C&D TECHNOLOGIES

RS-990

LIBERTY® SERIES 1000
Valve-regulated Lead Acid Batteries
Installation and Operating Instructions



SAFETY PRECAUTIONS

Only authorized and trained personnel familiar with standby battery installation, preparation, charging and maintenance should be permitted access to the battery.

WARNING



SHOCK HAZARD - DO NOT TOUCH UN-INSULATED BATTERY, CONNECTORS OR TERMINALS. BE SURE TO DISCHARGE STATIC ELECTRICITY FROM TOOLS AND TECHNICIAN BY TOUCHING A GROUNDED SURFACE IN THE VICINITY OF THE BATTERIES BUT AWAY FROM THE CELLS AND FLAME ARRESTERS.

ALL TOOLS SHOULD BE ADEQUATELY INSULATED TO AVOID THE POSSIBILITY OF SHORTING CONNECTIONS. DO NOT LAY TOOLS ON THE TOP OF THE BATTERY.



ALTHOUGH LIBERTY® SERIES 1000 BATTERIES ARE SEALED AND EMIT NO GAS DURING NORMAL OPERATION, THEY CONTAIN POTENTIALLY EXPLOSIVE GASES, WHICH MAY BE RELEASED UNDER ABNORMAL OPERATING CONDITIONS, SUCH AS A CHARGER MALFUNCTION. PROVIDE ADEQUATE VENTILATION SO HYDROGEN GAS ACCUMULATION IN THE BATTERY AREA DOES NOT EXCEED ONE PERCENT BY VOLUME. HOWEVER, NORMAL AIR CIRCULATION IN A VENTILATED FACILITY WILL PRECLUDE ANY HYDROGEN BUILD-UP, EVEN DURING EQUALIZE CHARGING. NEVER INSTALL BATTERIES IN A SEALED CABINET OR ENCLOSURE. IF YOU HAVE ANY QUESTIONS, CONTACT YOUR LOCAL C&D TECHNOLOGIES AGENT.



THIS BATTERY CONTAINS **SULFURIC ACID**, WHICH CAN CAUSE SEVERE BURNS. IN CASE OF SKIN CONTACT WITH ELECTROLYTE, REMOVE CONTAMINATED CLOTHING AND FLUSH AFFECTED AREAS THOROUGHLY WITH WATER. IF EYE CONTACT HAS OCCURRED, FLUSH FOR A MINIMUM OF 15 MINUTES WITH LARGE AMOUNTS OF RUNNING WATER AND SEEK IMMEDIATE MEDICAL ATTENTION.

THIS BATTERY IS DESIGNED FOR **INDUSTRIAL USE ONLY** AND IS NOT INTENDED FOR APPLICATION IN VEHICULAR STARTING, LIGHTING AND IGNITION AND/OR OPERATION OF PORTABLE TOOLS AND APPLIANCES. USE ONLY IN ACCORDANCE WITH MANUFACTURER'S WRITTEN INSTRUCTIONS. USE OF THIS PRODUCT OTHER THAN IN ACCORDANCE WITH MANUFACTURER'S WRITTEN INSTRUCTIONS MAY PRODUCE HAZARDOUS AND UNSAFE OPERATING CONDITIONS, LEADING TO DAMAGE OF EQUIPMENT AND/OR PERSONAL INJURY.

IMPORTANT FOLLOW MANUFACTURER'S PUBLISHED INSTRUCTIONS WHEN INSTALLING, CHARGING AND SERVICING BATTERIES. THIS MANUAL IS TO BE USED FOR THE INSTALLATION AND OPERATION OF **C&D TECHNOLOGIES VALVE-REGULATED LIBERTY SERIES 1000 BATTERIES.**

FOR ADDITIONAL INFORMATION CONTACT:

C&D Technologies, Inc.
1400 Union Meeting Road, PO Box 3053
Blue Bell, PA 19422-0858
215-619-2700 or 1-800-543-8630, Fax 215-619-7899
www.cdtechno.com

FOR TECHNICAL or WARRANTY ASSISTANCE CONTACT:

Technical Service Department located at:
1400 Union Meeting Road
Blue Bell, PA 19422
215-619-2700 or 1-800-543-8630, Fax 215-619-7842

WARRANTY NOTICE

This instruction manual is not a warranty. Each standby battery is sold subject to a limited warranty, which is in place of all other warranties, express or implied (including the warranties of merchantability or fitness for a particular purpose) and which limits a purchaser's (user's) remedy to the repair or replacement of a defective battery or parts thereof. The terms of the limited warranty are incorporated herein and are available upon written request from C&D Technologies, Inc., 1400 Union Meeting Road, PO Box 3053, Blue Bell, PA 19422-0858 or in Canada C&D Technologies, Inc., Canada, 7430 Pacific Circle, Mississauga, ON L5T 2A3.

INTRODUCTION

The batteries referenced in this document are valve-regulated lead acid Liberty Series 1000®. They are constructed with pasted lead calcium plates with an absorbent glass mat and are valve-regulated. They are designed to provide long, reliable service life with minimal maintenance. The cells/units are shipped pre-assembled in 2-, 4-, 6- and 12-Volt modules to enable quick and easy installation. When operated at the recommended float voltage and temperature, the batteries emit virtually no gas or acid mist and do not need special ventilation other than what is required by local building codes. This makes Liberty Series 1000 batteries an ideal reserve power source for many critical applications, including telecommunications, switchgear and control, and uninterruptible power supply (UPS) systems. The Liberty Series 1000 product brochure and additional information are available on the C&D Technologies website at www.cdtechno.com.

Recombination: A More Efficient Design

In addition to eliminating the need for watering, the uniquely efficient recombination design also makes Liberty Series 1000 batteries lighter and more powerful than conventional lead-acid batteries. Oxygen evolves from the positive plates where it is converted back to water by electro chemical recombination, eliminating the need for watering.

CAUTION: Do not remove vent covers, they must remain in place at all times. Removal will void warranty.

Specifications are subject to change without notice. Contact your C&D Technologies sales office for the latest specifications. All statements, information and data given herein are believed to be accurate and reliable but are presented without guaranty, warranty, or responsibility of any kind, express or implied. Statements or suggestions concerning possible use of our products are made without representation or warranty that any such use is free of patent infringement, and are not recommendations to infringe any patent. The user should not assume that all safety measures are indicated, or that other measures may not be required.

RECOMMENDED TECHNICAL REFERENCES AND EXPERTISE

These instructions assume a certain level of competence by the installer/user. The following recommended practices and codes contain relevant information, and should be consulted for safe handling, installation, testing and maintaining standby batteries. Applicable state and local codes must be followed.

IEEE Std. 485-1997, IEEE Recommended Practice for Sizing Large Lead Acid Storage Batteries for Generating Stations and Substations (ANSI)

IEEE 1189-1996, IEEE Guide for Selection of Valve-Regulated Lead Acid (VRLA) Batteries for Stationary Applications

IEEE 1188-1996, IEEE Recommended Practice for Maintenance, Testing, and Replacement of Valve Regulated Lead-Acid Storage Batteries for Stationary Applications

IEEE 1187-2000, IEEE Recommended Practice for Installation Design and Installation of Valve Regulated Lead-Acid Storage Batteries for Stationary Applications

IEEE - PAR-1375-1998 "Guide for Protection of Stationary Battery Systems"

NESC, National Electric Safety Code, ANSI C2-1993 (or latest revision)

Copies may be obtained by writing: The Institute of Electrical and Electronic Engineers, Inc.
345 East 47th Street, New York, NY 10017, USA

ANSI - T1.330-1997, Valve-Regulated Lead Acid Batteries Used in the Telecommunications Environment

NEC National Electrical Code NFPA -70 (latest version) available from:

National Fire Protection Association Batterymarch Park, Quincy, MA 02269

Federal Codes:

29CFR1926.441	"Safety Requirements for Special Equipment"
29CFR1910.151(c)	"Medical Services and First Aid"
29CFR1910.268(g)	"Telecommunications"
29CFR1910.305(j)	"Wiring Methods, Components and Equipment"
STD 1-8.2(e)	"OSHA Standing Directive"

IBC, International Building Code

This manual is divided into four parts: Receiving and Installation of the battery, Operation and Maintenance, Reference and Trouble-Shooting section to assist the user should he require more detailed explanation of battery performance and maintenance procedures, and the Appendix.

Before handling cells or storing cells for future installation take time to read this manual. It contains information that could avoid irreparable damage to the battery and/or void product warranty.

LIBERTY SERIES 1000
VALVE-REGULATED (SEALED) LEAD ACID BATTERIES
INSTALLATION AND OPERATING INSTRUCTIONS

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PART 1
RECEIVING AND INSTALLATION

SECTION 1 - RECEIVING

1.1 General Information and Precautions

This battery is designed for industrial use only and is not intended for application in vehicular starting, lighting, and ignition, and/or operation of portable tools and appliances. Use only in accordance with manufacturer's written instructions. Use of this product other than in accordance with manufacturer's written instructions may produce hazardous and unsafe operating conditions, leading to damage of equipment and/or personal injury.

1.2 Safety

Charge only in accordance with manufacturer's operating instructions.
Do not expose to open flame or electrical arc.
Do not tamper with cell covers that prevent access to vents.
Observe all precautions shown on the inside cover of this manual.

1.3 Packing, Inspection at time of delivery

Every precaution has been taken to pack the battery for shipment to ensure its safe arrival. As soon as you receive the battery, check the packing material for evidence of damage in transit. If the packing material is physically damaged or wet acid stains are present, make a notation on the delivery receipt **before you accept the shipment/ delivery**.

Note: Freight Carriers generally require that the carriers' representative inspect concealed damage within 15 days from date of delivery to determine responsibility. The resolution of such claims may extend up to 9 months.

Verify the number of cartons and skids against the bill of lading and verify the components against the packing lists. Keep a copy of the verified lists for your installation records. It is important to verify that the accessory package is present and the component quantity is correct. If help is required call your local C&D Technologies Representative or C&D Technologies Customer Service at 800-543-8630 to report any discrepancies.

1.4 Damage and shortage situations

C&D Technologies 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 Technologies and use the replacement cost as the amount of freight that damages or shortages involved. If individual components or parts are missing, a shortage report should be filed immediately with C&D Technologies. Mail (express mail recommended) or fax a copy of the VERIFIED compo-

nent 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 the list to:
C&D Technologies, Inc.
Attn.: Customer Service
1400 Union Meeting Road
Blue Bell, PA 19422

SECTION 2 - STORAGE and SHELF LIFE

2.1 Storage of VRLA (valve regulated lead acid) Batteries

Store batteries indoors, preferably at 77°F (25°C) or in a cool 20°F to 90°F (-7°C to 32°C), dry location and place on charge by the **date found on the battery carton.**

Note: Batteries that are not placed in service for several months will self-discharge.

Storage time is based on storage at 77°F (25°C) and is six months for Liberty Series 1000 valve regulated cells. Do not allow the electrolyte to freeze, as this will destroy the battery and can cause a potentially hazardous condition and leakage.

Refer to Table 1, for electrolyte freezing temperatures. Although the specific gravity of a fully charged battery may present no freezing problem, a discharged battery gravity may freeze at relatively mild temperatures.

TABLE 1 - FREEZING TEMPERATURE VS SPECIFIC GRAVITY

Specific Gravity at 77°F (25°C)	Freezing Temperature	
	Celsius	Fahrenheit
1.000	0.0	+32
1.050	-3.3	+26
1.100	-7.7	+18
1.150	-15	+ 5
1.200	-27	-17
1.250	-52	-61
1.300	-70	-95
1.350	-49	-56
1.400	-36	-33

Note: Store cells upright in order to maximize electrolyte contact with the plates.

2.2 Storage limitations

C&D Technologies Liberty Series 1000 valve-regulated (sealed) lead

acid batteries are warranted against defects in materials or manufacturing or both. To keep the warranty in effect, you must place the units on charge by the date stamped on the shipping carton when stored at 77°F (25°C). If storage beyond this time is required or storage temperature is in excess of 77°F (25°C), monitor battery voltage at monthly intervals, if possible. A convenient measurement technique is to read the open circuit voltage. If the open circuit voltage drops below 2.10 volts per cell from the nominal value, the cell(s) must be given a boost charge at the "Initial/Equalize" voltage shown in Table 2. With the exception of the LS 2-600 all units consist of multiple cells. Refer to Table 2 for the nominal voltage and number of cells for a particular Liberty Series unit. Never charge the cells at a higher voltage than the equalize/ boost voltage recommended in Table 2, at 77°F (25°C). If cell temperature is below 60°F (16°C), **double** the initial/equalize charge time that is typically 12-16 hours at 77°F (25°C).

If this is not possible, contact C&D Technologies, Inc., Technical Services Department for special instructions.

Always complete a record of initial charge, refresh charges during storage, and float charge readings as described in **"initial charge" Part 2, Section 1.2 using RS-1511** of this manual and retain the readings in your files for future reference. Clearly identify your installation location, application, C&D Technologies model number, the date, and name of the person who took the readings.

The service life of the battery will depend on its ambient temperature, frequency and depth of discharge, discharge rate, charge voltage, and regulation of the battery charger.

SECTION 3 - INSTALLATION AND CONNECTION

3.1 Location and Preparation

Liberty Series 1000 batteries are best installed upright. Physical dimensions for layout may be found in Table 2. Install battery in a cool, dry location away from heat sources. The recommended operating temperature is 65-77°F (18-25°C). The allowable temperature range with performance degradation at the extreme temperatures is 32-90°F (0-32°C). Float voltage compensation should be made for temperatures other than 77°F (25°C).

Avoid sources of hot or cold air directed on a section of the battery that could cause temperature variations within the battery assembly. Such variations will compromise optimum battery performance such as float voltages of individual cells.

When handling units never lift them by the terminals as this can damage the post seals and cause acid leakage.

TABLE 2 - BATTERY SPECIFICATIONS
(Characteristics subject to change without notice. Refer to current specifications 12-373)

Model	LS 12-25*	LS 6-50*	LS 12-55	LS 12-80
Nominal voltage	12 Volts	6 Volts	12 Volts	12 Volts
Number of cells in module	6/unit	3/unit	6/unit	6/unit
Rated 8 hr. Capacity (Ampere-hours to 1.75 Vpc)	25 Ah to 10.50 Volts	50 Ah to 5.25 Volts	52 Ah to 10.50 Volts	80 Ah to 10.50 Volts
Rated 15-min. capacity (kiloWatts to 1.67 Vpc)	0.092	0.185	0.172	0.275
Internal resistance/cell	0.0017 Ohms	0.0008 Ohms	0.00157 Ohms	0.00094 Ohms
Short circuit current	1155 A	2310 A	1274 A	2128 A
Unit height	7.11 in (181 mm)	7.11 in (181 mm)	9.20 in (234 mm)	9.20 in (234 mm)
Unit length (includes handles)	7.64 in (194 mm)	7.64 in (194 mm)	10.20 in (234 mm)	13.94 in (354 mm)
Unit width	5.20 in (132 mm)	5.20 in (132 mm)	6.80 in (173 mm)	6.80 in (173 mm)
Weight	23 lbs (10 kg)	23 lbs (10 kg)	56 lbs (25 kg)	79 lbs (36 kg)
Terminal Characteristics	0.55 in (14 mm) diameter threaded brass insert, 0.50 in (13 mm) deep. Fasten with 10-32 stainless steel hex bolt/washer	0.55 in (14 mm) diameter threaded brass insert, 0.50 in (13 mm) deep. Fasten with 10-32 stainless steel hex bolt/washer	0.55 in (14 mm) diameter threaded brass insert, 0.50 in (13 mm) deep. Fasten with 10-32 stainless steel hex bolt/washer	1.00 in (25 mm) diameter threaded brass insert, 0.75 in (19 mm) deep. Fasten with 1/4-20 stainless steel hex bolt/washer
Tightening torque Re-torque	45 in-lbs (5.1 N*m) 40 in-lbs (4.5 N*m)	45 in-lbs (5.1 N*m) 40 in-lbs (4.5 N*m)	45 in-lbs (5.1 N*m) 40 in-lbs (4.5 N*m)	110 in-lbs (12.4 N*m) 100 in-lbs (11.3 N*m)
Boost charge voltage	2.33 +/-.02 Vpc	2.33 +/-.02 Vpc	2.33 +/-.02 Vpc	2.33 +/-.02 Vpc
Nominal float voltage	2.26 +/-.01 Vpc	2.26 +/-.01 Vpc	2.26 +/-.01 Vpc	2.26 +/-.01 Vpc
Electrolyte at 77°F (25°C) nominal value	1.300 Specific Gravity	1.300 Specific Gravity	1.300 Specific Gravity	1.300 Specific Gravity

*These units have been discontinued

TABLE 2 (CONTINUED)

Model	LS 12-100	LS 6-200	LS 4-300	LS 2-600
Nominal voltage	12 Volts	6 Volts	4 Volts	2 Volts
Number of cells in module	6/unit	3/unit	2/unit	1/unit
Rated 8 hr. capacity (Ampere-hours to 1.75 Vpc)	100 Ah to 10.5 Volts	200 Ah to 5.25 Volts	300 Ah to 3.5 Volts	600 Ah to 1.75 Volts
Rated 15-min capacity (kiloWatts to 1.67 Vpc)	0.344	0.688	1.032	2.063
Internal resistance/cell	0.0008 Ohms	0.0004 Ohms	0.0003 Ohms	0.0001 Ohms
Short circuit current	2545 A	5089 A	7634 A	15267 A
Unit height	9.20 in (234 mm)	9.20 in (234 mm)	9.20 in (234 mm)	9.20 in (234 mm)
Unit length (includes handles)	16.58 in (421 mm)	16.58 in (421 mm)	16.58 in (421 mm)	16.58 in (421 mm)
Unit width	6.84 in (174 mm)	6.84 in (174 mm)	6.84 in (174 mm)	6.84 in (174 mm)
Weight	95 lbs (43 kg)	95 lbs (43 kg)	95 lbs (43 kg)	95 lbs (43 kg)
Terminal characteristics	1.00 in (25 mm) diameter threaded brass insert, 0.75 in (19 mm) deep. Fasten with 1/4-20 stainless steel hex bolt/washer	.00 in (25 mm) diameter threaded brass insert, 0.75 in (19 mm) deep. Fasten with 1/4-20 stainless steel hex bolt/washer	1.00 in (25 mm) diameter threaded brass insert, 0.75 in (19 mm) deep. Fasten with 1/4-20 stainless steel hex bolt/washer	1.00 in (25 mm) diameter threaded brass insert, 0.75 in (19 mm) deep. Fasten with 1/4-20 stainless steel hex bolt/washer
Tightening torque Re-torque	110 in-lbs (12.4 N*m) 100 in-lbs (11.3 N*m)	110 in-lbs (12.4 N*m) 100 in-lbs (11.3 N*m)	110 in-lbs (12.4 N*m) 100 in-lbs (11.3 N*m)	110 in-lbs (12.4 N*m) 100 in-lbs (11.3 N*m)
Boost charge voltage	2.33 +/-.02 Vpc	2.33 +/-.02 Vpc	2.33 +/-.02 Vpc	2.33 +/-.02 Vpc
Nominal float voltage	2.26 +/-.01 Vpc	2.26 +/-.01 Vpc	2.26 +/-.01 Vpc	2.26 +/-.01 Vpc
Electrolyte at 77°F (25°C) nominal value	1.300 Specific Gravity	1.300 Specific Gravity	1.300 Specific Gravity	1.300 Specific Gravity

3.2 Ventilation

The Liberty Series 1000 battery is a valve-regulated, low-maintenance battery, which, under normal float conditions, requires only normal room ventilation. Therefore, under normal float operation, Liberty batteries can be installed in proximity to electronic equipment and in computer rooms with personnel present.

However, should the battery be subjected to excessive overcharge, hydrogen and oxygen can be vented to the atmosphere. **Therefore, the battery should never be installed in an airtight enclosure.** Sufficient precautions must be taken to prevent excessive overcharge and containment of potential gases.

VRLA batteries when subjected to extreme overcharge (above the recombinant ability of the cell) can release hydrogen gas at a maximum rate of 0.000269 cubic feet per minute per ampere of charging current at 77°F (25°C) at atmospheric pressure.

3.3 Rack Assemblies

Liberty Series 1000 batteries may be installed in a variety of mounting assemblies

- Modular Rack assembly (Figure 3.1) - battery units may be assembled in a floor mounted module or rack. One modular rack available from C&D Technologies, Inc. is designed to mount the units in a sturdy open frame that is stackable. They are available in 29" and 43" (74 cm and 109 cm) lengths. Optional panels are available to enclose the racks, providing a cabinet-like appearance. (Figure 3.2) For additional information refer to specification 12-373 and 12-380.
- When large numbers of batteries are required for the application and a dedicated battery room may be provided, conventional tiered racks may be appropriate.

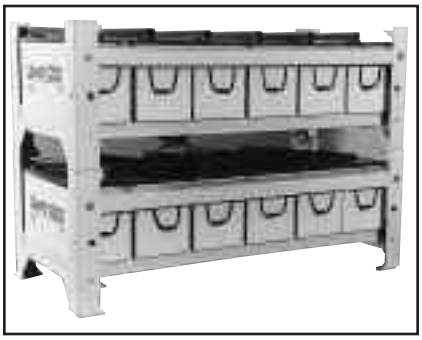


FIGURE 3.1 - Modular Rack Assembly

3.4 Relay Rack Assembly

- Battery units can be mounted in standard 19" and 23" (48 cm and 58 cm) relay rack frames. A typical C&D Technologies “tray layout” is shown in Figure 3.3. Specially designed trays/fixtures should be ordered for relay rack applications.



FIGURE 3.2 - Modular Rack With Panels

3.5 Optional Steel Jackets for Batteries/Units operating in a demanding environment

Although a metal jacket cannot change the thermal degradation or electro/chemical properties of the battery exposed to elevated temperatures, it will physically contain the cells exposed to elevated temperatures by retaining compression on the positive and negative plates and absorbent glass mat between the plates. The net effect and purpose is that the plates are provided with a uniform exposure to the contained electrolyte.

Note: Optional steel jackets are recommended if the batteries are expected to experience frequent periods of operation at temperatures in excess of 90°F (33°C).



FIGURE 3.3 - Relay Rack Trays

SECTION 4 - ELECTRICAL CONNECTIONS

WARNING

- Always use protective insulating equipment, such as gloves, shoes and eye and face protection. Wrenches and other tools must be insulated.
- Observe local, state, and national electric codes at all times.
- Always work with the battery ungrounded. Battery ground connections, if required, should be made last.
- To avoid working with high voltages, break the battery down into convenient lower-voltage modules, i.e., equal to or less than 48-Volts.
- Always maintain a firm grasp on tools and hardware when working on the battery. Dropped hardware can cause a short circuit, possibly resulting in serious personal injury and/or damage to the equipment.
- Before working on the battery, be sure to discharge static electricity that can build up on tools or the technician by touching a grounded surface in the vicinity of the battery but far enough away from the cells and flame arresters. Avoid creating sparks or exposing cells to open flames that could ignite the gasses produced by a charging battery.

4.1 Preparing electrical contacting surfaces

All electrical contacting surfaces must have a clean and electrolyte free finish. Any tarnish or discoloration should be carefully removed. Do not use steel brushes or other abrasive tools to clean the tin plated battery posts and intercell connectors. **The posts and intercell connectors are plated with a thin layer of tin. Cable lugs are tin plated. It is important that the electro-plating must not be damaged or removed.**

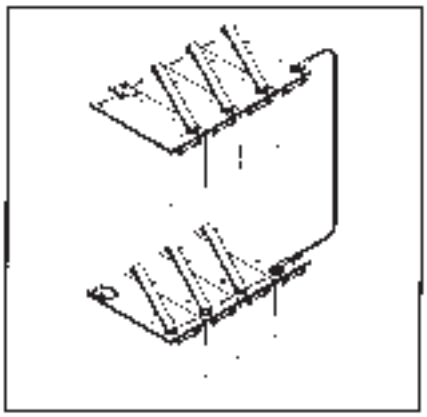
1. With a dry cloth, remove any factory-applied grease or oil coating from the contact surfaces or posts.
2. Brush the contacting surfaces of battery posts/terminals and intercell connectors to a clean corrosion free finish using a **fine brass plater's wire brush (multiple 0.010 diameter brass wire construction).**
3. After brushing connections with a fine brass plater's brush, terminals and interface can be coated with NO-OX which prevents oxidation between connections.

CAUTION

Do not use steel brushes, steel wool, sandpaper or emery cloth to clean surfaces, as these will damage the plating. Do not use cleaning solvents. Solvents can cause crazing or cracking of the plastic cell containers or covers. Use of solvents will void the warranty.

4. Attach intercell connectors or cable/lugs from the positive post of one unit to the negative post of the next cell or unit for series connection. If the units are mounted on more than one tier make certain to follow the polarity convention, positive post to negative post. Inter-tier and inter-row connections are typically made with cables with lugs on both ends. Do Not Use Steel or Cadmium Plated Lugs.

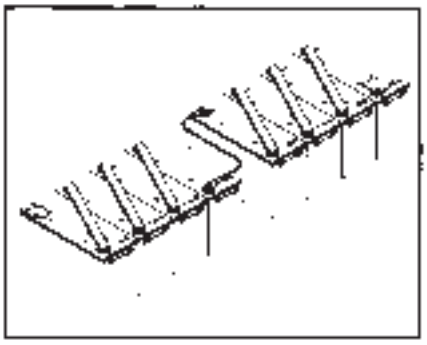
5. Large batteries may use "Terminal Plates" to accommodate multiple cable connections. There are a variety of optional terminal plates available from C&D Technologies, Inc., Inc. Terminal plates should be clean and prepared in the same manner as the intercell connectors.



LS 12-100 Inter-Tier Connection

4.2 Polarity of assembled units/cells and inter-row, inter-tier connections

Cell/unit polarities have been marked by a raised mark in the covers to provide proper interconnection between cells. When connecting cells/units be sure that all terminals, including inter-tier, have been connected positive (+) to negative (-) from one cell/unit to another throughout the battery.



LS 12-100 Inter-Rack Connection

4.3 Connecting and torquing battery terminal posts

Liberty Series 1000 batteries are available in various sizes and voltages as described in Table 2 and with corresponding Ampere-hour ratings at the 8 hour rate of discharge: 80 Ah, 100 Ah, 125 Ah, 200 Ah, 300 Ah, and 600 Ah. The units are connected positive to negative from one unit to another unit in a series arrangement. This is accomplished by fastening the tin plated connector (used on larger size units) or lugs found on cables (for smaller size units) from the positive terminal of a unit to the negative terminal of the next unit. The lug or connector is secured with the appropriate terminal hardware described in Table 2 and tightened to the torque value specified in Table 2.

Connect cells/units with the stainless steel hex head bolts and washers in accordance with the connecting instructions for the system. Torque all connections to the proper torque value shown in Table 2.

It is recommended that the top tier of connectors be installed first on multi-tier racks, then the second and so on, working from the top down. This may avoid short circuiting connected groups of units in lower tiers.

CAUTION

Use extreme care when installing connectors; maintain a firm grasp on each connector as it is being installed, to prevent it from dropping and potentially causing a short circuit.

Note: Over-torquing can damage the post seal causing electrolyte leakage.

4.4 Checking connection integrity

- Check once again that all units are connected positive terminals to negative terminals. Measure the battery voltage with a digital voltmeter. The voltage should be approximately 2.15 Volts (open circuit) times the number of cells per unit times the number of units connected in series. Example: 2.15 Volts x 2 cells/unit (model LS 4-300) x 6 units = 25.8 Volts, representative of the nominal open circuit voltage of a 24-Volt system.

- Recheck the torque of connections to make certain that there are no loose connections that could cause a poor connection thereby creating an arc or spark or a hot connection that on discharge could melt the lead components.

- Follow the charger manufacturer's instructions and make the connections to the battery with the charger de-energized.

CAUTION

It is the sole responsibility of the user to check connections. All connections should be checked at regular intervals to ensure that connections are clean and tight. Never operate a battery with loose or corroded connections. When checking connections, disconnect the battery from the load and the charging equipment, and follow all precautionary measures outlined above and the general safety references.

Typical internal cell resistance values are provided in Table 2 according to cell type. In addition a listing of short circuit current in amperes is provided to further inform the user of the potential energy available from the batteries.

4.5 Paralleling Batteries

When strings of batteries of equal voltage are connected in parallel, the total capacity is equal to the sum of the capacities of the individual strings. C&D Technologies recommends parallel strings when the required capacity exceeds available Ampere-hour sizes or when physical arrangement favors this choice. The use of parallel strings permits maintenance on one string while the other(s) remain functional at a somewhat lower reserve time. Limit the number of paralled battery strings to six.

When paralleling is necessary to obtain required capacity, the cable size and external cable length should be optimized to match the cable

resistance for each battery. A wide variation in circuit resistance can result in unbalanced discharging and charging of cells. As a consequence this can produce unequal float voltages of the connected cells and individual strings can sustain a loss of performance and capacity, resulting in higher loads on the other parallel strings with lower cable (circuit) resistance.

PART 2
CHARGING AND OPERATION OF BATTERY

SECTION 1 - CHARGING

1.1 General Information and Precautions

To safely charge the Liberty Series 1000 batteries and avoid damaging the battery and/or connected equipment, observe the following:

- Use only direct current for charging. AC ripple current from charger must not exceed 5 percent of the 8-hour (Ampere-hour) rating of the battery.
- Be sure charger is turned off before making electrical connections between the battery and system.
- Connect battery positive terminal to charger positive terminal and battery negative terminal to charger negative terminal. Grounding battery may be either to positive or negative terminal of the battery. This will depend upon the system design.
- Be certain that all connections are tight and secured before turning on the charger.
- Perform a voltage test to assure proper connection (Section 4.4).

CAUTION

If the proper polarities are not observed when charging the battery, the battery or groups of reverse-connected cells will be irreparably damaged.

1.2 Initial charge

All cells/units are shipped fully charged but will lose some charge in transit or storage before installation. Provide an initial charge by the date stamped on the shipping container when stored in a clean, dry and cool (between 32°F-77°F [0°C-25°C]) location.

CAUTION

Valve-regulated batteries must receive a boost charge (see Part 1, Section 2) if installation will not occur by the date on the carton or if open circuit voltage drops to 2.10 Volts per cell. Multiply the open circuit voltage by the number of cells in a unit to obtain unit voltage. Use initial/equalize charge voltages as shown in Table 2 of Part 1 or Table 3 of Part 2 for boosting cells at the Initial/Equalize Voltage.

TABLE 3
CHARGE VOLTAGES FOR LIBERTY SERIES 1000 CELLS
CHARGE VOLTAGES AT 77°F (25°C)

Cell Type	Open Circuit (Vpc)	Minimum Cell Voltage (Vpc)	Float Voltage (Vpc)	Initial Charge Voltage (Vpc)	Typical Charging Time for Initial Charge
All Liberty Series 1000®	2.15	2.20	2.26 +/- 0.01	2.33 +/- 0.02	12 - 16 Hours

Note 1:
1 - Applies to average cell voltage. Battery voltage should be set at average cell voltage multiplied by the number of cells in unit or string. Individual cell voltages may vary by +/- 0.05 Volts from the average.
2 - Charging time will vary due to open circuit stand, temperature and charger voltage available.
3 - If cell temperature is below 60°F (16°C), double the charge time for initial or equalize charge.

Note 2:
All lead-acid batteries lose a certain amount of charge when removed from a constant voltage source charger, set at a potential that is higher than the open circuit potential of the battery. As the charge is lost, the electrochemical process produces lead sulfate in the positive and negative plates of every cell in the battery. If left uncharged for a significant period of time, the lead sulfate will begin to form large crystals of lead sulfate. Because of their size, these crystals may be somewhat difficult to reduce (break down) through normal charging procedures and may inhibit the complete electro/chemical process necessary to sustain a healthy lead-acid battery. Frequently, higher-than-normal charging potentials or even more sophisticated remedial approaches may be necessary to recover the affected battery. In cases of severe sulfation, replacement may be the only solution.

Higher than normal storage temperature (77°F [25°C] nominal) will accelerate internal self-discharge of a battery by a factor of two for each 15°F (9°C) over nominal 77°F (25°C) storage temperature. This, in turn, will reduce the allowable time before initial and subsequent charging.

Therefore it is very important that boost charges be given at the appropriate time to avoid major remedial action or damage to product.

All batteries, including Liberty Series 1000, are capable of generating potentially explosive gases when charged at higher than normal voltages typical of initial or equalizing charge. The Liberty Series 1000 cells are equipped with a “flame arrestor and pressure relief valve” assembly that seals the cells during normal charge and operation but allows it to safely vent in case of overcharge. Removing the cover and/or valve assembly can cause the release of potentially explosive gases and such action will void the warranty.

CAUTION
Never expose a cell or battery to sparks or an open flame. When working on a battery, discharge static electricity on the body, tools, etc., by touching a grounded surface in the vicinity of the battery rack.

1.3 Constant voltage charging

The recommended method of providing an initial/equalize charge is to first determine the maximum allowable voltage that may be applied to the connected equipment. Divide this by the number of cells in the battery to obtain maximum average voltage per cell allowed by the equipment. Adjust this number down to a recommended initial value found in Table 3 and continue charging at this voltage for the time specified. Next put the battery at the recommended float voltage for a

minimum of 72 hours before any load is placed on the system. The battery is now considered fully charged and is ready for either initial acceptance testing or regular service.

Use only direct current for charging. AC ripple current from charger must not exceed 5 percent of the 8-hour (Ampere-hour) rating of the battery.

1.4 Initial charge records

At the completion of the initial charge and after the cells have been on float charge for approximately one week, record voltages of the individual cells or units, the total battery voltage and ambient temperature. Retain this information in your files for future reference. This information establishes one baseline for future reference. Refer to RS-1511 found in the appendix. Make a photocopy of the form and use it whenever necessary to record readings taken on the battery.

IMPORTANT: Initial charge records are essential for review by C&D Technologies sales/service agents in the event of a problem. Since records can materially affect your warranty, be sure to maintain clear, signed, and dated copies.

1.5 Warning labels

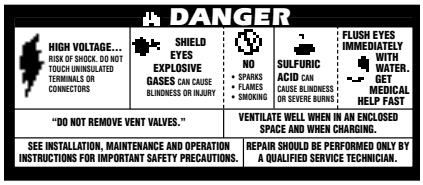


FIGURE 1.1 - BCI Battery Warning Label

C&D Technologies, Inc., provided a warning label to assist in maintaining standby batteries and to advise you of certain hazards. **This label may be found on the battery cover** visible to anyone in the immediate vicinity of the battery. Make certain that all individuals who could be operating near the battery read the warning that is intended to inform the individuals of basic safety practices.

SECTION 2 - BATTERY OPERATION

2.1 Float charging

Standby batteries are continuously connected to control circuits, which must be energized at all times. Connected to a load in parallel with a continuously operating power supply, these batteries assure instantaneous support of the load in the event of a power failure or brownout. In addition to operating the connected load, the power supply keeps the standby battery fully charged. This parallel interconnection and operation is called float service. Maximum battery life can be expected in full float service, in which the frequency and depth of discharges are kept at a minimum.

Deep and/or frequent discharges, such as those in a UPS application, can shorten service life, even with proper battery maintenance. Maximum battery life can be expected only in full float service.

For optimum service, adjust the power supply to the float voltages shown in Table 3. If the power supply is intermittent or more frequent discharges are anticipated, use a higher value recommended voltage setting.

Note: For locations that exhibit frequent temperature variations it is recommended that temperature compensated rectifiers be used that adjust the voltage in accordance with sub-sections 3.4 and 3.5 of Section 3.

2.2 Equalizing charge

Under normal operating conditions, it should not be necessary to equalize batteries when charged at the recommended voltage in Tables 2 and 3. An equalizing charge delivered at a voltage higher than the nominal float voltage is used to restore uniform cell voltage to a battery.

Note 1: Some hydrogen gas may be liberated at equalize charging voltage.

An equalizing charge can be provided when individual cell voltages go below the minimum value shown in Table 3 or 0.05 Volts below the minimum float voltage specified in Table 3. Remember to divide the number of cells into unit voltage to arrive at cell voltage. Presence of a minimum voltage does not imply a battery is malfunctioning or that it will not provide the necessary power when called upon.

Note 2: Chargers must be current limited to 25 Amperes per 100-Ampere-hour battery rating. Higher charging currents could potentially destroy the battery by overheating. This heating can subsequently cause more current to flow, creating a vicious cycle sometimes referred to as “thermal runaway.”

Note 3: Minimum voltage is the point at which plans should be made to provide an equalizing charge. Note that the normal equalize voltage level (initial charge level) will not be effective in VRLA product as the voltage is not high enough to enable the negative plates to charge. An equalizing charge of 2.45 volts per cell can be applied to the string or problem cell/unit for a period not exceeding eight hours. Consult the C&D Technologies Technical Service Department for answers to specific questions.

2.3 Over-voltage

When a charger is improperly set or a panel meter is improperly calibrated battery over-voltage or under-voltage may result. Higher than normal battery voltage can damage a battery, significantly shortening its service life. This is especially important in valve-regulated product where over-voltage increases gas generation that could cause pressure build-up within the cell. The excess pressure will cause the cells to vent the gases generated, causing premature dry out of the battery electrolyte. Even a small increase in over-voltage, beyond what is recommended in Table 3, increases the corrosion rate of the positive grid element and will contribute to reduced battery life.

To avoid over-voltage, periodically check battery voltage with a calibrated digital voltmeter. If an over-voltage is recorded, check and readjust the rectifier and/or panel meter calibration as necessary. Place the battery at the recommended float charging voltage as soon as possible. Restoring the proper float voltage will preclude further damage caused by charging at an over-voltage but it cannot reverse damage that has already been sustained by the battery.

CAUTION

Liberty Series 1000 batteries produce virtually no gas emissions during normal operation. However, potentially explosive gases may be released under abnormal operating conditions or initial/equalize charge. Provide adequate ventilation so hydrogen gas accumulation in the battery area does not exceed one percent. Do not smoke, use open flame or create sparks near battery.

2.4 Voltmeter calibration

Panel voltmeters used in conjunction with float charging systems should be kept in accurate calibration by checking with a known standard per the manufacturer's recommendations. Always measure battery voltage at the battery terminals and compare the reading with the panel meter to eliminate the effect of line drop between the battery and connected system or charger. Battery voltage should always be measured with a digital voltmeter with at least a 3½-digit display and a minimum accuracy of 0.25 percent. Battery voltage must be measured at the battery, not at the system connection. This type of instrumentation is also particularly useful in recording individual cell potentials.

SECTION 3 - GENERAL INFORMATION AND MAINTENANCE

3.1 Performance characteristics

Battery performance at a given discharge rate is related to the internal resistance of the cells and the external resistance of the conductors connecting the cells. Aging increases internal resistance that results in greater voltage drop, or losses. The effects of aging have the greatest impact on high rate performance. A battery whose resistance has increased by 10%, for example, when discharged at its 8-hour rate will experience a loss of approximately 10% of its reserve capacity or provide only 7.2 hours of support. But the same battery discharged at its 15 minute rate will experience a loss of approximately 20% capacity and provide only 12 minutes of support to its final voltage. Internal cell resistance is provided in Table 2, Part 1 of this manual.

Typically during the last half of the battery service life, performance will begin to fall slowly at first, then at an increasing rate. Lead-acid batteries have reached the end of their useful life when performance has fallen to 80 percent of published ratings.

Note: Frequent charge/discharge cycles accelerate battery aging and performance degradation.

To insure adequate performance it is recommended that a battery be sized with additional margin for operation at minimum expected temperature and for loss of capacity as the battery ages.

3.2 Capacity and testing

Batteries are rated in Ampere-hours or kiloWatts on their ability to deliver a certain number of amperes or power, respectively, to the load for a specified amount of time before cell voltages drop to a final design potential. It is important to understand that the ampere-hour capacity or kiloWatts of a cell or battery depends upon the rate at which it is discharged. Consult C&D Technologies specification sheet 12-373 for the ratings of various cell types.

C&D Technologies lead-acid batteries and cells are designed for optimum performance, either as short, high-rate or long, low-rate discharge batteries. Short, high-rate discharge batteries are typically discharged to lower end-potentials, such as 1.65 to 1.67 Volts per cell. These voltages are not practical end potentials for long, low-rate discharges that normally terminate at 1.75 Volts per cell or higher final voltages.

It is also important to consider low ambient operating temperatures when calculating required battery size. Low operating temperatures will reduce available battery capacity approximately 0.5 percent per degree F. Refer to Section 3.4 “Effects of Temperature” for temperature compensation and additional information. To be valid, a capacity test must be based upon:

- A fully charged battery and balanced cell potentials. This may require an equalize charge or, in cases of sulfation, other action. Consult the C&D Technologies Technical Service Department at the address or telephone number shown on **page 1** of this manual for additional information.
- Battery must be at float voltage for at least 3-7 days. This is especially important following an equalize charge in order to clear gases developed at the surface of the plates.
- Temperature correction for cells tested at any temperature other than 77°F (25°C).
- All connections are correct and at minimal resistance.

A complete description of capacity tests is beyond the scope of this manual but is discussed in detail in IEEE 1188-1996 and other professional society standards. These standards are applicable to VRLA batteries similar to the Liberty Series 1000 batteries. **It is important to recognize that standby batteries/cells are designed for emergency standby operation and excessive testing or cycling of a battery can materially shorten the life of a battery.**

C&D Technologies can supply batteries specifically designed for cycle service. Consult your C&D Technologies representative or the Technical Service Department located in Blue Bell, PA about testing procedures and special service requirements.

3.3 Low cell voltages

With proper float operation at recommended voltages, individual cell voltages should be within +/- 0.05 Volts of the average cell voltage for Liberty Series 1000 batteries.

When the voltages of individual cells are lower than normal, it is possible to conclude that insufficient charging has occurred.

The following are possible causes of cell voltage variations:

- **Panel voltmeter reading high -** This results in a low float voltage. Re-calibrate the panel voltmeter.

- **Poor intercell/inter-unit or terminal connections -** If any connection is found to be higher than 20% of the initial installation values, disassemble and clean contact surfaces and reassemble.

- **A temperature variation of more than 5°F (2.8°C) between cells -** Warmer cells drop to a lower voltage, because they require more float current to keep them fully charged. Avoid exposing batteries to external heat sources, which can cause temperature imbalance.

3.4 Effects of temperature

A lead-acid battery is an electro chemical device. Heat accelerates chemical activity; cold slows it down. Normal battery operating temperature is 77°F (25°C). Higher than normal temperatures have the following effects on a lead-acid battery:

- Increases capacity
- Shortens life
- Increases internal discharge or local action losses
- Lowers cell voltage for a given charge current
- Raises charging current for a given charge voltage
- Increases the rate of dry-out of electrolyte

Lower than normal temperatures have the opposite effect and reduce capacity. In general, at proper float voltage, a battery in a cool location will last longer than one in a warm location.

Note: No temperature correction is required when operating at 77°F +/- 10°F, (25°C +/- 5.5°C). The following correction factors apply for a range not exceeding +/- 30°F from nominal. For further
assistance with temperature correction factors, contact C&D Technologies.

If the operating temperature is other than 77°F (25°C), it is recommended that the float voltage be changed as follows:

For temperatures other than 77°F (25°C), correct float voltage by 2 mV per degree F (3.6 mV per degree C):

- Add 2 mV (0.002 Volts) per degree F (3.6 mV per degree C) below 77°F (25°C)
- Subtract 2 mV (0.002 Volts) per degree F (3.6 mV per degree C) above 77°F (25°C)

Note: Temperature compensation will materially improve battery service life when provided.

If continuous adjustment of the battery plant charger voltage relative to ambient temperature is impractical, it is recommended the appropriate fixed float voltage setting of Table 4 is used.

At temperatures below 77°F (25°C), battery capacity will be reduced by approximately 0.5 percent per degree Fahrenheit.

Caution must be exercised when operating or storing batteries at low temperature because of the possibility of electrolyte freezing. Although the specific gravity of your fully charged battery may present no freezing problem, the discharged specific gravity may. Refer to Part 1, Section 2, Table 1.

3.5 High ambient temperature

At higher than normal ambient temperature 77°F (25°C), gas that may exceed the rate of recombination will be evolved internally. This gas will vent to the atmosphere when internal pressure causes the relief valve to open. This is the equivalent of water loss that cannot be replenished and therefore accelerates the rate of dry-out, resulting in loss of capacity. The Liberty Series 1000 valve-regulated battery should be placed in an operating environment in which the battery room temperature does not **exceed 90°F (33°C)**. The Liberty Series 1000 batteries can tolerate a temperature up to 120°F (49°C) with significant de-rating of expected life. They must be contained in the optional steel jacket if temperatures are expected to exceed 100°F (38°C). Valve-regulated lead acid batteries will incur a 50 percent reduction in expected life for each 15°F (9°C) in average temperature above 77°F (25°C).

Note: Operation at high temperature causes VRLA batteries to draw more current thereby increasing the internal temperature of the cells. As the temperature increases more current is supplied to the cells. This condition can lead to destruction of the cells by an effect sometimes referred to as “thermal runaway.” Care should be exercised when ambient temperatures exceed 90 Fahrenheit.

TABLE 4
ADJUSTMENT OF FLOAT VOLTAGE FOR TEMPERATURE FOR LIBERTY SERIES 1000®
Given in volts per cell and accuracy of adjustment

AMBIENT TEMPERATURE RANGE			
67°F-87°F	80°F-100°F	90°F-110°F	100°F-120°F
2.26 Vpc	2.24 Vpc	2.22 Vpc	2.20 Vpc
+/-0.010 Volts	+/-0.010 Volts	+/-0.010 Volts	+/-0.010 Volts

Note:
1. If the average ambient temperature changes over time more than 20°F (11.1°C) and no correction in float voltage is made, permanent battery degradation will occur.
2. Temperature variations within the battery string of more than 5°F (2.8°C) can cause cells at the extremes to be either over or under-charged, depending on where the float voltage has been set.

3.6 Cleaning cell covers

- Cell covers can be dusted with a clean cloth or clean dry paintbrush.
- Cell covers may also be cleaned with clear water and a small amount of baking soda and dried after cleaning.
- If residual acid appears on the cover surfaces it may be neutralized with a solution of one pound baking soda and one gallon of clear water. Rinse with water following neutralization and air dry.

CAUTION

Never use solvents other than water to clean battery containers. Many solvents will damage the plastic materials causing the materials to crack or fail. A neutralizing solution of baking soda and water may be used to clean acid spills.

3.7 Tap connections

Tap connections on the battery electrically unbalance the battery and should never be used. Installing a tap will result either in partial or complete discharge of the group of cells that are furnishing current to the auxiliary load. In addition an overcharge is imposed on the untapped cells that will materially decrease their useful life. Tap connections most often inadvertently occur during initial installation when installers may be tempted to use a portion of the battery to power their equipment, particularly prior to installation of electrical service. **The use of tap connections will void the warranty.**

3.8 Putting batteries into storage

A battery on float charge provides maximum service life and, therefore, should not be stored on open circuit unless it is unavoidable, but in such cases only for a very limited time as discussed earlier in Part 1, Section 2. In such cases, follow these recommendations before de-energizing:

- Provide an equalize charge as described in Part 2, Section 1.3 and Section 2.2.
- De-energize battery only after it is fully charged, typically 12 to 16 hours.
- Disconnect battery terminals or remove battery system fuses, so there is no possibility of discharge through the electrical circuits. As an added precaution, open one intercell connector on each row of batteries.
- Store the battery at approximately 77°F (25°C) in a horizontal position. When returning the battery to service, restore all open connections, replace fuses, and treat as a new battery by providing an initial charge.

3.9 Record keeping

At a minimum, annual measurement of unit voltages should be taken and recorded. On occasion, if a long discharge has been experienced,

completely recharge the battery and take a set of voltage readings, recording them for future reference if the readings are satisfactory. Provide remedial action or an equalize charge if necessary. **Do not discharge a battery below the design final voltage.** Remedial action may be required if the battery was discharged below its final design voltage. Very deep discharges can, without an immediate recharge, completely deplete the electrolyte and cause hydration.

Note: Refer to sample form RS-1511 found in the Appendix to record readings.

1. BATTERY IDENTIFICATION
2. DATE OF REPORT
3. BATTERY FLOAT VOLTAGE
4. AMBIENT OPERATING AND STORAGE TEMPERATURES
5. DATE AND DESCRIPTION OF LAST EQUALIZING CHARGE (IF APPLICABLE)
6. GENERAL OBSERVATIONS FROM VISUAL INSPECTION AND INDIVIDUAL CELL VOLTAGES
7. NAME OF INSPECTING TECHNICIAN

If any unusual readings or visual indications are observed, consult your C&D Technologies representative and send a copy of your latest maintenance report to the Technical Services Department, C&D Technologies, Inc., 1400 Union Meeting Road, Blue Bell, PA 19422. Indicate to whom you have spoken in C&D Technologies sales and service and when your battery was last inspected.

PART 3
TROUBLE-SHOOTING, AVOIDING BATTERY DEGRADATION AND RECOGNIZING PROBLEMS

SECTION 1 - HOW TO AVOID BATTERY DEGRADATION

1.1 General Information and Precautions

Properly maintained and charged, Liberty Series 1000 batteries will provide many years of trouble-free service. However, despite their inherent dependability, failure to operate and maintain them correctly can lead to damage, shortened service life or cause loss of service. The following sections address some of the most frequently encountered errors.

1.2 Float versus cycle life

Standby batteries are designed and constructed to provide long life in continuous float service. They differ in their design from "cycling batteries," such as "starting" or "traction" types. Standby batteries are continuously charged at a comparatively low float voltage in parallel with the load, ready to supply instantaneous dc power either directly to the load or by way of interfacing electronics, such as an un-interruptible power supply (UPS) system. The name "stationary" implies the battery is usually permanently placed in a given location and not transferred from place to place in its service life.

Standby battery calendar life is affected by and may be reduced by repeated cycling. Depth of discharge, number of discharges, rate of discharge, and the interval between discharges are some of the determining factors in battery life. **Cycling should therefore be kept to a minimum.**

To ensure that the battery will perform during power outages and other emergencies, it is strongly recommended that testing be kept to a minimum in accordance with the following practices:

- The performance of an initial acceptance test not to exceed user's originally specified system reserve time.
- A full-load service test should be performed not more than once every 12 months to verify battery capacity at user's originally specified discharge rate.
- A monthly transfer test not to exceed 30 seconds of battery discharge time at user's originally specified discharge rate to verify system load transfer and electrical system performance. The time that is required to synchronize the UPS system and return to rectifier power must be taken into account when calculating total discharge time.

The user is expected to maintain complete records of all battery testing and emergency discharges in order to comply with the requirements of the warranty.

CAUTION

RECHARGE BATTERIES AS SOON AS POSSIBLE AFTER AN EMERGENCY DISCHARGE. Failure to recharge batteries immediately after emergency discharge may lead to sulfation or, in the case of deep discharge, to complete battery failure due to hydration. If recharging at equalize voltage is impractical, recharge at float voltage.

1.3 Low float voltage and sulfation

Either because of incorrect charger voltage adjustment or excessive intermittent or static loads paralleling the charging source or low operating temperature, a battery may not receive adequate charge. In some cases, the charger may even be turned off, erroneously or by choice. The net result is a battery left in a partially discharged condition. The first observable signs may be erratic cell voltages. Although not visible to the observer, the plates will become sulfated.

If you suspect sulfated plates, contact C&D Technologies Technical Services Department for assistance. Sulfated batteries are partially charged batteries and have not completed the electrochemical reaction of recharge. Accordingly, they will have reduced capability and available capacity. If allowed to remain in a partially charged condition for an extended period of time, sulfated batteries may suffer irreversible damage, requiring replacement.

1.4 Hydration

A battery that has been severely over-discharged and left in a discharged condition without immediate recharge is subject to damage known as hydration. This is a phenomenon in which the electrolyte specific gravity has been reduced to a value so low it permits the lead components to dissolve into the electrolyte.

The reaction of dissolution forms many compounds and salts, generically referred to as hydrate. On recharge these compounds react to clog separator pores and form metallic lead. As time passes thousands of short circuit paths are created in the separators placed between the positive and negative plates to provide electrical insulation. Very often, the effect of these short circuits goes unnoticed except for a slight increase in charging current. As the reaction continues, however, short circuits become so extensive it is almost impossible to keep the cells charged. Finally, the cells experience total failure.

1.5 Open circuit - late installations

As soon as a battery is disconnected from a charger, local action (discharge) begins. This is caused by inherent internal losses within the cell. In the case of Liberty Series 1000 cells, a self-discharge is expected to occur at a rate of “up to 3.0 percent” of full charge per month at 77°F (25°C). Therefore, if cells remain, for whatever reason, on open circuit (with no charge supplied) for prolonged periods of time,

the affected cells may become sulfated and require corrective action.

1.6 Parallel battery strings

When strings of batteries of equal voltage are connected in parallel, the overall capacity is equal to the sum of the capacities of the individual strings. When paralleling valve-regulated batteries is necessary, the external circuit resistance must be matched for each battery. A large variation between battery string resistance can result in unbalanced discharge (i.e., excessive discharge currents in some batteries and less discharge in others). As a consequence, cell failures in one battery string and the subsequent loss of performance capacities of that string will result in higher loads in the lower resistance interconnections of some parallel strings that may exceed the ratings of the battery interconnections and/or cables. C&D Technologies recommends paralleling strings to obtain higher capacity. **Paralleling cells is not recommended due to potential safety and maintenance problems.**

1.7 High temperature operation

Operating a battery at temperatures exceeding 77°F (25°C) will reduce battery service life. Elevated temperatures accelerate the electro chemical reaction within lead acid batteries.

Refer to Part 2, Sections 3.4 and 3.5 for more information concerning “Effects of Temperature.”

14-312

C&D TECHNOLOGIES

STANDBY POWER DIVISION

MATERIAL SAFETY DATA SHEET

SECTION I: CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT IDENTITY:
Sealed, Lead-Calcium Battery

CDID: LIBERTY 1000 SERIES
LS 12-25 6-50 12-100 6-200 4-300 & 2-600
LFA 12-100 6-200 & 2-600
FAM 12-100 & 12-150

MANUFACTURER NAME: C & D Technologies, Inc

ADDRESS:
1400 Union Meeting Road
P. O. Box 3053
Blue Bell, PA 19422-0858
TELEPHONE: (215) 619-2700
EMERGENCY: (610) 828-9309

24 HOUR EMERGENCY TELEPHONE: (CHEMTEL) 1-800-255-3924

SECTION II: COMPOSITION / INFORMATION ON INGREDIENTS

NOTE: The C&D "Liberty Series" batteries are sealed, recombinant design. Under normal use and handling the customer has no contact with the chemical components of the battery or the chemical hazards. Under normal use and handling these batteries do not emit regulated or hazardous substances.

HAZARDOUS COMPONENT	CAS#	OSHA PEL	ACGIH TLV	% BY WEIGHT
*Lead, Lead compounds	7439-92-1	0.05mg/m3	0.05mg/m3	55-77%
*Sulfuric Acid	7664-93-9	1.0mg/m3	1.0mg/m3	5 - 9%
Tin	7440-31-5	2.0mg/m3	2.0mg/m3	.1 - 3%
Aluminum	7429-90-5	15.0mg/m3	10.0mg/m3	< 0.1%
*Copper	7440-50-8	1.0mg/m3	1.0mg/m3	≤ 1%
NON-HAZARDOUS INGREDIENTS				
Water	7732-18-5	N/A	N/A	10 - 15%
Calcium	7440-70-2	N/A	N/A	.03 - .04%
Inert Components	N/A	N/A	N/A	7 - 12%

SECTION 313 (40 CFR 372) LISTED TOXIC CHEMICALS ARE PRECEDED BY AN *.

SECTION III: HAZARDS IDENTIFICATION

APPEARANCE AND ODOR: Colorless, Oily Fluid. Vapors are Colorless. Acrid odor when hot or charging.

RATING CODES: 0=Insignificant 1=Slight **2**=Moderate 3 High **4**=Extreme

HMIS RATING:	Health: 2	Flammability: 0	Reactivity: 1	Other: 0
NFPA RATING:	Health: 2	Flammability: 0	Reactivity: 1	Other: CORR

TARGET ORGANS: Skin, Eyes, Upper Respiratory Tract

ROUTES OF ENTRY: Inhalation X Skin X Ingestion X

HEALTH HAZARDS (ACUTE AND CHRONIC):

ACUTE: Tissue destruction on contact. May cause 2nd and 3rd degree burns or blindness with prolonged contact. Ingestion will cause corrosive burns on contact. May be fatal if swallowed.

CHRONIC: Inhalation of mists may cause upper respiratory irritation.

SIGNS AND SYMPTOMS: Irritation and burning of exposed tissues.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Respiratory disorders may be aggravated by prolonged inhalation of mists.

California Proposition 65 Warning *Battery posts, terminals, and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm. Batteries also contain other chemicals known to the State of California to cause cancer. Wash hands after*

handling.

SECTION IV: FIRST AID MEASURES

EMERGENCY AND FIRST AID PROCEDURES:

SKIN / EYES	INGESTION
• Flush with water for 15 minutes • Remove contaminated clothing • If irritation continues, seek medical attention	• Drink large quantities of milk or water • Do not induce vomiting • Give CPR if breathing has stopped • Seek medical attention immediately

SECTION V: FIREFIGHTING MEASURES

FIRE AND EXPLOSIVE PROPERTIES:

Flash Point: N/A	Flammable Limits (as H_2 gas):	**LEL: 4%**	UEL: **74%**

UNUSUAL FIRE AND EXPLOSION HAZARDS: Hydrogen gas may be present when used in a battery. Hydrogen gas and acid mist are generated upon overcharge or in fires. Ventilate area.

EXTINGUISHING MEDIA: Class ABC or CO_2. Caution should be taken not to use CO_2 directly on the battery cell as the thermal shock may cause cracking of the battery case and release of battery electrolyte.

SPECIAL FIREFIGHTING PROCEDURES: Ventilate the area well. SCBA and acid protective clothing are recommended.

SECTION VI: ACCIDENTAL RELEASE MEASURES

STEPS TO BE TAKEN IF BATTERY IS BROKEN: Neutralize exposed battery parts with soda ash or sodium bicarbonate until fizzing stops. pH should be neutral at 6-8. Collect residue in a suitable container. Residue may be hazardous waste. When neutralized, the battery parts are non-hazardous. Place the broken battery in a heavy gauge plastic bag or other non-metallic container. Provide adequate ventilation, hydrogen gas may be given off during neutralization.

SECTION VII: HANDLING AND STORAGE

Store in a cool, dry area away from combustibles. Do not store in sealed, unventilated areas. Avoid over-heating and overcharging. Do not use organic solvents or other than recommended chemical cleaners on the batteries.

SECTION VIII: EXPOSURE CONTROLS / PERSONAL PROTECTION

ENGINEERING CONTROLS: General room ventilation is sufficient during normal use and handling. Do not install these batteries in a sealed, unventilated area.

PERSONAL PROTECTIVE EQUIPMENT (IN THE EVENT OF BATTERY BREAKAGE):

Eye Protection = chemical goggles or safety glasses with sideshields and a full-face shield.

Protective Gloves = rubber or neoprene

Respiratory Protection = NIOSH approved acid mist respirator, if OSHA PEL is exceeded or respiratory irritation occurs.

Other Protective Equipment = acid resistant apron or clothes.

WORK PRACTICES: Do not wear metallic jewelry when working with batteries. Use non-conductive tools only. Discharge static electricity prior to working on a battery. Maintain an eyewash, fire extinguisher and emergency communication device in the work area.

SECTION IX: PHYSICAL AND CHEMICAL PROPERTIES

ACID: Appearance / Odor: At normal temperatures: colorless, oily fluid / acrid odor when hot.

Boiling Point: N/A	Vapor Pressure: N/A
Vapor Density: (air=1): >1	Melting Point: N/A
Evaporation Rate (water=1): N/A	Solubility in water: N/A
Specific Gravity (contained in battery): 1.300+/-.010	

SECTION X: STABILITY AND REACTIVITY

STABILITY: This battery and contents are stable.

CONDITIONS TO AVOID: Overheating, overcharging which result in acid mist / Hydrogen generation.

INCOMPATIBILITY (MATERIALS TO AVOID): Strong alkaline materials, conductive metals, organic solvents, sparks or open flame.

HAZARDOUS DECOMPOSITION OR BYPRODUCTS: Hydrogen gas may be generated in an overcharged condition, in fire or at very high temperatures. In fire may emit CO, CO2 and Sulfur Oxides.

HAZARDOUS POLYMERIZATION WILL NOT OCCUR.

SECTION XI: TOXICOLOGICAL INFORMATION - SULFURIC ACID

The "Liberty Series" batteries are sealed, recombinant design. Under normal use and handling the customer has no contact with the internal components of the battery or the chemical hazards. Under normal use and handling these batteries do not emit regulated or hazardous substances.

LD 50: Administration Route: Oral	Dose: **2140mg/kg**	Test Animal: **Rat**
LDLo: Administration Route: **Unreported**	Dose: **135mg/kg**	Test Animal: **Man**
LC50: Administration Route: **Inhalation**	Dose: **510mg/m3**	Test Animal: **Rat**

CARCINOGENICITY: The International Agency for Research on Cancer (IARC) has classified "strong inorganic acid mists containing sulfuric acid" as a category 1 carcinogen (inhalation), a substance that is carcinogenic to humans. "The National Toxicology Program (NTP) has designated strong inorganic sulfuric mists as a known human carcinogen." This classification does not apply to the liquid forms of sulfuric acid contained within the battery. Misuse of the product, such as overcharging, may result in the generation of sulfuric acid mist at high levels.

SECTION XII: ECOLOGICAL INFORMATION

Lead and its compounds can pose a threat if released to the environment. See waste disposal method in Section XIII.

SECTION XIII: DISPOSAL CONSIDERATIONS

WASTE DISPOSAL METHOD: This battery is recyclable. It is illegal to dispose of lead-acid batteries by any means other than recycling. C&D provides an environmentally responsible nation wide lead acid battery collection and recycling program. Contact your local C&D sales representative for more information.

HAZARDOUS WASTE CODES: **D002, D008**

SECTION XIV: TRANSPORTATION INFORMATION

All DOMESTIC SHIPMENTS:
BATTERY, ELECTRIC STORAGE, WET, NON- SPILLABLE, NOT REGULATED.

FOR WATER EXPORT AND CANADIAN SHIPMENTS:

FOR AIR: NON-SPILLABLE, NOT REGULATED. UNITS MEET A67 SPECIAL PROVISION	
REQUIREMENTS OF THE IATA REGULATIONS.	UN OR NA IDENTIFICATION: UN-2800
PROPER DOT SHIPPING NAME: Batteries, Wet, Non-spillable, Electric Storage	
HAZARD CLASS: 8	PACKING GROUP: III
LABEL: Corrosive (NOT REQUIRED FOR CANADA)	NO PLACARDS OR LABELS REQUIRED.

SECTION XV: REGULATORY INFORMATION

See 29 CFR 1910.268(b)(2)

SECTION XVI: OTHER INFORMATION

The information herein is given in good faith, but no warranty, expressed or implied, is made.

MSDS Preparation / Review Date: 7/05 Revision Number: 21 Prepared by: W. Kozlowski 14-312

C&D TECHNOLOGIES

MATERIAL SAFETY DATA SHEET

SECTION I: CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT IDENTITY:
Sealed, Lead-Calcium Battery
CDID: [illegible] BERTY SERIES 12-55, 12-80 Dry, FA 12-129, FAM 12-129

EMERGENCY: (610) 828-9290
24 HOUR EMERGENCY TELEPHONE:
(CHEM TEL) 1-800-255-3924

MANUFACTURER NAME: C & D Technologies, Inc.

ADDRESS:
1400 Union Meeting Road
P. O. Box 3053
Blue Bell, PA 19422-0858

TELEPHONE: (215) 619-2700

SECTION II: COMPOSITION / INFORMATION ON INGREDIENTS

NOTE: The C&D "Liberty Series" batteries are sealed, recombinant design. Under normal use and handling the customer has no contact with the internal components of the battery or the chemical hazards. Under normal use and handling these batteries do not contain regulated or hazardous substances.

HAZARDOUS COMPONENT	CAS#	OSHA PEL	ACGIH TLV	% BY WEIGHT
*Lead, Lead compounds	7439-92-1	0.05mg/m3	0.05mg/m3	60-71%
*Sulfuric Acid	7664-93-9	1.0mg/m3	1.0mg/m3	6-9%
Tin	7440-31-5	2.0mg/m3	2.0mg/m3	<1%
Aluminum	7429-90-5	15.0mg/m3	10.0mg/m3	<.01%
*Copper	7440-50-8	1.0mg/m3	1.0mg/m3	<.01%
NON-HAZARDOUS INGREDIENTS				
Water	7732-18-5	N/A	N/A	24-16%
Calcium	7440-70-2	N/A	N/A	.01%
Inert Components	N/A	N/A	N/A	7-12%

SECTION 313 (40 CFR 372) LISTED TOXIC CHEMICALS ARE PRECLUDED BY ANY

SECTION III: HAZARDS IDENTIFICATION

APPEARANCE AND ODOR: Colorless, Dry Fine, Vapors are Colorless; Acrid odor when hot or charging

RATING CODES: 0=*Insignificant* 1=*Slight* 2=*Moderate* 3 *High* 4 *Extreme*

HMIS RATING: Health: **2** Flammability: **0** Reactivity: **1** Other: **0**

NFPA RATING: Health: **2** Flammability: **0** Reactivity: **1** Other: **CORR**

ROUTES OF ENTRY: Inhalation **X** Skin **X** Ingestion **X**

TARGET ORGANS: Skin, Eyes, Upper Respiratory Tract

HEALTH HAZARDS (ACUTE AND CHRONIC):

ACUTE: Tissue destruction on contact. May cause 2nd and 3rd degree burns or blindness with prolonged contact. Ingestion will cause corrosive burns on contact. May be fatal if swallowed.

CHRONIC: Inhalation of mists may cause upper respiratory irritation.

SIGNS AND SYMPTOMS: Irritation and burning of exposed tissues.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Respiratory disorders may be aggravated by prolonged inhalation of mists.

California Proposition 65 Warning – *Battery posts, terminals, and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm. Batteries also contain other chemicals known to the State of California to cause cancer. Wash hands after handling.*

SECTION IV: FIRST AID MEASURES

EMERGENCY AND FIRST AID PROCEDURES:

SKIN / EYES	INGESTION
• Flush with water for 15 minutes • Remove contaminated clothing • If irritation continues, seek medical attention.	• Do not induce vomiting • Drink large quantities of milk or water • Give CPR if breathing has stopped • Seek medical attention immediately

SECTION V: FIREFIGHTING MEASURES

FIRE AND EXPLOSIVE PROPERTIES:

Flammable Limits (as H_2 gas) **LEL: 4%** UEL:**74%**	**Oxygen Index:** >32	**Flash Point:** N/A

UNUSUAL FIRE AND EXPLOSION HAZARDS: Hydrogen gas may be present when used in a battery. Hydrogen gas and acid mist is generated upon overcharge or in fires. Ventilate area.

EXTINGUISHING MEDIA: Class ABC or CO_2. Caution should be taken not to use CO_2 directly on the battery cell as the thermal shock may cause cracking of the battery case and release of battery electrolyte.

SPECIAL FIREFIGHTING PROCEDURES: Ventilate the area well. SCBA and acid protective clothing are recommended.

SECTION VI: ACCIDENTAL RELEASE MEASURES

STEPS TO BE TAKEN IF BATTERY IS BROKEN: Neutralize any spilled electrolyte or exposed battery parts with soda ash or sodium bicarbonate until fizzing stops. **pH** should be neutral at **6-8**. Collect residue and place in a suitable container. Residue may be hazardous waste. When neutralized, the spill is non-hazardous. Keep untrained individuals away from the spilled material. Place the broken battery in a heavy gauge plastic bag or other non-metallic container. Provide adequate ventilation, hydrogen gas may be given off during neutralization.

SECTION VII: HANDLING AND STORAGE

Store in a cool, dry area away from combustibles. Do not store in sealed, unventilated areas. Avoid overheating and overcharging. Do not use organic solvents or other than recommended chemical cleaners on the batteries.

SECTION VIII: EXPOSURE CONTROLS / PERSONAL PROTECTION

ENGINEERING CONTROLS: General room ventilation is sufficient during normal use and handling. Do not install these batteries in a sealed, unventilated area.

PERSONAL PROTECTIVE EQUIPMENT (IN THE EVENT OF BATTERY BREAKAGE):

Eye Protection = chemical goggles or safety glasses with sideshields and a full-face shield.

Protective Gloves = rubber or neoprene

Respiratory Protection = NIOSH approved acid mist respirator, if OSHA PEL is exceeded or respiratory irritation occurs.

Other Protective Equipment = acid resistant apron or clothes.

WORK PRACTICES: Do not wear metallic jewelry when working with batteries. Use non-conductive tools only. Discharge static electricity prior to working on a battery. Maintain an eyewash, fire extinguisher and emergency communication device in the work area.

SECTION IX: PHYSICAL AND CHEMICAL PROPERTIES

ACID:

Evaporation Rate (water=1) : N/A	**Vapor Density:** (air=1) : >1
Solubility in water: N/A	**Vapor Pressure:** N/A
Specific Gravity (contained in battery): 1.300 +/- .010	**Melting Point:** N/A

Appearance / Odor: colorless, oily fluid, acrid odor when hot.	**Boiling Point:** N/A

SECTION X: STABILITY AND REACTIVITY

STABILITY: This battery and contents are stable.

CONDITIONS TO AVOID: Overheating, overcharging which result in acid mist / hydrogen generation.

INCOMPATIBILITY (materials to avoid): Strong alkaline materials, conductive metals, organic solvents, sparks or open flame.

HAZARDOUS DECOMPOSITION OR BYPRODUCTS: Hydrogen gas may be generated in an overcharged condition, in fire or at very high temperatures. In fire- may emit CO, CO2 and Sulfur Oxides.

HAZARDOUS POLYMERZATION WILL NOT OCCUR.

SECTION XI: TOXICOLOGICAL INFORMATION – SULFURIC ACID

The "**Liberty Series**" batteries are sealed, recombinant design. Under normal use and handling the customer has no contact with the internal components of the battery or the chemical hazards. Under normal use and handling these batteries do not emit regulated or hazardous substances.

LD 50:	Administration Route: **Oral**	**Dose:** 2140mg/kg	**Test Animal:** Rat
LDLo:	Administration Route: **Unreported**	**Dose:** 135mg/kg	**Test Animal:** Man
LC50:	Administration Route: **Inhalation**	**Dose:** 510mg/m3	**Test Animal:** Rat

CARCINOGENICITY: The **International Agency for Research on Cancer** (IARC) has classified "strong inorganic acid mists containing sulfuric acid" as a category 1 carcinogen (inhalation), a substance that is carcinogenic to humans. "The National Toxicology Program (NTP) has designated strong inorganic sulfuric acid mists as a known human carcinogen." This classification does not apply to the liquid forms of sulfuric acid contained within the battery. Misuse of the product, such as overcharging, may result in the generation of sulfuric acid mist at high levels.

SECTION XII: ECOLOGICAL INFORMATION

Lead and its compounds can pose a threat if released to the environment. See waste disposal method in Section XIII.

SECTION XIII: DISPOSAL CONSIDERATIONS

WASTE DISPOSAL METHOD: This battery is recyclable. It is illegal to dispose of lead-acid batteries by any means other than recycling. C&D provides an environmentally responsible nation wide lead acid battery collection and recycling program. Contact your local C&D sales representative for more information.

HAZARDOUS WASTE CODES: D002, D008

SECTION XIV: TRANSPORTATION INFORMATION

FOR DOMESTIC, CANADIAN, AND EXPORT SHIPMENTS:

UN OR NA IDENTIFICATION: **UN-2794**

PROPER DOT SHIPPING NAME: **Batteries, Wet, Filled with Acid, Electric Storage**

HAZARD CLASS: 8	**PACKING GROUP: III**	**LABEL: Corrosive**

SECTION XV: REGULATORY INFORMATION

See 29 CFR 1910.268(b)(2)

SECTION XVI: OTHER INFORMATION

The information herein is given in good faith, but no warranty, expressed or implied, is made.

MSDS Preparation / Review Date: 6/07 Revision Number: 14 Prepared by: W. Kozlowski

Appendix B - WARRANTY PROVISIONS FOR LIBERTY SERIES 1000 BATTERIES

C&D Technologies valve regulated lead-acid batteries are warranted against defects in materials or manufacturing or both from C&D factory when operated in full float and when stored at 77°F (25°C). Refer to specific warranty certificates for your Liberty 1000 model for float or UPS operation and for storage at other temperatures.

IMPORTANT: Full and pro-rata warranty is reduced for operation exceeding 77°F (25°C) and is adjusted for cycle service (such as UPS service and similar applications). Refer to the specific warranty RS-924 for full float service and RS-1224 for cycle service (such as UPS) provided in the time period when the battery was purchased.

Always complete the record of initial charge, float charge and ambient temperature as described in the initial charge section of this manual and retain them in your files for future reference. Clearly identify your location, application, C&D Technologies model number, the date, and name of the person who took the readings.

The service life of your battery will depend on ambient temperature, frequency and depth of discharge, discharge rate, charge voltage, and regulation of the battery charger. A product warranty is available by writing C&D Technologies, Inc., 1400 Union Meeting Road, PO Box 3053, Blue Bell, PA 19422-0858.

CAUTION

Due to the operating requirements of valve-regulated batteries, Liberty Series 1000 batteries are sealed and hydrometer readings cannot be taken. Removal of vents voids warranty.

Appendix C - VALVE-REGULATED LEAD ACID BATTERY AND CHARGER INSPECTION REPORT

A sample inspection report form is provided in the following pages of this manual and is referred to as **RS-1511**. This form should be used to record appropriate battery, charger and related system information at timely events such as:

- Initial installation of the battery at which time open circuit voltage of all cells should be recorded.
- The initial charge is provided at equalize or float voltage (if first charge is provided within a short time after receipt of battery).
- The system is finalized and float voltage is established to the battery.
- Whenever equalize charge is delivered to the battery to balance cell potentials.
- At periodic maintenance.
- Following a deep discharge or capacity test.

Important information can be found on unit labels affixed to the cell covers:

1 - Label contains the:
- Battery Model or Type Identification
- Ampere-hour Rating (Ah)
- Shipping Date, from C&D Technologies factory
- Order Number

User Note: Make a photocopy of the RS-1511 form shown in the following pages so that additional copies may be made at subsequent inspections.

TECHNICAL SERVICES DEPARTMENT
1400 UNION MEETING ROAD
BLUE BELL, PA 19422

Inspection by:_____

Date of Inspection:_____

LIBERTY® SERIES 1000 BATTERY AND CHARGER INSPECTION REPORT

User's Name:	Authorized Site Contact:
Installation Location:	Phone No.:
	Other:
System OEM:	Installation by:

BATTERY & CHARGER SYSTEM INFORMATION

USER INSPECTION	C&D TECHNOLOGIES INSPECTION
C&D Technologies Order No.	Appearance of Following Battery Items
C&D Technologies Ship Date	Positive Posts
Date Installed	Negative Posts
Battery Model	Cell Covers
Cells x Strings	Presence of Lubricant on Cells ☐ Yes ☐ No
Application	
Bus Voltage, Portable Meter	
Bus Voltage, Equipment, Final	
Charger Size, Type, Serial No. & Mfg.	
Ambient Room Temperature	
Last Discharge	
Peak Load Current Amp. or KW	
Typical Load Current/KW	
Cell Arrangement	

COMMENTS AND RECOMMENDATIONS

BATTERY CHARGE STATUS ☐ **OPEN CIRCUIT** ☐ **FLOAT** ☐ **EQUALIZE**

BATTERY BUS VOLTAGE __________**Vdc** __________**Vdc** _________**Vdc**

Location: **Model:** **Date:**

Cell No.	Volts +2.000	Serial No.	Connection Resistance	Internal Cell Conductance /Impedance/ Resistance	Cell No.	Volts +2.000	Serial No.	Connection Resistance	Internal Cell Conductance /Impedance/ Resistance

NOTES

NOTES

OFFICES

C&D WORLD HEADQUARTERS
200 Precision Road
Horsham, Pennsylvania 19044 USA

C&D UNITED KINGDOM
25 Earlstrees Road
Corby, NN17 4AZ, UK

CANADA
C&D Mississauga Sales Office
6665 Millcreek Dr. Unit 3 Mississauga,
Ontario L5N 5M4 Canada

MANUFACTURING

UNITED STATES
C&D Attica Manufacturing
200 W. Main Street
Attica, Indiana 47918-0279 USA

MEXICO
C&D Reynosa Manufacturing Ave.
Industrial del Norte S/N Lote 6,
Manzana 9
Reynosa, Tamaulipas

CHINA
C&D Shanghai PSD Manufacturing No 55
Liandu Road
Spark Development Zone FengXian
District
Shanghai, China, 201419

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