

C&D TECHNOLOGIES, INC.

Power Solutions

STANDBY BATTERY LI TEL48-170C INSTALLATION AND OPERATING MANUAL

Before handling or storing the battery take time to read this manual. It contains information that could avoid irreparable damage to the battery and/or void product warrant. Keep a copy of the manual available for future reference.

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INTRODUCTION

C&D Technologies, Inc. manufactures batteries, electronics, and fully integrated power systems which provide back-up battery power in the event of a primary power loss or interruption. Meeting the needs of customers in the telecommunications, uninterruptible power supply (UPS) and utility, switchgear and control, cable, broadband, and solar markets, C&D offers a wide selection of products for all of your Standby Power needs.

The purpose of this document is to instruct installers how to receive, install, operate, and maintain C&D Li 48 170C Li-ion battery pack. Unlike a traditional Lead-Acid battery, this battery pack includes an embedded Battery Management System (BMS). The BMS electronics and multiple Li-ion modules combine to form an advanced battery pack. The battery pack autonomously protects itself and does not require any additional external controllers or integrated charger communication. The unique autonomous design allows the battery pack to be used simply as a battery. The BMS operation under normal conditions is transparent from the end user and only takes action to disconnect or shut-down the battery pack to prevent abuse or potentially dangerous use.

As with any battery, the performance and life expectancy of this lithium-ion battery depends heavily on how it is used and stored. In order to ensure optimal performance, life, and safety, please read this document thoroughly and be sure to consult with C&D Technologies in advance regarding battery charging, discharging, specifications, and capabilities when designing equipment or systems that include these batteries.

SECTION 1 –BATTERY PACK

1.1 DESCRIPTION

C&D Technologies' advanced battery systems provide a unique combination of safe and reliable, high density energy storage, with long life for backup power applications around the world. Typical applications include telecommunications infrastructure powered from high cost primary energy sources (e.g. diesel genset powered in off-grid or unreliable grid locations) and anywhere energy storage systems are used to reduce carbon dioxide (CO₂) emissions or applications with size and weight constraints that traditional battery technologies are not able to satisfy.

The LI TEL48-170C is designed for cycling and floating operation. The battery is suitable for paralleling of multiple battery packs for increased reserve time or energy storage. The battery provides high performance energy storage in a significantly reduced size (50% to 80%) and lighter weight (4 to 10 times) than conventional batteries.

1.2 APPLICATIONS

BTS: Base Transceiver Stations	Wireless, Hybrid energy technology
OSP: Wireline Outside Plants	Optimized space, weight, and floor loading
CO: Central Office	Distributed power, with floor loading constraints
Renewable Energy	Reduce CO ₂ emissions, intermitted sources

1.3 FEATURES

- High and Deep Cycling capabilities
- High performance, float applications
- High roundtrip efficiency
- State of Health, State of Life, for prognostics, future replacement
- Self-Diagnostics, and Lockout mode for safety
- High Rate, up to an 80 ADC maximum continuous current
- Storage "Sleep mode" to maximize shelf life
- Sealed design, no gas emissions, maintenance free
- LED Major and Minor alarm indication on front of battery

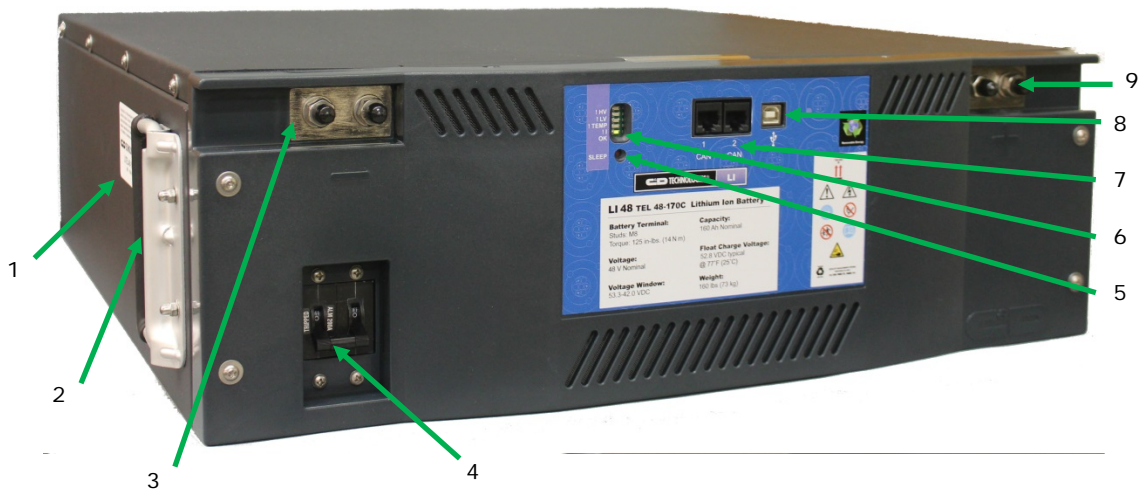
1.4 DIMENSIONS

Width	Height	Depth	Weight
21.2"/538 mm (no side handles) 22.2: / 564 mm (with side handles)	6.77"/172 mm/4RU	21.2"/564 mm	160 LBS/72.6 kg

1.5 CONNECTIONS

The battery connections include battery terminals (+/-), Chassis ground, CAN bus and USB port.

As shown below, the battery terminals are covered with Black vinyl end caps (4) from the factory to protect the terminals during shipment; these must be removed before the battery is used.



Battery Front View

1. Model number and serial number label
2. Side handles (optional)
3. Negative (-) battery terminal, two M8 studs
4. Circuit Breaker
5. Sleep / Storage Push Button Switch
6. Battery Status, major and minor alarm indication
7. CAN Bus connection, CAN 1 and CAN 2 (isolated)
8. USB 2.0 type B connector (isolated) not used in normal use, only to update battery firmware
9. Positive (+) battery terminal, two M8 studs
10. Chassis ground connection on back of battery (not shown above)

1.5.1 Terminals

The battery pack (+, -) terminals are recessed from the front of the battery and ship from the factory with a protective vinyl cap over the studs with an anti-corrosive grease coating applied to the terminal plates. The terminals are corrosion resistant stainless steel, M8 studs designed to accommodate copper two-hole compression lugs having 1" (25.4 mm) centers.

	Connection	Description
Positive terminal	(+)	two M8 threaded studs
Negative terminal	(-)	two M8 threaded studs
Application Torque		125 in.- lbs. (14.2 N*m)
M8 threaded stud material		Stainless Steel

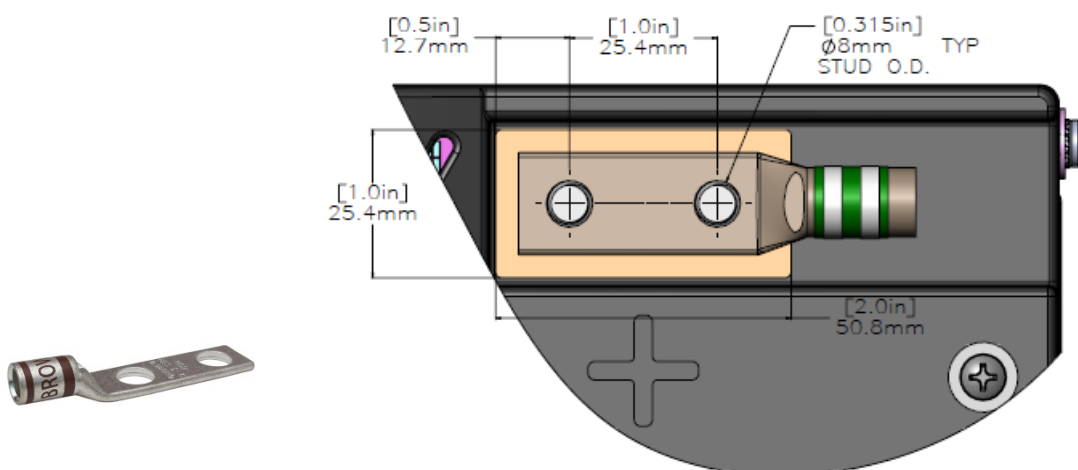
Battery Terminals

Note: The battery is designed to support up to 4/0 AWG stranded copper cable. Proper sizing of battery power cables is the sole responsibility of the installer/ end user. Factors to consider for cable sizing include the applicable local electrical codes; the 200ADC circuit breaker; application DC loads; the required desired voltage drop; and the temperature rise of the cable.

The lugs used on the battery cable must be properly installed, straight standard barrel, copper tin plated. Four stainless-steel M13 nuts and lock washers are included with the battery.



Undersized battery power cables or a loose connection can create an abnormal temperature rise on the terminals. This may result in the battery disconnecting from the system and dropping the site load. As part of the battery pack's safety features, when the battery senses high battery terminal temperature the battery will disconnect itself from the system via the internal battery disconnect switch.



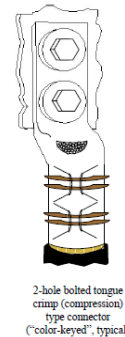
Two-Hole Compression Lug, Battery Terminal Connection,

NOTE: The two-hole lug shown in the picture above is for illustrative purposes only. Actual lug may differ in appearance from the illustration depending upon cable sizing selected. Lug width may not exceed 1 inch (25.4 mm). Lug hole to hole centers must be 1 inch (25.4 mm) while lug hole diameters need to be 0.315 inch (8 mm).

1.5.2 Ground

Battery chassis grounding provisions on each unit includes two, M6 threaded inserts for a two-hole copper compression lug. The grounding connection area is coated with NO-OX-ID grease and then covered at the factory to help prevent oxidation during transportation and storage. A hardware kit for this connection as well as the 120 Ohm CAN bus terminator is supplied in a small bag inside the battery packaging.

The battery pack frame ground connection is located on the rear of the battery pack. This is intended to connect a ground cable to the battery by placing a lock washer between the lug and the head of the screw or bolt. Torque to 100 in lbs (11.3 N*m).



Case ground connection on rear of battery

1.5.3 Circuit Breaker

The battery faceplate includes a 200A DC circuit breaker. To use the battery make sure the circuit breaker is in the ON position. During installation, shipping, or storage the circuit breaker should be in the OFF position.

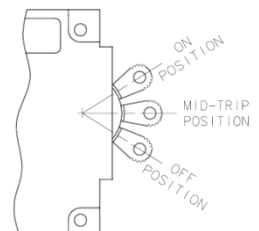


Circuit Breaker on front of battery

MID-TRIP POSITION

The handle position indicates the status of the circuit breaker. In addition to the full ON (UP) and full OFF (DOWN) positions, there is a middle position (Mid-Trip) indicating that the breaker has electrically tripped.

The automatic handle movement to the mid-trip position upon an electrical overload and Current Alarm LED on the front panel allow for easier detection of the fault on a given battery. The mid-trip breaker off condition can be disengaged by the manual actuation of the handle to the OFF position. Once the original source of the fault has been corrected, the circuit breaker can be reset to the ON position.



If the breaker is electrically tripped, typically this is due to an overload. As another layer of protection the battery can electrically trip the breaker as a result of an internal pack issue detected during the periodic self-diagnostic process. By using the C&D Battery monitoring software it is possible to view the alarm status and history.

1.5.4 Status LEDs

The five LEDs provide a simple visual display of the battery status while the battery is operating and not in Storage Mode.



Battery Status LEDs on front of battery

The green Battery OK LED is on continuously for normal operation. Each red alarm LED is on during a specific alarm. In general, a red LED is on continuously during an active alarm and blinks during an active warning. The function of each LED is provided in the table below.

Indicator LED	Description
Battery OK , Green LED	On: Normal operation, no active alarms Blink: (two cases, as shown below) PC software, when communicating to PC Storage, determining if refresh charge is required Off: An alarm is active
Current (!I), Red LED	On: High battery current alarm is active Blink: High current warning is active Off: Normal, no battery current alarms
Temperature (!T), Red LED	On: High or low temperature alarm is active Blink: Temperature warning is active Off: Normal, no temperature alarm active
Low Voltage (!LV), Red LED	On: Low cell or battery voltage alarm is active Blink: Low voltage warning is active, or if the battery is in storage mode this LED blinks to indicate a refresh charge is required Off: Normal, no low cell or battery voltage alarm
High Voltage (!HV), Red LED	On: High cell or battery voltage alarm is active Blink: High voltage warning is active Off: Normal, no high cell or battery voltage alarm

Battery Status Lights Operation

STORAGE mode, all LEDs are off, this indicates the battery is in Storage mode.

LOCKOUT mode, LEDs scanning sequentially up and down indicates a critical alarm is active and the battery is in Lockout mode and requires service.

The Battery includes comprehensive battery monitoring and diagnostics. The battery status lights indicate only a few key alarms and warnings. For ease of troubleshooting, detailed battery status information is available by connecting a PC to the battery pack's CAN Bus port (CAN to USB adapter is required) and using the C&D Battery monitoring software. For additional details, see the C&D Battery Monitoring Software User's manual.

1.5.5 Storage Mode

The SLEEP switch has two functions: Storage Mode and Battery reset. The SLEEP push-button switch is recessed in from the front of the battery to avoid unintentional use and damage. To access the switch lightly insert an insulated #0 point, Philips screwdriver or other non-conductive tool through the access hole provided on the front of the battery to momentarily press and release the switch.



Enable Storage Mode

To enable the Storage mode, press and hold the switch for six seconds. Initially, when the switch is pressed, all five status LEDs will light. The LEDs will turn off consecutively, one every second. When all LEDs are off, wait for one second and then release the switch and the battery will enter the low-power Storage mode. All LEDs should be off if the battery was successfully put into Storage mode. During Storage mode, the internal battery switch is open, and the USB and CAN bus communication ports are disabled. The battery circuit breaker in the faceplate should be switched to the OFF position for battery storage.

Exit Storage Mode

To manually exit the Storage mode, press and hold the switch for six seconds and the battery will start normal operation. The five LEDs will turn on consecutively, one every second. When all LEDs are on, wait for one second and release the switch and the battery will restart normal operation. After a brief delay for the self-diagnostics to complete, the green OK LED turns on indicating the battery has successfully exited Storage mode and is in normal mode.

Reset Battery (not necessary under normal use)

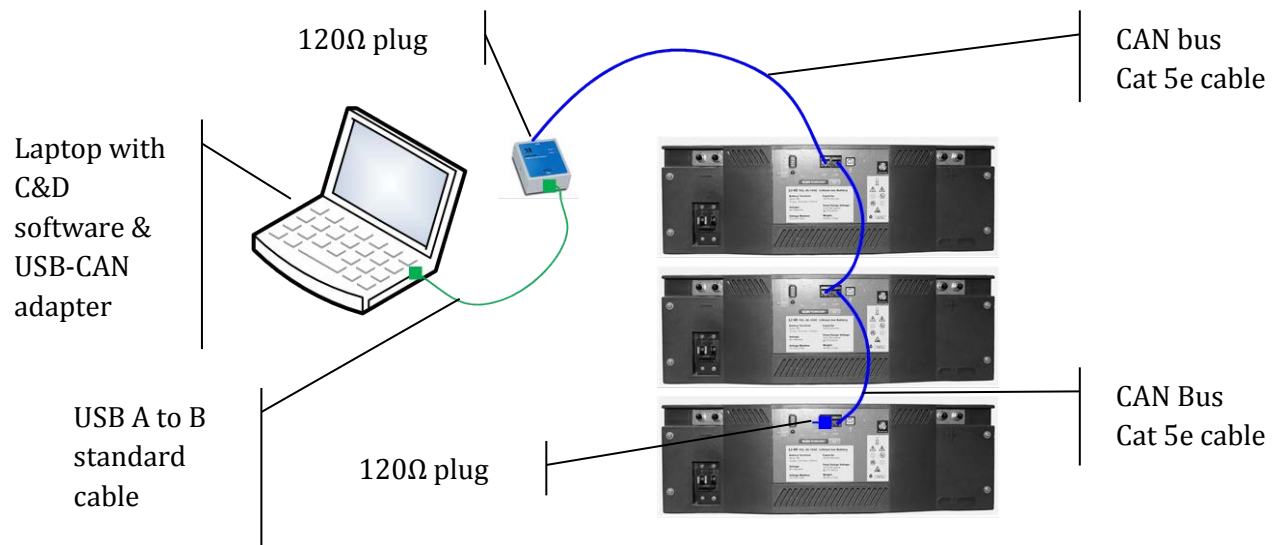
To reset the battery pack, press and hold the switch for 30 seconds or slightly longer. Release the switch and the battery will reset, the green OK LED goes off momentarily, performs a self-diagnostic process, and restarts normal operation with the green OK LED on.

1.5.6 Battery Network

The battery features the capability to share data across a string of batteries for local monitoring of the whole string with a connection to only one battery. Using the battery to battery network is optional; the battery can be used as a stand-alone battery.

The C&D battery-to-battery data network allows the user to connect battery packs together in a daisy-chain fashion using LAN cables. Each battery has two connectors (CAN 1, CAN 2) for connecting batteries together with standard category 5e cables.

As shown below, one battery CAN bus connector connects to the cable from the previous battery and the other connector is for the cable to the next battery downstream. A C&D Technologies, 120 Ohm, network termination plug is required at each end of the CAN bus.



Battery Data Network Daisy Chain Connection

The C&D battery network uses an electrically isolated Controller Area Network (CAN) data bus running over a standard LAN 5e cable. CAN bus is a high-integrity serial data communications bus with excellent error detection and confinement capabilities.

The C&D Battery Monitor PC software allows viewing up to five batteries simultaneously with the USB adapter's CAN bus attached to just one battery in the string. The USB-CAN adapter connection is made to a battery (CAN 1 or CAN 2) at one end of the data bus. Contact your C&D representative for the C&D Software and USB-CAN adapter hardware information.

Remote monitoring of the battery(s) is possible with a Delta Orion, rectifier controller. Contact C&D for more information on this integrated system solution for monitoring of remote sites.

SECTION 2 – RECEIVING

2.1 INSPECTION

Precautions have been taken to pack the battery for shipment to ensure its safe arrival. Upon receipt, inspect the battery pack for physical damage to the battery and terminals. If the packing material is physically damaged, make a notation on the delivery receipt before you accept the shipment/delivery. If damage is found, do not bring the battery out of Storage mode or attempt to use it, a claim must be filed with the carrier.

Verify the number of cartons and skids against the bill of lading and verify their components against the packing lists. Keep a copy of the verified lists for your installation records.

Accessories

Inside each battery packaging is a small bag that contains the M6 hardware for the ground connection and the battery network 120 Ohm terminator required for the installation. Please remove this bag before discarding the original packaging and box.



NOTICE: The battery should never be opened without C&D Technologies approval, and should not be destroyed or incinerated since the battery may cause fire or the ingredients contained in the cells could be harmful under some circumstances if exposed. Do not attempt to use or install this battery if any of the following conditions are observed: there is an unusual smell, the battery feels hot, has a deformed shape, or appears abnormal in any other way.

Damage and shortage situations

C&D ships FOB plant (ownership passes at our dock). If shipments are damaged or if cartons or skids are damaged or missing, a claim must be filed with the carrier. Place an immediate order for replacement with C&D and use the replacement cost as the amount of freight damages or shortages involved. If individual component items are missing, a shortage report should be filed immediately with C&D. Mail (express mail recommended) or fax a copy of the VERIFIED component packing list. This verified list should show both the name of the packer, as well as the quantities of items checked off by the receiver. Send this list to:

C&D TECHNOLOGIES, INC.:
Attn.: Customer Service
1400 Union Meeting Road
Blue Bell, PA 19422 USA
Tel. 215-619-2700; FAX 215-619-7840

SECTION 3 – INSTALLATION

3.1 PRE-INSTALLATION

Prior to installation, turn off the charging source and disconnect the battery being installed from the DC source by turning the circuit breaker(s) off, if so equipped. Put battery in Storage mode and switch the 200A breaker to the “off” position. Do not attempt to make connections while the battery terminals are live or charging source is live.

Always observe local, state, and national electrical codes at all times. LI TEL48-170C, li-ion batteries are typically 160 pounds (72.6 kg) each. Make sure the proper lifting and moving arrangements are in place for safe handling of the battery pack before traveling to the site.

Handling

- After unpacking the battery, keep the battery lying flat, dry, and up right as indicated on the front label
- Do not transport or move the battery by holding onto the terminals or battery cables
- Do not short (+) or (-) terminals with electrically conductive material
- Do not connect with reversed polarity (+/-)
- Do not mix different types of batteries
- Do not open the battery
- Do not use the Li-ion battery without the embedded Battery Management System
- Do not subject the battery to excessive mechanical or electrical stress
- Do not expose the battery to water or condensation
- Do not directly heat, solder, weld, or place into fire. Such inappropriate use can cause leakage of electrolyte or cause fire or explosion
- Immediately disconnect the battery packs if, during operation they omit an unusual smell, feel hot, show signs of corrosion, changed in shape or appear abnormal in any other way. Contact C&D if any of these problems are observed.
- Do not connect battery packs in series.



This Li-ion battery is a sealed unit when offered for sale. It is a manufactured article and does not expose the user to hazardous chemicals when used in accordance with the manufacturer.

If abused or damaged, liquid emission from a battery may be electrolyte, which can cause severe irritation to the respiratory tract, eyes and skin. All precautions should be taken to limit exposure to the electrolyte vapor. Review the MSDS sheet included in the appendix of this document prior to working with batteries, so that you are familiar with the steps to take in the event of a release.

3.2 TOOLS

Before installing the battery pack, gather the following tools and equipment.

Insulated torque wrench (100 in-lbs, 11.3 N*m)	Insulated 10 mm socket for torque wrench
Insulated torque wrench (125 in-lbs, 14.1 N*m)	Insulated 13 mm socket for torque wrench
Insulated Philips, #0 point tip, screwdriver	DMM, Voltmeter
Clamp on DC ammeter, 0 to 200 ADC range	PC laptop: C&D Battery Monitor software installed, USB-CAN bus adapter, USB Type A/B standard cable (optional)
Cat5e cables (optional) for battery to battery data network	

Tools and Equipment for installation

Optional test equipment: system load bank.

Preparing electrical contacting surfaces

The battery chassis ground connection on the back of the battery case is coated with NO-OX-ID grease at the factory to prevent oxidation. Remove any factory-applied cover and grease from the battery ground area with a clean dry cloth, as it may be contaminated or dirty.

All electrical contacting surfaces must have a clean finish. Any tarnish or discoloration should be removed with a non-conductive fiber brush, or burlap cloth. Be careful not to remove the plating on the positive and negative battery terminal plates.

Parallel Connection of individual batteries

C&D recommends each individual battery be cabled separately to a common junction point or DC bus. The battery terminals (+/-) should not be “daisy chained” in parallel.

Each battery includes an integrated 200ADC circuit breaker on the front panel and a Storage mode to facilitate installation and maintenance. The parallel connection should be completed only if the charger and load are not connected to the battery output circuit.



When the separate batteries are to be initially connected in parallel, their open circuit voltages must be within +/- 0.5 VDC of each other prior to making the paralleling connection. Use a digital voltmeter or the C&D Battery Monitoring PC Software to compare the individual battery voltages.

3.2 INSTALLATION



*Prior to installation, turn off the charging source and disconnect (isolate) the battery being installed from the DC source by turning the circuit breaker(s) off, if so equipped. In addition, verify the battery is in Storage mode and then switch the 200A breaker to the “off” position. **Do not** attempt to make connections while the battery terminals or charging source is electrically live.*

Step 1. C&D recommends prior to installation, the battery is in Storage mode and the 200A breaker is in the “OFF” position. The battery status light should be off if the unit is in Storage mode, as indicated by all the Battery Status LEDs being off.

Step 2. Beginning with the lowest shelf, place one, LI TEL48-170C, battery per shelf. Clear any battery hold-down straps from the shelf to make way for the battery. Align the battery with the shelf and slide the battery onto the shelf. Secure the battery to the rack or enclosure.

Step 3. Remove and save the four vinyl battery terminal (+) (-) protectors and install a 120 Ohm terminator plug to the battery pack, CAN 1 connector on the front panel.

Step 4. Once the batteries are placed in the rack, they should be numbered for future identification during maintenance. Label the lowest battery tray as battery 1 with the battery above as battery 2. Repeat the sequence, up to battery six on the highest shelf.

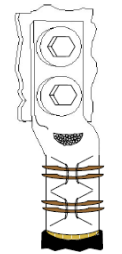
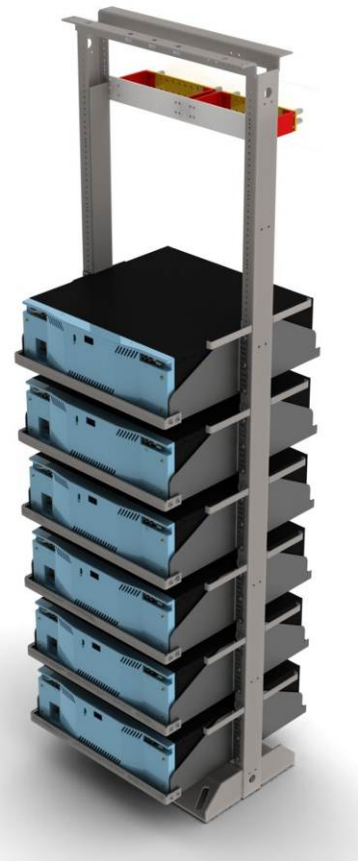
Step 5. Connect the power supply positive (+) cable lug onto battery 1 positive (+) terminal (M8 studs) using two of the M13 stainless-steel hex nuts and lock washers included with the battery. Tighten the two nuts and lock washers hand tight.

Step 6. Connect the power negative (-) cable lug onto battery 1 negative (-) terminal using the hardware provided (M13 stainless-steel hex nuts and lock washers). Tighten the two nuts and lock washers hand tight.

Step 7. Torque the battery terminals, (four M8 studs) to 125 inch-pounds (14.1 N*m). If the M8 threaded studs are over-torqued, this may distort the battery posts, permanently damaging the battery.

Step 8. Frame ground each battery with a separate #6 AWG ground cable. The metal contact area shall be prepared to a bare bright finish and coated with an anti-oxidant compound before joining. Connect a two-hole cable lug to each battery using the hardware, M6 bolt and lock washer provided. Torque the two bolts on the battery to 100 inch-pounds (11.3 N*m) using a 10 mm socket and insulated torque wrench. If the bolts are over-torqued, this may result in permanent damage to the battery.

Step 9. Repeat steps 6 to 8 for each battery, working from lowest battery to the battery on the highest shelf.



2-hole bolted tongue
cable (compression)
type connector
("color-keyed", typical)

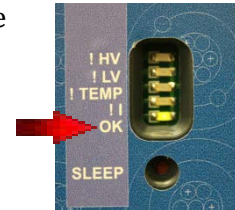
Step 10. Recheck the torque of all connections, in sequence.

Step 11. Recheck and correct battery polarities. Making this correction will avoid the possibility of connecting battery packs together with reversed polarity.

Step 12. Switch the 200A breaker to the “on” position, starting with battery 1.

Step 13. Wake-up Battery 1, from Storage mode, lightly press and hold the Sleep switch with an insulated Philips, #0 point, screwdriver for six seconds. The five status LEDs will turn on consecutively, one every second. After all LEDs are on for one second, release the switch.

Step 14. Confirm the status of Battery 1, by verifying the battery OK, green, LED is on continuously and the four red alarm LEDs are off.



Step 15. Check the battery voltage and status, using the C&D Battery Monitoring software and a PC.

Step 16. Wake-up the next battery by repeating Step 12 to 15 above. Repeat as required until all batteries are operating normally.



Before connecting battery to charger, it is important to note that several hazards are associated with battery systems, where terminal voltages can exceed 50 VDC and currents may exceed several thousand amperes. By exercising proper care and allowing only properly trained personnel to work on them, batteries should serve you well and perform without incident. Observe precautions and become familiar with local, state, federal, company, and professional codes and procedures.

Step 17. Energize the system by following the manufacturer’s procedures. Switch the battery string circuit breaker or disconnect switch to the ON position (if applicable). Turn on the DC charging source. When battery pack(s) senses the charger output voltage at the battery terminals, the internal battery switch will close, connecting the pack’s internal lithium-ion cells to the charging source.

Step 18. Using the C&D Battery software, check the battery voltage and current closely matches the digital voltmeter and clamp-on ammeter. Verify the status of each battery using the C&D Battery Monitoring software. The applied charger voltage must be less than 53.5 VDC as measured at the battery terminals and the individual battery current must not be greater than 80 ADC or the battery pack will automatically disconnect from the charger on a high voltage or high current alarm condition.

Step 19. Using the C&D Battery software set the date and time of each battery. The battery monitoring software uses the date and time from the PC to set the battery’s real time clock. Refer to the C&D Battery Monitoring software user’s guide for details.

SECTION 4.0 OPERATION

4.1 MODES

The battery pack has three modes of operation: Run, Storage, and Fault. The Run state is the normal operating mode. The Storage mode minimizes energy consumption of the embedded battery management system (BMS) while the battery is not in use, stored, or during an extended power outage. The Fault state disconnects the internal string of lithium-ion cells from the battery terminals in the event of an active alarm condition or an internal battery fault is detected.

Mode	Description	Operation
Run Mode	Normal Operating mode	<ul style="list-style-type: none">▪ All features active, Status LEDs used▪ Battery continuously monitors voltage, current and temperatures and balances internal li-ion cells.▪ Protection warnings and alarms active if a parameter(s) found outside factory set limits.
Active Alarm (Run Mode)	Management system sensed an active alarm condition, a measured parameter (voltage, temperature, current) exceeded the alarm threshold value	<ul style="list-style-type: none">▪ Internal battery switch opens, disconnecting the terminals from the site DC bus.▪ Requires the alarm condition(s) to clear before the normal operation can automatically resume.▪ CAN bus communication enabled
Storage Mode	Battery Storage mode	<ul style="list-style-type: none">▪ Battery charge and discharge disabled via internal switches. (Circuit breaker on front panel may have been switched to OFF.)▪ Battery management electronics operating in lowest power state▪ Minimal functionality, no USB / CAN communication▪ Battery periodically wakes-up and checks the battery state of charge to determine if a recharge required. The red low voltage LED blinks when a charge is required.
Lockout Mode/ Battery shutdown	A cell voltage or temperature exceeded a critical safety threshold, or the self-diagnostics failed, battery operation is disabled	<ul style="list-style-type: none">▪ Internal battery switch open permanently – no reset available. Battery requires factory service.▪ CAN bus communication enabled until battery automatically goes to Sleep / Storage mode after 30 seconds without any CAN bus communication.

Battery Operating Modes

4.2 CHARGING

For a lithium-ion battery, the charging voltage needs to be regulated precisely to avoid triggering the safety alarms / warnings or affecting the battery's useable Ah capacity.

Charge with specified charger designed for this battery or commercial cycling test equipment that includes an upper voltage fail-safe limit of 53.5 VDC or lower. Discharge only in systems that include a fail-safe low voltage limit or a Low Voltage Disconnect of 41.9 VDC or higher, to prevent over discharge.

Li-ion battery service life is affected by the voltage and current levels at end of charge, the operating State of Charge range, and temperature. Many customers decide to use less than the full rated capacity as a trade-off to improve life. For this reason, the battery's factory settings can vary by customer. The following specifications are provided as typical values, the actual values set at the factory are viewable using the C&D PC Battery Monitor Software.

Following a discharge the constant-current, constant-voltage, (CC-CV) method is used to charge lithium ion batteries. When a battery is charged with a CC-CV profile, it is initially charged with a constant current and the battery voltage gradually increases over time to the controlled voltage. At this point, the constant voltage phase begins and the charge current naturally decreases to a float charging state. When charging the battery, either use a specified battery charger or otherwise ensure that the battery charging conditions specified by C&D Technologies are met.

- | | |
|--------------------------------|--|
| ▪ Typical Float Voltage: | 52.80 VDC at 25°C (77°F) |
| ▪ Current, continuous: | 80 ADC @ 25°C (77°F) Maximum |
| ▪ Charge, ambient temperature: | 0°C to 50°C, (32°F to 122°F) Maximum
0°C to 40°C, (32°F to 104°F) Recommended |

Only use direct current (DC) for charging. Charge with the specified charger for this battery or commercial cycling equipment that has upper voltage fail safe conditions.

Do not overcharge as venting and combustion can occur. Do not over discharge.

Equalize Charge

Sometimes, traditional lead-acid batteries require equalize charging periodically to narrow the overall voltage spread of individual cell voltages within the battery. The C&D LI TEL48-170C battery pack includes a built-in, fully automatic active cell-to-cell balancing feature. No equalize charge should be applied or the safety protection features may activate causing the battery to open the internal battery switch and interrupt charging.

4.3 DISCHARGING

The maximum discharging current is 80 ADC per battery. Ensure the charger current limit or system design complies with this limit or the over current battery safety features may automatically terminate the discharge. When the discharge current exceeds the high current warning threshold the battery current red LED begins to blink on/off on the battery's front panel. When the current exceeds the alarm set point an active alarm qualified the red current LED on solid and the main internal battery switch is opened, preventing continued discharging.

- Typical Discharge voltage cutoff: 42.00 VDC
- Current, continuous: 80 ADC @ 25°C (77°F) Maximum
- Discharge ambient temperature: -30°C to 50°C, (-22°F to 122°F)

Ensure the Low Voltage Disconnect (LVD) of the system is set to 42.0 V or higher. The battery includes under voltage protection alarms as backup to the system design LVD. Three battery pack threshold levels are provided, Warning, Alarm, and Protection.

When the battery or an individual cell voltage reaches the Low Voltage Warning threshold value, the front panel red Low Voltage LED begins to blink on / off. If the voltage continues to drop and reaches the Low Voltage Alarm threshold, the internal battery discharge switch will open disabling discharge and the Low Voltage red LED is on solid. The internal discharge switch will remain open until the low voltage alarm condition is cleared or the presence of charger voltage is sensed at the battery terminals. Discharging is disabled and charging is enabled while an active low voltage alarm is present. A third, very low voltage threshold is provided to protect the cells from a non-recoverable over discharge condition.

In the event the voltage continues to drop and is below the very low voltage protection point, the internal battery switch opens, disabling discharging and the battery will automatically enter the low power storage mode to conserve the remaining energy in the cells. To recover from this protection alarm state, manually wake-up the battery from Storage mode and apply an appropriate charge.



Do not leave the battery in a discharged state for an extended period without recharging. This may lead to the cell voltage falling below the very low voltage protection point causing the battery to automatically enter the Storage mode or given enough time exceed the critical low voltage threshold, permanently disabling use of the battery.

4.4 STORAGE

Store the batteries in a clean, cool, dry, and ventilated area. The recommended temperature range for storage is 50°F (10°C) to 77°F (25°C). A fully charged battery may be stored at these temperatures for up to six months or as soon as the Low Voltage red LED starts blinking. Storing the battery above this temperature range may harm the performance of the battery and reduce the battery's life expectancy.

While in Storage mode, the battery will periodically wake-up and check the State of Charge to determine if a refresh charge is required. If the State of Charge is found below the factory set point for a refresh charge, the red Low Voltage LED will blink. The end user is responsible to monitor the battery status and recharge the battery to prevent over discharge.

Monitor at least monthly for recharging. Failure to monitor the state of charge or refresh charge required indication is potentially detrimental to the battery and can void the warranty if not given a freshening charge when required. Li-ion cells that become over-discharged are considered critical and the battery will enter the Lockout mode. The battery pack requires factory service to resolve Lockout mode.



Store the LI TEL48-170C batteries in a clean, dry, cool area away from radiant heat sources. Before storing the battery, verify the battery pack is in Storage Mode. Follow instructions as outlined in Storage Mode switch section of this document. When the battery is operating in Storage Mode, the red Low Voltage LED will blink if the battery pack detects a refresh charge is required.

Because batteries utilize a chemical reaction, battery performance will deteriorate over time even if stored for a long period without being used. In addition, if the various usage conditions such as charge, discharge, ambient temperature, etc. are not maintained within the specified ranges, life expectancy of the battery may be shortened. Elevated temperatures can result in accelerated aging and shortened battery life.

Battery's Date and Time

The battery pack includes a real time clock. A date and time stamp is included in the alarm and event history logs. This clock will maintain the date and time while the battery is in Storage mode. Use the C&D battery monitoring software and a PC to reset the date and time as required or if it is moved to a different time zone.

SECTION 5 – MAINTENANCE

Unlike some commonly used Lead-Acid batteries that require water addition, specific gravity measurements, or electrolyte levels checked throughout its life; this battery does not require any electrical maintenance. However, it is recommended to properly follow the below maintenance procedure. This will assure that the batteries are well maintained and ready for operation when needed.

5.1 MONTHLY INSPECTION

1. Perform a visual inspection of the battery for general appearance, connector and cable conditions, unusual smells, signs of over-heating, or any other abnormal appearances.
2. Check for an OFF circuit breaker, alarm and warning status indicators on the battery.
3. View and download the battery alarm and event history using the C&D Battery Monitoring software.

5.2 ANNUAL INSPECTION

Annually (in addition to monthly inspection)

1. Re-Torque the four M8 battery terminals, (four posts) to 125 inch-pounds (14.1 N*m) using a 13 mm socket and an insulated torque wrench.
2. Re-Torque the two Battery pack frame ground bolts on the battery to 100 inch-pounds (11.3 Newton-meters) using a 10 mm socket and insulated torque wrench.

For technical assistance contact the Customer Service Department located at:

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