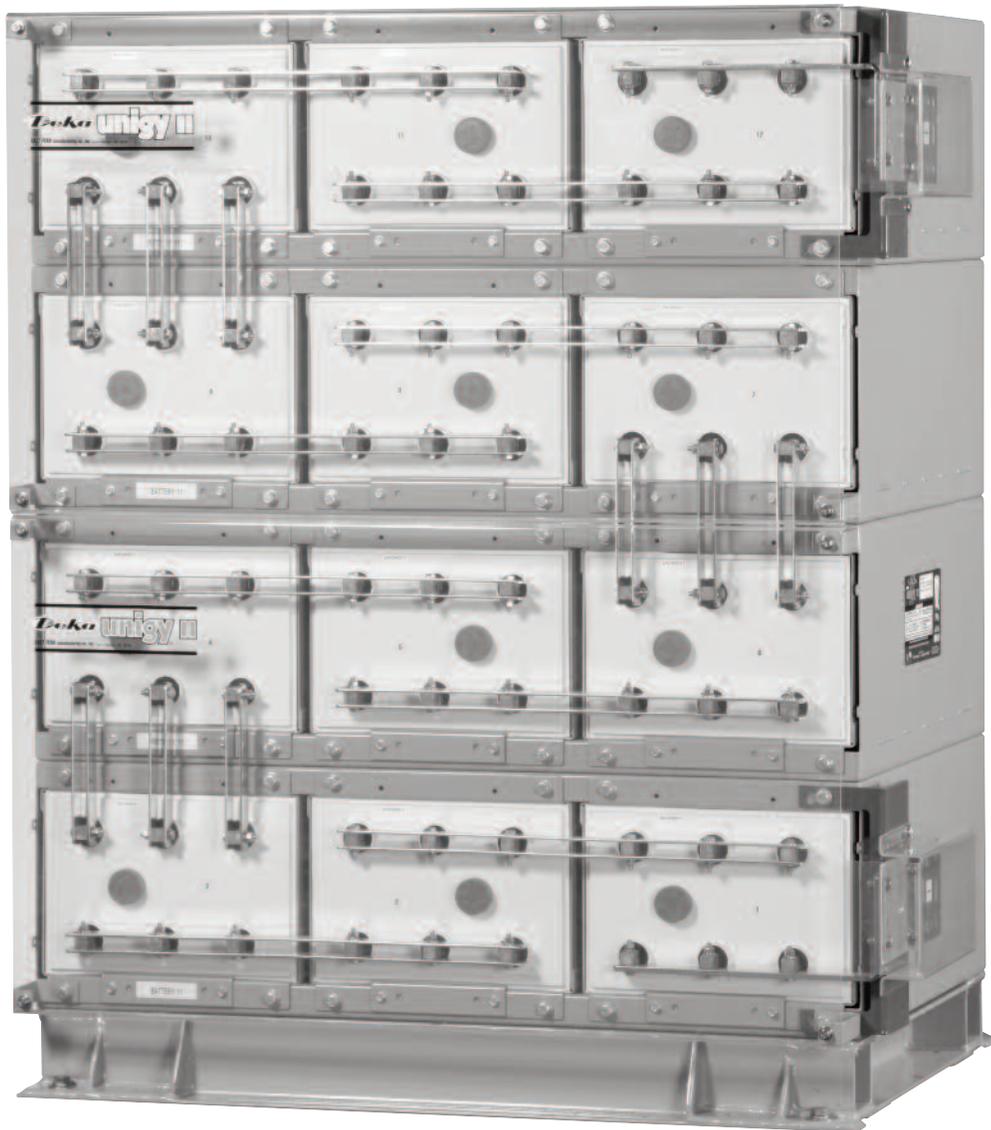


Deka[®] **unigy II** **II**

NEBS CERTIFIED UNIGY II SYSTEM NC4-2000 125 AH

Installation and Operation Manual



**California
Proposition 65
Warning:**

Batteries, battery posts, terminals and related accessories contain lead and lead compounds, and other chemicals known to the state of California to cause cancer and birth defects or other reproductive harm. **Wash hands after handling.**

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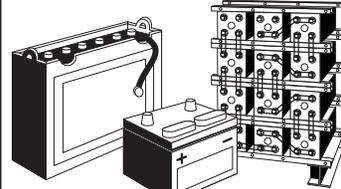
⚠ DANGER

 <p>HIGH VOLTAGE... RISK OF SHOCK. DO NOT TOUCH UNINSULATED TERMINALS OR CONNECTORS.</p>	 <p>SHIELD EYES. EXPLOSIVE GASES CAN CAUSE BLINDNESS OR INJURY.</p>	 <p>NO • SPARKS • FLAMES • SMOKING</p>	 <p>SULFURIC ACID CAN CAUSE BLINDNESS OR SEVERE BURNS.</p>	 <p>FLUSH EYES IMMEDIATELY WITH WATER. GET MEDICAL HELP FAST.</p>
<p>DO NOT REMOVE VENT VALVE. WARRANTY VOID IF VENT VALVE IS REMOVED.</p>		<p>VENTILATE WELL WHEN IN AN ENCLOSED SPACE AND WHEN CHARGING.</p>		
<p>SEE INSTALLATION, MAINTENANCE AND OPERATION INSTRUCTIONS FOR IMPORTANT SAFETY PRECAUTIONS.</p>				

California Proposition 65 Warning:

Batteries, battery posts, terminals and related accessories contain lead and lead compounds, and other chemicals known to the state of California to cause cancer and birth defects or other reproductive harm. **Wash hands after handling.**

BATTERIES AND OTHER RELATED PARTS CONTAIN LEAD



WARNING:
 Battery posts, terminals and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm.
 Batteries also contain other chemicals known to the State of California to cause cancer.
WASH HANDS AFTER HANDLING!

Form No. 1314 Rev. 5/98 Must be posted in workplace near batteries.

SAFETY PRECAUTIONS

Although all valve-regulated batteries have the electrolyte immobilized within the cell, the electrical hazard associated with batteries still exists. **Work performed on these batteries should be done with the tools and the protective equipment listed below.** Valve-regulated battery installations should be supervised by personnel familiar with batteries and battery safety precautions.

Protective Equipment

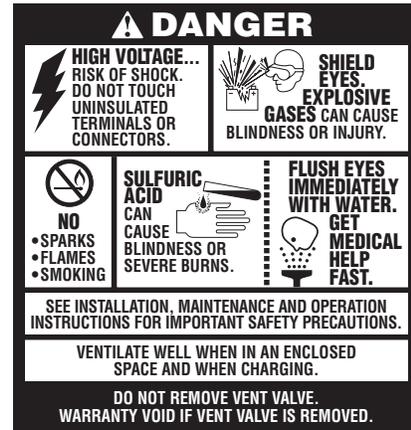
To assure safe battery handling, installation and maintenance, the following protection equipment should be used:

1. Safety glasses or face shield
2. Acid-resistant gloves
3. Protective aprons and safety shoes
4. Proper lifting devices
5. Properly insulated tools

Procedures

The following safety procedures should be followed during installation: **(Always wear safety glasses or face shield when working on or near batteries.)**

1. These batteries contain no free-flowing electrolyte. Under normal operating conditions, they do not present any acid danger. However, if the battery jar or cover is damaged, acid could be present. **Sulfuric acid is harmful to the skin and eyes. Flush affected area with water immediately and consult a physician if splashed in the eyes.**
2. **Prohibit smoking and open flames, and avoid arcing in the immediate vicinity of the battery.**
3. Do not wear metallic objects, such as jewelry, while working on batteries. Do not store un-insulated tools in pockets or tool belt while working in vicinity of battery.
4. Keep the top of the battery dry and clear of tools and other foreign objects.
5. Provide adequate ventilation **(per IEEE standard 1187 and/or local codes)** and follow recommended charging voltages.
6. Extinguishing media: Class ABC extinguisher.
Note: CO₂ may be used but not directly on the cells due to thermal shock and potential cracking of cases.
7. **Never** remove or tamper with the pressure relief valves. Warranty void if vent valve is removed.
8. Inspect all flooring and lifting equipment for functional adequacy.
9. Adequately secure battery modules, racks, or cabinets to the floor.
10. Connect support structures to ground system in accordance with applicable codes.
11. The below IEEE Standards contain additional information. Other standards may be relevant to your specific application.
IEEE 1187 – Recommended Practice for Installation Design of VRLA Batteries
IEEE 1188 – Recommended Practice for Maintenance, Testing, of VRLA Batteries
IEEE 1189 – Selection of VRLA Batteries for Stationary Applications



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RECEIVING & STORAGE

Receiving Inspection

Upon receipt, and at the time of actual unloading, each package should be visually inspected for any possible damage or electrolyte leakage. If either is evident, a more detailed inspection of the entire shipment should be conducted and noted on the bill of lading. Record receipt date, inspection data and notify carrier of any damage.

Unpacking

1. Always wear eye protection.
2. Check for visible defects such as cracked containers, loose terminal posts, or other unreparable problems. Batteries with these defects must be replaced.
3. Check the contents of the package against the packaging list. Report any missing parts or shipping damage to your East Penn agent or East Penn Mfg. Co. immediately.
4. Never lift batteries by the terminal posts.
5. When lifting batteries, the proper equipment is needed such as a forklift or a portable crane. Always check the lifting capacities of the equipment being used and never lift more than one module at a time by the module mounting holes.

Storage

1. Cells should be stored indoors in a clean, level, dry, cool location. Recommended storage temperature is 0°F to 90°F (-18°C to 32°C).
2. Stored lead-acid batteries self discharge and must be given a boost charge six months from the date of manufacture to prevent permanent performance degradation. Record dates and conditions for all charges during storage.
3. Recommended charge during storage is at a constant voltage of 0.05 volts per cell greater than recommended float voltage for 24 hours. Reference voltage chart in SYSTEM OPERATION section.
4. Do not store beyond 12 months.
5. Store in horizontal position only.

INSTALLATION

General

Caution should be taken when installing batteries to insure no damage occurs. The battery cabinet, tray, rack, etc. shall be inspected for sharp edges that could cause damage to the battery casing. Batteries shall not be dropped, slid, or placed on rough or uneven surfaces such as tray lips or grated flooring. Mishandling of batteries could result in equipment damage or human injury. East Penn will not be liable for damage or injury as a result of mishandling or misuse of the product.

Grounding

When grounding the battery system, proper techniques should be applied per electrical standards, such as NEC and/or local codes.

Two .201 diameter x .750 center holes are provided in back of each module to accept a #6 x .750 center compression grounding lug. The holes must be tapped for a 1/4-20UNC thread and paint must be removed for a proper grounding pad location.

Electric Code for Maintenance Access

Refer to ANSI/NFPA-70 National Electric Code for access and working space requirements around the battery. A minimum of 36" aisle space is recommended in front of the battery for service and inspection.*

**Note: Battery system and/or individual module grounding, if required, is the installer's responsibility.*

Floor Anchoring & Module Arrangements

See East Penn Mfg. Co.'s schematic diagram illustration. One is supplied with each shipment. If it cannot be located, contact East Penn Mfg. Co. for a copy. Refer to your delivery number, located on the packing slip. This will aid in obtaining the proper drawing.

Hardware Torque Requirements

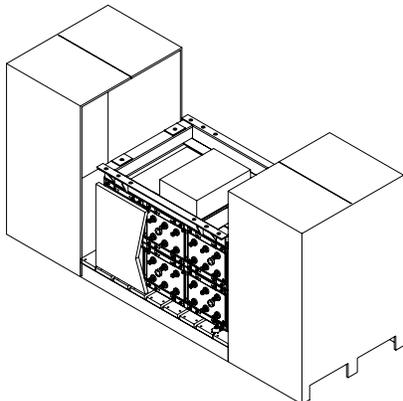
Bolt Size	Torque	
1/2-13	100 ft-lb	135.5 Nm
3/8-16	25ft-lb	33.8 Nm
1/4-20	125 in-lb	14.1Nm

System Installations

System Shipment

Battery System are typically received per detail below.

Note: 3 cell modules are typically shipped 2 modules per pallet. 2 cell modules will be shipped 3 modules per pallet.

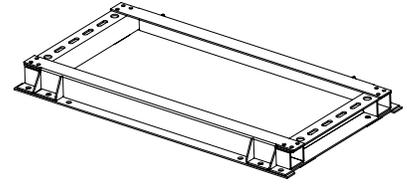


Module Installation

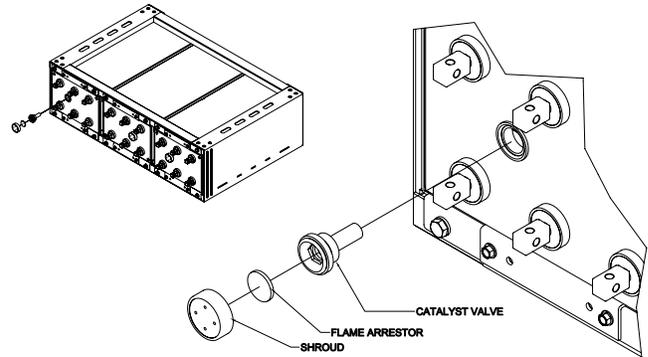
Assemble system per the following details.

All parts should be verified against packaging list. Report any missing parts.

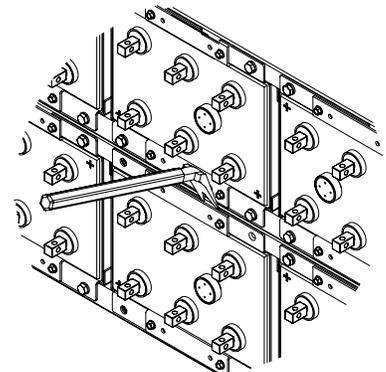
1. Remove floor-mounting base support from the top of the modules. Base is bolted to module assembly, upside down.
2. Position base(s), consult included layout diagram for required configuration. Bases are required to be level prior to installing modules.
3. Anchor holes can be marked and drilled with bases in place. All anchor holes in base (16 per base) are required to be used to meet seismic requirements. **Consult local building codes for anchor bolt requirements. Anchor bolts not included.**



4. Cell must be removed from modules prior to installing modules to base
 - a. Batteries develop internal pressure. Relieving this pressure from the cell will make it easier to remove the cell / sleeve assemblies from the modules.
 1. Pry off vent shroud
 2. Remove flame arrestor
 3. Unscrew valve with 17mm hex key (pressure will release)
 4. Reinstall valve immediately and torque to 12-14 in lb with 17mm hex key.



5. Cell / sleeve assembly removal from module
 - a. Thread polypropylene rope through two terminals and knot.
 - b. Remove 3/8-16 x 1 1/4 bolts and lock washers from sleeve.
 - c. Use an insulated prybar to loosen the center cell / sleeve from the module. Place the prybar into the cutout behind the retainer.

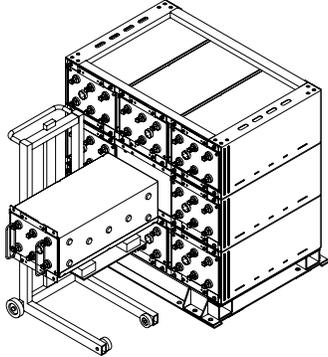


d. Position lifting device under cell to be removed.

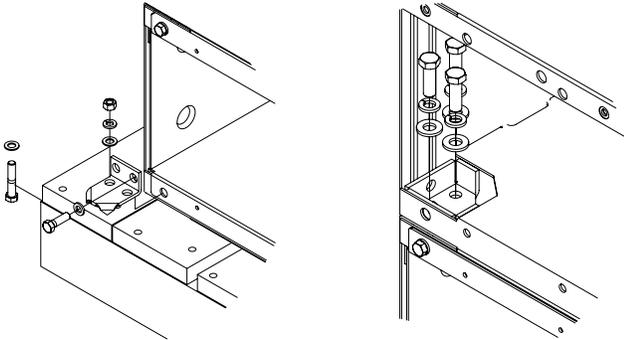
Warning: Care should be taken not to have lifting device come in contact with cells /sleeve assemblies.

e. Slide sleeve and cell across cell lifting device. It is recommended that you use two pieces of 2" x 4" or equivalent lumber to remove cell. (**Care should be taken as not to damage front flange**).

f. Cells / sleeve assemblies should be stored in horizontal position.

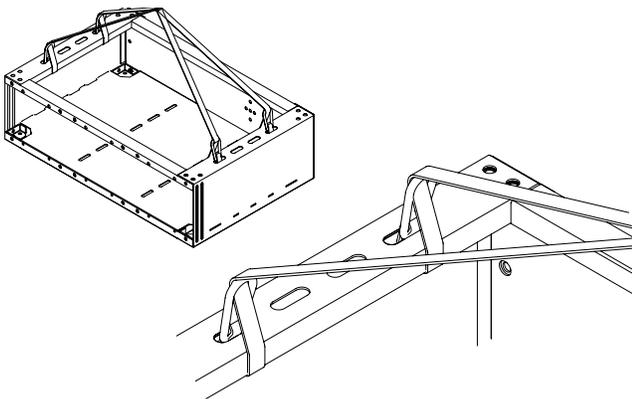


6. Remove hardware holding modules together and holding modules to skid. Hardware removed from modules will be reused to attach modules to bases and to each other. Hardware holding modules to skid will not be reused.

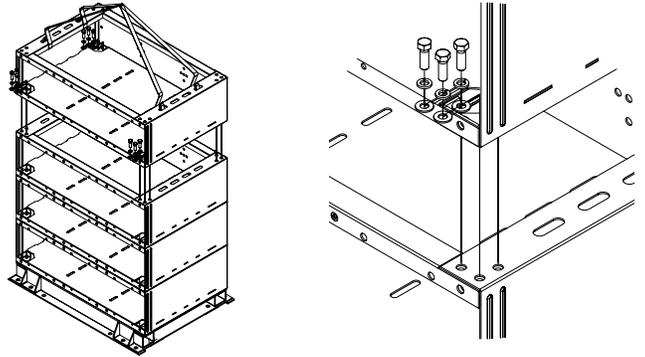


CAUTION: Never lift more than one module at a time with the supplied lifting slings.

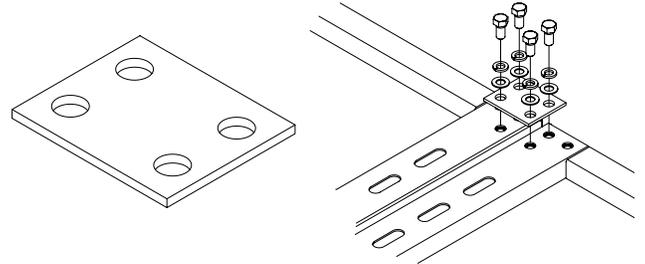
7. Install modules onto bases using supplied lifting straps. Consult below diagram for proper sling attachment and lifting. Consult included layout diagram for module position.



8. Module layout should be compared to system layout diagram and all hardware should be checked for proper torque before proceeding. Consult "Hardware Torque Requirements" (pg 4) for proper torque values.

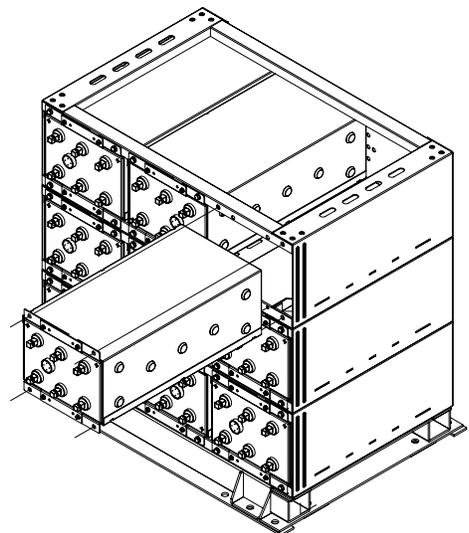


9. For multiple stack systems... Joining plates are to be placed at the rear of the modules at the top of the stacks. One joining plate is to be used at the junction of two modules. Use 1/2-13 x 1.50" hardware to install the plates. Hardware should be torqued after module installation is complete. Consult "Hardware Torque Requirements" (pg 4) for proper torque values.

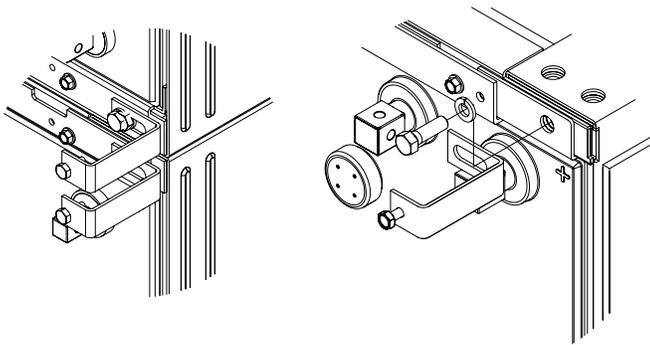


Cell Installation

1. Install cells into modules. Consult layout drawing for cell location and polarity. Attach cell to module using (4) 3/8-16 x 1.25" hardware*. Consult "Hardware Torque Requirements" (pg 4) for proper torque values. **Care should be taken when installing cells that lifting device does not damage brackets.**



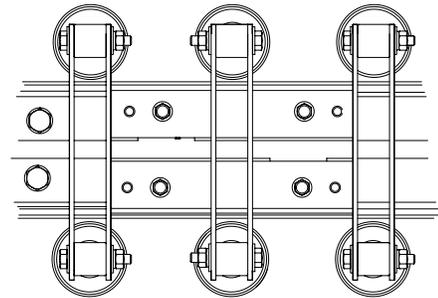
2. Safety Shield Brackets are to be installed at the outside corners of every 2 modules starting from the bottom and working towards the top. Use 3/8-16 x 1.25" hardware to install brackets. Consult "Hardware Torque Requirements" (pg 4) for proper torque values.



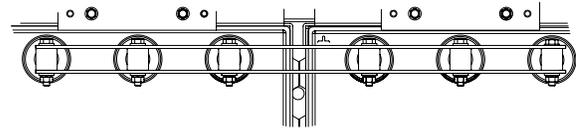
3. Module layout should be compared to system layout diagram and all hardware should be checked for proper torque before proceeding. Consult "Hardware Torque Requirements" (pg 4) for proper torque values.

require 6 connectors per connection (3 per side). Tighten & torque all bolts after all connectors are installed. Consult "Hardware Torque Requirements" (pg 4) for proper torque values.

2CU Package Detail



Tier to Tier



Stack to Stack / Cell to Cell

ELECTRICAL CONNECTION

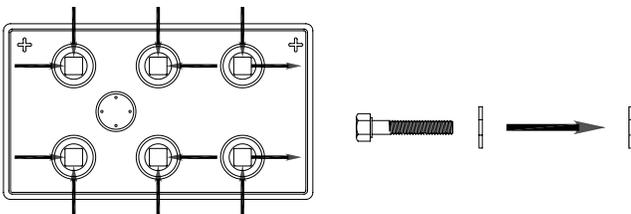
Connector Assembly

1. The contact surfaces of each individual post on every cell have been cleaned and coated with a thin film of no-ox-ID "A" grease at the factory. Assure the contact surfaces are free of dust or dirt prior to assembly.
2. The battery system is supplied with a connector package appropriate to the required load the batteries are connected to. Review the below chart "Connector Packages" to ensure the correct connector package has been supplied.

Bolt Package		
2CU	1/4-20 x 1.50"	JMP1407
4CU	1/4-20 x 1.75"	JMP1435
6CU	1/4-20 x 2.00"	JMP1409

Connector Packages		
Type	AMPS	WPC
2CU	≤700	≤1200
4CU	≤2000	≤3200
6CU	≤3000	≤4800

3. Installation and direction of the battery post hardware is important. Consult the below diagram for clarification.



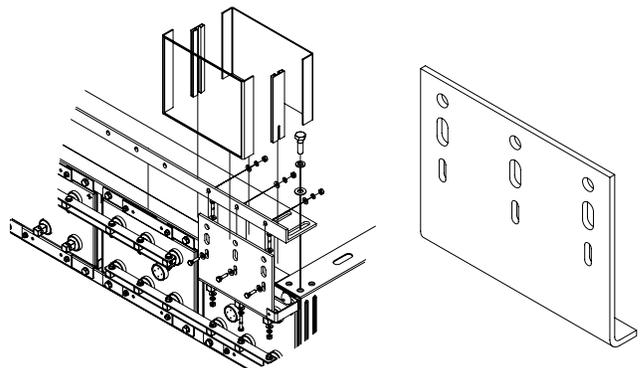
4. High Rate applications will require multiple connectors to be used per battery post. A 2CU connector package will require 2 connectors per connection (1 per side), see example below. A 4CU package will require 4 connectors per connection (2 per side) and an 6CU package will

Terminal Assembly

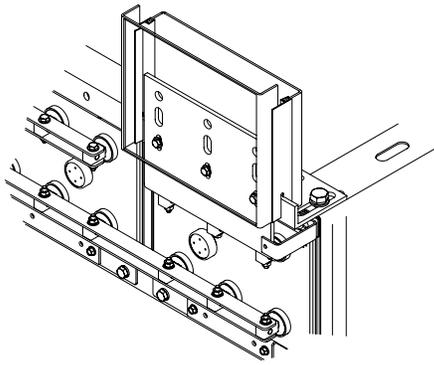
TOP TERMINATION

Consult layout diagram for termination location.

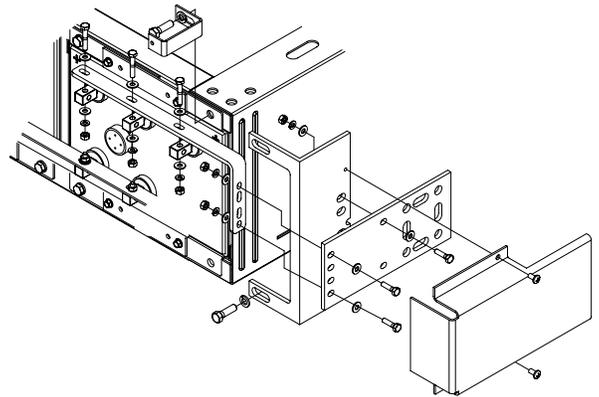
1. Install terminal plate bracket to the top of the module. Use 1/2-13 x 1.50" hardware. Install loosely for future alignment.
2. Remove cell sleeve bolts directly behind location of terminal plate.
3. Replace flat washer with cap washer. Re-install 3/8-16 x 1.25" into cell sleeve with safety shield bracket (if required). Torque hardware at 25ft-lb (33.8Nm). Install rubber caps over bolts.
4. Install terminal plate to battery posts using 1/4-20 x 1.75" hardware. Attach terminal plate to terminal plate bracket. Note position of terminal plate. Terminal Plate Bracket may have to be moved in order to be flush with the terminal plate.
5. Consult "Hardware Torque Requirements" (pg 4) for proper torque values.



Terminal Plate to be installed on battery posts as shown



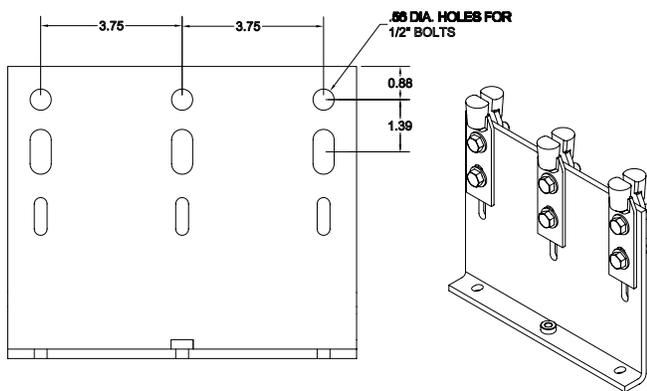
Complete Assembly



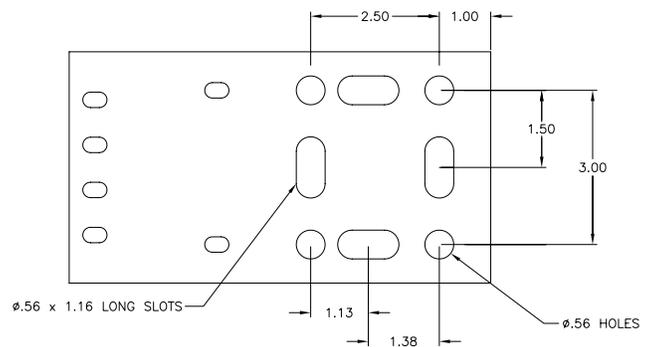
Side Terminal Assembly

6. Top terminal plate designed to use up to 0.50" dia. bolt and a maximum 1.75" centers, 2 hole lug. Lug hardware not included.

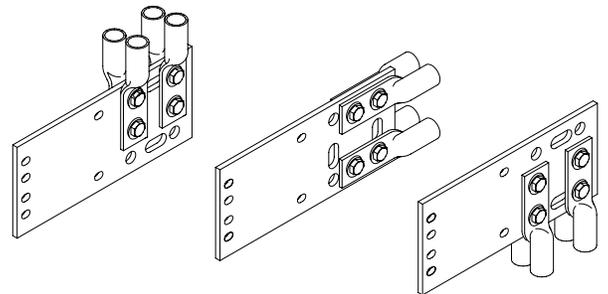
9. Side Terminal Plate is designed to use up to 0.50" dia. bolt and a maximum 1.75" centers, 2 hole lug. Plate is capable of handling 4 runs of cable.



Hole Layout



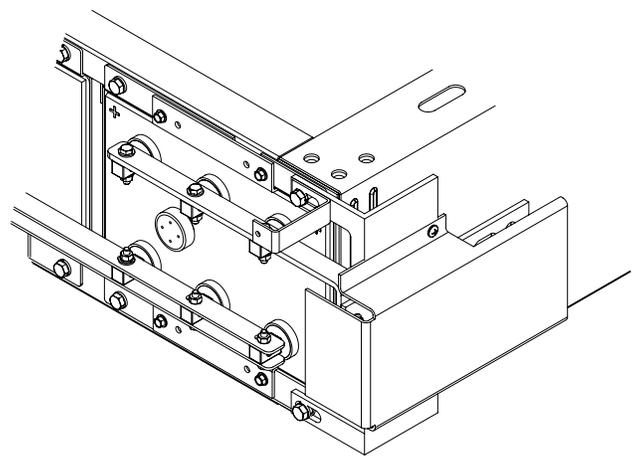
Lug Positioning Options:



SIDE TERMINATION

Consult layout diagram for termination location.

1. Remove cell sleeve bolts (3/8-16 x 1.25") from the module (retain for later use).
2. Install plastic Side Terminal Bracket in location where bolts were removed in previous step. Use 3/8-16 x 1.25" bolts from Step 1. Bolts should be installed loosely for future adjustments.
3. Safety Shield Bracket may also be required to be installed. They are to be installed in front of the side terminal bracket.
4. Install side terminal plate to side terminal bracket using 1/4-20 x 1.00" hardware. Bolts should be installed loosely for future adjustments.
5. Install side terminal connectors to battery posts using 1/4-20 bolts. Bolts should be installed loosely for future adjustments.
6. Connect side terminal plate to side terminal connectors. Side terminal bracket and side terminal connectors may have to be adjusted to insure plate and connectors are flush. Use 1/4-20 x 1.25" hardware.
7. After all parts are installed and alignment is confirmed, torque all bolts. Consult "Hardware Torque Requirements" (pg 4) for proper torque values.
8. Install Side Terminal Shield to Side Terminal Bracket using 1/4-20 screws.
Tighten but do not torque hardware.



Complete Assembly

Final Assembly Check Procedure

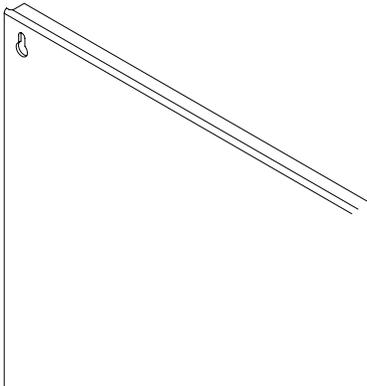
1. For future identification of all cells, number individual cells in sequence, beginning with number one (1) at the positive end of the battery. The last cell of the battery is located at the negative output terminal.
2. Read and record the voltages of the individual cells to assure that they are connected properly. The total battery voltage should be approximately equal to the number of cells connected in series multiplied by the measured voltage of one cell. If the measurement is less, recheck the connections for proper polarity. Verify that all cell and battery connections have been properly torqued.
3. Measure and record the intercell connection resistance using a micro-ohms meter. This helps determine the adequacy of initial connections and can be used as a reference for future maintenance requirements. Refer to the recording forms in Appendix A of this manual. Review the records of each connection and detail resistance measurements. Clean, remake, and remeasure any connection that has a resistance measurement greater than **10%** of the average of all the same type connections (i.e. intercell, intermodule, etc.).
4. Battery performance is based on the output at the battery terminals. Therefore, the shortest electrical connection between the battery system and the operating equipment results in maximum total system performance.

Select cable size based on current carrying capability and voltage drop.

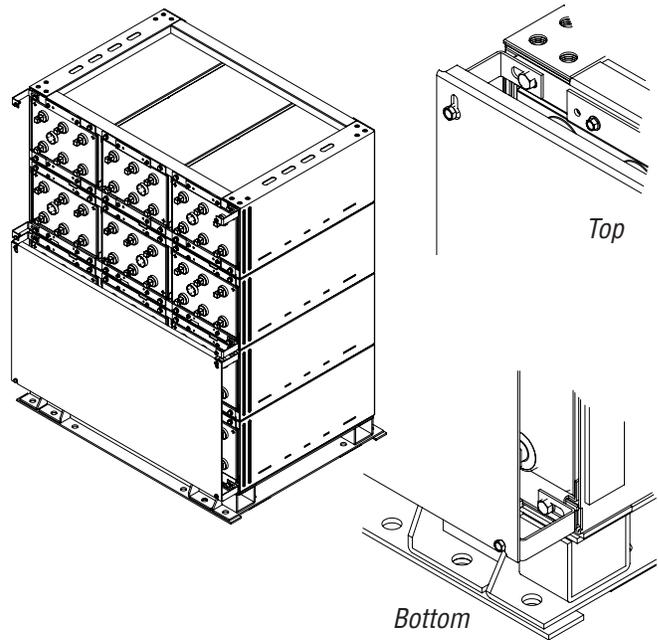
Cable size should not provide a greater voltage drop between the battery system and operating equipment than specified. Excessive voltage drop in cables will reduce the desired reserve time and power from the battery system.

Safety Shield Assembly

1. All Safety Shield Brackets should already be installed at this time. Refer to Cell Installation Section for bracket installation.
2. Safety Shields are designed with a “keyhole” type attachment



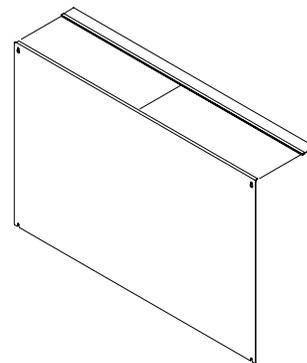
3. One shield will cover two modules. Hang the first shield on the top brackets through the large part of the keyhole. At the same time aligning the cutout at the bottom of the shield with the second set of brackets. After all shields are in place tighten, but **do not torque** hardware.



Top Protection Shield Installation

For side terminal assembly, attach top protective cover to highest front shield.

For top terminal assembly, cut protective cover to fit between the terminals and then attach to front shield.



SYSTEM OPERATIONS

Charger Voltage

These batteries are designed for continuous float applications. When setting the float voltage on the charger, the system should be set to float at the nominal cell float voltage times the number of cells per string. The charger must be able to maintain the system voltage within $\pm 0.5\%$ of the desired level at all times. The desired float voltage varies with temperature according to the table in the next column.

Operating Temperatures

Battery Temperature		Float Voltage per Cell ± .01 volts
°F	°C	
50°	10°	2.25
59°	15°	2.25
68°	20°	2.25
77°	25°	2.25
86°	30°	2.25
95°	35°	2.23

Operating at temperatures greater than 77°F (25°C) will reduce the operating life of the battery. If operating temperatures are expected to be in excess of 95°F (35°C), contact East Penn for recommendations.

Cell Voltage

Although the charger must maintain the system voltage within ± 0.5%, individual cell voltages may vary by ± 0.05 volts of the average cell float voltage.

Rectifier Ripple Voltage

Acceptable charging ripple (peak to peak) shall be less than 0.5% of the manufacturer's recommended string float voltage or have a duration shorter than 8 milliseconds.

RECORD KEEPING

Voltages, Temperatures & Ohmic Readings

Record keeping is an important part of stationary battery maintenance and warranty coverage. This information will help in establishing a life history of the battery and inform the user if and when corrective action needs to be taken.

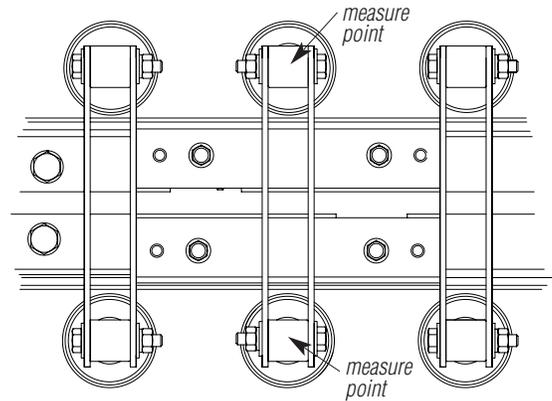
(Refer to Appendix A, Battery Maintenance Report)

While it is acceptable to operate at temperatures less than 77°F (25°C), it will require longer charging time to become fully recharged. Also, the capacity will be less at operating temperatures below 77°F (25°C).

After installation and when the batteries have been on float charge for one week, the following data should be recorded:

1. Battery terminal voltage.
2. Charger voltage.
3. Individual cell float voltages.
4. Ambient temperatures.
5. Terminal connections should be checked to verify that the installer did torque all connections properly, consult "Hardware Torque Requirements" (pg 4) for proper torque values. Micro-ohm readings should be taken across every connection. Refer to meter manufacturer's instructions for proper placement of probes. If any reading differs by more than **20%** from its initial installation value, re-torque the connection, consult "Hardware Torque Requirements" (pg 4) for proper torque values. **If reading remains high, clean contact surfaces according to Step 1 under Connector Assembly.**

6. Individual cell ohmic readings. For 6-post cells, measure from center positive to center negative posts. Do not measure diagonally from positive to negative posts. See below page for specific location.



MAINTENANCE

Always wear eye protection when working on or near batteries. Keep sparks and open flames away from batteries at all times. See Safety Precautions on pg. 3.

Annual Inspection ⁽¹⁾

1. Conduct a visual inspection of each cell.
2. Record the battery string voltage.
3. Record the charger voltage.
4. Record the individual cell voltages. The accuracy of the DMM (Digital Multimeter) must be .05% (on dc scale) or better. The DMM must be calibrated to NIST traceable standards. Because float readings are affected by discharge and recharges, these readings must be taken when batteries have been on continuous, uninterrupted float for at least one month. Cells should be within ± 0.05 volts of the average cell float voltage.
5. Record the ambient temperatures.
6. Record individual cell ohmic readings.
7. Record all interunit and terminal connection resistances. Micro-ohm readings should be taken during this inspection. If any reading differs by more than 20% from initial readings taken, retorque the connection. Recheck the micro-ohm reading. If the reading remains high, clean the contact surface according to installation portion of this manual.

⁽¹⁾ **Other Maintenance Inspection intervals follow IEEE 1188**

Rectifier Ripple Voltage

Acceptable charging ripple (peak to peak) shall be less than 0.5% of the manufacturer's recommended string float voltage or have a duration shorter than 8 milliseconds.

Battery Cleaning

Batteries, cabinets, racks, and modules should be cleaned with clear water or a mixture of baking soda and water. **Never use solvents to clean the battery.**

Capacity Testing

Capacity tests should not be run unless the battery's operation is questionable. Do not discharge the batteries beyond the specified final voltage. When discharging at higher rates, extra connectors may need to be added to prevent excessive voltage drop. When performing capacity testing and recording data use **IEEE 1188** instructions. Should it be determined that any individual battery(ies) or cell(s) need to be replaced, contact your nearest East Penn agent or East Penn Service Center.

SLEEVE / CELL REMOVAL PROCEDURE

1. Before removing sleeve / cell, review Safety Precautions on pg. 3 of this manual. Contact East Penn Mfg. Company, Inc. with specific questions or concerns.
2. Remove bolts from cell sleeve from battery to be replaced. Do not remove cell retainer bars and hardware.
3. All tools used to remove cell / sleeve shall be insulated to avoid contact with battery posts.
4. Lifting device shall be rated to handle weight of cell / sleeve.
5. Remove one cell / sleeve at a time.
6. A slot is provided behind the steel sleeve to assist in removing cell / sleeve from module.
7. Refer to Section "Cell Installation" for installing replacement cell.

NC4-2000 125 AH Acid Volumes & Weights

Cell Size	Electrolyte				Pure Acid lb
	cc	gal	gm	lb	
AVR125-33	25,793	6.81	33,531	73.92	29.55

** Data subject to change.*

MSDS sheets can be obtained at www.eastpennunigy.com.

APPENDIX A

BATTERY MAINTENANCE REPORT

Date _____

Company _____

Address _____

Battery Location and/or Number _____

No. of Cells _____ Type _____ Date Mfg. _____ Date Installed _____

Charger Output _____ Ambient Air Temperature _____ °F

Total Battery Voltage _____ Panel Meter Volts _____ Installer _____

INDIVIDUAL CELL READINGS

Cell No.	Serial No.	Volts	Cell Ohmic Value	Connector Ohmic Value	Cell No.	Serial No.	Volts	Cell Ohmic Value	Connector Ohmic Value	Cell No.	Serial No.	Volts	Cell Ohmic Value	Connector Ohmic Value
1					21					41				
2					22					42				
3					23					43				
4					24					44				
5					25					45				
6					26					46				
7					27					47				
8					28					48				
9					29					49				
10					30					50				
11					31					51				
12					32					52				
13					33					53				
14					34					54				
15					35					55				
16					36					56				
17					37					57				
18					38					58				
19					39					59				
20					40					60				

Remarks and Recommendations _____

Readings Taken By _____

Readings should be taken at installation and at least annually thereafter.

Notation: This form must be completed and submitted with any product warranty claim.

"POWERED FOR PERFORMANCE"®

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