NB Module - AVR125-33, HT125-33

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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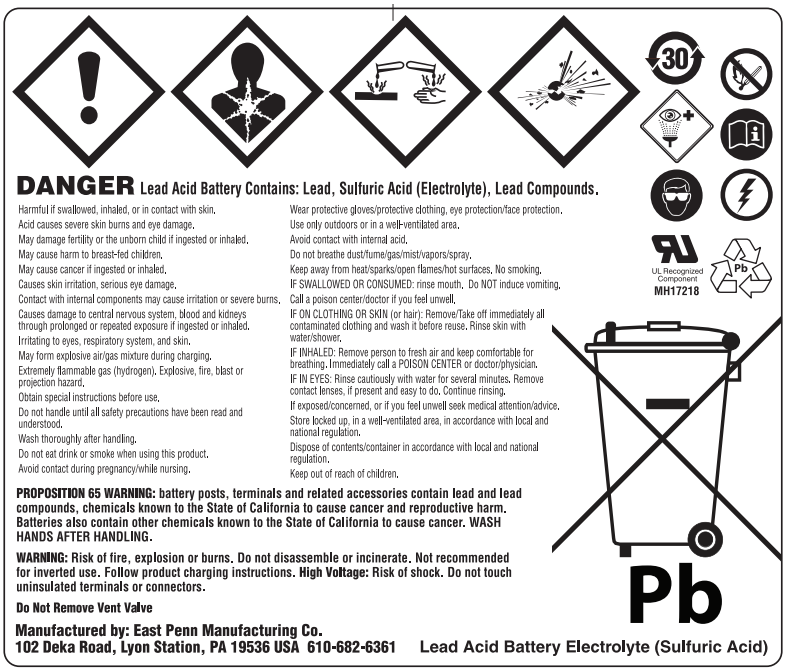


IN REFERENCE TO THIS MANUAL:

– "Cell" is defined as an individual 2-volt unit
– "Battery string" is defined as a series connected electrical system comprised of cells (individual 2-volt units).

For Energy Storage applications following UL 1973 requirements, Appendix A must be reviewed.

SAFETY PRECAUTIONS

Although all valve-regulated cells 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 cell installations should be supervised by personnel familiar with batteries and battery safety precautions.

WARNING: Risk of fire, explosion or burns. Do not disassemble, heat above 65°C, or incinerate.

Protective Equipment

Although VRLA cells can vent or leak small amounts of electrolyte, electrical safety is the principle but not the only concern for safe handling. Per IEEE 1188 recommendations, the following minimum set of equipment for safe handling of the cells and protection of personnel shall be available:

1. **Safety glasses with side shields, or goggles, or face shields as appropriate. (Consult application specific requirements)**
2. Electrically insulated gloves, appropriate for the installation.
3. Protective aprons and safety shoes.
4. Portable or stationary water facilities in the battery vicinity for rinsing eyes and skin in case of contact with acid electrolyte.
5. Class C fire extinguisher.
6. Acid neutralizing agent.
7. Adequately insulated tools.
8. Lifting devices of adequate capacity, when required.

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 cells are sealed and contain no free electrolyte. Under normal operating conditions, they do not present any acid danger. However, if the cell 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.** Consult SDS for additional precautions and first aid measures.
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 cells. 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: CO_2 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 unless for cell replacement. 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

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 date and notify carrier of any damage.

Unpacking

1. **Always wear eye protection.**
2. Check all cells for visible defects such as cracked containers, loose terminal posts, or other unrepairable problems. Cells with these defects must be replaced.
3. Check the contents of the packages 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 cells, 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 and/or cell at a time.

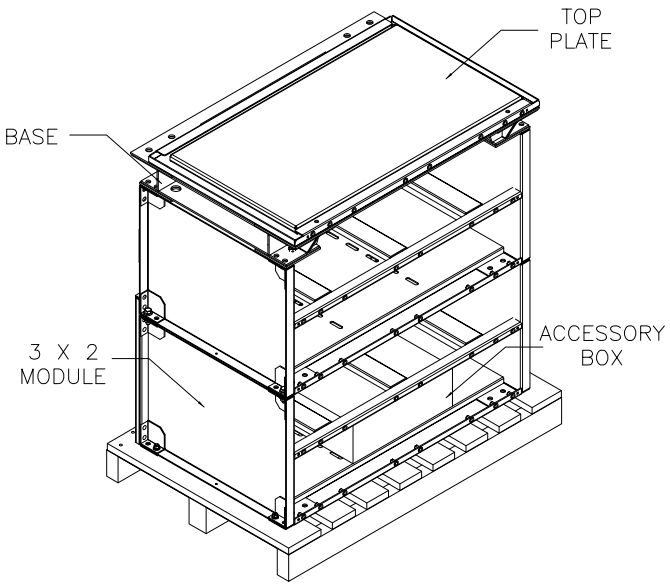
System Shipment

Battery System will be received with cells and modules on separate pallets. Amount of pallets dependent on number of cells and module type.

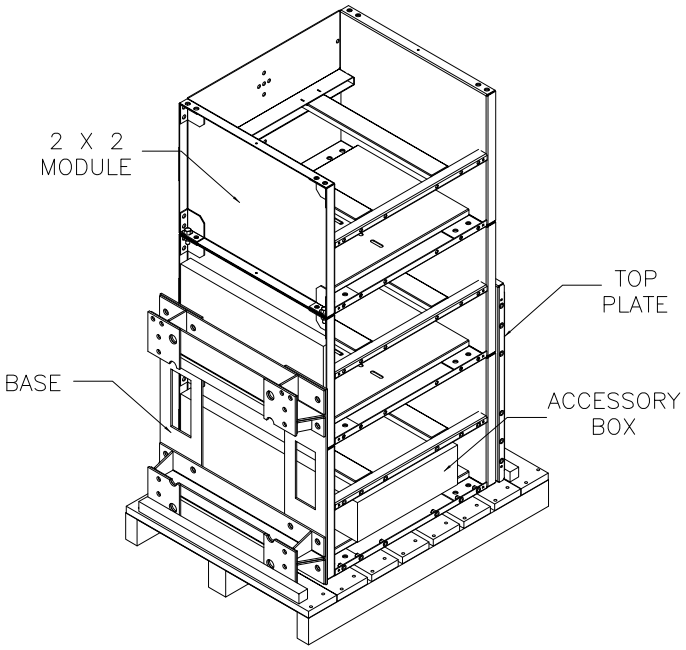
RECEIVING & STORAGE *CONT.*

Module Shipment

All battery accessories (connectors, terminal plates, hardware) will be included with a module pallet. The pallet will be indicated with an “Accessory” sticker. The “Accessory” module pallet will include a base and a top plate. 3 x 2 modules will be shipped two high with base plate and top plate on top of the module assembly. 2 x 2 modules will be shipped 3 high with base plate & top plate on either side of the module assembly.



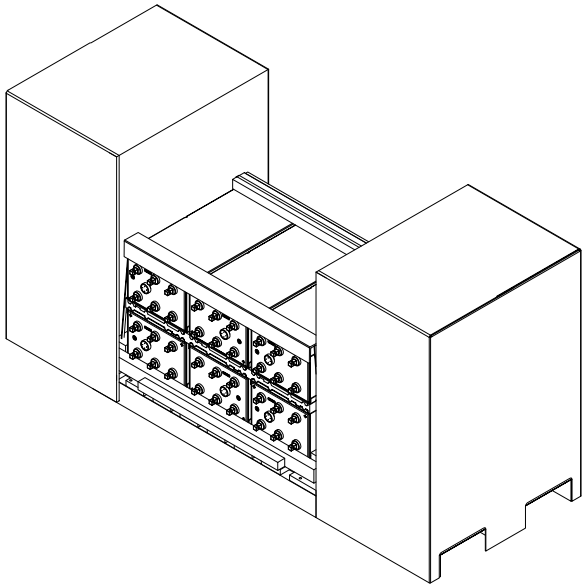
3 x 2 Module Assembly



2 x 2 Module Assembly

Cell Shipment

Each cell will be in an individual sleeve. There will be a maximum of 6 cells per pallet.



Storage / Refresh

Cells should be installed, and float charged upon delivery. If cells are to be stored, the below requirements shall be followed.

1. Cells shall be stored indoors in a clean, level, dry, cool location.
2. Store, charge, and ship in horizontal position only.
3. Recommended storage temperature is 50°F (10°C) to 77°F (25°C). Acceptable storage temperature is 0°F (-18°C) to 90°F (32°C).
4. The cells shall be given a refresh charge at regular intervals as detailed below:

   0°F(-18°C) to 77°F (25°C)

   Cells shall be charged by the “battery charge date” marked on pallet.
   Successive recharges shall be performed every 6 months.

   78°F (26°C) to 90°F (32°C)

   Cell voltage readings shall be taken monthly. Cells must be given a refresh charge within 3 months from date of receipt or if any cell voltage falls below 2.12 vpc, whichever occurs first.
   Successive refresh charges shall be performed every 3 months.
5. Whenever a refresh charge is required, it’s important that all batteries to be installed in the same series string receive a charge at the same time to ensure continuity once placed in their intended application.
6. Each cell shall be charged for 24 hours at a constant voltage equal to 2.40 volts per cell. To ensure the cells are fully charged within 24hrs, the charger used for this refresh charge must have the capacity to provide at least the minimum charge current specification and not exceed the maximum charge current for the given cell type (model).
7. All requested information on “Refresh Record Form” in Appendix B should be completed for each refresh charge.
8. Cells shall not be stored beyond 12 months. Storing beyond 12 months will affect warranty.
9. If the storage / refresh requirements cannot be met, contact the East Penn Reserve Power Product Support Department for alternate instructions.

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.

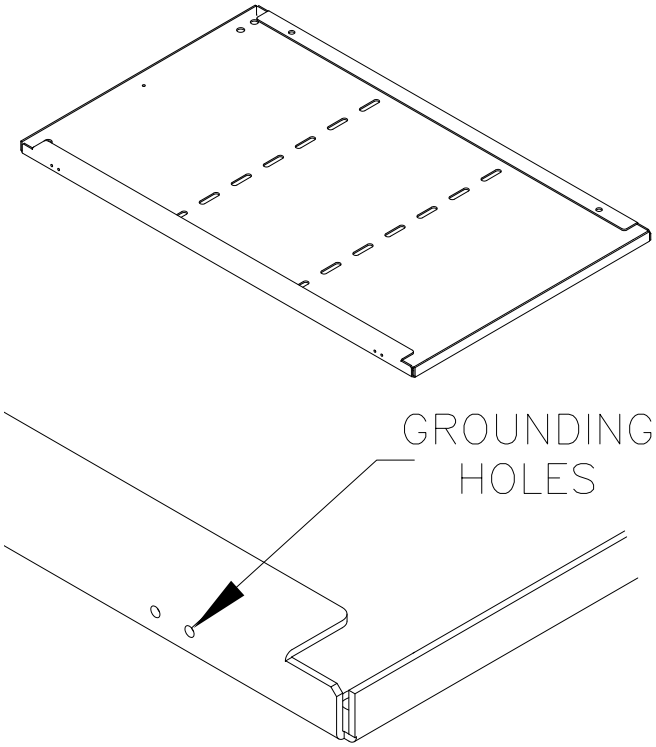
Electrical Connections

When making electrical connections to the battery string, proper techniques should be applied per electrical standards such as NEC and/or Federal, State and Local codes, as well as User Manual of specific application.

Grounding

When grounding the battery system, proper techniques should be applied per electrical standards, such as NEC and/or local codes. All module structural bolting connections are provided with grounding washers. Two sets of 0.201 diameter x .750" center holes are provided on the back side of the top plate 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.*

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



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. Additional spacing may be required to meet earthquake seismic requirements.

Module Arrangement See East Penn Mfg. Co.'s system layout diagram. 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 diagram.

Hardware Torque Requirements

Bolt Size	Torque/Retorque	
1/2-13	100ft-lb	135.5 Nm
3/8-16	45ft-lb	61.0 Nm
1/4-20	125 in-lb	14.1 Nm

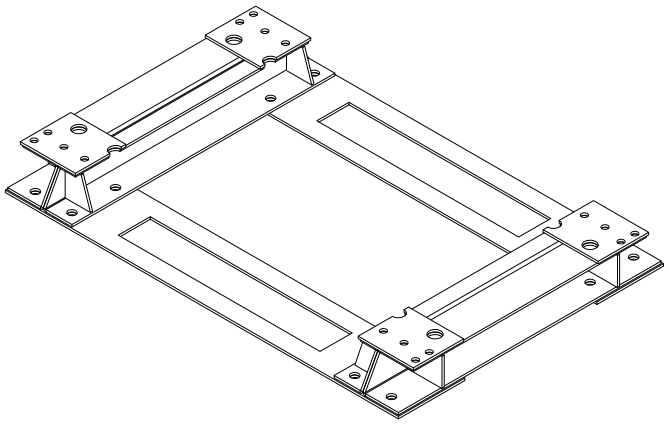
SYSTEM INSTALLATIONS

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

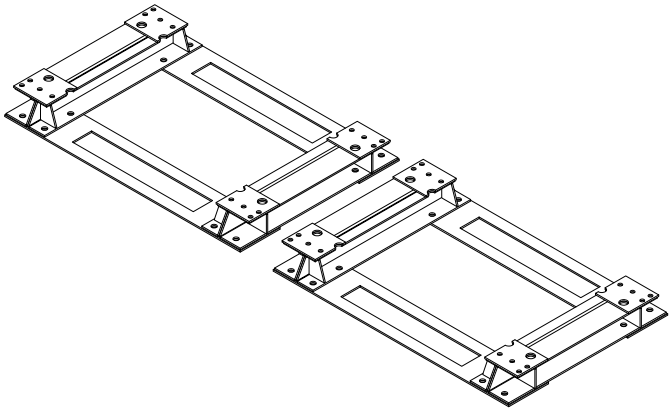
Module Installation

Assemble system per the following details.

1. Remove floor-mounting base support from module pallet.
2. Position base(s), consult included system layout diagram for required configuration. **Bases are required to be level prior to installing modules.**



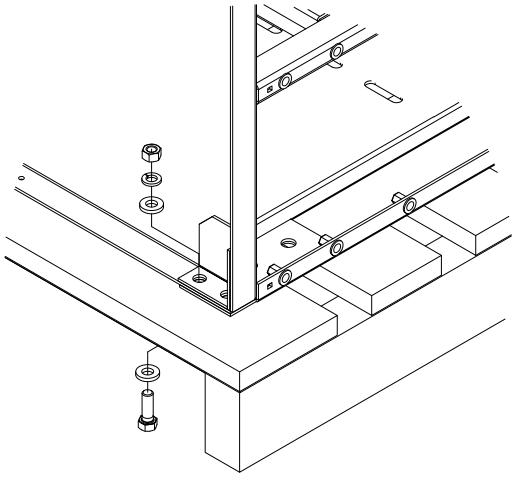
3. Multiple stack systems should have a minimum of 4.00" between bases. The additional spacing is for proper installation of modules.



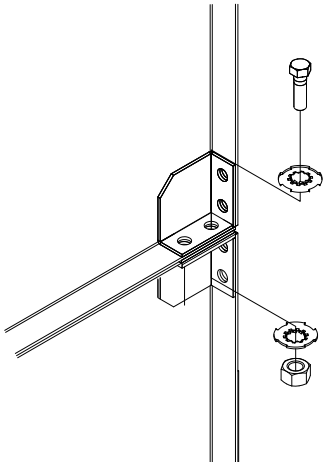
4. Anchor holes can be marked and drilled with bases in place. All anchor holes in base (16 per base) are required to be used to meet NEBS Zone 4 seismic requirements. Anchors required to be installed prior to modules being installed onto base. Reference Appendix C for base plate anchor hole layout.
   Consult local building codes for anchor bolt requirements. Anchor bolts not included.

SYSTEM INSTALLATIONS *CONT.*

5. Remove hardware holding modules together (4 bolt assemblies) and holding modules to pallet (4 bolt assemblies). Hardware removed from module to module will be reused to attach modules to modules. Hardware holding modules to pallet can be discarded.

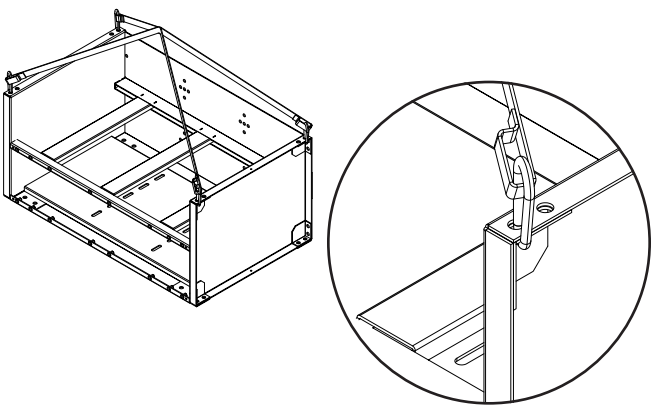


Module to Pallet Disassemble

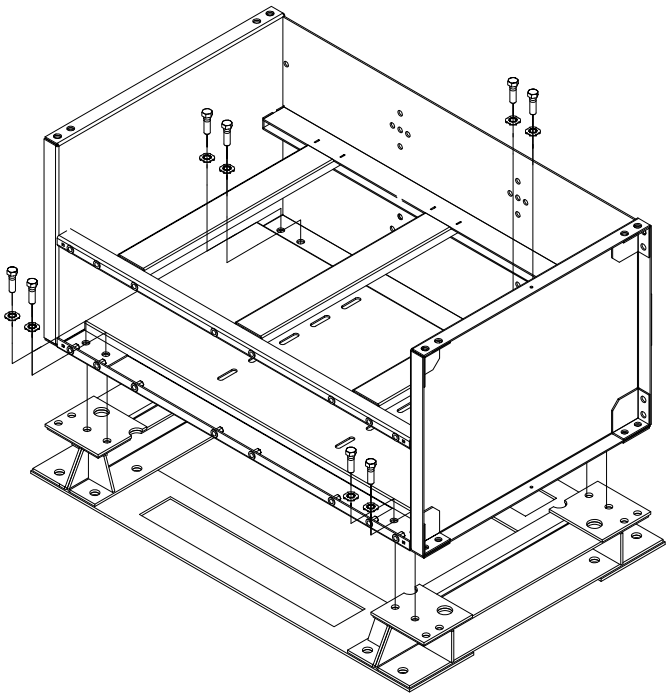


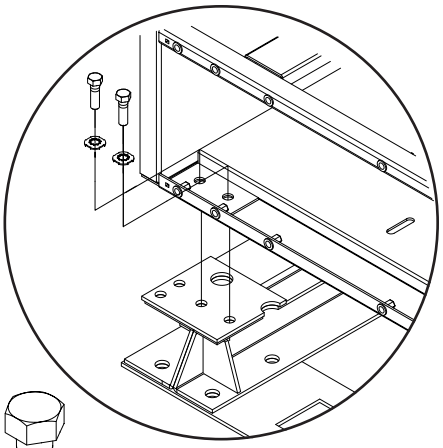
Module to Module Separation

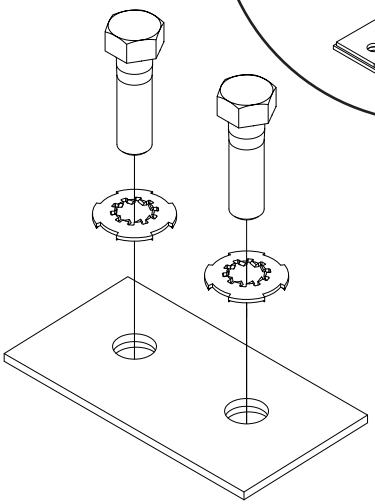
6. Install modules onto bases using supplied lifting straps. Consult below diagram for proper sling attachment and lifting. Consult included system layout diagram for module position. **CAUTION: Never lift more than one module at a time with the supplied lifting slings.**



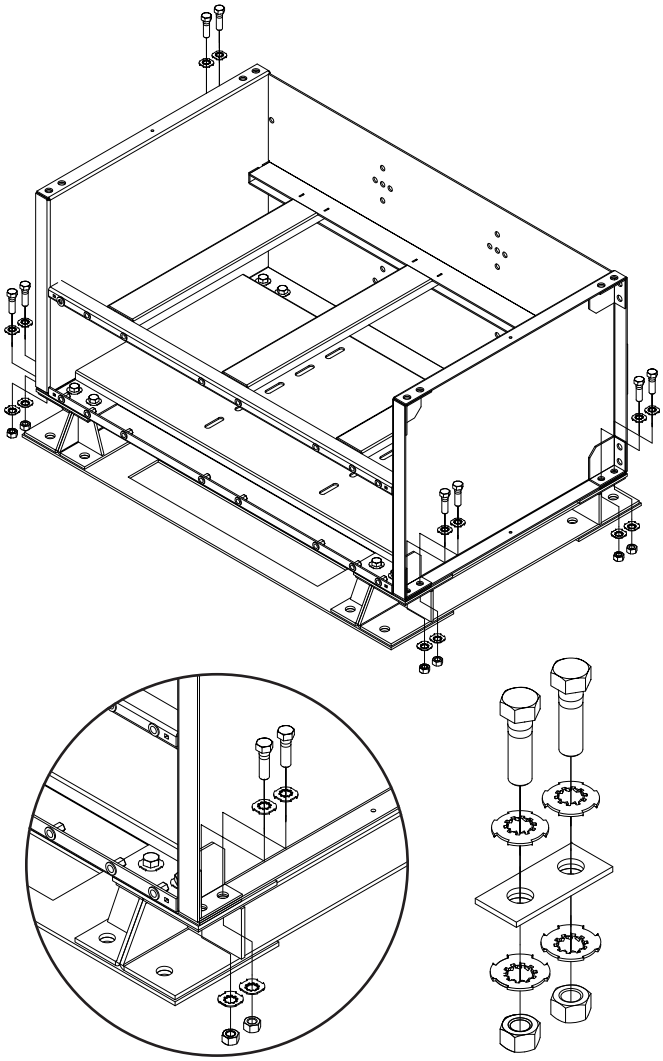
7. Base and module layout should be compared to system layout diagram. All ½-13 x 1.75" hardware (2 per corner) are to be installed on the inside of the module for module to base connection. All hardware should be checked for proper torque before proceeding. Star washers are to be installed with teeth towards module to ensure proper grounding. **Consult "Hardware Torque Requirements" (pg 5) for proper torque values.**



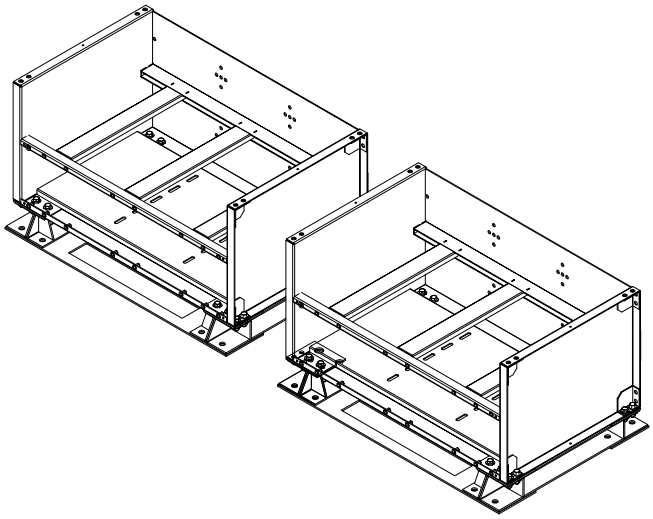




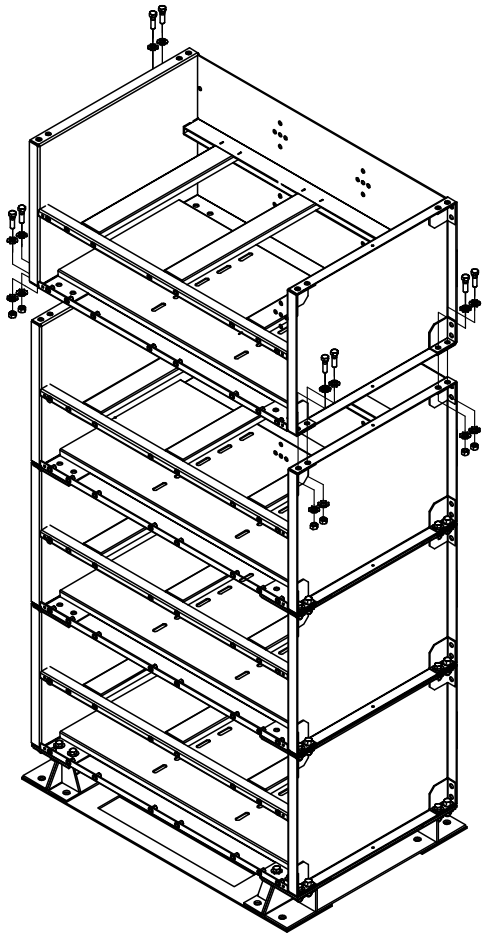
8. Bolt assemblies (two per corner) are required on the outside of the module to complete the base to module connection. All ½-13 x 1.75" hardware should be checked for proper torque before proceeding. Star washers are to be installed with teeth towards module to ensure proper grounding. **Consult "Hardware Torque Requirements" (pg 5) for proper torque values.**

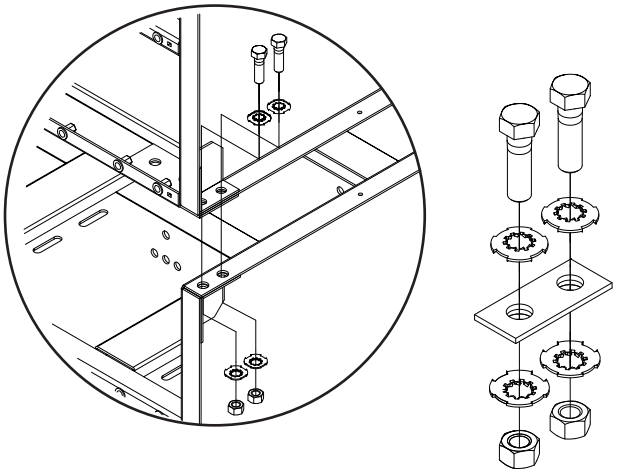


9. **Multiple battery systems —** all stacks should have the same tier completed before moving to the next tier.



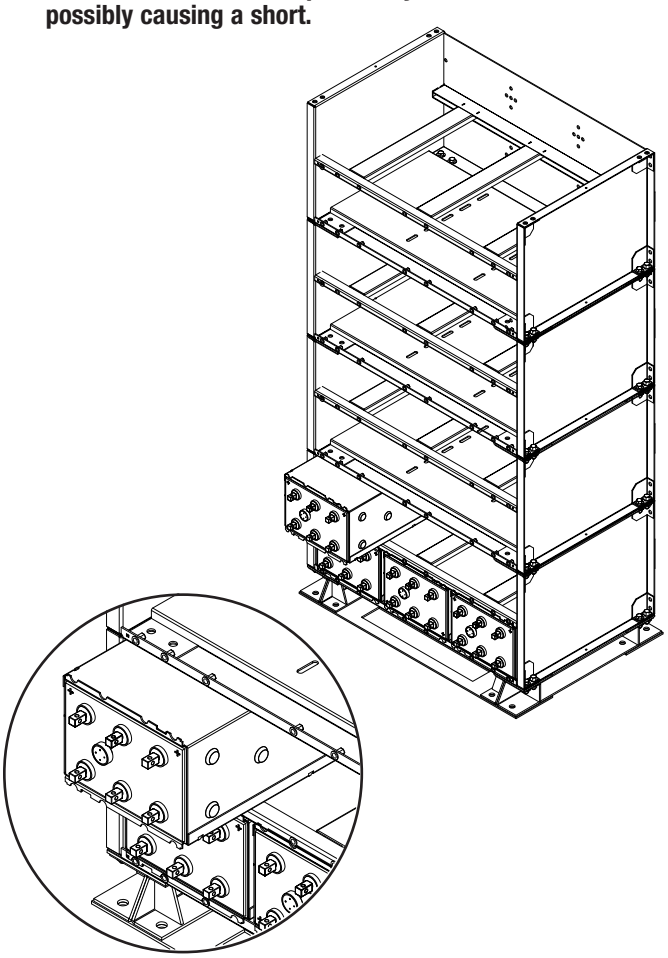
10. The system layout diagram should be consulted to determine module configuration. System design limits modules to be stacked no higher than 4 modules (8 cells high). Bolt assemblies (two per corner) are required on the outside of the module to complete the module to module connection. All ½-13 x 1.75" hardware should be checked for proper torque before proceeding. Star washers are to be installed with teeth towards module to ensure proper grounding. **Consult "Hardware Torque Requirements" (pg 2) for proper torque values.**



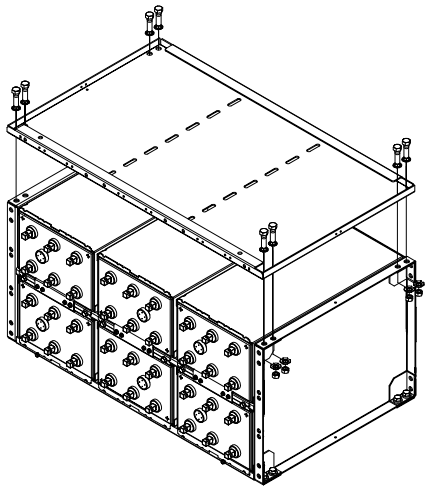


SYSTEM INSTALLATIONS *CONT.*

11. **Cell / Sleeve Installation —** Install cells into modules. Cells are shipped separate from modules. Cell polarity orientation responsibility of installer. Consult system layout diagram for cell location and polarity.
    Care should be taken when installing cells that lifting device does not contact previously installed cells possibly causing a short.

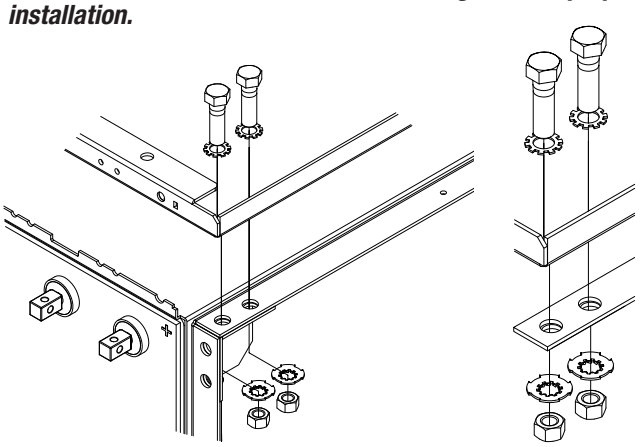


12. **Top Plate Installation —** The top plate is to be installed on the top module after all cell / sleeve assemblies have been installed. Bolt assemblies (two per corner) are required on the outside of the module to complete the top plate to module connection. All ½-13 x 1.75" hardware should be checked for proper torque before proceeding. **Consult "Hardware Torque Requirements" (pg 5) for proper torque values.**



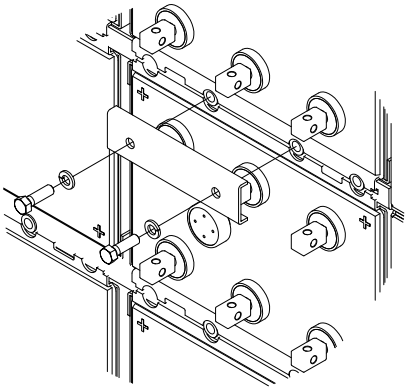
Star washers are to be installed with teeth towards module to ensure proper grounding.

Note: Top Plate hardware contains two different types of star washers. Consult below hardware diagrams for proper installation.



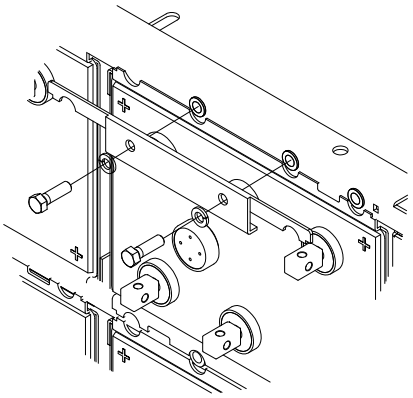
Retainer Bar Installation

1. **Tier to Tier Retainer Bar Installation —** Retainer bars are to be installed per the below detail. All 3/8-16 x 1.25" hardware should be checked for proper torque before proceeding. **Consult "Hardware Torque Requirements" (pg 5) for proper torque values.**

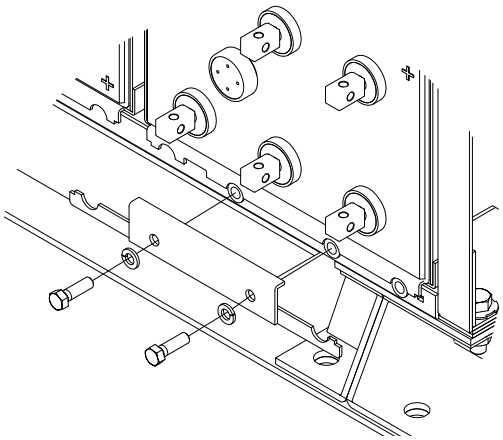


Tier to Tier Retainer Bar

2. Top & Bottom Retainer Bar Installation — Retainer bars are to be installed per the below detail. Top plate is to be installed on the top module prior to installing top retainer bar. All 3/8-16 x 1.25" hardware should be checked for proper torque before proceeding. **Consult "Hardware Torque Requirements" (pg 5) for proper torque values.**



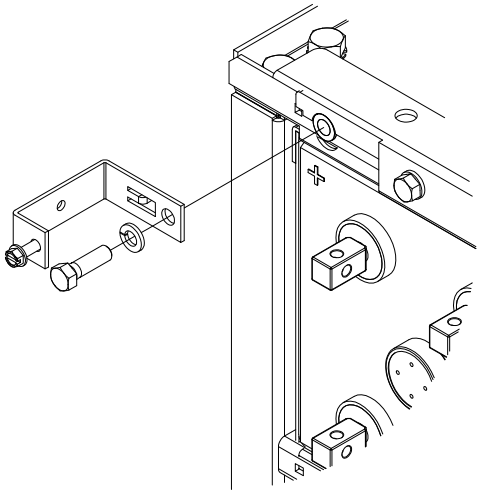
Top Retainer Bar



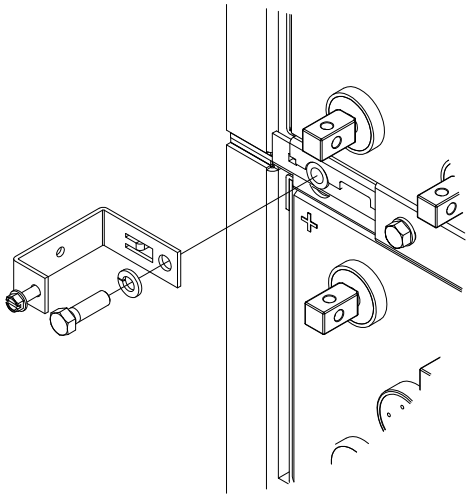
Bottom Retainer Bar

Safety Shield Bracket Installation

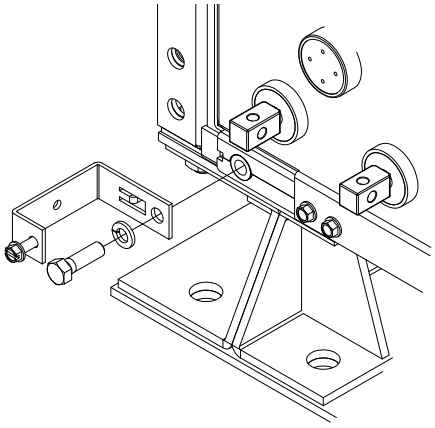
1. Safety Shield Brackets are to be installed at the outside corners of each module (4 per module). Consult below detail for locations. Use 3/8-16 x 1.25" hardware to install brackets. **Consult "Hardware Torque Requirements" (pg 5) for proper torque values.**



Top Shield Bracket Installation



Center Shield Bracket Installation



Bottom Shield Bracket Installation

2. 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 5) for proper torque values.

ELECTRICAL CONNECTION

Follow all safety requirements as detailed in "Safety Precautions" section prior to working on any electrical connections.

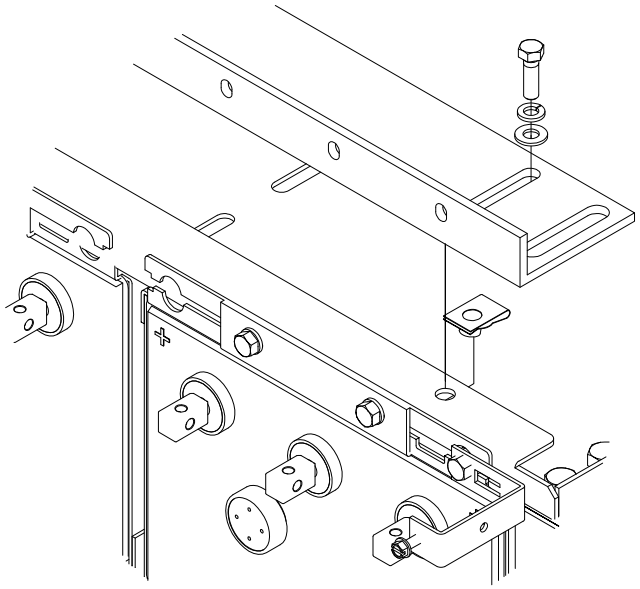
Some installations may require the terminal plates to be in close proximity of each other. It is recommended that the terminal plate assembly installations be completed prior to installing the inter-cell connections. This practice will reduce the risk of a possible electrical short from damaging the entire battery system.

TERMINAL ASSEMBLY

Top Termination

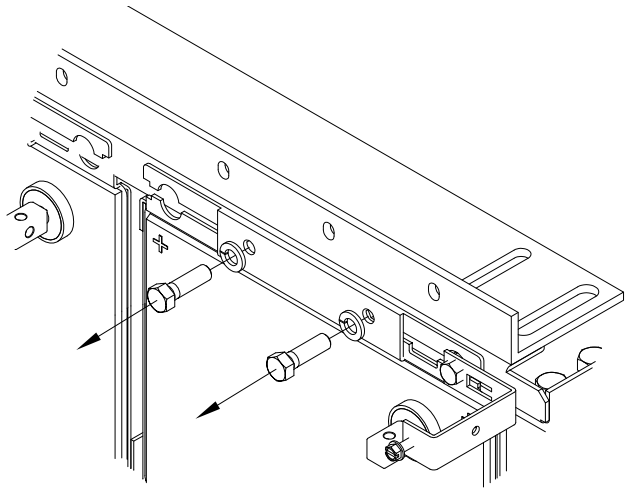
Consult system layout diagram for termination locations.

1. Install terminal plate bracket to the top of the module. Slide clip onto back of channel at hole locations. Use 3/8-16 x 1.25" hardware. Install loosely for future alignment.

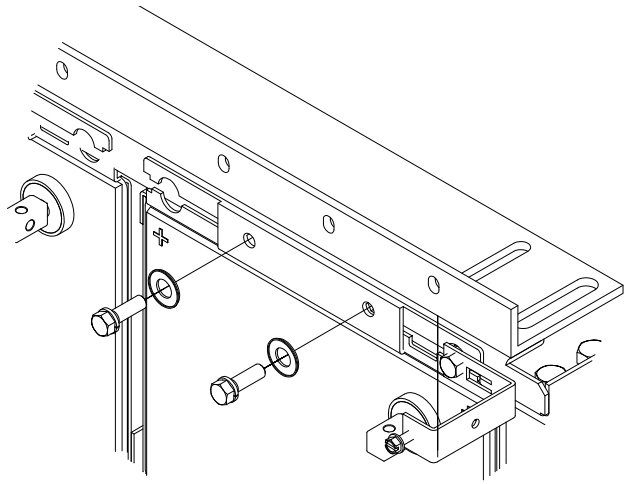


TERMINAL ASSEMBLY *CONT.*

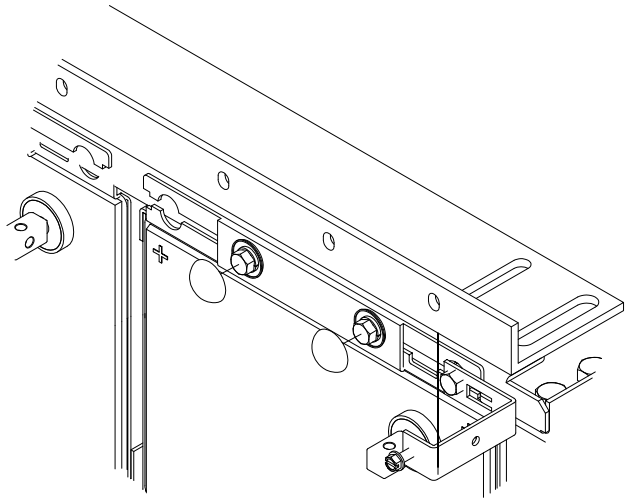
2. Remove module bolts directly behind location of terminal plate.



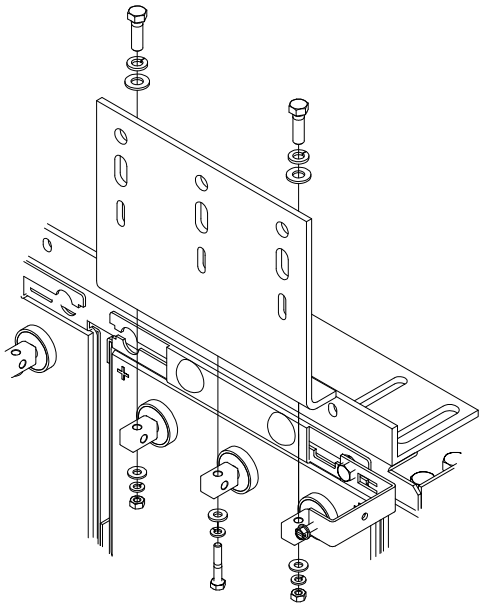
3. Replace flat washer with cap washer. Re-install 3/8-16 x 1.25" into module with safety shield bracket (if required). Torque hardware before proceeding. Consult **"Hardware Torque Requirements" (pg 5) for proper torque values.**



4. Install rubber caps over bolts.

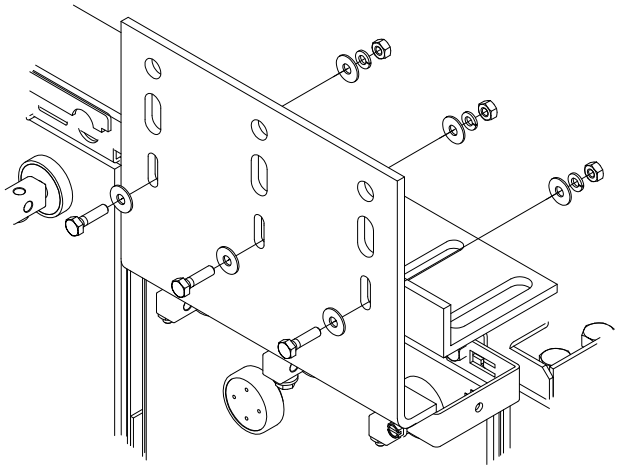


5. Install terminal plate to battery posts using 1/4-20 x 1.00" hardware. **** When assembling the terminal plate, the center bolt to the battery post should be loosely installed prior to installing the outer bolts.**

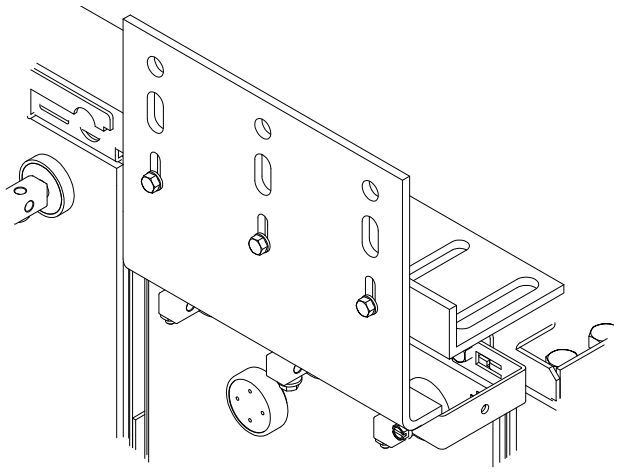


Terminal Plate to be installed on battery posts as shown

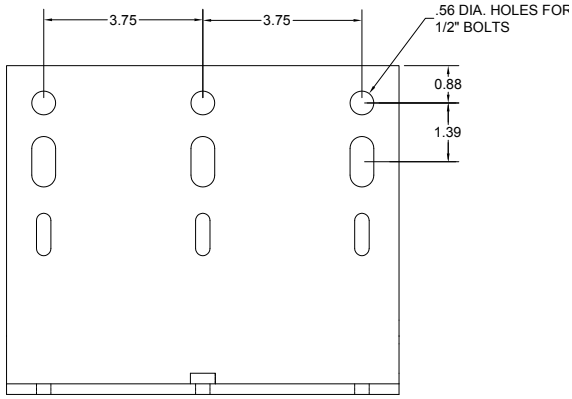
6. Attach terminal plate to terminal plate bracket. Note position of terminal plate. Terminal Plate Bracket may have to be moved in order to be flush with the terminal plate.



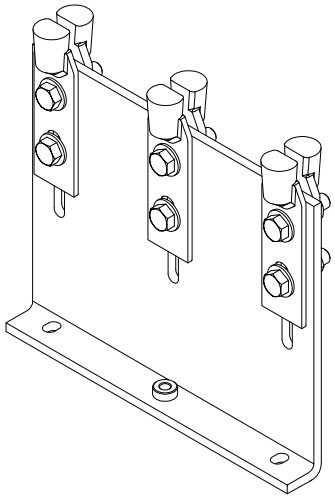
7. All hardware should be checked for proper torque before proceeding. **Consult "Hardware Torque Requirements" (pg 5) for proper torque values.**



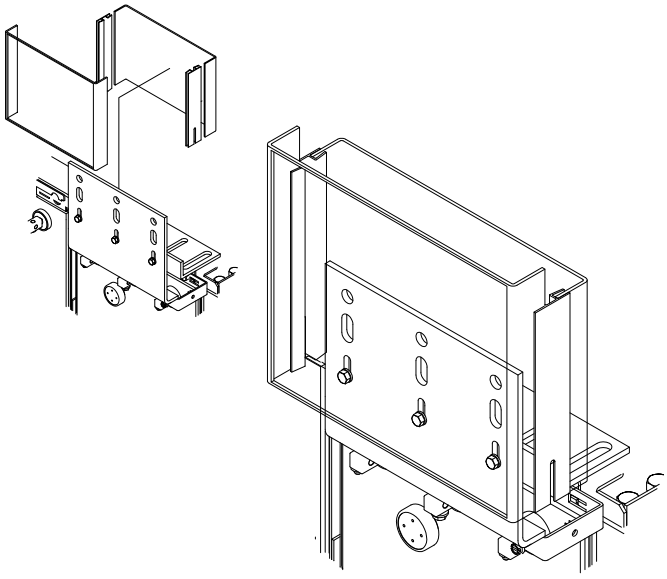
8. **Lug Hole Layout —** Top terminal plate designed to use up to 0.50" dia. bolt and a maximum 1.75" centers and 1.188" min., 2 hole lug.



9. **Lug Attachment —** Maximum of six cable lugs can be installed per terminal plate. Lug Hardware not included.



10. **Safety Shield Installation —** Top terminal safety shield consists of three pieces. Assemble per the below illustration. Clear plastic shields are of different lengths. Longer shield to be installed on the front side of the terminal plate. The shields should be even at the bottom, making the front shield longer at the top.

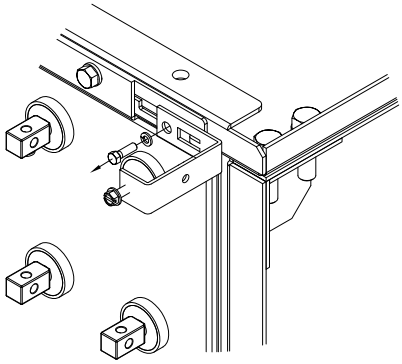


Complete Assembly

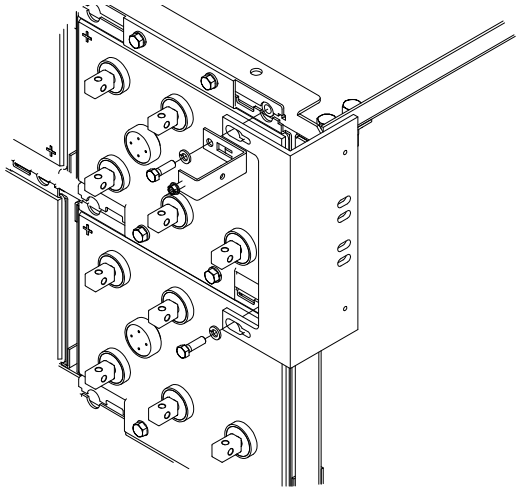
Side Termination

Consult system layout diagram for side termination location.

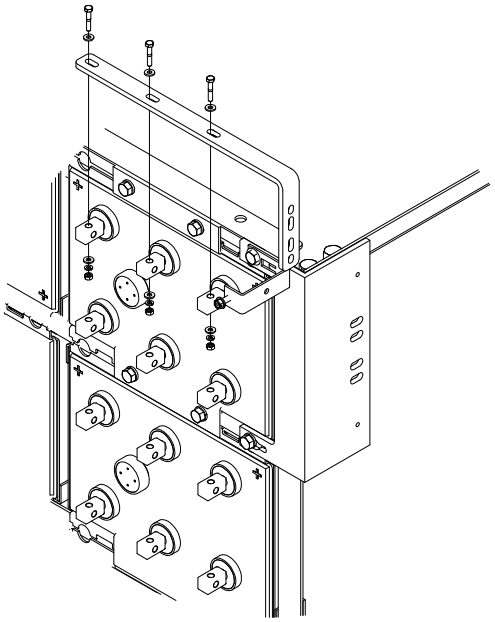
1. Remove safety shield bracket if required.



2. Install plastic Side Terminal Bracket and re-install safety shield bracket using bolts from previous step. Use 3/8-16 x 1.50" bolt for the remaining bracket assembly. Bolts should be installed loosely for future adjustments.

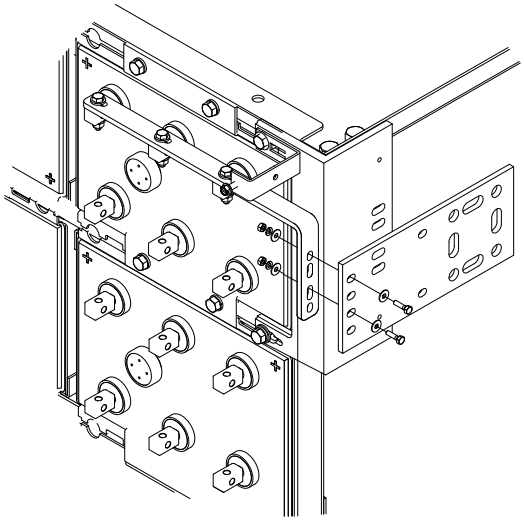


3. Install side terminal connector to battery posts using 1/4-20 hardware plate to terminal plate bracket using 1/4-20 x 1.00" hardware. Bolts should be installed loosely for future adjustments.

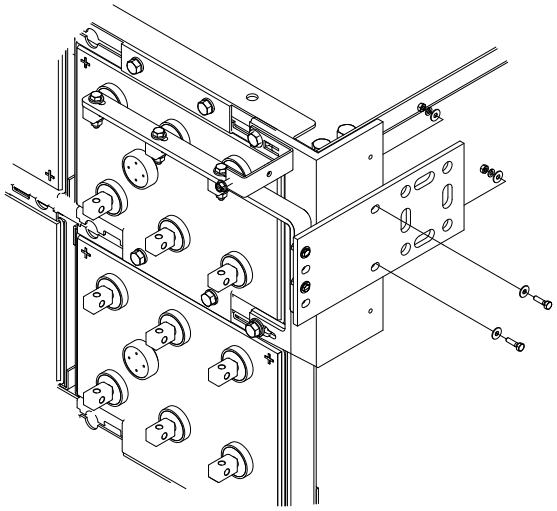


TERMINAL ASSEMBLY *CONT.*

4. Connect side terminal plate to side terminal plate 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.

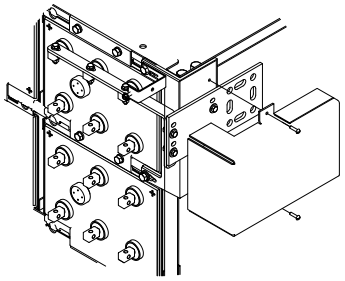


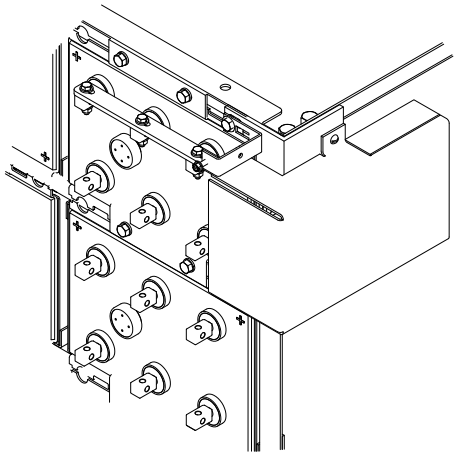
5. Connect side terminal plate to terminal plate bracket using 1/4-20 x 1.00" hardware. Bolts should be installed loosely for future adjustments.



6. After all parts are installed and alignment is confirmed, torque all bolts. **Consult "Hardware Torque Requirements" (pg 5) for proper torque values.**

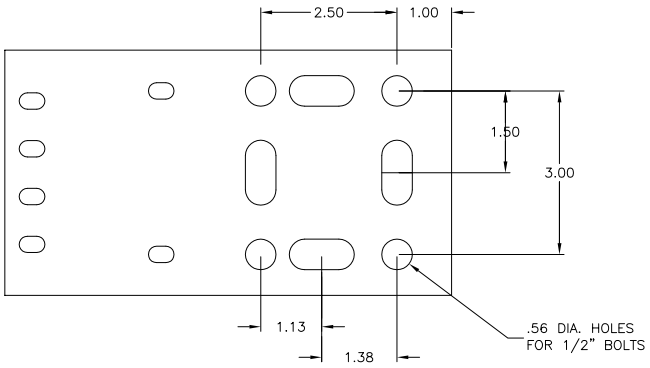
7. Install Side Terminal Shield to Side Terminal Plate using ¼-20 screws.
   Tighten but do not torque hardware.





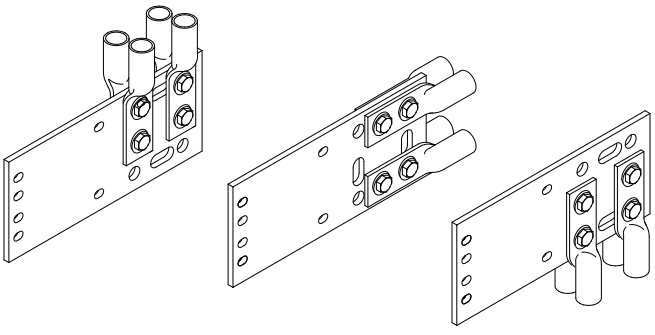
Complete Assembly

8. Side Terminal Plate is designed to use up to 0.50" dia. bolt and a maximum 1.75" centers and 1.188" min., 2 hole lug. Plate is capable of handling 4 runs of cable.



Lug Positioning Options:

Maximum of four cable lugs can be installed per terminal plate. Lug Hardware not included.



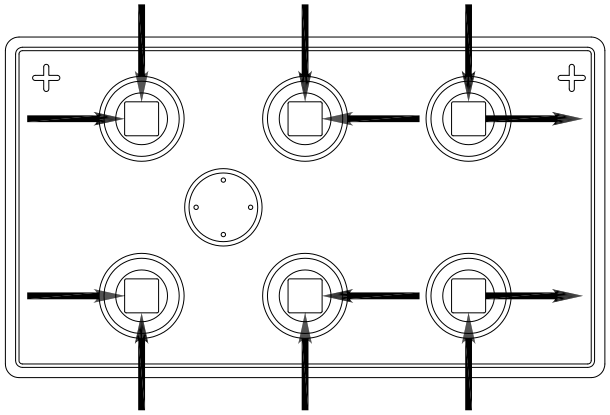
CONNECTOR ASSEMBLY

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. A clean non-abrasive cloth should be used to remove any dirt. Re-apply a light coat of No-Ox-ID “A” grease to all cleaned surfaces.
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.

Connector Packages			
Type	**Plates**	**AMPS**	**WPC**
2CU	5-33	≤1000	≤1600
4CU	5-33	≤2000	≤3200
6CU	5-33	≤3000	≤4800

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

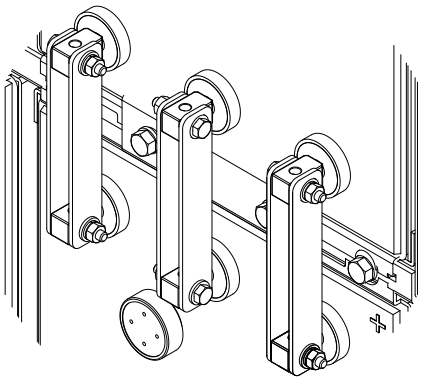
3. Installation and direction of the battery post hardware is important to ensure proper electrical clearance between battery posts of adjacent cells and within a cell. Consult the below diagram for clarification.



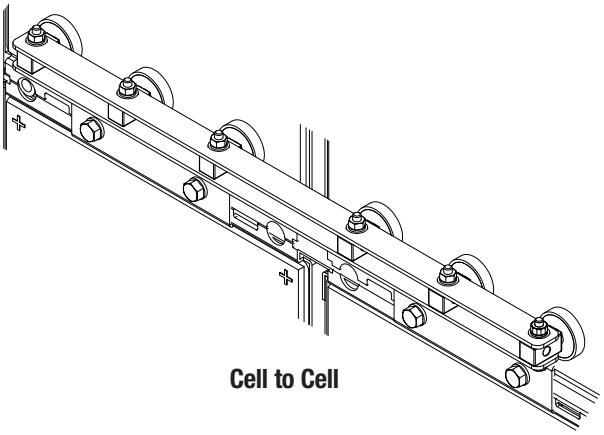
4. Battery post bolt hardware to be installed as shown.

5. NB battery systems are supplied with 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 require 6 connectors per connection (3 per side). Tighten & torque all bolts after all connectors are installed. **Consult “Hardware Torque Requirements” (pg 5) for proper torque values.**

2CU Package Detail



Tier to Tier



Cell to Cell

Final Assembly Check Procedure

1. For future identification of all cells, number individual cells in electrical connection 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.

Note: Following steps are to be followed with battery disconnected from any load or charge source.

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 measured is less, recheck the connections for proper polarity. Verify that all cells 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 connection installation and can be used as a reference for future maintenance requirements. Refer to the Battery Maintenance Report on pg. 19. 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.).

CONNECTOR ASSEMBLY *CONT.*

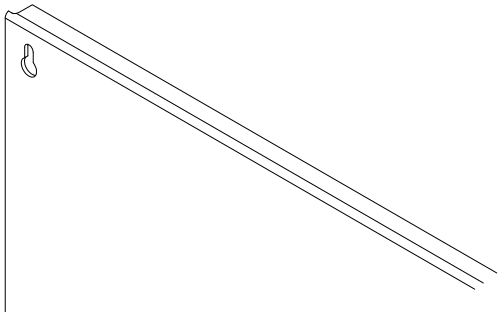
4. Battery performance is based on the output at the battery terminals. Therefore, the shortest electrical connection between the battery system and the operating equipment results in maximum total system performance.

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

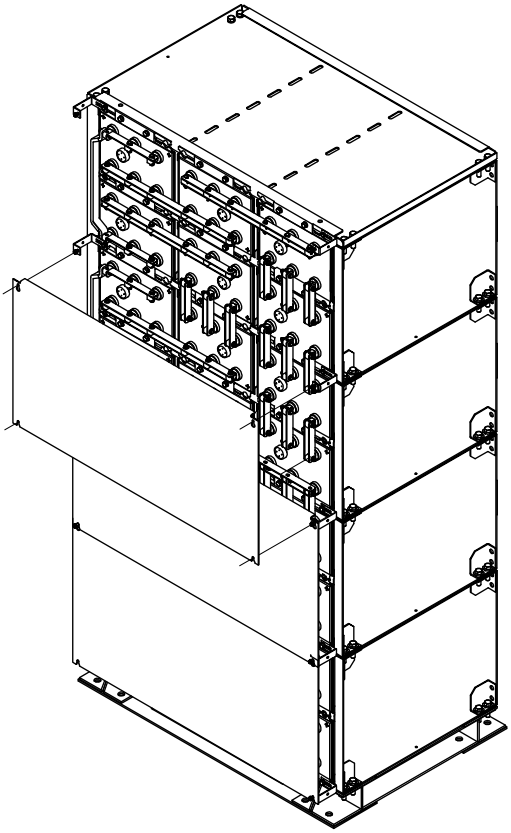
Cable size should not provide a greater voltage drop between the battery system and operating equipment than specified. Excessive voltage drop in cables will reduce the desired reserve time and power from the battery system.

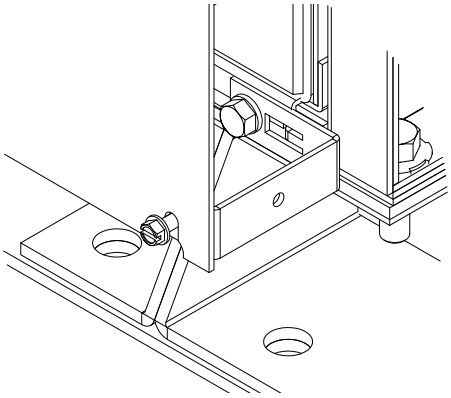
SAFETY SHIELD ASSEMBLY

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.

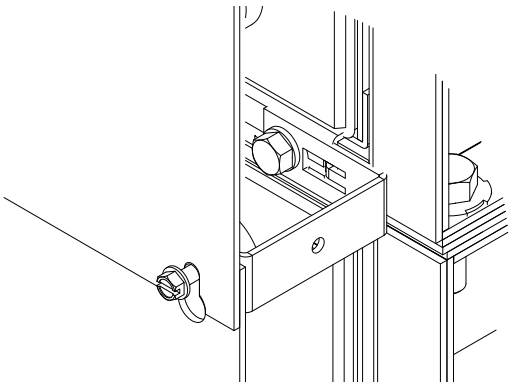


3. One shield will cover one module or two tiers. Starting with the bottom module, hang the first shield on the top brackets through the large part of the keyhole. At the same time aligning the cutout at the bottom of the shield with the second set of brackets. After all shields are in place tighten,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

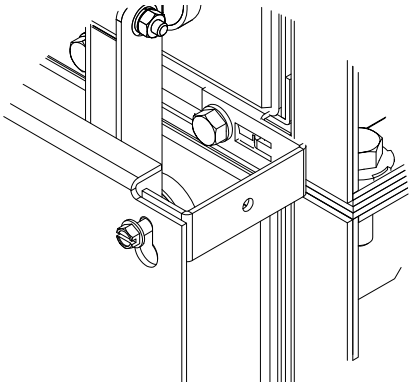




Bottom



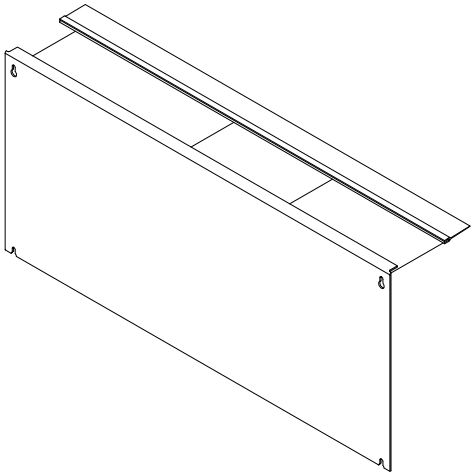
Overlap



Top

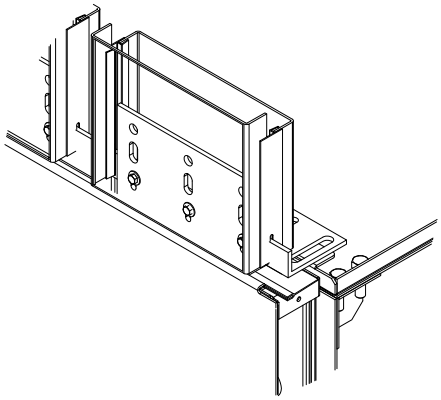
Top Protection Shield Installation

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



For top terminal assembly, align protective cover in front of top terminal plates. Mark area of protective shield that is required to be removed in order to fit between the terminals. Cut protective cover along marks.

Attach to front shield and verify fit. Additional trimming may be required to ensure proper fit.



SYSTEM OPERATIONS

Charger Voltage

These batteries are designed for continuous float applications.

Float / Standby

2.25 vpc ± 0.01 @ 77°F (25°C)

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 ± 0.5% of the desired level at all times. The desired float voltage varies with temperature according to the table in the next column.

Charge Current

Charge current should not exceed the recommended minimum and maximum requirements as detailed below.

Cell Type	Max. Charge Current (A)	Min. Charge Current (A)**
AVR125-33	352	106
HT125-33	315	94

**** - Using minimum charge current will extend recharge time and increase risk of battery being undercharged.**

Temperature Compensation

Battery voltage should be adjusted for ambient temperature variations.

2mV per °C (1.8°F) per cell

For temperatures above 77°F (25°C) subtract and for temperatures below 77°F (25°C) add.

Consult **Voltage Compensation Chart** in Appendix C for temperature compensation voltage maximum and minimum limits.

The average battery operating temperature should not exceed 95°F (35°C) and should never exceed 105°F (40.5°C) for more than an eight-hour period. 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.

Discharging at temperatures less than 77°F (25°C) will reduce the capacity of the battery.

Battery Voltage

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

Equalizing

Upon installation of the battery, an optional boost charge of 2.40 vpc ± 0.01 vpc for of 24 hours (not to exceed 24 hours) can be applied. (Note: Verify that the higher battery voltage will not adversely affect the other connected equipment.) If this is done, be sure to reset the charging equipment to the proper float voltage.

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.

Battery Operation

Battery string operating temperature will affect battery string capacity and operating life.

Discharging at temperatures less than 77°F (25°C) will reduce the capacity of the battery and require longer charging time to become fully charged.

If operating temperatures are expected to be less than 50°F (10°C) contact East Penn for recommendations.

The battery string must be located in a manner that the individual cells do not vary by more than 5°F (2.8°C) between the lowest and highest individual cell temperature.

Temperatures greater than 77°F (25°C) will reduce the operating life of the battery.

*Deka Unigy II***

The battery string should not exceed 105°F (40.5°C) for more than 8 hrs and should never exceed 95°F (35°C).

If the above limits are not able to be followed, contact East Penn for recommendations.

*Deka Fahrenheit 2V***

The battery string should not exceed 140°F (60°C). If the above limit is not able to be followed, contact East Penn for recommendations.

**** Review warranty documents for details.**

Rectifier Ripple Voltage

FREQUENCY

Ripple that has a frequency greater than 667Hz (duration less than 1.5ms) is acceptable, unless it is causing additional battery heating. Ripple that has a frequency less than 667Hz (duration greater than1.5ms), must meet the following voltage specification to be acceptable.

VOLTAGE

Ripple voltage shall be less than 0.5% peak to peak of the manufacturer's recommended string voltage. Failure to comply can void the warranty.

RECORD KEEPING

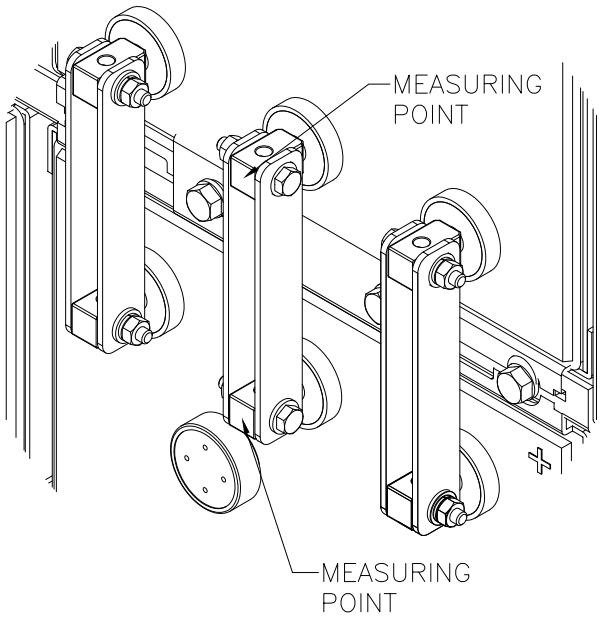
Voltages, Temperatures & Ohmic Readings

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 pg. 19, 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 2) 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 5) 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 next page for specific location.



ACCEPTANCE TESTING

Each cell should be at 100% State of Charge prior to performing an acceptance test on the battery system. To ensure the cells are fully charged the following charge schedule should be followed.

Cells should be charged at the equalization rate of 2.40 volts per cell for 24 hours. Temperature compensated charging parameters shall be applied as detailed in "Temperature Compensation" in Appendix C of this manual.

To ensure the cells are fully charged within 24hrs; the charger used for this charge must have the current equal to the maximum charge current for the given cell type (model), as called out in the below chart.

Cell Type	Max. Charge Current (A)	Min. Charge Current (A)**
AVR125-33	352	106
HT125-33	315	94

**** - Using minimum charge current will extend recharge time and increase risk of battery being undercharged.**

If these requirements cannot be met, contact East Penn Reserve Power's Product Support group for alternate instructions.

Upon completion, the charge voltage should be lowered to the float voltage of 2.25 volts per cell for a minimum period of 72 hours. Reference: IEEE 1188-2005 Section 7.2 for additional acceptance test requirements.

Upon completion of the above charge, the desired acceptance test can be performed.

NOTE: There shall be no discharges of any duration between the start of the equalization and the completion of the float period. If a discharge does occur, the charging regime detailed above shall be repeated.

Upon completion of the acceptance test, the battery system should be placed on float charge at 2.25 volts per cell to restore the battery to its' rated capacity.

Batteries should not require an equalization charge once they have passed their initial acceptance test. Consult with East Penn Reserve Power's Product Support group before performing additional equalizing charges on batteries that have successfully passed their initial acceptance test.

MAINTENANCE

Always wear eye protection when working on or near batteries. Keep sparks and open flames away from batteries at all times. Review Safety Precautions on pg. 1.

The following values should be recorded using the "Battery Maintenance Report" found in the back of this manual.

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 intercell, 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***

Battery Cleaning

Batteries, cabinets, racks, and modules should be cleaned with clear water or a mixture of baking soda and water or East Penn mfg. supplied battery cleaner (part # 00321). Use clean water to remove baking soda residue.

Never use solvents to clean the battery.

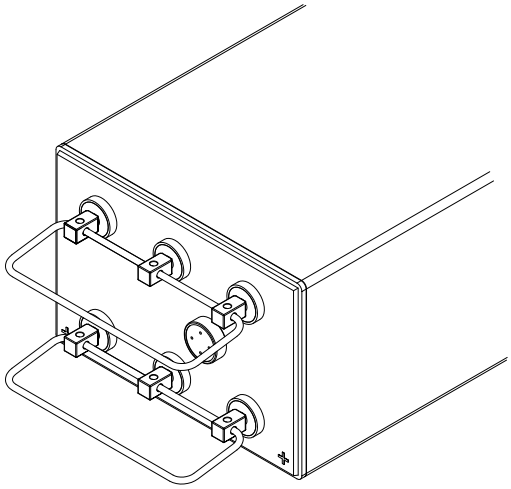
Capacity Testing

Per IEEE 1188 "Capacity testing is used to trend battery aging. The result of a capacity test is a calculation of the capacity of the battery. The calculated capacity is also used to determine if the battery requires replacement."

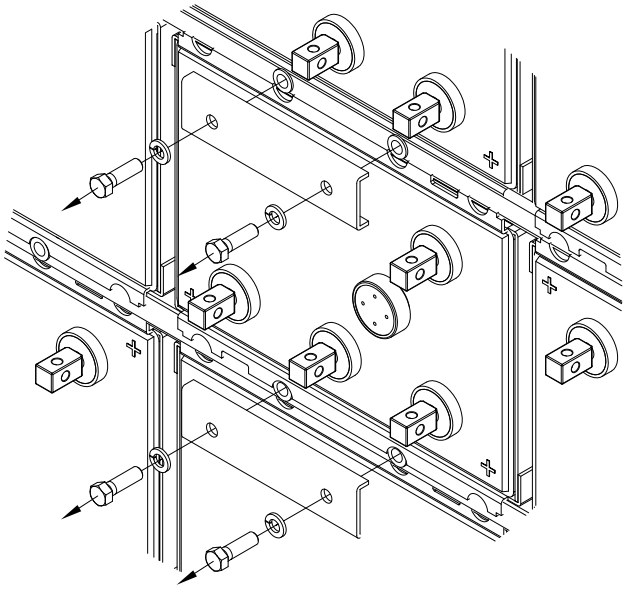
Do not discharge the batteries beyond the specified final voltage. When discharging at higher rates, extra connectors may need to be added to prevent excessive voltage drop and / or excessive temperature rise. Consult "Connector Packages" chart (pg. 15) for current limits. When performing capacity testing 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.

CELL REMOVAL PROCEDURE

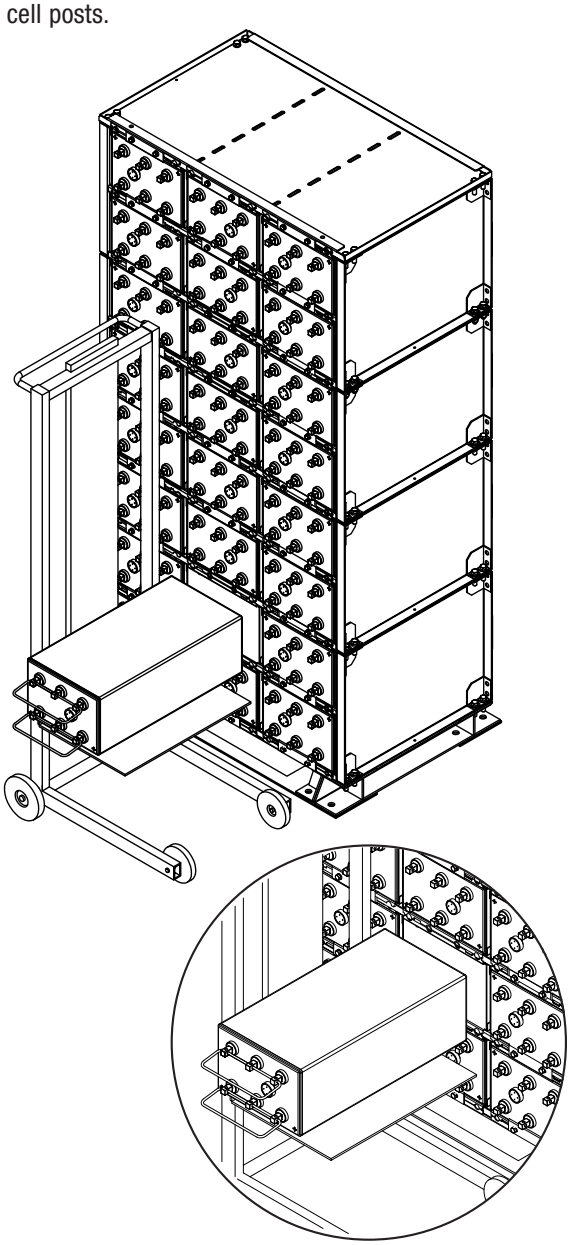
1. Before removing cell, review Safety Precautions on pg. 2 of this manual. Contact East Penn Mfg. Company, Inc. with specific questions or concerns.
2. Remove one cell at a time.
3. Confirm the lifting device is rated to handle the weight of one cell.
4. **All tools used to remove the cell shall be insulated to avoid metal contact with battery posts.**
5. Remove bolts from the retainer bar from the cell to be replaced.
6. Cells develop internal pressure. Relieving this pressure from the cell will make it easier to remove the cell from the sleeve assembly.
   a. Pry off the vent shroud
   b. Remove the flame arrestor
   c. Loosen valve using a 17mm hex key approximately ½ turn to release the internal pressure. A cloth should be used to cover the valve when releasing pressure to avoid any chance of acid spray being released"
   d. Immediately tighten the valve and torque to 12-14 in-lb (1.4-1.6 Nm).
7. Thread Polypropylene rope through the battery posts as illustrated below and knot.



8. Remove the two retaining bars holding in the cell to be removed.



9. Pull cell from module onto lifting device. Care should be taken so lifting device does not come in contact with cell posts.



10. Replacement cell may have built up pressure while on open circuit. Refer to step 5 for relieving the internal cell pressure.
11. After cell has been installed into sleeve refer to “Retainer Bar Installation” section (pg 8).

Unigy II - Acid Volumes & Weights

Battery Type	Cell Weight		Electrolyte (per cell)				Pure Acid (pure battery)	
			Volume		Weight		Weight	
	lb	kg	gal	liter	lb	kg	lb	kg
AVR125-33	300	136	6.81	25.79	73.92	33.53	30.90	14.02
HT125-33	300	136	6.81	25.79	73.92	33.53	30.90	14.02

SDS sheets can be obtained at www.eastpennmanufacturing.com.

Deka unigy II Battery Maintenance Report

Company _____ Service Date _____

Address _____ Battery Dwg # _____

Battery Location & I.D. Number _____ Connector Pkg _____ *(See Manual)* Ambient Air Temp. _____ ºF

Total No. of Cells _____ Charger Output Voltage _____ Float Currnet _____ Battery I.D. # _____

Battery Type* _____ Total Battery Voltage _____ *(read at battery terminals)* Installer _____

Date of Mfg.* _____ Panel Meter Voltage _____ *(display voltage)* Date Installed _____

Site Load Current _____ *Amps* Conductance/Impendance Meter _____ *(mfg. & model)*

Rectifier Mfg. & Model _____ AC Ripple Voltage _____ *(Note if voltage is expressed in RMS, Peak. or Peak To Peak)*

Environment (i.e. Hut. Central Office. etc...) _____

**Consult Cell type/Battery Type Label – Found on Retaining Bar or Left Side of Each Module.*

Cell No.	Serial Number	Cell Temp.	Volts (Float)	Cell Ohmic Value*	Connector Ohmic Value			Cell No.	Serial Number	Cell Temp.	Volts (Float)	Cell Ohmic Value*	Connector Ohmic Value		
					1	2	3						1	2	3
1								31							
2								32							
3								33							
4								34							
5								35							
6								36							
7								37							
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30								60							

*CONSULT I&O MANUAL, "RECORD KEEPING", FOR ADDITIONAL INFORMATION INCLUDING PROPER LOCATION OF PROBES FOR MULTI-TERMINAL JARS.

Remarks and Recommendations: _____

Readings Taken By: _____

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

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

APPENDIX A

For Energy Storage applications following UL 1973, the following shall be reviewed:

1. Batteries and components shall be installed in accordance with Article 480 or Article 706 of NFPA 70 or Section 64 of CSA C22.1.

2. The charger shall comply with one of the following standards: UL 1012, UL 1741, UL 60335-2-29/CSA C22.2 No. 60335-2-29, CAN/CSA C22.2 No. 107.2, or UL 62368-1/CSA C22.2 No. 62368-1

3. If the batteries are being installed in a system greater than 60V, a disconnecting mean shall be provided for all ungrounded conductors in accordance with Article 480 of NFPA 70 or Section 64 of CSA C22.1.

4. Service disconnects shall be provided as applicable to the end product battery system in accordance with Article 480 of NFPA 70 or Section 64 of CSA C22.1.

5. Protection devices supplied with the battery should be installed prior to use. Consult electrical standards such as NEC and/or Federal, State and Local codes for additional protection device requirements, as well as User Manual of specific application.

6. The grounding and bonding system shall be checked after the completion of the assembly to ensure that the resistance is less than or equal to 0.1 Ω.

7. The maximum battery system voltage should not exceed a nominal 960 VDC. If this voltage is exceeded, a repeat of the dielectric voltage withstand test of the assembly of the higher voltage shall be performed.

APPENDIX B

EastPenn	REFRESH RECORD FORM								
	EPM Order Number*		Pallet ID Number		Individual Performing Test (Full Name)			Date of Refresh	Refresh Duration
Model Number	Information Prior to Refresh				Information within 1 hour of Refresh Completion			Notes & Comments	
	Date Code	Cell Serial Number	Open Circuit Voltage		Cell Voltage Reading	Charging Current	Cell Temperature		
Cell 1									
Cell 2									
Cell 3									
Cell 4									
Cell 5									
Cell 6									
Cell 7									
Cell 8									
Cell 9									
Cell 10									
Cell 11									
Cell 12									
Cell 13									
Cell 14									
Cell 15									
Cell 16									
Cell 17									
Cell 18									
Cell 19									
Cell 20									
Cell 21									
Cell 22									
Cell 23									
Cell 24									

ALL FIELDS TO THE RIGHT OF THE CELL NUMBER ABOVE MUST BE COMPLETED

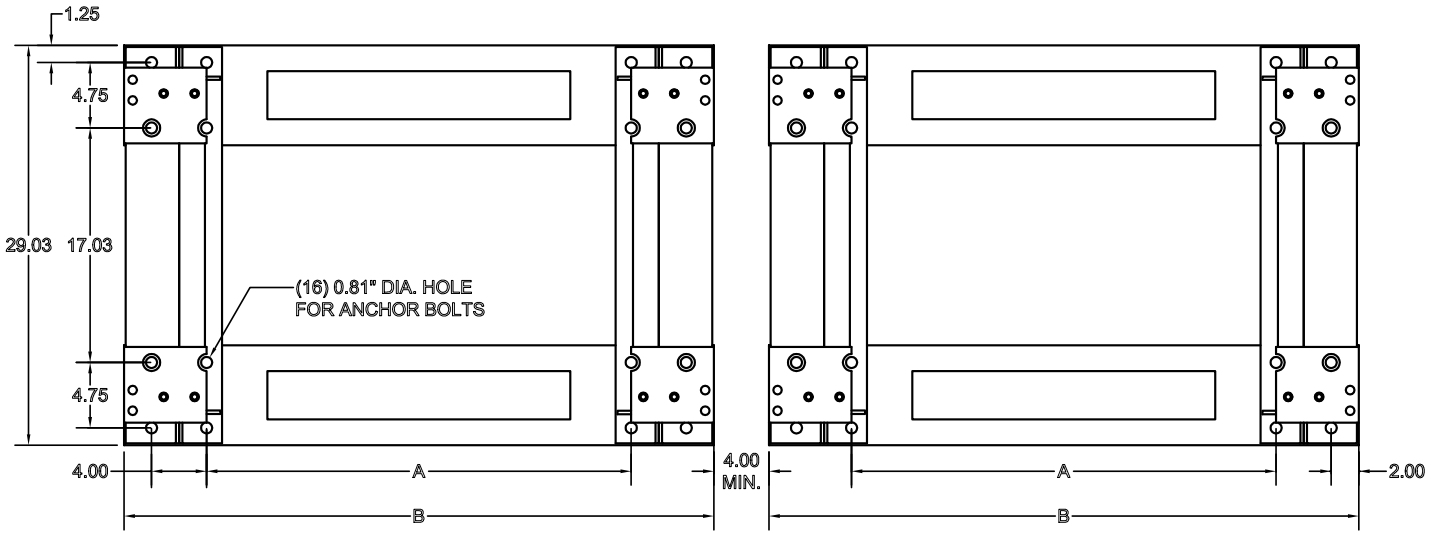
EPM ORDER NUMBER WILL APPEAR ON THE SHIPPING LABEL ON THE CARTON COVERING EACH PALLET OF CELLS

TO ENSURE CONTINUATION OF WARRANTY, SUBMIT FORMS TO: East Penn Mfg. Co, Inc.,
Reserve Power Division, Product Support & Warranty Dept. (reservepowerwarranty@dekabatteries.com)

APPENDIX C

BASE ANCHOR HOLE PATTERN

Module Type	A	B
2 x 2	17.55	29.55
3 x 2	30.33	42.83



APPENDIX D

VOLTAGE COMPENSATION CHART

°C	Float	Refresh/ Equalize	°F
>35	2.230	2.380	>95
34	2.232	2.382	93.2
33	2.234	2.384	91.4
32	2.236	2.386	89.6
31	2.238	2.388	87.8
30	2.240	2.390	86.0
29	2.242	2.392	84.2
28	2.244	2.394	82.4
27	2.246	2.396	80.6
26	2.248	2.398	78.8
25	**2.250**	**2.400**	**77.0**
24	2.252	2.402	75.2
23	2.254	2.404	73.4
22	2.256	2.406	71.6
21	2.258	2.408	69.8
20	2.260	2.410	68.0
19	2.262	2.412	66.2
18	2.264	2.414	64.4
17	2.266	2.416	62.6
16	2.268	2.418	60.8
15	2.270	2.420	59.0
14	2.272	2.422	57.2
13	2.274	2.424	55.4
12	2.276	2.426	53.6
11	2.278	2.428	51.8
<10	2.280	2.430	<50

2mV per °C

e-mail: reservepowersales@dekabatteries.com

East Penn Manufacturing Co. Lyon Station, PA 19536-0147 Phone: 610-682-4231 Fax: 610-682-4781 **www.dekabatteries.com**

E.P.M. Form No. 2038 11/23