COLUMBIA®

# Owner and Operator Manual

## EX-21 EXPEDITER Electric Vehicles

P/N 709447-03 7/2012

## *Preface*

*Welcome, and congratulations on your choice of vehicle from Columbia ParCar Corp.!* Your vehicle has been designed and manufactured to conform to applicable sections of ANSI B56.8. Your safe use and operation of your vehicle is important to us. Any alteration of your Columbia vehicle that results in the vehicle being in noncompliance with applicable ANSI standards is strictly prohibited. Columbia ParCar Corp. is not responsible or liable for any damage that results from any such alteration, and all warranties for any such altered vehicles are null and void.

These vehicles are not designed for over-the-road use. They do not conform to Federal Motor Vehicle Safety Standards or EPA regulations, and are not equipped for operation on public streets, roads, or highways.

To the best knowledge of Columbia ParCar Corp., the material contained herein is accurate as of the date this publication was approved for printing. Columbia ParCar Corp. 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. Columbia ParCar Corp. reserves the right to change specifications, equipment or designs at any time without notice and without incurring obligation.

 Columbia ParCar Corp. products are manufactured under one or more of the following U.S. Patents - 2986162, 2987934, 3116089, 3144631, 3144860, 3229792, 3434887, 3559773, 3673359, 3680403, 3683716, 3709317, 4648473, Des. 225626.

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*NOTICE*: **In an effort to streamline product support, please ensure your vehicle is properly registered with Columbia ParCar. Registration allows for more effective product support including product updates and warranty processing. Please consult with your servicing dealer to verify or complete the registration process.**

| CHANGE HISTORY | | |
|---|---|---|
| **DATE** | **DESCRIPTION** | **BY** |
| 6/2008 | Issued | TS |
| 5/2011 | Added above block | TS |
| 7/12 | Added remote Delta Q LED | TS |
| | | |
| | | |

## 1.0 INTRODUCTION

This manual provides important safety information, operating instructions, model specifications and maintenance instructions for the Scout and Utilitruck vehicles.

The information in this manual is limited to care and maintenance information only. Information covering repairs and technical service is provided in detailed service manuals available from Columbia Dealers. These activities require the attention of a skilled technician and the use of special tools and equipment. Your Columbia Dealer has the facilities, experience and genuine Columbia vehicle parts and accessories to properly service Columbia vehicles.

## 1.1 SAFETY MESSAGES

Safety messages and other information in this manual are preceded by the words **DANGER, WARNING, CAUTION or *NOTICE***. They are printed in bold face, and are very important. We recommend you take special notice of this information.

| ⚠ DANGER |
| --- |
| **Danger indicates a hazardous situation which, if not avoided, will result in death or serious injury.** |
| ⚠ WARNING |
| **Warning indicates a hazardous situation which, if not avoided, could result in death or serious injury.** |
| ⚠ CAUTION |
| **Caution indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.** |
| ***NOTICE:* Notices are messages not related to personal injury. They will provide key information to prevent property damage and to assure procedures are more easily understood or implemented.** |

## 1.2 VEHICLE DESCRIPTION

The EX-21 Expediter is an electric three or four wheel vehicle. It is designed for one person and load or two persons (one facing the rear).

This vehicle is designed to be driven over smooth surfaces in and around places such as warehouses, factories, industrial sites, motels, parks, and resorts. It is not approved for use on public highways.

It is designed to conform to requirements for Type E vehicles as described in O.S.H.A. Standard Section 1910.178 (Powered Industrial Trucks) and with all applicable portions of the American National Standard for Personnel and Burden Carriers (ANSI B56.8 2006 Part III).

## 1.3 VEHICLE IDENTIFICATION NUMBER (VIN)

| ⚠ CAUTION |
| --- |
| **Do not remove any nameplate, warnings, or instructions affixed to your Columbia Industrial Vehicle. Promptly replace any that become damaged or removed.** |

Each vehicle is assigned a unique Vehicle Identification Number (VIN). The VIN describes facts and features of the vehicle and contains thirteen (13) digits.

The VIN number can be found in two locations. Under the rear deck, stamped in the right front corner of the rear body chassis as shown in Figure 1.3.1. It is also on the vehicle nameplate located on the vertical panel below the seat as shown in Figure 1.3.2.

The nameplate has important information such as model, vehicle weights and rated capacity (load, operator and passenger). Do not exceed this rated capacity. Read carefully.

To ensure prompt service when repairs or adjustments are required, your Columbia Dealer must have the VIN. **ET2C2-3ZG1234** is an example of a current VIN.

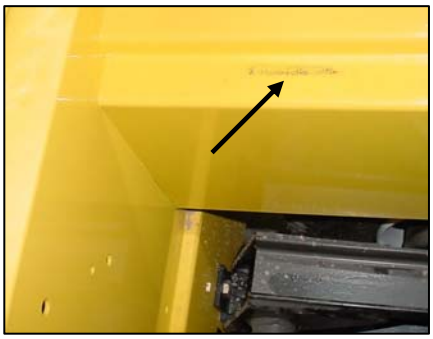

**Figure 1.3.1**

**Figure 1.3.2**

For your own personal reference, fill in the VIN in the space provided below.

## 1.4 13 DIGIT VIN MATRIX

| | |
|---|---|
| **Digit 1 thru 3 = Abbreviation (Model)** | ET2 (Three Wheel)<br>EF2 (Four Wheel) |
| **Digit 4 = Power System** | E = Sep Ex, Regen: (ACE*plus*) |
| **Digit 5 = System Voltage** | 2 = 24V (4 – 6 V)<br>B = 48V (4 – 12V) |
| **Digit 6 = VIN Spacer** | # = Special Product |

| | |
|---|---|
| **Digit 7= Controller Amperage** | 3 = 300 Amp<br>4 = 400 Amp |
| **Digit 8 = Axle/Brake System** | Z = Rear Mechanical |
| **Digit 9 = Build Year** | L = 2012, M = 2013, N = 2014, etc. |
| **Digit 10 Thru 13 – Build Sequence** | 1234 |

## 1.5 VEHICLE SPECIFICATIONS

| | **EX21 T 24** | **EX21 F 24** | **EX21 T 48** | **EX21 F 48** |
|---|---|---|---|---|
| **Passenger Capacity** | One or Two | | | |
| **Max. Speed (mph)** | 8 | | | |
| **Turning Curb to Curb (in)** | 128 | 168 | 128 | 168 |
| **Turning Intersecting Aisle (in)** | 54 | 64 | 54 | 64 |
| **Ground Clearance (in)** | 4 | | | |
| **Wheelbase (in)** | 52.5 | 53.5 | 52.5 | 53.5 |
| **Overall Length (in)** | 84 | | | |
| **Overall Width (in)** | 29.3 | | | |
| **Overall Height (in)** | 46.5 | | | |
| **Bed Size L x W (in)** | 21.5 x 26.0 | | | |
| **Bed Height (in)** | 20.5 | | | |
| **Tires** | 4.80x8, Pneumatic, 6 ply, Load Range C<br>4.80x8, Foam Filled, 6 ply, Load Range C | | | |

# 2.0 SAFETY

## 2.1 GETTING STARTED

For personal safety before operating the vehicle, it is the operator's responsibility to read, understand and follow the basic rules of operation and maintenance instructions in this manual. If you are responsible for the use of the vehicle, it is your responsibility to inform the person or persons using the vehicle about the following basic rules of operation for their personal safety.

It is Columbia ParCar Corporation's specific recommendation that the following warnings must be observed at all times. Not all are repeated throughout this manual, but the recommendations included must be observed whenever these subjects (indoor vehicle operation hazards, battery hazards, etc.) are encountered. Section 4.0 ELECTRIC SYSTEM contains important safety and other system information.

## 2.2 SAFETY VEHICLE STATEMENTS

**⚠ DANGER**

**Any modifications or changes to the vehicle that affect the stability, steering or that results in increased speed beyond factory specifications could result in vehicle damage, severe personal injury or death.**

**⚠WARNING**

**Only trained service professionals should repair or service this vehicle. Persons doing even simple repairs or maintenance should have working knowledge and experience in general electrical and mechanical repair.**

**Follow all procedures exactly and observe all safety messages stated in this manual. Working on vehicles without following proper procedures and using proper equipment may result in vehicle damage or personal injury. See Section 2.3 OPERATOR SAFETY INSTRUCTIONS.**

**Moving parts hazard! When operating any vehicle in a stationary position, avoid components which could snag clothing or cause sever injury to body parts. A running vehicle must be worked on with the greatest care.**

**Failure to maintain vehicle properly could result in decreased vehicle performance, reliability or cause severe personal injury.**

**⚠WARNING**

**Always wear safety glasses or approved eye protection while performing vehicle maintenance.**

**This vehicle is not Federal or State DOT approved and is not equipped to be operated on public roads or highways.**

**Do not exceed the rated vehicle speed. Exceeding this speed may result in steering difficulty, motor damage, and/or loss of control and injury.**

**If any problems are found during scheduled maintenance or inspections, Do not operate vehicle until repairs are made.**

**Failure to make necessary repairs could result in fire, property damage, severe personal injury, or death.**

**⚠CAUTION**

**When replacement parts are required, use only genuine Columbia Industrial & Commercial Vehicle parts.**

**No modifications or additions, which affect the mechanical or electrical integrity and the safe operation of the vehicle, shall be made without the written approval of the manufacturer. If such modifications are approved, the capacity, operation, and maintenance instruction markings shall be changed accordingly. If in doubt about any modification, contact your local Columbia Dealer or Columbia ParCar Corp. Customer Service.**

**Do not overload the vehicle. Never exceed the rated capacity as specified on the Vehicle Nameplate.**

Your safety and the safety of others depend on your safe operation and maintenance of this vehicle.

## 2.3 OPERATOR SAFETY INSTRUCTIONS

**⚠WARNING**

**For personal safety and to maintain stability and control, operate this vehicle under these conditions only. Failure to comply with these warnings may result in bodily injury and property damage.**

- **Do not drive this vehicle unless you are a qualified and trained operator and familiar with the vehicle operational controls.**
- **All vehicles should be operated from the driver's side.**
- **Never exceed the capacity ratings of the vehicle. Exceeding these limits may endanger occupants.**
- **Personal injury may result if body parts (arms, head, and legs) are not kept inside vehicle while moving.**
- **Allow only one occupant per seat. Do not start moving until all occupants are seated with seat belts fastened, if equipped. Remain seated and hold on while vehicle is in motion.**
- **Before leaving your seat, completely stop vehicle and lock parking brake. If vehicle is to be left unattended, turn keyswitch to "OFF" and remove key.**
- **Do not use accelerator to hold vehicle on an incline. Use brake.**
- **Make sure directional keyswitch is in position for the desired direction of travel before depressing the accelerator. Do not change the directional keyswitch while vehicle is moving.**
- **Drive slowly in turns and up and down grades. Do not make turns on steep hills or inclines.**
- **Do not operate while under the influence of alcohol or drugs.**
- **To avoid the risk of injury or vehicle damage, operate at maximum speed only on smooth flat surfaces.**
- **Allow additional stopping distance when traveling at higher speeds.**
- **Do not drive this vehicle in hazardous areas unless this vehicle is approved and labeled for such operation.**
- **Keep a safe distance when following other vehicles and from the edge of ramps and platforms.**
- **Immediately report any accident or vehicle problem to your supervisor.**

## 2.4 SAFETY CONCERNS

It is recommended that the operator and owner or renter of this vehicle comply with the OSHA requirements as stated in the Code of Federal Regulations, Section 29, 1910.178, Powered Industrial Truck Training Standard and the ANSI requirements as stated in Personnel and Burden Carriers ANSI B56.8.

As a minimum every operator should , in addition to the above requirements found in the standards noted above:

- Demonstrate a working knowledge of each control.
- Understand all safety rules and guidelines as presented in this manual.
- Know how to properly load and unload cargo.
- Know how to properly park the vehicle.
- Recognize an improperly maintained vehicle.
- Demonstrate ability to handle the vehicle in all conditions.

Every owner or renter of this vehicle must, at a minimum:

- Define where the vehicles should and should not be driven and utilized.
- Ensure all proper warnings as to driving hazards are properly displayed and visible.
- Install safety signage concerning hills, speed bumps, ramps, turns, blind crossings, intersections, etc.
- Define who should and who should not drive the vehicles.
- Enforce safe driving and operating rules.
- Provide driver training for first time operators and review safe operating recommendations regularly.
- Maintain vehicles in a safe operating condition and maintain a schedule for daily, weekly, monthly, quarterly, semi-annually and annual vehicle inspections.
- Determine who, when, and how should pre-operation inspections be conducted.
- Notify operators what should be done if an unsafe condition or operating problem is discovered.

# 3.0 OPERATIONS AND CONTROLS

## 3.1 IMPORTANT FIRST STEP

Upon initial delivery, it is very important that the battery pack is properly charged. This is required if the vehicle is to be stored for later use or is to be used immediately.

- Check that the batteries are not damaged or leaking and that connections are tight.
- Remove the battery vent caps and inspect each cell for proper electrolyte level. The battery manifold assemblies on vehicles with a single point watering system will require a ¼ counterclockwise turn to be removed for this inspection.
- If the electrolyte level is below the plates add only enough water to cover the plates. See Section 4.2.

***NOTICE*: Do not overfill a cell. Electrolyte expands and can overflow during charging.**

- For vehicles with a single point watering system, replace the manifold assemblies with a ¼ clockwise turn.
- With the electrolyte level correct, use the on board Delta-Q Charger to charge the batteries as described in Section 4.5.1.
- Charging is complete when the Delta-Q green 100% charge LED lights.
- Vehicles without a single point watering system, refill cells to below the bottom of the each cell vents. See Figure 4.2.1.
- Vehicles with a single point watering system will require completion of 4 to 5 charge cycles before watering.

***NOTICE*: If the vehicle is not going to be used the Delta-Q Charger can remain connected to an AC source. It has the capability to test and recharge the battery pack during storage.**

## 3.2 INSPECTING THE VEHICLE

After battery charging, perform a pre-delivery inspection of the vehicle. Also, before using the vehicle, there are checks that must be performed to ensure that it is in safe proper working order.

***NOTICE:* Vehicle should be inspected immediately after delivery. Use the following guidelines to make sure there are no obvious problems.**

Examine the contents of all packages and accessories that may have come in separate packages with this vehicle. Make sure everything listed on the packing slip is there. Items should not be broken or damaged.

Examine any visible wiring for obvious signs of damage. Check that all connections are secure.

Inspect the tires for obvious wear or damage. Check for proper tire inflation. Refer to manufactures recommendation imprinted on tire sidewall. Make sure that all wheel lugs are secure.

Check the body, seats, trim and other external parts for obvious damage. Look for body damage, jagged edges etc. that may cause personal injury.

Operate each of the following controls before turning on the power keyswitch.

- Accelerator Pedal for smooth operation.
- Braking Pedal, assure presence of a firm pedal with minimal travel.
- Steering, check for responsiveness and little play.
- Key can only be removed when keyswitch in “OFF” position.

***NOTICE*: Each control should operate smoothly and easily without sticking or requiring excessive effort.**

Check that the directional selector operates properly, that the horn and brake light works and that the warning buzzer sounds in reverse.

If vehicle has just been delivered, report any physical damage or missing items to the shipping company and your local Columbia Dealer.

Report any battery or service issue problems to the individual(s) responsible for correction and/or repair or contact your local Columbia Dealer for service.

**⚠ DANGER**

**If any problems are found, do not operate vehicle until repairs are made. Failure to make necessary repairs could result in fire, severe personal injury, property damage or death. Consult your local Columbia Dealer for professional service.**

## 3.3 VEHICLE CONTROLS

This section describes the operating controls of the vehicle. Figure 3.3.1 identifies many of these controls.

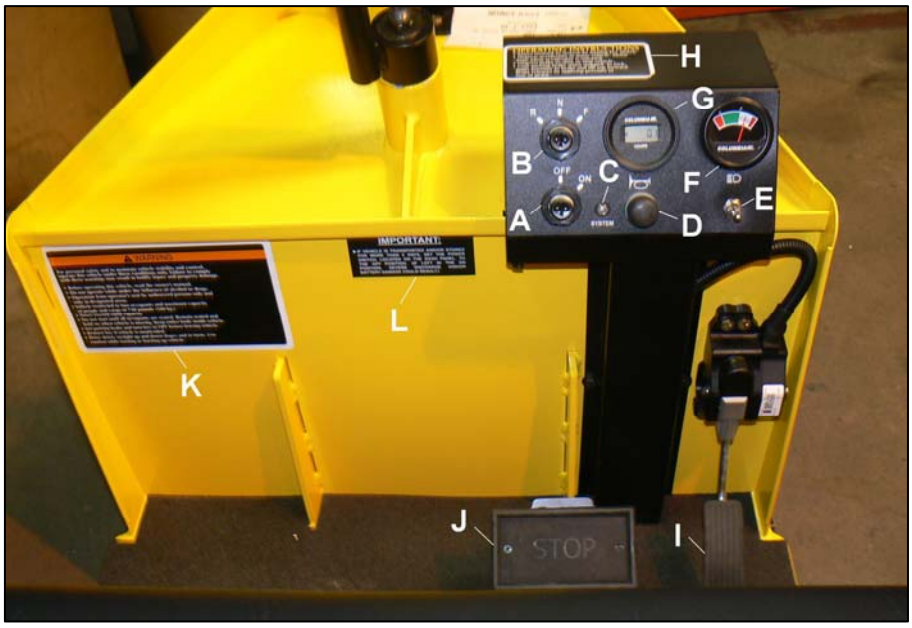


**Figure 3.3.1**

### 3.3.1 POWER KEYSWITCH – Figure 3.3.1A

With the power keyswitch in the "OFF" position, the Traction System is powered down. This conserves battery energy by reducing the power draw when vehicle is not in use. Turning the power keyswitch to OFF is highly recommended whenever vehicle is not in use. Always take the key out of the keyswitch when leaving the vehicle.

### 3.3.2 DIRECTION SELECTOR – Figure 3.3.1B

When the direction selector is in the vertical position, the vehicle's direction signal is turned OFF or in neutral (N).

Turn direction selector to the right from vertical position to move the vehicle in forward (F) direction. Turn direction selector to the left from vertical position to move the vehicle in reverse (R) direction. A warning buzzer sounds when in reverse.

***NOTICE:* Direction selector must be in the N or neutral position prior to turning on the ACE*plus* power keyswitch, or a reset of the direction selector to neutral will be required before traction drive is enabled. See Section 5.10 CONTROLLER TROUBLESHOOTING.**

### 3.3.3 SYSTEM STATUS LIGHT - Figure 3.3.1C

Vehicle will be equipped with an additional green System Status LED light located on the dash. With the power keyswitch in the “ON” position, the controller is powered up and this light should display a steady green light. If this green status light is not lit or is flashing refer to Section 5.10 CONTROLLER TROUBLESHOOTING.

### 3.3.4 HORN BUTTON – Figure 3.3.1D

Press button to sound the horn.

### 3.3.5 LIGHT SWITCH – Figure 3.3.1E

If equipped, the light switch is a two-position switch. Move switch up to activate headlights and taillights, down to turn off.

### 3.3.6 BATTERY STATE OF CHARGE METER – Figure 3.31F

This meter will display the battery state of charge. It is an analog gauge meter with an indicating needle and a colored background. It is a continuously reading meter. At rest with fully charged batteries the meter should read in the right white region.

When accelerating quickly, the needle will move to the left green region near the very far left red region. This is normal. If the needle continues past the green region into the very far left red region, it indicates that the batteries are 80% discharged or basically empty (only 20% charge remaining). Recharge as soon as possible to avoid a shut-down of the vehicle.

When decreasing speed, the needle will move to the right as electrical energy is being “regenerated” back into the batteries.

***NOTICE:*** **At 80% discharge, you must immediately charge batteries or vehicle operation will cease and permanent battery damage could occur.**

### 3.3.7 HOUR METER INDICATOR – Figure 3.3.1G

If equipped, the hour meter indicates the total number of hours the vehicle has been operating.

### 3.3.8 OPERATING INSTRUCTION - Figure 3.3.1H

Read this information carefully before operating the vehicle. Promptly replace if removed or damaged. Contact Columbia ParCar for replacements if needed.

### 3.3.9 ACCELERATOR PEDAL – Figure 3.3.3I

The accelerator pedal controls the speed of the vehicle in the same manner as a conventional automobile. The pedal must be fully released when changing directions.

**⚠CAUTION**

**To avoid injury, speed in reverse should always be kept at a minimum.**

**Be sure the direction selector is in the desired direction of travel before depressing the accelerator pedal.**

### 3.3.10 BRAKE PEDAL/PARKING BRAKE - Figure 3.3.3J

Depress the brake pedal to slow or stop the vehicle. Pressing the brake pedal activates the brake light.

The parking brake is controlled by the brake pedal. To lock for parking, depress the pedal and rock forward to engage the parking brake. To release, press on the rear of the brake pedal. Always apply parking brake when leaving the vehicle.

***NOTICE:*** **Do not operate the vehicle with the parking brake applied. Damage to the vehicle could result.**

***NOTICE:*** **Never rest your foot on brake pedal while operating the vehicle. This wears brake pads, creates drag and causes excess battery discharge.**

### 3.3.11 WARNING LABEL - Figure 3.3.3K

Read this information carefully before operating the vehicle. Promptly replace if removed or damaged. Contact Columbia ParCar for replacements if needed.

### 3.3.12 CHARGER RECEPTACLE & REMOTE LED

The charger receptacle (Figure 3.3.2) is located on the panel near the driver's position. The AC cord is plugged in here for battery charging. The charger is inter-locked with the traction control system which powers down the vehicle during charging. Near the receptacle is a remote multicolored LED which will indicate the Delta Q charge status. See Section 4.5.1 for information on the remote LED.

Always apply the parking brake when charging.

***NOTICE:*** **Before removing the AC cord, be sure to check the Delta-Q status light.**

**Figure 3.3.2**

### 3.3.13 BACKREST/REAR PASSENGER SEAT – Figure 3.3.5

For carrying one rear facing passenger, lift backrest (Arrow A) and fold it rearward. In the down position, it becomes the seat for the rear facing passenger. Passenger to observe the warning label (Arrow B) and use the hand holds (Arrow C) while vehicle is moving.

When operating without passenger, lift backrest completely and drop into upright position.


**Figure 3.3.5**

**⚠WARNING**

- **Never carry passenger unless backrest/seat is in "down" position.**
- **Always verify that passenger is seated and gripping hand hold bars before proceeding.**
- **Never transport more than one operator and one passenger.**

### 3.3.14 STEERING WHEEL/HANDLE BAR/TILLER – NOT SHOWN

Three types of steering are used on these vehicles. Each control the path of the vehicle exactly the same as a conventional automobile wheel.

### 3.3.15 SEAT SWITCH/TRACTION INTERLOCK – NOT SHOWN

Seat switch/traction interlock requires operator in seat for traction drive operation. A reset traction controller may be required if operator leaves seats while acceleration foot pedal is depressed.

## 3.4 VEHICLE OPERATING INSTRUCTIONS

### 3.4.1 DRIVING THE VEHICLE

- Complete the following PRE-OPERATION CHECKLIST.
- Insert key, press brake pedal firmly, and turn key to "ON" position.
- Switch the direction selector to the direction of desired travel.
- Release the parking brake and brake pedal.
- Slowly press accelerator pedal to obtain desired vehicle speed.
- To slow or stop, remove foot from accelerator and press brake pedal.

### 3.4.2 PRE-OPERATION CHECKLIST

| ⚠CAUTION |
|---|
| **Should any item malfunction or need adjustment. Do not operate vehicle until the problem has been corrected.** |

| ITEM | PROCEDURE |
|---|---|
| Batteries | Fully charged or adequately charged to provide power for duration of operations. |
| | The AC cord is disconnected from the vehicle. |
| | Electrolyte level in each cell covers the top of cell plates.<br><br>(See Section 4.11 if vehicle is equipped with a Single Point Battery Watering System.) |
| | Batteries are secure and free of corrosion. |
| | All terminals and connections are tight. |
| Tire Pressure | Inflated to the specifications labeled on the tire sidewall. Free from damage. |
| Lights, Horn and Reverse Buzzer | If equipped, turn lights on and make sure they illuminate. |
| | Press horn button to sound horn. |
| | Reverse buzzer operating. (Operator seat must be occupied.) |
| Brakes | Brake pedal has firm pedal pressure with minimal travel. |
| | Brake light illuminates. |
| | Parking brake has proper engagement and release. |
| Steering | Responsiveness and absence of excessive free play. |
| Cargo | Load secured, balanced and not top heavy. |
| Obstacles | Path of intended travel is free for obstructions. |
| Labels | All warning and operation labels in place. |
| Accelerator | Check for smooth operation. |

# 4.0 ELECTRIC SYSTEM

## 4.1 IMPORTANT INFORMATION

The type of battery used in a Columbia vehicle has a service requirement which is quite different from that of an automotive battery.

The electric vehicle battery supplies all of the power to drive the vehicle. During operation the power stored in the batteries is expended. While the amperage drain rate can vary greatly depending on the type of service, the duration of use and the number of "starts" and "stops" made during a day, the batteries nevertheless progress through each duty cycle from "fully charged" to an almost depleted state.

This type of service is known as "deep cycle" service and electric vehicle batteries are specifically designed to handle this type of service.

Proper performance of your Columbia vehicle can only be obtained from specified deep cycle, electric vehicle batteries.

**PLEASE REVIEW IMPORTANT DANGER, AND WARNING STATEMENTS WHEN WORKING AROUND BATTERIES AND CHARGING SYSTEMS!**

**⚠ DANGER**

**Always remove key and disconnect battery pack before servicing or repairing the vehicle. See Section 4.9.**

**Always wear full-face shield when working on or near batteries.**

**All batteries used in electric vehicles can explode! Batteries produce explosive hydrogen gas at all times, especially, during charging or discharging. Ventilate area when charging batteries.**

**Do not attempt to charge a battery if it is frozen, or if the case is bulged excessively. Frozen batteries can explode! Properly dispose of the battery.**

**Do not smoke around batteries. Keep sparks and flames away from batteries and the charging area. Use care to prevent an accidental arc which could cause an explosion. Use only approved insulated tools, remove jewelry such as rings, watches, chains etc. and place an insulating material (wood, plastic, rubber etc.) over all battery connections.**

**Never add acid to a battery.**

**⚠ DANGER**

**Battery acid is poisonous and can cause severe burns. Avoid contact with skin, eyes, or clothing.**

**ANTIDOTES:**

**EXTERNAL: Flush with water. Call a physician immediately.**

**INTERNAL: Drink large quantities of milk or water. Follow with milk of magnesia or vegetable oil. Call a physician immediately.**

**EYES: Flush with water for fifteen minutes. Call physician immediately.**

**⚠WARNING**

**To reduce the risk of electrical shock or injury:**
**Do not use an ungrounded two to three-prong adapter to connect the charger to a two-prong outlet or extension cord.**

**The battery charger must be properly grounded. Use a three prong No. 12 AWG heavy duty power cord no more than 50 feet long.**

**Locate all cords so that they will not be stepped on, tripped on, or otherwise damaged. Immediately replace worn, cut, or damaged power cords or wires.**

**Do not connect the power cord near fuels, grain dust, solvents, thinners, or other flammables. The spark can ignite flammable materials and vapors.**

***NOTICE:* Automotive batteries should never be used for "deep cycle" application, as their useful life will be very short.**

**Install surge arrestors on incoming AC power lines. Surge arrestors will help protect electrical/electronic components in the charger and vehicle from all but direct or "close proximity" lightning strikes.**

**Damaged or corroded battery terminals should be replaced or cleaned as necessary. Failure to do so may cause overheating during operation.**

**Do not attempt to recharge batteries with a charger not designed for your vehicle.**

**Only trained technicians should service the Delta Q charger. Contact your Columbia Dealer for assistance.**

## 4.2 BATTERY INSPECTION & MAINTENANCE

Check the electrolyte level on new batteries before they are put into service, and, at a minimum, once a week thereafter. Water use increases as batteries age. (See Section 4.11 if vehicle is equipped with a Single Point Battery Watering System.)

See Figure 4.2.1. Never allow the electrolyte level (A) to fall below the top of the plates (C). If the plates are exposed, add only enough to cover the plates before charging. After batteries are fully charged, fill cells to just below the bottom of the cell vents (B), approximately 1/8" to 1/4". Electrolyte level should not touch the bottom of the cell vents.

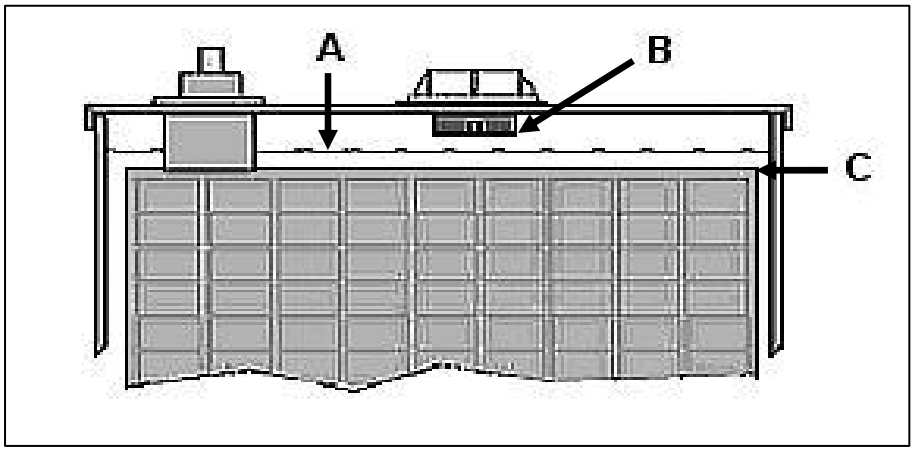


**Figure 4.2.1**

If the vehicle is equipped with 12 volt batteries as shown in Figure 4.2.2, they will require watering.

The cell vents are located below the covers (Figure 4.2.2 Arrows).


**Figure 4.2.2**

Do not overfill batteries. Electrolyte expands and can overflow during charging. Water added to replace the spillage dilutes the electrolyte and reduces its specific gravity.

Use only distilled water. Vehicle batteries may use up to 16 quarts of water during their useful life and non-distilled water may contain harmful minerals which will have a cumulative adverse effect on battery performance and life.

Be sure battery hold downs are properly tightened. A loose hold down may allow the battery to become damaged from vibration or jarring. A hold down that is too tight may buckle or crack the battery case.

Weekly inspect battery posts, clamps and cables for breakage, loose connections and corrosion. Replace any that are damaged. Check to see that battery cap vent holes are clear. Plugged vent holes will not permit gas to escape from the cell and could result in battery damage. Batteries and connections must be clean and dry. See Section 4.3.

Weekly an equalization charge is to be applied to the battery pack. This process balances the electrical charge in the battery pack and will extend battery life. The following procedure is used to complete this.

- Charge the battery pack allowing the Delta-Q Charger to go to green 100% charge.
- Once the green LED lights unplug the power cord.
- Wait approximately 30 seconds. Reconnect the power cord and allow the Delta-Q to complete a second charge cycle.
- If the vehicle is not to be used, leave power cord connected. The Delta-Q can test and recharge as needed.

## 4.3 BATTERY CLEANING

Acid-soaked debris on the battery terminal connections will cause current leakage, reduces battery efficiency, and battery life.

Check that all vent caps are tightly in place. Hose wash battery terminal connections periodically with clean low-pressure water to keep them free of acid spillage, dirt, and other debris. Do not hose wash electronic controllers, switches, solenoids and other electrical control devices. Cover as necessary to prevent splashing.

Clean battery terminal connections with baking soda (sodium bicarbonate) and water solution. Mix 5 teaspoons baking soda per quart of water. Use a stiff bristle brush, rinse with clean water and dry with a clean cloth. Do not allow solution to enter cap vent holes.

***NOTICE:*** **Follow local ordinances and codes for proper disposal of battery cleaning waste.**

## 4.4 CONDITIONS WHICH AFFECT CHARGING

Always schedule enough charging time so the Delta-Q Charger attains the 100% level. Charging time is affected by age and battery condition, state of discharge, electrolyte temperature, AC line voltage, and other variables. Correct charging methods extend battery life and vehicle range between charges.

New batteries need up to four hours more charging than “mature” batteries. Before the first use, completely charge new batteries. Charging time will vary based on conditions noted above but will probably be 12 hours.

Limit new batteries use between charges for the first 25 – 50 cycles. New batteries have less capacity than seasoned batteries. New batteries should not be discharged more the 20 – 30% before recharging. This will prevent premature battery failure.

Battery efficiency is affected by temperature. If the temperature of the outside air and/or batteries is below 60º F, battery capacity is reduced. Batteries will require more frequent and longer charge periods in early spring, fall and winter.

As batteries age, they finish charge at progressively higher charge rates and tend to use more distilled water. At this point in battery age, charger will automatically begin reducing charge time.

Batteries found defective must be replaced. All batteries in a vehicle should be matched according to age, capacity and brand.

## 4.5 DELTA-Q BATTERY CHARGING

All current production Columbia 24/36/48 volt electric vehicles are built with a new solid state on-board, fully automatic Delta-Q Battery Charger (Figure 4.5A) as standard equipment. This section explains in more detail the Delta-Q Charger Operations. The Delta Q charge status can be found in two locations. On the Delta Q face and on a remote multicolored LED (Figure 4-5B). This LED and descriptive label will located near the Charger Receptacle.

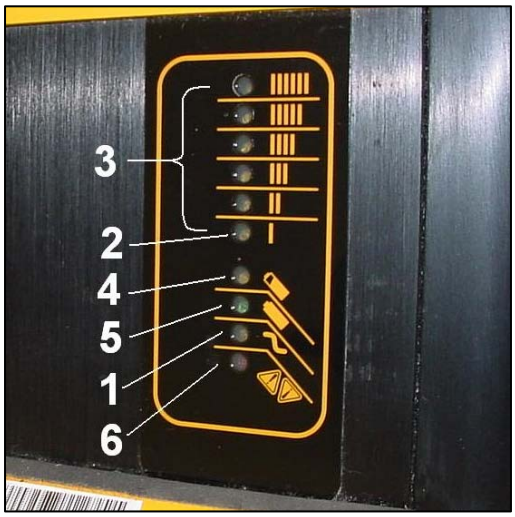


**Figure 4.5A**

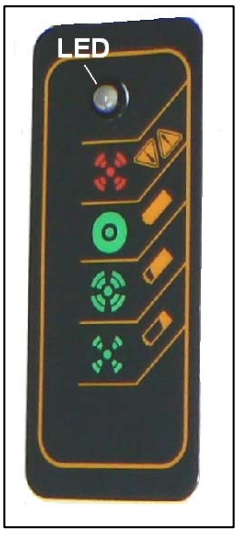


**Figure 4.5B**

***NOTICE:*** **Do not cover the charger cabinet or cooling fins with clothing, blankets, or other material. Fins provide ventilation and prevent overheating.**

**Do not disassemble the charger. There are no serviceable components.**

### 4.5.1 CHARGER OPERATING INSTRUCTIONS

Connect the supplied power cord to the vehicle charger receptacle and to a properly grounded wall outlet. Charger start and charge time is automatic. The Yellow AC power LED (Fig. 4.5A No. 1) should remain illuminated while the Charger is plugged into an AC source. The remote LED will be flashing short green. If these LED’s are not lit, before replacing Charger, recheck the AC connection and the AC source fuse or breaker. If this fails to correct the problem, contact your Columbia Dealer for assistance.

Charger will automatically turn on and conduct a short self-test and battery pack test. All Delta Q LED's will flash in sequence and then a trickle current will be applied to batteries until a minimum voltage is reached. In Figure 4.5A No. 3 indicates the Bar Graph and No. 2 indicates the lowest LED. Three (3) amperes is displayed as the lowest LED on the Bar Graph.

If the batteries meet the minimum voltage requirements of the Charger, signifying they are serviceable (chargeable), the Charger enters the bulk charging (higher amperage-constant current) stage. The Delta Q Bar Graph LED's indicate the electrical current being delivered to the batteries as the Charger moves through its automatic charge profile. The length of charge time at each level will vary due to battery size and battery charge depletion. The remote LED will be flashing short green.

***NOTICE:*** **If the batteries are excessively discharged, the Delta-Q Charger will not be able to charge the complete set of batteries. The Delta-Q RED FAULT LED (Fig. 4.5A No. 6) and the remote LED will be flashing red.(see Section 4.5.2 Red Light Charger Error Codes). It will then be necessary to follow the Special Charging for Excessively Discharged Batteries, Section 4.6.**

When the Yellow 80% LED (Fig 4.5A No. 4) is lit, the Charger has completed the bulk stage and the batteries are at approximately 80% state of charge. The 80% LED remains on as the last 20% of charge is returned to the batteries in the second phase (constant voltage phase). At this time the remote LED will flash long green.

***NOTICE:*** **You can terminate charging at this point if necessary. The vehicle can be used, but completing the charge cycle is highly recommended.**

Charge completion is when the 100% Green LED is lit (Fig. 4.5 No. 5). The remote LED will be green.

Repeated "Short Charging" leaving the charge short of 100% will shorten operating cycle distance and reduced battery life.

A Green LED continuously lit indicates the batteries are completely charged. The Charger may now be unplugged from the AC source. If the batteries will not be used for a length of time, check monthly for the charge level. It is also acceptable to leave the Charger plugged in. The Delta-Q has the capability to test and recharge if necessary.

A fault occurring while charging causes the RED FAULT LED and the remote LED to flash with a code relaying the error. Some errors may require repair by a qualified technician and others may be simply transient and will automatically recover when the fault condition is eliminated and the Delta-Q cycled by disconnecting the AC source for a minimum of 11 seconds.

***NOTICE:*** **A Yellow (Amber) flashing LED in the upper Bar Graph (Fig. 4.5 No. 3) and a flashing yellow remote LED indicates the thermostatic control has limited the Charger output due to ambient temperature conditions. It is still charging, but at a reduced rate.**

### 4.5.2 RED LIGHT CHARGER ERROR CODES

**1 FLASH** = Battery Voltage High: Auto-recover. May be temporary condition, or wrong Charger installed, i.e. 36 volt Charger on 48 volt battery pack.

**2 FLASH** = Battery Voltage Low: Auto-recover. Confirm each individual batteries minimum voltage with a voltmeter. Two or more 6 volt batteries register less than 5.85 volts, or accumulative total pack voltage has been discharged to less than 20% remaining. Vehicle operation will cease until batteries are recharged. See EXCESSIVELY DISCHARGED BATTERIES Section 4.6.

**3 FLASH** = Charge Timeout: The charging did not complete in allowed time, 12-14 hours. This may indicate a battery problem, or that the Charger output was reduced due to high ambient temperatures. Disconnect AC supply, confirm sufficient ventilation, allow cool down time, and restart Charger.

*NOTICE:* **If the Delta-Q is exhibiting a 3 flash fault and it has been determined that the cause was not due to ventilation or high ambient temperature, the following procedure may restore the battery pack to normal operation.**

- **Battery posts and terminals must be clean and free of corrosion.**
- **Check that electrolyte level just covers plates.**
- **Plug in charger for at least a 16 hour charge.**
- **Check and fill electrolyte.**
- **Drive the vehicle for less than half the distance normally driven.**
- **Repeat the above steps until the Delta-Q goes green 100% charge on a 16 hour charge.**

**If repeated cycles (5-7) do not result in a 100% green charge, the batteries are beyond useful life and will need replacement.**

**4 FLASH** = Check Battery: The batteries could not be trickle charged up to a minimum level to start Charger. This may be the result of badly discharged batteries, or one (or more) damaged cells. See EXCESSIVELY DISCHARGED BATTERIES Section 4.6.

**5 FLASH** = Over-Temperature: The Charger shutdown due to high internal temperature. May require reset (AC unplugged) and cool down to restart charging cycle. This fault may indicate inadequate cooling airflow or high ambient air temperatures. Check for debris or blockage at cooling fins. Move the vehicle to a cooler, well ventilated area, or adjust time of day when charging.

**6 FLASH** = Delta-Q Charger Fault: A fault was detected either in the batteries or in the Charger. The batteries must be tested to ensure there is no damage to one or more cells. If the batteries are found to be good, the Charger may need to be replaced by a qualified technician.

**A STEADY RED FAULT LED** confirms an internal electrical fault of the Delta-Q and requires Charger replacement and return.

### 4.5.3 CHECK / CHANGE CHARGING ALGORITHM

The Delta-Q Charger has been programmed for use with the Columbia ParCar supplied batteries and contains ten algorithms for use with different batteries. The Table 2 details these battery models.

**TABLE 2**

| ALGORITHM # | BATTERY TYPE |
|---|---|
| 43 | Discovery 200-400 Ah AGM |
| 37 | Trojan T105 DV/DT CP – 42V pack w/ 48V Charger |
| 27 | Crown CR-325 |
| 8 | Concorde 10xAh AGM |
| 7 | J305 DV/DT CP |
| 6 | DEKA 8G31 Gel |
| 5 | Trojan 30/31XHS<br>or<br>Northern 31EV (EX21 48 Volt) |
| 4 | US Battery US 2200 (EX21 24 Volt) |
| 3 | T105 DV/DT CP |
| 1 | Trojan T105 |

***NOTICE*: For maximum battery life the correct algorithm must be used.**

***NOTICE*: If your battery model is not listed in Table 2, contact Delta-Q for further information.**

Each time AC power is applied with the battery pack NOT connected, the charger enters an algorithm select/display mode for approximately 11 seconds. It will also be displayed on the remote LED.

During this time, the current algorithm # is indicated on the 80% LED light. A single digit algorithm # is indicated by the number of blinks separated by a pause. A two digit algorithm # is indicated by the number of blinks for the first digit followed by a short pause, then the number of blinks for the second digit followed by a longer pause.

To check/change the charging algorithm:

- Disconnect the charger positive connector from battery pack. Apply AC power and after the LED test, the algorithm # will be displayed for 11 seconds.
- To change the algorithm, touch the positive connector during the 11 second display period to the battery pack's positive terminal for 3 seconds and then remove. The algorithm # will advance after 3 seconds. Repeat until the desired algorithm # is displayed. A 30 second timeout is extended for every increment. Incrementing beyond the last algorithm moves back to the first algorithm. After the desired algorithm # is displayed touch the charger connector to the battery positive until the output relay is heard to click (~ 10 seconds). The algorithm is now in permanent memory.
- Remove AC power from the charger and reconnect the charger positive connector to the battery pack. It is highly recommended to check a newly changed algorithm by repeating the above steps.

## 4.6 EXCESSIVELY DISCHARGED BATTERIES

***NOTICE*: Columbia Dealer will have the equipment and experience to perform the following battery inspections.**

### 4.6.1 DELTA-Q WILL NOT CHARGE

The Delta Q will not charge dead batteries. First establish that none of the batteries have an internal fault or bad cell. If a battery has remained too long in a discharged state (ie. 2-4 volts each), it may be internally damaged and not capable of accepting a charge and must be replaced.

If the electrolyte Specific Gravity is low (less than 1.1098 SG) or individual battery voltage is les than 5.25 volts for three cells (10.5 volts for six cells), recharge each battery with an ordinary automotive style trickle charger at a rate of 3 to 6 amps.

It is not necessary to disconnect the battery cables, as the alligator style clips can be connected to each positive and negative battery post. Follow specific Charger instructions.

**⚠ DANGER**

**To prevent a spark from igniting the gas emitted from the batteries, always disconnect the Charger AC power cord first when moving the positive/negative alligator clips.**

Be sure to charge all of the batteries in the set. Each battery may require two to three hours of charging to bring it back to serviceable condition. After all batteries have been individually charged, remove the automotive Charger and restart charging with the Delta-Q Charger (Section 4.5.1). If again the Delta-Q Charger has the RED FAULT LED (Fig. 4.5 No. 6) flashing there is a problem with one or more of the batteries.

If repeated cycles (5-7) do not result in a 100% green charge, the batteries are beyond useful life and will need replacement.

## 4.7 SPECIFIC GRAVITY TEST

It is possible to determine a battery's ability to perform by measuring the specific gravity (sp. gr.) of each cell with a hydrometer. This is the best method to determine a defective battery.

The hydrometer readings indicate two things:

- State of Charge - The amount of electrical power stored in the battery.
- Condition - The ability of battery to store and deliver power.

***NOTICE:* Batteries should be fully charged before performing specific gravity tests to determine battery condition. Hydrometer tests of batteries not fully charged are misleading and inconclusive.**

There are different type hydrometers. Carefully read and follow the instructions supplied with your hydrometer.

***NOTICE:* Specific gravity readings are at $80^0$F. Values need adjustment for electrolyte temperature. Reduce .004 for every $10^0$F below $80^0$F. Increase by that amount for every $10^0$F above.**

## 4.8 TIPS FOR PROLONGING BATTERY LIFE

***NOTICE:* A common misconception is Deep Cycle Batteries develop a memory, lose capacity, or must be discharged until the BDI warning flashes and then recharged. Deep Cycle Wet Lead Acid Batteries are not like cell phone NiCad Batteries. Deep Cycle Batteries benefit from frequent charging and being maintained at as close as possible to a 100% state of charge. Plugging in the Delta Q Charger overnight or when the vehicle is not in use for 3-5 or more days is encouraged.**

- To prolong battery life, recharge batteries as soon as they become 20% or more discharged (less than 1.238 sp. gr.).
- Make it a regular habit to plug in the charger when the vehicle is not in use. Batteries may be recharged if vehicle has been driven 15 minutes or more since the previous charge.
- Make sure your electrical outlet is operational.
- Never go below 20% state of charge (or 80% discharged) without recharging immediately. Allow 14 – 16 hours of charging.
- Batteries will provide a longer life if not deeply discharged. Batteries that are regularly deeply discharged will require more work by the charger and will have a shorter life.
- Make it a regular habit to check (and water) your batteries after charging. Always add water after charging. This will reduce the chance for overflow due to expanding water.
- Weekly equalize the battery pack.
- If the vehicle is not operated daily the Power keyswitch should be turned off. This will power down the traction control system and reduces power loss on the batteries.
- Batteries in storage may self discharge and should be recharged when the specific gravity falls below 1.238 sp. gr.

## 4.9 BATTERY DISCONNECT METHODS

Figure 4.9.1 illustrates the 4 six volt and 4 twelve volt battery configurations. Disconnect both battery pack leads (Main Solenoid and Controller B-) before performing any maintenance.

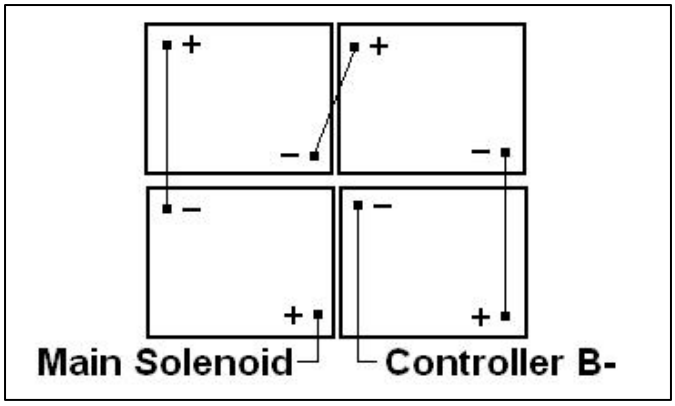


**Figure 4.9.1**

## 4.10 BATTERY REMOVAL AND INSTALLATION

### 4.10.1 24 VOLT SYSTEM

- Remove battery negative (-) cables.
- Remove battery positive (+) cables.
- Remove battery hold down.
- Remove batteries from vehicle.
- To install batteries, reverse the removal procedure with the negative (-) cables being attached last.

### 4.10.2 48 VOLT SYSTEM

The 48 volt system has the Delta-Q charger located above the batteries. To service or remove the batteries will require rotating the charger up and to the side.

See Figure 4.10.2.1. Two wing nuts (A) secure the charger to a support bar (B). Loosen each wing nut approximately 1 1/4 turns.

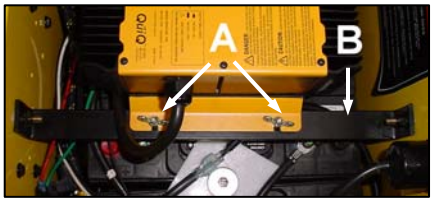


**Figure 4.10.2.1**

***NOTICE:* The wing nuts must be loosened only enough to allow the support bar (B) to rotate. If loosened too much the base of the wing nut will not allow the support bar to rotate.**

After loosening, make sure the wing nuts are aligned with the slots in the charger as shown in Figure 4.10.2.2.

**Figure 4.10.2.2**

While supporting the charger with one hand, rotate the support bar way from the charger. This will free the charger. See Figure 4.10.2.3.

**Figure 4.10.2.3**

See Figure 4.10.2.4. The charger can now be rotated upward allowing access to the batteries.


**Figure 4.10.2.4**

To remove batteries:
- Remove battery negative (-) cables.
- Remove battery positive (+) cables.
- Remove battery hold down.

Reverse these steps to reinstall the batteries (negative cables attached last) and to secure the charger. Be sure to retighten the two wing nuts.

## 4.11 SINGLE POINT BATTERY WATERING SYSTEM

When equipped, this is a single point watering system for maintaining a sufficient electrolyte level in the batteries.

***NOTICE:*** **Do not operate this system on brand new batteries. See Section 3.1 for the initial check on the electrolyte level of new batteries. Complete 4 to 5 charge cycles before using the system.**

**System is to be used only after fully charging the batteries and batteries are warm.**

The fill tube assembly which is used for adding water to the battery pack consists of a fill tube, one end having a filter screen, the other having a female coupler and a rubber squeeze bulb.

Check the battery pack water level weekly by:
- Inserting the fill tube filter end in an approved water supply.
- Attaching the female coupler to the battery pack male coupler.
- Squeeze the rubber ball until firm which indicates that filling is complete. Immediately disconnect the couplers by depressing the push button on the female coupler. If the water supply is left connected after the filling process is finished it could lead to an overfill.

# 5.0 SERVICING YOUR VEHICLE

## 5.1 MAINTENANCE GUIDELINES

To ensure that the vehicle is kept in a safe and correct operating condition, it must be inspected and maintained on a regular basis. Proper lubrication, electrical control adjustments, safety feature checks, etc. performed at recommended intervals will help prevent damage or failure of the unit while providing optimum performance.

Follow the guidelines below to assure proper maintenance.

- Allow only trained maintenance personnel to maintain, repair, and inspect the vehicle.
- Before starting any repairs or maintenance, immobilize the vehicle by turning the power keyswitch off, removing the key and setting the park brake.
- Disconnect both of the main battery pack leads before working on or disconnecting any electrical component or wire.
- Block the chassis with jack stands before working under a raised vehicle.
- Conduct vehicle performance checks in an authorized area where a safe clearance exists.
- Before starting the vehicle, follow the recommended safety procedures in Chapter 2, (SAFETY).
- Avoid fire hazards and have fire protection equipment present in the work area.
- Do not use flammable fluids for cleaning parts.
- Work in a properly ventilated work area.
- Regularly inspect and maintain in safe working condition the brakes, steering mechanisms, speed and directional control mechanisms, warning devices, guards and safety devices.
- Keep the vehicle in a clean condition to minimize fire hazards and facilitate detection of loose or defective parts.

## 5.2 MECHANICAL BRAKE SYSTEM

The mechanical brakes consist of two rear drum brakes which are self-adjusting. Monthly, with the vehicle stationary, depress the brake pedal and check for not less than 1/2” pedal free travel before resistance is felt. Maximum pedal free travel should not exceed 2”. See Figure 5.2.1.

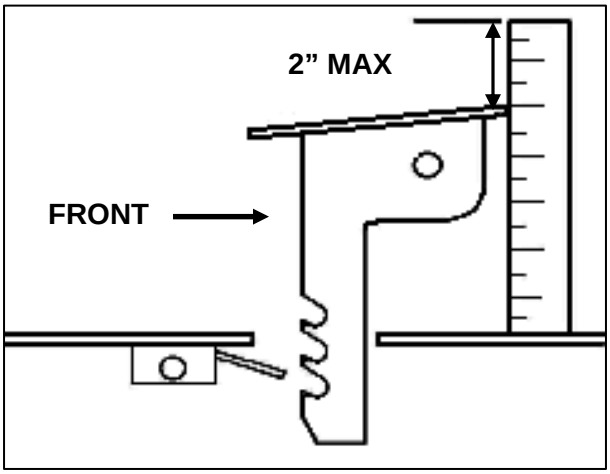


**Figure 5.2.1**

The parking brake is applied by depressing the parking brake pad at the top of the brake pedal which locks the brakes in place. If the brakes fail to hold the vehicle in position, contact your Columbia Dealer for qualified service assistance.

**⚠ DANGER**

**If any of the listed limits are exceeded stop and do not use the vehicle. Contact your Columbia Dealer for qualified service assistance.**

## 5.3 TIRE CARE

Improper inflation will shorten the life of your tires and will adversely affect performance. For proper tire inflation refer to manufacturer's recommendation imprinted on tire sidewall.

***NOTICE:*** **Replacement tires must be the same size as original equipment. Increased tire load ratings are permissible but tire rating does not increase the rated load carrying capacity of the vehicle.**

## 5.4 WHEEL & TIRE REMOVAL/INSTALLATION

Place blocks ahead of and behind the wheels that will remain on ground. Slightly loosen lug nuts. Place jack under one side of vehicle on frame rail at point midway from front and back of vehicle. Raise vehicle and remove lug nuts and wheels. To install, tighten the lug nuts evenly in a star pattern until the nuts are all seated and torque to. 65 ft. lbs. (88.1 N.m). Recheck lug nut torque with the vehicle on the ground.

***NOTICE:*** **The wheel may be bent if not torqued in a crossing pattern. This will cause the wheel to wobble.**

## 5.5 CLEANING

Wash underside to remove all dirt and debris. Do not direct high pressure water at the controller, speed switches, or tops of the batteries.

Wash body and seat with a mild detergent. Do not use abrasives (bodies are painted). Frequent washings with mild soap will preserve the finish of your vehicle. For stubborn and imbedded dirt, a soft bristle brush may be used. Tar, asphalt, creosote and the like should be removed immediately to prevent staining of paint.

## 5.6 LUBRICATION

For three wheel vehicles, semi-annually grease the single front hub assembly (Figure 5.6.1). For four wheel vehicles, semi-annually grease the two steering arm spindles (Figure 5.6.2). Use a high quality wheel bearing grease. Remove the weight from the front suspension before lubricating to ensure proper grease distribution.

**Figure 5.6.1**

**Figure 5.6.2**

The differential should be checked periodically for signs of leakage. Contact your Columbia Dealer for fluid replacement.

## 5.7 MAINTENANCE SCHEDULE - OWNER/OPERATOR

| Item | Operation | Weekly | Monthly | Semi-Annual |
|---|---|---|---|---|
| **Tires** | Lug nuts tight. | | * | |
| | Check tire pressure, wear, damage. dented rims. | | * | |
| **Electrical** | Check electrolyte level. | * | | |
| | As required, clean battery terminals and wash cases. | * | | |
| | Apply equalization charge to the battery pack. | * | | |
| | Check the general condition of the electrical system (connections, frayed/broken cables). | | * | |
| **Brakes** | Check pedal & park brake operation. | | * | |
| **Body and Frame** | Inspect for loose hardware (bolts & nuts). | * | | |
| | Clean body and seats, Wash as needed. | * | | |
| | Wash engine/motor compartment and undercarriage. | * | | |
| **Lube** | Visual check for differential leak. | | * | |
| | Oil movement points (body hinges, brake mech. and linkage, leaf spring bushings etc.). | | | * |
| **Single Point Watering System** | Add water per Section 4.11. | * | | |
| | Check condition of tubing, couplers. Secure & leak free. | | * | |
| | Clean filter screen. | | | * |

## 5.8 MAINTENANCE SCHEDULE - QUALIFIED TECHNICIAN

Recommended that the following be performed by a trained qualified technician or your Columbia Dealer

| Item | Operation | Quarterly | Semi-Annual | Annual |
|---|---|---|---|---|
| **Tires** | Front wheel alignment and camber. | | * | |
| **Electrical** | Test batteries. | | * | |
| | Check motor condition and operation | | | * |
| **Brakes** | Check brakes, clean, adjust, replace if needed. | | * | |
| **Lube** | Check differential fluid level. | | | * |
| | Grease fittings. | | * | |
| **Wheel** | Check wheel axle nuts for tightness & torque. | | * | |
| | Wheel bearings, repack, replace if needed. | | | * |
| **Accelerator** | Check micro switch adjustment, if equipped. | | * | |

## 5.9 VEHICLE TROUBLESHOOTING

| PROBLEM | CHECK |
|---|---|
| Will not move | Power keyswitch on.<br>Direction selector in desired direction.<br>Keyswitch for loose wires. |
| | Batteries for loose terminals, corrosion, electrolyte level or state of charge. |
| | Motor for loose wires. |
| Will not move when power keyswitch is on and the direction selector is in the desired direction | Controller green light. See Section 5.10 |
| Runs slow | Batteries for loose terminals, corrosion, electrolyte level or state of charge. |
| | Brakes dragging. |
| | Under inflated or flat tires. |
| | Wheels for binding, do not spin freely. |
| If these test procedures do not resolve your vehicle problem, contact your Columbia Dealer for service. | |

## 5.10 CONTROLLER TROUBLESHOOTING

The controller is located under the rear deck facing the rear of the vehicle. The controller has a green LED diagnostic light See Figure 5.10.1) which is a good tool to indicate a fault in the electrical system. The vehicle is equipped with a dash System Status LED which functions the same as the controller LED.

It is essential to observe the flashing pattern (number of blinks followed by a pause) of the LED light any time the vehicle is not operating as expected. The number of blinks is very useful for your servicing dealer to accurately and quickly diagnose any faults that exist.

However, two of the flash codes may indicate an operation fault, and likely do not require component changes or dealer service.

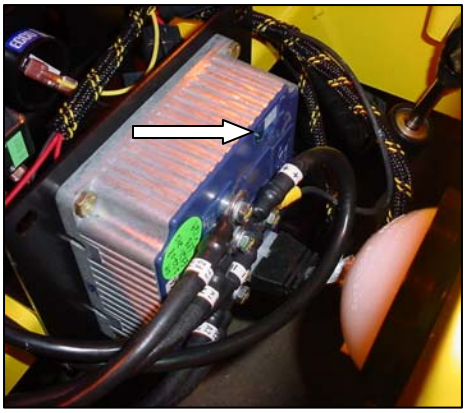

**Figure 5.10.1**

A “2 Flash fault” may indicate a start-up sequence fault. This is caused when the vehicle direction selector is not in the neutral position when the power keyswitch is turned on. Steps to take to possibly clear this fault are:

- Set the parking brake.
- Turn vehicle power keyswitch to OFF and the direction selector to N – Neutral.
- Ensure the accelerator pedal is at its resting (up) position.
- Turn vehicle power keyswitch to ON and select the desired direction on the direction selector.
- Release parking brake and depress accelerator.

A "7 flash fault" may indicate that the battery voltage is too high or too low for the vehicle power system. Voltage too high occurs when rapidly descending hills with a vehicle equipped with the ACE*plus* Regenerative braking system. The electrical system creates current which causes a spike in battery voltage.

To prevent this, always travel at a safe, prudent speed when driving on declines, especially with freshly charged batteries. To possibly clear this fault turn the power keyswitch to OFF and back to ON. If there is still a “7 flash fault”, the battery voltage may be low. Check and charge batteries or replace batteries.

If the operational fault persists or the LED is not lit or there is a “flash fault” other than 2 or 7, contact your Columbia ParCar Dealer.

# 6.0 TOWING & TRANSPORTING

***NOTICE:*** **Use only straps, chains or towing devices that are rated to handle the full weight capacity of the vehicle in tow.**

**Use caution and common sense while towing disabled vehicles.**

## 6.1 TOWING

Use a tow chain, strap or towing device long enough to provide a safe distance between vehicles. Connect the selected towing device to appropriate secure positions on both vehicles.

Turn the key to the off position. Disengage the parking brake. DO NOT exceed 8 KPH (5 MPH) while towing. Allow ONLY one person in the towed vehicle to steer and apply additional braking, as necessary. Tow only one vehicle at a time unless a multiple vehicle towing bar system is used. Avoid sudden stops, sudden starts and sharp turns while towing.

If the vehicle is equipped for trailer towing, do not over load the deck while towing heavy loads. The ACE Plus regen traction system offers extra control for handling heavy towing loads, but the operator must not compromise the vehicle's ability to decelerate or stop with the extra load.

## 6.2 TRANSPORTING YOUR VEHICLE

***NOTICE:*** **Never tow a vehicle behind an auto or truck unless on an approved trailer.**

When trailering your vehicle over long distances or on the highway observe the following:

- Use trailers specifically designed to carry your Columbia ParCar vehicle that meets all federal, state and local requirements.
- Secure vehicle to the trailer following trailer manufacturer's instruction.
- The key should be removed from the vehicle, the parking brake firmly locked, and the wheels blocked.
- On vehicles equipped with high or wide additions or accessories be certain they are secured properly to prevent loss or damage while trailering.

# 7.0 VEHICLE STORAGE (over 6 weeks)

## 7.1 BATTERY PREPARATION

Before storage make sure batteries are fully charged and the electrolyte is full in all cells per Section 4.2. Clean the batteries and connections per Section 4.3.

The Delta-Q charger has the capability to test and recharge batteries during storage. Leave the batteries connected and the Delta-Q charger plugged into a reliable AC source.

If the Delta-Q is not used:

- Batteries will "self-discharge" during storage and recharging will be necessary. Frequency for recharging is as follows:

| STORAGE TEMPERATURE | CHARGE AT |
|---|---|
| Below $4^0$ C ($40^0$ F) | Every 6 months |
| $4^0$ C - $16^0$ C ($40^0$ – $60^0$ F) | Every 2 months |
| Above $16^0$ C ($60^0$ F) | Once a month |

- The specific gravity of the electrolyte should be checked every 6 to 8 weeks using a hydrometer. See Section 4.7 for further details.
- The batteries should be recharged to a specific gravity of approximately 1.260 sp. gr.
- After charging, disconnect the battery pack. See Section 4.9.

**⚠ DANGER**

**Batteries in a low state of charge will freeze at higher temperatures than fully charged batteries. Do not attempt to charge a battery that is frozen or if battery case is excessively bulged. Properly dispose of battery, because frozen batteries can explode.**

Table C indicates freezing points of batteries at different specific gravities.

| TABLE C | |
|---|---|
| **SPECIFIC GRAVITY** | **FREEZE POINT $^O$F/$^O$C** |
| 1.260 | -70/-57 |
| 1.230 | -39/-38 |
| 1.200 | -16/-26 |
| 1.117 | -2/-19 |
| 1.110 | +17/-8 |

***NOTICE:*** **Specific gravity readings are at $80^0$F. Values need adjustment for electrolyte temperature. Reduce .004 for every $10^0$F below $80^0$F. Increase by that amount for every $10^0$F above.**

Vehicles with single point watering system, quarterly during storage check water levels per Section 4.11.

## 7.2 VEHICLE PREPARATION

- Store the vehicle in a cool place.
- Maintain tire pressure at sidewall recommendation.
- Grease suspension and continue quarterly lubrication during storage period.
- Clean vehicle body, seats, battery compartment and vehicle underside.
- Do not engage park brake. Block wheels to prevent movement.

***NOTICE: M*ake sure power keyswitch is in the OFF position.**

## 7.3 RETURNING VEHICLE TO SERVICE

- If necessary, connect the battery pack and fully recharge batteries.
- Check tire pressure and readjust if necessary.
- Complete the pre-operation checks per Section 3.4.2.

For vehicles with a single point watering system:

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


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