



SERVICE MANUAL

OX EV

Automatic Parking Brake
Samsung SDI Lithium Powered

10017055-A

For questions on material in this manual, contact an authorized representative for clarification.

Read and understand all labels on the vehicle. Always replace any damaged or missing labels.

The manufacturer reserves the right to incorporate engineering and design changes to products in this manual, without obligation to include these changes on units sold previously.

The information contained in this manual may be revised periodically by the manufacturer, and therefore is subject to change without notice.

TSV DISCLAIMS LIABILITY FOR ERRORS IN THIS MANUAL, and SPECIFICALLY DISCLAIMS LIABILITY FOR INCIDENTAL AND CONSEQUENTIAL DAMAGES resulting from the use of the information and materials in this manual.

These are the original instructions as defined by 2006/42/EC.

The following symbols appear throughout this manual and on your vehicle. Your safety is involved when these symbols are used. Become familiar with their meanings before reading the manual.



DANGER indicates a hazardous situation that, if not avoided, will result in death or serious injury.



WARNING indicates a hazardous situation, if not avoided, could result in death or serious injury.



CAUTION indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.



Read and comply with all of the instructions and safety precautions in this manual and on all product labels.

Failure to follow the safety precautions could result in serious injury or death.

Never modify the vehicle in any way that will alter the weight distribution of the vehicle, decrease its stability or increase the speed beyond the factory-set speed. Such modifications can cause serious personal injury or death. The manufacturer of this vehicle prohibits and disclaims responsibility for any such modifications or any other alteration which would adversely affect the safety of the vehicle.

SERVICE MANUAL

OX EV

MODEL YEAR 2023 - CURRENT

CONTACT INFORMATION:

TEXTRON SPECIALIZED VEHICLES

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706-798-4311

800-774-3946 Customer Care
800-438-3946 Cushman Genuine Parts and Accessories
www.cushman.com

GENERAL INFORMATION

This vehicle was designed and manufactured in the United States of America (USA). The standards and specifications listed in the following text originate in the USA unless otherwise indicated.

Use Original Equipment Manufacturer (OEM) approved parts to keep the warranty effective.

Failure to properly maintain batteries may void the warranty. Refer to the battery manual for instructions on the proper maintenance and care of the batteries.

Lithium-ion batteries are not serviceable. If there is an issue with the battery, it must be replaced. Battery pack units must be replaced as a set.

BATTERY PROLONGED STORAGE

The batteries discharge over time. The rate of discharge changes according to the ambient temperature, the age and condition of the batteries.

Completely charged batteries will not freeze in winter temperatures unless the temperature is less than -75°F (-60°C).

For winter storage, the batteries must be clean, fully charged and disconnected from any source of electrical drain.

The battery charger may be left connected to the vehicle to maintain a full charge on the batteries, provided the charger is plugged into an active electrical source. If power to the electrical source is disconnected or interrupted, the battery charger will continue to check the charge on the battery pack. This will draw power from the battery pack and eventually drain the batteries if power is not restored in a timely manner.

As with all electric vehicles, the batteries must be checked and recharged as required or at a minimum of 30 day intervals.

Do not leave the charger connected to the battery during long term storage.

The optimal storage temperature range is between 65°F and 82°F (18°C and 28°C).

In hot climates, store the vehicle with a 30% to 50% state of charge.

Check the state of charge every 30 days. If the SOC is below 30%, charge the battery until the SOC reaches 50%.

BATTERY DISPOSAL

Lithium-ion batteries are recyclable. Return discarded batteries to distributor, manufacturer or contact your local recycling center for instructions. Dispose in accordance with local, state and federal regulations for Lithium-ion batteries. Contact local or state environmental authorized people for the disposal information.

SAFETY INFORMATION

This manual contains recommended maintenance procedures from the manufacturer. Follow the procedures and fault isolation information to get the best service from the product. To decrease the risk of personal injury or property damage, read and follow all safety information and operational procedures in this manual.

GENERAL

Vehicles are used for different purposes, so it is not possible to know and inform of every possible occurrence. Be careful when you drive to prevent avoidable personal injury or damage to the vehicle. All users must read and obey this manual. Make sure you give special attention to the CAUTIONS, WARNINGS and DANGERS.

Anyone who operates the vehicle must read the entire owner's guide provided with the purchase of the vehicle, paying particular attention to the CAUTIONS, WARNINGS and DANGERS within.

For questions about this vehicle, contact your dealer or write to the address on the back cover of this publication, Attention: Customer Care Department.

The manufacturer has the right to change the design of the vehicle. There is no responsibility to make the changes on units purchased before changes were made. The information in this manual can change without notice.


THE MANUFACTURER IS NOT LIABLE FOR ERRORS IN THIS MANUAL. THE MANUFACTURER IS NOT LIABLE FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES THAT RESULT FROM THE USE OF THE MATERIAL IN THIS MANUAL.

This vehicle meets the current applicable standard for safety and performance requirements.

These vehicles are for off-road use. They DO NOT meet the federal Motor Vehicle Safety Standards of the United States of America (USA) and are not for operation on the public streets. Some areas allow the operation of the vehicles on their streets according to local codes.

Refer to *VEHICLE SPECIFICATIONS* on page 119 for capacity of the vehicle.

Ensure all electrical accessories are grounded directly to the battery (-) post. **Never use the chassis or body as a ground connection.**

 **WARNING** *Do not change the vehicle in any manner that changes the weight distribution, decreases stability, increases speed or extends the necessary distance to stop more than the factory specification. Such changes can cause personal injury or death.*

Do not change the vehicle in any manner that changes the weight distribution, decreases stability, increases speed or extends the necessary distance to stop more than the factory specification. The manufacturer is not responsible for changes that cause the vehicle to be dangerous.

Do not let anyone below the height of 59 inches (150 cm) operate the vehicle.

Speed should be moderated by the environmental conditions, terrain and common sense.

GENERAL OPERATION

ALWAYS:

- Use the vehicle responsibly and keep the vehicle in safe condition for operation.
- Read and obey all warnings and operation instruction labels on the vehicle.
- Follow all safety rules in the area where the vehicle is operated.
- When there is a risk of lightning, leave the vehicle and look for a safe location to wait until the lightning has stopped.
- Drive the vehicle only as fast as terrain and conditions allow.
- Apply the brake to control the speed on steep grades.
- Keep enough distance between vehicles.
- Decrease speed in wet areas.
- Be careful when making sharp turns, or turns you are not familiar with.
- Be careful when driving on loose terrain.
- Be careful when operating the vehicle in a populated area.

SAFETY INFORMATION

MAINTENANCE

ALWAYS:

- Replace damaged or missing warning, caution or information labels.
- Service the vehicle according to the periodic service schedule in this manual.
- Make sure that approved and qualified personnel do all repairs.
- Follow the manufacturer's maintenance procedures.
- Use insulated tools within the battery area to prevent blowing the BMS internal fuse.
- Use specified replacement parts. DO NOT use replacement parts of less quality.
- Use recommended tools.
- Make sure that tools and procedures not specified by the manufacturer will not be a safety risk to personnel or operation of the vehicle.
- Support the vehicle with wheel chocks and jack stands. NEVER get under a vehicle that is supported by a jack. Lift the vehicle according to the manufacturers instructions.
- Make sure you service the vehicle in an area away from open flame or sparks.
- Know that a vehicle in need of repair does not operate correctly and can be dangerous to operate.
- After you make repairs or do maintenance, test the vehicle in a safe area that is free from vehicle and person traffic.
- Make sure you record and keep all of the maintenance history of the vehicle.

CHARGER

ALWAYS:

- Charge in an area free from flammable liquids and items.
- Charge a vehicle in an area that is free from flame or spark. Charge in an area that is a safe distance from gas water heaters and furnaces.
- Use a dedicated circuit for the battery charger. Do not plug other appliances into the receptacle when the charger is in operation.
- Operate the charger according to the charger manufacturers recommendations or applicable electrical code.

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GENERAL INFORMATION & ROUTINE MAINTENANCE

SERIAL NUMBER LOCATION

Three serial number and manufacture date code labels are on the vehicle. One is on the body below the front, driver side of the seat. The other two are located on the frame under the seat. A PIN Plate is also riveted to the frame.

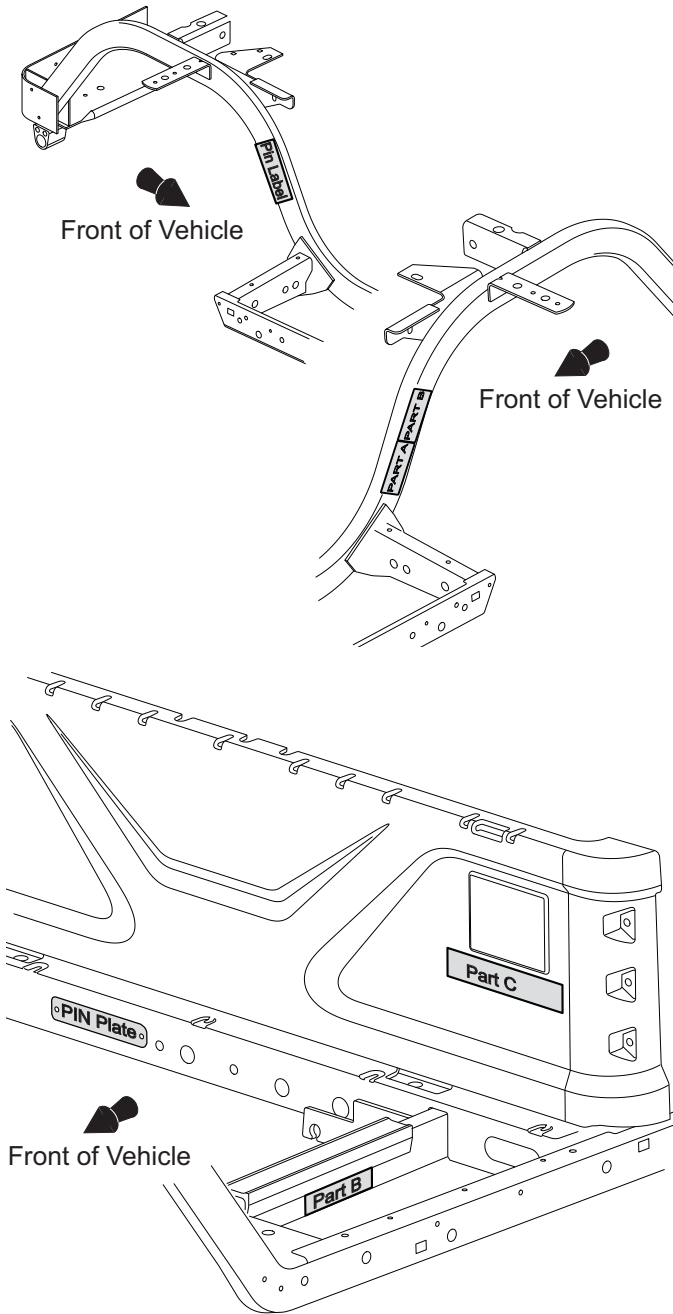


Figure 1 Serial Number Location

Design changes take place on an ongoing basis. In order to obtain correct components for the vehicle, the manufacture date code, serial number and vehicle model must be provided when ordering service parts.

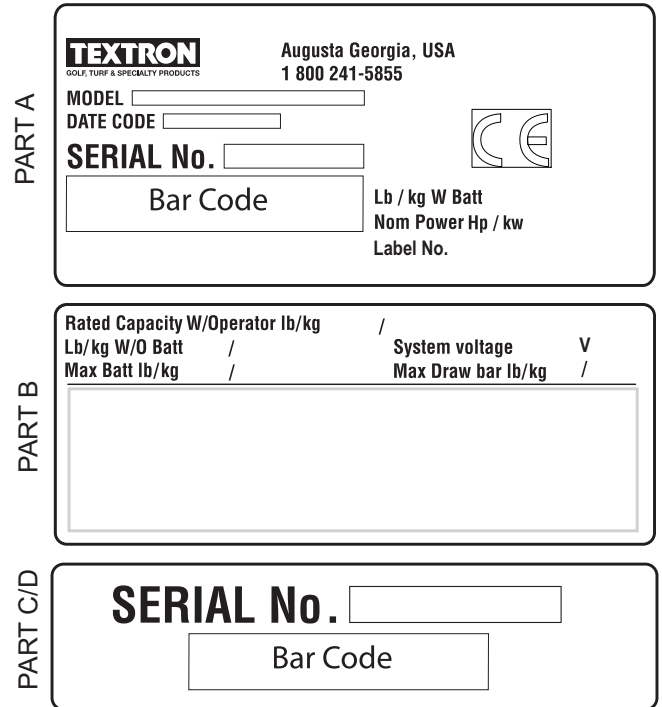


Figure 2 Serial Number Labels

SERVICING THE VEHICLE

WARNING To prevent severe injury or death resulting from improper servicing techniques, observe the following warnings:

Do not attempt any type of servicing operations before reading and understanding all notices, cautions and warnings in this manual.

Any servicing requiring adjustments to be made to the powertrain while the motor is running must be made with both drive wheels raised.



Wear eye protection when working on the vehicle. In particular, use caution when working around battery packs, or using solvents or compressed air.

To prevent the possibility of motor disintegration, never operate vehicle at full throttle for more than 4 - 5 seconds while vehicle is in a "no load" condition.

GENERAL INFORMATION AND MAINTENANCE

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

It is in the best interest of both vehicle owner and servicing dealer to carefully follow the procedures recommended in this manual. Adequate preventive maintenance, applied at regular intervals, is the best guarantee for keeping the vehicle both dependable and economical.

Before a new vehicle is put into operation, it is recommended that the items shown in the INITIAL SERVICE CHART be performed (Ref. Figure 3).

ITEM	SERVICE OPERATION
Batteries	Charge battery pack
Seats	Remove protective plastic covering
Brakes	Check operation and adjust if necessary
	Establish acceptable stopping distance
Tires	Check air pressure (see SPECIFICATIONS)
Portable Charger	Remove from vehicle and properly mount

Figure 3 Initial Service Chart

TOWING

WARNING Only tow the vehicle for recovery purposes. Before towing, turn the key switch to N and move the Run/ Tow switch to the TOW position. Make sure that the brakes and steering are operable. Always have a person driving the vehicle to steer and operate the brakes when it is being towed. Do not tow the vehicle above 5 mph (8 kph). Failure to abide by these instructions could cause harm to the vehicle and persons involved.

It is recommended that the vehicle be moved by placing the entire vehicle on a trailer, flatbed truck or other suitable transport.

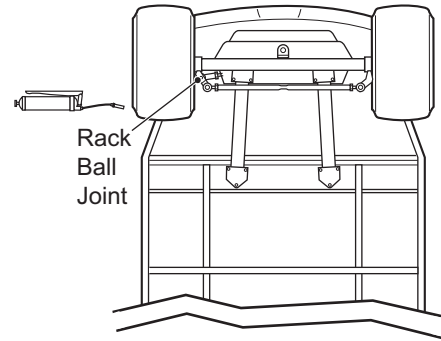
ROUTINE MAINTENANCE

This vehicle will give years of satisfactory service as long as it receives regular maintenance. Refer to the Periodic Service Schedule for appropriate service intervals (Ref. Figure 6).

NOTICE: Some maintenance items must be serviced more frequently on vehicles used under severe driving conditions.

Periodic lubrication of the steering is recommended (Ref. Figure 4).

CAUTION Do not use more than three pumps of grease in each grease fitting at any one time. Excess grease may cause grease seals to fail or grease migration into areas that could damage components.



View from Underside of Vehicle

Figure 4 Lubrication Points

REAR AXLE

The only maintenance required for the first five years is the periodic inspection of the lubricant level. The rear axle is provided with a lubricant level check/fill plug located on the bottom of the differential. Unless leakage is evident, the lubricant only requires replacing after five years. The procedure to follow for checking the rear axle lubricant level is located in the REAR AXLE section of this manual (See REAR AXLE MAINTENANCE on page 95).

BRAKES

WARNING To prevent severe injury or death resulting from operating a vehicle with an improperly operating brake system, the braking system must be properly maintained. All driving brake tests must be done in a safe location with regard for the safety of all personnel.

NOTICE: Over time, a subtle loss of performance may take place. Therefore, it is important to establish the standard with a new vehicle.

TIRES

Tire condition should be inspected on a daily basis. Inflation pressures should be checked on a weekly basis when the tires are cool. Be sure to reinstall the valve dust cap after checking or inflating a tire (See WHEEL AND TIRE SERVICE on page 21).

GENERAL INFORMATION AND MAINTENANCE

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

TRAILERING

WARNING To prevent personal injury to occupants of other highway vehicles, be sure that the vehicle and any contents are adequately secured to the trailer.

Do not ride on a vehicle being trailered.

Remove the windshield before trailering.

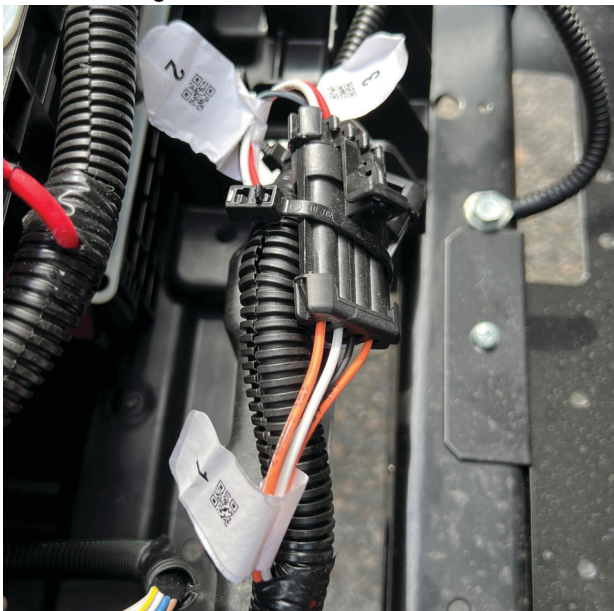
Maximum speed with a sun top is 50 mph (80 kph).

If the vehicle is to be transported on a trailer at highway speeds, the windshield and sun top must be removed and the seat bottom secured. Always check that the vehicle and any contents are adequately secured before trailering the vehicle. The rated capacity of the trailer must exceed the weight of the vehicle and load (See VEHICLE SPECIFICATIONS on page 119). Secure the vehicle to the trailer using ratchet tie downs.

PARKING BRAKE RELEASE

In case of total power loss and the RUN/TOW switch does not release the automatic parking brake, the park brake will have to be manually released. Chock the tires to prevent the vehicle from moving when the brake is released.

Make sure that the key switch is in the OFF position and chock the tires to prevent the vehicle from moving; Then do the following:



1. Locate the brake release plugs at the front of the battery tray under the seat.
2. Cut the zip tie grouping the plugs together.
3. Locate the 'Auxiliary Power' line (3) and remove the weather pack seal from the connector.

4. Locate the 'Primary Power' line connector (2) and disconnect it from line (1).
5. Connect the 'Auxiliary Power' line (7) to the 'Primary Power' line (2).
6. Turn the key switch to the neutral 'N' position, which releases the brake. If the tires are not chocked and the vehicle is not on flat ground, the vehicle will move immediately.
7. Move the vehicle to desired, safe location. Turn the key switch to the 'OFF' position and chock the tires immediately.
8. Disconnect the 'Auxiliary Power' line (3) from the 'Primary Power' line (2).
9. Connect the 'Primary Power' line (2) to line (1).
10. Replace the weather pack seal on the 'Auxiliary Power' line connector (3).
11. Group the plugs back together with a new zip tie.



TOP AND WINDSHIELD

WARNING The top does not provide protection from roll over or falling objects. The windshield does not provide protection from tree limbs or flying objects.

Clean with water and a clean cloth. Minor scratches may be removed using a commercial plastic polish or Plexus plastic cleaner.

WINTER OR PROLONGED STORAGE

See *Prolonged Storage* on page 51.

GENERAL INFORMATION AND MAINTENANCE

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

CARE AND CLEANING

⚠ CAUTION Do not use a pressure washer to clean the vehicle.

To prevent cosmetic damage, do not use any abrasive or reactive solvents to clean plastic parts.

It is important that proper techniques and cleaning materials be used.

Normal cleaning of vinyl seats and plastic or rubber trim requires the use of a mild soap solution applied with a sponge or soft brush and wiped with a damp cloth.

Removal of oil, tar, asphalt, shoe polish, etc. will require the use of a commercially available vinyl/rubber cleaner.

The painted surfaces of the vehicle provide an attractive appearance and durable protection. Frequent washing with lukewarm or cold water is the best method of preserving the painted surfaces.

Do not use hot water, strong soap or harsh chemical detergents.

Rubber parts should be cleaned with non-abrasive household cleaner.

Occasional cleaning and waxing with non-abrasive products designed for 'clear coat' automotive finishes will enhance the appearance and durability of the painted surfaces.

Corrosive materials used as fertilizers or for dust control can collect on the under-body of the vehicle. These materials could cause corrosion of under-body parts. It is recommended that the under-body be flushed occasionally with plain water. Thoroughly clean any areas where mud or other debris can collect. Sediment packed in closed areas should be loosened to ease its removal, taking care not to chip or otherwise damage paint.

VEHICLE CARE PRODUCTS

To help maintain the vehicle, the manufacturer has several products, available through a local Distributor, an authorized Branch, or the Service Parts Department, among them are

- Touch-up paint specially formulated to match vehicle colors for use on both metal and TPE (plastic) bodies. (P/N 28432-G**)
- Multi-purpose battery protectant formulated to form a long-term, flexible, non-tacky, dry coating that will not crack, peel or flake over a wide temperature range. (P/N 606312)
- Multi-purpose Hand Cleaner is an industrial strength cleaner containing no harsh solvents, yet gently lifts grease off hands. May be used with or without water. (P/N 607636)
- Plexus plastic cleaner and polish removes minor scratches from windshield. (P/N 606314)

HARDWARE

Periodically the vehicle should be inspected for loose fasteners. Fasteners should be tightened in accordance with the Torque Specifications table (Ref. Figure 5). Use care when tightening fasteners and refer to the sections in this manual for specific torque values.

Generally, two grades of hardware are used in the vehicle. Grade 5 hardware can be identified by the three marks on the hexagonal head. Unmarked hardware is Grade 2 (Ref. Figure 5).

GENERAL INFORMATION AND MAINTENANCE

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

TORQUE SPECIFICATIONS







ALL TORQUE FIGURES ARE IN FT. LBS. (Nm) Unless otherwise noted in text, tighten all hardware in accordance with this chart. This chart specifies 'lubricated' torque figures. Fasteners that are plated or lubricated when installed are considered 'wet' and require approximately 80% of the torque required for 'dry' fasteners.										
BOLT SIZE	1/4"	5/16"	3/8"	7/16"	1/2"	9/16"	5/8"	3/4"	7/8"	1"
Grade 2 	4 (5)	8 (11)	15 (20)	24 (33)	35 (47)	55 (75)	75 (102)	130 (176)	125 (169)	190 (258)
Grade 5 	6 (8)	13 (18)	23 (31)	35 (47)	55 (75)	80 (108)	110 (149)	200 (271)	320 (434)	480 (651)
Grade 8 	6 (8)	18 (24)	35 (47)	55 (75)	80 (108)	110 (149)	170 (230)	280 (380)	460 (624)	680 (922)
BOLT SIZE	M4	M5	M6	M8	M10	M12	M14			
Class 5.8 (Grade 2) 	1 (2)	2 (3)	4 (6)	10 (14)	20 (27)	35 (47)	55 (76.4)			
Class 8.8 (Grade 5) 	2 (3)	4 (6)	7 (10)	18 (24)	35 (47)	61 (83)	97 (131)			
Class 10.9 (Grade 8) 	3 (4)	6 (8)	10 (14)	25 (34)	49 (66)	86 (117)	136 (184)			

Figure 5 Torque Specifications

GENERAL INFORMATION AND MAINTENANCE

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

SCHEDULED MAINTENANCE CHART

Perform all services at the maintenance interval reached first.

Item	Interval (perform at interval that comes first)		Remarks	Page
	Hours	Calendar		
Overall vehicle condition	Pre-ride		Inspect.	
Battery Module	Daily		Charge daily after use.	
Steering	Pre-ride		Check for smooth and free operation.	
Front suspension	Pre-ride		Inspect. Check for leaks and loose or missing hardware.	
Rear suspension	Pre-ride		Inspect. Check for leaks and loose or missing hardware.	
Tires	Pre-ride		Check condition and pressure.	21
Wheel lug nuts	Pre-ride		Check for loose or missing.	
Accelerator	Pre-ride		Check for smooth operation.	41
Brake system	Pre-ride		Check for smooth operation and acceptable stopping distance.	75
Frame hardware	Pre-ride		Check for loose or missing.	
Reverse warning alarm	Pre-ride		Check operation.	
Switches	Pre-ride		Check operation.	
Brake shoes	10	Monthly	Inspect. Replace as needed.	
Charger receptacle	20	Monthly	Clean connections.	
Accelerator	20	Monthly	Check for smooth operation.	
Wiring	20	Monthly	Inspect for loose connections, broken or missing insulation.	
Steering	20	Monthly	Check for excess play, loose or missing hardware.	
Tie rods	20	Monthly	Check for excess play, bent rods, loose or missing hardware.	
Front suspension	20	Monthly	Inspect strut for leaks. Check hubs and kingpins, for excessive play, worn bushings, loose or missing hardware.	
Rear axle	20	Monthly	Check for leakage; add oil as required.	
Brakes	20	Monthly	Check for smooth operation and acceptable stopping distance.	75
Front wheel alignment	60	3 Months	Check for unusual tire wear.	
Rear Suspension	60	3 Months	Check for shock oil leakage, worn bushings, loose or missing hardware.	
General lubrication	50	3 Months	Lubricate all fittings, pivots, cables, etc. where required.	2
Rear axle	500	5 years	Replace fluid.	
Motor coupling	20,000 Amp Hours	5 years	Add anti-seize compound (approx. 1 tbsp.)	

Figure 6 Maintenance Schedule

SAFETY

NOTICES, CAUTIONS, WARNINGS AND DANGERS

Throughout this manual, the following **NOTICES, CAUTIONS, WARNINGS and DANGERS** are used. For the protection of all personnel and the vehicle, be aware of and observe the following:

A NOTICE indicates a condition that should be observed.

CAUTION A CAUTION indicates a condition that may result in damage to the vehicle or surrounding facilities.

WARNING A WARNING indicates a hazardous condition which could result in serious injury or death.

DANGER Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

IMPORTANT SAFETY WARNING

In any product, components will eventually fail to perform properly as the result of normal use, age, wear or abuse. It is impossible to anticipate all possible component failures or the manner in which each component may fail.

Be aware that a vehicle requiring repair indicates that the vehicle is no longer functioning as designed and therefore should be considered potentially hazardous. Use extreme caution when servicing any vehicle. When diagnosing, removing or replacing any components that are not operating correctly, take the time to consider the safety of yourself and others around you if the component should move unexpectedly.

Some components are heavy, spring loaded, highly corrosive, explosive, may produce high amperage, or reach high temperatures. Be careful not to place hands, face, feet or body in a location that could expose them to injury should an unforeseen situation occur.

CAUTION Always use the appropriate tools listed in the tool list and wear approved safety equipment.

MODIFICATIONS TO VEHICLE

WARNING To prevent personal injury or death to the operator or passenger(s), do not make changes to the weight distribution or the center of gravity which could make the vehicle unstable or prone to roll over.

Do not modify the vehicle in any manner that will change the weight distribution of the vehicle.

GENERAL MAINTENANCE

WARNING To prevent severe injury or death resulting from improper servicing techniques, observe the following Warnings:

Do not attempt any type of servicing operations before reading and understanding all notes, cautions, warnings and dangers in this manual.

When any maintenance procedure or inspection is performed, it is important to follow all of the recommended safety procedures in this manual. This will assure the safety of the technician/mechanic or bystanders and to prevent damage to the vehicle.

Always read and understand the **entire** relevant manual section (chapter) before attempting any inspection or service.

BEFORE SERVICING THE VEHICLE

Before attempting to inspect or service a vehicle, be sure to read and understand the following warnings:

WARNING Before working on the vehicle, remove all jewelry (watches, rings, etc.).

Be sure that loose clothing or hair cannot become caught in the moving parts of the powertrain.

Use caution not to contact hot objects.

Any service requiring adjustments to be made to the powertrain while the motor is running must be made with both rear wheels raised.

To prevent the possibility of motor disintegration, never operate the vehicle at full throttle for more than 4 - 5 seconds while the vehicle is in a "no load" condition.

Wear OSHA approved clothing and eye protection when working on anything that could expose the body or eyes to potential injury. In particular, use care when working with or around batteries, compressed air, or solvents.

Always turn the key switch to the OFF position and remove the key before disconnecting a live circuit.

When connecting battery cables, pay particular attention to the polarity of the battery terminals. Never confuse the positive and negative cables.

If repairs are to be made that will require welding or cutting, the battery pack must be removed.

Before servicing the electrical system, be sure to read and understand the following warnings that pertain to electrical system repair or maintenance.

SAFETY

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

⚠ WARNING Be sure that the key switch is off and all electrical accessories are turned off before starting work on vehicle.

Never disconnect a circuit under load at a battery terminal.



Wear eye protection when working on the vehicle. In particular, use caution when working around battery packs, or using solvents or compressed air.

Use insulated wrenches to prevent the possibility of a dropped wrench from blowing the internal BMS fuse.

DISCONNECT BATTERY

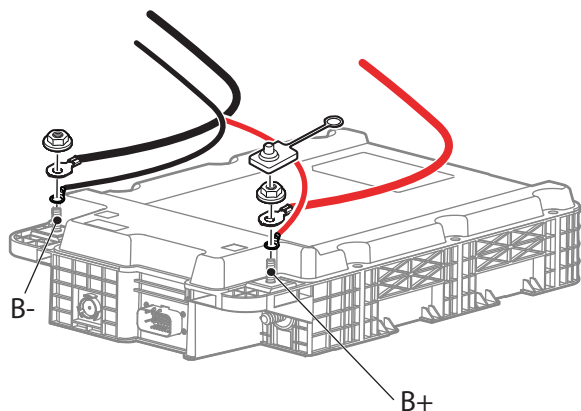
Tool List

Qty.

Insulated Wrench, 13 mm..... 1

The battery is located under the seat.

Disconnect the negative battery cable (B-) using an insulated wrench.



LIFTING THE VEHICLE

Tool List

Qty.

Floor Jack..... 1

Jack Stands..... 4

Wheel Chocks..... 4

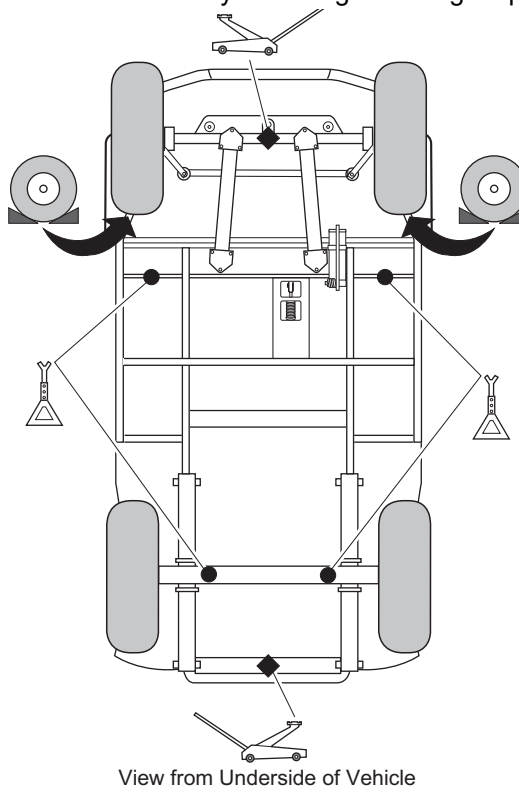
Some servicing operations may require the vehicle to be lifted.

⚠ WARNING To prevent possible injury or death resulting from a vehicle falling from a jack, be sure the vehicle is on a firm and level surface. Never get under a vehicle while it is supported solely by a jack. Use jack stands and test the stability of the vehicle on the stands. Always place chocks in front and behind the wheels not being raised. Use extreme caution since the vehicle is extremely unstable during the lifting process

⚠ CAUTION When lifting the vehicle, position jack stands only in the areas indicated.

No person(s) should be in or on the vehicle while lifting.

1. To raise the entire vehicle, install chocks in front and behind each front wheel (Ref. Figure 1).
2. Center the jack under the rear frame crossmember.
3. Raise the vehicle and position jack stands under each outer end of the rear axle.
4. Lower the jack and test the stability of the vehicle on the two jack stands.
5. Place the jack at the center of the front axle.
6. Raise the vehicle and position jack stands under the inner frame member as indicated.
7. Lower the jack and test the stability of the vehicle on the four jack stands.
8. If only the front or rear of the vehicle is to be raised, place the chocks in front and behind each wheel not being raised in order to stabilize the vehicle.
9. Lower the vehicle by reversing the lifting sequence.



View from Underside of Vehicle

Figure 1 Lifting the Vehicle

BODY

GENERAL

WARNING Batteries should always be removed before any servicing that will generate sparks.

It is important to use a sharp drill bit when removing the rivets on the side of the vehicle. Extreme caution must be used when drilling out the rivets located in the front of the body and the bottom side of the body. Excessive pressure could result in the drill bit being forced through the body panel and penetrating a battery. As extra protection, it is recommended that a protective piece of sheet metal be placed between the battery and the rivet. Use of a drill depth stop will provide additional protection.

In general, body component replacement can be accomplished with a minimum of specialized tools. Most body components are held in place with conventional removable hardware (nuts, bolts, washers and screws). Some components are mounted with 'pop' rivets which require that the rivet head be removed in order to push out the shank of the rivet. The rivet head is easily removed by drilling into the head with a sharp drill bit that is slightly larger than the shank of the rivet (Ref. Figure 1). Caution must be exercised when drilling to prevent the drill from being forced through and damaging components where it could damage components located immediately behind the rivet. The best way to prevent this from occurring is to use a sharp drill bit that requires very little pressure to cut successfully and to place a piece of protective sheet metal between the surface being drilled and components directly behind it.

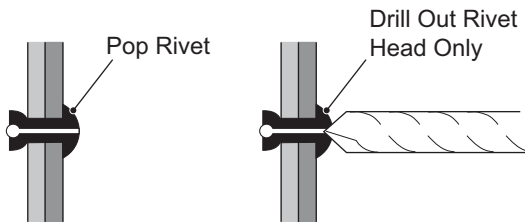


Figure 1 Drill Out Metal Rivet

COMPONENT REPLACEMENT

The body components can be replaced by removing the securing hardware, replacing the component and securing with hardware in the same orientation as removed. The illustrations on the following pages indicate the assembly methods for the various components.

NOTICE: If the instrument panel is to be replaced, the serial number plate and CE plate must be removed and reinstalled on the new instrument panel.

Rocker Panel Replacement

Tool List	Qty.
Torx Bit, T-30	1
Socket, 10 mm	1
Wrench, 10 mm.....	1
Ratchet.....	1
Drill Bit.....	1
Drill.....	1
Torque Wrench, in. lb	1

1. Drill out the rivets (2) securing the lower rocker panel (1).
2. Remove the nuts (6) and screws (3) securing the lower rocker panel (1). Make sure to retain the spacers (4) for reuse during assembly.
3. Remove two nuts (7) and screws (8) securing the upper rocker panel (5). Make sure to retain the spacers (9) for reuse during assembly (Ref. Figure 2).
4. If the fender flares needs replacing, drill out the four rivets securing it to the frame.

Assemble in the reverse order of removal using new rivets. Tighten all hardware to the torque values below.

Item	Torque Specification
6, 7	45 - 55 in. lb (5 - 6 Nm)

BODY

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

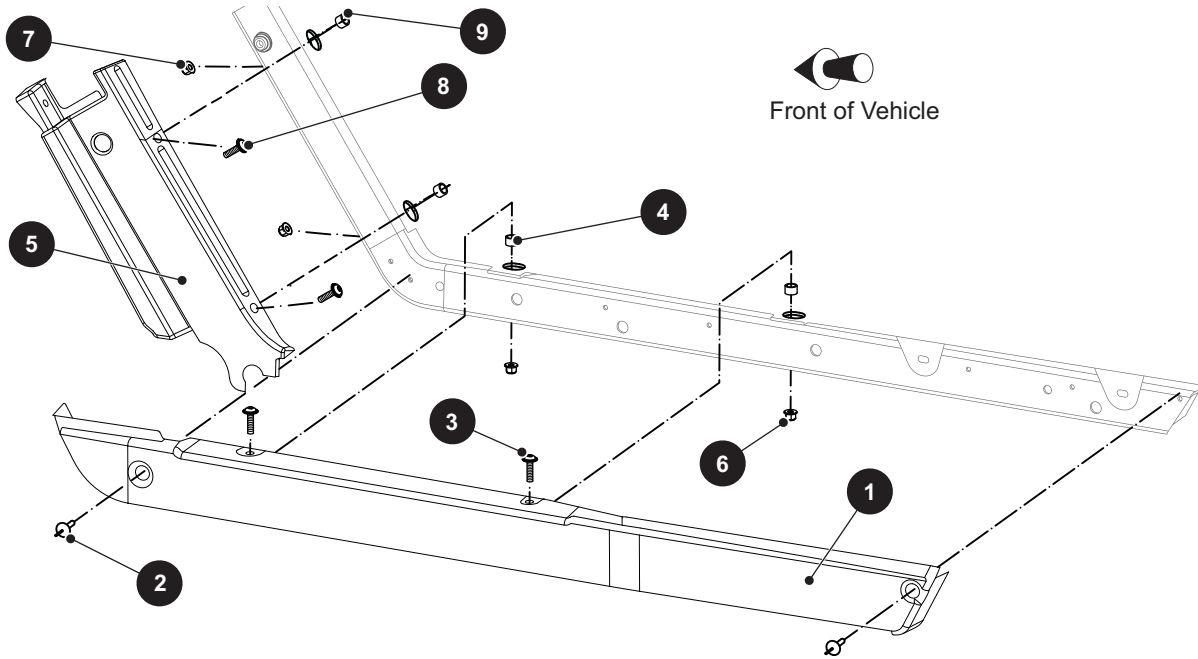


Figure 2 Rocker Panel

Gauge Panel Replacement

Tool List

	Qty
Torx Bit, T-30	1
Screwdriver, Straight Blade	1
Pliers, Needle Nose	1
Drill Bit	1
Bit Driver	1
Drill	1
Torque Wrench, in. lb.....	1

NOTICE: The gauge panel can be removed without removing the instrument panel.

WARNING To prevent personal injury, disconnect the negative (-) battery cable before servicing the vehicle.

Removal:

1. Remove the two screws (12) that secure the gauge panel (15) to the instrument panel (10).
2. Gently pry out the top of the gauge panel.
3. Remove the connections from the main electrical harness to the electrical accessories in the gauge panel.
4. Pull the bottom of the gauge panel away from and out of the instrument panel (Ref. Figure 3).

Assembly:

1. Connect the main harness to all electrical accessories in the gauge panel.
2. Push the body clips (11) through the instrument panel (10).

3. Install the two screws (8) and tighten to the torque values below.

Item	Torque Specification
8	18 - 26 in. lb (2 - 3 Nm)

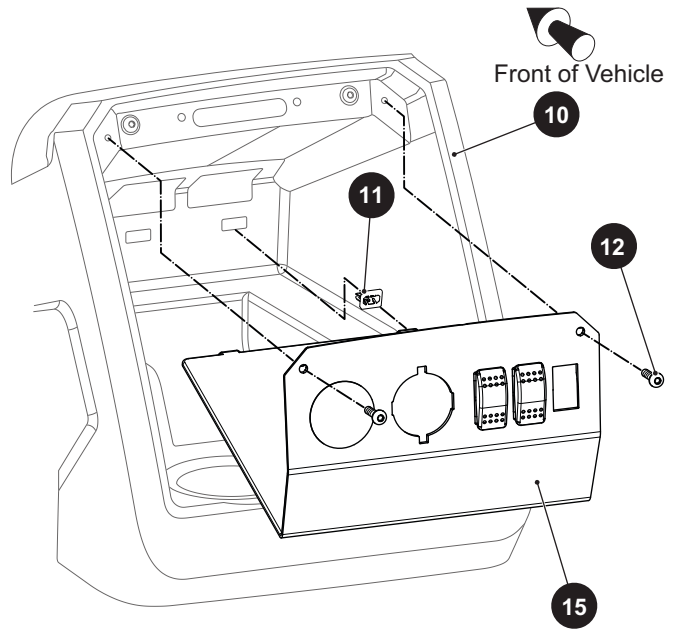


Figure 3 Gauge Panel

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Cowl Replacement

Tool List

	Qty
Drill Bit.....	1
Drill.....	1

1. Disconnect the wiring harness from the headlights.
2. Remove the screws (12) from the gauge panel (15) (See Gauge Panel Replacement on page 10).

3. Pull down the front of the gauge panel (15) and drill out the upper rivets (13) securing the cowl (20) to the instrument panel (10).
4. Drill out the remaining rivets (13) (Ref. Figure 4).
5. Remove the cowl assembly (20) from the vehicle.

Assemble in the reverse order of removal using new rivets.

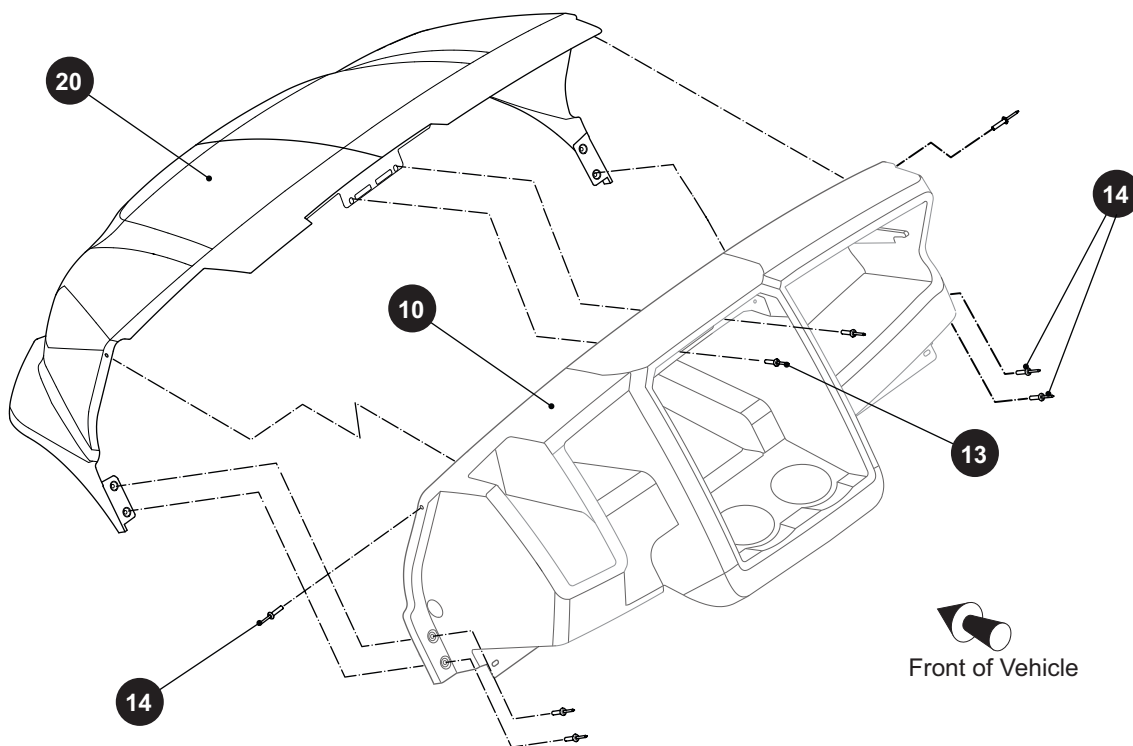


Figure 4 Cowl

Fascia Replacement

Tool List

	Qty
Socket, 3/8".....	1
Wrench, 3/8".....	1
Drill Bit.....	1
Drill.....	1
Ratchet.....	1
Torque Wrench, ft. lb.....	1

1. Remove the cowl (See Cowl Replacement on page 11).
2. Drill out the rivets (16) securing the sides of the fascia (25) to the mounting bracket (19).
3. Remove the screws (17) and washers (18) securing the front of the fascia (25) to the frame and place the horn out of the way.

4. If the mounting bracket (19) is damaged, remove it by removing the screws (21) securing it to the frame (Ref. Figure 5).

Assemble in the reverse order of removal using new rivets. Tighten all hardware to the torque values below.

Item	Torque Specification
17, 21	6 - 8 ft. lb (8 -10.5 Nm)

BODY

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Headlight Grille Replacement

Tool List

	Qty
Socket, 10 mm	1
Wrench, 10 mm	1
Ratchet	1
Pry Bar	1

1. Disconnect the wire harness from the headlight (23).
2. Remove the nuts (22) that secure the headlight grille (25) to the cowl (15).
3. Remove the headlight grille assembly (30) from the outside of the cowl (20). It may be necessary to gently pry the headlight grille assembly away from the cowl (Ref. Figure 6).

Assemble in the reverse order of removal. Tighten the nuts to the torque values below.

Item	Torque Specification
22	17- 25 in. lb (2 - 3 Nm)

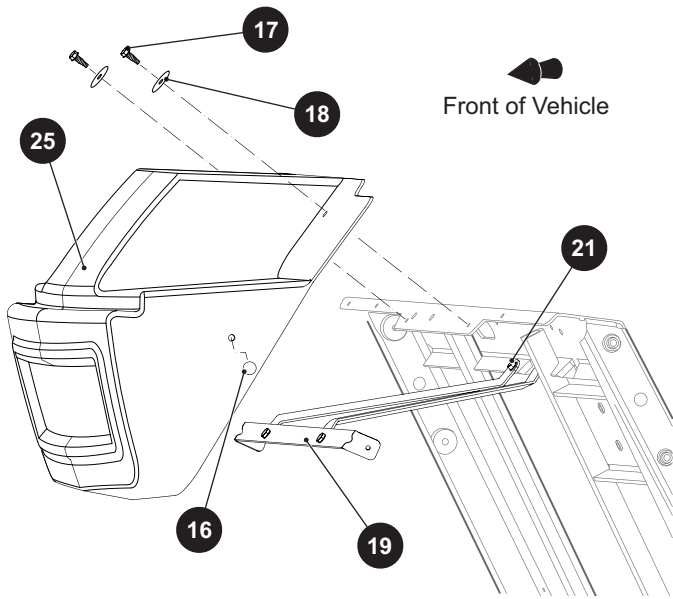


Figure 5 Fascia

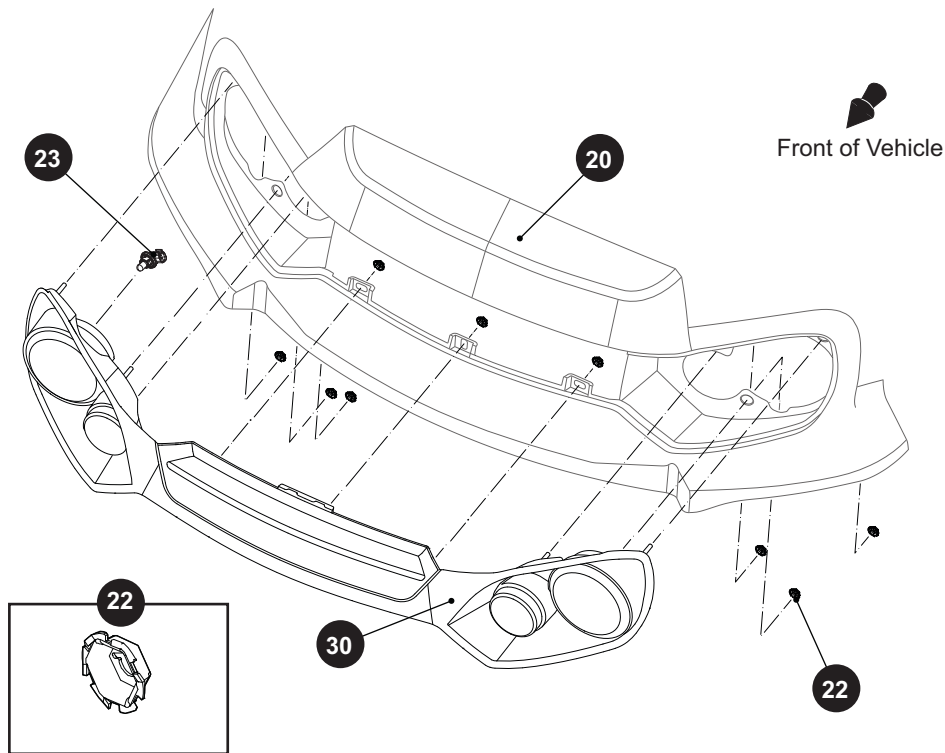


Figure 6 Headlight Grille

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Instrument Panel Replacement

Tool List

	Qty
Socket, 3/8"	1
Socket, 1/2"	1
Socket, 10 mm	1
Torx Bit, T-30	1
Wrench, 3/8"	1
Wrench, 1/2"	1
Wrench, 10 mm	1
Drill Bit	1
Drill	1
Ratchet	1
Torque Wrench, in. lb	1
Torque Wrench, ft. lb	1

1. Remove the rocker panels from the vehicle (See Rocker Panel Replacement on page 9).
2. Remove the cowl from the vehicle (See Cowl Replacement on page 11).

3. Drill out the rivets (27) securing the instrument panel (10) to the floor (Ref. Figure 7).
4. Remove the screws (34) securing the instrument panel (10) to the support weldment (30) (Ref. Figure 8).
5. Remove the self threading nuts (32) securing the instrument panel (10) to the support weldment (35).
6. If the support weldment (35) is damaged, remove it by removing the bolts (33) securing it to the frame.

Assemble in the reverse order of removal using new rivets. Tighten all hardware to the torque values below.

Item	Torque Specification
32	12 - 18 in. lb (1.3 - 2 Nm)
33	6 - 8 ft. lb (8 - 11 Nm)
34	25 - 40 in. lb (2.8 - 4.5 Nm)

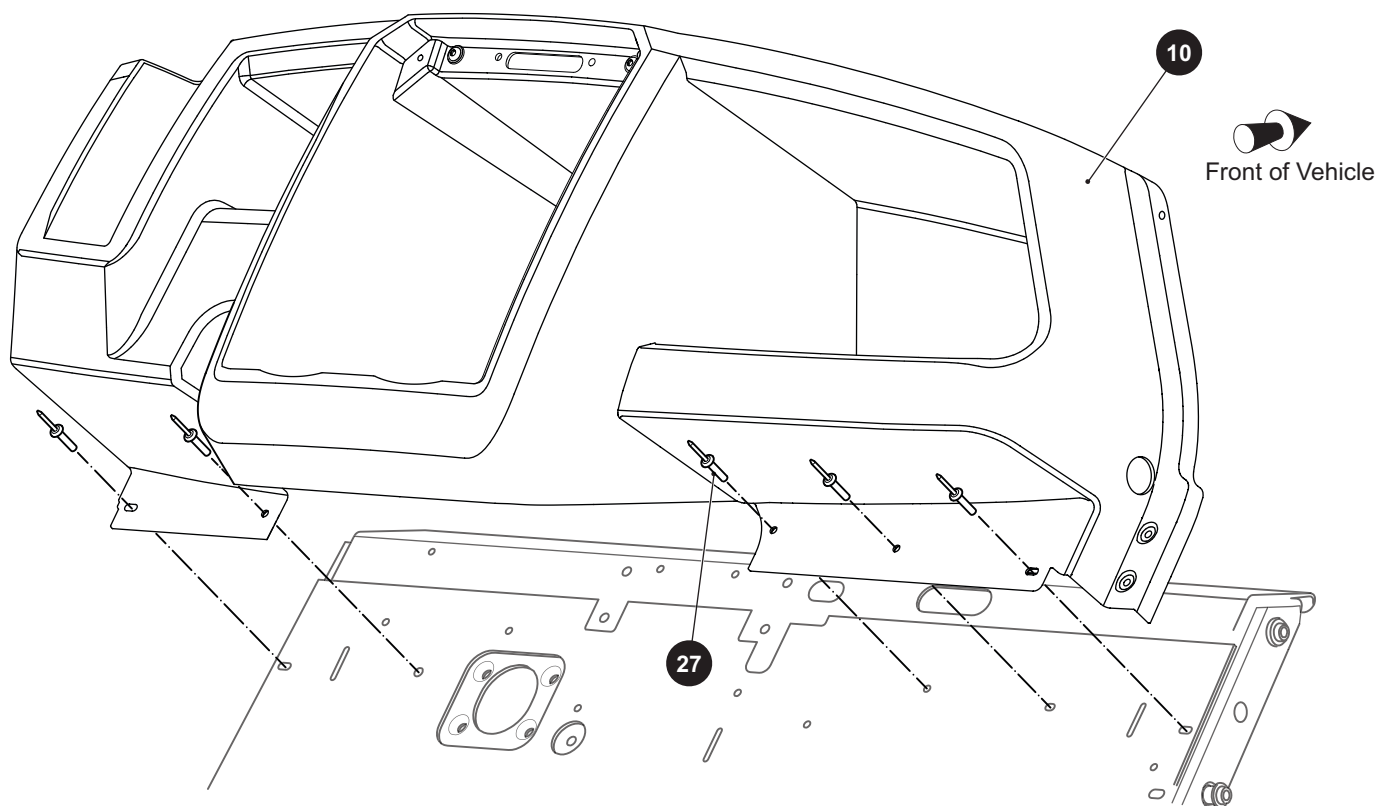


Figure 7 Instrument Panel (Front)

BODY

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

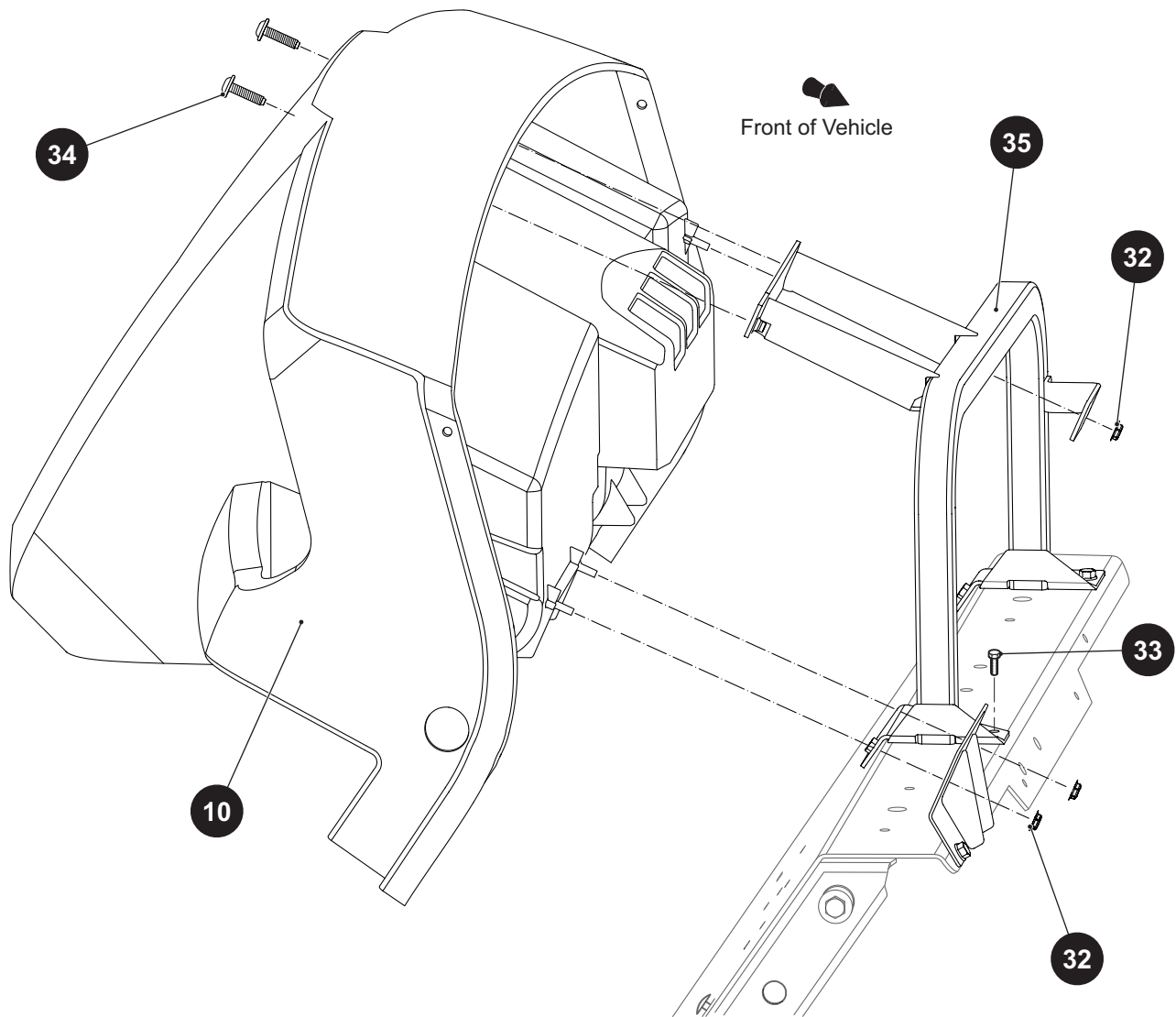


Figure 8 Instrument Panel (Back)

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Seat Wrap Removal

Tool List

	Qty
Torx Bit, T-30	1
Torx Bit, T-25	1
Drill Bit	1
Drill	1
Ratchet	1
Bit Driver	1
Torque Wrench, in. lb	1
Torque Wrench, ft. lb	1

1. Drill out the rivets (36) securing the top of the seat wrap front (45) to the frame and the bottom to the floor (Ref. Figure 9).
2. Drill out the rivets (53) securing the seat wrap sides to (40) the rear fenders (60) (Ref. Figure 11).

3. Drill out the rivets (37) securing the seat wrap sides (40) to the frame.
4. Remove the screws (38) securing the seat wrap front to the sides.
5. Remove the two screws (39) securing each seat wrap side (40) to the frame.

Assembly is in the reverse order of removal using new rivets. Tighten all hardware to the torque values below.

Item	Torque Specification
38	2 - 3 ft. lb (2.7 - 4 Nm)
39	13 - 18 in. lb (1.3 - 2 Nm)

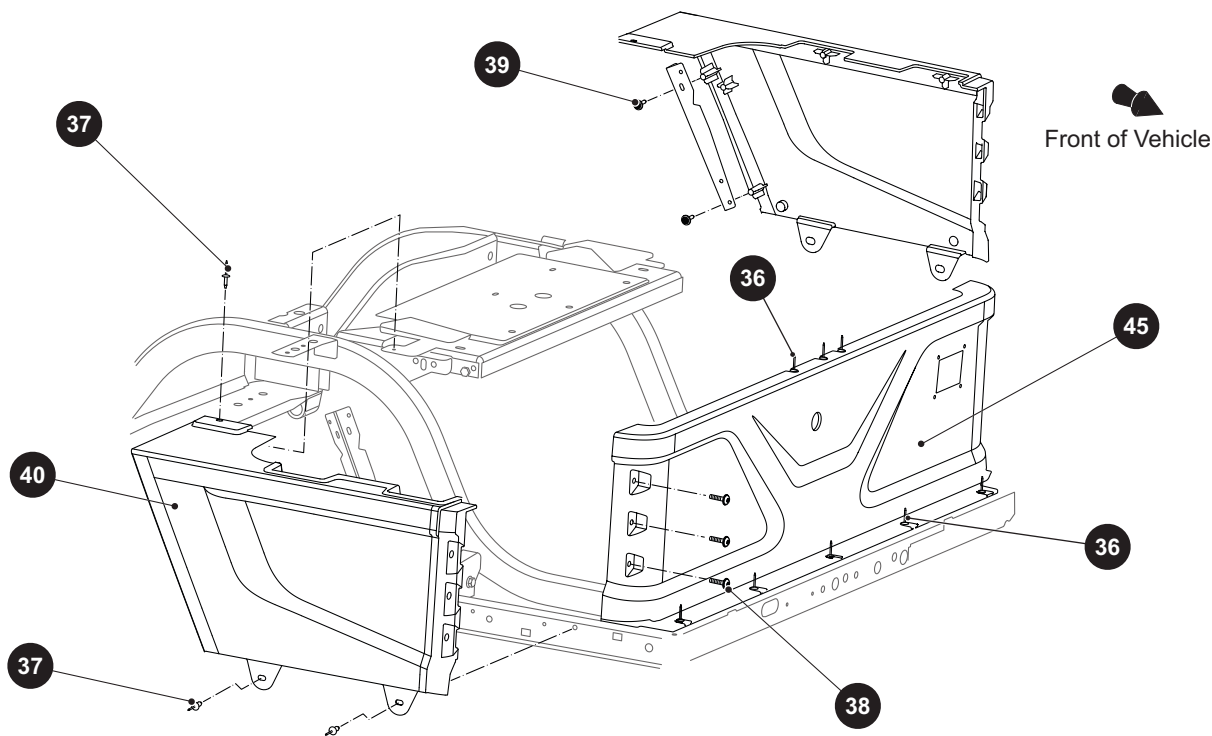


Figure 9 Seat Wrap

BODY

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Truck Bed Removal

Tool List

	Qty
Wrench, 1/2"	1
Crow's Foot Socket, 1/2"	1
Torque Wrench, ft. lb	1

- Remove the cotter pin (41) and clevis pin (46) from the top of the bed tether (47).
- Remove the cotter pins (41), washers (42), and clevis pins (48) securing the bed (50) to the hinges (43).
- Remove the truck bed from the vehicle.
- Inspect the bushings (49) for excessive wear and cracks and replace if necessary.

- Inspect the bed tether (47) for damage and replace it if necessary by removing the lower cotter pin (41) and clevis pin (51).
- Inspect the rubber bumpers (52) for excess wear and cracks and replace if necessary.

Assembly is in the reverse of removal. Tighten hardware to the torque values listed below.

Item	Torque Specification
42	15 - 18 ft. lb (2.7 - 4 Nm)

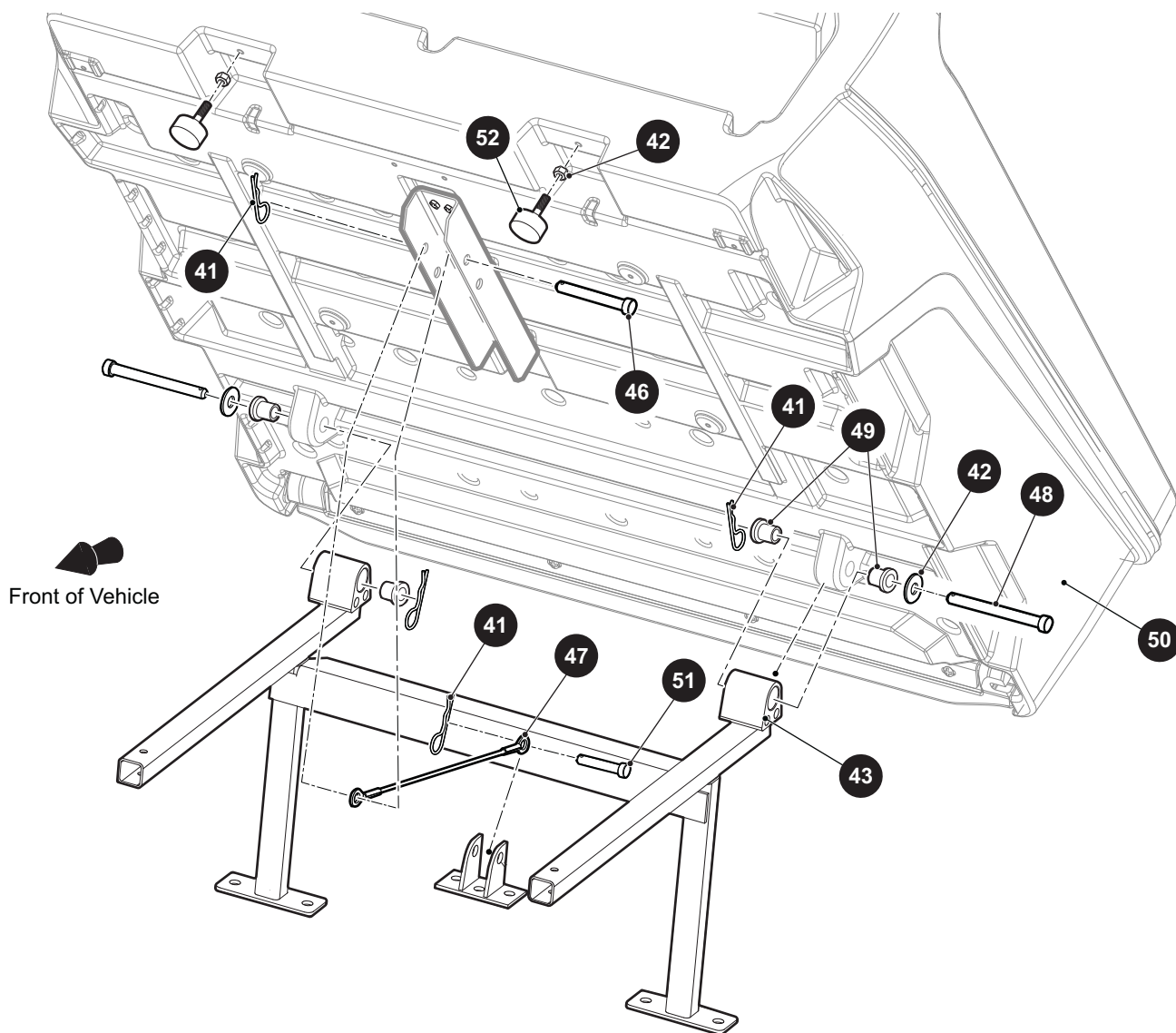


Figure 10 Truck Bed

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Rear Body Replacement

Tool List	Qty
Drill Bit.....	1
Drill.....	1
Pry Bar.....	1

1. Remove the truck bed (See Truck Bed Removal on page 16).
2. Drill out the rivets (53) securing the rear fender (60) to the seat wrap sides (40).
3. Drill out the rivets (54) securing the rear fender (60) to the rear valence (55).
4. Pry out the ratchet rivets (56) securing the rear fenders (66) the frame.
5. Repeat steps 2 through 4 to remove the opposite fender.
6. Remove the ratchet rivets (52) securing the rear valence (55) to the frame.

Assemble in the reverse order of removal using new rivets.

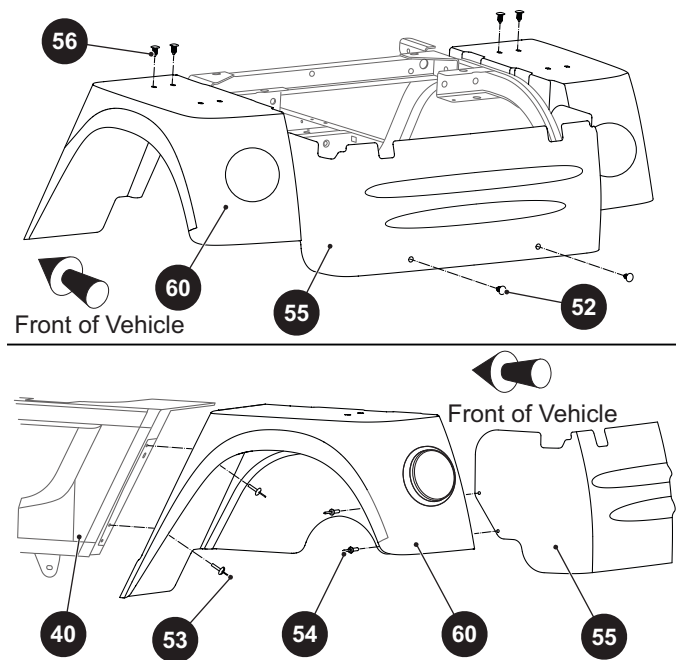


Figure 11 Rear Body Components

Hitch Receiver

Tool List	Qty
Socket, 1/2".....	1
Socket, 5/8".....	1
Wrench, 1/2".....	1
Wrench, 5/8".....	1
Ratchet.....	1
Screwdriver, Flat Blade.....	1
Torque Wrench, ft. lb.....	1

1. Remove the lock nut (63), washer (68), and screw (62) through the center of the hitch receiver (70).
2. Remove the lock nuts (64), washers (67), and bolts (61) securing the hitch receiver (70) to the frame (Ref. Figure 12).

Assemble in the reverse order of removal using new lock nuts. Tighten the lock nuts to the torque values below.

Item	Torque Specification
63	10 - 14 ft. lb (13.5 - 19 Nm)
64	45 - 50 ft. lb (61 - 68 Nm)

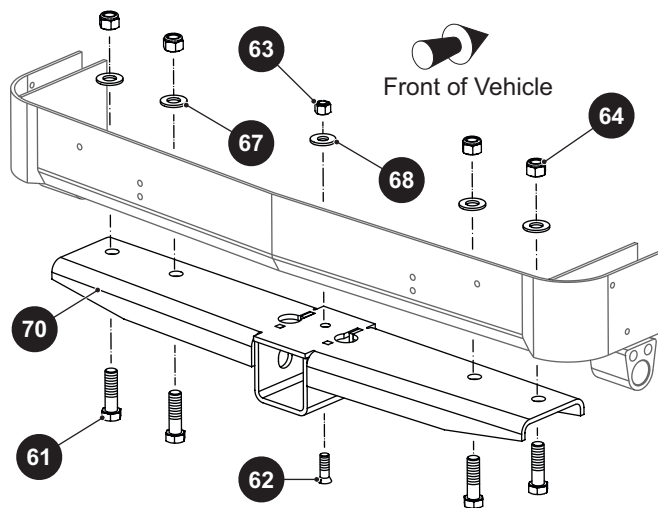


Figure 12 Hitch Receiver

BODY

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Seat Back

Tool List

	Qty
Wrench, 7/16"	1
Socket, 7/16"	1
Ratchet	1
Torque Wrench, ft. lb	1

Remove the bolts (71), lock washers (72), and flat washers (73) securing the seat back (75) to the support (80) (Ref. Figure 13).

Assemble in the reverse order of removal. Tighten the bolts (71) to the torque values below.

Item	Torque Specification
71	13 - 15 ft. lb (17.5 - 20 Nm)

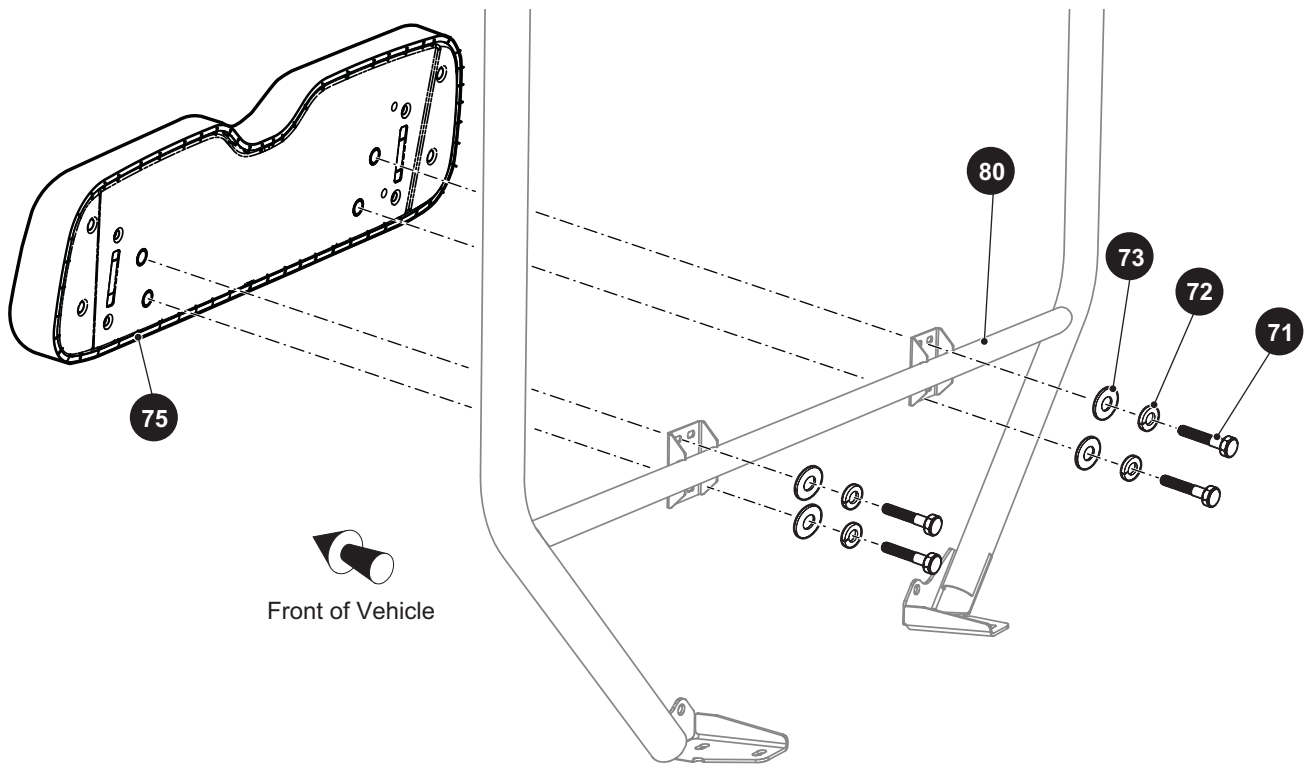


Figure 13 Seat Back Support and Support Bracket

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Brush Guard

Tool List

	Qty
Socket, 15 mm	1
Wrench, 15 mm	1
Ratchet	1
Torque Wrench, ft. lb	1

1. Remove the lock nuts securing the brush guard to the OPS.
2. Secure the brush guard to the OPS using new lock nuts.
3. Tighten the lock nuts to the torque values below.

Item	Torque Specification
83	45 - 50 ft. lb (61 - 68 Nm)

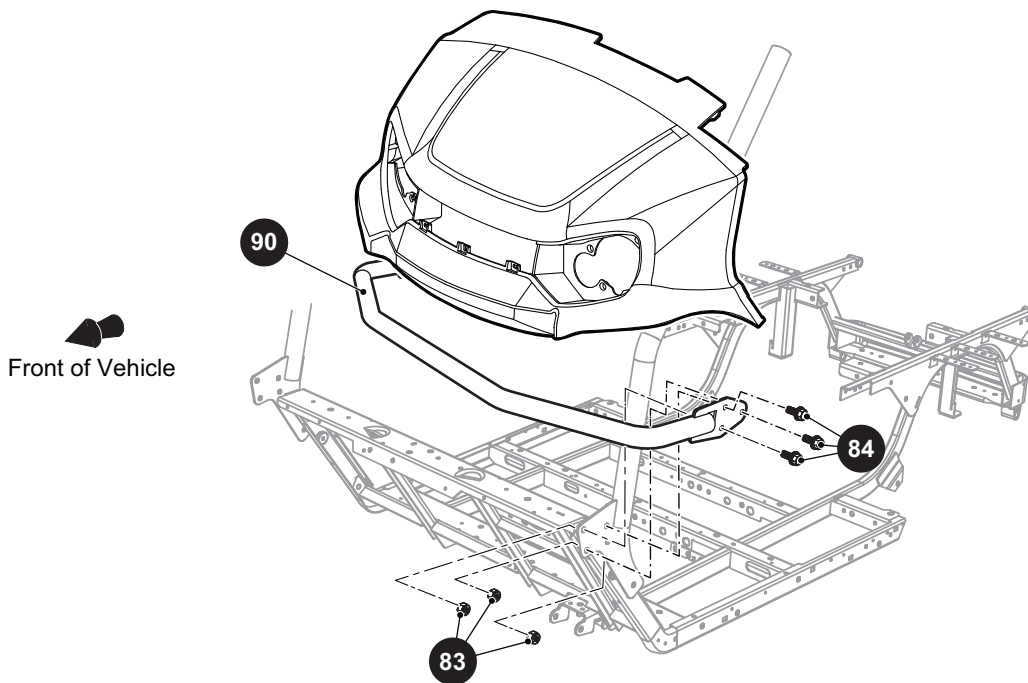


Figure 14 Brush Guard

BODY

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

PAINTING

Follow the paint manufacturer's recommendations for specific painting procedures and information.

⚠ WARNING *All painting must be done in an area with adequate ventilation to safely disperse harmful vapors.*

Wear eye protection and a respirator, following manufacturers instructions to protect from overspray and air borne mist.

⚠ CAUTION *Provide protection from overspray to vehicle and surrounding area.*

Minor Scratches

For minor scratches, the manufacturer suggests the following steps be taken to repair the Durashield™ body:

1. Thoroughly clean the surface to be repaired with alcohol and dry.
2. Touch up the damaged area with sequential coats using brush on touch-up paint, until coating layer is visible, slightly above the surface of the part. Two coats minimum are recommended, allowing 30 - 45 minutes between coats, increasing to 45 - 60 minutes in higher humidity.
3. Use 400 grit "wet" sand paper to blend the touch up area level with the rest of the part being repaired.
4. Use a polishing compound (3M Finesse or automotive grade) to renew gloss and to further blend and transition newly painted surface.
5. Clean with alcohol and dry.
6. (Optional but recommended) Follow this process with a clear coat to renew and protect the depth of the finish.
7. Wax or polish with a Carnauba base product available at any automotive parts distributor.

Larger Scratches

For larger scratches, the manufacturer suggests the following steps be taken to repair the Durashield™ body:

1. Thoroughly clean the surface to be repaired with alcohol and dry.
2. Mask the area to be painted (common masking tape is adequate) prior to repair and use aerosol type touch-up paint.
3. Apply spray touch up paint in light, even, overlapping strokes. Multiple coats may be applied to provide adequate coverage and finish. Always remember to shake the can for a minimum of one minute to mix the paint and achieve the best color match.
4. After painting, allow to dry overnight.

5. Smooth the mask lines using 400 grit "wet" sand paper to blend the touch up area level with the rest of the part being repaired.
6. Use a polishing compound (3M Finesse or automotive grade) to renew gloss and to further blend and transition newly painted surface.
7. Clean with alcohol and dry.
8. (Optional but recommended) Follow this process with a clear coat to renew and protect depth of finish.
9. Wax or polish with a Carnauba base product available at any automotive parts distributor.

Complete Panel Repair

In situations where large panels or areas must be painted, touch up paint is not recommended. In such cases professional painting or panel replacement is called for. The manufacturer suggests body panel replacement be considered as a cost effective alternative to painting. If the decision to repaint is taken, the task can be accomplished by any paint and body shop with experience in painting 'TPE' panels. TPE is a common material in modern automobile bodies and all body shops should be familiar with the materials and processes required.

The finish will include an application of a primer coat, a base color coat and a clear coat. The manufacturer does not supply these materials due to the variety of paint manufacturers and the preferences of the individual painter.

Most paint manufacturers can perform a computer paint match to assure accurate color matching.

WHEELS AND TIRES

WHEEL AND TIRE SERVICE

Tools List	Qty.
Lug Wrench, 3/4"	1
Impact Wrench.....	1
Impact Socket, 3/4".....	1
Torque Wrench, ft. lb.....	1

⚠ WARNING *To prevent injury caused by a broken socket, use only sockets designed for impact wrench use. Never use a conventional socket.*

Tire condition should be inspected per the Periodic Service Schedule (See SCHEDULED MAINTENANCE CHART on page 6). Inflation pressures should be checked when the tires are cool. When removing wheels with an impact wrench, use only impact sockets. Regular sockets are not designed for impact pressures exerted by power tools.

⚠ WARNING *A tire explosion can cause severe injury or death. Never exceed inflation pressure rating on tire sidewall.*

To prevent tire explosion, pressurize tire with small amount of air applied intermittently to seat beads. Never exceed the tire manufacturer's recommendation when seating a bead. Protect face and eyes from escaping air when removing valve core.

Use caution when inflating tires. Due to the low volume of these small tires, over-inflation can occur in a matter of seconds. Over-inflation could cause the tire to separate from the wheel or cause the tire to explode, either of which could cause personal injury.

Do not use low inflation pressure tires on this vehicle. Do not use any tire which has a recommended inflation pressure less than 18 psi (124 kPa).

Use caution when inflating tires. Due to the low volume of these small tires, over inflation can occur in a matter of seconds. Over inflation could cause the tire to separate from the rim or cause the tire to explode, either of which could cause personal injury.

Tire inflation should be determined by the condition of the terrain(See VEHICLE SPECIFICATIONS on page 119). For outdoor applications with major use on grassy areas, the following should be considered. On hard turf, it is desirable to have a **slightly** higher inflation pressure. On very soft turf, a lower pressure prevents tires from cutting into the turf. For vehicles being used on paved or hard surfaces, tire inflation pressure should be in the higher allowable range, but under no condition should inflation pressure be higher than recommended on tire sidewall. **All four tires** should have the same pressure for optimum handling characteristics. Be careful not to over-inflate. Due to the low volume of these small tires, over-inflation can occur in a matter of seconds. Be sure to

install the valve dust cap after checking or inflating.

Tire Repair

The vehicle is fitted with low pressure tubeless tires mounted on one piece rims.

Generally, the most cost effective way to repair a flat tire resulting from a puncture in the tread portion of the tire is to use a commercial tire plug.

NOTICE: *Tire plug tools and plugs are available at most automotive parts outlets and have the advantage of not requiring the tire be removed from the wheel.*

If the tire is flat:

1. Remove the wheel.
2. Inflate the tire to the maximum recommended pressure for the tire.
3. Immerse the tire in water to locate the leak and mark with chalk.
4. Insert tire plug in accordance with manufacturer's specifications.

If tire is to be removed or mounted, the tire changing machine manufacturer's recommendations must be followed in order to minimize possibility of personal injury.

⚠ WARNING *To prevent injury, be sure mounting/demounting machine is anchored to floor. Wear OSHA approved safety equipment when mounting/demounting tires.*



Follow all instructions and safety warnings provided by the mounting/demounting machine manufacturer.

WHEEL INSTALLATION

⚠ CAUTION *Do not tighten lug nuts (1) to more than 85 ft. lb (115 Nm) torque.*

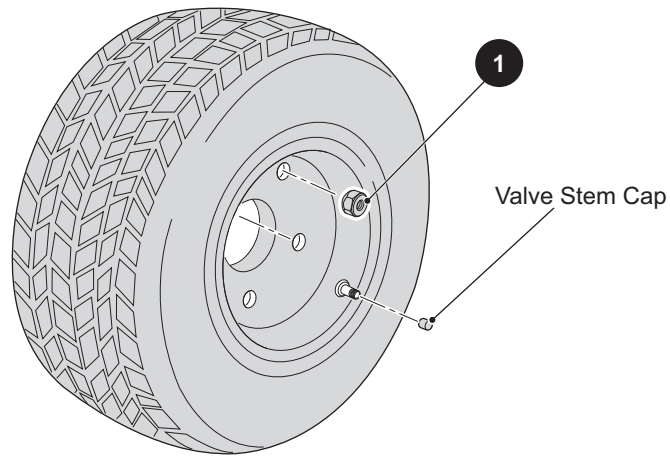
NOTICE: *It is important to follow the 'cross sequence' pattern when installing lug nuts. This will assure even seating of the wheel against the hub.*

1. With the valve stem to the outside, mount the wheel onto the hub with lug nuts (1).
2. Finger tighten lug nuts (1) as shown.
3. Tighten lug nuts to 50 - 85 ft. lb (70 - 115 Nm) torque in 20 ft. lb (30 Nm) increments following the same pattern.

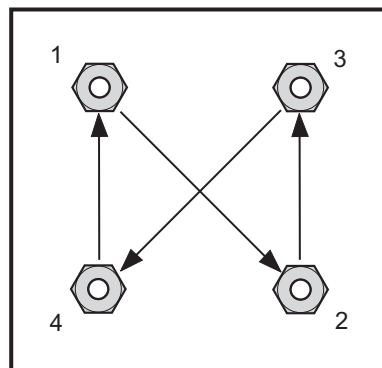
Item	Torque Specification
1	50 - 85 ft. lb (70 - 115 Nm)

WHEELS AND TIRES

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.



Tire style may vary



Cross Sequence

Figure 1 Wheel and Tire Installation

FRONT SUSPENSION, STEERING, & AXLE

MAINTENANCE

Routine maintenance of the front suspension and steering consists of:

- periodic inspections for loose, worn or damaged components
- alignment checks
- lubrication of ball joints and wheel bearings

Be sure to use only the recommended lubricants. Maintain correct adjustment of the front bearings and repack in accordance with the Periodic Service Schedule or if a bearing replacement is required. Routine examination of the tires will provide indications if an alignment is required (See SCHEDULED MAINTENANCE CHART on page 6).

Lubrication

Tool List

	Qty.
Grease Gun	1
Shop Towels	AR

Grease the rack ball joint (1). Wipe off old grease and dirt from the grease fitting and do not use more than three (3) pumps of grease in any grease fitting. Wipe off any grease that is forced out of rubber boot (Ref. Figure 1).

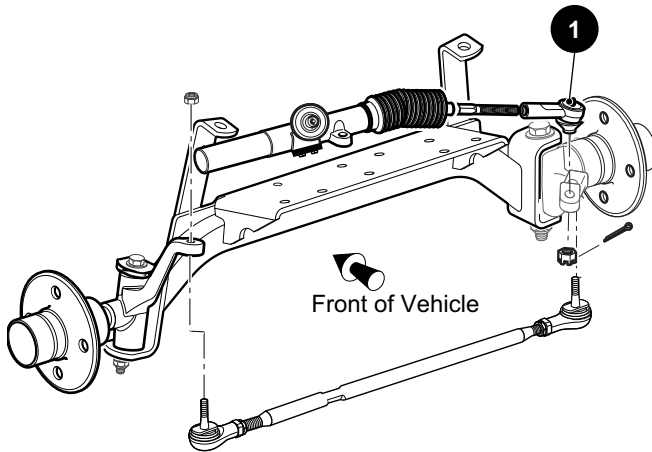


Figure 1 Lubrication Points

CAUTION Do not use more than three (3) pumps of grease in any grease fitting at any one time. Excess grease may cause grease seals to fail or grease migration into areas that could damage components.

Wheel Bearing and King Pin Bushing Inspection

WARNING To prevent possible injury or death resulting from a vehicle falling from a jack, follow the lifting procedure. Be sure vehicle is on a firm and level surface (See LIFTING THE VEHICLE on page 8).

Never get under a vehicle while it is supported by a jack. Use jack stands and test the stability of the vehicle on stands before beginning any repair procedure. Always place chocks in front and behind wheels not being raised. Use extreme care since the vehicle is extremely unstable during the lifting process.

Lift the front of the vehicle and support on jack stands (See LIFTING THE VEHICLE on page 8). Rotate the front wheel and feel for any roughness. While holding the spindle with one hand, grasp the bottom of the tire with the other hand and rock the tire back and forth on the spindle.

NOTICE: Some minor rocking movement of tire is normal.

If excess movement is detected, the wheel bearing may require repacking and adjusting or replacement (See Wheel Bearing Packing on page 23) (See Wheel Bearing and Race Replacement on page 29).

If excess movement is detected and the wheel bearing is in good condition a worn spindle bearing is indicated. The spindle bearings can not be replaced, the spindle with bearings installed is available through service parts (See Spindle Replacement on page 34).

Wheel Bearing Packing

Tool List

	Qty.
Grease Gun	1
Bearing Packer (Recommended).....	1

Remove the hub from the spindle and disassemble (See Hub Replacement on page 28).

Clean all bearings, grease seal and hub in solvent and dry thoroughly. Inspect for signs of damage. Pitting or a blue coloration of the rollers will require replacement of the bearing. If the roller portion of the bearing is to be replaced, the race must also be replaced (See Wheel Bearing and Race Replacement on page 29).

The front wheel bearings are tapered roller type and must be packed with grease at installation or any time the bearing is removed for inspection. It is recommended that a bearing packer attached to a grease gun be used; however, manual packing is acceptable if done correctly. To pack a bearing manually requires that a dab of grease be placed in the palm of the hand and the bearing be

FRONT SUSPENSION & STEERING

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

dipped in the grease. Force the grease up through and around all of the rollers until the entire bearing is saturated in grease.

NOTICE: Once the hub is placed onto the spindle and before outer the wheel bearing is installed, fill the area between the inner and outer wheel bearings about 1/2 - 3/4 full with grease.

Wheel Bearing Adjustment

Tool List	Qty.
Socket, 1 1/2"	1
Lug Wrench, 3/4"	1
Ratchet	1
Pliers, Needle Nose	1
Torque wrench, ft. lb	1
Torque wrench, in. lb	1

1. If performing a wheel bearing adjustment only, lift and support front of vehicle (See LIFTING THE VEHICLE on page 8).
2. Remove the cotter pin (2) and loosen the castellated nut (3).
3. If performing a wheel bearing adjustment as part of another procedure, make sure the wheel is mounted to the hub hand tight with lug nuts (4) and the hub is loosely retained on the spindle (5) with the castellated nut (Ref Fig. 16).
4. Seat the bearings by rotating the wheel while tightening the castellated nut until slight resistance is felt.
5. Rotate the wheel 2 - 3 more turns to displace excess grease. If required, tighten the castellated nut (3) again until slight resistance is felt. If the cotter pin hole in the spindle (5) aligns with a slot in the castellated nut, insert a new cotter pin (2). If the hole does not align, the castellated nut must be **loosened** to align with the **closest available** slot in the nut.
6. Check for smooth and free rotation of the wheel and an absence of play when the wheel is grasped by the outside of the tire.
7. Bend the cotter pin (2) against the flats of the castellated nut (3).
8. If completing a wheel bearing adjustment as part of another procedure, tighten the front wheels (See WHEEL INSTALLATION on page 21).

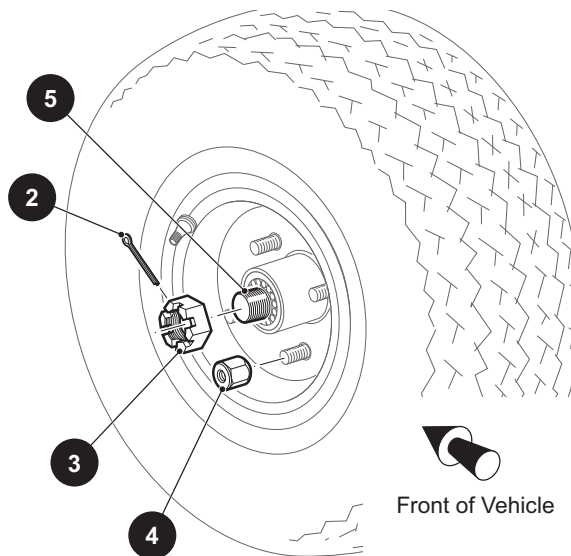


Figure 2 Bearing Adjustment

Wheel Alignment

Tool List	Qty.
Wrench, 3/4"	1
Wrench, 1/2"	1
Wrench, 14mm.....	1
Crowfoot Socket, 3/4"	1
Socket, 13 mm	1
Ratchet	1
Tape Measure	1
Chalk.....	1
Torque Wrench, ft. lb.....	1

1. Lift and support the front of the vehicle (See LIFTING THE VEHICLE on page 8).
2. Confirm the alignment of the front springs (Ref. Figure 7).
3. Rotate each wheel and scribe a chalk line around the circumference of the tire at the center of the tread pattern.
4. Lower the vehicle and, with tires in the straight ahead position, roll it forward approximately five feet in order to allow the tires to take their normal running position.
5. Measure the distance between the chalk lines at both the front and the rear of the tires (Ref. Figure 3).
6. The measurement taken at the front of the tires should be 0" - 1/8" (0 - 3 mm) less than the rear.

FRONT SUSPENSION & STEERING

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

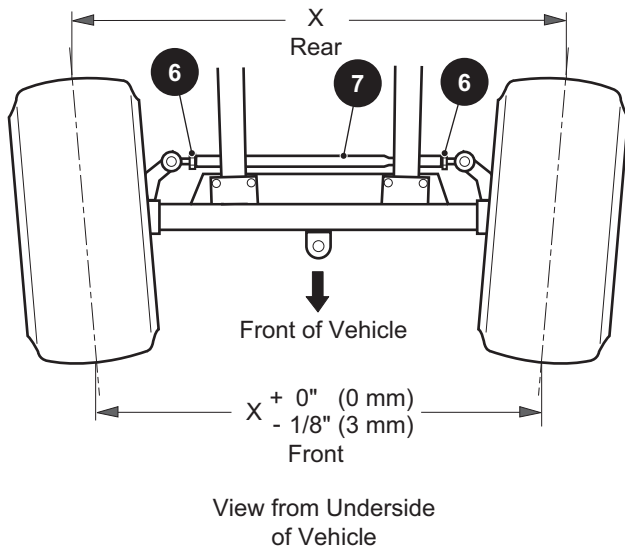


Figure 3 Wheel Alignment

NOTICE: To hold the threaded tube while loosening the jam nut, use a wrench on the center, flat section of the tube.

The tie rod has different threads on each end. It is adjusted in the same manner as a turnbuckle. The end with the flat area on the threaded tube has left hand threads (clockwise to loosen) while the end without the flat has conventional right hand threads (counter-clockwise to loosen).

7. To adjust the wheel alignment, loosen the tie rod jam nuts (6) and turn the tie rod (7) until the correct alignment is achieved.
8. Tighten the jam nuts to the torque values below.

Test drive the vehicle and confirm the steering wheel is correctly centered. If it is not centered, proceed below.

9. Remove the bolt (8) connecting the intermediate shaft to the steering shaft and center the steering wheel (Ref. Figure 4).
10. Reconnect the intermediate shaft and tighten the bolt to the torque values below.

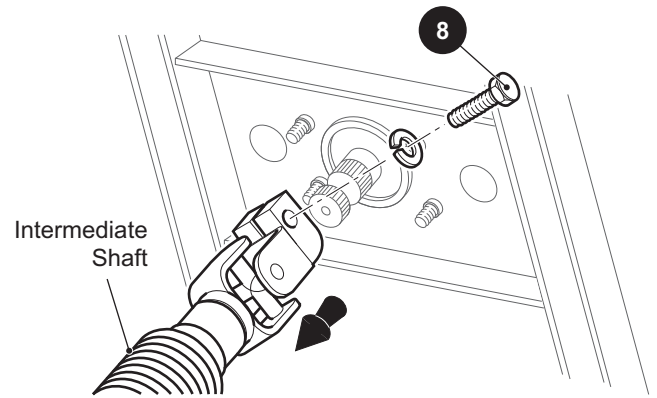


Figure 4 Intermediate Shaft to Steering Shaft

Item	Torque Specification
Jam Nut	36 - 40 ft. lb (49 - 54 Nm)
8	13 - 18 ft. lb (18-24 Nm)

FRONT SUSPENSION & STEERING

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

FRONT SUSPENSION

Front Shock Absorber Replacement

Tool List	Qty.
Wrench, 1/4"	1
Wrench, 9/16"	1

1. Remove the vinyl cap (6), nut (12), concave washer (11), and rubber bushing (9) from the bottom of the shock absorber (10) at the front axle.
2. Compress the shock absorber to clear the mounting bracket.
3. Remove the nut from the top of the shock absorber at the frame.
4. Remove the shock absorber.

Assemble in the reverse order of removal. The mounting nuts should be tightened until the rubber bushings (9) expand to the diameter of the concave washers (11).

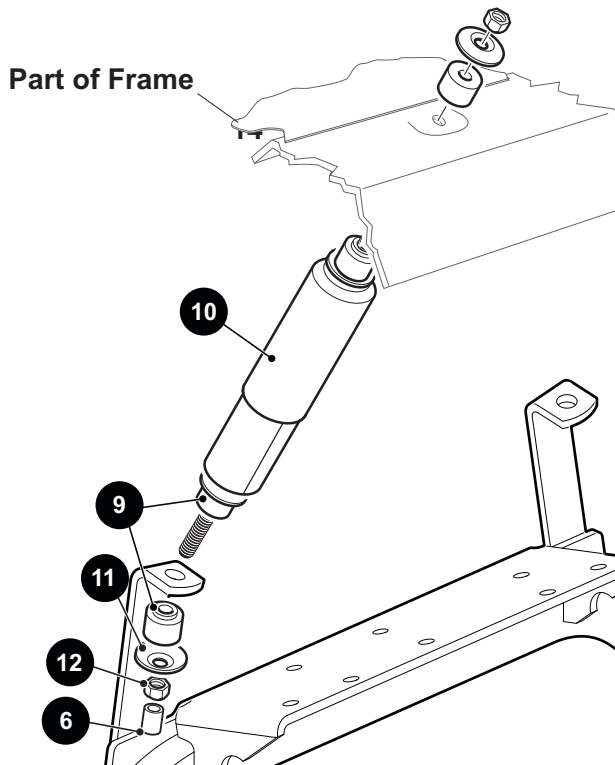


Figure 5 Shock Absorber

Front Spring Replacement

Tool List	Qty.
Floor Jack	1
Jack Stands	4
Ratchet	1
Socket, 3/4"	1
Socket, 5/8"	1
Wrench, 5/8"	1
Torque Wrench ft. lb.	1
Tape Measure	1

NOTICE: Failure of a single spring will result in overstressing the other spring; therefore, always replace the front springs as a set.

The following procedure will replace one spring at a time.

1. Loosen the front wheels.
2. Lift and support front of vehicle (See LIFTING THE VEHICLE on page 8)
3. Remove the front wheels.

To detach the driver side spring (20):

1. Fully loosen the two lock nuts (16) on the bellows end of the rack and pinion unit (15) until only one thread is engaged (Ref. Figure 6).
2. Remove the lock nut (19) and washers (14) from the long bolt (47). The rack and pinion unit (15) is now loose.
3. Remove the bolts (18) and lock nuts (34) securing the front of the driver side spring (20) to the axle.
4. Hold the nut (21) with a wrench and loosen the long bolt (47). Note the location of the washer (22) and thread the long bolt out as far as possible to remove the washer, nut and spacer (23).
5. Remove the long bolt (47) and spring plate (26) from the axle and spring (20).
6. Pull the upper driver side of the floor mat out of the plastic trim retainer and away from the floor.
7. Remove the lock nuts (27), bolts (29), and spring plate (31) securing the rear of the spring (20) to the vehicle frame.

CAUTION To prevent stress and possible damage to the rack and pinion unit, the driver side spring must be mounted to the axle with the hardware installed in its original location (Ref. Figure 6).

Installation is the reverse order of removal:

- Make sure to install the long bolt (47), spring plate (26), spacer (23), nut (21) and washer (22) in their original locations.
- Use new lock nuts (16, 19, 27) and wait to torque the hardware until after both springs are aligned.

FRONT SUSPENSION & STEERING

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

To detach passenger side spring (25):

1. Remove the lock nuts (33), bolts (17), and spring plate (26) securing the front of the passenger side leaf spring (25) to the axle (Ref. Figure 6).
2. Pull the upper passenger side of the floor mat out of the plastic trim retainer and away from the floor.
3. Remove the lock nuts (28), bolts (24), and spring plate (32) securing the rear of the spring (25) to the vehicle frame.

Installation is in the reverse order of removal using new lock nuts (33, 28).

NOTICE: After the springs are replaced, the axle will need to be aligned to the frame. Unless the axle has been replaced, wheel alignment will not be affected; however, it is always good practice to check wheel alignment any time the front-end components are replaced or adjusted.

After installation:

1. Measure the distance from the center bolt at the rear of the left spring to the center bolt at the front of the right spring (Ref. Figure 7).
2. Measure the distance from the center bolt at the rear of the right spring to the center bolt at the front of the left spring.

NOTICE: The two measurements must be equal.

3. Tighten the spring hardware (27, 28, 33, 34) first and the rack and pinion unit hardware (16, 19) next. Tighten all hardware to the torque values below.

Item	Torque Specification
16, 19, 27, 28, 33, 34	35 - 50 ft. lb (47 - 67 Nm)

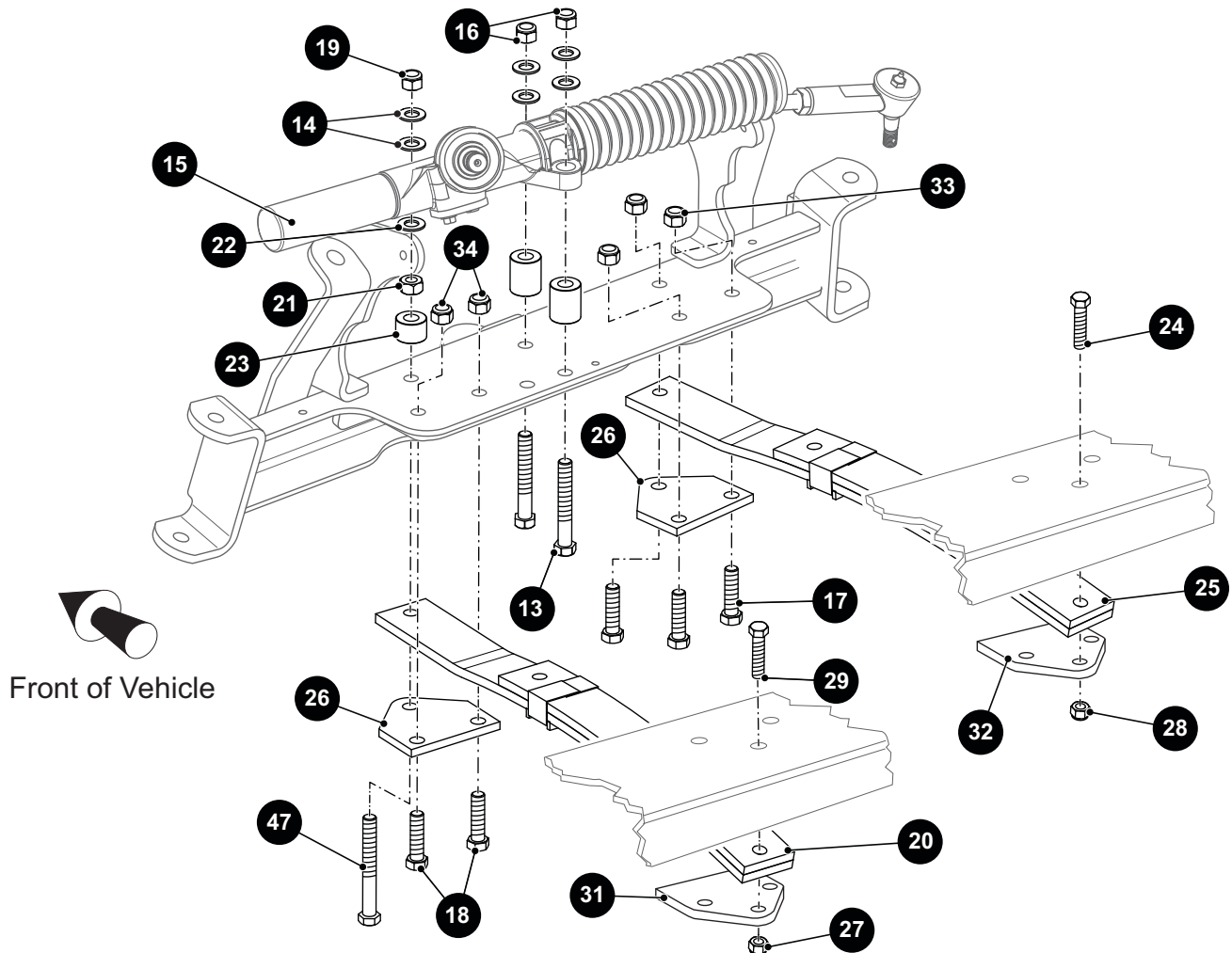


Figure 6 Leaf Springs

FRONT SUSPENSION & STEERING

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

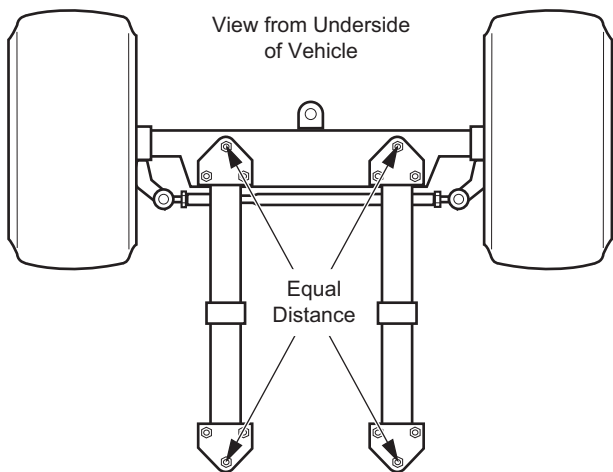


Figure 7 Front Axle Alignment

4. Replace the upper portion of the floor mat in the plastic trim retainers.
5. Install the front wheels (See WHEEL INSTALLATION on page 21) and lower the vehicle.
6. Check the front wheel alignment and adjust if necessary (See Wheel Alignment on page 24).

Hub Replacement

Tool List	Qty.
Socket, 3/4"	1
Ratchet	1
Straight Blade Screwdriver	1
Ball Peen Hammer	1
Needle Nose Pliers	1
Socket, 1 1/2"	1
Wheel Bearing Grease	AR
Seal Driver	1

1. Loosen the front wheel(s).
2. Lift and support the front of the vehicle and remove the front wheel(s) (See LIFTING THE VEHICLE on page 8).
3. Remove the cotter pin (37) and castellated nut (38) (Ref. Figure 8).
4. While holding the outer wheel bearing (41) in place, slide the hub (30) from the spindle (35).
5. Clean the spindle and new hub thoroughly with solvent.
6. Pack the new bearings with grease (See Wheel Bearing Packing on page 23).
7. Apply a light coat of grease to the inner race and place the inner wheel bearing (39) in the hub.
8. Orient the new grease seal (36) so that the flange side of the seal is facing into the bore.

9. Tap gently into place until the seal is flush with the end of the hub.
10. Lubricate lips of seal and spindle with grease (Ref. Figure 9).
11. Place the new hub (30) onto the spindle (35) and fill the area between the two wheel bearings about 1/2 - 3/4 full with grease and apply a light coating to the outer bearing race.
12. Install the outer wheel bearing (41) and secure the hub (30) loosely with the castellated nut (37).
13. Place the wheel onto the hub and hand tighten the lug nuts.

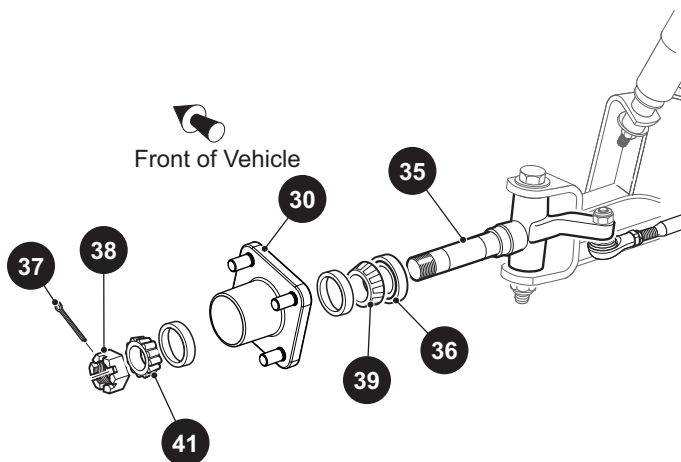


Figure 8 Hub Replacement

14. Adjust the bearing (See Wheel Bearing Adjustment on page 24).
15. Lower the vehicle and tighten front wheel(s) (See WHEEL INSTALLATION on page 21).

- A - Install this side of seal into housing
- B - Lubricate lip of seal

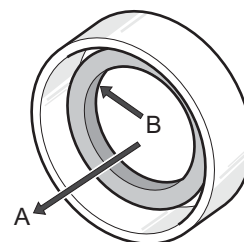


Figure 9 Seal Installation

FRONT SUSPENSION & STEERING

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Wheel Bearing and Race Replacement

Tool List	Qty.
Arbor Press	1
Bearing Driver	1
Non-Ferrous Punch	1
Ball Peen Hammer	1

1. Remove the hub (30) from the spindle (See Hub Replacement on page 28).
2. Remove the grease seal (36) and inner wheel bearing (39).
3. Use an arbor press and bearing driver to press out the bearing races.
4. If an arbor press is not available, tap the bearing race using a hammer and a soft non-ferrous punch through the other side of hub. Tap the race in a circular pattern while moving from side to side to avoid damaging the bore of the hub.
5. Clean the outer wheel bearing (41), inner wheel bearing (39) and hub in solvent and dry thoroughly.
6. Inspect for signs of damage. Pitting or a blue coloration of the rollers requires replacement of the bearing. If the roller portion of the bearing is to be replaced, the race must also be replaced.
7. Make sure the bore of the hub (30) is clean and place the new race (42) over the bore of the hub.
8. Press the new race into the hub using an arbor press and a bearing driver.
9. If an arbor press is not available, evenly tap with a hammer and a bearing driver to drive race fully into the bore.
10. Repeat on the other side of the hub.
11. Clean the spindle (35) and pack the new bearings with grease (See Wheel Bearing Packing on page 23).
12. Install the inner wheel bearing (39) and new grease seal in the hub.
13. Mount the hub to the spindle (See Hub Replacement on page 28).
14. Adjust the bearing (See Wheel Bearing Adjustment on page 24).
15. Lower the vehicle and tighten the front wheel(s) (See WHEEL INSTALLATION on page 21).

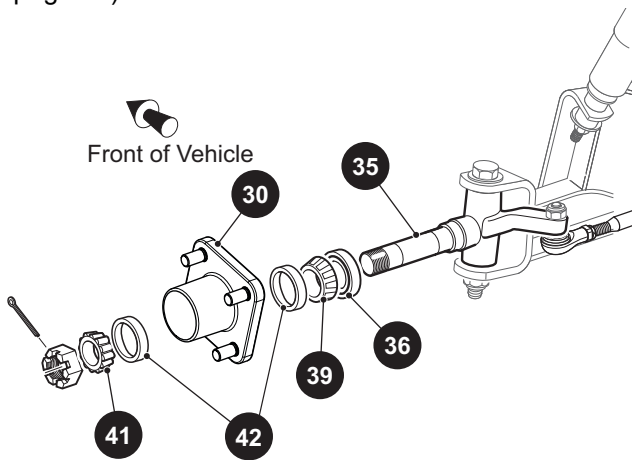


Figure 10 Wheel Bearing Replacement

FRONT SUSPENSION & STEERING

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

STEERING

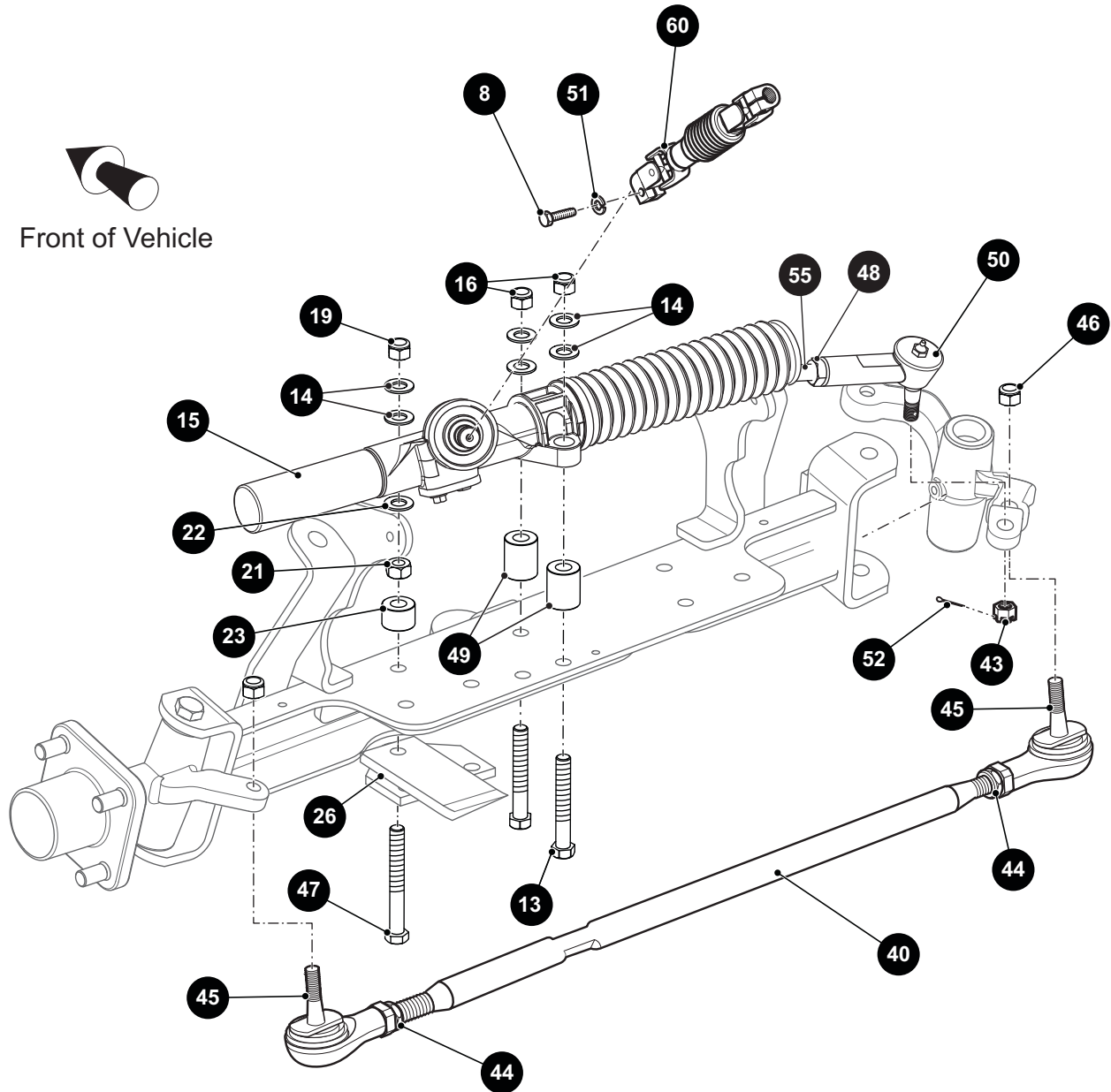


Figure 11 Steering Components

FRONT SUSPENSION & STEERING

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

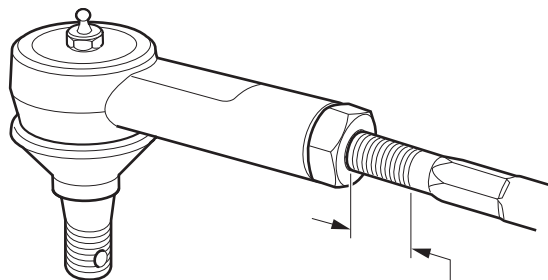
Rack Ball Joint Replacement

Tool List

	Qty.
Wrench, 11/16"	1
Wrench, 3/4"	1
Socket, 11/16"	1
Crow's Foot Socket, 3/4"	1
Pliers, Needle Nose.....	1
Wire Ties	2
Ball Joint Separator	1
Plastic Faced Hammer	1
Tape Measure.....	1
Torque Wrench, ft. lb	1

- Loosen the passenger side front wheel and lift and support the front of the vehicle (See LIFTING THE VEHICLE on page 8).
- Remove the passenger side front wheel and turn the steering wheel fully to the left.
- Remove the cotter pin (52) and loosen the castellated nut (43) until the rack ball joint (50) threads are protected (Ref. Figure 11).
- Using a ball joint separator as a lever, apply pressure to the ball joint and tap the nut with a plastic faced hammer to release the ball joint from the passenger side spindle arm.
- Remove the castellated nut (43) from the ball joint (50).
- Remove the ball joint (50) from the spindle arm.
- Cut away the wire ties (53, 54) from the bellows (65) and pull the bellows back to expose the threads on the rack extension (55) (Ref. Figure 14).
- Measure the amount of threads exposed from the jam nut.

NOTICE: To install new rack ball joint close to its correct position, measure the amount of threads exposed from jam nut (Ref. Figure 12).



Measure exposed thread length and use length to position new ball joint at same location

Figure 12 Rack Ball Joint Installation

- Loosen the jam nut (48) and remove the rack ball (50) joint from the rack extension (55).
- Using the measurement made earlier, thread the jam nut (48) and the new rack ball (50) joint to the previous location on the rack extension (55) and set the jam nut (48) hand tight.
- Attach the rack ball joint (50) to the spindle arm.
- Tighten castellated nut (43) to the torque values listed below and continue to tighten as needed to insert a new cotter pin (42). Maximum torque is 50 ft. lb (70 Nm).

CAUTION After replacing or servicing steering components, always verify that an 1/8" gap exists between large hex of rack extension and rack and pinion unit when steering is turned fully to the right forcing passenger spindle arm against front axle (Ref Fig. 32).

- Check for proper rack extension-to-rack and pinion unit clearance before tightening the jam nut (48) to the torque settings listed below (See Checking/ Adjusting Rack Extension-to-Rack and Pinion Unit Clearance on page 37).
- Inspect the bellows for cracks and replace if necessary (See Bellows Replacement on page 33).
- Install passenger side front wheel and lower vehicle (See WHEEL INSTALLATION on page 21).
- Check front wheel alignment and adjust if necessary (See Wheel Alignment on page 24).

Item	Torque Specification
43	36 ft. lb (50 Nm)
48	35 - 45 ft. lb (47 - 61 Nm)

FRONT SUSPENSION & STEERING

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Tie Rod End Inspection/Replacement

Tool List	Qty.
Tape Measure	1
Wrench, 9/16"	1
Wrench, 11/16"	1
Wrench, 3/4"	1
Socket, 11/16"	1
Crow's Foot Socket, 3/4"	1
Needle Nose Pliers	1
Ball Joint Separator	1
Plastic Faced Hammer	1
Torque Wrench, ft. lb	1

- Grasp the tie rod (40) at the ball joints (45) and check for any vertical motion which would indicate a worn condition and require replacement (Ref. Figure 11).
- Loosen the wheels.
- Lift and support the front of the vehicle (See LIFTING THE VEHICLE on page 8).
- Remove the front wheel.
- To install the new tie rod ball joint close to its correct position, measure the exposed thread length from the jam nut (Ref. Figure 13).

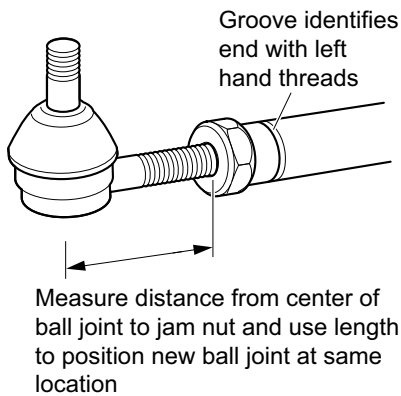


Figure 13 Tie Rod Replacement

- Loosen the jam nut (44) at the threaded tube (40).
- NOTICE: To hold threaded tube while loosening jam nut, use a wrench on the center, flat section of tube (Ref Fig. 25).**
- The tie rod has different threads on each end. It is adjusted similar to a turnbuckle. The end with the flat area on the threaded tube has left hand threads (clockwise to loosen) while the end without the flat has conventional right hand threads (counter-clockwise to loosen).**
- Remove the lock nut (46) until tie rod ball joint (45) threads are protected.
 - Using a ball joint separator as a lever, apply pressure to the ball joint and tap the nut with a plastic faced hammer to release the tie rod from the spindle arm.

- Remove the lock nut to drop the tie rod from the spindle arm.
 - Unscrew the tie rod ball joint and jam nut from threaded tube.
 - Thread on the new jam nut and then, using the measurement made earlier, screw the ball joint to the previous location in the threaded tube.
 - Set the jam nut hand tight.
- NOTICE: The distance to center of tie rod ball joint from jam nut on both ends of threaded tube should be the same.**
- Attach the tie rod to the spindle.
 - Tighten the lock nut (46) to the torque settings below.
 - Tighten the jam nut (44) to the torque values listed below.
 - Install the front wheel(s) and lower the vehicle (See WHEEL INSTALLATION on page 21).
 - A worn tie rod is likely to have caused incorrect wheel alignment. Check the front wheel alignment and adjust if necessary (See Wheel Alignment on page 24).

Item	Torque Specification
44, 46	35 - 50 ft. lb (47- 67 Nm)

FRONT SUSPENSION & STEERING

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Bellows Replacement

Tool List	Qty.
Needle Nose Pliers.....	1
Wrench, 11/16"	1
Wrench, 3/4"	1
Socket, 11/16"	1
Crow's Foot Socket, 3/4"	1
Ball Joint Separator	1
Plastic Faced Hammer	1
Tape Measure.....	1
Wire Cutters	1
Wire Ties	2
Torque Wrench, ft. lb	1

- Loosen the passenger side front wheel and lift and support the front of the vehicle (See LIFTING THE VEHICLE on page 8).
- Remove the passenger side front wheel and turn the steering wheel fully to the left.
- Remove the rack ball joint (50) and jam nut (48) from the rack extension (55) (See Rack Ball Joint Replacement on page 31).
- Cut the wire ties (53, 54) and slide the bellows (65) off of the rack extension (Ref. Figure 14).
- Install a new bellows aligning the small end over the groove in the rack extension and secure it with a new wire tie (53).
- Leave the large end of the bellows loose until the rack the extension-to-rack and pinion unit clearance is checked or adjusted.

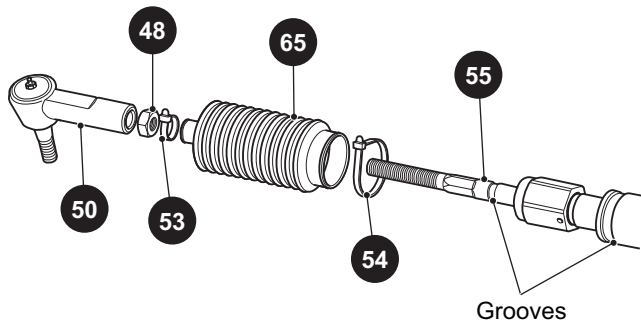


Figure 14 Bellows Replacement

- Install the jam nut (48) and rack ball joint (50) on the rack extension (55) and reattach it to the spindle arm.

CAUTION After replacing or servicing steering components, always verify that an 1/8" gap exists between large hex of rack extension and rack and pinion unit when steering is turned fully to the right forcing the passenger spindle arm against the front axle.

- Check for proper rack extension-to-rack and pinion unit clearance before tightening the jam nut (48) to the torque values listed below (See Checking/Adjust-

ing Rack Extension-to-Rack and Pinion Unit Clearance on page 37).

- Secure the large end of the bellows with a new wire tie (54).
- Install the passenger side front wheel and lower the vehicle (See WHEEL INSTALLATION on page 21).
- Check the front wheel alignment and adjust if necessary (See Wheel Alignment on page 24).

Item	Torque Specification
48	35 - 45 ft. lb (47 - 61 Nm)
6	155 -215 in. lb (18-24 Nm)

Rack and Pinion Unit Replacement

Tool List	Qty.
Wrench, 13 mm	1
Wrench, 5/8"	1
Wrench, 11/16"	1
Socket, 13 mm.....	1
Wrench, 5/8"	1
Wrench, 11/16"	1
Ratchet	1
Needle Nose Pliers.....	1
Ball Joint Separator	1
Plastic Faced Hammer	1
Torque Wrench, ft. lb.....	1
Torque Wrench, in. lb.....	1

- Loosen the front wheels and lift and support the front of the vehicle (See LIFTING THE VEHICLE on page 8).
- Remove the front wheels.
- Remove the bolt (8) and washer (51) securing the intermediate shaft (60) to the rack and pinion unit (15) (Ref. Figure 11).
- Remove the cotter pin (52) and loosen the castellated nut (43) until the rack ball joint (50) threads are protected.
- Using a ball joint separator as a lever, apply pressure to the ball joint and tap the nut with a plastic faced hammer to release the ball joint from the passenger side spindle arm.
- Remove the lock nut from the ball joint and the ball joint from the spindle arm.
- Remove the lock nuts (16, 19), bolts (13), washers (14), and spacers (49) securing the rack and pinion unit to the front axle.

Installation is in the reverse order of removal using new lock nuts.

Tighten all the hardware to the torque values below. Continue tightening the castellated nut as needed to insert a

FRONT SUSPENSION & STEERING

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

new cotter pin. Maximum torque is 50 ft. lb (70 Nm).

CAUTION After replacing or servicing steering components, always verify that an 1/8" gap exists between large hex of rack extension and rack and pinion unit when the steering is turned fully to the right forcing the passenger spindle arm against the front axle.

- Set the proper rack extension-to-rack and pinion unit clearance (See Checking/Adjusting Rack Extension-to-Rack and Pinion Unit Clearance on page 37).
- Install the front wheels and lower the vehicle (See WHEEL INSTALLATION on page 21).
- Check the front wheel alignment and adjust if necessary (See Wheel Alignment on page 24).

Item	Torque Specification
16	35 - 50 in. lb (47 - 67 Nm)
43	36 ft. lb (50 Nm)
6	13 - 18 ft. lb (18 - 24 Nm)

Pinion Seal Replacement

Tool List	Qty.
Vice.....	1
Straight Blade Screwdriver, Small	1
Ball Peen Hammer	1
Sandpaper, 600 Grit	AR
Shop Towel	AR
Wheel Bearing Grease	AR
Socket, 1 1/2"	1

CAUTION Secure the rack and pinion unit in a vice by the mounting ears only. The rack and pinion unit is made of aluminum and can be damaged if held otherwise.

- Remove the rack and pinion unit from the vehicle (See Rack and Pinion Unit Replacement on page 33).
- Anchor in a vice by clamping on the mounting ears of the rack and pinion unit.
- Slide a small straight blade screwdriver between the lip of the seal and the pinion and pry the top portion of the seal up to remove (Ref. Figure 15).

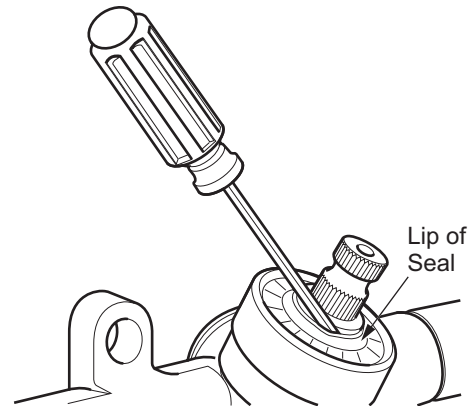


Figure 15 Pinion Seal Replacement

- Check the outer pinion surface for roughness and sand lightly if needed.

NOTICE: Wipe the bore clean and lubricate the pinion and the lip of the seal with grease.

The bore has a positive stop to correctly locate the seal during installation.

- Place the seal over the pinion and tap it carefully with a socket and hammer to start the seal straight into the bore. Drive the seal fully into the bore until it seats and wipe clean of any excess grease.
- Attach the rack and pinion unit to the front axle (See Rack and Pinion Unit Replacement on page 33).

Spindle Replacement

Tool List	Qty.
Wrench, 11/16"	1
Wrench, 3/4"	1
Socket, 11/16"	1
Socket, 3/4"	1
Ratchet	1
Pliers, Needle Nose	1
Ball Joint Separator	1
Plastic Faced Hammer	1
Torque Wrench, ft. lb.....	1

CAUTION The spindle bearings are designed to be lube-free. Lubrication attracts dirt and will ruin the bearings. Do not apply grease to the spindle bearings.

- Loosen the front wheel and lift and support the front of the vehicle (See LIFTING THE VEHICLE on page 8).
- Remove the front wheel.
- Loosen the lock nut (46) until the tie rod ball joint (45) threads are protected (Ref. Figure 16).
- Using a ball joint separator as a lever, apply pressure to the ball joint and tap the nut with a plastic faced

FRONT SUSPENSION & STEERING

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hammer to release the tie rod from the spindle arm (70).

5. Remove the nut from the tie rod and the tie rod from the spindle arm.
6. If removing the passenger side spindle, repeat the previous step for the rack ball joint.
7. Remove the lock nut (56), washers (57), and bolt (59).
8. Remove the spindle (70) from the axle.
9. Remove the thrust washer (61) and the king pin tube (58) from the spindle.

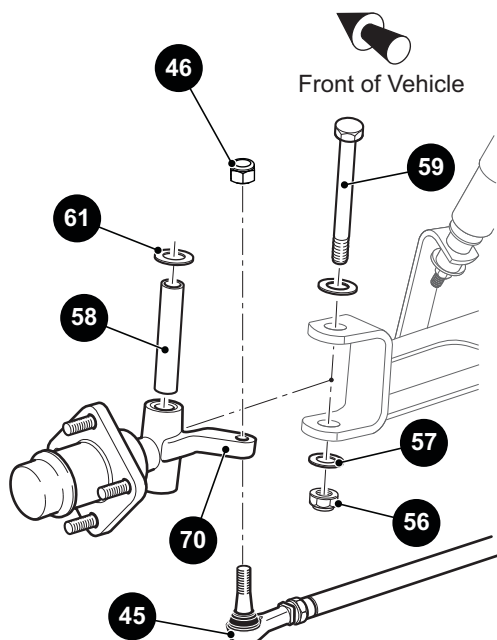


Figure 16 Spindle Replacement

NOTICE: The thrust washer (9) is located on top of spindle between spindle and front axle.

Assemble in the reverse order of removal using new lock nuts.

1. Tighten all hardware to the torque values listed below.
2. Check that the spindle turns freely on the king pin tube after tightening.
3. Install the front wheels and lower the vehicle (See WHEEL INSTALLATION on page 21).
4. Check the front wheel alignment and adjust if necessary (See Wheel Alignment on page 24).

Item	Torque Specification
56	56 - 70 ft. lb (75 - 95 Nm)
46	35 - 50 ft. lb (47 - 67 Nm)

Front Axle Replacement

Tool List	Qty.
Socket, 9/16"	1
Socket, 5/8"	1
Socket, 3/4"	1
Wrench, 1/4"	1
Wrench, 9/16"	1
Wrench, 5/8"	1
Wrench, 11/16"	1
Wrench, 3/4"	1
Ratchet	1
Plastic Faced Hammer	1
Shop Towels	AR
Wire	AR
Torque Wrench, ft. lb.	1

1. Loosen the front wheels.
2. Lift and support the front of the vehicle (See LIFTING THE VEHICLE on page 8).
3. Remove the front wheels (See WHEEL INSTALLATION on page 21).
4. Remove the shock absorbers (See Front Shock Absorber Replacement on page 26).
5. Remove the driver side spindle (See Spindle Replacement on page 34).
6. Wrap a towel around the spindle and set the spindle aside.
7. Repeat at the passenger side letting the rack ball joint (50) rest on the front spring to support the spindle.

WARNING To prevent possible injury from falling steering components, secure the rack and pinion unit (16) to the front springs with a wire. This will prevent the intermediate shaft connecting the rack and pinion unit to the steering column from pulling apart due to the weight of the steering system.

NOTICE: The intermediate shaft is assembled with the universal joints set 90° out of phase with each other.

8. Remove the bolt (8) and washer (51) securing the intermediate shaft (60) to the rack and pinion unit (15).
9. Remove the lock nuts (16, 19), bolts (13), and washers (14) securing the rack and pinion unit (15) to the front axle (Ref. Figure 11).
10. Move the rack and pinion unit back to rest on top of the front springs.
11. Secure the rack and pinion unit to the spring with a wire to prevent the intermediate shaft from pulling apart.

FRONT SUSPENSION & STEERING

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

- Remove the lock nuts (33), bolts (17), and spring plate (26) securing the passenger side spring to the axle (Ref. Figure 6).
- At the long bolt (47) securing the front of the left spring. Note the location of the washer (22) and remove it from end of bolt.
- Remove the lock nuts (34), hex nut (21), spacer (23), bolts (47, 18) and spring plate (26) securing the driver side spring to the axle.

CAUTION To prevent stress and possible damage to the rack and pinion unit, the axle must first be mounted to the springs with the hardware installed in its original location.

Assemble in the reverse order of removal using new lock nuts. All hardware must be installed in its original location. Tighten the shock absorber mounting hardware until the rubber bushings expand to the diameter of the washers. Tighten all other hardware to the torque values listed below.

Check the front wheel alignment and adjust if necessary (See Wheel Alignment on page 24).

Item	Torque Specification
16, 19, 21, 33, 46	35 - 50 ft. lb (47 - 67 Nm)
43	36 ft. lb (50 Nm)
56	56 - 70 ft. lb (75 - 95 Nm)

Rack and Pinion Unit Disassembly and Inspection

Tool List	Qty.
Vice.....	1
Socket, 3/8".....	1
Wrench, 11/16".....	1
Wrench, 3/4".....	1
Ratchet.....	1
Wire Cutter.....	1
Retaining Ring Pliers.....	1
Shop Towel.....	AR
CITGO Lithoplex MP No. 2 grease.....	AR
Wire Tie, 8" Long.....	1
Wire Tie, 10" Long.....	1
Torque Wrench, in. lb.....	1

NOTICE: The rack and pinion gears are not serviceable items. If they are found to be damaged or excessively worn, a new rack and pinion unit must be installed.

CAUTION Secure the rack and pinion unit in a vice by the mounting ears only. The rack and pinion unit is made of aluminum and can be damaged if held otherwise.

- Remove the rack and pinion unit from vehicle (See Rack and Pinion Unit Replacement on page 33).
- Anchor in a vice by clamping on the mounting ears of the unit.
- Remove the screws (63) securing the tensioner assembly (66) in the rack and pinion unit.
- Remove the tensioner assembly (66) to relieve pressure on the rack (75) and pinion (80).
- Loosen the jam nut (48) and remove the rack ball joint (50) from the rack extension (55).
- Cut the wire ties (53, 54) securing the bellows (65) and slide the bellows off the rack extension.
- Pull the rack gear (75) from the unit.
- Remove the pinion seal (67) (See Pinion Seal Replacement on page 34).
- Remove the internal retaining ring (68) from rack and pinion unit.
- Pull out the pinion gear (80) and ball bearing (64) as an assembly.

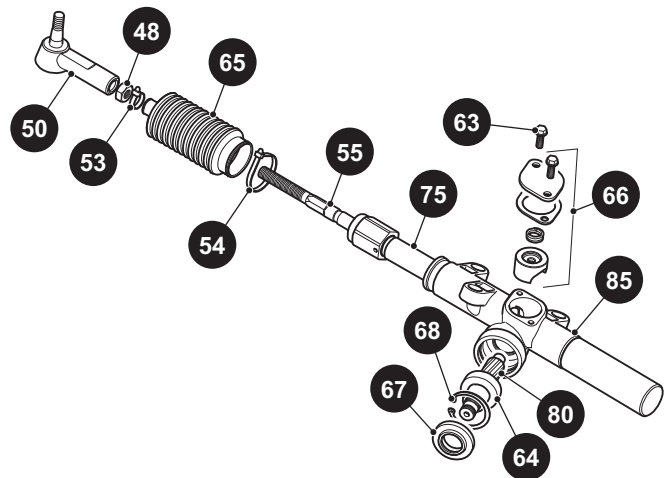


Figure 17 Rack and Pinion Unit Disassembly

- Clean the rack (75), pinion (80), and housing (85).
- Inspect the gear teeth, bearing surfaces and grease seal surfaces of rack and pinion for excessive wear or damage. If any is found, the rack and pinion unit **must be** replaced as an assembly.
- If rack and pinion pass inspection, clean them, the tensioner, and the housing thoroughly and lubricate for assembly. Use the grease specified in the tool list.
- Install the pinion gear (80) and ball bearing (64) assembly in the reverse order of removal, making sure to lubricate the pinion seal lip prior to installing seal (See Pinion Seal Replacement on page 34).
- Insert the rack gear (75) into the rack and pinion unit. Turn the pinion gear (80) clockwise to help pull the rack in if necessary.

FRONT SUSPENSION & STEERING

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

16. Install the bellows (65) and secure to the rack extension (55) with a wire tie (53). **Do not** secure the large end of bellows to the rack and pinion unit until instructed to do so after setting the proper rack extension-to-rack and pinion unit clearance.
17. Install the tensioner (66) and tighten the bolts (63) to the torque values below.
18. Thread the jam nut (48) and rack ball joint (50) to the original location on the rack extension and set the jam nut hand tight.
19. Install the rack and pinion unit on the vehicle (See Rack and Pinion Unit Replacement on page 33).

CAUTION After replacing or servicing steering components, always verify that an 1/8" gap exists between large hex of rack extension and rack and pinion unit when the steering is turned fully to the right forcing the passenger spindle arm against front axle.

20. Set the proper rack extension-to-rack and pinion unit clearance (See Checking/Adjusting Rack Extension-to-Rack and Pinion Unit Clearance on page 37).

Item	Torque Specification
48	35 - 45 ft. lb (47 - 61 Nm)
13	100 - 120 in. lb (11.25 - 13.5 Nm)

Checking/Adjusting Rack Extension-to-Rack and Pinion Unit Clearance

Tool List	Qty.
Wrench, 11/16"	1
Wrench, 3/4"	1
Wrench, 1/2"	1
Socket, 11/16"	1
Ratchet	1
Wire Cutter	1
Washer, 1/8" Thick	1
Crowfoot Socket, 3/4"	1
Torque Wrench, ft. lb	1
Angle Pliers	1
Wire Tie, 10" long	1

1. Turn the steering wheel fully to the right.
2. The rear spindle arm on the passenger side **must rest against** the front axle (Ref. Figure 18). If it does not, all adjustment is made at the rack ball joint (50) (Ref. Figure 17).
3. Loosen the jam nut (48) at the rack ball joint and use a wrench to thread the shaft of the rack extension (55) further into rack ball joint. This will provide more travel for the steering wheel to be turned to the right.

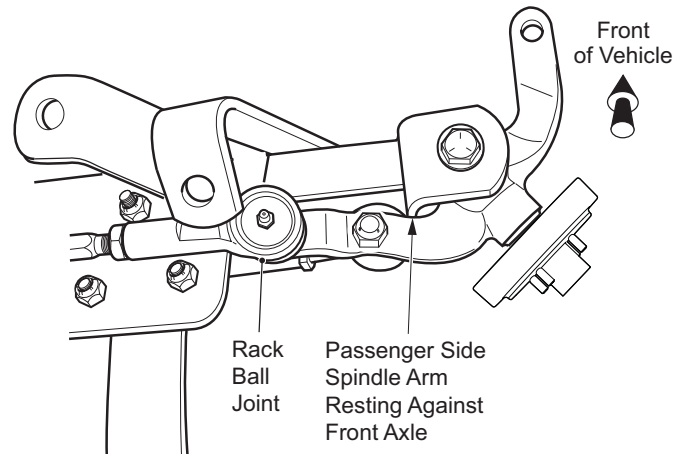


Figure 18 Spindle Contact with Front Axle

4. With the spindle arm resting against front axle, cut the wire tie (54) securing the bellows (65) to the rack and pinion unit.
5. Slide the bellows away from the rack and pinion unit to see the large hex of the rack extension.
6. An 1/8" gap should exist between the large hex and the end of the rack and pinion unit (Ref. Figure 19).

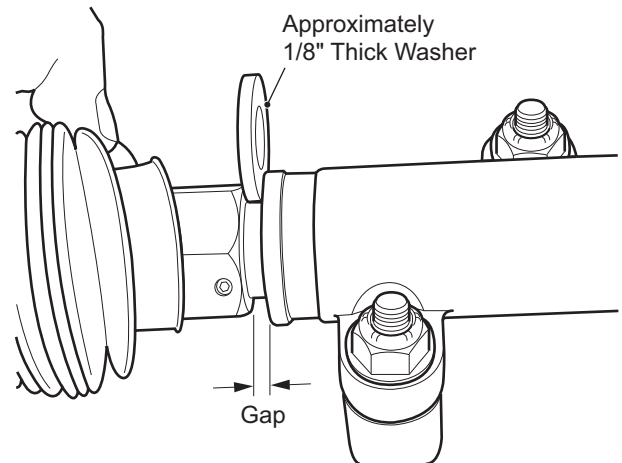


Figure 19 Checking Gap

7. Adjust, using an 1/8" thick washer as a gauge, by turning the shaft of the rack extension with a wrench to create the 1/8" gap.
8. Tighten the jam nut (48) to the torque values below.
9. Secure the bellows to the rack and pinion unit with a new wire tie (54).

Item	Torque Specification
48	35 - 45 ft. lb (47 - 61 Nm)

FRONT SUSPENSION & STEERING

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Steering Wheel Replacement

Tool List	Qty.
Socket, 15/16"	1
Ratchet	1
Plastic Faced Hammer	1
Ball Peen Hammer	1
Anti-seize Compound	1
Torque Wrench, ft. lb	1

NOTICE: To maintain the correct orientation when replacing the steering wheel, first turn the wheels straight ahead.

CAUTION To prevent damage to the Steering wheel cover, perform the following removal procedure. Do not use a screwdriver to push or pry the retaining tabs.

1. From the front side of the steering wheel (90), pull straight up on the bottom of the steering wheel cover (95) to release the two bottom retaining tabs.
2. Using a thumb for leverage as shown, reach from behind the steering wheel with fingertips to first pull down, and then push up to release the two top steering wheel cover retaining tabs (Ref. Figure 20).
3. Loosen the steering wheel retaining nut (68) two to three turns until the threads on the steering column shaft are protected (Ref. Figure 21).
4. Apply upward pressure to the steering wheel. Place a plastic faced hammer against the steering wheel nut and strike a plastic faced hammer sharply with a ball peen hammer.

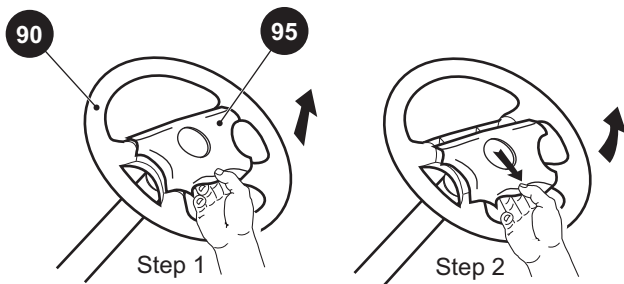


Figure 20 Steering wheel cover Removal

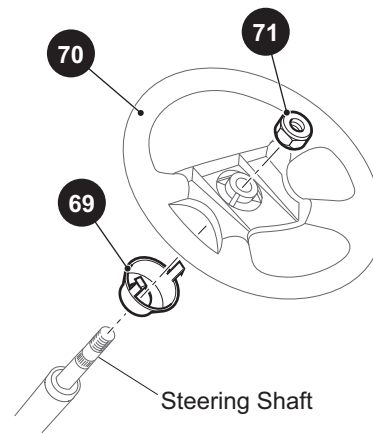


Figure 21 Steering Wheel Replacement

CAUTION Do not strike steering nut or end of steering shaft directly with ball peen hammer. Internal damage to rack and pinion unit can result.

5. When the steering wheel is loose, remove the retaining nut (71) and remove the steering wheel (90).
6. Prior to replacement, assemble the replacement steering wheel by aligning the retaining tabs on the rear collar hub (69) with the slots in the back of the steering wheel (Ref. Figure 21).
7. Squeeze the tabs to allow insertion of the hub. **Do not force.** Squeeze the hub on top and bottom to fully seat.
8. Lightly coat the splines of the steering shaft with a commercially available anti-seize compound.
9. With the vehicle wheels in the straight ahead position, align the steering wheel on the steering shaft and slide the wheel onto the shaft.
10. Tighten the steering wheel nut (71) to the torque values below.
11. Inspect the four retaining tabs on the clipboard (95) for white stress lines. If stress lines are present, replace the clipboard with a new one.
12. Install by carefully pressing, first the top two, then the bottom two retaining tabs into the matching slots in the steering wheel.

Item	Torque Specification
68	15 - 20 ft. lb (20 - 27 Nm)

FRONT SUSPENSION & STEERING

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Steering Shaft and Column Replacement

Tool List	Qty.
Wrench, 13 mm	1
Wrench, 9/16"	1
Socket, 13 mm	1
Socket, 9/16"	1
Socket, 15/16"	1
Ratchet	1
Snap Ring Pliers	1
Bearing Separator	1
Gear Puller	1
Arbor Press	1
Bearing Driver Set	1
Torque Wrench, ft. lb	1
Wheel Bearing Grease	AR

1. Remove the steering wheel (See Steering Wheel Replacement on page 38).
2. Loosen the front wheels and lift and support the front of the vehicle (See LIFTING THE VEHICLE on page 8).
3. Remove the front wheels.
4. Remove the bolt (8) and washer (51) securing the intermediate shaft (60) to the steering shaft (105).
5. Remove the four bolts (82) and washers (83) that secure the steering column (100) to the chassis and remove the column.
6. Remove the large retaining ring (87) on the bottom end of the column and pull the shaft (105) and bearing (86) out as an assembly.
7. Slide the wave washer (89) out the bottom end of the steering column (100) and retain for reuse during assembly.
8. Remove the small retaining ring (88) and press the bearing from the steering shaft.
9. Press the new bearing onto the shaft until it seats against the shoulder.
10. With the small retaining ring oriented with the arch up, slide the ring onto the shaft as far as possible using snap ring pliers (Ref. Figure 23).
11. Use fingers to seat the retaining ring fully into the groove.
12. Slide the wave washer into the base of the steering column.
13. Apply wheel bearing grease to the lip of the seal in the bushing (81) at the top of the column and press the steering shaft and bearing assembly into the column base.
14. Secure with the large retaining ring (87), making sure it is fully seated in the groove of the column.
15. Place the steering column on the vehicle and tighten the column bolts (82) to the torque values below.

16. Tighten the bolt (8) securing the intermediate shaft (60) to the steering shaft (105) to the torque values below (Ref. Figure 22).
17. Install front wheel(s) and lower vehicle (See WHEEL INSTALLATION on page 21).
18. Install the steering wheel (See Steering Wheel Replacement on page 38).

Item	Torque Specification
Jam Nut	45 - 55 in. lb (5 - 6 Nm)
8	155 -215 in. lb (18-24 Nm)

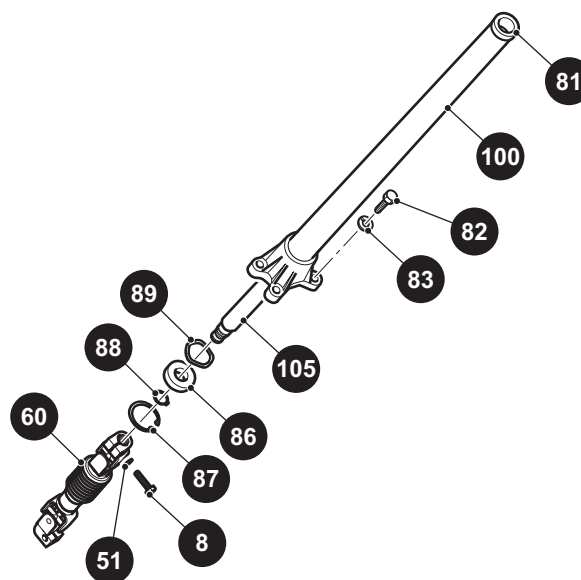


Figure 22 Steering Shaft and Column

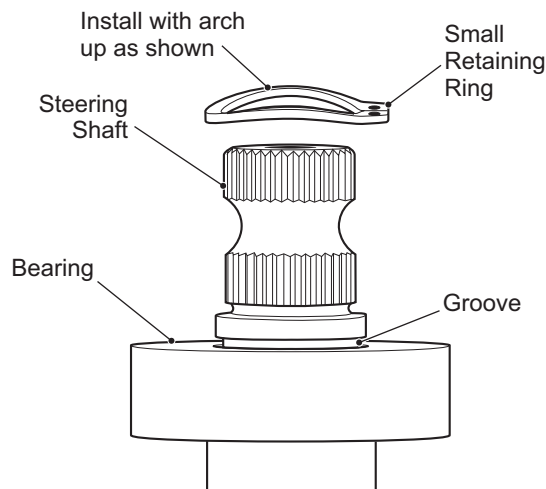


Figure 23 Small Retaining Ring Orientation

FRONT SUSPENSION & STEERING

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Notes:

ELECTRONIC SPEED CONTROL

PERFORMANCE

NOTICE: The vehicle will operate only when the key switch is in the ON position. The vehicle's top speed is sensed and regulated directly by the controller and the feature to slow the vehicle when the accelerator pedal is up is mild.

Speed Control

⚠ WARNING To prevent the possibility of loss of control that could cause severe injury or death, use the service brake to control the speed. The speed control system is not a substitute for the service brake.

Speed control system vehicles are equipped with a regenerative motor control system.

Example: If all of the following events occur:

- the vehicle is being driven down a slope
- the vehicle attempts to exceed the specified top speed with the accelerator pedal pressed or released

the regenerative brake will limit the speed of the vehicle to the specified top speed but the warning beeper will **not** activate. When the regenerative braking system is activated by this sequence of occurrences, the motor generates power which is returned to the batteries.

If the operator attempts to override the electronic brake by moving the key switch to another position, the vehicle will slow **rapidly** until it reaches the speed of approximately 2 mph (3 kph).

If the key switch is placed in the OFF position with the vehicle in motion, the controller will attempt to bring the vehicle to a stop and engage the automatic parking brake.

Pedal-Up Braking

Pedal-up braking is regenerative braking that occurs when the accelerator pedal is released while the vehicle is moving.

Pedal-up braking decreases speed until the vehicle stops or the accelerator pedal is applied. The warning beeper will **not** activate. When pedal-up braking is activated by this sequence of occurrences, the motor generates power which is returned to the battery pack.

Anti-Stall Feature

Anti-Stall protection prevents motor damage if the vehicle is stalled against an object or on a hill.

Example: If all of the following events occur:

- the system senses that the accelerator pedal is pressed (power applied to motor)
- the motor is stopped long enough that additional time can cause damage to the motor.

the Anti-Stall feature will interrupt power to the motor. This brief interruption will permit the vehicle to roll backwards slightly before again stopping in the stalled condition. To restore power to the motor, power cycle the key switch to the OFF position and back to the ON position.

High Pedal Disable Feature

High pedal disable prevents acceleration of the vehicle if the key switch is in moved to the ON position (R, N, or F) while the accelerator pedal is pressed.

OPERATION

With the key switch in the OFF position:

- the controller is deactivated within 3 seconds
- the automatic parking brake is engaged
- the reverse warning beeper is deactivated

With the key switch in ON position:

- the controller is activated
- the electronic braking system and reverse warning beeper features are activated

⚠ WARNING To prevent the possibility of loss of control that could cause severe injury or death, always use the service brake to control speed. The controller system is not a substitute for the service brake.

If all of the following events occur with the key switch in the ON position

- the vehicle is being driven down a slope
- the vehicle speed exceeds the designed speed with the accelerator pedal pressed or released

the regenerative brake will limit the speed of the vehicle to the designed speed range (the warning beeper will **not** sound). When the electronic braking system is activated by this sequence of events, the motor generates power which is returned to the batteries. This vehicle is equipped with a regenerative motor control system.

The speed of the motor is sensed and regulated directly by the controller. As a vehicle begins to accelerate while

ELECTRONIC SPEED CONTROL

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

descending a hill, the speed sensor will cause the motor to electrically reduce the speed of the vehicle through regenerative braking.

If the operator attempts to override the regenerative brake feature by moving the direction selector or key switch to another position:

- Neutral: the controller will slow the vehicle until stopped and then set the automatic park brake
- Opposite Direction of Travel (with the accelerator pedal pressed): the controller will slow the vehicle to a stop and then accelerate in the direction selected
- Off: the reverse buzzer will beep and the controller will slow the vehicle to a stop and the automatic parking brake will engage

The system is a low power consumption unit but it will drain the vehicle batteries over a period of time. If the vehicle is to be stored for a prolonged period of time, the controller should be disconnected from the batteries by setting the key switch to the OFF position.

The Electronic Speed Control system consists of three separate units, a pedal box, speed sensor, and controller.

Pedal Box

The pedal box assembly is a modularized unit that contains the accelerator pedal, return spring, and an enclosed box that contains the pedal position micro switch and a solid state Inductive Throttle Sensor (ITS) that is activated by a moving plunger attached to the accelerator pedal.

To access the pedal box:

1. Remove the rocker panel.
2. Lift the floor mat.
3. Remove the access cover from the floor (Ref. Figure 1).

4. The ITS and plunger are accessed by removing the four screws and top cover from the enclosed pedal box.

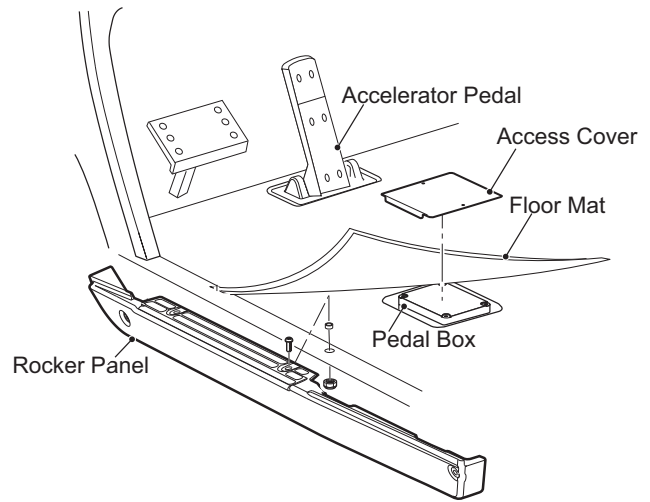


Figure 1 Access to Pedal Box

ELECTRONIC SPEED CONTROL

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Speed Sensor

The speed sensor uses a sealed sensor to read the impulses of a ring magnet attached to the armature shaft of the motor. Magnetic pulses are converted into electrical signals which the controller uses to determine the motor speed.

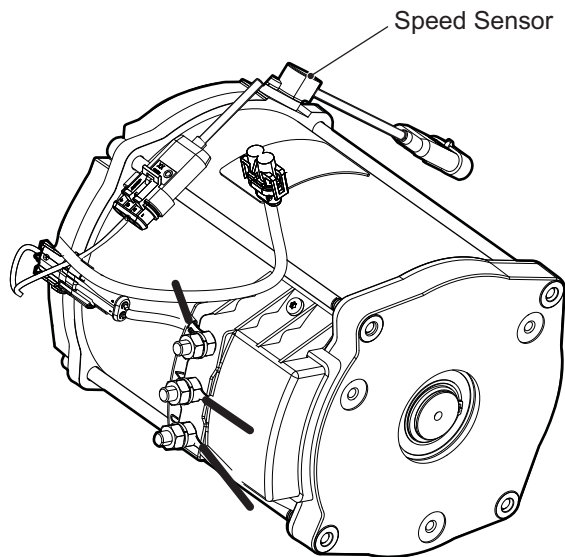


Figure 2 Speed Sensor

Controller

The controller is a solid state unit that activates a solenoid and controls the function of the vehicle by responding to inputs from the ITS and motor speed sensor. The controller and solenoid are located under the front facing rear seat on the rear-passenger side of the under seat compartment.

The pedal box and the speed sensor are connected to the controller through a 35-pin connector on the controller.

The controller is wired to the batteries and develops a regulated power supply for the ITS. The plunger position relative to the ITS varies the voltage which is fed back to the controller which interprets the change in voltage and supplies the appropriate power to the motor.

The ITS unit and the controller are both solid state units that contain no user serviceable parts. **The testing procedures are designed to test the basic functionality of the power and control wiring systems.** Once the functionality of the wiring has been confirmed, the remaining tests are used to identify which of the components (controller or ITS) must be replaced.

GENERAL TROUBLESHOOTING

Testing

A maintenance feature of the controller is the ability to diagnose electrical faults preventing the vehicle to operate at its fullest potential. A light on the controller face will blink a code informing the technician to the likely cause of the vehicle malfunction.

A series of blinks will indicate the fault code. The first digit of the code is indicated by the number of red flashes. The second digit of the code is indicated by the number of yellow flashes. By reading the Diagnostic Mode Fault Code chart, the likely fault, symptom(s), and corrective action to be taken can be found (See LED Fault Code on page 103) (See FAULT CODE REFERENCE LIST on page 121).

It is unlikely that the mechanical adjustment of the pedal box has changed. The initial tests should be conducted with a digital volt ohm meter (DVOM) to identify the failed component.

A recommended DVOM is available through the E-Z-GO Service Parts Department as P/N 27481-G01. Any DVOM may be used. The accuracy, controls, displays and features may vary depending on the make and model. Always follow the meter manufacturer's recommendations and instructions for the use and care of the meter.

To assure accurate readings, be sure to set the meter to the closest voltage reading above the expected voltage.

⚠ WARNING *To prevent an injury resulting from the unexpected movement of the vehicle, always raise the rear wheels before conducting any tests.*

To prevent possible motor damage, never operate the vehicle at full throttle for more than 4-5 seconds while the vehicle is in a "no-load" condition.

For static tests, raise the rear wheels of the vehicle and support the vehicle on jack stands. Test the vehicle stability before proceeding (See LIFTING THE VEHICLE on page 8).

Begin with the key switch in the OFF position for at least one minute.

Place the key switch in the F position. Press the accelerator pedal until the micro switch in the pedal box activates causing the solenoid mounted to the controller to make an audible click. If the solenoid does not click, test the batteries (See Power Supply on page 68).

ELECTRONIC SPEED CONTROL

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

INDUCTIVE THROTTLE SENSOR (ITS) TESTING AND REPLACEMENT

Tool List	Qty.
Phillips screwdriver	1
Wrench, 7/16"	1
Nut driver, 7/16"	1
Drill bit, 7/32"	1
DVOM	1

1. Lift and support the vehicle (See LIFTING THE VEHICLE on page 8).
2. Remove the driver side rocker panel insert and pull the floor mat forward to expose the metal cover to the pedal box.
3. Remove the metal cover and remove the four screws securing the plastic cover to the pedal box (Ref. Figure 3).

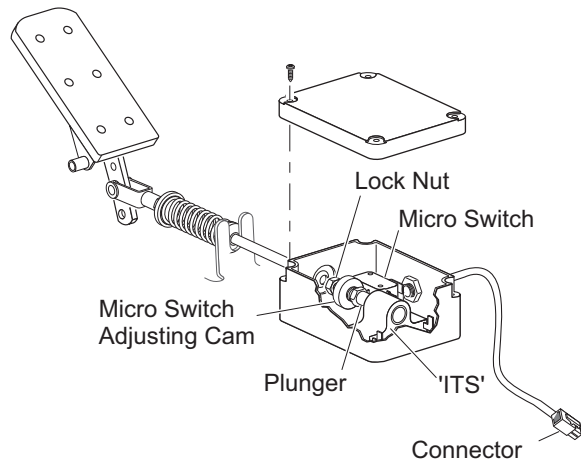


Figure 3 ITS and Plunger

4. With the DVOM set to volts, probe the white wire at the ITS with the positive (+) probe and attach the negative (-) probe to the negative (-) battery terminal.
5. Place the key switch in the F position.
6. Press the accelerator pedal. The meter should read $1.0V \pm 0.3V$ when the solenoid clicks and $2.7V \pm 0.5$ volts at full pedal. If the reading is out of specification, the ITS is faulty.

CAUTION *The ITS attaches to the plastic pedal box using two plastic studs and two speed nuts. Use caution not to overtighten the nuts which could strip the plastic studs while tightening the nuts enough to prevent movement of the ITS.*

7. Carefully remove the two wires that attach to the ITS and carefully remove the nuts securing the ITS to the plastic pedal box studs.
8. Install a new ITS being careful to align the ITS and not to overtighten the retaining nuts.

9. Attach the wiring.
10. With the accelerator pedal in the full up position, insert a 7/32" drill bit between the plunger and the face of the ITS. The drill bit should be used to verify and adjust the distance between the face of the ITS and the face of the plunger.
11. If the plunger needs adjustment, loosen the lock nut at the accelerator yoke and rotate the plunger until the desired dimension is achieved.
12. Firmly tighten the jam nut.
13. Replace the plastic cover and press it firmly into place before tightening the cover screws.
14. Replace the metal cover, floor mat and rocker panel insert.

MOTOR

GENERAL

CAUTION Do not use the accelerator and motor to hold the vehicle on a hill. Leaving the motor in a stalled condition for more than 3-4 seconds can cause permanent damage.

Disassembly of the motor is not recommended.

Neither the motor housing nor armature are available as service items, therefore in the unlikely event of a failure in either component, the entire motor must be replaced.

WARNING Disconnect the negative (-) battery cable with an insulated wrench before removing wires from the motor.

Disassembly of the motor is not recommended.

Neither the motor housing nor armature are available as service items, therefore in the unlikely event of a failure in either component, the entire motor must be replaced.

WARNING The wheels must be chocked before removing the brake or the motor. There is no other parking brake on the vehicle.

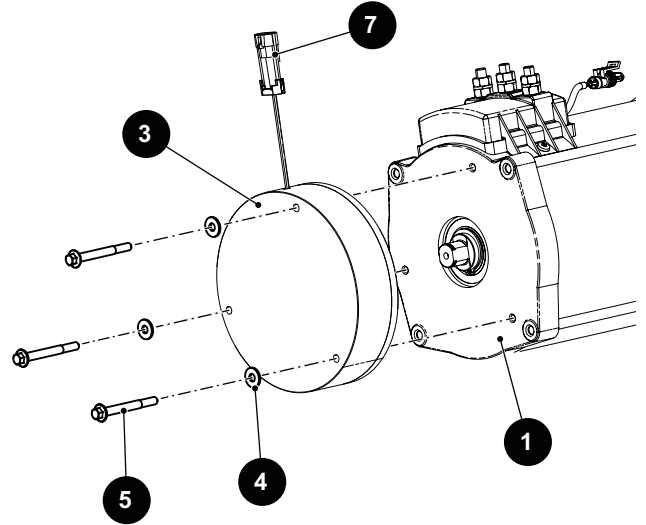


Fig. 1 Motor Brake

Motor Brake Removal

Tool List	Qty.
Wrench, 10mm	1
Insulated Wrench, 13mm	1
Insulated Socket, 13mm	1
Ratchet	1
1. Use an insulated wrench to disconnect the negative (-) battery cable from the battery (Ref. Figure 2).	
2. Disconnect the harness from the motor brake connector (7).	
3. Remove the three bolts (5) and washers (4) securing the motor brake (3) to the motor (1).	
4. Remove the motor brake (3).	
5. Make sure to retain the gasket (2) for reassembly or replace it if it is damaged (Ref. Fig. 1).	

Motor Brake Installation

1. Verify that the seal is in place and that the mounting bolts pass through the holes without any interference.
2. Apply a small amount of anti-seize to the armature shaft.
3. Install the motor brake onto the motor leaving the bolts loose.
4. Connect the wiring harness.
5. Reconnect the negative (-) battery cable.
6. Turn the key switch on and set the park brake switch to the "RELEASE" position.
7. Tighten the bolts to the torque values below.
8. Return the park brake release switch to "RUN".

Item	Torque Specification
5	72 - 78 in. lb (8 - 9 Nm)

MOTOR

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Motor Removal

Tool List

	Qty.
Wrench, 10mm	1
Insulated Wrench, 13 mm.....	1
Chalk or Paint Pen.....	1
Socket, 10mm.....	1
Ratchet.....	1
Torque Wrench, in. lb.....	1

1. Use an insulated wrench to disconnect the negative (-) battery cable from the battery (Ref. Figure 2).
2. Mark both the axle and motor housings to help with realignment during assembly of the motor to rear axle (Ref. Figure 3).
3. Disconnect the motor wires from terminals U, V, and W (12) (Ref. Figure 4) (Ref. Figure 5).

CAUTION Do not damage the splines when removing and installing the motor to the rear axle housing.

4. Disconnect the speed sensor (8) and temperature sensor (9). (Ref. Figure 4).
5. Remove the bolts (11) securing the motor (1) to the axle housing, and carefully slide the motor straight out from the axle splines.
6. Clean the motor coupler with compressed air and use a scraper to remove any rust deposits.

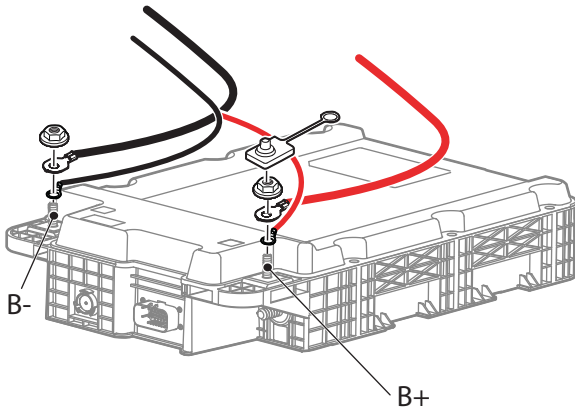


Figure 2 Disconnect Battery Cable

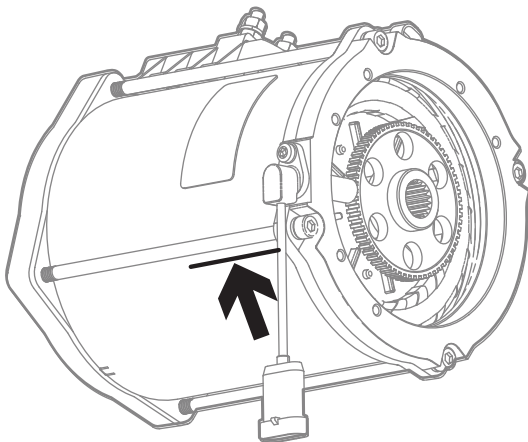


Figure 3 Mark Axle and Motor

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

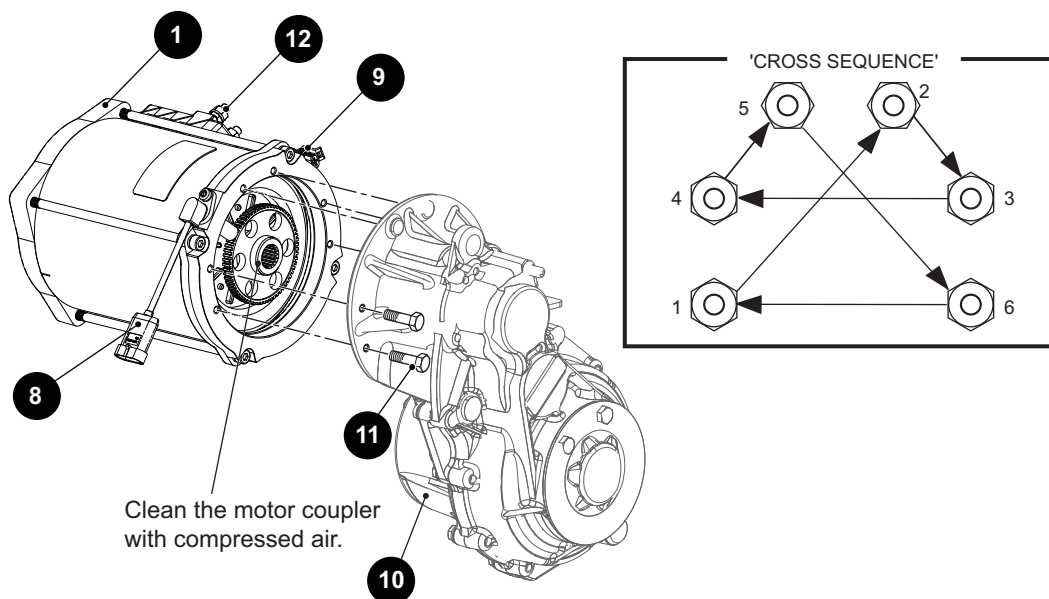


Figure 4 Motor Components

Motor Installation

Assemble in the reverse order of removal.

1. Apply a small quantity of molybdenum grease or a generous amount of silver grade anti-seize grease to the female part of the spline.
2. Carefully align the motor spline with the input shaft of the axle. Align the orientation marks and install the mounting hardware.
3. Finger tighten the bolts (11) in a 'cross sequence' (Ref. Figure 4), then tighten in 25 in. lb (2.82 Nm) increments of torque using the same 'cross sequence' pattern to the torque values below.
4. Reconnect the temperature sensor (9) and speed sensor (8) wiring harnesses.
5. Reconnect the U, V, and W terminals (12) (Ref. Figure 4) (Ref. Figure 5) and tighten to the torque values below.

Item	Torque Specification
11	72 - 78 in. lb (8 - 9 Nm)
12	7 in. lb (0.8 Nm)

MOTOR WIRING

Motor Terminal	Wire Marker	From
U	U	Controller "U"
V	V	Controller "V"
W	W	Controller "W"

Figure 5 Motor Wiring

MOTOR TESTS

The armature and motor housing are not available as individual parts. The Curtis handheld can show specific motor faults (See CURTIS CONTROLLER on page 102). The motor can also be tested using a DVOM (See AC Motor Bench Test on page 117). Additionally, when a test of the power wiring system indicates that the system is operating correctly and the vehicle either does not run or runs poorly, the motor is the only remaining component and should be replaced.

MOTOR

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Notes:

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

BATTERIES AND CHARGING

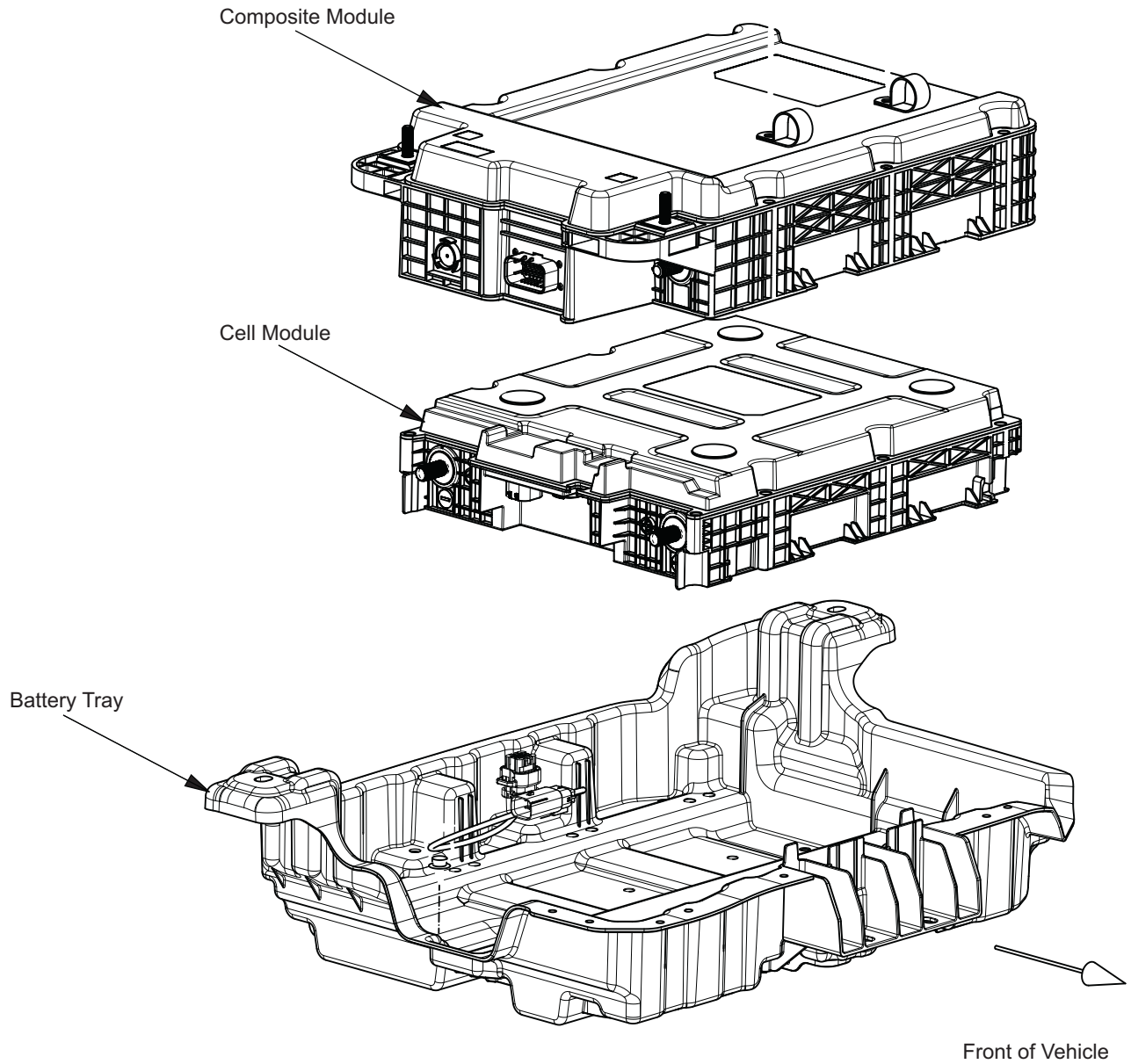


Figure 1 Battery Pack Components

BATTERIES AND CHARGING

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

LITHIUM ION BATTERY PACK

The battery pack consists of a composite module and optional cell modules. The composite module incorporates battery cells and a Battery Management System (BMS) in a single unit.

The battery terminals do not require protective grease. Li-ion batteries terminals do not corrode.

The battery modules are equipped with a pressure relief valve.

The battery components are matched to the vehicle serial number.

Charge the battery pack using only the OEM approved Lithium-Ion battery charger.

Composite Battery/Battery Management System (BMS)

The composite battery/battery management system's (BMS) primary function is to maximize energy efficiency between cells and to provide protection for the battery modules. The circuitry inside the BMS communicates with the battery modules and the electronic speed controller on the vehicle. Cell temperature, cell voltage, and current are monitored by the BMS module. It prevents excessive discharge and overcharge. A contactor opens and closes based on the vehicle and battery conditions. A 400 amp fuse is placed in the BMS module to protect the battery management system in case of short circuit. The circuit board in this module is protected by a 5 amp fuse. The composite BMS module can only be serviced by the battery manufacturer. Do not disassemble the BMS.

The composite BMS module is water resistant, but not waterproof. Do not flood the composite module with water. Do not pressure wash the composite module. Do not turn the vehicle ignition on if the vehicle has been submerged. Disconnect the composite modules immediately.

On-board diagnostics are provided by the BMS module. Diagnostics are accessed using the Curtis 1313 hand held tool or the Battery Diagnostic Tool with a smart phone application.

Safety

Always obey the following warnings when working on or near batteries.

⚠ WARNING *Improper handling of batteries and electrical components can result in serious injury or death.*

Keep all flammable materials, open flames, or sparks away from the batteries.

Make sure the key switch is in the OFF position and the RUN/TOW switch is in the RUN position before servicing the vehicle.

Make sure the key switch is in the OFF position and all electrical accessories are off before servicing the vehicle.

Turn off all accessories before disconnecting the battery terminal.



When servicing the vehicle, always wear eye protection. Be careful when working around the battery pack or using solvents or compressed air.



Use safe procedures to move the battery pack. Always lift the battery pack with a commercially available battery lifting device.

Use insulated wrenches to decrease the risk of a short-circuit if a wrench falls across the battery terminals. A battery short-circuit can blow the internal BMS fuse.

ABC type fire extinguishers are to be used on Lithium Ion battery fires.

Do not ship damaged batteries.

Do not puncture the battery modules.

Do not ship the battery modules by air. Only ship by ground.

Only ship in company provided packaging.

Do not ship at full charge. Use 30% SOC as a guideline.

Do not short B+ and B- together.

Make sure covers are installed over terminal posts.

Do not apply direct water spray to the module set.

Do not attempt to start a vehicle or charge the battery pack if the vehicle has been soiled at or below freezing temperatures. Allow 24 hours for the pack to defrost before use or charging.

Avoid module / vehicle submersion.

Use insulated tools to remove and replace fasteners.

Do not attempt to jump start the vehicle.

Do not charge the battery pack with jumper cables.

Do not use a discharge machine for diagnostics.

Contact your local recycling facility for disposal

BATTERIES AND CHARGING

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

instructions.

If the battery module set is ever submersed, do not turn the key on and disconnect B+ and B-.

There are no serviceable parts in the composite or cell modules. They must be replaced as a set to ensure they are electrically balanced.

Bus bars and COM cables are the only replaceable components.

Use compressed air to remove debris from the battery module compartment.

Battery Disposal



Lithium-Ion batteries are recyclable:

Return discarded batteries to distributor or manufacturer for recycling.

Contact local or state environmental department for the disposal information.

Prolonged Storage



Disconnect the battery charger, controller, and other electronic devices for extended storage. All connected electronic components will discharge the batteries.

Improper storage may damage, destroy or cause permanent loss of battery capacity. Do not exceed storage time or temperature limits. Batteries must be charged to the correct level before storage. Storing fully depleted batteries will make them perma-

nently unusable.

NOTICE: To prevent draining of the batteries during extended storage of the vehicle, turn the key switch to the OFF position and place the run/tow switch in the RUN position.

Storage Preparation

The optimum storage temperature range is between 65°F and 82°F (18°C and 28°C).

Charge the battery module based on climate during storage period.

In cold climates, fully charge the battery module. Make sure that the charging operation is complete and there are no faults displayed on the charger. The green light on the charger should be on indicating the charge cycle is complete.

In hot climates, store the vehicle with a 30% to 50% charge of battery pack capacity.

Turn the key to the OFF position and remove it from the key switch.

Check the run - tow switch under the seat, make sure it is set in the RUN position.

Turn off all accessories.

The storage time for properly charged Lithium-Ion batteries supplied with this vehicle varies based on the ambient temperature.

Temperature	Length of Storage Time
-22°F to -4°F (-30°C to -20°C)	One month at 100% battery charge, all accessories turned off.
-4°F to 113°F (-20°C to 45°C)	Six months at 100% battery charge, all accessories turned off.
113°F to 140°F (45°C to 60°C)	One month at 30% - 50% charge, all accessories turned off.

Setting State of Charge (SOC)

The optional SOC meter or the hand held programmer may be used to determine the state of charge of the battery module. If the SOC is below 30%, charge the battery module until the state of charge reaches 50%. The charge cycle may be interrupted by disconnecting the charger from the AC power source first, then from the charging receptacle on the vehicle. If the SOC is above 50%, operate the vehicle until the SOC is below 50%.

During Storage

Check the state of charge every 30 days. If the SOC is below 30%, charge the battery module until the state of charge reaches 50%.

Returning Vehicle to Service

At the end of the storage period, charge the battery module to 100% before operating the vehicle.

BATTERIES AND CHARGING

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Battery Charging

Charging should be performed when ambient temperatures are between 25°F and 107°F (-4°C and 42°C). The battery pack may be charged or topped off after every use.

The battery will get slightly warm during charging. If the battery becomes hot or gives off an odor during charging, terminate the charging immediately and contact the manufacturer.

Use only the OEM approved Lithium-Ion battery charger for your vehicle. See charger operating instructions in Appendix A.

Park the vehicle on a flat, level surface.

Turn the key switch to the OFF position and remove the key.

Inspect the charger cord for cracks, frayed wires, or loose connections. If the cord is damaged, replace it.

Inspect the vehicle charger receptacle and charger plug for dirt, debris or damage. Clean the receptacle if necessary and replace immediately if damage is found.

Connect the charger to a wall receptacle. Do not use a multi-plug adapter or power strip. Do not connect anything else to the same receptacle.

Connect the charger to the vehicle receptacle.

When the battery pack is finished charging, disconnect the charger cord from the vehicle. If disconnecting before the charge cycle is complete, it is recommended that the charger be disconnected from the wall receptacle first, then unplug the charger from the vehicle receptacle.

Before charging, the following must be observed:

- The charger connector components must be in good condition and free from dirt and particles.
- The charger connector must be completely installed in the vehicle receptacle.
- The charger connector and cord set must be protected from damage. The charger connector and cord set must be used in an area where it is not possible for personnel to run over or trip over the cord set.
- The charger automatically turns off during the connect and disconnect cycle so no electrical arc is generated at the DC plug and receptacle contacts.

AC Voltage

The battery charger output is directly related to the input voltage. If the vehicle receives an incomplete charge in a normally adequate time period, low AC voltage can be the cause. Consult an electrician if necessary.

Troubleshooting

Troubleshooting is done for two reasons:

- A battery pack that performs poorly and is outside of the manufacturers specification must be identified to replace it within the terms of the manufacturer's warranty. Different manufacturers have different requirements. Refer to the battery manufacturer or the manufacturer's representative for specified requirements.
- Find the reason a vehicle does not perform adequately. Performance problems can cause a vehicle to run slowly or not operate for the time required.

Battery Charger Maintenance

Connect the charger plug into the vehicle receptacle and wait for the relay to activate.

Move the plug back and forth in the receptacle. If the charger turns off, check the plug for a broken red wire in the DC cord.

⚠ WARNING *Do not attempt to start the vehicle or charge the battery pack if the vehicle has been stored at or below freezing temperatures.*

Do not spray the battery module with water. Do not attempt to add water to the battery module.

Do not charge the batteries if the ambient temperature is below 14°F (-10°C) or above 140°F (60°C). Refer to Appendix A for battery charger operating instructions.

Before connecting the battery charger:

- Park the vehicle, turn the key switch to the OFF position and remove the key.
- Inspect the charging receptacle for dirt or debris. Remove dirt or debris if found.
- Inspect the charger cords and plugs for cracks or damage. Replace any damaged cords before use.
- Plug the charger into a receptacle on a dedicated circuit. Do not connect any other devices to the receptacle.
- Connect the charger to the vehicle.

BATTERIES AND CHARGING

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

BATTERY CHARGING

The battery charger is designed to completely charge the battery pack. If the batteries are severely deep cycled the charger will indicate a fault. The automatic charger determines the correct length of charge to the battery pack and turns off when the batteries are charged. Always refer to the instructions supplied with the charger (See BATTERY CHARGER USER'S GUIDES on page 135).

Operating voltage range is 39.2V to 56.7V.

Plug the charger cord into the receptacle on the vehicle. There is a three second to two minute delay before the charger will turn on. Wait for the charger light and the light on the vehicle receptacle to illuminate. The charger will emit a click sound when it activates.

The battery charger will not turn on if the cell temperature is above 140° F (60° C).

The BMS prevents charging below 14° F (-10° C) and above 140° F (60° C) (cell temps, not ambient). Between 14° F (-10° C) and 41° F (5° C), and between 113° F (45° C) and 140° F (60° C), charging proceeds at a slow rate (6 amps). Between 41° F (5° C) and 113° F (45° C), full charging is allowed (~14 Amps). The charger and BMS automatically set the charge rate, and the rate will update automatically as the cell temperature changes.

Li-Ion batteries do not have a "memory", so charge cycling is not required.

As with other new Li-ion battery products, charge the vehicle one full cycle before use.

Do not leave the charger plugged in during long term storage.

Replace the cell modules if voltage drops too low to activate the charger.

Set the run / tow switch to the RUN position.

AC Voltage

The battery charger output is directly related to the input voltage. If the vehicle receives an incomplete charge in a normally adequate time period, low AC voltage can be the cause. Consult an electrician if necessary.

BATTERY DIAGNOSTIC TOOL

The Battery Diagnostic Tool (BDT) is used to inspect the battery pack condition. If the vehicle has stopped or doesn't operate properly; the tool will indicate what the Battery Management System (BMS) has detected and controlled for the purpose of protection. It also provides fault cause and actions for recovery.

The BDT consists of:

- BDT hardware, communication cable, and diagnostic applications for Android and iOS smart phones.
- BDT hardware for Bluetooth communication
- BDT module & three AA batteries. The silicone protector is optional.
- Communication cable for connection to the battery pack or system connector
- CAN_H, CAN_L signal connection
- Tow mode on/off switch, Amphenol receptacle and 12pin connector housing
- Pack Diagnostics application for Android or iOS devices.

BDT Features

- Diagnostic function of the battery pack condition and failure modes
- CAN Communication with the battery pack
- Wireless communication between BDT and mobile devices
- Fault cause and action guidance
- Diagnose the pack status
- Email diagnostic capability
- BMS firmware update & Logging
- Display LED to check BDT operation status
- Plot chart
- Check BDT information

Hardware Requirements

To install and operate the Battery Diagnostic Tool, the following will be needed:

- BDT Module
- Android application (Can be installed on devices with Bluetooth SMART (Bluetooth Low Energy) chip, GPS chip and network service.)
- iOS application (Can be installed on iPhones (iPhone 4s and later) and iPad, that supports GPS and network service)

Software Requirements

The Android application can be installed on devices with Android version 4.3 (API level 18) and above.

The iOS application can be installed on devices with iOS version 6 and above.

BATTERIES AND CHARGING

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Software Installation

The installation file can be downloaded via email or access on TSV Connect.

Android Software:

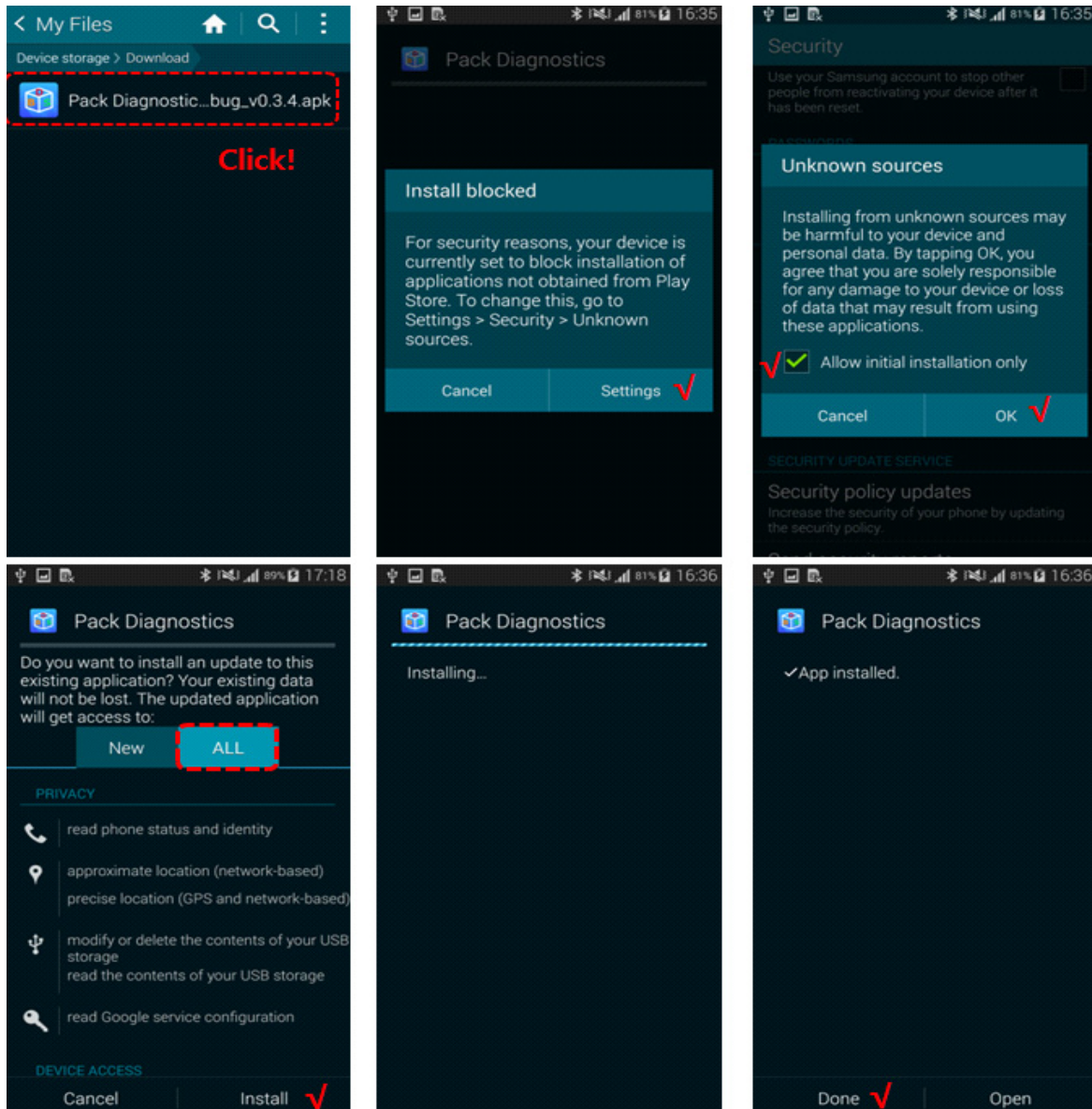


Figure 2 Software Installation

1. Allow the installation of non-market application (APK) files on the device.
2. Copy the latest Pack Diagnostics APK file to the Android device.
3. Open “My Files” or other file manager.
4. Go to the folder the APK file copied.
5. Click on the file name, Pack Diagnostics-debug_v0.x.x.apk.
6. Click “Settings”.
7. Set checked “Security->Unknown sources”.
8. Set checked “Allow initial installation only”.
9. Select “ALL”.
10. Click the “Install” button.
11. After installation completes, click the “Done” button.
12. Check the “Pack Diagnostics” icon creation in the home screen.
13. Connect the BDT to the battery pack.

BATTERIES AND CHARGING

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.



Power On/Off



Tow Mode On/Off

14. Unplug the pack ~ VCU cable from the vehicle.

15. Plug the 12 pin connector of the BDT cable into the BDT.
16. Plug the 8 pin connector of the BDT cable into the VCU cable.
17. Turn ON the power switch of the BDT. The red LED will illuminate first. The green LED will begin flashing.
18. Set the Tow Mode to ON.

Usage

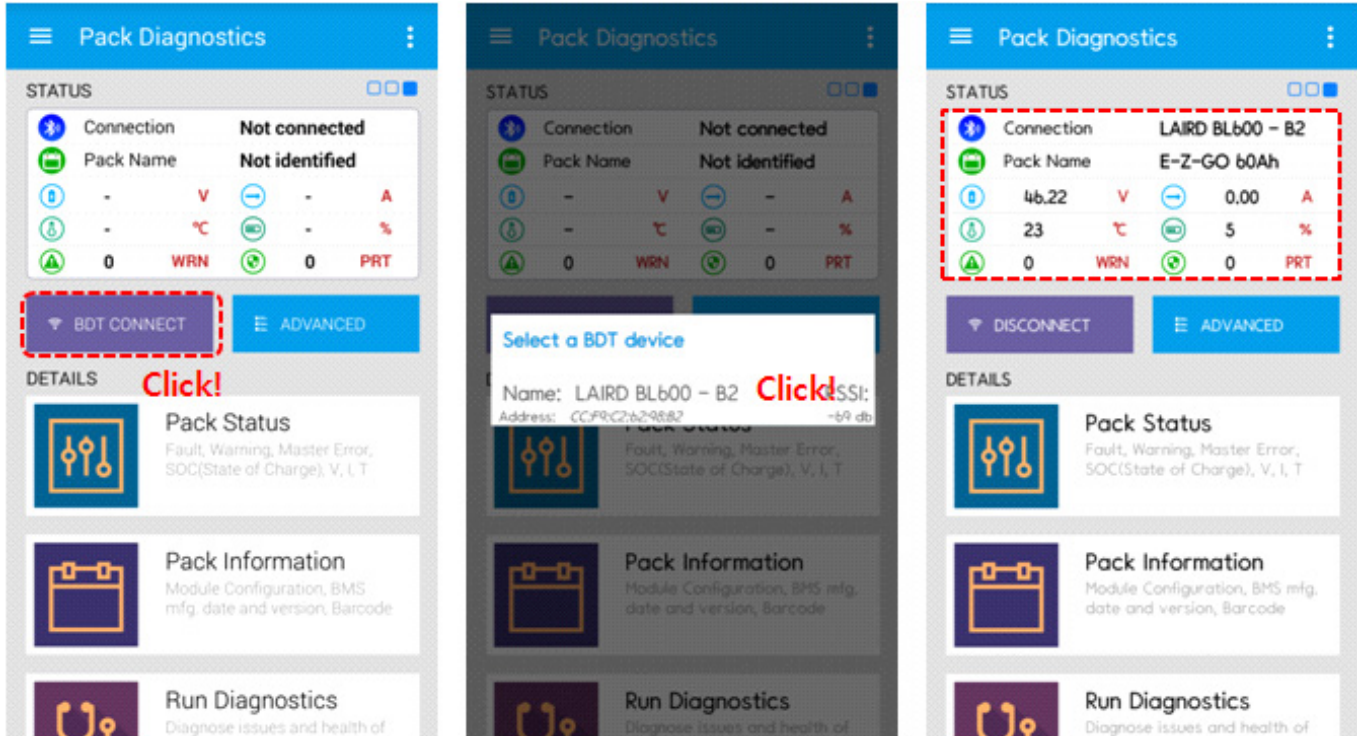


Figure 3 Battery Pack Diagnostics Software

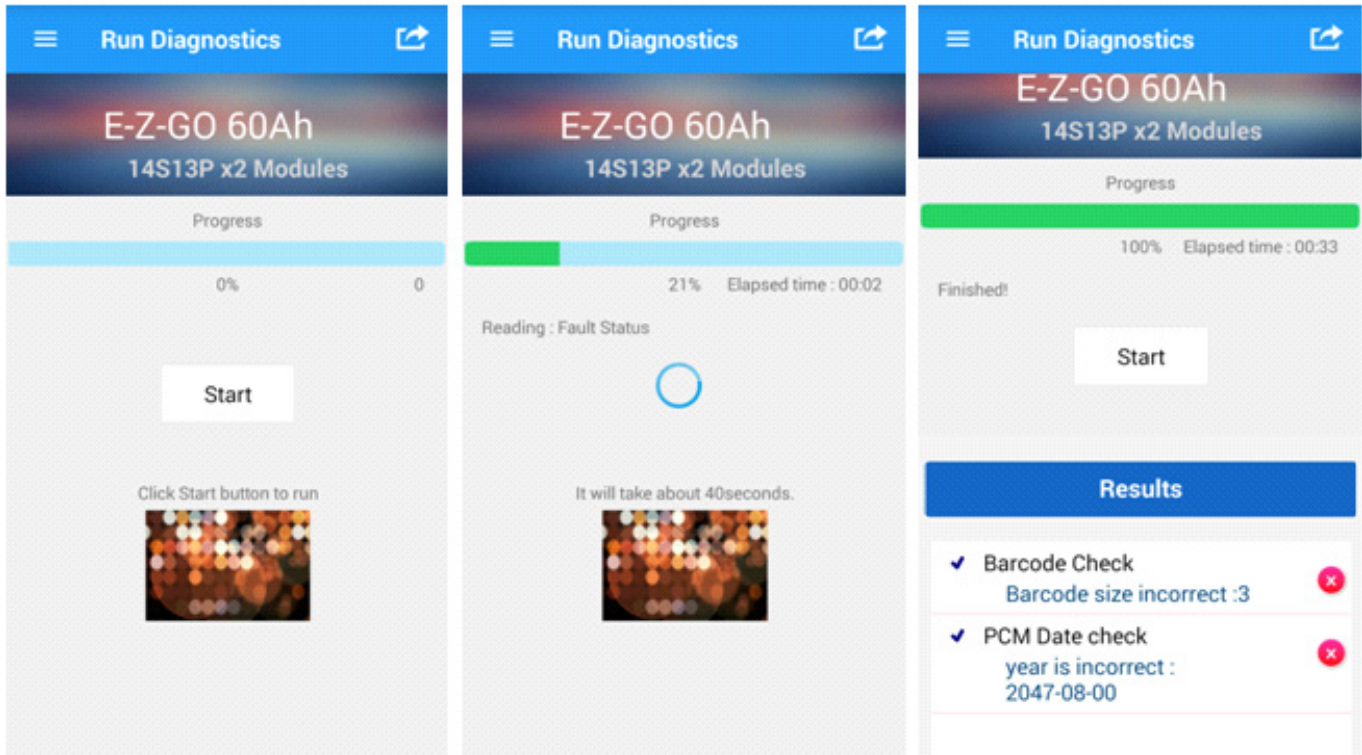
To prepare the Android or iOS device Pack Diagnostics application (APK) for installation:

1. Verify the connection between the pack and the BDT.
2. Turn on the BDT and set to Tow mode.
3. Launch the application and check the pack status.
4. Run the diagnostic functions and send results via email.
5. Launch Pack Diagnostics application.
6. Enable "Bluetooth" in the settings.
7. Enable "Location" in the settings.
8. Click the "BDT CONNECT" button.
9. "Select a BDT device" window will appear.
10. Select one by clicking LAIRD BL600-XX. The application will attempt to connect the BDT and identify the pack name. If successful, the red LED stays on and the orange LED will continue flashing. If unsuccessful, a connection failure message will appear.
11. Click "OK".
12. Check the battery pack status. The "Fault flag detected" window will appear.
13. Click "OK". The Pack Status will show detected flags.

BATTERIES AND CHARGING

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Fault Cause and Action



The BMS provides a warning or fault condition for battery protection. The cause and action will be shown.

1. Click one flag you want to see.
2. The selected fault flag's cause and action will show.
3. Correct the condition to recover or prevent faults.
4. Diagnose the pack.
5. Click "Run Diagnostics".
6. Click the start button. Wait until progress completes.
7. Check diagnosis results shown.
8. Click "Send email" after completion.

BATTERIES AND CHARGING

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Send Email

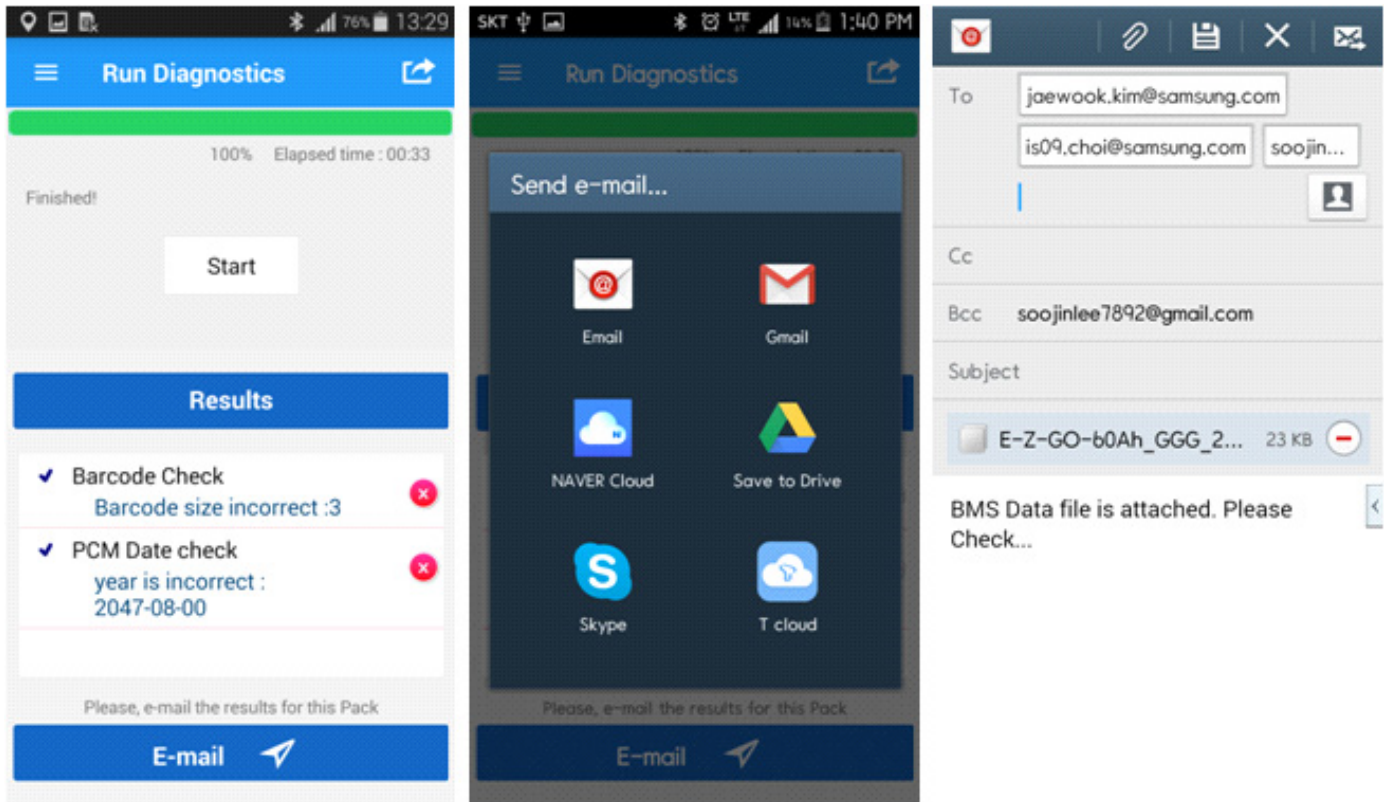


Figure 4 Sending Diagnostic Email

1. Scroll down until the email button shows.
2. Click "Send email".
3. Select the data to be sent.
4. Add the email address.
5. Click the send button.

Abbreviation	Description
BMS	Battery Management System
RSOC	Relative State of Charge
SOH	State of Health
EOC	End of Charge
EOD	End of Discharge
MCU	Micro Control Unit
AFE	Analog Front End
CAN	Controller Area Network
COVW	Cell Over Voltage Warning
CUVW	Cell Under Voltage Warning

Figure 5 Abbreviations

BATTERIES AND CHARGING

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Abbreviation	Description
OTCW_HT	Over Temperature in Charge Warning (High Temperature)
OTCW_LT	Over Temperature in Charge Warning (Low Temperature)
OTDW_HT	Over Temperature in Discharge Warning (High Temperature)
OTDW_LT	Over Temperature in Discharge Warning (Low Temperature)
OCCW	Over Current in Charge Warning
OCDW	Over Current in Discharge Warning
BUSBAR_OTW	Bus-bar Over Temperature Warning
LOWSOC	Low SOC Warning
COVP	Cell Over Voltage Protection
CUVP	Cell Under Voltage Protection
OTCP_HT	Over Temperature in Charge Protection (High Temperature)
OTCP_LT	Over Temperature in Charge Protection (Low Temperature)
OTDP_HT	Over Temperature in Discharge Protection (High Temperature)
OTDP_LT	Over Temperature in Discharge Protection (Low Temperature)
OCCP	Over Current in Discharge Protection
CIBF	Cell Imbalance Failure
CDDF	Cell Deep Discharged Failure
CHGP_CROSSCOND	Charger Protection (Cross Conduction)
BUSBAR_OTP_HT	Bus-bar Over Temperature Protection (High Temperature)
LOSS_OF_CAN	Loss of CAN communication Protection
SWTF_COMM_SLAVE	Master-Slave communication error
SWTF_CHKSUM_ROM	ROM checksum error
SWTF_INITDATA	initial data error
SWTF_CONFDATA	configuration data error
SWTF_NVM	NVM read/write/erase error
HWTF_CVSENS	cell voltage sensing error
HWTF_BVSENS	battery voltage sensing error
HWTF_ISENS	current sensor error (open, short)
HWTF_THERMISTOR	thermistor error (open, short)
HWTF_MVDELTA	module (slave) voltage delta error
HWPF_HRELAY_ON	high-side relay on error
HWPF_HRELAY_OFF	high-side relay off error
CC	Constant Currents
CV	Constant Voltage

Figure 5 Abbreviations

BATTERIES AND CHARGING

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

BATTERY PACK REMOVAL

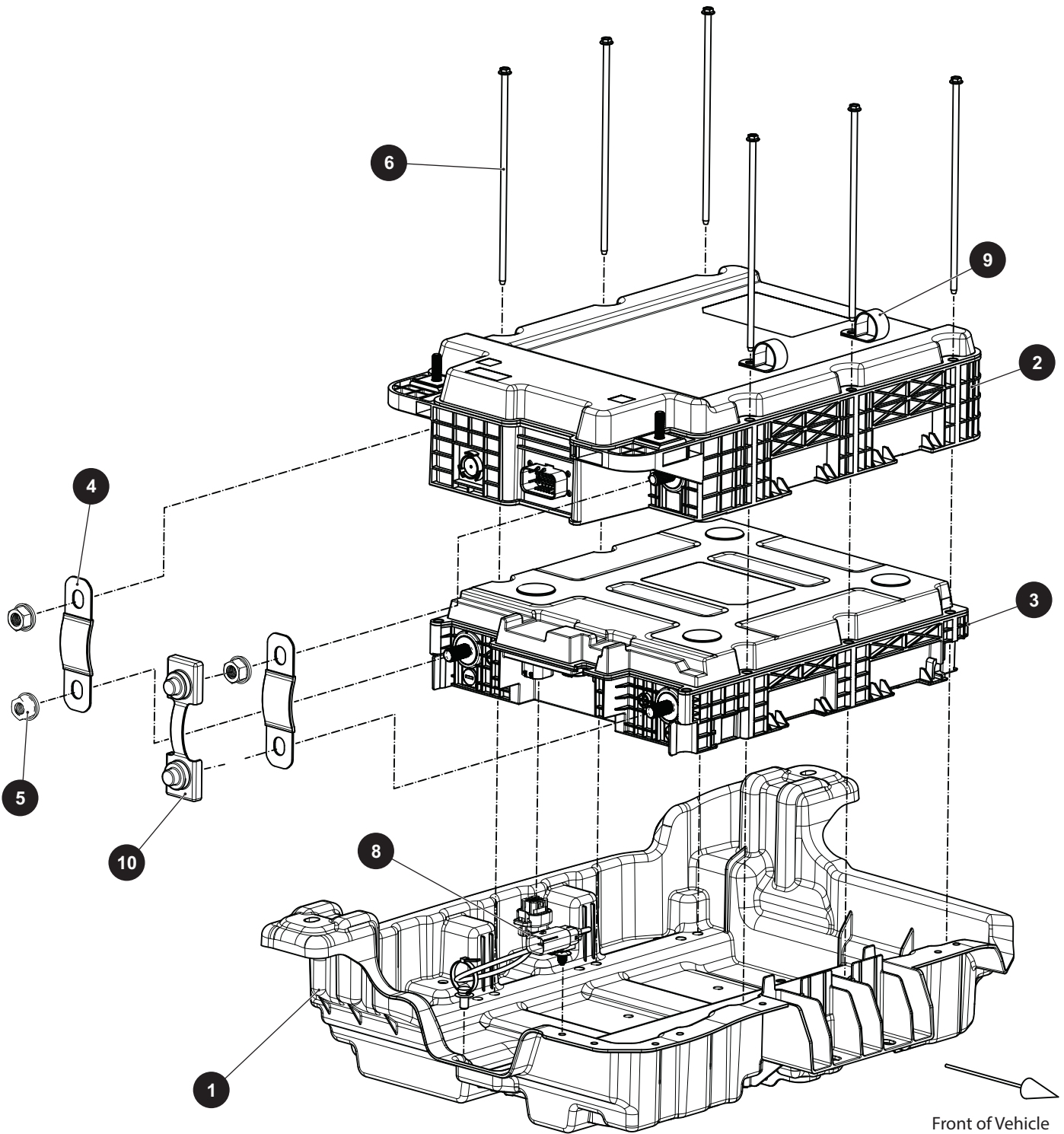


Figure 6 Battery Pack Removal

BATTERIES AND CHARGING

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Tool List	Quantity
Torx T-25 Security Driver	1
Insulated 10mm Socket	1
Insulated 13mm Socket	1
Ratchet	1
Torque Wrench, in. lb.....	1

NOTICE: Hardware that is removed must be installed in its original position unless otherwise specified. If torque values are not specified, refer to the Torque Specifications table.

1. Turn the key switch to the OFF position and remove the key.
2. Disconnect the main power cables.
3. Disconnect and remove all other wires from the vehicle connected to the battery pack.
4. Remove the six hex flange screws (6) that secure the composite module (2) and the cell module (3) to the battery tray (5) (Ref. Figure 6).
5. Remove the four nuts (5) securing the boot terminal (10) and insulated busbars (4) connecting the composite module (2) to the cell module (3).

NOTICE: If vehicle is not equipped with cell module (3), disregard procedure concerning boot terminal (10) and insulated busbars (4).

6. Composite battery (2) and cell module (3) can be lifted from battery tray (1).

Battery Pack Installation

NOTICE: To prevent BMS damage, the battery wires must be connected in the reverse order that they were removed. Connect the communication cable first, then connect the power cables.

1. Install battery pack in the reverse order of removal.
2. Torque hex flange screws (6) in the sequence shown below:

Item	Torque Specification
screw (6)	4 - 5 ft. lb (5 - 6 Nm)

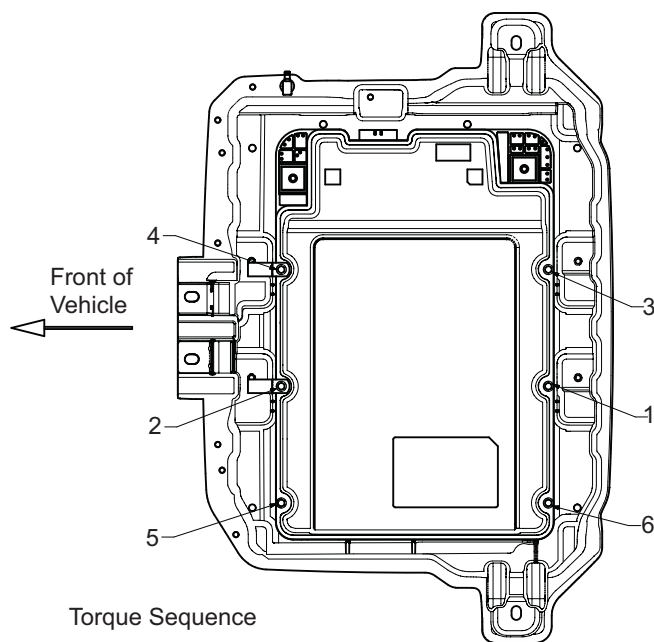


Figure 7 Torque Sequence

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

ELECTRICAL SYSTEM

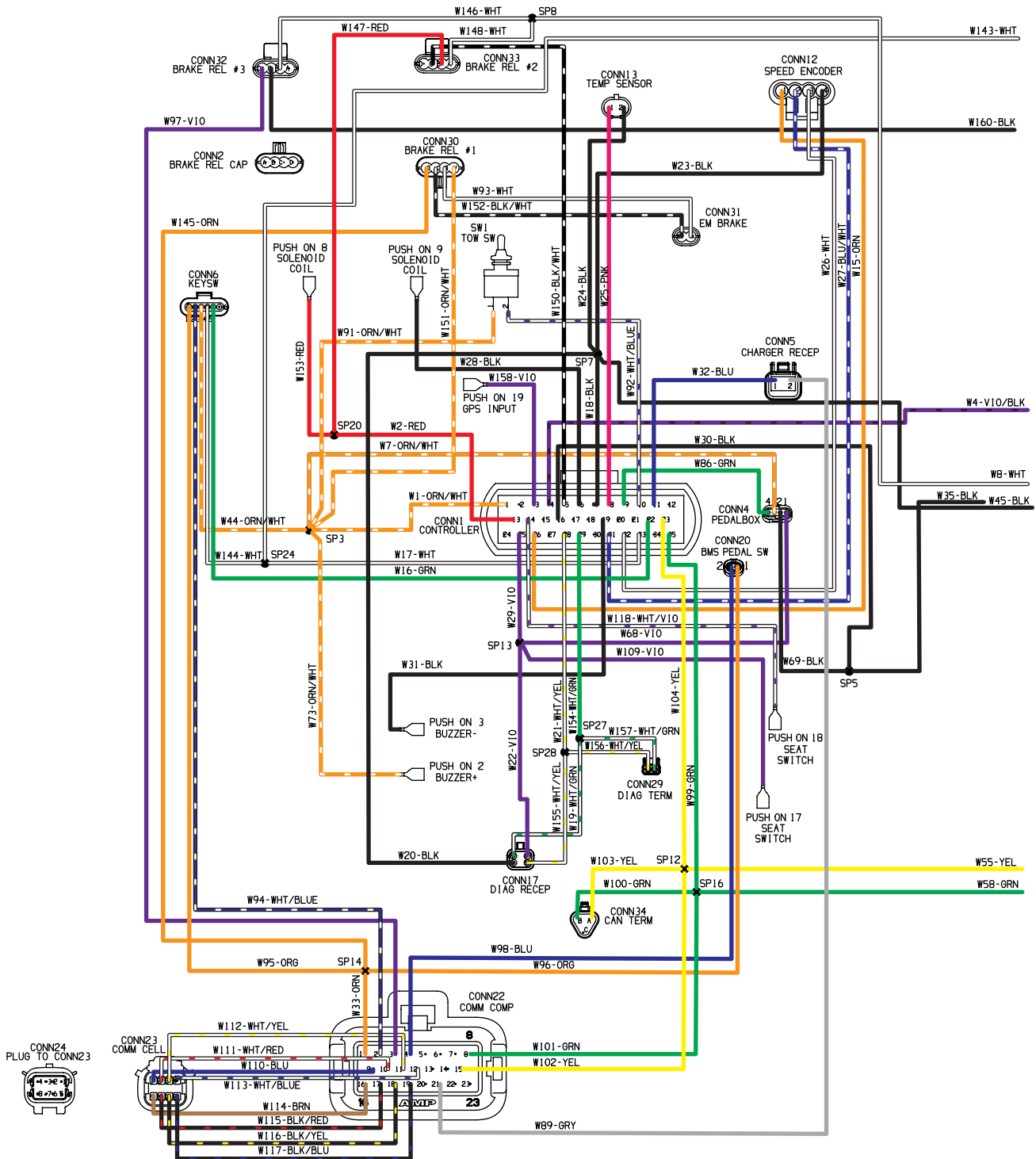


Figure 1 Wiring Diagram

ELECTRICAL SYSTEM

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

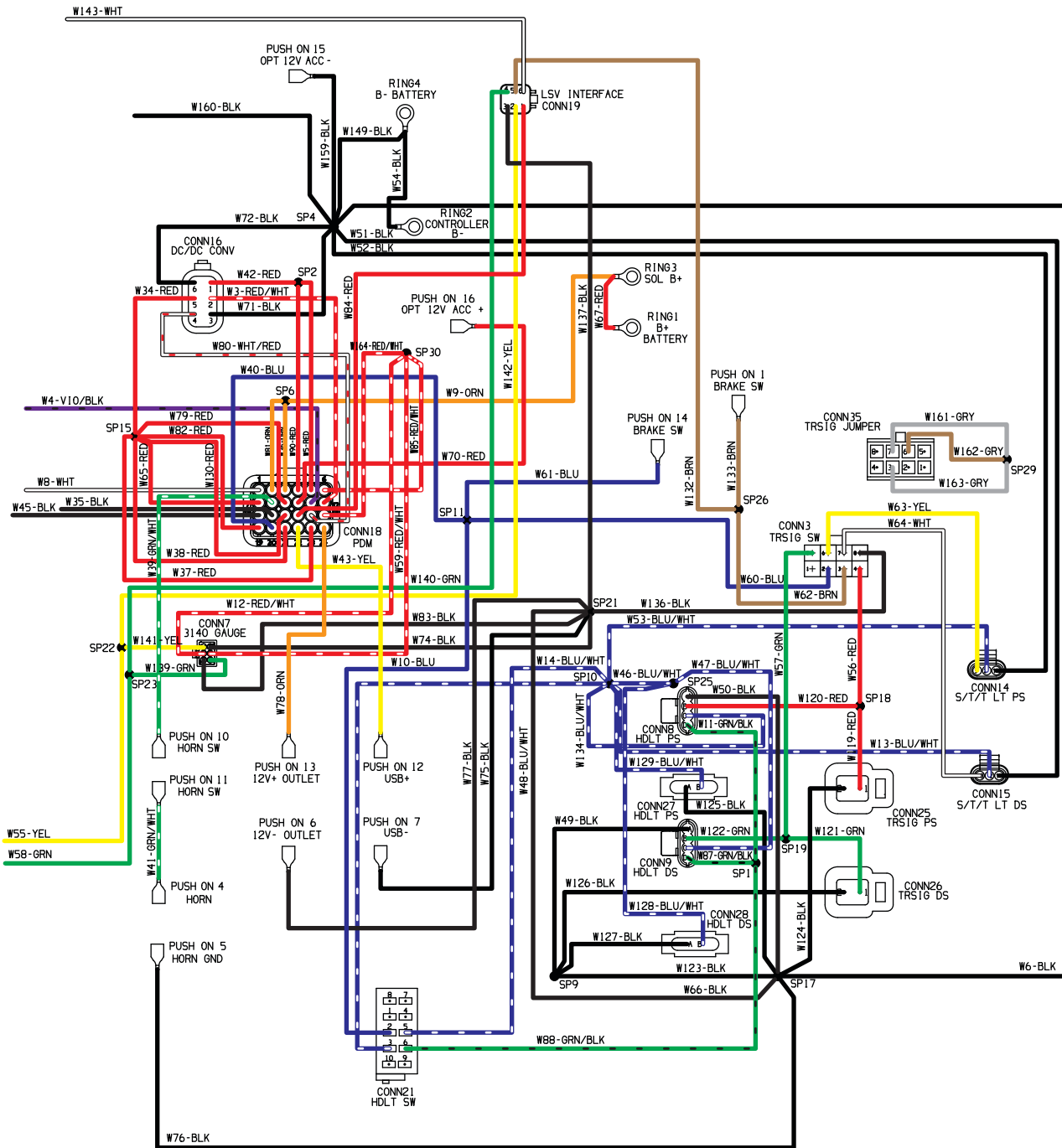


Figure 2 Wiring Diagram (cont.)

ELECTRICAL SYSTEM

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

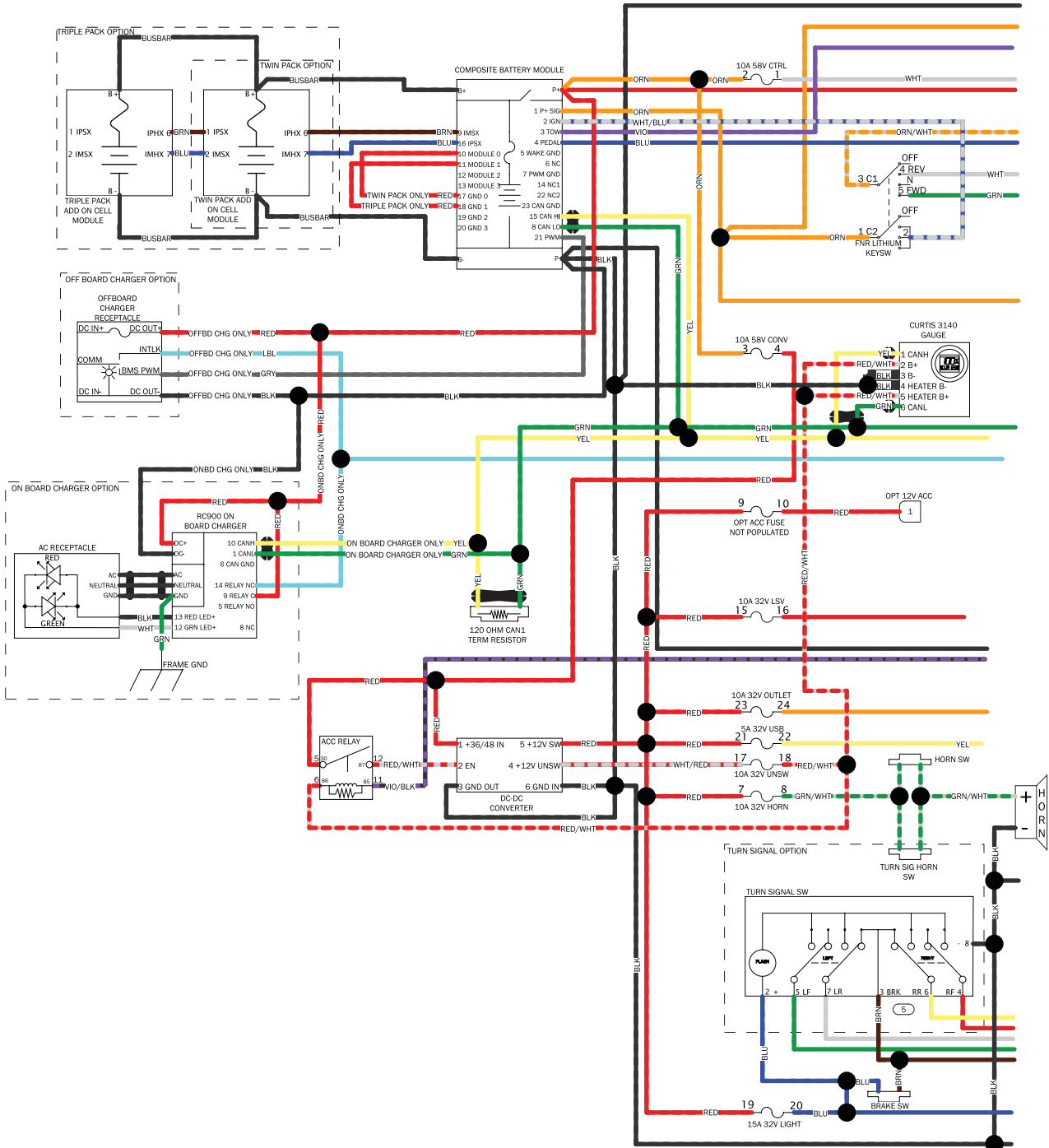


Figure 3 Electrical Schematic

ELECTRICAL SYSTEM

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

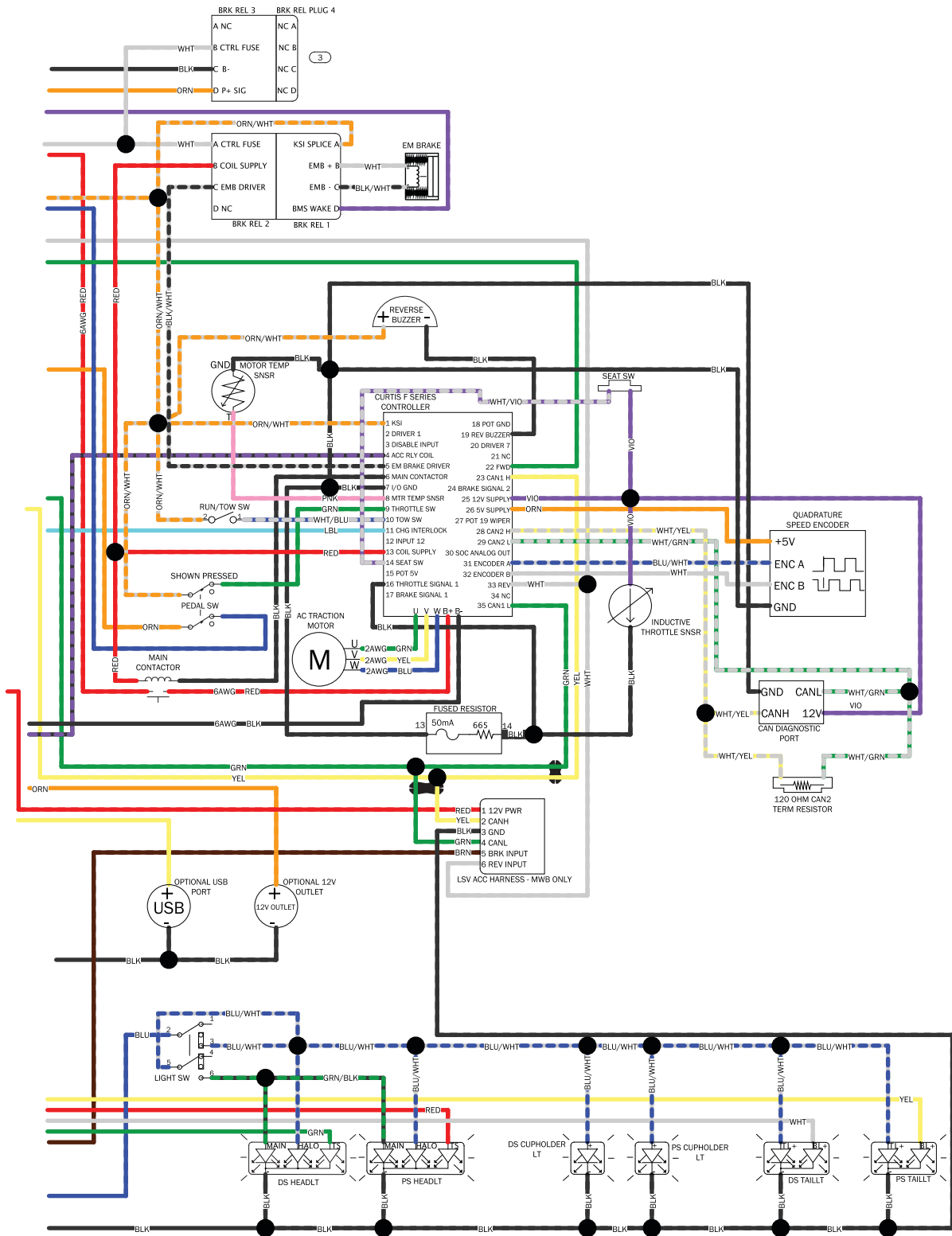


Figure 4 Electrical Schematic (Continued)

ELECTRICAL SYSTEM

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

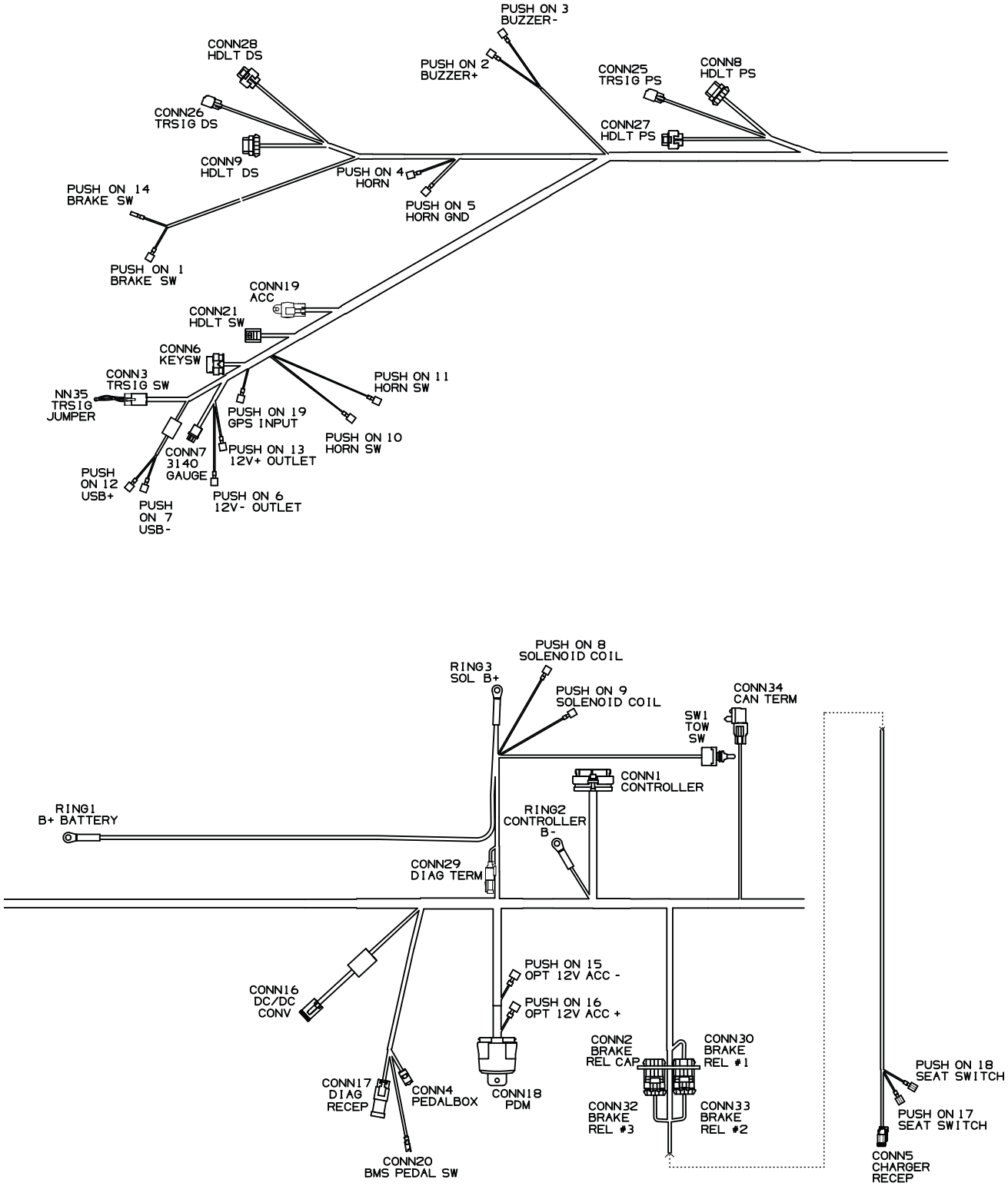


Figure 5 Harness Overview

ELECTRICAL SYSTEM

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

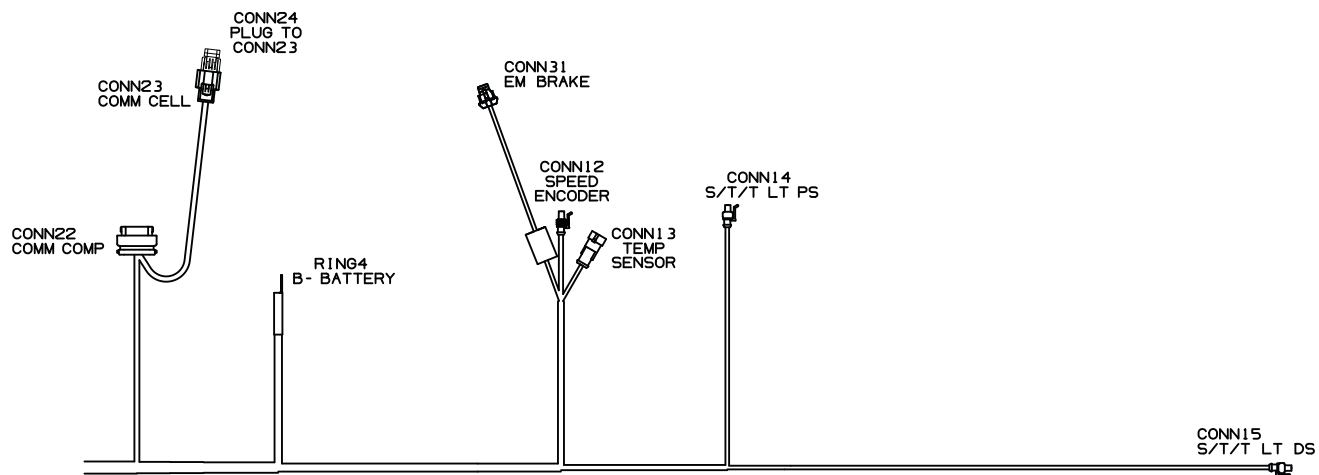


Figure 6 Harness Overview (continued)

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

DIGITAL VOLT OHM METER

A typical digital volt ohm meter (DVOM) is shown (Ref. Figure 7). A recommended DVOM is available through the Service Parts Department as P/N 27481G01. For the purpose of this section, the red probe (+) and black probe (-) are used. Any DVOM may be used, however the controls, displays, accuracy and features may vary depending on the make and model. Always follow the meter manufacturer's recommendations and instructions for the use and care of the meter.

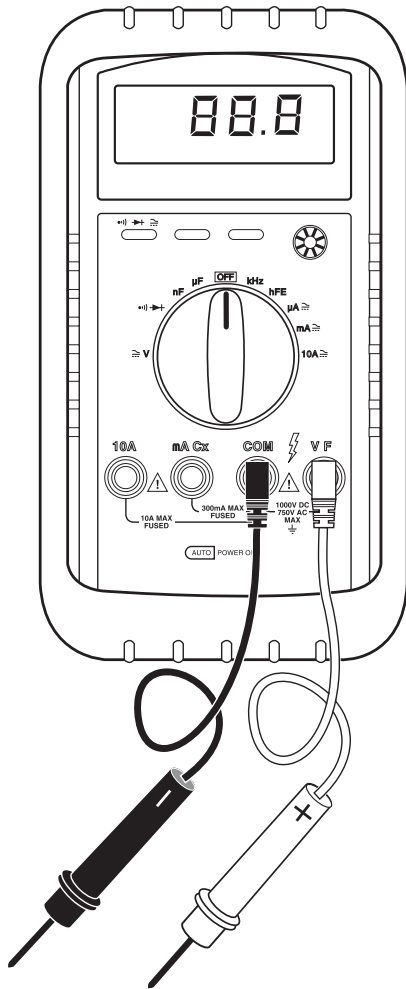


Figure 7 DVOM

TROUBLESHOOTING

In order to effectively troubleshoot the circuits that include the horn, lighting, brake/turn signals and gauges, the technician must be able to use the wiring diagram and a DVOM.

The wiring diagram and electrical schematic shows the path followed by a voltage or signal from its origination point to its destination (Ref. Figure 1) (Ref. Figure 2)(Ref. Figure 3). Each wire is indicated by color.

The technician should use simple logic troubleshooting in order to reduce the number of steps required to isolate the problem.

Example 1: If the vehicle will not start and none of the lights function (or burn dimly) the battery should be tested before trying to troubleshoot the lighting circuit.

Example 2: If a problem occurs in the lighting circuit that results in only one of the headlights not working, there is no reason to check battery wiring or the fuse since it is obvious that voltage is present. Since bulbs will burn out over time, the obvious place to start is at the headlight that is not functioning. If power is present at the connector and the ground wiring is satisfactory, the only possibilities that exist are a burned out bulb or a poor contact between the connectors and the headlight.

If power is not present but the other headlight functions, a wiring problem is indicated between the two headlights.

In some cases where battery voltage is expected, the easiest way to test the circuit is to set the DVOM to DC volts and place the negative (-) probe of the DVOM on the negative battery terminal. Move the positive (+) probe to each wire termination starting at the battery and working out to the device that is not working. Be sure to check both sides of all switches and fuses.

When no battery voltage is found, the problem lies between the point where no voltage is detected and the last place that voltage was detected. In circuits where no voltage is expected, the same procedure may be used except that the DVOM is set to continuity. Place the negative (-) probe on a wire terminal at the beginning of the circuit and work towards the device that is not working with the positive (+) probe. When continuity is no longer indicated, a failed conductor or device is indicated.

ELECTRICAL SYSTEM

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

MAIN HARNESS

Power Supply

Tool List	Qty.
DVOM.....	1

1. Check For Loose or Bare Wires
 - a. Check for loose wires at each terminal connection and for worn insulation or bare wires touching the frame. **Bare wires may cause a short circuit.**

NOTICE: If any DVOM readings indicate a faulty wire, it is recommended that the condition of the terminals and wire junction be examined. A faulty wire should be replaced with one of the same gauge and color and wired between the correct components and wire tied to the harness bundle. The faulty wire should be cut back close to the harness and the ends protected with vinyl electrical tape.

2. Check Battery Condition
 - a. Check for adequate battery volts (nominal 48 VDC) by setting DVOM to 50 VDC range and place the red probe (+) on the positive battery post (B+). Place the black probe (-) on the negative battery post (B-). A reading of 47 VDC or greater indicates adequate battery condition. No reading indicates (a) a poor connection between the probes and the battery terminals; (b) a faulty DVOM. A voltage reading below 47 volts indicates poor battery condition and the vehicle should be recharged before proceeding with the test.
 - b. If the DVOM shows 0 VDC, the BMS may have entered sleep mode. Place the key switch in the OFF position and wait 10 seconds before returning it to the ON (R,N, or F) position.

NOTICE: Due to the resistance of the wires involved within the harness, voltage readings may be somewhat lower than battery voltage. A reading of 1 volt below battery voltage is acceptable.

3. Check the power wire.
 - a. Attach the black probe (-) to the battery post with the black wire attached.
 - b. Attach the red probe (+) to the power wire (yellow) terminal at the fuse block.
 - c. A reading of battery voltage indicates that the power wire is in good condition.

NOTICE: The power wire supplies power to the entire fuse block.

4. Check the fuse (Ref. Figure 8).
 - a. Place the red probe (+) to each wire terminal on the fuse block.
 - b. A reading of battery voltage indicates that the fuse is in good condition.

- c. No reading indicates a faulty fuse. Replace the faulty fuse with a good fuse of the same amperage rating.

CAUTION The use of an incorrect fuse rating can damage the electrical components.

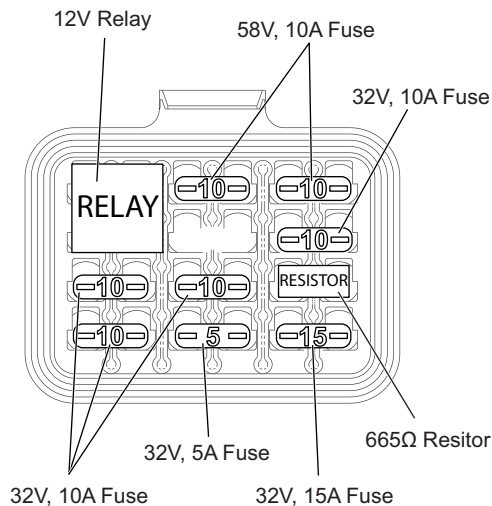
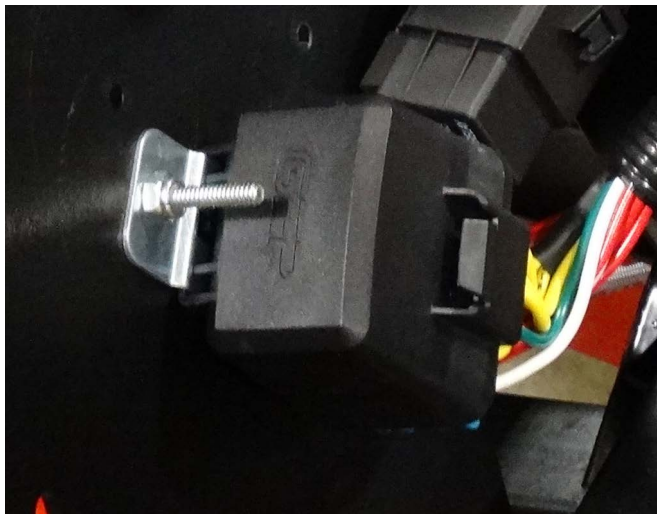


Figure 8 Fuse Block

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Accessory Wiring

After determining that there is power to the fuse panel, and the fuse is good, check the circuit using the procedures previously used to check the power supply (See Power Supply on page 68).

Use the wiring diagram to check for the correct wiring and wire routing (Ref. Figure 1). If there is power at the fuse end of the wire, there is power at the other end of the wire at the switch or electrical accessory, and there is continuity at the ground connection; then the circuit is complete. Electricity must flow from the fuse panel through the full length of the circuit to the ground connection. Correct any interruption of electricity flow, by repairing or replacing the wire or the switch or accessory.

Faulty Wire Replacement

Replace a faulty wire with one of the same gauge and color. Connect the new wire between the correct components, and secure it to the harness bundle with a wire tie. Cut the faulty wire back close to the harness and wrap the ends with vinyl electrical tape.

LED Headlight Assembly Replacement

1. Disconnect the headlight harness from the headlight.
2. Remove the screws securing the headlight assembly to the headlight bezel.
3. Remove the headlight assembly and install the new one with screws.
4. Connect the harness to the headlight assembly.

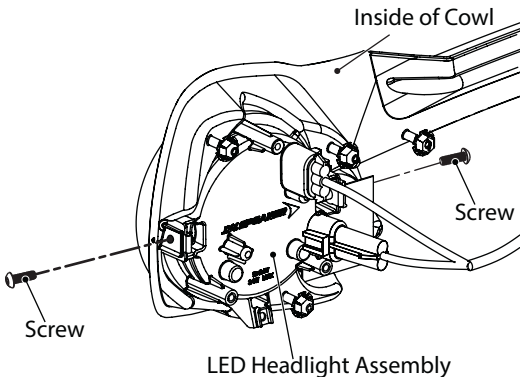


Figure 9 Headlight

Controller Replacement

Tool List	Qty.
Socket, 10 mm.....	1
Torx Socket, T-30	
Wrench, 10 mm	1
Insulated Wrench, 13 mm.....	1
Ratchet	1
Pin Punch	1
Torque Wrench, in. lb	1

WARNING To prevent electrical shock, the negative (-) wire must be removed before discharging the controller.

Use a large screwdriver to cause a short-circuit in the positive (+) and negative (-) terminals of the controller. Be sure to hold the screwdriver by the insulated handle.

NOTICE: Record the location of the wiring on the controller before disconnecting it.

NOTICE: Always test the motors for a shorted condition before installing a new controller. An electrical motor short may be the cause of the controller failure and will damage the new controller (See AC Motor Bench Test on page 117).

1. Use an insulated wrench to disconnect the negative (-) battery terminal.
2. Remove the plastic rivets (15) securing the splash shield (17) to the controller bracket (2)
3. Disconnect the main harness from the controller (3) (Ref. Figure 10).
4. Remove the bolts (16) securing the wires from the battery and motor to the controller. Be sure to label the wires so they can be installed in the original location.
5. Remove the screws (12) securing the controller to the controller bracket.
6. If the bracket is to be replaced, remove the bolts (13) and lock nuts (14) securing it to the floor.

Inspect and replace any damaged barrel clips. Assemble in the reverse order of removal. Tighten the all hardware to the torque values below.

Item	Torque Specification
12	36 - 60 in. lb (4.1 - 6.8 Nm)
1	80.5 - 100 in. lb (9.1- 11.3 Nm)
Battery and motor wires	77 - 88 in. lb (8.5 - 10 Nm)

ELECTRICAL SYSTEM

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

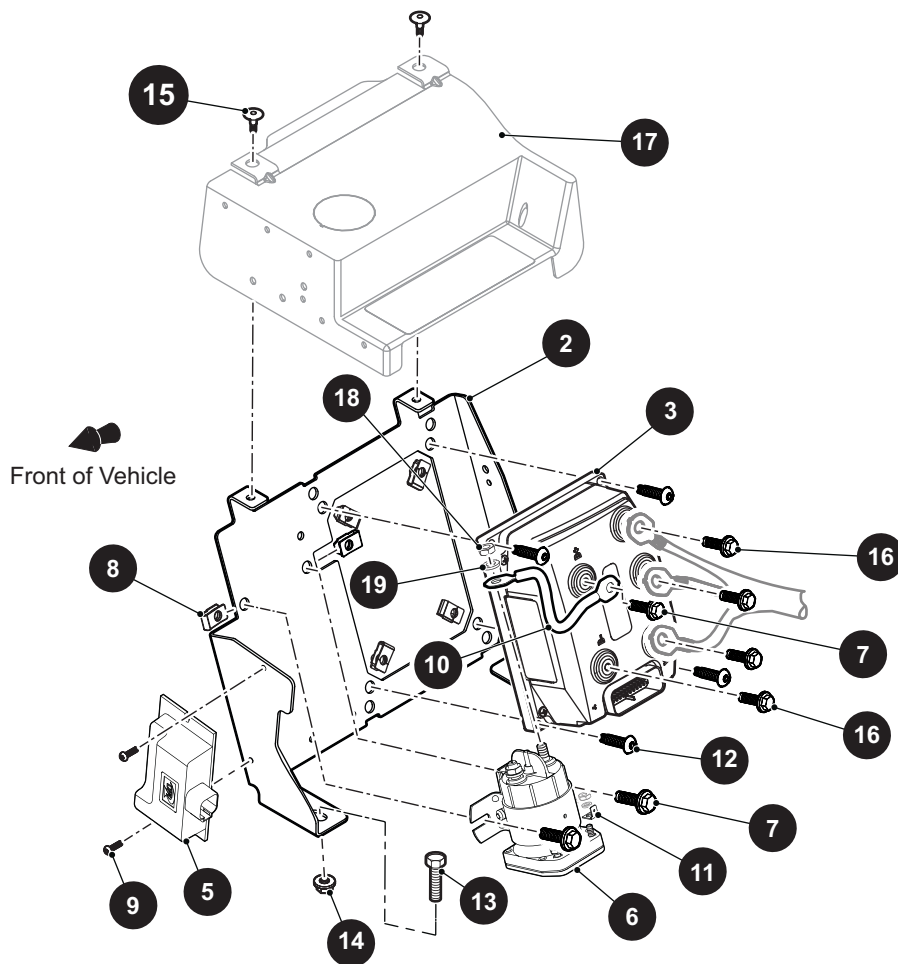


Figure 10 Controller

Solenoid Replacement

Tool List

	Qty.
Socket, 10 mm	1
Socket, 1/2"	1
Wrench, 10 mm	1
Wrench, 1/2"	1
Ratchet	1
Torque Wrench, in. lb	1

⚠ WARNING To prevent electrical shock, the negative (-) wire must be removed before discharging the controller. Use a large screwdriver to cause a short-circuit in the positive (+) and negative (-) terminals of the controller. Be sure to hold the screwdriver by the insulated handle.

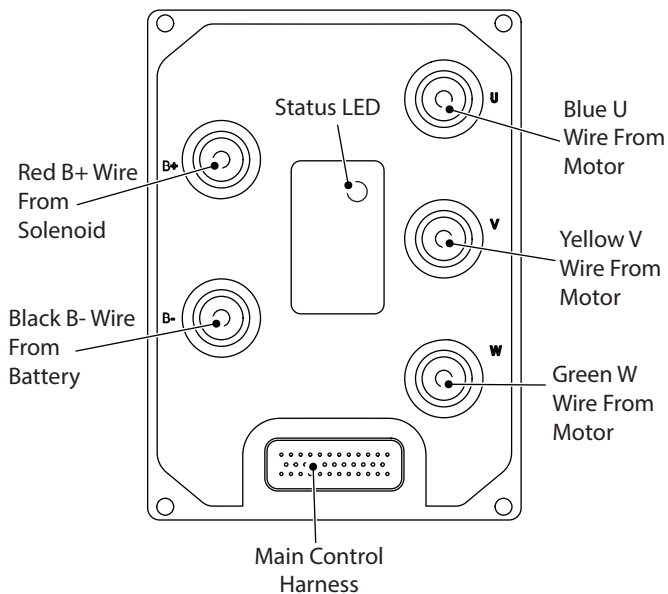


Figure 11 Controller Wiring

ELECTRICAL SYSTEM

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

NOTICE: Record the location of the wiring on the controller before disconnecting the wiring from the solenoid. Use an insulated wrench to remove the negative (-) wire from the battery.

1. Use an insulated wrench to disconnect the negative (-) battery terminal.
2. Remove the rivets (15) securing the splash shield (60) to the controller bracket and floorboard.
3. Remove the push on wires from tabs (11) on the solenoid
4. Remove the nuts (18) and lock washers (19) securing the battery cable to the solenoid (6) (Ref. Figure 10).
5. Remove the bolts (7) securing the solenoid to the controller bracket.

Inspect and replace any damaged barrel clips (8). Assemble in the reverse order of removal. Tighten the all hardware to the torque values below.

Item	Torque Specification
18	45 - 53 in. lb (5.6 - 6.7 Nm)
12	80.5 - 100 in. lb (9.1 - 11.3 Nm)

DC to DC Converter

Tool List	Qty.
Wrench, 7/16"	1
Insulated Wrench, 13 mm	1
Socket, 7/16"	1
Screwdriver, Phillips	1
Ratchet	1
Torque Wrench, in. lb	1
Torque Wrench, ft. lb	1

1. Disconnect the negative (-) battery cable using an insulated wrench.
2. Disconnect the electrical connector (Ref. Figure 10).
3. Remove the screws (13) securing the DC to DC converter (30) to the bracket (35).
4. If the DC to DC converter bracket requires replacing, remove the bolts (14), washers (16), and lock nuts (17) securing it to the floor.

Assemble in the reverse order of removal. Tighten all hardware to the torque values below

Item	Torque Specification
17	8 - 10 ft. lb. (11 - 13.5 Nm)
13	43 - 50 in. lb (5 - 5.5 Nm)

Reverse Buzzer

Tool List	Qty.
Insulated Wrench, 13 mm	1
Screwdriver, Phillips	1
Drill Bit	1
Drill	1
Rivet Gun	1

1. Disconnect the negative (-) battery cable using an insulated wrench.
2. Remove the cowl from the instrument panel (See Cowl Replacement on page 11).
3. Disconnect the push on connections (24) (Ref. Figure 12).
4. Drill out the rivets (23) securing the reverse buzzer (45) to the instrument panel.

Assemble in the reverse order of removal using new rivets. Make sure that the black wire connects to the negative (-) terminal of the buzzer and the orange and white wire connects to the positive (+) terminal.

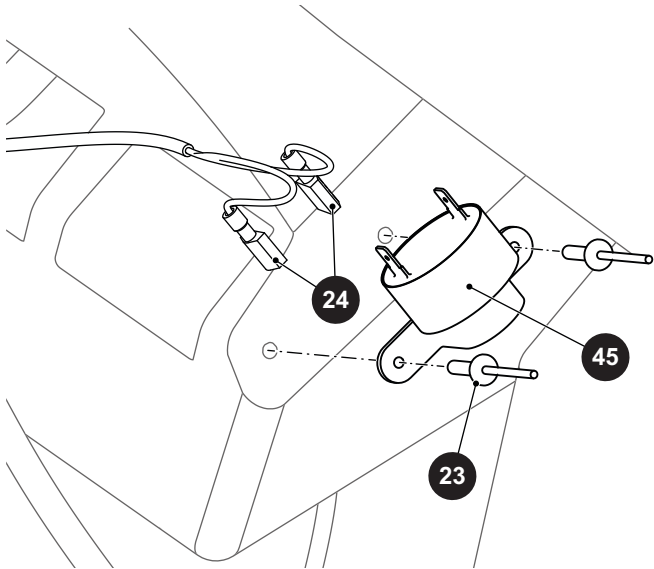


Figure 12 Reverse Buzzer

ELECTRICAL SYSTEM

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Horn

Tool List

Wrench, 3/8"	1
Insulated Wrench, 13 mm.....	1
Socket, 3/8"	1
Ratchet.....	1
Torque Wrench, ft. lb	1

NOTICE: The horn is mounted to the frame on the top side of the fascia.

1. Disconnect the negative (-) battery cable using an insulated wrench.
2. Remove the cowl (See Cowl Replacement on page 11).
3. Remove the push on electrical connectors from the horn (50) (Ref. Figure 13).
4. Remove the bolt (26) and washer (27) securing the horn to the fascia (55) and frame.

Assemble in the reverse order of removal. Tighten the bolt (26) to the torque values below.

Item	Torque Specification
26	6 - 8 ft. lb (8 -10.5 Nm)

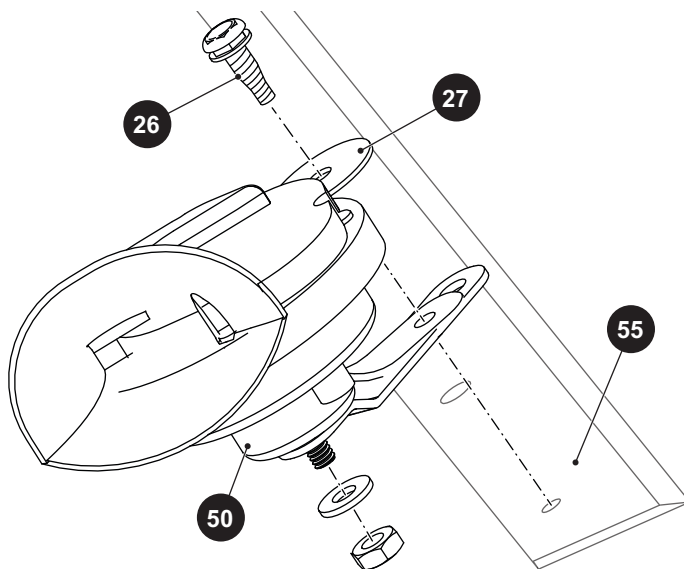


Figure 13 Horn

TROUBLESHOOTING

General

Knowledge of the use of wiring diagrams and a Digital Volt Ohm Meter (DVOM) is necessary to effectively determine a fault within the circuits that include the electrical accessories, lighting, and gauges.

The wiring diagram shows the path followed by a voltage or signal from its origination point to its destination. Each wire is indicated by color.

Knowledge of simple logic troubleshooting will reduce the number of steps required to isolate the problem.

Example 1: If the vehicle does not start and none of the lights operate or burn dimly, test the battery before trying to determine a fault within the lighting circuit.

Example 2: If a problem occurs in the lighting circuit that causes only one of the headlights to fail, it is not necessary to check the battery wiring or the fuse since voltage is present. Check the headlight that is not operating. If power is found at the connector and the ground wiring is satisfactory, the fault is a burned out bulb or a poor contact between the connectors and the headlight.

If power is not present but the other headlight functions, a wiring problem is indicated between the two headlights.

In some cases where battery voltage is expected, the easiest way to test the circuit is to set the DVOM to DC volts and put the negative (-) probe on the negative battery terminal. Move the positive (+) probe to each wire terminal starting at the battery and moving out to the device that is not working. Check both sides of all switches and fuses.

When no battery voltage is found, the problem is between the point where no voltage is detected, and the last place that voltage was detected. In circuits where no voltage is expected, the same procedure can be used except that the DVOM is set to continuity. Place the negative (-) probe on a wire terminal at the beginning of the circuit and move toward the device that is not working with the positive (+) probe. When continuity is no longer indicated, a failed conductor or device is indicated.

Continuity Check

⚠ WARNING To prevent blowing the internal BMS fuse, disconnect the electrical power. Use an insulated wrench to remove the negative (-) wire from the battery.

Before removing the negative (-) wire at the battery, set the key switch to the OFF position, then remove the key from the switch. Always use insulated wrenches when working on batteries.

To check for continuity, set the DVOM to the KΩ setting and select 'Continuity'. The meter will give an audible signal when it detects continuity. If the meter does not have a continuity setting, set it to KΩ, the meter will indicate "0" when it detects continuity.

ELECTRICAL SYSTEM

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Testing a Switch for Continuity

Put one probe on one contact of the switch. Put the second probe on the second terminal of the switch (Ref. Figure 14).

Actuating a normally open (NO) switch causes the DVOM to show “0”, or gives an audible indication when the switch is operated. A normally closed (NC) switch causes the meter to show “0”, or gives an audible indication when the probes are attached, without activating switch. The audible indicator will stop and the meter display will show a value greater than “0” when the switch is activated.

The change in display or audible indicator shows that the switch is functioning.

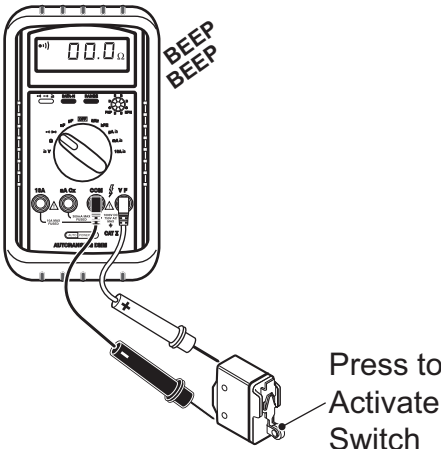


Figure 14 Continuity Check of Switch

Testing a Solenoid for Continuity

Put one probe on one of the large terminals and the other probe on the second large terminal (Ref. Figure 15).

If the meter shows “0” or gives an audible indication, the solenoid terminals are “welded” closed and the solenoid must be replaced.

If the continuity test shows that contacts are not “welded” and the wiring to the solenoid coil is good, the coil has failed and the solenoid must be replaced.

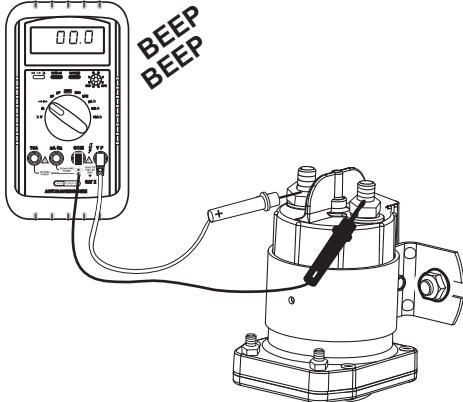


Figure 15 Continuity Check of Solenoid

ELECTRICAL SYSTEM

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Notes:

BRAKES

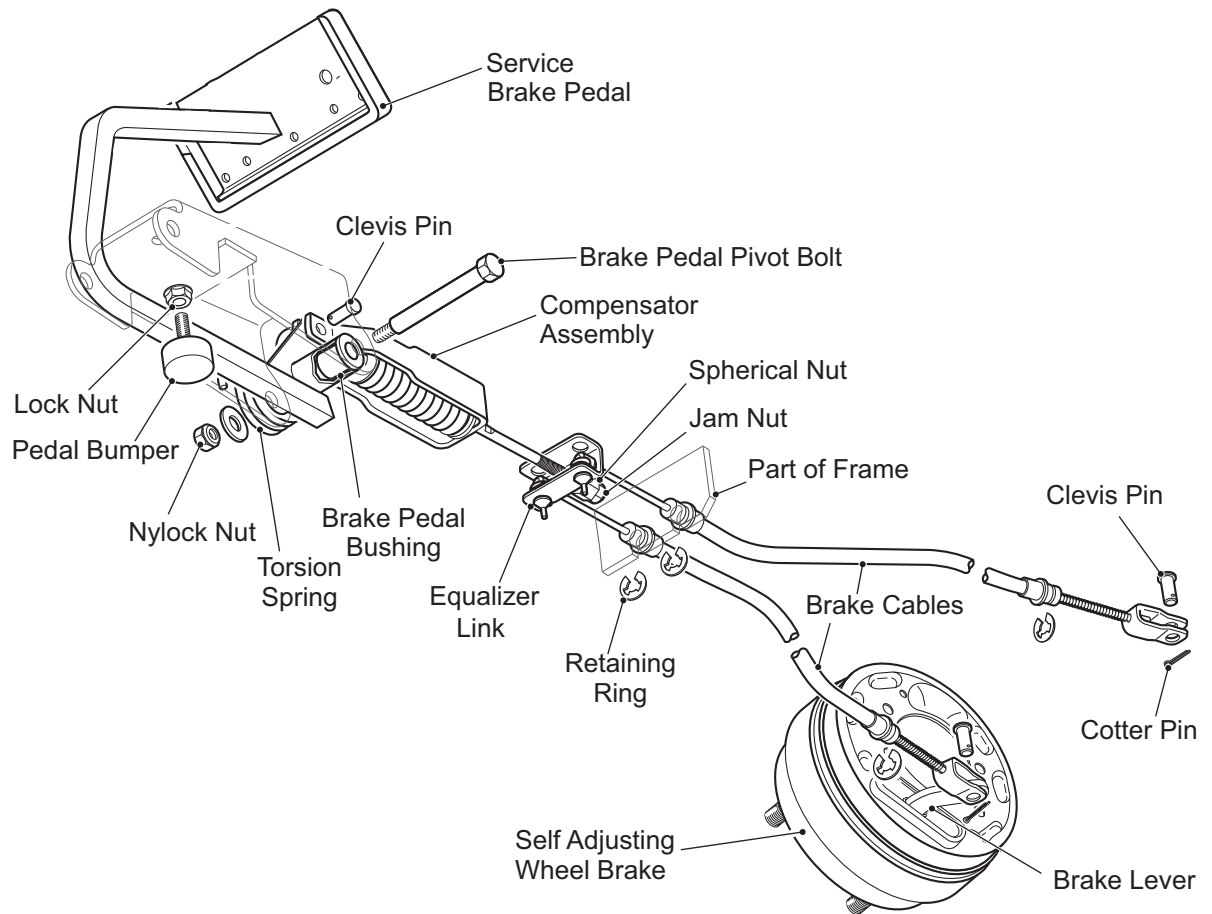


Figure 1 Mechanical Brake System

BRAKE SYSTEM OVERVIEW

General Description

This vehicle is equipped with a mechanically activated rear drum brake system. The brake system consists of a service brake, equalizer link, brake cables, and self adjusting wheel brake assemblies (Ref. Figure 1). The vehicle is also equipped with an automatic electric motor brake that acts as the parking brake.

Although the brake system is similar to an automobile, it is **different in important ways**. The system operates in a very severe environment. Fertilizer, dust, grass clippings, tree roots, and other objects can cause corrosion and physical damage to the brake components. Unlike automotive hydraulic brakes, mechanical brakes depend on the travel of the brake cables to move the brake

shoes against the brake drums. The travel of the brake cables is governed by the brake pedal. If the cables cannot travel far enough to absorb the slack (free travel) in the system and still apply the shoes to the drums, the braking effort at the wheel brake will not be adequate. The self adjusting mechanism in the wheel brakes requires enough cable travel at the wheel brake to work reliably. When the brake is released, there must be slack in the system so the brakes will release fully and the adjusters will function. Free pedal travel, pedal force, shoe to drum clearance, and braking capability are closely related. It is very important to maintain the proper relationships to assure braking performance and the best wheel brake adjustment.

BRAKES

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

How the Service Brake Works

Pressing the service brake pedal pulls the equalizer link, which is connected to the brake cables (Ref. Figure 1). The first part of the pedal travel removes slack from the system. Continued motion of the brake pedal pulls both the left and right brake cables. Each brake cable pulls a brake lever which pushes the rear brake shoe against the brake drum. When the rear shoe contacts the brake drum, it can no longer move rearward. Additional pedal (and cable) travel causes the actuator bracket (moving anchor) to move and applies force to the front shoe, pushing it against the brake drum. The force applied to the front and rear shoes is approximately equal. As the shoes contact the moving brake drum, the shoes try to move in the direction of drum rotation. This movement results in the typical brake shoe wear patterns.

Equalizer Link

The equalizer link balances braking between the driver and passenger sides of the vehicle. Variations in wheel brake adjustment, cable friction and manufacturing tolerances may cause the equalizer to be slightly misaligned. This misalignment is normal.

Automatic Adjuster Mechanism

CAUTION *Never manually adjust the brakes at the star wheel. Doing so will cause permanent damage to the adjuster mechanism and result in a gradual loss of brakes.*

The wheel brakes are equipped with an automatic adjuster mechanism that is designed to compensate for brake shoe wear and eliminate the need for manual brake shoe adjustment. Do not manually adjust the brakes by prying back the adjuster arm and turning the star wheel. Permanent damage to the adjuster will result.

Adjustment takes place only when the brake is fully applied and released **while the vehicle is moving**.

When the brake pedal is applied, the brake lever moves toward the front of the vehicle (A) (Ref. Figure 2).

The other end of the brake lever moves to the rear of the vehicle (B) where it contacts the brake adjuster arm, causing it to move.

The brake adjuster arm moves away from the star-wheel (C). The amount of adjuster travel is limited by the amount of brake shoe travel required to contact the brake drum. The amount of travel increases as the brake shoe lining wears.

When the brake pedal is released, the adjuster spring retracts the brake adjuster arm which contacts the star-wheel. Note that adjustment only takes place when the brake pedal is released while the vehicle is in motion.

If the shoes have worn far enough to permit the brake adjuster arm to contact the next tooth of the star-wheel,

the star wheel will be advanced by the tension applied to the adjuster arm by the adjuster spring.

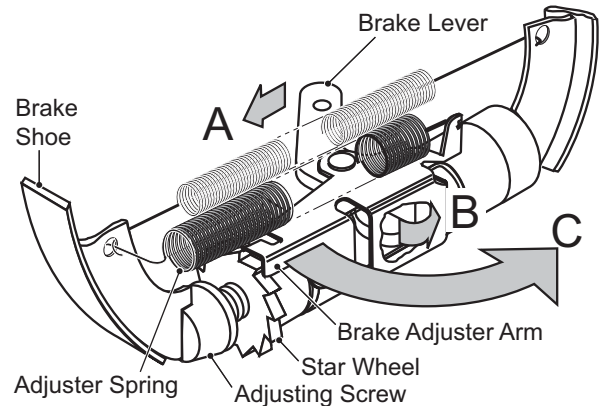


Figure 2 Automatic Adjuster Mechanism

How the Parking Brake Works

This vehicle is equipped with an automatic parking brake. When the vehicle is stopped, the parking brake sets automatically. The automatic parking brake releases when the vehicle is in F (forward) or R (reverse) and the accelerator is pressed. The automatic parking brake also releases when the RUN/TOW switch is in the TOW position with the key switch placed in the N (neutral) position.

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

TROUBLESHOOTING TABLE

Refer to the following troubleshooting table only after a thorough visual inspection, Periodic Brake Performance

Test (PBPT), and Aggressive Stop Test is performed (Ref. Figure 3).

Condition	Possible Cause	Correction
Poor Brake Performance by stopping in a longer distance than normal	Wheel brake failure due to severely worn or damaged components.	Replace all severely worn or damaged components.
	Brake pedal not returning Brake not adjusting.	Check for binding of brake pedal. Check brake pedal free travel. Check brake cables. Check brake adjusters. Check pedal pivot.
	Brake shoes wet.	Check again when shoes are dry.
	Brake cables damaged or sticky.	Check brake cable and replace if sticky or damaged.
	Brake shoes severely worn.	Replace.
	Brake shoes glazed.	Sand shoes with emery cloth provided that shoes have .06" (1.5 mm) min. material.
	System not adjusted properly.	Check and adjust
	End of brake cable loose from anchor brackets.	Check and repair.
	Cracked brake drum.	Replace.
In excess of 1 1/8" (2.9 cm) free pedal travel (Soft Pedal)	Brake cables damaged.	Replace.
	Brake return bumper out of adjustment.	Adjust per manual.
	End of brake cable loose from anchor brackets.	Check and repair.
	Wheel brake failure due to severely worn or damaged components.	Replace all severely worn or damaged components.
	System not adjusted properly.	Adjust per Manual.
Less than 7/8" (2.2 cm) free pedal travel (Hard Pedal)	Brake cables damaged or sticky.	Check brake cable and replace if sticky or damaged.
	System not adjusted properly.	Check and adjust per manual.
	Wheel brake failure due to severely worn or damaged components.	Replace all severely worn or damaged components.
Neither wheel locks when braking aggressively. (Note: At full speed the wheels may not lock, but should brake aggressively).	Incorrect compensator spring adjustment.	Return to factory specification.
	Excessive brake pedal free travel.	Adjust per manual.

Figure 3 Troubleshooting Table

BRAKES

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Condition	Possible Cause	Correction
Unequal braking (one wheel locks while other rotates)	Wheel not locking is not adjusting.	Check brake operation of wheel that is not locking.
	Sticky/dragging cable.	Check for brake lever return Check that brake levers return at equal rate - (Indication of dragging cable).
	Cracked brake drum.	Replace.
	Brake shoes wet or glazed.	Check again when shoes are dry.
	Rusted or sticky brake pivot hardware	Replace.
Neither wheel locks	Brake system requires complete adjustment.	Adjust entire system.
	Brake pedal not returning.	Check for binding of brake pedal Check brake pedal free travel
Grabbing brakes (oversensitive)	Moisture has caused surface rust on drums.	Apply moderate force to pedal while at maximum level ground speed to remove rust until condition is relieved.
	Brake Pivot binding.	Check and replace poor components

Figure 3 Troubleshooting Table

TROUBLESHOOTING & INSPECTION

New Vehicles

A new vehicle will undergo an initial break-in of components including brake cables and brake shoes. In this break-in period, it is not uncommon for the brake pedal free travel to change. The timing of this change varies with terrain and the driving habits of the operator. When this occurs, the brake linkage should be adjusted (See Adjusting Brake Pedal Free Travel on page 83). After this initial period, no further adjustments should be required until routine maintenance is scheduled (See SCHEDULED MAINTENANCE CHART on page 6).

Troubleshooting and Inspection Procedures

To troubleshoot the mechanical brake system:

1. Inspect the brake pedal and linkage to find worn or damaged parts per the troubleshooting table (See TROUBLESHOOTING TABLE on page 77).
2. If required, disassemble the wheel brake to locate and correct internal faults (See Wheel Brake Service on page 84).

CAUTION Satisfactory brake performance does not eliminate the need for routine brake testing and inspection.

Continued proper brake operation depends on periodic maintenance (See SCHEDULED MAINTENANCE CHART on page 6).

Brake Pedal and Linkage Inspection

1. Inspect the brake pedal return bumper.
 - Be sure that the brake pedal is contacting the pedal return bumper when released and that the bumper is in good condition.

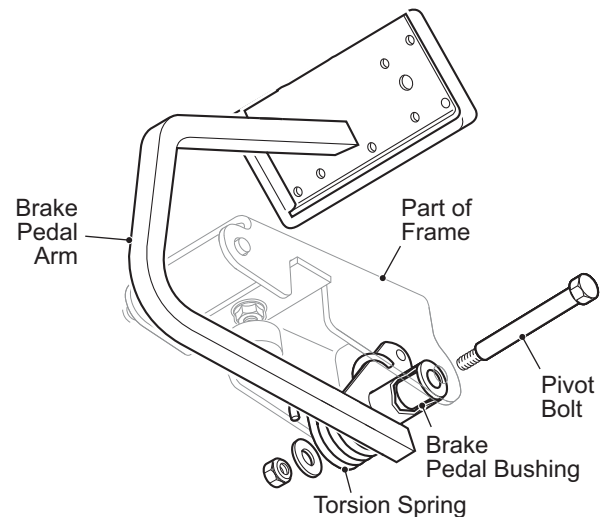


Figure 4 Brake Pedal Inspection

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

2. Check the brake pedal return.
 - Apply the brake pedal and release.
 - Check that the brake pedal arm rests against the pedal bumper when released.
 - If the pedal does not return fully or is sluggish, the brake pedal bushings and pivot bolt should be inspected (Ref. Figure 4).
 - Replace the pedal, spring, bushings, and bolt as required (See Brake Pedal on page 88).
3. Check the brake pedal free travel.
 - Brake pedal free travel is the distance the pedal moves from rest to the point at which the brake shoes first contact the brake drums. This should not be confused with the light resistance that is felt as the brake pedal is pressed enough to remove slack from the compensator and cables.
 - Too much pedal free travel may indicate that the wheel brakes are not adjusting, wear in the cables and linkages, or initial break-in of components.
 - Not enough pedal free travel may indicate improper adjustment of the wheel brake or the brake linkage. Either condition can prevent the brakes from adjusting properly.

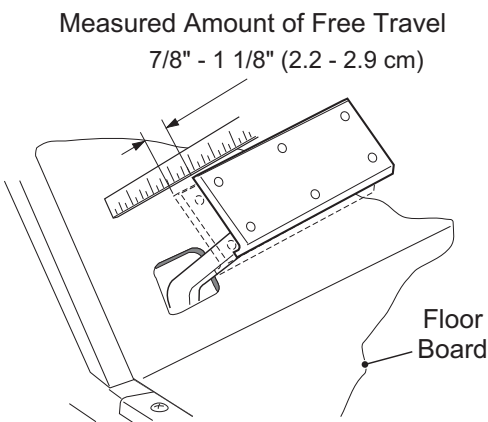
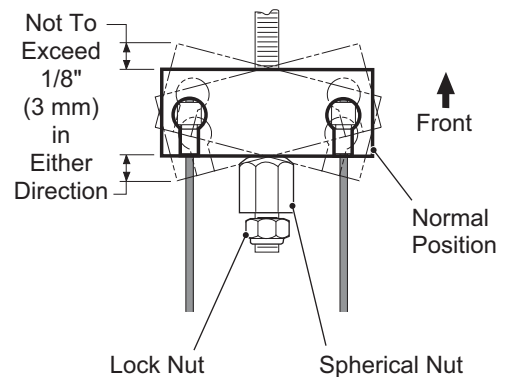


Figure 5 Checking for Excessive Free Travel

4. Inspect the brake cables.
 - Free travel should be set at $7/8'' - 1\ 1/8''$ (2.2 - 2.9 cm) (Ref. Figure 5).
4. Inspect the brake cables.
 - Inspect for damage to the outer cable, fraying of the inner cable, or lack of free motion when the pedal is applied and released.
 - Inspect the brake cable support brackets to be sure the cables are properly secured.
 - If any of these conditions are found, replace all cables and the equalizer as a set (See Brake Cable and Equalizer Assembly on page 87).

5. Check the clevis pins.
 - Check the clevis pins attaching the brake cables to the brake levers. They must be loose when the brake pedal has been released.
 - If the clevis pins are not loose, but the brake pedal free travel is correctly adjusted and the brake cables move freely, the problem is likely in the wheel brake (See Wheel Brake Inspection on page 80).
6. Inspect the brake cable equalizer linkage.
 - Inspect for signs of corrosion, damage, wear, or excessive misalignment.
 - Replace if corrosion, damage, or wear is found.
7. Inspect the compensator assembly.
 - Inspect for damage, corrosion, or wear.
 - Replace the complete assembly if problems are found.
 - In general, no adjustment will be needed, as the spring assembly is factory calibrated.
 - Check that the compensator spring length is $3\ 15/16''$ (10 cm) (Ref. Figure 6).
 - If an adjustment is required, it should be made at the nuts at the spring facing the front of the vehicle.
 - Tighten the lock nut firmly after adjusting.



View From Below

NOTE: This dimension is factory pre-set and is not to be changed.

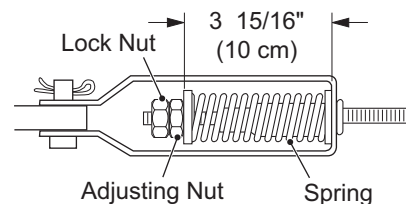


Figure 6 Equalizer and Compensator

BRAKES

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Aggressive Stop Test

WARNING To prevent a serious injury or death, all brake tests must be done in a safe location with regard for the safety of all personnel.

Always conduct a visual inspection and evaluate pedal travel before operating a vehicle to verify some braking function is present.

The purpose of this test is to attempt to fully expand and release the brake adjusters. It is important that the technician/mechanic exercise care and perform the test in a non-congested area with regard for the safety of all personnel.

1. Equally load both sides of the vehicle (Ref. Figure 7) and apply maximum force and travel to the service brake pedal while moving.
2. Do this a total of 10 times with the first few at slow speed.
3. If brake function is adequate or improves, increase speed for the remaining tests.
4. Before the end of the tests, both wheels should lock at approximately the same time and slide straight.

NOTICE: The brake adjuster mechanism must expand and release fully to function. Under light usage this may not occur, even though the vehicle stops acceptably.

The adjuster functions most consistently with aggressive braking.

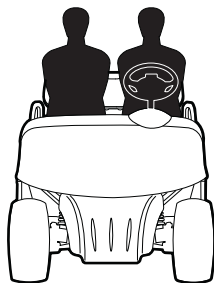


Figure 7 Equally Load Vehicle

Wheel Brake Inspection

WARNING Wear a dust mask and eye protection whenever working the on wheel brakes. Do not use pressurized air to blow dust from the brake assemblies. Replace both brake shoes on both wheels if one or more shoes are worn below .06" (1.5mm) thickness at any point.

CAUTION Do NOT touch any of the wheel brake mechanism except as instructed.

Do NOT use a commercial brake cleaner unless the entire brake has been disassembled.

1. Remove the brake drums. Do not disturb the adjuster mechanisms (See Brake Drum on page 84).
2. Remove any excess dust and dirt from the drum with a brush.

WARNING The drum must not be turned to "true" a worn friction surface. Turning will make the drum too thin and will cause drum failure and a loss of brakes which could cause severe injury or death.

3. Inspect the brake drum.
 - Look for a blue coloration or blistered paint that would indicate that it has overheated.
 - Check for any evidence of scoring.
 - Check for any excessive wear indicated by the friction surface being significantly worn and leaving a ledge of unworn drum.
 - Inspect the splines for galling, wear, and corrosion.
 - If any of these problems are found, the drum must be replaced.
4. Remove any accumulated brake dust from the wheel brake assembly with a brush.
5. Visually inspect the axle seal for oil leakage and the condition of the thrust washer. If oil is present, a repair to the rear axle is necessary (See Axle Shaft Seal Removal and Replacement on page 96).
6. Verify that the inner brake drum washer is present and check its condition. Replace the washer if it is damaged or missing.

WARNING If one wheel brake assembly requires replacement, the opposite must also be replaced.

CAUTION Use care when handling the adjuster arm. Too much force will damage the adjuster and require that both wheel brake assemblies be replaced.

7. Visually check the condition and operation of the adjuster mechanism.
8. Inspect the brake lever for damage or wear. Test the adjuster function as follows:
 - Push the front brake shoe in the direction of the rear of the vehicle and hold in position.
 - Operate the brake lever.

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

- Observe the brake adjuster arm and note if the arm engages the star wheel and attempts to rotate it (Ref. Figure 8)

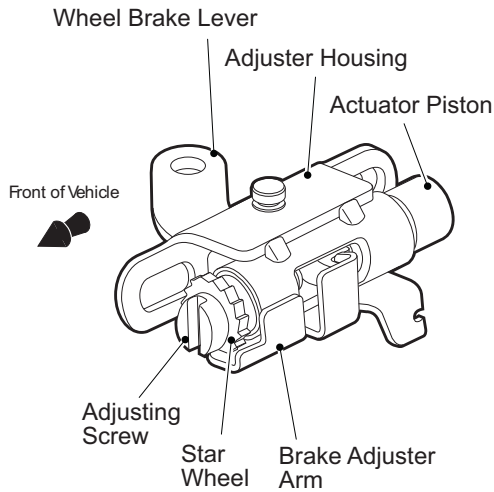


Figure 8 . Adjuster Mechanism

- If the adjuster arm **engages and turns** the star wheel, proceed to step 9. If the arm **fails to engage** the star wheel, it has been damaged and both wheel brake assemblies must be replaced.
 - If the adjuster arm engages star wheel but **fails to rotate it**, the adjuster assemblies must be replaced with new color-coded adjusters.
 - Note the location of the two Teflon coated washers (Ref. Figure 14).
9. Check the condition and operation of the moving anchor assembly.
- Operate the brake lever to check for free motion.
 - The adjuster assembly and brake lever should move smoothly from front to back on the backing plate.
 - If the moving anchor assembly is damaged or binds against the backing plate, replace both of the wheel brake assemblies.

⚠ WARNING *A backing plate assembly that shows any indication of galling or gouging is not repairable and must be replaced with a new wheel brake assembly. Always replace wheel brake assemblies in pairs.*

10. Inspect the backing plate.
- Inspect for gouges, galling, or other damage, particularly where the backing plate is contacted by the brake shoes and by the moving anchor assembly.
 - Replace both backing plates if any gouges or galling is found.
11. Measure the brake shoe thickness.
- Measure at the most worn area. Brake shoe thickness must never be less than .060" (1.5 mm) at any point on the shoe.
 - It is normal for the shoes to show more wear at the leading and trailing edges (Ref. Figure 9).
 - If the brake shoe thickness is approaching .060" (1.5 mm), it is recommended that the shoes be replaced.
 - It is recommended that the brake shoe springs and brake adjusters be replaced when installing new brake shoes.
12. Inspect the brake shoe springs.
- Be sure that the springs are not broken or damaged and are correctly installed.
 - The hooked end of the adjuster spring is inserted through the front of the front shoe and the opposite end hooked to the adjuster with the hook end facing out.
 - The brake shoe springs must be installed with the light spring closest to the adjuster mechanism with the hook installed down through the rear brake shoe and up through the front brake shoe.
 - The heavy top spring is installed with both spring hooks installed down through the brake shoes (Ref. Figure 10).

BRAKES

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

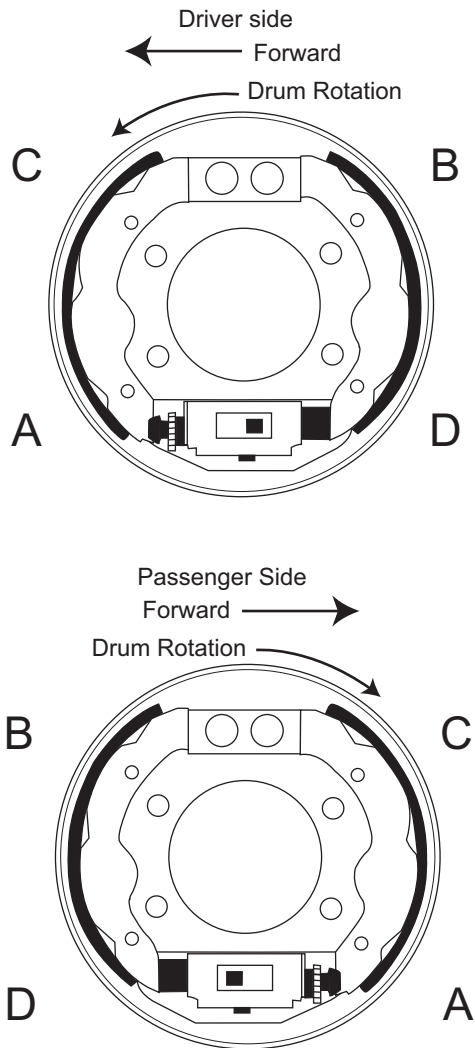


Figure 9 Brake Shoe Wear

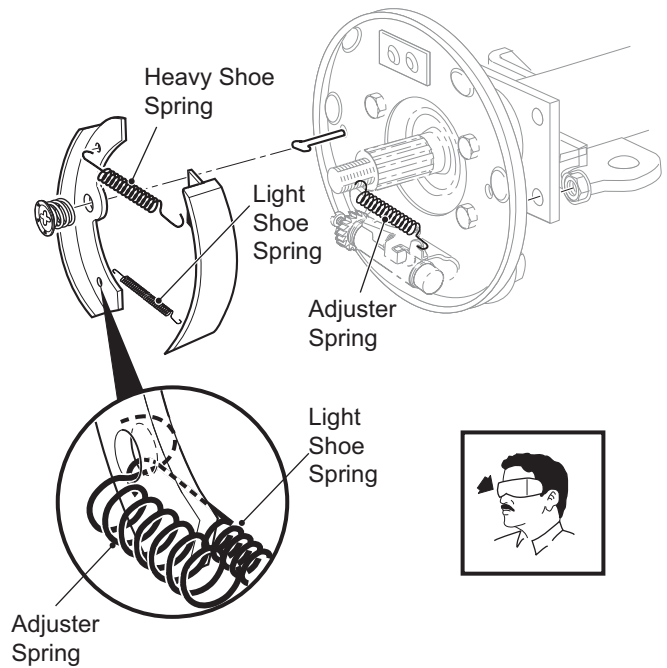


Figure 10 Orientation of Brake Shoe Springs

13. Repeat the procedure at the opposite wheel brake.
14. Check/adjust the brake pedal free travel.
 - Whenever the brake system is serviced or requires a parts replacement, the brake pedal free travel must be checked and adjusted (See Adjusting Brake Pedal Free Travel on page 83).
 - This includes all linkage and wheel brake components.

MAINTENANCE AND REPAIRS

Parts Replacement vs. Repair

Some maintenance or repair tasks can take considerable labor to do correctly. Assessment of the condition of worn components is critical to the operation of the brake system. In some cases, component replacement may be more cost effective than the removal, cleaning, inspection and reassembly of the component(s).

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Adjusting Brake Pedal Free Travel

NOTICE: It is not necessary to lift the vehicle to access the compensator assembly.

Tool List	Qty.
Wrench, 1/2"	1
Wrench, 9/16"	1
Crow's Foot Socket, 1/2"	1
Torque Wrench, ft. lb	1
Ruler	1

CAUTION Brake pedal free travel **MUST** be checked and adjusted any time that the brake system is serviced or when parts are replaced.

Brake pedal free travel is the distance the pedal travels from rest to the point at which the brake cables start to move the brake levers. This should not be confused with the light resistance that is felt as the brake pedal is pressed enough to remove slack from the compensator and cables. Correct adjustment of free travel is essential to proper brake function. Too much pedal free travel will limit braking capability. Too little pedal free travel may cause the brakes to drag (not fully released). Either condition can prevent the brakes from adjusting properly.

This procedure is intended to adjust the brakes and seat the brake system components. The brake system may not be effective for the first few applications of the brake pedal.

1. Pre-adjust the service brake pedal free travel to the correct setting by loosening the jam nut and adjusting the spherical nut (Ref. Figure 11).
2. Tighten the jam nut to the torque values below

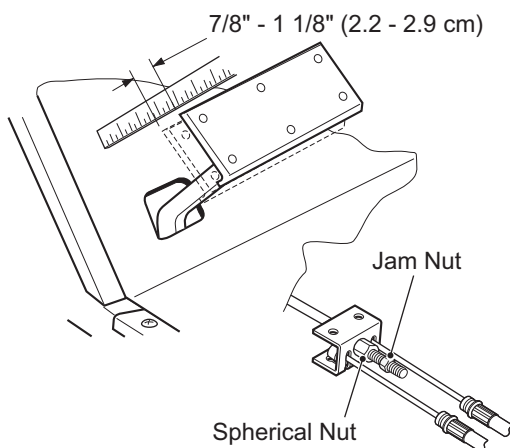


Figure 11 Free Travel Adjustment

3. The correct brake pedal free travel should be set at 7/8" - 1 1/8" (2.2 - 2.9 cm).

4. Press the brake pedal aggressively 4 - 6 times to establish known free travel.

WARNING All brake tests must be done in a safe location with regard for the safety of all personnel.

5. In a safe location free from people and vehicles, drive the vehicle at reduced speed and apply the brakes aggressively.
6. As the brakes adjust and stop the vehicle effectively, start driving at maximum speed and brake aggressively 10 times.
7. At the spherical nut, adjust the free travel as noted above.
8. Drive again and brake aggressively 10 times.
9. Repeat the previous steps until the pedal free travel does not change during the aggressive braking.
10. Check to see that the clevis pins attaching the brake cables to the brake levers are loose. If they are not loose, inspect the system again and correct as required (Ref. Figure 12).

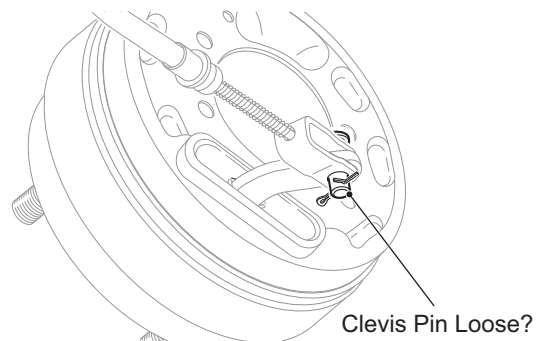


Figure 12 Check Clevis Pins

11. Tighten the jam nut at the spherical nut to the torque values below.

Item	Torque Specification
Jam Nut	10 - 11 ft. lb (14 - 15 Nm)

BRAKES

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Brake Drum

Tool List

	Qty.
Socket, 28 mm.....	1
Pliers, Needle Nose.....	1
Screwdriver, Straight Blade.....	1
Floor Jack.....	1
Jack Stands.....	2
Torque Wrench, ft. lb.....	1
Anti-Seize Compound.....	A/N

1. Raise and support the rear of the vehicle (See LIFTING THE VEHICLE on page 8).
2. Remove the cotter pin (2).
3. Remove the castellated nut (3) and washer (4).

NOTICE: Do not apply the brake when removing the nut. The shoes may not fully retract preventing removal of the brake drum.

4. Slide the brake drum (1) from the axle shaft (5). If required, tap the drum with a plastic faced hammer to loosen it from the axle shaft or use a drum puller (P/N 15947-G1) (Ref. Figure 13).

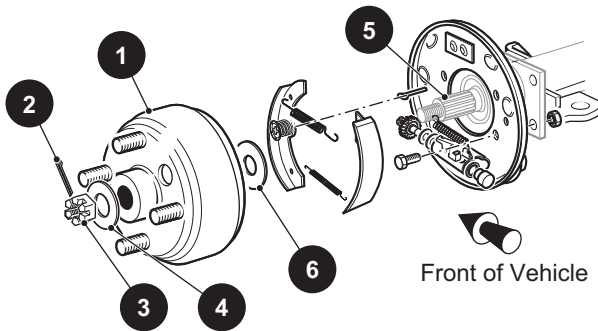


Figure 13 Brake Assembly

CAUTION Use caution when raising the adjuster arm. Too much force will damage the adjuster and require that both wheel brake assemblies be replaced.

5. If the drum does not slide from the brake assembly, the brake shoes must be retracted.
6. Rotate the hub so that the hole in the drum is in the six o'clock position which is directly over the brake mechanism.
7. Use a small straight blade screwdriver to raise the adjuster arm **just above** the star wheel.
8. Loosen the star wheel to retract the brake shoes and remove the brake drum.

NOTICE: Pay particular attention to the location of the inner brake drum washer (6) inside the brake drum, which may be on the axle shaft or attached to the rear of the drum hub. This washer must be reinstalled when the brake is reassembled.

To install the brake drum:

1. Clean the axle shaft (5) and the splines on the brake drum (1) to remove dirt, grease and foreign matter.
2. Apply a small amount of anti-seize compound to the axle spline.
3. Install the inner brake drum washer (6) and slide the brake drum (5) into place (Ref. Figure 13).
4. Check to ensure the nose of drum hub is beyond the end of the axle splines. If not, remove the drum and install one additional inner brake drum washer (total of 2) to obtain the required spacing.

CAUTION Do not back off the castellated nut to install cotter pin.

5. Install the remaining hardware and tighten the castellated nut (3) to the torque values below. Continue to tighten until a new cotter pin (2) can be installed through the castellated nut and the hole in the axle. Maximum torque is 140 ft. lb (190 Nm).

Item	Torque Specification
3	80 - 90 ft. lb (108 - 122 Nm)

Wheel Brake Service

Tool List

	Qty.
Socket, 24mm.....	1
Pliers, Needle Nose.....	1
Brush.....	1
Screwdriver, Straight Blade.....	1
Floor Jack.....	1
Jack Stands.....	2
Torque Wrench, ft. lb.....	1
Anti-Seize Compound.....	A/N
Brake Cleaner.....	A/N
Multi-Purpose Grease.....	A/N
Emery Cloth.....	1

Wheel brake service consists of removal, cleaning, inspection, lubrication and re-assembly of the wheel brake. Worn or damaged components must be replaced. Wheel brake service is required periodically as a preventive maintenance measure (See SCHEDULED MAINTENANCE CHART on page 6). The wear rate of brake shoes and required service intervals will vary based on usage, terrain, and other conditions.

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

1. Remove the brake drum (See Brake Drum on page 84).

WARNING Wear eye protection and a dust mask when cleaning the brake components. Do not use compressed air to remove brake dust from the brake assembly.

CAUTION Do NOT use a commercial brake cleaner unless the entire brake has been disassembled.

2. Remove any accumulated brake dust with a brush.
3. Remove the brake shoes and adjuster mechanism (See Brake Shoe and Adjuster on page 86).
4. Clean the backing plate with a commercial brake cleaner and allow it to dry completely.

CAUTION It is important that the friction areas between the backing plate and the brake shoes are lubricated. Be careful not to allow the lubricant to contact the braking portion of the brake shoes or the friction surface of the brake drum. Use only recommended lubricants.

5. Lubricate the backing plate friction points of the shoes and moving anchor with multi purpose grease (MPG) lubricant (Ref. Figure 14).

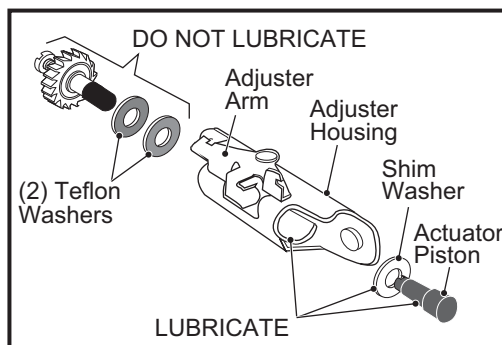
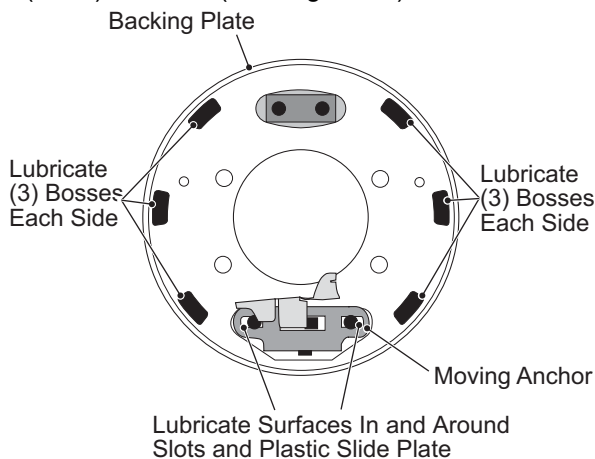


Figure 14 Wheel Brake Lubrication Points

6. Install the actuator components, adjuster components and brake shoes (See Brake Shoe and Adjuster on page 86).

7. If the brake shoes and drum are not to be replaced, sand the friction surfaces lightly with an emery cloth to remove any foreign material.

CAUTION Be sure that the adjusting screw is screwed into the star wheel nut until only 1 - 2 threads are exposed (Ref. Figure 17). If the brake shoes are replaced, replace the three brake springs and the adjuster components.

8. Replace the springs one side at a time, using the other side as a guide.
9. Install the brake drum (See Brake Drum on page 84).
10. Repeat on the opposite side of vehicle.
11. Adjust the brake pedal free travel.

Backing Plate/Entire Wheel Brake Assembly Removal and Installation

Tool List	Qty.
Socket, 1/2"	1
Wrench, 1/2"	1
Floor Jack	1
Jack Stands	2
Torque Wrench, ft. lb.	1

1. Lift and support the rear of the vehicle (See LIFTING THE VEHICLE on page 8).
2. Remove the brake drum (See Brake Drum on page 84).
3. Remove the clevis pin securing the brake cable to the brake lever.
4. Remove the bolts (7) and lock nuts (8) securing the wheel brake backing plate to the flange (10) on the axle tube (Ref. Figure 15).

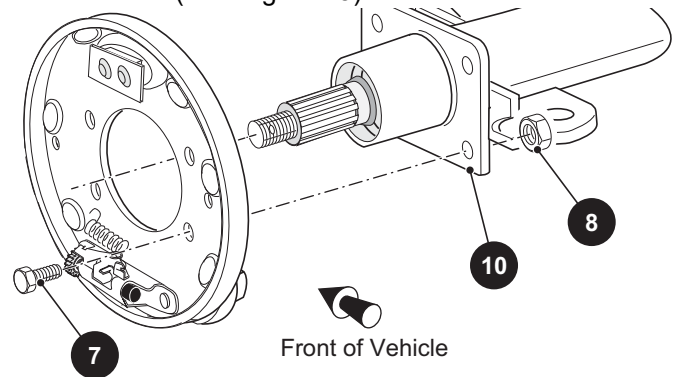


Figure 15 Backing Plate Removal and Installation

Installation is the reverse of removal using new lock nuts. Tighten all hardware to the torque values below.

Item	Torque Specification
7	23 - 27 ft. lb (31 - 36.5 Nm)

BRAKES

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Brake Shoe and Adjuster

Tool List

	Qty.
Pliers, Needle Nose	1
Floor Jack	1
Jack Stands	2
Multi-Purpose Grease.....	A/N

NOTICE: It is recommended that when brake shoes are replaced, the adjusters and springs also be replaced. It is good practice to do one side at a time, using the other side for reference.

1. Lift and support the rear of the vehicle (See LIFTING THE VEHICLE on page 8).
2. Remove the brake drum (See Brake Drum on page 84)
3. Remove the three brake shoe springs (11, 12, 13). Note the location of the heavy spring and the adjuster spring (Ref. Figure 16).
4. Hold the shoe clamp pin (14) and compress and rotate the shoe clamp (16) 90° to release it from the shoe clamp pin.
5. Remove the brake shoes (15), adjuster (20) and remaining components.
6. Clean the backing plate with a commercial brake cleaner and allow to dry completely.
7. Lubricate the friction points of the shoes and moving anchor with multi purpose grease (MPG) lubricant (Ref. Figure 14).

CAUTION Be sure that the adjusting screw is screwed into the star wheel nut until only 1 - 2 threads are exposed.

8. Install the adjuster mechanism (driver side silver, passenger side gold). Be sure that the two Teflon coated washers are installed as shown (Ref. Figure 14).
9. The adjusting screw must be screwed into the star wheel nut until only 1 - 2 threads are exposed (Ref. Figure 17).
10. Install the actuator piston. Be sure the hardened shim washer is installed as shown (Ref. Figure 14).

Always replace both brake shoes on both wheels as a set. Install the shoes as indicated and install the shoe clamp (5) over the shoe clamp pin (4) and rotate 90° to lock them in place (Ref. Figure 16).

New Brake Shoes

Screw Adjusting Screw In Until 1 - 2 Threads Are Exposed

Existing Brake Shoes

Adjust 'in' 10 - 15 'clicks'

(Minimum of 1 - 2 Threads Must Be Exposed)

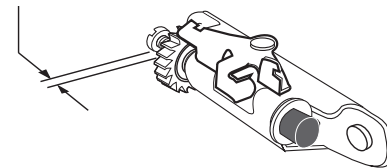


Figure 17 Setting Adjuster Screw

11. Install new brake shoe (11, 12) and adjuster (13) springs. The hooked end of the adjuster spring is inserted through the front of the front shoe as shown(Ref. Figure 16).
12. The opposite end of the adjuster spring is hooked to the adjuster with the hook end facing out.
13. The brake shoe springs must be installed with the light spring closest to the adjuster mechanism with the hook installed down through the rear brake shoe and up through the front brake shoe.
14. The heavy top spring is installed with both spring hooks installed down through the brake shoes.
15. Check to see that the brake is functioning properly.
16. Install the brake drum (See Brake Drum on page 84).
17. Repeat on the opposite side of vehicle.
18. Adjust the brake pedal free travel (See Adjusting Brake Pedal Free Travel on page 83).

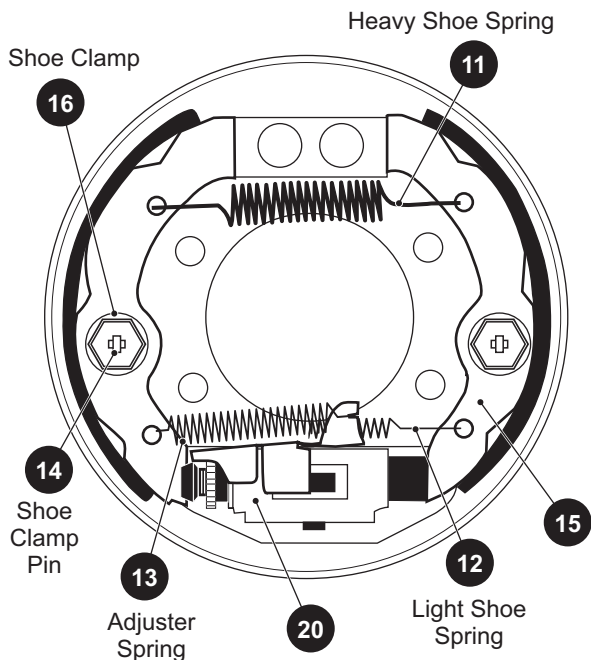


Figure 16 Brake Shoes and Springs

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Brake Cable and Equalizer Assembly

Tool List	Qty.
Wrench, 1/2"	1
Wrench, 9/16"	1
Crow's Foot Socket	1
Screwdriver, Straight Blade	1
Floor Jack	1
Jack Stands	4
Pliers, Needle Nose	1
Torque Wrench, ft. lb	1

NOTICE: The brake cables and equalizer are only serviceable as a complete assembly.

1. Remove the cotter pins and clevis pins connecting the brake cables to the brake levers.
2. Remove the retaining rings (18) connecting the brake cables to the brackets (19) at both ends of the cable (25) (Ref. Figure 18).

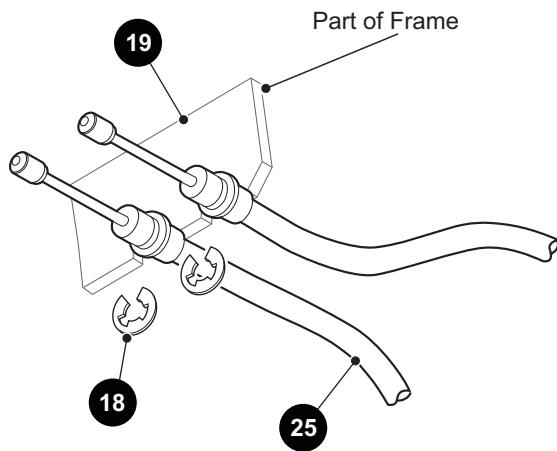


Figure 18 Cable Connection (Pedal End)

3. Loosen and remove the jam nut (24) and the spherical nut (23) on the equalizer link (30).
4. Inspect the hardware and replace if needed.
5. Remove the brake cable (20) and equalizer assembly (30) (Ref. Figure 19).

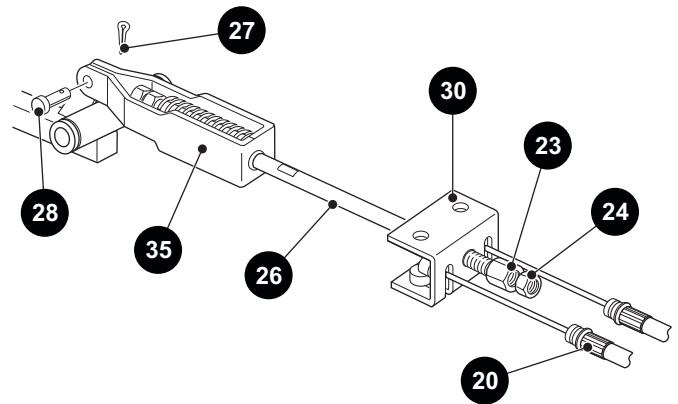


Figure 19 Equalizer and Compensator

6. Slide the equalizer link (30) of the new assembly over the compensator rod (26).
7. Loosely install the spherical nut (23) and new locking jam nut (24).
8. Insert the cables (20) into the brackets (19).
9. Install new retaining rings (18) (Ref. Figure 18).
10. Connect the cables (20) to the brake levers using new clevis pins (22) and new cotter pins (21) (Ref. Figure 20).
11. Adjust the brake pedal free travel (See Adjusting Brake Pedal Free Travel on page 83).

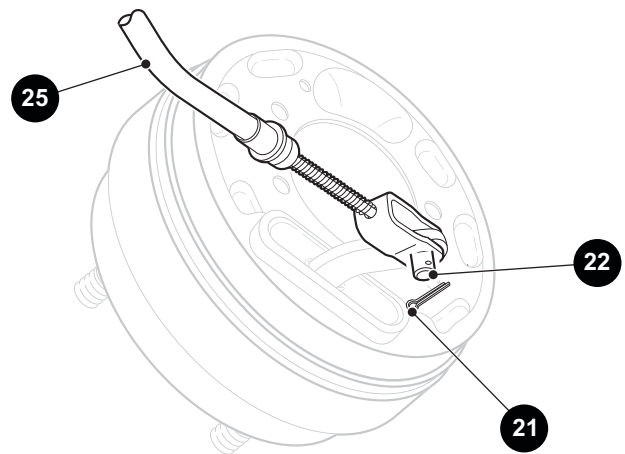


Figure 20 Cable Connection (Drum End)

BRAKES

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Compensator Assembly

Tool List	Qty.
Wrench, 1/2"	1
Wrench, 9/16"	1
Pliers, Needle Nose	1

1. Disconnect the compensator assembly (35) from the brake pedal (40) by removing the cotter pin (27) and clevis pin (28) (Ref. Figure 19).
2. Loosen and remove the jam nut (24) and the spherical nut (23) connecting the compensator rod (26) to the equalizer link (30).
3. Remove the compensator assembly (35).
4. Assemble in the reverse order of removal using new cotter pins (11) in the clevis pin. If the clevis pins are worn, replace them as well.
5. Adjust the brake pedal free travel (See Adjusting Brake Pedal Free Travel on page 83).

Brake Pedal

Tool List	Qty.
Wrench, 9/16"	1
Wrench, 3/4"	1
Socket, 9/16"	1
Socket, 3/4"	1
Screwdriver, Straight Blade	1
Pliers, Needle Nose	1
Torque Wrench, in. lb.....	1

1. Disconnect the compensator assembly (35) from the brake pedal (40) by removing the cotter pin (27) and the clevis pin (28) (Ref. Figure 21).
2. Unplug the wiring harness on models equipped with brake lights.
3. Unhook the torsion spring (36) by inserting a thin blade screwdriver between the small hook and the bracket. Move the hook back and to the side to release the torsion spring
4. Remove the lock nut (34) and bolt (37) and remove the brake pedal.
5. Inspect the bolt (37) for corrosion that could cause binding. The bolt and both bushings (33) must be replaced if corrosion or wear is found (Ref. Figure 21).
6. Assemble in the reverse order of removal using new cotter pins and lock nuts.
7. Tighten the nut (34) to the torque values below.
8. Connect the brake light wiring harness, if equipped.
9. Adjust the brake pedal free travel (See Adjusting Brake Pedal Free Travel on page 83).

10. Check for proper brake light operation if equipped.

Item	Torque Specification
34	8 - 11 in. lb (11 - 15 Nm)

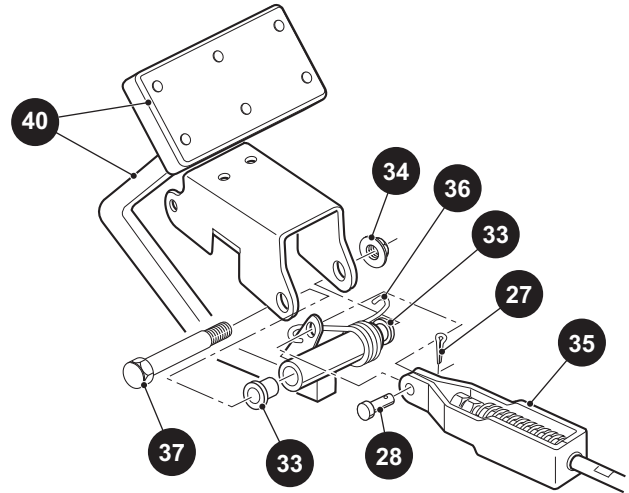


Figure 21 Brake Pedal Removal and Installation.

REAR SUSPENSION

SHOCK ABSORBER

Tool List	Qty.
Wrench, 1/4"	1
Wrench, 9/16"	1
Deep Socket, 9/16"	1
Ratchet	1
Extension	1
Floor Jack	1
Wheel Chocks	4
Jack Stands	4

⚠ WARNING *To reduce the possibility of personal injury, follow the lifting procedure of this manual. Place wheel chocks in front and behind the front wheels and check the stability of the vehicle on the jack stands before starting any repair procedure. Never work on a vehicle that is supported by a jack alone (See LIFTING THE VEHICLE on page 8).*

Removal

1. Lift and support the rear of the vehicle and remove the rear wheels (See LIFTING THE VEHICLE on page 8) (See WHEEL AND TIRE SERVICE on page 21).
2. Remove the vinyl cap (2), hex nut (3), washer (4) and rubber bushing (6) from the lower end of the shock absorber.
3. Remove the hex nut (8), washer (9) and rubber bushing (11) from the upper end of the shock absorber.
4. Compress the shock absorber (1) and remove it from between the frame mounting bracket (10) and the lower mounting plate (5).

Installation

1. Install the washer (9) with the cupped surface facing upward and the rubber bushing (11) on the top stud of the shock absorber (1).
2. Install the washer (4) with the cupped surface facing downward and the rubber bushing (6) on the bottom stud of the shock absorber (1).
3. Insert the top stud into the mounting hole on the frame bracket (10) and compress the shock absorber (1) until the bottom stud can be installed into the lower mounting plate (5).
4. Install a rubber bushing (11) and washer (9) with the cupped surface facing down on the upper shock absorber stud.

5. Install the hex nut (8) and tighten it until the rubber bushing (11) expands to the same diameter as the washer (9).
6. Install a rubber bushing (6) and washer (4) with the cupped surface facing up on the lower shock absorber stud.
7. Install the hex nut (3) and tighten it until the rubber bushing (6) expands to the same diameter as the washer (4).
8. Install the vinyl cap (2).

Removal and installation of the shock is the same for both sides of the vehicle.

⚠ CAUTION *Replace any worn or damaged hardware with new parts.*

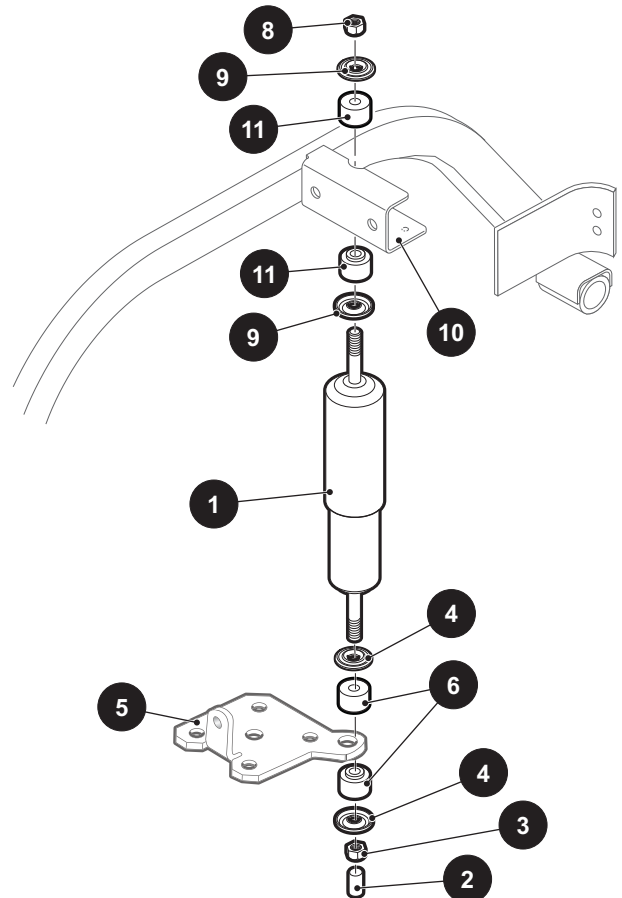


Figure 1 Shock Absorber

REAR SUSPENSION

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

REAR LEAF SPRINGS

Tool List	Qty.
Wrench, 1/4"	1
Wrench, 9/16"	1
Wrench, 3/4"	1
Socket, 9/16"	1
Socket, 3/4"	1
Ratchet	1
Floor Jack	1
Wheel Chocks	4
Jack Stands	4
Torque Wrench, ft. lb	1

NOTICE: If both springs are to be replaced and the rear axle is not to be removed, it is important to remove and replace one spring at a time. Springs must be replaced in sets. Never replace just one.

NOTICE: Be sure to note whether the springs are installed on top or bottom of the axle (Ref. Figure 3).

Removal

1. Lift and support the rear of the vehicle and remove the rear wheels (See LIFTING THE VEHICLE on page 8) (See WHEEL AND TIRE SERVICE on page 21).
2. Remove the shock absorber (See SHOCK ABSORBER on page 89).
3. Remove the lock nuts (19) and upper washers (18) from the bolts (23) and remove the bolts and lower washers from the axle (20), lift bracket (35), and spring plate (5) assembly (Ref. Figure 2) (Ref. Figure 3).
4. Place the floor jack under the rear frame of the vehicle and raise it enough to take pressure from the leaf spring (15) off of the axle assembly. Support the vehicle frame with another set of jack stands.
5. Remove the bolts (12) and lock nuts (17) from the shackle (13) at the rear of the frame (30).
6. Remove the bushings (14) and spacers (16).
7. Remove the lock nut (21), washers (26) and bolt (22) from the forward leaf spring mounting bracket (25).
8. The leaf spring (15) can now be removed from the vehicle.

Installation

1. Inspect all of the bushings, bumpers, and hardware and replace any worn or damaged parts with new hardware.
2. Position the spring over the top of the axle and align the pin on the leaf spring (15) with the holes in the leaf spring mounting plate (5) and lift bracket (35).
3. Assemble the axle (20), lift bracket (35), spring (15) and spring plate (5) stack-up and loosely secure it

using the bolts (23), washers (18), and new lock nuts (19) (Ref. Figure 2).

4. Install the bushings (24) in the forward end of the leaf spring (15) and place the leaf spring in the forward mounting bracket (Ref. Figure 3).
5. Install the bolt (22), washer (26) and new lock nut (21) to secure the forward end of the leaf spring (15) in the bracket (25).
6. Install one set bushings (14) and a spacer (16) in the rear frame mounting holes (30).
7. Position the shackle (13) over the bushings and install a bolt (12) and a new lock nut (14) in the upper bolt hole.
8. Install another pair of bushings (14) and a spacer (16) in the leaf spring (15).
9. Position the leaf spring between the shackle plates (14) and install the bolt (12) and a new lock nut (17).
10. Tighten all hardware to the torque values below making sure that the leaf spring pin remains aligned with the holes in the leaf spring mounting plate(s) and lift bracket.

Removal and installation of the leaf spring is the same for both sides of the vehicle.

Item	Torque Specification
17	10 - 15 ft. lb (13.5 - 20 Nm)
21	18 - 23 ft. lb (24.5 - 31 Nm)
19	18 - 20 ft. lb (24.5 - 27 Nm)

REAR SUSPENSION

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

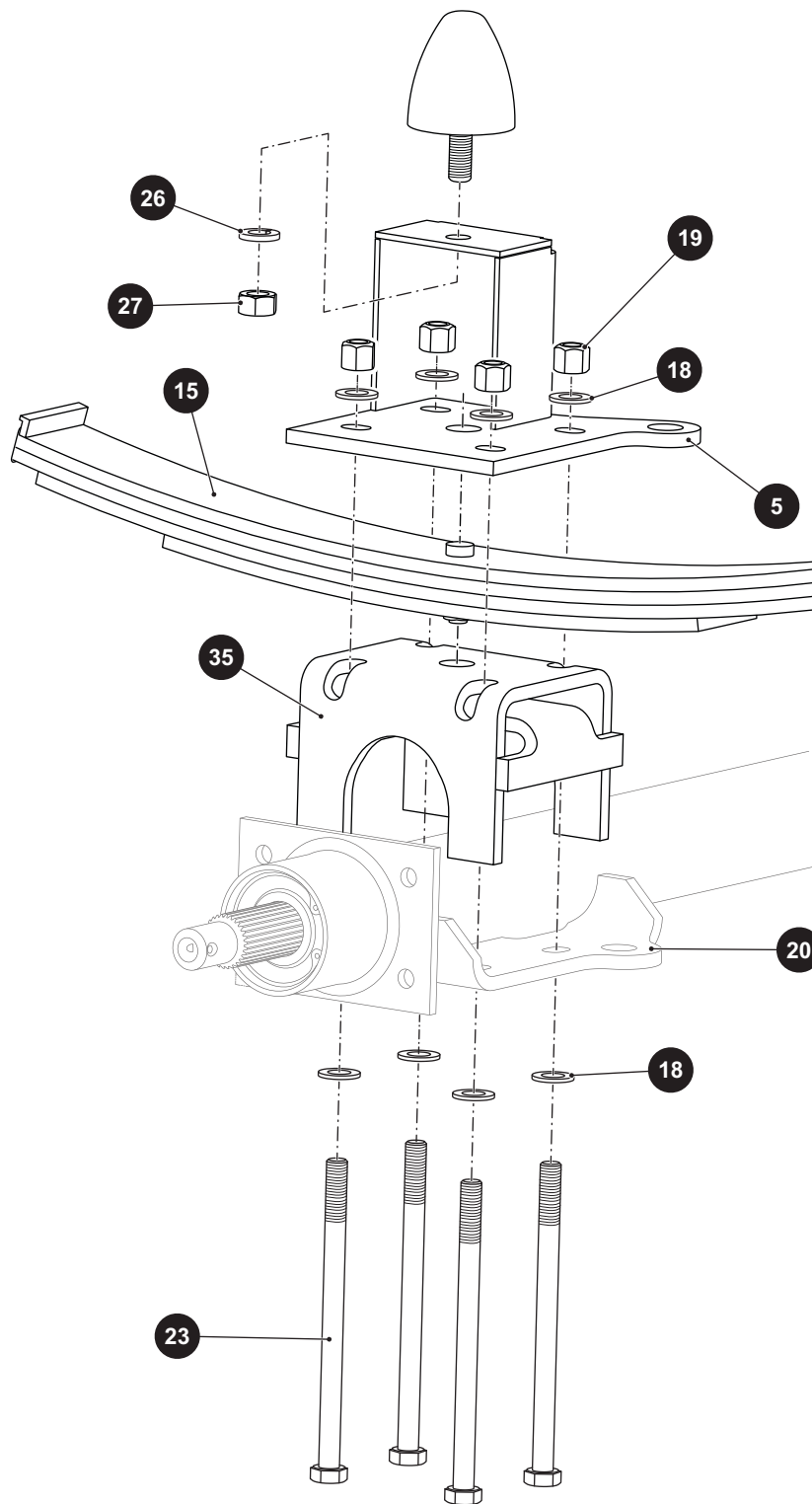


Figure 2 Spring Stack-up

REAR SUSPENSION

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

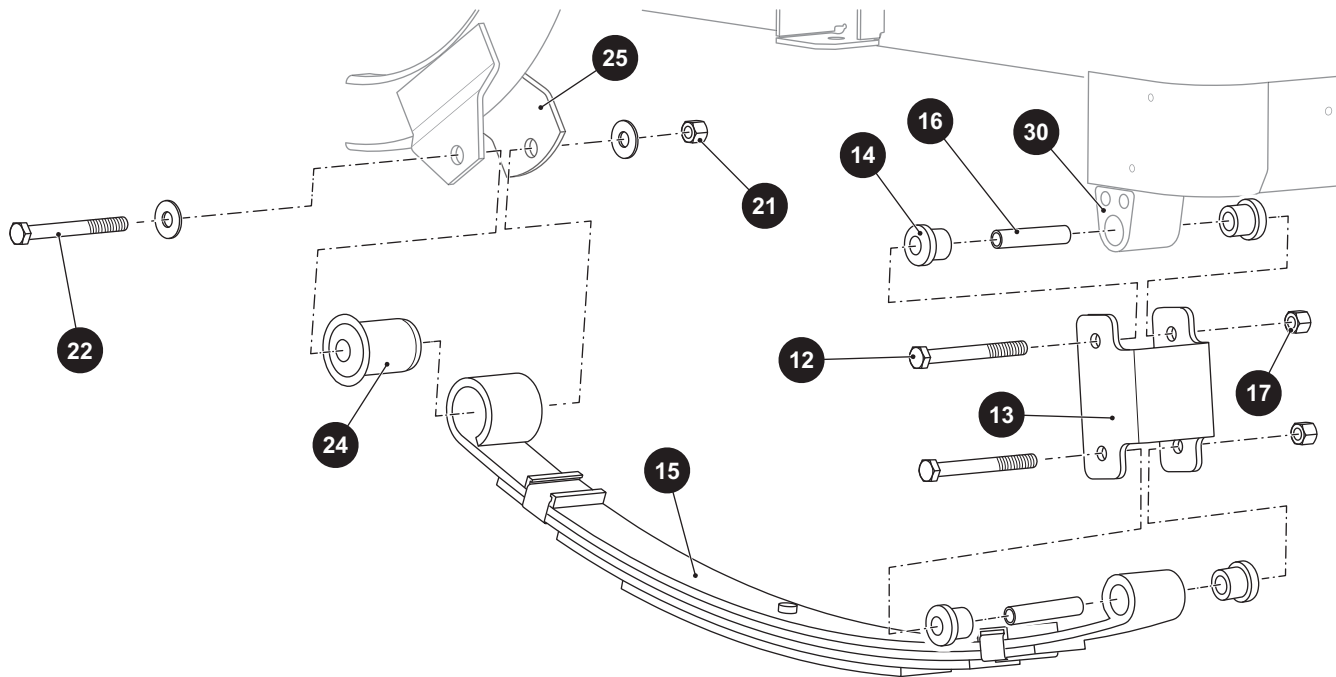


Figure 3 Spring to Frame

REAR AXLE

Tool List

Insulated Wrench, 13 mm.....	1
Floor Jack.....	1
Jack Stands,	4
Wheel Chocks	2

WARNING The rear axle assembly is top heavy. To reduce the possibility of personal injury while removing the rear axle, be sure to support the axle and motor assembly when removing the springs.

If no lifting device is available, a second person should hold the motor in the correct position until the springs are removed. Both persons should remove the rear axle and motor assembly.

Disconnect the negative (B-) battery cable with an insulated wrench before attempting to remove wires from the motor (See DISCONNECT BATTERY on page 8).

To reduce the possibility of personal injury, follow the lifting procedure in SAFETY section of this manual (See LIFTING THE VEHICLE on page 8). Place wheel chocks in front and behind the front wheels and check the stability of the vehicle on the jack stands before starting any repair procedure. Never work on a vehicle that is supported by a jack alone.

CAUTION Before any electrical service is performed on TCT model vehicles, the Run-Tow/Maintenance switch must be placed in the 'Tow/Maintenance' position.

If a power wire (battery, motor or controller) is disconnected for any reason on the TCT model vehicle, the Run-Tow/Maintenance switch must be left in the 'Tow/Maintenance' position for at least 30 seconds after the circuit is restored.

REAR SUSPENSION

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

1. Disable the electrical system to the motor by turning the key switch to the 'OFF' position and disconnect negative (B-) battery cable from the battery.

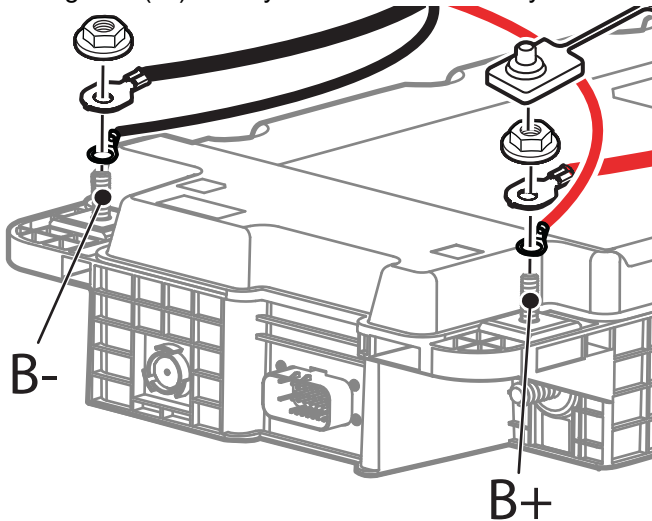


Fig. 4 Disconnect Battery Cable

2. Remove the wires to the motor, being careful to prevent the axle assembly from rotating (See Motor Removal on page 46).
3. Remove the bottom shock mounting hardware and the springs from the rear axle as detailed (See REAR LEAF SPRINGS on page 90).
4. Disconnect brake cables at rear wheel and axle bracket (See Brake Cable and Equalizer Assembly on page 87).
5. The rear axle and motor assembly can now be lifted from the jack stands and lowered to the floor.
6. Assemble in the reverse order of removal.

NOTICE: To remove the rear axle assembly will require the use of an overhead hoist that can support the motor. The position of the motor will cause the rear axle assembly to rotate when the 'U' bolts (7) are removed. If no hoist is available, the motor may be held in position by a second person. With the springs removed, both persons can lift the entire assembly from the jack stands and lower it to the floor.

REAR SUSPENSION

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Notes:

REAR AXLE

For further axle information, see Electric Rear Axle Manual P/N 28148G01.

Refer to REAR SUSPENSION section for axle removal (See REAR AXLE on page 92).

REAR AXLE MAINTENANCE

The only maintenance required for the first five years is the periodic inspection of the lubricant level. The rear axle is provided with a lubricant level check/fill plug located on the bottom of the differential. Unless leakage is evident, the lubricant need only be replaced after five years.

Checking the Lubricant Level

1. Clean the area around the check/fill plug and remove plug. The correct lubricant level is just below the bottom of the threaded hole.
2. If lubricant is low, add lubricant as required.
3. Add lubricant slowly until lubricant starts to seep from the hole.
4. Install the check/fill plug.

In the event that the lubricant is to be replaced, the vehicle must be elevated and the oil pan removed or the oil siphoned out through the check/fill hole (Ref. Figure 1).

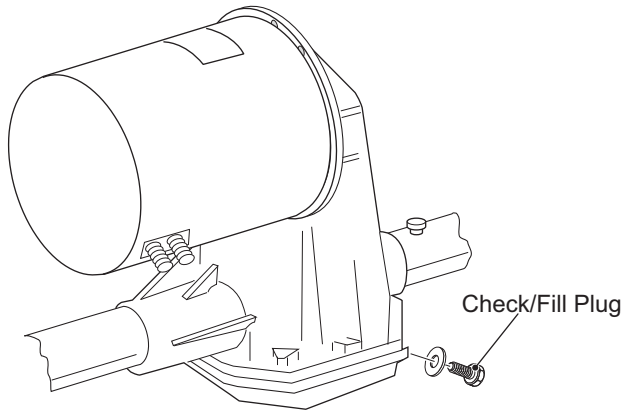


Figure 1 Add, Check and Drain Rear Axle Lubricant

REAR AXLE DISASSEMBLY

CAUTION The rear axle is a precision assembly, and therefore any repair or replacement of parts must be done with extreme caution in a clean environment. Before attempting to perform any service on the axle, read and understand all of the following text and illustrations before disassembling the unit.

Handle all splines with extreme caution.

Snap rings must be removed/installed with care to

prevent damage of bearings, seals and bearing bores.

NOTICE: It is recommended that whenever a bearing, seal or 'O' ring is removed, it be replaced with a new one regardless of mileage. Always wipe the seals and 'O' rings with a light oil before installing.

WARNING To reduce the possibility of personal injury, follow the lifting procedure in SAFETY section (See LIFTING THE VEHICLE on page 8). Place wheel chocks in front and behind the front wheels and check the stability of the vehicle on the jack stands before starting any repair procedure. Never work on a vehicle that is supported by a jack alone.

Axle Shaft Removal and Disassembly

Tool List	Qty.
Arbor Press	1
Bearing Separator	1
Needle Nose Pliers	1
Internal Snap Ring Pliers	1
Slide Hammer, P/N 18753G1	1

1. Remove brake drum (See Brake Drum on page 84).
2. Remove the outer snap ring from the axle tube (Ref. Figure 2).

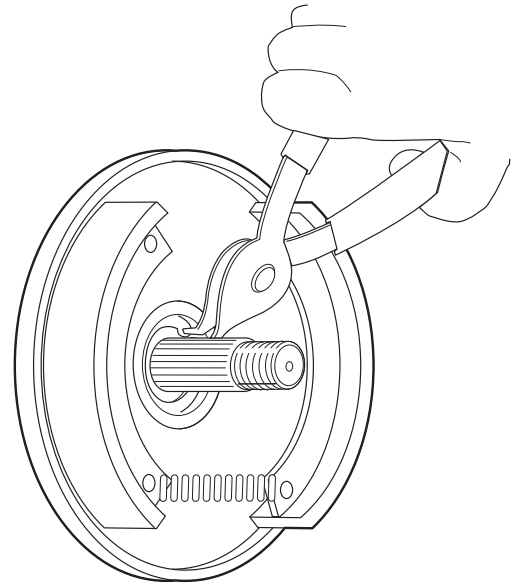


Figure 2 Removing/Installing Outer Snap Ring

REAR AXLE

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

3. Attach a slide hammer to the axle shaft thread and remove the axle and bearing from the axle tube (Ref. Figure 3).

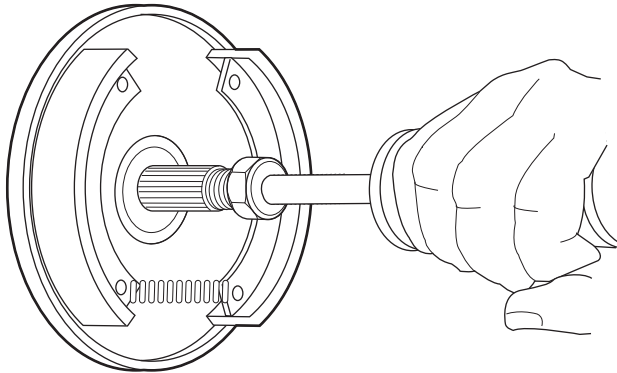


Figure 3 Removing/Installing Axle Shaft

4. Remove the bearing by supporting the inner race of the bearing on an arbor press bed and apply pressure to the threaded end of the axle shaft (Ref. Figure 4).

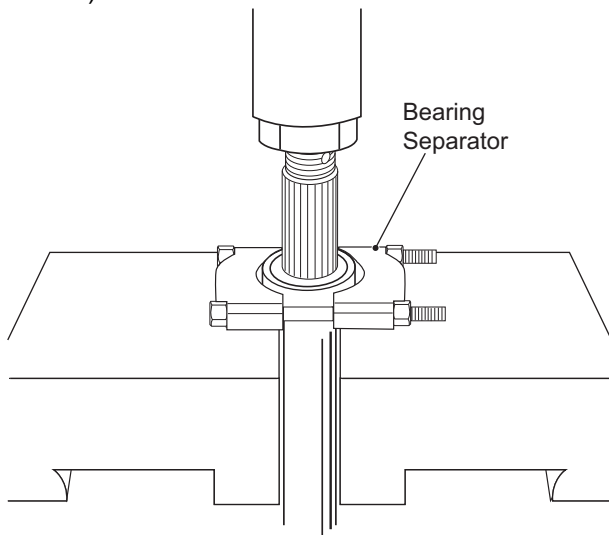


Figure 4 Pressing Bearing from Axle Shaft

Axle Shaft Seal Removal and Replacement

Tools List

	Qty.
Internal Snap Ring Pliers	1
Seal Puller	1
Seal Installer, P/N 18739G1	1
Ball Peen Hammer.....	1

CAUTION Use caution to prevent damage to the inner surface of the axle tube at the sealing area.

1. Remove the inner snap ring (Ref. Figure 5).
2. Use a puller to remove the seal (Ref. Figure 6).

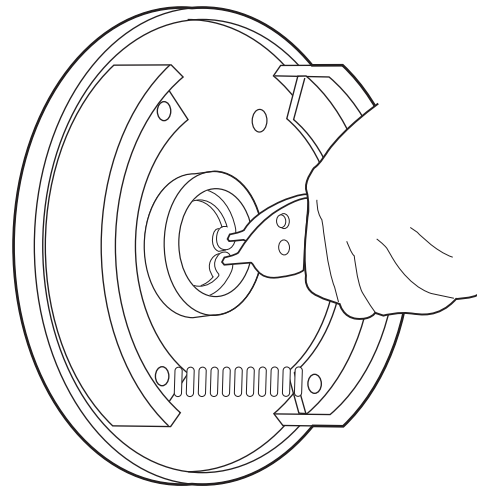


Figure 5 Removing/Installing Inner Snap Ring

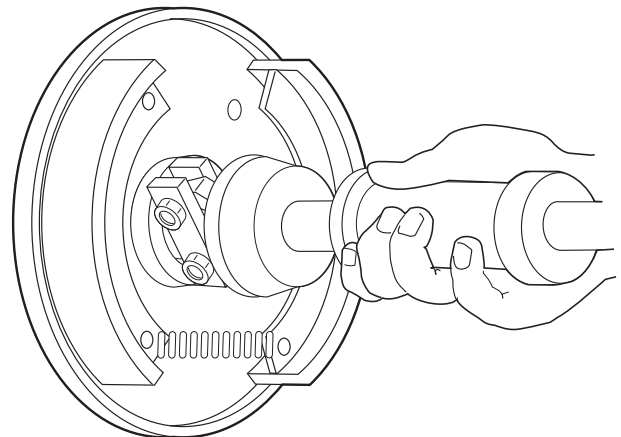


Figure 6 Removing Seal

3. To install the seal, use the special seal installer to drive the seal into its correct position (Ref. Figure 7).

CAUTION To prevent seal damage, lightly coat the axle shaft with bearing grease and support the shaft during installation.

4. Install the inner snap ring (Ref. Figure 5).

Read all of **SAFETY** and this section before attempting any procedure. Pay particular attention to **Notices, Cautions, Warnings and Dangers.**

Axle Shaft Replacement

1. Carefully insert the axle shaft and bearing through the oil seal.
2. Rotate the shaft until the spline engages with the differential side gears.
3. Install the outer snap ring.
4. Coat the outboard spline of the axle with a commercially available anti-seize compound. Install the brake hub and drum, thrust washer, nut and new cotter pin (Ref. Figure 8).

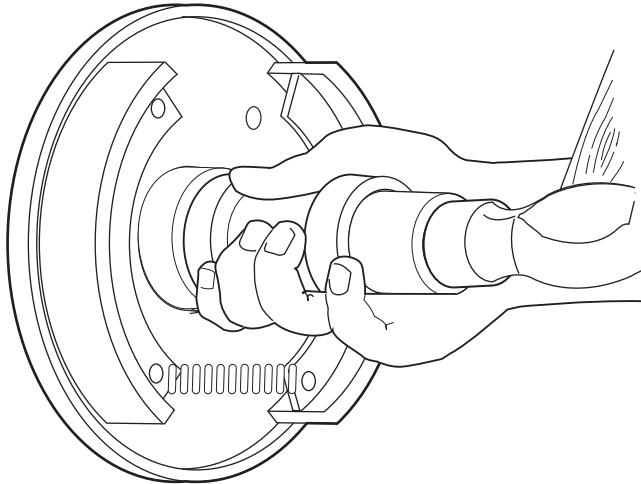


Figure 7 Installing Seal

NOTICE: Tighten the castellated axle nut to 70 ft. lb (95 Nm) torque minimum, 140 ft. lb (190 Nm) torque maximum. Continue to tighten until the slot in the nut aligns with the cotter pin hole.

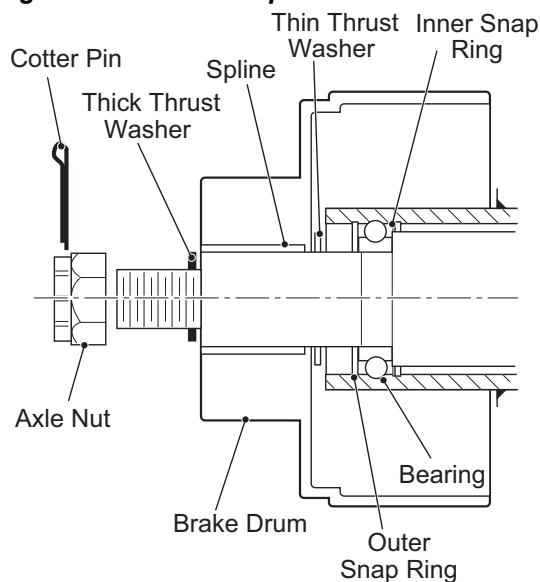


Figure 8 Cut Away of Outer Bearing and Brake Drum

REAR AXLE

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Notes:

WEATHER PROTECTION

CANOPY TOP AND SUPPORTS

WARNING The top does not provide protection from roll over or falling objects.

CAUTION This procedure requires at least two people. Three people is recommended.

The canopy top is designed for weather protection only.

Tool List	Qty.
Wrench, 9/16"	1
Wrench, 1/2"	2
Wrench, 17 mm	1
Allen Wrench, 8 mm	1
Socket, 9/16"	1
Socket, 1/2"	1
Socket, 17 mm.....	1
Allen Socket, 8 mm.....	1
Torx Bit, T27 IP.....	1
Torx Bit, T40.....	2
Ratchet	2
Torque Wrench, ft. lb.....	1

Removal:

1. Remove the truck bed (See Truck Bed Removal on page 16).
2. Remove the seat back (See Seat Back on page 18)
3. Remove the seat bottom.
4. Remove the torx screws (1), flat washers (2), and rubber washers (3, 4) securing the canopy top (5) to the canopy supports (10, 15). Make sure to retain the barrel clips (6) for assembly (Ref. Figure 2).
5. Remove the lock nuts (17) and allen bolts (16) securing the front and rear canopy supports together (Ref. Figure 1).
6. With one person on each side to support the front support bracket (10), remove the lock nuts (7), torx bolts (11) and spacers (8, 9) securing the support bracket to the frame (Ref. Figure 3).
7. With one person on each side to support the rear support bracket (15), remove the lock nuts (14), bolts (12), and flat washers (13) securing the bed bumpers (20) and rear support bracket to the frame (Ref. Figure 4).

Assembly:

1. Loosely secure the rear canopy bracket (15) and bed bumpers (20) to the frame finger tight using the bolts(12), flat washers (13), and new lock nuts (14).
2. Loosely secure the front support bracket (10) to the frame using the torx bolts (11), spacers(8, 9), and new lock nuts and mate the front and rear support brackets.

Note that the lower upper bolt uses two equal spacers between the support bracket and the body while the lower bolt uses one long spacer and one shorter spacer.

3. Secure the front and rear support brackets together using the allen bolts (16) and lock nuts (17) finger tight
4. Tighten all hardware to the torque values below from front to rear.
5. Install the seat bottom.
6. Install the seat back (See Seat Back on page 18).
7. Install the truck bed (See Truck Bed Removal on page 16).

Item	Torque Specification
1	3 - 5 ft. lb (4 - 6.5 Nm)
11	13 - 15 ft. lb (17.5 - 20 Nm)
14	21 - 25 ft. lb (28.5 - 34 Nm)
17	35 - 40 ft. lb (47.5 - 54 Nm)

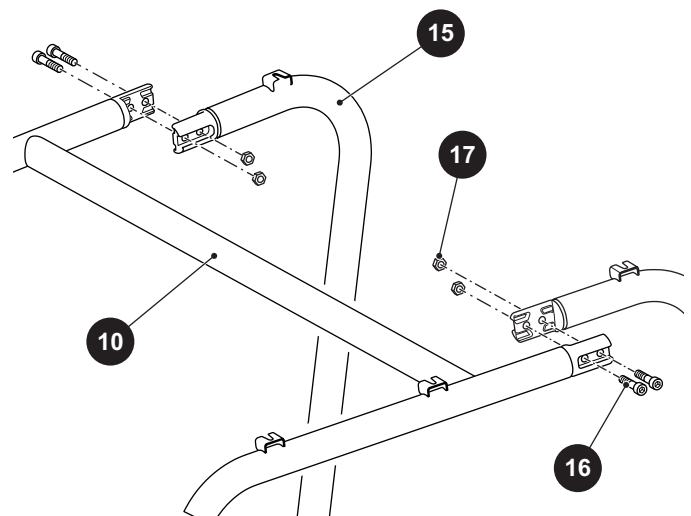


Figure 1 Canopy Support

WEATHER PROTECTION

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

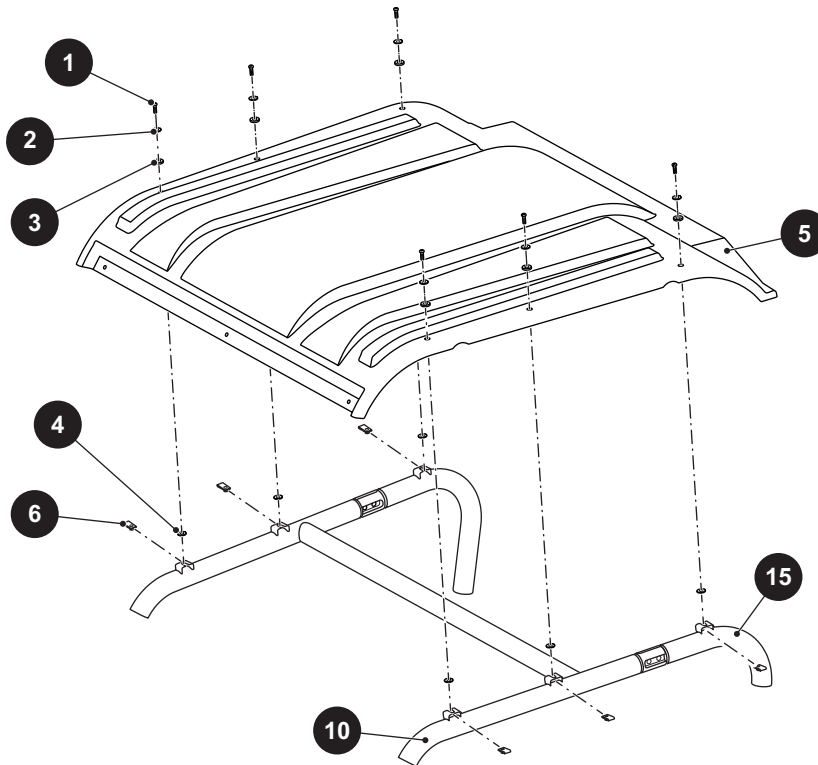


Figure 2 Canopy Top

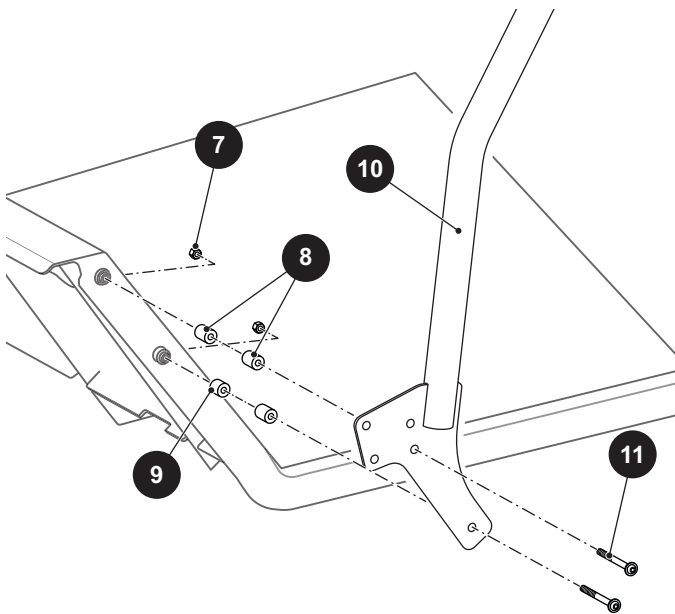


Figure 3 Front Canopy Support

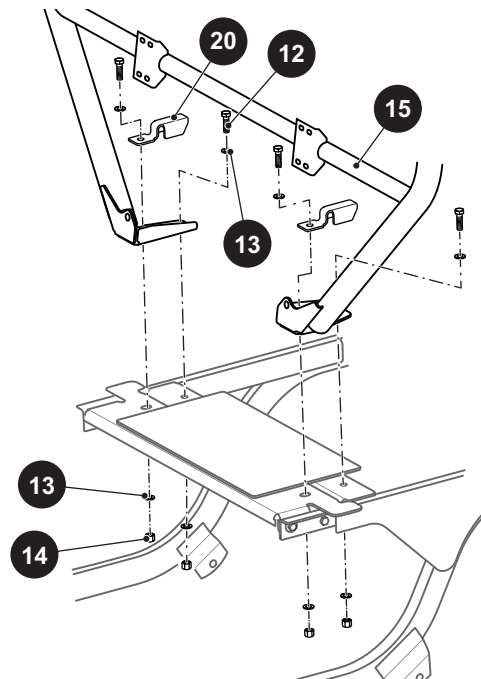


Figure 4 Rear Canopy Support

TROUBLESHOOTING

SUSPENSION AND STEERING

Condition	Possible Cause	Correction
UNEVEN TIRE WEAR	Incorrect tire pressure	Inflate to recommended pressure
	Improper alignment (Incorrect toe in)	Align front tires
STIFF STEERING	Water has entered steering box and can freeze in cold conditions	Remove steering column, pinion and bearing and remove water before adding grease; Inspect gasket for good seal
	Excessive grease in steering box has moved into steering rack bellows	Raise the vehicle and observe the rack bellows while moving the steering from lock to lock Any distortion of the bellows can indicate an excess of grease has accumulated in the bellows Remove the bellows and remove excess grease
	Insufficient lubricant in king pins, tie rod ends, idler bushing, rack tensioner or steering box	Add one shot of lubricant to each grease fitting and operate steering from lock to lock. Do not over grease If steering does not return to acceptable condition, proceed to next step
	Bent rack	Remove rack and place on flat surface with rack teeth up; If a 0.015" (0.381 mm) feeler gauge will pass under the rack, the rack must be replaced
PLAY IN STEERING	Steering wheel loose	Inspect splines - replace steering wheel if required; Tighten steering wheel nut
	Steering components worn	Replace
	Loose wheel bearings	Adjust or replace
VIBRATION	Steering components worn	Replace
	Loose wheel bearings	Adjust or replace
	Out of round tires, wheels, or brake drums	Inspect and replace if out of round
STEERING PULLS TO ONE SIDE	Incorrect tire pressure	Inflate to recommended pressure
	Dragging wheel brakes	Service brake system
	Suspension component failure	Repair
	Alignment incorrect	Align

Figure 1 Suspension and Steering Fault Diagnosis

TROUBLESHOOTING

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

CURTIS CONTROLLER

General

Notice: Contact customer care at the phone number at the front of this manual if having difficulty connecting.

Use the Curtis handheld programmer for programming, troubleshooting, tuning, diagnosing and adjusting parameters for the speed controller and auxiliary devices (Ref. Figure 2). A Curtis 1313 with a blue band is required to communicate with the F-Series controller. Gray band handsets will not connect.



Figure 2 Curtis Handheld Programmer

WARNING Connect the Curtis handheld programmer power cord to the Curtis programmer port only. If connected to the wrong port, voltage from other interface circuits can permanently damage the programmer.

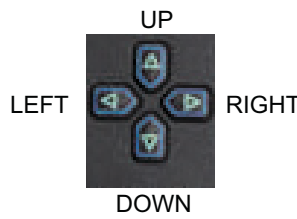


Figure 3 Curtis Programmer Port

Connect the Molex plug to the controller receptacle. The controller receptacle is an easily identifiable bright orange color. The plug is mounted to the seat frame on the passenger side of the vehicle.

Navigation

A blinking square on the left indicates the position of the cursor.



The blinking square moves vertically when the up or down arrow on the navigation key is pressed.

Press the right arrow on the navigation key to display a column of sub-menus. Press the right arrow a second time to display more than one level of sub-menus.



The book icon indicates that a menu option is read only.



The pencil icon indicates that a menu option is editable.



The list icon indicates that additional menu options are within a current menu option.

Changing Data Value



Press the up or down arrow on the data value key to change the value of the parameter.

Favorites



Press the favorites (star) key for four seconds (until the favorites set screen is displayed), to set a position in the menu.

Press the appropriate favorites key to move to a selected favorites position.

TROUBLESHOOTING

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

LED Fault Code

DIAGNOSTICS: Diagnostics information can be obtained by two methods:

- by reading the display on a 1313 programmer or
- by observing the fault codes issued by the Status LEDs on the top of the controller.

The 1313 programmer displays all faults that are currently set, as well as a history of the faults that have been set since the history log was last cleared. The 1313 displays the faults by name.

The LED built into the controller produces flash codes that display all the currently set faults in a repeating cycle. Each code has two digits. The red LED flashes the first digit of the code, and the yellow LED then flashes the appropriate number of times for the second digit.

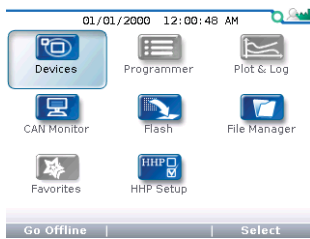
The numerical codes used by the LED are listed in the fault diagnosis chart, which also lists possible fault causes and describes the conditions that set and clear each fault. The two LED's have four different display modes that indicate the type of information they provide. (See FAULT CODE REFERENCE LIST on page 121)

TYPES OF LED DISPLAY	
DISPLAY	STATUS
LED OFF	Controller is not powered on; or vehicle has dead battery; or severe damage.
LED Slowly Flashing Yellow	Controller is operating normally.
LED Solid Yellow or Orange	Controller is in Flash program mode.
LED Solid Red	Internal hardware fault detected by the primary microprocessor, or there is no software loaded.
LED Flashing in a Red/Yellow Pattern	A fault or event is active. The first digit is the number of red flashes, the second digit is the number of yellow flashes. Consult the fault code chart.

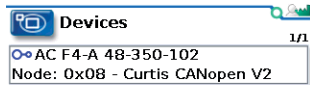
TROUBLESHOOTING

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Curtis Handheld Diagnostic Tool Function



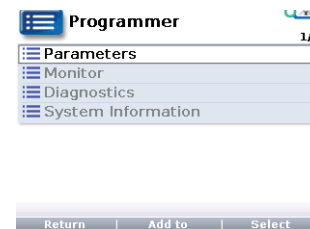
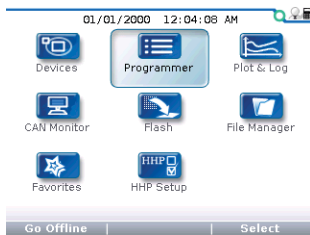
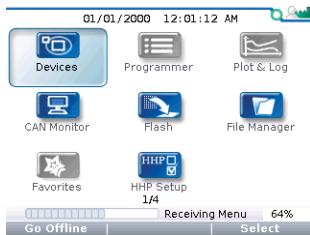
Upon connection to the vehicle, the handheld should power up automatically. The key switch may need to be in the ON position in some situations. When the main menu is displayed, select the “Devices” menu icon.



The next screen shows a list of CAN devices available on the bus. Other devices may appear in the menu, but select only the motor controller as seen in this image.



The first time that a handheld is connected, it may take up to 5 minutes to establish the connection and will go through 4 steps. A progress meter can be observed at the bottom of the screen. Subsequent connections should only take around 30 seconds to establish.

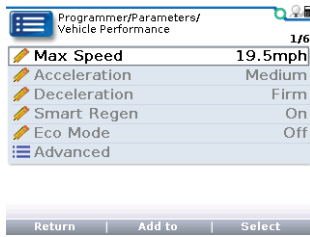


Under the Programmer menu are 4 separate submenus.

Figure 4 Handheld Tool Function

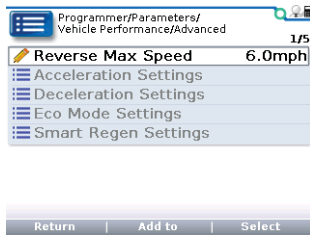
TROUBLESHOOTING

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

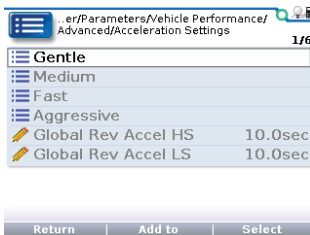


Select Vehicle Performance under the Parameters menu to adjust the following:

- Max Speed
- Acceleration
- Deceleration
- Smart Regen
- Eco Mode

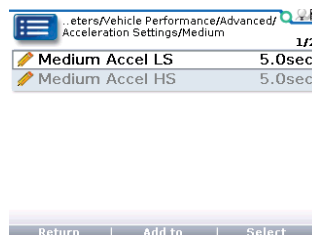
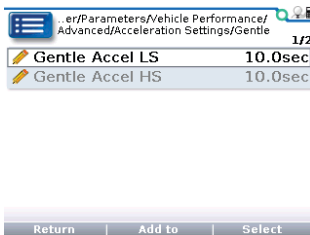


Select Advanced under Vehicle Performance to adjust the Reverse Max Speed.



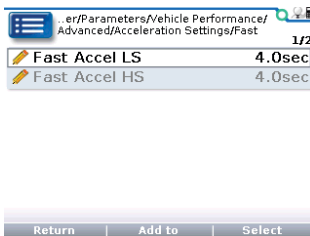
Select Acceleration Settings to fine tune each option. These settings should not typically need to be adjusted from factory settings. Option include:

- Gentle
- Medium
- Fast
- Aggressive



Any adjustments made in these menus will affect vehicle acceleration performance. Always be sure to record the default value in order to restore the factory settings if needed.

LS settings control low speed acceleration while HS settings control high speed acceleration. LS applies to the slowest 70% of the vehicle's top speed.

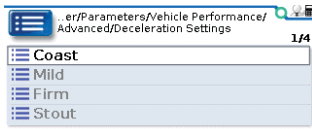


LS and HS settings should be the same or very close so that acceleration feels linear through the full travel of the pedal.

Figure 4 Handheld Tool Function (Continued)

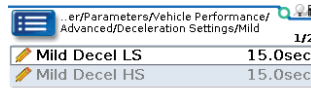
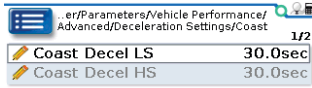
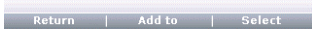
TROUBLESHOOTING

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.



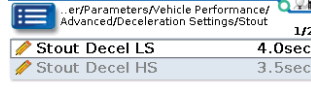
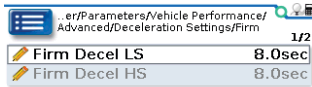
Select Deceleration Settings to fine tune each option. These settings should not typically need to be adjusted from factory settings. Option include:

- Coast
- Mild
- Firm
- Stout

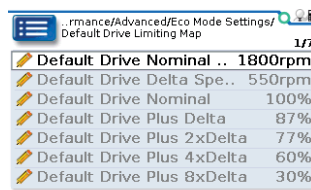
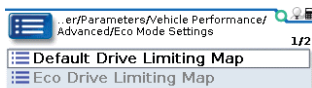


Any adjustments made in these menus will affect vehicle deceleration performance. Always be sure to record the default value in order to restore the factory settings if needed.

LS settings control low speed acceleration while HS settings control high speed acceleration. LS applies to the slowest 70% of the vehicle's top speed.



LS and HS settings should be the same or very close so that acceleration feels linear through the full travel of the pedal.



The Eco Mode Settings define the percentage of drive current that will be applied at the speeds defined by the nominal speed and each of the delta speed parameters.

This can allow the controller to reduce the drive current as a percentage of the speed. Reducing the power requirements at certain speeds will restrict performance.

This can be useful in reducing motor temperature.

This can also be used to keep consistent vehicle power with changing battery state of charge.

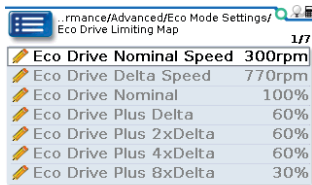
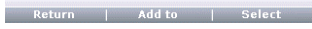
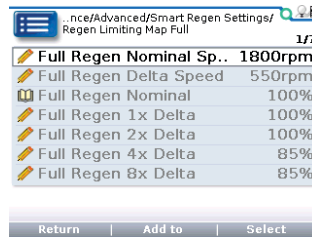
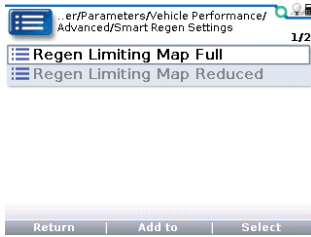


Figure 4 Handheld Tool Function (Continued)

TROUBLESHOOTING

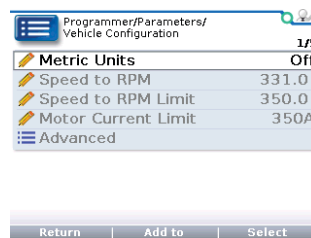
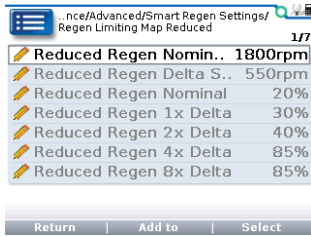
Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.



The Smart Regen Settings define the percentage of the braking current limit at the speeds defined by the nominal speed and each of the delta speed parameters.

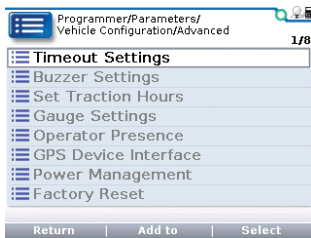
Use these parameters to shape the curve for limiting the available torque at various speeds.

One possible use is to compensate for the torque-speed characteristics of the motor.

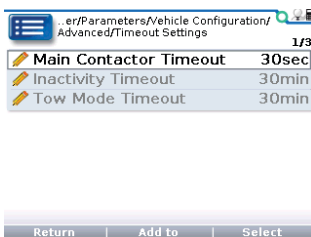


Select Vehicle Configuration under the Parameters menu to adjust the following:

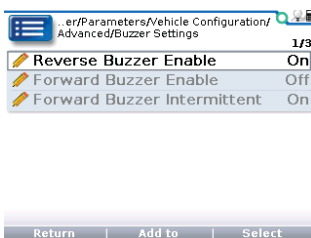
- Metric Units - switch between °C and °F as well as MPH and KPH
- Speed to RPM
- Speed to RPM Limit
- Motor Current Limit



In the Advanced menu under Vehicle Configuration there are several options that can be adjusted.



Select Timeout Settings to adjust when the controller times out as well as when the controller goes to sleep.



Select Buzzer Settings to adjust when and how the buzzer is activated.

- Reverse Buzzer Enable - turn the reverse buzzer on or off
- Forward Buzzer Enable - tun the forward buzzer on or off
- Forward Buzzer Intermittent - buzzer will intermittently buzz when in the on position. This setting is typically ON for airport terminals and other crowded areas.

Figure 4 Handheld Tool Function (Continued)

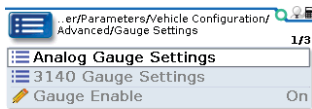
TROUBLESHOOTING

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

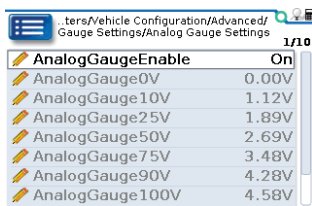


Select Set Traction Hours when replacing a controller. This will allow for the vehicle runtime to remain accurate.

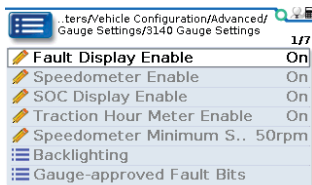
1. Record the runtime from the old controller.
2. Change the hour value to match the recorded value from the old controller.
3. Place Set Traction Hours to ON to store the parameter.



Select Gauge Settings menu to make changes. Gauge Enable must be set to ON for any available gauges to function.



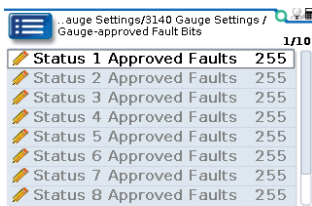
In the Gauge Settings menu, Analog Gauge Settings allows fine tuning the SOC gauge readings.



In the Gauge Settings menu, 3140 Gauge Settings allows turning options on or off that you want to display on the digital gauge.



The Backlighting menu allows for the brightness of the digital gauge to be adjusted.

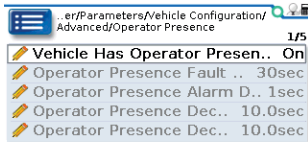


Never make adjustment to the Approved Faults. Changing the values will affect how codes are displayed on the digital gauge.

Figure 4 Handheld Tool Function (Continued)

TROUBLESHOOTING

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.



The Operator Presence menu allows adjustments to the seat switch. Adjusting these settings is not advised except for unique situations.



If Pace Technology is installed on the vehicle, the GPS Device Interface menu allows the system reaction to a vehicle outside of a predetermined boundary to be adjusted.



The Power Management menu allows controlling whether accessories turn off upon connecting the charger to the vehicle. Battery charge can also be set to terminate short of 100% if needed.



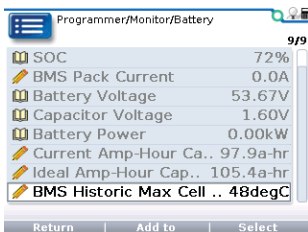
A Factory Reset option is available in case changes were made to troubleshoot and no improvement was made.



Applying a factory reset will revert **ALL** parameters back to the factory defaults. Any customization will be lost.



The Monitor menu contains 6 submenus where data on the components of the vehicle can be obtained.

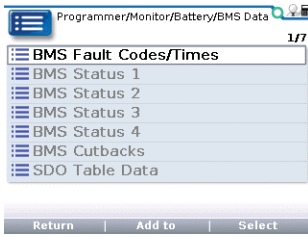


The Battery submenu allows for reading battery pack information such as SOC, battery voltage, pack current. In order to get a idea of the general overall health of the battery pack, ideal and current amp hour capacity.

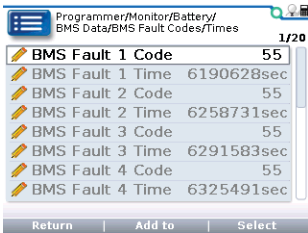
Figure 4 Handheld Tool Function (Continued)

TROUBLESHOOTING

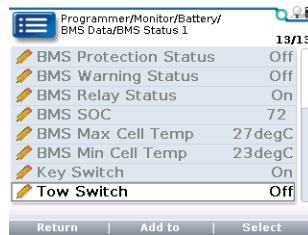
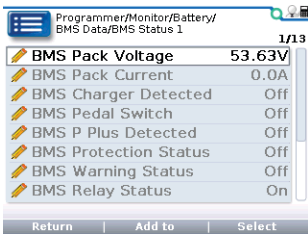
Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.



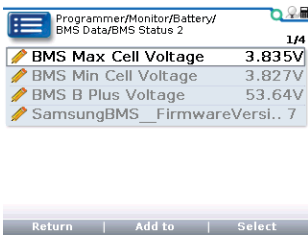
The BMS Data submenu contains 7 other submenus where BMS data can be obtained.



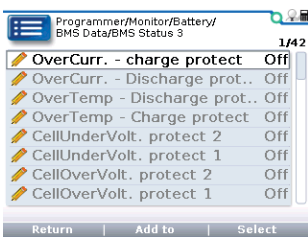
The BMS Fault Codes/Times submenu will show any BMS faults as well as times that the fault occurred.



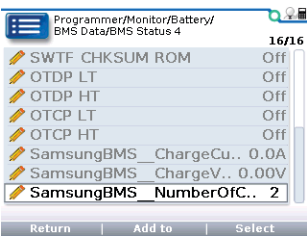
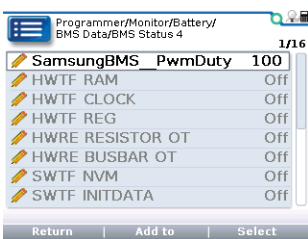
The BMS Status 1 submenu shows the various statuses to in these images as well as the battery pack voltage as well as minimum and maximum cell temperatures.



The BMS Status 2 submenu shows the minimum and maximum cell voltage, output voltage to the battery terminal, and the current BMS firmware version.



The BMS Status 3 submenu shows up to 42 protection and warning faults. Unless there is an issue, all lines should read OFF.

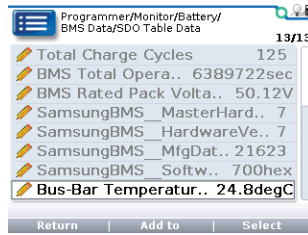
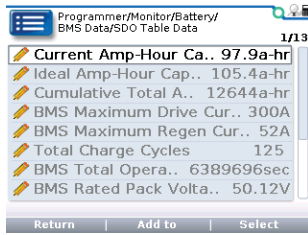


Any statuses reading ON in the BMS Status 4 submenu likely indicates a BMS hardware issue. Charge current, charge voltage, and the number of battery modules installed are within this submenu as well.

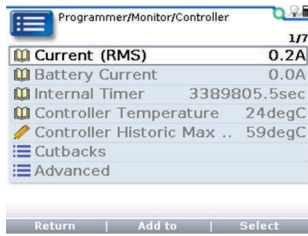
Figure 4 Handheld Tool Function (Continued)

TROUBLESHOOTING

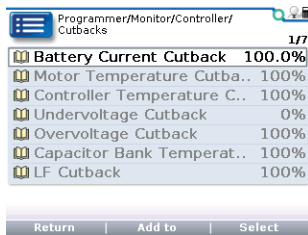
Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.



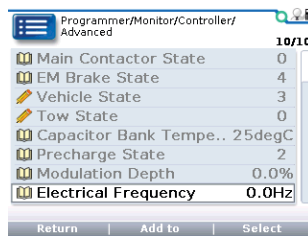
The SDO Table Data submenu shows total amp hours, max drive current, max regen current, total charge cycle, total number of charge cycles, BMS operation time, and bus bar temperature data.



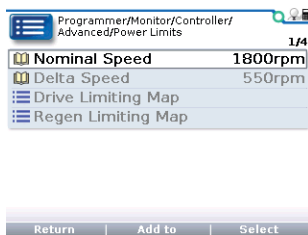
The Controller menu shows controller and battery current as well as historic temperatures.



Controller cutbacks will read as 100% during normal operation.



Additional controller component temperatures are available under the Advanced submenu as well as the state of various components.



The Power Limits submenu shows the nominal speed and delta speed. These are set to control the controller output at certain points to help reduce the motor and controller temperatures.

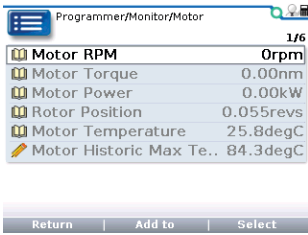


The listing maps (Drive & Regen) limit the current supplied by the controller at various motor speed thresholds.

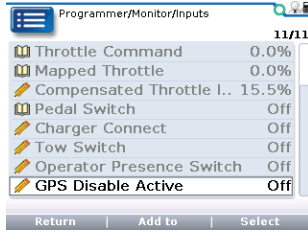
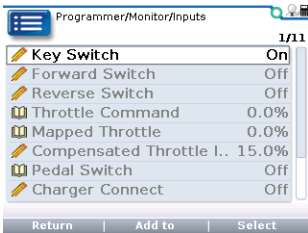
Figure 4 Handheld Tool Function (Continued)

TROUBLESHOOTING

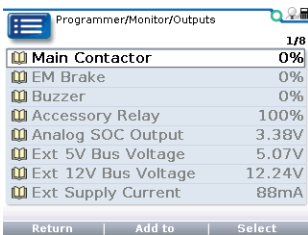
Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.



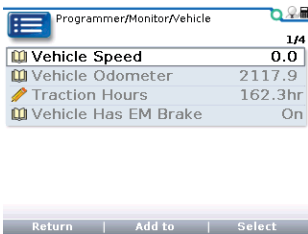
Motor torque, power, and temperature relation can all be observed when driving the vehicle with the handheld in the Motor submenu.



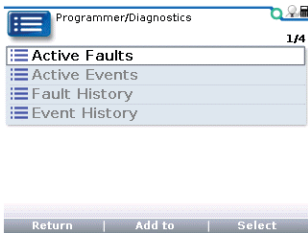
The Inputs submenu displays various component inputs. Throttle command relates to input from the accelerator to the controller. Mapped throttle is the controller's actual output to the motor. Both of these should display very similar values. Charger connect displays the interlock function when the vehicle is charging.



The Outputs submenu displays various component outputs including ground driver outputs and the 5V and 12V controller outputs. Excessive external supply current could indicate that an added accessory is affecting the power supply.

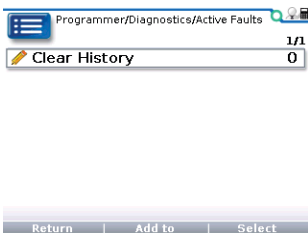


The Vehicle submenu displays the vehicle speed, odometer, and hours. This submenu also displays whether the vehicle has an E-brake.



The Diagnostics menu contains 4 submenus.

- Active Faults
- Active Events
- Fault History
- Event History

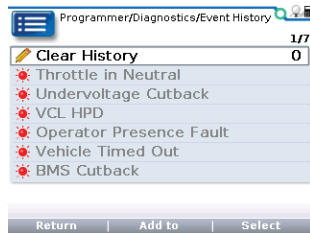


The Active Faults submenu will display any currently present faults. These faults can be cleared using the Clear History option. If there is an active issue the fault will reappear.

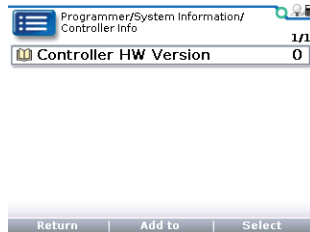
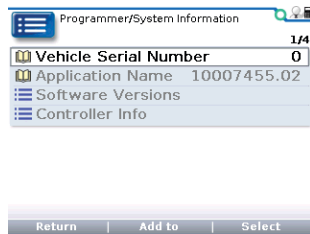
Figure 4 Handheld Tool Function (Continued)

TROUBLESHOOTING

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.



The Event History submenu will display all events that have occurred. These can be cleared using the Clear History option. Most if not all events occur under normal operating conditions.



The System Information menu will display the vehicle serial number. The Software Versions and Controller Info submenus are also under this menu.

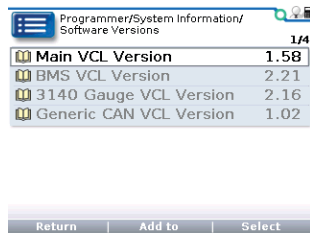


Figure 4 Handheld Tool Function (Continued)

TROUBLESHOOTING

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

COMPONENT TESTING

Voltmeter

⚠ WARNING Before performing any test of wiring components, disconnect the battery cables from the battery posts to prevent electrical shock.

Electrical tests of the wiring for continuity can be done with a DVOM (Digital Volt Ohm Meter), available through the Service Parts Department (P/N 27481G01). The actual model can vary depending on availability. The DVOM (digital volt ohm meter) shown in Figure 10, is representative only. Any DVOM can be used, however the controls, displays and features can vary depending on the make and model. Always follow the meter manufacturer's recommendations and instructions for the use and care of the meter. For the purpose of this section, the red probe is represented as (+) and black probe as (-). Set the meter selector to the ohms scale, and check continuity between each circuit component as indicated.

Example: If a switch is open or if there is a break in the wiring, the meter will display a visual signal. If an analog meter is used, it will read infinity (∞).



Fig. 5 Digital Voltmeter

Fuses - Testing

Check all the fuses to make sure that components are properly powered (Ref. Figure 6). If the fuse is blown,

replace the fuse.

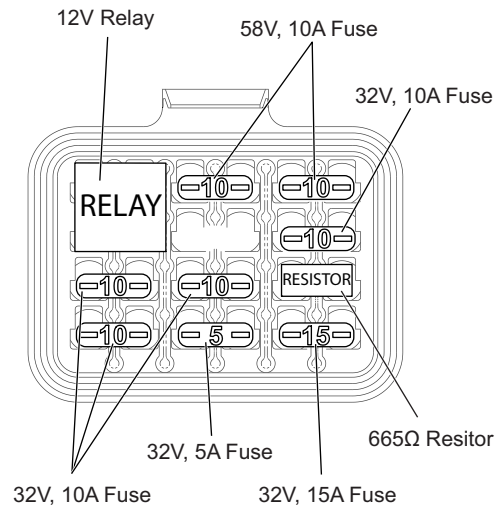
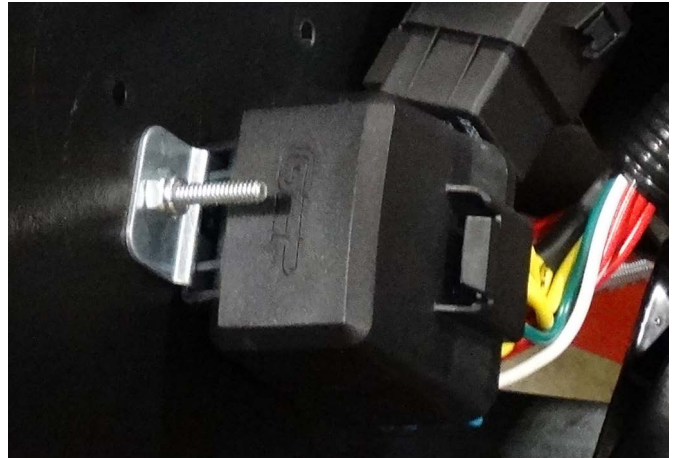


Figure 6 Fuse Block

NOTICE: To test the components on the control panel, the control panel has to be removed to access the individual component circuit terminals (See Gauge Panel Replacement on page 10).

TROUBLESHOOTING

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Key Switch - Testing

Use the handheld diagnostic tool to verify operation of the key switch. See the inputs on the monitor menu. Operate the switch to change its status. This will confirm a failed switch or a bad circuit.

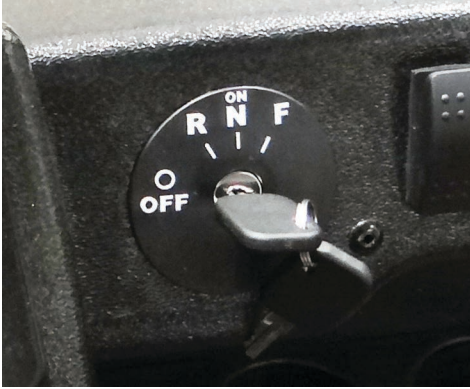


Figure 7 Key Switch

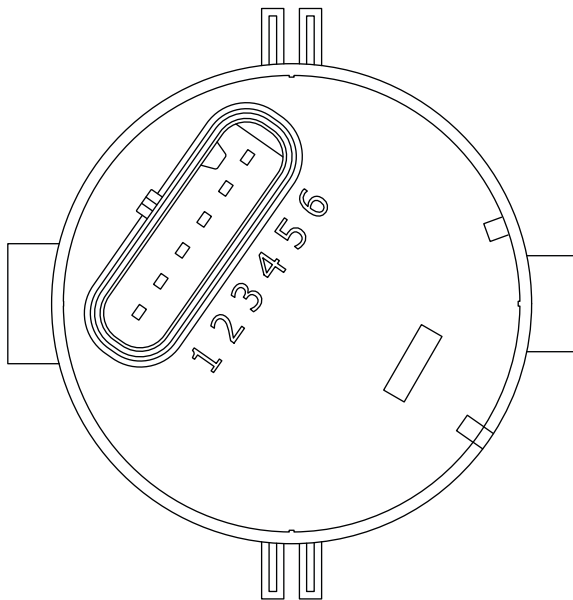


Figure 8 Circuit Pins

NOTICE: This test can also be done with the handheld tool. Scroll down to the direction functions in the Monitor Menu.

If a handheld programmer is not available, the key switch can be tested for continuity using a DVOM (See Electrical Schematic on page 63).

Solenoid - Testing

To check the electronic speed controller solenoid for energy; follow the steps below:

1. Put the positive (+) meter probe on the white wire primary circuit terminal. Put the negative (-) meter probe on the black / orange primary circuit terminal. 48V should be indicated on the meter with the key on.
2. Put the negative meter probe on controller B or the negative 48V battery terminal. Put the positive probe on the secondary circuit battery side terminal. 48V should be indicated. If not, check the battery voltage and wiring.

NOTICE: The solenoid testing can also be done with the handheld tool. Scroll down to the Monitor Menu. Check the inputs and outputs for a change in status. Check for contactor related faults in the faults menu.

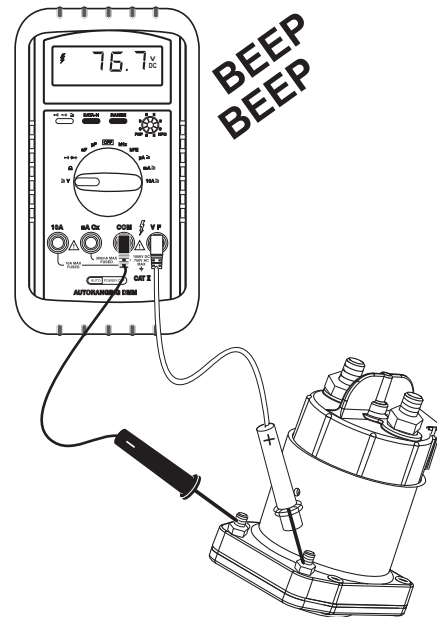


Figure 9 Solenoid

Temperature Sensor - Testing

NOTICE: If the temperature sensor is faulty, the entire motor assembly must be replaced (See Motor Removal on page 46).

1. If possible, allow the vehicle to cool to room temperature.
2. Unplug the temperature sensor harness at the motor (Ref. 2.)

TROUBLESHOOTING

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

- Use the DVOM set on OHMS (Ω) and test the resistance between the two pins on the motor side.

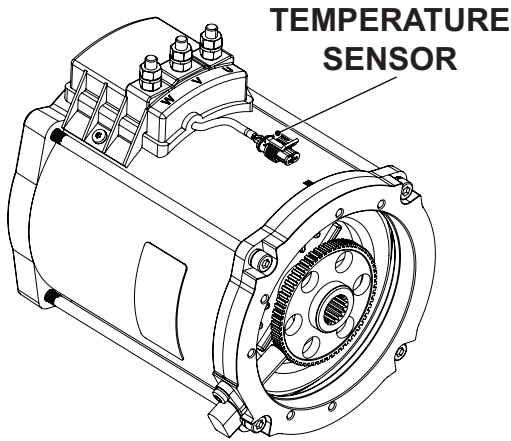


Figure 10 Temperature Sensor

- A reading showing at or below the minimum value indicates a bad sensor.
- A reading showing at or above the thermal cutoff temperature indicates either a faulty sensor or a severely overheating motor (Ref. Figure 11) (Ref. Figure 12).

Minimum Value	$\approx 359 \Omega$ (-40°C)
Room Temperature	$\approx 603 \Omega$ (25°C)
Beginning of Thermal Cutback	$\approx 1297 \Omega$ (145°C)
Thermal Cutoff Temperature	$\approx 1407 \Omega$ (160°C)

Figure 11 KTY Temperature Sensor (male pins on the connector)

Minimum Value	$\approx 843 \Omega$ (-40°C)
Room Temperature	$\approx 962 \Omega$ (25°C)
Beginning of Thermal Cutback	$\approx 1555 \Omega$ (145°C)
Thermal Cutoff Temperature	$\approx 1610 \Omega$ (160°C)

Figure 12 PT1000 Temperature Sensor (female pins on the connector)

Electronic Speed Sensor - Testing

Use the DVOM probes to check the motor speed sensor while the connector is plugged in.

- Place the key switch in the N position.
- Put the positive meter probe in the red wire connection. Put the negative meter probe in the black wire connection. 5V should be indicated. If not, check the wiring and the signal from the controller. Replace the speed sensor if these are good.
- Put the negative meter probe in the black wire connection. Put the positive meter probe in the green wire connection. A 0 – 5V flash signal should be indicated when the motor armature is rotated slowly. If not, check the sensor magnet in the motor, then replace the speed sensor.

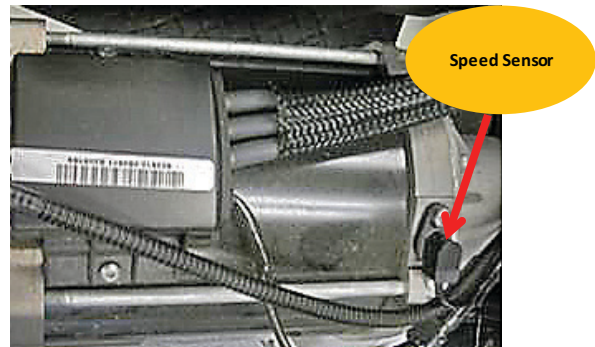


Figure 13 Speed Sensor

Back probe pins are needed to perform electrical tests via wire harness connectors.

TROUBLESHOOTING

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

AC Motor Bench Test

Set a standard digital volt/ohm meter to the diode test position. Make sure the audible alarm can be heard.

1. Place one meter probe on the U-terminal and the other probe on the W-terminal. Full continuity should be observed (Ref. Figure 14).



Figure 14 U and W terminal

2. Now place one meter probe on the V-terminal and the other probe on the W-terminal. Full continuity should be observed (Ref. Figure 15).



Figure 15 V and W terminal

3. Then place one meter probe on the U-terminal and the other probe on the V-terminal. Full continuity should be observed (Ref. Figure 16).



Figure 16 U and V terminal

NOTICE: If continuity is not observed between terminals; an open motor field condition may exist. Disassemble the motor to visually confirm.

4. Place one meter probe on any of the three motor terminals. The other meter probe should be placed on the motor case. No continuity should be observed (Ref. Figure 17).

NOTICE: If continuity is observed between the case and terminals; a field to motor case short exists.



Figure 17 Terminal and Motor case

TROUBLESHOOTING

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Notes:

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

VEHICLE SPECIFICATIONS

VEHICLE SPECIFICATIONS

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

OX EV

Item	Specification
Overall Length	121.5 in. (309 cm)
Overall Width	55.2 in. (140 cm)
Overall Height (no canopy)	58.7 in. (149 cm)
Overall Height (with canopy)	82.8 in (210 cm)
Wheelbase	77.3 in. (196 cm)
Front Wheel Track	38.2 in. (97 cm)
Rear Wheel Track	38.8 in. (99 cm)
Ground Clearance at Differential	11.8 in. (30 cm)
Cargo Box Width	44 in. (112 cm)
Cargo Box Length	39 in. (99 cm)
Cargo Box Material	Roto-molded Plastic
Power Source	39.2 - 56.7 Volts Li-Ion Battery
Motor Type	48 Volt AC Induction
Horsepower (kW)	14.9 hp (11.1 kW) Peak
Electrical System	48 Volt, 12Vauxilliary
Battery Quantity and Type	Single 56.7V Max Li-Ion composite module and cell module (twin pack)
Key or Pedal Start	Pedal Start
Battery Charger	56.7V 811W world charger, 3 m charging cord
Speed Controller	350 Amp AC Controller
Drive Train	Motor Shaft Direct Drive
Trans-axle	Limited slip differential with helical gears
Gear Selection	Dash mounted Key Switch Forward-Neutral-Reverse
Rear Axle Ratio	16.99:1
Seating Capacity	2 person
Weight (No Batteries)	928 lb (421 kg) without batteries
Curb Weight	1009 lb (458 kg) (Standard Configuration)
Bed Load Capacity	500 lb (227 kg)
Vehicle Load Capacity	900 lb (408 kg)
Outside Clearance Circle	23.9 ft. (7.3 m)
Speed (Level Ground)	16.5 +/-0.5 mph (26.35 +/-0.8 kph)
Towing Capacity	1200 lb (544 kg)
Steering	Self-compensating rack and pinion
Front Suspension	Leaf springs with hydraulic shock absorbers
Rear Suspension	Leaf springs with hydraulic shock absorbers
Service Brake	Rear wheel mechanical self-adjusting drum
Parking Brake	Automatic electromagnetic
Front and Rear Tires	KTR Desert Eagle 23x10-14 (4 ply)
Frame	Welded steel with E-Shield ecoat plus DuraShield™ powder coat
Body and Finish	Injection molded TPO
Vibration, WBV	Highest RMS value of weighted acceleration is less than 1.92 m/s ² The uncertainty of measurement is 0.17 m/s ²
Vibration, HAV	Highest RM value of weighted acceleration is less than 2.5 m/s ²
	Measurement methods were applied per ISO 2631 and ISO 5349 standards under conditions of typical vehicle surfaces.

FAULT CODE REFERENCE LIST

NOTES

- The columns of this chart span two pages. The left side of the chart appears on even numbered pages. The right side appears on the odd numbered pages.
- The faults/events in this list are ordered by the perceived likelihood.
- During normal operation with no faults or events active, the LED on the controller should slowly blink yellow.
- Flash codes refer to the LED light on the face of the controller.
 - When a fault or event is active, the LED flashes red and then yellow for each code.
 - The first digit is the number of red flashes.
 - The second digit is the number of yellow flashes.
 - Flash codes are hexadecimal.
 - 0-9 flashes = 0-9
 - 10 flashes = A
 - 11 flashes = B
 - 12 flashes = C
 - 13 flashes = D
 - 14 flashes = E
 - 15 flashes = F
- Codes can also be made to display on the digital SOC meter (if equipped).
 - Fault Display must be enabled using the handheld controller in order for faults to be displayed on the digital SOC meter.

FAULT CODES

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

CHART

Fault/Event Name	Flash Code	Fault or Event	Displayed on Digital SOC	Likely Cause	Likely Resolution
Undervoltage Cutback	23	event	N	Normal use - low battery	No fix needed; recharge battery
Overvoltage Cutback	24	event	N	Normal use - regen with full battery	No fix needed; operate vehicle normally
BMS Cutback	C2	event	N	Normal use - throws when battery current limit is hit and also with low and high cell cutbacks	No fix needed
Throttle in Neutral	51	event	N	Throttle applied in neutral, or throttle applied with direction signal broken	Select direction prior to pressing throttle; check forward and reverse wires for continuity - if wires are OK, replace keyswitch
Operator Presence Fault	58	event	N	Seat switch not registering closure	Seat switch may require shimming for easier engagement depending on operator size and seating position
BMS Low Cell Cutback	55	event	N	Normal use - low battery; could also be a weak cell in battery	Charge battery - if persistent, consider replacing battery pack
BMS High Cell Cutback	56	event	N	Normal use - regen with full battery; could also be a weak cell in battery	If persistent after discharging battery, consider replacing battery pack
BMS Temperature Cutback	54	event	N	Normal use - battery hot	Allow battery to cool; if persistent, check for sources of mechanical resistance such as brake drag
Controller Overtemp Cutback	22	event	N	Normal use - controller hot	No fix needed; allow controller to cool
Motor Temp Hot Cutback	28	event	N	Normal use - motor hot	No fix needed; allow motor to cool
VCL HPD Fault	52	event	Y	Improper sequencing of pedal and key inputs; pedalbox issue	Make sure to select key position prior to pressing pedal; if persistent, replace accel pedalbox
Key Off in Motion	5A	event	N	Key turned off (or signal lost) while driving	Stop before turning off key; verify continuity of all keyswitch wires; replace keyswitch

FAULT CODES

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Vehicle Response	Set Conditions	Clear Conditions
Allowed drive current reduced	Ctrl B+ stud voltage below undervoltage cutback setpoint with main contactor closed	Ctrl B+ stud voltage recovers above undervoltage cutback setpoint
Allowed regen current reduced	Ctrl B+ stud voltage above overvoltage cutback setpoint with main contactor closed	Ctrl B+ stud voltage recovers below overvoltage cutback setpoint
Battery current not allowed to rise beyond limit	Battery current limit reached	Battery current request drops back below limit
Throttle disabled	Accel pedal pressed while key in neutral	Release accel pedal
Throttle disabled, buzzer sounds while pedal is pressed	Seat switch open (operator not sitting properly) when requesting to drive from a stop, or if switch opens while driving for longer than the delay time	Release accel pedal. Sit prior to pressing pedal again to drive.
Allowed drive current reduced	Battery's lowest individual cell voltage below setpoint	Battery's lowest individual cell voltage recovers above setpoint
Allowed regen current reduced	Battery's highest individual cell voltage above setpoint	Battery's highest individual cell voltage recovers below setpoint
Allowed current reduced	Battery's hottest individual cell temperature above setpoint	Battery's hottest individual cell temperature cools below setpoint
Allowed current reduced	Controller internal temperature rises above cutback start setpoint	Controller internal temperature falls below cutback start setpoint
Allowed current reduced	Motor internal temperature rises above cutback start setpoint	Motor internal temperature falls below cutback start setpoint
Throttle disabled	Multiple - pedal switch failed to close when pressed, pedal down with key off, throttle supply voltage issue	Release accel pedal
Throttle disabled, aggressive decel, buzzer beeps	Key Switch turned OFF while moving (EM brake car only)	Key ON, pedal released, and stopped

FAULT CODES

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Fault/Event Name	Flash Code	Fault or Event	Displayed on Digital SOC	Likely Cause	Likely Resolution
Severe KSI Undervoltage	17	event	N	May occur erroneously during normal power-on/power-off; otherwise, severely low battery or poor connection between pin 1 and battery +	Check battery + connections, charge battery
Encoder Fault	36	fault	Y	Bad speed sensor	Replace speed sensor; replace harness if that doesn't help
Encoder Limp Mode	93	fault	Y	Bad speed sensor or speed sensor wiring	Check speed sensor wiring, replace speed sensor if OK
Controller Overcurrent	12	fault	Y	Bad speed sensor	Replace speed sensor; replace controller if that doesn't help
Stall Detected	73	event	N	Motor stall detected while power was applied	Reduce mechanical load on vehicle - check for brake drag, remove weight if fully loaded and traversing an obstacle/grade
Encoder Pulse Error	88	fault	Y	Incorrect software or bad parameter settings	Factory reset with handset and/or reflash controller with correct software
Charger Interlock Fault	53	event	Y	Charger still plugged in; bad charge receptacle; broken wire in harness; bad charger	Ensure charger is unplugged; replace charge receptacle; verify continuity of both charge receptacle wires; replace charger
Direction Switch Fault	57	fault	Y	Forward and reverse inputs high at same time	Replace key switch; replace controller; replace harness
BMS Communication Fault	59	fault	Y	CAN communication failure	Check for 60 or 120 ohm resistance between harness CAN wires; check for terminal seating and condition at battery, controller, and 3140 gauge signal connectors

FAULT CODES

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Vehicle Response	Set Conditions	Clear Conditions
Open main contactor, vehicle totally disabled	Logic power supply dropped into brownout region	Logic power supply returns to normal range
Vehicle will stumble and then coast with motor disabled - if speed sensor issue persists after reset, vehicle will enter a limp mode.	Speed sensor failure detected - signal went missing, power supply interrupted, bad sensor, etc	Reset controller
Substantially limited performance, drive is not as smooth	Speed sensor failure detected and issue still present after reset	Reset controller with condition resolved
Motor disabled	Motor phase current exceeded current measurement limit	Reset controller
Motor disabled	No vehicle movement detected when movement was expected	Reset controller
Motor disabled	Wrong setting of encoder steps parameter detected	Perform factory reset with diagnostic handset
Throttle disabled	Throttle detected while charger is plugged in	Release accel pedal
Throttle disabled	Both forward and reverse inputs detected at once	Erratic direction signal is removed with accel pedal released
Throttle disabled	CAN bus messaging from BMS not detected for at least 3 seconds	CAN communication is restored with accel pedal released

FAULT CODES

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Fault/Event Name	Flash Code	Fault or Event	Displayed on Digital SOC	Likely Cause	Likely Resolution
BMS Protection Fault	61	fault	Y	BMS has determined it must protect battery by opening its contactor	Use Samsung BDT (battery diagnostic tool) or handset to investigate specific nature of battery fault condition
BMS Voltage Mismatch Fault	62	event	N	Excessive voltage difference between battery and controller	Check for loose connections at battery and controller
Throttle Signal	42	fault	Y	Bad throttle "fusistor" in fuse box	Replace fusistor
Throttle Out of Range	65	fault	Y	Bad throttle "fusistor" in fuse box or bad pedalbox	Replace fusistor; replace accel pedalbox if that doesn't help
Vehicle Timed Out	66	event	N	Vehicle left inactive for an extended period	Cycle key; consider adjusting inactivity timeout duration
EM Brake Driver Fault	32	fault	Y	EM brake circuit broken	Check continuity of both EM brake wires; replace brake if wires all check out
Main Contactor Driver Fault	31	fault	Y	Main contactor circuit broken	Check continuity of both contactor wires; replace contactor if wires all check out
Accessory Relay Driver Fault	A3	fault	N	Incorrect software or bad parameter settings	Factory reset with handset and/or reflash controller with correct software
Software Not Loaded	7D	fault	N/A	Controller was not flashed on assembly line or at service kiosk	Reflash controller with correct software
External Device Lockout Active	64	event	Y	Remote device is asserting vehicle disable	Leave restricted area; unplug remote device
Main Contactor Did Not Close	39	fault	Y	Bad main contactor	Replace main contactor

FAULT CODES

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Vehicle Response	Set Conditions	Clear Conditions
BMS contactor de-energizes entire electrical system after 3 seconds; throttle disabled; if EM brake, also aggressive decel, buzzer beeps	Battery conditions cause BMS to assert Protection Status and open its contactor 3 seconds later	Battery conditions return to normal, pedal released
Information only at launch	BMS voltage significantly different from controller voltage	BMS and controller voltage return to being close
Throttle disabled	Throttle signal out of range or missing completely	Reset controller
Throttle disabled	Invalid power supply to throttle sensor or throttle voltage too high	Resolve set conditions with accel pedal released
Throttle disabled, accessory relay disabled	No throttle detected for duration of inactivity timeout (30 min by default)	Key cycle; if vehicle has seat switch, can clear and drive just by applying throttle normally
Throttle disabled, aggressive decel	EM brake circuit open or shorted	Reset controller
Motor disabled, coasts	Main contactor coil circuit open or shorted	Reset controller
Accessory relay disabled	Accessory relay coil circuit open or shorted	Reset controller
Vehicle completely disabled, handset menu shows this fault and nothing else	Controller never programmed, still has blank firmware	Flash controller with correct software
Drive disabled in forward; reverse drive may also be disabled dependent upon Force Neutral in Reverse parameter	An external device is commanding near-zero speed either via a discrete input or CAN bus signal	External device condition must clear, or external device must be disconnected
Vehicle completely disabled	Main contactor was commanded to close but control did not detect closure	Reset controller

FAULT CODES

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Fault/Event Name	Flash Code	Fault or Event	Displayed on Digital SOC	Likely Cause	Likely Resolution
Main Contactor Welded	38	fault	Y	Bad main contactor	Replace main contactor
Motor Open	37	fault	Y	Motor cable disconnected	Check large UVW motor cables; if all connected, replace motor
Controller Current Sensor	13	fault	Y	Bad speed sensor	Replace speed sensor; replace controller if that doesn't help
Controller 12V Supply Failure	26	fault	Y	Controller 12V or 5V bus shorted to ground or excessive load	Check voltage at pins 25 (12V) and pin 26 (5V) - disconnect components from each bus to see if voltage recovers; replace controller if that doesn't find a problem; replace harness if that doesn't help
Controller 5V Supply Failure	25	fault	Y	Controller 5V bus shorted to ground or excessive load, could be bad speed sensor	Check voltage at pins 25 (12V) and pin 26 (5V) - starting with speed sensor on 5V bus, disconnect components from each bus to see if voltage recovers; replace controller if that doesn't find a problem; replace harness if that doesn't help
EM Brake Failed to Set	92	fault	Y	EM brake mechanical failure or on too steep of grade	Park on a lower grade or replace EM brake
Following Error	48	fault	Y	Controller cannot regulate speed	Replace controller
Parameter Change Fault	49	fault	Y	Sensitive parameter changed with handset during use	Reset controller
Motor Temp Sensor Fault	29	fault	Y	Motor temp sensor disconnected	Check continuity of both motor temp sensor wires; replace motor if wires all check out

FAULT CODES

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Vehicle Response	Set Conditions	Clear Conditions
Motor disabled, coasts	Main contactor was commanded to open but failed to do so	Reset controller
Motor disabled, coasts	Open circuit detected on one or more motor phases	Reset controller
Motor disabled, coasts	Internal current sensor reading determined to be invalid	Reset controller
12V supply disabled, which disables throttle	12V sensor supply voltage or current out of range	Reset controller
5V supply disabled, which disables motor speed sensor, vehicle may stumble and then coast if moving at the time of fault	5V sensor supply voltage or current out of range	Reset controller
Vehicle enters walkaway and limits speed while beeping buzzer	Movement sensed after EM brake was commanded to set	Apply throttle to drive out of condition
Vehicle disabled - this should not ever throw on TSV F series controller	Motor position substantially different than commanded	Reset controller
Vehicle completely disabled	Critical parameter changed while main contactor is closed	Reset controller
Motor power severely limited in case motor is overheated	Motor temp sensor determined to be disconnected	Motor temperature reading becomes valid again

FAULT CODES

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Fault/Event Name	Flash Code	Fault or Event	Displayed on Digital SOC	Likely Cause	Likely Resolution
Parameter Out of Range	89	fault	Y	Parameter written outside of normal range	Reset controller, verify software is correct, disconnect any additional devices on CAN bus that may be setting parameters
Controller Supervision	77	fault	Y	Bad controller	Replace controller
Coil Supply Fault	A9	fault	Y	Shorted EM brake or main contactor, or bad controller	Unplug EM brake, main contactor, and accessory relay in fuse box one at a time; if fault goes away when one is unplugged, replace that component; replace controller if above do not help; replace wire harness if that does not help
Supervision Input Check	79	fault	Y	Power quality on charger wakeup	Turn key on prior to plugging in charger
Controller Hardware Fault	83	fault	Y	Bad controller	Replace controller
Controller Severe Overtemp	16	event	Y	Normal use - controller hot	Allow controller to cool. If persistent, investigate whether a mechanical resistance is present such as service brake drag
Controller Severe	15	event	Y	Water in controller	Replace controller
Severe Undervoltage	17	event	Y	Normal use - low battery	No fix needed; recharge battery
Severe Overvoltage	18	event	Y	Normal use - regen with full battery	No fix needed; operate vehicle normally
Precharge Failed	14	fault	Y	Excessive load on 48V bus	Make sure no component is drawing too much power directly from battery + terminal during controller power-on
PWS Missing Fault	67	fault	N	Incorrect software or bad parameter settings	Factory reset with handset and/or reflash controller with correct software

FAULT CODES

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Vehicle Response	Set Conditions	Clear Conditions
Vehicle completely disabled	A parameter has been set outside its predefined limits	Reset controller or return parameter within limits
Vehicle completely disabled	Internal controller failure	Reset controller
Vehicle completely disabled	Driver output short circuit detected (EM brake, main contactor, acc relay, etc)	Reset controller
Vehicle completely disabled	Internal controller failure	Reset controller
Vehicle completely disabled	Internal controller failure	Reset controller
Motor disabled, coasts	Controller internal temperature above 95C	Reset controller with internal temperature below 95C
Motor disabled, coasts	Controller internal temperature below -40C	Reset controller with internal temperature above -40C
Drive torque disabled	Undervoltage cutback reaches 0% or brownout voltage is reached	B+ voltage recovers to nonzero cutback
Motor disabled	Controller B+ stud exceeded severe overvoltage limit	Controller B+ stud voltage recovers back into normal range
Vehicle completely disabled	Controller attempted to pre-charge its internal capacitor bank and failed	Reset controller
Information only unless parameter is turned ON to disable drive for fault	PWS (pedestrian warning system) noisemaker disconnected for at least 10 seconds while it is powered	Reconnect PWS noisemaker, or plug in charger

FAULT CODES

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Fault/Event Name	Flash Code	Fault or Event	Displayed on Digital SOC	Likely Cause	Likely Resolution
VCL Runtime Error	68	fault	Y	Incorrect software	Reflash controller with correct software
OS HPD Fault	47	event	N	Incorrect software or bad parameter settings	Factory reset with handset and/or reflash controller with correct software
Driver 4 Fault	A4	fault	N	Incorrect software or bad parameter settings	Factory reset with handset and/or reflash controller with correct software
Driver 1 Fault	A1	fault	N	Incorrect software or bad parameter settings	Factory reset with handset and/or reflash controller with correct software
Driver 5 Fault	A5	fault	N	Incorrect software or bad parameter settings	Factory reset with handset and/or reflash controller with correct software
Driver 2 Fault	A2	fault	N	EM brake circuit broken	Check continuity of both EM brake wires; replace brake if wires all check out
VCL Encoder Fault	63	fault	Y	Incorrect software or bad parameter settings	Factory reset with handset and/or reflash controller with correct software
Motor Characterization Error	87	fault	N	Incorrect software or bad parameter settings	Factory reset with handset and/or reflash controller with correct software
Controller OS Fault	71	fault	Y	Incorrect software or bad parameter settings	Factory reset with handset and/or reflash controller with correct software
PDO Timeout	72	fault	Y	Incorrect software or bad parameter settings	Factory reset with handset and/or reflash controller with correct software
PDO Mapping Error	82	fault	Y	Incorrect software or bad parameter settings	Factory reset with handset and/or reflash controller with correct software
Bad Firmware	91	fault	Y	Incorrect software	Reflash controller with correct software
Memory Failure	46	fault	Y	Bad controller	Replace controller
Parameter Mismatch	99	fault	Y	Incorrect software	Reflash controller with correct software
Emer Rev HPD	47	event	N	Incorrect software or bad parameter settings	Factory reset with handset and/or reflash controller with correct software

FAULT CODES

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Vehicle Response	Set Conditions	Clear Conditions
Vehicle completely disabled	Application software ceases to run due to internal error	Reset controller
Throttle disabled	Incorrect sequence of key switch, direction, and throttle inputs	Reapply inputs in correct sequence
Driver 4 disabled	Driver 4 circuit open or shorted	Reset controller
Driver 1 disabled	Driver 1 circuit open or shorted	Reset controller
Driver 5 disabled	Driver 5 circuit open or shorted	Reset controller
Driver 2 disabled	Driver 2 circuit open or shorted	Reset controller
Motor disabled, coasts	Speed sensor values dropped in implausible way	Reset controller
Vehicle completely disabled	Motor characterization failed while running characterization routine	Reset controller
Vehicle completely disabled	Internal controller failure	Reset controller
Motor disabled, coasts	Time between received CAN messages exceeded timeout period	Reset controller or receive appropriate messaging
Some CAN messaging disabled	Incorrect CAN PDO message detected	Reset controller
Vehicle completely disabled	Software is not compatible with controller	Reflash controller with appropriate software
Vehicle completely disabled	Read or write to non-volatile memory failed	Reset controller
Vehicle completely disabled	Conflicting parameter settings	Perform factory reset with diagnostic handset
Throttle disabled	Incorrect input sequencing after emergency reverse event	Reapply inputs in correct sequence

FAULT CODES

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Notes:

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

APPENDIX A

BATTERY CHARGER USER'S GUIDES

APPENDIX A

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

QuiQ™

1 kW Industrial Battery Charger

QuiQ Charger - E-Z-GO Product Manual

This manual contains important safety and operating instructions for versions of the Delta-Q QuiQ (Model nos. 913-4830-E3/-E3B/-E5 /-E5B) installed on E-Z-GO brand vehicles. Please read this information before using your QuiQ Charger. For manufacturer contact information and technical support resources, please visit delta-q.com/support



SAVE THESE IMPORTANT SAFETY INSTRUCTIONS - This manual contains important safety and operating instructions – read before using charger.



Warning

Charge only 48 Volt Lithium-Ion type batteries activated by Samsung SDI. Other types of batteries may burst causing personal injury and damage. Never charge a frozen battery. Study the battery manufacturer's specific precautions.



Danger

Risk of electric shock. Connect charger power cord to an outlet that has been properly installed and grounded in accordance with all local codes and ordinances. A grounded outlet is required to reduce risk of electric shock – do not use ground adapters or modify plug. Do not touch uninsulated portions of output connector or uninsulated battery terminals. Disconnect the charger from either the AC supply or from the golf cart, before making or breaking the connections to the battery. Do not open or disassemble charger. Do not operate this charger if the AC supply cord is damaged or if the charger has received a sharp blow, been dropped, or is damaged in any way – refer all repair work to the manufacturer, or qualified personnel. This charger is not intended for use by persons (including children) with reduced physical, sensory or mental capabilities, or lack of experience and knowledge on electrical systems and battery charging, unless they have been given supervision or instruction concerning use of the charger by a person responsible for their safety. Children should be supervised to ensure that they do not play with the charger.

INFORMATIONS IMPORTANTES DE SÉCURITÉ Ce manuel contient des instructions importantes concernant la sécurité et le fonctionnement.



Attention

Recharger uniquement les batteries de type Lithium-Ion 48V activées par Samsung SDI. Autres types de batteries pourraient exploser causant des blessures corporelles et des dommages. Ne jamais charger une batterie gelée. Prendre connaissance des mesures de précaution spécifiées par le fabricant de la batterie.



Danger

Risque de décharge électrique. Ne pas toucher les parties non isolées du connecteur de sortie ou les bornes non isolées de la batterie. Toujours connecter le chargeur à une prise de courant mise à la terre. Déconnectez la source AC avant de faire ou défaire les connections à la batterie en chargement. Ne pas utiliser le chargeur si le cordon d'alimentation AC est endommagé ou si le chargeur est abîmé suite à une chute ou autre incident. Ne pas ouvrir ni désassembler le chargeur – référer toute réparation aux personnes qualifiées. Cet appareil n'est pas destiné à un usage par des personnes (dont les enfants) avec des facultés motrices, sensorielles ou mentales réduites, ou ayant une expérience et des connaissances insuffisantes, à moins qu'elles sont sous la supervision ou reçoivent les instructions sur l'utilisation de l'appareil d'un répondant garant de leur sécurité. Les enfants devraient être surveillés afin qu'il ne jouent en aucun temps avec l'appareil.

Maintenance Instructions

1. Do not expose charger to high pressure water spray when cleaning vehicle.
2. The enclosure of the charger meets IP66, making it dust-tight and protected against powerful water jets. The AC connection is rated to IP20, which is not protected against water. Protect the AC connection if used in wet or dusty environments.
3. If the detachable input power supply cord set is damaged, replace with a cord that is appropriate for your region:
 - + This charger is provided with a cord set for connection to outlets operating at nominal 120 Volts (or 240 Volts as appropriate). If the input plug does not fit the power outlet, contact Delta-Q Technologies for the proper cord set terminating in an attachment plug of the proper configuration for the power outlet.
 - + 'North America: UL or CSA listed / approved detachable cord, 3 conductor, 16AWG minimum and rated SJT; terminated in a grounding type IEC 60320 C14 plug rated 250V, 13A minimum
 - + For all other regions: 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.

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(PN: 710-0219 Rev 2 Date: 01/12/2017)

1

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Delta-Q QuiQ Charger Manual

Operating Instructions


CAUTION: Charger enclosure may be hot during charging. Use hand protection if handling the charger while charging.

- + Extension cords must be 3-wire cord no longer than 30m(100') at 10AWG or 7.5m(25') at 16AWG per UL guidelines.
- + Only connect **ONE** QuiQ charger to a single 15A circuit or the circuit may become overloaded.

Ammeter

Displays scale of output current

- + If only ammeter and AC Indicator LEDs are lit: Less than 80% state of charge
- + If flashing: Output has been reduced due to high internal charger temperature.



Charger 10-LED Display

Charge Indicator (Orange Light)

- + If solid: Greater than 80% state of charge
- + If off: Less than 80% state of charge or pre-charge

Charge Completion Indicator (Green Light)

- + If solid: Charging is complete

AC Indicator (Orange Light)

- + If solid: AC power is present.
- + If flashing: Low AC voltage. Check electrical source and cord length.

Fault Indicator (Red Light)

- + Charger error. Refer to troubleshooting information below.



Receptacle Display

LED	Indication
Solid	Charge complete
Long flash	Greater than 80% state of charge
Short flash	Less than 80% state of charge
Off	See charger for indications.

Troubleshooting Instructions

If a fault occurs, count the number of red flashes between pauses and refer to the table below.

Flashes	Cause	Solution
⏸️ 🔴 🔴 ⏸️	Charger unable to apply wake-up pulse	Refer cart to service department
⏸️ 🔴 🔴 🔴 ⏸️	Charge timeout	Possible BMS error - refer cart to service department
⏸️ 🔴 🔴 🔴 🔴 ⏸️	BMS fault	Refer cart to service department
⏸️ 🔴 🔴 🔴 🔴 🔴 ⏸️	Charger shutdown due to high internal temperature.	Ensure sufficient cooling airflow. Reset the charger by interrupting AC power for 15+ seconds.
⏸️ 🔴 🔴 🔴 🔴 🔴 🔴 ⏸️	Internal charger fault	Reset the charger by interrupting AC power for 15+ seconds. Return to service department if fault persists.

Note: This is a Class A product. In a domestic environment this product may cause radio interference, in which case the user may be required to take adequate measures.

APPENDIX A

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

ELiTE

Lithium Golf Cart
Battery Charger



Chargeur de batterie au lithium
pour chariot de golf

E-Z-GO ELiTE Charger Original User Manual

This manual contains important safety and operating instructions for these versions of the Delta-Q ELiTE Charger (Part Nos. 958-0001, 958-0002, 958-0003, and 958-0004) for use with E-Z-GO ELiTE lithium brand vehicles. Read this information in its entirety before using your ELiTE Charger. For manufacturer contact information and technical support, visit <http://support.delta-q.com/>.

SAVE THESE SAFETY INSTRUCTIONS

This manual contains important safety & operating instructions. Read before using the charger.



Warning

Charge only 48V lithium-ion type batteries activated by Samsung SDI. Other types of batteries may burst causing personal injury and damage. Never charge a frozen battery. Study the battery manufacturer's specific precautions before using this charger.



Danger

Risk of electric shock. Connect charger power cord to an AC outlet that has been properly installed and grounded in accordance with all local codes and ordinances. A grounded AC outlet is required to reduce risk of electric shock – do not use ground adapters or modify the plug. Do not touch uninsulated portions of the output connector or uninsulated battery terminals. Disconnect the AC supply before making or breaking the connections to the battery. Do not open or disassemble the charger. Do not operate the charger if the AC supply cord or DC output cord is damaged or if the charger has received a sharp blow, been dropped, or is damaged in any way. Refer all repair work to the manufacturer or qualified personnel. This charger is not intended for use by persons (including children) with reduced physical, sensory or mental capabilities, or lack of experience and knowledge on electrical systems and battery charging, unless they have been given supervision or instruction concerning use of the charger by a person responsible for their safety. Children should be supervised to ensure they do not play with the charger.

Manuel d'origine de l'utilisateur du Chargeur E-Z-GO ELiTE

Le présent manuel contient d'importantes consignes de sécurité et d'utilisation pour ces versions du Chargeur Delta-Q ELiTE (numéros de référence 958-0001, 958-0002, 958-0003, et 958-0004) pour utilisation avec les véhicules de marque E-Z-GO ELiTE alimentés au lithium. Lisez en entier les informations fournies avant d'utiliser le Chargeur ELiTE. Pour les coordonnées et le soutien technique du fabricant, visitez <http://support.delta-q.com/>.

CONSERVEZ CES CONSIGNES DE SÉCURITÉ

Le présent manuel contient d'importantes consignes de sécurité et d'utilisation. Lisez-les avant d'utiliser le chargeur.



Mise en garde

Chargez uniquement les batteries au lithium-ion 48 V activées par Samsung SDI. Les autres types de batteries pourraient exploser causant des blessures corporelles et des dommages. Ne chargez jamais une batterie gelée. Prenez connaissance des mesures de précaution spécifiées par le fabricant de la batterie avant d'utiliser ce chargeur.



Danger

Risque de choc électrique. Branchez le cordon d'alimentation du chargeur à une prise CA qui a été correctement installée et mise à la terre conformément à tous les codes et règlements locaux en matière d'électricité. Une prise CA mise à la terre est requise pour réduire les risques d'électrocution; n'utilisez pas d'adaptateurs de terre ou ne modifiez pas la fiche. Ne touchez pas la partie non isolée du connecteur de sortie ou les bornes de la batterie non isolées. Débranchez l'alimentation CA avant d'effectuer ou de rompre les connexions à la batterie. N'ouvrez pas ou ne démontez pas le chargeur. N'utilisez pas le chargeur si son cordon d'alimentation CA ou son cordon de sortie CC est endommagé ou si le chargeur a reçu un coup violent, s'il est tombé ou s'il a été endommagé de quelque façon que ce soit. Le chargeur ne doit être réparé que par le fabricant ou du personnel qualifié. Ce chargeur n'est pas conçu pour être utilisé par des personnes (y compris les enfants) ayant des capacités physiques, sensorielles ou mentales réduites, ou manquant d'expérience et de connaissances des systèmes électriques et de la charge de batteries, à moins qu'une personne responsable de leur sécurité ne les supervise ou ne leur ait fourni les consignes d'utilisation. Les enfants doivent être supervisés pour s'assurer qu'ils ne jouent pas avec le chargeur.

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(PN: 710-0240 Rev 2 Date: 10/14/2020)

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Maintenance Instructions

- The enclosure on all charger models meets IP56, making it protected from dust ingress and powerful water jets. The AC connection on the 958-0002 and 958-0004 models requires an external AC cord and is rated to IP20, which is not protected against dust or water. Protect this AC connection if the charger is used in wet or dusty environments and inspect it regularly for contamination.
- If the AC power supply cord is damaged:
 - The 958-0001 and 958-0003 charger models have an integral AC cord for connection to North American outlets operating at 120 Volts nominal. If this AC power supply cord is damaged, do not use the charger and send it to a qualified service technician for repair.
 - The 958-0002 and 958-0004 charger models have a 7-inch (185mm) AC cord terminated with an IEC 320 C14 plug. If this AC power supply cord is damaged, do not use the charger and send it to a qualified service technician for repair. If the mating AC cord to the wall outlet is damaged, replace it with a 6 feet (1.83 meter) long UL/CSA approved AC cord with a grounded IEC 320 C13 socket rated 250V, 13A minimum on the charger side and an approved 3-prong grounded plug compatible with the local AC power outlet (110VAC to 240VAC). If the 3-prong grounded plug does not fit the local AC power outlet, contact E-Z-GO or Delta-Q Technologies for the proper cord for the local AC power outlet.
 - For regions with 220-240V mains supply, select a safety approved AC cord, 3-conductor, 1.0mm² minimum, rated appropriately for industrial use. The cord must be terminated on one end with a grounded input connector appropriate for the AC power in the country of destination and, on the charger end, a grounding type IEC 320 C13 socket.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC/ICES Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications.

Mounting Instructions

The charger can be mounted horizontally or vertically with the cables and LED indicators pointing downward. Five (5) robust mounting points are cast into the charger's aluminum enclosure and another mounting hole in the center of the handle. The charger can be screwed to a table or wall with the four (4) slotted mounting holes, two (2) on each side using M6 or ¼-inch fasteners. A vertical mounting from the single cast keyhole mounting slot opposite the cables is possible using a suitable 8 or 10mm or 3/8-inch J-hook. A suspended horizontal mounting is achieved using a ceiling secured 5/16-inch threaded rod secured with nuts above and below the handle.

Consignes d'entretien

- Le boîtier en tout modèles de chargeur est conforme à la norme IP56, le protégeant ainsi contre l'infiltration de poussière et les jets d'eau puissants. Le branchement CA sur les modèles 958-0002 et 958-0004 nécessite un cordon CA externe et est conforme à la norme IP20, qui n'offre pas de protection contre la poussière ou l'eau. Protégez ce branchement CA si le chargeur est utilisé dans un environnement humide ou poussiéreux et inspectez le régulièrement pour déceler toute contamination.
- Si le cordon d'alimentation CA est endommagé :
 - Les modèles de chargeur 958-0001 et 958-0003 sont équipés d'un cordon CA intégré pour le branchement sur les prises en Amérique du Nord fonctionnant à une tension nominale de 120 volts. Si ce cordon d'alimentation CA est endommagé, n'utilisez pas le chargeur et envoyez-le à un technicien de service qualifié pour la réparation.
 - Les modèles de chargeur 958-0002 et 958-0004 sont équipés d'un cordon d'alimentation CA de 7 pouces (185 millimètre) se terminant par une fiche IEC 320 C14. Si ce cordon d'alimentation CA est endommagé, n'utilisez pas le chargeur et envoyez-le à un technicien de service qualifié pour la réparation. Si le cordon d'alimentation CA d'accouplement à la prise murale est endommagé, remplacez-le par un cordon d'alimentation CA approuvé UL/CSA de 6 pieds (1,83 m) de longueur avec une prise IEC 320 C13 reliée à la terre fonctionnant à une tension nominale de 250 V, 13A minimum au côté chargeur et une fiche mise à la terre approuvée à 3 broches compatible avec la prise de courant CA locale (110 V c.a. à 240 V c.a.). Si la fiche mise à la terre à 3 broches ne convient pas à la prise de courant CA locale, communiquez avec E-Z-GO ou Delta-Q Technologies pour connaître le cordon approprié pour la prise de courant CA locale.
 - Pour les régions utilisant une alimentation secteur 220-240 V, sélectionnez un cordon d'alimentation CA approuvé, à 3 conducteurs, 1,0 mm² minimum, évalué de façon appropriée pour une utilisation industrielle. Le cordon doit se terminer, à une extrémité, par un connecteur d'entrée mis à la terre approprié pour l'alimentation CA dans le pays de destination et, à l'autre extrémité du chargeur, par une fiche IEC 320 C13 mise à la terre.

REMARQUE: cet équipement a été testé et déclaré conforme aux limites pour appareils numériques de classe B, selon la section 15 des règlements de la FCC et de l'ICES. Ces limites sont destinées à assurer une protection raisonnable contre les interférences nuisibles dans une installation résidentielle. Cet équipement produit, utilise et peut émettre de l'énergie radio électrique et, s'il n'est pas installé et utilisé conformément aux présentes instructions, peut causer des interférences nuisibles aux communications radio.

Instructions de montage

Le chargeur peut être monté à l'horizontale ou à la verticale avec les câbles et les indicateurs DEL orientés vers le bas. Cinq (5) points de montage robustes sont moulés dans le boîtier en aluminium du chargeur et un autre trou de montage se trouve dans le centre de la poignée. Le chargeur peut être vissé sur une table ou un mur avec les quatre (4) fentes de montage, deux (2) de chaque côté, à l'aide d'attaches M6 ou de 1/4 de pouce. Un montage vertical à partir de la fente de montage en forme de trou de serrure à l'opposé des câbles est possible à l'aide d'un crochet en J approprié de 8 ou de 10 mm ou de 3/8 po. Un montage horizontal suspendu se réalise à l'aide d'une tige filetée de 5/16 po fixée au plafond avec des écrous au-dessus et en-dessous de la poignée.

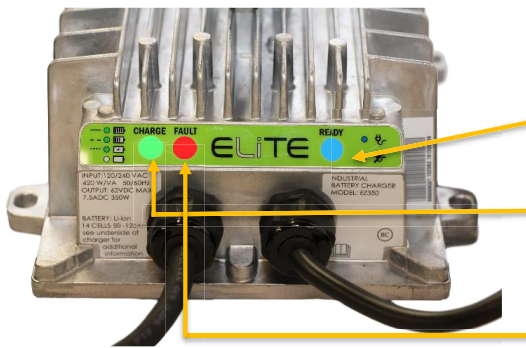
APPENDIX A

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Operating Instructions

CAUTION: The charger enclosure may be hot during charging. Use hand protection if handling the charger while charging.

- ✦ The extension cord must be a 3-wire cord less than 30m (100') at 10AWG or 7.5m (25') at 16AWG per UL guidelines.
- ✦ If you are connecting four (4) ELiTE Chargers to a single 120V mains circuit, a 20A circuit is recommended.

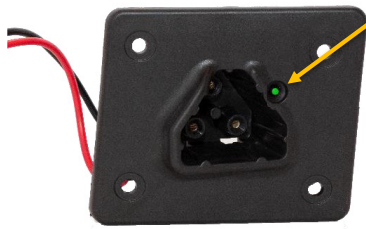


Charger Indicators

Indicator	Indication
<ul style="list-style-type: none"> ● AC Indicator Blue Light 	<ul style="list-style-type: none"> • If solid, AC power is present.
<ul style="list-style-type: none"> ● Charger Status Indicator Green Light 	<ul style="list-style-type: none"> • If solid, charging is complete. • If slow breathing, it is more than 80% charged. • If fast breathing, it is less than 80% charged.
<ul style="list-style-type: none"> ● Fault Indicator Red Light 	<ul style="list-style-type: none"> • Charger error. Refer to <i>Troubleshooting Instructions</i>.

Note: The charger will flash green when the lithium Battery Management System (BMS) is in wakeup mode.

DC Receptacle Indicators



LED	Indication
Solid	Charging is complete.
Slow Flash	More than 80% state of charge.
Fast Flash	Less than 80% state of charge.
Off	See charger indicators for status.

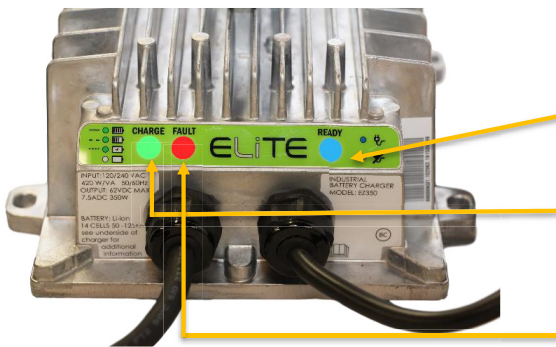
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Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Mode d'emploi

MISE EN GARDE : Le boîtier du chargeur peut devenir chaud pendant le chargement. Utilisez une protection pour les mains si vous manipulez le chargeur pendant le chargement.

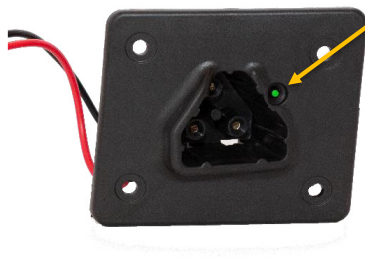
- + La rallonge électrique doit être un cordon à 3 fils de moins de 30 m (100 pi) de long à 10 AWG ou 7,5 m (25 pi) à 16 AWG selon les directives UL.
- + Si vous connectez **quatre (4) chargeurs ELiTE** à un seul circuit de 120V, un circuit de 20 A est recommandé.



Indicateurs du chargeur

Indicateur	Indication
● Indicateur CA Voyant bleu	<ul style="list-style-type: none"> • Si constant, il y a une alimentation CA.
● Indicateur de l'état du chargeur Voyant bleu	<ul style="list-style-type: none"> • Si constant, la charge est terminée. • Si la pulsation est lente, la batterie est chargée à plus de 80%. • Si la pulsation est rapide, la batterie est chargée à moins de 80%.
● Indicateur de défaut Voyant rouge	<ul style="list-style-type: none"> • Erreur du chargeur. Consultez les <i>Instructions de dépannage</i>.

Remarque: le chargeur clignotera en vert lorsque le système de gestion de la batterie au lithium est en mode d'éveil.



Indicateurs de prise de courant CC

DEL	Indication
Constant	La charge est terminée.
Clignotement lente	Charge de plus de 80%.
Clignotement rapide	Charge de moins de 80%.
Éteint	Voir les indicateurs du chargeur pour l'état.

APPENDIX A

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Troubleshooting Instructions

If a fault occurs, count the number of red flashes between pauses and refer to this table:

Flashes	Cause	Solution
	The lithium battery pack issued a fault indicating a wiring or charger hardware issue.	Check the green DC paddle and receptacle for damage, corrosion, and ensure it is properly inserted. Reset the charger by interrupting AC power for 15+ seconds. If the fault returns, contact E-Z-GO Customer Care.
	The charge time or amp-hour limit was exceeded.	Check the green DC paddle and receptacle for damage, corrosion, and ensure it is properly inserted. Ensure the charger has sufficient cooling airflow in ambient temperatures below 40°C; if in the sun, move to the shade. Reset the charger by interrupting AC power for 15+ seconds. If the fault returns, contact E-Z-GO Customer Care.
	The lithium battery pack shut down charging and issued a fault.	Reset the lithium battery pack by turning the ignition and tow mode off, remove the green charger paddle from the receptacle, wait 5+ seconds, re-insert the paddle. If the fault returns, contact E-Z-GO Customer Care.
	Internal charger fault	Reset the charger by interrupting AC power for 15+ seconds. If the fault returns, contact E-Z-GO Customer Care.

Instructions de dépannage

S'il survient une erreur, comptez le nombre de clignotements rouges entre les pauses et reportez-vous au tableau suivant :

Clignotement	Cause	Solution
	Le bloc-batterie au lithium a émis un défaut indiquant un problème de câblage ou de matériel du chargeur.	Vérifiez la palette CC verte et la prise pour vous assurer qu'il n'y a pas de dommage ou de corrosion et assurez-vous qu'elle est bien insérée. Réinitialisez le chargeur en interrompant l'alimentation CA pendant 15 secondes ou plus. Si le défaut revient, communiquez avec le service à la clientèle E-Z-GO.
	La limite de temps de charge ou d'ampères par heure a été dépassée.	Vérifiez la palette CC verte et la prise pour vous assurer qu'il n'y a pas de dommage ou de corrosion et assurez-vous qu'elle est bien insérée. Assurez-vous que le chargeur a suffisamment de circulation d'air de refroidissement dans les températures ambiantes inférieures à 40° C. Si le chargeur est au soleil, mettez-le à l'ombre. Réinitialisez le chargeur en interrompant l'alimentation CA pendant 15 secondes ou plus. Si le défaut revient, communiquez avec le service à la clientèle E-Z-GO.
	Le bloc-batterie au lithium a arrêté la charge et a émis un défaut.	Réinitialisez le bloc-batterie au lithium en coupant l'allumage et en désactivant le mode de remorquage, enlevez la palette verte du chargeur de la prise, attendez 5 secondes ou plus et réinsérez la palette. Si le défaut revient, communiquez avec le service à la clientèle E-Z-GO.
	Défaut interne du chargeur	Réinitialisez le chargeur en interrompant l'alimentation CA pendant 15 secondes ou plus. Si le défaut revient, communiquez avec le service à la clientèle E-Z-GO.



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Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

ELiTE



RC900 ELiTE Onboard Charger Original User Manual

This manual contains important safety and operating instructions for this version of the Delta-Q RC900 ELiTE Onboard Charger (Part No. 944-0003) for use with E-Z-GO ELiTE lithium brand vehicles (Model 673928). For manufacturer contact information and technical support, please visit <http://support.delta-q.com/>.

SAVE THESE SAFETY INSTRUCTIONS
This manual contains important safety & operating instructions. Read before using the charger.



Warning

Charge only 48V lithium-ion type batteries activated by Samsung SDI. Other types of batteries may burst causing personal injury and damage. The Samsung Battery Management System (BMS) ensures that in all operating modes, the battery cells are protected from inappropriate levels of voltage, current, temperature, and state of charge. Never charge a frozen battery. Study the battery manufacturer's specific precautions before using this charger.



Danger

Risk of electric shock. Connect charger power cord to an AC outlet that has been properly installed and grounded in accordance with all local codes and ordinances. A grounded AC outlet is required to reduce the risk of electric shock—do not use ground adapters or modify the plug. Do not touch uninsulated portions of the output connector or uninsulated battery terminals. Disconnect the AC supply before making or breaking the connections to the battery. Do not open or disassemble the charger. Do not operate this charger if the AC supply cord or DC output cord is damaged or if the charger is damaged in any way. Refer all repair work to the manufacturer, or qualified personnel. This charger is not intended for use by persons (including children) with reduced physical, sensory or mental capabilities, or lack of experience and knowledge on electrical systems and battery charging, unless they have been given supervision or instruction concerning use of the charger by a person responsible for their safety. Children should be supervised to ensure they do not play with the charger.

Manuel d'origine de l'utilisateur du Chargeur À bord RC900 ELiTE

Le présent manuel contient d'importantes consignes de sécurité et d'utilisation pour cette version du chargeur Delta-Q à bord RC900 ELiTE (numéro de référence 944-0003) pour utilisation avec les véhicules de marque E-Z-GO ELiTE alimentés par des batteries au lithium-ion (Modèle 673928). Pour les coordonnées et le soutien technique du fabricant, visitez <http://support.delta-q.com/>.

CONSERVEZ CES CONSIGNES DE SÉCURITÉ
Le présent manuel contient d'importantes consignes de sécurité et d'utilisation. Lisez-les avant d'utiliser le chargeur.



Attention

Chargez uniquement les batteries au lithium-ion 48 V activées par Samsung SDI. Les autres types de batteries pourraient exploser causant des blessures corporelles et des dommages. Le système de gestion des batteries intégrés (BMS) garantit que dans tous les modes de fonctionnement, les cellules de la batterie sont protégées contre les niveaux inappropriés de tension, de courant, de température et d'état de charge. Ne chargez jamais une batterie gelée. Prenez connaissance des mesures de précaution spécifiées par le fabricant de la batterie avant d'utiliser ce chargeur.



Danger

Risque de décharge électrique. Toujours connecter le cordon d'alimentation du chargeur à une prise de secteur CA proprement installée et mise à la terre conformément à tous les codes et règlements locaux.. Une prise secteur CA mise à la terre est nécessaire pour réduire le risque de choc électrique - n'utilisez pas d'adaptateurs de terre et ne modifiez pas la fiche. Ne pas toucher les parties non isolées du connecteur de sortie ou les bornes non isolées de la batterie. Déconnectez la source CA avant de faire ou défaire les connections à la batterie en chargement. Ne pas ouvrir ni désassembler le chargeur. Ne pas utiliser le chargeur si le cordon d'alimentation CA ou le cordon de sortie CC est endommagé ou si le chargeur est abîmé suite à une chute ou autre incident – Référez toute réparation au fabricant ou aux personnes qualifiées. Cet appareil n'est pas destiné à un usage par des personnes (dont les enfants) avec des facultés motrices, sensorielles ou mentales réduites, ou ayant une expérience et des connaissances insuffisantes, à moins qu'elles sont sous la supervision ou reçoivent les instructions sur l'utilisation de l'appareil par une personne responsable de leur sécurité. Les enfants doivent être surveillés afin qu'il ne jouent en aucun temps avec le le chargeur.

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APPENDIX A

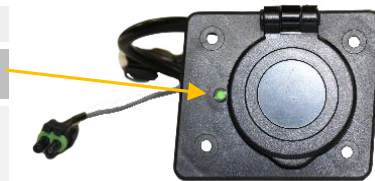
Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

Operating & Maintenance Instructions

- ❖ The charger may become hot during charging. Do not touch the charger when it is charging.
- ❖ To maintain safe operations, the unit automatically reduces its output power if the temperature rises above set thresholds, or if the AC input voltage is too low. The charger also reduces output power if it detects the battery pack is damaged.
- ❖ If power is interrupted, and then returns, the charger starts and continues to operate without hazard to the user, or damage to the batteries.
- ❖ Unplug the charger from AC when cleaning, moving, or conducting any maintenance or repair on the vehicle. No user serviceable parts are inside the charger. Do not remove the charger or the cover due to the risk of electrical shock.
- ❖ Do not expose the charger to oil, dirt, mud, or direct heavy water spray when cleaning the vehicle or machine.
- ❖ The enclosure on these chargers meets IP56, making it protected from dust ingress and powerful water jets. The AC receptacle requires an external AC cord which is not protected against dust or water. Protect this AC connection if the charger is used in wet or dusty environments. Inspect it regularly for contamination. If the charger and/or cord are in a damp location, use a Class A GFCI AC outlet.
- ❖ If the detachable AC input power cord or DC output cord is damaged, do not use the charger until they are replaced by a qualified service technical with cord sets appropriate to your region and application.
- ❖ To charge your vehicle, use a 3-wire extension cord less than 30m (100') at 10 AWG or 7.5m (25') at 16 AWG, per UL guidelines.

AC Receptacle Indicators

LED	Indication
Off	No AC Power. Check for AC cord damage; plug into AC power outlet; ensure AC outlet has power.
Slow Green Breathing	More than 80% state of charge.
Fast Green Breathing	Less than 80% state of charge.
Solid Green	Charge Complete
Rapid Amber Flash	Error. Unplug and plug the charger in again. If the error remains, contact a qualified service technician.
Solid Red	Fault. Unplug and plug the charger in again. If the fault remains, contact a qualified service technician.



Identifying Charger Serial Number

The serial number is printed on the front of the charger. Use this number when requesting technical support.



NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC/ICES Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications.

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User Documentation: www.delta-q.com/resources

Read all of SAFETY and this section before attempting any procedure. Pay particular attention to Notices, Cautions, Warnings and Dangers.

NOTICE: Read the following warnings before operating the vehicle:

⚠ WARNING When leaving the vehicle, turn the key switch to the OFF position and remove the key from the vehicle.

Drive the vehicle only as fast as the terrain and conditions allow. Consider the environmental conditions that change the terrain and your ability to control the vehicle.

Do not drive fast downhill. Sudden stops or changes of direction can cause a loss of control. Use the service brake to control the speed of the vehicle when driving down a slope.

When possible, stay in approved areas and do not drive on steep slopes.

Always keep feet, legs, hands and arms inside the vehicle.

Do not drive the vehicle on rough terrain.

Before driving in reverse, make sure the area behind the vehicle is clear.

Make sure the direction selector is in the correct position before pressing the accelerator pedal.

Decrease speed before and during turns.

Make sure to completely stop the vehicle before moving the direction selector.

Do not load the vehicle beyond the capacities (See VEHICLE SPECIFICATIONS on page 119).

NOTICE: Read the following information and warnings before operating vehicle:

In any product, components will eventually fail to perform properly as the result of normal use, age, wear or abuse.

Normal use, age, wear or abuse can cause some components on the vehicle to fail. The manufacturer can not know all possible component failures or the methods that failures can occur.

A vehicle in need of repair does not operate correctly can be dangerous.

Be careful when servicing the vehicle. Be aware of your safety and the safety of any bystanders.

Some components are heavy, spring loaded, corrosive, explosive, can cause high amperage, or get hot. Do not put hands, face, feet or body in a location that can expose them to injury if an unexpected situation occurs.

Always use the correct tools shown in the tool list and wear recommended safety equipment.

⚠ WARNING Remove all jewelry before servicing the vehicle.

Do not allow loose clothing or hair to contact any moving parts.

Do not touch hot objects.

The drive wheels must be lifted and supported on jack stands before performing any service to the powertrain when the motor is in operation.



Always wear eye protection when servicing the vehicle. Be careful when working around batteries or working with solvents or compressed air.

Use wrenches with insulation to decrease the risk of a short-circuit if a wrench falls across the battery terminals. A battery short-circuit can cause the internal BMS fuse to blow.

Keep all flammable materials, open flames or sparks away from the batteries.



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Service Parts Manuals and Service Manuals
are available from the manufacturer.

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