2. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries on page 1-3.**



(Viewed from underside of instrument panel)
A. Pink B. Orange/White

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Figure 14-7 Reverse Buzzer

ELECTRONICS MODULE

See General Warnings on page 1-2.

While it is not necessary to remove the electronics module from the vehicle, access to individual components may be easier with the module removed.

ELECTRONICS MODULE REMOVAL

1. Disconnect the batteries and discharge the controller (1). **See Disconnecting the Batteries on page 1-3.**
2. Remove the batteries from the vehicle to provide enough room to access the controller (1) **(Figure 14-8, Page 14-10)**. **See Battery Replacement on page 15-5.**
3. Remove the bolt (2) that secures the electronics module (3) to the battery bucket.
4. Pull electronics module (3) forward and disconnect the heavy gauge wires from the controller (1) and solenoid (4).
5. Disconnect the 16-pin connector, 4-pin connector, and spade connectors from the controller (1).
6. Disconnect the spade connectors on the front of the solenoid (4).
7. Disconnect the two wires from Tow/Run switch (5).
8. Lift the electronics module (3) from the vehicle. **See following WARNING.**

⚠ WARNING

- **Shorting of battery terminals can cause personal injury or death.**
  - **Do not place component mounting plate directly on top of batteries when removing or installing plate.**
  - **Remove plate from vehicle completely.**

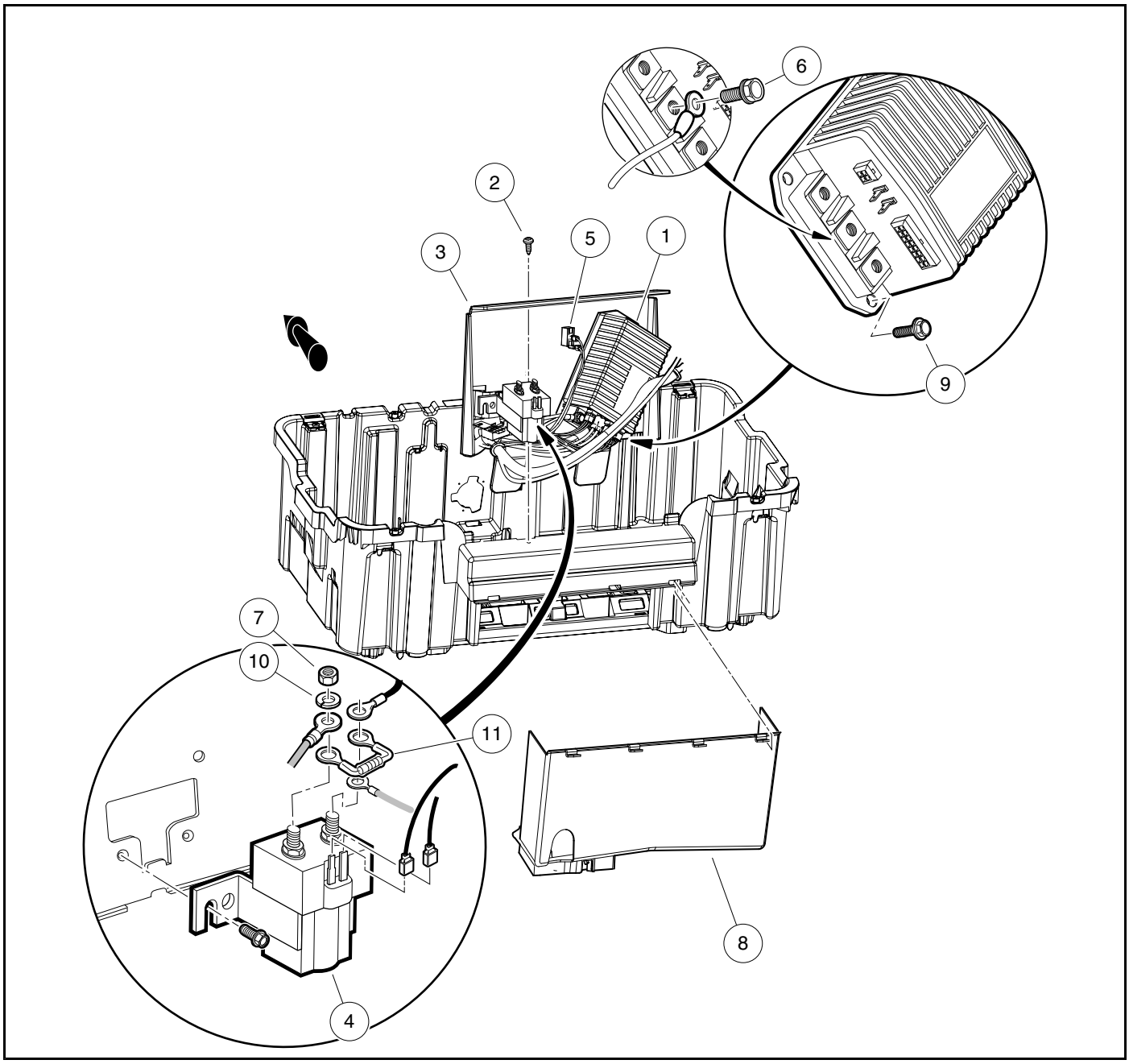

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Figure 14-8 Controller and Solenoid Removal

ELECTRONICS MODULE INSTALLATION

1. Return electronics module (3) to its location in vehicle but leave it tilted forward.
2. Complete connections to the controller (1), the Tow/Run switch (5) and the solenoid (4) per the electrical schematics. **See Wiring Diagrams on page 13-4.**
3. Tighten bolts (6) on the controller to 108 in·lb (12.2 N·m).
4. Tighten nuts (7) on the solenoid to 6.4 ft·lb (8.7 N·m).
5. Set electronics module in place and secure with bolt (2) **(Figure 14-8, Page 14-10)**. Tighten bolt to 40 in·lb (4.5 N·m).

6. Install the batteries and battery cables in their original locations. **See Battery Replacement on page 15-5.**
7. Place the Tow/Run switch (5) in the TOW position and connect the batteries. **See Connecting the Batteries on page 1-3.**
8. Place the Tow/Run switch (5) in the RUN position.
9. Inspect the vehicle for proper operation. **See following WARNINGS.**

⚠ WARNING

- **Make sure that the vehicle operates in the forward direction when the Forward/Reverse switch is in the FORWARD position.**
- **Make sure that the vehicle operates in the reverse direction when the Forward/Reverse switch is in the REVERSE position. The reverse buzzer will sound as a warning when the Forward/Reverse switch is in REVERSE.**
- **Make sure that the vehicle does not operate when the Forward/Reverse switch is in the NEUTRAL position.**

SPEED CONTROLLER (350-AMP)

See General Warnings on page 1-2.

TESTING THE SOLID STATE SPEED CONTROLLER

See Test Procedure 13 – A1 and A2 Motor Voltage on page 13-30.

SPEED CONTROLLER REMOVAL

1. Disconnect the batteries and discharge the controller (1). **See Disconnecting the Batteries on page 1-3.**
2. Remove the electronics module cover (8) to access the controller (1). **See Electronics Module Cover Removal on page 14-5.**
3. Disconnect the heavy gauge wires from the controller by removing the three screws (6) **(Figure 14-8, Page 14-10)**.
4. Disconnect the 16-pin connector, 4-pin connector, and spade connectors from the controller (1).
5. Remove the one self-tapping screw (9) nearest the B- terminal of the controller. Loosen the remaining two self-tapping screws (9) that secure the controller and remove controller from vehicle.

SPEED CONTROLLER INSTALLATION

1. Install controller (1) on the two self-tapping screws (9). Install third self-tapping screw (9) and tighten to 5.5 ft·lb (7.5 N·m) **(Figure 14-8, Page 14-10)**.
2. Connect the 16-pin connector, 4-pin connector, and spade connectors to the controller (1).
3. Connect the the heavy gauge wires to the controller (1) per the electrical schematics. **See Wiring Diagrams on page 13-4.** Tighten terminal screws (6) on the controller to 108 in·lb (12.2 N·m).

4. Return electronics module cover (8) to its original location. **See Electronics Module Cover Installation on page 14-5.**
5. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries on page 1-3.**
6. Place the Tow/Run switch in the RUN position.
7. If vehicle is equipped with the Guardian SVC system, perform the following additional steps for proper setup.
   7.1. Connect an IQDM to the IQDM port on the vehicle.
   7.2. Select *Program, Settings, Control Mode* and set the value to 1.
   7.3. Select *Program, Settings, Anti Tamper* and set the value to 0.
   7.4. Select *Program, Vehicle ID, Vehicle S/N* and enter the last six digits of the vehicle serial number.

NOTE: *The speed for scrolling values may be increased by utilizing the bookmark keys (yellow buttons) in combination with the data inc/dec key (+/-).*

   7.5. Select *Program, Vehicle ID, Vehicle Decal* and enter the number on the Vehicle Number Decal.
   7.6. Select *Program, Vehicle ID, Vehicle Date of Manufacture* and enter the number on the model year and week from the vehicle serial number.
   7.7. Select *Information, Software Version* and verify the value is 13 or higher. If not, contact a Club Car Technical Representative.
   7.8. Place the Tow/Run switch in the TOW position for 30 seconds. Then return it to RUN.
8. Inspect the vehicle for proper operation.

⚠ WARNING

- **Make sure that the vehicle operates in the forward direction when the Forward/Reverse switch is in the FORWARD position.**
- **Make sure that the vehicle operates in the reverse direction when the Forward/Reverse switch is in the REVERSE position. The reverse buzzer will sound as a warning when the Forward/Reverse switch is in REVERSE.**
- **Make sure that the vehicle does not operate when the Forward/Reverse switch is in the NEUTRAL position.**

SOLENOID

See General Warnings on page 1-2.

The solenoid is located on the rear side of the electronics module.

TESTING THE SOLENOID

See Test Procedure 7 – Solenoid Activating Coil on page 13-24 and Test Procedure 9 – Solenoid Continuity on page 13-24.

SOLENOID REMOVAL

1. Disconnect the batteries and discharge the controller (1). **See Disconnecting the Batteries on page 1-3.**
2. Remove the electronics module cover (8) to access the solenoid (4). **See Electronics Module Cover Removal on page 14-5.**
3. Disconnect the heavy gauge wires from the solenoid (4) by removing the nuts (7) and washers (10) **(Figure 14-8, Page 14-10)**.
4. Disconnect the spade connectors from the solenoid (4).
5. Loosen, but do not remove, the right screw that holds the solenoid (4) to the mounting plate.
6. Remove the left screw that holds the solenoid (4) to the mounting plate and remove solenoid.

SOLENOID INSTALLATION

1. Mount solenoid (4) onto mounting plate with screws **(Figure 14-8, Page 14-10)**. Tighten screws to 66 in-lb (7.5 N·m).
2. With resistor (11) in place as shown, connect the four wires to the appropriate solenoid terminals. **See Wiring Diagrams on page 13-4.** Tighten the nuts (7) that secure the heavy-gauge yellow and red wires to 77 in·lb (8.7 N·m).
3. Return electronics module cover (8) to its original location. **See Electronics Module Cover Installation on page 14-5.**
4. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries on page 1-3.**

CHARGER RECEPTACLE

See General Warnings on page 1-2.

The charger cord, plug, and receptacle are wear items and should be inspected daily. Visually inspect them for cracks, loose connections, and frayed wiring; they must be replaced when worn or damaged. If charger plug or receptacle show signs of corrosion or the plug is difficult to insert or remove, the receptacle contacts and plug terminals should be cleaned with a good electrical contact cleaner or lightly sprayed with WD-40® brand spray lubricant. The plug should then be inserted and removed several times to ensure ease of insertion, ease of removal, and good electrical contact.

TESTING THE CHARGER RECEPTACLE

See Test Procedure 14 – Voltage at Charger Receptacle Red Wire Socket on page 13-31.
See also the appropriate battery charger maintenance and service manual.

CHARGER RECEPTACLE INSPECTION

Inspect the receptacle for cracks, loose connections and frayed wiring.

NOTE: *Disassembly of the charger receptacle, for the purpose of removal or installation, is not recommended.*

CHARGER RECEPTACLE REMOVAL

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries on page 1-3.**
2. Remove kick plate. **See Kick Plate and Charger Receptacle Bezel on page 4-11.**
3. Remove the 10-gauge red wire from the solenoid.
4. Disconnect the 10-gauge black wire from the controller B- terminal.
5. Disconnect the light blue wire from main harness at the bullet connector.
6. Remove the three screws (1) that secure the charger receptacle (2) to the bucket.

CHARGER RECEPTACLE INSTALLATION

1. Insert the wires through the hole in the bucket.
2. Insert receptacle (2) into bucket.
3. Install the three screws (1) that secure the receptacle to the bucket. Tighten screws to 16 in·lb (1.8 N·m).
4. Connect 10-gauge red wire to solenoid. Tighten nut 72 to 84 in·lb (8 to 9.5 N·m).
5. Connect 10-gauge black wire to controller B- terminal. Tighten bolt to 108 in·lb (12.2 N·m).
6. Connect light blue wire to main harness at bullet connector with light blue wire.
7. Install kick plate. **See Kick Plate and Charger Receptacle Bezel on page 4-11.**
8. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries on page 1-3.**

⚠ DANGER

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

⚠ WARNING

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

⚠ 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.**
- **Charge batteries in a well-ventilated area only. Batteries emit hydrogen while being charged. Hydrogen is an explosive gas and must never exceed a level of 2% of the air.**
- **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.**

⚠ WARNING

- **Wear safety glasses or approved eye protection when servicing the vehicle or battery charger. Wear a full face shield and rubber gloves when working on or near batteries.**
- **Use insulated tools when working near batteries or electrical connections. Use extreme caution to avoid shorting of components or wiring.**
- **Ensure battery connections are clean and properly tightened. See Battery Care on page 15-6.**

CAUTION

- **On all vehicles, turn off all accessories before charging batteries.**

NOTE: *Recycle or dispose of discarded batteries in accordance with local, state, and federal regulations.*

GENERAL INFORMATION

The batteries supplied with an electric vehicle are different from those supplied with an automobile. The outward appearance of these two batteries is similar, but the operating characteristics are very different. The electric vehicle battery is a deep-cycle battery, and the automotive battery is a “starting, lighting and ignition” (SLI) battery. They should never be substituted for one another.

BATTERY TESTING BASICS – 8 VOLT

See General Warnings on page 1-2.

OBSERVATION

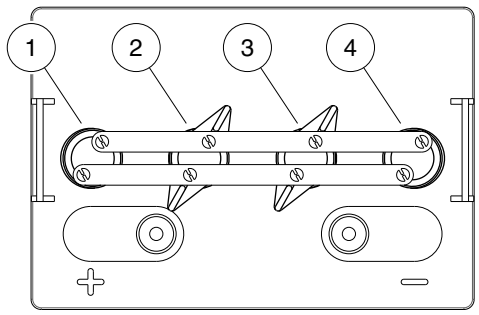
Inspect the battery compartment for the following items:

- Rusted, corroded, or broken battery posts
- Rusted, corroded, loose or broken wires
- Low or overfilled electrolyte levels
- Cracked, punctured, or bulging battery cases
- Loose, over-tightened, missing, or improperly placed battery hold-downs
- Incorrect orientation of batteries (i.e. terminal posts)
- Poor, fair, or proper cleanliness of batteries
- Added electric accessories
- Use of a single-point watering system (SPWS)

MEASURING VOLTAGE OF BATTERY SET

Set the multimeter to 200 volts DC. Place the red (+) probe on the positive (+) post of battery no. 1 and the black (–) probe on the negative (–) post of battery no. 6. Record the reading.

BATTERY CELL NUMBERING



1. Cell 1 (Cell with Positive Post)
2. Cell 2 (Cell adjacent to Positive Post)
3. Cell 3 (Cell adjacent to Negative Post)
4. Cell 4 (Cell with Negative Post)

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Figure 15-1 Battery Cell Numbering – 8 Volt

BATTERY TESTING – 8 VOLT

See General Warnings on page 1-2.

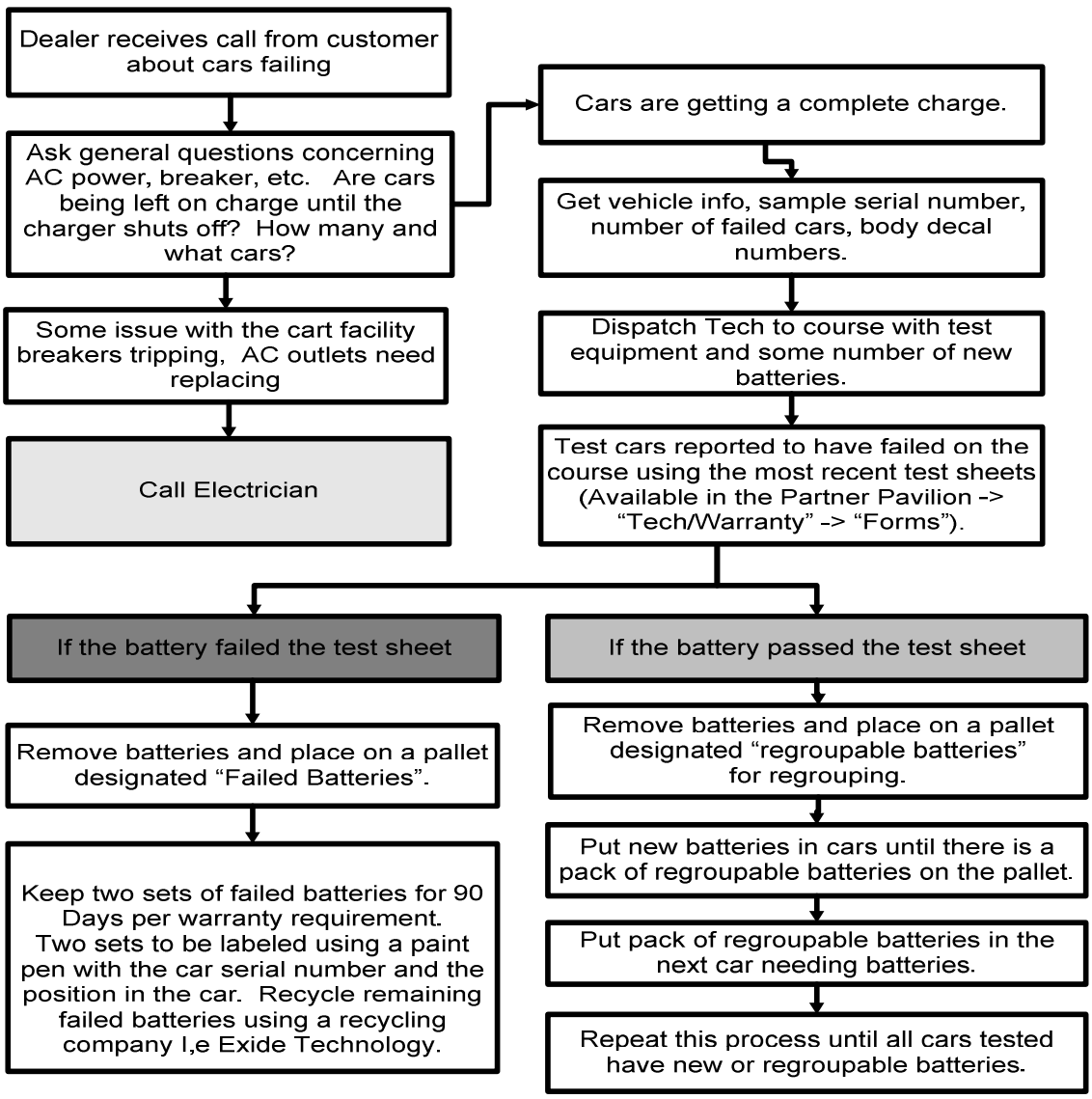
Test procedures not available at time of publication. Refer to any Bulletin that is released concerning testing for Model Year 2014.

BATTERY REGROUPING

CAUTION

- **To prevent degradation of battery performance and life, never mix batteries of different part numbers or brands/model numbers. Anytime a different model of battery is used, the charging algorithm must be changed to match it. For vehicles with PowerDrive charger, the vehicles' onboard computer must be changed to one that is specific to the battery installed. For vehicles with high-frequency charger (e.g. ERIC or QuiQ), the charger must be reprogrammed with the appropriate algorithm specific to the battery installed.**

Regrouping is now Club Car's standard battery replacement method. *Regrouping* is the practice of placing batteries of similar condition together in one vehicle. For example, if there was an issue with the batteries in two cars and the battery test indicated three failed batteries in each car, after removing the failed batteries, there will be six good batteries remaining. Install the six remaining good batteries together in one car and install NEW batteries in the other car. We recommend regrouping batteries in as many cars as possible at a given opportunity to minimize mixing old and new batteries together in one battery pack. A training video for regrouping is available to view in the Partner Pavilion under "Tech/Warranty" and then "Training Videos". Contact your regional Tech Support person to assist you in the regrouping process if needed.



CAUTION: To prevent degradation of battery performance and life, never mix batteries of different part numbers or brands/model numbers. Charging algorithms are specific to a particular battery model.

1. **Install all new batteries or all regroupable batteries of the same brand and model or part number; do not mix new with regroupable except for the last car regrouped.**
2. **Accurate and accumulative Amp Hours are required for Warranty claims. Make sure to have battery lights on hand to replace ones that may be defective so you can capture every car's Amp Hour reading.**

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Figure 15-2 Battery Regrouping Process Flow

BATTERY REPLACEMENT

See General Warnings on page 1-2.

⚠ WARNING

- **Wear steel-toe shoes when replacing batteries.**
- **To prevent electrolyte leakage from the battery vents, batteries must be kept in an upright position. Tipping a battery beyond a 45° angle in any direction can allow a small amount of electrolyte to leak out the vent hole. Do not exceed this 45° angle when lifting, carrying, or installing batteries. Battery acid can cause severe personal injury to skin or eyes, and can damage clothing.**
- **When replacing batteries in the Single Point Watering System, place the battery cap from the new replacement battery onto the used battery being removed from the car. Important safety warnings on the battery cap must remain with the battery after it has been removed from the car**

CAUTION

- **To prevent degradation of battery performance and life, never mix batteries of different part numbers or brands/model numbers. Anytime a different model of battery is used, the charging algorithm must be changed to match it. For vehicles with PowerDrive charger, the vehicles' onboard computer must be changed to one that is specific to the battery installed. For vehicles with high-frequency charger (e.g. ERIC or QuiQ), the charger must be reprogrammed with the appropriate algorithm specific to the battery installed.**

1. Before removing batteries, note the orientation of the batteries and the connecting wires. Disconnect the battery cables and discharge the controller as instructed. **See Disconnecting the Batteries on page 1-3.** Remove remaining wires and batteries.
2. Visually inspect the new batteries for any damage that may have occurred in transit. New batteries will not deliver their full capabilities until they have been discharged and recharged 50 to 70 times. To obtain the maximum service life from new batteries, restrict vehicles with new batteries to one hour of operation between charges for the first two months vehicle is in service. Batteries should be fully charged before first use of new vehicle, before first use of a vehicle after storage, and before use each day.
3. If the battery cables are to be reused, inspect them for broken or frayed wires, damaged terminals, or worn insulation. Remove any corrosion on the connectors. A solution of baking soda and water (1 cup (237 mL) baking soda per 1 gallon (3.8 L) of water) does an excellent job of neutralizing and removing the corrosion. Be careful not to allow the baking soda solution to enter the battery.
4. Check and clean the battery rack and hold-downs. The nuts and bolts on the hold-downs may corrode. It is therefore advised they be cleaned periodically and replaced as necessary.
5. Regroup batteries as required. **See Battery Regrouping on page 15-3.**
6. Install regrouped or new batteries in the proper orientation **(Figure 1-1, Page 1-3)**. Install battery hold-downs. The hold-downs should be tight enough so batteries do not move while vehicle is in motion, but not so tight as to crack or buckle battery case. Tighten hold-down retaining nuts to 72 in·lb (8.1 N·m), alternating between hold-down bolts.
7. Install wires in proper sequence. Install black wire to negative post of battery no. 6 (6 x 8-Volt battery set) last. **See Connecting the Batteries on page 1-3.**
8. If replacement batteries have a different part number than the batteries removed, either replace the vehicles' onboard computer or reprogram the high-frequency charger. **See preceding CAUTION.**
9. Give the batteries a full charge prior to operation. This ensures all the batteries are fully charged and the cells are equalized prior to use.

BATTERY CARE

See General Warnings on page 1-2.

WATER QUALITY

Water purity is the most important factor in the performance and life span of the vehicle batteries. Club Car is, therefore, placing increased importance on battery water quality.
Outlined below are four battery watering procedures, grouped into two categories: Preferred and Alternate methods. Club Car recommends the use of a deionizer or distilled water. Alternate methods of reverse osmosis or tap water are allowable but should be avoided since water quality can change from day to day depending on additives, water main leaks, etc.

Preferred Methods

- **Distilled Water:** Distilled water is the most common type of water used in batteries. Distilled water is created by boiling water, collecting the steam, and allowing the steam to condense back into water. The distilling process results in water that is free of minerals that can lead to the degradation of battery performance and life.
- **Deionized Water:** Deionized water is created by inducing electrically charged resins that attract and bind to sodium, calcium, iron, copper, chloride, and bromide ions. The result of this electrical filtering is purified water, which contains little to no mineral ions. To make sure the deionized water remains at a high quality, replace the filter in the deionizer per the manufacturer's recommendations.
- **Deionized Systems:** The Service Parts Department at Club Car offers one deionizer system: for vehicles equipped with the Single Point Watering System (SPWS), CC P/N 105166801; for vehicles without SPWS, CC P/N 105166801 (used in combination with AM10818 Battery Watering Nozzle Gun).

Alternate Methods

- **Reverse Osmosis:** Reverse osmosis involves forcing water through a membrane that allows water to pass while trapping solids. The choice of membrane used determines the amount of solids or impurities that get trapped and hence the purity quality of the filtered water. In addition, the usage frequency of the membrane can also contribute to the filtered water quality. Due to the variance in water quality consistency, Club Car recommends the use of the deionizer or distilled water.
- **Tap Water:** While the use of tap water without filtering is an alternate method of battery watering, its use should be limited due to the levels of dissolved minerals and chemicals that can degrade battery performance and life. If unfiltered tap water is used, regular water analyses must be conducted to check for impurities. The following chart lists the maximum allowable minerals, solids, and contaminates in parts per million and their impact on battery performance. Water testing, however, is expensive, and water quality can change from day to day depending on additives, water main leaks, etc. Due to the cost and labor of performing water quality tests, Club Car recommends the use of distilled water or a deionizer.

IMPURITY	ALLOWABLE CONTENT (PARTS PER MILLION)	EFFECTS OF IMPURITY
Suspended matter	Trace	N/A
Total solids	100.0	N/A
Organic and volatile matter	50.0	Corrosion of positive plates
Ammonia	8.0	Slight self-discharge of both plates
Antimony	5.0	Self-discharge, reduces life, lower on-charge voltage
Arsenic	0.5	Self-discharge, can form poisonous gas

TABLE CONTINUED ON NEXT PAGE

IMPURITY	ALLOWABLE CONTENT (PARTS PER MILLION)	EFFECTS OF IMPURITY
Calcium	40.0	Increase of positive plate shedding
Chloride	5.0	Loss of capacity in plates, greater loss in positive plates
Copper	5.0	Increased self-discharge, lower on-charge voltage
Iron	3.0	Increased self-discharge, lower on-charge voltage
Magnesium	40.0	Reduced life
Nickel	None allowed	Intense lowering of on-charge voltage
Nitrates	10.0	Increased sulfation of negative plate
Nitrites	5.0	Plate corrosion, loss of capacity, reduced life
Platinum	None allowed	Violent self-discharge, lower on-charge voltage
Selenium	2.0	Positive plate shedding
Zinc	4.0	Slight self-discharge of negative plates

DEIONIZER

Deionizer systems for SPWS configured fleets became standard with Model Year 2014 fleet golf orders.

Regular Maintenance

This system requires regular preventative maintenance on at least a quarterly basis.

- Check all screens and/or filters on water supplies. Clean or replace all filters / line strainers as necessary. Failure to do so can cause a reduction in the water pressure and flow rates needed to operate the system properly. A filter screen can be found on the inlet of all regulators, and a line strainer on all supply hoses. Be sure to replace the deionizer filter cartridge as indicated by the water quality light. The CC P/N 105166801 Deionizer system has a battery-powered, water quality light. Deionizer filters have a limited life cycle and are disposable. Life cycle of the filter will vary based on incoming water quality and water usage. If the deionizer system is equipped with a water quality light, press the button to check. Replace filter immediately if the red light comes ON indicating service is required.

  The following replacement filter is available from Club Car Service Parts:

  — Use filter P/N 104005901 for Deionizer Systems P/N's 105166801, 104006001 and AM10974.

  — Use filter P/N AM10975 for Deionizer System P/N AM10974.

NOTE: *The filter P/N AM10975 will be sold to depletion. After this part becomes unavailable, use the filter P/N 104005901 for Deionizer System P/N AM10974.*

- Inspect the condition of all tubing, connections, and couplers. Make sure that all parts are in good working condition, secure, leak free, and properly connected. The coupler must have an O-ring and the dust cover properly attached.
- Clean optical indicator of the water quality light. If the optical indicator is dirty, clean it by wiping with a cloth.

Decals

Starting December 2013, new decals were installed on the deionizer wall bracket and the deionizer filter. The blue, deionizer wall bracket decal is a Filter Replacement Record Log. The yellow filter decal is a Fleet Inspection Record

Log. Use these decals to record filter replacement activity and fleet inspection activity. For convenience, both decals have a QR code for ordering replacement filters.

Seasonal Maintenance

Water supplies must be drained and stored in an empty state if they will be exposed to freezing temperatures. Failure to do so can cause permanent damage.

Single point watering systems will require seasonal maintenance if vehicles are taken out of service or put into storage for a period of 6 weeks or longer. To prepare the SPWS, ensure the feed tube and coupler are on top of battery. Then, use the following steps to bring vehicle back into service:

1. After the batteries have been fully charged/equalized, connect the system to its water supply for 3 to 5 seconds, then disconnect regardless of whether or not the batteries are completely full.
2. Return the vehicle to normal operation.
3. Place the vehicle back into its regular watering schedule, waiting at least one week until next watering.

BATTERY CARE – VEHICLES EQUIPPED WITH THE SINGLE-POINT WATERING SYSTEM

To keep batteries in good working condition, follow this maintenance program on a regular basis:

1. Keep the batteries 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 of the batteries. Do not allow this solution to enter the battery. Be sure terminals are tight. Let the terminals dry and then coat with Battery Terminal Protector Spray (CC PN 1014305). **See following NOTE.**

NOTE: *Dispose of waste water properly.*

2. The battery hold-downs should be tight enough so that the batteries do not move while the vehicle is in motion, but not so tight as to crack or buckle the battery case. For 8-volt batteries, tighten hold-down retaining nuts to 106 in·lb (12 N·m). The terminal connections should be clean and tight, and any worn insulation or frayed wires should be replaced. Tighten battery terminals to proper torque. **See Connecting the Batteries on page 1-3. See following WARNING.**

⚠ WARNING

- **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 fire, property damage, or personal injury.**

3. After use, charge the batteries. The batteries should never be left discharged any longer than absolutely necessary (do not leave discharged overnight).
4. Water the batteries monthly or according to the watering interval. **See Establishing the Watering Interval for New Vehicles on page 15-9. See Watering Batteries with the SPWS on page 15-11.**

CAUTION

- **The watering interval must adequately maintain the electrolyte level above the top of the plates. See Figure 15-3.**

- **Water the batteries only AFTER charging.**

NOTE: *Bottled distilled water, with the hand pump, CC PN 104006101, is recommended for private consumer SPWS applications.*

Establishing the Watering Interval for New Vehicles

If you do not already have a battery watering interval for your vehicles, manually check the battery water level weekly to establish the correct watering interval. Thereafter, water batteries according to the established interval. During periods of heavy use, add additional watering as required.

Single-Point Watering System (SPWS) Maintenance

1. For vehicles newly equipped with the Single-Point Watering System, the initial electrolyte level check on all battery cells verifies that all the valves in the SPWS are functioning correctly. **See Periodic Service Schedule on page 10-4.** If a valve fails to open, the cell will eventually dry out. The initial one-time inspection of all cells will identify any occurrence of a valve that fails to open. If a valve fails to close, it will become evident due to the cell overflowing during routine watering. Either failure scenario is rare, but should be monitored in the initial inspection and during routine watering sessions. Replace malfunctioning valves to ensure maximum battery life. **See following CAUTION.**

CAUTION

- **After checking the electrolyte, fully tighten the battery caps to prevent electrolyte leakage.**

2. After the initial six-week inspection, manually check the electrolyte level at least once per year, particularly after long-term storage or any other period of vehicle inactivity. **See preceding CAUTION.**

BATTERY CARE – VEHICLES WITHOUT THE SINGLE-POINT WATERING SYSTEM

To keep batteries in good working condition, follow this maintenance program on a regular basis:

1. Keep the batteries 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 of the batteries. Do not allow this solution to enter the battery. Be sure terminals are tight. Let the terminals dry and then coat with Battery Terminal Protector Spray (CC PN 1014305). **See following NOTE.**

NOTE: *Dispose of waste water properly.*

2. Check the electrolyte level weekly **(Figure 15-3)**. Add water only **after** charging unless the electrolyte level is below the top of the plates. In this case, add just enough water to cover the plates, charge, and then check the level again. Never charge batteries if plates are exposed above electrolyte level. For best battery life, add only distilled water. **See following CAUTION and NOTE.**

⚠ CAUTION

- **Do not overfill the batteries.**

NOTE: *A battery watering gun or bottle (CC P/N AM10818) is available from your authorized Club Car dealer.*

3. The battery hold-downs should be tight enough so that the batteries do not move while the vehicle is in motion, but not so tight as to crack or buckle the battery case. For 8-volt batteries, tighten hold-down retaining nuts to 106 in·lb (12 N·m). The terminal connections should be clean and tight, and any worn insulation or frayed wires should be replaced. Tighten battery terminals to proper torque. **See Connecting the Batteries on page 1-3. See following WARNING.**

⚠ WARNING

- **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 fire, property damage, or personal injury.**

4. After use, charge the batteries. The batteries should never be left discharged any longer than absolutely necessary (do not leave discharged overnight).

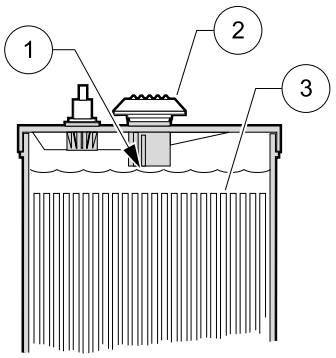
SELF-DISCHARGE

Contaminants on dirty batteries can provide a path for a small current draw that can slowly discharge batteries, thus wasting valuable energy. To prevent self-discharge, batteries 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 set of batteries will discharge. In hotter climates, batteries should be checked more often. When storing batteries, keep in a cool place. **See Battery Storage on page 15-13.**

ELECTROLYTE LEVEL

⚠ CAUTION

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



1. Level Indicator 2. Cap 3. Plates
Maintain electrolyte level from at least 1/2 inch (13 mm) above plates to 1/4 inch (6 mm) below level indicator.

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Figure 15-3 Battery Electrolyte Level

Add water only after charging unless the electrolyte is below the level of the plates. If the electrolyte level is below the level of the plates, add just enough water to cover the plates and then charge the batteries. After charging, fill with water to the level indicator. Filling a battery to the level indicator before charging will result in overfilling because the electrolyte level will rise during charging and some of the electrolyte may bubble out of the cap. This reduces the battery's capacity and corrodes the metal parts around it.
The electrolyte level should be checked weekly to be sure electrolyte is at its proper level **(Figure 15-3, Page 15-10)**. Never allow the electrolyte level to fall below the tops of the plates because this will cause the exposed part of the plate

to become permanently inactive. For best results, use a battery watering gun to add water to batteries. Check the electrolyte level more frequently in hot weather or when batteries are old.

VIBRATION DAMAGE

The battery hold-downs should always be tight enough to keep the battery from bouncing. Battery life may be severely shortened if the battery hold-downs are too loose. **See step 6. of Battery Replacement on page 15-5.** Excessive vibration causes the plates to shed prematurely and 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 which is lost reduces the capacity of the battery and cannot be replaced. Battery hold-downs should NOT be so tight as to crack or buckle the battery case. This may cause leaks which would dry out a cell or cause internal short circuits. **See Battery Replacement on page 15-5.**

SINGLE POINT WATERING SYSTEM (SPWS)

⚠ WARNING

- **When replacing batteries in the Single Point Watering System, place the battery cap from the new replacement battery onto the used battery being removed from the car. Important safety warnings on the battery cap must remain with the battery after it has been removed from the car**

CAUTION

- **Water the batteries only AFTER charging.**
- **Use water that meets the quality standards shown on page 15-6. Maximize battery life by removing ions and heavy metals from water with the use of a single point watering system deionizer. A deionizer for vehicles with SPWS, Club Car Part Number 105166801 is available from Service Parts (DC powered water quality indicator light). Replacement cartridge: 104005901. Bottled distilled water, with hand pump, Club Car Part Number 104006101, is recommended for private consumer applications.**

INITIAL MAINTENANCE OF THE SPWS

After six weeks of operation, remove the valves from the batteries and manually check the battery water level to ensure that the SPWS is not leaving any cells dry. This initial electrolyte level check on all the battery cells verifies that all the valves in the SPWS are functioning correctly. If a valve fails to open, the cell will eventually dry out. The initial one-time inspection of all cells will identify any occurrence of a valve that fails to open. If a valve fails to close, it will become evident due to the cell overflowing during routine watering. Either failure scenario is rare, but should be monitored in the initial inspection and during routine watering sessions. Replace malfunctioning valves to ensure maximum battery life. After the initial six-week inspection, manually check the battery water levels at least once per year, particularly after winter storage or any other period of vehicle inactivity. **See following NOTE.**

NOTE: *For the longest battery life, be sure the mineral contents of the water meet the minimum requirements as stated in the vehicle's appropriate maintenance and service manual.* ***See Battery Care on page 15-6.***

WATERING BATTERIES WITH THE SPWS

Checking the Water Flow Rate

1. Connect the water hose with the built-in screen filter (2) to the water faucet (1) **(Figure 15-4)**. **See following CAUTION.**

CAUTION

- **Make sure the screen filter is clean.**
- **Do not use a longer garden hose than provided with the System (20 feet), as a decrease in water pressure could overfill the batteries and damage the refill system.**

2. Before screwing the hose-end assembly (3) onto the opposite end of the water hose, check the screen filter (4) inside the end of the assembly to make sure it is clean **(Figure 15-4)**.
3. Connect the purger (5) to the female coupler (8) on the end of the hose-end assembly **(Figure 15-5)**.

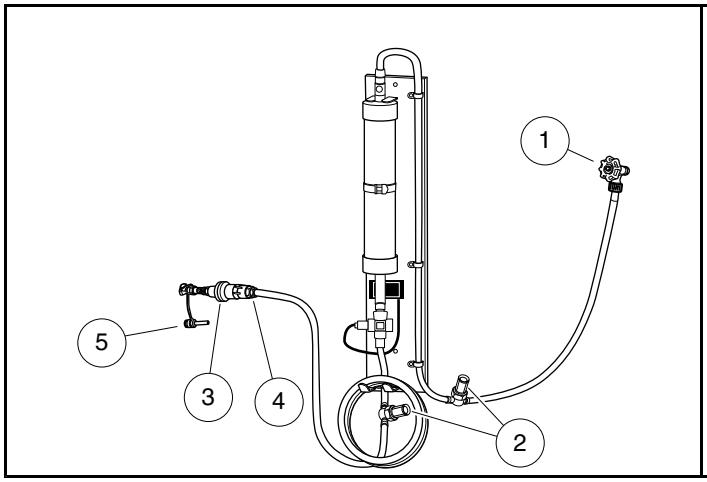

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Figure 15-4 Connecting Hose with Filter to Water Source

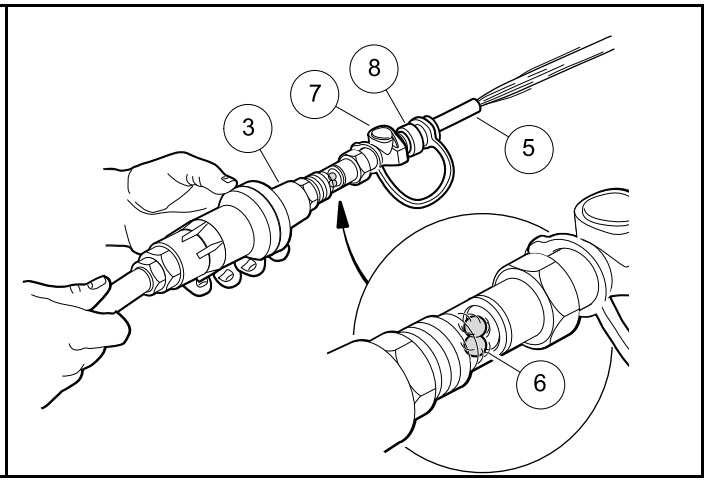

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Figure 15-5 Checking the Water Flow Rate

4. Completely open the water faucet until the water flows out of the hose-end assembly (3), and note the movement of the red flow indicator balls (6). **See following NOTE.**

NOTE: *This step also eliminates any trapped air from the water hose.*

The water flow rate must be at least 2 gallons per minute (7.6 L per minute) and the water pressure must be no more than 100 psig (689.5 kPa) when static (no flow) for the SPWS to function properly.

5. Check the water quality light on the deionizer to make sure the light is green in color, indicating acceptable water quality. If the light indicates unacceptable water quality, the cartridge must be replaced.
6. After ensuring adequate water flow rate and water quality, press the grey button (7) on the end of the female coupler (8) to disconnect the purger from the pressure regulator.

Refilling the Batteries

1. Locate the battery fill coupling (9) on the driver side of the battery compartment, remove the dust cover (10) from the male connector **(Figure 15-6)**, and connect the hose-end assembly (3) **(Figure 15-7)**. The water flow will begin immediately.

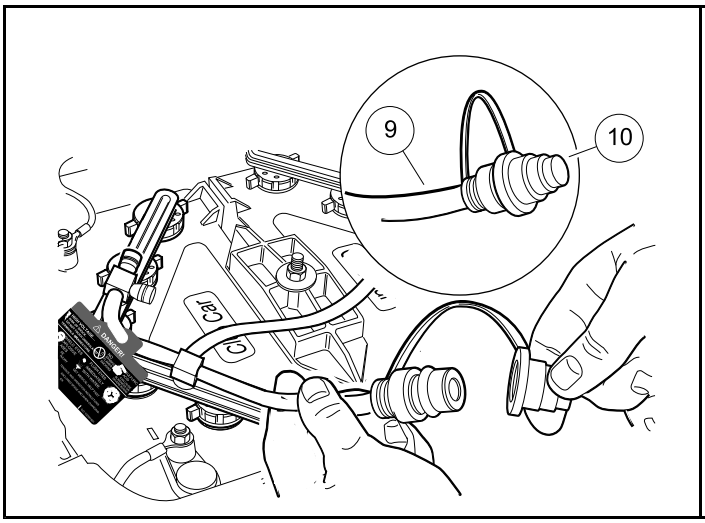

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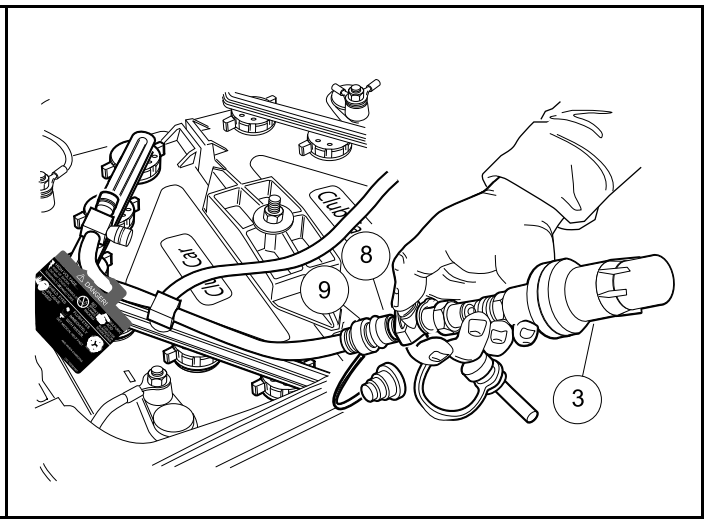
Figure 15-6 Dust Cap



71
Figure 15-7 Connecting Hose-end Assembly to Battery Fill Connector

2. The red flow indicator balls should swirl, indicating that the batteries are being filled. **See following CAUTION.**

CAUTION

- **If at any time water overflows from the batteries, immediately stop the refill process, disconnect the pressure regulator from the battery fill coupling, and call for service.**

3. When the red flow indicator balls stop moving, immediately press the grey button to disconnect the hose-end assembly from the battery fill coupling (9), and squeeze the dust cover (10) to lightly secure it to the male connector of the battery fill coupling **(Figure 15-6)**.
4. Place the battery fill coupling into the space between the battery bucket and the car body. Leaving the fill coupling on top of the battery bank or tucked between the batteries and the battery bucket can result in coupling damage.
5. Turn the water faucet off when finished filling the vehicle(s).

BATTERY STORAGE

See Storage, Section 3, Page 3-3.

FLEET ROTATION

Rotate vehicle usage. It is very hard on batteries if the last vehicles in at night are the first ones out in the morning. Spread the workload evenly, giving all vehicles the same amount of use. This will keep your fleet in balance and will not overwork certain sets of batteries. **See following NOTE.**

NOTE: *When vehicles are being rotated, the IQDM (IQ Display Module) can be a very helpful service tool. Monitoring the value of the Odometer or Amp-Hours with the IQDM simplifies vehicle usage scheduling.* ***See Monitor Menu, Section 11, Page 11-5.***

DEEP-DISCHARGE

Never discharge batteries to the point the vehicle will no longer operate. This will considerably shorten the cycle life of the batteries, and may permanently damage the batteries. It is possible the batteries will not accept a charge if they are completely discharged. The deeper the discharge, the harder it is on the batteries. For this reason, it is recommended that electric vehicle batteries be charged after each use (provided the charge cycle will not be interrupted and the charger will be allowed to shut off automatically). Placing the batteries on charge after each use reduces the depth of discharge and prolongs battery life.

EARLY EXCESSIVE DISCHARGING

When vehicle batteries are new, they do not reach their full capacity until they have been discharged and recharged 50 to 70 times. If they are excessively discharged early in their life, their effective service life will be shortened. It is advisable to limit the use of any vehicle with new batteries for at least the first four weeks and then gradually increase their range.

SECTION 16 – BATTERY CHARGER: FOR ERIC CHARGING SYSTEM

16

See General Warnings on page 1-2.

⚠ DANGER

- **The charging area must be ventilated. Hydrogen level in the air must never exceed 2%. The total volume of air in the charging area must be changed at least five times per hour. Exhaust fans should be located at the highest point of the roof. Contact a local HVAC engineer.**
- **Do not charge the vehicle batteries with the vehicle covered or enclosed. Any enclosure or cover should be removed or unzipped and pulled back when batteries are being charged. An accumulation of hydrogen gas could result in an explosion.**

⚠ WARNING

- **Only trained technicians should repair or service the charger. Contact your nearest Club Car distributor/dealer.**
- **This appliance is not intended for use by persons (including children) with reduced physical, sensory or mental capabilities, or lack of experience and knowledge, unless they have been given supervision or instruction concerning use of the appliance by a person responsible for their safety. Children should be supervised to ensure that they do not play with the appliance.**
- **Do not operate the charger if it has received a sharp blow, was dropped, or otherwise damaged in any way.**
- **Have worn, cut, or damaged power cords or wires replaced immediately.**
- **Do not connect a stationary charger to the receptacle if the charger cord, plug, or the vehicle receptacle is broken, damaged, or does not make a good electrical connection. Fire or personal injury can result. Have a qualified technician replace the damaged parts.**
- **Do not use near fuels, grain dust, solvents, thinners, or other flammables. Chargers can ignite flammable materials and vapors.**
- **Do not expose to rain or any liquid. Keep the charger dry.**
- **When the charger is on, the charger DC cord may be disconnected from the vehicle receptacle slowly. Jerking or pulling the DC cord out quickly could cause arcing and burning that could damage the plug and receptacle and could cause batteries to explode.**
- **Do not cover the charger cooling fins. Do not allow clothing, blankets, or other material to cover the charger. The fins dissipate heat and protect the charger from overheating.**
- **Cooling fins will become hot during charging. Do not touch. Use the handle.**

CAUTION

- **The high-frequency battery charger was specifically designed for use with the high-frequency charging system. Do not use the high-frequency battery charger with other operating systems, and do not use other charger models with high-frequency charging system vehicles.**
- **The battery charger provided with this vehicle is approved for use only with the battery type originally shipped with the vehicle. Using a different battery type (different brand, different capacity, etc.) can cause under or overcharging and subsequent battery damage unless the charger is first reprogrammed with a new charging algorithm. Club Car only recommends OEM replacement batteries. Contact your authorized Club Car dealer/distributor with any questions about battery and charger compatibility or algorithm updates.**

GENERAL INFORMATION

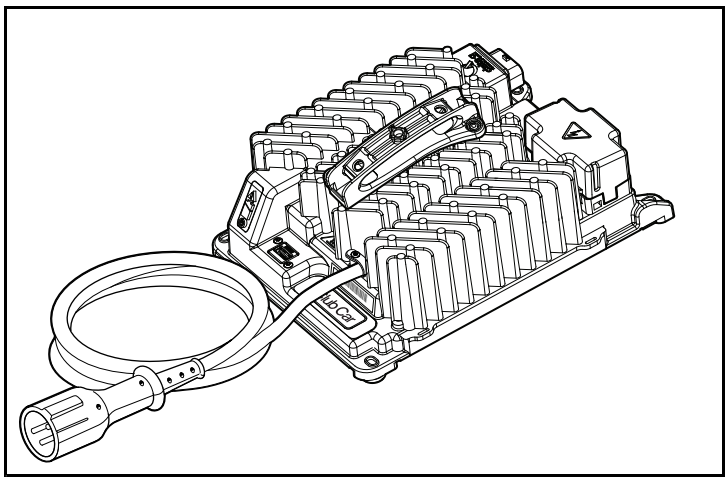
NOTE: *This charger has no internals to service or repair. It only has a few external repairs that can be performed. If an internal component needs repair, the charger must be replaced.*

Because the charger has a storage charge feature that automatically checks and recharges the batteries as necessary, the charger can remain plugged to the vehicle throughout the storage period.

Key Differences between ERIC Chargers and PowerDrive Chargers

- Programmable in the field instead of changing onboard computer (OBC).
- Ability to fully update software via USB flash drive or laptop computer instead of changing OBC.
- DV/DT charge termination instead of Amp-Hour Returned charge termination.
- Communication Display Module (CDM) is not used. Only an IQDM is needed for data.
- The IQDM will remain ON when the charger is connected.
- Only PD+ 8-volt batteries are approved for use with this high-frequency charging system at this time. Other batteries have not been approved. When other batteries are approved, the charger can be updated with the appropriate algorithm using the USB port.

This section includes information, troubleshooting and service procedures pertaining to the external high-frequency battery charger (model number IC0650-048-CC). Do not attempt to service a battery charger that has not been properly identified. If a charger cannot be properly identified, contact your local Club Car dealer or distributor.



COV-1481
Figure 16-1 High-Frequency Battery Charger – External

The high-frequency battery charger is automatic and has no external controls. It functions as an integral part of the vehicles' electrical system and will not work with other electric vehicles. The charger is programmed with a specific charge algorithm that is appropriate to the specific battery type used in the vehicle. When the charger is connected, there is a 2 to 5 second delay before charging begins. When the AC cord is connected, the charger performs a start-up self-test (all three charger status indicators on the front of the charger flash ON at the same time).

The charger supplied with the electric vehicle resolves the most common problems associated with battery charging. The charger utilizes sophisticated charge termination criterion to shut off automatically, preventing the possibility of either undercharging or overcharging. The charger accomplishes this by monitoring battery voltage, charge current, charge time and using strict dV/dt termination criterion.

Batteries should never be left in a discharged state, as this too affects the internal components and can reduce the capacity of the battery. The batteries should be charged every day they are used. However, the batteries should not be charged if they have not been used.

USB SERVICE PORT

The charger has a USB port for use by Club Car authorized technicians for data transfer, reconfiguration, and updates. Keep the USB port cover in place when the port is not in use.

UL AND CSA LISTING

High-frequency charging system battery chargers have been listed by UL and by the Canadian Underwriters and meet the criteria of the Canadian Standards Association.

CE COMPLIANCE

This battery charger is compliant with the EU EMC Directive 2004/108/EC.

PLUG AND RECEPTACLE

The charger cord, plug, and receptacle are wear items and should be inspected daily. Visually inspect for cracks, loose connections, frayed wiring or bent pins; they must be immediately replaced when worn or damaged. Do not attempt to straighten a bent pin. If charger plug or receptacle show signs of corrosion or the plug is difficult to insert or remove, check for bent pins, then clean the receptacle contacts and plug terminals with a good electrical contact cleaner or light coating of WD-40® brand spray lubricant. The plug should then be inserted and removed several times to ensure ease of insertion, ease of removal, and good electrical contact.

⚠ DANGER

- **To prevent fire, immediately replace battery charger DC cord plug and receptacle if the following conditions exist:**
  - **Plug pins have worn nickel plating and copper is exposed.**
  - **Plug requires an inordinate amount of force to insert into receptacle, especially if accompanied by a “grinding” feel.**

⚠ WARNING

- **If pins are bent, the plug must be replaced immediately. The plug is not serviceable. Do not attempt to repair the plug or straighten bent pins.**
- **Disconnect the AC cord prior to lubricating the plug and receptacle.**

NOTE: *If the warning tag has been damaged or removed from the DC cord, have it replaced immediately.*

CHARGER POWER CONNECTION FUSE

The charger receptacle harness has an in-line, 30-amp fuse located near the solenoid.

CHARGER INTERLOCK

External Charger: While the charger DC cord is plugged into the vehicle, the vehicle control circuit is locked out, preventing operation of the vehicle, as well as the possibility of consequent damage to the charger and the vehicle.
Onboard Charger: While the charger AC cord is plugged into an electrical outlet, the vehicle control circuit is locked out, preventing operation of the vehicle, as well as the possibility of consequent damage to the charger and the vehicle.

AC INPUT VOLTAGE DETECTION

The high-frequency charger automatically detects the AC input voltage and will operate at full power if the voltage is within the 100 to 240 VAC range. The charger also will function outside of that range down to 85 VAC and up to 270 VAC although charging times will be longer. Outside of the 85 to 270 VAC range, the charger will not operate.

THERMAL CUTBACK

The charger operates at full power in ambient temperatures between -40 °F (-40 °C) and 104 °F (40 °C). The charger also will function outside of that range although charging times will be longer.

CHARGE INDICATOR LIGHT

Excel System vehicles with ERIC Charging system feature a dash mounted charge indicator light (below the steering column) that serves two functions: 1) Battery low state of charge warning, and 2) Charging confirmation. The charge indicator light is controlled by pin 11 of the controller.

Battery Low State of Charge Warning

- The light comes on and remains solid when the battery state of charge falls below 20%.
- The light begins flashing when the battery state of charge falls below 10%.

Charging Confirmation

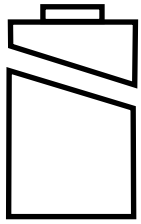
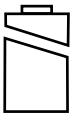
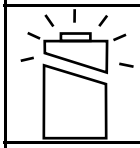
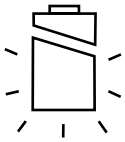
- The light will flash three times and the reverse buzzer simultaneously will sound three times to indicate a battery charging session has begun. **See following NOTE.**

NOTE: *The number of flashes and beeps can vary depending on the Beep Option setting.* ***See Beep Option, Section 12, Page 12-5.***

CHARGER STATUS INDICATORS

The indicator lights on the charger provides information concerning charger status.

TABLE CONTINUED ON NEXT PAGE

LIGHT	STATUS		STATUS EXPLANATION
	Solid red		Charger error. Reset charger power. **See Resetting Power – External Charger on page 16-14.**
	Flashing orange		Charger unable to complete charge.
		Solid green Solid green	Charging is complete. Battery pack is fully charged.
		Flashing green Solid green	Charging is in progress. Battery pack has reached a high state of charge.
		Off Flashing green	Charging is in progress. Battery pack has NOT reached a high state of charge.
	Solid blue		AC power to charger is present.

LONG-TERM STORAGE

High-frequency chargers are designed to be left connected with AC power to the charger during off-season or long-term storage. **See Storage on page 3-3.**

EXTERNAL CHARGER MOUNTING

⚠ WARNING

- **Make sure the charger is securely mounted. Do not hang the charger by its handle.**
- **Place all cords so they will not be stepped on, tripped over, or otherwise subjected to damage or stress.**

CAUTION

- **Do not mount the charger in exceptionally hot locations, such as on a tin exterior wall with southern or western exposure, with chargers stacked together and especially with heatsinks next to each other, etc.**
- **Charger must not be subjected to water spray.**

Use the mounting holes to secure the charger **(Figure 16-2)**. Position the charger so that is has adequate ventilation and the charger status indicator panel is visible. The charger can be mounted in any orientation (right-side up, upside down, etc.) provided the cooling fins are unobstructed it has adequate ventilation **(Figure 16-3)**.

To help ensure optimal charge times, mount the charger in an area where ambient temperatures during charging remain below 104 °F (40 °C). **See Thermal Cutback on page 16-4.**

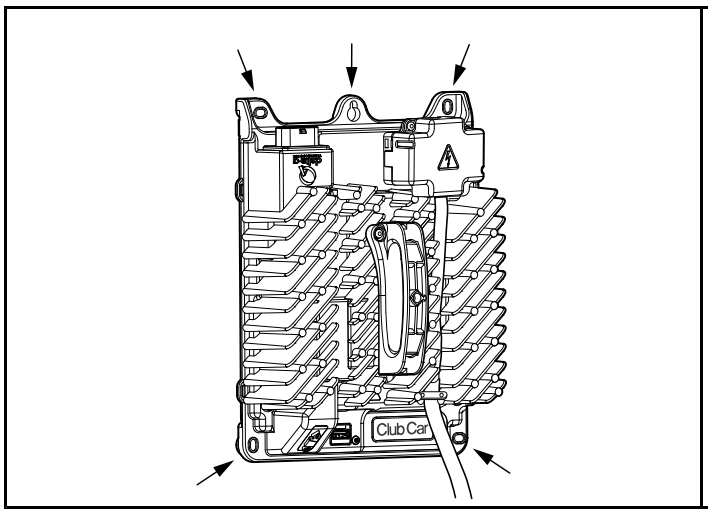


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Figure 16-2 Charger Mounting Holes

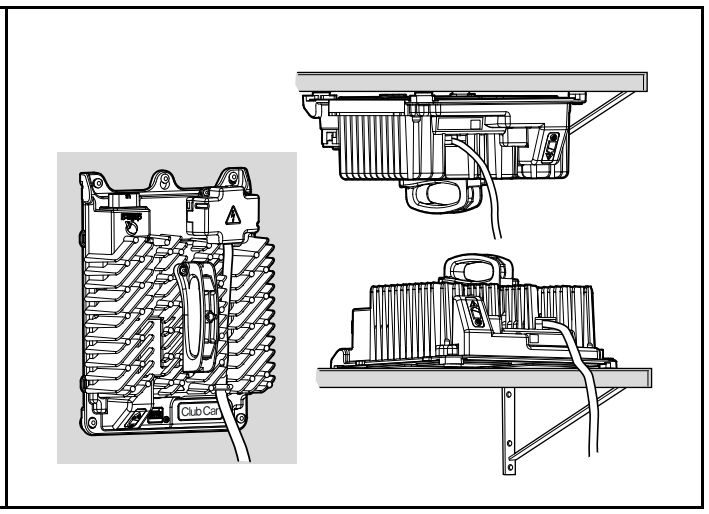

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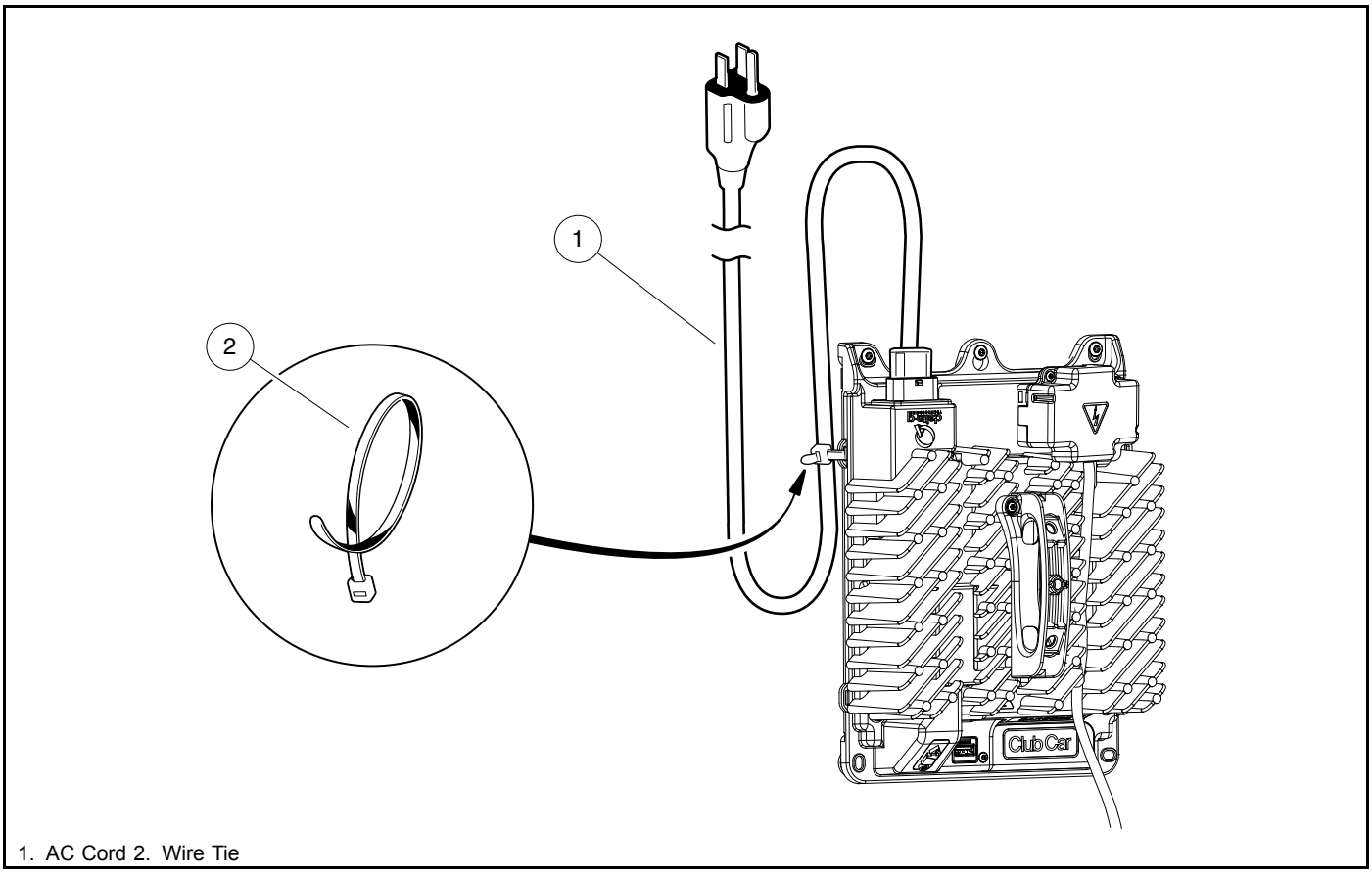
Figure 16-3 Examples of Charger Mounting Orientation

When installing charger, incorporate a "drip loop" in the AC cord to prevent water from running down the cord and into the AC cord receptacle on the charger **(Figure 16-4, Page 16-7)**.



1. AC Cord 2. Wire Tie

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Figure 16-4 AC Cord Drip-Loop Example

AC POWER CONNECTION

⚠ WARNING

- **Install surge arrestors on incoming AC power lines. Surge arrestors will help protect electrical components in the charger and on the vehicle from all but direct or close lightning strikes.**
- **Two high-frequency chargers can share a circuit, which should be a dedicated 15 or 20 ampere separately protected (circuit breaker or fuse) single-phase branch circuit that complies with all applicable electrical codes for the location.**
- **Connect the charger AC supply cord to a properly grounded, three-wire outlet within the voltage and frequency range shown on the charger.**
- **Do not use an adapter to plug the charger with a three-prong plug into a two-prong outlet. Improper connection of the equipment-grounding conductor can result in a fire or an electrical shock.**
- **Place all cords so they will not be stepped on, tripped over, or otherwise subjected to damage or stress.**

NOTE: *Make sure that the AC cord provided with your charger has the proper AC plug for your location. If it does not, contact your Club Car representative to obtain the proper cord or plug.*

Two of these high-frequency chargers can be used on a dedicated 15 or 20 ampere, single-phase branch circuit. This high-frequency charger caps current draw at 6 amps and will operate at full power if the voltage is within the 100 to

240 VAC and 50 to 60 Hz ranges. The charger also will function outside of those ranges (down to 85 VAC and 40 Hz, up to 270 VAC and 70 Hz) although charging times will be longer. Outside of the 85 to 270 VAC and 40 to 70 Hz ranges, the charger will not operate.

To reduce the risk of electric shock, the battery charger must be grounded. The charger is equipped with an AC electric cord having an equipment-grounding conductor and a grounding type plug. The AC plug must be connected to an appropriate receptacle that is properly installed and grounded in accordance with the National Electrical Code and all local codes and ordinances.

The use of an extension cord with the charger should be avoided. If one must be used, heed the following WARNING.

⚠ WARNING

- **An extension cord or electrical outlet must accept a three-prong plug. The extension cord should be a three-wire No. 12 AWG (American Wire Gauge) or no. 14 (British Standard Wire Gauge), and be as short as possible (no more than 12 feet (3.7 m). The use of an improper extension cord could result in fire or an electrical shock.**

THE CHARGE CIRCUIT

External Charger: The charge circuit consists of the charger receptacle, interlock wire, controller, solenoid and battery pack **(Figure 16-5, Page 16-8)**.

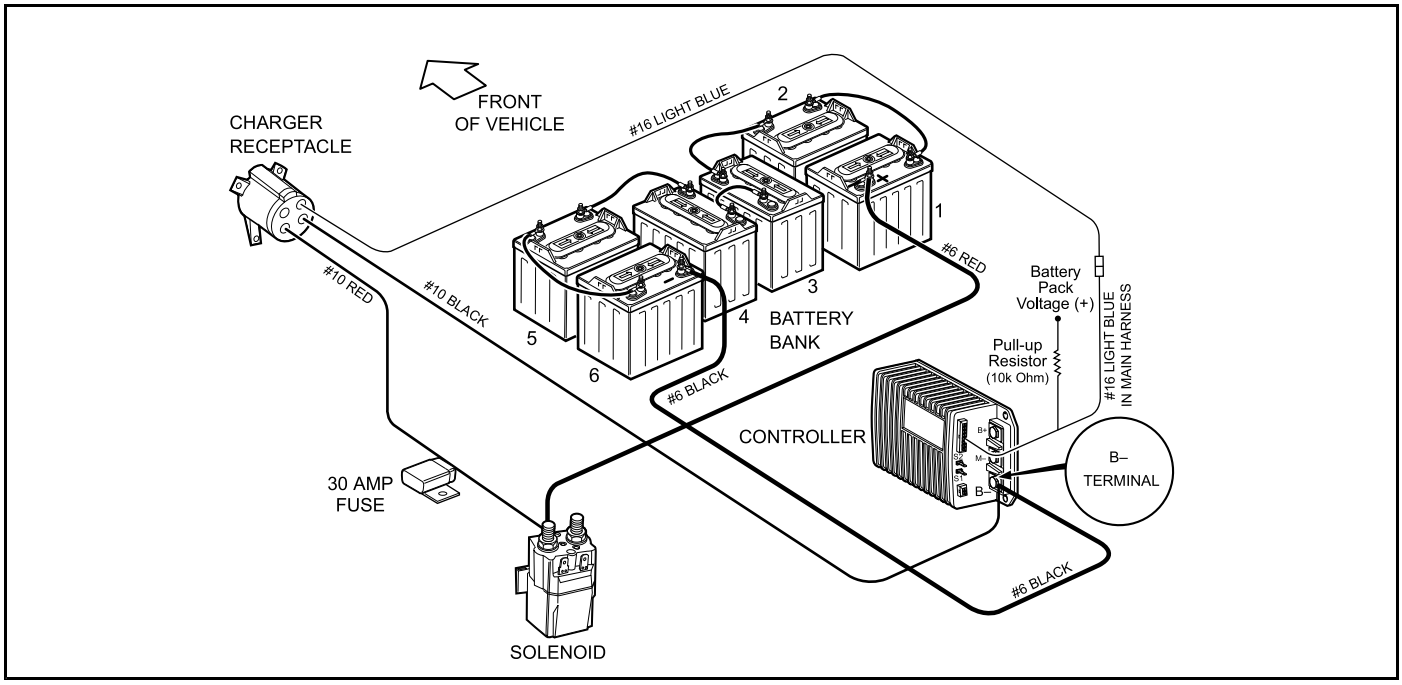

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Figure 16-5 Charge Circuit – External High-Frequency Charger

CHARGER OPERATION

CHARGING BATTERIES

See Dangers and Warnings beginning on page 16-1.

⚠ WARNING

- **Be sure all wire connections at the receptacle are clean and tight.**
- **Do not rock or bend the plug. To connect the charger plug to the vehicle receptacle, grasp the plug handle and push the plug straight into the receptacle (Figure 16-6, Page 16-11).**
- **Do not pull on the DC cord (Figure 16-7, Page 16-11). Do not twist, rock or bend the plug. To disconnect the charger plug from the vehicle receptacle, grasp the plug by the handle and pull the plug straight out of the receptacle.**
- **Do not connect a charger to the receptacle if the charger cord, plug, or the vehicle receptacle is broken, damaged in any manner, or does not make a good electrical connection. Fire or personal injury can result. Have it replaced by a qualified service person immediately. Failure to follow these instructions could result in damage to the charger cord, the plug, and (or) the vehicle receptacle.**
- **Do not attempt to charge frozen batteries or batteries with bulged cases. Discard the battery in accordance with all environmental laws or return to an authorized Club Car dealer. Frozen batteries can explode.**
- **Do not use a charger if any of the following conditions exist:**
  - **The plug is too loose or does not make a good connection.**
  - **The plug and receptacle feel hotter than normal during charge.**
  - **The plug pins or receptacle contacts are bent or corroded.**
  - **The plug, receptacle, or cords are cut, worn, have any exposed wires or are damaged in any way.**
- **Using the charger with any of the above symptoms could result in a fire, property damage, personal injury, or death.**

CAUTION

- **On all vehicles, turn off all accessories before charging batteries.**
- **The battery charger provided with this vehicle is approved for use only with the battery type originally shipped with the vehicle. Using a different battery type (different brand, different capacity, etc.) can cause under or overcharging and subsequent battery damage unless the charger is first reprogrammed with a new charging algorithm. Club Car only recommends OEM replacement batteries. Contact your authorized Club Car dealer/distributor with any questions about battery and charger compatibility or algorithm updates.**

NOTE: *Unlike the PowerDrive family of chargers, battery pack voltage does not have to be above 32 volts for charging to begin.*

When temperatures fall below 65 °F (18.3 °C), batteries charged in unheated areas should be placed on charge as soon as possible after use. Batteries are warmest immediately after use, and cold batteries require more time to fully charge.

Batteries should be put on charge even if they have been used for only a short period.

Because the charger has a storage charge feature that automatically checks and recharges the batteries as necessary, the charger can remain plugged to the vehicle throughout the storage period. ***See Storage, Section 3, Page 3-3.***

Vehicles should be restricted to 40 to 50 amp hours of discharge between charges until the batteries have been properly seasoned (50 to 70 charge cycles). For maximum battery life, Club Car recommends that electric vehicles always be recharged after 40 to 50 amp hours of discharge or each night in order to avoid deeply discharging the batteries. To detect amp-hour discharge, use the IQDM diagnostic tool (CC P/N 102248803).

Battery Charging Procedure

1. **External Chargers:** With the charger DC cord disconnected from the vehicle charger receptacle, insert the charger AC plug into a dedicated and properly wired AC outlet. Connect a maximum of two chargers per dedicated circuit.

   Onboard Chargers: Insert the onboard charger AC plug into a dedicated and properly wired AC outlet to begin a charge cycle. Connect a maximum of two chargers per dedicated circuit.

2. **External Chargers:** Insert the charger DC cord plug into the vehicle receptacle to begin a charge cycle. When inserting the plug, align the raised guide on the plug with the guide slot in the receptacle and push straight in slowly **(Figure 16-6, Page 16-11)**.
3. **External Chargers:** The charger will turn on two to five seconds later, after the charger interlock function activates. The charger interlock remains activated and prevents operation of the vehicle until the DC cord is disconnected from the vehicle. **See following NOTE.**

   Onboard Chargers: The charger will turn on two to five seconds later, after the charger interlock function activates. The charger interlock remains activated and prevents operation of the vehicle until the AC cord is disconnected from the AC outlet. **See following NOTE.**

NOTE: *The dash-mounted charge indicator light will flash three times and the reverse buzzer simultaneously will sound three times to indicate charging has begun. The number of flashes and beeps can vary depending on the Beep Option setting.* ***See Beep Option, Section 12, Page 12-5.***

4. The charger monitors battery voltage, charge current and charge time to determine when the batteries are properly charged. The charger will shut off by itself and the entire battery-shaped green light will stop flashing and remain on. As long as the charger is allowed to shut off by itself, the batteries will be fully charged. Overcharging and undercharging will normally be prevented.
5. If the charger does not seem to be operating properly, or if the batteries seem weak, see Charger Troubleshooting on page 16-13. If troubleshooting does not solve the issue, contact your local Club Car distributor/dealer.

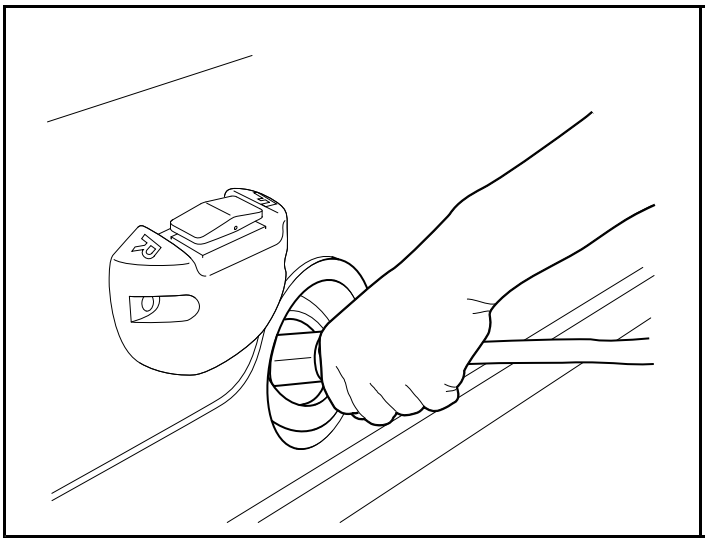

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Figure 16-6 Correct Insertion of External Charger DC Plug

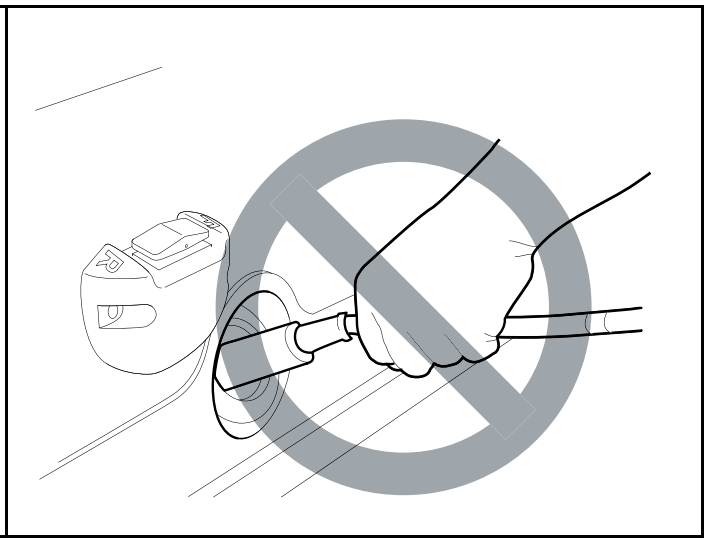

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Figure 16-7 Incorrect Removal of External Charger DC Plug

CHARGER MAINTENANCE

See General Warnings on page 1-2.

To ensure trouble-free performance, it is very important to follow an established preventive maintenance program. Regular and consistent maintenance can prevent vehicle downtime and expensive repairs that can result from neglect.

Any charger 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.

To perform all periodic service, see Periodic Maintenance on page 10-1.

To perform all troubleshooting, see Charger Troubleshooting on page 16-13.

To perform all repairs, see External Charger Repairs on page 16-19.

⚠ WARNING

- **If any problems are found during scheduled inspection or service, do not operate the vehicle until repairs are made. Failure to make necessary repairs could result in fire, property damage, severe personal injury, or death.**
- **Do not wear loose clothing or jewelry, such as rings, watches, chains, etc., when servicing the charger.**

- Do not expose charger to oil, dirt, mud or direct heavy water spray when cleaning vehicle.
- Keep all AC connections clean and dry.
- Keep all cooling fins clean.
- If the detachable input power supply cord set is damaged, replace with a cord that meets the following criteria:

For North America:	UL or CSA listed/approved detachable cord, 3 conductor, 16AWG minimum, and rated SJT; terminating in a grounding type IEC 60320 C14 plug rated 250V, 13A minimum.
For all other countries:	Safety approved detachable cord, 3 conductor, 1.5mm²; minimum, rated appropriately for industrial use. The cord set must be terminated on one end with a grounding type input connector appropriate for use in the country of destination and, on the other end, an output grounding type IEC 60320 C14 plug.

CHARGER TROUBLESHOOTING

See General Warnings on page 1-2.

⚠ DANGER

- **Do not touch any wire or component in the battery charger while AC power is present. Failure to heed this warning will result in an electric shock.**

⚠ WARNING

- **Knowledge of battery charger wiring and component terminology is required before attempting any repair. See The Charge Circuit on page 16-8.**
- **Prior to servicing the external charger, disconnect the DC plug from the vehicle charger receptacle and the AC power supply cord from the wall outlet.**

NUMBERING VEHICLES AND CHARGERS

Return the vehicles to the same charger each night if possible. If the vehicles are put in a storage facility at random and a vehicle dies while in use and testing shows the batteries are sound, then the problem is most likely with the charger. However, finding the problem charger may prove to be quite time consuming. Numbering the vehicles and the chargers and returning each vehicle to its designated charger each night can significantly reduce the amount of time spent troubleshooting a problem.

USB SERVICE PORT

NOTE: *The triangular charge status light doubles as the USB light. Flashing green means data transfer from the USB is occurring. Solid green means data transfer is complete.*

Use the USB service port for charging algorithm updates, software updates and troubleshooting.
To use the port, pull the cover from the port and insert a USB flash drive.
To update charger: With update file already on flash drive, insert drive into charger and let charger find file and update itself.
To download from charger: Insert an empty flash drive into charger and let charger write charge history file to it.
When finished, reinstall the cover.

INCOMING AC SERVICE

Make sure the incoming AC line service is sufficient. If circuit breakers are tripping, fuses blow during the night or the charger does not give the required starting rate when sound batteries are put on charge, an AC line problem exists. The electrical service to the vehicle storage facility should be sufficient to deliver adequate voltage and current to each charger with all the chargers turned on. If not, consult your local power company or electrical contractor.

TERMINAL BLOCK COVER

The terminal block cover prevents water exposure and prevents a short across the terminals, which will blow the 30-amp fuse in the charger receptacle wire harness.

RESETTING POWER – EXTERNAL CHARGER

The triangular status indicator light on the charger comes on in a solid red state to communicate a significant charger hardware or software failure. **See Charger Status Indicators on page 16-4.** Before replacing the charger, however, reset the charger in case the failure was caused by a temporary situation. To reset charger power, take the following steps:

1. Unplug the DC cord from the vehicle.
2. Unplug the AC cord from the AC power source.
3. Wait for the red light to go off, wait 30 seconds, then plug the AC cord into the AC power source.
4. When the blue AC status indicator light comes on, connect the DC cord to the vehicle.
5. If the triangular status indicator light comes on, contact your Club Car dealer. If the light does not come back on, attempt to charge the car as usual.

RESETTING POWER – ONBOARD CHARGER

The triangular status indicator light on the charger comes on in a solid red state to communicate a significant charger hardware or software failure. **See Charger Status Indicators on page 16-4.** Before replacing the charger, however, reset the charger in case the failure was caused by a temporary situation. To reset charger power, take the following steps:

1. Unplug the AC cord from the AC power source.
2. Disconnect the DC cord under the rear-facing seat.
3. Wait for the red light to go off, wait 30 seconds, then plug the AC cord into the AC power source.
4. When the blue AC status indicator light comes on, reconnect the DC cord under the rear-facing seat.
5. If the triangular status indicator light comes on, contact your Club Car dealer. If the light does not come back on, attempt to charge the vehicle as usual.

CHARGER TROUBLESHOOTING INDICATORS

If a fault occurs, count the number of red flashes (on the charger or dash) between pauses and refer to the table below:

HIGH-FREQUENCY BATTERY CHARGER TROUBLESHOOTING GUIDE				
CHECK STATUS INDICATOR LIGHT	**STATUS**	**STATUS EXPLANATION**	**POSSIBLE CAUSES** (check in order shown)	**SOLUTIONS**
	OFF	AC power to charger is NOT present.	1. AC cord connection	Unplug and inspect AC cord. Reconnect and attempt to charge again.
			2. AC power supply was shut off	Verify AC power is present and charge again. **See AC Power and Continuity Test of AC Circuit on page 16-17.**
			3. AC circuit breaker is tripped	Reset AC circuit breaker and charge again.
			4. Improper AC outlet voltage	Test AC outlet voltage and correct if necessary. **See AC Power and Continuity Test of AC Circuit on page 16-17.**
			5. Failed AC plug or cord	Replace cord. **See AC Power and Continuity Test of AC Circuit on page 16-17.**
	Flashing orange	Charger unable to complete charge. (Usually not related to charger itself. Something occurred to prevent the charger from completing the charge. Check external factors first.)	1. Erroneous event (an unknown variable; something occurred to the charger or vehicle that was not the fault of either)	Reset charger power. **See Resetting Power – External Charger on page 16-14.** Reconnect DC cord to vehicle. If status goes away, continue using charger.
			2. Battery high voltage	Ensure battery set is rated 48 volts and composed of 24 cells. **See Battery Voltage Using Multimeter on page 16-16.** If not, replace with correct battery set. Reset charger power. **See Resetting Power – External Charger on page 16-14.**
			3. Battery low voltage	Ensure battery set is rated 48 volts and composed of 24 cells. Also, check the voltage of each individual battery. **See Battery Voltage Using Multimeter on page 16-16.** If not, replace with correct battery set. Reset charger power. **See Resetting Power – External Charger on page 16-14.**
			4. Charge timeout caused by battery pack not reaching required voltage.	Check for loose or corroded connections. Check for old or defective batteries. **See Test Procedures on page 16-16.**
			5. Bad battery pack	Test battery pack health. Look for shorted or damaged cells. **See Battery Condition Using Charger on page 16-17. See also Batteries: Electric Vehicle with ERIC Charging on page 15-1.**
			6. AC voltage out-of-range	Test and inspect incoming AC power. **See AC Power and Continuity Test of AC Circuit on page 16-17.**
			7. Ambient temperature too hot (above 104 °F (40 °C))	Check for dirty, obstructed, or damaged cooling fins. Clean if necessary and ensure sufficient cooling air flow. Chargers stacked on top of or located too close to each other. Move chargers farther apart. If issue continues, wait for ambient temperature to cool or relocate charger to a cooler environment.
			8. Ambient temperature too cold (below -40 °F (-40 °C))	Wait for ambient temperature to warm or relocate charger to a warmer environment.

TABLE CONTINUED ON NEXT PAGE

HIGH-FREQUENCY BATTERY CHARGER TROUBLESHOOTING GUIDE				
			9. Bad DC connection	Inspect charger receptacle, receptacle harness connections and DC cord connection to charger. **See DC Plug and Receptacle on page 16-16. See Charger DC Circuit Continuity Test on page 16-18.**
			10. Corroded or loose connections	Clean or tighten connections.
	Solid red	Charger error	1. Charger abnormality	Reset charger power. **See Resetting Power – External Charger on page 16-14.** Reconnect DC cord to vehicle. If status goes away, proceed to charge again. **See Charger Output Test on page 16-18.** If status occurs again during the next charge cycle, attempt to charge with another identical charger. If charge is successful, proceed to step 2. If status occurs again, troubleshoot the AC power supply, vehicle and battery pack.
			2. Charger internal fault	Replace charger.

TEST PROCEDURES

See General Warnings on page 1-2.

When the upper green light is flashing, indicating the charger is in finish charge, it is okay to begin a battery discharge test if so desired.

Index of Test Procedures

1 – Battery Voltage Using Multimeter
2 – DC Plug and Receptacle
3 – Battery Condition Using Charger
4 – On-Charge Battery Voltage Using Charger And Multimeter
5 – AC Power and Continuity Test of AC Circuit
6 – Charger DC Circuit Continuity Test
7 – Charger Output Test

TEST PROCEDURE 1 – Battery Voltage Using Multimeter

1. Check battery pack voltage. **See Measuring Voltage of Battery Set, Section 15, Page 15-2.**
2. Normal no-load voltage should be between 50 and 52 volts for a fully charged battery set. Normal no-load voltage of an individual battery should not be less than 0.7 volts of the other 5 batteries (for 6 x 8-volt battery set).

TEST PROCEDURE 2 – DC Plug and Receptacle

1. Check the DC plug and the vehicle charger receptacle for damage, dirt, corrosion, bent pins or any condition that might prevent a sound electrical connection. **See Plug and Receptacle on page 16-3.**
2. Inspect the receptacle contacts to ensure that they are not damaged and they are firmly seated within the receptacle. **See Plug and Receptacle on page 16-3.**
3. Check the wire connections from the charger receptacle.
   3.1. Verify that the 10-gauge red wire from the charger receptacle is connected to the large post of solenoid with 6-gauge red wire **(Figure 16-5, Page 16-8)**.
   3.2. Verify that the 10-gauge black wire from the charger receptacle is connected to the B- terminal of controller.

3.3. Verify that the 16-gauge light blue wire from the charger receptacle is connected to the light blue wire bullet connector from the main wire harness.

4. With batteries connected, DC cord disconnected, and using a multimeter set to 200 volts DC, place the black (–) probe in the charger receptacle socket connected to the black 10-gauge wire and place the red (+) probe in the charger receptacle socket connected to the red 10-gauge wire. The reading should be 48 to 50 volts (full battery voltage).
5. If the reading is not 48 to 50 volts, check the following items:
   – The 30-amp fuse (located near solenoid) in the 10-gauge red wire of the charger receptacle harness.
   – Continuity of the 10-gauge red wire from the solenoid to the receptacle socket.
   – Continuity of the 6-gauge red wire from the positive post of battery no. 1 to the solenoid.

TEST PROCEDURE 3 – Battery Condition Using Charger

The easiest way to monitor the condition of a vehicle's batteries is simply to observe the Charger Status Indicators on the charger at the end of the charge cycle. After a full charge, disconnect the charger DC plug, wait 30 seconds and reconnect the charger DC plug. The battery-shaped status indicator will be green with the upper half flashing at first and then stay on continuously within 10 to 20 minutes, indicating sound, fully charged batteries. **See Charger Status Indicators on page 16-4.**

NOTE: *Batteries near the end of their useful lives may not allow the battery charge current to taper and the upper half of the battery-shaped status indicator will continue to flash.* ***See Section 15 – Batteries: Electric Vehicle with ERIC Charging.***

Continued poor performance may indicate a problem in the vehicle electrical system, brakes or battery charger. If the problem is not found in the vehicle or charging system, proceed to the on-charge voltage test. If the upper half of the battery-shaped status indicator does not stop flashing, the batteries should be tested further using the on-charge voltage test.

TEST PROCEDURE 4 – On-Charge Battery Voltage Using Charger And Multimeter

When the batteries are fully charged, disconnect the charger DC plug. Wait 20 to 30 seconds and reconnect the DC plug to restart the charger. After 5 minutes, use a multimeter to check and record the voltage of the battery set as well as the individual batteries. Set the multimeter to 200 volts DC. Place the red (+) probe on the positive (+) post of battery no. 1 and the black (–) probe on the negative (–) post of battery no. 6 (for 6 x 8-volt battery set). Record reading. Then set multimeter to 20 volts DC and place the red (+) probe on the positive (+) post and the black (–) probe at the negative (–) post of each battery. Record the readings.

The on-charge voltage for the set should be between 56.0 and 63.0 volts depending on the age and state of charge of the batteries being tested.

Old batteries may have enough capacity left to last several more months.

TEST PROCEDURE 5 – AC Power and Continuity Test of AC Circuit

1. Disconnect AC cord from the wall outlet and DC plug from the vehicle receptacle.
2. Check the AC line fuse or circuit breaker in the storage facility.
3. With a multimeter set to 500 volts AC, check incoming AC voltage. Insert multimeter test probes into AC wall outlet; voltage should be between 85 and 270 volts. **See AC Input Voltage Detection on page 16-4.** If proper voltage is not present, have building wiring checked by a licensed electrical contractor.

4. If the charger will not power ON, check AC cord connections.
5. If the charger is connected correctly, check continuity of the AC cord wires.

TEST PROCEDURE 6 – Charger DC Circuit Continuity Test

1. Disconnect the AC cord from the wall outlet and the DC cord from the vehicle charger receptacle.
2. Remove DC terminal block cover. **See Terminal Block Cover Removal on page 16-19.**
3. Note polarity and loosen screws securing DC cord wires. Pull wires from DC terminals on charger.
4. Check continuity of the DC cord wires from plug pin to fork terminal.
5. When finished, attach DC cord white wire to positive terminal (+) and black wire to negative terminal (–) with torx screws. **See following NOTE.** Tighten torx screws to 39.8 in·lb (4.5 N·m).

NOTE: *The positive symbol (+) and negative symbol (–) are molded into the terminal block for easy identification.*

6. Install terminal block cover. **See Terminal Block Cover Installation on page 16-20.**

TEST PROCEDURE 7 – Charger Output Test

Without a Meter: Connect DC cord and start a charge cycle. If buzzer sounds three times, then charger is functioning. Both a confirmed connection with the charger and a rise in battery pack voltage are required for buzzer to sound three times. **See following NOTE.**

NOTE: *The number of flashes and beeps can vary depending on the Beep Option setting.* ***See Beep Option, Section 12, Page 12-5.***

With a Meter: A clamp meter can be used to measure current in the red battery cable (connected to the positive (+) post of battery no. 1) while charging. Current can reach just over 13-amps at the beginning of a charge session and taper down to approximately 5-amps near the end.

EXTERNAL CHARGER REPAIRS

See General Warnings on page 1-2.

⚠ WARNING

- **Knowledge of battery charger wiring and component terminology is required before attempting any repair (Figure 16-5, Page 16-8).**
- **Prior to servicing the charger, disconnect the DC plug from the vehicle charger receptacle and the AC cord from the AC outlet.**

NOTE: *This charger has no internals to service or repair. It only has a few external repairs that can be performed. If an internal component needs repair, the charger must be replaced.*

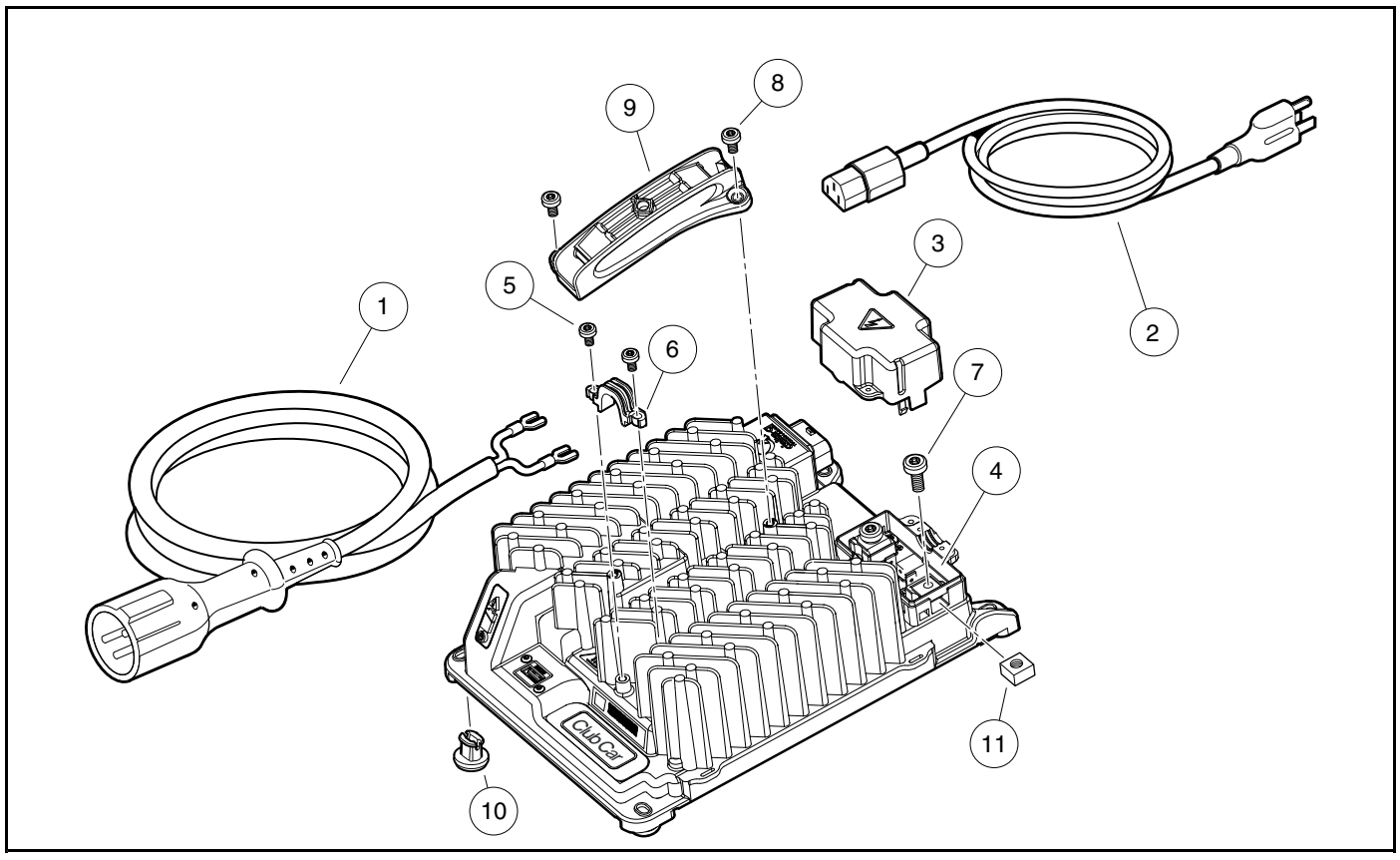

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Figure 16-8 External High-Frequency Charger Components

TERMINAL BLOCK COVER REMOVAL

1. Disconnect DC cord (1) from vehicle.
2. Disconnect AC cord (2) from AC outlet.
3. Push in mounting tabs **(Figure 16-9, Page 16-20)** to release cover (3) from terminal block (4).

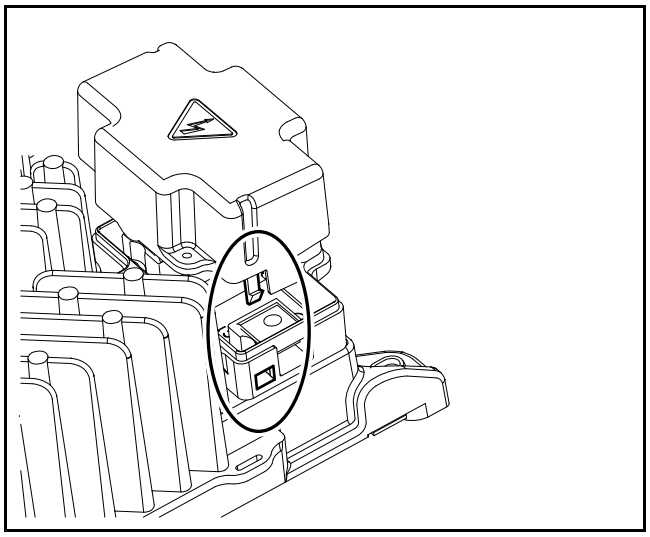

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Figure 16-9 Terminal Block Cover Mounting Tabs

TERMINAL BLOCK COVER INSTALLATION

⚠ WARNING

- **The terminal block cover (3) on the DC terminal block (4) must be installed properly to comply with UL code. This cover prevents water exposure and prevents a short across the DC terminals.**

1. Align cover (3) with terminal block (4) and push onto block until tabs lock into place.

DC CORD AND STRAIN RELIEF REMOVAL

1. Disconnect DC cord (1) from vehicle.
2. Disconnect AC cord (2) from AC outlet.
3. Remove two torx screws (5) securing strain relief (6) to charger.
4. Remove terminal block cover (3). **See Terminal Block Cover Removal on page 16-19.**
5. Remove torx screw (7) securing each DC cord wire to terminal block (4).

DC CORD AND STRAIN RELIEF INSTALLATION

1. Attach DC cord white wire to positive terminal (+) and black wire to negative terminal (–) with torx screws (7). **See following NOTE.** Tighten screws (7) to 39.8 in·lb (4.5 N·m).

NOTE: *The positive symbol (+) and negative symbol (–) are molded into the terminal block for easy identification.*

2. Install terminal block cover (3). **See Terminal Block Cover Installation on page 16-20.**
3. Secure strain relief (6) to charger with torx screws (5). Tighten screws (5) to 27 in·lb (3.1 N·m).

HANDLE REMOVAL

Remove torx screws (8) securing handle (9) to charger.

HANDLE INSTALLATION

Place handle (9) onto charger and seat it onto mounting bosses of charger. **See following NOTE.**

NOTE: *The handle (9) features locating tabs to aid installation.*

Secure handle (9) to charger with two torx screws (8). Tighten screws (8) to 39.8 in·lb (4.5 N·m).

FOOT REMOVAL

1. Disconnect DC cord (1) from vehicle.
2. Disconnect AC cord (2) from AC outlet.
3. If mounted, detach charger from shelf or wall.
4. Squeeze barbs on back side of foot (10) and push foot out of charger mounting tab. Repeat for other feet if necessary.

FOOT INSTALLATION

1. Push foot (10) into hole in charger mounting tab until the barbs come through and secure foot in place.
2. If required, mount charger to shelf or wall. **See External Charger Mounting on page 16-6.**

⚠ DANGER

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

⚠ WARNING

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

GENERAL INFORMATION

The Precedent Stretch and Golf 4Fun vehicles are equipped with a 48-volt DC, 3.7 horsepower, shunt-wound, reversible traction motor. Club Car recommends that motors requiring major repair be sent to a qualified motor repair shop; however, there are many relatively simple tasks that can be performed by a technician with general knowledge and experience in electric motor repair.

EXTERNAL MOTOR TESTING

The following tests can be performed without disassembling the motor using a multimeter or continuity tester.

NOTE: *Tag the motor wires for identification before disconnecting.*

Index of Test Procedures

1 – Internal Short Circuits
2 – Armature Circuit Open
3 – Field Circuit Open

TEST PROCEDURE 1 – Internal Short Circuits

See General Warnings on page 1-2.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries, Section 1, Page 1-3.**
2. Disconnect wires from terminals on motor using two wrenches to prevent posts from turning.
3. With a multimeter set to 200 ohms, place black (–) probe on motor housing. Scratch through paint to ensure a good connection. Place red (+) probe on A1, A2, F1, and F2 terminals respectively. Multimeter should indicate no continuity. If readings are incorrect, motor will need to be removed from the vehicle and repaired by a qualified technician. **See Motor Removal on page 17-2.**
   3.1. An incorrect reading from the A1 or A2 terminal indicates three possible problems: a grounded A1 or A2 terminal, a grounded wire in the brush area, or a grounded armature/commutator. An incorrect reading for the F1 or F2 terminal indicates a possible grounded F1 or F2 terminal or field coil.
4. Connect the batteries. **See Connecting the Batteries, Section 1, Page 1-3.**

TEST PROCEDURE 2 – Armature Circuit Open

See General Warnings on page 1-2.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries, Section 1, Page 1-3.**
2. Disconnect wires from the A1 and A2 terminals on the motor using two wrenches to prevent posts from turning. Set a multimeter to 200 ohms and place the red (+) probe on the A1 terminal and black (–) probe on the A2 terminal. The multimeter should indicate 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 motor will need to be removed from the vehicle and repaired by a qualified technician. **See Motor Removal on page 17-2.**
3. Connect the batteries. **See Connecting the Batteries, Section 1, Page 1-3.**

TEST PROCEDURE 3 – Field Circuit Open

See General Warnings on page 1-2.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries, Section 1, Page 1-3.**
2. Disconnect wires from the F1 and F2 terminals on the motor using two wrenches to prevent posts from turning. Set a multimeter to 200 ohms and place the red (+) probe on the F1 terminal and the black (–) probe on the F2 terminal. The multimeter should indicate continuity. If the reading is incorrect, a possible open field coil or bad connections at the terminals may be the cause. The motor will need to be removed from the vehicle and repaired by a qualified technician. **See Motor Removal on page 17-2.**
3. Connect the batteries. **See Connecting the Batteries, Section 1, Page 1-3.**

MOTOR REMOVAL

See General Warnings on page 1-2.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries, Section 1, Page 1-3.**
2. Disconnect wires from the terminals on the motor using two wrenches to prevent posts from turning. Label the wires to ensure proper assembly.
3. Place chocks at the front wheels.
4. Lift rear of vehicle and support on jack stands. **See Lifting Only The Rear, Section 3, Page 3-5.**
5. Remove both rear wheels.
6. Remove the nut, cup washer, and bushing from the bottom side of the shock absorber. Compress the shock absorber (pushing upwards) to move it out of the way **(Figure 17-1, Page 17-3)**.
7. Remove the nuts and bolts mounting the rear leaf springs to the shackles.
8. To gain easier access to the motor, lower the transaxle as low as it will go. If more room is needed, remove the jack from beneath the transaxle and allow the springs to rest on the floor **(Figure 17-1, Page 17-3)**.

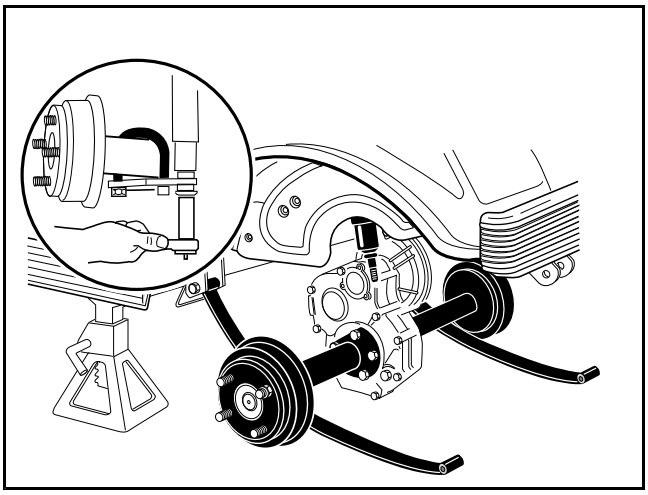


Figure 17-1 Lower Axle

9. Remove the four bolts that mount the motor to the transaxle **(Figure 17-19, Page 17-15)**. **See following CAUTION.**

⚠ CAUTION

- **Do not position fingers under motor when sliding motor off of the input shaft in step 9. Fingers may get pinched when motor disengages.**

10. Carefully slide the motor away from the transaxle until the motor spline disengages the input shaft and remove the motor from the vehicle.

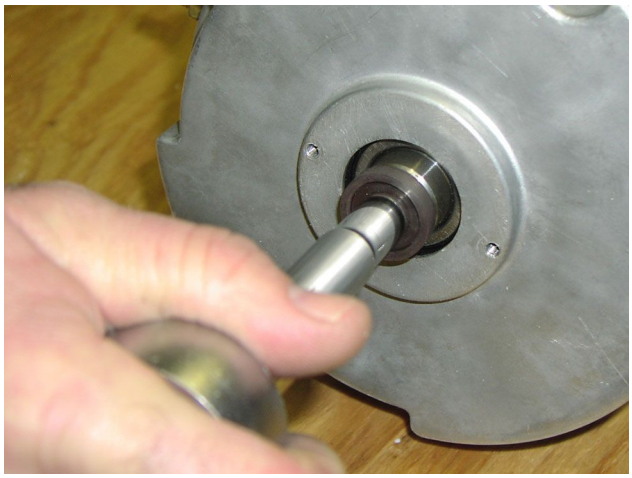


Figure 17-2 Speed Sensor Magnet

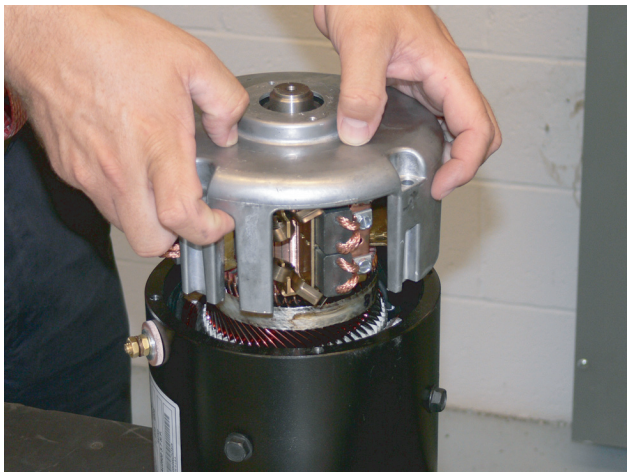


Figure 17-3 End Cap Removal

MOTOR DISASSEMBLY

1. Release the clasp and remove the headband assembly (21) from the motor. Visually inspect brushes and springs. **(Figure 17-11, Page 17-9)**.
2. Before continuing disassembly, place match marks on the motor end cap (20) and motor frame (14).
3. Remove speed sensor (10) and magnet (12).
   3.1. Remove the two screws (11) and clamp that secure the speed sensor (10) to the end cap (20).

3.2. Remove the bolt (13) securing the magnet (12) to the armature shaft (15). Hold the back of the armature assembly to keep it from turning as you remove the bolt.

3.3. Inspect the speed sensor magnet. **See Speed Sensor Magnet Inspection on page 17-8.**

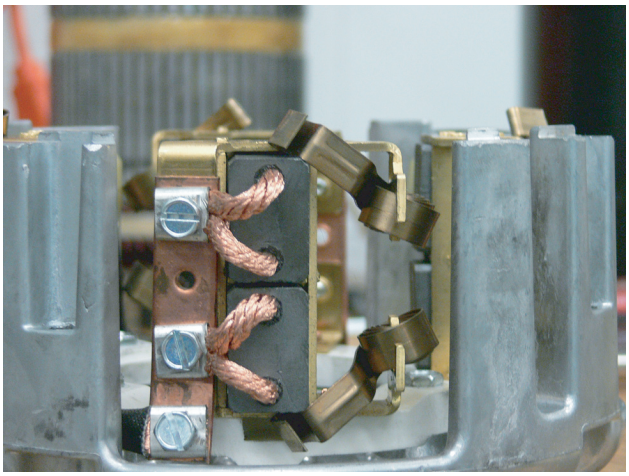


Figure 17-4 Brush Springs Positioning

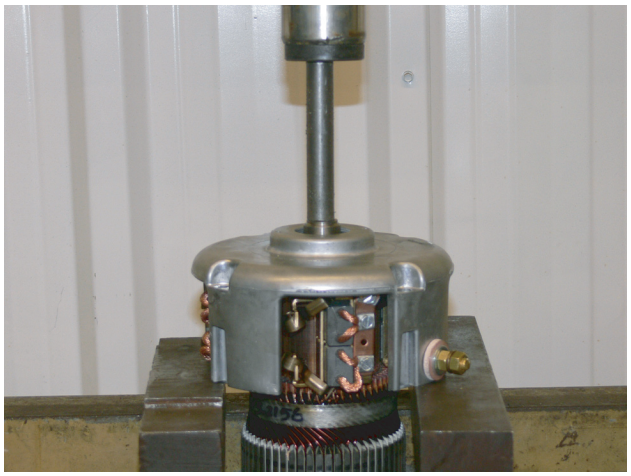


Figure 17-5 Armature Removal

4. Orient the motor so that the splined end of the armature is facing down.
5. Remove the four end cap bolts. The weight of the motor housing will cause it to drop when the bolts are removed. See following Caution.

⚠ CAUTION

- **The motor housing will drop when the bolts are removed. Do not put fingers under the motor housing when removing bolts.**

6. Remove the end cap and armature from the motor frame **(Figure 17-3, Page 17-3)**.
7. Inspect the brush springs for proper tension. **See Motor Brush, Spring, and Terminal Insulator Inspection on page 17-7.**
8. Remove the armature from the end cap bearing. **See following CAUTION and NOTE.**

⚠ CAUTION

- **Removing the armature from the end cap requires two people: one to operate the press, and another to hold the armature. Failure to heed this CAUTION could result in personal injury and/or damage to the armature resulting from an unsupported armature falling after it becomes disengaged from the end cap bearing.**

NOTE: *Replacement of the end cap bearing is recommended if the armature is removed.*

8.1. Position the brush springs to reduce tension during removal of the armature. **(Figure 17-4, Page 17-4)**.

8.2. Place the end cap in a press with the armature facing down.

8.3. Place a bearing press tool with an outer diameter smaller than that of the armature shaft between the press ram and the armature shaft **(Figure 17-5, Page 17-4)**.

8.4. Have an assistant support the armature while the press is activated.

9. Inspect the armature for wear and damage. **See Armature Inspection and Testing on page 17-6.**
10. Inspect the motor frame and field windings. **See Motor Frame and Field Windings Inspection on page 17-7.**

11. Remove the brush rigging.
    11.1. Mark the brush terminal posts (A1 and A2).
    11.2. Remove the two nuts securing the brush terminals (A1 and A2) to the end cap.
    11.3. Remove the four bolts and the brush rigging from the end cap **(Figure 17-6, Page 17-5)**.
12. Inspect the terminal insulators. **See Terminal Insulator Inspection on page 17-8.**
13. Remove the bearing from the end cap.
    13.1. Remove the retaining ring that secures the bearing in the end cap **(Figure 17-7, Page 17-5)**.
    13.2. Use an arbor press to remove the bearing from the end cap.
14. Inspect the bearing for wear and damage. **See Bearing Inspection on page 17-8.**

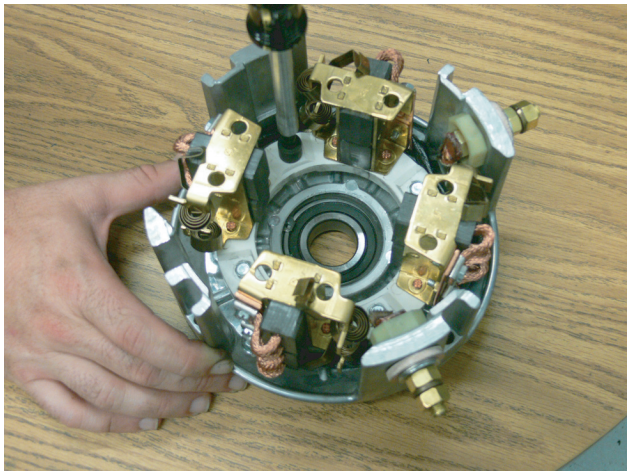


Figure 17-6 Brush Rigging Removal

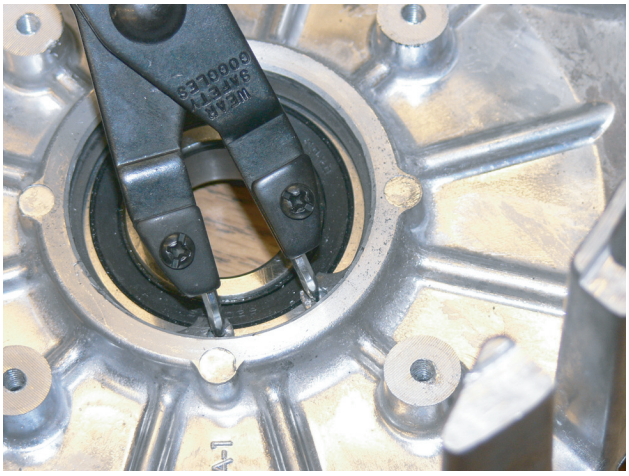


Figure 17-7 Retaining Ring Removal

MOTOR COMPONENT TESTING AND INSPECTION

See General Warnings on page 1-2.

ARMATURE INSPECTION AND TESTING

1. Remove the motor from the vehicle. **See Motor Removal, Section 17, Page 17-2.**
2. Remove the end cap and armature by performing steps 1 through 6 of Motor Disassembly on page 17-3.

Visual Inspection

- Burned, charred or cracked insulation
- Improperly cured varnish
- Thrown solder
- Flared armature windings
- Damaged armature core laminations
- Worn, burned or glazed commutators
- Dirty or oily commutators
- Raised commutator bars
- Worn armature bearing or shaft

A dirty or oily commutator should be cleaned and wiped dry. Abnormalities identified during the inspection can help determine original cause of failure. Slight roughness of the commutator can be polished smooth with 400 grit or finer sandpaper. **See following CAUTION and NOTE.**

CAUTION

- **Do not use emery cloth to polish 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.**

NOTE: *Oil on the commutator may indicate a faulty transaxle input shaft oil seal.*

Armature Ground Test

CAUTION

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

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

1. With a multimeter set to 200 ohms, place one probe on the commutator (1) and the other on the armature core (2). The multimeter should indicate no continuity ***(Figure 17-8, Page 17-7)***. If the reading is incorrect, replace the armature.

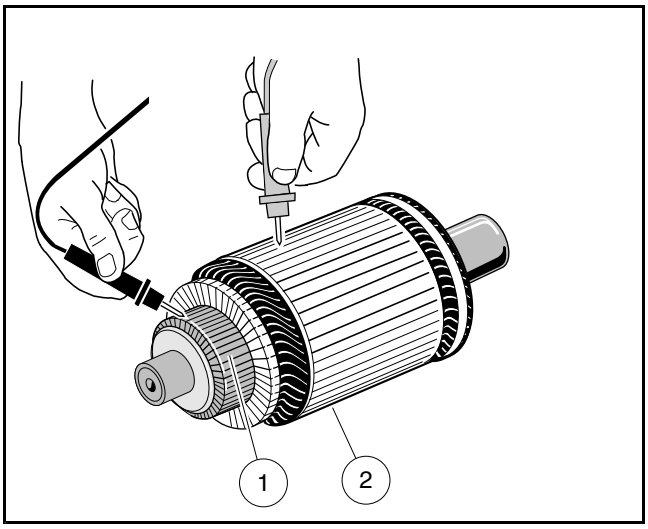


Figure 17-8 Armature Test

MOTOR FRAME AND FIELD WINDINGS INSPECTION

1. Remove the motor from the vehicle. **See Motor Removal, Section 17, Page 17-2.**
2. Remove the end cap and armature by performing steps 1 through 6 of Motor Disassembly on page 17-3.
3. Burned or scorched insulation on the field windings indicates the motor has overheated due to overloads or grounded or shorted coil windings. If the insulation on the field windings is scorched, replace the motor or the stator shell assembly.

MOTOR BRUSH, SPRING, AND TERMINAL INSULATOR INSPECTION

Brush Spring Tension Test

1. Remove the motor from the vehicle. **See Motor Removal, Section 17, Page 17-2.**
2. Release the clasp and remove the headband from the motor.
3. Inspect the brush springs (18) **(Figure 17-11, Page 17-9)**. Replace springs that are discolored from heat (light gold or blue tinted).
4. Test the brush springs for proper tension.
   - 4.1. Place a C-shaped steel plate (1) on a scale (2).
   - 4.2. Place the end of the C-shaped plate (1) so that it is between the spring and the brush.
   - 4.3. Gently pull the scale (2) to obtain the spring tension reading. **See following CAUTION.**

CAUTION

- **When checking brush spring tension, do not over-extend the spring. Using excessive force will damage the spring.**

4.4. Replace springs which require a force of less than 35 ozf. (990 gf.) **(Figure 17-9, Page 17-8)**. **See following NOTE.**

NOTE: *When installing new brushes, remove and replace brushes one at a time. This method ensures the terminals and brushes will be properly positioned in the rigging. Refer to* ***Motor Assembly on page 17-10*** *for brush installation.*

When replacing brushes, replace all four brushes. Never replace only two.

Install the brushes in the same rigging 180° apart from each other.

Brush Inspection

1. Remove the motor from the vehicle. **See Motor Removal, Section 17, Page 17-2.**
2. Release the clasp and remove the headband from the motor.
3. Inspect the brushes (16) for damage or excessive wear **(Figure 17-11, Page 17-9)**. Replace brushes if required. **See preceding NOTE.**
4. Use dial calipers or a micrometer to measure the brush length. The minimum-allowable brush length is 0.62 inches (16 mm). Replace the set of brushes as required. **See preceding NOTE.**

Terminal Insulator Inspection

1. Remove the motor from the vehicle. **See Motor Removal, Section 17, Page 17-2.**
2. Remove the terminal insulators by performing steps 1 through 11 of Motor Disassembly on page 17-3.
3. Inspect the insulators for cracks or other damage. Replace insulators as required.

Bearing Inspection

NOTE: *Replacement of the end cap bearing is highly-recommended if the end cap is removed from the motor. The following procedure is provided as a guideline for determining general bearing failure.*

1. Remove the motor from the vehicle. **See Motor Removal, Section 17, Page 17-2.**
2. Remove the bearing by performing steps 1 through 13 of Motor Disassembly on page 17-3.
3. Use a clean cloth to wipe the carbon dust off of the bearing. Inspect the bearing by spinning it by hand and checking for both axial (A) and radial (B) play **(Figure 17-10, Page 17-8)**.
4. Replace the bearing if it is noisy, does not spin smoothly, or has excessive play. Check the bearing and replace if rusted, worn, cracked, or if there is an abnormal color change in the metal of the bearing.

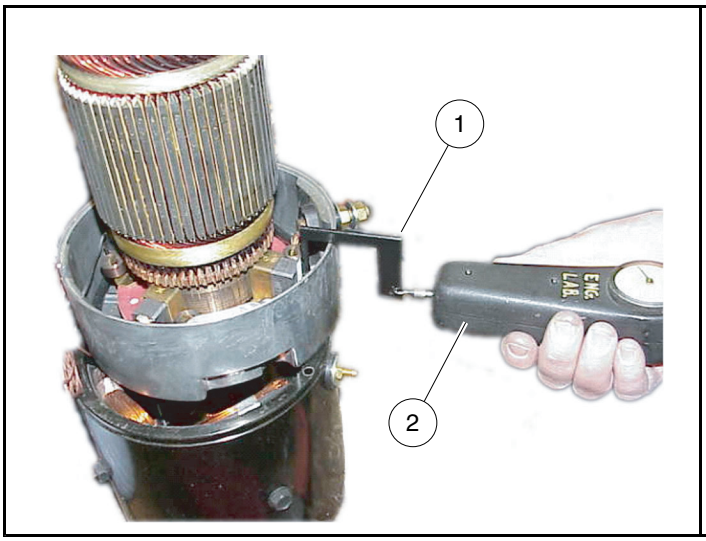


Figure 17-9 Brush Spring Tension Test

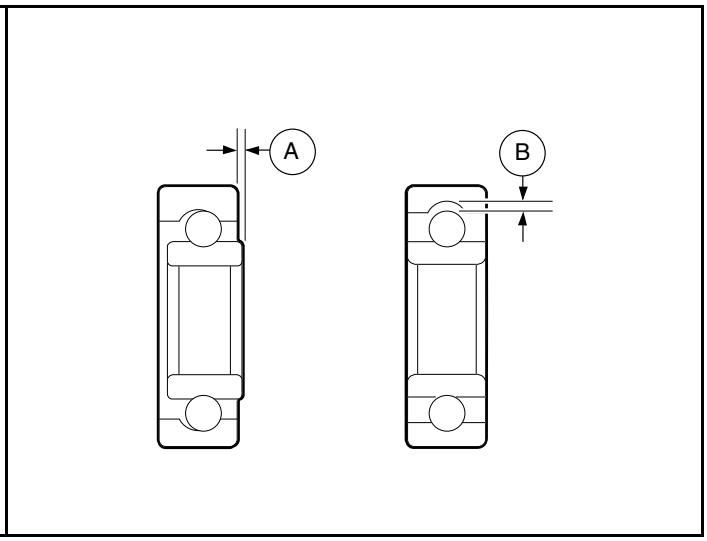


Figure 17-10 Bearing Inspection

Speed Sensor Magnet Inspection

Inspect the speed sensor magnet (12) for rust, wear, and cracks **(Figure 17-11, Page 17-9)**. Replace the magnet if necessary.

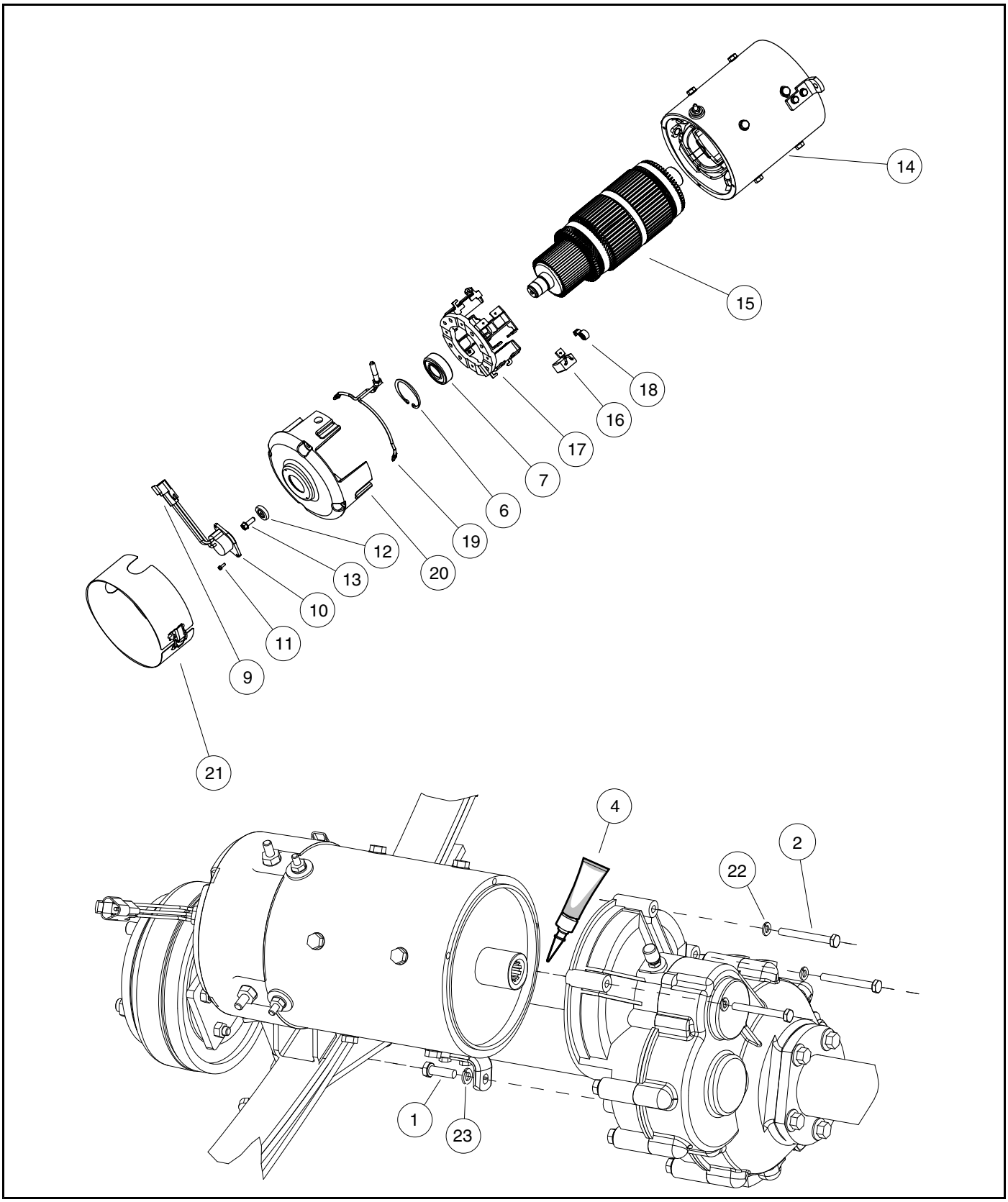


Figure 17-11 Motor

RECONDITIONING THE MOTOR

See General Warnings on page 1-2.

Motor reconditioning must be performed by a qualified motor repair technician. The use of proper tools and procedures is absolutely essential for successful motor reconditioning.

MOTOR SPECIFICATIONS

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

ITEM	SERVICE LIMIT
Commutator diameter (minimum)	2.80 in. (71.10 mm)
Commutator concentric with armature shaft within	0.003 in. (0.08 mm)
Bar to bar runout should not exceed	0.005 in. (0.013 mm)
Undercut of segment insulator after machining commutator	0.040 in. (1.0 mm)
Armature resistance at 75 °F (24 °C)	0.014 ohms between bars 1 and 15
Field resistance at 75 °F (24 °C)	0.55 ohms

MOTOR ASSEMBLY

See General Warnings on page 1-2.

1. Replace the bearing.
   1.1. Use an arbor press to install a new bearing into the end cap. To help avoid damaging the bearing, apply pressure only to the outer race when installing the bearing.
   1.2. Install the retaining ring to secure the bearing.
2. Install the brushes and brush rigging. **See following NOTE.**

NOTE: *When installing new brushes, remove and replace brushes one at a time. This method ensures the terminals and brushes will be properly positioned in the rigging.*

When replacing brushes, replace all eight brushes.

Install the brushes in the same rigging 180° apart from each other.

   2.1. Insert the brushes into the brush rigging as shown.
   2.2. Insert the two terminal posts through insulators in the end cap (20) wall at the A1 and A2 positions **(Figure 17-11, Page 17-9)**.
   2.3. Place external insulators and washers on each terminal post, and secure terminal with nuts. Tighten nuts to 100 in·lb (11.3 N·m). Ensure that the terminal posts do not rotate when tightening the nuts.
   2.4. Secure the brush rigging to the end cap with four bolts. Tighten the bolts to 25 in·lb (2.8 N·m).
   2.5. One at a time, push the brushes back until they are completely retracted into their mounting slots **(Figure 17-12, Page 17-11)**.

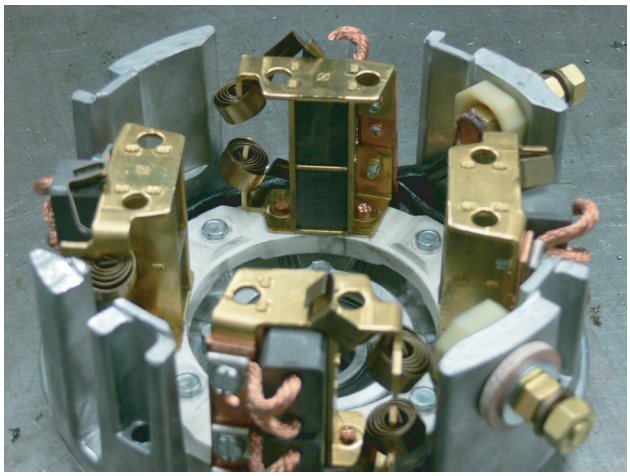


Figure 17-12 Retracted Brushes

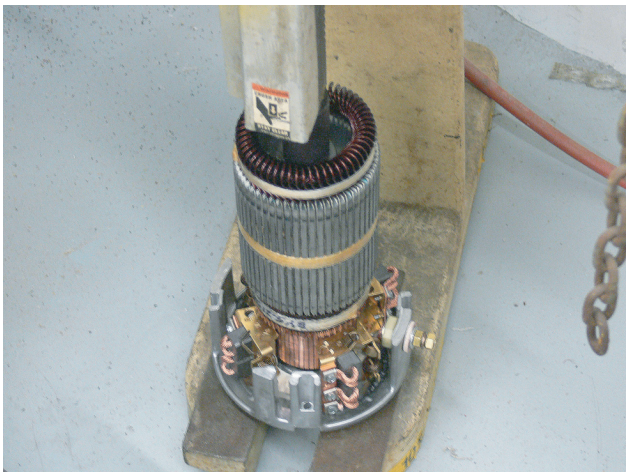


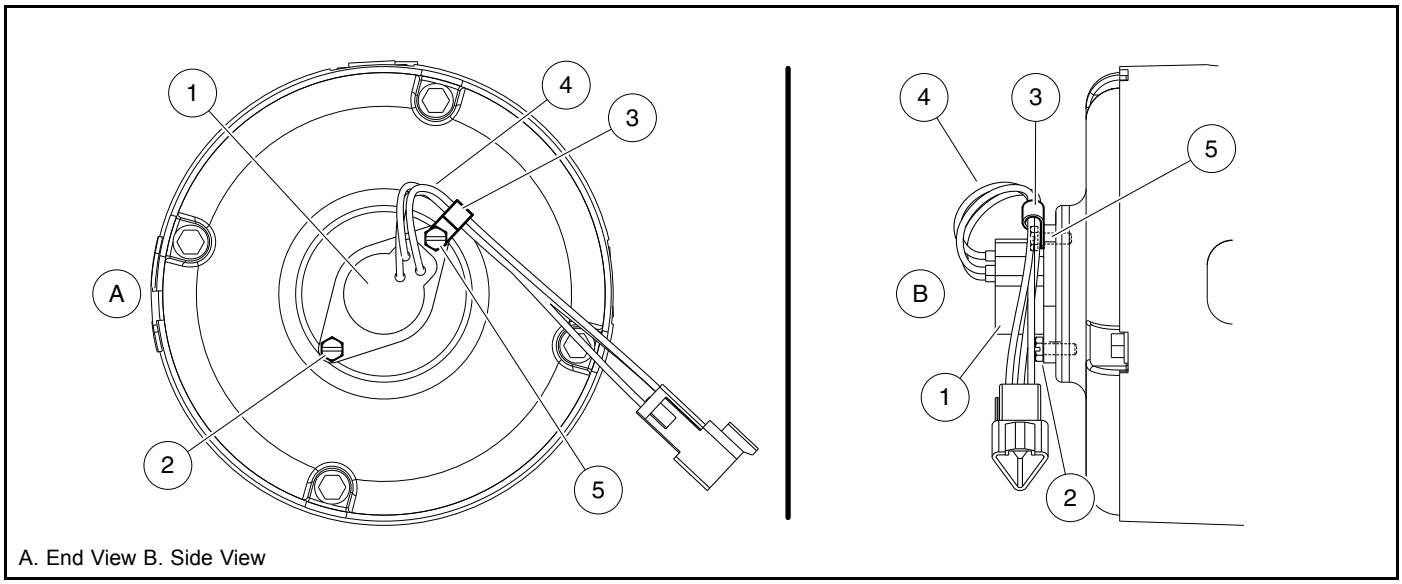
Figure 17-13 Armature Installation

3. With the brushes retracted, use an arbor press to press the armature shaft into the end cap bearing **(Figure 17-13, Page 17-11)**. **See following CAUTION.**

CAUTION

- **Make sure the brushes are held back. Do not allow the brushes to support the weight of the commutator. The brushes can be easily damaged by this weight.**

4. Move the springs back to their original position. Ensure that the spring rests on the end of each brush.
5. Align the match marks on the end cap (20) and the motor frame (14) and secure with four bolts **(Figure 17-11, Page 17-9)**. Tighten bolts to 130 in·lb (14.7 N·m).
6. Install the speed sensor magnet (12) with bolt (13). Tighten to 65 in·lb (7.3 N·m).
7. Install the speed sensor (1) with one screw (2) finger-tight **(Figure 17-14, Page 17-12)**.
8. Install clamp (3) onto sensor wires (4) and secure with other screw (5) finger-tight. Ensure clamp (3) and wires (4) are oriented as shown **(Figure 17-14, Page 17-12)**. Tighten both screws (2 and 5) to 20 in·lb (2.2 N·m).
9. Make sure the armature turns freely. If it does not turn freely, disassemble the motor to find the problem.



A. End View B. Side View

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Figure 17-14 Speed Sensor Clamp

MOTOR INSTALLATION

See General Warnings on page 1-2.

1. Clean the transaxle input shaft.
   1.1. Spray the input shaft thoroughly with CRC® Brakleen™ or equivalent brake cleaner degreaser.
   1.2. Wipe input shaft with a clean cloth.
   1.3. Inspect the grooves of the input shaft and remove any remaining debris.
   1.4. Repeat steps 1.1 through 1.3 until input shaft is clean.
2. Lubricate the transaxle input shaft.
   2.1. Squeeze approximately 1/2 inch (1.3 cm) of moly-teflon lubricant (CCI P/N 102243403) from tube onto a putty knife as shown **(Figure 17-15, Page 17-13)**.
   2.2. Rotate wheels to rotate input shaft.
   2.3. Apply motor coupling grease evenly to the rotating input shaft starting at approximately 1/8 inch (3.1 mm) from the end of the shaft and working back toward the transaxle (away from the end of the shaft) **(Figure 17-16, Page 17-13)**.
   2.4. The grease should be evenly distributed in the grooves to a width of approximately 3/8 inch (9.5 mm).
   2.5. Use a flat screwdriver to clean the grease out of one of the grooves and allow air to escape when the motor is pushed onto the input shaft.

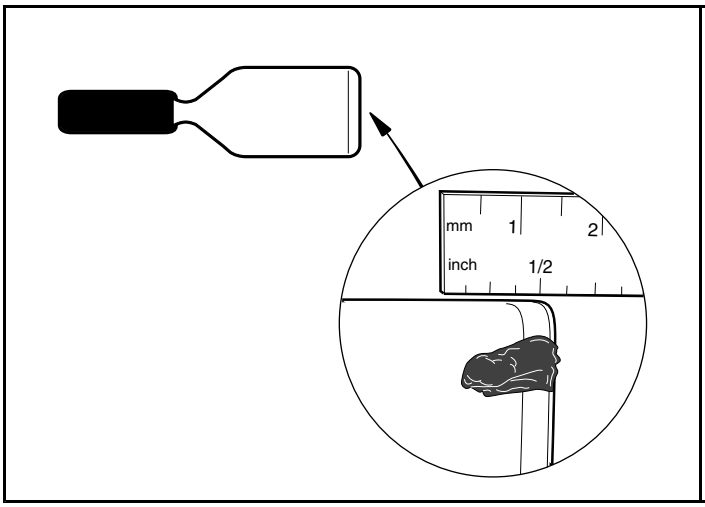


Figure 17-15 Grease on Putty Knife

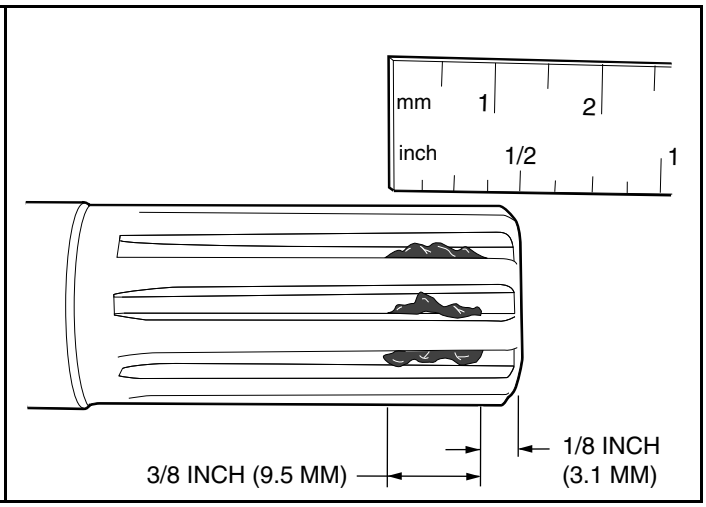


Figure 17-16 Application of grease to Input Shaft Grooves

2.6. Check the chamfer (1) and end (2) of the input shaft to ensure these areas are completely clean of grease as shown **(Figure 17-17, Page 17-14)**.

3. Install motor on transaxle.

3.1. Slide the motor coupling onto the transaxle input shaft. **See following NOTE.**

NOTE: *The coupling will push any excess grease on the input shaft along the shaft toward the transaxle.*

When the motor is pushed onto the input shaft, the motor housing will not bottom out against the transaxle housing. There will be approximately 1/16 inch (1.6 mm) gap between the motor adapter ring and transaxle housing as shown ***(Figure 17-18, Page 17-14)****.*

3.2. Loosely install the four bolts that secure the motor to the transaxle. Do not tighten.

3.3. Begin finger-tightening the bolts (1 and 2) in the sequence indicated **(Figure 17-19, Page 17-15)**. Continue tightening by hand until the motor is seated in the transaxle housing. **See following CAUTION and NOTE.**

CAUTION

- **Make sure the motor is properly seated in the transaxle housing.**

NOTE: *Failure to install and tighten the motor mounting bolts in the proper sequence and to the proper tightness may result in motor noise during operation.*

3.4. Tighten the right bolt (1) to 65 in·lb (7.3 N·m) **(Figure 17-19, Page 17-15)**.

3.5. Tighten the left bolt (2) to 65 in·lb (7.3 N·m) **(Figure 17-19, Page 17-15)**.

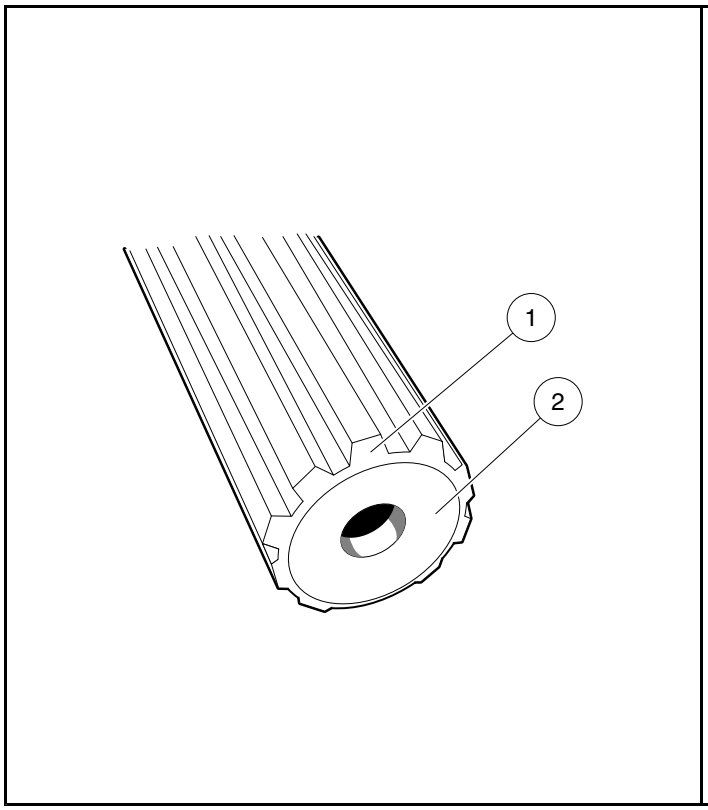
3.6. Tighten the center bolt (3) to 65 in·lb (7.3 N·m).

3.7. Tighten the bolt (4) inserted through the tab to 155 in·lb (17.5 N·m).

3.8. Install the motor wires, making sure they are connected to the correct motor terminals and that the terminal orientation is correct. **See Wiring Diagrams on page 13-4.** Tighten the terminal retaining nuts to 65 in·lb (7.3 N·m). Use a wrench on the bottom nuts to keep the terminals from moving.

3.9. Secure the white, orange, green, and blue wires with a wire tie so that none of the motor wires will scrub the motor or transaxle when the vehicle is in operation.

3.10. Connect the three-pin speed sensor plug to the vehicle wire harness.



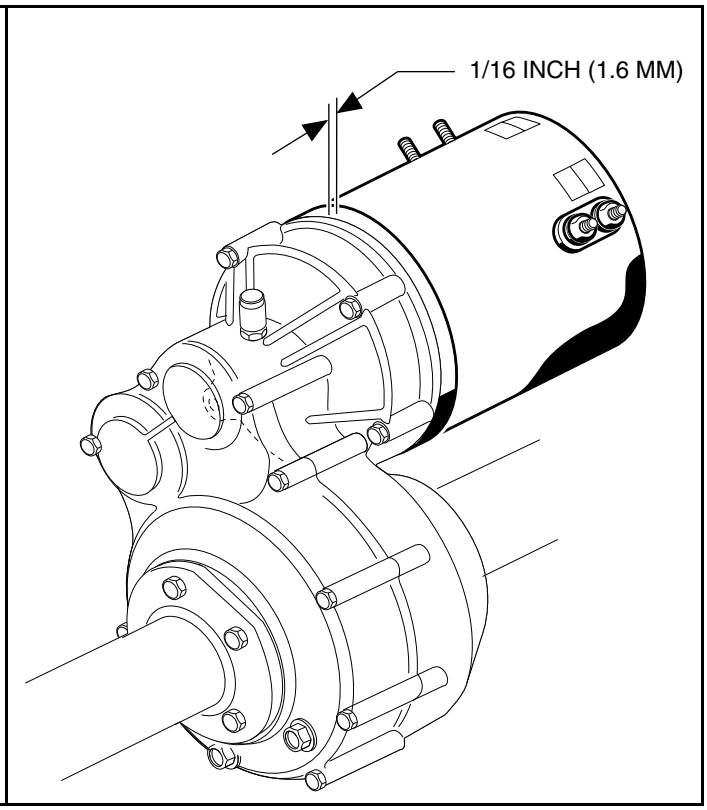


Figure 17-17 Clean Chamfer and Input Shaft End

Figure 17-18 Gap at Motor and Transaxle

4. If using a chain hoist, lower the vehicle and guide the leaf springs into the shackles. If using a floor jack, raise the transaxle until the leaf springs can be guided into the shackles.
5. Insert the mounting bolts through the spring shackles and the bushings in the leaf spring eyes and install locknuts. Tighten the bolts to 23 ft·lb (31 N·m). **See Rear Suspension Section.**
6. Install the shock absorbers. Tighten nut until rubber bushing expands to the diameter of the cup washer.
7. If removed, install wheels and finger tighten the lug nuts.
8. Lift vehicle and remove jack stands. Lower vehicle to the floor and tighten lug nuts, using a crisscross pattern. **See Wheel Installation, Section 8, Page 8-1.**
9. Connect the batteries. **See Connecting the Batteries, Section 1, Page 1-3.**
10. Place the Tow/Run switch in the RUN position.
11. Inspect the vehicle for proper operation. **See following WARNING.**

⚠ WARNING

- **Make sure that the vehicle operates in the forward direction when the Forward/Reverse switch is in the FORWARD position.**
- **Make sure that the vehicle operates in the reverse direction when the Forward/Reverse switch is in the REVERSE position. The reverse buzzer will sound as a warning when the Forward/Reverse switch is in REVERSE.**
- **Make sure that the vehicle does not operate when the Forward/Reverse switch is in the NEUTRAL position.**

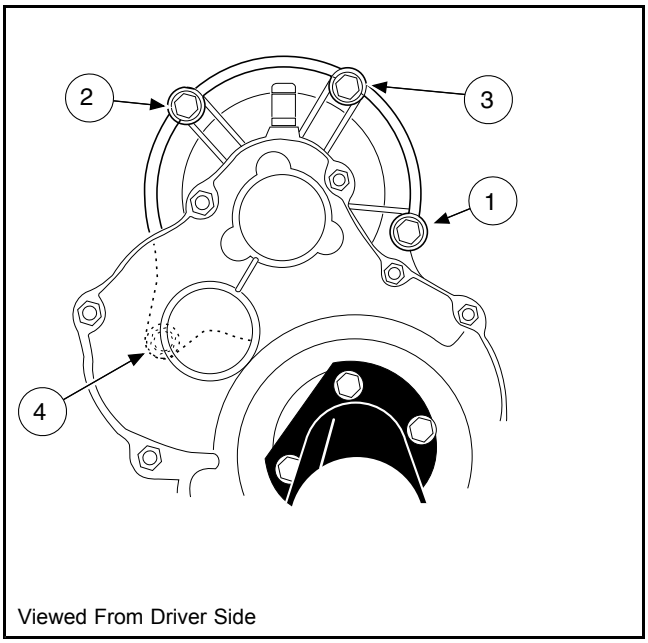


Figure 17-19 Motor Tightening Sequence

⚠ DANGER

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

⚠ WARNING

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

LUBRICATION

See General Warnings on page 1-2.

There are two plugs located on the lower half of the transaxle housing. The upper plug (21) (as viewed when the vehicle is on a level surface) is used as a lubricant level indicator **(Figure 18-5, Page 18-3)**. When the vehicle is parked on a level surface, the lubricant level should be even with the bottom of the hole. The lower plug (22) is for draining the lubricant. When draining the lubricant, the upper plug should be removed so the lubricant will drain faster. Be sure the drain plug is installed before filling. **See following NOTE.**

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

AXLE BEARING AND SHAFT

See General Warnings on page 1-2.

AXLE SHAFT

Axle Shaft and Oil Seal Removal

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries on page 1-3.**
2. Place chocks at the front wheels. Loosen lug nuts on 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. **See WARNING "Lift only one end..." in General Warnings on page 1-2.**
3. Remove the rear wheel and brake drum. See Section 6 – Wheel Brake Assemblies. See Section 8 – Wheels and Tires.
4. Use 90° internal snap ring pliers to remove the internal retaining ring (6) from the axle tube **(Figure 18-5, Page 18-3)**. **See also Figure 18-1, Page 18-2.**
5. Remove the axle, retaining ring, and bearing assembly by pulling the axle straight out of the housing.
6. If necessary, remove the axle oil seal and adapter ring.
   6.1. Use a bearing puller (P/N 1016417) to remove the axle seal and adapter ring from the axle tube **(Figure 18-2, Page 18-2)**. **See following CAUTION and NOTE.**

CAUTION

- **Do not scar or damage the inside surfaces of the tube when removing the oil seal and adapter ring. A damaged tube might have to be replaced.**

NOTE: *Do not discard the adapter ring. If the adapter ring is lost or damaged, the axle tube will have to be replaced. Varying rear axle configurations have been installed on vehicles. If replacing axle tubes, take note of individual axle tube lengths to ensure proper fit.*

6.2. Use a press to separate the axle oil seal (15) from the adapter ring (39) **(Figure 18-3, Page 18-2)**. Retain the adapter ring and discard the oil seal.

7. Inspect the axle shaft assembly to be sure the bearing and collar have not slipped and are still seated against the shoulder on the axle shaft.
8. Inspect bearing (5) **(Figure 18-5, Page 18-3)**. If the bearing in a Type G transaxle is worn or damaged, the entire axle shaft assembly (1 or 2) must be replaced.

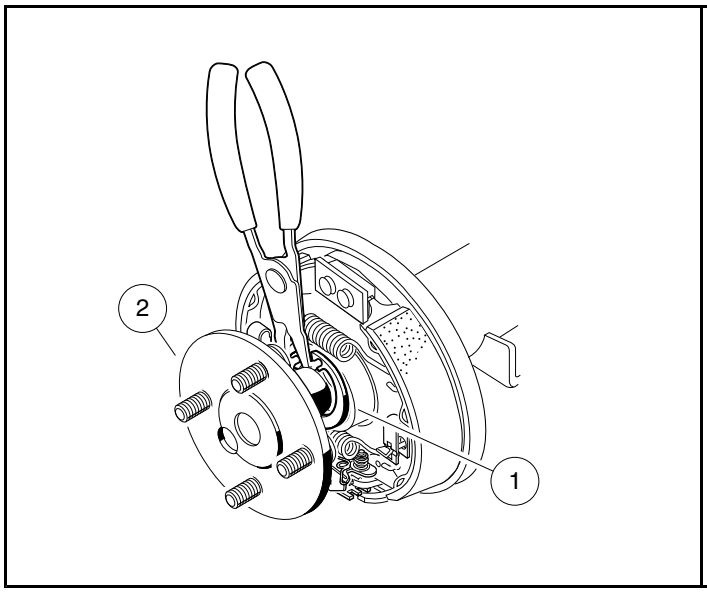


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Figure 18-1 Remove Internal Retaining Ring

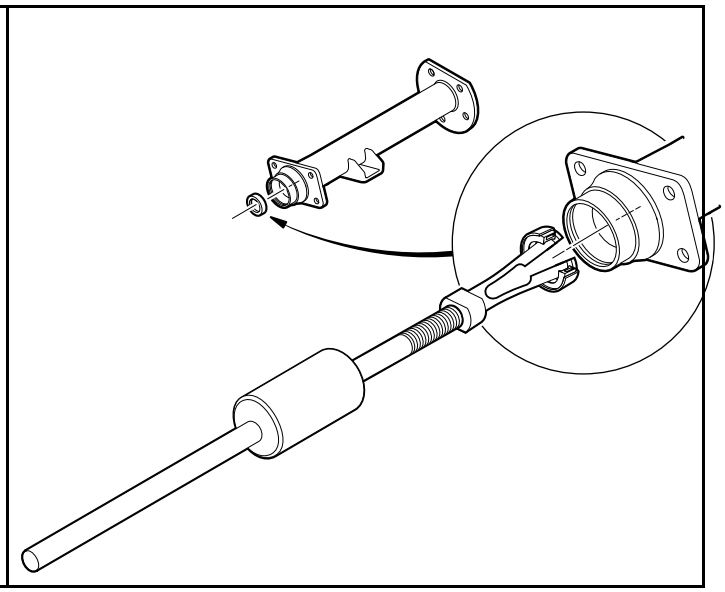

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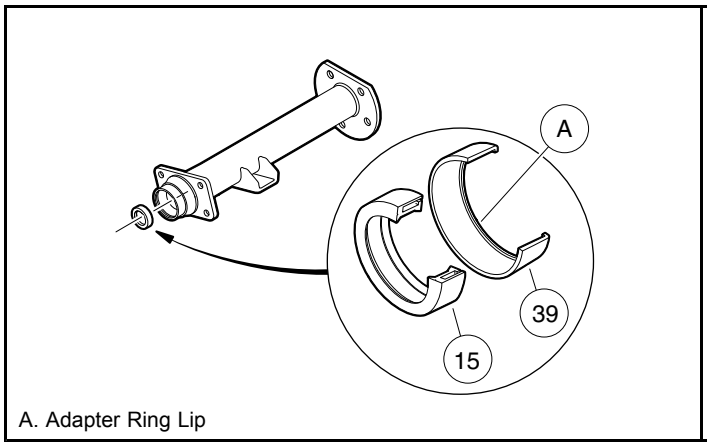
Figure 18-2 Axle Seal and Adapter Ring Removal



A. Adapter Ring Lip

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Figure 18-3 Axle Seal and Adapter Ring

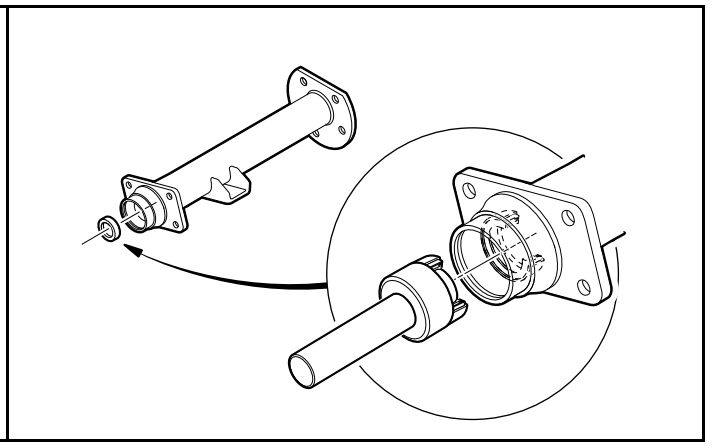

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Figure 18-4 Axle Seal and Adapter Ring Installation

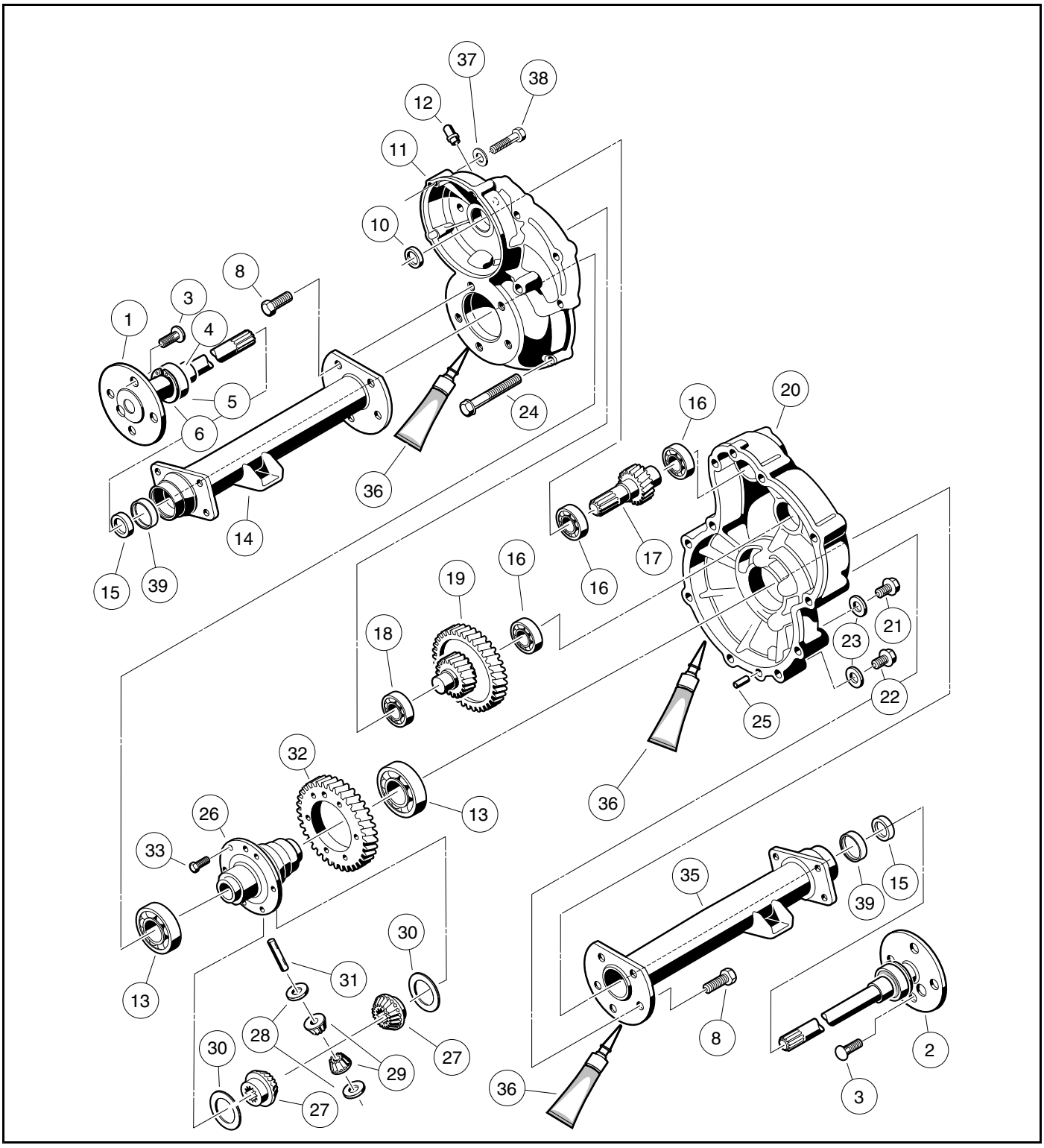

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Figure 18-5 Transaxle – Type G

Axle Shaft and Oil Seal Installation

1. If previously removed, install a new oil seal.
   1.1. Clean seal seat in the adapter ring (39) **(Figure 18-3, Page 18-2)**.
   1.2. Place a new seal (15) in the adapter ring with the seal lip facing toward the adapter ring lip **(Figure 18-3, Page 18-2)**. Use an axle seal tool (P/N 1014162) and mallet to tap it in until it seats firmly in position **(Figure 18-3, Page 18-2)**. A hydraulic press may also be used with the axle seal tool.
   1.3. Clean adapter ring seat(s) in the axle tube (14 or 35) **(Figure 18-5, Page 18-3)**.
   1.4. Apply Loctite® 603 to the outer diameter of the adapter ring.
   1.5. Place the oil seal and adapter ring assembly into the axle tube with the seal lip facing away from the bearing **(Figure 18-4, Page 18-2)**. Use an axle seal tool (P/N 1014162) and mallet to tap it in until it seats firmly in position. **See following CAUTION.**

CAUTION

- **Clean any residual oil from the exposed end of the axle shaft and from the oil seal area prior to installing the axle shaft to prevent oil from coming in contact with brakes.**

2. Install the rear axle into the transaxle. **See following NOTE.**
   2.1. Insert the shaft, splined end first, through the seal and into the axle tube. Be careful not to damage the seal on the inside of the axle tube hub. Advance the shaft through to the bearing on the shaft, then rotate it to align the shaft splines with the splined bore of the differential side gear (27) **(Figure 18-5, Page 18-3)**. Continue advancing the shaft until the bearing on the axle is firmly seated within the axle tube hub seat.
   2.2. Use a pair of snap ring pliers to install the retaining ring (6) inside axle tube hub so that it seats against the axle bearing assembly and into the machined slot in the inside wall of the axle tube hub **(Figure 18-5, Page 18-3)**.

NOTE: *If the retaining ring (6), axle bearing (5), or sleeve (4) must be replaced, the entire axle shaft assembly (1 or 2) must be replaced* ***(Figure 18-5, Page 18-3)***.

   2.3. Place a 1/4 to 3/8-inch (6 to 10 mm) diameter rod against the retaining ring and tap lightly at four to five locations around the retaining ring to ensure it is properly seated. **See following WARNING.**

⚠ WARNING

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

3. If a new oil seal was installed, allow 24 hours before operating the vehicle to allow the Loctite® 603 to fully cure.

AXLE BEARING

Do not remove the axle bearing (5) from a Type G transaxle. If bearing is worn or damaged, the entire axle assembly (1 or 2) must be replaced **(Figure 18-5, Page 18-3)**.

TRANSAXLE REMOVAL

See General Warnings on page 1-2.

1. Disconnect the batteries and discharge the controller. **See Disconnecting the Batteries on page 1-3.**
2. Place chocks at the front wheels and slightly loosen lug nuts on both rear wheels. **See WARNING "Lift only one end..." in General Warnings on page 1-2.**
3. Place a floor jack under the transaxle and raise the rear of the vehicle. Position jack stands under the aluminum frame rails forward of the spring mount. Lower the vehicle to let the jack stands support the vehicle **(Figure 18-6, Page 18-5)**. **See WARNING "Lift only one end of the vehicle..." in General Warnings on page 1-2.**
4. Remove the rear wheels, then thread one lug nut onto a stud on each rear hub. This will keep the brake drums on the hubs.
5. Remove the bow tie pins (1) and brake cable clevis pins (3). Use tool (P/N 102555501) to compress tangs on cable end and remove cable end from bracket (4) **(Figure 18-7, Page 18-5)**.

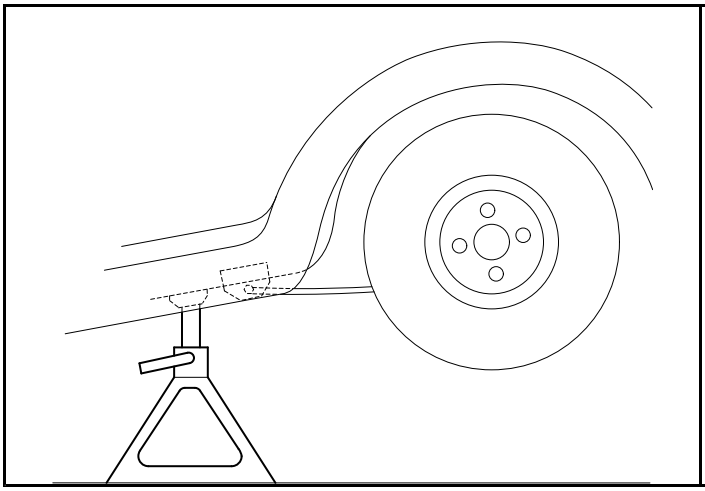

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Figure 18-6 Vehicle Supported on Jack Stands

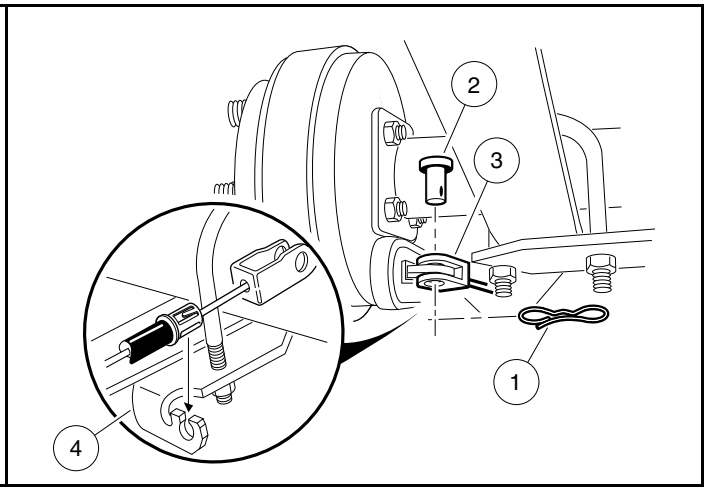

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Figure 18-7 Brake Cable

6. Disconnect the shock absorbers from their lower mounts **(Figure 18-8, Page 18-6)**.
7. Disconnect the four motor wires. Use two wrenches to prevent the post from turning.
8. With a floor jack supporting the transaxle, remove lower spring shackle nuts and bolts. Position shackles so they are clear of springs **(Figure 18-9, Page 18-6)**.
9. If a chain hoist was used to raise the vehicle, lift the vehicle high enough to permit easy access and clearance for removal of the motor. If a floor jack was used to raise the vehicle, lower the transaxle enough to permit easy access and clearance for removal of the motor.
10. Remove the three motor mounting bolts (1) **(Figure 18-11, Page 18-6)** securing the motor to the transaxle. **See following CAUTION.**

⚠ CAUTION

- **Do not position fingers under motor when sliding motor off of the input shaft. Fingers may get pinched when motor disengages.**

11. Carefully remove the motor from the transaxle. Slide the motor away from the transaxle until the motor spline becomes disengaged from the input shaft, then lift motor out. **See preceding WARNING.**

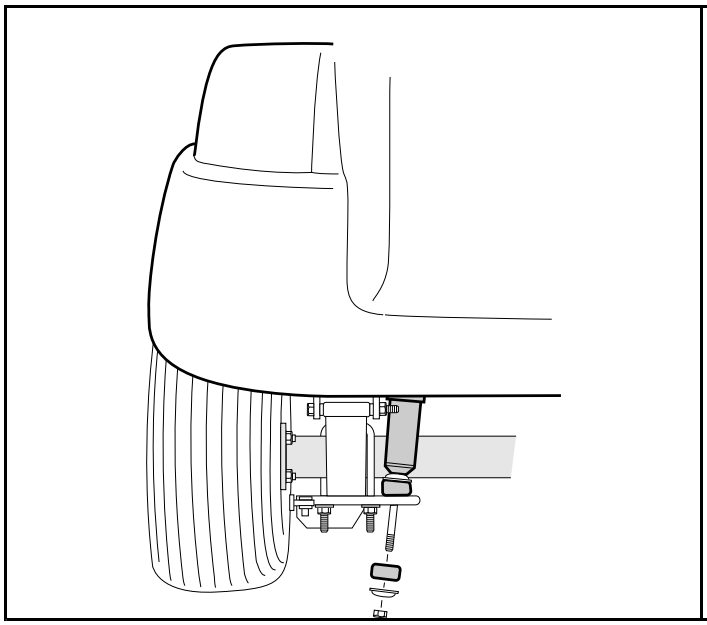

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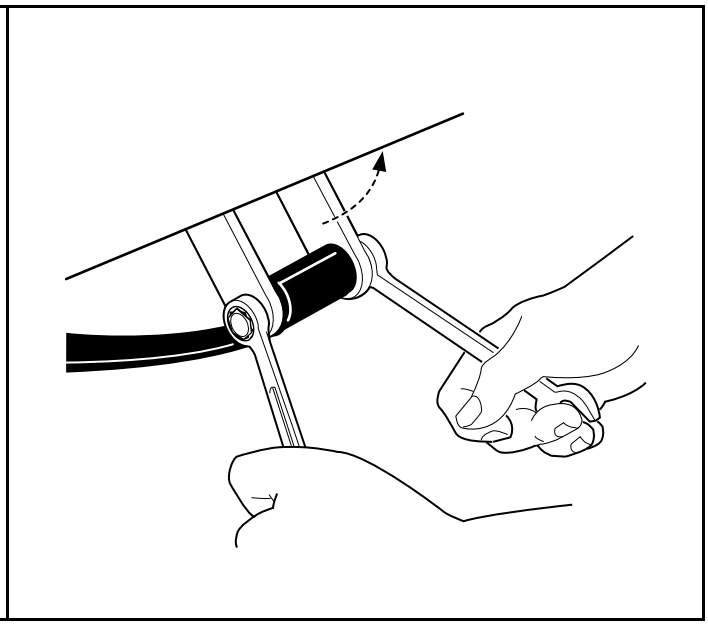
Figure 18-8 Disconnect Shocks



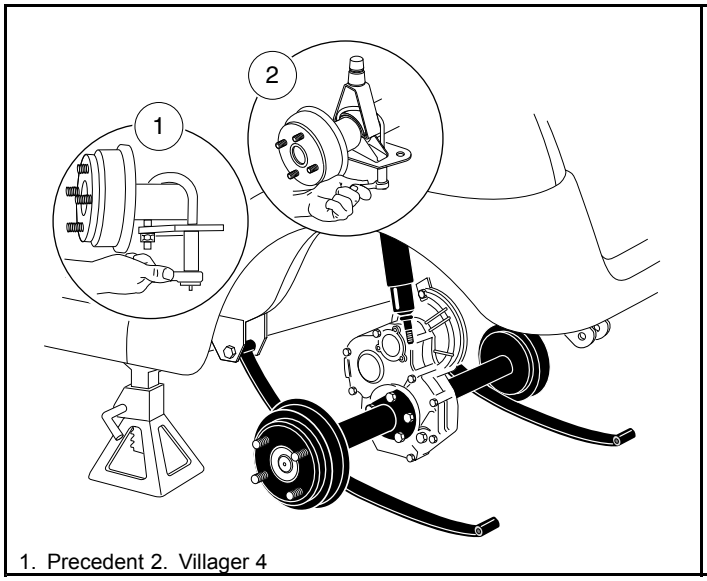
2700

Figure 18-9 Shackles

12. If a floor jack was used, pull floor jack from beneath the transaxle and allow the springs to rest on the floor.
13. Remove the U-bolts attaching the transaxle to the leaf springs **(Figure 18-10, Page 18-6)**.
14. Carefully lift each end of the transaxle off its positioning pin (on the leaf spring) and slide the transaxle to the rear and out of the vehicle.
15. Drain the lubricant from the transaxle and remove the axle shafts. **See Axle Shaft and Oil Seal Removal on page 18-1.See following NOTE.**

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

16. Remove the brake assemblies if required. **See Brake Cluster Removal on page 6-10.**



1. Precedent 2. Villager 4

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Figure 18-10 Leaf Springs

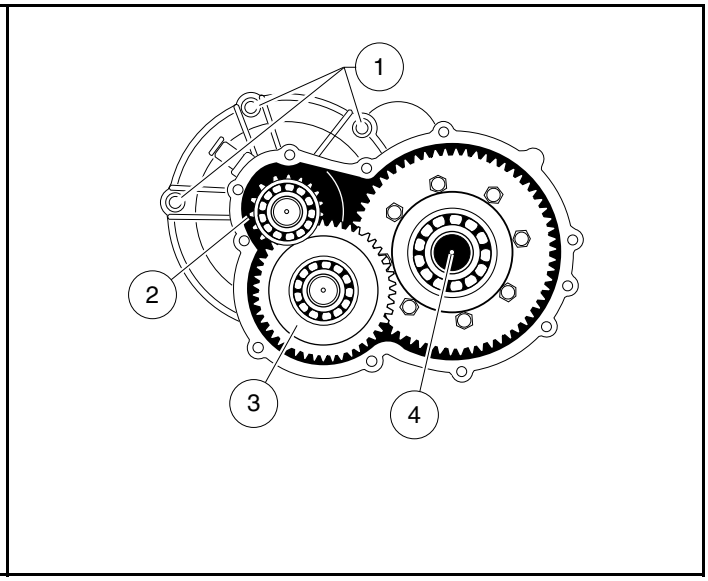

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Figure 18-11 Motor Mounting Bolts

TRANSAXLE DISASSEMBLY, INSPECTION, AND ASSEMBLY

See General Warnings on page 1-2.

TRANSAXLE DISASSEMBLY AND INSPECTION

1. To detach axle tubes (14 and 35) from the transaxle housing, remove the bolts (8) **(Figure 18-5, Page 18-3)**.
2. Remove 11 bolts (24) that hold housing together.
3. Pull the halves of the housing (11 and 20) apart. If necessary, tap lightly on the spline of the input pinion (17). **See following CAUTION.**

CAUTION

- **To prevent damage to the housing mating seal surfaces, use caution when separating halves.**

4. Remove input pinion gear (17) by pulling gear out while rocking intermediate gear assembly (19). Lift intermediate gear assembly and differential gear case unit out simultaneously **(Figure 18-5, Page 18-3)**. **See following CAUTION.**

CAUTION

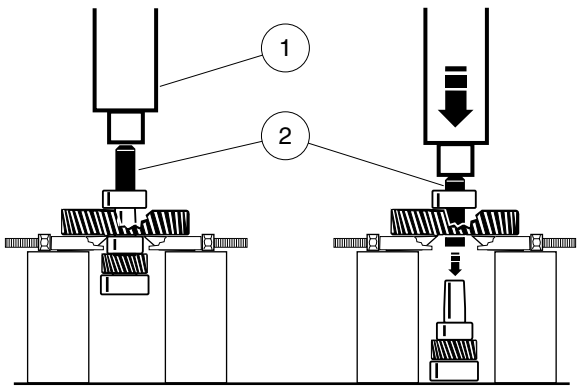
- **Do not damage gears. Use extreme care when handling them.**

5. Use a bearing puller or arbor press to remove bearings (16) from the input pinion gear. If the oil seal (10) is damaged, replace it **(Figure 18-5, Page 18-3)**. **See also Figure 18-12, Page 18-7. See following CAUTION.**

CAUTION

- **Do not reuse bearings after removing them. Replace bearings with new ones.**

6. To disassemble the intermediate gear assembly, press off together the bearing (16) and the gear (19) **(Figure 18-5, Page 18-3)**. **See also Figure 18-12, Page 18-7.**
7. Press the bearing (18) off the intermediate gear assembly **(Figure 18-5, Page 18-3)**.



1. Press Ram 2. Arbor

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Figure 18-12 Intermediate Gear Assembly

8. Disassemble the differential gear case:
   8.1. Remove the hex bolts (33) and the ring gear (32) from the differential case **(Figure 18-5, Page 18-3)**.
   8.2. Remove the ring gear.
   8.3. Separate the differential gear case housing. If necessary, install two of the hex bolts (removed previously in step 8.1.) into the differential gear unit and, while holding the unit slightly above the work area, lightly tap the bolt heads **(Figure 18-13, Page 18-8)**. Remove the two bolts.

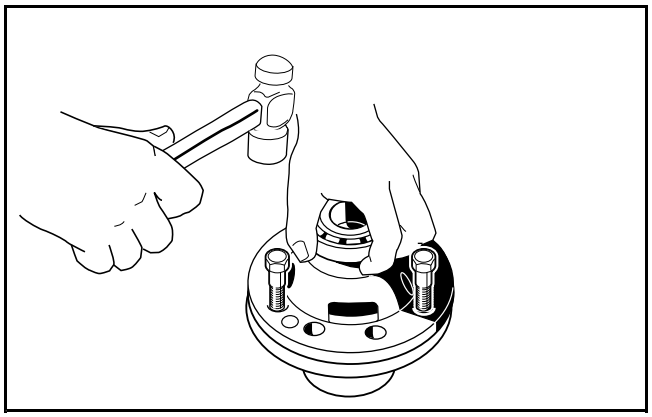

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Figure 18-13 Separate Housing

   8.4. Remove the differential pin (31) by pushing pin through differential gear case from one side **(Figure 18-5, Page 18-3)**. **See also Figure 18-14, Page 18-8.**
   8.5. Remove the idler gears (1 and 2) and thrust plates (3 and 4) **(Figure 18-15, Page 18-8)**.

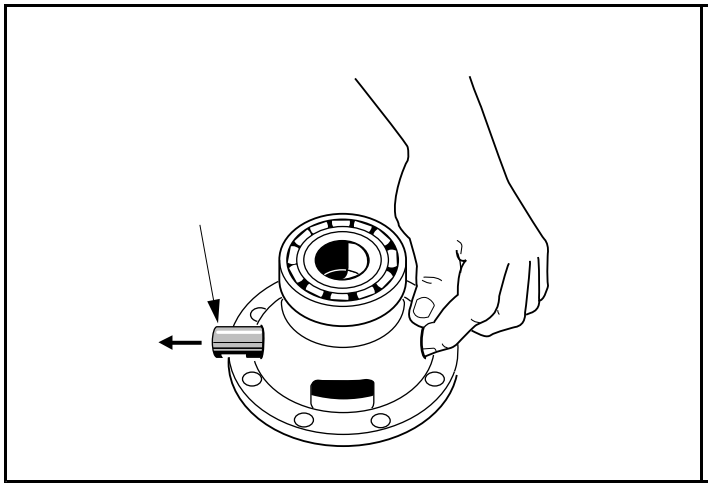

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Figure 18-14 Differential Pin

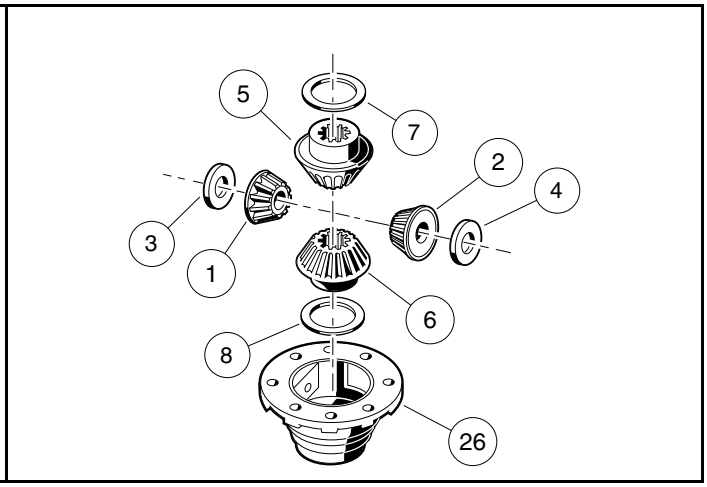

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Figure 18-15 Left Differential

   8.6. Remove the differential gears (5 and 6) and thrust plates (7 and 8).
   8.7. Inspect the bearings (13) of the differential case (26) and replace them if they are damaged **(Figure 18-5, Page 18-3)**. To remove them, press them off. **See following CAUTION.**

CAUTION

- **Do not reuse bearings after removing them. Replace bearings with new ones.**

9. Inspect parts for wear or damage. Any worn or damaged parts should be replaced. **See following NOTE.**

NOTE: *Damaged or worn gears should be replaced as sets.*

TRANSAXLE ASSEMBLY

CAUTION

- **Do not press against the bearing outer race.**
- **The housing and all parts must be wiped clean and dry before reassembly.**

1. If bearings (13) were removed during disassembly, install new bearings using an arbor press **(Figure 18-5, Page 18-3)**.
2. Assemble the differential gear case.
   2.1. Install the pin (31) **(Figure 18-5, Page 18-3)**. Apply a small amount of oil to all thrust plates and to both ends of the pin.
   2.2. Install the hex bolts (33) and output gear (32). Tighten bolts to 58 ft·lb (78.6 N·m).
3. Press a new bearing (18) onto the intermediate gear assembly **(Figure 18-5, Page 18-3)**.
4. Press new bearing (16) onto input pinion gear (17).
5. Apply grease to the lip of the new oil seal (10) and install the seal using a transaxle pinion seal tool (P/N 1014161). The lip of the oil seal should face the inside of the transaxle housing. Make sure the seal is firmly seated.
6. Install the differential assembly (4), the intermediate gear assembly (3), and the input pinion gear (2) simultaneously. Be sure all bearings are seated properly in the housing. Rotate the input shaft to check for smooth gear operation **(Figure 18-11, Page 18-6)**.
7. Install dowel pin(s) (25) (if originally installed) in the transaxle housing (20) **(Figure 18-5, Page 18-3)**.
8. Install left half of transaxle housing:
   8.1. Place a 1/8-inch (3 mm) bead of Three Bond liquid gasket on mating surface of housing.
   8.2. Install left half of transaxle housing (20) **(Figure 18-5, Page 18-3)**.
   8.3. Install bolts (24) in the case housing and tighten to 19 ft·lb (25.7 N·m). Type G transaxles have no shims or gasket.
   8.4. Install axle tube (14 and 35) with bolts (8) **(Figure 18-5, Page 18-3)**. Tighten the bolts to 37 ft·lb (50.2 N·m).
9. Install the brake assemblies as instructed. **See Brake Cluster Installation on page 6-10.**
10. Apply a small amount of grease to the lip of the oil seal (15) **(Figure 18-5, Page 18-3)**. **See following CAUTION.**

⚠ CAUTION

- **Clean any residual oil from the exposed end of the axle shaft and from the oil seal area prior to installing the axle shaft to prevent oil from coming in contact with brakes.**

11. Install the rear axle onto the transaxle.
    11.1. Insert the splined end of the axle shaft into the axle tube. Be careful not to damage the seal on the inside of the axle tube hub. Advance the shaft through to the bearing on the shaft, and rotate it to align the shaft splines with the splined bore of the differential gear. Continue advancing the shaft until the bearing on the axle is firmly seated within the axle tube hub seat.
    11.2. Using 90° internal snap ring pliers (0.090 tip) (P/N 1012560), attach the internal retaining ring into the axle tube hub so that it seats against the axle bearing assembly and into the machined slot in the inside wall of the axle tube hub **(Figure 18-5, Page 18-3)**.
    11.3. Place a 1/4 to 3/8-inch (6 to 10 mm) diameter rod against the retaining ring and tap lightly at four or five locations to ensure it is properly seated. **See following WARNING.**

⚠ WARNING

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

12. Make sure the drain plug (22) is installed in the transaxle and tightened to 23 ft·lb (31 N·m). Fill the transaxle, through the level indicator hole, with 22 ounces of SAE 30 API Class SE, SF, or SG oil (a higher grade may also be used). Install and tighten the level indicator plug (21) to 23 ft·lb (31 N·m).

TRANSAXLE INSTALLATION

See General Warnings on page 1-2.

1. If using a chain hoist, raise the vehicle and place transaxle in position on the jack stands. If using a floor jack, lower the jack stands to their lowest settings and place the transaxle in position on the jack stands.
2. Align the center hole in the saddle of the transaxle with the pilot bolt in the leaf spring assembly.
3. Install the two U-bolts, jounce bumper mount (if required), and spacers, lock washers, and nuts. Tighten the nuts to 25 ft·lb (34 N·m). Tighten the U-bolt nuts so an equal amount of thread is visible on each leg of the bolt.
4. Install the motor. **See Motor Installation on page 17-12.**
5. If using a chain hoist, lower the vehicle while guiding the leaf springs into the rear spring shackles. If using a floor jack, raise the differential while guiding the leaf springs into the rear spring shackles. Then raise the jack stands to support the transaxle.
6. Connect the motor wires, making sure they are connected to the correct motor terminals and that the terminal orientation is correct. Hold the bottom nut of stud with wrench and tighten the terminal retaining nuts. For 5/16 inch (8mm) diameter studs, tighten the nuts to 100 in·lb (11 N·m). For 1/4 inch (6.3mm) diameter studs, tighten the nuts to 45 in·lb (5.0 N·m). **See following NOTE.**

NOTE: *If the motor wires were not tagged when disconnected, refer to the wiring diagram for proper connection.* ***See Wiring Diagrams on page 13-4.***

7. Insert bolts through the spring shackles and bushings in the leaf spring eyes. Secure bolts with lock nuts. Tighten to 18.5 ft·lb (25 N·m).
8. Connect the brake cables using new bow tie pins (1) **(Figure 18-7, Page 18-5)**.
9. Install the shock absorbers. Tighten shock absorber retaining nuts until the rubber bushings expand to the same size as the cup washers.
10. Install the rear wheels and finger-tighten the lug nuts.
11. Lift the vehicle and remove the jack stands.
12. Lower vehicle and tighten the lug nuts, using a crisscross pattern, to 55 ft·lb (74.6 N·m).
13. Place the Tow/Run switch in the TOW position and connect the batteries. **See Connecting the Batteries on page 1-3.**
14. Inspect the vehicle to check for proper operation. **See following WARNING.**

⚠ WARNING

- **Make sure that the vehicle operates in the forward direction when the Forward/Reverse switch is in the FORWARD position.**

WARNING CONTINUED ON NEXT PAGE

⚠ WARNING

- **Make sure that the vehicle operates in the reverse direction when the Forward/Reverse switch is in the REVERSE position. The reverse buzzer will sound as a warning when the Forward/Reverse switch is in REVERSE.**
- **Make sure that the vehicle does not operate when the Forward/Reverse switch is in the NEUTRAL position.**

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