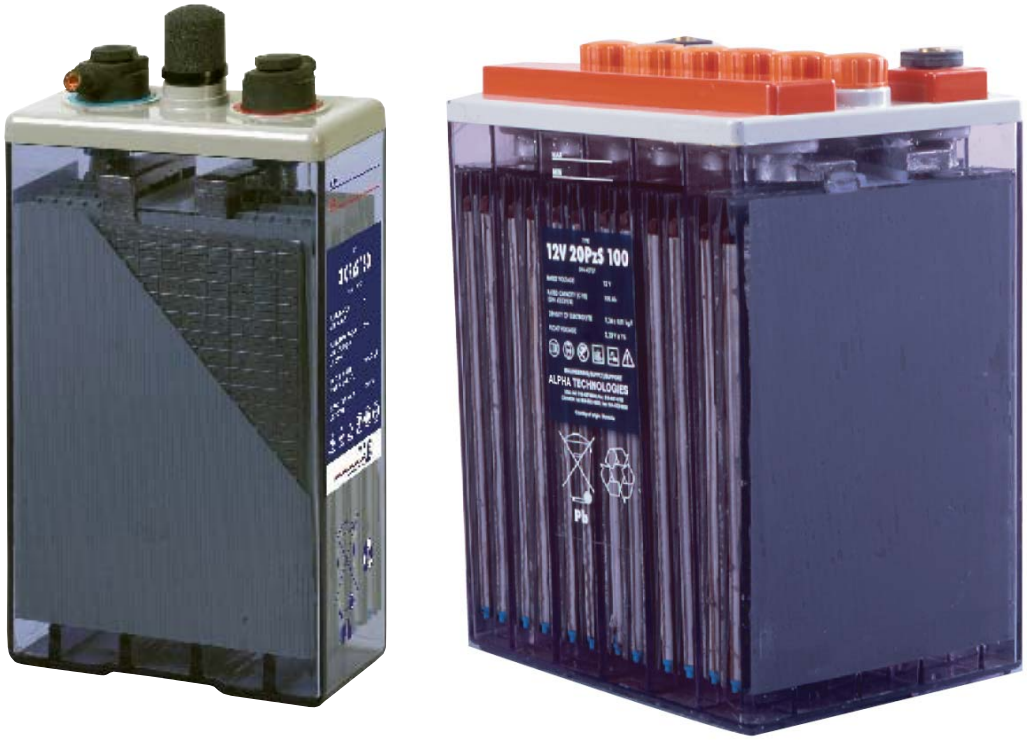
AlphaCell OPzS

Stationary Flooded Tubular Lead-acid Batteries



Technical Manual

AlphaCell OPzS Battery

Effective: January 2008

Alpha Technologies

Alpha Technologies

Power

AlphaCell OPzS Battery
Installation and Operation Manual

OPzS-BATTERY

Effective Date: January 2008

Alpha Technologies, Inc.

A Member of the Alpha Group

NOTE:

Photographs contained in this manual are for illustrative purposes only. These photographs may not match your installation.

NOTE:

Operator is cautioned to review the drawings and illustrations contained in this manual before proceeding. If there are questions regarding the safe operation of this powering system, please contact Alpha Technologies or your nearest Alpha representative.

NOTE:

Alpha shall not be held liable for any damage or injury involving its enclosures, power supplies, generators, batteries, or other hardware if used or operated in any manner or subject to any condition not consistent with its intended purpose, or is installed or operated in an unapproved manner, or improperly maintained.

Contacting Alpha Technologies: *www.alpha.com*

or

For general product information and customer service (7 AM to 5 PM, Pacific Time), call

1 800 863 3930

For complete technical support, call

1 800 863 3364

7 AM to 5 PM, Pacific Time or 24/7 emergency support

Table of Contents

Safety Notes 8

Battery Safety Notes 9

Chemical Hazards 9

Recycling and Disposal Instructions 9

1.0 General Information 10
- 1.1 Introduction 10
- 1.2 Precautions 10

2.0 Safety 11
- 2.1 General 11
- 2.2 Safety Equipment and Clothing 11
- 2.3 Safety Precautions 11
  - 2.3.1 Sulfuric Acid Burns 11
  - 2.3.2 Explosive Gases and Fire 12
  - 2.3.3 Electrical Shocks and Burns 12

3.0 Inspecting the Battery Shipment 13
- 3.1 General 13
- 3.2 Visible External Damage 13
- 3.3 Concealed Damage 13

4.0 Battery Storage Before Installation 14
- 4.1 General 14
- 4.2 Storage Interval 14
  - 4.2.1 Filled and charged cells 14
  - 4.2.2 Dry charged cells 14
- 4.3 Advanced Preparation 14

5.0 Selection and Accommodation Considerations 15
- 5.1 General 15
- 5.2 Battery Selection 15
- 5.3 Accommodation Considerations 15

Table of Contents, continued

6.0 Unpacking and Handling for Installation 16
6.1 General 16
6.2 Recommended Installation Equipment and Supplies 16
6.3 Cell Handling 16

7.0 System Installation 17
7.1 General 17
7.2 System Layout 17
7.3 Installation Considerations 17
7.3.1 Arrangement 17
7.3.2 Spacing 18
7.4 Battery Installation 18
7.5 Preparing and Installing Connections 19
7.5.1 Terminal Posts 19
7.5.2 Intercell Connectors 20
7.5.3 Terminal Plates 20

8.0 Battery Taps 21

9.0 Pilot Cell 21

10.0 Freshening Charge 22

11.0 Operation 23
11.1 Battery Charging and Operation Mode 23
11.1.1 Charging 23
11.1.2 Floating operation 23
11.1.3 Switch mode operation 24
11.1.4 Battery charge/discharge operation 24
11.2 Hydrometer Readings - Specific Gravity 24
11.3 Equalizing Charge 24
11.3.1 Equalizing Charge Method 25
11.4 Operating Temperature 25

Table of Contents, continued

12.0 Maintenance 26

12.1 Battery Cleaning 26

12.1.1 Standard Cleaning 26
12.1.2 Corrosion Cleaning 26
12.1.3 Heavy Corrosion Cleaning 27
12.1.4 Cleaning Flame Arrestors 27
12.1.5 Replacing or Isolating a Cell 27

12.2 Maintenance Records 28

12.3 Corrective Actions 29

12.4 Adding Water 30

12.5 Quality of Water 30

12.6 Filling Dry-Charged Cells 31

13.0 Test Procedures 32

13.1 Procedure for Battery Capacity Tests 32

14.0 Specifications 33

15.0 Battery Room Ventilation Calculation 42

16.0 Maintenance Records 43

Figures and Tables

Fig. 2-1, Safety Labels.....11

Fig. 16-1, Charged Battery Readings Before Discharge Begins Form..... 43

Fig. 16-2, After “Load Profile” Battery Form..... 44

Fig. 16-3, “Final Recharge” Battery Readings Form..... 45

Table 14-1, OPzS Dimensions..... 33

Table 14-2, OPzS General Specifications 34

Table 14-3, OPzS Capacity 34

Table 14-4, Discharge Current (1.83Vpc End Voltage) 35

Table 14-5, Discharge Current (1.80Vpc End Voltage) 36

Table 14-6, Discharge Current (1.75Vpc End Voltage) 37

Table 14-7, Discharge Current (1.70Vpc End Voltage) 38

Table 14-8, Sulphuric Acid Impurities 39

Table 14-9, Demineralized Water Impurities..... 40

Table 14-10, List of Reference Standards 40

Table 14-11, Total Gas Emission for OPzS Batteries after 10 years of Operation..... 41

Table 14-12, Internal Resistance and Short Circuit Currents (2 Volts) 42

Safety Notes

Review the drawings and illustrations contained in this manual before proceeding. If there are any questions regarding the safe installation or operation of the system, contact Alpha Technologies or the nearest Alpha representative. Save this document for future reference.

To reduce the risk of injury or death, and to ensure the continued safe operation of this product, the following symbols have been placed throughout this manual. Where these symbols appear, use extra care and attention.

ATTENTION:

The use of ATTENTION indicates specific regulatory/code requirements that may affect the placement of equipment and installation procedures.

NOTE:

A NOTE provides additional information to help complete a specific task or procedure.

CAUTION!

The use of CAUTION indicates safety information intended to PREVENT DAMAGE to material or equipment.

WARNING!

A WARNING presents safety information to PREVENT INJURY OR DEATH to the technician or user.

Battery Safety Notes

WARNING!

Lead-acid batteries contain dangerous voltages, currents and corrosive material. Battery installation, maintenance, service and replacement must be performed only by authorized personnel.

Chemical Hazards

Any liquid leakage from a flooded lead-acid battery contain dilute sulfuric acid, which is harmful to the skin and eyes. Emissions are electrolytic, and are electrically conductive and corrosive.

To avoid injury:

- The servicing and connection of batteries shall be performed by, or under the direct supervision of, personnel knowledgeable of batteries and required safety precautions.
- Always wear eye protection, rubber gloves, and a protective vest when working near batteries. Remove all metallic objects from hands and neck.
- Batteries produce explosive gases. Keep all open flames and sparks away from batteries.
- Use tools with insulated handles, do not rest any tools on top of batteries.
- Lead-acid batteries contain or emit chemicals known to the State of California to cause cancer and birth defects or other reproductive harm. Battery post terminals and related accessories contain lead and lead compounds. Wash hands after handling (California Proposition 65).
- Wear protective clothing (insulated gloves, eye protection, etc.) when installing, maintaining, servicing, or replacing batteries.
- If any battery emission contacts the skin, wash immediately and thoroughly with water. Follow your company's approved chemical exposure procedures.
- Neutralize any spilled battery emission with the special solution contained in an approved spill kit or with a solution of one pound bicarbonate of soda to one gallon of water. Report a chemical spill using your company's spill reporting structure and seek medical attention if necessary.
- Always replace batteries with those of an identical type and rating. Never install old or untested batteries.
- Do not charge batteries in a sealed container. Each individual battery should have at least 0.5 inches of space between it and all surrounding surfaces to allow for convection cooling.
- All battery compartments must have adequate ventilation to prevent accumulation of potentially dangerous gas. Ventilation should prevent trapped hydrogen gas pockets from exceeding a 1% concentration as per regulation 70E of the National Fire Protection Agency (NFPA).
- Prior to handling the batteries, touch a grounded metal object to dissipate any static charge that may have developed on your body.
- Never use uninsulated tools or other conductive materials when installing, maintaining, servicing, or replacing batteries.
- Use special caution when connecting or adjusting battery cabling. An improperly connected or unconnected battery cable can make contact with an unintended surface resulting in arcing, fire, or possible explosion.
- A battery showing signs of cracking, leaking, or swelling should be replaced immediately by authorized personnel using a battery of identical type and rating.

Equipment Cautions

- Do not operate NiCd and lead-acid batteries in the same room. NiCd emissions will neutralize the lead-acid solution, rendering the battery useless.
- Overcharging the battery can result in a loss of capacity and excess release of gas.

Recycling and Disposal Instructions

Spent or damaged batteries are considered environmentally unsafe. Always recycle used batteries or dispose of the batteries in accordance with all federal, state and local regulations.

1.0 General Information

1.1 Introduction

OpzS batteries are intended for telecommunication facilities, computers, emergency lighting, alarm, control and monitoring systems in power plants and distribution stations, railway stations, airports etc. Due to their extremely low self-discharge rate they are also suitable for plants supplied by solar cells.

When properly handled and operated stationary OpzS batteries do not represent any danger or harm for the operators and environment. When handling take into account all safety and operating instructions.

1.2 Precautions

Before unpacking, storing, handling, installing, operating, or performing maintenance on the battery system read the following information thoroughly.

It is important to read, understand and strictly follow the instructions in this manual.

If the following precautions are not fully understood, or if local conditions are not covered, contact the manufacturer for clarification or ask for technical advice.

Refer to all applicable state and local regulations and industry standards.

NOTE:

You should be trained in handling, installing, operating and maintaining batteries before you work on any battery system.

.

2.0 Safety

Follow Instructions	Use Protective Goggle and Clothes	Avoid Sparks, Flames, or Arcing	Explosive Gases (Avoid Short Circuit	Caustic Acid	Danger

Fig. 2-1, Safety Labels «

CAUTION!

If you have any questions concerning safety, contact your local manufacturer sales representative to clarify any of the noted safety precautions or call the Alpha Customer Service number listed on the back of this manual.

2.1 General

Like all other flooded, lead-acid batteries, OPzS stationary batteries may leak, release hydrogen gas or cause acid misting. Always follow the generally accepted safety procedures for handling batteries. In addition, it is very important that the precautions recommended in this manual are observed.

You must understand the risk of working with batteries and be prepared to take the necessary safety precautions.

2.2 Safety Equipment and Clothing

When working with any battery system, be sure you have the necessary tools and safety equipment, including but not limited to: insulated tools, face shield and protective goggles, rubber apron or acid resistant cloth, rubber gloves, emergency eye wash and shower, fire extinguisher and acid spill cleanup kit.

Always:

- Remove all jewelry (i.e., rings, watches, chains, etc.).
- Keep sparks, flames and smoking materials away from the battery.

Never lay tools or other metallic objects on the battery cell. Using the correct tools and wearing proper safety equipment will help prevent injury should an accident occur.

NOTE:

In case of a sulfuric acid spill, bicarbonate of soda or an emergency spill kit should be within the battery room.

2.3 Safety Precautions

2.3.1 Sulfuric Acid Burns

Stationary batteries are safe when operated and handled properly. However, they do contain sulfuric acid, which can cause burns and other serious injuries. Always wear protective clothing.

In case of contact with skin or cloth, immediately:

- Remove contaminated clothing.
- Flush the area thoroughly with water.
- Get medical attention, if required.

2.3.1 Sulfuric Acid Burns, continued

In case of eye contact with sulfuric acid, immediately:

- Flush thoroughly every few minutes with large amounts of water.
- Get medical attention.

If acid is spilled it should be neutralized with a solution of 1 pound of baking soda to 1 gallon of water (1 kg $NaHCO_3$ / 10 l water) and then washed off with water.

2.3.2 Explosive Gases and Fire

Batteries generate explosive gases in all stages of operation. Under extreme conditions these gases can explode, causing blindness and other serious personal injury. Consider the following:

- Always wear protective clothing and use the correct safety tools.
- Eliminate any potential of sparks, flames or arcing.
- 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 arresters to avoid ignition of any hydrogen gas present.
- Provide adequate ventilation of the battery room.

In case of fire:

- If batteries are connected to a charger, shut off power.
- Extinguish a fire in a battery room containing lead acid batteries, using CO2, foam, or dry chemical extinguishing media. Do NOT discharge the extinguisher directly onto the battery. The resulting thermal shock may cause cracking of the battery case/cover.
- Leave the area as soon as possible if toxic fumes are present.
- Wear breathing apparatus if it is required to remain in the area.

2.3.3 Electrical Shocks and Burns

Multi-cell battery systems can attain high voltage and/or currents, therefore, do not touch un-insulated battery connectors or terminals. To prevent serious electrical shock and burns, use extreme caution when working with the system.

Always wear protective clothing and use nonconductive or insulated tools when working with any battery system.

Remove any jewelry or clothing that could produce a short circuit between the positive and negative terminal of a battery or battery string.

Before working on the system:

- Disconnect all loads and power sources to the battery.
- If working on an assembled battery system, sectionalize (interrupt the battery sections) into safe working voltage levels.
- Check the battery system grounding. Grounding of the battery system is not recommended. However, grounding of the rack is recommended.

Should you be required to work on a grounded battery system, make absolutely sure you use the correct safety precautions, equipment and clothing.

3.0 Inspecting the Battery Shipment

3.1 General

Precautions have been taken to pack the cells/battery units for shipment to ensure its safe arrival. However, upon receipt, you should inspect for evidence of damage that may have occurred during transit.

WARNING!

During inspections, take precautions against electrical shock. You are handling live batteries.

3.2 Visible External Damage

Inventory all materials against the bill of lading and inspect for visible external damage. Check material quantities received including the number of battery pallets and the number of accessory boxes.

Note any damage to packing material and wetness or stains, indicating electrolyte leakage and contact the manufacturer.

3.3 Concealed Damage

Within 15 days of receipt (or as soon as practical), unpack the cells. Check the received materials against the detailed packing list to verify receipt of all materials in the quantities specified and check for concealed damage.

Examine the electrolyte level to ensure that none has been spilled. If electrolyte has been lost in transit and no damage is established which can cause leak add sulfuric acid electrolyte of the nominal operating specific gravity indicated on the cell nameplate, and bring to the low level line on open circuit.

If damage is noted file a claim for concealed damage.

If cells are shipped charged and dry with separate electrolyte, fill only when ready to place in service.

DELAY IN NOTIFYING MAY RESULT IN LOSS OF YOUR RIGHT TO REFUND FOR DAMAGES.

If you have questions concerning potential damages, contact the manufacturer’s sales representative or Alpha Technologies Customer Service.

4.0 Battery Storage Before Installation

4.1 General

Batteries should be unpacked, installed and charged as soon as possible after receipt. However, if this is impractical, follow the instructions below for storing the battery before installation.

Stationary battery cells can be filled with electrolyte and charged - flooded or dry-charged.

Store batteries indoors in a clean, dry, cool and frost free location (10 °C – 30 °C). Storage at higher temperatures will result in accelerated rates of self-discharge and possible deterioration of battery performance and life.

Do not stack pallets. Damage may occur and the warranty will be voided.

4.2 Storage Interval

4.2.1 Filled and charged cells

Filled and charged cells should be recharged every 90 days to prevent their failure. Use the date of battery shipment to determine freshening charge requirements.

Storage times exceeding the above may result in plate sulfation, which may adversely affect electrical performance and expected life.

4.2.2 Dry charged cells

Dry charged cells may stand for a longer time as long as they are sealed and stored with as little temperature variations as possible within 24 hours (< 30 °C, < 50 % H).

In the winter the storage room should be safe from freezing.

Maximum total storage time before installation is 2 years from the date of shipment from the factory to the customer.

4.3 Advanced Preparation

If storage time is likely to be exceeded, make advanced preparation to have an adequate charger available and adjacent to an appropriate AC supply voltage. Positioning of the cells to accept the temporary intercell connectors is another consideration of advance planning.

Make every effort to get the battery connected to the charger before the expiration of the storage period.

NOTE:

Failure to charge as noted voids the battery warranty.

5.0 Selection and Accommodation Considerations

5.1 General

If you have any questions concerning the battery selection and installation considerations, contact your local manufacturer's representative or Alpha Technologies Customer Service.

5.2 Battery Selection

To correctly match your battery needs with the correct battery, please consider the following information:

- Type of consuming device (telephone plant, DC-AC converter, emergency lighting etc).
- Operating energy of the consumer (kW, kVA, cosf).
- Minimum and maximum allowable rated voltage at consuming device (V).
- Time diagram of a consumer load, and the required time autonomy (reserve).
- Expected voltage drop in the supply lines - surrounding temperature in the battery room (average, minimum, maximum).
- Type of rectifier, its characteristics, regulating point I (A) or U (V), respectively, float voltage (V) (direct voltage of rapid-charging current Imax (A), float charging voltage).
- Outline or dimensions of the battery room.
- Type of installation (welded, bolted, on wooden or metal racks, in case, on earthquake-proof racks).
- Battery maintenance accessories (V-meter, areometer (hygrometer), thermometers).

5.3 Accommodation Considerations

When planning the system accommodation for flooded stationary batteries consider following:

Space: The aisle space provided in front of all racks should be a minimum of 36 inches (915 mm), where this dimension is not in conflict with any local codes or regulations. A minimum of 9 inches (230 mm) is desirable above the tops of the cell posts of the top row of cells to permit access for maintenance or cell removal. Each cell should be accessible for the addition of water and for taking individual cell voltage and hydrometer readings.

Environment: Clean, cool and dry. A location should be selected which keeps water, oil and dirt away from all cells.

Temperature: Recommended ambient temperature shall be between 50°F and 86°F (10 °C to 30 °C). Elevated temperatures reduce operating life. Lower temperatures reduce battery performance. Minimize temperature variations between the cells. To avoid temperature variation between the cells, do NOT locate the battery near HVAC ducts or exhausts, heat sources (i.e., equipment that generates heat) or direct sunlight.

Ventilation: Adequate ventilation must be provided, so as to prevent hydrogen gas from exceeding explosive concentration. Ventilation must be adequate to ensure that pockets of trapped hydrogen gas do not develop, particularly at the ceiling. Also refer to EN 50272-2 or IEEE 484 for determining ventilation requirements.

Grounding: It is recommended that the racks be grounded. Also refer to national/local codes.

Codes: Refer to national/local building codes and fire codes.

Floor: The floor of the battery room should be made of an acid-resistant material, such as asphalt, ceramic plates or acid-resistant hard burnt bricks. The ceiling and walls of the battery room should be painted with an acid-resistant paints.

Anchoring: Anchoring should meet national/local codes and industry standards. Floor anchoring and its design are the responsibility of the installer.

Proximity to Electronic Equipment: Series flooded stationary batteries may be installed next to or under electronic equipment.

Racks: OPzS flooded stationary batteries designed for racks or cabinets should be installed on racks specifically designed for those batteries by the manufacturer. Use of another rack design is the responsibility of the user.

6.0 Unpacking and Handling for Installation

6.1 General

Batteries are shipped assembled, charged, and filled with the electrolyte near the low level lines as marked on the jar. If the electrolyte level is above the low level line on open circuit, electrolyte must be removed to avoid flooding during freshening charge.

All accessories for installation and use are supplied as optional prepackaged kits. Cells may be packed in wooden boxes, which must be opened completely and carefully. The cells are then handled as described in Section 6.3.

6.2 Recommended Installation Equipment and Supplies

Before working with the battery system, be sure that you have the proper protective clothing, safety equipment and insulated tools as specified in Section 2.0. Additional equipment for the installation of the battery system is listed below:

- Forklift or portable lift crane and lifting belt
- Chalk line
- Floor anchors (user-supplied per battery system and attached stress analysis)
- Floor shims (user-supplied)
- Wrench, screwdrivers
- Wipes (paper or cloth)
- Plastic bristle brush or nonmetallic cleaning pad
- Tape measure (nonmetallic)
- Personal protective/safety equipment and clothing
- Small paint brush
- ARONIX grease (corrosion inhibitor)

Be sure you have all the proper protective clothing and safety tools and equipment on hand before starting the installation.

6.3 Cell Handling

To prevent personal injury and damage to the cells when moving or handling the batteries, follow the procedure in this section:

- Do not lift any cell by the terminal posts. Lifting the cell by the post can damage the seals and will void the warranty.
- When lifting large cells or units with a crane, hoist or similar device, use the lifting belt.
- Do not tamper with seal nuts on the cell posts, as this will void the warranty.

6.3 Cell Handling, continued

Lifting procedure:

1. Tilt the cell about 1 inch (25 mm) to position the lifting belt.
2. Slide belt underneath cell.
3. Bring the end rings of the belt together over the cover and engage the hook of the lifting device in both rings. Always lift vertically and balance the cell.
4. Lift cell into position. Exercise extreme care when initially lifting cells and when lowering them into their final position on the rack. To prevent one end of the unit from “kicking out,” assign one person to steady the unit on a level plane during the entire lifting procedure.
5. Remove the belt after positioning the cell.

7.0 System Installation

7.1 General

Stationary flooded batteries are installed on racks that differ in type, size, seismic rating, and configuration. Refer to the assembly drawing, which is included in the shipment, for the particulars of your installation.

7.2 System Layout

Layout the system and consult Section 5.3 of this manual prior to installing the battery system:

1. Locate the system position in the area designated.
2. Mark floor with system outline dimensions.
3. Using assembly drawing (included with shipment) and rack components, locate the position of the floor anchors. Floor anchors are the responsibility of the user. Follow the installation instructions of the manufacturer.
4. Batteries should be kept in the original shipping containers until installed. However, if you must remove the batteries before installation, see the procedures in Section 6.3, “Cell Handling.”

7.3 Installation Considerations

7.3.1 Arrangement

1. Arrange the cells so that the positive terminal of one cell will be adjacent to the negative terminal of the next cell/jar throughout the battery string.
2. Cells are usually positioned on rack rails with plates perpendicular to the rails.
3. Take care when positioning cells to ensure the main battery terminals are not close together on step or back-to-back racks.

7.3.2 Spacing

Maintain proper spacing between cells on the rack to provide thermal management and to allow for the proper fit of hardware and connections.

7.4 Battery Installation

Prior to installation ensure the following:

- The floor is flat without bulges. In the event it is not, suitable brackets should be made and laid under the trays.
- When mounted in the plastic trays or on the wooden stands, the cells stand firmly. Spacing between the cells should correspond to the dimensions of the battery connectors. In the event that the cells do not stand vertically, they should be under-laid with lead or plastic brackets.
- Cells are not damaged or unserviceable. Voltages and electrolyte density are measured and the results are written in the acceptance log.
- The cell polarity is correct.
- When mounting multiple batteries side by side, a minimum of 20 in. (.5 m) (32 in. recommended) of space should be left on all sides for maintenance purposes.

There are two methods available to connect the cells into the battery:

- Rubber-coated connectors (thread system) that are screwed firmly to the terminal posts by stainless steel screws. All terminal posts, connectors and screws shall be greased with no-acid grease (ARONIX).
- Lead connectors (welding system), which are welded to the terminal posts.

CAUTION!

Dropping the cell or unit can damage the internal cell components.

WARNING!

Improper lifting can result in personal injury or damage to the module.

To install a battery system:

1. Install the rack according to the rack assembly drawing (included with the shipment).
2. Before lifting cells, determine which two sides will be positioned across the rails.
3. Employ the appropriate handling method for the cells to be installed (as described in Section 6.3). Exercise extreme caution when initially lifting cells and when lowering them into final position on the rack. To prevent one end of the unit from “kicking out,” assign one person to steady the unit on a level plane during the entire lifting procedure.
4. Position the first cell on the bottom shelf, centered across the rails. After placement, remove the lifting belt (if used) from the hook and pull the belt from under the module.

   When sliding the cells onto rails, do not push on the center of the cell or unit. Hold the cell by placing hands on the corners of the jar and then push to slide.
5. If provided, place the long rubber angle cell spacer on the mid-point of the cell cover. Position one leg on top of the cover and the other so that it extends down over the edge of the cover to the side where the next cell is to be positioned.

6. Lift the next cell to be installed and place it next to the previously installed unit. Be certain to allow proper spacing between cells as outlined in Section 7.3.2. Exercise extreme care when positioning cells. Bumping or scraping a cell against the adjacent cell or unit or rack member may damage the jar material.

   Do not use any kind of tool to pry cells into position.

   Take care to position cells so the main battery terminals are not close together on step racks or on back-to-back racks.

7. Remove the belt loops (if used) from the lifting hook and pull the belt free from under the unit.

8. Repeat steps 5 through 7 until all units are installed on all tiers of the rack.

9. As soon as cells are unpacked and installed on the rack, remove the shipping vent plugs and immediately install the flame arrestors. Do not attempt to charge cells unless flame arrestors are in place.

   Once installed, do not remove the flame arrestors, except when measuring or refilling water.

10. Number the cells starting from the positive terminal of the battery. The cell numbers supplied are backed with pressure-sensitive adhesive and should be applied to the rails or the jars. Before applying the cell numbers, clean surfaces.

7.5 Preparing and Installing Connections

7.5.1 Terminal Posts

All bolted type terminal posts of the cells are greased at the factory to prevent oxidation.

The cells are now positioned and ready to be connected. Connect the cells according to the assembly drawing (included with the shipment) and the following instructions:

1. Remove the grease with a paper towel.

2. Inspect each terminal post. If discoloration or tarnishing is noted, neutralize the post with sodium bicarbonate and water solution (Section 12.1.2, Procedure 2). Do not allow cleaning solution to enter cell. Dry thoroughly.

3. Clean the contact surface with a stiff-bristle nonmetallic brush/pad until a clean, bright surface is obtained. Do not expose copper.

4. Apply a light coat of ARONIX grease.

7.5.2 Intercell Connectors

The connections are made by bolting the flexible copper intercell connectors to the cell posts of opposite polarity on adjacent cells. When more than one intercell connector per cell is furnished, bolt the connectors on opposite sides of the cell posts. See the assembly drawing, included with the shipment, for details.

1. Clean the contact surface of the intercell connector using a stiff bristle nonmetallic brush/pad.
2. With a small paintbrush, apply a light coat of ARONIX grease to the contact surface of the intercell connector.
3. Bolt all intercell connectors according to the assembly drawing.
4. Secure all connections finger-tight to allow for some adjustment of position.
5. After all connections are completed, torque all stainless steel connector bolts 132-177 inch lbs (15-20 Nm). Make sure that all bolted battery connections are torqued to the recommended values. The increased resistance of a loose connection can generate heat and become a fire hazard.
6. Apply a light coat of ARONIX grease to the bolted connection with a small paintbrush in the area of the terminal post only.

7.5.3 Terminal Plates

If terminal plates are supplied with the battery system to provide a system connection point. All system connections must be made to the terminal plate and never to the cell terminal post.

1. Clean the electrical contact areas of the terminal plate, terminal connectors, and cell/jar posts with a stiff-bristle nonmetallic brush or pad until the surface is bright.
2. With a small paintbrush, apply a light coating of ARONIX grease to contact areas.
3. Install terminal connectors to cell posts. Tighten connections to 132-177-inch lbs (15-20 Nm).
4. With a small paintbrush, apply a light coat of ARONIX grease to the electrical contact areas of the terminal plate.
5. Install the terminal plate to the terminal connectors again using the torque values of 132-177 inch lbs (15-20 Nm).
6. Connect the positive lead from the charger to the positive terminal plate of the battery and the negative lead from the charger to the negative terminal plate of the battery (Some seismic installations have interface connections).
7. Connectors to battery terminal plates should be flexible, since rigid terminal connectors may transmit vibrations or strain to cell posts that could result in loose connections. Support cables so that the cell post does not bear the load.

8. Before activating the charger:
   - Inspect the cell connections of the system to ensure that all cells are connected correctly, POSITIVE (+) to NEGATIVE (-) according to the assembly drawing.
   - Measure the voltage across the system terminals. Voltage of the battery should equal approximately 2.08 times the number of cells in the string.

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 connectors. When restoring connections, disconnect the battery from the load and the charging equipment and follow the entire precautionary measures outlined in this manual.

8.0 Battery Taps

Connections made to a battery for tapping a certain group of cells to provide a voltage other than the total battery voltage is not recommended and can void the warranty. Tapping results in an imbalance of the system during charging and discharging, causing unsatisfactory operation.

9.0 Pilot Cell

Every 6th cell in a battery is usually selected as a pilot cell. It becomes an indicator of the general condition of the entire battery with regard to voltage, gravity and temperature. Pilot cell readings serve as an interim indicator between regularly scheduled voltage and gravity readings of the complete battery.

Because a small amount of electrolyte may be lost in taking hydrometer readings, you should select a different cell as the pilot cell annually.

Read and record the pilot cell voltage on a monthly basis between regularly scheduled individual cell readings.

10.0 Freshening Charge

Refresh charging only applies to wet batteries in storage. Dry batteries may be stored for up to 2 years as long as environmental requirements are met.

Batteries lose some initial charge during shipment and storage. A filled and charged cell should be recharged every 90 days to prevent failure. Use the date of battery shipment to determine freshening charge requirements.

CAUTION!

Do not attempt a freshening charge unless the electrolyte levels are near the low level line on open circuit. When necessary, remove electrolyte to that level from cells with high levels.

1. Open crate, remove any packaging material from the top of the batteries and vacuum the tops of the cells to remove any dust or other debris.
2. Remove the “Last Charged Date” stickers and the cell terminal caps.
3. Perform open circuit voltage check on each cell terminal and record data.
4. Wipe off all NO-OX grease on terminals with cloth dampened with distilled water and check each terminal for visible signs of corrosion. If corrosion is present clean the corroded terminals with solution of baking soda solution one pound to 1 gallon of distilled water, being careful not to spill solution in the vent openings.
5. Using wire leads, connect cells in series for charging. When connections are complete check for proper string voltage and record data. Remove shipping vent caps and replace with flame arresting vent plugs on all cells. Before switching on the charger, ensure that shipping vent plugs are removed and flame arrestors are installed.
6. Connect battery string to charger and monitor charge rate to ensure the ampere rate does not exceed the 10-hour discharge rate.
7. Equalize charge at a voltage of 2.35VPC with the ampere rate not to exceed the 10-hour discharge rate and charge for 8 hours at this constant voltage.

CAUTION!

Monitor cell temperatures during equalize and if electrolyte temperature reaches 113ºF (45ºC) then stop the charge for 1 hour. After temperature returns to acceptable level then re-commence equalize charge by adjusting current limit to half the initial rate for the remainder of the 8-hour charge time.

8. After completion of the 8-hour equalize charge, commence float charge at a voltage of 2.25VPC. After 16-hour float charge, cell voltage measurements should be taken and when three successive hourly measurements are the same, adequate charge has been provided and the charge may be terminated.
9. After charging, disconnect batteries from the charger. During the 2-3 hour waiting period, remove wire leads and flame-arresting vent plugs, and replace with shipping vent caps. At the end of the waiting period, verify all cells are charged to a minimum voltage of 2.20VPC and a specific gravity (test with hydrometer) of 1.24 ± 0.01 Kg/liter. Record cell voltage and specific gravity data.
10. Clean terminals as necessary with baking soda and distilled water solution using a firm fiber bristle brush.
11. Apply NO-OX grease to all terminals.
12. Inspect battery cell covers, vent openings etc. for battery acid and clean/neutralize as necessary.
13. Re-install shipping caps onto terminals for storage and/or shipping.
14. Apply new “Last Charged Date” stickers and replace any packaging material then re-seal crates.

11.0 Operation

WARNING!

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 you well and perform without incident. Observe precautions and become familiar with local, state, federal, and professional codes and procedures.

11.1 Battery Charging and Operation Mode

11.1.1 Charging

All charging procedures may be used with their limit values as specified for:

- IU characteristic
- W characteristic
- I characteristic

The battery can be float-charged with voltage of 2.23 to 2.25 V/cell or in case of rapid charging after discharge, with voltage of 2.35 to 2.40 V/cell.

Rapid charging usually lasts another 3-5 hours after the voltage has already reached 2.35 to 2.40 V/cell. When that occurs, an automatic switchover to the constant maintaining (float charge) voltage of 2.23 to 2.25 V/cell takes place.

Depending on the system at hand, charging may be carried out under either a floating or switch operating mode.

11.1.2 Floating operation

In this type of operation, the battery and the critical load circuits are continuously connected in parallel with a constant voltage charger. The charger must be capable of:

- Charging the battery from the discharged condition while supplying the DC power to the connected DC load
- Providing the required constant float voltage
- Providing voltage for equalizing the battery

Float voltage sustains the battery in a fully charged condition and makes it available to provide the emergency power required in the event of an AC power interruption or charger failure.

The charge voltage should be set at 2.23 V ± 1% x number of cells.

An equalizing charge should be given when:

- The temperature corrected specific gravity has fallen more than 10 points (.010).
- More than one cell falls below 2.15 V on float, corrected for temperature (Refer to Section 11.3 for equalizing charge).

11.1 Battery charging and operation mode, continued

11.1.3 Switch mode operation

In the switch mode operation the battery is separated from the load. Towards the end of charging the charge voltage of the battery is 2.6 - 2.70 V/cell. The charging process must be monitored. On reaching a full charge state, charging should be terminated or switched to float operation mode.

11.1.4 Battery charge/discharge operation

In the charge/discharge operation only the battery supplies operation load. Towards the end of charging, the charge voltage of the battery is 2.6 - 2.70 V/ cell. The charging process must be monitored. On reaching a full charge state charging should be terminated. The battery may be connected to the load if required.

11.2 Hydrometer Readings - Specific Gravity

Specific gravity is a measurement of the density or weight of the electrolyte compared with water (1.000). Specific gravity decreases on discharge and rises again on charge as a result of the electrochemical reaction within the cell.

Because both the cell temperature and the electrolyte level affect the specific gravity reading, they should be recorded at the same time as the gravity reading.

Do not take gravity readings immediately after adding water to the cells. Complete mixing usually takes several days. Because of the low charging currents in float service mixing of the electrolyte is a very slow process.

When taking hydrometer readings, hold the hydrometer stem in an upright position so that the hydrometer floats freely and does not touch at either the top or the sides.

Periodically clean the hydrometer barrel and float with soap and water for ease of reading and improved accuracy.

Specific gravity readings should be corrected for temperature. For every 10 °C of temperature above 25 °C, add 0.007 g/cm3 to the hydrometer reading. For every 10 °C of temperature below 25 °C, subtract one 0.007 g/cm3 from the hydrometer reading.

11.3 Equalizing Charge

Under normal conditions an equalizing charge is not required. An equalizing charge is a special charge given to a battery when non-uniformity in voltage has developed between cells. It is given to restore all cells to a fully charged condition.

Non-uniformity of cells may result from:

- Low float voltage due to improper adjustment of the charger.
- A panel voltmeter that reads high, resulting in a low charger output voltage.
- Selection of a low float voltage.
- Variations in cell temperatures in the series at a given time, due to environmental conditions or module arrangement. The maximum cell-to-cell temperature difference is 3°C. If cell temperature is the problem, review the location instructions in Section 5.0 to ensure proper location of the battery system.

11.3.1 Equalizing Charge Method

Constant voltage charging is the method for giving an equalizing charge.

Determine the equalizing voltage based on the maximum voltage allowed by the system equipment connected to the DC bus.

NOTE:

The voltage of a warm cell will be lower than the average. Its voltage can be corrected for temperature by adding 0.005 V/°C that the cell temperature is above the average temperature of the other cells.

During the equalizing charge, monitor the temperature of a pilot cell. It should not rise above 45°C. If it does, the equalizing voltage should be lowered to 2.20 or 2.25 V per cell until the cells cool down to a temperature of 30°C or lower. At this point, the equalizing charge may be resumed.

11.4 Operating Temperature

Normal battery life may be expected only when batteries are operated under the following temperature conditions 15 °C to 25 °C.

The room air circulation should be adequate to maintain all cells in the battery within 3 °C of each other.

High temperature increases realized capacity but decreases life expectancy, while low temperatures decrease capacity, but may not affect life expectancy.

12.0 Maintenance

For OPzS batteries maintenance is reduced to a minimum and is required only from time to time. At normal operation, only some distilled water has to be added once in a 2-3 year period and, if necessary, the surface of cells has to be cleaned. All stated voltage values are valid for the temperature range from 15 °C to 25 °C. Out of this range the corrections given by the battery producer are necessary.

12.1 Battery Cleaning

Check the battery for cleanliness at regular intervals. Keep cell terminals and connectors free of corrosion. Terminal corrosion may adversely affect the performance of the battery and could present a safety hazard.

12.1.1 Standard Cleaning

To perform a standard cleaning of the battery, follow the procedure below:

1. Disconnect the battery.
2. Wipe off any accumulation of dust on the cell covers with a cloth dampened in clean water.
3. If the cell covers or jars are damp with spilled electrolyte, wipe with a cloth dampened with a solution of sodium bicarbonate and cold water, mixed in the proportions of 1.0 lb/1.0 gal (0.5 kg/5.0 liter) of water. Follow this by wiping with a cloth dampened in clear water and then wipe dry with a clean cloth.

CAUTION!

Do not use any type of oil, solvent, detergent, petroleum-based solvent or ammonia solution to clean the jars or covers. These materials will cause permanent damage to the battery jar and cover and will void the warranty.

12.1.2 Corrosion Cleaning

To clean mild corrosion from cell posts:

1. Disconnect the battery.
2. Remove corrosion by wiping with a cloth dampened with baking soda solution [mix 1 gallon of water with 1 pound of baking soda]. Do not allow solution to enter cells. Follow with a cloth dampened with clear water.
3. Dry with a clean cloth.
4. With a small paintbrush, apply a light coat of ARONIX grease to the entire bolted connection. Wipe any excess grease from the cover.

12.1.3 Heavy Corrosion Cleaning

If the routine cleaning of bolted connections has been neglected, heavy post corrosion may occur. The performance of the battery under load could be adversely affected and this condition could present a safety hazard.

To perform the heavy corrosion cleaning:

1. Unbolt and remove connectors.
2. Apply a solution of baking soda and water to the cell posts and connectors to neutralize the corrosion (as shown in Section 12.1.2, Procedure 1). Do not allow solution to enter cells.
3. Clean the contact surfaces by rubbing the surface of the post or terminal and lead plated contact surfaces with a stiff-bristle nonmetallic brush or pad. Exercise care so you do not remove the lead plating on the connectors, terminal plates or lugs, exposing copper.
4. Recoat the contact surfaces with a thin application of the ARONIX grease, applied with a small paintbrush. Remove any excess grease from the cover.
5. Reinstall and tighten connections to appropriate torque value. See Section 7.5.3.

12.1.4 Cleaning Flame Arrestors

When cells are overfilled with electrolyte (above the high level line) or are excessively overcharged, the diffuser material of the flame arrestor may become partially clogged from electrolyte spray. Replace all flame arrestors having clogged pores or clean the arrestors as follows:

- Immerse the flame arrestor several times in a plastic bucket filled with distilled water. After each immersion, eject the water by vigorous shaking or with an air blast. Following the immersion of 15 flame arrestors, dump and refill the bucket with clean distilled water.
- Do not use any cleaning or neutralizing agents in the cleaning water, since any dry residue may clog the pores of the diffuser materials.

12.1.5 Replacing or Isolating a Cell

To replace or isolate a cell for maintenance:

1. Unbolt and remove connectors.
2. Remove and replace cell or isolate the required cell.
3. Reinstall and torque connections according to Section 7.5.3.

12.2 Maintenance Records

A complete recorded history of the battery operation is essential for obtaining satisfactory performance. Good record keeping will show when corrective action is required to eliminate possible charging, corrosion, maintenance or environmental problems.

Should you have any questions concerning how to perform the required maintenance, contact your nearest manufacturer service representative or call the corporate office number listed on the back of this manual and ask for Alpha Technologies Customer Service.

Accumulate and permanently record the following data for review so that any necessary remedial action may be taken:

The initial records are those readings taken after the battery has been in regular float service for 3 months (90 days). These should include the battery terminal float voltage and specific gravity reading of each cell corrected to 20°C, all cell voltages, the electrolyte level, temperature of one cell on each row of each rack, and cell-to-cell and terminal connection detail resistance readings. It is important that these readings be retained for future comparison.

The frequency and types of readings recorded are usually governed by the standard operating procedures and policies of the user. Adequate battery records are an invaluable aid as a check on maintenance procedures, environmental problems, system failures and corrective actions taken in the past.

NOTE:

Keeping the maintenance schedules is required to protect the warranty. Submission of the recorded data is required for any warranty claim made on the battery.

Monthly Maintenance Schedule (Recommended):

1. Check float charge voltage as measured at the battery terminals.
2. Check general appearance and cleanliness.
3. Check electrolyte levels.
4. Check for cracks in cells or leakage of electrolyte.
5. Check for evidence of corrosion at terminals or connectors. Clean and neutralize accordingly.
6. Check ambient temperature and condition of ventilating equipment.
7. Check pilot cell voltage, specific gravity and electrolyte temperature.
8. Check for evidence of voltage leaks to ground.
9. Record findings clearly and date originals and copies.

12.2 Maintenance Records, continued

Quarterly Maintenance Schedule (Required)

In addition to the monthly items listed above also measure and record the following:

1. Measure and record specific gravity of each cell.
2. Measure and record voltage of each cell.
3. Measure and record the total battery string voltage.
4. Measure and record the electrolyte temperature of one cell in each row of each rack.
5. Randomly select and check resistances of 10% of intercell connections.

Annual Maintenance Schedule (Required)

In addition to the monthly and quarterly items, also do the following:

1. Perform detailed visual inspection of each cell.
2. Check all bolted connections, re-torque as required. Tighten all bolted connections to the torque value of 132-177-inch lbs (15–20 Nm).
3. Check resistance of connecting cable from cell to cell.
4. Check conductance of each cell and record Siemens reading.
5. Ensure air flows freely through flame arrestors and clean as needed.
6. Check the integrity of rack.
7. Record findings clearly in log, date originals and copies.

12.3 Corrective Actions

Low electrolyte levels should be corrected by following the procedures given in Section 12.4.

If charger output voltage is not within the recommended voltage range, make adjustments. Determine the cause of the shift and correct the problem.

Keep cells clean, terminal posts and connectors corrosion-free, and grounds eliminated by following the procedures in Section 12.1.

When cell temperatures deviate more than 3°C from each other during an inspection, determine the cause and correct the problem.

When the connection resistance value of any intercell or terminal connection exceeds the installation base value by more than 20%, then this must be corrected using the procedures in Section 12.1.3.

12.4 Adding Water

Cells on charge normally show a very gradual lowering of the electrolyte level over a period of time, due to a loss of water from the electrolyte. Hydrogen and oxygen gasses are liberated by electrolysis as a result of charging current. Cells also lose water from normal evaporation, at a rate relative to the cell temperature and the humidity.

At regular intervals this water loss must be replaced with distilled, de-ionized or approved water, so as to maintain the electrolyte level at the mid-point between the high and low level lines marked on the jar, while on float.

The best time to add water to the stationary lead-acid battery is when the recharge or equalizing charge is about two-thirds completed. In this condition the electrolyte should be brought up to the high line. Water tends to float on top of the electrolyte for a while, but the gassing action of the latter part of the charging period will mix the water into the electrolyte. If temperatures may possibly drop below freezing, water should be added at the start of the recharge or equalizing charge to ensure thorough mixing with the acid solution.

Take care to keep the solution level below the top mark of the cell jar's solution level markings while on equalize. Overflow of solution can occur during gassing if too much water is added to the electrolyte.

Under certain conditions some batteries may never require an equalizing charge. These batteries may be watered when required. The mixing of the water with the electrolyte is a very slow process. In these cases realistic specific gravity readings may be obtained only after six or more weeks of charging at float voltages.

In cold climate with unheated battery rooms, water should be added only when the battery temperature is 10°C or above.

Never add any special types of powders, solutions or jellies to the batteries.

12.5 Quality of Water

Only distilled, de-ionized or other approved water should be added to the battery.

The conductivity of the water should be less then 30 ms.

Approved water is water that has been analyzed by a qualified laboratory and found safe for use with lead-acid storage batteries. Obtain an analysis from the local municipality to be sure the results comply with the impurity levels (see Table 14-9).

12.6 Filling Dry-Charged Cells

Cells may be received dry-charged. Dry-charged cells should be activated (filled with electrolyte and charged) only when ready to be placed in service. Dry-charged cells may be stored for up to 2 years without deterioration in cool, low-humidity locations (<30°C, <50% H).

To activate the cells, remove and discard the shipping plugs or pressure-relief valves for moist-charged cells and fill the cells to the low level line with an approved grade electrolyte. Mix the electrolyte before use to eliminate stratification.

WARNING!

Do not short the terminal posts.

NOTE:

When filling electrolyte, specific gravity must be 15 points (.015) less than the cell nominal specific gravity.

CAUTION!

When mixing electrolyte, always add acid to water. Pour slowly and stir constantly to avoid excessive heat or violent chemical reaction.

- Allow the battery to stand for 4 hours after filling. Add additional sulfuric acid of the filling electrolyte specific gravity to bring the electrolyte level up to the low level line. Charging must then be started within 12 hours.
- Before charging, install the flame arrestors, and then lock in place with one quarter turn clockwise.
- Start charging according to section 10.
- If cell temperatures exceed 45 °C, interrupt the charge and wait until the temperature has dropped to 30 °C. Then the charging may be resumed.
- Add filling electrolyte, where necessary, so all cells are at the high level line when the activating charge is about two-thirds complete.
- At the completion of the charge, the specific gravity of all cells, corrected to 20 °C, should be within the range indicated on the nameplate. At the end of charge, if the specific gravity is higher, remove some electrolyte and replace with water. If lower, remove some electrolyte and replace with electrolyte of higher specific gravity. At some remote locations, electrolyte with higher specific gravity may not be available. In this case, adjust the level with electrolyte instead of water. Measure the specific gravity and keep adjusting the level with electrolyte until a normal specific gravity reading is achieved.
- Electrolyte quality dilute sulfuric acid (H_2SO_4) - maximum impurities (see Table 14-8).

13.0 Test Procedures

13.1 Procedure for Battery Capacity Tests

At least 3 days but not more than 7 days before a battery capacity test, give the battery an equalizing charge as described in Section 11.3.

1. Make sure all battery connections are clean, tight, and free of corrosion.
2. While the battery is on float, read and record the specific gravity and voltage of each cell, the temperature of at least every 6th cell, and battery terminal float voltage.
3. Disconnect the battery charger and any other load on the battery to be tested.
4. Select the discharge rate based upon requirements (Reference to EN 60896-1, IEC 60896-1 or IEEE 450).
5. With the variable load bank having an ammeter in series and a voltmeter across the battery terminals, connect the load, simultaneously starting the timing device. Maintain the correct current while periodically reading and recording total battery voltage. When the minimum total voltage has been reached, it is desirable to read and record each cell voltage including an intercell connector.
6. Observe the battery for intercell connector heating.
7. Calculate the capacity using the following formula:

   % Capacity at 25°C = Ta/Ts x 100

   Ta = test discharge time to specified voltage.

   Ts = rated discharge time to specified voltage.
8. Recharge the battery, preferably using an equalizing charge (Section 11.3) to minimize the recharge time.

14.0 Specifications

Specifications and data are subject to change without notice.

TYPE	L (in/mm)	W (in/mm)	H (in/mm)	Filled Weight (lbs/kg)
12V 1 OPzS 50	10.5/272	8.0/205	15.0/388	80/37
12V 2 OPzS 100	10.5/272	8.0/205	15.0/388	117/53
12V 3 OPzS 150	15/380	8.0/205	15.0/388	167/76
6V 4 OPzS 200	10.5/272	8.0/205	15.0/388	108/48
6V 5 OPzS 250	15/380	8.0/205	15.0/388	143/65
6V6 OPzS 300	15/380	8.0/205	15.0/388	160/73
3 OPzS 150	4.0/103	8.0/206	14.5/375	35/16
4 OPzS 200	4.0/103	8.0/206	14.5/375	40/18
5 OPzS 250	4.5/124	8.0/206	14.5/375	48/22
6 OPzS 300	5.5/145	8.0/206	14.5/375	57/26
5 OPzS 350	4.5/124	8.0/206	19.0/491	64/29
6 OPzS 420	5.5/145	8.0/206	19.0/491	75/34
7 OPzS 490	6.5/166	8.0/206	19.0/491	86/39
6 OPzS 600	5.5/145	8.0/206	26.0/666	110/50
8 OPzS 800	7.5/191	8.2/210	26.0/666	143/65
10OPzS 1000	9.0/233	8.2/210	26.0/666	176/80
12 OPzS 1200	11.0/275	8.2/210	26.0/666	204/93
12 OPzS 1500	11.0/275	8.2/210	32.0/821	262/119
16 OPzS 2000	15.5/397	8.3/212	31.0/797	352/160
20 OPzS 2500	19.0/487	8.3/212	31.0/797	440/200
24 OPzS 3000	22.5/576	8.3/212	31.0/797	529/240

Table 14-1, OPzS Dimensions «

14.0 Specifications, continued

Specifications and data are subject to change without notice.

2V Cells – OPzS															
OPzS Cell Type	3 OPzS 150	4 OPzS 200	5 OPzS 250	6 OPzS 300	5 OPzS 350	6 OPzS 420	7 OPzS 490	6 OPzS 600	8 OPzS 800	10 OPzS 1000	12 OPzS 1200	12 OPzS 1500	16 OPzS 2000	20 OPzS 2500	24 OPzS 3000
Plate Type	OPzS 50 (SPg 250)**				OPzS 70 (SPg 315)			OPzS 100 (SPg 445)				OPzS 125 (SPg 555)			
Capacity (AH) when discharging															
1 hr	78	104	130	156	180	216	252	324	432	540	648	780	1040	1300	1560
3 hr	113	150	189	225	264	315	369	450	600	750	900	1125	1500	1875	2250
5 hr	126	170	215	255	300	360	425	510	690	865	1040	1275	1700	2125	2550
10 hr	150	200	250	300	350	420	490	600	800	1000	1200	1500	2000	2500	3000
Current (A) when discharging															
1 hr	78	104	130	156	180	216	252	324	432	540	648	780	1040	1300	1560
3 hr	37.6	50	63	75	88	105	123	150	200	250	300	375	500	625	750
5 hr	25.2	34	43	51	60	72	85	102	138	173	208	255	340	425	510
10 hr	15	20	25	30	35	42	49	60	80	100	120	150	200	250	300
Final voltage (v/cell) when discharging															
1 hr	1.79				1.74			1.73				1.70			
3 hr	1.82				1.79			1.79				1.79			
5 hr	1.83				1.81			1.81				1.81			
10 hr	1.85				1.83			1.83				1.85			

Table 14-2, OPzS General Specifications «

12V Blocks – OPzS		
OPzS CellType	Volts	Capacity 10 Hrs to1.8Vpc
12V 1 OPzS 50	12	60
12V 2 OPzS 100	12	105
12V 3 OPzS 150	12	158
6V 4 OPzS 200	6	210
6V 5 OPzS 250	6	263
6V 6 OPzS 300	6	315

Table 14-3, OPzS Capacity «

14.0 Specifications, continued

Specifications and data are subject to change without notice.

Cell Type	10 Min	30 Min	1 Hr	3 Hr	4 Hr	5 Hr	8 Hr	10 Hr	24 Hr
12V 1 OPzS 50	38.4	32	24	12	9.7	9	6	5	2.3
12V 2 OPzS 100	66.0	55	42.7	24	18.4	17	11.4	10.2	4.6
12V 3 OPzS 150	99.0	82.5	64.1	36	27.6	25.5	17.1	15.3	6.9
6V 4 OPzS 200	132.0	110	85.4	48	36.8	34	22.8	20.4	9.2
6V 5 OPzS 250	165.0	137.5	106.8	60	46	42.5	28.5	25.5	11.5
6V 6 OPzS 300	198.0	165	128.1	72	55.2	51	34.2	30.6	13.8
2 OPzS 100	66.0	55	42.7	24	18.4	17	11.4	10.2	4.6
3 OPzS 150	99.0	82.5	64.1	36	27.6	25.5	17.1	15.3	6.9
4 OPzS 200	132.0	110	85.4	48	36.8	34	22.8	20.4	9.2
5 OPzS 250	165.0	137.5	106.8	60	46	42.5	28.5	25.5	11.5
6 OPzS 300	198.0	165	128.1	72	55.2	51	34.2	30.6	13.8
5 OPzS 350	214.2	178.5	140	80.5	64.4	56	38.9	35	15.8
6 OPzS 420	257.0	214.2	168	96.6	77.3	67.2	46.6	42	18.9
7 OPzS 490	299.9	249.9	196	112.7	90.2	78.4	54.4	49	22.1
6 OPzS 600	350.6	292.2	228	132	109.2	96	66.6	60	27.0
12 OPzS 600	396.0	330	256	144	110	102	68	61	27.5
8 OPzS 800	467.5	389.6	304	176	145.6	128	88.8	80	36.0
12 OPzS 840	513.6	428	336	193	155	134	93	84	37.8
10OPzS 1000	584.4	487	380	220	182	160	111	100	45.0
12 OPzS 1200	701.3	584.4	456	264	218.4	192	133.2	120	54.0
12 OPzS 1500	792.0	660	541.5	330	274.5	240	169.5	150	67.5
16 OPzS 2000	1056.0	880	722	440	366	320	226	200	90.5
20 OPzS 2500	1320.0	1100	902.5	550	457.5	400	282.5	250	112.5
24 OPzS 3000	1584.0	1320	1083	660	549	480	339	300	135.0

Table 14-4, Discharge Current (1.83Vpc End Voltage) «

14.0 Specifications, continued

Specifications and data are subject to change without notice.

Cell Type	1 Min	10 Min	30 Min	1 Hr	3 Hr	4 Hr	5 Hr	8 Hr	10 Hr	24 Hr
12V 1 OPzS 50	58.6	42	35	25	13	9.6	9	7	6	2.7
12V 2 OPzS 100	125.6	90	75	51	25	19.3	18	12	10.5	4.7
12V 3 OPzS 150	188.3	135	112.5	76.5	37.5	29	27	18	15.8	7.1
6V 4 OPzS 200	251.1	180	150	102	50	38.6	35	24	21	9.5
6V 5 OPzS 250	313.9	225.5	187.5	127.5	62.5	48.3	45	30	26.3	11.8
6V 6 OPzS 300	376.7	270	225	153	75	57.9	54	36	31.5	14.2
2 OPzS 100	125.6	90	75	51	25	19.3	18	12	10.5	4.7
3 OPzS 150	188.3	135	112.5	76.5	37.5	29	27	18	15.8	7.1
4 OPzS 200	251.1	180	150	102	50	38.6	36	24	21	9.5
5 OPzS 250	313.9	225	187.5	127.5	62.5	48.3	45	30	26.3	11.8
6 OPzS 300	376.7	270	225	153	75	57.9	54	36	31.5	14.2
5 OPzS 350	391.7	280.8	234	161	84	67.9	59.5	40.6	35.7	16.1
6 OPzS 420	450.0	322.6	268.8	193.2	100.8	81.5	71.4	48.7	42.8	19.3
7 OPzS 490	525.0	376.3	313.6	225.4	117.6	95.1	83.3	56.8	50	22.5
6 OPzS 600	532.3	381.6	318	258	144	115.2	102	70.2	61.2	27.5
12 OPzS 600	753.3	540	450	306	150	116	108	72	63	28.4
8 OPzS 800	709.8	508.8	424	344	192	153.6	135	93.6	81.6	36.7
12 OPzS 840	900.6	645.6	538	386	202	163	143	97	86	38.7
10OPzS 1000	887.2	636	530	430	240	192	170	117	102	45.9
12 OPzS 1200	1064.7	763.2	636	516	288	230.4	204	140.4	122.4	55.1
12 OPzS 1500	1305.7	936	780	600	345	286.5	255	178.5	153	68.9
16 OPzS 2000	1741.0	1248	1040	800	460	382	340	238	204	91.8
20 OPzS 2500	2176.2	1560	1300	1000	575	477.5	425	297.5	255	114.8
24 OPzS 3000	2611.4	1872	1560	1200	690	573	510	357	357	137.7

Table 14-5, Discharge Current (1.80Vpc End Voltage) «

14.0 Specifications, continued

Specifications and data are subject to change without notice.

Cell Type	1 Min	10 Min	30 Min	1 Hr	3 Hr	4 Hr	5 Hr	8 Hr	10 Hr	24 Hr
12V 1 OPzS 50	-	46.8	39	26	13	9.7	9	7	-	-
12V 2 OPzS 100	-	94.9	79.1	54	26.1	20.4	19	12.6	-	-
12V 3 OPzS 150	-	142.4	118.7	81	39.2	30.6	28.5	18.9	-	-
6V 4 OPzS 200	-	189.8	158.2	108	52.2	40.8	38	25.2	-	-
6V 5 OPzS 250	-	237.4	197.8	135	65.3	51	47.5	31.5	-	-
6V 6 OPzS 300	-	284.8	237.3	162	78.3	61.2	57	37.8	-	-
2 OPzS 100	140	94.9	79.1	54	26.1	20.4	19	12.6	-	-
3 OPzS 150	210	142.4	118.7	81	39.2	30.6	28.5	18.9	-	-
4 OPzS 200	280	189.8	158.2	108	52.2	40.8	38	25.2	-	-
5 OPzS 250	350	237.4	197.8	135	65.3	51	47.5	31.5	-	-
6 OPzS 300	420	284.8	237.3	162	78.3	61.2	57	37.8	-	-
5 OPzS 350	490	302.4	252	178.5	91	72.5	63	42	-	-
6 OPzS 420	588	362.9	302.4	214.2	109.2	86.9	75.6	50.4	-	-
7 OPzS 490	686	423.4	352.8	249.9	127.4	101.4	88.2	58.8	-	-
6 OPzS 600	840	460.8	384	288	156	121.2	108	74	-	-
12 OPzS 600	-	570.0	475	324	157	122	114	76	-	-
8 OPzS 800	1120	614.4	512	384	208	161.6	144	99.2	-	-
12 OPzS 840	-	726.0	605	428	218	174	151	101	-	-
10OPzS 1000	1400	768.0	640	480	260	202	180	124	-	-
12 OPzS 1200	1680	921.6	768	576	312	242.4	216	148.8	-	-
12 OPzS 1500	2100	1116.0	930	705	390	303	270	189	-	-
16 OPzS 2000	2800	1488.0	1240	940	520	404	360	252	-	-
20 OPzS 2500	3500	1860	1550	1175	650	505	450	315	-	-
24 OPzS 3000	4200	2232.0	1860	1410	780	606	540	378	-	-

Table 14-6, Discharge Current (1.75Vpc End Voltage) «

14.0 Specifications, continued

Specifications and data are subject to change without notice.

Cell Type	10 Min	30 Min	1 Hr	3 Hr	4 Hr	5 Hr	8 Hr	10 Hr	24 Hr
12V 1 OPzS 50	49.2	41	27	13	9.5	9	-	-	-
12V 2 OPzS 100	102.0	85	58	27	21.2	20	-	-	-
12V 3 OPzS 150	153.0	127.5	87	40.5	31.8	30	-	-	-
6V 4 OPzS 200	204.0	170	116	54	42.4	40	-	-	-
6V 5 OPzS 250	255.0	212.5	145	67.5	53	50	-	-	-
6V 6 OPzS 300	306.0	255	174	81	63.6	60	-	-	-
2 OPzS 100	102.0	85	58	27	21.2	20	-	-	-
3 OPzS 150	153.0	127.5	87	40.5	31.8	30	-	-	-
4 OPzS 200	204.0	170	116	54	42.4	40	-	-	-
5 OPzS 250	255.0	212.5	145	67.5	53	50	-	-	-
6 OPzS 300	306.0	255	174	81	63.6	60	-	-	-
5 OPzS 350	331.0	275.8	192.5	92.8	74.9	70	-	-	-
6 OPzS 420	397.2	331	231	111.3	89.9	84	-	-	-
7 OPzS 490	463.3	386.1	269.5	129.9	104.9	98	-	-	-
6 OPzS 600	518.4	432	312	159	127.2	117	-	-	-
12 OPzS 600	612.0	510	348	162	127	120	-	-	-
8 OPzS 800	691.2	576	416	212	169.6	156	-	-	-
12 OPzS 840	794.4	662	462	223	180	168	-	-	-
10OPzS 1000	864.0	720	520	265	212	195	-	-	-
12 OPzS 1200	1036.0	864	624	318	254.4	234	-	-	-
12 OPzS 1500	1242.0	1035	765	397.5	318	285	-	-	-
16 OPzS 2000	1656.0	1380	1020	530	424	380	-	-	-
20 OPzS 2500	2070.0	1725	1275	662.5	530	475	-	-	-
24 OPzS 3000	2484.0	2070	1530	795	636	570	-	-	-

Table 14-7, Discharge Current (1.70Vpc End Voltage) «

14.0 Specifications, continued

Specifications and data are subject to change without notice.

Electrolyte Quality (Dilute Sulfuric Acid H_2SO_4) - Maximum Impurities (% by Weight)		
	1.250 - 1.300	1.170 - 1.215
Organic Matter	None	None
Platinum (Pt)	None	None
Sulfurous Acid (SO2)	0.0016	0.0013
Iron (Fe)	0.0020	0.0016
Copper (Cu)	0.0001	0.00008
Zinc (Zn)	0.0016	0.0013
Arsenic (As)	0.00004	0.00003
Antimony (Sb)	0.00004	0.00003
Selenium (Se)	0.0008	0.0006
Nickel (Ni)	0.00004	0.00003
Manganese (Mn)	0.000008	0.000006
Nitrates (NO3)	0.0002	0.00016
Ammonium (NH4)	0.0004	0.0003
Chloride (CI)	0.0004	0.0003
Fixed Residue	0.012	0.009

Table 14-8, Sulphuric Acid Impurities «

14.0 Specifications, continued

Specifications and data are subject to change without notice.

Battery Water Quality Maximum Impurities (Parts per Million (PPM))	
Requirements	Maximum Allowable Limits
Total Solids	350.0
Fixed Solids	200.0
Organic and Volatile	150.0
Iron	4.0
Chloride	25.0
Ammonium (NH4)	4.0
Nitrates (NO2)	10.0
Nitrates (NO3)	10.0
Manganese	0.07
Calcium and Magnesium	40.0

Table 14-9, Demineralized Water Impurities «

List of Reference Standards	
Stationary lead-acid batteries. General requirements and methods of test Part 1. Vented types.	EN60896-1, IEC 896-1
Sulphuric acid for use in lead-acid batteries	BS3031
Sulphuric acid and water for use in lead-acid batteries	DIN 43 530-1
Stationary lead-acid batteries accessories	DIN 40 740
Stationary lead-acid batteries - tubular positive plates	DIN 40 736
Safe operation of starter batteries	BS 6604
Safety reqs for secondary batteries and battery installations Part 2: Stationary lead-acid batteries	EN50 272-2 (VDE 0510)
Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications	IEEE 450
Recommended practice fro installation design and installation of vented lead-acid batteries for stationary applications (ANSI/BCI)	IEEE 484
Sizing lead-acid batteries for stationary applications (BCI)	IEEE 485

Table 14-10, List of Reference Standards «

14.0 Specifications, continued

Specifications and data are subject to change without notice.

Voltage is 2.23 Float						for 60 cells
Type of cell	ml/cell,month	ml gas/cell,h	ml H2/cell,h	lH2/cell,min	cu.ftH2/cell,min	cu.ftH2/day
3OPzS150	24750	33	22	0.0003	0.0000130	1.126
4OPzS200	33000	44	30	0.00049	0.0000174	1.502
5OPzS250	41250	55	37	0.00062	0.0000217	1.877
6OPzS300	49500	67	44	0.00074	0.0000261	2.252
5OPzS350	57750	78	52	0.00086	0.0000304	2.628
6OPzS420	69300	93	62	0.00103	0.0000365	3.153
7OPzS490	80850	109	72	0.00121	0.0000426	3.679
6OPzS600	99000	133	89	0.00148	0.0000521	4.505
8OPzS800	132000	177	118	0.00197	0.0000695	6.006
10OPzS1000	165000	222	148	0.00246	0.0000869	7.508
12OPzS1200	198000	266	177	0.00295	0.0001043	9.009
12OPzS1500	247500	333	222	0.00369	0.0001303	11.261
16OPzS2000	330000	444	295	0.00492	0.0001738	15.015
20OPzS2500	412500	554	369	0.00615	0.0002172	18.769
24OPzS3000	495000	665	443	0.00739	0.0002607	22.523
12OPzS600	99000	133	89	0.00148	0.0000521	4.505
12OPzS840	138600	186	124	0.00207	0.0000730	6.306
Voltage is 2.35-2.40Vpc						**for 60 cells**
Type of cell	ml/cell,month	ml gas/cell,h	ml H2/cell,h	lH2/cell,min	cu.ftH2/cell,min	cu.ftH2/day
3OPzS150	49500	67	44	0.00074	0.0000261	2.252
4OPzS200	66000	89	59	0.00098	0.0000348	3.003
5OPzS250	82500	111	74	0.00123	0.0000434	3.754
6OPzS300	99000	133	89	0.00148	0.0000521	4.505
5OPzS350	115500	155	103	0.00172	0.0000608	5.255
6OPzS420	138600	186	124	0.00207	0.0000730	6.306
7OPzS490	161700	217	145	0.00241	0.0000852	7.357
6OPzS600	198000	266	177	0.00295	0.0001043	9.009
8OPzS800	264000	355	236	0.00394	0.0001390	12.012
10OPzS1000	330000	444	295	0.00492	0.0001738	15.015
12OPzS1200	396000	532	354	0.00591	0.0002085	18.018
12OPzS1500	495000	665	443	0.00739	0.0002607	22.523
16OPzS2000	660000	887	591	0.00985	0.0003476	30.030
20OPzS2500	825000	1109	739	0.01231	0.0004345	37.538
24OPzS3000	990000	1331	886	0.01477	0.0005214	45.046
12OPzS600	198000	266	177	0.00295	0.0001043	9.009
12OPzS840	277200	373	248	0.00414	0.0001460	12.613
Voltage is 2.40Vpc (Gassing)						**for 60 cells**
Type of cell	**ml/cell,month**	**ml gas/cell,h**	**ml H2/cell,h**	**lH2/cell,min**	**cu.ftH2/cell,min**	**cu.ftH2/day**
3OPzS150	84150	113	75	0.00126	0.0000443	3.829
4OPzS200	112200	151	100	0.00167	0.0000591	5.105
5OPzS250	140250	189	126	0.00209	0.0000739	6.381
6OPzS300	168300	226	151	0.00251	0.0000886	7.658
5OPzS350	196350	264	176	0.00293	0.0001034	8.934
6OPzS420	235620	317	211	0.00352	0.0001241	10.721
7OPzS490	274890	369	246	0.00410	0.0001448	12.508
6OPzS600	336600	452	301	0.00502	0.0001773	15.316
8OPzS800	448800	603	402	0.00670	0.0002364	20.421
10OPzS1000	561000	754	502	0.00837	0.0002954	25.526
12OPzS1200	673200	905	603	0.01004	0.0003545	30.631
12OPzS1500	841500	1131	753	0.01255	0.0004432	38.289
16OPzS2000	1122000	1508	1004	0.01674	0.0005909	51.052
20OPzS2500	1402500	1885	1255	0.02092	0.0007386	63.815
24OPzS3000	1683000	2262	1507	0.02511	0.0008863	76.578
12OPzS600	336600	452	301	0.00502	0.0001773	15.316
12OPzS840	471240	633	422	0.00703	0.0002482	21.442

Table 14-11, Total Gas Emission for OPzS Batteries after 10 years of Operation «

Specifications and data are subject to change without notice.

OPzS Cell Type	RI(mΩ)/CELL	Short Circuit Current (amps)
3 OPzS 150	1.15	1739
4 OPzS 200	0.74	2703
5 OPzS 250	0.63	3175
6 OPzS 300	0.52	3846
5 OPzS 350	0.58	3448
6 OPzS 420	0.53	3774
7 OPzS 490	0.48	4167
6 OPzS 600	0.47	4255
8 OPzS 800	0.40	5000
10 OPzS 1000	0.30	6667
12 OPzS 1200	0.29	6897
12 OPzS 1500	0.29	6897
16 OPzS 2000	0.18	11111
20 OPzS 2500	0.16	12500
24 OPzS 3000	0.15	13333
12 OPzS 600	0.31	6452
12 OPzS 840	0.25	8000

14-12, Internal Resistance and Short Circuit Currents (2 Volts) «

15.0 Battery Room Ventilation Calculation

For the batteries charged in “buffer coupling” or “full float” systems up to 2.4 Volts per cell, use the following calculation to determine the battery room ventilation:

Q = 55 x n x I

where:

Q = the amount of the fresh air in liters per hour,

n = the number of cells in the battery or in the battery room and

I = the charge current in amperes causing hydrogen evolution.

Example:

For stationary batteries OPzS charged to 2.40 V/cell I = 2 A is taken for each 100 Ah of rated battery capacity (C10).

The calculation of the ventilation for battery consisting of 54 cells type 4 OPzS 200 is as follows:

Q = 55 x 54 x (2 x 200/100) = 11.880 liters/hour

In the event where the unoccupied space of the battery room is 50 m^3 the air in the room should be exchanged with a fresh air every 4.2 hours. If the natural room ventilation cannot reach the calculated amount of air above, then the installation of forced a ventilation system with an acid-resistant pulling fan is required.

16.0 Maintenance Records

CHARGED BATTERY READINGS BEFORE DISCHARGE BEGINS

BATTERY TYPE _____ DATE_____ ROOM TEMP_____UNITS_____
VENDOR_____
BATTERY VOLTAGE : _____ VDC AT FLOAT _____ VDC OPEN CIRCUIT
COMMENTS:

Cell No.	Volts+2.000	Elect. Temp.	Sp.Gr.+1.000	Electrolyte Level*	CellNo.	Volts+2.000	Elect. Temp.	Sp.Gr.+1.000	Electrolyte Level*
1					30				
2					31				
3					32				
4					33				
5					34				
6					35				
7					36				
8					37				
9					38				
10					39				
11					40				
12					41				
13					42				
14					43				
15					44				
16					45				
17					46				
18					47				
19					48				
20					49				
21					50				
22					51				
23					52				
24					53				
25					54				
26					55				
27					56				
28					57				
29					58				

* Indicate Level By Marking Each Cell & Check off

Fig. 16-1, Charged Battery Readings Before Discharge Begins Form «

16.0 Maintenance Records, continued

AFTER “LOAD PROFILE” BATTERY

BATTERY TYPE _____ DATE_____ ROOM TEMP_____UNITS_____
VENDOR_____
BATTERY VOLTAGE : _____ VDC AT FLOAT _____ VDC OPEN CIRCUIT
COMMENTS:

Cell No..	Volts+2.000	Elect. Temp.	Sp.Gr.+1.000	Electrolyte Level*	Cell No..	Volts+2.000	Elect. Temp.	Sp.Gr.+1.000	Electrolyte Level*
1					30				
2					31				
3					32				
4					33				
5					34				
6					35				
7					36				
8					37				
9					38				
10					39				
11					40				
12					41				
13					42				
14					43				
15					44				
16					45				
17					46				
18					47				
19					48				
20					49				
21					50				
22					51				
23					52				
24					53				
25					54				
26					55				
27					56				
28					57				
29					58				

* Indicate Level By Marking Each Cell & Check off

Fig. 16-2, After “Load Profile” Battery Form «

16.0 Maintenance Records, continued

““FINAL RECHARGE” BATTERY READINGS

BATTERY TYPE _____ DATE_____ ROOM TEMP_____UNITS_____
VENDOR_____
BATTERY VOLTAGE : _____ VDC AT FLOAT _____ VDC OPEN CIRCUIT
COMMENTS:

Cell No..	Volts+2.000	Elect. Temp.	Sp.Gr.+1.000	Electrolyte Level*	Cell No..	Volts+2.000	Elect. Temp.	Sp.Gr.+1.000	Electrolyte Level*
1					30				
2					31				
3					32				
4					33				
5					34				
6					35				
7					36				
8					37				
9					38				
10					39				
11					40				
12					41				
13					42				
14					43				
15					44				
16					45				
17					46				
18					47				
19					48				
20					49				
21					50				
22					51				
23					52				
24					53				
25					54				
26					55				
27					56				
28					57				
29					58				

* Indicate Level By Marking Each Cell & Check off

Fig. 16-3, “Final Recharge” Battery Readings Form «

Power

Alpha Technologies

Alpha Technologies
3767 Alpha Way
Bellingham, WA 98226
USA
Tel: +1 360 647 2360
Fax: +1 360 671 4936
Web: www.alpha.com

Alpha Technologies Inc.
G.B. Enterprises Inc.
Alpha Industrial Power Inc.
1075 Satellite Blvd NW,
Suite 400
Suwanee, GA 30024
United States
Tel: +1 678 475 3995
Fax: +1 678 584 9259
USA
Tel: +1 360 647 2360
Fax: +1 360 671 4936

Web: www.alpha.com

Alpha Technologies Ltd.
4084 McConnell Court
Burnaby, BC, V5A 3N7
CANADA
Tel: +1 604 430 1476
Fax: +1 604 430 8908

Alpha Technologies
Europe Ltd.
Twyford House
Thorley
Bishop's Stortford
Hertfordshire
CM22 7PA
UNITED KINGDOM
Tel: +44 0 1279 501110
Fax: +44 0 1279 659870

Alpha Technologies GmbH
Hansastrasse 8
D 91126 Schwabach
GERMANY
Tel: +49 9122 79889 0
Fax: +49 9122 79889 21

Alphatec, Ltd
P.O. Box 56468
Limassol, Cyprus
CYPRUS
Tel: +357 25 375675
Fax: +357 25 359595

AlphaTEK ooo
Khokhlovskiy Pereulok 16
Stroenie 1, Office 403
109028 Moscow
RUSSIA
Tel: +7 495 916 1854
Fax: +7 495 916 1349

Alphatec Baltics
Konarskio G. 48
2009 Vilnius
LITHUANIA
Tel: +370 5 213 8822
Fax: +370 5 213 7799

Alpha Technologies
9, Impasse Sans Souci
92140 Clamart France
FRANCE
Tel: +33 141 900 707
Fax: +33 141 909 312