

**Lucent Technologies**  
Bell Labs Innovations



# *Victory Class Batteries*

## *WP-93936*

Product Manual  
Select Code 157-629-705  
Comcode 108674615  
Issue 1  
May 2000  
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***Product Manual***  
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***Comcode 108674615***  
***Issue 1***  
***May 2000***

***Lucent Technologies***  
***Victory Class Batteries***  
***WP-93936***

**Notice:**

Every effort was made to ensure that the information in this document was complete and accurate at the time of printing. However, information is subject to change.



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# ***1 Introduction***

## ***Product Summary***

This product manual (Select Code 157-629-705) provides information on Lucent Technologies' Victory Class Batteries. A Victory Class Battery is a rectangular, stationary, lead-acid, flooded, 2-volt cell.

Lucent Technologies power products have proved their reliability by serving the telephone industry for decades. All of the components in the Victory Class Battery meet Lucent Technologies' strict specifications and quality standards.

Designed for a Central Office environment, the Victory Class Battery provides long reliable service life and reduced lifetime maintenance costs.

## ***Customer Assistance Contacts***

### ***Customer Training***

Lucent Technologies offers customer training on many Power Systems products. For information call 1-972-284-2163. This number is answered from 8:00 a.m. until 4:30 p.m., Central Time Zone (Zone 6), Monday through Friday.

### ***Customer Service***

For customers in the United States, Canada, Puerto Rico, and the US Virgin Islands, call 1-800-THE-1PWR (1-800-843-1797). Services provided through this contact include initiating the spare parts procurement process for out of service emergencies, ordering Lucent Technologies documents, and providing other product and service information.

For other customers worldwide, call 001-972-840-0382. This number is answered from 8:00 a.m. until 4:30 p.m., Central Time Zone (Zone 6), Monday through Friday.

**Customer  
Assistance  
Contacts,  
continued**

**Technical Support**

Technical support for Lucent Technologies customers is available around the world during the normal product warranty period and also while specific contractual agreements extend this service.

For customers in the United States, Canada, Puerto Rico, and the US Virgin Islands, call 1-800-CAL-RTAC (1-800-225-7822) to contact a product specialist to answer your technical questions and assist in troubleshooting problems.

For other customers worldwide, contact your local field support center or your sales representative to discuss your specific needs.

**Product Repair and  
Return**

Repair and return service is provided for Lucent Technologies customers around the world.

For customers in the United States, Canada, Puerto Rico, and the US Virgin Islands, call 1-800-255-1402 for information on returning of products for repair.

For other customers worldwide, contact your sales representative to discuss your particular circumstances.

**Warranty Service**

For domestic warranty service, contact your Warranty Service Manager (WSM). For international warranty service, contact your sales representative.

**On-Line Power  
Systems Product  
Manuals**

For Lucent Technologies users logging in from inside the corporate firewall, the address of the "Power Systems On-Line Product Manuals" page is <http://www.cic.lucent.com/lineage.html>.

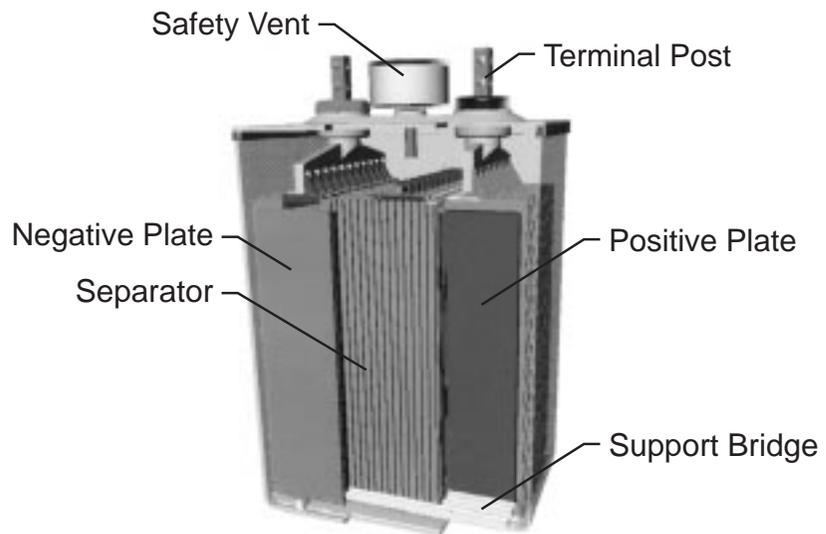
For customers logging in from outside the firewall, the address is <http://www.lucent8.com/lineage.html>. The annual subscription fee for access to this site is \$25. To obtain a password, follow the instructions on-line or call 1-888-Lucent8 (1-888-582-3688). When prompted for an order number, enter or say "167-790-010."

## 2 *Product Description*

### *Battery*

#### *Components*

Figure 2-1 shows a cutaway view of the Victory Class Battery.

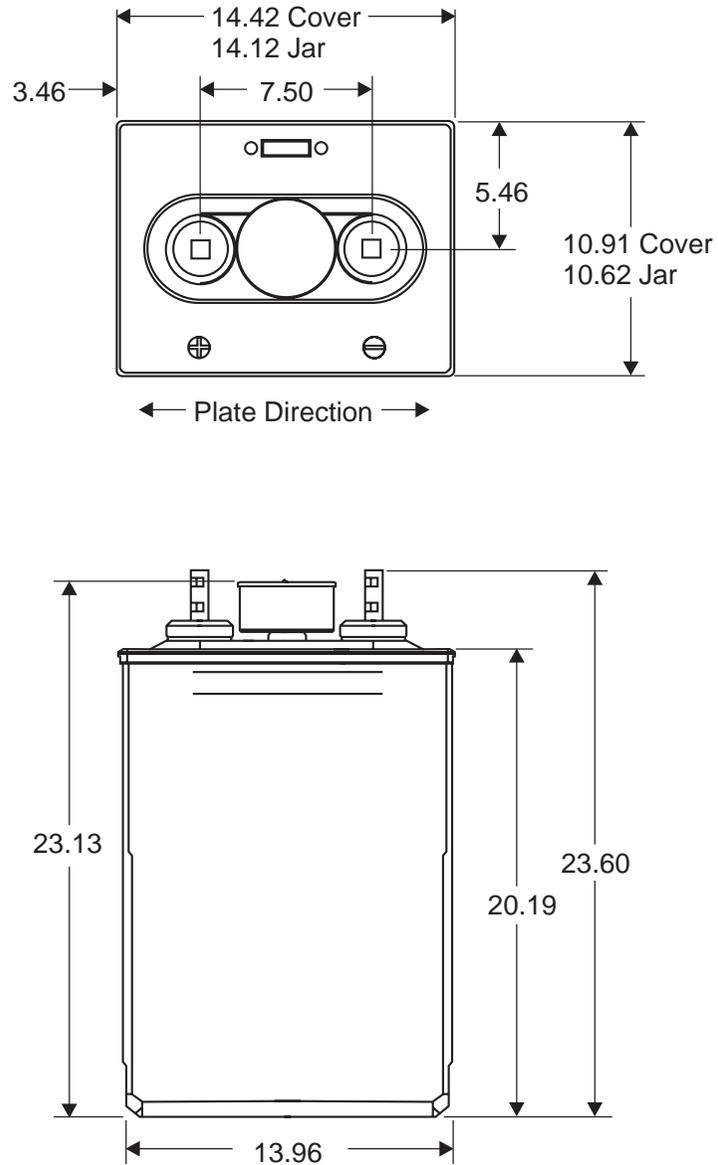


*Figure 2-1: WP-93936 Victory Class Battery (Cutaway View)*

## Battery, continued

### Dimensions

Figure 2-2 provides dimensions of the Victory Class Battery.



**Figure 2-2: WP-93936 Victory Class Battery (Dimensions)**

***Battery, continued***

***Specifications***

The Lucent Technologies Victory Class Battery is available in one size, which is ordered as WP-93936 List 1. Specifications for the List 1 Victory Class Battery are provided in Table 2-A.

**Table 2-A: Victory Class Battery Specifications**

<b>WP-93936 List 1</b>	
Ampere Hours (8 hour rate @ 25°C/77°F)	1680 Ah
Normal Voltage	2 volts
Float Voltage Range	2.17 - 2.22 volts
Specific Gravity of Electrolyte	1.215
Weight (approximate)	310 lbs. (136 kg)
Height	23.60 in. (59.9 cm)
Width	14.42 in. (36.63 cm)
Depth	10.91 in. (27.7 cm)
Total Weight (Volume) of Electrolyte	78 lbs. (8.7 gal.) 35.5 kg (32.8 L)
Total Weight (Volume) of Sulfuric Acid	22.5 lbs. (1.6 gal.) 10.6 kg (6.3 L)

## ***Battery, continued***

### ***Features***

- Lead-calcium grids
- Water impermeable PVC jar and cover with oxygen index of 33%
- Solid copper posts with lead-tin coating
- Leak-preventing post seal incorporates epoxy sleeve rubber boot and proprietary lead-calcium-tin alloy
- Increased jar/cover seal interface compared to KS-15544 L508 product
- Bottom pour positive grids
- Non-organic expander in negative paste
- Footprint same as existing KS-15544 List 508 product

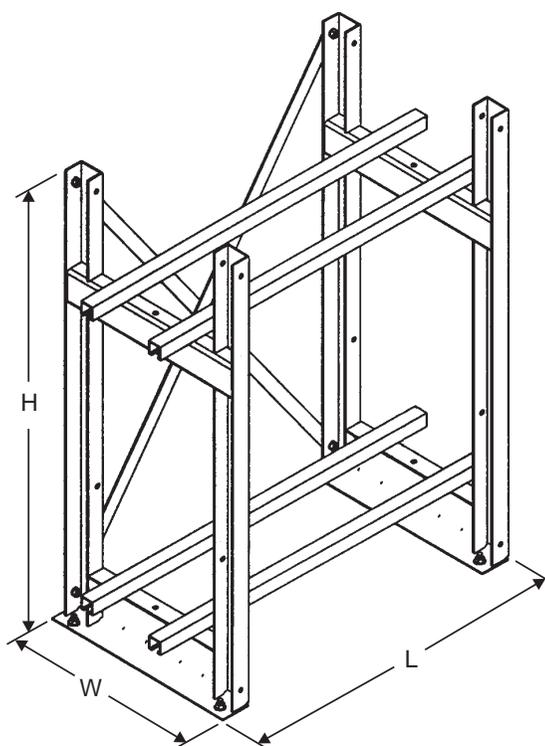
### ***Benefits***

- **Minimum maintenance**
  - No need for routine specific gravity measurements
  - No need for routine re-torquing
  - Utilizes post seal reliability of Round Cell
  - Utilizes two cross-drilled, lead-plated copper posts for zero maintenance connections and ease of installation
- **Safety/standards compliance**
  - Designed to minimize the hazards of fire and electrolyte leakage
  - Flammability rating; UL94V-0, ASTM D 2863
  - Seismic rating with specific battery stand
- **High reliability**
  - Improved performance at 2-5 hour rates to 1.88Vpc (for today's switching systems)
  - A battery life of 25 years when well maintained and operated under normal conditions
  - No premature failures from post seal and jar/cover seal leaks

## ***Battery Racks***

Metal racks for mounting the Victory Class Batteries are available in two-tier single row and two-tier two-row configurations. These stands have been designed and tested to meet various seismic zones and requirements (i.e., Bellcore GR63-CORE, Uniform Building Code, and PacBell). The racks are constructed using xx AWG steel and are epoxy coated to prevent corrosion.

Tables 2-B and 2-C provide the dimensions in inches of the battery racks. Figure 2-3 illustrates the three measurements listed, which are given in the following order: length (L), width (W), and maximum installed height (H).



***Figure 2-3: Battery Rack Dimensions***

S-S and E-E refer to the orientation of the racks, and are designated as follows:

(S-S) = Cells placed Side-to-Side, or with plates perpendicular to rails  
(E-E) = Cells placed End-to-End, or with plates parallel to rails

Table 2-B provides information on 24V systems; Table 2-C gives information for 48V systems.

**Battery Racks, continued**

**24V Systems**

**Table 2-B: Battery Rack Dimensions (24V)**

		<b>L x W x Maximum Installed Height (Inches)</b>		
<b>Config.</b>	<b># Cells</b>	<b>UBC Zone 0 Standard Rack</b>	<b>UBC Zones 1-2B</b>	<b>UBC Zones 3-4</b>
2T/1R (S-S)	12 (6/tier)	72 x 24.06 x 69.95	72 x 24.06 x 69.95	72 x 24.06 x 69.95
2T/1R (E-E)	12 (6/tier)	90 x 18.38 x 70.26	90 x 20.63 x 70.26	90 x 20.63 x 70.26
<b>Config.</b>	<b># Cells</b>	<b>Bellcore Zone 3</b>	<b>Bellcore Zone 4</b>	<b>Pac Bell Zone 4</b>
2T/1R (S-S)	12 (6/tier)	70.88 x 24.13 x 69.95	70.88 x 24.13 x 69.95	80.47 x 26.85 x 68.88
2T/1R (E-E)	12 (6/tier)	90 x 20.63 x 70.26	90 x 20.63 x 70.26	98.3 x 23.35 x 69.19

**Battery Racks, continued**

**48V Systems**

**Table 2-C: Battery Rack Dimensions (48V)**

		<b>L x W x Maximum Installed Height (Inches)</b>		
<b>Config.</b>	<b># Cells</b>	<b>UBC Zone 0 Standard Rack</b>	<b>UBC Zones 1-2B</b>	<b>UBC Zones 3-4</b>
2T/2R	24 (6/row)	72 x 48.12 x 69.95	72 x 48.12 x 69.95	72 x 48.12 x 69.95
2T/2R (E-E)	24 (6/row)	90 x 35.38 x 70.26	90 x 39.13 x 70.26	90 x 39.13 x 70.26
2T/2R	48 (12/row)	144 x 48.12 x 69.95	144 x 48.12 x 69.95	144 x 48.12 x 69.95
2T/2R (E-E)	48 (12/row)	180 x 35.38 x 70.26	180 x 39.13 x 70.26	180 x 39.13 x 70.26
2T/1R	24 (12/row)	144 x 24.06 x 69.95	144 x 24.06 x 69.95	144 x 24.06 x 69.95
2T/1R (E-E)	24 (12/row)	180 x 18.38 x 70.26	180 x 20.63 x 70.26	180 x 20.63 x 70.26
<b>Config.</b>	<b># Cells</b>	<b>Bellcore Zone 3</b>	<b>Bellcore Zone 4</b>	<b>Pac Bell Zone 4</b>
2T/2R	24 (6/row)	70.88 x 46.13 x 69.95	70.88 x 46.13 x 69.95	N/A
2T/2R (E-E)	24 (6/row)	90 x 39.13 x 70.26	90 x 39.13 x 70.26	N/A
2T/2R	48 (12/row)	137.63 x 46.13 x 69.95	137.63 x 46.13 x 69.95	143 x 53.7 x 68.88
2T/2R (E-E)	48 (12/row)	180 x 39.13 x 70.26	180 x 39.13 x 70.26	180.06 x 37.75 x 69.07
2T/1R	24 (12/row)	137.63 x 24.13 x 69.95	137.63 x 24.13 x 69.95	143 x 26.85 x 68.88
2T/1R (E-E)	24 (12/row)	180 x 20.63 x 70.26	180 x 20.63 x 70.26	180.79 x 23.35 x 69.19



## 3 *Ordering Information*

### *Battery and Racks*

Table 3-A lists the comcodes of the Victory Class Battery and the most frequently ordered battery racks, as well as associated accessory kits and spill containment systems.

**Table 3-A: Ordering Information**

<b>Item</b>	<b>Description</b>	<b>Comcode</b>
WP-93936, List 1	Victory Class flooded lead-acid battery, 1680Ah nominal rating single 2-volt cell*	408339836
RD-2206-7.5 BC3	2T2R, 7.5-ft Stand for 24 cells arranged End to End, UBC Zone 0-2**	408056034
RE-3881	Accessory kit for above RD-2206-7.5***	408397560
SCC-94-39	Acid spill containment system for above RD-2206-7.5, with floor coating****	408397792
RD-2206-15 BC3	2T2R, 15-ft Stand for 48 cells arranged End to End, UBC Zone 0-2**	408358547
RE-3882-2	Accessory kit for above RD-2206-15***	408397552
SCC-184-43	Acid spill containment system for above RD-2206-15, with floor coating****	408397776
RD-2206-7.5 BC4	2T2R, 7.5-ft Stand for 24 cells arranged End to End, UBC Zone 3-4**	408056034
RE-3881	Accessory kit for above RD-2206-7.5***	408397560
SCC-94-39	Acid spill containment system for above RD-2206-7.5, with floor coating****	408397792
RD-2206-15 BC4	2T2R, 15-ft Stand for 48 cells arranged End to End, UBC Zone 3-4**	408056034
RE-3881	Accessory kit for above RD-2206-15***	408397552
SCC-94-39	Acid spill containment system for above RD-2206-15, with floor coating****	408397776
<p>*A single battery includes connecting hardware (nuts, bolts, and washers), shipping plug, vent assemblies, and instruction manual</p> <p>**The racks listed above are for cells placed side-to-side (perpendicular to rack) with plate-ends visible. Seismic Zone designations are per Uniform Building Code (UBC). For details on the above racks, or for other rack configurations, contact your Lucent Technologies account manager.</p> <p>***Accessory kit includes installation drawing, inter-cell and inter-tier connectors, terminal plate assembly, safety labels, connecting hardware, hydrometer, thermometer, vent assemblies, no-ox grease, lifting strap and spreader, terminal cleaning brush, cell identification numbers, miscellaneous hardware, and instruction manual.</p> <p>****Acid spill containment system includes 4" high barrier around the battery perimeter, liquid-tight epoxy sealant.</p>		



# 4 *Safety*

## *Introduction*

**Read and understand this section thoroughly before moving, unpacking, installing, or maintaining Victory Class Batteries. Fully brief anyone with access to battery areas, or who are working near or with batteries, on the hazards associated with lead-acid batteries.**

Follow the procedures noted in the *Battery Storage* and *Installation* sections.

Additional information that everyone needs to understand before having access to the batteries can be found in the Material Safety Data Sheet (MSDS) in Section 10 of this product manual. The MSDS includes health hazard summaries, first aid procedures, fire and explosion hazard data, reactivity data, special protection information, environmental information (spill clean-up and disposal), and special precautions.

## Safety Symbols



### Admonitions

**DANGER** indicates the presence of an imminently hazardous situation that *will* cause death or severe personal injury if the hazard is not avoided.

**WARNING** indicates the presence of a potentially hazardous situation that *can* cause death or severe personal injury if the hazard is not avoided.

**CAUTION** indicates the presence of a hazard that *will* or *can* cause minor personal injury or property damage if the hazard is not avoided.

**NOTE** or **NOTICE** indicates instructions that need to be followed for correct use and/or to minimize the chance of equipment damage.

## ***Poison***

**POISON**  
**CAUSES SEVERE BURNS**

Lead-acid batteries contain toxic and caustic materials (lead, lead compounds, and sulfuric acid). Do not incinerate or mutilate. Avoid contact with skin, eyes, or clothing. Recycle batteries in approved reclamation centers according to local, state, and federal regulations.

Lead-acid batteries contain electrolyte (sulfuric acid and water), a highly corrosive substance. It is possible that mishandling, certain types of physical damage, and/or abusive charging may force electrolyte outside the battery container.

- When handling batteries or cells, wear protective equipment (e.g., acid-resistant rubber gloves, acid-resistant rubber aprons, and impact-resistant, splash-proof goggles or full face mask).
- Even when not handling batteries, as a minimum protection wear splash-proof and impact-resistant goggles while working around batteries or on equipment containing batteries.
- Never tip a cell more than 25 degrees or electrolyte may spill through the vent.

The following items can be ordered from Lucent Technologies. These items should be available to anyone working around batteries. Local, state, or federal codes for certain installations require some or all of these items to be installed and/or kept at the installation site.

- Battery cleaning and maintenance kits, including protective gear
- Acid spill clean-up kit
- Acid Spill Management System

## ***Electrical Hazard***

### **WARNING ELECTRICAL HAZARD**

In addition to proper job training and safety procedures, the following are some basic precautions that should always be followed when working with or around batteries (including equipment connected to batteries):

- Always use insulated tools.
- Never place uninsulated metal objects on top of a battery.
- Remove all metal jewelry, such as rings, watches, bracelets, necklaces, and other metallic items.
- Do not short circuit the battery.
- Ensure proper polarity when making connections.
- Wear non-conductive eye protection.
- Remove items that could fall out of clothing pockets.
- Personnel with implanted electronic medical devices need to be aware of their restrictions when working around electricity.

Batteries differ from other sources of power in that they are delivered to the points of installation as energized units. A battery gives no indication by its appearance of the potential energy stored in it. Batteries have enormous short circuit capability that can result in serious burns or create dangerous projectiles from the object causing the short circuit. Even a single battery poses a potentially high energy hazard if shorted. Shorting a battery may result in explosion of the battery, injury to personnel, and damage to equipment. A tool or other metal object causing the short may be thrown or vaporized due to the energy produced by the battery or system.

- Exercise extreme care to avoid any short circuits across the battery terminals.
- In a grounded battery system, use extreme care not to short any metal objects from the ungrounded battery terminal to ground (which can include the equipment metal chassis, building structure, cable racks, etc.).
- If Victory Class cells are used on metal stands, install nonconducting mats between the battery and the shelf.

***Electrical  
Hazard,  
continued***

- Electricity produces magnetic fields that can affect implanted electronic devices. The strength of the magnetic field depends on the amount of current in the circuit, as well as other conditions (such as: number of conductors, placement, and distance from the conductor). DC power and distribution systems, including the batteries, that are typically used in telecommunication utility rooms can operate at high current levels. Personnel with electronic medical devices need to be aware of their restrictions when working around electricity.

***Shock Hazard***

A single cell is typically at low voltage; however, cells connected together in a system can pose a shock hazard in addition to an energy hazard.

- When interconnection of the cells creates a hazardous voltage supply, post appropriate warnings in the end systems or installations.
- For all systems and/or installations, use additional markings based on the use of the battery, industry standards, and local, state, and federal regulations.

## **Battery Gases**

**DANGER  
RISK OF EXPLOSION**

- Battery gases can be highly explosive. **DO NOT ALLOW** sparks, including sparks generated by electrostatic discharge (ESD), or open flame, near battery modules.
- Do not smoke around batteries.
- Make sure the battery area is properly ventilated before performing any work.
- Do not place batteries in a sealed enclosure. Even enclosures with ventilation need to be properly evaluated to assure hydrogen will not accumulate to explosive levels.
- Make sure vent funnel is properly placed on each Victory Class Battery before charging. If vent funnel must be removed for transportation, let battery sit for 48 hours at open circuit before removing the vent funnel and replacing it with the orange shipping plug.

Lead-acid batteries produce hydrogen gas even under normal charging and open circuit conditions. Boost charging or abnormal conditions, such as high temperature, abnormal charging, shorted cells, etc., can produce greater amounts of gas. If not permitted to escape, this gas can build up to explosive concentrations.

- Make sure the area is properly ventilated before performing any work. If working around or with batteries in an area that may not have sufficient air movement, provide more air movement (for example, by using a portable fan placed at a safe distance from the batteries).
- **ALWAYS** place batteries in a well-ventilated area.
- **NEVER** place batteries in a sealed enclosure.
- Since gas generated by batteries is explosive, avoid any activity that could ignite the gas (especially in the area of the vents). Some examples of possible ignition sources that must be avoided include: sparks (including those from static electricity or from making/breaking electrical connections), open flame, smoking, and any tools/appliances that may generate sparks, e.g., motors.
- Before performing any work operation, follow proper ESD protection procedures to discharge the static electricity from your body.

***Battery Gases,  
continued***

- Never tamper with or block the vents of batteries. Damaged or clogged vents may result in an explosion due to excessive internal pressure. Such an explosion could short circuit other battery modules, result in a fire, injure personnel, or cause damage to equipment.
- Never charge a battery that is visibly damaged or frozen (typically at temperatures less than -40°C or -40°F).
- Do not disconnect the circuit at the battery terminals while the battery is being discharged or charged.
- Isolate the battery string from any power source or load before making or removing connections at the battery terminals. If there are no devices (fuses, circuit breakers, or disconnect switches) for opening the circuit, here are some suggested procedures:
  - Make sure the free end of any wire to be connected to the batteries is insulated until it is ready to be connected to the load or charger or immediately after being disconnected from the load or charger.
  - Connect to the battery terminals first before connecting to the load or charging system.
  - Disconnect at the load or charger first before disconnecting at the battery terminals.

Lucent Technologies recommends not making connections to the battery terminals while the circuit is attached to a power source or load. However, Lucent is aware that some applications may require personnel to perform this function to avoid interruption of service. If a situation exists where it is necessary to make connections without isolating the battery as stated above, refer to the “Battery Replacement” procedure in Section 8, *Maintenance*.

This procedure must only be performed by qualified personnel who understand the procedures and the risks involved, have read and understand the safety precautions, and have the proper tools and personal protection equipment and clothing.

## ***Vent Funnel and Orange Shipping Plug***

**DANGER  
RISK OF EXPLOSION**

The vent funnel and orange shipping plug must be used properly to reduce the risk of explosion. Improper use could increase the risk of explosion due to concentrations of hydrogen gas around the vents, or excessive internal pressure.

The following guidelines cover the proper use of the orange shipping plug and vent funnel:

- The orange shipping plug is used for transportation. It is provided with a small opening to allow some hydrogen gas to escape and to minimize the spill of electrolyte. The opening is sized to allow the minor amounts of hydrogen to escape that can exist under open circuit. **It WILL NOT provide sufficient ventilation or dispersing of gas from the battery under ANY charging conditions.**
  - DO NOT charge battery with orange shipping plug in place.
  - DO NOT remove vent funnel and replace with the orange shipping plug UNLESS the battery has been left at open circuit for at least 48 hours.
- The vent funnel must be in place before applying ANY charge. Once the battery is in place, before making any connections, remove the orange shipping plug and insert the vent funnel. The vent funnel is designed to ventilate the hydrogen gas from the battery by dispersing the gas through many pores around the vent. Dispersing the gas helps reduce the risk of explosion. However, applying a charge greater than the float voltage creates additional gas around the vent funnel that increases the risk of explosion.
  - ALWAYS let the battery sit for at least 48 hours at a voltage equal to or less than the float voltage before doing any work around the battery (especially electrical connections). It is important that the voltage is verified to be equal or less than the recommended float voltage.
  - DO NOT handle or work around batteries while charging at greater than the recommended float voltage.
  - Seat vent funnel properly.

## ***Warning Signs***

To direct attention to the possible sources of danger, post one or more warning signs, lettered in large characters, in a conspicuous location near the batteries.

The warning signs are not meant to be a replacement for proper job procedures and training. All information noted in this section is important and must be understood by anyone working around or handling batteries. A warning sign should serve as a strong reminder.

The following are examples of the type of information that should be used:

<p style="text-align: center;"><b>DANGER!</b> <b>RISK OF EXPLOSION</b></p> <ul style="list-style-type: none"><li>• Battery gases are explosive. No sparks or open flame near batteries. No smoking.</li><li>• Never charge batteries without vent funnel in place.</li><li>• Do not handle, move, or work around batteries during or for 48 hours after charging at a voltage greater than 2.20V/cell.</li><li>• Handle, move, or store charged cells only with vent funnel (NOT orange shipping plug) in place.</li><li>• If the orange plug is needed for transporting the battery, let the battery sit at open circuit with the vent funnel in place for at least 48 hours before inserting the orange plug.</li><li>• Do not allow gas vents to become clogged or an explosion due to internal pressure may result.</li><li>• Properly ventilate battery area.</li></ul>
--

Note: In California, sellers and installers are required to post Prop. 65 workplace warning signs to notify employees about lead hazards.

Separate warning signs alerting personnel to electrical hazards and the hazards of electrolyte should also be considered.

## ***First Aid***

Refer to the MSDS in Section 10 for first aid procedures.

## ***Transportation***

New batteries are shipped meeting United Nations standard, DOT, IATA, IMDG, and other State and Government regulations.

## ***Handling***

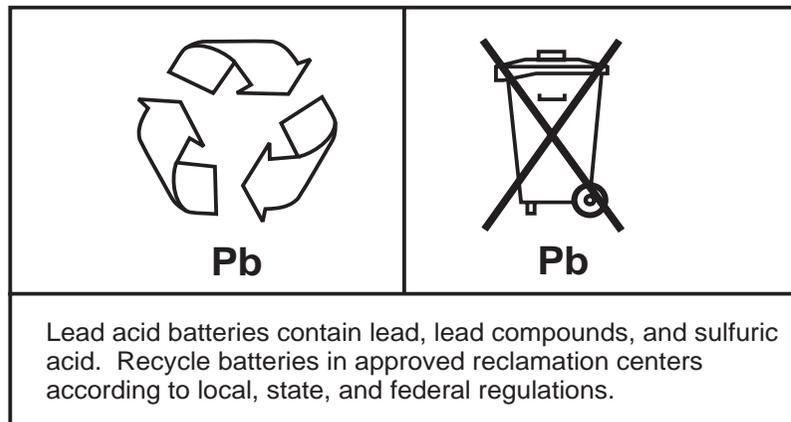
Refer to “Unpacking and Handling” in the Installation section of this product manual for specific handling instructions.

## ***Battery Disposal***

When a battery reaches 80% of its rated capacity it is typically considered for replacement. When a lead-acid battery or cell must be scrapped, it must be disposed of in the proper manner. There are government regulations controlling the safe disposal of lead-acid batteries. Contact your local Lucent Technologies agent for assistance in disposal of your battery.

Old/used batteries should be considered as Hazardous Waste and transported according to respective DOT, EPA, OSHA, and other governing regulations or guidelines for Hazardous Waste.

Do not discard batteries in trash cans.



## 5 *Battery Storage*

### *State of New Battery*

The Victory Class Battery is shipped charged and wet. The open circuit voltage for a Victory Class Battery is approximately 2.06V/cell.

### *Storage Time*

Charged and wet batteries should be placed in service before the date stamped on the shipping carton when stored at 77°F (25°C). The indicated storage time is based on storage at 77°F (25°C) and is 6 months. If storage beyond this time is required or temperature is in excess of 77°F (25°C), monitor battery at monthly intervals, if possible. A convenient measurement technique is to read the open circuit voltage and compare it with Table 5-A. If the open circuit voltage drops 0.02 volts from the nominal value, the cell(s) must be given a boost charge.

**Table 5-A: Open Circuit Cell Voltages  
Fully Charged With Electrolyte Between High and Low Level Lines  
Cell on Open Circuit for 24-72 Hours**

<b>Specific Gravity of Cell</b>	<b>Individual Cell Voltage</b>
1.170	2.025
1.215	2.063
1.225	2.075
1.250	2.098
1.275	2.123
1.300	2.145

***Storage Time,  
continued***

If you prefer to check specific gravity, a drop of 25 points (0.025) below the nominal value requires that the battery be given a boost charge.

The boost charge is conducted at equalize voltage (or in cases when constant current charging equipment is available, at five amperes per 100 ampere-hours rated 8-hour capacity for a period not exceeding 24 hours) as specified in Table 7-A, "Equalize Charge Voltages." The Equalize charge may be given to individual cells, groups of cells or the entire battery.

***Storing  
Charged and  
Wet Batteries***

- Store batteries in an upright position in a dry and cool environment (60°F to 85°F, preferably 77°F) without exposure to direct sunlight.
- Provide adequate ventilation during storage.
- Do not stack pallets of batteries on top of each other.
- Do not allow the electrolyte to freeze, as this will severely damage the battery and can cause a potentially hazardous leakage. Refer to Table 5-B for data on temperature versus freezing point for sulfuric acid solutions from the electrolyte contained within the cells.
- Exercise caution when operating or storing batteries at low temperatures because of the possibility of electrolyte freezing.
- Although the specific gravity of a fully charged battery may present no freezing problem, the discharged specific gravity may. Table 5-B provides information on freezing temperatures versus specific gravity.

**Table 5-B: Freezing Temperature vs. Specific Gravity**

Specific Gravity at 77°F (25°C)	Freezing Temperature	
	Celsius	Fahrenheit
1.000	0.0	+32.0
1.050	-3.3	+26.0
1.100	-7.7	+18.0
1.150	-15.0	+5.0
1.200	-27.0	-17.0
1.250	-52.0	-61.0
1.300	-70.0	-95.0
1.350	-49.0	-56.0
1.400	-36.0	-33.0

***Shelf Life  
Limitations,  
Wet and  
Charged Cells***

Lucent Technologies' lead-acid batteries are warranted against defects in materials and workmanship for a period of five years from the date of manufacture. To keep the warranty in effect, you must place the cells on charge within the time specified on the carton (no longer than 6 months between charges). Store cells at 77°F (25°C) or at a lower temperature, but not near freezing. If this is not possible, you must contact Lucent Technologies Technical Support for assistance and special instructions. For example, if cells are stored at 92°F (33.3°C) storage time will be reduced by 50 percent.

***Environmental  
Requirements***

Recommended temperature range for standby battery operation is 60°F (15°C) minimum to 90°F (32°C) maximum; 77°F (25°C) yearly average.

Operating temperature limits to prevent mechanical and/or performance degradation (or failure) is 32°F (0°C) minimum to 120°F (49°C) maximum, at standard atmospheric pressure.



# 6 *Installation*

## ***Introduction***

This section provides guidelines and procedures for installing the Victory Class cells and battery racks.

Please read the safety statements and precautions in Section 4 before unpacking and installing the batteries.

## ***Tools and Equipment***

Before installing batteries, gather the following tools and equipment:

- Safety equipment: eye protection, safety shoes, rubber apron, acid resistant gloves, and portable or stationary water facilities for rinsing eyes and skin in the event of contact with electrolyte
- Insulated (0-65 ft-lb) torque wrench with 3/8" and 1/2" hex sockets
- Adjustable wrench or 3/8" and 1/2" box wrenches
- Tape measure
- Square and leveling devices
- Thermostatically controlled hot plate
- Baking soda, water, a bucket, and clean rags  
(Do not use solvents of any kind, other than water.)
- 1-inch paint brush for applying NO-OX-ID grease
- Cotton cloth (packed with battery accessories)
- Cell lifting strap/spreader block (when provided)
- Battery hoist of appropriate lifting capacity
- Platform lift, when applicable
- Hot air gun or blower (optional)

## ***Terminal Plates, Cables, and Lugs***

Lucent Technologies offers a variety of cables, terminal lugs, and special terminal plates as optional equipment for specific battery installations.

Before beginning installation, check the accessories cartons to determine if the parts ordered have been received. Also check for additional instructions which may be specific to your application. This should be done before you schedule installation to permit delivery of necessary additional hardware.

Standard length inter-row and inter-tier (not inter-aisle or charger) cables are supplied by Lucent Technologies. They are approved, flexible battery cables with lead-plated copper lugs, properly sized for minimal voltage drop.

Terminal plates facilitate the connection of multiple power leads. They are made of heavy copper, lead-plated and formed to permit connection to posts of various configurations.

### **Caution**

Large cables attached directly to cell posts exert an undesirable force on post seals that can damage the seals and cause acid leakage.

### **Note**

Lucent Technologies recommends the use of lead-plated electrical lugs on vented lead-acid batteries, particularly if connections will be made directly to the posts of cells.

## ***Rack Installation Guidelines***

### ***Introduction***

Note: Rack installation instructions and basic assembly information are included in this manual, and should be consulted for detailed instructions specific to the rack to be installed and its assembly.

### ***General Information***

Standby battery and rack systems will be in place for many years. Racks are assembled first. Refer to the rack assembly drawing packed with racks, and note frame spacing.

#### **Caution**

Racks must be installed in a safe location for maintenance and away from radiant heat sources. Before batteries are installed, racks must be level and cross braces in place. All bolts must be tightened to specified torque values.

Floor loading must be considered in the planning phase.

#### **Caution**

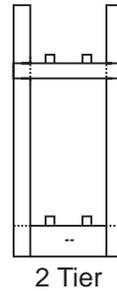
- Top rows of batteries in multiple-tier installations tend to operate at slightly higher temperatures than those on lower rows. Always provide adequate ceiling clearance for ventilation.
- When assembled, battery racks must be anchored to the floor.
- Do not place battery cells on the rack until it has been completely assembled with the braces installed, secured to the floor, and all bolts tightened to specified torque (refer to sequential steps of rack assembly). Otherwise, the weight of the cells may cause the rack to shift and collapse.
- Never loosen or remove braces from a standard loaded battery rack. Removal of bracing can allow the rack to shift and collapse. Front restraining rails on Seismic racks may be removed to accommodate loading cells.
- Never remove more than one brace on racks.

Victory Class batteries can be installed in either a back-back or end-end orientation. More information is given later in this section.

## ***Rack Installation Guidelines, continued***

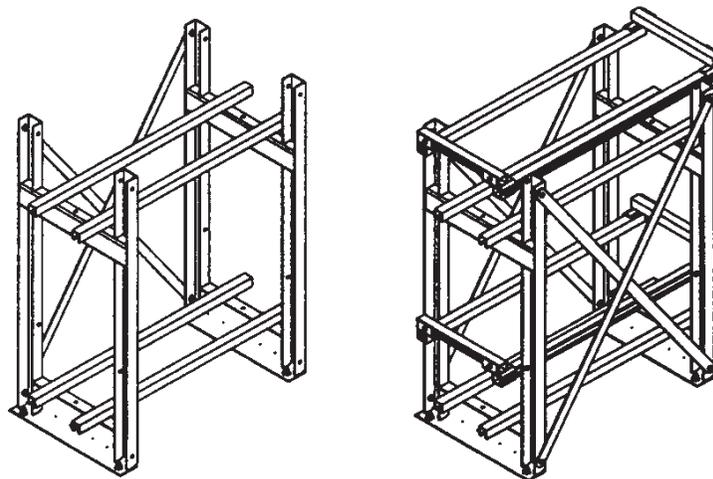
### ***Standard and Seismic Racks***

Racks are available in a 2-tier configuration, as shown in Figure 6-1. Rack components are supplied loose and must be assembled and secured on-site in accordance with these assembly instructions, the drawings included with the rack shipment, and applicable codes.



***Figure 6-1: 2-Tier Rack Configuration***

Seismic racks are similar to Standard racks, with the exception of additional frame bracing, battery constraints, and spacer elements. Frames are the same for both Standard and Seismic racks. Seismic racks are certified to Section 1630 of the Uniform Building Code, 1994 edition. See Figure 6-2.



Two Tier Standard Rack

Two Tier Seismic Rack

***Figure 6-2: Standard vs. Seismic Rack***

## ***Rack Installation Guidelines, continued***

### ***Rack Location***

Locate racks in a clean, cool, dry place so batteries are not affected by sources of radiant heat, such as sunshine, heating units, radiators, and steam pipes. Variations of more than 5°F between cells may cause the battery to become electrically unbalanced. Top rows of batteries in multiple-tier configurations tend to operate at slightly higher temperature than those on lower tiers. Always provide adequate ceiling clearance for ventilation and maintenance.

### ***Anchoring***

To provide stability, safety, and seismic integrity (for Seismic series) racks must be securely anchored to the floor. Install anchor bolts according to contractor specifications and in accordance with applicable codes. Do not attach rack to walls without consulting Lucent Technologies first. Mounting holes are provided in the base of each frame. All frames must be secured to floor using all anchor bolt locations. It is the responsibility of the customer to secure racks in accordance with allowable floor loading, applicable codes, and regulations.

Note: Anchor bolts are not provided by Lucent Technologies but are the responsibility of the installer. Installation must be in accordance with Building Code Requirements.

### ***Grounding***

Rack grounding provisions are integrated into the base of each frame. Two thru holes are located at the center of the frame's bottom cross member and may be used to secure a standard NEMA lug. These holes are 0.44" in diameter and 1.0" between centers. The surfaces surrounding the holes have been masked and are free of powder coat to allow electrical contact. Frame to frame grounding integrity is accomplished via the lower support rail, attached to each frame with Internal/External "star" washers.

### **Caution**

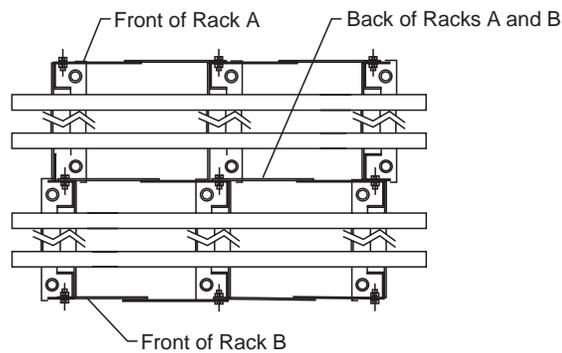
- Do not install batteries until the rack has been properly installed, with all bolts tightened to specified torque and frames anchored to the floor.
- Do not use oil or grease as a lubricant for cell installation. Lubrication is usually not required due to the low friction interface of the insulating covers. If necessary, a small amount of water or unscented talcum can be applied to the rail covers to reduce friction.

## ***Rack Installation Guidelines, continued***

### ***Back to Back Orientation***

Where two rows of racks are required, two rack assemblies may be installed in parallel back to back.

Locate back to back frames relative to each other as shown, so that the rear cross brace attachment holes align for the two adjoining frames. All braces must be installed, as described previously, except that a single bolt may be used to connect the front and rear frames and respective cross braces. Use 3/16" spacers and/or washers to fill gaps between adjacent frames. See Figure 6-3.

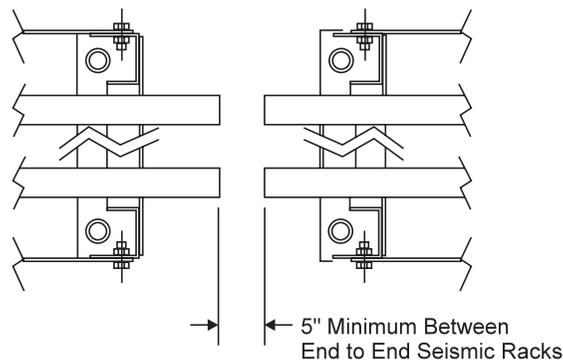


***Figure 6-3: Back to Back Rack Assembly***

### ***End to End Orientation***

Where a continuous rack string is required, two racks may be installed adjacent in length.

End to end rack assemblies are installed as two individual, stand-alone rack assemblies as shown in Figure 6-4. When installing standard racks, the minimum clearance between racks is 0". When installing Seismic racks the two racks must be spaced apart so that the minimum distance between the ends of the support rails is 5".



***Figure 6-4: End to End Rack Assembly***

## ***Rack Installation Guidelines, continued***

### ***Cleaning Racks***

Clean the rack(s) and the area surrounding the installation to remove abrasive materials and residual building materials before installing cells. This will not only reduce the chance of damaging cell containers but will ease installation and simplify final cleaning of the assembled battery.

## Cell Installation Guidelines

### Introduction

These instructions apply to lead-acid batteries configured as single cells or multi-cell units. The term “cells” can apply to both configurations.

### Safety

#### Caution

Before handling a battery, discharge static electricity by touching a grounded surface in the vicinity of the batteries, but far enough from the cells and flame arrestors to avoid creating sparks or exposing cells to open flames that could ignite the gases produced by a charging battery.

#### Warning

- Storage batteries present both electrical and chemical hazards to those who install or service them. It is essential to exercise extreme care at all times to assure a safe working environment.
- Gases produced by wet-cell lead-acid batteries are explosive. Do not smoke, use an open flame, or create an arc or sparks in the vicinity of a battery.
- Always use protective insulating equipment, such as gloves, shoes, and eye protectors. Wrenches and other tools must be insulated.
- Observe local, state, and national electrical 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., do not interconnect rows or tiers of cells until the final step in connection.
- Lead-acid cells contain diluted sulfuric acid. Avoid contact with eyes, skin, and clothing. Should contact occur, remove contaminated clothing immediately and flush affected body areas immediately and thoroughly with water. Wash clothing thoroughly before reuse. Do not attempt to clean and reuse contaminated shoes. If acid should contact the eye, flush immediately with large amounts of water for at least 15 minutes. **Always consult a physician in cases of acid contact with the eyes.**
- 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 from the cells and flame arrestors. Avoid creating sparks or exposing cells to open flames that could ignite the gases produced by a charging battery.

## ***Cell Installation Guidelines, continued***

### ***Unpacking and Handling***

Large single cells and multi-cell monoblocs are packed in individual cartons strapped to a wooden pallet. Remove the straps and carefully lift off cartons for access to lifting slots in the bottom support piece.

Always lift cells from the bottom, never by the posts. A lifting sling and spreader board are packed in the accessories carton. Slip the lifting sling under the cell, then install the spreader block on top of the cell. Ensure that the sling fits in notches in the spreader board. Use the loops in the sling to hoist the cell.

At the first opportunity, check the electrolyte level in each cell. It should be between the “high” and “low” level lines on the container. If the level is more than 1/2-inch below the top of the plates, order a new cell and file a claim for concealed damage against the carrier. If the cell plates are covered but the level is lower than one-half-inch below the “high” level mark, make no additions (i.e., water or acid) until the cells have been on float charge for one week, and contact Lucent Technologies Technical Support.

If electrolyte is found on the top of the cell or terminal posts, clean immediately with a solution consisting of one pound baking soda to one gallon of water. Do not allow cleaning solution to enter cell.

## ***Cell Installation Guidelines, continued***

### ***Arrangement***

The cell arrangement, rack(s), and connections are typically installed using generic information provided by Lucent Technologies. However, a customized and detailed installation drawing may be obtained from Lucent Technologies at an additional charge when placing an original order.

Plan the battery arrangement starting with the positive terminal of the battery to the negative terminal. Planning should be completed before receipt of the battery. First, sketch a footprint of the rack location. Allow sufficient aisle width to permit loading cells directly to their ultimate location on the rack and clearance for maintenance. Determine the battery terminations and locations on the rack layout.

### **Warning**

<p>The positive (red terminal cover) and negative (black terminal cover) terminal connections of a battery should never be terminated in a multi-cell unit. The positive and negative terminal connections of a battery must be from different cell containers to provide maximum isolation between the highest potential differences of the battery. The National Electric Code (NEC) prohibits more than 250 volts on a single rack.</p>
--

When possible, always install cells in the center of the row and work out toward the ends. On properly anchored step type racks, it is permissible to load the middle of the top step first to avoid reaching across cells that could be installed on the bottom step. On multi-tier type racks, always begin installing cells on the bottom tier, completing that row before starting the next higher tier.

Cells can be installed with the plates perpendicular or parallel to the longitudinal axis of the rack.

Cells should be loaded by placing them directly in front of the designated location on the rack. It is recommended that a platform lift be used for this procedure; however, the hoist used to lift the cell from its container may be used to position the cell. Carefully adjust the cell into its final position.

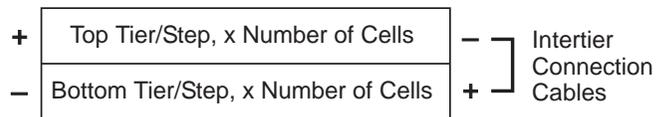
Space cells approximately 1/2 inch apart.

## Cell Installation Guidelines, continued

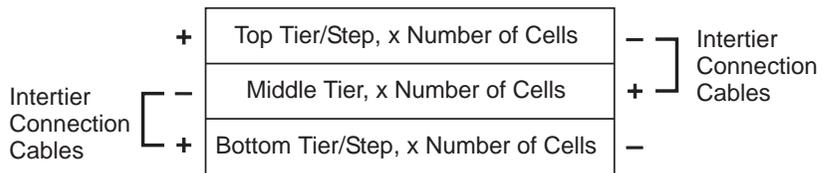
### Arrangement, continued

Arrange cells so the positive post (terminal) of one cell can be connected to the negative post (terminal) of the next cell. Cell post polarity is marked with symbols molded in the cover. A plus sign (+) and red terminal cover denote the positive post and a minus sign (-) and black terminal cover denote the negative post. There is no need to apply a lubricant to the plastic rack rail covers for adjustments or positioning cells.

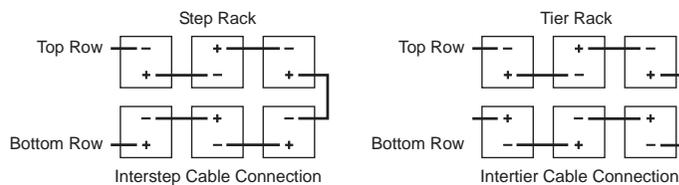
If there are an even number of tiers or steps, the battery will terminate on a common end.



If there are an odd number of tiers (or steps) it will terminate at opposite ends.



Cells at the end of each row in stepped or tiered racks must be arranged for the shortest cable run between steps and tiers. See illustrations below. Failure to follow the layout drawing will result in some cables being too short.



## ***Cell Installation Guidelines, continued***

### ***Arrangement, continued***

If the aisle is too narrow to allow access to the rack from the front, it may be necessary to load the rack from the end. Lubrication is typically not required since the plastic rail covering provides a low friction surface for sliding the cells. If a lubricant is deemed necessary, unscented talcum powder may be used sparingly. The talcum powder may be removed with a cloth dampened in water. An equally acceptable method for lubrication is to use a small amount of water applied sparingly to the rail covers. Do not use any other solvents.

### **Warning**

Do not use wire pulling compounds, oils, grease, or any other material not specifically authorized by Lucent Technologies in writing, as these may contain additives that could damage the plastic containers.

For Seismic racks, place spacers (supplied with battery racks) between cells. Add front and end restraining rails and install front-to-back restraining rail tie rods for Seismic racks. End rails should be placed within 1/8 inch from end cells.

### **Caution**

Where multiple standard type racks are installed end-to-end, no more than one-eighth inch of cell length should rest over a support rail that is not rigidly spliced.

Never move or adjust a rack with batteries loaded on it.

After cells have been placed on the rack(s), remove the orange shipping vents and install the flame arrestors and dust cover vent assemblies, which are provided in the accessory kit.

## ***Cell Installation Guidelines, continued***

### ***Measuring Specific Gravity of a Cell Using a Hydrometer***

A hydrometer float inserted in a glass-barreled, rubber bulb syringe is used to measure the specific gravity of electrolyte. The float is graduated in points of specific gravity, wherein 0.001 equals one point of specific gravity. The specific gravity is read on the hydrometer scale at the level at which it floats in the electrolyte.

Note: Digital electronic hydrometers are available and may provide a more convenient method of measurement for your needs. They still require immersion into the electrolyte, and the same care should be taken to avoid spillage of electrolyte onto the cell and connections.

Specific gravity readings are taken through the vent funnel. When taking hydrometer readings, always hold the hydrometer syringe vertically and make sure the float is floating freely with no pressure applied to the bulb. The glass parts of the hydrometer syringe should be washed with soap and warm water as needed and rinsed with clear water to keep them clean and accurate.

The specific gravity of a fully charged Victory Class cell is 1.215 at 77°F (25°C). As the cell discharges, the hydrometer will measure a lower specific gravity. A hydrometer reading is, therefore, an indication of the state of charge or discharge of the cell. However, note that readings on recharge lag behind the ampere-hours returned on charge. The specific gravity does not immediately indicate the true state of recharge. Mixing the electrolyte is dependent upon the amount of gas generated and acid diffusion. Usually, specific gravity measured at the top of the cell is only accurate following an equalizing charge during which the cell has gassed enough to thoroughly mix the electrolyte. This is because concentrated acid formed at the plates during charge drops to the bottom of the cell container because it is heavier than the depleted electrolyte solution.

Specific gravity readings should be taken when the battery is first installed. Additional readings should not be necessary unless visual inspection reveals signs of crystallization.

## ***Installing Standard and Seismic Racks***

### ***Introduction***

These instructions detail the proper procedure for installing Standard and Seismic battery racks. The following procedure describe how to locate, assemble, and load open-frame battery racks for battery mounting applications. Proper attention to these instructions will help ensure safe, trouble free performance.

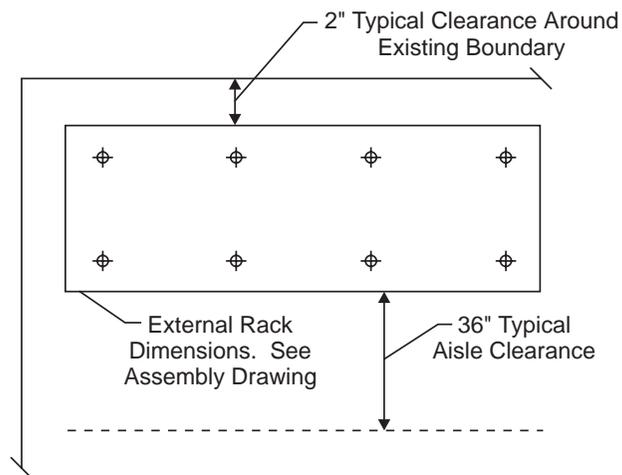
### ***Material Verification***

1. Battery racks are shipped unassembled with a complete set of related drawings and documentation. Check received parts and quantities against the rack's bill of materials on provided drawings and/or packing list. Do not assemble rack if parts are missing or quantities are incomplete.

### ***Location of Rack Assembly***

2. On the battery room floor, mark the rack layout, the rack footprint, rack frame locations, and anchor bolt locations. Drill holes for anchor bolts.

When determining rack location and floor bolt pattern, use applicable drawings provided with rack shipment. Locate the rack's general position, considering boundary and aisle clearances. Locate floor mounting locations using provided drawings. See Figure 6-5.



***Figure 6-5: Rack Assembly Location and Anchor Bolt Pattern***

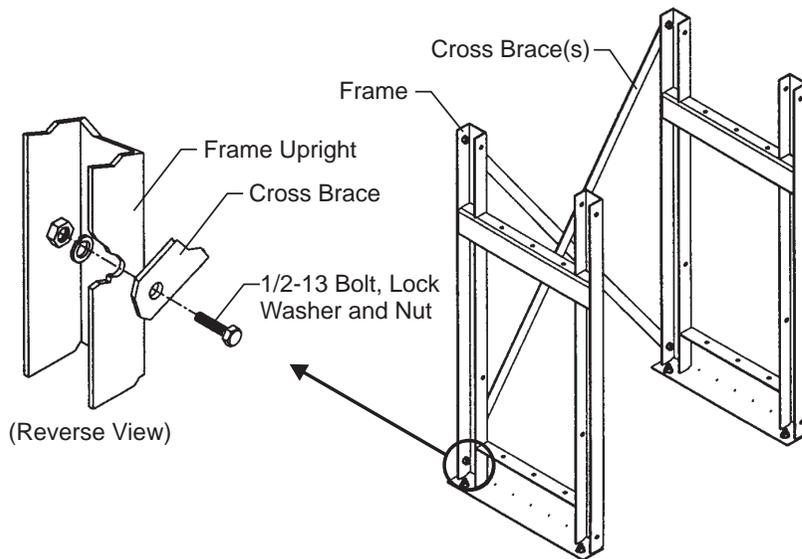
Note: The choice of floor mounting hardware should be determined in accordance with applicable building codes. Mounting hardware anchoring bolts are neither specified nor provided by Lucent Technologies.

## ***Installing Standard and Seismic Racks, continued***

### ***Initial Assembly***

3. Place frames over installed floor mounting hardware, finger tight (hardware not supplied). All frames must face the same direction.
4. Install back cross braces, finger tight. See Figure 6-6.

Note: If front cross braces are to be installed, do not install at this time.



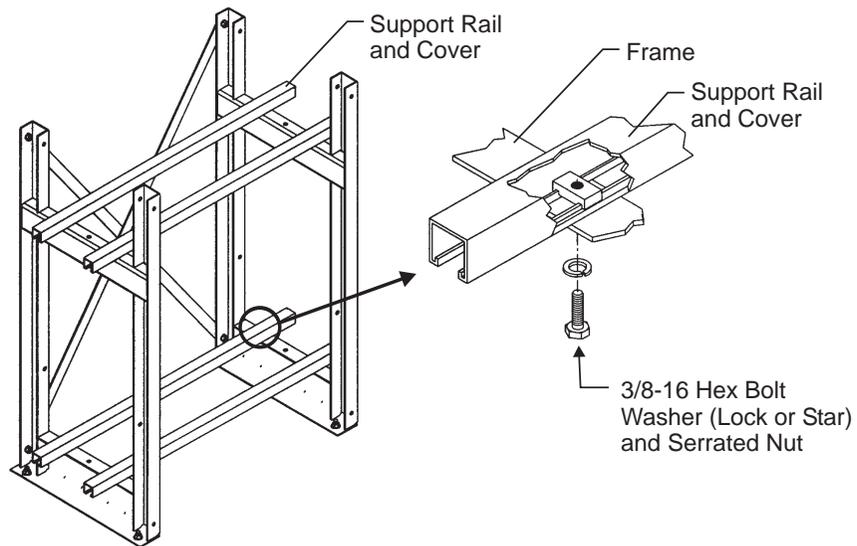
***Figure 6-6: Initial Assembly With Brace to Frame Connection (Reverse View)***

Note: Cross bracing pattern along the length of the rack may not necessarily be symmetric. Cross bracing pattern is detailed on assembly drawing provided with the racks.

## ***Installing Standard and Seismic Racks, continued***

### ***Installing Support Rail(s)***

5. Place support rail(s) in location using supplied 3/8" bolt, washer, and serrated strut nut; finger tighten. See Figure 6-7.
6. Align support rails with "A" dimension from rack assembly drawing.
7. Install rail covers.



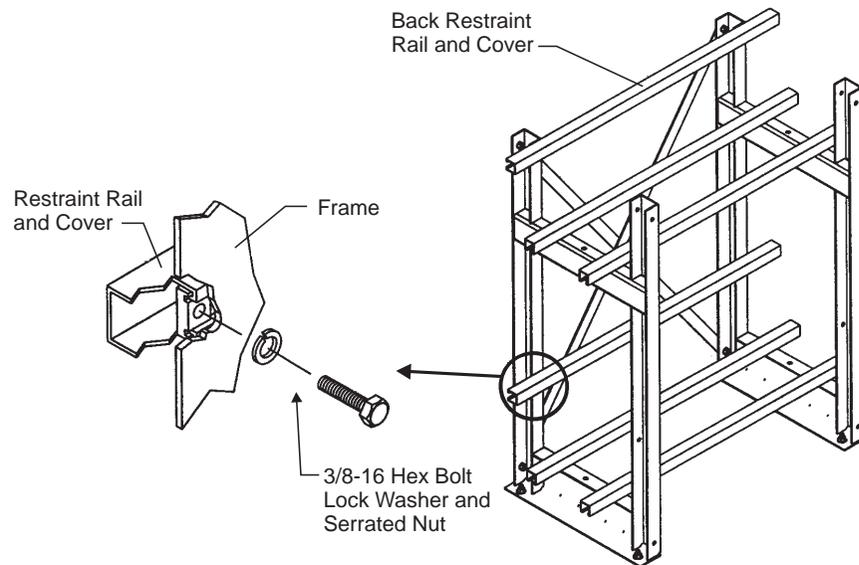
***Figure 6-7: Support Rail Installation With Detail of Frame and Support Rail Connection***

8. An internal/external "star" washer is used in place of lock washer on bottom tier or step, for grounding connection. The optional third rail should be installed at this time.
9. If installing a Standard rack, proceed to "Leveling and Securing Rack Assembly." If installing a Seismic rack, perform Steps 10 and 11."

## ***Installing Standard and Seismic Racks, continued***

### ***Seismic Rack Assembly***

10. Install all back restraint rail(s) and cover(s). See Figure 6-8.
11. Position front restraint rail and cover temporarily next to front support rail prior to installing cells.



***Figure 6-8: Initial Step for Seismic Rack  
With Detail of Frame and Restraint Rail(s) (Reverse View)***

### ***Leveling and Securing Rack Assembly***

12. Check that the rack is level and square.
13. Torque down all bolts. First torque the cross brace bolts to 55-65 ft.-lbs, then torque the rail to frame bolts to 15-20 ft.-lbs. Torque anchor bolts to manufacturer's recommended value.

## ***Installing Cells***

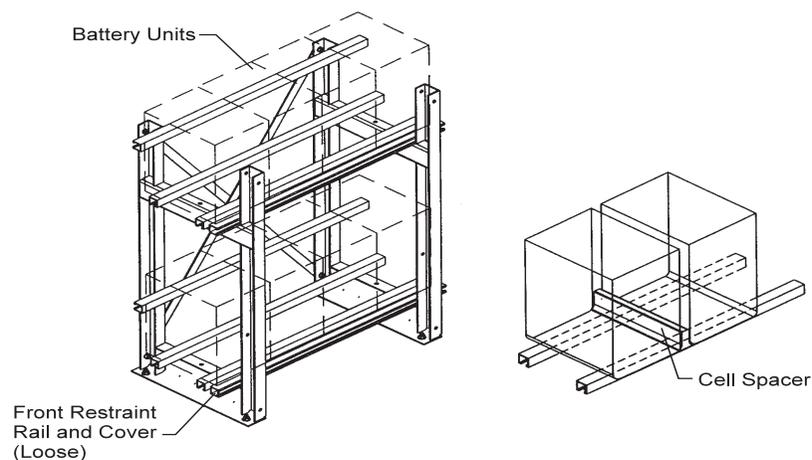
Cells may now be loaded onto the rack(s). **Always lift cells by the bottom only.**

1. If not instructed otherwise, install cells starting at the center of the bottom row and work out to each end, leaving a half-inch space between cells. See Figure 6-9.

For rows having an odd number of batteries, the center of the first battery installed will match the center of the row. For rows having an even number of batteries, a cell space will coincide with the center of the row. Pay attention to polarities and terminal placement. All cells should be pushed back against rail and cover. Up to 1/8-inch gap between restraint rail and cells is acceptable.

Note: Do not use oil or grease as lubricants. Instead, a small amount of water or unscented talcum may be applied to the rail cover to help reduce friction.

2. For Seismic racks, use spacers between cells as supplied.
3. Repeat this procedure for remaining steps and tiers, working upward.
4. Install inter-cell and inter-unit connectors and cable assemblies as specified by battery arrangement.
5. If installing cells in a Standard rack, skip to Step 7. If installing cells in a Seismic rack, perform Steps 6 and 7.

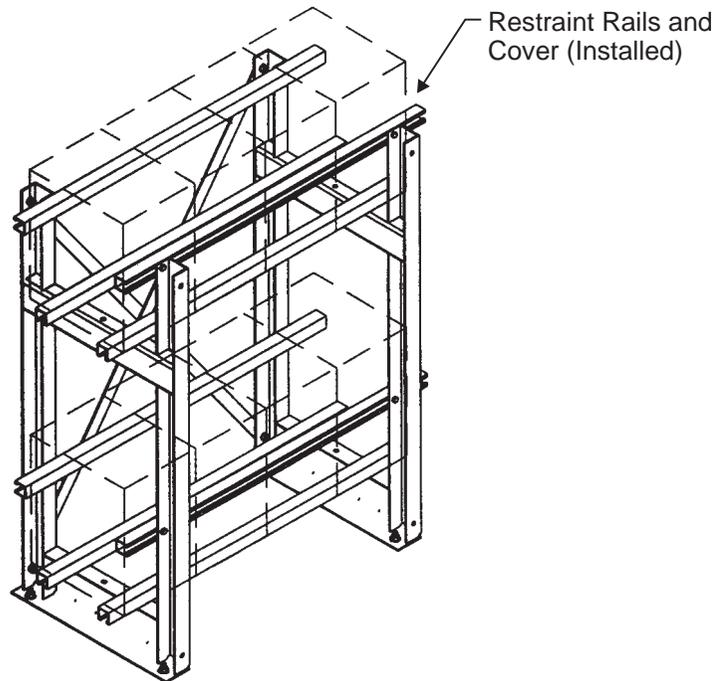


***Figure 6-9: Cell Installation With Cell Spacer Detail***

## ***Installing Front Restraint Rail (Seismic Only)***

### ***Front Restraint Rail (Seismic Only)***

6. With the batteries in place, slide the front side support rail and cover up from its resting location to its mounting location, aligning with rear side restraint rail. Install hardware and torque to 15-20 ft.-lbs. See Figure 6-10.

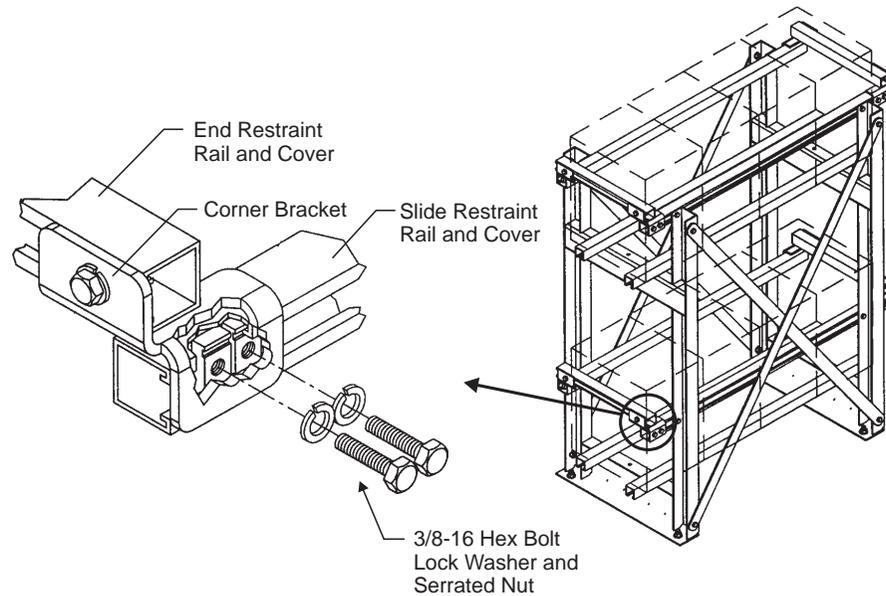


***Figure 6-10: Installed Front Restraint Rail***

## ***Final Assembly***

### ***Corner Brackets, End Restraint Rails, and Covers***

7. Install corner brackets, end restraint rails, and covers. Position end restraint rails against end battery unit. Note that the corner bracket may be reversed by 180°, if required. Install all front cross braces if indicated by rack assembly drawing. Torque to 55-65 ft.-lbs. See Figure 6-11 for final rack assembly.



***Figure 6-11: Assembled Seismic Rack With Front Cross Braces With Detail of End Restraint Rail(s) and Corner Bracket***

## ***Numbering Cells, Labels, and Warnings for Battery***

Lucent Technologies provides many labels and warnings to help you maintain your battery and to apprise you of certain hazards.

1. Attach maintenance and operating labels to cells so they may be read by anyone working on or in the vicinity of the battery.
2. For ease of identification, number all cells of a battery using the plastic peel-and-stick numbers that are furnished in the accessories package. Common practice is to start with Cell 1 located on a bottom tier (for multiple tiers) at what will be the “ground” potential of the battery. This will be the positive (+) terminal of the battery for negative (-) potential plants or the negative (-) terminal of the battery for the positive (+) potential plants. Then follow the electrical circuit with succeeding numbers to the highest potential cell of the battery string. Remove the plastic backing and firmly press the number into position on the appropriate cell. Be careful not to scratch the plastic jar.

Note: This is a good time to confirm proper cell orientation, insuring correct polarity and terminal location (i.e., positive to negative to positive, etc.).

## ***Temperature Reference Cell***

1. Select one cell in a battery as a temperature reference (pilot) cell for readings. Since all cells in the battery receive the same amount of charge or discharge current, their specific gravities will fall or rise proportionately to that of the pilot cell. It is advisable to change pilot cells after about 10 readings, because a slight amount of electrolyte is lost each time a hydrometer reading is taken. This rotation of pilot cells distributes the electrolyte loss over all the cells in the battery.
2. Take an initial reading of the pilot cell. Return the electrolyte in the hydrometer syringe to the cell from which it came.
3. Record pilot cell number and reading on Installation Form.

## ***Preparing Electrical Contacting Surfaces***

### ***Guidelines***

All electrical contacting surfaces must have a clean, electrolyte-free finish. Any tarnish or discoloration should be removed with the cotton cloth that is provided. **Do not remove lead plating.**

To maintain electrical contact integrity, Lucent Technologies supplies NO-OX-ID grease (in the accessories package) as a corrosion resistant coating for all bolted electrical contacting surfaces.

### ***Procedure***

For optimum connection integrity, Lucent Technologies recommends the following procedure:

1. Remove any factory-applied grease coating from the posts and post seals with a dry cloth as they may be contaminated with dirt or residual acid.
2. With a neutralizing solution consisting of one pound baking soda mixed with one gallon water, wipe the cover, post, and post seals with a cloth moistened with the neutralizing solution. Rinse with clear water and dry thoroughly.
3. Lightly rub the post and lead ring of the post seal with the cotton cloth to provide a clean finish. **Never use steel brushes or other abrasive tools or materials.** Cells designed for high discharge currents are constructed with copper posts with a thin lead plating on the contacting surfaces to optimize conductivity with the inter-cell connectors. This plating should be lightly buffed to avoid removal of the plating.
4. Carefully remove any oxidation or white powder from the inter-cell connectors with a piece of burlap cloth, and buff to a clean and uniform finish. Inter-cell connectors are lead plated copper and require that care be taken not to remove the plating.

*Continued on next page.*

## ***Preparing Electrical Contacting Surfaces, continued***

5. Heat the NO-OX-ID to a cream-like consistency using a thermostatically controlled hot-plate. Set the temperature between 160°F (71°C) to 185°F (85°C) to maintain the desired consistency.

### **Caution**

If the hot plate does not have a thermostatic control, exercise extreme care to avoid overheating the grease and causing a fire. Do not use open flames. NO-OX-ID has a minimum flash point of 450°F (232°C).
---

6. Apply a thin coat of NO-OX-ID to each end of the inter-cell connectors (where they will make contact with posts) by dipping connectors into the melted grease to a depth of approximately two inches. On four-hole and six-hole connectors, use a one-inch paint brush to apply NO-OX-ID to both sides of the middle holes and to cell posts. To achieve a continuous film of protective NO-OX-ID, finish the completely assembled battery with a hot air gun or blower. Wipe any excess NO-OX-ID from the cover(s).

## ***Flame Arrestors and Dust Covers***

All Lucent Technologies standby cells use flame arrestors. Cells are shipped with orange colored vent plugs which must be removed and discarded before installing the flame arrestors.

1. Remove orange colored vent plugs.
2. Install flame arrestors.
3. Install dust cover vent assemblies.

## Making the Connections

### Introduction

Cells are supplied with different post configurations suited to their current-handling requirements.

The 5/16-18 stainless steel bolt assemblies are used with copper posts. The copper posts have two holes in both axes of the post.

### Caution

Be sure flame arrestors are installed before making battery connections.

### Procedure

1. Place inter-cell connectors against cell posts and insert Lucent-supplied brass stud or stainless steel bolt through the bolt hole in the post and the hole in the connector. Install heavy-duty washers, bolts and nuts, and hand tighten.
2. Tighten connections to the torque values shown in Table 6-A, using an insulated torque wrench and an insulated open-end wrench in counter-torque.
3. Align cells so the inter-cell connectors match up with the holes of the terminal posts. The two inter-cell connectors must be placed on opposite sides of the posts. Make the connection using the bolt assemblies supplied (positive to negative).
4. Tighten the connections to the specified torque values using two wrenches, a torque, and box wrench in counter-torque to avoid damaging posts or stripping threads.

**Table 6-A: Torque Requirements for Specific Cell/Unit Types**

Bolt Assembly		Terminal Design	Initial Torque inch pounds*	Maintenance Torque inch pounds*	Current Cell/Unit Types	Discontinued Cell/Unit Types
Standard	Optional					
B	C	Square (8)	160	125	Victory Class	N/A
Note: 1 - Use the same torque values for connection to terminal plates or cable lugs. * Tolerances: +10 inch-lb, -0 inch-lb in all cases						

## ***Checking Connection Integrity***

### ***Introduction***

Initial cleaning, surface preparation, and torquing establishes the lowest possible resistance between posts, connectors, and lugs, all of which may have somewhat irregular surface finishes.

Maintain clean, tight connections. Periodically check torque values or connection resistance. Connection maintenance is the responsibility of the user.

### **Caution**

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

The preferred method of checking connection integrity is by using a digital low-resistance micro-ohm meter (DLRO) and recording the resistance values of each connection. Remake any connection that is more than 10 percent above the average value or 5 micro-ohms, whichever is greater, for new installations. Refer to IEEE-450 and 484 professional standards.

### ***Procedure***

1. After connecting and torquing all cells in the battery and prior to connecting to the charger or dc system, recheck the torque of all connections, in sequence.
2. Immediately check the total voltage of the battery, using a digital dc voltmeter. Total battery voltage should equal the open circuit voltage (2.06) of an individual cell multiplied by the number of cells in series connection. If the battery voltage is less than this value, either the voltmeter is incorrect or one or more of the cells is installed in reverse polarity.
3. If necessary, check and correct cell polarities. Making this correction will avoid the possibility of charging cells in reverse and destroying them.

## ***Connecting Battery to Charger***

### ***Guidelines***

#### **Caution**

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

### ***Procedure***

1. Use only direct current (dc) for charging. With the charging source de-energized, connect the positive terminal of the battery to the positive terminal of the charger or system bus, and the negative terminal of the battery to the negative terminal of the charger or system bus.
2. Check polarities with a voltmeter to be sure that connections are correct.
3. Energize the system by following the manufacturer's procedures.

#### **Caution**

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

4. Complete a "Record" of open circuit voltage, initial charge, float charge readings, and connection resistances DLRO, if taken. Retain the readings in your files for future reference. If you have equipment to measure cell impedance, conductance, or resistance, include the readings in your records. Send Lucent Technologies a copy of the readings, clearly identifying your location, application, test equipment identification, and name of the person who took the readings. For convenience, use the form in Section 11 of this manual. Make a photocopy of the form so the original will be available for subsequent use. The service life of your battery will depend on boost charges (if in storage), its operating temperature, frequency and depth of discharge, discharge rate, and float charge voltage and regulation.

## ***Charging Battery***

### **Caution**

#### **POTENTIALLY EXPLOSIVE GASES**

Flooded lead-acid cells release hydrogen gas during charge, which is potentially explosive. Flame arrestors reduce the likelihood of ignition within a cell; however, caution must still be exercised not to bring an open flame or sparks near the battery. Hydrogen can be evolved at the rate of (0.000269 cubic feet per minute) per charging ampere per cell at 77°F (25°C). The maximum amount of hydrogen released into the battery room should not exceed 2 percent by volume. Do not install batteries in unventilated areas or enclosures.

### ***Initial Charge***

All batteries shipped wet and fully charged lose some charge in transit or while standing idle before installation. At the first opportunity, they should be given a boost charge, using either the constant voltage method or the constant current method.

Lead-calcium batteries must receive a boost or initial charge within six months of shipping date from the factory when stored at 77°F (25°C). Batteries not placed in service following boost charge should be recharged every six months up to a maximum of one year from date of shipment from the factory. Limits are determined and charge terminated when the lowest voltage cell in the battery is no less than 0.05V from the average cell voltage. Higher than normal storage temperature 77°F (25°C) 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 factor will shorten the allowable time before initial and subsequent charging.

### ***Float Charge***

Standby batteries are continuously connected to control circuits that 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 an absolute minimum.

## Charging Battery, continued

### Procedure

1. Provide an initial/boost charge to the battery at the recommended voltage shown in Table 6-B.

**Table 6-B: Initial Charge Voltage and Duration of Charge**

Nominal Specific Gravity +0.010 / -0.005	Volts Per Cell Vpc* Maximum	Time in Hours** at Maximum Cell Voltage
1.215	2.38	100
* Applies to average cell voltage. Battery voltage should be set at average cell voltage multiplied by the number of cells in battery.		
** Charging time will vary due to the time on open circuit, storage temperature, and available charging voltage. If the battery is placed in service within 2 weeks of receipt from place of shipment, charging time may be reduced to 24 hours or less. After 8 hours on charge, cell voltage measurements should be taken. When 3 successive hourly measurements are the same, adequate charge has been provided and the charge may be terminated.		

2. After charging for the above periods of time, read the voltages and specific gravities. The charge can be reduced to float voltage when the lowest cell voltage is less than 0.05 volts below the average of the string. The specific gravities should be within +0.010/-0.005 of the average of the string.
3. For optimum service, adjust the power supply to the float voltages shown in Table 6-C. If the power supply is intermittent or more frequent discharges are anticipated, use a higher recommended voltage setting.

**Table 6-C: Float Voltage Per Cell Vpc**

Lead Calcium Cells			
Nominal Specific Gravity + 0.010 / -0.005	Recommended Float Voltage Vpc Min / Max	Allowable Float Voltage Vpc Min / Max	Allowable Individual Cell Voltage Vpc Min / Max
1.215*	2.19 - 2.20	2.17 - 2.22	2.12 - 2.27
1.215	2.21 - 2.22	2.20 - 2.23	2.12 - 2.29
Note: Recommended Float Voltage based on Total Battery Voltage.			
*Applicable to Telecom Applications, only.			

## ***Cleaning Cells***

### **Caution**

To clean thermoplastic cell containers, clean or wash the containers with clear water only. Do not use other solvents or glass cleaners.

### ***Acid Spills***

Neutralize acid spills with a solution of baking soda consisting of one pound of sodium bicarbonate mixed with one gallon of clear water. Never use ammonia, soda ash, sodium hydroxide, or any strong alkalis. If alkalis are inadvertently spilled on the containers, they should be immediately washed off with clear water. Large spills can be absorbed and neutralized using Neutramat™ pillows or First Response Kit neutralizer, which are available from Lucent Technologies.

## ***Watering Cells and Adjusting Electrolyte Levels***

### **Caution**

Do not add water or electrolyte to cells, particularly before initial charging. Adjust electrolyte levels only when cells are fully charged and stabilized at float voltage.

### ***Battery Condition***

Before adding water or acid to a battery, consider its condition and state of charge. For example, a new battery which has recently experienced vibration during shipment will appear to have a low electrolyte level. Do not add water or acid to cells unless the plates are uncovered. If the plates are covered by electrolyte, the battery should be placed on charge. The gases produced by charging will displace the electrolyte and will raise it to an acceptable level between the high and low level marks on the container. Had the level been adjusted to the "High" mark before charging, charging could have caused the electrolyte to rise to a point where it could overflow through the vent or be forced up into the flame arrestor, requiring needless maintenance.

Note: Adding water to a battery to bring the initial electrolyte level up will reduce the specific gravity. Add water through the vent funnel.

If, after charging, the electrolyte levels have not risen to between the high and low level lines, sulfuric acid of the same specific gravity may be added to bring levels to the high mark. Adding acid is a procedure that should be done only after consultation with Lucent Technologies or should be performed by a Lucent Technologies agent.



# 7

## *Operation*

### *Float Service*

In ideal float service a battery is always maintained in a fully charged condition. However, in the event of a power failure or system test in which the power supply is shut down, the battery must support the load, resulting in a battery discharge. Typically, a standby battery will not be subjected to more than one test discharge each year and a transfer test monthly.

Additional deep and/or frequent discharges can shorten service life, even with proper maintenance and operation. This section will consider batteries that are used in full float service. They will not be exposed to service in which the charger is not capable of supporting peak loads. In such cases the battery would be exposed to numerous partial discharges. In float service the charger voltage is regulated and filtered and the battery is operated in a controlled environment.

For optimal service, adjust the power supply to the recommended float voltages shown in Table 6-C. If you anticipate more frequent discharges, use a higher float voltage setting.

Based upon these operating criteria maximum service life should be expected with minimal maintenance.

An equalizing charge may be required at a voltage higher than the nominal float voltage to restore proper voltage to a battery that has:

- been subjected to frequent discharges
- been charged at less than minimum float voltage due to an incorrect adjustment of the power supply or miscalibration of the panel voltmeter

An equalizing charge should be given when the lowest cell voltage reaches the minimum allowable cell voltage shown in Table 7-A.

***Equalize Charge***

**Table 7-A: Equalize Charge Voltages**

<b>Nominal Specific Gravity +0.010 / -0.005</b>	<b>Equalize When Lowest Cell in String Reaches This Vpc</b>	<b>Equalize Voltage Per Cell</b>
1.215	2.12	2.33 - 2.38

Note: Minimum allowable cell voltage is the point at which arrangements should be made to provide an equalizing charge. It does not imply the battery is malfunctioning or will not provide power if called upon. Some equipment may not have the required equalizing potentials available, thereby lengthening the charging period. As an alternative, a single-cell charger with ac line isolation may be paralleled across the affected cell while still part of the overall battery and yet provide an over-voltage to the subject cell. Do not be alarmed if equalize charging must continue for several weeks, particularly considering that the currents actually passing through the cells are very small. Cell voltages within 0.050 volts of the average are acceptable. If the low voltage cell does not respond to equalizing charging, or for answers to specific questions, consult Lucent Technologies Technical Support.

***Environmental Requirements***

Recommended temperature range for standby battery operation is 60°F (15°C) minimum to 90°F (32°C) maximum; 77°F (25°C) yearly average. Operating temperature limits to prevent mechanical and/or performance degradation (or failure) is 32°F (0°C) minimum to 120°F (49°C) maximum, at standard atmospheric pressure.

***Electrolyte Level***

When water is lost from the electrolyte the result will be a more concentrated solution and thereby a higher specific gravity reading. The reverse condition applies when water has been added to adjust electrolyte level. The apparent level can be significantly effected by charging voltage. If the voltage is higher than specified in the float tables or if the battery is being charged at equalize voltage gases will be generated displacing the electrolyte causing the level to rise. Reliable specific gravity measurements can only be obtained when the fully charged battery has stabilized at float voltage for at least 3 days providing sufficient time for gases to dissipate.

**Caution**

Never allow electrolyte level to drop below the flame arrestor vent tube. Should this occur hydrogen generated within the cell will not be dispersed by the flame arrestor and ignition of the hydrogen is possible.

## ***Effect of Temperature***

Electrolyte above 77°F (25°C) will result in a lower observed specific gravity reading approximately equal to a loss of 1 point (0.001) for each 3°F (1.67°C). In contrast, electrolyte below 77°F (25°C) will read approximately 1 point (0.001) higher for each 3°F (1.67°C). Higher temperatures expand the volume of electrolyte, which reduces the observed specific gravity, while lower temperatures condense the electrolyte, which increases the observed specific gravity.

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

- increases deliverable capacity
- increases discharge rate capability
- increases self discharge or local action losses
- lowers cell voltage for a given charge current
- raises charging current for a given charge voltage
- shortens life
- increases water usage
- increases maintenance requirements

Lower than normal temperatures have the opposite effects. In general, at recommended float voltage, a battery in a cool location will last longer and requires less maintenance than one in a warm location. If the operating temperature is something other than 77°F (25°C), it is desirable to modify the float voltage as follows:

For temperatures below 77°F (25°C), add 2.8 mV (0.0028 volt) per °F (5.0 mV/°C).

For temperatures above 77°F (25°C), subtract 2.8 mV (0.0028 volts) per °F (5.0 mV/°C).

Example:

Victory Class Battery nominal float @ 77°F is 2.20 Vpc

Corrected float @ 67°F is 2.228 Vpc

Corrected float @ 87°F is 2.172 Vpc

At higher than normal operating temperatures, for every additional 15°F (8°C) battery life is decreased by 50 percent. Therefore, continued operation at an average cell temperature of 92°F (33°C) will reduce battery life to 50 percent of that typical at 77°F (25°C).

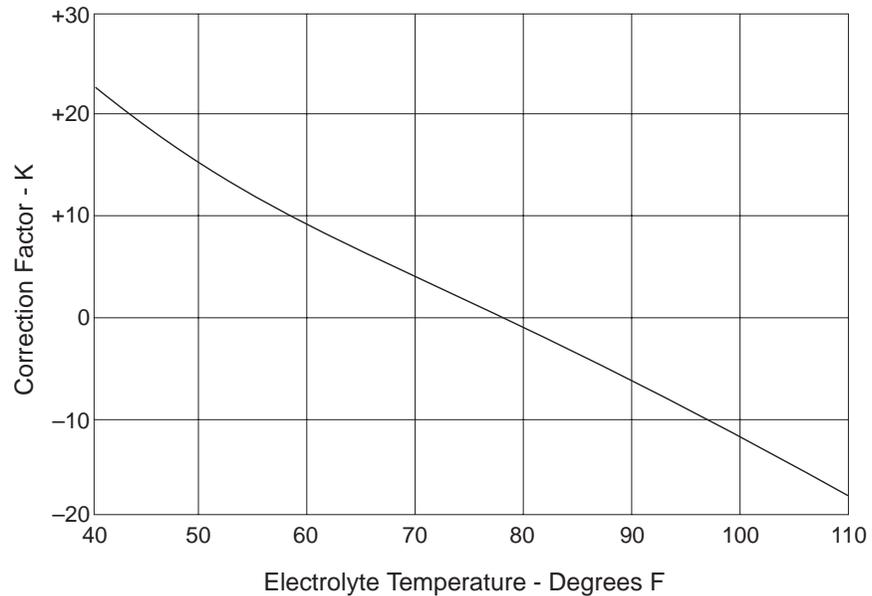
## *Effect of Temperature, continued*

At lower than normal operating temperatures, battery power capacity will be reduced, but battery life will be extended.

Determine the percent of rated capacity for the battery at 77°F (25°C) using the following formula:

$$\% \text{ Rated Capacity} = ([\text{discharge time (minutes)} / \text{rated discharge time (minutes)}] / 100) \pm K$$

Variation of K with temperature is shown in Figure 7-1.



**Figure 7-1: Battery Capacity vs. Operating Temperature**

## ***Recharge and Electrolyte Stratification***

When the battery is discharged the specific gravity of its electrolyte is reduced. This is a result of the utilization of sulfate ions in the chemical reaction with the active materials in the positive and negative plates. The sponge lead in the negative plate and the lead dioxide in the positive plate convert to lead sulfate, combining the sulfate ions of the electrolyte with the lead compounds in the plates.

On recharge, lead sulfate in the plates is converted back to the original compounds and the sulfate ions are released from the plates. The sulfate ions combine to produce sulfuric acid with a density greater than that of the electrolyte. As a result, the newly generated, concentrated (heavy acid) falls to the bottom of the cell container. Specific gravity measurements taken at the top of the cell will be lower than those taken at the bottom. This physical condition is called electrolyte stratification.

Stratification does not materially inhibit the ability of a lead-acid battery to deliver power. However, battery performance will be less than optimum and specific gravity measurements must take into consideration the non-homogeneity of the electrolyte. Specific gravity measurements will not be accurate or reflect the true value.

There are two ways to eliminate stratification. The first is to provide sufficient time for chemical “diffusion.” This can take several weeks at float potential, depending upon the degree of stratification. A more efficient method is to provide an equalize charge voltage that will mix the electrolyte. Gases produced by an equalizing charge “stir up” the electrolyte, causing uniformity throughout the cell. After a relatively short time, the electrolyte will become mixed and homogenous. The degree of gassing and the setting for the equalize potential are directly associated with the time required for mixing.

## ***Performance Characteristics***

Battery performance is rated at 77°F (25°C). Operation at a higher temperature increases capacity, but reduces life approximately 50 percent for every 15°F (9°C) rise. Operation at lower temperatures reduces available capacity but extends life.

Battery performance at a given 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.

Typically, during the last half of the battery service life capacity 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 a battery be sized with additional margin for operation at minimum expected temperature and for loss of capacity as the battery ages.

## ***Gassing Rate***

All lead-acid batteries generate hydrogen and oxygen gas at the negative and positive plates respectively. The generation of these gases occurs during all conditions of use, including charge, discharge and while on open circuit during storage. The rate of gas generation on discharge and open circuit is generally very small but cannot be completely ignored. For this reason, never place lead-acid batteries in an airtight enclosure. Explosive mixtures of hydrogen in air are present when the hydrogen concentration exceeds four (4) percent by volume. The concentration of oxygen does not significantly change the lower explosive limit of hydrogen in air, and therefore, only hydrogen will be considered here.

If the concentration of hydrogen in air exceeds four (4) percent by volume, there is a risk of explosion if the gas is ignited. Therefore, to provide a margin of safety, lead-acid battery areas must be ventilated to limit the accumulation of hydrogen gas under all anticipated use conditions to a recommended maximum of two (2) percent of the total free volume in the battery area.

In flooded lead-acid batteries, the gassing rate approaches the theoretical value calculated from the dissociation of water. From electrochemical theory, if all the charging current is used to generate gas, **each cell will generate 0.016 cubic feet of hydrogen per hour, per ampere of charging current at 77°F (25°C) and one atmosphere pressure.**

For example, a 48V string of lead-acid batteries requiring 0.1 Amp of float current at 77°F can produce as much as 0.04 cubic feet of hydrogen per hour ( $0.016\text{ft}^3/\text{hr} \times 0.1 \text{ Amp} \times 24 \text{ cells}$ ).

The quantity of fresh air required to maintain an explosion safe environment in the battery area will vary greatly depending on many factors including, but not limited to, the age and condition of the battery, the number of cells in the battery area, the battery temperature and the current flowing through the batteries. Therefore, the design of a ventilation system for batteries in a specific application requires careful consideration of factors other than the gassing rate of new batteries in typical float operation. Typical gassing rates may be useful as a “best case” condition, but cannot adequately address “worst case” or any other operating condition that may occur during the service life of the battery.



## 8 *Maintenance*

### *Overview*

Proper maintenance will prolong the life of a battery and will aid in ensuring it is capable of satisfying its design requirements. A good battery maintenance program will serve as a valuable aid in determining the need for battery replacement.

Note: These recommended procedures use cell voltage measurement as an indicator of acceptable operation.

The frequency of battery inspections should be based on the criticalness of the loads that must be supplied by the battery under emergency conditions, and the availability of other power sources. As a minimum, yearly maintenance should be performed.

Read Section 4, *Safety*, before performing the maintenance procedures.

## ***Recommended Procedures and Intervals***

### ***Reference Tables***

**Table 8-A: Semi-Annual Maintenance Procedures**

<b>Procedure</b>
Check and record individual cells for crystals.
Check and record reference cell temperature.
Check electrolyte levels.
Check string voltage

**Table 8-B: Annual Maintenance Procedures**

<b>Procedure</b>
Check individual cell float voltages.
Inspect battery jars and stands.
Inspect the porous stone part of the flame arrestors for contamination.
Clean or replace flame arrestors, if required.
Check battery connections.

**Table 8-C: At 5-year Intervals Maintenance Procedures**

<b>Procedure</b>
Perform discharge capacity test, if required.

### ***Safety***

Read Section 4, *Safety*, before performing the maintenance procedures.

***Check and  
Record  
Individual Cells  
for Crystals***

Perform this procedure *semi-annually*.

***Guidelines***

Throughout the life of a battery plant, the absence of lead-sulfate crystals indicates that the cells are floating properly and maintaining a full state of charge. Corrective action for crystalline cells is not usually an urgent item since the presence of lead-sulfate crystals usually does not mean that the battery or cell is incapable of providing adequate capacity.

A crystalline cell will suffer an immediate loss of approximately 5 percent of its rated capacity. Any further decay in capacity will depend upon the precise cause for the crystalline condition.

An easy way to assess the ability of a crystalline cell to deliver capacity is to make a specific gravity reading. If the specific gravity is within  $\pm 0.01$  of the nameplate value, the reduction in cell capacity will be approximately 5 percent. Concern for the ability of a crystalline cell to deliver reasonable capacity should begin when the specific gravity decreases by 0.03 of the nameplate value.

If allowed to remain in a partially recharged condition for an extended period of time, sulfated batteries may suffer irreversible damage, possibly requiring replacement. For additional information on recovery of sulfated batteries, contact your Lucent Technologies agent or Technical Support.

**Caution**

**RECHARGE BATTERIES AS SOON AS POSSIBLE AFTER A  
DISCHARGE**

Failure to recharge batteries promptly after a discharge may lead to sulfation or, in the case of deep discharge, to a complete battery failure due to hydration. If charging at equalize voltage is not practical, recharge battery at float voltage.

## ***Check and Record Individual Cells for Crystals, continued***

### ***If Crystals Appear on All Cells in a String***

If lead-sulfate crystals appear on all cells in a string, check the following as possible causes for the abnormal condition:

- **Rectifier voltage:** The appearance of lead-sulfate crystals may indicate a low battery plant float voltage. Check the battery plant float voltage and make appropriate rectifier adjustments.
- **Plant discharge:** A battery discharge resulting from a power failure or other reasons may produce lead-sulfate crystals on the cells. This is normal with all lead-acid cells since lead sulfate is the material produced when a lead-acid cell is discharged. If the cause of the lead-sulfate crystals is a recent discharge, the crystals will disappear when the cells have been fully recharged on float (usually within two weeks). Check plant records to determine if a discharge has occurred. Another method of determining if a plant discharge has occurred is to measure cell specific gravities. Readings of .03 less than the nameplate values on most cells would be a clear indication that a plant discharge has occurred.
- If the presence of lead-sulfate crystals on all cells in a string is not attributable to a plant discharge or improper rectifier voltage, report the condition to Lucent Technologies.

## ***Check and Record Individual Cells for Crystals, continued***

### ***If Crystals Appear on One or a Few Cells***

If lead-sulfate crystals appear on one or a few cells in a string, the following actions should be taken:

<b>Crystals on One or a Few Cells</b>	
<b>Step</b>	<b>Action</b>
1	Check to see if a plant discharge has occurred.
2	Measure the cell voltage. If a crystalline cell reads 2.09 volts or less and the crystal deposit is heavy, the cell is shorted and should be reported to Lucent Technologies.
3	Measure temperatures of cells in each tier of the string to determine the extremes of temperature differences. Temperature differences of 5°F (2.8°C) or more between cells in a string can result in the appearance of lead-sulfate crystals in the warmer cells. Provide appropriate ventilation if temperature differences exceed 5°F (2.8°C).

**Check and  
Record  
Reference Cell  
Temperature**

Perform this procedure *semi-annually*.

**Guidelines**

The Victory Class Batteries, like all lead-acid cells, are affected by the temperature of its electrolyte. Observe the following precautions when working with the Victory Class Batteries:

**Note**

To avoid possible electrolyte contamination, NEVER use mercury thermometers to take cell temperature readings. Use toluene thermometers (KS-5499 List 1352, List 1353).

- The Victory Class Batteries can tolerate extreme temperatures for short and infrequent periods, but every attempt should be made to maintain the electrolyte temperature from exceeding 110°F (43.3°C). Electrolyte temperatures from 77°F (25°C) down to freezing result in lowered battery capacity. Elevated temperatures result in decreased battery life.
- Temperatures of cells within the same string should be within 5°F (2.8°C) of each other. The top row of 3-tier stands is particularly apt to have higher temperatures than the bottom row. Where necessary, use fans or other means of ventilation to minimize temperature variations between cells in the same string.

**Temperature  
Reference Cell**

During the installation period, one cell in each tier was selected as the temperature reference cell for that tier. This cell is used for taking the temperature measurement.

**Procedure**

<b>Measuring Reference Cell Temperature</b>	
<b>Step</b>	<b>Action</b>
1	Insert the thermometer into the reference cell through the vent funnel.
2	Submerge the bulb of the thermometer completely in the electrolyte for at least 2 minutes before taking a reading.
3	Record the reference cell temperature.

## ***Check Electrolyte Levels***

Perform this procedure *semi-annually*.

### ***Guidelines***

Apart from losses due to evaporation and oxygen diffusion, the quantity of water consumed by a battery is proportional to the amount of overcharge it receives.

Maintain the electrolyte level between the black high- and low-level lines on the battery jar. Electrolyte level checking requirements depend upon local conditions. It is expected for the Victory Class Batteries that water may need to be added only once every 5 years.

- Use only distilled water, deionized water, or other water approved for storage battery use, to bring electrolyte up to the required level. When the actual electrolyte temperature is below 50°F (10°C), do not raise the electrolyte level appreciably above the minimum level. This helps to prevent an overflow on charge.
- Acid or electrolyte should not be added to any cell as a substitute for adequate charging. Do not contaminate the electrolyte of Victory Class Batteries by using the electrolyte from lead-antimony cells.
- Use the vent funnel on the cell to fill the cell to the proper level.
- Neutralize electrolyte with soda or lime before disposal to prevent damage. Dispose of electrolyte according to local, state, and federal regulations.

***Check  
Individual Cell  
Float Voltage***

Perform this procedure *annually*.

***Guidelines***

It is extremely important to maintain the battery at the proper float voltage.

***Determining Float  
Voltage***

Determine the float voltage as follows:

Battery float voltage = 2.17-2.20 x number of cells for low specific gravity (1.215)

For example, a 60-cell string of 2.17 V/cell should be floated at:

Battery float voltage = 2.17 x 60 = 130.2 volts

Individual cell voltages should typically be within  $\pm 0.05V$  of the average.

***Taking Voltage  
Readings***

- To make battery readings, use a DMM (Digital Multimeter) with the accuracy of 0.02 percent on the dc scale.
- Check meter accuracy and calibration periodically.

**Caution**

- Use extreme caution when making voltage readings to prevent accidental grounding or shorting of leads during test operations. Connections at the meter should be secure and free of any possibility of touching or becoming grounded.
- Never remove connections at the meter end without first disconnecting the test leads from the battery. Remove test lead connections at the battery immediately after each reading is taken.

## ***Cleaning Cell Jars and Covers***

Perform this procedure *annually*.

Never use solvents, detergents, glass cleaners, special battery cleaning materials, oils, waxes or polishes on the plastic containers or covers, since these materials may attack the plastic and cause it to craze or crack. Cracks and crazing of the plastic components may not be observed for months, but eventually the condition will occur and in many cases result in large cracks in the containers or covers causing failure and leakage of electrolyte. Covers and containers should be clean and dry at all times.

<b>Cleaning Cell Jars and Covers</b>	
<b>Step</b>	<b>Action</b>
1	Wipe the outside of the cells as necessary with a cloth moistened with water to remove dust and ordinary dirt. If electrolyte is spilled on the covers, neutralize it with a cloth moistened with a solution of baking soda and water mixed in the proportion of one pound of baking soda to one gallon of water. When fizzing stops as fresh baking soda solution is applied, wipe with a water-moistened cloth to remove all traces of soda.
2	Properly dispose of cleaning cloths.  Note: Electrolyte is considered to be Hazardous Waste. After cleaning corroded areas, dispose of cleaning cloths according to local, state, and federal regulations.

***Cleaning  
Battery Stands,  
Cabinets, and  
Miscellaneous  
Equipment***

Perform this procedure *annually*.

<b>Cleaning Battery Stands, Cabinets, and Miscellaneous Equipment</b>	
<b>Step</b>	<b>Action</b>
1	Wipe battery stands, cabinets, etc., at regular intervals with a cloth dampened in clean water.
2	Clean corrosion on metal battery stands with a metal brush.  <b>Warning</b> <b>Never bring the wire brush close to cell terminals and intercell connectors.</b>
3	Wipe corroded areas with a cloth dampened with a weak soda solution, then wipe with a cloth dampened in clean water.  Note: Electrolyte is considered to be Hazardous Waste. After cleaning corroded areas, dispose of cleaning cloths according to local, state, and federal regulations.

***Flame  
Arrestors,  
Contamination***

Perform this procedure *annually*.

If electrolyte levels are permitted to exceed the high level mark at full charge, it is possible for electrolyte to be pumped up into the vent and contaminate the porous stone. In such cases it will be necessary to remove the flame arrestor, replacing it with another flame arrestor, for cleaning. Adjust the electrolyte level, while the battery is on float charge, to between the high and low level lines.

Clean the contaminated flame arrestor stone in a mild solution of baking soda and water. Provide a final rinse in water and allow the stone to dry. All white deposits should be removed from the stone if the procedure was performed successfully.

## ***Check Battery Connections***

Perform this procedure *annually*.

### ***Safety***

- Do not loosen or remove a battery connection while cells are gassing, charging, or discharging. Disconnect string from the load and charger.
- Connect to the battery terminals first before connecting to the load or charging system.
- Only perform this operation after the battery has been on float at 2.20Vpc or less for at least 48 hours.
- Battery connections should be tight and corrosion-free.
- Be sure that all intercell connections are tight except for the connection that is being opened for cleaning or other purposes.

### **DANGER**

Avoid creating sparks, including those from static electricity, or the use of an open flame near batteries since the gas is explosive when sufficiently concentrated. Before performing each individual work operation, firmly touch a grounded rack to discharge the static electricity from your body.
--

Connection integrity is critical to the safe and efficient operation of any battery. This is the sole responsibility of the installer/user. Connections must be inspected at least once a year for the following:

- **Cleanliness:** Remove all corrosion by-products and restore as described in “Preparing Electrical Contacting Surfaces” in Section 6.
- **Hardware:** Replace worn or damaged hardware.

The importance of connection integrity cannot be overemphasized. Take time to check all connections periodically. Batteries with voltages of 250 volts or greater and/or batteries used in high rate applications should have their connections inspected at least twice each year.

## ***Check Battery Connections, continued***

### ***Connection Voltage Drop***

The importance of the integrity of its inter-cell, inter-aisle, and inter-row connections has been stated. Loose, dirty, or oxidized connections have higher than normal resistance and increased voltage drop resulting in less reserve time.

Typically, the designed voltage drop across the inter-cell connector between cells should be 30 millivolts or less at rated current. Voltage drop between rows for standard (inter-tier/inter-step) cables is typically less than 100 millivolts at rated current.

### ***Measuring Connection Resistance***

Checking voltage drop with conventional voltmeters requires that measurements be taken while the battery is discharging at its rated discharge current. The resistance may be calculated using Ohm's law. A preferred method of measuring connection resistance uses a sensitive digital micro-ohm meter.

### **Caution**

<p>Note that cycling will shorten the life of the battery. For this reason, the use of digital, low-resistance ohmmeters is recommended. This type of equipment allows the measurement of connection resistance without discharging or cycling the battery.</p>
---

## Check Battery Connections, continued

### Measuring Connection Resistance, continued

To measure connection resistance with a digital, low resistance ohmmeter, proceed as follows:

Step	Action
1	Be sure all connections are clean and torqued to the values specified in Table 6-A for re-torque.
2	With the battery on float charge or open circuit, take measurements post to post
3	Starting at one end of the string, work toward the other end, recording micro-ohm resistances, and noting connections with unacceptable resistances or resistance values that exceed the average by 20 percent. <b>Never use the DLRO to take a reading across a cell or the terminals of the battery. This could seriously damage the instrument.</b>
4	Recheck connections that exhibit unacceptable resistance. Clean and re-torque to the original (initial) torque value, when required.  Note: Whenever a connection must be disassembled and reworked, be certain to re-torque the connection to the original (initial) installation torque value given in Table 6-A.
5	Compare resistance readings with the original installation readings and records taken when the battery was first installed. Connections that still exhibit unacceptable resistance after cleaning and re-torquing may indicate the presence of improperly sized or damaged cables or inter-cell connectors. Call Lucent Technologies Technical Support.

Note: IEEE-450 - 1995 (or its latest revision) provides a comprehensive description of how to measure connection resistance. Details may be found in the Annex F of IEEE-450.

## **Battery Discharge Test**

Perform this procedure *once every 5 years*. It is important to recognize that standby batteries are designed for a finite number of discharges. Excessive testing or cycling of the battery can materially shorten battery life.

Batteries are rated on their ability to deliver a certain number of amperes or watts to the load for a specified amount of time before the battery voltage drops to a final cutoff voltage. Consult the specifications sheets for ratings of the Victory Class Batteries.

The performance of a cell or battery depends on several factors:

- the discharge rate
- electrolyte temperature at the start of the discharge
- state of charge
- integrity of the connections
- operating history and age of battery

To be valid, a performance test requires that the following conditions exist:

- A fully charged battery and balanced cell potentials and specific gravities. In some cases, this may require an equalize charge or, in cases of sulfation, other action. Call Lucent Technologies Technical Support.
- Battery must remain at float voltage for at least 72 hours prior to test. This is especially important following an equalize charge to clear the gases developed at the surface of the plates. All connections; inter-cell, inter-row and inter-aisle must be optimized to their minimum resistance and all connections securely tightened.
- The discharge rate depends upon the type of test. For an acceptance or performance test, the discharge rate should be a constant current or constant power load equal to the rating of the battery for a selected test duration and to a final predetermined voltage. The rated capacity of the Victory Class cell is 1680Ah (8 hour discharge rate to 1.75 V/cell).

Since electrolyte temperature impacts performance, the discharge rate or the discharge time must be corrected if it is different than 77°F (25°C). (See Figure 7-1.)

Note: A complete description of testing vented lead-acid batteries is beyond the scope of this manual but is discussed in detail in IEEE STD 450-1995, or its latest revision or supplements and other professional standards.

## **Battery Replacement**

### ***Replacing a Cell in a String Connected to Load/Charger***

- Only qualified, trained personnel that have read and understand the hazards described in the Safety section of this manual should perform this work. Appropriate protective equipment must be used.
- Follow the appropriate procedures in the installation section for unpacking and performing the initial charge on the cell(s).
- In addition to other important safety precautions, ensure the following:
  - The vent funnel has been properly installed before making any electrical connections to the new battery.
  - The string and new cell has been at float (less than 2.20 volts/cell) for at least 48 hours.
  - The time the new cell is left on open circuit after charging and before connecting into the new string does not exceed 24 hours.
- One cell at a time may be replaced in an existing string without removing the battery string from the plant bus.

### **Warning**

This process increases the risk of creating sparks at the battery terminals and should be avoided unless absolutely necessary. It is extremely important that this process only be performed by qualified, trained personnel who have read and understand the hazards described in the safety section of this product manual and who are using the proper protective equipment.

## Battery Replacement, continued

### *Replacing a Cell in a String Connected to Load/Charger, continued*

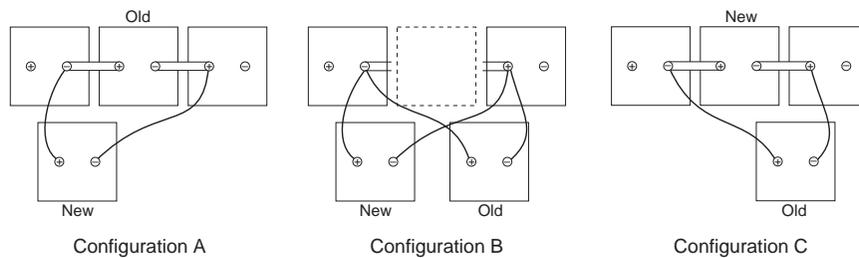
Connect the new cell in parallel with the defective (old) cell using two pairs of suitable length cables (see Figure 8-1).

#### **DANGER RISK OF EXPLOSION**

The string and new battery must be verified to have been on float charge at a voltage less than 2.20 volts/cell for at least 48 hours before performing this function.

#### **WARNING ELECTRICAL HAZARD**

Insulate the end of the cable that is not connected if the other end is connected to the battery terminal.



**Figure 8-1: Replacing a Defective Cell With a New Cell**

# 9 *Troubleshooting*

## ***Introduction***

When properly maintained and charged, lead-acid storage batteries should provide many years of trouble-free service. However, despite their inherent dependability, failure to operate or maintain them correctly may lead to damage, shortened life, and possible loss of service. The following information addresses some of the typical errors in operation and maintenance:

## ***Batteries on Open Circuit***

As soon as a battery is removed from a charger, self-discharge begins. Even under the best conditions, lead-calcium cells will self-discharge at a rate of one to two percent a month. Therefore, if cells remain on open circuit (with no charging voltage supplied) for prolonged periods, the affected cells may become sulfated and require corrective action. In most cases an equalize charge is adequate to restore the cells/battery to a satisfactory operating condition. However, in extreme conditions when the battery is left on open circuit for a very long time the cells may become “hydrated.” This condition is irreversible.

## ***Hydration***

When a battery has been over-discharged, well beyond its design limits, and left in a discharged state without timely recharge it is subject to irreversible damage known as “hydration.” This is a phenomenon in which the specific gravity of the electrolyte has been depleted to a value so low that it permits the lead components to go into solution, totally destroying the cells. The reaction of dissolution forms many compounds and salts generically referred to as hydrate. These compounds clog the separator pores and, upon recharge, react to form metallic lead. As the process continues, thousands of short circuit paths are created. Very often, the effect of the short circuits goes unnoticed except for an observed increase in charging current. As the reaction proceeds over an extended period of time, the short circuits become so extensive that it is difficult to keep the cells charged. Finally, the cells may experience terminal short circuit failure.

Hydration can be avoided by the use of low-voltage cut-out devices, which disconnect the battery from the load after the battery is discharged at its specified load current and reaches its designed cut-off voltage. The battery must be recharged as soon as possible.

Battery hydration usually occurs when the load on the battery is very much less than the design load current. This condition allows the battery to discharge to a very low depth of discharge, depleting the available acid ions in the electrolyte. The specific gravity of the electrolyte finally approaches that of water.

Typically, if one or more cells in a battery become visibly hydrated, it is only a matter of time before the remaining cells exhibit the same condition.

## ***Cell Reversal***

Cell(s) may be reverse charged during a deep discharge. On recharge these cells may read as high as 4 volts, indicating a high internal resistance. "Reversed cell" temperatures may rise significantly on recharge, and immediate action is necessary to avoid permanent damage to the cell(s). Recharge voltage must be decreased to insure that the reversed cell(s) do not exceed 3.0 volts or 110 degrees Fahrenheit. If the cell(s) do not respond to this special charging it may be advisable to charge the cell individually. A single cell charger is required for this procedure. Contact your Lucent Technologies agent for additional assistance.

## ***Measurement of Internal Cell Impedance and Conductance***

A technique that has gained popularity, particularly in "valve-regulated, lead-acid" (VRLA) batteries, is the measurement of internal cell impedance and/or conductance. Since the plates are not visible in VRLA batteries many of the visual analytical techniques that can be used for vented lead-acid batteries are not applicable in sealed products. Primarily for this reason other methods of analysis have been developed.

The measurement of internal impedance and/or conductance utilizes either AC (alternating current) at various frequencies or DC resistance measured across the cell terminals to determine the degree of deterioration of the element from a baseline value taken when the cell(s) was first installed. A change of more than 20% from the value recorded on original installation may constitute a reason for further investigation. These techniques are discussed in IEEE Standard 1188-1996, Appendix D. The discussion is intended for VRLA batteries. There is not a similar reference in IEEE-450 written for vented batteries.

However, some users of vented batteries have chosen to use the impedance, conductance, or resistance measurement technique for additional analytical data. It is important that a baseline be established upon initial installation of the battery. Subsequent tests may then be referenced to the original values.

***Plate  
Polarization  
Measurements***

The life of a lead-acid battery is optimum when it is properly floated at the minimum recommended string float voltage, operated in a temperature controlled environment, and is rarely cycled. Application requirements can make the ideal operating parameters impossible or compromised. To better understand and monitor the health of a flooded lead-acid battery, it is possible to measure the plate potentials independent of the float voltage of a given cell.

This technique makes use of an instrument known as a “third electrode.” The third electrode is inserted into the electrolyte of the cell under examination and voltage measurements are made that may be either direct measurements or converted measurements, depending on the type of third electrode used to record the polarization potentials of the positive and negative plates. It is interesting to note that although a given cell float voltage may be above or below the recommended average value of cells in a battery, the cell may be operating properly. This is because the polarization potentials of the positive and negative plates are within an acceptable range. Third electrode measurement instruments are available in both miniature lead-acid cells and mercury/mercurous sulfate cells.

Although the technique has been used almost exclusively by battery manufacturers and research and development laboratories for years or under highly controlled field test conditions, some “battery testing organizations” have added this test parameter for in-depth customer site evaluations.

Third electrode measurements can inform the experienced battery technician of the following: if the positive plates are properly polarized excessive plate corrosion will be minimized while still maintaining the plates at a sufficient potential and state of charge to avoid sulfation.

It is essential that the negative plates remain fully charged while at the same time not depressing the potential of the positive plates. The correct negative plate potential is dependent on individual manufacturers’ design parameters and vary widely due to the addition of organic material (expanders) in the negative plates and/or depolarizers added to the electrolyte.

# ***10 Discharge and Power Data***

## ***Introduction***

This section provides discharge capacity information for the Victory Class Batteries.

### **Note**

All Victory Class Batteries are capacity tested before shipment and after 6 days float. The data provided in these tables represent the guaranteed minimum value at the time of shipment and are the minimum values for the lifetime of the cells.
--

## ***Battery Discharge Capacity Tables***

Table 10-A gives the battery discharge amperes per cell. Table 10-B gives the battery discharge watts per cell.

**Table 10-A: Battery Discharge Amperes Per Cell  
Model WP-93936 List 1**

Discharge Rate at 77°F (28°C) (Hours)*	End of Discharge Volts Per Cell					
	1.75V	1.80V	1.84V	1.86V	1.88V	1.90V
0.5	1008	845	704	630	562	488
1.0	798	698	609	557	494	441
1.5	651	588	525	483	441	399
2.0	551	509	462	436	399	362
2.5	477	452	415	389	357	331
3.0	432	404	368	352	326	299
4.0	358	341	315	294	278	257
5.0	304	289	268	257	242	221
6.0	266	257	242	231	215	205
8.0	210	201	190	181	170	160
10.0	177	169	159	153	142	132
12.0	153	146	138	133	127	118
24.0	86	83	79	75	72	67

Note: The values in this table include inter-cell connector loss. This loss is based on the use of four lead plated copper straps between each cell:

side-to-side configuration: strap dimension = 1.0" x 12.12" x 0.12", strap resistance  $16.034 \times 10^{-6} \Omega$   
 end-to-end configuration: strap dimension = 1.0" x 8.12" x 0.12", strap resistance  $10.266 \times 10^{-6} \Omega$

\*Hours reserve reflect cell performance at electrolyte specific gravity of  $1.215 \pm 0.005$  at 77°F (25°C)

**Table 10-B: Battery Discharge Watts Per Cell  
Model WP-93936 List 1**

Discharge Rate at 77°F (28°C) (Hours)*	End of Discharge Volts Per Cell					
	1.75V	1.80V	1.84V	1.86V	1.88V	1.90V
0.5	1.815	1.555	1.311	1.186	1.067	0.934
1.0	1.455	1.296	1.141	1.053	0.941	0.847
1.5	1.198	1.097	0.989	0.918	0.844	0.768
2.0	1.021	0.954	0.873	0.830	0.765	0.699
2.5	0.888	0.849	0.786	0.744	0.686	0.639
3.0	0.808	0.762	0.699	0.674	0.627	0.579
4.0	0.673	0.647	0.602	0.565	0.538	0.500
5.0	0.575	0.550	0.513	0.496	0.468	0.430
6.0	0.506	0.492	0.465	0.447	0.418	0.400
8.0	0.403	0.387	0.368	0.352	0.332	0.314
10.0	0.342	0.327	0.310	0.299	0.279	0.260
12.0	0.296	0.283	0.269	0.260	0.250	0.232
24.0	0.186	0.160	0.154	0.147	0.141	0.132

Note: The values in this table include inter-cell connector loss. This loss is based on the use of four lead plated copper straps between each cell:

side-to-side configuration: strap dimension = 1.0" x 12.12" x 0.12", strap resistance  $16.034 \times 10^{-6} \Omega$   
end-to-end configuration: strap dimension = 1.0" x 8.12" x 0.12", strap resistance  $10.266 \times 10^{-6} \Omega$

\*Hours reserve reflect cell performance at electrolyte specific gravity of 1.215±0.005 at 77°F (25°C)



# 11 *Installation and Maintenance Records*

## ***Battery Records***

Battery records are extremely useful for evaluating the installation, operation, and maintenance of the battery over its service life. This point has been made throughout the manual. Forms are included in this section to assist you in maintaining a record of service. It is recommended that you make a photocopy of the original so that additional copies may be made for future records.

### **Note**

Failure to adhere to the maintenance schedules and routines described in the <i>Maintenance</i> section of this product manual will void the product warranty and may result in reduced performance of your batteries.
--

## ***Storage Battery Report***

The battery installer should follow the instructions in Section 6, “Unpacking and Handling” and “Installation Records,” to begin the recordkeeping on the “Storage Battery Report.” **The installer should then turn these records over to the Maintenance organization, who keeps them as part of their permanent records.**

## ***Battery Maintenance Record***

The Maintenance organization will record results of maintenance procedures on the “Battery Maintenance Record.” If a warranty claim is made, the Maintenance organization will be required to show records to support the claim.

Refer to Section 8, *Maintenance*, for required actions and measurements.





# Battery Maintenance Record

For Year \_\_\_\_\_

Office ID
Supervisor's Name

City and State
Phone

Type of Power Plant
Battery type = WP-93936 List 1

Total Rectifier Capacity (Amps)
Typical Plant Load (Amps)

Monthly: Check and Record Battery Float Voltage												
Month	JAN	FEB	MAR	APR	MAY	JUN	JULY	AUG	SEP	OCT	NOV	DEC
Volts												
Tech Init.												

Quarterly: Check and Record Individual Cells for Crystals; Check and Record Reference Cell Temperature; Check Electrolyte Levels.														
		(Circle)	JAN	FEB	MAR	APR	MAY	JUNE	JUL	AUG	SEP	OCT	NOV	DEC
String A	Cell #'s w/crystals													
	Temperature Reference Cell													
	Water Added to Cell #'s or OK													
String B	Cell #'s w/crystals													
	Temperature Reference Cell													
	Water Added to Cell #'s or OK													
String C	Cell #'s w/crystals													
	Temperature Reference Cell													
	Water Added to Cell #'s or OK													
String D	Cell #'s w/crystals													
	Temperature Reference Cell													
	Water Added to Cell #'s or OK													
String E	Cell #'s w/crystals													
	Temperature Reference Cell													
	Water Added to Cell #'s or OK													
String F	Cell #'s w/crystals													
	Temperature Reference Cell													
	Water Added to Cell #'s or OK													
Recorded by:														

## Battery Maintenance Record

(Use Additional Sheets if Required)

Date: \_\_\_\_\_

Recorded by: \_\_\_\_\_

Annually: Check and Record Individual Cell Float Voltages; Check Battery Cycle Monitor (if applicable);  
Inspect Battery Jars and Stands; Inspect Safety Vent Funnel

Cell #	String A		String B		String C		String D		String E		String F	
	Volts	T Ref Cell										
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												

Battery Cycle Monitor Reading: \_\_\_\_\_ (if applicable)

Power Outage Log:

Date	Time	Duration	Remarks	Initials



# ***12***

## ***Material Safety Data Sheet***

This section contains the Material Safety Data Sheet for the Victory Class Batteries.

**Lucent Technologies**  
Bell Labs Innovations



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## MATERIAL SAFETY DATA SHEET

Lucent Technologies  
600 Mountain Avenue  
Murray Hill, NJ 07974

Issue Date: 03/03/00  
Issue Number: 1

**Non-Emergency Telephone # 908-582-3700**

**Emergency Telephone # 800-424-9300 (CHEMTREC)**

Use CHEMTREC only in the event of chemical emergencies involving a spill, leak, fire, exposure, or accident involving chemicals.

### I. PRODUCT IDENTIFICATION

**Product Name: Battery, Victory Class**

**Chemical Name/Synonym: Flooded Lead-acid Battery**

**HMDB Number: 11743**

**Label Codes**

**Health:** 3 - Corrosive  
**Fire:** 0 - Non-flammable  
**Reactivity:** 2 - Moderately reactive

### II. HAZARDOUS INGREDIENTS

<u>Component</u>	<u>CAS #</u>	<u>%</u>	<u>TLV(ACGIH)</u>	<u>PEL(OSHA)</u>
*Lead and lead sulfate (7446-14-2)	7439-92-1	< 60	.05 mg/m <sup>3</sup>	.05 mg/m <sup>3</sup>
**Sulfuric acid	7664-93-9	10-30	1 mg/m <sup>3, 1</sup>	1 mg/m <sup>3</sup>

<sup>1</sup>STEL (ACGIH): 3 mg/m<sup>3</sup>

<sup>1</sup>STEL (OSHA): N/A

**Comments:** The data presented refer primarily to the acid electrolyte since this compound poses the predominant immediate hazard associated with this product. \*These chemicals are subject to Section 313 Title III SARA Reporting Requirements. \*\*This chemical in its existing form is not subject to SARA 313 Title III Reportable Requirement. However, if the use of this product results in aerosol formation of this chemical, then the aerosol of this chemical is subject to SARA 313 Title III Reportable Requirements.

### III. PHYSICAL PROPERTIES

**Appearance/Odor:** Acid electrolyte is clear with a strong acrid odor.

**Specific Gravity:** 1.30

**Boiling Point:** > 219 °F

**Vapor-Pressure:** > 20 mm Hg at 77 °F

**Evaporation Rate:** < 1

**% Volatiles by Volume:** N/A

**% Volatile Organic Carbon:** N/A

**Vapor Density (Air=1):** >1

**Melting Point:** -17 °F

**Solubility in Water:** Soluble

**pH:** < 1

#### IV. HEALTH HAZARD SUMMARY

##### Primary Routes of Exposure

**Oral:**                      **Skin: X**                      **Eye: X**                      **Inhalation: X**

##### Effects of Overexposure:

The electrolyte is corrosive to skin, eyes, and mucous membranes. Repeated or prolonged inhalation of mists can cause inflammation of the upper respiratory tract and chronic bronchitis; pulmonary edema and death may occur from severe exposures.

Early symptoms of lead intoxication include a persistent metallic taste, vomiting, diarrhea or constipation, and severe abdominal pain. Continued exposures may result in muscle weakness and fatigue, nerve system damage, paralysis, liver and kidney damage, anemia, anorexia, and adverse reproductive and developmental effects.

##### Listed as a Carcinogen or Potential Carcinogen By the Following Agencies?

**NTP: No**                      **IARC: Yes**                      **OSHA: No**

##### Toxicity Study Information:

Only select Registry of Toxic Effects of Chemical Substances (RTECS) data are presented here. Consult latest issue for more information.

**Sulfuric acid:** The International Agency for Research on Cancer (IARC) has classified "strong inorganic acid mist containing sulfuric acid" as a Category I carcinogen, a substance that is carcinogenic to humans. This classification does not apply to liquid forms of sulfuric acid contained within a battery. The inorganic acid mist is not generated under normal use of this product. Misuse of the product such as overcharging, may result in the generation of sulfuric acid mist.

**Lead:** TC<sub>10</sub>: .01 mg/m<sup>3</sup>, human, inhalation; TD<sub>10</sub>: 450 mg/kg/yr, human, oral. Reported to cause chromosomal aberrations in human and animal cells. Causes reproductive and developmental effects in experimental animals.

According to the International Agency for Research on Cancer (IARC) Monograph Supplement (1987), there is inadequate evidence for the carcinogenicity of lead in humans. Lead and inorganic lead compounds are classified as group 2B carcinogens by IARC. OSHA regulated (29 CFR 1910.1025).

**Lead sulfate:** LD<sub>50</sub>: 2 g/kg, dog, oral; LD<sub>50</sub>: 30 g/kg, guinea pig, oral. Positive sister chromatid exchange assays in human and animal cells.

The lead and lead sulfate contained in this product pose a minimal hazard because they are enclosed. A lead hazard may result during recycling or if battery is discarded improperly.

**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. Wash hands after handling.



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## IX. ENVIRONMENTAL INFORMATION

**Steps to be Taken in Case Material is Released or Spilled:** If an acid spill is external to the battery, cover the spill with clay or other recognized acid absorbing agent. Neutralize the acid with sodium bicarbonate (baking soda) or other recognized neutralizer. In an emergency sand, ashes, or gravel can be used to cover spill, and soda ash or lime used to neutralize acid; such substances should not be used on the battery itself as they can cause damage to it. Do not flush with water, even after acid has been neutralized.

**Waste Disposal Method:** Contains lead. Dispose of according to all applicable regulations.

**TSCA Status:** All components appear on the TSCA Chemical Substance Inventory.

**Shipping Information: USDOT/IATA: Name:** Battery, Wet, Filled with acid

**Class:** 8

**ID#:** UN2794

**PG:** III

## X. SPECIAL PRECAUTIONS

### Storage and Handling Requirements:

Store in a cool, dry, well ventilated area. Protect batteries from physical damage. All lead acid cells have enormous circuit capability. Extreme care should be exercised to avoid shorting of cell terminals. When working around cells remove rings, wrist watches, necklaces, metal bracelets, belt buckles, etc. Explosive hydrogen gas may be generated during charging. Avoid creating sparks, keep away from sources of ignition and ventilate area during charging.

**N.D.** = Not Determined

**N/A** = Not Applicable.

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*While information in this fact sheet has been compiled from reference materials and other sources believed to be reliable, its accuracy and completeness is not guaranteed, nor is any responsibility assumed or implied for any loss or damage resulting from inaccuracies or omissions. Any specific evaluation will involve professional judgement by the user's industrial hygiene personnel.*



# 13 *Product Warranty*

Victory Class Battery Warranty:

- A. Seller warrants to Customer that:
1. As of the date title to product sold (Product) passes, Seller will have the right to sell, transfer, and assign such Product, and the title conveyed by Seller shall be good;
  2. Upon shipment, Product will be free from defects in material and workmanship, and will conform to Seller's specification.
- B. The Warranty Periods and Conditions applicable to new products are listed below:

**Table 13-A: New Battery Warranty Periods and Conditions**

<b>Warranted Years of Life</b>	<b>Maximum Battery Temperature During Normal Float</b>	<b>Full Replacement</b>	<b>Pro-Rata Replacement</b>
25	77°F (25°C)	5 years	20 years
15	90°F (32°C)	7 years	8 years
7	99.9°F (37.76°C)	1.5 years	5.5 years
Void	>100°F (>37.77°C)	0 years	0 year
Note: Operation or storage of batteries for any length of time above 50°C (122°F) will void the product warranty.			

The Warranty Period commences on the date of manufacture.

Temperature and maintenance records shall be maintained by Customer in accordance with Seller's published instructions in the *Operation and Maintenance* section of this product manual.

Number of discharges and discharge depths shall not exceed:

- 225 Cycles during warranted years of life with a 30 percent discharge depth
- 185 Cycles during warranted years of life with a 50 percent discharge depth
- 100 Cycles during warranted years of life with a 100 percent discharge depth

If, during the Warranty Period, a defect or nonconformity is identified in a Product and Customer notifies Seller in writing of such defects or nonconformity, and follows Seller's instructions regarding return of defective or nonconforming Products, Seller shall, at its option, repair or replace such Product without charge or provide a credit as specified in Paragraph C. Where Seller has elected to repair a Product and Seller ascertains that the Product is not readily returnable for repair, Seller will repair the Product at Customer's site.

C. If notification of defect is:

- Within the years of the full replacement portion of the Warranty, Seller will, at its option, either repair or replace the Product or provide a 100 percent credit based on the lesser of either current price or original purchase price. Credit will be applied to a replacement Lucent Technologies product.
- Within the years of the pro-rata replacement portion of the Warranty, Seller will, at its option, either repair or replace the Product or provide a credit based on the following pro-rata formula:  $C = [(WR - ML)/WR] \times PR$

where: C = Credit  
ML = Months of Life Obtained  
PR = Current Replacement Billing Price  
WR = Warranted Months of Life as determined in Paragraph B.

Credit will be applied to a replacement of Lucent Technologies product.

D. If Seller has elected to repair or replace a defective Product the cost of removal and the reinstallation shall be borne by Customer. Products returned for repair or replacement will be accepted by

Seller only in accordance with its instructions for such returns. The transportation expense and risk of loss associated with returning such Product to Seller shall be borne by Customer. Seller shall bear the cost of transportation and risk of loss of the repaired or replacing Product to the destination originally designated by Customer at time of purchase. When Seller has elected to replace Product or give credit, Product shall remain the Buyer's property to be disposed of in accordance with Federal, State, and local regulations for hazardous materials.

- E. If Seller determines that a Product for which warranty service is claimed is not defective or nonconforming, Customer shall pay or reimburse Seller for all costs of handling, inspecting, testing, disposal, and transportation, and, if applicable, traveling and related expenses.
- F. Seller makes no warranty with respect to defective conditions or nonconformities resulting from actions of anyone other than Seller or its subcontractor, caused by any of the following: modifications, misuse, neglect, accident, or abuse; improper wiring, repairing, alteration, installation, storage, or maintenance; use in a manner not in accordance with Seller's specifications, or operating instructions, or failure of Customer to apply previously applicable Seller modifications and corrections. In addition, Seller makes no warranty with respect to Products which have had their serial numbers or month and year of manufacture removed or altered.
- G. All maintenance records shall be provided for warranty consideration.
- H. Warranty for products that are not recharged within the specified recharge date will be void.
- I. This warranty shall run only to Customer who is a direct purchaser from the Seller.

THE FOREGOING WARRANTIES ARE EXCLUSIVE AND IN LIEU OF ALL OTHER EXPRESS AND IMPLIED WARRANTIES, INCLUDING BUT NOT LIMITED TO WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. CUSTOMER'S SOLE AND EXCLUSIVE REMEDY SHALL BE SELLER'S OBLIGATION TO REPAIR, REPLACE, OR CREDIT AS SET FORTH PREVIOUSLY IN THIS WARRANTY.

