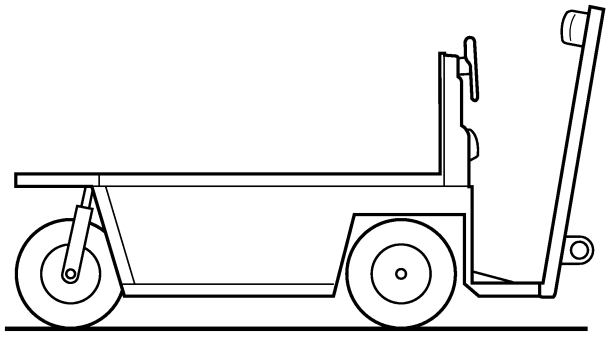
35996-G01

TEXTRON
GOLF, TURF & SPECIALTY PRODUCTS

TECHNICIAN'S REPAIR AND SERVICE MANUAL



ELECTRIC THREE WHEEL UTILITY VEHICLE

STARTING MODEL YEAR: 2002

SAFETY

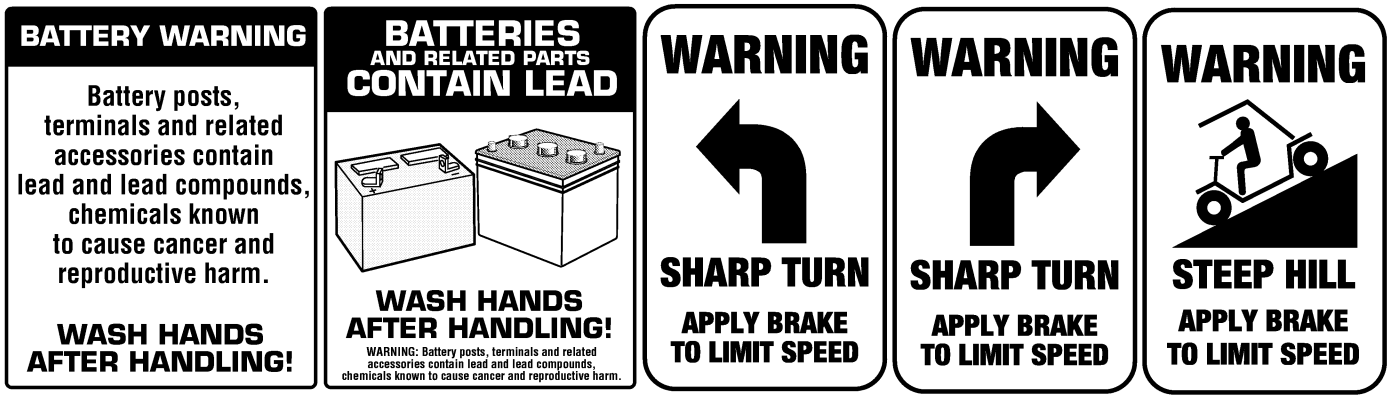
Read and understand all labels located on the vehicle. For any questions on any of the information, contact a representative for clarification.

Always replace any damaged or missing labels.

On steep hills it is possible for vehicles to coast at greater than normal speeds encountered on a flat surface. To prevent loss of vehicle control and possible serious injury, speeds should be limited to no more than the maximum speed on level ground. (See vehicle specification.) Limit speed by applying the service brake.

Catastrophic damage to the drive train components due to excessive speed may result from driving the vehicle above specified speed. Damage caused by excessive speed may cause a loss of vehicle control, is costly, is considered abuse and will not be covered under warranty.

If the vehicle is to be used in a commercial environment, signs similar to the ones illustrated should be used to warn of situations that could result in an unsafe condition.



Be sure that this manual remains as part of the permanent service record should the vehicle be resold.

NOTES, CAUTIONS AND WARNINGS

Throughout this guide **NOTE, CAUTION** and **WARNING** will be used.

NOTE *A **NOTE** indicates a condition that should be observed.*

CAUTION **A CAUTION indicates a condition that may result in damage to the vehicle.**

⚠ WARNING ⚠ ***A WARNING indicates a hazardous condition that could result in severe injury or death.***

Please observe these **NOTES, CAUTIONS** and **WARNINGS;** be aware that servicing a vehicle requires mechanical skill and a regard for conditions that could be hazardous. Improper service or repair may damage the vehicle or render it unsafe.

⚠ WARNING ⚠ ***Battery posts, terminals and related accessories contain lead and lead compounds. Wash hands after handling.***

(NOTES, CAUTIONS AND WARNINGS CONTINUED ON INSIDE OF BACK COVER)

TECHNICIAN'S REPAIR AND SERVICE MANUAL

ELECTRIC THREE WHEEL UTILITY VEHICLE

VEHICLE

Industrial 640

Stock Chaser

CUSTOMER SERVICE DEPARTMENT IN USA PHONE: 1-800-241-5855 FAX: 1-800-448-8124

OUTSIDE USA PHONE: 010-1-706-798-4311, FAX: 010-1-706-771-4609

TEXTRON GOLF, TURF & SPECIALTY PRODUCTS, P.O.BOX 388, AUGUSTA, GEORGIA USA 30903-0388

NOTES

To obtain a copy of the limited warranty applicable to the vehicle, call or write a local distributor, authorized Branch or the Warranty Department with vehicle serial number and manufacturer code.

The use of non original equipment manufacturer (OEM) parts may void the warranty.

Overfilling of batteries may void the warranty.

BATTERY PROLONGED STORAGE

All batteries will self discharge over time. The rate of self discharge varies depending on the ambient temperature and the age and condition of the batteries.

A fully charged battery will not freeze in winter temperatures unless the temperature falls below -75° F (-60° C).

For prolonged storage, the batteries must be clean, fully charged and disconnected from any source of electrical drain, such as the battery charger. Disconnect the battery charger cable from the vehicle batteries when not charging.

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

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SAFETY INFORMATION

This manual has been designed to assist the owner-operator in maintaining the vehicle in accordance with procedures developed by manufacturer. Adherence to these procedures and troubleshooting tips will ensure the best possible service from the product. To reduce the chance of personal injury and/or property damage, the following instructions must be carefully observed:

GENERAL

Many vehicles are used for a variety of tasks beyond the original intended use of the vehicle; therefore it is impossible to anticipate and warn against every possible combination of circumstances that may occur. No warnings can take the place of good common sense and prudent driving practices.

Good common sense and prudent driving practices do more to prevent accidents and injury than all of the warnings and instructions combined. The manufacturer strongly suggests that the owner-operator read this entire manual paying particular attention to the CAUTIONS and WARNINGS contained therein. It is further recommended that employees and other operators be encouraged to do the same.

If you have any questions, contact your closest representative or write to the address on the back cover of this publication, Attention: Product Service Department.

Textron Golf, Turf & Specialty Products reserves the right to make design changes without obligation to make these changes on units previously sold and the information contained in this manual is subject to change without notice.

Textron Golf, Turf & Specialty Products is not liable for errors in this manual or for incidental or consequential damages that result from the use of the material in this manual.

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

These vehicles are designed and manufactured for off-road use. They do not conform to Federal Motor Vehicle Safety Standards and are not equipped for operation on public streets. Some communities may permit these vehicles to be operated on their streets on a limited basis and in accordance with local ordinances.

With electric powered vehicles, be sure that all electrical accessories are grounded directly to the battery (-) post. **Never use the chassis or body as a ground connection.**

Refer to GENERAL SPECIFICATIONS for vehicle seating capacity.

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 specification. Such modifications can cause serious personal injury or death. Modifications that increase the speed and/or weight of the vehicle will extend the stopping distance and may reduce the stability of the vehicle. Do not make any such modifications or changes. Manufacturer prohibits and disclaims responsibility for any such modifications or any other alteration which would adversely affect the safety of the vehicle.

Vehicles that are capable of higher speeds must limit their speed to no more than the speed of similar vehicles when used in an industrial environment. Additionally, speed should be further moderated by the environmental conditions, locale and common sense.

GENERAL OPERATION

Always use the vehicle in a responsible manner and maintain the vehicle in safe operating condition.

Always read and observe all warnings and operation instruction labels affixed to the vehicle.

Always follow all safety rules established in the area where the vehicle is being operated.

Always reduce speed to compensate for poor terrain or conditions.

Always apply service brake to control speed on steep grades.

Always maintain adequate distance between vehicles.

Always reduce speed in wet areas.

Always use extreme caution when approaching sharp or blind turns.

Always use extreme caution when driving over loose terrain.

Always use extreme caution in areas where pedestrians are present.

MAINTENANCE

Always maintain your vehicle in accordance with the manufacturer's periodic service schedule.

Always ensure that mechanics performing repairs are trained and qualified to do so.

Always follow the manufacturer's directions if you do any maintenance on your vehicle. Be sure to disable the vehicle before performing any maintenance. Disabling includes removing the key from the key switch and removal of a battery wire.

Always insulate any tools used within the battery area in order to prevent sparks or battery explosion caused by shorting the battery terminals or associated wiring. Remove the batteries or cover exposed terminals with an insulating material.

Always check the polarity of each battery terminal and be sure to rewire the batteries correctly.

Always use specified replacement parts. Never use replacement parts of lesser quality.

Always use recommended tools.

Always determine that tools and procedures not specifically recommended by the manufacturer will not compromise the safety of personnel nor jeopardize the safe operation of the vehicle.

Always support the vehicle using wheel chocks and safety stands. Never get under a vehicle that is supported by a jack. Lift the vehicle in accordance with the manufacturer's instructions.

Never attempt to maintain a vehicle in an area where exposed flame is present or persons are smoking.

Always be aware that a vehicle that is not performing as designed is a potential hazard and must not be operated.

The manufacturer cannot anticipate all situations, therefore people attempting to maintain or repair the vehicle must have the skill and experience to recognize and protect themselves from potential situations that could result in severe personal injury or death and damage to the vehicle. Use extreme caution and, if unsure as to the potential for injury, refer the repair or maintenance to a qualified mechanic.

Always test drive the vehicle after any repairs or maintenance. All tests must be conducted in a safe area that is free of both vehicular and pedestrian traffic.

Always replace damaged or missing warning, caution or information labels.

Always keep complete records of the maintenance history of the vehicle.

VENTILATION

Hydrogen gas is generated in the charging cycle of batteries and is explosive in concentrations as low as 4%. Because hydrogen gas is lighter than air, it will collect in the ceiling of buildings necessitating proper ventilation. Five air exchanges per hour is considered the minimum requirement.

Never charge a vehicle in an area that is subject to flame or spark. Pay particular attention to natural gas or propane gas water heaters and furnaces.

Always use a dedicated circuit for each battery charger. Do not permit other appliances to be plugged into the receptacle when the charger is in operation.

Chargers must be installed and operated in accordance with charger manufacturers recommendations or applicable electrical code (whichever is more restrictive).

Notes:

GENERAL INFORMATION & ROUTINE MAINTENANCE

A

TABLE OF CONTENTS FOR SECTION 'A'

LIST OF ILLUSTRATIONS

Notes:

GENERAL INFORMATION & ROUTINE MAINTENANCE

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

SERIAL NUMBER PLATE LOCATION

The serial and manufacturing numbers are located on a plate on the right side of the vehicle (Ref Fig. 1 on page A-1).

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

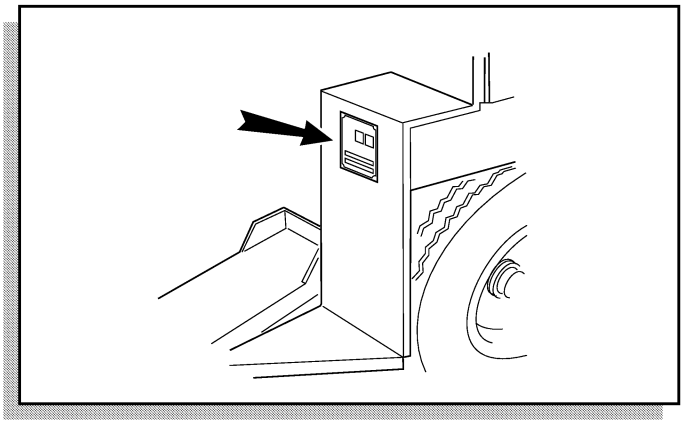

Fig. 1 Serial No. Plate Location

SERVICING THE VEHICLE

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

Do not attempt any type of servicing operations before reading and understanding all notes, 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 care when working around batteries, or using solvents or compressed air.

To reduce the possibility of causing an electrical arc, which could result in a battery explosion, turn off all electrical loads from the batteries before removing any heavy gauge battery wires.

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.

It is in the best interest of both vehicle owner and servicing dealer to carefully follow the procedures recommended in this manual. Adequate preventative 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 inspected (Ref Fig. 2 on page A-1).

ITEM	SERVICE OPERATION
Batteries	Charge batteries
Brakes	Check operation and adjust if necessary
Tires	Check pressure (see SPECIFICATIONS)

Fig. 2 Initial Service Chart

Vehicle batteries must be fully charged before initial use.

ROUTINE MAINTENANCE

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

This vehicle will give years of satisfactory service providing it receives regular maintenance. Refer to the Periodic Service Schedule for appropriate service intervals (Ref Fig. 6 on page A-5). Refer to Lubrication Points for appropriate lubrication locations (Ref Fig. 3 on page A-2).

CAUTION **Do not use more than three (3) 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.**

Putting more than three pumps of grease in a grease fitting could damage grease seals and cause premature bearing failure.

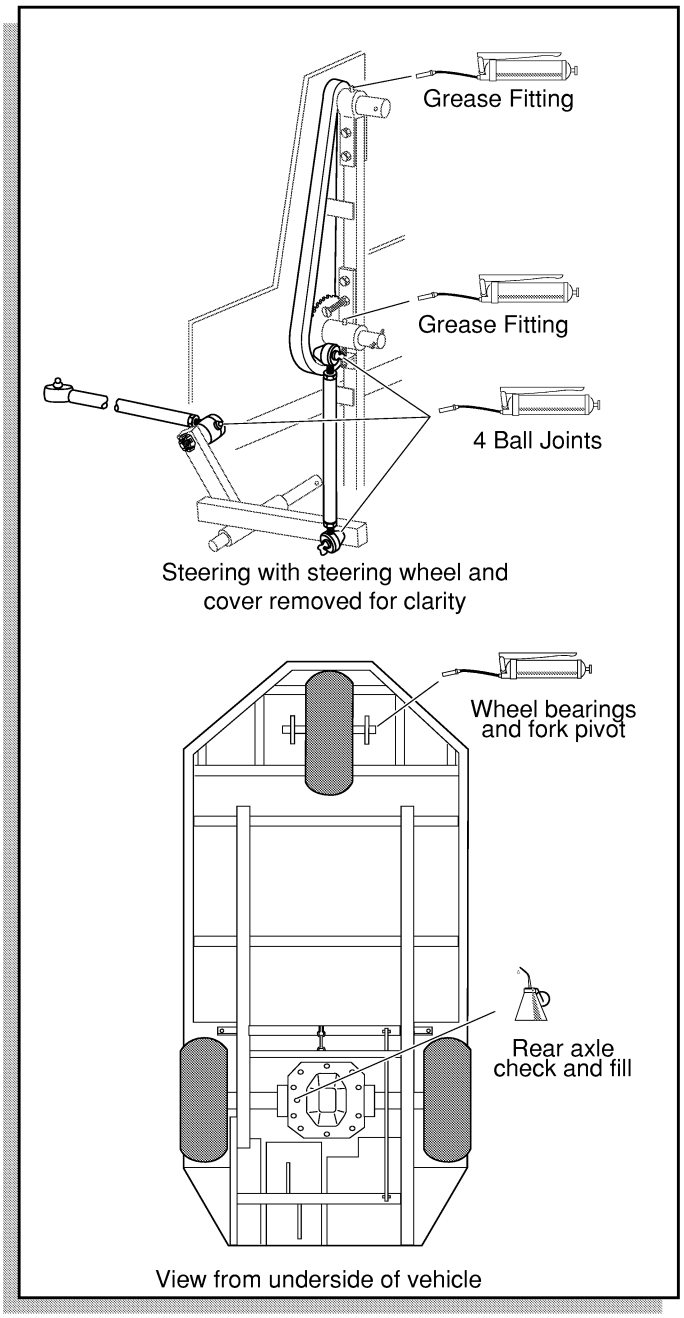

Fig. 3 Lubrication Points

REAR AXLE

The only maintenance to the rear axle 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. The procedure to follow for checking the rear axle lubricant level is in the REAR AXLE section.

BRAKES

After the vehicle has been put into service, it is recommended that the brakes be checked daily by performing a brake test.

⚠ WARNING ⚠ ***To prevent severe injury or death resulting from operating a vehicle with 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.***

For information on conducting a brake test, refer to BRAKES section.

TIRES

Tire condition should be inspected per the Periodic Service Schedule. Inflation pressure should be checked when the tires are cool. Be sure to reinstall valve dust cap after checking or inflating. For additional information, refer to WHEELS AND TIRES section.

LIGHT BULB REPLACEMENT

To replace the headlight bulb, pivot the headlight forward and remove the two Phillips head screws from back side and separate light assembly. Place new bulb in place and secure with screws previously removed.

To replace the taillight bulb, roll the rubber bezel from around the edge of the taillight and remove lens. Replace with new bulb.

Replacement headlight and taillight bulbs and 15 amp fuses are available from a local distributor, an authorized Branch or the Service Parts Department.

CARE AND CLEANING OF THE VEHICLE

CAUTION **When pressure washing vehicle, do not use pressure in excess of 700 psi. 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. Using excessive water pressure may cause damage to seals, plastics, the electrical system, body finish or back cushion material. Do not use pressure in excess of 700 psi to wash vehicle.

Normal cleaning of vinyl backrests and plastic or rubber trim requires the use of a mild soap solution applied with a sponge or soft brush and wipe 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 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 for dust control can collect on the underbody of the vehicle. These materials will accelerate corrosion of underbody parts. It is recommended that the underbody 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, there are several products, available through a local Distributor, an authorized Branch, or the Service Parts Department.

- Touch-up paint specially formulated to match vehicle colors for use on metal bodies (P/N28140-G** and 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 75500-G01).
- White Lithium Grease designed to provide lubrication protection in areas where staining or discoloring is a problem, or in areas of extreme temperature ranges (P/N 75502-G01).
- Penetrant/Lubricant, a 4-in-1 product that penetrates the most stubborn of frozen parts, lubricates leaving a light lubricating film, prevents corrosion by adhering to wet or dry surfaces and displaces moisture, sealing against future moisture return (P/N 75503-G01).
- Multi-purpose Cleaner and Degreaser that contains natural, environmentally safe solvents (P/N 75504-G01).
- 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 75505-G01).
- Battery Cleaner that promotes easy, non-violent neutralization of battery acids and battery acid crystals. The resulting sodium salts are water soluble and easily washed away (P/N 75506-G01).
- Battery Maintenance Kit for complete battery cleaning and watering, with battery maintenance instructions (P/N 25587-G01).
- Biodegradable Cleaner that cleans the toughest dirt and heavy soils by breaking down grease to be easily wiped or rinsed away (P/N 75507-G01).
- Multi-purpose Value Pack sampler package including 4 ounce (118 ml) aerosol cans of Battery Protector, Penetrant/Lubricant, White Lithium Grease, and Carburetor and Choke Cleaner (P/N 75508-G01).

HARDWARE

Periodically the vehicle should be inspected for loose fasteners. Fasteners should be tightened in accordance with the Torque Specifications table (Ref Fig. 5 on page A-4) or specific torque values stated in procedures.

In general 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 Fig. 4 on page A-3).

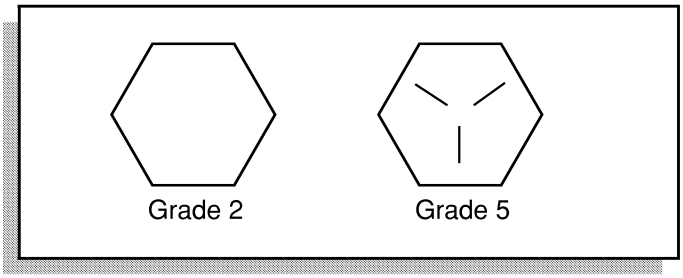

Fig. 4 Bolt Grades

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

TORQUE SPECIFICATIONS

ALL TORQUE FIGURES ARE IN FT. LBS. (Nm)
Unless otherwise noted in text, tighten all hardware in accordance with this chart.
The table below 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)

Fig. 5 Torque Specifications

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

PERIODIC SERVICE SCHEDULE

✓ Check ♦ Clean, Adjust, etc. ▲ Replace

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

DAILY	
BODY	♦ Clean body components as required
REVERSE WARNING DEVICE	✓ Check operation when direction selector is in reverse
TIRES	✓ Examine for cuts, excessive wear and pressure (see WHEELS AND TIRES)
WHEELS	✓ Check for bent rims, missing or loose lug nuts (see WHEELS AND TIRES)
BATTERIES	✓ Recharge to full state of charge after each day's use
CHARGER / RECEPTACLE	✓ Inspect connector system at each battery charge
MONTHLY - 20 HOURS (includes items listed in previous table & the following)	
BATTERIES	♦ Clean batteries & terminals with 1/4 cup (60 ml) baking soda to 1 1/2 gallons (6 liters) water solution, rinse with clear water ✓ Check charge condition and all connections
SERVICE BRAKE	✓ Check brake performance, smooth operation ♦ Adjust as required
WIRING	✓ Check all wiring for loose connections and broken/missing insulation
CHARGER / RECEPTACLE	♦ Clean connections, keep receptacles free of dirt and foreign matter
ACCELERATOR	✓ Check for smooth movement
DIRECTION SELECTOR	✓ Check attachment, adjust as required
STEERING AND LINKAGES	✓ Check for abnormal play, tightness of all hardware
REAR AXLE	✓ Check for oil leakage, add lubricant (SAE 30 oil) as required
QUARTERLY - 50 HOURS (includes items listed in previous tables & the following)	
FRONT FORK	✓ Check for damage to axle and loose or missing hardware
FRONT WHEEL ALIGNMENT	✓ Check for unusual tire wear, align if required
SERVICE BRAKE	✓ Check for bent/binding linkage rods ✓ Check for damage or wear
CHARGER PLUG/RECEPTACLE	♦ Spray with P/N 27934-G02

Fig. 6 Periodic Service Schedule

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

SEMI-ANNUAL - 125 HOURS (includes items listed in previous tables & the following)	
DIRECTION SELECTOR	✓ Check for wear and smooth movement (lubricate shaft with light oil if required)
SERVICE BRAKES	♦ Clean and adjust (see BRAKES) ✓ Check brake shoe linings (see BRAKES)
BODY	♦ Clean body components and wax all painted surfaces
STEERING ANE LINKAGES	♦ Lubricate linkage with wheel bearing grease
ANNUAL - 250-300 HOURS (includes items listed in previous tables & the following)	
FRONT WHEEL BEARINGS	♦ Adjust (See STEERING) ♦ Pack with wheel bearing grease
REAR AXLE	✓ Check lubricant, add lubricant (SAE 30 oil) as required ▲ Replace lubricant after 5 years

Fig. 6 Periodic Service Schedule

TABLE OF CONTENTS FOR SECTION 'B'

LIST OF ILLUSTRATIONS

Notes:

Read all of Section A and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

GENERAL

The following text is provided as recommended by part II of ASME/ANSI B56.8-1988. The manufacturer strongly endorses the contents of this specification.

PART II FOR THE USER

4 GENERAL SAFETY PRACTICES

4.1 Introduction

4.1.1 Like other machines, carriers can cause injury if improperly used or maintained. Part II contains broad safety practices applicable to carrier operations. Before operation, the user shall establish such additional specific safety practices as may reasonably be required for safe operation.

4.2 Stability

4.2.1 Experience has shown that this vehicle, which complies with this standard, is stable when properly operated and when operated in accordance with specific safety rules and practices established to meet actual operating terrain and conditions. However, improper operation, faulty maintenance, or poor housekeeping may contribute to a condition of instability and defeat the purpose of the standard. Some of the conditions which may affect stability are failure of the user to follow safety practices; also, ground and floor conditions, grade, speed, loading, the operation of the carrier with improper loads, battery weight, dynamic and static forces, and the judgement exercised by the carrier operator.

(a) The user shall train carrier operators to adhere strictly to the operating instructions stated in this Standard.

(b) The user shall survey specific operating conditions and environment, and establish and train carrier operators to comply with additional, specific safety practices.

4.3 Nameplates, Markings, Capacity, and Modifications

4.3.1 The user shall maintain in a legible condition all nameplates, warnings, and instructions which are supplied by the manufacturer.

4.3.2 The user shall not perform any modification or addition which affects capacity or safe operation, or make any change not in accordance with the owner's manual without the manufacturer's prior written authorization. Where authorized modifications have been made, the user shall ensure that capacity, operation, warning, and maintenance instruction plates, tags, or decals are changed accordingly.

4.3.3 As required under paras. 4.3.1 or 4.3.2, the manufacturer shall be contacted to secure new nameplates, warnings, or instructions which shall then be affixed in their proper place on the carrier.

4.4 Fuel Handling and Storage

4.4.1 The user shall supervise the storage and handling of liquid fuels (when used) to be certain that it is in accordance with appropriate paragraphs of ANSI/NFPA 505 and ANSI/NFPA 30.

4.4.2 Storage and handling of liquefied petroleum gas fuels shall be in accordance with appropriate paragraphs of ANSI/NFPA 505 and ANSI/NFPA 58. If such storage or handling is not in compliance with these standards, the user shall prevent the carrier from being used until such storage and handling is in compliance with these standards.

4.5 Changing and Charging Storage Batteries for Electric Personnel and Burden Carriers

4.5.1 The user shall require battery changing and charging facilities and procedures to be in accordance with appropriate paragraphs of ANSI/NFPA 505.

4.5.2 The user shall periodically inspect facilities and review procedures to be certain that appropriate paragraphs of ANSI/NFPA 505, are strictly complied with, and shall familiarize carrier operators with it.

4.6 Hazardous Locations

4.6.1 The user shall determine the hazard classification of the particular atmosphere or location in which the carrier is to be used in accordance with ANSI/NFPA 505.

4.6.2 The user shall permit in hazardous areas only those carriers approved and of the type required by ANSI/NFPA 505.

4.7 Lighting for Operating Areas

4.7.1 The user, in accordance with his responsibility to survey the environment and operating conditions, shall determine if the carrier requires lights and, if so, shall equip the carrier with appropriate lights in accordance with the manufacturer's recommendations.

4.8 Control of Noxious Gases and Fumes

4.8.1 When equipment powered by internal combustion engines is used in enclosed areas, the atmosphere shall be maintained within limits specified in the American Conference of Governmental Industrial Hygienists publication, "Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment". This shall be accomplished by ventilation provided by the user, and/or the installation, use, and proper maintenance of emission control equipment recommended or provided by the manufacturer of the equipment.

4.9 Warning Device(s)

4.9.1 The user shall make periodic inspections of the carrier to be certain that the sound-producing and/or visual device(s) are maintained in good operating condition.

4.9.2 The user shall determine if operating conditions require the carrier to be equipped with additional sound-producing and/or visual devices and be responsible for providing and maintaining such devices, in accordance with the manufacturer's recommendations.

5 OPERATING SAFETY RULES AND PRACTICES

5.1 Personnel and Burden Carrier Operator Qualifications

5.1.1 Only persons who are trained in the proper operation of the carrier shall be authorized to operate the carrier. Operators shall be qualified as to visual, auditory, physical, and mental ability to safely operate the equipment according to Section 5 and all other applicable parts of this Standard.

5.2 Personnel and Burden Carrier Operators' Training

5.2.1 The user shall conduct an operators' training program.

5.2.2 Successful completion of the operators' training program shall be required by the user before operation of the carrier. The program shall be presented in its entirety to all new operators and not condensed for those claiming previous experience.

5.2.3 The user should include in the operators' training program the following:

(a) instructional material provided by the manufacturer;

(b) emphasis on safety of passengers, material loads, carrier operator, and other employees;

(c) general safety rules contained within this Standard and the additional specific rules determined by the user in accordance with this Standard, and why they were formulated;

(d) introduction of equipment, control locations and functions, and explanation of how they work when used properly and when used improperly, and surface conditions, grade, and other conditions of the environment in which the carrier is to be operated;

(e) operational performance tests and evaluations during, and at completion of, the program.

5.3 Personnel and Burden Carrier Operator Responsibility

5.3.1 Operators shall abide by the following safety rules and practices in paras. 5.4, 5.5, 5.6, and 5.7.

5.4 General

5.4.1 Safeguard the pedestrians at all times. Do not drive carrier in a manner that would endanger anyone.

5.4.2 Riding on the carrier by persons other than the operator is authorized only on personnel seat(s) provided by the manufacturer. All parts of the body shall remain within the plan view outline of the carrier.

5.4.3 When a carrier is to be left unattended, stop carrier, apply the parking brake, stop the engine or turn off power, turn off the control or ignition circuit, and remove the key if provided. Block the wheels if machine is on an incline.

5.4.4 A carrier is considered unattended when the operator is 25 ft. (7.6 m) or more from the carrier which remains in his view, or whenever the operator leaves the carrier and it is not within his view. When the operator is dismounted and within 25 ft. (7.6 m) of the carrier still in his view, he still must have controls neutralized, and the parking brake(s) set to prevent movement.

5.4.5 Maintain a safe distance from the edge of ramps and platforms.

5.4.6 Use only approved carriers in hazardous locations, as defined in the appropriate safety standards.

5.4.7 Report all accidents involving personnel, building structures, and equipment.

5.4.8 Operators shall not add to, or modify, the carrier.

5.4.9 Carriers shall not be parked or left unattended such that they block or obstruct fire aisles, access to stairways, or fire equipment.

5.5 Traveling

5.5.1 Observe all traffic regulations, including authorized speed limits. Under normal traffic conditions keep to the right. Maintain a safe distance, based on speed of travel, from a carrier or vehicle ahead; and keep the carrier under control at all times.

5.5.2 Yield the right of way to pedestrians, ambulances, fire trucks, or other carriers or vehicles in emergency situations.

5.5.3 Do not pass another carrier or vehicle traveling in the same direction at intersections, blind spots, or at other dangerous locations.

5.5.4 Keep a clear view of the path of travel, observe other traffic and personnel, and maintain a safe clearance.

5.5.5 Slow down or stop, as conditions dictate, and activate the sound-producing warning device at cross aisles and when visibility is obstructed at other locations.

5.5.6 Ascend or descend grades slowly.

5.5.7 Avoid turning, if possible, and use extreme caution on grades, ramps, or inclines; normally travel straight up and down.

5.5.8 Under all travel conditions the carrier shall be operated at a speed that will permit it to be brought to a stop in a safe manner.

5.5.9 Make starts, stops, turns, or direction reversals in a smooth manner so as not to shift the load, endanger passengers, or overturn the carrier.

5.5.10 Do not indulge in dangerous activities, such as stunt driving or horseplay.

5.5.11 Slow down when approaching, or on, wet or slippery surfaces.

5.5.12 Do not drive carrier onto any elevator unless specifically authorized to do so. Approach elevators slowly, and then enter squarely after the elevator car is properly leveled. Once on the elevator, neutralize the controls, shut off power, and set parking brakes. It is advisable that all other personnel leave the elevator before a carrier is allowed to enter or exit.

5.5.13 Avoid running over loose objects, potholes, and bumps.

5.5.14 To negotiate turns, reduce speed to improve stability, then turn hand steering wheel or tiller in a smooth, sweeping motion.

5.6 Loading

5.6.1 Handle only stable and safely arranged loads. When handling off-center loads which cannot be centered, operate with extra caution.

5.6.2 Handle only loads within the capacity of the carrier as specified on the nameplate.

5.6.3 Handle loads exceeding the dimensions used to establish carrier capacity with extra caution. Stability and maneuverability may be adversely affected.

5.7 Operator Care of Personnel and Burden Carriers

5.7.1 At the beginning of each shift during which the carrier will be used, the operator shall check the carrier condition and inspect the tires, warning devices, lights, battery(s), speed and directional controllers, brakes, and steering mechanism. If the carrier is found to be in need of repair, or in any way unsafe, the matter shall be reported immediately to the designated authority and the carrier shall not be operated until it has been restored to safe operating condition.

5.7.2 If during operation the carrier becomes unsafe in any way, the matter shall be reported immediately to the designated authority, and the carrier shall not be operated until it has been restored to safe operating condition.

5.7.3 Do not make repairs or adjustments unless specifically authorized to do so.

5.7.4 The engine shall be stopped and the operator shall leave the carrier while refueling.

5.7.5 Spillage of oil or fuel shall be carefully and completely absorbed or evaporated and fuel tank cap replaced before starting engine.

5.7.6 Do not operate a carrier with a leak in the fuel system or battery(s).

5.7.7 Do not use open flames for checking electrolyte level in storage battery(s) or liquid level in fuel tanks.

6 MAINTENANCE PRACTICES

6.1 Introduction

6.1.1 Carriers may become hazardous if maintenance is neglected. Therefore, maintenance facilities, trained personnel, and procedures shall be provided. Such facilities may be on or off the premises.

6.2 Maintenance Procedures

6.2.1 Maintenance and inspection of all carriers shall be performed in conformance with the manufacturer's recommendations and the following practices.

(a) A scheduled preventive maintenance, lubrication, and inspection system shall be followed.

(b) Only qualified and authorized personnel shall be permitted to maintain, repair, adjust, and inspect carriers.

(c) Before undertaking maintenance or repair, follow the manufacturer's recommendations for immobilizing the carrier.

(d) Block chassis before working underneath it.

(e) Before disconnecting any part of the engine fuel system of a gasoline or diesel powered carrier with gravity feed fuel systems, be sure shutoff valve is closed, and run engine until fuel system is depleted and engine stops running.

(f) Before disconnecting any part of the engine fuel system of LP gas powered carriers, close the LP gas cylinder valve and run the engine until fuel in the system is depleted and the engine stops running.

(g) Operation to check performance of the carrier shall be conducted in an authorized area where safe clearance exists.

(h) Before commencing operation of the carrier, follow the manufacturer's instructions and recommended procedures.

(i) Avoid fire hazards and have fire protection equipment present in the work area. Do not use an open flame to check level or leakage of fuel, battery electrolyte, or coolant. Do not use open pans of fuel or flammable cleaning fluids for cleaning parts.

(j) Properly ventilate the work area.

(k) Handle LP gas cylinders with care. Physical damage, such as dents, scrapes, or gouges, may dangerously weaken the tank and make it unsafe for use.

(l) Brakes, steering mechanisms, speed and directional control mechanisms, warning devices, lights, governors, guards, and safety devices shall be inspected regularly and maintained in a safe operating condition.

(m) Special carriers or devices designed and approved for hazardous area operation shall be inspected to ensure that maintenance preserves the original approved safe operating features.

(n) Fuel systems shall be checked for leaks and condition of parts. If a leak is found, action shall be taken to prevent the use of the carrier until the leak has been eliminated.

(o) The carrier manufacturer's capacity, operation, and maintenance instruction plates, tags, or decals shall be maintained in legible condition.

(p) Batteries, motors, speed and directional controllers, limit switches, protective devices, electrical conductors, and connections shall be inspected and maintained in conformance with manufacturers recommended procedures.

(q) Carriers shall be kept in a clean condition to minimize fire hazards and facilitate detection of loose or defective parts.

(r) Modifications and additions which affect capacity and safe machine operation shall not be performed by the customer or user without manufacturer's prior written authorization; where authorized modifications have been made, the user shall ensure that capacity, operation, warning, and maintenance instruction plates, tags, or decals are changed accordingly.

(s) Care shall be taken to ensure that all replacement parts are interchangeable with the original parts and of a quality at least equal to that provided in the original equipment.

End of ASME/ANSI B56.8-1988, Part II

NOTES, CAUTIONS AND WARNINGS

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

NOTE *A NOTE 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.***

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 virtually 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 care when working on 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 or may produce high amperage or reach high temperatures. Battery acid and hydrogen gas could result in serious bodily injury to the technician/mechanic and bystanders if not treated with utmost caution. Be careful not to place hands, face, feet or body in a location that could expose them to injury should an unforeseen situation occur.

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

MODIFICATIONS TO VEHICLE

⚠ WARNING ⚠ ***Changes to the weight distribution or the center of gravity may make the vehicle unstable or prone to roll over which could result in injury or death to the operator or passenger(s).***

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 Warning:***

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

When any maintenance procedure or inspection is performed, it is important that care be exercised to insure 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 ⚠ ***To prevent severe injury or death, observe the following:***

Before working on vehicle, remove all jewelry (watch, rings, etc.).

Be sure that no loose clothing or hair can become caught in the moving parts of the powertrain.

Use care not to contact hot objects.

Any servicing requiring adjustments to be made to the powertrain while the motor is running must be made with entire vehicle raised and supported on jack stands.

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.

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 'OFF' 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 batteries must be removed.

Additional Warnings

Before working on the electrical system, be sure to read and understand the following warnings that pertain to electrical system repair or maintenance:

⚠ WARNING ⚠ ***To prevent battery explosion that could result in severe injury or death, keep all smoking materials, open flame or sparks away from the batteries.***

Hydrogen gas is generated in the charging cycle of batteries and is explosive in concentrations as low as 4%. Because hydrogen gas is lighter than air, it will collect in the ceiling of buildings necessitating proper ventilation. Five air exchanges per hour is considered the minimum requirement.

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

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

Never disconnect a circuit under load at a battery terminal.

Batteries are heavy. Use proper lifting techniques when moving them. Always lift the battery with a commercially available battery lifting device. Use care not to tip batteries when removing or installing them; spilled electrolyte can cause burns and damage.

The electrolyte in a storage battery is an acid solution which can cause severe burns to the skin and eyes. Treat all electrolyte spills to the body and eyes with extended flushing with clear water. Contact a physician immediately.

Wear eye protection when working on the vehicle. In particular, use care when working around batteries, or using solvents or compressed air.

Any electrolyte spills should be neutralized with a solution of 1/4 cup (60 ml) of sodium bicarbonate (baking soda) dissolved in 1 1/2 gallons (6 liters) of water and flushed with water.

Wrap wrenches with vinyl tape to prevent the possibility of a dropped wrench from 'shorting out' a battery, which could result in an explosion and severe injury or death.

Aerosol containers of battery terminal protectant must be used with extreme care. Insulate metal container to prevent the can from contacting battery terminals which could result in an explosion.

LIFTING THE VEHICLE

Tool List	Qty. Required
Floor jack	1
Jack stands	4
Chocks	4

Some servicing operations may require the entire vehicle to be raised.

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

Never attempt to raise the rear wheels of a three wheel vehicle without first raising the front of the vehicle and supporting on jack stands.

CAUTION **When lifting vehicle, position jacks and jack stands only on areas indicated.**

Servicing that requires access to the underside of the vehicle may be accomplished by raising the front of the vehicle with a chain hoist attached to the front frame members. Always use an additional safety chain to prevent injury should the hoist malfunction.

To remove the front axle, loosen the hardware and turn the front wheel to the position indicated. Position a jack in the location indicated and carefully raise the front of the vehicle. Position the jack stands as shown. Use care not to place the jack or stands where they could interfere with wiring or linkages (Ref Fig. 1 on page B-7). Slowly lower the jack and test the stability of the vehicle.

Do not lift the rear of the vehicle without stabilizing the front of the vehicle. To raise the rear of the vehicle, position the jack in the position shown (Ref Fig. 1 on page B-7). Carefully raise the rear of the vehicle with the jack and place two jack stands in the position shown. Slowly lower the jack and check that the vehicle is securely supported by the jack stands before proceeding.

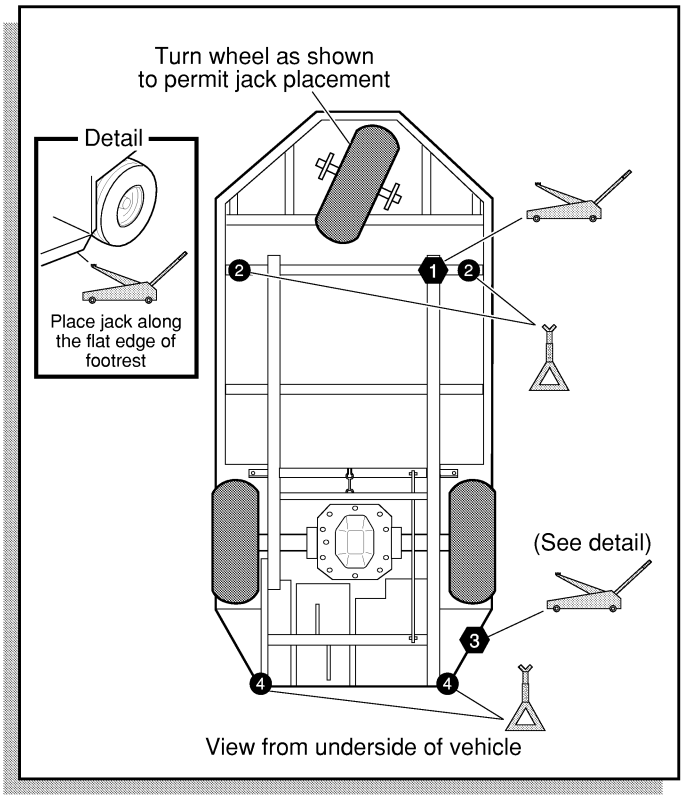

Fig. 1 Lifting the Vehicle

Read all of Section A and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

Notes:

TABLE OF CONTENTS FOR SECTION 'C'

LIST OF ILLUSTRATIONS

Notes:

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

BODY

NOTE *In the following text, there are references to removing/installing bolts etc. Additional hardware (nuts, washers etc.) that are removed must always be installed in their original positions unless otherwise specified. Non-specified torques are as shown in the table in Section A.*

General

⚠ WARNING ⚠ ***To prevent possible injury or death from battery explosion, batteries should always be removed before any servicing that could generate sparks.***

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 Fig. 1 on page C-1). Care must be exercised when drilling to prevent the drill from being forced through the body 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.

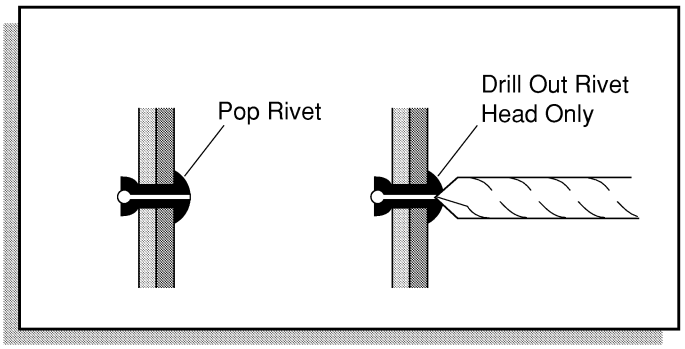

Fig. 1 Drill Out Metal Rivet

BODY 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.

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

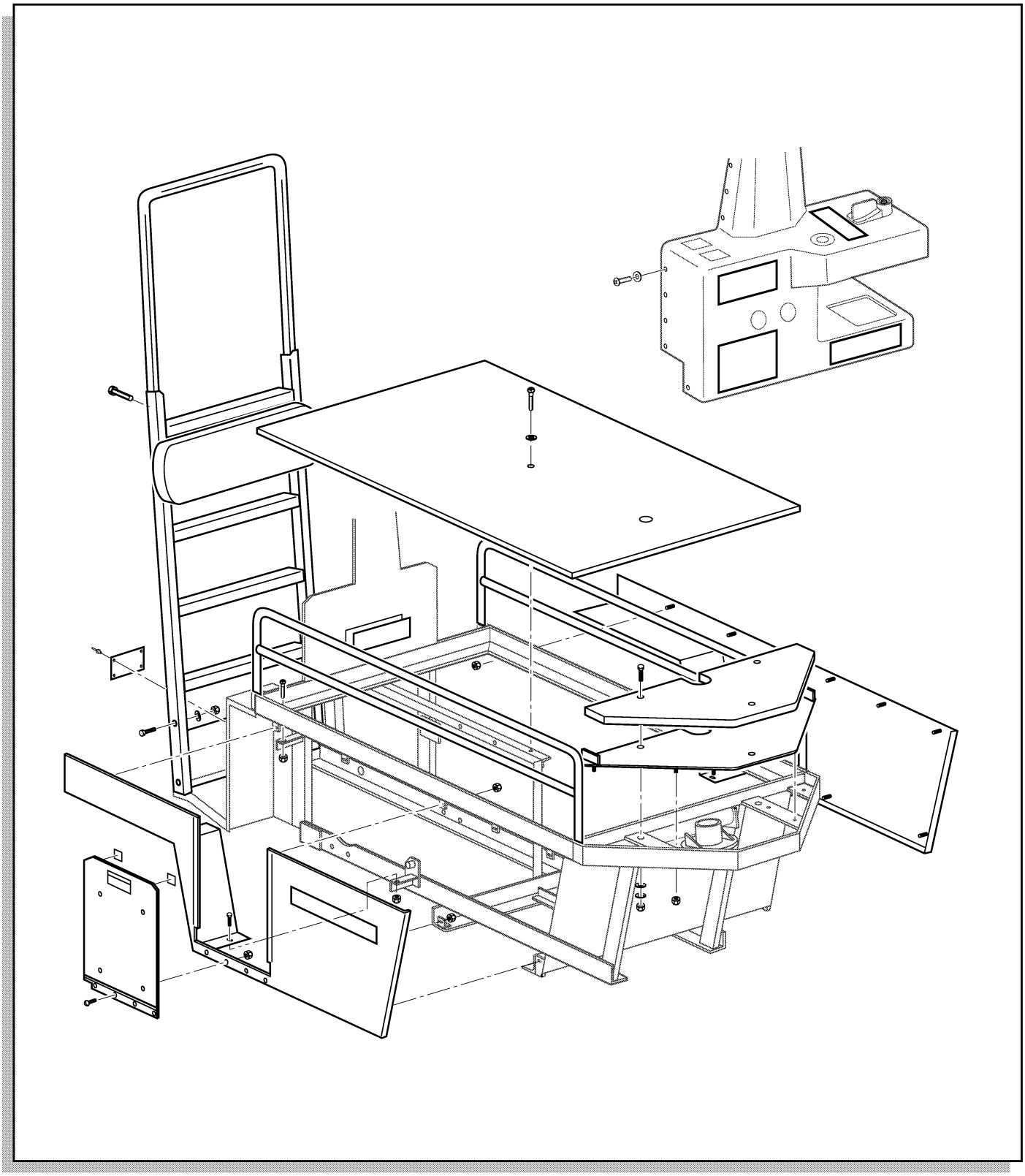

Fig. 2 Body Components

WHEELS AND TIRES

D

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LIST OF ILLUSTRATIONS

Notes:

WHEELS AND TIRES

D

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

WHEEL AND TIRE SERVICE

Tools List	Qty. Required
Lug wrench, 3/4"	1
Impact wrench, 1/2" drive	1
Impact socket, 3/4", 1/2" drive	1
Torque wrench, 1/2" drive, ft. lbs.	1

⚠ WARNING ⚠ ***To prevent injury caused by a broken socket, use only sockets designed for impact wrench use.***

Tire condition should be inspected on a daily basis. Inflation pressures should be checked on a weekly basis 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 excaping air when removing valve core.

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

Use caution when inflating tires. Due to the low volume of these small tires, overinflating can occur in a matter of seconds. Overinflation 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 use. 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 three tires** should have the same pressure for optimum handling characteristics. Be careful not to overinflate. Due to the low volume of these small tires, overinflation 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.

NOTE *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, remove the wheel and inflate the tire to the maximum recommended pressure for the tire. Immerse the tire in water to locate the leak and mark with chalk. Insert tire plug in accordance with manufacturer's specifications.

If the 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.***

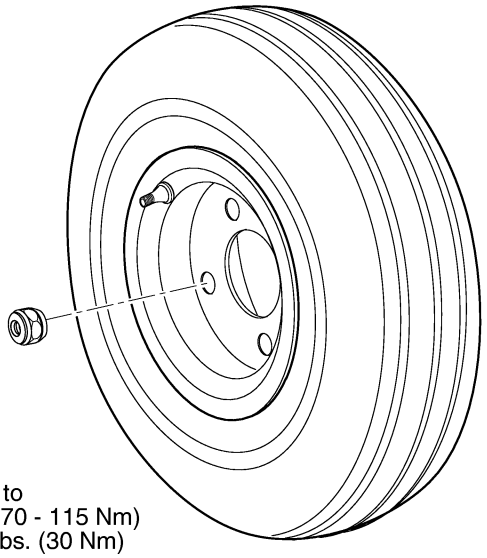
Follow all instructions and safety warnings provided by the mounting/demounting machine manufacturer.

Wheel Installation

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

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

With the valve stem to the outside, mount the wheel onto the hub with lug nuts. Finger tighten lug nuts in a 'cross sequence' pattern (Ref Fig. 1 on page D-2). Then, tighten lug nuts to 50 - 85 ft. lbs. (70 - 115 Nm) torque in 20 ft. lbs. (30 Nm) increments following the same 'cross sequence' pattern.



Tighten lug luts to
50 - 85 ft. lbs. (70 - 115 Nm)
torque in 20 ft. lbs. (30 Nm)
increments

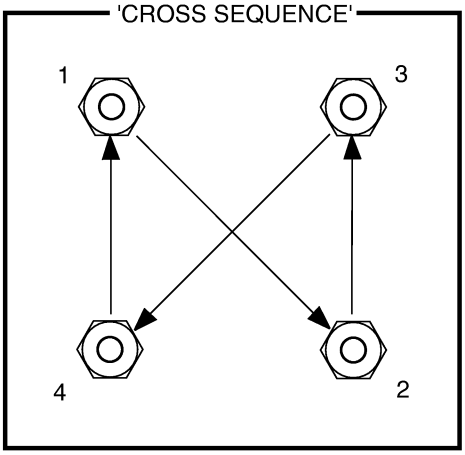


Fig. 1 Wheels and Tires

ELECTRONIC SPEED CONTROL

E

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LIST OF ILLUSTRATIONS

Notes:

ELECTRONIC SPEED CONTROL

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

GENERAL

There are two distinct circuits used in the operation of an electric vehicle. These circuits are the CONTROL and the POWER circuits (Ref Fig. 2 on page E-2) (Ref Fig. 3 on page E-3).

CONTROL CIRCUIT

The control circuit may be identified by the light gauge wire used. The control circuit components consist of the key switch, the solenoid, a reverse warning device and two micro switches. Micro switch 2 (MS-2) is actuated by the direction selector (Ref Fig. 9 on page E-9) and micro switch 3 (MS-3) is actuated by movement of the potentiometer lever which is moved by the accelerator linkage (Ref Fig. 11 on page E-12).

Forward Operation

With the key switch in the 'ON' position and the direction selector switch in the 'FORWARD' (F) position, micro switch 2 (MS-2) is closed which provides an electrical path to accelerator micro switch. Depressing the accelerator pedal moves the lever of the potentiometer from the 'OFF' position and also activates micro switch 3 (MS-3). The closure of micro switch 3 (MS-3) completes the control circuit and activates the coil of the solenoid. This causes the solenoid contacts to close which in turn activates the power circuit.

Reverse Warning Operation

The reverse operation is identical to forward operation except that a reverse warning device is activated by the direction selector switch that is placed in the 'REVERSE' (R) position which activates micro switch 1 (MS-1). This warning device is in continuous operation while the direction selector switch is in the 'REVERSE' (R) position.

POWER CIRCUIT

With the control circuit activated, the solenoid contacts are closed. Power is applied to the power circuit. Depressing the accelerator/brake pedal moves the lever of the potentiometer which increases the resistance from 0 - 5000Ω (Ref Fig. 1 on page E-1).

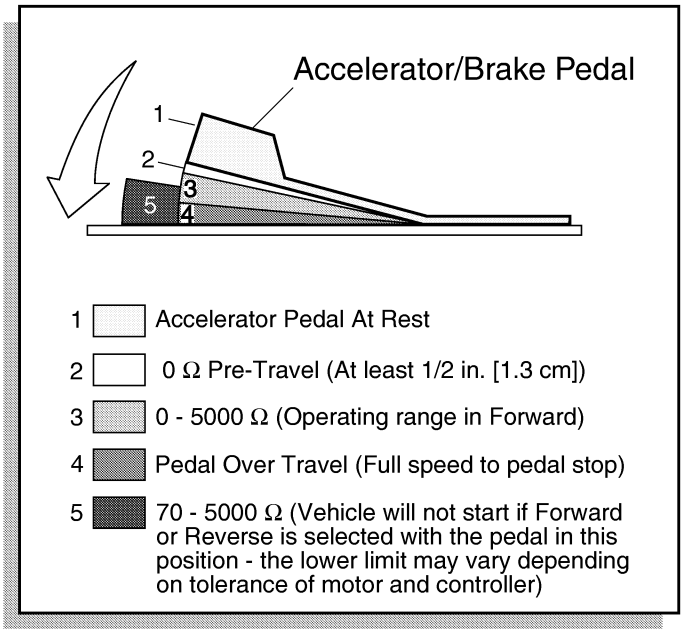

Fig. 1 Accelerator Positions

The controller uses solid state circuitry to supply the appropriate power required through the direction selector switch which directs this power through the field windings of the motor to control the speed of the vehicle.

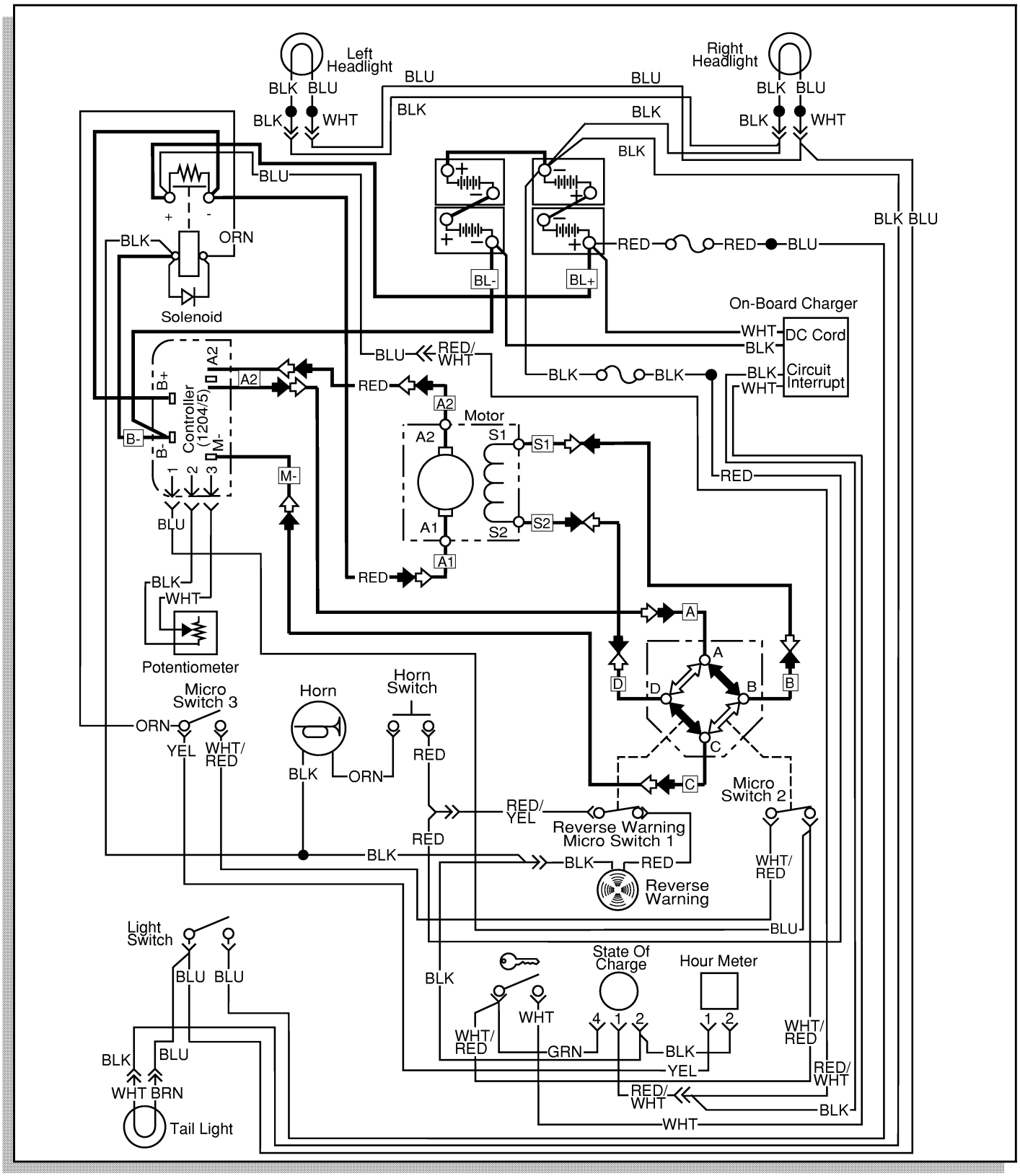

Fig. 2 Wiring Diagram (Onboard Charger)

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

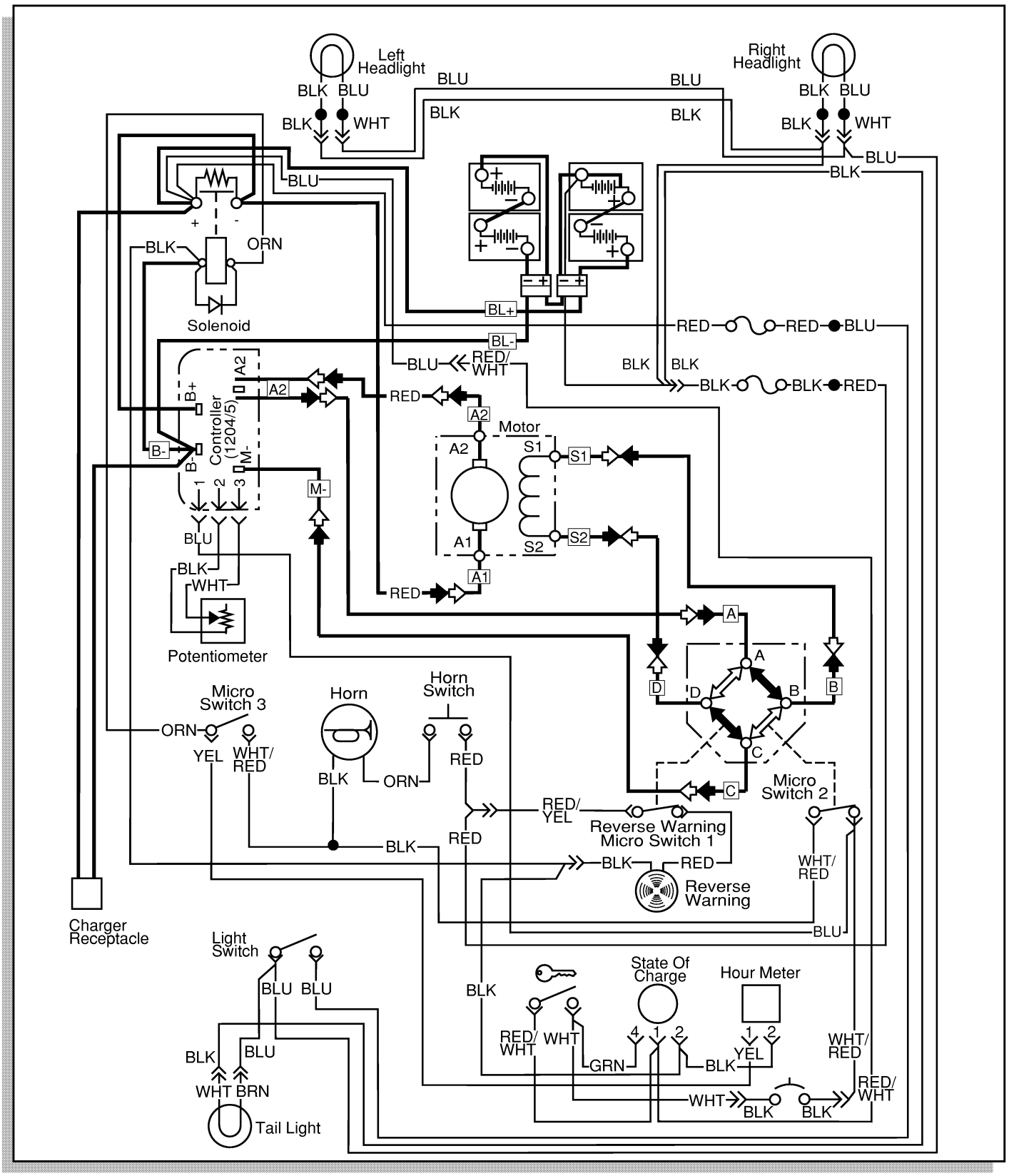

Fig. 3 Wiring Diagram (Lift-Out Battery Tray)

TROUBLESHOOTING VEHICLE WIRING

Tool List **Qty. Required**

Digital Volt Ohm Meter (DVOM) 1

Symptoms

If the vehicle does not operate, operates poorly or intermittently, the following test sequence should be followed:

Testing

It is unlikely that the mechanical adjustment of the accelerator has changed, therefore the initial tests will be conducted with a Digital Volt Ohm Meter (DVOM) to identify the failed component.

A typical DVOM is shown in illustrations. A recommended DVOM is available through the Service Parts Department as P/N 27481-G01. Any DVOM may be used; however, 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 unexpected movement of the vehicle, always raise the entire vehicle before conducting any tests.***

Never operate vehicle at full throttle for more than 4 - 5 seconds while vehicle is in a 'no-load' condition.

Raise the vehicle and support on jack stands (as specified in SAFETY section). Test the vehicle stability before proceeding.

Examine all wiring of the controller to assure that all wires are without physical damage or corrosion. Check the routing of all wiring and the tightness of each connection. Repair or replace any suspect wires or connections.

Testing Battery Voltage

It is important to determine the condition of the battery set before proceeding with any electrical troubleshooting. An open voltage test is of little use since a battery that has deteriorated to the point of requiring replacement will still show six volts or better in an open voltage test. If there is any doubt as to the adequacy of the battery set, the batteries must be charged or replaced.

With the adequacy of the batteries confirmed, use a DVOM connected directly to the battery terminal posts to determine the open voltage of the set (Ref Fig. 4 on page E-4). In the following tests, this voltage level will be used as a reference. Some loss due to resistance of wires and connectors may be indicated by readings that may be up to one volt less than the reference voltage. No reading indicates an 'open' condition and the power circuit should be inspected for a broken or disconnected conductor.

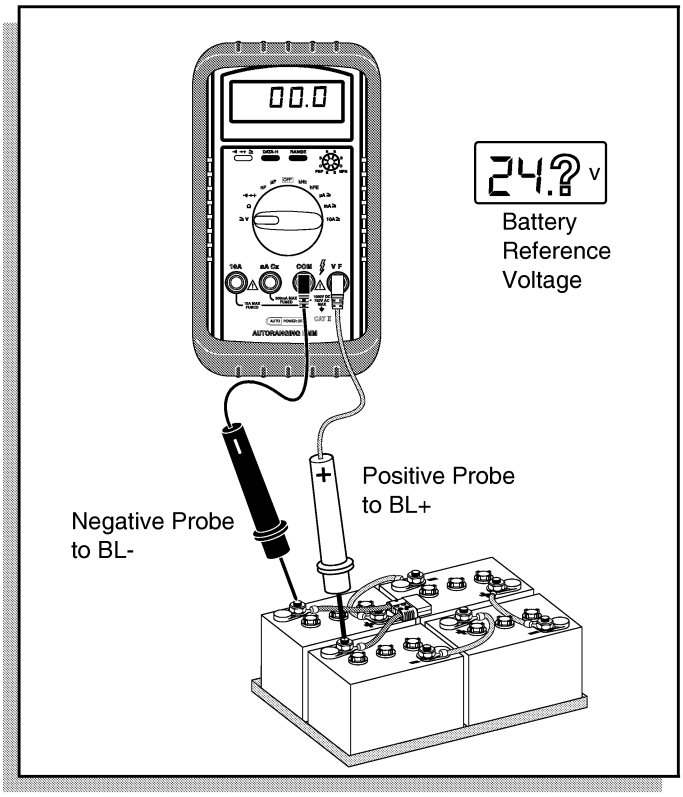

Fig. 4 Battery Reference Voltage

Continuity Check

⚠ WARNING ⚠ ***Before attempting to perform a continuity check, turn the key switch to 'OFF' and place the direction selector in neutral.***

Using an insulated wrench, remove the BL- wire from the battery to disconnect electrical power to vehicle.

If the solenoid does not function, the potentiometer micro switch (MS-3), neutral micro switch (direction selector switch) (MS-2), solenoid, key switch and four pin connector should be checked for continuity.

Turn the key switch to 'OFF' and place the direction selector in neutral before disconnecting power by removing the B+ connection to the battery. **Always use insu-**

lated 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.

Testing a Switch for Continuity

Place one probe on one contact of the switch, place the second probe on the second terminal of the switch (Ref Fig. 5 on page E-5).

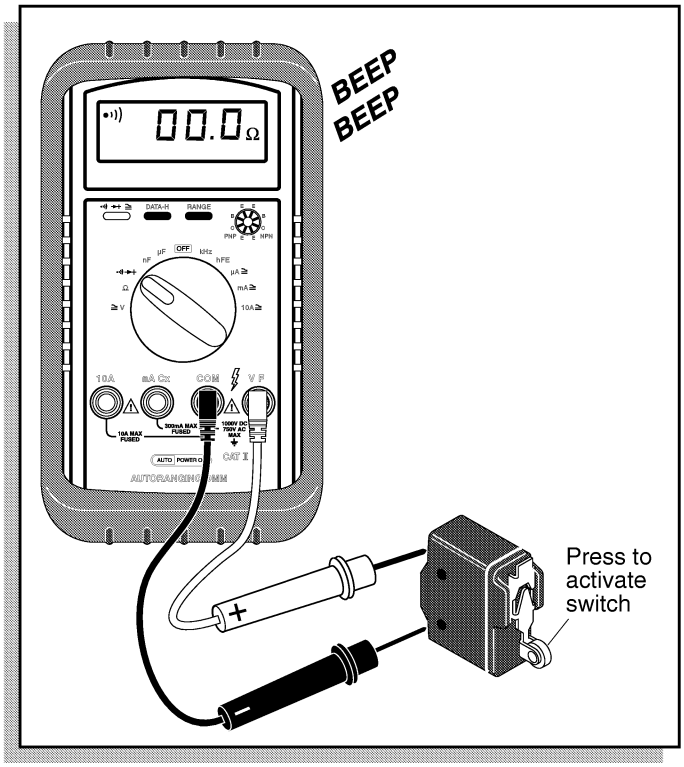

Fig. 5 Continuity Check of Switch

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

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

Testing a Solenoid for Continuity

Place one probe on one of the large terminals and the other probe on the second large terminal (Ref Fig. 6 on page E-5). 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 indicates that contacts are not 'welded' and the wiring to the solenoid coil is good, the coil has failed and **the solenoid must be replaced.**

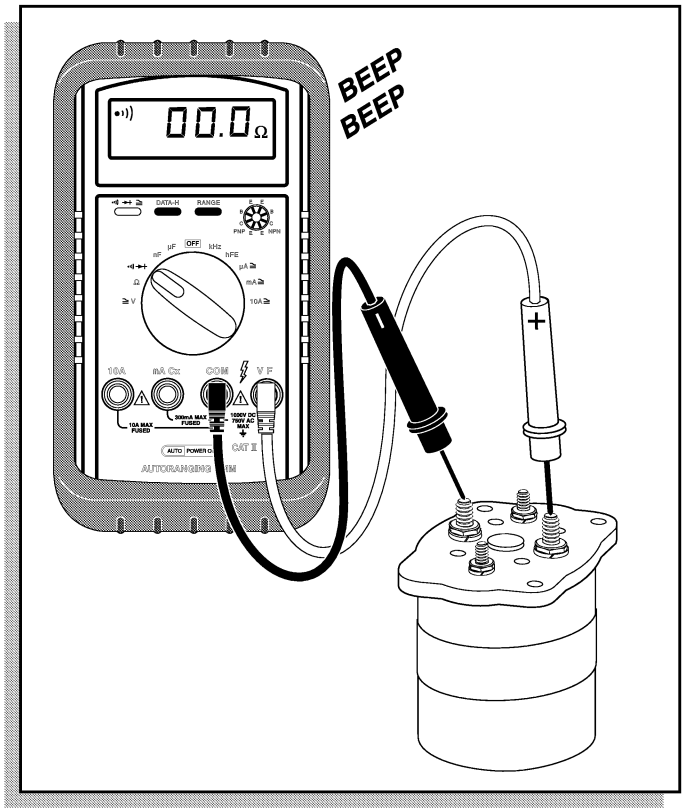

Fig. 6 Continuity Check of Solenoid

With the direction selector switch in the 'FORWARD' (F) position, place the red (+) probe to the positive (+) terminal of the solenoid. A meter reading of the specified battery reference voltage will indicate that the heavy gauge wire (BL+) and terminations between the battery and solenoid positive (+) terminal are in good condition.

TROUBLESHOOTING SOLID STATE SPEED CONTROLLER

⚠ WARNING ⚠ ***Refer to the appropriate paragraphs in section B for the correct procedure for raising the entire vehicle. Observe all Warnings pertaining to safe practices when working on a electric vehicle. Always wear approved eye protection.***

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

General

The following procedures will assist in the troubleshooting and repair or adjustment of the solid state speed controller in an efficient and timely manner.

No procedure can cover every situation, therefore this procedure should be used in conjunction with good repair practices.

Tool List	**Qty. Required**
DVOM	1
Open end wrench, 7/16"	1
Open end wrench, 1/2"	1
Open end wrench, 3/8"	1

No special tools are required to install, remove or adjust the unit. Good quality tools are required and locking pliers, pliers or adjustable wrenches should not be used. The use of a Digital Volt Ohm Meter (DVOM) is **mandatory** to perform troubleshooting on the solid state speed controller. When selecting a DVOM, it should be capable of accurately measuring both voltage and resistance. The meter will be reading voltages from 1 to 50 and resistances from 0 to 10,000Ω. Most important is to be sure that you know how to use it efficiently.

Troubleshooting

Use common sense and the following step by step chart when troubleshooting the entire accelerator and solid state controller system (Ref Fig. 7 on page E-7).

1. Verify that adequate battery voltage is present to operate the vehicle. Battery voltage should be reference voltage after the surface charge is removed.
2. Examine all the wiring to assure all wires are without physical damage or corrosion. Check the routing of all wiring and the tightness of each connection. Repair or replace any suspect wires or connections (Ref Fig. 4 on page E-4).
3. Inspect the male 'push on' contacts at the control unit and be sure they and the areas around them are free of corrosion.

NOTE *Use radio and TV tuner cleaner applied with a cotton swab or a small brush.* ***Do not use solvents that could attack the plastic sealant.*** *Mild soap and water applied with a soft brush (tooth brush) rinsed with clear water and thoroughly dried is very effective.*

4. Remove the blue wire at 'push on' connection from the control unit (wire from the micro switch to the control unit). Place the direction selector switch in the 'FORWARD' (F) position. Turn the key switch to 'ON' and slowly depress the accelerator pedal. The solenoid should make an audible 'click'. If there is an audible 'click' go to step 5. If there is no 'click' the fault is in the solenoid coil, micro switch, key switch or wiring. The following procedures should be followed to find the fault.
   - With the DVOM adjusted to the correct scale, connect the (B-) probe to the (B-) terminal at the battery set. Connect the (B+) probe to the female contact of the blue wire that was removed in step 4. With the key switch in the 'ON' position and the accelerator pedal in the fully depressed position, battery voltage should be indicated. If battery voltage is present at the female connection of the wire removed in step 4 and the solenoid does not 'click' the fault is in the solenoid coil windings and the solenoid must be replaced. If battery reference voltage is not indicated move the (B+) probe to each component working towards the positive side of the battery until the failed component is found. Example: From wire to accelerator micro switch to key switch to (+) terminal of battery.
   - With the DVOM adjusted to the correct scale and with the blue 'push on' connector removed, place the direction selector switch in the 'FORWARD' (F) position. Connect the (B-) probe to the (B-) terminal at the battery set. Connect the (B+) probe to the large solenoid contact connected to the positive side of the battery set and verify that battery voltage is present. Move the (B+) probe to the other large contact. The meter should indicate approximately 1 volt less than battery reference voltage indicating that the resistor is in good condition. No voltage drop indicates a welded solenoid that must be replaced. A reading of 0 volts indicates a poor resistor that must be replaced. Depress the accelerator pedal several times to activate the solenoid and observe the meter. No meter movement or erratic movement indicates a poor or failed solenoid which must be replaced. Full battery reference voltage indicates that the system is functioning properly.
5. At the control unit, remove the two wires (BLK and WHT) with female 'push on' connectors coming from the potentiometer. With the DVOM adjusted to the correct Ω scale, attach each probe to the two wires from the potentiometer. With accelerator pedal in the released position, the meter must indicate less than 50Ω and continue to indicate less than 50 through at least 1/2" (13 mm) of downward pedal movement. Slowly depress accelerator pedal and observe the

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

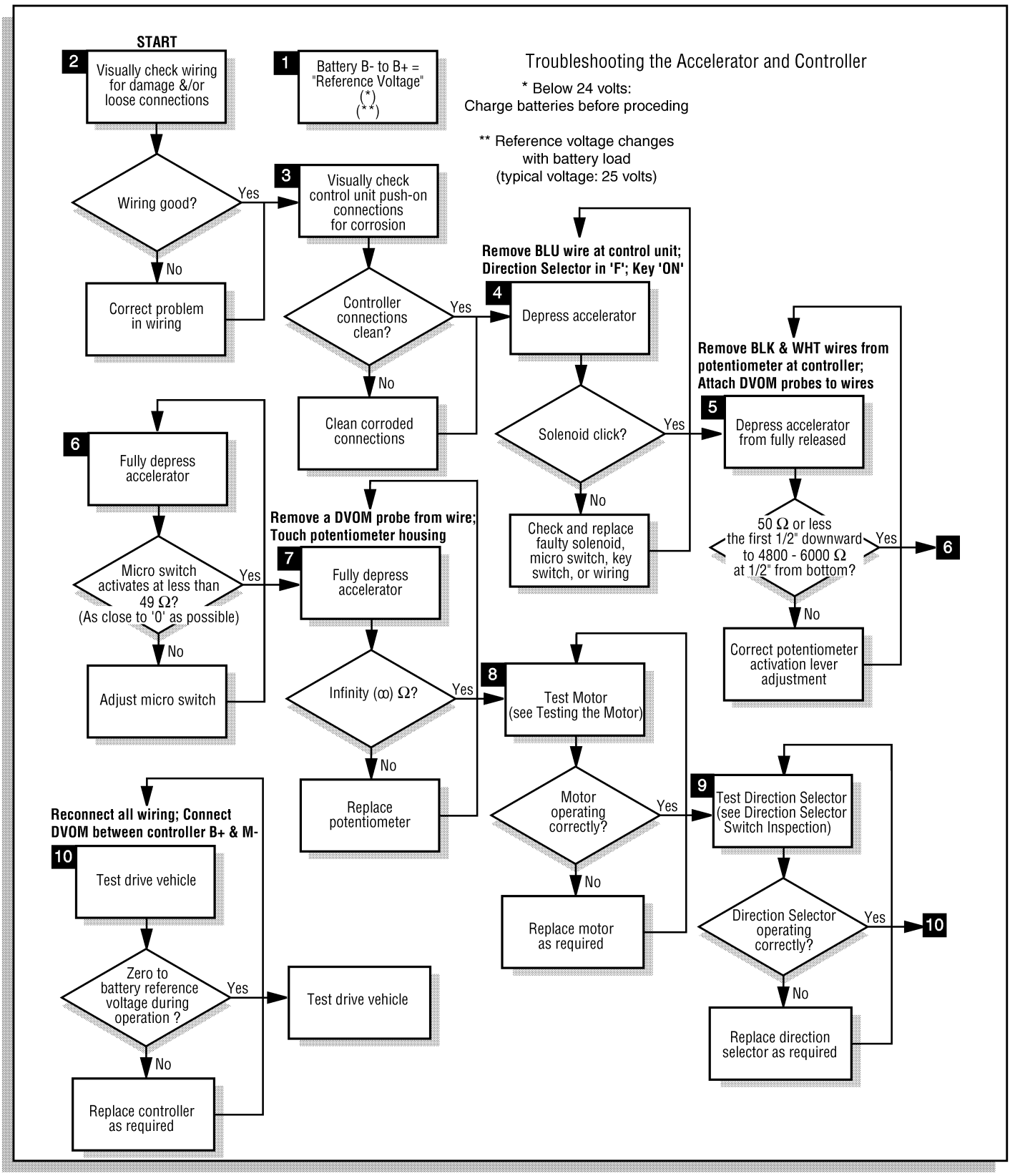

Fig. 7 Troubleshooting Diagram

meter. The meter should rise smoothly to a minimum of 4800Ω and a maximum of 6000Ω. When the meter indicates this range, the pedal should not be fully depressed. (Approximately 1/2" [13 mm] of pedal travel should remain after reaching this reading.) If correct readings are not achieved, check the potentiometers activating linkage.

- With the accelerator in the released position, place accelerator link yoke (1) in position on control arm (2) and attach with clevis pin (3) (Ref Fig. 8 on page E-8). Check travel of control arm to ensure the yoke or screw threads do not bind on arm.To be properly adjusted, the accelerator link should be as far as possible to the right end of the slot (4) while at the same time the yoke does not bind and the screw threads do not touch the control arm at any time in it's full range of movement. Adjust yoke as necessary and lock in place with lock nut (5).

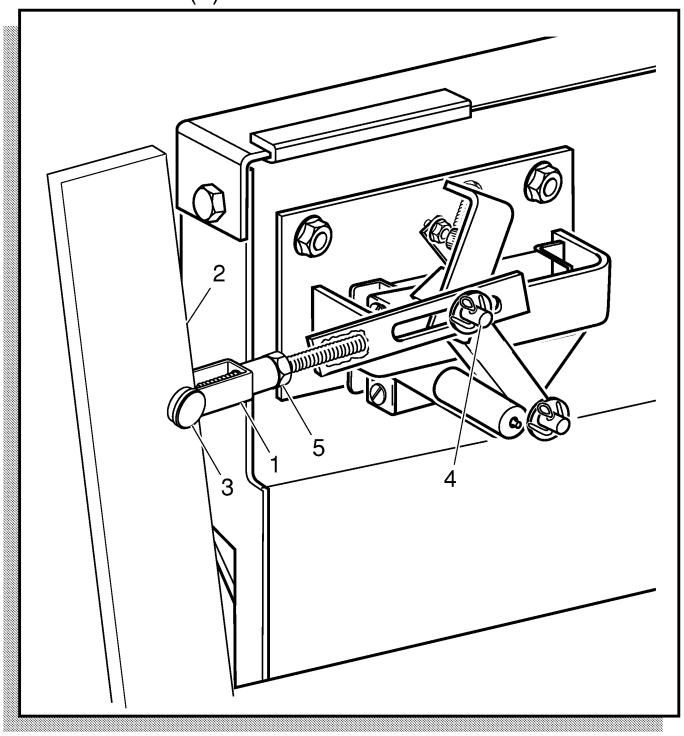

Fig. 8 Accelerator Adjustments

6. Depress the accelerator pedal. The micro switch attached to the potentiometer should activate as near to the 0Ω position as possible. Readings less than 49Ω are acceptable

NOTE *If the micro switch activation takes place at 50 Ω or higher, the high pedal protection circuit will be activated which will cause the unit to malfunction.*

7. Remove one of the DVOM probes and touch to the metal housing of the potentiometer. The meter should read infinity. If it does not, replace the potentiometer.
8. Reconnect the wiring. If the vehicle does not operate correctly, check the direction selector switch and the motor by using a DVOM wired between controller B+ and M-. This should indicate between 0 and battery reference voltage when the accelerator pedal is operated. If all the previous checks indicate the vehicle is in good operating condition, the control module must be replaced with a new one that is known to be good.

REVERSE WARNING DEVICE

The completion of the preceding troubleshooting procedure will have checked all wiring and components in the control circuit.

The reverse warning device does not affect the operation of the vehicle, however, the manufacturer strongly recommends that its operation be checked and maintained since the correct functioning of this safety device may prevent an accident.

The warning device (Ref Fig. 9 on page E-9) should sound whenever the direction selector switch is in the 'REVERSE' (R) position.

POWER CIRCUIT

Tool List	Qty. Required
DVOM	1

⚠ WARNING ⚠ ***To prevent vehicle from inadvertently accelerating, which could cause bodily injury, the vehicle must be lifted to raise all wheels off the ground.***

Vehicle Will Not Run

Raise the vehicle (as specified in SAFETY section), make continuity tests on all wiring components and make repairs as necessary.

Vehicle Runs But Performs Erratically

Raise the vehicle (as specified in SAFETY section) before proceeding.

If the vehicle continues to run with the accelerator pedal in the released position, the accelerator linkage is out of adjustment (see Troubleshooting, step 5).

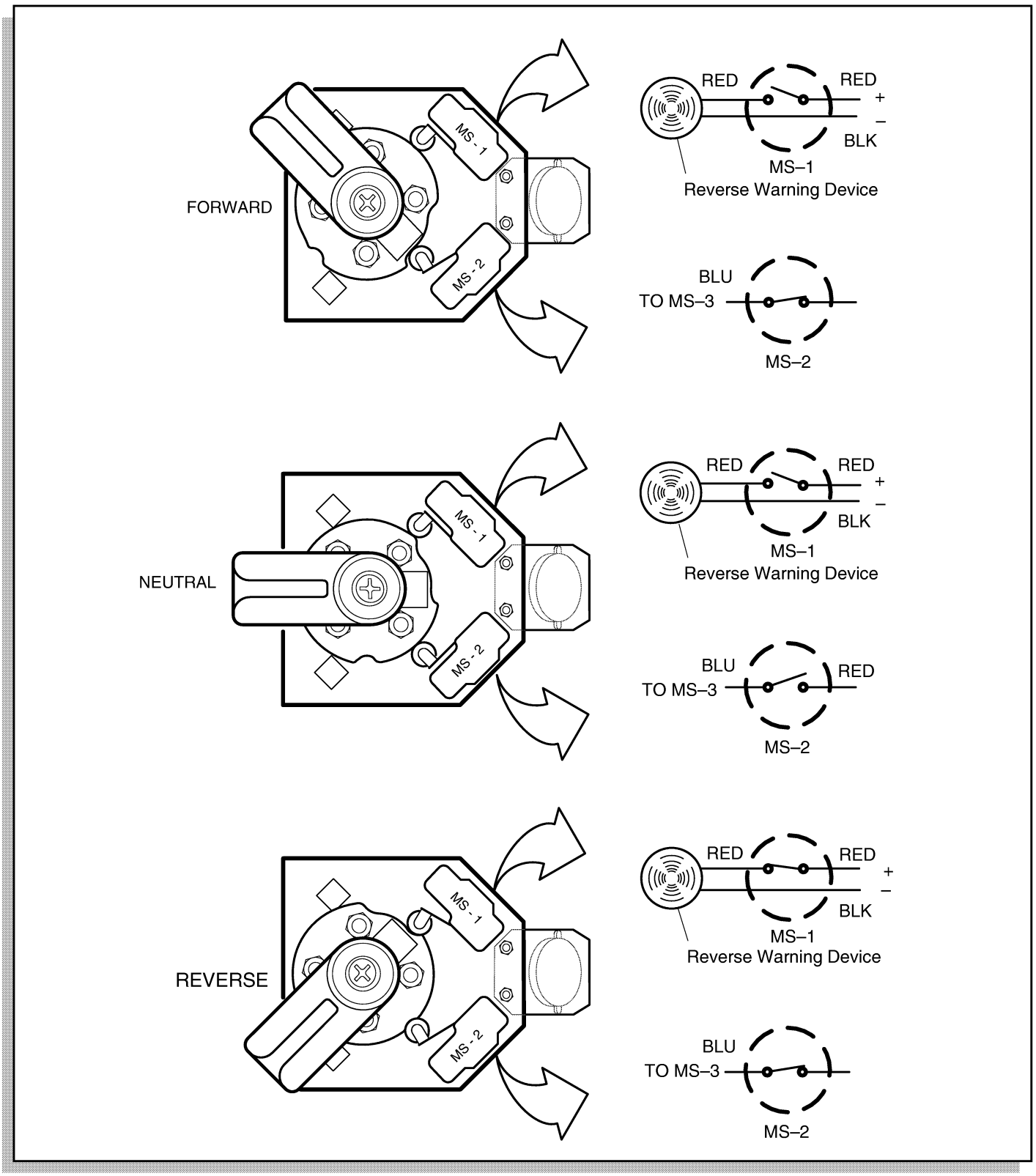

Fig. 9 Direction Selector Micro Switches and Reverse Warning Device

Testing The Motor

Tool List	Qty. Required
DVOM	1

NOTE *This test is valid only after the control and power wiring has been inspected as detailed in the preceding procedures.*

Raise the vehicle, as shown in SAFETY section, before proceeding.

⚠ WARNING ⚠ ***To prevent vehicle from inadvertently accelerating, which could cause bodily injury, the vehicle must be lifted to raise all wheels off the ground.***

NOTE *Use the following test* ***only if the motor will not run****.*

Place key switch in the 'ON' position and the direction selector switch to the 'FORWARD' (F) position.

This check is for open circuits in field coils, brushes or brush rigging. To check for a short circuit, refer to the Motor Section.

Set the DVOM to the 50 VDC range.

Locate the black (-) probe to the negative (-) contact of the vehicle DC receptacle and the red (+) probe to the motor terminal S2. A meter reading of 1 volt less than reference voltage indicates a good condition. Locate the red (+) probe on the motor terminal S1. A meter reading of 1 volt less than reference voltage indicates the field coils are satisfactory. A meter reading of 0 indicates the field coils are open and the motor must be repaired or replaced.

Locate the red (+) probe on the motor terminal A2. A reading other than 0 VDC indicates the power wiring should be rechecked. Locate the red (+) probe to the motor terminal A1. A meter reading of 1 volt less than reference voltage indicates the brushes, brush holder and all connections are satisfactory. A meter reading of 0 indicates a problem with the brushes, brush holder or connections.

The following tests may be performed with a DVOM or test light.

⚠ WARNING ⚠ ***Remove the battery (+) connections before continuing with this test. Shorting of motor wires could result in an explosion.***

Check for continuity between each of the motor terminals and the motor shell. Continuity between terminals S1 and S2 to the motor shell indicates a short circuit between the field coils and the case. Continuity between terminals A1 or A2 to the motor shell indicates a short circuit in the armature. Both of the preceding conditions will require the motor to be repaired or replaced.

Tighten all motor terminal connections to 35 - 40 in. lbs. (4 - 5 Nm) torque.

DIRECTION SELECTOR SWITCH

The direction selector switch operation is described in Power Circuit at the beginning of this section.

Switch Lubrication

During the servicing of the vehicle, the direction selector switch shaft (2) should be removed, cleaned and lubricated with bearing grease (Ref Fig. 10 on page E-11). The contact surfaces may also be lubricated with a thin coat of petroleum jelly to permit smooth operation of the switch.

Direction Selector Switch Inspection and Repair

⚠ WARNING ⚠ ***Disconnect the battery lead (BL+) from the battery before attempting service of the direction selector switch.***

Periodic inspection of the switch should include the following:

1. Check that all wire connections are tight and free of corrosion.
2. Check contacts for abnormal wear. The contacts in the movable cam portion of the switch are spring loaded and the cam assembly must be replaced when worn sufficiently to cause a loss of spring pressure.
3. Rotate the switch lever (1) from 'stop to stop' to check for smooth operation. If the switch is excessively hard to operate, inspect for rough contact surfaces and replace if required. If the contact surfaces are good, the stationary contact surfaces may be lubricated, if required, with a very thin coat of petroleum jelly.

If the switch lever is abnormally loose, check the shaft nut (3) and tighten if required. Inspect for abnormally worn spring loaded contacts.

Inspect the micro switches for operation and dirt that might inhibit their operation.

Direction Selector Switch Removal and Disassembly

Tool List **Qty. Required**

Box end combination wrench, 7/16" - 1/2" 1

Box end wrench, 9/16" 1

Screwdriver, Phillips 1

Remove switch lever (1) from shaft (2) (Ref Fig. 10 on page E-11).

Disconnect all the wiring connections from the rear of the switch. Disconnect the push-on connections and any other connections securing the switch to the vehicle electrical system. Disconnect the wire from the micro switch to the key switch at micro switch 2 (MS-2).

Remove the hardware (4) which secures the switch to the console and remove the switch assembly.

Remove the nut (3) from the switch shaft (2). Remove the cam assembly (5) complete with the switch shaft from the bushing and remove the switch shaft from the cam assembly.

Reassemble the switch in the reverse order of disassembly. Rotate the cam from stop to stop and check the operation of the micro switch rollers.

Reinstall the direction selector switch in the vehicle. Tighten the hardware that secures the direction selector switch to the vehicle to 10 - 12 ft. lbs. (14 - 16 Nm) torque.

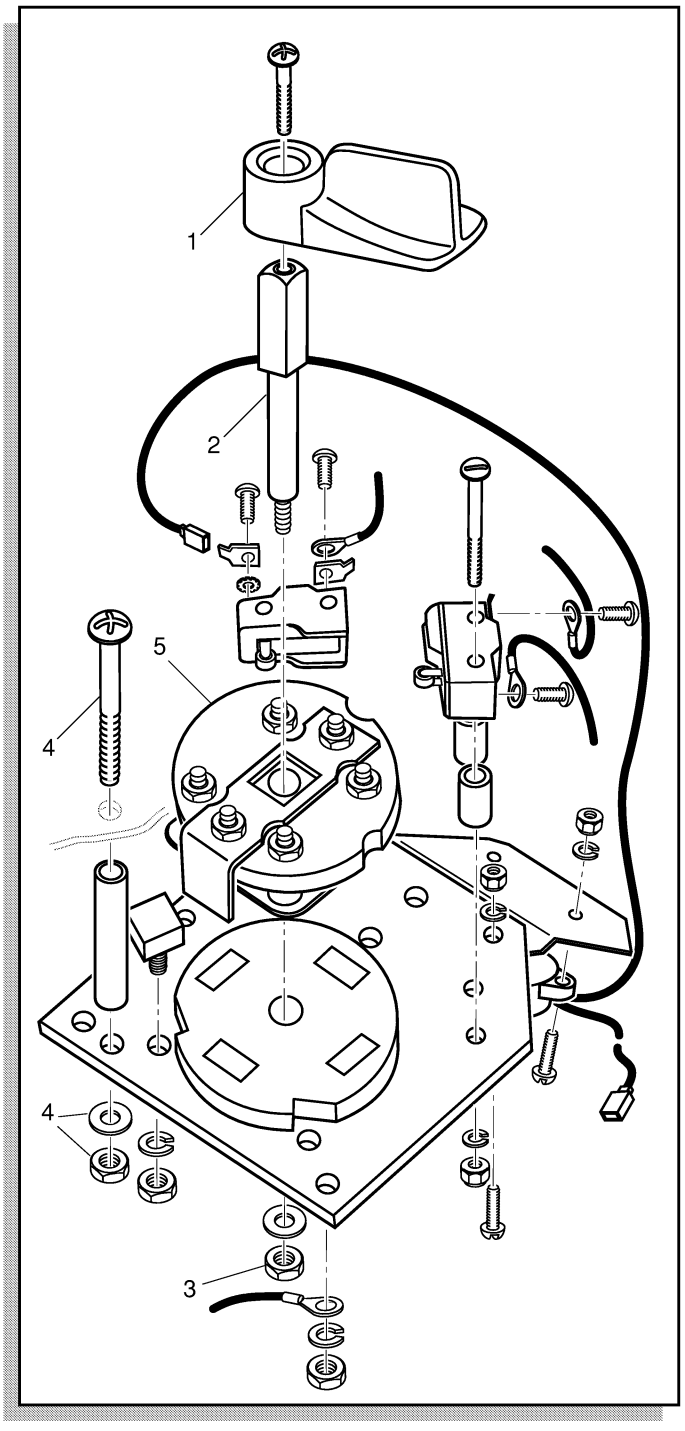

Fig. 10 Direction Selector Switch Assembly

ACCELERATOR/BRAKE PEDAL

Accelerator/Brake Pedal Removal

Tool List **Qty. Required**

Needle nose pliers..... 1

Raise the vehicle as specified in SAFETY section before proceeding.

Disable the electrical system of the accelerator by turning the key switch to the 'OFF' position and remove the power cable at the positive battery terminal.

Disconnect the accelerator control link (1) at the accelerator pedal pivot (2) by removing the cotter pin and clevis pin (3) (Ref Fig. 11 on page E-12).

Remove the cotter pin and bushing (4) on end of accelerator pivot shaft (5).

Slide pivot shaft to the right, and drop end below frame rail. Remove bushing on inside frame rail and slide pedal and pivot to the left off pivot shaft.

Accelerator/Brake Pedal Installation

Accelerator/brake pedal installation is in the reverse order of disassembly.

Accelerator/Brake Rod Adjustment

Adjust accelerator/brake connecting rod per directions described earlier in this section.

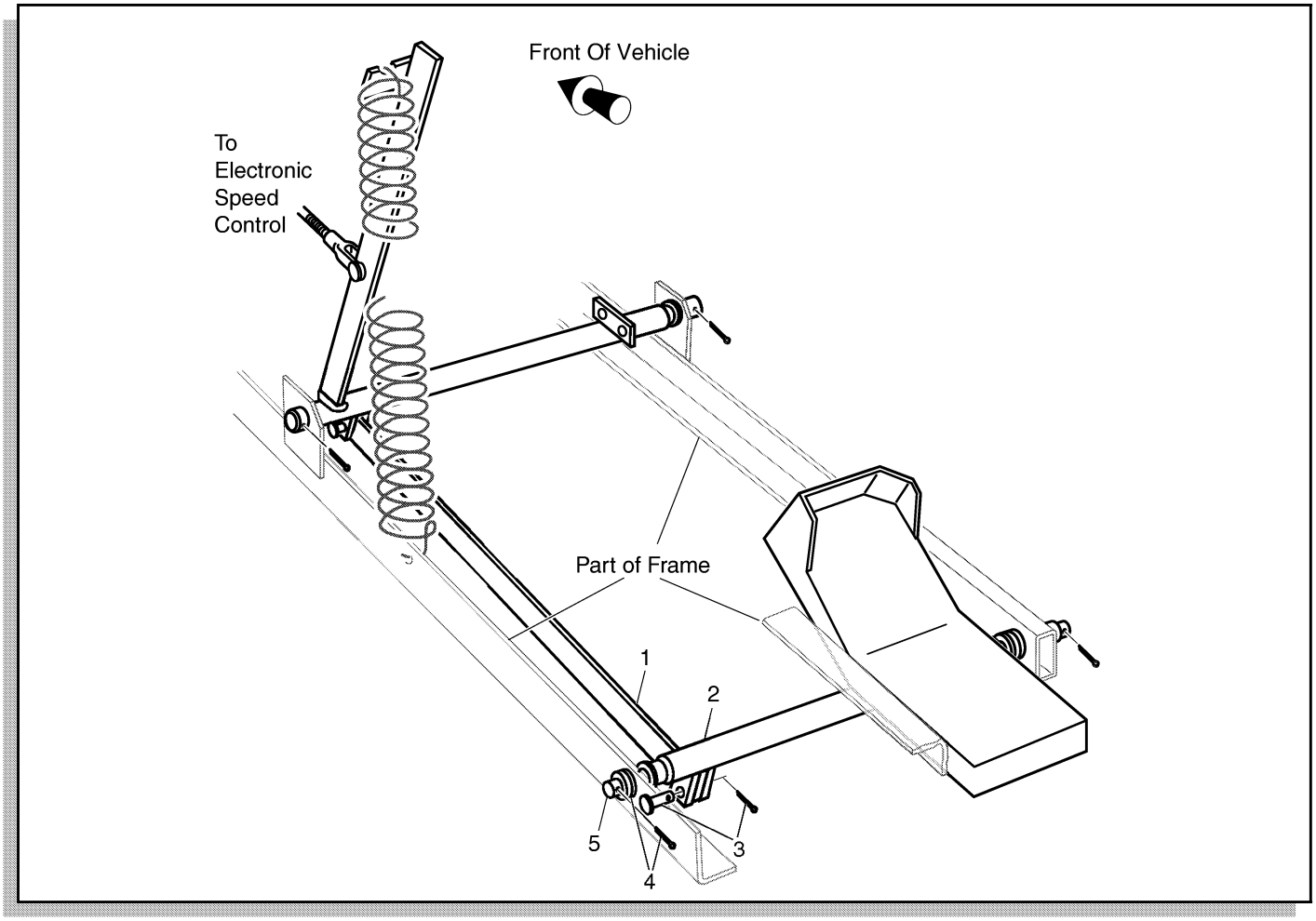

Fig. 11 Accelerator Pedal Removal

TABLE OF CONTENTS FOR SECTION 'F'

SECTION TITLE **PAGE NO.**

LIST OF ILLUSTRATIONS

Notes:

STEERING

NOTE *In the following text, there are references to removing/installing bolts etc. Additional hardware (nuts, washers etc.) that are removed must always be installed in their original positions unless otherwise specified. Non-specified torque specifications are as shown in the table contained in Section A.*

Tool List **Qty. Required**

Floor jack 1
Jack stands.....2
Wheel chocks 4

For all steering repairs, raise the front end using the procedures described in Section 'B' (Safety) of this manual and support the vehicle frame on jack stands.

⚠ WARNING ⚠ ***To reduce the possibility of personal injury, follow the lifting procedure in Section 'B' of this manual. Place wheel chocks in front and behind the rear 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.***

FRONT WHEEL

Front Wheel Removal

Tool List **Qty. Required**

Box end wrench, 9/16".....1
Socket, 9/16", 3/8" drive 1
Open end wrench, 1 1/8" 2
Socket, 1 1/8", 1/2" drive 1
Ratchet, 3/8" drive 1
Ratchet, 1/2" drive 1
Framing square.....1
Tape measure 1

While holding nut (item 1), remove nut (item 2) securing axle (item 3) to front fork (4) (Ref Fig. 1 on page F-1). Remove washer (item 5). Repeat on other side of front fork.

Remove axle assembly from front fork. Remove nuts (6) to remove wheel from axle.

Front Wheel Installation

Front wheel installation is the reverse order of removal.

With vehicle sitting on a level surface, adjust front axle so that the tire does not have more than 1/4" (6 mm) lean from vertical in either direction.

Replace washer (item 5) and nut (item 2). Tighten nut to 90 - 100 ft. lbs. (120 - 135 Nm) torque. Repeat on other side of front fork. Lower vehicle.

Check for smooth rotation of wheel and an absence of play when the wheel is grasped by the outside of the tire.

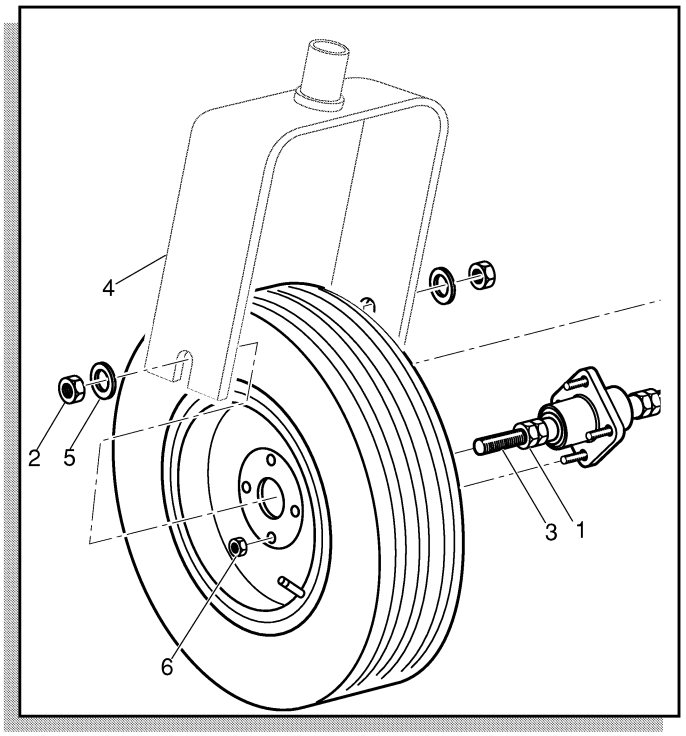

Fig. 1 Front Wheel Removal

MAINTENANCE

Good routine maintenance of the steering consists of routine lubrication (See Lubrication Chart and the Periodic Service Schedule in Section A). Be sure to use the recommended lubricants. Maintain the correct adjustment of the front bearings and repack them in accordance with the Periodic Service Schedule or if a bearing replacement is required. Routine examination of the front tire will provide indications that an alignment is required.

Lubrication

Tool List **Qty. Required**

Floor jack 1
Jack stands 2
Wheel chocks..... 4
Grease gun 1
Bearing packer..... 1

Lubricate vehicle per schedule contained in section "A".

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

Wheel Bearing Inspection

Tool List	Qty. Required
Floor jack	1
Jack stands	2
Wheel chocks	4
Grease gun	1
Bearing packer	1
Box end wrench, 1 1/8"	1
Non ferrous punch	1
Ball peen hammer	1

Lift the front of the vehicle and support on jack stands as detailed in Section B of this manual. Rotate the front wheel and feel for any roughness. Grasp the outside of the tire and rock it. If any movement is detected, the wheel bearing may require replacement/adjustment.

Remove the front wheel from the fork, proceeding as described above. Remove the wheel from the axle, (Ref Fig. 1 on page F-1). Remove the nuts and spacer securing the bearing assembly on the axle (Ref Fig. 2 on page F-2). Remove the grease seal from the axle and gently tap out the roller bearing. Clean the roller bearing with solvent and dry thoroughly. Inspect the rollers for signs of damage/wear. Pitting or blue coloration of the rollers will indicate the need for replacement. If the rollers need replacing, the bearing race must also be replaced. It may be removed by tapping out from the other end of the hub through the bore. Tap out in a circular pattern to prevent damage to the hub bore.

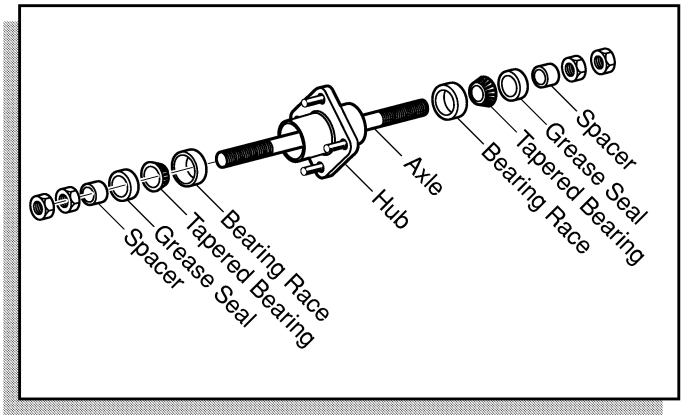

Fig. 2 Front Axle Assembly

Packing Wheel Bearings

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. Packing a bearing manually requires placing a dab of grease in the palm of the hand and dipping the bearing in the grease. Force the grease up through and around all of the rollers until the entire bearing is coated in grease. Fill the area between the rollers with grease and apply a light coating to the bearing race. Install bearings into hub.

Seal Installation

Clean the hub seal surface to remove grease and press the seal into place with the flange side of the seal facing into the bore (Ref Fig. 3 on page F-2). Tap gently into place with a seal installation tool until it is flush with the outside of the hub assembly. Lubricate the seal surface with grease.

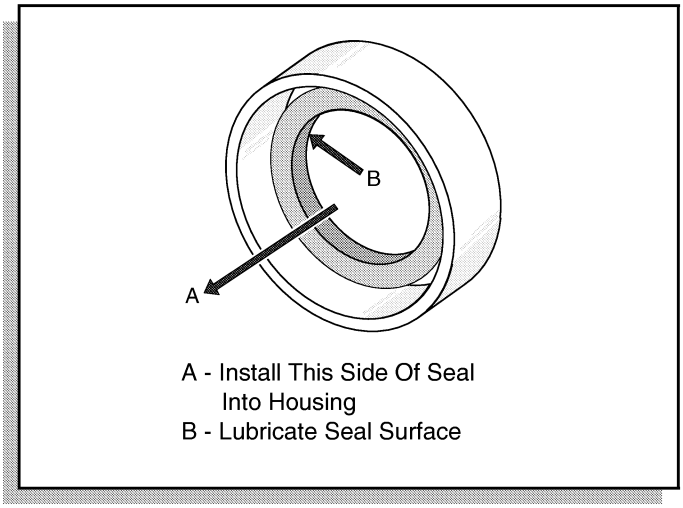

Fig. 3 Seal Installation

Bearing Adjustment

Assemble axle bearings and grease seals in hub. Assemble spacers and nuts on axle so that axle protrudes 5 1/8" (10.5 cm) from wheel mounting face of hub. Rotate the hub while tightening the inner nut (item 3) to 20 - 30 ft. lbs. (25 - 40 Nm) torque.

Loosen the nut. Re-tighten inner jam nuts to 15 - 30 in. lbs. (20 - 40 Nm) torque while rotating hub. Tighten outer jam nuts to 70 - 80 ft. lbs. (95 - 105 Nm) torque while holding inner nuts with a wrench.

Install wheel/tire assembly and check for smooth rotation of the wheel and an absence of play when the wheel is grasped by the outside of the tire.

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

Fork Bearing Inspection

Tool List	Qty. Required
Floor jack	1
Jack stands	2
Wheel chocks	4
Grease gun	1
Bearing packer	1
Wrench, 15/16"	1
Wrench, 1 1/2"	1
Non ferrous punch	1
Ball peen hammer	1
Plastic faced hammer	1
Ball joint separator	1

Lift the front of the vehicle and support on jack stands as shown in Section B (Safety). Turn the steering wheel and feel for any roughness. Grasp the lower fork and rock it. If any movement is detected, the fork bearing may require replacement/adjustment.

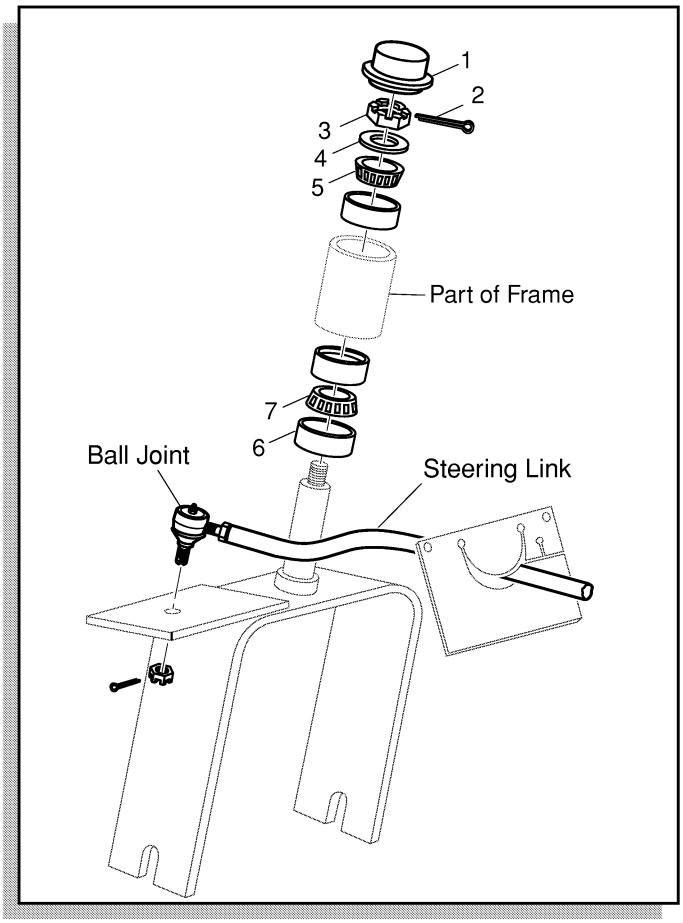

Fig. 4 Remove Steering Fork

Before the steering fork can be removed, the steering link must be removed from the fork at the ball joint. Care must be taken to not damage the ball joint in the process.

Remove the cotter pin; loosen the castellated nut to the end of the threads; using a ball joint separator as a lever, apply pressure to the ball joint and tap nut with plastic faced hammer to remove ball joint from steering fork plate. Remove nut and separate link from steering fork.

While supporting front fork, remove cap (1), cotter pin (2) and nut (item 3) securing fork in frame tube (Ref Fig. 4 on page F-3). Slide fork out of frame.

Remove washer (item 4) and lift out the upper bearing (item 5). Remove grease seal (item 6) in bottom of tube and remove bearing (item 7). Clean the bearings with solvent and dry thoroughly. Inspect the rollers for damage/wear. Pitting or blue coloration of the rollers will indicate the need for replacement.

Packing Fork Bearings

The steering 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. Packing a bearing manually requires placing a dab of grease in the palm of the hand and dipping the bearing in the grease. Force the grease up through and around the rollers until the entire bearing is coated in grease.

Bearing Installation and Adjustment

Clean lower bearing race and grease seal area. Apply a light coat of grease in bearing race and insert roller bearing. Install grease seal. Clean bearing surface on neck of steering fork, apply a light coat of grease and install steering fork in frame tube. Install upper roller bearing, bearing cover and castellated nut.

While turning steering fork from side to side, tighten nut to 20 - 30 ft. lbs. (25 - 40 Nm) torque to seat bearing.

Loosen nut. Re-tighten nut to 15 - 30 in. lbs. (1.7 - 3.4 Nm) while turning steering fork and install new cotter pin.

Replace steering link ball joint in steering fork plate. Tighten nut to 35 ft. lbs (50 Nm) torque. Install new cotter pin.

Steering Gear Inspection

Tool List	Qty. Required
Floor jack	1
Jack stands	2
Wheel chocks	4
Grease gun	1
Bearing packer	1
Wrench, 1/2"	2

Lift the front of the vehicle and support on jack stands as shown in Section B (Safety). Turn the steering wheel and feel for any roughness. Grasp the lower fork and turn steering wheel. If any looseness is detected, the steering gear may require replacement/adjustment.

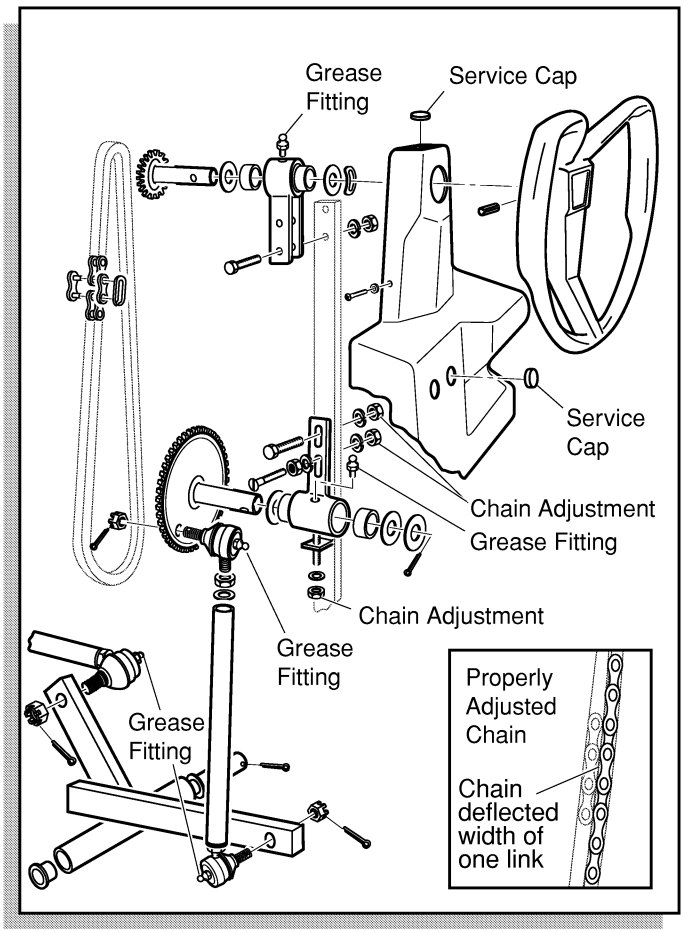

Fig. 5 Steering Gear

Lubrication of the steering gear may be accomplished by removing the service caps (Ref Fig. 5 on page F-4). Adjustments may also be made through the service holes in the console cover.

Before any adjustments are made to the chain system, ensure the grease fittings are greased. The need for grease in the fittings may cause a loose feel in the steering system.

Should adjustments be required to the chain, loosen the two nuts on the side of the upright frame member near the lower chain gear pivot. Adjust the lower nut to loosen or tighten the chain so that the slack in the chain is approximately the width of the chain (Ref Fig. 5 on page F-4). Once the chain has been properly adjusted, tighten the two nuts securing the chain gear pivot in place. Tighten the lower nut against the bracket to keep it from loosening and falling off the stud.

The steering system is a very simple arrangement and component replacement is very straight forward. The console cover may be removed by removing the self tapping screws around the perimeter of the plastic cover. Once the cover is removed, the complete steering system is accessible for service, adjustment or component replacement.

Steering Alignment

When replacing a steering component, it will be necessary to align the front wheel with the steering wheel. It will require removing the instrument panel cover and the cargo deck cover to access the steering chain and connecting rod.

To remove the instrument panel cover, remove the steering wheel by driving out the roll pin securing the steering wheel to the steering gear (Ref Fig. 5 on page F-4). Remove the screws around the perimeter of the cover attaching the cover to the body and remove the cover.

To remove the cargo deck cover, remove the screw in the center of the cover and lift off the deck cover.

Replace the steering wheel and loosely replace the roll pin attaching the steering wheel to the steering gear.

Center the front wheel, connecting rod and steering wheel. Install the chain and adjust chain tension. Align the system as much as possible. Make final adjustment by adjusting the connecting rod ball joint ends as necessary.

Replace cargo deck cover and instrument panel cover.

TABLE OF CONTENTS FOR SECTION 'G'

SECTION TITLE **PAGE NO.**

LIST OF ILLUSTRATIONS

Notes:

MOTOR

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

GENERAL

CAUTION **Do not hold vehicle on hill by using accelerator and motor. Leaving the motor in a stalled condition for more than 3-4 seconds will raise the commutator bars resulting in unacceptable noise and accelerated brush wear and cause permanent damage to motor.**

Disassembly of the motor is not recommended except to replace a worn or noisy bearing. If the motor is disassembled, it should be cleaned of any dirt buildup and the brush length checked. Replace brushes if required.

Neither the motor housing nor field coil is available as service items, therefore in the unlikely event of a failure in either of these components, the entire motor must be replaced.

Motor Removal

⚠ WARNING ⚠ ***Disconnect the negative (BL-) battery cable with an insulated wrench before attempting to remove wires from the motor (see safety procedures in SAFETY section of this manual). The shorting of motor wires could cause an explosion.***

Tool List	Qty. Required
Insulated wrench, 9/16"	1
Chalk or paint pen	1
Socket, 7/16", 3/8" drive	1
Ratchet, 3/8" drive	1

Using an insulated wrench, disconnect the negative (-) battery cable from the battery (Ref Fig. 1 on page G-1). Remove all wires from motor.

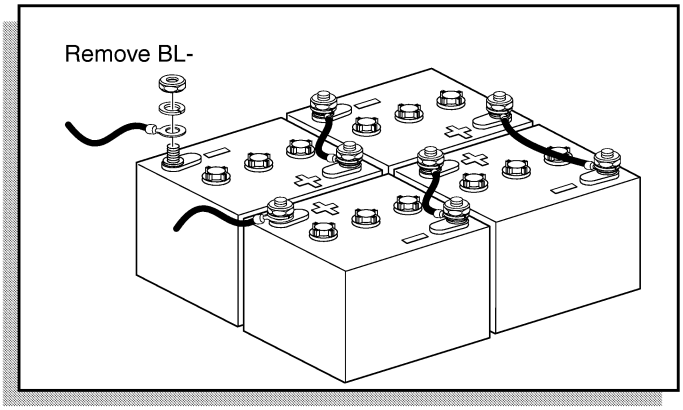

Fig. 1 Disconnect Battery Cable

Mark both the axle and motor housings to permit realignment during reassembly of motor to rear axle (Ref Fig. 2 on page G-1).

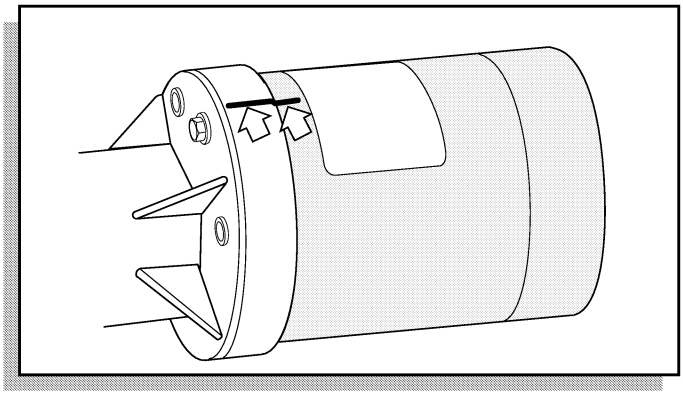

Fig. 2 Mark Axle and Motor

CAUTION **Take care not to damage the splines when removing and reassembling the motor to the rear axle housing.**

Remove the three bolts that secure the motor to the axle housing and carefully slide the motor straight out from the axle splines.

Motor Disassembly

Tool List	Qty. Required
Straight blade screwdriver	1
Ratchet, 3/8" drive	1
Socket, 3/8", 3/8" drive	1
Plastic faced hammer	1

Remove bearing cap (1) (Ref Fig. 3 on page G-2).

Remove bolts (2) that hold the commutator end cover (3) to the motor housing (4).

Pull on commutator end cover to remove armature (5) and cover (as an assembly) from the housing. A light tap on the end cover may be necessary to loosen.

Bearing Replacement

Tool List	Qty. Required
Heat gun or lamp	1
Arbor press	1
Bearing driver set	1
Snap ring pliers	1

CAUTION **Do not use a torch to heat the commutator end cover. Only a moderate amount of heat should be applied. Excessive heat will damage the end cover and bearing.**

Proper support must be given to the commutator end cover during press operations. Inadequate and/or uneven support will cause the end cover to fracture.

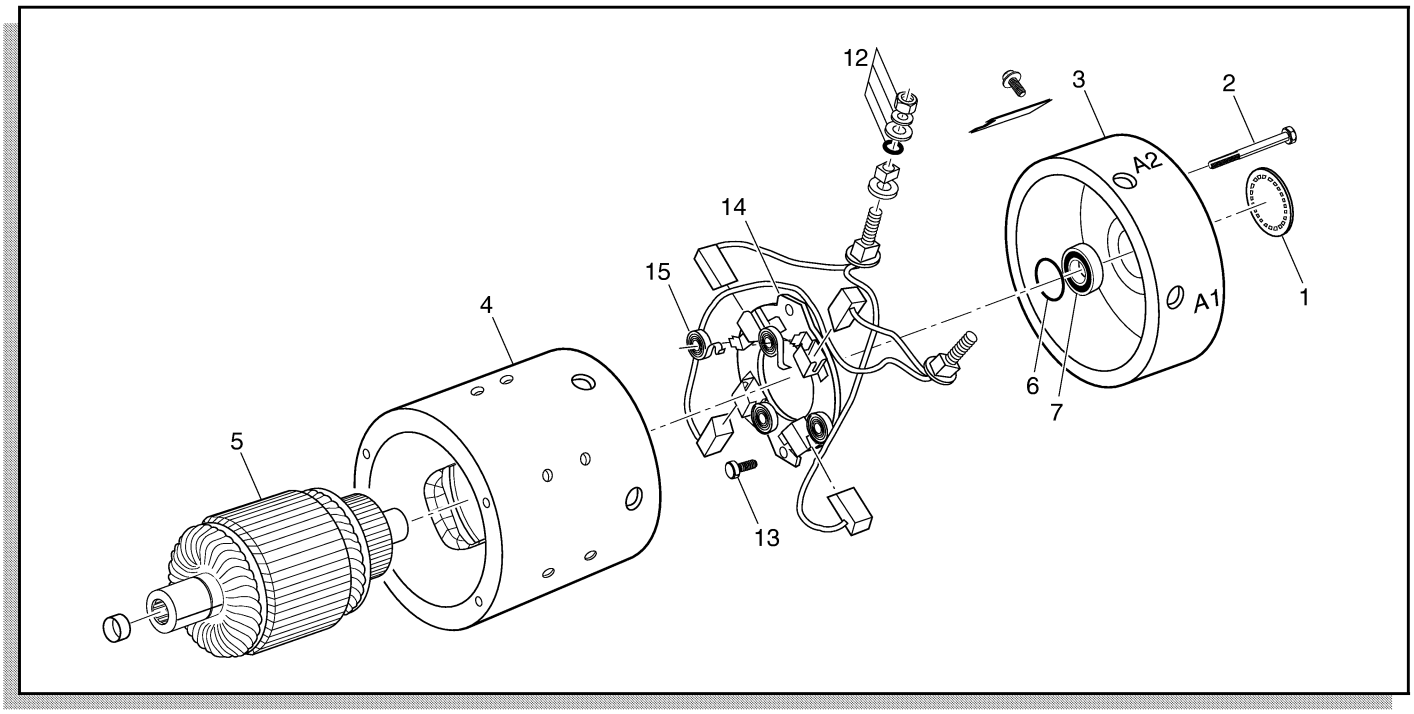

Fig. 3 Motor Components

To aid disassembly, heat only the commutator end cover before attempting removal of the armature.

Once heated, place the commutator end cover/armature assembly in press, giving as much support to the end cover as possible, and press the armature out of the bearing.

Push back each brush until its spring (15) is resting against the side of the brush. This keeps the brushes out of the way during bearing replacement (Ref Fig. 5 on page G-3).

Remove internal snap ring (6) and heat the commutator end cover again. Press bearing (7) out from commutator end cover (3).

CAUTION **When installing bearing into end cover, apply pressure against the bearing's outer race to avoid bearing damage.**

Press the new bearing into the commutator end cover using heat again to aid installation.

Install the snap ring.

NOTE *If brushes are to be replaced, proceed now to 'Brush Replacement' **before** installing the armature.*

For proper location, the armature has a positive stop feature.

CAUTION **When installing armature into the bearing/end cover assembly, support the bearing's inner race to avoid damage.**

Press the armature into the new bearing using moderate heat to aid installation.

Release brushes against commutator. Ensure the springs are seated against the rear of the brushes and are able to move freely.

Brush Replacement

Tool List	Qty. Required
Wrench, 1/2"	1
Ratchet, 1/4" drive	1
Socket, 5/16", 1/4" drive	1

Brushes should be measured as shown and replaced when the minimum dimension of .62" (16 mm) is reached (Ref Fig. 4 on page G-3).

Remove brush terminal hardware (12) at A1 and A2 (Ref Fig. 3 on page G-2).

Remove screws (13) securing brush plate (14). Remove brushes, rigging and brush plate.

Pull back each brush until each of the springs (15) rest against the side of its brush (Ref Fig. 5 on page G-3). Remove brushes and replace with new brush replacement kit. Locate springs against the side of each brush.

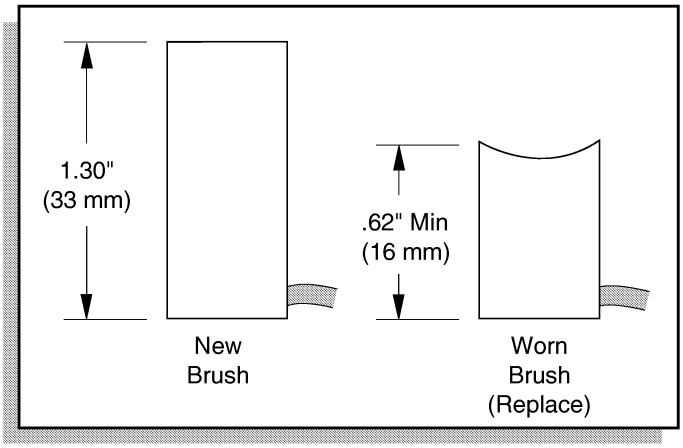

Fig. 4 Brush Wear

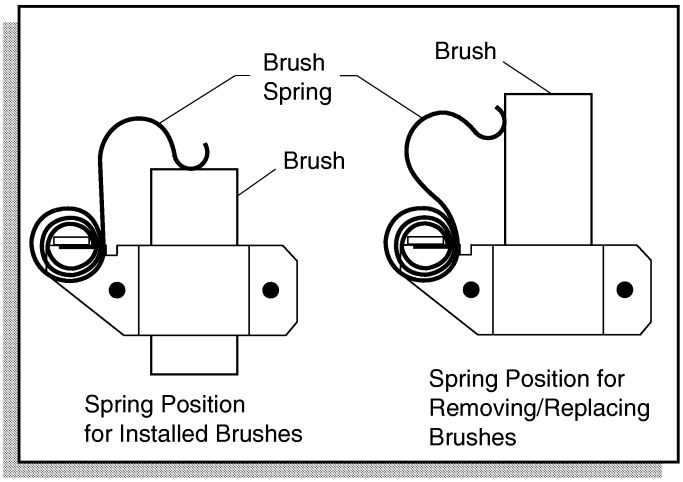

Fig. 5 Securing Brushes

Install terminals and brush plate using reverse order of removal. Install armature (commutator end) through brush plate and press into new bearing using moderate heat to aid installation. Position brushes against commutator. Ensure the springs are seated against the rear of the brushes and are able to move freely.

Motor Assembly

Tool List **Qty. Required**

Socket, 3/8", 3/8" drive 1

Torque wrench, in. lbs., 3/8" drive 1

Align the commutator end cover with the holes in the motor housing and assemble (Ref Fig. 3 on page G-2). Secure the commutator end cover to the motor housing with bolts (2) and tighten to 90 in. lbs. (10 Nm) torque. Install bearing cap (1).

Motor Tests

The field coil and motor housing are not available as individual parts. No testing is recommended to determine the specific area of failure. 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 must be replaced.

Motor Installation

Tool List **Qty. Required**

Socket, 7/16", 3/8" drive 1

Torque wrench, in. lbs., 3/8" drive 1

Be sure that a bumper spline is installed between the motor input pinion shaft and splines. Apply a small quantity of **molybdenum** grease to the **male** portion of the spline. Carefully mate the motor spline with the input shaft of the rear axle. Align the orientation marks and install the mounting hardware. Tighten to 168 in. lbs. (19 Nm) torque (Ref Fig. 2 on page G-1).

Attach the four motor wires to motor (Ref Fig. 6 on page G-3). Tighten the nuts to 66 in. lbs. (7 Nm) torque.

MOTOR WIRING

Motor Terminal	Wire Marker	From
S1	S1	Direction Selector "B"
S2	S2	Direction Selector "D"
A1	A1	Solenoid "-"
A2	A2	Controller "A2"

Fig. 6 Motor Wiring

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

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BATTERIES AND CHARGING

H

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BATTERIES AND CHARGING

H

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

SAFETY

Always observe the following warnings when working on or near batteries:

⚠ WARNING ⚠ ***To prevent battery explosion that could result in severe personal injury or death, keep all smoking materials, open flame or sparks away from the batteries.***

Hydrogen gas is formed when charging batteries. Do not charge batteries without adequate ventilation. A 4% concentration of hydrogen gas is explosive.

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.

Batteries are heavy. Use proper lifting techniques when moving them. Always lift the battery with a commercially available battery lifting device. Use care not to tip batteries when removing or installing them; spilled electrolyte can cause burns and damage.

The electrolyte in a storage battery is an acid solution which can cause severe burns to the skin and eyes. Treat all electrolyte spills to the body and eyes with extended flushing with clear water. Contact a physician immediately.

Always wear a safety shield or approved safety goggles when adding water or charging batteries.

Any electrolyte spills should be neutralized with a solution of 1/4 cup (60 ml) sodium bicarbonate (baking soda) dissolved in 1 1/2 gallons (6 liters) of water and flushed with water.

Overfilling batteries may result in electrolyte being expelled from the battery during the charge cycle. Expelled electrolyte may cause damage to the vehicle and storage facility.

Aerosol containers of battery terminal protectant must be used with extreme care. Insulate metal container to prevent can from contacting battery terminals which could result in an explosion.

Wrap wrenches with vinyl tape to prevent the possibility of a dropped wrench from 'shorting out' a battery, which could result in an explosion and severe personal injury or death.

BATTERY

A battery is defined as two dissimilar metals immersed in an acid. If the acid is absent or if the metals are not dissimilar, a battery has not been created. The batteries most commonly used in these vehicles are lead acid.

A battery does not store electricity, but is able to produce electricity as the result of a chemical reaction which releases stored chemical energy in the form of electrical energy. The chemical reaction takes place faster in warm conditions and slower in cold conditions. Temperature is important when conducting tests on a battery and test results must be corrected to compensate for temperature differences.

As a battery ages, it still performs adequately except that its **capacity** is diminished. Capacity describes the time that a battery can continue to provide its design amperes from a full charge.

A battery has a maximum life, therefore good maintenance is designed to maximize the **available** life and reduce the factors that can reduce the life of the battery.

BATTERY MAINTENANCE

Tool List	Qty. Required
Insulated wrench, 1/2"	1
Battery carrier	1
Hydrometer	1
Battery maintenance kit P/N 25587-G01	1

At Each Charging Cycle

⚠ WARNING ⚠ ***To reduce the possibility of fire, never attach a battery charger to a vehicle that is to be unattended beyond the normal charging cycle. Overcharging could cause damage to the vehicle batteries and result in extreme overheating. The charger should be checked after 24 hours and unplugged after the charge cycle is complete.***

Before charging the batteries, inspect the plug of the battery charger and vehicle receptacle housing for dirt or debris.

Charge the batteries after each days use.

Monthly

- Inspect all wiring for fraying, loose terminations, corrosion or deterioration of insulation.
- Check that the electrolyte level is correct and add suitable water as required.
- Clean the batteries and wire terminations.

Electrolyte Level and Water

The correct level of the electrolyte is 1/2" (13 mm) above the plates in each cell (Ref Fig. 1 on page H-2).

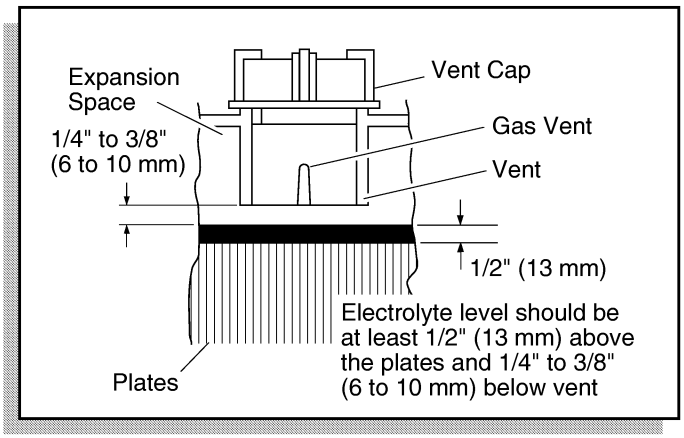

Fig. 1 Correct Electrolyte Level

This level will leave approximately 1/4" - 3/8" (6 - 10 mm) of space between the electrolyte and the vent tube. The electrolyte level is important since **any portion** of the plates exposed to air will be ruined beyond repair. Of equal importance is too much water which will result in electrolyte being forced out of the battery due to gassing and the increase in volume of the electrolyte that results from the charging cycle.

CAUTION **Do not overfill batteries. The charging cycle will expel electrolyte and result in component damage.**

A battery being charged will 'gas' with the majority of the gassing taking place at the end of the charging cycle. This gas is hydrogen which is lighter than air. Water and sulfuric acid droplets will be carried out of the battery vents by the hydrogen gas; however, this loss is minimal. If the battery electrolyte level is too high, the electrolyte will block the vent tube and the gas will **force** it out of the vent tube and battery cap. The water will evaporate but the sulfuric acid will remain where it can damage vehicle components and the storage facility floor. Sulfuric acid loss will weaken the concentration of acid within the electrolyte and reduce the life of the battery.

Over the life of the battery, a considerable amount of water is consumed. It is important that the water used be pure and free of contaminants that could reduce the life of the battery by reducing the chemical reaction. The water must be distilled or purified by an efficient filtration system. Water that is not distilled should be analyzed and if required, filtration installed to permit the water to meet the requirements of the water purity table (Ref Fig. 2 on page H-2).

Impurity	Parts Per Million
Color	Clear
Suspended	Trace
Total Solids	100
Calcium & Magnesium Oxides	40
Iron	5
Ammonia	8
Organic & Volatile Matter	50
Nitrites	5
Nitrates	10
Chloride	5

Fig. 2 Water Purity Table

Even if the water is colorless, odorless, tasteless and fit for drinking, the water should be analyzed to see that it does not exceed the impurity levels specified in the table.

Automatic watering devices such as the one included in the Battery Maintenance Kit (P/N 25587-G01) can be used with an approved water source (Ref Fig. 3 on page H-3). These watering devices are **fast and accurate** to use and maintain the correct electrolyte level within the battery cells.

NOTE *The watering device should only be used if the electrolyte level is less than 1/2" (13 mm) above top of plates.*

Cleaning Batteries

When cleaning the outside of the batteries and terminals, do not use a water hose without first spraying with a solution of sodium bicarbonate (baking soda) and water to neutralize any acid deposits.

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

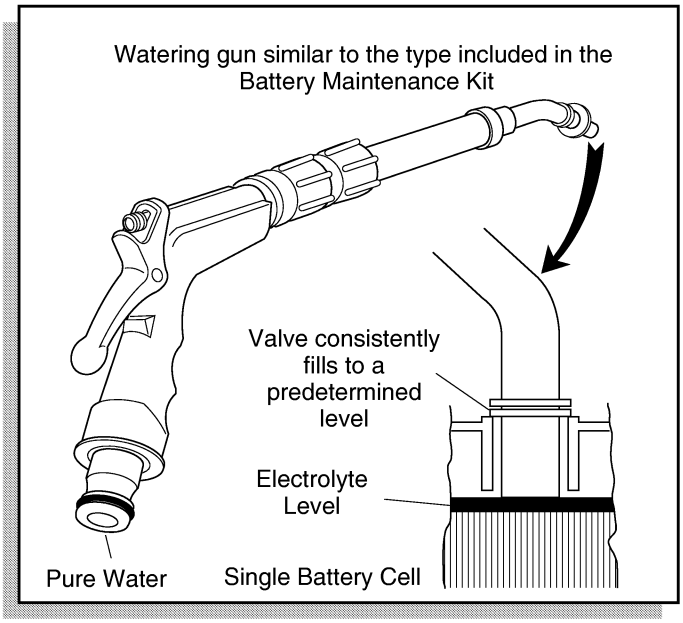

Fig. 3 Automatic Watering Gun

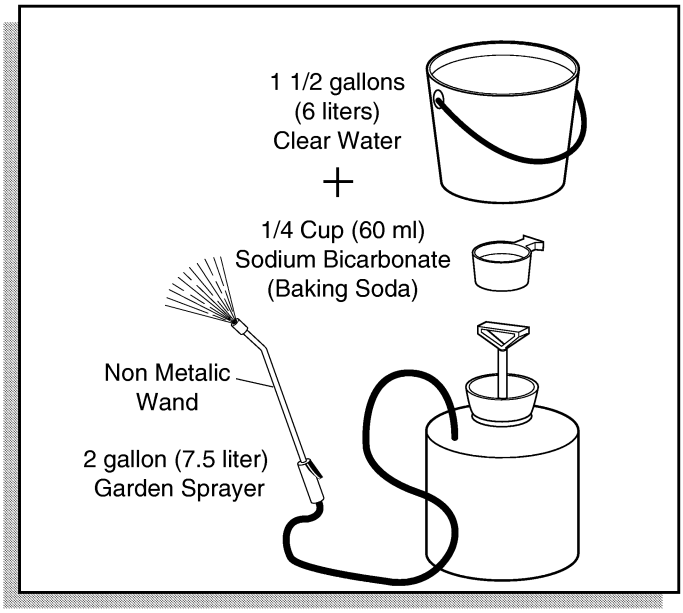

Fig. 4 Preparing Acid Neutralizing Solution

Use of a water hose without first neutralizing any acid, will move acid from the top of the batteries to another area of the vehicle or storage facility where it will attack the metal structure or the concrete/asphalt floor. After hosing down the batteries, a residue will be left on the batteries which is conductive and will contribute to the discharge of the batteries.

CAUTION **To prevent battery damage, be sure that all battery caps are tightly installed.**

The correct cleaning technique is to spray the top and sides of the batteries with a solution of sodium bicarbonate (baking soda) and water. This solution is best applied with a garden type sprayer equipped with a **non metallic spray wand**. The solution should consist of 1/4 cup (60 ml) of sodium bicarbonate (baking soda) mixed with 1 1/2 gallons (6 liters) of clear water (Ref Fig. 4 on page H-3). In addition to the batteries, special attention should be paid to metallic components adjacent to the batteries which should also be sprayed with the sodium bicarbonate (baking soda) solution.

Allow the solution to sit for at least three minutes; use a soft bristle brush or cloth to wipe the tops of the batteries in order to remove any residue that could cause the self discharge of the battery. Rinse the entire area with low pressure clear water. All of the items required for complete battery cleaning and watering are contained in the Battery Maintenance Kit (P/N 25587-G01).

Cleaning should take place once a month or more often under extreme conditions.

Battery Replacement

Remove battery hold downs and cables. Lift out batteries with a commercially available lifting device.

If the batteries have been cleaned and any acid in the battery rack area neutralized as recommended, no corrosion to the battery racks or surrounding area should be present. Any corrosion found should be immediately removed with a putty knife and a wire brush. The area should be washed with a solution of sodium bicarbonate (baking soda) and water and thoroughly dried before priming and painting with a corrosion resistant paint.

The batteries should be placed into the battery racks and the battery hold downs tightened to 45 - 55 in. lbs. (5 - 6 Nm) torque, to prevent movement but not tight enough to cause distortion of the battery cases.

Inspect all wires and terminals. Clean any corrosion from the battery terminals or the wire terminals with a solution of sodium bicarbonate (baking soda) and brush clean if required.

⚠ WARNING ⚠ ***To prevent battery explosion that could result in severe personal injury or death, extreme care must be used with aerosol containers of battery terminal protectant. Insulate the metal container to prevent the metal can from contacting battery terminals which could result in an explosion.***

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

Use care to connect the battery wires as shown (Ref Fig. 5 on page H-4). Tighten the battery post hardware to 50 - 70 in. lbs. (6 - 8 Nm) torque. Protect the battery terminals and battery wire terminals with a commercially available protective coating.

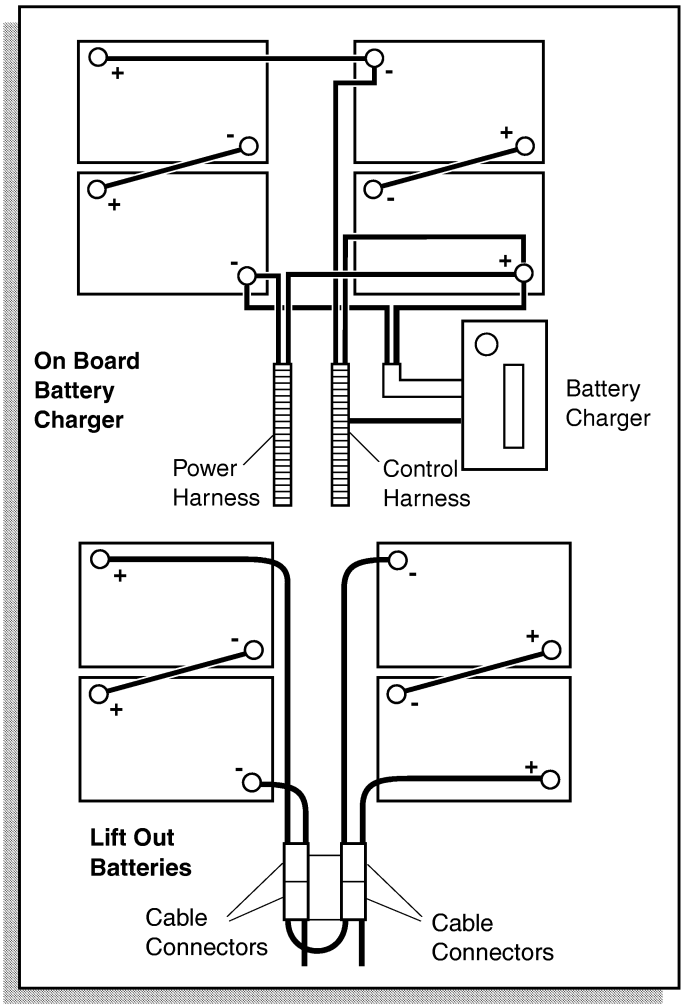

Fig. 5 Battery Connections

Prolonged Storage

CAUTION **Battery charger and controller and other electronic devices need to be disconnected since they will contribute to the premature discharge of batteries.**

During periods of storage, the batteries will need attention to keep them maintained and prevent discharge.

In high temperatures the chemical reaction is faster, while low temperatures cause the chemical reaction to slow down. A vehicle that is stored at 90° F (32° C) will lose .002 of specific gravity each day. If a fully charged battery has a specific gravity of 1.275, and the battery is allowed to sit unused, it will become partially discharged. When it reaches 1.240, which it will do in less than twenty days, it should be recharged. If a battery is left in a discharged state, sulfating takes place on and within the plates. This condition is not reversible and will cause permanent damage to the battery. In order to prevent damage, the battery should be recharged. A hydrometer (P/N 50900-G1) can be used to determine the specific gravity and therefore the state of charge of a battery.

In winter conditions, the battery must be fully charged to prevent the possibility of freezing (Ref Fig. 6 on page H-4). A fully charged battery will not freeze in temperatures above -75° F (-60° C). Although the chemical reaction is slowed in cold temperatures, the battery must be stored fully charged, and disconnected from any circuit that could discharge the battery. For portable chargers, disconnect the charging plug from the vehicle receptacle. For on-board chargers, disconnect the charging harness from the batteries. The batteries must be cleaned and all deposits neutralized and removed from the battery case to prevent self discharge. The batteries should be tested or recharged at thirty day minimum intervals.

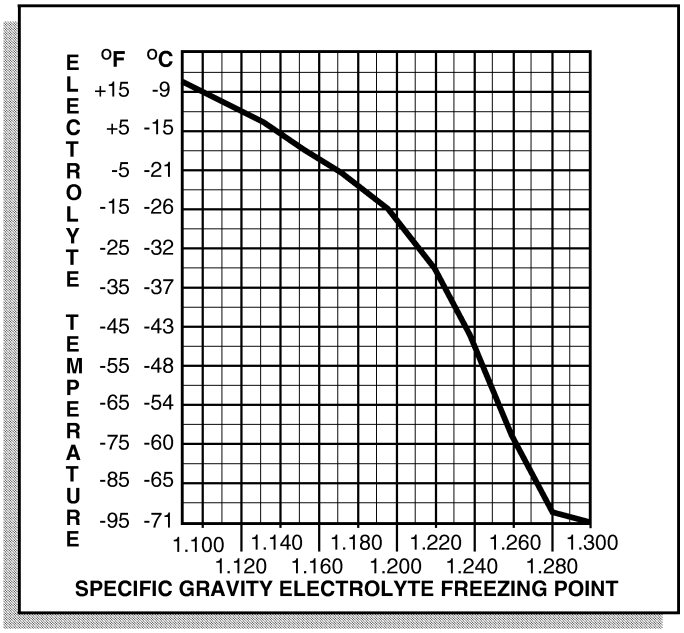

Fig. 6 Freezing Point of Electrolyte

Battery Charging

The battery charger is designed to fully charge the battery set. If the batteries are severely deep cycled, some automatic battery chargers contain an electronic module that may not activate and the battery charger will not function. Automatic chargers will determine the correct duration of charge to the battery set and will shut off when the battery set is fully charged. Always refer to the instructions of the specific charger used.

Before charging, the following should be observed:

CAUTION **Do not overfill batteries. The charging cycle will expel electrolyte and result in component damage.**

- The electrolyte level in all cells must be at the recommended level and cover the plates.
- The charging must take place in an area that is well ventilated and capable of removing the hydrogen gas that is generated by the charging process. A **minimum** of five air exchanges per hour is recommended.
- The charging connector components are in good condition and free from dirt or debris.
- The charger connector is fully inserted into the vehicle receptacle.
- The charger connector/cord set is protected from damage and is located in an area to prevent injury that may result from personnel running over or tripping over the cord set.
- The charger is automatically turned off during the connect/disconnect cycle and therefore no electrical arc is generated at the DC plug/receptacle contacts.

NOTE *In some portable chargers, there will be a rattle present in the body of the charger DC plug. This rattle is caused by an internal magnet contained within the charger plug. The magnet is part of the interlock system that prevents the vehicle from being driven when the charger plug is inserted in the vehicle charging receptacle.*

AC Voltage

Battery charger output is directly related to the input voltage. If multiple vehicles are receiving an incomplete charge in a normally adequate time period, low AC voltage could be the cause and the power company should be consulted.

TROUBLESHOOTING

In general, troubleshooting will be done for two distinct reasons. First, a battery that performs poorly and is outside of the manufacturers specification should be identified in order to replace it under the terms of the manufacturer's warranty. Different manufacturers have different requirements. Consult the battery manufacturer or the manufacturer's representative for specific requirements.

The second reason is to determine why a particular vehicle does not perform adequately. Performance problems may result in a vehicle that runs slowly or in a vehicle that is unable to operate for the time required.

A new battery must **mature** before it will develop its maximum capacity. Maturing may take up to 100 charge/discharge cycles. After the maturing phase, the older a battery gets, the lower the capacity. The only way to determine the capacity of a battery is to perform a load test using a discharge machine following manufacturer's recommendations.

A cost effective way to identify a poorly performing battery is to use a hydrometer to identify a battery in a set with a lower than normal specific gravity. Once the particular cell or cells that are the problem are identified, the suspect battery can be removed and replaced. At this point there is nothing that can be done to salvage the battery; however, the individual battery should be replaced with a good battery of the same brand, type and approximate age.

Hydrometer

A hydrometer (P/N 50900-G1) is used to test the state of charge of a battery cell (Ref Fig. 7 on page H-6). This is performed by measuring the density of the electrolyte, which is accomplished by measuring the specific gravity of the electrolyte. The greater the concentration of sulfuric acid, the more dense the electrolyte becomes. The higher the density, the higher the state of charge.

⚠ WARNING ⚠ ***To prevent a battery explosion that could result in severe personal injury or death, never insert a metal thermometer into a battery. Use a hydrometer with a built in thermometer that is designed for testing batteries.***

Specific gravity is the measurement of a liquid that is compared to a baseline. The baseline is water which is assigned a base number of 1.000. The concentration of sulfuric acid to water in a new golf car battery is 1.280 which means that the electrolyte weighs 1.280 times the weight of the same volume of water. A fully charged battery will test at 1.275 - 1.280 while a discharged battery will read in the 1.140 range.

NOTE *Do not perform a hydrometer test on a battery that has just been watered. The battery must go through at least one charge and discharge cycle in order to permit the water to adequately mix with the electrolyte.*

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

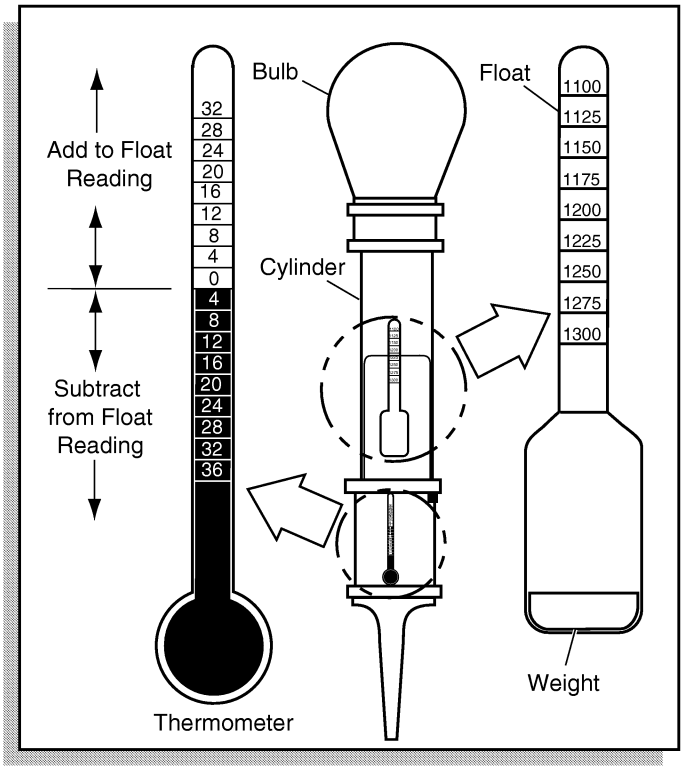

Fig. 7 Hydrometer

The temperature of the **electrolyte** is important since the hydrometer reading must be corrected to 80° F (27° C). High quality hydrometers are equipped with an internal thermometer that will measure the temperature of the electrolyte and will include a conversion scale to correct the float reading. It is important to recognize that the electrolyte temperature is significantly different from the ambient temperature if the vehicle has been operated.

Using A Hydrometer

1. Draw electrolyte into the hydrometer several times to permit the thermometer to adjust to the electrolyte temperature and note the reading. Examine the color of the electrolyte. A brown or gray coloration indicates a problem with the battery and is a sign that the battery is nearing the end of its life.
2. Draw the minimum quantity of electrolyte into the hydrometer to permit the float to float freely without contacting the top or bottom of the cylinder.
3. Hold the hydrometer in a vertical position at eye level and note the reading where the electrolyte meets the scale on the float.
4. Add or subtract four points (.004) to the reading for every 10°F (6°C) the electrolyte temperature is above or below 80°F (27°C). Adjust the reading to conform with the electrolyte temperature, e.g., if the reading indicates a specific gravity of 1.250 and the electrolyte temperature is 90°F (32°C), **add** four points (.004) to the 1.250 which gives a corrected reading of 1.254. Similarly if the temperature was 70°F (21°C), **subtract** four points (.004) from the 1.250 to give a corrected reading of 1.246 (Ref Fig. 8 on page H-7).
5. Test each cell and note the readings (corrected to 80° F or 27°C). A variation of fifty points between any two cell readings (example 1.250 - 1.200) indicates a problem with the low reading cell(s).

As a battery ages the specific gravity of the electrolyte will decrease at full charge. This is not a reason to replace the battery, providing all cells are within fifty points of each other.

Since the hydrometer test is in response to a vehicle exhibiting a performance problem, the vehicle should be recharged and the test repeated. If the results indicate a weak cell, the battery or batteries should be removed and replaced with a good battery of the same brand, type and approximate age.

BATTERY CHARGER

Description

The battery charger accompanying this vehicle is 120 volt AC, 60 Hz input with 48 volt DC output. Contact charger manufacturer for maintenance or service parts.

For service assistance, contact Service Parts Department, 1-800-227-7029.

Portable Charger Installation

⚠ WARNING ⚠ ***Portable chargers must be mounted on a platform above the ground or in such a manner as to permit the maximum air flow underneath and around the charger. Do not block or obstruct the airways as overheating may result which could cause serious damage to the charger and create the potential for fire.***

If the charger is operated in an outdoor location, rain and sun protection must be provided.

A dedicated circuit is required for the charger. Refer to the charger manual for appropriate circuit protection. The charger may remain plugged into the AC outlet. To charge the vehicle, refer to the instruction labels on the charger. Insert the DC plug completely into the vehicle receptacle located on the left side of the instrument panel

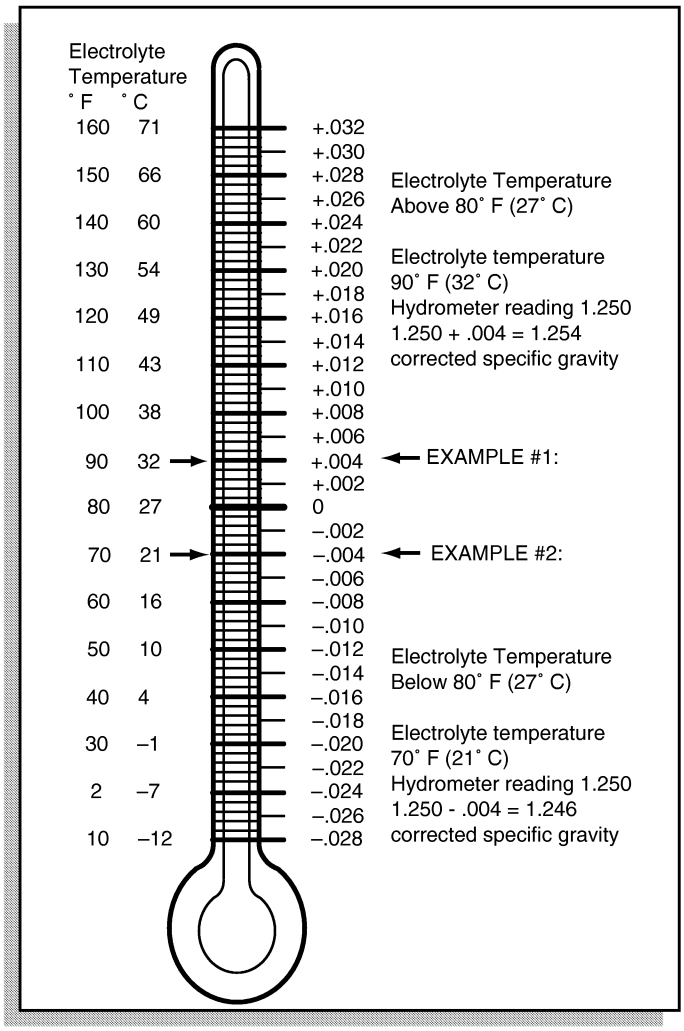

Fig. 8 Hydrometer Temperature Correction

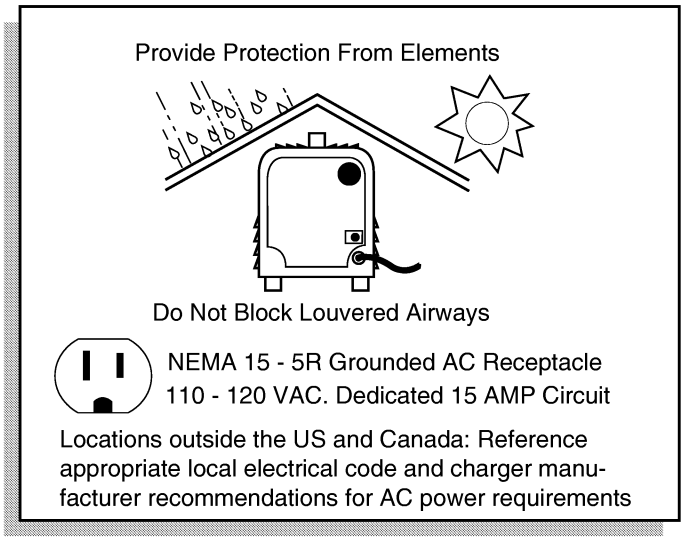

Fig. 9 Charger Installation

(Ref Fig. 10 on page H-7). After inserting the polarized DC plug, wait a few seconds and observe ammeter on charger to make sure it moves indicating that charger is charging.

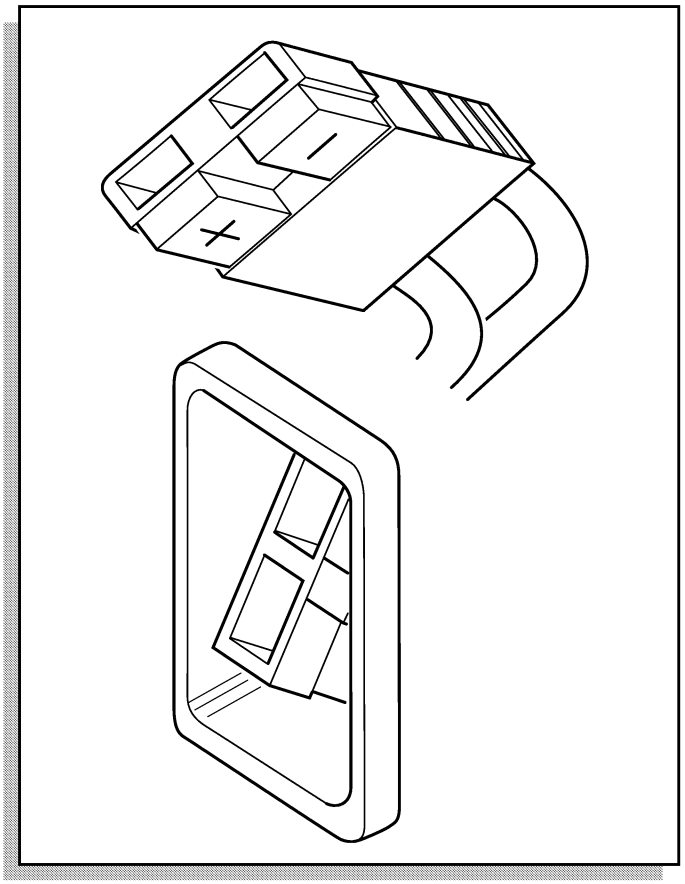

Fig. 10 Charger Plug & Receptacle

The charger will automatically start a few seconds after plug insertion. The charger will automatically stop when batteries are fully charged and the DC plug can be removed to permit use of the vehicle.

The charger may remain plugged into the AC outlet. To charge the vehicle, refer to the instruction label on charger.

Charger Maintenance

The charging (DC) cord is equipped with a polarized connector which fits into a matching receptacle on the vehicle. The power (AC) cord is equipped with an appropriate plug. If the charger is equipped with a grounding plug, do not attempt to remove or bend the ground plug.

BATTERIES AND CHARGING

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

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BATTERY CHARGER

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DESCRIPTION

The Total Charge® III battery charger is automatic and is designed specifically for charging electric vehicle batteries.

The charger type is known as ferroresonant. The term is applied to a charger that starts the charge at a relatively high rate of charge and continuously reduces the rate as the batteries come nearer to the full charge condition.

The On-Board charger is AC driven, meaning that the charger resets itself when the AC cord is unplugged from and replugged into the AC electrical receptacle.

The Portable charger is DC driven, meaning that the charger resets itself when the DC cord is unplugged from and replugged into the DC receptacle of the battery charging harness.

The battery charger will charge the batteries fully before shutting itself off. The charger has a 3 second delay before turn on after plugging receptacle into vehicle.

The electronic module within the charger samples the battery voltage during the charging period. If the module senses that the battery voltage has risen, it continues to charge. If the module senses no change, it determines the batteries are fully charged and shuts the charger off.

On Board Charger

The on-board charger is mounted to a door located on the right side of the vehicle. It is wired directly to the batteries, only requiring it be plugged into a dedicated 15 amp AC outlet to be operational (Ref Fig. 1 on page J-1). When charge cycle is complete, replace cord onto the cord storage handle on the seat back.

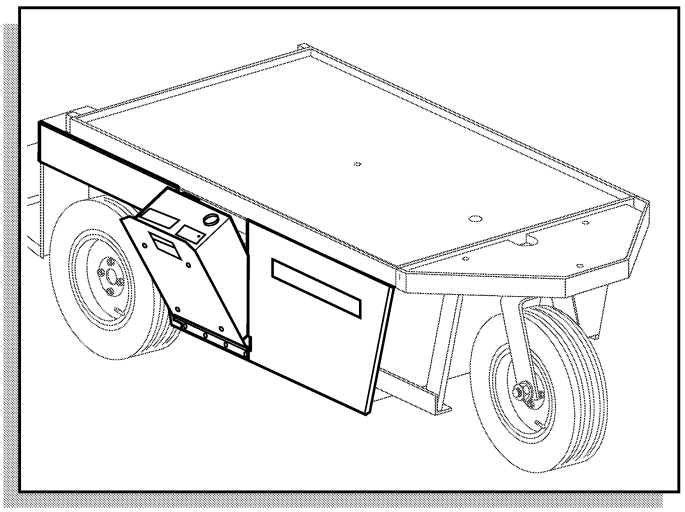


Fig. 1 On-board Charger

Portable Charger Installation (if equipped)

⚠ WARNING ⚠ ***Portable chargers should be mounted on a platform above the ground or in such a manner as to permit the maximum air flow underneath and around the charger. Do not block or obstruct the louvers as overheating may result which could cause serious damage to the charger and create the potential for fire.***

Portable chargers are shipped with the vehicle. Prior to vehicle or charger operation, chargers must be removed and mounted on a platform or wall above the ground to permit maximum air flow around and underneath the charger. If the charger is operated in an outdoor location, rain and sun protection must be provided (Ref Fig. 2 on page J-1). A dedicated circuit is required for the charger. Refer to label on side of charger for appropriate circuit protection.

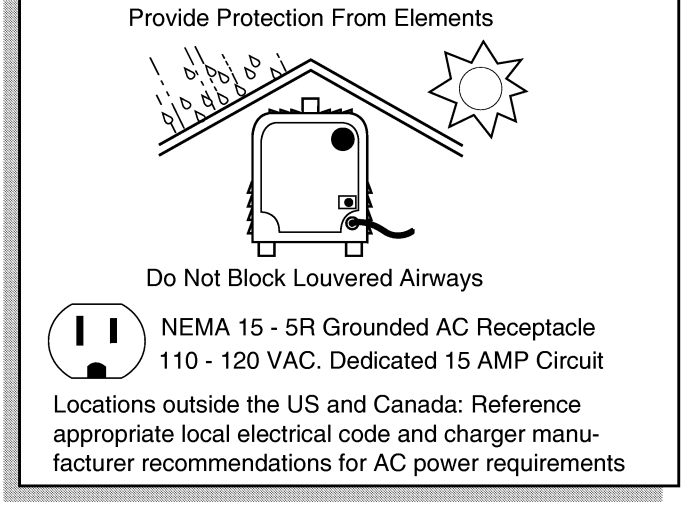


Fig. 2 Charger Installation

Charging with the Portable Charger

The charger may remain plugged into the AC outlet. To charge the batteries, refer to the instruction labels on the charger. Insert the polarized DC plug completely into the charger receptacle located on the left side of the instrument panel (Ref Fig. 3 on page J-2). After inserting the polarized DC plug, wait a few seconds and observe the ammeter on the charger to make sure it moves indicating the charger is charging.

The charger will automatically start a few seconds after plug insertion and will automatically stop when batteries are fully charged. The DC plug can then be removed to permit use of the vehicle.

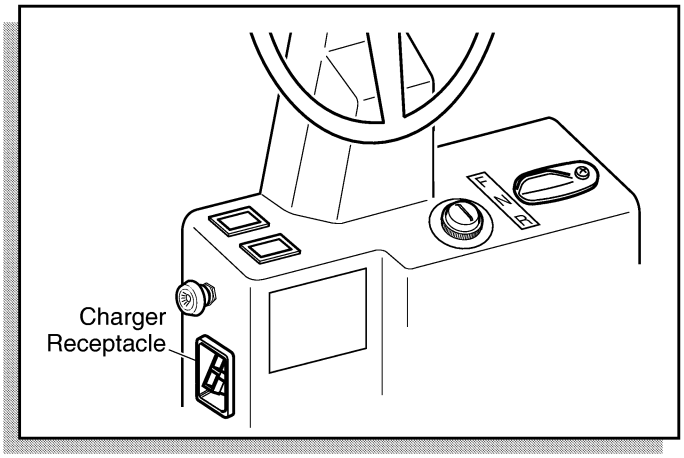


Fig. 3 Polarized Receptacle

NOTE *Looping the DC cord through the steering wheel when charging serves as a good reminder to store the cord out of the way when finished with charging. The DC plug can be damaged by driving over or catching the cord on the vehicle when driving away.*

The power (AC) cord is equipped with a grounded plug. Do not attempt to pull out, cut or bend the ground post.

⚠ WARNING ⚠ ***To prevent a physical hazard that could result in an electrical shock or electrocution, be sure that the charger plug is not damaged and is inserted into a grounded receptacle.***

The power (AC) cord is equipped with a grounded plug, do not attempt to pull out, cut or bend the ground post.

To disconnect charger before the charging cycle is completed, disconnect the AC cord from the AC outlet first and then disconnect the DC cord from the vehicle.

The charging (DC) cord is equipped with a polarized connector which fits into a matching receptacle on vehicle.

The power (AC) cord is equipped with a ground plug. Do not attempt to pull out, cut off or bend the ground plug.

NOTE *If vehicle is to be charged with a non Original Equipment Manufacturer (OEM) charger, refer to the instructions supplied with the charger. charger, refer to the instructions supplied with the charger.*

UNDERSTANDING THE PORTABLE CHARGER

The portable battery charger reacts to unusual situations in various ways.

- If the charger is disconnected from the vehicle during the charge cycle, it will shut off immediately.
- If the AC power is interrupted, the charge cycle will continue normally for the remainder of the cycle when the power is restored.
- If the batteries become fully charged in a short period of time (under 2 hours), the charger will shut off. If the open circuit battery voltage drops to the point that charge is required the charger will turn itself on until the batteries are fully charged.
- The charger features an internal timer that will permit no more than 16 hours of continuous charge.

⚠ WARNING ⚠ ***To prevent electrical shock or arc, which could cause serious body injury or damage to the facility or charger, unplug the charger from both the AC and DC power sources before starting any repair or maintenance procedure.***

OPENING THE CHARGERS

⚠ WARNING ⚠ ***Lethal voltages are present when charger is plugged in and the cover is removed.***

If you have any doubts regarding your ability to safely perform the following test, have the charger repaired by a trained electrician/technician.

Use extreme care not to permit the uninsulated portion of test leads to contact any other component or the chassis of the charger.

Remove the screws securing the cover to the sides of the charger (Ref Fig. 4 on page J-2). (On Board shown.)

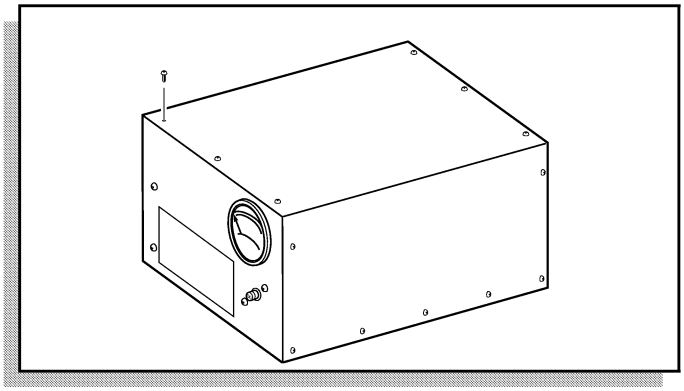


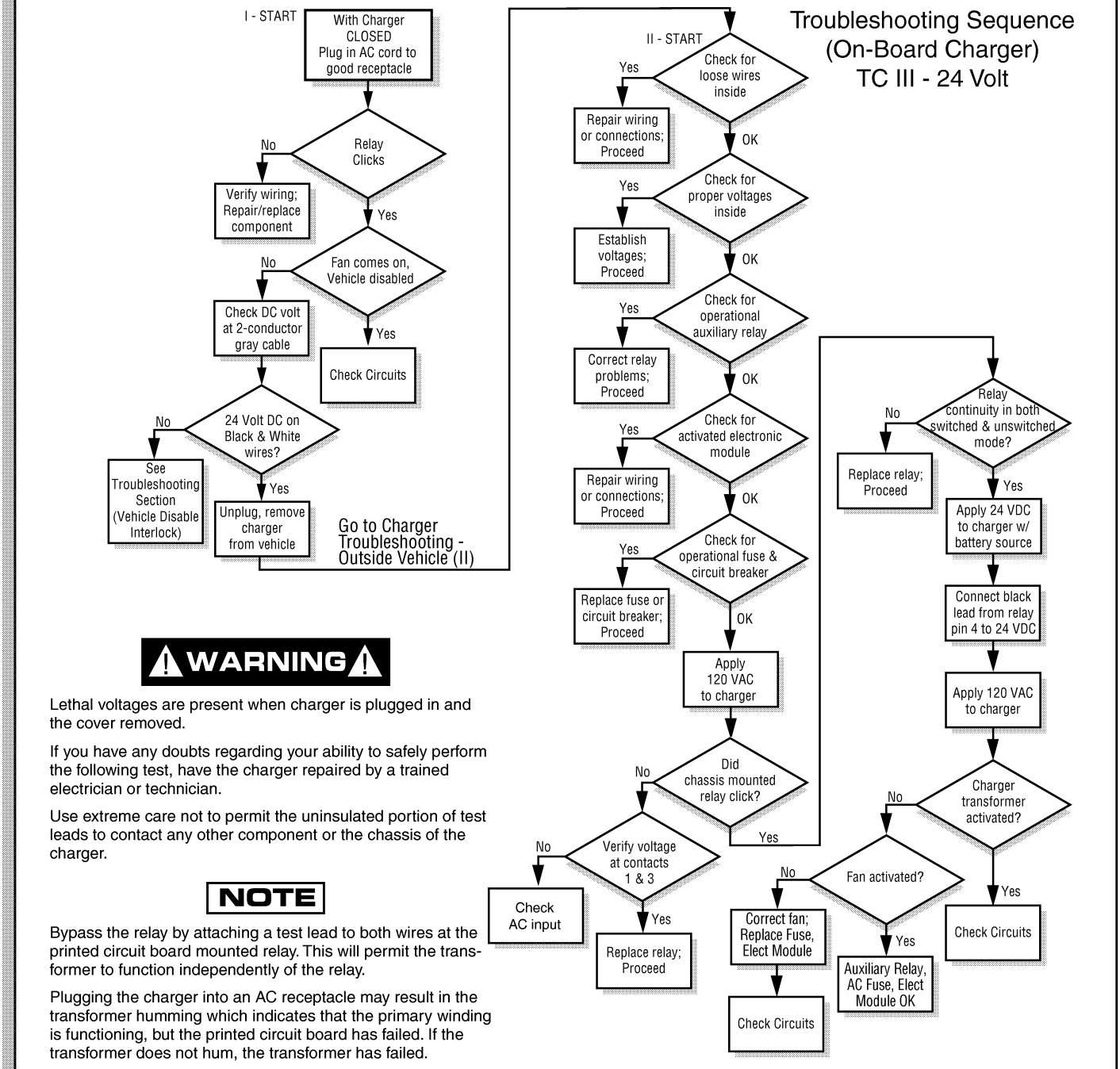
Fig. 4 Opening the Charger

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

TROUBLESHOOTING

Tool List	Qty. Required
DVOM	1
Phillips screwdriver	1

A simple but effective method of troubleshooting a battery charger that does not operate is to follow the sequenced troubleshooting procedures (Ref Fig. 5 on page J-3) (Ref Fig. 6 on page J-4) and wiring diagram (Ref Fig. 9 on page J-6) (Ref Fig. 10 on page J-7).



⚠ WARNING ⚠

Lethal voltages are present when charger is plugged in and the cover removed.

If you have any doubts regarding your ability to safely perform the following test, have the charger repaired by a trained electrician or technician.

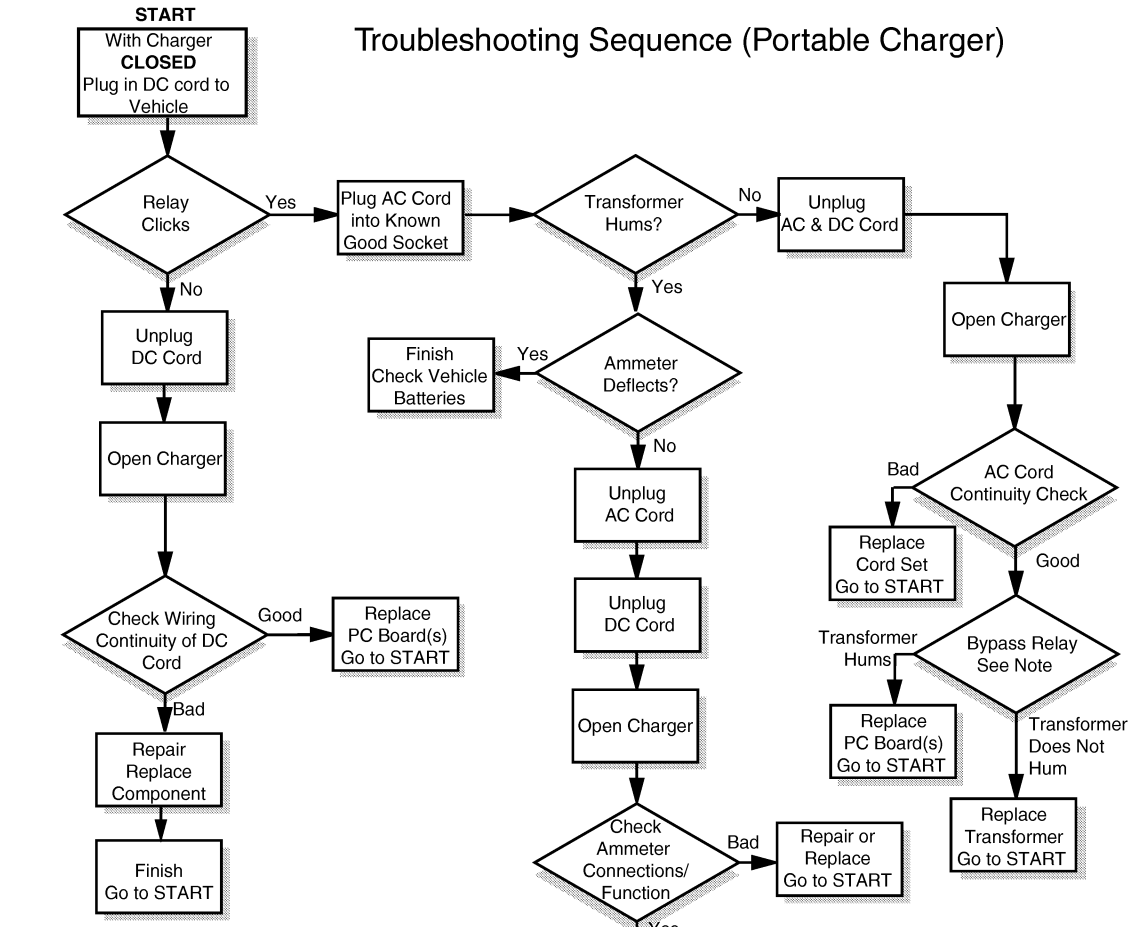
Use extreme care not to permit the uninsulated portion of test leads to contact any other component or the chassis of the charger.

NOTE

Bypass the relay by attaching a test lead to both wires at the printed circuit board mounted relay. This will permit the transformer to function independently of the relay.

Plugging the charger into an AC receptacle may result in the transformer humming which indicates that the primary winding is functioning, but the printed circuit board has failed. If the transformer does not hum, the transformer has failed.

Fig. 5 Troubleshooting Sequence (On-Board)



⚠ WARNING ⚠

Lethal voltages are present when charger is plugged in and the cover removed.

If you have any doubts regarding your ability to safely perform the following test, have the charger repaired by a trained electrician or technician.

Use extreme care not to permit the uninsulated portion of test leads to contact any other component or the chassis of the charger.

NOTE

Bypass the relay by attaching a test lead to both wires at the printed circuit board mounted relay. This will permit the transformer to function independently of the relay.

Plugging the charger into an AC receptacle may result in the transformer humming which indicates that the primary winding is functioning, but the printed circuit board has failed. If the transformer does not hum, the transformer has failed.

Fig. 6 Troubleshooting Sequence (Portable)

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

Continuity Checks

⚠ WARNING ⚠ ***Before attempting to perform a continuity check, disconnect the battery charger from both AC and DC power sources.***

To check for continuity, set the DVOM (digital volt ohm meter) to 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 the meter then to KΩ, the meter will indicate "0" when continuity is detected (Ref Fig. 7 on page J-5).

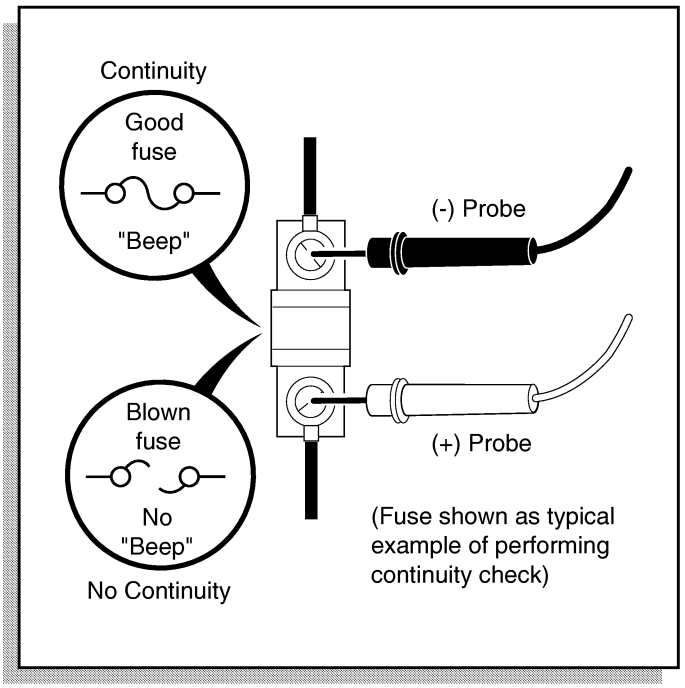


Fig. 7 Continuity Check

Diode Test Procedure

Tool List **Qty. Required**

DVOM 1

To test the diode, disconnect the battery charger AC power cord. With the DVOM set at highest ohms range available, place probes on diode as shown (Ref Fig. 8 on page J-5). A reading other than that shown indicates the diode is bad. Replace as necessary.

COMPONENT REPLACEMENT

When replacing components, reinstall in reverse order of disassembly. Pay particular attention to any wiring that may have been disconnected, being sure to replace in original position.

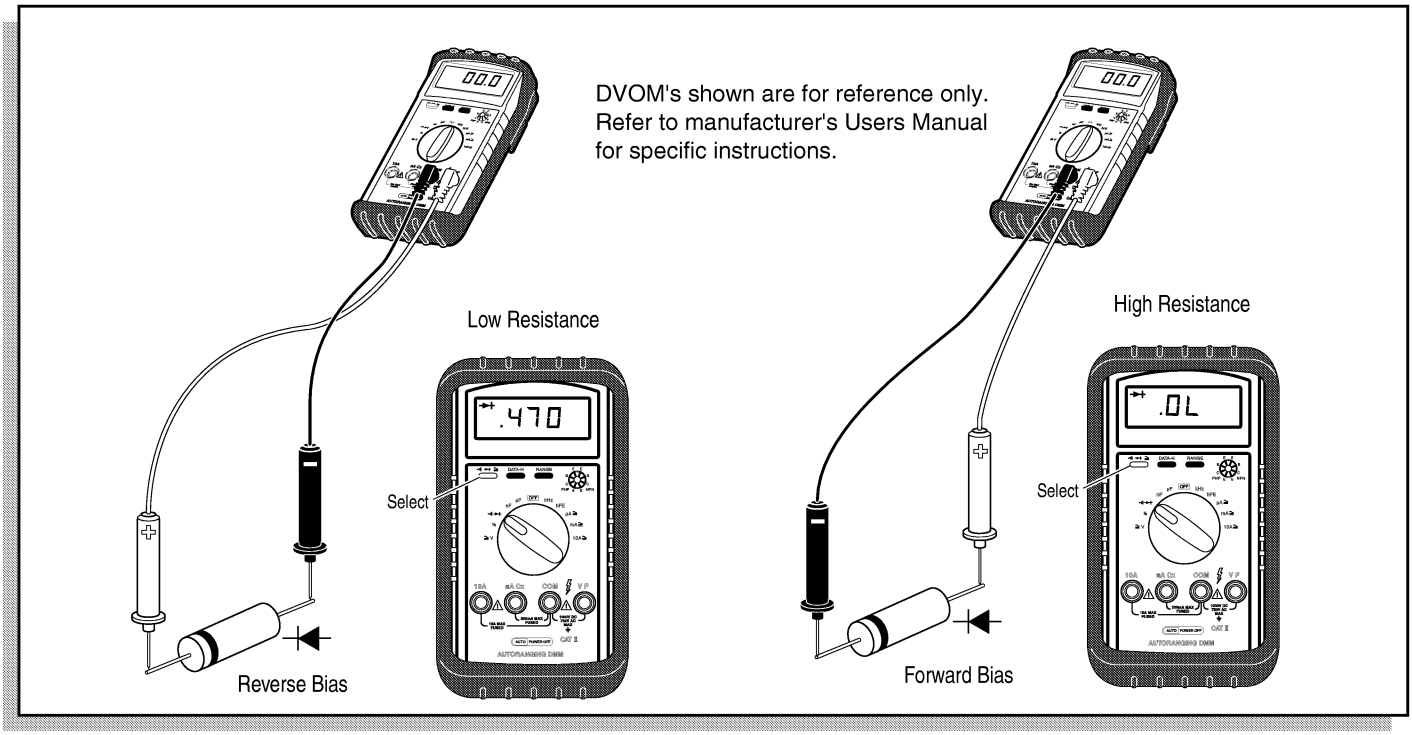


Fig. 8 Diode Test Procedure

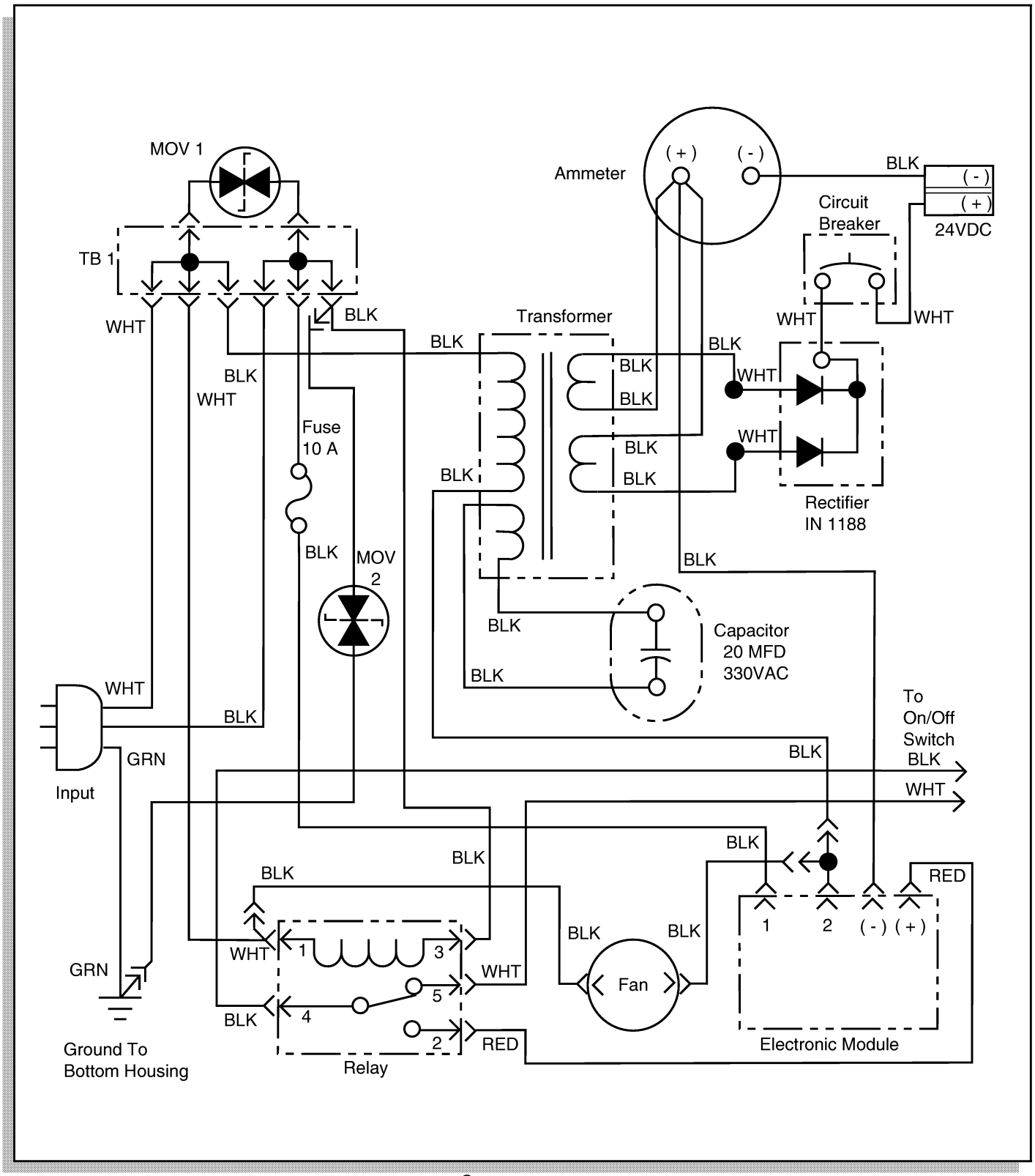


Fig. 9 Total Charge® III Wiring Diagram (On-Board)

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

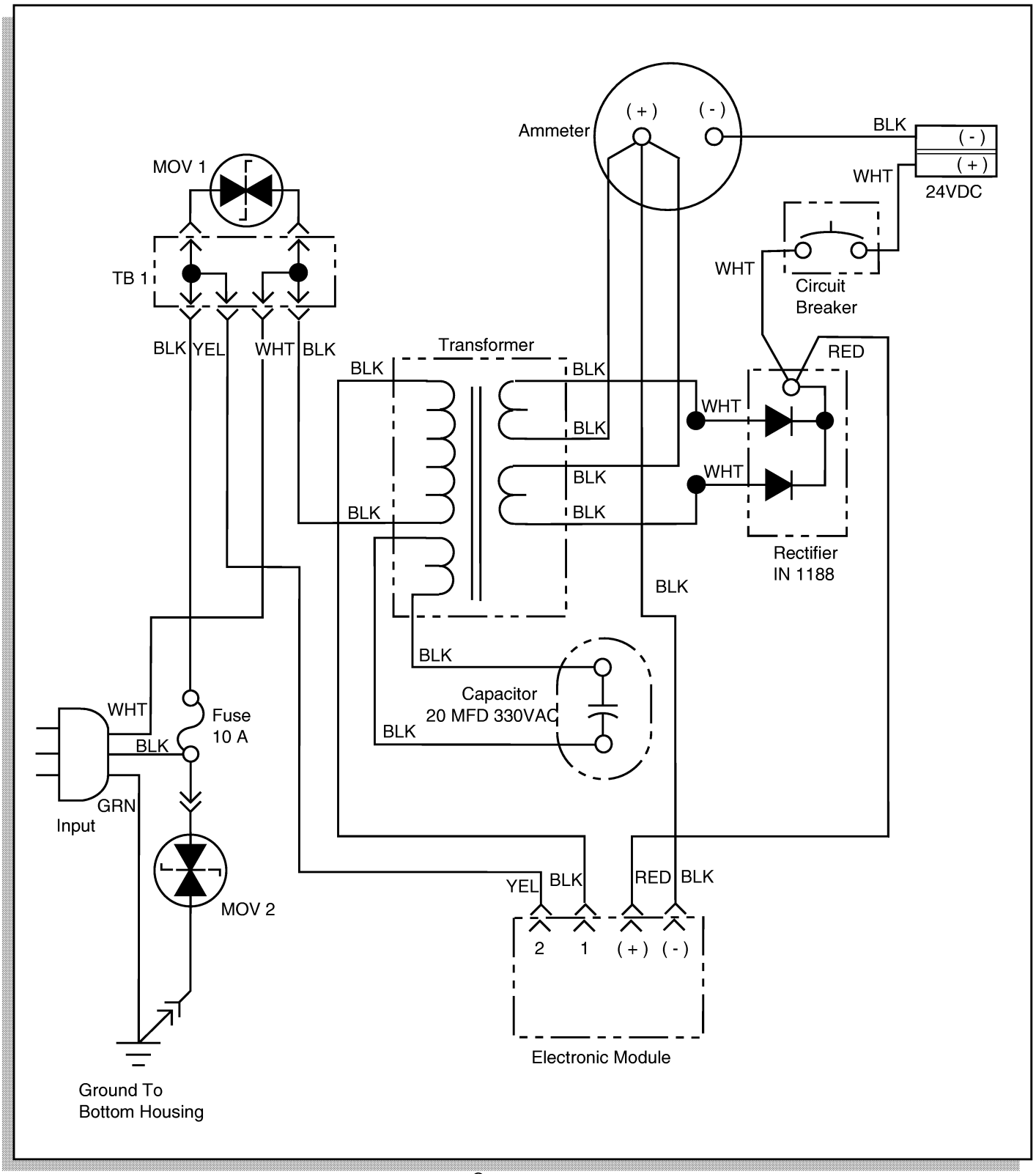


Fig. 10 Total Charge® III Wiring Diagram (Portable)

BATTERY CHARGER

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

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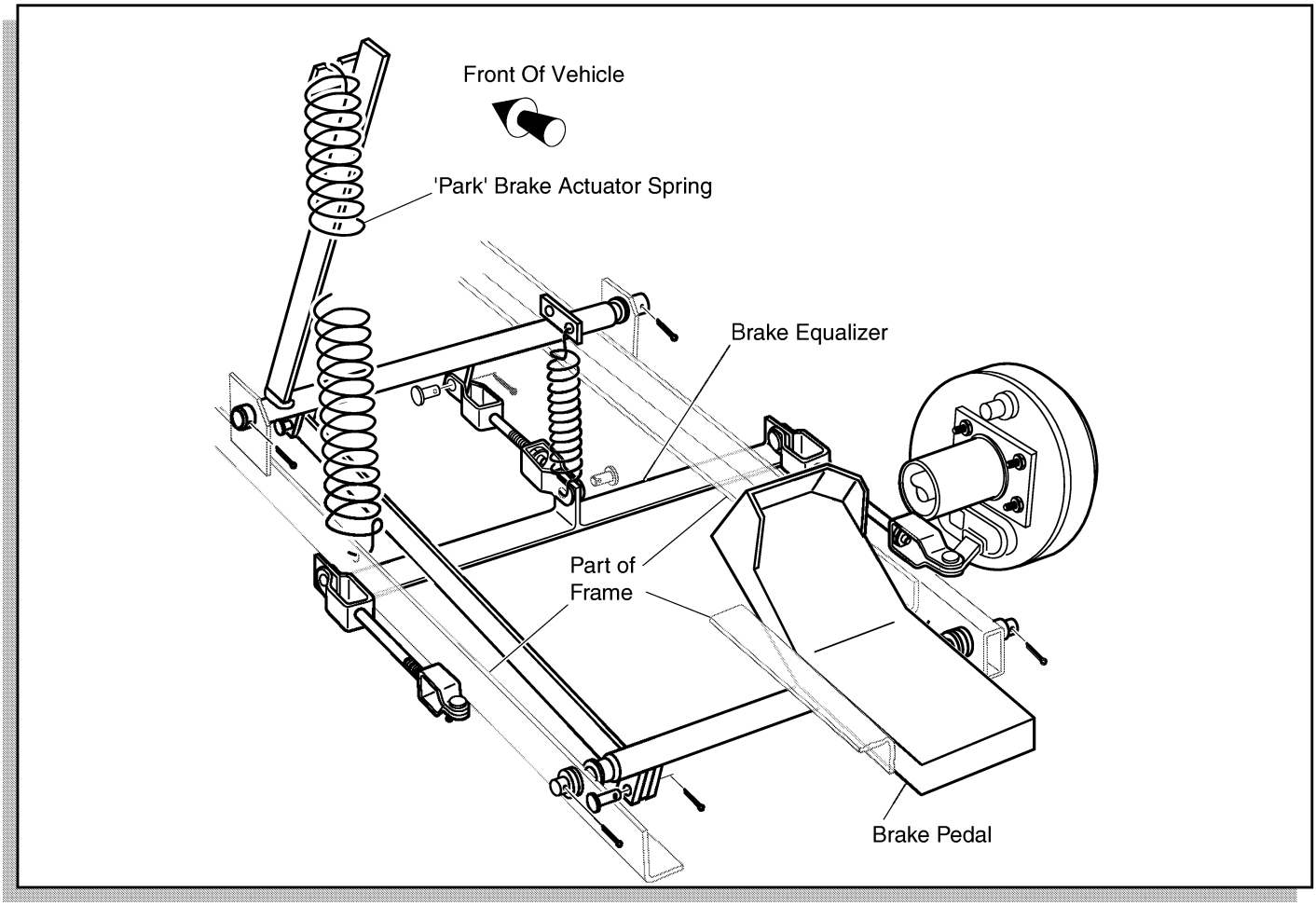

Fig. 1 Brake System

NOTE *To assure correct braking performance, all periodic maintenance, inspections and procedures must be performed as indicated in the Periodic Service Schedule in Section 'A' of this manual.* ***It is most important that a Daily Brake Performance Test be performed and the entire brake system be serviced in accordance with the Periodic Service Schedule****.*

GENERAL

The brake system is mechanical and consists of actuating linkages and manually adjusted wheel brake assemblies (Ref Fig. 1 on page K-1). The actuating linkages require periodic adjustment to compensate for the normal wear of system components. Replacement of any linkage components will also require a linkage adjustment.

The wheel brake units are manually adjusted which requires periodic adjustment to compensate for brake shoe wear. The brake **does** require routine inspection and lubrication of the backing plate and adjuster mechanism (See Periodic Service Schedule in Section 'A' of this manual).

NOTE *If* ***any*** *brake system component is replaced, the* ***entire*** *brake system must be adjusted.*

To determine the adequacy of the vehicle brake system, a brake performance test should be performed daily.

DAILY BRAKE PERFORMANCE TEST

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

General

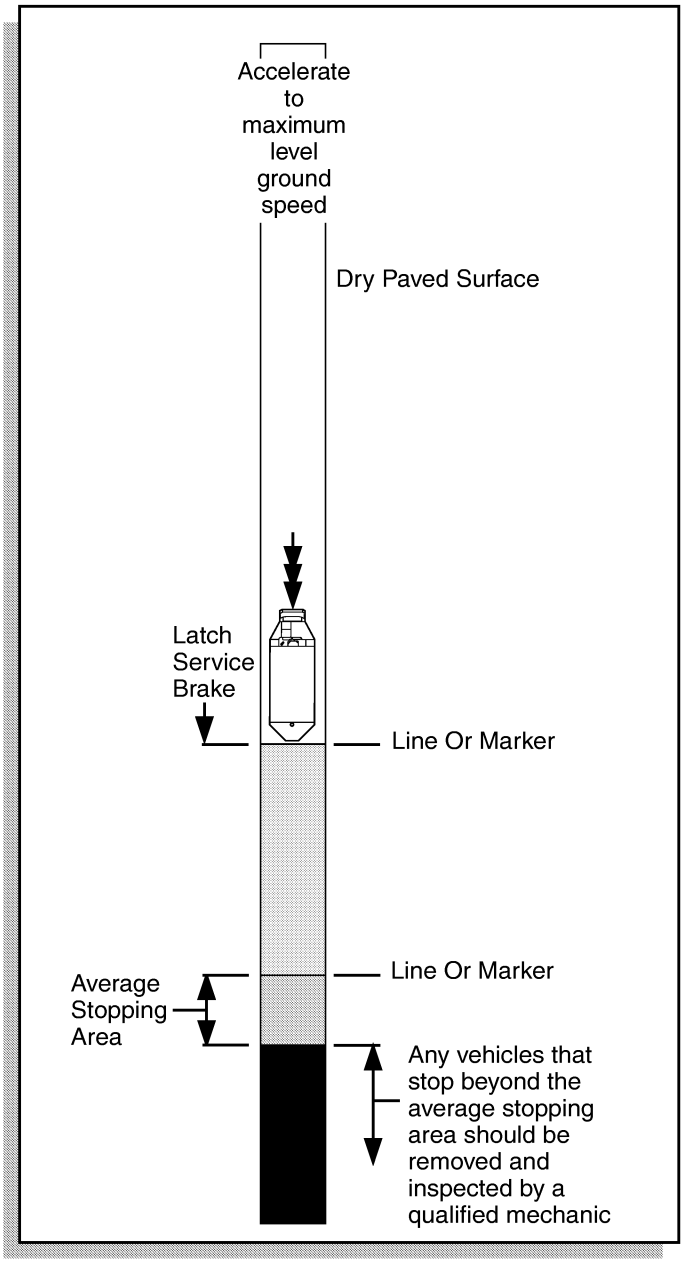

Fig. 2 Typical Brake Test

Since weather conditions and terrain frequently vary, no specific braking distance can be specified. The test is intended to compare similar vehicles by applying the parking brake (to eliminate different pedal pressures) at a common point to determine if any vehicle shows significantly different braking characteristics from other vehicles being tested.

Since loss of braking performance can deteriorate over a prolonged period, brake performance characteristics should also be compared to the performance of a new vehicle.

Test Method

On a dry paved surface that is free of gravel, sand, etc., approach a marker at full speed (Ref Fig. 2 on page K-2). Engage the service brake at the marker and observe the stopping distance of the vehicle. Any vehicle that stops in a significantly greater distance than an acceptable vehicle should be tested again. If it again fails to stop in an acceptable distance, it should be immediately removed from service and inspected by a qualified mechanic.

The mechanic should perform a 'panic stop' by applying maximum force and travel to the service brake pedal while moving at full speed. If one wheel fails to lock, it is reasonable to expect that a problem exists with the service brake system and a complete brake maintenance (described elsewhere in this section) must be performed.

Test the vehicle before returning it to service.

SIX MONTH BRAKE SYSTEM MAINTENANCE

Raise the entire vehicle (as specified in Section B - Safety).

Rotate each rear wheel by hand. Feel for a dragging brake shoe that prevents smooth movement of the wheel and brake drum.

Remove the clevis pin from both connecting rods where they attach to the wheel brake levers (Ref Fig. 1 on page K-1).

Again rotate each wheel by hand and feel for a dragging brake shoe that prevents smooth movement of the wheel and brake drum. If the wheel rotates more smoothly than with the brake rods attached, an out of adjustment braking system is indicated and **must** be repaired.

Inspect the connecting rods for damage. A damaged connecting rod will result in the system dragging. Any worn or bent rod **must** be replaced. Operate the brake pedal and observe the movement of the rods. Both should move the same amount and return fully when the brake pedal is released. If the brake pedal does not return to the full upright position, excess pedal bushing

friction is indicated or a system is in need of service. The bushing must be removed and lubricated or replaced. Observe the equalizer bar to see if it pivots during operation of the brake pedal. A pivoting equalizer bar, uneven movement or failure of the brake rods to return fully indicates a dragging brake system which **must** be repaired.

Remove each brake drum and shoes according to procedures indicated in **BRAKE DRUM REMOVAL** and **BRAKE SHOE REMOVAL** sections. Clean and inspect all brake parts. If there is evidence of rust or if the lever slide mechanism does not move smoothly in the backing plate, the surfaces must be cleaned and smoothed using an emery cloth. The backing plate **must** be replaced if excessive wear such as gouges or galling are in evidence on the backing plate.

HOW THE BRAKE SYSTEM WORKS

Wheel Brake Servo Action

NOTE *The wheel brakes are 'servo acting' and will require periodic adjustment. Periodic inspection and lubrication of the wheel brake is required as part of the routine brake maintenance procedure.*

The actuating linkage may require periodic adjustment to compensate for normal component wear or the replacement of individual components.

The brake system is a servo action brake.

When the accelerator pedal is released, the linkage pulls the brake lever forward which, in turn, pushes the rear brake shoe rearward and against the brake drum. This, in turn, reacts against the lever slide mechanism which forces the front brake shoe to move forward against the drum. At this point, the servo action is moving forward when the brakes are applied, the rear brake shoe moves upward applying force against the upper rear portion of the brake drum. The front brake shoe moves downward applying force against the lower front portion of the brake drum.

The action reverses when the vehicle is operating in reverse (Ref Fig. 3 on page K-3).

Normal brake wear will show wear in quadrants A, B, C and D with quadrant 'A' showing the most wear, 'B' the second most wear, and etc. Quadrants A and D will always be toward the front of the vehicle.

The brake shoes should be replaced when lining thickness (measured at point of greatest wear) becomes approximately .040 thick.

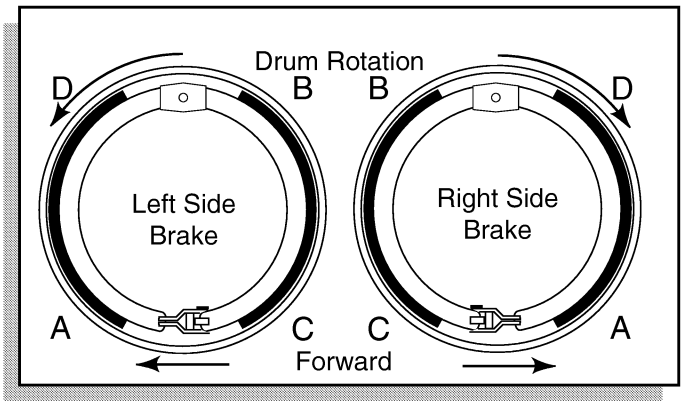

Fig. 3 Servo Action

It is very important to the function of the brake assembly and to proper wear of the brake lining that the brake be adjusted properly. If the brakes are adjusted by the brake linkage rod (attached to brake pivot) only, the geometry of the brake mechanism is compromised resulting in rapid and abnormal wear of the brake linings. This also results in a high braking effort at the brake pedal.

Wheel Brake Adjuster

The brake adjusting screw (anchor) has a conical shape with six flats at one end (Ref Fig. 4 on page K-3).

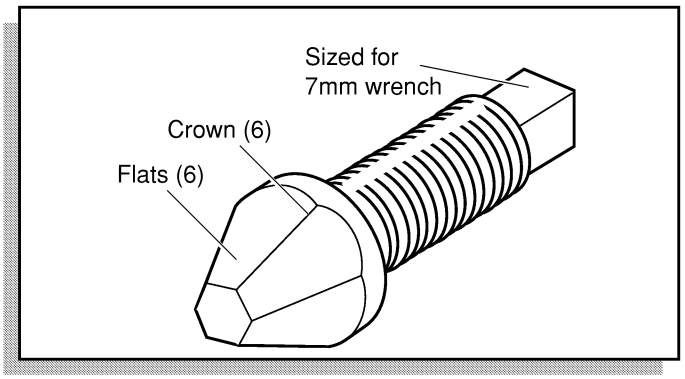

Fig. 4 Adjusting Screw

An extension spring holds the front and rear brake shoes against two (2) anchor pistons that ride on the conical end of the adjusting screw (Ref Fig. 5 on page K-4). A ratcheting or indexing effect is encountered when turning the adjusting screw as the two anchor pistons are forced outward by the crowns and pulled back into the flats by the spring.

Tool List	**Qty. Required**
Hydraulic floor jack	1
Jack stands	4
Chocks	4
Open end wrench, 7 mm	1

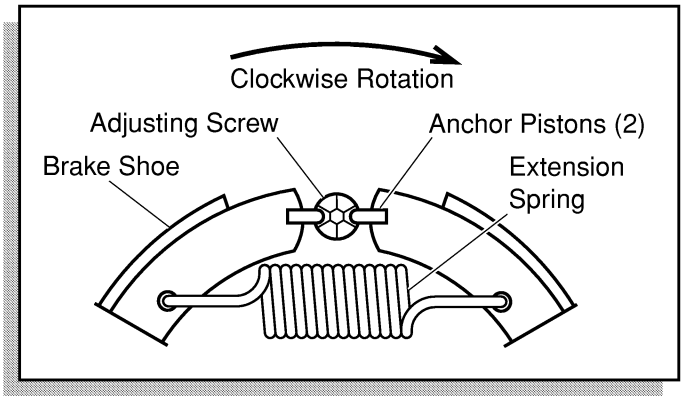

Fig. 5 Brake Adjustment

When tightening the adjusting screw, raise the rear of the vehicle and install jack stands. Remove the wheel and tire assembly, leaving the brake drum on the axle. Facing the brake assembly from the side of the vehicle, reach over the top of the brake and remove the adjusting screw boot. With a wrench, turn the adjusting screw counterclockwise until it will no longer turn. (**Do not force**.) Notice that the screw will turn clockwise easily but will not turn counterclockwise. This means that the brake shoes have expanded against the drum and that the crowns of the adjusting screw cannot expand the brake shoes any more.

CAUTION **Forcing of the screw to turn counterclockwise can cause internal damage to the adjusting mechanism.**

Turn the adjusting screw clockwise to the last flat that was encountered during tightening. Starting at this flat, turn the adjusting screw clockwise three more flats.

Replace the adjusting screw boot.

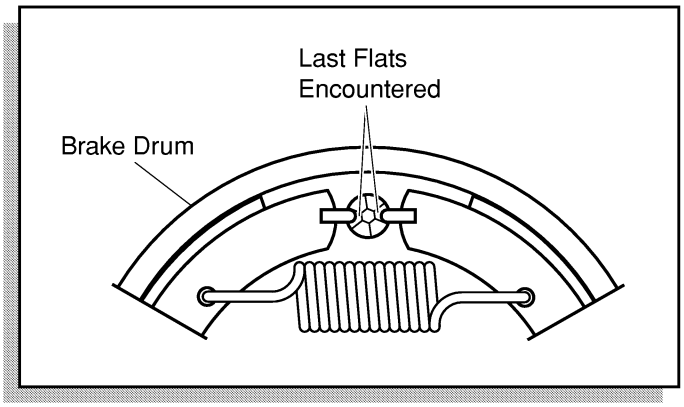

Fig. 6 Tightened Adjuster

BRAKE DRUM AND SHOE REMOVAL

Brake Drum Removal

Tool List	Qty. Required
Hydraulic floor jack	1
Jack stands	4
Chocks	4
Plastic faced hammer	1

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

To remove the brake drums, lift the entire vehicle and support on jack stands. Tap the brake drum lightly with a plastic faced hammer to loosen the drum. If the drum will not come off, it will be necessary to loosen the adjusting screw.

Remove the brake drum.

WARNING ***Do not machine drums in order to true up the braking surface.***

Slight scores in the drum brake surface may be removed by lightly polishing with a fine emery cloth. An extensively scored drum will cause excessive brake lining wear and must be replaced with a new drum. An out-of-round drum makes accurate brake adjustment impossible due to its eccentric action. A drum that is more than .010 inch out-of-round on the inside diameter should be replaced with a new drum.

CAUTION **Gasoline or kerosene should not be used as there is a danger that a portion of the diluted oily substrate may be left on the braking surface.**

It is recommended that a suitable greaseless type solvent be used to clean the braking surface of brake drums before they are placed in service to assure the cleanest possible surface.

Brake Shoe Removal

Tool List	Qty. Required
Hydraulic floor jack	1
Jack stands	4
Chocks	4
Plastic faced hammer	1
Pliers	1

Using a pair of pliers, compress the brake shoe spring retainer (1) at the open end of spring (Ref Fig. 7 on page K-5). While holding the tension pin (2) with the pliers, turn the retainer spring 1/4 turn to align the slot in the spring retainer with the flats on the tension spring.

CAUTION **Do not turn the pins as their seal may be broken.**

Remove the brake shoe retainer springs.

Grasp the brake shoes (3) in the center and tilt them outward and away from the back mounting plate. This will release the tension on the brake springs (4). Remove the brake springs and remove the brake shoes.

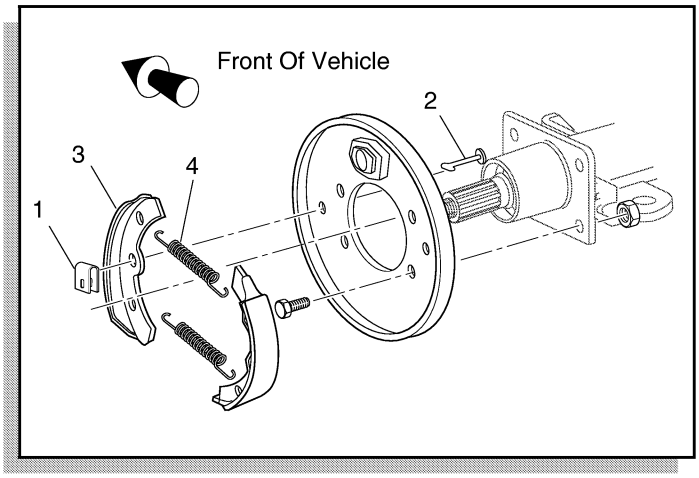

Fig. 7 Wheel Brake

Brake Removal

Tool List	Qty. Required
Hydraulic floor jack	1
Jack stands	4
Chocks	4
Ratchet, 1/2” drive	1
Socket, 1/2”	1
Retaining ring puller	1

To remove the brake assembly for axle or seal replacement, the brake must be removed. Raise the vehicle and support on jack stands. Remove the wheel and brake drum.

Remove the retaining ring from the inside of the axle tube and pull the axle and bearing assembly outwards.

Remove the cotter pin and clevis pin attaching the brake actuator to the brake lever. Using 1/2” socket wrenches, remove the four bolts and nuts attaching the brake assembly to the axle and remove the brake assembly.

Reinstall brake in the reverse order of disassembly. Tighten the brake mounting bolts to 23 - 25 ft. lbs. 31 - 34 Nm) torque.

CAUTION **Use care to prevent damage to seal.**

Clean the axle shaft to remove grease, dirt and all foreign matter. Apply small amount and lubricant (Neversieze) to the spline. Install the axle and bearing assembly and reinstall retaining ring.

RECOMMENDED BRAKE ADJUSTING PROCEDURE

NOTE *If there is any doubt whether or not the brakes have been adjusted properly in the past, then it is recommended that before any adjustments is made at the brake adjusting screw that the brake pedal linkage rod be loosened to allow plenty of slack in the system. This will allow the brake lever to return to its proper position. Proceed with step 1.*

1. Lift the entire vehicle off the ground and support on jack stands.
2. Remove the wheel and tire assembly.
3. Face the brake assembly from the side of the vehicle, reach over the top of the brake and remove the brake adjusting boot.
4. While holding the drum in place, turn the adjusting screw counterclockwise until the adjusting screw will no longer turn. **Do not force.**
5. Turn the adjusting screw clockwise until it indexes on the last flat surface encountered when tightening.
6. Starting at this flat, turn the adjusting screw clockwise three more flats.
7. Replace the rubber boot and wheel and tire assembly.
8. Repeat steps 1 - 7 on the other side of vehicle.
9. After adjusting the brake with the brake adjusting screw, check to see if the brake is fully engaged with the foot pedal assembly at rest. Check to see that the brake is fully released as the foot pedal engages the accelerator switch. The brakes need to be fully released before the activator block on the accelerator switch is moved. If any of these conditions are not as described, proceed with the following adjustments.
10. With the foot pedal assembly against the stop, adjust the accelerator switch linkage rod so that the activator block is against the forward stop.

11. Pump the foot pedal to be sure accelerator switch travels stop to stop. Readjust as necessary.
12. With the foot pedal in the rest position, adjust the brake lever yoke rods to remove any slack while keeping the brake equalizer parallel. with the control arm. Adjust the brake yokes equally to fully engage brakes when accelerator switch is approximately 1/2" from engagement or activation (full engagement is when tire will not rotate with moderate force). Make sure brakes are fully released before accelerator switch is engaged.
13. Activate the brake system a minimum of 10 times to ensure consistent operation. Re-adjust if necessary to ensure full accelerator switch travel and full brake engagement.

NOTE *This procedure will eliminate any high braking effort and/or dragging brakes.*

The brake manufacturer recommends the surfaces of the brake lever slide mechanism be lubricated with grease every three to four months of normal operating conditions.

CAUTION **If free movement cannot be obtained with lubrication, the entire back plate assembly must be replaced. No disassembly of slide lever mechanism may be accomplished.**

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REAR AXLE

N

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

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

Refer to REAR SUSPENSION section for axle removal.

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

Clean the area around the check/fill plug and remove plug. The correct lubricant level is just below the bottom of the threaded hole. If lubricant is low, add lubricant as required. Add lubricant slowly until lubricant starts to seep from the hole. 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 Fig. 1 on page N-1).

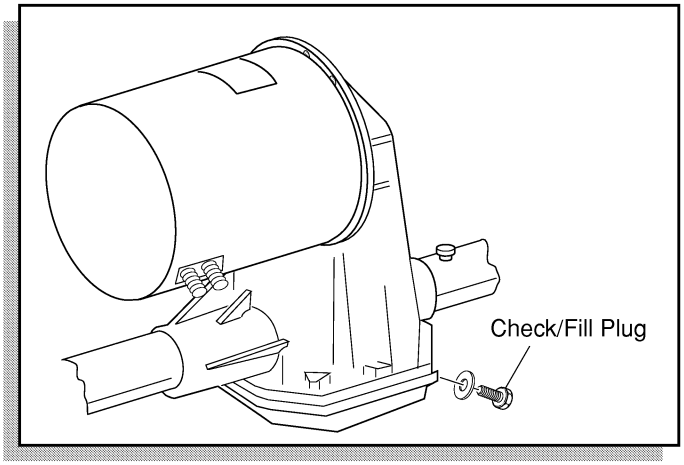

Fig. 1 Add, Check and Drain Rear Axle Lubricant

REAR AXLE DISASSEMBLY

CAUTION **The rear axle is a precision assembly, and therefore any repair or replacement of parts must be done with extreme care 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 care.

Snap rings must be removed/installed with care to prevent damage of bearings, seals and bearing bores.

NOTE *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 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.***

Axle Shaft Removal and Disassembly

Tool List	Qty. Required
Arbor press	1
Bearing separator	1
Needle nose pliers	1
Internal snap ring pliers	1
Slide hammer, P/N 18753-G1	1

For brake drum removal, see BRAKES section.

Remove the outer snap ring from the axle tube (Ref Fig. 2 on page N-1).

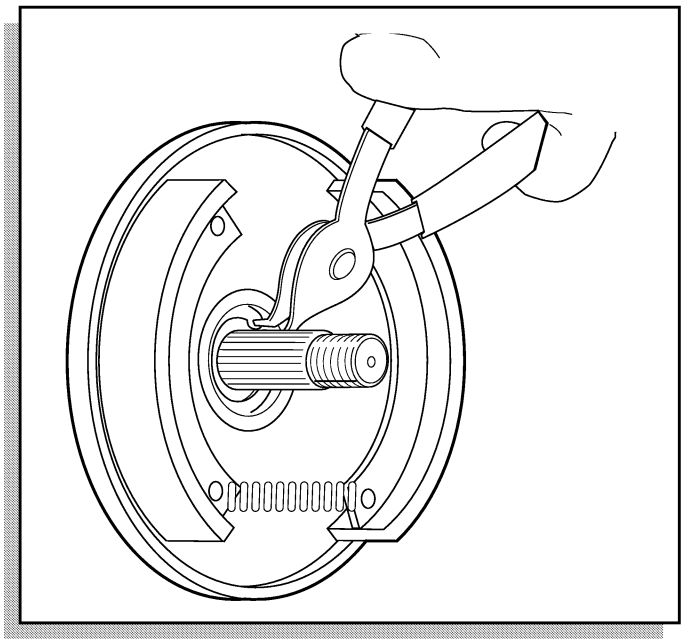

Fig. 2 Removing/Installing Outer Snap Ring

Attach a slide hammer to the axle shaft thread and remove the axle and bearing from the axle tube (Ref Fig. 3 on page N-2).

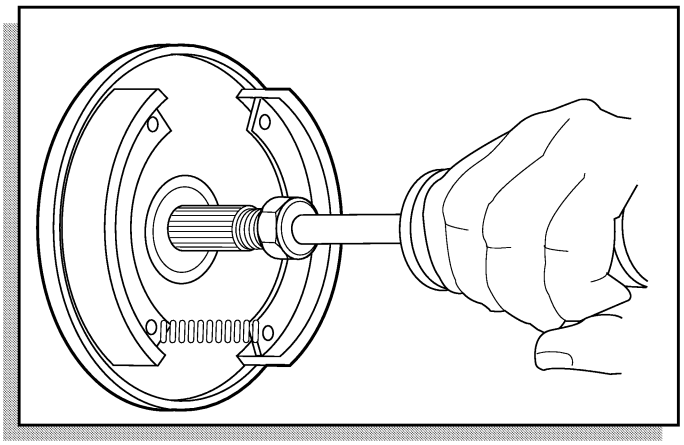

Fig. 3 Removing/Installing Axle Shaft

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 Fig. 4 on page N-2).

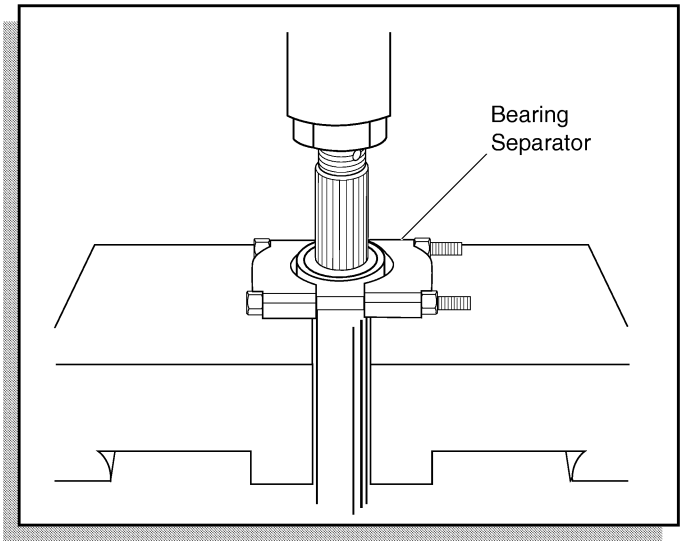

Fig. 4 Pressing Bearing from Axle Shaft

Axle Shaft Seal Removal and Replacement

Tools List	Qty. Required
Internal snap ring pliers	1
Seal puller	1
Seal installer, P/N 18739-G1	1
Ball peen hammer	1

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

Remove the inner snap ring (Ref Fig. 5 on page N-2).

Use a puller to remove the seal (Ref Fig. 6 on page N-2).

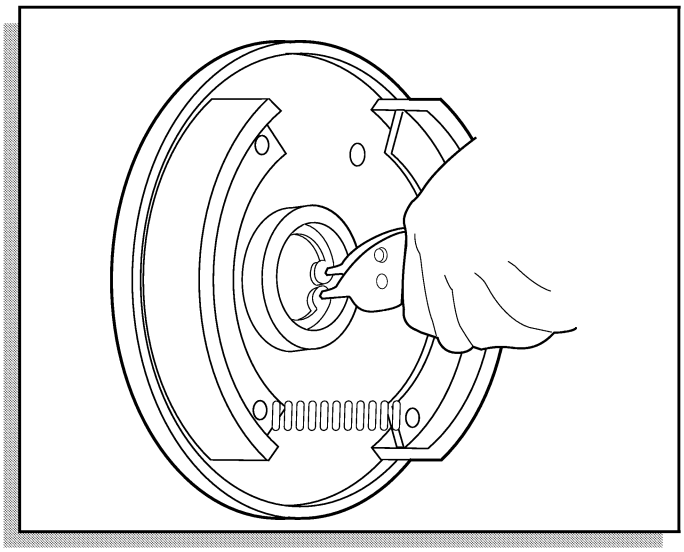

Fig. 5 Removing/Installing Inner Snap Ring

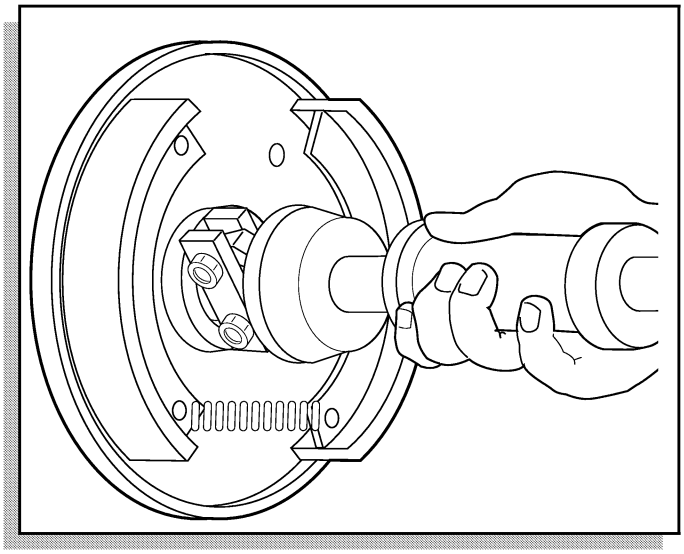

Fig. 6 Removing Seal

To install the seal, use the special seal installer to drive the seal into its correct position (Ref Fig. 7 on page N-3).

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

Install the inner snap ring (Ref Fig. 5 on page N-2).

Axle Shaft Replacement

Carefully insert the axle shaft and bearing through the oil seal. Rotate the shaft until the spline engages with the differential side gears. Install the outer snap ring.

Coat the outboard spline of the axle with a commercially available anti-seize compound. Install the brake hub and

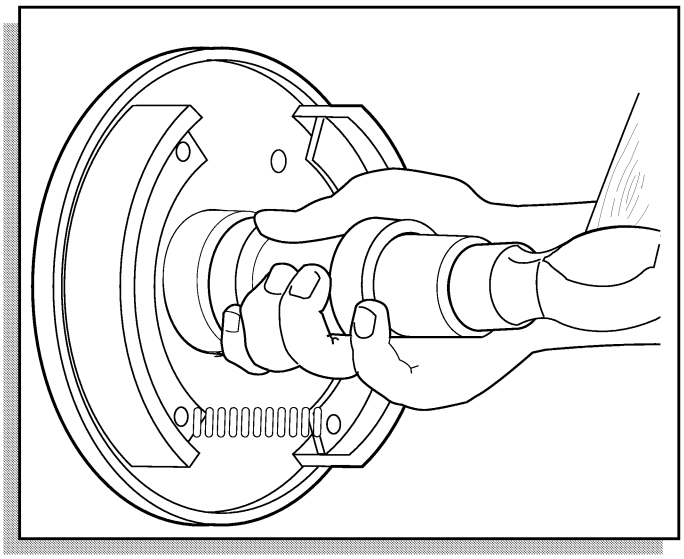

Fig. 7 Installing Seal

drum, thrust washer, nut and new cotter pin (Ref Fig. 8 on page N-3).

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

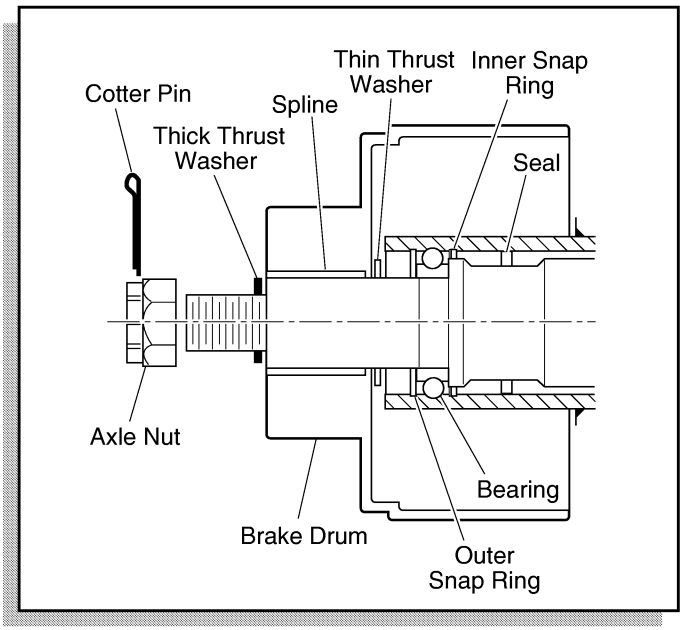

Fig. 8 Cut Away of Outer Bearing and Brake Drum

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

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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 respirator, following manufacturers instructions to protect from overspray and air borne mist.

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

The manufacturer can provide touch up paint in convenient touch up pens and aerosol spray cans to match the vehicle color.

Minor Scratches

For minor scratches, the following steps be taken to repair the steel body panels:

I. Thoroughly clean the surface to be repaired with alcohol and dry.

II. Touch up damaged area with sequential coats (two coats minimum recommended, allowing 30 - 45 minutes between coats, increasing to 45 - 60 minutes in higher humidity) using brush-on touch-up paint, until coating layer is visible, slightly above the surface of the part.

III. Use 400 grit "wet" sand paper to blend touch up area level with the rest of the part being repaired. Use a polishing compound (3M Finesse or automotive grade) to renew gloss and to further blend and transition newly painted surface.

IV. Clean with alcohol and dry.

V. (Optional but recommended) Follow this process with clear coat to renew and protect depth of finish.

VI. Wax or polish with Carnauba base product, available at any automotive parts distributor.

Larger Scratches

For larger scratches, the following steps be taken to repair the steel body panels:

I. Thoroughly clean the surface to be repaired with alcohol and dry.

II. Mask the area to be painted (common masking tape is adequate) prior to repair and use aerosol type touch-up paint.

III. 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.

IV. After painting, allow to dry overnight. Smooth the mask lines using 400 grit "wet" sand paper to blend touch up area level with the rest of the part being repaired. Use a polishing compound (3M Finesse or automotive grade) to renew gloss and to further blend and transition newly painted surface.

V. Clean with alcohol and dry.

VI. (Optional but recommended) Follow this process with clear coat to renew and protect depth of finish.

VII. Wax or polish with 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 steel panels. All body shops should be familiar with the materials and processes required.

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

PAINT

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

Notes:

LIGHTNING PROTECTION AND GROUNDING

R

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LIGHTNING PROTECTION AND GROUNDING

Notes:

LIGHTNING PROTECTION AND GROUNDING

Read all of Section B and this section before attempting any procedure. Pay particular attention to all Notes, Cautions and Warnings

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EFFECTIVE: 10/19/92	SUPERCEDES: Rev -, ECN 027194	

1. Grounding Requirements

For the purpose of this specification, building ground systems should serve two primary functions: personal safety and equipment protection. In order to be effective, all elements and functions of building ground system must receive equal consideration in design and installation. Once installed, it is up to the owner to adequately maintain the system by implementing periodic inspections and ground tests in order to determine its effectiveness.

2. Ground Systems

All electronic equipment is inherently related to earth by capacitive coupling, accidental or incidental contact and intentional connection. The earth forms a natural readily available form of common potential reference for all electrical circuits. For maximum effectiveness, grounding must be looked at from a total system viewpoint, with various sub-systems comprising the total facility ground system. The interconnection of the various sub-systems into a building ground system will provide a direct path, of known low impedance, between earth and the various electrical and other equipment. This effectively extends an approximation of ground reference throughout the building. The total building ground system is composed of an earth electrode system, a lightning protection system and an equipment fault protective system.

Resistance To Earth: The resistance to earth of the ground system should not exceed 10 ohms. Where the resistance of 10 ohms cannot be obtained due to high soil resistivity, rock formations or other abnormal conditions, alternate methods for reducing the resistance to earth must be considered.

Chemical Treatments: No salt, coke or other chemicals may be used to treat the soil in order to obtain the required ground resistance readings. Approved methods of enhancement are bentonite clay or the GEM product for ground enhancement as manufactured by Erico Products of Solon, Ohio.

Ground Tests: The resistance to earth of the ground system shall be measured by the “Fall of Potential Method”. Acceptable resistance meters/testers are those manufactured by Biddle or AEMC.

3. Lightning Protection Requirements

The external lightning protection system shall be designed and installed by a contractor who specializes in the lightning protection field. The contractor must be listed with Underwriters Laboratories Inc. and be in good standing. All work shall be under the direct supervision of a Certified Master Installer with current credentials from the Lightning Protection Institute.

The materials and design for the structure will comply with the most recent edition of the National Fire Protection Association Lightning Protection Code, NFPA 780 and the Materials Standard for Safety from Underwriters Laboratories UL96. Materials for this project may be those of Harger Lightning Protection, 1066 Campus Drive, Mundelein, Illinois (800-842-7437).

Upon completion of the project, the contractor will supply to the owner the Master Label issued by Underwriters Laboratories.

4. Equipment Fault and Personal Safety System

The standard method of providing an equipment fault protection ground network is to run a good ground conductor (green wire) through the conduit together with the AC distribution system. This method is required for all types of conduit, including metallic.

5. Ground Network Requirements

Install the conduit in accordance with local regulations or as prescribed by the National Electrical Code.

6. External Grounding Requirements

For optimum results, earth electrode installation must be accomplished early in the construction of a new site. The earth electrode system should be established at the same time utilities are installed to insure proper interconnection of all utility grounds/systems.

For existing sites, the earth electrode installation shall be constructed using the most economical means possible in order to meet the intent of this specification.

Prior to the installation or design of the ground system, a survey should be taken in order to determine the earth resistivity, types of soil or any manmade features that may have a significant effect upon the efficiency of the grounding system. Based on the information gathered, deviations from this specification (Exceeding normal requirements) may be necessary in order to achieve desired results.

7. Materials

Ground Rod Electrodes: Ground rod electrodes shall have a minimum diameter of 5/8" and be no less than 10’-0" in length. Rods may be copper, copper-clad steel or stainless steel. Galvanized steel rods are not permitted unless it is determined that the galvanized rod will have a longer life expectancy due to soil conditions.

Ground Rod Spacing: Ground rods shall not be spaced at intervals exceeding 60’-0" around the perimeter of the structure.

Ground Loop Conductor: In no case shall the ground loop conductor be smaller than a 2/0 AWG bare, stranded, soft drawn copper wire. The ground loop must be installed at least 24" below grade and be at least 24" away from the structure. All bends in the conductor shall have a minimum radius of 8" and be no less than 90 degrees.

Ground Mats: In areas where electrodes cannot be driven, a ground mat consisting of a #6 solid copper or a copper-copper clad steel mesh, utilizing a 12" x 12" cross pattern may be used. All inter-connections in the mesh shall be brazed or silver soldered.

Ground Plates: Ground plates if utilized shall be 24" x 24" x .032" thick solid copper. Ground plates should only be used if a ground rod cannot be driven.

Ground Connections: Unless otherwise specified or approved by the owner, all connections below grade shall be by exothermic weld (Cadweld). Where exothermic welds may not be practical, UL approved grounding clamps that utilize two bolts for pressure may be used. NOTE: Prior approval must be obtained in order to use a mechanical connection below grade.

8. Earth Electrode System

The earth electrode system consists of a network of earth electrode rods, plates, mats or grids and their interconnecting conductors. The extensions into the building are used as the principle grounding point for connecting to the ground system serving the building. Ground potential is established by electrodes in the earth.

An electrode may be a metallic water pipe that has no isolation joints, a system of buried, driven rods interconnected with a bare wire that normally forms a ring around the building or a ground plane of horizontal buried wires. Depending upon soil conditions, building design and the existing water pipe networks, an electrode may be a combination of any of the above mentioned systems.

9. Lightning Protection System

The lightning protection system provides a non-destructive path to ground for lightning energy contacting or induced onto or in a building. To effectively protect from lightning damage, air terminals are installed according to the National Fire Protection Association Lightning Protection Code (NFPA 780). Air terminals will intercept the discharge to keep it from penetrating or structurally damaging the building. This is done by providing a low impedance path from the air terminals to the earth electrode system.

10. Equipment Fault and Personal Safety System

The equipment fault protective system ensures that personnel are protected from shock hazard and equipment is protected from damage or destruction resulting from faults (lightning induced surges) that may develop in the electrical system. Deliberately engineered ground conductors (green wire safety ground) shall be provided throughout the AC distribution system to afford electrical paths of sufficient capacity, so that protective devices can operate promptly and efficiently. The use of conduit for grounding in lieu of a dedicated green wire is unacceptable.

Install the green wire ground (#6 stranded) with the AC power distribution conductors. There shall be no green wires spliced within the conduit. All splices shall be performed at the appropriate junction boxes.

Bond the ground conductor to all pull boxes, junction boxes and power panels.

In existing facilities where an existing conduit is not large enough to accommodate an additional ground conductor, or where a conduit section is insulated from other conduit sections, an external ground conductor may be installed to maintain continuity. All mounting hardware and connectors shall be UL approved.

All DC chargers are to be grounded to the green wire ground using UL approved connectors. At no point should the chargers be isolated from the grounding system.

All interior grounding should return to a single ground point. From this location it is then connected to the exterior ground system. Optional Interior Ground Halo: If an interior ground halo is to be installed around the inside perimeter of the structure, this conductor (#2/0 green insulated minimum) shall be securely fastened to the structure.

All connections to the halo shall be made using UL listed connectors.

Transient Voltage Surge Suppression: TVSS shall be provided at the main electrical service entrance panel. Protection at this point shall be as follows:

UL 1449 Listed device

25,000 ampere surge capacity with maximum 495 volt clamping voltage

Protection should be Line to Ground, Neutral to Ground and Line to Neutral

Internally fused for safety

Failure mode indicator lights

Suppression may be as the 14000 series of Harger Lightning Protection, Inc., 1066 Campus Drive, Mundelein, IL (800-842-7437), or MBP 120EFI series from EFI Electronics Corporation, 2415 South 2300 West, Salt Lake City, UT (801-977-9009).

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GENERAL SPECIFICATIONS

S

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LIST OF ILLUSTRATIONS

GENERAL SPECIFICATIONS

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NOTE *Read and understand the following warnings before attempting to operate the vehicle:*

⚠ WARNING ⚠ ***To prevent personal injury or death, observe the following:***

When vehicle is to be left unattended, engage parking (PARK) brake, move direction selector to neutral, turn key to 'OFF' position and remove key.

Drive vehicle only as fast as terrain and safety considerations allow. Consider the terrain and traffic conditions. Consider environmental factors which effect the terrain and the ability to control the vehicle.

Avoid driving fast down hill. Sudden stops or change of direction may result in a loss of control. Use service brake to control speed when traveling down an incline.

Use extra care and reduced speed when driving on poor surfaces, such as loose dirt, wet pavement, gravel, etc.

All travel should be directly up or down hills.

Use extra care when driving the vehicle across an incline.

Stay in designated areas and avoid steep slopes.

Keep feet, legs, hands and arms inside vehicle at all times.

Avoid extremely rough terrain.

Check area behind the vehicle before operating in reverse.

Make sure the direction selector is in correct position before attempting to start the vehicle.

Slow down before and during turns. All turns should be executed at reduced speed.

Always bring vehicle to a complete stop before shifting the direction selector.

See GENERAL SPECIFICATIONS for standard vehicle load capacity.

NOTE *Read and understand the following text and warnings before attempting to service vehicle:*

In any product, components will eventually fail to perform properly as the result of normal use, age, wear or abuse.

It is virtually 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 care when working on any vehicle. When diagnosing, removing or replacing any components that are not operating correctly, take time to consider the safety of yourself and others around you should the component move unexpectedly.

Some components are heavy, spring loaded, highly corrosive, explosive or may produce high amperage or reach high temperatures. Battery acid and hydrogen gas could result in serious bodily injury to the technician/mechanic and bystanders if not treated with the utmost caution. Be careful not to place hands, face, feet or body in a location that could expose them to injury should an unforeseen situation occur.

⚠ WARNING ⚠ ***Before working on the vehicle, remove all jewelry (rings, watch, necklaces, etc.).***

Be sure no loose clothing or hair can contact moving parts.

Use care not to touch hot objects.

Raise entire vehicle and support on jack stands before attempting to run or adjust powertrain.

Wear eye protection when working on or around the vehicle. In particular, use care when working around batteries, using solvents or compressed air.

Hydrogen gas is formed when charging batteries. Do not charge batteries without adequate ventilation.

Do not permit open flame or anyone to smoke in an area that is being used for charging batteries. A concentration of 4% hydrogen gas or more is explosive.

TEXTRON
GOLF, TURF & SPECIALTY PRODUCTS

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