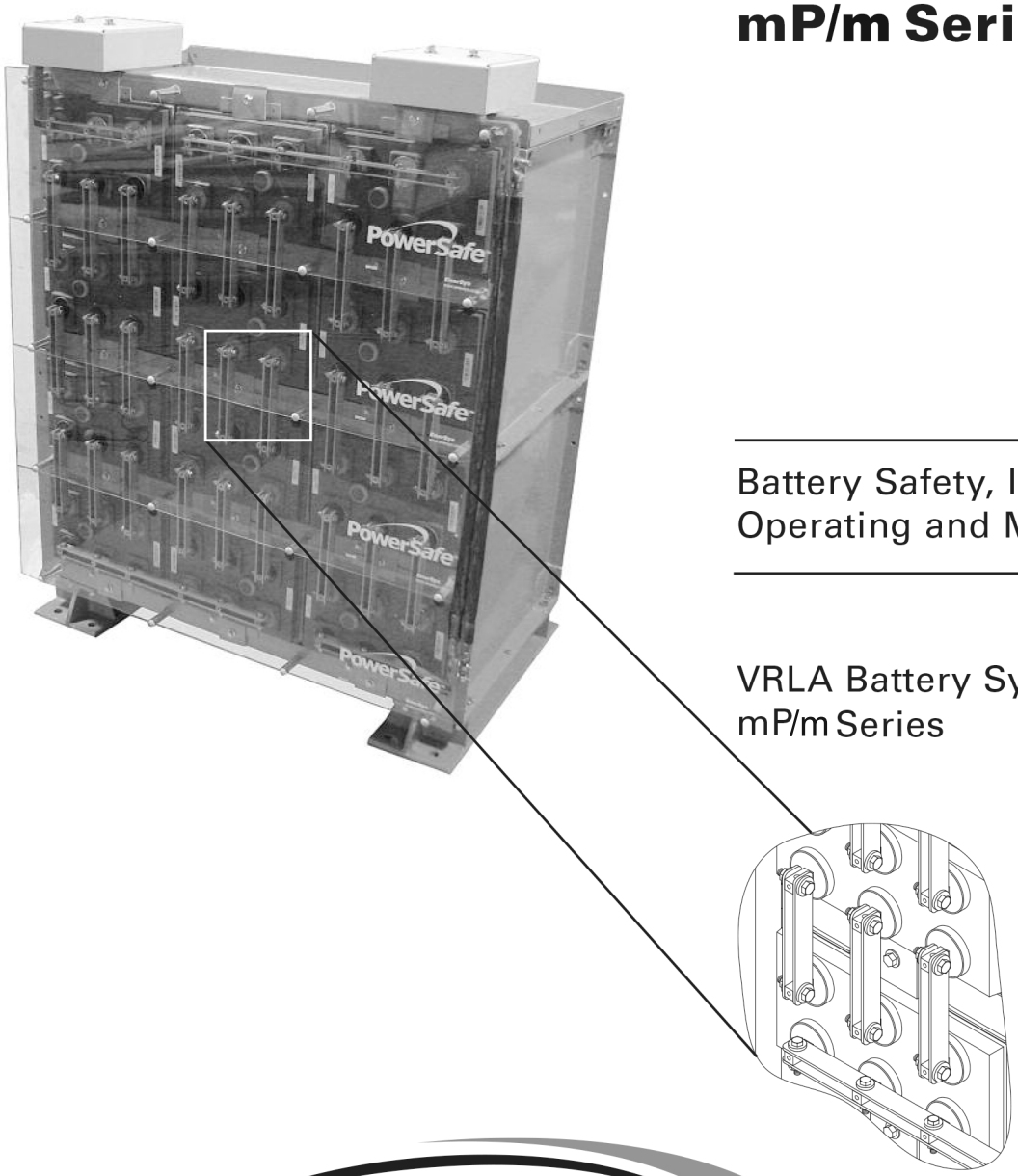
PowerSafe®

mP/m Series



Battery Safety, Installation, Storage, Operating and Maintenance Manual

VRLA Battery System
mP/m Series

EnerSys®
Power/Full Solutions

RESERVE
POWER

Publication No. US-MP-OM-001 — March 2012

Contact EnerSys® Reserve Power Technical Support at 1-800-538-3627 if you require clarification on any information contained in this manual.

This manual provides full instructions regarding safety, installation, storage, operation, and maintenance for EnerSys® valve-regulated lead acid batteries, as well as certain installation considerations. Failure to observe the precautions as presented may result in injury or loss of life.

Please check our website for literature updates.
www.enersys.com

Publication No. US-MP-OM-001
March 2017

GENERAL SAFETY INSTRUCTIONS

Warnings in this manual appear in any of three ways:

Danger

The danger symbol is a lightning bolt mark enclosed in a triangle. The danger symbol is used to indicate imminently hazardous situations, locations and conditions which, if not avoided, WILL result in death, serious injury and/or severe property damage.

Warning

The warning symbol is an exclamation mark in a triangle. The warning symbol is used to indicate potentially hazardous situations and conditions, which if not avoided COULD result in serious injury or death. Severe property damage COULD also occur.

Caution

The caution symbol is an exclamation mark enclosed in a triangle. The caution symbol is used to indicate potentially hazardous situations and conditions, which if not avoided may result in injury. Equipment damage may also occur.

Other warning symbols may appear along with the Danger and Caution symbol and are used to specify special hazards. These warnings describe particular areas where special care and/or procedures are required in order to prevent serious injury and possible death:

Electrical warnings

The electrical warning symbol is a lightning bolt mark enclosed in a triangle. The electrical warning symbol is used to indicate high voltage locations and conditions, which may cause serious injury or death if the proper precautions are not observed.

Explosion warnings

The explosion warning symbol is an explosion mark enclosed in a triangle. The explosion warning symbol is used to indicate locations and conditions where molten, exploding parts may cause serious injury or death if the proper precautions are not observed.

IMPORTANT SAFETY INSTRUCTIONS

DANGER

A battery can present a risk of electrical shock and high short circuit current.

The following safety precautions should be observed when working with batteries.

1. Verify that all power has been disconnected from battery prior to servicing.
2. Remove watches, rings or other metal objects.
3. Use tools with insulated handles to prevent inadvertent shorts.
4. Wear steel toe safety shoes.
5. Do not lay tools or metal parts on top of batteries.
6. Determine if the battery is inadvertently grounded. If inadvertently grounded, remove source of ground. Contact with any part of a grounded battery can result in electrical shock. The likelihood of such shock will be reduced if such grounds are removed during installation and maintenance.
7. Verify circuit polarities before making connections.
8. Disconnect charging source and load before connecting or disconnecting terminals.
9. Valve-regulated lead-acid (VRLA) batteries contain an explosive mixture of hydrogen gas. Do not smoke, cause a flame or spark in the immediate area of the batteries. This includes static electricity from the body.
10. Use proper lifting means when moving batteries and wear all appropriate safety clothing and equipment.
11. Do not dispose of lead acid batteries except through channels in accordance with local, state and federal regulations.

IMPORTANT SAFETY INSTRUCTIONS

SAVE THESE INSTRUCTIONS

This manual contains important instructions for PowerSafe® mP Lead-Acid Battery Systems that should be followed during the installation and maintenance of the battery system.

Only a qualified EnerSys® service representative or others who are knowledgeable in batteries and the required precautions should perform servicing of the batteries. Keep unauthorized personnel away from batteries.

CAUTION Misuse of this equipment could result in human injury and equipment damage. In no event will EnerSys be responsible or liable for either indirect or consequential damage or injury that may result from the use of this equipment.

CAUTION Do not dispose of the batteries in a fire.

CAUTION Do not open or mutilate the batteries. Released electrolyte is harmful to the eyes and skin and may also be toxic.

WARNING This unit contains sealed lead acid batteries. Lack of preventative maintenance could result in batteries exploding and emitting gasses and/or flame. An authorized, trained technician must perform annual preventative maintenance.

WARNING Failure to replace a battery before it reaches end of life may cause the case to crack, possibly releasing electrolyte from inside the battery and resulting in secondary faults such as odor, corrosion, smoke and fire.

WARNING Installation and servicing of batteries should be performed by personnel knowledgeable about batteries and the required precautions. Keep unauthorized personnel away from the batteries.

WARNING Proper maintenance to the battery system of this unit must be done by a qualified service technician. This is essential to the safety and reliability of your system.

WARNING Risk of fire, explosion, or burns. Do not disassemble, heat above 60°C (140°F), or incinerate.

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1.0 GENERAL INFORMATION

1.1 Introduction

EnerSys® modular valve-regulated lead acid (VRLA) batteries have unique features that make them easy to install and maintain. These batteries are composed of absorbed glass mat (AGM) separators with flat plates and electrolyte.

The AGM retains the electrolyte between the plates to ensure long float service.

PowerSafe® batteries utilize calcium alloy grids (NO cadmium) which float at a lower current than antimony (Sb) grids. Lower float currents, in conjunction with superior and uniform thermal management, reduce the chances of thermal runaway. (Temperature compensation chargers are also recommended.)

PowerSafe® VRLA batteries typically do not require a seperate battery room or “Hood” exhaust system like traditional Vented Lead Acid (VLA) Batteries. However, they do require adequate ventilation and should not be placed in “air tight” locations.

Systems are available in 24 VDC and 48 VDC configurations. These systems allow for assembly at remote locations.

See the *ASSEMBLY DRAWING* included with the product shipment to determine the configuration for your installation.

Before installation: Verify items received versus Bill of Lading. Verify parts against system Bill of Materials.

1.2 Precautions

BEFORE UNPACKING, STORING, HANDLING, INSTALLING, OPERATING OR PERFORMING MAINTENANCE ON THE ENERSYS® VRLA 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 your nearest EnerSys® sales/service representative for clarification or call the corporate office number listed on the back of this manual and ask for EnerSys Reserve Power Service.

Also, refer to all applicable federal, state and local regulations and industry standards.

YOU SHOULD BE TRAINED IN HANDLING, INSTALLING, OPERATING AND MAINTAINING BATTERIES BEFORE YOU WORK ON **ANY** BATTERY SYSTEM

1.3 Service

Should you require installation supervision, service, parts, accessories or maintenance; EnerSys® has a nationwide service organization to assist with your new battery purchase.

Please call your nearest EnerSys sales/service representative for more information or call the corporate office number listed on the back of this manual and ask for EnerSys Reserve Power Service.

2.0 SAFETY

2.1 General

PowerSafe® VRLA lead acid batteries are reduced-maintenance batteries that operate on recombinant principles and do not require water addition throughout their service life.

Under **NORMAL** operating conditions and use (i.e. properly charged and maintained), their design features include:

- minimized hydrogen gas release
- the virtual elimination of acid misting
- essentially the elimination of electrolyte leakage

Under **ABNORMAL** operating conditions (i.e. not properly charged and maintained) or as a result of damage, abuse and/or misuse, the potentially hazardous conditions of hydrogen gassing, acid misting and leakage may occur.

YOU SHOULD BE **TRAINED** IN HANDLING, INSTALLING, OPERATING AND MAINTAINING BATTERIES BEFORE YOU WORK ON ANY BATTERY SYSTEM.

You MUST understand the risk of working with batteries and BE PREPARED and EQUIPPED to take the necessary safety precautions. If not, contact EnerSys® Reserve Power Service.

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
- rubber gloves
- fire extinguisher
- rubber apron
- safety goggles & shoes
- acid spill cleanup kit
- face shields
- emergency eye wash
- and shower, if available

ALWAYS:

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

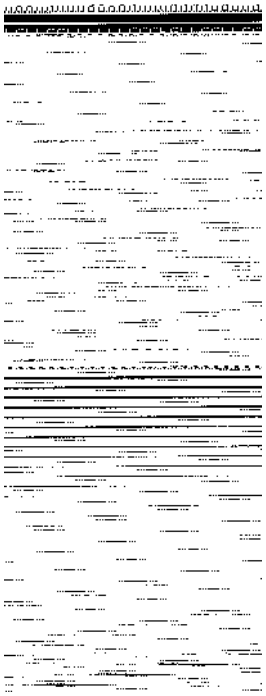
NEVER lay tools or other metallic objects on the battery modules.

Using the correct tools and wearing proper safety equipment will help prevent injury should an accident occur.

2.3 Safety Precautions

2.3.1 Electrolyte Burns

Because VRLA cells are sealed, they normally do not present an acid danger. However, they do contain electrolyte which can cause burns and other serious injuries.



Always wear protective clothing AND use the correct safety tools.

In case of **SKIN CONTACT** with sulfuric acid, **IMMEDIATELY**

1. **REMOVE** contaminated **CLOTHING**
2. **FLUSH** the area **THOROUGHLY** with **WATER**
3. Get **MEDICAL ATTENTION**, if required.

In case of **EYE CONTACT** with sulfuric acid, **IMMEDIATELY**

1. **FLUSH THOROUGHLY** for at least 15 minutes with large amounts of **WATER.**
2. Get **MEDICAL ATTENTION.**

In case of sulfuric acid **CONTACT WITH CLOTHING OR MATERIAL, IMMEDIATELY**

1. **REMOVE** contaminated **CLOTHING**
2. Apply a solution of sodium bicarbonate solution (1.0lb/1.0gal or 0.5 kg/5.0 liters of water) on the clothing or material.
3. Apply the solution until bubbling stops, then rinse with clean water.

NOTE:

In case of a electrolyte **SPILL,** bicarbonate of soda or an emergency spill kit should be within the battery room.

2.3.2 Explosive Gases

Batteries can generate gases which, when released, can explode causing blindness and other serious personal injury.

Always wear protective clothing and use the correct safety tools.

Eliminate any potential of sparks, flames or arcing.

IN CASE OF FIRE: To extinguish a fire in a battery room containing lead-acid batteries, use a CO_2, foam or dry-chemical extinguishing medium. Do NOT discharge the extinguisher directly onto the battery. The resulting thermal shock may cause cracking of the battery case/cover.

SPECIAL PROCEDURES:

If batteries are on charge, shut off power. Use positive-pressure, self-contained breathing apparatus. Wear acid resistant clothing. Water applied to electrolyte generates heat and causes it to splatter.

TOXIC FUMES:

Burning plastic may cause toxic fumes. Leave area as soon as possible if toxic fumes are present. Wear breathing apparatus if required to remain in the area.

2.3.3 Electrical Shocks and Burns

Multi-cell battery systems can attain high voltage and/or currents. Do NOT touch uninsulated batteries, connectors or terminals. To prevent serious electrical burns and shock, use EXTREME CAUTION when working with the system.

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

Remove all jewelry that could produce a short circuit.

BEFORE working on the system:

1. Disconnect ALL loads and power sources to the battery. Use appropriate lockout/tagout procedures.

IF BATTERY SYSTEM IS GROUNDED: (system is intentionally grounded by connecting a battery terminal to ground)

1. An increased shock hazard exists between the terminal of opposite polarity and ground (i.e., dirt and acid on top of battery cell touching rack).

2. If an unintentional ground develops within the already grounded system, a short circuit may occur and cause explosion or fire.

IF BATTERY SYSTEM IS UNGROUNDED (system is NOT grounded):

1. If an unintentional ground develops within the system, an increased shock hazard exists between the terminal of opposite polarity and ground.

2. If a second unintentional ground develops within the already unintentionally grounded system, a short circuit may occur and cause explosion or fire.

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

IMPORTANT:

If you have **ANY** questions concerning safety when working with the battery system, contact your nearest EnerSys® sales/service representative to clarify any of the noted safety precautions, or call the corporate office number listed on the back of this manual and ask for EnerSys Reserve Power Service.

3.0 INSPECTING THE BATTERY SHIPMENT

3.1 General

Precautions have been taken to pack the battery units, individual cells or cabinets containing batteries for shipment to ensure their 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

IMMEDIATELY upon delivery (while the carrier representative is still on-site) inventory all materials against the Bill of Lading and inspect for visible external damage.

Check material quantities received against the Bill of Lading, including the number of battery pallets and the number of accessory boxes.

Note any:

- damage to packing material and/or product.
- wetness or stains, indicating electrolyte leakage.

If damage is noted:

1. Make a descriptive notation on the delivery receipt before signing.
2. Request an inspection by the carrier.
3. File a damage report.

3.3 Concealed Damage

Within **15 days of receipt**, unpack the cells/batteries and check for concealed damage. Remember, you are handling a **LIVE** battery. Take precaution against a shock hazard. Follow all safety precautions as noted in Section 2.0.

Note any:

- damage to packing material and/or product.
- wetness or stains, indicating electrolyte leakage.

If damage is noted:

1. Request an inspection by the carrier.
2. File a concealed-damage claim.

Check the received materials against the detailed packing list to verify receipt of all materials in the quantities specified.

For export, the cells may be packed in wooden boxes which must be opened completely and carefully, and the cells then handled as described hereafter. See Section 6 for unpacking and handling.

DELAY IN NOTIFYING THE CARRIER MAY RESULT IN LOSS OF YOUR RIGHT TO REIMBURSEMENT FOR DAMAGES. Refer to the Bill of Lading, if, when performing the parts inventory, you are unsure about the appearance of a part.

If you have any questions concerning potential damages, contact your nearest EnerSys® sales/service representative, or call the corporate office number listed on the back of this manual and ask for EnerSys Reserve Power 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.

4.2 Storage Location

1. Store batteries indoors in a clean, dry and cool location. Storage at higher temperatures will result in accelerated rates of self-discharge and possible deterioration of battery performance and life.

2. Do **NOT** stack pallets. **DAMAGE MAY OCCUR AND WARRANTIES MAY BE VOIDED.**

3. Recharge the PowerSafe® mP Series before their Open Circuit Voltage (OCV) reaches 2.11 Vdc.

4. If no voltmeter is available, the maximum storage time from shipment to initial charge is six months for batteries stored at ambient temperatures no warmer than 77˚F (25˚C). For storage temperatures greater than 77˚F (25˚C), the battery must be recharged one (1) month sooner for every 5˚F (3˚C) increase above 77˚F (25˚C). See Table 4.1.

TABLE 4.1

STORAGE TEMPERATURE	STORAGE TIME
32˚F (0˚C) to 50˚F (10˚C)	9 months
51˚F (11˚C) to 77˚F (25˚C)	6 months
78˚F (26˚C) to 92˚F (33˚C)	3 months

If storage time exceeds the storage time recommended in Table 4.1, give the battery a freshening charge before the end of the recommended storage interval. See Section 16 for charging information.

PowerSafe® VRLA mP Series batteries must be charged in the horizontal position. Charging in the vertical position may void product warranty.

5. Repeat the *freshening charge* (Reference Section 16) for each additional storage interval until the battery is installed.

   Storage at higher temperatures will result in accelerated rates of self-discharge and possible deterioration of battery performance and life. Storage times exceeding the above may result in plate sulfation, which may adversely affect electrical performance and expected life.

6. Maximum total storage time prior to installation is two (2) years from date of shipment from the factory to the customer. *Freshening charges* are required before the end of the storage time period, or more frequently, as noted in Table 4.1.

7. **FAILURE TO CHARGE AS NOTED VOIDS THE BATTERY'S WARRANTY.**

4.3 Advanced Preparation

If storage times are likely to be exceeded, it may be beneficial to plan ahead and have an adequate charger available with an appropriate AC supply voltage. The positioning of the cells to accept temporary inter-cell connectors is another consideration for advanced planning.

Make every effort to get the battery connected to the charger before expiration of the storage period, thereby avoiding the additional labor cost of freshening charges.

WARNING

Failure to charge as noted voids the battery's warranty.

BEFORE INSTALLATION
READ THIS SECTION THOROUGHLY.

5.0 INSTALLATION CONSIDERATIONS

5.1 General

If you have any questions concerning the installation considerations, contact your EnerSys® sales/service representative for clarification or call the corporate office number listed on the back of this manual and ask for EnerSys Reserve Power Service.

When planning the system space requirements, consider the following:

- space
- environment
- temperature
- distance from operating equipment
- ventilation
- battery system configuration
- floor loading
- floor anchoring

Table 5.1 will assist you to ensure that all requirements for installation location are considered.

TABLE 5.1

CONSIDERATION	RECOMMENDATION
Space	Aisle space should be in accordance with the National Electric Code (NEC) Article 110-16 or local codes. Clearance from wall/equipment — 4" (10 cm) minimum
Environment	Clean, cool and dry. The location should be selected to keep water, sunlight, oil, and dirt away from all cells.
Temperature	Ambient temperature between 72˚–78˚F (23˚–26˚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.

TABLE 5.1 (continued)	
CONSIDERATION	**RECOMMENDATION**
Ventilation	No seperate battery room or “hood” exhaust is required. However, VRLA batteries do require adequate ventilation and should not be installed in “air tight” locations.
Grounding	It is recommended that the modules or racks be grounded in accordance with NEC and/or local codes.
Floor	Reasonably level. Shimming up to 1/4" (6mm) maximum to level battery front to rear and side to side. Capable of supporting the weight of the battery as well as any auxiliary equipment.
Anchoring	**All** installations should be floor anchored. Anchoring should meet all local, state, federal codes and industry standards. **Floor anchoring and its design are the responsibility of the installer.** Ensure **seismic** requirements are considered.
Proximity to Electronic Equipment	PowerSafe® VRLA batteries may be installed next to electronic equipment, unless the equipment generates heat.
Cell Identification/ Numbering	EnerSys® recommends battery one (1) be at the positive (+) output. Then label the cells in ascending sequential order as the cells are connected in series. The cells at the end or last cell should be the highest numbered cell and be at the negative (-) output.

5.2 Considerations for Connecting the Battery System to Operating Equipment

The battery has been sized based on a specific load (amps or KW) for a specific run time, temperature and end voltage. Consult with the system/equipment supplier to determine these parameters. Battery performance is based on these values which are measured at the battery terminals.

It is important to ensure that the load cables:

- between the battery and its load are the shortest routing possible to the terminal, allowing sufficient additional cable (about 6" [15 cm]) for connect/disconnect.
- are the proper size to minimize the voltage drop between the battery output terminals and the load.
- are connected to the terminal plate (NEVER connect the load cable(s) directly to the battery terminal).

To select the proper cable size:

1. Determine the cable size necessary to carry the design load.
2. Calculate the voltage drop of the cable between the battery terminal plate and the operating equipment.
3. Increase cable size to achieve the allowable voltage drop.

Cable selection should provide no greater voltage drop than required between the battery system and the operating equipment as determined by the equipment/system supplier. Excessive voltage drop will reduce the desired support time of the battery system.

5.3 Considerations for Parallel Installation

If it is necessary to connect the battery system in parallel to obtain sufficient capacity, cable connections to each of the parallel strings are important.

To obtain proper load sharing on the discharge, satisfactory recharge, and the same float voltage for each string, cables from the batteries to the load must be:

- as short as possible (equal to the longest inter-cell connector).
- of equal lengths to the load.
- of sufficient ampacity (cable ampacity should not be exceeded).

6.0 UNPACKING AND HANDLING FOR INSTALLATION

6.1 General

Battery modules are shipped upright on pallets. Accessories for installation and use are supplied as optional prepackaged kits and are shipped on separate pallet(s) and/or in box (es). Cells may be packed in wooden boxes, which must be opened completely and carefully. The cells **must then be handled as described in the battery cell installation portion of this Manual (Section 9.0).**

DO NOT Lift any cell by the terminal posts as this will void the warranty.

Safety is the first priority when lifting cells. There are several methods that can be employed when lifting cells for stowing. When lifting large cells/units with a crane, hoist or similar device, the use of lifting belt(s) is recommended. When lifting a cell into place with a “plate” or “table” type lift, it is suggested that the cell be laid on two short pieces of 2x4 lumber to avoid damaging the front metal jacket tab. This will allow the cell to be better aligned when sliding/stowing it in to the system. Note: The use of 2x4 lumber may also be beneficial when using belts to install a cell as this will provide space to pass the belt under the product. **Terminal caps must be in place during product installation.**

DO NOT attempt to remove the pressure relief valves or vent covers as this will void the warranty. Attempted removal of the valve may also damage the vent and prevent proper functioning of the battery.

DO NOT attempt to remove the cell from the metal jacket it is contained in as this will void the warranty. The metal jacket not only provides protection to the product but is an integral part of the cells design.

6.2 Accessories

CHECK accessory package with Packing List/Bill of Material to ensure completeness. VERIFY QUANTITY OF ITEMS WITH THE *PACKING LIST*. DO NOT proceed with installation until all accessory parts are available.

Accessories are packed in a separate carton and ***may*** include, but are not limited to, the following:

TABLE 6.1

ACCESSORIES	CHECK IF RECEIVED
Connector Hardware: • Bolts • Washers • Nuts	
Post Connectors	
Terminal Plate Kits	
Terminal Plate Connectors	
Cell Number Set Labels	
Assembly Hardware	
Rack Parts	
NO-OX-ID Grease for Battery Posts	
Assembly Drawing	
Bill of Materials/Packing List	
Operation & Installation Manual	
Safety Shields and Standoffs	
Miscellaneous: • Cables • Side Termination Kits	

6.3 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.

The following is a list of equipment typically recommended for installation of a PowerSafe® VRLA Battery System.

TABLE 6.2

EQUIPMENT RECOMMENDED	CHECK IF ON HAND
Forklift or Portable Lift Crane	
Cell Lift Cart	
Chalk Line	
Torpedo Level (Plastic)	
Torque Wrench (10-200 in-lbs)	
Torque Wrench (50-100 ft-lbs)	
Floor Anchors (User-supplied per battery system and stress analysis)	
Floor Shims (User-supplied)	
3/8" Drive Rachet Insulated Wrench with Minimum 3" Extension with 5/16" thru 3/4" Sockets	
Insulated Box Wrenches (5/8" thru 3/4")	
Screwdrivers	
Wipes, Paper or Cloth	
Stiff-Bristle Nonmetallic Brush/Pad	
Tape Measure (Nonmetallic)	
Safety Equipment and Clothing	
Small Paintbrush	
NO-OX-ID Grease	

CAUTION

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

7.0 SYSTEM LAYOUT

Before installing the battery system, layout available floor space including aisles for installation, maintenance and possible cell replacement. Review the installation considerations of this manual (Section 5.0). The recommended clearance between these racks and any objects (including walls and equipment) is 4 inches (102 mm).

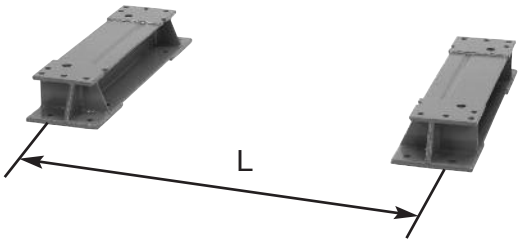


FIGURE 1

NOTE:

- Floor anchoring is REQUIRED for all installations.
- Floor anchors are not provided.
- Allow sufficient clearance between adjacent walls or equipment for proper installation of anchors. Please check your local codes for clearances required.
- Floor anchor design (including, but not limited to size, quantity, and capacity) and installation are the responsibility of the user/installer — based on applicable codes and regulations.
- Follow the user's design and the manufacturer's instructions.

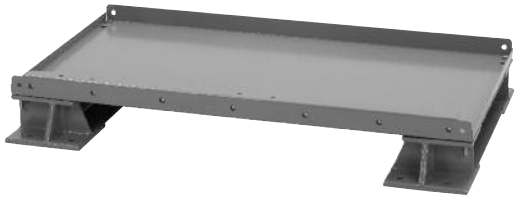


FIGURE 2

1. Use the system base beams to layout the system configuration.

2. Refer to Figure 1 and Table 7.1 to determine the anchor spacing. The top module weldment can also be used to position the base beams, loosely bolt the top module weldment to the base beams. See Figure 2.

3. Mark the floor with the location of the floor anchors. All holes are to be used when anchoring to the floor. Dimension "L" in Figure 1 is to the outermost set of holes.

7.1 Anchor Spacing

TABLE 7.1
Base Beam Anchor Spacing

mP Cell Model	2 Cells Wide		3 Cells Wide		4 Cells Wide		6 Cells Wide			
	Single Stack		Single Stack		Single Stack		Single Stack		Multi - Stack	
	L (in)	L (cm)	L (in)	L (cm)	L (in)	L (cm)	L (in)	L (cm)	L (in)	L (cm)
mP50-09	6.49	16.5	N/A	N/A	13.99	35.5	21.49	54.6	N/A	N/A
mP50-13	9.49	24.1	N/A	N/A	19.99	50.8	30.49	77.4	N/A	N/A
mP50-17	12.99	33.0	19.99	50.8	26.98	68.5	40.97	104.1	N/A	N/A
mP85-13	9.49	24.1	N/A	N/A	19.99	50.8	30.49	77.4	N/A	N/A
mP85-15	10.99	27.9	N/A	N/A	22.99	58.4	34.99	88.9	N/A	N/A
mP85-21	15.99	40.6	24.49	62.2	32.98	83.8	N/A	N/A	24.49	62.2
mP85-25	18.99	48.2	28.99	73.6	38.98	99.0	N/A	N/A	28.99	73.6
mP85-27	20.49	52.0	31.24	79.3	41.98	106.6	N/A	N/A	31.24	79.3
mP85-33	24.99	63.5	37.99	96.5	50.98	129.5	N/A	N/A	37.99	96.5
mP100-21	15.99	40.6	24.49	62.2	32.98	83.8	N/A	N/A	24.49	62.2
mP100-25	18.99	48.2	28.99	73.6	38.98	99.0	N/A	N/A	28.99	73.6
mP100-27	20.49	52.0	31.24	79.3	41.98	106.6	N/A	N/A	31.24	79.3
mP100-33	24.99	63.5	37.99	96.5	50.98	129.5	N/A	N/A	37.99	96.5
mP125-25	18.99	48.2	28.99	73.6	38.98	99.0	N/A	N/A	28.99	73.6
mP125-27	20.49	52.0	31.24	79.3	41.98	106.6	N/A	N/A	31.24	79.3
mP125-33	24.99	63.5	37.99	96.5	50.98	129.5	N/A	N/A	37.99	96.5

FIGURE 3
SINGLE STACK

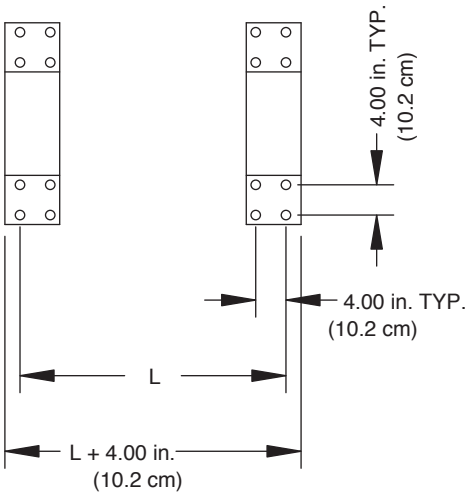
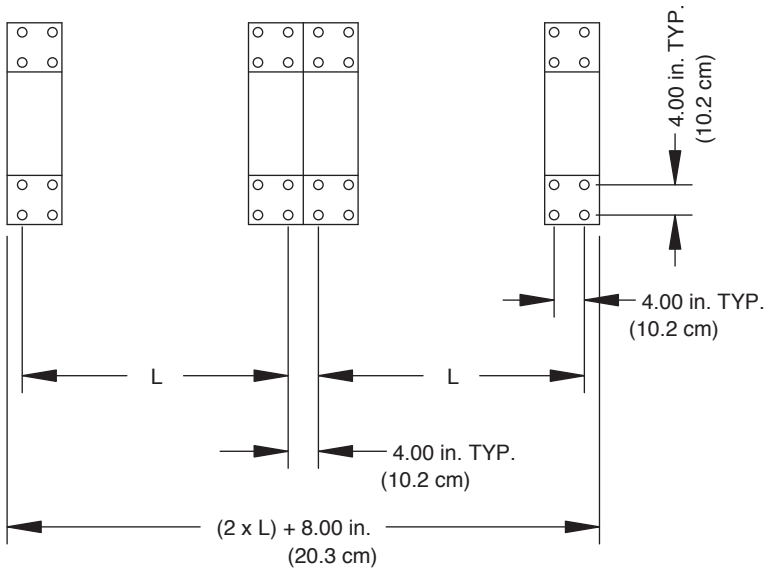


FIGURE 4
MULTI-STACK



8.0 FRAME ASSEMBLY AND INSTALLATION

To assemble and install the frame for the PowerSafe® mP Series battery system, follow the procedure below using the system layout determined in the "System Layout" section of this manual (Section 7.0). This manual uses a 3 wide x 4 high system for reference purposes.

8.1 Base Beams

1. LEVEL with customer-supplied floor shims, and anchor in place. **Do NOT torque anchor bolts until frame assembly is complete.**

2. Install ALL base beams before continuing.

8.2 Frame Module Weldment

1. Install frame module weldment on top of base beams. See Figure 5.

2. Bolt frame module weldment to base beams. Refer to below list for hardware order and Figure 5a:

    - Hex Bolt (M12x1.75-40mm)
    - Lock Washer
    - Frame Module Weldment
    - Base Beam
    - Flat Washer
    - Hex Nut

3. Torque all module connections (except anchor bolts) to 75 ft-lbs.

Cells may be installed at this time or the next frame module weldment may be fastened to the previously installed module. This manual will follow the method of installing cells next.

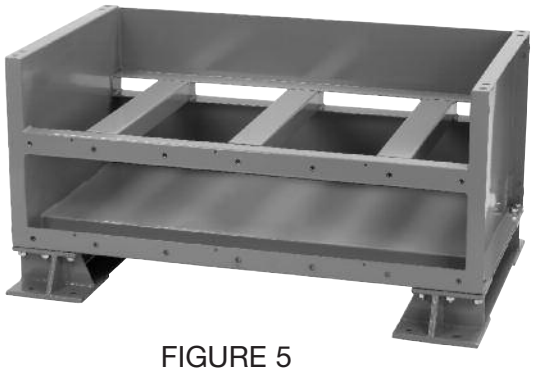


FIGURE 5

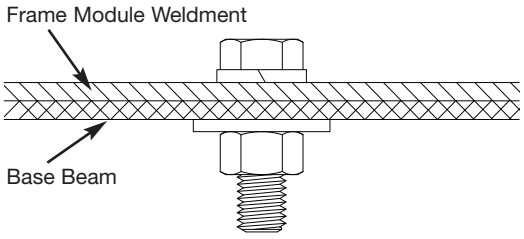


FIGURE 5a

9.0 BATTERY CELL MODULE INSTALLATION

PowerSafe® mP Series battery cells are designed for shipment and use in steel modules.

CAUTION

USE CAUTION WHEN HANDLING THE PowerSafe® mP Series Cells. After a cell has been inserted into a metal can at the factory, a loose fit could develop because of recombination. The cell could slip very easily from the metal can if the cell is turned so that the open end of the metal can is lower than the closed end of the metal can. Serious personal injury could result if the cell unintentionally slides from the metal can. Keep shipping/installation retainer in place until cells are safely positioned on the shelves/modules.

1. Remove terminal safety caps.
2. BEFORE installing the cells, check the cells open circuit voltages. The minimum acceptable cell voltage is 2.11 vpc.

   If a cell has a voltage below 2.11 vpc, the cells should receive a freshening/equalization charge. See Section 16.
3. Inspect each terminal for visual signs of mechanical defects.
4. Reinstall terminal safety caps.

NOTE:

Report any defects to your nearest EnerSys® sales/service representative for resolution, or call the corporate office number listed on the back of this manual and ask for EnerSys Reserve Power Service.

5. Place the FIRST PowerSafe® mP Series cell module onto the LOWEST EMPTY shelf, with the terminals toward the front. Refer to the Assembly Drawing for the cell polarity configuration.

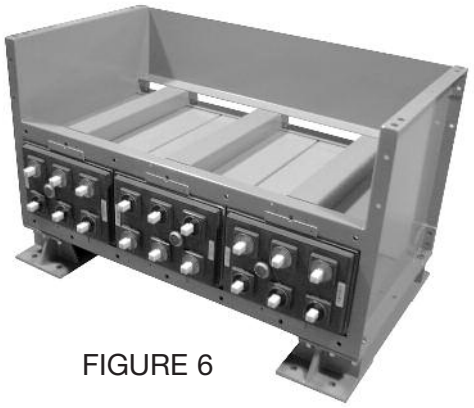


FIGURE 6

CAUTION

The larger cell modules are too heavy to manually lift on to the shelves. To avoid personal injury use the appropriate lifting devices when lifting modules onto the shelves.

6. Slide the cell module back into a safe position. Remove the shipping retainer.

7. Slide cell module completely into position so the lip of the cell module touches the front of the shelf.

8. Place another cell module onto the shelf next to the previously placed cell module. Refer to the Assembly Drawing for the cell polarity configuration. See Figure 6.

9. Leave safety caps on terminals until connections are ready to be made.

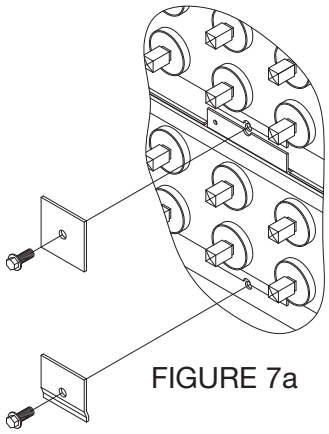


FIGURE 7a

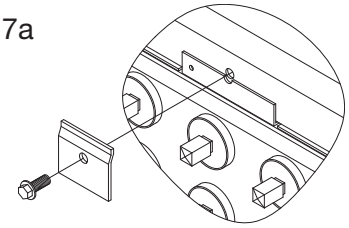


FIGURE 7b

9.1 Module Retainers

1. For each cell module, install retainer plates, using a M10x1.5 - 25mm Serrated Hex Bolt. See Figure 7. The middle rows use a flat retainer, the top and bottom rows use a retainer with a formed edge. See Figure 7a & 7b.

2. Torque to 20 ft-lbs.

3. Install cell modules and retainer plates as described until module is full. See Figure 7.

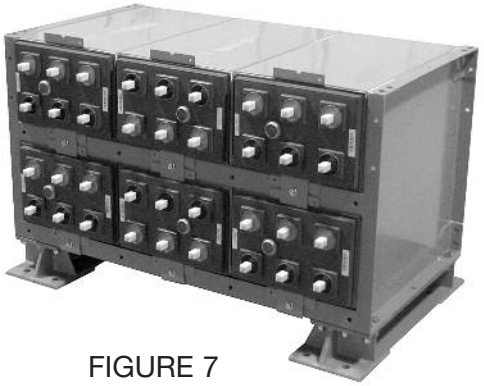


FIGURE 7

4. Install next empty frame module weldment as described in Section 8.2. See Figure 8 and 8a. Torque bolts to 75 ft-lbs.

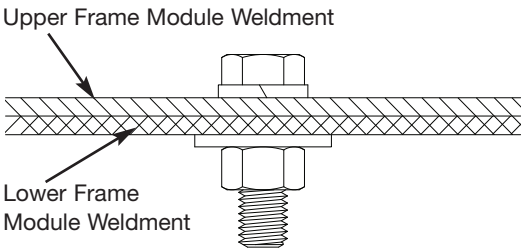


FIGURE 8a

FIGURE 8

5. Install cell modules and retainer plates as described in Section 9.0 & 9.1. See Figures 9, 10, 11.

FIGURE 9

FIGURE 10

FIGURE 11

10.0 TOP MODULE WELDMENT

After all frame module weldments, cell modules and retainer plates have been installed for a particular system, install the top module weldment. See Figure 12.

1. Bolt top module weldment to frame module. Refer to below list for hardware order and Figure 12a.

- Hex bolt (M12x1.75-40mm)
- Lock washer
- Top module weldment
- Frame module weldment
- Flat washer
- Hex nut

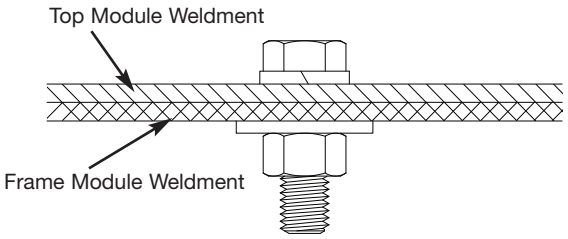


FIGURE 12a

2. Install top row of retainer plates as described in Section 9.1. See Figure 13.

FIGURE 12

FIGURE 13

11.0 ELECTRICAL BONDING INSTRUCTIONS

For each cell module, install (1) M6 self-tapping screw through front lip of the cell module into the frame module weldment. See Figure 14 & 14a. For each module to base, module to module and top to module joint install (2) M6 self-tapping screws (1 per side). See Figure 14b.

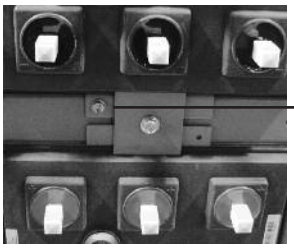


FIGURE 14

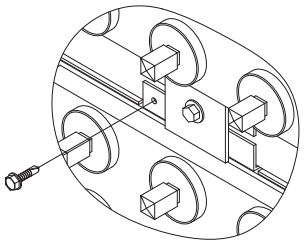


FIGURE 14a

12.0 TERMINAL PLATES

Terminal plates are provided with the battery system to provide a system connections point. All system connections must be made to the terminal plate and NEVER to the cell terminal. Top termination is standard, side termination is optional.

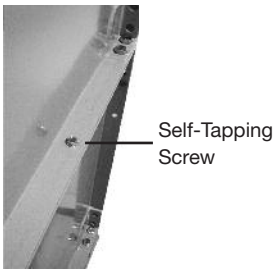


FIGURE 14b

1. Clean the terminal plate electrical contact areas with a stiff-bristle nonmetallic brush/pad until the surface is bright.

CAUTION

Tin plated parts do not require plating removal to provide an adequate contact surface, only foreign material removal. Very light brushing and cleaning with a cloth is generally sufficient.

Lead Plated Parts — Be careful not to remove the lead plating with excessive brushing

FIGURE 15

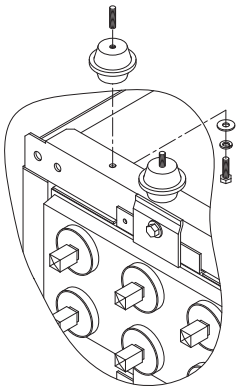


FIGURE 15a

2. Assemble and install the terminal plate assembly finger-tight as shown in Figure 15, 15a, 16 & 16a.

3. Torque all bolts to 15 ft-lbs. Hand tighten red insulators (cherries).

FIGURE 16

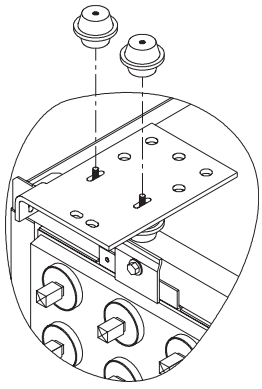


FIGURE 16a

13.0 CONNECTIONS

The system is now ready to be connected. The cells must be connected according to the polarities on the *ASSEMBLY DRAWING* and the following instructions.

13.1 Inter-Cell Connectors

The connections are made by bolting the supplied lead or tin-plated copper inter-cell and inter-module connectors to the cell terminals of opposite polarity on adjacent cells. See *ASSEMBLY DRAWING* for details.

1. Clean the contact surface of the inter-cell connector using a stiff-bristle nonmetallic brush/pad.

CAUTION

Tin plated parts do not require plating removal to provide an adequate contact surface, only foreign material removal. Very light brushing and cleaning with a cloth is generally sufficient.

Lead Plated Parts — Be careful not to remove the lead plating with excessive brushing.

2. Apply a light coat of NO-OX-ID grease to the contact surfaces of the inter-cell connector and terminal post.

3. Bolt all inter-cell connectors according to the *ASSEMBLY DRAWING*. Assemble as the example shown in Figure 17 and below list:

NOTE:

Inter-cell connections vary in length depending on the type of connection (cell-to-cell, module-to-module, etc.). Always insure that there is a connector bar on each side of the terminal.

WARNING

Stamped flat washers may have one sharp edge. Install the washer with the sharp edge away from the inter-cell connector to avoid damaging the plating.

a. Hex Bolt
b. Flat Washer
c. Inter-cell Connector
d. Battery Terminal
e. Inter-cell Connector
f. Flat Washer
g. Lock Washer
h. Hex Nut

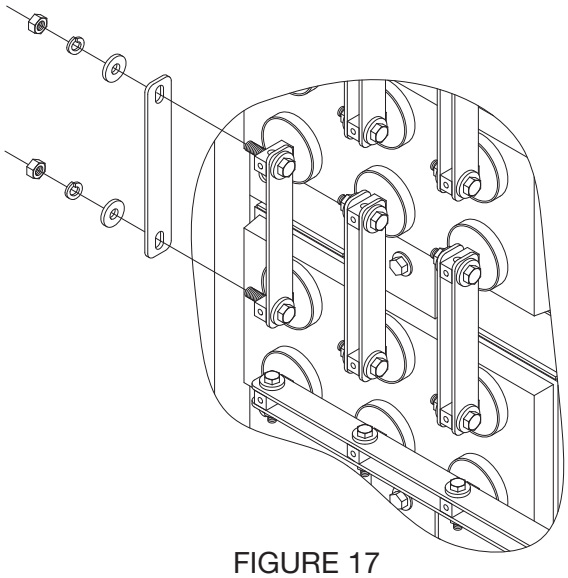


FIGURE 17

4. Secure all connections finger-tight to allow for some adjustment of position.

5. After all inter-cell connections are completed, torque to 85 in-lbs.

13.2 Terminal Connections

Terminal bars are supplied with the battery system to provide a cell terminal-to-terminal plate connection, some of these connections may be made with cable connections.

1. Inspect the system to be assured that all cells are connected correctly — POSITIVE to NEGATIVE and according to the ASSEMBLY DRAWING.

2. Clean the terminal bar contact area with a stiff-bristle nonmetallic brush/pad.

CAUTION

Tin plated parts do not require plating removal to provide an adequate contact surface, only foreign material removal. Very light brushing and cleaning with a cloth is generally sufficient.

Lead Plated Parts — Be careful not to remove the lead plating with excessive brushing.

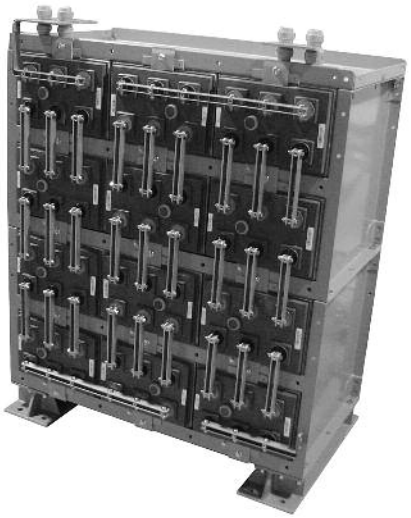


FIGURE 18

3. Apply a light coat of NO-OX-ID grease to the terminal bar contact area.

4. Install terminal bar as described in Section 13.1 and as shown in Figure 18a.

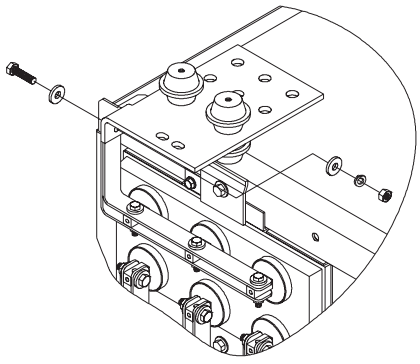


FIGURE 18a

5. For cable connections from the cell terminal-to-terminal plate, it is recommended to install the safety shield standoff in the upper corner of the system where the connection will be made to the terminal plate as shown in Figure 18b.

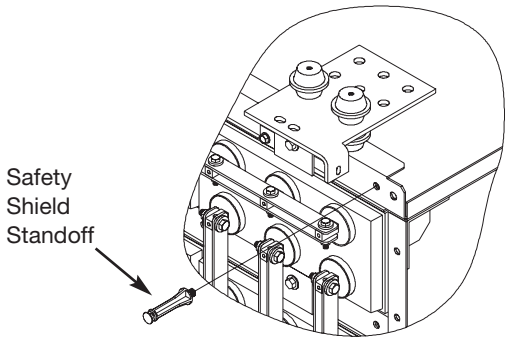


FIGURE 18b

6. Assemble the cable(s) to the L-Bracket before attaching either end to the system as shown in Figure 18c.

7. Bolt lower terminal bars to the cell terminals before attaching cable(s). Attach cable(s) to the terminal bars as shown in Figure 18d.

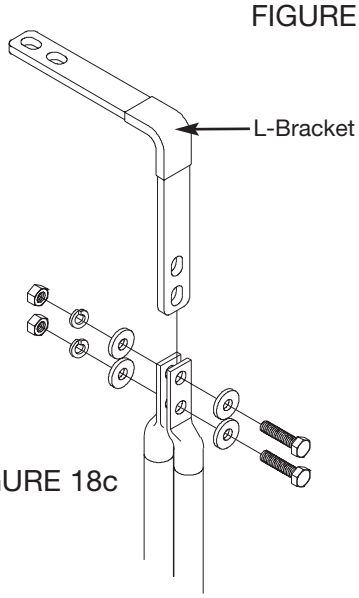


FIGURE 18c

CAUTION

Extreme care should be taken when connecting cables to the system. Inadvertent contact of the cable ends with the system frame, terminals or terminal bars may result in electrical shock and/or system short.

8. For the final system connection, bolt the L-Bracket to the terminal plate as shown in Figure 18e.

9. Torque bolts to 85 in-lbs.

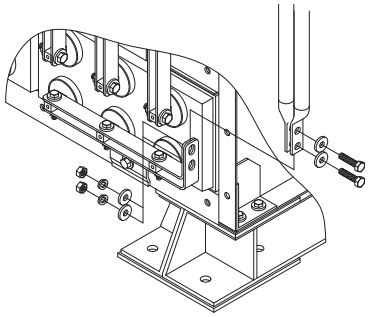


FIGURE 18d

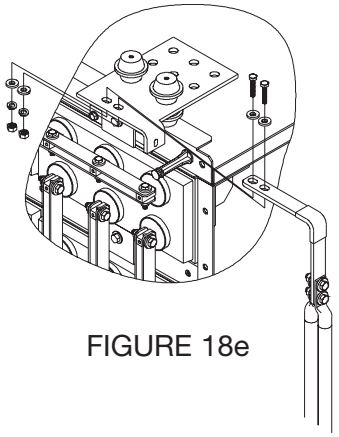


FIGURE 18e

14.0 INITIAL SYSTEM READINGS

1. Measure the **DC** system voltage across the system terminals. Voltage should equal approximately 2.15 times the number of cells in the system (See Table 14.1).

2. If the voltage is lower than 2.15 times the number of cells in the system, inspect the system to be assured that all cells are connected correctly — POSITIVE to NEGATIVE and according to the ASSEMBLY DRAWING.

TABLE 14.1
APPROXIMATE VOLTAGE

Number of Cells	(2.15 x number of cells)
12	25.8
24	51.6

3. If the voltage is persistently lower than 2.15 times the number of cells in the system, contact your EnerSys® sales/service representative, or call the corporate office number listed on the back of this manual and ask for EnerSys Reserve Power Service.

4. Make a copy of the Battery Maintenance Report found in the Safety, Storage, Operating and Maintenance Manual. Measure and record the connection resistance of “CELL to CELL” and

CAUTION

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. It can affect the serviceability of the battery. Tapping results in an imbalance of the system during charging and discharging and results in unsatisfactory operation.

15.0 TERMINAL PLATE COVERS AND SAFETY SHIELDS

Shields and covers are provided to help prevent accidental contact with connections after installation and during operations. Safety shields and covers should remain in place at all times during normal operation of the system. Terminal plate covers are provided as necessary to prevent accidental contact with the “live” terminal plate. Safety shields are designed to be removed for service or maintenance.

FIGURE 19

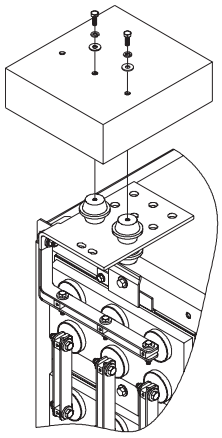


FIGURE 19a

15.1 Terminal Plate Covers

1. Install terminal plate covers as shown in Figure 19a. Use hardware that is identified on the Assembly drawing located in the terminal plate box included with your shipment.

2. An optional standoff is included in the terminal plate assembly kit in case additional space is needed between terminal plate and its cover.

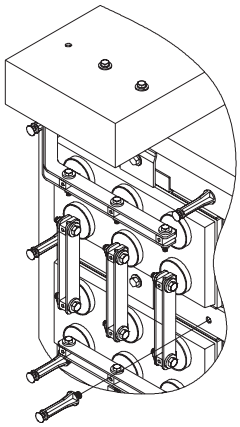


FIGURE 20a

15.2 Safety Shields

1. Install ALL safety shield standoffs into modules as shown in Figure 20a.

2. Starting with bottom row, hang safety shields on standoffs as shown in Figure 21a.

FIGURE 21

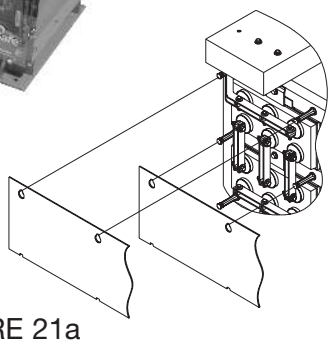


FIGURE 21a

NOTE:

The bottom of each safety shield will overlap, on the outside, the top of the shield below it.

16.0 INITIAL and/or FRESHENING CHARGE

Batteries lose some initial charge during shipment and storage. Depending on storage time, a battery may require a *freshening charge*. See Section 4.0 for battery storage times.

Constant voltage is the ONLY charging method allowed. Confirm that your charger bus is a constant voltage type. (Most modern chargers are the constant voltage type.)

If all cells OCV's are above 2.11 vpc, no initial or freshening charge is required. However, an initial or freshening charge will reduce the time required for the battery strings' individual cell voltages to balance with each other.

1. Determine the maximum voltage that may be applied to the system equipment (or maximum charger voltage if load is not yet connected). Refer to the recommendations of the manufacturer/supplier of system equipment connected to DC bus.

2. Divide the maximum total system voltage by the number of cells (not units) connected in series. This is the maximum volts per cell that may be used for the initial charge. **Do NOT exceed 2.35 volts per cell.**

Table 16.1 lists recommended initial charge voltages per cell and charge time for the initial charge. Select the HIGHEST voltage the system allows for the initial charge without exceeding 2.35 volts per cell.

TABLE 16.1

CELL VOLTS Initial Charge	TIME (Hours) Temp. 60˚-90˚F (16˚-32˚C)	TIME (Hours) Temp. 40˚-59˚F (5˚-15˚C)	TIME (Hours) Temp. < 39˚F (<4˚C)
2.27	60	120	240
2.30	48	96	192
2.32	24	48	96
2.35	12	24	48

3. Connect battery positive (+) terminal to charger bus positive (+) terminal.

4. Connect battery negative (-) terminal to charger bus negative (-) terminal.

5. Raise the voltage to the maximum value permitted by the equipment as shown in Table 16.1. **Do NOT exceed 2.35 volts** under any conditions.

6. When charging current has decreased and stabilized (i.e., no further reduction for three hours), charge for the hours shown in Table 16.1, or until the lowest cell voltage ceases to rise.

CAUTION

Monitor the battery temperature during the charge. If the cell/battery temperature exceeds 105˚F (40˚C) stop the charge immediately and allow the temperature to decrease below 90˚F (32˚C). Failure to follow this warning may result in severe overcharge and damage to the cell/battery.

17.0 OPERATION

17.1 General

The sealed design of the VRLA batteries makes it impossible to measure specific gravity as a state-of-charge indicator. The state-of-charge can be identified to some degree by the amount of charging current going to the battery.

17.1.1 Determining the State-of-Charge

The following method can be used to determine the state-of-charge of the battery.

1. Place the battery on charge/recharge following a discharge.

Read the ammeter.

The charging current will be a combination of the load current plus the current necessary to charge the battery.

2. The battery becomes fully charged when the current to the battery starts to decrease and stabilize.

3. When the current level remains constant for three consecutive hours, the state-of-charge is approximately 95 to 98%. Full charge can be assumed.

For most requirements, the battery is ready for use.

17.2 Float 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 should 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

If the batteries' ambient temperature is outside the range of 68°F (20°C) to 80°F (27°C), it is highly recommended that the battery be charged with a temperature compensated charger with adjustment as stated in Table 17.1. If a temperature compensated charger is not used, manual adjustments must be made according to Table 17.1.

TABLE 17.1

AVERAGE AMBIENT TEMPERATURE		RECOMMENDED FLOAT VOLTAGE
°F	°C	VOLTS PER CELL
25	-4	2.33
35	2	2.33
45	7	2.32
55	13	2.30
65	18	2.28
77	25	2.25
85	29	2.23
95	35	2.21
105	41	2.19
115	46	2.17
125	52	2.17

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

Constant voltage output charging equipment is recommended. This type of charger, properly adjusted to the recommended float voltages, and the following recommended surveillance procedures will assist in obtaining consistent serviceability and optimum life.

17.2.1 Float Charge Method

A float charge is given after the battery has been given its initial charge. To perform a float charge, follow the procedure below after the battery has been given its initial charge:

1. Determine that the VOLTS PER CELL nominal value is within the 2.23 to 2.27 range. This can be done by measuring the total battery string voltage and dividing by the number of cells in the string. Make sure the voltage does NOT exceed the maximum voltage for the connected load.

2. Adjust the charger to provide the recommended float voltage **at the battery terminals.** Do NOT use float voltages HIGHER or LOWER than those recommended. Otherwise reduced battery life or reduced capacity will result.

3. Check and record battery terminal voltage monthly for accurate calibration.

4. If the VOLTS PER CELL average voltage is above or below the range recommended in Procedure 1, adjust the charger to provide proper voltage as measured **at the battery terminals.**

   (When the **mP Series** cells are new, expect to see variations in float voltage from cell to cell within a string. These cell voltages should be within ±0.05 volts of the nominal setting).

17.3 Equalizing Charge

Under NORMAL conditions an equalizing charge is NOT required. An equalizing charge is a special charge given to a battery when nonuniformity in voltage has developed between cells. It is given to restore all cells to a fully charged condition.

Nonuniformity 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 too low a 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 5˚F (3˚C). If cell temperature is the problem, review the location instructions in Section 5.0 to ensure proper location of the battery system.

An equalizing charge should be given when:

- the float voltage of any cell is less than 2.17 volts per cell.

Do **NOT** equalize **mP Series** cells if they are within the following voltage limits:

NEW	±0.09 volts of the nominal value, as determined in Section 17.2.1, Procedure No.1.
AFTER ONE YEAR	±0.05 volts of the nominal value, as determined in Section 17.2.1, Procedure No.1.

17.3.1 Equalizing Charge Method

Constant voltage charging is the method for giving an equalizing charge. To perform an equalizing charge, follow the procedure below:

1. Determine the maximum voltage that may be applied to the system equipment.

2. Divide this voltage by the number of cells connected in a series.
   This is the MAXIMUM VOLTS PER CELL to be used for the equalizing charge.
   This number should NOT exceed 2.35 VOLTS PER CELL average.

3. Use Table 17.2 to determine the equalize charge time.

The times listed are the number of hours to charge the battery system AFTER the charge current has been stabilized for three hours.

Stabilization occurs when the current level remains constant for three hours.

TABLE 17.2

CELL VOLTS	TIME (hours) AFTER CURRENT STABILIZATION (3 hours without change) AT AMBIENT TEMPERATURES FROM 70-90˚F (21-32˚C)	TIME (hours) AFTER CURRENT STABILIZATION (3 hours without change) AT AMBIENT TEMPERATURES FROM 55–69˚F (13–20˚C)
2.32	24	48
2.35	12	24

CAUTION

During charge, if the cell/battery temperature exceeds 105˚F (40˚C) stop the charge immediately and allow the temperature to decrease below 90˚F (32˚C). Failure to follow this warning may result in severe overcharge and damage to the cell/battery

18.0 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.

19.0 PILOT CELL

One 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 and temperature. Designate as the pilot cell the cell with the lowest cell voltage in the series string following the initial charge. Pilot cell readings serve as an interim indicator between regularly scheduled voltage readings of the complete battery. The temperature sensor should be connected to the negative post of the pilot cell.

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

20.0 MAINTENANCE

20.1 Battery Cleaning

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

20.1.1 Standard Cleaning

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

1. Remove safety shields.
2. Wipe off any accumulation of dust on the cell covers with a cloth dampened in clean water.

WARNING

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

20.1.2 Mild Corrosion Cleaning

To clean mild corrosion from the battery:

1. Remove safety shields.
2. Remove corrosion by wiping with a cloth dampened with bicarbonate of soda solution [mix 1 gallon (4 l) of water with 1 lb. (500g) of bicarbonate of soda]. Follow with a cloth dampened with clean water.
3. Dry with a clean cloth.

20.1.3 Terminal Rework

If a terminal connection needs to be reworked (for any reason) follow the steps below:

1. Disconnect the battery from load.
2. Remove safety shields.
3. Unbolt and remove connectors.
4. Apply a solution of bicarbonate of soda and water to the cell posts and connectors to neutralize the corrosion (as described in Section 20.1.2).
5. Clean the contact surfaces by rubbing the surface of post or terminal and lead-plated or tin-plated contact surfaces with a stiff-bristle nonmetallic brush/scotch brite type pad. Lightly brush tin plated connectors. Exercise care so you **do NOT remove the plating on the connectors, terminal plates or lugs, exposing copper.**
6. Apply a thin coating of NO-OX-ID type grease to the contact surfaces.
7. Bolt all inter-cell connectors. Install as follows (Refer to Figure 17 in Section 13.1):

a. Bolt	c. Connector	e. Connector	g. Lock Washer
b. Flat Washer	d. Battery Terminal	f. Flat Washer	h. Hex Nut

WARNING
STAMPED FLAT WASHERS MAY HAVE ONE SHARP EDGE. INSTALL THE WASHER WITH THE SHARP EDGE AWAY FROM THE INTER-CELL CONNECTOR TO AVOID DAMAGING THE PLATING.

8. Install all connections finger-tight to allow for some adjustment of position.
9. After all connections are completed, torque as specified in Section 13.0.
10. Recoat the contact surfaces with a thin application of the NO-OX-ID grease.
11. Re-install safety shields. Start with bottom row.

20.2 TEST PROCEDURES

20.2.1 Procedure for Battery Capacity Tests

For proper testing protocol, it is recommended to refer to the latest version of IEEE-1188.*

* IEEE-1188: Recommended Practice for Maintenance, Testing and Replacement of Valve-Regulated Lead-Acid (VRLA) Batteries for Stationary Applications.

20.3 Maintenance Records

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

Should you have **ANY** questions concerning how to perform the required maintenance, contact your nearest EnerSys® sales/service representative or call the corporate office number listed on the back of this manual and ask for EnerSys Reserve Power Service.

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

1. Upon completion of the initial charge and with the battery on float charge at the proper voltage for one (1) week, read and record the following:
   - individual cell or unit voltages (volts)
   - cell-to-cell connection resistance (ohms)
   - terminal connection resistance (ohms)
   - ambient temperature in the immediate battery environment (˚F or ˚C)

NOTE:

Some internal failure modes of cell type mP Series cannot be detected by cell or unit voltage measurements. IEEE-1188 recommends taking an internal ohmic measurement of the cell/unit at quarterly intervals. These internal ohmic measurements, when compared with baseline value or the average value, may indicate the beginning of a problem inside the cell. Then corrective actions can be taken to avoid a battery system failure. EnerSys® recommends that you follow IEEE-1188 standards for internal ohmic measurements for VRLA cell types.

2. Every 12 months, read and record the following:

- individual cell or unit voltages (volts)
- cell-to-cell connection resistance (ohms)
- terminal connection resistance (ohms)
- ambient temperature in the immediate battery environment (˚F or ˚C)

Any connection resistance that exceeds the base value by more than 20% should be corrected by the procedures of Section 20.

3. If corrosion is present in the connections, clean according to Section 20.1.

4. Whenever the battery is given an equalizing charge, an additional set of readings should be taken and recorded.

THE ABOVE FREQUENCY OF RECORD TAKING IS THE ABSOLUTE MINIMUM TO PROTECT THE WARRANTY. This data will be required for any warranty claim made on the battery. For system protection and to suit local conditions/requirements, more frequent readings (quarterly) are desirable.

Sample record charts are provided on the following pages. Make a copy of the chart to use for your permanent records.

BATTERY MAINTENANCE REPORT — DDm, DDS, DDV, DGX, mSeries, and mP Series

COMPANY _____ **DATE** ___/___/___ **PAGE** 1 of _____

ADDRESS _____ **BATTERY LOCATION and/or NUMBER** _____

No. of CELLS _____ **TYPE** _____ **DATE NEW** ___/___/___ **DATE INSTALLED** ___/___/___ **SERIAL NO.** _____

SYSTEM VOLTAGE _____ **TEMPERATURE** _____ **CHARGER VOLTAGE** _____ **CHARGER CURRENT** _____

Cell to Cell Resistance	Cell No.	Volts	Terminal Connection Resistance	Cell to Cell Resistance	Cell No.	Volts	Terminal Connection Resistance	Cell to Cell Resistance	Cell No.	Volts	Terminal Connection Resistance	Cell to Cell Resistance	Cell No.	Volts	Terminal Connection Resistance
—	1			—	31			—	61			—	91		
	2				32				62				92		
	3				33				63				93		
	4				34				64				94		
	5				35				65				95		
	6				36				66				96		
	7				37				67				97		
	8				38				68				98		
	9				39				69				99		
	10				40				70				100		
	11				41				71				101		
	12				42				72				102		
	13				43				73				103		
	14				44				74				104		
	15				45				75				105		
	16				46				76				106		
	17				47				77				107		
	18				48				78				108		
	19				49				79				109		
	20				50				80				110		
	21				51				81				111		
	22				52				82				112		
	23				53				83				113		
	24				54				84				114		
	25				55				85				115		
	26				56				86				116		
	27				57				87				117		
	28				58				88				118		
	29				59				89				119		
—	30			—	60			—	90			—	120		

BATTERY MAINTENANCE REPORT — DDm, DDS, DDV, DGX, mSeries, and mP Series

COMPANY _____ **DATE** ____/____/____ **PAGE** 2 of _____

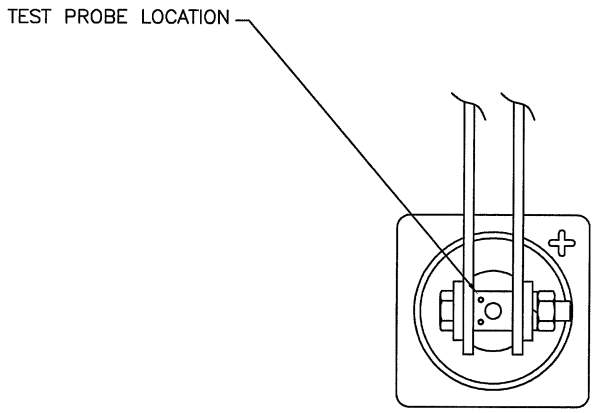
Cell to Cell Resistance	Cell No.	Volts	Terminal Connection Resistance	Cell to Cell Resistance	Cell No.	Volts	Terminal Connection Resistance	Cell to Cell Resistance	Cell No.	Volts	Terminal Connection Resistance	Cell to Cell Resistance	Cell No.	Volts	Terminal Connection Resistance
—	121			—	151			—	181			—	211		
	122				152				182				212		
	123				153				183				213		
	124				154				184				214		
	125				155				185				215		
	126				156				186				216		
	127				157				187				217		
	128				158				188				218		
	129				159				189				219		
	130				160				190				220		
	131				161				191				221		
	132				162				192				222		
	133				163				193				223		
	134				164				194				224		
	135				165				195				225		
	136				166				196				226		
	137				167				197				227		
	138				168				198				228		
	139				169				199				229		
	140				170				200				230		
	141				171				201				231		
	142				172				202				232		
	143				173				203				233		
	144				174				204				234		
	145				175				205				235		
	146				176				206				236		
	147				177				207				237		
	148				178				208				238		
	149				179				209				239		
—	150			—	180			—	210			—	240		

ADDITIONAL COMMENTS: _____

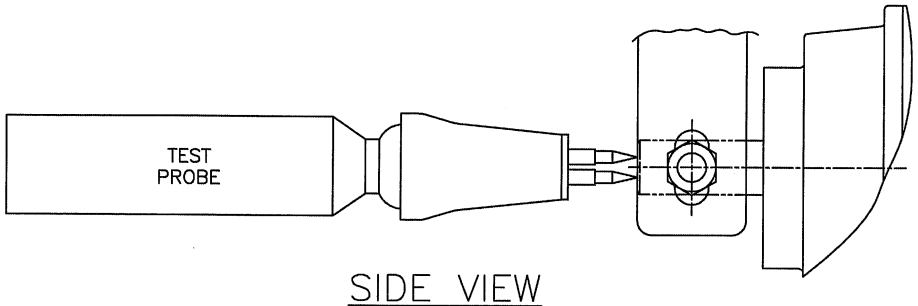
_____

21.0 CELL READING

The square post terminal on this product allows for direct access to the terminal when taking cell readings. The diagrams below are meant as a reference guide when taking readings.



END VIEW



SIDE VIEW

NOTE: APPLY TEST PROBE TO THE TERMINAL POST ONLY NOT TO CONNECTORS OR FASTENERS

22.0 TEMPORARY NON-USE (EXTENDED OUTAGE)

22.1 Installed/Out-of-Service System

If an INSTALLED battery is expected to STAND IDLE longer than the storage period recommended for the storage temperature (see Table 4.1 on page 9), treat as follows:

1. Before taking the battery out of service, insure that the cells are fully charged. This can be accomplished by applying a freshening or equalization charge as described in Section 16.

2. After the charge, open the connections at the battery terminals to remove load from the battery.

3. Throughout the extended non-use period, give the battery a recharge per the recommendations noted in Section 4.2. Disconnect the battery from the charger between charges.

22.2 Return to Service

To return the battery to normal service:

1. Reconnect the battery, the load and charger.

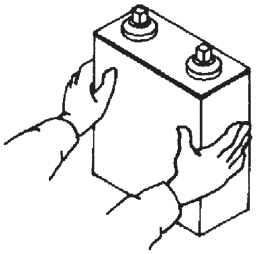
2. If any cells OCV's are below 2.11 V, give the battery an equalizing charge as described in Section 17.3.1.

3. Return the battery to float operation.

PRECAUTIONS*

1. Do not bring any heat or flame source near battery.
2. Do not remove pressure relief valves.

DO NOT PUSH ON CENTER
TO POSITION BATTERY



USE EDGE OF CELL
WHEN POSITIONING BATTERY

3. Do not lift any cells by the terminal posts.
4. Do not tamper with post seals.
5. Do not remove plating from post or connectors and expose any bare copper.
6. Do not allow cell temperature to exceed 105˚F during charging.
7. Do not clean cell with anything other than water/bicarbonate of soda.
8. Do not over torque connections.
9. Do not store VRLA type batteries for over six months without charge, at normal temperatures.

* These are only a few of the precautions. Please read all accompanying literature thoroughly for specific safety and installation information

When ordering new batteries, also remember to properly recycle your old lead batteries. Federal and state regulations require lead-acid batteries be recycled. The EnerSys® nationwide service organization can arrange pickup, transportation to and recycling at any one of our company affiliated smelters. Call 1-800-972-7372 for more information.

ISO 9000™

Please visit www.enersys.com for literature updates.

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