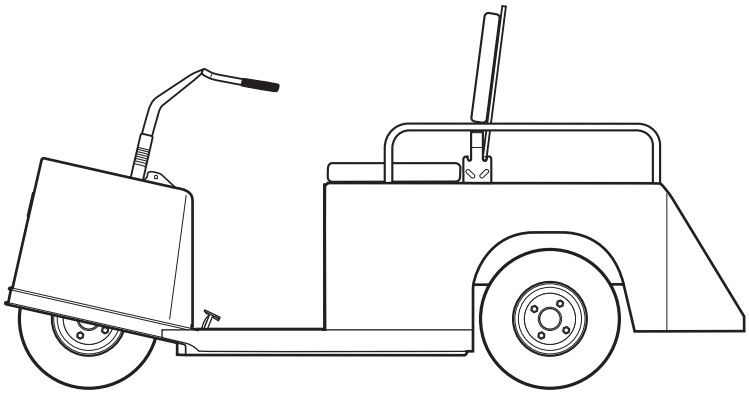
600198-G01

CUSHMAN
A Textron Company

TECHNICIAN'S REPAIR AND SERVICE MANUAL



ELECTRIC POWERED THREE WHEEL SERVICE VEHICLE

ISSUED NOVEMBER 2003 REVISED FEBRUARY 2007

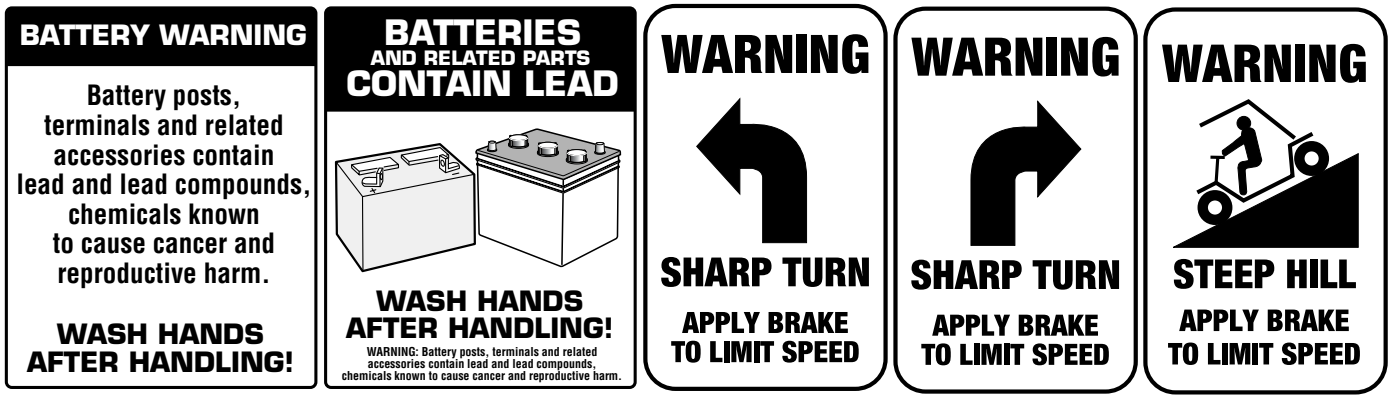
SAFETY

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.

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 POWERED THREE WHEEL SERVICE VEHICLE

VEHICLES

CUSHMAN MINUTE MISER™

STARTING MODEL YEAR : 2004

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

OUTSIDE USA PHONE: 001-706-798-4311, FAX: 001-706-771-4609

E-Z-GO DIVISION OF TEXTRON INC., 1451 MARVIN GRIFFIN ROAD, AUGUSTA, GEORGIA USA 30906-3852

NOTES

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

The use of non Original Equipment Manufacturer (OEM) parts may void the warranty.

Overfilling of batteries may void the warranty.

BATTERY PROLONGED STORAGE

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

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

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

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

Refer to the 'Prolonged Storage' section within the BATTERIES AND CHARGING section of this manual.

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TABLE OF CONTENTS

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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.

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).

SAFETY INFORMATION

Notes:

GENERAL INFORMATION & ROUTINE MAINTENANCE

A

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LIST OF ILLUSTRATIONS

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GENERAL INFORMATION & ROUTINE MAINTENANCE

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

SERIAL NUMBER LABEL LOCATION

The product model number, model year and serial number must appear on all correspondence concerning this unit. These identification numbers appear on the label attached to the left side of the kick panel (Ref Fig. 1 on page A-1).

Fig. 1 Model Number, Model Year and Serial Number

1. Model Number, Model Year and Serial Number.

The vehicle serial number is located under seat (Ref Fig. 2 on page A-1).

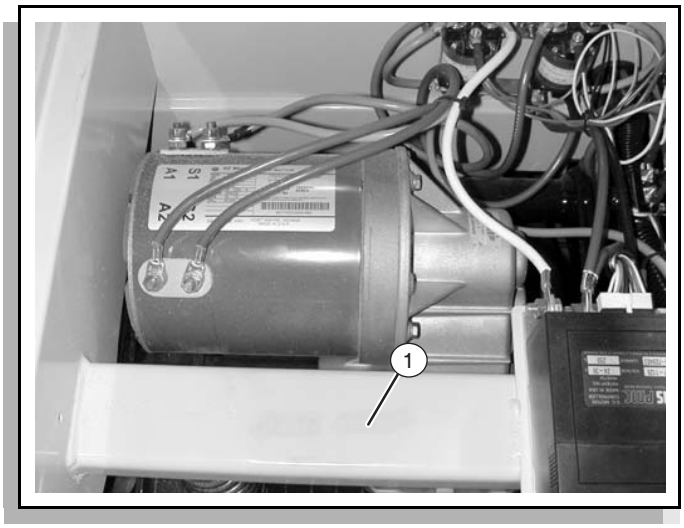

Fig. 2 Serial Numbers Under Seat

1. Serial Numbers Under Seat.

SERVICING THE VEHICLE

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

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

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

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

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

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

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

Before a new vehicle is put into operation, it is recommended that the items shown in the INITIAL SERVICE CHART be inspected (Ref Fig. 3 on page A-1).

ITEM	SERVICE OPERATION
Batteries	Charge batteries
Seats	Remove protective plastic covering
Brakes	Check operation and adjust if necessary
Tires	Check air pressure (see SPECIFICATIONS)

Fig. 3 Initial Service Chart

Vehicle batteries must be fully charged before initial use.

CAUTION **In order to prevent damage to the battery charger transformer, blow water from charger with compressed air. Allow sufficient time (1 - 2 hours) after washing the vehicle for the transformer to dry before operating the charger.**

PMC Controller should be covered during washing of the vehicle.

ROUTINE MAINTENANCE

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

This vehicle will give years of satisfactory service providing it receives regular maintenance. Refer to the Periodic Service Schedule for appropriate service intervals (Ref Fig. 19 on page A-10). Refer to Lubrication Points for appropriate lubrication locations (Ref Fig. 4 on page A-2).

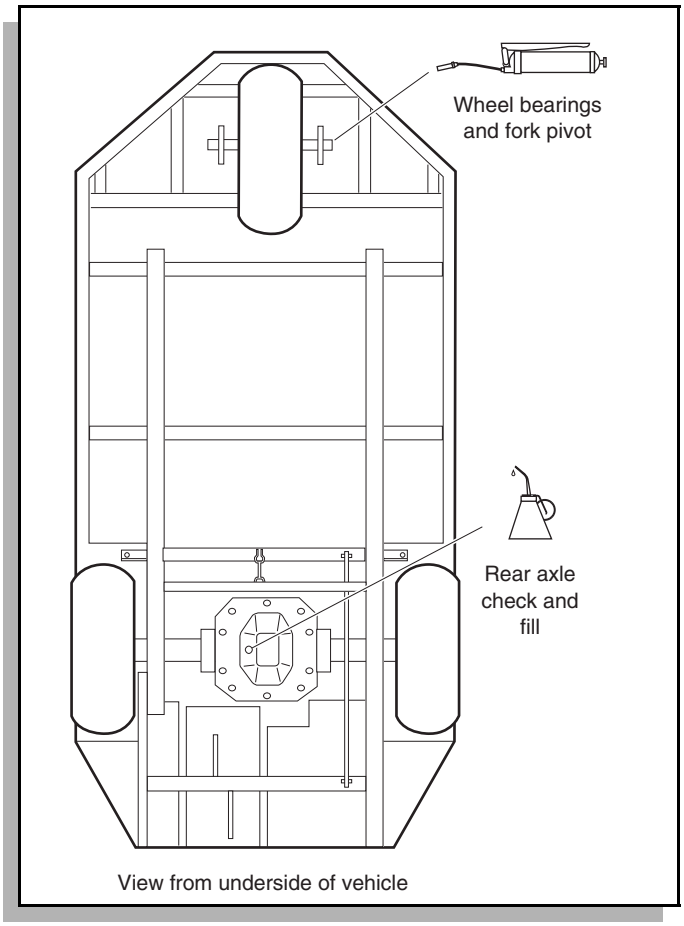

Fig. 4 Lubrication Points

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

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

REAR AXLE

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

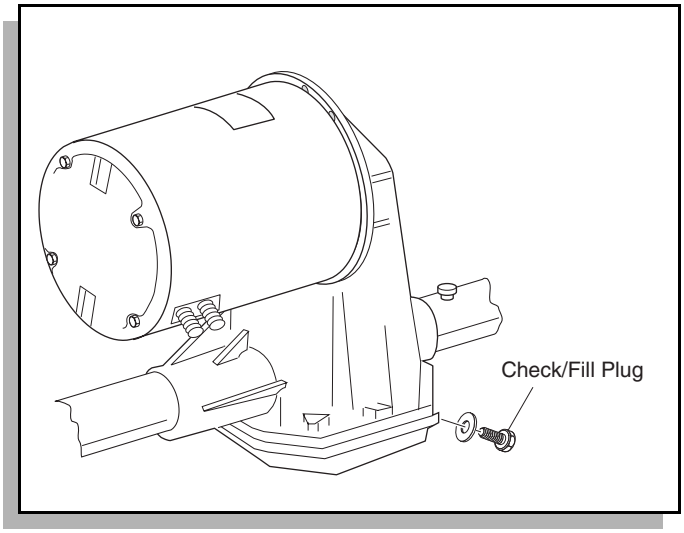

Fig. 5 Rear Axle Lubricant Check and Fill

Checking the Lubricant Level

With the vehicle on level ground, 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. 5 on page A-2).

BRAKES

Service brakes in accordance with the Perodic Service Schedule (Ref Fig. 19 on page A-10). Lubricate brake bushes and linkage (Ref Fig. 6 on page A-3).

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

Fig. 6 Brake Bushing Lubrication

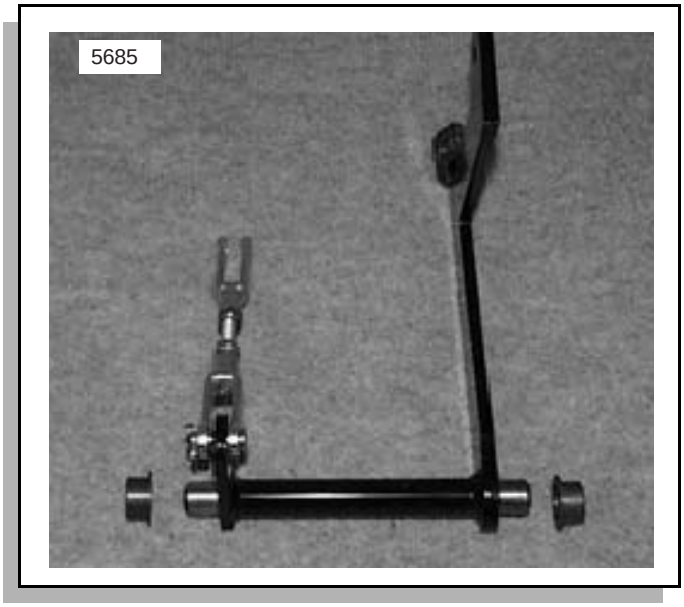

Fig. 7 Lubrication

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

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

TIRES

Tire condition should be inspected per the Periodic Service Schedule (Ref Fig. 19 on page A-10). Inflation pressure should be checked when the tires are cool. Be sure to reinstall valve dust cap after checking or inflating. For additional information, refer to WHEELS AND TIRES section.

LIGHT BULB REPLACEMENT

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

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

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

CARE AND CLEANING OF THE VEHICLE

CAUTION **When pressure washing vehicle, do not use pressure in excess of 700 psi. To prevent cosmetic damage, do not use any abrasive or reactive solvents to clean plastic parts.**

It is important that proper techniques and cleaning materials be used. Using excessive water pressure may cause damage to seals, plastics, the electrical system, body finish or back cushion material. Do not use pressure in excess of 700 psi to wash vehicle.

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

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

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

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

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

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

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

VEHICLE CARE PRODUCTS

To help maintain the vehicle, there are several products, available through a local Distributor, an authorized Branch, or the Service Parts Department.

- Touch-up paint specially formulated to match vehicle colors for use on metal bodies (P/N 28140-G** and 28432-G**).
- Multi-purpose Battery Protectant formulated to form a long-term, flexible, non-tacky, dry coating that will not crack, peel or flake over a wide temperature range (P/N 75500-G01).
- White Lithium Grease designed to provide lubrication protection in areas where staining or discoloring is a problem, or in areas of extreme temperature ranges (P/N 75502-G01).
- Penetrant/Lubricant, a 4-in-1 product that penetrates the most stubborn of frozen parts, lubricates leaving a light lubricating film, prevents corrosion by adhering to wet or dry surfaces and displaces moisture, sealing against future moisture return (P/N 75503-G01).
- Multi-purpose Cleaner and Degreaser that contains natural, environmentally safe solvents (P/N 75504-G01).
- Multi-purpose Hand Cleaner is an industrial strength cleaner containing no harsh solvents, yet gently lifts grease off hands. May be used with or without water (P/N 75505-G01).
- Battery Cleaner that promotes easy, non-violent neutralization of battery acids and battery acid crystals. The resulting sodium salts are water soluble and easily washed away (P/N 75506-G01).
- Battery Maintenance Kit for complete battery cleaning and watering, with battery maintenance instructions (P/N 25587-G01).
- Biodegradable Cleaner that cleans the toughest dirt and heavy soils by breaking down grease to be easily wiped or rinsed away (P/N 75507-G01).
- Multi-purpose Value Pack sampler package including 4 ounce (118 ml) aerosol cans of Battery Protector, Penetrant/Lubricant, White Lithium Grease, and Carburetor and Choke Cleaner (P/N 75508-G01).

HARDWARE

Periodically the vehicle should be inspected for loose fasteners. Fasteners should be tightened in accordance with the Torque Specifications table (Ref Fig. 18 on page A-9) or specific torque values stated in procedures.

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

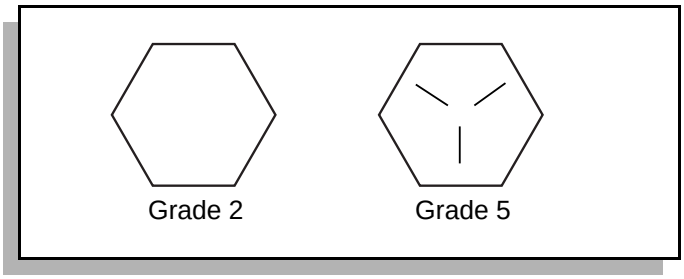

Fig. 8 Bolt Grades

Controls

(Ref Fig. 9 on page A-5) and (Ref Fig. 10 on page A-5) Controls on the dash and the floorboard.

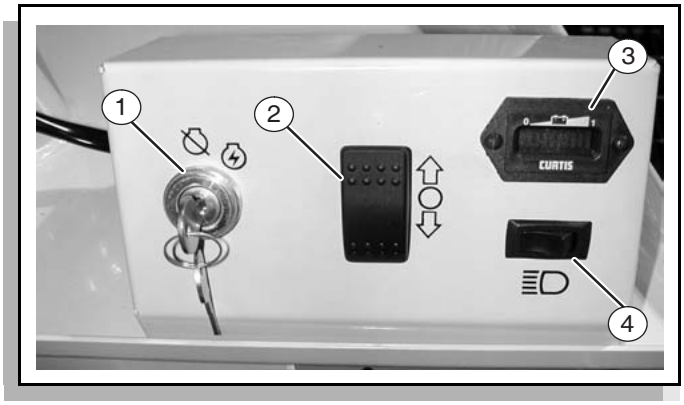

Fig. 9 Controls On Dashboard

1. Key Switch
2. Direction Selector Switch
3. Power On/Battery Condition Meter
4. Headlight Switch

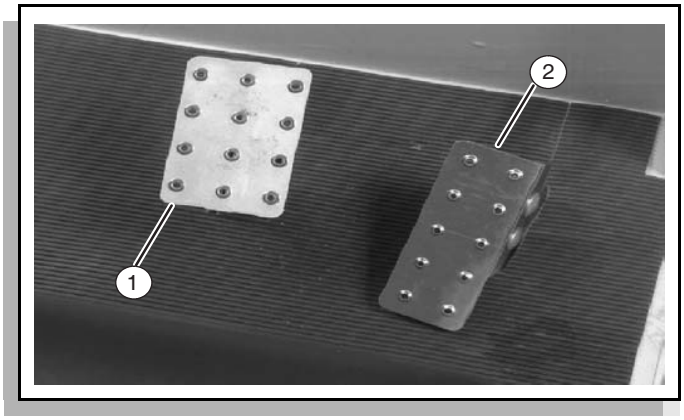

Fig. 10 Controls On Floorboard

1. Service/Parking Brake Pedal
2. Accelerator Pedal

(Ref Fig. 11 on page A-5) shows the horn button and handlebar.

1. Handlebar
2. Horn

Key Switch

The key switch, located in the vehicle dash, supplies or interrupts power to the vehicle electrical system.

ON POSITION: Supplies power

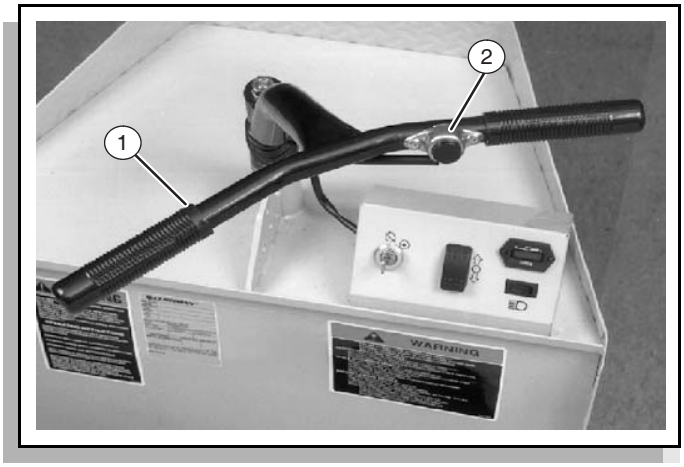

Fig. 11 Horn Switch

OFF POSITION: Interrupts power (Ref Fig. 12 on page A-5)

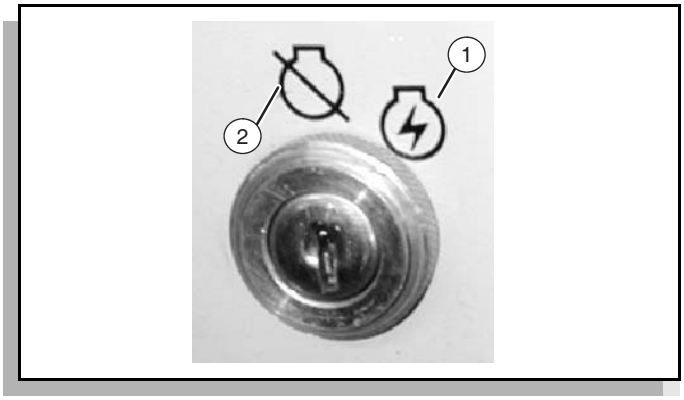

Fig. 12 Key Switch

1. On Position
2. Off Position

⚠ WARNING ⚠ ***To prevent unexpected vehicle movement or unauthorized use, always turn the key switch to the OFF position and remove the key when the vehicle is not in use.***

Direction Selector Switch

The direction selector switch, located on the dash panel, controls the direction of vehicle movement. The panel is marked with FORWARD, NEUTRAL and REVERSE

positions. Push to the NEUTRAL position when leaving the vehicle seat.

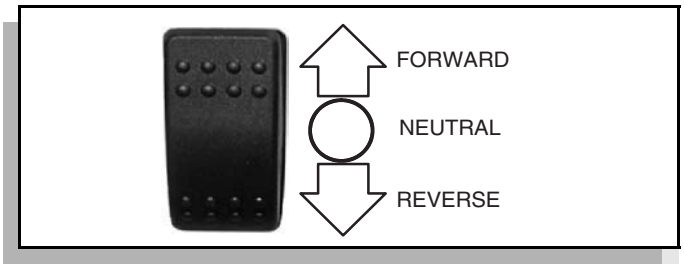

Fig. 13 Direction Selector Switch

⚠ WARNING ⚠ ***To prevent unexpected vehicle movement when you or other persons next operate the vehicle, ALWAYS place the direction selector switch in the NEUTRAL position when leaving the vehicle seat.***

Remove the key to prevent unauthorized use of the vehicle.

Power ON/Battery Condition Meter

The power on/battery condition meter indicates whether power is supplied to the unit and the state of battery charge. The meter illuminates only when power is being supplied.

The meter scale is a 10--bar LED (light emitting diode) displaying the state of charge successively, bar by bar, from full to empty.

- At 70% of discharge, a flashing light signals an “energy reserve” alert.
- At 80% of discharge, a double flashing light signals as “empty” alarm. The batteries should be fully charged before using the vehicle.

Headlight (Accessory)

The headlight can be pivoted on the mounting as required. Push the headlight switch on the dash panel to turn the headlight on or off.

Service/Parking Brake Pedal

The service and parking brakes are combined in the left pedal on the floorboard. Depressing the pedal will slow or stop the vehicle. Once the vehicle has stopped, the parking brake can be engaged by pressing the front portion of the pedal.

The floorboard catch should engage in the first notch of the parking brake lock catch when the brake is properly adjusted. (Ref Fig. 14 on page A-6).

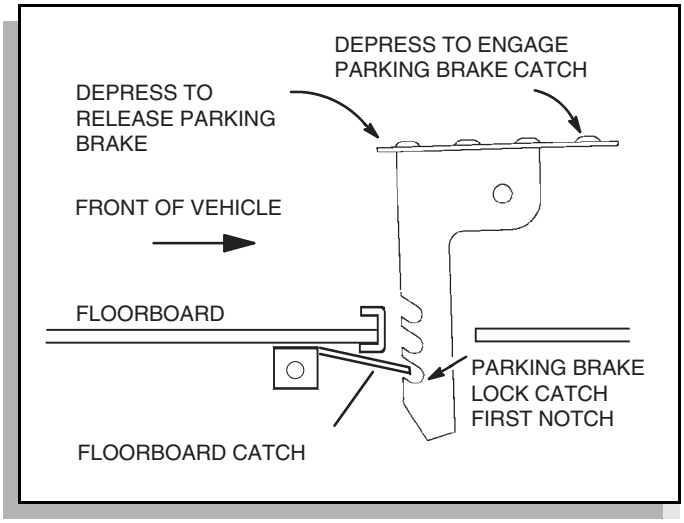

Fig. 14 Speed Control Pedal

To release the parking brake, depress the service/parking brake pedal.

⚠ WARNING ⚠ ***ALWAYS apply the parking brake when the vehicle is to be left unattended. The parking brake is NOT automatically applied.***

Accelerator Pedal

Depressing the accelerator pedal starts the motor; releasing the pedal stops the motor.

Operation with the pedal fully depressed gives maximum speed but is recommended only when the vehicle can be operated safely. For slower speeds, depress the pedal as required.

NOTE *Reverse speed is half of forward speed.*

⚠ WARNING ⚠ ***To prevent loss of vehicle control, NEVER exceed safe operating speed. ALWAYS adjust speed to conditions.***

Horn and Handlebar

The horn button switch is attached to the handlebar on the standard equipment vehicle.

A vehicle equipped with optional wheel type steering will have the horn button located on the right side of the steering console.

Depress the button to sound the horn. The horn will not sound when the key is in off position.

Handlebar Installation

CAUTION **If the handlebar is factory installed, make sure the retaining nut is tight. Otherwise install the fork spindle key, handle, lockwasher and nut. Tighten the nut to 50 ft. lbs. (68 Nm) torque.**

⚠ WARNING ⚠ ***Failure to install the fork spindle key and to tighten the handlebar retaining nut may allow the handlebar to come loose, resulting in loss of vehicle steering control.***

Seat Switch

The seat switch, located under the operator's seat, allows the vehicle to function only when the seat is in position and the operator is properly seated. Should the operator leave the seat during operation, the vehicle will stop (Ref Fig. 15 on page A-7).

Fig. 15 Seat Switch

⚠ WARNING ⚠ ***To prevent unexpected vehicle movement, NEVER operate the vehicle if the seat switch is malfunctioning.***

Hour Meter (Accessory)

The hour meter, located in the motor compartment, behind the speed controller, records the number of hours the vehicle has been operated.

ADDITIONAL FEATURES

Additional features include a built-in battery charger, a fold down backrest and a programmable speed controller.

Battery Charger

The standard vehicle is equipped with a built-in 24 volt, 25 amp DC, 120 volt AC, 60 Hz, fully automatic charger, located under the driver's seat. There is also a storage area under the seat for the charger cord (Ref Fig. 16 on page A-7).

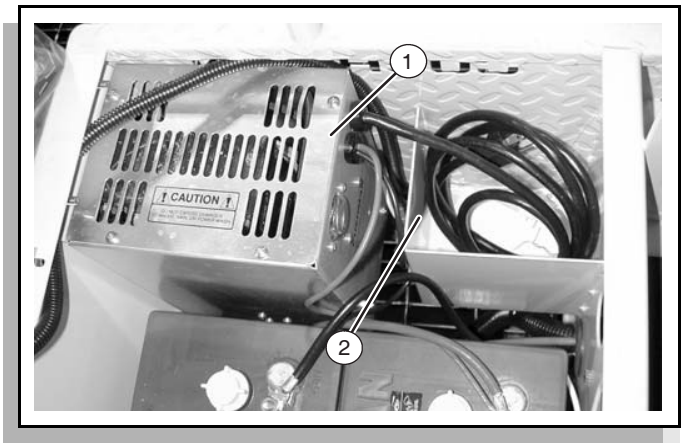

Fig. 16 Battery Charger

Fold Down Backrest

The backrest is easily positioned to provide seating for a passenger or, in a raised position, for cargo.

To lower the backrest, lift it upward and toward the front of the vehicle. When the pins on either side have cleared the slots, slowly lower the backrest into position. Reverse the procedure when raising the backrest (Ref Fig. 17 on page A-7).

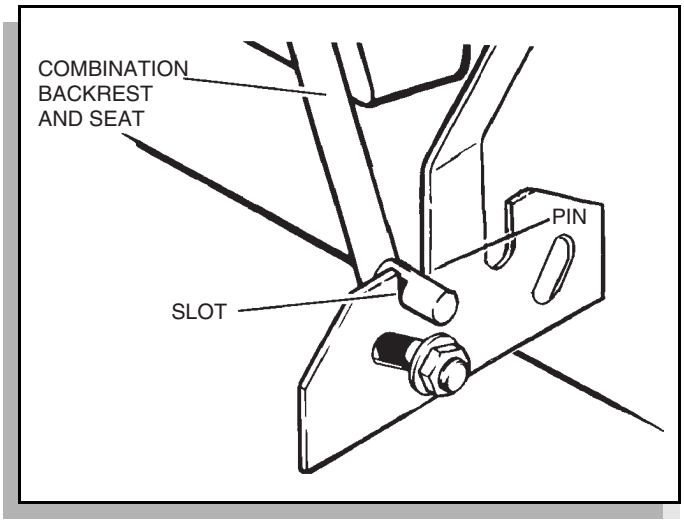

Fig. 17 Fold Down Backrest

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

⚠ WARNING ⚠ ***To prevent possible injury, make sure the seat is in the lowered position when carrying a passenger. Raise the seat if no passenger will be carried. DO NOT allow a passenger to stand on the rear step.***

Programmable Speed Controller

The vehicle is equipped with a programmable speed controller, which provides a variety of diagnostic data and can be used to change factory speed settings. For information about diagnostics, troubleshooting, adjustments and factory settings, see pages 27 - 30 of this manual.

EE UNITS

This vehicle is available in "EE" versions. "EE" Units meet all the requirements of "E" Units and provide additional safeguards against inherent fire and electrical hazards, as specified per U.L. 583.

The additional components used on "EE" vehicles include:

- head light guard
- rear light guard
- terminal boots for the circuit breaker, motor, and forward, reverse and main solenoids
- a static strap
- a safety hasp to keep the battery compartment securely closed

"EE" Units function identically to "E" Units.

BEFORE ENTERING VEHICLE

1. Check for correct tire inflation.
2. Inspect for fluid leaks.
3. Be sure everything is properly stored and secured.

If vehicle has built-in charger, unplug power cord from electrical outlet and properly store cord under instrument panel prior to moving vehicle. If vehicle has a portable charger, remove charger plug from vehicle receptacle and properly store cable prior to moving vehicle.

OPERATING THE VEHICLE

CAUTION **Improper use of the vehicle or the lack of proper maintenance may result in decreased performance or damage to the vehicle.**

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

⚠ WARNING ⚠ ***To reduce the possibility of severe injury or death resulting from loss of vehicle control, the following warnings must be observed:***

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

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

Avoid extremely rough terrain.

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

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

All travel should be directly up or down hills.

Use extra care when driving the vehicle across any incline.

Stay in designated areas and avoid steep slopes. To reduce the possibility of severe injury or death resulting from improper vehicle operation, the following warnings must be observed:

Refer to GENERAL SPECIFICATIONS for capacity.

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

Do not take vehicle out of 'gear' while in motion (coast).

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

Check the area behind the vehicle before operating in reverse.

Always hold on while the vehicle is in motion. Keep feet, legs, hands and arms inside the vehicle at all times.

To prevent inadvertent movement when the vehicle is to be left unattended, set parking brake pedal completely, move direction selector switch to neutral position, turn key to 'OFF' position and remove key.

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

STARTING THE VEHICLE

To start the vehicle: Place the key in the key switch and turn to the 'ON' position. Move the direction selector to the direction desired, release park brake and press the accelerator pedal to start the vehicle.

NOTE *When the direction selector is in the reverse position, a warning signal will sound. This is a device to indicate the vehicle is ready to run in reverse.*

Releasing the accelerator slows the vehicle. To stop the vehicle more quickly, depress the brake pedal.

CAUTION **To avoid component damage, the vehicle must be brought to a complete stop before shifting the direction selector switch.**

Do not hold vehicle on hill by using accelerator and motor. Leaving motor in a stalled condition for more than 3-4 seconds will cause permanent damage to motor.

COASTING

⚠ WARNING ⚠ ***To prevent injury or death resulting from coasting at above recommended speeds, limit speed with service brake.***

On steep hills/ramps, it is possible for vehicles to coast at faster than normal speeds that may be encountered on a flat surface. To prevent loss of vehicle control, speeds should be limited to no more than the maximum speed on level ground (see GENERAL SPECIFICATIONS). Limit speed by releasing the accelerator pedal and applying pressure to the heel of the pedal. Severe 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 control, is costly, is considered abuse and will not be covered under warranty.

TORQUE SPECIFICATIONS

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

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

BOLT SIZE	M4	M5	M6	M8	M10	M12	M14			
Class 5.8 (Grade 2) 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. 18 Torque Specifications

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

PERIODIC SERVICE SCHEDULE

✓ Check ♦ Clean, Adjust, etc. ▲ Replace

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

DAILY	
BODY	♦ Clean body components as required
REVERSE WARNING DEVICE	✓ Check operation when direction selector is in reverse
TIRES	✓ Examine for cuts, excessive wear and pressure (See GENERAL SPECIFICATIONS)
WHEELS	✓ Check for bent rims, missing or loose lug nuts
BATTERIES	♦ Recharge to full state of charge after each day's use
MONTHLY - 20 HOURS (includes items listed in previous table & the following)	
BATTERIES	♦ Clean batteries & terminals with 1/4 cup (60 ml) baking soda to 1 1/2 gallons (6 liters) water solution, rinse with clear water ✓ Check charge condition and all connections
SERVICE/ PARK BRAKE	✓ Check brake performance, smooth operation ♦ Adjust if required
WIRING	✓ Check all wiring for loose connections and broken/missing insulation
ACCELERATOR	✓ Check for smooth movement
STEERING	✓ Check for excessive play, tightness of all hardware and bent or loose components
REAR AXLE	✓ Check for oil leakage, add lubricant (SAE 80-90 oil) as required 10 Oz (.3L) Capacity.
QUARTERLY - 50 HOURS (includes items listed in previous tables & the following)	
FRONT FORK	✓ Check for damage to axle and loose or missing hardware
FRONT WHEEL ALIGNMENT	✓ Check for unusual tire wear, align if required
SERVICE / PARK BRAKE	✓ Check for bent/binding linkage rods ✓ Check for damage or wear

Fig. 19 Periodic Service Schedule

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

SEMI-ANNUAL - 125 HOURS (includes items listed in previous tables & the following)	
SERVICE / PARK BRAKES	♦ Clean and adjust, see Technician's Repair and Service Manual ✓ Check brake shoe linings, see Technician's Repair and Service Manual
BODY	♦ Clean body components and wax all painted surfaces
STEERING	♦ Lubricate, use wheel bearing grease
ANNUAL - 250-300 HOURS (includes items listed in previous tables & the following)	
FRONT WHEEL BEARINGS	♦ Adjust, see Technician's Repair and Service Manual ♦ Pack, use lithium based wheel bearing grease
REAR AXLE	✓ Check lubricant, add lubricant (SAE 80-90 oil) as required ▲ Replace lubricant after 5 years

Fig. 19 Periodic Service Schedule

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

Notes:

TABLE OF CONTENTS FOR SECTION 'B'

LIST OF ILLUSTRATIONS

Notes:

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

GENERAL

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

PART II
FOR THE USER

4 GENERAL SAFETY PRACTICES

4.1 Introduction

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

4.2 Stability

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

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

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

4.3 Nameplates, Markings, Capacity, and Modifications

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

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

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

4.4 Fuel Handling and Storage

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

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

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

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

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

4.6 Hazardous Locations

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

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

4.7 Lighting for Operating Areas

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

4.8 Control of Noxious Gases and Fumes

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

4.9 Warning Device(s)

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

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

5 OPERATING SAFETY RULES AND PRACTICES

5.1 Personnel and Burden Carrier Operator Qualifications

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

5.2 Personnel and Burden Carrier Operators' Training

5.2.1 The user shall conduct an operators' training program.

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

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

(a) instructional material provided by the manufacturer;

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

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

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

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

5.3 Personnel and Burden Carrier Operator Responsibility

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

5.4 General

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

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

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

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

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

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

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

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

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

5.5 Traveling

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

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

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

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

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

5.5.6 Ascend or descend grades slowly.

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

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

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

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

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

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

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

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

5.6 Loading

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

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

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

5.7 Operator Care of Personnel and Burden Carriers

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

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

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

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

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

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

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

6 MAINTENANCE PRACTICES

6.1 Introduction

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

6.2 Maintenance Procedures

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

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

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

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

(d) Block chassis before working underneath it.

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

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

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

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

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

(j) Properly ventilate the work area.

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

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

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

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

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

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

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

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

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

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

NOTES, CAUTIONS AND WARNINGS

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

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

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

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

IMPORTANT SAFETY WARNING

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

It is virtually impossible to anticipate all possible component failures or the manner in which each component may fail.

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

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

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

MODIFICATIONS TO VEHICLE

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

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

GENERAL MAINTENANCE

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

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

When any maintenance procedure or inspection is performed, it is important that care be exercised to insure the safety of the technician/mechanic or bystanders and to prevent damage to the vehicle.

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

SAFETY

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

BEFORE SERVICING THE VEHICLE

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

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

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

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

Use care not to contact hot objects.

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

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

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

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

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

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

Additional Warnings

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

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

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

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

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

Never disconnect a circuit under load at a battery terminal.

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

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

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

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

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

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

LIFTING THE VEHICLE

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

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

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

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

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

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

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

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

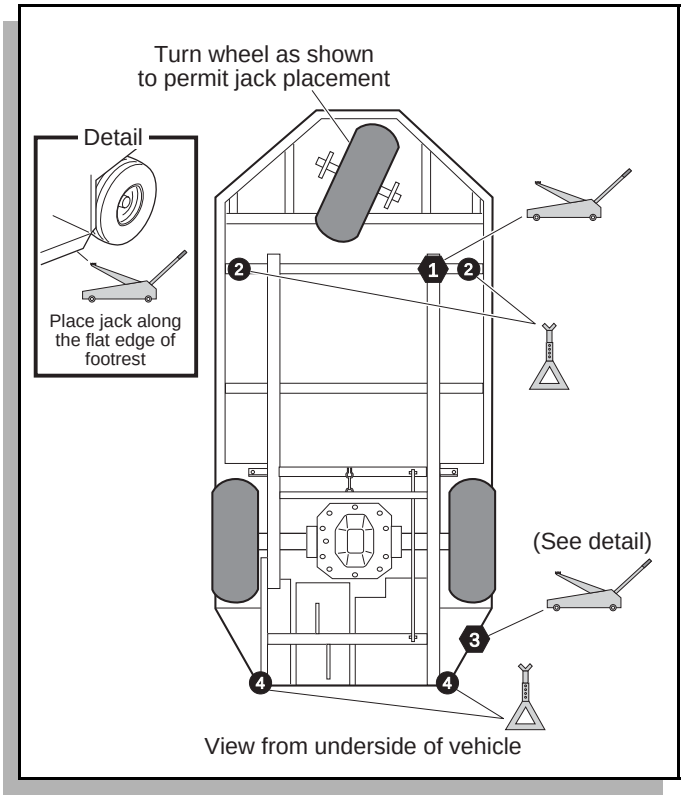

Fig. 1 Lifting the Vehicle

Towing

⚠ WARNING ⚠ ***This vehicle is not designed to be towed.***

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

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

STANDARDS AND PUBLICATIONS

This unit is not a motor vehicle within the definition of the National Traffic Motor Vehicle Safety Act. It is not designed or manufactured for use on roads, streets, or highways, and is not appropriate for such use. This unit is not meant to be licensed as a motor vehicle.

The Electric 3 wheel service vehicle is available as Type "E" and Type "EE" Units. Type "E" Units are electrically powered units having minimum acceptable safeguards against inherent fire hazards.Type "EE" Units have additional safeguards against such hazards.

Users, operators and service persons should be familiar with the following standards and publications:

Standards

(The material may be obtained from the address shown).

- Factory Mutual Approval Standard:
  Class # 7820; Electric Battery Powered Trucks, Types E and EE.
  ADDRESS:
  Factory Mutual Research Corp.
  1151 Boston--Providence Highway
  Norwood, Massachusetts 02062 USA

- National Fire Protection Association:
  ANSI/NFPA #505; Powered Industrial Trucks.
  ADDRESS:
  National Fire Protection Association
  Batterymarch Park
  Quincy, Massachusetts 02269 USA

- ANSI/ASME B56.8
  Personnel and Burden Carriers
  ADDRESS:
  American National Standards Institute, Inc.
  1430 Broadway
  New York, New York 10018 USA

- ANSI/UL 583; Electric Battery Powered Industrial Trucks
  ADDRESS:
  American National Standards Institute, Inc.
  1430 Broadway
  New York, New York 10018 USA

  OR

  Underwriters Laboratories Inc.
  333 Pfingsten Road
  Northbrook, Illinois 60062 USA

This Electric Vehicle complies with ANSI B56.8 as it applies to OSHA for Powered Industrial Trucks under the Type E and EE classifications. This vehicle has been approved by Factory Mutual Research Corporation. To meet the manufacturer portions of the OSHA requirements (as stated in section 1910.178, Paragraph a3) Powered Industrial Trucks must bear the approval mark of either UL (Underwriters Laboratory) or FM (Factory Mutual) or other nationally recognized testing laboratories.

Publications

Additional operator's manuals and parts manuals are available for a minimum charge.

Parts Manual 29177-G01

Thank you for this purchase. The vehicle is equipped with an electronic speed control unit that is the most advanced in the industry. Before driving the vehicle, we ask you to spend some time reading this Owner's Manual and Service Guide. This guide contains information that will assist you in maintaining your highly reliable vehicle. Some illustrations may show items that are optional for your vehicle.

Most of the service procedures in this guide can be accomplished by an individual using common automotive hand tools. Refer to an authorized service representative for information on servicing the vehicle in accordance with the Periodic Service Schedule.

To facilitate maintenance, a Service Parts Manual and a Technician's Repair and Service Manual is available from a local Distributor, an authorized Branch or the Service Parts Department. When ordering parts or requesting information for your vehicle, provide vehicle model, serial number and manufacture code.

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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

BODY

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

General

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

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

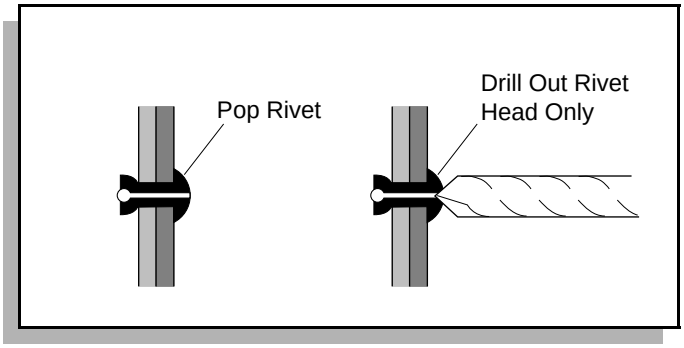

Fig. 1 Drill Out Metal Rivet

BODY COMPONENT REPLACEMENT

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

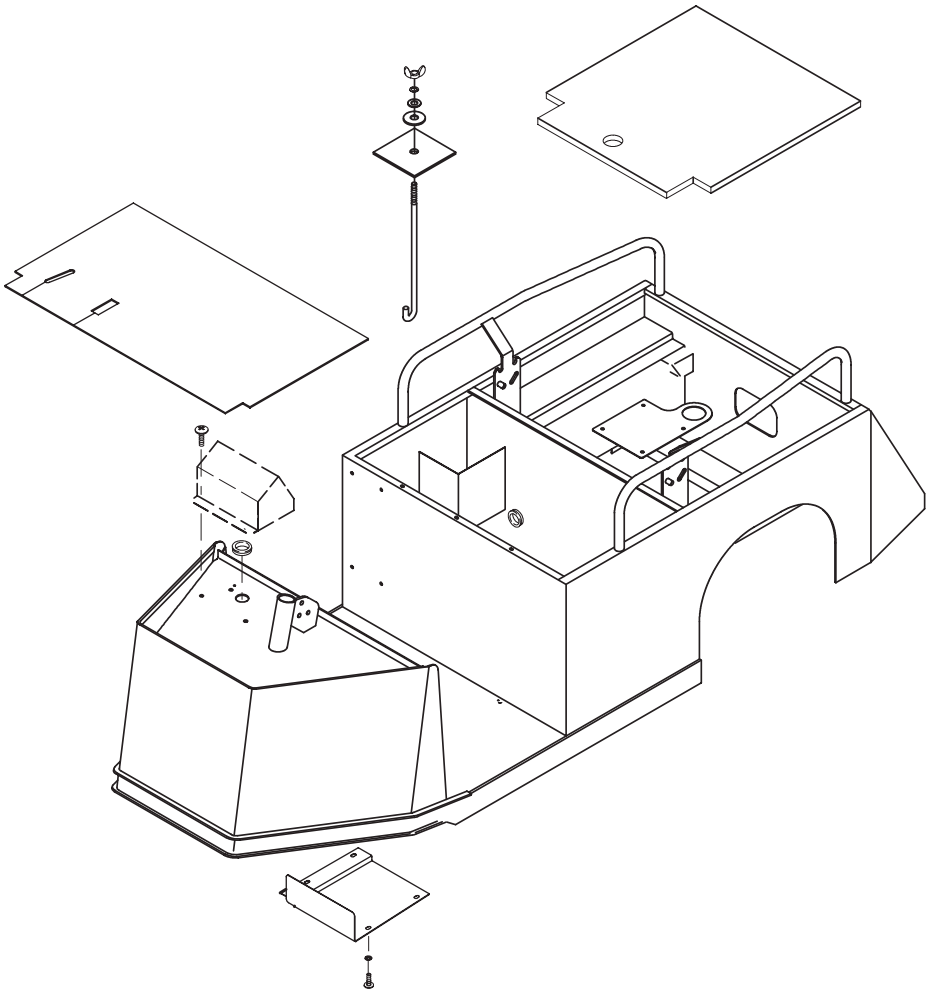

Fig. 2 Body Components

WHEELS AND TIRES

D

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Notes:

WHEELS AND TIRES

D

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

WHEEL AND TIRE SERVICE

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

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

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

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

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

Tire inflation should be determined by the condition of use. For vehicles being used on paved or hard surfaces, tire inflation pressure should be in the higher allowable range, but under no condition should inflation pressure be higher than recommended on tire sidewall. **All three tires** should have the same pressure for optimum handling characteristics. Be careful not to overinflate. Due to the low volume of these small tires, overinflation can occur in a matter of seconds. Be sure to install the valve dust cap after checking or inflating.

Tire Repair

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

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

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

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

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

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

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

Wheel Installation

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

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

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

WHEELS AND TIRES

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

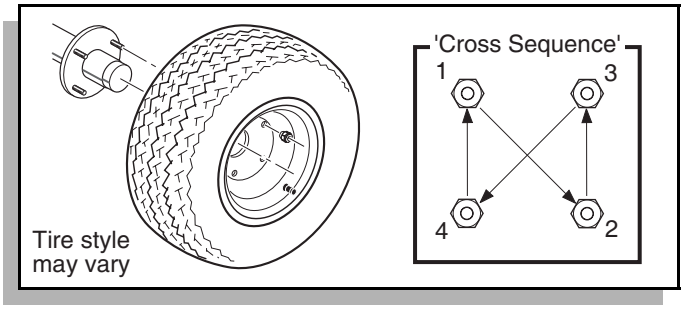

Fig. 1 Wheel Installation

NOTE *Install the wheel assembly with the valve stem on the same side as the wheel retaining nuts.*

⚠ WARNING ⚠ ***To prevent possible injury, always deflate the tire completely before removing from the wheel.***

When reinstalling the front wheel assembly, always place the axle and retaining washer over the axle locks (as shown) and tighten the axle nuts. Tighten axle nuts to 100 to 120 ft. lbs. (130 to 156 Nm) torque. Failure to follow the procedure may allow the axle to drop, resulting in loss of vehicle control.

Removing and Reinstalling Front Tire

To remove and reinstall the front tire, complete the following steps and (Ref Fig. 2 on page D-2).

1. Front Axle Lock
2. Axle Nut
3. Retaining Washer
4. Wheel Retaining Nut
5. Valve Stem

1. Loosen the axle nuts and lower entire wheel, hub and axle assembly from front fork. Remove the four wheel retaining nuts.
2. Completely deflate the tire, then remove from wheel.
3. Reinstall tire and wheel by reversing the above sequence and tighten wheel retaining nuts. Tighten to 70 to 80 ft. lbs. (95 to 108.5 Nm) torque.
4. Position the large flat washer located on the ends of the axle above the front axle locks.
5. Tighten axle nuts to 100 to 120 ft. lbs. (130 to 156 Nm) torque.

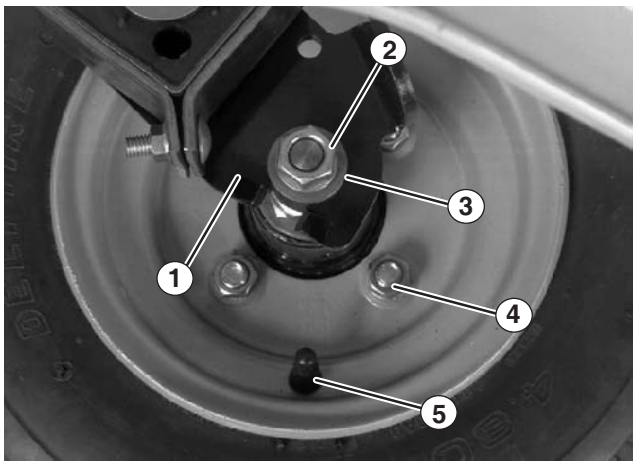

Fig. 2 Front Wheel Installation

Removing and Reinstalling Rear Tire

1. Remove the wheel retaining nuts and remove the wheel assembly from the hub.
2. Completely deflate the tire, then remove from wheel.
3. Reinstall the tire and wheel by reversing above sequence and tighten wheel retaining nuts. Tighten to 70 to 80 ft. lbs. (95 to 108.5 Nm) torque.
4. Make sure the valve stem is located toward the outside.

BATTERIES AND CHARGING

E

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BATTERIES AND CHARGING

Safety

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

⚠ WARNING ⚠ ***To prevent burns or 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 personal injury and damage to the vehicle and storage facility.

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.

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

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, 9/16"	1
Battery carrier	1
Hydrometer P/N 50900-G1	1
Battery maintenance kit P/N 25587-G01	1

At Each Charging Cycle

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

Before charging the batteries, inspect all plugs/receptacles of the battery charging system for dirt or debris.

Charge the batteries after each days use.

Monthly

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

Electrolyte Level and Water

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

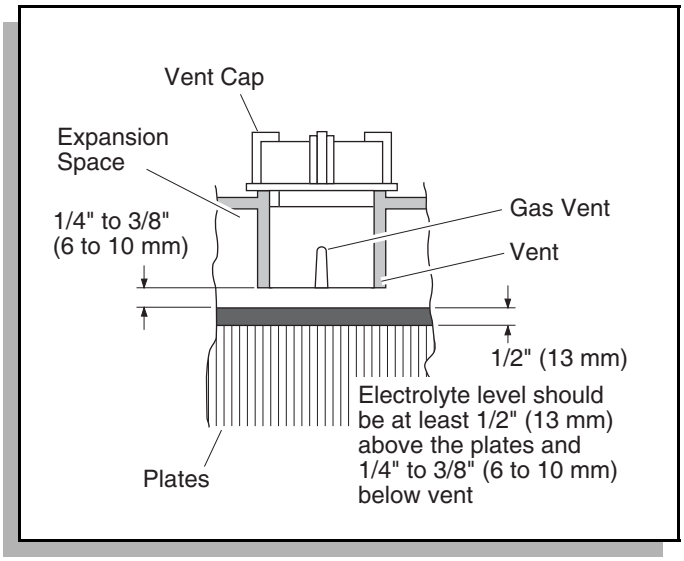

Fig. 1 Correct Electrolyte Level

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 E-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 can be used with an

approved water source (Ref Fig. 3 on page E-3). These watering devices are **fast and accurate** to use and maintain the correct electrolyte level within the battery cells.

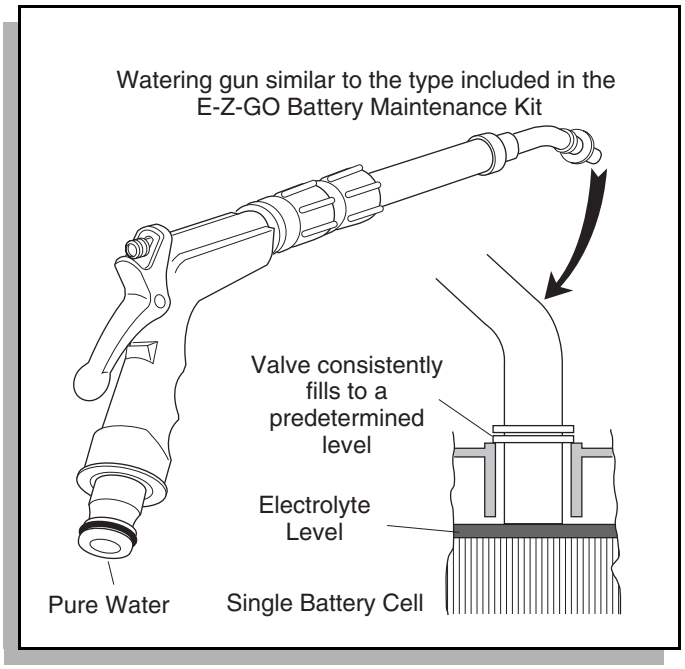

Fig. 3 Automatic Watering Gun

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

Cleaning Batteries

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

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

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

The correct cleaning technique is to spray the top and sides of the batteries with a solution of sodium bicarbonate (baking soda) and water. This solution is best applied with a garden type sprayer equipped with a **non metallic spray wand**. The solution should consist of 1/4 cup (60 ml) of sodium bicarbonate (baking soda) mixed with 1 1/2 gallons (6 liters) of clear water (Ref Fig. 4 on page E-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.

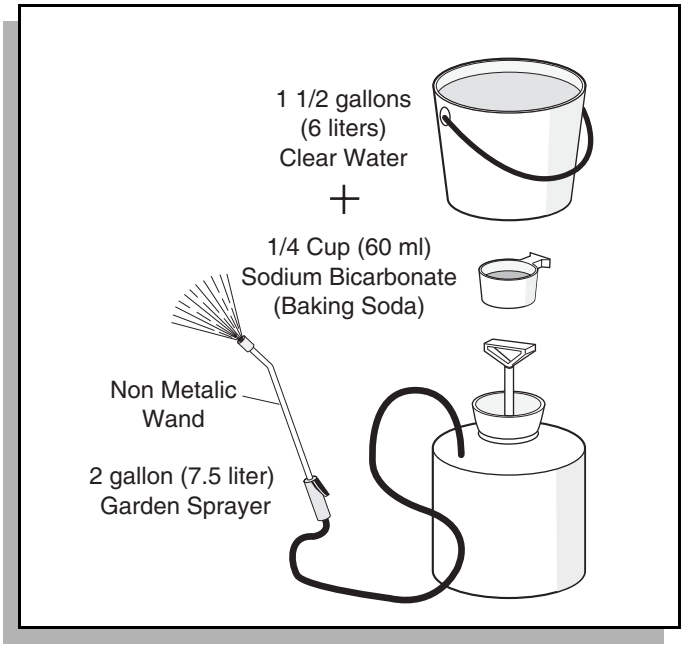

Fig. 4 Preparing Acid Neutralizing Solution

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.

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

Battery Replacement

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

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

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

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

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

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

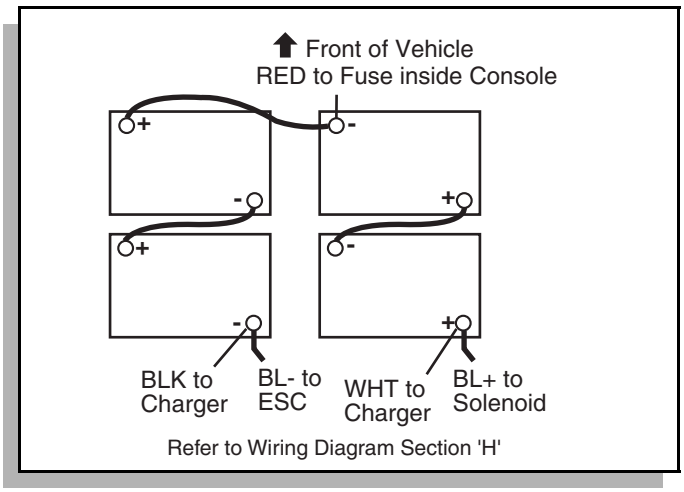

Fig. 5 Battery Connections

Prolonged Storage

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

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 can be used to determine the specific gravity and therefore the state of charge of a battery.

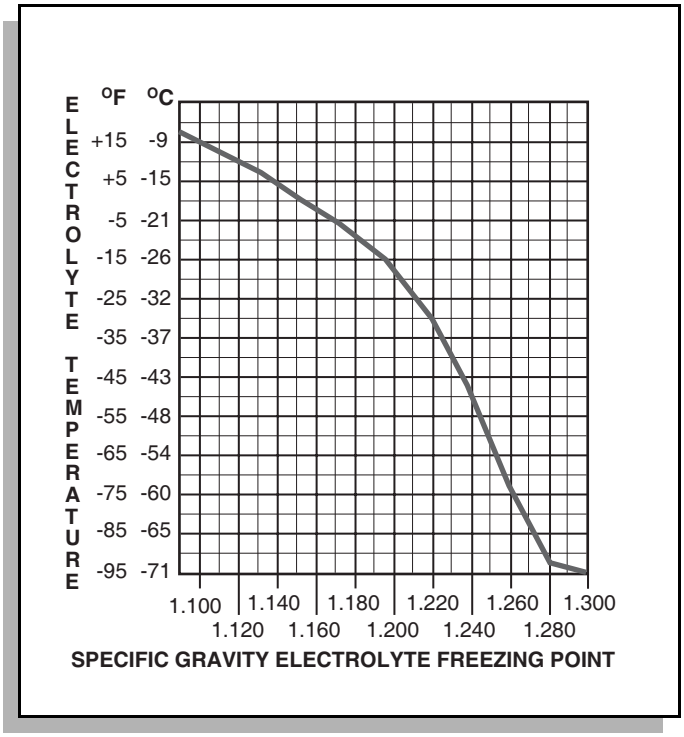

Fig. 6 Freezing Point of Electrolyte

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

Battery Charging

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

Before charging, the following should be observed:

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

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

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 a service representative for specific requirements.

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

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

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

Hydrometer

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

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

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

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

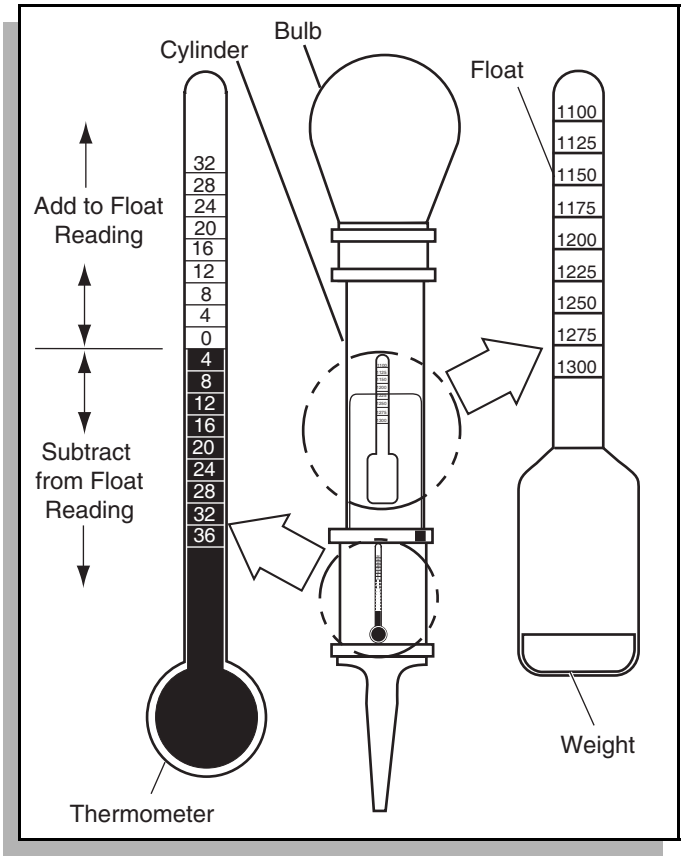

Fig. 7 Hydrometer

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

Using A Hydrometer

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

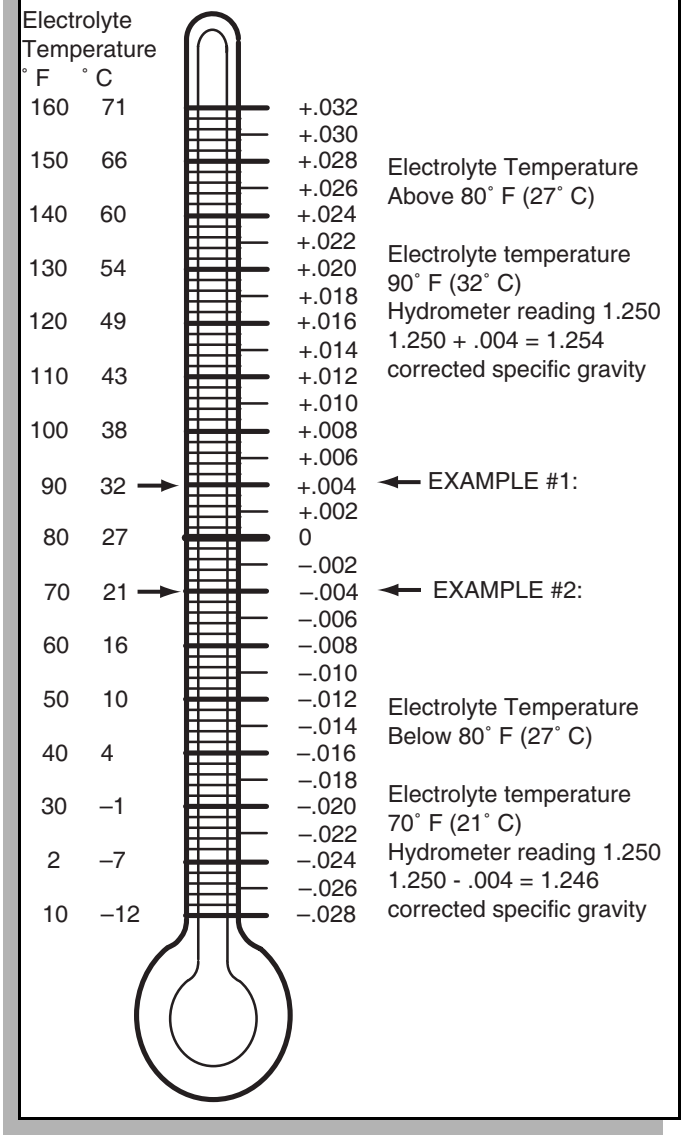

Fig. 8 Hydrometer Temperature Correction

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.

BATTERIES AND CHARGING

Read all of manual to become thoroughly familiar with this vehicle. Pay particular attention to all Notes, Cautions and Warnings

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ELECTRONIC SPEED CONTROL

F

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ELECTRONIC SPEED CONTROL

F

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

PROGRAMMABLE SPEED CONTROLLER

The vehicle is equipped with an electronic speed controller that does not require servicing. Some controllers may not have current and speed limit adjustment.

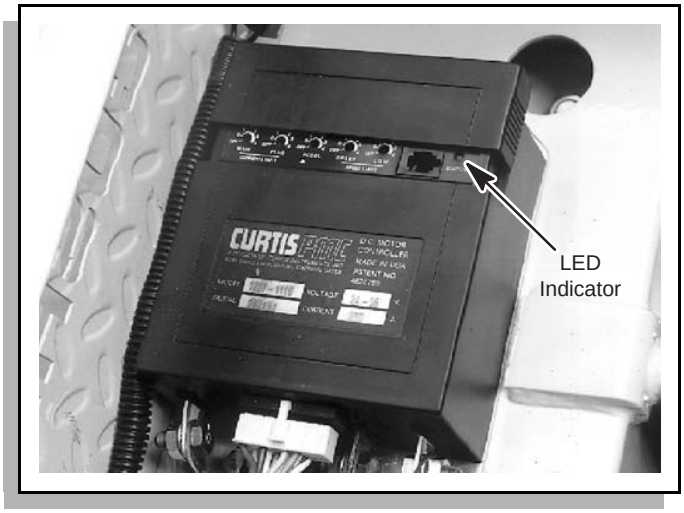

Fig. 1 Controller LED Status Indicator

DIAGNOSTICS AND TROUBLESHOOTING

LED Diagnostics

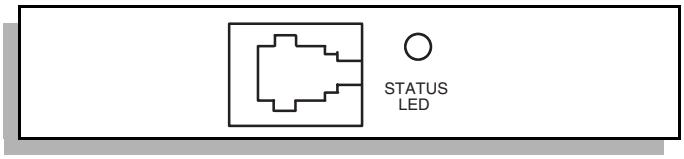

Fig. 2 Controller LED Status Indicator

During normal operation, with no faults present, the Status LED flashes a single flash at approximately 1 flash/second. If the controller detects a fault, a 2-digit code (see Table) is flashed continuously until the fault is corrected. For example, code “3,2” welded direction contactor appears as:

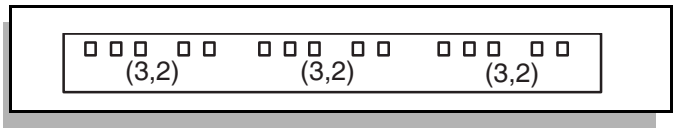

Fig. 3 Welded Direction Contactor

TROUBLESHOOTING CHART

LED CODE	PROGRAMMER LCD DISPLAY	EXPLANATION	POSSIBLE CAUSE
1,2	HW FAILSAFE	hardware fail-safe error	1. Controller defective.
1,3	M-FAULT	M-output shorted	1. M-output shorted to ground. 2. Direction contractor not closing. 3. Direction contractor not closing fast enough. 4. Internal motor short to ground.
1,4	SRO	SRO fault	1. Improper sequence of KSI, brake and direction inputs. 2. Wrong SRO type selected. 3. Brake or direction switch circuit open. 4. Sequencing delay too short.
2,1	THROTTLE FAULT 1	5kOhm-0 or wiper fault	1. Throttle input wire open. 2. Throttle input wire shorted to ground or B+. 3. Throttle pot defective. 4. Wrong throttle type selected.
2,2	BB WIRING CHECK	emer, reverse wiring fault	1. BB wire open. 2. BB check wire open.
2,3	HPD	HPD sequencing fault	1. Improper seq. of KSI, brake, throttle inputs. 2. Wrong HPD type selected. 3. Misadjusted throttle pot.
2,4	THROTTLE FAULT 2	Pot Low broken or shorted	1. Pot Low wire open. 2. Pot Low wire shorted. 3. Wrong throttle type selected.
3,1	CONT DRVR OC	driver output overcurrent	1. Direction contactor coil shorted. 2. Shunt field shorted.
3,2	DIR CONT WELDED	welded direction contactor	1. Direction contactor stuck closed.
3,4	MISSING CONTACTOR	missing contactor or shunt	1. Direction contactor coil open. 2. Direction contactor missing. 3. Shunt field open. 4. Wire to shunt or direction contactor open.
4,1	LOW BATTERY VOLTAGE	low battery voltage	1. Battery voltage <16 volts. 2. Corroded battery terminal. 3. Loose battery or controller terminal.
4,2	OVERVOLTAGE	overvoltage	1. Battery voltage >45 volts. 2. Vehicle operating with charger attached.

Fig. 4 Troubleshooting Chart

4,3	THERMAL CUTBACK	over/under-temp. cutback	1. Temperature >85°C or <-25 °C. 2. Excessive load on vehicle. 3. Improper mounting of controller. 4. Operation in extreme environments.

Fig. 4 Troubleshooting Chart

E-Z-GO FACTORY SET CONTROLLER PARAMETERS

PARAMATER	RANGE	DEFAULT	DESIRED	UNITS	DESCRIPTION
Current Limit, Main	20 - 250	250	250	Amps	Maximum current forward speed
Current Limit, Low Speed Main	20 - 250	250	250	Amps	Maximum current reverse speed
Current Limit, Plug	20 - 250	70	70	Amps	Max. plug current forward speed
Current Limit, Low Speed Plug	20 - 250	70	70	Amps	Max. plug current reverse speed
Current Limit, Emergency Reverse	20 - 250	140	250	Amps	Max. plug current in emergency reverse
Current Limit, Low Speed Emergency Reverse	20 - 250	140	250	Amps	Max. plug current in low speed emergency reverse
Current Limit, Ramp Start	20 - 250	140	250	Amps	Max. plug current during ramp start
Current Limit, Low Speed Ramp Start	20 - 250	140	250	Amps	Max. plug current during ramp start in low speed
Acceleration Rate	0 - 3	1	0.8	Sec.	Time to reach full output from zero output
Quick Start	0 - 6	1.4	0.2		Output will respond to rate of throttle change
Throttle type	type 1, 2, 3	type 1	type 2	Ohm or Volts	Type of throttle input type 2 = 0-5V, 3-wire pot
Ramp Shape	20 - 70	50	50	%	Adjust desired PWM output at 50% throttle to vary throttle sensitivity at low speed
Creep Speed/Min. Duty Cycle	0 - 25	10	0	%	Speed at min. throttle setting
Low Speed	40 - 100	60	55	%	Max. speed in reverse
High Speed	40 - 100	100	100	%	Max. speed in forward
Emergence Reverse Speed	25 - 100	100	100	%	Speed during emergency reverse
Sequencing Delay	0 - 3	0	0	Sec.	Delays HPD and SRO from brake after controller is enabled
Variable Plug	On/Off	On	On		On = plug current dependent upon throttle position. Off = fixed
High Pedal Disable (HPD)	0 - 2	0	1		Option to disable controller if throttle is applied before brake or keyswitch input (KSI)
Static Return To Off (SRO)	type 0, 1, 2	type 1 brake	type 0 No SRO		Sequencing of KSI or brake before direction is selected
Anti - tiedown	On/Off	On	Off		Prevents high speed mode if HSS in not released after brake

Fig. 5 Factory Settings

TABLE OF CONTENTS FOR SECTION 'G'

SECTION TITLE **PAGE NO.**

LIST OF ILLUSTRATIONS

Notes:

MOTOR

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

GENERAL

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

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

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

Motor Removal

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

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

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

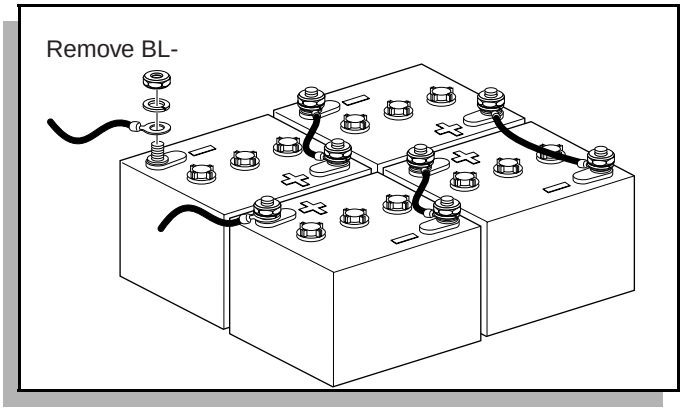

Fig. 1 Disconnect Battery Cable

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

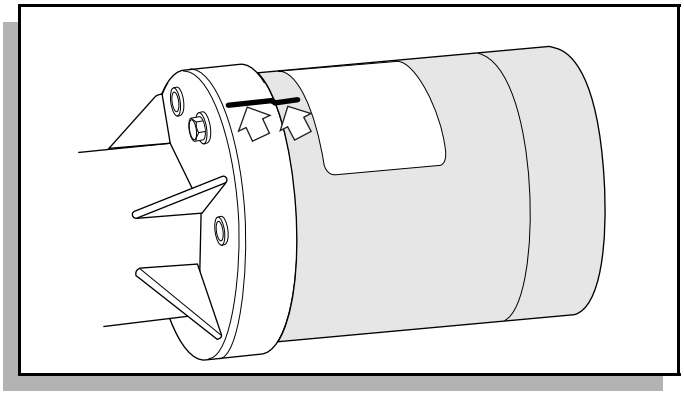

Fig. 2 Mark Axle and Motor

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

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

Motor Disassembly

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

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

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

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

Bearing Replacement

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

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

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

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

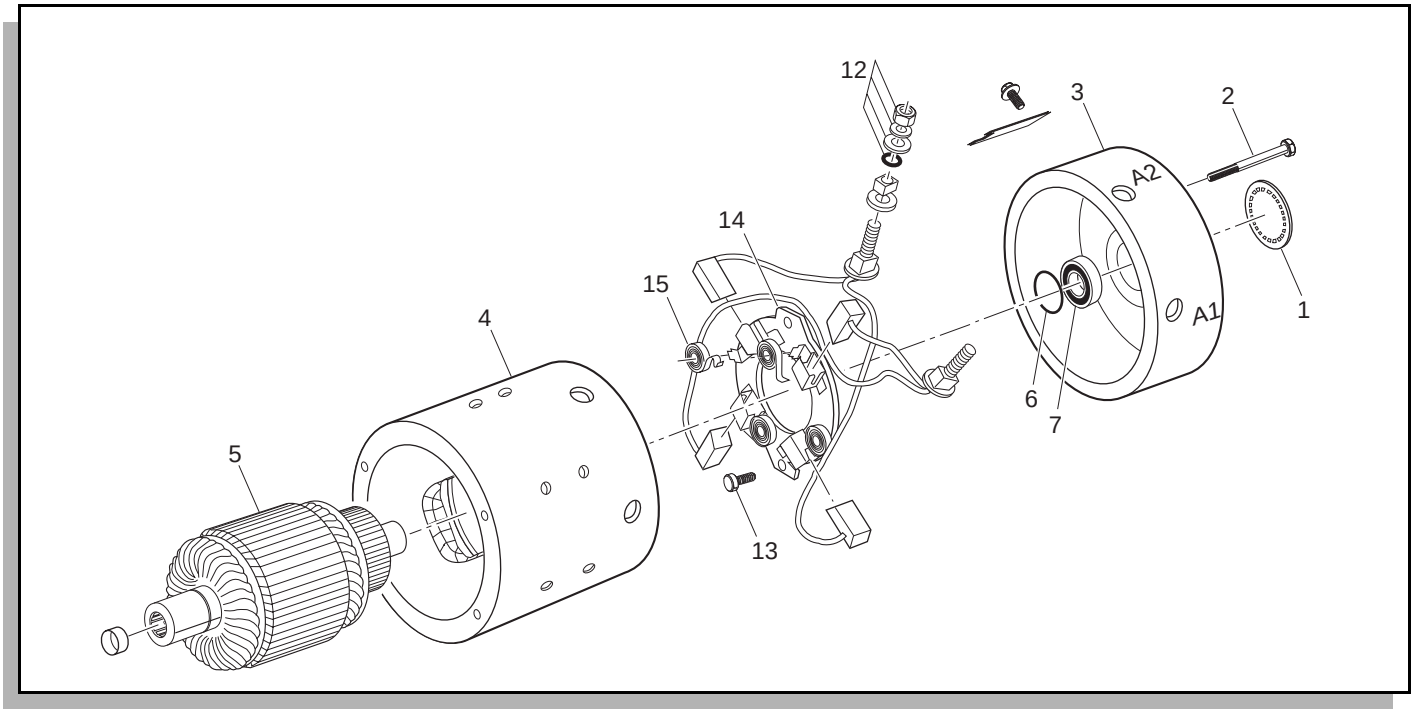

Fig. 3 Motor Components

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

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

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

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

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

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

Install the snap ring.

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

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

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

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

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

Brush Replacement

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

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

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

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

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

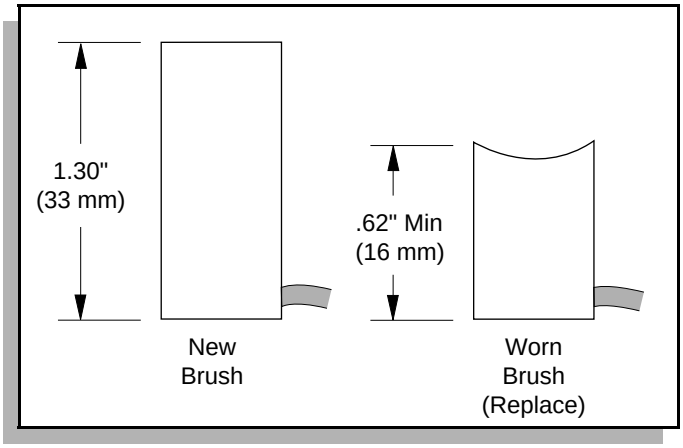

Fig. 4 Brush Wear

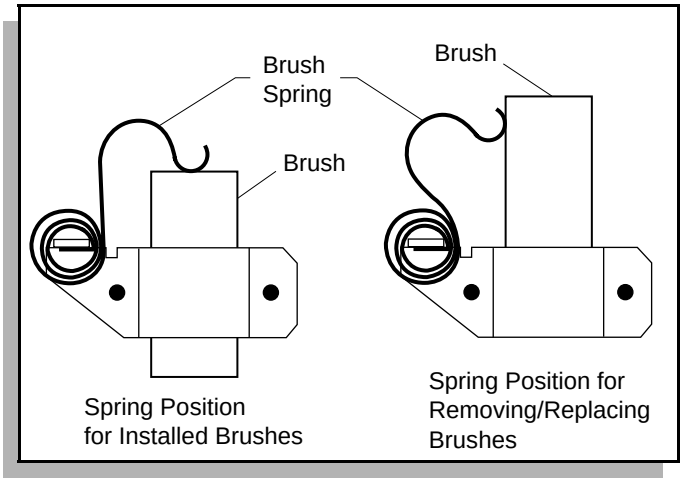

Fig. 5 Securing Brushes

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

Motor Assembly

Tool List **Qty. Required**

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

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

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

Motor Tests

The field coil and motor housing are not available as individual parts. No testing is recommended to determine the specific area of failure. When a test of the power wiring system indicates that the system is operating correctly and the vehicle either does not run or runs poorly, the motor is the only remaining component and must be replaced.

Motor Installation

Tool List **Qty. Required**

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

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

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

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

MOTOR WIRING

Motor Terminal	Wire Marker	From
S1	S1	Controller 'B+'
S2	S2	Reverse Solenoid
A1	A1	Controller 'M1'
A2	A2	Controller 'A2'

Refer to Wiring Diagram Section 'H'

Fig. 6 Motor Wiring

MOTOR

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

Notes:

ELECTRICAL SYSTEM AND BATTERY CHARGER

H

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LIST OF ILLUSTRATIONS

ELECTRICAL SYSTEM AND BATTERY CHARGER

Notes:

TROUBLESHOOTING VEHICLE WIRING

Tool List **Qty. Required**

Digital Volt Ohm Meter (DVOM) 1

Symptoms

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

Testing

Initial tests will be conducted with a Digital Volt Ohm Meter (DVOM) to identify the failed component.

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

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

⚠ WARNING ⚠ ***To prevent unexpected movement of the vehicle, always raise the entire vehicle before conducting any tests.***

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

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

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

Testing Battery Voltage

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

With the adequacy of the batteries confirmed, use a DVOM connected directly to the battery terminal posts to determine the open voltage of the set (Ref Fig. 1 on page H-1). In the following tests, this voltage level will be used as a reference. Some loss due to resistance of wires and connectors may be indicated by readings that may be up to one volt less than the reference voltage. No reading indicates an 'open' condition and the power circuit should be inspected for a broken or disconnected conductor.

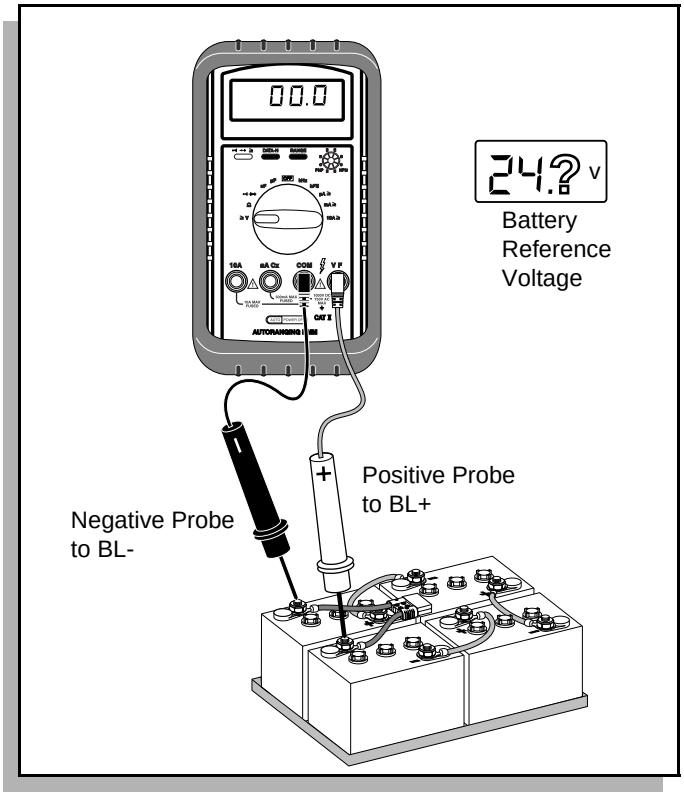


Fig. 1 Battery Reference Voltage

Continuity Check

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

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

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. 2 on page H-2).

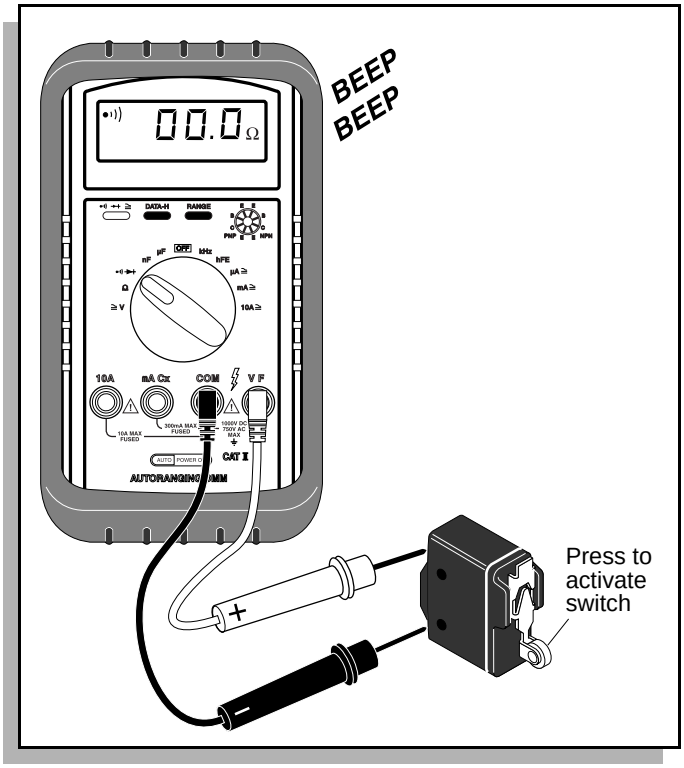
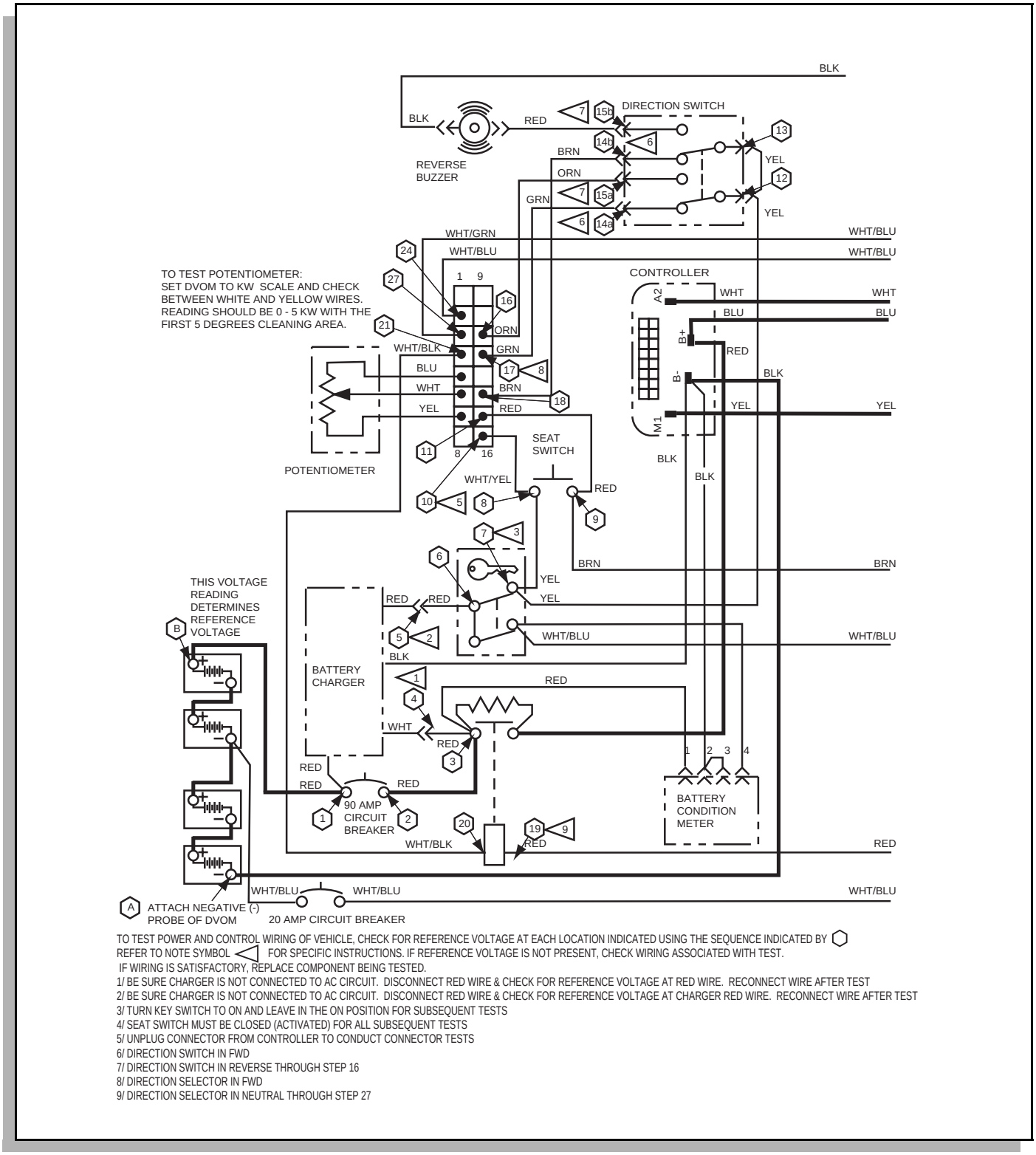


Fig. 2 Continuity Check of Switch

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

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

Refer to wiring diagram set DVOM to DC Volts attach negative (-) probe to battery post indicated. Follow steps shown on wiring diagram and test for battery voltage at location indicated.



TO TEST POWER AND CONTROL WIRING OF VEHICLE, CHECK FOR REFERENCE VOLTAGE AT EACH LOCATION INDICATED USING THE SEQUENCE INDICATED BY ⬡
REFER TO NOTE SYMBOL ◁ FOR SPECIFIC INSTRUCTIONS. IF REFERENCE VOLTAGE IS NOT PRESENT, CHECK WIRING ASSOCIATED WITH TEST.
IF WIRING IS SATISFACTORY, REPLACE COMPONENT BEING TESTED.

1/ BE SURE CHARGER IS NOT CONNECTED TO AC CIRCUIT. DISCONNECT RED WIRE & CHECK FOR REFERENCE VOLTAGE AT RED WIRE. RECONNECT WIRE AFTER TEST
2/ BE SURE CHARGER IS NOT CONNECTED TO AC CIRCUIT. DISCONNECT RED WIRE & CHECK FOR REFERENCE VOLTAGE AT CHARGER RED WIRE. RECONNECT WIRE AFTER TEST
3/ TURN KEY SWITCH TO ON AND LEAVE IN THE ON POSITION FOR SUBSEQUENT TESTS
4/ SEAT SWITCH MUST BE CLOSED (ACTIVATED) FOR ALL SUBSEQUENT TESTS
5/ UNPLUG CONNECTOR FROM CONTROLLER TO CONDUCT CONNECTOR TESTS
6/ DIRECTION SWITCH IN FWD
7/ DIRECTION SWITCH IN REVERSE THROUGH STEP 16
8/ DIRECTION SELECTOR IN FWD
9/ DIRECTION SELECTOR IN NEUTRAL THROUGH STEP 27

Fig. 3 Wiring Diagram

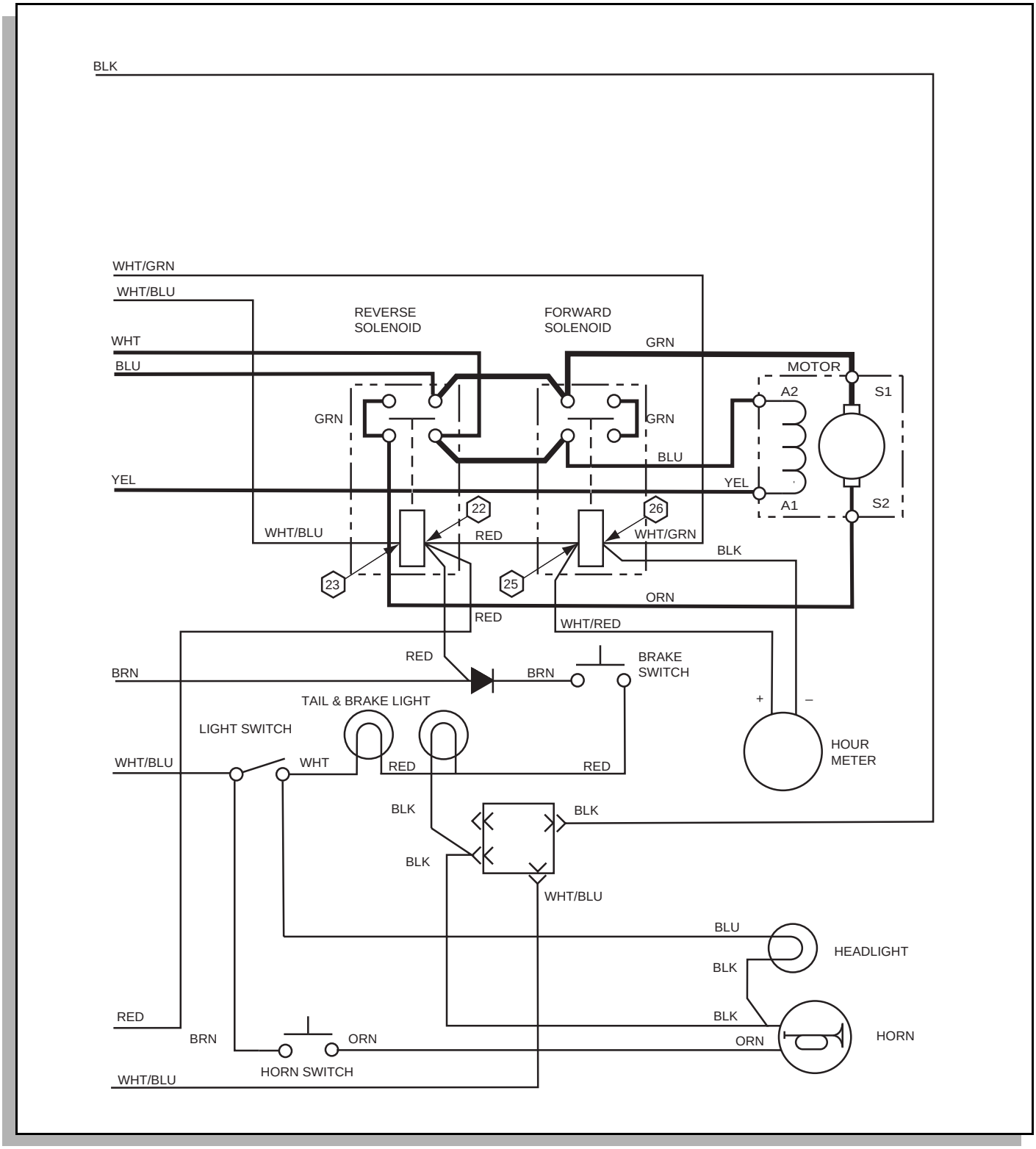


Fig. 4 Wiring Diagram (Cont.)

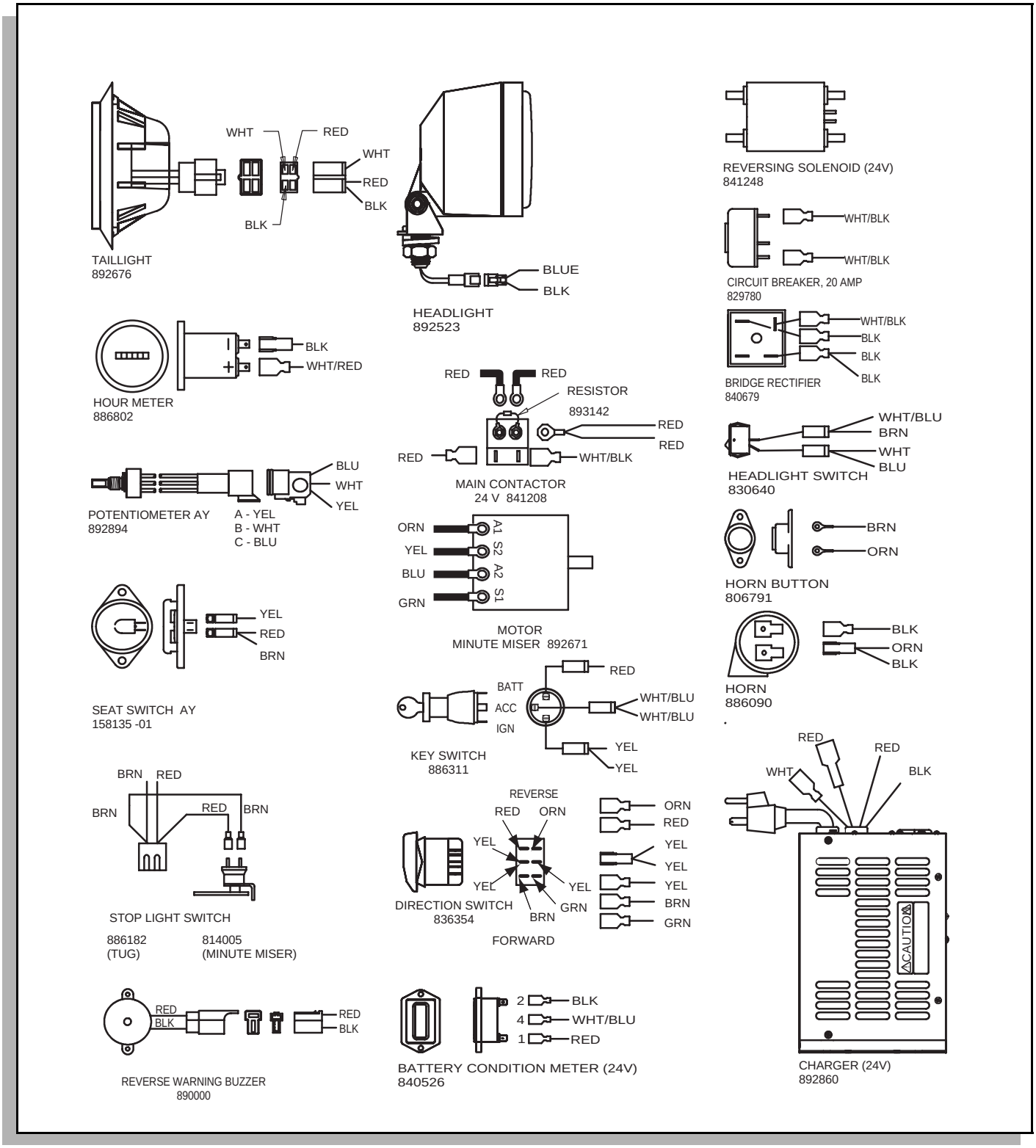


Fig. 5 Switches, Fuses and Receptacles

Vehicle Moves When Selector Is Turned On

Possible Causes	Remedy
Failed solenoid	Test, replace
Incorrect solenoid	Ensure proper replacement parts are used. Consult a part manual
Incorrect wiring	Consult proper wiring diagram

Cold temperatures also will diminish performance, by reducing the power and efficiency of the batteries.

Troubleshooting Will Not Run Very Far

Possible Causes	Remedy
Battery run down	Charge battery
Defective battery	Test battery, Replace as needed.
Circuit breaker opens	Check current draw, remedy as needed
Motor draw excessive	Check for drag, eliminate friction.
Brake drag	Adjust brake

Solenoid Burns up

Possible Causes	Remedy
Improperly installed solenoid	Replace, install properly
Incorrect wiring	Rewire (consult proper wiring diagram).
Incorrect solenoid	Ensure proper original equipment replacement parts are used. Consult a current parts manual.

BATTERY CHARGER

The following tests are arranged sequentially according to relative failure rate. If any test indicates a failed component, replace that component and retest before proceeding to any later test procedure.

⚠ WARNING ⚠ ***Make sure the charger is turned off before working near capacitor terminals. With the charger on, the transformer capacitor terminals carry a very high voltage, which may cause severe electrical shock.***

Since each component can be tested individually, troubleshooting is a simple task. The following is a list of symptoms with their associated test procedures and remedies:

Transformer Hums, But Batteries Will Not Take A Charge

1. Check to insure that the batteries are properly connected.

⚠ WARNING ⚠ ***DO NOT allow the disconnected leads to come in contact with battery terminals during service procedures. Severe injury due to electrical shock may result.***

DC Circuit Continuity Test

1. Disconnect the AC supply cord from the wall outlet and the DC output leads from the batteries. Remove the charger from the vehicle.
2. Check the fuses on the charger front panel. If one or more fuses have blown, refer to “Charger Fuse Blows” for further tests. If the fuses are good, go to next step.
3. Use a low voltage test light or Ohmmeter. Connect the tester leads to the charger output leads and note the reading.
4. Reverse the tester leads and check the output leads again. The circuit should be complete in only one direction.
5. If the circuit does not conduct in either direction and fuses are good, individually check the DC output leads, ammeter, diodes, and fuse connections (Each may be checked with a continuity tester). If the Circuit conducts in both directions, a short exists in the DC circuit. Go to next step.
6. Check DC output leads for a short between the two wires. If the problem still has not been located, probably one or more diodes has (have) shorted. Refer to “Charger DC fuse Blows”, part (b), for continuity testing procedures for diodes.

   If the test shows that the DC circuit is good, a check of the capacitor is necessary.

⚠ WARNING ⚠ ***NEVER touch capacitor terminals with uninsulated tools or probes, or with any part of your body, because the high voltage in the capacitor coil can cause serious injury due to electrical shock.***

The most probable cause is one diode shorting and blowing one fuse. Refer to “Charger DC Fuse Blows” for procedures to check the diodes. If a diode is shorted, both the failed diode and the failed fuse assembly must be replaced.

If testing shows the diodes to be good, check for a short circuit of the transformer coils. See “the transformer has a short or burnout”, for test procedures.

Charger DC Fuse Blows

The charger fuse consists of two fusible links mounted in a single assembly and the charger front panel. Each fuse link is electrically connected in series with one diode to provide protection for the transformer in the event of failure of the diode.

Fuse links may blow because of either a reversed polarity between the charger and the batteries or a short circuit failure of one or both diodes. Excessive heat due to a loose internal fuse connection can also cause one or both fuse links to blow.

1. Check for reversed polarity (which normally causes both fuse links to blow) by checking for:

   A) Incorrect installation of batteries, or improper wiring. Consult the wiring diagram.

   B) Faulty wiring of the charger output leads. If both are correct go to next step.
2. Unplug the AC supply cord.
3. Disconnect the DC output leads from the batteries.
4. Remove the charger from the vehicle.
5. Disconnect one transformer secondary coil lead from the diode terminal (Ref Fig. 6 on page H-7).
6. Connect one lead of a low-voltage continuity tester to the diode mounting plate and the other lead to a diode terminal. Note the reading.
7. Reverse the tester leads and check the diode again. Perform the test-and-reverse procedure for each diode. If a diode conducts current in both directions, the diode is shorted and the entire heat-sink assembly with diodes must be replaced.

If the above steps fail to reveal the malfunction, check the wiring of both the charger and the battery connections against their respective wiring diagrams.

Electronic Timer Testing

NOTE *Batteries must have 70% of nominal voltage for the electronic timer to start and charger to operate properly.*

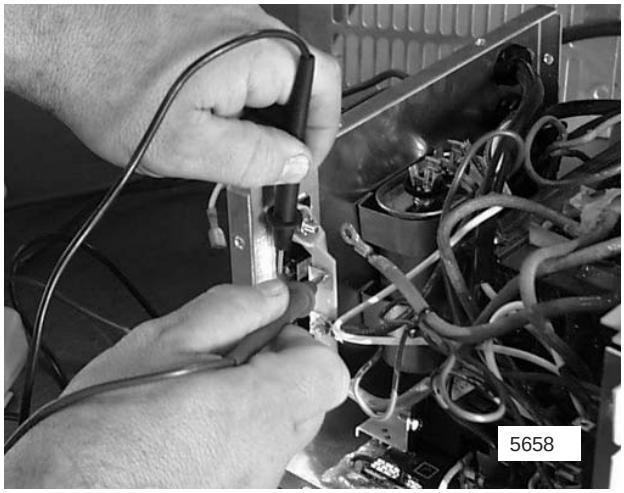


Fig. 6 Voltage Test

If the battery pack has discharged below the 70% rate as specified above, the automatic charger will NOT charge the battery pack. Use a mechanical trickle charger to charge the pack up to nominal voltage before the automatic charging process takes effect.
For example, you may hook two of 6 volt batteries in series to allow charging by an automotive-style 12 volt charger. Charge the remaining two batteries to bring the entire pack up above nominal.

If the electronic timer fails to turn off after 18 hours (maximum). Verify that the green wire from the electronic timer and the secondary transformer lead are securely connected to the diode lead. If the green wire is loose or disconnected, the timer will not turn off. If the connection is secure and the electronic timer will not turn off, the electronic timer has failed and needs to be replaced.

A simple verification procedure, using a DC voltmeter capable of reading in increments of 0.001 volts, is to charge the batteries normally and connect the voltmeter to the battery terminals after the charge rate has tapered to its lowest point. The electronic timer should shut off if an hourly check of the reading shows increases of less than 0.012 volts, or if it shows a voltage decrease between readings. If the timer does not shut off, a malfunction is indicated and the electronic timer must be replaced.

The electronic timer may be bypassed in order to verify that a malfunction exists:

1. Unplug the charger AC supply cord from the outlet, and disconnect the DC output connecter from the battery connecter. Remove the charger from the vehicle.

2. Place a jumper wire between #1 and #3 on the electronic timer. The AC cord is now connected directly to the primary transformer coil and the transformer should hum when the AC supply cord is connected to an outlet (Ref Fig. 7 on page H-8).

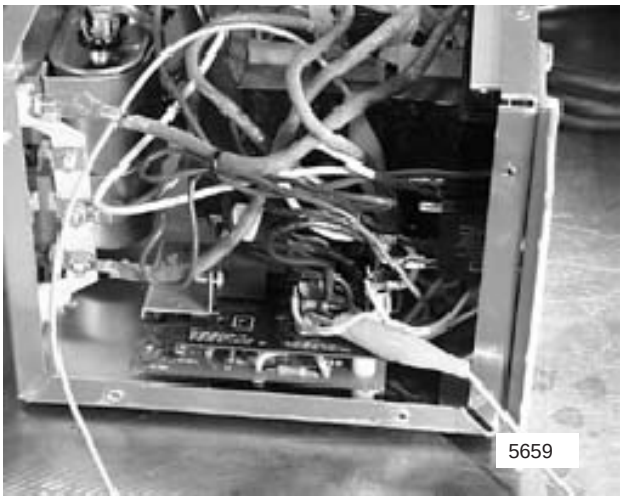


Fig. 7 Jumper Wire

3. Reconnect the charger DC output connecter to the battery connecter and then connect the AC power supply cord to an outlet. If the transformer hums, and the ammeter registers normal charging current, the electronic timer is defective and must be replaced.

   Do not operate the charger with the electronic timer bypassed. The charger will remain on as long as the AC supply cord is connected to an outlet. Severe overcharging and eventual damage to the batteries will result.

   If the electronic timer has been bypassed or replaced and still no hum is noticed, a continuity test of the AC circuit is necessary. Go to next step.
4. Disconnect the AC supply cord from the outlet and the DC output connectors from the batteries.
5. Use a suitable continuity tester to check the circuit across the AC plug prongs. **The circuit should be incomplete**. If it is not incomplete, individually check the AC cord, timer and all connections.

Testing The Charger

After installing the electronic timer, the charger may be checked for proper operation as follows:

1. Install the charger in the vehicle.
2. Disconnect the DC output leads from the batteries.

NOTE ***Do not*** *allow leads to contact each other or other items.*

3. Insert the AC supply cord into an outlet. The charger should not turn on, and the voltage at the DC output leads should be zero.
4. Unplug the AC supply cord, then connect the DC output leads to the batteries. After 2 to 5 seconds, you should hear a “Click” as the relay closes.
5. Plug the AC supply cord into an outlet. Charge batteries in the normal manner, monitoring the charger to ensure that it turns off after the charging period. If the charger fails to charge properly, consult the wiring diagram and check for incorrect wiring.

The Transformer Is Silent

1. Check the AC cord to be sure it is securely plugged into a live AC outlet. Avoid two or three-pronged adapters if possible, because these will work loose and give a poor connection.
2. If possible, measure voltage at the outlet to ensure power availability. Plug in a functioning electrical device to test the power if necessary.
3. If there is AC power at the outlet, disconnect the AC cord from the outlet and the DC output connectors from the batteries. Bypass the electronic timer (as described on page 40), and use a suitable continuity tester to check continuity across the prongs of the AC cord. With the electronic timer bypassed, the circuit should be complete.
4. If the circuit is complete, consult the wiring diagram and check the relay wiring and all connections.

   If the circuit is not complete, check the wiring of AC cord, the transformer primary coil leads, and the electronic timer.

   If the charger is wired correctly, individually test the continuity of the power supply cord, transformer primary coil and relay.

An AC Line Fuse Or Circuit Breaker Blows

1. Disconnect the AC supply cord.
2. Check to be sure the charger is properly wired.
3. If the wiring is correct, connect the continuity tester across the AC plug prongs. If the circuit is complete, the AC cord is shorted and must be replaced. If the circuit is not complete, check the transformer by following the procedures under “The Transformer Has A Short Or Burn Out”.

Capacitor Quick Test

⚠ WARNING ⚠ ***NEVER touch capacitor terminals with uninsulated tools or probes, or with any part of your body, because the high voltage in the capacitor coil can cause serious injury due to electrical shock.***

To quickly test the capacitor:

Equipment needed: Ohmmeter, with X5 or X10 scale

1. Disconnect the power supply cord from its outlet, and the DC output connectors from the batteries.

NOTE ***Do not*** *allow leads to contact each other or other items.*

2. Remove the charger from the vehicle.

NOTE *Use a resistor or 12 volt load to discharge capacitor.*

3. Disconnect one coil lead from the capacitor, being very careful not to break the wires.
4. Connect one lead from the Ohmmeter to the capacitor.
5. Watch the Ohmmeter reading as you connect the other lead to the capacitor.

a. **If the needle registers a very low resistance**, the capacitor has failed in shorted mode and is no longer serviceable.

b. **If the needle does not move**, the capacitor has failed in the open mode and is no longer serviceable.

c. **If the needle "bumps"** (registers a significant voltage, then drops down to a lower reading), it indicates that the capacitor is storing voltage and has not failed.

If you are unsure whether the needle bumped up or not, reverse the leads and watch the meter as the second lead is touched to the capacitor. The bump should register clearly, because a negative voltage is being combined with a positive voltage.

The Transformer Has A Short Or Burn-out

Failure of the transformer may be caused by natural aging or premature shorting of adjacent coil turns or over heating damage. A low or complete lack of output would be observed, but the transformer may hum when the charger is on.

The most common cause of transformer over heating and premature burn-out is the result of misuse, connecting the charger to a battery system of low voltage than specified on the charger.

Darkening of all the transformer secondary coil windings is an indication of possible over heating damage. A low or complete lack of output would be observed on the ammeter, however the transformer may hum or the AC line fuse of circuit breaker may blow when the charger is turned on.

To test the transformer, disconnect the power supply cord from its outlet and the DC output leads from the batteries. Then disconnect the transformer secondary coil leads #1 and #4 from the diode terminals and disconnect the transformer capacitor leads from the capacitor terminals. Use care when disconnecting the capacitor leads so the wires do not break.

⚠ WARNING ⚠ ***HIGH VOLTAGE: With the charger operating, the charger capacitor voltage is approximately 650 volts AC. Use extreme caution when working near capacitor terminals.***

In order to apply AC power directly to the transformer primary coil the Electronic Timer Kit must be bypassed.

With Electronic Timer Kit bypassed and taking care for personal safety, connect the power supply cord to an outlet. If the AC line fuse or circuit breaker blows, the transformer is shorted internally and must be replaced. If this does not occur, check the transformer secondary and capacitor coil voltages using a suitable AC voltmeter. If the measured voltages are substantially lower than those shown, the transformer is shorted internally and must be replaced.

If the transformer secondary coil voltage and the capacitor coil voltage check good, disconnect the power supply cord from its outlet. Check the capacitor to be sure its rating is 6 Mfd, 660 volts AC, and then carefully reconnect the capacitor coil leads to the capacitor terminals.

Then, taking care for personal safety reconnect the power supply cord to an outlet and measure the transformer secondary voltage again. The correct voltage is shown in figure b. if the transformer secondary voltage reading is the same as measured with capacitor disconnected, from figure a, the capacitor may be open or the capacitor terminals may not be making proper electrical contact. If the voltage readings are correct, both the transformer and capacitor are good.

If it should become necessary to replace a terminal on one of the transformer leads, the new terminal must be crimped and soldered.

NOTE *Some transformer leads may be aluminum wire and a solder must be used on these wires that is intended for use on aluminum, such as Alcoa #807 solder with Alcoa #69 flux. If these materials are not available locally, contact the Lester Electric Factory.*

Open Circuit Transformer Test

Failure of the transformer may be caused by natural aging or premature shorting of adjacent coil turns or over heating damage. The most common cause of transformer over heating and premature burn-out is the result of misuse, connecting the charger to a battery system of lower voltage than specified on the charger. Darkening of all the transformer secondary coil windings is an indication of possible over heating damage.

⚠ WARNING ⚠ ***HIGH VOLTAGE : With the charger operating, the charger capacitor voltage can be as high as 660 volts AC. Use extreme care when working near the capacitor terminals. High voltage can cause shocks, burns or death.***

Determine whether the transformer secondary coil is within factory specification (Ref Fig. 8 on page H-10).

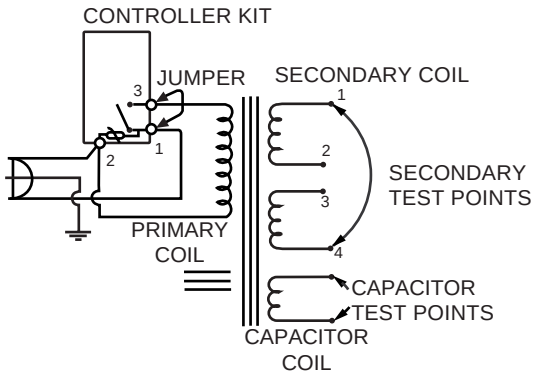
No Load Open Circuit Transformer Secondary Coil AC Voltage

Charger Voltage (Volts DC)	Qty. of Batteries In Series	Resonant Capacitor Connected	Resonant Capacitor Disconnected
24	4	54 To 66 Volts	36 To 44 Volts

Fig. 8 No Load Open Circuit Transformer Secondary Coil AC Voltage

The readings are approximate and the transformer failure is indicted when the measured voltages are significantly lower than those calculated in the table. DC voltages measured at the charging leads are about half the transformer test voltage amount.

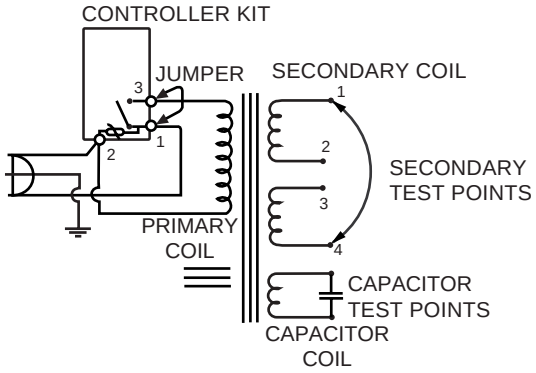
Transformer secondary voltage measurements made with the resonant capacitor connected can occasionally result in noticeably higher readings than expected. No-load transformer instabilities and peculiar wave shapes can increase these voltage readings. This is particularly true when using digital meters, as several models get confused with other than pure sine-wave AC or pure ripple free DC.



CHARGER NAME PLATE RATING	SECONDARY COIL VOLTS
	CAPACITOR COIL VOLTS
24 VOLT DC	APPROX. 38-42V AC
	APPROX. 410 - 470V AC

115 VAC MODEL CHARGERS

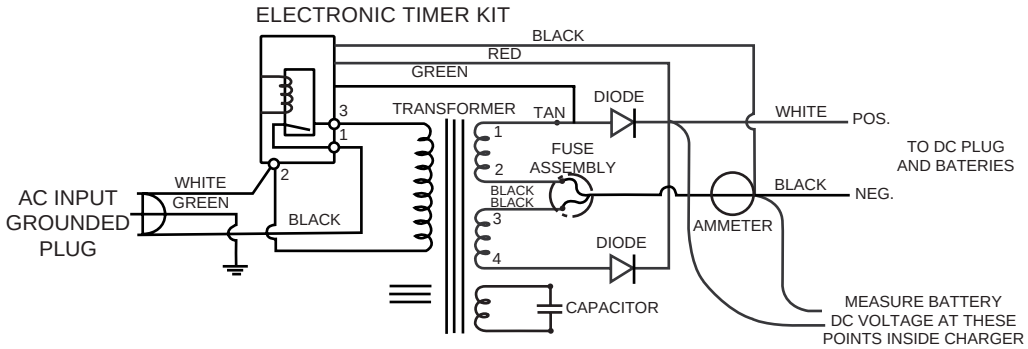
TRANSFORMER COIL VOLTAGE TEST
(without capacitor)



CHARGER NAME PLATE RATING	SECONDARY COIL VOLTS
24 VOLT DC	APPROX. 84 - 90V AC

115 VAC MODEL CHARGERS

TRANSFORMER COIL VOLTAGE TEST
(with capacitor)



CHARGER WIRING

Fig. 9 Charger Wiring

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

Notes:

BRAKES

J

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BRAKES

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BRAKES

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

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

GENERAL

The brake system is mechanical and consists of actuating linkages and manually adjusted wheel brake assemblies. The actuating linkages require periodic adjustment to compensate for the normal wear of system components. Replacement of any linkage components will also require a linkage adjustment.

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

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

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

DAILY BRAKE PERFORMANCE TEST

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

General

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

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

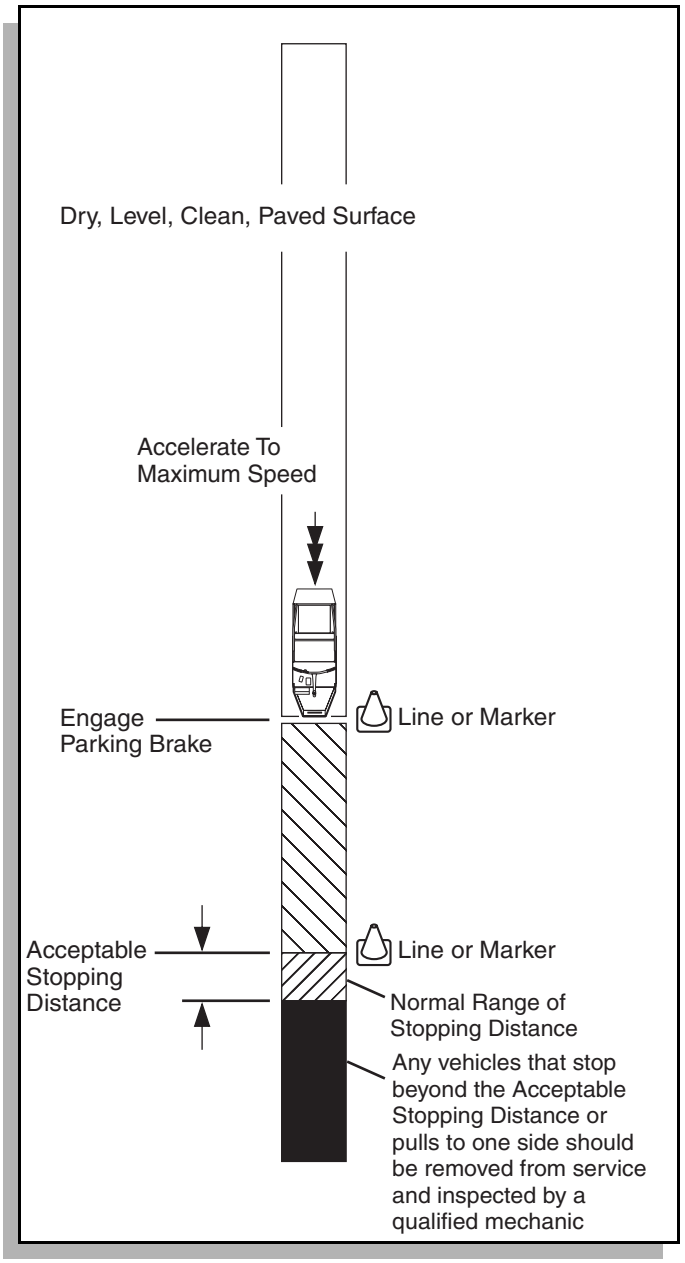


Fig. 1 Typical Brake Test

Test Method

On a dry paved surface that is free of gravel, sand, etc., approach a marker at full speed (Ref Fig. 1 on page J-1). Engage the service brake at the marker and observe the stopping distance of the vehicle. Any vehicle that stops in a significantly greater distance than an acceptable vehicle should be tested again. If it again fails to stop in an acceptable distance, it should be immediately removed from service and inspected by a qualified mechanic.

BRAKES

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

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

Test the vehicle before returning it to service.

SIX MONTH BRAKE SYSTEM MAINTENANCE

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

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

Remove the clevis pin from brake straps where it is attach to the wheel brake levers

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

Inspect the brake strap for damage. A damaged brake strap will result in the system dragging. Any worn out strap **must** be replaced. Operate the brake pedal and observe the movement of the strap. Both should move the same amount and return fully when the brake pedal is released. If the brake pedal does not return to the full upright position, excess pedal bushing friction is indicated or a system is in need of service. The bushing must be removed and lubricated or replaced. Observe the equalizer bar to see if it pivots during operation of the brake pedal. A pivoting equalizer bar, uneven movement or failure of the brake strap to return fully indicates a dragging brake system which **must** be repaired.

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

HOW THE SERVICE BRAKE WORKS

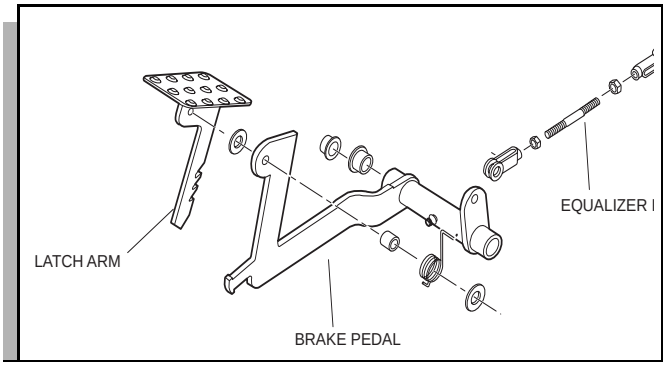


Fig. 2 Brake Pedal

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

Equalizer Link

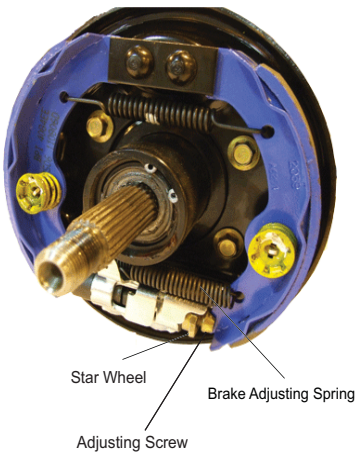
The equalizer link balances braking between the driver and passenger sides of the vehicle. Variations in wheel brake adjustment, strap friction and manufacturing tolerances may cause the equalizer to be slightly misaligned. This misalignment is normal.

Automatic Adjuster Mechanism

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

The wheel brakes are equipped with an automatic adjuster mechanism that is designed to compensate for brake shoe wear and eliminate the need for manual brake shoe adjustment. Do not manually adjust the brakes by prying back the adjuster arm and turning the star wheel. Permanent damage to adjuster will result Adjustment takes place only when the brake is fully applied and released while the vehicle is moving (Ref Fig. 3 on page J-3). It is very important that the brake

strap permit the brake levers to release fully when the brake pedal is in the released position.



Brakes adjust only while the vehicle is moving.

When the brake pedal is depressed, the brake lever (not shown in picture) moves toward the front of the vehicle.

The other end of the brake lever moves to the rear of the vehicle where it contacts the brake adjusting arm, causing it to move.

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

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

If the brake shoes have worn far enough to permit the brake adjuster arm to contact the next tooth of the star wheel, the star wheel will be advanced by the tension applied to the adjuster arm by the adjuster spring.

If the brake shoes have not worn enough to permit the brake adjuster arm to contact the next tooth of the star wheel, the brake adjuster arm will move on the flat of the star wheel. The star wheel does not rotate and no adjustment occurs.

Fig. 3 Wheel Brake Adjustment

How the Parking Brake Works

Depressing the brake pedal moves the latch arm against the catch bracket. As the brake pedal is depressed, the brake is applied until the notch in the latch arm engages with the catch bracket. The brake pedal is held in the applied (down) position by the catch bracket. The latch arm is held in position by the tension in the brake linkage. The Brake can be released by depressing the brake, which permits the spring loaded Brake pedal to return to its original position, disengaging the latch arm from the catch bracket. This is the preferred method which minimizes wear on components.

BRAKE DRUM AND SHOE REMOVAL

Brake Drum Removal

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

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

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

Remove the brake drum.

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

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

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

the braking surface.

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

Brake Shoe Removal

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

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

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

Remove the brake shoe retainer springs.

Grasp the brake shoes (3) in the center and tilt them outward and away from the back mounting plate. This will release the tension on the heavy shoe springs (4). Remove the brake springs and remove the brake shoes.Brake shoe installation is the reverse of removal procedure.

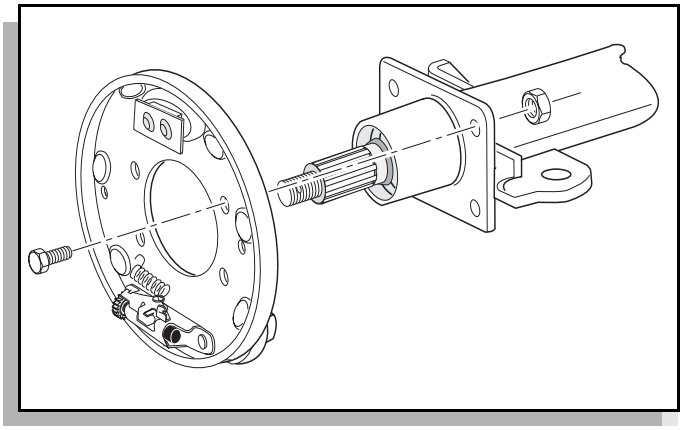


Fig. 5 Backing Plate Removal and Installation

NOTE *The brake manufacturer recommends to replace all springs, pins and retainer when new brake shoe is installed.*

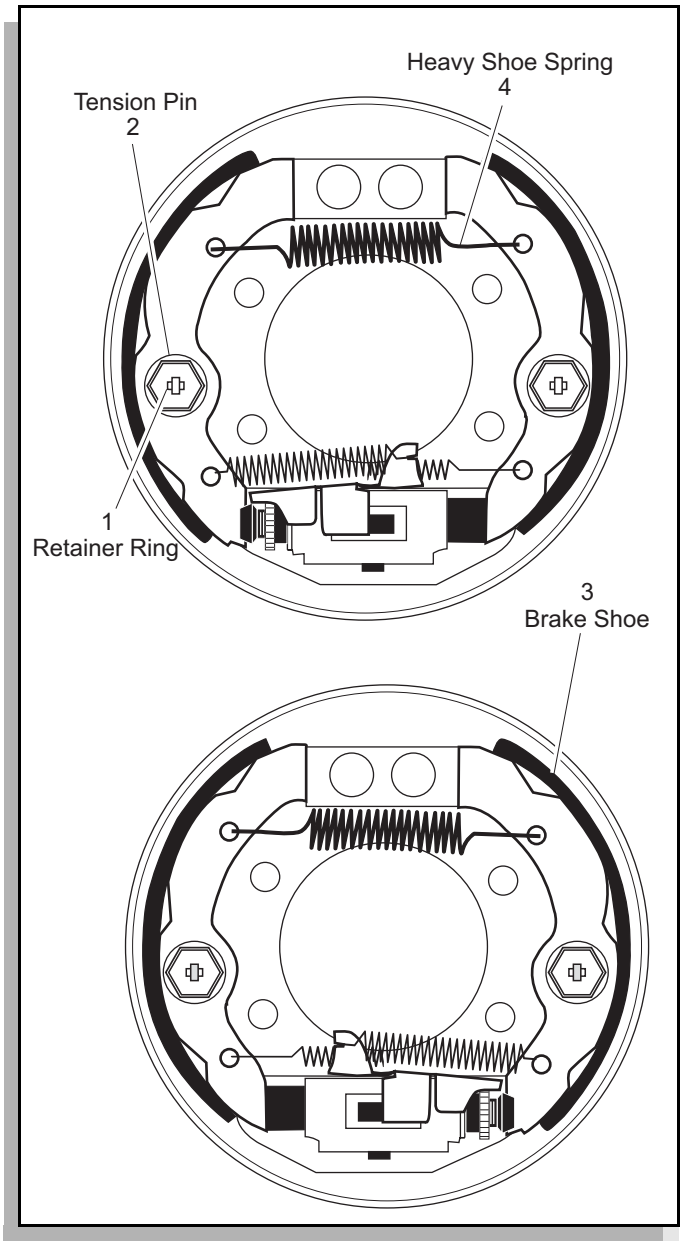


Fig. 4 Brake Shoes and Springs

Brake Removal

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

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

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

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

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

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

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

Brake Adjustment

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

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

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

Adjust the brakes as follows:

1. Loosen the nut securing the front clevis.
2. Remove the cotter pin.
3. Turn the clevis on the brake rod as required to achieve 1/4" (6.4 mm) pedal free travel. Free travel is movement of the brake pedal without activating the brake. Properly adjusted brakes should NOT drag when the wheels are turned.
4. Reinstall the clevis pin, washer and NEW cotter pin.
5. Tighten the clevis nut.

Brake Components

1. Brake Rod
2. Nut
3. Front Clevis

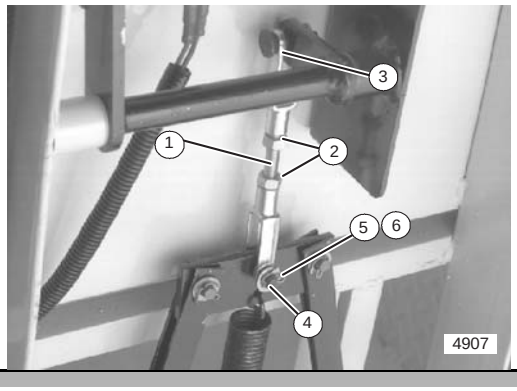


Fig. 6 Brake Components

4. Clevis Pin
5. Washer
6. Cotter Pin

Brake Repair/Replacement

⚠ WARNING ⚠ ***When it is necessary to raise the vehicle while working on the suspension system, jack the vehicle only at proper jacking points and support it with approved jack-stands, to prevent it from falling and causing injury. Do not rely on hydraulic or mechanical jacks, which might fall under continuous load.***

1. Raise the vehicle as needed for removal of the wheel and tire (as specified in the SAFETY section).
2. Remove the cotter pin and castle nut which secure the hub to the axle.
3. Remove the brake drum from the axle shaft.
4. Remove and service brake shoes as needed.
5. Replace the hub, drum, wheel and tire by reversing the removal procedure.

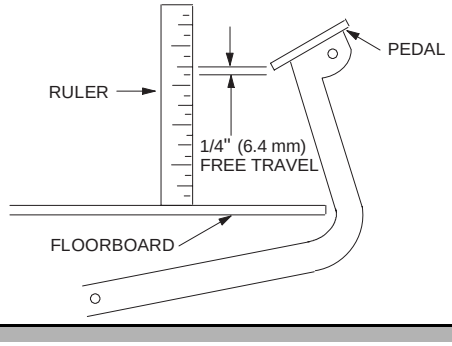


Fig. 7 Brake Dimensions

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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

REAR AXLE DISASSEMBLY

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

Handle all splines with extreme care.

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

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

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

Axle Shaft Removal and Disassembly

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

For brake drum removal, see BRAKES section.

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

Attach a slide hammer to the axle shaft thread and remove the axle and bearing from the axle tube (Ref Fig. 2 on page K-1).

Remove the bearing by supporting the inner race of the bearing on an arbor press bed and apply pressure to the threaded end of the axle shaft (Ref Fig. 3 on page K-2).

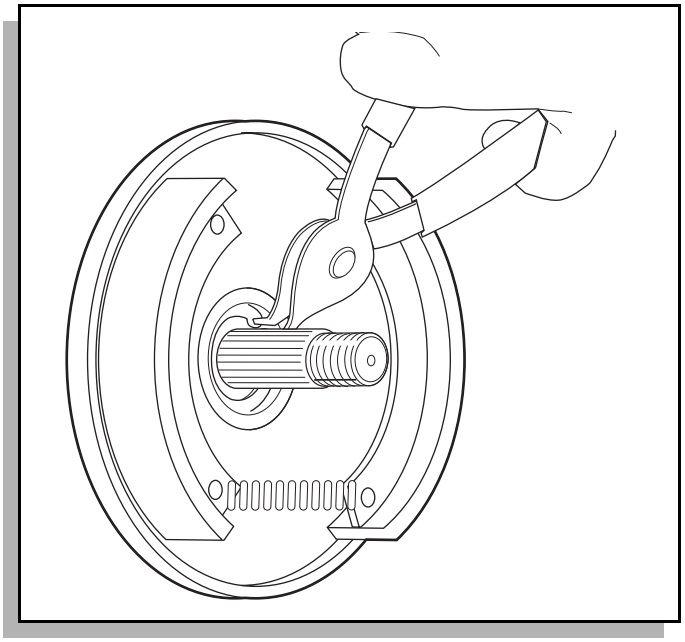

Fig. 1 Removing/Installing Outer Snap Ring

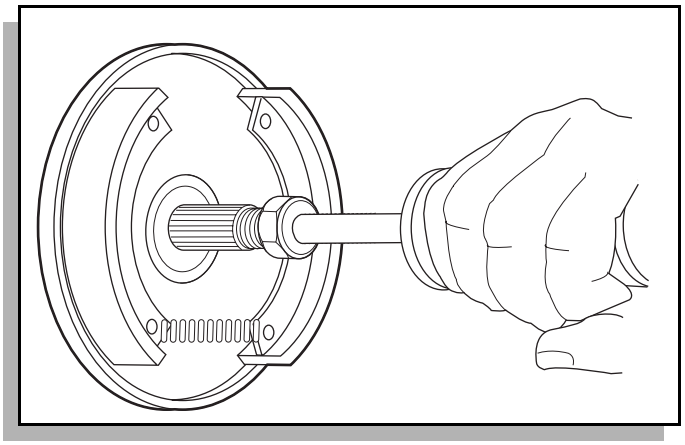

Fig. 2 Removing/Installing Axle Shaft

Axle Shaft Seal Removal and Replacement

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

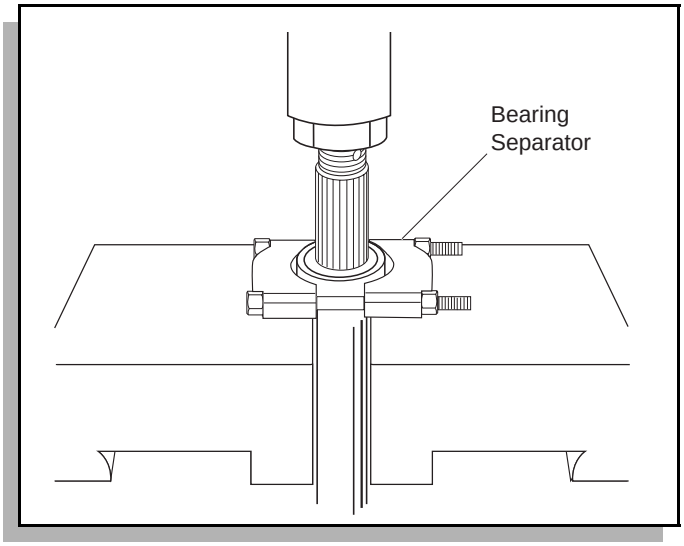

Fig. 3 Pressing Bearing from Axle Shaft

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

Remove the inner snap ring (Ref Fig. 4 on page K-2).

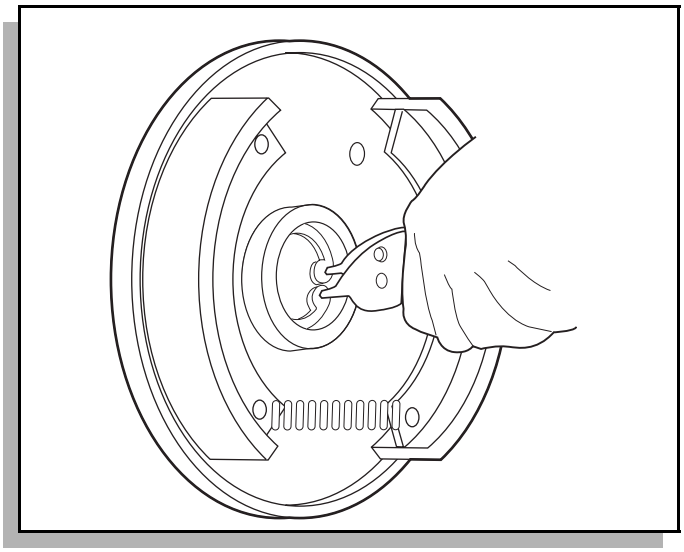

Fig. 4 Removing/Installing Inner Snap Ring

Use a puller to remove the seal (Ref Fig. 5 on page K-2).

To install the seal, use the special seal installer to drive the seal into its correct position (Ref Fig. 6 on page K-2).

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

Install the inner snap ring (Ref Fig. 4 on page K-2).

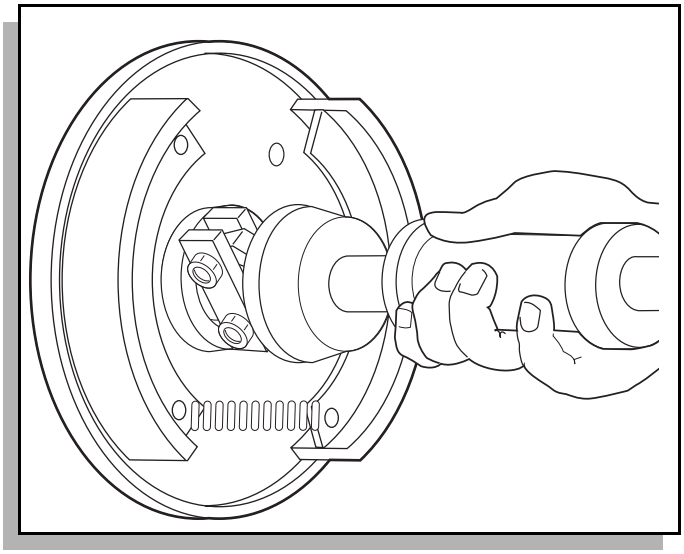

Fig. 5 Removing Seal

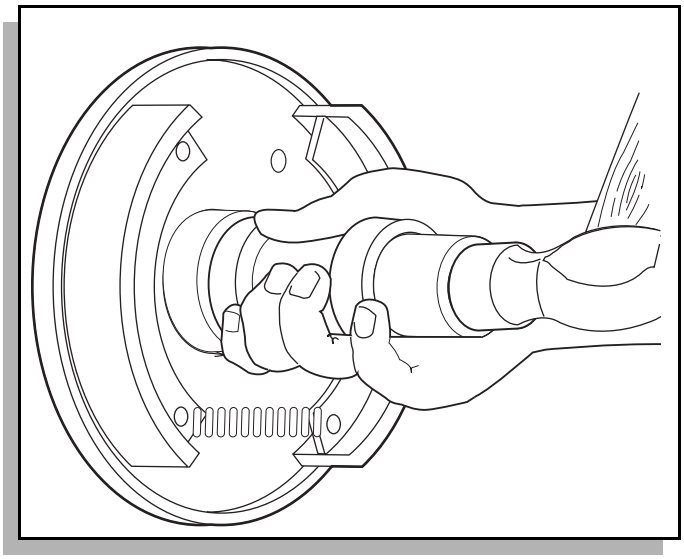

Fig. 6 Installing Seal

Axle Shaft Replacement

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

Coat the outboard spline of the axle with a commercially available anti-seize compound. Install the brake hub and drum, thrust washer, nut and new cotter pin (Ref Fig. 7 on page K-3).

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

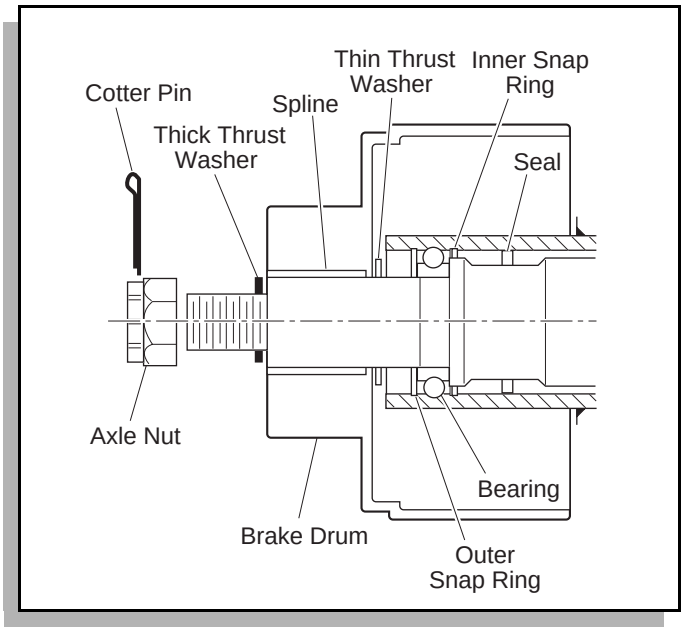

Fig. 7 Cut Away of Outer Bearing and Brake Drum

REAR AXLE

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

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PAINTING

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

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

Wear eye protection and respirator, following manufacturers instructions to protect from overspray and airborne mist.

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

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

Minor Scratches

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

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

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

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

IV. Clean with alcohol and dry.

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

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

Larger Scratches

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

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

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

III. Apply spray touch up paint in light even overlapping strokes. Multiple coats may be applied to provide adequate coverage and finish. Always remember to shake the can for a minimum of one minute to mix the paint and achieve the best color match.

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

V. Clean with alcohol and dry.

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

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

Complete Panel Repair

In situations where large panels or areas must be painted, touch up paint is not recommended. In such cases professional painting is called for. If the decision to repaint is taken, the task can be accomplished by any paint and body shop with experience in painting steel panels. All body shops should be familiar with the materials and processes required.

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

PAINT

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

Notes:

LIGHTNING PROTECTION AND GROUNDING

M

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LIGHTNING PROTECTION AND GROUNDING

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LIGHTNING PROTECTION AND GROUNDING

M

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 manmade features that may have a significant effect upon the efficiency of the grounding system. Based on the information gathered, deviations from this specification (Exceeding normal requirements) may be necessary in order to achieve desired results.

7. Materials

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

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

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

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

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

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

8. Earth Electrode System

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

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

9. Lightning Protection System

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

10. Equipment Fault and Personal Safety System

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

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

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

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

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

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

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

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

UL 1449 Listed device

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

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

Internally fused for safety

Failure mode indicator lights

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

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GENERAL SPECIFICATIONS

N

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GENERAL SPECIFICATIONS

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GENERAL SPECIFICATIONS

N

ELECTRIC POWERED THREE WHEEL SERVICE VEHICLE

BATTERY MONITORING	LED State of charge meter
BATTERIES	Four 6 volt deep cycle (105 minute minimum, 180 amp-hour @ 20 hour discharge rate)
SPEED CONTROLLER	Programmable Solid state, 250 amp capacity
MOTOR	24 VDC, series wound 1.5 hp (1.1 kW) @ 2800 rpm & 4.3 hp (3.2 kW) @ 1600 rpm, brazed armature and solid copper windings
REAR AXLE	Bevel gear with spur and helical gear reduction
BRAKES	Dual rear wheel, self adjusting mechanical drum brakes
PARKING BRAKE	Toe lock combined with service brake
FRONT SUSPENSION	Rubber mounted torque arm
REAR SUSPENSION	Coil springs and hydraulic shock absorber
STEERING	Handlebar connected directly to front fork
SEATING	Driver and rear facing passenger
TOTAL LOAD CAPACITY	Includes operator & cargo 450 lbs. (204 kg)
SPEED	11 mph (18 kph)
CHASSIS	Welded tubular steel; powder coated (Durashield™)
VEHICLE PROTECTION	None
BODY	Diamond pattern body with Durashield™ Industrial Yellow powder coat paint
STANDARD COLOR	Industrial Yellow
LOAD BED	22 3/4" (58cm) x 28 1/2" (72cms) x 4" (10cms)
LOAD BED FEATURES	Removable panel for powertrain access
LIGHTING (Standard)	Rear brake light
TIRES (Standard)	4.80 x 8 Industrial Load Range B
TIRE PRESSURE	60 psi (415 kPa)
WEIGHT (with batteries)	690 lbs. (315 kg)
OPERATING CONTROLS & INSTRUMENTATION	Removable key, 'deadman' accelerator control, direction selector, audible reverse warning
BATTERY CHARGER	Lestronic II built-in 24 V, 120 VAC, fully automatic, line compensating, 25 amp DC output at 24 volts, 60 Hz, UL recognized, CSA certified
RANGE (Nominal)	35 miles (56km) max

Specifications subject to change without notice* Specifications subject to change without notice.

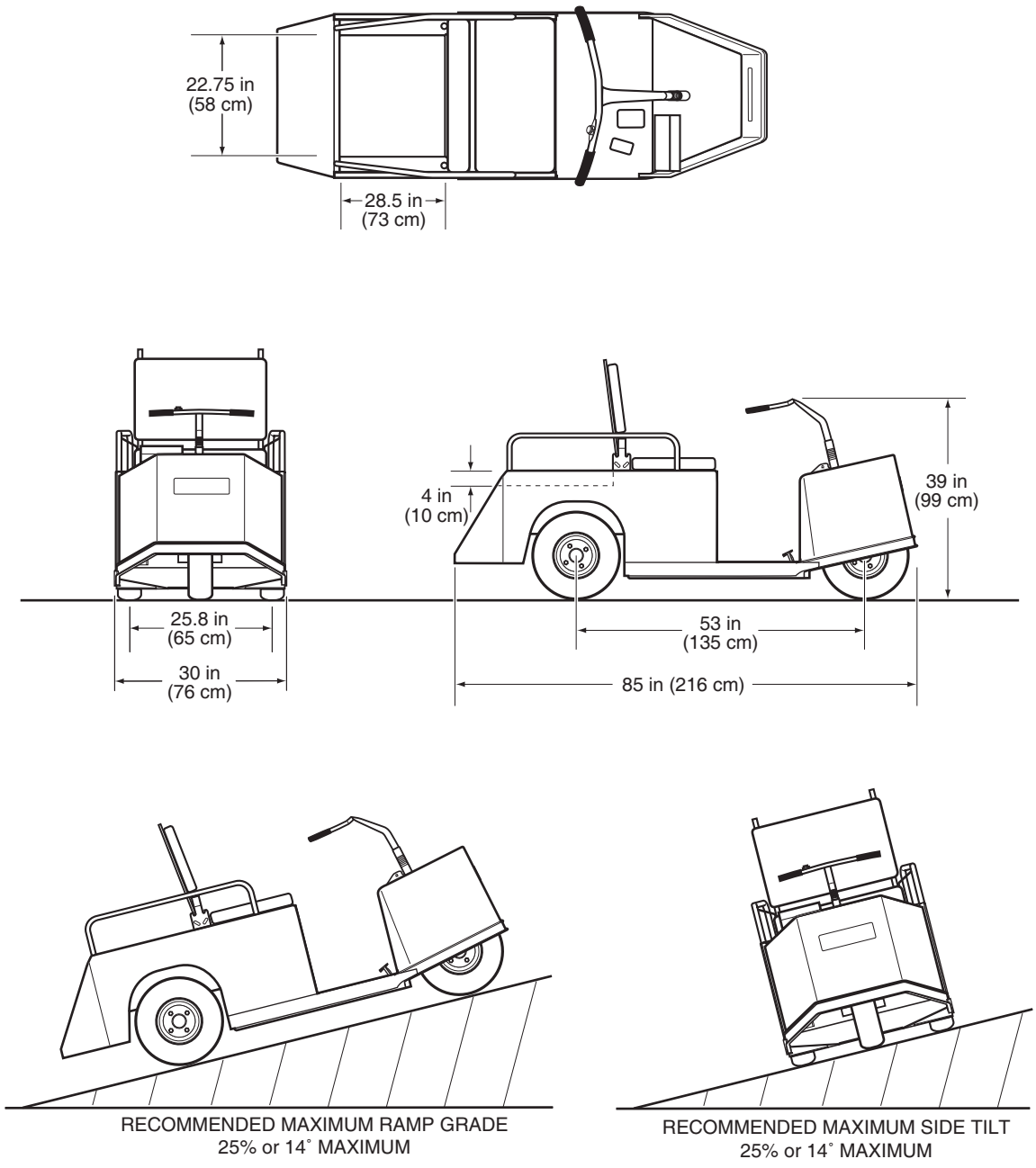

Fig. 1 Vehicle Dimensions and Incline Specifications

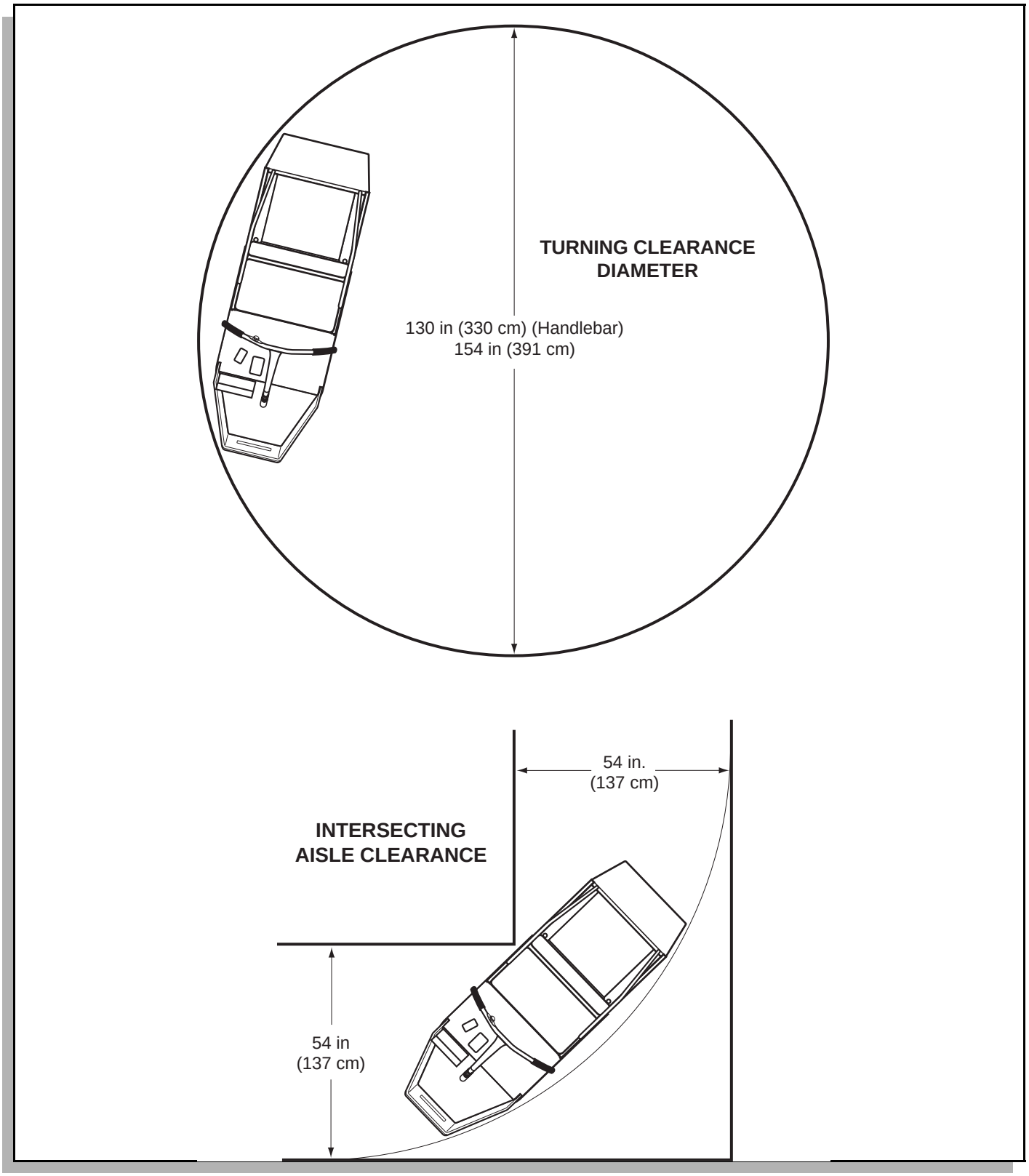

Fig. 2 Vehicle Turning Clearance Diameter and Intersecting Aisle Clearance

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STEERING AND SUSPENSION

P

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STEERING AND SUSPENSION

P

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

STEERING

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

Tool List **Qty. Required**

Floor jack 1
Jack stands 2
Wheel chocks 4

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

⚠ WARNING ⚠ ***To reduce the possibility of personal injury, follow the lifting procedure in Section 'B' of this manual. Place wheel chocks in front and behind the rear wheels and check the stability of the vehicle on the jack stands before starting any repair procedure. Never work on a vehicle that is supported by a jack alone.***

HANDLEBAR STEERING

Standard steering on the Minute-Miser model is by handlebar. There are no gears or steering sectors to be adjusted.

FRONT WHEEL

Front Wheel Removal

Tool List **Qty. Required**

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

While holding nut (item 1), remove nut (item 2) securing axle (item 3) to front fork (item 4) (Ref Fig. 1 on page P-1). Remove lock washer (item 5) and flat washer (item 6). Repeat on other side of front fork. Remove axle assembly from front fork.

Front Wheel Installation

Front wheel installation is the reverse order of removal.

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

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

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

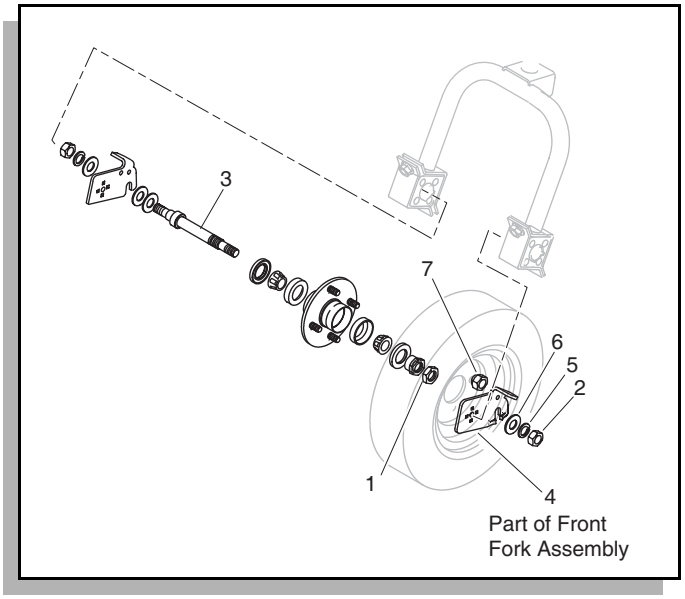

Fig. 1 Front Wheel Removal

MAINTENANCE

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

Lubrication

Tool List **Qty. Required**

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

Lubricate vehicle per schedule contained in Section 'A'.

Wheel Bearing Inspection

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

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

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

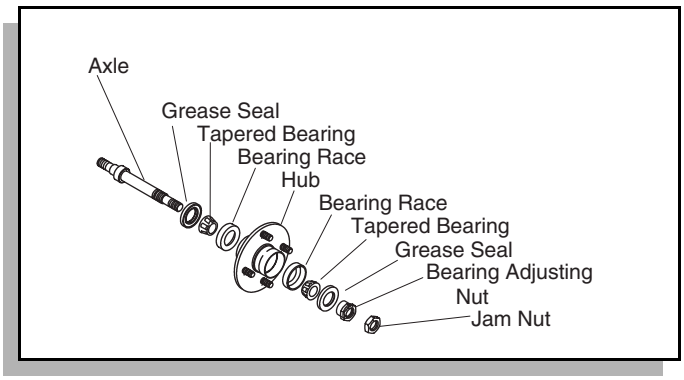

Fig. 2 Front Axle Assembly

Packing Wheel Bearings

The front wheel bearings are tapered roller type and must be packed with grease at installation or any time the bearing is removed for inspection. It is recommended that a bearing packer attached to a grease gun be used; however, manual packing is acceptable if done correctly. Packing a bearing manually requires placing a dab of grease in the palm of the hand and dipping the bearing in the grease. Force the grease up through and around all of the rollers until the entire bearing is coated in grease. Fill the area between the rollers with grease and apply a light coating to the bearing race. Install bearings into hub.

Seal Installation

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

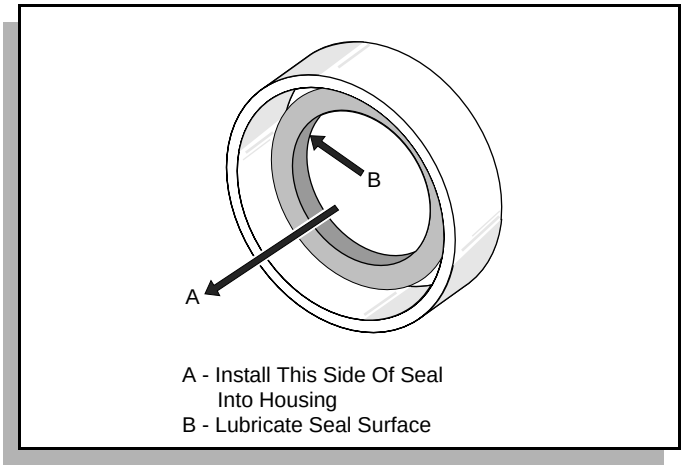

Fig. 3 Seal Installation

Bearing Adjustment

Assemble axle bearings and grease seals in hub (Ref Fig. 2 on page P-2). Assemble wheel and tire with lug nuts (item 1). Tighten wheel nuts (item 1) to 70 - 100 ft.lbs. (95 - 140 N.m.) torque. Install axle assembly into front fork (item 6) using jam nut (item 3) flat washer (item 6), lock washer (item 7) and nut (item 8) (Ref Fig. 4 on page P-3). Rotate the hub while tightening the inner (bearing adjusting nut) (item 2) until drag can be felt while rotating wheel. **Slightly** loosen the bearing adjusting nut to permit free movement of the wheel but with no lateral play. Loosen the jam nut (item 3) and while holding the bearing adjusting nut (item 2) firmly, tighten the jam nut against the bearing adjusting nut to 15 - 30 in. lbs. (1.69 - 3.39 Nm) torque.

Tighten outer jam nuts to 70 - 80 ft. lbs. (95 - 105 Nm) torque while holding inner nuts with a wrench.

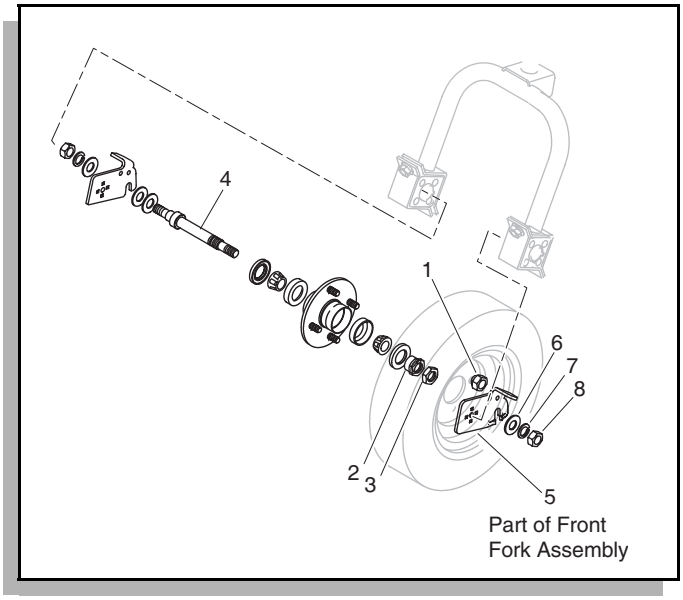

Fig. 4 Front Wheel and Bearing Installation

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

Fork Bearing Inspection

Tool List	**Qty. Required**
Floor jack	1
Jack stands	2
Wheel chocks	4
Grease	A/R
Wrench, 15/16"	1
Wrench, 1 1/2"	1

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

Remove the nut (item 1), washer (item 2), boot (item 3) and handlebar (item 4). Remove the jam nut (item 5), spindle nut (item 6) and remove fork assembly (item 7). The bushings (item 8) may now be removed. Inspect the fork assembly shaft (item 7) and the bushings (item 8) for excessive wear and replace if required (Ref Fig. 5 on page P-3).

Inspect the V ring (item 9), Thrust washer (item 10) and rubber washer (item 11) for wear or deterioration and replace if required.

Installation is the reverse order of disassembly. Tighten the spindle nut (item 6) until the fork assembly (item 7) moves freely but without vertical motion. Tighten the jam nut (item 5) firmly and confirm that the adjustment is still satisfactory.

Install the woodruff key (item 12) and position boot (item 3) over nuts. Locate handlebar (item 4) over woodruff key and secure with nut item (item 1). Tighten firmly.

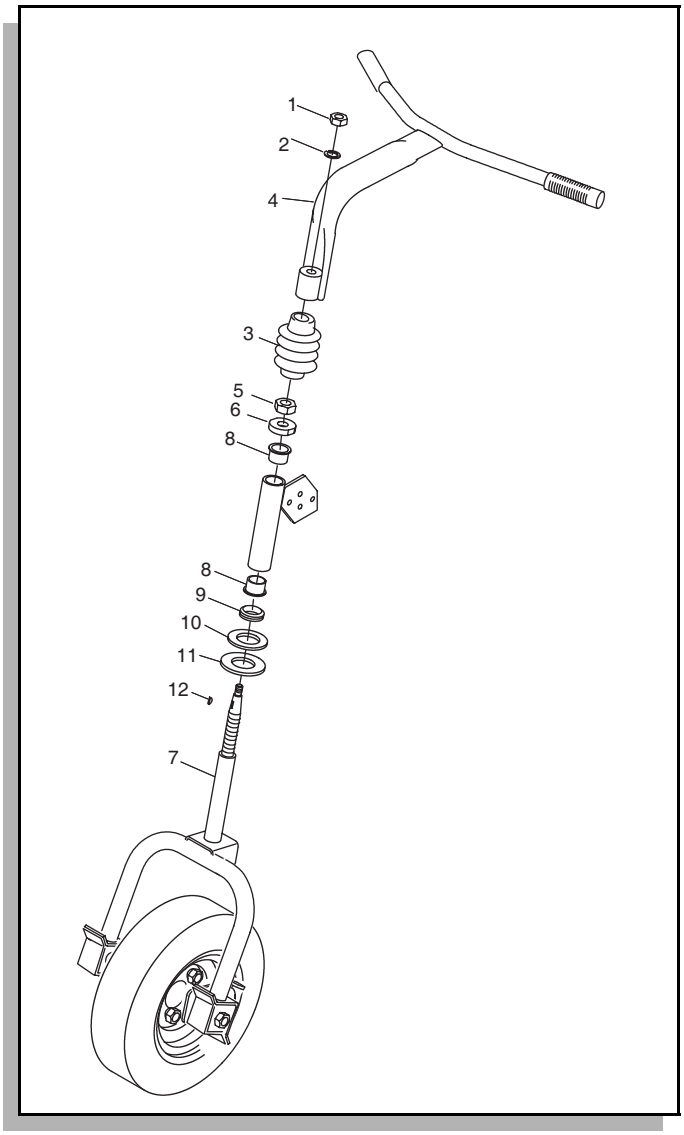

Fig. 5 Fork, Hub and Handlebar Components

Wheel Steering

Fig. 6 Steering

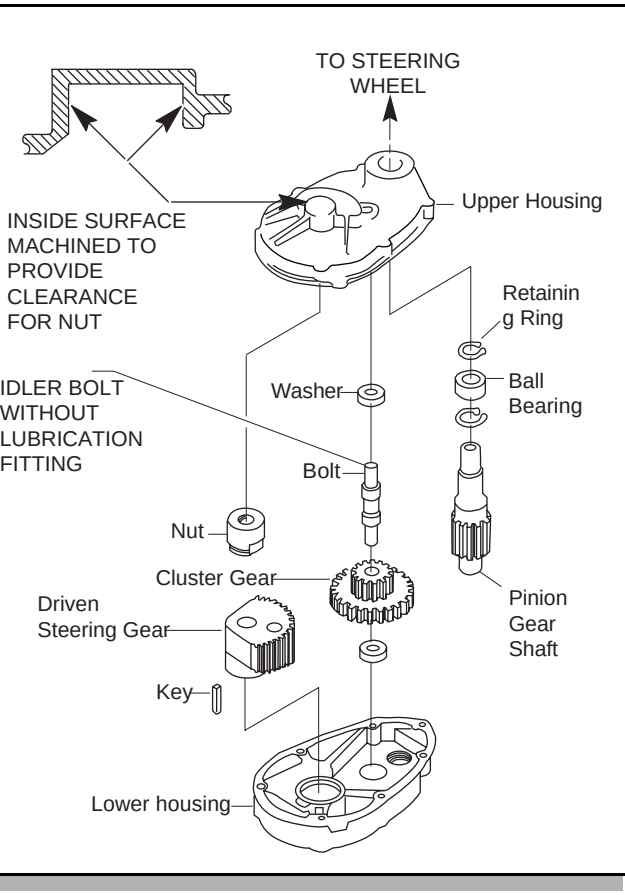

Fig. 7 Steering Components

Gear Drive Adjustment

Normal wear of steering parts will require backlash adjustment only.

Adjust backlash as follows:

1. Make sure the weight of the vehicle is on the wheels, or hold the front wheel to prevent the fork from turning.
2. Loosen the upper and lower idler bolt adjusting nuts, ten turn the steering wheel counter clockwise and hold it with light pressure.
3. Snug the lower idler adjusting nut and then upper adjusting nut. Use a socket wrench with at least 4" (102mm) extension.
   Care must be taken to avoid cocking the idler bolt.
4. With slight pressure on the steering wheel in a counter clockwise direction, tighten the lower nut to 40- 50 lbs. ft. (54Nm-70Nm) torque.
5. Check backlash for a maximum of 1/4" (6mm) travel of the steering wheel rim, then tighten the upper adjusting nut to 40-50 lbs. ft. (54Nm-70Nm) torque.
6. Check the steering for free operation. A slight amount of roughness is permitted after the front fork and wheel has rotated either direction 15 degrees. It is better to have the allowable roughness than the maximum permitted backlash. If it is necessary to readjust the idler bolt, the locating washers must be rotate4d to prevent the serrations from falling into the same mark.

Disassembly And Repair

⚠ WARNING ⚠ ***Inspect all gears and splines for wear or damage. If the wear or damage is excessive, replace with new parts. Also inspect the pinion for wear.***

1. Remove the steering wheel from the pinion gear shaft.
2. Remove the top nut and washer from the idler bolt. Remove the gear case retaining screws, and lift the case off.
3. Remove the driven gear nut. The gear may now be removed by using a 1/2 x 20 knockoff.
4. Remove the lower nut and washer from the idler bolt, and lift the cluster gear and idler bolt from the lower case.

5. Replace worn gears as required. Replace the roll pin in the sector gear or driven gear, if required, to provide adequate stops as the steering wheel is turned.

   A.)When the driver gear is reinstalled, make sure the correct keyway is used (Ref Fig. 8 on page P-5).

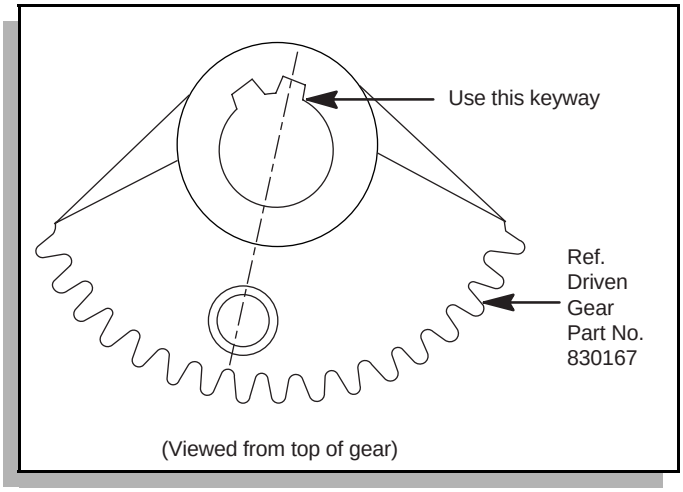

Fig. 8 Gear

   B.)Place a liberal amount of lithium base pressure gun lubricant in the upper housing cavity above the steering bushing nut, in the recess in the idler bolt, in the gear teeth and on all ball bearing surfaces.

   Correct positioning is crucial to proper adjustment and function of the steering system.

   Torque the steering bushing nut or nut securing the driven gear, 40 to 50 lbs. ft. (50Nm to 70Nm).

6. Adjust the height of the lower housing until the bottom of the driven gear teeth are 0.050" to 0.080" (1.27 to 2.03mm) above the top of the cluster gear teeth at the large diameter. Tighten the support mounting screws.

7. Rotate the front fork and wheel to check the gear alignment. If a smooth, free turning movement is NOT achieved, loosen the three screws attaching the lower housing until a smooth-turning fork is achieved.

   Tighten the hardware securing the lower housing to the support brackets to 3 - 4 lbs. ft. (4Nm – 5Nm) torque and recheck by rotating the fork and wheel.

   Additional adjustments is allowed by loosening the hardware attaching the supports to the spindle brackets; however, when adjustment is required, it may be necessary to remove the upper housing assembly and readjust the lower housing to provide proper positioning as explained above and shown in step 6.

8. After completing step1 and step 2, tighten the attaching hardware in the following sequence:

   A.) Tighten the seven 1/4 - 20 upper housing - to - lower housing screws to 8 to 10 lbs. ft. (11Nm to 14Nm) torque.

   Tighten the five 3/8 - 16 lower housing and support bracket screws to 20 to 25 lbs. ft (27Nm to 34Nm) torque.

9. Tighten the nut securing the steering wheel to the steering shaft before the vehicle is placed into service. The correct torque is 40 lbs. ft (54Nm).
   Refer “Gear Drive Adjustment” section on previous page for backlash adjustment.

SPRINGS

Front Springs

Fig. 9 Front Spring

The Minute-Miser uses rubber torsional mounts as front springs. Replace the mounts by using the following procedure:

1. Raise the vehicle as required for removal of the front wheel assembly.

2. Loosen the axle nuts and lower the entire wheel, hub and axle assembly from the front fork.

3. With tire and wheel removed, remove the flange bolt and washer passing through the center of the rubber suspension mount.

4. Remove the two clamping bolts and nuts, remove the clamp (Ref Fig. 9 on page P-5).

5. Remove the rubber torsalastic spring.

6. Reverse the procedure for reassembly.

Rear Springs

1. Raise the vehicle as necessary to relieve tension on the springs.

2. Remove the nuts which secure the shock to vehicle and to the power frame. Note the orientation of the special cupped washers, so they can be installed the same way.

3. Remove the nut which secures the bottom spring retainer disk to the power frame assembly.

4. Raise the rear of the vehicle, following the power frame to swing down.

5. Loosen or remove the nuts which secure the spring retainers to the vehicle body.

6. To reinstall, insert the upper spring retainer disks into the top ends of the springs. Turn them until the end of the spring coil extends 1/4" beyond the edge of the flange, and install them into the vehicle frame.

7. Insert the spring bumpers into the springs, then reinstall the lower spring retainer disks by turning them into the bottoms of the springs until the end of the spring coil extends approximately 1/4" beyond the edge of the retainer disk flange (Ref Fig. 10 on page P-6). Tighten the nuts to hold them to the power frame.

8. Lower the vehicle to compress the springs and allow reattachment of the shock absorber.

9. Reconnect the shock absorber, with the edges of the cupped washer against the shock absorber and their centers bowed away from the shock absorber.

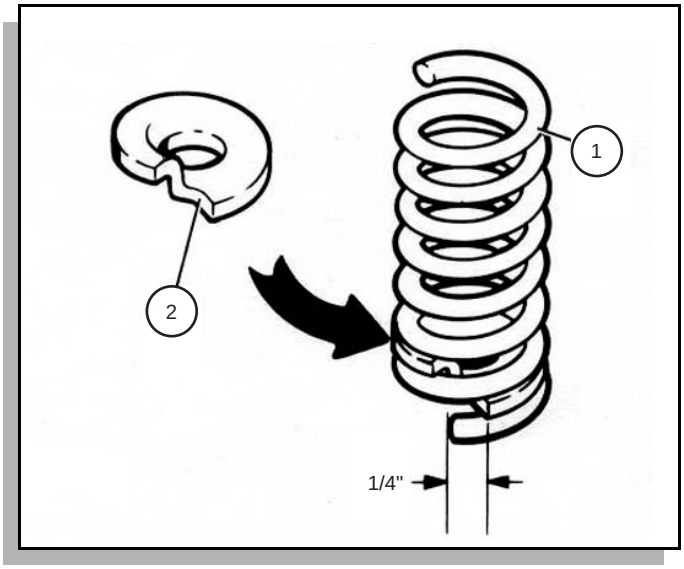

Fig. 10 Spring

Shock Absorber

1. Remove the lock nuts and cupped washers securing the shock absorber to the mounting studs. Note the direction of curvature of the special cupped washers.
2. Raise the rear of the vehicle enough to relieve pressure on the shock absorber, and remove it from the vehicle.
3. Reverse the procedure to reinstall the shock absorber.

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

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

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

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

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

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

All travel should be directly up or down hills.

Use extra care when driving the vehicle across an incline.

Stay in designated areas and avoid steep slopes.

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

Avoid extremely rough terrain.

Check area behind the vehicle before operating in reverse.

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

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

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

See GENERAL SPECIFICATIONS for standard vehicle load capacity.

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

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

It is virtually impossible to anticipate all possible component failures or the manner in which each component may fail.

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

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

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

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

Use care not to touch hot objects.

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

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

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

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

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