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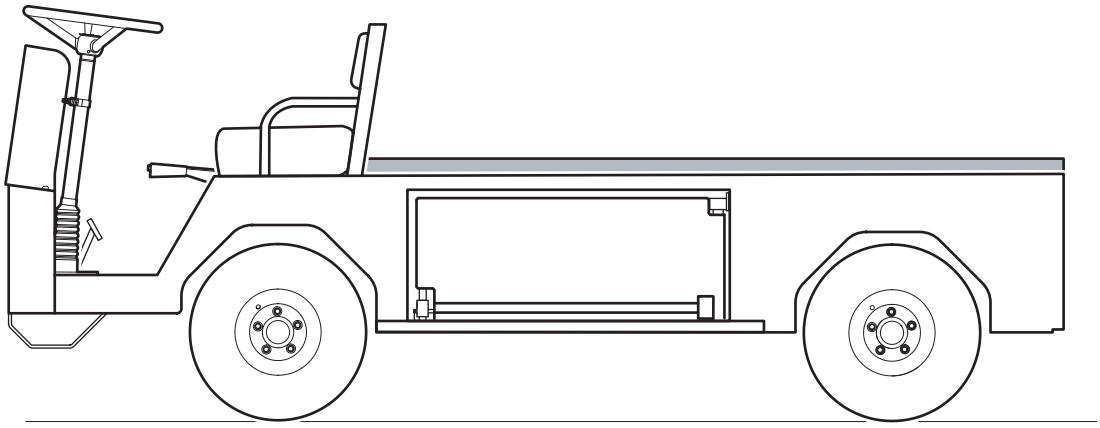
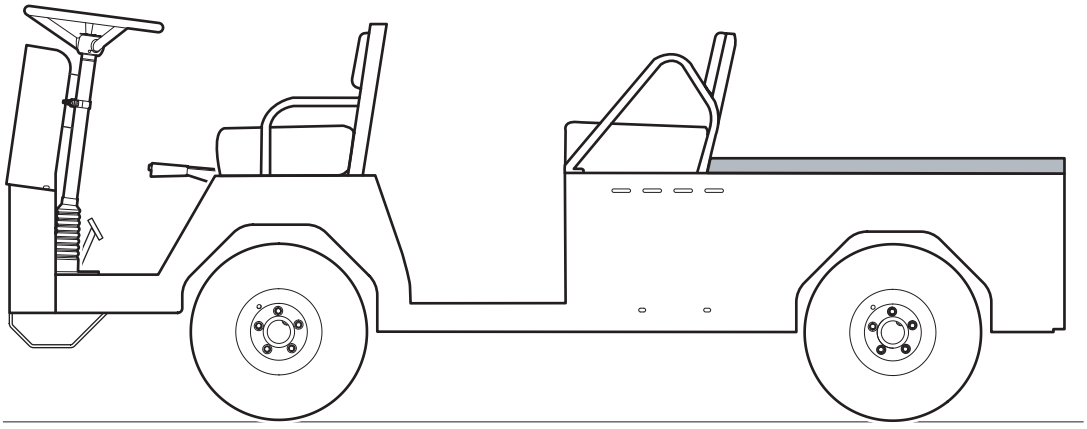
TECHNICIAN'S REPAIR AND SERVICE MANUAL





ELECTRIC CARGO AND PERSONNEL CARRIERS (INDUSTRIAL 875 & TITAN)

STARTING MODEL YEAR: 2005 REVISED JULY 2010

SAFETY

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

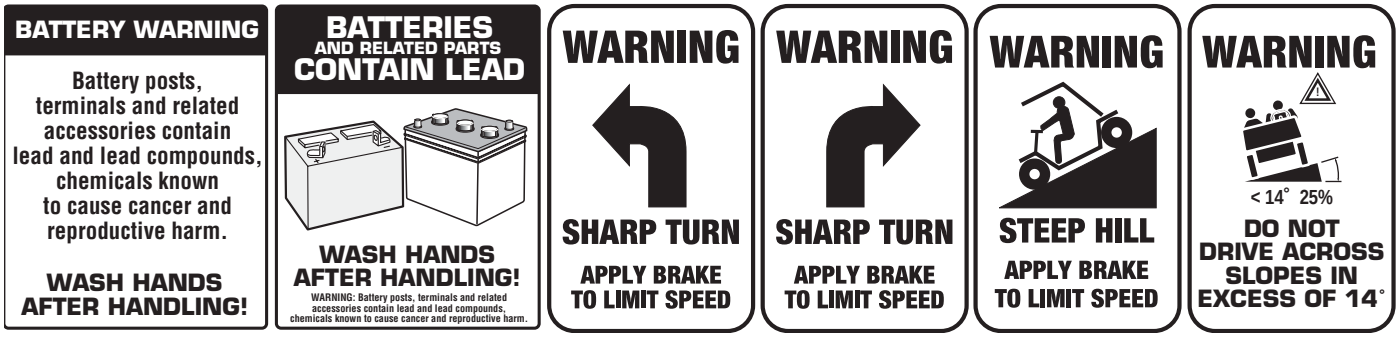
Always replace any damaged or missing labels.

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 GENERAL SPECIFICATIONS). 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.

48V Vehicles must be moved with the Run-Tow/Maintenance switch, located under the passenger seat, in the 'Tow/ Maintenance' position.

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 UTILITY VEHICLES

INDUSTRIAL 875 36V

INDUSTRIAL 875 36V PERSONNEL CARRIER

INDUSTRIAL 875 48V

INDUSTRIAL 875 48V PERSONNEL CARRIER

TITAN 36V

TITAN 36V PERSONNEL CARRIER

TITAN 48V

TITAN 48V PERSONNEL CARRIER

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

E-Z-GO DIVISION OF TEXTRON, INC., 1451 MARVIN GRIFFIN RD., AUGUSTA, GEORGIA USA 30906

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).

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 the 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.

The manufacturer 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.

The manufacturer 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. The 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 other vehicles when used in a golf course environment. Additionally, speed should be further moderated by the environmental conditions, terrain 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.

SAFETY INFORMATION

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 higher).

Notes:

GENERAL INFORMATION & ROUTINE MAINTENANCE

TABLE OF CONTENTS FOR SECTION 'A'

SECTION TITLE **PAGE NO.**

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 AND MANUFACTURING NUMBER LABEL LOCATIONS

Supplemental Information Label Location

The supplemental Information label is located on the inside of the cowl (driver side).

Serial and Manufacturing No. Label Location

The serial and manufacturing number label is located on the inside of the cowl (driver side).

Serial and Manufacturing No. (Stamped)

The serial number and manufacturing number are stamped on the frame below the load bed.

Serial No. Sticker Location

The serial number is located under the seat on the frame.

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

SERVICING THE ELECTRIC VEHICLE

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.

A vehicle requiring repair indicates that the vehicle is no longer functioning as designed and 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, may produce 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 dangerous situation occur.

⚠ WARNING ⚠ ***Before attempting any type of servicing operations, read and understand all Notes, Cautions and Warnings in this manual.***

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

⚠ WARNING ⚠ ***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.***

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

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

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

Before a new vehicle is put into operation, it is recommended that the items shown in the INITIAL SERVICE CHART be performed (Ref Fig. 1 on page A-1).

ITEM	SERVICE OPERATION
Batteries	Charge batteries
Seats	Remove protective plastic covering
Brakes	Check operation and adjust if necessary
	Check hydraulic brake fluid level
Tires	Check pressure

Fig. 1 Initial Service Chart

Vehicle batteries must be fully charged before initial use.

ROUTINE MAINTENANCE

This vehicle will give years of satisfactory service providing it receives regular maintenance. Refer to the Periodic Service Schedule (Ref Fig. 5 on page A-5) for appropri-

ate service intervals. Refer to Lubrication Points (Ref Fig. 2 on page A-2) for appropriate lubrication locations.

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.**

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

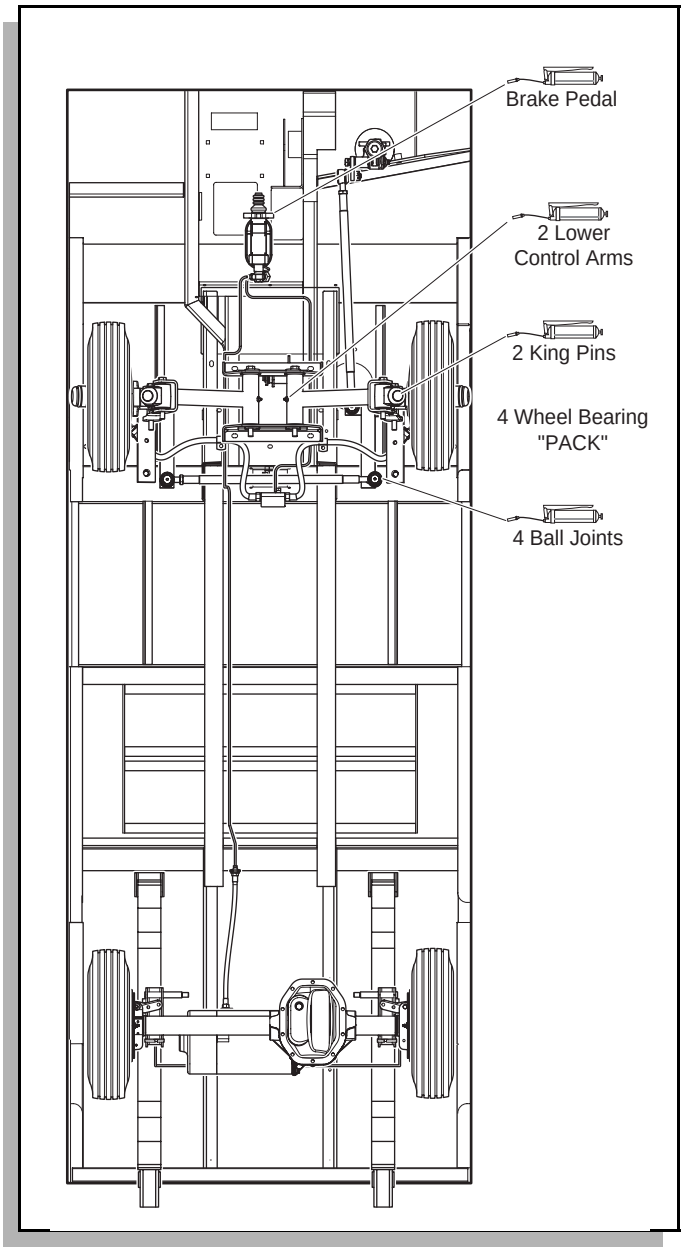

Fig. 2 Lubrication Points

REAR AXLE

The only maintenance required for the first five years is the periodic inspection of the lubricant level. The rear axle is provided with a lubricant level check/fill plug located on the bottom of the differential. Unless leakage is evident, the lubricant 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 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. 3 on page A-2).

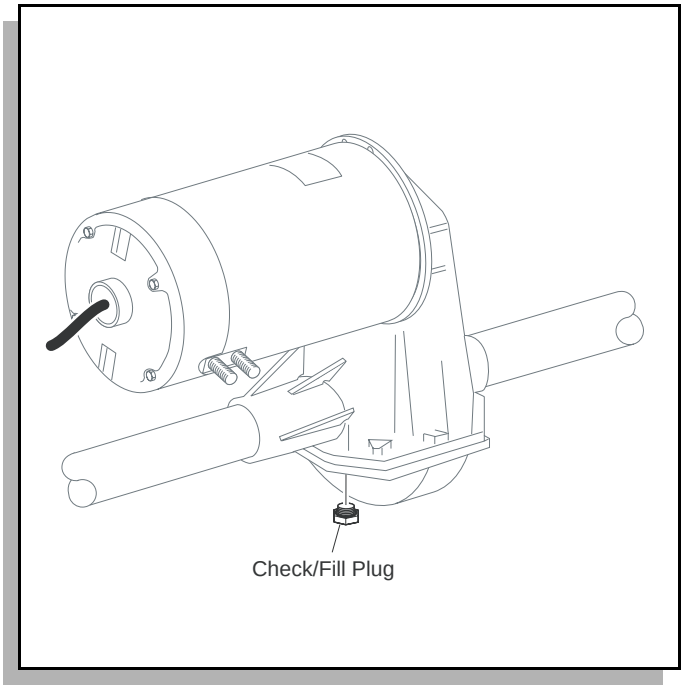

Fig. 3 Add, Check and Drain Rear Axle Lubricant

DAILY BRAKE TEST

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

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

Depress the brake pedal. The pedal should have some free travel and then become hard. A brake pedal that has no free travel, excessive free travel or a spongy feel is indicating that a brake inspection is required. A brake pedal that falls after it is applied indicates a leak in the master or wheel cylinders. Check for adequate brake fluid level. Adjust brakes if required and inspect system for fluid leaks.

TIRES

Tire condition should be inspected on a daily basis. Inflation pressures should be checked when the tires are cool. For additional information, refer to WHEELS AND TIRES section.

CARE AND CLEANING OF THE VEHICLE

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

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

Normal cleaning of vinyl seats and plastic or rubber trim require 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 as fertilizers or for dust control can collect on the underbody of the vehicle. These materials could cause 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, the manufacturer has several products, available through a local Distributor, a Branch, or the Service Parts Department.

- Touch-up paint specially formulated to match vehicle colors for use on both metal and TPO (plastic) 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)
- Plexus plastic cleaner and polish removes minor scratches from windshield. (P/N 28433-G**)

TRAILERING

⚠ WARNING ⚠ ***Personal injury to occupants of other highway vehicles may occur if vehicle and contents are not adequately secured to trailer.***

Do not ride on vehicle being trailered.

If the vehicle is to be transported on a trailer at highway speeds, check that the vehicle and contents are adequately secured before trailering the vehicle. The rated capacity of the trailer used must exceed the weight of the vehicle (See GENERAL SPECIFICATIONS for vehicle weight) and load plus 1000 lbs (450 kg). Lock the parking brake and secure the vehicle to the trailer using ratchet tie downs.

TORQUE SPECIFICATIONS

HARDWARE

Periodically the vehicle should be inspected for loose fasteners. Fasteners should be tightened in accordance with the Torque Specifications table (Ref Fig. 4 on page A-4).

Generally, three grades of hardware are used in the vehicle. Grade 5 hardware can be identified by the three marks on the hexagonal head and grade 8 hardware is identified by 6 marks on the head. Unmarked hardware is Grade 2 (Ref Fig. 4 on page A-4).

ALL TORQUE FIGURES ARE IN FT. LBS. (Nm)
Unless otherwise noted in text, tighten all hardware in accordance with this chart.
This chart specifies 'lubricated' torque figures. Fasteners that are plated or lubricated when installed are considered 'wet' and require approximately 80% of the torque required for 'dry' fasteners.

BOLT SIZE	1/4"	5/16"	3/8"	7/16"	1/2"	9/16"	5/8"	3/4"	7/8"	1"
Grade 2	4 (5)	8 (11)	15 (20)	24 (33)	35 (47)	55 (75)	75 (102)	130 (176)	125 (169)	190 (258)
Grade 5	6 (8)	13 (18)	23 (31)	35 (47)	55 (75)	80 (108)	110 (149)	200 (271)	320 (434)	480 (651)
Grade 8	6 (8)	18 (24)	35 (47)	55 (75)	80 (108)	110 (149)	170 (230)	280 (380)	460 (624)	680 (922)

BOLT SIZE	M4	M5	M6	M8	M10	M12	M14			
Class 5.8 (Grade 2) 5.8	1 (2)	2 (3)	4 (6)	10 (14)	20 (27)	35 (47)	55 (76.4)			
Class 8.8 (Grade 5) 8.8	2 (3)	4 (6)	7 (10)	18 (24)	35 (47)	61 (83)	97 (131)			
Class 10.9 (Grade 8) 10.9	3 (4)	6 (8)	10 (14)	25 (34)	49 (66)	86 (117)	136 (184)			

Ref Tsp 1

Fig. 4 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

To perform service that is listed in this schedule but not described in this manual, contact a local Service Representative or see the Repair and Service Manual for this vehicle.

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

DAILY	
	BEFORE USE: ✓ Check service brake general operation ✓ Check park brake function ✓ Check warning device function in reverse ✓ Check tire condition ✓ Check overall vehicle condition ♦ Recharge batteries to full state of charge after each day's use ✓ Inspect charger AC plug and cord for damage. Be sure ground pin is in place
WEEKLY	
TIRES	✓ Examine for cuts, excessive wear and pressure (See GENERAL SPECIFICATIONS)
WHEELS	✓ Check for bent rims, missing or loose lug nuts
MONTHLY - 20 HOURS (includes items listed in previous table & the following)	
BATTERIES	♦ Clean batteries & terminals. See BATTERY CLEANING. ✓ Check charge condition and all connections
WIRING	✓ Check all wiring for loose connections and broken/missing insulation
ACCELERATOR	✓ Check for smooth movement
SERVICE BRAKE (HYDRAULIC BRAKES)	✓ Conduct brake performance test
PARK BRAKE	✓ Check brake performance and adjust if required
DIRECTION SELECTOR (36V models)	✓ Check attachment, tighten if required
STEERING ASSEMBLY	✓ Check for abnormal play, tightness of all hardware
TIE ROD/LINKAGES	✓ Check for excessive play, bent components or loose connections
48V SYSTEM	✓ Check for Controller braking force (see 48V MODEL VEHICLES in text) proper operation of system
REAR AXLE	✓ Check for leakage, add SAE 30 oil as required
QUARTERLY - 50 HOURS (includes items listed in previous tables & the following)	
FRONT AXLE	✓ Check for damage to axle and loose or missing hardware
FRONT SHOCK ABSORBERS	✓ Check for oil leakage and loose fasteners

Fig. 5 Periodic Service Schedule

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

FRONT SPRINGS	✓ Check for loose hardware, cracks at attachments
FRONT WHEEL ALIGNMENT	✓ Check for unusual tire wear, align if required
PARK BRAKE	✓ Check for smooth operation of lever ✓ Check for damage to ratchet, ✓ Check that park brake holds vehicle at 6th click ♦ Lubricate as required, use light oil. DO NOT LUBRICATE CABLES OR BRAKE LATCH
REAR SHOCK ABSORBERS	✓ Check for oil leakage, loose mounting hardware
HARDWARE AND FASTENERS	✓ Check for loose or missing hardware and components ♦ Tighten or replace missing hardware
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)
KING PINS	✓ Check for excessive play and tightness of retaining nuts
STEERING ASSEMBLY	✓ Check bellows and pinion seal for damage or grease leakage
GREASE FITTINGS	♦ Lubricate, use wheel bearing grease
REAR AXLE	✓ Check for unusual noise and loose or missing mounting hardware
ANNUAL - 250-300 HOURS (includes items listed in previous tables & the following)	
FRONT WHEEL BEARINGS	✓ Check and adjust as required, see Technician's Repair and Service Manual
REAR AXLE	✓ Check lubricant, add lubricant (SAE 30 oil) as required
SERVICE BRAKES	♦ Clean and adjust, see Technician's Repair and Service Manual ✓ Check brake shoe linings, see Technician's Repair and Service Manual ✓ Check brake fluid

Fig. 5 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,

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

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

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

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

⚠ WARNING ⚠ ***Changes to the weight distribution or the center of gravity may make it unstable or prone to roll over resulting in injury or death to the operator or passenger.***

GENERAL MAINTENANCE

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 ⚠ ***Before working on vehicle, remove all jewelry (watches, 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.

Before attempting to operate or adjust the powertrain, the rear of the vehicle must be raised and supported on jack stands.

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.

Set the parking brake before performing any work on the vehicle.

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

Keep all smoking materials, open flame or spark from gasoline or batteries.

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 ⚠ ***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 th 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.

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

Never disconnect a circuit under load at a battery terminal.

Use proper lifting techniques when moving batteries. 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) of 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. Electrolyte may cause personal injury and damage to the vehicle and storage facility.

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

BATTERY REMOVAL

Tool List	Qty. Required
Insulated wrench, 1/2"	1
Socket, 1/2", 3/8" drive	1
Extension, 12", 3/8" drive	1
Ratchet, 3/8" drive	1
Battery carrier	1
Torque wrench (in. lbs.), 3/8" drive	1

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 contained in Section "A".*

⚠ WARNING ⚠ ***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.***

Turn vehicle key to 'OFF' and remove. Insure all optional electrical accessories are turned OFF.

Using an insulated wrench, remove the main negative (-) cable (BL-), the main positive (+) cable (BL+) then all other cables from the vehicle batteries (Ref Fig. 1 on page B-8). Remove the battery hold downs by removing the hardware and lifting the retainer from the batteries.

Remove the batteries using a commercial battery carrier.

BATTERY INSTALLATION

If the batteries have been cleaned and any acid in the battery rack area neutralized on a regular basis, no corrosion to the battery racks or surrounding area should be present. If any corrosion is found, it 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 tray 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 cables and terminals. Clean any corrosion from the battery terminals or the cable terminals with a solution of sodium bicarbonate (baking soda) and wire brush if required.

Use care to connect the battery cables as shown (Ref Fig. 1 on page B-8). **Connect the main positive (+) battery cable (BL+) first**, other battery connecting cables, and then **connect the main negative (-) cable (BL-) last**. Tighten the battery post hardware to 90 - 110 in. lbs. (10 - 12 Nm). Protect the battery terminals and battery cable terminals with a commercially available protective coating.

⚠ WARNING ⚠ ***Aerosol containers of battery terminal protectant must be used with extreme care. Insulate the metal container to prevent the metal 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 front wheels, the rear wheels, or the entire vehicle be raised.

⚠ WARNING ⚠ ***To reduce the possibility of severe injury or death from a vehicle falling from a jack:***

Be sure the vehicle is on a firm and level surface.

Never get under a vehicle while it is supported by a jack.

Use jack stands and test the stability of the vehicle on the stands.

Always place chocks in front and behind the wheels not being raised.

Use extreme care since the vehicle is extremely unstable during the lifting process.

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

To raise the entire vehicle, install chocks in front and behind each front wheel (Ref Fig. 2 on page B-8). Center

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

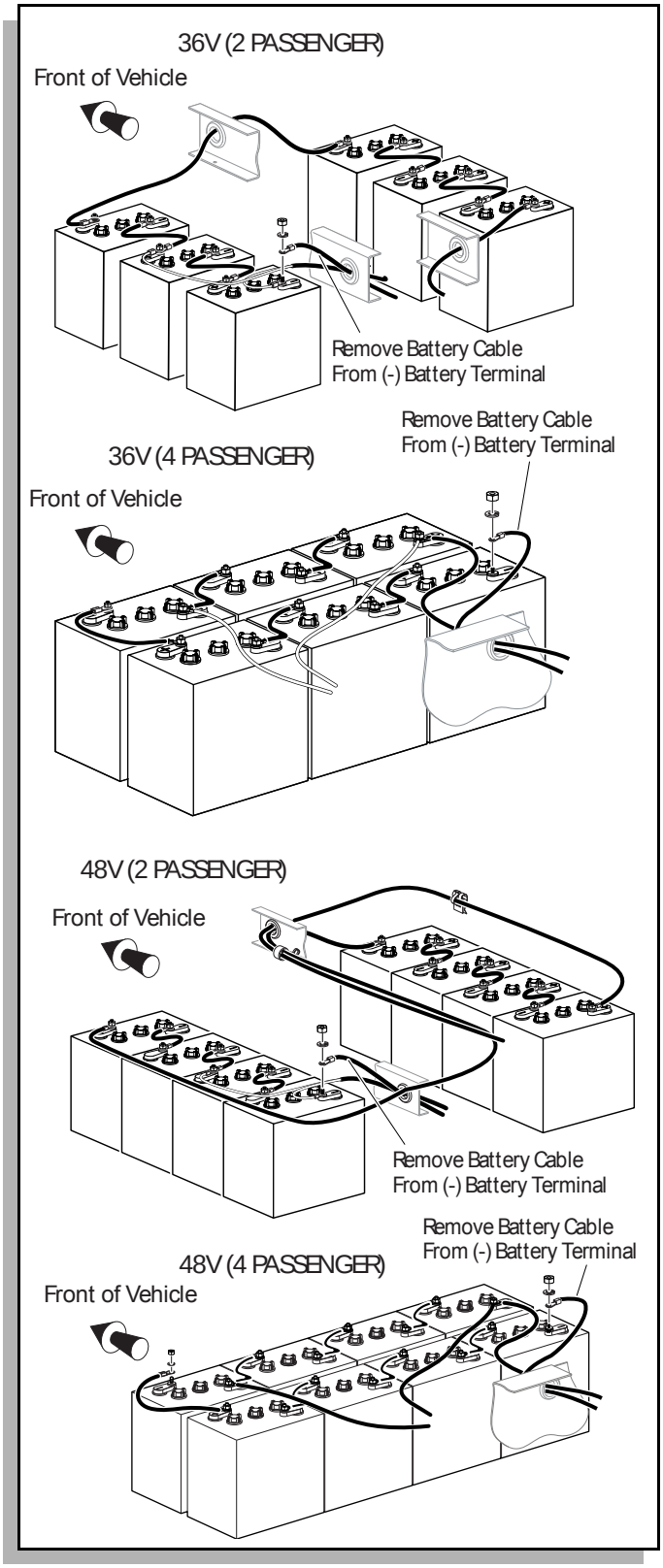

Fig. 1 Battery Connections

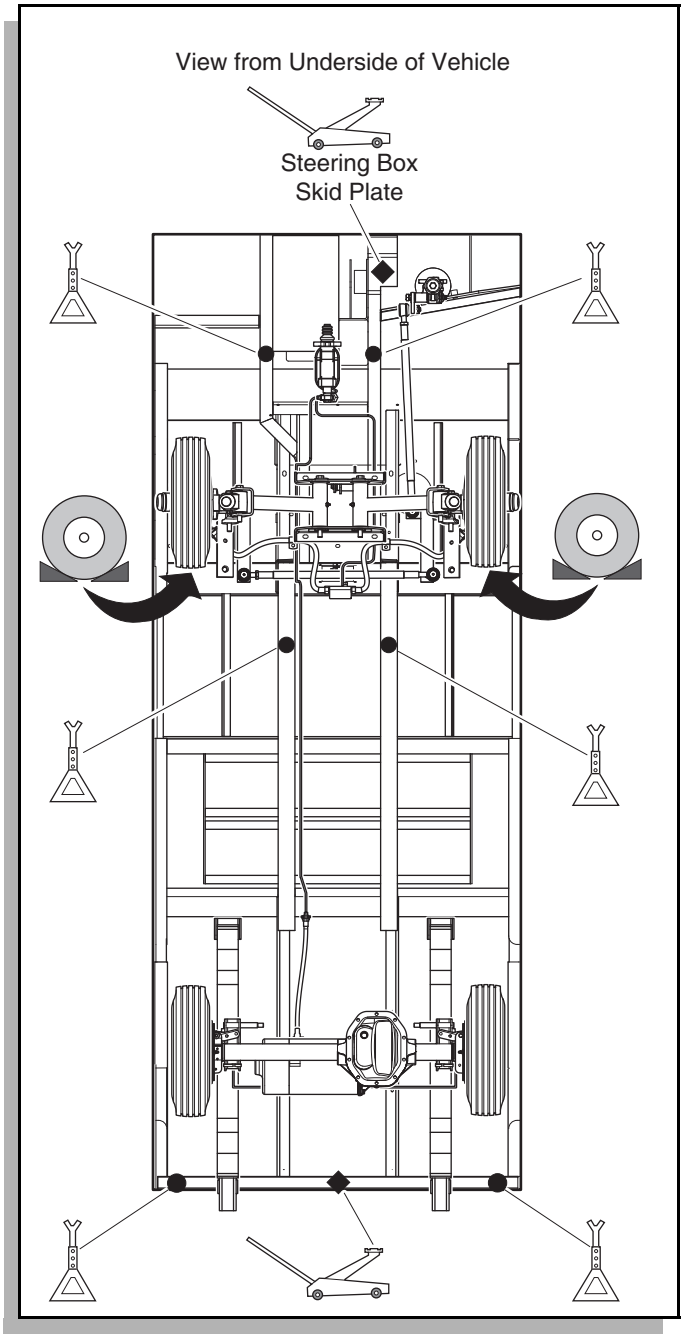

Fig. 2 Lifting the Vehicle

the jack under the rear frame crossmember. Raise the vehicle enough to place a jack stand under the outer ends of the rear frame crossmember.

Lower the jack and test the stability of the vehicle on the two jack stands.

Place the jack at the flat section of steering box skid plate. Raise the vehicle enough to place jack stands under the frame members as indicated.

Lower the jack and test the stability of the vehicle on all four jack stands.

If only the front or rear of the vehicle is to be raised, place the chocks in front and behind each wheel not being raised to stabilize the vehicle.

Lower the vehicle by reversing the lifting sequence.

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

Notes:

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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 serious injury or death resulting from a battery explosion. Batteries should always be removed before any servicing that could generate sparks, or repairs that require welding or cutting.***

The body is a welded frame and body unit. Both the 48V and 36V two passenger models use a common frame and body. The 48V unit has two swing out battery racks that pivot out from both sides of the vehicle and are held in place with positive latches. The 36V two passenger unit is not equipped with swing out battery racks but is fitted with two battery racks with blank panels that are mounted in the battery rack cavities. The four passenger model uses a separate frame and body assembly. The cowl which incorporates the dash panel, bolts to the front of both frame configurations (Ref Fig. 1 on page C-1). The seat back support/cargo deck, bulkhead bolt to the body, as do the seats**.**

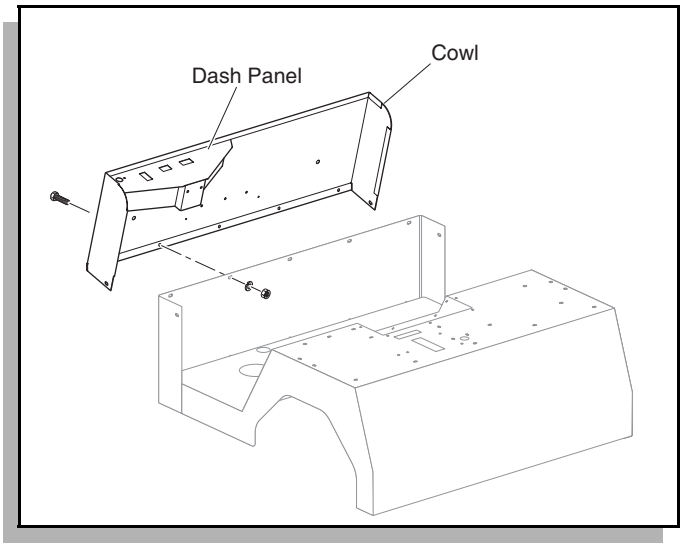

Fig. 1 Cowl Attachment

Swing Out Battery Racks

To open the battery rack (1), lift up on the latch (2) and pull the rack outwards (Ref Fig. 2 on page C-1). If the rack is not supported by the rollers (3) or are difficult to open, first check that all grease points have been lubricated and that the racks are in adjustment.

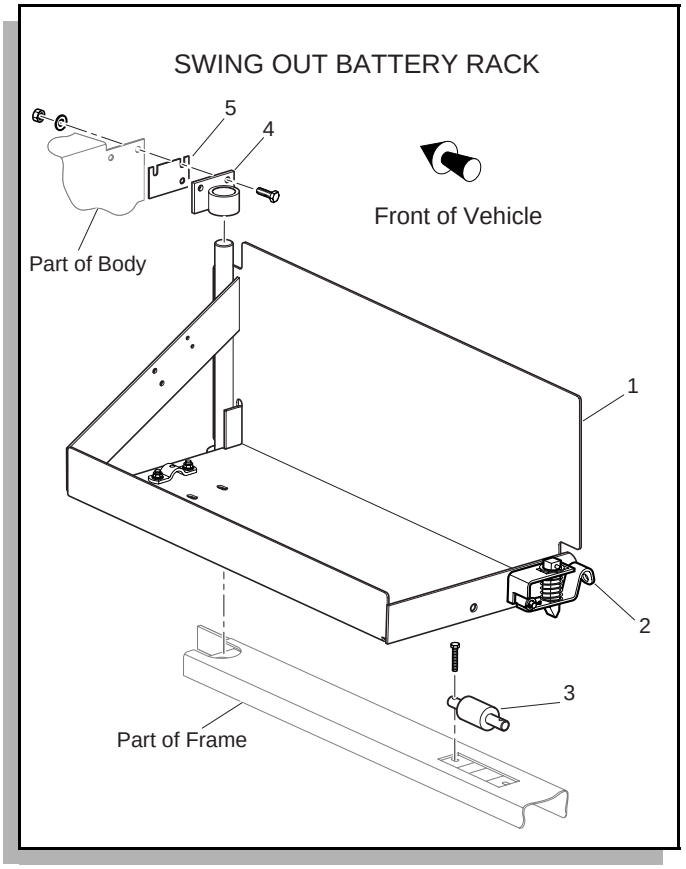

Fig. 2 Swing Out Battery Rack

The battery racks are adjusted at the factory to accommodate the batteries that the vehicle was shipped with. If a heavier/lighter battery is retrofitted, the racks may have to be shimmed to accommodate the change in weight.

Loosen the upper pivot (4) and support the outer end of the battery rack with a floor jack, If the outer end of the rack is to be raised, remove shims (5) as required. If lighter batteries are used requiring the outer end of the battery rack to be lowered, add shims as required. The correct adjustment is when the battery rack (with batteries installed) just contacts the nylon rollers (3).

Fixed Battery Racks

The battery racks in the two and four passenger 36V models are bolted to the frame members and are not intended to be removed during normal usage of the vehicle (Ref Fig. 3 on page C-2).

Access panels for the master cylinder, parking brake and parking brake support assembly are held in place with

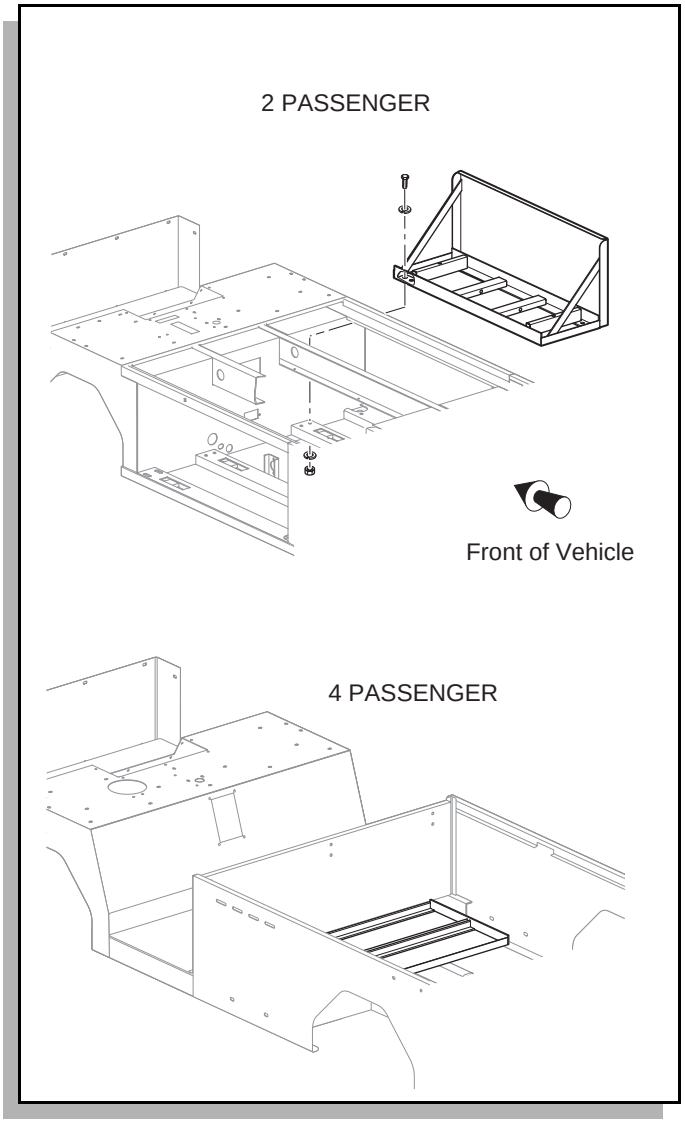

Fig. 3 Fixed Battery Racks

conventional removable hardware (speed nuts, bolts, washers and screws) (Ref Fig. 4 on page C-3).

CARGO DECK REPLACEMENT

Access panels are provided to perform servicing operations not accessible by removing the cargo deck.

The body components and cargo deck 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 (Ref Fig. 5 on page C-4), (Ref Fig. 6 on page C-5), (Ref Fig. 7 on page C-6) and (Ref Fig. 8 on page C-7).

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

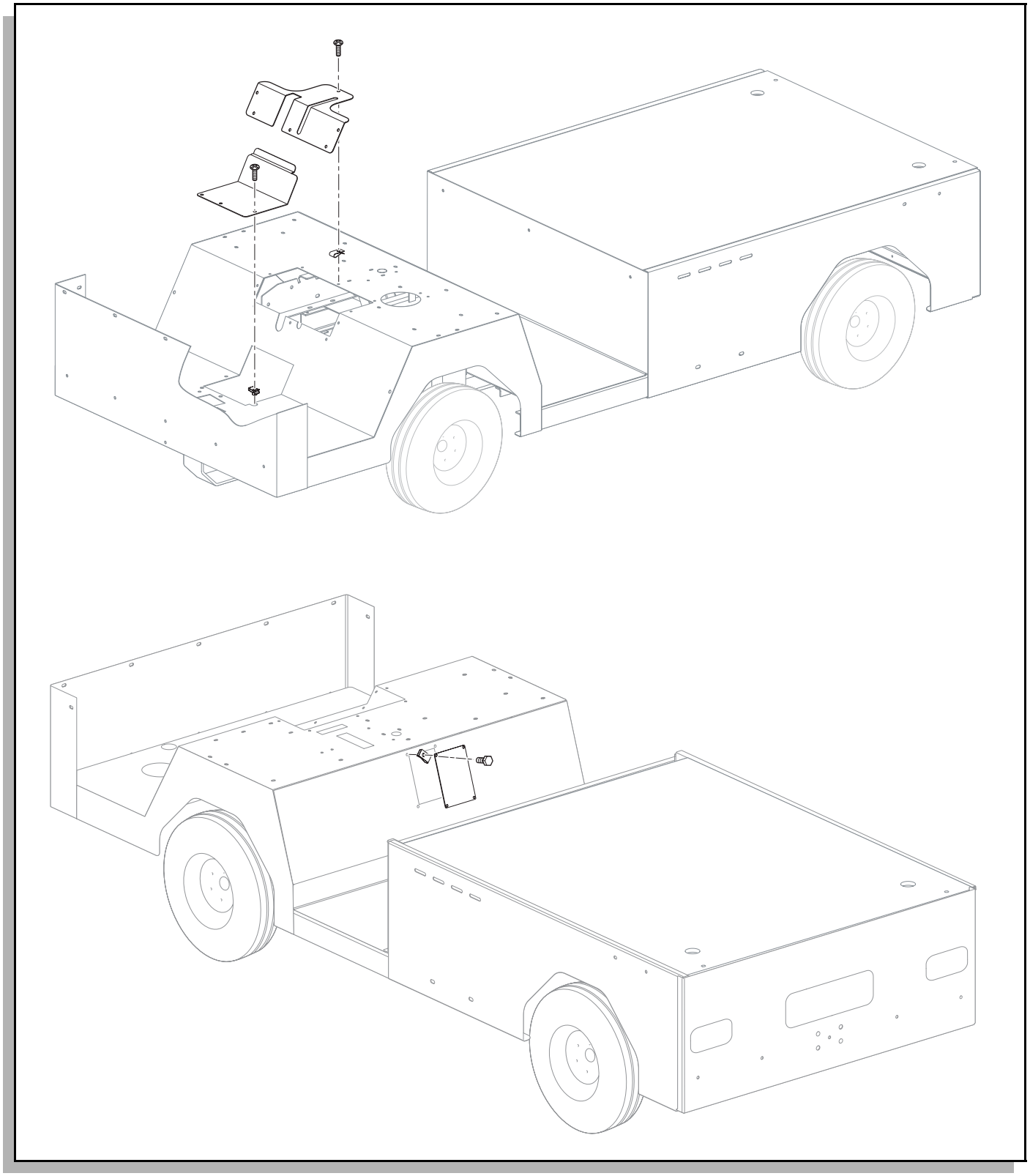

Fig. 4 Body Components

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

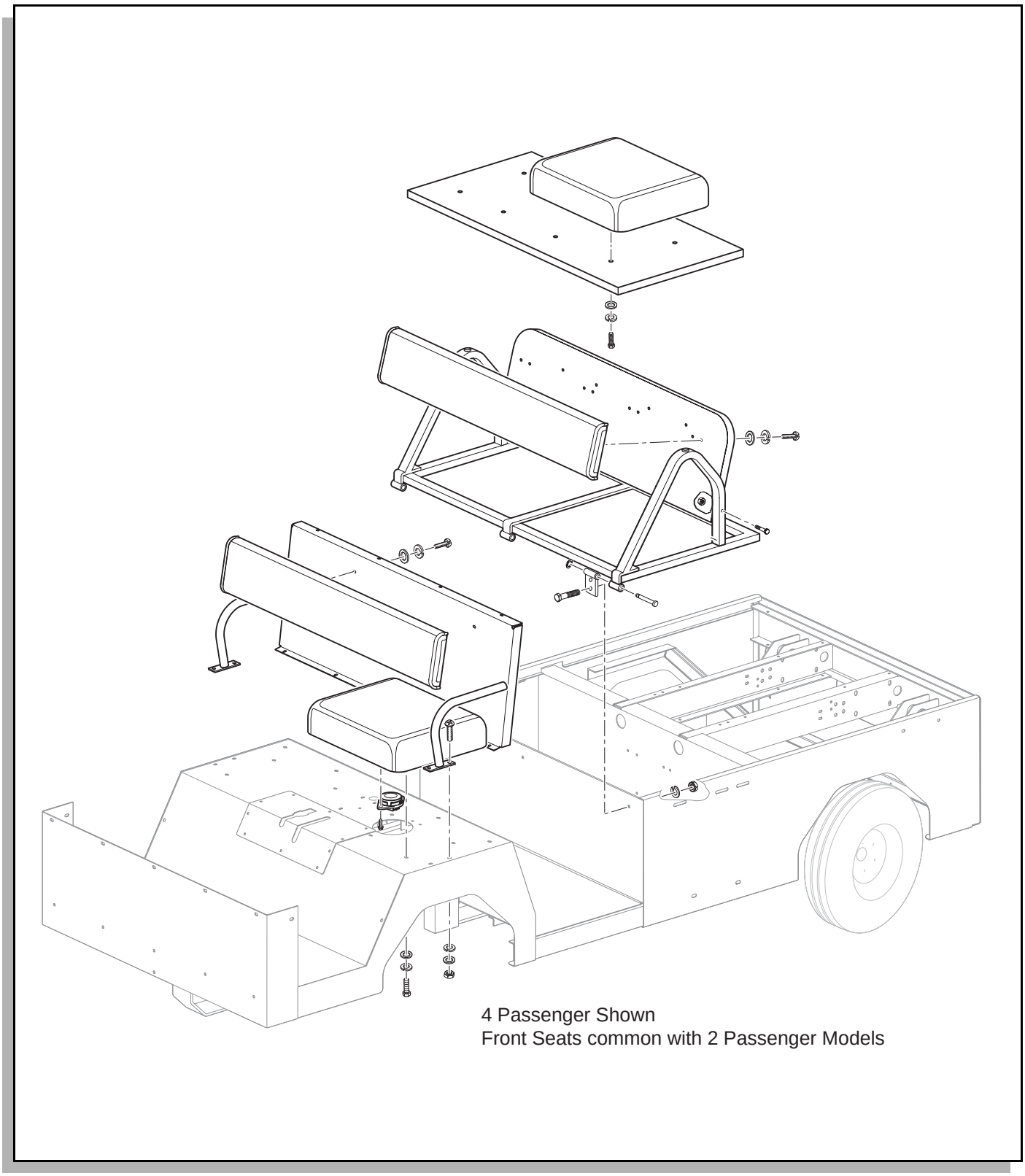

Fig. 5 Body Components (Seating)

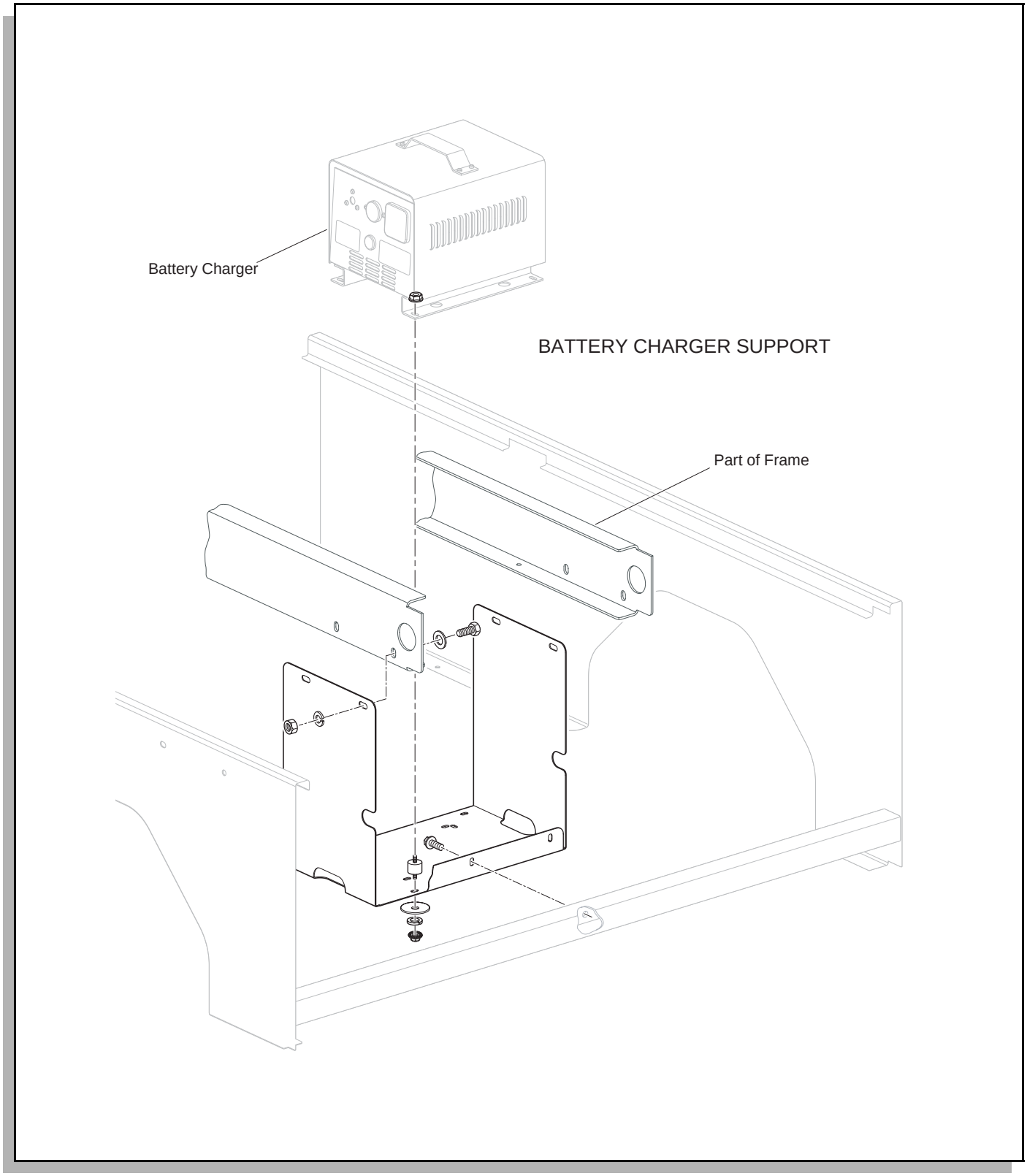

Fig. 6 Battery Charger Support

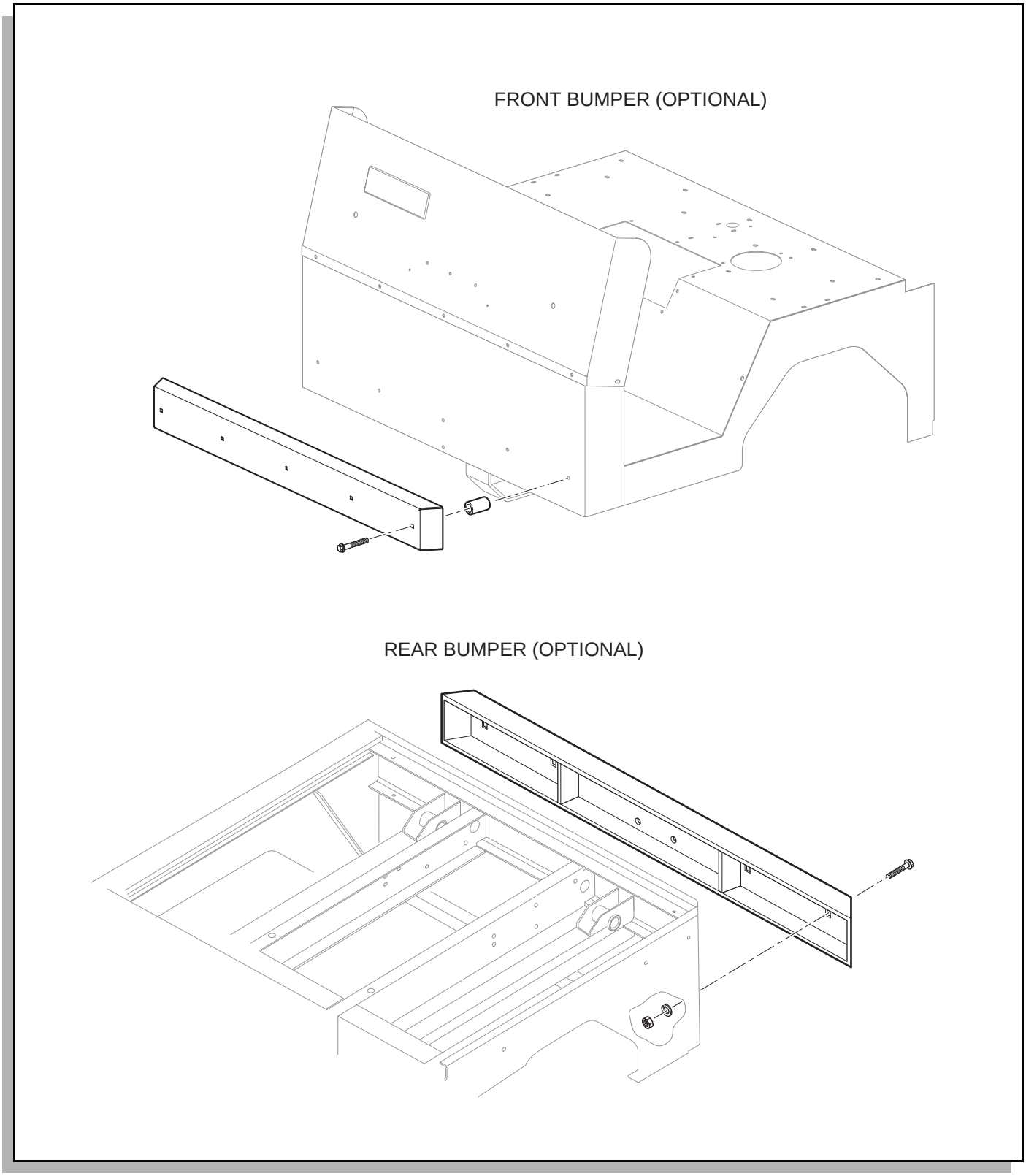

Fig. 7 Bumper and Hitches

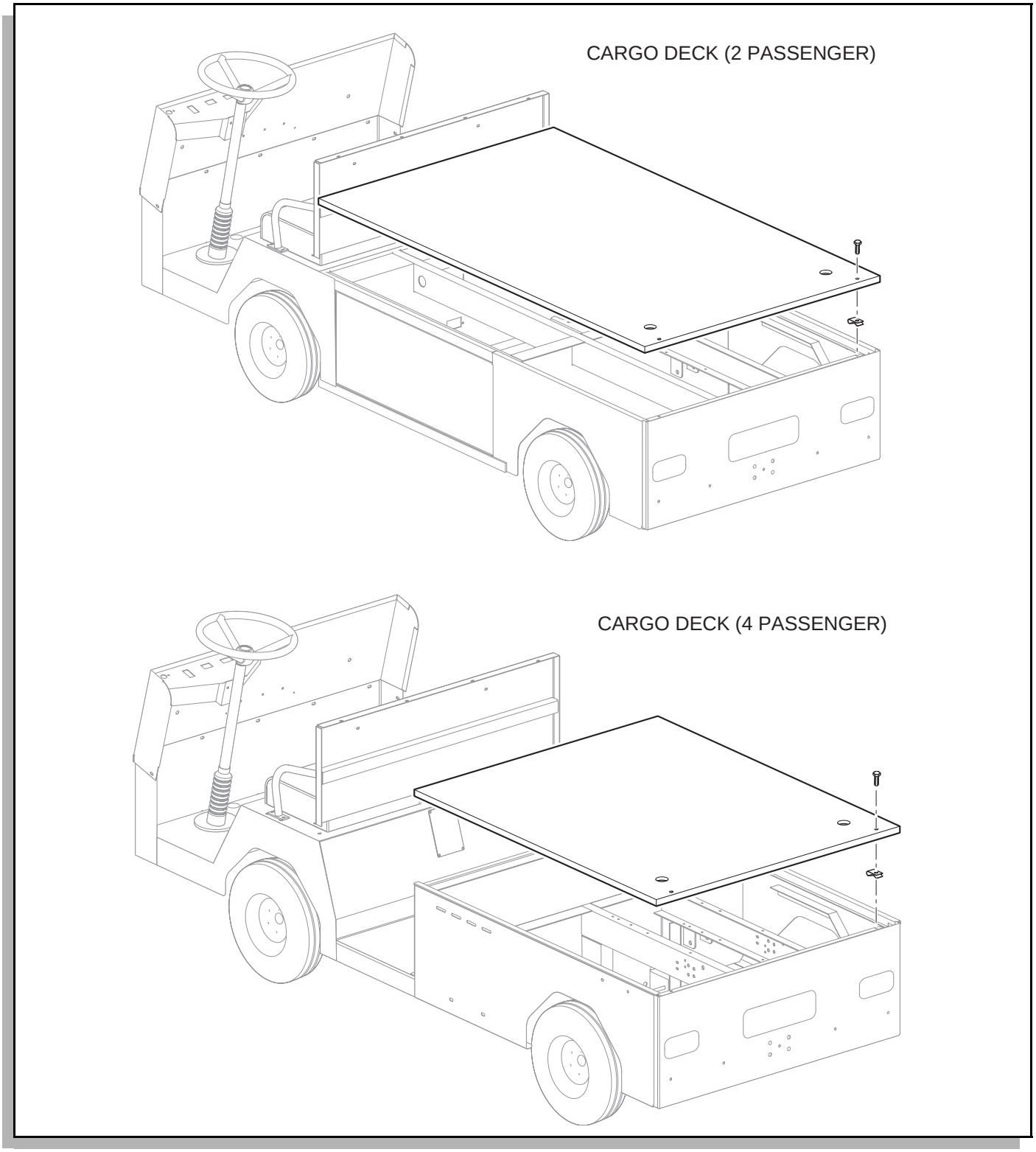

Fig. 8 Cargo Decks

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

Notes:

WHEELS AND TIRES

D

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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. Never use a conventional socket.***

Tire condition should be inspected on a daily basis. Inflation pressures should be checked on a weekly basis when tires are cool. When removing wheels with an impact wrench, use only impact sockets. Regular sockets are not designed for impact pressures exerted by power tools.

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

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

Use caution when inflating tires. Due to the low volume of these small tires, 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, overinflation 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 the terrain. See GENERAL SPECIFICATIONS section for recommended tire inflation pressure. For outdoor applications with major use on grassy areas, the following should be considered. On hard turf, it is desirable to have a **slightly** higher inflation pressure. On very soft turf, a lower pressure prevents tires from cutting into the turf. For vehicles being used on paved or hard surfaces, tire inflation pressure should be in the higher allowable range, but under no condition should inflation pressure be higher than recommended on tire sidewall. **All four tires** should have the same pressure for optimum handling characteristics. Be careful not to 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 tire is to be removed or mounted, the tire changing machine manufacturer's recommendations must be followed in order to minimize possibility of personal injury.

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

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

Wheel Installation

CAUTION **Do not tighten lug nuts 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 as shown (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 pattern.

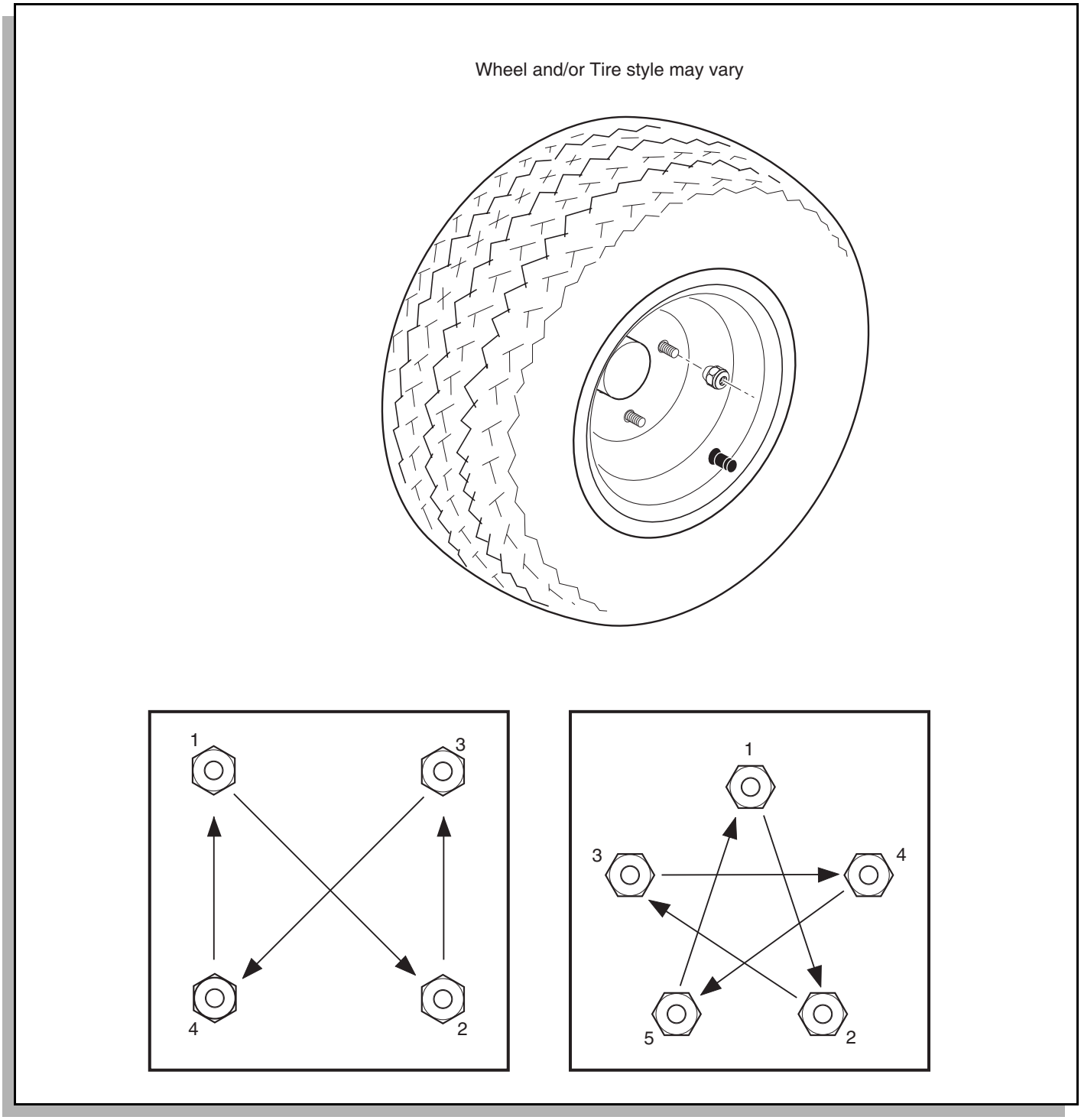

Fig. 1 Wheels and Tires

ELECTRONIC SPEED CONTROL 36V

E

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ELECTRONIC SPEED CONTROL 36V

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

GENERAL

The Electronic Speed Control system consists of two separate units, the pedal box and the controller.

Pedal Box

The Pedal Box assembly is a modularized unit (Ref Fig. 1 on page E-1) that contains the accelerator pedal (1), return spring (2) and an enclosed pedal box (3) that contains the pedal position micro switch and a solid state Inductive Throttle Sensor (ITS) that is activated by a moving plunger attached to the accelerator pedal.

To access the pedal box (3), remove the three screws (4) and remove the access cover (5) from the floor. The ITS and plunger are accessed by removing the top cover from the enclosed pedal box.

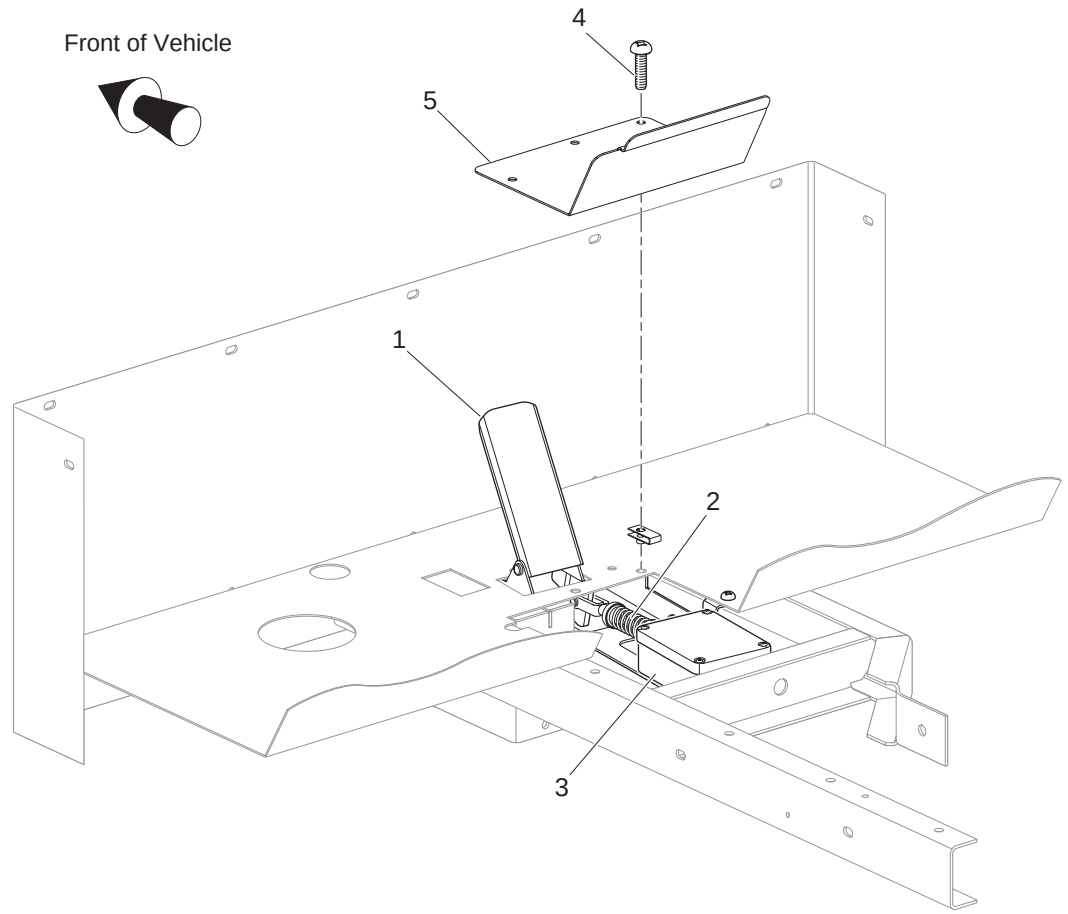


Fig. 1 Access to Pedal Box

Controller

CAUTION **If the diode is incorrectly oriented, the pedal box micro switch and the direction selector micro switch may be permanently damaged.**

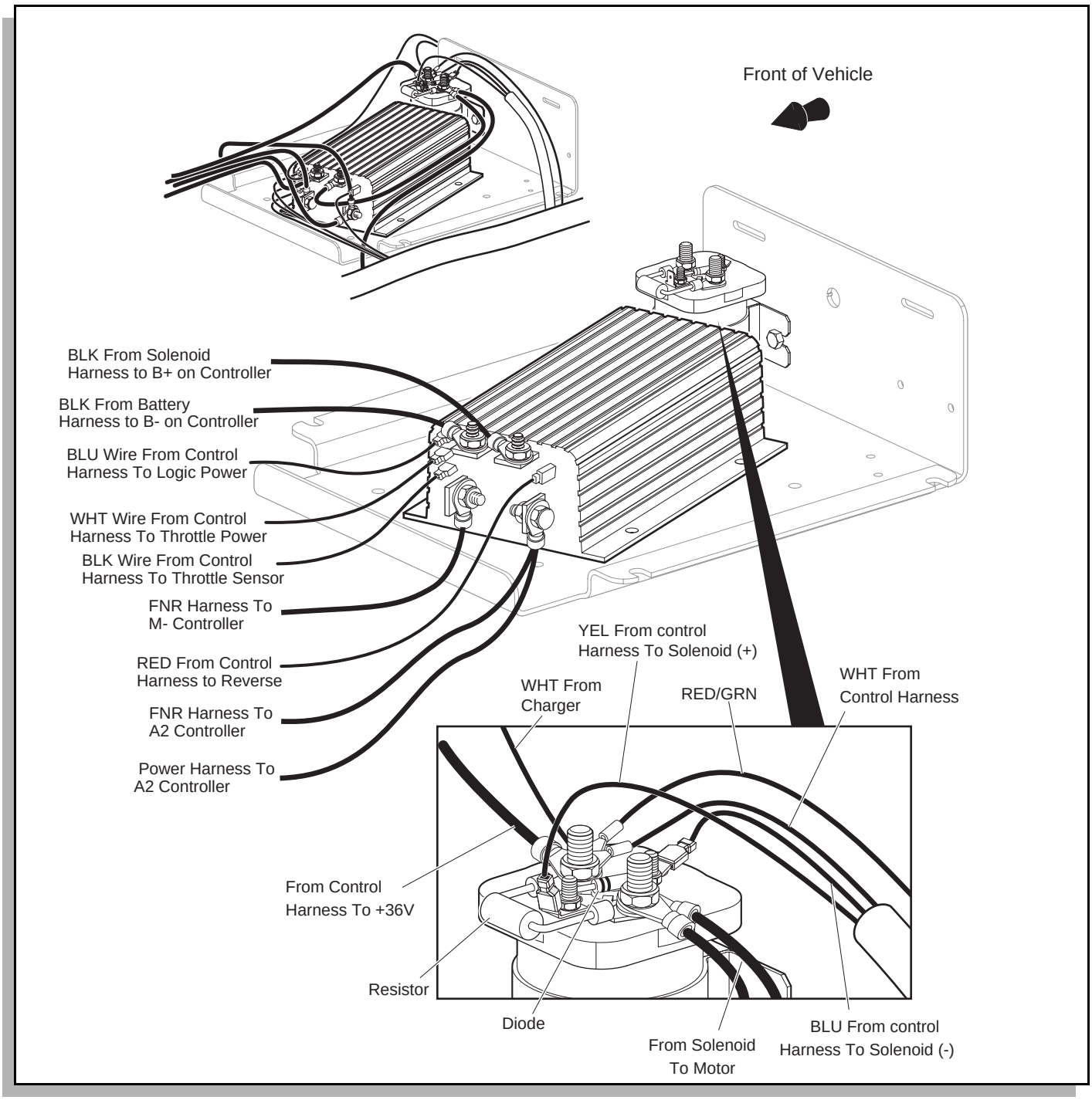


Fig. 2 Controller and Solenoid

The Controller is a solid state unit activated by a solenoid. Both are located in an electrical box located under the cargo deck.

A diode is positioned between the two coil terminals of the solenoid. Its orientation is critical. The cathode side of the diode, identified with a silver band, is oriented to the solenoid terminal with the yellow wire attached.

The pedal box and controller are connected by a four pin connector that is located in front of the pedal box assembly.

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

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

GENERAL TROUBLESHOOTING

Tool List	Qty. Required
Floor jack	1
Jack stands	2
Wheel chocks	4
Jumper wire (with alligator clips)	1
DVOM	1
Socket, 3/8", 3/8" drive	1
Ratchet, 3/8" drive	1
Torque wrench, in. lbs., 3/8" drive	1
Torque wrench, ft. lbs., 3/8" drive	1
Extension, 6", 3/8" drive	1
Insulated wrench, 9/16"	1
Wrench, 1/2"	1
Wrench, 7/16"	1
Phillips screwdriver, large	1
Phillips screwdriver, small	1
Shop towel	1
Allen wrench, .050"	1

Symptoms

Vehicle does not operate, operates poorly or intermittently.

Testing

It is unlikely that the mechanical adjustment of the pedal box 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 injury resulting from unexpected movement of the vehicle, always raise the rear wheels before conducting any tests.***

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

Raise the rear wheels of the vehicle and support on jack stands (Refer to the Lifting Procedure in Section 'B' Safety). Test the vehicle stability before proceeding.

Place the direction selector in 'F' and turn the key switch to 'ON'. Depress the accelerator pedal until the micro switch in the pedal box activates which should cause the solenoid to make an audible click.

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 can still show six volts or higher in an open voltage test. If there is any doubt as to the adequacy of the battery set, charge the batteries and perform a load test using a discharge machine following manufacturers instructions. If batteries are satisfactory, recharge battery set.

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. 3 on page E-4). In the following tests, this voltage level will be used

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

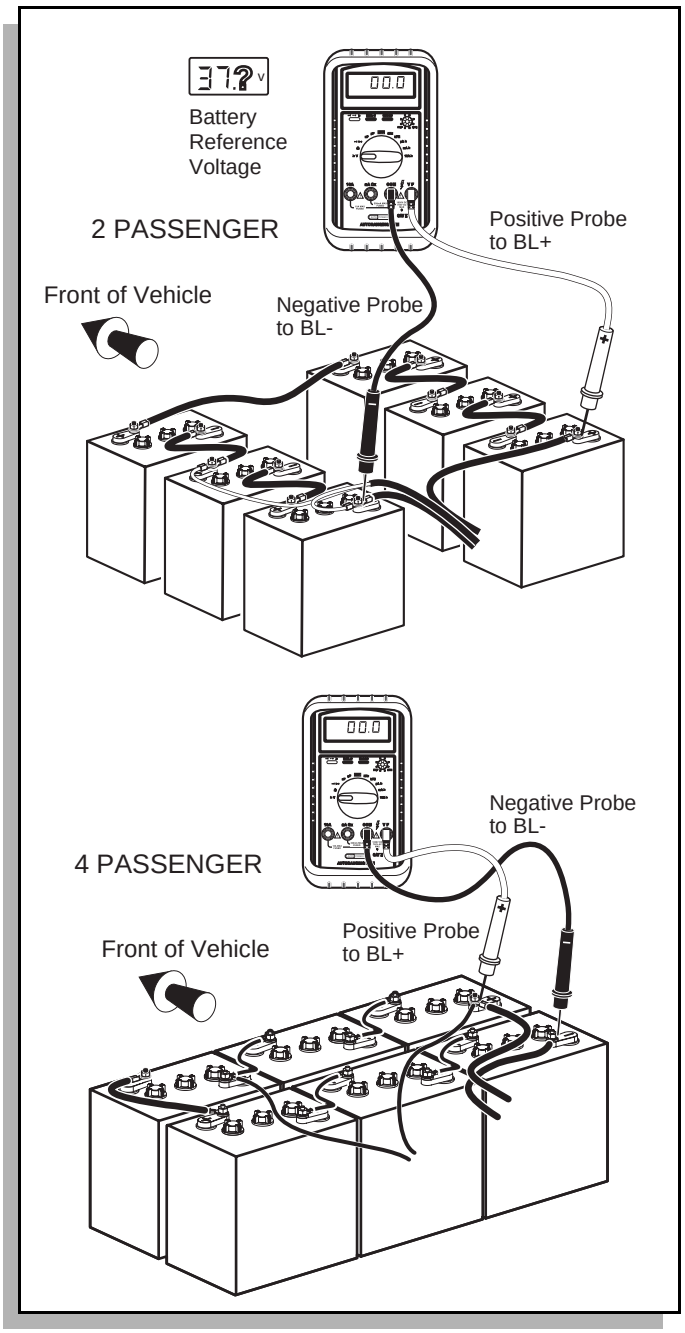


Fig. 3 Battery Reference Voltage

as a reference. Some loss due to resistance or wires and connectors may be indicated by readings that could be up to one volt less than the reference voltage. No reading indicates an "open" condition and the battery wires should be inspected for a broken or disconnected wire or component.

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 B+ wire from the battery to disconnect electrical power to vehicle.

Continuity checks must be performed with the power off.

If the solenoid does not function, the pedal micro switch, neutral micro switch (direction selector switch), 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 insulated wrenches when working on batteries.** To check for continuity, set the DVOM to the KΩ setting and select 'Continuity'. The meter will give an audible signal when it detects continuity. If the meter does not have a continuity setting, set it to KΩ, the meter will indicate "0" when it detects continuity.

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. 4 on page E-5).

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.

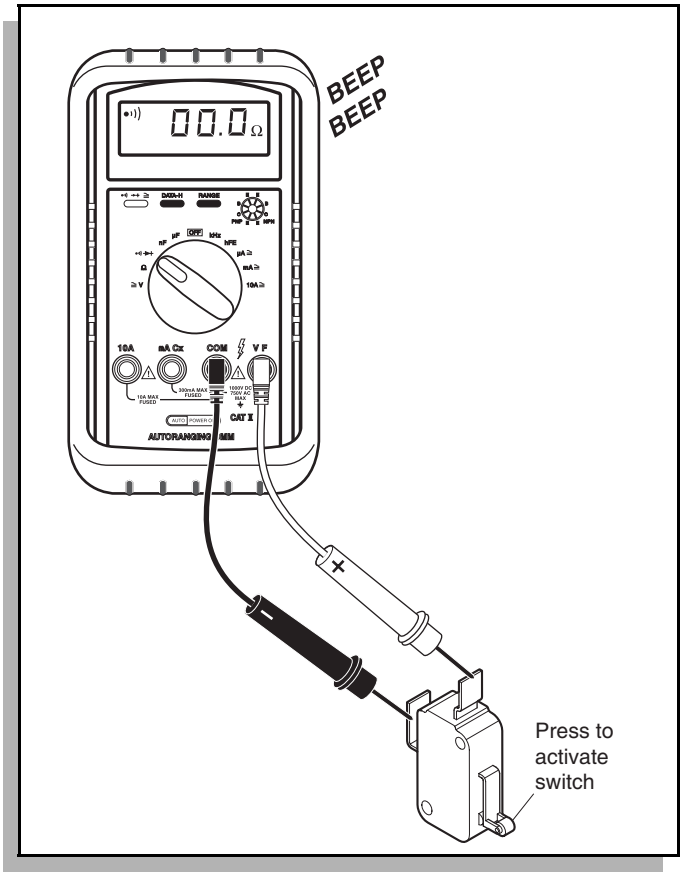


Fig. 4 Continuity Check of Switch

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. 5 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.**

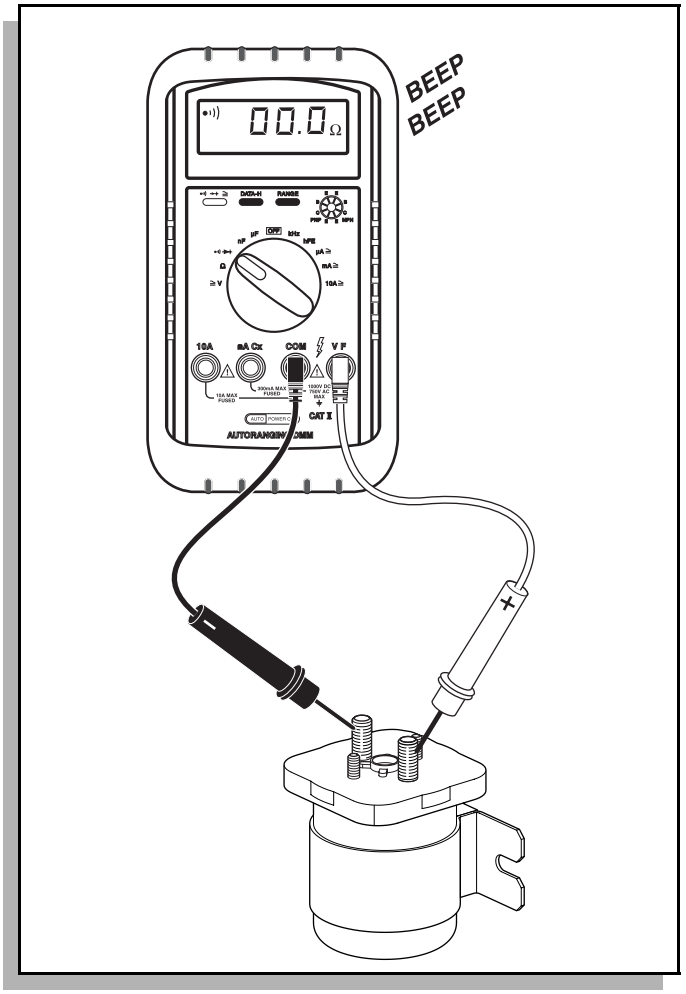


Fig. 5 Continuity Check of Solenoid

TROUBLESHOOTING DIAGRAMS

The simplified troubleshooting diagram is a quick ESC diagnosis (Ref Fig. 6 on page E-6). Use this diagram to perform initial troubleshooting. Follow the indicated step numbers to the information in the detailed troubleshooting diagram.

It is vital to the safety of the technician and assistants that all warnings and safety procedures in this section be followed.

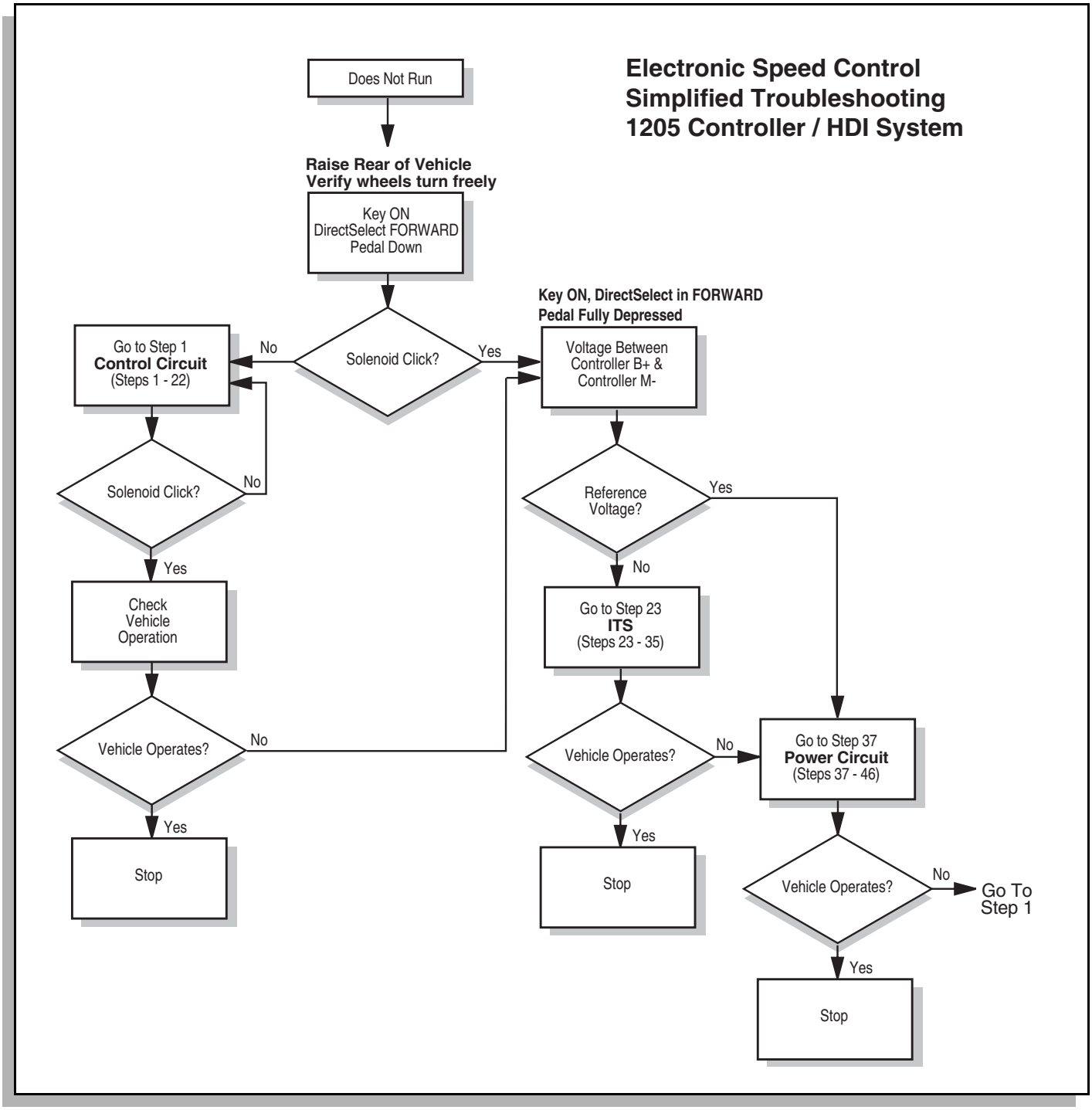


Fig. 6 Simplified Troubleshooting Diagram

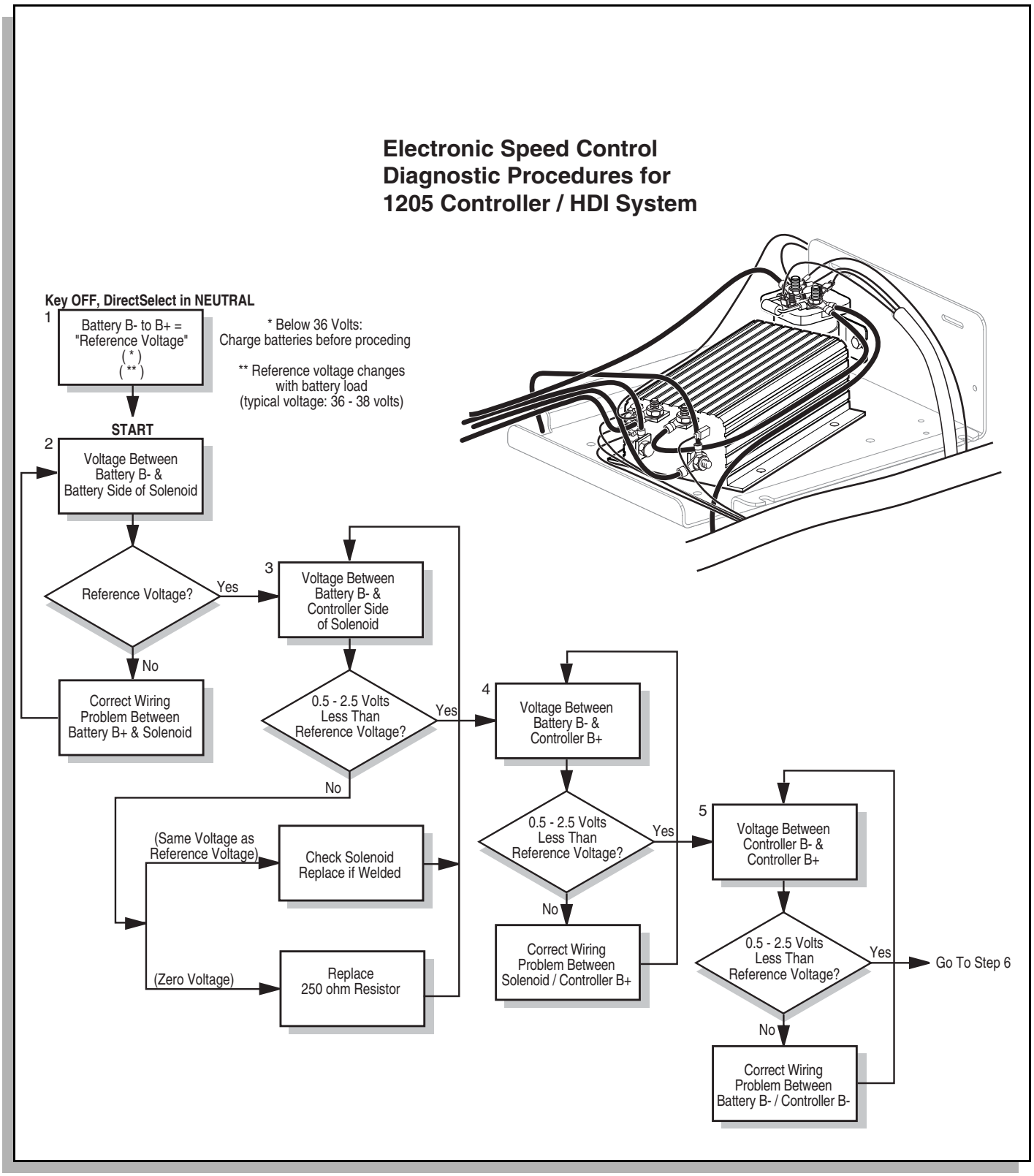


Fig. 7 Detailed Troubleshooting Diagram (Sheet 1 of 8)

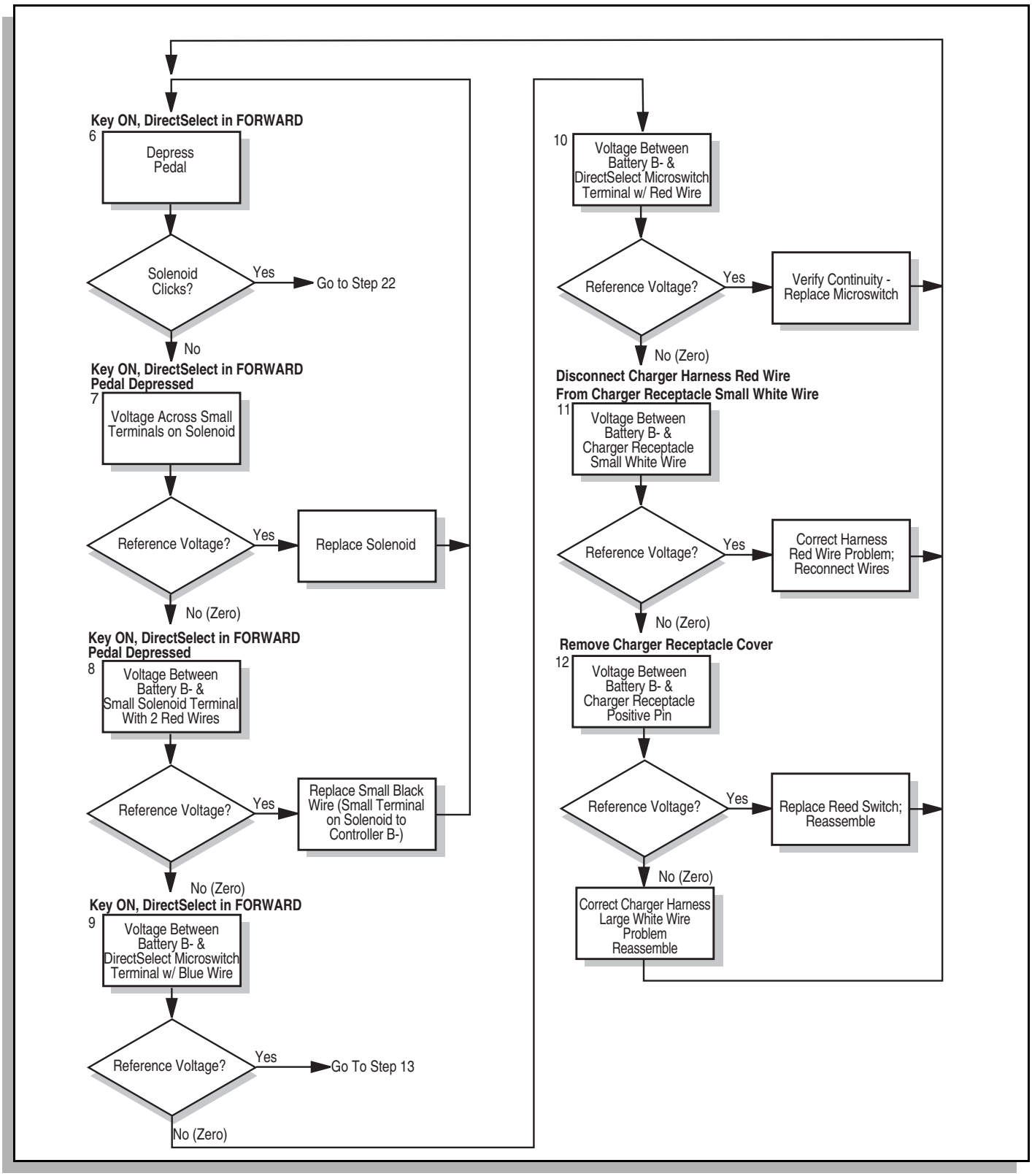


Fig. 8 Detailed Troubleshooting Diagram (Sheet 2 of 8)

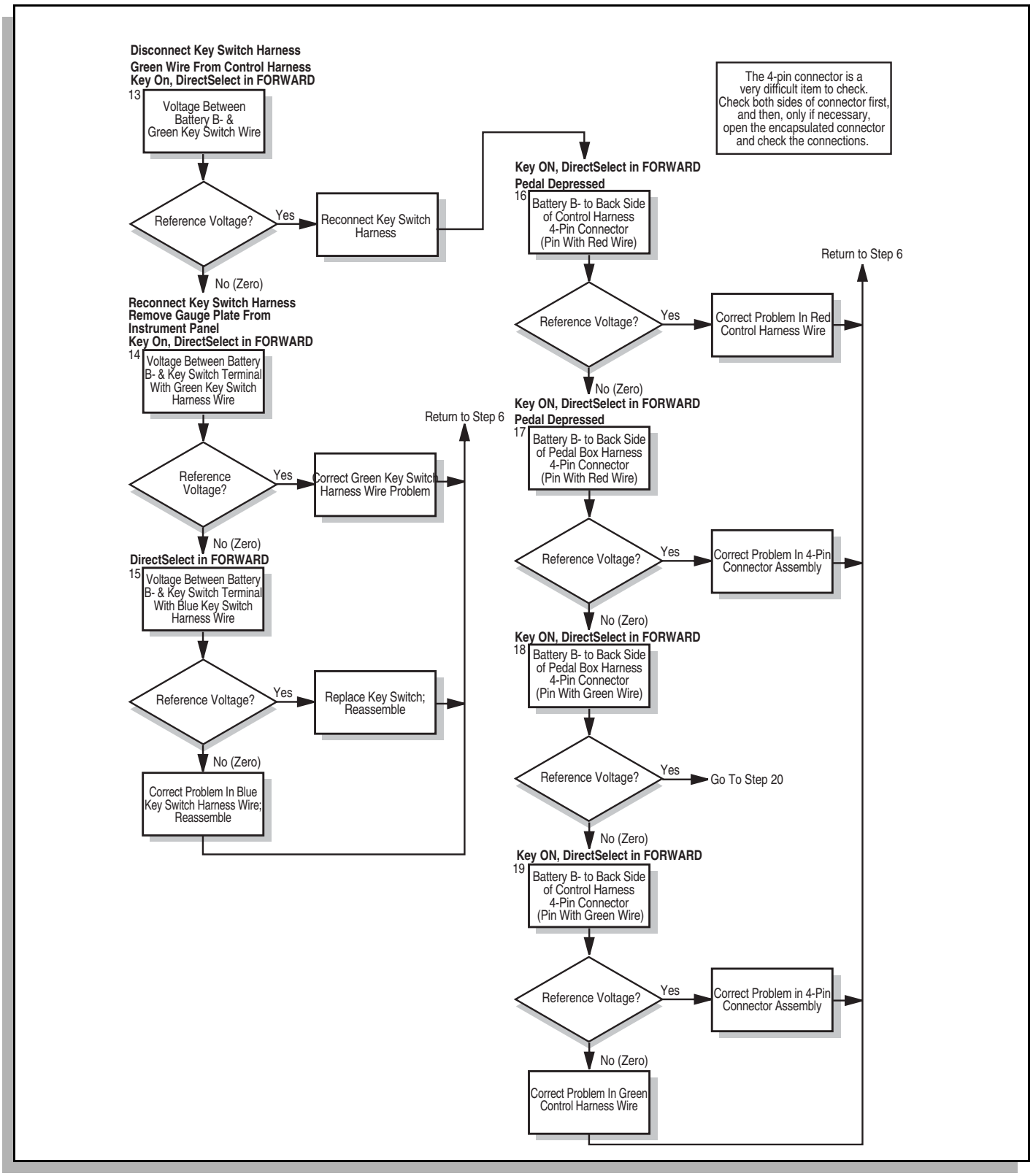


Fig. 9 Detailed Troubleshooting Diagram (Sheet 3 of 8)

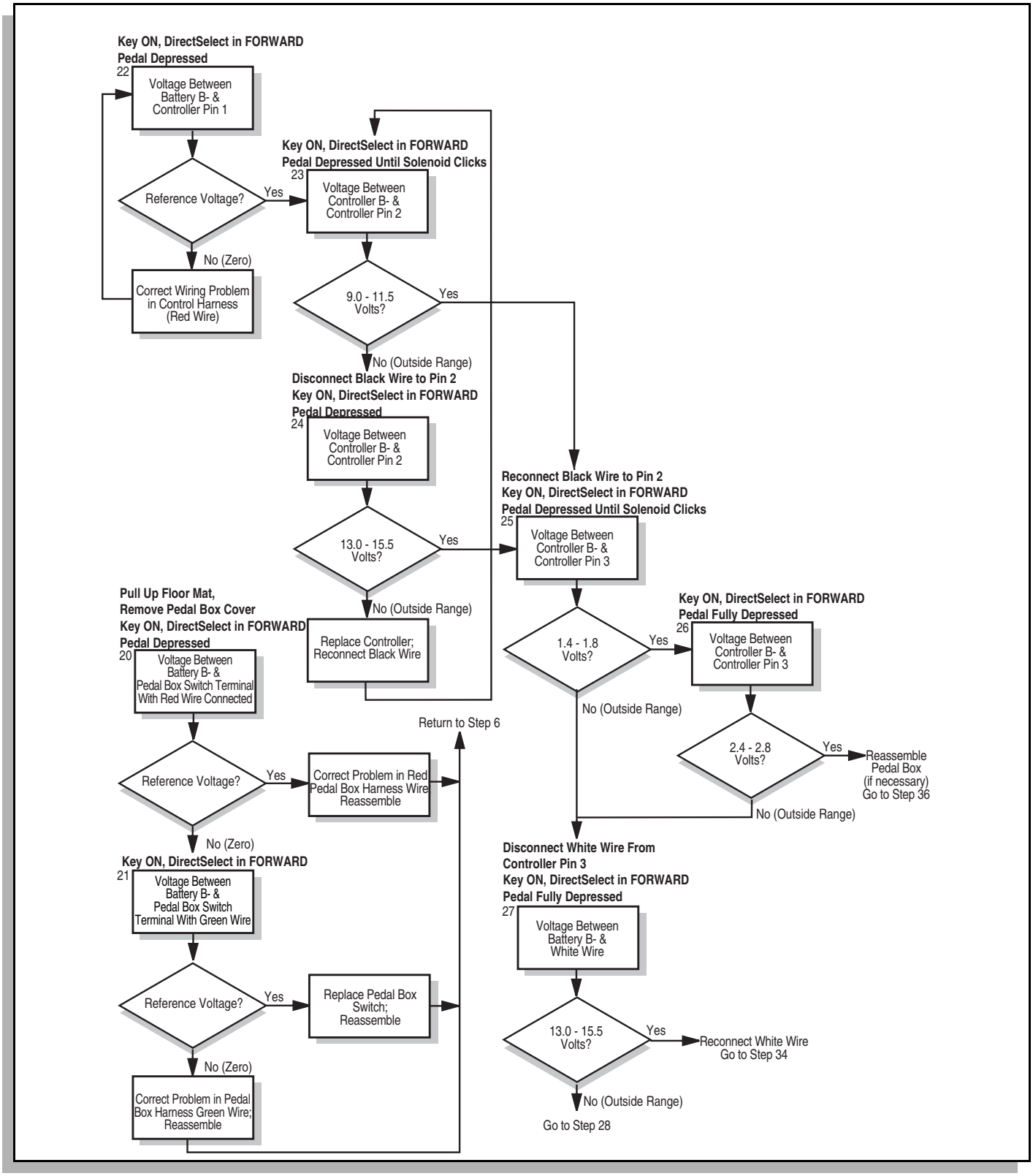


Fig. 10 Detailed Troubleshooting Diagram (Sheet 4 of 8)

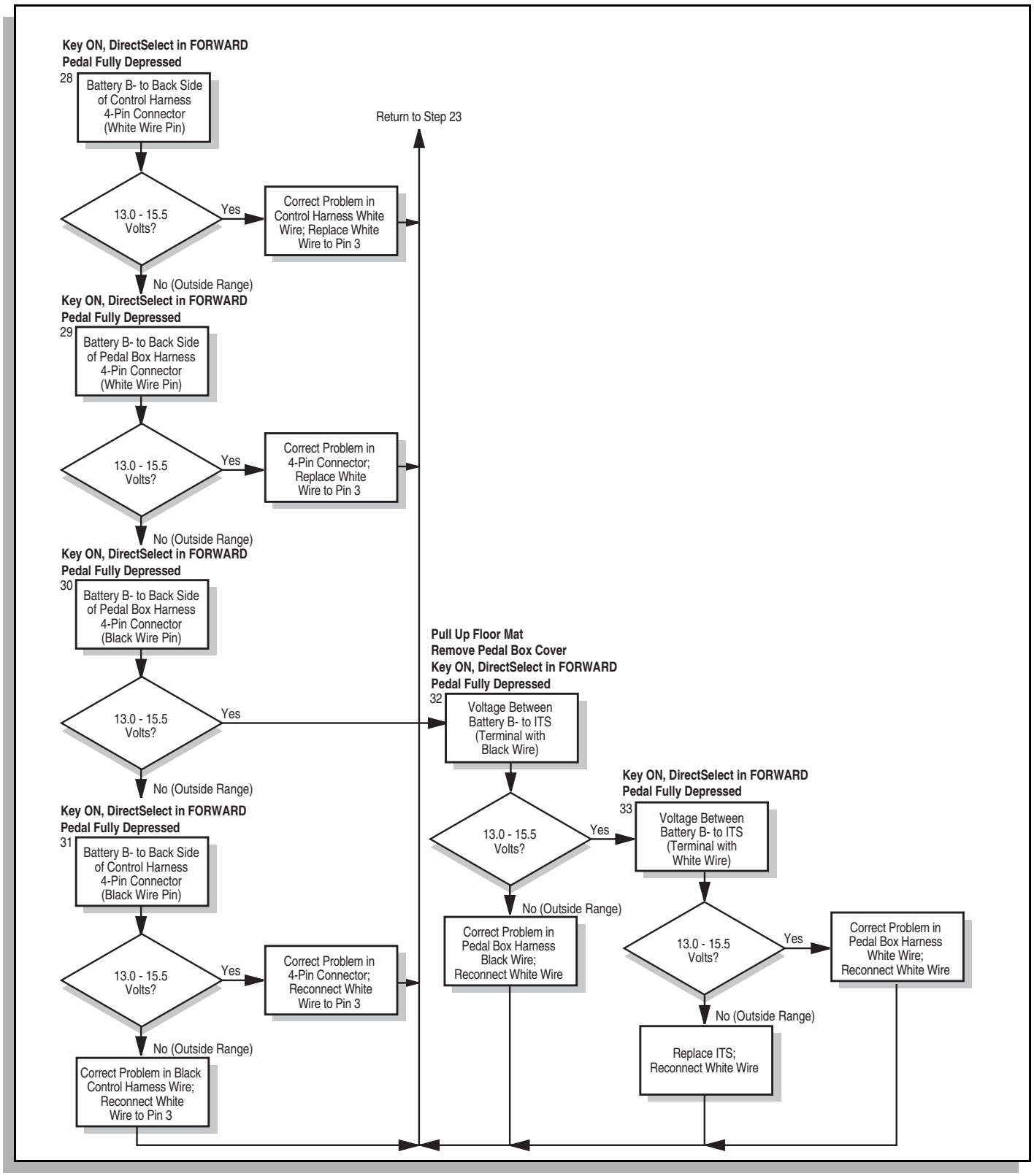


Fig. 11 Detailed Troubleshooting Diagram (Sheet 5 of 8)

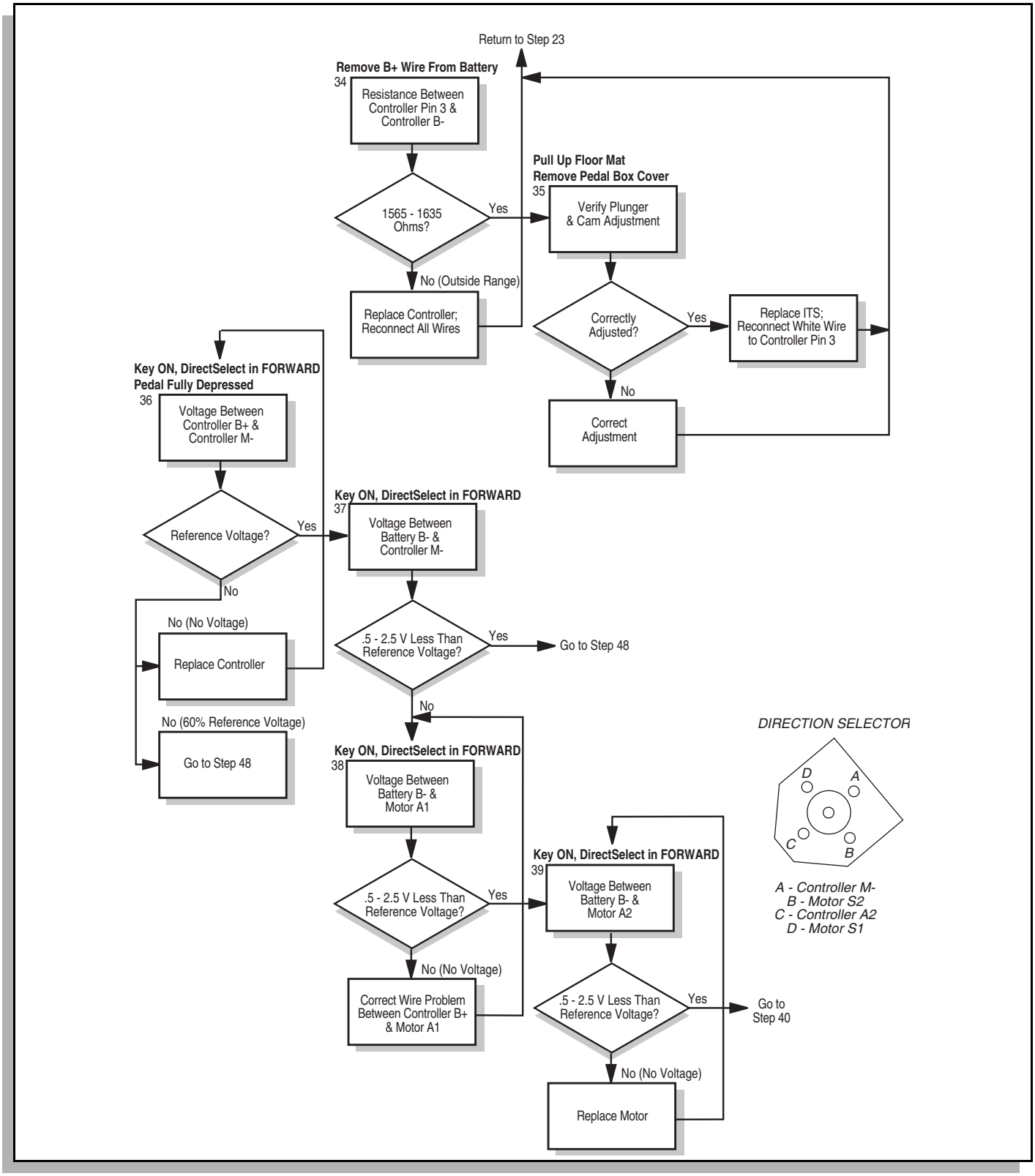


Fig. 12 Detailed Troubleshooting Diagram (Sheet 6 of 8)

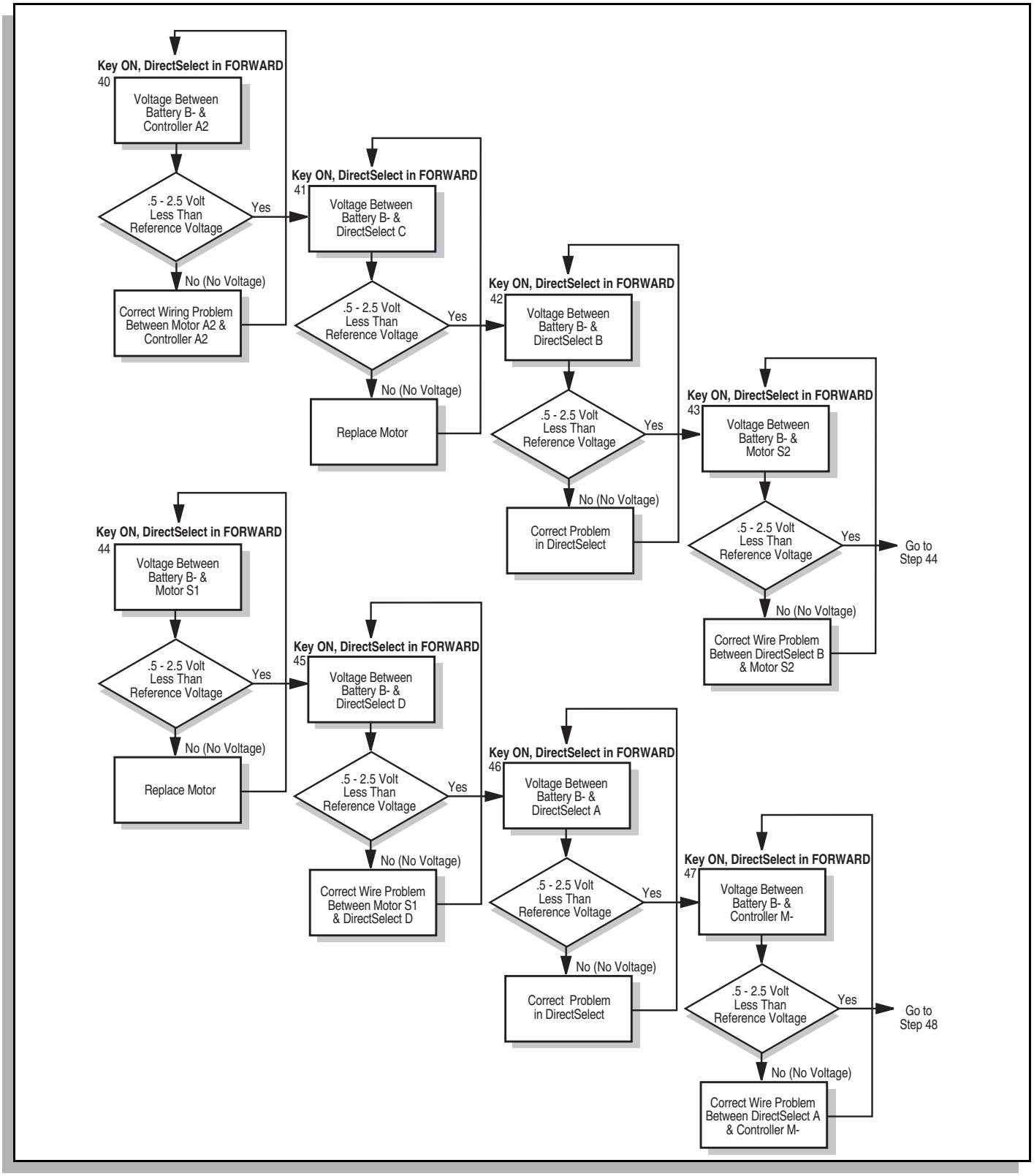


Fig. 13 Detailed Troubleshooting Diagram (Sheet 7 of 8)

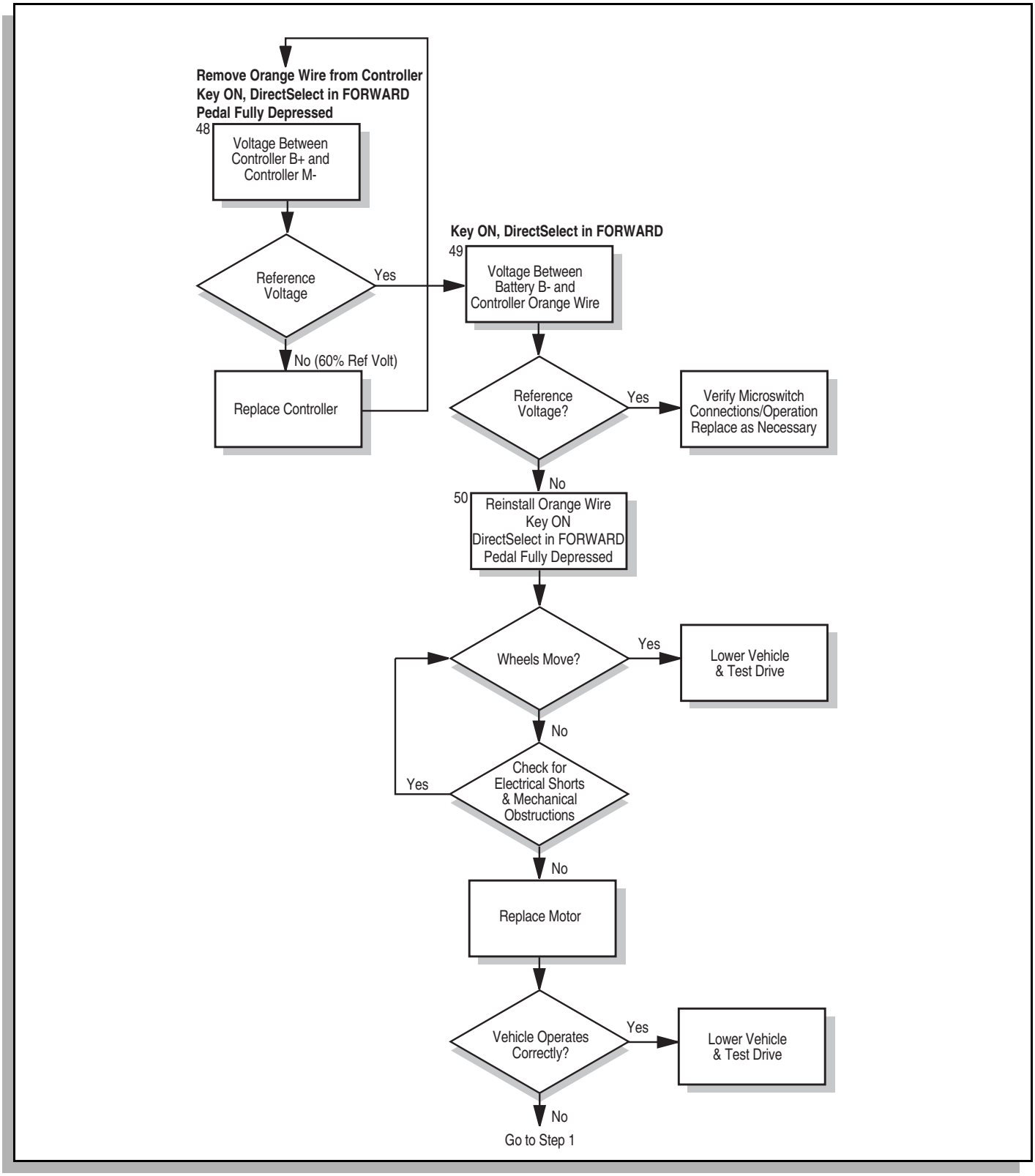


Fig. 14 Detailed Troubleshooting Diagram (Sheet 8 of 8)

INDUCTIVE THROTTLE SENSOR (ITS) TESTING AND REPLACEMENT

Tool List	Qty. Required
Phillips screwdriver	1
Wrench, 7/16"	1
Nut driver, 7/16"	1
Drill bit, 17/64"	1
DVOM	1

Raise the rear wheels of the vehicle and support the vehicle on jack stands (Refer to Lifting Procedure in Section 'B' Safety). Test the vehicle stability before proceeding.

Remove the access cover and remove the four screws securing the plastic cover to the pedal box (Ref Fig. 15 on page E-15).

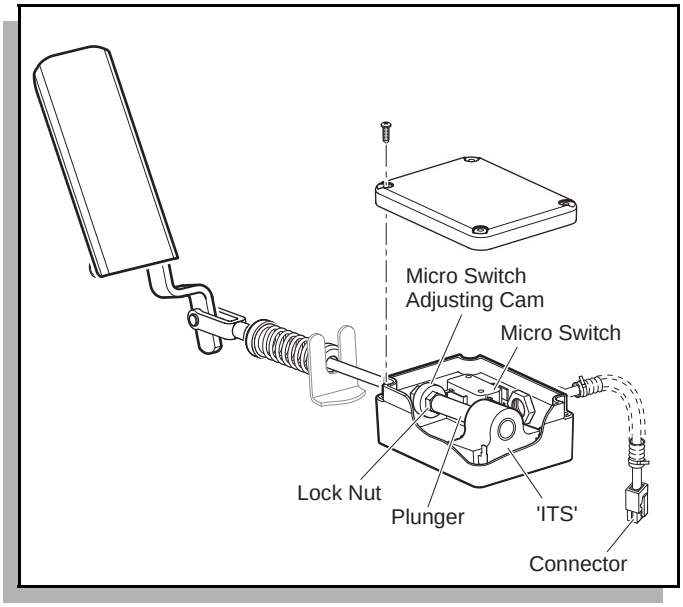


Fig. 15 ITS and Plunger

Set the parking 'PARK' brake. With the DVOM set to volts, probe the white wire at the ITS with the positive probe and attach the negative probe to the B- at battery. Place the direction selector in 'F' and turn the key switch to 'ON'. Depress the accelerator pedal. As the solenoid clicks the meter should read between 0.4 - 0.6 volts. The meter should read 1.5 - 1.7 volts at full pedal (Ref Fig. 17 on page E-17). If the reading is out of specification, **the ITS sensor must be replaced.**

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

Carefully remove the two wires that attach to the ITS and carefully remove the nuts securing the ITS to the plastic pedal box studs.

Install a new ITS being careful to align the ITS and not to overtighten the retaining nuts. Attach the wiring.

With the accelerator pedal in the full up position, insert a 17/64" drill bit between the plunger and the face of the ITS. The drill bit should be used to verify and adjust the distance between the face of the ITS and the face of the plunger (Ref Fig. 16 on page E-16). **If the plunger needs adjustment**, loosen the lock nut and rotate the plunger until the desired dimension is achieved. Firmly tighten the jam nut.

Replace the plastic cover and press it firmly into place before tightening the cover screws.

Replace the metal access cover.

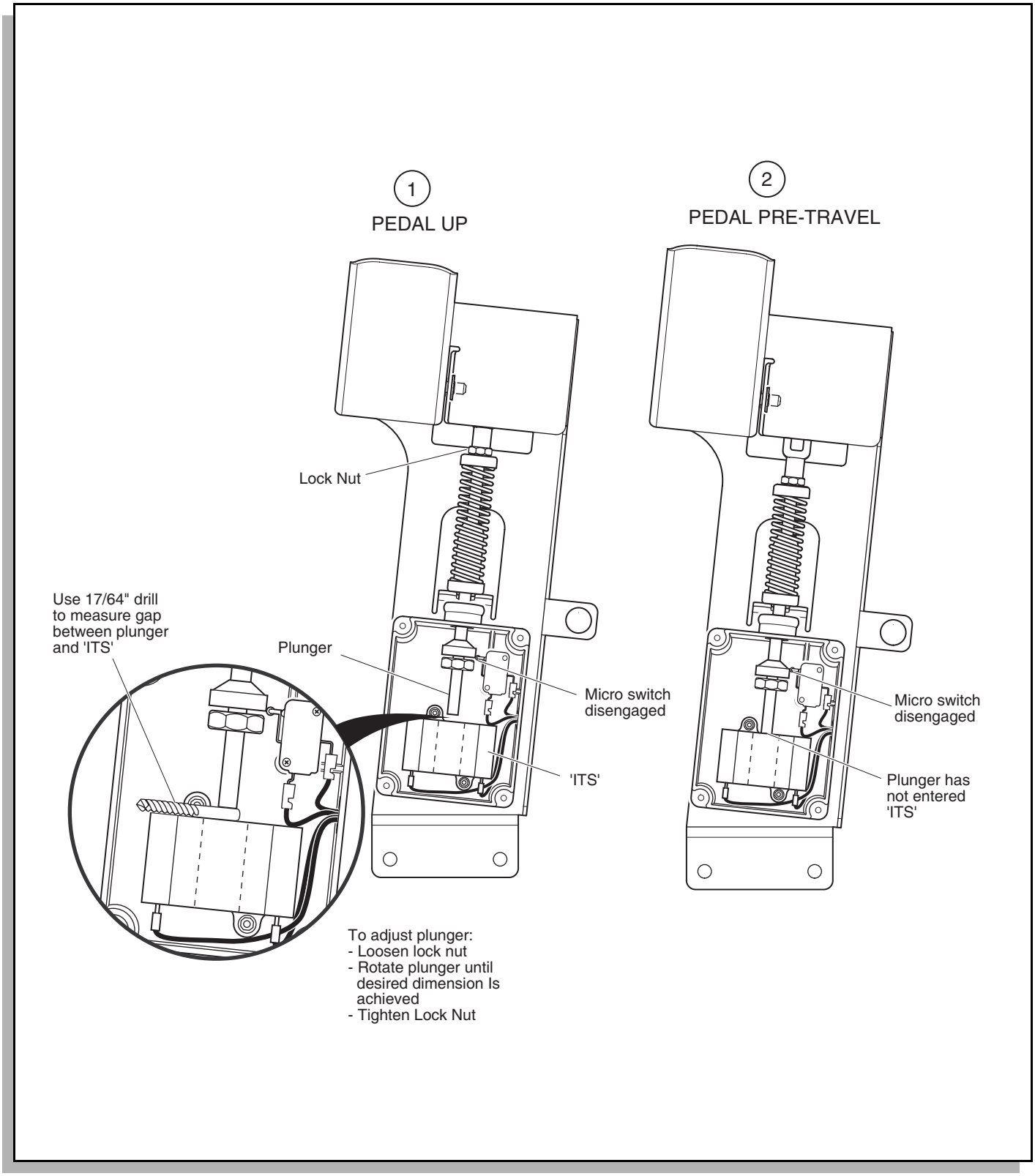


Fig. 16 ITS Adjustment

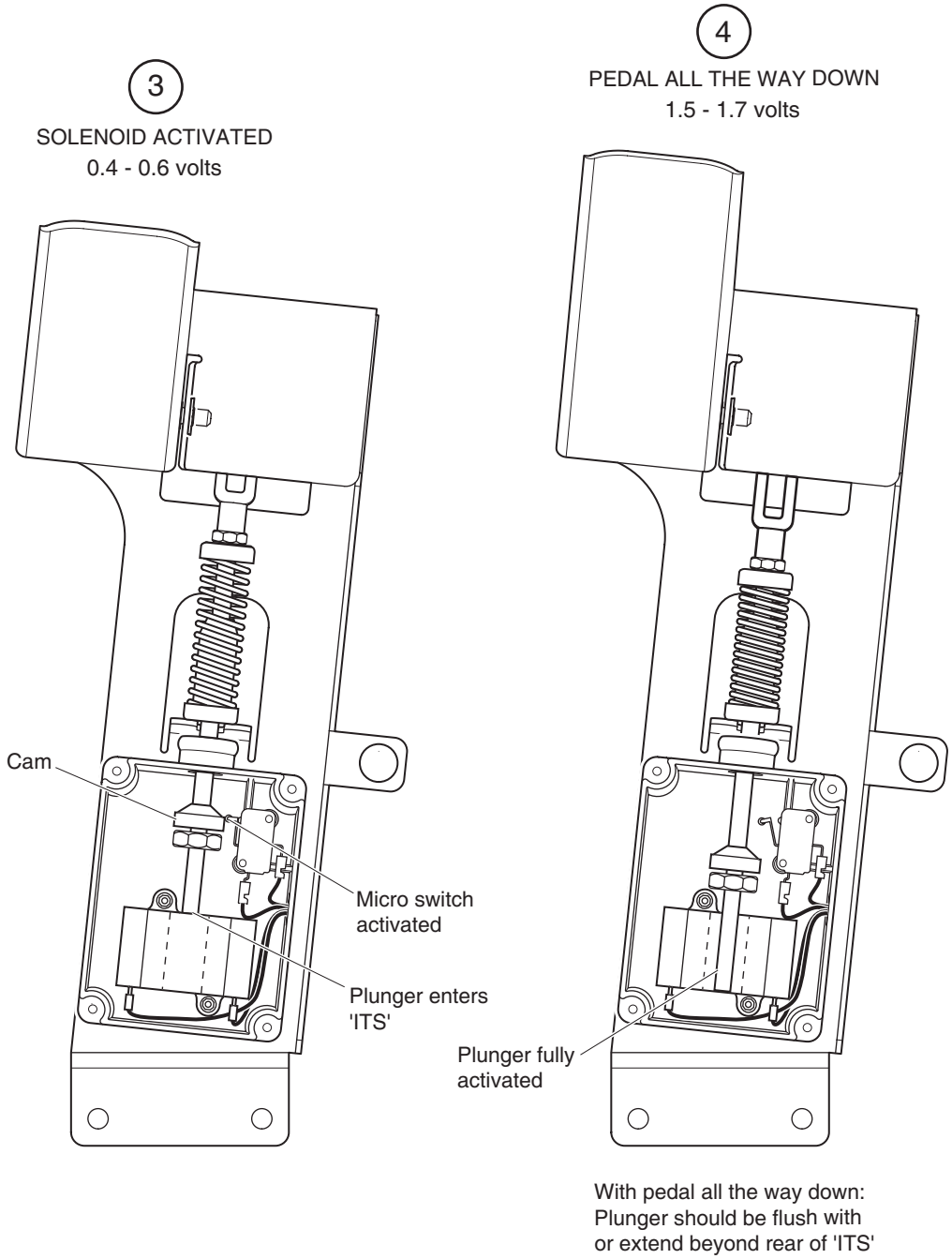


Fig. 17 ITS Adjustment

CONTROLLER REPLACEMENT

Tool List	Qty. Required
Socket, 3/8", 3/8" drive	1
Socket, 7/16", 3/8" drive	1
Socket, 1/2", 3/8" drive	1
Ratchet, 3/8" drive	1
Extension, 6", 3/8" drive	1
Insulated wrench, 9/16"	1
Shop towel	1
Torque wrench, 3/8" drive, in. lbs.	1
Torque wrench, 3/8" drive, ft. lbs.	1
Large screwdriver	1

Remove the seat.

Using an insulated wrench, remove the B+ wire from the battery.

⚠ WARNING ⚠ ***The B+ wire must be removed before discharging the controller. Discharge the controller by shorting the B+ and B- terminals of the controller with a large screwdriver. Be sure to hold screwdriver by the insulated portion.***

NOTE *Note the location of the wiring on the controller before removing wiring from controller (Ref Fig. 2 on page E-2). Remove the controller mounting bolts and remove the controller.*

Mount new controller and reconnect wiring. Tighten the 1205 controller mounting bolts to 68 - 82 in. lbs. (8 - 9 Nm) torque and the terminal bolts to 45 - 50 ft. lbs. (5 Nm) torque.

Tighten the mounting bolts to 108 - 132 in. lbs. (12 - 15 Nm) torque.

Reconnect the B+ battery cable and replace the seat.

SOLENOID REPLACEMENT

Tool List	Qty. Required
Socket, 3/8", 3/8" drive	1
Socket, 7/16", 3/8" drive	1
Socket, 1/2", 3/8" drive	1
Ratchet, 3/8" drive	1
Extension, 6", 3/8" drive	1
Insulated wrench, 9/16"	1
Shop towel	1
Torque wrench, 3/8" drive, in. lbs.	1
Torque wrench, 3/8" drive, ft. lbs.	1

Remove the seat.

Using an insulated wrench, remove the B+ wire from the battery and cover the direction selector switch with a shop towel.

NOTE *Note the location of the wiring on the solenoid before removing wiring from solenoid (Ref Fig. 2 on page E-2). Remove the solenoid mounting bolts and remove the solenoid.*

Mount new solenoid and reconnect wiring. Tighten the solenoid mounting nuts to 68 - 82 in. lbs. (8 - 9 Nm) torque, the #10 terminal nuts to 15 - 20 in. lbs. (2 Nm) and the 5/16" terminal nuts to 50 - 55 in. lbs (6 Nm) torque.

Tighten the mounting bolts to 108 - 132 in. lbs. (12 - 15 Nm) torque.

Reconnect the B+ battery cable and replace the seat.

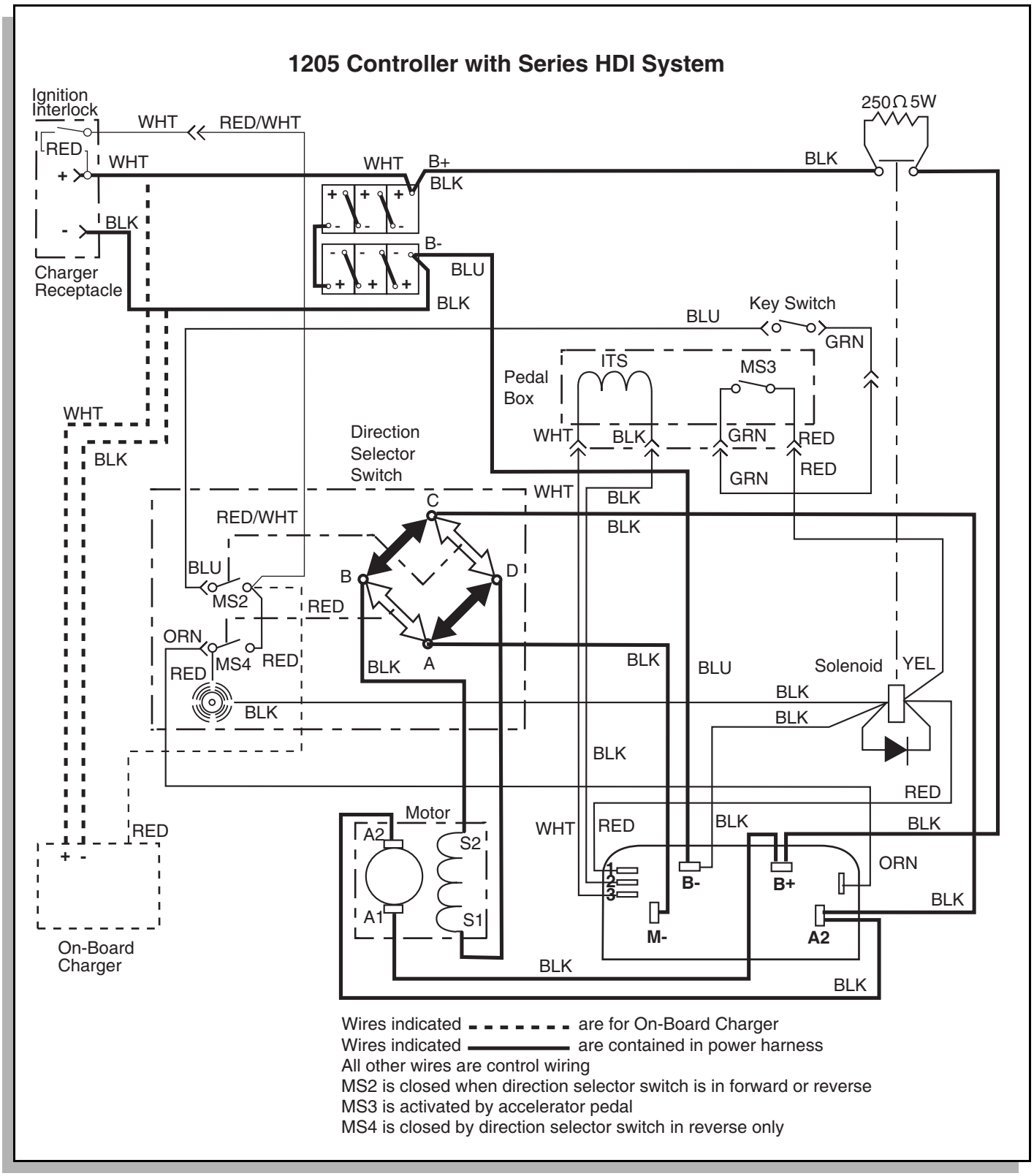


Fig. 18 Wiring Diagram

ELECTRONIC SPEED CONTROL 36V

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

Notes:

ELECTRONIC SPEED CONTROL (48V)

F

TABLE OF CONTENTS FOR SECTION 'F'

SECTION TITLE **PAGE NO.**

LIST OF ILLUSTRATIONS

Notes:

ELECTRONIC SPEED CONTROL (48V)

F

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

48 VOLT SYSTEM VEHICLES GENERAL

48 Volt vehicles may be equipped with one of four modes or “performance options”. The factory installed Performance Option is the ‘No Plug’, however it is possible that the technician may encounter a vehicle equipped with an aftermarket option. The option of the vehicle is determined by which performance plug is installed in the Electronic Speed Control Assembly. The options are defined as follows:

1. The ‘No Plug’ performance option: The motor’s speed is sensed and regulated to 13.5 mph (22 kph) directly by the controller, the vehicle’s flat ground speed will not change with different ground surfaces. The speed sensor also allows for precise control of the downhill vehicle speed during compression braking. Compression braking occurs when the throttle is released while the vehicle is moving. The motor will electrically retard the motion of the vehicle until the throttle is depressed again or the vehicle stops. This is the strongest of the two compression braking options. As the vehicle crests a hill and begins to descend, the speed will be smoothly regulated to 13.5 mph (22 kph). This option is enabled when there is a blank plug installed.
2. The ‘Blue Plug’ performance option: This option includes all of the driving features of the ‘No Plug’ option except that the compression braking feel is milder.
3. The ‘Yellow Plug’ performance option: This option includes all of the driving features of the ‘No Plug’ option, except the flat ground compression braking speeds are 15 mph (24 kph) instead of 13.5 mph (22 kph).
4. The ‘Red Plug’ performance option: This option includes all of the driving features of the ‘Blue Plug’ option except that the flat ground and downhill compression braking speeds are 15 mph (24 kph) instead of 13.5 mph (22 kph).

Performance options of the Precision Drive System include:

- Anti-Roll back to limit backward motion of the vehicle down an incline to less than 2 mph (3 kph)
- Walk-Away to limit vehicle movement without driver input, slowing the vehicle to 2 mph (3 kph) and sounding an audible alarm (reverse beeper)
- Anti-Stall protection to prevent commutator damage from stalling the vehicle against an object or on a hill
- High pedal disable to prevent undesired acceleration if the direction selector lever is changed, or the key is turned on while the accelerator is depressed
- Diagnostic light indicator to ease troubleshooting

PERFORMANCE OPTIONS & DIAGNOSTICS

Performance Option	Top Speed	Compression Braking Strength	Anti-Stall Protection
No Plug	13.5 mph (22 kph)	Heavy	Yes
Blue Plug	13.5 mph (22 kph)	Mild	Yes
Yellow Plug	15 mph (24 kph)	Heavy	Yes
Red Plug	15 mph (24 kph)	Mild	Yes

Changing Performance Options

The performance option may be changed if the existing option is not compatible with the terrain that the vehicle will be operated.

1. Raise the seat and move the Run-Tow/Maintenance switch to the ‘TOW/MAINTENANCE’ position.
2. Locate the 5-pin performance option plug emanating from the J-1 connector and remove the option plug.
3. Replace the existing performance option plug with the desired new plug.
4. Move the Run-Tow/Maintenance switch to ‘RUN’.

(To activate a newly installed performance option plug, cycle the Run-Tow/Maintenance switch by moving switch to 'Tow/Maintenance' once again, and back to Run).

At monthly intervals, test the 48 volt system by allowing the vehicle to roll down an incline with the accelerator pedal released. Braking force should be felt at approximately 2 mph (3 kph) indicating that the 48 volt system is functioning. If vehicle speed continues to rise, apply the service brake to control speed and proceed with diagnostic check.

The 48 volt vehicle has the ability to diagnose and report several common vehicle fault modes. These faults are reported through a light emitting diode on the face of the controller through a sequence of blinks.

The faults are reported as a series of blinks followed by a pause and then another series of blinks. The number of blinks in each series constitute the fault code. For example: three short blinks followed by a pause, and then two more short blinks would indicate fault code 3-2.

The two-position 'Run-Tow/Maintenance' switch is located under the passenger seat (Ref Fig. 1 on page F-2).

OPERATION

With the switch in 'TOW/MAINTENANCE' position:

- the controller is deactivated
- the electronic braking system is deactivated which allows the vehicle to be towed or roll freely
- the reverse warning beeper is deactivated

With the switch in 'RUN' position:

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

NOTE *48 volt vehicles operate only in the 'RUN' position.*

If all of the following events occur with the switch in 'RUN' position

a) the vehicle has been stopped for more than one second
b) the accelerator pedal has been released for more than one second
c) the vehicle begins to roll above 2 mph (3 kph)

the electronic braking will limit speed to approximately 2 mph (3 kph) and the warning beeper will sound. When the accelerator pedal is depressed, the electronic braking and warning beeper will be overridden and normal vehicle operation resumes. Any unusual situation sensed by the 48 volt system will cause a similar response. The system functions in all key switch positions.

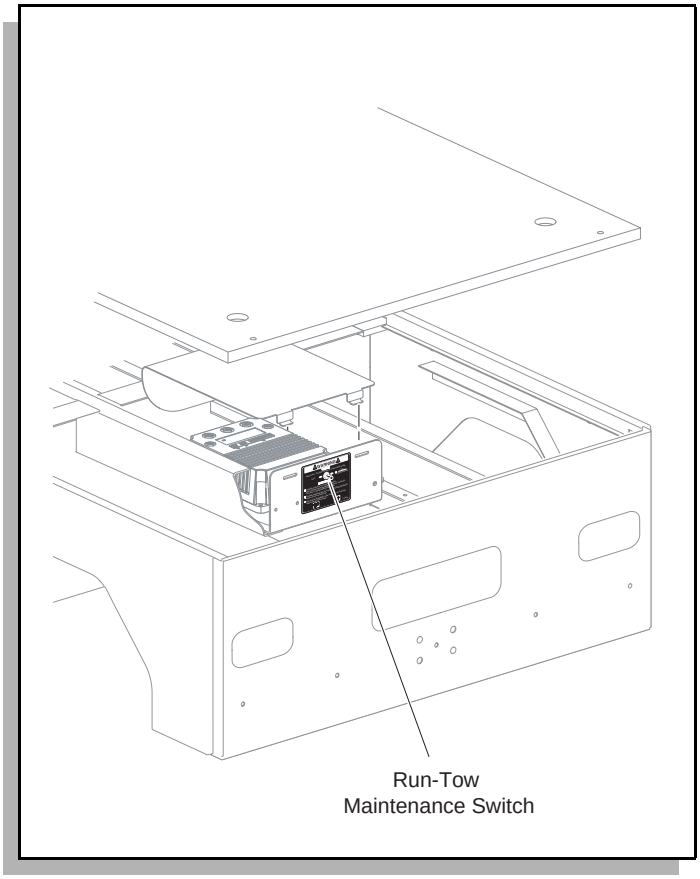


Fig. 1 Run-Tow/Maintenance Switch

⚠ WARNING ⚠ ***The 48 volt system is not a substitute for the service brake which should be used to control speed and reduce possibility of injury.***

If all of the following events occur with the switch in 'RUN' position

a) the vehicle is being driven down a slope
b) the vehicle speed exceeds the designed speed with the accelerator pedal depressed **or** released (except options equipped with compression braking)

the electronic braking will limit the speed of the vehicle to the designed speed range (the warning beeper will **not** sound). When the electronic braking system is activated by this sequence of events, the motor generates power

which is returned to the batteries. 48 volt models are equipped with a regenerative motor control system.

The motor's speed is sensed and regulated directly by the controller. As a vehicle begins to accelerate while descending a hill, the speed sensor will cause the motor to electrically retard the speed of the vehicle through regenerative braking.

If the operator attempts to override the electronic braking feature by moving the direction selector or key switch to another position, the warning beeper will sound and the vehicle will brake **rapidly** until it reaches the speed of approximately 2 mph (3 kph).

The 48 volt system also incorporates an anti-stall protection feature that prevents commutator damage from stalling the vehicle against an obstacle or ascending a hill. The electrical power to the motor will be interrupted intermittently allowing the vehicle to roll a short distance, thereby allowing the internal components of the motor to move before damage can be done.

The No Plug option (See chart on page 1) features a different degree of compression braking that takes place any time that accelerator pedal is released. The No Plug option will rapidly slow the vehicle to a stop unless the accelerator pedal is depressed. The three other options will slow the vehicle to a stop at different rates unless the accelerator pedal is depressed.

The 48 volt system is a low power consumption unit but it will drain the vehicle batteries over a period of time. If the vehicle is to be stored for a prolonged period of time, the 48 volt system should be disconnected from the batteries by selecting the 'TOW/MAINTENANCE' position on the Run-Tow/Maintenance switch located under the passenger seat.

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

Pedal Box

The Pedal Box assembly is a modularized unit that contains the accelerator pedal (1), return spring (2) and an enclosed pedal box (3) that contains lthe pedal position micro switch and a solid state Inductive Throttle Sensor (ITS) that is activated by a moving plunger attached to the accelerator pedal.

To access the pedal box (3), remove the three screws (4) and remove the access cover (5) from the floor (Ref Fig. 2 on page F-4). The ITS and plunger are accessed by removing the top cover from the enclosed pedal box.

Controller

The Controller is a solid state unit activated by a solenoid. Both are located in an electrical box located under the cargo deck.

A diode is positioned between the two coil terminals of the solenoid. Its orientation is critical. The cathode side of the diode, identified with a silver band, is oriented to the solenoid terminal with the red wire attached.

CAUTION **If the diode is incorrectly oriented, the pedal box micro switch and the direction selector micro switch may be permanently damaged.**

The pedal box and controller are connected by a four pin connector that is located at the front of the vehicle.

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

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

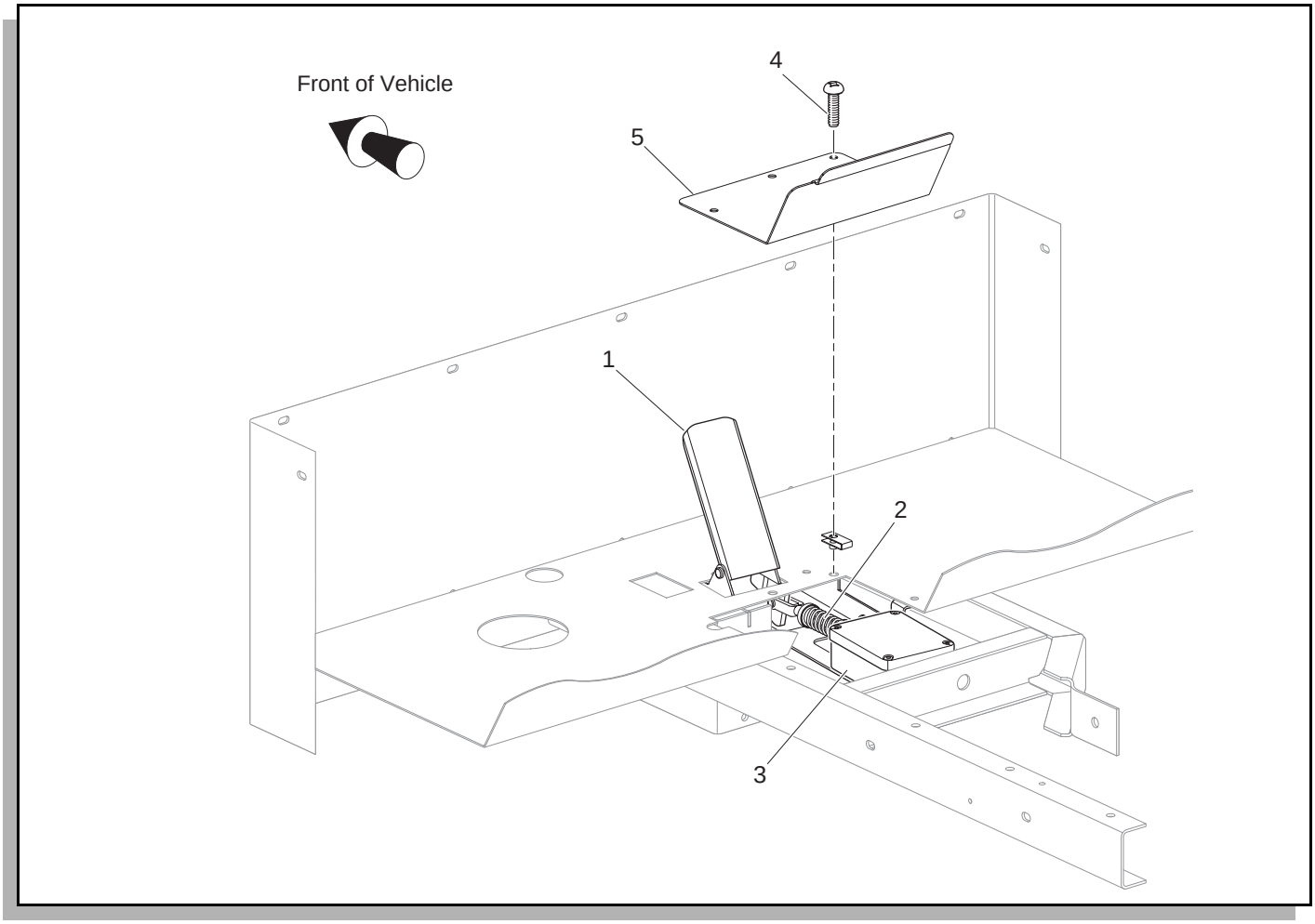


Fig. 2 Access to Pedal Box

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

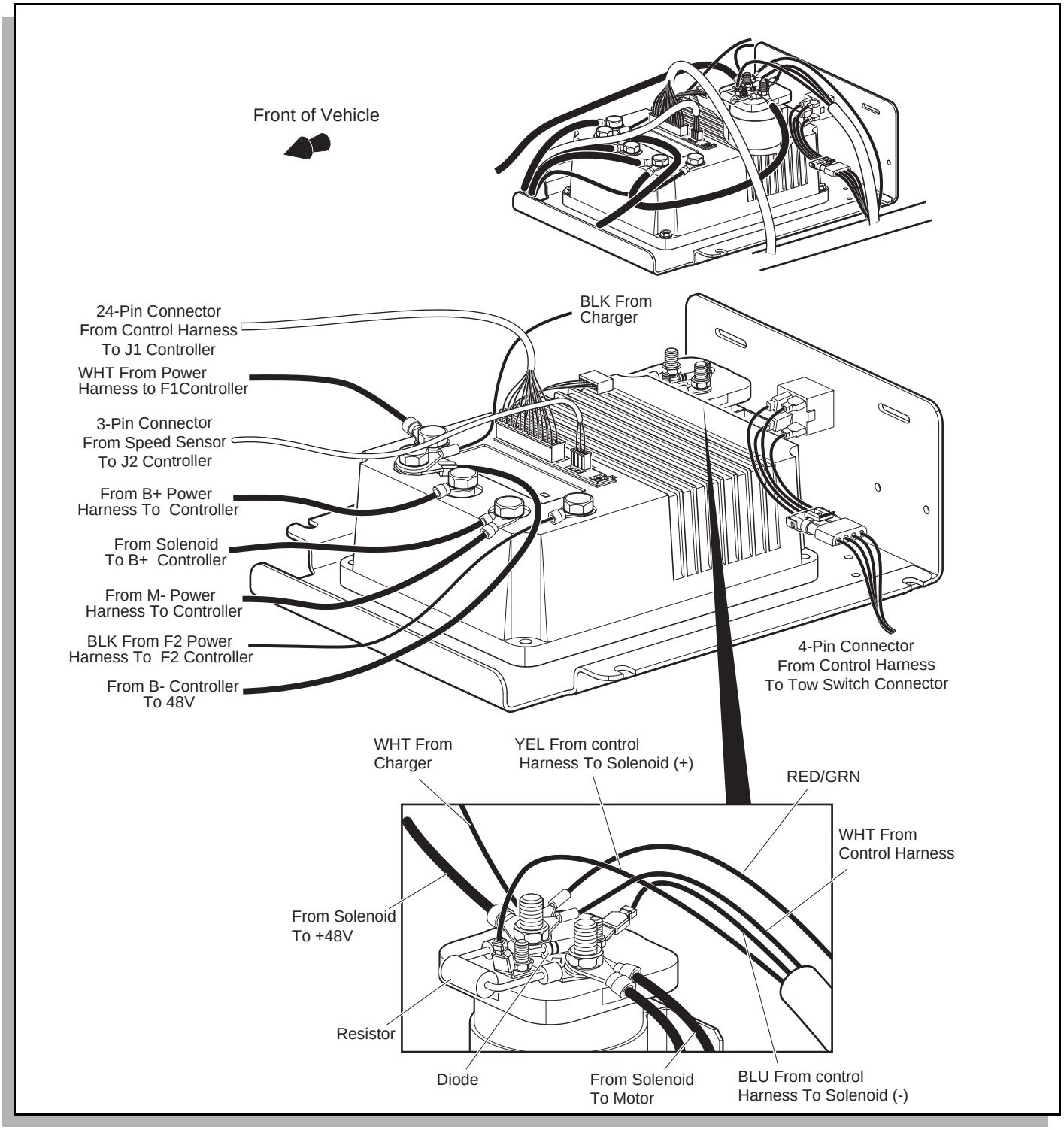


Fig. 3 Controller and Solenoid

GENERAL TROUBLESHOOTING

Tool List	Qty. Required
Floor jack	1
Jack stands	2
Wheel chocks	4
Jumper wire (with alligator clips)	1
DVOM	1
Socket, 3/8", 3/8" drive	1
Ratchet, 3/8" drive	1
Torque wrench, in. lbs., 3/8" drive	1
Torque wrench, ft. lbs., 3/8" drive	1
Extension, 6", 3/8" drive	1
Insulated wrench, 9/16"	1
Wrench, 1/2"	1
Wrench, 7/16"	1
Phillips screwdriver, large	1
Phillips screwdriver, small	1
Shop towel	1
Allen wrench, .050"	1

Symptoms

Vehicle does not operate, operates poorly or intermittently.

Testing

It is unlikely that the mechanical adjustment of the pedal box 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.

Controller

The controller is a solid state unit that activates a solenoid and controls the function of the vehicle by responding to inputs from the ITS and motor speed sensor. The controller and solenoid are located in encloser under deck (Ref Fig. 4 on page F-6).

The pedal box is connected to the controller through a 24-pin plug at J1 on the controller. The speed sensor is connected to the controller through a three-pin plug at J2 (Ref Fig. 9 on page F-11).

The controller is wired to the batteries and develops a regulated power supply for the ITS. The plunger position

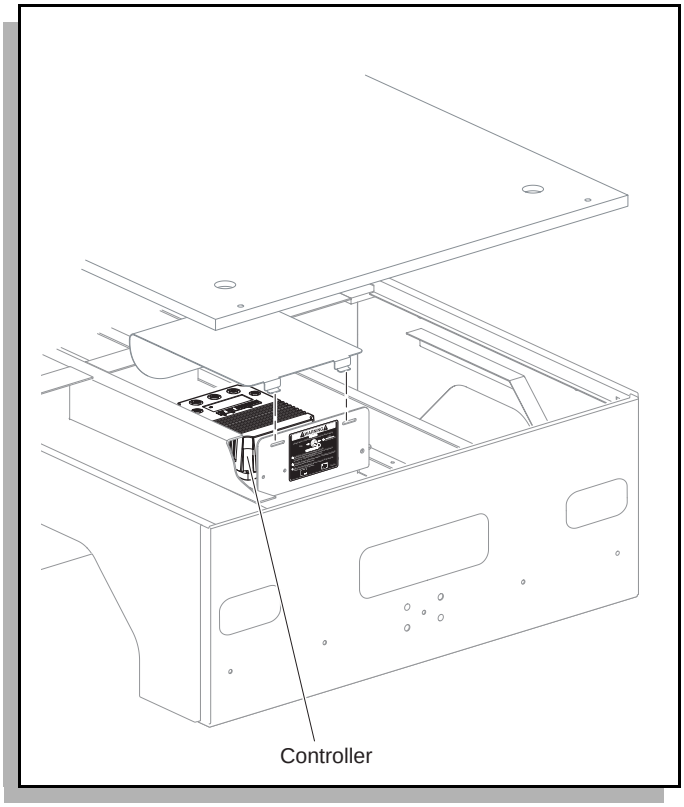


Fig. 4 Controller

relative to the ITS varies the voltage which is fed back to the controller which interprets the change in voltage and supplies the appropriate power to the motor.

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

GENERAL TROUBLESHOOTING

Tool List	Qty. Required
Floor jack	1
Jack stands	2
Wheel chocks	4
Jumper wire (with alligator clips)	1
DVOM	1
Socket, 3/8", 3/8" drive	1
Ratchet, 3/8" drive	1
Torque wrench, in. lbs., 3/8" drive	1
Torque wrench, ft. lbs., 3/8" drive	1

Extension, 6", 3/8" drive 1
Insulated wrench, 9/16" 1
Wrench, 1/2" 1
Wrench, 7/16" 1
Phillips screwdriver, large 1
Phillips screwdriver, small 1
Shop towel 1
Allen wrench, .050" 1
Drill bit, 7/32" 1

Symptoms

Vehicle does not operate, operates poorly or intermittently.

Testing

A maintenance feature of the 48 volt controller is the ability to diagnose electrical faults preventing the vehicle to operate at its fullest potential. A light on the controller face will blink informing the technician to the cause of the vehicle malfunction.

A series of blinks will indicate the fault code (one, two, three, four or five followed by a pause and one, two, three, four or five more blinks). By reading the decal attached near the controller, or by reading the 48 volt Diagnostic Mode Fault Code chart (Ref Fig. 8 on page F-10), the fault, its symptom(s) and corrective action to be taken can be found.

It is unlikely that the mechanical adjustment of the pedal box 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 injury resulting from unexpected movement of the vehicle, always raise the rear wheels before conducting any tests.***

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

For static tests, raise the rear wheels of the vehicle and support the vehicle on jack stands (Refer to the Lifting Procedure in Section 'B' Safety). Test the vehicle stability before proceeding.

Place the direction selector in 'F' and turn the key switch to 'ON'. Depress the accelerator pedal until the micro switch in the pedal box activates which should cause the solenoid mounted to the controller to make an audible click. If the solenoid does not click, test the batteries.

Testing Battery Voltage

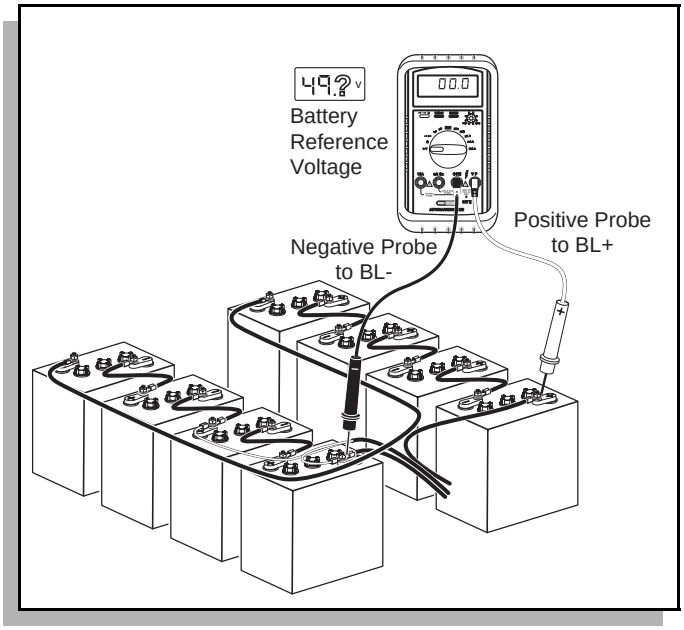


Fig. 5 Battery Reference Voltage

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 can still show six volts or higher in an open voltage test. If there is any doubt as to the adequacy of the battery set, charge the batteries and perform a load test using a discharge machine following manufacturer's instructions. If batteries are satisfactory, recharge battery set.

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. 5 on page F-7). 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 could be up to one volt less than the reference voltage. No reading indicates an "open" condition and the battery wires should be inspected for a broken or disconnected wire or component.

Continuity Check

⚠ WARNING ⚠ ***To prevent possible injury or death resulting from a battery explosion, use an insulated wrench and remove the BL- wire from the battery to disconnect electrical power to vehicle.***

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

CAUTION **Before any electrical service is performed on 48 volt model vehicles, the Run-Tow/Maintenance switch must be placed in the 'Tow/Maintenance' position.**

If a power wire (battery, motor or controller) is disconnected for any reason on the 48 volt model vehicle, the Run-Tow/Maintenance switch must be left in the 'Tow/Maintenance' position for at least 30 seconds after the circuit is restored.

Turn the key switch to 'OFF' and place the direction selector in neutral before disconnecting power by removing the BL- connection to the battery. **Always use insulated wrenches when working on batteries.** To check for continuity, set the DVOM to the KΩ setting and select 'Continuity'. The meter will give an audible signal when it detects continuity. If the meter does not have a continuity setting, set it to KΩ, the meter will indicate "0" when it detects continuity.

Testing a Switch for Continuity

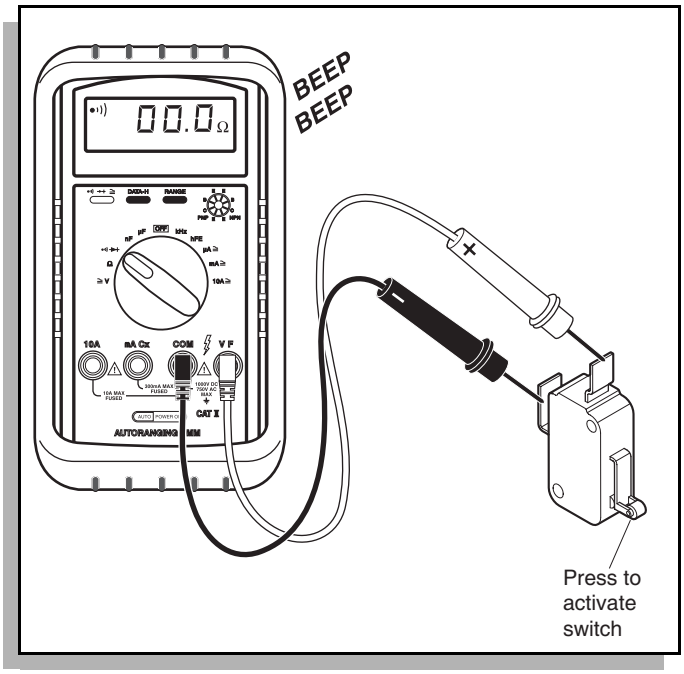


Fig. 6 Continuity Check of Switch

Place one probe on one contact of the switch, place the second probe on the second terminal of the switch (Ref Fig. 6 on page F-8).

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. 7 on page F-9). If the meter shows "0" or gives an audible indi-

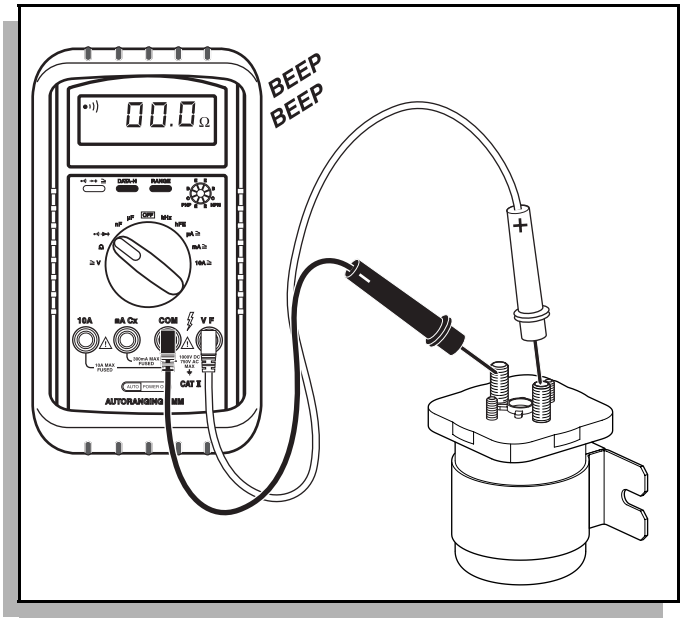


Fig. 7 Continuity Check of Solenoid

cation, 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.**

TROUBLESHOOTING DIAGRAMS

The following diagrams will assist in servicing the vehicle. By utilizing the Fault Codes, considerable time will be saved in determining the probable vehicle operating malfunction. The vehicle power and control wiring diagram is included for your convenience in tracing the electrical wiring (Ref Fig. 10 on page F-12). The following 6 flow charts will assist in diagnosing and correcting problems not diagnosed through the Fault Codes.

Fault Code	Fault	Vehicle Operation Change	Corrective Action
- - -	Direction Selector Fault	Vehicle Operates in One Direction Only	• At Direction Selector check wiring Bad - Replace/repair wiring; Good - Replace selector switch
- - -	No Buzzer	Buzzer Inoperative	• Verify Run-Tow/Maintenance Switch is in 'RUN' position; • Verify 48 volts at J1 Pin 10; Repair/replace Pin 10 wire; • Verify 48 volts at J1 Pin 1; Repair/replace Logic Power; • (In Reverse) Verify 48 volts at J1 Pin 2; Repair/replace wire or micro switch in Direction Selector switch
0 - 0	No Fault Codes	Vehicle Inoperative with Key ON	• Open Pedal Box, verify micro switch wiring is connected & is not damaged; Repair/replace as necessary; • Direction Selector Forward micro switch OPEN, verify switch is operational and wiring is connected & not damaged; Repair/replace as necessary; • Verify Key Switch is operational; Repair/replace as necessary
The following codes require the rear wheels be raised before performing tests:			
1 - 1	Hardware Failsafe	Vehicle will not run	• Check motor wiring; Replace controller
1 - 2	Throttle Fault 1	Vehicle will not run	• Check pedal box adjustment, connections; Replace ITS
1 - 3	Speed Sensor Fault	Vehicle runs slowly	• Check speed sensor magnet, wire, sensor & connector connections; Replace speed sensor if necessary
1 - 4	High pedal disable	Vehicle will not run	• Release and reapply pedal; Check pedal box, linkage, switch, key switch
1 - 5	Motor stall	Vehicle stopped	• Remove mechanical blockage
2 - 1	Low Battery Voltage	Vehicle performance reduced	• Perform discharge test; Charge batteries/replace bad batteries
2 - 2	High Battery Voltage	Vehicle performance reduced	• Verify that battery system is less than 48 volts
2 - 3	Thermal Cutback	Vehicle performance reduced	• Allow controller to cool and verify heat sink bolt tightness
2 - 4	Main driver on	Vehicle runs slowly	• Solenoid driver defective; Replace controller
2 - 5	Volts direct current fault	Vehicle will not run	• Replace controller
3 - 1	Main driver off	Solenoid does not close	• Replace controller
3 - 2	Solenoid Welded	Vehicle runs slowly	• Replace solenoid
3 - 3	Precharge fault	Vehicle will not run	• Check for additional electronics attached to B+; Replace controller
3 - 4	Field missing	Solenoid closes, Vehicle will not run	• Check wiring; Replace power harness and motor if required
3 - 5	Field overcurrent	Vehicle will not run	• Field windings or power harness shorted; Verify; Replace motor if necessary

Fig. 8 48 Volt Fault Codes

4 - 1	Current sense fault	Vehicle will not run	• Replace controller
4 - 3	M- fault	Vehicle will not run	• Check M- wiring and repair; Replace controller
4 - 4	Auxiliary contact did not close	Vehicle will not run	• Replace controller
4 - 5	Welded auxiliary contact	Vehicle runs slowly	• Replace controller
5 - 1	EEprom failsafe	Vehicle will not run	• Replace controller
5 - 2	Main coil open	Vehicle will not run	• Check coil connections/wiring; Replace solenoid if necessary
5 - 3	Main contact did not close	Vehicle will not run	• Check all solenoid wiring; Replace solenoid if necessary
5 - 5	Missing contactor	Vehicle stops	• Check all solenoid wiring; Replace solenoid if necessary

Fig. 8 48 Volt Fault Codes

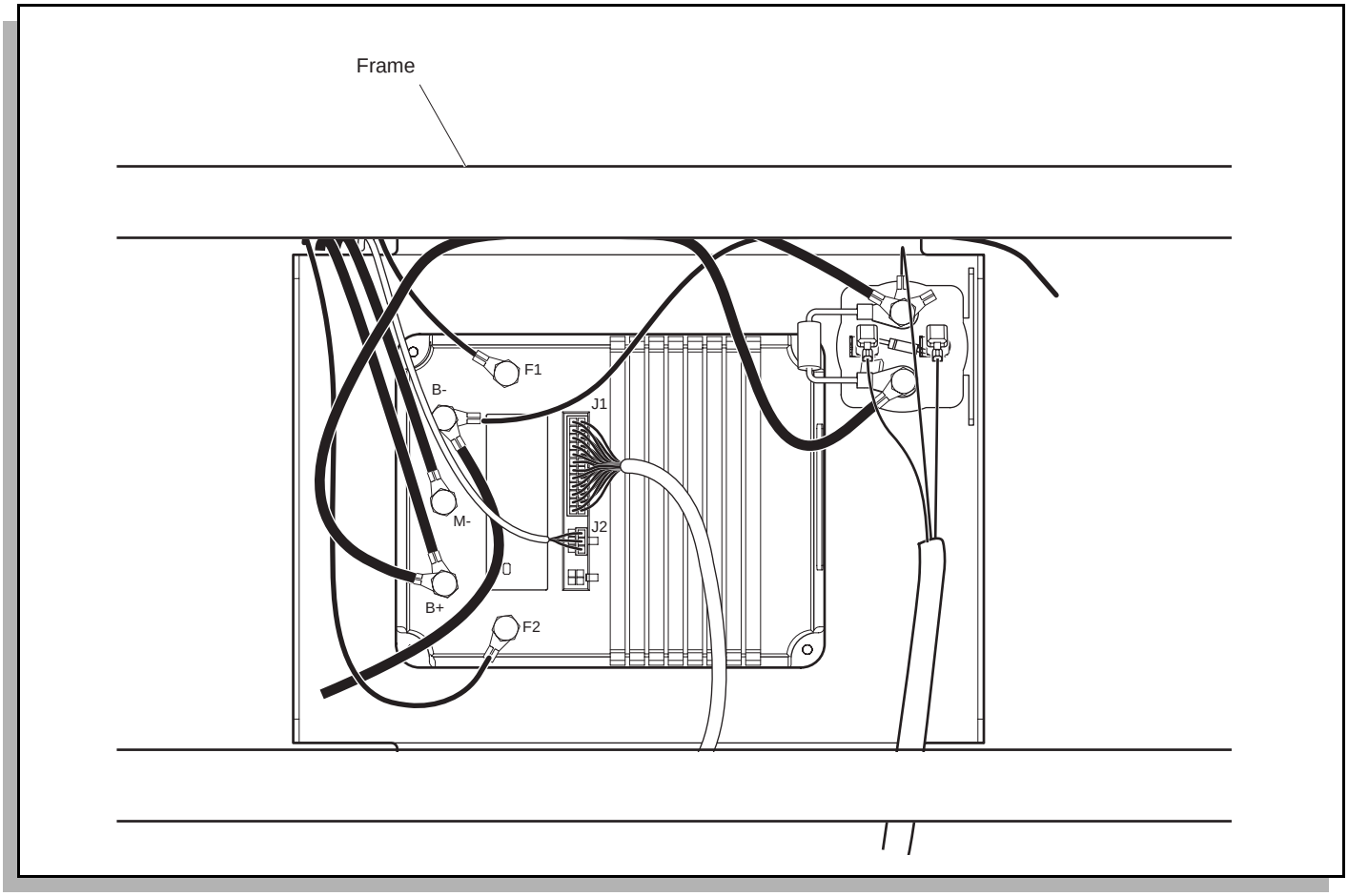


Fig. 9 Controller Connectors and Connections

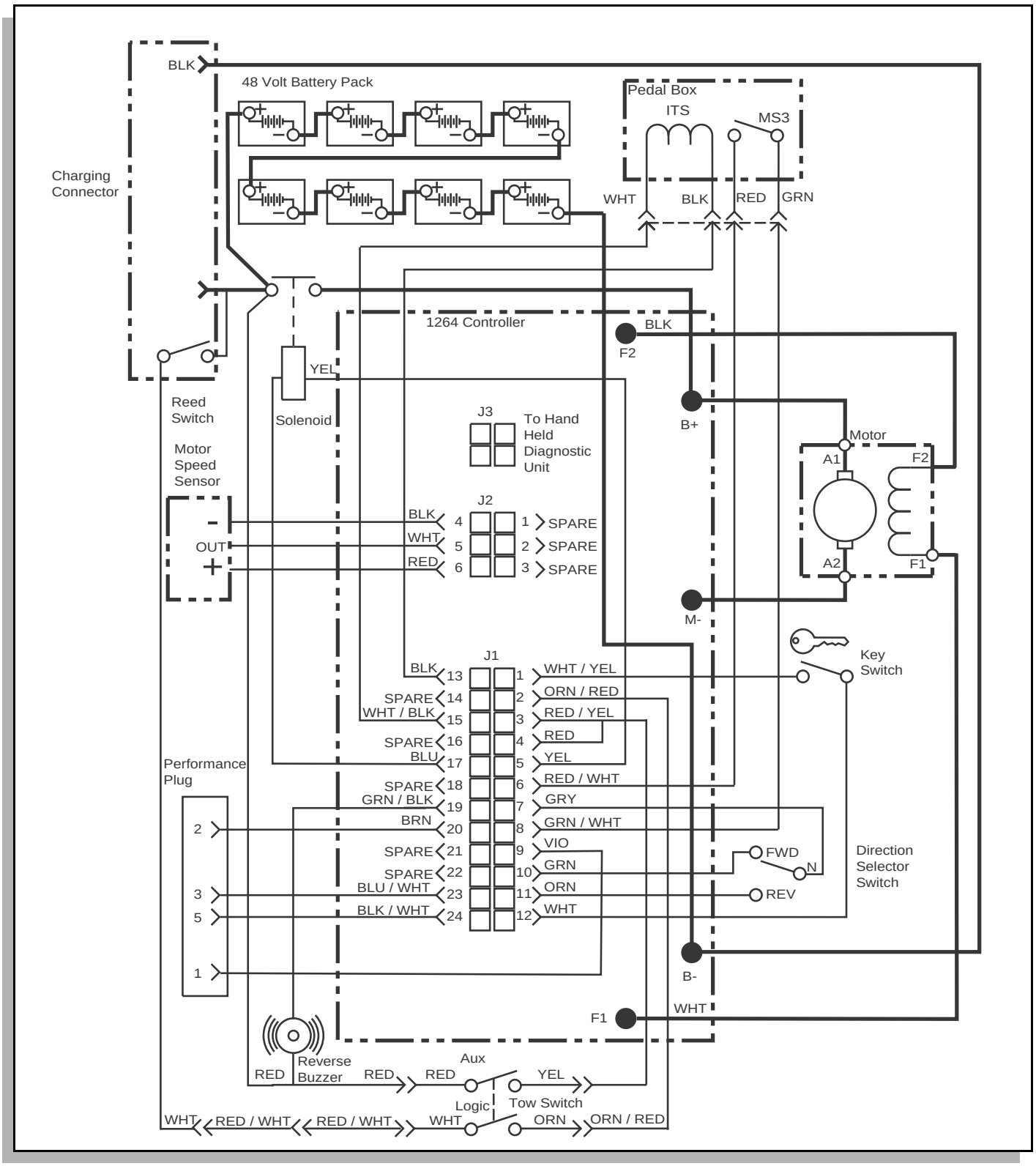


Fig. 10 48 Volt Wiring Diagram

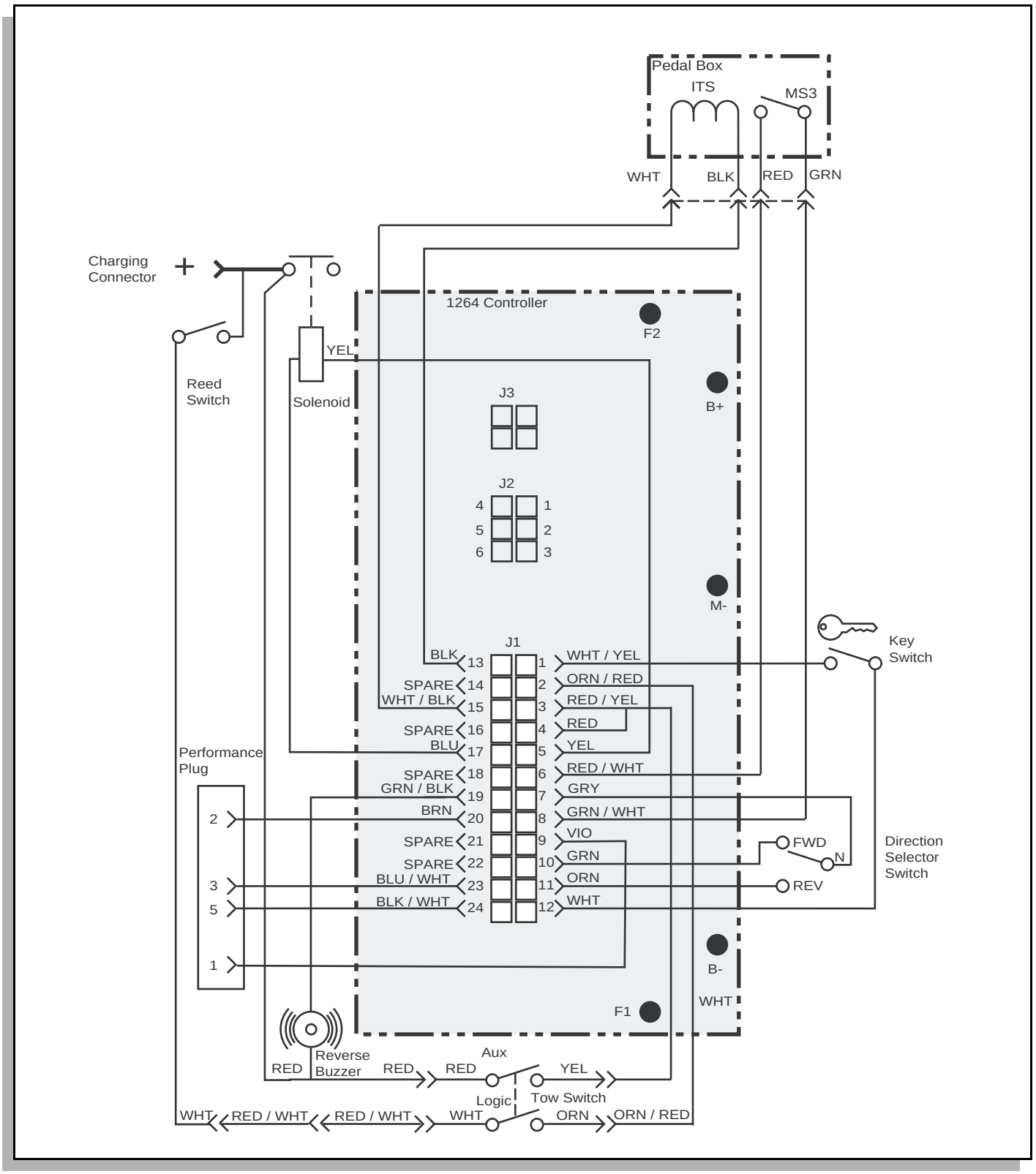


Fig. 11 J-1 Pin Connector Diagnostics

All tests are to be performed with the negative lead of the DVOM connected to the negative side of battery pack voltage.

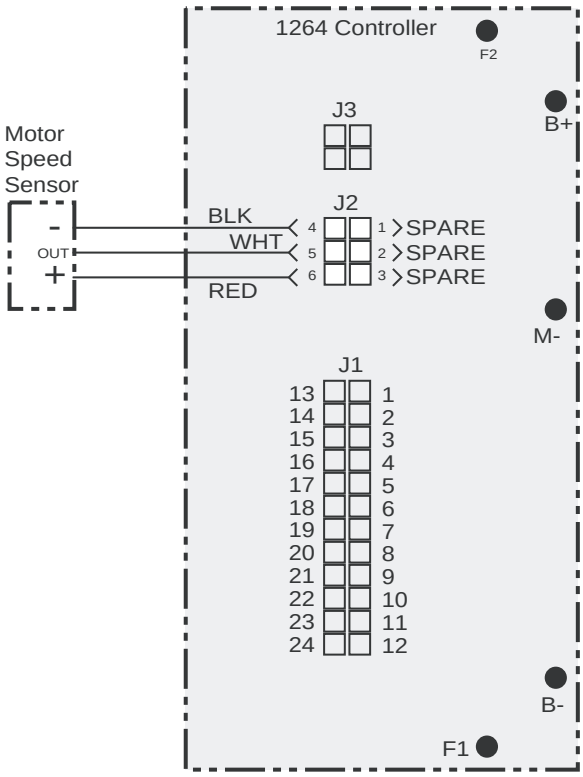
The positive lead of the DVOM is used to probe the controller/battery connections. Leave connections plugged in the controller.

Verify the Battery Reference Voltage at the main battery pack leads. (should be around 48 volts in 8 battery applications) All pin connector checks are performed with the key 'ON' and the 'Tow/Maintenance' switch in the RUN position.

Make certain all pin connections are firmly seated.

Pin number	Voltage	If not/ Then
J1-1	BRV	Verify key switch, wiring connections, and pin 12 voltage.
J1-2	BRV	Verify reed switch, tow switch, and wiring connections
J1-3	BRV	Verify tow switch and aux power wiring
J1-4	BRV	Verify aux power voltage and wire condition.
J1-5	BRV	Verify wiring. Possible controller failure.
J1-6	BRV	Verify accelerator micro, wiring, and pin 8 voltage.
J1-7	BRV	Verify wire connections. Possible controller failure.
J1-8	BRV	Verify wiring. Possible faulty controller.
J1-9		Performance option plug wiring. No need to check.
J1-10	BRV	Verify direction selector and wiring.
J1-11	BRV	Verify direction selector and wiring.
J1-12	BRV	Verify wiring. Possible faulty controller.
J1-13	1-3.5 volts	ITS output. Verify wiring and ITS field. Measured with pedal up to wide open throttle.
J1-15	16 - 17 volts	ITS input voltage. If low voltage is observed, unplug from field. If voltage comes up, replace the ITS field. If voltage remains low, replace the controller
J1-17	BRV	BRV will be observed until solenoid engages. BRV will diminish to around 0 volts to engage solenoid. If not, verify wiring. Possible faulty controller or shorted solenoid.
J1-19	BRV	BRV will be observed until vehicle is placed in the reverse direction. BRV will diminish to 0 - 4 volts. Operates reverse alarm. If not, verify wiring. Possible faulty controller.
J1-20		Performance option plug wiring. No need to check.
J1-23		Performance option plug wiring. No need to check.
J1-24		Performance option plug wiring. No need to check.

Fig. 12 J-1 Pin Connector Diagnostics (Continued)



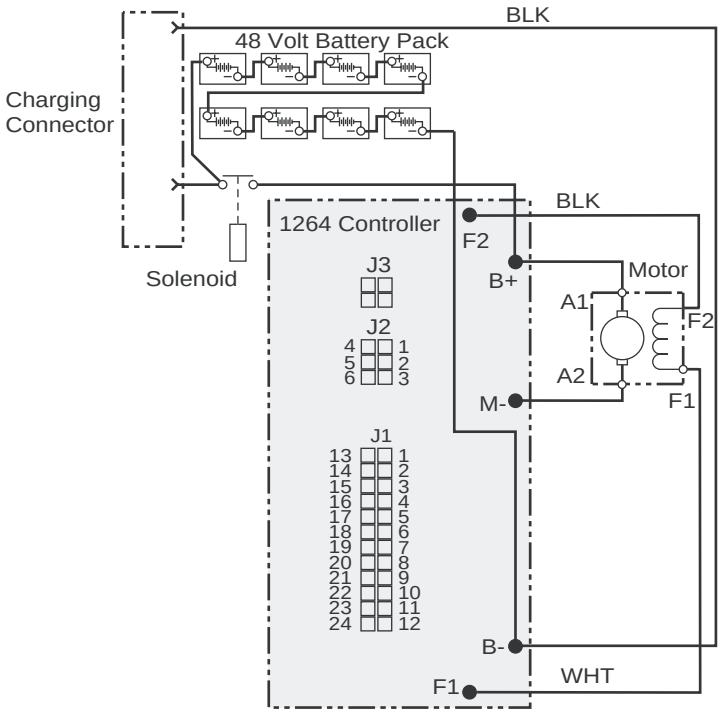
All tests are to be performed with the negative lead of the DVOM connected to the negative side of battery pack voltage.

The positive lead of the DVOM is used to probe the controller connections. Leave connections plugged in the controller

Armature will need to be rotated for this test. Jack vehicle up on the passenger side and rotate the rear wheel by hand

Pin number	Voltage	If not/ Then
J2-1		Spare
J2-2		Spare
J2-3		Spare
J2-4	0 volts	Verify sensor harness and connection. This connection serves as the sensor ground
J2-5	0 - 6.5 volts	Verify the speed sensor and harness . This connection provides the flash voltage from the sensor while the armature rotates.
J2-6	16 - 17 volts	Verify sensor harness. Possible faulty controller

Fig. 13 J-2 Pin Connector Diagnostics



This test will verify secondary circuit voltage. Please refer the chart for probe connections.

Probe Connection	Voltage	If not/ Then
Positive prove on BL+ and negative probe on BL-	BRF preferably 48 Volt	Perform battery discharge test. Verify the chrager/process
Negative probe on BL- and positive probe on battery side of solenoid	BRF	Verify wire/connection quality
Negative probe on BL- and positive probe on solenoid B+	BRF with solenoid engaged	Verify primary voltage at Pin 5 & 17. If BRF is found on the primary terminals, replace solenoid.
Positive probe on B+ and negative probe on B-	BRF	Verify solenoid function. Check wiring.
Positive probe on B+ and negative probe on M-	1-48 Volt depending on performance plug	To verify: engage solenoid at high pedal. Voltage should start around 1-2 volt. As the pedal is slowly depressed to the floor, voltage should rise to around 48 volt. If extremely low voltage is observed, replace the controller. If immediate high voltage is observed, replace the motor.

Fig. 14 Secondary Wiring Diagnostics

INDUCTIVE THROTTLE SENSOR (ITS) TESTING AND REPLACEMENT

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

Raise the rear wheels of the vehicle and support the vehicle on jack stands (Refer to Lifting Procedure in Section 'B'). Test the vehicle stability before proceeding.

To access the pedal box, remove three screws and remove the access cover from the floor. The ITS and plunger are accessed by removing the four screws from the plastic top cover and removing

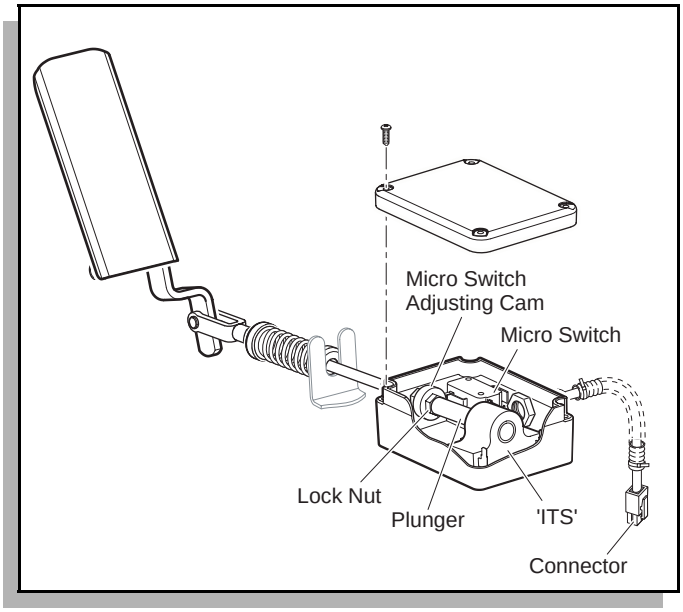


Fig. 15 ITS and Plunger

With the DVOM set to volts, probe the white wire at the ITS with the positive probe and attach the negative probe to the B- at battery. Place the direction selector in 'F' and turn the key switch to 'ON'. Depress the accelerator pedal. The meter should read 1.0V ± 0.3V when the solenoid clicks and 2.7V ± 0.5 volts at full pedal (Ref Fig. 17 on page F-19). If the reading is out of specification, **the ITS sensor must be replaced.**

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

Carefully remove the two wires that attach to the ITS and carefully remove the nuts securing the ITS to the plastic pedal box studs.

Install a new ITS being careful to align the ITS and not to overtighten the retaining nuts. Attach the wiring.

With the accelerator pedal in the full up position, insert a 7/32" drill bit between the plunger and the face of the ITS. The drill bit should be used to verify and adjust the distance between the face of the ITS and the face of the plunger (Ref Fig. 16 on page F-18). **If the plunger needs adjustment**, loosen the lock nut at the accelerator yoke and rotate the plunger until the desired dimension is achieved. Firmly tighten the jam nut.

Replace the plastic cover and press it firmly into place before tightening the cover screws.

Replace the metal access cover.

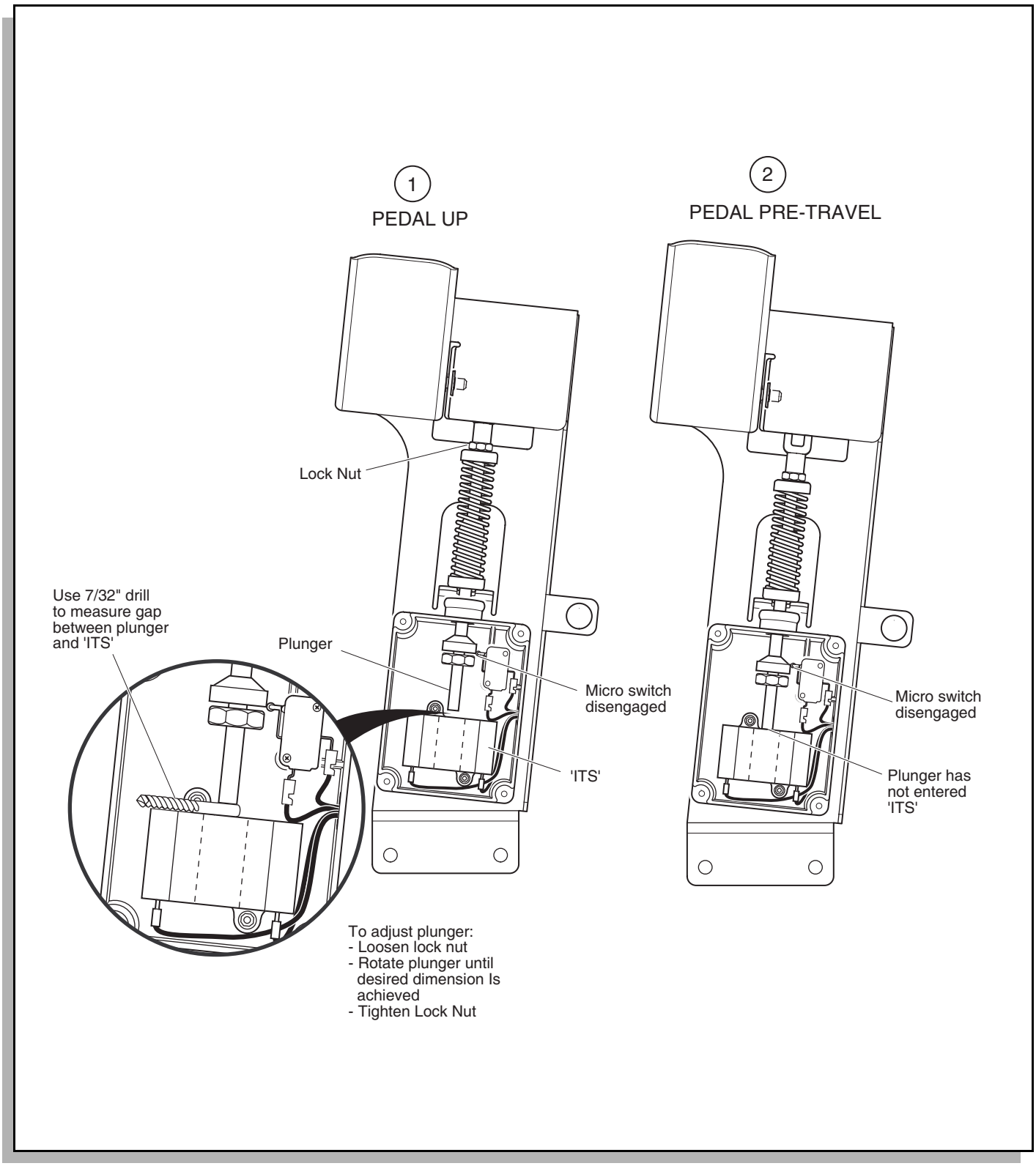


Fig. 16 ITS Adjustment (Sheet 1 of 2)

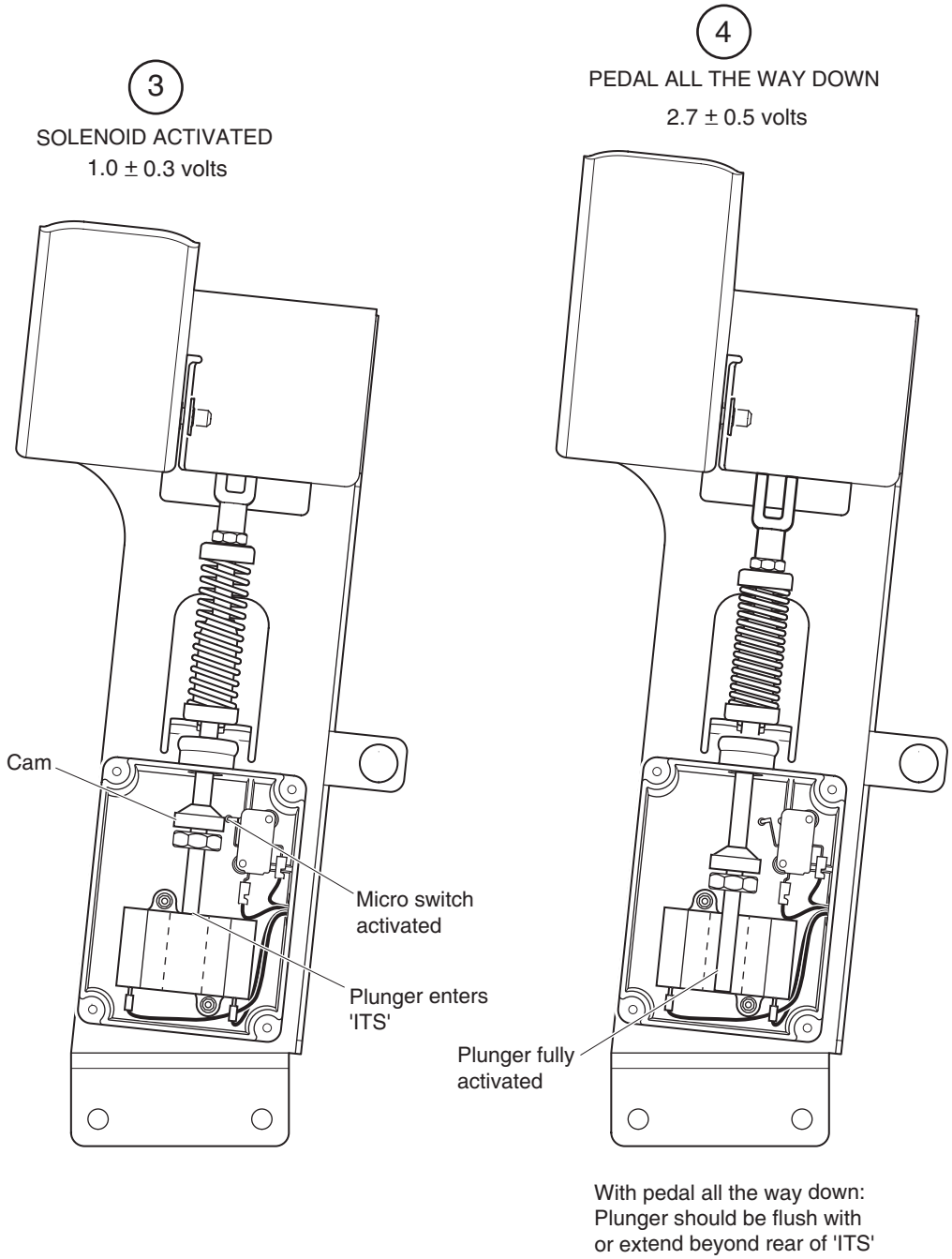


Fig. 17 ITS Adjustment (Sheet 2 of 2)

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

CONTROLLER REPLACEMENT

Tool List	Qty. Required
Socket, 10mm, 3/8" drive	1
Socket, 7/16", 3/8" drive	1
Socket, 13mm, 3/8" drive	1
Ratchet, 3/8" drive	1
Extension, 6", 3/8" drive	1
Insulated wrench, 9/16"	1
Shop towel	1
Torque wrench, 3/8" drive, in. lbs.	1
Torque wrench, 3/8" drive, ft. lbs.	1

Remove the cargo bed to access electrical box. Remove electrical box cover.

CAUTION **Before any electrical service is performed on 48 volt model vehicles, the Run-Tow/Maintenance switch must be placed in the 'Tow/Maintenance' position.**

If a power wire (battery, motor or controller) is disconnected for any reason on the 48 volt model vehicle, the Run-Tow/Maintenance switch must be left in the 'Tow/Maintenance' position for at least 30 seconds after the circuit is restored.

⚠ WARNING ⚠ ***To prevent electrical shock, the BL- wire must be removed before discharging the controller by shorting the B+ and B- terminals of the controller with a large screwdriver. Be sure to hold screwdriver by the insulated portion.***

Using an insulated wrench, remove the BL- wire from the battery.

NOTE *Note the location of the wiring on the controller before removing wiring from controller. (Ref Fig. 18 on page F-21)*

Remove the controller mounting hardware and remove the controller.

Mount new controller to electrical box and reconnect wiring. Tighten the controller mounting bolts to 108 - 132 in. lbs. (12 - 15 Nm) torque and the M6 (F1 and F2) bolts to 80 - 90 in. lbs. (9 - 10 Nm) torque and M8 (B+, M-, B-) bolts to 120 - 130 in. lbs. (14 - 15 Nm) torque.

Reconnect the BL- battery cable and replace the cargo bed.

SOLENOID REPLACEMENT

Tool List	Qty. Required
Socket, 3/8", 3/8" drive	1
Socket, 7/16", 3/8" drive	1
Socket, 1/2", 3/8" drive	1
Ratchet, 3/8" drive	1
Extension, 6", 3/8" drive	1
Insulated wrench, 9/16"	1
Shop towel	1
Torque wrench, 3/8" drive, in. lbs	1

Remove the cargo bed to access electrical box. Remove electrical box cover.

CAUTION **Before any electrical service is performed on 48 volt model vehicles, the Run-Tow/Maintenance switch must be placed in the 'Tow/Maintenance' position.**

If a power wire (battery, motor or controller) is disconnected for any reason on the 48 volt model vehicle, the Run-Tow/Maintenance switch must be left in the 'Tow/Maintenance' position for at least 30 seconds after the circuit is restored.

⚠ WARNING ⚠ ***To prevent electrical shock, the BL- wire must be removed before discharging the controller by shorting the B+ and B- terminals of the controller with a large screwdriver. Be sure to hold screwdriver by the insulated portion.***

Using an insulated wrench, remove the BL- wire from the battery.

NOTE *Note the location of the wiring on the solenoid before removing wiring from solenoid (Ref Fig. 18 on page F-21)*

When connecting wires to solenoid, be sure to use a wrench to hold the inner nut while tightening the outer one.

Remove the solenoid mounting bolts and remove the solenoid.

Mount new solenoid and reconnect wiring. Tighten the solenoid mounting nuts to 67 - 82 in. lbs. (8 - 9 Nm) torque, the #10 terminal nuts to 13 - 17 in. lbs. (1 - 2 Nm)

and the 5/16" terminal nuts to 50 - 60 in. lbs (6 - 7 Nm) torque.

Reconnect the BL- battery cable and replace the seat.

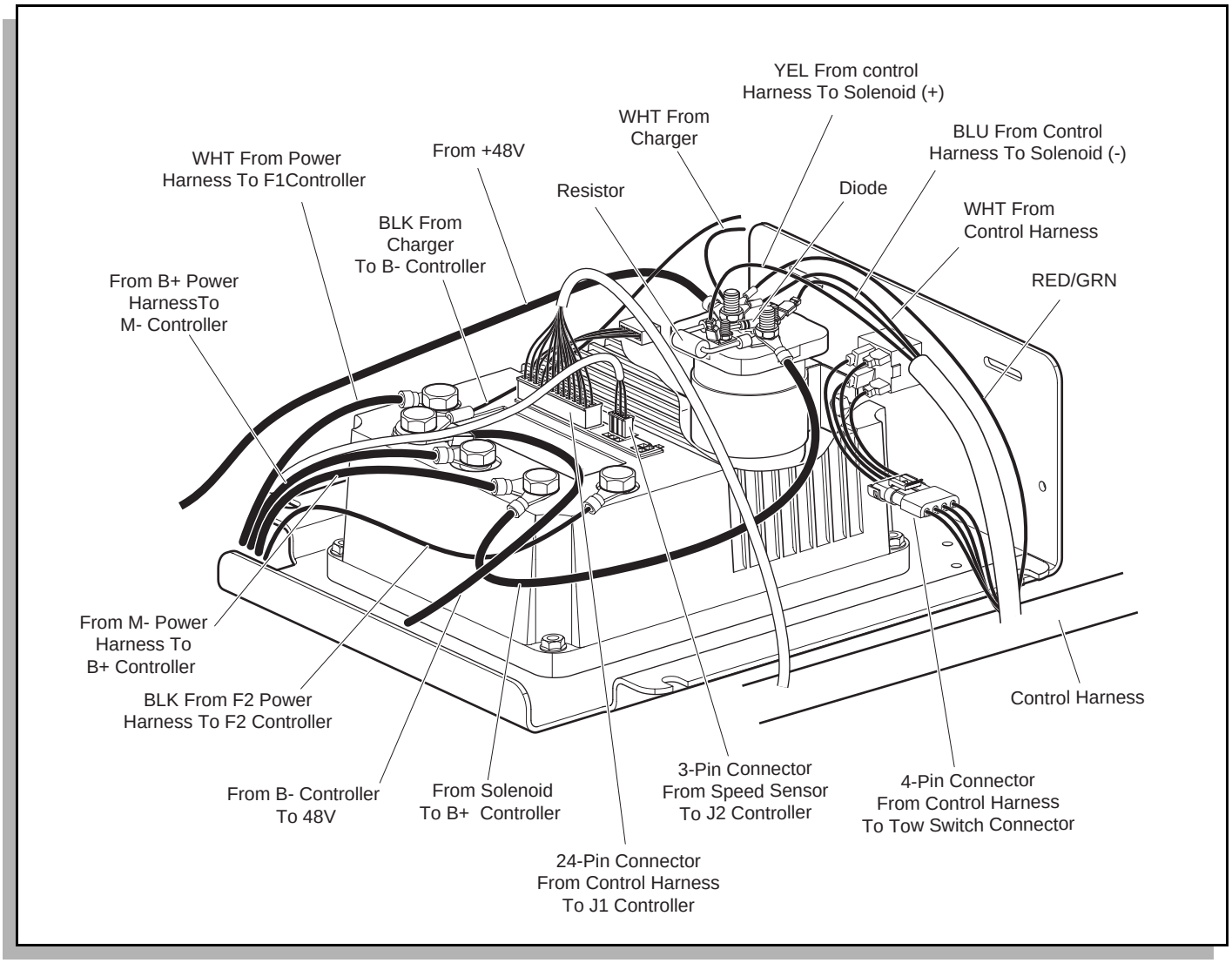


Fig. 18 Controller Wiring

Notes:

TABLE OF CONTENTS FOR SECTION 'G'

SECTION TITLE **PAGE NO.**

LIST OF ILLUSTRATIONS

Notes:

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

GENERAL

CAUTION **Do not hold a 36V vehicle on a hill or ramp 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.

The motor housing and field coils are not available as individual components, therefore in the unlikely event of a failure in these components, the entire housing and field coil assembly 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
Internal snap ring pliers	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.

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

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.

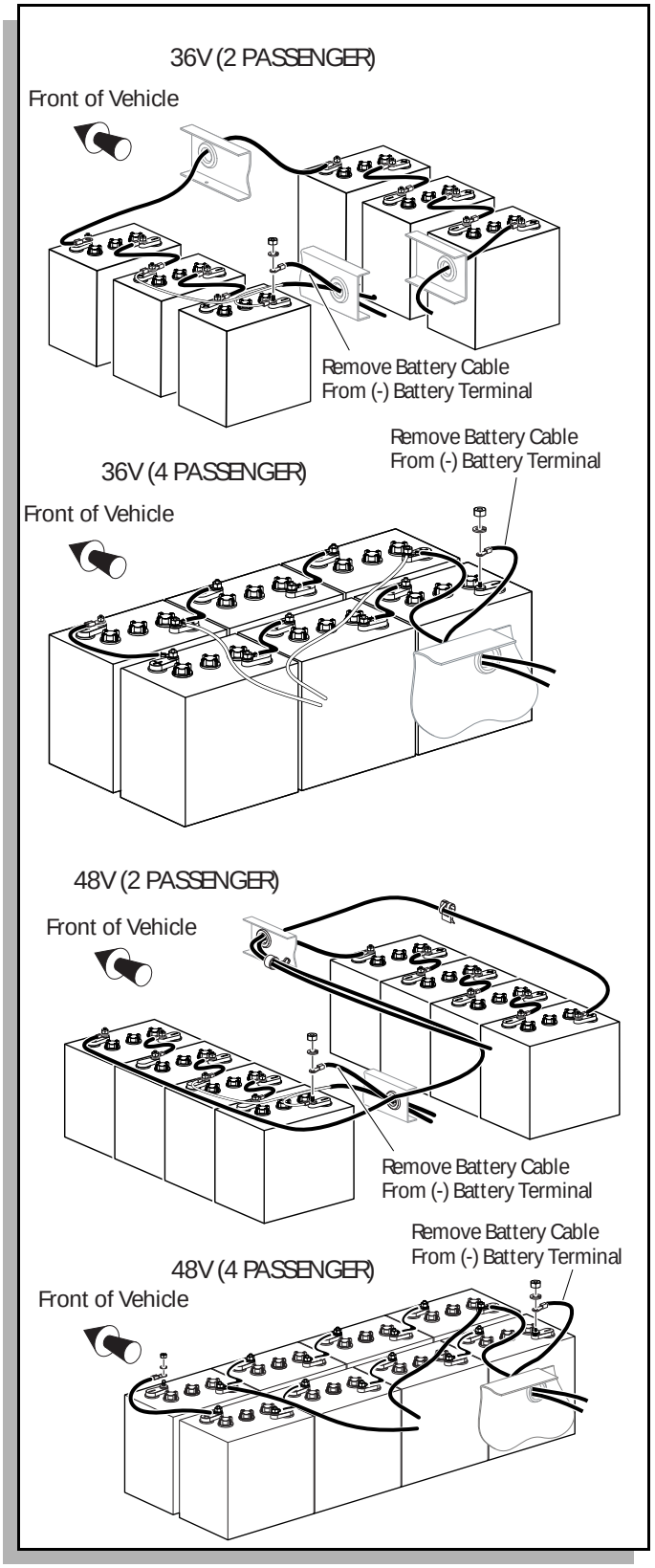


Fig. 1 Disconnect Battery Cable

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

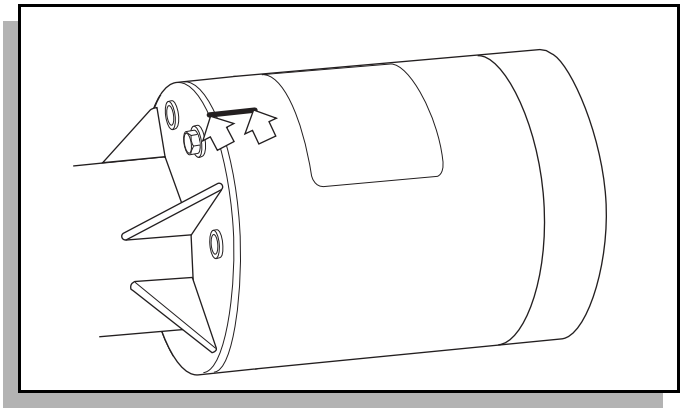


Fig. 2 Mark Axle and Motor

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
Internal snap ring pliers	1
Torx T-125 bit, 3/8" drive	1

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

48V Vehicle motors Only:

Remove the two retaining rings (18) securing the speed sensor (19). Remove the magnet (20) on the end of the armature by carefully removing the attaching screw (17).

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.

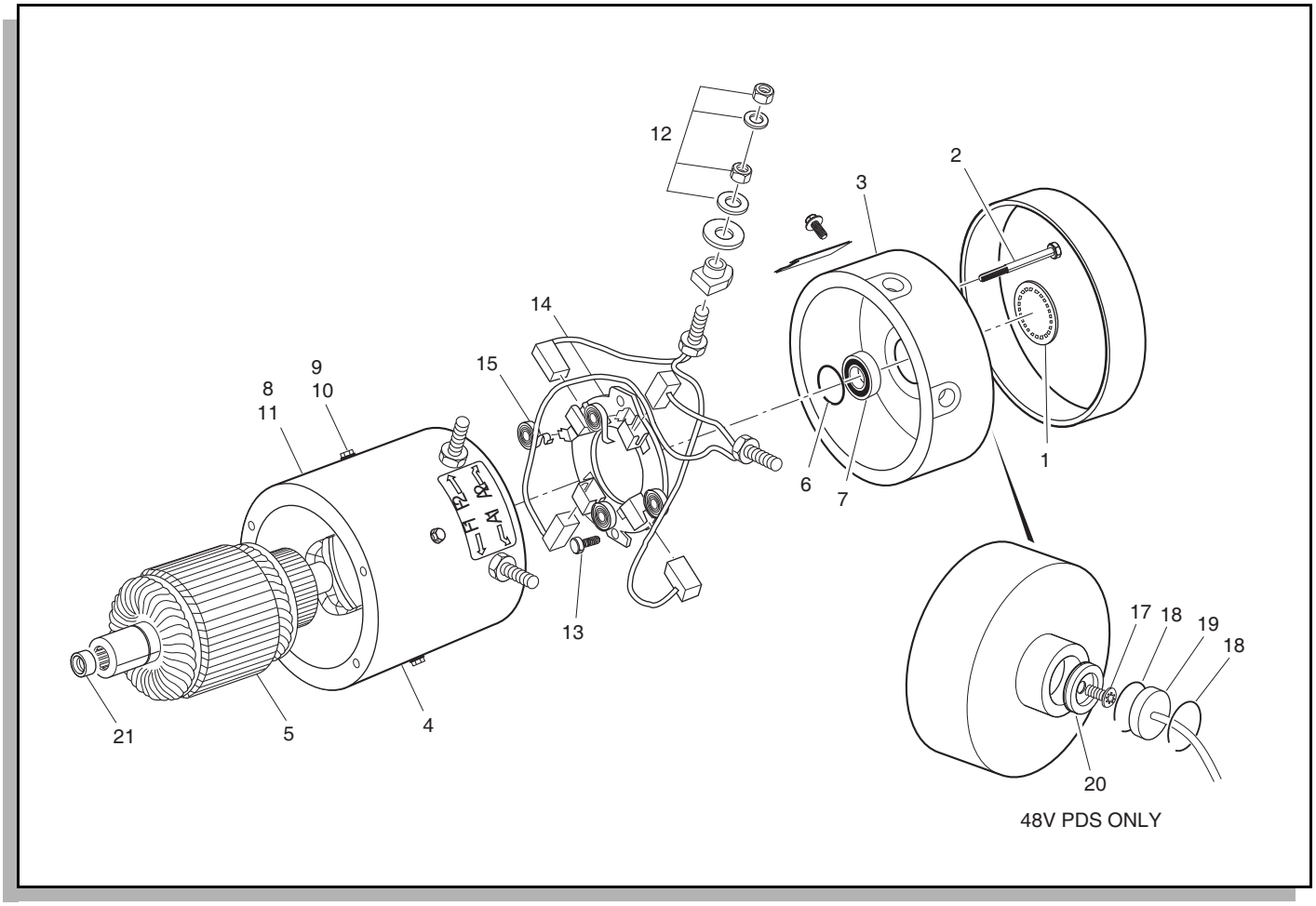


Fig. 3 Motor Components

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

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.

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-4).

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.

Field Coil Replacement

Tool List	Qty. Required
Wrench, 1/2"	1
Ratchet, 3/8" drive	1
Socket, 1/2", 3/8" drive	1

To replace field coil (8), remove field coil terminal hardware (9) at F1 and F2 (Ref Fig. 3 on page G-2).

Remove bolts (10) that secure field coil retainers (11) to motor housing (4). Remove the field coils.

Replacement of field coils are installed in reverse order of disassembly.

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).

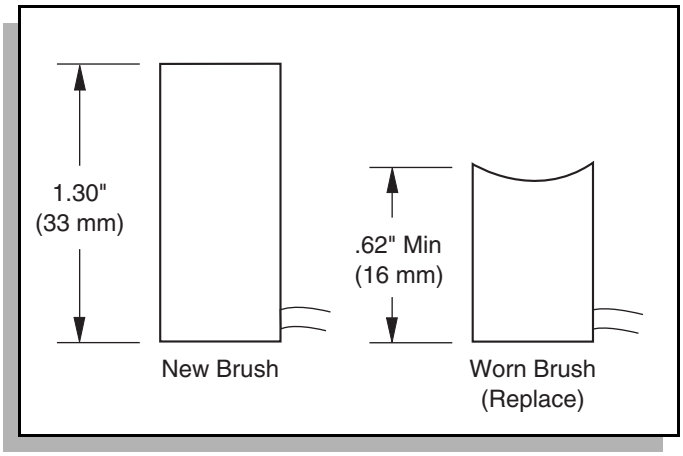


Fig. 4 Brush Wear

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-4). Remove brushes and replace with new brush replacement kit. Locate springs against the side of each brush.

Install terminals and brush plate using reverse order of removal. Install armature (commutator end) through brush plate and press into new bearing using moderate

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

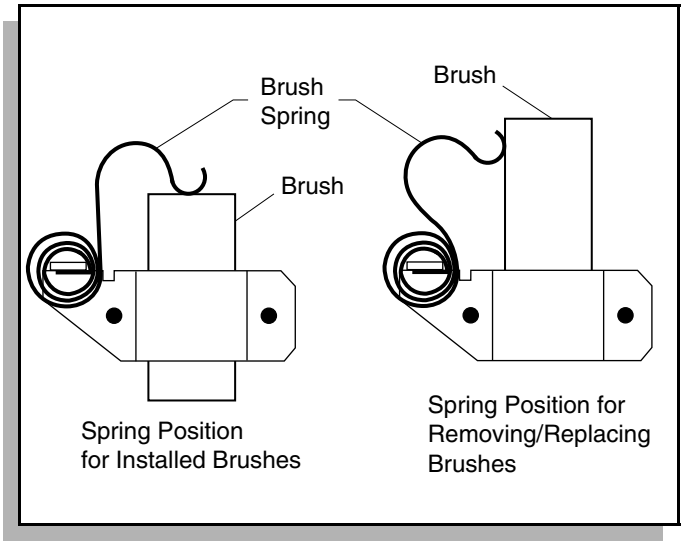


Fig. 5 Securing Brushes

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

Torx T-125 bit, 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. For non PDS motors, install bearing cap (1). For PDS vehicles, attach ring magnet (20) to armature shaft with screw (17). Tighten armature screw to 18 - 23 in. lbs. (2 Nm) torque. Install inner snap ring (18) in cover (3) and insert speed sensor (19). Secure with second snap ring (18) (Ref Fig. 3 on page G-2).

Motor Tests

The motor housing is not available as an individual part. 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 (21) 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-2).

Attach the four motor wires to motor (Ref Fig. 6 on page G-4) (Ref Fig. 7 on page G-4). Tighten the nuts to 66 in. lbs. (7 Nm) torque.

MOTOR WIRING - 36V

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

Fig. 6 Motor Wiring 36V

MOTOR WIRING - 48V

Motor Terminal	Wire Marker	From
F1	F1	Controller "F1"
F2	F2	Controller "F2"
A1	A1	Controller "B+"
A2	A2	Controller "M-"

Fig. 7 Motor Wiring 48V

BATTERIES AND CHARGING

H

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SECTION TITLE **PAGE NO.**

LIST OF ILLUSTRATIONS

BATTERIES AND CHARGING

Notes:

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

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 the metal 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***

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

plug in an on-board battery charger 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 AC plug for damaged or missing pins. 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).

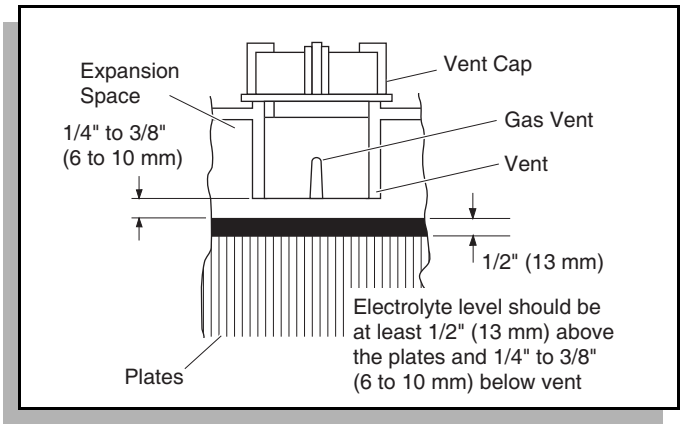

Fig. 1 Correct Electrolyte Level

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.*

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

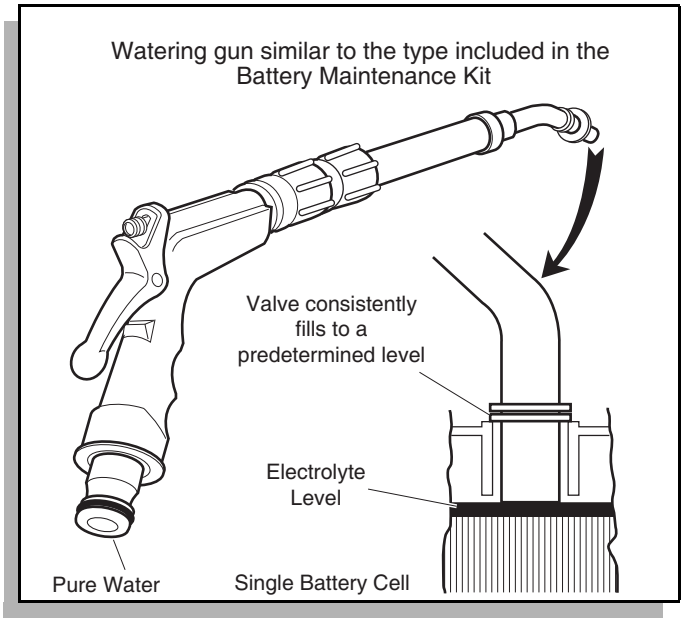

Fig. 3 Automatic Watering Gun

Cleaning Batteries

CAUTION **To reduce the possibility of damage to vehicle or floor, neutralize acid before rinsing batteries.**

To reduce possible damage to electrical components while cleaning, do not use pressure washer to clean batteries.

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

Cleaning should take place per Periodic Service Schedule (Ref. GENERAL INFORMATION & ROUTINE MAINTENANCE).

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.

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.

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 quart sized hand sprayer. The solution should consist of 2 teaspoons (10 ml) of sodium bicarbonate (baking soda) mixed with 1 quart (1 liter) 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.

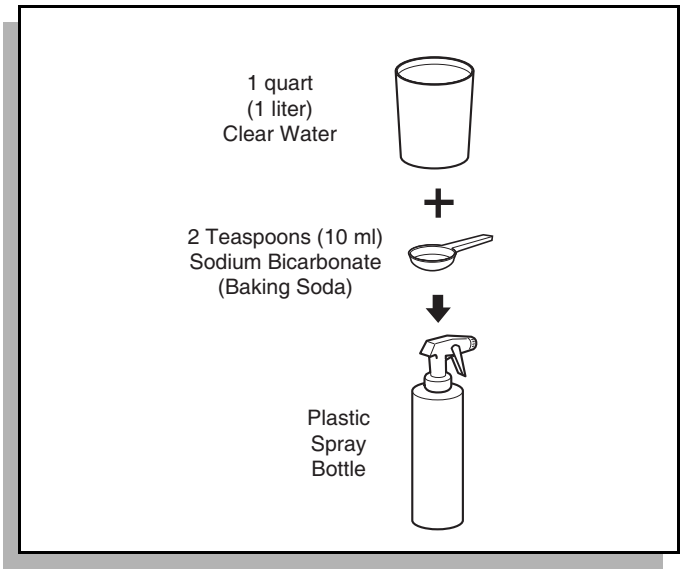

Fig. 4 Preparing Acid Neutralizing Solution

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).

Battery Replacement

CAUTION **Before any electrical service is performed on 48 volt model vehicles, the Run-Tow/Maintenance switch must be placed in the 'Tow/Maintenance' position.**

If a power wire (battery, motor or controller) is disconnected for any reason on the 48 volt model vehicle, the Run-Tow/Maintenance switch must be left in the 'Tow/Maintenance' position for at least 30 seconds after the circuit is restored.

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

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

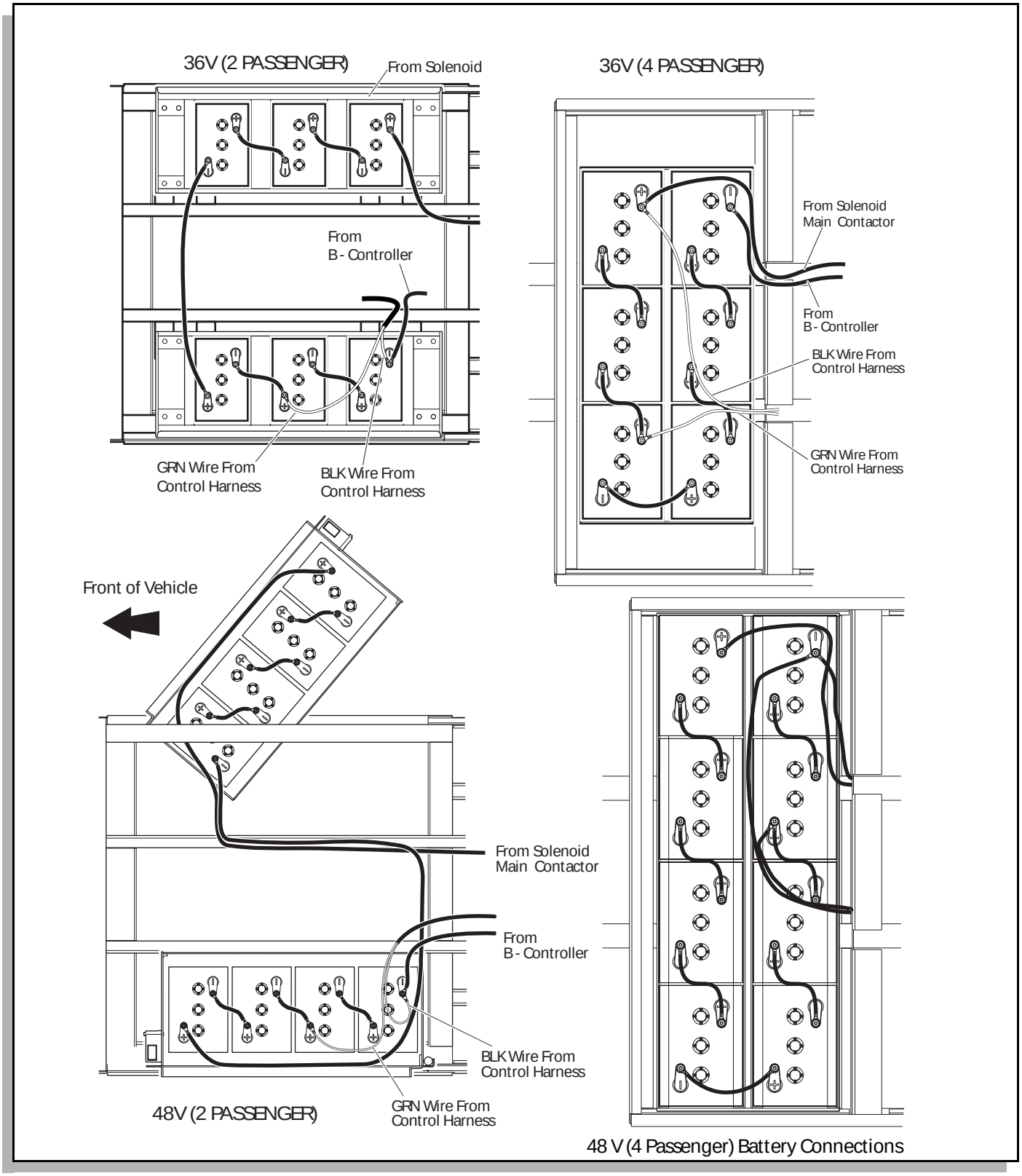

Fig. 5 Battery Connections

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.***

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.

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-5). 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.

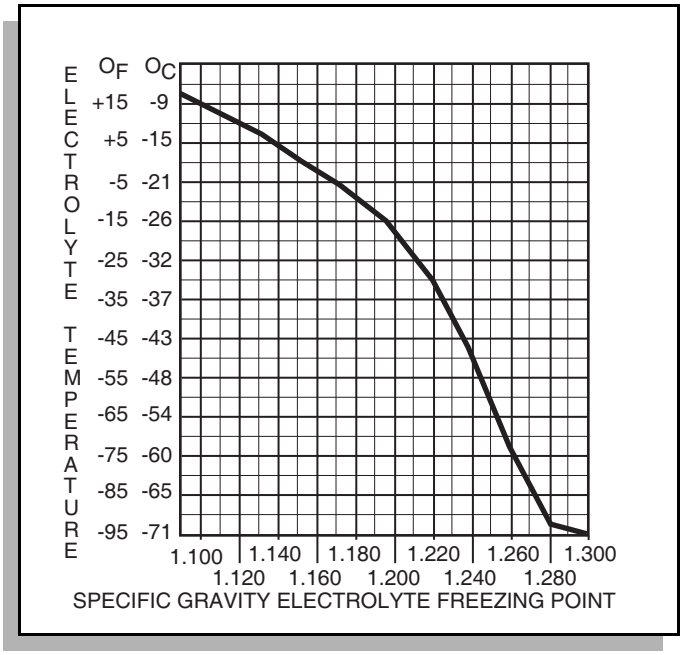

Fig. 6 Freezing Point of Electrolyte

Battery Charging

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

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.

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

Before charging, the following should be observed:

- 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.

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

⚠ 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.***

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.*

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.

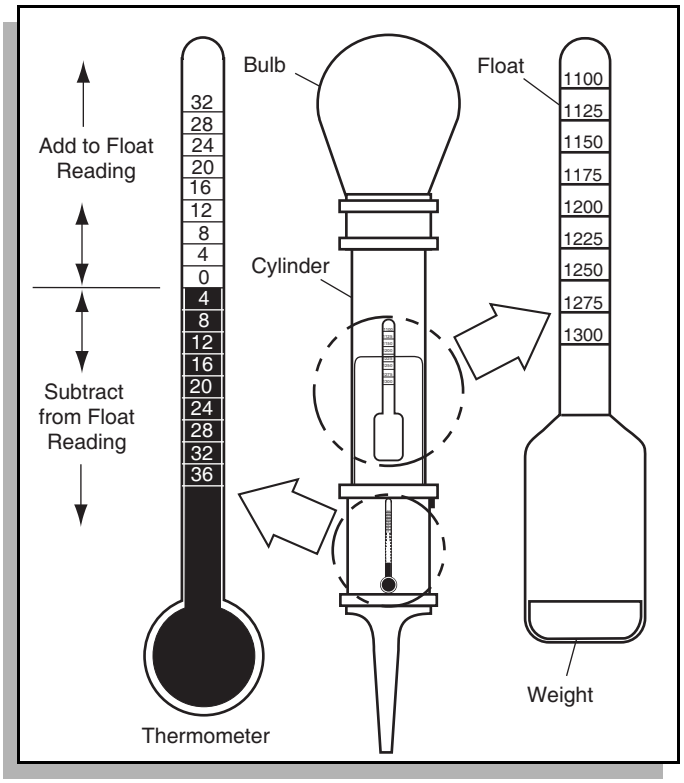

Fig. 7 Hydrometer

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.

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.

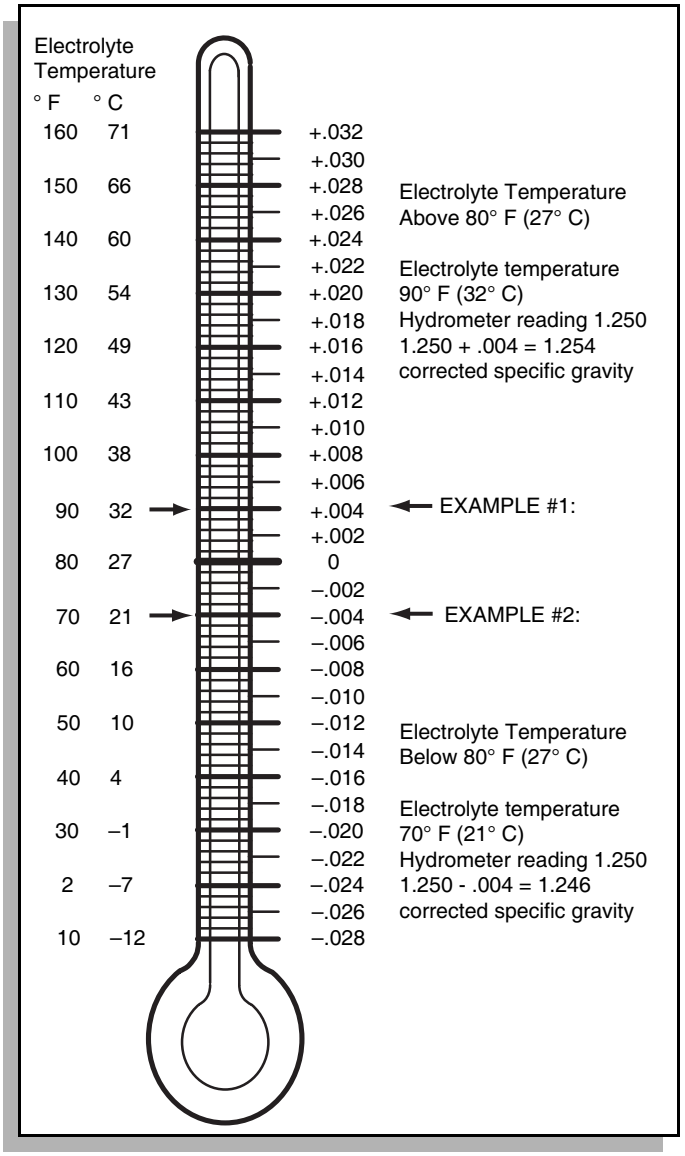

Fig. 8 Hydrometer Temperature Correction

BATTERY CHARGER

Description

The battery charger accompanying this vehicle is 120 volt AC, 60 Hz input with 48 volt or 36 volt DC output. Contact charger manufacturer for maintenance or service parts.

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

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

On-Board Charger Use

A dedicated circuit is required for the charger. Refer to the charger manual for appropriate circuit protection.

NEMA 15 - 5R Grounded AC Receptacle
110 - 120 VAC. Dedicated 15 AMP Circuit

Locations outside the US and Canada: Refer appropriate local electrical code and charger manufacturer recommendations for AC power requirements

Fig. 9 AC Charger Plug Requirements

The charger will automatically start a few seconds after plug insertion. The charger will automatically stop when batteries are fully charged and the AC plug can be removed and stored 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 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.

ELECTRICAL SYSTEM

J

TABLE OF CONTENTS FOR SECTION 'J'

LIST OF ILLUSTRATIONS

ELECTRICAL SYSTEM

Notes:

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

DIGITAL VOLT OHM METER

A typical digital volt ohm meter (DVOM) is shown (Ref Fig. 1 on page J-1). A recommended DVOM is available through the Service Parts Department as P/N 27481-G01. For the purpose of this section, the red probe (+) and black probe (-) are used. Any DVOM may be used, however the controls, displays, accuracy and features may vary depending on the make and model. Always follow the meter manufacturer's recommendations and instructions for the use and care of the meter.

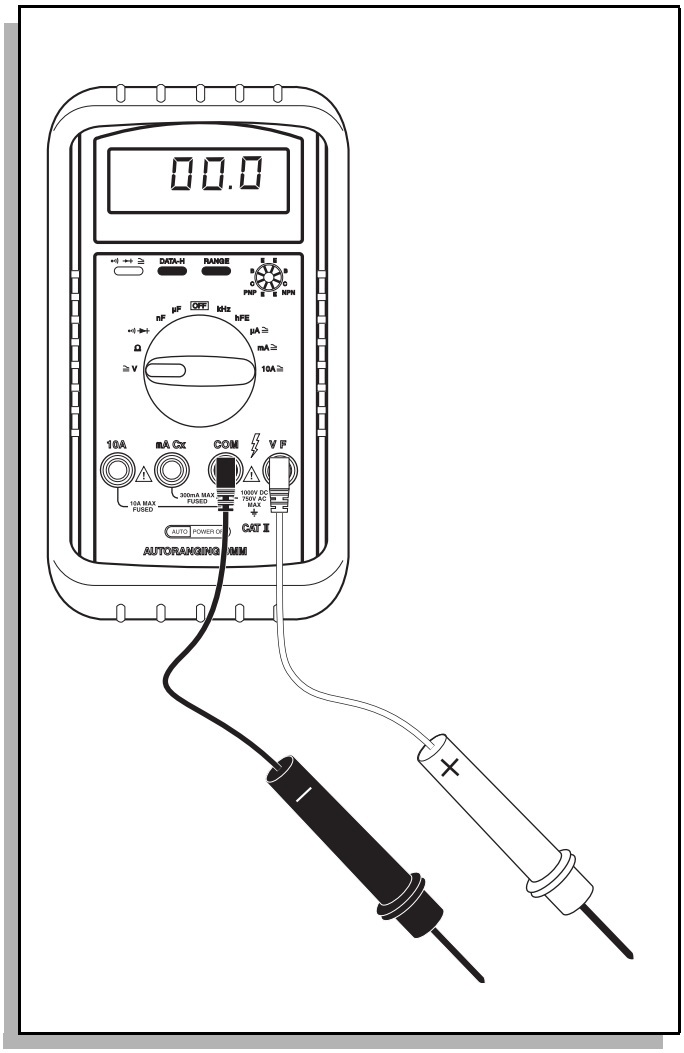

Fig. 1 DVOM

TROUBLESHOOTING

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

The wiring diagram shows the path followed by a voltage or signal from its origination point to its destination (Ref Fig. 2 on page J-2). Each wire is indicated by color.

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

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

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

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

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

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

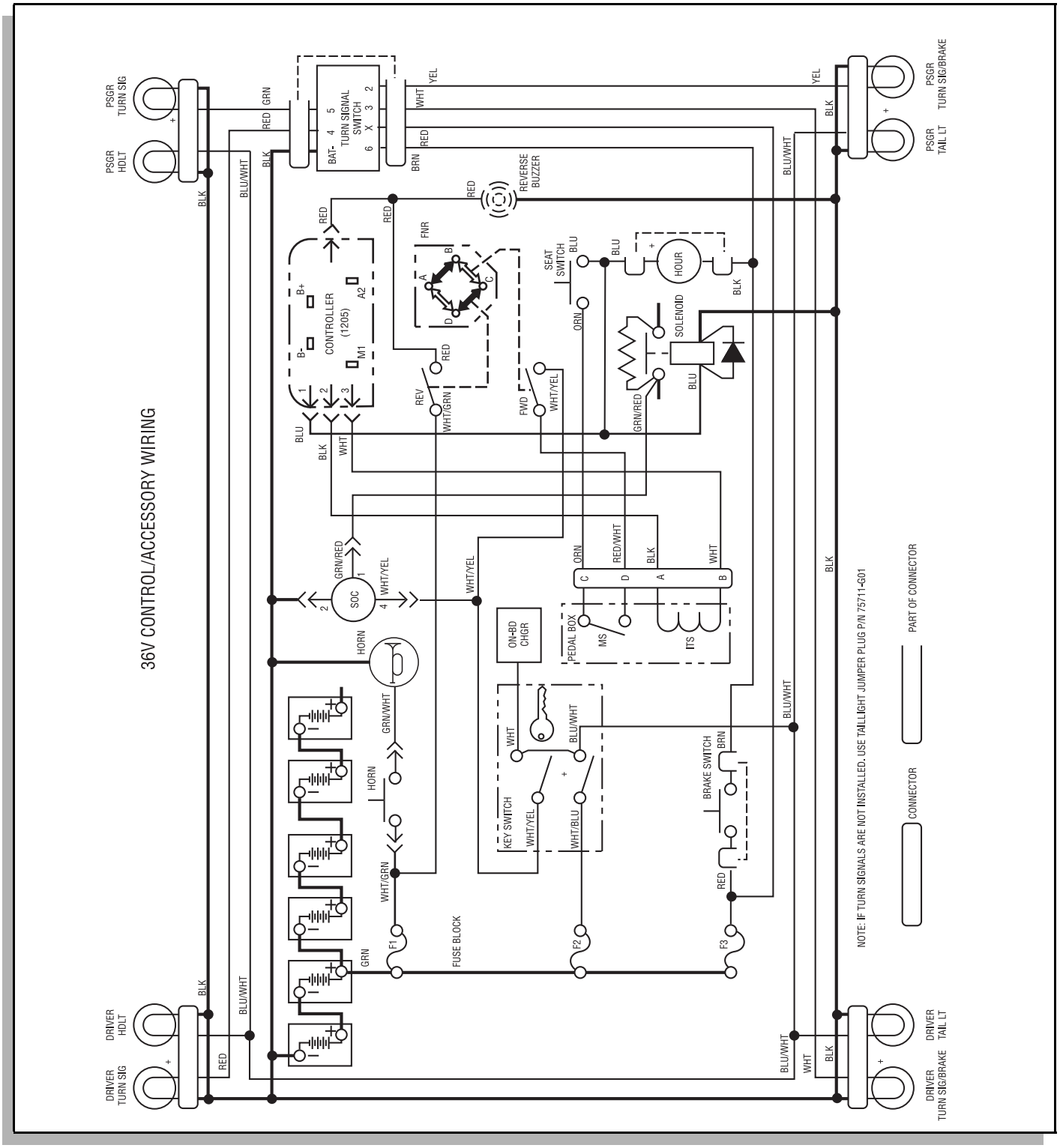

Fig. 2 36 Volt Wiring Diagram

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

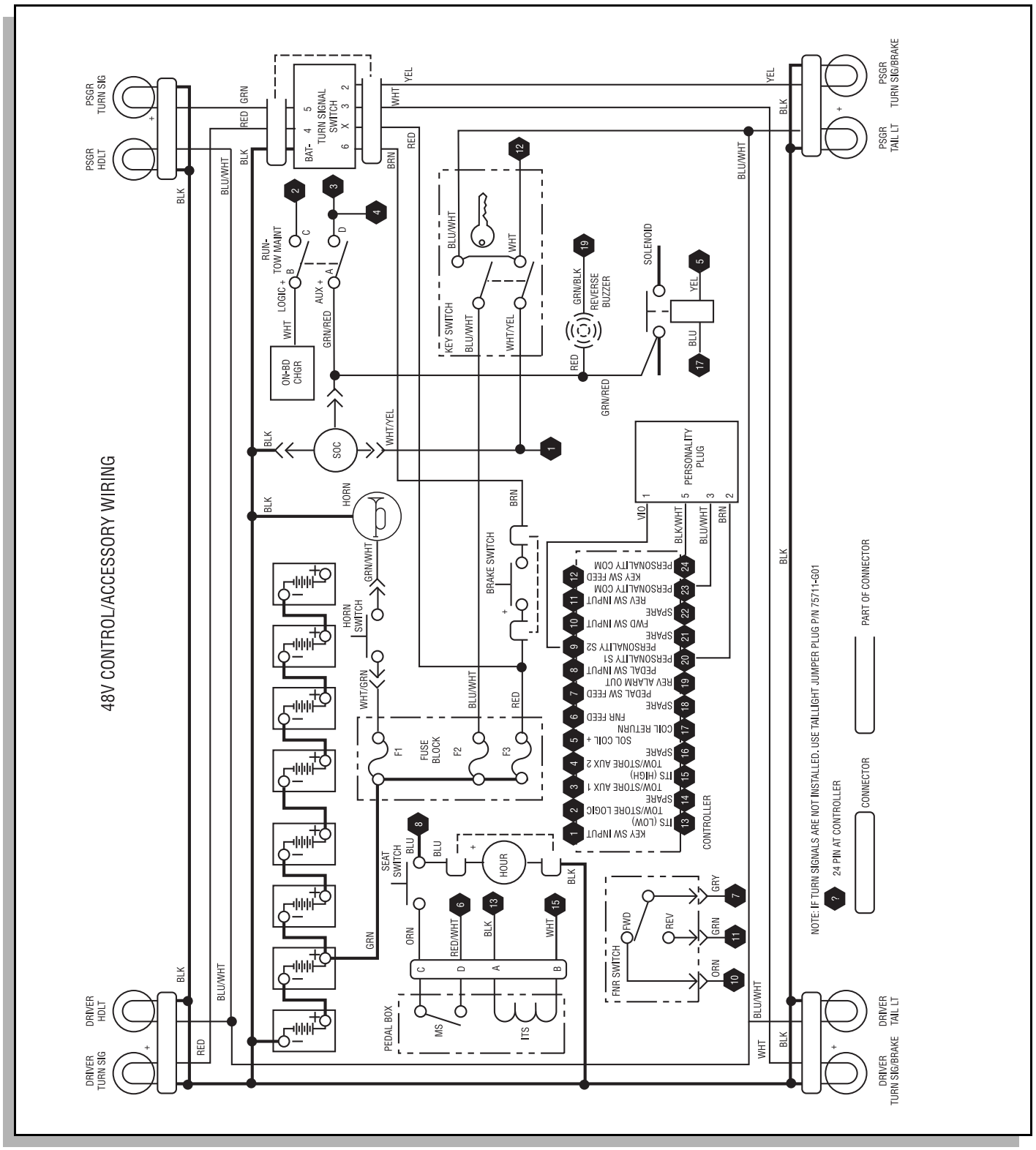

Fig. 3 48 Volt Wiring Diagram

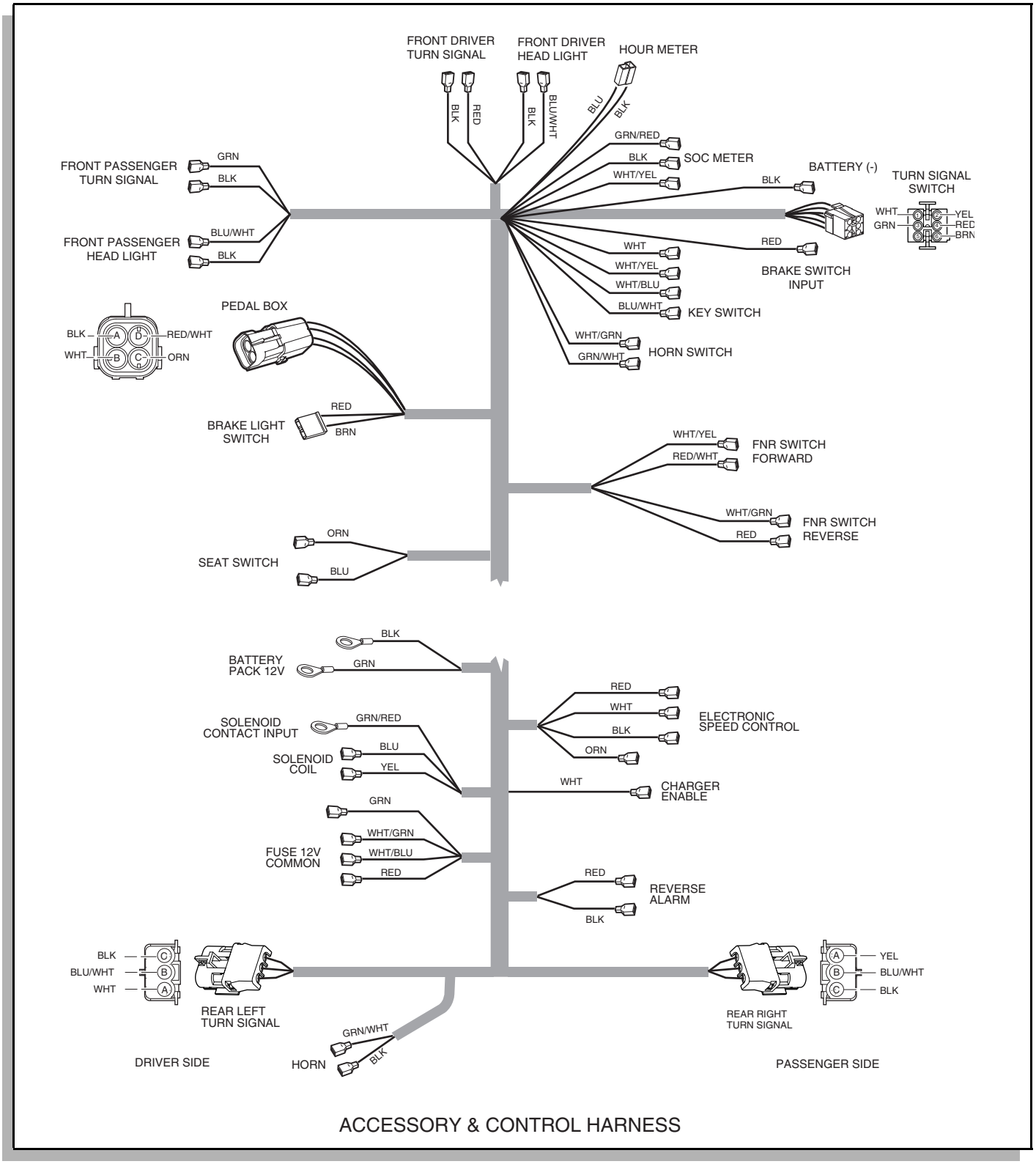

Fig. 4 36V Accessory Wiring Harness

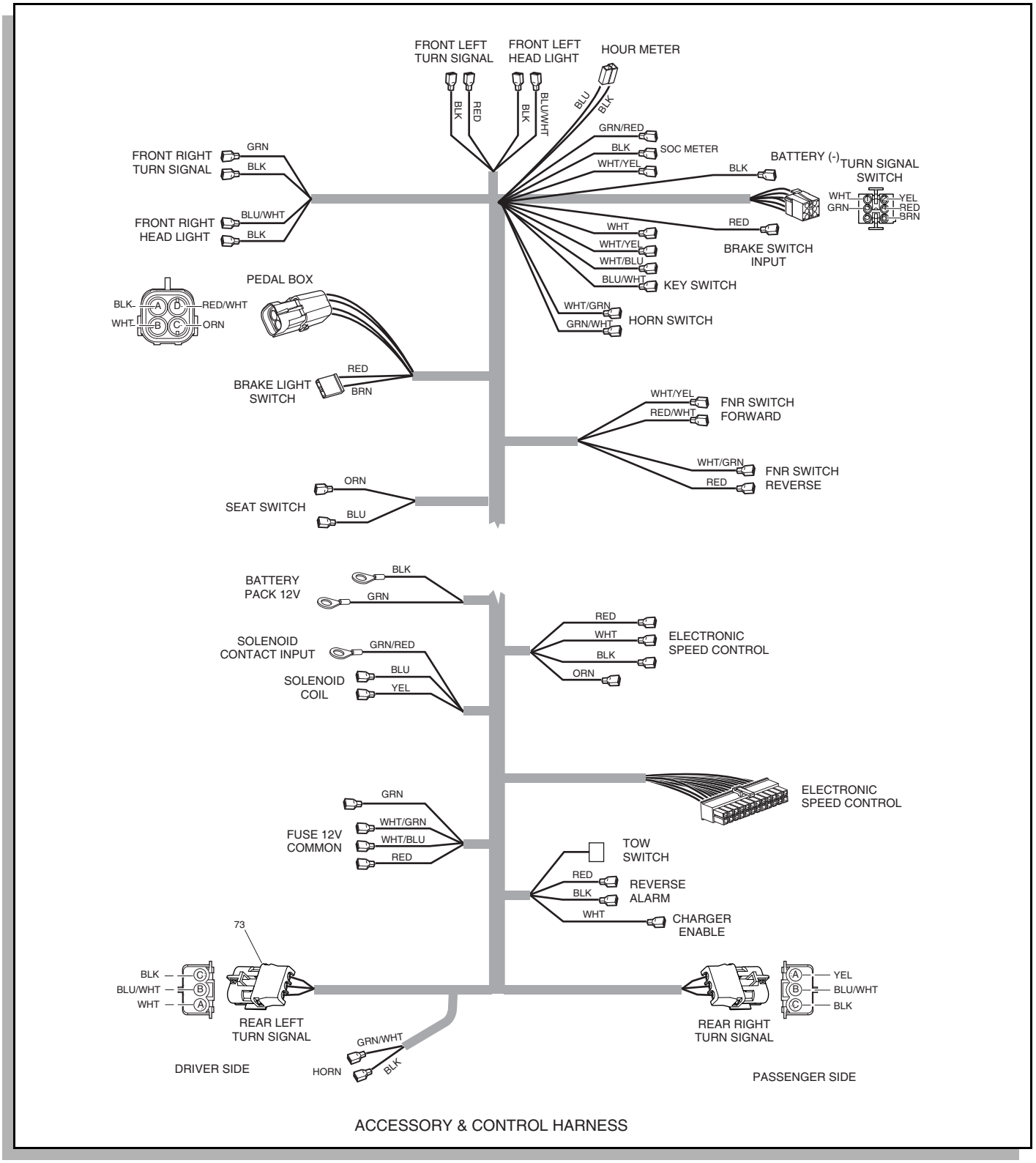

Fig. 5 48V Accessory Wiring Harness

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

POWER SUPPLY

Tool List **Qty. Required**

DVOM..... 1

1. CHECK FOR LOOSE OR BARE WIRES

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

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

2. CHECK BATTERY CONDITION

Check for adequate battery volts (nominal 12V DC) by setting DVOM to 30V DC range and place the red probe (+) to the middle negative (-) battery post with the green wire attached. Place the black probe (-) to the first negative (-) battery post on the driver side with the black wire attached. A reading of 11V DC or greater indicates adequate battery condition. No reading indicates (a) a poor connection between the probes and the battery terminals; (b) a faulty DVOM. A voltage reading below 11 volts indicates poor battery condition and the vehicle should be recharged before proceeding with the test.

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

3. CHECK GREEN POWER WIRE

Firmly attach black probe (-) to the first negative(-) battery post on the driver side with the black wire attached and the red probe (+) to the terminal on the side of the fuse block where the green wire is connected. A reading of battery voltage indicates that the green wire is in good condition.

NOTE *The green wire supplies power to the entire fuse block.*

4. CHECK FUSE

Place the red probe (+) to each wire terminal on the fuse block. A reading of battery voltage indicates that the fuse is in good condition. No reading indicates a faulty fuse; replace with a good 15 amp fuse.

ACCESSORY WIRING

After determining that there is power to the fuse panel, and the fuse is good, continue checking the circuit using the procedures previously used to check the power supply, i.e. loose or rusted connections, bare wires, continuity of the wiring from terminal to terminal, operating condition of switch, etc.

Use the wiring diagrams (Ref Figs 2, 3, 4 and 5 on pages J-2, 3, 4 and 5), and illustrations (Ref Figs 6, 7 and 8 on pages J-7, 8 and 9) to check correct wiring and wire routing. If there is power at the fuse end of the wire, there must also be power at the other end of the wire at the switch or electrical accessory, and eventually at the ground connection. Electricity must flow from the fuse panel through the full length of the circuit to the ground connection. Any interruption of electricity flow must be corrected, whether by repairing or replacing the wire, the switch or accessory.

LIGHT BULB REPLACEMENT

Remove two screws from rear of head light housing and pull sealed beam unit from housing. Disconnect harness at sealed beam unit. Replace sealed beam unit and tighten screws.

To replace the tail light bulb, remove hardware securing lens and remove lens. Install replacement bulb and reinstall lens.

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

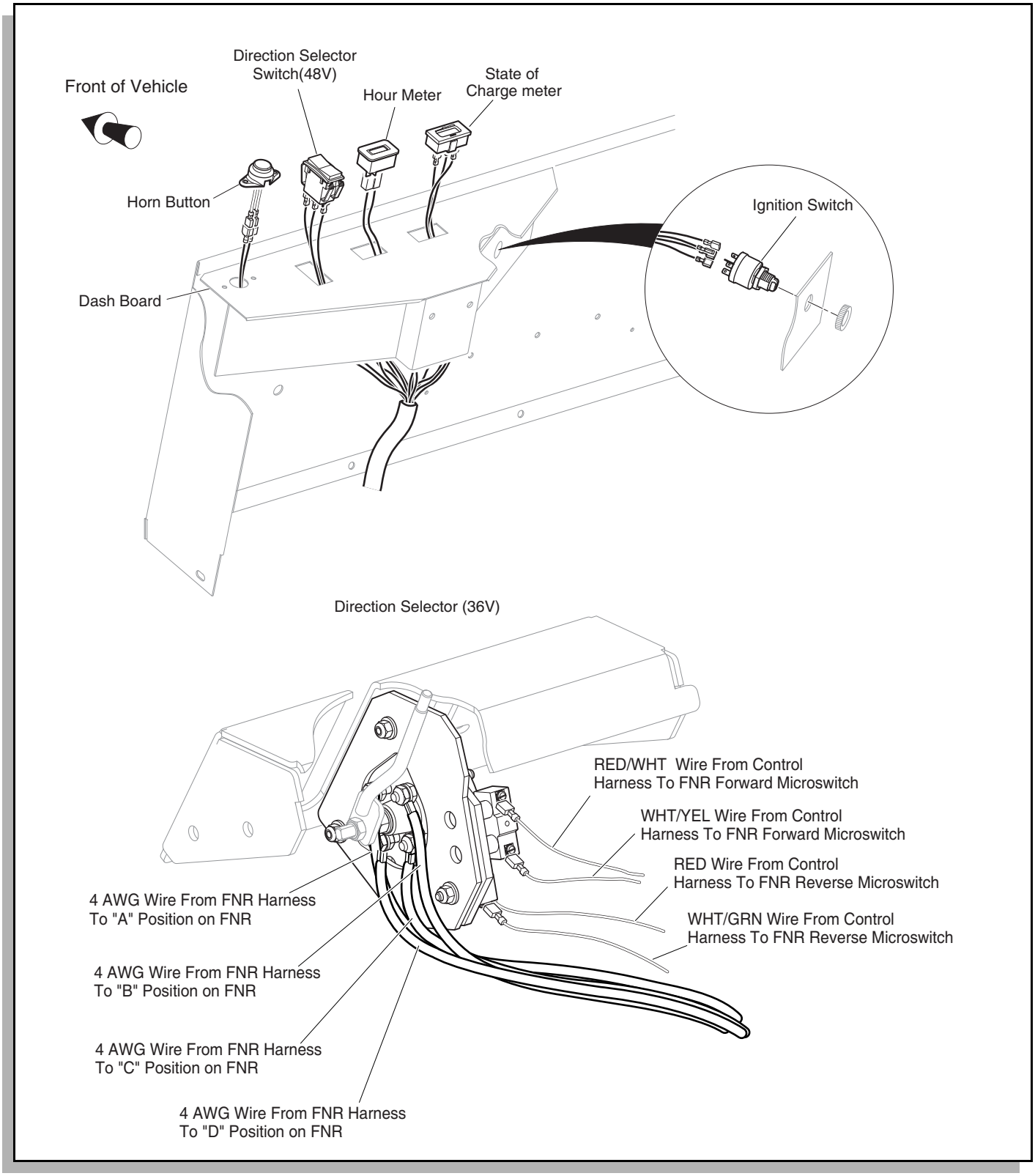

Fig. 6 Ignition Switch, Direction Selector, State of Charge Meter, Hour Meter, Horn Button

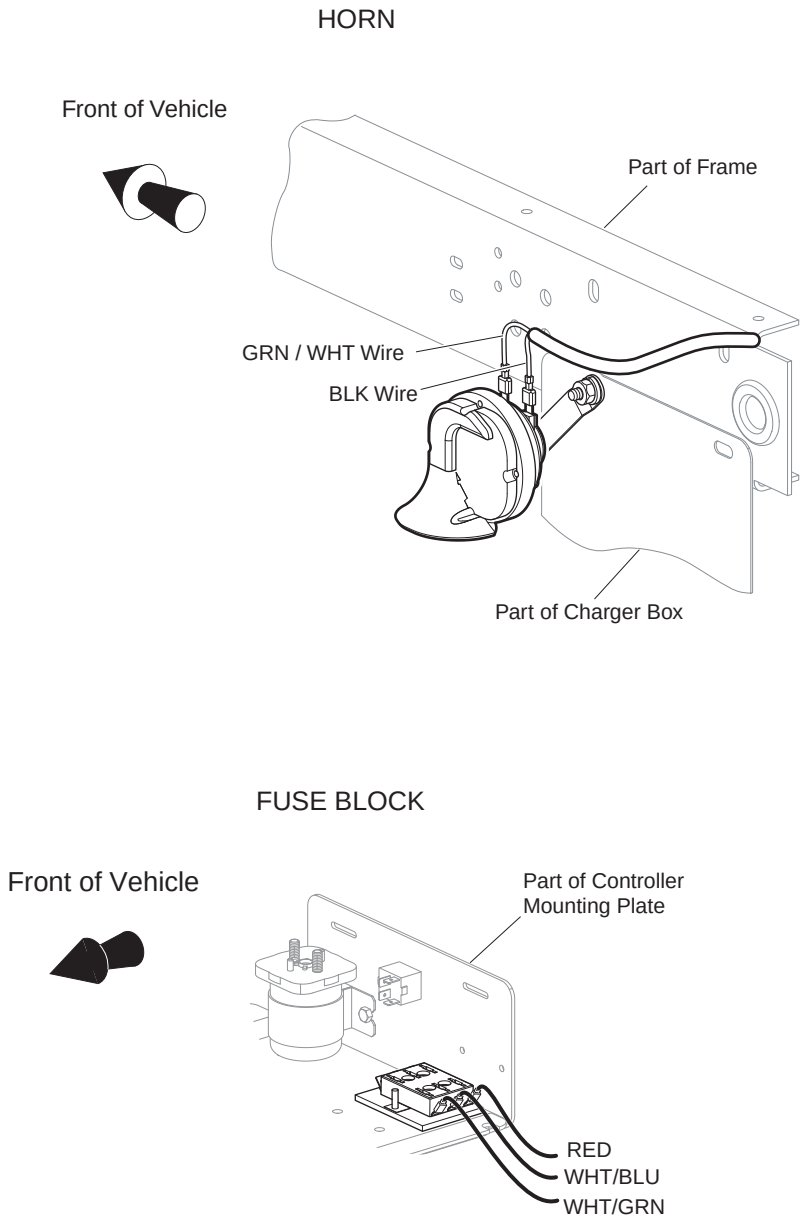

Fig. 7 Horn, Fuse Block

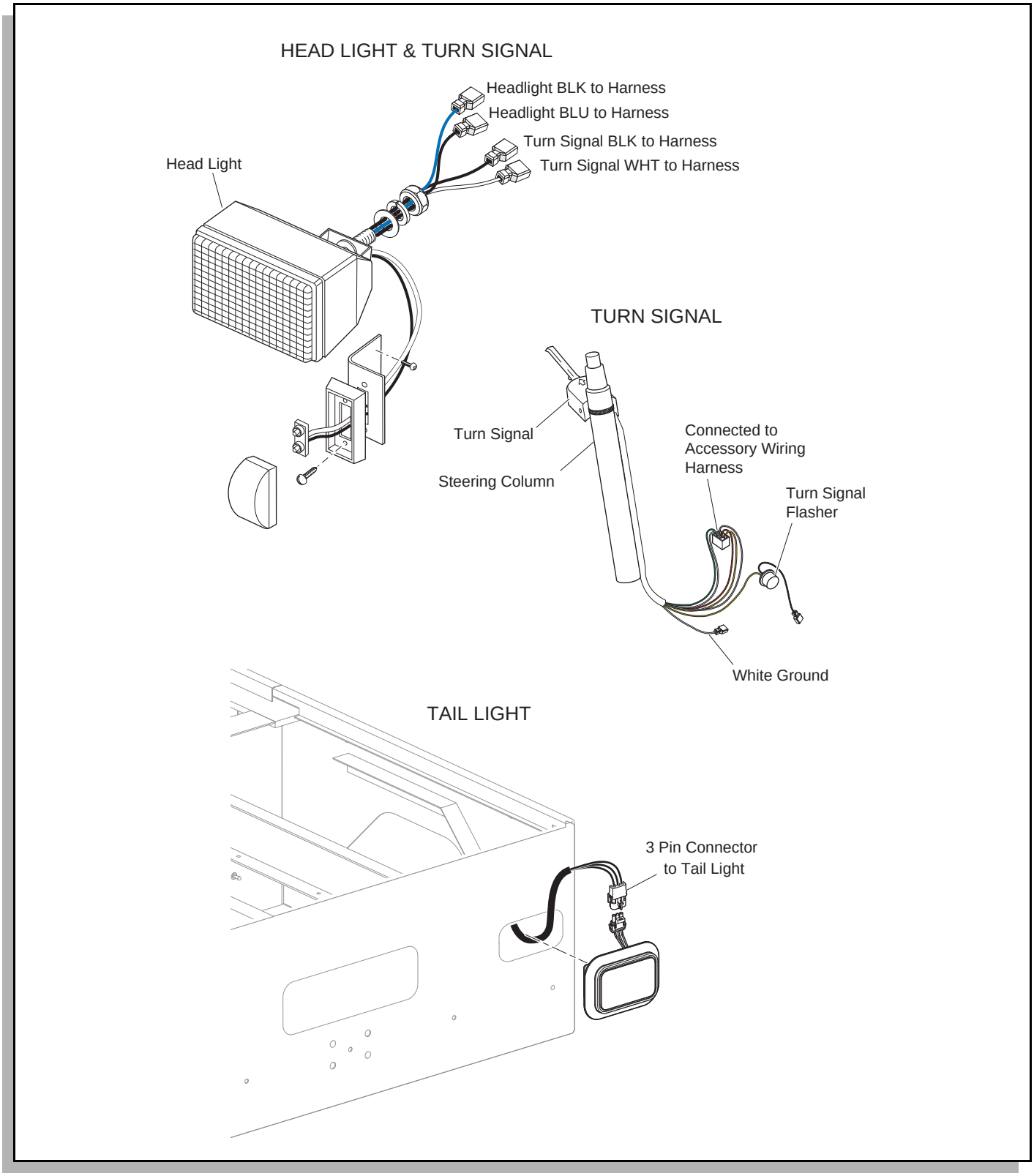

Fig. 8 Turn Signal, Headlight, Tail Light

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

Notes:

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LIST OF ILLUSTRATIONS

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

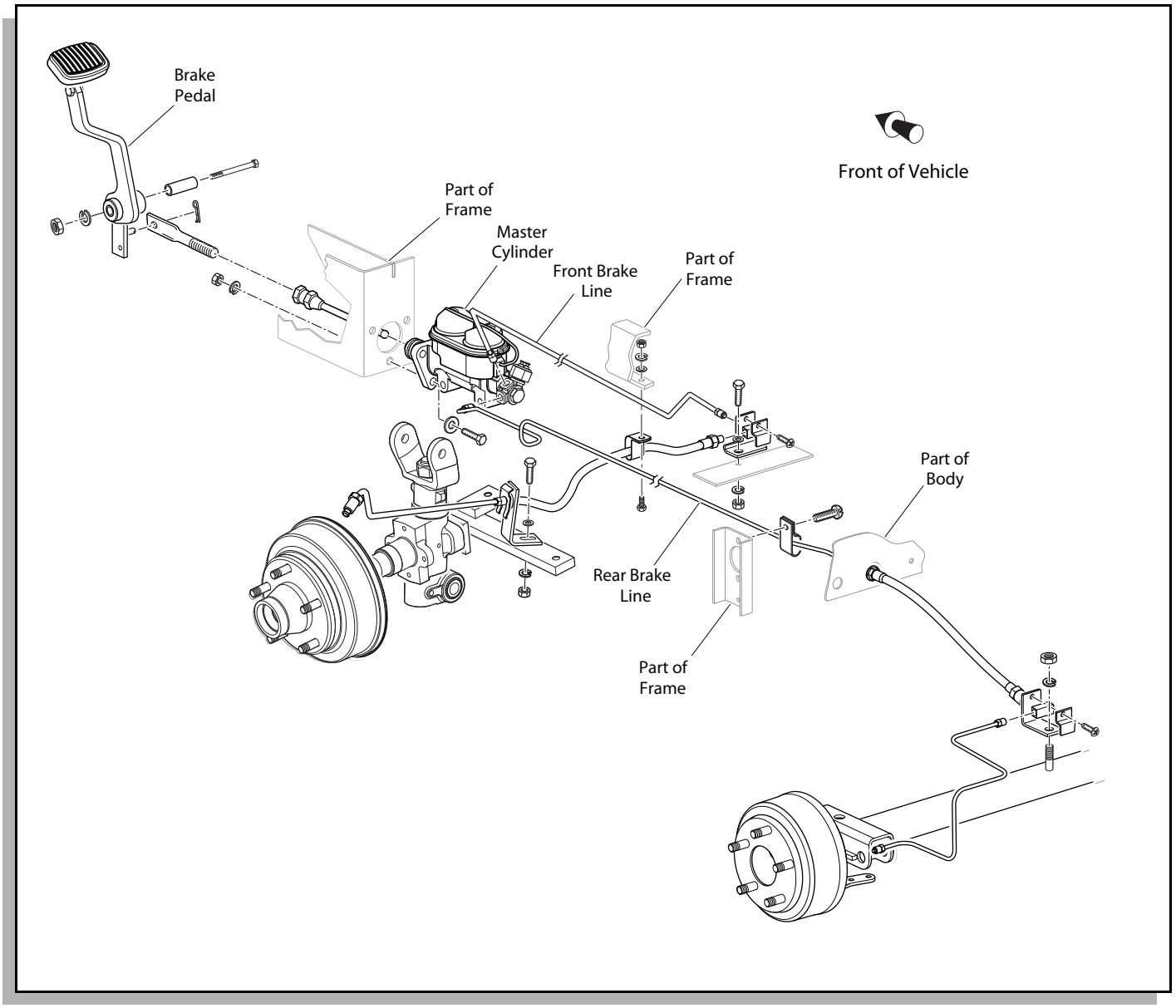

Fig. 1 Hydraulic Brake System

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 important that a Daily Brake Performance Test be performed and the entire brake system be serviced in accordance with the Periodic Service Schedule****.*

The brake system must be bled whenever ***any part of the brake system*** *has been replaced.*

DAILY BRAKING PERFORMANCE TEST

Depress the brake pedal. The pedal should have some free play and then become hard. A brake pedal that has no free travel, excessive free travel or a spongy feel is indicating that a brake inspection is required. A brake pedal that falls after it is applied indicates a leak in the master or wheel cylinders. Check for adequate brake fluid level. Adjust brakes if required and inspect system for fluid leaks.

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

HOW THE BRAKE SYSTEM WORKS

A hydraulic system is used to actuate the brakes. The system transmits the power required to activate the friction surfaces (shoes or pads) of the braking system from the pedal to the individual brake units at each wheel.

The hydraulic system operates as follows:

When at rest, the entire system is full of brake fluid. Upon application of the brake pedal, fluid trapped in front of the master cylinder piston is forced through the lines to the wheel cylinders. Here, it forces the pistons outwards against the brake shoes or pads which in turn contact the brake drum or disc. Upon release of the brake pedal, a spring located inside the master cylinder immediately returns the piston to the normal position. The brake shoe return springs retract the brake shoes and wheel cylinders which returns the brake fluid to its original position within the master cylinder. Refer to 'Front Hydraulic Disc Brakes' for additional information.

BRAKE MASTER CYLINDER FLUID

NOTE *Hydraulic brake systems must be totally flushed if the fluid becomes contaminated with water, dirt or other corrosive chemicals. To flush, bleed the entire system until all brake fluid has been replaced with fresh DOT 3 standard automotive brake fluid.*

It is important to maintain proper fluid levels in the brake master cylinder. The fill cap for the cylinder is located under the seat. To prevent contamination when checking the fluid, wipe off any dirt from the fill cap before removing it. Fluid level should be maintained at 1/8" (3 mm) below the top of the housing. Use DOT 3 standard automotive brake fluid.

MASTER CYLINDER SERVICING

The usual reason for a master cylinder failure is the cylinder seals (cups) deteriorate. Fluid leaks past the cups and shows as an external leak. A common symptom is a 'spongy' brake pedal that goes all the way to the floor when all the other brake components are in good condition. The rubber parts wear with usage or deteriorate with age or fluid contamination. Corrosion or deposits formed in the cylinder bore due to moisture or dirt in the hydraulic system may result in wear of the cylinder bore or related parts. The manufacturer of you vehicle does not recommend disassembly or rebuilding of the master cylinder. Replace a failed master cylinder with a new one.

Master Cylinder Removal and Replacement

CAUTION **During this process, it is likely that brake fluid will leak from the master cylinder. Avoid allowing brake fluid to contact the painted body components of the vehicle. Wipe off immediately.**

Clean the area around the master cylinder to prevent dirt and grease from contaminating the cylinder or hydraulic lines.

Disconnect the brake light terminal and the brake lines at the branch tee.

Remove the hardware that secures the master cylinder to the vehicle and remove the master cylinder from the vehicle(Ref Fig. 1 on page K-1).

Remove the reservoir cover and drain the brake fluid from the reservoir.

Master Cylinder Installation

Reinstall hardware securing master cylinder to frame.

Reinstall brake lines and brake light terminal to branch tee to 70 - 80 in. lbs. (8 - 9 Nm).

Replace brake fluid into reservoir and bleed system per 'Bleeding Brakes'.

BRAKE LINKAGE

Tool List **Qty. Required**

Wrench, 9/16" 1

NOTE *The master cylinder has built in free travel.*

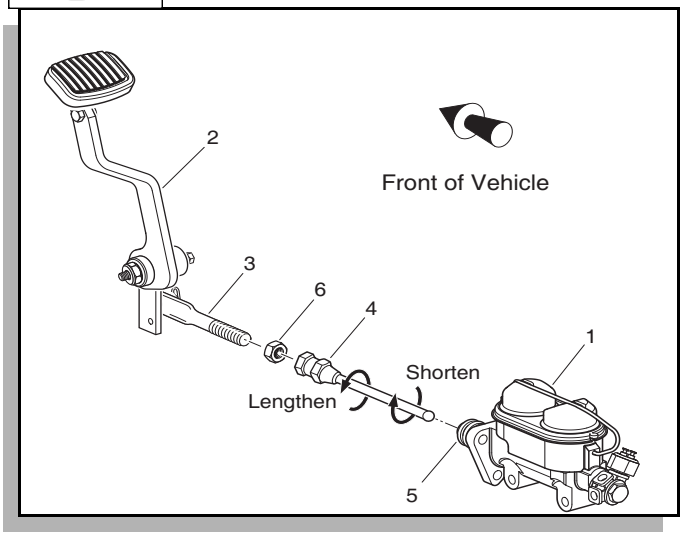

Fig. 2 Brake Linkage Adjustment

The brake pedal linkage is set at the factory. However, if the master cylinder should have to be removed for any reason, the pedal will require readjustment.

The master cylinder (1) is located under the floor access panel and is connected to the brake pedal (2) by an adjustable linkage (Ref Fig. 2 on page K-2). The threaded operating rod (3) should be snug against the master cylinder piston (4) (inside cylinder, under rubber boot (5)) with no pressure on the piston.

To adjust, loosen jam nut (6) on the rod and turn the rod in the desired direction until it becomes snug against the piston. Tighten jam nut firmly.

FRONT BRAKE SHOE ADJUSTMENT

Tool List	**Qty. Required**
Lug wrench, 3/4"	1
Jack	1
Jack stands	4
Open end wrench, 1/4"	2
Open end wrench, 9/16"	1

NOTE *The front brakes are adjusted in a different way from the rear.*

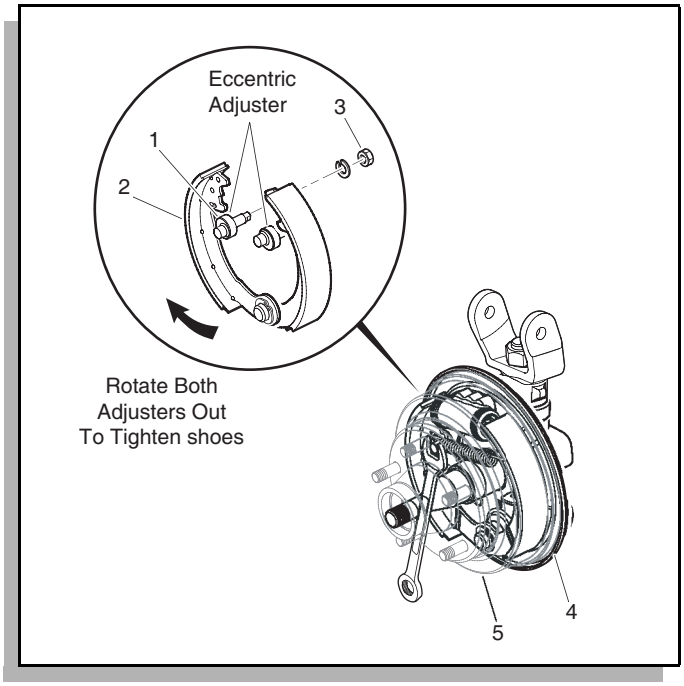

Fig. 3 Front Brake Shoe Adjustment

The vehicle may be equipped with an optional automotive type brake drum and shoe system on the front wheels. Should the braking be inadequate, adjustment should be made at the wheel brake (Ref Fig. 3 on page K-3).

Raise the vehicle enough so that the wheel turns freely. (See SAFETY Section for procedure and safety information). The adjusters are eccentric cams (1) which push the brake shoes (2) outwards. Loosen the lock nuts (3) on the rear of the backing plate (4) and attach a wrench to each of the adjusters. Raise both wrenches until the shoes contact the drum (5) and then back off slightly to prevent the shoes from dragging. Tighten the lock nuts firmly while holding each adjuster in place.

Rotate the wheel by hand and check that the brake shoes are not contacting the brake drum.

FRONT BRAKE SHOE CENTERING

Tool List	**Qty. Required**
Lug wrench, 3/4"	1
Jack	1
Jack stands	4
Open end wrench, 1"	2

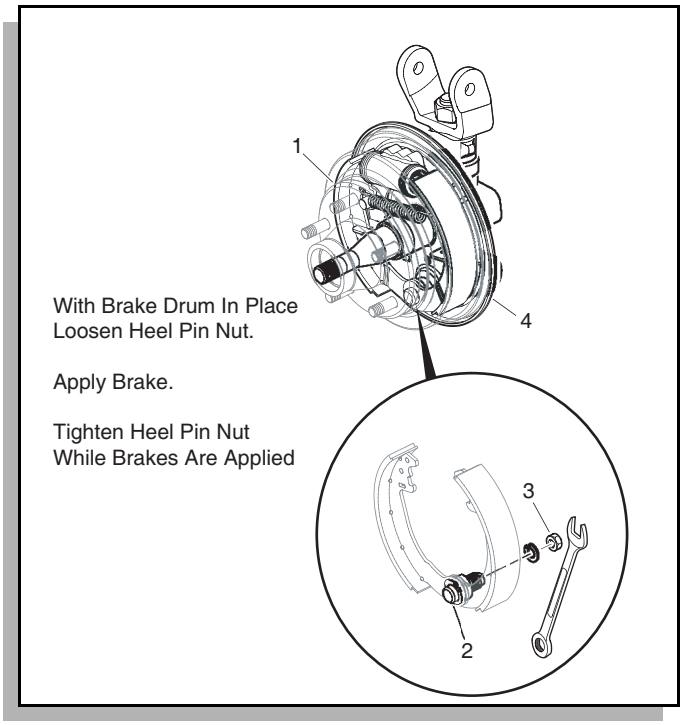

Fig. 4 Centering Brake Shoes

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

Brake shoes (1) are centered at the factory, however, in the event that the heel pin (2) should come loose or the brake has a 'spongy' feel that bleeding the brakes does not rectify, the brake shoes should be centered (Ref Fig. 4 on page K-3).

Loosen the heel pin nut (3) on the rear of the backing plate (4) and apply the brakes (brake drum in place). With the brakes applied, tighten the heel pin lock nut.

FRONT BRAKE DISASSEMBLY

Tool List	Qty. Required
Lug wrench, 3/4"	1
Jack	1
Jack stands	4
Straight blade screwdriver	1
Open end wrench 1 1/16"	1
Needle nose pliers	1
Rubber faced hammer	1
Non ferrous punch	1
Ball peen hammer	1

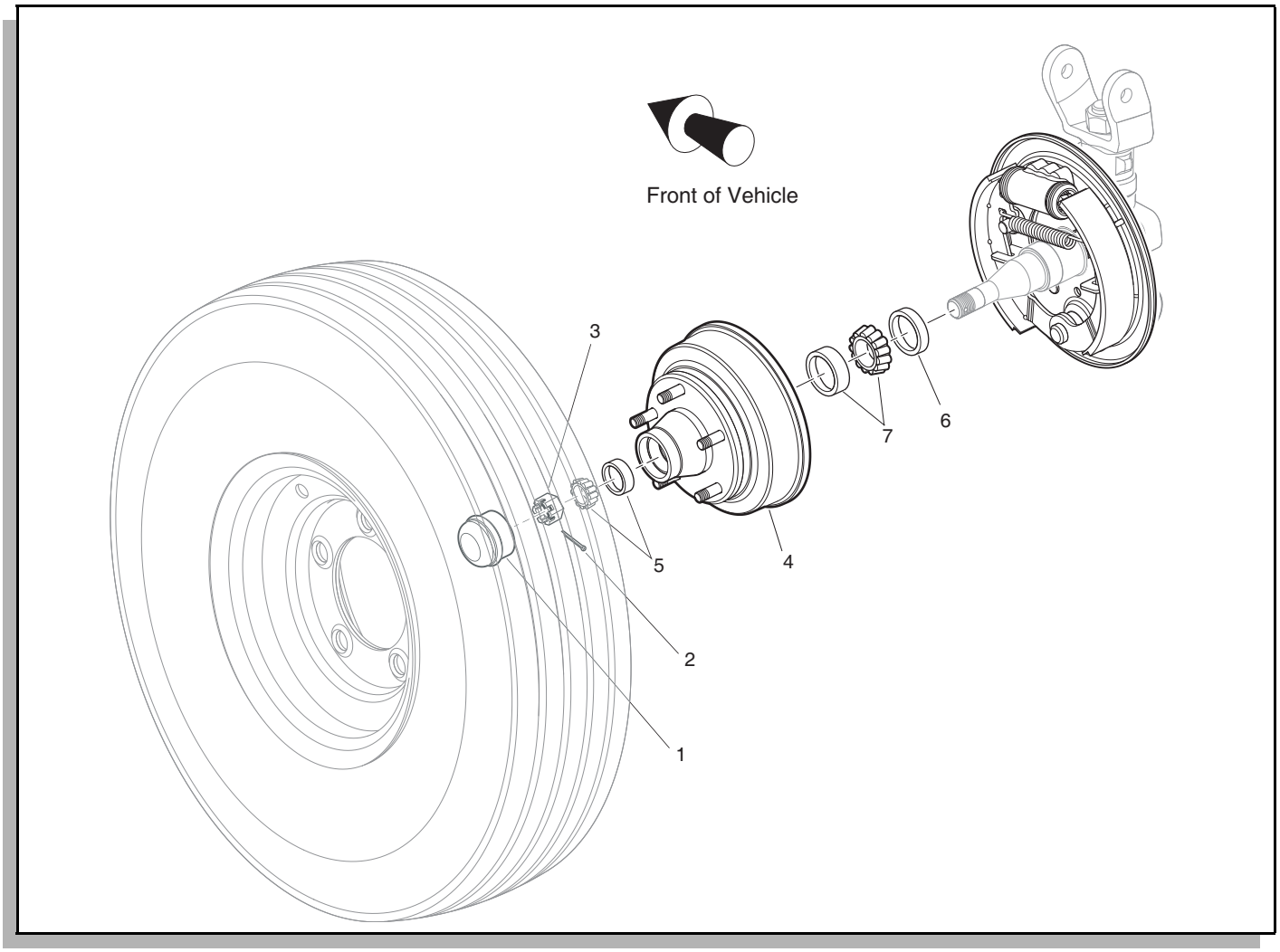

Fig. 5 Accessing Front Brake

CAUTION **To prevent damage to the hub bore, use a non ferrous punch to tap out the bearing race. Tap opposite sides of the race while moving the punch around the circumference of the race.**

NOTE *If the brake drum cannot be removed, the brake shoes may need to be retracted by rotating the adjusters in the opposite direction to that shown (Ref Fig. 7 on page K-7). If after retracting the shoes, the brake drum still remains in place, tap brake drum with a plastic faced hammer to release it from the brake shoes.*

If the outer roller bearing (6) is to be reused, protect it from contaminants until ready for reuse.

To access the front brake assembly components (Ref Fig. 5 on page K-4):

1. Remove the wheel and tire.
2. Remove the dust cap (1).
3. Remove the cotter pin (2) from the castle nut (3) and discard.
4. Remove the castle nut (3), and pull the brake drum (4) away from axle.

If the roller bearings (5) are to be replaced, remove the grease seal (6) and the inner roller bearing (7).

When replacing roller bearings, the races (5, 7) should be replaced.

Assembly is in the reverse order of disassembly. Always use a new cotter pin.

When installing bearings (new or existing), they should be repacked and adjusted.

WHEEL BEARING PACKING

Tool List	**Qty. Required**
Grease gun	1
Bearing packer (Recommended)	1

CAUTION **To prevent damage to the hub bore, use a non ferrous punch to tap out the bearing race. Tap opposite sides of the race while moving the punch around the circumference of the race.**

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

Remove hub from spindle and disassemble. See 'WHEEL BEARING ADJUSTMENT' on page L-5.

Clean all bearings, grease seal, hub and dust cap in solvent and dry thoroughly. Inspect for signs of damage. Pitting or a blue coloration of the rollers will require replacement of the bearing. If the roller portion of the bearing is to be replaced, the race must also be replaced.

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

Assemble hub and install on spindle. (Ref Fig. 6 on page K-5)

WHEEL BEARING ADJUSTMENT

Tool List	**Qty. Required**
Socket, 1 1/2", 1/2" drive	1
Ratchet, 1/2" drive	1
Torque wrench, 1/2" drive, ft. lbs.	1
Adapter, 3/8" drive to 1/2"	1
Torque wrench, 3/8" drive, in. lbs.	1

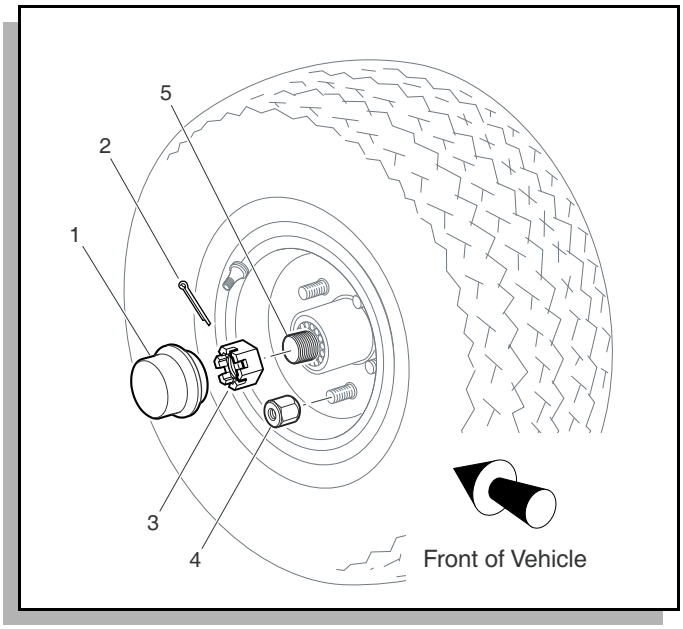

Fig. 6 Bearing Adjustment

If performing a wheel bearing adjustment only, lift and support front of vehicle per SAFETY section. Remove dust cap (1) and cotter pin (2) and loosen castellated nut (3).

If performing a wheel bearing adjustment as part of another procedure, make sure wheel is mounted to hub hand tight with lug nuts (4) and hub is loosely retained on spindle (5) with castellated nut (Ref Fig. 6 on page K-5).

Seat bearings by rotating wheel while tightening castellated nut until slight resistance is felt.

Rotate the wheel 2 - 3 more turns to displace excess grease. If required, tighten castellated nut (3) again until slight resistance is felt. If the cotter pin hole in the spindle (5) aligns with a slot in the castellated nut, insert a new cotter pin (2). If the hole does not align, the castellated nut must be **loosened** to align with the **closest available** slot in the nut.

Check for smooth and free rotation of the wheel and an absence of play when the wheel is grasped by the outside of the tire. Bend the cotter pin (2) against the flats of the castellated nut (3).

Replace the dust cap (1) and lower vehicle per SAFETY section.

If completing a wheel bearing adjustment as part of another procedure, tighten front wheels per WHEELS AND TIRES section.

FRONT BRAKE SHOE REPLACEMENT

Remove the hub and drum See 'FRONT BRAKE DISASSEMBLY' on page L-4.

Remove the return spring from both brake shoes. Remove the retaining ring from the heel pin.

Pivot both shoes out from the wheel cylinder and pull brake shoes from the heel pin.

Inspect the brake shoes. If any portion of the shoe is worn below 0.060" (1.5 mm) both brake shoes on both front wheels must be replaced.

If the top of one shoe and the bottom of the other show excessive wear, center the brake shoes See 'FRONT BRAKE SHOE CENTERING' on page L-3.

Tool List	**Qty. Required**
Needle nose pliers	1
Snap ring pliers	1
Commercial brake cleaner	AR
Commercial brake lubricant	AR

Thoroughly clean the backing plate of all brake dust using a commercial brake cleaner following the cautions and warnings provided with the product. Look for signs of corrosion and remove using emory cloth. Loosen the brake adjusters and rotate them to the lowest position. Inspect the wheel cylinder for signs of wear or fluid leakage and replace if any is found (Brake bleeding is mandatory any time the hydraulic system is opened). Apply a commercial brake lubricant following the cautions and warnings provided with the product to the heel pin and the contact surface of the brake shoe where it contacts the wheel cylinder. Install the lower brake shoe and apply a light coat of lubricant to the area around the heel pin before installing the outer brake shoe. Install the heel pin retaining ring and install the brake shoe return spring. Inspect to see that there is no lubricant on the friction surface.

Inspect the brake drum for excessive wear, gouges or signs of overheating. If evidence is found, replace the drum and do not attempt to true it. Reassemble brake drum and hub and adjust bearings. See 'WHEEL BEARING PACKING' on page L-5.

Adjust brakes See 'FRONT BRAKE SHOE ADJUSTMENT' on page L-3.

REAR BRAKE SHOE ADJUSTMENT

Tool List	**Qty. Required**
Lug wrench, 3/4"	1
Jack	1
Jack stands	4
Brake adjusting tool	1
Rubber faced hammer	1

⚠ WARNING ⚠ ***Never work on a vehicle supported by a jack alone. To prevent possible personal injury, the vehicle must be supported on jack stands during this procedure.***

The vehicle is equipped with an automotive type brake drum and shoe system on the rear wheels. Should the braking be inadequate, adjustment should be made at the wheel brake. Use the following adjustment procedure:

1. At the brake to be adjusted, loosen the lug nuts 1/2 turn.
2. Raise the vehicle enough so that the wheel turns freely. (See SAFETY Section for procedure and safety information.) Remove the lug nuts and wheel.

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

3. Remove the brake drum and inspect the brake shoes to determine that at least 0.060" (1.52 mm) brake shoe material remains.

NOTE *If the brake drum cannot be removed, the brake shoes may need to be retracted by rotating the star wheel in the opposite direction to that shown (Ref Fig. 7 on page K-7). The star wheel is accessed through the slot in the brake drum and adjusted with a brake adjusting tool or a flat blade screwdriver. If after retracting the shoes, the brake drum still remains in place, tap brake drum with a plastic faced hammer to release it from wheel bolts.*

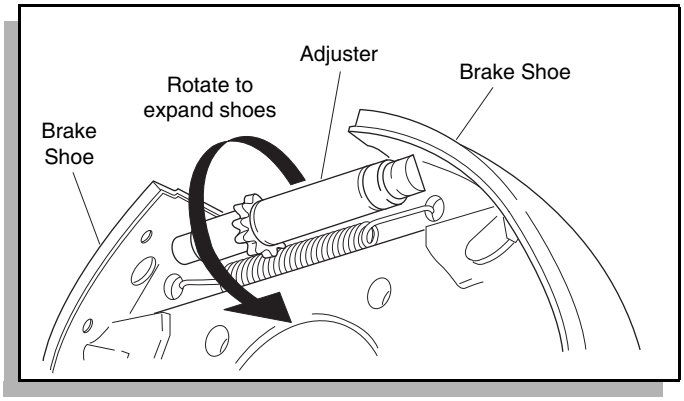

Fig. 7 Rear Brake Shoe Adjustment

a) If shoe replacement is not required, the shoes must be adjusted. Replace brake drum. Note that the slot in drum must be aligned with adjuster.
b) Rotate the star wheel adjuster one full turn at a time through opening in drum until the brake shoes contact the brake drum (Ref Fig. 7 on page K-7).
c) Loosen star wheel 3 'clicks'. Rotate the brake drum, if any drag is encountered, the star wheel may be loosened one additional 'click'. If the drum still binds, repeat the adjustment procedure. If the drum continues to bind, the drum should be checked for a warped or out of round condition.

REAR BRAKE SHOE REPLACEMENT

Tool List	**Qty. Required**
Wrench, 11/16"	1
Needle nose pliers	1
Brake cleaner	A/R
Brake lubricant	A/R

⚠ WARNING ⚠ ***Never work on a vehicle supported by a jack alone. To prevent possible personal injury, the vehicle must be supported on jack stands during this procedure.***

NOTE *The factory recommends changing all brake shoes at the same time because proper adjustment will result in even wear of all brake shoes.*

Prior to making the repairs included in this section, check the pedal adjustment, the cylinder fluid level and the brake shoe adjustment.

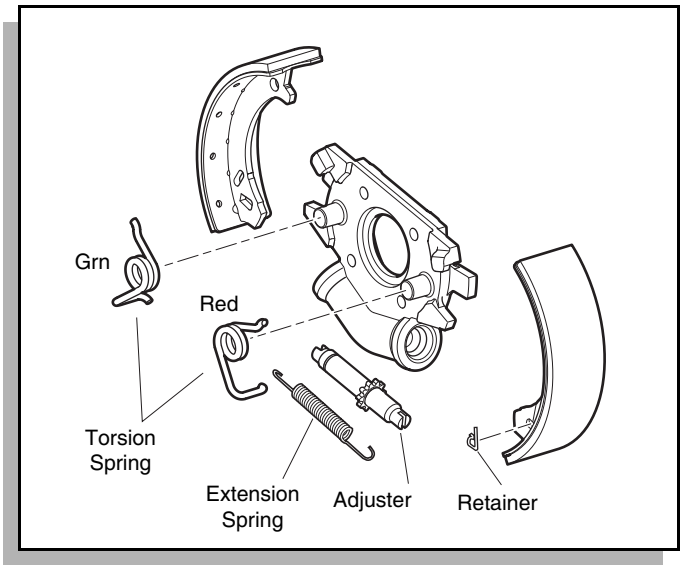

Fig. 8 Brake Shoe Replacement

The shoes should be replaced whenever **any** portion of the shoe material is less than 0.060" (1.52 mm), the braking effect has diminished or the brakes start squeaking and proper adjustment does not remedy the problem. Always replace both shoes at both wheels. Use the following procedure for shoe replacement:

1. At the rear wheels, loosen the lug nuts 1/2 turn.
2. Raise the vehicle and support with jack stands. (See SAFETY Section for procedure and safety information.)
3. Remove wheel and brake drum as described in previous section.
4. To remove the shoes, remove the extension spring from the hole in each brake shoe. Remove the torsion springs and retainers. Remove the adjuster. With these springs removed, the brake shoes can be removed (Ref Fig. 8 on page K-7).
5. Separate, clean and lubricate the adjuster with commercially available products. Screw the adjuster together to achieve its shortest length.
6. Reassemble the brake in the reverse order of assem-

bly. Note that the slot in the drum must be in line with adjuster.

7. After assembly, the brakes should be adjusted as previously detailed.

BRAKE SYSTEM INSPECTION

CAUTION **Do not allow brake fluid to contact painted surfaces. Wipe off immediately.**

NOTE *Care should be taken to prevent brake fluid from coming into contact with the brake shoes. If the brake shoes should become wet, remove the brake drum and wipe the brake shoes and drum until they are dry.*

Brake failure usually occurs as either a gradual decrease in braking effect from the shoe material being worn away, a loss of braking at one wheel or a sudden and complete failure with no brakes working except the parking brake.

Should the brakes at one wheel become ineffective while the brakes at the other wheel functions properly, remove the wheel and drum. Inspect the brake for a leaking or inoperative wheel cylinder assembly.

Complete brake failure usually indicates a loss of hydraulic fluid pressure. Check the fluid level at the master cylinder. If the cylinder is full, inspect the master cylinder for a defective piston seal which will allow the fluid to escape around the piston. A master cylinder repair kit is available through the Service Parts Department (E-Z-GO P/N 28066-G02). Tubing joints and the wheel cylinder seals are locations that should be checked for leaks. If the inspection does not reveal a leak, fill the master cylinder with brake fluid. While you observe the vehicle, have an assistant depress the brake pedal. The brake fluid will be forced out of the defect, making the leaking point readily apparent.

The hydraulic system may be checked for leaks by applying pressure to the pedal gradually and steadily. If the pedal sinks very slowly to the floor, the system has a leak. This is not to be confused with a springy or spongy feel due to the compression of air within the lines.

Check for leaks along all lines and at brake assembly. If no external leaks are apparent, the problem is inside the master cylinder.

After making any repairs to the hydraulic lines, wheel cylinders or master cylinder, the brakes must be bled to remove any trapped air. A bleeder valve is located at each wheel cylinder for this purpose.

BLEEDING BRAKES

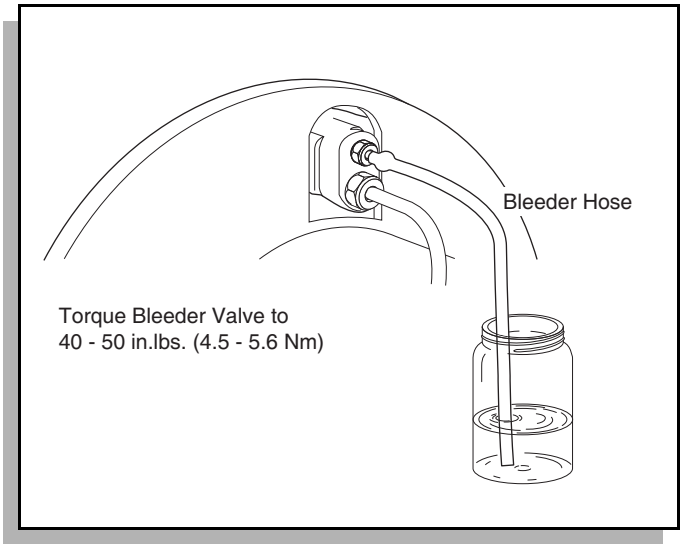

Fig. 9 Bleeding Brakes

Tool List	**Qty. Required**
Tubing	A/R
Clean container	1
Brake fluid	A/R

WARNING ***Never reuse any excess fluid or return to the original container. Dispose of brake fluid properly.***

NOTE *The bleeder valve at the wheel cylinder must be closed at the end of each stroke and before the brake pedal is released to insure that air cannot enter the system. It is also important that the brake pedal be returned to full 'up' position.*

The hydraulic brake system must be free of air to operate properly. Air can enter the system when hydraulic parts are disconnected for servicing or replacement, or when the fluid level in the master cylinder reservoir is very low. Air in the system will give the brake pedal a spongy feeling upon application.

NOTE *An assistant will be necessary to perform this procedure.*

Use a clean cloth to wipe off the master cylinder reservoir and wheel cylinder bleeder valves (Ref Fig. 10 on page K-9). Clean each fitting before opening to prevent contaminating the system. Open the master cylinder reservoir and top off with standard automotive brake fluid.

Attach a short length of clear hose to the wheel cylinder bleed valve and insert the other end into a suitable clean

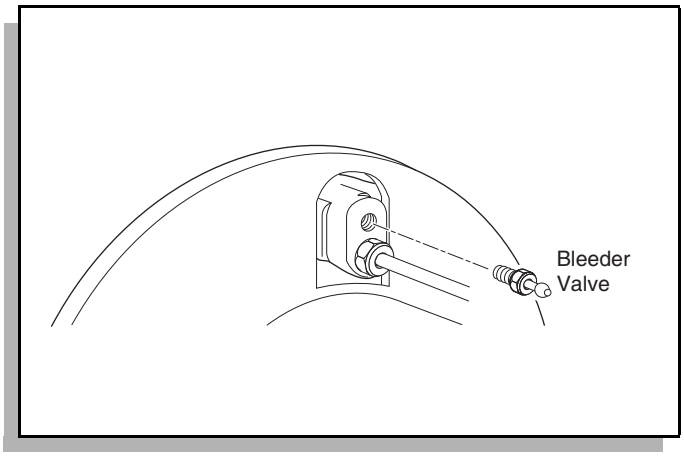

Fig. 10 Bleeder Valve

container containing fresh, clean brake fluid (Ref Fig. 9 on page K-8). Check the fluid level in the master cylinder frequently during this operation to prevent air from entering the lines

Starting with the passenger side rear brake and going to the driver side rear brake, bleed the brakes using the following procedure:

Open the bleeder valve and have an assistant depress brake pedal **gently** until fluid flows into container. Close the bleeder valve and have the assistant slowly release the brake pedal. Repeat the process until no bubbles can be seen leaving the bleeder valve. Close the valve and move to the next brake.

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

PARKING BRAKE

The parking brake is operated by a lever located between the front seats through cables to the rear wheel brake mechanical actuators (Ref Fig. 12 on page K-11)

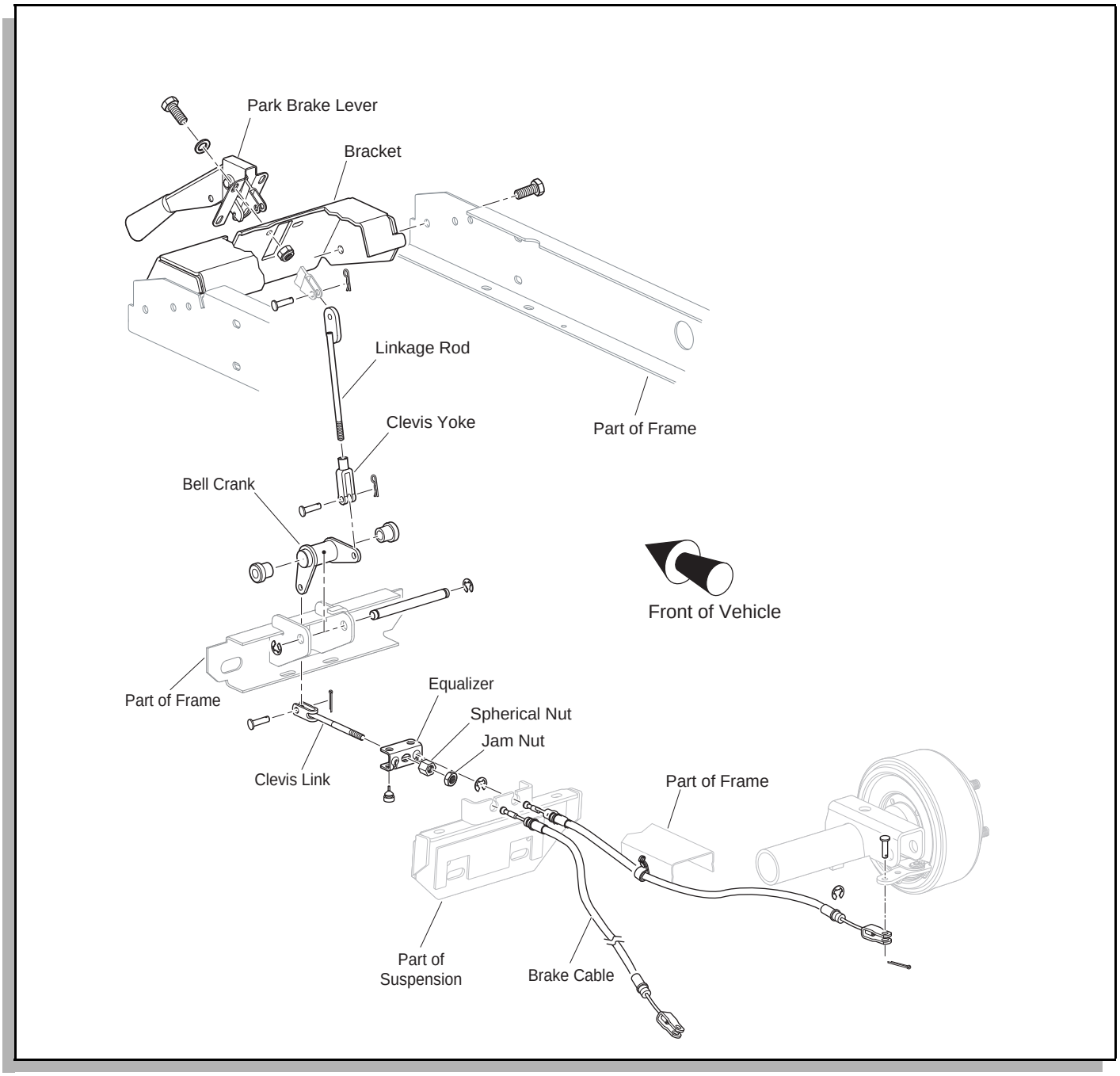

Fig. 11 Parking Brake System

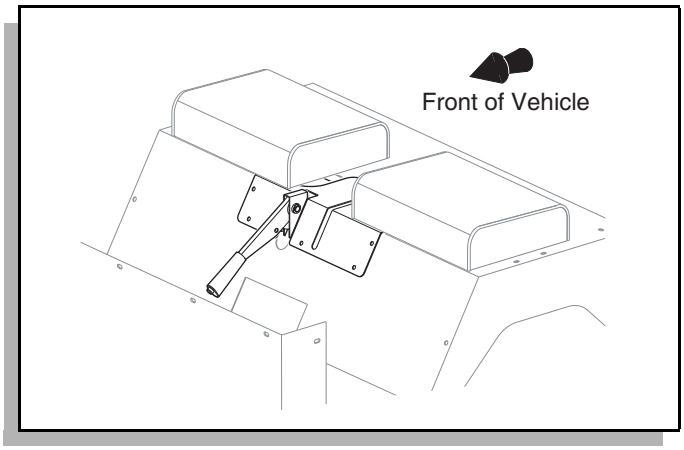

Fig. 12 Parking Brake

Lubrication

CAUTION **When lubricating parking brake, be sure to use the recommended dry spray lubricant. Commercial grease can attract dirt and accelerate wear.**

The parking brake lever requires periodic lubrication with a dry graphite or molybdenum disulfide lubricant. Raise the lever and spray into the underside to access the pivot arm and ratchet mechanism of the parking brake. See Section A - Periodic Service Schedule for recommended lubrication schedule.

Adjustment

After brakes are adjusted at each wheel the parking brake can be adjusted by rotating the spherical nut on the parking brake linkage (Ref Fig. 13 on page K-11). Rotate the spherical nut until 0.06" - 0.10" (1.5 - 2.5 mm) gap is obtained between the equalizer and fitting. Secure with jam nut.

Cable Replacement

Cables should be replaced when they become inoperable. Cable replacement consists simply of disconnecting the present cable, installing new cable and adjusting.

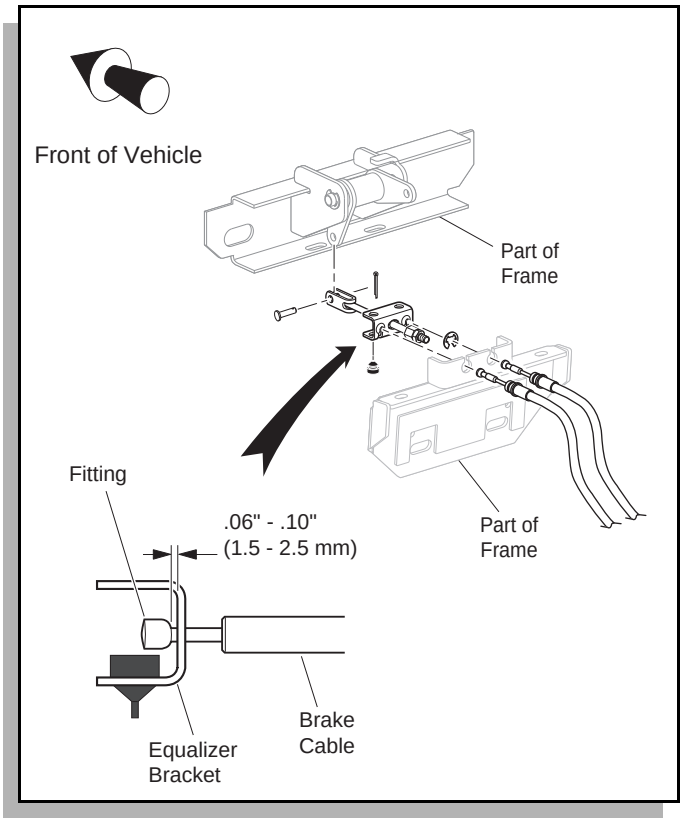

Fig. 13 Parking Brake Adjustment

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

Notes:

REAR SUSPENSION

L

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REAR SUSPENSION

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.*

GENERAL

The rear suspension consists of the rear axle and attachments that secure it to the springs and shock absorbers. Rear axle removal is covered in the REAR AXLE section.

Shock Absorber Removal

Tool List	Qty. Required
Wrench, 11/16"	1

Raise the rear cargo deck panel to allow access to the top of the shock absorbers (1).

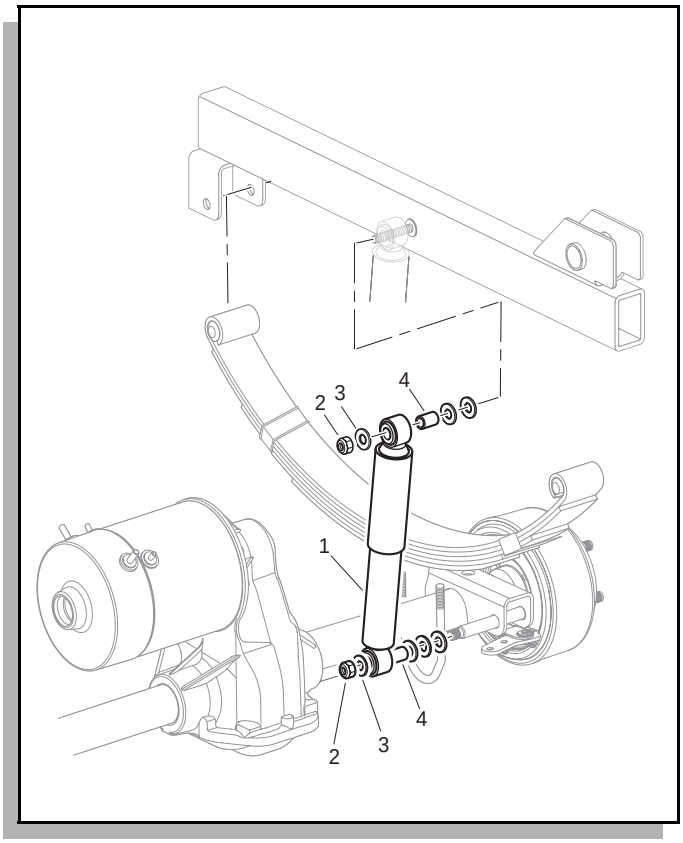

Fig. 1 Shock Absorber Replacement

Remove the top and bottom shock absorber nuts (2) and washers (3). Retain spacers (4) for use in reassembly (Ref Fig. 1 on page L-1).

Remove the shock absorber (1).

Shock Absorber Installation

Shock absorber installation is in the reverse order of disassembly.

Rear Spring Removal

Tool List	Qty. Required
Wheel chocks	4
Jack stands	4
Floor jack	1
Socket, 11/16", deepwell, 1/2" drive	1
Ratchet, 1/2" drive	1
Wrench, 3/4"	1
Torque wrench, 1/2" drive ft.lbs.	1

⚠ WARNING ⚠ ***Be sure the vehicle is on a firm and level surface. Never get under a vehicle while it is supported by a jack. Use safety stands and test the stability of the vehicle on the stands. Always place chocks in front and behind the wheels that are not to be raised. Use extreme care since the vehicle is extremely unstable during the lifting process.***

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

The shock absorbers do not have to be removed to replace springs.

Remove the cargo bed. Lift the entire vehicle and support on jack stands as instructed in the SAFETY section being careful not to damage brake lines or cables. Place a floor jack under the bottom of the shock absorber on the side of the vehicle that the spring is to be replaced and raise the jack just enough to apply pressure to the shock absorber.

With both the rear axle and the frame supported, the U - bolt (1), hardware (2 & 3) and mounting plate (4) securing the spring (5) to the axle can be removed (Ref Fig. 2 on page L-2). Lower the jack until the shock absorber is fully extended or the tire contacts the ground.

Remove hardware (6, 7 & 8) securing the front end of the spring to the fixed bracket on the frame.

Remove the bottom hardware (9, 10 & 11) from the spring shackles (12) securing the spring to the frame at the rear of the vehicle.

Remove the spring.

Rear Spring Installation

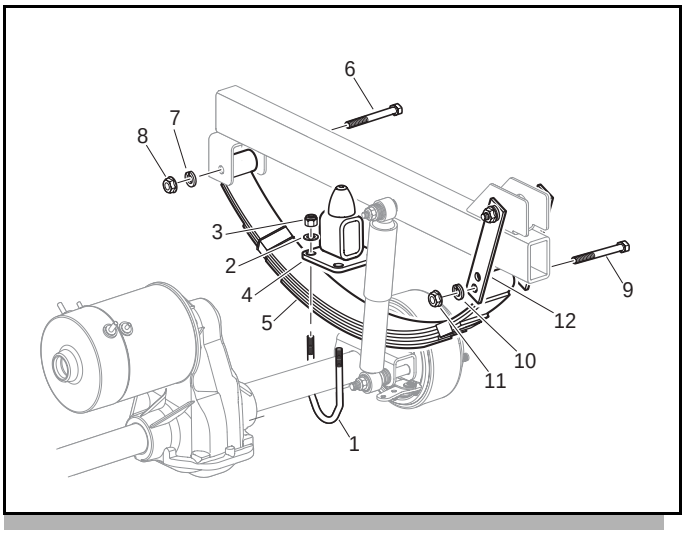

Fig. 2 Spring Replacement

Spring installation is in the reverse order of disassembly using new lock nuts.

Tighten front (8) and rear (11) spring mounting hardware to 21 - 25 ft. lbs. (28 - 34 Nm) torque.

Tighten axle mounting hardware (3) to 16 - 20 ft. lbs. (22 - 27 Nm) torque.

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REAR AXLE

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 E-Z-GO P/N 28148-G01.

REAR AXLE REMOVAL

Tool List	Qty. Required
Wrench, 1/2" insulated	1
Lug wrench, 3/4"	1
Wheel chocks	4
Jack stands	6
Floor jack	1
Needle nose pliers	1
Flare nut wrench, 3/8"	1
Wrench, 3/4"	1
Socket, 9/16", deepwell, 1/2" drive	1
Ratchet, 1/2" drive	1

⚠ WARNING ⚠ ***To reduce the possibility of personal injury, follow the lifting procedure per SAFETY section of this manual. Place wheel chocks in front and behind each wheel not being raised 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.***

The rear axle assembly is top heavy. To reduce the possibility of personal injury while removing the rear axle, be sure to support the motor with an overhead hoist when separating from springs.

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

Raise cargo deck panel to gain access to the motor and axle. Move the Run - Tow/Maintenance switch to Tow/Maintenance (Ref Fig. 1 on page M-1).

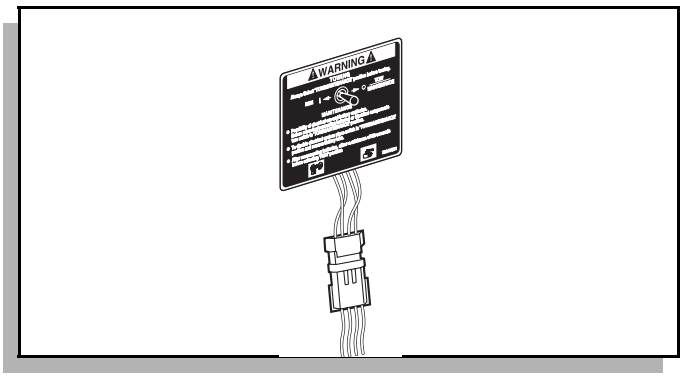

Fig. 1 Run - Tow/Maintenance switch

Loosen both rear wheels by loosening each lug nut approximately one turn.

Being careful not to damage brake cables or brake hydraulic lines, lift the entire vehicle just enough for the rear wheels to be approximately 1" (2.5 cm) above the floor, according to lifting procedure in the SAFETY section of this manual.

Disable the electrical system to the motor by turning the key switch to the 'OFF' position and remove battery wire (B-) per SAFETY section of this manual.

Disconnect the parking brake cables from their actuating levers and axle brackets (Ref Fig. 2 on page M-1).

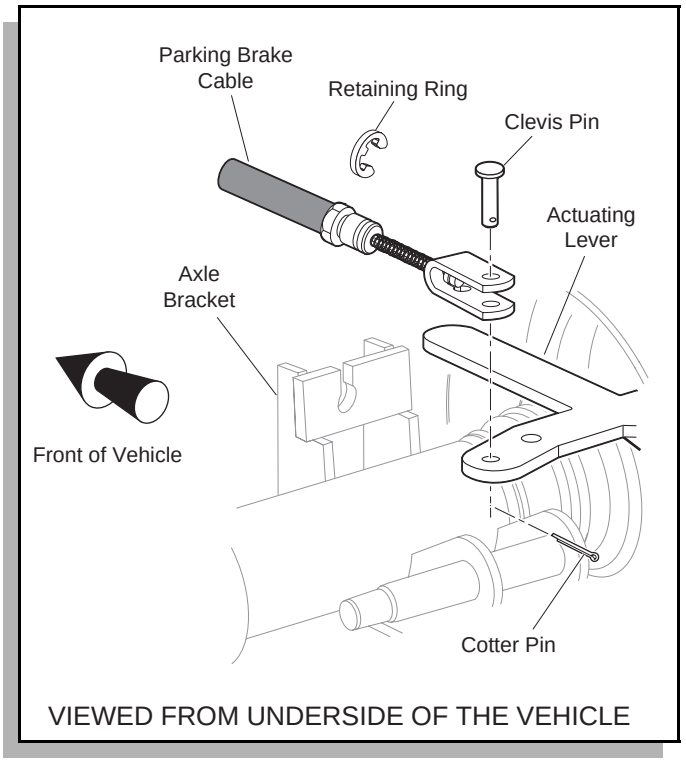

Fig. 2 Disconnecting Parking Brake Cables

Disconnect the hydraulic brake line at the "T" connection on the axle housing (Ref Fig. 3 on page M-2). Drain fluid and discard. Bleeding the hydraulic brakes at installation is mandatory.

Remove the four wires connected to the motor. Remove the hardware (1 & 2) securing the bottom of the shock absorber (3) to the axle and compress the shock absorber (Ref Fig. 4 on page M-2).

Remove the hardware (4, 5 & 6) securing the rear spring shackles (7) to the vehicle frame and allow the wheels to touch the floor. Remove the hardware (8, 9 & 10) securing the front of the spring to the vehicle frame. Raise the

REAR AXLE

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

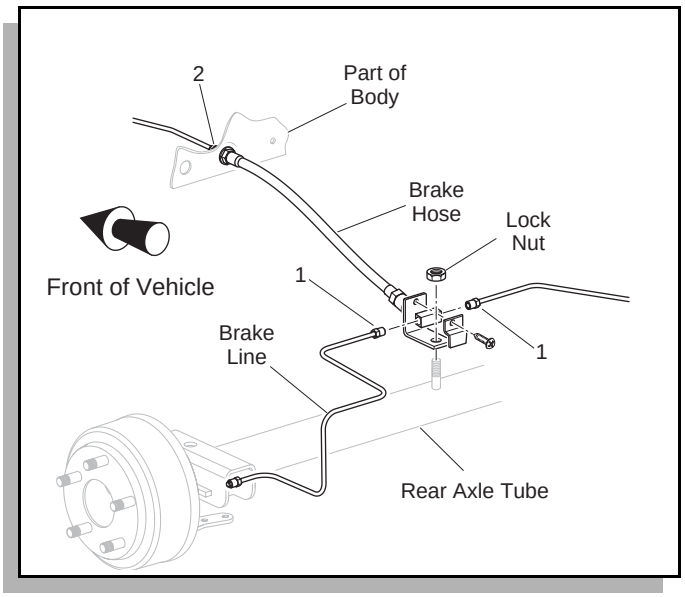

Fig. 3 Disconnecting Brake Lines

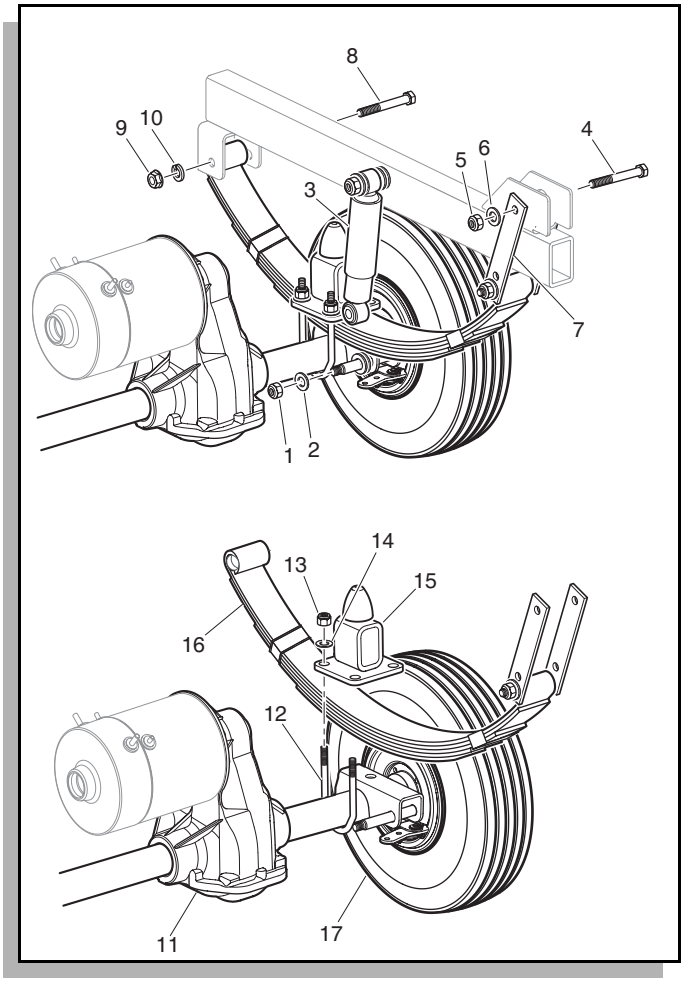

Fig. 4 Rear Axle Removal

rear of the vehicle according to lifting procedure in the SAFETY section, and roll the rear axle assembly (11) from under the vehicle.

Being careful to prevent the axle assembly (11) from rotating, remove the 'U' bolt (12) and hardware (13 & 14), spring plate (15) and leaf spring (16).

Remove the wheels (17) from the axle (11).

REAR AXLE INSTALLATION

Tool List	**Qty. Required**
Torque wrench, ft. lbs., 1/2" drive	1
Socket, 1/2", 3/8" drive	1
Wrench, 1/2" insulated	1
Lug wrench, 3/4"	1
Wheel chocks	4
Jack stands	6
Floor jack	1
Needle nose pliers	1
Flare nut wrench, 3/8"	1
Wrench, 3/4"	1
Socket, 9/16", deepwell, 1/2" drive	1

Installation is in the reverse order of disassembly. Tighten rear spring mounting hardware (4) to 21 - 25 ft. lbs. (28 - 34 Nm) torque. Tighten axle mounting hardware (13) to 16 - 20 ft. lbs. (22 - 27 Nm) torque (Ref Fig. 4 on page M-2).

Connect brake lines and tighten hardware (1) to 70 - 80 in. lbs (8 - 9 Nm) and (2) to 150 - 160 in. lbs (17 - 18 Nm) (Ref Fig. 3 on page M-2).

Reconnect the motor wires to motor (Ref Fig. 5 on page M-3). Tighten motor terminal hardware to 66 in. lbs. (8 Nm) torque.

Use new cotter pins when installing brake cables.

Replace all lock nuts with new ones.

Bleed the hydraulic brake system per BRAKES section.

Move the Run - Tow/Maintenance switch to Run and lower cargo deck.

MOTOR WIRING - 36V

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

MOTOR WIRING - 48V

Motor Terminal	Wire Marker	From
F1	F1	Controller "F1"
F2	F2	Controller "F2"
A1	A1	Controller "B+"
A2	A2	Controller "M-"

Fig. 5 Motor Wiring

AXLE SHAFT 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.**

Handle all splines with extreme care.

⚠ WARNING ⚠ ***To reduce the possibility of personal injury, follow the lifting procedure per SAFETY section of this manual. Place wheel chocks in front of 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

Tool List **Qty. Required**

Lug wrench, 3/4" 1
Wheel chocks..... 4
Jack stands 2
Floor jack 1
Flare nut wrench, 3/8" 1
Ratchet, 1/2" drive..... 1
Socket, 1/2", 1/2" drive..... 1
Puller 1

CAUTION **Do not damage bore of axle housing when removing oil seal.**

NOTE *The wheel bearing assembly and retainer ring are cemented together with an epoxy adhesive and in most cases the bearing assembly will remain intact on the axle shaft. If it does not, the bearing assembly and retainer ring must be removed from the axle housing with an internal puller.*

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.

Loosen rear wheel lug nuts on the side of vehicle to be serviced. Lift side of vehicle according to lifting procedure in SAFETY section. Remove wheel and brake drum (Ref Fig. 6 on page M-3) (refer to BRAKES section).

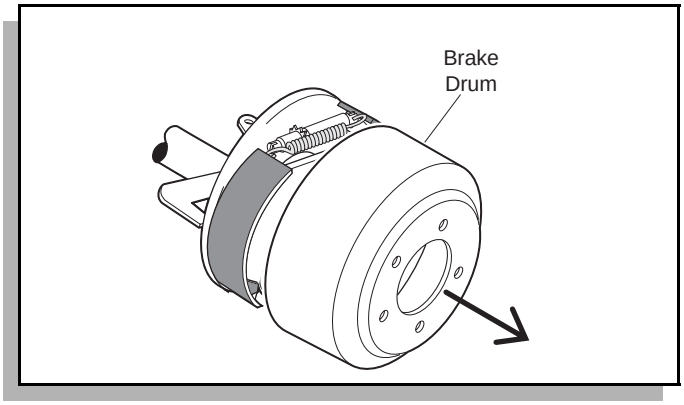

Fig. 6 Removing Brake Drum

Disconnect hydraulic brake line from the wheel cylinder.

Line up the hole in the axle shaft flange with the backing plate nuts and remove the backing plate nuts which hold the axle shaft assembly in the axle (Ref Fig. 7 on page M-4).

Remove the axle shaft assembly by grasping the axle shaft assembly and pulling free. The axle shaft assembly includes axle shaft, wiper seal, brake assembly, gasket, bearing and retainer.

Remove oil seal from axle housing using puller. Discard seal and replace with new one at time of assembly (Ref Fig. 8 on page M-4).

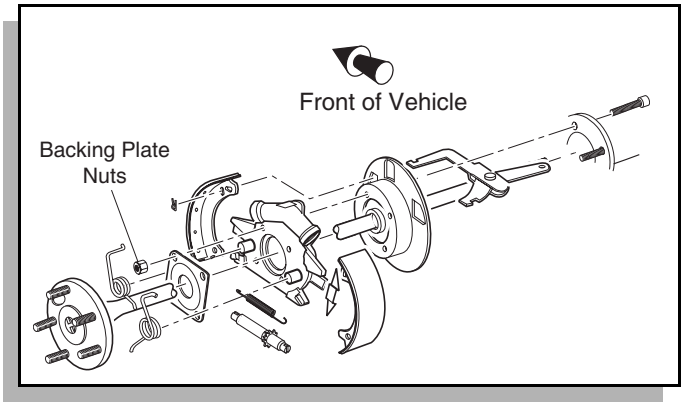

Fig. 7 Removing Backing Plate Nuts

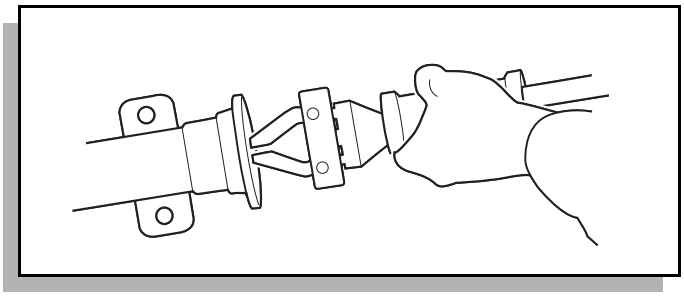

Fig. 8 Removing Oil Seal with Puller

Bearing Removal

Tools List	Qty. Required
Center punch	1
Ball peen hammer	1
Drill	1
Drill bit, 1/4"	1
Chisel	1
Arbor press	1

CAUTION **Drilling completely through the retainer ring could damage the axle shaft.**

Place axle shaft assembly in a vise. Center punch the outside of the retainer ring (Ref Fig. 9 on page M-4).

Drill 1/4" (6 mm) hole in the outside of the retainer ring to a depth approximately 3/4 the thickness of the ring.

After drilling, position a chisel across the hole and strike sharply to break the ring. Replace with a new ring at time of assembly.

Support the axle shaft assembly in a suitable press. Press on the end of the axle shaft until the wheel bearing assembly and brake assembly are removed.

It is important to note the order of components for axle shaft assembly, especially note the correct orientation for

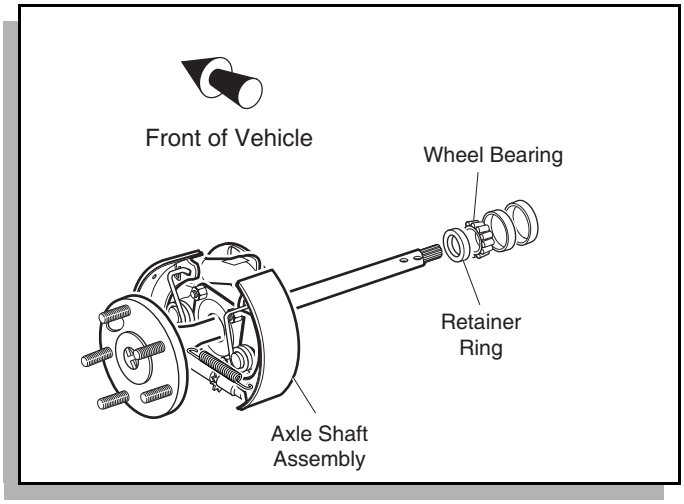

Fig. 9 Wheel Bearing Removal

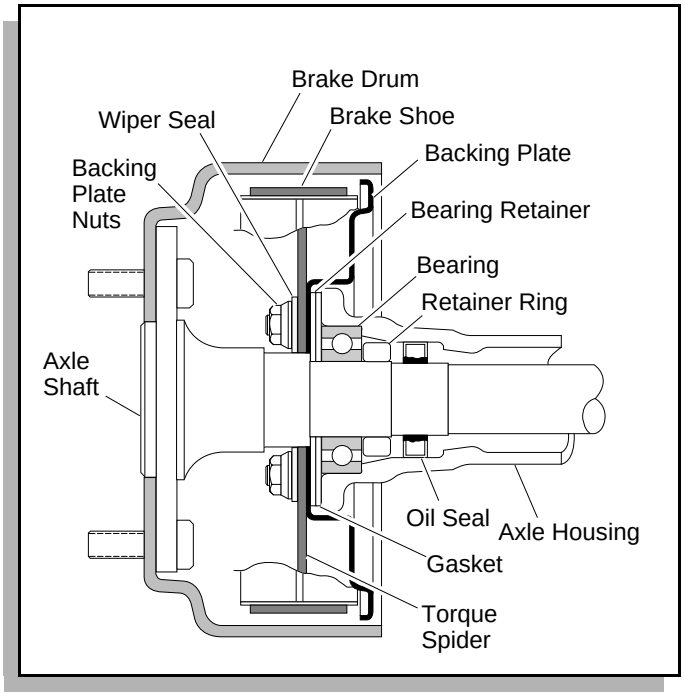

Fig. 10 Components Orientation

AXLE COMPONENTS INSPECTION

Roller Bearing

It is recommended, that whenever the bearings are removed, they are replaced with new ones regardless of mileage.

Oil Seals

Inspect oil seals for signs of leaking. Look for cuts or cracks. Be sure the spring on the inside of the seal lip is in place.

Axle Shaft Seal Surface

Inspect sealing surface of axle shaft. Replace if seal has grooved the surface more than 1/64" (0.4 mm).

AXLE SHAFT ASSEMBLY

Bearing Installation

Inspect shaft for possible damage, replace if damage is evident. In the following order, place new wiper seal, brake assembly, bearing retainer and new grease packed bearing assembly (with unit bearing rib ring toward flanged end of shaft) on the axle shaft.

Support the bearing assembly in a suitable press. Press axle shaft assembly until bearing is firmly seated against axle shaft shoulder.

Slide new retainer ring on the axle shaft and support the shaft in suitable press.

Press the retainer ring firmly against bearing.

Axle Shaft Installation

Tools List	**Qty. Required**
Seal driver	1
Machinist Rule, 6"	1
Torque wrench, ft. lbs., 1/2" drive	1

Install new oil seal into axle housing and set to original depth of 1 7/32" ±0.010" (31 mm ± 0.25 mm) from the outer flange of the axle tube.

After seal has been installed, grease lip of seal.

Assemble bolts and new gasket on axle housing. Then install axle shaft assembly into axle housing. Care should be taken not to damage gasket, oil seal, or bearing. Line up holes of brake assembly and wiper seal. Push axle shaft as far as possible into axle housing.

Start backing plate nuts on bolts by hand. Tighten nuts in a diagonal pattern to assure the retainer ring and wheel bearing assembly are drawn evenly into axle housing. Tighten backing plate nuts to 37 - 45 ft. lbs (50 - 61 Nm) torque.

Install brake drum and connect the hydraulic brake line to the wheel cylinder. Bleed the hydraulic brake system per BRAKES section.

REAR AXLE

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

Notes:

PAINT

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PAINT

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

PAINTING

⚠ 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.**

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

Minor Scratches

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

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 manufacturer suggests the following steps be taken to repair the Durashield™ body:

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 is called for. If the decision to repaint is taken, the task can be accomplished by any paint and body shop.

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

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

PAINT

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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STEERING & FRONT SUSPENSION

P

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STEERING & FRONT SUSPENSION

NOTE *For unspecified torques, refer to chart in GENERAL INFORMATION section.*

⚠ WARNING ⚠ ***To prevent serious personal injury or death resulting from a vehicle falling from a jack, be sure that 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. Always place chocks in front of and behind the wheels not being raised. Use extreme care since the vehicle is extremely unstable during the lifting process.***

STEERING

The steering system consists of a steering wheel (1) attached to a steering shaft (2) fitted with a 'U' joint that connects directly to the input shaft of the steering box (3) (Ref Fig. 1 on page P-1). A pitman arm (4) is attached to the output shaft of the steering box and is joined to the driver side steering arm (5) with an adjustable drag link (6). Steering arms (5 & 7) are attached to each king pin and spindle assembly (8). An adjustable tie rod (9) connects the steering arms.

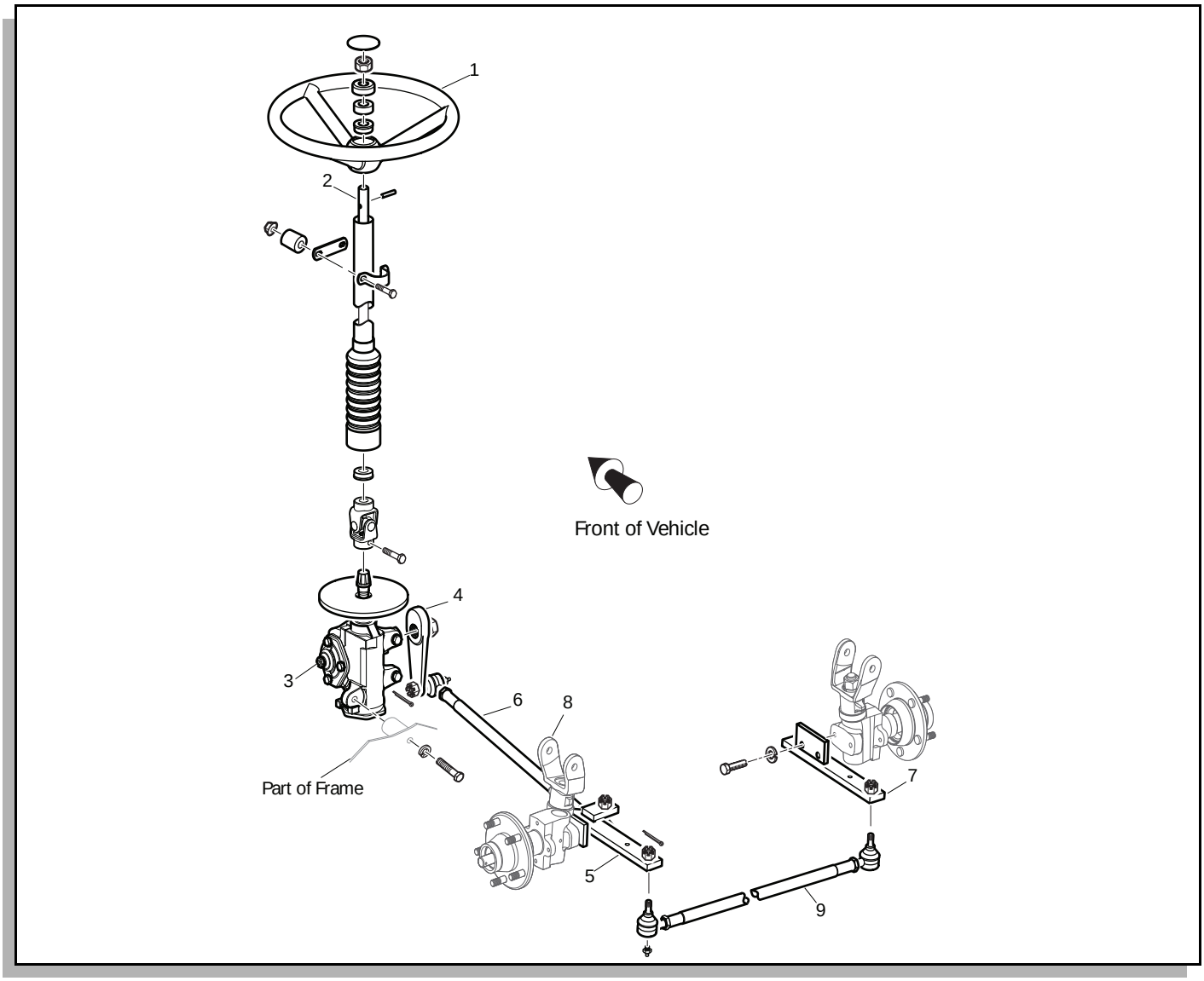

Fig. 1 Steering System

FRONT SUSPENSION

The front suspension consists of a transverse leaf spring (1) clamped to a spring perch (2) bolted to the vehicle frame (Ref Fig. 2 on page P-2). The upper end of the king pin and spindle assembly (3) is attached to the outer end of the transverse spring. The lower end of the king pin and spindle assembly is attached to a lower control arm (4) that is mounted to support brackets (5 & 6) that are bolted to the vehicle frame. Eccentric bolts (7) pass through the brackets and the lower control arm.

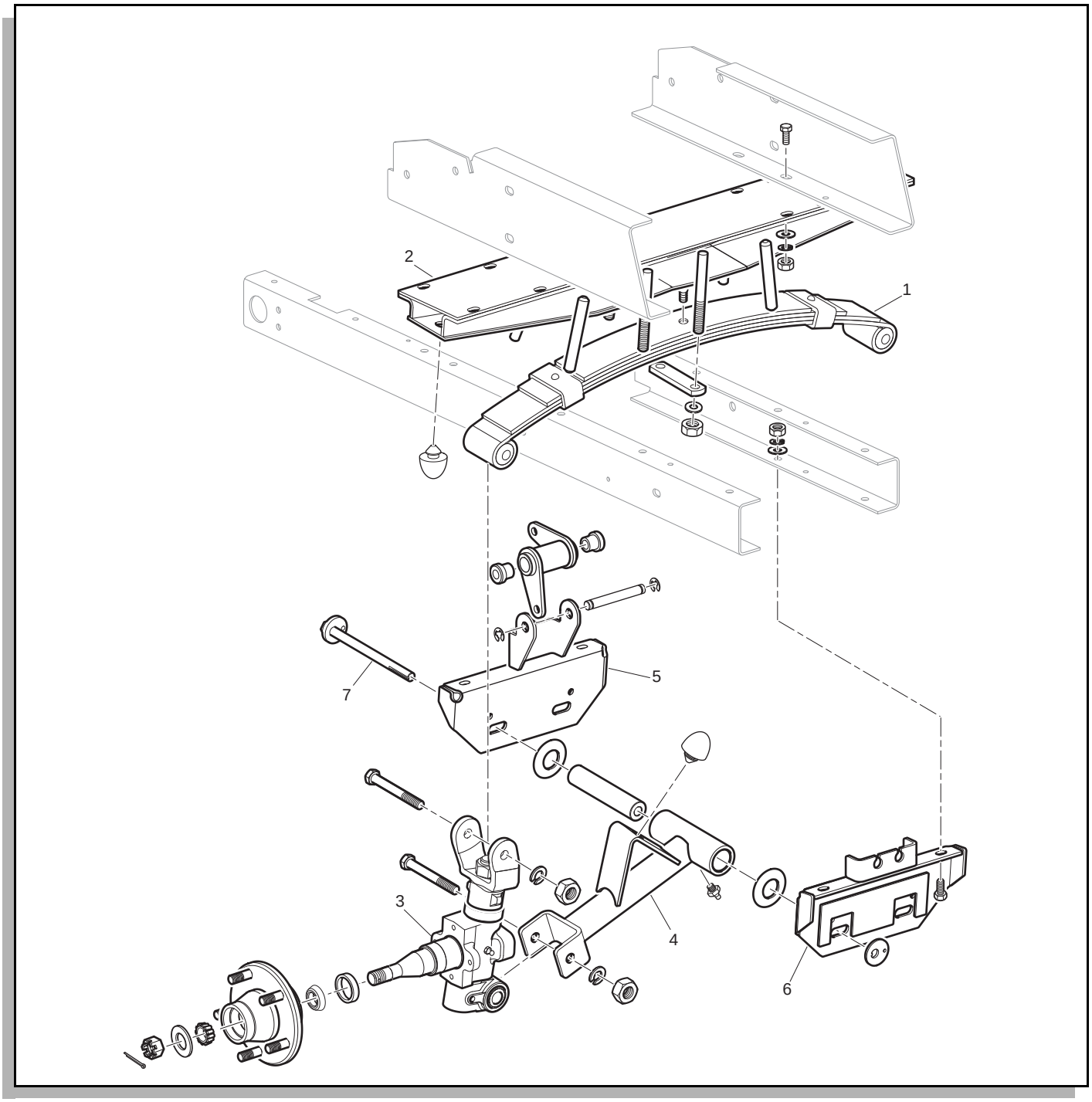

Fig. 2 Front Suspension

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

Shock Absorbers

A shock absorber perch (1) is bolted to the top of the spring perch (2) and a 'U' bolt (3) secures the lower shock mount (4) to the king pin and spindle assembly (5) (Ref Fig. 3 on page P-3). The shock absorber (6) is mounted between upper and lower shock mounting studs.

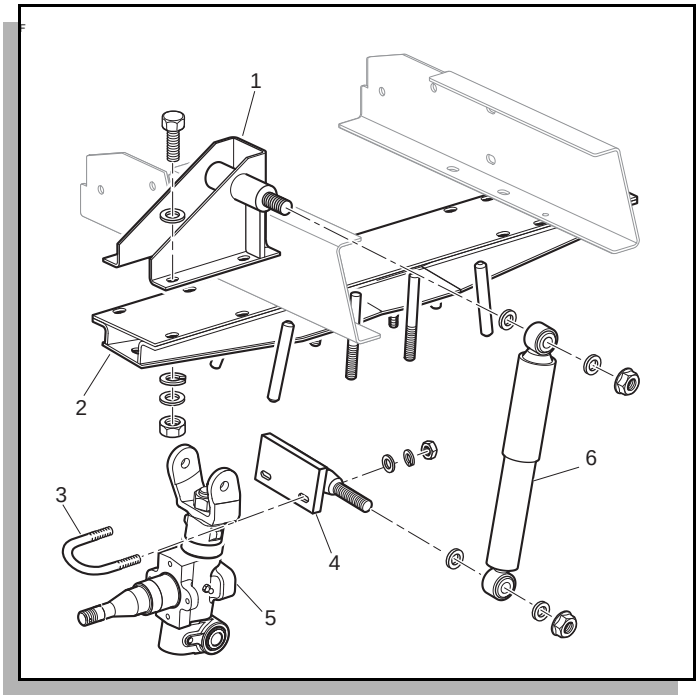

Fig. 3 Front Shock Absorbers

Steering Wheel Removal.

The steering wheel (1) is secured to the steering shaft (2) with a roll pin (3) and a nut (4). The nut is covered by a decorative blank cover (5) (Ref Fig. 4 on page P-3). To remove the steering wheel, remove the decorative cover to expose the nut. Remove the nut and drive out the roll pin. The steering wheel can now be removed.

Installation is in the reverse order of disassembly. Tighten the nut to 91 ft. lbs. (123 Nm) torque. A new roll pin is recommended.

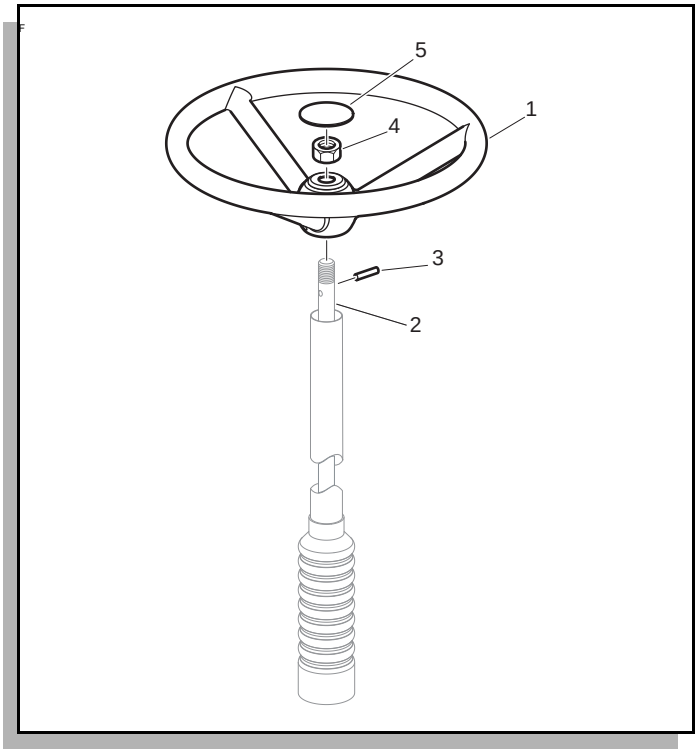

Fig. 4 Steering Wheel Removal

Steering Box Removal

Roll up the rubber boot (1) at the bottom of the steering shaft (2) to expose the set screw (3) in the 'U' joint (4) (Ref Fig. 5 on page P-4). Loosen the set screw (3). Loosen the bolt (5) and remove the nuts, washers, spacers and clamp (6, 7, 8 & 9) that secure the steering column (10) to the vehicle dash. Remove the steering column (10) and shaft (2) from the steering box (11). Raise the vehicle per SAFETY Section B and support on Jack stands. Remove the cotter pin (12) and castellated nut (13) from the drag link (14) where it joins to the pitman arm (15). Use a ball joint separator (pickle fork) to separate the ball joint (16) from the pitman arm (15). Remove the three bolts (17) and washers (18) securing the steering box (11) to the vehicle frame and remove the steering box (11).

Installation is in the reverse order of disassembly, except that it is important to straighten the front wheels and confirm that the pitman arm is in the center of it's travel. Position the steering column and shaft to align the steering wheel. Make any necessary adjustments to the drag link to permit the tie rod end to align with the pitman arm. Tighten the steering box bolts (17) to 46 ft.lbs. (62 Nm) torque.

Tighten the castellated nut to 46 ft.lbs. (62 Nm) torque and be sure to use a new cotter pin.

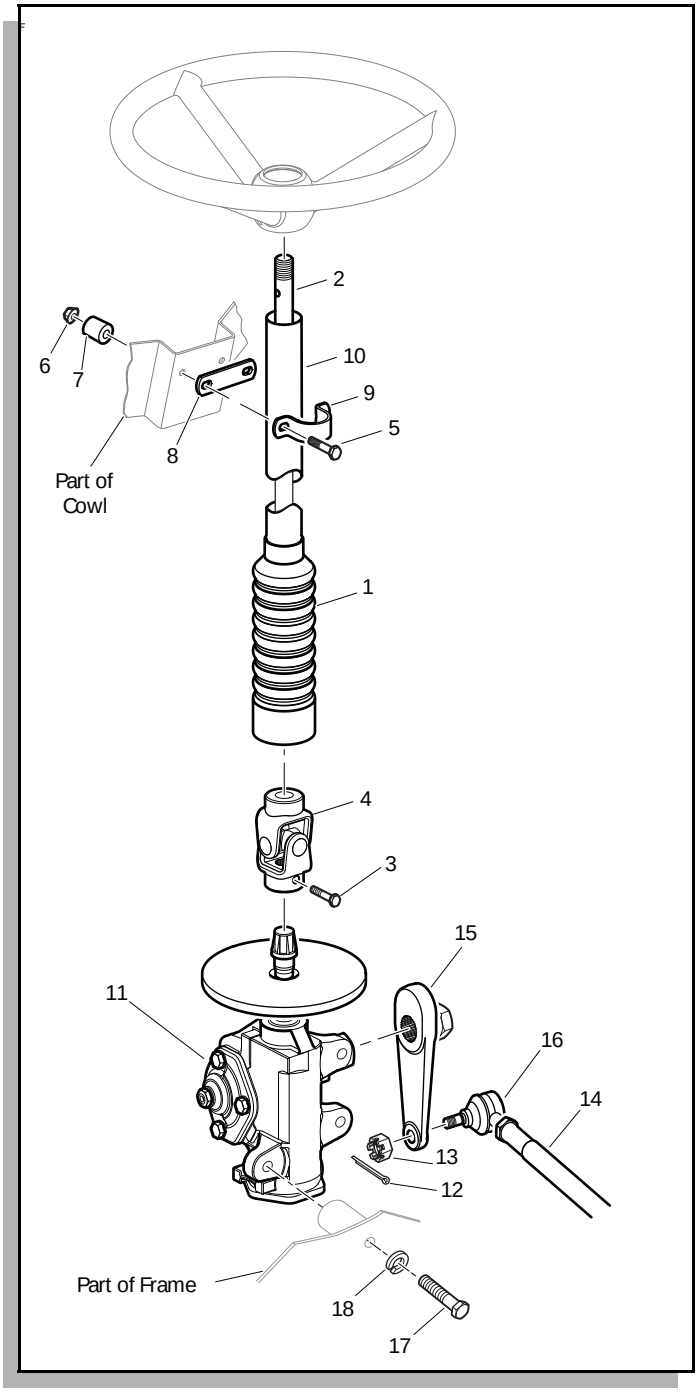

Fig. 5 Steering Box

Tighten the set screw to 16 ft. lbs. (22 Nm) torque. Worn tie rod ends can be replaced in the conventional way using a ball joint separator (pickle fork). Always use a new cotter pin when installing the castellated nut.

Front Suspension Disassembly

CAUTION **If the vehicle is equipped with front brakes, the brake assemblies must be secured with tie wraps or wire, to prevent strain being applied to the brake hoses.**

Service of the front suspension requires that the vehicle be raised and supported on jack stands as per lifting instructions in Section B SAFETY.

For unspecified torques refer to standard torque table.

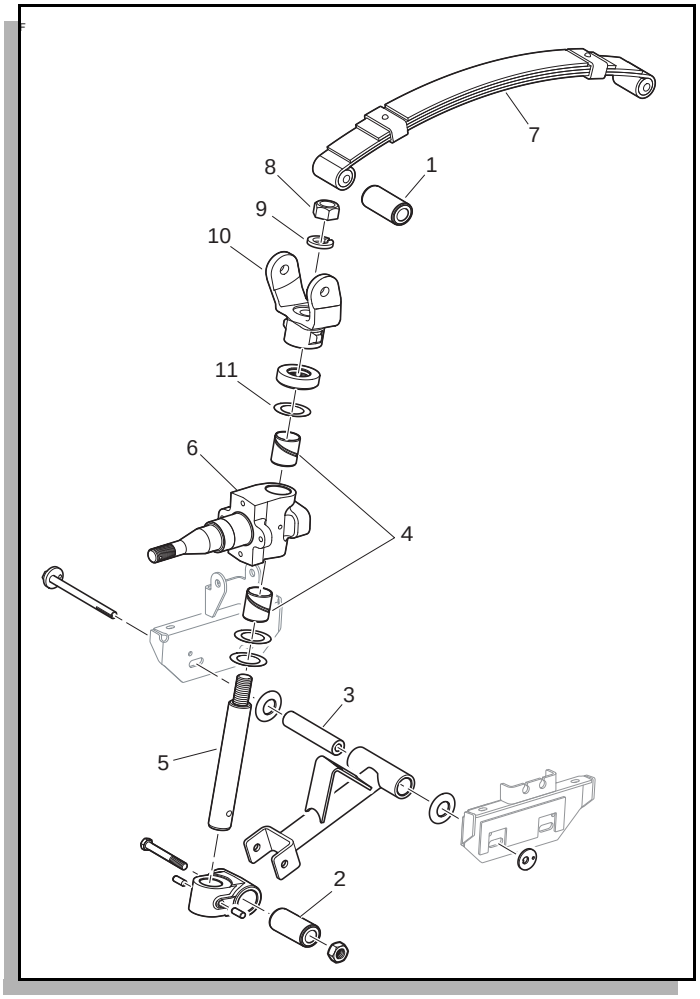

Fig. 6 Bushings

The front suspension of the vehicle is very robust, and with regular lubrication should require little or no maintenance (Ref Fig. 6 on page P-4). Primary wear items are bushings which are located in the upper (1) and lower (2) spring to king pin assemblies and the bushings in the

lower control arms (3), These bushings are easily accessible by removing the through bolts and replacing the bushings. The king pin and spindle bushings (4) can be removed by first removing the king pin (5) and spindle (6) from the transverse spring (7) to access the nut (8) and lock washer (9) securing the large clevis (10) to the king pin. Remove the nut (8) and separate the components of the king pin and spindle assembly, being careful to note the location of components. Be sure to reinstall the shims (11) in their original location to maintain correct clearances of .001 to .011 between the spindle casting and the king pin assembly. The bushings may be replaced and the assembly reassembled. Tighten the king pin nut (8) to 100 - 130 ft. lbs. (135 - 175 Nm) torque.

Lubrication

Tool List **Qty. Required**

Grease gun 1

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(Ref Fig. 7 on page P-5).**

Wheel Bearing Inspection/Packing

Tool List **Qty. Required**

Floor jack 1
Jack stands 2
Wheel chocks 4
Wrench, 1 1/2" 1
Needle nose pliers 1
Non-ferrous punch 1
Ball peen hammer 1
Ratchet, 1/2" drive 1
Socket, 3/4", 1/2" drive 1
Extension, 6", 1/2" drive 1
Grease gun 1
Bearing packer 1

Lift the front of the vehicle and support on jack stands as per Section 'B'. 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 or the upper or lower control arm bushings may require replacement/ adjustment. If the control arm bushing is satisfactory, a worn wheel bearing is indicated. Remove the wheel.

Remove the dust cap (1), cotter pin (2) castellated nut (3) and washer (4), outer roller bearing (5) and hub assembly (6) from the spindle (7) (Ref Fig. 8 on page P-6). Remove the inner bearing seal (8), inner roller bearing (9) and bearing races (10) by tapping lightly around the bearing race through the hub using a soft non ferrous punch. Tap the punch in a circular pattern to avoid damaging the bore of the hub. Clean all bearings, seal, hub and dust cap in solvent and dry thoroughly. Inspect for signs of damage. Pitting or a blue coloration of the rollers will require replacement of the bearing. If the roller portion of the bearing is to be replaced, the race must also

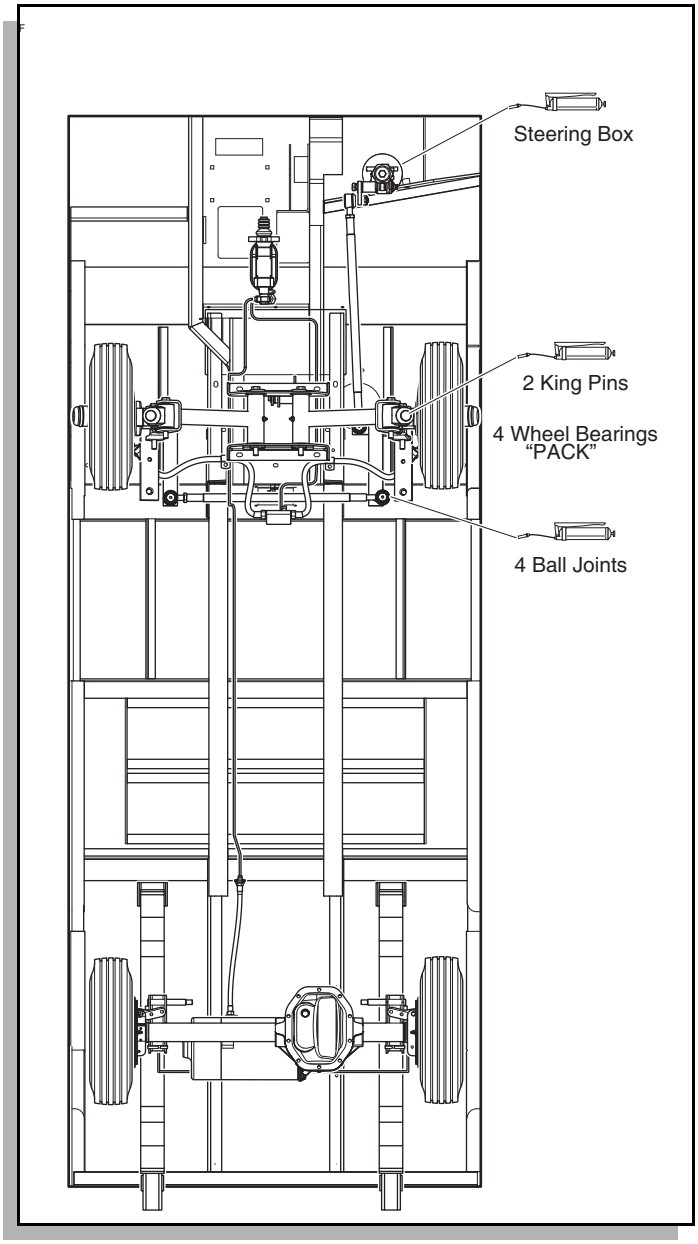

Fig. 7 Lubrication

be replaced. Install new bearing only after packing with grease.

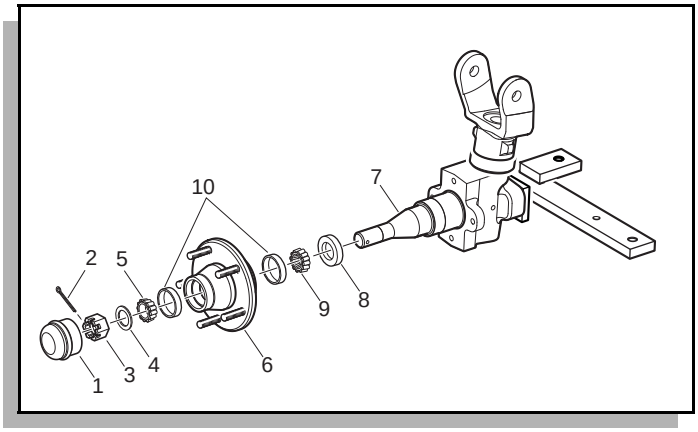

Fig. 8 Wheel Bearing Replacement

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

Seal Installation

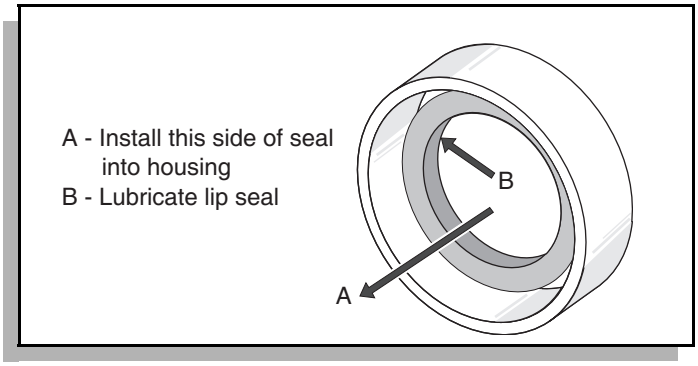

Fig. 9 Seal Installation

Clean the hub seal surface to remove grease and press the inner bearing seal into place with the flange side of the seal facing into the bore. 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 a light oil. (Ref Fig. 9 on page P-6)

Bearing Adjustment

Assemble hub with bearings (1) on spindle (2). Reinstall wheel on hub. Rotate the wheel while tightening the castellated nut (3). (Ref Fig. 10 on page P-6) Tighten the castellated nut (3) until slight resistance to rotation is noticed.

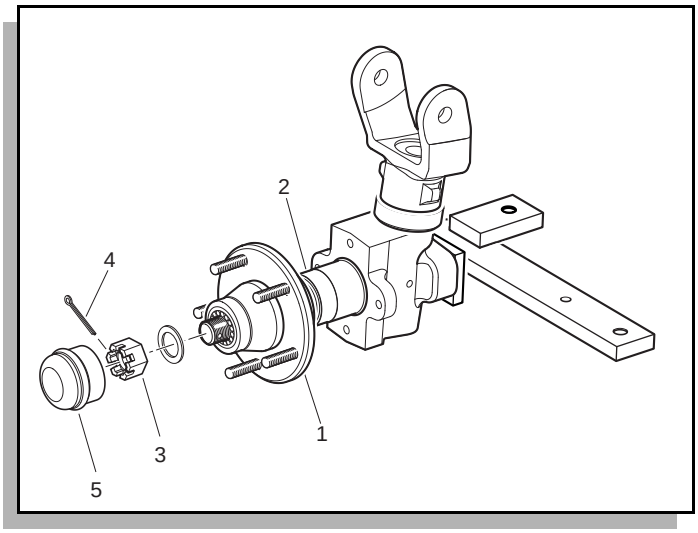

Fig. 10 Front Spindle and Bearing

Rotate the wheel 2 - 3 more turns to displace excess grease. If required, tighten castellated nut (3) again until slight resistance is felt. If the cotter pin hole in the spindle (2) aligns with a slot in the castellated nut (3), insert a new cotter pin (4). If the hole does not align, the castellated nut must be **loosened** to align with the **closest available** slot in the nut.

Check for smooth and free rotation of the wheel and an absence of play when the wheel is grasped by the outside of the tire. Bend the cotter pin (4) against the flats of the castellated nut (3) and cut off any excess.

Replace the dust cap (5).

Wheel Alignment (Toe In)

Tool List	**Qty. Required**
Floor jack	1
Jack stands	2
Wheel chocks	4
Box end wrench, 1 1/4"	1
Tape measure	1
Chalk	1

Lift the front of the vehicle and support on jack stands as per Section ‘B’.

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

Before attempting a wheel alignment, thoroughly inspect for worn/loose bushings or bearings and replace/adjust as required. A wheel alignment cannot be done unless the entire front suspension is without excess play.

Turn the steering wheel from lock to lock and then center the steering wheel in the center of travel. Check to see that the front wheels are pointing straight ahead. If not, adjust the drag link between the Pitman arm and the front spindle arm until the wheels are straight ahead with the steering box at the center of travel. Tighten the castellated nut and install a new cotter pin.

Rotate each wheel and scribe or chalk a line around the circumference of the tire at the center of the tread pattern. Lower the vehicle and roll it forward approximately five feet in order to allow the tires to take their normal running position.

Measure the distance between the chalk lines at both the front and rear of the tires. (Ref Fig. 11 on page P-7) The measurement taken at the front of the tire should be 1/4" +0 -1/8" (6.35 mm +0 -3 mm) less than the rear. This adjustment provides a toe in of 1/2° to 1°.

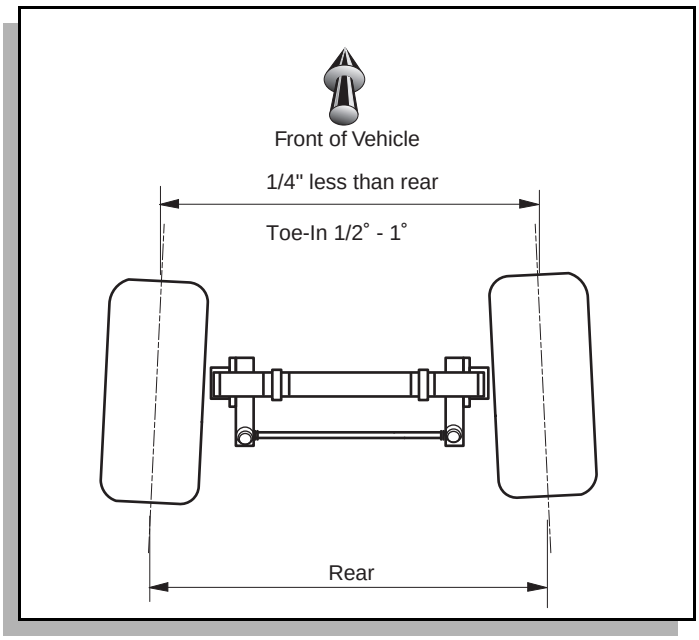

Fig. 11 Front Wheel Alignment

To adjust the wheel alignment, loosen the tie rod jam nuts and adjust the tie rods until the correct dimension is achieved. Lock the tie rod jam nuts 25 - 30 ft. lbs. (34 - 41 Nm) torque.Test drive the vehicle and confirm that the steering wheel is correctly centered. If not, repeat the adjustment of the drag link, remembering to tighten the castellated nuts and install a new cotter pin.

Wheel Alignment (Camber)

Tool List	**Qty. Required**
Floor jack	1
Jack stands	2
Wheel chocks	4
Box end wrench, 1 1/4"	1
Tape measure	1
Framing square	1

Before attempting a wheel alignment, thoroughly inspect for worn/loose bushings or bearings and replace/adjust as required. A wheel alignment cannot be done unless the entire front suspension is without excess play.

ALL measurements must be made with the vehicle unloaded and on a level surface with the tires correctly inflated (Ref Fig. 12 on page P-8).

With the vehicle wheels pointing straight ahead, place a framing square on the ground with the vertical arm passing through the center of the spindle. Move the square until it touches the front tire. Measure the distance between the vertical face of the framing square and the top of the wheel rim and record the measurement.

Measure the distance between the vertical face of the framing square and the bottom of the wheel rim and record the measurement.

The bottom dimension should be greater than the top dimension by 1/4" (6.35 mm).

If the camber needs adjustment:

Lift the front of the vehicle and support on jack stands as per Section ‘B’.

Loosen the nuts securing the eccentric bolts and rotate slightly. This will have the effect of lengthening or shortening the lower control arms. Tighten the nuts and lower the vehicle.

Recheck the camber and repeat the adjustment procedure until the desired adjustment is achieved.

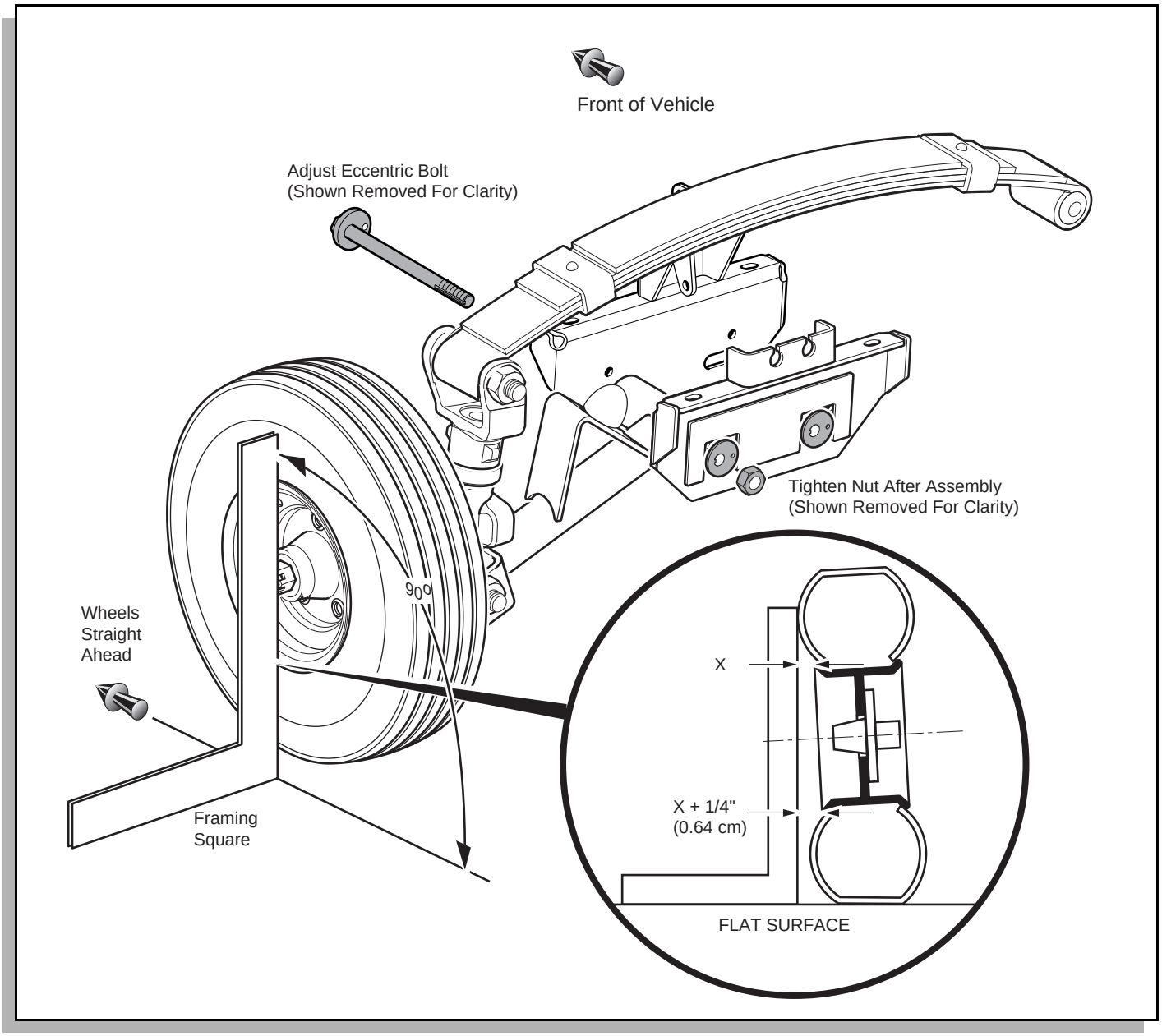

Fig. 12 Camber Adjustment

LIGHTNING PROTECTION AND GROUNDING

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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

GS-726-006	REVISION: A	TITLE: General Specification: Lightning Protection and Grounding
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 man made 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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TROUBLESHOOTING

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

ELECTRICAL SYSTEM

Condition	Possible Cause	Correction
VEHICLE WILL NOT MOVE (36 VOLT VEHICLES) Refer to (Electronic Speed Control Section (48Volt) for 48 Volt vehicles	Key 'OFF' or no direction selected	Turn key 'ON' and select direction
	Batteries discharged	Charge batteries
	Batteries unable to be charged	Load test and replace batteries that cannot be charged
	Corroded or loose battery connections	Clean and tighten battery connections Apply a coat of commercial terminal protectant to all terminals
	Corroded or loose battery connections to ESC controller, direction switch or motor	Repair or replace faulty wiring
	Solenoid has failed	Replace solenoid
	Key switch has failed	Replace key switch
	Micro switch at direction selector switch has failed	Replace micro switch
	Connector loose or separated	Install connector correctly
	Faulty motor	Repair or replace motor
	Faulty ESC system	Test and replace components as indicated by test procedure
	Ignition interlock switch has failed	Replace relay (on-board charger)
VEHICLE SPEED ERRATIC	Faulty ESC system	Test and replace components as indicated by test procedure
NO REDUCED SPEED IN REVERSE	Faulty ESC system	Test and replace components as indicated by test procedure
MOTOR NOISY	Damaged bearing	Replace bearing
	Raised commutator bar(s)	Replace motor
	Loose motor mounting hardware	Tighten
BATTERIES WILL NOT CHARGE	Charger not functioning correctly	Repair or replace charger
	Vehicle charging wiring faulty	Repair or replace wiring
	Vehicle/charger connector damaged	Replace connector
	Battery case damaged	Replace battery
	Low electrolyte level	Maintain correct electrolyte level
	Battery capacity deficient	Hydrometer/load test Replace battery, if required
	Damaged battery	Replace battery

TROUBLESHOOTING

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

Basic Electrical Power System Troubleshooting

To diagnose electrical problems in the electrical power system, refer to the ELECTRONIC SPEED CONTROL (36 VOLT) section or the ELECTRONIC SPEED CONTROL (48 VOLT) section.

Basic Electrical Troubleshooting for Accessories

To diagnose electrical problems in the vehicle electrical wiring system, refer to the ELECTRICAL SYSTEM section.

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

SUSPENSION AND STEERING

Condition	Possible Cause	Correction
UNEVEN TIRE WEAR	Incorrect tire pressure	Inflate to recommended pressure
	Improper alignment	Align wheels
STIFF STEERING	Water has entered steering box and may freeze in cold conditions	Remove steering column, pinion and bearing and remove water before adding grease Inspect gasket for good seal
	Insufficient lubricant in king pins or rod ends	Add one pump of lubricant to each grease fitting and operate steering from lock to lock. **Do not over grease**
PLAY IN STEERING	Steering wheel loose	Check roll pin. Replace steering wheel, if required Tighten steering wheel nut
	Steering components worn	Replace
	Loose wheel bearings	Adjust or replace
VIBRATION	Steering components worn	Replace
	Damaged wheel bearings	Replace
	Out of round tires, wheels or brake drums	Inspect and replace, if out of round
	Loose lug nuts	Tighten to 50 - 85 ft. lbs. (68 - 115 Nm)
STEERING PULLS TO ONE SIDE	Incorrect tire pressure	Inflate to recommended pressure
	Dragging wheel brake	Service brake system
	Suspension component failure	Repair
	Improper alignment	Align

TROUBLESHOOTING

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

Notes:

GENERAL SPECIFICATIONS

S

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LIST OF ILLUSTRATIONS

GENERAL SPECIFICATIONS

Notes:

GENERAL SPECIFICATIONS

INDUSTRIAL 875 / TITAN 36V

WEIGHT (without batteries)	1410 lbs. (640 kg)
GROUND CLEARANCE (at differential)	5 in (12.7 cm)
TIRES	Sure Trail Industrial, 5.70 x 8 LRC
TIRE PRESSURE	70 psi (483 kPa)
LOAD CAPACITY (including operator, passenger, cargo and accessories)	3,000 lbs (1360 kg)
CHASSIS, BODY & FINISH	1 piece body with welded high yield strength tubular steel with powder coat paint Heavy duty four way diamond pattern body. Safety yellow modified acrylic topcoat over polyester primer
SAFETY	Removable dash mounted key switch, reverse warning indicator, 'deadman' accelerator control, operator presence seat switch, integral handgrip on hip restraints, forward/reverse selector with 'neutral' and electric horn
LIGHTING PACKAGE	Dual taillights, brake lights (optional headlights)
STEERING	Automotive, with steering wheel
BRAKES	Dual rear wheel, hydraulic drum brakes. Hand operated parking brake with manual adjustment. Front hydraulic brakes (optional)
FRONT SUSPENSION	Independent, leaf spring with hydraulic shock absorbers
REAR SUSPENSION	Leaf springs with hydraulic shock absorbers
SEATING	Formed fabric backed vinyl covers over cushion foam. Seating for operator and one passenger
SPEED	Up to 13.5 mph (21.7 km/h)
TRANSAXLE	Direct drive, 14.76:1 ratio
CLASSIFICATION	UL (Underwriters Laboratory) Approved type "E" classification
ELECTRICAL SYSTEM	36 volt DC, six 6 volt heavy duty, deep cycle storage batteries (115 minute, 225 amp hour @ 20 hour discharge rate)
SPEED CONTROL	Solid state controller, 400 amp rated
MOTOR	36 volt DC, high efficiency series wound, brazed armature, solid copper windings, vented, 8 hp (6kw) at 1600 rpm
CHARGER	PowerWise™ on board, 21 amp DC output at 36 volts; input 110 - 120 volts, 9.5 amps, 60 cycle AC, Underwriters Laboratory (UL) Listed, CSA Certified, anti-drive away charger/vehicle interlock

GENERAL SPECIFICATIONS

INDUSTRIAL 875 / TITAN 48V

WEIGHT (without batteries)	1740 lbs. (790 kg)
GROUND CLEARANCE (at differential)	5 in (12.7 cm)
TIRES	Sure Trail Industrial, 5.70 x 8 LRC
TIRE PRESSURE	70 psi (483 kPa)
LOAD CAPACITY (including operator, passenger, cargo and accessories)	3,000 lbs (1360 kg)
CHASSIS, BODY & FINISH	1 piece body with welded high yield strength tubular steel with powder coat paint Heavy duty four way diamond pattern body. Safety yellow modified acrylic topcoat over polyester primer
SAFETY	Removable dash mounted key switch, reverse warning indicator, 'deadman' accelerator control, operator presence seat switch, integral handgrip on hip restraints, forward/reverse selector with 'neutral' and electric horn
LIGHTING PACKAGE	Dual taillights, brake lights (optional headlights)
STEERING	Automotive, with steering wheel
BRAKES	Dual rear wheel, hydraulic drum brakes. Hand operated parking brake with manual adjustment. Front hydraulic brakes (optional)
FRONT SUSPENSION	Independent, leaf spring with hydraulic shock absorbers
REAR SUSPENSION	Leaf springs with hydraulic shock absorbers
SEATING	Formed fabric backed vinyl covers over cushion foam. Seating for operator and one passenger
DRIVE TRAIN	Direct motor shaft connected to transaxle pinion shaft
TRANSAXLE	Direct drive, 14.76:1 ratio
CLASSIFICATION	UL (Underwriters Laboratory) Approved type "E" classification
ELECTRICAL SYSTEM	48 volt DC, eight 6-volt 225 amp hr batteries. Electronic speed controller. Regenerative braking. Batteries contained in swing out battery trays (1 per side)
DIRECTION SELECTOR	Electronic three position switch
SPEED CONTROL	Solid state continuously variable speed controller
CHARGER	Lestronic, fully automatic, 48 volt output 25 amp On-board
MOTOR	High efficiency DC shunt wound, brazed armature, solid copper windings. 15.2 hp (11.3 kw) at 1600 rpm 400 amp current draw
SPEED	Up to 13.5 mph (22 kph)

INDUSTRIAL 875 / TITAN 36V PC

WEIGHT (without batteries)	1475 lbs. (640 kg))
GROUND CLEARANCE (at differential)	5 in (12.7 cm)
TIRES	Sure Trail Industrial, 5.70 x 8 LRC
TIRE PRESSURE	70 psi (483 kPa)
LOAD CAPACITY (including operator, passenger, cargo and accessories)	3,000 lbs (1360 kg)
CHASSIS, BODY & FINISH	1 piece body with welded high yield strength tubular steel with powder coat paint Heavy duty four way diamond pattern body. Safety yellow modified acrylic topcoat over polyester primer
SAFETY	Removable dash mounted key switch, reverse warning indicator, 'deadman' accelerator control, operator presence seat switch, integral handgrip on hip restraints, forward/reverse selector with 'neutral' and electric horn
LIGHTING PACKAGE	Dual taillights, brake lights (optional headlights)
STEERING	Automotive, wheel type
BRAKES	Dual rear wheel, hydraulic drum brakes. Hand operated parking brake with manual adjustment. Front hydraulic brakes (optional)
FRONT SUSPENSION	Independent, leaf spring with hydraulic shock absorbers
REAR SUSPENSION	Leaf springs with hydraulic shock absorbers
SEATING	Formed fabric backed vinyl covers over cushion foam. Seating for operator and three passengers
SPEED	Up to 13.5 mph (21.7 km/h)
TRANSAXLE	Direct drive, 14.76:1 ratio
CLASSIFICATION	UL (Underwriters Laboratory) Approved type "E" classification
ELECTRICAL SYSTEM	36 volt DC, six 6 volt heavy duty, deep cycle storage batteries (115 minute, 225 amp hour @ 20 hour discharge rate)
SPEED CONTROL	Solid state controller, 400 amp rated
MOTOR	36 volt DC, high efficiency series wound, brazed armature, solid copper windings, vented, 8 hp (6kw) at 1600 rpm
CHARGER	PowerWise™ on board, 21 amp DC output at 36 volts; input 110 - 120 volts, 9.5 amps, 60 cycle AC, Underwriters Laboratory (UL) Listed, CSA Certified, anti-drive away charger/vehicle interlock

Specifications subject to change without notice.

GENERAL SPECIFICATIONS

INDUSTRIAL 875 / TITAN 48V PC

WEIGHT (without batteries)	1740 lbs. (790 kg))
GROUND CLEARANCE (at differential)	5 in (12.7 cm)
TIRES	Sure Trail Industrial, 5.70 x 8 LRC
TIRE PRESSURE	70 psi (483 kPa)
LOAD CAPACITY (including operator, passenger, cargo and accessories)	3,000 lbs (1360 kg)
CHASSIS, BODY & FINISH	1 piece body with welded high yield strength tubular steel with powder coat paint Heavy duty four way diamond pattern body. Safety yellow modified acrylic topcoat over polyester primer
SAFETY	Removable dash mounted key switch, reverse warning indicator, 'deadman' accelerator control, operator presence seat switch, integral handgrip on hip restraints, forward/reverse selector with 'neutral' and electric horn
LIGHTING PACKAGE	Dual taillights, brake lights (optional headlights)
STEERING	Automotive, with steering wheel
BRAKES	Dual rear wheel, hydraulic drum brakes. Hand operated parking brake with manual adjustment. Front hydraulic brakes (optional)
FRONT SUSPENSION	Independent, leaf spring with hydraulic shock absorbers
REAR SUSPENSION	Leaf springs with hydraulic shock absorbers
SEATING	Formed fabric backed vinyl covers over cushion foam. Seating for operator and one passenger
DRIVE TRAIN	Direct motor shaft connected to transaxle pinion shaft
TRANSAXLE	Direct drive, 14.76:1 ratio
CLASSIFICATION	UL (Underwriters Laboratory) Approved type "E" classification
ELECTRICAL SYSTEM	48 volt DC, eight 6-volt 225 amp hr batteries. Electronic speed controller. Regenerative braking. Batteries contained in swing out battery trays (1 per side)
DIRECTION SELECTOR	Electronic three position switch
SPEED CONTROL	Solid state continuously variable speed controller
CHARGER	Lestronic, fully automatic, 48 volt output 25 amp On-board
MOTOR	High efficiency DC shunt wound, brazed armature, solid copper windings. 15.2 hp (11.3 kw) at 1600 rpm 400 amp current draw
SPEED	Up to 13.5 mph (22 kph)

Specifications subject to change without notice.

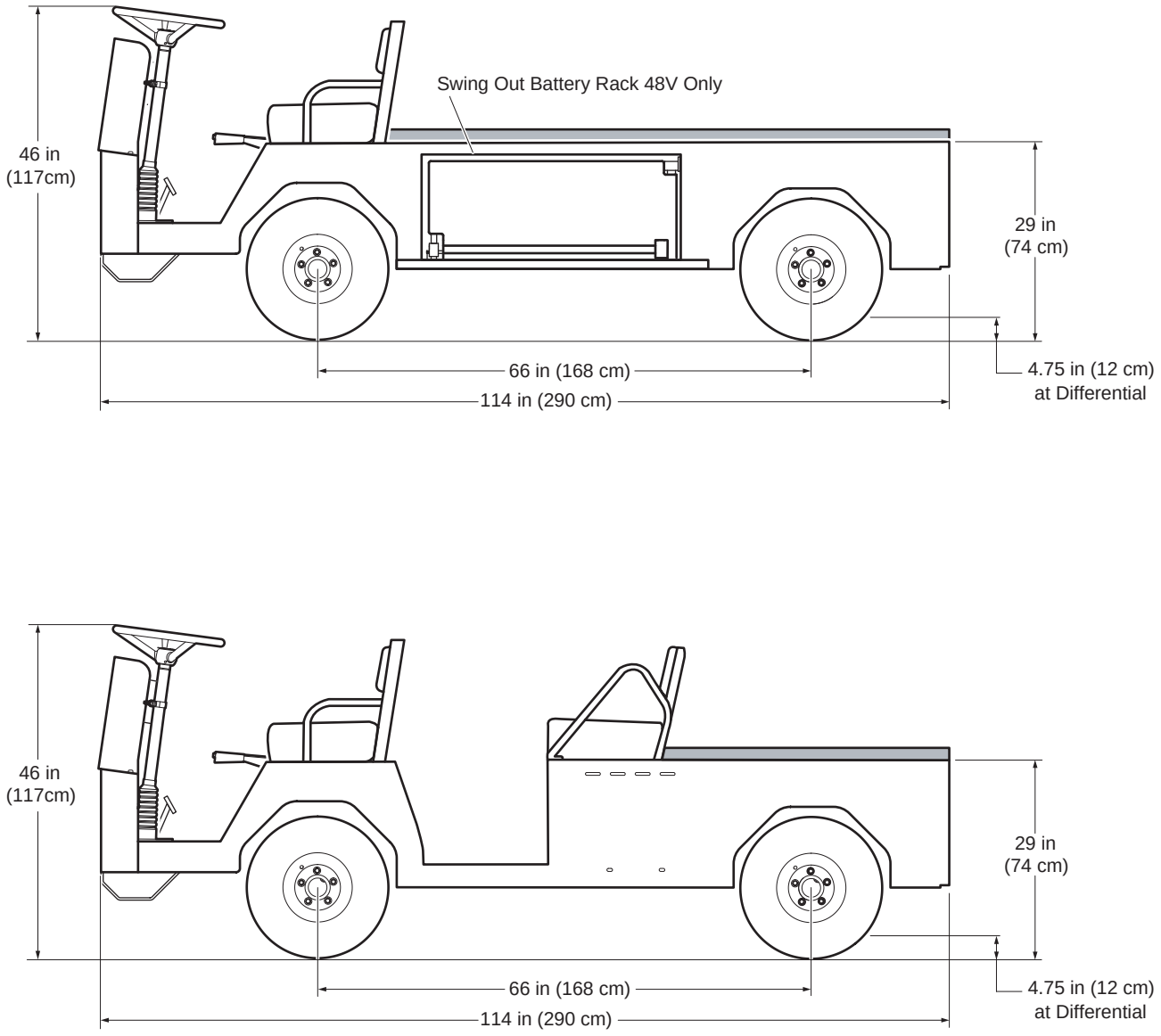

Fig. 1 Vehicle Dimensions

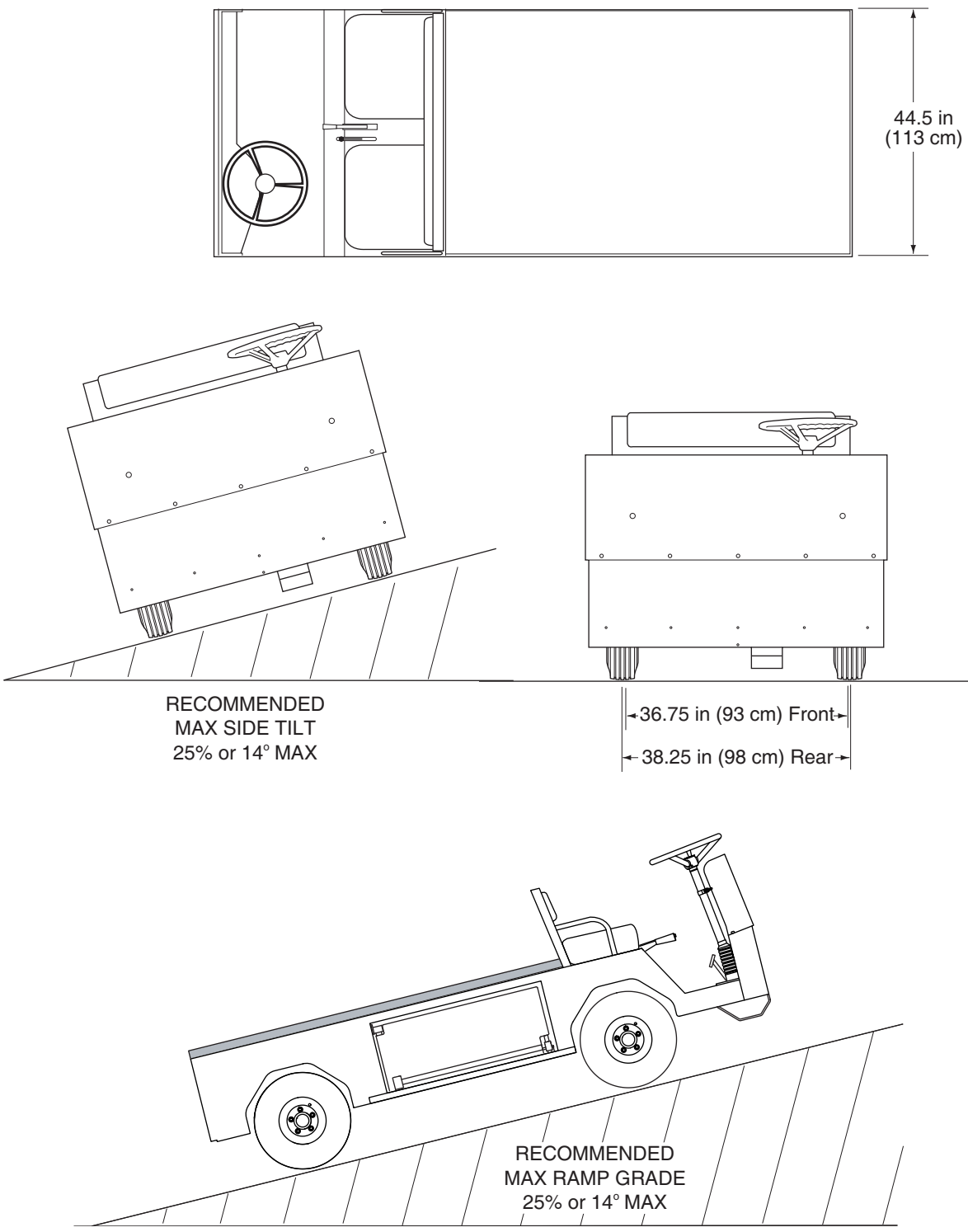

Fig. 2 Vehicle Dimensions and Incline Specifications

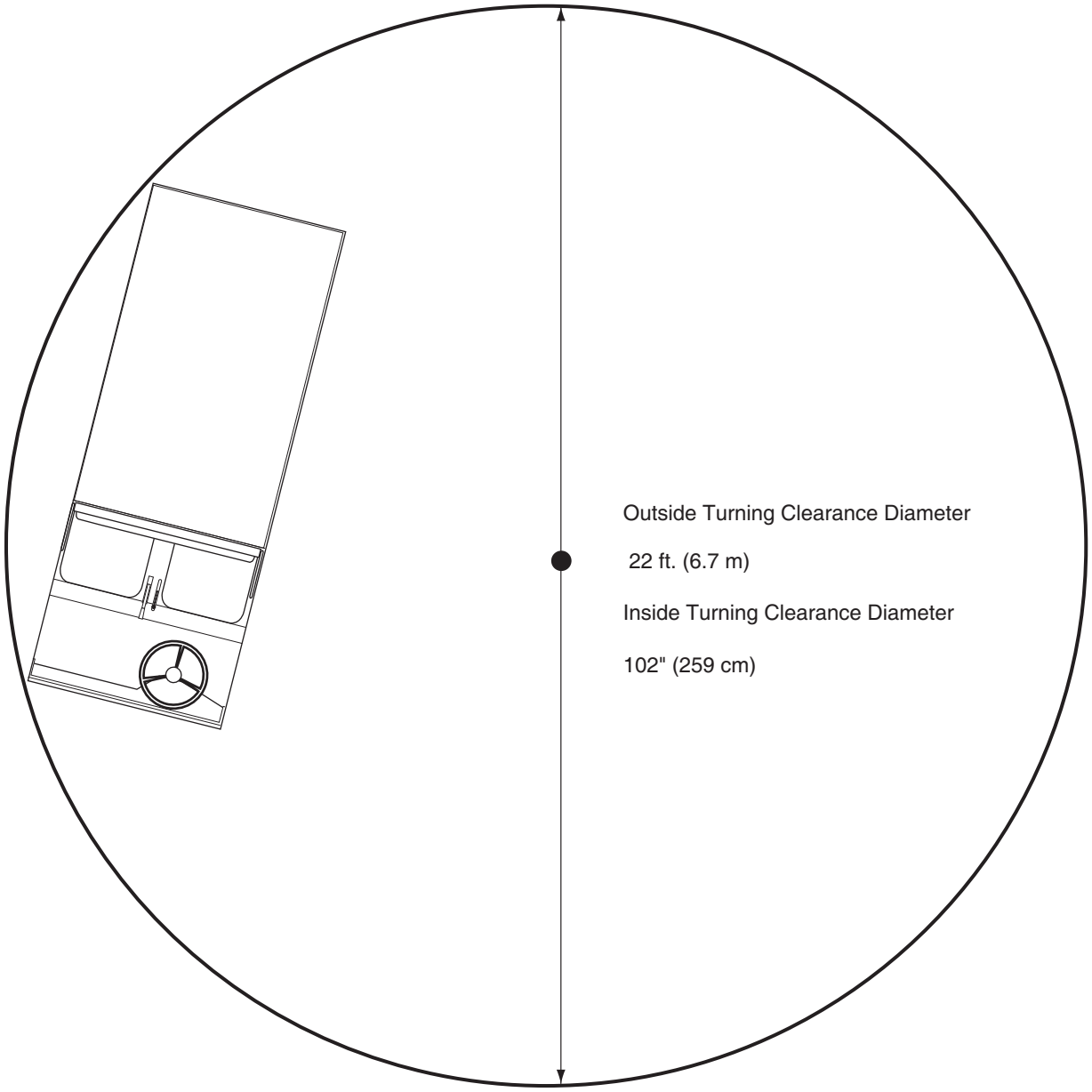

Fig. 3 Vehicle Turning Clearance Diameter

GENERAL SPECIFICATIONS

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. Use the parking brake whenever the vehicle is parked.

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 and seating 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 rear of 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.

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